

## DATASHEET

# Apollo3 Blue SoC

(Includes Apollo3 Blue Thin SoC)

Ultra-low Power Apollo SoC Family

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## Features

### Ultra-low supply current:

- 6  $\mu$ A/MHz executing from FLASH or RAM at 3.3 V
- Low-power sleep and deep sleep modes with selectable levels of RAM/cache retention

### High-performance ARM Cortex-M4 Processor:

- 48 MHz nominal clock frequency, with 96 MHz high performance TurboSPOT™ Mode
- Floating point unit
- Memory protection unit
- Wake-up interrupt controller with 32 interrupts

### Integrated Bluetooth<sup>1</sup> 5 low-energy controller:

- RF sensitivity: -93 dBm (typical)
- TX peak output power: 3 dBm (max)

### Ultra-low power memory:

- Up to 1 MB of flash memory for code/data
- Up to 384 KB of low latency/leakage SRAM for code/data
- 16 KB 2-way Associative/Direct-Mapped Cache

### Ultra-low power interface for on- and off-chip sensors:

- 14 bit ADC at up to 1.2 MS/s, 15 selectable input channels
- Voltage Comparator
- Temperature sensor with  $\pm 3^{\circ}\text{C}$  accuracy after calibration

### ISO7816 Secure interface

### Flexible serial peripherals:

- 1x 2/4/8-bit SPI master interface (MSPI)
- 6x I<sup>2</sup>C/SPI masters for peripheral communication
- I<sup>2</sup>C/SPI slave for host communications
- 2x UART modules with 32-location TX and RX FIFOs
- PDM for mono and stereo audio microphone
- 1x I<sup>2</sup>S slave for PDM audio pass-through

### Rich set of clock sources:

- 32.768 kHz XTAL oscillator
- Low frequency RC oscillator – 1.024 kHz
- High frequency RC oscillator – 48/96 MHz
- RTC based on Ambiq's AM08X5/18X5 families

### Wide operating range: 1.755-3.63 V, $-40$ to $85^{\circ}\text{C}$

### Compact packages:

- 5 x 5 mm (<0.5mm thick pkg) 81-pin BGA with 50 GPIO

- 3.37 x 3.25 mm (<0.35mm thk pkg) 66-pin WLCSP with 37 GPIO
- 3.37 x 3.25 mm (<0.30mm thk pkg) 66-pin WLCSP with 37 GPIO (Apollo3 Blue Thin MCU)

## Applications

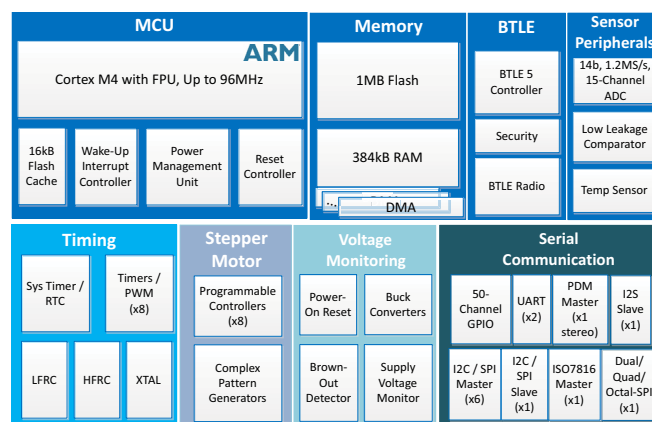
- Voice-on-SPOT™ compatible for always-listening keyword detect, audio command recognition and voice assistant integration in battery-powered devices including:
  - Bluetooth headsets, earbuds, and truly wireless earbuds
  - Remote and Gaming Controls
  - Smart home
- Wearables including smart watches and fitness/activity trackers
- Hearing aids, Digital Health Monitoring and Sensing Devices
- Smart Home Automation, Security and Lighting control

## Description

The Apollo MCU Family is an ultra-low power, highly integrated microcontroller platform based on Ambiq Micro's patented Sub-threshold Power Optimized Technology (SPOT™) and designed for battery-powered and portable, mobile devices. The Apollo3 Blue MCU sets a new standard in energy efficiency for battery-powered devices with an integrated ARM Cortex-M4 processor with Floating Point Unit and TurboSPOT™ increasing the computational capabilities of the ARM Cortex M4F core to 96 MHz while lowering the active power consumption to <6 $\mu$ A/MHz. This combination dramatically reduces energy consumption while still enabling abundant application processing power to add greater capability and extended life to battery operated devices.

The Apollo3 Blue brings several new features to Ambiq's SPOT-based Apollo MCU Family including an integrated DMA engine, QSPI interface, and advanced stepper motor control for ultra-low power analog watch hand management. With unprecedented energy efficiency and PDM microphone inputs, the Apollo3 Blue also forms the core of Ambiq's Voice-on-SPOT™ reference platform making it the perfect device for customers who want to add always-on voice assistant integration and command recognition to battery-powered devices. To increase design flexibility and enable connections to the phone and cloud, the Apollo3 Blue provides a dedicated second core for the ultra-low power BLE5 connectivity platform providing superior RF throughput and leaving plenty of resources available for user applications.

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## 1. Apollo3 Blue SoC Package Pins

### 1.1 Pin Configuration

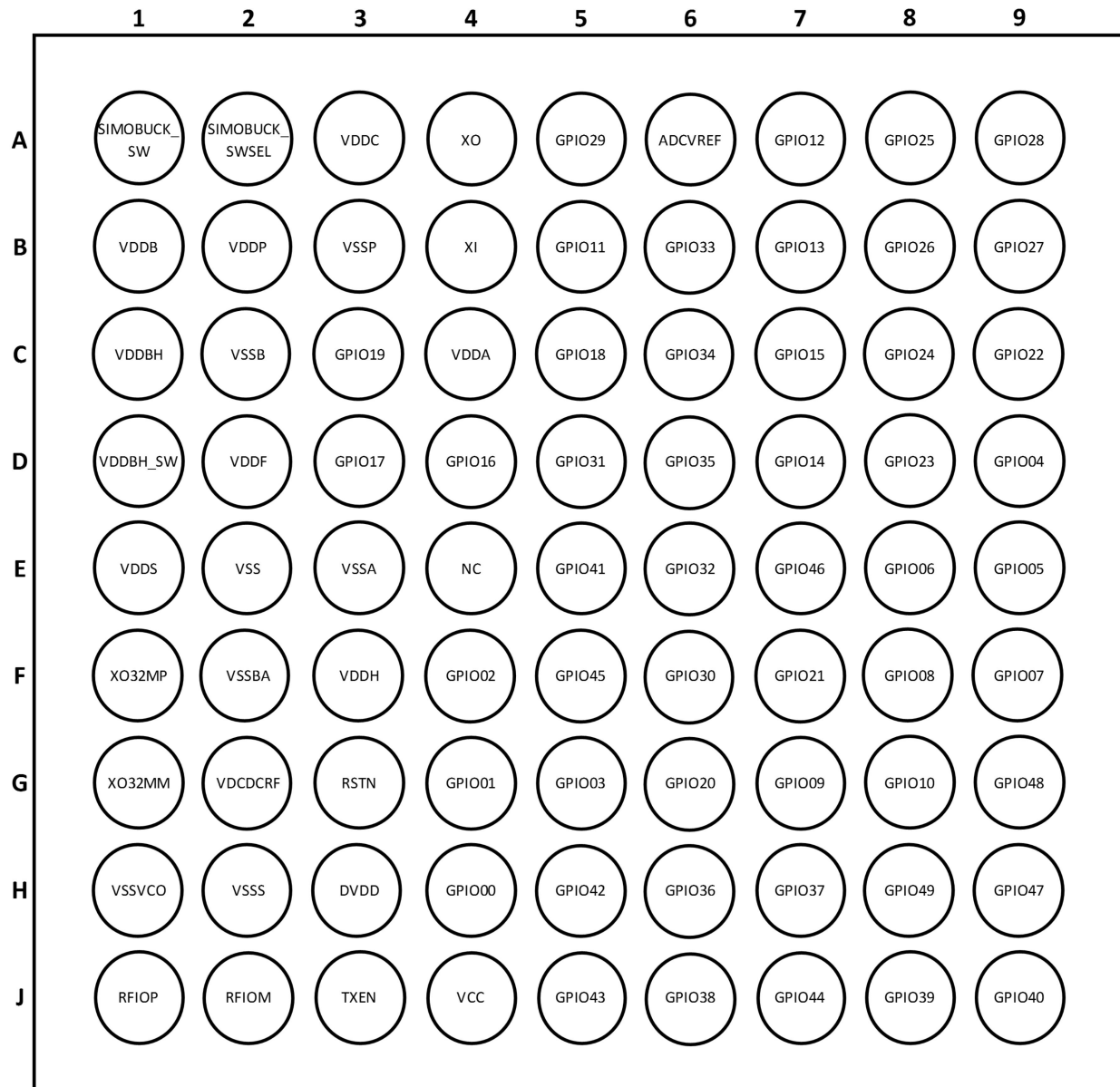


Figure 1. Apollo3 Blue SoC BGA Pin Configuration Diagram

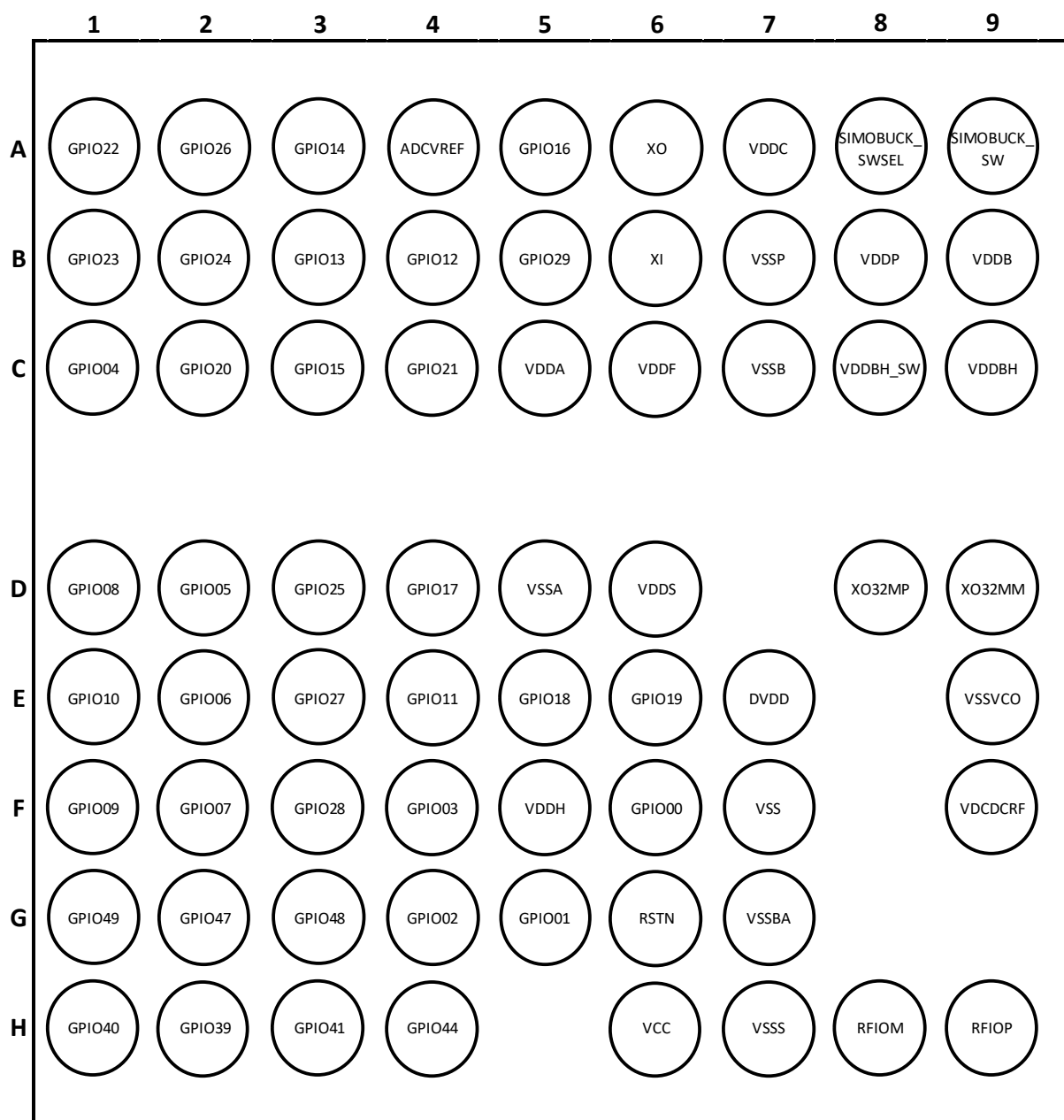


Figure 2. Apollo3 Blue SoC CSP Pin Configuration Diagram - Top View

## 1.2 Pin Connections

The following table lists the external pins of the Apollo3 Blue SoC and their available functions.

**Table 1: Pin List and Function Table**

| BGA Pin Number    | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                            | Pin Type |
|-------------------|----------------|-----------------|------------------------|-------------------|--------------------------------------------------------|----------|
| <b>POWER</b>      |                |                 |                        |                   |                                                        |          |
| B2                | B8             | -               | -                      | VDDP              | VDD Supply for SIMO Buck Converter                     | Power    |
| B1                | B9             | -               | -                      | Vddb              | VDD Supply for BLE/Burst Buck Converter                | Power    |
| F3                | F5             | -               | -                      | VDDH              | VDD Supply for I/O Pads                                | Power    |
| C4                | C5             | -               | -                      | VDDA              | Analog Voltage Supply                                  | Power    |
| J4                | H6             | -               | -                      | VCC               | RF Voltage Supply                                      | Power    |
| E1                | D6             | -               | -                      | VDDS              | High Voltage Digital Supply                            | Power    |
| G2                | F9             | -               | -                      | VDCDCRF           | RF Voltage Supply                                      | Power    |
| B3                | B7             | -               | -                      | VSSP              | Ground Connection for SIMO Buck Converter              | Ground   |
| E3                | D5             | -               | -                      | VSSA              | Ground for Analog Supply                               | Ground   |
| C2                | C7             | -               | -                      | VSSB              | Ground Connection for BLE/Burst Buck Converter         | Ground   |
| E2                | F7             | -               | -                      | VSS               | Ground for Digital                                     | Ground   |
| F2                | G7             | -               | -                      | VSSBA             | Ground for BLE Analog Supply                           | Ground   |
| H1                | E9             | -               | -                      | VSSVCO            | Ground for BLE VCO Supply                              | Ground   |
| H2                | H7             | -               | -                      | VSSS              | Ground for BLE RF Supply                               | Ground   |
| A6                | A4             | -               | -                      | ADCVREF           | Analog to Digital Converter Reference Voltage          | Analog   |
| H3                | E7             | -               | -                      | DVDD              | Decoupling Cap for BLE digital supply                  | Power    |
| E4                | -              | -               | -                      | NC                | No Connect                                             |          |
| <b>BUCK</b>       |                |                 |                        |                   |                                                        |          |
| A3                | A7             | -               | -                      | VDDC              | SIMO Buck Converter Voltage Core Output Supply         | Power    |
| D2                | C6             | -               | -                      | VDDF              | SIMO Buck Converter Voltage Flash/Memory Output Supply | Power    |
| A1                | A9             | -               | -                      | SIMO-BUCK_SW      | SIMO Buck Converter Inductor Switch Output             | Power    |
| A2                | A8             | -               | -                      | SIMO-BUCK_SWSEL   | SIMO Buck Converter Inductor Switch Input              | Power    |
| D1                | C8             | -               | -                      | VDDbH_SW          | BLE/Burst Buck Converter Inductor Switch               | Power    |
| C1                | C9             | -               | -                      | VDDbH             | BLE/Burst Buck Converter Voltage Output Supply         | Power    |
| <b>OSCILLATOR</b> |                |                 |                        |                   |                                                        |          |
| A4                | A6             | -               | -                      | XO                | 32.768 kHz Crystal Output                              | XT       |
| B4                | B6             | -               | -                      | XI                | 32.768 kHz Crystal Input                               | XT       |
| G1                | D9             | -               | -                      | XO32MM            | 32 MHz Crystal Input                                   | XT       |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                          | Pin Type                 |
|----------------|----------------|-----------------|------------------------|-------------------|----------------------------------------------------------------------|--------------------------|
| F1             | D8             | -               | -                      | XO32MP            | 32 MHz Crystal Output                                                | XT                       |
| <b>RESET</b>   |                |                 |                        |                   |                                                                      |                          |
| G3             | G6             | -               | -                      | RSTN              | External Reset Input                                                 | Input/Output             |
| <b>RF</b>      |                |                 |                        |                   |                                                                      |                          |
| J2             | H8             | -               | -                      | RFIOM             | RF I/O Negative                                                      | Analog                   |
| J1             | H9             | -               | -                      | RFIOP             | RF I/O Positive                                                      | Analog                   |
| J3             | -              | -               | -                      | TXEN              | Transmitter Enable                                                   | Output                   |
| <b>GPIO</b>    |                |                 |                        |                   |                                                                      |                          |
| H4             | F6             | 0               | 0                      | SLSCL             | I <sup>2</sup> C Slave Clock                                         | Input                    |
|                |                |                 | 1                      | SLSCK             | SPI Slave Clock                                                      | Input                    |
|                |                |                 | 2                      | CLKOUT            | Programmable Output Clock                                            | Output                   |
|                |                |                 | 3                      | GPIO00            | General Purpose I/O                                                  | Input/Output             |
|                |                |                 | 4                      | RSV               | Reserved                                                             |                          |
|                |                |                 | 5                      | MSPI4             | MSPI Master Interface Signal 4<br>See "MSPI Connection" on page 407. | Input/Output             |
|                |                |                 | 6                      | RSV               | Reserved                                                             |                          |
|                |                |                 | 7                      | NCE0              | IO Master N Chip Select 0<br>See NCE Encoding Table in GPIO Chapter  | Output                   |
| G4             | G5             | 1               | 0                      | SLSDAWIR3         | I <sup>2</sup> C Slave I/O Data<br>SPI Master 3 3 Wire Data          | Bidirectional Open Drain |
|                |                |                 | 1                      | SLMOSI            | SPI Slave Input Data                                                 | Input                    |
|                |                |                 | 2                      | UART0TX           | UART0 Transmit                                                       | Output                   |
|                |                |                 | 3                      | GPIO01            | General Purpose I/O                                                  | Input/Output             |
|                |                |                 | 4                      | RSV               | Reserved                                                             | Input                    |
|                |                |                 | 5                      | MSPI5             | MSPI Master Interface Signal 5<br>See "MSPI Connection" on page 407. | Input/Output             |
|                |                |                 | 6                      | RSV               | Reserved                                                             |                          |
|                |                |                 | 7                      | NCE1              | IO Master N Chip Select 1<br>See NCE Encoding Table in GPIO Chapter  | Output                   |
| F4             | G4             | 2               | 0                      | UART1RX           | UART1 Receive                                                        | Input                    |
|                |                |                 | 1                      | SLMISO            | SPI Slave Output Data                                                | Output                   |
|                |                |                 | 2                      | UART0RX           | UART0 Receive                                                        | Input                    |
|                |                |                 | 3                      | GPIO02            | General Purpose I/O                                                  | Input/Output             |
|                |                |                 | 4                      | RSV               | Reserved                                                             |                          |
|                |                |                 | 5                      | MSPI6             | MSPI Master Interface Signal 6<br>See "MSPI Connection" on page 407. | Input/Output             |
|                |                |                 | 6                      | RSV               | Reserved                                                             |                          |
|                |                |                 | 7                      | NCE2              | IO Master N Chip Select 2<br>See NCE Encoding Table in GPIO Chapter  | Output                   |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type                |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|-------------------------|
| G5             | F4             | 3               | 0                      | UA0RTS            | UART0 Request To Send (RTS)                                                                    | Output                  |
|                |                |                 | 1                      | SLnCE             | SPI Slave Chip Enable                                                                          | Input                   |
|                |                |                 | 2                      | NCE3              | IO Master N Chip Select 3<br>See NCE Encoding Table in GPIO Chapter                            | Output                  |
|                |                |                 | 3                      | GPIO03            | General Purpose I/O                                                                            | Input/<br>Output        |
|                |                |                 | 4                      | RSV               | Reserved                                                                                       |                         |
|                |                |                 | 5                      | MSPI7             | MSPI Master Interface Signal 7<br>See "MSPI Connection" on page 407.                           | Input/<br>Output        |
|                |                |                 | 6                      | TRIG1             | ADC Trigger Input                                                                              | Input                   |
|                |                |                 | 7                      | I2SWCLK           | I2S Word Clock                                                                                 | Input                   |
| D9             | C1             | 4               | 0                      | UA0CTS            | UART0 Clear To Send (CTS)                                                                      | Input                   |
|                |                |                 | 1                      | SLINT             | Configurable Slave Interrupt                                                                   | Output                  |
|                |                |                 | 2                      | NCE4              | IO Master N Chip Select 4<br>See NCE Encoding Table in GPIO Chapter                            | Output                  |
|                |                |                 | 3                      | GPIO04            | General Purpose I/O                                                                            | Input/<br>Output        |
|                |                |                 | 4                      | RSV               | Reserved                                                                                       |                         |
|                |                |                 | 5                      | UART1RX           | UART1 Receive                                                                                  | Input                   |
|                |                |                 | 6                      | CT17              | Timer/Counter Interface Signal 17<br>See "Implementing Counter/Timer Connections" on page 408. | Output                  |
|                |                |                 | 7                      | MSPI2             | MSPI Master Interface Signal 2<br>See "MSPI Connection" on page 407.                           | Input/<br>Output        |
| E9             | D2             | 5               | 0                      | M0SCL             | I <sup>2</sup> C Master 0 Clock                                                                | Open<br>Drain<br>Output |
|                |                |                 | 1                      | M0SCK             | SPI Master 0 Clock                                                                             | Output                  |
|                |                |                 | 2                      | UA0RTS            | UART0 Request To Send (RTS)                                                                    | Output                  |
|                |                |                 | 3                      | GPIO05            | General Purpose I/O                                                                            | Input/<br>Output        |
|                |                |                 | 4                      | RSV               | Reserved                                                                                       |                         |
|                |                |                 | 5                      | RSV               | Reserved                                                                                       |                         |
|                |                |                 | 6                      | RSV               | Reserved                                                                                       |                         |
|                |                |                 | 7                      | CT8               | Timer/Counter Interface Signal 8<br>See "Implementing Counter/Timer Connections" on page 408.  | Output                  |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type                 |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|--------------------------|
| E8             | E2             | 6               | 0                      | M0SDAWIR3         | I <sup>2</sup> C Master 0 Data<br>SPI Master 0 3 Wire Data                                     | Bidirectional Open Drain |
|                |                |                 | 1                      | M0MISO            | SPI Master 0 Input Data                                                                        | Input                    |
|                |                |                 | 2                      | UA0CTS            | UART0 Clear To Send (CTS)                                                                      | Input                    |
|                |                |                 | 3                      | GPIO06            | General Purpose I/O                                                                            | Input/Output             |
|                |                |                 | 4                      | RSV               | Reserved                                                                                       |                          |
|                |                |                 | 5                      | CT10              | Timer/Counter Interface Signal 10<br>See "Implementing Counter/Timer Connections" on page 408. | Output                   |
|                |                |                 | 6                      | RSV               | Reserved                                                                                       |                          |
|                |                |                 | 7                      | I2SDAT            | I2S Data                                                                                       | Output                   |
| F9             | F2             | 7               | 0                      | NCE7              | IO Master N Chip Select 7<br>See NCE Encoding Table in GPIO Chapter                            | Output                   |
|                |                |                 | 1                      | M0MOSI            | SPI Master 0 Output Data                                                                       | Output                   |
|                |                |                 | 2                      | CLKOUT            | Programmable Output Clock                                                                      | Output                   |
|                |                |                 | 3                      | GPIO07            | General Purpose I/O                                                                            | Input/Output             |
|                |                |                 | 4                      | TRIG0             | ADC Trigger Input                                                                              | Input                    |
|                |                |                 | 5                      | UART0TX           | UART0 Transmit                                                                                 | Output                   |
|                |                |                 | 6                      | RSV               | Reserved                                                                                       |                          |
|                |                |                 | 7                      | CT19              | Timer/Counter Interface Signal 19<br>See "Implementing Counter/Timer Connections" on page 408. | Output                   |
| F8             | D1             | 8               | 0                      | M1SCL             | I <sup>2</sup> C Master 1 Clock                                                                | Open Drain Output        |
|                |                |                 | 1                      | M1SCK             | SPI Master 1 Clock                                                                             | Output                   |
|                |                |                 | 2                      | NCE8              | IO Master N Chip Select 8<br>See NCE Encoding Table in GPIO Chapter                            | Output                   |
|                |                |                 | 3                      | GPIO08            | General Purpose I/O                                                                            | Input/Output             |
|                |                |                 | 4                      | SCCCLK            | Secure Card Controller Clock                                                                   | Output                   |
|                |                |                 | 5                      | RSV               | Reserved                                                                                       |                          |
|                |                |                 | 6                      | UART1TX           | UART1 Transmit                                                                                 | Output                   |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                          |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type                 |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|--------------------------|
| G7             | F1             | 9               | 0                      | M1SDAWIR3         | I <sup>2</sup> C Master 1 Data<br>SPI Master 1 3 Wire Data                                     | Bidirectional Open Drain |
|                |                |                 | 1                      | M1MISO            | SPI Master 1 Input Data                                                                        | Input                    |
|                |                |                 | 2                      | NCE9              | IO Master N Chip Select 9<br>See NCE Encoding Table in GPIO Chapter                            | Output                   |
|                |                |                 | 3                      | GPIO09            | General Purpose I/O                                                                            | Input/Output             |
|                |                |                 | 4                      | SCCIO             | Secure Card Controller I/O                                                                     | Input/Output             |
|                |                |                 | 5                      | RSV               | Reserved                                                                                       |                          |
|                |                |                 | 6                      | UART1RX           | UART1 Receive                                                                                  | Input                    |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                          |
| G8             | E1             | 10              | 0                      | UART1TX           | UART1 Transmit                                                                                 | Output                   |
|                |                |                 | 1                      | M1MOSI            | SPI Master 1 Output Data                                                                       | Output                   |
|                |                |                 | 2                      | NCE10             | IO Master N Chip Select 10<br>See NCE Encoding Table in GPIO Chapter                           | Output                   |
|                |                |                 | 3                      | GPIO10            | General Purpose I/O                                                                            | Input/Output             |
|                |                |                 | 4                      | PDMCLK            | PDM Clock Output                                                                               | Output                   |
|                |                |                 | 5                      | UA1RTS            | UART1 Request To Send                                                                          | Output                   |
|                |                |                 | 6                      | RSV               | Reserved                                                                                       |                          |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                          |
| B5             | E4             | 11              | 0                      | ADCSE2            | Analog to Digital Converter Single-Ended Input 2                                               | Input                    |
|                |                |                 | 1                      | NCE11             | IO Master N Chip Select 11<br>See NCE Encoding Table in GPIO Chapter                           | Output                   |
|                |                |                 | 2                      | CT31              | Timer/Counter Interface Signal 31<br>See "Implementing Counter/Timer Connections" on page 408. | Output                   |
|                |                |                 | 3                      | GPIO11            | General Purpose I/O                                                                            | Input/Output             |
|                |                |                 | 4                      | SLINT             | Configurable Slave Interrupt                                                                   | Output                   |
|                |                |                 | 5                      | UA1CTS            | UART1 Clear To Send                                                                            | Input                    |
|                |                |                 | 6                      | UART0RX           | UART0 Receive                                                                                  | Input                    |
|                |                |                 | 7                      | PDMDATA           | PDM Data                                                                                       | Input                    |



Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type         |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|------------------|
| A7             | B4             | 12              | 0                      | ADCD0NSE9         | Analog to Digital Converter Differential N Input 0 / Single-Ended Input 9                      | Input            |
|                |                |                 | 1                      | NCE12             | IO Master N Chip Select 12<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT0               | Timer/Counter Interface Signal 0<br>See "Implementing Counter/Timer Connections" on page 408.  | Output           |
|                |                |                 | 3                      | GPIO12            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | RSV               | Reserved                                                                                       |                  |
|                |                |                 | 5                      | PDMCLK            | PDM Clock Output                                                                               | Output           |
|                |                |                 | 6                      | UA0CTS            | UART0 Clear To Send (CTS)                                                                      | Input            |
|                |                |                 | 7                      | UART1TX           | UART1 Transmit                                                                                 | Output           |
| B7             | B3             | 13              | 0                      | ADCD0PSE8         | Analog to Digital Converter Differential P Input 0 / Single-Ended Input 9                      | Input            |
|                |                |                 | 1                      | NCE13             | IO Master N Chip Select 13<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT2               | Timer/Counter Interface Signal 2<br>TSee "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 3                      | GPIO13            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | I2SBCLK           | I2S Bit Clock                                                                                  | Input            |
|                |                |                 | 5                      | RSV               | Reserved                                                                                       |                  |
|                |                |                 | 6                      | UA0RTS            | UART0 Request To Send (RTS)                                                                    | Output           |
|                |                |                 | 7                      | UART1RX           | UART1 Receive                                                                                  | Input            |
| D7             | A3             | 14              | 0                      | ADCD1P            | Analog to Digital Converter Differential P Input 1                                             | Input            |
|                |                |                 | 1                      | NCE14             | IO Master N Chip Select 14<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | UART1TX           | UART1 Transmit                                                                                 | Output           |
|                |                |                 | 3                      | GPIO14            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | PDMCLK            | PDM Output Clock                                                                               | Output           |
|                |                |                 | 5                      | RSV               | Reserved                                                                                       |                  |
|                |                |                 | 6                      | SWDCK             | Serial Wire Debug Clock                                                                        | Input            |
|                |                |                 | 7                      | 32kHzXT           | 32kHz Clock                                                                                    | Output           |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                   | Pin Type              |
|----------------|----------------|-----------------|------------------------|-------------------|-----------------------------------------------------------------------------------------------|-----------------------|
| C7             | C3             | 15              | 0                      | ADCD1N            | Analog to Digital Converter Differential N Input 1                                            | Input                 |
|                |                |                 | 1                      | NCE15             | IO Master N Chip Select 15<br>See NCE Encoding Table in GPIO Chapter                          | Output                |
|                |                |                 | 2                      | UART1RX           | UART1 Receive                                                                                 | Input                 |
|                |                |                 | 3                      | GPIO15            | General Purpose I/O                                                                           | Input/<br>Output      |
|                |                |                 | 4                      | PDMDATA           | PDM Data                                                                                      | Input                 |
|                |                |                 | 5                      | RSV               | Reserved                                                                                      |                       |
|                |                |                 | 6                      | SWDIO             | Serial Wire Debug I/O                                                                         | Bidirectional 3-state |
|                |                |                 | 7                      | SWO               | Serial Wire Debug Output                                                                      | Output                |
| D4             | A5             | 16              | 0                      | ADCSE0            | Analog to Digital Converter Single-Ended Input 0                                              | Input                 |
|                |                |                 | 1                      | NCE16             | IO Master N Chip Select 16<br>See NCE Encoding Table in GPIO Chapter                          | Output                |
|                |                |                 | 2                      | TRIG0             | ADC Trigger Input 0                                                                           | Input                 |
|                |                |                 | 3                      | GPIO16            | General Purpose I/O                                                                           | Input/<br>Output      |
|                |                |                 | 4                      | SCCRST            | Secure Card Controller Reset                                                                  | Output                |
|                |                |                 | 5                      | CMPIN0            | Voltage Comparator Input 0                                                                    | Input                 |
|                |                |                 | 6                      | UART0TX           | UART0 Transmit                                                                                | Output                |
|                |                |                 | 7                      | UA1RTS            | UART1 Request To Send (RTS)                                                                   | Output                |
| D3             | D4             | 17              | 0                      | CMPRF1            | Voltage Comparator Reference 1                                                                | Input                 |
|                |                |                 | 1                      | NCE17             | IO Master N Chip Select 17<br>See NCE Encoding Table in GPIO Chapter                          | Output                |
|                |                |                 | 2                      | TRIG3             | ADC Trigger Input 3                                                                           | Input                 |
|                |                |                 | 3                      | GPIO17            | General Purpose I/O                                                                           | Input/<br>Output      |
|                |                |                 | 4                      | SCCCLK            | Secure Card Controller Clock                                                                  | Output                |
|                |                |                 | 5                      | RSV               | Reserved                                                                                      |                       |
|                |                |                 | 6                      | UART0RX           | UART0 Receive                                                                                 | Input                 |
|                |                |                 | 7                      | UA1CTS            | UART1 Clear To Send (CTS)                                                                     | Input                 |
| C5             | E5             | 18              | 0                      | CMPIN1            | Voltage Comparator Input 1                                                                    | Input                 |
|                |                |                 | 1                      | NCE18             | IO Master N Chip Select 18<br>See NCE Encoding Table in GPIO Chapter                          | Output                |
|                |                |                 | 2                      | CT4               | Timer/Counter Interface Signal 4<br>See "Implementing Counter/Timer Connections" on page 408. | Output                |
|                |                |                 | 3                      | GPIO18            | General Purpose I/O                                                                           | Input/<br>Output      |
|                |                |                 | 4                      | UA0RTS            | UART0 Request To Send                                                                         | Output                |
|                |                |                 | 5                      | RSV               | Reserved                                                                                      |                       |
|                |                |                 | 6                      | UART1TX           | UART1 Transmit                                                                                | Output                |
|                |                |                 | 7                      | SCCCLK            | Secure Card Controller Clock                                                                  | Output                |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                   | Pin Type                 |
|----------------|----------------|-----------------|------------------------|-------------------|-----------------------------------------------------------------------------------------------|--------------------------|
| C3             | E6             | 19              | 0                      | CMPRF0            | Comparator Reference 0                                                                        | Input                    |
|                |                |                 | 1                      | NCE19             | IO Master N Chip Select 19<br>See NCE Encoding Table in GPIO Chapter                          | Output                   |
|                |                |                 | 2                      | CT6               | Timer/Counter Interface Signal 6<br>See "Implementing Counter/Timer Connections" on page 408. | Output                   |
|                |                |                 | 3                      | GPIO19            | General Purpose I/O                                                                           | Input/<br>Output         |
|                |                |                 | 4                      | SCCIO             | Secure Card Controller I/O                                                                    | Input/<br>Output         |
|                |                |                 | 5                      | RSV               | Reserved                                                                                      |                          |
|                |                |                 | 6                      | UART1RX           | UART1 Receive                                                                                 | Input                    |
|                |                |                 | 7                      | I2SBCLK           | I2S Bit Clock                                                                                 | Input                    |
| G6             | C2             | 20              | 0                      | SWDCK             | Software Debug Clock                                                                          | Input                    |
|                |                |                 | 1                      | NCE20             | IO Master N Chip Select 20<br>See NCE Encoding Table in GPIO Chapter                          | Output                   |
|                |                |                 | 2                      | RSV               | Reserved                                                                                      |                          |
|                |                |                 | 3                      | GPIO20            | General Purpose I/O                                                                           | Input/<br>Output         |
|                |                |                 | 4                      | UART0TX           | UART0 Transmit                                                                                | Output                   |
|                |                |                 | 5                      | UART1TX           | UART1 Transmit                                                                                | Output                   |
|                |                |                 | 6                      | I2SBCLK           | I2S Bit Clock                                                                                 | Input                    |
|                |                |                 | 7                      | UA1RTS            | UART1 Request To Send (RTS)                                                                   | Output                   |
| F7             | C4             | 21              | 0                      | SWDIO             | Software Data I/O                                                                             | Bidirectional<br>3-state |
|                |                |                 | 1                      | NCE21             | IO Master N Chip Select 21<br>See NCE Encoding Table in GPIO Chapter                          | Output                   |
|                |                |                 | 2                      | RSV               | Reserved                                                                                      | Output                   |
|                |                |                 | 3                      | GPIO21            | General Purpose I/O                                                                           | Input/<br>Output         |
|                |                |                 | 4                      | UART0RX           | UART0 Receive                                                                                 | Input                    |
|                |                |                 | 5                      | UART1RX           | UART1 Receive                                                                                 | Input                    |
|                |                |                 | 6                      | SCCRST            | Secure Card Controller Reset                                                                  | Output                   |
|                |                |                 | 7                      | UA1CTS            | UART1 Clear To Send (CTS)                                                                     | Input                    |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type         |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|------------------|
| C9             | A1             | 22              | 0                      | UART0TX           | UART0 Transmit                                                                                 | Output           |
|                |                |                 | 1                      | NCE22             | IO Master N Chip Select 22<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT12              | Timer/Counter Interface Signal 12<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 3                      | GPIO22            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | PDMCLK            | PDM Output Clock                                                                               | Output           |
|                |                |                 | 5                      | RSV               | Reserved                                                                                       |                  |
|                |                |                 | 6                      | MSPI0             | MSPI Master Interface Signal 0<br>See "MSPI Connection" on page 407.                           | Input/<br>Output |
|                |                |                 | 7                      | SWO               | Serial Wire Debug Output                                                                       | Output           |
| D8             | B1             | 23              | 0                      | UART0RX           | UART0 Receive                                                                                  | Input            |
|                |                |                 | 1                      | NCE23             | IO Master N Chip Select 23<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT14              | Timer/Counter Interface Signal 14<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 3                      | GPIO23            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | I2SWCLK           | I2S Word Clock                                                                                 | Input            |
|                |                |                 | 5                      | CMPOUT            | Voltage Comparator Output                                                                      | Output           |
|                |                |                 | 6                      | MSPI3             | MSPI Master Interface Signal 3<br>See "MSPI Connection" on page 407.                           | Input/<br>Output |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                  |
| C8             | B2             | 24              | 0                      | UART1TX           | UART1 Transmit                                                                                 | Output           |
|                |                |                 | 1                      | NCE24             | IO Master N Chip Select 24<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | MSPI8             | MSPI Master Interface Signal 8<br>See "MSPI Connection" on page 407.                           | Input/<br>Output |
|                |                |                 | 3                      | GPIO24            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | UA0CTS            | UART0 Clear To Send (CTS)                                                                      | Input            |
|                |                |                 | 5                      | CT21              | Timer/Counter Interface Signal 21<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 6                      | 32kHzXT           | 32kHz Clock Output                                                                             | Output           |
|                |                |                 | 7                      | SWO               | Serial Wire Debug Output                                                                       | Output           |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                   | Pin Type                    |
|----------------|----------------|-----------------|------------------------|-------------------|-----------------------------------------------------------------------------------------------|-----------------------------|
| A8             | D3             | 25              | 0                      | UART1RX           | UART1 Receive                                                                                 | Input                       |
|                |                |                 | 1                      | NCE25             | IO Master N Chip Select 25<br>See NCE Encoding Table in GPIO Chapter                          | Output                      |
|                |                |                 | 2                      | CT1               | Timer/Counter Interface Signal 1<br>See "Implementing Counter/Timer Connections" on page 408. | Output                      |
|                |                |                 | 3                      | GPIO25            | General Purpose I/O                                                                           | Input/<br>Output            |
|                |                |                 | 4                      | M2SDAWIR3         | I <sup>2</sup> C Master 2 I/O Data<br>SPI Master 2 3 Wire Data                                | Bidirectional<br>Open-Drain |
|                |                |                 | 5                      | M2MISO            | SPI Master 2 Input Data                                                                       | Input                       |
|                |                |                 | 6                      | RSV               | Reserved                                                                                      |                             |
|                |                |                 | 7                      | RSV               | Reserved                                                                                      |                             |
| B8             | A2             | 26              | 0                      | RSV               | Reserved                                                                                      |                             |
|                |                |                 | 1                      | NCE26             | IO Master N Chip Select 26<br>See NCE Encoding Table in GPIO Chapter                          | Output                      |
|                |                |                 | 2                      | CT3               | Timer/Counter Interface Signal 3<br>See "Implementing Counter/Timer Connections" on page 408. | Output                      |
|                |                |                 | 3                      | GPIO26            | General Purpose I/O                                                                           | Input/<br>Output            |
|                |                |                 | 4                      | SCCRST            | Secure Card Controller Reset                                                                  | Output                      |
|                |                |                 | 5                      | MSPI1             | MSPI Master Interface Signal 1<br>See NCE Encoding Table in GPIO Chapter                      | Input/<br>Output            |
|                |                |                 | 6                      | UART0TX           | UART0 Transmit                                                                                | Output                      |
|                |                |                 | 7                      | UA1CTS            | UART1 Clear To Send (CTS)                                                                     | Input                       |
| B9             | E3             | 27              | 0                      | UART0RX           | UART0 Receive                                                                                 | Input                       |
|                |                |                 | 1                      | NCE27             | IO Master N Chip Select 27<br>See NCE Encoding Table in GPIO Chapter                          | Output                      |
|                |                |                 | 2                      | CT5               | Timer/Counter Interface Signal 5<br>See "Implementing Counter/Timer Connections" on page 408. | Output                      |
|                |                |                 | 3                      | GPIO27            | General Purpose I/O                                                                           | Input/<br>Output            |
|                |                |                 | 4                      | M2SCL             | I <sup>2</sup> C Master 2 Clock                                                               | Open<br>Drain               |
|                |                |                 | 5                      | M2SCK             | SPI Master 2 Clock                                                                            | Output                      |
|                |                |                 | 6                      | RSV               | Reserved                                                                                      |                             |
|                |                |                 | 7                      | RSV               | Reserved                                                                                      |                             |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type         |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|------------------|
| A9             | F3             | 28              | 0                      | I2SWCLK           | I2S Word Clock                                                                                 | Input            |
|                |                |                 | 1                      | NCE28             | IO Master N Chip Select 28<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT7               | Timer/Counter Interface Signal 7<br>See "Implementing Counter/Timer Connections" on page 408.  | Output           |
|                |                |                 | 3                      | GPIO28            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | RSV               | Reserved                                                                                       |                  |
|                |                |                 | 5                      | M2MOSI            | SPI Master 2 Output Data                                                                       | Output           |
|                |                |                 | 6                      | UART0TX           | UART0 Transmit                                                                                 | Output           |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                  |
| A5             | B5             | 29              | 0                      | ADCSE1            | Analog to Digital Converter Single-Ended Input 1                                               | Input            |
|                |                |                 | 1                      | NCE29             | IO Master N Chip Select 29<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT9               | Timer/Counter Interface Signal 9<br>See "Implementing Counter/Timer Connections" on page 408.  | Output           |
|                |                |                 | 3                      | GPIO29            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | UA0CTS            | UART0 Clear To Send (CTS)                                                                      | Input            |
|                |                |                 | 5                      | UA1CTS            | UART1 Clear To Send (CTS)                                                                      | Input            |
|                |                |                 | 6                      | UART0RX           | UART0 Receive                                                                                  | Input            |
|                |                |                 | 7                      | PDMDATA           | PDM Data                                                                                       | Input            |
| F6             | -              | 30              | 0                      | RSV               | Reserved                                                                                       |                  |
|                |                |                 | 1                      | NCE30             | IO Master N Chip Select 30<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT11              | Timer/Counter Interface Signal 11<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 3                      | GPIO30            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | UART0TX           | UART0 Transmit                                                                                 | Output           |
|                |                |                 | 5                      | UA1RTS            | UART1 Request To Send (RTS)                                                                    | Output           |
|                |                |                 | 6                      | BLEIF_SCK         | BLE Interface SCK Observation                                                                  | Output           |
|                |                |                 | 7                      | I2SDAT            | I2S Data Output                                                                                | Output           |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type         |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|------------------|
| D5             | -              | 31              | 0                      | ADCSE3            | Analog to Digital Converter Single-Ended Input 3                                               | Input            |
|                |                |                 | 1                      | NCE31             | IO Master N Chip Select 31<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT13              | Timer/Counter Interface Signal 13<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 3                      | GPIO31            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | UART0RX           | UART0 Receive                                                                                  | Input            |
|                |                |                 | 5                      | SCCCLK            | Secure Card Controller Clock                                                                   | Output           |
|                |                |                 | 6                      | BLEIF_MISO        | BLE Interface MISO Observation                                                                 | Output           |
|                |                |                 | 7                      | UA1RTS            | UART1 Request To Send (RTS)                                                                    | Output           |
| E6             | -              | 32              | 0                      | ADCSE4            | Analog to Digital Converter Single-Ended Input 4                                               | Input            |
|                |                |                 | 1                      | NCE32             | IO Master N Chip Select 32<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT15              | Timer/Counter Interface Signal 15<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 3                      | GPIO32            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | SCCIO             | Secure Card Controller I/O                                                                     | Input/<br>Output |
|                |                |                 | 5                      | RSV               | Reserved                                                                                       |                  |
|                |                |                 | 6                      | BLEIF_MOSI        | BLE Interface MOSI Observation                                                                 | Output           |
|                |                |                 | 7                      | UA1CTS            | UART1 Clear To Send (CTS)                                                                      | Input            |
| B6             | -              | 33              | 0                      | ADCSE5            | Analog to Digital Converter Single-Ended Input 5                                               | Input            |
|                |                |                 | 1                      | NCE33             | IO Master N Chip Select 33<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | 32kHzXT           | 32kHz Clock Output                                                                             | Output           |
|                |                |                 | 3                      | GPIO33            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | BLEIF_CSN         | BLE Interface Chip Select Observation                                                          | Output           |
|                |                |                 | 5                      | UA0CTS            | UART0 Clear To Send (CTS)                                                                      | Input            |
|                |                |                 | 6                      | CT23              | Timer/Counter Interface Signal 23<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 7                      | SWO               | Serial Wire Debug Output                                                                       | SWO              |



Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type         |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|------------------|
| C6             | -              | 34              | 0                      | ADCSE6            | Analog to Digital Converter Single-Ended Input 6                                               | Input            |
|                |                |                 | 1                      | NCE34             | IO Master N Chip Select 34<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | UA1RTS            | UART1 Request To Send (RTS)                                                                    | Output           |
|                |                |                 | 3                      | GPIO34            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | CMPRF2            | Voltage Comparator Reference 2                                                                 | Input            |
|                |                |                 | 5                      | UA0RTS            | UART0 Request To Send (RTS)                                                                    | Output           |
|                |                |                 | 6                      | UART0RX           | UART0 Receive                                                                                  | Input            |
|                |                |                 | 7                      | PDMDATA           | PDM Data                                                                                       | Input            |
| D6             | -              | 35              | 0                      | ADCSE7            | Analog to Digital Converter Single-Ended Input 7                                               | Input            |
|                |                |                 | 1                      | NCE35             | IO Master N Chip Select 35<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | UART1TX           | UART1 Transmit                                                                                 | Output           |
|                |                |                 | 3                      | GPIO35            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | I2SDAT            | I2S Data                                                                                       | Output           |
|                |                |                 | 5                      | CT27              | Timer/Counter Interface Signal 27<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 6                      | UA0RTS            | UART0 Request To Send (RTS)                                                                    | Output           |
|                |                |                 | 7                      | BLEIF_STA-TUS     | BLE Interface STATUS Observation                                                               | Output           |
| H6             | -              | 36              | 0                      | TRIG1             | ADC Trigger Input 1                                                                            | Input            |
|                |                |                 | 1                      | NCE36             | IO Master N Chip Select 36<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | UART1RX           | UART1 Receive                                                                                  | Input            |
|                |                |                 | 3                      | GPIO36            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | 32kHzXT           | 32kHz Clock Output                                                                             | Output           |
|                |                |                 | 5                      | UA1CTS            | UART1 Clear To Send (CTS)                                                                      | Input            |
|                |                |                 | 6                      | UA0CTS            | UART0 Clear To Send (CTS)                                                                      | Input            |
|                |                |                 | 7                      | PDMDATA           | PDM Data                                                                                       | Input            |
| H7             | -              | 37              | 0                      | TRIG2             | ADC Trigger Input 2                                                                            | Input            |
|                |                |                 | 1                      | NCE37             | IO Master N Chip Select 37<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | UA0RTS            | UART0 Request To Send (RTS)                                                                    | Output           |
|                |                |                 | 3                      | GPIO37            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | SCCIO             | Secure Card Controller I/O                                                                     | Input/<br>Output |
|                |                |                 | 5                      | UART1TX           | UART1 Transmit                                                                                 | Output           |
|                |                |                 | 6                      | PDMCLK            | PDM Output Clock                                                                               | Output           |
|                |                |                 | 7                      | CT29              | Timer/Counter Interface Signal 29<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type                       |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|--------------------------------|
| J6             | -              | 38              | 0                      | TRIG3             | ADC Trigger Input 3                                                                            | Input                          |
|                |                |                 | 1                      | NCE38             | IO Master N Chip Select 38<br>See NCE Encoding Table in GPIO Chapter                           | Output                         |
|                |                |                 | 2                      | UA0CTS            | UART0 Clear To Send (CTS)                                                                      | Input                          |
|                |                |                 | 3                      | GPIO38            | General Purpose I/O                                                                            | Input/<br>Output               |
|                |                |                 | 4                      | RSV               | Reserved                                                                                       |                                |
|                |                |                 | 5                      | M3MOSI            | SPI Master 3 Output Data                                                                       | Output                         |
|                |                |                 | 6                      | UART1RX           | UART1 Receive                                                                                  | Input                          |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                                |
| J8             | H2             | 39              | 0                      | UART0TX           | UART0 Transmit                                                                                 | Output                         |
|                |                |                 | 1                      | UART1TX           | UART1 Transmit                                                                                 | Output                         |
|                |                |                 | 2                      | CT25              | Timer/Counter Interface Signal 25<br>See "Implementing Counter/Timer Connections" on page 408. | Output                         |
|                |                |                 | 3                      | GPIO39            | General Purpose I/O                                                                            | Input/<br>Output               |
|                |                |                 | 4                      | M4SCL             | I <sup>2</sup> C Master 4 Clock                                                                | Open<br>Drain                  |
|                |                |                 | 5                      | M4SCK             | SPI Master 4 Clock                                                                             | Output                         |
|                |                |                 | 6                      | RSV               | Reserved                                                                                       |                                |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                                |
| J9             | H1             | 40              | 0                      | UART0RX           | UART0 Receive                                                                                  | Input                          |
|                |                |                 | 1                      | UART1RX           | UART1 Receive                                                                                  | Input                          |
|                |                |                 | 2                      | TRIG0             | ADC Trigger Input 0                                                                            | Input                          |
|                |                |                 | 3                      | GPIO40            | General Purpose I/O                                                                            | Input/<br>Output               |
|                |                |                 | 4                      | M4SDAWIR3         | I <sup>2</sup> C Master 4 I/O Data<br>SPI Master 4 3 Wire Data                                 | Bidirectional<br>Open<br>Drain |
|                |                |                 | 5                      | M4MISO            | SPI Master 4 Data Input                                                                        | Input                          |
|                |                |                 | 6                      | RSV               | Reserved                                                                                       |                                |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                                |
| E5             | H3             | 41              | 0                      | NCE41             | IO Master N Chip Select 41<br>See NCE Encoding Table in GPIO Chapter                           | Output                         |
|                |                |                 | 1                      | BLEIF_IRQ         | BLE Interface IRQ Observation                                                                  | Output                         |
|                |                |                 | 2                      | SWO               | Serial Wire Debug Output                                                                       | Output                         |
|                |                |                 | 3                      | GPIO41            | General Purpose I/O                                                                            | Input/<br>Output               |
|                |                |                 | 4                      | I2SWCLK           | I2S Word Clock                                                                                 | Input                          |
|                |                |                 | 5                      | UA1RTS            | UART1 Request To Send (RTS)                                                                    | Output                         |
|                |                |                 | 6                      | UART0TX           | UART0 Transmit                                                                                 | Output                         |
|                |                |                 | 7                      | UA0RTS            | UART0 Request To Send (RTS)                                                                    | Output                         |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type                    |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|-----------------------------|
| H5             | -              | 42              | 0                      | UART1TX           | UART1 Transmit                                                                                 | Output                      |
|                |                |                 | 1                      | NCE42             | IO Master N Chip Select 42<br>See NCE Encoding Table in GPIO Chapter                           | Output                      |
|                |                |                 | 2                      | CT16              | Timer/Counter Interface Signal 2. See "Implementing Counter/Timer Connections" on page 408.    | Output                      |
|                |                |                 | 3                      | GPIO42            | General Purpose I/O                                                                            | Input/<br>Output            |
|                |                |                 | 4                      | M3SCL             | I <sup>2</sup> C Master 3 Clock                                                                | Open Drain                  |
|                |                |                 | 5                      | M3SCK             | SPI Master 3 Clock                                                                             | Output                      |
|                |                |                 | 6                      | RSV               | Reserved                                                                                       |                             |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                             |
| J5             | -              | 43              | 0                      | UART1RX           | UART1 Receive                                                                                  | Input                       |
|                |                |                 | 1                      | NCE43             | IO Master N Chip Select 43<br>See NCE Encoding Table in GPIO Chapter                           | Output                      |
|                |                |                 | 2                      | CT18              | Timer/Counter Interface Signal 18<br>See "Implementing Counter/Timer Connections" on page 408. | Output                      |
|                |                |                 | 3                      | GPIO43            | General Purpose I/O                                                                            | Input/<br>Output            |
|                |                |                 | 4                      | M3SDAWIR3         | I <sup>2</sup> C Master 3 I/O<br>SPI Master 3 3 Wire Data                                      | Bidirectional<br>Open Drain |
|                |                |                 | 5                      | M3MISO            | SPI Master 3 Input Data                                                                        | Input                       |
|                |                |                 | 6                      | RSV               | Reserved                                                                                       |                             |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                             |
| J7             | H4             | 44              | 0                      | UA1RTS            | UART1 Request To Send (RTS)                                                                    | Output                      |
|                |                |                 | 1                      | NCE44             | IO Master N Chip Select 44<br>See NCE Encoding Table in GPIO Chapter                           | Output                      |
|                |                |                 | 2                      | CT20              | Timer/Counter Interface Signal 20<br>See "Implementing Counter/Timer Connections" on page 408. | Output                      |
|                |                |                 | 3                      | GPIO44            | General Purpose I/O                                                                            | Input/<br>Output            |
|                |                |                 | 4                      | RSV               | Reserved                                                                                       |                             |
|                |                |                 | 5                      | M4MOSI            | SPI Master 4 Output Data                                                                       | Output                      |
|                |                |                 | 6                      | UART0TX           | UART0 Transmit                                                                                 | Output                      |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                             |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type         |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|------------------|
| F5             | -              | 45              | 0                      | UA1CTS            | UART1 Clear To Send (CTS)                                                                      | Input            |
|                |                |                 | 1                      | NCE45             | IO Master N Chip Select 45<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT22              | Timer/Counter Interface Signal 22<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 3                      | GPIO45            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | I2SDAT            | I2S Data                                                                                       | Output           |
|                |                |                 | 5                      | PDMDATA           | PDM Data                                                                                       | Input            |
|                |                |                 | 6                      | UART0RX           | UART0 Receive                                                                                  | Input            |
|                |                |                 | 7                      | SWO               | Serial Wire Debug Output                                                                       | Output           |
| E7             | -              | 46              | 0                      | I2SBCLK           | I2S Bit Clock                                                                                  | Input            |
|                |                |                 | 1                      | NCE46             | IO Master N Chip Select 46<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT24              | Timer/Counter Interface Signal 24<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 3                      | GPIO46            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | SCCRST            | Secure Card Controller Reset                                                                   | Output           |
|                |                |                 | 5                      | PDMCLK            | PDM Output Clock                                                                               | Output           |
|                |                |                 | 6                      | UART1TX           | UART1 Transmit                                                                                 | Output           |
|                |                |                 | 7                      | SWO               | Serial Wire Debug Output                                                                       | Output           |
| H9             | G2             | 47              | 0                      | 32kHzXT           | 32kHz Clock Output                                                                             | Output           |
|                |                |                 | 1                      | NCE47             | IO Master N Chip Select 47<br>See NCE Encoding Table in GPIO Chapter                           | Output           |
|                |                |                 | 2                      | CT26              | Timer/Counter Interface Signal 26<br>See "Implementing Counter/Timer Connections" on page 408. | Output           |
|                |                |                 | 3                      | GPIO47            | General Purpose I/O                                                                            | Input/<br>Output |
|                |                |                 | 4                      | RSV               | Reserved                                                                                       |                  |
|                |                |                 | 5                      | M5MOSI            | SPI Master 5 Output Data                                                                       | Output           |
|                |                |                 | 6                      | UART1RX           | UART1 Receive                                                                                  | Input            |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                  |

Table 1: Pin List and Function Table

| BGA Pin Number | CSP Pin Number | GPIO Pad Number | Function Select Number | Pad Function Name | Description                                                                                    | Pin Type                       |
|----------------|----------------|-----------------|------------------------|-------------------|------------------------------------------------------------------------------------------------|--------------------------------|
| G9             | G3             | 48              | 0                      | UART0TX           | UART0 Transmit                                                                                 | Output                         |
|                |                |                 | 1                      | NCE48             | IO Master N Chip Select 48<br>See NCE Encoding Table in GPIO Chapter                           | Output                         |
|                |                |                 | 2                      | CT28              | Timer/Counter Interface Signal 28<br>See "Implementing Counter/Timer Connections" on page 408. | Output                         |
|                |                |                 | 3                      | GPIO48            | General Purpose I/O                                                                            | Input/<br>Output               |
|                |                |                 | 4                      | M5SCL             | I <sup>2</sup> C Master 5 Clock                                                                | Open<br>Drain                  |
|                |                |                 | 5                      | M5SCK             | SPI Master 5 Clock                                                                             | Output                         |
|                |                |                 | 6                      | RSV               | Reserved                                                                                       |                                |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                                |
| H8             | G1             | 49              | 0                      | UART0RX           | UART0 Receive                                                                                  | Input                          |
|                |                |                 | 1                      | NCE49             | IO Master N Chip Select 49<br>See NCE Encoding Table in GPIO Chapter                           |                                |
|                |                |                 | 2                      | CT30              | Timer/Counter Interface Signal 30<br>See "Implementing Counter/Timer Connections" on page 408. | Output                         |
|                |                |                 | 3                      | GPIO49            | General Purpose I/O                                                                            | Input/<br>Output               |
|                |                |                 | 4                      | M5SDAWIR3         | I <sup>2</sup> C Master 5 I/O Data<br>SPI Master 5 3 Wire Data                                 | Bidirectional<br>Open<br>Drain |
|                |                |                 | 5                      | M5MISO            | SPI Master 5 Input Data                                                                        | Input                          |
|                |                |                 | 6                      | RSV               | Reserved                                                                                       |                                |
|                |                |                 | 7                      | RSV               | Reserved                                                                                       |                                |

## 2. System Core

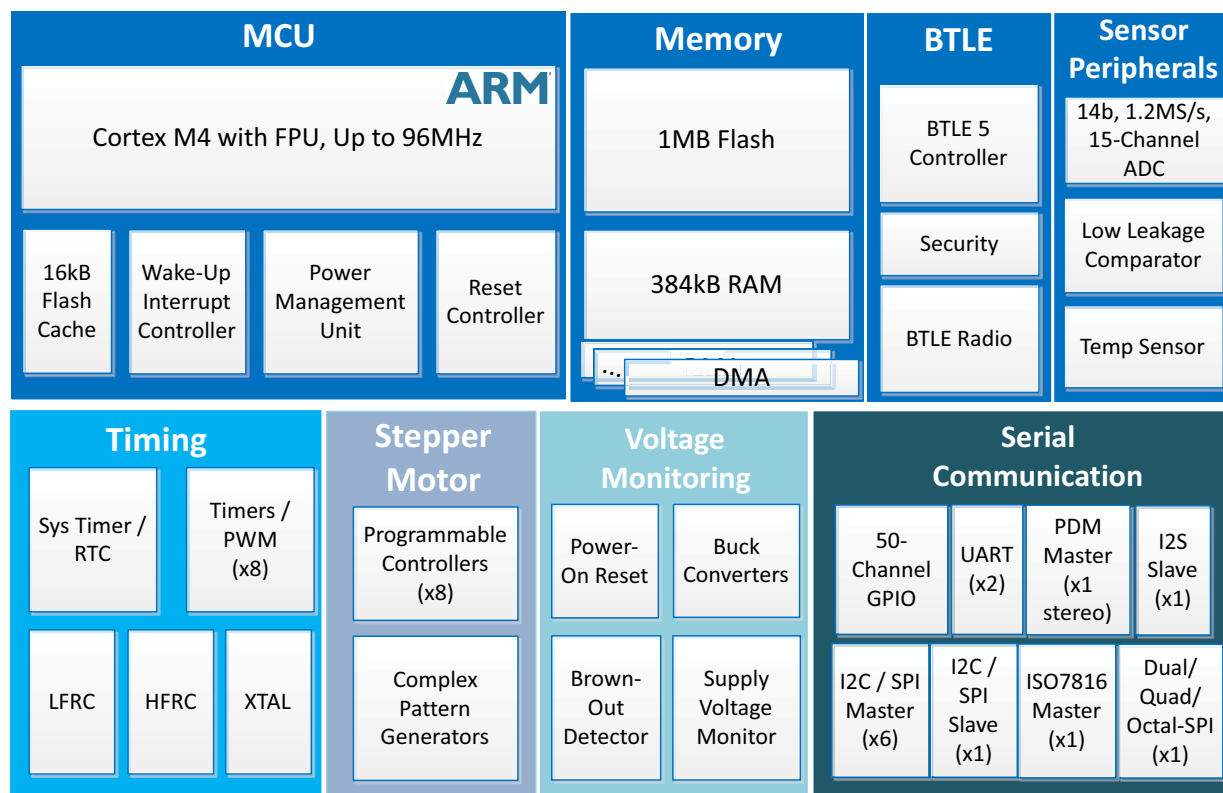


**Figure 3. Block Diagram for the Ultra-Low Power Apollo3 Blue SoC**

The ultra-low power Apollo3 Blue SoC, shown in Figure 3, is an ideal solution for battery-powered applications requiring sensor measurement and data analysis. In a typical system, the Apollo MCU serves as an applications processor for one or more sensors and has a fully integrated BLE 5 radio. The MCU can measure analog sensor outputs using an integrated ADC and digital sensor outputs using the integrated serial master ports. The Cortex-M4 core with Floating Point Unit (referred to throughout this document as “M4”, “M4 Core” or “Cortex-M4”) integrated in the Apollo MCU is capable of running complex data analysis and sensor fusion algorithms to process the sensor data. The Cortex-M4 core with FPU also enables accelerated time-to-market since application code may be efficiently executed in floating point form without the need to perform extensive fixed point optimizations. In other configurations, a host processor can communicate with the MCU over its serial slave port using the I<sup>2</sup>C, SPI or I<sup>2</sup>S protocol.

With unprecedented energy efficiency for sensor conversion and data analysis, the Apollo3 Blue SoC enables months and years of battery life for products only achieving days or months of battery life today. For example, a fitness monitoring device with days or weeks of life on a rechargeable battery could be redesigned to achieve a year or more of life on a non-rechargeable battery. Similarly the Apollo MCUs enable the use of more complex sensor processing algorithms due to its extremely low active mode power of 6  $\mu$ A/MHz. By using the Apollo MCUs, the aforementioned fitness monitoring device could achieve the current multi-day or multi-week battery life while adding new computation-intensive functions like context detection and gesture recognition.

The Apollo3 Blue SoC provides support for higher performance operating modes through Ambiq’s TurboSPOT™ technology. The TurboSPOT™ technology allows applications to meet critical timing as/

when needed while still providing extremely high energy efficiency operation. The Apollo3 Blue SoC also supports secure boot using Ambiq's SecureSPOT technology enabling applications to establish and maintain a root of trust from boot to execution.

At the center of the Apollo3 Blue SoC is a 32-bit ARM Cortex-M4 processor with Floating Point Unit with several tightly coupled peripherals. The Ambiq Micro implementation of the Cortex-M4 core delivers both greater performance and much lower power than 8-bit, 16-bit, and other comparable 32-bit cores. Code and data may be stored in the 1 MB Flash Memory and the 384 KB Low Leakage SRAM.

The Wake-Up Interrupt Controller (WIC) coupled with the Cortex-M4 supports sophisticated and configurable sleep state transitions with a variety of interrupt sources.

An integrated Bluetooth low energy controller provides support for Bluetooth 5 at 3 mA RX/TX. Apollo3 Blue SoC supports up to 4 dBm transmit power with optional external power amplifier controls to enable even higher transmit range.

A rich set of sensor peripherals enable the monitoring of several sensors. An integrated temperature sensor enables the measurement of ambient temperature. A scalable ultra-low power Successive Approximation Register (SAR) Analog-to-Digital Converter (ADC) monitors the temperature sensor, several internal voltages, and up to eight external sensor signals. The ADC is uniquely tuned for minimum power with a configurable measurement mode that does not require MCU intervention. In addition to integrated analog sensor peripherals, I<sup>2</sup>C/SPI/PDM master ports and/or UART ports enables the MCU to communicate with external sensors and radios (such as Bluetooth transceivers) that have digital outputs. For higher bandwidth peripherals, the Apollo3 Blue SoC supports a multi-bit SPI (MSPI) controller for 1-bit, 2-bit, 4-bit and 8-bit data. For devices requiring secure communication, it supports an ISO7816 compliant master controller.

The Apollo3 Blue SoC also includes a set of timing peripherals and an RTC which is based on Ambiq's AM08XX and AM18XX Real-Time Clock (RTC) families. The general purpose Timer/Counter Module (CTIMER), 32-bit System Timer (STIMER), and the RTC may be driven independently by one of three different clock sources: a low frequency RC oscillator, a high frequency RC oscillator, and a 32.768 kHz crystal (XTAL) oscillator. These clock sources use the proprietary advanced calibration techniques developed for the AM08XX and AM18XX products that achieve XTAL-like accuracy with RC-like power. Additionally, the Apollo MCU includes clock reliability functions first offered in the AM08XX and AM18XX products. For example, the RTC can automatically switch from an XTAL source to an RC source in the event of an XTAL failure.

Apollo3 supports highly optimized PWM pattern generation for complex, efficient stepper motor control operation. Up to 8 independent motors can be controlled from the MCU supporting several different operating modes.

As with any ARM-based MCU, the Apollo3 Blue SoC is supported by a complete suite of standard software development tools. Ambiq Micro provides drivers for all peripherals along with basic application code to shorten development times. Software debug is facilitated by the addition of an Instrumentation Trace Macrocell (ITM), a Trace Port Interface Unit (TPIU) and through the use of a Serial Wire Debugger interface (SWD).

## 3. MCU Core Details

### 3.1 Functional Overview

At the center of the Apollo3 Blue SoC is a 32-bit ARM Cortex-M4 core with the floating point option. This 3-stage pipeline implementation of the ARM v7-M architecture offers highly efficient processing in a very low power design. The ARM M DAP enables debugging access via a Serial Wire Interface from outside of the MCU which allows access to all of the memory and peripheral devices of the MCU.

The M4 core offers some other advantages including:

- Single 4 GB memory architecture with all Peripherals being memory-mapped
- Low-Power Consumption Modes:
  - Active
  - Sleep
  - Deep-Sleep
  - Power-Off
- Interrupts and Events
  - NVIC – interrupt controller
  - WIC – Wake-Up Interrupt Controller
  - Sleep-on-Exit (reduces interrupt overhead, used in an ISR SW structure)
  - WFI (enter sleep modes, wait for interrupts)

The following sections provide behavioral and performance details about each of the peripherals controlled by the MCU core. Where multiple instances of a peripheral exist on Apollo3 Blue SoC (e.g., the I<sup>2</sup>C/SPI master modules), base memory addresses for the registers are provided for each and noted as INSTANCE 0, INSTANCE 1, etc.

### 3.2 Interrupts

Within the MCU, multiple peripherals can generate interrupts. In some cases, a single peripheral may be able to generate multiple different interrupts. Each interrupt signal generated by a peripheral is connected back to the M4 core in two places. First, the interrupts are connected to the Nested Vectored Interrupt Controller, NVIC, in the core. This connection provides the standard changes to program flow associated with interrupt processing. Additionally, they are connected to the WIC outside of the core, allowing the interrupt sources to wake the M4 core when it is in a deep sleep (SRPG) mode.

The MCU supports the M4 NMI as well as the normal interrupt types. For details on the Interrupt model of the M4, please see the “**Cortex-M4 Devices Generic User Guide**,” document number DUI0553A.

Below is the M4 Vector Table for Apollo3 Blue SoC.



**Table 2: ARM Cortex-M4 Vector Table for Apollo3 Blue SoC**

| Exception Number | IRQ Number | Offset | Vector                  | Peripheral/Description                     |
|------------------|------------|--------|-------------------------|--------------------------------------------|
| 255              | 239        | 0x03FC | IRQ239                  |                                            |
| .                | .          | .      | .                       |                                            |
| .                | .          | 0x00C0 | IRQ31                   | Clock Control                              |
| .                | .          | 0x00BC | IRQ23-30                | Stimer Compare[0:7]                        |
| .                | .          | 0x009C | IRQ22                   | Stimer Capture/Overflow                    |
| .                | .          | 0x0098 | IRQ21                   | SW INT                                     |
| .                | .          | 0x0094 | IRQ20                   | MSPI                                       |
| .                | .          | 0x0090 | IRQ19                   | PDM                                        |
| .                | .          | 0x008C | IRQ18                   | ADC                                        |
| .                | .          | 0x0088 | IRQ17                   | SCARD                                      |
| .                | .          | 0x0084 | IRQ16                   | UART1                                      |
| .                | .          | 0x0080 | IRQ15                   | UART0                                      |
| .                | .          | 0x007C | IRQ14                   | Counter/Timers                             |
| .                | .          | 0x0078 | IRQ13                   | GPIO                                       |
| .                | .          | 0x0074 | IRQ12                   | BLE                                        |
| .                | .          | 0x0070 | IRQ11                   | I <sup>2</sup> C/SPI Master 5              |
| .                | .          | 0x006C | IRQ10                   | I <sup>2</sup> C/SPI Master 4              |
| .                | .          | 0x0068 | IRQ9                    | I <sup>2</sup> C/SPI Master 3              |
| .                | .          | 0x0064 | IRQ8                    | I <sup>2</sup> C/SPI Master 2              |
| .                | .          | 0x0060 | IRQ7                    | I <sup>2</sup> C/SPI Master 1              |
| .                | .          | 0x005C | IRQ6                    | I <sup>2</sup> C/SPI Master 0              |
| .                | .          | 0x0058 | IRQ5                    | I <sup>2</sup> C/SPI Slave Register Access |
| .                | .          | 0x0054 | IRQ4                    | I <sup>2</sup> C/SPI Slave                 |
| .                | .          | 0x0050 | IRQ3                    | Voltage Comparator                         |
| 18               | 2          | 0x004C | IRQ2                    | RTC                                        |
| 17               | 1          | 0x0048 | IRQ1                    | Watchdog Timer                             |
| 16               | 0          | 0x0044 | IRQ0                    | Brownout Detection                         |
| 15               | -1         | 0x0040 | Systick                 |                                            |
| 14               | -2         | 0x003C | PendSV                  |                                            |
| 13               |            | 0x0038 | Reserved                |                                            |
| 12               |            |        | Reserved for Debug      |                                            |
| 11               | -5         |        | SVCALL                  |                                            |
| 10               |            | 0x002C |                         |                                            |
| 9                |            |        | Reserved                |                                            |
| 8                |            |        |                         |                                            |
| 7                |            |        |                         |                                            |
| 6                | -10        |        | Usage Fault             |                                            |
| 5                | -11        | 0x0018 | Bus Fault               |                                            |
| 4                | -12        | 0x0014 | Memory management Fault |                                            |
| 3                | -13        | 0x0010 | Hard fault              |                                            |
| 2                | -14        | 0x000C | NMI                     | Unused                                     |
| 1                |            | 0x0008 | Reset                   |                                            |
|                  |            | 0x0004 | Initial SP value        |                                            |
|                  |            | 0x0000 |                         |                                            |

The Cortex-M4 allows the user to assign various interrupts to different priority levels based on the requirements of the application. In this MCU implementation, 8 different priority levels are available.

One additional feature of the M4 interrupt architecture is the ability to relocate the Vector Table to a different address. This could be useful if the application requires a different set of interrupt service routines for a particular mode of an application. The software could move the Vector Table into SRAM and reassign the interrupt service routine entry addresses as needed.

Hardware interrupts are assigned in the MCU to the M4 NVIC as shown below.

**Table 3: MCU Interrupt Assignments**

| IRQ      | Peripheral/Description                       |
|----------|----------------------------------------------|
| NMI      | Unused                                       |
| IRQ0     | Brownout Detection                           |
| IRQ1     | Watchdog Timer                               |
| IRQ2     | RTC                                          |
| IRQ3     | Voltage Comparator                           |
| IRQ4     | I <sup>2</sup> C / SPI Slave                 |
| IRQ5     | I <sup>2</sup> C / SPI Slave Register Access |
| IRQ6     | I <sup>2</sup> C / SPI Master0               |
| IRQ7     | I <sup>2</sup> C / SPI Master1               |
| IRQ8     | I <sup>2</sup> C / SPI Master2               |
| IRQ9     | I <sup>2</sup> C / SPI Master3               |
| IRQ10    | I <sup>2</sup> C / SPI Master4               |
| IRQ11    | I <sup>2</sup> C / SPI Master5               |
| IRQ12    | BLE                                          |
| IRQ13    | GPIO                                         |
| IRQ14    | Counter/Timers                               |
| IRQ15    | UART0                                        |
| IRQ16    | UART1                                        |
| IRQ17    | SCARD                                        |
| IRQ18    | ADC                                          |
| IRQ19    | PDM                                          |
| IRQ20    |                                              |
| IRQ21    | SW INT                                       |
| IRQ22    | STimer Capture/Overflow                      |
| IRQ23-30 | STimer Compare[0:7]                          |
| IRQ31    | Clock Control                                |

### 3.3 Memory Map

ARM has a well-defined memory map for devices based on the ARM v7-M Architecture. The M4 further refines this map in the area of the Peripheral and System address ranges. Below is the system memory map as defined by ARM:

**Table 4: ARM Cortex-M4 Memory Map**

| Address                 | Name                   | Executable | Description                               |
|-------------------------|------------------------|------------|-------------------------------------------|
| 0x00000000 – 0x1FFFFFFF | Code                   | Y          | ROM or Flash Memory                       |
| 0x20000000 – 0x3FFFFFFF | Reserved               | N          | Reserved                                  |
| 0x40000000 – 0x5FFFFFFF | Peripheral             | N          | On-chip peripheral address space          |
| 0x60000000 – 0x9FFFFFFF | External RAM           | Y          | External / Off-chip Memory                |
| 0xA0000000 – 0xDFFFFFFF | External Device        | N          | External device memory                    |
| 0xE0000000 – 0xE00FFFFF | Private Peripheral Bus | N          | NVIC, System timers, System Control Block |
| 0xE0100000 – 0xFFFFFFFF | Vendor_SYS             | N          | Vendor Defined                            |

The MCU-specific implementation of this memory map is as follows:

**Table 5: MCU System Memory Map**

| Address                 | Name                | Executable | Description                                                   |
|-------------------------|---------------------|------------|---------------------------------------------------------------|
| 0x00000000 – 0x000FFFFF | Flash               | Y          | Flash Memory                                                  |
| 0x00100000 – 0x03FFFFFF | Reserved            | X          | No device at this address range                               |
| 0x04000000 – 0x07FFFFFF | External MSPI Flash | Y          | XIP Read-Only External MSPI Flash                             |
| 0x08000000 – 0x08000FFF | Boot Loader ROM     | Y          | Execute Only Boot Loader and Flash Helper Functions.          |
| 0x08001000 – 0x0FFFFFFF | Reserved            | X          | No device at this address range                               |
| 0x10000000 – 0x1000FFFF | SRAM (TCM)          | Y          | Low-power / Low Latency SRAM (TCM)                            |
| 0x10010000 – 0x1005FFFF | SRAM (Main)         | Y          | Main SRAM                                                     |
| 0x10060000 – 0x3FFFFFFF | Reserved            | X          | No device at this address range                               |
| 0x40000000 – 0x50FFFFFF | Peripheral          | N          | Peripheral devices                                            |
| 0x51000000 – 0x51FFFFFF | External Memory     | X          | Read/Write External Memory (MSPI)<br><i>[Chip Rev B Only]</i> |
| 0x52000000 – 0xDFFFFFFF | Reserved            | X          | No device at this address range                               |
| 0xE0000000 – 0xE00FFFFF | PPB                 | N          | NVIC, System timers, System Control Block                     |
| 0xE0100000 – 0xEFFFFFFF | Reserved            | X          | No device at this address range                               |
| 0xF0000000 – 0xF0000FFF | Debug ROM           | N          | Debug ROM                                                     |
| 0xF0001000 – 0xFFFFFFFF | Reserved            | X          | No device at this address range                               |

Peripheral devices within the memory map are allocated on 4 KB boundaries, allowing each device up to 1024 32-bit control and status registers. Peripherals will return undefined read data when an attempt to access a register which does not exist occurs. Peripherals, whether accessed via the APB or the AHB, will always accept any write data sent to their registers without attempting to return an ERROR response. Specifically, a write to a read-only register would just become a don't-care write.

Table 6 shows the address mapping for the peripheral devices of the Base Platform.

**Table 6: MCU Peripheral Device Memory Map**

| Address                 | Device                         |
|-------------------------|--------------------------------|
| 0x40000000 – 0x400003FF | Reset / BoD Control            |
| 0x40000400 – 0x40003FFF | Reserved                       |
| 0x40004000 – 0x400041FF | Clock Generator                |
| 0x40004200 - 0x400043FF | RTC                            |
| 0x40004400 – 0x40007FFF | Reserved                       |
| 0x40008000 – 0x400083FF | Timers                         |
| 0x40008400 – 0x4000BFFF | Reserved                       |
| 0x4000C000 – 0x4000C3FF | Voltage Comparator             |
| 0x4000C400 – 0x4000FFFF | Reserved                       |
| 0x40010000 – 0x400103FF | GPIO Control                   |
| 0x40010400 – 0x40010FFF | Reserved                       |
| 0x40011000 – 0x400113FF | Fast GPIO Control              |
| 0x40011400 – 0x40017FFF | Reserved                       |
| 0x40018000 – 0x40018FFF | Flash Cache Control            |
| 0x40019000 – 0x4001BFFF | Reserved                       |
| 0x4001C000 – 0x4001C3FF | UART0                          |
| 0x4001C400 – 0x4001CFFF | Reserved                       |
| 0x4001D000 – 0x4001D3FF | UART1                          |
| 0x4001D400 – 0x4001FFFF | Reserved                       |
| 0x40020000 – 0x400203FF | Miscellaneous Control          |
| 0x40020400 – 0x40020FFF | Reserved                       |
| 0x40021000 – 0x400213FF | Power Control                  |
| 0x40021400 – 0x40023FFF | Reserved                       |
| 0x40024000 – 0x400243FF | Watchdog Timer                 |
| 0x40024400 – 0x4007FFFF | Reserved                       |
| 0x40080000 - 0x400803FF | Secure Card                    |
| 0x40080400 - 0x4FFFFFFF | Reserved                       |
| 0x50000000 – 0x500003FF | I <sup>2</sup> C / SPI Slave   |
| 0x50000400 – 0x50003FFF | Reserved                       |
| 0x50004000 – 0x50004FFF | I <sup>2</sup> C / SPI Master0 |
| 0x50005000 – 0x50005FFF | I <sup>2</sup> C / SPI Master1 |

**Table 6: MCU Peripheral Device Memory Map**

| Address                 | Device                         |
|-------------------------|--------------------------------|
| 0x50006000 – 0x50006FFF | I <sup>2</sup> C / SPI Master2 |
| 0x50007000 – 0x50007FFF | I <sup>2</sup> C / SPI Master3 |
| 0x50008000 – 0x50008FFF | I <sup>2</sup> C / SPI Master4 |
| 0x50009000 – 0x50009FFF | I <sup>2</sup> C / SPI Master5 |
| 0x5000A000 – 0x5000BFFF | Reserved                       |
| 0x5000C000 – 0x5000CFFF | BLE                            |
| 0x5000D000 – 0x5000FFFF | Reserved                       |
| 0x50010000 – 0x500103FF | ADC                            |
| 0x50010400 – 0x50010FFF | Reserved                       |
| 0x50011000 – 0x500113FF | PDM                            |
| 0x50011400 – 0x50013FFF | Reserved                       |
| 0x50014000 – 0x500143FF |                                |
| 0x50014400 – 0x5001FFFF | Reserved                       |
| 0x50020000 – 0x5002FFFF | Flash OTP                      |
| 0x50030000 – 0x50FFFFFF | Reserved                       |

### 3.4 Memory Protection Unit (MPU)

The Apollo3 Blue SoC includes an MPU which is a core component for memory protection. The M4 processor supports the standard ARMv7 *Protected Memory System Architecture* model. The MPU provides full support for:

- Protection regions.
- Overlapping protection regions, with ascending region priority:
  - 7 = highest priority
  - 0 = lowest priority.
- Access permissions
- Exporting memory attributes to the system.

MPU mismatches and permission violations invoke the programmable-priority MemManage fault handler. See the ARM®v7-M Architecture Reference Manual for more information.

You can use the MPU to:

- Enforce privilege rules.
- Separate processes.
- Enforce access rules.

### 3.5 System Buses

The ARM Cortex-M4 utilizes 3 instances of the AMBA AHB bus for communication with memory and peripherals. The ICode bus is designed for instruction fetches from the 'Code' memory space while the

DCode bus is designed for data and debug accesses in that same region. The System bus is designed for fetches to the SRAM and other peripheral devices of the MCU.

The Apollo3 Blue SoC maps the available SRAM memory onto an address space within the 'Code' memory space. This gives the user the opportunity to perform instruction and data fetches from the lower-power SRAM to effectively lower the power consumption of the MCU.

The peripherals of the Apollo3 Blue SoC which are infrequently accessed are located on an AMBA APB bus. A bridge exists which translates the accesses from the System AHB to the APB. Accesses to these peripherals will inject a single wait-state on the AHB during any access cycle.

## 3.6 Power Management

The Power Management Unit (PMU) is a finite-state machine that controls the transitions of the MCU between power modes. When moving from Active Mode to Deep Sleep Mode, the PMU manages the state-retention capability of the registers within the Cortex-M4 core and also controls the shutdown of the voltage regulators of the MCU. Once in the Deep Sleep Mode, the PMU, in conjunction with the Wake-Up Interrupt Controller, waits for a wakeup event. When the event is observed, the PMU begins the power restoration process by re-enabling the on-chip voltage regulators and restoring the CPU register state. The M4 is then returned to active mode once all state is ready.

The Apollo3 Blue SoC power modes are described in the subsequent discussion along with the operation of the PMU.

### NOTE

Transition from TurboSpot Mode to either Sleep Mode or Deep Sleep Mode must first transition to Active Mode.

### 3.6.1 Cortex-M4 Power Modes

The ARM Cortex-M4 defines the following 3 power modes:

- Active
- Sleep
- Deep Sleep

In addition to the above ARM-defined modes, the Apollo3 Blue SoC will support a Shutdown mode in which the entire device is powered down except for the logic required to support a Power-On Reset.

Each mode is described below.

#### 3.6.1.1 TurboSpot Mode

The Apollo3 Blue SoC supports the Ambiq TurboSPOT™ Mode which enables a higher frequency operating mode (TurboSPOT mode). In this mode, the M4 and all memory run at an elevated frequency. All of the non-debug ARM clocks (FCLK, HCLK) also operate at the elevated frequency level. All peripherals are maintained at the nominal frequency level during burst. This mode is entered and exited under software direction but transitions are completely handled in hardware.

### NOTE

In TurboSPOT Mode on the Apollo3 Blue SoC, the SYSTICK increments at twice the normal (48 MHz) clock rate. Some RTOSes may use SYSTICK for scheduler timing by default, in which case scheduler event timing will be wrong when using TurboSPOT Mode. It is recommended not to use SYSTICK and TurboSPOT Mode together unless proper compensation is made.



**NOTE**

Transition from TurboSpot Mode to either Sleep Mode or Deep Sleep Mode must first transition to Active Mode.

**3.6.1.2 Active Mode**

In the Active Mode, the M4 is powered up, clocks are active, and instructions are being executed. In this mode, the M4 expects all (enabled) devices attached to the AHB and APB to be powered and clocked for normal access. All of the non-debug ARM clocks (FCLK, HCLK) are active in this state.

To transition from the Active Mode to any of the lower-power modes, a specific sequence of instructions is executed on the M4 core. First, specific bits in the *ARMv7-M System Control Register* must be set to determine the mode to enter. See page B3-269 of the *ARMv7-M Architecture Reference Manual* for more details.

After the SCR is setup, code can enter the low-power states using one of the 3 following methods:

- Execute a Wait-For-Interrupt (WFI) instruction.
- Execute a Wait-For-Event (WFE) instruction.
- Set the SLEEPONEXIT bit of the SCR such that the exit from an ISR will automatically return to a sleep state.

The M4 will enter a low-power mode after one of these are performed (assuming all conditions are met) and remain there until some event causes the core to return to Active Mode. The possible reasons to return to Active Mode are:

- A reset
- An enabled Interrupt is received by the NVIC
- An event is received by the NVIC
- A Debug Event is received from the DAP

**3.6.1.3 Sleep Mode**

In the Sleep Mode, the M4 is powered up, but the clocks (HCLK, FCLK) are not active. The power supply is still applied to the M4 logic such that it can immediately become active on a wakeup event and begin executing instructions.

**3.6.1.4 Deep Sleep Mode**

In the Deep Sleep Mode, the M4 enters SRPG mode where the main power is removed, but the flops retain their state. The clocks are not active, and the MCU clock sources for HCLK and FCLK can be deactivated. To facilitate the removal of the source supply and entry into SRPG mode, the M4 will handshake with the Wake-up Interrupt Controller and Power Management Unit and set up the possible wakeup conditions.

**3.6.2 System Power Modes**

In addition to the CPU power states, there are system power states defined as follows.

**3.6.2.1 SYS Active Burst ( $S_{ACTB}$ )**

CPU is in Active TurboSPOT Mode and executing instructions. All peripheral devices are on and available.

### 3.6.2.2 **SYS Active ( $S_{ACT}$ )**

CPU is in Active Mode and executing instructions. All peripheral devices are on and available.

### 3.6.2.3 **SYS Sleep Mode 0 ( $S_{S0}$ )**

In SYS Sleep Mode 0, this is a low power state for the MCU. In this mode, all SRAM memory is retained (up to 384KB), Flash memory is in standby, HFRC is on, main core clock domain is gated but peripheral clock domains can be on. CPU is in Sleep Mode.

This state can be entered if a peripheral device (such as SPI/UART/I2C) is actively transferring data and the time window is sufficient for CPU to enter Sleep Mode but is not long enough to go into a Deep Sleep Mode.

### 3.6.2.4 **SYS Sleep Mode 1 ( $S_{S1}$ )**

In SYS Sleep Mode 1, this is a low power state for the MCU. In this mode, all SRAM memory is retained, Flash memory is in standby, HFRC is on, all functional clocks are gated. CPU is in Sleep Mode.

This state can be entered if a no peripheral device (SPI/UART/I2C/MSPI/SCARD/BLE) is actively transferring data, however, communication may occur within a short time window which will prevent the CPU from entering Deep Sleep Mode (and subsequently the system from entering a lower power state).

This state is also referred to as “Active Idle”. In other words, all power domains are powered on, but all clocks are gated. This state is a good power baseline for the system as it represents the active mode DC power level. Typically the power in this state is dominated by leakage, and always-on functional blocks.

### 3.6.2.5 **SYS Deep Sleep Mode 0 ( $S_{DS0}$ )**

In SYS Deep Sleep Mode 0, this is a deep low power state for the MCU. In this mode, SRAM is in retention (capacity controlled by software), cache memory is in retention (16 KB), Flash memory is in power down, HFRC is on, main core power domain is off but peripheral power domains can be on. CPU is in Deep Sleep. Core logic state is retained.

This state can be entered if a peripheral device (SPI/UART/I2C/MSPI/SCARD/BLE) is actively (or intermittently) transferring data but the window of acquisition is long enough to allow the CPU to go into a deeper low power state.

#### NOTE

For easier notation, SRAM memory retention is defined as follows:

- 384KB:  $S_{DS0-384RET}$
- 256KB:  $S_{DS0-256RET}$
- 128KB:  $S_{DS0-128RET}$
- 64KB:  $S_{DS0-64RET}$
- 8KB:  $S_{DS0-8RET}$
- 0KB:  $S_{DS0}$

### 3.6.2.6 **SYS Deep Sleep Mode 1 ( $S_{DS1}$ )**

In SYS Deep Sleep Mode 1, this is a deep low power state for the MCU. In this mode, SRAM is in retention (capacity controlled by software), cache memory is powered down, Flash memory is in power down, HFRC

is on, main core power domain is off but peripheral power domains can be on. CPU is in Deep Sleep. Core logic state is retained.

This state can be entered if the latency to warm up the cache can be tolerated. This could be an extended wait for peripheral communication event.

#### NOTE

For easier notation, SRAM memory retention in DS1 is defined as follows:

- 384KB:  $S_{DS1-384RET}$
- 256KB:  $S_{DS1-256RET}$
- 128KB:  $S_{DS1-128RET}$
- 64KB:  $S_{DS1-64RET}$
- 8KB:  $S_{DS1-8RET}$
- 0KB:  $S_{DS1}$

### 3.6.2.7 SYS Deep Sleep Mode 2 ( $S_{DS2}$ )

In SYS Deep Sleep Mode 2, this is the minimum power state that the MCU can resume normal operation. In this mode, minimal SRAM memory is retained as needed for software to resume (note that SRAM can have 0-384 KB in retention depending on the software/system functional and latency requirements), Cache is powered off (no retention), Flash memory is in power down, HFRC is off, XTAL is ON, all internal switched power domains are off/gated. CPU is in Deep Sleep. Core logic state is retained.

#### NOTE

For easier notation, SRAM memory retention in DS2 is defined as follows:

- 384KB:  $S_{DS2-384RET}$
- 256KB:  $S_{DS2-256RET}$
- 128KB:  $S_{DS2-128RET}$
- 64KB:  $S_{DS2-64RET}$
- 8KB:  $S_{DS2-8RET}$
- 0KB:  $S_{DS2}$

This state can be entered when all activity has suspended for a duration of time sufficient to sustain the longer exit latencies to resume. This could be a state where periodic data samples are taken and the data is locally processed/accumulated/transferred at long time intervals. This state can only be entered (vs  $S_{DS1}$ ) if the peripheral devices are either not enabled/active or if the application can afford to save/restore the state of the controller(s) on entry/exit of this mode.

### 3.6.2.8 SYS Deep Sleep Mode 3 ( $S_{DS3}$ )

In SYS Deep Sleep Mode 3, this is a deep sleep power state for the MCU. In this mode, no memory is in retention, all memory is powered down, LFRC is on (HFRC and XTAL are off), all internal switched power domains are off/gated. CPU is in Deep Sleep. Core logic state is retained. Single timer is running.

This state can be entered on long inactivity periods. Also can be used for very low power ADC sampling without CPU interaction.

### 3.6.2.9 *SYS OFF Mode (S<sub>OFF</sub>)*

In SYS OFF Mode, MCU is completely powered down with no power supplied. CPU is in shutdown mode with no state retention. Only Flash memory is retained.

This mode is controlled external to the MCU by removing power to the device.

### 3.6.3 *Power Control*

The Power Control block provides control and status for the power state of all the power domains and voltage regulators in the SoC. Software can control these blocks via power control registers within this block.

The power control block controls the power sequence to power up or power down a particular peripheral device and memory power domain. Status of each of these can be monitored in the respective power control status register. The power controller also supports event notification to indicate peripheral power transition completion. Event notification is the preferred power-optimized method in lieu of status polling.

The power controller is also the primary control block for the BLE/Burst and SIMO Buck converters as well as the LDO regulators when Bucks are disabled. Similarly, event notification is supported to provide the appropriate handshake to software as needed as well as status register indicators.

This block handles all power sequencing during initial power on and all power mode transitions.

#### 3.6.3.1 *PWRCTRL Registers*

##### **PWR Controller Register Bank**

**INSTANCE 0 BASE ADDRESS:**0x40021000

Power Controller register Bank - this is the place SW writes to.

### 3.6.3.1.1 Register Memory Map

**Table 7: PWRCTRL Register Map**

| Address(es) | Register Name | Description                                                                                |
|-------------|---------------|--------------------------------------------------------------------------------------------|
| 0x40021000  | SUPPLYSRC     | Voltage Regulator Select Register                                                          |
| 0x40021004  | SUPPLYSTATUS  | Voltage Regulators status                                                                  |
| 0x40021008  | DEVPWREN      | Device Power Enables                                                                       |
| 0x4002100C  | MEMPWDINSLEEP | Power-down SRAM banks in Deep Sleep mode                                                   |
| 0x40021010  | MEMPWREN      | Enables individual banks of the MEMORY array                                               |
| 0x40021014  | MEMPWRSTATUS  | Mem Power ON Status                                                                        |
| 0x40021018  | DEVPWRSTATUS  | Device Power ON Status                                                                     |
| 0x4002101C  | SRAMCTRL      | SRAM Control register                                                                      |
| 0x40021020  | ADCSTATUS     | Power Status Register for ADC Block                                                        |
| 0x40021024  | MISC          | Power Optimization Control Bits                                                            |
| 0x40021028  | DEVPWREVENTEN | Event enable register to control which DEVPWRSTATUS bits are routed to event input of CPU. |
| 0x4002102C  | MEMPWREVENTEN | Event enable register to control which MEMPWRSTATUS bits are routed to event input of CPU. |

### 3.6.3.1.2 PWRCTRL Registers

#### 3.6.3.1.2.1 SUPPLYSRC Register

##### Voltage Regulator Select Register

**OFFSET:** 0x00000000

**INSTANCE 0 ADDRESS:** 0x40021000

This register controls the enable for BLE BUCK.

**Table 8: SUPPLYSRC Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1    | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | BLEBUCKEN |        |

**Table 9: SUPPLYSRC Register Bits**

| Bit  | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                     |
|------|-----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:1 | RSVD      | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                       |
| 0    | BLEBUCKEN | 0x0   | RW | <p>Enables and Selects the BLE Buck as the supply for the BLE power domain or for Burst LDO. It takes the initial value from Customer INFO space. Buck will be powered up only if there is an active request for BLEH domain or Burst mode and appropriate feature is allowed.</p> <p>EN = 0x1 - Enable the BLE Buck.<br/>DIS = 0x0 - Disable the BLE Buck.</p> |

#### 3.6.3.1.2.2 SUPPLYSTATUS Register

##### Voltage Regulators status

**OFFSET:** 0x00000004

**INSTANCE 0 ADDRESS:** 0x40021004

Provides an indicator for the BLE BUCK and SIMO BUCK status. Once the SIMO BUCK is powered up MEM and CORE LDOs are disabled.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |           |            |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----------|------------|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0         | 0          | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5         | 4          | 3 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | BLEBUCKON | SIMOBUCKON |   |

| Bit  | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:2 | RSVD       | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 1    | BLEBUCKON  | 0x0   | RO | <p>Indicates whether the BLE (if supported) domain and burst (if supported) domain is supplied from the LDO or the Buck. Buck will be powered up only if there is an active request for BLEH domain or Burst mode and appropriate feature is allowed.</p> <p>LDO = 0x0 - Indicates the the LDO is supplying the BLE/Burst power domain</p> <p>BUCK = 0x1 - Indicates the the Buck is supplying the BLE/Burst power domain</p> |
| 0    | SIMOBUCKON | 0x0   | RO | <p>Indicates whether the Core/Mem low-voltage domains are supplied from the LDO or the Buck.</p> <p>OFF = 0x0 - Indicates the the SIMO Buck is OFF.</p> <p>ON = 0x1 - Indicates the the SIMO Buck is ON.</p>                                                                                                                                                                                                                  |

## Device Power Enables

**INSTANCE 0 ADDRESS: 0x40021008**

This enables various peripherals power domains.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |         |          |        |          |          |         |         |         |         |         |         |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|---------|----------|--------|----------|----------|---------|---------|---------|---------|---------|---------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3  | 1<br>2 | 1<br>1  | 1<br>0   | 0<br>9 | 0<br>8   | 0<br>7   | 0<br>6  | 0<br>5  | 0<br>4  | 0<br>3  | 0<br>2  | 0<br>1  | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | PWRBLEL | PWRPDM | PWRMSP1 | PWRSCARD | PWRADC | PWRUART1 | PWRUART0 | PWR10M5 | PWR10M4 | PWR10M3 | PWR10M2 | PWR10M1 | PWR10M0 | PWR10S |

Table 13: DEVPWREN Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                            |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------|
| 31:14 | RSVD     | 0x0   | RO | RESERVED.                                                                                              |
| 13    | PWRBLEL  | 0x0   | RW | Power up BLE controller<br>EN = 0x1 - Power up BLE controller<br>DIS = 0x0 - Power down BLE controller |
| 12    | PWRPDM   | 0x0   | RW | Power up PDM block<br>EN = 0x1 - Power up PDM<br>DIS = 0x0 - Power down PDM                            |
| 11    | PWRMSPI  | 0x0   | RW | Power up MSPI Controller<br>EN = 0x1 - Power up MSPI<br>DIS = 0x0 - Power down MSPI                    |
| 10    | PWRSCARD | 0x0   | RW | Power up SCARD Controller<br>EN = 0x1 - Power up SCARD<br>DIS = 0x0 - Power down SCARD                 |
| 9     | PWRADC   | 0x0   | RW | Power up ADC Digital Controller<br>EN = 0x1 - Power up ADC<br>DIS = 0x0 - Power Down ADC               |
| 8     | PWUART1  | 0x0   | RW | Power up UART Controller 1<br>EN = 0x1 - Power up UART 1<br>DIS = 0x0 - Power down UART 1              |
| 7     | PWUART0  | 0x0   | RW | Power up UART Controller 0<br>EN = 0x1 - Power up UART 0<br>DIS = 0x0 - Power down UART 0              |
| 6     | PWRIOM5  | 0x0   | RW | Power up IO Master 5<br>EN = 0x1 - Power up IO Master 5<br>DIS = 0x0 - Power down IO Master 5          |
| 5     | PWRIOM4  | 0x0   | RW | Power up IO Master 4<br>EN = 0x1 - Power up IO Master 4<br>DIS = 0x0 - Power down IO Master 4          |
| 4     | PWRIOM3  | 0x0   | RW | Power up IO Master 3<br>EN = 0x1 - Power up IO Master 3<br>DIS = 0x0 - Power down IO Master 3          |
| 3     | PWRIOM2  | 0x0   | RW | Power up IO Master 2<br>EN = 0x1 - Power up IO Master 2<br>DIS = 0x0 - Power down IO Master 2          |
| 2     | PWRIOM1  | 0x0   | RW | Power up IO Master 1<br>EN = 0x1 - Power up IO Master 1<br>DIS = 0x0 - Power down IO Master 1          |



| Bit | Name    | Reset | RW | Description                                                                                   |
|-----|---------|-------|----|-----------------------------------------------------------------------------------------------|
| 1   | PWRIOM0 | 0x0   | RW | Power up IO Master 0<br>EN = 0x1 - Power up IO Master 0<br>DIS = 0x0 - Power down IO Master 0 |
| 0   | PWRIOS  | 0x0   | RW | Power up IO Slave<br>EN = 0x1 - Power up IO slave<br>DIS = 0x0 - Power down IO slave          |

This controls the power down of the SRAM banks in deep sleep mode. If this is set, then the power for that SRAM bank will be gated when the core goes into deep sleep. Upon wake, the data within the SRAMs will be erased. If this is not set, retention voltage will be applied to the SRAM bank when the core goes into deep sleep. Upon wake, the data within the SRAMs are retained. Do not set this if the SRAM bank is used as the target for DMA transfer while CPU in deepsleep.

|             |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |              |              |            |        |        |        |        |        |        |        |        |        |            |        |        |  |
|-------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|--------------|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------|--------|--------|--|
| 3<br>1      | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4       | 1<br>3       | 1<br>2     | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2     | 0<br>1 | 0<br>0 |  |
| CACHEPWDSLP | RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | FLASH1PWDSLP | FLASH0PWDSLP | SRAMPWDSLP |        |        |        |        |        |        |        |        |        | DTCMPWDSLP |        |        |  |

| Bit   | Name          | Reset | RW | Description                                                                                                                                         |
|-------|---------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | CACHEPWD-SLP  | 0x0   | RW | power down cache in deep sleep<br><br>EN = 0x1 - Power down cache in deep sleep<br>DIS = 0x0 - Retain cache in deep sleep                           |
| 30:15 | RSVD          | 0x0   | RO | RESERVED.                                                                                                                                           |
| 14    | FLASH1PWD-SLP | 0x1   | RW | Power-down flash1 in deep sleep<br><br>EN = 0x1 - Flash1 is powered down during deepsleep<br>DIS = 0x0 - Flash1 is kept powered on during deepsleep |

Table 15: MEMPWDINSLEEP Register Bits

| Bit  | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|---------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | FLASH0PWD-SLP | 0x1   | RW | Power-down flash0 in deep sleep<br>EN = 0x1 - Flash0 is powered down during deepsleep<br>DIS = 0x0 - Flash0 is kept powered on during deepsleep                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 12:3 | SRAMPWDSLP    | 0x0   | RW | Selects which SRAM banks are powered down in deep sleep mode, causing the contents of the bank to be lost.<br><br>NONE = 0x0 - All banks retained<br>GROUP0 = 0x1 - SRAM GROUP0 powered down (64KB-96KB)<br>GROUP1 = 0x2 - SRAM GROUP1 powered down (96KB-128KB)<br>GROUP2 = 0x4 - SRAM GROUP2 powered down (128KB-160KB)<br>GROUP3 = 0x8 - SRAM GROUP3 powered down (160KB-192KB)<br>GROUP4 = 0x10 - SRAM GROUP4 powered down (192KB-224KB)<br>GROUP5 = 0x20 - SRAM GROUP5 powered down (224KB-256KB)<br>GROUP6 = 0x40 - SRAM GROUP6 powered down (256KB-288KB)<br>GROUP7 = 0x80 - SRAM GROUP7 powered down (288KB-320KB)<br>GROUP8 = 0x100 - SRAM GROUP8 powered down (320KB-352KB)<br>GROUP9 = 0x200 - SRAM GROUP9 powered down (352KB-384KB)<br>SRAM32K = 0x1 - Power-down lower 32k SRAM (64KB-96KB)<br>SRAM64K = 0x3 - Power-down lower 64k SRAM (64KB-128KB)<br>SRAM128K = 0xF - Power-down lower 128k SRAM (64KB-192KB)<br>ALLBUTLOWER32K = 0x3FE - All SRAM banks but lower 32k powered down (96KB-384KB).<br>ALLBUTLOWER64K = 0x3FC - All banks but lower 64k powered down.<br>ALLBUTLOWER128K = 0x3F0 - All banks but lower 128k powered down.<br>ALL = 0x3FF - All banks powered down. |
| 2:0  | DTCMPWDSLP    | 0x0   | RW | power down DTCM in deep sleep<br><br>NONE = 0x0 - All DTCM retained<br>GROUP0DTCM0 = 0x1 - Group0_DTCM0 powered down in deep sleep (0KB-8KB)<br>GROUP0DTCM1 = 0x2 - Group0_DTCM1 powered down in deep sleep (8KB-32KB)<br>GROUP0 = 0x3 - Both DTCMs in group0 are powered down in deep sleep (0KB-32KB)<br>ALLBUTGROUP0DTCM0 = 0x6 - Group1 and Group0_DTCM1 are powered down in deep sleep (8KB-64KB)<br>GROUP1 = 0x4 - Group1 DTCM powered down in deep sleep (32KB-64KB)<br>ALL = 0x7 - All DTCMs powered down in deep sleep (0KB-64KB)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

### 3.6.3.1.2.5 MEMPWREN Register

Enables individual banks of the MEMORY array

OFFSET: 0x00000010

INSTANCE 0 ADDRESS: 0x40021010

This register enables the individual banks for the memories. When set, power will be enabled to the banks. This register works in connection with the MEMPWDINSLEEP register. When this register is set, then the MEMPWINSLEEP register will determine whether power is enabled to the SRAMs in deep sleep. If this register is not set, then power will always be disabled to the memory bank.



| Bit | Name | Reset | RW | Description                                                                                                                                                                                                                                                                                              |
|-----|------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2:0 | DTCM | 0x7   | RW | Power up DTCM<br><br>NONE = 0x0 - Do not enable power to any DTCMs<br>GROUP0DTCM0 = 0x1 - Power ON only GROUP0_DTCM0<br>GROUP0DTCM1 = 0x2 - Power ON only GROUP0_DTCM1<br>GROUP0 = 0x3 - Power ON only DTCMs in group0<br>GROUP1 = 0x4 - Power ON only DTCMs in group1<br>ALL = 0x7 - Power ON all DTCMs |

## Mem Power ON Status

**INSTANCE 0 ADDRESS: 0x40021014**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6  | 1<br>5  | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CACHEB2 | CACHEB0 | FLASH1 | FLASH0 | SRAM9  | SRAM8  | SRAM7  | SRAM6  | SRAM5  | SRAM4  | SRAM3  | SRAM2  | SRAM1  | SRAM0  | DTCM1  | DTCM01 | DTCM00 |

| Bit   | Name    | Reset | RW | Description                                        |
|-------|---------|-------|----|----------------------------------------------------|
| 31:17 | RSVD    | 0x0   | RO | This bit field is reserved for future use.         |
| 16    | CACHEB2 | 0x0   | RO | This bit is 1 if power is supplied to Cache Bank 2 |
| 15    | CACHEB0 | 0x0   | RO | This bit is 1 if power is supplied to Cache Bank 0 |
| 14    | FLASH1  | 0x1   | RO | This bit is 1 if power is supplied to FLASH 1      |
| 13    | FLASH0  | 0x1   | RO | This bit is 1 if power is supplied to FLASH 0      |
| 12    | SRAM9   | 0x1   | RO | This bit is 1 if power is supplied to SRAM GROUP9  |
| 11    | SRAM8   | 0x1   | RO | This bit is 1 if power is supplied to SRAM GROUP8  |

Table 19: MEMPWRSTATUS Register Bits

| Bit | Name   | Reset | RW | Description                                         |
|-----|--------|-------|----|-----------------------------------------------------|
| 10  | SRAM7  | 0x1   | RO | This bit is 1 if power is supplied to SRAM GROUP7   |
| 9   | SRAM6  | 0x1   | RO | This bit is 1 if power is supplied to SRAM GROUP6   |
| 8   | SRAM5  | 0x1   | RO | This bit is 1 if power is supplied to SRAM GROUP5   |
| 7   | SRAM4  | 0x1   | RO | This bit is 1 if power is supplied to SRAM GROUP4   |
| 6   | SRAM3  | 0x1   | RO | This bit is 1 if power is supplied to SRAM GROUP3   |
| 5   | SRAM2  | 0x1   | RO | This bit is 1 if power is supplied to SRAM GROUP2   |
| 4   | SRAM1  | 0x1   | RO | This bit is 1 if power is supplied to SRAM GROUP1   |
| 3   | SRAM0  | 0x1   | RO | This bit is 1 if power is supplied to SRAM GROUP0   |
| 2   | DTCM1  | 0x1   | RO | This bit is 1 if power is supplied to DTCM GROUP1   |
| 1   | DTCM01 | 0x1   | RO | This bit is 1 if power is supplied to DTCM GROUP0_1 |
| 0   | DTCM00 | 0x1   | RO | This bit is 1 if power is supplied to DTCM GROUP0_0 |

### 3.6.3.1.2.DEVPWRSTATUS Register

#### Device Power ON Status

**OFFSET:** 0x00000018

**INSTANCE 0 ADDRESS:** 0x40021018

This provides the power status for the peripheral devices- BLEL, PDM, MSPI, SCARD, ADC, UART0 & 1, IOM5 to 0, IOSLAVE and MCUL (DMA and Fabrics) and MCUH (ARM core). The status here should reflect the enable provided by the DEVPWREN register. There may be a lag time between setting the bits in DEVPWREN register and DEVPWRSTATUS register, due to the need to cycle the power gate, isolation and reset sequences to the device power domains.

Table 20: DEVPWRSTATUS Register

|              |               |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |
|--------------|---------------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|
| 3<br>1       | 3<br>0        | 2<br>9    | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6  | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| SYSDEEPSLEEP | COREDEEPSLEEP | CORESLEEP | RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | BLEH   | BLEL   | PWRPDM | PWRMSPI | PWRADC | HCPC   | HCPB   | HCPA   | MCUH   | MCUL   |

**Table 21: DEVPWRSTATUS Register Bits**

| Bit   | Name           | Reset | RW | Description                                                                        |
|-------|----------------|-------|----|------------------------------------------------------------------------------------|
| 31    | SYSDEEPS-LEEP  | 0x0   | RO | This bit is 1 if SYSTEM has been in Deep Sleep. Write '1' to this bit to clear it. |
| 30    | COREDEEPS-LEEP | 0x0   | RO | This bit is 1 if CORE has been in Deep Sleep. Write '1' to this bit to clear it.   |
| 29    | CORESLEEP      | 0x0   | RO | This bit is 1 if CORE has been in SLEEP State. Write '1' to this bit to clear it.  |
| 28:10 | RSVD           | 0x0   | RO | This bit field is reserved for future use.                                         |
| 9     | BLEH           | 0x0   | RO | This bit is 1 if power is supplied to BLEH                                         |
| 8     | BLEL           | 0x0   | RO | This bit is 1 if power is supplied to BLEL                                         |
| 7     | PWRPDM         | 0x0   | RO | This bit is 1 if power is supplied to PDM                                          |
| 6     | PWRMSPI        | 0x0   | RO | This bit is 1 if power is supplied to MSPI                                         |
| 5     | PWRADC         | 0x0   | RO | This bit is 1 if power is supplied to ADC                                          |
| 4     | HCPC           | 0x0   | RO | This bit is 1 if power is supplied to HCPC domain (IO MASTER4, 5, 6)               |
| 3     | HCPB           | 0x0   | RO | This bit is 1 if power is supplied to HCPB domain (IO MASTER 0, 1, 2)              |
| 2     | HCPA           | 0x0   | RO | This bit is 1 if power is supplied to HCPA domain (IO SLAVE, UART0, UART1, SCARD)  |
| 1     | MCUH           | 0x1   | RO | This bit is 1 if power is supplied to MCUH                                         |
| 0     | MCUL           | 0x1   | RO | This bit is 1 if power is supplied to MCUL                                         |

**3.6.3.1.2.8SRAMCTRL Register****SRAM Control register****OFFSET:** 0x0000001C**INSTANCE 0 ADDRESS:** 0x4002101C

This register provides additional fine-tune power management controls for the SRAMs and the SRAM controller. This includes enabling light sleep for the SRAM and TCM banks, and clock gating for reduced dynamic power.

Table 22: SRAMCTRL Register

|      |   |   |   |   |   |   |   |   |   |   |                |   |   |   |   |   |   |   |   |   |   |      |   |   |   |                   |             |      |
|------|---|---|---|---|---|---|---|---|---|---|----------------|---|---|---|---|---|---|---|---|---|---|------|---|---|---|-------------------|-------------|------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1              | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0    | 0 | 0 | 0 | 0                 | 0           | 0    |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0              | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9    | 8 | 7 | 6 | 5                 | 4           | 3    |
| RSVD |   |   |   |   |   |   |   |   |   |   | SRAMLIGHTSLEEP |   |   |   |   |   |   |   |   |   |   | RSVD |   |   |   | SRAMMASTERCLKGATE | SRAMCLKGATE | RSVD |

Table 23: SRAMCTRL Register Bits

| Bit   | Name               | Reset | RW | Description                                                                                                                                                                                                                                                                                                                            |
|-------|--------------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:20 | RSVD               | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                                                                                                                             |
| 19:8  | SRAMLIGHT-SLEEP    | 0x0   | RW | Light Sleep enable for each TCM/SRAM bank. When 1, corresponding bank will be put into light sleep. For optimal power, banks should be put into light sleep while the system is active but the bank has minimal or no accesses.<br><br>ALL = 0xFF - Enable LIGHT SLEEP for ALL SRAMs<br>DIS = 0x0 - Disables LIGHT SLEEP for ALL SRAMs |
| 7:3   | RSVD               | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                                                                                                                             |
| 2     | SRAMMASTER-CLKGATE | 0x0   | RW | This bit is 1 when the master clock gate is enabled (top-level clock gate for entire SRAM block)<br><br>EN = 0x1 - Enable Master SRAM Clock Gate<br>DIS = 0x0 - Disables Master SRAM Clock Gating                                                                                                                                      |
| 1     | SRAMCLKGATE        | 0x0   | RW | This bit is 1 if clock gating is allowed for individual system SRAMs<br><br>EN = 0x1 - Enable Individual SRAM Clock Gating<br>DIS = 0x0 - Disables Individual SRAM Clock Gating                                                                                                                                                        |
| 0     | RSVD               | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                                                                                                                             |

### 3.6.3.1.2.9 ADCSTATUS Register

#### Power Status Register for ADC Block

OFFSET: 0x00000020

INSTANCE 0 ADDRESS: 0x40021020

This provides the power status for various blocks within the ADC. These status comes directly from the ADC module and is captured through this interface.

Table 24: ADCSTATUS Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |           |            |         |          |        |        |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----------|------------|---------|----------|--------|--------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0         | 0          | 0       | 0        | 0      | 0      |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7         | 6          | 5       | 4        | 3      | 2      |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | REFBUFPWD | REFKEEPPWD | VBATPWD | VPTATPWD | BGTPWD | ADCPWD |

Table 25: ADCSTATUS Register Bits

| Bit  | Name       | Reset | RW | Description                                                                     |
|------|------------|-------|----|---------------------------------------------------------------------------------|
| 31:6 | RSVD       | 0x0   | RO | RESERVED.                                                                       |
| 5    | REFBUFPWD  | 0x1   | RO | This bit indicates that the ADC REFBUF is powered down                          |
| 4    | REFKEEPPWD | 0x1   | RO | This bit indicates that the ADC REFKEEP is powered down                         |
| 3    | VBATPWD    | 0x1   | RO | This bit indicates that the ADC VBAT resistor divider is powered down           |
| 2    | VPTATPWD   | 0x1   | RO | This bit indicates that the ADC temperature sensor input buffer is powered down |
| 1    | BGTPWD     | 0x1   | RO | This bit indicates that the ADC Band Gap is powered down                        |
| 0    | ADCPWD     | 0x1   | RO | This bit indicates that the ADC is powered down                                 |

### 3.6.3.1.2.10MISC Register

#### Power Optimization Control Bits

OFFSET: 0x00000024

INSTANCE 0 ADDRESS: 0x40021024

This register includes additional debug control bits. This is an internal Ambiq-only register. Customers should not attempt to change this or else functionality cannot be guaranteed.



Table 26: MISC Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |                 |            |               |                    |                     |                  |            |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------|------------|---------------|--------------------|---------------------|------------------|------------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7          | 0<br>6     | 0<br>5        | 0<br>4             | 0<br>3              | 0<br>2           | 0<br>1     | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | FORCEBLEBUCKACT | MEMVRLPBLE | FORCEMEMVRADC | FORCEMEMVRLPTIMERS | FORCECOREVRLPTIMERS | FORCECOREVRLPPDM | SIMOBUCKEN |        |

Table 27: MISC Register Bits

| Bit  | Name                 | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|----------------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD                 | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 7    | FORCEBLE-BUCKACT     | 0x0   | RW | Control Bit to enable BLE Buck to be in active state when BLE Buck is enabled. Default behavior is to be in active only when Burst or BLEH power on are requested.                                                                                                                                                                                                                                                                                                                                           |
| 6    | MEMVRLPBLE           | 0x0   | RW | Control Bit to let Mem VR go to LP mode in deep sleep even when BLEL or BLEH is powered on given none of the other domains require it.<br><br>EN = 0x1 - Mem VR can go to LP mode even when BLE is powered on.<br>DIS = 0x0 - Mem VR will stay in active mode when BLE is powered on.                                                                                                                                                                                                                        |
| 5:4  | FORCEMEM-VRADC       | 0x0   | RW | Control Bit to force Mem VR to LP or ACT mode in deep sleep when ADC is powered ON. 0x3 results in picking LP mode.<br><br>ACT = 0x2 - In this mode if all the other domains but ADC are powered down, Mem VR will stay in ACT mode.<br>LP = 0x1 - In this mode if all the other domains but ADC are powered down, Mem VR will stay in LP mode.<br>DIS = 0x0 - In this mode if all the other domains but ADC are powered down, Mem VR will duty cycle between active and LP modes depending on ADC sampling. |
| 3    | FORCEMEM-VRLPTIMERS  | 0x0   | RW | Control Bit to force Mem VR to LP mode in deep sleep even when hfric based ctimer or stimer is running.                                                                                                                                                                                                                                                                                                                                                                                                      |
| 2    | FORCECOREV-RLPTIMERS | 0x0   | RW | Control Bit to force Core VR to LP mode in deep sleep even when hfric based ctimer or stimer is running.                                                                                                                                                                                                                                                                                                                                                                                                     |
| 1    | FORCECOREV-RLPPDM    | 0x0   | RW | Control bit to enable the core VR to go into LP mode with HCPA/B/C/MSPI are powered off but PDM is powered on                                                                                                                                                                                                                                                                                                                                                                                                |

| Bit | Name       | Reset | RW | Description                                                                                                                                                                                                                               |
|-----|------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | SIMOBUCKEN | 0x0   | RW | <p>Enables and Selects the SIMO Buck as the supply for the low-voltage power domain. It takes the initial value from the bit set in Customer INFO space.</p> <p>EN = 0x1 - Enable the SIMO Buck<br/>DIS = 0x0 - Disable the SIMO Buck</p> |

**Event enable register to control which DEVPWRSTATUS bits are routed to event input of CPU.**

**INSTANCE 0 ADDRESS: 0x40021028**

### Table 28: DEVPWREVENTEN Register

### Table 29: DEVPWREVENTEN Register Bits

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**Table 29: DEVPWREVENTEN Register Bits**

| Bit | Name     | Reset | RW | Description                                                                                                                          |
|-----|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------|
| 8   | BLELEVEN | 0x0   | RW | Control BLE power-on status event<br>EN = 0x1 - Enable BLE power-on status event<br>DIS = 0x0 - Disable BLE power-on status event    |
| 7   | PDMEVEN  | 0x0   | RW | Control PDM power-on status event<br>EN = 0x1 - Enable PDM power-on status event<br>DIS = 0x0 - Disable PDM power-on status event    |
| 6   | MSPIEVEN | 0x0   | RW | Control MSPI power-on status event<br>EN = 0x1 - Enable MSPI power-on status event<br>DIS = 0x0 - Disable MSPI power-on status event |
| 5   | ADCEVEN  | 0x0   | RW | Control ADC power-on status event<br>EN = 0x1 - Enable ADC power-on status event<br>DIS = 0x0 - Disable ADC power-on status event    |
| 4   | HCPCEVEN | 0x0   | RW | Control HCPC power-on status event<br>EN = 0x1 - Enable HCPC power-on status event<br>DIS = 0x0 - Disable HCPC power-on status event |
| 3   | HCPBEVEN | 0x0   | RW | Control HCPB power-on status event<br>EN = 0x1 - Enable HCPB power-on status event<br>DIS = 0x0 - Disable HCPB power-on status event |
| 2   | HCPAEVEN | 0x0   | RW | Control HCPA power-on status event<br>EN = 0x1 - Enable HCPA power-on status event<br>DIS = 0x0 - Disable HCPA power-on status event |
| 1   | MCUHEVEN | 0x0   | RW | Control MCUH power-on status event<br>EN = 0x1 - Enable MCHU power-on status event<br>DIS = 0x0 - Disable MCUH power-on status event |
| 0   | MCULEVEN | 0x0   | RW | Control MCUL power-on status event<br>EN = 0x1 - Enable MCUL power-on status event<br>DIS = 0x0 - Disable MCUL power-on status event |

**3.6.3.1.2 MEMPWREVENTEN Register**

Event enable register to control which MEMPWSTATUS bits are routed to event input of CPU.

**OFFSET:** 0x0000002C

**INSTANCE 0 ADDRESS:** 0x4002102C

This register controls which power enable for the memories will result in an event to the CPU. It includes all the power on status for the memory domains. If any bits are set, then if the domain is turned on, it will result in an event to the ARM core.



Table 31: MEMPWREVENTEN Register Bits

| Bit | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2:0 | DTCMEN | 0x0   | RW | Enable DTCM power-on status event<br><br>NONE = 0x0 - Do not enable DTCM power-on status event<br>GROUP0DTCM0EN = 0x1 - Enable GROUP0_DTCM0 power on status event<br>GROUP0DTCM1EN = 0x2 - Enable GROUP0_DTCM1 power on status event<br>GROUP0EN = 0x3 - Enable DTCMs in group0 power on status event<br>GROUP1EN = 0x4 - Enable DTCMs in group1 power on status event<br>ALL = 0x7 - Enable all DTCM power on status event |

### 3.7 Debug Interfaces

An external debugger can be connected to the MCU using the ARM Serial Wire Debug (SWD) interface. The SWD interface is a 2-wire interface that is supported by a variety of off-the-shelf commercial debuggers, enabling customers to utilize their development environment of choice.

Several useful debug facilities are provided in the Apollo3 Blue SoC:

- Instruction Trace Macrocell (ITM)
- Trace Port Interface Unit (TPIU)
- Faulting Address Trapping Hardware

#### 3.7.1 Instrumentation Trace Macrocell (ITM)

For system trace the processor integrates an *Instrumentation Trace Macrocell* (ITM) alongside data watchpoints and a profiling unit. To enable simple and cost-effective profiling of the system events these generate, a *Serial Wire Viewer* (SWV) can export a stream of software-generated messages, data trace, and profiling information through a single pin.

#### 3.7.2 Trace Port Interface Unit (TPIU)

The Apollo3 Blue SoC includes a Cortex-M4 Trace Port Interface Unit (TPIU). The TPIU is an ARM IP component that acts as a bridge between the on-chip trace data from the ITM and the single pin supporting the Serial Wire Viewer Protocol.

The TPIU includes a Trace Output Serializer that can format and send the SWV protocol in either a Manchester encoded form or as a standard UART stream.

#### 3.7.3 Faulting Address Trapping Hardware

The Apollo3 Blue SoC offers an optional facility for trapping the address associated with bus faults occurring on any of the three AMBA AHB buses on the chip. This facility must be specifically enabled so that energy is not wasted when one is not actively debugging.

### 3.8 ITM Registers

ARM ITM Registers.

INSTANCE 0 BASE ADDRESS:0x00000000

### 3.8.1 Register Memory Map

Table 32: ITM Register Map

| Address(s) | Register Name | Description               |
|------------|---------------|---------------------------|
| 0xE0000000 | STIM0         | Stimulus Port Register 0  |
| 0xE0000004 | STIM1         | Stimulus Port Register 1  |
| 0xE0000008 | STIM2         | Stimulus Port Register 2  |
| 0xE000000C | STIM3         | Stimulus Port Register 3  |
| 0xE0000010 | STIM4         | Stimulus Port Register 4  |
| 0xE0000014 | STIM5         | Stimulus Port Register 5  |
| 0xE0000018 | STIM6         | Stimulus Port Register 6  |
| 0xE000001C | STIM7         | Stimulus Port Register 7  |
| 0xE0000020 | STIM8         | Stimulus Port Register 8  |
| 0xE0000024 | STIM9         | Stimulus Port Register 9  |
| 0xE0000028 | STIM10        | Stimulus Port Register 10 |
| 0xE000002C | STIM11        | Stimulus Port Register 11 |
| 0xE0000030 | STIM12        | Stimulus Port Register 12 |
| 0xE0000034 | STIM13        | Stimulus Port Register 13 |
| 0xE0000038 | STIM14        | Stimulus Port Register 14 |
| 0xE000003C | STIM15        | Stimulus Port Register 15 |
| 0xE0000040 | STIM16        | Stimulus Port Register 16 |
| 0xE0000044 | STIM17        | Stimulus Port Register 17 |
| 0xE0000048 | STIM18        | Stimulus Port Register 18 |
| 0xE000004C | STIM19        | Stimulus Port Register 19 |
| 0xE0000050 | STIM20        | Stimulus Port Register 20 |
| 0xE0000054 | STIM21        | Stimulus Port Register 21 |
| 0xE0000058 | STIM22        | Stimulus Port Register 22 |
| 0xE000005C | STIM23        | Stimulus Port Register 23 |
| 0xE0000060 | STIM24        | Stimulus Port Register 24 |
| 0xE0000064 | STIM25        | Stimulus Port Register 25 |
| 0xE0000068 | STIM26        | Stimulus Port Register 26 |
| 0xE000006C | STIM27        | Stimulus Port Register 27 |
| 0xE0000070 | STIM28        | Stimulus Port Register 28 |
| 0xE0000074 | STIM29        | Stimulus Port Register 29 |
| 0xE0000078 | STIM30        | Stimulus Port Register 30 |
| 0xE000007C | STIM31        | Stimulus Port Register 31 |
| 0xE0000E00 | TER           | Trace Enable Register.    |
| 0xE0000E40 | TPR           | Trace Privilege Register. |
| 0xE0000E80 | TCR           | Trace Control Register.   |
| 0xE0000FB0 | LOCKAREG      | Lock Access Register      |



Table 32: ITM Register Map

| Address(s) | Register Name | Description                          |
|------------|---------------|--------------------------------------|
| 0xE0000FB4 | LOCKSREG      | Lock Status Register                 |
| 0xE0000FD0 | PID4          | Peripheral Identification Register 4 |
| 0xE0000FD4 | PID5          | Peripheral Identification Register 5 |
| 0xE0000FD8 | PID6          | Peripheral Identification Register 6 |
| 0xE0000FDC | PID7          | Peripheral Identification Register 7 |
| 0xE0000FE0 | PID0          | Peripheral Identification Register 0 |
| 0xE0000FE4 | PID1          | Peripheral Identification Register 1 |
| 0xE0000FE8 | PID2          | Peripheral Identification Register 2 |
| 0xE0000FEC | PID3          | Peripheral Identification Register 3 |
| 0xE0000FF0 | CID0          | Component Identification Register 1  |
| 0xE0000FF4 | CID1          | Component Identification Register 1  |
| 0xE0000FF8 | CID2          | Component Identification Register 2  |
| 0xE0000FFC | CID3          | Component Identification Register 3  |

### 3.8.2 ITM Registers

#### 3.8.2.1 STIM0 Register

**Stimulus Port Register 0**

**OFFSET:** 0xE0000000

**INSTANCE 0 ADDRESS:** 0xE0000000

Stimulus Port Register 0

**Table 33: STIM0 Register**

|       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 34: STIM0 Register Bits**

| Bit  | Name  | Reset | RW | Description               |
|------|-------|-------|----|---------------------------|
| 31:0 | STIM0 | 0x0   | RW | Stimulus Port Register 0. |

#### 3.8.2.2 STIM1 Register

**Stimulus Port Register 1**

**OFFSET:** 0xE0000004

**INSTANCE 0 ADDRESS:** 0xE0000004

Stimulus Port Register 1

**Table 35: STIM1 Register**

|       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 36: STIM1 Register Bits**

| Bit  | Name  | Reset | RW | Description               |
|------|-------|-------|----|---------------------------|
| 31:0 | STIM1 | 0x0   | RW | Stimulus Port Register 1. |





### Stimulus Port Register 8

|       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM8 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name  | Reset | RW | Description               |
|------|-------|-------|----|---------------------------|
| 31:0 | STIM8 | 0x0   | RW | Stimulus Port Register 8. |

### Stimulus Port Register 9

**INSTANCE 0 ADDRESS: 0xE0000024**

### Stimulus Port Register 9

|       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM9 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name  | Reset | RW | Description               |
|------|-------|-------|----|---------------------------|
| 31:0 | STIM9 | 0x0   | RW | Stimulus Port Register 9. |

### Stimulus Port Register 10

**INSTANCE 0 ADDRESS: 0xE0000028**

## Stimulus Port Register 10













|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM20 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                |
|------|--------|-------|----|----------------------------|
| 31:0 | STIM20 | 0x0   | RW | Stimulus Port Register 20. |

### Stimulus Port Register 21

**INSTANCE 0 ADDRESS: 0xE0000054**

### Stimulus Port Register 21

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM21 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                |
|------|--------|-------|----|----------------------------|
| 31:0 | STIM21 | 0x0   | RW | Stimulus Port Register 21. |

### Stimulus Port Register 22

**INSTANCE 0 ADDRESS: 0xE0000058**

## Stimulus Port Register 22



|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM24 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                |
|------|--------|-------|----|----------------------------|
| 31:0 | STIM24 | 0x0   | RW | Stimulus Port Register 24. |

### Stimulus Port Register 25

**INSTANCE 0 ADDRESS: 0xE0000064**

## Stimulus Port Register 25

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM25 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                |
|------|--------|-------|----|----------------------------|
| 31:0 | STIM25 | 0x0   | RW | Stimulus Port Register 25. |

### Stimulus Port Register 26

**INSTANCE 0 ADDRESS: 0xE0000068**

## Stimulus Port Register 26

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM26 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                |
|------|--------|-------|----|----------------------------|
| 31:0 | STIM26 | 0x0   | RW | Stimulus Port Register 26. |

### Stimulus Port Register 27

**INSTANCE 0 ADDRESS: 0xE000006C**

### Stimulus Port Register 27

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM27 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                |
|------|--------|-------|----|----------------------------|
| 31:0 | STIM27 | 0x0   | RW | Stimulus Port Register 27. |

### Stimulus Port Register 28

**INSTANCE 0 ADDRESS: 0xE0000070**

### Stimulus Port Register 28





|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM30 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                |
|------|--------|-------|----|----------------------------|
| 31:0 | STIM30 | 0x0   | RW | Stimulus Port Register 30. |

### Stimulus Port Register 31

**INSTANCE 0 ADDRESS: 0xE000007C**

### Stimulus Port Register 31

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIM31 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                |
|------|--------|-------|----|----------------------------|
| 31:0 | STIM31 | 0x0   | RW | Stimulus Port Register 31. |

### Trace Enable Register.

**INSTANCE 0 ADDRESS: 0xE0000E00**

### Trace Enable Register.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| STIMENA |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name    | Reset | RW | Description                                                                   |
|------|---------|-------|----|-------------------------------------------------------------------------------|
| 31:0 | STIMENA | 0x0   | RW | Bit mask to enable tracing on ITM stimulus ports. One bit per stimulus port.. |

### Trace Privilege Register.

**INSTANCE 0 ADDRESS: 0xE0000E40**

## Trace Privilege Register.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0        | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7        | 6 | 5 | 4 | 3 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | PRIVMASK |   |   |   |   |

| Bit  | Name     | Reset | RW | Description                                                                                                                                                                    |
|------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:4 | RSVD     | 0x0   | RO | RESERVED.                                                                                                                                                                      |
| 3:0  | PRIVMASK | 0x0   | RW | Bit mask to enable tracing on ITM stimulus ports. bit[0] = stimulus ports[7:0], bit[1] = stimulus ports[15:8], bit[2] = stimulus ports[23:16], bit[3] = stimulus ports[31:24]. |

### Trace Control Register.

**INSTANCE 0 ADDRESS: 0xE0000E80**

Trace Control Register.

Table 101: TCR Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |             |        |        |        |        |            |            |             |           |            |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|-------------|--------|--------|--------|--------|------------|------------|-------------|-----------|------------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4  | 1<br>3      | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8     | 0<br>7     | 0<br>6      | 0<br>5    | 0<br>4     | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        | BUSY   | ATB_ID |        |        |        |        | RSVD   |        |        | TS_FREQ | TS_PRESCALE |        | RSVD   |        |        | SWV_ENABLE | DWT_ENABLE | SYNC_ENABLE | TS_ENABLE | ITM_ENABLE |        |        |        |        |

Table 102: TCR Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                       |
|-------|-------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:24 | RSVD        | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                         |
| 23    | BUSY        | 0x0   | RW | Set when ITM events present and being drained.                                                                                                                                                                                                                                                                                    |
| 22:16 | ATB_ID      | 0x0   | RW | ATB ID for CoreSight system.                                                                                                                                                                                                                                                                                                      |
| 15:12 | RSVD        | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                         |
| 11:10 | TS_FREQ     | 0x0   | RW | Global Timestamp Frequency.                                                                                                                                                                                                                                                                                                       |
| 9:8   | TS_PRESCALE | 0x0   | RW | Timestamp prescaler: 0b00 = no prescaling 0b01 = divide by 4 0b10 = divide by 16 0b11 = divide by 64.                                                                                                                                                                                                                             |
| 7:5   | RSVD        | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                         |
| 4     | SWV_ENABLE  | 0x0   | RW | Enable SWV (Serial Wire Viewer) behavior - count on TPIUEMIT and TPIU-BAUD: Aka SWOENA Enables asynchronous clocking of the timestamp counter.                                                                                                                                                                                    |
| 3     | DWT_ENABLE  | 0x0   | RW | Enables the DWT stimulus.                                                                                                                                                                                                                                                                                                         |
| 2     | SYNC_ENABLE | 0x0   | RW | Enables sync packets for TPIU.                                                                                                                                                                                                                                                                                                    |
| 1     | TS_ENABLE   | 0x0   | RW | Enables differential timestamps. Differential timestamps are emitted when a packet is written to the FIFO with a non-zero timestamp counter, and when the timestamp counter overflows. Timestamps are emitted during idle times after a fixed number of cycles. This provides a time reference for packets and inter-packet gaps. |
| 0     | ITM_ENABLE  | 0x0   | RW | Enable ITM. This is the master enable, and must be set before ITM Stimulus and Trace Enable registers can be written.                                                                                                                                                                                                             |



| Bit | Name    | Reset | RW | Description                                                                        |
|-----|---------|-------|----|------------------------------------------------------------------------------------|
| 1   | ACCESS  | 0x0   | RO | Write access to component is blocked. All writes are ignored, reads are permitted. |
| 0   | PRESENT | 0x1   | RO | Indicates that a lock mechanism exists for this component.                         |

## Peripheral Identification Register 4

[illegible]

| Bit  | Name | Reset | RW | Description                  |
|------|------|-------|----|------------------------------|
| 31:0 | PID4 | 0x4   | R0 | Peripheral Identification 4. |

## Peripheral Identification Register 5

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------|
| 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |      |
| 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | PID5 |

| Bit  | Name | Reset | RW | Description                  |
|------|------|-------|----|------------------------------|
| 31:0 | PID5 | 0x0   | R0 | Peripheral Identification 5. |

## Peripheral Identification Register 6

**INSTANCE 0 ADDRESS: 0xE000FD8**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| PID6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name | Reset | RW | Description                  |
|------|------|-------|----|------------------------------|
| 31:0 | PID6 | 0x0   | R0 | Peripheral Identification 6. |

## Peripheral Identification Register 7

**INSTANCE 0 ADDRESS: 0xE000FDC**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 |
| PID7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name | Reset | RW | Description                  |
|------|------|-------|----|------------------------------|
| 31:0 | PID7 | 0x0   | R0 | Peripheral Identification 7. |

## Peripheral Identification Register 0

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| PID0   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

| Bit  | Name | Reset | RW | Description                  |
|------|------|-------|----|------------------------------|
| 31:0 | PID0 | 0x1   | R0 | Peripheral Identification 0. |

## Peripheral Identification Register 1

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 | 0 |   |
| PID1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name | Reset | RW | Description                  |
|------|------|-------|----|------------------------------|
| 31:0 | PID1 | 0xb0  | R0 | Peripheral Identification 1. |

## Peripheral Identification Register 2

**INSTANCE 0 ADDRESS: 0xE000FE8**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| PID2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name | Reset | RW | Description                  |
|------|------|-------|----|------------------------------|
| 31:0 | PID2 | 0x3b  | R0 | Peripheral Identification 2. |

### Peripheral Identification Register 3

**INSTANCE 0 ADDRESS: 0xE0000FEC**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| PID3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |



| Bit  | Name | Reset | RW | Description                  |
|------|------|-------|----|------------------------------|
| 31:0 | PID3 | 0x0   | R0 | Peripheral Identification 3. |

## Component Identification Register 1

**INSTANCE 0 ADDRESS: 0xE0000FF0**

## Component Identification Register 1

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CID0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name | Reset | RW | Description                 |
|------|------|-------|----|-----------------------------|
| 31:0 | CID0 | 0xd   | R0 | Component Identification 1. |

## Component Identification Register 1

**INSTANCE 0 ADDRESS: 0xE0000FF4**

## Component Identification Register 1

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CID1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name | Reset | RW | Description                 |
|------|------|-------|----|-----------------------------|
| 31:0 | CID1 | 0xe0  | R0 | Component Identification 1. |

## Component Identification Register 2

**INSTANCE 0 ADDRESS: 0xE0000FF8**

## Component Identification Register 2

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CID2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name | Reset | RW | Description                 |
|------|------|-------|----|-----------------------------|
| 31:0 | CID2 | 0x5   | R0 | Component Identification 2. |

### Component Identification Register 3

**INSTANCE 0 ADDRESS: 0xE0000FFC**

### Component Identification Register 3

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CID3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 130: CID3 Register Bits**

| Bit  | Name | Reset | RW | Description                 |
|------|------|-------|----|-----------------------------|
| 31:0 | CID3 | 0xb1  | R0 | Component Identification 3. |

### **3.9 MCUCTRL Registers**

**MCU Miscellaneous Control Logic**

**INSTANCE 0 BASE ADDRESS:**0x40020000

### 3.9.1 Register Memory Map

**Table 131: MCUCTRL Register Map**

| Address(s) | Register Name  | Description                                                                                                                                 |
|------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 0x40020000 | CHIPPN         | Chip Information Register                                                                                                                   |
| 0x40020004 | CHIPID0        | Unique Chip ID 0                                                                                                                            |
| 0x40020008 | CHIPID1        | Unique Chip ID 1                                                                                                                            |
| 0x4002000C | CHIPREV        | Chip Revision                                                                                                                               |
| 0x40020010 | VENDORID       | Unique Vendor ID                                                                                                                            |
| 0x40020014 | SKU            | Unique Chip SKU                                                                                                                             |
| 0x40020018 | FEATUREENABLE  | Feature Enable on Burst and BLE                                                                                                             |
| 0x40020020 | DEBUGGER       | Debugger Control                                                                                                                            |
| 0x40020104 | ADCPWRDLY      | ADC Power Up Delay Control                                                                                                                  |
| 0x4002010C | ADCCAL         | ADC Calibration Control                                                                                                                     |
| 0x40020110 | ADCBATTLOAD    | ADC Battery Load Enable                                                                                                                     |
| 0x40020118 | ADCTRIM        | ADC Trims                                                                                                                                   |
| 0x4002011C | ADCREFCOMP     | ADC Reference Keeper and Comparator Control                                                                                                 |
| 0x40020120 | XTALCTRL       | XTAL Oscillator Control                                                                                                                     |
| 0x40020124 | XTALGENCTRL    | XTAL Oscillator General Control                                                                                                             |
| 0x40020198 | MISCCTRL       | Miscellaneous control register.                                                                                                             |
| 0x400201A0 | BOOTLOADER     | Bootloader and secure boot functions                                                                                                        |
| 0x400201A4 | SHADOWVALID    | Register to indicate whether the shadow registers have been successfully loaded from the Flash Information Space.                           |
| 0x400201B0 | SCRATCH0       | Scratch register that is not reset by any reset                                                                                             |
| 0x400201B4 | SCRATCH1       | Scratch register that is not reset by any reset                                                                                             |
| 0x400201C0 | ICODEFAULTADDR | ICODE bus address which was present when a bus fault occurred.                                                                              |
| 0x400201C4 | DCODEFAULTADDR | DCODE bus address which was present when a bus fault occurred.                                                                              |
| 0x400201C8 | SYSFAULTADDR   | System bus address which was present when a bus fault occurred.                                                                             |
| 0x400201CC | FAULTSTATUS    | Reflects the status of the bus decoders' fault detection. Any write to this register will clear all of the status bits within the register. |
| 0x400201D0 | FAULTCAPTUREEN | Enable the fault capture registers                                                                                                          |
| 0x40020200 | DBGR1          | Read-only debug register 1                                                                                                                  |
| 0x40020204 | DBGR2          | Read-only debug register 2                                                                                                                  |
| 0x40020220 | PMUENABLE      | Control bit to enable/disable the PMU                                                                                                       |
| 0x40020250 | TPIUCTRL       | TPIU Control Register. Determines the clock enable and frequency for the M4's TPIU interface.                                               |
| 0x40020264 | OTAPOINTER     | OTA (Over the Air) Update Pointer/Status. Reset only by POA                                                                                 |

Table 131: MCUCTRL Register Map

| Address(s) | Register Name         | Description                                                                    |
|------------|-----------------------|--------------------------------------------------------------------------------|
| 0x40020284 | SRAMMODE              | SRAM Controller mode bits                                                      |
| 0x40020348 | KEXTCLKSEL            | Key Register to enable the use of external clock selects via the EXTCLKSEL reg |
| 0x40020358 | SIMOBUCK3             | SIMO Buck Control Reg3                                                         |
| 0x4002035C | SIMOBUCK4             | SIMO Buck Control Reg1                                                         |
| 0x40020368 | BLEBUCK2              | BLEBUCK2 Control Reg                                                           |
| 0x400203A0 | FLASHWPROT0           | Flash Write Protection Bits                                                    |
| 0x400203A4 | FLASHWPROT1           | Flash Write Protection Bits                                                    |
| 0x400203B0 | FLASHRPROT0           | Flash Read Protection Bits                                                     |
| 0x400203B4 | FLASHRPROT1           | Flash Read Protection Bits                                                     |
| 0x400203C0 | DMA SRAMWRITEPROTECT0 | SRAM write-protection bits.                                                    |
| 0x400203C4 | DMA SRAMWRITEPROTECT1 | SRAM write-protection bits.                                                    |
| 0x400203D0 | DMA SRAMREADPROTECT0  | SRAM read-protection bits.                                                     |
| 0x400203D4 | DMA SRAMREADPROTECT1  | SRAM read-protection bits.                                                     |







|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        | SIPART |        |        |        |        |        |        |        |        |        | REVMAJ |        |        |        | REVMIN |        |        |        |        |        |

| Bit   | Name   | Reset | RW | Description                                                                                                                                                                       |
|-------|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:20 | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                         |
| 19:8  | SIPART | 0x0   | RO | Silicon Part ID                                                                                                                                                                   |
| 7:4   | REVMAJ | 0x0   | RO | Major Revision ID.<br><br>B = 0x2 - Apollo3 revision B<br>A = 0x1 - Apollo3 revision A                                                                                            |
| 3:0   | REVMIN | 0x1   | RO | Minor Revision ID.<br><br>REV1 = 0x2 - Apollo3 minor rev 1.<br>REV0 = 0x1 - Apollo3 minor rev 0. Minor revision value, succeeding minor revisions will increment from this value. |

### Unique Vendor ID

**INSTANCE 0 ADDRESS: 0x40020010**

### Unique Vendor ID

|          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3        | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1        | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| VENDORID |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name     | Reset | RW | Description                                                      |
|------|----------|-------|----|------------------------------------------------------------------|
| 31:0 | VENDORID | 0x0   | RO | Unique Vendor ID<br>AMBIQ = 0x414D4251 - Ambiq Vendor ID 'AMBIQ' |



| Bit  | Name       | Reset | RW | Description                                                                                                                                  |
|------|------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------|
| 31:7 | RSVD       | 0x0   | RO | RESERVED.                                                                                                                                    |
| 6    | BURSTAVAIL | 0x0   | RO | Availability of Burst functionality<br><br>AVAIL = 0x1 - Burst functionality available<br>NOTAVAIL = 0x0 - Burst functionality not available |
| 5    | BURSTACK   | 0x0   | RO | ACK for BURSTREQ                                                                                                                             |
| 4    | BURSTREQ   | 0x0   | RW | Controls the Burst functionality<br><br>EN = 0x1 - Enable the Burst functionality<br>DIS = 0x0 - Disable the Burst functionality             |
| 3    | RSVD       | 0x0   | RO | RESERVED.                                                                                                                                    |
| 2    | BLEAVAIL   | 0x0   | RO | AVAILABILITY of the BLE functionality<br><br>AVAIL = 0x1 - BLE functionality available<br>NOTAVAIL = 0x0 - BLE functionality not available   |
| 1    | BLEACK     | 0x0   | RO | ACK for BLEREQ                                                                                                                               |
| 0    | BLEREQ     | 0x1   | RW | Controls the BLE functionality<br><br>EN = 0x1 - Enable the BLE functionality<br>DIS = 0x0 - Disable the BLE functionality                   |

## Debugger Control

**INSTANCE 0 ADDRESS: 0x40020020**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1  | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | LOCKOUT |        |

| Bit  | Name    | Reset | RW | Description                |
|------|---------|-------|----|----------------------------|
| 31:1 | RSVD    | 0x0   | RO | RESERVED                   |
| 0    | LOCKOUT | 0x0   | RW | Lockout of debugger (SWD). |

## ADC Power Up Delay Control

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6       | 5 | 4 | 3 | 2 | 1 | 0 | 9       | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ADCPWR1 |   |   |   |   |   |   | ADCPWR0 |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                                                                          |
|-------|---------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------|
| 31:16 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                            |
| 15:8  | ADCPWR1 | 0x0   | RW | ADC Reference Keeper enable delay in 16 ADC CLK increments for ADC_CLKSEL = 0x1, 8 ADC CLOCK increments for ADC_CLKSEL = 0x2.        |
| 7:0   | ADCPWR0 | 0x0   | RW | ADC Reference Buffer Power Enable delay in 64 ADC CLK increments for ADC_CLKSEL = 0x1, 32 ADC CLOCK increments for ADC_CLKSEL = 0x2. |

## ADC Calibration Control

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |               |            |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|------------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2        | 0<br>1     | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | ADCCALIBRATED | CALONPWRUP |        |

| Bit  | Name          | Reset | RW | Description                                                                                                                                                                          |
|------|---------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:2 | RSVD          | 0x0   | RO | RESERVED.                                                                                                                                                                            |
| 1    | ADCCALIBRATED | 0x0   | RO | Status for ADC Calibration<br><br>FALSE = 0x0 - ADC is not calibrated<br>TRUE = 0x1 - ADC is calibrated                                                                              |
| 0    | CALONPWRUP    | 0x1   | RW | Run ADC Calibration on initial power up sequence<br><br>DIS = 0x0 - Disable automatic calibration on initial power up<br>EN = 0x1 - Enable automatic calibration on initial power up |

## ADC Battery Load Enable

**INSTANCE 0 ADDRESS: 0x40020110**

### Table 152: ADCBATTLOAD Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0   |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | BATTL0AD |

| Bit  | Name     | Reset | RW | Description                                                                                                            |
|------|----------|-------|----|------------------------------------------------------------------------------------------------------------------------|
| 31:1 | RSVD     | 0x0   | RO | RESERVED.                                                                                                              |
| 0    | BATTLOAD | 0x0   | RW | Enable the ADC battery load resistor<br>DIS = 0x0 - Battery load is disconnected<br>EN = 0x1 - Battery load is enabled |

## ADC Trims

**INSTANCE 0 ADDRESS: 0x40020118**

Table 154: ADCTRIM Register

### Table 155: ADCTRIM Register Bits

| Bit   | Name              | Reset | RW | Description                          |
|-------|-------------------|-------|----|--------------------------------------|
| 31:13 | RSVD              | 0x0   | RO | RESERVED.                            |
| 12:11 | ADCRFBUFIB-TRIM   | 0x0   | RW | ADC reference buffer input bias trim |
| 10:6  | ADCREFBUF-TRIM    | 0x8   | RW | ADC Reference buffer trim            |
| 5:2   | RSVD              | 0x0   | RO | RESERVED.                            |
| 1:0   | ADCREFKEEP-IBTRIM | 0x0   | RW | ADC Reference Ibias trim             |

**3.9.2.13 ADCREFCOMP Register****ADC Referece Keeper and Comparator Control****OFFSET:** 0x0000011C**INSTANCE 0 ADDRESS:** 0x4002011C

ADC Referece Keeper and Comparator Control

**Table 156: ADCREFCOMP Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |             |        |                |        |        |        |        |        |        |        |        |        |        |                 |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|--------|----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6      | 1<br>5 | 1<br>4         | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3          | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        | ADCREFCMPEN | RSVD   | ADCREFKEEPTRIM | RSVD   |        |        |        |        |        |        |        |        |        | ADC_REFCOMP_OUT |        |        |        |

**Table 157: ADCREFCOMP Register Bits**

| Bit   | Name              | Reset | RW | Description                            |
|-------|-------------------|-------|----|----------------------------------------|
| 31:17 | RSVD              | 0x0   | RO | RESERVED                               |
| 16    | ADCREFCMPEN       | 0x0   | RW | ADC Reference comparator power down    |
| 15:13 | RSVD              | 0x0   | RO | RESERVED                               |
| 12:8  | ADCREFKEEP-TRIM   | 0x0   | RW | ADC Reference Keeper Trim              |
| 7:1   | RSVD              | 0x0   | RO | RESERVED                               |
| 0     | ADC_REFCOMP-P_OUT | 0x0   | RO | Output of the ADC reference comparator |

**3.9.2.14 XTALCTRL Register****XTAL Oscillator Control****OFFSET:** 0x00000120**INSTANCE 0 ADDRESS:** 0x40020120

XTAL Oscillator Control

Table 158: XTALCTRL Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |               |              |            |               |              |              |              |         |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------------|--------------|------------|---------------|--------------|--------------|--------------|---------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0             | 0            | 0          | 0             | 0            | 0            | 0            | 0       |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0             | 9            | 8          | 7             | 6            | 5            | 4            | 3       |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | XTALICOMPTRIM | XTALIBUFTRIM | PWDBODXTAL | PDNBCMPRXXTAL | PDNBCOREXTAL | BYPCMPRXXTAL | FDBKDSBLXTAL | XTALSWE |

Table 159: XTALCTRL Register Bits

| Bit   | Name           | Reset | RW | Description                                                                                                                                                  |
|-------|----------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:10 | RSVD           | 0x0   | RO | RESERVED.                                                                                                                                                    |
| 9:8   | XTALI-COMPTRIM | 0x1   | RW | XTAL ICOMP trim                                                                                                                                              |
| 7:6   | XTALIBUFTRIM   | 0x1   | RW | XTAL IBUFF trim                                                                                                                                              |
| 5     | PWDBODXTAL     | 0x0   | RW | XTAL Power down on brown out.<br>PWRUPBOD = 0x0 - Power up xtal on BOD<br>PWRDNBOD = 0x1 - Power down XTAL on BOD.                                           |
| 4     | PDNBCMPRX-TAL  | 0x1   | RW | XTAL Oscillator Power Down Comparator.<br>PWRUPCOMP = 0x1 - Power up XTAL oscillator comparator.<br>PWRDNCOMP = 0x0 - Power down XTAL oscillator comparator. |
| 3     | PDNBCOREX-TAL  | 0x1   | RW | XTAL Oscillator Power Down Core.<br>PWRUPCORE = 0x1 - Power up XTAL oscillator core.<br>PWRDNCORE = 0x0 - Power down XTAL oscillator core.                   |
| 2     | BYPCMPRXXTAL   | 0x0   | RW | XTAL Oscillator Bypass Comparator.<br>USECOMP = 0x0 - Use the XTAL oscillator comparator.<br>BYPCOMP = 0x1 - Bypass the XTAL oscillator comparator.          |
| 1     | FDBKDSBLX-TAL  | 0x0   | RW | XTAL Oscillator Disable Feedback.<br>EN = 0x0 - Enable XTAL oscillator comparator.<br>DIS = 0x1 - Disable XTAL oscillator comparator.                        |
| 0     | XTALSWE        | 0x0   | RW | XTAL Software Override Enable.<br>OVERRIDE_DIS = 0x0 - XTAL Software Override Disable.<br>OVERRIDE_EN = 0x1 - XTAL Software Override Enable.                 |

### 3.9.2.15 XTALGENCTRL Register

#### XTAL Oscillator General Control

OFFSET: 0x00000124



**INSTANCE 0 ADDRESS:** 0x40020124

XTAL Oscillator General Control

**Table 160: XTALGENCTRL Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |                 |        |        |        |        |               |        |        |        |        |          |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------|--------|--------|--------|--------|---------------|--------|--------|--------|--------|----------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3          | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8        | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3   | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | XTALKSBIAS-TRIM |        |        |        |        | XTALBIAS-TRIM |        |        |        |        | ACWARMUP |        |        |        |

**Table 161: XTALGENCTRL Register Bits**

| Bit   | Name            | Reset | RW | Description                                                                                                                                                                                                         |
|-------|-----------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:14 | RSVD            | 0x0   | RO | RESERVED.                                                                                                                                                                                                           |
| 13:8  | XTALKSBIAS-TRIM | 0x1   | RW | XTAL IBIAS Kick start trim. This trim value is used during the startup process to enable a faster lock.                                                                                                             |
| 7:2   | XTALBIAS-TRIM   | 0x0   | RW | XTAL BIAS trim                                                                                                                                                                                                      |
| 1:0   | ACWARMUP        | 0x0   | RW | Auto-calibration delay control<br>SEC1 = 0x0 - Warmup period of 1-2 seconds<br>SEC2 = 0x1 - Warmup period of 2-4 seconds<br>SEC4 = 0x2 - Warmup period of 4-8 seconds<br>SEC8 = 0x3 - Warmup period of 8-16 seconds |

**3.9.2.16 MISCCTRL Register****Miscellaneous control register.****OFFSET:** 0x00000198**INSTANCE 0 ADDRESS:** 0x40020198

Miscellaneous control register.

Table 162: MISCCTRL Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |            |               |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------|---------------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4     | 0<br>3        | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | BLE_RESETN | RESERVED_RW_0 |        |        |        |
|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |            |               |        |        |        |

Table 163: MISCCTRL Register Bits

| Bit  | Name           | Reset | RW | Description                                                                                                                                                                                        |
|------|----------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:6 | RSVD           | 0x0   | RO | RESERVED.                                                                                                                                                                                          |
| 5    | BLE_RESETN     | 0x0   | RW | BLE reset signal.                                                                                                                                                                                  |
| 4:0  | RESERVED_R-W_0 | 0x0   | RW | Reserved bits, always leave unchanged. The MISCCTRL register must be modified via atomic RMW, leaving this bitfield completely unmodified. Failure to do so will result in unpredictable behavior. |

### 3.9.2.17 BOOTLOADER Register

Bootloader and secure boot functions

OFFSET: 0x000001A0

INSTANCE 0 ADDRESS: 0x400201A0

Bootloader and secure boot functions

Table 164: BOOTLOADER Register

|              |         |        |                |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |               |        |        |
|--------------|---------|--------|----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|---------------|--------|--------|
| 3<br>1       | 3<br>0  | 2<br>9 | 2<br>8         | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4   | 0<br>3 | 0<br>2        | 0<br>1 | 0<br>0 |
| SECBOOTONRST | SECBOOT |        | SECBOOTFEATURE | RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | PROTLOCK | SBLOCK | BOOTLOADERLOW |        |        |

**Table 165: BOOTLOADER Register Bits**

| Bit   | Name                | Reset | RW | Description                                                                                                                                                                                        |
|-------|---------------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:30 | SEC-<br>BOOTONRST   | 0x0   | RO | Indicates whether the secure boot on warm reset is enabled<br><br>DISABLED = 0x0 - Secure boot disabled<br>ENABLED = 0x1 - Secure boot enabled<br>ERROR = 0x2 - Error in secure boot configuration |
| 29:28 | SECBOOT             | 0x0   | RO | Indicates whether the secure boot on cold reset is enabled<br><br>DISABLED = 0x0 - Secure boot disabled<br>ENABLED = 0x1 - Secure boot enabled<br>ERROR = 0x2 - Error in secure boot configuration |
| 27:26 | SECBOOTFEA-<br>TURE | 0x0   | RO | Indicates whether the secure boot feature is enabled.<br><br>DISABLED = 0x0 - Secure boot disabled<br>ENABLED = 0x1 - Secure boot enabled<br>ERROR = 0x2 - Error in secure boot configuration      |
| 25:3  | RSVD                | 0x0   | RO | RESERVED.                                                                                                                                                                                          |
| 2     | PROTLOCK            | 0x1   | RW | Flash protection lock. Always resets to 1, write 1 to clear. Enables writes to flash protection register set.<br><br>LOCK = 0x1 - Enable the secure boot lock                                      |
| 1     | SBLOCK              | 0x1   | RW | Secure boot lock. Always resets to 1, write 1 to clear. Enables system visibility to bootloader until set.<br><br>LOCK = 0x1 - Enable the secure boot lock                                         |
| 0     | BOOTLOADER-<br>LOW  | 0x1   | RW | Determines whether the bootloader code is visible at address 0x00000000 or not. Resets to 1, write 1 to clear.<br><br>ADDR0 = 0x1 - Bootloader code at 0x00000000.                                 |

**3.9.2.18 SHADOWVALID Register**

Register to indicate whether the shadow registers have been successfully loaded from the Flash Information Space.

**OFFSET:** 0x000001A4

**INSTANCE 0 ADDRESS:** 0x400201A4

Register to indicate whether the shadow registers have been successfully loaded from the Flash Information Space.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |            |         |       |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------------|---------|-------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0          | 0       | 0     |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4          | 3       | 2     |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | INFO_VALID | BDSLEEP | VALID |

| Bit  | Name        | Reset | RW | Description                                                                                                                                                        |
|------|-------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:3 | RSVD        | 0x0   | RO | RESERVED.                                                                                                                                                          |
| 2    | INFO0_VALID | 0x1   | RO | Indicates whether info0 contains valid data<br><br>VALID = 0x1 - Flash info0 (customer) space contains valid data.                                                 |
| 1    | BLDSLEEP    | 0x1   | RO | Indicates whether the bootloader should sleep or deep sleep if no image loaded.<br><br>DEEPSLEEP = 0x1 - Bootloader will go to deep sleep if no flash image loaded |
| 0    | VALID       | 0x1   | RO | Indicates whether the shadow registers contain valid data from the Flash Information Space.<br><br>VALID = 0x1 - Flash information space contains valid data.      |

Scratch register that is not reset by any reset

|          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3        | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1        | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SCRATCH0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name     | Reset | RW | Description         |
|------|----------|-------|----|---------------------|
| 31:0 | SCRATCH0 | 0x0   | RW | Scratch register 0. |

### Scratch register that is not reset by any reset

**INSTANCE 0 ADDRESS: 0x400201B4**

Scratch register that is not reset by any reset

|          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3        | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1        | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SCRATCH1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name     | Reset | RW | Description         |
|------|----------|-------|----|---------------------|
| 31:0 | SCRATCH1 | 0x0   | RW | Scratch register 1. |

**ICODE bus address which was present when a bus fault occurred.**

**INSTANCE 0 ADDRESS: 0x400201C0**

ICODE bus address which was present when a bus fault occurred.

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| ICODEFAULTADDR |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name                | Reset | RW | Description                                                                                                                                                                                        |
|------|---------------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | ICODE-<br>FAULTADDR | 0x0   | RO | The ICODE bus address observed when a Bus Fault occurred. Once an address is captured in this field, it is held until the corresponding Fault Observed bit is cleared in the FAULTSTATUS register. |

DCODE bus address which was present when a bus fault occurred.

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| DCODEFAULTADDR |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name                | Reset | RW | Description                                                                                                                                                                                        |
|------|---------------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | DCODE-<br>FAULTADDR | 0x0   | RO | The DCODE bus address observed when a Bus Fault occurred. Once an address is captured in this field, it is held until the corresponding Fault Observed bit is cleared in the FAULTSTATUS register. |

System bus address which was present when a bus fault occurred.

|              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3            | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1            | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SYSFAULTADDR |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name              | Reset | RW | Description                                                                                                                                                                                  |
|------|-------------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SYS-<br>FAULTADDR | 0x0   | RO | SYS bus address observed when a Bus Fault occurred. Once an address is captured in this field, it is held until the corresponding Fault Observed bit is cleared in the FAULTSTATUS register. |

Reflects the status of the bus decoders' fault detection. Any write to this register will clear all of the status bits within the register.

**INSTANCE 0 ADDRESS: 0x400201CC**

Table 178: FAULTSTATUS Register

### Table 179: FAULTSTATUS Register Bits

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| Bit | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                     |
|-----|------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | ICODEFAULT | 0x0   | RW | <p>The ICODE Bus Decoder Fault Detected bit. When set, a fault has been detected, and the ICODEFAULTADDR register will contain the bus address which generated the fault.</p> <p>NOFAULT = 0x0 - No ICODE fault has been detected.<br/> FAULT = 0x1 - ICODE fault detected.</p> |

## Enable the fault capture registers

**INSTANCE 0 ADDRESS: 0x400201D0**

## Enable the fault capture registers

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |                |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |                |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | FAULTCAPTUREEN |

| Bit  | Name           | Reset | RW | Description                                                                                                                                                                                                                                             |
|------|----------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:1 | RSVD           | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                               |
| 0    | FAULTCAPTUREEN | 0x0   | RW | <p>Fault Capture Enable field. When set, the Fault Capture monitors are enabled and addresses which generate a hard fault are captured into the FAULTADDR registers.</p> <p>DIS = 0x0 - Disable fault capture.<br/>EN = 0x1 - Enable fault capture.</p> |

### Read-only debug register 1

**INSTANCE 0 ADDRESS: 0x40020200**

Read-only debug register 1



Table 182: DBGR1 Register

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| ONETO8 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 183: DBGR1 Register Bits

| Bit  | Name   | Reset      | RW | Description                                     |
|------|--------|------------|----|-------------------------------------------------|
| 31:0 | ONETO8 | 0x12345678 | RO | Read-only register for communication validation |

**3.9.2.27 DBGR2 Register**

Read-only debug register 2

OFFSET: 0x00000204

INSTANCE 0 ADDRESS: 0x40020204

Read-only debug register 2

Table 184: DBGR2 Register

|          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3        | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1        | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| COOLCODE |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 185: DBGR2 Register Bits

| Bit  | Name     | Reset      | RW | Description                                     |
|------|----------|------------|----|-------------------------------------------------|
| 31:0 | COOLCODE | 0xc001c0de | RO | Read-only register for communication validation |

**3.9.2.28 PMUENABLE Register**

Control bit to enable/disable the PMU

OFFSET: 0x00000220

INSTANCE 0 ADDRESS: 0x40020220

Control bit to enable/disable the PMU

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0      |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3      |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ENABLE |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:1 | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 0    | ENABLE | 0x1   | RW | <p>PMU Enable Control bit. When set, the MCU's PMU will place the MCU into the lowest power consuming Deep Sleep mode upon execution of a WFI instruction (dependent on the setting of the SLEEPDEEP bit in the ARM SCR register). When cleared, regardless of the requested sleep mode, the PMU will not enter the lowest power Deep Sleep mode, instead entering the Sleep mode.</p> <p>DIS = 0x0 - Disable MCU power management.<br/> EN = 0x1 - Enable MCU power management.</p> |

**TPIU Control Register.** Determines the clock enable and frequency for the M4's TPIU interface.

**INSTANCE 0 ADDRESS: 0x40020250**

TPIU Control Register. Determines the clock enable and frequency for the M4's TPIU interface.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |  |        |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CLKSEL |        | RSVD   |        |        |        |        |        |        |        |        |  | ENABLE |

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:11 | RSVD | 0x0   | RO | RESERVED.   |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|--------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10:8 | CLKSEL | 0x0   | RW | <p>This field selects the frequency of the ARM M4 TPIU port.</p> <p>LOWPWR = 0x0 - Low power state.<br/>           HFRCDIV2 = 0x1 - Selects HFRC divided by 2 as the source TPIU clk<br/>           HFRCDIV8 = 0x2 - Selects HFRC divided by 8 as the source TPIU clk<br/>           HFRCDIV16 = 0x3 - Selects HFRC divided by 16 as the source TPIU clk<br/>           HFRCDIV32 = 0x4 - Selects HFRC divided by 32 as the source TPIU clk</p> |
| 7:1  | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 0    | ENABLE | 0x0   | RW | <p>TPIU Enable field. When set, the ARM M4 TPIU is enabled and data can be streamed out of the MCU's SWO port using the ARM ITM and TPIU modules.</p> <p>DIS = 0x0 - Disable the TPIU.<br/>           EN = 0x1 - Enable the TPIU.</p>                                                                                                                                                                                                           |

## OTA (Over the Air) Update Pointer/Status. Reset only by POA

**INSTANCE 0 ADDRESS: 0x40020264**

OTA (Over the Air) Update Pointer/Status. Reset only by POA

|            |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |              |           |        |
|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|-----------|--------|
| 3<br>1     | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2       | 0<br>1    | 0<br>0 |
| OTAPointer |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | OTASBLUPDATE | OTAVVALID |        |

| Bit  | Name              | Reset | RW | Description                                  |
|------|-------------------|-------|----|----------------------------------------------|
| 31:2 | OTAPOINTER        | 0x0   | RW | Flash page pointer with updated OTA image    |
| 1    | OTASBLUP-<br>DATE | 0x0   | RW | Indicates that the sbl_init has been updated |

Table 191: OTAPOINTER Register Bits

| Bit | Name      | Reset | RW | Description                           |
|-----|-----------|-------|----|---------------------------------------|
| 0   | OTAVVALID | 0x0   | RW | Indicates that an OTA update is valid |

**3.9.2.31 SRAMMODE Register****SRAM Controller mode bits****OFFSET:** 0x00000284**INSTANCE 0 ADDRESS:** 0x40020284

SRAM Controller mode bits

Table 192: SRAMMODE Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |                 |           |        |                 |           |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------|-----------|--------|-----------------|-----------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6          | 0<br>5    | 0<br>4 | 0<br>3          | 0<br>2    | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | RSVD   | DPREFETCH_CACHE | DPREFETCH | RSVD   | IPREFETCH_CACHE | IPREFETCH |        |        |

Table 193: SRAMMODE Register Bits

| Bit  | Name            | Reset | RW | Description                                                                                                                                                                                                |
|------|-----------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD            | 0x0   | RO | RESERVED.                                                                                                                                                                                                  |
| 7:6  | RSVD            | 0x0   | RO | RESERVED.                                                                                                                                                                                                  |
| 5    | DPREFETCH_CACHE | 0x0   | RW | Secondary prefetch feature that will cache prefetched data across bus wait-states (requires DPREFETCH to be set).                                                                                          |
| 4    | DPREFETCH       | 0x0   | RW | When set, data bus accesses to the SRAM banks will be prefetched (normally 2 cycle read access). Use of this mode bit is only recommended if the work flow has a large number of sequential accesses.      |
| 3:2  | RSVD            | 0x0   | RO | RESERVED.                                                                                                                                                                                                  |
| 1    | IPREFETCH_CACHE | 0x0   | RW | Secondary prefetch feature that will cache prefetched data across bus wait-states (requires IPREFETCH to be set).                                                                                          |
| 0    | IPREFETCH       | 0x0   | RW | When set, instruction accesses to the SRAM banks will be prefetched (normally 2 cycle read access). Generally, this mode bit should be set for improved performance when executing instructions from SRAM. |



Table 197: SIMOBUCK3 Register Bits

| Bit   | Name                         | Reset | RW | Description                                                                                                                                                                                         |
|-------|------------------------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:16 | RESERVED_R-W_16              | 0x0   | RW | Reserved bits, always leave unchanged. The SIMOBUCK3 register must be modified via atomic RMW, leaving this bitfield completely unmodified. Failure to do so will result in unpredictable behavior. |
| 15:12 | SIMOBUCK-MEMLPLOW-TOFFTRIM   | 0xa   | RW | simobuck_mem_lp_low_toff_trim                                                                                                                                                                       |
| 11:8  | SIMOBUCK-MEMLPHIGH-TOFFTRIM  | 0xa   | RW | simobuck_mem_lp_high_toff_trim                                                                                                                                                                      |
| 7:4   | SIMOBUCK-CORELPLOW-TOFFTRIM  | 0xa   | RW | simobuck_core_lp_low_toff_trim                                                                                                                                                                      |
| 3:0   | SIMOBUCK-CORELPHIGH-TOFFTRIM | 0xa   | RW | simobuck_core_lp_high_toff_trim                                                                                                                                                                     |

### 3.9.2.34 SIMOBUCK4 Register

#### SIMO Buck Control Reg1

OFFSET: 0x0000035C

INSTANCE 0 ADDRESS: 0x4002035C

SIMO Buck Control Reg1

Table 198: SIMOBUCK4 Register

|                   |        |        |        |                  |        |                     |                        |                   |                   |        |        |                   |                        |        |        |                      |        |        |                 |        |        |        |        |                        |        |                         |        |                          |        |                         |        |  |  |  |
|-------------------|--------|--------|--------|------------------|--------|---------------------|------------------------|-------------------|-------------------|--------|--------|-------------------|------------------------|--------|--------|----------------------|--------|--------|-----------------|--------|--------|--------|--------|------------------------|--------|-------------------------|--------|--------------------------|--------|-------------------------|--------|--|--|--|
| 3<br>1            | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7           | 2<br>6 | 2<br>5              | 2<br>4                 | 2<br>3            | 2<br>2            | 2<br>1 | 2<br>0 | 1<br>9            | 1<br>8                 | 1<br>7 | 1<br>6 | 1<br>5               | 1<br>4 | 1<br>3 | 1<br>2          | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7                 | 0<br>6 | 0<br>5                  | 0<br>4 | 0<br>3                   | 0<br>2 | 0<br>1                  | 0<br>0 |  |  |  |
| SIMOBUCKIBIASTRIM |        |        |        | SIMOBUCKUVLOMODE |        | SIMOBUCKPRIORITYSEL | SIMOBUCKCOMP2TIMEOUTEN | SIMOBUCKCOMP2LPEN | SIMOBUCKCLKDIVSEL |        |        | SIMOBUCKEXTCLKSEL | SIMOBUCKUVLODRVSTRTRIM |        |        | SIMOBUCKUVLOCNTRTRIM |        |        | SIMOBUCKKZXTRIM |        |        |        |        | SIMOBUCKMEMLEAKAGETRIM |        | SIMOBUCKMEMLPDRVSTRTRIM |        | SIMOBUCKMEMACTDRVSTRTRIM |        | SIMOBUCKMEMLPLOWTONTRIM |        |  |  |  |

Table 199: SIMOBUCK4 Register Bits

| Bit   | Name                               | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|------------------------------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:28 | SIMOBUCKIBI-<br>ASTRIM             | 0x3   | RW | simobuck_bias_trim                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 27:26 | SIMOBUCKU-<br>VLOMODE              | 0x3   | RW | simobuck_uvlo_mode. In B0, these bits are used as SIMOBUCK mode bits. uvlo_mode[0] enables use of tonclk_lp for all operations and uvlo_mode[1] controls core_low/mem_low synchronization.<br><br>USE_LP_CLOCK = 0x1 - LP clock is used for simobuck in both active and low-power mode.<br>X_LOW_NOSYNC = 0x2 - No synchronization is applied to core_low/mem_low inputs (A1 behavior)<br>X_LOW_SYNC = 0x0 - Synchronization is applied to core_low/mem_low inputs                                                                                                                                                                                                                                                                                                |
| 25    | SIMOBUCKPRI-<br>ORITYSEL           | 0x0   | RW | simobuck_priority_sel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 24    | SIMOBUCK-<br>COMP2TIME-<br>OUTEN   | 0x0   | RW | simobuck_comp2_timeout_en                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 23    | SIMOBUCK-<br>COMP2LPEN             | 0x1   | RW | simobuck_comp2_lp_en                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 22:21 | SIMOBUCK-<br>CLKDIVSEL             | 0x0   | RW | simobuck_clkdiv_sel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 20    | SIMOBUCKEX-<br>TCLKSEL             | 0x0   | RW | simobuck_extclk_sel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 19:17 | SIMOBUCKU-<br>VLODRVSTR-<br>TRIM   | 0x6   | RW | simobuck_uvlo_drvstr_trim                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 16:14 | SIMOBUCKU-<br>VLOCNTRTRIM          | 0x6   | RW | For B0, this register has been redefined as mode bits for the Simobuck. Each bit is independent: [0]=always enable LP clock [1]=enable priority_state [2]=enable zx_comp reset removal fix<br><br>ENABLE_LP_CLK = 0x1 - When set to 1, the LP clock will always be activated. When 0, the logic will request the clock when needed<br>DISABLE_PRIORITY_STATE = 0x2 - (Inverse polarity mode bit) When set to 1, the priority state logic will be disabled and when set to 0, priority_state will enforce that both core and mem bucks get equal priority.<br>ENABLE_ZXCOMP_SYNC = 0x4 - When set to 1, ZXCOMP will be routed through a flop and removal synchronized to the internal clock. When set to 0, logic will act like A1 logic and will be asynchronous. |
| 13:10 | SIMOBUCKZX-<br>TRIM                | 0x0   | RW | simobuck_zx_trim                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 9:8   | SIMOBUCK-<br>MEMLEAKAG-<br>ETRIM   | 0x0   | RW | simobuck_mem_leakage_trim                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 7:6   | SIMOBUCK-<br>MEMLP-<br>DRVSTRTRIM  | 0x2   | RW | simobuck_mem_lp_drvstr_trim                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 5:4   | SIMOBUCKME-<br>MACTDRVSTR-<br>TRIM | 0x2   | RW | simobuck_mem_act_drvstr_trim                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

Table 199: SIMOBUCK4 Register Bits

| Bit | Name                      | Reset | RW | Description                  |
|-----|---------------------------|-------|----|------------------------------|
| 3:0 | SIMOBUCK-MEMLPLOW-TONTRIM | 0xa   | RW | simobuck_mem_lp_low_ton_trim |

**3.9.2.35 BLEBUCK2 Register****BLEBUCK2 Control Reg****OFFSET:** 0x00000368**INSTANCE 0 ADDRESS:** 0x40020368

BLEBUCK2 Control Reg

Table 200: BLEBUCK2 Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |                   |        |        |        |                  |        |        |        |                   |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------------|--------|--------|--------|------------------|--------|--------|--------|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7            | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3           | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9            | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        | BLEBUCKTOND2ATRIM |        |        |        | BLEBUCKTONHITRIM |        |        |        | BLEBUCKTONLOWTRIM |        |        |        |        |        |        |        |        |        |

Table 201: BLEBUCK2 Register Bits

| Bit   | Name               | Reset | RW | Description          |
|-------|--------------------|-------|----|----------------------|
| 31:18 | RSVD               | 0x0   | RO | RESERVED.            |
| 17:12 | BLEBUCK-TOND2ATRIM | 0x0   | RO | blebuck_ton_trim     |
| 11:6  | BLEBUCKTON-HITRIM  | 0x1   | RW | blebuck_ton_hi_trim  |
| 5:0   | BLEBUCKTON-LOWTRIM | 0xe   | RW | blebuck_ton_low_trim |

**3.9.2.36 FLASHWPROT0 Register****Flash Write Protection Bits****OFFSET:** 0x000003A0**INSTANCE 0 ADDRESS:** 0x400203A0

These bits write-protect flash in 16KB chunks.



|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FW0BITS |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                 |
|------|---------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | FW0BITS | 0x0   | RW | Write protect flash 0x00000000 - 0x0007FFFF. Each bit provides write protection for 16KB chunks of flash data space. Bits are cleared by writing a 1 to the bit. When read, 0 indicates the region is protected. Bits are sticky (can be set when PROTLOCK is 1, but only cleared by reset) |

These bits write-protect flash in 16KB chunks.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FW1BITS |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                 |
|------|---------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | FW1BITS | 0x0   | RW | Write protect flash 0x00080000 - 0x000FFFFF. Each bit provides write protection for 16KB chunks of flash data space. Bits are cleared by writing a 1 to the bit. When read, 0 indicates the region is protected. Bits are sticky (can be set when PROTLOCK is 1, but only cleared by reset) |

These bits read-protect flash in 16KB chunks.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FR0BITS |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                           |
|------|---------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | FR0BITS | 0x0   | RW | Copy (read) protect flash 0x00000000 - 0x0007FFFF. Each bit provides read protection for 16KB chunks of flash. Bits are cleared by writing a 1 to the bit. When read, 0 indicates the region is protected. Bits are sticky (can be set when PROTLOCK is 1, but only cleared by reset) |

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |
| FR1BITS |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                           |
|------|---------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | FR1BITS | 0x0   | RW | Copy (read) protect flash 0x00080000 - 0x000FFFFF. Each bit provides read protection for 16KB chunks of flash. Bits are cleared by writing a 1 to the bit. When read, 0 indicates the region is protected. Bits are sticky (can be set when PROTLOCK is 1, but only cleared by reset) |

**Table 210: DMASRAMWRITEPROTECT0 Register**

|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3          | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1          | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |
| DMA_WPROT0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 211: DMASRAMWRITEPROTECT0 Register Bits**

| Bit  | Name       | Reset | RW | Description                                                                                                                                                                                        |
|------|------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | DMA_WPROT0 | 0x0   | RW | Write protect SRAM from DMA. Each bit provides write protection for an 8KB region of memory. When set to 1, the region will be protected from DMA writes, when set to 0, DMA may write the region. |

**3.9.2.41 DMASRAMWRITEPROTECT1 Register**

SRAM write-protection bits.

OFFSET: 0x000003C4

INSTANCE 0 ADDRESS: 0x400203C4

These bits write-protect system SRAM from DMA operations in 8KB chunks.

**Table 212: DMASRAMWRITEPROTECT1 Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1          | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5          | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DMA_WPROT1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 213: DMASRAMWRITEPROTECT1 Register Bits**

| Bit   | Name       | Reset | RW | Description                                                                                                                                                                                        |
|-------|------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:16 | RSVD       | 0x0   | RO | RESERVED.                                                                                                                                                                                          |
| 15:0  | DMA_WPROT1 | 0x0   | RW | Write protect SRAM from DMA. Each bit provides write protection for an 8KB region of memory. When set to 1, the region will be protected from DMA writes, when set to 0, DMA may write the region. |

**3.9.2.42 DMASRAMREADPROTECT0 Register**

SRAM read-protection bits.

OFFSET: 0x000003D0

INSTANCE 0 ADDRESS: 0x400203D0

These bits read-protect system SRAM from DMA operations in 8KB chunks.

**Table 214: DMASRAMREADPROTECT0 Register**

|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3          | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1          | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| DMA_RPROTO |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 215: DMASRAMREADPROTECT0 Register Bits**

| Bit  | Name       | Reset | RW | Description                                                                                                                                                                                     |
|------|------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | DMA_RPROTO | 0x0   | RW | Read protect SRAM from DMA. Each bit provides write protection for an 8KB region of memory. When set to 1, the region will be protected from DMA reads, when set to 0, DMA may read the region. |

**3.9.2.43 DMASRAMREADPROTECT1 Register**

SRAM read-protection bits.

OFFSET: 0x000003D4

INSTANCE 0 ADDRESS: 0x400203D4

These bits read-protect system SRAM from DMA operations in 8KB chunks.

**Table 216: DMASRAMREADPROTECT1 Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1          | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5          | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DMA_RPROT1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |  |

**Table 217: DMASRAMREADPROTECT1 Register Bits**

| Bit   | Name       | Reset | RW | Description                                                                                                                                                                                     |
|-------|------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:16 | RSVD       | 0x0   | RO | RESERVED.                                                                                                                                                                                       |
| 15:0  | DMA_RPROT1 | 0x0   | RW | Read protect SRAM from DMA. Each bit provides write protection for an 8KB region of memory. When set to 1, the region will be protected from DMA reads, when set to 0, DMA may read the region. |

### 3.10 Memory Subsystem

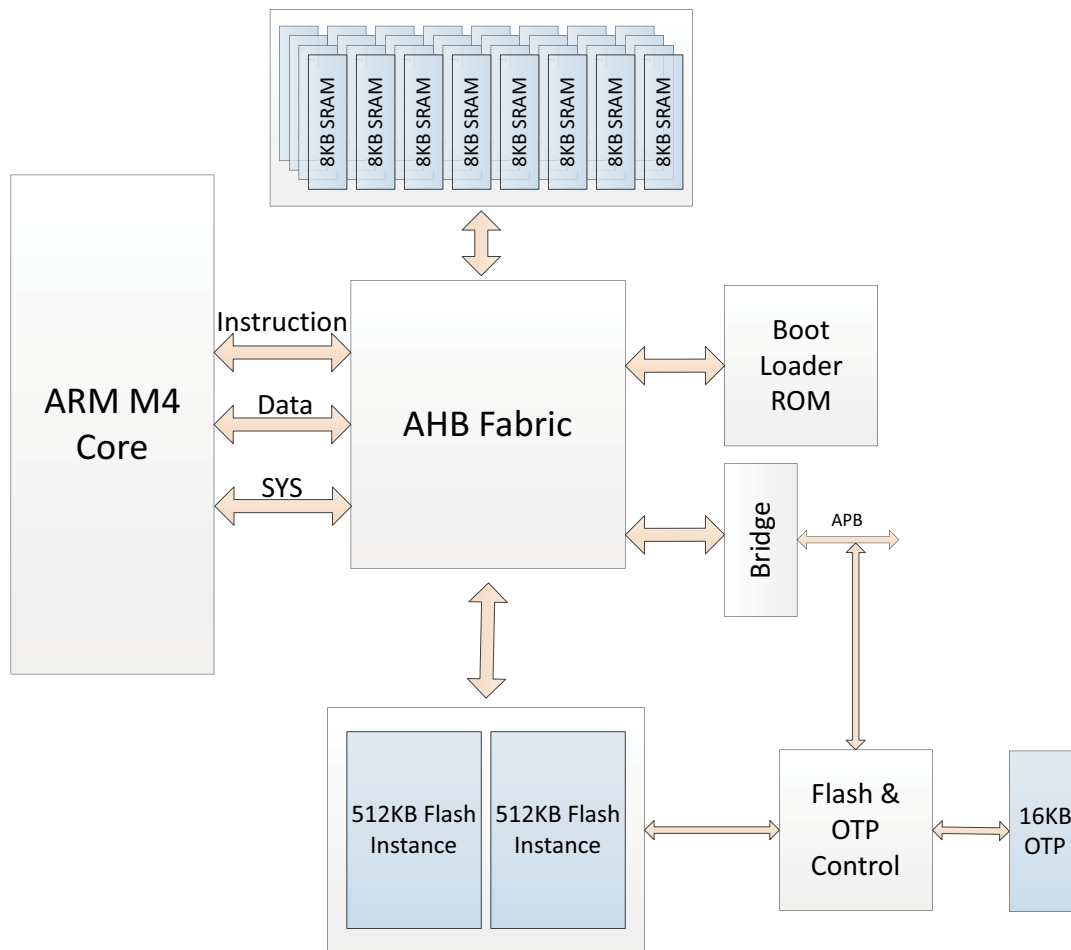


Figure 4. Block Diagram for Flash and OTP Memory Subsystem

#### 3.10.1 Features

The Apollo3 Blue SoC integrates four kinds of memory as shown in Figure 3:

- SRAM
- Integrated Flash / External Memory via MSPI (with Flash cache)
- Boot Loader ROM
- One Time Programmable (OTP) memory

Key features include:

- 384 KB SRAM
- 2 instances of 512 KB flash memory (up to 1 MB total)
- 16 KB Flash cache (2-way set-associative/Direct Mapped, 512 entry, 128-bit line size)

- 16 KB OTP
  - 8 KB contain factory preset per chip trim values.
  - 8 KB for customer use, including flash protection fields
- Flash Protection specified in 16 KB Chunks
  - 64 OTP bits specify Write Protected Chunks
  - 64 OTP bits specify Read Protected Chunks
  - A Chunk is Execute Only if Both Corresponding Protection Bits Specified
  - OTP bits Specify Debugger Lock Out State
  - OTP bits Can Protect SRAM Contents From Debugger Inspection
- External Flash with XiP (via MSPI) with cache support (up to 64MB)

### **3.10.2 Functional Overview**

The Apollo3 Blue SoC Integrates up to 1024 KB of on-board Flash non-volatile memory and 16 KB of one time programmable memory. These memories are managed by the APB flash controller for write operations.

During normal MCU code execution, the Flash Cache Controller translates requests from the CPU core to the Flash Memory instance for instruction and data fetches. The Controller is designed to return data in zero wait-states when accesses hit into the cache and can operate up to the maximum operating frequency of the CPU core. On cache misses, the controller issues miss requests to the Flash memory controller.

The Flash Memory Controller facilitates flash erase and programming operations. When erase or programming operations are active, instructions cannot be fetched for execution from the Flash memory, so the on-chip SRAM would have to be used for code execution. The cache controller ensures these operations are synchronized. To facilitate the management of Flash updates and OTP programming, a number of Flash helper functions are provided in the boot loader ROM.

The boot loader ROM contains instructions that are executed upon power up of the processor. Once a valid reset vector is established at offset zero in the flash memory, the boot loader transfers control to users application by issuing a POR type reset which causes the core to enter the reset vector in flash.

The Apollo3 Blue SoC supports secure boot leveraging the SecureSPOT technology. The root of trust for the secure boot is the boot ROM and the Ambiq secure boot loader. Secure boot, if enabled, will be invoked on each boot and reset cycle. Some secure boot functionality is conditionally supported on reset leveraging the SECBOOTONRST configuration in OTP. More details on the Apollo3 Blue SoC security features are described in “Security” on page 182 and also in the Ambiq Apollo3 Blue SoC Security Whitepaper.

### 3.10.3 Flash Cache

#### Functional Overview

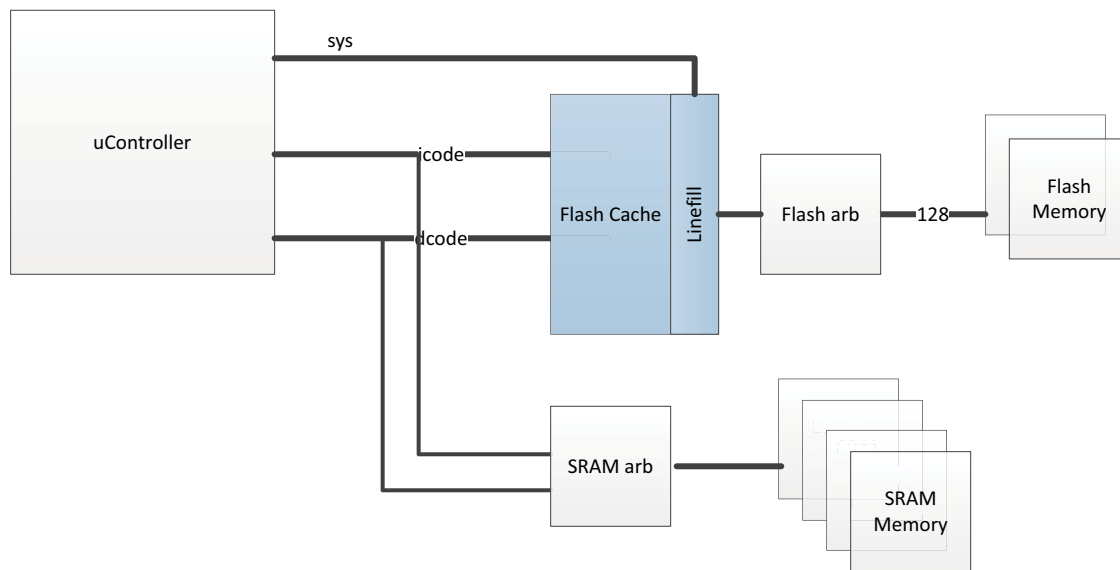


Figure 5. Block Diagram for Apollo3 Blue SoC with Flash Cache

Apollo3 Blue SoC incorporates a Flash cache to the ICode and DCode path from the microcontroller. This controller is intended to provide single cycle read access to Flash and reduce overall accesses to the Flash to reduce power. The controller is a unified ICode and DCode cache controller. The cache fill path is arbitrated between cache misses as well as the other Flash read agents (Info, Reg, BIST). Caching is supported for the entire 1 MB internal Flash and the 64 MB external Flash aperture (via MSPI). The cache is configurable 2-way set associative or direct mapped, 128b line size.

#### 3.10.3.0.1 Cache Operation

To enable the cache, software should write the CACHEDCFG register with the desired setting. The ENABLE field in this register will power up the cache SRAMs and initiate the cache startup sequence which will flush the cache RAMs. Once the sequence is complete (indicated by the CACHE\_READY bit in the CACHECTRL register), the cache will automatically begin servicing instruction and/or data fetches from the cache depending on the state of the ICACHE\_ENABLE and DCACHE\_ENABLE values. Software can choose to enable/disable these independently and they can be dynamically changed during operation. Additionally, the non-cachable region registers can be used to mark regions as non-cached, which supersedes the I/D enable bits and causes all fetches from within this range to be non-cached.

The cache will automatically flush data contents if flash is erased/programmed or if the primary cache enable bit is disabled. Additionally, software can invalidate the cache by writing the INVALIDATE bit of the CACHECTRL register. Since this register contains only status information (on reads) and activates controls based on bits set, there is no need to perform a read-modify-write.

For any mode changes, the cache should first be disabled by writing the ENABLE bit to 0, changing the configuration, then re-writing the enable bit to a 1.

### 3.10.3.0.2 Cache Performance Monitors

The cache also includes logic to monitor cache performance, which should be used in conjunction with the STIMER or CTIMER to determine elapsed time. The instruction and data buses have independent monitoring logic that keep counts of the following conditions:

- ACCESS\_COUNT - total number of reads performed on the bus
- LOOKUP\_COUNT - number of tag lookups performed
- HIT\_COUNT - number of tag lookups that result in a hit
- LINE\_COUNT - number of reads that were serviced from the line buffers (on a miss or non-cached access) or directly from the RAM because they fell within the same line as the previous lookup.

The LOOKUP and LINE counts should sum to the ACCESS COUNT and the number of cache misses can be calculated as LOOKUP\_COUNT - HIT\_COUNT.

#### NOTE

The DMONn and IMONn registers should be read with the cache monitor disabled (CACHECFG[ENABLE\_MONITOR] = 0x0).

Cache monitor counters will automatically freeze the counts when either of the access counters reaches a value of 0xFFFF0000 to prevent the counters from rolling over. The monitor counts can be reset at any time by writing the RESET\_STAT bit in the CACHECTRL register.

The monitors do not provide an indication of wait-states added to accesses, so the elapsed time should be used to infer this value (wait states are added as a result of cache misses or contention for the tag lookup if both buses require a simultaneous lookup).

### 3.10.3.1 CACHECTRL Registers

#### Flash Cache Controller

**INSTANCE 0 BASE ADDRESS:**0x40018000



### 3.10.3.1.1 Register Memory Map

**Table 218: CACHECTRL Register Map**

| Address(s) | Register Name | Description                            |
|------------|---------------|----------------------------------------|
| 0x40018000 | CACHECFG      | Flash Cache Control Register           |
| 0x40018004 | FLASHCFG      | Flash Control Register                 |
| 0x40018008 | CTRL          | Cache Control                          |
| 0x40018010 | NCR0START     | Flash Cache Noncachable Region 0 Start |
| 0x40018014 | NCR0END       | Flash Cache Noncachable Region 0 End   |
| 0x40018018 | NCR1START     | Flash Cache Noncachable Region 1 Start |
| 0x4001801C | NCR1END       | Flash Cache Noncachable Region 1 End   |
| 0x40018040 | DMON0         | Data Cache Total Accesses              |
| 0x40018044 | DMON1         | Data Cache Tag Lookups                 |
| 0x40018048 | DMON2         | Data Cache Hits                        |
| 0x4001804C | DMON3         | Data Cache Line Hits                   |
| 0x40018050 | IMON0         | Instruction Cache Total Accesses       |
| 0x40018054 | IMON1         | Instruction Cache Tag Lookups          |
| 0x40018058 | IMON2         | Instruction Cache Hits                 |
| 0x4001805C | IMON3         | Instruction Cache Line Hits            |

### 3.10.3.1.2 CACHEDCTRL Registers

#### 3.10.3.1.2.1 CACHEDCFG Register

##### Flash Cache Control Register

**OFFSET:** 0x00000000

**INSTANCE 0 ADDRESS:** 0x40018000

Flash Cache Control Register

**Table 219: CACHEDCFG Register**

|        |        |        |        |        |        |        |                |        |        |        |              |        |        |        |        |        |        |        |        |        |          |               |               |               |        |        |        |        |            |            |        |        |
|--------|--------|--------|--------|--------|--------|--------|----------------|--------|--------|--------|--------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|---------------|---------------|---------------|--------|--------|--------|--------|------------|------------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4         | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0       | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0   | 0<br>9        | 0<br>8        | 0<br>7        | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2     | 0<br>1     | 0<br>0 |        |
| RSVD   |        |        |        |        |        |        | ENABLE_MONITOR | RSVD   |        |        | DATA_CLKGATE | RSVD   |        |        |        |        |        |        |        |        | CACHE_LS | CACHE_CLKGATE | DCACHE_ENABLE | ICACHE_ENABLE | CONFIG |        |        |        | ENABLE_NC1 | ENABLE_NC0 | LRU    | ENABLE |

**Table 220: CACHEDCFG Register Bits**

| Bit   | Name           | Reset | RW | Description                                                                                                                                                                                                                                                                                                |
|-------|----------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:25 | RSVD           | 0x0   | RO | This bitfield is reserved for future use.                                                                                                                                                                                                                                                                  |
| 24    | ENABLE_MONITOR | 0x0   | RW | Enable Cache Monitoring Stats. Cache monitoring consumes additional power and should only be enabled when profiling code and counters will increment when this bit is set. Counter values will be retained when this is set to 0, allowing software to enable/disable counting for multiple code segments. |
| 23:21 | RSVD           | 0x0   | RO | This bitfield is reserved for future use.                                                                                                                                                                                                                                                                  |
| 20    | DATA_CLKGATE   | 0x1   | RW | Enable aggressive clock gating of entire data array. This bit should be set to 1 for optimal power efficiency.                                                                                                                                                                                             |
| 19:12 | RSVD           | 0x0   | RO | This bitfield is reserved for future use.                                                                                                                                                                                                                                                                  |
| 11    | CACHE_LS       | 0x1   | RW | Enable LS (light sleep) of cache RAMs. Software should DISABLE this bit since cache activity is too high to benefit from LS usage.                                                                                                                                                                         |
| 10    | CACHE_CLKGATE  | 0x1   | RW | Enable clock gating of cache TAG RAM. Software should enable this bit for optimal power efficiency.                                                                                                                                                                                                        |
| 9     | DCACHE_ENABLE  | 0x0   | RW | Enable Flash Data Caching.                                                                                                                                                                                                                                                                                 |
| 8     | ICACHE_ENABLE  | 0x0   | RW | Enable Flash Instruction Caching                                                                                                                                                                                                                                                                           |

| Bit | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                                                    |
|-----|------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:4 | CONFIG     | 0x5   | RW | Sets the cache configuration<br><br>W1_128B_512E = 0x4 - Direct mapped, 128-bit linesize, 512 entries (4 SRAMs active)<br>W2_128B_512E = 0x5 - Two-way set associative, 128-bit linesize, 512 entries (8 SRAMs active)<br>W1_128B_1024E = 0x8 - Direct mapped, 128-bit linesize, 1024 entries (8 SRAMs active) |
| 3   | ENABLE_NC1 | 0x0   | RW | Enable Non-cacheable region 1. See NCR1 registers to define the region.                                                                                                                                                                                                                                        |
| 2   | ENABLE_NC0 | 0x0   | RW | Enable Non-cacheable region 0. See NCR0 registers to define the region.                                                                                                                                                                                                                                        |
| 1   | LRU        | 0x0   | RW | Sets the cache replacement policy. 0=LRR (least recently replaced), 1=LRU (least recently used). LRR minimizes writes to the TAG SRAM.                                                                                                                                                                         |
| 0   | ENABLE     | 0x0   | RW | Enables the flash cache controller and enables power to the cache SRAMs. The ICACHE_ENABLE and DCACHE_ENABLE should be set to enable caching for each type of access.                                                                                                                                          |

## Flash Control Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |             |        |        |        |        |         |         |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|--------|--------|--------|--------|---------|---------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2      | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7  | 0<br>6  | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | LPMODE | LPM_RD_WAIT |        |        |        | RSVD   | SEDELAY | RD_WAIT |        |        |        |        |        |        |

| Bit   | Name | Reset | RW | Description                               |
|-------|------|-------|----|-------------------------------------------|
| 31:14 | RSVD | 0x0   | RO | This bitfield is reserved for future use. |

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                |
|-------|-------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13:12 | LPMMODE     | 0x0   | RW | Controls flash low power modes (control of LPM pin).<br><br>NEVER = 0x0 - High power mode (LPM not used).<br>STANDBY = 0x1 - Fast Standby mode. LPM deasserted for read operations, but asserted while flash IDLE.<br>ALWAYS = 0x2 - Low Power mode. LPM always asserted for reads. LPM_RD_WAIT must be programmed to accomodate longer read access times. |
| 11:8  | LPM_RD_WAIT | 0x8   | RW | Sets flash waitstates when in LPM Mode 2 (RD_WAIT in LPM mode 2 only)                                                                                                                                                                                                                                                                                      |
| 7     | RSVD        | 0x0   | RO | This bitfield is reserved for future use.                                                                                                                                                                                                                                                                                                                  |
| 6:4   | SEDELAY     | 0x7   | RW | Sets SE delay (flash address setup). A value of 5 is recommended.                                                                                                                                                                                                                                                                                          |
| 3:0   | RD_WAIT     | 0x3   | RW | Sets read waitstates for normal (fast) operation. A value of 1 is recommended.                                                                                                                                                                                                                                                                             |

## Cache Control

**INSTANCE 0 ADDRESS: 0x40018008**

## Cache Control

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |                   |                    |                   |        |                   |                    |                   |        |             |            |            |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------------|--------------------|-------------------|--------|-------------------|--------------------|-------------------|--------|-------------|------------|------------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0            | 0<br>9             | 0<br>8            | 0<br>7 | 0<br>6            | 0<br>5             | 0<br>4            | 0<br>3 | 0<br>2      | 0<br>1     | 0<br>0     |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | FLASH1_SLM_ENABLE | FLASH1_SLM_DISABLE | FLASH1_SLM_STATUS | RSVD   | FLASH0_SLM_ENABLE | FLASH0_SLM_DISABLE | FLASH0_SLM_STATUS | RSVD   | CACHE_READY | RESET_STAT | INVALIDATE |

| Bit   | Name | Reset | RW | Description                               |
|-------|------|-------|----|-------------------------------------------|
| 31:11 | RSVD | 0x0   | RO | This bitfield is reserved for future use. |

Table 224: CTRL Register Bits

| Bit | Name               | Reset | RW | Description                                                                                                                                                                                                         |
|-----|--------------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10  | FLASH1_SLM_ENABLE  | 0x0   | WO | Enable Flash Sleep Mode. Write to 1 to put flash 1 into sleep mode. NOTE: there is a 5us latency after waking flash until the first access will be returned.                                                        |
| 9   | FLASH1_SLM_DISABLE | 0x0   | WO | Disable Flash Sleep Mode. Write 1 to wake flash1 from sleep mode (reading the array will also automatically wake it).                                                                                               |
| 8   | FLASH1_SLM_STATUS  | 0x0   | RO | Flash Sleep Mode Status. 1 indicates that flash1 is in sleep mode, 0 indicates flash1 is in normal mode.                                                                                                            |
| 7   | RSVD               | 0x0   | RO | This bitfield is reserved for future use.                                                                                                                                                                           |
| 6   | FLASH0_SLM_ENABLE  | 0x0   | WO | Enable Flash Sleep Mode. Write to 1 to put flash 0 into sleep mode. NOTE: there is a 5us latency after waking flash until the first access will be returned.                                                        |
| 5   | FLASH0_SLM_DISABLE | 0x0   | WO | Disable Flash Sleep Mode. Write 1 to wake flash0 from sleep mode (reading the array will also automatically wake it).                                                                                               |
| 4   | FLASH0_SLM_STATUS  | 0x0   | RO | Flash Sleep Mode Status. 1 indicates that flash0 is in sleep mode, 0 indicates flash0 is in normal mode.                                                                                                            |
| 3   | RSVD               | 0x0   | RO | This bitfield is reserved for future use.                                                                                                                                                                           |
| 2   | CACHE_READY        | 0x0   | RO | Cache Ready Status (enabled and not processing an invalidate operation)                                                                                                                                             |
| 1   | RESET_STAT         | 0x0   | WO | Reset Cache Statistics. When written to a 1, the cache monitor counters will be cleared. The monitor counters can be reset only when the CACHECFG.ENABLE_MONITOR bit is set.<br><br>CLEAR = 0x1 - Clear Cache Stats |
| 0   | INVALIDATE         | 0x0   | WO | Writing a 1 to this bitfield invalidates the flash cache contents.                                                                                                                                                  |

**3.10.3.1.2.4NCR0START Register****Flash Cache Noncachable Region 0 Start****OFFSET:** 0x00000010**INSTANCE 0 ADDRESS:** 0x40018010

Flash Cache Noncachable Region 0 Start

Table 225: NCR0START Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        | ADDR   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | RSVD   |        |        |        |        |

| Bit   | Name | Reset | RW | Description                               |
|-------|------|-------|----|-------------------------------------------|
| 31:27 | RSVD | 0x0   | RO | This bitfield is reserved for future use. |
| 26:4  | ADDR | 0x0   | RW | Start address for non-cacheable region 0  |
| 3:0   | RSVD | 0x0   | RO | This bitfield is reserved for future use. |

## Flash Cache Noncachable Region 0 End

|      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |   |   |   |   |
|------|---|---|---|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2    | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0    | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7    | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3    | 2 | 1 | 0 | 0 |   |
| RSVD |   |   |   | ADDR |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | RSVD |   |   |   |   |   |

| Bit   | Name | Reset | RW | Description                               |
|-------|------|-------|----|-------------------------------------------|
| 31:27 | RSVD | 0x0   | RO | This bitfield is reserved for future use. |
| 26:4  | ADDR | 0x0   | RW | End address for non-cacheable region 0    |
| 3:0   | RSVD | 0x0   | RO | This bitfield is reserved for future use. |

## Flash Cache Noncachable Region 1 Start

|      |   |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |   |   |   |   |   |   |
|------|---|---|---|---|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2    | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0    | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6    | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6    | 5 | 4 | 3 | 2 | 1 | 0 |   |
| RSVD |   |   |   |   | ADDR |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | RSVD |   |   |   |   |   |   |   |

| Bit   | Name | Reset | RW | Description                               |
|-------|------|-------|----|-------------------------------------------|
| 31:27 | RSVD | 0x0   | RO | This bitfield is reserved for future use. |
| 26:4  | ADDR | 0x0   | RW | Start address for non-cacheable region 1  |
| 3:0   | RSVD | 0x0   | RO | This bitfield is reserved for future use. |

## Flash Cache Noncachable Region 1 End

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |  |
| RSVD   |        |        |        |        | ADDR   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | RSVD   |        |        |        |  |

| Bit   | Name | Reset | RW | Description                               |
|-------|------|-------|----|-------------------------------------------|
| 31:27 | RSVD | 0x0   | RO | This bitfield is reserved for future use. |
| 26:4  | ADDR | 0x0   | RW | End address for non-cacheable region 1    |
| 3:0   | RSVD | 0x0   | RO | This bitfield is reserved for future use. |

**OFFSET:** 0x00000040











### 3.10.3.2 Flash Memory Controller

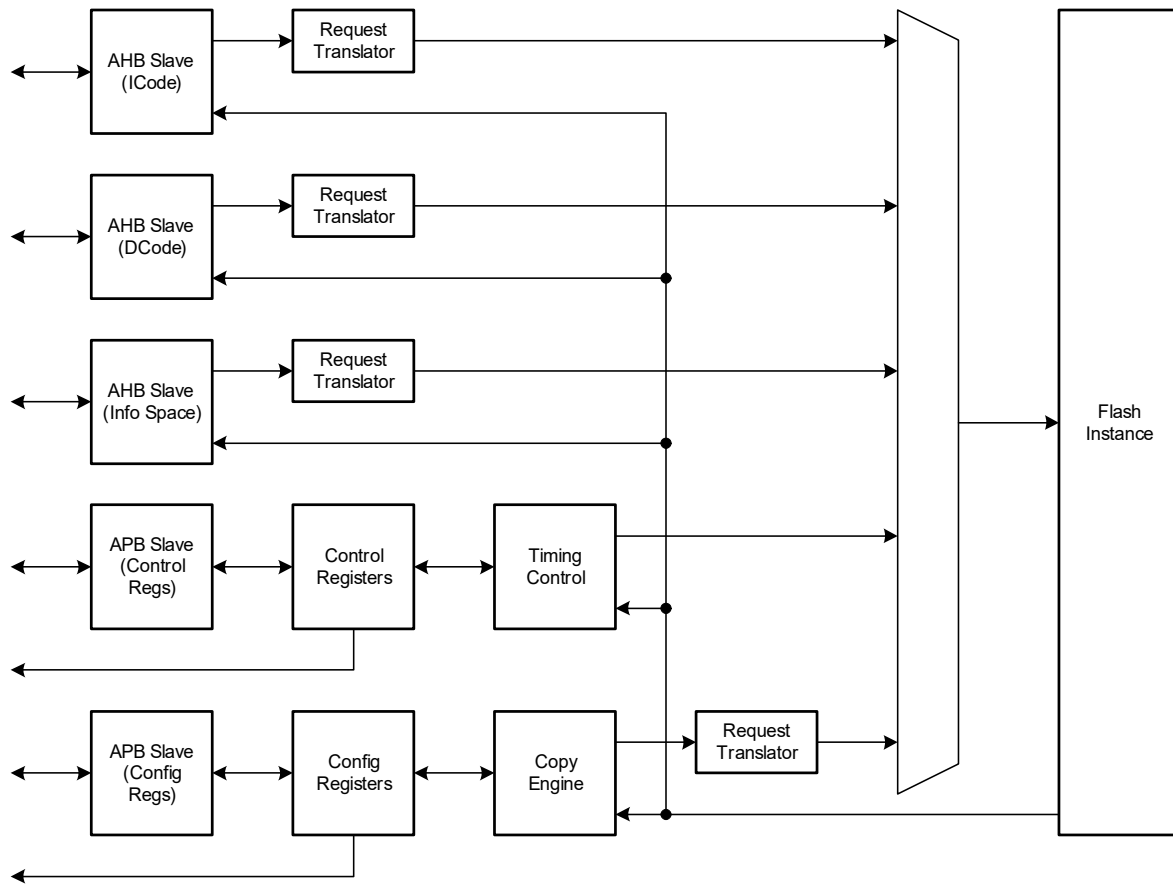


Figure 6. Block diagram for the Flash Memory Controller

#### 3.10.3.2.1 Functional Overview

During normal MCU code execution, the Flash Memory Controller translates requests from the CPU core (via the Flash cache) to the Flash Memory instance for instruction and data fetches. The Controller is designed to return data to the cache in single wait-state and can operate up to the maximum operating frequency of half the CPU core frequency.

The Controller facilitates flash erase and programming operations through the control registers. When erase or programming operations are active, data cannot be fetched from the Flash memory. This will be naturally handled by the cache controller fill logic to stall until the program operation is complete and the Flash device is available. With the cache enabled, this collision should happen very infrequently.

Another function of the Controller is to capture the configuration values which are distributed to the various on-chip peripherals of the MCU at chip power-up. These are read from the Information Space of the Flash Memory and captured in registers to be used by the other peripherals. The configuration values are reloaded each time a full-chip POI cycle occurs.

**NOTE**

A Flash page size is 8 KB, which is the minimum size that can be erased. An erase cycle will set all the bits in the Flash page to 1's and bits can be programmed only to a zero state. The same 32-bit word can be programmed a maximum of 4 times, otherwise data corruption or retention issues may appear within the word line. The AmbiqSuite SDK provides a "modify" function to help with this.

**NOTE**

The number of individual word-size programming cycles performed per word line (512 bytes) should be limited to no more than 160 before an erase. Full-line programming of the entire 512-byte word line is faster and less stressful such that programming all 512 bytes in a single transaction counts as only 60 individual writes. Therefore, following a full-line programming of all 512 bytes, no more than an additional 100 word-programming operations can be performed before an erase is required. Doing more than the specified number of program cycles to the same line before an erase operation may cause data corruption or retention issues within the word line.

### 3.10.4 SRAM Interface

#### 3.10.4.1 Functional Overview

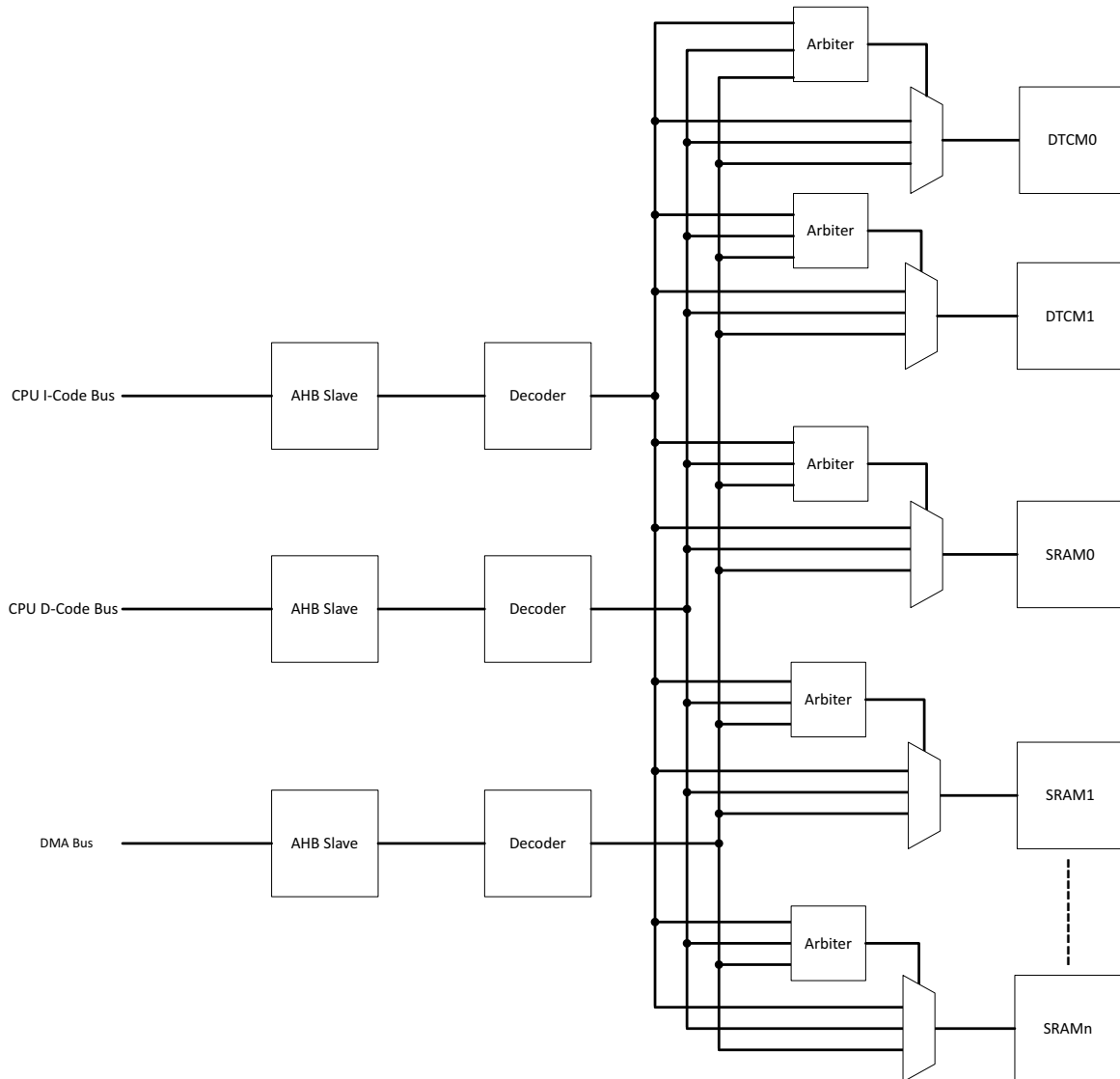


**Figure 7. Block diagram for the SRAM Interface**

The SRAM Interface translates requests from the CPU core and DMA controllers to the SRAM Memory Instances for instruction and data fetches. The SRAM interface is designed to return data in zero wait-states and can operate up to the maximum operating frequency of the CPU core. On Apollo3, the DTCM banks are guaranteed to be zero wait-state unless there is contention for that specific memory array with another requester (CPU I/D Bus or DMA Bus). The Main SRAM banks are zero wait-state for sequential accesses or 1-wait state for non-sequential accesses for I/D Bus accesses unless there is contention for that specific memory array with another requester (CPU I/D Bus or DMA Bus). DMA accesses to Main

SRAM are always 0-wait state unless there is contention for that specific memory array. Prefetching is used on the I/D Bus accesses to Main SRAM to minimize/eliminate wait-state bubbles. Prefetching can be enabled/disabled for I and/or D Bus accesses.

The Interface contains arbitration logic for each SRAM instance which allows one of 2 bus slaves access to the SRAM on any given cycle.

Figure 7 shows a logical block diagram of the SRAM Interface, where  $n = 9$  for this MCU.

## 4. Security

### 4.1 Functional Overview

The security features on the Apollo3 Blue MCU Family enable a trusted firmware model which is critical for wearables and general Internet of Things (IoT) devices. Unless otherwise noted, the following information for the Apollo3 Blue is equally applicable to the Apollo3 and the Apollo3 Blue Plus.

The Apollo3 Blue establishes a Root-of-Trust, leveraging hardware and secure firmware to maintain this secure foundation throughout the device boot/reset flow which is based on the Ambiq SecureSPOT™ technology. To ensure a full end-to-end security model, the Apollo3 Blue not only supports a secure/trusted boot flow but also supports secure firmware updates (wired or OTA), secure key storage and provisioning, secure in-field feature upgrades, debug policy enforcement, Flash memory protection, as well as inline scrambling/descrambling for external memory interface.

Specifically, the Apollo3 Blue SoC supports the following security features:

- Secure Keybank with Key wrapping and revocation support
- Secure over-the-air (OTA) updates with support for:
  - Integrity check
  - Authentication
  - Decryption
  - Anti-rollback support
- Wired interface support for secure programming/update
- Image protections (copy and write protection) in the main flash
- External Flash In-line Encrypt/Decrypt support
- Recovery (factory reset)

More details on the Apollo3 family security features are described in the Ambiq Apollo3 Blue Security white paper.

See “Flash OTP INSTANCE0 INFO0 Words” on page 835.



## 4.2 Standard Boot

The boot loader for standard boot on the Apollo3 Blue SoC is a reliable boot-up process performed upon installation and boot/reset, and provides firmware recovery and OTA update support.

A high level flow diagram of the standard boot process is illustrated in Figure 8.

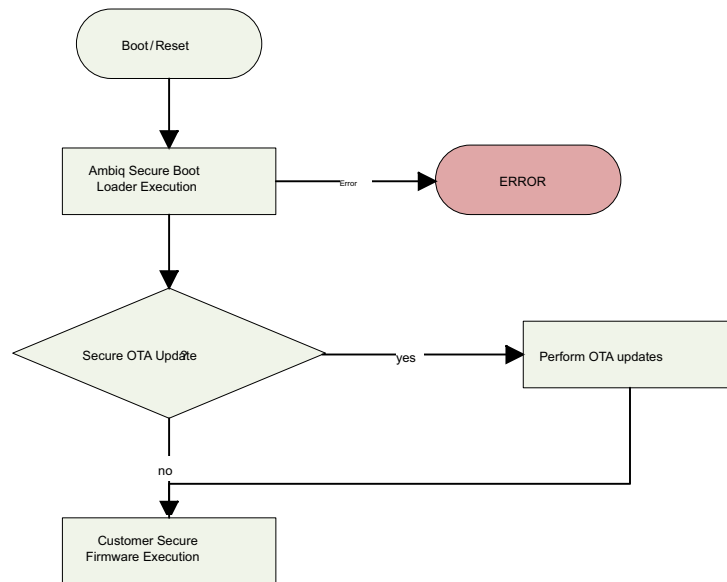


**Figure 8. Standard Boot Flow**

### 4.3 Secure OTA

The Apollo3 Blue SoC supports secure OTA leveraging the Ambiq secure boot loader. Customers can update any firmware component securely as directed via the security policy configuration in OTP.

The basic flow is shown in Figure 9.

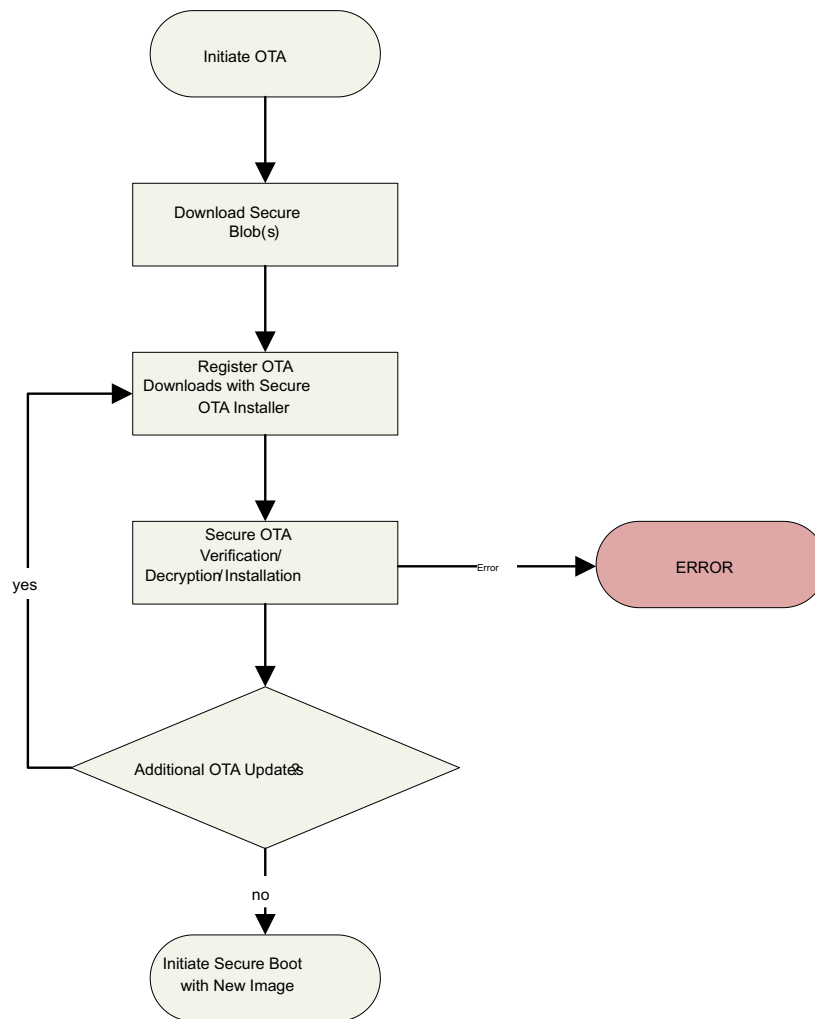


**Figure 9. Secure OTA Flow**

### 4.4 Secure Key Storage

Key Storage is managed in hardware and provides secure access to keys as needed to support secure boot as well as any other runtime security operation. A customer key bank is provided and can be provisioned and allocated as required to support various configurations.

It may also be necessary to initiate key revocation in the event a particular key is compromised, stale or needing to be refreshed. The Apollo3 Blue SoC provides key revocation for customer key bank keys as needed. The number of key revocations supported is dependent on the length of keys required and the partitioning/allocation of the key bank.

## 4.5 External Flash In-line Encrypt/Decrypt

External flash is supported on Apollo3 Blue SoC via the MSPI controller interface. The MSPI controller supports in-line encrypt/decrypt to enable customers to securely store firmware or any other secure image data in external flash without concern of the firmware/data confidentiality being compromised.

The Ambiq secure in-line encrypt/decrypt provides robust, high performance and extremely low power protection for external flash contents. Ambiq's in-line encrypt/decrypt enables truly in-line capability that does not degrade performance when accessing external flash.

For more details on the in-line support, See "MSPI Master Module" on page 226.

## 5. DMA

### 5.1 Functional Overview

The Apollo3 Blue SoC supports DMA capability for the following peripheral controllers:

- SPI Master
- I<sup>2</sup>C Master
- PDM
- ADC
- MSPI
- Bluetooth Low Energy Controller
- Security

DMA is supported from peripheral to SRAM and SRAM/flash to peripheral. DMA transactions to/from SRAM occur concurrently to CPU instruction/data accesses as long as the accesses are to different physical banks of memory. Accesses to the same physical bank are arbitrated in hardware. Similarly, accesses to flash occur concurrently to other DMA transactions to SRAM. CPU accesses (via cache miss or uncacheable access) are arbitrated with DMA accesses in hardware. There is hardware support to manage DMA request arbitration, physical memory resource arbitration, clocking and power management.

DMA configuration is programmed via the respective peripheral controller interface. Each peripheral has the same DMA capability with some minor exceptions where peripheral specific behavior is required. For example, for configuring the DMA transaction trigger, there are different trigger options for each peripheral depending on the mode of operation.

### 5.2 General Usage

The DMA controller is enabled at reset and no chip-level initialization is required (DMA may be disabled by clearing the DMA\_ENABLE bit in the APBDMACTRL register in the CONTROL register block). The DMA controller automatically manages byte-aligned addresses in memory and non-word transfer lengths. While peripherals have the ability to DMA large blocks of data to/from memory, individual DMA transfers are performed at a granularity of 1-16 bytes per transfer.

To utilize DMA, software should program the peripheral's DMA control registers to enable data transfer to/from the FIFOs that would normally have been done by software. DMA-capable peripherals have been updated with additional interrupts to notify software of transfer and DMA completion events. Each peripheral also has the following common registers:

- DMATARGADDR: Specifies the SRAM or flash address for the start of the transfer. As the transfer proceeds, the peripheral will update this address to track the current DMA location in memory.
- DMATOTCOUNT: Specifies the total number of bytes to be transferred to/from memory. This value will also decrement throughout the transfer.
- DMABCOUNT: Specifies the DMA "burst" size or number of bytes to be transferred each time a DMA access is triggered in the peripheral. For most optimal efficiency, this should be set to 16 or 32 bytes which would correspond to one or two actual transactions to memory.

Each peripheral also has registers to control when DMA transfers are initiated. Upon reaching the DMA threshold, the device will request a DMA transfer and the DMA engine will perform the required number of read/write operations to move the data to/from SRAM or flash memory. Peripherals will typically issue multiple DMA read/write operations to complete a longer DMA transfer and each peripheral has a few configuration options to help software manage the flow of data. For instance, a peripheral with a 16-word FIFO might be configured to transfer 4 words each time the FIFO reaches 4 entries while the CPU is awake in order to flush data as quickly as possible while during periods of deep-sleep, the peripheral may be configured to transfer 8-12 words at a time once the FIFO reaches 12-16 entries in order to minimize the wake time of the SRAM banks.

### 5.3 Auto Power Down

The DMA-capable peripherals can be configured to automatically power down the respective peripheral device once the total DMA transaction is complete. This feature is particularly useful in cases where a device transaction can be queued up allowing the CPU to go into deep sleep while the transaction completes which could take a long time depending on the data rate of the device and/or the trigger conditions for sending/receiving data.

The auto power down mode is fully autonomous where not only is the peripheral device powered down but any associated memory is also replaced back into its lowest power state as applicable. The auto power down mode is enabled in the DMA\_CFG register of the respective peripheral device register space.

### 5.4 Priority

Each DMA agent can be assigned a high priority or a “best effort” priority. This allows software to ensure a certain quality of service as required for the particular peripheral depending on the use case requirements. The peripheral also has safeguards to auto promote priority if its corresponding trigger levels are approaching critical levels. This is to ensure the respective peripheral does not overflow/underflow.

The priority settings as well as the auto promote feature are enabled in the DMA\_CFG register of the respective peripheral device register space.

### 5.5 Hardware Handshake / Hardware Triggering

The IOM, Bluetooth Low Energy Controller and MSPI peripherals include handshaking to allow coordination of data flow between the peripherals and system memory without CPU involvement by using the command queuing support in the peripheral. See the respective peripheral sections for details regarding command queuing and hardware triggering.

## 6. Bluetooth Low Energy Controller

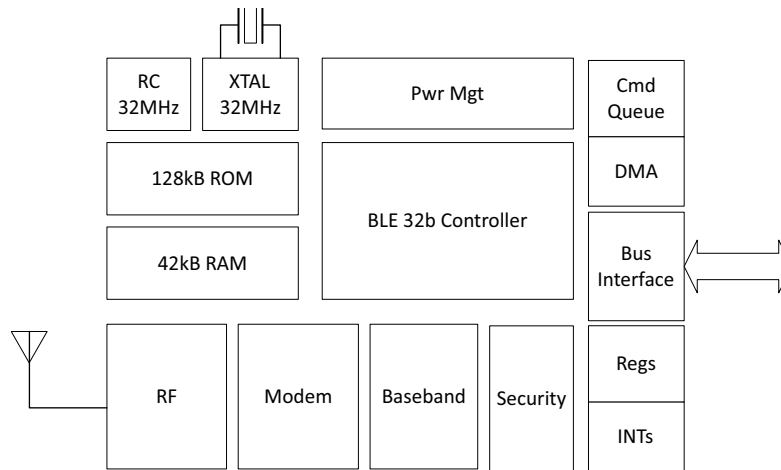


Figure 10. Block Diagram for the Bluetooth Low Energy Controller

### 6.1 Functional Overview

#### 6.1.1 Introduction

The Apollo3 Blue SoC includes a low power Bluetooth low energy subsystem. The Bluetooth Low Energy Controller, referred to throughout as BLE or BLEC, and host can be configured to support up to seven simultaneous connections on chip revision A1 (4 on chip revision B0). Secure connections and extended packet length are also supported.

The subsystem contains a 2.4 GHz RF transceiver, modem, baseband and 32-bit processor. It supports an external 32 MHz crystal clock source as well as an internal 32 MHz RC oscillator clock source. The 32 MHz crystal is required as the frequency reference for the radio and also as the main clock source for the controller blocks. The internal 32 MHz RC can be used as a clock source for the RF processor if the requirements allow for lower precision and lower power operation. Driving an active clock into BLE crystal pins is not supported, as the crystal pins do not support active components.

The subsystem provides a Host Controller Interface (HCI) to the host.

#### 6.1.2 Main Features

The highlighted features of the Bluetooth Low Energy Controller are as follows:

##### Bluetooth 5 Low Energy Technology

- Full on-chip HCI Transport Layer
- Up to seven (7) simultaneous connections supported on chip revision A1 (4 simultaneous connections supported starting with chip revision B0)
- Extended PDU length and enhanced security
- AES-128 Hardware Encryption Engine

##### Secure Firmware Over-the-Air Updating

- Per application, function or configuration

##### High Performance RF

- -93 dBm Bluetooth low energy transceiver sensitivity, selectivity and blocking performance

- -10 to +3 dBm transmitter output power range
- External Power Amplifier support
- Integrated Balun and antenna matching network

## 6.2 Functional Description

The Bluetooth Low Energy subsystem is a fully integrated system providing autonomous clock and power management. The subsystem is accessed via the BLE interface block. Software leverages the fully HCI compliant interface for Bluetooth operation. A series of proprietary HCI commands are also leveraged to provide additional performance and low power operation.

The BLE subsystem must first be enabled by issuing an enable to the BLEREQ field of the Feature Enable Register (Section 3.9.2.7 on page 136). The device is then enabled by setting the BLEL controller device enable field in the power controller device register (DEVPWREN Register in System Core chapter). Once the BLEL domain is powered up through the BLEL enable, software can enable the power state machine within the BLE interface module to allow the BLEH power domain to be activated.

Communication between the BLE core and the MCU is done through the BLE interface (BLEIF) module. This module uses a similar interface as the IOM module. This module will facilitate the data transfer to and from the BLE core and supports direct and DMA data transfer mechanisms. The module also contains the power sequencing logic to control the power domains used for the BLE Core. This logic will control the initial power on, as well as power down of domains during sleep mode automatically.

The BLEIF contains flow control mechanisms that allow write transactions under control of the BSTATUS signal from the BLE core, and will similarly gate read transactions using the BLEIRQ signal from the BLE Core. These are enabled via the BLEIF\_MSPICFG register fields of RDFC and WTFC.

The BLE subsystem will automatically enter into a low power sleep mode when no active commands are issued and no active TX/RX events.

### 6.2.1 Data Transfers

Data transfers to and from the BLE core are done using HCI packets. The HCI packet structure is used for both data input and output. For event frames read from the BLE Core, an optional mode is available to prepend a 2 byte length to the start of the packet. This mode is enabled with a vendor specific command.

The HCI commands and packet formats are detailed in the Bluetooth specification, version 4.2, volume 2, part E, sections 7.8.1 through 7.8.46 (LE Controller commands). Additional vendor specific commands are also available for operations such as setting the frame mode, setting sleep mode and other BLE Core specific commands.

#### 6.2.1.1 DMA data transfers

DMA transfers are enabled by configuring the DMA related registers, enabling the DMA channel, and then issuing the command. The command will automatically fetch and store the data associated with the command without MCU intervention. The DMA channel is enabled via the DMAEN field in the BLEIF\_DMCFG register. P2M DMA operations transfer data from peripheral to memory, and are used in BLEIF READ operations. M2P DMA operations transfer data from memory to peripheral, and are used in BLEIF write operations. DMA transfer size is programmed into the BLEIF\_DMATOTCOUNT register and supports up to 4095 bytes of data transfer. The DMA transfer size is independent from the transaction size, and allows a single DMA setting to be used across multiple commands. The direction of DMA data transfer must match the command. The DMAEN field in the BLEIF\_DMCFG register enables/disables the DMA transfer capability and must be set last when configuring the DMA, generally prior to sending the command.

The DMA engine within the module will initiate a transfer of data when a trigger event occurs. There are 2 type of triggers available, threshold (THR) and command completion (CMDCMP). The THR trigger will

activate when the threshold programmed into the FIFOWTHR or FIFORTH in the BLEIF\_FIFOTH register meets the data criteria. Because the MCU access to the interface is 32b wide, only the word count of the selected THR is used, and the low order bits of the FIFOWTHR or FIFORTH are ignored.

During the transfer, the TOTCOUNT register is decremented to reflect the number of bytes transferred.

For BLE write operations (data written from BLEIF into the BLE Core), the THR trigger will activate when the write FIFO contains FIFOWTHR[5:2] free words. If the remaining DMA transfer size is less than this, only the needed number of words are transferred.

For BLE read operations (data read from BLE Core from the BLEIF), the THR trigger will activate when the read FIFO contains FIFORTH[5:2] words of valid data. If the remaining DMA transfer size is less than the RTHR words, then the CMDCMP trigger can be enabled to transfer the remaining data. If the CMDCMP trigger is disabled, and the number of bytes in the read FIFO is greater to or equal to the current TOTCOUNT, a DMA transfer of TOTCOUNT will be done to complete the DMA operation. Note that this mode requires that the THR trigger be enabled as well.

The CMDCMP trigger activates when the command is complete, and will transfer the lesser of the TOTCOUNT or the number of bytes in the read FIFO. Note, this trigger is not needed for write operations, and the THR trigger should be used in this case. If a read operation is done, and the THR trigger is disabled, and only the CMDCMP trigger is enabled, and the transaction size is greater than the FIFO size (32 bytes), the module will hang, as there is not trigger to cause a DMA operation, and the logic will pause the interface until there is room within the read FIFO to store data.

If DMA transfer size is matched to the BLEIF transaction size, it is recommended to program both the FIFORTH and FIFOWTHR to 0x10 (16 bytes) and only enable the THR trigger.

#### **6.2.1.2 Command Queue**

The BLEIF module can also fetch register write data from SRAM or FLASH, and update the registers as if the write was performed via the MCU. Register data is stored as a doublet of 2 words. The first word is the register address offset, word aligned. The second word is the write data value. Once enabled, the command queue (CQ) will fetch the address, and perform a write to the register. If no command is started by the register write, the next doublet will be fetched by the CQ. If a command is started, the transaction will run, and the CQ will continue fetching when the module is idle. No pre-fetching is done via the CQ, and the register write operations are performed in series with the transactions. This allows a predictable path for execution of commands.

## **6.3 BLEIF Registers**

### **BLE Interface**

**INSTANCE 0 BASE ADDRESS:**0x5000C000

Registers associated with the BLE Core interface module. The BLEIF module is used to interface with the embedded BLE Core module and supports read and write transactions to the BLE Core. It also contains the power sequencing control which will switch the BLEH power to the BLE core when needed. The registers control the speed of the interface, mode of operation and other parameters for the transaction. It is recommended to run at 16MHz with a mode of 3 on the SPI interface. Prior to use and access, the BLE module domain must be powered up through registers within the power control module. Once powered, the power state machine must be enabled to allow power control of the BLE Core module



### 6.3.1 Register Memory Map

**Table 249: BLEIF Register Map**

| Address(s) | Register Name | Description                                                                                                                      |
|------------|---------------|----------------------------------------------------------------------------------------------------------------------------------|
| 0x5000C000 | FIFO          | FIFO Access Port                                                                                                                 |
| 0x5000C100 | FIFOPTR       | FIFO size and remaining slots open values                                                                                        |
| 0x5000C104 | FIFOTHR       | FIFO Threshold Configuration                                                                                                     |
| 0x5000C108 | FIFOPOP       | FIFO POP register                                                                                                                |
| 0x5000C10C | FIFOPUSH      | FIFO PUSH register                                                                                                               |
| 0x5000C110 | FIFOCTRL      | FIFO Control Register                                                                                                            |
| 0x5000C114 | FIFOLOC       | FIFO Pointers                                                                                                                    |
| 0x5000C200 | CLKCFG        | I/O Clock Configuration                                                                                                          |
| 0x5000C20C | CMD           | Command and offset Register                                                                                                      |
| 0x5000C210 | CMDRPT        | Command Repeat Register                                                                                                          |
| 0x5000C214 | OFFSETHI      | High order offset bytes                                                                                                          |
| 0x5000C218 | CMDSTAT       | Command status                                                                                                                   |
| 0x5000C220 | INTEN         | IO Master Interrupts: Enable                                                                                                     |
| 0x5000C224 | INTSTAT       | IO Master Interrupts: Status                                                                                                     |
| 0x5000C228 | INTCLR        | IO Master Interrupts: Clear                                                                                                      |
| 0x5000C22C | INTSET        | IO Master Interrupts: Set                                                                                                        |
| 0x5000C230 | DMATRIGEN     | DMA Trigger Enable Register                                                                                                      |
| 0x5000C234 | DMATRIGSTAT   | DMA Trigger Status Register                                                                                                      |
| 0x5000C238 | DMACFG        | DMA Configuration Register                                                                                                       |
| 0x5000C23C | DMATOTCOUNT   | DMA Total Transfer Count                                                                                                         |
| 0x5000C240 | DMATARGADDR   | DMA Target Address Register                                                                                                      |
| 0x5000C244 | DMASTAT       | DMA Status Register                                                                                                              |
| 0x5000C248 | CQCFG         | Command Queue Configuration Register                                                                                             |
| 0x5000C24C | CQADDR        | CQ Target Read Address Register                                                                                                  |
| 0x5000C250 | CQSTAT        | Command Queue Status Register                                                                                                    |
| 0x5000C254 | CQFLAGS       | Command Queue Flag Register                                                                                                      |
| 0x5000C258 | CQSETCLEAR    | Command Queue Flag Set/Clear Register                                                                                            |
| 0x5000C25C | CQPAUSEEN     | Command Queue Pause Enable Register                                                                                              |
| 0x5000C260 | CQCURIDX      | IOM Command Queue current index value. Compared to the CQENDIDX reg contents to generate the IDXEQ Pause event for command queue |
| 0x5000C264 | CQENDIDX      | IOM Command Queue current index value. Compared to the CQCURIDX reg contents to generate the IDXEQ Pause event for command queue |
| 0x5000C268 | STATUS        | IOM Module Status Register                                                                                                       |
| 0x5000C300 | MSPICFG       | SPI module master configuration                                                                                                  |
| 0x5000C304 | BLECFG        | BLE Core Control                                                                                                                 |

**Table 249: BLEIF Register Map**

| Address(s) | Register Name | Description                 |
|------------|---------------|-----------------------------|
| 0x5000C308 | PWRCMD        | BLE Power command interface |
| 0x5000C30C | BSTATUS       | BLE Core status             |
| 0x5000C410 | BLEDBG        | BLEIF Master Debug Register |



| Bit   | Name     | Reset | RW | Description                                                                                      |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------|
| 31:24 | FIFO1REM | 0x0   | RO | The number of remaining data bytes slots currently in FIFO 1 (written by interface, read by MCU) |
| 23:16 | FIFO1SIZ | 0x0   | RO | The number of valid data bytes currently in FIFO 1 (written by interface, read by MCU)           |
| 15:8  | FIFO0REM | 0x0   | RO | The number of remaining data bytes slots currently in FIFO 0 (written by MCU, read by interface) |
| 7:0   | FIFO0SIZ | 0x0   | RO | The number of valid data bytes currently in the FIFO 0 (written by MCU, read by interface)       |

## FIFO Threshold Configuration

**INSTANCE 0 ADDRESS: 0x5000C104**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |         |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3   | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8  | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | FIFOWTHR |        |        |        | RSVD   | FIFORTH |        |        |        |        |        |        |        |        |

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:14 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 13:8  | FIFOWTHR | 0x0   | RW | FIFO write threshold in bytes. A value of 0 will disable the write FIFO level from activating the threshold interrupt. If this field is non-zero, it will trigger a threshold interrupt when the write FIFO contains FIFOWTHR free bytes, as indicated by the FIFO0REM field. This is intended to signal when a transfer of FIFOWTHR bytes can be done from the host to the IOM write FIFO to support large IOM write operations. |
| 7:6   | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                          |

| Bit | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----|---------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5:0 | FIFORTH | 0x0   | RW | FIFO read threshold in bytes. A value of 0 will disable the read FIFO level from activating the threshold interrupt. If this field is non-zero, it will trigger a threshold interrupt when the read FIFO contains FIFORTH valid bytes of data, as indicated by the FIFO1SIZ field. This is intended to signal when a data transfer of FIFORTH bytes can be done from the IOM module to the host via the read FIFO to support large IOM read operations. |

## FIFO POP register

**INSTANCE 0 ADDRESS: 0x5000C108**

Will advance the internal read pointer of the incoming FIFO (FIFO1) when read, if POPWR is not active. If POPWR is active, a write to this register is needed to advance the internal FIFO pointer.

|          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3        | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1        | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FIFODOUT |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name     | Reset | RW | Description                                                                                                                                                                                                                         |
|------|----------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | FIFODOUT | 0x0   | RW | This register will return the read data indicated by the current read pointer on reads. If the POPWR control bit in the FIFOCTRL register is reset (0), the FIFO read pointer will be advanced by one word as a result of the read. |

## FIFO PUSH register

**INSTANCE 0 ADDRESS: 0x5000C10C**

Will write new data into the outgoing FIFO and advance the internal write pointer.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FIFODIN |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name    | Reset | RW | Description                                                                                                                                                                                                                 |
|------|---------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | FIFODIN | 0x0   | RW | This register is used to write the FIFORAM in FIFO mode and will cause a push event to occur to the next open slot within the FIFORAM. Writing to this register will cause the write point to increment by 1 word(4 bytes). |

Provides controls for the operation of the internal FIFOs. Contains fields used to control the operation of the POP register, and also controls to reset the internal pointers of the FIFOs.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2   | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | FIFORSTN | POPWR  |        |

| Bit  | Name     | Reset | RW | Description                                                                                                                                                                                                        |
|------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:2 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                           |
| 1    | FIFORSTN | 0x1   | RW | Active low manual reset of the FIFO. Write to 0 to reset FIFO, and then write to 1 to remove the reset.                                                                                                            |
| 0    | POPWR    | 0x0   | RW | Selects the mode in which 'pop' events are done for the FIFO read operations. A value of '1' will prevent a pop event on a read operation, and will require a write to the FIFOPOP register to create a pop event. |

Provides a read only value of the current read and write pointers. This register is read only and can be used along with the FIFO direct access method to determine the next data to be used for input and output functions.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |      |   |          |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|------|---|----------|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1        | 1 | 0    | 0 | 0        | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3        | 2 | 1    | 0 | 9        | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | FIFORPTR |   | RSVD |   | FIFOWPTR |   |   |   |   |   |   |   |   |   |

| Bit   | Name     | Reset | RW | Description                                                                                                                                                       |
|-------|----------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:12 | RSVD     | 0x0   | RO | Reserved                                                                                                                                                          |
| 11:8  | FIFORPTR | 0x0   | RW | Current FIFO read pointer. Used to index into the incoming FIFO (FIFO1), which is used to store read data returned from external devices during a read operation. |
| 7:4   | RSVD     | 0x0   | RO | Reserved                                                                                                                                                          |
| 3:0   | FIFOWPTR | 0x0   | RW | Current FIFO write pointer. Value is the index into the outgoing FIFO (FIFO0), which is used during write operations to external devices.                         |

Provides clock related controls used internal to the BLEIF module, and enablement of 32KHz clock to the BLE Core module. The internal clock sourced is selected via the FSEL and can be further divided by 3 using the DIV3 control.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |        |        |        |        |        |         |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1   | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1  | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DIV3   | CLK32KEN | FSEL   | RSVD   |        |        |        |        |        |        |        | IOCLKEN |        |

Table 265: CLKCFG Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 12    | DIV3     | 0x0   | RW | Enable of the divide by 3 of the source IOCLK.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 11    | CLK32KEN | 0x0   | RW | Enable for the 32Khz clock to the BLE module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 10:8  | FSEL     | 0x0   | RW | Select the input clock frequency.<br><br>MIN_PWR = 0x0 - Selects the minimum power clock. This setting should be used whenever the IOM is not active.<br>HFRC = 0x1 - Selects the HFRC as the input clock.<br>HFRC_DIV2 = 0x2 - Selects the HFRC / 2 as the input clock.<br>HFRC_DIV4 = 0x3 - Selects the HFRC / 4 as the input clock.<br>HFRC_DIV8 = 0x4 - Selects the HFRC / 8 as the input clock.<br>HFRC_DIV16 = 0x5 - Selects the HFRC / 16 as the input clock.<br>HFRC_DIV32 = 0x6 - Selects the HFRC / 32 as the input clock.<br>HFRC_DIV64 = 0x7 - Selects the HFRC / 64 as the input clock. |
| 7:1   | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 0     | IOCLKEN  | 0x0   | RW | Enable for the interface clock. Must be enabled prior to executing any IO operations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

### 6.3.2.9 CMD Register

#### Command and offset Register

**OFFSET:** 0x0000020C

**INSTANCE 0 ADDRESS:** 0x5000C20C

Writes to this register will start an IO transaction, as well as set various parameters for the command itself. Reads will return the command value written to the CMD register.

Table 266: CMD Register

|          |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |        |        |        |        |        |        |        |        |
|----------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1   | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3  | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| OFFSETLO |        |        |        |        |        |        |        | RSRVD54 | CMDSEL | TSIZE  |        |        |        |        |        |        |        |        |        |        |        | CONT   | OFFSETCNT | CMD    |        |        |        |        |        |        |        |



| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                  |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:24 | OFFSETLO  | 0x0   | RW | This register holds the low order byte of offset to be used in the transaction. The number of offset bytes to use is set with bits 1:0 of the command. Offset bytes are transferred starting from the highest byte first.                    |
| 23:22 | RSRVD54   | 0x0   | RO | Reserved                                                                                                                                                                                                                                     |
| 21:20 | CMDSEL    | 0x0   | RW | Command Specific selection information                                                                                                                                                                                                       |
| 19:8  | TSIZE     | 0x0   | RW | Defines the transaction size in bytes. The offset transfer is not included in this size.                                                                                                                                                     |
| 7     | CONT      | 0x0   | RW | Continue to hold the bus after the current transaction if set to a 1 with a new command issued.                                                                                                                                              |
| 6:5   | OFFSETCNT | 0x0   | RW | Number of offset bytes to use for the command - 0, 1, 2, 3 are valid selections. The second (byte 1) and third byte (byte 2) are read from the OFFSETHI register, and the low order byte is pulled from this register in the OFFSETLO field. |
| 4:0   | CMD       | 0x0   | RW | Command for submodule.<br><br>WRITE = 0x1 - Write command using count of offset bytes specified in the OFFSETCNT field<br>READ = 0x2 - Read command using count of offset bytes specified in the OFFSETCNT field                             |

## Command Repeat Register

**INSTANCE 0 ADDRESS: 0x5000C210**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |   |   |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|---|---|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0      | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7      | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 |   |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMDRPT |   |   |   |   |   |   |   |   |   |  |  |

| Bit  | Name   | Reset | RW | Description                                          |
|------|--------|-------|----|------------------------------------------------------|
| 31:5 | RSVD   | 0x0   | RO | RESERVED                                             |
| 4:0  | CMDRPT | 0x0   | RW | Count of number of times to repeat the next command. |

## High order offset bytes

**INSTANCE 0 ADDRESS: 0x5000C214**

### Table 270: OFFSETHI Register

Table 271: OFFSETHI Register Bits

| Bit   | Name     | Reset | RW | Description                                                                  |
|-------|----------|-------|----|------------------------------------------------------------------------------|
| 31:16 | RSVD     | 0x0   | RO | Reserved                                                                     |
| 15:0  | OFFSETHI | 0x0   | RW | Holds the high order bytes of the 2 or 3 byte offset phase of a transaction. |

## Command status

**INSTANCE 0 ADDRESS: 0x5000C218**

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Table 272: CMDSTAT Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7  | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSRVD0 |        |        |        |        |        |        |        |        |        |        |        | CTSIZE |        |        |        |        |        |        |        |        |        |        |        | CMDSTAT | CCMD   |        |        |        |        |        |        |

Table 273: CMDSTAT Register Bits

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                             |
|-------|---------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:20 | RSRVD0  | 0x0   | RO | Reserved                                                                                                                                                                                                                                                                |
| 19:8  | CTSIZE  | 0x0   | RO | The current number of bytes still to be transferred with this command. This field will count down to zero.                                                                                                                                                              |
| 7:5   | CMDSTAT | 0x0   | RO | The current status of the command execution.<br><br>ERR = 0x1 - Error encountered with command<br>ACTIVE = 0x2 - Actively processing command<br>IDLE = 0x4 - Idle state, no active command, no error<br>WAIT = 0x6 - Command in progress, but waiting on data from host |
| 4:0   | CCMD    | 0x0   | RO | current command that is being executed                                                                                                                                                                                                                                  |

**6.3.2.13 INTEN Register****IO Master Interrupts: Enable****OFFSET:** 0x00000220**INSTANCE 0 ADDRESS:** 0x5000C220

Set bits in this register to allow this module to generate the corresponding interrupt.

Table 274: INTEN Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |           |          |        |        |          |        |        |           |         |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|-----------|----------|--------|--------|----------|--------|--------|-----------|---------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5    | 1<br>4   | 1<br>3 | 1<br>2 | 1<br>1   | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7  | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        | B2MSHUTDN | B2MACTIVE | B2MSLEEP | CQERR  | CQUPD  | CQPAUSED | DERR   | DCMP   | BLECSSTAT | BLECIRQ | ICMD   | IACC   | B2MST  | FOVFL  | FUNDL  | THR    | CMDCMP |

Table 275: INTEN Register Bits

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                     |
|-------|-----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                        |
| 16    | B2MSHUTDN | 0x0   | RW | Revision A: The B2M_STATE from the BLE Core transitioned into shutdown state. Revision B: Falling BLE Core Status signal. Asserted when the BLE_STATUS signal from the BLE Core is deasserted (1 -> 0)                                                                          |
| 15    | B2MACTIVE | 0x0   | RW | Revision A: The B2M_STATE from the BLE Core transitioned into the active state. Revision B: Falling BLE Core IRQ signal. Asserted when the BLE_IRQ signal from the BLE Core is deasserted (1 -> 0)                                                                              |
| 14    | B2MSLEEP  | 0x0   | RW | The B2M_STATE from the BLE Core transitioned into the sleep state                                                                                                                                                                                                               |
| 13    | CQERR     | 0x0   | RW | Command queue error during processing. When an error occurs, the system will stop processing and halt operations to allow software to take recovery actions                                                                                                                     |
| 12    | CQUPD     | 0x0   | RW | Command queue write operation executed a register write with the register address bit 0 set to 1. The low address bits in the CQ address fields are unused and bit 0 can be used to trigger an interrupt to indicate when this register write is performed by the CQ operation. |
| 11    | CQPAUSED  | 0x0   | RW | Command queue is paused due to an active event enabled in the PAUSEEN register. The interrupt is posted when the event is enabled within the PAUSEEN register, the mask is active in the CQIRQMASK field and the event occurs.                                                  |
| 10    | DERR      | 0x0   | RW | DMA Error encountered during the processing of the DMA command. The DMA error could occur when the memory access specified in the DMA operation is not available or incorrectly specified.                                                                                      |
| 9     | DCMP      | 0x0   | RW | DMA Complete. Processing of the DMA operation has completed and the DMA submodule is returned into the idle state                                                                                                                                                               |
| 8     | BLECSSTAT | 0x0   | RW | BLE Core SPI Status interrupt. Asserted when the SPI_STATUS signal from the BLE Core is asserted, indicating that SPI writes can be done to the BLE Core.                                                                                                                       |
| 7     | BLECIRQ   | 0x0   | RW | BLE Core IRQ signal. Asserted when the BLE_IRQ signal from the BLE Core is asserted, indicating the availability of read data from the BLE Core.                                                                                                                                |
| 6     | ICMD      | 0x0   | RW | illegal command interrupt. Asserted when a command is written when an active command is in progress.                                                                                                                                                                            |
| 5     | IACC      | 0x0   | RW | illegal FIFO access interrupt. Asserted when there is a overflow or underflow event                                                                                                                                                                                             |
| 4     | B2MST     | 0x0   | RW | B2M State change interrupt. Asserted on any change in the B2M_STATE signal from the BLE Core.                                                                                                                                                                                   |

**Table 275: INTEN Register Bits**

| Bit | Name   | Reset | RW | Description                                                                                                                                                                    |
|-----|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3   | FOVFL  | 0x0   | RW | Write FIFO Overflow interrupt. This occurs when software tries to write to a full FIFO. The current operation does not stop.                                                   |
| 2   | FUNDFL | 0x0   | RW | Read FIFO Underflow interrupt. Asserted when a pop operation is done to a empty read FIFO.                                                                                     |
| 1   | THR    | 0x0   | RW | FIFO Threshold interrupt. For write operations, asserted when the number of free bytes in the write FIFO equals or exceeds the WTHR field.                                     |
| 0   | CMDCMP | 0x0   | RW | Command Complete interrupt. Asserted when the current operation has completed. For repeated commands, this will only be asserted when the final repeated command is completed. |

**6.3.2.14 INTSTAT Register****IO Master Interrupts: Status****OFFSET:** 0x00000224**INSTANCE 0 ADDRESS:** 0x5000C224

Read bits from this register to discover the cause of a recent interrupt.

**Table 276: INTSTAT Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |           |          |        |        |          |        |        |           |         |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|-----------|----------|--------|--------|----------|--------|--------|-----------|---------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5    | 1<br>4   | 1<br>3 | 1<br>2 | 1<br>1   | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7  | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        | B2MSHUTDN | B2MACTIVE | B2MSLEEP | CQERR  | CQUPD  | CQPAUSED | DERR   | DCMP   | BLECSSTAT | BLECIRQ | ICMD   | IACC   | B2MST  | FOVFL  | FUNDFL | THR    | CMDCMP |

**Table 277: INTSTAT Register Bits**

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                              |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                 |
| 16    | B2MSHUTDN | 0x0   | RW | Revision A: The B2M_STATE from the BLE Core transitioned into shutdown state<br>Revision B: Falling BLE Core Status signal. Asserted when the BLE_STATUS signal from the BLE Core is deasserted (1 -> 0) |
| 15    | B2MACTIVE | 0x0   | RW | Revision A: The B2M_STATE from the BLE Core transitioned into the active state<br>Revision B: Falling BLE Core IRQ signal. Asserted when the BLE_IRQ signal from the BLE Core is deasserted (1 -> 0)     |
| 14    | B2MSLEEP  | 0x0   | RW | The B2M_STATE from the BLE Core transitioned into the sleep state                                                                                                                                        |

Table 277: INTSTAT Register Bits

| Bit | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                     |
|-----|-----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13  | CQERR     | 0x0   | RW | Command queue error during processing. When an error occurs, the system will stop processing and halt operations to allow software to take recovery actions                                                                                                                     |
| 12  | CQUPD     | 0x0   | RW | Command queue write operation executed a register write with the register address bit 0 set to 1. The low address bits in the CQ address fields are unused and bit 0 can be used to trigger an interrupt to indicate when this register write is performed by the CQ operation. |
| 11  | CQPAUSED  | 0x0   | RW | Command queue is paused due to an active event enabled in the PAUSEEN register. The interrupt is posted when the event is enabled within the PAUSEEN register, the mask is active in the CQIRQMASK field and the event occurs.                                                  |
| 10  | DERR      | 0x0   | RW | DMA Error encountered during the processing of the DMA command. The DMA error could occur when the memory access specified in the DMA operation is not available or incorrectly specified.                                                                                      |
| 9   | DCMP      | 0x0   | RW | DMA Complete. Processing of the DMA operation has completed and the DMA submodule is returned into the idle state                                                                                                                                                               |
| 8   | BLECSSTAT | 0x0   | RW | BLE Core SPI Status interrupt. Asserted when the SPI_STATUS signal from the BLE Core is asserted, indicating that SPI writes can be done to the BLE Core.                                                                                                                       |
| 7   | BLECIRQ   | 0x0   | RW | BLE Core IRQ signal. Asserted when the BLE_IRQ signal from the BLE Core is asserted, indicating the availability of read data from the BLE Core.                                                                                                                                |
| 6   | ICMD      | 0x0   | RW | illegal command interrupt. Asserted when a command is written when an active command is in progress.                                                                                                                                                                            |
| 5   | IACC      | 0x0   | RW | illegal FIFO access interrupt. Asserted when there is a overflow or underflow event                                                                                                                                                                                             |
| 4   | B2MST     | 0x0   | RW | B2M State change interrupt. Asserted on any change in the B2M_STATE signal from the BLE Core.                                                                                                                                                                                   |
| 3   | FOVFL     | 0x0   | RW | Write FIFO Overflow interrupt. This occurs when software tries to write to a full FIFO. The current operation does not stop.                                                                                                                                                    |
| 2   | FUNDL     | 0x0   | RW | Read FIFO Underflow interrupt. Asserted when a pop operation is done to a empty read FIFO.                                                                                                                                                                                      |
| 1   | THR       | 0x0   | RW | FIFO Threshold interrupt. For write operations, asserted when the number of free bytes in the write FIFO equals or exceeds the WTHR field.                                                                                                                                      |
| 0   | CMDCMP    | 0x0   | RW | Command Complete interrupt. Asserted when the current operation has completed. For repeated commands, this will only be asserted when the final repeated command is completed.                                                                                                  |

### 6.3.2.15 INTCLR Register

IO Master Interrupts: Clear

OFFSET: 0x00000228

INSTANCE 0 ADDRESS: 0x5000C228

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

Table 278: INTCLR Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |           |          |        |        |          |        |        |           |         |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|-----------|----------|--------|--------|----------|--------|--------|-----------|---------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5    | 1<br>4   | 1<br>3 | 1<br>2 | 1<br>1   | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7  | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        | B2MSHUTDN | B2MACTIVE | B2MSLEEP | CQERR  | CQUPD  | CQPAUSED | DERR   | DCMP   | BLECSSTAT | BLECIRQ | ICMD   | IACC   | B2MST  | FOVFL  | FUNDFL | THR    | CMDCMP |

Table 279: INTCLR Register Bits

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                     |
|-------|-----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                        |
| 16    | B2MSHUTDN | 0x0   | RW | Revision A: The B2M_STATE from the BLE Core transitioned into shutdown state<br>Revision B: Falling BLE Core Status signal. Asserted when the BLE_STATUS signal from the BLE Core is deasserted (1 -> 0)                                                                        |
| 15    | B2MACTIVE | 0x0   | RW | Revision A: The B2M_STATE from the BLE Core transitioned into the active state<br>Revision B: Falling BLE Core IRQ signal. Asserted when the BLE_IRQ signal from the BLE Core is deasserted (1 -> 0)                                                                            |
| 14    | B2MSLEEP  | 0x0   | RW | The B2M_STATE from the BLE Core transitioned into the sleep state                                                                                                                                                                                                               |
| 13    | CQERR     | 0x0   | RW | Command queue error during processing. When an error occurs, the system will stop processing and halt operations to allow software to take recovery actions                                                                                                                     |
| 12    | CQUPD     | 0x0   | RW | Command queue write operation executed a register write with the register address bit 0 set to 1. The low address bits in the CQ address fields are unused and bit 0 can be used to trigger an interrupt to indicate when this register write is performed by the CQ operation. |
| 11    | CQPAUSED  | 0x0   | RW | Command queue is paused due to an active event enabled in the PAUSEEN register. The interrupt is posted when the event is enabled within the PAUSEEN register, the mask is active in the CQIRQMASK field and the event occurs.                                                  |
| 10    | DERR      | 0x0   | RW | DMA Error encountered during the processing of the DMA command. The DMA error could occur when the memory access specified in the DMA operation is not available or incorrectly specified.                                                                                      |

**Table 279: INTCLR Register Bits**

| Bit | Name      | Reset | RW | Description                                                                                                                                                                    |
|-----|-----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9   | DCMP      | 0x0   | RW | DMA Complete. Processing of the DMA operation has completed and the DMA submodule is returned into the idle state                                                              |
| 8   | BLECSSTAT | 0x0   | RW | BLE Core SPI Status interrupt. Asserted when the SPI_STATUS signal from the BLE Core is asserted, indicating that SPI writes can be done to the BLE Core.                      |
| 7   | BLECIRQ   | 0x0   | RW | BLE Core IRQ signal. Asserted when the BLE_IRQ signal from the BLE Core is asserted, indicating the availability of read data from the BLE Core.                               |
| 6   | ICMD      | 0x0   | RW | illegal command interrupt. Asserted when a command is written when an active command is in progress.                                                                           |
| 5   | IACC      | 0x0   | RW | illegal FIFO access interrupt. Asserted when there is a overflow or under-flow event                                                                                           |
| 4   | B2MST     | 0x0   | RW | B2M State change interrupt. Asserted on any change in the B2M_STATE signal from the BLE Core.                                                                                  |
| 3   | FOVFL     | 0x0   | RW | Write FIFO Overflow interrupt. This occurs when software tries to write to a full FIFO. The current operation does not stop.                                                   |
| 2   | FUNDL     | 0x0   | RW | Read FIFO Underflow interrupt. Asserted when a pop operation is done to a empty read FIFO.                                                                                     |
| 1   | THR       | 0x0   | RW | FIFO Threshold interrupt. For write operations, asserted when the number of free bytes in the write FIFO equals or exceeds the WTHR field.                                     |
| 0   | CMDCMP    | 0x0   | RW | Command Complete interrupt. Asserted when the current operation has completed. For repeated commands, this will only be asserted when the final repeated command is completed. |

**6.3.2.16 INTSET Register****IO Master Interrupts: Set****OFFSET:** 0x0000022C**INSTANCE 0 ADDRESS:** 0x5000C22C

Write a 1 to a bit in this register to instantly generate an interrupt from this module. (Generally used for testing purposes).



Table 280: INTSET Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |           |          |        |        |          |        |        |           |         |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|-----------|----------|--------|--------|----------|--------|--------|-----------|---------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5    | 1<br>4   | 1<br>3 | 1<br>2 | 1<br>1   | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7  | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        | B2MSHUTDN | B2MACTIVE | B2MSLEEP | CQERR  | CQUPD  | CQPAUSED | DERR   | DCMP   | BLECSSTAT | BLECIRQ | ICMD   | IACC   | B2MST  | FOVFL  | FUNDL  | THR    | CMDCMP |

Table 281: INTSET Register Bits

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                     |
|-------|-----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                        |
| 16    | B2MSHUTDN | 0x0   | RW | Revision A: The B2M_STATE from the BLE Core transitioned into shutdown state<br>Revision B: Falling BLE Core Status signal. Asserted when the BLE_STATUS signal from the BLE Core is deasserted (1 -> 0)                                                                        |
| 15    | B2MACTIVE | 0x0   | RW | Revision A: The B2M_STATE from the BLE Core transitioned into the active state<br>Revision B: Falling BLE Core IRQ signal. Asserted when the BLE_IRQ signal from the BLE Core is deasserted (1 -> 0)                                                                            |
| 14    | B2MSLEEP  | 0x0   | RW | The B2M_STATE from the BLE Core transitioned into the sleep state                                                                                                                                                                                                               |
| 13    | CQERR     | 0x0   | RW | Command queue error during processing. When an error occurs, the system will stop processing and halt operations to allow software to take recovery actions                                                                                                                     |
| 12    | CQUPD     | 0x0   | RW | Command queue write operation executed a register write with the register address bit 0 set to 1. The low address bits in the CQ address fields are unused and bit 0 can be used to trigger an interrupt to indicate when this register write is performed by the CQ operation. |
| 11    | CQPAUSED  | 0x0   | RW | Command queue is paused due to an active event enabled in the PAUSEEN register. The interrupt is posted when the event is enabled within the PAUSEEN register, the mask is active in the CQIRQMASK field and the event occurs.                                                  |
| 10    | DERR      | 0x0   | RW | DMA Error encountered during the processing of the DMA command. The DMA error could occur when the memory access specified in the DMA operation is not available or incorrectly specified.                                                                                      |
| 9     | DCMP      | 0x0   | RW | DMA Complete. Processing of the DMA operation has completed and the DMA submodule is returned into the idle state                                                                                                                                                               |
| 8     | BLECSSTAT | 0x0   | RW | BLE Core SPI Status interrupt. Asserted when the SPI_STATUS signal from the BLE Core is asserted, indicating that SPI writes can be done to the BLE Core.                                                                                                                       |

| Bit | Name    | Reset | RW | Description                                                                                                                                                                    |
|-----|---------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7   | BLECIRQ | 0x0   | RW | BLE Core IRQ signal. Asserted when the BLE_IRQ signal from the BLE Core is asserted, indicating the availability of read data from the BLE Core.                               |
| 6   | ICMD    | 0x0   | RW | illegal command interrupt. Asserted when a command is written when an active command is in progress.                                                                           |
| 5   | IACC    | 0x0   | RW | illegal FIFO access interrupt. Asserted when there is a overflow or under-flow event                                                                                           |
| 4   | B2MST   | 0x0   | RW | B2M State change interrupt. Asserted on any change in the B2M_STATE signal from the BLE Core.                                                                                  |
| 3   | FOVFL   | 0x0   | RW | Write FIFO Overflow interrupt. This occurs when software tries to write to a full FIFO. The current operation does not stop.                                                   |
| 2   | FUNDFL  | 0x0   | RW | Read FIFO Underflow interrupt. Asserted when a pop operation is done to a empty read FIFO.                                                                                     |
| 1   | THR     | 0x0   | RW | FIFO Threshold interrupt. For write operations, asserted when the number of free bytes in the write FIFO equals or exceeds the WTHR field.                                     |
| 0   | CMDCMP  | 0x0   | RW | Command Complete interrupt. Asserted when the current operation has completed. For repeated commands, this will only be asserted when the final repeated command is completed. |

## DMA Trigger Enable Register

**INSTANCE 0 ADDRESS: 0x5000C230**

Provides control on which event will trigger the DMA transfer after the DMA operation is setup and enabled. The trigger event will cause a number of bytes (depending on trigger event) to be

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1    | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DTHREN | DCMDCMPEN |        |

| Bit  | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|-----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:2 | RSVD      | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1    | DTHREN    | 0x0   | RW | Trigger DMA upon THR level reached. For M2P DMA operations (IOM writes), the trigger will assert when the write FIFO has (WTHR/4) number of words free in the write FIFO, and will transfer (WTHR/4) number of words                                                                                                                                                                                                                                                                     |
| 0    | DCMDCMPEN | 0x0   | RW | Trigger DMA upon command complete. Enables the trigger of the DMA when a command is completed. When this event is triggered, the number of words transferred will be the lesser of the remaining TOTCOUNT bytes, or the number of bytes in the FIFO when the command completed. If this is disabled, and the number of bytes in the FIFO is equal or greater than the TOTCOUNT bytes, a transfer of TOTCOUNT bytes will be done to ensure read data is stored when the DMA is completed. |

## DMA Trigger Status Register

**INSTANCE 0 ADDRESS: 0x5000C234**

Provides the status of trigger events that have occurred for the transaction. Some of the bits are read only and some can be reset via a write of 0.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |         |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|---------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3  | 0<br>2 | 0<br>1  | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DTOTCMP | DTHR   | DCMDCMP |        |

| Bit  | Name    | Reset | RW | Description                                                                                                                                                                                                                                    |
|------|---------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:3 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                      |
| 2    | DTOTCMP | 0x0   | RO | DMA triggered when DCMDCMP = 0, and the amount of data in the FIFO was enough to complete the DMA operation (greater than or equal to current TOTCOUNT) when the command completed. This trigger is default active when the DCMDCMP trigger is |
| 1    | DTHR    | 0x0   | RO | Triggered DMA from THR event. Bit is read only and can be cleared by disabling the DTHR trigger enable or by disabling DMA.                                                                                                                    |

Table 285: DMATRIGSTAT Register Bits

| Bit | Name    | Reset | RW | Description                                                                                                                                 |
|-----|---------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | DCMDCMP | 0x0   | RO | Triggered DMA from Command complete event. Bit is read only and can be cleared by disabling the DCMDCMP trigger enable or by disabling DMA. |

**6.3.2.19 DMACFG Register****DMA Configuration Register****OFFSET:** 0x00000238**INSTANCE 0 ADDRESS:** 0x5000C238

Configuration control of the DMA process, including the direction of DMA, and enablement of DMA

Table 286: DMACFG Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |      |   |   |   |   |        |       |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|------|---|---|---|---|--------|-------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0      | 0    | 0 | 0 | 0 | 0 | 0      | 0     |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0      | 9    | 8 | 7 | 6 | 5 | 4      | 3     |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DMAPRI | RSVD |   |   |   |   | DMADIR | DMAEN |

Table 287: DMACFG Register Bits

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                               |
|------|--------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:9 | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                 |
| 8    | DMAPRI | 0x0   | RW | Sets the Priority of the DMA request<br>LOW = 0x0 - Low Priority (service as best effort)<br>HIGH = 0x1 - High Priority (service immediately)                                                                                                                                             |
| 7:2  | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                 |
| 1    | DMADIR | 0x0   | RW | Direction<br>P2M = 0x0 - Peripheral to Memory (SRAM) transaction. To be set when doing IOM read operations, i.e., reading data from external devices.<br>M2P = 0x1 - Memory to Peripheral transaction. To be set when doing IOM write operations, i.e., writing data to external devices. |
| 0    | DMAEN  | 0x0   | RW | DMA Enable. Setting this bit to EN will start the DMA operation. This should be the last DMA related register set prior to issuing the command<br>DIS = 0x0 - Disable DMA Function<br>EN = 0x1 - Enable DMA Function                                                                      |

**6.3.2.20 DMATOTCOUNT Register****DMA Total Transfer Count****OFFSET:** 0x0000023C



| Bit   | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                             |
|-------|------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28    | TARGADDR28 | 0x0   | RW | Bit 28 of the target byte address for source of DMA (either read or write). In cases of non-word aligned addresses, the DMA logic will take care for ensuring only the target bytes are read/written.                                                                                   |
| 27:21 | RSVD       | 0x0   | RO | Reserved                                                                                                                                                                                                                                                                                |
| 20:0  | TARGADDR   | 0x0   | RW | Bits [19:0] of the target byte address for source of DMA (either read or write). The address can be any byte alignment, and does not have to be word aligned. In cases of non-word aligned addresses, the DMA logic will take care for ensuring only the target bytes are read/written. |

## DMA Status Register

**INSTANCE 0 ADDRESS: 0x5000C244**

Status of the DMA operation currently in progress.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |         |        |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|---------|--------|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0      | 0       | 0      | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3      | 2       | 1      | 0 |   |   |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DMAERR | DMA CPL | DMATIP |   |   |   |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                             |
|------|--------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:3 | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                               |
| 2    | DMAERR | 0x0   | RW | DMA Error. This active high bit signals that an error was encountered during the DMA operation.                                                                         |
| 1    | DMACPL | 0x0   | RW | DMA Transfer Complete. This signals the end of the DMA operation. This bit can be cleared by writing to 0.                                                              |
| 0    | DMATIP | 0x0   | RO | DMA Transfer In Progress indicator. 1 will indicate that a DMA transfer is active. The DMA transfer may be waiting on data, transferring data, or waiting for priority. |



|        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9   | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSRVD2 |        | CQADDR28 | RSRVD1 |        |        |        |        |        |        |        | CQADDR |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | RSRVD0 |        |        |        |        |

| Bit   | Name     | Reset | RW | Description                                                                                                  |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------|
| 31:29 | RSRVD2   | 0x0   | RO | Reserved                                                                                                     |
| 28    | CQADDR28 | 0x0   | RW | Bit 28 of target byte address for source of CQ (read only). Used to denote Flash (0) or SRAM (1) access      |
| 27:21 | RSRVD1   | 0x0   | RO | Reserved                                                                                                     |
| 20:2  | CQADDR   | 0x0   | RW | Bits 19:2 of target byte address for source of CQ (read only). The buffer must be aligned on a word boundary |
| 1:0   | RSRVD0   | 0x0   | RO | Reserved                                                                                                     |

## Command Queue Status Register

**INSTANCE 0 ADDRESS: 0x5000C250**

Provides the status of the command queue operation. If the command queue is disabled, these bits will be cleared. The bits are read only

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2   | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CQERR  | CQPAUSED | CQTIP  |        |



| Bit  | Name     | Reset | RW | Description                                                                                                                                                         |
|------|----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:3 | RSVD     | 0x0   | RO | RESERVED.                                                                                                                                                           |
| 2    | CQERR    | 0x0   | RW | Command queue processing error. This active high bit signals that an error was encountered during the CQ operation.                                                 |
| 1    | CQPAUSED | 0x0   | RO | Command queue operation is currently paused.                                                                                                                        |
| 0    | CQTIP    | 0x0   | RO | Command queue Transfer In Progress indicator. 1 will indicate that a CQ transfer is active and this will remain active even when paused waiting for external event. |

## Command Queue Flag Register

**INSTANCE 0 ADDRESS: 0x5000C254**

Provides the current status of the SWFLAGS (bits 7:0) and the hardware generated flags (15:8). A '1' will pause the CQ operation if it the same bit is enabled in the CQPAUSEEN register

|           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3         | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1         | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CQIRQMASK |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQFLAGS |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                 |
|-------|-----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:16 | CQIRQMASK | 0x0   | RW | Provides for a per-bit mask of the flags used to invoke an interrupt. A '1' in the bit position will enable the pause event to trigger the interrupt, if the CQWT_int interrupt is enabled. |
| 15:0  | CQFLAGS   | 0x0   | RO | Current flag status (read-only). Bits [7:0] are software controllable and bits [15:8] are hardware status.                                                                                  |

## Command Queue Flag Set/Clear Register

**INSTANCE 0 ADDRESS: 0x5000C258**

Set/Clear the command queue software pause flags on a per-bit basis. Contains 3 fields, allowing for setting, clearing or toggling the value in the software flags. Priority when the same bit

**Table 302: CQSETCLEAR Register**

|      |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2      | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1      | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0      | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3      | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5      | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7      | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   | CQFCLR |   |   |   |   |   |   |   | CQFTGL |   |   |   |   |   |   |   | CQFSET |   |   |   |   |   |   |   |

**Table 303: CQSETCLEAR Register Bits**

| Bit   | Name   | Reset | RW | Description                                                                                                              |
|-------|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------|
| 31:24 | RSVD   | 0x0   | RO | Reserved                                                                                                                 |
| 23:16 | CQFCLR | 0x0   | WO | Clear CQFlag status bits. Will clear to 0 any SWFLAG with a '1' in the corresponding bit position of this field          |
| 15:8  | CQFTGL | 0x0   | WO | Toggle the indicated bit. Will toggle the value of any SWFLAG with a '1' in the corresponding bit position of this field |
| 7:0   | CQFSET | 0x0   | WO | Set CQFlag status bits. Will set to 1 the value of any SWFLAG with a '1' in the corresponding bit position of this field |

### 6.3.2.28 CQPAUSEEN Register

#### Command Queue Pause Enable Register

**OFFSET:** 0x0000025C

**INSTANCE 0 ADDRESS:** 0x5000C25C

Enables a flag to pause an active command queue operation. If a bit is '1' and the corresponding bit in the CQFLAG register is '1', CQ processing will halt until either value is changed to '0'.

**Table 304: CQPAUSEEN Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1     | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5     | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQPEN |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 305: CQPAUSEEN Register Bits**

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:16 | RSVD | 0x0   | RO | Reserved    |

Table 305: CQPAUSEEN Register Bits

| Bit  | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15:0 | CQPEN | 0x0   | RW | <p>Enables the specified event to pause command processing when active</p> <p>CNTEQ = 0x8000 - Pauses command queue processing when HWCNT matches SWCNT</p> <p>BLEXOREN = 0x4000 - Pause command queue when input BLE bit XOREd with SWFLAG4 is '1'</p> <p>IOMXOREN = 0x2000 - Pause command queue when input IOM bit XOREd with SWFLAG3 is '1'</p> <p>GPIOXOREN = 0x1000 - Pause command queue when input GPIO irq_bit XOREd with SWFLAG2 is '1'</p> <p>MSPI1XNOREN = 0x800 - Pause command queue when input MSPI1 bit XNOREd with SWFLAG1 is '1'</p> <p>MSPI0XNOREN = 0x400 - Pause command queue when input MSPI0 bit XNOREd with SWFLAG0 is '1'</p> <p>MSPI1XOREN = 0x200 - Pause command queue when input MSPI1 bit XOREd with SWFLAG1 is '1'</p> <p>MSPI0XOREN = 0x100 - Pause command queue when input MSPI0 bit XOREd with SWFLAG0 is '1'</p> <p>SWFLAGEN7 = 0x80 - Pause the command queue when software flag bit 7 is '1'.</p> <p>SWFLAGEN6 = 0x40 - Pause the command queue when software flag bit 7 is '1'</p> <p>SWFLAGEN5 = 0x20 - Pause the command queue when software flag bit 7 is '1'</p> <p>SWFLAGEN4 = 0x10 - Pause the command queue when software flag bit 7 is '1'</p> <p>SWFLAGEN3 = 0x8 - Pause the command queue when software flag bit 7 is '1'</p> <p>SWFLAGEN2 = 0x4 - Pause the command queue when software flag bit 7 is '1'</p> <p>SWFLAGEN1 = 0x2 - Pause the command queue when software flag bit 7 is '1'</p> <p>SWFLAGEN0 = 0x1 - Pause the command queue when software flag bit 7 is '1'</p> |

### 6.3.2.29 CQCURIDX Register

IOM Command Queue current index value. Compared to the CQENDIDX reg contents to generate the IDXEQ Pause event for command queue

OFFSET: 0x00000260

INSTANCE 0 ADDRESS: 0x5000C260

Current index value, targeted to be written by register write operations within the command queue. This is compared to the CQENDIDX and will stop the CQ operation if bit 15 of the CQPAUSEEN is '1' and

Table 306: CQCURIDX Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0        | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0        | 9 | 8 | 7 | 6 | 5 | 4 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQCURIDX |   |   |   |   |   |   |

| Bit  | Name     | Reset | RW | Description                                                                                                                                                                                                                                 |
|------|----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                    |
| 7:0  | CQCURIDX | 0x0   | RW | Holds 8 bits of data that will be compared with the CQENDIX register field. If the values match, the IDXEQ pause event will be activated, which will cause the pausing of command queue operation if the IDXEQ bit is enabled in CQPAUSEEN. |

End index value, targeted to be written by software to indicate the last valid register pair contained within the command queue for register write operations within the command queue.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |   |   |  |  |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|--|--|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0        | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |  |  |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9        | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQENDIDX |   |   |   |   |   |   |   |   |   |  |  |  |  |  |  |

| Bit  | Name     | Reset | RW | Description                                                                                                                                                                                                                                 |
|------|----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                    |
| 7:0  | CQENDIDX | 0x0   | RW | Holds 8 bits of data that will be compared with the CQCURIX register field. If the values match, the IDXEQ pause event will be activated, which will cause the pausing of command queue operation if the IDXEQ bit is enabled in CQPAUSEEN. |

General status of the IOM module command execution.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |        |     |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|--------|-----|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0      | 0      | 0   | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7      | 6      | 5   | 4 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | IDLEST | CMDACT | ERR |   |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                       |
|------|--------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:3 | RSVD   | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                          |
| 2    | IDLEST | 0x0   | RO | <p>indicates if the active I/O state machine is IDLE. Note - The state machine could be in idle state due to hold-offs from data availability, or as the command gets propagated into the logic from the registers.</p> <p>IDLE = 0x1 - The I/O state machine is in the idle state.</p>                                                                           |
| 1    | CMDACT | 0x0   | RO | <p>Indicates if the active I/O Command is currently processing a transaction, or command is complete, but the FIFO pointers are still synchronizing internally. This bit will go high at</p> <p>ACTIVE = 0x1 - An I/O command is active. Indicates the active module has an active command and is processing this. De-asserted when the command is completed.</p> |
| 0    | ERR    | 0x0   | RO | <p>Bit has been deprecated. Please refer to the other error indicators. This will always return 0.</p> <p>ERROR = 0x1 - Bit has been deprecated and will always return 0.</p>                                                                                                                                                                                     |

Controls the configuration of the SPI master module, including POL/PHA, LSB, flow control, and delays for MISO and MOSI

|        |         |         |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |      |      |
|--------|---------|---------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|------|------|
| 3<br>1 | 3<br>0  | 2<br>9  | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2  | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0  |      |      |
| RSVD   | MSPIRST | DOU7DLY |        |        | DINDLY |        |        | SPILSB | RDFCPOL | WTF-   | RSVD   |        |        | RDFC   | WTFC   | RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        | FULLDUP | SPHA | SPOL |

Table 313: MSPICFG Register Bits

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------|---------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 30    | MSPIRST | 0x1   | RW | Bit is deprecated. setting it will have no effect.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 29:27 | DOUTDLY | 0x0   | RW | Delay tap to use for the output signal (MOSI). This give more hold time on the output data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 26:24 | DINDLY  | 0x0   | RW | Delay tap to use for the input signal (MISO). This gives more hold time on the input data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 23    | SPILSB  | 0x0   | RW | Selects data transfer as MSB first (0) or LSB first (1) for the data portion of the SPI transaction. The offset bytes are always transmitted MSB first.<br><br>MSB = 0x0 - Send and receive MSB bit first<br>LSB = 0x1 - Send and receive LSB bit first                                                                                                                                                                                                                                                                                                               |
| 22    | RDFCPOL | 0x0   | RW | Selects the read flow control signal polarity. When set, the clock will be held low until the flow control is deasserted.<br><br>NORMAL = 0x0 - SPI_STATUS signal from BLE Core high(1) creates flow control and new read SPI transactions will not be started until the signal goes low.(default)<br>INVERTED = 0x1 - SPI_STATUS signal from BLE Core low(0) creates flow control and new read SPI transactions will not be started until the signal goes high.                                                                                                      |
| 21    | WTFCPOL | 0x0   | RW | Selects the write flow control signal polarity. The transfers are halted when the selected flow control signal is OPPOSITE polarity of this bit. (For example: WTFCPOL = 0 will allow a SPI_STATUS=1 to pause transfers).<br><br>NORMAL = 0x0 - SPI_STATUS signal from BLE Core high(1) creates flow control and new write SPI transactions will not be started until the signal goes low.(default)<br>INVERTED = 0x1 - SPI_STATUS signal from BLE Core high(1) creates low(0) control and new write SPI transactions will not be started until the signal goes high. |
| 20:18 | RSVD    | 0x0   | RO | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 17    | RDFC    | 0x0   | RW | Enables flow control of new read transactions based on the SPI_STATUS signal from the BLE Core.<br><br>DIS = 0x0 - Read mode flow control disabled.<br>EN = 0x1 - Read mode flow control enabled.                                                                                                                                                                                                                                                                                                                                                                     |
| 16    | WTFC    | 0x0   | RW | Enables flow control of new write transactions based on the SPI_STATUS signal from the BLE Core.<br><br>DIS = 0x0 - Write mode flow control disabled.<br>EN = 0x1 - Write mode flow control enabled.                                                                                                                                                                                                                                                                                                                                                                  |
| 15:3  | RSVD    | 0x0   | RO | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 2     | FULLDUP | 0x0   | RW | Full Duplex mode. Capture read data during writes operations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

**Table 313: MSPICFG Register Bits**

| Bit | Name | Reset | RW | Description                                                                                                                                                                                                                                                                                                                          |
|-----|------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | SPHA | 0x0   | RW | Selects the SPI phase; When 1, will shift the sampling edge by 1/2 clock.<br><br>SAMPLE_LEADING_EDGE = 0x0 - Sample on the leading (first) clock edge, rising or falling dependent on the value of SPOL<br>SAMPLE_TRAILING_EDGE = 0x1 - Sample on the trailing (second) clock edge, rising or falling dependent on the value of SPOL |
| 0   | SPOL | 0x0   | RW | This bit selects SPI polarity.<br><br>CLK_BASE_0 = 0x0 - The initial value of the clock is 0.<br>CLK_BASE_1 = 0x1 - The initial value of the clock is 1.                                                                                                                                                                             |

**6.3.2.33 BLECFG Register****BLE Core Control****OFFSET:** 0x00000304**INSTANCE 0 ADDRESS:** 0x5000C304

Provides control of isolation and IO signals between the interface module and the BLE Core.

**Table 314: BLECFG Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |           |            |        |           |           |            |            |           |         |         |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|-----------|------------|--------|-----------|-----------|------------|------------|-----------|---------|---------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5    | 1<br>4    | 1<br>3     | 1<br>2 | 1<br>1    | 1<br>0    | 0<br>9     | 0<br>8     | 0<br>7    | 0<br>6  | 0<br>5  | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | SPIISOCTL | PWRISOCTL | STAYASLEEP | FRCLK  | MCUFRCSLP | WT4ACTOFF | BLEHREQCTL | DCDCFLGCTL | WAKEUPCTL | BLERSTN | PWRSMEN |        |        |        |        |        |

**Table 315: BLECFG Register Bits**

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                 |
|-------|-----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:16 | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                    |
| 15:14 | SPIISOCTL | 0x0   | RW | Configuration of BLEH isolation controls for SPI related signals.<br><br>ON = 0x3 - SPI signals from BLE Core to/from MCU Core are isolated.<br>OFF = 0x2 - SPI signals from BLE Core to/from MCU Core are not isolated.<br>AUTO = 0x0 - SPI signals from BLE Core to/from MCU Core are automatically isolated by the logic |
| 13:12 | PWRISOCTL | 0x0   | RW | Configuration of BLEH isolation control for power related signals.<br><br>ON = 0x3 - BLEH power signal isolation to on (isolated).<br>OFF = 0x2 - BLEH power signal isolation to off (not isolated).<br>AUTO = 0x0 - BLEH Power signal isolation is controlled automatically through the interface logic                    |

Table 315: BLECFG Register Bits

| Bit | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----|------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11  | STAYASLEEP | 0x0   | RW | Set to prevent the BLE power control module from waking up the BLE Core after going into power down. To be used for graceful shutdown, set by software prior to powering off and will allow assertion of reset from sleep state.                                                                                                                                                                                                                                                     |
| 10  | FRCCLK     | 0x0   | RW | Force the clock in the BLEIF to be always running                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 9   | MCUFRCSLP  | 0x0   | RW | Force power state machine to go to the sleep state. Intended for debug only. Has no effect on the actual BLE Core state, only the state of the BLEIF interface state machine.                                                                                                                                                                                                                                                                                                        |
| 8   | WT4ACTOFF  | 0x0   | RW | Debug control of BLEIF power state machine. Allows transition into the active state in the BLEIF state without waiting for DCDC request from BLE Core.                                                                                                                                                                                                                                                                                                                               |
| 7:6 | BLEHREQCTL | 0x0   | RW | BLEH power on request override. The value of this field will be sent to the BLE Core when the PWRSRM is off. Otherwise, the value is supplied from internal logic.<br>ON = 0x3 - BLEH Power-on reg signal is set to on (1).<br>OFF = 0x2 - BLEH Power-on signal is set to off (0).<br>AUTO = 0x0 - BLEH Power-on signal is controlled by the PWRSRM logic and automatically controlled                                                                                               |
| 5:4 | DCDCFLGCTL | 0x0   | RW | DCDCFLG signal override. The value of this field will be sent to the BLE Core when the PWRSRM is off. Otherwise, the value is supplied from internal logic.<br>ON = 0x3 - DCDC Flag signal is set to on (1).<br>OFF = 0x2 - DCDC Flag signal is set to off (0).<br>AUTO = 0x0 - DCDC Flag signal is controlled by the PWRSRM logic and automatically controlled                                                                                                                      |
| 3:2 | WAKEUPCTL  | 0x0   | RW | WAKE signal override. Controls the source of the WAKE signal to the BLE Core.<br>ON = 0x3 - Wake signal is set to on (1).<br>OFF = 0x2 - Wake signal is set to off (0).<br>AUTO = 0x0 - Wake signal is controlled by the PWRSRM logic and automatically controlled                                                                                                                                                                                                                   |
| 1   | BLERSTN    | 0x0   | RW | Reset line to the BLE Core. This will reset the BLE core when asserted ('0') and must be written to '1' prior to performing any BTLE related operations to the core.<br>ACTIVE = 0x1 - The reset signal is active (0)<br>INACTIVE = 0x0 - The reset signal is inactive (1)                                                                                                                                                                                                           |
| 0   | PWRSRMEN   | 0x0   | RW | Enable the power state machine for automatic sequencing and control of power states of the BLE Core module.<br>ON = 0x1 - Internal power state machine is enabled and will sequence the BLEH power domain as indicated in the design document. Overrides for the power signals are not enabled.<br>OFF = 0x0 - Internal power state machine is disabled and will not sequence the BLEH power domain. The values of the overrides will be used to drive the output sequencing signals |





Table 319: BSTATUS Register Bits

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------|-----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:13 | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 12    | BLEHREQ   | 0x0   | RO | Value of the BLEHREQ signal to the power control unit. The BLEHREQ signal is sent from the BLEIF module to the power control module to request the BLEH power up. When the BLEHACK signal is asserted,                                                                                                                                                                                                                                                                                                                                           |
| 11    | BLEHACK   | 0x0   | RO | Value of the BLEHACK signal from the power control unit. If the signal is '1', the BLEH power is active and ready for use.                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 10:8  | PWRST     | 0x0   | RO | Current status of the power state machine<br><br>OFF = 0x0 - Internal power state machine is disabled and will not sequence the BLEH power domain. The values of the overrides will be used to drive the output sequencing signals<br>INIT = 0x1 - Initialization state. BLEH not powered<br>PWRON = 0x2 - Waiting for the power-up of the BLEH<br>ACTIVE = 0x3 - The BLE Core is powered and active<br>SLEEP = 0x6 - The BLE Core has entered sleep mode and the power request is inactive<br>SHUTDOWN = 0x4 - The BLE Core is in shutdown mode |
| 7     | BLEIRQ    | 0x0   | RO | Status of the BLEIRQ signal from the BLE Core. A value of 1 indicates that read data is available in the core and a read operation needs to be performed.                                                                                                                                                                                                                                                                                                                                                                                        |
| 6     | WAKEUP    | 0x0   | RO | Value of the WAKEUP signal to the BLE Core. The WAKEUP signal is sent from the BLEIF to the BLECORE to request the BLE Core transition from sleep state to active state.                                                                                                                                                                                                                                                                                                                                                                         |
| 5     | DCDCFLAG  | 0x0   | RO | Value of the DCDCFLAG signal to the BLE Core. The DCDCFLAG is a signal to the BLE Core indicating that the BLEH power is active.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 4     | DCDCREQ   | 0x0   | RO | Value of the DCDCREQ signal from the BLE Core. The DCDCREQ signal is sent from the core to the BLEIF module when the BLE core requires BLEH power to be active. When activated, this is                                                                                                                                                                                                                                                                                                                                                          |
| 3     | SPISTATUS | 0x0   | RO | Value of the SPISTATUS signal from the BLE Core. The signal is asserted when the BLE Core is able to accept write data via the SPI interface. Data should be transmitted to the                                                                                                                                                                                                                                                                                                                                                                  |
| 2:0   | B2MSTATE  | 0x0   | RO | State of the BLE Core logic.<br><br>RESET = 0x0 - Reset State<br>Shutdown = 0x0 - Shutdown state<br>Sleep = 0x1 - Sleep state.<br>Standby = 0x2 - Standby State<br>Idle = 0x3 - Idle state<br>Active = 0x4 - Active state.                                                                                                                                                                                                                                                                                                                       |

**6.3.2.36 BLEDBG Register****BLEIF Master Debug Register****OFFSET:** 0x00000410**INSTANCE 0 ADDRESS:** 0x5000C410

Debug control

**Table 320: BLEDBG Register**

|         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |         |        |
|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|---------|--------|
| 3<br>1  | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2   | 0<br>1  | 0<br>0 |
| DBGDATA |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | APBCLKON | IOCLKON | DBGEN  |

**Table 321: BLEDBG Register Bits**

| Bit  | Name     | Reset | RW | Description                                                                                                                                            |
|------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:3 | DBGDATA  | 0x0   | RW | Debug data                                                                                                                                             |
| 2    | APBCLKON | 0x0   | RW | APBCLK debug clock control. Enable APB_CLK to be active when this bit is '1'. Otherwise, the clock is controlled with gating from the logic as needed. |
| 1    | IOCLKON  | 0x0   | RW | IOCLK debug clock control. Enable IO_CLK to be active when this bit is '1'. Otherwise, the clock is controlled with gating from the logic as needed.   |
| 0    | DBGEN    | 0x0   | RW | Debug Enable. Setting this bit will enable the update of data within this register, otherwise it is clock gated for power savings                      |

## 7. MSPI Master Module

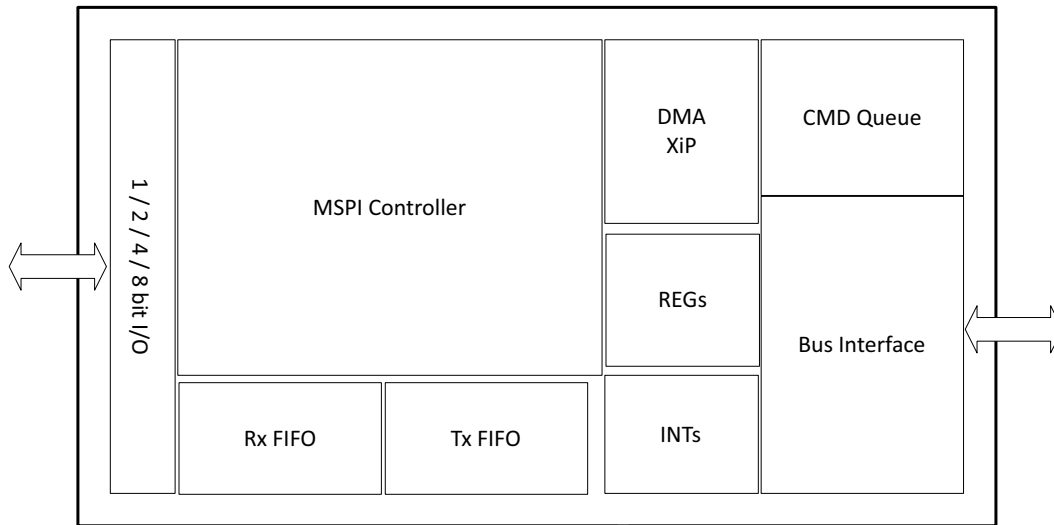


**Figure 11. Block Diagram for the MSPI Master Module**

### 7.1 Functional Overview

The Apollo3 MCU Family includes one or more Multi-bit SPI (MSPI) modules which can be used to connect to external memory devices or displays. The Apollo3 Blue SoC has a single MSPI controller which supports operation up to 48 MHz (24MHz for earlier revision A1 devices) in serial, dual and quad transfer modes, and up to 24 MHz in octal mode. The MSPI module has a unified 16-entry FIFO (32 bits wide) that is used for both transmit and receive data. To ensure that transactions are not dropped because of system or software latency, the MSPI controller will pause the clock (and thus the transfer on the bus) if the TX FIFO empties or the RX FIFO fills during an operation. It will automatically resume once the FIFO condition has cleared.

MSPI transfers generally consist of transmitting a 1 byte instruction, a 1-4 byte address (optional), and 1 byte to 64KB of write or read data (with an optional number of turnaround clock cycles between address and RX data, as well as an optional number of turnaround clock cycles between address and RX data).

The MSPI interface, when connected to external memory devices, is accessible via three methods:

- XIP, where instructions/data can be cached through an aperture in the flash cache interface (read-only).
- XIPMM, where the device is memory mapped for direct read/write accesses (non-cached).
- DMA, where the MSPI can autonomously transfer data between the device and system memory or flash.

Note that XIPMM and DMA do not enforce hardware coherency, so the cache should be disabled or invalidated when performing DMA or XIPMM operations to regions that contain code that may be cached. In each of these modes, the MSPI module also supports data scrambling on accesses within a programmable address range having boundaries aligned to 64K address boundaries.

Once the external devices are configured, the MSPI supports a simple DMA model, where software can program the internal (SRAM or flash) address and external device address, transfer direction, and transfer size. Once enabled, the MSPI DMA interface will move data between the system and external flash and interrupt when complete. The MSPI also supports a higher-level command queuing (CQ) protocol, where software can construct a buffer of operations in SRAM (or internal flash memory) and the MSPI will execute the series of operations autonomously. The MSPI can also power itself down at the end of DMA or CQ operations.

While the MSPI module can be used as a generic SPI device (with two chip enables), in addition to supporting Serial, Dual, and Quad displays, it is primarily designed to support serial NAND/NOR flash memory or PSRAM memory. It is intended to be used to initialize the external memory devices and then be configured with the parameters matching the flash access characteristics. Devices can then be accessed through DMA or XIP operations with minimal software overhead.

## 7.2 Configuration

The MSPI module should be configured to match the transfer characteristics of the external device(s) on the bus. Generally, the configuration sequence would proceed as follows:

- Configure MSPI clock divider (CLKDIV field in the MSPICFG register). The MSPI's reference frequency is 48 MHz, so the resulting clock frequency is 48/CLKDIV value.
- Configure MSPI transfer characteristics (CFG register) to initialize the device (usually mode 0, serial transfers)
- Configure MSPI PADOUTEN to enable the desired bits on the MSPI bus (clock plus relevant data bits).

### NOTE

Enabling unused data lines will impact the values present on those pads even if the GPIO function select is not set to MSPI.

- Program external flash device to the appropriate mode, enable dual/quad/octet modes
- Update CFG register to new settings (in cases of a transfer mode or addressing change)
- Write FLASH register to set read/write instructions and transfer characteristics for DMA/XIP operations (and optionally enable XIP mode).

The MSPI's CFG register contains the controller's settings when communicating with any given device and it is expected that these values will be static after initial configuration of the external memory devices. The MSPI\_CFG\_DEVCFG field specifies both the transfer mode (serial, dual, quad, etc) as well as which chip enable is used to access the device. The MSPI\_CFG\_ISIZE and MSPI\_CFG\_ASIZ fields indicate the number of bytes transmitted for the instruction and address phases, but individual operations can select whether to transmit these or not. The TURNAROUND field indicates the number of cycles between the TX of instruction/address and reception of the first RX byte (the flash device must be programmed to use the same count).

### NOTE

Each MSPI controller is limited to clock polarity/phase mode 0 operation. Mode 0 specifies a clock polarity setting where the inactive state is low (CPOL=0), and a clock phase setting where the clock toggles in the middle of the data bit (CPHA=0). The other three clock polarity/phase modes (1-3) are not supported.

### 7.3 PIO Operations

Software can issue general PIO operations to devices on the MSPI bus using the INSTR, ADDR, and CTRL registers. Software should first write the instruction to be sent to the INSTR register and the address to be sent to the ADDR register (if required) followed by a write to the CTRL register to start the transfer. The CTRL\_TXRX bit indicates whether data should flow to or from the device and CTRL\_XFERBYTES indicates the number of bytes to transfer. CTRL\_SENDI and CTRL\_SENDA can be used to enable or disable the instruction or address phases and the CTRL\_ENTURN is used to enable the turnaround phase. The transfer will only commence if the CTRL\_START bit is set. Software may read the BUSY and STATUS fields to check on transaction status, otherwise the CMDCPL interrupt (INTEN\_CMDCPL) can be used to indicate completion.

```
AM_REG(MSPI, INSTR) = instr;
AM_REG(MSPI, CTRL) = AM_REG_MSPI_CTRL_XFERBYTES(bytes) |
                     AM_REG_MSPI_CTRL_SENDI_M |
                     AM_REG_MSPI_CTRL_TXRX(1) |
                     AM_REG_MSPI_CTRL_START_M;
```

Write latency, the time between the address and first data byte, can be set and controlled by setting the CTRL\_ENWLAT bit to enable the Write Latency Counter, which sets the latency from 0 to 63 counter clocks with the setting in the CFG\_Writelatency field.

For write (TX) operations, data should be written to the TXFIFO after the transaction has been started. Software should read TXENTRIES before writing to ensure that space is available in the FIFO before writing new TX data. For read operations, software should read the RXENTRIES to determine the number of words available and then read the data from the RXFIFO register.

```
// Example TX data write loop
for (i = 0; i < count; i++) {
    temp1 = AM_REG(MSPI, TXENTRIES);
    for (; (temp1 < 16) && (i < count); temp1++, i++) {
        AM_REG(MSPI, TXFIFO) = data[i];
    }
}
```

## 7.4 DMA Operations

The MSPI controller tightly integrates the DMA controller with the transfer interface and automatically handles sequencing of instructions and address to serial flash device and the subsequent transfer of data to/from system memory. Before starting DMA operations, software should have already configured the CFG register (to specify device configuration) and the FLASH register (to specify the template used for DMA operations). Software should first set up the static DMA parameters which specify the DMA burst parameters:

```
MSPI(mspiModule)->DMATHRESH=8;           // Issue new DMA at FIFO half empty/full condition
MSPI(mspiModule)->DMABCOUNT=32;           // burst count=32 bytes (8 words)
```

The MSPI implements a single FIFO for both TX and RX transfers as well as separate threshold values for RX/TX operations. In most cases, the DMATHRESH\_DMATXTHRESH field should be set at 8 to indicate that a TX DMA (read from SRAM) will be triggered when the FIFO drops below eight entries and will trigger an RX DMA (write to SRAM) when the FIFO level reaches eight entries. The DMABCOUNT\_BCOUNT field indicates the number of words that will be transferred each time that DMA is triggered. The DMA will also trigger automatically to flush or fill the FIFOs at the end of transfer if the total count is not a multiple of 32 bytes.

To initiate a DMA transfer, software should issue the following register operations:

```
MSPI(mspiModule)->DMADEVADDR=(uint32_t) addr;           // set device address
MSPI(mspiModule)->DMATARGADDR=(uint32_t) data;          // set address in system memory
MSPI(mspiModule)->DMATOTCOUNT=(count<<2);             // set total number of bytes
MSPI(mspiModule)->DMACFG= AM_REG_MSPI_DMACFG_DMAEN |
    AM_REG_MSPI_DMACFG_DMADIR_P2M;                      // enable DMA peripheral to memory
```

When complete, the MSPI will issue the DMACPL interrupt or software can monitor the status by reading the DMASTAT\_DMATIP bit. For writes to peripherals, software should also check the INTSTAT\_CMDCMP bit to ensure the transaction has finished. Transfers to the flash device are initiated by setting the DMACFG\_DMADIR field to M2P (Memory to Peripheral).

The controller will use the template in the FLASH register to determine whether to send the instruction and address phases (XIPSENDI, XIPSEDA) and whether to insert turnaround cycles (FLASH\_XIPENTURN). Instruction and address lengths are determined by the settings in the CFG register and the address and transfer count are set by the DMADEVADDR and DMATOTCOUNT registers. The instruction sent for read (RX) operations is specified in the READINSTR field of the XIPINSTR register and likewise the WRITEINSTR field is used when transmitting data to the flash device.

If the AUTO DMA cannot be used because the device's characteristics don't fit into the template, software can issue PIO operations to initiate a more complex transfer setup and then enable DMA for just the bulk DMA portions using the DMAEN\_EN instead of DMAEN\_AUTO.

Optionally, the MSPI can turn off its power domain at the end of a DMA transfer if the DMAPWROFF bit is set in the DMACFG register. The domain will only power off once the entire DMA is complete (i.e. writes have been committed to system memory or have completed to the external flash device).

## 7.5 Execute in Place (XIP) Operations

The XIP mode of operation allows devices on the MSPI interface to be mapped into the flash cache's address space and appear as an extension to the internal flash array(s). Once enabled by the XIPEN bit in the FLASH register, the flash/cache module will decode the address region and forward operations to the MSPI interface for completion. XIP mode uses the same configuration information as DMA mode and will automatically execute a cache line read fetch from the attached device and return it to the cache controller.

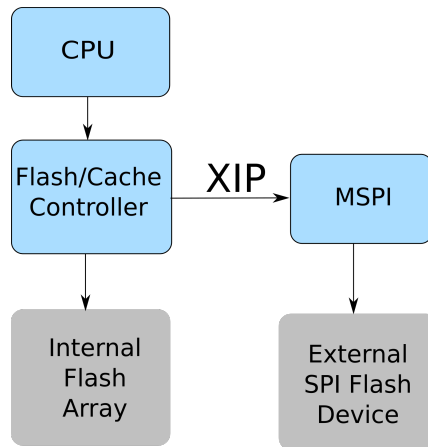


**Figure 12. XIP Block Diagram**

XIP and DMA/PIO operations can all be interleaved since the MSPI controller will allow the current operation to complete before performing the XIP operation. XIP may be interleaved within an ongoing DMA transfer as configured by either the DMABOUNDARY\_DMATIMELIMIT transaction time or the DMABOUNDARY\_DMABOUND address boundary.

Generally DMA read operations can safely be interleaved with XIP, however, XIP mode may have to be disabled during flash programming operations since the flash array within the device may not be available during program or erase operations and thus would return invalid data.

### 7.5.1 XIP Operation

For Apollo3 Blue SoC Revision B0, the MSPI additionally supports a memory-mapped XIP mode (XIPMM) that enables full read/write mapping of an MSPI device such as a PSRAM to the CPU's peripheral address map at offset 0x51000000-0x51FFFFFF for MSPI. This is mapped to offset 0 of the device on the MSPI bus and is not cached (unlike XIP space) and thus can be used as an extension to system SRAM. The MSPI device can be accessed by both XIP and XIP accesses (the regions overlap), but it is recommended that XIP used for static data/instructions and that a separate area of the MSPI device is used for read/write operations to avoid having stale data visible in the cache.

XIP seamlessly supports word, halfword, and byte read and write accesses, however, there are a few restrictions and caveats:

- As mentioned above, writes to XIP do not flush cached data to the same address.
- For scrambled regions, XIP can only be written safely by writing words (byte and halfword writes will corrupt the scrambled data at that location). Byte, halfword, and word reads may all be performed to scrambled regions.
- Read/Write performance to the XIP region will be significantly slower than accesses to internal SRAM since there are multiple cycles of command, addressing, and data transfer overhead. For this reason, internal SRAM should be used for frequently accessed data and XIP should be used for infrequently used data.



To help minimize the access penalty on XIP writes, a 2-entry write FIFO buffers all writes to XIP. These will be immediately accepted on the CPU's bus allowing it to continue execution. However, the CPU will stall if another write or peripheral read is performed before the previous writes complete.

### **7.5.2 Optimized XIP Addressing**

Some SPI flash devices support an optimized XIP mode that minimizes the number of instruction/address cycles that must be transmitted in order to reduce overall fetch latency. To activate this mode, software should program the flash device's registers to enter the device XIP mode, and then update the CFG\_DEVCFG field to the specified number of address bytes and then disable the FLASH\_XIPSENDI field (assuming that no instruction needs to be sent). To exit the device's XIP mode, software should reconfigure the MSPI interface in order to send the required XIP exit sequence to the device.

### **7.5.3 Micron XIP Support**

Micron flash devices support an XIP mode that does not require the instruction byte to be transmitted, which minimizes the access time to the device. In order to transition in and out of this mode, the MSPI controller must issue an acknowledgment of XIP mode during the first turnaround cycle for each XIP access. When transitioning into and out of XIP mode, software must set the FLASH\_XIPACK field appropriately.

Under normal operation, the XIPACK should be set to NOACK (0x0), indicating that no acknowledgment should be sent. To transition into XIP mode, software should perform the following actions:

1. Activate XIP in the Micron device by writing the Volatile Configuration register
2. Set the FLASH\_XIPACK bit field to ACK (0x2)
3. Perform a memory read from the Micron device (instruction must be sent). This access will allow the MSPI controller to acknowledge switching into the XIP mode
4. Set the CTRL\_XIPSENDI bit field to 0 to indicate that the instruction byte no longer needs to be sent.

The MSPI will now transmit just the address to the Micron device and drive a 0 onto the data lines on the first turnaround cycle to remain in XIP mode. It is important that software ONLY perform read operations to the flash device until XIP mode has been exited.

To terminate XIP mode, software should perform the following sequence:

1. Set the FLASH\_XIPACK bit field to TERMINATE (0x3)
2. Issue a memory read to the Micron device. This will allow the MSPI controller to signal termination of XIP mode by driving the data lines high during the first turnaround cycle.
3. Set the FLASH\_XIPACK bit field to NOACK (0x0) and the CTRL\_XIPSENDI bit field to 1.

After this sequence has completed, software can erase, program, or send any other instructions to the Micron flash again.

## 7.6 Command Queueing (CQ)

The MSPI's command queueing (CQ) interface is similar to command queueing implementation in the IOM and BLE modules. To utilize the command queue, software basically constructs a series of register operations that would be issued to the MSPI device, but instead places them in an array in system SRAM (or internal flash). The start of this buffer is then written to the CQADDR register and the commands can be issued by enabling the CQEN bit in the CQCFG register. The CQ logic then reads the address/data pairs via DMA operations and will continue executing them until the end of the command queue, which is denoted as a write to the STOP bit in the CQPAUSE register. As the CQ logic issues register operations, it will automatically pause fetching new operations while the transfer module is busy or can be paused to wait for external events based on the status of the CQPAUSE and CQFLAGS registers.

The primary limitation of CQ operations is that all addresses must reside within the MSPI module since the operations are executed internally by the MSPI module (i.e. it cannot write register in other modules, etc).

### 7.6.1 Command Queue Data Format

As the command queue resides in system memory, the general format is pairs of words that form the register address to write as well as the data to write. Assuming the CQ base address is 0x10000, system SRAM might look like the following table:

**Table 322: Command Queue Example**

| Address | Data       | Description                                                     |
|---------|------------|-----------------------------------------------------------------|
| 0x10000 | 0x50014258 | DMATARGADDR register address                                    |
| 0x10004 | 0x00002800 | Data to write to DMATARGADDR (i.e. 0x2800 is the target buffer) |
| 0x10008 | 0x5001425C | DMADEVADDR register address                                     |
| 0x1000C | 0x00304000 | Address within flash device                                     |
| 0x10010 | 0x50014260 | DMATOTCOUNT register address                                    |
| 0x10014 | 0x00000100 | Transfer 256 bytes of data                                      |
| 0x10018 | 0x50014250 | DMACFG register address                                         |
| 0x1001C | 0x00000003 | AUTO DMA enable on peripheral to memory transfer                |
| 0x10020 | 0x50014288 | CQPAUSE register address                                        |
| 0x10024 | 0x00008000 | End of Command Queue (write to STOP bit)                        |

The AM\_REG macros can be used to construct the CQ table in a manner similar to below:

```
uint32_t *cqptr = 0x10000;
*cqptr++ = AM_REG_ADDR(MSPI, DMADEVADDR);
*cqptr++ = devaddr; // set device address (for encryption)
*cqptr++ = AM_REG_ADDR(MSPI, DMATARGADDR);
*cqptr++ = data_buffer; // set source address in memory
*cqptr++ = AM_REG_ADDR(MSPI, DMATOTCOUNT);
*cqptr++ = 4*num_words; // set total number of bytes
*cqptr++ = AM_REG_ADDR(MSPI, DMACFG);
*cqptr++ = AM_REG_MSPI_DMACFG_DMAEN_AUTO |
            AM_REG_MSPI_DMACFG_DMADIR_M2P; // enable DMA write
*cqptr++ = AM_REG_ADDR(MSPI, CQPAUSE);
*cqptr++ = AM_REG_MSPI_CQFLAGS_STOP_M;
```

## 7.6.2 CQ Interrupts

The MSPI CQ module provides several interrupts via the INTEN register to provide feedback to software as the MSPI works through its command queue.

- **CQERR:** Indicates that the command queue encountered an error when fetching the command queue instructions. This can be caused by an invalid CQ pointer that points to an invalid flash or SRAM address (SRAM powered down, etc).
- **CQPAUSED:** Indicates that the command queue has encountered a pause condition. This can be triggered by an index match or when the CQ is waiting on a software or hardware flag.
- **CQCMP:** Indicates that the command queue has completed operations. This is typically used when the command queue is executing a single-shot set of commands which end with the CQ writing the STOP bit in the CQPAUSE register.
- **CQUPD:** Indicates a generic CQ update interrupt which is triggered by execution of a command queue entry.

Software can generate a CQUPD interrupt at any point during command queue operation by setting bit[0] of the register address of the command to a 1 (basically OR 0x1 with the address portion of a CQ entry. This can be useful when software would like intermediate interrupts as operations complete such as after each CQ index is updated.

## 7.6.3 Pausing CQ Operations

While the basic operation of the CQ functionality is pretty straightforward, constructing more complex scenarios such as queuing of multiple operations requires additional logic to accommodate handshaking with the software managing the queue and other modules within the chip. The MSPI accomplishes both of these by providing the ability to pause the CQ processing using a pause mask (CQPAUSE register) and software and hardware pause flags.

After the MSPI executes a CQ write operation, it will check all bits specified in the CQPAUSE register against their CQFLAGS status, and will pause operation if all of the associated CQFLAGS bits are set. Since all registers are available to be written by both CPU software and CQ commands, there are numerous ways these can be used, but two common scenarios are

- Software can initially set a mask in CQPAUSE and CQ operation will continue until the matching CQFLAGS condition is encountered.
- The CQ command stream can set the CQPAUSE register during execution and pause until the status in FLAGS changes to indicate that it should restart.

The CQFLAGS register contains 8 soft flags (register bits that can be controlled by either the CPU or the QC operation) and an additional 8 hard flags, which are hardware status flags tied to logic in the MSPI module or other modules in the chip. The lowest two soft flags are also exported to the IOM SPI modules to facilitate communication between an IOM and the MSPI to enable management of common MSPI/IOM buffers via the command queues. The table below lists the flags available in the MSPI:

**Table 323: CQFLAGS**

| Bit | Type | Mnemonic | Description/Use                                                                                                                              |
|-----|------|----------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 15  | Hard | STOP     | CQ Stop Flag. When set to 1, CQ processing will terminate and the CQCPL interrupt will be generated.                                         |
| 14  | Hard | CQIDX    | CQ Index Pointer Match. Will be set to 1 when the CURIDX and ENDIDX pointers match. Generally used by software when forming a request queue. |

**Table 323: CQFLAGS**

| Bit | Type | Mnemonic                 | Description/Use                                                                                                                                                                                          |
|-----|------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13  | Hard |                          | Reserved                                                                                                                                                                                                 |
| 12  | Hard |                          | Reserved                                                                                                                                                                                                 |
| 11  | Hard | DMACPL                   | DMA Complete Status (hardwired DMACPL bit in DMASTAT)                                                                                                                                                    |
| 10  | Hard | CMDCPL                   | PIO Operation completed (STATUS bit in CTRL register)                                                                                                                                                    |
| 9   | Hard | IOM1READY/<br>BUF1XNOREN | Buffer 1 Ready Status. IOM Buffer 1 Ready Status (from selected IOM). This status is the result of XNOR'ing the IOM0START with the incoming status from the IOM. When high, MSPI can send to the buffer. |
| 8   | Hard | IOM0READY/<br>BUF0XNOREN | Buffer 0 Ready Status. IOM Buffer 0 Ready Status (from selected IOM). This status is the result of XNOR'ing the IOM0START with the incoming status from the IOM. When high, MSPI can send to the buffer. |
| 7   | Soft | SWFLAG7                  | Software flag                                                                                                                                                                                            |
| 6   | Soft | SWFLAG6                  | Software flag                                                                                                                                                                                            |
| 5   | Soft | SWFLAG5                  | Software flag                                                                                                                                                                                            |
| 4   | Soft | SWFLAG4                  | Software flag                                                                                                                                                                                            |
| 3   | Soft | SWFLAG3                  | Software flag                                                                                                                                                                                            |
| 2   | Soft | SWFLAG2                  | Software flag                                                                                                                                                                                            |
| 1   | Soft | IOM1START                | Flag wired to IOM devices as a hard flag for intercommunication. Typically indicates that buffer 1 has been filled by MSPI and can be emptied by the IOM.                                                |
| 0   | Soft | IOM0START                | Flag wired to IOM devices as a hard flag for intercommunication. Typically indicates that buffer 0 has been filled by MSPI and can be emptied by the IOM.                                                |

The soft flags can be set/cleared/toggled via writes to the CQSETCLEAR register and their status can be read by software by reading the CQFLAGS register directly. The CQPAUSE mask bits are enumerated in the same manner.

In order to minimize the need to pause for individual operations, the CQ will automatically pause any time the MSPI's transfer block is active (for PIO, DMA, or XIP operations). Thus, whenever the CQ enables a DMA operation, there is an implicit pause until the operation completes, and then the CQ will resume fetching additional commands. To terminate the CQ processing, the CQ or software should set the most significant (unreserved) CQPAUSE register bit (STOP), which will cause the MSPI to terminate processing of the command queue and issue a CQCPL interrupt.

#### 7.6.4 Using the CQ Index registers

The MSPI command queuing implementation also includes a pair of registers that allow software to manage a list of outstanding operations: CQCURIDX and CQENDIDX. When initializing the command queue software can set both of these registers to the same value, which indicate an index or reference into the position of the command queue. The CQPAUSE can then be set to CQIDX and the command queue enabled. Since the CQCURIDX equals the CQENDIDX, the command queue will immediately pause and wait for them to be not equal again triggering resumption of CQ processing.

For each group of commands in the command queue, software can place a write to the CQCURIDX after each DMA operation in the command queue and then directly write the CQENDIDX register with the index of the last operation in the queue. Since the CQENDIDX now mismatches the CQCURIDX, the command queue will begin processing commands and start working its way through the queue. After completing the first operation, the command queue will include a write to the CQCURIDX to indicate that the operation has completed, and the CQ logic will check to see if the CQCURIDX equals the CQENDIDX and either pause or continue processing until the two are equal again.

This mechanism allows software to asynchronously post additional operations to the command queue by simply writing the new commands to memory and then updating the CQENDIDX to the index of the last operation. Because the MSPI CQ hardware simply looks for a match between the registers, software may roll over from 0xFF to 0x00 or use the indices in any manner they see fit as long as the end index value is not found elsewhere in the command queue.

Software can monitor the progress of the MSPI's CQ processing by enabling the DMACPL interrupt, which will generate an interrupt after each DMA completion. The interrupt routine can read the CQCURIDX register to determine which operations have completed in order to return the proper status to the application.

### 7.6.5 MSPI and IOM Intercommunication

The MSPI module and IOM modules can be linked through the command queue flags to allow a simple form of handshaking to facilitate data flow between the two modules. The MSPI only has a single pair of hardware flags dedicated to IOM communication so software must write the IOMSEL field in the MSPICFG register to select which IOM is paired with the MSPI.

A typical use model for this feature is for transmitting blocks of data stored in external flash to a device (such as a display) on the IOM interface. In this scenario, software would allocate two buffers in SRAM which would be filled by the MSPI and emptied by the IOM. At the beginning of the operation, software would clear the IOM0START and IOM1START flags and initialize the MSPI command queue with two read operations to load data into buffer 0 and buffer 1. Software would also initialize the corresponding flags in the other device and set up the command queue to point to begin reading at buffer 0, but pause until it sees the buffer0 status is ready.

When the MSPI command queue is enabled, it will check the IOM0READY flag (which will be zero since the incoming bit is zero and the IOM0START flag is zero) and begin processing the operation which would DMA data from the external flash to fill buffer 0. At the end of the operation, the CQ would write the CQPAUSE register with the mask for IOM1READY. The status of IOM1READY will also be zero, so it will continue processing to fill buffer 1. At the end of this operation, the CQ will write the CQPAUSE register to IOM0READY again, but this time it will likely pause because the IOM is still reading data out of buffer 0. Once the IOM finishes its reads from buffer 0, its CQ will set the flag for buffer 0, which will in turn cause the IOM0READY hardware flag to become zero and allow the MSPI to continue processing (which would fill buffer 0 again). In this manner, software would only need to continue adding commands to the MSPI command queue in order to continuously feed data frames to the IOM device.

## 7.7 Data Scrambling

In order to protect customer data stored on external flash devices, the MSPI module supports a data scrambling algorithm to obfuscate data on the MSPI bus. Scrambling can be enabled by programming the SCRAMBLING\_SCRSTART and SCRAMBLING\_SCREND fields to correspond to the address range to be encrypted and setting the SCRENABLE bit in the SCRAMBLING register. Scrambling is enabled for all DMA and XIP operations that fall within the scrambling window.

Accesses to the scrambling region must always be to an aligned, four-byte boundary (i.e. device address must always end in 0x0, 0x4, 0x8, 0xC). Accesses through the XIP region are always aligned to cache lines, but software must ensure that DMA operations are properly aligned. In the case of a mis-aligned DMA access, the MSPI will issue the SCRERR interrupt (SCRambling ERRor).

## 7.8 Auto Power Down

The MSPI module has the ability to power itself down at the end of a DMA or CQ operation. This would usually be done while the system is going into deep sleep but desires the MSPI to transfer data to or from a flash device during the beginning of the sleep period. To enable auto-power down, software should

enable the DMA with the DMACFG\_DMAPWROFF bit set or command queuing with the CQCFG\_CQPWROFF bit set.

## 7.9 Pad Configuration and Enables

The MSPI transfer block generally handles the bit/byte alignment for transfers, but the MSPI also provides a set of internal pin muxes controlled by the MSPI\_PADCFG register to provide system level designers more options when connecting flash devices by allowing the association of chip enable with a mixture of data pins - for instance, chip enable 1 may be used in a quad configuration with data pins 0, 1, 6, 7 of the SPI interface. The pin muxing also controls the separation of I/O operations for serial devices or transfer modes, where pin 0 is typically MOSI and pin 1 is MISO instead of being a shared tristate pin.

MSPI supports the following external connections. The columns to the right indicate which bits are used in each configuration (S=serial, D=dual, Q=quad, O=octal with CE#). Within the table, O=output pin, I=input pin, and X=bidirectional.

**Table 324: MSPI Pin Muxing**

| Pin Name | Direction    | GPIO                 | Description     | S0 | S1 | D0 | D1 | Q0 | Q1 | O0 | O1 |
|----------|--------------|----------------------|-----------------|----|----|----|----|----|----|----|----|
| MSPI.0   | Output       | 1, 7, 10, 15, 19, 28 | MSPI CE0        | O  |    | O  |    | O  |    | O  |    |
| MSPI.1   | Output       | 12,32,36,41,43,46    | MSPI CE1        |    | O  |    | O  |    | O  |    | O  |
| MSPI8    | Output       | 24                   | MSPI CLK        | O  | O  | O  | O  | O  | O  | O  | O  |
| MSPI7    | Input/Output | 3                    | MSPI Data Bit 7 |    |    |    |    |    | X  | X  | X  |
| MSPI6    | Input/Output | 2                    | MSPI Data Bit 6 |    |    |    |    |    | X  | X  | X  |
| MSPI5    | Input/Output | 1                    | MSPI Data Bit 5 |    | I  |    | X  |    | X  | X  | X  |
| MSPI4    | Input/Output | 0                    | MSPI Data Bit 4 |    | O  |    | X  |    | X  | X  | X  |
| MSPI3    | Input/Output | 23                   | MSPI Data Bit 3 |    |    |    |    | X  |    | X  | X  |
| MSPI2    | Input/Output | 4                    | MSPI Data Bit 2 |    |    |    |    | X  |    | X  | X  |
| MSPI1    | Input/Output | 26                   | MSPI Data Bit 1 | I  |    | X  |    | X  |    | X  | X  |
| MSPI0    | Input/Output | 22                   | MSPI Data Bit 0 | O  |    | X  |    | X  |    | X  | X  |

The PADOUTEN register should be programmed to enable the proper pins for the selected mode. While the MSPI will automatically drive and sample data from the proper data lines, the MSPI also contains the ability to map bit lanes from the lower quad to the upper quad in case the system-level design cannot accommodate mapping the four contiguous pins within the lower quad. This is done via the PADCFG register, which has separate input and output muxing options.

Typically, most serial SPI devices use a separate MOSI and MISO when operating in serial mode. The SEPIO bit in the CFG register should be set when software needs to read data from devices in serial mode, since it redirects the MISO input from pin 1 down to input data pin 0 of the MSPI's RX logic.

Table 325 below shows the required field configurations for typical MSPI operating modes. It should be noted that if the settings in the PADCFG register are changed, then the PADOUTEN\_OUTEN field must be

adjusted accordingly. For example, if PADCFG\_OUT3 is set to move the CLK pin from MSPI\_8 to MSPI\_3 (serial or dual mode), then the PADOUTEN\_OUTEN field must be adjusted accordingly, e.g., 0x101 becomes 0x009.

**Table 325: Required Settings for Typical Configurations**

| Mode (Data Lines and CE) |         |        |             |                  | CFG_DEVCFG  | CFG_SEPIO | FLASH_XIPMIXED | PADOUTEN_OUTEN |
|--------------------------|---------|--------|-------------|------------------|-------------|-----------|----------------|----------------|
| Instruction              | Address | Data   | Separate IO | Chip Enable (CE) |             |           |                |                |
| Serial                   | Serial  | Serial | Yes         | 0                | SERIAL0 (1) | 1         | NORMAL (0)     | 0x103          |
| Serial                   | Serial  | Serial | Yes         | 1                | SERIAL1 (2) | 1         | NORMAL (0)     | 0x130          |
| Serial                   | Serial  | Serial | No          | 0                | SERIAL0 (1) | 0         | NORMAL (0)     | 0x101          |
| Serial                   | Serial  | Serial | No          | 1                | SERIAL1 (2) | 0         | NORMAL (0)     | 0x110          |
| Serial                   | Serial  | Dual   | No          | 0                | SERIAL0 (1) | 0         | D2 (1)         | 0x103          |
| Serial                   | Serial  | Dual   | No          | 1                | SERIAL1 (2) | 0         | D2 (1)         | 0x130          |
| Serial                   | Dual    | Dual   | No          | 0                | SERIAL0 (1) | 0         | AD2 (3)        | 0x103          |
| Serial                   | Dual    | Dual   | No          | 1                | SERIAL1 (2) | 0         | AD2 (3)        | 0x130          |
| Serial                   | Serial  | Quad   | No          | 0                | SERIAL0 (1) | 0         | D4 (5)         | 0x10F          |
| Serial                   | Serial  | Quad   | No          | 1                | SERIAL1 (2) | 0         | D4 (5)         | 0x1F0          |
| Serial                   | Quad    | Quad   | No          | 0                | SERIAL0 (1) | 0         | AD4 (7)        | 0x10F          |
| Serial                   | Quad    | Quad   | No          | 1                | SERIAL1 (2) | 0         | AD4 (7)        | 0x1F0          |
| Dual                     | Dual    | Dual   | No          | 0                | DUAL0 (5)   | 0         | NORMAL (0)     | 0x103          |
| Dual                     | Dual    | Dual   | No          | 1                | DUAL1 (6)   | 0         | NORMAL (0)     | 0x130          |
| Quad                     | Quad    | Quad   | No          | 0                | QUAD0 (9)   | 0         | NORMAL (0)     | 0x10F          |
| Quad                     | Quad    | Quad   | No          | 1                | QUAD1 (A)   | 0         | NORMAL (0)     | 0x1F0          |
| Octal                    | Octal   | Octal  | No          | 0                | OCTAL0 (D)  | 0         | NORMAL (0)     | 0x1FF          |
| Octal                    | Octal   | Octal  | No          | 1                | OCTAL1 (E)  | 0         | NORMAL (0)     | 0x1FF          |

### 7.9.1 Internal Pin Muxing Options

The MSPI also has the ability to swap some pin functionality to provide some additional flexibility in selecting pins used by the MSPI. Table 324 shows the MSPI pin mapping through the GPIO module, which has fixed pads for each MSPI pin, however, the MSPI can also perform a minimal second layer of function swapping within the MSPI pins using the PADCFG register as shown in Table 326.

**Table 326: PADCFG Description**

| Bitfield        | Description                                                                                                                                           |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| REVCS           | Swaps chip enable outputs, allowing pins mapped to CS1 to be associated with the lower quad of data pins.                                             |
| IN3,IN2,IN1,IN0 | Allows muxing of individual bit inputs from the upper quad (MSPI data bits 7:4) into the lower quad. Typically the OUT7-4 bits would be set to match. |



**Table 326: PADCFG Description**

| Bitfield            | Description                                                                                                                    |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------|
| OUT7,OUT6,OUT5,OUT4 | Allows muxing of individual bit outputs from the lower quad to the upper quad. Typically the IN3-0 bits would be set to match. |
| OUT3                | Allows MSPI pin [3] to be used as the clock output.                                                                            |

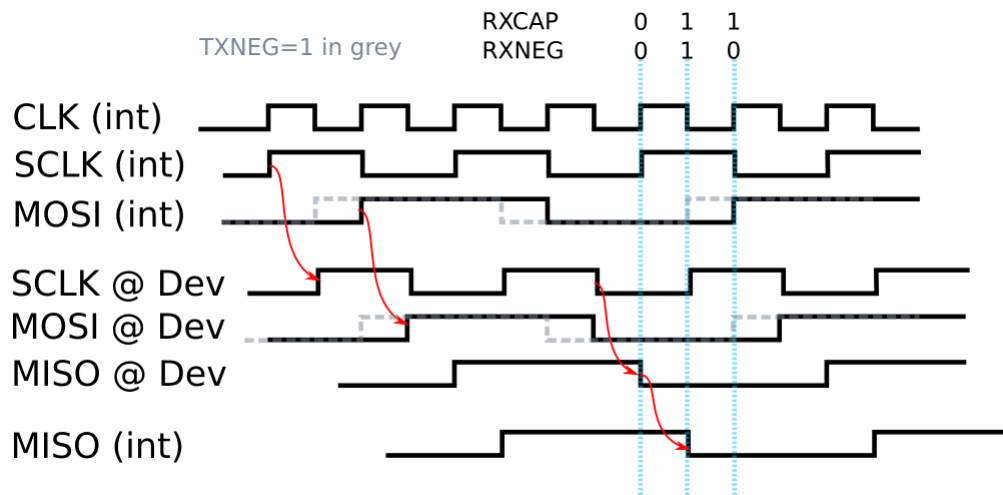
Since the data lines within a quad are balanced with respect to each other, it is recommended that customers do not use the internal muxing features unless pin requirements disallow the use of a contiguous quad.

### 7.9.2 MSPI Pin Timing Board/Package Considerations

The MSPI pins in the chip pin muxing are grouped by the two sets of quad pairs. The lower MSPI quad should be used whenever possible since these pads are closer to the MSPI logic and have less delay than the upper quad. When running in octal mode, the timings through the upper pins will dictate the speed of the interface.

The MSPI logic contains controls to adjust I/O timings to accommodate differences in board or device timings through the RXCAP, RXNEG, and TXNEG bits in the MSPICFG register. The discussion below assumes SPI mode 0 (CPHA=0, CPOL=0) and that in dual/quad/octal modes that MOSI refers to all pins in transmission mode and MISO refers to all pins when in receive mode.

If there were no delays in the chip/board/device, then ideally, data is launched on the negedge of the clock and captured on the posedge of the clock at both the master (MSPI) and target (flash) device. However the presence of delays in the system complicates timing and the timing diagram shown in Figure 13 indicates how these delays are accommodated in the MSPI interface design. The CLK (int) refers to the internal 48MHz clock used by the MSPI, and the SCLK/MOSI (int) are the internal chip timings for the outgoing clock and MOSI lines. Likewise, the @ Dev signals indicate the timing at the target device's pins. (Delays shown are just representative and may not reflect actual device timings.)

**Figure 13. MSPI Interface Diagram**

Note that bit transmission from the MSPI to the target is fairly straightforward since both the SCLK and MOSI are delayed by similar amounts (two red arrows on the left). Depending on which pins are used,



there may be some skew between the SCLK and MOSI, however, it should be relatively small compared to the half-cycle of setup time. If additional setup is required, however, setting the TXNEG bit to 1 will launch MOSI a half cycle (~10ns) early, which is indicated by the dotted gray waveform on the MOSI signals.

The target to master (MISO) timings on SPI interfaces are a bit more difficult to handle because of the cumulative round trip delay that consists of the clock delay from master to target, the access time at the target itself, and the return delay MISO path (first, third, and fourth red arrows). For this reason, read timings often dictate the frequency of a SPI bus.

The RXCAP and RXNEG bits are used together to determine the incoming RX data capture point. In an ideal world (zero delays), the MSPI would capture data at the rising edge of the internal SCLK, which would correspond to the setting of RXCAP = 0, RXNEG = 0 (the first vertical blue bar). It is useful, however, to push out the RX capture point to accommodate the late arrival of MISO. A setting of RXCAP = 1, RXNEG = 0 is the ideal setting and will delay the capture point by about 20ns (one internal 48MHz clock) as indicated in the third vertical blue line. The MSPI also supports an RXCAP = 1/RXNEG = 1 combination, which samples in between these two points.

## 7.10 MSPI Registers

### Multibit SPI Master

**INSTANCE 0 BASE ADDRESS:**0x50014000

### 7.10.1 Register Memory Map

**Table 327: MSPI Register Map**

| Address(es) | Register Name | Description                                             |
|-------------|---------------|---------------------------------------------------------|
| 0x50014000  | CTRL          | MSPI PIO Transfer Control/Status Register               |
| 0x50014004  | CFG           | MSPI Transfer Configuration Register                    |
| 0x50014008  | ADDR          | MSPI Transfer Address Register                          |
| 0x5001400C  | INSTR         | MSPI Transfer Instruction                               |
| 0x50014010  | TXFIFO        | TX Data FIFO                                            |
| 0x50014014  | RXFIFO        | RX Data FIFO                                            |
| 0x50014018  | TXENTRIES     | TX FIFO Entries                                         |
| 0x5001401C  | RXENTRIES     | RX FIFO Entries                                         |
| 0x50014020  | THRESHOLD     | TX/RX FIFO Threshold Levels                             |
| 0x50014100  | MSPICFG       | MSPI Module Configuration                               |
| 0x50014104  | PADCFG        | MSPI Output Pad Configuration                           |
| 0x50014108  | PADOUTEN      | MSPI Output Enable Pad Configuration                    |
| 0x5001410C  | FLASH         | Configuration for XIP/DMA support of SPI flash modules. |
| 0x50014120  | SCRAMBLING    | External Flash Scrambling Controls                      |
| 0x50014200  | INTEN         | MSPI Master Interrupts: Enable                          |
| 0x50014204  | INTSTAT       | MSPI Master Interrupts: Status                          |
| 0x50014208  | INTCLR        | MSPI Master Interrupts: Clear                           |
| 0x5001420C  | INTSET        | MSPI Master Interrupts: Set                             |
| 0x50014250  | DMACFG        | DMA Configuration Register                              |
| 0x50014254  | DMASTAT       | DMA Status Register                                     |
| 0x50014258  | DMATARGADDR   | DMA Target Address Register                             |
| 0x5001425C  | DMADEVADDR    | DMA Device Address Register                             |
| 0x50014260  | DMATOTCOUNT   | DMA Total Transfer Count                                |
| 0x50014264  | DMABCOUNT     | DMA BYTE Transfer Count                                 |
| 0x50014278  | DMATHRESH     | DMA Transmit Trigger Threshold                          |
| 0x500142A0  | CQCFG         | Command Queue Configuration Register                    |
| 0x500142A8  | CQADDR        | CQ Target Read Address Register                         |
| 0x500142AC  | CQSTAT        | Command Queue Status Register                           |
| 0x500142B0  | CQFLAGS       | Command Queue Flag Register                             |
| 0x500142B4  | CQSETCLEAR    | Command Queue Flag Set/Clear Register                   |
| 0x500142B8  | CQPAUSE       | Command Queue Pause Mask Register                       |
| 0x500142C0  | CQCURIDX      | Command Queue Current Index                             |
| 0x500142C4  | CQENDIDX      | Command Queue End Index                                 |

## 7.10.2 MSPI Registers

### 7.10.2.1 CTRL Register

#### MSPI PIO Transfer Control/Status Register

**OFFSET:** 0x00000000

**INSTANCE 0 ADDRESS:** 0x50014000

This register is used to enable individual PIO based transactions to a device on the bus. The CFG register must be programmed properly for the transfer, and the ADDR and INSTR registers should be programmed if the SENDI and SENDA fields are enabled.

**Table 328: CTRL Register**

|           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |             |        |        |        |        |           |        |        |        |        |        |        |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|--------|--------|--------|--------|-----------|--------|--------|--------|--------|--------|--------|
| 3<br>1    | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1      | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6    | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| XFERBYTES |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | RSVD   |        |        |        | PIOSCRAMBLE | TXRX   | SENDI  | SEDA   | ENTURN | BIGENDIAN | RSVD   |        | RSVD   | BUSY   | STATUS | START  |

**Table 329: CTRL Register Bits**

| Bit   | Name        | Reset | RW | Description                                                                                                                  |
|-------|-------------|-------|----|------------------------------------------------------------------------------------------------------------------------------|
| 31:16 | XFERBYTES   | 0x0   | RW | Number of bytes to transmit or receive (based on TXRX bit)                                                                   |
| 15:12 | RSVD        | 0x0   | RO | RESERVED                                                                                                                     |
| 11    | PIOSCRAMBLE | 0x0   | RW | Enables data scrambling for PIO operations. This should only be used for data operations and never for commands to a device. |
| 10    | TXRX        | 0x0   | RW | 1 Indicates a TX operation, 0 indicates an RX operation of XFERBYTES                                                         |
| 9     | SENDI       | 0x0   | RW | Indicates whether an instruction phase should be sent (see INSTR field and ISIZE field in CFG register)                      |
| 8     | SEDA        | 0x0   | RW | Indicates whether an address phase should be sent (see ADDR register and ASIZE field in CFG register)                        |
| 7     | ENTURN      | 0x0   | RW | Indicates whether TX->RX turnaround cycles should be enabled for this operation (see TURNAROUND field in CFG register).      |
| 6     | BIGENDIAN   | 0x0   | RW | 1 indicates data in FIFO is in big endian format (MSB first); 0 indicates little endian data (default, LSB first).           |
| 5:4   | RSVD        | 0x0   | RO | RESERVED                                                                                                                     |

**Table 329: CTRL Register Bits**

| Bit | Name   | Reset | RW | Description                                                                                                                      |
|-----|--------|-------|----|----------------------------------------------------------------------------------------------------------------------------------|
| 3   | RSVD   | 0x0   | RO | Reserved                                                                                                                         |
| 2   | BUSY   | 0x0   | RO | Command status: 1 indicates controller is busy (command in progress)                                                             |
| 1   | STATUS | 0x0   | RO | Command status: 1 indicates command has completed. Cleared by writing 1 to this bit or starting a new transfer.                  |
| 0   | START  | 0x0   | RW | Write to 1 to initiate a PIO transaction on the bus (typically the entire register should be written at once with this bit set). |

**7.10.2.2 CFG Register****MSPI Transfer Configuration Register****OFFSET:** 0x00000004**INSTANCE 0 ADDRESS:** 0x50014004

Command formatting for PIO based transactions (initiated by writes to CTRL register)

**Table 330: CFG Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |            |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4     | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        | CPOL   | CPHA   | RSVD   | TURNAROUND |        |        |        |        |        | SEPIO  | ISIZE  | ASIZE  | DEVCFG |        |        |        |        |        |

**Table 331: CFG Register Bits**

| Bit   | Name       | Reset | RW | Description                                                                                                                     |
|-------|------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------|
| 31:18 | RSVD       | 0x0   | RO | RESERVED                                                                                                                        |
| 17    | CPOL       | 0x0   | RW | Serial clock polarity.<br>LOW = 0x0 - Clock inactive state is low.<br>HIGH = 0x1 - Clock inactive state is high.                |
| 16    | CPHA       | 0x0   | RW | Serial clock phase.<br>MIDDLE = 0x0 - Clock toggles in middle of data bit.<br>START = 0x1 - Clock toggles at start of data bit. |
| 15:14 | RSVD       | 0x0   | RO | RESERVED                                                                                                                        |
| 13:8  | TURNAROUND | 0x0   | RW | Number of turnaround cycles (for TX->RX transitions). Qualified by ENTURN or XIPENTURN bit field.                               |

| Bit | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7   | SEPIO  | 0x0   | RW | Separate IO configuration. This bit should be set when the target device has separate MOSI and MISO pins. Respective IN/OUT bits below should be set to map pins.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 6   | ISIZE  | 0x0   | RW | Instruction Size                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 5:4 | ASIZE  | 0x0   | RW | Address Size. Address bytes to send from ADDR register                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 3:0 | DEVCFG | 0x1   | RW | Flash configuration for XIP and AUTO DMA operations. Controls value for SER (Slave Enable) for XIP operations and address generation for DMA/ XIP modes. Also used to configure SPIFRF (frame format).<br><br>SERIAL0 = 0x1 - Single bit SPI flash on chip select 0<br>SERIAL1 = 0x2 - Single bit SPI flash on chip select 1<br>DUAL0 = 0x5 - Dual SPI flash on chip select 0<br>DUAL1 = 0x6 - Dual bit SPI flash on chip select 1<br>QUAD0 = 0x9 - Quad SPI flash on chip select 0<br>QUAD1 = 0xA - Quad SPI flash on chip select 1<br>OCTAL0 = 0xD - Octal SPI flash on chip select 0<br>OCTAL1 = 0xE - Octal SPI flash on chip select 1 |

## MSPI Transfer Address Register

**INSTANCE 0 ADDRESS: 0x50014008**

Optional Address field to send for PIO transfers

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| ADDR   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

| Bit  | Name | Reset | RW | Description                                                                                                                                           |
|------|------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | ADDR | 0x0   | RW | Optional Address field to send (after optional instruction field) - qualified by ASIZE in CMD register. NOTE: This register is aliased to DMADEVADDR. |

## MSPI Transfer Instruction

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**INSTANCE 0 ADDRESS:** 0x5001400C

Optional Instruction field to send for PIO transfers

**Table 334: INSTR Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1     | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5     | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | INSTR |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 335: INSTR Register Bits**

| Bit   | Name  | Reset | RW | Description                                                              |
|-------|-------|-------|----|--------------------------------------------------------------------------|
| 31:16 | RSVD  | 0x0   | RO | RESERVED                                                                 |
| 15:0  | INSTR | 0x0   | RW | Optional Instruction field to send (1st byte) - qualified by ISEND/ISIZE |

### 7.10.2.5 TXFIFO Register

**TX Data FIFO**

**OFFSET:** 0x00000010

**INSTANCE 0 ADDRESS:** 0x50014010

TX Data FIFO

**Table 336: TXFIFO Register**

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| TXFIFO |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 337: TXFIFO Register Bits**

| Bit  | Name   | Reset | RW | Description                                                                                                               |
|------|--------|-------|----|---------------------------------------------------------------------------------------------------------------------------|
| 31:0 | TXFIFO | 0x0   | WO | Data to be transmitted. Data should normal be aligned to the LSB (pad the upper bits with zeros) unless BIGENDIAN is set. |

### 7.10.2.6 RXFIFO Register

**RX Data FIFO**

**OFFSET:** 0x00000014

**INSTANCE 0 ADDRESS:** 0x50014014

RX Data FIFO

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 |   |
| RXFIFO |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                                                                                    |
|------|--------|-------|----|------------------------------------------------------------------------------------------------|
| 31:0 | RXFIFO | 0x0   | RO | Receive data. Data is aligned to the LSB (padded zeros on upper bits) unless BIGENDIAN is set. |

## TX FIFO Entries

**INSTANCE 0 ADDRESS: 0x50014018**

Number of words in TX FIFO

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |           |   |   |   |   |   |   |   |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----------|---|---|---|---|---|---|---|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0         | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6         | 5 | 4 | 3 | 2 | 1 | 0 |   |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | TXENTRIES |   |   |   |   |   |   |   |  |  |  |  |

| Bit  | Name      | Reset | RW | Description                               |
|------|-----------|-------|----|-------------------------------------------|
| 31:5 | RSVD      | 0x0   | RO | RESERVED                                  |
| 4:0  | TXENTRIES | 0x0   | RO | Number of 32-bit words/entries in TX FIFO |

## RX FIFO Entries

**INSTANCE 0 ADDRESS: 0x5001401C**

Number of words in RX FIFO

Table 342: RXENTRIES Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |           |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----------|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0         | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7         | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | RXENTRIES |   |   |   |   |   |   |   |

Table 343: RXENTRIES Register Bits

| Bit  | Name      | Reset | RW | Description                               |
|------|-----------|-------|----|-------------------------------------------|
| 31:5 | RSVD      | 0x0   | RO | RESERVED                                  |
| 4:0  | RXENTRIES | 0x0   | RO | Number of 32-bit words/entries in RX FIFO |

**7.10.2.9 THRESHOLD Register****TX/RX FIFO Threshold Levels****OFFSET:** 0x00000020**INSTANCE 0 ADDRESS:** 0x50014020

Threshold levels that trigger RXFull and TXEmpty interrupts

Table 344: THRESHOLD Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |          |   |   |   |      |   |          |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------|---|----------|---|---|---|------|---|----------|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1    | 1 | 1        | 1 | 0 | 0 | 0    | 0 | 0        | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5    | 4 | 3        | 2 | 1 | 0 | 9    | 8 | 7        | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | RSVD |   | RXTHRESH |   |   |   | RSVD |   | TXTHRESH |   |   |   |   |   |   |   |

Table 345: THRESHOLD Register Bits

| Bit   | Name     | Reset | RW | Description                                           |
|-------|----------|-------|----|-------------------------------------------------------|
| 31:16 | RSVD     | 0x0   | RO | RESERVED                                              |
| 15:13 | RSVD     | 0x0   | RO | RESERVED                                              |
| 12:8  | RXTHRESH | 0x0   | RW | Number of entries in TX FIFO that cause RXE interrupt |
| 7:5   | RSVD     | 0x0   | RO | RESERVED                                              |
| 4:0   | TXTHRESH | 0x0   | RW | Number of entries in TX FIFO that cause TXF interrupt |



### 7.10.2.10 MSPICFG Register

#### MSPI Module Configuration

**OFFSET:** 0x00000100

**INSTANCE 0 ADDRESS:** 0x50014100

Timing configuration bits for the MSPI module. PRSTN, IPRSTN, and FIFORESET can be used to reset portions of the MSPI interface in order to clear error conditions. The remaining bits control clock frequency and TX/RX capture timings.

**Table 346: MSPICFG Register**

|        |        |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9    | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| PRSTN  | IPRSTN | FIFORESET | RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CLKDIV |        |        |        | RSVD   | IOMSEL |        |        | TXNEG  | RXNEG  | RXCAP  | APBCLK |        |        |

**Table 347: MSPICFG Register Bits**

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------|-----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | PRSTN     | 0x1   | RW | Peripheral reset. Master reset to the entire MSPI module (DMA, XIP, and transfer state machines). 1=normal operation, 0=in reset.                                                                                                                                                                                                                                                                                                                                                        |
| 30    | IPRSTN    | 0x1   | RW | IP block reset. Write to 0 to put the transfer module in reset or 1 for normal operation. This may be required after error conditions to clear the transfer on the bus.                                                                                                                                                                                                                                                                                                                  |
| 29    | FIFORESET | 0x0   | RW | Reset MSPI FIFO (active high). 1=reset FIFO, 0=normal operation. May be used to manually flush the FIFO in error handling.                                                                                                                                                                                                                                                                                                                                                               |
| 28:14 | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 13:8  | CLKDIV    | 0x2   | RW | Clock Divider. Allows dividing 48 MHz base clock by integer multiples. Enumerations are provided for common frequency, but any integer divide from 48 MHz is allowed. Odd divide ratios will result in a 33/66 percent duty cycle with a long low clock pulse (to allow longer round-trip for read data).<br>CLK24 = 0x2 - 24 MHz MSPI clock<br>CLK12 = 0x4 - 12 MHz MSPI clock<br>CLK6 = 0x8 - 6 MHz MSPI clock<br>CLK3 = 0x10 - 3 MHz MSPI clock<br>CLK1_5 = 0x20 - 1.5 MHz MSPI clock |
| 7     | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

| Bit | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----|--------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6:4 | IOMSEL | 0x0   | RW | <p>Selects which IOM is selected for CQ handshake status.</p> <p>IOM0 = 0x0 - IOM0 selected<br/> IOM1 = 0x1 - IOM1 selected<br/> IOM2 = 0x2 - IOM2 selected<br/> IOM3 = 0x3 - IOM3 selected<br/> IOM4 = 0x4 - IOM4 selected<br/> IOM5 = 0x5 - IOM5 selected<br/> DISABLED = 0x7 - No IOM selected. Signals always zero.</p>                                                                                                                                                                                                                                             |
| 3   | TXNEG  | 0x0   | RW | <p>Launches TX data a half clock cycle (~10ns) early. This should normally be programmed to zero (NORMAL).</p> <p>NORMAL = 0x0 - TX launched from posedge internal clock<br/> NEGEDGE = 0x1 - TX data launched from negedge of internal clock</p>                                                                                                                                                                                                                                                                                                                       |
| 2   | RXNEG  | 0x0   | RW | <p>Adjusts the RX capture phase to the negedge of the 48MHz internal clock (~10ns early). For normal operation, it is expected that RXNEG will be set to 0.</p> <p>NORMAL = 0x0 - RX data sampled on posedge of internal clock<br/> NEGEDGE = 0x1 - RX data sampled on negedge of internal clock</p>                                                                                                                                                                                                                                                                    |
| 1   | RXCAP  | 0x0   | RW | <p>Controls RX data capture phase. A setting of 0 (NORMAL) captures read data at the normal capture point relative to the internal clock launch point. However, to accomodate chip/pad/board delays, a setting of RXCAP of 1 is expected to be used to align the capture point with the return data window. This bit is used in conjunction with RXNEG to provide 4 unique capture points, all about 10ns apart.</p> <p>NORMAL = 0x0 - RX Capture phase aligns with CPHA setting<br/> DELAY = 0x1 - RX Capture phase is delayed from CPHA setting by one clock edge</p> |
| 0   | APBCLK | 0x0   | RW | <p>Enable continuous APB clock. For power-efficient operation, APBCLK should be set to 0.</p> <p>DIS = 0x0 - Disable continuous clock.<br/> EN = 0x1 - Enable continuous clock.</p>                                                                                                                                                                                                                                                                                                                                                                                     |

## MSPI Output Pad Configuration

**INSTANCE 0 ADDRESS: 0x50014104**

Configuration bits for the MSPI pads. Allows pads associated with the upper quad to be mapped to corresponding bits on the lower quad. Use of Quad0 pins is recommended for optimal timing.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        | REVCS  | IN3    | IN2    | IN1    | IN0    | RSVD   |        |        |        |        |        |        |        |        |        | OUT7   | OUT6   | OUT5   | OUT4   | OUT3   |        |        |

**Table 349: PADCFG Register Bits**

| Bit   | Name | Reset | RW | Description                                                                                                              |
|-------|------|-------|----|--------------------------------------------------------------------------------------------------------------------------|
| 31:22 | RSVD | 0x0   | RO | RESERVED                                                                                                                 |
| 21    | REVC | 0x0   | RW | Reverse CS connections. Allows CS1 to be associated with lower data lanes and CS0 to be associated with upper data lines |
| 20    | IN3  | 0x0   | RW | Data Input pad 3 pin muxing: 0=pad[3] 1=pad[7]                                                                           |
| 19    | IN2  | 0x0   | RW | Data Input pad 2 pin muxing: 0=pad[2] 1=pad[6]                                                                           |
| 18    | IN1  | 0x0   | RW | Data Input pad 1 pin muxing: 0=pad[1] 1=pad[5]                                                                           |
| 17:16 | IN0  | 0x0   | RW | Data Input pad 0 pin muxing: 0=pad[0] 1=pad[4] 2=pad[1] 3=pad[5]                                                         |
| 15:5  | RSVD | 0x0   | RO | RESERVED                                                                                                                 |
| 4     | OUT7 | 0x0   | RW | Output pad 7 configuration. 0=data[7] 1=data[3]                                                                          |
| 3     | OUT6 | 0x0   | RW | Output pad 6 configuration. 0=data[6] 1=data[2]                                                                          |
| 2     | OUT5 | 0x0   | RW | Output pad 5 configuration. 0=data[5] 1=data[1]                                                                          |
| 1     | OUT4 | 0x0   | RW | Output pad 4 configuration. 0=data[4] 1=data[0]                                                                          |
| 0     | OUT3 | 0x0   | RW | Output pad 3 configuration. 0=data[3] 1=CLK                                                                              |

**7.10.2.12 PADOUTEN Register****MSPI Output Enable Pad Configuration****OFFSET:** 0x00000108**INSTANCE 0 ADDRESS:** 0x50014108

Enable bits for the MSPI output pads. Each active MSPI line should be set to 1 in the OUTEN field below.

**Table 350: PADOUTEN Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |   |   |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|---|---|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0     | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | OUTEN |   |   |   |   |   |   |   |   |   |   |  |

| Bit  | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                  |
|------|-------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:9 | RSVD  | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                     |
| 8:0  | OUTEN | 0x0   | RW | <p>Output pad enable configuration. Indicates which pads should be driven. Bits [3:0] are Quad0 data, [7:4] are Quad1 data, and [8] is clock.</p> <p>QUAD0 = 0x10F - Quad0 (4 data + 1 clock)<br/>           QUAD1 = 0x1F0 - Quad1 (4 data + 1 clock)<br/>           OCTAL = 0x1FF - Octal (8 data + 1 clock)<br/>           SERIAL0 = 0x103 - Serial (2 data + 1 clock)</p> |

### Configuration for XIP/DMA support of SPI flash modules.

**INSTANCE 0 ADDRESS: 0x5001410C**

|           |        |        |        |        |        |        |        |            |        |        |        |        |        |        |        |        |        |        |        |          |        |          |          |           |              |        |        |        |        |        |        |
|-----------|--------|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|----------|----------|-----------|--------------|--------|--------|--------|--------|--------|--------|
| 3<br>1    | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3     | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1   | 1<br>0 | 0<br>9   | 0<br>8   | 0<br>7    | 0<br>6       | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| READINSTR |        |        |        |        |        |        |        | WRITEINSTR |        |        |        |        |        |        |        | RSVD   |        |        |        | XIPMIXED |        | XIPSENDI | XIPSENDA | XIPENTURN | XIPBIGENDIAN | XIPACK |        | RSVD   | XIPEN  |        |        |

| Bit   | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                              |
|-------|------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:24 | READINSTR  | 0xb   | RW | Read command sent to flash for DMA/XIP operations                                                                                                                                                                                                                                                                                                                        |
| 23:16 | WRITEINSTR | 0x6   | RW | Write command sent for DMA operations                                                                                                                                                                                                                                                                                                                                    |
| 15:11 | RSVD       | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                 |
| 10:8  | XIPMIXED   | 0x0   | RW | NORMAL = 0x0 - Transfers all proceed using the settings in CFG_DEVCFG field (everything in the same data rate)<br>D2 = 0x1 - Data operations proceed in dual data rate<br>AD2 = 0x3 - Address and Data operations proceed in dual data rate<br>D4 = 0x5 - Data operations proceed in quad data rate<br>AD4 = 0x7 - Address and Data operations proceed in quad data rate |

| Bit | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----|--------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7   | XIPSENDI     | 0x0   | RW | Indicates whether XIP/AUTO DMA operations should send an instruction (see READINSTR field and ISIZE field in CFG)                                                                                                                                                                                                                                                                                                                                                                   |
| 6   | XIPSENDER    | 0x0   | RW | Indicates whether XIP/AUTO DMA operations should send an address phase (see DMADEVADDR register and ASIZE field in CFG)                                                                                                                                                                                                                                                                                                                                                             |
| 5   | XIPENTURN    | 0x0   | RW | Indicates whether XIP/AUTO DMA operations should enable TX->RX turnaround cycles                                                                                                                                                                                                                                                                                                                                                                                                    |
| 4   | XIPBIGENDIAN | 0x0   | RW | Indicates whether XIP/AUTO DMA data transfers are in big or little endian format                                                                                                                                                                                                                                                                                                                                                                                                    |
| 3:2 | XIPACK       | 0x0   | RW | Controls transmission of Micron XIP acknowledge cycles (Micron Flash devices only)<br><br>NOACK = 0x0 - No acknowledge sent. Data IOs are tristated the first turnaround cycle<br>ACK = 0x2 - Positive acknowledge sent. Data IOs are driven to 0 the first turnaround cycle to acknowledge XIP mode<br>TERMINATE = 0x3 - Negative acknowledge sent. Data IOs are driven to 1 the first turnaround cycle to terminate XIP mode. XIPSENDI should be re-enabled for the next transfer |
| 1   | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 0   | XIPEN        | 0x0   | RW | Enable the XIP (eXecute In Place) function which effectively enables the address decoding of the MSPI device in the flash/cache address space at address 0x04000000-0x07FFFFFFF.                                                                                                                                                                                                                                                                                                    |

## External Flash Scrambling Controls

**INSTANCE 0 ADDRESS: 0x50014120**

|          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |        |        |        |        |        |        |
|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1   | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0   | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| SCRENAME | RSVD   |        |        |        |        | SCREND |        |        |        |        |        |        |        |        |        | RSVD   |        |        |        |        | SCRSTART |        |        |        |        |        |        |        |        |        |        |

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                 |
|-------|-----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | SCRENABLE | 0x0   | RW | Enables Data Scrambling Region. When 1 reads and writes to the range will be scrambled. When 0, data will be read/written unmodified. Address range is specified in 64K granularity and the START/END ranges are included within the range. |
| 30:26 | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                    |
| 25:16 | SCREND    | 0x0   | RW | Scrambling region end address [25:16] (64K block granularity). The END block is the LAST block included in the scrambled address range.                                                                                                     |
| 15:10 | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                    |
| 9:0   | SCRSTART  | 0x0   | RW | Scrambling region start address [25:16] (64K block granularity). The START block is the FIRST block included in the scrambled address range.                                                                                                |

**INSTANCE 0 ADDRESS: 0x50014200**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0   | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | SCRERR | CQERR  | CQPAUSED | CQUPD  | CQCMP  | DERR   | DCMP   | RXF    | RXO    | RXU    | TXO    | TXE    | CMDCMP |

| Bit   | Name   | Reset | RW | Description                                                                                       |
|-------|--------|-------|----|---------------------------------------------------------------------------------------------------|
| 31:13 | RSVD   | 0x0   | RO | RESERVED                                                                                          |
| 12    | SCRERR | 0x0   | RW | Scrambling Alignment Error. Scrambling operations must be aligned to word (4-byte) start address. |
| 11    | CQERR  | 0x0   | RW | Command Queue Error Interrupt                                                                     |

| Bit | Name     | Reset | RW | Description                                                                                                                                        |
|-----|----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 10  | CQPAUSED | 0x0   | RW | Command Queue is Paused.                                                                                                                           |
| 9   | CQUPD    | 0x0   | RW | Command Queue Update Interrupt. Issued whenever the CQ performs an operation where address bit[0] is set. Useful for triggering CURIDX interrupts. |
| 8   | CQCMP    | 0x0   | RW | Command Queue Complete Interrupt                                                                                                                   |
| 7   | DERR     | 0x0   | RW | DMA Error Interrupt                                                                                                                                |
| 6   | DCMP     | 0x0   | RW | DMA Complete Interrupt                                                                                                                             |
| 5   | RXF      | 0x0   | RW | Receive FIFO full                                                                                                                                  |
| 4   | RXO      | 0x0   | RW | Receive FIFO overflow (cannot happen in MSPI design -- MSPI bus pins will stall)                                                                   |
| 3   | RXU      | 0x0   | RW | Receive FIFO underflow (only occurs when SW reads from an empty FIFO)                                                                              |
| 2   | TXO      | 0x0   | RW | Transmit FIFO Overflow (only occurs when SW writes to a full FIFO).                                                                                |
| 1   | TXE      | 0x0   | RW | Transmit FIFO empty.                                                                                                                               |
| 0   | CMDCMP   | 0x0   | RW | Transfer complete. Note that DMA and CQ operations are layered, so CMD-CMP, DCMP, and CQ* can all be signaled simultaneously                       |

## MSPI Master Interrupts: Status

**INSTANCE 0 ADDRESS: 0x50014204**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0   | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | SCRERR | CQERR  | CQPAUSED | CQUPD  | CQCMP  | DERR   | DCMP   | RXF    | RXO    | RXU    | TXO    | TXE    | CMDCMP |

**Table 359: INTSTAT Register Bits**

| Bit   | Name     | Reset | RW | Description                                                                                                                                        |
|-------|----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                           |
| 12    | SCRERR   | 0x0   | RW | Scrambling Alignment Error. Scrambling operations must be aligned to word (4-byte) start address.                                                  |
| 11    | CQERR    | 0x0   | RW | Command Queue Error Interrupt                                                                                                                      |
| 10    | CQPAUSED | 0x0   | RW | Command Queue is Paused.                                                                                                                           |
| 9     | CQUPD    | 0x0   | RW | Command Queue Update Interrupt. Issued whenever the CQ performs an operation where address bit[0] is set. Useful for triggering CURIDX interrupts. |
| 8     | CQCMP    | 0x0   | RW | Command Queue Complete Interrupt                                                                                                                   |
| 7     | DERR     | 0x0   | RW | DMA Error Interrupt                                                                                                                                |
| 6     | DCMP     | 0x0   | RW | DMA Complete Interrupt                                                                                                                             |
| 5     | RXF      | 0x0   | RW | Receive FIFO full                                                                                                                                  |
| 4     | RXO      | 0x0   | RW | Receive FIFO overflow (cannot happen in MSPI design -- MSPI bus pins will stall)                                                                   |
| 3     | RXU      | 0x0   | RW | Receive FIFO underflow (only occurs when SW reads from an empty FIFO)                                                                              |
| 2     | TXO      | 0x0   | RW | Transmit FIFO Overflow (only occurs when SW writes to a full FIFO).                                                                                |
| 1     | TXE      | 0x0   | RW | Transmit FIFO empty.                                                                                                                               |
| 0     | CMDCMP   | 0x0   | RW | Transfer complete. Note that DMA and CQ operations are layered, so CMD-CMP, DCMP, and CQ* can all be signaled simultaneously                       |

**7.10.2.17INTCLR Register****MSPI Master Interrupts: Clear****OFFSET:** 0x00000208**INSTANCE 0 ADDRESS:** 0x50014208

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.



|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0   | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | SCRERR | CQERR  | CQPAUSED | CQUPD  | CQCMP  | DERR   | DCMP   | RXF    | RXO    | RXU    | TXO    | TXE    | CMDCMP |

| Bit   | Name     | Reset | RW | Description                                                                                                                                        |
|-------|----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                           |
| 12    | SCRERR   | 0x0   | RW | Scrambling Alignment Error. Scrambling operations must be aligned to word (4-byte) start address.                                                  |
| 11    | CQERR    | 0x0   | RW | Command Queue Error Interrupt                                                                                                                      |
| 10    | CQPAUSED | 0x0   | RW | Command Queue is Paused.                                                                                                                           |
| 9     | CQUPD    | 0x0   | RW | Command Queue Update Interrupt. Issued whenever the CQ performs an operation where address bit[0] is set. Useful for triggering CURIDX interrupts. |
| 8     | CQCMP    | 0x0   | RW | Command Queue Complete Interrupt                                                                                                                   |
| 7     | DERR     | 0x0   | RW | DMA Error Interrupt                                                                                                                                |
| 6     | DCMP     | 0x0   | RW | DMA Complete Interrupt                                                                                                                             |
| 5     | RXF      | 0x0   | RW | Receive FIFO full                                                                                                                                  |
| 4     | RXO      | 0x0   | RW | Receive FIFO overflow (cannot happen in MSPI design -- MSPI bus pins will stall)                                                                   |
| 3     | RXU      | 0x0   | RW | Receive FIFO underflow (only occurs when SW reads from an empty FIFO)                                                                              |
| 2     | TXO      | 0x0   | RW | Transmit FIFO Overflow (only occurs when SW writes to a full FIFO).                                                                                |
| 1     | TXE      | 0x0   | RW | Transmit FIFO empty.                                                                                                                               |
| 0     | CMDCMP   | 0x0   | RW | Transfer complete. Note that DMA and CQ operations are layered, so CMD-CMP, DCMP, and CQ* can all be signaled simultaneously                       |

**7.10.2.18 INTSET Register****MSPI Master Interrupts: Set****OFFSET:** 0x0000020C**INSTANCE 0 ADDRESS:** 0x5001420C

Write a 1 to a bit in this register to instantly generate an interrupt from this module. (Generally used for testing purposes).

**Table 362: INTSET Register**

|      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |        |       |          |       |       |      |      |     |     |     |     |     |        |  |  |  |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--------|-------|----------|-------|-------|------|------|-----|-----|-----|-----|-----|--------|--|--|--|
| 31   | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11     | 10    | 09       | 08    | 07    | 06   | 05   | 04  | 03  | 02  | 01  | 00  |        |  |  |  |
| RSVD |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | SCRERR | CQERR | CQPAUSED | CQUPD | CQCMP | DERR | DCMP | RXF | RXO | RXU | TXO | TXE | CMDCMP |  |  |  |

**Table 363: INTSET Register Bits**

| Bit   | Name     | Reset | RW | Description                                                                                                                                        |
|-------|----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                           |
| 12    | SCRERR   | 0x0   | RW | Scrambling Alignment Error. Scrambling operations must be aligned to word (4-byte) start address.                                                  |
| 11    | CQERR    | 0x0   | RW | Command Queue Error Interrupt                                                                                                                      |
| 10    | CQPAUSED | 0x0   | RW | Command Queue is Paused.                                                                                                                           |
| 9     | CQUPD    | 0x0   | RW | Command Queue Update Interrupt. Issued whenever the CQ performs an operation where address bit[0] is set. Useful for triggering CURIDX interrupts. |
| 8     | CQCMP    | 0x0   | RW | Command Queue Complete Interrupt                                                                                                                   |
| 7     | DERR     | 0x0   | RW | DMA Error Interrupt                                                                                                                                |
| 6     | DCMP     | 0x0   | RW | DMA Complete Interrupt                                                                                                                             |
| 5     | RXF      | 0x0   | RW | Receive FIFO full                                                                                                                                  |
| 4     | RXO      | 0x0   | RW | Receive FIFO overflow (cannot happen in MSPI design -- MSPI bus pins will stall)                                                                   |
| 3     | RXU      | 0x0   | RW | Receive FIFO underflow (only occurs when SW reads from an empty FIFO)                                                                              |

| Bit | Name   | Reset | RW | Description                                                                                                                  |
|-----|--------|-------|----|------------------------------------------------------------------------------------------------------------------------------|
| 2   | TXO    | 0x0   | RW | Transmit FIFO Overflow (only occurs when SW writes to a full FIFO).                                                          |
| 1   | TXE    | 0x0   | RW | Transmit FIFO empty.                                                                                                         |
| 0   | CMDCMP | 0x0   | RW | Transfer complete. Note that DMA and CQ operations are layered, so CMD-CMP, DCMP, and CQ* can all be signaled simultaneously |

## DMA Configuration Register

**INSTANCE 0 ADDRESS: 0x50014250**

## DMA Configuration Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8    | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        | DMAPWROFF | RSVD   |        |        |        |        |        |        |        |        |        |        |        |        | DMAPRI | DMADIR | DMAEN  |        |        |

| Bit   | Name       | Reset | RW | Description                                                                                                                                                                                                                             |
|-------|------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:19 | RSVD       | 0x0   | RO | RESERVED.                                                                                                                                                                                                                               |
| 18    | DMA PWROFF | 0x0   | RW | Power off MSPI domain upon completion of DMA operation.                                                                                                                                                                                 |
| 17:5  | RSVD       | 0x0   | RO | RESERVED.                                                                                                                                                                                                                               |
| 4:3   | DMA PRI    | 0x0   | RW | Sets the Priority of the DMA request<br><br>LOW = 0x0 - Low Priority (service as best effort)<br>HIGH = 0x1 - High Priority (service immediately)<br>AUTO = 0x2 - Auto Priority (priority raised once TX FIFO empties or RX FIFO fills) |
| 2     | DMA DIR    | 0x0   | RW | Direction<br><br>P2M = 0x0 - Peripheral to Memory (SRAM) transaction<br>M2P = 0x1 - Memory to Peripheral transaction                                                                                                                    |

| Bit | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                            |
|-----|-------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1:0 | DMAEN | 0x0   | RW | <p>DMA Enable. Setting this bit to EN will start the DMA operation</p> <p>DIS = 0x0 - Disable DMA Function<br/>           EN = 0x3 - Enable HW controlled DMA Function to manage DMA to flash devices. HW will automatically handle issuance of instruction/address bytes based on settings in the FLASH register.</p> |

## DMA Status Register

**INSTANCE 0 ADDRESS: 0x50014254**

## DMA Status Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |        |        |        |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|--------|--------|--------|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0      | 0      | 0      | 0      | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7      | 6      | 5      | 4      | 3 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | SCRERR | DMAERR | DMACPL | DMATIP |   |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                 |
|------|--------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:4 | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                   |
| 3    | SCRERR | 0x0   | RW | Scrambling Access Alignment Error. This active high bit signals that a scrambling operation was specified for a non-word aligned DEVADDR.                                                                                                                                                                   |
| 2    | DMAERR | 0x0   | RW | DMA Error. This active high bit signals that an error was encountered during the DMA operation.                                                                                                                                                                                                             |
| 1    | DMACPL | 0x0   | RW | DMA Transfer Complete. This signals the end of the DMA operation.                                                                                                                                                                                                                                           |
| 0    | DMATIP | 0x0   | RO | DMA Transfer In Progress indicator. 1 will indicate that a DMA transfer is active. The DMA transfer may be waiting on data, transferring data, or waiting for priority. All of these will be indicated with a 1. A 0 will indicate that the DMA is fully complete and no further transactions will be done. |

## DMA Target Address Register

**OFFSET:** 0x00000258



**Table 372: DMATOTCOUNT Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1        | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5        | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | TOTCOUNT |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 373: DMATOTCOUNT Register Bits**

| Bit   | Name     | Reset | RW | Description                    |
|-------|----------|-------|----|--------------------------------|
| 31:16 | RSVD     | 0x0   | RO | Reserved                       |
| 15:0  | TOTCOUNT | 0x0   | RW | Total Transfer Count in bytes. |

**7.10.2.24 DMABCOUNT Register****DMA BYTE Transfer Count****OFFSET:** 0x00000264**INSTANCE 0 ADDRESS:** 0x50014264

DMA BYTE Transfer Count

**Table 374: DMABCOUNT Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1      | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5      | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | BCOUNT |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 375: DMABCOUNT Register Bits**

| Bit  | Name   | Reset | RW | Description                                                                                                                              |
|------|--------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD   | 0x0   | RO | Reserved                                                                                                                                 |
| 7:0  | BCOUNT | 0x0   | RW | Burst transfer size in bytes. This is the number of bytes transferred when a FIFO trigger event occurs. Recommended values are 16 or 32. |

**7.10.2.25 DMATHRESH Register****DMA Transmit Trigger Threshold****OFFSET:** 0x00000278**INSTANCE 0 ADDRESS:** 0x50014278

Indicates FIFO level at which a DMA should be triggered. For most configurations, a setting of 8 is recommended for both read and write operations.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |           |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----------|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0         | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7         | 6 | 5 | 4 | 3 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DMATHRESH |   |   |   |   |

| Bit  | Name      | Reset | RW | Description                                                                                                                                                                                                                                                 |
|------|-----------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:4 | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                    |
| 3:0  | DMATHRESH | 0x8   | RW | DMA transfer FIFO level trigger. For read operations, DMA is triggered when the FIFO level is greater than this value. For write operations, DMA is triggered when the FIFO level is less than this level. Each DMA operation will consist of BCOUNT bytes. |

## Command Queue Configuration Register

**INSTANCE 0 ADDRESS: 0x500142A0**

This register controls Command Queuing (CQ) operations in a manner similar to the DMACFG register.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |                 |          |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------|----------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3          | 0<br>2   | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CQAUTOCLEARMASK | CQPWROFF | CQPRI  | CQEN   |

| Bit  | Name             | Reset | RW | Description                                                                                                                                                     |
|------|------------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:4 | RSVD             | 0x0   | RO | RESERVED.                                                                                                                                                       |
| 3    | CQAUTO-CLEARMASK | 0x0   | RW | Enable clear of CQMASK after each pause operation. This may be useful when using software flags to pause CQ.                                                    |
| 2    | CQPWROFF         | 0x0   | RW | Power off MSPI domain upon completion of DMA operation.                                                                                                         |
| 1    | CQPRI            | 0x0   | RW | Sets the Priority of the command queue dma request<br><br>LOW = 0x0 - Low Priority (service as best effort)<br>HIGH = 0x1 - High Priority (service immediately) |
| 0    | CQEN             | 0x0   | RW | Command queue enable. When set, will enable the processing of the command queue<br><br>DIS = 0x0 - Disable CQ Function<br>EN = 0x1 - Enable CQ Function         |

**INSTANCE 0 ADDRESS: 0x500142A8**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        | CQADDR |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

| Bit   | Name   | Reset | RW | Description                                                                                              |
|-------|--------|-------|----|----------------------------------------------------------------------------------------------------------|
| 31:29 | RSVD   | 0x0   | RO | Reserved                                                                                                 |
| 28:0  | CQADDR | 0x0   | RW | Address of command queue buffer in SRAM or flash. The buffer address must be aligned to a word boundary. |



**7.10.2.28 CQSTAT Register****Command Queue Status Register****OFFSET:** 0x000002AC**INSTANCE 0 ADDRESS:** 0x500142AC

Command Queue Status Register

**Table 382: CQSTAT Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |       |       |       |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|-------|-------|-------|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0        | 0     | 0     | 0     | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5        | 4     | 3     | 2     | 1 | 0 |   |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQPAUSED | CQERR | CQCPL | CQTIP |   |   |   |

**Table 383: CQSTAT Register Bits**

| Bit  | Name     | Reset | RW | Description                                                                                                                                                         |
|------|----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:4 | RSVD     | 0x0   | RO | RESERVED.                                                                                                                                                           |
| 3    | CQPAUSED | 0x0   | RO | Command queue is currently paused status.                                                                                                                           |
| 2    | CQERR    | 0x0   | RW | Command queue processing Error. This active high bit signals that an error was encountered during the CQ operation.                                                 |
| 1    | CQCPL    | 0x0   | RW | Command queue operation Complete. This signals the end of the command queue operation.                                                                              |
| 0    | CQTIP    | 0x0   | RO | Command queue Transfer In Progress indicator. 1 will indicate that a CQ transfer is active and this will remain active even when paused waiting for external event. |

**7.10.2.29 CQFLAGS Register****Command Queue Flag Register****OFFSET:** 0x000002B0**INSTANCE 0 ADDRESS:** 0x500142B0

Command Queue Flag Register

---

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

0

**Table 386: CQSETCLEAR Register**

|      |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |           |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|-----------|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2      | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1         | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0      | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3      | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5         | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7      | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   | CQFCLR |   |   |   |   |   |   |   | CQFTOGGLE |   |   |   |   |   |   |   | CQFSET |   |   |   |   |   |   |   |

**Table 387: CQSETCLEAR Register Bits**

| Bit   | Name      | Reset | RW | Description                                                           |
|-------|-----------|-------|----|-----------------------------------------------------------------------|
| 31:24 | RSVD      | 0x0   | RO | Reserved                                                              |
| 23:16 | CQFCLR    | 0x0   | WO | Clear CQFlag status bits.                                             |
| 15:8  | CQFTOGGLE | 0x0   | RO | Toggle CQFlag status bits                                             |
| 7:0   | CQFSET    | 0x0   | WO | Set CQFlag status bits. Set has priority over clear if both are high. |

**7.10.2.31 CQPAUSE Register****Command Queue Pause Mask Register****OFFSET:** 0x000002B8**INSTANCE 0 ADDRESS:** 0x500142B8

Command Queue Pause Mask Register

**Table 388: CQPAUSE Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1      | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6      | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQMASK |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 389: CQPAUSE Register Bits**

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:16 | RSVD | 0x0   | RO | Reserved    |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15:0 | CQMASK | 0x0   | RW | <p>CQ will pause processing when ALL specified events are satisfied -- i.e. when (CQMASK and CQPAUSE)=CQMASK.</p> <p>STOP = 0x8000 - CQ Stop Flag. When set, CQ processing will complete.</p> <p>CQIDX = 0x4000 - CQ Index Pointers (CURIDX/ENDIDX) match.</p> <p>DMACPL = 0x800 - DMA Complete Status (hardwired DMACPL bit in DMASTAT)</p> <p>CMDCPL = 0x400 - PIO Operation completed (STATUS bit in CTRL register)</p> <p>IOM1READY = 0x200 - IOM Buffer 1 Ready Status (from selected IOM). This status is the result of XNOR'ing the IOM0START with the incoming status from the IOM. When high, MSPI can send to the buffer.</p> <p>IOM0READY = 0x100 - IOM Buffer 0 Ready Status (from selected IOM). This status is the result of XNOR'ing the IOM0START with the incoming status from the IOM. When high, MSPI can send to the buffer.</p> <p>SWFLAG7 = 0x80 - Software flag 7. Can be used by software to start/pause operations</p> <p>SWFLAG6 = 0x40 - Software flag 6. Can be used by software to start/pause operations</p> <p>SWFLAG5 = 0x20 - Software flag 5. Can be used by software to start/pause operations</p> <p>SWFLAG4 = 0x10 - Software flag 4. Can be used by software to start/pause operations</p> <p>SWFLAG3 = 0x8 - Software flag 3. Can be used by software to start/pause operations</p> <p>SWFLAG2 = 0x4 - Software flag 2. Can be used by software to start/pause operations</p> <p>SWFLAG1 = 0x2 - Software flag 1. Can be used by software to start/pause operations</p> <p>SWFLAG0 = 0x1 - Software flag 0. Can be used by software to start/pause operations</p> <p>IOM1START = 0x2 - IOM Buffer 1 status (same as SWFLAG1). When linked to IOM, indicates to IOM that buffer 1 is ready.</p> <p>IOM0START = 0x1 - IOM Buffer 0 status (same as SWFLAG0). When linked to IOM, indicates to IOM that buffer 0 is ready.</p> |

### Command Queue Current Index

**INSTANCE 0 ADDRESS: 0x500142C0**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|---|--|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0        | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |  |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0        | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQCURIDX |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |



## 8. I<sup>2</sup>C/SPI Master Module

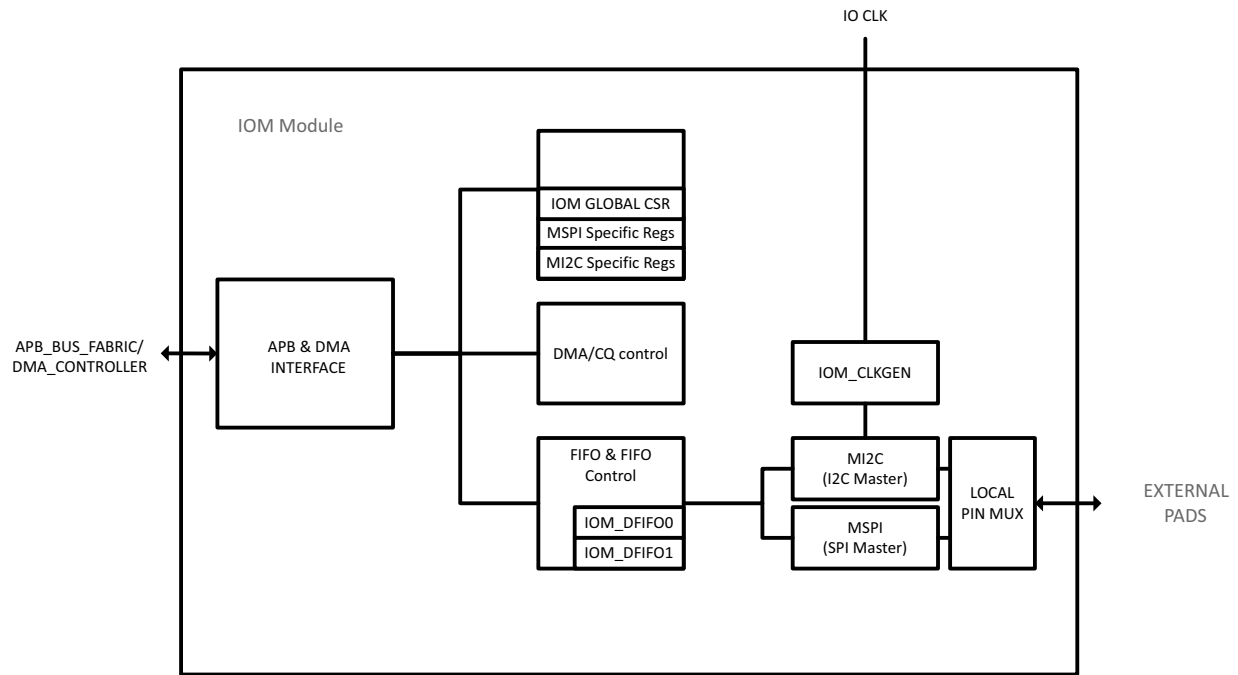


Figure 14. Block Diagram for the I<sup>2</sup>C/SPI Master Module

### 8.1 Features

No resources are shared between IOM modules, but within a single IOM module, the submodules share a common set of FIFO and command resources.

#### 8.1.1 Features common to all submodules

- 2 Independent 32-byte FIFOs, one dedicated each direction of data transfer
- Direct access of all FIFO data from MCU interface, including non-destructive reads.
- FIFO mode read/write access (push/pop mechanism)
- Direct command, direct data mode. (Command and data written to/read from the module registers directly)
- Direct command, DMA data mode. Commands are written directly to the module, but data is written to/read from the main SRAM array.
- Command queuing operations. Register write operations are read from main SRAM memory and fed to the register unit in series.
- Programmable interrupts
- Programmable threshold interrupt level
- Configurable clock selection
- Read data synchronized internally for MCU access
- Ability to send multi-byte offset addresses, with single command
- Ability to view FIFO data without causing pop operation
- Capability to store data for multiple commands in either FIFO
- Programmable number of byte offsets of 0-3

### 8.1.2 I<sup>2</sup>C Master features

- Support for standard mode (100 kHz), Fast mode (400 kHz), and Fast mode+ (1 MHz)
- Support for 7-bit and 10-bit addressing modes
- Transfer burst sizes of 0 to 512 bytes.
- Configurable LSB or MSB data transfer.
- Clock stretching support.

### 8.1.3 SPI Master features

- Support for transaction sizes up to 4095 bytes
- Programmable number of byte offsets of 0-3
- Programmable operation in all polarity modes
- 3-wire and 4-wire read and write support
- Flow control for reads or writes, based on MISO (write flow control), or external, selectable PIO.
- Full duplex operation

## 8.2 Functional Overview

The Apollo3 Blue SoC includes six I<sup>2</sup>C/SPI high-speed Master Modules (IOM), shown in Figure 14, each of which functions as the master of an I<sup>2</sup>C or SPI interface as selected by the IOMn\_SUBMODCTRL\_SMODnEN bits. A 64-byte bidirectional FIFO and a sophisticated Command mechanism allow simple initiation of I/O operations without requiring software interaction.

In I<sup>2</sup>C mode the I<sup>2</sup>C/SPI Master supports 7- and 10-bit addressing, multi-master arbitration, interface frequencies from 1.2 kHz to 1.0 MHz and up to 512-byte burst operations. In SPI mode the I<sup>2</sup>C/SPI Master supports up to 4 slaves with automatic nCE selection, 3- and 4-wire implementation, all SPI polarity/phase combinations and up to 4095-byte burst operations, with both standard embedded address operations and raw read/write transfers. Interface timing limits are as specified in the Serial Peripheral Interface (SPI) Master Interface table of the Electrical Characteristics chapter.

The active interface is selected by enabling the module enable bit (SMODnEN) for the interface in the IOMn\_SUBMODCTRL register. Only one interface can be active at a time.

Each module contains a separate pair of 32-byte FIFOs, each of which is dedicated to data flow in a single direction (input or output). The modules support data transfer to or from the module through either direct or DMA paths. SRAM can be used as the source or the sink of data, and storage data can be used as source data for IOM transaction. Command Queue operations are also supported to allow commands to be placed in memory and fetched and executed in series. The Command Queue interface also includes inter-module flags which allows event communication between other IOM modules, MSPI modules and external pins through the GPIO interface.

Also supported in the design are test modes for use in setup and power measurements, and debug facilities to aid in software/hardware debug.

## 8.3 Power Control

The 6 IOM modules must be enabled in the PWRCTRL\_DEVPWREN register prior to access and operation. The power status of the IOM modules can be read in the PWRCTRL\_DEVPWRSTATUS register. Note that the IOM modules are separated into 2 power domains, referred to as HCPB and HCPC. IOM modules 0, 1 and 2 are contained in HCPB, while IOM modules 3,4 and 5 are contained in HCPC power domain.

## 8.4 Clocking and Resets

The IOM design uses 2 main clocks, APB\_CLK and IO\_CLK. The APB\_CLK is used for all register and DMA accesses. It runs at 24 MHz and is interfaced via the APB fabric synchronous interface. The IO\_CLK is used as the source of the interface clock and has selectable frequencies. The overview of the clocking structure is shown below:

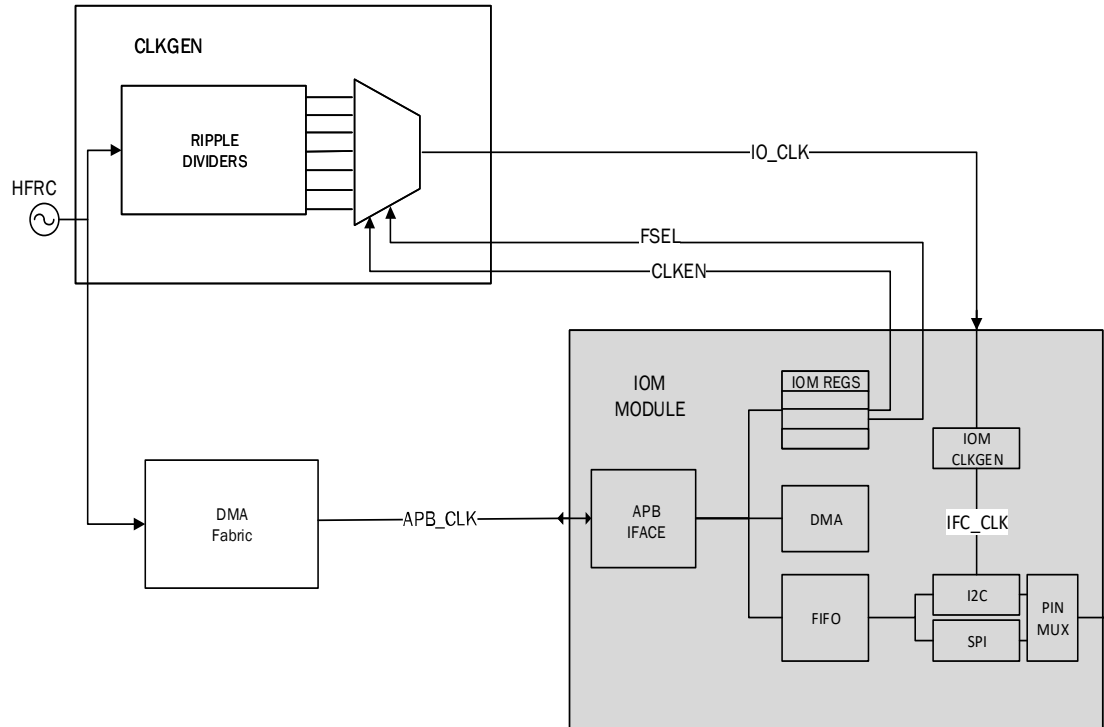


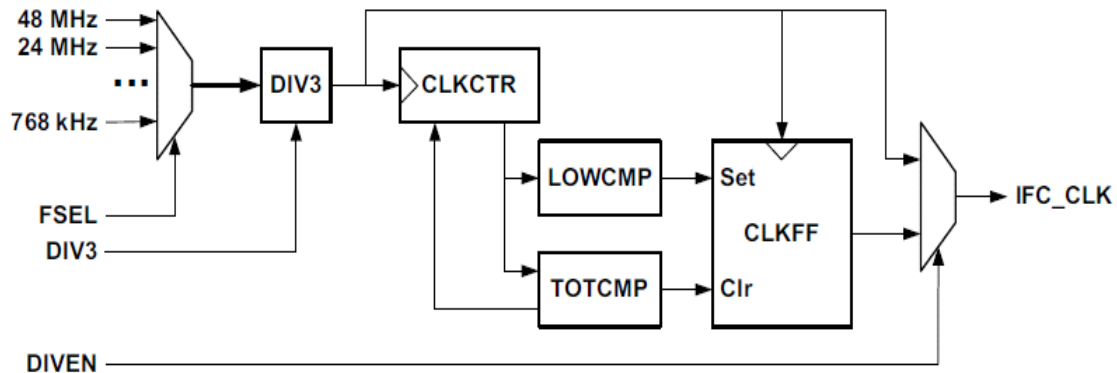
**Figure 15. Clocking Structure for IOM Module**

The APB\_CLK is an internal clock sourced from the bus fabric and operates at a fixed 48 MHz frequency. It is used for internal communication and is heavily clock gated to reduce dynamic power.

The IO\_CLK is generated within the central clocking module and enabled through the IOMn\_CLKCFGIOCLKEN field. This clock must be enabled by software prior to module operation. The primary frequency of the IO\_CLK is selected via the IOMn\_CLKCFGFSEL field, and further divided by either or both of the internal divide by 3 divider (enabled via the IOMn\_CLKCFGDIV3 field), or a programmable divider (enabled by IOMn\_CLKCFGDIVEN and division set by IOMn\_CLKCFGTOTPER and IOMn\_IOMCLKCFGLOWPER fields) as shown below.



Figure 16. IO\_CLK Generation



The divided by 3 divider is optional and will provide a 50% duty cycle divided by 3 clock. This divider is bypassed when the DIV3 field is set to 0.

The output of the DIV3 module is then fed to the programmable divider. This divider can be bypassed or enabled via the DIVEN field in the CLKCFG. It will divide at a rate of TOTPER+1 (subtract 1 from actual value when writing TOTPER field), and will toggle at LOWPER+1 clock count of the base IO\_CLK from the DIV3 module. This will generate the final IO\_CLK used by the interface module.

The IO\_CLK is used for the reference clock for the internal module state machine, and for the external output clock. The use in both areas is heavily gated and can also be overridden by setting register IOMn\_IOMDBG.IOCLKON field to 1.

## 8.5 I<sup>2</sup>C Clock Generation

The I<sup>2</sup>C output clock (SCL) is derived from dividing the final IO\_CLK by 2. For example, for 1 MHz I<sup>2</sup>C operation, an IO\_CLK frequency of 2 MHz is required. Because the state machine will operate at 2x the target frequency of the interface frequency, the nominal output clk (SCL) duty cycle will be 50%, regardless of the duty cycle of the IO\_CLK. However, the timing specification of some I<sup>2</sup>C modes require an asymmetrical duty cycle on the SCL output, with the high period of the clock less than the low period of the clock. The clocking module allows a programmable delay prior to propagating the rising edge of the SCL output. This delay is in units of the source IO\_CLK period (prior to any enabled division). This delay is specified in the IOMn\_MI2CCFGSCLENDLY register field. The recommended settings for this register for each mode are detailed below.

If clock stretching is done by the slave devices attached to the IOM interface, further restrictions must be observed during the setup of the clock controls. This is due to the possible clock stretch event done within a single cycle on the I<sup>2</sup>C SCL. In this case, the minimum SCL high time must be maintained, regardless of the time the slave releases the SCL. To detect the event within the single I<sup>2</sup>C cycle, the SCL signal needs to be sub-sampled. The source IO\_CLK is used for this purpose also and allows for sampling of the SCL signal by a programmable number of source IO\_CLK cycles. The sample granularity is determined by the ratio of the source IO\_CLK to final IO\_CLK frequency and must allow for synchronization time between the two domains. The recommended settings for each mode are below. Only speeds of 100 kHz, 400 kHz and 1 MHz are supported. Contact Ambiq for use of other frequencies.

| Mode                    | FSEL | DIV3 | DIV EN | TOT PER | LOW PER | SMP CNT | SDAEN DLY | SCLEN DLY |
|-------------------------|------|------|--------|---------|---------|---------|-----------|-----------|
| Standard Mode (100 kHz) | 2    | 0    | 1      | 119     | 59      | 3       | 15        | 0         |
| Fast Mode (400 kHz)     | 2    | 0    | 1      | 29      | 14      | 3       | 15        | 2         |
| Fast Mode+ (1000 kHz)   | 3    | 0    | 1      | 6       | 3       | 33      | 3         | 0         |

Table 394: Recommended Mode Settings for Standard I<sup>2</sup>C Clock Speeds

The full selection table is as follows:

| Mode                | FSEL | DIV3 | DIV EN | TOT PER | LOW PER | SMP CNT | SDAEN DLY | SCLEN DLY | Notes                              |
|---------------------|------|------|--------|---------|---------|---------|-----------|-----------|------------------------------------|
| Standard (100 kHz)  | 1    | 0    | 1      | 243     | 159     | 12      | 15        | 0         | Effective Freq 100 kHz             |
|                     | 2    | 0    | 1      | 121     | 79      | 6       | 15        | 0         | Effective Freq 100 kHz             |
|                     | 3    | 0    | 1      | 60      | 39      | 3       | 15        | 0         | Effective Freq 100 kHz             |
|                     | 4    | 0    | 1      | 30      | 19      | 1       | 15        | 0         | Effective Freq 93.7 kHz            |
|                     | 5    | 0    | 1      | 16      | 9       | 1       | 6         | 0         | Effective Freq 93.7 kHz, Low power |
| Fast Mode (400 kHz) | 1    | 0    | 1      | 62      | 39      | 7       | 15        | 4         | Effective Freq 400 kHz             |
|                     | 2    | 0    | 1      | 31      | 19      | 15      | 15        | 2         | Effective Freq 400 kHz             |
|                     | 3    | 0    | 1      | 15      | 9       | 2       | 7         | 1         | Effective Freq 375 kHz             |
|                     | 4    | 0    | 1      | 7       | 3       | 1       | 3         | 0         | Effective Freq 375 kHz             |
|                     | 5    | 0    | 1      | 5       | 3       | 1       | 3         | 0         | Effective Freq 375 kHz, Low power  |
| Fast+ Mode (1 MHz)  | 1    | 0    | 1      | 24      | 12      | 1       | 7         | 0         | Effective Freq 1 MHz               |
|                     | 2    | 0    | 1      | 12      | 6       | 1       | 6         | 0         | Effective Freq 1 MHz               |
|                     | 3    | 0    | 1      | 6       | 3       | 1       | 3         | 0         | Effective Freq 1 MHz               |

Table 395: Full Mode Settings for I<sup>2</sup>C Clock Speeds

### 8.5.1 SPI Clock Generation

The final IO\_CLK is used directly as the SPI clock output. No additional settings are needed.

## 8.6 FIFO

The IOM module contains 2 uni-directional FIFOs, each 32 bytes wide. These FIFOs are used only for data storage during IO transactions. The FIFO supports both single (half duplex) and duplex modes of operation.

During direct mode data transfer operations, IO data transfer between the IOM module and the MCU is done by accessing the IOMn\_FIFOP and IOMn\_FIFOPUSH registers. These registers allow read

(FIFOPOP) and write (FIFOPUSH) of data into and out of the FIFO, and automatic adjustment of pointers used by the submodules. Only word accesses are permitted to these registers and any unused byte locations will be ignored or filled with zero. If DMA is enabled during the IO command operation, data will automatically be read or written into the FIFO from the DMA address and the pointers updated. The FIFO pointers and data are NOT reset after each command, and care must be taken to not leave any extra data in the FIFO, as this will be used for subsequent transfers. If needed, there is a manual reset of the FIFO pointers that can be done using the IOMn\_FIFCTRLFIFORSTN field. Additional information on data alignment is covered in the later sections of this document.

The submodules will prevent overruns or underruns from the FIFO by pausing the active transaction, usually by stopping the output clock. Once data is available (write operations) or there is room in the FIFO (read operations), the transaction will continue.

For debug operations, the IOM module also allows direct access to the FIFO contents through the IOMn\_FIFO aperture. Access via this path does not affect the pointers used by the submodules and cannot be used to send or receive data as part of the IO operation. The FIFO aperture allows read and write operations into the write FIFO and read access into the read FIFO. The current FIFO pointers are readable via the FIFOLOC register. For the write FIFO, this will point to the next location to be written, while the read FIFO pointer will indicate the next location to be read.

#### NOTE

When DMA operations are in progress, the FIFOPUSH and FIFOPOP registers should not be accessed, as this will interfere with the DMA data.

## 8.7 Data Alignment

All data accesses between the MCU and the IOM interface are word aligned. Since the transfer size is specified in bytes, unused bytes within the word will either be discarded (for write operations) or filled with zero (read operations) to align to the next word boundary. DMA operations support a byte starting address, and the programmed DMA address does not have to be word aligned. Direct mode write operations will start transferring the least significant byte of the word (little endian style) at the current write FIFO pointer. If any remaining bytes are unused in a word at the end of the write operation, they will be discarded, and the write pointer will be set to the next word location. Direct mode read operations will store the first received byte into the least significant byte of location specified by the read FIFO pointer, and will fill any unused byte locations with zero if the transaction size is not a word multiple. The FIFO read pointer will point to the next FIFO location in the read FIFO, which will be word aligned.

### 8.7.1 Direct Mode Data Transfers

Direct mode data is enabled when DMA is disabled via the IOMn\_DMACFGDMAEN and the data transfer size (TSIZE) is greater than 0. In this mode, the MCU transfers data via direct writes or reads to registers in the IOM. The IOM maintains separate FIFO pointers for the read and write FIFOs, and updates these when a PUSH or POP register is accessed. Writing to the IOMn\_FIFOPUSH register will perform a push event of the word into the FIFO and update the write pointer by 4 bytes. Only word accesses are supported to the IOM, and any unused bytes within a word will be discarded. An example of a 5 byte write transfer is shown below.

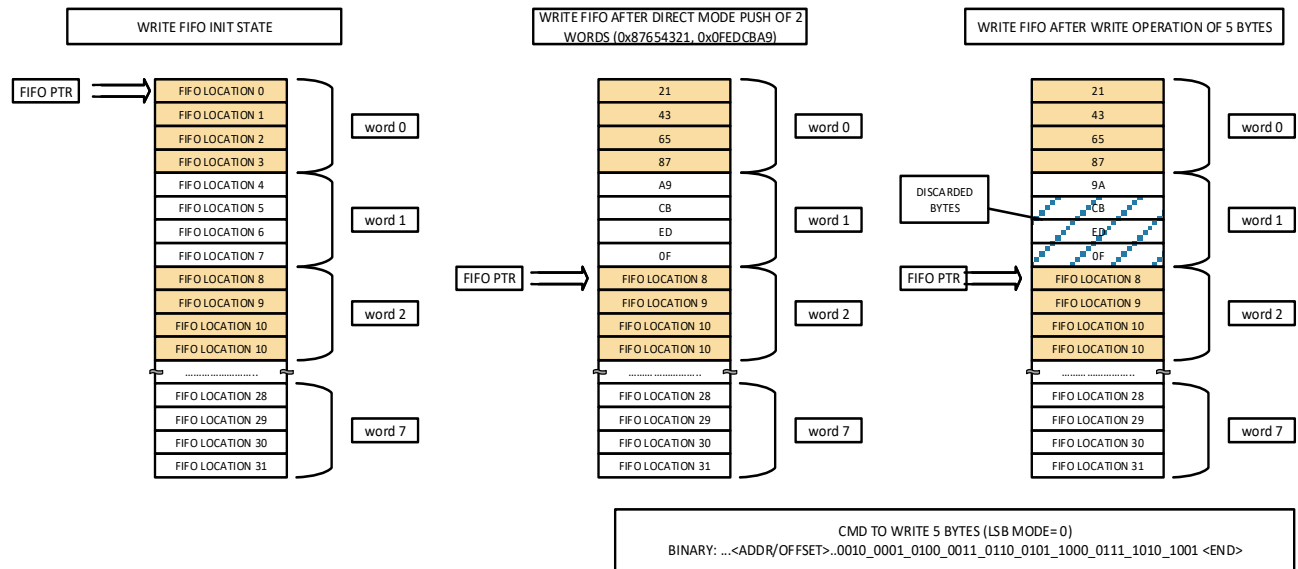


Figure 17. Direct Mode 5-byte Write Transfer

Reading from the IOMn\_FIFOPop register will perform a POP operation, return 4 bytes of data and advance the internal read FIFO pointer by 4 bytes. Any unused bytes within the read data will be filled with 0's and aligned to a word boundary at the end of the transaction. An example of a 5 byte read operation is shown below.

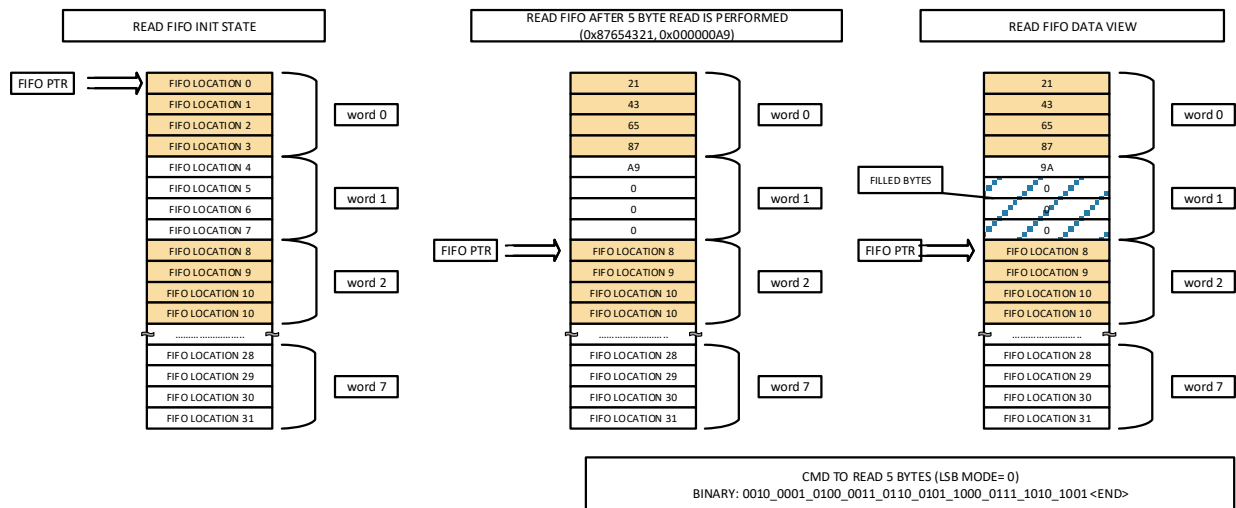


Figure 18. Direct Mode 5-byte Read

The IOM also supports a non-destructive POP mechanism to prevent unintended POP events from occurring. If the IOMn\_FIFOPop\_POPWR field is active (1), a write to the IOMn\_FIFOPop register will be required in order to complete the POP event. Reads will return the current data.

An active transaction will be paced by data availability and will hold the clock low if there is not enough data to continue write operations, or if the read FIFO is full during read operations. This wait condition is indicated when the IOMn\_CMDSTAT\_CMDSTAT field is 0x6. Once new data or FIFO locations are present, the command will continue operation automatically.

### 8.7.2 DMA Data transfers

DMA transfers are enabled by configuring the DMA related registers, enabling the DMA channel, and then issuing the command. The command will automatically fetch and store the data associated with the command without MCU intervention. The DMA channel is enabled via the IOMn\_DMACFGDMAEN field. P2M DMA operations transfer data from peripheral to memory and are used in IOM READ operations. M2P DMA operations transfer data from memory to peripheral and are used in IOM write operations. DMA transfer size is programmed into the IOMn\_DMATOTCOUNT register and supports up to 4095 bytes of data transfer. The DMA transfer size is independent from the transaction size, and allows a single DMA setting to be used across multiple commands. The direction of DMA data transfer must match the command. The IOMn\_DMACFGDMAEN field enables/disables the DMA transfer capability and must be set last when configuring the DMA, generally prior to sending the command.

The DMA engine within the module will initiate a transfer of data when a trigger event occurs. There are 2 types of triggers available, threshold (THR) and command completion (CMDCMP). The THR trigger will activate when the threshold programmed into the FIFOWTHR or FIFORTH in the IOMn\_FIFOTH register meets the data criteria. Because the MCU access to the interface is 32 bits wide, only the word count of the selected THR is used, and the low order bits of the FIFOWTHR or FIFORTH are ignored.

During the transfer, the TOTCOUNT register is decremented to reflect the number of bytes transferred.

For IOM write operations (data written from IOM out to an external device), the THR trigger will activate when the write FIFO contains FIFOWTHR[5:2] free words. If the remaining DMA transfer size is less than this, only the needed number of words are transferred.

For IOM read operations (data read from external device), the THR trigger will activate when the read FIFO contains FIFORTH[5:2] words of valid data. If the remaining DMA transfer size is less than the RTHR words, then the CMDCMP trigger can be enabled to transfer the remaining data. If the CMDCMP trigger is disabled, and the number of bytes in the read FIFO is greater to or equal to the current TOTCOUNT, a DMA transfer of TOTCOUNT will be done to complete the DMA operation. This mode requires that the THR trigger be enabled as well.

The CMDCMP trigger activates when the command is complete and will transfer the lesser of the TOTCOUNT or the number of bytes in the read FIFO. Note that this trigger is not needed for write operations, and the THR trigger should be used in this case. If a read operation is done, and the THR trigger is disabled, and only the CMDCMP trigger is enabled, and the transaction size is greater than the FIFO size (32 bytes), the module will hang, as there is no trigger to cause a DMA operation, and the logic will pause the interface until there is room within the read FIFO to store data.

If DMA transfer size is matched to the IOM transaction size, it is recommended to program both the FIFORTH and FIFOWTHR to 0x10 (16 bytes) and only enable the THR trigger.

## 8.8 Transaction Initiation

To start a transaction, the IOM module must be powered up and the target external pins enabled via the GPIO module. For SPI transactions, this will generally require 4 pins to be enabled via the function select field of the PADREG registers in the GPIO module. The CEN pin for SPI transaction requires setting of the FNCSEL field of the appropriate pin, as well as the CFGREG of the corresponding pin. This also includes the setting of the default value of the CEN. This is needed to allow the IOM module to power down and not activate the CEN signal.

Once the IOM module is powered on, and the external pins configured, the IOM submodule must be enabled via the IOMn\_SUBMODCTRL register. This will activate either the SPI or I<sup>2</sup>C interface. Once this is complete, the submodule specific registers should be configured to set the desired mode and features. If DMA is desired, the DMA registers should also be set, with the IOMn\_DMACTRLDMAEN field set last. The registers relating to DMA operations are as follows:

- IOMn\_DMATRIGEN – Sets the trigger source for starting a DMA transfer

- IOMn\_DMACHCFG – Sets the DMA direction and enable for DMA
- IOMn\_DMATOTCOUNT – Sets the total count of bytes to be transferred via the DMA operation. Recommended to match the IOMn\_CMD.TSIZE field for simplicity.
- IOMn\_DMATARGADDR – The source or destination address of the DMA data. Sources can be either SRAM or storage. Destination address can only be SRAM. This is the memory mapped address of the DMA data as accessed by the MCU.

After the module setup is complete, the command register is written. This will start the IO transfer. The IOMn\_CMD register contains the command itself, along with other fields used in the command, such as channel number, offset counts and transfer size. The IOM supports 2 main commands, read and write. A read command will write user selectable number of offset bytes (0 to 3), and then read IOMn\_CMDTSIZE bytes, storing the data into the read FIFO. A write command will write the user selectable number of offset bytes (0 to 3), followed by a write of IOMn\_CMDTSIZE bytes sourced from the write FIFO. Transfer sizes can be 0-4095 bytes for SPI operations and 0-512 bytes for I<sup>2</sup>C operations. The number of offset bytes for each command is specified in the IOMn\_CMDOFFSETCNT field.

## 8.9 Command Queue

The IOM module can also fetch register write data from SRAM or storage, and update the registers as if the write was performed via the MCU. Register data is stored as a doublet of 2 words. The first word is the module register address offset, word aligned. The second word is the write data value. Once enabled, the command queue (CQ) will fetch the address and perform a write to the register. If no command is started by the register write, the next doublet will be fetched by the CQ. If a command is started (write to IOMn\_CMD register is done), the CQ processing will wait until the transaction is complete before fetching the next register write doublet. This is shown in the diagram below. No prefetching is done via the CQ, and the register write operations are performed in series with the transactions. This allows a predictable path for execution of commands. DMA enabled commands should be used during CQ operation, as there is no support to perform a direct mode read operation via the CQ.

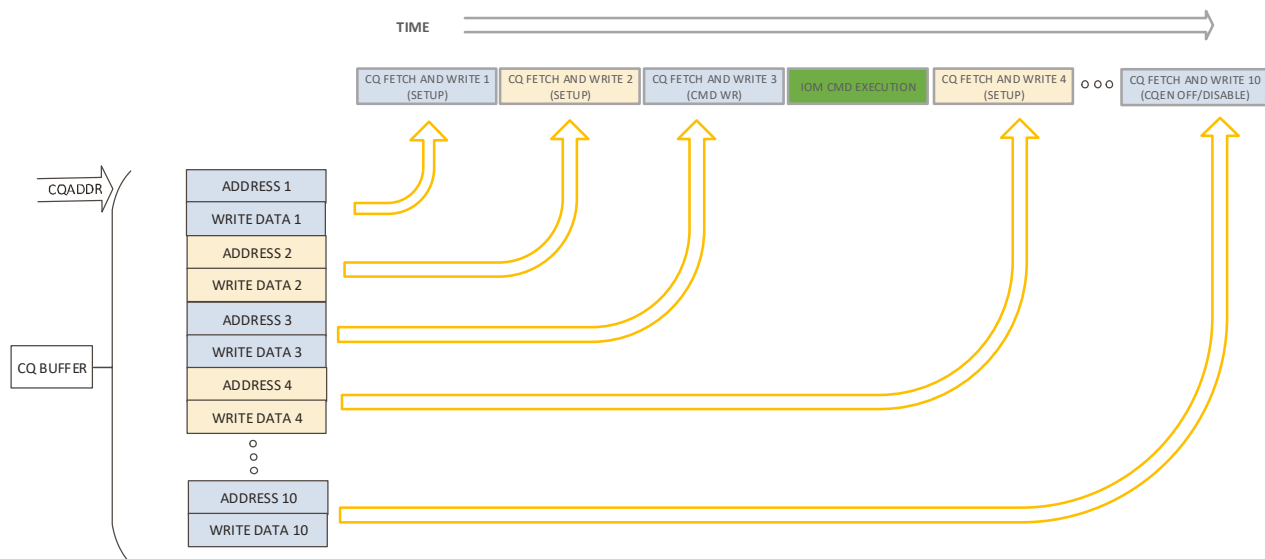


**Figure 19. Register Write Data Fetches**

The CQ starting fetch address is specified in the IOMn\_CQADDR register. The CQ operation will start to fetch when the IOMn\_CQCFG.CQEN field is set. This field should only be set when the IOM is idle and the FIFOs are empty. Once enabled, the CQ will continue to fetch sequentially until it encounters a pause

event. A pause event can be caused by a CQ register write operation, or from external signals. This is shown in the sequence below.

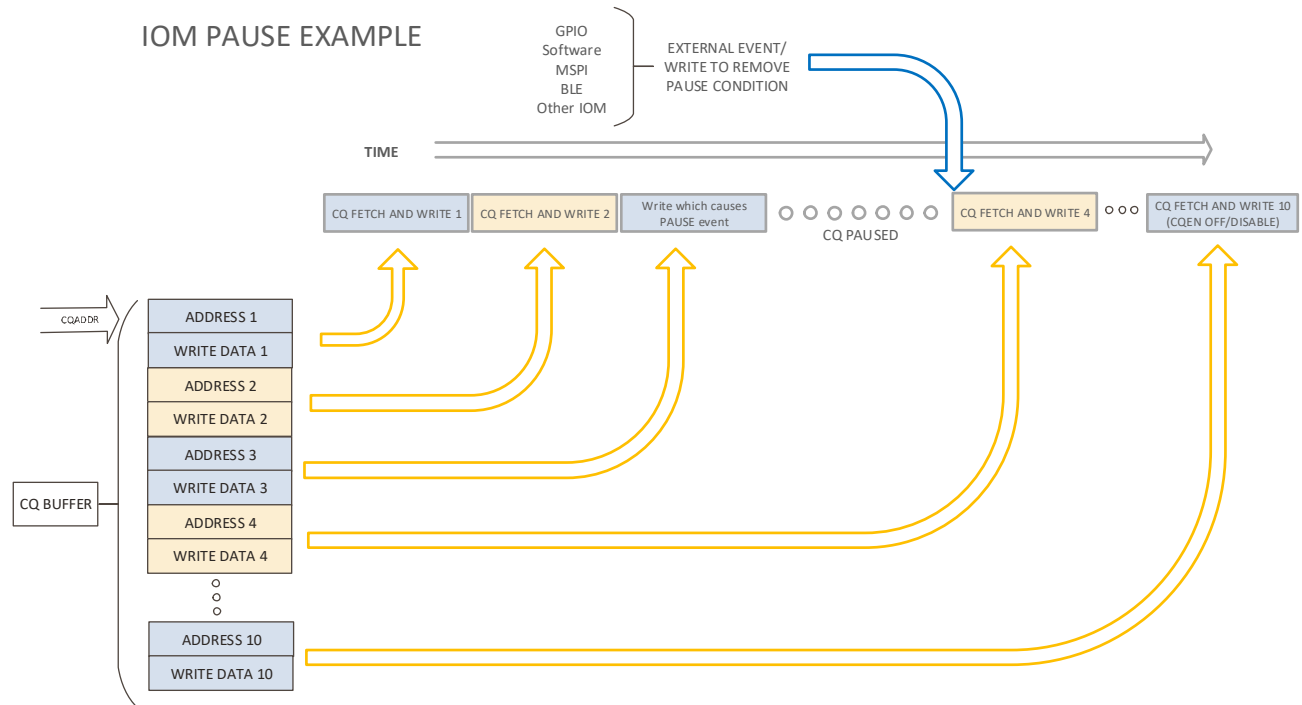


**Figure 20. IOM Pause Example**

Each pause source is independently enabled via the IOMn\_PAUSEEN register. In addition to independent enable of the pause bits, there is also independent control of which pause event will signal a CQPAUSE interrupt. This is controlled through the IOMn\_CQFLAGS.CQIRQMASK field.

There are 16 possible pause sources. When the value of the pause source is set, and the pause is enabled in the IOMn\_PAUSEEN register, the CQ will stop fetching. The IOMn\_CQADDR is updated after each fetch, and when paused, will point to the next doublet to be fetched when the pause condition is removed. The connection of the pause bits are shown below. The SW Flags are accessed via the IOMn\_CQSETCLEAR register.

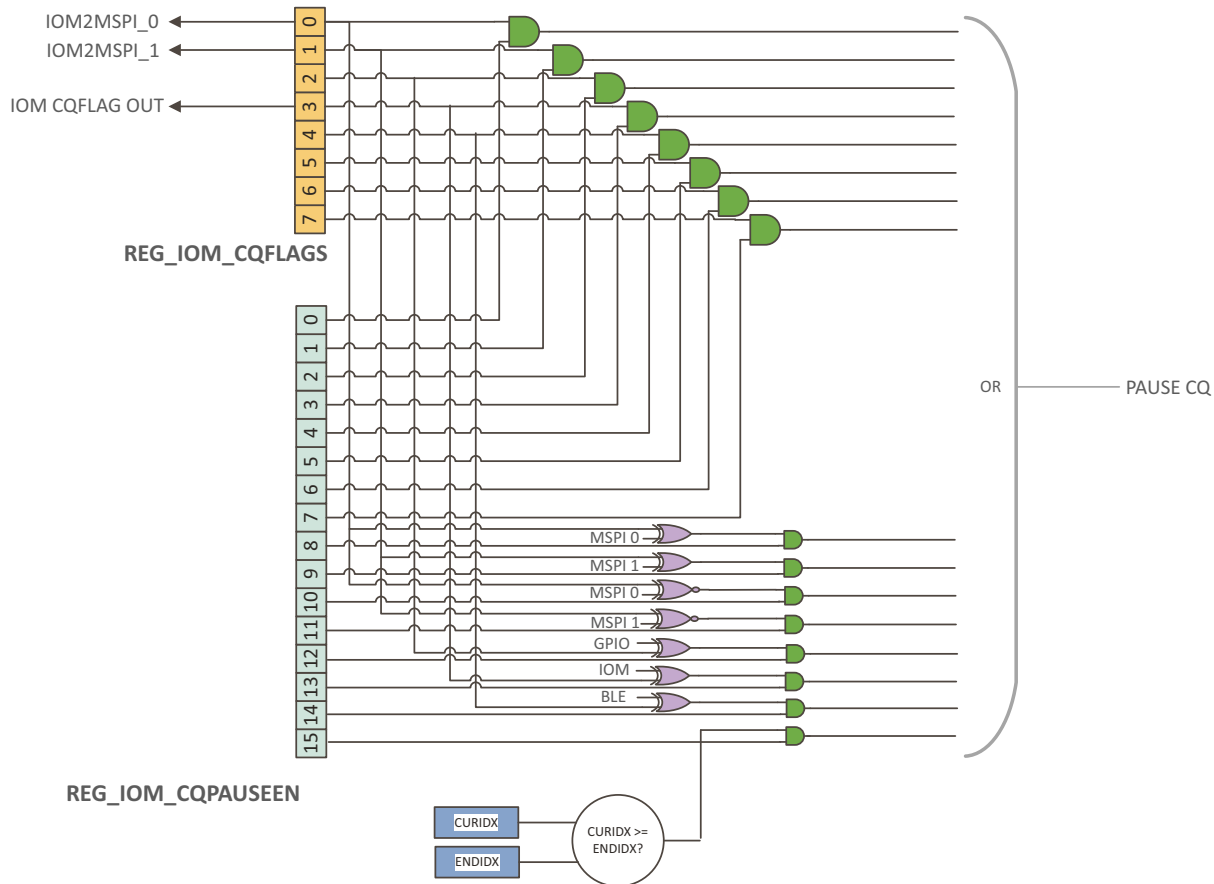


**Figure 21. CQ Pause Bit Fetching**

The first 8 pause sources (bits 7:0) are register bits which are directly writable via the MCU or through the CQ. These first 8 locations are called SW Flags. Because the CQ does not support a read-modify-write operation, special facilities are available to set, reset or toggle the SW Flags. This is accessed through the IOMn\_CQSETCLEAR register. The 3 fields in this register allow a per bit set, reset or toggle of the SW Flag bits.

The next 7 pause sources (bits 14:8) use the SW Flags along with an external signal to set the pause event. The external signals are from the GPIO module, the MSPI module, or other IOM modules. On some cases, such as the MSPI interface, 4 of the SW Flags are used and combined with 2 similar signals from the MSPI module to facilitate a ping pong method of sharing 2 buffers and preventing overruns without MCU intervention.

The last pause source (bit 15) is used for index pausing. If this pause bit is enabled, the CQ will pause when the value of the IOMn\_CURIDX matches the IOMn\_ENDIDX. This is useful for software to be able to update the CQ buffer without causing a race condition between the CQ data buffer writes and the CQ fetches.

### 8.9.1 CQ Programming Notes

- Additional restrictions when using the CQ function is that the DMA must be disabled prior to writing the IOMn\_CQADDR register, either from the MCU or from the CQ itself.
- For multiple commands using DMA, the DMAEN must be reset after the command is done and before the DMA registers are set for the next transaction.



- It is possible for the CQ to write the IOMn\_CQADDR register during the CQ operation. The new address will take effect on the next fetch and allows the CQ to be relocated or looped.
- When starting the CQ operation, 1 doublet will be fetched regardless of the state of the pause status and bits. If any pause is active, it will take effect after the first fetch. For this reason, it is generally advisable to have a dummy register write as the first CQ doublet.

CQ write operations to SW flags used in combination with pause events 15:8 must first disable the pause enable, perform the SW flag write, then re-enable the pause enable register. SW flags 7:0 can be written without this restriction and will cause a pause immediately if activated.

## 8.10 Programmer's Reference

An example register sequence to initiate an operation is shown below (note this does not show the data portion of the operation, only the command):

### SPI SAMPLE OPERATION:

```
// Enable clock for 24MHz SPI operation
AM_REG(IOM,CLKCFG)=(0 << AM_REG_IOM_CLKCFG_LOWPER_S) |
    (0 << AM_REG_IOM_CLKCFG_TOTPER_S) |
    (0 << AM_REG_IOM_CLKCFG_DIVEN_S) |
    (1 << AM_REG_IOM_CLKCFG_DIV3_S) |
    (1 << AM_REG_IOM_CLKCFG_FSEL_S) |
    (1 << AM_REG_IOM_CLKCFG_IOCLKEN_S);

// Setup the SPI configuration register. MSB first, no flow control, not full duplex, mode 0
AM_REG(IOM, SPICFG) = ((0 << AM_REG_IOM_MSPICFG_MSPIRST_S) & AM_REG_IOM_MSPICFG_MSPIRST_M) |
    ((0 << AM_REG_IOM_MSPICFG_DOUTDLY_S) & AM_REG_IOM_MSPICFG_DOUTDLY_M) |
    ((0 << AM_REG_IOM_MSPICFG_DINDLY_S) & AM_REG_IOM_MSPICFG_DINDLY_M) |
    ((0 << AM_REG_IOM_MSPICFG_SPILSB_S) & AM_REG_IOM_MSPICFG_SPILSB_M) |
    ((0 << AM_REG_IOM_MSPICFG_RDFCPOL_S) & AM_REG_IOM_MSPICFG_RDFCPOL_M) |
    ((0 << AM_REG_IOM_MSPICFG_WTFPCPOL_S) & AM_REG_IOM_MSPICFG_WTFPCPOL_M) |
    ((0 << AM_REG_IOM_MSPICFG_WTFCIRQ_S) & AM_REG_IOM_MSPICFG_WTFCIRQ_M) |
    ((0 << AM_REG_IOM_MSPICFG_MOSIINV_S) & AM_REG_IOM_MSPICFG_MOSIINV_M) |
    ((0 << AM_REG_IOM_MSPICFG_RDFC_S) & AM_REG_IOM_MSPICFG_RDFC_M) |
    ((0 << AM_REG_IOM_MSPICFG_WTFC_S) & AM_REG_IOM_MSPICFG_WTFC_M) |
    ((0 << AM_REG_IOM_MSPICFG_FULLDUP_S) & AM_REG_IOM_MSPICFG_FULLDUP_M) |
    ((0 << AM_REG_IOM_MSPICFG_SPHA_S) & AM_REG_IOM_MSPICFG_SPHA_M) |
    ((0 << AM_REG_IOM_MSPICFG_SPOL_S) & AM_REG_IOM_MSPICFG_SPOL_M);

// Send a read command (2) of size 0x20 using 1 byte offset of 0x32 to device on CEN
AM_REG(IOM, CMD) = ((2 << AM_REG_IOM_CMD_CMD_S) & AM_REG_IOM_CMD_CMD_M) | // READ COMMAND
    ((0 << AM_REG_IOM_CMD_CMDSEL_S) & AM_REG_IOM_CMD_CMDSEL_M) |
    ((0x20 << AM_REG_IOM_CMD_TSIZE_S) & AM_REG_IOM_CMD_TSIZE_M) |
    ((0 << AM_REG_IOM_CMD_CONT_S) & AM_REG_IOM_CMD_CONT_S) |
    ((1 << AM_REG_IOM_CMD_OFFSETCNT_S) & AM_REG_IOM_CMD_OFFSETCNT_M) |
    ((0x32 << AM_REG_IOM_CMD_OFFSETLO_S) & AM_REG_IOM_CMD_OFFSETLO_M);
```

## 8.11 Interface Clock Generation

The I<sup>2</sup>C/SPI Master can generate a wide range of I/O interface clocks, as shown in Figure 22. The source clock is a scaled version of the HFRC 48 MHz clock, selected by IOMn\_CLKCFG\_FSEL. A divide-by-3 circuit may be selected by IOMn\_CLKCFG\_DIV3, which is particularly important in creating a useful SPI frequency of 16 MHz. The output of the divide-by-3 circuit may then be divided by an 8-bit value, IOMn\_CLKCFG\_TOTPER + 1, to produce the interface clock. This structure allows very precise specification of the interface frequency, and produces a minimum available interface frequency of 1.2 kHz. If TOTPER division is enabled by IOMn\_CLKCFG\_DIVEN, the length of the low period of the clock is specified by IOMn\_CLKCFG\_LOWPER + 1. Otherwise, the clock will have a 50% duty cycle.

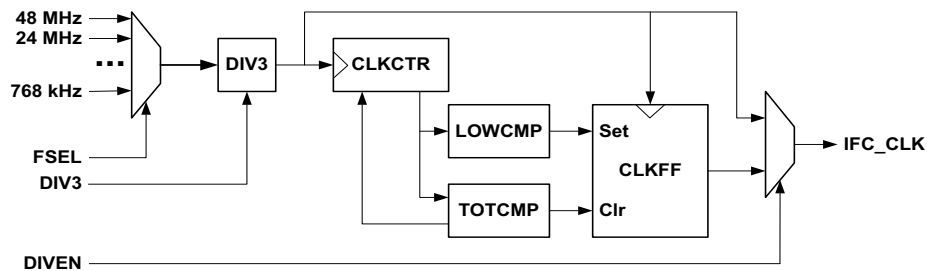


Figure 22. I<sup>2</sup>C/SPI Master Clock Generation

## 8.12 Command Operation

In order to minimize the amount of time the CPU must be awake during I<sup>2</sup>C/SPI Master operations, the architecture of the I<sup>2</sup>C/SPI Master is organized around processing commands which transfer data to and from an internal 64-byte FIFO.

The IOMn\_CMD register is used for command operations for both the SPI and I2C communication channels.

For writes to the interface, software writes data to the FIFO (IOMn\_FIFO) and then sends a single command to the IOMn\_CMD Register. Unless the TSIZE field of the CMD is zero, at least one word (4 bytes) of data must be written into the FIFO prior to writing the CMD Register or an ICMD interrupt will be generated and the operation will be terminated. The Command includes either the I<sup>2</sup>C slave address or the SPI channel select, the desired address offset and the length of the transfer. At that point the I<sup>2</sup>C/SPI Master executes the entire transfer, so the CPU can go to sleep. If more than 64 bytes are to be transferred, the Master will generate a THR interrupt when the FIFOSIZ value, IOMn\_FIFOPTR\_FIFOSIZ, drops below the write threshold IOMn\_FIFOTHR\_FIFOWTHR so the CPU can wake up and refill the FIFO. The I<sup>2</sup>C/SPI Master will generate the CMDCMP interrupt when the command is complete. In each case, the total number of bytes transferred in each operation is specified in the LENGTH field of the CMD Register. If software executes a write to the FIFO when it is full (FIFOSIZ is greater than 124) the FOVFL interrupt will be generated and the transfer will be terminated.

For reads, the CMD Register is first written with the command and the CPU can go to sleep. The Master initiates the read and transfers read data to the FIFO. If the FIFOSZ value exceeds the read threshold IOMn\_FIFOTHR\_FIFOTHR, a THR interrupt is generated so the CPU can wake up and empty the FIFO. A CMDCMP interrupt is also generated when the Command completes. If software executes a read from the FIFO when it has less than a word of data the FUNDFL interrupt will be generated and the transfer will be terminated. FUNDFL will not be generated if the read transfer has already completed, so that software can read the last FIFO word even if it is incomplete.

If the FIFO empties on a write or fills on a read, the I<sup>2</sup>C/SPI Master will simply pause the interface clock until the CPU has read or written a byte from the FIFO. This avoids the requirement that the thresholds be set conservatively so that the processor can wake up fewer times on long transfers without a risk of an underflow or overflow aborting a transfer in progress.

If software initiates an incorrect operation, such as attempting to read the FIFO on a write operation or when it is empty, or write the FIFO on a read operation or when it is full, the Master will generate an IACC error interrupt. If software attempts to write the Command Register when another Command is underway or write the CMD register with a write command when the FIFO is empty (unless the LENGTH field in the CMD is zero), the Master will generate an ICMD error interrupt.

### 8.13 FIFO

The I<sup>2</sup>C/SPI Master includes a 64-byte local RAM (LRAM) for data transfers. The LRAM functions as a FIFO. Only 32-bit word accesses are supported to the FIFO from the CPU. When a write operation is underway, a word written to the FIFO will increment the IOMn\_FIFOPTR\_FIFOnSIZ register by 4 and decrement the IOMn\_FIFOPTR\_FIFOnREM register by 4. Reading a byte from the FIFO via the I/O interface decrements FIFOnSIZ by 1 and increments FIFOnREM by 1. When a read operation is underway, a word read from the FIFO decrements FIFOnSIZ by 4 and increments FIFOnREM by 4. A byte read from the I/O interface into the FIFO increments FIFOnSIZ by 1 and decrements FIFOnREM by 1. If FIFOnSIZ becomes one during a write operation or 0x40 on a read operation and there is more data to be transferred, the clock of the I/O interface is paused until software accesses the FIFO.

Two threshold registers, FIFORTH and FIFOWTHR indicate when a THR interrupt should be generated to signal the processor that data should be transferred.

### 8.14 I<sup>2</sup>C Interface

The I<sup>2</sup>C/SPI Master supports a flexible set of Commands to implement a variety of standard I<sup>2</sup>C operations. The I<sup>2</sup>C interface consists of two lines: one bi-directional data line (SDA) and one clock line (SCL). Both the SDA and the SCL lines must be connected to a positive supply voltage via a pull-up resistor. By definition, a device that sends a message is called the “transmitter”, and the device that accepts the message is called the “receiver”. The device that controls the message transfer by driving SCL is called “master”. The devices that are controlled by the master are called “slaves”. The Apollo3 Blue SoC I<sup>2</sup>C Master is always a master device.

The following protocol has been defined:

- Data transfer may be initiated only when the bus is not busy.
- During data transfer, the data line must remain stable whenever the clock line is high.
- Changes in the data line while the clock line is high will be interpreted as control signals.

A number of bus conditions have been defined (see Figure 23) and are described in the following sections

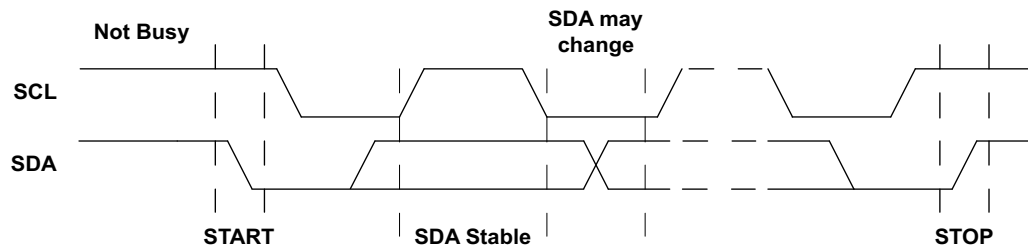


Figure 23. Basic I<sup>2</sup>C Conditions

#### 8.14.1 Bus Not Busy

Both SDA and SCL remain high.

#### 8.14.2 Start Data Transfer

A change in the state of SDA from high to low, while SCL is high, defines the START condition. A START condition which occurs after a previous START, but before a STOP, is called a RESTART condition, and functions exactly like a normal STOP followed by a normal START.

### 8.14.3 Stop Data Transfer

A change in the state of SDA from low to high, while SCL is high, defines the STOP condition.

### 8.14.4 Data Valid

After a START condition, SDA is stable for the duration of the high period of SCL. The data on SDA may be changed during the low period of SCL. There is one clock pulse per bit of data. Each data transfer is initiated with a START condition and terminated with a STOP condition. The number of data bytes transferred between the START and STOP conditions is not limited. The information is transmitted byte-wide and each receiver acknowledges with a ninth bit.

### 8.14.5 Acknowledge

Each byte of eight bits is followed by one acknowledge (ACK) bit as shown in Figure 24. This acknowledge bit is a low level driven onto SDA by the receiver, whereas the master generates an extra acknowledge related SCL pulse. A slave receiver which is addressed is obliged to generate an acknowledge after the reception of each byte. Also, on a read transfer, a master receiver must generate an acknowledge after the reception of each byte that has been clocked out of the slave transmitter. The device that acknowledges must pull down the SDA line during the acknowledge clock pulse in such a way that the SDA line is a stable low during the high period of the acknowledge related SCL pulse. A master receiver must signal an end-of-data to the slave transmitter by not generating an acknowledge (a NAK) on the last byte that has been clocked out of the slave. In this case, the transmitter must leave the data line high to enable the master to generate the STOP condition. If I/O Host attempts an I<sup>2</sup>C operation but no slave device generates an ACK, or if a slave fails to generate an ACK on a data byte before the transfer is complete, a NAK interrupt will be generated.

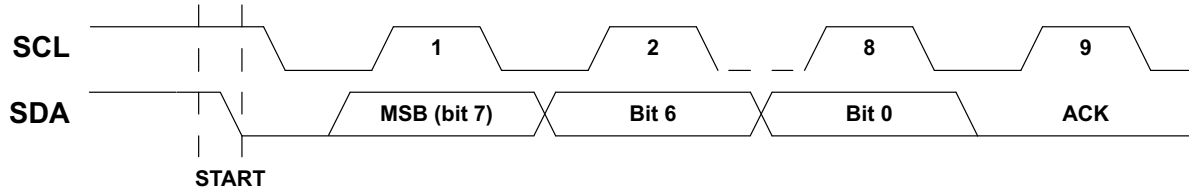


Figure 24. I<sup>2</sup>C Acknowledge

### 8.14.6 I<sup>2</sup>C Slave Addressing

For normal I<sup>2</sup>C reads and writes, the Command specifies the address to be sent on the interface. Both 7-bit and 10-bit addressing are supported, as selected by 10BIT in the Command. The address is specified in the ADDRESS field.

Figure 25 shows the operation in 7-bit mode in which the master addresses the slave with a 7-bit address configured as 0xD0 in the lower 7 bits of the ADDRESS field. After the START condition, the 7-bit address is transmitted MSB first. If this address matches the lower 7 bits of an attached slave device, the eighth bit indicates a write (RW = 0) or a read (RW = 1) operation and the slave supplies the ACK. If no slave acknowledges the address, the transfer is terminated and a NAK error interrupt is generated.

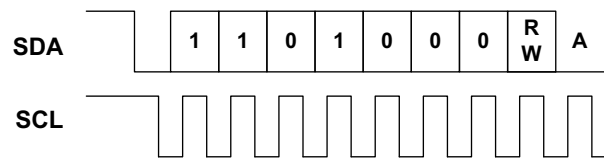
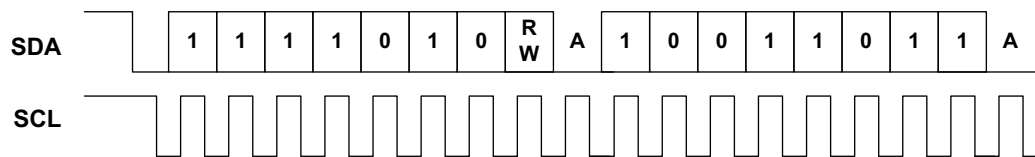
Figure 25. I<sup>2</sup>C 7-bit Address Operation

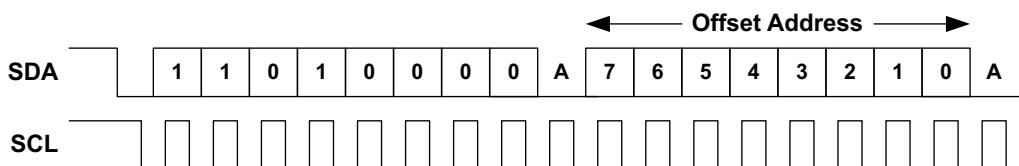
Figure 26 shows the operation with which the master addresses the Apollo3 Blue SoC with a 10-bit address configured at 0x536. After the START condition, the 10-bit preamble 0b11110 is transmitted first, followed by the upper two bits of the ADDRESS field and the eighth bit indicating a write (RW = 0) or a read (RW = 1) operation. If the upper two bits match the address of an attached slave device, it supplies the ACK. The next transfer includes the lower 8 bits of the ADDRESS field, and if these bits also match I2CADDR the slave again supplies the ACK. If no slave acknowledges either address byte, the transfer is terminated and a NAK error interrupt is generated.

Figure 26. I<sup>2</sup>C 10-bit Address Operation

#### 8.14.7 I<sup>2</sup>C Offset Address Transmission

If the OFFSETCNT field of the CMD register specifies that there is at least one byte of address offset for either a read or write command, then the I<sup>2</sup>C/SPI Master will first send one or more 8-bit Offset Address bytes, where the offset is specified in the OFFSETLO field of the CMD register, and the OFFSETHI field of the OFFSETHI register if multiple offset bytes have been specified.

This transfer is shown in Figure 27. The Offset Address is loaded into the Address Pointer of the slave.

Figure 27. I<sup>2</sup>C Offset Address Transmission

#### 8.14.8 I<sup>2</sup>C Write Operation with Address Offset

In a write operation the I<sup>2</sup>C/SPI Master transmits to a slave receiver. The Address Operation has a RW value of 0, and the second byte contains the Offset Address, as in Figure 27. The next byte is written to the slave register selected by the Address Pointer (which was loaded with the Offset Address) and the Address Pointer is incremented. Subsequent transfers write bytes into successive registers until a STOP condition is received, as shown in Figure 28.

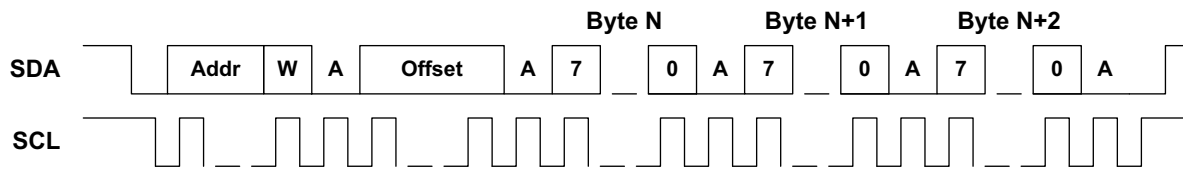


Figure 28. I²C Write Operation with Address Offset

#### 8.14.9 I²C Read Operation with Address Offset

If a read operation with address offset is selected, the I²C/SPI Master first executes an Offset Address Transmission to load the Address Pointer of the slave with the desired Offset Address.

A subsequent operation will again issue the address of the slave but with the RW bit as a 1 indicating a read operation. As shown in Figure 29, this transaction begins with a RESTART condition so that the interface will be held in a multi-master environment. After the address operation, the slave becomes the transmitter and sends the register value from the location pointed to by the Address Pointer, and the Address Pointer is incremented. Subsequent transactions produce successive register values, until the I²C/SPI Master receiver responds with a NAK and a STOP to complete the operation.

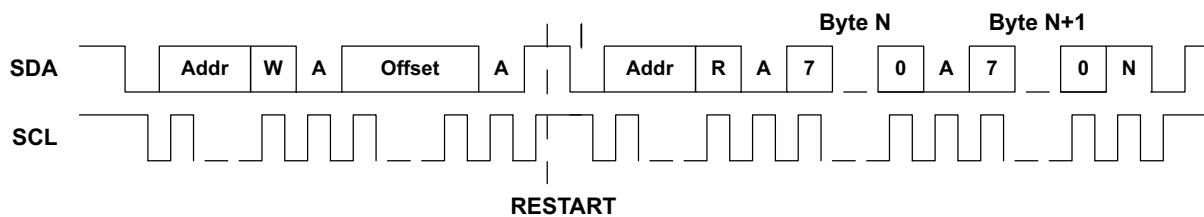


Figure 29. I²C Read Operation with Address Offset

#### 8.14.10 I²C Write Operation with No Address Offset

If a write with no address offset is selected in the CMD and OFFSETCNT fields of the CMD register, the I²C/SPI Master does not execute the Offset Address Transmission, but simply begins transferring bytes as shown in Figure 30. This provides support for slave devices which do not implement the standard offset address architecture. The OFFSETHI and OFFSETLO fields are not used in this case.

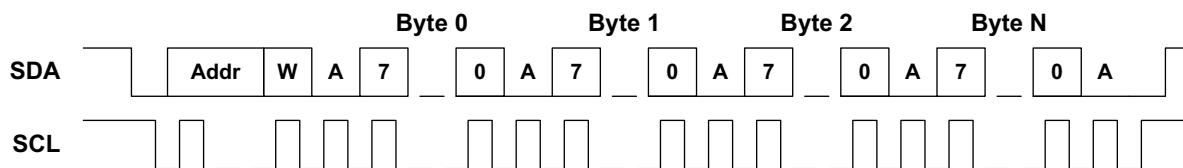


Figure 30. I²C Write Operation with No Address Offset

### 8.14.11 I<sup>2</sup>C Read Operation with No Address Offset

If a read with no address offset is selected in the CMD and OFFSETCNT fields of the CMD register, the I<sup>2</sup>C/SPI Master does not execute the Offset Address Transmission, but simply begins transferring bytes with a read as shown in Figure 31. This is important for slave devices which do not support an Address Pointer architecture. For devices which do include an Address Pointer, multiple reads with no address offset may be executed after a read with address offset to access subsequent registers as the Address Pointer increments, without having to execute the Offset Address Transmission for each access.

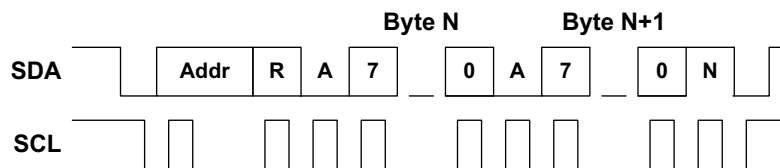


Figure 31. I<sup>2</sup>C Read Operation with No Address Offset

### 8.14.12 Holding the Interface with CONT

In all of the previously described transactions, the I<sup>2</sup>C/SPI Master terminates the I<sup>2</sup>C operation with a STOP sequence. In environments where there are other masters connected to the I<sup>2</sup>C interface, it may be necessary for the Apollo3 Blue SoC to hold the interface between Commands to insure that another master does not inadvertently access the same slave that the Apollo3 Blue SoC is accessing. In order to implement this functionality, the CONT bit should be set in the CMD Register. This will cause the I<sup>2</sup>C/SPI Master to keep SDA high at the end of the transfer so that a STOP does not occur, and the next transaction begins with a RESTART instead of a START. Note that for a Normal Read the interface is held between the Offset Address Transmission and the actual read independent of the state of CONT, but if CONT is set the read transaction will not terminate with a STOP.

### 8.14.13 I<sup>2</sup>C Multi-master Arbitration

The Apollo3 Blue SoC I<sup>2</sup>C/SPI Master supports multi-master arbitration in I<sup>2</sup>C mode. There are two cases which must be handled.

The first is the case where another master initiates an I<sup>2</sup>C operation when the Apollo3 Blue SoC Master is inactive. In this case the I<sup>2</sup>C/SPI Master will detect an I<sup>2</sup>C START operation on the interface and the START interrupt will be asserted, which tells the software not to generate any IO operations (which will not be executed in any case). Software then waits for the STOP interrupt, which reenables operation.

The second case is where another master initiates an operation at the same time as the Apollo3 Blue SoC. In this case there will be a point where one master detects that it is not driving SDA low but the bus signal is low, and that master loses the arbitration to the other master. If the Apollo3 Blue SoC I<sup>2</sup>C/SPI Master detects that it has lost arbitration, it will assert the ARB interrupt and immediately terminate its operation. Software must then wait for the STOP interrupt and re-execute the current Command.

## 8.15 SPI Operations

### 8.15.1 SPI Configuration

The I<sup>2</sup>C/SPI Master supports all combinations of the polarity and phase modes of SPI using the IOMn\_MSPICFG\_SPOL and IOMn\_MSPICFG\_SPHA bits. It also may be configured in either 3-wire or 4-

wire mode. In 4-wire mode, the MOSI and MISO interface signals use separate IO pins. In 3-wire mode, MOSI and MISO are multiplexed on a single IO pin for more efficient pin utilization. The 3/4 wire configuration is selected in the mapping function of the PINCFG module.

#### NOTE

Due to the susceptibility of creating a clock glitch which could cause register corruption, changing SPHA and SPOL bits should be done in separate writes to the MSPICFG register.

SPI operations may transfer up to 4095 bytes in a single transfer, as the TSIZE field in the CMD register provides a 12-bit length specification.

### 8.15.2 SPI Slave Addressing

In SPI mode, the Command specifies the slave channel to be used in the CMDSEL field. The I<sup>2</sup>C/SPI Master supports up to four slaves, each of which has its own nCE signal which can be configured on an IO pin. Additional slaves may be supported using GPIO pins and external decoding.

### 8.15.3 SPI Write with Address Offset

Figure 32 shows the case of a SPI Write with a one-byte address offset operation, whereby a write operation is selected in the CMD field. The operation is initiated when the I<sup>2</sup>C/SPI Master pulls one of the four nCE signals low. At that point the I<sup>2</sup>C/SPI Master begins generating the clock on SCK and the offset address is transmitted from the master on the MOSI line, with the upper R/W bit of the offset field indicating read (if 0) or write (if 1). In this example the R/W bit is a one selecting a write operation. The entire one, two or three offset, the length of which is specified by the OFFSETCNT field, is taken from the OFFSETLO field of the CMD and, depending on the value in OFFSETCNT, the OFFSETHI field in the OFFSETHI register. The MSB of the entire OFFSET should be set to 1 if the slave expects a RW bit. If the slave does not expect a RW bit, this allows the first byte of a write to be completely specified in the OFFSET field, and a single byte write in that case can be executed without requiring any data to be loaded in to the FIFO.

Each subsequent byte is read from the FIFO and transmitted. The operation is terminated when the I<sup>2</sup>C/SPI Master brings the nCE signal high. Note that the MISO line is not used in a write operation and is held in the high impedance state by the I<sup>2</sup>C/SPI Master.

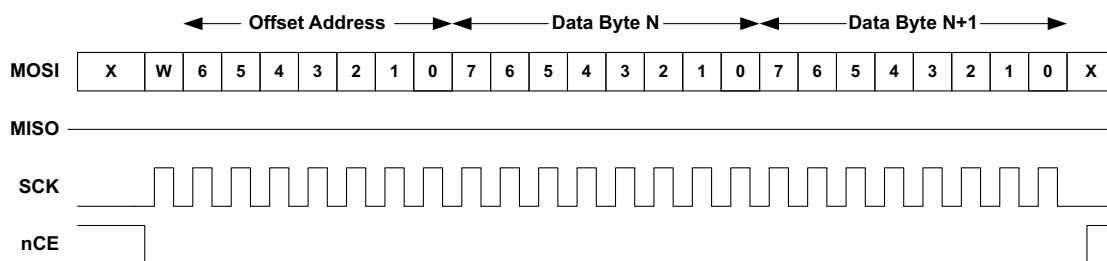


Figure 32. SPI Normal Write Operation (Single-byte Offset Address)

### 8.15.4 SPI Read with Address Offset

Figure 33 shows the case of a Read with a one-byte address offset operation, whereby a read operation is selected in the CMD field. The operation is initiated when the I<sup>2</sup>C/SPI Master pulls one of the four nCE



signals low. At that point the I<sup>2</sup>C/SPI Master begins driving the clock onto SCK and the address is transferred from the master to the slave just as it is in a write operation, but in this case the R/W bit is a 0 indicating a read. After the transfer of the last address bit (bit 0), the I<sup>2</sup>C/SPI Master stops driving the MOSI line and begins loading the FIFO with the data on the MISO line. The transfer continues until the I<sup>2</sup>C/SPI Master brings the nCE line high.

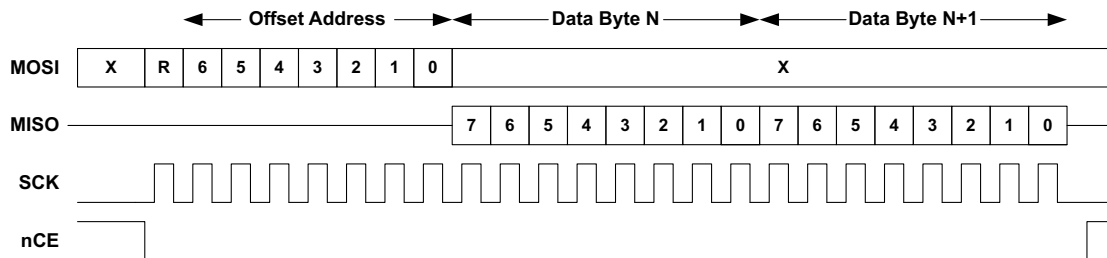


**Figure 33. SPI Normal Read Operation**

As with a Normal Write, the Offset Address byte including the R/W bit is taken from the offset field(s) of CMD. If the slave expects a R/W bit, the MSB of the offset must be set accordingly. This allows reads from devices which have different formats for the address byte.

#### 8.15.5 SPI Write with No Address Offset

If a write with no address offset is selected in the CMD field, the Offset Address byte is not sent and all data comes directly from the FIFO as shown in Figure 34. The OFFSET field is not used in this case.

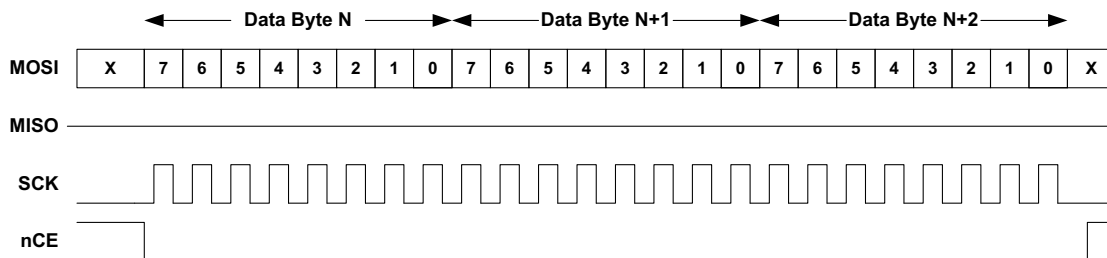


**Figure 34. SPI Raw Write Operation**

#### 8.15.6 SPI Read with No Address Offset

If a read with no address offset is selected in the CMD field, data goes directly to the FIFO as shown in Figure 35. The OFFSET field is not used in this case.

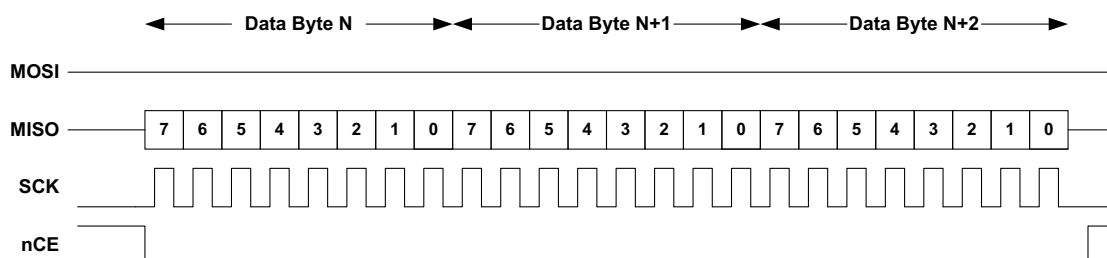


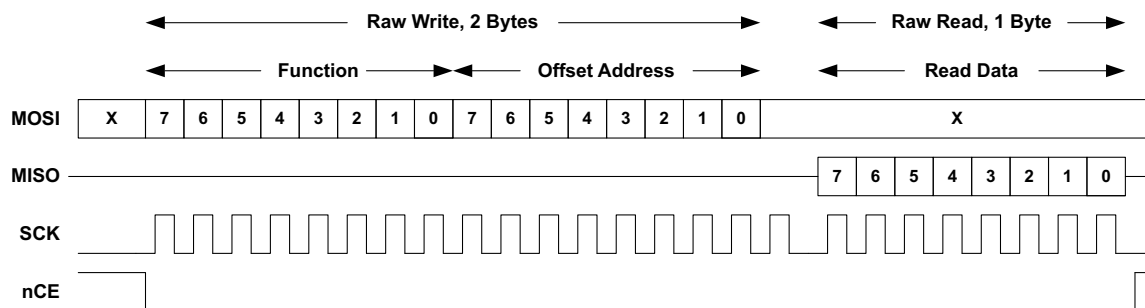
**Figure 35. SPI Raw Read Operation****8.15.7 SPI 3-wire Mode**

In 3-wire mode, the MOSI and MISO lines are shared on a single pin. As described in the previous sections, the MISO and MOSI lines are not driven at the same time, so 3-wire mode is equivalent to simply tying them together external to the Apollo3 Blue SoC. 3-wire mode is configured by selecting the MxWIR3 alternative (x = 0 to 5 selecting the I2C/SPI Master) in the GPIO Pad Multiplexor rather than the MxMOSI and MxMISO alternatives. Detailed configuration information is supplied in the GPIO and Pad Configuration Module chapter.

**8.15.8 Complex SPI Operations**

In some cases peripheral devices require more complex transaction sequences than those supported by a single Command. In order to support these transactions, the CONT bit may be set in the Command. In this case, the nCE pin selected by the Channel will remain asserted low at the end of the transaction, so that the next SPI operation will be seen as part of the same transaction. For example, there are peripheral devices which require both a Function and an Address Offset to be transmitted at the beginning of a read. Implementing this can be done in several ways. One example as shown in Figure 36 is:

1. Execute a Raw SPI write of length 2, with the data bytes being the Function and Offset. Set the CONT bit in this Command so nCE remains asserted low.
2. Execute a Raw SPI Read of the desired transfer length. The data will then be read into the FIFO. The CONT bit is not set in this Command.

**Figure 36. SPI Combined Operation****8.15.9 SPI Polarity and Phase**

The Apollo3 Blue SoC supports all combinations of CPOL (clock polarity) and CPHA (data phase) in SPI mode, as defined by the SPOL and SPHA bits. Figure 37 shows how these two bits affect the interface signal behavior.

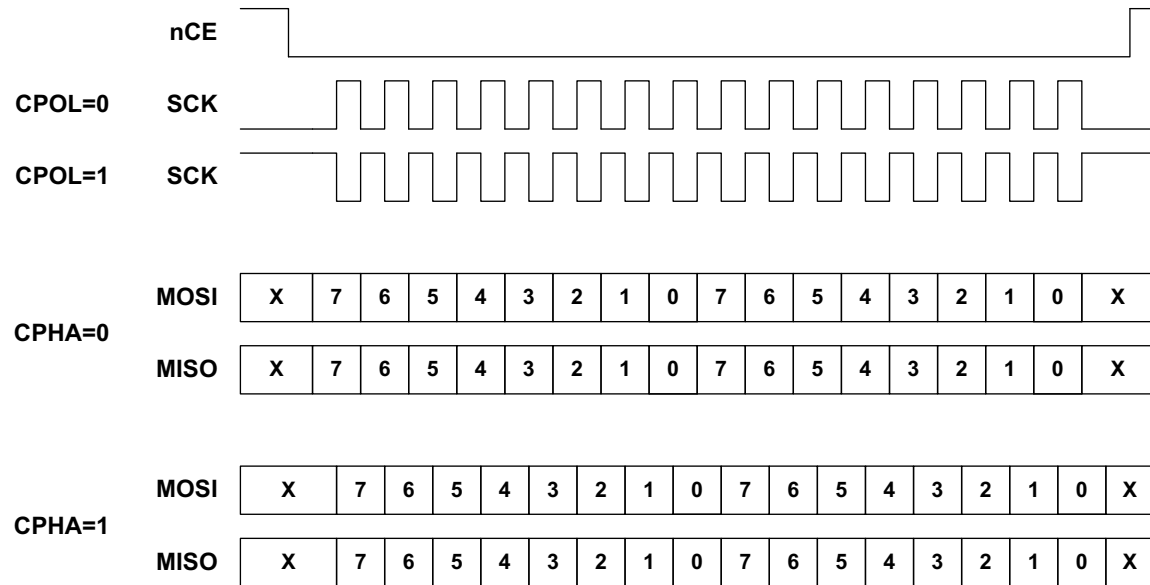


**Figure 37. SPI CPOL and CPHA**

If CPOL is 0, the clock SCK is normally low and positive pulses are generated during transfers. If CPOL is 1, SCK is normally high and negative pulses are generated during transfers.

If CPHA is 0, the data on the MOSI and MISO lines is sampled on the edge corresponding to the first SCK edge after nCE goes low (i.e. the rising edge if CPOL is 0 and the falling edge if CPOL is 1). Data on MISO and MOSI is driven on the opposite edge of SCK.

If CPHA is 1, the data on the MOSI and MISO lines is sampled on the edge corresponding to the second SCK edge after nCE goes low (i.e. the falling edge if CPOL is 0 and the rising edge if CPOL is 1). Data on MISO and MOSI is driven on the opposite edge of SCK.

The SPOL and SPHA bits may be changed between Commands if different slave devices have different requirements. In this case the SUBMODCTRL\_SMODnEN bit should be set to 0 either before or at the same time as SPHA and SPOL are changed, and then set back to 1 before CMD is written.

## 8.16 Bit Orientation

In both I<sup>2</sup>C and SPI modes, the I<sup>2</sup>C/SPI Master supports data transmission either LSB first or MSB first as configured by the LSB bit in the Command. If LSB is 0, data is transmitted and received MSB first. If LSB is 1, data is transmitted and received LSB first.

## 8.17 SPI Flow Control

The I<sup>2</sup>C/SPI Master supports flow control from the slave, which is controlled by several configuration bits. Either read or write (or both) flow control may be implemented. Read flow control is enabled by setting the IOMn\_MSPICFG\_RDFC bit, in which case the I<sup>2</sup>C/SPI Master will check the state of the Flow Control IRQ pin, and if it is inactive the SPI clock will stop at the completion of the current byte transfer until it becomes active. The Flow Control IRQ can be any of the 50 pins as selected by the GPIO\_IOMnIRQ register corresponding to the particular I<sup>2</sup>C/SPI Master. The polarity of the active state of the Flow Control IRQ is selected by the IOMn\_MSPICFG\_RDFCPOL.

Write flow control is enabled by setting the IOMn\_MSPICFG\_WTFC bit, but in this case either the Flow Control IRQ or the state of the MISO line may be used for flow control, as selected by the IOMn\_MSPICFG\_WTFCIRQ bit. If IRQ is selected by setting a one, the clock control is identical to that described for reads above and the IRQ polarity is set by the IOMn\_MSPICFG\_WTFCPOL bit. If MISO is selected by setting a zero in WTFCIRQ, the clock will be stopped if the MISO line is at the inactive polarity, which is set by the WTFCPOL bit.

Slave devices supporting flow control typically require specific states of the MOSI line prior to the start of a transfer. This state is controlled by the IOMn\_MSPICFG\_MOSIINV bit. If this bit is zero, MOSI will be driven to a 1 at the start of a write transaction and to a 0 at the start of a read transaction – this is the normal operation of devices with flow control support. If MOSIINV is set to one, these polarities will be inverted.

Flow control may be asserted either prior to the first byte transfer, which will delay the start of SCK, or within each byte transferred, which will pause SCK at the end of that byte. The examples below assume that WTFCPOL or RDFCPOL are set to 0.

Figure 38 shows the operation of flow control at the beginning of a write transfer or a normal read transfer which begins with an offset byte write. Either MISO or IRQ (selected by WTFCIRQ) must be deasserted low within  $\frac{1}{2}$  of the SCK period after nCE is asserted low in order to delay the clock. SCK will continue in its inactive state until MISO or IRQ is changed to the active state, and then will begin normal operation.

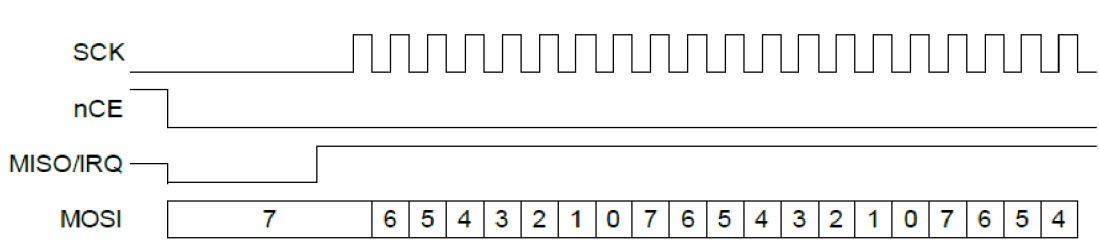


**Figure 38. Flow Control at Beginning of a Write Transfer**

Figure 39 shows the operation of flow control at the beginning of a raw read transfer. IRQ must be deasserted low within  $\frac{1}{2}$  of the SCK period after nCE is asserted low in order to delay the clock. SCK will continue in its inactive state until IRQ is changed to the active state, and then will begin normal operation.

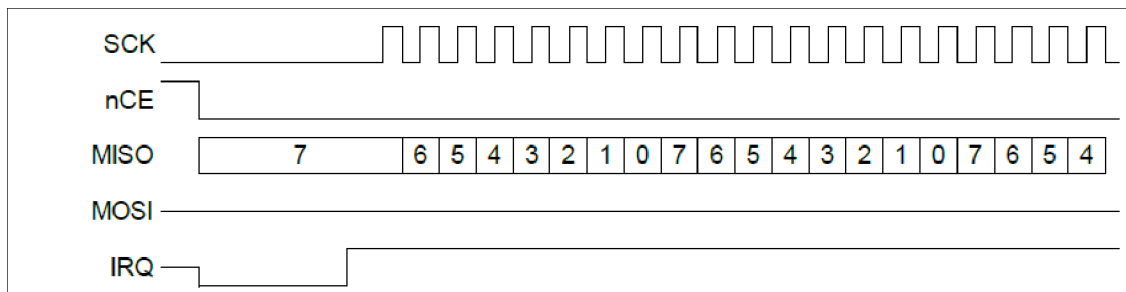


**Figure 39. Flow Control at Beginning of a Raw Read Transfer**

Figure 40 shows the operation of flow control in the middle of a write transfer. MISO or IRQ must be deasserted after the leading edge of SCK on the first bit of the byte (labeled 7) and before the falling edge of the 7th bit of the byte (labeled 1) in order to insure that SCK stops at the end of the byte. De-asserting MISO or IRQ outside of that window can produce unpredictable results. SCK will resume at some point after the assertion of MISO or IRQ.

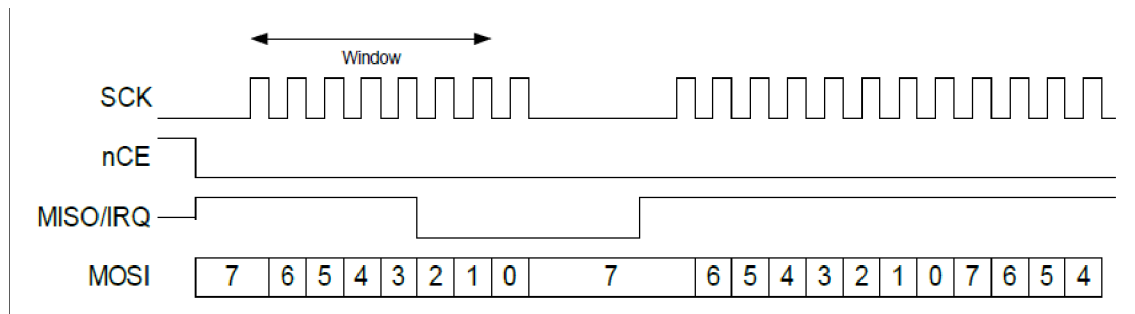


**Figure 40. Flow Control in the Middle of a Write Transfer**

Figure 41 shows the operation of flow control in the middle of a read transfer. IRQ must be deasserted after the leading edge of SCK on the first bit of the byte (labeled 7) and before the falling edge of the 7th bit of the byte (labeled 1) in order to insure that SCK stops at the end of the byte. De-asserting IRQ outside of that window can produce unpredictable results. SCK will resume at some point after the assertion of IRQ.

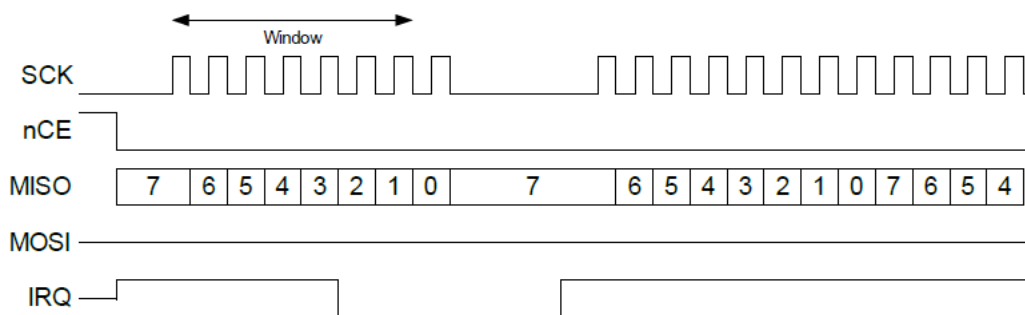


**Figure 41. Flow Control in the Middle of a Read Transfer**

## 8.18 Minimizing Power

Each I<sup>2</sup>C/SPI Master submodule has an interface enable bit `IIOMn_SUBMODCTRL_SMODnEN`. This bit should be kept at 0 (along with `PWRCTRL_DEVPWREN_PWRIOMn` fields) whenever the interface is not being used in order to minimize power consumption.

## 8.19 IOM Registers

### IO Peripheral Master

**INSTANCE 0 BASE ADDRESS:**0x50004000

**INSTANCE 1 BASE ADDRESS:**0x50005000

**INSTANCE 2 BASE ADDRESS:**0x50006000

**INSTANCE 3 BASE ADDRESS:**0x50007000

**INSTANCE 4 BASE ADDRESS:**0x50008000

**INSTANCE 5 BASE ADDRESS:**0x50009000

Registers associated with the IOM master module. The IOM master module is responsible for performing SPI and I2C master operations to/from external devices. Multiple devices

### 8.19.1 Register Memory Map

**Table 396: IOM Register Map**

| Address(s)                                                                       | Register Name | Description                               |
|----------------------------------------------------------------------------------|---------------|-------------------------------------------|
| 0x50004000<br>0x50005000<br>0x50006000<br>0x50007000<br>0x50008000<br>0x50009000 | FIFO          | FIFO Access Port                          |
| 0x50004100<br>0x50005100<br>0x50006100<br>0x50007100<br>0x50008100<br>0x50009100 | FIFOPTR       | FIFO size and remaining slots open values |
| 0x50004104<br>0x50005104<br>0x50006104<br>0x50007104<br>0x50008104<br>0x50009104 | FIFOTHR       | FIFO Threshold Configuration              |
| 0x50004108<br>0x50005108<br>0x50006108<br>0x50007108<br>0x50008108<br>0x50009108 | FIFOPOP       | FIFO POP register                         |
| 0x5000410C<br>0x5000510C<br>0x5000610C<br>0x5000710C<br>0x5000810C<br>0x5000910C | FIFOPUSH      | FIFO PUSH register                        |
| 0x50004110<br>0x50005110<br>0x50006110<br>0x50007110<br>0x50008110<br>0x50009110 | FIFOCTRL      | FIFO Control                              |
| 0x50004114<br>0x50005114<br>0x50006114<br>0x50007114<br>0x50008114<br>0x50009114 | FIFOLOC       | FIFO Pointers                             |
| 0x50004200<br>0x50005200<br>0x50006200<br>0x50007200<br>0x50008200<br>0x50009200 | INTEN         | IO Master Interrupts: Enable              |

Table 396: IOM Register Map

| Address(s)                                                                       | Register Name | Description                                            |
|----------------------------------------------------------------------------------|---------------|--------------------------------------------------------|
| 0x50004204<br>0x50005204<br>0x50006204<br>0x50007204<br>0x50008204<br>0x50009204 | INTSTAT       | IO Master Interrupts: Status                           |
| 0x50004208<br>0x50005208<br>0x50006208<br>0x50007208<br>0x50008208<br>0x50009208 | INTCLR        | IO Master Interrupts: Clear                            |
| 0x5000420C<br>0x5000520C<br>0x5000620C<br>0x5000720C<br>0x5000820C<br>0x5000920C | INTSET        | IO Master Interrupts: Set                              |
| 0x50004210<br>0x50005210<br>0x50006210<br>0x50007210<br>0x50008210<br>0x50009210 | CLKCFG        | I/O Clock Configuration                                |
| 0x50004214<br>0x50005214<br>0x50006214<br>0x50007214<br>0x50008214<br>0x50009214 | SUBMODCTRL    | Submodule control                                      |
| 0x50004218<br>0x50005218<br>0x50006218<br>0x50007218<br>0x50008218<br>0x50009218 | CMD           | Command and Offset                                     |
| 0x5000421C<br>0x5000521C<br>0x5000621C<br>0x5000721C<br>0x5000821C<br>0x5000921C | DCX           | DCX Control                                            |
| 0x50004220<br>0x50005220<br>0x50006220<br>0x50007220<br>0x50008220<br>0x50009220 | OFFSETHI      | High order 2 bytes of 3 byte offset for IO transaction |
| 0x50004224<br>0x50005224<br>0x50006224<br>0x50007224<br>0x50008224<br>0x50009224 | CMDSTAT       | Command status                                         |



Table 396: IOM Register Map

| Address(s)                                                                       | Register Name | Description                 |
|----------------------------------------------------------------------------------|---------------|-----------------------------|
| 0x50004240<br>0x50005240<br>0x50006240<br>0x50007240<br>0x50008240<br>0x50009240 | DMATRIGEN     | DMA Trigger Enable          |
| 0x50004244<br>0x50005244<br>0x50006244<br>0x50007244<br>0x50008244<br>0x50009244 | DMATRIGSTAT   | DMA Trigger Status          |
| 0x50004280<br>0x50005280<br>0x50006280<br>0x50007280<br>0x50008280<br>0x50009280 | DMACFG        | DMA Configuration           |
| 0x50004288<br>0x50005288<br>0x50006288<br>0x50007288<br>0x50008288<br>0x50009288 | DMATOTCOUNT   | DMA Total Transfer Count    |
| 0x5000428C<br>0x5000528C<br>0x5000628C<br>0x5000728C<br>0x5000828C<br>0x5000928C | DMATARGADDR   | DMA Target Address          |
| 0x50004290<br>0x50005290<br>0x50006290<br>0x50007290<br>0x50008290<br>0x50009290 | DMASTAT       | DMA Status                  |
| 0x50004294<br>0x50005294<br>0x50006294<br>0x50007294<br>0x50008294<br>0x50009294 | CQCFG         | Command Queue Configuration |
| 0x50004298<br>0x50005298<br>0x50006298<br>0x50007298<br>0x50008298<br>0x50009298 | CQADDR        | CQ Target Read Address      |
| 0x5000429C<br>0x5000529C<br>0x5000629C<br>0x5000729C<br>0x5000829C<br>0x5000929C | CQSTAT        | Command Queue Status        |

Table 396: IOM Register Map

| Address(s)                                                                       | Register Name | Description                                                                                                                       |
|----------------------------------------------------------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------|
| 0x500042A0<br>0x500052A0<br>0x500062A0<br>0x500072A0<br>0x500082A0<br>0x500092A0 | CQFLAGS       | Command Queue Flag                                                                                                                |
| 0x500042A4<br>0x500052A4<br>0x500062A4<br>0x500072A4<br>0x500082A4<br>0x500092A4 | CQSETCLEAR    | Command Queue Flag Set/Clear                                                                                                      |
| 0x500042A8<br>0x500052A8<br>0x500062A8<br>0x500072A8<br>0x500082A8<br>0x500092A8 | CQPAUSEEN     | Command Queue Pause Enable                                                                                                        |
| 0x500042AC<br>0x500052AC<br>0x500062AC<br>0x500072AC<br>0x500082AC<br>0x500092AC | CQCURIDX      | IOM Command Queue current index value . Compared to the CQENDIDX reg contents to generate the IDXEQ Pause event for command queue |
| 0x500042B0<br>0x500052B0<br>0x500062B0<br>0x500072B0<br>0x500082B0<br>0x500092B0 | CQENDIDX      | IOM Command Queue current index value . Compared to the CQCURIDX reg contents to generate the IDXEQ Pause event for command queue |
| 0x500042B4<br>0x500052B4<br>0x500062B4<br>0x500072B4<br>0x500082B4<br>0x500092B4 | STATUS        | IOM Module Status                                                                                                                 |
| 0x50004300<br>0x50005300<br>0x50006300<br>0x50007300<br>0x50008300<br>0x50009300 | MSPICFG       | SPI module master configuration                                                                                                   |
| 0x50004400<br>0x50005400<br>0x50006400<br>0x50007400<br>0x50008400<br>0x50009400 | MI2CCFG       | I2C Master configuration                                                                                                          |
| 0x50004404<br>0x50005404<br>0x50006404<br>0x50007404<br>0x50008404<br>0x50009404 | DEVCFG        | I2C Device Configuration register                                                                                                 |

Table 396: IOM Register Map

| Address(s)                                                                       | Register Name | Description |
|----------------------------------------------------------------------------------|---------------|-------------|
| 0x50004410<br>0x50005410<br>0x50006410<br>0x50007410<br>0x50008410<br>0x50009410 | IOMDBG        | IOM Debug   |



**Table 399: FIFOPTR Register**

|          |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |
|----------|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|
| 3        | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2        | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1        | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0        | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1        | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3        | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5        | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7        | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FIFO1REM |   |   |   |   |   |   |   | FIFO1SIZ |   |   |   |   |   |   |   | FIFO0REM |   |   |   |   |   |   |   | FIFO0SIZ |   |   |   |   |   |   |   |

**Table 400: FIFOPTR Register Bits**

| Bit   | Name     | Reset | RW | Description                                                                                      |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------|
| 31:24 | FIFO1REM | 0x0   | RO | The number of remaining data bytes slots currently in FIFO 1 (written by interface, read by MCU) |
| 23:16 | FIFO1SIZ | 0x0   | RO | The number of valid data bytes currently in FIFO 1 (written by interface, read by MCU)           |
| 15:8  | FIFO0REM | 0x0   | RO | The number of remaining data bytes slots currently in FIFO 0 (written by MCU, read by interface) |
| 7:0   | FIFO0SIZ | 0x0   | RO | The number of valid data bytes currently in the FIFO 0 (written by MCU, read by interface)       |

**8.19.2.3 FIFOTHR Register****FIFO Threshold Configuration****OFFSET:** 0x00000104**INSTANCE 0 ADDRESS:** 0x50004104**INSTANCE 1 ADDRESS:** 0x50005104**INSTANCE 2 ADDRESS:** 0x50006104**INSTANCE 3 ADDRESS:** 0x50007104**INSTANCE 4 ADDRESS:** 0x50008104**INSTANCE 5 ADDRESS:** 0x50009104

Sets the threshold values for incoming and outgoing transactions. The threshold values are used to assert the interrupt if enabled, and also used during DMA to set the transfer size as a result of DMATHR trigger.

**Table 401: FIFOTHR Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |         |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3   | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8  | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | FIFOWTHR |        |        |        | RSVD   | FIFOTHR |        |        |        |        |        |        |        |        |

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|-----------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:14 | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 13:8  | FIFOWTHR  | 0x0   | RW | FIFO write threshold in bytes. A value of 0 will disable the write FIFO level from activating the threshold interrupt. If this field is non-zero, it will trigger a threshold interrupt when the write FIFO contains FIFOWTHR free bytes, as indicated by the FIFOOREM field. This is intended to signal when a transfer of FIFOWTHR bytes can be done from the host to the IOM write FIFO to support large IOM write operations.                           |
| 7:6   | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 5:0   | FIFORTHRR | 0x0   | RW | FIFO read threshold in bytes. A value of 0 will disable the read FIFO level from activating the threshold interrupt. If this field is non-zero, it will trigger a threshold interrupt when the read FIFO contains FIFORTHRR valid bytes of data, as indicated by the FIFO1SIZ field. This is intended to signal when a data transfer of FIFORTHRR bytes can be done from the IOM module to the host via the read FIFO to support large IOM read operations. |

## FIFO POP register

**INSTANCE 0 ADDRESS: 0x50004108****INSTANCE 2 ADDRESS: 0x50006108****INSTANCE 4 ADDRESS: 0x50008108****INSTANCE 5 ADDRESS: 0x50009108**

Will advance the internal read pointer of the incoming FIFO (FIFO1) when read, if POPWR is not active. If POPWR is active, a write to this register is needed to advance the internal FIFO pointer.

|          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3        | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1        | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FIFODOUT |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name     | Reset | RW | Description                                                                                                                                                                                                                         |
|------|----------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | FIFODOUT | 0x0   | RW | This register will return the read data indicated by the current read pointer on reads. If the POPWR control bit in the FIFOCTRL register is reset (0), the FIFO read pointer will be advanced by one word as a result of the read. |

## FIFO PUSH register

**INSTANCE 5 ADDRESS: 0x5000910C**

Will write new data into the outgoing FIFO and advance the internal write pointer.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FIFODIN |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name    | Reset | RW | Description                                                                                                                                                                                                                 |
|------|---------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | FIFODIN | 0x0   | RW | This register is used to write the FIFORAM in FIFO mode and will cause a push event to occur to the next open slot within the FIFORAM. Writing to this register will cause the write point to increment by 1 word(4 bytes). |

## FIFO Control

**INSTANCE 3 ADDRESS: 0x50007110**





Table 409: FIFOLOC Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |          |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1   | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6   | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | FIFORPTR |        | RSVD   |        |        | FIFOWPTR |        |        |        |        |        |        |

Table 410: FIFOLOC Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                       |
|-------|----------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:12 | RSVD     | 0x0   | RO | Reserved                                                                                                                                                          |
| 11:8  | FIFORPTR | 0x0   | RW | Current FIFO read pointer. Used to index into the incoming FIFO (FIFO1), which is used to store read data returned from external devices during a read operation. |
| 7:4   | RSVD     | 0x0   | RO | Reserved                                                                                                                                                          |
| 3:0   | FIFOWPTR | 0x0   | RW | Current FIFO write pointer. Value is the index into the outgoing FIFO (FIFO0), which is used during write operations to external devices.                         |

### 8.19.2.8 INTEN Register

IO Master Interrupts: Enable

OFFSET: 0x00000200

INSTANCE 0 ADDRESS: 0x50004200

INSTANCE 1 ADDRESS: 0x50005200

INSTANCE 2 ADDRESS: 0x50006200

INSTANCE 3 ADDRESS: 0x50007200

INSTANCE 4 ADDRESS: 0x50008200

INSTANCE 5 ADDRESS: 0x50009200

Set bits in this register to allow this module to generate the corresponding interrupt.

Table 411: INTEN Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CQERR  | CQUPD  | CQPAUSED | DERR   | DCMP   | ARB    | STOP   | START  | ICMD   | IACC   | NAK    | FOVFL  | FUNDL  | THR    | CMDCMP |

Table 412: INTEN Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                           |
|-------|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:15 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                              |
| 14    | CQERR    | 0x0   | RW | Error during command queue operations                                                                                                                                                                                                                                 |
| 13    | CQUPD    | 0x0   | RW | CQ write operation performed a register write with the register address bit 0 set to 1. The low address bits in the CQ address fields are unused and bit 0 can be used to trigger an interrupt to indicate when this register write is performed by the CQ operation. |
| 12    | CQPAUSED | 0x0   | RO | Command queue is paused due to an active event enabled in the PAUSEEN register. The interrupt is posted when the event is enabled within the PAUSEEN register, the mask is active in the CQIRQMASK field and the event occurs.                                        |
| 11    | DERR     | 0x0   | RW | DMA Error encountered during the processing of the DMA command. The DMA error could occur when the memory access specified in the DMA operation is not available or incorrectly specified.                                                                            |
| 10    | DCMP     | 0x0   | RW | DMA Complete. Processing of the DMA operation has completed and the DMA submodule is returned into the idle state                                                                                                                                                     |
| 9     | ARB      | 0x0   | RW | Arbitration loss interrupt. Asserted when arbitration is enabled and has been lost to another master on the bus.                                                                                                                                                      |
| 8     | STOP     | 0x0   | RW | STOP command interrupt. Asserted when another master on the bus has signaled a STOP command.                                                                                                                                                                          |
| 7     | START    | 0x0   | RW | START command interrupt. Asserted when another master on the bus has signaled a START command.                                                                                                                                                                        |
| 6     | ICMD     | 0x0   | RW | illegal command interrupt. Asserted when a command is written when an active command is in progress.                                                                                                                                                                  |
| 5     | IACC     | 0x0   | RW | illegal FIFO access interrupt. Asserted when there is a overflow or underflow event                                                                                                                                                                                   |
| 4     | NAK      | 0x0   | RW | I2C NAK interrupt. Asserted when an unexpected NAK has been received on the I2C bus.                                                                                                                                                                                  |
| 3     | FOVFL    | 0x0   | RW | Write FIFO Overflow interrupt. This occurs when software tries to write to a full FIFO. The current operation does not stop.                                                                                                                                          |
| 2     | FUNDFL   | 0x0   | RW | Read FIFO Underflow interrupt. This occurs when software tries to pop from an empty FIFO.                                                                                                                                                                             |
| 1     | THR      | 0x0   | RW | FIFO Threshold interrupt. For write operations, asserted when the number of free bytes in the write FIFO equals or exceeds the WTHR field.                                                                                                                            |

| Bit | Name   | Reset | RW | Description                |
|-----|--------|-------|----|----------------------------|
| 0   | CMDCMP | 0x0   | RW | Command complete interrupt |

## IO Master Interrupts: Status

**INSTANCE 0 ADDRESS: 0x50004204**

**INSTANCE 2 ADDRESS: 0x50006204**

**INSTANCE 4 ADDRESS: 0x50008204**

**INSTANCE 5 ADDRESS: 0x50009204**

Read bits from this register to discover the cause of a recent interrupt.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CQERR  | CQUPD  | CQPAUSED | DERR   | DCMP   | ARB    | STOP   | START  | ICMD   | IACC   | NAK    | FOVFL  | FUNDPL | THR    | CMDCMP |

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                           |
|-------|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:15 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                              |
| 14    | CQERR    | 0x0   | RW | Error during command queue operations                                                                                                                                                                                                                                 |
| 13    | CQUPD    | 0x0   | RW | CQ write operation performed a register write with the register address bit 0 set to 1. The low address bits in the CQ address fields are unused and bit 0 can be used to trigger an interrupt to indicate when this register write is performed by the CQ operation. |
| 12    | CQPAUSED | 0x0   | RO | Command queue is paused due to an active event enabled in the PAUSEEN register. The interrupt is posted when the event is enabled within the PAUSEEN register, the mask is active in the CQIRQMASK field and the event occurs.                                        |

Table 414: INTSTAT Register Bits

| Bit | Name   | Reset | RW | Description                                                                                                                                                                                |
|-----|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11  | DERR   | 0x0   | RW | DMA Error encountered during the processing of the DMA command. The DMA error could occur when the memory access specified in the DMA operation is not available or incorrectly specified. |
| 10  | DCMP   | 0x0   | RW | DMA Complete. Processing of the DMA operation has completed and the DMA submodule is returned into the idle state                                                                          |
| 9   | ARB    | 0x0   | RW | Arbitration loss interrupt. Asserted when arbitration is enabled and has been lost to another master on the bus.                                                                           |
| 8   | STOP   | 0x0   | RW | STOP command interrupt. Asserted when another master on the bus has signaled a STOP command.                                                                                               |
| 7   | START  | 0x0   | RW | START command interrupt. Asserted when another master on the bus has signaled a START command.                                                                                             |
| 6   | ICMD   | 0x0   | RW | illegal command interrupt. Asserted when a command is written when an active command is in progress.                                                                                       |
| 5   | IACC   | 0x0   | RW | illegal FIFO access interrupt. Asserted when there is a overflow or underflow event                                                                                                        |
| 4   | NAK    | 0x0   | RW | I2C NAK interrupt. Asserted when an unexpected NAK has been received on the I2C bus.                                                                                                       |
| 3   | FOVFL  | 0x0   | RW | Write FIFO Overflow interrupt. This occurs when software tries to write to a full FIFO. The current operation does not stop.                                                               |
| 2   | FUNDFL | 0x0   | RW | Read FIFO Underflow interrupt. This occurs when software tries to pop from an empty FIFO.                                                                                                  |
| 1   | THR    | 0x0   | RW | FIFO Threshold interrupt. For write operations, asserted when the number of free bytes in the write FIFO equals or exceeds the WTHR field.                                                 |
| 0   | CMDCMP | 0x0   | RW | Command complete interrupt                                                                                                                                                                 |

**8.19.2.10INTCLR Register****IO Master Interrupts: Clear****OFFSET:** 0x00000208**INSTANCE 0 ADDRESS:** 0x50004208**INSTANCE 1 ADDRESS:** 0x50005208**INSTANCE 2 ADDRESS:** 0x50006208**INSTANCE 3 ADDRESS:** 0x50007208**INSTANCE 4 ADDRESS:** 0x50008208**INSTANCE 5 ADDRESS:** 0x50009208

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

**Table 415: INTCLR Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |       |          |      |      |     |      |       |      |      |     |       |        |     |        |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|-------|----------|------|------|-----|------|-------|------|------|-----|-------|--------|-----|--------|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1     | 1     | 1        | 1    | 1    | 0   | 0    | 0     | 0    | 0    | 0   | 0     | 0      | 0   |        |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5     | 4     | 3        | 2    | 1    | 0   | 9    | 8     | 7    | 6    | 5   | 4     | 3      | 2   | 1      | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQERR | CQUPD | CQPAUSED | DERR | DCMP | ARB | STOP | START | ICMD | IACC | NAK | FOVFL | FUNDFL | THR | CMDCMP |   |

**Table 416: INTCLR Register Bits**

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                           |
|-------|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:15 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                              |
| 14    | CQERR    | 0x0   | RW | Error during command queue operations                                                                                                                                                                                                                                 |
| 13    | CQUPD    | 0x0   | RW | CQ write operation performed a register write with the register address bit 0 set to 1. The low address bits in the CQ address fields are unused and bit 0 can be used to trigger an interrupt to indicate when this register write is performed by the CQ operation. |
| 12    | CQPAUSED | 0x0   | RO | Command queue is paused due to an active event enabled in the PAUSEEN register. The interrupt is posted when the event is enabled within the PAUSEEN register, the mask is active in the CQIRQMASK field and the event occurs.                                        |
| 11    | DERR     | 0x0   | RW | DMA Error encountered during the processing of the DMA command. The DMA error could occur when the memory access specified in the DMA operation is not available or incorrectly specified.                                                                            |
| 10    | DCMP     | 0x0   | RW | DMA Complete. Processing of the DMA operation has completed and the DMA submodule is returned into the idle state                                                                                                                                                     |
| 9     | ARB      | 0x0   | RW | Arbitration loss interrupt. Asserted when arbitration is enabled and has been lost to another master on the bus.                                                                                                                                                      |
| 8     | STOP     | 0x0   | RW | STOP command interrupt. Asserted when another master on the bus has signaled a STOP command.                                                                                                                                                                          |
| 7     | START    | 0x0   | RW | START command interrupt. Asserted when another master on the bus has signaled a START command.                                                                                                                                                                        |
| 6     | ICMD     | 0x0   | RW | illegal command interrupt. Asserted when a command is written when an active command is in progress.                                                                                                                                                                  |
| 5     | IACC     | 0x0   | RW | illegal FIFO access interrupt. Asserted when there is a overflow or underflow event                                                                                                                                                                                   |

| Bit | Name   | Reset | RW | Description                                                                                                                                |
|-----|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------|
| 4   | NAK    | 0x0   | RW | I2C NAK interrupt. Asserted when an unexpected NAK has been received on the I2C bus.                                                       |
| 3   | FOVFL  | 0x0   | RW | Write FIFO Overflow interrupt. This occurs when software tries to write to a full FIFO. The current operation does not stop.               |
| 2   | FUNDFL | 0x0   | RW | Read FIFO Underflow interrupt. This occurs when software tries to pop from an empty FIFO.                                                  |
| 1   | THR    | 0x0   | RW | FIFO Threshold interrupt. For write operations, asserted when the number of free bytes in the write FIFO equals or exceeds the WTHR field. |
| 0   | CMDCMP | 0x0   | RW | Command complete interrupt                                                                                                                 |

## IO Master Interrupts: Set

**INSTANCE 0 ADDRESS: 0x5000420C**

**INSTANCE 2 ADDRESS: 0x5000620C**

**INSTANCE 4 ADDRESS: 0x5000820C**

Write a 1 to a bit in this register to instantly generate an interrupt from this module. (Generally used for testing purposes).

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CQERR  | CQUPD  | CQPAUSED | DERR   | DCMP   | ARB    | STOP   | START  | ICMD   | IACC   | NAK    | FOVFL  | FUNDFL | THR    | CMDCMP |

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:15 | RSVD | 0x0   | RO | RESERVED    |

Table 418: INTSET Register Bits

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                           |
|-----|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14  | CQERR    | 0x0   | RW | Error during command queue operations                                                                                                                                                                                                                                 |
| 13  | CQUPD    | 0x0   | RW | CQ write operation performed a register write with the register address bit 0 set to 1. The low address bits in the CQ address fields are unused and bit 0 can be used to trigger an interrupt to indicate when this register write is performed by the CQ operation. |
| 12  | CQPAUSED | 0x0   | RO | Command queue is paused due to an active event enabled in the PAUSEEN register. The interrupt is posted when the event is enabled within the PAUSEEN register, the mask is active in the CQIRQMASK field and the event occurs.                                        |
| 11  | DERR     | 0x0   | RW | DMA Error encountered during the processing of the DMA command. The DMA error could occur when the memory access specified in the DMA operation is not available or incorrectly specified.                                                                            |
| 10  | DCMP     | 0x0   | RW | DMA Complete. Processing of the DMA operation has completed and the DMA submodule is returned into the idle state                                                                                                                                                     |
| 9   | ARB      | 0x0   | RW | Arbitration loss interrupt. Asserted when arbitration is enabled and has been lost to another master on the bus.                                                                                                                                                      |
| 8   | STOP     | 0x0   | RW | STOP command interrupt. Asserted when another master on the bus has signaled a STOP command.                                                                                                                                                                          |
| 7   | START    | 0x0   | RW | START command interrupt. Asserted when another master on the bus has signaled a START command.                                                                                                                                                                        |
| 6   | ICMD     | 0x0   | RW | illegal command interrupt. Asserted when a command is written when an active command is in progress.                                                                                                                                                                  |
| 5   | IACC     | 0x0   | RW | illegal FIFO access interrupt. Asserted when there is a overflow or underflow event                                                                                                                                                                                   |
| 4   | NAK      | 0x0   | RW | I2C NAK interrupt. Asserted when an unexpected NAK has been received on the I2C bus.                                                                                                                                                                                  |
| 3   | FOVFL    | 0x0   | RW | Write FIFO Overflow interrupt. This occurs when software tries to write to a full FIFO. The current operation does not stop.                                                                                                                                          |
| 2   | FUNDL    | 0x0   | RW | Read FIFO Underflow interrupt. This occurs when software tries to pop from an empty FIFO.                                                                                                                                                                             |
| 1   | THR      | 0x0   | RW | FIFO Threshold interrupt. For write operations, asserted when the number of free bytes in the write FIFO equals or exceeds the WTHR field.                                                                                                                            |
| 0   | CMDCMP   | 0x0   | RW | Command complete interrupt                                                                                                                                                                                                                                            |





| Bit  | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|---------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10:8 | FSEL    | 0x0   | RW | <p>Select the input clock frequency.</p> <p>MIN_PWR = 0x0 - Selects the minimum power clock. This setting should be used whenever the IOM is not active.</p> <p>HFRC = 0x1 - Selects the HFRC as the input clock.</p> <p>HFRC_DIV2 = 0x2 - Selects the HFRC / 2 as the input clock.</p> <p>HFRC_DIV4 = 0x3 - Selects the HFRC / 4 as the input clock.</p> <p>HFRC_DIV8 = 0x4 - Selects the HFRC / 8 as the input clock.</p> <p>HFRC_DIV16 = 0x5 - Selects the HFRC / 16 as the input clock.</p> <p>HFRC_DIV32 = 0x6 - Selects the HFRC / 32 as the input clock.</p> <p>HFRC_DIV64 = 0x7 - Selects the HFRC / 64 as the input clock.</p> |
| 7:1  | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 0    | IOCLKEN | 0x0   | RW | Enable for the interface clock. Must be enabled prior to executing any IO operations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

## Submodule control

**INSTANCE 0 ADDRESS: 0x50004214**

**INSTANCE 2 ADDRESS: 0x50006214**

**INSTANCE 4 ADDRESS: 0x50008214****INSTANCE 5 ADDRESS: 0x50009214**

Provides enable for each submodule. Only a single submodule can be enabled at one time.

|       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |           |         |           |         |   |   |   |
|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----------|---------|-----------|---------|---|---|---|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0         | 0       | 0         | 0       | 0 | 0 | 0 |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3         | 2       | 1         | 0       | 9 | 8 | 7 |
| RSRVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | SMOD1TYPE | SMOD1EN | SMOD0TYPE | SMOD0EN |   |   |   |

| Bit  | Name  | Reset | RW | Description |
|------|-------|-------|----|-------------|
| 31:8 | RSRVD | 0x0   | RO | Reserved    |

**Table 422: SUBMODCTRL Register Bits**

| Bit | Name      | Reset | RW | Description                                                                                                                                                                                                                                        |
|-----|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:5 | SMOD1TYPE | 0x1   | RO | Submodule 0 module type. This is the I2C Master interface<br><br>MSPI = 0x0 - SPI Master submodule<br>I2C_MASTER = 0x1 - MI2C submodule<br>SSPI = 0x2 - SPI Slave submodule<br>SI2C = 0x3 - I2C Slave submodule<br>NA = 0x7 - NOT INSTALLED        |
| 4   | SMOD1EN   | 0x0   | RW | Submodule 1 enable (1) or disable (0)                                                                                                                                                                                                              |
| 3:1 | SMOD0TYPE | 0x0   | RO | Submodule 0 module type. This is the SPI Master interface.<br><br>SPI_MASTER = 0x0 - MSPI submodule<br>I2C_MASTER = 0x1 - I2C Master submodule<br>SSPI = 0x2 - SPI Slave submodule<br>SI2C = 0x3 - I2C Slave submodule<br>NA = 0x7 - NOT INSTALLED |
| 0   | SMOD0EN   | 0x0   | RW | Submodule 0 enable (1) or disable (0)                                                                                                                                                                                                              |

**8.19.2.14CMD Register****Command and Offset****OFFSET:** 0x00000218**INSTANCE 0 ADDRESS:** 0x50004218**INSTANCE 1 ADDRESS:** 0x50005218**INSTANCE 2 ADDRESS:** 0x50006218**INSTANCE 3 ADDRESS:** 0x50007218**INSTANCE 4 ADDRESS:** 0x50008218**INSTANCE 5 ADDRESS:** 0x50009218

Writes to this register will start an IO transaction, as well as set various parameters for the command itself.  
Reads will return the command value written to the CMD register.

**Table 423: CMD Register**

|          |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |        |        |        |        |        |        |        |        |
|----------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1   | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3  | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| OFFSETLO |        |        |        |        |        |        |        | RSRVD22 | CMDSEL | TSIZE  |        |        |        |        |        |        |        |        |        |        |        | CONT   | OFFSETCNT | CMD    |        |        |        |        |        |        |        |

Table 424: CMD Register Bits

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|-----------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:24 | OFFSETLO  | 0x0   | RW | This register holds the low order byte of offset to be used in the transaction. The number of offset bytes to use is set with bits 1:0 of the command.                                                                                                                                                                                                                                                                                                                                                                              |
| 23:22 | RSRVD22   | 0x0   | RO | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 21:20 | CMDSEL    | 0x0   | RW | Command Specific selection information. Not used in Master I2C. Used as CEn select for Master SPI transactions                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 19:8  | TSIZE     | 0x0   | RW | Defines the transaction size in bytes. The offset transfer is not included in this size.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 7     | CONT      | 0x0   | RW | Continue to hold the bus after the current transaction if set to a 1 with a new command issued.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 6:5   | OFFSETCNT | 0x0   | RW | Number of offset bytes to use for the command - 0, 1, 2, 3 are valid selections. The second (byte 1) and third byte (byte 2) are read from the OFFSETHI register, and the low order byte is pulled from this register in the OFFSETLO field.                                                                                                                                                                                                                                                                                        |
| 4:0   | CMD       | 0x0   | RW | Command for submodule.<br><br>WRITE = 0x1 - Write command using count of offset bytes specified in the OFFSETCNT field<br>READ = 0x2 - Read command using count of offset bytes specified in the OFFSETCNT field<br>TMW = 0x3 - SPI only. Test mode to do constant write operations. Useful for debug and power measurements. Will continually send data in OFFSET field<br>TMR = 0x4 - SPI Only. Test mode to do constant read operations. Useful for debug and power measurements. Will continually read data from external input |

### 8.19.2.15DCX Register

#### DCX Control

**OFFSET:** 0x0000021C

**INSTANCE 0 ADDRESS:** 0x5000421C

**INSTANCE 1 ADDRESS:** 0x5000521C

**INSTANCE 2 ADDRESS:** 0x5000621C

**INSTANCE 3 ADDRESS:** 0x5000721C

**INSTANCE 4 ADDRESS:** 0x5000821C

**INSTANCE 5 ADDRESS:** 0x5000921C

Enables use of CE signals to transmit DCX level for SPI transactions. Only used in Apollo3 Revision B. For Revision A, this register MUST NOT be programmed!

**Table 425: DCX Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |        |        |        |        |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|--------|--------|--------|--------|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0     | 0      | 0      | 0      | 0      | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7     | 6      | 5      | 4      | 3      | 2 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DCXEN | CE3OUT | CE2OUT | CE1OUT | CE0OUT |   |

**Table 426: DCX Register Bits**

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                                     |
|------|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:5 | RSVD   | 0x0   | RO | RESERVED                                                                                                                                                                                                        |
| 4    | DCXEN  | 0x0   | RW | DCX Signaling Enable The selected DCX signal (unused CE pin) will be driven low during write of offset byte, and high during transmission of data bytes.<br>EN = 0x10 - Enable DCX.<br>DIS = 0x0 - Disable DCX. |
| 3    | CE3OUT | 0x0   | RW | Enable DCX output using CE3 output                                                                                                                                                                              |
| 2    | CE2OUT | 0x0   | RW | Enable DCX output using CE2 output                                                                                                                                                                              |
| 1    | CE1OUT | 0x0   | RW | Enable DCX output using CE1 output                                                                                                                                                                              |
| 0    | CE0OUT | 0x0   | RW | Enable DCX output using CE0 output                                                                                                                                                                              |

**8.19.2.16OFFSETHI Register****High order 2 bytes of 3 byte offset for IO transaction****OFFSET:** 0x00000220**INSTANCE 0 ADDRESS:** 0x50004220**INSTANCE 1 ADDRESS:** 0x50005220**INSTANCE 2 ADDRESS:** 0x50006220**INSTANCE 3 ADDRESS:** 0x50007220**INSTANCE 4 ADDRESS:** 0x50008220**INSTANCE 5 ADDRESS:** 0x50009220

High order 2 bytes of 3 byte offset for IO transaction

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1        | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6        | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   | OFFSETHI |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name     | Reset | RW | Description                                                                                                                                                        |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:16 | RSVD     | 0x0   | RO | Reserved                                                                                                                                                           |
| 15:0  | OFFSETHI | 0x0   | RW | Holds the high order 2 bytes of the 3 byte addressing/offset field to use with IO commands. The number of offset bytes to use is specified in the command register |

## Command status

**INSTANCE 0 ADDRESS: 0x50004224****INSTANCE 2 ADDRESS: 0x50006224****INSTANCE 4 ADDRESS: 0x50008224**

**INSTANCE 5 ADDRESS: 0x50009224**

Provides status on the execution of the command currently in progress. The fields in this register will reflect the real time status of the internal state machines and data transfers within the IOM.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7  | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSRVD0 |        |        |        |        |        |        |        |        |        |        |        | CTSIZE |        |        |        |        |        |        |        |        |        |        |        | CMDSTAT | CCMD   |        |        |        |        |        |        |

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                             |
|-------|---------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:20 | RSRVD0  | 0x0   | RO | Reserved                                                                                                                                                                                                                                                                |
| 19:8  | CTSIZE  | 0x0   | RO | The current number of bytes still to be transferred with this command. This field will count down to zero.                                                                                                                                                              |
| 7:5   | CMDSTAT | 0x0   | RO | The current status of the command execution.<br><br>ERR = 0x1 - Error encountered with command<br>ACTIVE = 0x2 - Actively processing command<br>IDLE = 0x4 - Idle state, no active command, no error<br>WAIT = 0x6 - Command in progress, but waiting on data from host |
| 4:0   | CCMD    | 0x0   | RO | current command that is being executed                                                                                                                                                                                                                                  |

## DMA Trigger Enable

**INSTANCE 0 ADDRESS: 0x50004240****INSTANCE 2 ADDRESS: 0x50006240****INSTANCE 4 ADDRESS: 0x50008240****INSTANCE 5 ADDRESS: 0x50009240**

Provides control on which event will trigger the DMA transfer after the DMA operation is setup and enabled. The trigger event will cause a number of bytes (depending on trigger event) to be

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1    | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DTHREN | DCMDCMPEN |        |

| Bit  | Name      | Reset | RW | Description                                                                                                                                                                                                          |
|------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:2 | RSVD      | 0x0   | RO | RESERVED.                                                                                                                                                                                                            |
| 1    | DTHREN    | 0x0   | RW | Trigger DMA upon THR level reached. For M2P DMA operations (IOM writes), the trigger will assert when the write FIFO has (WTHR/4) number of words free in the write FIFO, and will transfer (WTHR/4) number of words |
| 0    | DCMDCMPEN | 0x0   | RW | Trigger DMA upon command complete. Enables the trigger of the DMA when a command is completed. When this event is triggered, the number of words transferred will be the lesser of the remaining TOTCOUNT bytes, or  |

## DMA Trigger Status

**INSTANCE 0 ADDRESS: 0x50004244**

**INSTANCE 2 ADDRESS: 0x50006244**

**INSTANCE 3 ADDRESS: 0x50007244**

**INSTANCE 4 ADDRESS: 0x50008244****INSTANCE 5 ADDRESS: 0x50009244**

Provides the status of trigger events that have occurred for the transaction. Some of the bits are read only and some can be reset via a write of 0.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |         |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|---------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3  | 0<br>2 | 0<br>1  | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DTOTCMP | DTHR   | DCMDCMP |        |

| Bit  | Name | Reset | RW | Description |
|------|------|-------|----|-------------|
| 31:3 | RSVD | 0x0   | RO | RESERVED.   |

| Bit | Name    | Reset | RW | Description                                                                                                                                                                                                                                    |
|-----|---------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2   | DTOTCMP | 0x0   | RO | DMA triggered when DCMDCMP = 0, and the amount of data in the FIFO was enough to complete the DMA operation (greater than or equal to current TOTCOUNT) when the command completed. This trigger is default active when the DCMDCMP trigger is |
| 1   | DTHR    | 0x0   | RO | Triggered DMA from THR event. Bit is read only and can be cleared by disabling the DTHR trigger enable or by disabling DMA.                                                                                                                    |
| 0   | DCMDCMP | 0x0   | RO | Triggered DMA from Command complete event. Bit is read only and can be cleared by disabling the DCMDCMP trigger enable or by disabling DMA.                                                                                                    |

## DMA Configuration

**INSTANCE 0 ADDRESS: 0x50004280**

**INSTANCE 1 ADDRESS: 0x50005280**

**INSTANCE 2 ADDRESS: 0x50006280**

**INSTANCE 3 ADDRESS: 0x50007280**

**INSTANCE 4 ADDRESS: 0x50008280****INSTANCE 5 ADDRESS: 0x50009280**

Configuration control of the DMA process, including the direction of DMA, and enablement of DMA

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |        |      |   |   |   |   |   |        |       |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|--------|------|---|---|---|---|---|--------|-------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0       | 0      | 0    | 0 | 0 | 0 | 0 | 0 | 0      |       |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0       | 9      | 8    | 7 | 6 | 5 | 4 | 3 | 2      |       |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DPWROFF | DMAPRI | RSVD |   |   |   |   |   | DMADIR | DMAEN |

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                            |
|-------|---------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:10 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                              |
| 9     | DPWROFF | 0x0   | RW | <p>Power off module after DMA is complete. If this bit is active, the module will request to power off the supply it is attached to. If there are other units still requiring power from the same domain, power down will not be performed.</p> <p>DIS = 0x0 - Power off disabled<br/>EN = 0x1 - Power off enabled</p> |



| Bit | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                   |
|-----|---------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8   | DMA PRI | 0x0   | RW | Sets the Priority of the DMA request<br><br>LOW = 0x0 - Low Priority (service as best effort)<br>HIGH = 0x1 - High Priority (service immediately)                                                                                                                                             |
| 7:2 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                     |
| 1   | DMA DIR | 0x0   | RW | Direction<br><br>P2M = 0x0 - Peripheral to Memory (SRAM) transaction. To be set when doing IOM read operations, i.e., reading data from external devices.<br>M2P = 0x1 - Memory to Peripheral transaction. To be set when doing IOM write operations, i.e., writing data to external devices. |
| 0   | DMA EN  | 0x0   | RW | DMA Enable. Setting this bit to EN will start the DMA operation. This should be the last DMA related register set prior to issuing the command<br><br>DIS = 0x0 - Disable DMA Function<br>EN = 0x1 - Enable DMA Function                                                                      |

## DMA Total Transfer Count

**INSTANCE 0 ADDRESS: 0x50004288**

**INSTANCE 2 ADDRESS: 0x50006288**

**INSTANCE 4 ADDRESS: 0x50008288****INSTANCE 5 ADDRESS: 0x50009288**

Contains the number of bytes to be transferred for this DMA transaction. This register is decremented as the data is transferred, and will be 0 at the completion of the DMA operation.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |   |   |   |   |   |   |  |  |  |  |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|--|--|--|--|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1        | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |  |  |  |  |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3        | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |  |  |
| RSRVDD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | TOTCOUNT |   |   |   |   |   |   |   |   |   |   |   |   |   |  |  |  |  |

| Bit   | Name   | Reset | RW | Description |
|-------|--------|-------|----|-------------|
| 31:12 | RSRVDD | 0x0   | RO | Reserved    |

| Bit  | Name     | Reset | RW | Description                                                                                                                                       |
|------|----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 11:0 | TOTCOUNT | 0x0   | RW | Triggered DMA from Command complete event occurred. Bit is read only and can be cleared by disabling the DTHR trigger enable or by disabling DMA. |

## DMA Target Address

**INSTANCE 0 ADDRESS: 0x5000428C**

**INSTANCE 2 ADDRESS: 0x5000628C**

**INSTANCE 4 ADDRESS: 0x5000828C**

The source or destination address internal the SRAM for the DMA data. For write operations, this can only be SRAM data (ADDR bit 28 = 1); For read operations, this can be either SRAM or FLASH (ADDR bit 28 = 0)

|        |        |        |            |        |        |        |        |        |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |
|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|--|--|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8     | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9   | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |  |  |  |  |
| RSVD   |        |        | TARGADDR28 | RSVD   |        |        |        |        |        |        |        | TARGADDR |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |

| Bit   | Name       | Reset | RW | Description                                                                                                                                                                                           |
|-------|------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:29 | RSVD       | 0x0   | RO | Reserved                                                                                                                                                                                              |
| 28    | TARGADDR28 | 0x0   | RW | Bit 28 of the target byte address for source of DMA (either read or write). In cases of non-word aligned addresses, the DMA logic will take care for ensuring only the target bytes are read/written. |
| 27:21 | RSVD       | 0x0   | RO | Reserved                                                                                                                                                                                              |

| Bit  | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                             |
|------|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20:0 | TARGADDR | 0x0   | RW | Bits [19:0] of the target byte address for source of DMA (either read or write). The address can be any byte alignment, and does not have to be word aligned. In cases of non-word aligned addresses, the DMA logic will take care for ensuring only the target bytes are read/written. |

## DMA Status

**INSTANCE 0 ADDRESS: 0x50004290**

**INSTANCE 2 ADDRESS: 0x50006290****INSTANCE 4 ADDRESS: 0x50008290**

**INSTANCE 5 ADDRESS: 0x50009290**

Status of the DMA operation currently in progress.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |         |        |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|---------|--------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0      | 0       | 0      |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5      | 4       | 3      |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DMAERR | DMA CPL | DMATIP |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                      |
|------|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:3 | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                                        |
| 2    | DMAERR | 0x0   | RW | DMA Error. This active high bit signals an error was encountered during the DMA operation. The bit can be cleared by writing to 0. Once set, this bit will remain set until cleared by software. |
| 1    | DMACPL | 0x0   | RW | DMA Transfer Complete. This signals the end of the DMA operation. This bit can be cleared by writing to 0, and will also be cleared when a new DMA is started.                                   |
| 0    | DMATIP | 0x0   | RO | DMA Transfer In Progress indicator. 1 will indicate that a DMA transfer is active. The DMA transfer may be waiting on data, transferring data, or waiting for priority.                          |







**Table 449: CQFLAGS Register**

|           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3         | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1         | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CQIRQMASK |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQFLAGS |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 450: CQFLAGS Register Bits**

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:16 | CQIRQMASK | 0x0   | RW | Mask the bits used to generate the command queue interrupt. A '1' in the bit position will enable the pause event to trigger the interrupt, if the CQWT_int interrupt is enabled. Bits definitions are the same as CQPAUSE |
| 15:0  | CQFLAGS   | 0x0   | RO | Current flag status (read-only). Bits [7:0] are software controllable and bits [15:8] are hardware status.                                                                                                                 |

**8.19.2.28 CQSETCLEAR Register****Command Queue Flag Set/Clear****OFFSET:** 0x000002A4**INSTANCE 0 ADDRESS:** 0x500042A4**INSTANCE 1 ADDRESS:** 0x500052A4**INSTANCE 2 ADDRESS:** 0x500062A4**INSTANCE 3 ADDRESS:** 0x500072A4**INSTANCE 4 ADDRESS:** 0x500082A4**INSTANCE 5 ADDRESS:** 0x500092A4

Set/Clear the command queue software pause flags on a per-bit basis. Contains 3 fields, allowing for setting, clearing or toggling the value in the software flags. Priority when the same bit

**Table 451: CQSETCLEAR Register**

|      |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2      | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1      | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0      | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3      | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5      | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7      | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   | CQFCLR |   |   |   |   |   |   |   | CQFTGL |   |   |   |   |   |   |   | CQFSET |   |   |   |   |   |   |   |

**Table 452: CQSETCLEAR Register Bits**

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:24 | RSVD | 0x0   | RO | Reserved    |

| Bit   | Name   | Reset | RW | Description                                                                                                              |
|-------|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------|
| 23:16 | CQFCLR | 0x0   | WO | Clear CQFlag status bits. Will clear to 0 any SWFLAG with a '1' in the corresponding bit position of this field          |
| 15:8  | CQFTGL | 0x0   | WO | Toggle the indicated bit. Will toggle the value of any SWFLAG with a '1' in the corresponding bit position of this field |
| 7:0   | CQFSET | 0x0   | WO | Set CQFlag status bits. Will set to 1 the value of any SWFLAG with a '1' in the corresponding bit position of this field |

## Command Queue Pause Enable

**INSTANCE 0 ADDRESS: 0x500042A8**

**INSTANCE 2 ADDRESS: 0x500062A8**

**INSTANCE 4 ADDRESS: 0x500082A8**

**INSTANCE 5 ADDRESS: 0x500092A8**

Enables a flag to pause an active command queue operation. If a bit is '1' and the corresponding bit in the CQFLAG register is '1', CQ processing will halt until either value is changed to '0'.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1     | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6     | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQPEN |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:16 | RSVD | 0x0   | RO | Reserved    |



**Table 454: CQPAUSEEN Register Bits**

| Bit  | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15:0 | CQPEN | 0x0   | RW | <p>Enables the specified event to pause command processing when active</p> <p>IDXEQ = 0x8000 - Pauses the command queue when the current index matches the last index</p> <p>BLEXOREN = 0x4000 - Pause command queue when input BLE bit XORed with SWFLAG4 is '1'</p> <p>IOMXOREN = 0x2000 - Pause command queue when input IOM bit XORed with SWFLAG3 is '1'</p> <p>GPIOXOREN = 0x1000 - Pause command queue when input GPIO irq_bit XORed with SWFLAG2 is '1'</p> <p>MSPI1XNOREN = 0x800 - Pause command queue when selected MSPI input bit 1 (buffer 1 ready) XNORed with SWFLAG1 is '1'. MSPI used is selected in CQCFG.MSPIFLGSEL field.</p> <p>MSPI0XNOREN = 0x400 - Pause command queue when selected MSPI input bit 0 (buffer 0 ready) XNORed with SWFLAG1 is '1'. MSPI used is selected in CQCFG.MSPIFLGSEL field.</p> <p>MSPI1XOREN = 0x200 - Pause command queue when selected MSPI input bit 1 (buffer 1 ready) XORed with SWFLAG1 is '1'. MSPI used is selected in CQCFG.MSPIFLGSEL field.</p> <p>MSPI0XOREN = 0x100 - Pause command queue when selected MSPI input bit 0 (buffer 0 ready) XORed with SWFLAG1 is '1'. MSPI used is selected in CQCFG.MSPIFLGSEL field.</p> <p>SWFLAGEN7 = 0x80 - Pause the command queue when software flag bit 7 is '1'.</p> <p>SWFLAGEN6 = 0x40 - Pause the command queue when software flag bit 6 is '1'</p> <p>SWFLAGEN5 = 0x20 - Pause the command queue when software flag bit 5 is '1'</p> <p>SWFLAGEN4 = 0x10 - Pause the command queue when software flag bit 4 is '1'</p> <p>SWFLAGEN3 = 0x8 - Pause the command queue when software flag bit 3 is '1'</p> <p>SWFLAGEN2 = 0x4 - Pause the command queue when software flag bit 2 is '1'</p> <p>SWFLAGEN1 = 0x2 - Pause the command queue when software flag bit 1 is '1'</p> <p>SWFLAGEN0 = 0x1 - Pause the command queue when software flag bit 0 is '1'</p> |

**8.19.2.30CQCURIDX Register**

IOM Command Queue current index value . Compared to the CQENDIDX reg contents to generate the IDXEQ Pause event for command queue

**OFFSET:** 0x000002AC

**INSTANCE 0 ADDRESS:** 0x500042AC

**INSTANCE 1 ADDRESS:** 0x500052AC

**INSTANCE 2 ADDRESS:** 0x500062AC

**INSTANCE 3 ADDRESS:** 0x500072AC

**INSTANCE 4 ADDRESS:** 0x500082AC

**INSTANCE 5 ADDRESS:** 0x500092AC

Current index value, targeted to be written by register write operations within the command queue. This is compared to the CQENDIDX and will stop the CQ operation if bit 15 of the CQPAUSEEN is '1' and

**Table 455: CQCURIDX Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0        | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9        | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQCURIDX |   |   |   |   |   |   |   |   |   |

**Table 456: CQCURIDX Register Bits**

| Bit  | Name     | Reset | RW | Description                                                                                                                                                                                                                                  |
|------|----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                     |
| 7:0  | CQCURIDX | 0x0   | RW | Holds 8 bits of data that will be compared with the CQENDIDX register field. If the values match, the IDXEQ pause event will be activated, which will cause the pausing of command queue operation if the IDXEQ bit is enabled in CQPAUSEEN. |

**8.19.2.31CQENDIDX Register**

IOM Command Queue current index value . Compared to the CQCURIDX reg contents to generate the IDXEQ Pause event for command queue

OFFSET: 0x000002B0

INSTANCE 0 ADDRESS: 0x500042B0

INSTANCE 1 ADDRESS: 0x500052B0

INSTANCE 2 ADDRESS: 0x500062B0

INSTANCE 3 ADDRESS: 0x500072B0

INSTANCE 4 ADDRESS: 0x500082B0

INSTANCE 5 ADDRESS: 0x500092B0

End index value, targeted to be written by software to indicate the last valid register pair contained within the command queue for a register write operations within the command queue.

**Table 457: CQENDIDX Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0        | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9        | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CQENDIDX |   |   |   |   |   |   |   |   |   |

**Table 458: CQENDIDX Register Bits**

| Bit  | Name | Reset | RW | Description |
|------|------|-------|----|-------------|
| 31:8 | RSVD | 0x0   | RO | RESERVED    |

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                 |
|-----|----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0 | CQENDIDX | 0x0   | RW | Holds 8 bits of data that will be compared with the CQCURIX register field. If the values match, the IDXEQ pause event will be activated, which will cause the pausing of command queue operation if the IDXEQ bit is enabled in CQPAUSEEN. |

## IOM Module Status

**INSTANCE 0 ADDRESS: 0x500042B4**

**INSTANCE 2 ADDRESS: 0x500062B4**

**INSTANCE 4 ADDRESS: 0x500082B4**

## IOM Module Status

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | IDLEST | CMDACT | ERR    |        |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                       |
|------|--------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:3 | RSVD   | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                          |
| 2    | IDLEST | 0x0   | RO | <p>indicates if the active I/O state machine is IDLE. Note - The state machine could be in idle state due to hold-offs from data availability, or as the command gets propagated into the logic from the registers.</p> <p>IDLE = 0x1 - The I/O state machine is in the idle state.</p>                                                                           |
| 1    | CMDACT | 0x0   | RO | <p>Indicates if the active I/O Command is currently processing a transaction, or command is complete, but the FIFO pointers are still synchronizing internally. This bit will go high at</p> <p>ACTIVE = 0x1 - An I/O command is active. Indicates the active module has an active command and is processing this. De-asserted when the command is completed.</p> |

| Bit | Name | Reset | RW | Description                                                                                                                                                                   |
|-----|------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | ERR  | 0x0   | RO | <p>Bit has been deprecated. Please refer to the other error indicators. This will always return 0.</p> <p>ERROR = 0x1 - Bit has been deprecated and will always return 0.</p> |

**INSTANCE 5 ADDRESS: 0x50009300**

|        |        |         |        |        |        |        |        |        |         |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |      |      |
|--------|--------|---------|--------|--------|--------|--------|--------|--------|---------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|------|------|
| 3<br>1 | 3<br>0 | 2<br>9  | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2  | 2<br>1 | 2<br>0  | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |         |      |      |
| RSVD   | MSIRST | DOUTDLY |        |        | DINDLY |        |        | SPILSB | RDFCPOL | WTF-   | WTFCIRQ | RSVD   | MOSINV | RDFC   | WTFC   | RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | FULLDUP | SPHA | SPOI |

| Bit   | Name    | Reset | RW | Description                                                                                |
|-------|---------|-------|----|--------------------------------------------------------------------------------------------|
| 31    | RSVD    | 0x0   | RO | RESERVED                                                                                   |
| 30    | MSPIRST | 0x0   | RW | Not used. To reset the module, toggle the SMOD_EN for the module                           |
| 29:27 | DOUDDL  | 0x0   | RW | Delay tap to use for the output signal (MOSI). This give more hold time on the output data |
| 26:24 | DINDL   | 0x0   | RW | Delay tap to use for the input signal (MISO). This gives more hold time on the input data. |

Table 462: MSPICFG Register Bits

| Bit  | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|---------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23   | SPILSB  | 0x0   | RW | Selects data transfer as MSB first (0) or LSB first (1) for the data portion of the SPI transaction. The offset bytes are always transmitted MSB first.<br><br>MSB = 0x0 - Send and receive MSB bit first<br>LSB = 0x1 - Send and receive LSB bit first                                                                                                                                                                                                                                         |
| 22   | RDFCPOL | 0x0   | RW | selects the read flow control signal polarity.<br><br>HIGH = 0x0 - Flow control signal high creates flow control.<br>LOW = 0x1 - Flow control signal low creates flow control.                                                                                                                                                                                                                                                                                                                  |
| 21   | WTFCPOL | 0x1   | RW | selects the write flow control signal polarity. The transfers are halted when the selected flow control signal is OPPOSITE polarity of bit. (For example: WTFCPOL = 0 will allow a IRQ=1 to pause transfers).<br><br>HIGH = 0x0 - Flow control signal high(1) creates flow control and byte transfers will stop until the flow control signal goes low.<br>LOW = 0x1 - Flow control signal low(0) creates flow control and byte transfers will stop until the flow control signal goes high(1). |
| 20   | WTFCIRQ | 0x0   | RW | selects the write mode flow control signal.<br><br>MISO = 0x0 - MISO is used as the write mode flow control signal.<br>IRQ = 0x1 - IRQ is used as the write mode flow control signal.                                                                                                                                                                                                                                                                                                           |
| 19   | RSVD    | 0x0   | RO | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 18   | MOSIINV | 0x0   | RW | inverts MOSI when flow control is enabled.<br><br>NORMAL = 0x0 - MOSI is set to 0 in read mode and 1 in write mode.<br>INVERT = 0x1 - MOSI is set to 1 in read mode and 0 in write mode.                                                                                                                                                                                                                                                                                                        |
| 17   | RDFC    | 0x0   | RW | enables read mode flow control.<br><br>DIS = 0x0 - Read mode flow control disabled.<br>EN = 0x1 - Read mode flow control enabled.                                                                                                                                                                                                                                                                                                                                                               |
| 16   | WTFC    | 0x0   | RW | enables write mode flow control.<br><br>DIS = 0x0 - Write mode flow control disabled.<br>EN = 0x1 - Write mode flow control enabled.                                                                                                                                                                                                                                                                                                                                                            |
| 15:3 | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 2    | FULLDUP | 0x0   | RW | Enables full duplex mode for Master SPI write operations. Data will be captured simultaneously into the read FIFO                                                                                                                                                                                                                                                                                                                                                                               |
| 1    | SPHA    | 0x0   | RW | selects SPI phase.<br><br>SAMPLE_LEADING_EDGE = 0x0 - Sample on the leading (first) clock edge.<br>SAMPLE_TRAILING_EDGE = 0x1 - Sample on the trailing (second) clock edge.                                                                                                                                                                                                                                                                                                                     |
| 0    | SPOL    | 0x0   | RW | selects SPI polarity.<br><br>CLK_BASE_0 = 0x0 - The base value of the clock is 0.<br>CLK_BASE_1 = 0x1 - The base value of the clock is 1.                                                                                                                                                                                                                                                                                                                                                       |



| Bit | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                        |
|-----|--------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2   | ARBEN  | 0x0   | RW | <p>Enables multi-master arbitration for the I2C master. If the bus is known to have only a single master, this function can be disabled to save clock cycles on I2C transactions</p> <p>ARBEN = 0x1 - Enable multi-master bus arbitration support for this I2C master<br/>           ARBDIS = 0x0 - Disable multi-master bus arbitration support for this I2C master</p>           |
| 1   | I2CLSB | 0x0   | RW | <p>Direction of data transmit and receive, MSB(0) or LSB(1) first. Default per I2C specification is MSB first. This applies to both read and write data, and read data will be bit</p> <p>MSBFIRST = 0x0 - Byte data is transmitted MSB first onto the bus/read from the bus<br/>           LSBFIRST = 0x1 - Byte data is transmitted LSB first onto the bus/read from the bus</p> |
| 0   | ADDRSZ | 0x0   | RW | <p>Sets the I2C master device address size to either 7 bits (0) or 10 bits (1).</p> <p>ADDRSZ7 = 0x0 - Use 7-bit addressing for I2C master transactions<br/>           ADDRSZ10 = 0x1 - Use 10-bit addressing for I2C master transactions</p>                                                                                                                                      |

## I2C Device Configuration register

**INSTANCE 0 ADDRESS: 0x50004404**

**INSTANCE 2 ADDRESS: 0x50006404**

**INSTANCE 4 ADDRESS: 0x50008404****INSTANCE 5 ADDRESS: 0x50009404**

Contains the I2C device address.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DEVADDR |   |   |   |   |   |   |   |   |   |   |   |  |  |  |  |

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:10 | RSVD | 0x0   | RO | Reserved    |

| Bit | Name    | Reset | RW | Description                                                                                                                           |
|-----|---------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------|
| 9:0 | DEVADDR | 0x0   | RW | I2C address of the device that the Master will use to target for read/write operations. This can be either a 7-bit or 10-bit address. |

## IOM Debug

**INSTANCE 0 ADDRESS: 0x50004410**

**INSTANCE 2 ADDRESS: 0x50006410**

**INSTANCE 4 ADDRESS: 0x50008410****INSTANCE 5 ADDRESS: 0x50009410**

## Debug control

|         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |         |        |
|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|---------|--------|
| 3<br>1  | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2   | 0<br>1  | 0<br>0 |
| DBGDATA |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | APBCLKON | IOCLKON | DBGEN  |

| Bit  | Name     | Reset | RW | Description                                                                                                                                            |
|------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:3 | DBGDATA  | 0x0   | RW | Debug control for various options. DBGDATA[1:0] is used to select between different debug data available in the DBG0 and DBG1 registers.               |
| 2    | APBCLKON | 0x0   | RW | APBCLK debug clock control. Enable APB_CLK to be active when this bit is '1'. Otherwise, the clock is controlled with gating from the logic as needed. |
| 1    | IOCLKON  | 0x0   | RW | IOCLK debug clock control. Enable IO_CLK to be active when this bit is '1'. Otherwise, the clock is controlled with gating from the logic as needed.   |
| 0    | DBGEN    | 0x0   | RW | Debug Enable. Setting bit will enable the update of data within this register, otherwise it is clock gated for power savings                           |





## 9. I<sup>2</sup>C/SPI Slave Module

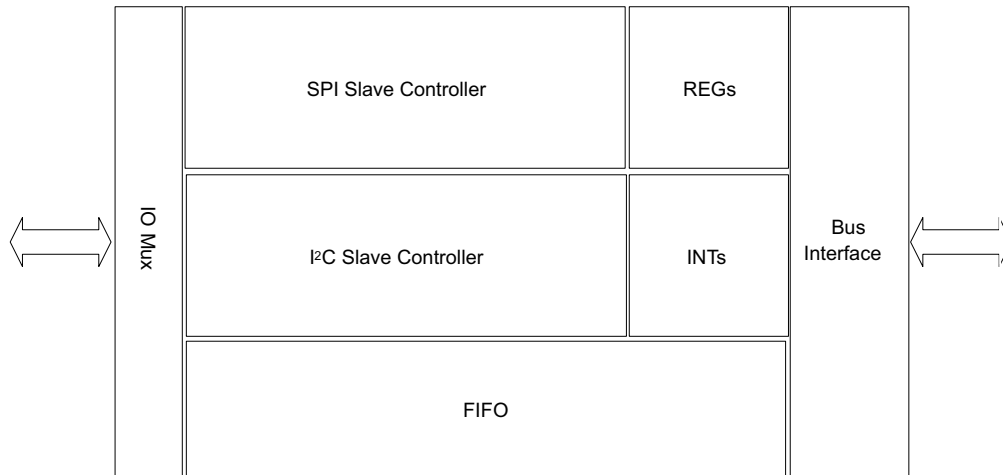


**Figure 42. Block diagram for the I<sup>2</sup>C/SPI Slave Module**

### 9.1 Functional Overview

The I<sup>2</sup>C/SPI Slave (IOS) Module, shown in Figure 42, allows the Apollo3 Blue SoC to function as a Slave in an I<sup>2</sup>C or SPI system. The I<sup>2</sup>C/SPI Slave operates in an independent fashion, so that the device may be placed in a sleep mode and still receive operations over the I/O interface. The Slave may be configured to generate an interrupt on specific references.

The I<sup>2</sup>C/SPI Slave contains 256 bytes of RAM which is only accessible when the module is enabled. This RAM may be flexibly configured into three spaces: a block directly accessible via the I/O interface, a block which functions as a FIFO for read operations on the interface, and a block of generally accessible RAM used to store parameters during deep sleep mode.

In I<sup>2</sup>C mode the Slave supports fully configurable 7 and 10-bit addressing with interface timing limits as specified in the Inter-Integrated Circuit (I<sup>2</sup>C) Interface section of the Electricals chapter. In SPI mode, the Slave supports all polarity/phase combinations and interface frequencies as specified in the Serial Peripheral Interface (SPI) Slave Interface section.

### 9.2 Local RAM Allocation

The I<sup>2</sup>C/SPI Slave is built around a 256-byte local RAM (LRAM), through which all data flows between the CPU AHB and the IO interface. The I<sup>2</sup>C/SPI Slave supports a 128-byte offset space when accessed from the I/O interface.

The LRAM is divided into three separate areas on 8-byte boundaries. These areas are:

1. A Direct Area for direct communication between the host and the MCU, which is mapped between the AHB address space and the I/O address space. This area is from LRAM address 0x00 to the address calculated from the 5-bit FIFOBASE field in the FIFO configuration register (FIFOCFG), minus 1. This 5-bit field (IOSLAVE\_FIFOCFG\_FIFOBASE) should contain a value that represents the start of the FIFO Area and, in so doing, defines the size of the Direct Area in 8-byte segments.

Part of this area can be defined as IO Slave Read-only starting at any 8-byte segment defined by IOSLAVE\_FIFOCFG\_ROBASE and extending through the end of the Direct Area at  $\text{FIFOBASE} * 8 - 1$ .

2. A FIFO Area which is used to stream data from the Apollo3 Blue SoC. This memory is directly addressed from the AHB, but accessed from the I/O Interface using a single I/O address 0x7F as a streaming port. The FIFO area is from the LRAM address calculated from the value in the FIFOBASE field,  $\text{FIFOBASE} * 8$ , to the LRAM address calculated from the value in the FIFOMAX field of the FIFOCFG register, IOSLAVE\_FIFOCFG\_FIFOMAX. The upper FIFO Area address is  $\text{FIFOMAX} * 8 - 1$ . The maximum value for FIFOMAX is 0x20, which would result in an upper FIFO Area address of 0xFF.
3. A RAM Area which is accessible only from the AHB Slave. The RAM area is from the LRAM address calculated from the value in the FIFOMAX field of the FIFOCFG register, IOSLAVE\_FIFOCFG\_FIFOMAX, to address 0xFF. Setting FIFOMAX to 0x20 would result in a RAM area of zero size.

The data in the LRAM is maintained in Deep Sleep Mode.

Figure 43 below shows the LRAM address mapping between the I/O interface and the AHB.

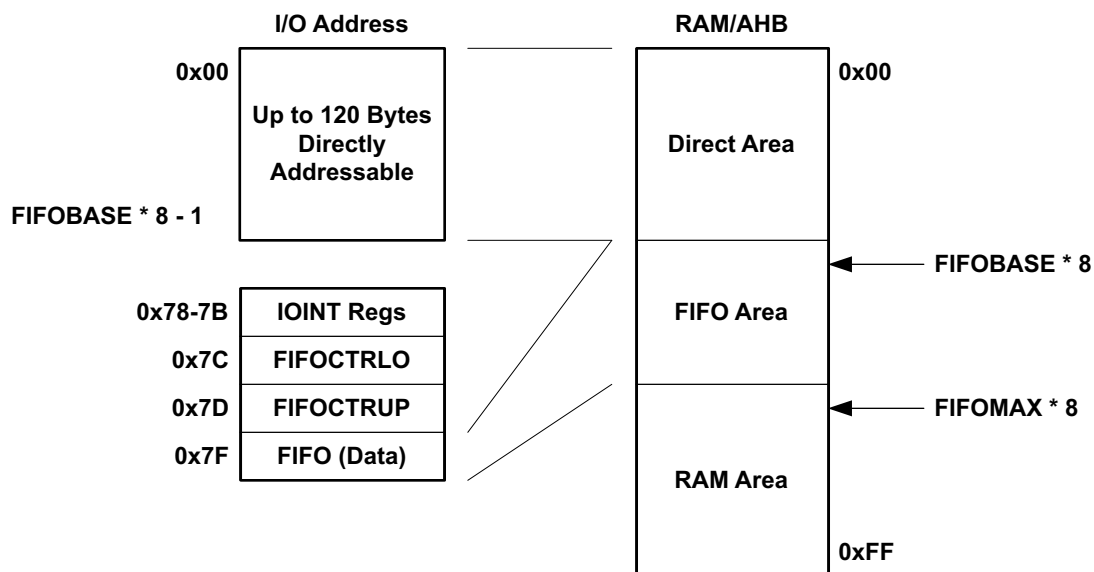


Figure 43. I<sup>2</sup>C/SPI Slave Module LRAM Addressing

### 9.3 Direct Area Functions

The Direct Area is used for direct communications between the interface Host and the Apollo3 Blue SoC. The Host may write a register in this Register Access space, called REGACC, and read it back without requiring the CPU to wake up, so that very low power interactions are supported. In some cases, however, accesses require interaction with the CPU.

REGACC interrupts are mapped in the Direct Area and operate as follows. Each REGACC interrupt status bit will be set whenever there is a read or write over the I<sup>2</sup>C or SPI interface in the Direct Area with an offset address which corresponds to a particular REGACC interrupt. Table 469 below lists the offsets to

memory locations within the Direct Area and corresponding interrupt bit settings in the REGACCINTSTAT register.

I/O writes to locations 0x0-0xF will set a corresponding interrupt flag in the REGACCINTSTAT register. These locations are typically used for specific commands to the Apollo3 Blue SoC. Note that not all flags need generate an actual interrupt, so small multi-byte commands may be transmitted in this area. For example, a write to location 0x0 will set bit 31 of the REGACCINTSTAT register, a write to location 0x1 will set bit 30 of REGACCINTSTAT, and a write to location 0xF will set bit 16 of the REGACCINTSTAT register.

The upper 16 REGACC interrupts are each generated on an access to the last byte of a 32-bit word, starting at 0x10. I/O writes to locations 0x10 to 0x4F will set a corresponding interrupt flag in the REGACCINTSTAT register if the I/O address modulo 4 is 3 (i.e. addresses 0x13, 0x17, 0x1B, etc.). This allows larger transfers to be sent in a burst with a trigger being generated on the last write, and it also allows specifying a data buffer of any whole word size and have an interrupt generated on access to the last byte of the buffer. For example, a write to location 0x13 will set bit 15 of the REGACCINTSTAT register, a write to location 0x17 will set bit 14 of REGACCINTSTAT, and a write to location 0x4F will set bit 0 of the REGACCINTSTAT register.

Table 469 lists the offsets to memory locations within the Direct Address Space and corresponding interrupt bit settings in the REGACCINTSTAT register.

**Table 469: Mapping of Direct Area Access Interrupts and Corresponding REGACCINTSTAT Bits**

| REGACCINTSTAT Bit | Direct Area Offset Address |
|-------------------|----------------------------|
| 31                | 0x0                        |
| 30                | 0x1                        |
| 29                | 0x2                        |
| 28                | 0x3                        |
| 27                | 0x4                        |
| 26                | 0x5                        |
| 25                | 0x6                        |
| 24                | 0x7                        |
| 23                | 0x8                        |
| 22                | 0x9                        |
| 21                | 0xA                        |
| 20                | 0xB                        |
| 19                | 0xC                        |
| 18                | 0xD                        |
| 17                | 0xE                        |
| 16                | 0xF                        |
| 15                | 0x13                       |
| 14                | 0x17                       |
| 13                | 0x1B                       |
| 12                | 0x1F                       |
| 11                | 0x23                       |
| 10                | 0x27                       |
| 9                 | 0x2B                       |
| 8                 | 0x2F                       |
| 7                 | 0x33                       |
| 6                 | 0x37                       |
| 5                 | 0x3B                       |
| 4                 | 0x3F                       |
| 3                 | 0x43                       |
| 2                 | 0x47                       |
| 1                 | 0x4B                       |
| 0                 | 0x4F                       |

The REGACCINTSTAT register provides status of the 32 individual write interrupts. If an interrupt is enabled and set, it shows as a high bit in this register. The highest priority REGACC bit is bit 31 (set on access to address 0x00), and the lowest priority is bit 0 (set on access to address 0x4F). The 5-bit IOSLAVE\_PRENC register provides an encoded value of the highest priority of these interrupts to speed

software decoding, and is therefore very useful for quickly servicing the highest priority REGACC interrupt (i.e. the one at the lowest offset address). The encoding works such that if interrupt 31 is set, PRENC will be 0. If interrupt 31 is not set and bit 30 is set, PRENC will be 1, and so on to the point where if bits 31-1 are not set and bit 0 is set PRENC will be 31. If no interrupts are set the value in PRENC is indeterminate.

The final special memory space within the Direct Area is a read-only area for the I/O Host, which is from I/O address (IOSLAVE\_FIFOCFG\_ROBASE \* 8) to (FIFOBASE \* 8 – 1). I/O writes to this address space will not change the LRAM, which allows the space to be used for returning status to the I/O Host. ROBASE should have a minimum value of 0x0A, representing a start address of 0x50 to allow space for special commands and burst writes in lower Direct Area space.

## 9.4 FIFO Area Functions

The FIFO is used to provide very efficient flow of data from the Apollo3 Blue SoC to the I/O Host processor with minimal CPU interaction. A FIFO of up to 1023 bytes can be easily maintained by software, with the oldest bytes residing in the LRAM FIFO Area and the newer data being held in system SRAM and transferred to the I<sup>2</sup>C/SPI Slave on demand. Several hardware features support this operation.

Figure 44 shows the basic FIFO operation. The main FIFO is held in a buffer in SRAM, and the oldest data in that FIFO has been transferred to the FIFO Area of the I/O Slave. The IOSLAVE\_FIFOPTR\_FIFOPTR register points to the next byte to be read on the I/O interface. IOSLAVE\_FIFOPTR\_FIFOSIZ holds the current number of valid bytes in the FIFO on the I<sup>2</sup>C/SPI Slave, and FIFOCOUNTER holds the total number of bytes in the FIFO. The value in IOSLAVE\_FIFOCOUNTER may be read indirectly at any time by the Host processor via the FIFOCOUNTERUP\_FIFOCOUNTERLO registers to determine if there is FIFO data available (and how much is currently in the FIFO). I/O Host access to the FIFO counter is at offset 0x7C/D.

### WARNING

The host read of the FIFOCOUNTER value via FIFOCOUNTERUP\_FIFOCOUNTERLO is not synchronized to the write clock. So if the host read happens during a FIFOCOUNTER update (either through a read-modify-write of FIFOCOUNTER register or an automatic update because of a write to the FIFOINC register by the Slave CPU), it is possible for the count value to be out of sync, impacting the value read in either or both the upper (FIFOCOUNTERUP) and lower (FIFOCOUNTERLO) bytes. This is a very rare case, but proper code would have the host read the two registers for the FIFOCOUNTER value multiple times until consecutive reads are the same.

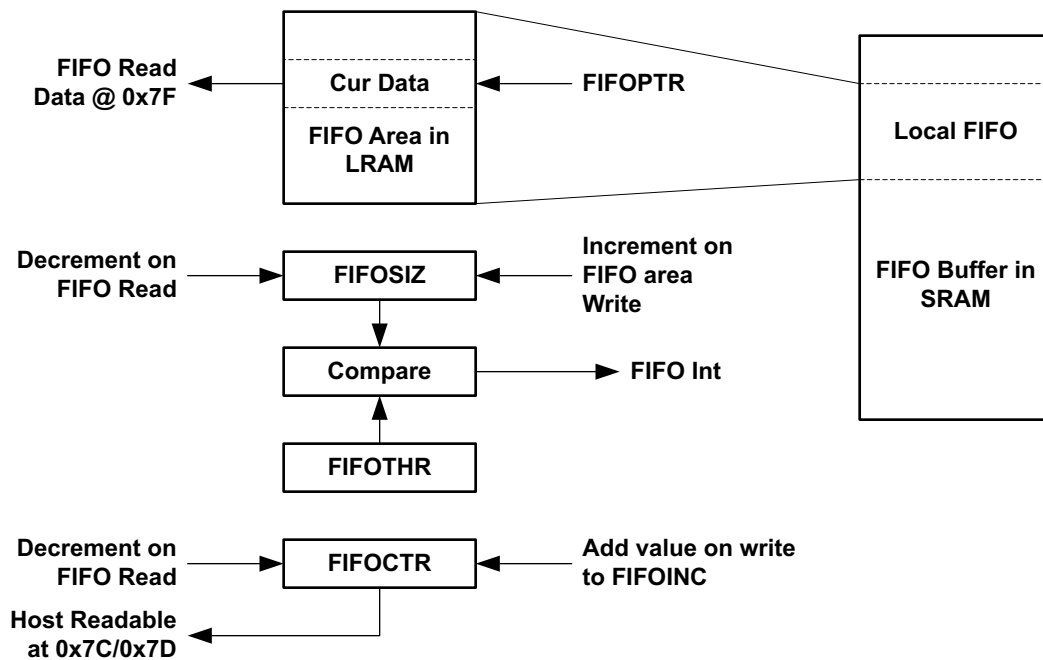


**Figure 44. I²C/SPI Slave Module FIFO**

When the host reads a byte from the FIFO, the data retrieved is pointed to by FIFOPTR, FIFOPTR is incremented and wraps around in the FIFO Area if it reaches FIFOMAX. FIFOSIZ and FIFOCTR are each decremented by one. The Host can read FIFOCTR and then read that many bytes without further checking. Note that this process can continue without requiring a CPU wakeup. If the Host attempts to read the FIFO when FIFOSIZ is 0, the FUNDFL interrupt flag is set in both the I²C Slave interrupt block and in the Host interrupt block.

When FIFOSIZ drops below the configured threshold IOSLAVE\_FIFOTHr the FSIZE interrupt flag is set and if enabled an interrupt is sent to the CPU which will wake it up. At that point, the CPU can move as much data from the SRAM FIFO to the I²C/SPI Slave FIFO as possible in a single operation and then go back to sleep. Since the FIFO Area can be quite large, CPU wake-ups will be very infrequent. If a write to the FIFOCTR which would increment the value beyond 1023 occurs, the FOVFL interrupt flag is set.

When some other process, such as a sensor read, produces new data for the FIFO, the CPU will add that data to the FIFO in SRAM, wrapping around as necessary. The IOSLAVE\_FIFOINC register is then written with the number of bytes added to the FIFO, which is added to the FIFOCTR register in an atomic fashion. In this way the Host processor can always determine how much read data is available.

The FIFO interface offset 0x7F is treated uniquely by the I²C/SPI Slave, in that an access to this address does not increment the Address Pointer. This allows the Host to initiate a burst read from address 0x7F of any length, and each read will supply the next byte in the FIFO.

## 9.5 Rearranging the FIFO

In normal operation the Host reads the oldest data from the FIFO, and the CPU writes new data onto the FIFO. In some cases it is desirable to modify this process, in particular for the FIFO to provide the newest data. The Apollo3 Blue SoC supports such operation using a special control function.

If software desires to write the current sample to the front of the FIFO, it first checks the IOSLAVE\_FUPD\_IOREAD status bit to ensure that there is not a Host read operation from the FIFO underway. Once IOREAD is clear, software sets the IOSLAVE\_FUPD\_FIFOUPT bit, writes the new sample data to the front of the FIFO and modifies the FIFOPTR to point to the new data. At that point the FIFOUPT bit is cleared.

If the Host attempts a FIFO read operation while the FIFOUPT is set, a RDERR interrupt will be generated to the Host and the FRDERR interrupt flag will be set. The Host must either poll the RDERR interrupt bit at the end of each operation or configure a hardware interrupt. Note that if the software does not support alternate FIFO ordering, the Host does not have to check the RDERR function.

## 9.6 Interface Interrupts

The CPU may also signal the Host via the IOINT interrupt, which may be connected to an Apollo3 Blue SoC pin and driven to the Host. Eight interrupts are available to be combined into the IOINT interrupt, and the Host can enable, read, clear and set these interrupts via the I/O interface. Software on the CPU can set 6 of the interrupts (SWINT0 through SWINT5) to communicate a variety of situations to the Host, and the other two interrupts indicate errors such as an attempt by the Host to read the FIFO when it is empty. A CPU interrupt is generated whenever the Host writes any IOINT registers (for example, to clear an interrupt) so the CPU can manage the interrupt interaction. The I<sup>2</sup>C/SPI Slave includes a mechanism to allow the Host CPU and the Apollo3 Blue SoC to each interrupt the other via a set of eight interrupts. The Host CPU accesses these interrupts via interface locations 0x78-0x7B, and the Apollo accesses these interrupts in the IOINTCTL Register.

The Host CPU may enable or disable any of the eight interrupts by writing the corresponding bit in the IOINTEN field of the IOINTCTL Register, which is accessed by the Host at interface location 0x78. The Host CPU may then clear or set any of the interrupts by writing a 1 to the corresponding bit of the clear (at location 0x7A) or set (at location 0x7B) registers. The current state of all eight interrupts may be read in the IOINT field at location 0x79. Note that this structure is identical to the standard Apollo3 Blue SoC interrupts in all modules. The MCU can read the value of the eight interrupt enables in the IOINTEN field of IOINTCTL, and can read the values of the eight interrupt status bits in the IOINT field of the IOINTCTL register. These two fields are read only. Table 470 summarizes these I/O interface interrupts and how they can be controlled and read.

**Table 470: I/O Interface Interrupt Control**

| RAM Location | IOINT Register <sup>1</sup> | Function             | MCU Register Field      | Description                                                                                                  |
|--------------|-----------------------------|----------------------|-------------------------|--------------------------------------------------------------------------------------------------------------|
| 0x78         | IOINTEN                     | I/O Interrupt Enable | IOINTCTL_IOINTEN (R/O)  | Each interrupt can be individually enabled by I/O Host, but can only be read by the MCU                      |
| 0x79         | IOINT                       | I/O Interrupt State  | IOINTCTL_IOINT (R/O)    | State of each interrupt, set or cleared, can be read by either the I/O Host or by the MCU                    |
| 0x7A         | IOINTCLR                    | I/O Interrupt Clear  | IOINTCTL_IOINTCLR (W/O) | Each interrupt can be individually cleared by the I/O Host, but the MCU can (only) clear all of them at once |
| 0x7B         | IOINTSET                    | I/O Interrupt Set    | IOINTCTL_IOINTSET (W/O) | Each interrupt can be individually set by either the I/O Host or the MCU                                     |

1. Readable by the I/O Host

The Apollo3 Blue SoC software may set any of the eight interrupt status register bits by writing a 1 to the corresponding bit of the IOINTSET field of the IOINTCTL Register, and may clear all of the interrupts by



writing a 1 to the IOINTCLR bit of the IOINTCTL register. This allows the MCU to generate a software interrupt to the Host device. In addition, a FIFO underflow interrupt FUNDFL in the I<sup>2</sup>C/SPI Slave will set interrupt bit 7, and a FIFO read error interrupt FRDERR will set interrupt bit 6 of the IO interrupt status register IOINT. Note that the MCU software cannot write the IOINTEN register, so that IO interrupts are controlled completely by the Host processor.

If any of the IOINT interrupt bits are set and the corresponding bit in IOINTEN is set, an IOINT interrupt will be generated. If the GPIO configuration registers have configured PAD4 as IOINT, that interrupt will be driven directly onto PAD\_IO[4]. This pin should be connected to an interrupt input pin of the Host interface device so that it can receive the interrupt and service it.

If the Host device writes to any of the interrupt register access locations (any location in 0x78-0x7B) the IOINTW interrupt will be set in the I2C/SPI INTSTAT Register. This allows Apollo3 Blue SoC software to receive a software interrupt from the Host device. Note that this interrupt will occur for all writes by the Host, including a write to clear an interrupt.

## 9.7 Command Completion Interrupts

Four interrupts in the I2C/SPI Slave module are generated when the Host interface device completes a transfer. This allows the MCU to be easily awakened for any transfer from the Host while maximizing the time the MCU is in sleep mode. The XCMPWR interrupt is generated at the completion of a Host write transfer which includes addresses in the currently configured Direct Register space, and the XCMPRR interrupt is generated on the completion of a Host read transfer to that space. The XCMPWF interrupt is generated at the completion of a Host write transfer which includes the FIFO address 0x7F (although that is an invalid access), and the XCMPRF interrupt is generated at the completion of a Host read transfer which includes the FIFO address 0x7F.

### NOTE

A write to 0x7F, which is the FIFO address, uses the address 0xFF since this includes the R/W bit in the upper (first) bit followed by the 7-bit Direct Register address (offset). The prescribed usage of IOS FIFO is only for READ from the host, and hence writing to the FIFO is generally an invalid operation. So, even though XCMPWF flag/interrupt is defined, it is likely never going to be used.

### NOTE

A burst transfer which begins in the Direct Register address space and is long enough to cause the Address Pointer to be 0x7F can set both the Direct Register and FIFO interrupts, although that would in general be an invalid operation.

## 9.8 Host Address Space and Registers

The Host of the I/O interface can access 128 bytes in the I<sup>2</sup>C/SPI Slave in either I<sup>2</sup>C or SPI mode. Offsets 0x00 to 0x77 may be directly mapped to the Direct RAM Area. The remaining eight offset locations access hardware functions within the I<sup>2</sup>C/SPI Slave. The R/W indicator is referring to accesses from the Host.

## 9.9 I<sup>2</sup>C Interface

The Apollo3 Blue SoC I<sup>2</sup>C Slave interface operates as a standard slave. The device is accessed at an address configured in the IOSLAVE\_IOSCFG\_I2CADDR field, and supports Fast Mode Plus (up to 1 MHz). Both 7-bit and 10-bit address modes are supported, as selected by IOSLAVE\_IOSCFG\_10BIT. The I<sup>2</sup>C interface consists of two lines: one bi-directional data line (SDA) and one clock line (SCL). Both

the SDA and the SCL lines must be connected to a positive supply voltage via a pull-up resistor. By definition, a device that sends a message is called the “transmitter”, and the device that accepts the message is called the “receiver”. The device that controls the message transfer by driving SCL is called “master”. The devices that are controlled by the master are called “slaves”. The MCU’s I<sup>2</sup>C Slave is always a slave device.

The following protocol has been defined:

- Data transfer may be initiated only when the bus is not busy.
- During data transfer, the data line must remain stable whenever the clock line is high.
- Changes in the data line while the clock line is high will be interpreted as control signals.

A number of bus conditions have been defined (see Figure 45) and are described in the following sections.

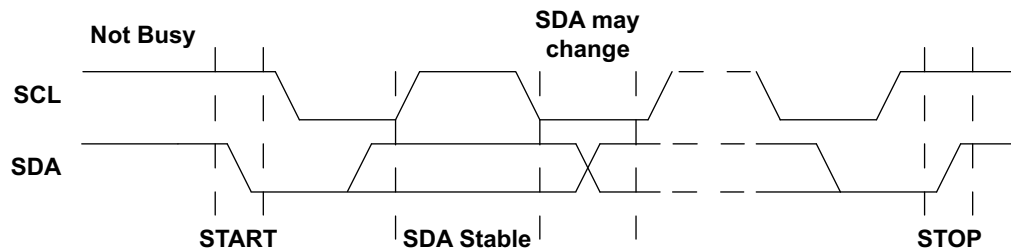


Figure 45. Basic I<sup>2</sup>C Conditions

### 9.9.1 Bus Not Busy

Both SDA and SCL remain high.

### 9.9.2 Start Data Transfer

A change in the state of SDA from high to low, while SCL is high, defines the START condition. A START condition which occurs after a previous START but before a STOP is called a RESTART condition, and functions exactly like a normal STOP followed by a normal START.

### 9.9.3 Stop Data Transfer

A change in the state of SDA from low to high, while SCL is high, defines the STOP condition.

### 9.9.4 Data Valid

After a START condition, SDA is stable for the duration of the high period of SCL. The data on SDA may be changed during the low period of SCL. There is one clock pulse per bit of data. Each data transfer is initiated with a START condition and terminated with a STOP condition. The number of data bytes transferred between the START and STOP conditions is not limited. The information is transmitted byte-wide and each receiver acknowledges with a ninth bit.

### 9.9.5 Acknowledge

Each byte of eight bits is followed by one Acknowledge (ACK) bit as shown in Figure 46. This Acknowledge bit is a low level driven onto SDA by the receiver, whereas the master generates an extra ACK related SCL pulse. A slave receiver which is addressed is obliged to generate an Acknowledge after the reception of each byte. Also, on a read transfer a master receiver must generate an Acknowledge after the reception of each byte that has been clocked out of the slave transmitter. The device that acknowledges must pull down the SDA line during the Acknowledge clock pulse in such a way that the

SDA line is a stable low during the high period of the Acknowledge related SCL pulse. A master receiver must signal an end-of-data to the slave transmitter by not generating an Acknowledge (a NAK) on the last byte that has been clocked out of the slave. In this case, the transmitter must leave the data line high to enable the master to generate the STOP condition.

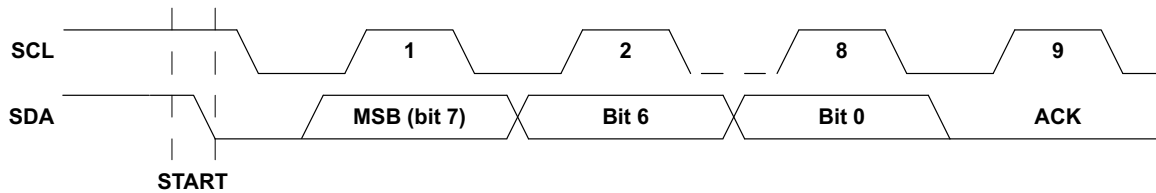


Figure 46. I<sup>2</sup>C Acknowledge

### 9.9.6 Address Operation

In I<sup>2</sup>C mode, the I<sup>2</sup>C/SPI Slave supports either 7-bit or 10-bit addressing, selected by the 10BIT bit in the IOSCFG Register. Figure 47 shows the operation in 7-bit mode in which the master addresses the Apollo3 Blue SoC with a 7-bit address configured as 0xD2 in the CFG\_I2CADDR field. After the START condition, the 7-bit address is transmitted MSB first. If this address matches the lower 7 bits of the CFG\_I2CADDR field, the MCU is selected, the eighth bit indicate a write (RW = 0) or a read (RW = 1) operation and the MCU supplies the ACK. The MCU ignores all other address values and does not respond with an ACK.

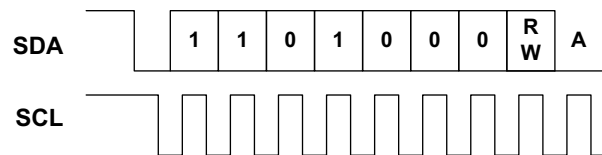


Figure 47. I<sup>2</sup>C 7-bit Address Operation

Figure 48 shows the operation with which the master addresses the MCU with a 10-bit address configured at 0x536. After the START condition, the 10-bit preamble 0b11110 is transmitted first, followed by the first two address bits and the eighth bit indicating a write (RW = 0) or a read (RW = 1) operation. If the upper two bits match the I2CADDR value, the I<sup>2</sup>C/SPI Slave supplies the ACK. The next transfer includes the lower 8 bits of the address, and if these bits also match I2CADDR the MCU again supplies the ACK. The I<sup>2</sup>C/SPI Slave ignores all other address values and does not respond with an ACK.

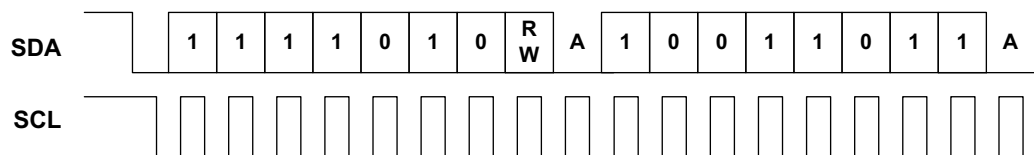


Figure 48. I<sup>2</sup>C 10-bit Address Operation

### 9.9.7 Offset Address Transmission

If the RW bit of the Address Operation indicates a write, the next byte transmitted from the master is the Offset Address as shown in Figure 49. This value is loaded into the Address Pointer of the I<sup>2</sup>C/SPI Slave.

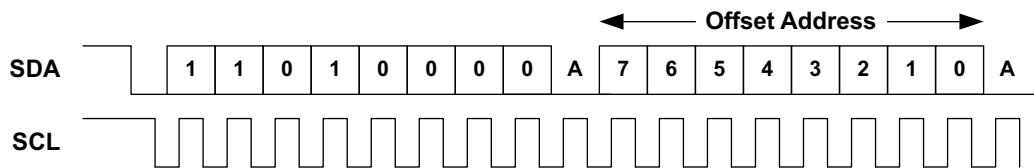


Figure 49. I²C Offset Address Transmission

### 9.9.8 Write Operation

In a write operation the master transmitter transmits to the Apollo3 Blue SoC slave receiver. The Address Operation has a RW value of 0, and the second byte contains the Offset Address as in Figure 49. The next byte is written to the register selected by the Address Pointer (which was loaded with the Offset Address) and the Address Pointer is incremented. Subsequent transfers write bytes into successive registers until a STOP condition is received, as shown in Figure 50. Note that if the Address Pointer is at 0x7F, it will not increment on the write.

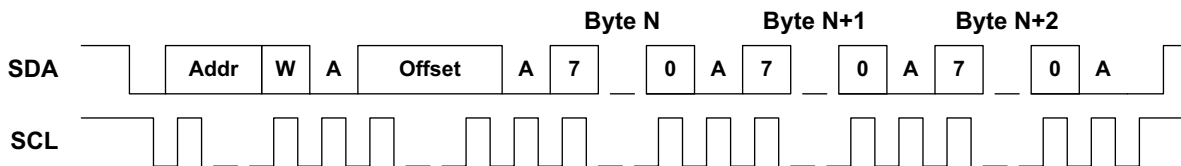


Figure 50. I²C Write Operation

### 9.9.9 Read Operation

In a read operation, the master first executes an Offset Address Transmission to load the Address Pointer with the desired Offset Address. A subsequent operation will again issue the address of the MCU but with the RW bit as a 1 indicating a read operation. Figure 51 shows this transaction beginning with a RESTART condition, although a STOP followed by a START may also be used. After the address operation, the slave becomes the transmitter and sends the register value from the location pointed to by the Address Pointer, and the Address Pointer is incremented. Subsequent transactions produce successive register values, until the master receiver responds with a NAK and a STOP to complete the operation. Because the Address Pointer holds a valid register address, the master may initiate another read sequence at this point without performing another Offset Address operation. Note that if the Address Pointer is at 0x7F, it will not increment on the read.

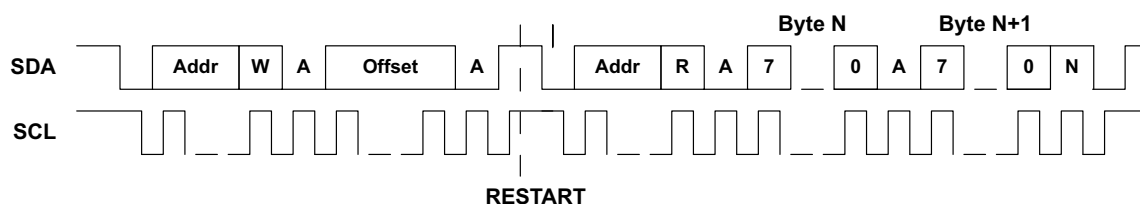


Figure 51. I²C Read Operation

### 9.9.10 General Address Detection

The I<sup>2</sup>C/SPI Slave may be configured to detect an I<sup>2</sup>C General Address (0x00) write. If this address is detected, the first data byte written is stored in the IOSLAVE\_GADATA Register and the GENAD interrupt flag is set. This allows software to create the appropriate response, which is typically to reset the I<sup>2</sup>C/SPI Slave.

## 9.10 SPI Interface

The I<sup>2</sup>C/SPI Slave includes a standard 3-wire or 4-wire SPI interface. The serial peripheral interface (SPI) bus is intended for synchronous communication between different ICs. 4-wire SPI consists of four signal lines: serial data input (MOSI), serial data output (MISO), serial clock (SCL) and an active low chip enable (nCE). The I<sup>2</sup>C/SPI Slave may be connected to a master with a 3-wire SPI interface by configuring 3-wire mode in the pin configuration block of the GPIO module, which will tie MOSI and MISO together. By definition, a device that sends a message is called the “transmitter”, and the device that accepts the message is called the “receiver”. The device that controls the message transfer by driving SCL is called “master”. The devices that are controlled by the master are called “slaves”. The I<sup>2</sup>C/SPI Slave SPI Slave is always a slave device.

The nCE input is used to initiate and terminate a data transfer. The SCL input is used to synchronize data transfer between the master and the slave devices via the MOSI (master to slave) and MISO (slave to master) lines. The SCL input, which is generated by the master, is active only during address and data transfer to any device on the SPI bus.

The I<sup>2</sup>C/SPI Slave supports all SPI configurations of CPOL and CPHA using the SPOL configuration bit. There is one clock for each bit transferred. Address and data bits are transferred in groups of eight bits.

### 9.10.1 Write Operation

Figure 52 shows a SPI write operation. The operation is initiated when the nCE signal to the MCU goes low. At that point an 8-bit Address byte is transmitted from the master on the MOSI line, with the upper RW bit indicating read (if 0) or write (if 1). In this example the RW bit is a one selecting a write operation, and the lower 7 bits of the Address byte contain the Offset Address, which is loaded into the Address Pointer of the I<sup>2</sup>C/SPI Slave.

Each subsequent byte is loaded into the register selected by the Address Pointer, and the Address Pointer is incremented. The operation is terminated by the master by bringing the nCE signal high. Note that the MISO line is not used in a write operation and is held in the high impedance state by the I<sup>2</sup>C/SPI Slave. Note also that if the Address Pointer is 0x7F, it does not increment on the read.

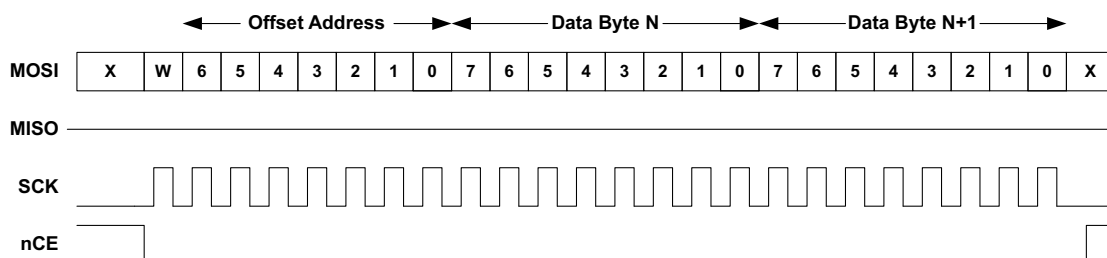


Figure 52. SPI Write Operation

### 9.10.2 Read Operation

Figure 53 shows a read operation. The address is transferred from the master to the slave just as it is in a write operation, but in this case the RW bit is a 0 indicating a read. After the transfer of the last address bit (bit 0), the I<sup>2</sup>C/SPI Slave begins driving data from the register selected by the Address Pointer onto the MISO line, bit 7 first, and the Address Pointer is incremented. The transfer continues until the master brings the nCE line high. Note that if the Address Pointer is 0x7F, it does not increment on the read.

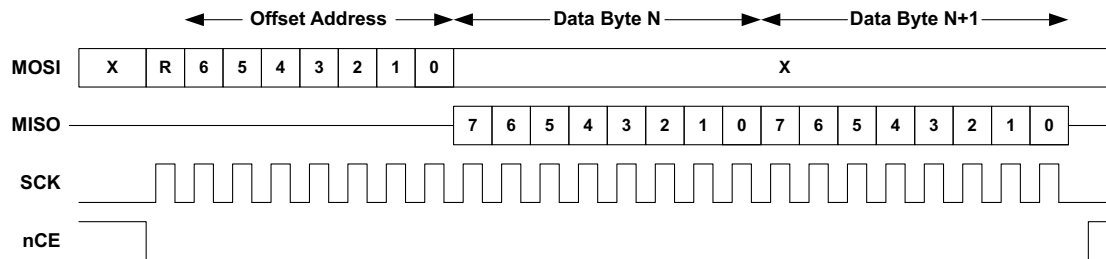


Figure 53. SPI Read Operation

### 9.10.3 Configuring 3-wire vs. 4-wire SPI Mode

The I<sup>2</sup>C/SPI Slave can operate in either 4-wire SPI mode, where the MISO and MOSI signals are on separate wires, or in 3-wire SPI mode where MISO and MOSI share a wire. This configuration is performed in the Pin Configuration module, and no configuration is necessary in the I<sup>2</sup>C/SPI Slave itself.

### 9.10.4 SPI Polarity and Phase

The I<sup>2</sup>C/SPI Slave supports all combinations of CPOL (clock polarity) and CPHA (data phase) in SPI mode. Figure 54 shows how these two bits affect the interface signal behavior.

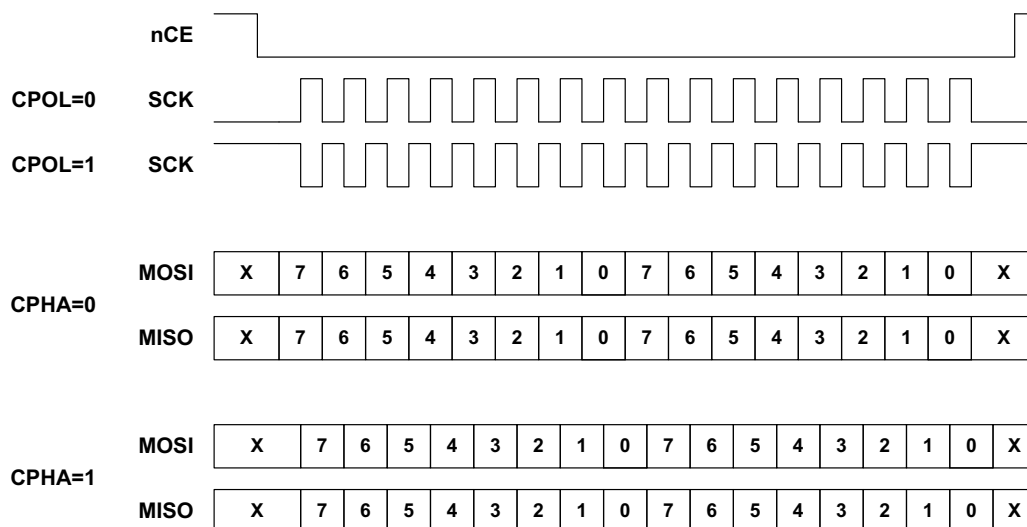


Figure 54. SPI CPOL and CPHA

If CPOL is 0, the clock SCK is normally low and positive pulses are generated during transfers. If CPOL is 1, SCK is normally high and negative pulses are generated during transfers.

If CPHA is 0, the data on the MOSI and MISO lines is sampled on the edge corresponding to the first SCK edge after nCE goes low (i.e. the rising edge if CPOL is 0 and the falling edge if CPOL is 1). Data on MISO and MOSI is driven on the opposite edge of SCK.

If CPHA is 1, the data on the MOSI and MISO lines is sampled on the edge corresponding to the second SCK edge after nCE goes low (i.e. the falling edge if CPOL is 0 and the rising edge if CPOL is 1). Data on MISO and MOSI is driven on the opposite edge of SCK.

The I<sup>2</sup>C/SPI Slave has only a single SPOL bit to control the polarity. If CPOL = CPHA, IOSLAVE\_IOSCFG\_SPOL must be set to 0. If CPOL ≠ CPHA, SPOL must be set to 1.

### 9.11 Bit Orientation

In both I<sup>2</sup>C and SPI modes, the I<sup>2</sup>C/SPI Slave supports data transmission either LSB first or MSB first as configured by the IOSLAVE\_IOSCFG\_LSB bit. If LSB is 0, data is transmitted and received MSB first. If LSB is 1, data is transmitted and received LSB first.

### 9.12 Wakeup Using the I<sup>2</sup>C/SPI Slave

The I<sup>2</sup>C/SPI Slave can continue to operate even if the MCU's CPU is in Sleep or Deep Sleep mode. The hardware will enable and disable the I<sup>2</sup>C/SPI Slave clock and oscillators as necessary. The only consideration in this environment is when the MCU is in a deep sleep mode, such that the HFRC Oscillator is powered down, and a master attempts to access the I<sup>2</sup>C/SPI Slave. In this case the HFRC Oscillator must be powered up before anything is transferred to or from the internal RAM. This process takes roughly 5-10 us, and is initiated by nCE going low in SPI mode or by the detection of a START in I<sup>2</sup>C mode.

For I<sup>2</sup>C applications, the time delay is typically not relevant. At the fastest system clock of 1 MHz, the master must transfer 9 bits of address plus 9 bits of offset before any FIFO access can occur, and that is a minimum of 18 us. The clocks will have started prior to that point in every case.

For SPI applications with fast interface clocks (faster than 1 MHz), the master must be programmed to pull nCE low at least 10 us prior to sending the first clock. If a master is unable to control the timing of nCE in this way, then a GPIO interrupt can be configured to wake the MCU prior to initiating any SPI transfers.

There is no delay restriction if the MCU is in normal Sleep mode. In that case the HFRC is not powered down and the I<sup>2</sup>C/SPI Slave clock will start immediately when nCE goes low. Alternatively, the FRCHFRC bit may be set in the FRCHFRC Register in the CLKGEN module. If this bit is set, the HFRC will continue to be active even if the MCU's CPU is in deep sleep mode, so that the I<sup>2</sup>C/SPI Slave can immediately begin transferring data independent of the SPI transfer rate. This will result in higher power because the HFRC remains active, so the FRCHFRC bit should only be set if it is known that a transfer is likely to begin prior to another interrupt.

### 9.13 IOSLAVE Registers

#### I<sup>2</sup>C/SPI Slave

**INSTANCE 0 BASE ADDRESS:**0x50000000

### 9.13.1 Register Memory Map

**Table 471: IOSLAVE Register Map**

| Address(s) | Register Name | Description                         |
|------------|---------------|-------------------------------------|
| 0x50000100 | FIFOPTR       | Current FIFO Pointer                |
| 0x50000104 | FIFOCFG       | FIFO Configuration                  |
| 0x50000108 | FIFOTHR       | FIFO Threshold Configuration        |
| 0x5000010C | FUPD          | FIFO Update Status                  |
| 0x50000110 | FIFOCTR       | Overall FIFO Counter                |
| 0x50000114 | FIFOINC       | Overall FIFO Counter Increment      |
| 0x50000118 | CFG           | I/O Slave Configuration             |
| 0x5000011C | PRENC         | I/O Slave Interrupt Priority Encode |
| 0x50000120 | IOINTCTL      | I/O Interrupt Control               |
| 0x50000124 | GENADD        | General Address Data                |
| 0x50000200 | INTEN         | IO Slave Interrupts: Enable         |
| 0x50000204 | INTSTAT       | IO Slave Interrupts: Status         |
| 0x50000208 | INTCLR        | IO Slave Interrupts: Clear          |
| 0x5000020C | INTSET        | IO Slave Interrupts: Set            |
| 0x50000210 | REGACCINTEN   | Register Access Interrupts: Enable  |
| 0x50000214 | REGACCINTSTAT | Register Access Interrupts: Status  |
| 0x50000218 | REGACCINTCLR  | Register Access Interrupts: Clear   |
| 0x5000021C | REGACCINTSET  | Register Access Interrupts: Set     |



### 9.13.2 IOSLAVE Registers

#### 9.13.2.1 FIFOPTR Register

Current FIFO Pointer

OFFSET: 0x00000100

INSTANCE 0 ADDRESS: 0x50000100

Current FIFO Pointer

Table 472: FIFOPTR Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9       | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | FIFOSIZ |   |   |   |   |   | FIFOPTR |   |   |   |   |   |   |   |   |   |

Table 473: FIFOPTR Register Bits

| Bit   | Name    | Reset | RW | Description                                         |
|-------|---------|-------|----|-----------------------------------------------------|
| 31:16 | RSVD    | 0x0   | RO | RESERVED                                            |
| 15:8  | FIFOSIZ | 0x0   | RW | The number of bytes currently in the hardware FIFO. |
| 7:0   | FIFOPTR | 0x0   | RW | Current FIFO pointer.                               |

#### 9.13.2.2 FIFOCFG Register

FIFO Configuration

OFFSET: 0x00000104

INSTANCE 0 ADDRESS: 0x50000104

FIFO Configuration

Table 474: FIFOCFG Register

|      |        |   |   |   |   |   |   |      |   |   |   |   |   |   |      |         |   |   |   |   |   |   |      |          |   |   |   |   |   |   |   |
|------|--------|---|---|---|---|---|---|------|---|---|---|---|---|---|------|---------|---|---|---|---|---|---|------|----------|---|---|---|---|---|---|---|
| 3    | 3      | 2 | 2 | 2 | 2 | 2 | 2 | 2    | 2 | 2 | 1 | 1 | 1 | 1 | 1    | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0    | 0        | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0      | 9 | 8 | 7 | 6 | 5 | 4 | 3    | 2 | 1 | 0 | 9 | 8 | 7 | 6    | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8    | 7        | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD | ROBASE |   |   |   |   |   |   | RSVD |   |   |   |   |   |   | RSVD | FIFOMAX |   |   |   |   |   |   | RSVD | FIFOBASE |   |   |   |   |   |   |   |

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                       |
|-------|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:30 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                          |
| 29:24 | ROBASE   | 0x20  | RW | Defines the read-only area. The IO Slave read-only area is situated in LRAM at (ROBASE*8) to (FIFOBASE*8-1)                                                                       |
| 23:16 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                          |
| 15:14 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                          |
| 13:8  | FIFOMAX  | 0x0   | RW | These bits hold the maximum FIFO address in 8 byte segments. It is also the beginning of the RAM area of the LRAM. Note that no RAM area is configured if FIFOMAX is set to 0x1F. |
| 7:5   | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                          |
| 4:0   | FIFOBASE | 0x0   | RW | These bits hold the base address of the I/O FIFO in 8 byte segments. The IO Slave FIFO is situated in LRAM at (FIFOBASE*8) to (FIFOMAX*8-1).                                      |

## FIFO Threshold Configuration

**INSTANCE 0 ADDRESS: 0x50000108**

## FIFO Threshold Configuration

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9       | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | FIFOTHR |   |   |   |   |   |   |   |   |   |  |  |  |  |

| Bit  | Name    | Reset | RW | Description                    |
|------|---------|-------|----|--------------------------------|
| 31:8 | RSVD    | 0x0   | RO | RESERVED                       |
| 7:0  | FIFOTHR | 0x0   | RW | FIFO size interrupt threshold. |



Table 481: FIFOCTR Register Bits

| Bit | Name    | Reset | RW | Description             |
|-----|---------|-------|----|-------------------------|
| 9:0 | FIFOCTR | 0x0   | RW | Virtual FIFO byte count |

**9.13.2.6 FIFOINC Register**

Overall FIFO Counter Increment

OFFSET: 0x00000114

INSTANCE 0 ADDRESS: 0x50000114

Overall FIFO Counter Increment

Table 482: FIFOINC Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0       | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | FIFOINC |   |   |   |   |   |   |   |   |   |   |   |

Table 483: FIFOINC Register Bits

| Bit   | Name    | Reset | RW | Description                                                 |
|-------|---------|-------|----|-------------------------------------------------------------|
| 31:10 | RSVD    | 0x0   | RO | RESERVED                                                    |
| 9:0   | FIFOINC | 0x0   | WO | Increment the Overall FIFO Counter by this value on a write |

**9.13.2.7 CFG Register**

I/O Slave Configuration

OFFSET: 0x00000118

INSTANCE 0 ADDRESS: 0x50000118

I/O Slave Configuration

Table 484: CFG Register

|       |      |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |      |   |   |   |         |      |     |      |        |   |
|-------|------|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|------|---|---|---|---------|------|-----|------|--------|---|
| 3     | 3    | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1       | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0    | 0 | 0 | 0 | 0       | 0    | 0   | 0    | 0      | 0 |
| 1     | 0    | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9       | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9    | 8 | 7 | 6 | 5       | 4    | 3   | 2    | 1      | 0 |
| IFCEN | RSVD |   |   |   |   |   |   |   |   |   |   | I2CADDR |   |   |   |   |   |   |   |   |   | RSVD |   |   |   | STARTRD | RSVD | LSB | SPOL | IFCSEL |   |
|       |      |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |      |   |   |   |         |      |     |      |        |   |
|       |      |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |      |   |   |   |         |      |     |      |        |   |
|       |      |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |      |   |   |   |         |      |     |      |        |   |
|       |      |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |      |   |   |   |         |      |     |      |        |   |

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                               |
|-------|---------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | IFCEN   | 0x0   | RW | IOSLAVE interface enable.<br><br>DIS = 0x0 - Disable the IOSLAVE<br>EN = 0x1 - Enable the IOSLAVE                                                                                                         |
| 30:20 | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                                  |
| 19:8  | I2CADDR | 0x0   | RW | 7-bit or 10-bit I2C device address.                                                                                                                                                                       |
| 7:5   | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                                  |
| 4     | STARTRD | 0x0   | RW | This bit holds the cycle to initiate an I/O RAM read.<br><br>LATE = 0x0 - Initiate I/O RAM read late in each transferred byte.<br>EARLY = 0x1 - Initiate I/O RAM read early in each transferred byte.     |
| 3     | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                                  |
| 2     | LSB     | 0x0   | RW | This bit selects the transfer bit ordering.<br><br>MSB_FIRST = 0x0 - Data is assumed to be sent and received with MSB first.<br>LSB_FIRST = 0x1 - Data is assumed to be sent and received with LSB first. |
| 1     | SPOL    | 0x0   | RW | This bit selects SPI polarity.<br><br>SPI_MODES_0_3 = 0x0 - Polarity 0, handles SPI modes 0 and 3.<br>SPI_MODES_1_2 = 0x1 - Polarity 1, handles SPI modes 1 and 2.                                        |
| 0     | IFCSEL  | 0x0   | RW | This bit selects the I/O interface.<br><br>I2C = 0x0 - Selects I2C interface for the IO Slave.<br>SPI = 0x1 - Selects SPI interface for the IO Slave.                                                     |

## I/O Slave Interrupt Priority Encode

**INSTANCE 0 ADDRESS: 0x5000011C**

### I/O Slave Interrupt Priority Encode

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7     | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | PRENC |   |   |   |   |   |   |   |   |  |  |  |

| Bit  | Name  | Reset | RW | Description                                                   |
|------|-------|-------|----|---------------------------------------------------------------|
| 31:5 | RSVD  | 0x0   | RO | RESERVED                                                      |
| 4:0  | PRENC | 0x0   | RO | These bits hold the priority encode of the REGACC interrupts. |

## I/O Interrupt Control

|          |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |
|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1   | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7   | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0  | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| IOINTSET |        |        |        |        |        |        |        | RSVD   |        |        |        |        |        | IOINTCLR | IOINT  |        |        |        |        |        | IOINTEN |        |        |        |        |        |        |        |        |        |        |

| Bit   | Name     | Reset | RW | Description                                                             |
|-------|----------|-------|----|-------------------------------------------------------------------------|
| 31:24 | IOINTSET | 0x0   | WO | These bits set the IOINT interrupts when written with a 1.              |
| 23:17 | RSVD     | 0x0   | RO | RESERVED                                                                |
| 16    | IOINTCLR | 0x0   | WO | This bit clears all of the IOINT interrupts when written with a 1.      |
| 15:8  | IOINT    | 0x0   | RO | These bits read the IOINT interrupts.                                   |
| 7:0   | IOINTEN  | 0x0   | RO | These read-only bits indicate whether the IOINT interrupts are enabled. |

## General Address Data

Table 490: GENADD Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0      | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0      | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | GADATA |   |   |   |   |   |   |   |   |   |   |

Table 491: GENADD Register Bits

| Bit  | Name   | Reset | RW | Description                                              |
|------|--------|-------|----|----------------------------------------------------------|
| 31:8 | RSVD   | 0x0   | RO | RESERVED                                                 |
| 7:0  | GADATA | 0x0   | RO | The data supplied on the last General Address reference. |

**9.13.2.11INTEN Register****IO Slave Interrupts: Enable****OFFSET:** 0x00000200**INSTANCE 0 ADDRESS:** 0x50000200

Set bits in this register to allow this module to generate the corresponding interrupt.

Table 492: INTEN Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | XCMPWR | XCMPWF | XCMPRR | XCMPRF | JOINTW | GENAD  | FRDERR | FUNDL  | FOVFL  | FSIZE  |

Table 493: INTEN Register Bits

| Bit   | Name   | Reset | RW | Description                                            |
|-------|--------|-------|----|--------------------------------------------------------|
| 31:10 | RSVD   | 0x0   | RO | RESERVED                                               |
| 9     | XCMPWR | 0x0   | RW | Transfer complete interrupt, write to register space.  |
| 8     | XCMPWF | 0x0   | RW | Transfer complete interrupt, write to FIFO space.      |
| 7     | XCMPRR | 0x0   | RW | Transfer complete interrupt, read from register space. |
| 6     | XCMPRF | 0x0   | RW | Transfer complete interrupt, read from FIFO space.     |

| Bit | Name   | Reset | RW | Description                    |
|-----|--------|-------|----|--------------------------------|
| 5   | IOINTW | 0x0   | RW | IO Write interrupt.            |
| 4   | GENAD  | 0x0   | RW | I2C General Address interrupt. |
| 3   | FRDERR | 0x0   | RW | FIFO Read Error interrupt.     |
| 2   | FUNDFL | 0x0   | RW | FIFO Underflow interrupt.      |
| 1   | FOVFL  | 0x0   | RW | FIFO Overflow interrupt.       |
| 0   | FSIZE  | 0x0   | RW | FIFO Size interrupt.           |

## IO Slave Interrupts: Status

**INSTANCE 0 ADDRESS: 0x50000204**

Read bits from this register to discover the cause of a recent interrupt.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | XCMPWR | XCMPWF | XCMPRR | XCMPRF | IOINTW | GENAD  | FRDERR | FUNDPL | FOVFL  | FSIZE  |

| Bit   | Name   | Reset | RW | Description                                            |
|-------|--------|-------|----|--------------------------------------------------------|
| 31:10 | RSVD   | 0x0   | RO | RESERVED                                               |
| 9     | XCMPWR | 0x0   | RW | Transfer complete interrupt, write to register space.  |
| 8     | XCMPWF | 0x0   | RW | Transfer complete interrupt, write to FIFO space.      |
| 7     | XCMPRR | 0x0   | RW | Transfer complete interrupt, read from register space. |
| 6     | XCMPRF | 0x0   | RW | Transfer complete interrupt, read from FIFO space.     |
| 5     | IOINTW | 0x0   | RW | IO Write interrupt.                                    |



| Bit | Name   | Reset | RW | Description                    |
|-----|--------|-------|----|--------------------------------|
| 4   | GENAD  | 0x0   | RW | I2C General Address interrupt. |
| 3   | FRDERR | 0x0   | RW | FIFO Read Error interrupt.     |
| 2   | FUNDFL | 0x0   | RW | FIFO Underflow interrupt.      |
| 1   | FOVFL  | 0x0   | RW | FIFO Overflow interrupt.       |
| 0   | FSIZE  | 0x0   | RW | FIFO Size interrupt.           |

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | XCMPWR | XCMPWF | XCMPRR | XCMPRF | IOINTW | GENAD  | FRDERR | FUNDPL | FOVFL  | F SIZE |

| Bit   | Name   | Reset | RW | Description                                            |
|-------|--------|-------|----|--------------------------------------------------------|
| 31:10 | RSVD   | 0x0   | RO | RESERVED                                               |
| 9     | XCMPWR | 0x0   | RW | Transfer complete interrupt, write to register space.  |
| 8     | XCMPWF | 0x0   | RW | Transfer complete interrupt, write to FIFO space.      |
| 7     | XCMPRR | 0x0   | RW | Transfer complete interrupt, read from register space. |
| 6     | XCMPRF | 0x0   | RW | Transfer complete interrupt, read from FIFO space.     |
| 5     | IOINTW | 0x0   | RW | IO Write interrupt.                                    |
| 4     | GENAD  | 0x0   | RW | I2C General Address interrupt.                         |

**Table 497: INTCLR Register Bits**

| Bit | Name   | Reset | RW | Description                |
|-----|--------|-------|----|----------------------------|
| 3   | FRDERR | 0x0   | RW | FIFO Read Error interrupt. |
| 2   | FUNDFL | 0x0   | RW | FIFO Underflow interrupt.  |
| 1   | FOVFL  | 0x0   | RW | FIFO Overflow interrupt.   |
| 0   | FSIZE  | 0x0   | RW | FIFO Size interrupt.       |

**9.13.2.14INTSET Register****IO Slave Interrupts: Set****OFFSET:** 0x0000020C**INSTANCE 0 ADDRESS:** 0x5000020C

Write a 1 to a bit in this register to instantly generate an interrupt from this module. (Generally used for testing purposes).

**Table 498: INTSET Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | XCMPWR | XCMPWF | XCMPRR | XCMPRF | IOINTW | GENAD  | FRDERR | FUNDFL | FOVFL  | FSIZE  |

**Table 499: INTSET Register Bits**

| Bit   | Name   | Reset | RW | Description                                            |
|-------|--------|-------|----|--------------------------------------------------------|
| 31:10 | RSVD   | 0x0   | RO | RESERVED                                               |
| 9     | XCMPWR | 0x0   | RW | Transfer complete interrupt, write to register space.  |
| 8     | XCMPWF | 0x0   | RW | Transfer complete interrupt, write to FIFO space.      |
| 7     | XCMPRR | 0x0   | RW | Transfer complete interrupt, read from register space. |
| 6     | XCMPRF | 0x0   | RW | Transfer complete interrupt, read from FIFO space.     |
| 5     | IOINTW | 0x0   | RW | IO Write interrupt.                                    |
| 4     | GENAD  | 0x0   | RW | I2C General Address interrupt.                         |

| Bit | Name   | Reset | RW | Description                |
|-----|--------|-------|----|----------------------------|
| 3   | FRDERR | 0x0   | RW | FIFO Read Error interrupt. |
| 2   | FUNDFL | 0x0   | RW | FIFO Underflow interrupt.  |
| 1   | FOVFL  | 0x0   | RW | FIFO Overflow interrupt.   |
| 0   | FSIZE  | 0x0   | RW | FIFO Size interrupt.       |

Set bits in this register to allow this module to generate the corresponding interrupt.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| REGACC |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                 |
|------|--------|-------|----|-----------------------------|
| 31:0 | REGACC | 0x0   | RW | Register access interrupts. |

Read bits from this register to discover the cause of a recent interrupt.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| REGACC |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                 |
|------|--------|-------|----|-----------------------------|
| 31:0 | REGACC | 0x0   | RW | Register access interrupts. |

### Register Access Interrupts: Clear

**INSTANCE 0 ADDRESS: 0x50000218**

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| REGACC |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                 |
|------|--------|-------|----|-----------------------------|
| 31:0 | REGACC | 0x0   | RW | Register access interrupts. |

### Register Access Interrupts: Set

**INSTANCE 0 ADDRESS: 0x5000021C**

Write a 1 to a bit in this register to instantly generate an interrupt from this module. (Generally used for testing purposes).

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| REGACC |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 507: REGACCINTSET Register Bits**

| Bit  | Name   | Reset | RW | Description                 |
|------|--------|-------|----|-----------------------------|
| 31:0 | REGACC | 0x0   | RW | Register access interrupts. |

## 9.14 Host Side Address Space and Register

### 9.14.1 Host Address Space and Registers

The Host of the I/O interface can access 128 bytes in the I<sup>2</sup>C/SPI Slave in either I<sup>2</sup>C or SPI mode. Offsets 0x00 to 0x77 may be directly mapped to the Direct RAM Area. The remaining eight offset locations access hardware functions within the I<sup>2</sup>C/SPI Slave. The R/W indicator refers to accesses from the Host.

#### 9.14.1.1 HOST\_IER Register

##### Host Interrupt Enable

**OFFSET:** 0x78

This register enables the FIFO read interrupts.

**Table 508: HOST\_IER Register**

|          |         |          |          |          |          |          |          |
|----------|---------|----------|----------|----------|----------|----------|----------|
| 0        | 0       | 0        | 0        | 0        | 0        | 0        | 0        |
| 7        | 6       | 5        | 4        | 3        | 2        | 1        | 0        |
| FUNDFLEN | RDERREN | SWINT5EN | SWINT4EN | SWINT3EN | SWINT2EN | SWINT1EN | SWINT0EN |

**Table 509: HOST\_IER Register Bits**

| Bit | Name     | Reset | RW | Description                                                                                                  |
|-----|----------|-------|----|--------------------------------------------------------------------------------------------------------------|
| 7   | FUNDFLEN | 0x0   | RW | If 1, enable an interrupt that triggers when the FIFO underflows                                             |
| 6   | RDERREN  | 0x0   | RW | If 1, enable the interrupt which occurs when the Host attempts to access the FIFO when read access is locked |
| 5   | SWINT5EN | 0x0   | RW | If 1, enable software interrupt 5                                                                            |
| 4   | SWINT4EN | 0x0   | RW | If 1, enable software interrupt 4                                                                            |
| 3   | SWINT3EN | 0x0   | RW | If 1, enable software interrupt 3                                                                            |
| 2   | SWINT2EN | 0x0   | RW | If 1, enable software interrupt 2                                                                            |
| 1   | SWINT1EN | 0x0   | RW | If 1, enable software interrupt 1                                                                            |
| 0   | SWINT0EN | 0x0   | RW | If 1, enable software interrupt 0                                                                            |

### 9.14.1.2 HOST\_ISR Register

#### Host Interrupt Status Register

**OFFSET:** 0x79

The host uses this register to read interrupt status.

**Table 510: HOST\_ISR Register**

|            |           |            |            |            |            |            |            |
|------------|-----------|------------|------------|------------|------------|------------|------------|
| 0          | 0         | 0          | 0          | 0          | 0          | 0          | 0          |
| 7          | 6         | 5          | 4          | 3          | 2          | 1          | 0          |
| FUNDFLSTAT | RDERRSTAT | SWINT5STAT | SWINT4STAT | SWINT3STAT | SWINT2STAT | SWINT1STAT | SWINT0STAT |

**Table 511: HOST\_ISR Register Bits**

| Bit | Name       | Reset | RW | Description                                                                                                                         |
|-----|------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------|
| 7   | FUNDFLSTAT | 0x0   | RO | This bit is set by writing a 1 to bit 31 of the IOINTCTL Register, or if the Host attempts a FIFO read when FIFOCTR is 0.           |
| 6   | RDERRSTAT  | 0x0   | RO | This bit is set by writing a 1 to bit 30 of the IOINTCTL Register, or if the Host attempts a FIFO read when the FIFOUdp bit is a 1. |
| 5   | SWINT5STAT | 0x0   | RO | This bit is set by writing a 1 to bit 29 of the IOINTCTL Register.                                                                  |
| 4   | SWINT4STAT | 0x0   | RO | This bit is set by writing a 1 to bit 28 of the IOINTCTL Register.                                                                  |
| 3   | SWINT3STAT | 0x0   | RO | This bit is set by writing a 1 to bit 27 of the IOINTCTL Register.                                                                  |
| 2   | SWINT2STAT | 0x0   | RO | This bit is set by writing a 1 to bit 26 of the IOINTCTL Register.                                                                  |
| 1   | SWINT1STAT | 0x0   | RO | This bit is set by writing a 1 to bit 25 of the IOINTCTL Register.                                                                  |
| 0   | SWINT0STAT | 0x0   | RO | This bit is set by writing a 1 to bit 24 of the IOINTCTL Register.                                                                  |

**NOTE**

All bits are cleared by a write to the IOINTCLR bit of the IOINTCTL Register.

### 9.14.1.3 HOST\_WCR Register

#### Host Interrupt Write-to-Clear Register

**OFFSET:** 0x7A

Write a 1 to a bit in this register to clear a pending interrupt.

**Table 512: HOST\_WCR Register**

|          |         |          |          |          |          |          |          |
|----------|---------|----------|----------|----------|----------|----------|----------|
| 0        | 0       | 0        | 0        | 0        | 0        | 0        | 0        |
| 7        | 6       | 5        | 4        | 3        | 2        | 1        | 0        |
| FUNDFLWC | RDERRWC | SWINT5WC | SWINT4WC | SWINT3WC | SWINT2WC | SWINT1WC | SWINT0WC |

**Table 513: HOST\_WCR Register Bits**

| Bit | Name     | Reset | RW | Description                                                                    |
|-----|----------|-------|----|--------------------------------------------------------------------------------|
| 7   | FUNDFLWC | 0x0   | WO | Writing a 1 to this bit will clear the pending interrupt status bit FUNDFLSTAT |
| 6   | RDERRWC  | 0x0   | WO | Writing a 1 to this bit will clear the pending interrupt status bit RDERRSTAT  |
| 5   | SWINT5WC | 0x0   | WO | Writing a 1 to this bit will clear the pending interrupt status bit SWINT5STAT |
| 4   | SWINT4WC | 0x0   | WO | Writing a 1 to this bit will clear the pending interrupt status bit SWINT4STAT |
| 3   | SWINT3WC | 0x0   | WO | Writing a 1 to this bit will clear the pending interrupt status bit SWINT3STAT |
| 2   | SWINT2WC | 0x0   | WO | Writing a 1 to this bit will clear the pending interrupt status bit SWINT2STAT |
| 1   | SWINT1WC | 0x0   | WO | Writing a 1 to this bit will clear the pending interrupt status bit SWINT1STAT |
| 0   | SWINT0WC | 0x0   | WO | Writing a 1 to this bit will clear the pending interrupt status bit SWINT0STAT |

**9.14.1.4 HOST\_WCS Register****Host Interrupt Write-to-Set Register****OFFSET:** 0x7B

Write a 1 to a bit in this register to set the status bit of a pending interrupt.

**Table 514: HOST\_WCS Register**

|          |         |          |          |          |          |          |          |
|----------|---------|----------|----------|----------|----------|----------|----------|
| 0        | 0       | 0        | 0        | 0        | 0        | 0        | 0        |
| 7        | 6       | 5        | 4        | 3        | 2        | 1        | 0        |
| FUNDFLWS | RDERRWS | SWINT5WS | SWINT4WS | SWINT3WS | SWINT2WS | SWINT1WS | SWINT0WS |

**Table 515: HOST\_WCS Register Bits**

| Bit | Name     | Reset | RW | Description                                                                  |
|-----|----------|-------|----|------------------------------------------------------------------------------|
| 7   | FUNDFLWS | 0x0   | WO | Writing a 1 to this bit will set the pending interrupt status bit FUNDFLSTAT |
| 6   | RDERRWS  | 0x0   | WO | Writing a 1 to this bit will set the pending interrupt status bit RDERRSTAT  |
| 5   | SWINT5WS | 0x0   | WO | Writing a 1 to this bit will set the pending interrupt status bit SWINT5STAT |
| 4   | SWINT4WS | 0x0   | WO | Writing a 1 to this bit will set the pending interrupt status bit SWINT4STAT |
| 3   | SWINT3WS | 0x0   | WO | Writing a 1 to this bit will set the pending interrupt status bit SWINT3STAT |
| 2   | SWINT2WS | 0x0   | WO | Writing a 1 to this bit will set the pending interrupt status bit SWINT2STAT |
| 1   | SWINT1WS | 0x0   | WO | Writing a 1 to this bit will set the pending interrupt status bit SWINT1STAT |
| 0   | SWINT0WS | 0x0   | WO | Writing a 1 to this bit will set the pending interrupt status bit SWINT0STAT |



**9.14.1.5 FIFOCTRLO Register****FIFOCTR Low Byte****OFFSET:** 0x7C

This register allows the host to read the lower eight bits of the FIFOCTR register.

**Table 516: FIFOCTRLO Register**

|           |   |   |   |   |   |   |   |
|-----------|---|---|---|---|---|---|---|
| 0         | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7         | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FIFOCTRLO |   |   |   |   |   |   |   |

**Table 517: FIFOCTRLO Register Bits**

| Bit | Name      | Reset | RW | Description                           |
|-----|-----------|-------|----|---------------------------------------|
| 7:0 | FIFOCTRLO | 0x0   | RO | Reads the lower eight bits of FIFOCTR |

**9.14.1.6 FIFOCTRUP Register****FIFOCTR Upper Byte****OFFSET:** 0x7D

This register allows the host to read the upper two bits of the FIFOCTR register.

**Table 518: FIFOCTRUP Register**

|      |   |   |   |   |   |           |   |
|------|---|---|---|---|---|-----------|---|
| 0    | 0 | 0 | 0 | 0 | 0 | 0         | 0 |
| 7    | 6 | 5 | 4 | 3 | 2 | 1         | 0 |
| RSVD |   |   |   |   |   | FIFOCTRUP |   |

**Table 519: FIFOCTRUP Register Bits**

| Bit | Name      | Reset | RW | Description                         |
|-----|-----------|-------|----|-------------------------------------|
| 1:0 | FIFOCTRUP | 0x0   | RO | Reads the upper two bits of FIFOCTR |

### 9.14.1.7 FIFO Register

#### FIFO Read Data

**OFFSET:** 0x7F

Read this register for FIFO data.

**Table 520: FIFO Register**

|      |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|
| 0    | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7    | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FIFO |   |   |   |   |   |   |   |

**Table 521: FIFO Register Bits**

| Bit | Name | Reset | RW | Description                    |
|-----|------|-------|----|--------------------------------|
| 7:0 | FIFO | 0x0   | RO | Reads the top byte of the FIFO |

## 10. PDM/I<sup>2</sup>S Module

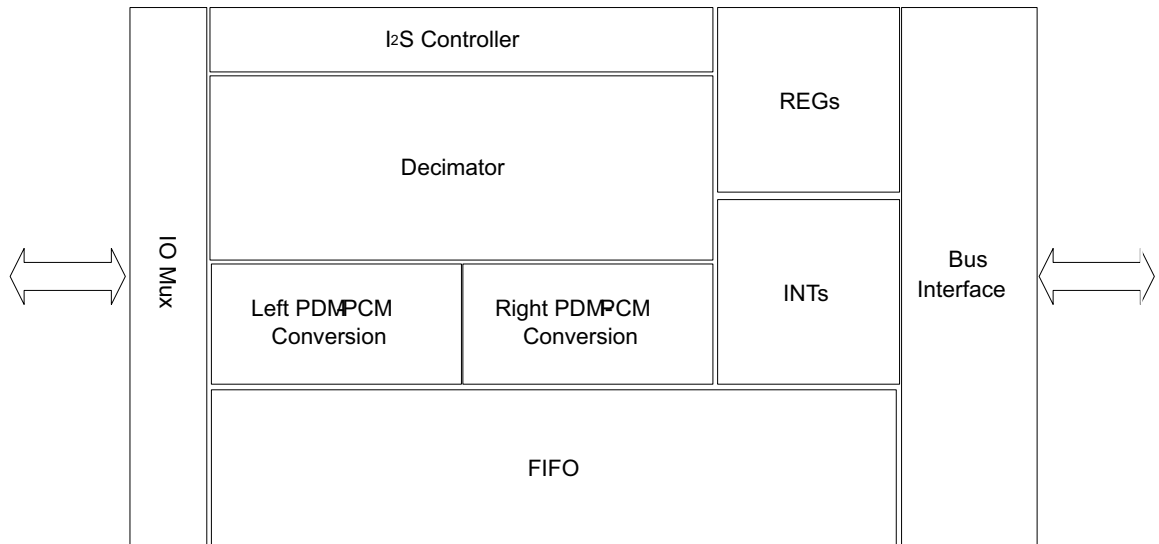


**Figure 55. Block Diagram for PDM Module**

### 10.1 Features

The PDM module provides support for low power Pulse-Density Modulated (PDM) to Pulse-Code Modulated (PCM) conversion and optional I<sup>2</sup>S slave interface for external host processor communication.

The PDM controller generates the clock output to interface to 1 (mono) or 2 (stereo) PDM-based digital microphones. The PDM input data is sampled on the rising (left/mono) and falling (right/stereo) edges of PDM clock. The controller supports 16-bit PCM output sampling at 8/16 KHz. The single bit pulse-density modulated (PDM) bit stream data is converted into pulse-code modulated (PCM) data and provides an optional I<sup>2</sup>S serial audio/voice data format. The converted PCM data is stored in an asynchronous FIFO where it can then be retrieved by the MCU CPU via the AHB slave interface.

The PDM controller includes the following features:

- Stereo or mono PDM input
- 16-bit PCM digital output
- I<sup>2</sup>S slave interface output (optional)
- Support for variable PDM output clock rates (750-768 KHz, 1.5-1.536 MHz, 3-3.072 MHz: output clock depends on source clock from I<sup>2</sup>S or MCU)
- 64x decimation of PDM bit stream input to PCM output
- Sampling rate: 8 KHz, 16 KHz (additional sample rates are supported as needed)
- AHB slave interface for register control, status programming and PCM FIFO data access

## 10.2 Functional Overview

The Apollo3 Blue SoC integrates a PDM controller which has two modes of operation: low power mode and normal mode. The low power mode is intended for wake-on-voice/keyword detect operation. A low frequency PDM clock is generated to the microphone (requires digital microphone that supports low power operation). Once a keyword is detected, the MCU generates a wake event to enter normal mode. In normal mode, higher PDM frequencies are supported to process audio/voice as needed for voice recording, voice calls, etc.

### 10.2.1 PDM-to-PCM Conversion

The PDM-to-PCM core IP converts PDM bit stream data into 16-bit PCM data through internal data sampling, filtering, and PGA amplification. The controller may be operated at stereo or mono mode in normal operation, system reset or power down mode when not in use. Each mode can be programmed through registers.

The basic PCM conversion flow is shown in Figure .

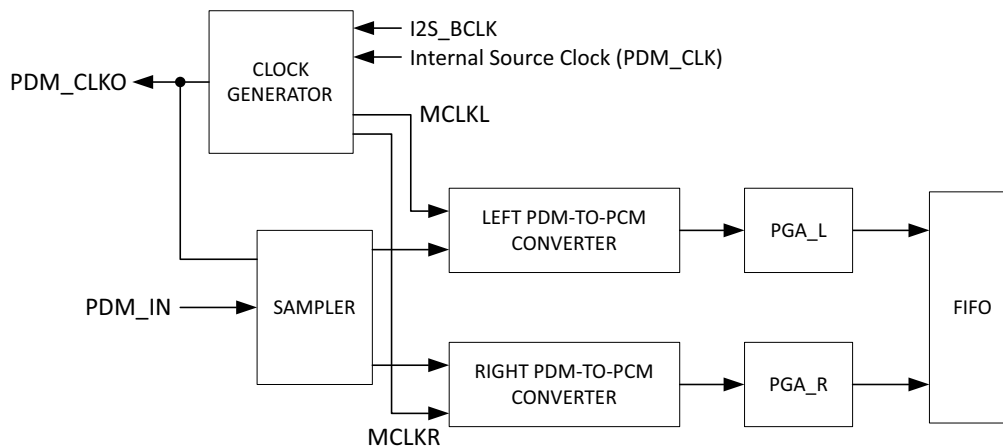


Figure 56. Stereo PDM to PCM Conversion Path

### 10.2.2 Clock Generation

The PDM module generates the clock which is supplied on the PDM\_CLKO pin to the PDM source, and is shown in Figure below.

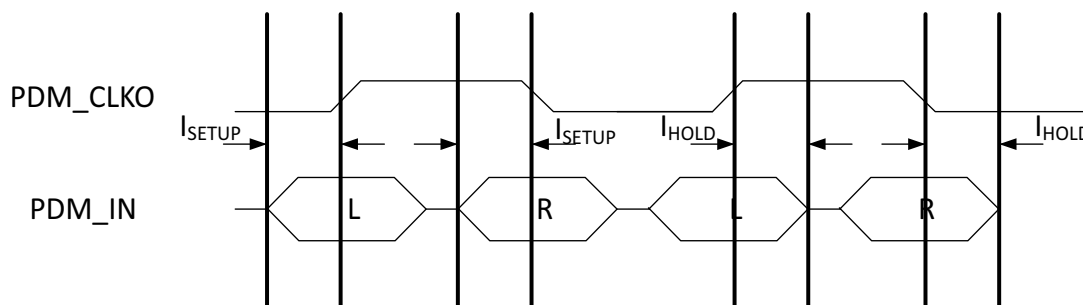


Figure 57. PDM Clock Timing Diagram

There are two sources for this clock, which are selected by the VCFG\_SELAP register bit. If SELAP is 0, this clock is an internally generated clock which is selected by the VCFG\_PDMCLKSEL field and can range from 12 MHz to 187.5 KHz, and is enabled by setting the PCFG\_PDMCLK bit. These clock selections are derived from the internal 48 MHz HFRC oscillator and therefore will have some frequency variation. If SELAP is 1, this clock is supplied externally on the I2S\_BCLK pin. The input clock is used as the clock of the internal PDM logic, and therefore the lowest acceptable frequency should be selected to minimize power. The PDM logic includes separately clocked sections for each of the left and right channels.

The input clock is divided by 1, 2, 3 or 4 as selected by the PCFG\_MCLKDIV field to produce the PDM\_CLKO output.

**NOTE**

If achieving a nominal 50% duty cycle PDM output clock is important, then using a clock divider of divide-by-3 (MCKDIV3) for PCFG\_MCLKDIV should be avoided as the resulting divided clock has a duty cycle of 67%, not the expected 50%. The other PCFG\_MCLKDIV settings, MCKDIV1, MCKDIV2 and MCKDIV4 can be used to generate an output clock close to 50% duty cycle. See Table 522 for reference.

The following equations are for reference showing the relationship between SINC\_RATE, MCLKDIV, sample rate and OSR.

$$F_{\text{PDM\_CLK}} = F_S \times 2 \times \text{SINC\_RATE} \times \text{MCLKDIV}$$

$$F_{\text{PDM\_CLKO}} = F_S \times 2 \times \text{SINC\_RATE}$$

$$\text{OSR} = F_{\text{PDM\_CLKO}} / F_S = 2 \times \text{SINC\_RATE}$$

**NOTE**

SINC\_RATE must not be set higher than 64, even though the field is 7-bits wide.

The PDM module also requires a system clock to operate, which is enabled by the VCFG\_IOCLKEN register bit. This bit should be kept at 0 whenever the PDM is not capturing input data to minimize power consumption.

The serial PDM input data is oversampled by a value specified in the PCFG\_SINCRATE register field to produce the PCM data. The resulting PCM data rate is the PDM\_CLKO frequency divided by the SINCRATE value and divided by 2. The table below shows some examples of frequency selection.

**Table 522: PDM Clock Output Reference Table**

| F <sub>S</sub> (kHz) | Duty Cycle (%) | F <sub>PDM_CLKO</sub> (kHz) | OSR | MCLKDIV | SINC_RATE | Clock Source               |
|----------------------|----------------|-----------------------------|-----|---------|-----------|----------------------------|
| 7.8125               | 50             | 750                         | 96  | MCKDIV1 | 48        | 750kHz (MCU HFRC)          |
| 15.625               | 50             | 750                         | 48  | MCKDIV1 | 24        | 750kHz (MCU HFRC)          |
| 15.625               | 50             | 1500                        | 96  | MCKDIV1 | 48        | 1.5MHz (MCU HFRC)          |
| 7.8125               | 67             | 1000                        | 128 | MCKDIV3 | 64        | 3MHz (MCU HFRC)            |
| 8                    | 50             | 768                         | 96  | MCKDIV1 | 48        | 768kHz (external I2S_BCLK) |
| 16                   | 50             | 768                         | 48  | MCKDIV1 | 24        | 768kHz (external I2S_BCLK) |

The PDM controller also includes separate clock gates for left and right channel. This allows for lower power operation in mono microphone configuration.

### 10.2.3 Clock Switching

The Apollo3 Blue SoC supports dual-mode clock sourcing for PDM microphone operation. The first mode is clock sourcing from the MCU directly (via divided down HFRC reference). The second mode is clock sourcing from an external host via the I2S\_BCLK.

The scenario for switching clock sources is if a higher accuracy clock is required based on the audio sampling requirements. The MCU clock source is based off of an RC oscillator which has intrinsic jitter that affects the quality of the resulting clock. For general voice command processing, the quality of the clock is sufficient. However, for voice recording/playback scenarios, this could manifest as pitch/noise problems. In a scenario where the MCU is used for voice/keyword detect, upon detection, the MCU can generate notification to the external host. The external host can then send a command to the MCU to switch clock source.

Clock switching requires careful orchestration since the PDM controller will continue to collect/process samples during this transition. The flow below is an example of how this transition can be handled.

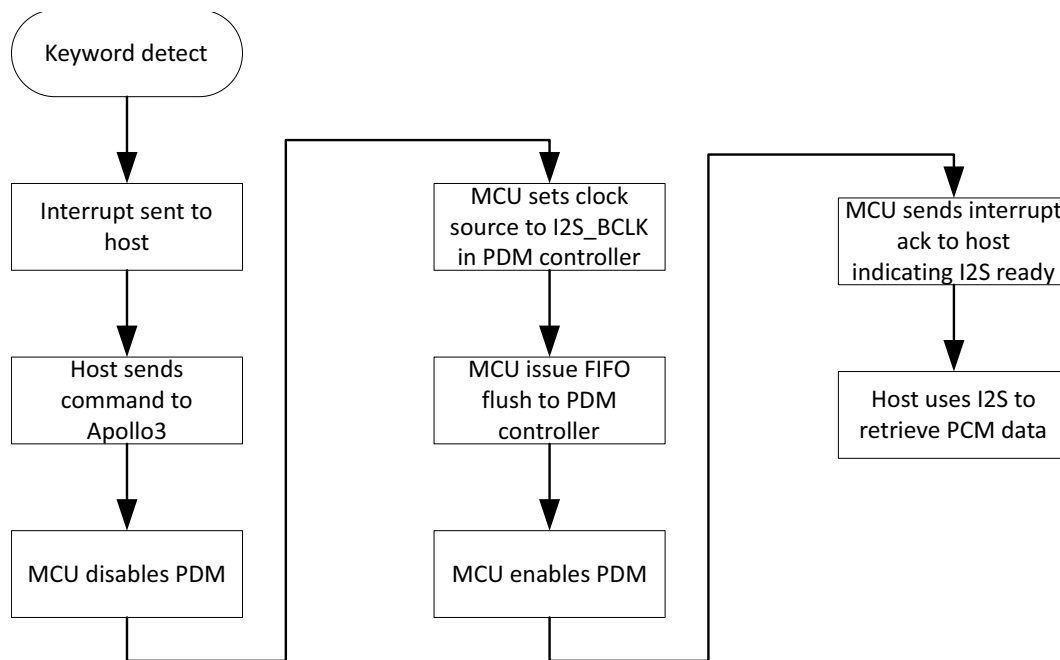


**Figure 58. PDM Clock Source Switching Flow**

### 10.2.4 Operating Modes

The PDM module can operate in a variety of modes selected by the CHSET, PCMPACK and LRSWAP register fields, as shown in Table 523 below. The FIFO Data Format column shows the PCM data that will be presented on each 32-bit read from the FIFO, in two 16-bit segments. “L0” indicates the first 16-bit

sample from the left channel, “L1” indicates the second left channel sample, “R0” indicates the first 16-bit sample from the right channel, etc.

**Table 523: PDM Operating Modes and Data Formats**

| Mode                    | CHSET | PCMPACK | LRSWAP | 31 - FIFO Data Format - 0 |      | MCLKL | MCLKR |
|-------------------------|-------|---------|--------|---------------------------|------|-------|-------|
| Mono Left Packed        | 01    | 1       | N/A    | L1                        | L0   | En    | Dis   |
|                         |       |         |        | L3                        | L2   |       |       |
| Mono Right Packed       | 10    | 1       | N/A    | R1                        | R0   | Dis   | En    |
|                         |       |         |        | R3                        | R2   |       |       |
| Stereo Packed           | 11    | 1       | 0      | R0                        | L0   | En    | En    |
|                         |       |         |        | R1                        | L1   |       |       |
| Stereo Packed Swapped   | 11    | 1       | 1      | L0                        | R0   | En    | En    |
|                         |       |         |        | L1                        | R1   |       |       |
| Mono Left Unpacked      | 01    | 0       | N/A    | 0000                      | L0   | En    | Dis   |
|                         |       |         |        | 0000                      | L1   |       |       |
| Mono Right Unpacked     | 10    | 0       | N/A    | 0000                      | R0   | Dis   | En    |
|                         |       |         |        | 0000                      | R1   |       |       |
| Stereo Unpacked         | 11    | 0       | 0      | 0000                      | L0   | En    | En    |
|                         |       |         |        | 0000                      | R0   |       |       |
| Stereo Unpacked Swapped | 11    | 0       | 1      | 0000                      | R0   | En    | En    |
|                         |       |         |        | 0000                      | L0   |       |       |
| Disabled                | 00    | N/A     | N/A    | 0000                      | 0000 | Dis   | Dis   |
|                         |       |         |        | 0000                      | 0000 |       |       |

The MCLKL and MCLKR columns indicate whether the left and right channel clocks are enabled or disabled.

### 10.2.5 FIFO Control and Interrupts

The PCM data is retrieved from the PDM module through a 32-word FIFO, read at the FRD Register. The number of words currently in the FIFO (0 to 32) is read in the FR\_FIFOCNT field. If the FLUSH Register is written (with any value) FIFOCNT is set to 0 and any data in the FIFO is discarded. Each read from the FRD Register will decrement the FIFOCNT value, and FIFOCNT will be incremented each time new PCM data is written into the FIFO.

There are three interrupts which are generated based on the number of words in the FIFO. The UNDFL interrupt is generated if software reads from the FRD register when FIFOCNT is 0. The OVF interrupt is generated if PCM data is received when FIFOCNT is 32. The THR interrupt is set if PCM data is received and FIFOCNT is greater than or equal to the value in the FTHR\_FIFOTHR Register field.

### 10.2.6 Digital Volume Gain

The PDM controller supports digital volume control with a range from -6 dB to +40.5 dB in steps of 1.5 dB. It is programmed by register PGA\_L and PGA\_R for both left and right channels.

**Table 525: PGA\_L and PGA\_R Fields of the PCFG Register**

| Port Name  | Default | Description                                                                                                                       |
|------------|---------|-----------------------------------------------------------------------------------------------------------------------------------|
| PGA_L[4:0] | 0000    | Left Channel PGA Gain:<br>+1.5dB/step, -6dB to +40.5dB<br>00000 = -6 dB<br>00001 = -4.5 dB<br>11110 = +39 dB<br>11111 = +40.5 dB  |
| PGA_R[4:0] | 0000    | Right Channel PGA Gain:<br>+1.5dB/step, -6dB to +40.5dB<br>00000 = -6 dB<br>00001 = -4.5 dB<br>11110 = +39 dB<br>11111 = +40.5 dB |

### 10.2.7 Low Pass Filter (LPF)

The controller's internal low pass filters attenuate the out-of-band noise at predefined bandwidth and corners.

**Table 526: LPF Digital Filter Parameters**

| Parameter                  | Min  | Typ  | Max | Units |
|----------------------------|------|------|-----|-------|
| Pass band corner frequency |      | 0.41 |     | Fs    |
| Pass band ripple           | -1   |      | 1   | dB    |
| Stop band corner frequency | 0.59 |      |     | Fs    |
| Stop band rejection        |      | -60  |     | dB    |

### 10.2.8 High Pass Filter

The discrete-time filter transfer function of the high pass filter as a function of the PDM\_PCFG\_HPCUTOFF field is:

$$H(Z) = (1 - Z^{-1}) / [1 - (1 - 2^{-(HPCUTOFF-8)}) Z^{-1}]$$

If HPCUTOFF = 1011, the high pass filter can be formulated by the polynomial:

$$H(Z) = (1 - Z^{-1}) / [1 - 0.875Z^{-1}]$$



At 16 KHz, the HPCUTOFF settings result in high pass corner frequencies as shown in Table 527.

**Table 527: High Pass Corner Frequency as a Function of HPCUTOFF**

| HPCUTOFF  | High Pass Corner Frequency (Hz) |
|-----------|---------------------------------|
| 0x0 - 0x7 | INVALID                         |
| 0x8       | 1843                            |
| 0x9       | 1049                            |
| 0xA       | 572                             |
| 0xB       | 301                             |
| 0xC       | 155                             |
| 0D        | 79                              |
| 0E        | 40                              |
| 0F        | 20                              |

## 10.3 PDM Registers

### PDM Audio

**INSTANCE 0 BASE ADDRESS:**0x50011000

### 10.3.1 Register Memory Map

**Table 528: PDM Register Map**

| Address(s) | Register Name | Description                  |
|------------|---------------|------------------------------|
| 0x50011000 | PCFG          | PDM Configuration            |
| 0x50011004 | VCFG          | Voice Configuration          |
| 0x50011008 | VOICESTAT     | Voice Status                 |
| 0x5001100C | FIFOREAD      | FIFO Read                    |
| 0x50011010 | FIFOFLUSH     | FIFO Flush                   |
| 0x50011014 | FIFOTHR       | FIFO Threshold               |
| 0x50011200 | INTEN         | IO Master Interrupts: Enable |
| 0x50011204 | INTSTAT       | IO Master Interrupts: Status |
| 0x50011208 | INTCLR        | IO Master Interrupts: Clear  |
| 0x5001120C | INTSET        | IO Master Interrupts: Set    |
| 0x50011240 | DMATRIGEN     | DMA Trigger Enable           |
| 0x50011244 | DMATRIGSTAT   | DMA Trigger Status           |
| 0x50011280 | DMACFG        | DMA Configuration            |
| 0x50011288 | DMATOTCOUNT   | DMA Total Transfer Count     |
| 0x5001128C | DMATARGADDR   | DMA Target Address           |
| 0x50011290 | DMASTAT       | DMA Status                   |

### 10.3.2 PDM Registers

#### 10.3.2.1 PCFG Register

##### PDM Configuration

**OFFSET:** 0x00000000

**INSTANCE 0 ADDRESS:** 0x50011000

PDM Configuration

**Table 529: PCFG Register**

|        |          |   |   |   |   |         |   |   |   |   |      |         |          |   |   |   |   |   |   |   |        |          |   |   |   |   |        |          |           |
|--------|----------|---|---|---|---|---------|---|---|---|---|------|---------|----------|---|---|---|---|---|---|---|--------|----------|---|---|---|---|--------|----------|-----------|
| 3      | 3        | 2 | 2 | 2 | 2 | 2       | 2 | 2 | 2 | 2 | 1    | 1       | 1        | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0      | 0        | 0 | 0 | 0 | 0 | 0      | 0        | 0         |
| 1      | 0        | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0    | 9       | 8        | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0      | 9        | 8 | 7 | 6 | 5 | 4      | 3        | 2         |
| LRSWAP | PGARIGHT |   |   |   |   | PGALEFT |   |   |   |   | RSVD | MCLKDIV | SINCRATE |   |   |   |   |   |   |   | ADCHPD | HPCUTOFF |   |   |   |   | CYCLES | SOFTMUTE | PDMCOREEN |

**Table 530: PCFG Register Bits**

| Bit | Name   | Reset | RW | Description                                                                                                                                                  |
|-----|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31  | LRSWAP | 0x0   | RW | Left/right channel swap.<br><br>EN = 0x1 - Swap left and right channels (FIFO Read RIGHT_LEFT).<br>NOSWAP = 0x0 - No channel swapping (IFO Read LEFT_RIGHT). |

Table 530: PCFG Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------|----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 30:26 | PGARIGHT | 0x0   | RW | <p>Right channel PGA gain.</p> <p>P405DB = 0x1F - 40.5 db gain.<br/> P390DB = 0x1E - 39.0 db gain.<br/> P375DB = 0x1D - 37.5 db gain.<br/> P360DB = 0x1C - 36.0 db gain.<br/> P345DB = 0x1B - 34.5 db gain.<br/> P330DB = 0x1A - 33.0 db gain.<br/> P315DB = 0x19 - 31.5 db gain.<br/> P300DB = 0x18 - 30.0 db gain.<br/> P285DB = 0x17 - 28.5 db gain.<br/> P270DB = 0x16 - 27.0 db gain.<br/> P255DB = 0x15 - 25.5 db gain.<br/> P240DB = 0x14 - 24.0 db gain.<br/> P225DB = 0x13 - 22.5 db gain.<br/> P210DB = 0x12 - 21.0 db gain.<br/> P195DB = 0x11 - 19.5 db gain.<br/> P180DB = 0x10 - 18.0 db gain.<br/> P165DB = 0xF - 16.5 db gain.<br/> P150DB = 0xE - 15.0 db gain.<br/> P135DB = 0xD - 13.5 db gain.<br/> P120DB = 0xC - 12.0 db gain.<br/> P105DB = 0xB - 10.5 db gain.<br/> P90DB = 0xA - 9.0 db gain.<br/> P75DB = 0x9 - 7.5 db gain.<br/> P60DB = 0x8 - 6.0 db gain.<br/> P45DB = 0x7 - 4.5 db gain.<br/> P30DB = 0x6 - 3.0 db gain.<br/> P15DB = 0x5 - 1.5 db gain.<br/> 0DB = 0x4 - 0.0 db gain.<br/> M15DB = 0x3 - -1.5 db gain.<br/> M300DB = 0x2 - -3.0 db gain.<br/> M45DB = 0x1 - -4.5 db gain.<br/> M60DB = 0x0 - -6.0 db gain.</p> |

Table 530: PCFG Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25:21 | PGALEFT  | 0x0   | RW | Left channel PGA gain.<br><br>P405DB = 0x1F - 40.5 db gain.<br>P390DB = 0x1E - 39.0 db gain.<br>P375DB = 0x1D - 37.5 db gain.<br>P360DB = 0x1C - 36.0 db gain.<br>P345DB = 0x1B - 34.5 db gain.<br>P330DB = 0x1A - 33.0 db gain.<br>P315DB = 0x19 - 31.5 db gain.<br>P300DB = 0x18 - 30.0 db gain.<br>P285DB = 0x17 - 28.5 db gain.<br>P270DB = 0x16 - 27.0 db gain.<br>P255DB = 0x15 - 25.5 db gain.<br>P240DB = 0x14 - 24.0 db gain.<br>P225DB = 0x13 - 22.5 db gain.<br>P210DB = 0x12 - 21.0 db gain.<br>P195DB = 0x11 - 19.5 db gain.<br>P180DB = 0x10 - 18.0 db gain.<br>P165DB = 0xF - 16.5 db gain.<br>P150DB = 0xE - 15.0 db gain.<br>P135DB = 0xD - 13.5 db gain.<br>P120DB = 0xC - 12.0 db gain.<br>P105DB = 0xB - 10.5 db gain.<br>P90DB = 0xA - 9.0 db gain.<br>P75DB = 0x9 - 7.5 db gain.<br>P60DB = 0x8 - 6.0 db gain.<br>P45DB = 0x7 - 4.5 db gain.<br>P30DB = 0x6 - 3.0 db gain.<br>P15DB = 0x5 - 1.5 db gain.<br>0DB = 0x4 - 0.0 db gain.<br>M15DB = 0x3 - -1.5 db gain.<br>M300DB = 0x2 - -3.0 db gain.<br>M45DB = 0x1 - -4.5 db gain.<br>M60DB = 0x0 - -6.0 db gain. |
| 20:19 | RSVD     | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 18:17 | MCLKDIV  | 0x0   | RW | PDM_CLK frequency divisor.<br><br>MCKDIV4 = 0x3 - Divide input clock by 4<br>MCKDIV3 = 0x2 - Divide input clock by 3<br>MCKDIV2 = 0x1 - Divide input clock by 2<br>MCKDIV1 = 0x0 - Divide input clock by 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 16:10 | SINCRATE | 0x30  | RW | SINC decimation rate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 9     | ADCHPD   | 0x1   | RW | High pass filter control.<br><br>EN = 0x0 - Enable high pass filter.<br>DIS = 0x1 - Disable high pass filter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 8:5   | HPCUTOFF | 0xb   | RW | High pass filter coefficients.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 4:2   | CYCLES   | 0x1   | RW | Number of clocks during gain-setting changes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 1     | SOFTMUTE | 0x0   | RW | Soft mute control.<br><br>EN = 0x1 - Enable Soft Mute.<br>DIS = 0x0 - Disable Soft Mute.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

Table 530: PCFG Register Bits

| Bit | Name      | Reset | RW | Description                                                                                         |
|-----|-----------|-------|----|-----------------------------------------------------------------------------------------------------|
| 0   | PDMCOREEN | 0x1   | RW | Data Streaming Control.<br>EN = 0x1 - Enable Data Streaming.<br>DIS = 0x0 - Disable Data Streaming. |

**10.3.2.2 VCFG Register****Voice Configuration****OFFSET:** 0x00000004**INSTANCE 0 ADDRESS:** 0x50011004

Voice Configuration

Table 531: VCFG Register

|         |      |           |          |      |   |   |   |   |   |   |       |         |      |          |       |      |   |   |   |   |         |      |   |   |       |      |   |   |
|---------|------|-----------|----------|------|---|---|---|---|---|---|-------|---------|------|----------|-------|------|---|---|---|---|---------|------|---|---|-------|------|---|---|
| 3       | 3    | 2         | 2        | 2    | 2 | 2 | 2 | 2 | 2 | 2 | 1     | 1       | 1    | 1        | 1     | 1    | 1 | 1 | 0 | 0 | 0       | 0    | 0 | 0 | 0     | 0    | 0 | 0 |
| 1       | 0    | 9         | 8        | 7    | 6 | 5 | 4 | 3 | 2 | 1 | 0     | 9       | 8    | 7        | 6     | 5    | 4 | 3 | 2 | 1 | 0       | 9    | 8 | 7 | 6     | 5    | 4 | 3 |
| IOCLKEN | RSTB | PDMCLKSEL | PDMCLKEN | RSVD |   |   |   |   |   |   | I2SEN | BCLKINV | RSVD | DMICKDEL | SELAP | RSVD |   |   |   |   | PCMPACK | RSVD |   |   | CHSET | RSVD |   |   |

Table 532: VCFG Register Bits

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                      |
|-------|-----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | IOCLKEN   | 0x0   | RW | Enable the IO clock.<br>DIS = 0x0 - Disable FIFO read.<br>EN = 0x1 - Enable FIFO read.                                                                                                                                                                                                                                                           |
| 30    | RSTB      | 0x0   | RW | Reset the IP core.<br>RESET = 0x0 - Reset the core.<br>NORM = 0x1 - Enable the core.                                                                                                                                                                                                                                                             |
| 29:27 | PDMCLKSEL | 0x0   | RW | Select the PDM input clock.<br><br>DISABLE = 0x0 - Static value.<br>12MHz = 0x1 - PDM clock is 12 MHz.<br>6MHz = 0x2 - PDM clock is 6 MHz.<br>3MHz = 0x3 - PDM clock is 3 MHz.<br>1_5MHz = 0x4 - PDM clock is 1.5 MHz.<br>750KHz = 0x5 - PDM clock is 750 KHz.<br>375KHz = 0x6 - PDM clock is 375 KHz.<br>187KHz = 0x7 - PDM clock is 187.5 KHz. |
| 26    | PDMCLKEN  | 0x0   | RW | Enable the serial clock.<br>DIS = 0x0 - Disable serial clock.<br>EN = 0x1 - Enable serial clock.                                                                                                                                                                                                                                                 |

**Table 532: VCFG Register Bits**

| Bit   | Name     | Reset | RW | Description                                                                                                                                                   |
|-------|----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25:21 | RSVD     | 0x0   | RO | This bit field is reserved for future use.                                                                                                                    |
| 20    | I2SEN    | 0x0   | RW | I2S interface enable.<br>DIS = 0x0 - Disable I2S interface.<br>EN = 0x1 - Enable I2S interface.                                                               |
| 19    | BCLKINV  | 0x0   | RW | I2S BCLK input inversion.<br>INV = 0x0 - BCLK inverted.<br>NORM = 0x1 - BCLK not inverted.                                                                    |
| 18    | RSVD     | 0x0   | RO | This bit field is reserved for future use.                                                                                                                    |
| 17    | DMICKDEL | 0x0   | RW | PDM clock sampling delay.<br>0CYC = 0x0 - No delay.<br>1CYC = 0x1 - 1 cycle delay.                                                                            |
| 16    | SELAP    | 0x0   | RW | Select PDM input clock source.<br>I2S = 0x1 - Clock source from I2S BCLK.<br>INTERNAL = 0x0 - Clock source from internal clock generator.                     |
| 15:9  | RSVD     | 0x0   | RO | This bit field is reserved for future use.                                                                                                                    |
| 8     | PCMPACK  | 0x0   | RW | PCM data packing enable.<br>DIS = 0x0 - Disable PCM packing.<br>EN = 0x1 - Enable PCM packing.                                                                |
| 7:5   | RSVD     | 0x0   | RO | This bit field is reserved for future use.                                                                                                                    |
| 4:3   | CHSET    | 0x1   | RW | Set PCM channels.<br>DIS = 0x0 - Channel disabled.<br>LEFT = 0x1 - Mono left channel.<br>RIGHT = 0x2 - Mono right channel.<br>STEREO = 0x3 - Stereo channels. |
| 2:0   | RSVD     | 0x0   | RO | This bit field is reserved for future use.                                                                                                                    |

**10.3.2.3 VOICESTAT Register****Voice Status****OFFSET:** 0x00000008**INSTANCE 0 ADDRESS:** 0x50011008

Voice Status

Table 533: VOICESTAT Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |  |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|--|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |  |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8       | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | FIFOCNT |   |   |   |   |   |   |   |   |  |  |  |  |  |

Table 534: VOICESTAT Register Bits

| Bit  | Name    | Reset | RW | Description                                 |
|------|---------|-------|----|---------------------------------------------|
| 31:6 | RSVD    | 0x0   | RO | This bit field is reserved for future use.  |
| 5:0  | FIFOCNT | 0x0   | RO | Valid 32-bit entries currently in the FIFO. |

**10.3.2.4 FIFOREAD Register****FIFO Read****OFFSET:** 0x0000000C**INSTANCE 0 ADDRESS:** 0x5001100C

FIFO Read

Table 535: FIFOREAD Register

|          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3        | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1        | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| FIFOREAD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 536: FIFOREAD Register Bits

| Bit  | Name     | Reset | RW | Description     |
|------|----------|-------|----|-----------------|
| 31:0 | FIFOREAD | 0x0   | RO | FIFO read data. |

**10.3.2.5 FIFOFLUSH Register****FIFO Flush****OFFSET:** 0x00000010**INSTANCE 0 ADDRESS:** 0x50011010

FIFO Flush



|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3          | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1          | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 |
| RSVD       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| FIFO/FLUSH |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name      | Reset | RW | Description                                |
|------|-----------|-------|----|--------------------------------------------|
| 31:1 | RSVD      | 0x0   | RO | This bit field is reserved for future use. |
| 0    | FIFOFLUSH | 0x0   | WO | FIFO FLUSH.                                |

## FIFO Threshold

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7       | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | FIFOTHR |   |   |   |   |   |   |   |   |  |  |  |

| Bit  | Name    | Reset | RW | Description                                                                                                                            |
|------|---------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------|
| 31:5 | RSVD    | 0x0   | RO | This bit field is reserved for future use.                                                                                             |
| 4:0  | FIFOTHR | 0x10  | RW | FIFO Threshold value. When the FIFO count is equal to, or larger than this value (in words), a THR interrupt is generated (if enabled) |

**OFFSET:** 0x00000200



| Bit  | Name  | Reset | RW | Description                           |
|------|-------|-------|----|---------------------------------------|
| 31:5 | RSVD  | 0x0   | RO | RESERVED                              |
| 4    | DERR  | 0x0   | RW | DMA Error received                    |
| 3    | DCMP  | 0x0   | RW | DMA completed a transfer              |
| 2    | UNDFL | 0x0   | RW | This is the FIFO underflow interrupt. |
| 1    | OVF   | 0x0   | RW | This is the FIFO overflow interrupt.  |
| 0    | THR   | 0x0   | RW | This is the FIFO threshold interrupt. |

## IO Master Interrupts: Clear

**INSTANCE 0 ADDRESS: 0x50011208**

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DERR   | DCMP   | UNDFL  | OVF    | THR    |        |

| Bit  | Name  | Reset | RW | Description                           |
|------|-------|-------|----|---------------------------------------|
| 31:5 | RSVD  | 0x0   | RO | RESERVED                              |
| 4    | DERR  | 0x0   | RW | DMA Error received                    |
| 3    | DCMP  | 0x0   | RW | DMA completed a transfer              |
| 2    | UNDFL | 0x0   | RW | This is the FIFO underflow interrupt. |
| 1    | OVF   | 0x0   | RW | This is the FIFO overflow interrupt.  |

| Bit | Name | Reset | RW | Description                           |
|-----|------|-------|----|---------------------------------------|
| 0   | THR  | 0x0   | RW | This is the FIFO threshold interrupt. |

### IO Master Interrupts: Set

**INSTANCE 0 ADDRESS: 0x5001120C**

Write a 1 to a bit in this register to instantly generate an interrupt from this module. (Generally used for testing purposes).

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DERR   | DCMP   | UNDFL  | OVF    | THR    |        |

| Bit  | Name  | Reset | RW | Description                           |
|------|-------|-------|----|---------------------------------------|
| 31:5 | RSVD  | 0x0   | RO | RESERVED                              |
| 4    | DERR  | 0x0   | RW | DMA Error received                    |
| 3    | DCMP  | 0x0   | RW | DMA completed a transfer              |
| 2    | UNDFL | 0x0   | RW | This is the FIFO underflow interrupt. |
| 1    | OVF   | 0x0   | RW | This is the FIFO overflow interrupt.  |
| 0    | THR   | 0x0   | RW | This is the FIFO threshold interrupt. |

## DMA Trigger Enable

**INSTANCE 0 ADDRESS: 0x50011240**

DMA Trigger Enable

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DTHR90 | DTHR   |        |

| Bit  | Name   | Reset | RW | Description                                                                                                   |
|------|--------|-------|----|---------------------------------------------------------------------------------------------------------------|
| 31:2 | RSVD   | 0x0   | RO | RESERVED.                                                                                                     |
| 1    | DTHR90 | 0x0   | RW | Trigger DMA at FIFO 90 percent full. This signal is also used internally for AUTOHIP function                 |
| 0    | DTHR   | 0x0   | RW | Trigger DMA upon when FIFO is filled to level indicated by the FIFO THRESHOLD,at granularity of 16 bytes only |

## DMA Trigger Status

**INSTANCE 0 ADDRESS: 0x50011244**

## DMA Trigger Status

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |            |          |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------|----------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2     | 0<br>1   | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DTHR90STAT | DTHRSTAT |        |

| Bit  | Name       | Reset | RW | Description                                      |
|------|------------|-------|----|--------------------------------------------------|
| 31:2 | RSVD       | 0x0   | RO | RESERVED.                                        |
| 1    | DTHR90STAT | 0x0   | RO | Triggered DMA from FIFO reaching 90 percent full |

| Bit | Name     | Reset | RW | Description                                |
|-----|----------|-------|----|--------------------------------------------|
| 0   | DTHRSTAT | 0x0   | RO | Triggered DMA from FIFO reaching threshold |

## DMA Configuration

|      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |         |          |        |      |    |    |    |    |        |      |       |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---------|----------|--------|------|----|----|----|----|--------|------|-------|
| 31   | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10      | 09       | 08     | 07   | 06 | 05 | 04 | 03 | 02     | 01   | 00    |
| RSVD |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | DPWROFF | DAUTOHIP | DMAPRI | RSVD |    |    |    |    | DMADIR | RSVD | DMAEN |

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                 |
|-------|----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:11 | RSVD     | 0x0   | RO | RESERVED.                                                                                                                                                                                   |
| 10    | DPWROFF  | 0x0   | RW | Power Off the ADC System upon DMACPL.                                                                                                                                                       |
| 9     | DAUTOHIP | 0x0   | RW | Raise priority to high on FIFO full, and DMAPRI set to low                                                                                                                                  |
| 8     | DMAPRI   | 0x0   | RW | Sets the Priority of the DMA request<br><br>LOW = 0x0 - Low Priority (service as best effort)<br>HIGH = 0x1 - High Priority (service immediately)                                           |
| 7:3   | RSVD     | 0x0   | RO | RESERVED.                                                                                                                                                                                   |
| 2     | DMADIR   | 0x0   | RO | Direction<br><br>P2M = 0x0 - Peripheral to Memory (SRAM) transaction. The PDM module will only DMA to memory.<br>M2P = 0x1 - Memory to Peripheral transaction. Not available for PDM module |
| 1     | RSVD     | 0x0   | RO | RESERVED.                                                                                                                                                                                   |
| 0     | DMAEN    | 0x0   | RW | DMA Enable<br><br>DIS = 0x0 - Disable DMA Function<br>EN = 0x1 - Enable DMA Function                                                                                                        |



| Bit  | Name      | Reset | RW | Description                                                                                                                                                     |
|------|-----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20:0 | LTARGADDR | 0x0   | RW | DMA Target Address. This register is not updated with the current address of the DMA, but will remain static with the original address during the DMA transfer. |

## DMA Status

**INSTANCE 0 ADDRESS: 0x50011290**

DMA Status

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DMAERR | DMACPL | DMATIP |

| Bit  | Name   | Reset | RW | Description              |
|------|--------|-------|----|--------------------------|
| 31:3 | RSVD   | 0x0   | RO | RESERVED.                |
| 2    | DMAERR | 0x0   | RW | DMA Error                |
| 1    | DMACPL | 0x0   | RW | DMA Transfer Complete    |
| 0    | DMATIP | 0x0   | RW | DMA Transfer In Progress |



## 11. GPIO and Pad Configuration Module

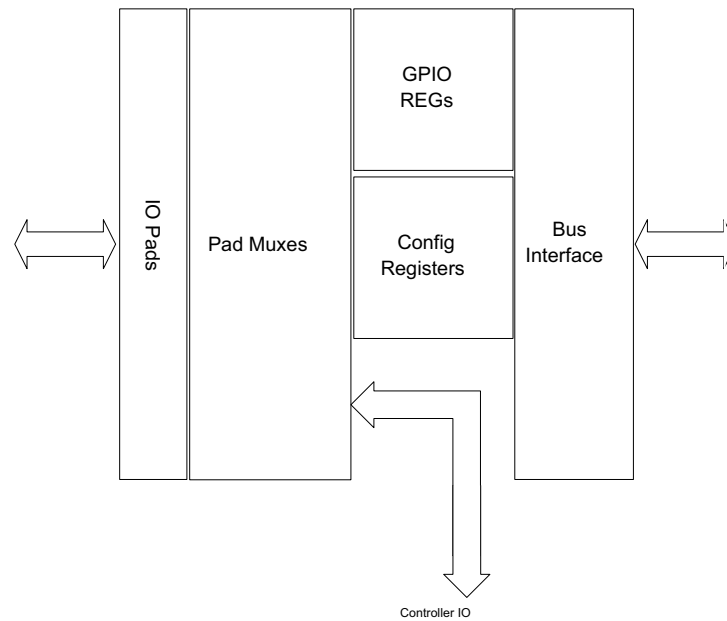


**Figure 59. Block diagram for the General Purpose I/O (GPIO) Module**

### 11.1 Functional Overview

The General Purpose I/O and Pad Configuration (GPIO) Module, shown in Figure 59, controls connections to up to 50 digital/analog pads. Each pad may be connected to a variety of module interface signals, with all pad input and output selection and control managed by the GPIO module. In addition, any pad may function as a general purpose input and/or output pad which may be configured for a variety of external functions. Each GPIO may be configured to generate an interrupt when a transition occurs on the input.

#### NOTE

Once the PADKEY is written, it should be explicitly cleared (with a non-key value) after GPIO configuration register updates are complete.

### 11.2 Pad Configuration Functions

The GPIO\_PADREG<sub>y</sub> (y = A to M) registers are used to control the function of each pad. Note that the GPIO\_PADKEY Register must be set to the value 0x73 in order to write the PADREG<sub>n</sub> registers. The GPIO\_PADREG<sub>y</sub>\_PADnFNCSEL (n = 0 to 49) field selects one of up to eight signals to be used for each pad, as shown in Table 562. Functions are grouped by module, with the color coding shown in Table 563. This table also defines the pad type for each configuration. The Special Pad Types are defined in Table 564. Note that the CSP package only supports pads 0 through 23, 26, 28-29, 39-41, 44 and 47-49, which are indicated by an 'X' in the CSP PKG column of Table 562.

The GPIO\_PADREGy\_PADnSTRNG and the GPIO\_ALTPADCFGy\_PADn\_DS1 bits control the drive strength of the pad. Nominal drive strengths of 2, 4, 8 or 12 mA can be selected with the setting of these two bits according to Table 561.

**Table 561: Drive Strength Control Bits**

| ALTPADCFGy_<br>PADn_DS1 | PADREGy_<br>PADnSTRNG | Nominal Drive<br>Strength (mA) |
|-------------------------|-----------------------|--------------------------------|
| 0                       | 0                     | 2                              |
| 0                       | 1                     | 4                              |
| 1                       | 0                     | 8                              |
| 1                       | 1                     | 12                             |

For all pads except for pad 20, GPIO\_PADREGy\_PADnPULL bit enables a weak pull-up on the pad when set to one. For pad 20, the GPIO\_PADREGy\_PAD20PULL bit enables a weak pull-down on the pad when set to one. The GPIO\_PADREGy\_PADnINPEN bit must be set to enable the pad input, and should be left clear whenever the pad is not used in order to eliminate any leakage current in the pad.

Pads 3 and 36 have selectable high side power switch transistors to provide  $\sim 1\ \Omega$  switches to VDDH. Pads 37 and 41 have selectable low side power switch transistors to provide  $\sim 1\ \Omega$  switches to VSS. A high side power switch is enabled by setting the GPIO\_PADREGA\_PAD3PWRUP or REG\_GPIO\_PADREGJ\_PAD36PWRUP bit, and a low side switch is enabled by setting the GPIO\_PADREGJ\_PAD37PWRDN or GPIO\_PADREGK\_PAD41PWRDN bit. Once enabled, the switches operate in parallel with the normal pad function.

Pads 0, 1, 5, 6, 8, 9, 25, 27, 39, 40, 42, 43, 48 and 49 include optional pull-up resistors for use in I<sup>2</sup>C mode, to eliminate the need for external resistors. If the pull-up is enabled by the PADnPULL bit, the GPIO\_PADREGy\_PADnRSEL field selects the size of the pull-up resistor as shown in Table 565.

Table 562: Apollo3 Blue SoC Pad Function Mapping

| Pad | PADnFNCSEL |           |         |        |           |         |            |              | CSP<br>PKG |
|-----|------------|-----------|---------|--------|-----------|---------|------------|--------------|------------|
|     | 0          | 1         | 2       | 3      | 4         | 5       | 6          | 7            |            |
| 0   | SLSCL      | SLSCK     | CLKOUT  | GPIO00 |           | MSPI4   |            | NCE0         | X          |
| 1   | SLSDAWIR3  | SLMOSI    | UART0TX | GPIO01 |           | MSPI5   |            | NCE1         | X          |
| 2   | UART1RX    | SLMISO    | UART0RX | GPIO02 |           | MSPI6   |            | NCE2         | X          |
| 3   | UA0RTS     | SLnCE     | NCE3    | GPIO03 |           | MSPI7   | TRIG1      | I2SWCLK      | X          |
| 4   | UA0CTS     | SLINT     | NCE4    | GPIO04 |           | UART1RX | CT17       | MSPI2        | X          |
| 5   | M0SCL      | M0SCK     | UA0RTS  | GPIO05 |           |         |            | CT8          | X          |
| 6   | M0SDAWIR3  | M0MISO    | UA0CTS  | GPIO06 |           | CT10    |            | I2SDAT       | X          |
| 7   | NCE7       | M0MOSI    | CLKOUT  | GPIO07 | TRIG0     | UART0TX |            | CT19         | X          |
| 8   | M1SCL      | M1SCK     | NCE8    | GPIO08 | SCCCLK    |         | UART1TX    |              | X          |
| 9   | M1SDAWIR3  | M1MISO    | NCE9    | GPIO09 | SCCIO     |         | UART1RX    |              | X          |
| 10  | UART1TX    | M1MOSI    | NCE10   | GPIO10 | PDMCLK    | UA1RTS  |            |              | X          |
| 11  | ADCSE2     | NCE11     | CT31    | GPIO11 | SLINT     | UA1CTS  | UART0RX    | PDMDATA      | X          |
| 12  | ADCD0NSE9  | NCE12     | CT0     | GPIO12 |           | PDMCLK  | UA0CTS     | UART1TX      | X          |
| 13  | ADCD0PSE8  | NCE13     | CT2     | GPIO13 | I2SBCLK   |         | UA0RTS     | UART1RX      | X          |
| 14  | ADCD1P     | NCE14     | UART1TX | GPIO14 | PDMCLK    |         | SWDCK      | 32KHzXT      | X          |
| 15  | ADCD1N     | NCE15     | UART1RX | GPIO15 | PDMDATA   |         | SWDIO      | SWO          | X          |
| 16  | ADCSE0     | NCE16     | TRIG0   | GPIO16 | SCCRST    | CMPIN0  | UART0TX    | UA1RTS       | X          |
| 17  | CMPRF1     | NCE17     | TRIG1   | GPIO17 | SCCCLK    |         | UART0RX    | UA1CTS       | X          |
| 18  | CMPIN1     | NCE18     | CT4     | GPIO18 | UA0RTS    |         | UART1TX    | SCCCLK       | X          |
| 19  | CMPRF0     | NCE19     | CT6     | GPIO19 | SCCIO     |         | UART1RX    | I2SBCLK      | X          |
| 20  | SWDCK      | NCE20     |         | GPIO20 | UART0TX   | UART1TX | I2SBCLK    | UA1RTS       | X          |
| 21  | SWDIO      | NCE21     |         | GPIO21 | UART0RX   | UART1RX | SCCRST     | UA1CTS       | X          |
| 22  | UART0TX    | NCE22     | CT12    | GPIO22 | PDMCLK    |         | MSPI0      | SWO          | X          |
| 23  | UART0RX    | NCE23     | CT14    | GPIO23 | I2SWCLK   | CMPOUT  | MSPI3      |              | X          |
| 24  | UART1TX    | NCE24     | MSPI8   | GPIO24 | UA0CTS    | CT21    | 32KHzXT    | SWO          | X          |
| 25  | UART1RX    | NCE25     | CT1     | GPIO25 | M2SDAWIR3 | M2MISO  |            |              | X          |
| 26  |            | NCE26     | CT3     | GPIO26 | SCCRST    | MSPI1   | UART0TX    | UA1CTS       | X          |
| 27  | UART0RX    | NCE27     | CT5     | GPIO27 | M2SCL     | M2SCK   |            |              | X          |
| 28  | I2SWCLK    | NCE28     | CT7     | GPIO28 |           | M2MOSI  | UART0TX    |              | X          |
| 29  | ADCSE1     | NCE29     | CT9     | GPIO29 | UA0CTS    | UA1CTS  | UART0RX    | PDMDATA      | X          |
| 30  |            | NCE30     | CT11    | GPIO30 | UART0TX   | UA1RTS  | BLEIF_SCK  | I2SDAT       |            |
| 31  | ADCSE3     | NCE31     | CT13    | GPIO31 | UART0RX   | SCCCLK  | BLEIF_MISO | UA1RTS       |            |
| 32  | ADCSE4     | NCE32     | CT15    | GPIO32 | SCCIO     |         | BLEIF_MOSI | UA1CTS       |            |
| 33  | ADCSE5     | NCE33     | 32KHzXT | GPIO33 | BLEIF_CSN | UA0CTS  | CT23       | SWO          |            |
| 34  | ADCSE6     | NCE34     | UA1RTS  | GPIO34 | CMPRF2    | UA0RTS  | UART0RX    | PDMDATA      |            |
| 35  | ADCSE7     | NCE35     | UART1TX | GPIO35 | I2SDAT    | CT27    | UA0RTS     | BLEIF_STATUS |            |
| 36  | TRIG1      | NCE36     | UART1RX | GPIO36 | 32KHzXT   | UA1CTS  | UA0CTS     | PDMDATA      |            |
| 37  | TRIG2      | NCE37     | UA0RTS  | GPIO37 | SCCIO     | UART1TX | PDMCLK     | CT29         |            |
| 38  | TRIG3      | NCE38     | UA0CTS  | GPIO38 |           | M3MOSI  | UART1RX    |              |            |
| 39  | UART0TX    | UART1TX   | CT25    | GPIO39 | M4SCL     | M4SCK   |            |              | X          |
| 40  | UART0RX    | UART1RX   | TRIG0   | GPIO40 | M4SDAWIR3 | M4MISO  |            |              | X          |
| 41  | NCE41      | BLEIF_IRQ | SWO     | GPIO41 | I2SWCLK   | UA1RTS  | UART0TX    | UA0RTS       | X          |
| 42  | UART1TX    | NCE42     | CT16    | GPIO42 | M3SCL     | M3SCK   |            |              |            |
| 43  | UART1RX    | NCE43     | CT18    | GPIO43 | M3SDAWIR3 | M3MISO  |            |              |            |
| 44  | UA1RTS     | NCE44     | CT20    | GPIO44 |           | M4MOSI  | UART0TX    |              | X          |
| 45  | UA1CTS     | NCE45     | CT22    | GPIO45 | I2SDAT    | PDMDATA | UART0RX    | SWO          |            |
| 46  | I2SBCLK    | NCE46     | CT24    | GPIO46 | SCCRST    | PDMCLK  | UART1TX    | SWO          |            |
| 47  | 32KHzXT    | NCE47     | CT26    | GPIO47 |           | M5MOSI  | UART1RX    |              | X          |
| 48  | UART0TX    | NCE48     | CT28    | GPIO48 | M5SCL     | M5SCK   |            |              | X          |
| 49  | UART0RX    | NCE49     | CT30    | GPIO49 | M5SDAWIR3 | M5MISO  |            |              | X          |

**Table 563: Pad Function Color and Symbol Code**

| Color/<br>Symbol | Function                              | Pad Type                                                                                                  |
|------------------|---------------------------------------|-----------------------------------------------------------------------------------------------------------|
|                  | ADC Signals                           | Analog or Input, as indicated by [A] or [I] respectively                                                  |
|                  | I <sup>2</sup> C/SPI Slave Signals    | Input, Special or Push-pull output, as indicated by [I], [S] or [O] respectively,                         |
|                  | I <sup>2</sup> C/SPI Master 0 Signals | Input, Special or Push-pull output, as indicated by [I], [S] or [O] respectively                          |
|                  | I <sup>2</sup> C/SPI Master 1 Signals | Input, Special or Push-pull output, as indicated by [I], [S] or [O] respectively                          |
|                  | I <sup>2</sup> C/SPI Master 2 Signals | Input, Special or Push-pull output, as indicated by [I], [S] or [O] respectively                          |
|                  | I <sup>2</sup> C/SPI Master 3 Signals | Input, Special or Push-pull output, as indicated by [I], [S] or [O] respectively                          |
|                  | I <sup>2</sup> C/SPI Master 4 Signals | Input, Special or Push-pull output, as indicated by [I], [S] or [O] respectively                          |
|                  | I <sup>2</sup> C/SPI Master 5 Signals | Input, Special or Push-pull output, as indicated by [I], [S] or [O] respectively                          |
|                  | MSPI Signals                          | Input, Special or Push-pull output, as indicated by [I], [S] or [O] respectively                          |
|                  | Global IOM/MSPI                       | Input, Special or Push-pull output, as indicated by [I], [S] or [O] respectively                          |
|                  | SCARD                                 | Input, Special or Push-pull output, as indicated by [I], [S] or [O] respectively                          |
|                  | GPIO Signals                          | Controlled by GPIO Configuration                                                                          |
|                  | Counter/Timer Signals                 | Controlled by CTIMER Configuration                                                                        |
|                  | UART0 Signals                         | Input or Push-pull output, as indicated by [I] or [O] respectively                                        |
|                  | UART1 Signals                         | Input or Push-pull output, as indicated by [I] or [O] respectively                                        |
|                  | Audio Signals                         | Input or Push-pull output, as indicated by [I] or [O] respectively                                        |
|                  | Clock Output Signals                  | Push-pull Output                                                                                          |
|                  | Debug Signals                         | Input Special or Push-pull output, as indicated by [I], [S] or [O] respectively                           |
|                  | High-side power switch                | Pads 3 and 36 have selectable high side power switch transistors to provide ~1 $\Omega$ switches to VDDH. |
|                  | Low-side power switch                 | Pads 37 and 41 have selectable low side power switch transistors to provide ~1 $\Omega$ switches to VSS.  |

**Table 564: Special Pad Types**

| Pad | PADnFNCSEL | Name  | Pad Type <sup>1</sup>     |
|-----|------------|-------|---------------------------|
| 1   | 0          | SLSDA | Bidirectional Open Drain* |
| 5   | 0          | M0SCL | Open Drain*               |
| 6   | 0          | M0SDA | Bidirectional Open Drain* |
| 8   | 0          | M1SCL | Open Drain*               |
| 9   | 0          | M1SDA | Bidirectional Open Drain* |
| 15  | 6          | SWDIO | Bidirectional Tri-state   |
| 21  | 0          | SWDIO | Bidirectional Tri-state   |
| 25  | 4          | M2SDA | Bidirectional Open Drain* |
| 27  | 4          | M2SCL | Open Drain*               |
| 40  | 4          | M4SDA | Bidirectional Open Drain* |
| 42  | 4          | M3SCL | Open Drain*               |
| 43  | 4          | M3SDA | Bidirectional Open Drain* |
| 48  | 4          | M5SCL | Open Drain*               |
| 49  | 4          | M5SDA | Bidirectional Open Drain* |

1. Pad types with \* have option for I<sup>2</sup>C pullup resistor.

**Table 565: I<sup>2</sup>C Pullup Resistor Selection**

| RSEL[1:0] | Pullup Resistor |
|-----------|-----------------|
| 00        | 1.5 kΩ          |
| 01        | 6 kΩ            |
| 10        | 12 kΩ           |
| 11        | 24 kΩ           |

Table 566: NCE Encoding Table

|       | GPIOxOUTCFG |        |        |        |
|-------|-------------|--------|--------|--------|
|       | 0           | 1      | 2      | 3      |
| NCE0  | IOM3.2      | IOM4.2 | IOM5.2 | IOM1.3 |
| NCE1  | IOM0.2      | IOM1.2 | IOM2.2 | MSPI.0 |
| NCE2  | IOM3.3      | IOM4.3 | IOM5.3 | IOM2.1 |
| NCE3  | IOM3.0      | IOM4.0 | IOM5.0 | IOM2.0 |
| NCE4  | IOM3.1      | IOM4.1 | IOM5.1 | IOM1.1 |
| -     | -           | -      | -      | -      |
| -     | -           | -      | -      | -      |
| NCE7  | IOM3.1      | IOM4.1 | IOM5.1 | MSPI.0 |
| NCE8  | IOM3.0      | IOM4.0 | IOM5.0 | IOM0.0 |
| NCE9  | IOM3.3      | IOM4.3 | IOM5.3 | IOM2.3 |
| NCE10 | IOM3.2      | IOM4.2 | IOM5.2 | MSPI.0 |
| NCE11 | IOM0.0      | IOM1.0 | IOM2.0 | IOM3.0 |
| NCE12 | IOM3.0      | IOM4.0 | IOM5.0 | MSPI.1 |
| NCE13 | IOM3.1      | IOM4.1 | IOM5.1 | IOM0.1 |
| NCE14 | IOM0.2      | IOM1.2 | IOM2.2 | IOM4.2 |
| NCE15 | IOM0.3      | IOM1.3 | IOM2.3 | MSPI.0 |
| NCE16 | IOM0.0      | IOM1.0 | IOM2.0 | IOM5.0 |
| NCE17 | IOM0.1      | IOM1.1 | IOM2.1 | IOM4.1 |
| NCE18 | IOM0.2      | IOM1.2 | IOM2.2 | IOM3.2 |
| NCE19 | IOM0.3      | IOM1.3 | IOM3.3 | MSPI.0 |
| NCE20 | IOM3.1      | IOM4.1 | IOM5.1 | IOM2.1 |
| NCE21 | IOM3.2      | IOM4.2 | IOM5.2 | IOM2.2 |
| NCE22 | IOM3.3      | IOM4.3 | IOM5.3 | IOM0.3 |
| NCE23 | IOM0.0      | IOM1.0 | IOM2.0 | IOM4.0 |
| NCE24 | IOM0.1      | IOM1.1 | IOM2.1 | IOM5.1 |
| NCE25 | IOM3.2      | IOM4.2 | IOM5.2 | IOM0.2 |
| NCE26 | IOM3.3      | IOM4.3 | IOM5.3 | IOM1.3 |
| NCE27 | IOM3.0      | IOM4.0 | IOM5.0 | IOM1.0 |
| NCE28 | IOM3.1      | IOM4.1 | IOM5.1 | MSPI.0 |
| NCE29 | IOM3.2      | IOM4.2 | IOM5.2 | IOM1.2 |
| NCE30 | IOM3.3      | IOM4.3 | IOM5.3 | IOM0.3 |
| NCE31 | IOM0.0      | IOM1.0 | IOM2.0 | IOM4.0 |
| NCE32 | IOM0.1      | IOM1.1 | IOM2.1 | MSPI.1 |
| NCE33 | IOM0.2      | IOM1.2 | IOM2.2 | IOM5.2 |
| NCE34 | IOM0.3      | IOM1.3 | IOM2.3 | IOM3.3 |
| NCE35 | IOM0.0      | IOM1.0 | IOM2.0 | IOM3.0 |
| NCE36 | IOM3.1      | IOM4.1 | IOM5.1 | MSPI.1 |
| NCE37 | IOM3.2      | IOM4.2 | IOM5.2 | IOM0.2 |
| NCE38 | IOM0.3      | IOM1.3 | IOM2.3 | IOM5.3 |
| -     | -           | -      | -      | -      |
| -     | -           | -      | -      | -      |
| NCE41 | IOM0.1      | IOM1.1 | IOM2.1 | MSPI.1 |
| NCE42 | IOM0.0      | IOM1.0 | IOM2.0 | IOM5.0 |
| NCE43 | IOM0.1      | IOM1.1 | IOM2.1 | MSPI.1 |
| NCE44 | IOM0.2      | IOM1.2 | IOM2.2 | IOM5.2 |
| NCE45 | IOM3.3      | IOM4.3 | IOM5.3 | IOM1.3 |
| NCE46 | IOM3.0      | IOM4.0 | IOM5.0 | MSPI.1 |
| NCE47 | IOM0.1      | IOM1.1 | IOM2.1 | IOM3.1 |
| NCE48 | IOM0.2      | IOM1.2 | IOM2.2 | IOM3.2 |
| NCE49 | IOM0.3      | IOM1.3 | IOM2.3 | IOM4.3 |

### 11.3 General Purpose I/O (GPIO) Functions

For each pad, if the PADnFNCSEL field is set to 0x3 the pad is connected to the corresponding GPIO signal. This section describes the configuration functions specific to GPIO pads.

#### 11.3.1 Configuring the GPIO Functions

Each GPIO must be configured in the GPIO\_CFGy (y = A to GJ) Registers as an input and/or output before using. Note that the PADKEY Register must be set to the value 0x73 in order to write the GPIO\_CFGy Registers. Each output may be push-pull, open drain, disabled, or tristated as selected by the GPIO\_CFGy\_GPIOOnOUTCFG field. If the output is configured as push-pull, the pad will be driven with the corresponding bit in the GPIO\_WTy (y = A or B) Register. If the output is configured as open drain, the pad will be pulled low if the corresponding bit in the WTy Register is a 0, and will be floating if the corresponding bit in the WTy Register is a 1. If the output is configured as tri-state, the pad will be driven with the corresponding bit in the WTy Register if the corresponding bit in the GPIO\_ENy Register is a 1. If the bit in ENy is a 0, the output will be floating.

If the PADxFNCSEL is set to a “NCE” signal group, the additional NCE encoding is applied as shown in Table 566 based on GPIOxOUTCFG and the pad is automatically configured for push-pull output. If the PADxFNCSEL is set to a “MSPI” signal group, the additional MSPI encoding is applied as shown in Section 11.5.2.

#### 11.3.2 Reading from a GPIO Pad

All GPIO inputs are readable at all times unless the interrupt configuration (determined by GPIO\_CFGy\_GPIOOnINCFG and GPIO\_CFGy\_GPIOOnINTD) is set to “disabled”, even if the pad is not configured as a GPIO. The current values of pads 0 to 31 are read in the GPIO\_RDA Register, and the current values of pads 32 to 49 are read in the GPIO\_RDB Register. If the GPIO\_CFGy\_GPIOOnINCFG bit is set for a GPIO and the interrupt configuration is set to “disabled”, it will always read as zero.

#### 11.3.3 Writing to a GPIO Pad

The GPIO pad outputs are controlled by the GPIO\_WTA/B Registers and the GPIO\_ENA/B Registers. Each of these registers may be directly written and read. Because each GPIO is often an independent function, the capability also exists to set or clear one or more bits without having to perform a read-modify-write operation. If the GPIO\_WTSA/B Register is written, the corresponding bit in WTA/B will be set if the write data is 1, otherwise the WTA/B bit will not be changed. If the GPIO\_WTCA/B Register is written, the corresponding bit in WTA/B will be cleared if the write data is 1, otherwise the WTA/B bit will not be changed.

If a GPIO pad is configured for tri-state output mode, the ENA/B Register controls the enabling of each bit. These registers may be directly written, and individual bits may be set or cleared by writing the ENSA/B or ENCA/B Registers with a 1 in the desired bit position.

#### 11.3.4 GPIO Interrupts

Each GPIO pad can be configured to generate an interrupt on a high-to-low transition or a low-to-high or either transition, as selected by setting the GPIO\_CFGy\_GPIOOnINTD bit and clearing the GPIO\_CFGy\_GPIOOnINCFG bit. This interrupt will be generated even if the pad is not configured as a GPIO in the Pad Configuration logic.

Table 567 below describes the interrupt trigger options.

**Table 567: Interrupt Trigger Options**

| INCFG | INTD | Interrupt                                    |
|-------|------|----------------------------------------------|
| 0     | 0    | Low -> high transition                       |
| 0     | 1    | High -> low transition                       |
| 1     | 0    | Disabled                                     |
| 1     | 1    | Either low -> high or high -> low transition |

Each interrupt is enabled, disabled, cleared or set with a standard set of interrupt registers GPIO\_INT0EN, GPIO\_INT0STAT, GPIO\_INT0CLR and GPIO\_INT0SET for GPIO pads 0 to 31, and Registers GPIO\_INT1EN, GPIO\_INT1STAT, GPIO\_INT1CLR and GPIO\_INT1SET for GPIO pads 32 to 49.

Note that these interrupts get mapped to different IRQs and hence respective interrupts need to be enabled in NVIC and serviced accordingly.

## 11.4 Pad Connection Summary

Figure 60 shows the detailed implementation of each pad. Each element will be described in detail.

### 11.4.1 Output Selection

There is a multiplexer which selects the module signal to be driven to the output based on GPIO\_PADREGy\_PADnFNCSEL (y = A to M (n = 0 to 49)) field. This implements the multiplexing shown in Table 562 for output pads. For all pads, a PADnFNCSEL value of 0x3 selects the value in the corresponding GPIO\_WTy register bit.

Certain functional groups, Timer (CT), NCE and MSPI in particular, have additional premuxing configuration as noted.

### 11.4.2 Output Control

The pad driver for each pad has a data input and an output enable input. Each of these controls is selected from among several alternatives based on the OUTDATSEL and OUTENSEL signals which are controlled by the selection of the output type as shown in Table 564 and Table 565.

OUTDATSEL normally selects the data from the output multiplexer, but if the pad is configured as Open Drain the data input is selected to be low.



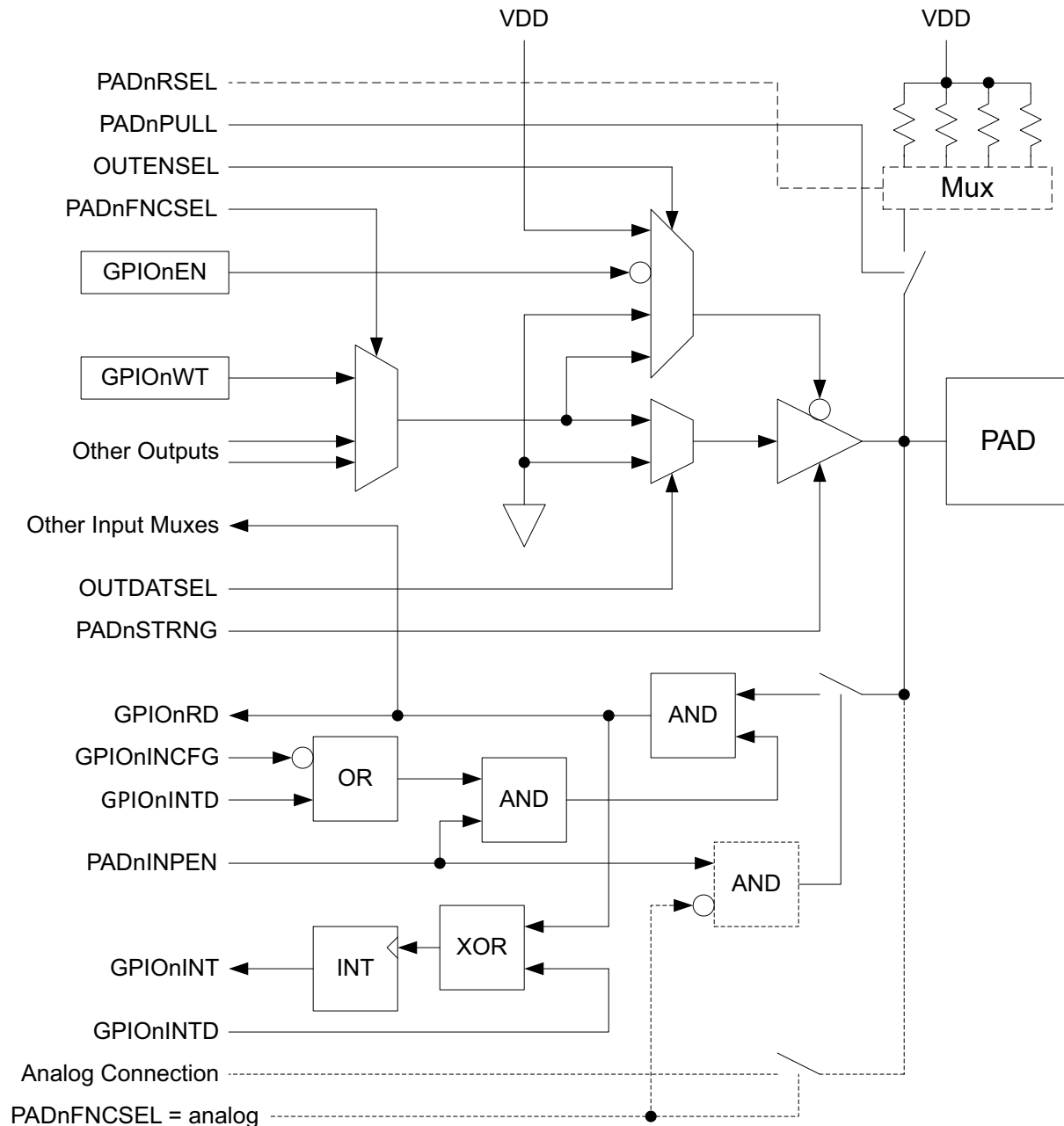


**Figure 60. Pad Connection Details**

OUTENSEL normally selects a ground signal to keep the pad driver enabled. If the pad is configured to be Open Drain, the pad enable is driven with the data from the output multiplexer. If the pad is configured as a GPIO (PADnFNCSEL = 0x3) and the GPIO drive type is tri-state (GPIOOUTCFG = 0x3), the pad enable is driven with the inverse of the corresponding GPIO bit in the GPIO\_ENx register. If the pad is not configured as an output, the pad enable is forced high to turn the driver off.

The drive strength of each pad driver is configured as described in Section 11.2 on page 391.

### 11.4.3 Input Control

The input circuitry of the pad may be disabled by clearing the PADnINPEN bit. This configuration should always be set if the pad input is not being used, as it prevents unnecessary current consumption if the pad voltage happens to float to a level between VDD and Ground. If PADnINPEN is 0, the pad will always read as a 0.

If PADnINPEN is set, the pad input then goes to two places. It is driven to the selected module signal as selected in Table 562. In addition, the pad input can always be read from the GPIO\_RDx register unless the pad is configured as a GPIO (PADnFNCSEL = 0x3) and GPIOINCFG is high, which will force the GPIO\_RD input to be a zero. The ability to always read the pad value is very useful in some diagnostic cases.

The pad input is always sent to the GPIO interrupt logic, and a pad transition in the direction selected by GPIOINTD will set the GPIO\_INT flip-flop. Note that this interrupt will be set even if the pad is not configured as a GPIO, which may be useful in detecting functions. As an example, this could be used to generate an interrupt when the I<sup>2</sup>C/SPI Slave nCE signal is driven low by the Interface Host.

### 11.4.4 Pull-up Control

If PADnPULL is high, a pull-up resistor is connected between the pad and VDDH, except for pad 20, where PADnPULL connects the resistor to VSS rather than VDDH.

The fourteen pads which can be I<sup>2</sup>C/SPI Master output drivers (0, 1, 5, 6, 8, 9, 25, 27, 39, 40, 42, 43, 48 and 49) contain the additional circuitry required for this functionality. In this case one of four different pull-up resistors are selected among options for the PADnRSEL field.

### 11.4.5 Analog Pad Configuration

Pads which may have analog connections (11-19, 29 and 31-35) include the circuitry shown with the dotted lines of Figure 60. If the pad is configured in analog mode (reference the analog input function selections in Table 1: Pin List and Function Table), the pad is connected directly to the particular analog module signal. In addition, OUTENSEL is forced high to disable the pad output, and the input of the pad is disabled independent of the value of PADnINPEN.

## 11.5 Module-specific Pad Configuration

The following sections describe in detail how to configure the pads for each module function.

### 11.5.1 Implementing IO Master Connections

The six IO Master modules must be correctly connected to the appropriate pads in order to operate.

#### 11.5.1.1 IO Master 0 I<sup>2</sup>C Connection

I<sup>2</sup>C mode of IO Master 0 uses pad 5 as SCL and pad 6 as SDA. This mode is configured by setting the PADnFNCSEL fields as shown in Table 568. The PAD5INPEN and PAD6INPEN bits must be set. If the internal I<sup>2</sup>C pullup resistors are to be used, PAD5PULL and PAD6PULL should be set, and the PAD5RSEL

and PAD6RSEL fields should be set to select the desired pullup resistor size as shown in Table 565. If external pullup resistors are used, PAD5PULL and PAD6PULL should be cleared.

**Table 568: IO Master 0 I<sup>2</sup>C Configuration**

| Field      | Value |
|------------|-------|
| PAD5FNCSEL | 0     |
| PAD6FNCSEL | 0     |

#### 11.5.1.2 IO Master 1 I<sup>2</sup>C Connection

I<sup>2</sup>C mode of IO Master 1 uses pad 8 as SCL and pad 9 as SDA. This mode is configured by setting the PADnFNCSEL fields as shown in Table 569. The PAD8INPEN and PAD9INPEN bits must be set. If the internal I<sup>2</sup>C pullup resistors are to be used, PAD8PULL and PAD9PULL should be set, and the PAD8RSEL and PAD9RSEL fields should be set to select the desired pullup resistor size as shown in Table 565. If external pullup resistors are used, PAD8PULL and PAD9PULL should be cleared.

**Table 569: IO Master 1 I<sup>2</sup>C Configuration**

| Field      | Value |
|------------|-------|
| PAD8FNCSEL | 0     |
| PAD9FNCSEL | 0     |

#### 11.5.1.3 IO Master 2 I<sup>2</sup>C Connection

I<sup>2</sup>C mode of IO Master 2 uses pad 27 as SCL and pad 25 as SDA. This mode is configured by setting the PADnFNCSEL fields as shown in Table 570. The PAD27INPEN and PAD25INPEN bits must be set. If the internal I<sup>2</sup>C pullup resistors are to be used, PAD27PULL and PAD25PULL should be set, and the PAD27RSEL and PAD25RSEL fields should be set to select the desired pullup resistor size as shown in Table 565. If external pullup resistors are used, PAD27PULL and PAD25PULL should be cleared.

**Table 570: IO Master 2 I<sup>2</sup>C Configuration**

| Field       | Value |
|-------------|-------|
| PAD25FNCSEL | 4     |
| PAD27FNCSEL | 4     |

#### 11.5.1.4 IO Master 3 I<sup>2</sup>C Connection

I<sup>2</sup>C mode of IO Master 3 uses pad 42 as SCL and pad 43 as SDA. This mode is configured by setting the PADnFNCSEL fields as shown in Table 571. The PAD42INPEN and PAD43INPEN bits must be set. If the internal I<sup>2</sup>C pullup resistors are to be used, PAD42PULL and PAD43PULL should be set, and the

PAD42RSEL and PAD43RSEL fields should be set to select the desired pullup resistor size as shown in Table 565. If external pullup resistors are used, PAD42PULL and PAD43PULL should be cleared.

**Table 571: IO Master 3 I<sup>2</sup>C Configuration**

| Field       | Value |
|-------------|-------|
| PAD42FNCSEL | 4     |
| PAD43FNCSEL | 4     |

#### 11.5.1.5 IO Master 4 I<sup>2</sup>C Connection

I<sup>2</sup>C mode of IO Master 4 uses pad 39 as SCL and pad 40 as SDA. This mode is configured by setting the PADnFNCSEL fields as shown in Table 572. The PAD39INPEN and PAD40INPEN bits must be set. If the internal I<sup>2</sup>C pullup resistors are to be used, PAD39PULL and PAD40PULL should be set, and the PAD39RSEL and PAD40RSEL fields should be set to select the desired pullup resistor size as shown in Table 565. If external pullup resistors are used, PAD39PULL and PAD40PULL should be cleared.

**Table 572: IO Master 4 I<sup>2</sup>C Configuration**

| Field       | Value |
|-------------|-------|
| PAD39FNCSEL | 4     |
| PAD40FNCSEL | 4     |

#### 11.5.1.6 IO Master 5 I<sup>2</sup>C Connection

I<sup>2</sup>C mode of IO Master 5 uses pad 48 as SCL and pad 49 as SDA. This mode is configured by setting the PADnFNCSEL fields as shown in Table 573. The PAD48INPEN and PAD49INPEN bits must be set. If the internal I<sup>2</sup>C pullup resistors are to be used, PAD48PULL and PAD49PULL should be set, and the PAD48RSEL and PAD49RSEL fields should be set to select the desired pullup resistor size as shown in Table 565. If external pullup resistors are used, PAD48PULL and PAD49PULL should be cleared.

**Table 573: IO Master 5 I<sup>2</sup>C Configuration**

| Field       | Value |
|-------------|-------|
| PAD48FNCSEL | 4     |
| PAD49FNCSEL | 4     |

#### 11.5.1.7 IO Master 0 4-wire SPI Connection

Four-wire SPI mode of IO Master 0 uses pad 5 as SCK, pad 6 as MISO and pad 7 as MOSI. This mode is configured by setting the PADnFNCSEL fields as shown in Table 574. The PAD5INPEN and PAD6INPEN bits must be set. PAD5PULL, PAD6PULL and PAD7PULL should be cleared. A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.

**Table 574: IO Master 0 4-wire SPI Configuration**

| Field      | Value |
|------------|-------|
| PAD5FNCSEL | 1     |
| PAD6FNCSEL | 1     |
| PAD7FNCSEL | 1     |

**11.5.1.8 IO Master 1 4-wire SPI Connection**

Four-wire SPI mode of IO Master 1 uses pad 8 as SCK, pad 9 as MISO and pad 10 as MOSI. This mode is configured by setting the PADnFNCSEL fields as shown in Table 575. The PAD8INPEN and PAD9INPEN bits must be set. PAD8PULL, PAD9PULL and PAD10PULL should be cleared.

**Table 575: IO Master 1 4-wire SPI Configuration**

| Field       | Value |
|-------------|-------|
| PAD8FNCSEL  | 1     |
| PAD9FNCSEL  | 1     |
| PAD10FNCSEL | 1     |

A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.

**11.5.1.9 IO Master 2 4-wire SPI Connection**

Four-wire SPI mode of IO Master 2 uses pad 27 as SCK, pad 28 as MOSI and pad 25 as MISO. This mode is configured by setting the PADnFNCSEL fields as shown in Table 576. The PAD27INPEN and PAD28INPEN bits must be set. PAD27PULL, PAD28PULL and PAD25PULL should be cleared.

**Table 576: IO Master 2 4-wire SPI Configuration**

| Field       | Value |
|-------------|-------|
| PAD27FNCSEL | 5     |
| PAD28FNCSEL | 5     |
| PAD25FNCSEL | 5     |

A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.

#### 11.5.1.10 IO Master 3 4-wire SPI Connection

Four-wire SPI mode of IO Master 3 uses pad 42 as SCK, pad 43 as MISO and pad 38 as MOSI. This mode is configured by setting the PADnFNCSEL fields as shown in Table 577. The PAD42INPEN and PAD38INPEN bits must be set. PAD38PULL, PAD42PULL and PAD43PULL should be cleared.

**Table 577: IO Master 3 4-wire SPI Configuration**

| Field       | Value |
|-------------|-------|
| PAD38FNCSEL | 5     |
| PAD42FNCSEL | 5     |
| PAD43FNCSEL | 5     |

A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.

#### 11.5.1.11 IO Master 4 4-wire SPI Connection

Four-wire SPI mode of IO Master 4 uses pad 39 as SCK, pad 40 as MISO and pad 44 as MOSI. This mode is configured by setting the PADnFNCSEL fields as shown in Table 578. The PAD39INPEN and PAD44INPEN bits must be set. PAD39PULL, PAD40PULL and PAD44PULL should be cleared.

**Table 578: IO Master 4 4-wire SPI Configuration**

| Field       | Value |
|-------------|-------|
| PAD39FNCSEL | 5     |
| PAD40FNCSEL | 5     |
| PAD44FNCSEL | 5     |

A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.

#### 11.5.1.12 IO Master 5 4-wire SPI Connection

Four-wire SPI mode of IO Master 5 uses pad 48 as SCK, pad 49 as MISO and pad 47 as MOSI. This mode is configured by setting the PADnFNCSEL fields as shown in Table 579. The PAD48INPEN and PAD47INPEN bits must be set. PAD48PULL, PAD49PULL and PAD47PULL should be cleared.

**Table 579: IO Master 5 4-wire SPI Configuration**

| Field       | Value |
|-------------|-------|
| PAD48FNCSEL | 5     |
| PAD49FNCSEL | 5     |
| PAD47FNCSEL | 5     |

A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.

### 11.5.1.13 IO Master 0 3-wire SPI Connection

Three-wire SPI mode of IO Master 0 uses pad 5 as SCK and pad 6 as MOSI/MISO. This mode is configured by setting the PADnFNCSEL fields as shown in Table 580. The PAD5INPEN and PAD6INPEN bits must be set. PAD5PULL and PAD6PULL should be cleared. Pad 7 may be used for other functions.

**Table 580: IO Master 0 3-wire SPI Configuration**

| Field      | Value |
|------------|-------|
| PAD5FNCSEL | 1     |
| PAD6FNCSEL | 0     |

A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.

### 11.5.1.14 IO Master 1 3-wire SPI Connection

Three-wire SPI mode of IO Master 1 uses pad 8 as SCK and pad 9 as MOSI/MISO. This mode is configured by setting the PADnFNCSEL fields as shown in Table 581. The PAD8INPEN and PAD9INPEN bits must be set. PAD8PULL and PAD9PULL should be cleared. Pad 10 may be used for other functions.

**Table 581: IO Master 1 3-wire SPI Configuration**

| Field      | Value |
|------------|-------|
| PAD8FNCSEL | 1     |
| PAD9FNCSEL | 0     |

A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.

### 11.5.1.15 IO Master 2 3-wire SPI Connection

Three-wire SPI mode of IO Master 2 uses pad 27 as SCK and pad 25 as MOSI/MISO. This mode is configured by setting the PADnFNCSEL fields as shown in Table 582. The PAD27INPEN and PAD25INPEN bits must be set. PAD27PULL and PAD25PULL should be cleared. Pad 28 may be used for other functions.

**Table 582: IO Master 2 3-wire SPI Configuration**

| Field       | Value |
|-------------|-------|
| PAD27FNCSEL | 5     |
| PAD25FNCSEL | 4     |

A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.

### 11.5.1.16 IO Master 3 3-wire SPI Connection

Three-wire SPI mode of IO Master 3 uses pad 42 as SCK and pad 43 as MOSI/MISO. This mode is configured by setting the PADnFNCSEL fields as shown in Table 583. The PAD42INPEN and PAD43INPEN bits must be set. PAD42PULL and PAD43PULL should be cleared. Pad 38 may be used for other functions.

**Table 583: IO Master 3 3-wire SPI Configuration**

| Field       | Value |
|-------------|-------|
| PAD42FNCSEL | 5     |
| PAD43FNCSEL | 4     |

A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.

### 11.5.1.17 IO Master 4 3-wire SPI Connection

Three-wire SPI mode of IO Master 4 uses pad 39 as SCK and pad 40 as MOSI/MISO. This mode is configured by setting the PADnFNCSEL fields as shown in Table 584. The PAD39INPEN and PAD40INPEN bits must be set. PAD39PULL and PAD40PULL should be cleared. Pad 44 may be used for other functions.

**Table 584: IO Master 0 3-wire SPI Configuration**

| Field       | Value |
|-------------|-------|
| PAD39FNCSEL | 5     |
| PAD40FNCSEL | 4     |

A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.

### 11.5.1.18 IO Master 5 3-wire SPI Connection

Three-wire SPI mode of IO Master 5 uses pad 48 as SCK and pad 49 as MOSI/MISO. This mode is configured by setting the PADnFNCSEL fields as shown in Table 585. The PAD48INPEN and PAD49INPEN bits must be set. PAD48PULL and PAD49PULL should be cleared. Pad 47 may be used for other functions.

**Table 585: IO Master 5 3-wire SPI Configuration**

| Field       | Value |
|-------------|-------|
| PAD48FNCSEL | 5     |
| PAD49FNCSEL | 4     |

A variety of pads may be used for up to four nCE signals to select up to four separate slaves. The nCE signals are premuxed into a signal group called NCE. The muxing configuration is shown in Table 566. The PADnINPEN and PADnPULL bits of any pad used for nCE should be cleared.



### 11.5.1.19 SPI Flow Control Connections

SPI Flow Control in interrupt mode requires an external pin to be specified as the interrupt pin. This is accomplished by configuring the desired pin in the IOMxIRQ register (x = 0 to 5).

### 11.5.2 MSPI Connection

The MSPI interface has various device configurations. These are mainly handled within the MSPI controller configuration. However, there are some additional pad muxing options to provide more flexibility for system integration. These mux configurations are listed below.

**Table 586: MSPI\_PADCFG Input Mux Configuration**

| Signal | IN0[1:0]  |           |           |           | IN1       |           | IN2       |           | IN3       |           |
|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|        | 3         | 2         | 1         | 0         | 1         | 0         | 1         | 0         | 1         | 0         |
| MSPI0  | MSPI D[5] | MSPI D[1] | MSPI D[4] | MSPI D[0] | -         | -         | -         | -         | -         | -         |
| MSPI1  | -         | -         | -         | -         | MSPI D[5] | MSPI D[1] | -         | -         | -         | -         |
| MSPI2  | -         | -         | -         | -         | -         | -         | MSPI D[6] | MSPI D[2] | -         | -         |
| MSPI3  | -         | -         | -         | -         | -         | -         | -         | -         | MSPI D[7] | MSPI D[3] |

**Table 587: MSPI\_PADCFG Output Mux Configuration**

| Signal | OUT7      |           | OUT6      |           | OUT5      |           | OUT4      |           | OUT3     |           |
|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|
|        | 1         | 0         | 1         | 0         | 1         | 0         | 1         | 0         | 1        | 0         |
| MSPI0  | MSPI D[0] |           |           |           |           |           |           |           |          |           |
| MSPI1  | MSPI D[1] |           |           |           |           |           |           |           |          |           |
| MSPI2  | MSPI D[2] |           |           |           |           |           |           |           |          |           |
| MSPI3  | -         | -         | -         | -         | -         | -         | -         | -         | MSPI CLK | MSPI D[3] |
| MSPI4  | -         | -         | -         | -         | -         | -         | MSPI D[0] | MSPI D[4] | -        | -         |
| MSPI5  | -         | -         | -         | -         | MSPI D[1] | MSPI D[5] | -         | -         | -        | -         |
| MSPI6  | -         | -         | MSPI D[2] | MSPI D[6] | -         | -         | -         | -         | -        | -         |
| MSPI7  | MSPI D[3] | MSPI D[7] | -         | -         | -         | -         | -         | -         | -        | -         |
| MSPI8  | MSPI CLK  |           |           |           |           |           |           |           |          |           |

### 11.5.3 Implementing IO Slave Connections

The IO Master module must be correctly connected to the appropriate pads in order to operate.

### 11.5.3.1 IO Slave I<sup>2</sup>C Connection

I<sup>2</sup>C mode of the IO Slave uses pad 0 as SCL and pad 1 as SDA. This mode is configured by setting the PADnFNCSEL fields as shown in Table 588. The PAD0INPEN and PAD1INPEN bits must be set. PAD0PULL and PAD1PULL should be cleared.

**Table 588: IO Slave I<sup>2</sup>C Configuration**

| Field      | Value |
|------------|-------|
| PAD0FNCSEL | 0     |
| PAD1FNCSEL | 0     |

### 11.5.3.2 IO Slave 4-wire SPI Connection

Four-wire SPI mode of the IO Slave uses pad 0 as SCK, pad 1 as MOSI, pad 2 as MISO and pad 3 as nCE. This mode is configured by setting the PADnFNCSEL fields as shown in Table 589. The PAD0INPEN, PAD1INPEN and PAD3INPEN bits must be set. PAD0PULL, PAD1PULL, PAD2PULL and PAD3PULL should be cleared.

**Table 589: IO Slave 4-wire SPI Configuration**

| Field      | Value |
|------------|-------|
| PAD0FNCSEL | 1     |
| PAD1FNCSEL | 1     |
| PAD2FNCSEL | 1     |
| PAD3FNCSEL | 1     |

### 11.5.3.3 IO Slave 3-wire SPI Connection

Three-wire SPI mode of the IO Slave uses pad 0 as SCK, pad 1 as MISO/MOSI and pad 3 as nCE. This mode is configured by setting the PADnFNCSEL fields as shown in Table 590. The PAD0INPEN, PAD1INPEN and PAD3INPEN bits must be set. PAD0PULL, PAD1PULL and PAD3PULL should be cleared. Pad 2 may be used for other functions.

**Table 590: IO Slave 3-wire SPI Configuration**

| Field      | Value |
|------------|-------|
| PAD0FNCSEL | 1     |
| PAD1FNCSEL | 0     |
| PAD3FNCSEL | 1     |

### 11.5.3.4 IO Slave Interrupt Connection

The IO Slave can be configured to generate an interrupt output under a variety of internal conditions. If this function is used, the interrupt will be generated on pad 4. PAD4FNCSEL must be set to 1, and PAD4INPEN and PAD4PULL should be cleared.

## 11.5.4 Implementing Counter/Timer Connections

Each Counter/Timer can optionally count pulses from an input pad, or generate pulses on an output pad. Table 814 and Table 815 of the CTIMER chapter show the PADnFNCSEL settings to connect each

Counter/Timer to the appropriate pad. If the pad is used as an input, the PADnINPEN bit should be set, otherwise it should be cleared. The PADnPULL bit may be set if the input signal is open drain.

### **11.5.5 Implementing UART Connections**

The UART signals can be connected to a variety of pads.

#### **11.5.5.1 UART0 TX/RX Connections**

The UART0 data signals TX and RX may each be connected to several pads. Note that TX and RX are selected independently. Table 591 shows the connections for TX, which should have the corresponding PADnINPEN and PADnPULL fields clear. Table 592 shows the connections for RX, which must have the corresponding PADnINPEN field set and should have the corresponding PADnPULL field clear.

**Table 591: UART0 TX Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD1FNCSEL  | 2     | 1   |
| PAD7FNCSEL  | 5     | 7   |
| PAD16FNCSEL | 6     | 16  |
| PAD20FNCSEL | 4     | 20  |
| PAD22FNCSEL | 0     | 22  |
| PAD26FNCSEL | 6     | 26  |
| PAD28FNCSEL | 6     | 28  |
| PAD30FNCSEL | 4     | 30  |
| PAD39FNCSEL | 0     | 39  |
| PAD41FNCSEL | 6     | 41  |
| PAD44FNCSEL | 6     | 44  |
| PAD48FNCSEL | 0     | 48  |

**Table 592: UART0 RX Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD2FNCSEL  | 2     | 2   |
| PAD11FNCSEL | 6     | 11  |
| PAD17FNCSEL | 6     | 17  |
| PAD21FNCSEL | 4     | 21  |
| PAD23FNCSEL | 0     | 23  |
| PAD27FNCSEL | 0     | 27  |
| PAD29FNCSEL | 6     | 29  |
| PAD31FNCSEL | 4     | 31  |
| PAD40FNCSEL | 0     | 40  |
| PAD45FNCSEL | 6     | 45  |
| PAD49FNCSEL | 0     | 49  |

### 11.5.5.2 UART0 RTS/CTS Connections

The UART modem control signals RTS and CTS may each be connected to one of two pads. Note that RTS and CTS are selected independently. Table 593 shows the connections for RTS, which should have the corresponding PADnINPEN and PADnPULL fields clear. Table 594 shows the connections for CTS, which must have the corresponding PADnINPEN field set and should have the corresponding PADnPULL field clear.

**Table 593: UART0 RTS Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD3FNCSEL  | 0     | 3   |
| PAD5FNCSEL  | 2     | 5   |
| PAD13FNCSEL | 6     | 13  |
| PAD18FNCSEL | 4     | 18  |
| PAD34FNCSEL | 5     | 34  |
| PAD35FNCSEL | 6     | 35  |
| PAD37FNCSEL | 2     | 37  |
| PAD41FNCSEL | 7     | 41  |

**Table 594: UART0 CTS Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD4FNCSEL  | 0     | 4   |
| PAD6FNCSEL  | 2     | 6   |
| PAD12FNCSEL | 6     | 12  |
| PAD24FNCSEL | 4     | 24  |
| PAD29FNCSEL | 4     | 29  |
| PAD33FNCSEL | 5     | 33  |
| PAD36FNCSEL | 6     | 36  |
| PAD38FNCSEL | 2     | 38  |

### 11.5.5.3 UART1 TX/RX Connections

The UART data signals TX and RX may each be connected to several pads. Note that TX and RX are selected independently. Table 595 shows the connections for TX, which should have the corresponding PADnINPEN and PADnPULL fields clear. Table 596 shows the connections for RX, which must have the corresponding PADnINPEN field set and should have the corresponding PADnPULL field clear.

**Table 595: UART1 TX Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD8FNCSEL  | 6     | 8   |
| PAD10FNCSEL | 0     | 10  |
| PAD12FNCSEL | 7     | 12  |
| PAD14FNCSEL | 2     | 14  |
| PAD18FNCSEL | 6     | 18  |
| PAD20FNCSEL | 5     | 20  |
| PAD24FNCSEL | 0     | 24  |
| PAD35FNCSEL | 2     | 35  |
| PAD37FNCSEL | 5     | 37  |
| PAD39FNCSEL | 1     | 39  |
| PAD42FNCSEL | 0     | 42  |
| PAD46FNCSEL | 6     | 46  |

**Table 596: UART1 RX Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD2FNCSEL  | 0     | 2   |
| PAD4FNCSEL  | 5     | 4   |
| PAD9FNCSEL  | 6     | 9   |
| PAD13FNCSEL | 7     | 13  |
| PAD15FNCSEL | 2     | 15  |
| PAD19FNCSEL | 6     | 19  |
| PAD21FNCSEL | 5     | 21  |
| PAD25FNCSEL | 0     | 25  |
| PAD36FNCSEL | 2     | 36  |
| PAD38FNCSEL | 6     | 38  |
| PAD40FNCSEL | 1     | 40  |
| PAD43FNCSEL | 0     | 43  |
| PAD47FNCSEL | 6     | 47  |

#### 11.5.5.4 UART1 RTS/CTS Connections

The UART modem control signals RTS and CTS may each be connected to one of two pads. Note that RTS and CTS are selected independently. Table 597 shows the connections for RTS, which should have the corresponding PADnINPEN and PADnPULL fields clear. Table 598 shows the connections for CTS, which must have the corresponding PADnINPEN field set and should have the corresponding PADnPULL field clear.

**Table 597: UART1 RTS Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD10FNCSEL | 5     | 10  |
| PAD16FNCSEL | 7     | 16  |
| PAD20FNCSEL | 7     | 20  |
| PAD30FNCSEL | 5     | 30  |
| PAD31FNCSEL | 7     | 31  |
| PAD34FNCSEL | 2     | 34  |
| PAD41FNCSEL | 5     | 41  |
| PAD44FNCSEL | 0     | 44  |

**Table 598: UART1 CTS Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD11FNCSEL | 5     | 11  |
| PAD17FNCSEL | 7     | 17  |
| PAD21FNCSEL | 7     | 21  |
| PAD26FNCSEL | 7     | 26  |
| PAD29FNCSEL | 5     | 29  |
| PAD32FNCSEL | 7     | 32  |
| PAD36FNCSEL | 5     | 36  |
| PAD45FNCSEL | 0     | 45  |

#### 11.5.6 Implementing Audio Connections

The Audio signals can be connected to a variety of pads.

##### 11.5.6.1 PDM Connections

The PDM CLK and DATA signals may each be connected to several pads. Note that CLK and DATA are selected independently. Table 599 shows the connections for PDM CLK, which should have the corresponding PADnINPEN and PADnPULL fields clear. Table 600 shows the connections for PDM DATA, which must have the corresponding PADnINPEN field set and the corresponding PADnPULL field clear.

**Table 599: PDM CLK Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD10FNCSEL | 4     | 10  |
| PAD12FNCSEL | 5     | 12  |
| PAD14FNCSEL | 4     | 14  |
| PAD22FNCSEL | 4     | 22  |
| PAD37FNCSEL | 6     | 37  |
| PAD46FNCSEL | 5     | 46  |

**Table 600: PDM DATA Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD11FNCSEL | 7     | 11  |
| PAD15FNCSEL | 4     | 15  |
| PAD29FNCSEL | 7     | 29  |
| PAD34FNCSEL | 7     | 34  |
| PAD36FNCSEL | 7     | 36  |
| PAD45FNCSEL | 5     | 45  |

### 11.5.6.2 I2S Connections

The I2S BCLK, WCLK and DAT signals may each be connected to one of several pads. Note that BCLK, WCLK and DAT are selected independently. Table 601 shows the connections for I2S BCLK, which should have the corresponding PADnINPEN set and the corresponding PADnPULL field clear. Table 602 shows the connections for I2S WCLK, which should have the corresponding PADnINPEN set and the PADnPULL field clear. Table 603 shows the connections for I2S DAT, which must have the corresponding PADnINPEN and PADnPULL fields clear.

**Table 601: I2S BCLK Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD13FNCSEL | 4     | 13  |
| PAD19FNCSEL | 7     | 19  |
| PAD20FNCSEL | 6     | 20  |
| PAD46FNCSEL | 0     | 46  |

**Table 602: I2S WCLK Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD3FNCSEL  | 7     | 3   |
| PAD23FNCSEL | 4     | 23  |
| PAD28FNCSEL | 0     | 28  |
| PAD41FNCSEL | 4     | 41  |



**Table 603: I2S DAT Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD6FNCSEL  | 7     | 6   |
| PAD30FNCSEL | 7     | 30  |
| PAD35FNCSEL | 4     | 35  |
| PAD45FNCSEL | 4     | 45  |

### 11.5.7 Implementing GPIO Connections

Each pad of the Apollo3 Blue SoC can be configured as a GPIO port by setting PADnFNCSEL to 3. PADnINPEN and PADnPULL must be set appropriately depending on the specific GPIO function.

### 11.5.8 Implementing CLKOUT Connections

The flexible clock output of the Clock Generator module, CLKOUT, may be configured on several pads as shown in Table 604. PADnINPEN and PADnPULL should be cleared in each case.

**Table 604: CLKOUT Configuration**

| Field      | Value | Pad |
|------------|-------|-----|
| PAD0FNCSEL | 2     | 0   |
| PAD7FNCSEL | 2     | 7   |

### 11.5.9 Implementing 32kHz CLKOUT Connections

In addition to the CLKOUT mux output, there is also a dedicated 32 kHz clock output. This clock is primarily for leveraging the 32 kHz oscillator clock from Apollo3 Blue SoC. This clock output may be configured on several pads as shown in Table 605. PADnINPEN and PADnPULL should be cleared in each case.

**Table 605: 32kHz CLKOUT Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD14FNCSEL | 7     | 14  |
| PAD24FNCSEL | 6     | 24  |
| PAD33FNCSEL | 2     | 33  |
| PAD36FNCSEL | 4     | 36  |
| PAD47FNCSEL | 0     | 47  |

### 11.5.10 Implementing ADC Connections

Three types of pad connections may be made for the ADC module. Up to twelve pads may be selected from and configured as the analog inputs, as shown in Table 606. The ADCREF reference voltage input is supplied on a dedicated input pin.

If an external digital trigger is desired, up to eight selectable pad choices may be selected from and configured, as shown in Table 607. For the trigger inputs, PADnINPEN must be set. For other inputs,

PADnINPEN should be cleared. PADnPULL should be cleared except in the case of an open drain trigger input.

**Table 606: ADC Analog Input Configuration**

| Field       | Value | Input          | Pad |
|-------------|-------|----------------|-----|
| PAD16FNCSEL | 0     | ADCSE0         | 16  |
| PAD29FNCSEL | 0     | ADCSE1         | 29  |
| PAD11FNCSEL | 0     | ADCSE2         | 11  |
| PAD31FNCSEL | 0     | ADCSE3         | 31  |
| PAD32FNCSEL | 0     | ADCSE4         | 32  |
| PAD33FNCSEL | 0     | ADCSE5         | 33  |
| PAD34FNCSEL | 0     | ADCSE6         | 34  |
| PAD35FNCSEL | 0     | ADCSE7         | 35  |
| PAD13FNCSEL | 0     | ADCD0M/<br>SE8 | 13  |
| PAD12FNCSEL | 0     | ADCD0P/<br>SE9 | 12  |
| PAD14FNCSEL | 0     | ADCD1P         | 14  |
| PAD15FNCSEL | 0     | ADCD1M         | 15  |

**Table 607: ADC Trigger Input Configuration**

| Field       | Value | Input | Pad |
|-------------|-------|-------|-----|
| PAD7FNCSEL  | 4     | TRIG0 | 7   |
| PAD16FNCSEL | 2     | TRIG0 | 16  |
| PAD40FNCSEL | 2     | TRIG0 | 40  |
| PAD3FNCSEL  | 6     | TRIG1 | 3   |
| PAD17FNCSEL | 2     | TRIG1 | 17  |
| PAD36FNCSEL | 0     | TRIG1 | 36  |
| PAD37FNCSEL | 0     | TRIG2 | 37  |
| PAD38FNCSEL | 0     | TRIG3 | 38  |

### 11.5.11 Implementing Voltage Comparator Connections

Two types of pad connections may be made for the Voltage Comparator (VCOMP) module. Three reference voltages may be used for the comparator negative input as shown in Table 608. The voltage to be applied to the comparator positive input are shown in Table 609. In each case PADnINPENn and PADnPULL should be cleared. Note that for CMPRF2, this pin is muxed with ADCSE6 allowing for the same reference input to be used for both ADC and VCOMP operations. Additionally, CMPIN0 is muxed with ADCSE0 allowing for the same input to be used for both ADC and VCOMP operations.

**Table 608: Voltage Comparator Reference Configuration**

| Field       | Value | Input  | Pad |
|-------------|-------|--------|-----|
| PAD19FNCSEL | 0     | CMPRF0 | 19  |
| PAD17FNCSEL | 0     | CMPRF1 | 17  |
| PAD34FNCSEL | 4     | CMPRF2 | 34  |

#### NOTE

If voltage comparator and ADC operation are concurrently sampling the CMPIN0/ADCSE0 input, quality of the sample may be degraded and cannot be guaranteed. It is recommended that voltage comparator and ADC operations are sampled independently (time sliced) to avoid any signal quality loss.

**Table 609: Voltage Comparator Input Configuration**

| Field       | Value | Input  | Pad |
|-------------|-------|--------|-----|
| PAD16FNCSEL | 5     | CMPIN0 | 16  |
| PAD18FNCSEL | 0     | CMPIN1 | 18  |

### 11.5.12 Implementing the Software Debug Port Connections

The software debug clock (SWDCK) and data (SWDIO) must be connected on pads 20 and 21 respectively. PAD20FNCSEL and PAD21FNCSEL must be set to 0, PAD20INPEN and PAD21INPEN must be set, and PAD20PULL and PAD21PULL must be set, which results in a default state of SWDCK low and SWDIO high. Pads 14 and 15 can alternatively be used for SWDCK and SWDIO functionality, respectively. These pads are, however, not selected by default. Using pads 14 and 15 requires PAD14FNCSEL to be set to 6 and PAD15FNCSEL to be set to 6, PAD14INPEN and PAD15INPEN to be set, and PAD14PULL and PAD15PULL to be set.

The optional continuous output signal SWO may be configured on a variety of pads as shown in Table 610, and PADnINPEN and PADnPULL should be cleared for the selected pad.

**Table 610: SWO Configuration**

| Field       | Value | Pad |
|-------------|-------|-----|
| PAD15FNCSEL | 7     | 15  |
| PAD22FNCSEL | 7     | 22  |
| PAD24FNCSEL | 7     | 24  |
| PAD33FNCSEL | 7     | 33  |
| PAD41FNCSEL | 2     | 41  |
| PAD45FNCSEL | 7     | 45  |
| PAD46FNCSEL | 7     | 46  |

### **11.5.13 Fast GPIO**

#### **11.5.13.1 Description**

Access to GPIO pin registers on the Apollo3 Blue SoC can be multiple CPU cycles to complete. To support certain functions that require shorter latency access, a fast GPIO interface is supported. The fast GPIO is accessed via the fast GPIO registers shown in the next section.

## 11.6 FASTGPIO Registers

### APB DMA Register Interfaces

INSTANCE 0 BASE ADDRESS:0x40011000

#### 11.6.1 Register Memory Map

Table 611: FASTGPIO Register Map

| Address(s) | Register Name | Description        |
|------------|---------------|--------------------|
| 0x40011000 | BBVALUE       | Control Register   |
| 0x40011004 | BBSETCLEAR    | Set/Clear Register |
| 0x40011008 | BBINPUT       | PIO Input Values   |
| 0x40011020 | DEBUGDATA     | PIO Input Values   |
| 0x40011040 | DEBUG         | PIO Input Values   |

## 11.6.2 FASTGPIO Registers

### 11.6.2.1 BBVALUE Register

#### Control Register

OFFSET: 0x00000000

INSTANCE 0 ADDRESS: 0x40011000

Control Register

Table 612: BBVALUE Register

|      |   |   |   |   |   |   |   |     |   |   |   |   |   |   |   |      |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|-----|---|---|---|---|---|---|---|------|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2   | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1    | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0       | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3   | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5    | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7       | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   | PIN |   |   |   |   |   |   |   | RSVD |   |   |   |   |   |   |   | DATAOUT |   |   |   |   |   |   |   |

Table 613: BBVALUE Register Bits

| Bit   | Name    | Reset | RW | Description        |
|-------|---------|-------|----|--------------------|
| 31:24 | RSVD    | 0x0   | RO | RESERVED           |
| 23:16 | PIN     | 0x0   | RO | PIO values         |
| 15:8  | RSVD    | 0x0   | RO | RESERVED           |
| 7:0   | DATAOUT | 0x0   | RW | Data Output Values |

### 11.6.2.2 BBSETCLEAR Register

#### Set/Clear Register

OFFSET: 0x00000004

INSTANCE 0 ADDRESS: 0x40011004

Set/Clear Register

Table 614: BBSETCLEAR Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        | CLEAR  |        |        |        |        |        |        |        | RSVD   |        |        |        |        |        |        |        | SET    |        |        |        |        |        |        |        |

| Bit   | Name  | Reset | RW | Description                                                                    |
|-------|-------|-------|----|--------------------------------------------------------------------------------|
| 31:24 | RSVD  | 0x0   | RO | RESERVED                                                                       |
| 23:16 | CLEAR | 0x0   | WO | Write 1 to clear PIO value                                                     |
| 15:8  | RSVD  | 0x0   | RO | RESERVED                                                                       |
| 7:0   | SET   | 0x0   | WO | Write 1 to set PIO value (set higher priority then clear if both bits are set) |

### PIO Input Values

**INSTANCE 0 ADDRESS: 0x40011008**

## PIO Input Values

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|---|---|---|--|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0      | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9      | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |  |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DATAIN |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |

| Bit  | Name   | Reset | RW | Description |
|------|--------|-------|----|-------------|
| 31:8 | RSVD   | 0x0   | RO | RESERVED    |
| 7:0  | DATAIN | 0x0   | RO | PIO values  |

### PIO Input Values

**INSTANCE 0 ADDRESS: 0x40011020**

### PIO Input Values





This is the detailed description of the general purpose I/O (GPIO) block, as well as for the PAD multiplexor. Note that GPIO interrupt bits are edge triggered. **WARNING:** if an interrupt bit is cleared while the combination of polarity and input are still asserted then this bit will not set again.

### 11.7.1 Register Memory Map

**Table 622: GPIO Register Map**

| Address(s) | Register Name | Description                                      |
|------------|---------------|--------------------------------------------------|
| 0x40010000 | PADREGA       | Pad Configuration Register A (Pads 3-0)          |
| 0x40010004 | PADREGB       | Pad Configuration Register B (Pads 7-4)          |
| 0x40010008 | PADREGC       | Pad Configuration Register C (Pads 11-8)         |
| 0x4001000C | PADREGD       | Pad Configuration Register D (Pads 15-12)        |
| 0x40010010 | PADREGE       | Pad Configuration Register E (Pads 19-16)        |
| 0x40010014 | PADREGF       | Pad Configuration Register F (Pads 23-20)        |
| 0x40010018 | PADREGG       | Pad Configuration Register G (Pads 27-24)        |
| 0x4001001C | PADREGH       | Pad Configuration Register H (Pads 31-28)        |
| 0x40010020 | PADREGI       | Pad Configuration Register I (Pads 35-32)        |
| 0x40010024 | PADREGJ       | Pad Configuration Register J (Pads 39-36)        |
| 0x40010028 | PADREGK       | Pad Configuration Register K (Pads 43-40)        |
| 0x4001002C | PADREGL       | Pad Configuration Register L (Pads 47-44)        |
| 0x40010030 | PADREGM       | Pad Configuration Register M (Pads 49-48)        |
| 0x40010040 | CFGA          | GPIO Configuration Register A (Pads 7-0)         |
| 0x40010044 | CFGB          | GPIO Configuration Register B (Pads 15-8)        |
| 0x40010048 | CFGC          | GPIO Configuration Register C (Pads 23-16)       |
| 0x4001004C | CFGD          | GPIO Configuration Register D (Pads 31-24)       |
| 0x40010050 | CFGE          | GPIO Configuration Register E (Pads 39-32)       |
| 0x40010054 | CFGF          | GPIO Configuration Register F (Pads 47-40)       |
| 0x40010058 | CFGG          | GPIO Configuration Register G (Pads 49-48)       |
| 0x40010060 | PADKEY        | Key Register for all pad configuration registers |
| 0x40010080 | RDA           | GPIO Input Register A (31-0)                     |
| 0x40010084 | RDB           | GPIO Input Register B (49-32)                    |
| 0x40010088 | WTA           | GPIO Output Register A (31-0)                    |
| 0x4001008C | WTB           | GPIO Output Register B (49-32)                   |
| 0x40010090 | WTSA          | GPIO Output Register A Set (31-0)                |
| 0x40010094 | WTSB          | GPIO Output Register B Set (49-32)               |
| 0x40010098 | WTCA          | GPIO Output Register A Clear (31-0)              |
| 0x4001009C | WTCB          | GPIO Output Register B Clear (49-32)             |
| 0x400100A0 | ENA           | GPIO Enable Register A (31-0)                    |
| 0x400100A4 | ENB           | GPIO Enable Register B (49-32)                   |
| 0x400100A8 | ENSA          | GPIO Enable Register A Set (31-0)                |
| 0x400100AC | ENSB          | GPIO Enable Register B Set (49-32)               |
| 0x400100B4 | ENCA          | GPIO Enable Register A Clear (31-0)              |
| 0x400100B8 | ENCB          | GPIO Enable Register B Clear (49-32)             |
| 0x400100BC | STMRCAP       | STIMER Capture Control                           |

Table 622: GPIO Register Map

| Address(s) | Register Name | Description                                    |
|------------|---------------|------------------------------------------------|
| 0x400100C0 | IOM0IRQ       | IOM0 Flow Control IRQ Select                   |
| 0x400100C4 | IOM1IRQ       | IOM1 Flow Control IRQ Select                   |
| 0x400100C8 | IOM2IRQ       | IOM2 Flow Control IRQ Select                   |
| 0x400100CC | IOM3IRQ       | IOM3 Flow Control IRQ Select                   |
| 0x400100D0 | IOM4IRQ       | IOM4 Flow Control IRQ Select                   |
| 0x400100D4 | IOM5IRQ       | IOM5 Flow Control IRQ Select                   |
| 0x400100D8 | BLEIFIRQ      | BLEIF Flow Control IRQ Select                  |
| 0x400100DC | GPIOOBS       | GPIO Observation Mode Sample register          |
| 0x400100E0 | ALTPADCFGA    | Alternate Pad Configuration reg0 (Pads 0-3)    |
| 0x400100E4 | ALTPADCFGB    | Alternate Pad Configuration reg1 (Pads 4-7)    |
| 0x400100E8 | ALTPADCFGC    | Alternate Pad Configuration reg2 (Pads 8-11)   |
| 0x400100EC | ALTPADCFGD    | Alternate Pad Configuration reg3 (Pads 12-15)  |
| 0x400100F0 | ALTPADCFGE    | Alternate Pad Configuration reg4 (Pads 16-19)  |
| 0x400100F4 | ALTPADCFGF    | Alternate Pad Configuration reg5 (Pads 20-23)  |
| 0x400100F8 | ALTPADCFGG    | Alternate Pad Configuration reg6 (Pads 24-27)  |
| 0x400100FC | ALTPADCFGH    | Alternate Pad Configuration reg7 (Pads 28-31)  |
| 0x40010100 | ALTPADCFGI    | Alternate Pad Configuration reg8 (Pads 32-35)  |
| 0x40010104 | ALTPADCFGJ    | Alternate Pad Configuration reg9 (Pads 36-39)  |
| 0x40010108 | ALTPADCFGK    | Alternate Pad Configuration reg10 (Pads 40-43) |
| 0x4001010C | ALTPADCFGL    | Alternate Pad Configuration reg11 (Pads 44-47) |
| 0x40010110 | ALTPADCFGM    | Alternate Pad Configuration reg12 (Pads 48-49) |
| 0x40010114 | SCDET         | SCARD Card Detect select                       |
| 0x40010118 | CTENCFG       | Counter/Timer Enable Config                    |
| 0x40010200 | INT0EN        | GPIO Interrupt Registers 31-0: Enable          |
| 0x40010204 | INT0STAT      | GPIO Interrupt Registers 31-0: Status          |
| 0x40010208 | INT0CLR       | GPIO Interrupt Registers 31-0: Clear           |
| 0x4001020C | INT0SET       | GPIO Interrupt Registers 31-0: Set             |
| 0x40010210 | INT1EN        | GPIO Interrupt Registers 49-32: Enable         |
| 0x40010214 | INT1STAT      | GPIO Interrupt Registers 49-32: Status         |
| 0x40010218 | INT1CLR       | GPIO Interrupt Registers 49-32: Clear          |
| 0x4001021C | INT1SET       | GPIO Interrupt Registers 49-32: Set            |

## 11.7.2 GPIO Registers

### 11.7.2.1 PADREGA Register

#### Pad Configuration Register A (Pads 3-0)

**OFFSET:** 0x00000000

**INSTANCE 0 ADDRESS:** 0x40010000

This register controls the pad configuration controls for PAD3 through PAD0. Writes to this register must be unlocked by the PADKEY register.

**Table 623: PADREGA Register**

|      |           |            |   |   |           |           |          |      |            |   |   |           |           |          |          |            |   |   |           |           |          |          |            |   |   |           |           |          |
|------|-----------|------------|---|---|-----------|-----------|----------|------|------------|---|---|-----------|-----------|----------|----------|------------|---|---|-----------|-----------|----------|----------|------------|---|---|-----------|-----------|----------|
| 3    | 3         | 2          | 2 | 2 | 2         | 2         | 2        | 2    | 2          | 1 | 1 | 1         | 1         | 1        | 1        | 1          | 1 | 1 | 0         | 0         | 0        | 0        | 0          | 0 | 0 | 0         | 0         | 0        |
| 1    | 0         | 9          | 8 | 7 | 6         | 5         | 4        | 3    | 2          | 1 | 0 | 9         | 8         | 7        | 6        | 5          | 4 | 3 | 2         | 1         | 0        | 9        | 8          | 7 | 6 | 5         | 4         | 3        |
| RSVD | PAD3PWRUP | PAD3FNCSEL |   |   | PAD3STRNG | PAD3INPEN | PAD3PULL | RSVD | PAD2FNCSEL |   |   | PAD2STRNG | PAD2INPEN | PAD2PULL | PAD1RSEL | PAD1FNCSEL |   |   | PAD1STRNG | PAD1INPEN | PAD1PULL | PAD0RSEL | PAD0FNCSEL |   |   | PAD0STRNG | PAD0INPEN | PAD0PULL |

**Table 624: PADREGA Register Bits**

| Bit   | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | RSVD       | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                          |
| 30    | PAD3PWRUP  | 0x0   | RW | Pad 3 VDD power switch enable<br>DIS = 0x0 - Power switch disabled<br>EN = 0x1 - Power switch enabled (switched to VDD)                                                                                                                                                                                                                                                                           |
| 29:27 | PAD3FNCSEL | 0x3   | RW | Pad 3 function select<br>UA0RTS = 0x0 - Configure as the UART0 RTS output<br>SLnCE = 0x1 - Configure as the IOSLAVE SPI nCE signal<br>NCE3 = 0x2 - IOM/MSPI nCE group 3<br>GPIO3 = 0x3 - Configure as GPIO3<br>RSVD = 0x4 - Reserved<br>MSPI7 = 0x5 - MSPI data connection 7<br>TRIG1 = 0x6 - Configure as the ADC Trigger 1 signal<br>I2S_WCLK = 0x7 - Configure as the PDM I2S Word Clock input |
| 26    | PAD3STRNG  | 0x0   | RW | Pad 3 drive strength.<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                       |
| 25    | PAD3INPEN  | 0x0   | RW | Pad 3 input enable.<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                             |
| 24    | PAD3PULL   | 0x0   | RW | Pad 3 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                   |

Table 624: PADREGA Register Bits

| Bit   | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                               |
|-------|------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23:22 | RSVD       | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                  |
| 21:19 | PAD2FNCSEL | 0x3   | RW | Pad 2 function select<br>UART1RX = 0x0 - Configure as the UART1 RX input.<br>SLMISO = 0x1 - Configure as the IOSLAVE SPI MISO signal.<br>UART0RX = 0x2 - Configure as the UART0 RX input.<br>GPIO2 = 0x3 - Configure as GPIO2.<br>RSVD4 = 0x4 - Reserved<br>MSPI6 = 0x5 - MSPI data connection 6.<br>RSVD6 = 0x6 - Reserved<br>NCE2 = 0x7 - IOM/MSPI nCE group 2                          |
| 18    | PAD2STRNG  | 0x0   | RW | Pad 2 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                |
| 17    | PAD2INPEN  | 0x0   | RW | Pad 2 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                      |
| 16    | PAD2PULL   | 0x0   | RW | Pad 2 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                           |
| 15:14 | PAD1RSEL   | 0x0   | RW | Pad 1 pullup resistor selection.<br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                                              |
| 13:11 | PAD1FNCSEL | 0x3   | RW | Pad 1 function select<br>SLSDAWIR3 = 0x0 - Configure as the IOSLAVE I2C SDA or SPI WIR3 signal<br>SLMOSI = 0x1 - Configure as the IOSLAVE SPI MOSI signal<br>UART0TX = 0x2 - Configure as the UART0 TX output signal<br>GPIO1 = 0x3 - Configure as GPIO1<br>RSVD4 = 0x4 - Reserved<br>MSPI5 = 0x5 - MSPI data connection 5<br>RSVD6 = 0x6 - Reserved<br>NCE1 = 0x7 - IOM/MSPI nCE group 1 |
| 10    | PAD1STRNG  | 0x0   | RW | Pad 1 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                |
| 9     | PAD1INPEN  | 0x0   | RW | Pad 1 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                      |
| 8     | PAD1PULL   | 0x0   | RW | Pad 1 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                           |

Table 624: PADREGA Register Bits

| Bit | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                   |
|-----|------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:6 | PAD0RSEL   | 0x0   | RW | Pad 0 pullup resistor selection.<br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                  |
| 5:3 | PAD0FNCSEL | 0x3   | RW | Pad 0 function select<br>SLSCL = 0x0 - Configure as the IOSLAVE I2C SCL signal<br>SLSCK = 0x1 - Configure as the IOSLAVE SPI SCK signal<br>CLKOUT = 0x2 - Configure as the CLKOUT signal<br>GPIO0 = 0x3 - Configure as GPIO0<br>RSVD4 = 0x4 - Reserved<br>MSPI4 = 0x5 - MSPI data connection 4<br>RSVD6 = 0x6 - Reserved<br>NCE0 = 0x7 - IOM/MSPI nCE group 0 |
| 2   | PAD0STRNG  | 0x0   | RW | Pad 0 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                    |
| 1   | PAD0INPEN  | 0x0   | RW | Pad 0 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                          |
| 0   | PAD0PULL   | 0x0   | RW | Pad 0 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                               |

**11.7.2.2 PADREGB Register****Pad Configuration Register B (Pads 7-4)****OFFSET:** 0x00000004**INSTANCE 0 ADDRESS:** 0x40010004

This register controls the pad configuration controls for PAD7 through PAD4. Writes to this register must be unlocked by the PADKEY register.

Table 625: PADREGB Register

|        |        |            |        |        |           |           |          |          |        |            |        |        |           |           |          |          |        |            |        |        |           |           |          |        |        |            |        |        |           |           |          |
|--------|--------|------------|--------|--------|-----------|-----------|----------|----------|--------|------------|--------|--------|-----------|-----------|----------|----------|--------|------------|--------|--------|-----------|-----------|----------|--------|--------|------------|--------|--------|-----------|-----------|----------|
| 3<br>1 | 3<br>0 | 2<br>9     | 2<br>8 | 2<br>7 | 2<br>6    | 2<br>5    | 2<br>4   | 2<br>3   | 2<br>2 | 2<br>1     | 2<br>0 | 1<br>9 | 1<br>8    | 1<br>7    | 1<br>6   | 1<br>5   | 1<br>4 | 1<br>3     | 1<br>2 | 1<br>1 | 1<br>0    | 0<br>9    | 0<br>8   | 0<br>7 | 0<br>6 | 0<br>5     | 0<br>4 | 0<br>3 | 0<br>2    | 0<br>1    | 0<br>0   |
| RSVD   |        | PAD7FNCSEL |        |        | PAD7STRNG | PAD7INPEN | PAD7PULL | PAD6RSEL |        | PAD6FNCSEL |        |        | PAD6STRNG | PAD6INPEN | PAD6PULL | PAD5RSEL |        | PAD5FNCSEL |        |        | PAD5STRNG | PAD5INPEN | PAD5PULL | RSVD   |        | PAD4FNCSEL |        |        | PAD4STRNG | PAD4INPEN | PAD4PULL |

Table 626: PADREGB Register Bits

| Bit   | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------|------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:30 | RSVD       | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                        |
| 29:27 | PAD7FNCSEL | 0x3   | RW | Pad 7 function select<br>NCE7 = 0x0 - IOM/MSPI nCE group 7<br>M0MOSI = 0x1 - Configure as the IOMSTR0 SPI MOSI signal<br>CLKOUT = 0x2 - Configure as the CLKOUT signal<br>GPIO7 = 0x3 - Configure as GPIO7<br>TRIG0 = 0x4 - Configure as the ADC Trigger 0 signal<br>UART0TX = 0x5 - Configure as the UART0 TX output signal<br>RSVD = 0x6 - Reserved<br>CT19 = 0x7 - CTIMER connection 19                      |
| 26    | PAD7STRNG  | 0x0   | RW | Pad 7 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                      |
| 25    | PAD7INPEN  | 0x0   | RW | Pad 7 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                            |
| 24    | PAD7PULL   | 0x0   | RW | Pad 7 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                 |
| 23:22 | PAD6RSEL   | 0x0   | RW | Pad 6 pullup resistor selection.<br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                                                                    |
| 21:19 | PAD6FNCSEL | 0x3   | RW | Pad 6 function select<br>M0SDAWIR3 = 0x0 - Configure as the IOMSTR0 I2C SDA or SPI WIR3 signal<br>M0MISO = 0x1 - Configure as the IOMSTR0 SPI MISO signal<br>UA0CTS = 0x2 - Configure as the UART0 CTS input signal<br>GPIO6 = 0x3 - Configure as GPIO6<br>RSVD4 = 0x4 - Reserved<br>CT10 = 0x5 - CTIMER connection 10<br>RSVD6 = 0x6 - Reserved<br>I2S_DAT = 0x7 - Configure as the PDM I2S Data output signal |
| 18    | PAD6STRNG  | 0x0   | RW | Pad 6 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                      |
| 17    | PAD6INPEN  | 0x0   | RW | Pad 6 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                            |
| 16    | PAD6PULL   | 0x0   | RW | Pad 6 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                 |



Table 626: PADREGB Register Bits

| Bit   | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                          |
|-------|------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15:14 | PAD5RSEL   | 0x0   | RW | Pad 5 pullup resistor selection.<br><br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                                     |
| 13:11 | PAD5FNCSEL | 0x3   | RW | Pad 5 function select<br><br>M0SCL = 0x0 - Configure as the IOMSTR0 I2C SCL signal<br>M0SCK = 0x1 - Configure as the IOMSTR0 SPI SCK signal<br>UA0RTS = 0x2 - Configure as the UART0 RTS signal output<br>GPIO5 = 0x3 - Configure as GPIO5<br>RSVD4 = 0x4 - Reserved<br><br>RSVD6 = 0x6 - Reserved<br>CT8 = 0x7 - CTIMER connection 8                                                |
| 10    | PAD5STRNG  | 0x0   | RW | Pad 5 drive strength<br><br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                       |
| 9     | PAD5INPEN  | 0x0   | RW | Pad 5 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                             |
| 8     | PAD5PULL   | 0x0   | RW | Pad 5 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                  |
| 7:6   | RSVD       | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                             |
| 5:3   | PAD4FNCSEL | 0x3   | RW | Pad 4 function select<br><br>UA0CTS = 0x0 - Configure as the UART0 CTS input signal<br>SLINT = 0x1 - Configure as the IOSLAVE interrupt out signal<br>NCE4 = 0x2 - IOM/SPI nCE group 4<br>GPIO4 = 0x3 - Configure as GPIO4<br>RSVD4 = 0x4 - Reserved<br>UART1RX = 0x5 - Configure as the UART1 RX input<br>CT17 = 0x6 - CTIMER connection 17<br>MSPI2 = 0x7 - MSPI data connection 2 |
| 2     | PAD4STRNG  | 0x0   | RW | Pad 4 drive strength<br><br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                       |
| 1     | PAD4INPEN  | 0x0   | RW | Pad 4 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                             |
| 0     | PAD4PULL   | 0x0   | RW | Pad 4 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                  |



Table 628: PADREGC Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                             |
|-------|-------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:19 | PAD10FNCSEL | 0x3   | RW | Pad 10 function select<br>UART1TX = 0x0 - Configure as the UART1 TX output signal<br>M1MOSI = 0x1 - Configure as the IOMSTR1 SPI MOSI signal<br>NCE10 = 0x2 - IOM/MSPI nCE group 10<br>GPIO10 = 0x3 - Configure as GPIO10<br>PDMCLK = 0x4 - PDM serial clock out<br>UA1RTS = 0x5 - Configure as the UART1 RTS output signal<br>RSVD6 = 0x6 - Reserved<br>RSVD7 = 0x7 - REserved         |
| 18    | PAD10STRNG  | 0x0   | RW | Pad 10 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                             |
| 17    | PAD10INPEN  | 0x0   | RW | Pad 10 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                   |
| 16    | PAD10PULL   | 0x0   | RW | Pad 10 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                        |
| 15:14 | PAD9RSEL    | 0x0   | RW | Pad 9 pullup resistor selection<br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                                             |
| 13:11 | PAD9FNCSEL  | 0x3   | RW | Pad 9 function select<br>M1SDAWIR3 = 0x0 - Configure as the IOMSTR1 I2C SDA or SPI WIR3 signal<br>M1MISO = 0x1 - Configure as the IOMSTR1 SPI MISO signal<br>NCE9 = 0x2 - IOM/MSPI nCE group 9<br>GPIO9 = 0x3 - Configure as GPIO9<br>SCCIO = 0x4 - SCARD data I/O connection<br>RSVD5 = 0x5 - Reserved<br>UART1RX = 0x6 - Configure as UART1 RX input signal<br>RSVD7 = 0x7 - Reserved |
| 10    | PAD9STRNG   | 0x0   | RW | Pad 9 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                              |
| 9     | PAD9INPEN   | 0x0   | RW | Pad 9 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                    |
| 8     | PAD9PULL    | 0x0   | RW | Pad 9 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                         |

Table 628: PADREGC Register Bits

| Bit | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                |
|-----|------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:6 | PAD8RSEL   | 0x0   | RW | Pad 8 pullup resistor selection.<br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                               |
| 5:3 | PAD8FNCSEL | 0x3   | RW | Pad 8 function select<br>M1SCL = 0x0 - Configure as the IOMSTR1 I2C SCL signal<br>M1SCK = 0x1 - Configure as the IOMSTR1 SPI SCK signal<br>NCE8 = 0x2 - IOM/MSPI nCE group 8<br>GPIO8 = 0x3 - Configure as GPIO8<br>SCCLK = 0x4 - SCARD serial clock output<br>RSVD5 = 0x5 - Reserved<br>UART1TX = 0x6 - Configure as the UART1 TX output signal<br>RSVD7 = 0x7 - Reserved |
| 2   | PAD8STRNG  | 0x0   | RW | Pad 8 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                 |
| 1   | PAD8INPEN  | 0x0   | RW | Pad 8 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                       |
| 0   | PAD8PULL   | 0x0   | RW | Pad 8 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                            |

**11.7.2.4 PADREGD Register****Pad Configuration Register D (Pads 15-12)****OFFSET:** 0x0000000C**INSTANCE 0 ADDRESS:** 0x4001000C

This register controls the pad configuration controls for PAD15 through PAD12. Writes to this register must be unlocked by the PADKEY register.

Table 629: PADREGD Register

|        |        |              |        |            |            |           |        |        |              |        |            |            |           |        |        |              |        |            |            |           |        |        |              |        |            |            |           |        |        |        |        |
|--------|--------|--------------|--------|------------|------------|-----------|--------|--------|--------------|--------|------------|------------|-----------|--------|--------|--------------|--------|------------|------------|-----------|--------|--------|--------------|--------|------------|------------|-----------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9       | 2<br>8 | 2<br>7     | 2<br>6     | 2<br>5    | 2<br>4 | 2<br>3 | 2<br>2       | 2<br>1 | 2<br>0     | 1<br>9     | 1<br>8    | 1<br>7 | 1<br>6 | 1<br>5       | 1<br>4 | 1<br>3     | 1<br>2     | 1<br>1    | 1<br>0 | 0<br>9 | 0<br>8       | 0<br>7 | 0<br>6     | 0<br>5     | 0<br>4    | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        | PAD15FNC-SEL |        | PAD15STRNG | PAD15INPEN | PAD15PULL | RSVD   |        | PAD14FNC-SEL |        | PAD14STRNG | PAD14INPEN | PAD14PULL | RSVD   |        | PAD13FNC-SEL |        | PAD13STRNG | PAD13INPEN | PAD13PULL | RSVD   |        | PAD12FNC-SEL |        | PAD12STRNG | PAD12INPEN | PAD12PULL |        |        |        |        |

Table 630: PADREGD Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------|-------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:30 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 29:27 | PAD15FNCSEL | 0x3   | RW | Pad 15 function select<br><br>ADCD1N = 0x0 - Configure as the analog ADC differential pair 1 N input signal<br>NCE15 = 0x1 - IOM/MSPI nCE group 15<br>UART1RX = 0x2 - Configure as the UART1 RX signal<br>GPIO15 = 0x3 - Configure as GPIO15<br>PDMDATA = 0x4 - PDM serial data input<br><br>SWDIO = 0x6 - Configure as an alternate port for the SWDIO I/O signal<br>SWO = 0x7 - Configure as an SWO (Serial Wire Trace output)               |
| 26    | PAD15STRNG  | 0x0   | RW | Pad 15 drive strength<br><br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                                |
| 25    | PAD15INPEN  | 0x0   | RW | Pad 15 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                      |
| 24    | PAD15PULL   | 0x0   | RW | Pad 15 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                           |
| 23:22 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 21:19 | PAD14FNCSEL | 0x3   | RW | Pad 14 function select<br><br>ADCD1P = 0x0 - Configure as the analog ADC differential pair 1 P input signal<br>NCE14 = 0x1 - IOM/MSPI nCE group 14<br>UART1TX = 0x2 - Configure as the UART1 TX output signal<br>GPIO14 = 0x3 - Configure as GPIO14<br>PDMCLK = 0x4 - PDM serial clock output<br><br>SWDCK = 0x6 - Configure as the alternate input for the SWDCK input signal<br>32kHzXT = 0x7 - Configure as the 32kHz crystal output signal |
| 18    | PAD14STRNG  | 0x0   | RW | Pad 14 drive strength<br><br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                                |
| 17    | PAD14INPEN  | 0x0   | RW | Pad 14 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                      |
| 16    | PAD14PULL   | 0x0   | RW | Pad 14 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                           |
| 15:14 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                       |

Table 630: PADREGD Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------|-------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13:11 | PAD13FNCSEL | 0x3   | RW | Pad 13 function select<br>ADCD0PSE8 = 0x0 - Configure as the ADC Differential pair 0 P, or Single Ended input 8 analog input signal. Determination of the D0P vs SE8 usage is done when the particular channel is selected within the ADC module<br>NCE13 = 0x1 - IOM/MSPI nCE group 13<br>CT2 = 0x2 - CTIMER connection 2<br>GPIO13 = 0x3 - Configure as GPIO13<br>I2SBCLK = 0x4 - I2C interface bit clock<br><br>UA0RTS = 0x6 - Configure as the UART0 RTS signal output<br>UART1RX = 0x7 - Configure as the UART1 RX input signal                                                    |
| 10    | PAD13STRNG  | 0x0   | RW | Pad 13 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 9     | PAD13INPEN  | 0x0   | RW | Pad 13 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 8     | PAD13PULL   | 0x0   | RW | Pad 13 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 7:6   | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 5:3   | PAD12FNCSEL | 0x3   | RW | Pad 12 function select<br>ADCD0NSE9 = 0x0 - Configure as the ADC Differential pair 0 N, or Single Ended input 9 analog input signal. Determination of the D0N vs SE9 usage is done when the particular channel is selected within the ADC module<br>NCE12 = 0x1 - IOM/MSPI nCE group 12<br>CT0 = 0x2 - CTIMER connection 0<br>GPIO12 = 0x3 - Configure as GPIO12<br>RSVD4 = 0x4 - This function select value is reserved<br>PDMCLK = 0x5 - PDM serial clock output<br>UA0CTS = 0x6 - Configure as the UART0 CTS input signal<br>UART1TX = 0x7 - Configure as the UART1 TX output signal |
| 2     | PAD12STRNG  | 0x0   | RW | Pad 12 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 1     | PAD12INPEN  | 0x0   | RW | Pad 12 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 0     | PAD12PULL   | 0x0   | RW | Pad 12 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |



Table 632: PADREGE Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------|-------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:19 | PAD18FNCSEL | 0x3   | RW | Pad 18 function select<br>CMPIN1 = 0x0 - Configure as the analog comparator input 1 signal<br>NCE18 = 0x1 - IOM/MSPI nCE group 18<br>CT4 = 0x2 - CTIMER connection 4<br>GPIO18 = 0x3 - Configure as GPIO18<br>UA0RTS = 0x4 - Configure as UART0 RTS output signal<br>ANATEST2 = 0x5 - Configure as ANATEST2 I/O signal<br>UART1TX = 0x6 - Configure as UART1 TX output signal<br>SCCIO = 0x7 - SCARD data input/output connectin |
| 18    | PAD18STRNG  | 0x0   | RW | Pad 18 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                      |
| 17    | PAD18INPEN  | 0x0   | RW | Pad 18 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                            |
| 16    | PAD18PULL   | 0x0   | RW | Pad 18 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                 |
| 15:14 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 13:11 | PAD17FNCSEL | 0x3   | RW | Pad 17 function select<br>CMPRF1 = 0x0 - Configure as the analog comparator reference signal 1 input signal<br>NCE17 = 0x1 - IOM/MSPI nCE group 17<br>TRIG1 = 0x2 - Configure as the ADC Trigger 1 signal<br>GPIO17 = 0x3 - Configure as GPIO17<br>SCCCLK = 0x4 - SCARD serial clock output<br>RSVD = 0x5 - Reserved<br>UART0RX = 0x6 - Configure as UART0 RX input signal<br>UA1CTS = 0x7 - Configure as UART1 CTS input signal |
| 10    | PAD17STRNG  | 0x0   | RW | Pad 17 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                      |
| 9     | PAD17INPEN  | 0x0   | RW | Pad 17 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                            |
| 8     | PAD17PULL   | 0x0   | RW | Pad 17 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                 |
| 7:6   | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                         |



Table 632: PADREGGE Register Bits

| Bit | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----|-------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5:3 | PAD16FNCSEL | 0x3   | RW | Pad 16 function select<br><br>ADCSE0 = 0x0 - Configure as the analog ADC single ended port 0 input signal<br>NCE16 = 0x1 - IOM/MSPI nCE group 16<br>TRIG0 = 0x2 - Configure as the ADC Trigger 0 signal<br>GPIO16 = 0x3 - Configure as GPIO16<br>SCCRST = 0x4 - SCARD reset output<br>CMPIN0 = 0x5 - Configure as comparator input 0 signal<br>UART0TX = 0x6 - Configure as UART0 TX output signal<br>UA1RTS = 0x7 - Configure as UART1 RTS output signal |
| 2   | PAD16STRNG  | 0x0   | RW | Pad 16 drive strength<br><br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                                           |
| 1   | PAD16INPEN  | 0x0   | RW | Pad 16 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                                 |
| 0   | PAD16PULL   | 0x0   | RW | Pad 16 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                                      |

**11.7.2.6 PADREGF Register****Pad Configuration Register F (Pads 23-20)****OFFSET:** 0x00000014**INSTANCE 0 ADDRESS:** 0x40010014

This register controls the pad configuration controls for PAD23 through PAD20. Writes to this register must be unlocked by the PADKEY register.

Table 633: PADREGF Register

|      |              |            |            |           |      |              |            |            |           |      |              |            |            |           |      |              |            |            |           |   |   |   |   |   |   |   |   |   |
|------|--------------|------------|------------|-----------|------|--------------|------------|------------|-----------|------|--------------|------------|------------|-----------|------|--------------|------------|------------|-----------|---|---|---|---|---|---|---|---|---|
| 3    | 3            | 2          | 2          | 2         | 2    | 2            | 2          | 2          | 2         | 2    | 1            | 1          | 1          | 1         | 1    | 1            | 1          | 1          | 0         | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0            | 9          | 8          | 7         | 6    | 5            | 4          | 3          | 2         | 1    | 0            | 9          | 8          | 7         | 6    | 5            | 4          | 3          | 2         | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 |
| RSVD | PAD23FNC-SEL | PAD23STRNG | PAD23INPEN | PAD23PULL | RSVD | PAD22FNC-SEL | PAD22STRNG | PAD22INPEN | PAD22PULL | RSVD | PAD21FNC-SEL | PAD21STRNG | PAD21INPEN | PAD21PULL | RSVD | PAD20FNC-SEL | PAD20STRNG | PAD20INPEN | PAD20PULL |   |   |   |   |   |   |   |   |   |

Table 634: PADREGF Register Bits

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:30 | RSVD | 0x0   | RO | RESERVED    |

Table 634: PADREGF Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                             |
|-------|-------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 29:27 | PAD23FNCSEL | 0x3   | RW | Pad 23 function select<br>UART0RX = 0x0 - Configure as the UART0 RX signal<br>NCE23 = 0x1 - IOM/MSPI nCE group 23<br>CT14 = 0x2 - CTIMER connection 14<br>GPIO23 = 0x3 - Configure as GPIO23<br>I2SWCLK = 0x4 - I2S word clock input<br>CMPOUT = 0x5 - Configure as voltage comparitor output<br>MSPI3 = 0x6 - MSPI data connection 3                   |
| 26    | PAD23STRNG  | 0x0   | RW | Pad 23 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                             |
| 25    | PAD23INPEN  | 0x0   | RW | Pad 23 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                   |
| 24    | PAD23PULL   | 0x0   | RW | Pad 23 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                        |
| 23:22 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                |
| 21:19 | PAD22FNCSEL | 0x3   | RW | Pad 22 function select<br>UART0TX = 0x0 - Configure as the UART0 TX signal<br>NCE22 = 0x1 - IOM/MSPI nCE group 22<br>CT12 = 0x2 - CTIMER connection 12<br>GPIO22 = 0x3 - Configure as GPIO22<br>PDM_CLK = 0x4 - Configure as the PDM CLK output<br>MSPI0 = 0x6 - MSPI data connection 0<br>SWO = 0x7 - Configure as the serial trace data output signal |
| 18    | PAD22STRNG  | 0x0   | RW | Pad 22 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                             |
| 17    | PAD22INPEN  | 0x0   | RW | Pad 22 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                   |
| 16    | PAD22PULL   | 0x0   | RW | Pad 22 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                        |
| 15:14 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                |

Table 634: PADREGF Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|-------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13:11 | PAD21FNCSEL | 0x0   | RW | Pad 21 function select<br>SWDIO = 0x0 - Configure as the serial wire debug data signal<br>NCE21 = 0x1 - IOM/MSPI nCE group 21<br>RSVD = 0x2 - Reserved<br>GPIO21 = 0x3 - Configure as GPIO21<br>UART0RX = 0x4 - Configure as UART0 RX input signal<br>UART1RX = 0x5 - Configure as UART1 RX input signal<br>I2SBCLK = 0x6 - I2S byte clock input<br>UA1CTS = 0x7 - Configure as UART1 CTS input signal     |
| 10    | PAD21STRNG  | 0x0   | RW | Pad 21 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                |
| 9     | PAD21INPEN  | 0x1   | RW | Pad 21 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                      |
| 8     | PAD21PULL   | 0x0   | RW | Pad 21 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                           |
| 7:6   | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                   |
| 5:3   | PAD20FNCSEL | 0x0   | RW | Pad 20 function select<br>SWDCK = 0x0 - Configure as the serial wire debug clock signal<br>NCE20 = 0x1 - IOM/MSPI nCE group 20<br>RSVD = 0x2 - Reserved<br>GPIO20 = 0x3 - Configure as GPIO20<br>UART0TX = 0x4 - Configure as UART0 TX output signal<br>UART1TX = 0x5 - Configure as UART1 TX output signal<br>I2SBCLK = 0x6 - I2S byte clock input<br>UA1RTS = 0x7 - Configure as UART1 RTS output signal |
| 2     | PAD20STRNG  | 0x0   | RW | Pad 20 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                |
| 1     | PAD20INPEN  | 0x1   | RW | Pad 20 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                      |
| 0     | PAD20PULL   | 0x0   | RW | Pad 20 pulldown enable<br>DIS = 0x0 - Pulldown disabled<br>EN = 0x1 - Pulldown enabled                                                                                                                                                                                                                                                                                                                     |

**11.7.2.7 PADREGG Register****Pad Configuration Register G (Pads 27-24)****OFFSET:** 0x00000018**INSTANCE 0 ADDRESS:** 0x40010018

This register controls the pad configuration controls for PAD27 through PAD24. Writes to this register must be unlocked by the PADKEY register.

**Table 635: PADREGG Register**

|           |   |              |   |   |            |            |           |      |              |   |   |   |            |            |           |           |   |              |   |   |            |            |           |      |              |   |   |   |            |            |           |
|-----------|---|--------------|---|---|------------|------------|-----------|------|--------------|---|---|---|------------|------------|-----------|-----------|---|--------------|---|---|------------|------------|-----------|------|--------------|---|---|---|------------|------------|-----------|
| 3         | 3 | 2            | 2 | 2 | 2          | 2          | 2         | 2    | 2            | 2 | 2 | 1 | 1          | 1          | 1         | 1         | 1 | 1            | 1 | 0 | 0          | 0          | 0         | 0    | 0            | 0 | 0 | 0 | 0          | 0          | 0         |
| 1         | 0 | 9            | 8 | 7 | 6          | 5          | 4         | 3    | 2            | 1 | 0 | 9 | 8          | 7          | 6         | 5         | 4 | 3            | 2 | 1 | 0          | 9          | 8         | 7    | 6            | 5 | 4 | 3 | 2          | 1          | 0         |
| PAD27RSEL |   | PAD27FNC-SEL |   |   | PAD27STRNG | PAD27INPEN | PAD27PULL | RSVD | PAD26FNC-SEL |   |   |   | PAD26STRNG | PAD26INPEN | PAD26PULL | PAD25RSEL |   | PAD25FNC-SEL |   |   | PAD25STRNG | PAD25INPEN | PAD25PULL | RSVD | PAD24FNC-SEL |   |   |   | PAD24STRNG | PAD24INPEN | PAD24PULL |
|           |   |              |   |   |            |            |           |      |              |   |   |   |            |            |           |           |   |              |   |   |            |            |           |      |              |   |   |   |            |            |           |

**Table 636: PADREGG Register Bits**

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                             |
|-------|-------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:30 | PAD27RSEL   | 0x0   | RW | Pad 27 pullup resistor selection.<br><br>PULL1_5K = 0x0 - Pullup is ~1.5 KOHms<br>PULL6K = 0x1 - Pullup is ~6 KOHms<br>PULL12K = 0x2 - Pullup is ~12 KOHms<br>PULL24K = 0x3 - Pullup is ~24 KOHms                                                                                                                                                                                       |
| 29:27 | PAD27FNCSEL | 0x3   | RW | Pad 27 function select<br><br>UART0RX = 0x0 - Configure as UART0 RX input signal<br>NCE27 = 0x1 - IOM/MSPI nCE group 27<br>CT5 = 0x2 - CTIMER connection 5<br>GPIO27 = 0x3 - Configure as GPIO27<br>M2SCL = 0x4 - Configure as I2C clock I/O signal from IOMSTR2<br>M2SCK = 0x5 - Configure as SPI clock output signal from IOMSTR2<br>RSVD6 = 0x6 - Reserved<br>RSVD7 = 0x7 - Reserved |
| 26    | PAD27STRNG  | 0x0   | RW | Pad 27 drive strength<br><br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                         |
| 25    | PAD27INPEN  | 0x0   | RW | Pad 27 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                               |
| 24    | PAD27PULL   | 0x0   | RW | Pad 27 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                    |
| 23:22 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                |

Table 636: PADREGG Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                    |
|-------|-------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:19 | PAD26FNCSEL | 0x3   | RW | Pad 26 function select<br><br>NCE26 = 0x1 - IOM/MSPI nCE group 26<br>CT3 = 0x2 - CTIMER connection 3<br>GPIO26 = 0x3 - Configure as GPIO26<br>SCCRST = 0x4 - SCARD reset output<br>MSPI1 = 0x5 - MSPI data connection 1<br>UART0TX = 0x6 - Configure as UART0 TX output signal<br>UA1CTS = 0x7 - Configure as UART1 CTS input signal                                                           |
| 18    | PAD26STRNG  | 0x0   | RW | Pad 26 drive strength<br><br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                |
| 17    | PAD26INPEN  | 0x0   | RW | Pad 26 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                      |
| 16    | PAD26PULL   | 0x0   | RW | Pad 26 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                           |
| 15:14 | PAD25RSEL   | 0x0   | RW | Pad 25 pullup resistor selection.<br><br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                                              |
| 13:11 | PAD25FNCSEL | 0x3   | RW | Pad 25 function select<br><br>UART1RX = 0x0 - Configure as UART1 RX input signal<br>NCE25 = 0x1 - IOM/MSPI nCE group 25<br>CT1 = 0x2 - CTIMER connection 1<br>GPIO25 = 0x3 - Configure as GPIO25<br>M2SDAWIR3 = 0x4 - Configure as the IOMSTR2 I2C SDA or SPI WIR3 signal<br>M2MISO = 0x5 - Configure as the IOMSTR2 SPI MISO input signal<br>RSVD6 = 0x6 - Reserved<br>RSVD7 = 0x7 - Reserved |
| 10    | PAD25STRNG  | 0x0   | RW | Pad 25 drive strength<br><br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                |
| 9     | PAD25INPEN  | 0x0   | RW | Pad 25 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                      |
| 8     | PAD25PULL   | 0x0   | RW | Pad 25 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                           |
| 7:6   | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                       |

| Bit | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----|-------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5:3 | PAD24FNCSEL | 0x3   | RW | Pad 24 function select<br><br>UART1TX = 0x0 - Configure as UART1 TX output signal<br>NCE24 = 0x1 - IOM/MSPI nCE group 24<br>MSPI8 = 0x2 - MSPI data connection 8<br>GPIO24 = 0x3 - Configure as GPIO24<br>UA0CTS = 0x4 - Configure as UART0 CTS input signal<br>CT21 = 0x5 - CTIMER connection 21<br>32kHzXT = 0x6 - Configure as the 32kHz crystal output signal<br>SWO = 0x7 - Configure as the serial trace data output signal |
| 2   | PAD24STRNG  | 0x0   | RW | Pad 24 drive strength<br><br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                   |
| 1   | PAD24INPEN  | 0x0   | RW | Pad 24 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                         |
| 0   | PAD24PULL   | 0x0   | RW | Pad 24 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                              |

### Pad Configuration Register H (Pads 31-28)

**INSTANCE 0 ADDRESS: 0x4001001C**

|      |              |   |   |   |            |   |            |   |           |   |      |   |   |   |              |   |   |   |            |   |            |   |           |   |      |   |   |  |              |  |  |  |            |  |            |  |           |  |      |  |  |  |              |  |  |  |            |  |            |  |           |  |
|------|--------------|---|---|---|------------|---|------------|---|-----------|---|------|---|---|---|--------------|---|---|---|------------|---|------------|---|-----------|---|------|---|---|--|--------------|--|--|--|------------|--|------------|--|-----------|--|------|--|--|--|--------------|--|--|--|------------|--|------------|--|-----------|--|
| RSVD | 3            | 3 | 2 | 2 | 2          | 2 | 2          | 2 | 2         | 2 | 2    | 1 | 1 | 1 | 1            | 1 | 1 | 1 | 1          | 0 | 0          | 0 | 0         | 0 | 0    | 0 | 0 |  |              |  |  |  |            |  |            |  |           |  |      |  |  |  |              |  |  |  |            |  |            |  |           |  |
|      | 1            | 0 | 9 | 8 | 7          | 6 | 5          | 4 | 3         | 2 | 1    | 0 | 9 | 8 | 7            | 6 | 5 | 4 | 3          | 2 | 1          | 0 | 9         | 8 | 7    | 6 | 5 |  |              |  |  |  |            |  |            |  |           |  |      |  |  |  |              |  |  |  |            |  |            |  |           |  |
|      | PAD31FNC-SEL |   |   |   | PAD31STRNG |   | PAD31INPEN |   | PAD31PULL |   | RSVD |   |   |   | PAD30FNC-SEL |   |   |   | PAD30STRNG |   | PAD30INPEN |   | PAD30PULL |   | RSVD |   |   |  | PAD29FNC-SEL |  |  |  | PAD29STRNG |  | PAD29INPEN |  | PAD29PULL |  | RSVD |  |  |  | PAD28FNC-SEL |  |  |  | PAD28STRNG |  | PAD28INPEN |  | PAD28PULL |  |
|      |              |   |   |   |            |   |            |   |           |   |      |   |   |   |              |   |   |   |            |   |            |   |           |   |      |   |   |  |              |  |  |  |            |  |            |  |           |  |      |  |  |  |              |  |  |  |            |  |            |  |           |  |

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:30 | RSVD | 0x0   | RO | RESERVED    |

Table 638: PADREGH Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|-------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 29:27 | PAD31FNCSEL | 0x3   | RW | Pad 31 function select<br>ADCSE3 = 0x0 - Configure as the analog input for ADC single ended input 3<br>NCE31 = 0x1 - IOM/MSPI nCE group 31<br>CT13 = 0x2 - CTIMER connection 13<br>GPIO31 = 0x3 - Configure as GPIO31<br>UART0RX = 0x4 - Configure as the UART0 RX input signal<br>SCCCLK = 0x5 - SCARD serial clock output<br>RSVD = 0x6 - Reserved<br>UA1RTS = 0x7 - Configure as UART1 RTS output signal |
| 26    | PAD31STRNG  | 0x0   | RW | Pad 31 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                 |
| 25    | PAD31INPEN  | 0x0   | RW | Pad 31 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                       |
| 24    | PAD31PULL   | 0x0   | RW | Pad 31 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                            |
| 23:22 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                    |
| 21:19 | PAD30FNCSEL | 0x3   | RW | Pad 30 function select<br>ANATEST1 = 0x0 - Configure as the ANATEST1 I/O signal<br>NCE30 = 0x1 - IOM/MSPI nCE group 30<br>CT11 = 0x2 - CTIMER connection 11<br>GPIO30 = 0x3 - Configure as GPIO30<br>UART0TX = 0x4 - Configure as UART0 TX output signal<br>UA1RTS = 0x5 - Configure as UART1 RTS output signal<br>RSVD = 0x6 - Reserved<br>I2S_DAT = 0x7 - Configure as the PDM I2S Data output signal     |
| 18    | PAD30STRNG  | 0x0   | RW | Pad 30 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                 |
| 17    | PAD30INPEN  | 0x0   | RW | Pad 30 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                       |
| 16    | PAD30PULL   | 0x0   | RW | Pad 30 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                            |
| 15:14 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                    |

Table 638: PADREGH Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|-------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13:11 | PAD29FNCSEL | 0x3   | RW | Pad 29 function select<br>ADCSE1 = 0x0 - Configure as the analog input for ADC single ended input 1<br>NCE29 = 0x1 - IOM/MSPI nCE group 29<br>CT9 = 0x2 - CTIMER connection 9<br>GPIO29 = 0x3 - Configure as GPIO29<br>UA0CTS = 0x4 - Configure as the UART0 CTS input signal<br>UA1CTS = 0x5 - Configure as the UART1 CTS input signal<br>UART0RX = 0x6 - Configure as the UART0 RX input signal<br>PDM_DATA = 0x7 - Configure as PDM DATA input |
| 10    | PAD29STRNG  | 0x0   | RW | Pad 29 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                                       |
| 9     | PAD29INPEN  | 0x0   | RW | Pad 29 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                             |
| 8     | PAD29PULL   | 0x0   | RW | Pad 29 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                                  |
| 7:6   | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 5:3   | PAD28FNCSEL | 0x3   | RW | Pad 28 function select<br>I2S_WCLK = 0x0 - Configure as the PDM I2S Word Clock input<br>NCE28 = 0x1 - IOM/MSPI nCE group 28<br>CT7 = 0x2 - CTIMER connection 7<br>GPIO28 = 0x3 - Configure as GPIO28<br>RSVD4 = 0x4 - Reserved<br>M2MOSI = 0x5 - Configure as the IOMSTR2 SPI MOSI output signal<br>UART0TX = 0x6 - Configure as the UART0 TX output signal<br>RSVD7 = 0x7 - Reserved                                                             |
| 2     | PAD28STRNG  | 0x0   | RW | Pad 28 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                                       |
| 1     | PAD28INPEN  | 0x0   | RW | Pad 28 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                             |
| 0     | PAD28PULL   | 0x0   | RW | Pad 28 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                                  |

**11.7.2.9 PADREGI Register****Pad Configuration Register I (Pads 35-32)****OFFSET:** 0x00000020**INSTANCE 0 ADDRESS:** 0x40010020





Table 640: PADREGI Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------|-------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18    | PAD34STRNG  | 0x0   | RW | Pad 34 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                             |
| 17    | PAD34INPEN  | 0x0   | RW | Pad 34 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                   |
| 16    | PAD34PULL   | 0x0   | RW | Pad 34 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                        |
| 15:14 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 13:11 | PAD33FNCSEL | 0x3   | RW | Pad 33 function select<br><br>ADCSE5 = 0x0 - Configure as the analog ADC single ended port 5 input signal<br>NCE33 = 0x1 - IOM/MSPI nCE group 33<br>32kHzXT = 0x2 - Configure as the 32kHz crystal output signal<br>GPIO33 = 0x3 - Configure as GPIO33<br>RSVD = 0x4 - Reserved<br>UA0CTS = 0x5 - Configure as the UART0 CTS input<br>CT23 = 0x6 - CTIMER connection 23<br>SWO = 0x7 - Configure as the serial trace data output signal |
| 10    | PAD33STRNG  | 0x0   | RW | Pad 33 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                             |
| 9     | PAD33INPEN  | 0x0   | RW | Pad 33 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                   |
| 8     | PAD33PULL   | 0x0   | RW | Pad 33 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                        |
| 7:6   | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 5:3   | PAD32FNCSEL | 0x3   | RW | Pad 32 function select<br><br>ADCSE4 = 0x0 - Configure as the analog input for ADC single ended input 4<br>NCE32 = 0x1 - IOM/MSPI nCE group 32<br>CT15 = 0x2 - CTIMER connection 15<br>GPIO32 = 0x3 - Configure as GPIO32<br>SCCIO = 0x4 - SCARD serial data input/output<br><br>RSVD = 0x6 - Reserved<br>UA1CTS = 0x7 - Configure as the UART1 CTS input                                                                               |
| 2     | PAD32STRNG  | 0x0   | RW | Pad 32 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                             |

| Bit | Name       | Reset | RW | Description                                                                               |
|-----|------------|-------|----|-------------------------------------------------------------------------------------------|
| 1   | PAD32INPEN | 0x0   | RW | Pad 32 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled |
| 0   | PAD32PULL  | 0x0   | RW | Pad 32 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled      |

This register controls the pad configuration controls for PAD39 through PAD36. Writes to this register must be unlocked by the PADKEY register.

|           |        |              |        |        |        |            |            |           |        |        |              |        |        |        |            |            |           |            |        |        |              |        |        |        |            |            |           |        |        |            |              |  |  |  |            |            |           |
|-----------|--------|--------------|--------|--------|--------|------------|------------|-----------|--------|--------|--------------|--------|--------|--------|------------|------------|-----------|------------|--------|--------|--------------|--------|--------|--------|------------|------------|-----------|--------|--------|------------|--------------|--|--|--|------------|------------|-----------|
| 3<br>1    | 3<br>0 | 2<br>9       | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5     | 2<br>4     | 2<br>3    | 2<br>2 | 2<br>1 | 2<br>0       | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6     | 1<br>5     | 1<br>4    | 1<br>3     | 1<br>2 | 1<br>1 | 1<br>0       | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6     | 0<br>5     | 0<br>4    | 0<br>3 | 0<br>2 | 0<br>1     | 0<br>0       |  |  |  |            |            |           |
| PAD39RSEL |        | PAD39FNC-SEL |        |        |        | PAD39STRNG | PAD39INPEN | PAD39PULL | RSVD   |        | PAD38FNC-SEL |        |        |        | PAD38STRNG | PAD38INPEN | PAD38PULL | PAD37PWRDN | RSVD   |        | PAD37FNC-SEL |        |        |        | PAD37STRNG | PAD37INPEN | PAD37PULL | RSVD   |        | PAD36PWRUP | PAD36FNC-SEL |  |  |  | PAD36STRNG | PAD36INPEN | PAD36PULL |

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|-------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:30 | PAD39RSEL   | 0x0   | RW | Pad 39 pullup resistor selection.<br><br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                                                 |
| 29:27 | PAD39FNCSEL | 0x3   | RW | Pad 39 function select<br><br>UART0TX = 0x0 - Configure as the UART0 TX output signal<br>UART1TX = 0x1 - Configure as the UART1 TX output signal<br>CT25 = 0x2 - CTIMER connection 25<br>GPIO39 = 0x3 - Configure as GPIO39<br>M4SCL = 0x4 - Configure as the IOMSTR4 I2C SCL signal<br>M4SCK = 0x5 - Configure as the IOMSTR4 SPI SCK signal<br>RSVD6 = 0x6 - Reserved<br>RSVD7 = 0x7 - Reserved |

Table 642: PADREGJ Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------|-------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26    | PAD39STRNG  | 0x0   | RW | Pad 39 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                        |
| 25    | PAD39INPEN  | 0x0   | RW | Pad 39 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                              |
| 24    | PAD39PULL   | 0x0   | RW | Pad 39 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                   |
| 23:22 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 21:19 | PAD38FNCSEL | 0x3   | RW | Pad 38 function select<br><br>TRIG3 = 0x0 - Configure as the ADC Trigger 3 signal<br>NCE38 = 0x1 - IOM/MSPI nCE group 38<br>UA0CTS = 0x2 - Configure as the UART0 CTS signal<br>GPIO38 = 0x3 - Configure as GPIO38<br>RSVD4 = 0x4 - Reserved<br>M3MOSI = 0x5 - Configure as the IOMSTR3 SPI MOSI output signal<br>UART1RX = 0x6 - Configure as the UART1 RX input signal<br>RSVD7 = 0x7 - Reserved                                 |
| 18    | PAD38STRNG  | 0x0   | RW | Pad 38 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                        |
| 17    | PAD38INPEN  | 0x0   | RW | Pad 38 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                              |
| 16    | PAD38PULL   | 0x0   | RW | Pad 38 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                   |
| 15    | PAD37PWRDN  | 0x0   | RW | Pad 37 VSS power switch enable<br>DIS = 0x0 - Power switch disabled<br>EN = 0x1 - Power switch enabled (switch to GND)                                                                                                                                                                                                                                                                                                             |
| 14    | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 13:11 | PAD37FNCSEL | 0x3   | RW | Pad 37 function select<br><br>TRIG2 = 0x0 - Configure as the ADC Trigger 2 signal<br>NCE37 = 0x1 - IOM/MSPI nCE group 37<br>UA0RTS = 0x2 - Configure as the UART0 RTS output signal<br>GPIO37 = 0x3 - Configure as GPIO37<br>SCCIO = 0x4 - SCARD serial data input/output<br>UART1TX = 0x5 - Configure as the UART1 TX output signal<br>PDMCLK = 0x6 - Configure as the PDM CLK output signal<br>CT29 = 0x7 - CTIMER connection 29 |

Table 642: PADREGJ Register Bits

| Bit | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----|-------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10  | PAD37STRNG  | 0x0   | RW | Pad 37 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                                                    |
| 9   | PAD37INPEN  | 0x0   | RW | Pad 37 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                                          |
| 8   | PAD37PULL   | 0x0   | RW | Pad 37 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                                               |
| 7   | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 6   | PAD36PWRUP  | 0x0   | RW | Pad 36 VDD power switch enable<br>DIS = 0x0 - Power switch disabled<br>EN = 0x1 - Power switch enabled (switched to VDD)                                                                                                                                                                                                                                                                                                                                       |
| 5:3 | PAD36FNCSEL | 0x3   | RW | Pad 36 function select<br><br>TRIG1 = 0x0 - Configure as the ADC Trigger 1 signal<br>NCE36 = 0x1 - IOM/MSPI nCE group 36<br>UART1RX = 0x2 - Configure as the UART1 RX input signal<br>GPIO36 = 0x3 - Configure as GPIO36<br>32kHzXT = 0x4 - Configure as the 32kHz output clock from the crystal<br>UA1CTS = 0x5 - Configure as the UART1 CTS input signal<br>UA0CTS = 0x6 - Configure as the UART0 CTS input signal<br>PDM DATA = 0x7 - PDM serial data input |
| 2   | PAD36STRNG  | 0x0   | RW | Pad 36 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                                                    |
| 1   | PAD36INPEN  | 0x0   | RW | Pad 36 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                                          |
| 0   | PAD36PULL   | 0x0   | RW | Pad 36 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                                               |

**11.7.2.11 PADREGK Register****Pad Configuration Register K (Pads 43-40)****OFFSET:** 0x00000028**INSTANCE 0 ADDRESS:** 0x40010028

This register controls the pad configuration controls for PAD43 through PAD40. Writes to this register must be unlocked by the PADKEY register.

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                    |
|-------|-------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:30 | PAD43RSEL   | 0x0   | RW | Pad 43 pullup resistor selection.<br><br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                                              |
| 29:27 | PAD43FNCSEL | 0x3   | RW | Pad 43 function select<br><br>UART1RX = 0x0 - Configure as the UART1 RX input signal<br>NCE43 = 0x1 - IOM/MSPI nCE group 43<br>CT18 = 0x2 - CTIMER connection 18<br>GPIO43 = 0x3 - Configure as GPIO43<br>M3SDAWIR3 = 0x4 - Configure as the IOMSTR3 I2C SDA or SPI WIR3 signal<br>M3MISO = 0x5 - Configure as the IOMSTR3 SPI MISO signal<br>RSVD6 = 0x6 - Reserved<br>RSVD7 = 0x7 - Reserved |
| 26    | PAD43STRNG  | 0x0   | RW | Pad 43 drive strength<br><br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                |
| 25    | PAD43INPEN  | 0x0   | RW | Pad 43 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                      |
| 24    | PAD43PULL   | 0x0   | RW | Pad 43 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                           |
| 23:22 | PAD42RSEL   | 0x0   | RW | Pad 42 pullup resistor selection.<br><br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                                              |

Table 644: PADREGK Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------|-------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:19 | PAD42FNCSEL | 0x3   | RW | Pad 42 function select<br>UART1TX = 0x0 - Configure as the UART1 TX output signal<br>NCE42 = 0x1 - IOM/MSPI nCE group 42<br>CT16 = 0x2 - CTIMER connection 16<br>GPIO42 = 0x3 - Configure as GPIO42<br>M3SCL = 0x4 - Configure as the IOMSTR3 I2C SCL clock I/O signal<br>M3SCK = 0x5 - Configure as the IOMSTR3 SPI SCK output<br>RSVD6 = 0x6 - Reserved<br>RSVD7 = 0x7 - Reserved                                |
| 18    | PAD42STRNG  | 0x0   | RW | Pad 42 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                        |
| 17    | PAD42INPEN  | 0x0   | RW | Pad 42 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                              |
| 16    | PAD42PULL   | 0x0   | RW | Pad 42 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                   |
| 15    | PAD41PWRDN  | 0x0   | RW | Pad 41 power switch enable<br>DIS = 0x0 - Power switch disabled<br>EN = 0x1 - Power switch enabled (Switch pad to VSS)                                                                                                                                                                                                                                                                                             |
| 14    | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                           |
| 13:11 | PAD41FNCSEL | 0x3   | RW | Pad 41 function select<br>NCE41 = 0x0 - IOM/MSPI nCE group 41<br>RSVD = 0x1 - Reserved<br>SWO = 0x2 - Configure as the serial wire debug SWO signal<br>GPIO41 = 0x3 - Configure as GPIO41<br>I2SWCLK = 0x4 - I2S word clock input<br>UA1RTS = 0x5 - Configure as the UART1 RTS output signal<br>UART0TX = 0x6 - Configure as the UART0 TX output signal<br>UA0RTS = 0x7 - Configure as the UART0 RTS output signal |
| 10    | PAD41STRNG  | 0x0   | RW | Pad 41 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                        |
| 9     | PAD41INPEN  | 0x0   | RW | Pad 41 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                              |
| 8     | PAD41PULL   | 0x0   | RW | Pad 41 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                   |

**Table 644: PADREGK Register Bits**

| Bit | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----|-------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:6 | PAD40RSEL   | 0x0   | RW | Pad 40 pullup resistor selection.<br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                                                                                         |
| 5:3 | PAD40FNCSEL | 0x3   | RW | Pad 40 function select<br>UART0RX = 0x0 - Configure as the UART0 RX input signal<br>UART1RX = 0x1 - Configure as the UART1 RX input signal<br>TRIG0 = 0x2 - Configure as the ADC Trigger 0 signal<br>GPIO40 = 0x3 - Configure as GPIO40<br>M4SDAWIR3 = 0x4 - Configure as the IOMSTR4 I2C SDA or SPI WIR3 signal<br>M4MISO = 0x5 - Configure as the IOMSTR4 SPI MISO input signal<br>RSVD6 = 0x6 - Reserved<br>RSVD7 = 0x7 - Reserved |
| 2   | PAD40STRNG  | 0x0   | RW | Pad 40 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                           |
| 1   | PAD40INPEN  | 0x0   | RW | Pad 40 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                                 |
| 0   | PAD40PULL   | 0x0   | RW | Pad 40 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                                      |

**11.7.2.12PADREGL Register****Pad Configuration Register L (Pads 47-44)****OFFSET:** 0x0000002C**INSTANCE 0 ADDRESS:** 0x4001002C

This register controls the pad configuration controls for PAD47 through PAD44. Writes to this register must be unlocked by the PADKEY register.

**Table 645: PADREGL Register**

|        |        |              |        |            |            |           |        |        |              |        |            |            |           |        |        |              |        |            |            |           |        |        |              |        |            |            |           |        |        |        |        |
|--------|--------|--------------|--------|------------|------------|-----------|--------|--------|--------------|--------|------------|------------|-----------|--------|--------|--------------|--------|------------|------------|-----------|--------|--------|--------------|--------|------------|------------|-----------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9       | 2<br>8 | 2<br>7     | 2<br>6     | 2<br>5    | 2<br>4 | 2<br>3 | 2<br>2       | 2<br>1 | 2<br>0     | 1<br>9     | 1<br>8    | 1<br>7 | 1<br>6 | 1<br>5       | 1<br>4 | 1<br>3     | 1<br>2     | 1<br>1    | 1<br>0 | 0<br>9 | 0<br>8       | 0<br>7 | 0<br>6     | 0<br>5     | 0<br>4    | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        | PAD47FNC-SEL |        | PAD47STRNG | PAD47INPEN | PAD47PULL | RSVD   |        | PAD46FNC-SEL |        | PAD46STRNG | PAD46INPEN | PAD46PULL | RSVD   |        | PAD45FNC-SEL |        | PAD45STRNG | PAD45INPEN | PAD45PULL | RSVD   |        | PAD44FNC-SEL |        | PAD44STRNG | PAD44INPEN | PAD44PULL |        |        |        |        |



Table 646: PADREGL Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------|-------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:30 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 29:27 | PAD47FNCSEL | 0x3   | RW | Pad 47 function select<br>32kHzXT = 0x0 - Configure as the 32kHz output clock from the crystal<br>NCE47 = 0x1 - IOM/MSPI nCE group 47<br>CT26 = 0x2 - CTIMER connection 26<br>GPIO47 = 0x3 - Configure as GPIO47<br>RSVD4 = 0x4 - Reserved<br>M5MOSI = 0x5 - Configure as the IOMSTR5 SPI MOSI output signal<br>UART1RX = 0x6 - Configure as the UART1 RX input signal<br>RSVD7 = 0x7 - Reserved                         |
| 26    | PAD47STRNG  | 0x0   | RW | Pad 47 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                              |
| 25    | PAD47INPEN  | 0x0   | RW | Pad 47 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                    |
| 24    | PAD47PULL   | 0x0   | RW | Pad 47 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                         |
| 23:22 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 21:19 | PAD46FNCSEL | 0x3   | RW | Pad 46 function select<br>32khz_XT = 0x0 - Configure as the 32kHz output clock from the crystal<br>NCE46 = 0x1 - IOM/MSPI nCE group 46<br>CT24 = 0x2 - CTIMER connection 24<br>GPIO46 = 0x3 - Configure as GPIO46<br>SCCRST = 0x4 - SCARD reset output<br>PDMCLK = 0x5 - PDM serial clock output<br>UART1TX = 0x6 - Configure as the UART1 TX output signal<br>SWO = 0x7 - Configure as the serial wire debug SWO signal |
| 18    | PAD46STRNG  | 0x0   | RW | Pad 46 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                              |
| 17    | PAD46INPEN  | 0x0   | RW | Pad 46 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                    |
| 16    | PAD46PULL   | 0x0   | RW | Pad 46 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                         |
| 15:14 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                 |

**Table 646: PADREGL Register Bits**

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------|-------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13:11 | PAD45FNCSEL | 0x3   | RW | Pad 45 function select<br>UA1CTS = 0x0 - Configure as the UART1 CTS input signal<br>NCE45 = 0x1 - IOM/MSPI nCE group 45<br>CT22 = 0x2 - CTIMER connection 22<br>GPIO45 = 0x3 - Configure as GPIO45<br>I2SDAT = 0x4 - I2S serial data output<br>PDMDATA = 0x5 - PDM serial data input<br>UART0RX = 0x6 - Configure as the SPI channel 5 nCE signal from IOM-STR5<br>SWO = 0x7 - Configure as the serial wire debug SWO signal |
| 10    | PAD45STRNG  | 0x0   | RW | Pad 45 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                  |
| 9     | PAD45INPEN  | 0x0   | RW | Pad 45 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                        |
| 8     | PAD45PULL   | 0x0   | RW | Pad 45 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                             |
| 7:6   | RSVD        | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 5:3   | PAD44FNCSEL | 0x3   | RW | Pad 44 function select<br>UA1RTS = 0x0 - Configure as the UART1 RTS output signal<br>NCE44 = 0x1 - IOM/MSPI nCE group 44<br>CT20 = 0x2 - CTIMER connection 20<br>GPIO44 = 0x3 - Configure as GPIO44<br>RSVD4 = 0x4 - Reserved<br>M4MOSI = 0x5 - Configure as the IOMSTR4 SPI MOSI signal<br>UART0TX = 0x6 - Configure as the UART0 TX output signal<br>RSVD = 0x7 - Reserved                                                 |
| 2     | PAD44STRNG  | 0x0   | RW | Pad 44 drive strength<br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                                                                  |
| 1     | PAD44INPEN  | 0x0   | RW | Pad 44 input enable<br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                                                                        |
| 0     | PAD44PULL   | 0x0   | RW | Pad 44 pullup enable<br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                                                             |

**11.7.2.13PADREGM Register****Pad Configuration Register M (Pads 49-48)****OFFSET:** 0x00000030**INSTANCE 0 ADDRESS:** 0x40010030



| Bit | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                             |
|-----|-------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:6 | PAD48RSEL   | 0x0   | RW | Pad 48 pullup resistor selection.<br><br>PULL1_5K = 0x0 - Pullup is ~1.5 KOhms<br>PULL6K = 0x1 - Pullup is ~6 KOhms<br>PULL12K = 0x2 - Pullup is ~12 KOhms<br>PULL24K = 0x3 - Pullup is ~24 KOhms                                                                                                                                                                                       |
| 5:3 | PAD48FNCSEL | 0x3   | RW | Pad 48 function select<br><br>UART0TX = 0x0 - Configure as the UART0 TX output signal<br>NCE48 = 0x1 - IOM/MSPi nCE group 48<br>CT28 = 0x2 - CTIMER conenction 28<br>GPIO48 = 0x3 - Configure as GPIO48<br>M5SCL = 0x4 - Configure as the IOMSTR5 I2C SCL clock I/O signal<br>M5SCK = 0x5 - Configure as the IOMSTR5 SPI SCK output<br>RSVD6 = 0x6 - Reserved<br>RSVD7 = 0x7 - Reserved |
| 2   | PAD48STRNG  | 0x0   | RW | Pad 48 drive strength<br><br>LOW = 0x0 - Low drive strength<br>HIGH = 0x1 - High drive strength                                                                                                                                                                                                                                                                                         |
| 1   | PAD48INPEN  | 0x0   | RW | Pad 48 input enable<br><br>DIS = 0x0 - Pad input disabled<br>EN = 0x1 - Pad input enabled                                                                                                                                                                                                                                                                                               |
| 0   | PAD48PULL   | 0x0   | RW | Pad 48 pullup enable<br><br>DIS = 0x0 - Pullup disabled<br>EN = 0x1 - Pullup enabled                                                                                                                                                                                                                                                                                                    |

GPIO configuration controls for GPIO[7:0]. Writes to this register must be unlocked by the PADKEY register.

[illegible]

Table 650: CFGA Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------|-------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | GPIO7INTD   | 0x0   | RW | GPIO7 interrupt direction, nCE polarity.<br><br>nCELOW = 0x0 - FNCSEL = 0x0 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x0 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x0, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x0, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x0, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x0, INCFG = 0 - Interrupt on high to low GPIO transition |
| 30:29 | GPIO7OUTCFG | 0x0   | RW | GPIO7 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE1 = 0x0 - FNCSEL = 0x0 - IOM3 nCE, Channel 1<br>M4nCE1 = 0x1 - FNCSEL = 0x0 - IOM4 nCE, Channel 1<br>M5nCE1 = 0x2 - FNCSEL = 0x0 - IOM5 nCE, Channel 1<br>MSPInCE0 = 0x3 - FNCSEL = 0x0 - MSPI nCE, Channel 0                                                                        |
| 28    | GPIO7INCFG  | 0x0   | RW | GPIO7 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                                         |
| 27    | GPIO6INTD   | 0x0   | RW | GPIO6 interrupt direction.<br><br>INTDIS = 0x0 - INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - INCFG = 0 - Interrupt on high to low GPIO transition                                                                                                                                                                                               |
| 26:25 | GPIO6OUTCFG | 0x0   | RW | GPIO6 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state                                                                                                                                                                                                                                                                                              |
| 24    | GPIO6INCFG  | 0x0   | RW | GPIO6 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                                         |
| 23    | GPIO5INTD   | 0x0   | RW | GPIO5 interrupt direction.<br><br>INTDIS = 0x0 - INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - INCFG = 0 - Interrupt on high to low GPIO transition                                                                                                                                                                                               |

Table 650: CFGA Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------|-------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22:21 | GPIO5OUTCFG | 0x0   | RW | GPIO5 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state                                                                                                                                                                                                                                                                                |
| 20    | GPIO5INCFG  | 0x0   | RW | GPIO5 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 19    | GPIO4INTD   | 0x0   | RW | GPIO4 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x2 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x2 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x2, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x2, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x2, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x2, INCFG = 0 - Interrupt on high to low GPIO transition |
| 18:17 | GPIO4OUTCFG | 0x0   | RW | GPIO4 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE1 = 0x0 - FNCSEL = 0x2 - IOM3 nCE, Channel 1<br>M4nCE1 = 0x1 - FNCSEL = 0x2 - IOM4 nCE, Channel 1<br>M5nCE1 = 0x2 - FNCSEL = 0x2 - IOM5 nCE, Channel 1<br>M1nCE1 = 0x3 - FNCSEL = 0x2 - IOM1 nCE, Channel 1                                                            |
| 16    | GPIO4INCFG  | 0x0   | RW | GPIO4 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 15    | GPIO3INTD   | 0x0   | RW | GPIO3 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x2 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x2 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x2, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x2, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x2, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x2, INCFG = 0 - Interrupt on high to low GPIO transition |

Table 650: CFGA Register Bits

| Bit   | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------|-------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14:13 | GPIO3OUTCFG | 0x0   | RW | GPIO3 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE0 = 0x0 - FNCSEL = 0x2 - IOM3 nCE, Channel 0<br>M4nCE0 = 0x1 - FNCSEL = 0x2 - IOM4 nCE, Channel 0<br>M5nCE0 = 0x2 - FNCSEL = 0x2 - IOM5 nCE, Channel 0<br>M2nCE0 = 0x3 - FNCSEL = 0x2 - IOM2 nCE, Channel 0                                                            |
| 12    | GPIO3INCFG  | 0x0   | RW | GPIO3 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 11    | GPIO2INTD   | 0x0   | RW | GPIO2 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x7 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x7 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x7, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x7, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x7, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x7, INCFG = 0 - Interrupt on high to low GPIO transition |
| 10:9  | GPIO2OUTCFG | 0x0   | RW | GPIO2 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE3 = 0x0 - FNCSEL = 0x7 - IOM3 nCE, Channel 3<br>M4nCE3 = 0x1 - FNCSEL = 0x7 - IOM4 nCE, Channel 3<br>M5nCE3 = 0x2 - FNCSEL = 0x7 - IOM5 nCE, Channel 3<br>M2nCE1 = 0x3 - FNCSEL = 0x7 - IOM2 nCE, Channel 1                                                            |
| 8     | GPIO2INCFG  | 0x0   | RW | GPIO2 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 7     | GPIO1INTD   | 0x0   | RW | GPIO1 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x7 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x7 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x7, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x7, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x7, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x7, INCFG = 0 - Interrupt on high to low GPIO transition |

Table 650: CFGA Register Bits

| Bit | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----|-------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6:5 | GPIO1OUTCFG | 0x0   | RW | GPIO1 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE2 = 0x0 - FNCSEL = 0x7 - IOM0 nCE, Channel 2<br>M1nCE2 = 0x1 - FNCSEL = 0x7 - IOM1 nCE, Channel 2<br>M2nCE2 = 0x2 - FNCSEL = 0x7 - IOM2 nCE, Channel 2<br>MSPIInCE0 = 0x3 - FNCSEL = 0x7 - MSPI nCE, Channel 0                                                         |
| 4   | GPIO1INCFG  | 0x0   | RW | GPIO1 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 3   | GPIO0INTD   | 0x0   | RW | GPIO0 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x7 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x7 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x7, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x7, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x7, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x7, INCFG = 0 - Interrupt on high to low GPIO transition |
| 2:1 | GPIO0OUTCFG | 0x0   | RW | GPIO0 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE2 = 0x0 - FNCSEL = 0x7 - IOM3 nCE, Channel 2<br>M4nCE2 = 0x1 - FNCSEL = 0x7 - IOM4 nCE, Channel 2<br>M5nCE2 = 0x2 - FNCSEL = 0x7 - IOM5 nCE, Channel 2<br>M1nCE3 = 0x3 - FNCSEL = 0x7 - IOM1 nCE, Channel 3                                                            |
| 0   | GPIO0INCFG  | 0x0   | RW | GPIO0 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

**11.7.2.15CFGB Register****GPIO Configuration Register B (Pads 15-8)****OFFSET:** 0x00000044**INSTANCE 0 ADDRESS:** 0x40010044

GPIO configuration controls for GPIO[15:8]. Writes to this register must be unlocked by the PADKEY register.





Table 652: CFGB Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------|---------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26:25 | GPIO14OUT-CFG | 0x0   | RW | GPIO14 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE2 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 2<br>M1nCE2 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 2<br>M2nCE2 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 2<br>M4nCE2 = 0x3 - FNCSEL = 0x1 - IOM4 nCE, Channel 2                                                            |
| 24    | GPIO14INCFG   | 0x0   | RW | GPIO14 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 23    | GPIO13INTD    | 0x0   | RW | GPIO13 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 22:21 | GPIO13OUT-CFG | 0x0   | RW | GPIO13 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE1 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 1<br>M4nCE1 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 1<br>M5nCE1 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 1<br>M0nCE1 = 0x3 - FNCSEL = 0x1 - IOM0 nCE, Channel 1                                                            |
| 20    | GPIO13INCFG   | 0x0   | RW | GPIO13 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 19    | GPIO12INTD    | 0x0   | RW | GPIO12 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |

Table 652: CFGB Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------|---------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18:17 | GPIO12OUT-CFG | 0x0   | RW | GPIO12 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE0 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 0<br>M4nCE0 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 0<br>M5nCE0 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 0<br>MSPInCE1 = 0x3 - FNCSEL = 0x1 - MPSI nCE, Channel 1                                                          |
| 16    | GPIO12INCFG   | 0x0   | RW | GPIO12 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 15    | GPIO11INTD    | 0x0   | RW | GPIO11 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 14:13 | GPIO11OUT-CFG | 0x0   | RW | GPIO11 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE0 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 0<br>M1nCE0 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 0<br>M2nCE0 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 0<br>M3nCE0 = 0x3 - FNCSEL = 0x1 - IOM3 nCE, Channel 0                                                            |
| 12    | GPIO11INCFG   | 0x0   | RW | GPIO11 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 11    | GPIO10INTD    | 0x0   | RW | GPIO10 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x2 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x2 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x2, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x2, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x2, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x2, INCFG = 0 - Interrupt on high to low GPIO transition |

Table 652: CFGB Register Bits

| Bit  | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|---------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10:9 | GPIO10OUT-CFG | 0x0   | RW | GPIO10 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE2 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 2<br>M4nCE2 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 2<br>M5nCE2 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 2<br>MSPInCE0 = 0x3 - FNCSEL = 0x1 - MPSI nCE, Channel 0                                                         |
| 8    | GPIO10INCFG   | 0x0   | RW | GPIO10 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                          |
| 7    | GPIO9INTD     | 0x0   | RW | GPIO9 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x2 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x2 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x2, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x2, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x2, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x2, INCFG = 0 - Interrupt on high to low GPIO transition |
| 6:5  | GPIO9OUTCFG   | 0x0   | RW | GPIO9 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE3 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 3<br>M4nCE3 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 3<br>M5nCE3 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 3<br>M2nCE3 = 0x3 - FNCSEL = 0x1 - IOM2 nCE, Channel 3                                                            |
| 4    | GPIO9INCFG    | 0x0   | RW | GPIO9 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 3    | GPIO8INTD     | 0x0   | RW | GPIO8 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x2 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x2 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x2, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x2, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x2, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x2, INCFG = 0 - Interrupt on high to low GPIO transition |

Table 652: CFGB Register Bits

| Bit | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----|-------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2:1 | GPIO8OUTCFG | 0x0   | RW | GPIO8 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE0 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 0<br>M4nCE0 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 0<br>M5nCE0 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 0<br>M0nCE0 = 0x3 - FNCSEL = 0x1 - IOM0 nCE, Channel 0 |
| 0   | GPIO8INCFG  | 0x0   | RW | GPIO8 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                |

**11.7.2.16CFG Register****GPIO Configuration Register C (Pads 23-16)****OFFSET:** 0x00000048**INSTANCE 0 ADDRESS:** 0x40010048

GPIO configuration controls for GPIO[23:16]. Writes to this register must be unlocked by the PADKEY register.

Table 653: CFGC Register

|            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |   |   |   |   |   |
|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|---|---|---|---|---|
| 3          | 3            | 2           | 2          | 2            | 2           | 2          | 2            | 2           | 2          | 2            | 1           | 1          | 1            | 1           | 1          | 1            | 1           | 1          | 0            | 0           | 0          | 0            | 0           | 0 | 0 | 0 | 0 | 0 |
| 1          | 0            | 9           | 8          | 7            | 6           | 5          | 4            | 3           | 2          | 1            | 0           | 9          | 8            | 7           | 6          | 5            | 4           | 3          | 2            | 1           | 0          | 9            | 8           | 7 | 6 | 5 | 4 | 3 |
| GPIO23INTD | GPIO23OUTCFG | GPIO23INCFG | GPIO22INTD | GPIO22OUTCFG | GPIO22INCFG | GPIO21INTD | GPIO21OUTCFG | GPIO21INCFG | GPIO20INTD | GPIO20OUTCFG | GPIO20INCFG | GPIO19INTD | GPIO19OUTCFG | GPIO19INCFG | GPIO18INTD | GPIO18OUTCFG | GPIO18INCFG | GPIO17INTD | GPIO17OUTCFG | GPIO17INCFG | GPIO16INTD | GPIO16OUTCFG | GPIO16INCFG |   |   |   |   |   |

Table 654: CFGC Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------|---------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | GPIO23INTD    | 0x0   | RW | GPIO23 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 30:29 | GPIO23OUT-CFG | 0x0   | RW | GPIO23 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE0 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 0<br>M1nCE0 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 0<br>M2nCE0 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 0<br>M4nCE0 = 0x3 - FNCSEL = 0x1 - IOM4 nCE, Channel 0                                                            |
| 28    | GPIO23INCFG   | 0x0   | RW | GPIO23 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 27    | GPIO22INTD    | 0x0   | RW | GPIO22 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 26:25 | GPIO22OUT-CFG | 0x0   | RW | GPIO22 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE3 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 3<br>M4nCE3 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 3<br>M5nCE3 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 3<br>M0nCE3 = 0x3 - FNCSEL = 0x1 - IOM0 nCE, Channel 3                                                            |
| 24    | GPIO22INCFG   | 0x0   | RW | GPIO22 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

Table 654: CFGC Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|---------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23    | GPIO21INTD    | 0x0   | RW | GPIO21 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 22:21 | GPIO21OUT-CFG | 0x0   | RW | GPIO21 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE2 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 2<br>M4nCE2 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 2<br>M5nCE2 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 2<br>M2nCE2 = 0x3 - FNCSEL = 0x1 - IOM2 nCE, Channel 2                                                            |
| 20    | GPIO21INCFG   | 0x1   | RW | GPIO21 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 19    | GPIO20INTD    | 0x0   | RW | GPIO20 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 18:17 | GPIO20OUT-CFG | 0x0   | RW | GPIO20 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE1 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 1<br>M4nCE1 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 1<br>M5nCE1 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 1<br>M2nCE1 = 0x3 - FNCSEL = 0x1 - IOM2 nCE, Channel 1                                                            |
| 16    | GPIO20INCFG   | 0x1   | RW | GPIO20 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

Table 654: CFGC Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------|---------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15    | GPIO19INTD    | 0x0   | RW | GPIO19 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 14:13 | GPIO19OUT-CFG | 0x0   | RW | GPIO19 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE3 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 3<br>M1nCE3 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 3<br>M2nCE3 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 3<br>MSPInCE0 = 0x3 - FNCSEL = 0x1 - MSPI nCE, Channel 0                                                          |
| 12    | GPIO19INCFG   | 0x0   | RW | GPIO19 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 11    | GPIO18INTD    | 0x0   | RW | GPIO18 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 10:9  | GPIO18OUT-CFG | 0x0   | RW | GPIO18 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE2 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 2<br>M1nCE2 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 2<br>M2nCE2 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 2<br>M3nCE2 = 0x3 - FNCSEL = 0x1 - IOM3 nCE, Channel 2                                                            |
| 8     | GPIO18INCFG   | 0x0   | RW | GPIO18 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |



Table 654: CFGC Register Bits

| Bit | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----|---------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7   | GPIO17INTD    | 0x0   | RW | GPIO17 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 6:5 | GPIO17OUT-CFG | 0x0   | RW | GPIO17 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE1 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 1<br>M1nCE1 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 1<br>M2nCE1 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 1<br>M4nCE1 = 0x3 - FNCSEL = 0x1 - IOM4 nCE, Channel 1                                                            |
| 4   | GPIO17INCFG   | 0x0   | RW | GPIO17 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 3   | GPIO16INTD    | 0x0   | RW | GPIO16 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 2:1 | GPIO16OUT-CFG | 0x0   | RW | GPIO16 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE0 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 0<br>M1nCE0 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 0<br>M2nCE0 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 0<br>M5nCE0 = 0x3 - FNCSEL = 0x1 - IOM5 nCE, Channel 0                                                            |
| 0   | GPIO16INCFG   | 0x0   | RW | GPIO16 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

**11.7.2.17CFGD Register****GPIO Configuration Register D (Pads 31-24)****OFFSET:** 0x0000004C**INSTANCE 0 ADDRESS:** 0x4001004C

GPIO configuration controls for GPIO[31:24]. Writes to this register must be unlocked by the PADKEY register.

**Table 655: CFGD Register**

|            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |   |   |   |   |   |
|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|---|---|---|---|---|
| 3          | 3            | 2           | 2          | 2            | 2           | 2          | 2            | 2           | 2          | 2            | 1           | 1          | 1            | 1           | 1          | 1            | 1           | 0          | 0            | 0           | 0          | 0            | 0           | 0 | 0 | 0 | 0 | 0 |
| 1          | 0            | 9           | 8          | 7            | 6           | 5          | 4            | 3           | 2          | 1            | 0           | 9          | 8            | 7           | 6          | 5            | 4           | 3          | 2            | 1           | 0          | 9            | 8           | 7 | 6 | 5 | 4 | 3 |
| GPIO31INTD | GPIO31OUTCFG | GPIO31INCFG | GPIO30INTD | GPIO30OUTCFG | GPIO30INCFG | GPIO29INTD | GPIO29OUTCFG | GPIO29INCFG | GPIO28INTD | GPIO28OUTCFG | GPIO28INCFG | GPIO27INTD | GPIO27OUTCFG | GPIO27INCFG | GPIO26INTD | GPIO26OUTCFG | GPIO26INCFG | GPIO25INTD | GPIO25OUTCFG | GPIO25INCFG | GPIO24INTD | GPIO24OUTCFG | GPIO24INCFG |   |   |   |   |   |

**Table 656: CFGD Register Bits**

| Bit   | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------|--------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | GPIO31INTD   | 0x0   | RW | GPIO31 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 30:29 | GPIO31OUTCFG | 0x0   | RW | GPIO31 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE0 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 0<br>M1nCE0 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 0<br>M2nCE0 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 0<br>M4nCE0 = 0x3 - FNCSEL = 0x1 - IOM4 nCE, Channel 0                                                            |
| 28    | GPIO31INCFG  | 0x0   | RW | GPIO31 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

Table 656: CFGD Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|---------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27    | GPIO30INTD    | 0x0   | RW | GPIO30 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 26:25 | GPIO30OUT-CFG | 0x0   | RW | GPIO30 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE3 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 3<br>M4nCE3 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 3<br>M5nCE3 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 3<br>M0nCE3 = 0x3 - FNCSEL = 0x1 - IOM0 nCE, Channel 3                                                            |
| 24    | GPIO30INCFG   | 0x0   | RW | GPIO30 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 23    | GPIO29INTD    | 0x0   | RW | GPIO29 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 22:21 | GPIO29OUT-CFG | 0x0   | RW | GPIO29 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE2 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 2<br>M4nCE2 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 2<br>M5nCE2 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 2<br>M1nCE2 = 0x3 - FNCSEL = 0x1 - IOM1 nCE, Channel 2                                                            |
| 20    | GPIO29INCFG   | 0x0   | RW | GPIO29 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

Table 656: CFGD Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|---------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19    | GPIO28INTD    | 0x0   | RW | GPIO28 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 18:17 | GPIO28OUT-CFG | 0x0   | RW | GPIO28 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE1 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 1<br>M4nCE1 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 1<br>M5nCE1 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 1<br>MSPInCE0 = 0x3 - FNCSEL = 0x1 - MSPI nCE, Channel 0                                                          |
| 16    | GPIO28INCFG   | 0x0   | RW | GPIO28 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 15    | GPIO27INTD    | 0x0   | RW | GPIO27 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 14:13 | GPIO27OUT-CFG | 0x0   | RW | GPIO27 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE0 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 0<br>M4nCE0 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 0<br>M5nCE0 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 0<br>M1nCE0 = 0x3 - FNCSEL = 0x1 - IOM1 nCE, Channel 0                                                            |
| 12    | GPIO27INCFG   | 0x0   | RW | GPIO27 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

Table 656: CFGD Register Bits

| Bit  | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|---------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | GPIO26INTD    | 0x0   | RW | GPIO26 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 10:9 | GPIO26OUT-CFG | 0x0   | RW | GPIO26 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE3 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 3<br>M4nCE3 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 3<br>M5nCE3 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 3<br>M1nCE3 = 0x3 - FNCSEL = 0x1 - IOM1 nCE, Channel 3                                                            |
| 8    | GPIO26INCFG   | 0x0   | RW | GPIO26 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 7    | GPIO25INTD    | 0x0   | RW | GPIO25 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 6:5  | GPIO25OUT-CFG | 0x0   | RW | GPIO25 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE2 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 2<br>M4nCE2 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 2<br>M5nCE2 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 2<br>M0nCE2 = 0x3 - FNCSEL = 0x1 - IOM0 nCE, Channel 2                                                            |
| 4    | GPIO25INCFG   | 0x0   | RW | GPIO25 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

Table 656: CFGD Register Bits

| Bit | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----|--------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3   | GPIO24INTD   | 0x0   | RW | GPIO24 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 2:1 | GPIO24OUTCFG | 0x0   | RW | GPIO24 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE1 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 1<br>M1nCE1 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 1<br>M2nCE1 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 1<br>M5nCE1 = 0x3 - FNCSEL = 0x1 - IOM5 nCE, Channel 1                                                            |
| 0   | GPIO24INCFG  | 0x0   | RW | GPIO24 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

**11.7.2.18CFGE Register****GPIO Configuration Register E (Pads 39-32)****OFFSET:** 0x00000050**INSTANCE 0 ADDRESS:** 0x40010050

GPIO configuration controls for GPIO[39:32]. Writes to this register must be unlocked by the PADKEY register.

Table 657: CFGE Register

|            |   |              |   |             |   |            |   |              |   |             |   |            |   |              |   |             |   |            |   |              |   |             |   |            |   |              |   |             |  |            |  |              |  |             |  |            |  |              |  |             |  |            |  |              |  |             |  |
|------------|---|--------------|---|-------------|---|------------|---|--------------|---|-------------|---|------------|---|--------------|---|-------------|---|------------|---|--------------|---|-------------|---|------------|---|--------------|---|-------------|--|------------|--|--------------|--|-------------|--|------------|--|--------------|--|-------------|--|------------|--|--------------|--|-------------|--|
| 3          | 3 | 2            | 2 | 2           | 2 | 2          | 2 | 2            | 2 | 2           | 1 | 1          | 1 | 1            | 1 | 1           | 1 | 1          | 0 | 0            | 0 | 0           | 0 | 0          | 0 | 0            | 0 | 0           |  |            |  |              |  |             |  |            |  |              |  |             |  |            |  |              |  |             |  |
| 1          | 0 | 9            | 8 | 7           | 6 | 5          | 4 | 3            | 2 | 1           | 0 | 9          | 8 | 7            | 6 | 5           | 4 | 3          | 2 | 1            | 0 | 9           | 8 | 7          | 6 | 5            | 4 | 3           |  |            |  |              |  |             |  |            |  |              |  |             |  |            |  |              |  |             |  |
| GPIO39INTD |   | GPIO39OUTCFG |   | GPIO39INCFG |   | GPIO38INTD |   | GPIO38OUTCFG |   | GPIO38INCFG |   | GPIO37INTD |   | GPIO37OUTCFG |   | GPIO37INCFG |   | GPIO36INTD |   | GPIO36OUTCFG |   | GPIO36INCFG |   | GPIO35INTD |   | GPIO35OUTCFG |   | GPIO35INCFG |  | GPIO34INTD |  | GPIO34OUTCFG |  | GPIO34INCFG |  | GPIO33INTD |  | GPIO33OUTCFG |  | GPIO33INCFG |  | GPIO32INTD |  | GPIO32OUTCFG |  | GPIO32INCFG |  |

Table 658: CFGE Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------|---------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | GPIO39INTD    | 0x0   | RW | GPIO39 interrupt direction.<br><br>INTDIS = 0x0 - INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - INCFG = 0 - Interrupt on high to low GPIO transition                                                                                                                                                                                 |
| 30:29 | GPIO39OUT-CFG | 0x0   | RW | GPIO39 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state                                                                                                                                                                                                                                                                                |
| 28    | GPIO39INCFG   | 0x0   | RW | GPIO39 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 27    | GPIO38INTD    | 0x0   | RW | GPIO38 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 26:25 | GPIO38OUT-CFG | 0x0   | RW | GPIO38 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE3 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 3<br>M1nCE3 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 3<br>M2nCE3 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 3<br>M5nCE3 = 0x3 - FNCSEL = 0x1 - IOM5 nCE, Channel 3                                                            |
| 24    | GPIO38INCFG   | 0x0   | RW | GPIO38 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

Table 658: CFGE Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|---------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23    | GPIO37INTD    | 0x0   | RW | GPIO37 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 22:21 | GPIO37OUT-CFG | 0x0   | RW | GPIO37 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE2 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 2<br>M4nCE2 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 2<br>M5nCE2 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 2<br>M0nCE2 = 0x3 - FNCSEL = 0x1 - IOM0 nCE, Channel 2                                                            |
| 20    | GPIO37INCFG   | 0x0   | RW | GPIO37 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 19    | GPIO36INTD    | 0x0   | RW | GPIO36 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 18:17 | GPIO36OUT-CFG | 0x0   | RW | GPIO36 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE1 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 1<br>M4nCE1 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 1<br>M5nCE1 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 1<br>MSPInCE1 = 0x3 - FNCSEL = 0x1 - MSPI nCE, Channel 1                                                          |
| 16    | GPIO36INCFG   | 0x0   | RW | GPIO36 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |



Table 658: CFGE Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|---------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15    | GPIO35INTD    | 0x0   | RW | GPIO35 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 14:13 | GPIO35OUT-CFG | 0x0   | RW | GPIO35 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE0 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 0<br>M1nCE0 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 0<br>M2nCE0 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 0<br>M3nCE0 = 0x3 - FNCSEL = 0x1 - IOM3 nCE, Channel 0                                                            |
| 12    | GPIO35INCFG   | 0x0   | RW | GPIO35 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 11    | GPIO34INTD    | 0x0   | RW | GPIO34 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 10:9  | GPIO34OUT-CFG | 0x0   | RW | GPIO34 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE3 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 3<br>M1nCE3 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 3<br>M2nCE3 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 3<br>M3nCE3 = 0x3 - FNCSEL = 0x1 - IOM3 nCE, Channel 3                                                            |
| 8     | GPIO34INCFG   | 0x0   | RW | GPIO34 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

Table 658: CFGE Register Bits

| Bit | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----|---------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7   | GPIO33INTD    | 0x0   | RW | GPIO33 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 6:5 | GPIO33OUT-CFG | 0x0   | RW | GPIO33 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE2 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 2<br>M1nCE2 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 2<br>M2nCE2 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 2<br>M5nCE2 = 0x3 - FNCSEL = 0x1 - IOM5 nCE, Channel 2                                                            |
| 4   | GPIO33INCFG   | 0x0   | RW | GPIO33 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 3   | GPIO32INTD    | 0x0   | RW | GPIO32 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 2:1 | GPIO32OUT-CFG | 0x0   | RW | GPIO32 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE1 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 1<br>M1nCE1 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 1<br>M2nCE1 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 1<br>MSPIInCE1 = 0x3 - FNCSEL = 0x1 - MSPI nCE, Channel 1                                                         |
| 0   | GPIO32INCFG   | 0x0   | RW | GPIO32 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

**11.7.2.19CFGF Register****GPIO Configuration Register F (Pads 47-40)****OFFSET:** 0x00000054**INSTANCE 0 ADDRESS:** 0x40010054

GPIO configuration controls for GPIO[47:40]. Writes to this register must be unlocked by the PADKEY register.

**Table 659: CFGF Register**

|            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |            |              |             |   |   |   |   |   |
|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|------------|--------------|-------------|---|---|---|---|---|
| 3          | 3            | 2           | 2          | 2            | 2           | 2          | 2            | 2           | 2          | 2            | 1           | 1          | 1            | 1           | 1          | 1            | 1           | 0          | 0            | 0           | 0          | 0            | 0           | 0 | 0 | 0 | 0 | 0 |
| 1          | 0            | 9           | 8          | 7            | 6           | 5          | 4            | 3           | 2          | 1            | 0           | 9          | 8            | 7           | 6          | 5            | 4           | 3          | 2            | 1           | 0          | 9            | 8           | 7 | 6 | 5 | 4 | 3 |
| GPIO47INTD | GPIO47OUTCFG | GPIO47INCFG | GPIO46INTD | GPIO46OUTCFG | GPIO46INCFG | GPIO45INTD | GPIO45OUTCFG | GPIO45INCFG | GPIO44INTD | GPIO44OUTCFG | GPIO44INCFG | GPIO43INTD | GPIO43OUTCFG | GPIO43INCFG | GPIO42INTD | GPIO42OUTCFG | GPIO42INCFG | GPIO41INTD | GPIO41OUTCFG | GPIO41INCFG | GPIO40INTD | GPIO40OUTCFG | GPIO40INCFG |   |   |   |   |   |

**Table 660: CFGF Register Bits**

| Bit   | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------|--------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | GPIO47INTD   | 0x0   | RW | GPIO47 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 30:29 | GPIO47OUTCFG | 0x0   | RW | GPIO47 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE1 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 1<br>M1nCE1 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 1<br>M2nCE1 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 1<br>M3nCE1 = 0x3 - FNCSEL = 0x1 - IOM3 nCE, Channel 1                                                            |
| 28    | GPIO47INCFG  | 0x0   | RW | GPIO47 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

Table 660: CFGF Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------|---------------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27    | GPIO46INTD    | 0x0   | RW | GPIO46 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 26:25 | GPIO46OUT-CFG | 0x0   | RW | GPIO46 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE0 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 0<br>M4nCE0 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 0<br>M5nCE0 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 0<br>MSPInCE1 = 0x3 - FNCSEL = 0x1 - MSPI nCE, Channel 1                                                          |
| 24    | GPIO46INCFG   | 0x0   | RW | GPIO46 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 23    | GPIO45INTD    | 0x0   | RW | GPIO45 interrupt direction.<br><br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 22:21 | GPIO45OUT-CFG | 0x0   | RW | GPIO45 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M3nCE3 = 0x0 - FNCSEL = 0x1 - IOM3 nCE, Channel 3<br>M4nCE3 = 0x1 - FNCSEL = 0x1 - IOM4 nCE, Channel 3<br>M5nCE3 = 0x2 - FNCSEL = 0x1 - IOM5 nCE, Channel 3<br>M1nCE3 = 0x3 - FNCSEL = 0x1 - IOM1 nCE, Channel 3                                                            |
| 20    | GPIO45INCFG   | 0x0   | RW | GPIO45 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

Table 660: CFGF Register Bits

| Bit   | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|---------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19    | GPIO44INTD    | 0x0   | RW | GPIO44 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 18:17 | GPIO44OUT-CFG | 0x0   | RW | GPIO44 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE2 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 2<br>M1nCE2 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 2<br>M2nCE2 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 2<br>M5nCE2 = 0x3 - FNCSEL = 0x1 - IOM5 nCE, Channel 2                                                            |
| 16    | GPIO44INCFG   | 0x0   | RW | GPIO44 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 15    | GPIO43INTD    | 0x0   | RW | GPIO43 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 14:13 | GPIO43OUT-CFG | 0x0   | RW | GPIO43 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE1 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 1<br>M1nCE1 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 1<br>M2nCE1 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 1<br>MSPIInCE1 = 0x3 - FNCSEL = 0x1 - MSPI nCE, Channel 1                                                         |
| 12    | GPIO43INCFG   | 0x0   | RW | GPIO43 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

Table 660: CFGF Register Bits

| Bit  | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|---------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | GPIO42INTD    | 0x0   | RW | GPIO42 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 10:9 | GPIO42OUT-CFG | 0x0   | RW | GPIO42 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE0 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 0<br>M1nCE0 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 0<br>M2nCE0 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 0<br>M5nCE0 = 0x3 - FNCSEL = 0x1 - IOM5 nCE, Channel 0                                                            |
| 8    | GPIO42INCFG   | 0x0   | RW | GPIO42 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 7    | GPIO41INTD    | 0x0   | RW | GPIO41 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x0 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x0 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x0, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x0, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x0, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x0, INCFG = 0 - Interrupt on high to low GPIO transition |
| 6:5  | GPIO41OUT-CFG | 0x0   | RW | GPIO41 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE1 = 0x0 - FNCSEL = 0x0 - IOM0 nCE, Channel 1<br>M1nCE1 = 0x1 - FNCSEL = 0x0 - IOM1 nCE, Channel 1<br>M2nCE1 = 0x2 - FNCSEL = 0x0 - IOM2 nCE, Channel 1<br>MSPIInCE1 = 0x3 - FNCSEL = 0x0 - MSPI nCE, Channel 1                                                         |
| 4    | GPIO41INCFG   | 0x0   | RW | GPIO41 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |

| Bit | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                             |
|-----|---------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3   | GPIO40INTD    | 0x0   | RW | GPIO40 interrupt direction.<br><br>INTDIS = 0x0 - INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - INCFG = 0 - Interrupt on high to low GPIO transition |
| 2:1 | GPIO40OUT-CFG | 0x0   | RW | GPIO40 output configuration.<br><br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state                                                                                                |
| 0   | GPIO40INCFG   | 0x0   | RW | GPIO40 input enable.<br><br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                           |

### GPIO Configuration Register G (Pads 49-48)

**INSTANCE 0 ADDRESS: 0x40010058**

GPIO configuration controls for GPIO[49:48]. Writes to this register must be unlocked by the PADKEY register.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |            |              |             |            |              |             |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------|--------------|-------------|------------|--------------|-------------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7     | 0<br>6       | 0<br>5      | 0<br>4     | 0<br>3       | 0<br>2      | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | GPIO49INTD | GPIO49OUTCFG | GPIO49INCFG | GPIO48INTD | GPIO48OUTCFG | GPIO48INCFG |        |        |

| Bit  | Name | Reset | RW | Description |
|------|------|-------|----|-------------|
| 31:8 | RSVD | 0x0   | RO | RESERVED    |

Table 662: CFGG Register Bits

| Bit | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----|---------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7   | GPIO49INTD    | 0x0   | RW | GPIO49 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 6:5 | GPIO49OUT-CFG | 0x0   | RW | GPIO49 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE3 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 3<br>M1nCE3 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 3<br>M2nCE3 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 3<br>M4nCE3 = 0x3 - FNCSEL = 0x1 - IOM4 nCE, Channel 3                                                            |
| 4   | GPIO49INCFG   | 0x0   | RW | GPIO49 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |
| 3   | GPIO48INTD    | 0x0   | RW | GPIO48 interrupt direction.<br>nCELOW = 0x0 - FNCSEL = 0x1 - nCE polarity active low<br>nCEHIGH = 0x1 - FNCSEL = 0x1 - nCE polarity active high<br>INTDIS = 0x0 - FNCSEL != 0x1, INCFG = 1 - No interrupt on GPIO transition<br>INTBOTH = 0x1 - FNCSEL != 0x1, INCFG = 1 - Interrupt on either low to high or high to low GPIO transition<br>INTLH = 0x0 - FNCSEL != 0x1, INCFG = 0 - Interrupt on low to high GPIO transition<br>INTHL = 0x1 - FNCSEL != 0x1, INCFG = 0 - Interrupt on high to low GPIO transition |
| 2:1 | GPIO48OUT-CFG | 0x0   | RW | GPIO48 output configuration.<br>DIS = 0x0 - FNCSEL = 0x3 - Output disabled<br>PUSHPULL = 0x1 - FNCSEL = 0x3 - Output is push-pull<br>OD = 0x2 - FNCSEL = 0x3 - Output is open drain<br>TS = 0x3 - FNCSEL = 0x3 - Output is tri-state<br>M0nCE2 = 0x0 - FNCSEL = 0x1 - IOM0 nCE, Channel 2<br>M1nCE2 = 0x1 - FNCSEL = 0x1 - IOM1 nCE, Channel 2<br>M2nCE2 = 0x2 - FNCSEL = 0x1 - IOM2 nCE, Channel 2<br>M3nCE2 = 0x3 - FNCSEL = 0x1 - IOM3 nCE, Channel 2                                                            |
| 0   | GPIO48INCFG   | 0x0   | RW | GPIO48 input enable.<br>READ = 0x0 - Read the GPIO pin data<br>RDZERO = 0x1 - INTD = 0 - Readback will always be zero<br>READEN = 0x1 - INTD = 1 - Read the GPIO pin data                                                                                                                                                                                                                                                                                                                                           |





















| Bit   | Name   | Reset | RW | Description                                                                                                                                |
|-------|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------|
| 22    | STPOL2 | 0x0   | RW | STIMER Capture 2 Polarity.<br>CAPLH = 0x0 - Capture on low to high GPIO transition<br>CAPHL = 0x1 - Capture on high to low GPIO transition |
| 21:16 | STSEL2 | 0x3f  | RW | STIMER Capture 2 Select.                                                                                                                   |
| 15    | RSVD   | 0x0   | RO | RESERVED                                                                                                                                   |
| 14    | STPOL1 | 0x0   | RW | STIMER Capture 1 Polarity.<br>CAPLH = 0x0 - Capture on low to high GPIO transition<br>CAPHL = 0x1 - Capture on high to low GPIO transition |
| 13:8  | STSEL1 | 0x3f  | RW | STIMER Capture 1 Select.                                                                                                                   |
| 7     | RSVD   | 0x0   | RO | RESERVED                                                                                                                                   |
| 6     | STPOL0 | 0x0   | RW | STIMER Capture 0 Polarity.<br>CAPLH = 0x0 - Capture on low to high GPIO transition<br>CAPHL = 0x1 - Capture on high to low GPIO transition |
| 5:0   | STSEL0 | 0x3f  | RW | STIMER Capture 0 Select.                                                                                                                   |

## IOM0 Flow Control IRQ Select

**INSTANCE 0 ADDRESS: 0x400100C0**

IOMSTR0 IRQ select for flow control.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9       | 8 | 7 | 6 | 5 | 4 | 3 |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | IOM0IRQ |   |   |   |   |   |   |  |

| Bit  | Name    | Reset | RW | Description             |
|------|---------|-------|----|-------------------------|
| 31:6 | RSVD    | 0x0   | RO | RESERVED                |
| 5:0  | IOM0IRQ | 0x3f  | RW | IOMSTR0 IRQ pad select. |









**Table 712: ALTPADCFGA Register Bits**

| Bit   | Name     | Reset | RW | Description                                                                                                        |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------|
| 28    | PAD3_SR  | 0x0   | RW | Pad 3 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                       |
| 27:25 | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 24    | PAD3_DS1 | 0x0   | RW | Pad 3 high order drive strength selection. Used in conjunction with PAD3STRNG field to set the pad drive strength. |
| 23:21 | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 20    | PAD2_SR  | 0x0   | RW | Pad 2 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                       |
| 19:17 | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 16    | PAD2_DS1 | 0x0   | RW | Pad 2 high order drive strength selection. Used in conjunction with PAD2STRNG field to set the pad drive strength. |
| 15:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 12    | PAD1_SR  | 0x0   | RW | Pad 1 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                       |
| 11:9  | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 8     | PAD1_DS1 | 0x0   | RW | Pad 1 high order drive strength selection. Used in conjunction with PAD1STRNG field to set the pad drive strength. |
| 7:5   | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 4     | PAD0_SR  | 0x0   | RW | Pad 0 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                       |
| 3:1   | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 0     | PAD0_DS1 | 0x0   | RW | Pad 0 high order drive strength selection. Used in conjunction with PAD0STRNG field to set the pad drive strength. |

**11.7.2.46ALTPADCFGB Register****Alternate Pad Configuration reg1 (Pads 4-7)****OFFSET:** 0x000000E4**INSTANCE 0 ADDRESS:** 0x400100E4

This register has additional configuration control for pads 7, 6, 5, 4

Table 713: ALTPADCFCB Register

|        |        |        |         |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |         |        |        |        |          |
|--------|--------|--------|---------|--------|--------|--------|----------|--------|--------|--------|---------|--------|--------|--------|----------|--------|--------|--------|---------|--------|--------|--------|----------|--------|--------|--------|---------|--------|--------|--------|----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8  | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4   | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0  | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6   | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2  | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8   | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4  | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0   |
| RSVD   |        |        | PAD7_SR | RSVD   |        |        | PAD7_DS1 | RSVD   |        |        | PAD6_SR | RSVD   |        |        | PAD6_DS1 | RSVD   |        |        | PAD5_SR | RSVD   |        |        | PAD5_DS1 | RSVD   |        |        | PAD4_SR | RSVD   |        |        | PAD4_DS1 |

Table 714: ALTPADCFCB Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                        |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------|
| 31:29 | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 28    | PAD7_SR  | 0x0   | RW | Pad 7 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                       |
| 27:25 | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 24    | PAD7_DS1 | 0x0   | RW | Pad 7 high order drive strength selection. Used in conjunction with PAD7STRNG field to set the pad drive strength. |
| 23:21 | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 20    | PAD6_SR  | 0x0   | RW | Pad 6 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                       |
| 19:17 | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 16    | PAD6_DS1 | 0x0   | RW | Pad 6 high order drive strength selection. Used in conjunction with PAD6STRNG field to set the pad drive strength. |
| 15:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 12    | PAD5_SR  | 0x0   | RW | Pad 5 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                       |
| 11:9  | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 8     | PAD5_DS1 | 0x0   | RW | Pad 5 high order drive strength selection. Used in conjunction with PAD5STRNG field to set the pad drive strength. |
| 7:5   | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 4     | PAD4_SR  | 0x0   | RW | Pad 4 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                       |

| Bit | Name     | Reset | RW | Description                                                                                                        |
|-----|----------|-------|----|--------------------------------------------------------------------------------------------------------------------|
| 3:1 | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 0   | PAD4_DS1 | 0x0   | RW | Pad 4 high order drive strength selection. Used in conjunction with PAD4STRNG field to set the pad drive strength. |

### Alternate Pad Configuration reg2 (Pads 8-11)

**INSTANCE 0 ADDRESS: 0x400100E8**

|        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |         |        |        |        |          |        |        |        |         |        |        |        |          |
|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|---------|--------|--------|--------|----------|--------|--------|--------|---------|--------|--------|--------|----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8   | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4    | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0   | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2  | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8   | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4  | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0   |
| RSVD   |        |        | PAD11_SR | RSVD   |        |        | PAD11_DS1 | RSVD   |        |        | PAD10_SR | RSVD   |        |        | PAD10_DS1 | RSVD   |        |        | PAD9_SR | RSVD   |        |        | PAD9_DS1 | RSVD   |        |        | PAD8_SR | RSVD   |        |        | PAD8_DS1 |

| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 31:29 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 28    | PAD11_SR  | 0x0   | RW | Pad 11 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 27:25 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 24    | PAD11_DS1 | 0x0   | RW | Pad 11 high order drive strength selection. Used in conjunction with PAD11STRNG field to set the pad drive strength. |
| 23:21 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 20    | PAD10_SR  | 0x0   | RW | Pad 10 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 19:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 16    | PAD10_DS1 | 0x0   | RW | Pad 10 high order drive strength selection. Used in conjunction with PAD10STRNG field to set the pad drive strength. |



| Bit   | Name     | Reset | RW | Description                                                                                                        |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------|
| 15:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 12    | PAD9_SR  | 0x0   | RW | Pad 9 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                       |
| 11:9  | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 8     | PAD9_DS1 | 0x0   | RW | Pad 9 high order drive strength selection. Used in conjunction with PAD9STRNG field to set the pad drive strength. |
| 7:5   | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 4     | PAD8_SR  | 0x0   | RW | Pad 8 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                       |
| 3:1   | RSVD     | 0x0   | RO | RESERVED                                                                                                           |
| 0     | PAD8_DS1 | 0x0   | RW | Pad 8 high order drive strength selection. Used in conjunction with PAD8STRNG field to set the pad drive strength. |

### Alternate Pad Configuration reg3 (Pads 12-15)

**INSTANCE 0 ADDRESS: 0x400100EC**

|        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |
|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8   | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4    | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0   | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4   | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0    |
| RSVD   |        |        | PAD15_SR | RSVD   |        |        | PAD15_DS1 | RSVD   |        |        | PAD14_SR | RSVD   |        |        | PAD14_DS1 | RSVD   |        |        | PAD13_SR | RSVD   |        |        | PAD13_DS1 | RSVD   |        |        | PAD12_SR | RSVD   |        |        | PAD12_DS1 |

| Bit   | Name     | Reset | RW | Description                                                                   |
|-------|----------|-------|----|-------------------------------------------------------------------------------|
| 31:29 | RSVD     | 0x0   | RO | RESERVED                                                                      |
| 28    | PAD15_SR | 0x0   | RW | Pad 15 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad |

**Table 718: ALTPADCFGD Register Bits**

| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 27:25 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 24    | PAD15_DS1 | 0x0   | RW | Pad 15 high order drive strength selection. Used in conjunction with PAD15STRNG field to set the pad drive strength. |
| 23:21 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 20    | PAD14_SR  | 0x0   | RW | Pad 14 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 19:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 16    | PAD14_DS1 | 0x0   | RW | Pad 14 high order drive strength selection. Used in conjunction with PAD14STRNG field to set the pad drive strength. |
| 15:13 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 12    | PAD13_SR  | 0x0   | RW | Pad 13 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 11:9  | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 8     | PAD13_DS1 | 0x0   | RW | Pad 13 high order drive strength selection. Used in conjunction with PAD13STRNG field to set the pad drive strength. |
| 7:5   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 4     | PAD12_SR  | 0x0   | RW | Pad 12 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 3:1   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 0     | PAD12_DS1 | 0x0   | RW | Pad 12 high order drive strength selection. Used in conjunction with PAD12STRNG field to set the pad drive strength. |

**11.7.2.49ALTPADCFGE Register****Alternate Pad Configuration reg4 (Pads 16-19)****OFFSET:** 0x000000F0**INSTANCE 0 ADDRESS:** 0x400100F0

This register has additional configuration control for pads 19, 18, 17, 16

[illegible]

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|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

| Bit | Name      | Reset | RW | Description                                                                                                          |
|-----|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 3:1 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 0   | PAD16_DS1 | 0x0   | RW | Pad 16 high order drive strength selection. Used in conjunction with PAD16STRNG field to set the pad drive strength. |

### Alternate Pad Configuration reg5 (Pads 20-23)

**INSTANCE 0 ADDRESS: 0x400100F4**

|        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |
|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8   | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4    | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0   | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4   | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0    |
| RSVD   |        |        | PAD23_SR | RSVD   |        |        | PAD23_DS1 | RSVD   |        |        | PAD22_SR | RSVD   |        |        | PAD22_DS1 | RSVD   |        |        | PAD21_SR | RSVD   |        |        | PAD21_DS1 | RSVD   |        |        | PAD20_SR | RSVD   |        |        | PAD20_DS1 |

| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 31:29 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 28    | PAD23_SR  | 0x0   | RW | Pad 23 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 27:25 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 24    | PAD23_DS1 | 0x0   | RW | Pad 23 high order drive strength selection. Used in conjunction with PAD23STRNG field to set the pad drive strength. |
| 23:21 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 20    | PAD22_SR  | 0x0   | RW | Pad 22 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 19:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 16    | PAD22_DS1 | 0x0   | RW | Pad 22 high order drive strength selection. Used in conjunction with PAD22STRNG field to set the pad drive strength. |

| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 15:13 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 12    | PAD21_SR  | 0x0   | RW | Pad 21 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 11:9  | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 8     | PAD21_DS1 | 0x0   | RW | Pad 21 high order drive strength selection. Used in conjunction with PAD21STRNG field to set the pad drive strength. |
| 7:5   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 4     | PAD20_SR  | 0x0   | RW | Pad 20 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 3:1   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 0     | PAD20_DS1 | 0x0   | RW | Pad 20 high order drive strength selection. Used in conjunction with PAD20STRNG field to set the pad drive strength. |

### Alternate Pad Configuration reg6 (Pads 24-27)

**INSTANCE 0 ADDRESS: 0x400100F8**

|        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |
|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8   | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4    | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0   | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4   | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0    |
| RSVD   |        |        | PAD27_SR | RSVD   |        |        | PAD27_DS1 | RSVD   |        |        | PAD26_SR | RSVD   |        |        | PAD26_DS1 | RSVD   |        |        | PAD25_SR | RSVD   |        |        | PAD25_DS1 | RSVD   |        |        | PAD24_SR | RSVD   |        |        | PAD24_DS1 |

| Bit   | Name     | Reset | RW | Description                                                                   |
|-------|----------|-------|----|-------------------------------------------------------------------------------|
| 31:29 | RSVD     | 0x0   | RO | RESERVED                                                                      |
| 28    | PAD27_SR | 0x0   | RW | Pad 27 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad |

**Table 724: ALTPADCFGG Register Bits**

| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 27:25 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 24    | PAD27_DS1 | 0x0   | RW | Pad 27 high order drive strength selection. Used in conjunction with PAD27STRNG field to set the pad drive strength. |
| 23:21 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 20    | PAD26_SR  | 0x0   | RW | Pad 26 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 19:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 16    | PAD26_DS1 | 0x0   | RW | Pad 26 high order drive strength selection. Used in conjunction with PAD26STRNG field to set the pad drive strength. |
| 15:13 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 12    | PAD25_SR  | 0x0   | RW | Pad 25 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 11:9  | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 8     | PAD25_DS1 | 0x0   | RW | Pad 25 high order drive strength selection. Used in conjunction with PAD25STRNG field to set the pad drive strength. |
| 7:5   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 4     | PAD24_SR  | 0x0   | RW | Pad 24 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 3:1   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 0     | PAD24_DS1 | 0x0   | RW | Pad 24 high order drive strength selection. Used in conjunction with PAD24STRNG field to set the pad drive strength. |

**11.7.2.52ALTPADCFGH Register****Alternate Pad Configuration reg7 (Pads 28-31)****OFFSET:** 0x000000FC**INSTANCE 0 ADDRESS:** 0x400100FC

This register has additional configuration control for pads 31, 30, 29, 28

Table 725: ALTPADCFGH Register

|      |   |          |      |   |           |      |   |          |      |   |           |      |   |          |      |   |           |      |   |          |      |   |           |      |   |          |      |   |
|------|---|----------|------|---|-----------|------|---|----------|------|---|-----------|------|---|----------|------|---|-----------|------|---|----------|------|---|-----------|------|---|----------|------|---|
| 3    | 3 | 2        | 2    | 2 | 2         | 2    | 2 | 2        | 2    | 2 | 1         | 1    | 1 | 1        | 1    | 1 | 1         | 1    | 0 | 0        | 0    | 0 | 0         | 0    | 0 | 0        | 0    | 0 |
| 1    | 0 | 9        | 8    | 7 | 6         | 5    | 4 | 3        | 2    | 1 | 0         | 9    | 8 | 7        | 6    | 5 | 4         | 3    | 2 | 1        | 0    | 9 | 8         | 7    | 6 | 5        | 4    | 3 |
| RSVD |   | PAD31_SR | RSVD |   | PAD31_DS1 | RSVD |   | PAD30_SR | RSVD |   | PAD30_DS1 | RSVD |   | PAD29_SR | RSVD |   | PAD29_DS1 | RSVD |   | PAD28_SR | RSVD |   | PAD28_DS1 | RSVD |   | PAD27_SR | RSVD |   |

Table 726: ALTPADCFGH Register Bits

| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 31:29 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 28    | PAD31_SR  | 0x0   | RW | Pad 31 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 27:25 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 24    | PAD31_DS1 | 0x0   | RW | Pad 31 high order drive strength selection. Used in conjunction with PAD31STRNG field to set the pad drive strength. |
| 23:21 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 20    | PAD30_SR  | 0x0   | RW | Pad 30 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 19:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 16    | PAD30_DS1 | 0x0   | RW | Pad 30 high order drive strength selection. Used in conjunction with PAD30STRNG field to set the pad drive strength. |
| 15:13 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 12    | PAD29_SR  | 0x0   | RW | Pad 29 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 11:9  | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 8     | PAD29_DS1 | 0x0   | RW | Pad 29 high order drive strength selection. Used in conjunction with PAD29STRNG field to set the pad drive strength. |
| 7:5   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 4     | PAD28_SR  | 0x0   | RW | Pad 28 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |

| Bit | Name      | Reset | RW | Description                                                                                                          |
|-----|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 3:1 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 0   | PAD28_DS1 | 0x0   | RW | Pad 28 high order drive strength selection. Used in conjunction with PAD28STRNG field to set the pad drive strength. |

### Alternate Pad Configuration reg8 (Pads 32-35)

**INSTANCE 0 ADDRESS: 0x40010100**

|        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |
|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8   | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4    | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0   | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4   | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0    |
| RSVD   |        |        | PAD35_SR | RSVD   |        |        | PAD35_DS1 | RSVD   |        |        | PAD34_SR | RSVD   |        |        | PAD34_DS1 | RSVD   |        |        | PAD33_SR | RSVD   |        |        | PAD33_DS1 | RSVD   |        |        | PAD32_SR | RSVD   |        |        | PAD32_DS1 |

| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 31:29 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 28    | PAD35_SR  | 0x0   | RW | Pad 35 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 27:25 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 24    | PAD35_DS1 | 0x0   | RW | Pad 35 high order drive strength selection. Used in conjunction with PAD35STRNG field to set the pad drive strength. |
| 23:21 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 20    | PAD34_SR  | 0x0   | RW | Pad 34 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 19:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 16    | PAD34_DS1 | 0x0   | RW | Pad 34 high order drive strength selection. Used in conjunction with PAD34STRNG field to set the pad drive strength. |



| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 15:13 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 12    | PAD33_SR  | 0x0   | RW | Pad 33 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 11:9  | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 8     | PAD33_DS1 | 0x0   | RW | Pad 33 high order drive strength selection. Used in conjunction with PAD33STRNG field to set the pad drive strength. |
| 7:5   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 4     | PAD32_SR  | 0x0   | RW | Pad 32 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 3:1   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 0     | PAD32_DS1 | 0x0   | RW | Pad 32 high order drive strength selection. Used in conjunction with PAD32STRNG field to set the pad drive strength. |

### Alternate Pad Configuration reg9 (Pads 36-39)

**INSTANCE 0 ADDRESS: 0x40010104**

This register has additional configuration control for pads 39, 38, 37, 36

|        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |
|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8   | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4    | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0   | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4   | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0    |
| RSVD   |        |        | PAD39_SR | RSVD   |        |        | PAD39_DS1 | RSVD   |        |        | PAD38_SR | RSVD   |        |        | PAD38_DS1 | RSVD   |        |        | PAD37_SR | RSVD   |        |        | PAD37_DS1 | RSVD   |        |        | PAD36_SR | RSVD   |        |        | PAD36_DS1 |

| Bit   | Name     | Reset | RW | Description                                                                   |
|-------|----------|-------|----|-------------------------------------------------------------------------------|
| 31:29 | RSVD     | 0x0   | RO | RESERVED                                                                      |
| 28    | PAD39_SR | 0x0   | RW | Pad 39 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad |

**Table 730: ALTPADCFGJ Register Bits**

| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 27:25 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 24    | PAD39_DS1 | 0x0   | RW | Pad 39 high order drive strength selection. Used in conjunction with PAD39STRNG field to set the pad drive strength. |
| 23:21 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 20    | PAD38_SR  | 0x0   | RW | Pad 38 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 19:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 16    | PAD38_DS1 | 0x0   | RW | Pad 38 high order drive strength selection. Used in conjunction with PAD38STRNG field to set the pad drive strength. |
| 15:13 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 12    | PAD37_SR  | 0x0   | RW | Pad 37 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 11:9  | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 8     | PAD37_DS1 | 0x0   | RW | Pad 37 high order drive strength selection. Used in conjunction with PAD37STRNG field to set the pad drive strength. |
| 7:5   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 4     | PAD36_SR  | 0x0   | RW | Pad 36 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 3:1   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 0     | PAD36_DS1 | 0x0   | RW | Pad 36 high order drive strength selection. Used in conjunction with PAD36STRNG field to set the pad drive strength. |

**11.7.2.55ALTPADCFGK Register****Alternate Pad Configuration reg10 (Pads 40-43)****OFFSET:** 0x00000108**INSTANCE 0 ADDRESS:** 0x40010108

This register has additional configuration control for pads 43, 42, 41, 40

Table 731: ALTPADCFGK Register

|        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |
|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8   | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4    | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0   | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4   | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0    |
| RSVD   |        |        | PAD43_SR | RSVD   |        |        | PAD43_DS1 | RSVD   |        |        | PAD42_SR | RSVD   |        |        | PAD42_DS1 | RSVD   |        |        | PAD41_SR | RSVD   |        |        | PAD41_DS1 | RSVD   |        |        | PAD40_SR | RSVD   |        |        | PAD40_DS1 |

Table 732: ALTPADCFGK Register Bits

| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 31:29 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 28    | PAD43_SR  | 0x0   | RW | Pad 43 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 27:25 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 24    | PAD43_DS1 | 0x0   | RW | Pad 43 high order drive strength selection. Used in conjunction with PAD43STRNG field to set the pad drive strength. |
| 23:21 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 20    | PAD42_SR  | 0x0   | RW | Pad 42 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 19:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 16    | PAD42_DS1 | 0x0   | RW | Pad 42 high order drive strength selection. Used in conjunction with PAD42STRNG field to set the pad drive strength. |
| 15:13 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 12    | PAD41_SR  | 0x0   | RW | Pad 41 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 11:9  | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 8     | PAD41_DS1 | 0x0   | RW | Pad 41 high order drive strength selection. Used in conjunction with PAD41STRNG field to set the pad drive strength. |
| 7:5   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 4     | PAD40_SR  | 0x0   | RW | Pad 40 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |

| Bit | Name      | Reset | RW | Description                                                                                                          |
|-----|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 3:1 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 0   | PAD40_DS1 | 0x0   | RW | Pad 40 high order drive strength selection. Used in conjunction with PAD40STRNG field to set the pad drive strength. |

### Alternate Pad Configuration reg11 (Pads 44-47)

**INSTANCE 0 ADDRESS: 0x4001010C**

This register has additional configuration control for pads 47, 46, 45, 44

|        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |
|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8   | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4    | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0   | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6    | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4   | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0    |
| RSVD   |        |        | PAD47_SR | RSVD   |        |        | PAD47_DS1 | RSVD   |        |        | PAD46_SR | RSVD   |        |        | PAD46_DS1 | RSVD   |        |        | PAD45_SR | RSVD   |        |        | PAD45_DS1 | RSVD   |        |        | PAD44_SR | RSVD   |        |        | PAD44_DS1 |

| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 31:29 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 28    | PAD47_SR  | 0x0   | RW | Pad 47 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 27:25 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 24    | PAD47_DS1 | 0x0   | RW | Pad 47 high order drive strength selection. Used in conjunction with PAD47STRNG field to set the pad drive strength. |
| 23:21 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 20    | PAD46_SR  | 0x0   | RW | Pad 46 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 19:17 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 16    | PAD46_DS1 | 0x0   | RW | Pad 46 high order drive strength selection. Used in conjunction with PAD46STRNG field to set the pad drive strength. |

| Bit   | Name      | Reset | RW | Description                                                                                                          |
|-------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 15:13 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 12    | PAD45_SR  | 0x0   | RW | Pad 45 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 11:9  | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 8     | PAD45_DS1 | 0x0   | RW | Pad 45 high order drive strength selection. Used in conjunction with PAD45STRNG field to set the pad drive strength. |
| 7:5   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 4     | PAD44_SR  | 0x0   | RW | Pad 44 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad                                        |
| 3:1   | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 0     | PAD44_DS1 | 0x0   | RW | Pad 44 high order drive strength selection. Used in conjunction with PAD44STRNG field to set the pad drive strength. |

### Alternate Pad Configuration reg12 (Pads 48-49)

**INSTANCE 0 ADDRESS: 0x40010110**

This register has additional configuration control for pads 49, 48

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |           |        |        |        |          |        |        |        |           |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|-----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8    | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4   | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0    |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | PAD49_SR | RSVD   |        |        | PAD49_DS1 | RSVD   |        |        | PAD48_SR | RSVD   |        |        | PAD48_DS1 |

| Bit   | Name     | Reset | RW | Description                                                                   |
|-------|----------|-------|----|-------------------------------------------------------------------------------|
| 31:13 | RSVD     | 0x0   | RO | RESERVED                                                                      |
| 12    | PAD49_SR | 0x0   | RW | Pad 49 slew rate selection.<br>SR_EN = 0x1 - Enables Slew rate control on pad |

| Bit  | Name      | Reset | RW | Description                                                                                                          |
|------|-----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 11:9 | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 8    | PAD49_DS1 | 0x0   | RW | Pad 49 high order drive strength selection. Used in conjunction with PAD49STRNG field to set the pad drive strength. |
| 7:5  | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 4    | PAD48_SR  | 0x0   | RW | Pad 48 slew rate selection.<br><br>SR_EN = 0x1 - Enables Slew rate control on pad                                    |
| 3:1  | RSVD      | 0x0   | RO | RESERVED                                                                                                             |
| 0    | PAD48_DS1 | 0x0   | RW | Pad 48 high order drive strength selection. Used in conjunction with PAD48STRNG field to set the pad drive strength. |

Scard card detect select.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7     | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | SCDET |   |   |   |   |   |   |   |   |  |  |  |

| Bit  | Name  | Reset | RW | Description                   |
|------|-------|-------|----|-------------------------------|
| 31:6 | RSVD  | 0x0   | RO | RESERVED                      |
| 5:0  | SCDET | 0x3f  | RW | SCARD card detect pad select. |

Pad enable configuration.

**Table 739: CTENCFG Register**

|      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |     |     |     |     |     |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|
| 3    | 3    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 0    | 0    | 0    | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| 1    | 0    | 9    | 8    | 7    | 6    | 5    | 4    | 3    | 2    | 1    | 0    | 9    | 8    | 7    | 6    | 5    | 4    | 3    | 2    | 1    | 0    | 9   | 8   | 7   | 6   | 5   | 4   | 3   |
| EN31 | EN30 | EN29 | EN28 | EN27 | EN26 | EN25 | EN24 | EN23 | EN22 | EN21 | EN20 | EN19 | EN18 | EN17 | EN16 | EN15 | EN14 | EN13 | EN12 | EN11 | EN10 | EN9 | EN8 | EN7 | EN6 | EN5 | EN4 | EN3 |
|      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |     |     |     |     |     |

**Table 740: CTENCFG Register Bits**

| Bit | Name | Reset | RW | Description                                                                             |
|-----|------|-------|----|-----------------------------------------------------------------------------------------|
| 31  | EN31 | 0x1   | RW | CT31 Enable<br>DIS = 0x1 - Disable CT31 for output<br>EN = 0x0 - Enable CT31 for output |
| 30  | EN30 | 0x1   | RW | CT30 Enable<br>DIS = 0x1 - Disable CT30 for output<br>EN = 0x0 - Enable CT30 for output |
| 29  | EN29 | 0x1   | RW | CT29 Enable<br>DIS = 0x1 - Disable CT29 for output<br>EN = 0x0 - Enable CT29 for output |
| 28  | EN28 | 0x1   | RW | CT28 Enable<br>DIS = 0x1 - Disable CT28 for output<br>EN = 0x0 - Enable CT28 for output |
| 27  | EN27 | 0x1   | RW | CT27 Enable<br>DIS = 0x1 - Disable CT27 for output<br>EN = 0x0 - Enable CT27 for output |
| 26  | EN26 | 0x1   | RW | CT26 Enable<br>DIS = 0x1 - Disable CT26 for output<br>EN = 0x0 - Enable CT26 for output |
| 25  | EN25 | 0x1   | RW | CT25 Enable<br>DIS = 0x1 - Disable CT25 for output<br>EN = 0x0 - Enable CT25 for output |
| 24  | EN24 | 0x1   | RW | CT24 Enable<br>DIS = 0x1 - Disable CT24 for output<br>EN = 0x0 - Enable CT24 for output |
| 23  | EN23 | 0x1   | RW | CT23 Enable<br>DIS = 0x1 - Disable CT23 for output<br>EN = 0x0 - Enable CT23 for output |
| 22  | EN22 | 0x1   | RW | CT22 Enable<br>DIS = 0x1 - Disable CT22 for output<br>EN = 0x0 - Enable CT22 for output |

Table 740: CTENCFG Register Bits

| Bit | Name | Reset | RW | Description                                                                             |
|-----|------|-------|----|-----------------------------------------------------------------------------------------|
| 21  | EN21 | 0x1   | RW | CT21 Enable<br>DIS = 0x1 - Disable CT21 for output<br>EN = 0x0 - Enable CT21 for output |
| 20  | EN20 | 0x1   | RW | CT20 Enable<br>DIS = 0x1 - Disable CT20 for output<br>EN = 0x0 - Enable CT20 for output |
| 19  | EN19 | 0x1   | RW | CT19 Enable<br>DIS = 0x1 - Disable CT19 for output<br>EN = 0x0 - Enable CT19 for output |
| 18  | EN18 | 0x1   | RW | CT18 Enable<br>DIS = 0x1 - Disable CT18 for output<br>EN = 0x0 - Enable CT18 for output |
| 17  | EN17 | 0x1   | RW | CT17 Enable<br>DIS = 0x1 - Disable CT17 for output<br>EN = 0x0 - Enable CT17 for output |
| 16  | EN16 | 0x1   | RW | CT16 Enable<br>DIS = 0x1 - Disable CT16 for output<br>EN = 0x0 - Enable CT16 for output |
| 15  | EN15 | 0x1   | RW | CT15 Enable<br>DIS = 0x1 - Disable CT15 for output<br>EN = 0x0 - Enable CT15 for output |
| 14  | EN14 | 0x1   | RW | CT14 Enable<br>DIS = 0x1 - Disable CT14 for output<br>EN = 0x0 - Enable CT14 for output |
| 13  | EN13 | 0x1   | RW | CT13 Enable<br>DIS = 0x1 - Disable CT13 for output<br>EN = 0x0 - Enable CT13 for output |
| 12  | EN12 | 0x1   | RW | CT12 Enable<br>DIS = 0x1 - Disable CT12 for output<br>EN = 0x0 - Enable CT12 for output |
| 11  | EN11 | 0x1   | RW | CT11 Enable<br>DIS = 0x1 - Disable CT11 for output<br>EN = 0x0 - Enable CT11 for output |
| 10  | EN10 | 0x1   | RW | CT10 Enable<br>DIS = 0x1 - Disable CT10 for output<br>EN = 0x0 - Enable CT10 for output |
| 9   | EN9  | 0x1   | RW | CT9 Enable<br>DIS = 0x0 - Disable CT9 for output<br>EN = 0x0 - Enable CT9 for output    |



**Table 740: CTENCFG Register Bits**

| Bit | Name | Reset | RW | Description                                                                          |
|-----|------|-------|----|--------------------------------------------------------------------------------------|
| 8   | EN8  | 0x1   | RW | CT8 Enable<br>DIS = 0x1 - Disable CT8 for output<br>EN = 0x0 - Enable CT8 for output |
| 7   | EN7  | 0x1   | RW | CT7 Enable<br>DIS = 0x1 - Disable CT7 for output<br>EN = 0x0 - Enable CT7 for output |
| 6   | EN6  | 0x1   | RW | CT6 Enable<br>DIS = 0x1 - Disable CT6 for output<br>EN = 0x0 - Enable CT6 for output |
| 5   | EN5  | 0x1   | RW | CT5 Enable<br>DIS = 0x1 - Disable CT5 for output<br>EN = 0x0 - Enable CT5 for output |
| 4   | EN4  | 0x1   | RW | CT4 Enable<br>DIS = 0x1 - Disable CT4 for output<br>EN = 0x0 - Enable CT4 for output |
| 3   | EN3  | 0x1   | RW | CT3 Enable<br>DIS = 0x1 - Disable CT3 for output<br>EN = 0x0 - Enable CT3 for output |
| 2   | EN2  | 0x1   | RW | CT2 Enable<br>DIS = 0x1 - Disable CT2 for output<br>EN = 0x0 - Enable CT2 for output |
| 1   | EN1  | 0x1   | RW | CT1 Enable<br>DIS = 0x1 - Disable CT1 for output<br>EN = 0x0 - Enable CT1 for output |
| 0   | EN0  | 0x1   | RW | CT0 Enable<br>DIS = 0x1 - Disable CT0 for output<br>EN = 0x0 - Enable CT0 for output |

**11.7.2.60INT0EN Register****GPIO Interrupt Registers 31-0: Enable****OFFSET:** 0x00000200**INSTANCE 0 ADDRESS:** 0x40010200

Set bits in this register to allow this module to generate the corresponding interrupt.

---

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

**Table 742: INT0EN Register Bits**

| Bit | Name   | Reset | RW | Description       |
|-----|--------|-------|----|-------------------|
| 13  | GPIO13 | 0x0   | RW | GPIO13 interrupt. |
| 12  | GPIO12 | 0x0   | RW | GPIO12 interrupt. |
| 11  | GPIO11 | 0x0   | RW | GPIO11 interrupt. |
| 10  | GPIO10 | 0x0   | RW | GPIO10 interrupt. |
| 9   | GPIO9  | 0x0   | RW | GPIO9 interrupt.  |
| 8   | GPIO8  | 0x0   | RW | GPIO8 interrupt.  |
| 7   | GPIO7  | 0x0   | RW | GPIO7 interrupt.  |
| 6   | GPIO6  | 0x0   | RW | GPIO6 interrupt.  |
| 5   | GPIO5  | 0x0   | RW | GPIO5 interrupt.  |
| 4   | GPIO4  | 0x0   | RW | GPIO4 interrupt.  |
| 3   | GPIO3  | 0x0   | RW | GPIO3 interrupt.  |
| 2   | GPIO2  | 0x0   | RW | GPIO2 interrupt.  |
| 1   | GPIO1  | 0x0   | RW | GPIO1 interrupt.  |
| 0   | GPIO0  | 0x0   | RW | GPIO0 interrupt.  |

**11.7.2.61INT0STAT Register****GPIO Interrupt Registers 31-0: Status****OFFSET:** 0x00000204**INSTANCE 0 ADDRESS:** 0x40010204

Read bits from this register to discover the cause of a recent interrupt.

**Table 743: INT0STAT Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| GPIO31 | GPIO30 | GPIO29 | GPIO28 | GPIO27 | GPIO26 | GPIO25 | GPIO24 | GPIO23 | GPIO22 | GPIO21 | GPIO20 | GPIO19 | GPIO18 | GPIO17 | GPIO16 | GPIO15 | GPIO14 | GPIO13 | GPIO12 | GPIO11 | GPIO10 | GPIO9  | GPIO8  | GPIO7  | GPIO6  | GPIO5  | GPIO4  | GPIO3  | GPIO2  | GPIO1  | GPIO0  |

Table 744: INT0STAT Register Bits

| Bit | Name   | Reset | RW | Description       |
|-----|--------|-------|----|-------------------|
| 31  | GPIO31 | 0x0   | RW | GPIO31 interrupt. |
| 30  | GPIO30 | 0x0   | RW | GPIO30 interrupt. |
| 29  | GPIO29 | 0x0   | RW | GPIO29 interrupt. |
| 28  | GPIO28 | 0x0   | RW | GPIO28 interrupt. |
| 27  | GPIO27 | 0x0   | RW | GPIO27 interrupt. |
| 26  | GPIO26 | 0x0   | RW | GPIO26 interrupt. |
| 25  | GPIO25 | 0x0   | RW | GPIO25 interrupt. |
| 24  | GPIO24 | 0x0   | RW | GPIO24 interrupt. |
| 23  | GPIO23 | 0x0   | RW | GPIO23 interrupt. |
| 22  | GPIO22 | 0x0   | RW | GPIO22 interrupt. |
| 21  | GPIO21 | 0x0   | RW | GPIO21 interrupt. |
| 20  | GPIO20 | 0x0   | RW | GPIO20 interrupt. |
| 19  | GPIO19 | 0x0   | RW | GPIO19 interrupt. |
| 18  | GPIO18 | 0x0   | RW | GPIO18 interrupt. |
| 17  | GPIO17 | 0x0   | RW | GPIO17 interrupt. |
| 16  | GPIO16 | 0x0   | RW | GPIO16 interrupt. |
| 15  | GPIO15 | 0x0   | RW | GPIO15 interrupt. |
| 14  | GPIO14 | 0x0   | RW | GPIO14 interrupt. |
| 13  | GPIO13 | 0x0   | RW | GPIO13 interrupt. |
| 12  | GPIO12 | 0x0   | RW | GPIO12 interrupt. |
| 11  | GPIO11 | 0x0   | RW | GPIO11 interrupt. |
| 10  | GPIO10 | 0x0   | RW | GPIO10 interrupt. |

| Bit | Name  | Reset | RW | Description      |
|-----|-------|-------|----|------------------|
| 9   | GPIO9 | 0x0   | RW | GPIO9 interrupt. |
| 8   | GPIO8 | 0x0   | RW | GPIO8 interrupt. |
| 7   | GPIO7 | 0x0   | RW | GPIO7 interrupt. |
| 6   | GPIO6 | 0x0   | RW | GPIO6 interrupt. |
| 5   | GPIO5 | 0x0   | RW | GPIO5 interrupt. |
| 4   | GPIO4 | 0x0   | RW | GPIO4 interrupt. |
| 3   | GPIO3 | 0x0   | RW | GPIO3 interrupt. |
| 2   | GPIO2 | 0x0   | RW | GPIO2 interrupt. |
| 1   | GPIO1 | 0x0   | RW | GPIO1 interrupt. |
| 0   | GPIO0 | 0x0   | RW | GPIO0 interrupt. |

## GPIO Interrupt Registers 31-0: Clear

**INSTANCE 0 ADDRESS: 0x40010208**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |       |       |       |       |       |       |       |       |       |       |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| GPIO31 | GPIO30 | GPIO29 | GPIO28 | GPIO27 | GPIO26 | GPIO25 | GPIO24 | GPIO23 | GPIO22 | GPIO21 | GPIO20 | GPIO19 | GPIO18 | GPIO17 | GPIO16 | GPIO15 | GPIO14 | GPIO13 | GPIO12 | GPIO11 | GPIO10 | GPIO9 | GPIO8 | GPIO7 | GPIO6 | GPIO5 | GPIO4 | GPIO3 | GPIO2 | GPIO1 | GPIO0 |
| 3      | 3      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| 1      | 0      | 9      | 8      | 7      | 6      | 5      | 4      | 3      | 2      | 1      | 0      | 9      | 8      | 7      | 6      | 5      | 4      | 3      | 2      | 1      | 0      | 9     | 8     | 7     | 6     | 5     | 4     | 3     | 2     | 1     | 0     |

| Bit | Name   | Reset | RW | Description       |
|-----|--------|-------|----|-------------------|
| 31  | GPIO31 | 0x0   | RW | GPIO31 interrupt. |
| 30  | GPIO30 | 0x0   | RW | GPIO30 interrupt. |

Table 746: INT0CLR Register Bits

| Bit | Name   | Reset | RW | Description       |
|-----|--------|-------|----|-------------------|
| 29  | GPIO29 | 0x0   | RW | GPIO29 interrupt. |
| 28  | GPIO28 | 0x0   | RW | GPIO28 interrupt. |
| 27  | GPIO27 | 0x0   | RW | GPIO27 interrupt. |
| 26  | GPIO26 | 0x0   | RW | GPIO26 interrupt. |
| 25  | GPIO25 | 0x0   | RW | GPIO25 interrupt. |
| 24  | GPIO24 | 0x0   | RW | GPIO24 interrupt. |
| 23  | GPIO23 | 0x0   | RW | GPIO23 interrupt. |
| 22  | GPIO22 | 0x0   | RW | GPIO22 interrupt. |
| 21  | GPIO21 | 0x0   | RW | GPIO21 interrupt. |
| 20  | GPIO20 | 0x0   | RW | GPIO20 interrupt. |
| 19  | GPIO19 | 0x0   | RW | GPIO19 interrupt. |
| 18  | GPIO18 | 0x0   | RW | GPIO18 interrupt. |
| 17  | GPIO17 | 0x0   | RW | GPIO17 interrupt. |
| 16  | GPIO16 | 0x0   | RW | GPIO16 interrupt. |
| 15  | GPIO15 | 0x0   | RW | GPIO15 interrupt. |
| 14  | GPIO14 | 0x0   | RW | GPIO14 interrupt. |
| 13  | GPIO13 | 0x0   | RW | GPIO13 interrupt. |
| 12  | GPIO12 | 0x0   | RW | GPIO12 interrupt. |
| 11  | GPIO11 | 0x0   | RW | GPIO11 interrupt. |
| 10  | GPIO10 | 0x0   | RW | GPIO10 interrupt. |
| 9   | GPIO9  | 0x0   | RW | GPIO9 interrupt.  |
| 8   | GPIO8  | 0x0   | RW | GPIO8 interrupt.  |
| 7   | GPIO7  | 0x0   | RW | GPIO7 interrupt.  |

| Bit | Name  | Reset | RW | Description      |
|-----|-------|-------|----|------------------|
| 6   | GPIO6 | 0x0   | RW | GPIO6 interrupt. |
| 5   | GPIO5 | 0x0   | RW | GPIO5 interrupt. |
| 4   | GPIO4 | 0x0   | RW | GPIO4 interrupt. |
| 3   | GPIO3 | 0x0   | RW | GPIO3 interrupt. |
| 2   | GPIO2 | 0x0   | RW | GPIO2 interrupt. |
| 1   | GPIO1 | 0x0   | RW | GPIO1 interrupt. |
| 0   | GPIO0 | 0x0   | RW | GPIO0 interrupt. |

## GPIO Interrupt Registers 31-0: Set

**INSTANCE 0 ADDRESS: 0x4001020C**

Write a 1 to a bit in this register to instantly generate an interrupt from this module. (Generally used for testing purposes).

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| GPIO31 | GPIO30 | GPIO29 | GPIO28 | GPIO27 | GPIO26 | GPIO25 | GPIO24 | GPIO23 | GPIO22 | GPIO21 | GPIO20 | GPIO19 | GPIO18 | GPIO17 | GPIO16 | GPIO15 | GPIO14 | GPIO13 | GPIO12 | GPIO11 | GPIO10 | GPIO9  | GPIO8  | GPIO7  | GPIO6  | GPIO5  | GPIO4  | GPIO3  | GPIO2  | GPIO1  | GPIO0  |

| Bit | Name   | Reset | RW | Description       |
|-----|--------|-------|----|-------------------|
| 31  | GPIO31 | 0x0   | RW | GPIO31 interrupt. |
| 30  | GPIO30 | 0x0   | RW | GPIO30 interrupt. |
| 29  | GPIO29 | 0x0   | RW | GPIO29 interrupt. |
| 28  | GPIO28 | 0x0   | RW | GPIO28 interrupt. |
| 27  | GPIO27 | 0x0   | RW | GPIO27 interrupt. |

Table 748: INT0SET Register Bits

| Bit | Name   | Reset | RW | Description       |
|-----|--------|-------|----|-------------------|
| 26  | GPIO26 | 0x0   | RW | GPIO26 interrupt. |
| 25  | GPIO25 | 0x0   | RW | GPIO25 interrupt. |
| 24  | GPIO24 | 0x0   | RW | GPIO24 interrupt. |
| 23  | GPIO23 | 0x0   | RW | GPIO23 interrupt. |
| 22  | GPIO22 | 0x0   | RW | GPIO22 interrupt. |
| 21  | GPIO21 | 0x0   | RW | GPIO21 interrupt. |
| 20  | GPIO20 | 0x0   | RW | GPIO20 interrupt. |
| 19  | GPIO19 | 0x0   | RW | GPIO19 interrupt. |
| 18  | GPIO18 | 0x0   | RW | GPIO18 interrupt. |
| 17  | GPIO17 | 0x0   | RW | GPIO17 interrupt. |
| 16  | GPIO16 | 0x0   | RW | GPIO16 interrupt. |
| 15  | GPIO15 | 0x0   | RW | GPIO15 interrupt. |
| 14  | GPIO14 | 0x0   | RW | GPIO14 interrupt. |
| 13  | GPIO13 | 0x0   | RW | GPIO13 interrupt. |
| 12  | GPIO12 | 0x0   | RW | GPIO12 interrupt. |
| 11  | GPIO11 | 0x0   | RW | GPIO11 interrupt. |
| 10  | GPIO10 | 0x0   | RW | GPIO10 interrupt. |
| 9   | GPIO9  | 0x0   | RW | GPIO9 interrupt.  |
| 8   | GPIO8  | 0x0   | RW | GPIO8 interrupt.  |
| 7   | GPIO7  | 0x0   | RW | GPIO7 interrupt.  |
| 6   | GPIO6  | 0x0   | RW | GPIO6 interrupt.  |
| 5   | GPIO5  | 0x0   | RW | GPIO5 interrupt.  |
| 4   | GPIO4  | 0x0   | RW | GPIO4 interrupt.  |



| Bit | Name  | Reset | RW | Description      |
|-----|-------|-------|----|------------------|
| 3   | GPIO3 | 0x0   | RW | GPIO3 interrupt. |
| 2   | GPIO2 | 0x0   | RW | GPIO2 interrupt. |
| 1   | GPIO1 | 0x0   | RW | GPIO1 interrupt. |
| 0   | GPIO0 | 0x0   | RW | GPIO0 interrupt. |

Set bits in this register to allow this module to generate the corresponding interrupt.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        | GPIO49 | GPIO48 | GPIO47 | GPIO46 | GPIO45 | GPIO44 | GPIO43 | GPIO42 | GPIO41 | GPIO40 | GPIO39 | GPIO38 | GPIO37 | GPIO36 | GPIO35 | GPIO34 | GPIO33 | GPIO32 |

| Bit   | Name   | Reset | RW | Description       |
|-------|--------|-------|----|-------------------|
| 31:18 | RSVD   | 0x0   | RO | RESERVED          |
| 17    | GPIO49 | 0x0   | RW | GPIO49 interrupt. |
| 16    | GPIO48 | 0x0   | RW | GPIO48 interrupt. |
| 15    | GPIO47 | 0x0   | RW | GPIO47 interrupt. |
| 14    | GPIO46 | 0x0   | RW | GPIO46 interrupt. |
| 13    | GPIO45 | 0x0   | RW | GPIO45 interrupt. |
| 12    | GPIO44 | 0x0   | RW | GPIO44 interrupt. |
| 11    | GPIO43 | 0x0   | RW | GPIO43 interrupt. |

**Table 750: INT1EN Register Bits**

| Bit | Name   | Reset | RW | Description       |
|-----|--------|-------|----|-------------------|
| 10  | GPIO42 | 0x0   | RW | GPIO42 interrupt. |
| 9   | GPIO41 | 0x0   | RW | GPIO41 interrupt. |
| 8   | GPIO40 | 0x0   | RW | GPIO40 interrupt. |
| 7   | GPIO39 | 0x0   | RW | GPIO39 interrupt. |
| 6   | GPIO38 | 0x0   | RW | GPIO38 interrupt. |
| 5   | GPIO37 | 0x0   | RW | GPIO37 interrupt. |
| 4   | GPIO36 | 0x0   | RW | GPIO36 interrupt. |
| 3   | GPIO35 | 0x0   | RW | GPIO35 interrupt. |
| 2   | GPIO34 | 0x0   | RW | GPIO34 interrupt. |
| 1   | GPIO33 | 0x0   | RW | GPIO33 interrupt. |
| 0   | GPIO32 | 0x0   | RW | GPIO32 interrupt. |

**11.7.2.65INT1STAT Register****GPIO Interrupt Registers 49-32: Status****OFFSET:** 0x00000214**INSTANCE 0 ADDRESS:** 0x40010214

Read bits from this register to discover the cause of a recent interrupt.

**Table 751: INT1STAT Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        | GPIO49 | GPIO48 | GPIO47 | GPIO46 | GPIO45 | GPIO44 | GPIO43 | GPIO42 | GPIO41 | GPIO40 | GPIO39 | GPIO38 | GPIO37 | GPIO36 | GPIO35 | GPIO34 | GPIO33 | GPIO32 |

**Table 752: INT1STAT Register Bits**

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:18 | RSVD | 0x0   | RO | RESERVED    |

**Table 752: INT1STAT Register Bits**

| Bit | Name   | Reset | RW | Description       |
|-----|--------|-------|----|-------------------|
| 17  | GPIO49 | 0x0   | RW | GPIO49 interrupt. |
| 16  | GPIO48 | 0x0   | RW | GPIO48 interrupt. |
| 15  | GPIO47 | 0x0   | RW | GPIO47 interrupt. |
| 14  | GPIO46 | 0x0   | RW | GPIO46 interrupt. |
| 13  | GPIO45 | 0x0   | RW | GPIO45 interrupt. |
| 12  | GPIO44 | 0x0   | RW | GPIO44 interrupt. |
| 11  | GPIO43 | 0x0   | RW | GPIO43 interrupt. |
| 10  | GPIO42 | 0x0   | RW | GPIO42 interrupt. |
| 9   | GPIO41 | 0x0   | RW | GPIO41 interrupt. |
| 8   | GPIO40 | 0x0   | RW | GPIO40 interrupt. |
| 7   | GPIO39 | 0x0   | RW | GPIO39 interrupt. |
| 6   | GPIO38 | 0x0   | RW | GPIO38 interrupt. |
| 5   | GPIO37 | 0x0   | RW | GPIO37 interrupt. |
| 4   | GPIO36 | 0x0   | RW | GPIO36 interrupt. |
| 3   | GPIO35 | 0x0   | RW | GPIO35 interrupt. |
| 2   | GPIO34 | 0x0   | RW | GPIO34 interrupt. |
| 1   | GPIO33 | 0x0   | RW | GPIO33 interrupt. |
| 0   | GPIO32 | 0x0   | RW | GPIO32 interrupt. |

**11.7.2.66INT1CLR Register****GPIO Interrupt Registers 49-32: Clear****OFFSET:** 0x00000218**INSTANCE 0 ADDRESS:** 0x40010218

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

Table 753: INT1CLR Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1      | 1      | 1      | 1      | 1      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |        |        |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7      | 6      | 5      | 4      | 3      | 2      | 1      | 0      | 9      | 8      | 7      | 6      | 5      | 4      | 3      | 2      | 1      | 0      |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   | GPIO49 | GPIO48 | GPIO47 | GPIO46 | GPIO45 | GPIO44 | GPIO43 | GPIO42 | GPIO41 | GPIO40 | GPIO39 | GPIO38 | GPIO37 | GPIO36 | GPIO35 | GPIO34 | GPIO33 | GPIO32 |

Table 754: INT1CLR Register Bits

| Bit   | Name   | Reset | RW | Description       |
|-------|--------|-------|----|-------------------|
| 31:18 | RSVD   | 0x0   | RO | RESERVED          |
| 17    | GPIO49 | 0x0   | RW | GPIO49 interrupt. |
| 16    | GPIO48 | 0x0   | RW | GPIO48 interrupt. |
| 15    | GPIO47 | 0x0   | RW | GPIO47 interrupt. |
| 14    | GPIO46 | 0x0   | RW | GPIO46 interrupt. |
| 13    | GPIO45 | 0x0   | RW | GPIO45 interrupt. |
| 12    | GPIO44 | 0x0   | RW | GPIO44 interrupt. |
| 11    | GPIO43 | 0x0   | RW | GPIO43 interrupt. |
| 10    | GPIO42 | 0x0   | RW | GPIO42 interrupt. |
| 9     | GPIO41 | 0x0   | RW | GPIO41 interrupt. |
| 8     | GPIO40 | 0x0   | RW | GPIO40 interrupt. |
| 7     | GPIO39 | 0x0   | RW | GPIO39 interrupt. |
| 6     | GPIO38 | 0x0   | RW | GPIO38 interrupt. |
| 5     | GPIO37 | 0x0   | RW | GPIO37 interrupt. |
| 4     | GPIO36 | 0x0   | RW | GPIO36 interrupt. |
| 3     | GPIO35 | 0x0   | RW | GPIO35 interrupt. |
| 2     | GPIO34 | 0x0   | RW | GPIO34 interrupt. |
| 1     | GPIO33 | 0x0   | RW | GPIO33 interrupt. |

Table 754: INT1CLR Register Bits

| Bit | Name   | Reset | RW | Description       |
|-----|--------|-------|----|-------------------|
| 0   | GPIO32 | 0x0   | RW | GPIO32 interrupt. |

**11.7.2.67INT1SET Register****GPIO Interrupt Registers 49-32: Set****OFFSET:** 0x0000021C**INSTANCE 0 ADDRESS:** 0x4001021C

Write a 1 to a bit in this register to instantly generate an interrupt from this module. (Generally used for testing purposes).

Table 755: INT1SET Register

|      |   |   |   |   |   |   |   |   |   |   |   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|------|---|---|---|---|---|---|---|---|---|---|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9      | 8      | 7      | 6      | 5      | 4      | 3      | 2      | 1      | 0      | 9      | 8      | 7      | 6      | 5      | 4      | 3      |
| RSVD |   |   |   |   |   |   |   |   |   |   |   | GPIO49 | GPIO48 | GPIO47 | GPIO46 | GPIO45 | GPIO44 | GPIO43 | GPIO42 | GPIO41 | GPIO40 | GPIO39 | GPIO38 | GPIO37 | GPIO36 | GPIO35 | GPIO34 | GPIO33 |
|      |   |   |   |   |   |   |   |   |   |   |   | GPIO32 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

Table 756: INT1SET Register Bits

| Bit   | Name   | Reset | RW | Description       |
|-------|--------|-------|----|-------------------|
| 31:18 | RSVD   | 0x0   | RO | RESERVED          |
| 17    | GPIO49 | 0x0   | RW | GPIO49 interrupt. |
| 16    | GPIO48 | 0x0   | RW | GPIO48 interrupt. |
| 15    | GPIO47 | 0x0   | RW | GPIO47 interrupt. |
| 14    | GPIO46 | 0x0   | RW | GPIO46 interrupt. |
| 13    | GPIO45 | 0x0   | RW | GPIO45 interrupt. |
| 12    | GPIO44 | 0x0   | RW | GPIO44 interrupt. |
| 11    | GPIO43 | 0x0   | RW | GPIO43 interrupt. |
| 10    | GPIO42 | 0x0   | RW | GPIO42 interrupt. |
| 9     | GPIO41 | 0x0   | RW | GPIO41 interrupt. |
| 8     | GPIO40 | 0x0   | RW | GPIO40 interrupt. |

**Table 756: INT1SET Register Bits**

| Bit | Name   | Reset | RW | Description       |
|-----|--------|-------|----|-------------------|
| 7   | GPIO39 | 0x0   | RW | GPIO39 interrupt. |
| 6   | GPIO38 | 0x0   | RW | GPIO38 interrupt. |
| 5   | GPIO37 | 0x0   | RW | GPIO37 interrupt. |
| 4   | GPIO36 | 0x0   | RW | GPIO36 interrupt. |
| 3   | GPIO35 | 0x0   | RW | GPIO35 interrupt. |
| 2   | GPIO34 | 0x0   | RW | GPIO34 interrupt. |
| 1   | GPIO33 | 0x0   | RW | GPIO33 interrupt. |
| 0   | GPIO32 | 0x0   | RW | GPIO32 interrupt. |

## 12. Clock Generator and Real Time Clock Module

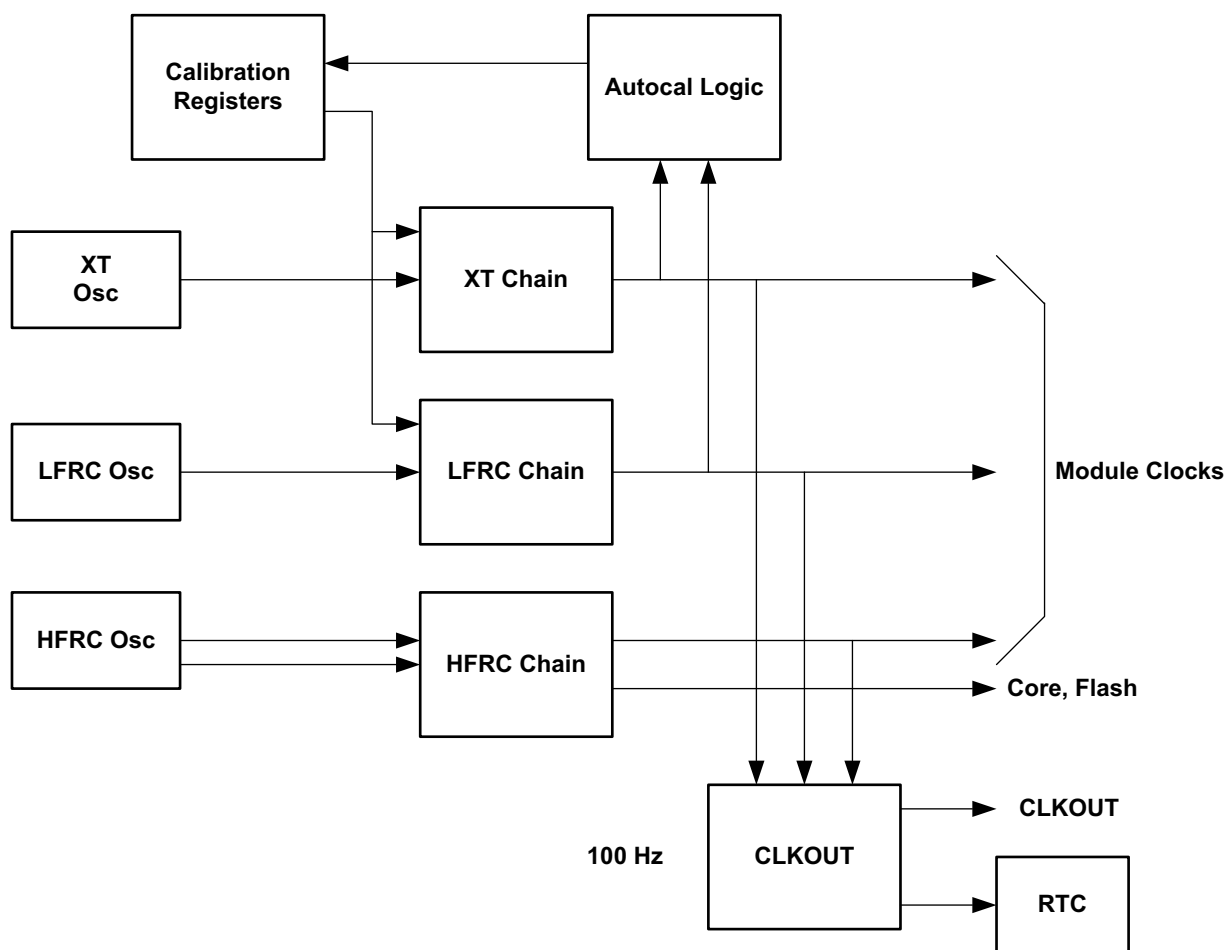


Figure 61. Block diagram for the Clock Generator and Real Time Clock Module

### 12.1 Clock Generator

#### 12.1.1 Functional Overview

A high-level view of the Clock Generator Module, which supplies all clocks required by the Apollo3 Blue SoC, is shown in Figure 61. These clocks are derived from one of three fundamental clock sources: a high precision crystal controlled oscillator (XT), a low power 1 kHz RC oscillator (LFRC) and a high frequency 48/96 MHz oscillator (HFRC).

A clock, CLKOUT, generated from any of the oscillators, may be configured and driven onto an external pin. CLKOUT also drives the Real Time Clock (RTC) Module and other internal clock nodes.

The Clock Generator automatically controls the enabling of the oscillators, so that they are only powered up and used when requested by another module. This allows minimal power consumption without complex software intervention, so that software does not need to manage any enabling or disabling of the

oscillators. As an example, an I<sup>2</sup>C/SPI Master requires the HFRC in order to generate the serial interface clock. If a transfer is initiated and the processor is put into Deep Sleep mode, the HFRC will remain active until the I/O transfer is completed. At that point the HFRC will be powered down without requiring any software intervention.

Figure 62 shows the available clock sources, divisors and distribution to the various modules of the Apollo3 Blue SoC.

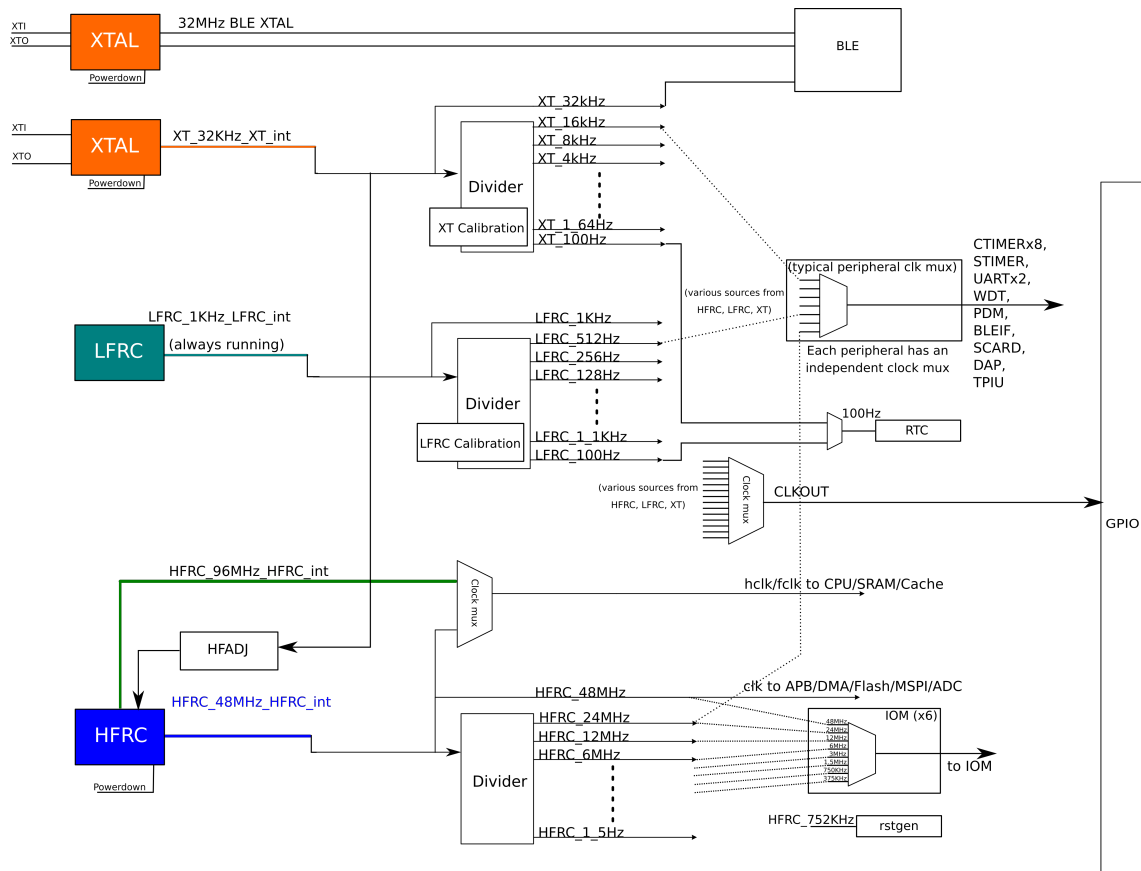


Figure 62. Apollo3 Blue Clock Tree

### 12.1.2 Low Frequency RC Oscillator (LFRC)

The low power LFRC, with a nominal frequency of 1024 Hz, is used when short term frequency accuracy is not important. It also supplies clocks for SIMO buck regulator in low power mode (32 kHz) as well as some basic state machines and is always enabled. Calibration logic is included.

#### 12.1.2.1 LFRC Oscillator Digital Calibration

The LFRC Oscillator includes a patented Distributed Digital Calibration function similar to that of the XT Oscillator (Section 12.1.3.1). Because the LFRC Oscillator has a greater fundamental variability, the required range of calibration is much larger. When the 1024 Hz RC oscillator is selected, the clock at the 512 Hz level of the divider chain is modified on a selectable interval using the calibration value CALRC in the CLKGEN\_CALRC Register. Clock pulses are either added or subtracted to ensure accuracy of the LFRC. CALRC cycles of the 512 Hz clock are gated (negative calibration) or replaced by 1024 Hz pulses (positive calibration) within every 1024 second calibration period. Each step in CALRC modifies the clock



frequency by 1.907 ppm, with a maximum adjustment of +249,954/-249,955 ppm ( $\pm 25\%$ ). This is enabled in the CALRC register, which is 18 bits wide. The most significant bit is the "sign" bit. A '1' on bit 17 would mean a subtraction, and a '0' would mean an addition. Bits 16 to 0 would be the number of cycles to be added to or subtracted from the 512Hz LFRC clock across a 1024 second period. The range of clocks that can be added or subtracted range from -131072 to 131071.

The pulses which are added to or subtracted from the 512 Hz clock are spread evenly over each 1024 second period using the Ambiq Micro patented Distributed Calibration algorithm. This ensures that in LFRC mode the maximum cycle-to-cycle jitter in any clock of a frequency 512 Hz or lower caused by calibration will be no more than one 512 Hz period ( $\sim 2$  ms). This maximum jitter applies to all clocks in the Apollo3 Blue SoC which use the LFRC.

#### NOTE

Since the 512 Hz LFRC clock is calibrated, the original 1024 Hz LFRC is an uncalibrated clock. This may be a useful selection in some cases.

### 12.1.2.2 LFRC Calibration Process

The LFRC oscillator calibration value is determined by the following process:

1. Write "0x47" to the CLKKEY register to enable access to CLKGEN registers.
2. Set the CALRC field to 0 to insure calibration is not occurring.
3. Select the LFRC oscillator by setting the CLKGEN\_OCTRL\_OSEL bit to 1.
4. Select the LFRC or a division of it on a CLKOUT pad.
5. Measure the frequency Fmeas at the CLKOUT pad.
6. Compute the adjustment value required in ppm as  $((F_{nom} - F_{meas}) * 1000000) / F_{meas} = P_{Adj}$ .
7. Compute the adjustment value in steps as  $P_{Adj} / (1000000 / 2^{19}) = P_{Adj} / (1.90735) = Adj$ .
8. Compare Adj value with min/max range of -131072 to 131071.
9. If the adjustment value falls between these two values, set CALRC = Adj.
10. Otherwise, the LFRC frequency is too low or too high to be calibrated.

### 12.1.3 High Precision XT Oscillator (XT)

The high accuracy XT Oscillator is tuned to an external 32.768 kHz crystal, and has a nominal frequency of 32.768 kHz. It is used when frequency accuracy is critically important. Because a crystal oscillator uses a significant amount of power, the XT is only enabled when an internal module is using it. Digital calibration logic is included. The output of the XT oscillator may be digitally calibrated to  $\pm 1$  ppm (part per million).

It should be noted that the XT oscillator is also optional if the requirements of the design can tolerate the internal LFRC/HFRC oscillator specifications. It should also be noted that external capacitors are not required to tune an internal divided clock of the crystal input to achieve a precise scaling of 32.768 kHz. This is handled within the Apollo3 Blue SoC.

#### 12.1.3.1 XT Oscillator Digital Calibration

The XT Oscillator includes a Distributed Digital Calibration function. When the 32 kHz XT oscillator is selected, the clock at the 16 kHz level of the divider chain is modified on a selectable interval using the calibration value CALXT in the CLKGEN\_CALXT Register. Clock pulses are either added or subtracted to ensure accuracy of the XT. CALXT cycles of the 16 kHz clock are gated (negative calibration) or replaced by 32 kHz pulses (positive calibration) within every 64 second calibration period. Each step in CALXT modifies the clock frequency by 0.9535 ppm, with a maximum adjustment of +975/-976 ppm ( $\pm 0.1\%$ ).

The pulses which are added to or subtracted from the 16 kHz clock are spread evenly over each 64 second period using the Ambiq Micro patented Distributed Calibration algorithm. This insures that in XT

mode the maximum cycle-to-cycle jitter in any clock of a frequency 16 kHz or lower caused by calibration will be no more than one 16 kHz period (~60 us). This maximum jitter applies to all clocks in theApollo3 Blue SoC which use the XT.

#### NOTE

Since the 16 kHz XT clock is calibrated, the 32 kHz XT is an uncalibrated clock. This may be a useful selection in some cases.

### 12.1.3.2 XT Calibration Process

The XT Oscillator calibration value is determined by the following process:

1. Write "0x47" to the CLKKEY register to enable access to CLKGEN registers
2. Set the CALXT register field to 0 to insure calibration is not occurring.
3. Select the XT oscillator by setting the CLKGEN\_OCTRL\_OSEL bit to 0.
4. Select the XT or a division of it on a CLKOUT pad.
5. Measure the frequency Fmeas at the CLKOUT pad.
6. Compute the adjustment value required in ppm as  $((F_{nom} - F_{meas}) * 1000000) / F_{meas} = P_{Adj}$ .
7. Compute the adjustment value in steps as  $P_{Adj} / (1000000 / 2^{19}) = P_{Adj} / (0.9535) = Adj$ .
8. Compare Adj value with min/max range of -976 to 975.
9. If target Adj is within min and max, set CALXT = Adj.
10. Otherwise, the XT frequency is too low to be calibrated.

If the 32 kHz XT Oscillator generates clocks at less than 8 kHz for a period of more than 32 ms, theApollo3 Blue SoC detects an Oscillator Failure. The Oscillator Fail (OF) flag is set when an Oscillator Failure occurs, and is also set when theApollo3 Blue SoC initially powers up. If the Oscillator Fail interrupt enable (OFIE) bit is set, the OF flag will generate an interrupt. The current status of the XT Oscillator can be read in the CLKGEN\_STATUS\_OSCF bit, which will be a 1 if the XT Oscillator is not running at least 8 kHz. Note that OSCF will always be set if the LFRC Oscillator is currently selected by the CLKGEN\_OCTRL\_OSEL bit.

If the FOS bit in CLKGEN\_OCTRL is set and theApollo3 Blue SoC RTC is currently using the XT Oscillator, it will automatically switch to the LFRC Oscillator on an Oscillator Failure. This guarantees that the RTC clock will not stop in any case. If the XT Oscillator experiences a temporary failure and subsequently restarts, theApollo3 Blue SoC will switch back to the XT Oscillator. The CLKGEN\_STATUS\_OMODE bit indicates the currently selected oscillator, which may not match the oscillator requested by the CLKGEN\_OCTRL\_OSEL bit if the XT Oscillator is not running.

### 12.1.4 High Frequency RC Oscillator (HFRC)

The high frequency HFRC Oscillator, with a nominal frequency of 48 MHz, is used to supply all high frequency clocks in theApollo3 Blue SoC such as the processor clock for the ARM core, memories and many peripheral modules. Digital calibration is not supported for the HFRC, but its frequency may be automatically adjusted by the Auto-adjustment function which is a combination of analog and digital operations.

The HFRC is enabled only when it is required by an internal module. When the ARM core goes into a sleep mode, the HFRC will be disabled unless another module is using it. If the ARM core goes into deep sleep mode, the HFRC will be powered down when it is not needed. When the HFRC is powered up, it will take a few microseconds for it to begin oscillating, and a few more microseconds before the output is completely stable. In order to prevent erroneous internal clocks from occurring, the internal clocks are gated until the HFRC is stable. The Apollo3 Blue SoC supports high frequency TurboSPOT™ burst mode. The HFRC supplies both the 96 MHz as well as the 48 MHz clocks to support the high frequency core/memory domains and the stable 48 MHz clock for the remaining logic/IO controllers.

### 12.1.5 HFRC Auto-adjustment

In some applications it is important that the HFRC frequency be more accurate than the  $\pm 2\%$  variation typically seen, particularly in cases where the temperature may vary widely. A good example of this is in cases where the Apollo3 Blue SoC communicates with another device via the UART. The frequency matching with the other device in the connection is an important factor in the reliability of the connection. In order to support a highly accurate HFRC, a function called Auto-adjustment is provided.

It should be noted that Auto-adjustment is dependent on an accurate clock source such as the crystal. The min/max variation of the HFRC frequency with and without adjustment is different. See Section 22.5 on page 808.

During auto-adjustment, the number of HFRC cycles which occur in one 32.768 kHz XT Oscillator cycle is compared to a target value. If the count is different from the target, an HFRC tuning value is modified to change the HFRC frequency. The target count is held in the CLKGEN\_HFADJ\_HFXTADJ field. If the target HFRC frequency is 48 MHz, the optimal HFXTADJ value is  $48,000/32.768$  or 1464. A different value will result in a different nominal HFRC frequency.

Auto-adjustment works by periodically enabling the HFRC and the XT, counting the HFRC cycles in a single XT cycle, subtracting that value from HFXTADJ and adding the resulting difference to the actual HFRC tuning value. The current tuning value may be read back in the HFTUNERB field of the CLKGEN\_HFVAL Register. Auto-adjustment is enabled in the CLKGEN\_HFADJ Register by loading the repeat frequency value into the HFADJCK field and then setting the HFADJEN bit.

Auto-adjustment cycles will occur continuously if both the XT and the HFRC are currently requested by other modules. If either oscillator is disabled, Auto-adjustment cycles will then occur at intervals determined by the CLKGEN\_HFADJ\_HFADJCK field, as shown in the register description. Shorter repeat intervals will result in more accurate HFRC frequencies, especially if the temperature is changing rapidly, but will result in higher power consumption. When an Auto-adjustment cycle occurs, if the XT was disabled it is enabled and then a delay occurs to allow the XT to stabilize. This delay is defined by the CLKGEN\_HFADJ\_HFWARMUP field as defined in the Register document. Once the HFRC is stable, the HFRC is enabled and several Auto-adjustments occur, each of which results in a refinement of the tuning value. Once those adjustments are complete, the HFRC and XT are powered down unless they are in use by other functions.

The following steps are recommended to enable the HFADJ functionality.

1. Write "0x47" to the CLKKEY register to enable access to CLKGEN registers
2. Set the HFADJCK field in HFADJ register to set the target HFRC adjustment period. It can range from 4 seconds (0x0) to 1024 seconds (0x7).
3. Set the gain for the adjustment through HFADJGAIN field in HFADJ register.
4. Set the HFWARMUP field if XT is STOP (through the OCTRL register STOPXT field).
5. Enable HFADJEN field in HFADJ register to start the adjustment cycle.

### 12.1.6 TurboSPOT Mode Support

The Apollo3 Blue SoC supports the TurboSPOT burst operating mode. In TurboSPOT mode, the core clock runs at 96 MHz. TurboSPOT mode is initiated when the BURSTREQ bit in CLKGEN\_FREQCTRL is written with a '1'. Once TurboSPOT mode is available, the power management unit will first increase the voltage going to the core and the memories. An acknowledgment will be sent back to CLKGEN. The CLKGEN block will then increase the frequency, and update the BURSTACK and BURSTSTATUS bit in CLKGEN\_FREQCTRL register are updated.

When TurboSPOT mode is no longer required, software will write a '0' to the BURSTREQ bit in CLKGEN\_FREQCTRL. This will instantly trigger a reduction in the frequency before the voltage is lowered by the power management unit. The BURSTSTATUS will be updated immediately, while the BURSTACK

will only be updated once the nominal operating mode is available after the power controller has switched the voltage down.

The following steps are necessary for enabling TurboSPOT mode:

(Note that Burst can only be enabled if Burst is allowed - indicated via the SKU register)

1. This can be checked with MCU\_CTRL\_SKU register in MCU\_CTRL - ALLOWBURST bit
2. Set the BURSTREQ bit in MCU\_CTRL\_FEATUREENABLE
3. Write "0x47" to the CLKKEY register to enable access to CLKGEN registers
4. Set BURSTREQ bit in CLKGEN\_FREQCTRL
5. Poll BURSTSTATUS bit and BURSTACK bit in CLKGEN\_FREQCTRL register

OR

Wait for Event trigger (enabled through BURSTFEATUREEVEN bit in PWRCTRL\_DEVP-WREVENTEN register).

#### NOTE

In TurboSPOT Mode on the Apollo3 Blue SoC, the SYSTICK increments at twice the normal (48 MHz) clock rate. Some RTOSes may use SYSTICK for scheduler timing by default, in which case scheduler event timing will be wrong when using TurboSPOT Mode. It is recommended not to use SYSTICK and TurboSPOT Mode together unless proper compensation is made, e.g., ignoring every other SYSTICK interrupt during TurboSPOT Mode.

### 12.1.7 Frequency Measurement

The Autocalibration logic may be used to measure the frequency of an internal clock signal relative to the XT Oscillator frequency. The following steps are required to perform this measurement:

1. Write "0x47" to the CLKKEY register to enable access to CLKGEN registers
2. Set the CLKGEN\_OCTRL\_ACAL field to 000.
3. Clear the ACC interrupt flag.
4. Select the clock to be measured with the CKSEL CLKGEN\_CLKOUT\_CKSEL field.
5. Set ACAL to 110.
6. Wait for the ACC interrupt flag to be set.
7. Read the CLKGEN\_ACALCTR\_ACALCTR field. This will contain the number of reference clocks which occurred during one cycle of the XT Oscillator.
8. Calculate the frequency of the measured clock.

The measured frequency is:

$$F_{MEAS} = F_{REF} \div ACALCTR$$

where  $F_{REF}$  is the frequency of the reference clock and ACALCTR is the value read from ACALCTR when the measurement is complete. Note that the longer the measurement period is, the more time the measurement takes, but the resulting  $F_{MEAS}$  will be more accurate.

### 12.1.8 Generating 100 Hz

The Real Time Clock (RTC) module requires a 100 Hz clock which is provided by the Clock Generator. This clock may come either from the LFRC or the XT Oscillators, as determined by the

CLKGEN\_OCTRL\_OSEL bit. Since 100 Hz is not a simple power of two division of either of these oscillators, special functions are used to create it.

If the XT Oscillator is selected, 100 Hz is generated by dividing the 2048 Hz division of the XT by 21 for 12 iterations and by 20 for 13 iterations out of every 25 clock periods. This produces an effective division of:

$$(21 * 12 + 20 * 13)/25 = 20.48$$

producing an exact average frequency of 100 Hz with a maximum jitter of less than 1 ms.

If the LFRC Oscillator is selected, 100 Hz is generated by dividing the 256 Hz division of the LFRC by 2 for 11 iterations and by 3 for 14 iterations out of every 25 clock periods. This produces an effective division of:

$$(2 * 11 + 3 * 14)/25 = 2.56$$

producing an exact average frequency of 100 Hz with a maximum jitter of less than 8 ms.

## 12.2 CLKGEN Registers

### Clock Generator

**INSTANCE 0 BASE ADDRESS:**0x40004000

This is the register bank for the clock generator registers. It includes the RTC unit and the register control for BLE Ton Adjust unit

### 12.2.1 Register Memory Map

**Table 757: CLKGEN Register Map**

| Address(es) | Register Name | Description                             |
|-------------|---------------|-----------------------------------------|
| 0x40004000  | CALXT         | XT Oscillator Control                   |
| 0x40004004  | CALRC         | RC Oscillator Control                   |
| 0x40004008  | ACALCTR       | Autocalibration Counter                 |
| 0x4000400C  | OCTRL         | Oscillator Control                      |
| 0x40004010  | CLKOUT        | CLKOUT Frequency Select                 |
| 0x40004014  | CLKKEY        | Key Register for Clock Control Register |
| 0x40004018  | CCTRL         | HFRC Clock Control                      |
| 0x4000401C  | STATUS        | Clock Generator Status                  |
| 0x40004020  | HFADJ         | HFRC Adjustment                         |
| 0x40004028  | CLOCKENSTAT   | Clock Enable Status                     |
| 0x4000402C  | CLOCKEN2STAT  | Clock Enable Status                     |
| 0x40004030  | CLOCKEN3STAT  | Clock Enable Status                     |
| 0x40004034  | FREQCTRL      | HFRC Frequency Control register         |
| 0x4000403C  | BLEBUCKTONADJ | BLE BUCK TON ADJUST                     |
| 0x40004100  | INTRPTEN      | CLKGEN Interrupt Register: Enable       |
| 0x40004104  | INTRPTSTAT    | CLKGEN Interrupt Register: Status       |
| 0x40004108  | INTRPTCLR     | CLKGEN Interrupt Register: Clear        |
| 0x4000410C  | INTRPTSET     | CLKGEN Interrupt Register: Set          |



## 12.2.2 CLKGEN Registers

### 12.2.2.1 CALXT Register

#### XT Oscillator Control

**OFFSET:** 0x00000000

**INSTANCE 0 ADDRESS:** 0x40004000

This is the XT Oscillator Calibration value. This value allows any derived XT clocks to be "calibrated". This means that the original 32KHz version of XT will not be changed, but a 16KHz version (divided down version) can be modified. This register value will add or subtract the number of cycles programmed in this register across a 32 seconds interval. For example, if a value of 100 is programmed in this register, then 100 additional clock cycles will be added into a 16KHz clock period across a 32 second interval.

**Table 758: CALXT Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |   |   |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|---|---|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0     | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CALXT |   |   |   |   |   |   |   |   |   |   |  |

**Table 759: CALXT Register Bits**

| Bit   | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|-------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:11 | RSVD  | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 10:0  | CALXT | 0x0   | RW | XT Oscillator calibration value. This register will enable the hardware to increase or decrease the number of cycles in a 16KHz clock derived from the original 32KHz version. The most significant bit is the sign. A '1' is a reduction, and a '0' is an addition. This calibration value will add or reduce the number of cycles programmed here across a 32 second interval. The maximum value that is effective is from -1024 to 1023. |

### 12.2.2.2 CALRC Register

#### RC Oscillator Control

**OFFSET:** 0x00000004

**INSTANCE 0 ADDRESS:** 0x40004004

This is the LFRC Calibration value. Similar to the XT calibration, it allows the derived LFRC clock to be calibrated. The original 1024Hz clock source will not change, but a 512Hz version (divided down version) can be modified. This register will add or subtract the number of cycles programmed in this register across a 1024 seconds interval. For example, if a value of 200 is programmed in this register, then 200 additional clocks will be added into the 512Hz derived clock across a 1024 seconds interval.

|      |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1     | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8     | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   | CALRC |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------|-------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:18 | RSVD  | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 17:0  | CALRC | 0x0   | RW | LFRC Oscillator calibration value. This register will enable the hardware to increase or decrease the number of cycles in a 512 Hz clock derived from the original 1024 version. The most significant bit is the sign. A '1' is a reduction, and a '0' is an addition. This calibration value will add or reduce the number of cycles programmed here across a 32 second interval. The range is from -131072 (decimal) to 131071 (decimal). This register is normally used in conjunction with ACALCTR register. The CALRC register will load the ACALCTR register (bits 17:0) if the ACALCTR register is set to measure the LFRC with the XT clock. |

**INSTANCE 0 ADDRESS: 0x40004008**

|        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3  | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        | ACALCTR |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:24 | RSVD | 0x0   | RO | RESERVED    |



| Bit  | Name    | Reset | RW | Description                                                                                                                                                      |
|------|---------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23:0 | ACALCTR | 0x0   | RO | Autocalibration Counter result. Bits 17 down to 0 of this is feed directly to the CALRC register if ACAL register in OCTRL register is set to 1024SEC or 512SEC. |

## Oscillator Control

**INSTANCE 0 ADDRESS: 0x4000400C**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | ACAL   |        | OSEL   | FOS    | RSVD   |        |        |        | STOPRC | STOPXT |        |

| Bit   | Name | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------|------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:11 | RSVD | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 10:8  | ACAL | 0x0   | RW | <p>Autocalibration control. This selects the source to be used in the autocalibration flow. This flow can also be used to measure an internal clock against an external clock source, with the external clock normally used as the reference.</p> <p>DIS = 0x0 - Disable Autocalibration<br/>           1024SEC = 0x2 - Autocalibrate every 1024 seconds. Once autocalibration is done, an interrupt will be triggered at the end of 1024 seconds.<br/>           512SEC = 0x3 - Autocalibrate every 512 seconds. Once autocalibration is done, an interrupt will be triggered at the end of 512 seconds.<br/>           XTFREQ = 0x6 - Frequency measurement using XT. The XT clock is normally considered much more accurate than the LFRC clock source.<br/>           EXTFREQ = 0x7 - Frequency measurement using external clock.</p> |
| 7     | OSEL | 0x0   | RW | <p>Selects the RTC oscillator (1 == LFRC, 0 == XT)</p> <p>RTC_XT = 0x0 - RTC uses the XT<br/>           RTC_LFRC = 0x1 - RTC uses the LFRC</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 6     | FOS  | 0x0   | RW | <p>Oscillator switch on failure function. If this is set, then LFRC clock source will switch from XT to RC.</p> <p>DIS = 0x0 - Disable the oscillator switch on failure function.<br/>           EN = 0x1 - Enable the oscillator switch on failure function.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

| Bit | Name   | Reset | RW | Description                                                                                                                                                     |
|-----|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5:2 | RSVD   | 0x0   | RO | RESERVED                                                                                                                                                        |
| 1   | STOPRC | 0x0   | RW | Stop the LFRC Oscillator to the RTC<br><br>EN = 0x0 - Enable the LFRC Oscillator to drive the RTC<br>STOP = 0x1 - Stop the LFRC Oscillator when driving the RTC |
| 0   | STOPXT | 0x0   | RW | Stop the XT Oscillator to the RTC<br><br>EN = 0x0 - Enable the XT Oscillator to drive the RTC<br>STOP = 0x1 - Stop the XT Oscillator when driving the RTC       |

This register enables the CLKOUT to the GPIOs, and selects the clock source to that.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CKEN   | RSVD   | CKSEL  |        |        |        |        |        |

| Bit  | Name | Reset | RW | Description                                                                        |
|------|------|-------|----|------------------------------------------------------------------------------------|
| 31:8 | RSVD | 0x0   | RO | RESERVED                                                                           |
| 7    | CKEN | 0x0   | RW | Enable the CLKOUT signal<br>DIS = 0x0 - Disable CLKOUT<br>EN = 0x1 - Enable CLKOUT |
| 6    | RSVD | 0x0   | RO | RESERVED                                                                           |

Table 767: CLKOUT Register Bits

| Bit | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----|-------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5:0 | CKSEL | 0x0   | RW | <p>CLKOUT signal select</p> <p>LFRC = 0x0 - LFRC<br/>           XT_DIV2 = 0x1 - XT / 2<br/>           XT_DIV4 = 0x2 - XT / 4<br/>           XT_DIV8 = 0x3 - XT / 8<br/>           XT_DIV16 = 0x4 - XT / 16<br/>           XT_DIV32 = 0x5 - XT / 32<br/>           RTC_1Hz = 0x10 - 1 Hz as selected in RTC<br/>           XT_DIV2M = 0x16 - XT / 2<sup>21</sup><br/>           XT = 0x17 - XT<br/>           CG_100Hz = 0x18 - 100 Hz as selected in CLKGEN</p> <p>LFRC_DIV2 = 0x23 - LFRC / 2<br/>           LFRC_DIV32 = 0x24 - LFRC / 32<br/>           LFRC_DIV512 = 0x25 - LFRC / 512<br/>           LFRC_DIV32K = 0x26 - LFRC / 32768<br/>           XT_DIV256 = 0x27 - XT / 256<br/>           XT_DIV8K = 0x28 - XT / 8192<br/>           XT_DIV64K = 0x29 - XT / 2<sup>16</sup><br/>           ULFRC_DIV16 = 0x2A - Uncal LFRC / 16<br/>           ULFRC_DIV128 = 0x2B - Uncal LFRC / 128<br/>           ULFRC_1Hz = 0x2C - Uncal LFRC / 1024<br/>           ULFRC_DIV4K = 0x2D - Uncal LFRC / 4096<br/>           ULFRC_DIV1M = 0x2E - Uncal LFRC / 2<sup>20</sup></p> <p>LFRC_DIV1M = 0x31 - LFRC / 2<sup>20</sup></p> <p>XTNE = 0x35 - XT (not autoenabled)<br/>           XTNE_DIV16 = 0x36 - XT / 16 (not autoenabled)<br/>           LFRNE_DIV32 = 0x37 - LFRC / 32 (not autoenabled)<br/>           LFRNE = 0x39 - LFRC (not autoenabled) - Default for undefined values</p> |

**12.2.2.6 CLKKEY Register****Key Register for Clock Control Register****OFFSET:** 0x00000014**INSTANCE 0 ADDRESS:** 0x40004014

Key Register for Clock Control Register

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CLKKEY |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                             |
|------|--------|-------|----|-----------------------------------------|
| 31:0 | CLKKEY | 0x0   | RW | Key register value.<br>Key = 0x47 - Key |

## HFRC Clock Control

**INSTANCE 0 ADDRESS: 0x40004018**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0     | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1     | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CORE- |   |

| Bit  | Name    | Reset | RW | Description                                                                                       |
|------|---------|-------|----|---------------------------------------------------------------------------------------------------|
| 31:1 | RSVD    | 0x0   | RO | RESERVED                                                                                          |
| 0    | CORESEL | 0x1   | RW | Core Clock divisor<br>HFRC = 0x0 - Core Clock is HFRC<br>HFRC_DIV2 = 0x1 - Core Clock is HFRC / 2 |

### Clock Generator Status



Table 775: HFADJ Register Bits

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|-----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23:21 | HFADJGAIN | 0x1   | RW | Gain control for HFRC adjustment<br>Gain_of_1 = 0x0 - HF Adjust with Gain of 1<br>Gain_of_1_in_2 = 0x1 - HF Adjust with Gain of 0.5<br>Gain_of_1_in_4 = 0x2 - HF Adjust with Gain of 0.25<br>Gain_of_1_in_8 = 0x3 - HF Adjust with Gain of 0.125<br>Gain_of_1_in_16 = 0x4 - HF Adjust with Gain of 0.0625<br>Gain_of_1_in_32 = 0x5 - HF Adjust with Gain of 0.03125                                                                                                                               |
| 20    | HFARMUP   | 0x0   | RW | XT warmup period for HFRC adjustment<br>1SEC = 0x0 - Autoadjust XT warmup period = 1-2 seconds<br>2SEC = 0x1 - Autoadjust XT warmup period = 2-4 seconds                                                                                                                                                                                                                                                                                                                                          |
| 19:8  | HFXTADJ   | 0x5b8 | RW | Target HFRC adjustment value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 7:4   | RSVD      | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 3:1   | HFADJCK   | 0x0   | RW | Repeat period for HFRC adjustment<br>4SEC = 0x0 - Autoadjust repeat period = 4 seconds<br>16SEC = 0x1 - Autoadjust repeat period = 16 seconds<br>32SEC = 0x2 - Autoadjust repeat period = 32 seconds<br>64SEC = 0x3 - Autoadjust repeat period = 64 seconds<br>128SEC = 0x4 - Autoadjust repeat period = 128 seconds<br>256SEC = 0x5 - Autoadjust repeat period = 256 seconds<br>512SEC = 0x6 - Autoadjust repeat period = 512 seconds<br>1024SEC = 0x7 - Autoadjust repeat period = 1024 seconds |
| 0     | HFADJEN   | 0x0   | RW | HFRC adjustment control<br>DIS = 0x0 - Disable the HFRC adjustment<br>EN = 0x1 - Enable the HFRC adjustment                                                                                                                                                                                                                                                                                                                                                                                       |

**12.2.2.10CLOCKENSTAT Register****Clock Enable Status****OFFSET:** 0x00000028**INSTANCE 0 ADDRESS:** 0x40004028

This register provides the enable status to all the peripheral clocks.

Table 776: CLOCKENSTAT Register

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CLOCKENSTAT |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name        | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-------------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | CLOCKENSTAT | 0x0   | RO | <p>Clock enable status</p> <p>ADC_CLKEN = 0x1 - Clock enable for the ADC.</p> <p>APBDMA_ACTIVITY_CLKEN = 0x2 - Clock enable for the APBDMA ACTIVITY</p> <p>APBDMA_AOH_CLKEN = 0x4 - Clock enable for the APBDMA AOH DOMAIN</p> <p>APBDMA_AOL_CLKEN = 0x8 - Clock enable for the APBDMA AOL DOMAIN</p> <p>APBDMA_APB_CLKEN = 0x10 - Clock enable for the APBDMA_APB</p> <p>APBDMA_BLEL_CLKEN = 0x20 - Clock enable for the APBDMA_BLEL</p> <p>APBDMA_HCPA_CLKEN = 0x40 - Clock enable for the APBDMA_HCPA</p> <p>APBDMA_HCPB_CLKEN = 0x80 - Clock enable for the APBDMA_HCPB</p> <p>APBDMA_HCPC_CLKEN = 0x100 - Clock enable for the APBDMA_HCPC</p> <p>APBDMA_MSPI_CLKEN = 0x200 - Clock enable for the APBDMA_MSPI</p> <p>APBDMA_PDM_CLKEN = 0x400 - Clock enable for the APBDMA_PDM</p> <p>BLEIF_CLK_CLKEN = 0x800 - Clock enable for the BLEIF</p> <p>BLEIF_CLK32K_CLKEN = 0x1000 - Clock enable for the BLEIF 32kHz CLOCK</p> <p>CTIMER_CLKEN = 0x2000 - Clock enable for the CTIMER BLOCK</p> <p>CTIMER0A_CLKEN = 0x4000 - Clock enable for the CTIMER0A</p> <p>CTIMER0B_CLKEN = 0x8000 - Clock enable for the CTIMER0B</p> <p>CTIMER1A_CLKEN = 0x10000 - Clock enable for the CTIMER1A</p> <p>CTIMER1B_CLKEN = 0x20000 - Clock enable for the CTIMER1B</p> <p>CTIMER2A_CLKEN = 0x40000 - Clock enable for the CTIMER2A</p> <p>CTIMER2B_CLKEN = 0x80000 - Clock enable for the CTIMER2B</p> <p>CTIMER3A_CLKEN = 0x100000 - Clock enable for the CTIMER3A</p> <p>CTIMER3B_CLKEN = 0x200000 - Clock enable for the CTIMER3B</p> <p>CTIMER4A_CLKEN = 0x400000 - Clock enable for the CTIMER4A</p> <p>CTIMER4B_CLKEN = 0x800000 - Clock enable for the CTIMER4B</p> <p>CTIMER5A_CLKEN = 0x1000000 - Clock enable for the CTIMER5A</p> <p>CTIMER5B_CLKEN = 0x2000000 - Clock enable for the CTIMER5B</p> <p>CTIMER6A_CLKEN = 0x4000000 - Clock enable for the CTIMER6A</p> <p>CTIMER6B_CLKEN = 0x8000000 - Clock enable for the CTIMER6B</p> <p>CTIMER7A_CLKEN = 0x10000000 - Clock enable for the CTIMER7A</p> <p>CTIMER7B_CLKEN = 0x20000000 - Clock enable for the CTIMER7B</p> <p>DAP_CLKEN = 0x40000000 - Clock enable for the DAP</p> <p>IOMSTRIFC0_CLKEN = 0x80000000 - Clock enable for the IOMSTRIFC0</p> |

This is a continuation of the clock enable status.

|              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3            | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1            | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CLOCKEN2STAT |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 779: CLOCKEN2STAT Register Bits**

| Bit  | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|---------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | CLOCK-EN2STAT | 0x0   | RO | <p>Clock enable status 2</p> <p>IOMSTRIFC1_CLKEN = 0x1 - Clock enable for the IO MASTER 1 IFC INTERFACE</p> <p>IOMSTRIFC2_CLKEN = 0x2 - Clock enable for the IO MASTER 2 IFC INTERFACE</p> <p>IOMSTRIFC3_CLKEN = 0x4 - Clock enable for the IO MASTER 3 IFC INTERFACE</p> <p>IOMSTRIFC4_CLKEN = 0x8 - Clock enable for the IO MASTER 4 IFC INTERFACE</p> <p>IOMSTRIFC5_CLKEN = 0x10 - Clock enable for the IO MASTER 5 IFC INTERFACE</p> <p>PDM_CLKEN = 0x20 - Clock enable for the PDM</p> <p>PDMIFC_CLKEN = 0x40 - Clock enable for the PDM INTERFACE</p> <p>PWRCTRL_CLKEN = 0x80 - Clock enable for the PWRCTRL</p> <p>PWRCTRL_COUNT_CLKEN = 0x100 - Clock enable for the PWRCTRL counter</p> <p>RSTGEN_CLKEN = 0x200 - Clock enable for the RSTGEN</p> <p>SCARD_CLKEN = 0x400 - Clock enable for the SCARD</p> <p>SCARD_ALTAPB_CLKEN = 0x800 - Clock enable for the SCARD ALTAPB</p> <p>STIMER_CNT_CLKEN = 0x1000 - Clock enable for the STIMER_CNT_CLKEN</p> <p>TPIU_CLKEN = 0x2000 - Clock enable for the TPIU_CLKEN</p> <p>UART0HF_CLKEN = 0x4000 - Clock enable for the UART0 HF</p> <p>UART1HF_CLKEN = 0x8000 - Clock enable for the UART1 HF</p> <p>WDT_CLKEN = 0x8000 - Clock enable for the Watchdog timer</p> <p>XT_32KHZ_EN = 0x40000000 - Clock enable for the XT 32KHZ</p> <p>FORCEHFRC = 0x80000000 - HFRC is forced on Status.</p> |

**12.2.2.12CLOCKEN3STAT Register****Clock Enable Status****OFFSET:** 0x00000030**INSTANCE 0 ADDRESS:** 0x40004030

This is a continuation of the clock enable status.

**Table 780: CLOCKEN3STAT Register**

|              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3            | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1            | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CLOCKEN3STAT |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |



| Bit  | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|---------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | CLOCK-EN3STAT | 0x0   | RO | <p>Clock enable status 3</p> <p>DAP_enabled = 0x20000 - DAP clock is enabled [17]<br/> VCOMP_enabled = 0x40000 - VCOMP powerdown indicator [18]<br/> XTAL_enabled = 0x1000000 - XTAL is enabled [24]<br/> HFRC_enabled = 0x2000000 - HFRC is enabled [25]<br/> HFADJEN = 0x4000000 - HFRC Adjust enabled [26]<br/> HFRC_en_out = 0x8000000 - HFRC Enabled out [27]<br/> RTC_XT = 0x10000000 - RTC use XT [28]<br/> clkout_xtal_en = 0x20000000 - XTAL clkout enabled [29]<br/> clkout_hfrc_en = 0x40000000 - HFRC clkout enabled [30]<br/> flashclk_en = 0x80000000 - Flash clk is enabled [31]</p> |

## HFRC Frequency Control register

**INSTANCE 0 ADDRESS: 0x40004034**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |          |          |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|----------|----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2    | 0<br>1   | 0<br>0   |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | BURSTATUS | BURSTACK | BURSTREQ |

| Bit  | Name        | Reset | RW | Description                                                                                                                                        |
|------|-------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:3 | RSVD        | 0x0   | RO | RESERVED                                                                                                                                           |
| 2    | BURSTSTATUS | 0x0   | RO | This represents frequency burst status.                                                                                                            |
| 1    | BURSTACK    | 0x0   | RO | Frequency Burst Request Acknowledge. Frequency burst requested is always acknowledged whether burst is granted or not depending on feature enable. |
| 0    | BURSTREQ    | 0x0   | RW | Frequency Burst Enable Request<br><br>DIS = 0x0 - Frequency for ARM core stays at 48MHz<br>EN = 0x1 - Frequency for ARM core is increased to 96MHz |

**12.2.2.14 BLEBUCKTONADJ Register****BLE BUCK TON ADJUST****OFFSET:** 0x0000003C**INSTANCE 0 ADDRESS:** 0x4000403C

This is the register control for BLE ton adjustment logic.

**Table 784: BLEBUCKTONADJ Register**

|        |        |        |                 |                   |        |        |        |             |                 |                  |        |        |        |        |        |        |        |        |        |        |        |                 |        |        |        |        |        |        |        |        |        |  |  |
|--------|--------|--------|-----------------|-------------------|--------|--------|--------|-------------|-----------------|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8          | 2<br>7            | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3      | 2<br>2          | 2<br>1           | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9          | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |  |  |
| RSVD   |        |        | ZEROLENDETECTEN | ZEROLENDETECTTRIM |        |        |        | TONADJUSTEN | TONADJUSTPERIOD | TONHIGHTHRESHOLD |        |        |        |        |        |        |        |        |        |        |        | TONLOWTHRESHOLD |        |        |        |        |        |        |        |        |        |  |  |

**Table 785: BLEBUCKTONADJ Register Bits**

| Bit   | Name            | Reset | RW | Description                                                                                                         |
|-------|-----------------|-------|----|---------------------------------------------------------------------------------------------------------------------|
| 31:28 | RSVD            | 0x0   | RO | RESERVED                                                                                                            |
| 27    | ZEROLENDETECTEN | 0x0   | RW | BLEBUCK ZERO LENGTH DETECT ENABLE<br>DIS = 0x0 - Disable Zero Length Detect<br>EN = 0x1 - Enable Zero Length Detect |

Table 785: BLEBUCKTONADJ Register Bits

| Bit   | Name              | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------|-------------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26:23 | ZEROLENDETECTTRIM | 0x0   | RW | <p>BLEBUCK ZERO LENGTH DETECT TRIM</p> <p>SetF = 0xF - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 81us (10 percent margin of error) or more</p> <p>SetE = 0xE - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 75.6us (10 percent margin of error) or more</p> <p>SetD = 0xD - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 70.2us (10 percent margin of error) or more</p> <p>SetC = 0xC - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 64.8us (10 percent margin of error) or more</p> <p>SetB = 0xB - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 59.4us (10 percent margin of error) or more</p> <p>SetA = 0xA - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 54.0us (10 percent margin of error) or more</p> <p>Set9 = 0x9 - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 48.6us (10 percent margin of error) or more</p> <p>Set8 = 0x8 - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 43.2us (10 percent margin of error) or more</p> <p>Set7 = 0x7 - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 37.8us (10 percent margin of error) or more</p> <p>Set6 = 0x6 - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 32.4us (10 percent margin of error) or more</p> <p>Set5 = 0x5 - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 27.0us (10 percent margin of error) or more</p> <p>Set4 = 0x4 - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 21.6us (10 percent margin of error) or more</p> <p>Set3 = 0x3 - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 16.2us (10 percent margin of error) or more</p> <p>Set2 = 0x2 - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 10.8us (10 percent margin of error) or more</p> <p>Set1 = 0x1 - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 5.4us (10 percent margin of error) or more</p> <p>Set0 = 0x0 - Indicator send when the BLE BUCK asserts blebuck_comp1 for about 2.0us (10 percent margin of error) or more</p> |
| 22    | TONADJUSTEN       | 0x0   | RW | <p>TON ADJUST ENABLE</p> <p>DIS = 0x0 - Disable Adjust for BLE BUCK TON trim</p> <p>EN = 0x1 - Enable Adjust for BLE BUCK TON trim</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 21:20 | TONADJUSTPERIOD   | 0x0   | RW | <p>TON ADJUST PERIOD</p> <p>HFRC_94KHz = 0x0 - Adjust done for every 1 94KHz period</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 19:10 | TONHIGHTHRESHOLD  | 0x0   | RW | <p>TON ADJUST HIGH THRESHOLD. Suggested values are #15(94KHz) #2A(47KHz) #A6(12KHz) #29A(3KHz)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 9:0   | TONLOWTHRESHOLD   | 0x0   | RW | <p>TON ADJUST LOW THRESHOLD. Suggested values are #A(94KHz) #15(47KHz) #53(12KHz) #14D(3KHz)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

### 12.2.2.15INTRPTEN Register

**CLKGEN Interrupt Register: Enable**

**OFFSET:** 0x00000100

**INSTANCE 0 ADDRESS:** 0x40004100

Set bits in this register to allow this module to generate the corresponding interrupt.

**Table 786: INTRPTEN Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | OF     | ACC    | ACF    |

**Table 787: INTRPTEN Register Bits**

| Bit  | Name | Reset | RW | Description                        |
|------|------|-------|----|------------------------------------|
| 31:3 | RSVD | 0x0   | RO | RESERVED                           |
| 2    | OF   | 0x0   | RW | XT Oscillator Fail interrupt       |
| 1    | ACC  | 0x0   | RW | Autocalibration Complete interrupt |
| 0    | ACF  | 0x0   | RW | Autocalibration Fail interrupt     |

### 12.2.2.16 INTRPTSTAT Register

**CLKGEN Interrupt Register: Status**

**OFFSET:** 0x00000104

**INSTANCE 0 ADDRESS:** 0x40004104

Read bits from this register to discover the cause of a recent interrupt.

**Table 788: INTRPTSTAT Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |     |     |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|-----|-----|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0   | 0   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0  | 0   | 0   |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | OF | ACC | ACF |

**Table 789: INTRPTSTAT Register Bits**

| Bit  | Name | Reset | RW | Description                        |
|------|------|-------|----|------------------------------------|
| 31:3 | RSVD | 0x0   | RO | RESERVED                           |
| 2    | OF   | 0x0   | RW | XT Oscillator Fail interrupt       |
| 1    | ACC  | 0x0   | RW | Autocalibration Complete interrupt |

| Bit | Name | Reset | RW | Description                    |
|-----|------|-------|----|--------------------------------|
| 0   | ACF  | 0x0   | RW | Autocalibration Fail interrupt |

## CLKGEN Interrupt Register: Clear

**INSTANCE 0 ADDRESS: 0x40004108**

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | OF     | ACC    | ACF    |        |

| Bit  | Name | Reset | RW | Description                        |
|------|------|-------|----|------------------------------------|
| 31:3 | RSVD | 0x0   | RO | RESERVED                           |
| 2    | OF   | 0x0   | RW | XT Oscillator Fail interrupt       |
| 1    | ACC  | 0x0   | RW | Autocalibration Complete interrupt |
| 0    | ACF  | 0x0   | RW | Autocalibration Fail interrupt     |

## CLKGEN Interrupt Register: Set

**INSTANCE 0 ADDRESS: 0x4000410C**

Write a 1 to a bit in this register to instantly generate an interrupt from this module. (Generally used for testing purposes).

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | OF     | ACC    | ACF    |        |

| Bit  | Name | Reset | RW | Description                        |
|------|------|-------|----|------------------------------------|
| 31:3 | RSVD | 0x0   | RO | RESERVED                           |
| 2    | OF   | 0x0   | RW | XT Oscillator Fail interrupt       |
| 1    | ACC  | 0x0   | RW | Autocalibration Complete interrupt |
| 0    | ACF  | 0x0   | RW | Autocalibration Fail interrupt     |

## 12.3 Real Time Clock

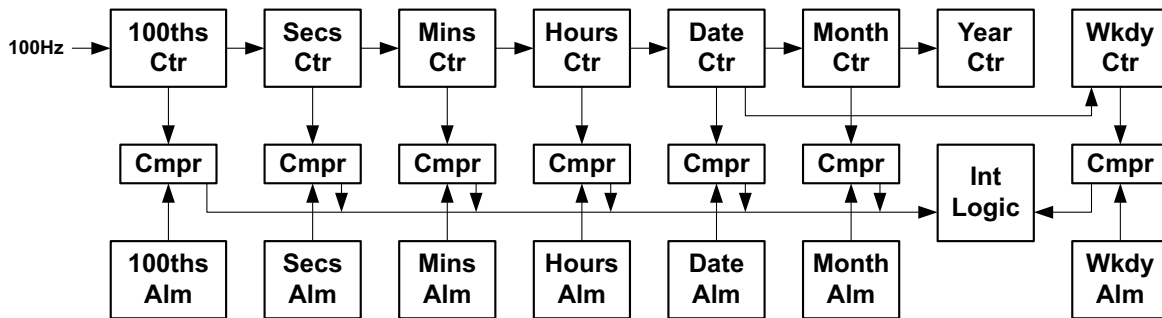


Figure 63. Block diagram for the Real Time Clock Module

### 12.3.1 RTC Functional Overview

The Real Time Clock (RTC) Module, shown in Figure 63, provides an accurate real time measurement. Key features are:

- 100<sup>th</sup> of a second resolution
- Time is measured for the years between 1900 and 2199
- Automatic leap year calculation
- Hours may be specified in 12 or 24 hour mode
- Alarm precise to 1/100 second
- Alarm interval every 100<sup>th</sup> second, 10<sup>th</sup> second, second, minute, hour, day, week, month or year.
- 100 Hz input clock taken from either the high accuracy XT Oscillator or the low power LFRC Oscillator.

### 12.3.2 Calendar Counters

The real time is held in a set of eight Calendar Counters, which hold the current 1/100<sup>th</sup> of a second (CLKGEN\_CTRLOW\_CTR100), the current second (CLKGEN\_CTRLOW\_CTRSEC), the minute (CLKGEN\_CTRLOW\_CTRMIN), the hour (CLKGEN\_CTRLOW\_CTRHR), the current day of the month (CLKGEN\_CTRUP\_CTRDATE), the current day of the week (CLKGEN\_CTRUP\_CTRWKDY), the current month (CLKGEN\_CTRUP\_CTRMO), the current year (CLKGEN\_CTRUP\_CTRYR) and the current century (CLKGEN\_CTRUP\_CB), all in BCD format. In order to insure that the RTC starts precisely, the timer chain which generates the 100 Hz clock is reset to 0 whenever any of the Calendar Counter Registers is written. Since unintentional modification of the Calendar Counters is a serious problem, the CLKGEN\_RTCCTL\_WRTC bit must be set in order to write any of the counters, and should be reset by software after any load of the Calendar Counters.

Software may stop the clock to the Calendar Counters by setting the CLKGEN\_RTCCTL\_RSTOP bit. This may be used in modes like Stopwatch to precisely start and stop the Calendar Counters.

### 12.3.3 Calendar Counter Reads

The RTC includes special logic to help insure that the Calendar Counters may be read reliably, i.e. that no rollover has occurred. Because two 32-bit reads are required to read the complete set of counters, it is possible that a delay occurs between the two reads which causes a rollover to occur. An interrupt is the most likely reason this could occur. If two 100 Hz clocks occur between these two reads, the CLKGEN\_CTRUP\_CTRERR bit will be set. Software should check this bit after any Calendar Counter read, and perform the read again if it is set. Any read of the upper counter word will clear the CTRERR bit.

### 12.3.4 Alarms

There are seven Alarm Registers which may be used to generate an Alarm interrupt at a specific time. These registers correspond to the 100<sup>th</sup> of a second (CLKGEN\_ALMLOW\_ALM100), second (CLKGEN\_ALMLOW\_ALMSEC), minute (CLKGEN\_ALMLOW\_ALMMIN), hour (CLKGEN\_ALMLOW\_ALMHR), day of the month (CLKGEN\_ALMUP\_ALMDATE), day of the week (CLKGEN\_ALMUP\_ALMWKDY) and month (CLKGEN\_ALMUP\_ALMMO) Calendar Counters. The comparison is controlled by the CLKGEN\_RTCCTL\_RPT field and the CLKGEN\_ALMLOW\_ALM100 Register as shown in 12/24 Hour Mode. In the ALM100 Register, n indicates any digit 0-9. When all selected Counters match their corresponding Alarm Register, the ALM interrupt flag is set (see the Clock Generator section for the ALM interrupt control).

**Table 794: Alarm RPT Function**

| RPT Value | Interval     | Comparison                                           |
|-----------|--------------|------------------------------------------------------|
| 000       | Disabled     | None                                                 |
| 001       | Every year   | 100 <sup>th</sup> , second, minute, hour, day, month |
| 010       | Every month  | 100 <sup>th</sup> , second, minute, hour, day        |
| 011       | Every week   | 100 <sup>th</sup> , second, minute, hour, weekday    |
| 100       | Every day    | 100 <sup>th</sup> , second, minute, hour             |
| 101       | Every hour   | 100 <sup>th</sup> , second, minute                   |
| 110       | Every minute | 100 <sup>th</sup> , second                           |
| 111       | Every second | 100 <sup>th</sup>                                    |

All alarm interrupts are asserted on the next 100 Hz clock cycle after the counters match the alarm register, except for 100ths of a second. To get an interrupt that occurs precisely at a certain time, the comparison value in the corresponding alarm register should be set 10 ms (one 100 Hz count) earlier than the desired interrupt time.

For the 100ths of a second interrupt, the first 100 Hz clock sets the comparison with the alarm register and the next clock asserts the interrupt. Therefore, the first 100ths interrupt will be asserted after 20 ms, not 10 ms. This occurs each and every time the 100ths of a second counter with interrupts is enabled if the RTC is stopped. If the RTC is already running when configured, then the first interrupt will occur between 10 and 20 ms after configuration.

### 12.3.5 12/24 Hour Mode

If the CLKGEN\_RTCCTL\_HR1224 bit is 0, the RTC is in 24-hour mode, and the Hours and Hours Alarm Registers hold a 6-bit BCD value which is the 24-hour time (values 0 to 23). If the HR1224 bit is 1, the RTC is in 12-hour mode, and the Hours and Hours Alarm Registers hold a 5-bit BCD value which is the 12-hour time (values 1 to 12), and bit 5 is the AP bit which is 0 for an AM time and 1 for a PM time. If the HR1224 bit is modified the Hours and Hours Alarm fields must be updated.

### 12.3.6 Century Control and Leap Year Management

The CLKGEN\_CTRUP\_CB bit indicates the current century. A value of 0 indicates the 20<sup>th</sup> century, and a value of 1 indicates the 19<sup>th</sup> or 21<sup>st</sup> century. The CB value will toggle when the Years counter rolls over from 99 to 0 if the CLKGEN\_CTRUP\_CEB bit is set, and will remain constant if CEB is clear. The century value is used to control the Leap Year functions, which create the correct insertion of February 29 in years which are divisible by 4 and not divisible by 100, and also the year 2000.



### 12.3.7 Weekday Function

The Weekday Counter is simply a 3-bit counter which counts up to 6 and then resets to 0. It is the responsibility of software to assign particular days of the week to each counter value.

## 12.4 RTC Registers

### Real Time Clock

**INSTANCE 0 BASE ADDRESS:**0x40004200

### 12.4.1 Register Memory Map

**Table 795: RTC Register Map**

| Address(s) | Register Name | Description           |
|------------|---------------|-----------------------|
| 0x40004240 | CTRL0W        | RTC Counters Lower    |
| 0x40004244 | CTRL0P        | RTC Counters Upper    |
| 0x40004248 | ALML0W        | RTC Alarms Lower      |
| 0x4000424C | ALML0P        | RTC Alarms Upper      |
| 0x40004250 | RTCCTL        | RTC Control           |
| 0x40004300 | INTEN         | RTC Interrupt: Enable |
| 0x40004304 | INTSTAT       | RTC Interrupt: Status |
| 0x40004308 | INTCLR        | RTC Interrupt: Clear  |
| 0x4000430C | INTSET        | RTC Interrupt: Set    |



Table 798: CTRUP Register

|       |      |     |    |         |       |   |   |   |   |   |   |      |       |   |   |   |      |         |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------|------|-----|----|---------|-------|---|---|---|---|---|---|------|-------|---|---|---|------|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3     | 3    | 2   | 2  | 2       | 2     | 2 | 2 | 2 | 2 | 2 | 1 | 1    | 1     | 1 | 1 | 1 | 1    | 1       | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1     | 0    | 9   | 8  | 7       | 6     | 5 | 4 | 3 | 2 | 1 | 0 | 9    | 8     | 7 | 6 | 5 | 4    | 3       | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CTERR | RSVD | CEB | CB | CTRWKDY | CTRYR |   |   |   |   |   |   | RSVD | CTRMO |   |   |   | RSVD | CTRDATE |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 799: CTRUP Register Bits

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                           |
|-------|---------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | CTERR   | 0x0   | RO | Counter read error status. Error is triggered when software reads the lower word of the counters, and fails to read the upper counter within 1/100 second. This is because when the lower counter is read, the upper counter is held off from incrementing until it is read so that the full time stamp can be read.<br><br>NOERR = 0x0 - No read error occurred<br>RDERR = 0x1 - Read error occurred |
| 30:29 | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                              |
| 28    | CEB     | 0x0   | RW | Century enable<br><br>DIS = 0x0 - Disable the Century bit from changing<br>EN = 0x1 - Enable the Century bit to change                                                                                                                                                                                                                                                                                |
| 27    | CB      | 0x0   | RW | Century<br><br>2000 = 0x0 - Century is 2000s<br>1900_2100 = 0x1 - Century is 1900s/2100s                                                                                                                                                                                                                                                                                                              |
| 26:24 | CTRWKDY | 0x0   | RW | Weekdays Counter                                                                                                                                                                                                                                                                                                                                                                                      |
| 23:16 | CTRYR   | 0x0   | RW | Years Counter                                                                                                                                                                                                                                                                                                                                                                                         |
| 15:13 | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                              |
| 12:8  | CTRMO   | 0x0   | RW | Months Counter                                                                                                                                                                                                                                                                                                                                                                                        |
| 7:6   | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                              |
| 5:0   | CTRDATE | 0x0   | RW | Date Counter                                                                                                                                                                                                                                                                                                                                                                                          |

### 12.4.2.3 ALMLow Register

#### RTC Alarms Lower

OFFSET: 0x00000048

INSTANCE 0 ADDRESS: 0x40004248



| Bit   | Name    | Reset | RW | Description    |
|-------|---------|-------|----|----------------|
| 31:19 | RSVD    | 0x0   | RO | RESERVED       |
| 18:16 | ALMWKDY | 0x0   | RW | Weekdays Alarm |
| 15:13 | RSVD    | 0x0   | RO | RESERVED       |
| 12:8  | ALMMO   | 0x0   | RW | Months Alarm   |
| 7:6   | RSVD    | 0x0   | RO | RESERVED       |
| 5:0   | ALMDATE | 0x0   | RW | Date Alarm     |

## RTC Control

**INSTANCE 0 ADDRESS: 0x40004250**

This is the register control for the RTC module. It sets the 12 or 24 hours mode, enables counter writes and sets the alarm repeat interval.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | HR1224 | RSTOP  | RPT    | WRTC   |        |        |

| Bit  | Name   | Reset | RW | Description                                                                                                      |
|------|--------|-------|----|------------------------------------------------------------------------------------------------------------------|
| 31:6 | RSVD   | 0x0   | RO | RESERVED                                                                                                         |
| 5    | HR1224 | 0x0   | RW | Hours Counter mode<br>24HR = 0x0 - Hours in 24 hour mode<br>12HR = 0x1 - Hours in 12 hour mode                   |
| 4    | RSTOP  | 0x0   | RW | RTC input clock control<br>RUN = 0x0 - Allow the RTC input clock to run<br>STOP = 0x1 - Stop the RTC input clock |

| Bit | Name | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                     |
|-----|------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3:1 | RPT  | 0x0   | RW | Alarm repeat interval<br><br>DIS = 0x0 - Alarm interrupt disabled<br>YEAR = 0x1 - Interrupt every year<br>MONTH = 0x2 - Interrupt every month<br>WEEK = 0x3 - Interrupt every week<br>DAY = 0x4 - Interrupt every day<br>HR = 0x5 - Interrupt every hour<br>MIN = 0x6 - Interrupt every minute<br>SEC = 0x7 - Interrupt every second/10th/100th |
| 0   | WRTC | 0x0   | RW | Counter write control<br><br>DIS = 0x0 - Counter writes are disabled<br>EN = 0x1 - Counter writes are enabled                                                                                                                                                                                                                                   |

### RTC Interrupt: Enable

**INSTANCE 0 ADDRESS: 0x40004300**

Set bits in this register to allow this module to generate the corresponding interrupt.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | ALM    |

| Bit  | Name | Reset | RW | Description         |
|------|------|-------|----|---------------------|
| 31:1 | RSVD | 0x0   | RO | RESERVED            |
| 0    | ALM  | 0x0   | RW | RTC Alarm interrupt |

### RTC Interrupt: Status

**INSTANCE 0 ADDRESS: 0x40004304**

Read bits from this register to discover the cause of a recent interrupt.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | ALM    |        |

| Bit  | Name | Reset | RW | Description         |
|------|------|-------|----|---------------------|
| 31:1 | RSVD | 0x0   | RO | RESERVED            |
| 0    | ALM  | 0x0   | RW | RTC Alarm interrupt |

### RTC Interrupt: Clear

**INSTANCE 0 ADDRESS: 0x40004308**

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | ALM    |        |        |

| Bit  | Name | Reset | RW | Description         |
|------|------|-------|----|---------------------|
| 31:1 | RSVD | 0x0   | RO | RESERVED            |
| 0    | ALM  | 0x0   | RW | RTC Alarm interrupt |

### RTC Interrupt: Set

**INSTANCE 0 ADDRESS: 0x4000430C**





## 13. Counter/Timer Module (CTIMER)

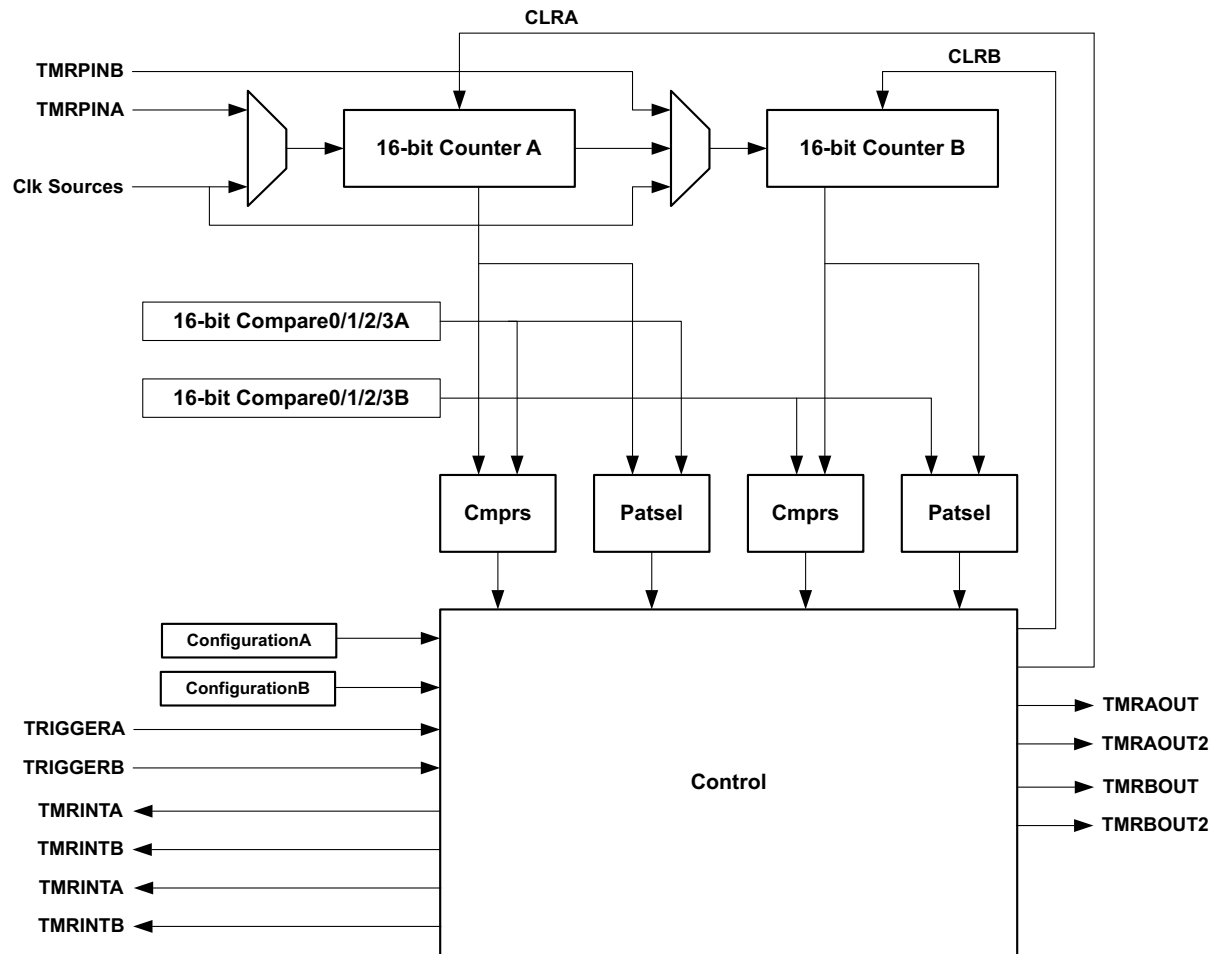


Figure 64. Block Diagram for One Counter/Timer Pair

### 13.1 Functional Overview

The Apollo3 Blue SoC Timer/Counter module includes eight Timer/Counter pairs, one of which is shown in Figure 64. This is in addition to a system timer as described in the System Timer chapter. Each Timer/Counter pair includes two very low power asynchronous 16-bit counters, which may be combined to provide a 32-bit counter. Eight registers contain reset values for the counters and/or comparison values to allow the generation of complex internal and external signals. Each Timer/Counter has an external pin connection, which can be configured to provide a variety of outputs.

The features of the Timer Module are as follows:

- Interrupt after a specified delay
- Interrupt periodically with a specified period
- Determine the time between events
- Generate an external pulse of a specified width, configurable after a specified delay
- Generate an external PWM signal with a specified period and duty cycle
- Count edges on an external input
- Interrupt after a specified number of external pulses

- Generate outputs triggered or terminated by outputs of other Timer/Counters
- Generate a specified number of patterns
- Special inversion functions to support bidirectional stepper motor patterns
- 

#### NOTE

In Apollo3 Blue SoC silicon revision B0, there is capability to enable an STIMER capture/compare event to trigger a GPIO transition primarily for system synchronization without CPU involvement. The CTIMER is used to enable this linkage between an STIMER event and GPIO action by accepting a CTIMER interrupt request as a trigger for one of its timers. To implement this, the CTIMER must be configured to have the two channels of either CTIMER4 or CTIMER5 linked to form a 32-bit timer (CTIMER\_CTRLn\_CTLINKn = 1, n = 4 or 5 only), making the CTIMER\_AUXn\_TMRBnTRIG field unused for setting a trigger. In this configuration:

- if the CTIMER\_AUXn\_TMRBnTRIG field is set to 0 (default), then the timer uses the selected CTIMER trigger source as specified in the CTIMER\_AUXn\_TMRAnTRIG field.
- If the CTIMER\_AUXn\_TMRBnTRIG field is set to anything but 0, and the CTIMER\_AUXn\_TMRAnTRIG field is set to 1, then the timer uses the selected STIMER interrupt as specified in the CTIMER\_AUXn\_TMRBnTRIG field as the trigger source, where valid settings in the CTIMER\_AUXn\_TMRBnTRIG field are 0x4-0xF.

When the two timer channels are *not* linked for 32-bit timer operation (CTIMER\_AUXn\_TMRAnTRIG = 0) and channel B is used as a 16-bit timer, then the STIMER settings in the CTIMER\_AUXn\_TMRBnTRIG field (0x4-0xF) are not valid selections as a trigger for timer channel B.

## 13.2 Counter/Timer Functions

Each Counter/Timer operates in a mode controlled by the CTIMER\_CTCTRLx\_TMRxyFN bit field (x=0 to 7, y=A or B). The mode affects both the generation of interrupts and the control of the outputs. Each mode is described in the following sections. Note that for all functions except for Pattern Generation, a CTIMER\_CMPR0/1/2/3 value of zero (a count of 1) is invalid, and that the first measured period will be between the CTIMER\_CMPR0 value plus 2 and the specified value plus 3. Subsequent repeated cycles will be correctly of length (CMPR value + 1). There are eight modes:

- 0 => Single Count: Counts one time to the compare value, then the output changes polarity and stays at that level, with an optional interrupt.
- 1 => Repeated Count: Periodic 1-clock-cycle wide pulses with optional interrupts.
- 2 => Single Pulse (One Shot): A single pulse of programmed width, with an optional interrupt.
- 3 => Repeated Pulse: A rectangular (or square) waveform with programmed high and low widths, and optional interrupts on each cycle.
- 4 => Single Pattern: one burst of bits specified by the CMPR0/1/2/3 registers.
- 5 => Repeated Pattern: repeated burst of bits specified by the CMPR0/1/2/3 registers.
- 6 => Continuous: Free running timer with a single level change on the output and a single optional interrupt.
- 7 => Alternate Pulse: like Repeated Pulse but alternating between two different pulse width/spacing settings.

### 13.2.1 Single Count (FN = 0)

Operation in this mode is shown in Figure 65. When the Timer is enabled, the pin output is at the level selected by the POL bit and the Timer is at zero because CLR has been asserted previously. The Timer counts up on each selected clock, and when it reaches the value in the corresponding CTIMER\_CMPR0 Register the output pin switches polarity (if the PE bit is set) and an interrupt is generated (if the IE bit is set). At this point the Timer resets to 0 and the output pin is maintained at the selected level until the Timer is cleared with CLR. The interrupt may be cleared by writing the corresponding WC bit in the TMRWCR Register.

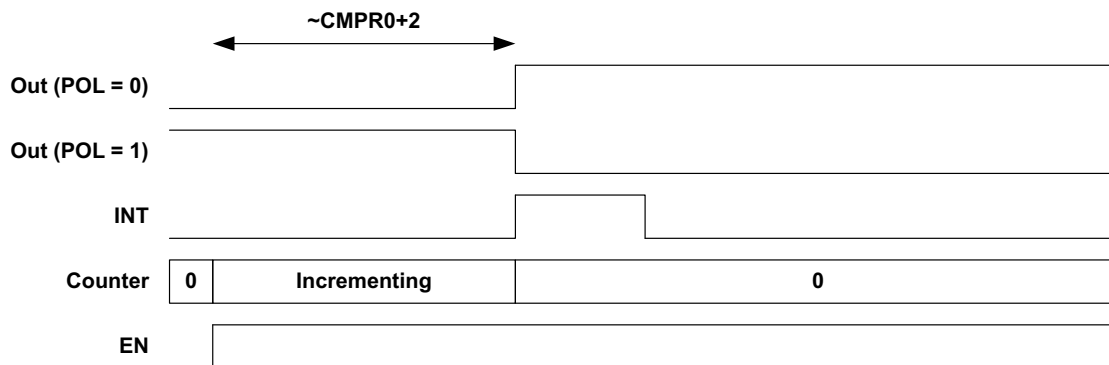


Figure 65. Counter/Timer Operation, FN = 0

### 13.2.2 Repeated Count (FN = 1)

Operation in this mode is shown in Figure 66. When the Timer is enabled, the pin output is at the level selected by the POL bit and the Timer is at zero because CTIMER\_TMRxyCLR has been asserted previously. The Timer counts up on each selected clock, and when it reaches the value in the corresponding CMPR0 Register the output pin switches polarity (if the CTIMER\_TMRxyPE bit is set) and an interrupt is generated (if the IE bit is set). At this point the Timer resets to 0 and the output pin is maintained at the selected level for one clock cycle, after which it returns to the original value. The Timer continues to count up and the process is repeated, creating a stream of pulses or interrupts at a fixed interval. The interrupt may be cleared by writing the corresponding WC bit in the TMRWCR Register at any point prior to the next setting pulse.

If the CTIMER\_TMRxyEN bit is cleared, the Timer will stop counting but will not be cleared, so the sequence may be paused and then resumed. Setting CLR will reset the Timer to zero. Note that CMPR0 must be at least 1 so that the repeat interval is two clock cycles.

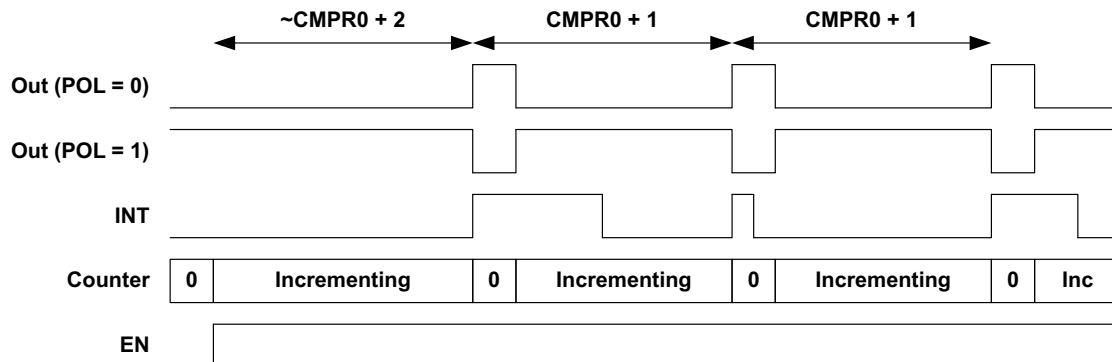


Figure 66. Counter/Timer Operation, FN = 1

### 13.2.3 Single Pulse (FN = 2)

Operation in this mode is shown in Figure 67. When the Timer is enabled, the pin output is at the level selected by the CTIMER\_TMRxyPOL bit and the Timer is at zero because CLR has been asserted previously. The Timer counts up on each selected clock, and when it reaches the value in the corresponding CMPR0 Register the output pin switches polarity (if the CTIMER\_TMRxyPE bit is set) and an interrupt is generated (if the CTIMER\_TMRxyIE bit is set). At this point the Timer continues to increment and the output pin is maintained at the selected level until the Timer reaches the value in the CMPR1 Register, at which point it switches back to the original level. This allows the creation of a pulse of a specified width. The Timer is reset to 0 so that a single pulse is created. The interrupt may be cleared by writing the corresponding WC bit in the TMRWCR Register.

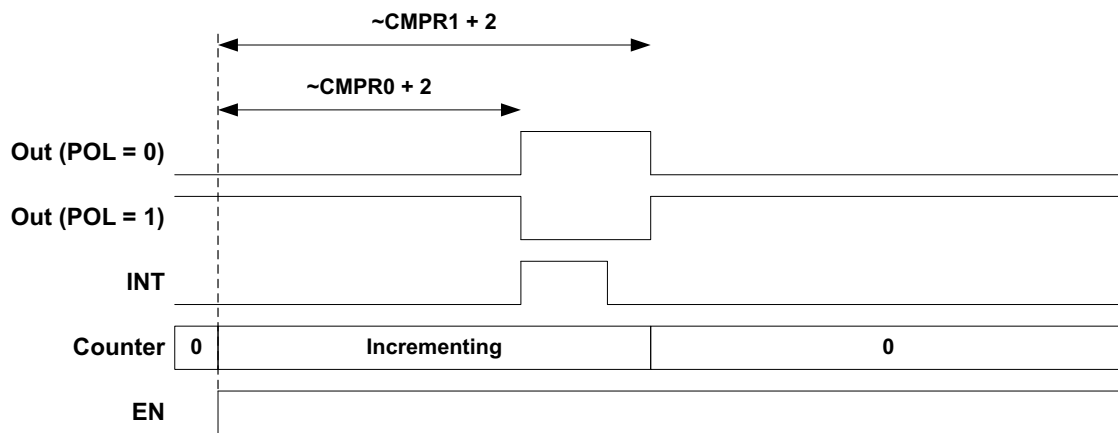


Figure 67. Counter/Timer Operation, FN = 2

The normal interrupt is generated on the rising edge of the output (before polarity is applied) if IE0 is set, as shown in Counter/Timer Operation, FN = 2 Figure 67. The secondary interrupt is generated on the falling edge of the output if the CTIMER\_TMRxyIE1 bit is set.

### 13.2.4 Repeated Pulse (FN = 3)

Operation in this mode is shown in Figure 68. When the Timer is enabled, the pin output is at the level selected by the POL bit and the Timer is at zero because CLR has been asserted previously. The Timer counts up on each selected clock, and when it reaches the value in the corresponding CMPR0 Register the output pin switches polarity (if the PE bit is set) and an interrupt is generated (if the IE bit is set). At this point the Timer continues to increment and the output pin is maintained at the selected level until the Timer reaches the value in the CMPR1 Register, at which point it switches back to the original level. This allows the creation of a pulse of a specified width. The interrupt may be cleared by writing the corresponding WC bit in the TMRWCR Register. Note that CMPR1 must be at least 1 so that the repeat interval is two clock cycles.

The Timer is reset to 0 and continues to increment, so that a stream of pulses of the specified width and period is generated. If the EN bit is cleared, the Timer stops counting, but is not cleared, so the sequence may be paused and restarted. This mode is particularly valuable for creating a PWM (Pulse Width Modulation) output on the pin which may be used, for example, to vary the brightness of an LED.



### 13.2.5 Single Pattern (FN = 4)

Timing diagram for the LMT+1 pattern generation. The diagram shows four signals: OUT, INT, Counter, and EN. OUT is a pulse labeled 'PATTERN' with a duration of 'LMT + 1'. INT is a pulse that occurs during the 'PATTERN' duration. Counter is a register that increments from 0 to LMT+1 during the 'PATTERN' duration and then resets to 0. EN is an enable signal that is active during the 'PATTERN' duration.

The primary interrupt is generated when the pattern completes if IE0 is set. If LMT is greater than 31 and less than 63, the secondary interrupt will be generated when the Counter increments to 32 if IE1 is set. If LMT is 63, the secondary interrupt will be generated both when the Counter increments to 32, and when the Counter rolls over to 0.

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remaining bits (up to a total of 128) are taken from the CMPRB0/1/2/3 registers. If IE1 is set, the secondary interrupt will be generated when the Counter increments to 64. If LMT is 127, the secondary interrupt will also be generated when the Counter rolls over to 0.

If LMT is greater than 127, the pattern will continue to repeat until the Counter reaches LMT. The secondary interrupt will be generated each time the Counter increments to a multiple of 64.

### 13.2.6 Repeat Pattern (FN = 5)

In this mode the CTIMER outputs the pattern from CMPR0/1/2/3 just as in the Single Pattern case, but the pattern repeats as soon as the LMT value is reached, as shown in Figure 70. The polarity is controlled by POL, and if LMT is greater than 63 the pattern will repeat within each pattern burst, although it will restart at the beginning once LMT is reached. The pattern generation will begin between 1 and 2 clock cycles after EN is asserted.

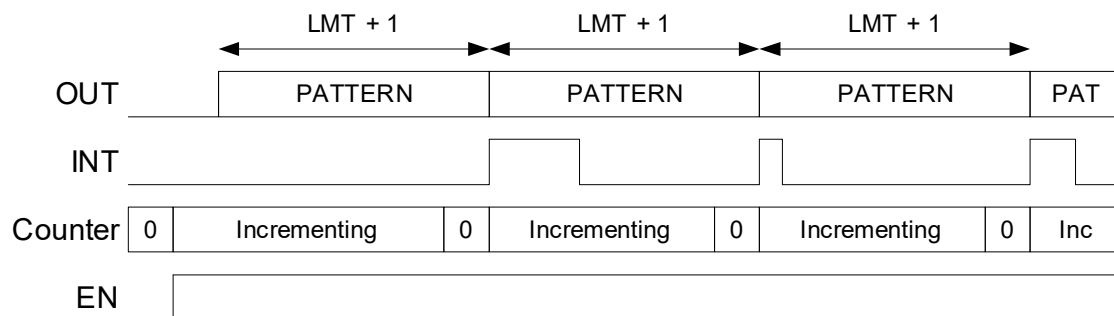


**Figure 70. Counter/Timer Operation, FN = 5**

The primary interrupt is generated when the pattern rolls over to 0 (if IE0 is set). If LMT is greater than 31 and less than 63, the secondary interrupt will be generated when the Counter increments to 32 (if IE1 is set). If LMT is 63, the secondary interrupt will be generated both when the Counter increments to 32, and when the Counter rolls over to 0.

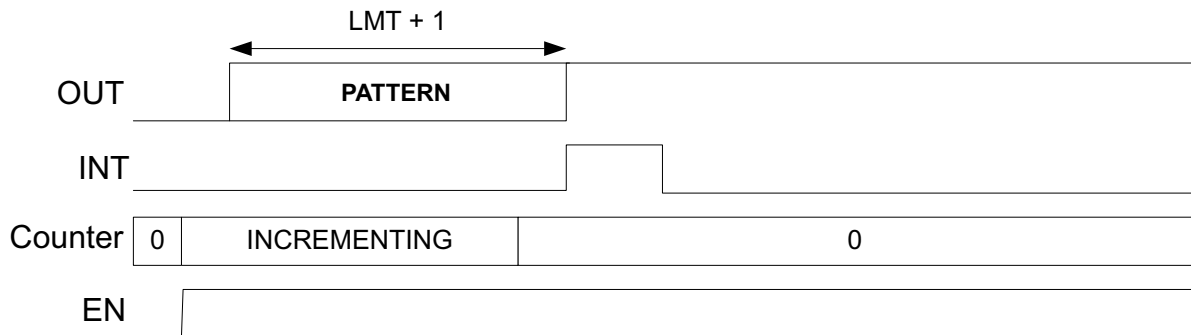
If LMT is greater than 63, the pattern generation will use 128-bit mode. This mode is only available for the A CTIMER of a CTIMER pair, and the CTIMER\_CTCTRLx\_CTRLINKx bit must be set. In this mode, the first 64 bits of the pattern are taken from the CMPRA0/1/2/3 registers as described above, and the remaining bits (up to a total of 128) are taken from the CMPRB0/1/2/3 registers. The secondary interrupt will be generated when the Counter increments to 64 (if IE1 is set). If LMT is 127, the secondary interrupt will also be generated when the Counter rolls over to 0.

If LMT is greater than 127, the pattern will continue to repeat until the Counter reaches LMT, and then it will repeat from the beginning. The secondary interrupt will be generated each time the Counter increments to a multiple of 64.

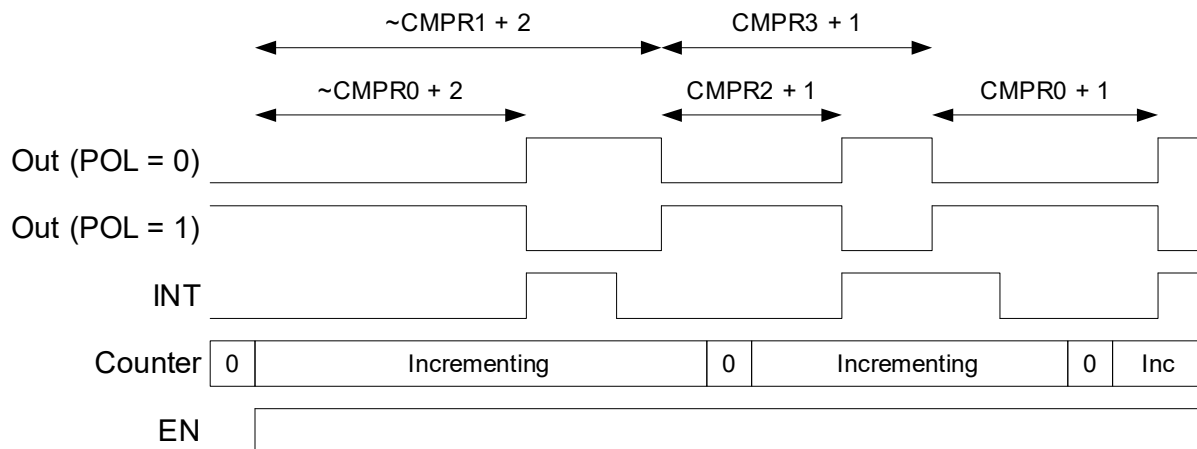
### 13.2.7 Continuous (FN = 6)

Operation in this mode is shown in Figure 71. When the Timer is enabled, the pin output is at the level selected by the POL bit and the Timer is at zero because CLR has been asserted previously. The Timer counts up on each selected clock, and when it reaches the value in the corresponding CMPR0 Register the output pin switches polarity (if the PE bit is set) and an interrupt is generated (if the IE bit is set). The Timer continues to count and is never automatically reset. If the Timer rolls over to zero and reaches the CMPR0 value again, an interrupt will not be generated and the output pin will not change.

This mode is primarily used for two functions. The first is counting transitions on the external input pin, and it may be valuable to generate an interrupt when a specified number of transitions have been detected. The second is as a general timer which software reads in order to measure time periods. In this second case an interrupt is often not used and will not be enabled.

**Figure 71. Counter/Timer Operation, FN = 4****13.2.8 Alternate Pulse (FN = 7)**

Operation in this mode is shown in Figure 72, and is very similar to Repeated Pulse mode (FN = 3). The only difference is that at the end of each cycle, the comparison register switch between CMPR0/1 and CMPR2/3. This can be used to create a more complex stream of pulses, and may also be used to support an efficient software controlled audio output.

**Figure 72. Counter/Timer Operation, FN = 7**

The normal interrupt is generated on the rising edge of the output (before polarity is applied) if IE0 is set, as shown in Counter/Timer Operation, FN = 7. The secondary interrupt is generated on the falling edge of the output if the IE1 bit is set.

**13.3 Creating 32-bit Counters**

Each pair (A/B) of 16-bit counters may be combined to create a 32-bit counter. This configuration is created by setting the CTIMER\_CTCTRLx\_CTRLINKx bit for the pair. The control bits for the A counter of the pair are used to control the 32-bit counter, and the B control bits are ignored. The CMPR0, CMPR1, CMPR2 and CMPR3 registers for each 16-bit counter are concatenated to provide the 32-bit comparison values, and all timer modes are supported.

**13.4 Creating a Secondary Output with CMPR2/3**

In any of the Count or Pulse modes (FN = 0, 1, 2 or 3), the CTIMER\_CMPR2 and CTIMER\_CMPR3 registers provide two additional comparison points. When the counter reaches a value in either CMPR2 or

CMPR3, the secondary output OUT2 is toggled. This allows the creation of complex combinations of the two outputs, as shown in Complex Operations with CMPR2 and CMPR3. In these examples, the CTIMER is configured in repeated pulse mode (FN = 3) to produce the OUT output, and several variations of the output OUT2 are shown. The third example is particularly interesting. If CMPR2 and CMPR3 are set to the same value, or one of them is set to a value larger than CMPR1, OUT2 will toggle only once per OUT cycle, creating a divide-by-two signal.

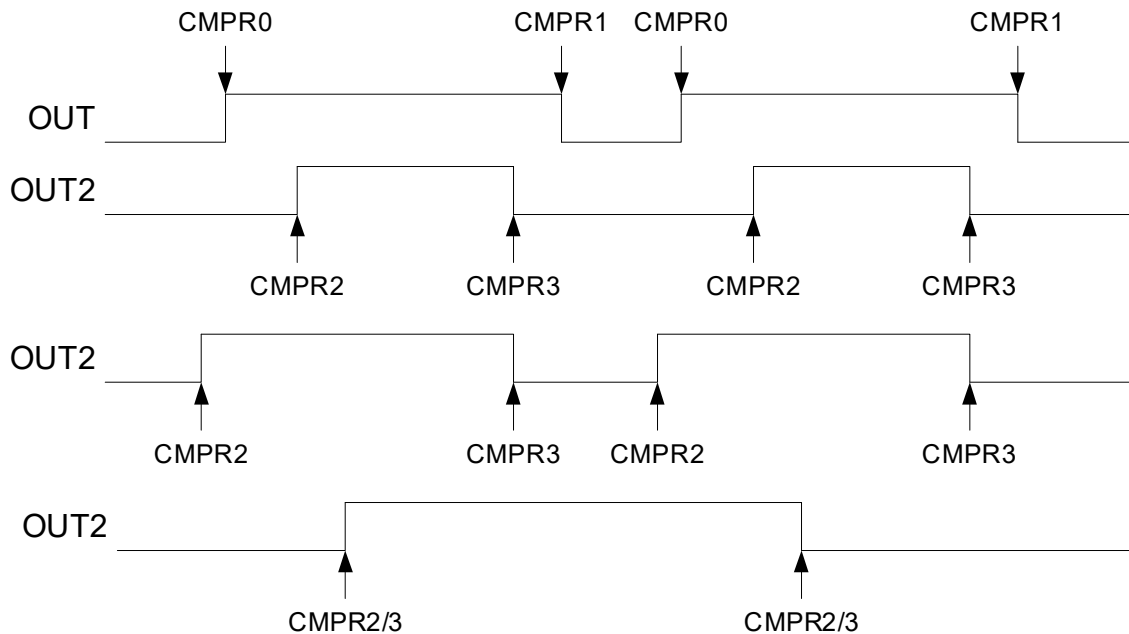


**Figure 73. Complex Operations with CMPR2 and CMPR3**

CMPR2 and CMPR3 operate in the same way for pulse and count modes. Thus in Single Count mode (FN = 0) for example, OUT2 can produce a single pulse or transition at any time prior to the termination of the count when OUT goes high. The polarity of OUT2 is controlled by the CTIMER\_CTAUXxy\_POL23 bit.



### 13.5 Generating Dual Patterns

If the CTIMER\_CTAUXxy\_EN23 bit is set in a Pattern Mode, a dual pattern will be created on OUT and OUT2. The pattern on OUT will use only the CMPR0/1 register bits, and the pattern on OUT2 will use the CMPR2/3 register bits, so that the longest dual pattern that can be created from a single CTIMER is 32 bits. The output patterns are shown in Figure . Dual patterns are particularly valuable in the case of stepper motor control signals, which require positive and negative signals to be generated synchronously.

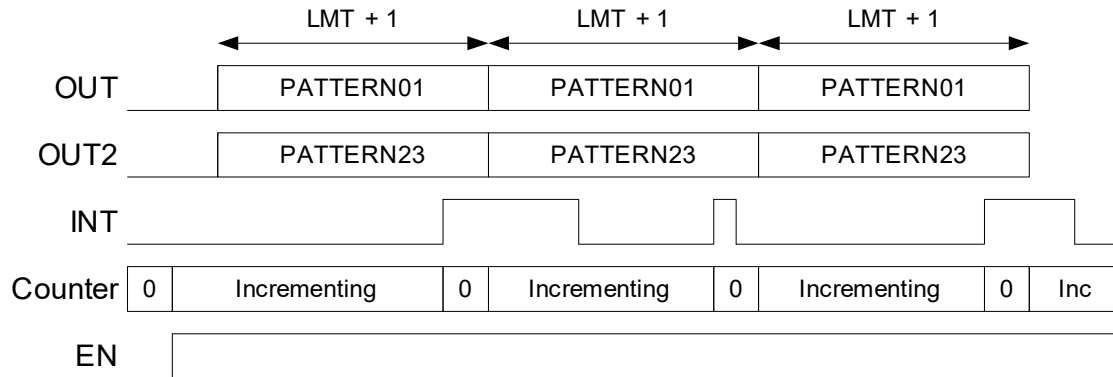


Figure 74. Dual Pattern Generation

### 13.6 Synchronized A/B Patterns

If the CTLINK bit is set for the B timer of a pair when a Pattern mode is selected (FN = 4 or 5), the pattern comparison value is taken from the A Counter rather than the B Counter. This allows the generation of dual up to 64-bit patterns using the OUT outputs of both the A and B Timers with EN23 clear in both cases, or quad up to 32-bit patterns using the OUT and OUT2 outputs of both timers with EN23 set in both cases.

### 13.7 Triggering Functions

The CTIMER\_CTAUXxy\_TRIG field allows the specification of the output of another CTIMER to be used as a trigger. There are several areas where the trigger function may be used to create extremely sophisticated pattern outputs. If the TRIG field is 0, the triggering function is disabled. Otherwise, TRIG selects the internal timer output to be used as the trigger.

#### 13.7.1 Initiating a One-shot Operation

If the mode of a CTIMER is as a one-shot (FN = 2 or 4), when EN is asserted one cycle of the operation will be executed. At that point, a rising edge on the trigger signal selected by TRIG will cause the operation to be executed again. This allows the creation of complex operations with a single configuration. Figure 75 shows an example of this. The TRIG signal is the OUT signal from a CTIMER configured for Repeat Count.

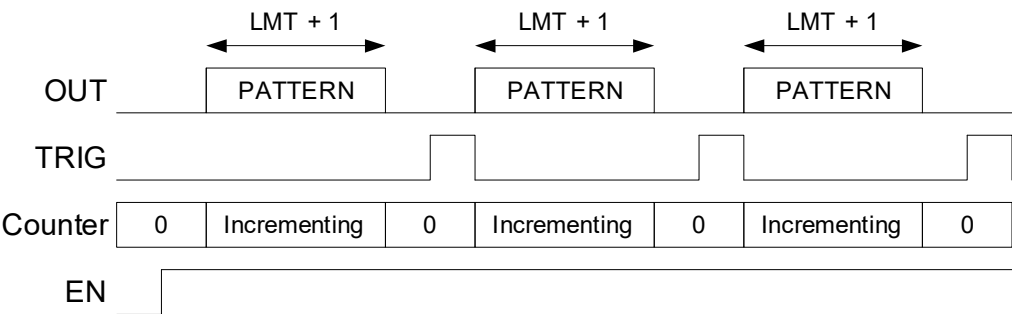


Figure 75. Triggered One-Shot Patterns

13.7.2 Terminating a Repeat Operation

If the mode of a CTIMER is a repeat mode (FN = 1, 3 or 5), a rising edge on the trigger signal selected by TRIG will cause the repeated operation to terminate after the current cycle is complete. This allows the easy creation of a burst of pulses or patterns of a specified length. This is shown in Figure 76 for the case of Repeat Pulse mode. In this case the TRIG signal is the output of a TIMER configured in Single Pulse mode (FN = 2) with the time configured to be somewhat more than 3 times the pulse repeat. When the TRIG signal occurs, the pulse output is terminated at the end of the current cycle.

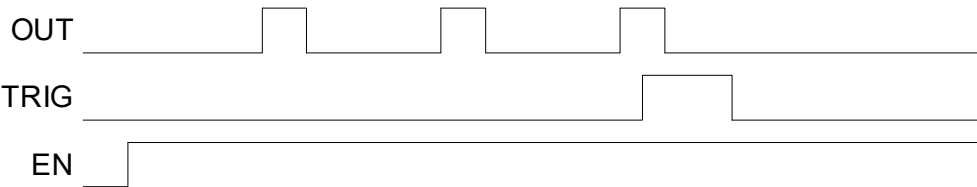


Figure 76. Terminated Repeat Patterns

13.7.3 Complex Patterns with Triggers

The two trigger modes can be combined to produce even more complex patterns. As a particular example, the OUT signal of Figure 76 could be selected as the TRIG signal in Figure 75. This would then produce exactly four bursts of the pattern.

13.7.4 Dual Edge Triggers

Some of the trigger input selections specify dual edge triggers. In that case, the trigger occurs on both the rising and falling edge of the trigger signal. This is very valuable in some stepper motor applications described below.

13.7.5 Trigger Controlled Inversion

If the CTIMER\_CTAUXxy\_TMRxyTINV bit is set, both the OUT and OUT2 outputs will be XORed with the trigger signal selected by TRIG. This enables some complex stepper motor configurations described below.

### 13.8 Clocking Timer/Counters with Other Counter/Timer Outputs

There are cases where it is very valuable to use the output of a CTIMER as the clock of another CTIMER. The TMRxyCLK field includes choices which implement this function, in addition to the normal clocks taken from the internal oscillators. If the clock of the timer which produces the TRIG signal were taken from the OUT output of the first timer, the CMPR0 value used for the trigger generator would be trivially calculated as 2, and would be independent of the actual clock used to generate the OUT signal.

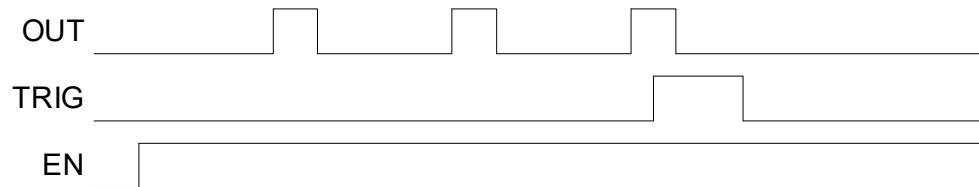


Figure 77. Terminated Repeat Patterns

### 13.9 Power Optimization by Measuring HCLK\_DIV4

Each timer has the capability to select the processor clock HCLK\_DIV4 as the counter clock input. This allows a very straightforward measurement of how much of the time the processor is in a Sleep or Deep Sleep mode. Two counters are configured with FN = 6 so that they count continuously. One is supplied HCLK\_DIV4 as its clock, and the other is supplied with a divided version of the HFRC clock. The two counters are enabled simultaneously, and after some period of system operation they are disabled and read. The HFRC count value defines how much real time has elapsed and how many HCLK\_DIV4 counts could have occurred in that time, and the HCLK\_DIV4 count value defines how many actual HCLK\_DIV4 counts were received in that time. The scaled ratio is an accurate measurement of the percentage of time the CPU is asleep, and is an effective tool for power optimization.

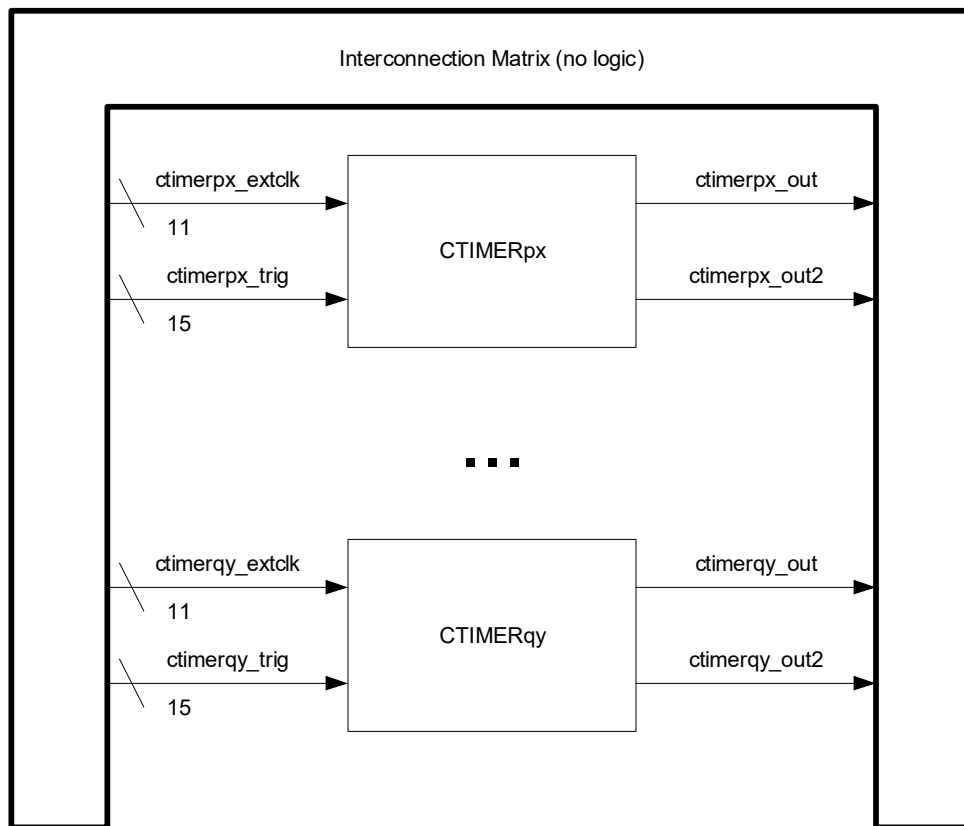


Figure 78. CTIMER Interconnection

### 13.10 Pad Connections from the Timer/Counter

In order to provide flexibility in connecting timers to external devices, a secondary multiplexing mechanism is provided for the timer outputs. There are 32 pads which can be configured for either inputs to or outputs from the Timer/Counter module. Each of these pads can be driven by one of eight outputs, including force high or force low, selected by the CTIMER\_OUTCFG0/1/2/3 registers, as shown in Table 814. The ctimer\_out column specifies the bit in GPIO\_CTENCFG (EN0-EN31) which enables the corresponding pad CT0-31 output. The Output Selection columns define the output choices for each output based on the CFG fields in OUTCFGx, where CFG=0 forces the output to 0, CFG=1 forces the output to 1 and CFG=2 through 7 produce the choices in the table.

**Table 814: Counter/Timer Output Pad Configuration**

| Pad<br>(FNCSEL) | ctimer<br>output<br>signal | Output Selection (CTIMER_OUTCFG) |            |        |        |        |        |        |        |
|-----------------|----------------------------|----------------------------------|------------|--------|--------|--------|--------|--------|--------|
|                 |                            | 0                                | 1          | 2      | 3      | 4      | 5      | 6      | 7      |
| PAD4 (6)        | CT17                       | Force to 0                       | Force to 1 | A4OUT2 | B7OUT  | A4OUT  | A1OUT2 | A6OUT2 | A7OUT2 |
| PAD5 (7)        | CT8                        | Force to 0                       | Force to 1 | A2OUT  | A3OUT2 | A4OUT2 | B6OUT  | A6OUT2 | A7OUT2 |
| PAD6 (5)        | CT10                       | Force to 0                       | Force to 1 | B2OUT  | B3OUT2 | B4OUT2 | A6OUT  | A6OUT2 | A7OUT2 |
| PAD7 (7)        | CT19                       | Force to 0                       | Force to 1 | B4OUT2 | A2OUT  | B4OUT  | B1OUT2 | A6OUT2 | A7OUT2 |
| PAD11 (2)       | CT31                       | Force to 0                       | Force to 1 | B7OUT2 | A6OUT  | B7OUT  | B3OUT2 | A6OUT2 | A7OUT2 |
| PAD12 (2)       | CT0                        | Force to 0                       | Force to 1 | A0OUT  | B2OUT2 | A5OUT2 | A6OUT  | A6OUT2 | A7OUT2 |
| PAD13 (2)       | CT2                        | Force to 0                       | Force to 1 | B0OUT  | B1OUT2 | B6OUT2 | A7OUT  | A6OUT2 | A7OUT2 |
| PAD18 (2)       | CT4                        | Force to 0                       | Force to 1 | A1OUT  | A2OUT2 | A5OUT2 | B5OUT  | A6OUT2 | A7OUT2 |
| PAD19 (2)       | CT6                        | Force to 0                       | Force to 1 | B1OUT  | A1OUT  | B5OUT2 | B7OUT  | A6OUT2 | A7OUT2 |
| PAD22 (2)       | CT12                       | Force to 0                       | Force to 1 | A3OUT  | B1OUT  | B0OUT2 | B6OUT2 | A6OUT2 | A7OUT2 |
| PAD23 (2)       | CT14                       | Force to 0                       | Force to 1 | B3OUT  | B1OUT  | B7OUT2 | A7OUT  | A6OUT2 | A7OUT2 |
| PAD24 (5)       | CT21                       | Force to 0                       | Force to 1 | A5OUT2 | A1OUT  | B5OUT  | A0OUT2 | A6OUT2 | A7OUT2 |
| PAD25 (2)       | CT1                        | Force to 0                       | Force to 1 | A0OUT2 | A0OUT  | A5OUT  | B7OUT2 | A6OUT2 | A7OUT2 |
| PAD26 (2)       | CT3                        | Force to 0                       | Force to 1 | B0OUT2 | B0OUT  | A1OUT  | A6OUT  | A6OUT2 | A7OUT2 |
| PAD27 (2)       | CT5                        | Force to 0                       | Force to 1 | A1OUT2 | A1OUT  | B6OUT  | A7OUT  | A6OUT2 | A7OUT2 |
| PAD28 (2)       | CT7                        | Force to 0                       | Force to 1 | B1OUT2 | B1OUT  | B5OUT  | A7OUT  | A6OUT2 | A7OUT2 |
| PAD29 (2)       | CT9                        | Force to 0                       | Force to 1 | A2OUT2 | A2OUT  | A4OUT  | B0OUT  | A6OUT2 | A7OUT2 |
| PAD30 (2)       | CT11                       | Force to 0                       | Force to 1 | B2OUT2 | B2OUT  | B4OUT  | B5OUT2 | A6OUT2 | A7OUT2 |
| PAD31 (2)       | CT13                       | Force to 0                       | Force to 1 | A3OUT2 | A3OUT  | A6OUT  | B4OUT2 | A6OUT2 | A7OUT2 |
| PAD32 (2)       | CT15                       | Force to 0                       | Force to 1 | B3OUT2 | B3OUT  | A7OUT  | A4OUT2 | A6OUT2 | A7OUT2 |
| PAD33 (6)       | CT23                       | Force to 0                       | Force to 1 | B5OUT2 | A7OUT  | A5OUT  | B0OUT2 | A6OUT2 | A7OUT2 |
| PAD35 (5)       | CT27                       | Force to 0                       | Force to 1 | B6OUT2 | A1OUT  | B6OUT  | B2OUT2 | A6OUT2 | A7OUT2 |
| PAD37 (7)       | CT29                       | Force to 0                       | Force to 1 | B5OUT2 | A1OUT  | A7OUT  | A3OUT2 | A6OUT2 | A7OUT2 |
| PAD39 (2)       | CT25                       | Force to 0                       | Force to 1 | B4OUT2 | B2OUT  | A6OUT  | A2OUT2 | A6OUT2 | A7OUT2 |
| PAD42 (2)       | CT16                       | Force to 0                       | Force to 1 | A4OUT  | A0OUT  | A0OUT2 | B3OUT2 | A6OUT2 | A7OUT2 |
| PAD43 (2)       | CT18                       | Force to 0                       | Force to 1 | B4OUT  | B0OUT  | A0OUT  | A3OUT2 | A6OUT2 | A7OUT2 |
| PAD44 (2)       | CT20                       | Force to 0                       | Force to 1 | A5OUT  | A1OUT  | A1OUT2 | B2OUT2 | A6OUT2 | A7OUT2 |
| PAD45 (2)       | CT22                       | Force to 0                       | Force to 1 | B5OUT  | A6OUT  | A1OUT  | A2OUT2 | A6OUT2 | A7OUT2 |
| PAD46 (2)       | CT24                       | Force to 0                       | Force to 1 | A6OUT  | A2OUT  | A1OUT  | B1OUT2 | A6OUT2 | A7OUT2 |
| PAD47 (2)       | CT26                       | Force to 0                       | Force to 1 | B6OUT  | B2OUT  | A5OUT  | A1OUT2 | A6OUT2 | A7OUT2 |
| PAD48 (2)       | CT28                       | Force to 0                       | Force to 1 | A7OUT  | A3OUT  | A5OUT2 | B0OUT2 | A6OUT2 | A7OUT2 |
| PAD49 (2)       | CT30                       | Force to 0                       | Force to 1 | B7OUT  | B3OUT  | A4OUT2 | A0OUT2 | A6OUT2 | A7OUT2 |

Each timer may be clocked by one of the two listed pads, selected by the CTIMER\_INCFG register as shown in Table 815. The polarity of the input clock is selection by the POL23 bit.

**Table 815: CTIMER Pad Input Connections**

| CTIMER   | INCFG |      | CTIMER   | INCFG |      |
|----------|-------|------|----------|-------|------|
|          | 0     | 1    |          | 0     | 1    |
| CTIMERA0 | CT0   | CT1  | CTIMERB0 | CT2   | CT3  |
| CTIMERA1 | CT4   | CT5  | CTIMERB1 | CT6   | CT7  |
| CTIMERA2 | CT8   | CT9  | CTIMERB2 | CT10  | CT11 |
| CTIMERA3 | CT12  | CT13 | CTIMERB3 | CT14  | CT15 |
| CTIMERA4 | CT16  | CT17 | CTIMERB4 | CT18  | CT19 |
| CTIMERA5 | CT20  | CT21 | CTIMERB5 | CT22  | CT23 |
| CTIMERA6 | CT24  | CT25 | CTIMERB6 | CT26  | CT27 |
| CTIMERA7 | CT28  | CT29 | CTIMERB7 | CT30  | CT31 |

The GPIO\_CTENCFG register holds one bit for each pad, which selects whether the pad is an output (if 0) or an input (if 1).

The assignments in Table 814 and Table 815 assume that COMMON outputs will be created from either A7OUT2 or A6OUT2. These outputs can also be used in the case where it is desired to drive multiple outputs from the same timer.

Note that for the Pulse and Count modes, the CMPR2/3 registers can always be configured so that OUT2 matches OUT. This provides more flexibility in the pin assignments, as any OUT2 connection can be used as the corresponding OUT function if a separate OUT2 function is not required. For a single 32-bit pattern from a timer, OUT2 can be configured in the CMPR2/3 registers to produce the same pattern as OUT.

The OUT and OUT2 outputs of each CTIMER will be toggling whenever the CTIMER is enabled, independent of any pin connections configured for it. This allows these signals to be used as clocks and triggers for other CTIMERs even when they are not being used as pin outputs.

Example flow is illustrated below:

- 1) Pick the pad you want to use, from column Pad (FNCSEL).
- 2) Set that pad's FNCSEL to the value in parentheses.
- 3) Determine which of the outputs in columns 2-7 you want to use to drive this pin.
- 4) Set the OUTCFG0/1/2/3\_CFGx bitfield to the value of 2 through 7 to select the desired CTIMER output.
- 5) Clear the bit in CTENCFG corresponding to the CTxx value that matches the pad, to make it an output.

### 13.11 Generating the Sample Rate for the ADC

Timer CTTMRA3 has a special function which allows it to function as the sample trigger generator for the ADC. If the CTIMER\_CTCTRL3\_ADCEN bit is set, the output of the timer is sent to the ADC which uses it as a trigger. Typically, Ctimer3 is configured in Repeated Count(FN =1) mode. TMRA3IE may be set to generate an interrupt whenever the trigger occurs, but typically the ADC interrupt will be used for this purpose.

### 13.12 Software Generated Serial Data Stream

It is possible to use the Repeat Pattern mode to produce a serial data stream, such as PDM. A Timer/Counter would be configured to use an external pad as the clock. Software would load the CMPR0/1/2/3 registers with the first 64 bits of the pattern. When the secondary interrupt is received, the first 32 bits will have been transferred, and software can load the next 32 bits into CMPR0/1. When the next secondary interrupt is generated, software can load the next 32 bits into the CMPR2/3 registers, and continue to toggle between the two pairs of registers. This can continue indefinitely.

Note that the requirement for software to update the registers continuously will require the processor to remain awake, unless the transfer is quite slow. For example, if the clock frequency were 1 MHz, software would have to load a 32-bit register every 32  $\mu$ s, which would probably not support a wakeup interrupt. However, at lower frequencies this could be a useful function.

### 13.13 Software Generated PWM Audio Output

The Alternate Pulse mode can be used to efficiently create an audio output stream in software. In many cases, audio can be effectively produced by generating a stream of pulses with a fixed period, but a variable duty cycle (i.e. a variable pulse width). When this is applied through a low pass filter, reasonable audio output will result. In Alternate Pulse mode, CMPR1 and CMPR3 are set to the desired sample period, and CMPR0 and CMPR2 are configured with the widths of the first two pulses. When the interrupt occurs at the end of the period, software loads CMPR0 with the next pulse width. When the next interrupt occurs, software loads CMPR2 with the next pulse width, and toggles between the two registers for each subsequent pulse. Because the sample rate of audio is often quite slow, software can generally handle this process in an interrupt driven fashion. When the interrupt occurs, there is a full sample period before new register data is needed, so that the interrupt service requirement is easy to achieve.

### 13.14 Stepper Motors Driven by Pattern Generation

Stepper motors can be driven by the CTIMERS by utilizing the pattern generation feature. Some of the key pattern generation features are arbitrary patterns up to 128 bits long, synchronization of multiple CTIMER pattern generation outputs, and the ability to use another CTIMER to generate the pattern clock base for CTIMER pattern generation output.

### 13.15 Pattern-based Sine Wave Examples

Some applications, such as driving the Linear Resonance Actuator (LRA) in a Haptic Driver or vibrator, require the generation of a pattern which is integrated into an analog signal, most commonly as a sine wave. Figure 79 shows the typical function. The square pulses have variable duty cycles, and they are integrated by the external device to produce the sine wave. The external device typically has positive and negative inputs, so the positive-going pulses occur on a pin which is connected to the positive input and the negative-going pulses are actually positive pulses connected to the negative input. The CTIMER can generate these pulse trains in two different ways.

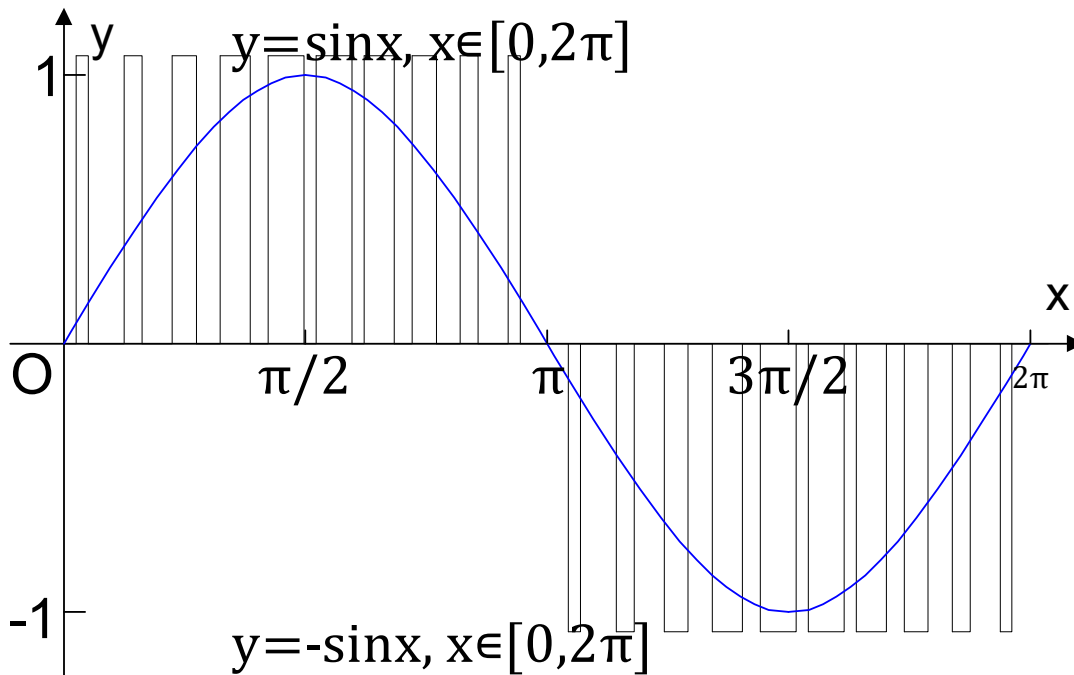


Figure 79. Creating a Sine Wave

### 13.15.1 PWM-based Pulse Trains

The pulse patterns shown in Figure 79 can be generated using the Alternate Pulse function described in Section 13.2.8. The PWM pulses are shown in Figure 80. Initially CMPR0/1/2/3 are configured with the desired parameters for the first two pulses. In many cases, the PWM Period is fixed so that CMPR1/3 contain the same value and never change, but these times can also be varied. When the first interrupt is received at the end of first CMPR0 period, software will update the CMPR0 register with the value required in the next period (and would also update CMPR3 with the next value if it should change). When the next interrupt is received at the comparison to CMPR2, a new CMPR2 value (and a new CMPR1 value if desired) are loaded. This process proceeds throughout the cycle which generates  $\frac{1}{2}$  of the sine wave. A similar process is repeated for the negative output to produce the second  $\frac{1}{2}$  of the sine wave. Note that software must be able to respond to the interrupt within a period which is slightly longer than the PWM Period, in order to insure that the correct comparison values are loaded.

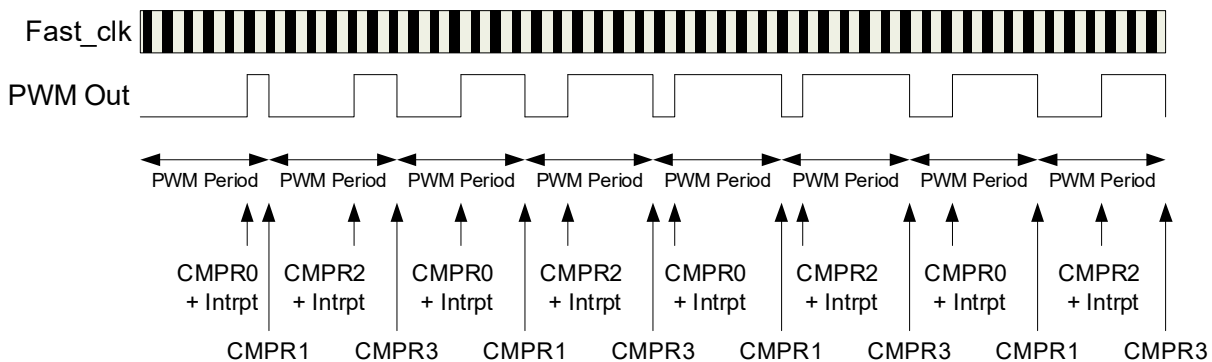


Figure 80. PWM-based Pulse Train



### 13.15.2 Pattern-based Pulse Trains

The pulse patterns may also be generated using the Repeated Pattern function described in Section 13.2.6. This is shown in Figure 81, and assumes the same pattern as the one in Figure 80. However, in this case the first N bits of the desired pattern (where N can be 64 or 128) are loaded into the CMPR0/1/2/3 registers of either a single CTIMER (for 64-bit patterns) or the A and B CTIMERS of a CTIMER pair (for 128-bit patterns). A full pattern consists of both Pattern 1 and Pattern 2 in Figure 81, for example. The process is started, and an interrupt will occur after  $\frac{1}{2}$  of the first full pattern (32 or 64 bits) has been generated. At that point software loads a new  $\frac{1}{2}$  pattern into the appropriate CMPR registers, and the process continues until the complete pattern has been generated.

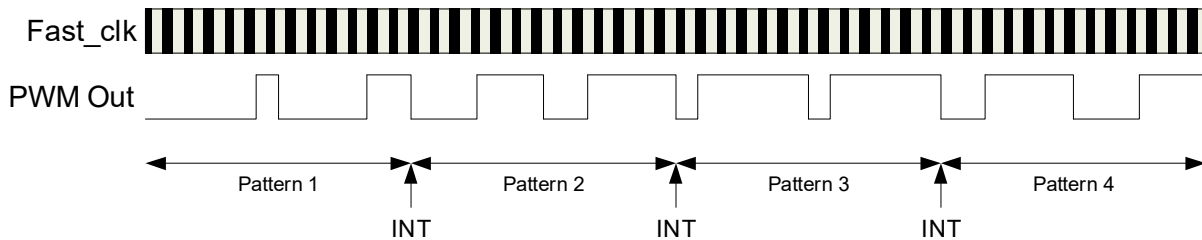


**Figure 81. Pattern-based Pulse Train**

The selection of 64-bit vs. 128-bit patterns is a tradeoff between power (the longer pattern results in half as many interrupts) and resource usage (the longer pattern requires two CTIMERS instead of one). If there are sufficient CTIMERS available, the 128-bit pattern is always more efficient.

### 13.15.3 Selecting the Optimal Method

Both of the above approaches produce the same result in terms of the generated pattern, so the optimal selection is a function of minimizing the number of interrupts required to produce the overall pattern. Fewer interrupts result in longer CPU sleep times and less interrupt servicing overhead, which reduces the overall power. If the half pattern can cover more time than the average PWM Period, the Pattern-based approach will typically be more energy efficient. Whether this is the case is a function of the desired fast clock frequency, which determines the precision of the pulses, and the desired pulse lengths.

## 13.16 CLR and EN Details

The overall operation of each CTIMER is controlled by two configuration bits, CLR and EN. When CLR is set to 1, the CTIMER is immediately set to all zeros and will remain there independent of any other configuration. CLR is typically used to initialize a CTIMER before use.

EN is used to enable (when 1) and disable (when 0) the counting function of the CTIMER. However, EN and the deassertion of CLR are synchronized to the selected clock, which must be accounted for when they are used. CLR and EN Operation shows how this synchronization occurs. When CLR is set to 0, the Counter will begin counting on the second edge of the selected clock if EN is set to 1. When EN is set to 0, the Counter will increment on the next clock (from 1 to 2 in CLR and EN Operation) and then hold its current value. When EN is set to 1, the Counter will resume counting on the second following edge.

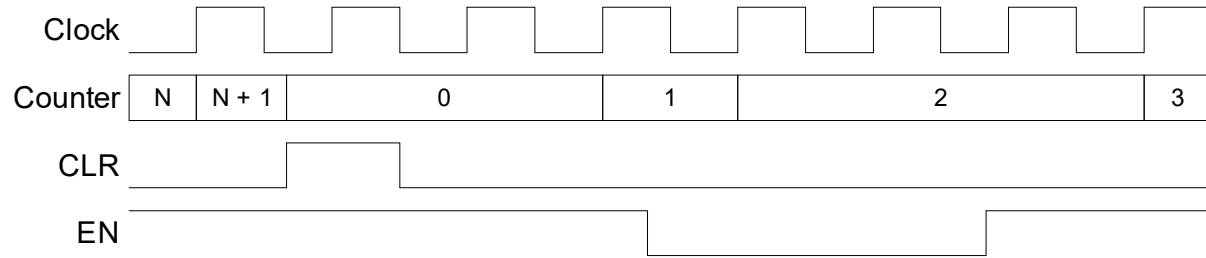


**Figure 82. CLR and EN Operation**

Since the operation of the processor is essentially asynchronous to the selected clock, the synchronization introduces an uncertainty as to when the Counter will begin counting. If the frequency of the selected clock is high relative to the processor clock, the impact of the synchronization will be negligible. However, for low frequency clocks, external pin clocks and the buck clocks the effective delay caused by the synchronization may be significant.

### 13.17 NOSYNC Function

Under normal conditions, the CTIMER clocks are supplied directly by the clock selected in the CTIMER\_CTCTRLx\_TMRxyCLK register field. However, if software reads the TMR value the clock will be temporarily synchronized to the processor clock, which may cause the time of edges on an output to move slightly. The time of any edge will be moved by at most 20 ns from the normal time. If this variation is unacceptable for a specific application, it can be eliminated in one of two ways:

1. Do not read the TMR value during the output generation. This is often an acceptable restriction.
2. Set the CTIMER\_CTAUXxy\_NOSYNC register bit. This will disable the synchronization function.

If the NOSYNC bit is set, the TMR update will no longer be synchronized to the processor clock. As a result, the TMR value read might be incorrect. In this case, software should read the TMR three times in quick succession (with interrupts disabled) and determine the correct value from those. If the first two reads are the same, that is the correct value. If they are different, the third value is correct.

### 13.18 Counter Functions

A CTIMER operates in counter mode when the TMRxyCLK field selects either the external pad input (if 0x00) or a buck pulse input (if 0x10). Although any of the modes may be selected, the typical configuration is Continuous. In this mode the CTIMER will count edges on the selected clock, and may be configured to generate an interrupt on a particular count value. The different clock selections provide different functions.

#### 13.18.1 Counting External Edges

If the TMRxyCLK field is 0x00, the CTIMER clock input comes from an external pad as selected by the INCFG register. This allows the CTIMER to monitor pulses or edges on an external signal.

#### 13.18.2 Counting Buck Converter Edges

Apollo3 includes three separate buck converter inputs which provide power for the processor power domain (BUCKA), the Memory power domain (BUCKB) and the BLE interface module (BUCKBLE). Each CTIMER may be connected to a pulse stream from any of the three analog Buck Converters. One pulse is generated each time the Buck Converter inserts charge into the capacitor, and therefore the number of pulses is a good indication of the amount of energy used by the corresponding power domain in a particular time period.

A possible option to determine energy consumption is as follows. Two counters could be configured with  $FN = 6$  so that they count continuously. One is supplied a Buck Converter pulse stream as its clock, and the other is supplied with a divided version of the LFRC clock to avoid creating extra power consumption due to the power measurement. Once configured such, the two counters should be enabled simultaneously, and after some period of system operation they should be disabled and read. The LFRC count value would now define how much real time has elapsed, and the Buck Converter count value would define how much energy was consumed in that time.

### 13.19 Interconnecting CTimers

The OUT or OUT2 output of one CTIMER may be used as either the Trigger or the clock of another CTIMER. Figure 78 shows the interconnection structure for two example CTIMERS, where p and q are A or B and x and y are 0 through 7. The selection of the actual clock or trigger interconnection is made within each CTIMER. The interconnection Matrix is not complete, as each CTIMER can select from only 15 triggers and 12 external clocks.

## 13.20 CTIMER Registers

### Counter/Timer

**INSTANCE 0 BASE ADDRESS:**0x40008000

The Counter/Timer block contains 8 sixteen bit counter or timer functions. Each pair of these counters can be cascaded into 32 bit Counter/Timer functions.

### 13.20.1 Register Memory Map

**Table 816: CTIMER Register Map**

| Address(s) | Register Name | Description                        |
|------------|---------------|------------------------------------|
| 0x40008000 | TMR0          | Counter/Timer 0                    |
| 0x40008004 | CMPRA0        | Counter/Timer A0 Compare           |
| 0x40008008 | CMPRB0        | Counter/Timer B0 Compare           |
| 0x4000800C | CTRL0         | Counter/Timer Control 0            |
| 0x40008014 | CMPRAUXA0     | Counter/Timer A0 Auxiliary Compare |
| 0x40008018 | CMPRAUXB0     | Counter/Timer B0 Auxiliary Compare |
| 0x4000801C | AUX0          | Counter/Timer 0 Auxiliary          |
| 0x40008020 | TMR1          | Counter/Timer 1                    |
| 0x40008024 | CMPRA1        | Counter/Timer A1 Compare           |
| 0x40008028 | CMPRB1        | Counter/Timer B1 Compare           |
| 0x4000802C | CTRL1         | Counter/Timer 1 Control            |
| 0x40008034 | CMPRAUXA1     | Counter/Timer A1 Auxiliary Compare |
| 0x40008038 | CMPRAUXB1     | Counter/Timer B1 Auxiliary Compare |
| 0x4000803C | AUX1          | Counter/Timer 1 Auxiliary          |
| 0x40008040 | TMR2          | Counter/Timer 2                    |
| 0x40008044 | CMPRA2        | Counter/Timer A2 Compare           |
| 0x40008048 | CMPRB2        | Counter/Timer B2 Compare           |
| 0x4000804C | CTRL2         | Counter/Timer 2 Control            |
| 0x40008054 | CMPRAUXA2     | Counter/Timer A2 Auxiliary Compare |
| 0x40008058 | CMPRAUXB2     | Counter/Timer B2 Auxiliary Compare |
| 0x4000805C | AUX2          | Counter/Timer 2 Auxiliary          |
| 0x40008060 | TMR3          | Counter/Timer 3                    |
| 0x40008064 | CMPRA3        | Counter/Timer A3 Compare           |
| 0x40008068 | CMPRB3        | Counter/Timer B3 Compare           |
| 0x4000806C | CTRL3         | Counter/Timer 3 Control            |
| 0x40008074 | CMPRAUXA3     | Counter/Timer A3 Auxiliary Compare |
| 0x40008078 | CMPRAUXB3     | Counter/Timer B3 Auxiliary Compare |
| 0x4000807C | AUX3          | Counter/Timer 3 Auxiliary          |
| 0x40008080 | TMR4          | Counter/Timer 4                    |
| 0x40008084 | CMPRA4        | Counter/Timer A4 Compare           |
| 0x40008088 | CMPRB4        | Counter/Timer B4 Compare           |
| 0x4000808C | CTRL4         | Counter/Timer 4 Control            |
| 0x40008094 | CMPRAUXA4     | Counter/Timer A4 Auxiliary Compare |
| 0x40008098 | CMPRAUXB4     | Counter/Timer B4 Auxiliary Compare |
| 0x4000809C | AUX4          | Counter/Timer 4 Auxiliary          |
| 0x400080A0 | TMR5          | Counter/Timer 5                    |

Table 816: CTIMER Register Map

| Address(s) | Register Name | Description                        |
|------------|---------------|------------------------------------|
| 0x400080A4 | CMPRA5        | Counter/Timer A5 Compare           |
| 0x400080A8 | CMPRB5        | Counter/Timer B5 Compare           |
| 0x400080AC | CTRL5         | Counter/Timer 5 Control            |
| 0x400080B4 | CMPRAUXA5     | Counter/Timer A5 Auxiliary Compare |
| 0x400080B8 | CMPRAUXB5     | Counter/Timer B5 Auxiliary Compare |
| 0x400080BC | AUX5          | Counter/Timer 5 Auxiliary          |
| 0x400080C0 | TMR6          | Counter/Timer 6                    |
| 0x400080C4 | CMPRA6        | Counter/Timer A6 Compare           |
| 0x400080C8 | CMPRB6        | Counter/Timer B6 Compare           |
| 0x400080CC | CTRL6         | Counter/Timer 6 Control            |
| 0x400080D4 | CMPRAUXA6     | Counter/Timer A6 Auxiliary Compare |
| 0x400080D8 | CMPRAUXB6     | Counter/Timer B6 Auxiliary Compare |
| 0x400080DC | AUX6          | Counter/Timer 6 Auxiliary          |
| 0x400080E0 | TMR7          | Counter/Timer 7                    |
| 0x400080E4 | CMPRA7        | Counter/Timer A7 Compare           |
| 0x400080E8 | CMPRB7        | Counter/Timer B7 Compare           |
| 0x400080EC | CTRL7         | Counter/Timer 7 Control            |
| 0x400080F4 | CMPRAUXA7     | Counter/Timer A7 Auxiliary Compare |
| 0x400080F8 | CMPRAUXB7     | Counter/Timer B7 Auxiliary Compare |
| 0x400080FC | AUX7          | Counter/Timer 7 Auxiliary          |
| 0x40008100 | GLOBEN        | Counter/Timer Global Enable        |
| 0x40008104 | OUTCFG0       | Counter/Timer Output Config 0      |
| 0x40008108 | OUTCFG1       | Counter/Timer Output Config 1      |
| 0x4000810C | OUTCFG2       | Counter/Timer Output Config 2      |
| 0x40008114 | OUTCFG3       | Counter/Timer Output Config 3      |
| 0x40008118 | INCFG         | Counter/Timer Input Config         |
| 0x40008200 | INTEN         | Counter/Timer Interrupts: Enable   |
| 0x40008204 | INTSTAT       | Counter/Timer Interrupts: Status   |
| 0x40008208 | INTCLR        | Counter/Timer Interrupts: Clear    |
| 0x4000820C | INTSET        | Counter/Timer Interrupts: Set      |

### 13.20.2 CTIMER Registers

#### 13.20.2.1 TMR0 Register

Counter/Timer 0

OFFSET: 0x00000000

INSTANCE 0 ADDRESS: 0x40008000

This register holds the running time or event count for CTIMER 0. This is either for each 16 bit half or for the whole 32 bit count when the pair is linked. If the pair is not linked, they can be running on separate clocks and are completely independent.

Table 817: TMR0 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CTTMRB0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CTTMRA0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 818: TMR0 Register Bits

| Bit   | Name    | Reset | RW | Description       |
|-------|---------|-------|----|-------------------|
| 31:16 | CTTMRB0 | 0x0   | RO | Counter/Timer B0. |
| 15:0  | CTTMRA0 | 0x0   | RO | Counter/Timer A0. |

#### 13.20.2.2 CMPRA0 Register

Counter/Timer A0 Compare

OFFSET: 0x00000004

INSTANCE 0 ADDRESS: 0x40008004

This contains the Compare limits for timer 0 half A.

Table 819: CMPRA0 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1A0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0A0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR1A0 | 0x0   | RW | Counter/Timer A0 Compare Register 1. Holds the upper limit for timer half A. |
| 15:0  | CMPR0A0 | 0x0   | RW | Counter/Timer A0 Compare Register 0. Holds the lower limit for timer half A. |

This contains the Compare limits for timer 0 B half.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 | 0 |   |
| CMPR1B0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0B0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR1B0 | 0x0   | RW | Counter/Timer B0 Compare Register 1. Holds the upper limit for timer half B. |
| 15:0  | CMPR0B0 | 0x0   | RW | Counter/Timer B0 Compare Register 0. Holds the lower limit for timer half B. |

This includes the Control bit fields for both halves of timer 0.



Table 823: CTRL0 Register

|         |      |          |          |          |          |         |          |   |   |   |   |         |      |          |          |          |          |         |          |   |   |   |   |         |   |   |   |
|---------|------|----------|----------|----------|----------|---------|----------|---|---|---|---|---------|------|----------|----------|----------|----------|---------|----------|---|---|---|---|---------|---|---|---|
| 3       | 3    | 2        | 2        | 2        | 2        | 2       | 2        | 2 | 2 | 2 | 1 | 1       | 1    | 1        | 1        | 1        | 1        | 1       | 0        | 0 | 0 | 0 | 0 | 0       | 0 | 0 | 0 |
| 1       | 0    | 9        | 8        | 7        | 6        | 5       | 4        | 3 | 2 | 1 | 0 | 9       | 8    | 7        | 6        | 5        | 4        | 3       | 2        | 1 | 0 | 9 | 8 | 7       | 6 | 5 | 4 |
| CTLINK0 | RSVD | TMRB0POL | TMRB0CLR | TMRB0IE1 | TMRB0IE0 | TMRB0FN | TMRB0CLK |   |   |   |   | TMRB0EN | RSVD | TMRA0POL | TMRA0CLR | TMRA0IE1 | TMRA0IE0 | TMRA0FN | TMRA0CLK |   |   |   |   | TMRA0EN |   |   |   |

Table 824: CTRL0 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                             |
|-------|----------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | CTLINK0  | 0x0   | RW | Counter/Timer A0/B0 Link bit.<br>TWO_16BIT_TIMERS = 0x0 - Use A0/B0 timers as two independent 16-bit timers (default).<br>32BIT_TIMER = 0x1 - Link A0/B0 timers into a single 32-bit timer.                             |
| 30:29 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                |
| 28    | TMRB0POL | 0x0   | RW | Counter/Timer B0 output polarity.<br>NORMAL = 0x0 - The polarity of the TMRPINB0 pin is the same as the timer output.<br>INVERTED = 0x1 - The polarity of the TMRPINB0 pin is the inverse of the timer output.          |
| 27    | TMRB0CLR | 0x0   | RW | Counter/Timer B0 Clear bit.<br>RUN = 0x0 - Allow counter/timer B0 to run<br>CLEAR = 0x1 - Holds counter/timer B0 at 0x0000.                                                                                             |
| 26    | TMRB0IE1 | 0x0   | RW | Counter/Timer B0 Interrupt Enable bit for COMPR1.<br>DIS = 0x0 - Disable counter/timer B0 from generating an interrupt based on COMPR1.<br>EN = 0x1 - Enable counter/timer B0 to generate an interrupt based on COMPR1. |
| 25    | TMRB0IE0 | 0x0   | RW | Counter/Timer B0 Interrupt Enable bit for COMPR0.<br>DIS = 0x0 - Disable counter/timer B0 from generating an interrupt based on COMPR0.<br>EN = 0x1 - Enable counter/timer B0 to generate an interrupt based on COMPR0. |

Table 824: CTRL0 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24:22 | TMRB0FN  | 0x0   | RW | Counter/Timer B0 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0B0, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0B0, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0B0, assert, count to CMPR1B0, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0B0, assert, count to CMPR1B0, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 21:17 | TMRB0CLK | 0x0   | RW | Counter/Timer B0 Clock Select.<br><br>TMRPIN = 0x0 - Clock source is TMRPINB.<br>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br>XT = 0x6 - Clock source is the XT (uncalibrated).<br>XT_DIV2 = 0x7 - Clock source is XT / 2<br>XT_DIV16 = 0x8 - Clock source is XT / 16<br>XT_DIV128 = 0x9 - Clock source is XT / 128<br>LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br>LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br>LFRC = 0xD - Clock source is LFRC<br>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br>HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br>XT_DIV4 = 0x10 - Clock source is XT / 4<br>XT_DIV8 = 0x11 - Clock source is XT / 8<br>XT_DIV32 = 0x12 - Clock source is XT / 32<br>RSVD = 0x13 - Clock source is Reserved.<br>CTMRA0 = 0x14 - Clock source is CTIMERA0 OUT.<br>CTMRB1 = 0x15 - Clock source is CTIMERA1 OUT.<br>CTMRA1 = 0x16 - Clock source is CTIMERA2 OUT.<br>CTMRA2 = 0x17 - Clock source is CTIMERA3 OUT.<br>CTMRB2 = 0x18 - Clock source is CTIMERA4 OUT.<br>CTMRB3 = 0x19 - Clock source is CTIMERA5 OUT.<br>CTMRB4 = 0x1A - Clock source is CTIMERA6 OUT.<br>CTMRB5 = 0x1B - Clock source is CTIMERA7 OUT.<br>CTMRB6 = 0x1C - Clock source is CTIMERA8 OUT.<br>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses. |
| 16    | TMRB0EN  | 0x0   | RW | Counter/Timer B0 Enable bit.<br><br>DIS = 0x0 - Counter/Timer B0 Disable.<br>EN = 0x1 - Counter/Timer B0 Enable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 15:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

Table 824: CTRL0 Register Bits

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12  | TMRA0POL | 0x0   | RW | Counter/Timer A0 output polarity.<br><br>NORMAL = 0x0 - The polarity of the TMRPINA0 pin is the same as the timer output.<br>INVERTED = 0x1 - The polarity of the TMRPINA0 pin is the inverse of the timer output.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 11  | TMRA0CLR | 0x0   | RW | Counter/Timer A0 Clear bit.<br><br>RUN = 0x0 - Allow counter/timer A0 to run<br>CLEAR = 0x1 - Holds counter/timer A0 at 0x0000.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 10  | TMRA0IE1 | 0x0   | RW | Counter/Timer A0 Interrupt Enable bit based on COMP1.<br><br>DIS = 0x0 - Disable counter/timer A0 from generating an interrupt based on COMP1.<br>EN = 0x1 - Enable counter/timer A0 to generate an interrupt based on COMP1.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 9   | TMRA0IE0 | 0x0   | RW | Counter/Timer A0 Interrupt Enable bit based on COMP0.<br><br>DIS = 0x0 - Disable counter/timer A0 from generating an interrupt based on COMP0.<br>EN = 0x1 - Enable counter/timer A0 to generate an interrupt based on COMP0.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 8:6 | TMRA0FN  | 0x0   | RW | Counter/Timer A0 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0A0, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0A0, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0A0, assert, count to CMPR1A0, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0A0, assert, count to CMPR1A0, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM |

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5:1 | TMRA0CLK | 0x0   | RW | <p>Counter/Timer A0 Clock Select.</p> <p>TMRPIN = 0x0 - Clock source is TMRPINA.<br/>           HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br/>           HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br/>           HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br/>           HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br/>           HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br/>           XT = 0x6 - Clock source is the XT (uncalibrated).<br/>           XT_DIV2 = 0x7 - Clock source is XT / 2<br/>           XT_DIV16 = 0x8 - Clock source is XT / 16<br/>           XT_DIV128 = 0x9 - Clock source is XT / 128<br/>           LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br/>           LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br/>           LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br/>           LFRC = 0xD - Clock source is LFRC<br/>           RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br/>           HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br/>           XT_DIV4 = 0x10 - Clock source is XT / 4<br/>           XT_DIV8 = 0x11 - Clock source is XT / 8<br/>           XT_DIV32 = 0x12 - Clock source is XT / 32<br/>           RSVD = 0x13 - Clock source is Reserved.<br/>           CTMRB0 = 0x14 - Clock source is CTIMERB0 OUT.<br/>           CTMRA1 = 0x15 - Clock source is CTIMERA1 OUT.<br/>           CTMRB1 = 0x16 - Clock source is CTIMERB1 OUT.<br/>           CTMRA2 = 0x17 - Clock source is CTIMERA2 OUT.<br/>           CTMRB2 = 0x18 - Clock source is CTIMERB2 OUT.<br/>           CTMRB3 = 0x19 - Clock source is CTIMERB3 OUT.<br/>           CTMRB4 = 0x1A - Clock source is CTIMERB4 OUT.<br/>           CTMRB5 = 0x1B - Clock source is CTIMERB5 OUT.<br/>           CTMRB6 = 0x1C - Clock source is CTIMERB6 OUT.<br/>           BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br/>           BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br/>           BUCKA = 0x1F - Clock source is CPU buck converter TON pulses.</p> |
| 0   | TMRA0EN  | 0x0   | RW | <p>Counter/Timer A0 Enable bit.</p> <p>DIS = 0x0 - Counter/Timer A0 Disable.<br/>           EN = 0x1 - Counter/Timer A0 Enable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

Enhanced compare limits for timer half A. This is valid if timer 0 is set to function 4 and function 5.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR3A0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2A0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3A0 | 0x0   | RW | Counter/Timer A0 Compare Register 3. Holds the upper limit for timer half A. |
| 15:0  | CMPR2A0 | 0x0   | RW | Counter/Timer A0 Compare Register 2. Holds the lower limit for timer half A. |

### Counter/Timer B0 Auxiliary Compare

**INSTANCE 0 ADDRESS: 0x40008018**

Enhanced compare limits for timer half B. This is valid if timer 0 is set to function 4 and function 5.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR3B0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2B0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3B0 | 0x0   | RW | Counter/Timer B0 Compare Register 3. Holds the upper limit for timer half B. |
| 15:0  | CMPR2B0 | 0x0   | RW | Counter/Timer B0 Compare Register 2. Holds the lower limit for timer half B. |

### Counter/Timer 0 Auxiliary

**INSTANCE 0 ADDRESS: 0x4000801C**

Control bit fields for both halves of timer 0.



**Table 830: AUX0 Register Bits**

| Bit   | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|--------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:16 | TMRB0LMT     | 0x0   | RW | Counter/Timer B0 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 15    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 14    | TMRA0EN23    | 0x0   | RW | Counter/Timer A0 Upper compare enable.<br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 13    | TMRA0POL23   | 0x0   | RW | Counter/Timer A0 Upper output polarity<br>NORM = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 12    | TMRA0TINV    | 0x0   | RW | Counter/Timer A0 Invert on trigger.<br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 11    | TMRA0NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 10:7  | TMRA0TRIG    | 0x0   | RW | Counter/Timer A0 Trigger Select.<br><br>DIS = 0x0 - Trigger source is disabled.<br>B0OUT = 0x1 - Trigger source is CTIMERB0 OUT.<br>B3OUT = 0x2 - Trigger source is CTIMERB3 OUT.<br>A3OUT = 0x3 - Trigger source is CTIMERA3 OUT.<br>A1OUT = 0x4 - Trigger source is CTIMERA1 OUT.<br>B1OUT = 0x5 - Trigger source is CTIMERB1 OUT.<br>A5OUT = 0x6 - Trigger source is CTIMERA5 OUT.<br>B5OUT = 0x7 - Trigger source is CTIMERB5 OUT.<br>B3OUT2 = 0x8 - Trigger source is CTIMERB3 OUT2.<br>A3OUT2 = 0x9 - Trigger source is CTIMERA3 OUT2.<br>B6OUT2 = 0xA - Trigger source is CTIMERB6 OUT2.<br>A2OUT2 = 0xB - Trigger source is CTIMERA2 OUT2.<br>A6OUT2DUAL = 0xC - Trigger source is CTIMERA6 OUT2, dual edge.<br>A7OUT2DUAL = 0xD - Trigger source is CTIMERA7 OUT2, dual edge.<br>B4OUT2DUAL = 0xE - Trigger source is CTIMERB4 OUT2, dual edge.<br>A4OUT2DUAL = 0xF - Trigger source is CTIMERA4 OUT2, dual edge. |
| 6:0   | TMRA0LMT     | 0x0   | RW | Counter/Timer A0 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

**13.20.2.8TMR1 Register****Counter/Timer 1****OFFSET:** 0x00000020**INSTANCE 0 ADDRESS:** 0x40008020

This register holds the running time or event count for CTIMER 1. This is either for each 16 bit half or for the whole 32 bit count when the pair is linked. If the pair is not linked, they can be running on separate clocks and are completely independent.

Table 831: TMR1 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CTTMRB1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CTTMRA1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 832: TMR1 Register Bits

| Bit   | Name    | Reset | RW | Description       |
|-------|---------|-------|----|-------------------|
| 31:16 | CTTMRB1 | 0x0   | RO | Counter/Timer B1. |
| 15:0  | CTTMRA1 | 0x0   | RO | Counter/Timer A1. |

**13.20.2.9CMPRA1 Register****Counter/Timer A1 Compare****OFFSET:** 0x00000024**INSTANCE 0 ADDRESS:** 0x40008024

This contains the Compare limits for timer 1 A half.

Table 833: CMPRA1 Register

|         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1  | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5  | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| CMPR1A1 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CMPR0A1 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

Table 834: CMPRA1 Register Bits

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1A1 | 0x0   | RW | Counter/Timer A1 Compare Register 1. |
| 15:0  | CMPR0A1 | 0x0   | RW | Counter/Timer A1 Compare Register 0. |

**13.20.2.10CMPRB1 Register****Counter/Timer B1 Compare****OFFSET:** 0x00000028**INSTANCE 0 ADDRESS:** 0x40008028

This contains the Compare limits for timer 1 B half.



|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1B1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0B1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1B1 | 0x0   | RW | Counter/Timer B1 Compare Register 1. |
| 15:0  | CMPR0B1 | 0x0   | RW | Counter/Timer B1 Compare Register 0. |

This includes the Control bit fields for both halves of timer 1.

|         |        |        |          |          |          |          |         |        |        |          |        |        |        |         |        |        |          |          |          |          |         |        |          |        |        |        |         |        |        |        |        |        |
|---------|--------|--------|----------|----------|----------|----------|---------|--------|--------|----------|--------|--------|--------|---------|--------|--------|----------|----------|----------|----------|---------|--------|----------|--------|--------|--------|---------|--------|--------|--------|--------|--------|
|         | 3<br>1 | 3<br>0 | 2<br>9   | 2<br>8   | 2<br>7   | 2<br>6   | 2<br>5  | 2<br>4 | 2<br>3 | 2<br>2   | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8  | 1<br>7 | 1<br>6 | 1<br>5   | 1<br>4   | 1<br>3   | 1<br>2   | 1<br>1  | 1<br>0 | 0<br>9   | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5  | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| CTLINK1 | RSVD   |        | TMRB1POL | TMRB1CLR | TMRB1IE1 | TMRB1IE0 | TMRB1FN |        |        | TMRB1CLK |        |        |        | TMRB1EN | RSVD   |        | TMRA1POL | TMRA1CLR | TMRA1IE1 | TMRA1IE0 | TMRA1FN |        | TMRA1CLK |        |        |        | TMRA1EN |        |        |        |        |        |

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                     |
|-------|---------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | CTLINK1 | 0x0   | RW | Counter/Timer A1/B1 Link bit.<br><br>TWO_16BIT_TIMERS = 0x0 - Use A1/B1 timers as two independent 16-bit timers (default).<br>32BIT_TIMER = 0x1 - Link A1/B1 timers into a single 32-bit timer. |
| 30:29 | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                        |

Table 838: CTRL1 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28    | TMRB1POL | 0x0   | RW | Counter/Timer B1 output polarity.<br><br>NORMAL = 0x0 - The polarity of the TMRPINB1 pin is the same as the timer output.<br>INVERTED = 0x1 - The polarity of the TMRPINB1 pin is the inverse of the timer output.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 27    | TMRB1CLR | 0x0   | RW | Counter/Timer B1 Clear bit.<br><br>RUN = 0x0 - Allow counter/timer B1 to run<br>CLEAR = 0x1 - Holds counter/timer B1 at 0x0000.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 26    | TMRB1IE1 | 0x0   | RW | Counter/Timer B1 Interrupt Enable bit for COMP1.<br><br>DIS = 0x0 - Disable counter/timer B1 from generating an interrupt based on COMP1.<br>EN = 0x1 - Enable counter/timer B1 to generate an interrupt based on COMP1.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 25    | TMRB1IE0 | 0x0   | RW | Counter/Timer B1 Interrupt Enable bit for COMP0.<br><br>DIS = 0x0 - Disable counter/timer B1 from generating an interrupt based on COMP0.<br>EN = 0x1 - Enable counter/timer B1 to generate an interrupt based on COMP0                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 24:22 | TMRB1FN  | 0x0   | RW | Counter/Timer B1 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0B1, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0B1, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0B1, assert, count to CMPR1B1, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0B1, assert, count to CMPR1B1, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM |

Table 838: CTRL1 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------|----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:17 | TMRB1CLK | 0x0   | RW | <p>Counter/Timer B1 Clock Select.</p> <p>TMRPIN = 0x0 - Clock source is TMRPINB.</p> <p>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4</p> <p>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16</p> <p>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256</p> <p>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024</p> <p>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096</p> <p>XT = 0x6 - Clock source is the XT (uncalibrated).</p> <p>XT_DIV2 = 0x7 - Clock source is XT / 2</p> <p>XT_DIV16 = 0x8 - Clock source is XT / 16</p> <p>XT_DIV128 = 0x9 - Clock source is XT / 128</p> <p>LFRC_DIV2 = 0xA - Clock source is LFRC / 2</p> <p>LFRC_DIV32 = 0xB - Clock source is LFRC / 32</p> <p>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024</p> <p>LFRC = 0xD - Clock source is LFRC</p> <p>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.</p> <p>HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)</p> <p>XT_DIV4 = 0x10 - Clock source is XT / 4</p> <p>XT_DIV8 = 0x11 - Clock source is XT / 8</p> <p>XT_DIV32 = 0x12 - Clock source is XT / 32</p> <p>RSVD = 0x13 - Clock source is Reserved.</p> <p>CTMRA1 = 0x14 - Clock source is CTIMERA1 OUT.</p> <p>CTMRA0 = 0x15 - Clock source is CTIMERA0 OUT.</p> <p>CTMRB0 = 0x16 - Clock source is CTIMERB0 OUT.</p> <p>CTMRA2 = 0x17 - Clock source is CTIMERA2 OUT.</p> <p>CTMRB2 = 0x18 - Clock source is CTIMERB2 OUT.</p> <p>CTMRB3 = 0x19 - Clock source is CTIMERB3 OUT.</p> <p>CTMRB4 = 0x1A - Clock source is CTIMERB4 OUT.</p> <p>CTMRB5 = 0x1B - Clock source is CTIMERB5 OUT.</p> <p>CTMRB6 = 0x1C - Clock source is CTIMERB6 OUT.</p> <p>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.</p> <p>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.</p> <p>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses.</p> |
| 16    | TMRB1EN  | 0x0   | RW | <p>Counter/Timer B1 Enable bit.</p> <p>DIS = 0x0 - Counter/Timer B1 Disable.</p> <p>EN = 0x1 - Counter/Timer B1 Enable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 15:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 12    | TMRA1POL | 0x0   | RW | <p>Counter/Timer A1 output polarity.</p> <p>NORMAL = 0x0 - The polarity of the TMRPINA1 pin is the same as the timer output.</p> <p>INVERTED = 0x1 - The polarity of the TMRPINA1 pin is the inverse of the timer output.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 11    | TMRA1CLR | 0x0   | RW | <p>Counter/Timer A1 Clear bit.</p> <p>RUN = 0x0 - Allow counter/timer A1 to run</p> <p>CLEAR = 0x1 - Holds counter/timer A1 at 0x0000.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 10    | TMRA1IE1 | 0x0   | RW | <p>Counter/Timer A1 Interrupt Enable bit based on COMP1.</p> <p>DIS = 0x0 - Disable counter/timer A1 from generating an interrupt based on COMP1.</p> <p>EN = 0x1 - Enable counter/timer A1 to generate an interrupt based on COMP1.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

Table 838: CTRL1 Register Bits

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9   | TMRA1IE0 | 0x0   | RW | Counter/Timer A1 Interrupt Enable bit based on COMP0.<br><br>DIS = 0x0 - Disable counter/timer A1 from generating an interrupt based on COMP0.<br>EN = 0x1 - Enable counter/timer A1 to generate an interrupt based on COMP0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 8:6 | TMRA1FN  | 0x0   | RW | Counter/Timer A1 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to COMP0A1, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to COMP0A1, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to COMP0A1, assert, count to COMP1A1, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to COMP0A1, assert, count to COMP1A1, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM<br>TRIGCOPY = 0x7 - Replicate the trigger input<br>DUALTRIGPATTERN = 0x4 - Single pattern, trigger on either edge.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 5:1 | TMRA1CLK | 0x0   | RW | Counter/Timer A1 Clock Select.<br><br>TMRPIN = 0x0 - Clock source is TMRPINA.<br>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br>XT = 0x6 - Clock source is the XT (uncalibrated).<br>XT_DIV2 = 0x7 - Clock source is XT / 2<br>XT_DIV16 = 0x8 - Clock source is XT / 16<br>XT_DIV128 = 0x9 - Clock source is XT / 128<br>LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br>LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br>LFRC = 0xD - Clock source is LFRC<br>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br>HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br>XT_DIV4 = 0x10 - Clock source is XT / 4<br>XT_DIV8 = 0x11 - Clock source is XT / 8<br>XT_DIV32 = 0x12 - Clock source is XT / 32<br>RSVD = 0x13 - Clock source is Reserved.<br>CTMRB1 = 0x14 - Clock source is CTIMERB1 OUT.<br>CTMRA0 = 0x15 - Clock source is CTIMERA0 OUT.<br>CTMRB0 = 0x16 - Clock source is CTIMERB0 OUT.<br>CTMRA2 = 0x17 - Clock source is CTIMERA2 OUT.<br>CTMRB2 = 0x18 - Clock source is CTIMERB2 OUT.<br>CTMRB3 = 0x19 - Clock source is CTIMERB3 OUT.<br>CTMRB4 = 0x1A - Clock source is CTIMERB4 OUT.<br>CTMRB5 = 0x1B - Clock source is CTIMERB5 OUT.<br>CTMRB6 = 0x1C - Clock source is CTIMERB6 OUT.<br>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses. |

| Bit | Name    | Reset | RW | Description                                                                                                      |
|-----|---------|-------|----|------------------------------------------------------------------------------------------------------------------|
| 0   | TMRA1EN | 0x0   | RW | Counter/Timer A1 Enable bit.<br><br>DIS = 0x0 - Counter/Timer A1 Disable.<br>EN = 0x1 - Counter/Timer A1 Enable. |

Enhanced compare limits for timer half A. This is valid if timer 1 is set to function 4 and function 5.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6       | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR3A1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2A1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3A1 | 0x0   | RW | Counter/Timer A1 Compare Register 3. Holds the upper limit for timer half A. |
| 15:0  | CMPR2A1 | 0x0   | RW | Counter/Timer A1 Compare Register 2. Holds the lower limit for timer half A. |

Enhanced compare limits for timer half B. This is valid if timer 1 is set to function 4 and function 5.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR3B1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2B1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3B1 | 0x0   | RW | Counter/Timer B1 Compare Register 3. Holds the upper limit for timer half B. |
| 15:0  | CMPR2B1 | 0x0   | RW | Counter/Timer B1 Compare Register 2. Holds the lower limit for timer half B. |

Control bit fields for both halves of timer 0.

[illegible]

| Bit | Name       | Reset | RW | Description                                                                                                                |
|-----|------------|-------|----|----------------------------------------------------------------------------------------------------------------------------|
| 31  | RSVD       | 0x0   | RO | RESERVED                                                                                                                   |
| 30  | TMRB1EN23  | 0x0   | RW | Counter/Timer B1 Upper compare enable.<br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions. |
| 29  | TMRB1POL23 | 0x0   | RW | Upper output polarity<br>NORM = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.          |
| 28  | TMRB1TINV  | 0x0   | RW | Counter/Timer B1 Invert on trigger.<br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger        |

Table 844: AUX1 Register Bits

| Bit   | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|--------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27    | TMRB1NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 26:23 | TMRB1TRIG    | 0x0   | RW | Counter/Timer B1 Trigger Select.<br><br>DIS = 0x0 - Trigger source is disabled.<br>A1OUT = 0x1 - Trigger source is CTIMERA1 OUT.<br>B3OUT = 0x2 - Trigger source is CTIMERB3 OUT.<br>A3OUT = 0x3 - Trigger source is CTIMERA3 OUT.<br>A6OUT = 0x4 - Trigger source is CTIMERA6 OUT.<br>B6OUT = 0x5 - Trigger source is CTIMERB6 OUT.<br>A0OUT = 0x6 - Trigger source is CTIMERA0 OUT.<br>B0OUT = 0x7 - Trigger source is CTIMERB0 OUT.<br>B3OUT2 = 0x8 - Trigger source is CTIMERB3 OUT2.<br>A3OUT2 = 0x9 - Trigger source is CTIMERA3 OUT2.<br>A4OUT2 = 0xA - Trigger source is CTIMERA4 OUT2.<br>B4OUT2 = 0xB - Trigger source is CTIMERB4 OUT2.<br>A6OUT2DUAL = 0xC - Trigger source is CTIMERA6 OUT2, dual edge.<br>A7OUT2DUAL = 0xD - Trigger source is CTIMERA7 OUT2, dual edge.<br>B5OUT2DUAL = 0xE - Trigger source is CTIMERB5 OUT2, dual edge.<br>A5OUT2DUAL = 0xF - Trigger source is CTIMERA5 OUT2, dual edge. |
| 22    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 21:16 | TMRB1LMT     | 0x0   | RW | Counter/Timer B1 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 15    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 14    | TMRA1EN23    | 0x0   | RW | Counter/Timer A1 Upper compare enable.<br><br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 13    | TMRA1POL23   | 0x0   | RW | Counter/Timer A1 Upper output polarity<br><br>NORMAL = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 12    | TMRA1TINV    | 0x0   | RW | Counter/Timer A1 Invert on trigger.<br><br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 11    | TMRA1NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Bit  | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|-----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10:7 | TMRA1TRIG | 0x0   | RW | <p>Counter/Timer A1 Trigger Select.</p> <p>DIS = 0x0 - Trigger source is disabled.<br/> B1OUT = 0x1 - Trigger source is CTIMERB1 OUT.<br/> B3OUT = 0x2 - Trigger source is CTIMERB3 OUT.<br/> A3OUT = 0x3 - Trigger source is CTIMERA3 OUT.<br/> A0OUT = 0x4 - Trigger source is CTIMERA0 OUT.<br/> B0OUT = 0x5 - Trigger source is CTIMERB0 OUT.<br/> A5OUT = 0x6 - Trigger source is CTIMERA5 OUT.<br/> B5OUT = 0x7 - Trigger source is CTIMERB5 OUT.<br/> B3OUT2 = 0x8 - Trigger source is CTIMERB3 OUT2.<br/> A3OUT2 = 0x9 - Trigger source is CTIMERA3 OUT2.<br/> A4OUT2 = 0xA - Trigger source is CTIMERA4 OUT2.<br/> B4OUT2 = 0xB - Trigger source is CTIMERB4 OUT2.<br/> A6OUT2DUAL = 0xC - Trigger source is CTIMERA6 OUT2, dual edge.<br/> A7OUT2DUAL = 0xD - Trigger source is CTIMERA7 OUT2, dual edge.<br/> B5OUT2DUAL = 0xE - Trigger source is CTIMERB5 OUT2, dual edge.<br/> A5OUT2DUAL = 0xF - Trigger source is CTIMERA5 OUT2, dual edge.</p> |
| 6:0  | TMRA1LMT  | 0x0   | RW | Counter/Timer A1 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

**INSTANCE 0 ADDRESS: 0x40008040**

Table 845: TMR2 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CTTMRB2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CTTMRA2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description       |
|-------|---------|-------|----|-------------------|
| 31:16 | CTTMRB2 | 0x0   | RO | Counter/Timer B2. |
| 15:0  | CTTMRA2 | 0x0   | RO | Counter/Timer A2. |



**13.20.2.16CMPRA2 Register****Counter/Timer A2 Compare****OFFSET:** 0x00000044**INSTANCE 0 ADDRESS:** 0x40008044

This register holds the compare limits for timer 2 A half.

**Table 847: CMPRA2 Register**

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1A2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0A2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 848: CMPRA2 Register Bits**

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1A2 | 0x0   | RW | Counter/Timer A2 Compare Register 1. |
| 15:0  | CMPR0A2 | 0x0   | RW | Counter/Timer A2 Compare Register 0. |

**13.20.2.17CMPRB2 Register****Counter/Timer B2 Compare****OFFSET:** 0x00000048**INSTANCE 0 ADDRESS:** 0x40008048

This register holds the compare limits for timer 2 B half.

**Table 849: CMPRB2 Register**

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1B2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0B2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 850: CMPRB2 Register Bits**

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1B2 | 0x0   | RW | Counter/Timer B2 Compare Register 1. |
| 15:0  | CMPR0B2 | 0x0   | RW | Counter/Timer B2 Compare Register 0. |



Table 852: CTRL2 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24:22 | TMRB2FN  | 0x0   | RW | Counter/Timer B2 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0B2, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0B2, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0B2, assert, count to CMPR1B2, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0B2, assert, count to CMPR1B2, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 21:17 | TMRB2CLK | 0x0   | RW | Counter/Timer B2 Clock Select.<br><br>TMRPIN = 0x0 - Clock source is TMRPINB.<br>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br>XT = 0x6 - Clock source is the XT (uncalibrated).<br>XT_DIV2 = 0x7 - Clock source is XT / 2<br>XT_DIV16 = 0x8 - Clock source is XT / 16<br>XT_DIV128 = 0x9 - Clock source is XT / 128<br>LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br>LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br>LFRC = 0xD - Clock source is LFRC<br>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br>HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br>XT_DIV4 = 0x10 - Clock source is XT / 4<br>XT_DIV8 = 0x11 - Clock source is XT / 8<br>XT_DIV32 = 0x12 - Clock source is XT / 32<br>RSVD = 0x13 - Clock source is Reserved.<br>CTMRA2 = 0x14 - Clock source is CTIMERA2 OUT.<br>CTMRB3 = 0x15 - Clock source is CTIMERA3 OUT.<br>CTMRA3 = 0x16 - Clock source is CTIMERB3 OUT.<br>CTMRA4 = 0x17 - Clock source is CTIMERA4 OUT.<br>CTMRB4 = 0x18 - Clock source is CTIMERB4 OUT.<br>CTMRB0 = 0x19 - Clock source is CTIMERB0 OUT.<br>CTMRB1 = 0x1A - Clock source is CTIMERB1 OUT.<br>CTMRB5 = 0x1B - Clock source is CTIMERB5 OUT.<br>CTMRB6 = 0x1C - Clock source is CTIMERB6 OUT.<br>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses. |
| 16    | TMRB2EN  | 0x0   | RW | Counter/Timer B2 Enable bit.<br><br>DIS = 0x0 - Counter/Timer B2 Disable.<br>EN = 0x1 - Counter/Timer B2 Enable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 15:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

Table 852: CTRL2 Register Bits

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12  | TMRA2POL | 0x0   | RW | Counter/Timer A2 output polarity.<br><br>NORMAL = 0x0 - The polarity of the TMRPINA2 pin is the same as the timer output.<br>INVERTED = 0x1 - The polarity of the TMRPINA2 pin is the inverse of the timer output.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 11  | TMRA2CLR | 0x0   | RW | Counter/Timer A2 Clear bit.<br><br>RUN = 0x0 - Allow counter/timer A2 to run<br>CLEAR = 0x1 - Holds counter/timer A2 at 0x0000.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 10  | TMRA2IE1 | 0x0   | RW | Counter/Timer A2 Interrupt Enable bit based on COMP1.<br><br>DIS = 0x0 - Disable counter/timer A2 from generating an interrupt based on COMP1.<br>EN = 0x1 - Enable counter/timer A2 to generate an interrupt based on COMP1.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 9   | TMRA2IE0 | 0x0   | RW | Counter/Timer A2 Interrupt Enable bit based on COMP0.<br><br>DIS = 0x0 - Disable counter/timer A2 from generating an interrupt based on COMP0.<br>EN = 0x1 - Enable counter/timer A2 to generate an interrupt based on COMP0.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 8:6 | TMRA2FN  | 0x0   | RW | Counter/Timer A2 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0A2, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0A2, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0A2, assert, count to CMPR1A2, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0A2, assert, count to CMPR1A2, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM |

**Table 852: CTRL2 Register Bits**

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5:1 | TMRA2CLK | 0x0   | RW | Counter/Timer A2 Clock Select.<br><br>TMRPIN = 0x0 - Clock source is TMRPINA.<br>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br>XT = 0x6 - Clock source is the XT (uncalibrated).<br>XT_DIV2 = 0x7 - Clock source is XT / 2<br>XT_DIV16 = 0x8 - Clock source is XT / 16<br>XT_DIV128 = 0x9 - Clock source is XT / 128<br>LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br>LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br>LFRC = 0xD - Clock source is LFRC<br>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br>HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br>XT_DIV4 = 0x10 - Clock source is XT / 4<br>XT_DIV8 = 0x11 - Clock source is XT / 8<br>XT_DIV32 = 0x12 - Clock source is XT / 32<br>RSVD = 0x13 - Clock source is Reserved.<br>CTMRB2 = 0x14 - Clock source is CTIMERB2 OUT.<br>CTMRB3 = 0x15 - Clock source is CTIMERA3 OUT.<br>CTMRA3 = 0x16 - Clock source is CTIMERB3 OUT.<br>CTMRA4 = 0x17 - Clock source is CTIMERA4 OUT.<br>CTMRB4 = 0x18 - Clock source is CTIMERB4 OUT.<br>CTMRB0 = 0x19 - Clock source is CTIMERB0 OUT.<br>CTMRB1 = 0x1A - Clock source is CTIMERB1 OUT.<br>CTMRB5 = 0x1B - Clock source is CTIMERB5 OUT.<br>CTMRB6 = 0x1C - Clock source is CTIMERB6 OUT.<br>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses. |
| 0   | TMRA2EN  | 0x0   | RW | Counter/Timer A2 Enable bit.<br><br>DIS = 0x0 - Counter/Timer A2 Disable.<br>EN = 0x1 - Counter/Timer A2 Enable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

**13.20.2.19CMPRAUXA2 Register****Counter/Timer A2 Auxiliary Compare****OFFSET:** 0x00000054**INSTANCE 0 ADDRESS:** 0x40008054

Enhanced compare limits for timer half A.

**Table 853: CMPRAUXA2 Register**

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1      | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5      | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 |
| CMR3A2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMR2A2 |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3A2 | 0x0   | RW | Counter/Timer A2 Compare Register 3. Holds the upper limit for timer half A. |
| 15:0  | CMPR2A2 | 0x0   | RW | Counter/Timer A2 Compare Register 2. Holds the lower limit for timer half A. |

Enhanced compare limits for timer half B.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR3B2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2B2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3B2 | 0x0   | RW | Counter/Timer B2 Compare Register 3. Holds the upper limit for timer half B. |
| 15:0  | CMPR2B2 | 0x0   | RW | Counter/Timer B2 Compare Register 2. Holds the lower limit for timer half B. |

Control bit fields for both halves of timer 0.



Table 858: AUX2 Register Bits

| Bit   | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|--------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:16 | TMRB2LMT     | 0x0   | RW | Counter/Timer B2 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 15    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 14    | TMRA2EN23    | 0x0   | RW | Counter/Timer A2 Upper compare enable.<br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 13    | TMRA2POL23   | 0x0   | RW | Counter/Timer A2 Upper output polarity<br>NORM = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 12    | TMRA2TINV    | 0x0   | RW | Counter/Timer A2 Invert on trigger.<br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 11    | TMRA2NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 10:7  | TMRA2TRIG    | 0x0   | RW | Counter/Timer A2 Trigger Select.<br><br>DIS = 0x0 - Trigger source is disabled.<br>B2OUT = 0x1 - Trigger source is CTIMERB2 OUT.<br>B3OUT = 0x2 - Trigger source is CTIMERB3 OUT.<br>A3OUT = 0x3 - Trigger source is CTIMERA3 OUT.<br>A0OUT = 0x4 - Trigger source is CTIMERA0 OUT.<br>B0OUT = 0x5 - Trigger source is CTIMERB0 OUT.<br>A4OUT = 0x6 - Trigger source is CTIMERA4 OUT.<br>B4OUT = 0x7 - Trigger source is CTIMERB4 OUT.<br>B3OUT2 = 0x8 - Trigger source is CTIMERB3 OUT2.<br>A3OUT2 = 0x9 - Trigger source is CTIMERA3 OUT2.<br>A5OUT2 = 0xA - Trigger source is CTIMERA5 OUT2.<br>B5OUT2 = 0xB - Trigger source is CTIMERB5 OUT2.<br>A6OUT2DUAL = 0xC - Trigger source is CTIMERA6 OUT2, dual edge.<br>A7OUT2DUAL = 0xD - Trigger source is CTIMERA7 OUT2, dual edge.<br>B4OUT2DUAL = 0xE - Trigger source is CTIMERB4 OUT2, dual edge.<br>A4OUT2DUAL = 0xF - Trigger source is CTIMERA4 OUT2, dual edge. |
| 6:0   | TMRA2LMT     | 0x0   | RW | Counter/Timer A2 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

**13.20.2.22TMR3 Register****Counter/Timer 3****OFFSET:** 0x00000060**INSTANCE 0 ADDRESS:** 0x40008060

Counter/Timer 3



Table 859: TMR3 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CTTMRB3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CTTMRA3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 860: TMR3 Register Bits

| Bit   | Name    | Reset | RW | Description       |
|-------|---------|-------|----|-------------------|
| 31:16 | CTTMRB3 | 0x0   | RO | Counter/Timer B3. |
| 15:0  | CTTMRA3 | 0x0   | RO | Counter/Timer A3. |

**13.20.2.23CMPRA3 Register****Counter/Timer A3 Compare****OFFSET:** 0x00000064**INSTANCE 0 ADDRESS:** 0x40008064

This register holds the compare limits for timer half A.

Table 861: CMPRA3 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1A3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0A3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 862: CMPRA3 Register Bits

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1A3 | 0x0   | RW | Counter/Timer A3 Compare Register 1. |
| 15:0  | CMPR0A3 | 0x0   | RW | Counter/Timer A3 Compare Register 0. |

**13.20.2.24CMPRB3 Register****Counter/Timer B3 Compare****OFFSET:** 0x00000068**INSTANCE 0 ADDRESS:** 0x40008068

This register holds the compare limits for timer half B.

Table 863: CMPRB3 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1B3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0B3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 864: CMPRB3 Register Bits

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1B3 | 0x0   | RW | Counter/Timer B3 Compare Register 1. |
| 15:0  | CMPR0B3 | 0x0   | RW | Counter/Timer B3 Compare Register 0. |

**13.20.2.25CTRL3 Register****Counter/Timer 3 Control****OFFSET:** 0x0000006C**INSTANCE 0 ADDRESS:** 0x4000806C

This register holds the control bit fields for both halves of timer 3.

Table 865: CTRL3 Register

|         |      |          |          |          |          |         |   |   |   |   |          |   |   |   |   |         |       |      |          |          |          |          |         |   |   |   |   |          |   |   |   |  |         |
|---------|------|----------|----------|----------|----------|---------|---|---|---|---|----------|---|---|---|---|---------|-------|------|----------|----------|----------|----------|---------|---|---|---|---|----------|---|---|---|--|---------|
| 3       | 3    | 2        | 2        | 2        | 2        | 2       | 2 | 2 | 2 | 2 | 2        | 1 | 1 | 1 | 1 | 1       | 1     | 1    | 1        | 1        | 0        | 0        | 0       | 0 | 0 | 0 | 0 | 0        | 0 | 0 |   |  |         |
| 1       | 0    | 9        | 8        | 7        | 6        | 5       | 4 | 3 | 2 | 1 | 0        | 9 | 8 | 7 | 6 | 5       | 4     | 3    | 2        | 1        | 0        | 9        | 8       | 7 | 6 | 5 | 4 | 3        | 2 | 1 | 0 |  |         |
| CTLINK3 | RSVD | TMRB3POL | TMRB3CLR | TMRB3IE1 | TMRB3IE0 | TMRB3FN |   |   |   |   | TMRB3CLK |   |   |   |   | TMRB3EN | ADCEN | RSVD | TMRA3POL | TMRA3CLR | TMRA3IE1 | TMRA3IE0 | TMRA3FN |   |   |   |   | TMRA3CLK |   |   |   |  | TMRA3EN |

Table 866: CTRL3 Register Bits

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                     |
|-------|---------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | CTLINK3 | 0x0   | RW | Counter/Timer A3/B3 Link bit.<br><br>TWO_16BIT_TIMERS = 0x0 - Use A3/B3 timers as two independent 16-bit timers (default).<br>32BIT_TIMER = 0x1 - Link A3/B3 timers into a single 32-bit timer. |
| 30:29 | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                        |

Table 866: CTRL3 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28    | TMRB3POL | 0x0   | RW | Counter/Timer B3 output polarity.<br><br>NORMAL = 0x0 - The polarity of the TMRPINB3 pin is the same as the timer output.<br>INVERTED = 0x1 - The polarity of the TMRPINB3 pin is the inverse of the timer output.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 27    | TMRB3CLR | 0x0   | RW | Counter/Timer B3 Clear bit.<br><br>RUN = 0x0 - Allow counter/timer B3 to run<br>CLEAR = 0x1 - Holds counter/timer B3 at 0x0000.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 26    | TMRB3IE1 | 0x0   | RW | Counter/Timer B3 Interrupt Enable bit for COMPR1.<br><br>DIS = 0x0 - Disable counter/timer B3 from generating an interrupt based on COMPR1.<br>EN = 0x1 - Enable counter/timer B3 to generate an interrupt based on COMPR1.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 25    | TMRB3IE0 | 0x0   | RW | Counter/Timer B3 Interrupt Enable bit for COMPR0.<br><br>DIS = 0x0 - Disable counter/timer B3 from generating an interrupt based on COMPR0.<br>EN = 0x1 - Enable counter/timer B3 to generate an interrupt based on COMPR0                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 24:22 | TMRB3FN  | 0x0   | RW | Counter/Timer B3 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0B3, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0B3, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0B3, assert, count to CMPR1B3, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0B3, assert, count to CMPR1B3, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM |

Table 866: CTRL3 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------|----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:17 | TMRB3CLK | 0x0   | RW | <p>Counter/Timer B3 Clock Select.</p> <p>TMRPIN = 0x0 - Clock source is TMRPINB.</p> <p>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4</p> <p>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16</p> <p>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256</p> <p>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024</p> <p>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096</p> <p>XT = 0x6 - Clock source is the XT (uncalibrated).</p> <p>XT_DIV2 = 0x7 - Clock source is XT / 2</p> <p>XT_DIV16 = 0x8 - Clock source is XT / 16</p> <p>XT_DIV128 = 0x9 - Clock source is XT / 128</p> <p>LFRC_DIV2 = 0xA - Clock source is LFRC / 2</p> <p>LFRC_DIV32 = 0xB - Clock source is LFRC / 32</p> <p>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024</p> <p>LFRC = 0xD - Clock source is LFRC</p> <p>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.</p> <p>HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)</p> <p>XT_DIV4 = 0x10 - Clock source is XT / 4</p> <p>XT_DIV8 = 0x11 - Clock source is XT / 8</p> <p>XT_DIV32 = 0x12 - Clock source is XT / 32</p> <p>RSVD = 0x13 - Clock source is Reserved.</p> <p>CTMRA3 = 0x14 - Clock source is CTIMERA3 OUT.</p> <p>CTMRA2 = 0x15 - Clock source is CTIMERA2 OUT.</p> <p>CTMRB2 = 0x16 - Clock source is CTIMERB2 OUT.</p> <p>CTMRA4 = 0x17 - Clock source is CTIMERA4 OUT.</p> <p>CTMRB4 = 0x18 - Clock source is CTIMERB4 OUT.</p> <p>CTMRB0 = 0x19 - Clock source is CTIMERB0 OUT.</p> <p>CTMRB1 = 0x1A - Clock source is CTIMERB1 OUT.</p> <p>CTMRB5 = 0x1B - Clock source is CTIMERB5 OUT.</p> <p>CTMRB6 = 0x1C - Clock source is CTIMERB6 OUT.</p> <p>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.</p> <p>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.</p> <p>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses.</p> |
| 16    | TMRB3EN  | 0x0   | RW | <p>Counter/Timer B3 Enable bit.</p> <p>DIS = 0x0 - Counter/Timer B3 Disable.</p> <p>EN = 0x1 - Counter/Timer B3 Enable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 15    | ADCEN    | 0x0   | RW | Special Timer A3 enable for ADC function.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 14:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 12    | TMRA3POL | 0x0   | RW | <p>Counter/Timer A3 output polarity.</p> <p>NORMAL = 0x0 - The polarity of the TMRPINA3 pin is the same as the timer output.</p> <p>INVERTED = 0x1 - The polarity of the TMRPINA3 pin is the inverse of the timer output.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 11    | TMRA3CLR | 0x0   | RW | <p>Counter/Timer A3 Clear bit.</p> <p>RUN = 0x0 - Allow counter/timer A3 to run</p> <p>CLEAR = 0x1 - Holds counter/timer A3 at 0x0000.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**Table 866: CTRL3 Register Bits**

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10  | TMRA3IE1 | 0x0   | RW | Counter/Timer A3 Interrupt Enable bit based on COMPR1.<br><br>DIS = 0x0 - Disable counter/timer A3 from generating an interrupt based on COMPR1.<br>EN = 0x1 - Enable counter/timer A3 to generate an interrupt based on COMPR1.                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 9   | TMRA3IE0 | 0x0   | RW | Counter/Timer A3 Interrupt Enable bit based on COMPR0.<br><br>DIS = 0x0 - Disable counter/timer A3 from generating an interrupt based on COMPR0.<br>EN = 0x1 - Enable counter/timer A3 to generate an interrupt based on COMPR0.                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 8:6 | TMRA3FN  | 0x0   | RW | Counter/Timer A3 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0A3, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0A3, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0A3, assert, count to CMPR1A3, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0A3, assert, count to CMPR1A3, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM |

Table 866: CTRL3 Register Bits

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5:1 | TMRA3CLK | 0x0   | RW | <p>Counter/Timer A3 Clock Select.</p> <p>TMRPIN = 0x0 - Clock source is TMRPINA.<br/> HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br/> HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br/> HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br/> HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br/> HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br/> XT = 0x6 - Clock source is the XT (uncalibrated).<br/> XT_DIV2 = 0x7 - Clock source is XT / 2<br/> XT_DIV16 = 0x8 - Clock source is XT / 16<br/> XT_DIV128 = 0x9 - Clock source is XT / 128<br/> LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br/> LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br/> LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br/> LFRC = 0xD - Clock source is LFRC<br/> RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br/> HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br/> XT_DIV4 = 0x10 - Clock source is XT / 4<br/> XT_DIV8 = 0x11 - Clock source is XT / 8<br/> XT_DIV32 = 0x12 - Clock source is XT / 32<br/> RSVD = 0x13 - Clock source is Reserved.<br/> CTMRB3 = 0x14 - Clock source is CTIMERB3 OUT.<br/> CTMRA2 = 0x15 - Clock source is CTIMERA2 OUT.<br/> CTMRB2 = 0x16 - Clock source is CTIMERB2 OUT.<br/> CTMRA4 = 0x17 - Clock source is CTIMERA4 OUT.<br/> CTMRB4 = 0x18 - Clock source is CTIMERB4 OUT.<br/> CTMRB0 = 0x19 - Clock source is CTIMERB0 OUT.<br/> CTMRB1 = 0x1A - Clock source is CTIMERB1 OUT.<br/> CTMRB5 = 0x1B - Clock source is CTIMERB5 OUT.<br/> CTMRB6 = 0x1C - Clock source is CTIMERB6 OUT.<br/> BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br/> BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br/> BUCKA = 0x1F - Clock source is CPU buck converter TON pulses.</p> |
| 0   | TMRA3EN  | 0x0   | RW | <p>Counter/Timer A3 Enable bit.</p> <p>DIS = 0x0 - Counter/Timer A3 Disable.<br/> EN = 0x1 - Counter/Timer A3 Enable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

**13.20.2.26CMPRAUXA3 Register****Counter/Timer A3 Auxiliary Compare****OFFSET:** 0x00000074**INSTANCE 0 ADDRESS:** 0x40008074

Enhanced compare limits for timer half A.

Table 867: CMPRAUXA3 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR3A3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2A3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3A3 | 0x0   | RW | Counter/Timer A3 Compare Register 3. Holds the upper limit for timer half A. |
| 15:0  | CMPR2A3 | 0x0   | RW | Counter/Timer A3 Compare Register 2. Holds the lower limit for timer half A. |

Enhanced compare limits for timer half B.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR3B3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2B3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3B3 | 0x0   | RW | Counter/Timer B3 Compare Register 3. Holds the upper limit for timer half B. |
| 15:0  | CMPR2B3 | 0x0   | RW | Counter/Timer B3 Compare Register 2. Holds the lower limit for timer half B. |

Control bit fields for both halves of timer 0.





Table 872: AUX3 Register Bits

| Bit   | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|--------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:16 | TMRB3LMT     | 0x0   | RW | Counter/Timer B3 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 15    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 14    | TMRA3EN23    | 0x0   | RW | Counter/Timer A3 Upper compare enable.<br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 13    | TMRA3POL23   | 0x0   | RW | Counter/Timer A3 Upper output polarity<br>NORM = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 12    | TMRA3TINV    | 0x0   | RW | Counter/Timer A3 Invert on trigger.<br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 11    | TMRA3NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 10:7  | TMRA3TRIG    | 0x0   | RW | Counter/Timer A3 Trigger Select.<br><br>DIS = 0x0 - Trigger source is disabled.<br>B3OUT = 0x1 - Trigger source is CTIMERB3 OUT.<br>B2OUT = 0x2 - Trigger source is CTIMERB2 OUT.<br>A2OUT = 0x3 - Trigger source is CTIMERA2 OUT.<br>A4OUT = 0x4 - Trigger source is CTIMERA4 OUT.<br>B4OUT = 0x5 - Trigger source is CTIMERB4 OUT.<br>A7OUT = 0x6 - Trigger source is CTIMERA7 OUT.<br>B7OUT = 0x7 - Trigger source is CTIMERB7 OUT.<br>B5OUT2 = 0x8 - Trigger source is CTIMERB5 OUT2.<br>A5OUT2 = 0x9 - Trigger source is CTIMERA5 OUT2.<br>A1OUT2 = 0xA - Trigger source is CTIMERA1 OUT2.<br>B1OUT2 = 0xB - Trigger source is CTIMERB1 OUT2.<br>A6OUT2DUAL = 0xC - Trigger source is CTIMERA6 OUT2, dual edge.<br>A7OUT2DUAL = 0xD - Trigger source is CTIMERA7 OUT2, dual edge.<br>B2OUT2DUAL = 0xE - Trigger source is CTIMERB2 OUT2, dual edge.<br>A2OUT2DUAL = 0xF - Trigger source is CTIMERA2 OUT2, dual edge. |
| 6:0   | TMRA3LMT     | 0x0   | RW | Counter/Timer A3 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

**13.20.2.29TMR4 Register****Counter/Timer 4****OFFSET:** 0x00000080**INSTANCE 0 ADDRESS:** 0x40008080

This register holds the running time or event count, either for each 16 bit half or for the whole 32 bit count when the pair is linked.

Table 873: TMR4 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CTTMRB4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CTTMRA4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 874: TMR4 Register Bits

| Bit   | Name    | Reset | RW | Description       |
|-------|---------|-------|----|-------------------|
| 31:16 | CTTMRB4 | 0x0   | RO | Counter/Timer B4. |
| 15:0  | CTTMRA4 | 0x0   | RO | Counter/Timer A4. |

**13.20.2.30CMPRA4 Register****Counter/Timer A4 Compare****OFFSET:** 0x00000084**INSTANCE 0 ADDRESS:** 0x40008084

Compare limits for timer half A.

Table 875: CMPRA4 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1A4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0A4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 876: CMPRA4 Register Bits

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR1A4 | 0x0   | RW | Counter/Timer A4 Compare Register 1. Holds the upper limit for timer half A. |
| 15:0  | CMPR0A4 | 0x0   | RW | Counter/Timer A4 Compare Register 0. Holds the lower limit for timer half A. |

**13.20.2.31CMPRB4 Register****Counter/Timer B4 Compare****OFFSET:** 0x00000088**INSTANCE 0 ADDRESS:** 0x40008088

Compare limits for timer half B.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1B4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0B4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR1B4 | 0x0   | RW | Counter/Timer B4 Compare Register 1. Holds the upper limit for timer half B. |
| 15:0  | CMPR0B4 | 0x0   | RW | Counter/Timer B4 Compare Register 0. Holds the lower limit for timer half B. |

Control bit fields for both halves of timer 4.

[illegible]

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                     |
|-------|---------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | CTLINK4 | 0x0   | RW | Counter/Timer A4/B4 Link bit.<br><br>TWO_16BIT_TIMERS = 0x0 - Use A4/B4 timers as two independent 16-bit timers (default).<br>32BIT_TIMER = 0x1 - Link A4/B4 timers into a single 32-bit timer. |
| 30:29 | RSVD    | 0x0   | RO | RESERVED                                                                                                                                                                                        |

Table 880: CTRL4 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28    | TMRB4POL | 0x0   | RW | Counter/Timer B4 output polarity.<br><br>NORMAL = 0x0 - The polarity of the TMRPINB4 pin is the same as the timer output.<br>INVERTED = 0x1 - The polarity of the TMRPINB4 pin is the inverse of the timer output.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 27    | TMRB4CLR | 0x0   | RW | Counter/Timer B4 Clear bit.<br><br>RUN = 0x0 - Allow counter/timer B4 to run<br>CLEAR = 0x1 - Holds counter/timer B4 at 0x0000.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 26    | TMRB4IE1 | 0x0   | RW | Counter/Timer B4 Interrupt Enable bit for COMPR1.<br><br>DIS = 0x0 - Disable counter/timer B4 from generating an interrupt based on COMPR1.<br>EN = 0x1 - Enable counter/timer B4 to generate an interrupt based on COMPR1.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 25    | TMRB4IE0 | 0x0   | RW | Counter/Timer B4 Interrupt Enable bit for COMPR0.<br><br>DIS = 0x0 - Disable counter/timer B4 from generating an interrupt based on COMPR0.<br>EN = 0x1 - Enable counter/timer B4 to generate an interrupt based on COMPR0                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 24:22 | TMRB4FN  | 0x0   | RW | Counter/Timer B4 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0B4, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0B4, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0B4, assert, count to CMPR1B4, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0B4, assert, count to CMPR1B4, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM |

Table 880: CTRL4 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:17 | TMRB4CLK | 0x0   | RW | <p>Counter/Timer B4 Clock Select.</p> <p>TMRPIN = 0x0 - Clock source is TMRPINB.<br/> HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br/> HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br/> HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br/> HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br/> HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br/> XT = 0x6 - Clock source is the XT (uncalibrated).<br/> XT_DIV2 = 0x7 - Clock source is XT / 2<br/> XT_DIV16 = 0x8 - Clock source is XT / 16<br/> XT_DIV128 = 0x9 - Clock source is XT / 128<br/> LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br/> LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br/> LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br/> LFRC = 0xD - Clock source is LFRC<br/> RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br/> HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br/> XT_DIV4 = 0x10 - Clock source is XT / 4<br/> XT_DIV8 = 0x11 - Clock source is XT / 8<br/> XT_DIV32 = 0x12 - Clock source is XT / 32<br/> RSVD = 0x13 - Clock source is Reserved.<br/> CTMRA4 = 0x14 - Clock source is CTIMERA4 OUT.<br/> CTMRA1 = 0x15 - Clock source is CTIMERA1 OUT.<br/> CTMRB1 = 0x16 - Clock source is CTIMERB1 OUT.<br/> CTMRA5 = 0x17 - Clock source is CTIMERA5 OUT.<br/> CTMRB5 = 0x18 - Clock source is CTIMERB5 OUT.<br/> CTMRB0 = 0x19 - Clock source is CTIMERB0 OUT.<br/> CTMRB2 = 0x1A - Clock source is CTIMERB2 OUT.<br/> CTMRB3 = 0x1B - Clock source is CTIMERB3 OUT.<br/> CTMRB6 = 0x1C - Clock source is CTIMERB6 OUT.<br/> BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br/> BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br/> BUCKA = 0x1F - Clock source is CPU buck converter TON pulses.</p> |
| 16    | TMRB4EN  | 0x0   | RW | <p>Counter/Timer B4 Enable bit.</p> <p>DIS = 0x0 - Counter/Timer B4 Disable.<br/> EN = 0x1 - Counter/Timer B4 Enable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 15:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 12    | TMRA4POL | 0x0   | RW | <p>Counter/Timer A4 output polarity.</p> <p>NORMAL = 0x0 - The polarity of the TMRPINA4 pin is the same as the timer output.<br/> INVERTED = 0x1 - The polarity of the TMRPINA4 pin is the inverse of the timer output.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 11    | TMRA4CLR | 0x0   | RW | <p>Counter/Timer A4 Clear bit.</p> <p>RUN = 0x0 - Allow counter/timer A4 to run<br/> CLEAR = 0x1 - Holds counter/timer A4 at 0x0000.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 10    | TMRA4IE1 | 0x0   | RW | <p>Counter/Timer A4 Interrupt Enable bit based on COMP1.</p> <p>DIS = 0x0 - Disable counter/timer A4 from generating an interrupt based on COMP1.<br/> EN = 0x1 - Enable counter/timer A4 to generate an interrupt based on COMP1.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

Table 880: CTRL4 Register Bits

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9   | TMRA4IE0 | 0x0   | RW | Counter/Timer A4 Interrupt Enable bit based on COMP0.<br><br>DIS = 0x0 - Disable counter/timer A4 from generating an interrupt based on COMP0.<br>EN = 0x1 - Enable counter/timer A4 to generate an interrupt based on COMP0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 8:6 | TMRA4FN  | 0x0   | RW | Counter/Timer A4 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to COMP0A4, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to COMP0A4, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to COMP0A4, assert, count to COMP1A4, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to COMP0A4, assert, count to COMP1A4, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 5:1 | TMRA4CLK | 0x0   | RW | Counter/Timer A4 Clock Select.<br><br>TMRPIN = 0x0 - Clock source is TMRPINA.<br>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br>XT = 0x6 - Clock source is the XT (uncalibrated).<br>XT_DIV2 = 0x7 - Clock source is XT / 2<br>XT_DIV16 = 0x8 - Clock source is XT / 16<br>XT_DIV128 = 0x9 - Clock source is XT / 128<br>LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br>LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br>LFRC = 0xD - Clock source is LFRC<br>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br>HCLK_DIV4 = 0xF - Clock source is HCLK / 4. (note: this clock is only available when MCU is in active mode)<br>XT_DIV4 = 0x10 - Clock source is XT / 4<br>XT_DIV8 = 0x11 - Clock source is XT / 8<br>XT_DIV32 = 0x12 - Clock source is XT / 32<br>RSVD = 0x13 - Clock source is Reserved.<br>CTMRB4 = 0x14 - Clock source is CTIMERA4 OUT.<br>CTMRA1 = 0x15 - Clock source is CTIMERA1 OUT.<br>CTMRB1 = 0x16 - Clock source is CTIMERA1 OUT.<br>CTMRA5 = 0x17 - Clock source is CTIMERA5 OUT.<br>CTMRB5 = 0x18 - Clock source is CTIMERA5 OUT.<br>CTMRB0 = 0x19 - Clock source is CTIMERA0 OUT.<br>CTMRB2 = 0x1A - Clock source is CTIMERA2 OUT.<br>CTMRB3 = 0x1B - Clock source is CTIMERA3 OUT.<br>CTMRB6 = 0x1C - Clock source is CTIMERA6 OUT.<br>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses. |

| Bit | Name    | Reset | RW | Description                                                                                                      |
|-----|---------|-------|----|------------------------------------------------------------------------------------------------------------------|
| 0   | TMRA4EN | 0x0   | RW | Counter/Timer A4 Enable bit.<br><br>DIS = 0x0 - Counter/Timer A4 Disable.<br>EN = 0x1 - Counter/Timer A4 Enable. |

Enhanced compare limits for timer half A.

|         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1  | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5  | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| CMPR3A4 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CMPR2A4 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3A4 | 0x0   | RW | Counter/Timer A4 Compare Register 3. Holds the upper limit for timer half A. |
| 15:0  | CMPR2A4 | 0x0   | RW | Counter/Timer A4 Compare Register 2. Holds the lower limit for timer half A. |

Enhanced compare limits for timer half B.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 | 0 |   |
| CMPR3B4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2B4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3B4 | 0x0   | RW | Counter/Timer B4 Compare Register 3. Holds the upper limit for timer half B. |
| 15:0  | CMPR2B4 | 0x0   | RW | Counter/Timer B4 Compare Register 2. Holds the lower limit for timer half B. |

### Counter/Timer 4 Auxiliary

**INSTANCE 0 ADDRESS: 0x4000809C**

Control bit fields for both halves of timer 4.

|      |           |            |           |             |           |   |   |   |   |      |          |   |   |   |   |      |           |            |           |             |           |   |   |   |   |          |   |   |   |   |   |   |  |  |  |
|------|-----------|------------|-----------|-------------|-----------|---|---|---|---|------|----------|---|---|---|---|------|-----------|------------|-----------|-------------|-----------|---|---|---|---|----------|---|---|---|---|---|---|--|--|--|
| 3    | 3         | 2          | 2         | 2           | 2         | 2 | 2 | 2 | 2 | 2    | 2        | 1 | 1 | 1 | 1 | 1    | 1         | 1          | 1         | 1           | 0         | 0 | 0 | 0 | 0 | 0        | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |
| 1    | 0         | 9          | 8         | 7           | 6         | 5 | 4 | 3 | 2 | 1    | 0        | 9 | 8 | 7 | 6 | 5    | 4         | 3          | 2         | 1           | 0         | 9 | 8 | 7 | 6 | 5        | 4 | 3 | 2 | 1 | 0 |   |  |  |  |
| RSVD | TMRB4EN23 | TMRB4POL23 | TMRB4TINV | TMRB4NOSYNC | TMRB4TRIG |   |   |   |   | RSVD | TMRB4LMT |   |   |   |   | RSVD | TMRA4EN23 | TMRA4POL23 | TMRA4TINV | TMRA4NOSYNC | TMRA4TRIG |   |   |   |   | TMRA4LMT |   |   |   |   |   |   |  |  |  |

| Bit | Name       | Reset | RW | Description                                                                                                                |
|-----|------------|-------|----|----------------------------------------------------------------------------------------------------------------------------|
| 31  | RSVD       | 0x0   | RO | RESERVED                                                                                                                   |
| 30  | TMRB4EN23  | 0x0   | RW | Counter/Timer B4 Upper compare enable.<br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions. |
| 29  | TMRB4POL23 | 0x0   | RW | Upper output polarity<br>NORM = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.          |
| 28  | TMRB4TINV  | 0x0   | RW | Counter/Timer B4 Invert on trigger.<br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger        |



Table 886: AUX4 Register Bits

| Bit   | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------|--------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27    | TMRB4NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 26:23 | TMRB4TRIG    | 0x0   | RW | Counter/Timer B4 Trigger Select.<br><br>DIS = 0x0 - Trigger source is disabled.<br>A4OUT = 0x1 - Trigger source is CTIMERA4 OUT.<br>B3OUT = 0x2 - Trigger source is CTIMERB3 OUT.<br>A3OUT = 0x3 - Trigger source is CTIMERA3 OUT.<br>A7OUT = 0x4 - Trigger source is CTIMERA7 OUT.<br>B7OUT = 0x5 - Trigger source is CTIMERB7 OUT.<br>A1OUT = 0x6 - Trigger source is CTIMERA1 OUT.<br>B1OUT = 0x7 - Trigger source is CTIMERB1 OUT.<br>B3OUT2 = 0x8 - Trigger source is CTIMERB3 OUT2.<br>A3OUT2 = 0x9 - Trigger source is CTIMERA3 OUT2.<br>A1OUT2 = 0xA - Trigger source is CTIMERA1 OUT2.<br>B1OUT2 = 0xB - Trigger source is CTIMERB1 OUT2.<br>A6OUT2DUAL = 0xC - Trigger source is CTIMERA6 OUT2, dual edge.<br>A7OUT2DUAL = 0xD - Trigger source is CTIMERA7 OUT2, dual edge.<br>B5OUT2DUAL = 0xE - Trigger source is CTIMERB5 OUT2, dual edge.<br>A5OUT2DUAL = 0xF - Trigger source is CTIMERA5 OUT2, dual edge.<br>STIMERCAP0 = 0x4 - Trigger source is STimer Capture0 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0)<br>STIMERCAP1 = 0x5 - Trigger source is STimer Capture1 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0)<br>STIMERCAP2 = 0x6 - Trigger source is STimer Capture2 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0)<br>STIMERCAP3 = 0x7 - Trigger source is STimer Capture3 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0)<br>STIMERCMP0 = 0x8 - Trigger source is STimer Compare0 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0)<br>STIMERCMP1 = 0x9 - Trigger source is STimer Compare1 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0)<br>STIMERCMP2 = 0xA - Trigger source is STimer Compare2 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0)<br>STIMERCMP3 = 0xB - Trigger source is STimer Compare3 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0)<br>STIMERCMP4 = 0xC - Trigger source is STimer Compare4 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0)<br>STIMERCMP5 = 0xD - Trigger source is STimer Compare5 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0)<br>STIMERCMP6 = 0xE - Trigger source is STimer Compare6 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0)<br>STIMERCMP7 = 0xF - Trigger source is STimer Compare7 Interrupt. When CTLINK==1 and TMRA4TRIG==1. (Apollo3 - B0) |
| 22    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 21:16 | TMRB4LMT     | 0x0   | RW | Counter/Timer B4 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 15    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 14    | TMRA4EN23    | 0x0   | RW | Counter/Timer A4 Upper compare enable.<br><br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

**Table 886: AUX4 Register Bits**

| Bit  | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|--------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | TMRA4POL23   | 0x0   | RW | Counter/Timer A4 Upper output polarity<br>NORM = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 12   | TMRA4TINV    | 0x0   | RW | Counter/Timer A4 Invert on trigger.<br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 11   | TMRA4NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 10:7 | TMRA4TRIG    | 0x0   | RW | Counter/Timer A4 Trigger Select.<br><br>DIS = 0x0 - Trigger source is disabled.<br>STIMER = 0x1 - Trigger source is STimer Interrupt. Only Active When CTLINK==1 and TMRB4TRIG!=0. TMRB4TRIG selects an STIMER interrupt<br>B4OUT = 0x1 - Trigger source is CTIMERB4 OUT.<br>B3OUT = 0x2 - Trigger source is CTIMERB3 OUT.<br>A3OUT = 0x3 - Trigger source is CTIMERA3 OUT.<br>A6OUT = 0x4 - Trigger source is CTIMERA6 OUT.<br>B6OUT = 0x5 - Trigger source is CTIMERB6 OUT.<br>A2OUT = 0x6 - Trigger source is CTIMERA2 OUT.<br>B2OUT = 0x7 - Trigger source is CTIMERB2 OUT.<br>B3OUT2 = 0x8 - Trigger source is CTIMERB3 OUT2.<br>A3OUT2 = 0x9 - Trigger source is CTIMERA3 OUT2.<br>A1OUT2 = 0xA - Trigger source is CTIMERA1 OUT2.<br>B1OUT2 = 0xB - Trigger source is CTIMERB1 OUT2.<br>A6OUT2DUAL = 0xC - Trigger source is CTIMERA6 OUT2, dual edge.<br>A7OUT2DUAL = 0xD - Trigger source is CTIMERA7 OUT2, dual edge.<br>B5OUT2DUAL = 0xE - Trigger source is CTIMERB5 OUT2, dual edge.<br>A5OUT2DUAL = 0xF - Trigger source is CTIMERA5 OUT2, dual edge. |
| 6:0  | TMRA4LMT     | 0x0   | RW | Counter/Timer A4 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

**13.20.2.36TMR5 Register****Counter/Timer 5****OFFSET:** 0x000000A0**INSTANCE 0 ADDRESS:** 0x400080A0

This register holds the running time or event count, either for each 16 bit half or for the whole 32 bit count when the pair is linked.

**Table 887: TMR5 Register**

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CTTMRB5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CTTMRA5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description       |
|-------|---------|-------|----|-------------------|
| 31:16 | CTTMRB5 | 0x0   | RO | Counter/Timer B5. |
| 15:0  | CTTMRA5 | 0x0   | RO | Counter/Timer A5. |

This register holds the compare limits for timer half A.

|         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1  | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5  | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| CMPR1A5 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CMPR0A5 |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1A5 | 0x0   | RW | Counter/Timer A5 Compare Register 1. |
| 15:0  | CMPR0A5 | 0x0   | RW | Counter/Timer A5 Compare Register 0. |

This register holds the compare limits for timer half B.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1B5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0B5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1B5 | 0x0   | RW | Counter/Timer B5 Compare Register 1. |
| 15:0  | CMPR0B5 | 0x0   | RW | Counter/Timer B5 Compare Register 0. |

Control bit fields for both halves of timer 0.

[illegible]

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                        |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | CTLINK5  | 0x0   | RW | Counter/Timer A5/B5 Link bit.<br><br>TWO_16BIT_TIMERS = 0x0 - Use A5/B5 timers as two independent 16-bit timers (default).<br>32BIT_TIMER = 0x1 - Link A5/B5 timers into a single 32-bit timer.                    |
| 30:29 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                           |
| 28    | TMRB5POL | 0x0   | RW | Counter/Timer B5 output polarity.<br><br>NORMAL = 0x0 - The polarity of the TMRPINB5 pin is the same as the timer output.<br>INVERTED = 0x1 - The polarity of the TMRPINB5 pin is the inverse of the timer output. |
| 27    | TMRB5CLR | 0x0   | RW | Counter/Timer B5 Clear bit.<br><br>RUN = 0x0 - Allow counter/timer B5 to run<br>CLEAR = 0x1 - Holds counter/timer B5 at 0x0000.                                                                                    |

Table 894: CTRL5 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26    | TMRB5IE1 | 0x0   | RW | Counter/Timer B5 Interrupt Enable bit for COMPR1.<br><br>DIS = 0x0 - Disable counter/timer B5 from generating an interrupt based on COMPR1.<br>EN = 0x1 - Enable counter/timer B5 to generate an interrupt based on COMPR1.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 25    | TMRB5IE0 | 0x0   | RW | Counter/Timer B5 Interrupt Enable bit for COMPR0.<br><br>DIS = 0x0 - Disable counter/timer B5 from generating an interrupt based on COMPR0.<br>EN = 0x1 - Enable counter/timer B5 to generate an interrupt based on COMPR0                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 24:22 | TMRB5FN  | 0x0   | RW | Counter/Timer B5 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0B5, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0B5, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0B5, assert, count to CMPR1B5, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0B5, assert, count to CMPR1B5, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM |

Table 894: CTRL5 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:17 | TMRB5CLK | 0x0   | RW | <p>Counter/Timer B5 Clock Select.</p> <p>TMRPIN = 0x0 - Clock source is TMRPINB.<br/> HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br/> HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br/> HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br/> HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br/> HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br/> XT = 0x6 - Clock source is the XT (uncalibrated).<br/> XT_DIV2 = 0x7 - Clock source is XT / 2<br/> XT_DIV16 = 0x8 - Clock source is XT / 16<br/> XT_DIV128 = 0x9 - Clock source is XT / 128<br/> LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br/> LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br/> LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br/> LFRC = 0xD - Clock source is LFRC<br/> RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br/> HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br/> XT_DIV4 = 0x10 - Clock source is XT / 4<br/> XT_DIV8 = 0x11 - Clock source is XT / 8<br/> XT_DIV32 = 0x12 - Clock source is XT / 32<br/> RSVD = 0x13 - Clock source is Reserved.<br/> CTMRA5 = 0x14 - Clock source is CTIMERA5 OUT.<br/> CTMRA0 = 0x15 - Clock source is CTIMERA0 OUT.<br/> CTMRB0 = 0x16 - Clock source is CTIMERB0 OUT.<br/> CTMRA6 = 0x17 - Clock source is CTIMERA6 OUT.<br/> CTMRB6 = 0x18 - Clock source is CTIMERB6 OUT.<br/> CTMRB1 = 0x19 - Clock source is CTIMERB1 OUT.<br/> CTMRB2 = 0x1A - Clock source is CTIMERB2 OUT.<br/> CTMRB3 = 0x1B - Clock source is CTIMERB3 OUT.<br/> CTMRB4 = 0x1C - Clock source is CTIMERB4 OUT.<br/> BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br/> BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br/> BUCKA = 0x1F - Clock source is CPU buck converter TON pulses.</p> |
| 16    | TMRB5EN  | 0x0   | RW | <p>Counter/Timer B5 Enable bit.</p> <p>DIS = 0x0 - Counter/Timer B5 Disable.<br/> EN = 0x1 - Counter/Timer B5 Enable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 15:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 12    | TMRA5POL | 0x0   | RW | <p>Counter/Timer A5 output polarity.</p> <p>NORMAL = 0x0 - The polarity of the TMRPINA5 pin is the same as the timer output.<br/> INVERTED = 0x1 - The polarity of the TMRPINA5 pin is the inverse of the timer output.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 11    | TMRA5CLR | 0x0   | RW | <p>Counter/Timer A5 Clear bit.</p> <p>RUN = 0x0 - Allow counter/timer A5 to run<br/> CLEAR = 0x1 - Holds counter/timer A5 at 0x0000.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 10    | TMRA5IE1 | 0x0   | RW | <p>Counter/Timer A5 Interrupt Enable bit based on COMP1.</p> <p>DIS = 0x0 - Disable counter/timer A5 from generating an interrupt based on COMP1.<br/> EN = 0x1 - Enable counter/timer A5 to generate an interrupt based on COMP1.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

Table 894: CTRL5 Register Bits

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9   | TMRA5IE0 | 0x0   | RW | Counter/Timer A5 Interrupt Enable bit based on COMP0.<br><br>DIS = 0x0 - Disable counter/timer A5 from generating an interrupt based on COMP0.<br>EN = 0x1 - Enable counter/timer A5 to generate an interrupt based on COMP0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 8:6 | TMRA5FN  | 0x0   | RW | Counter/Timer A5 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to COMP0A5, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to COMP0A5, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to COMP0A5, assert, count to COMP1A5, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to COMP0A5, assert, count to COMP1A5, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM<br>TRIGCOPY = 0x7 - Replicate the trigger input<br>DUALTRIGPATTERN = 0x4 - Single pattern, trigger on either edge.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 5:1 | TMRA5CLK | 0x0   | RW | Counter/Timer A5 Clock Select.<br><br>TMRPIN = 0x0 - Clock source is TMRPINA.<br>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br>XT = 0x6 - Clock source is the XT (uncalibrated).<br>XT_DIV2 = 0x7 - Clock source is XT / 2<br>XT_DIV16 = 0x8 - Clock source is XT / 16<br>XT_DIV128 = 0x9 - Clock source is XT / 128<br>LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br>LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br>LFRC = 0xD - Clock source is LFRC<br>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br>HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br>XT_DIV4 = 0x10 - Clock source is XT / 4<br>XT_DIV8 = 0x11 - Clock source is XT / 8<br>XT_DIV32 = 0x12 - Clock source is XT / 32<br>RSVD = 0x13 - Clock source is Reserved.<br>CTMRB5 = 0x14 - Clock source is CTIMERB5 OUT.<br>CTMRA0 = 0x15 - Clock source is CTIMERA0 OUT.<br>CTMRB0 = 0x16 - Clock source is CTIMERB0 OUT.<br>CTMRA6 = 0x17 - Clock source is CTIMERA6 OUT.<br>CTMRB6 = 0x18 - Clock source is CTIMERB6 OUT.<br>CTMRB1 = 0x19 - Clock source is CTIMERB1 OUT.<br>CTMRB2 = 0x1A - Clock source is CTIMERB2 OUT.<br>CTMRB3 = 0x1B - Clock source is CTIMERB3 OUT.<br>CTMRB4 = 0x1C - Clock source is CTIMERB4 OUT.<br>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses. |

| Bit | Name    | Reset | RW | Description                                                                                                      |
|-----|---------|-------|----|------------------------------------------------------------------------------------------------------------------|
| 0   | TMRA5EN | 0x0   | RW | Counter/Timer A5 Enable bit.<br><br>DIS = 0x0 - Counter/Timer A5 Disable.<br>EN = 0x1 - Counter/Timer A5 Enable. |

Enhanced compare limits for timer half A.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR3A5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2A5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3A5 | 0x0   | RW | Counter/Timer A5 Compare Register 3. Holds the upper limit for timer half A. |
| 15:0  | CMPR2A5 | 0x0   | RW | Counter/Timer A5 Compare Register 2. Holds the lower limit for timer half A. |

Enhanced compare limits for timer half B.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR3B5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2B5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |



| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3B5 | 0x0   | RW | Counter/Timer B5 Compare Register 3. Holds the upper limit for timer half B. |
| 15:0  | CMPR2B5 | 0x0   | RW | Counter/Timer B5 Compare Register 2. Holds the lower limit for timer half B. |

Control bit fields for both halves of timer 0.

|          |           |            |           |             |           |          |          |          |          |          |          |          |          |          |          |          |           |            |           |             |           |          |          |          |          |          |          |          |          |          |          |  |
|----------|-----------|------------|-----------|-------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|------------|-----------|-------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--|
| <b>3</b> | <b>3</b>  | <b>2</b>   | <b>2</b>  | <b>2</b>    | <b>2</b>  | <b>2</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b>  | <b>0</b>   | <b>0</b>  | <b>0</b>    | <b>0</b>  | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> |          |          |          |  |
| <b>1</b> | <b>0</b>  | <b>9</b>   | <b>8</b>  | <b>7</b>    | <b>6</b>  | <b>5</b> | <b>4</b> | <b>3</b> | <b>2</b> | <b>1</b> | <b>0</b> | <b>9</b> | <b>8</b> | <b>7</b> | <b>6</b> | <b>5</b> | <b>4</b>  | <b>3</b>   | <b>2</b>  | <b>1</b>    | <b>0</b>  | <b>9</b> | <b>8</b> | <b>7</b> | <b>6</b> | <b>5</b> | <b>4</b> | <b>3</b> | <b>2</b> | <b>1</b> | <b>0</b> |  |
| RSVD     | TMRB5EN23 | TMRB5POL23 | TMRB5TINV | TMRB5NOSYNC | TMRB5TRIG |          |          |          |          | RSVD     | TMRB5LMT |          |          |          |          | RSVD     | TMRA5EN23 | TMRA5POL23 | TMRA5TINV | TMRA5NOSYNC | TMRA5TRIG |          |          |          |          | TMRA5LMT |          |          |          |          |          |  |

| Bit | Name       | Reset | RW | Description                                                                                                                |
|-----|------------|-------|----|----------------------------------------------------------------------------------------------------------------------------|
| 31  | RSVD       | 0x0   | RO | RESERVED                                                                                                                   |
| 30  | TMRB5EN23  | 0x0   | RW | Counter/Timer B5 Upper compare enable.<br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions. |
| 29  | TMRB5POL23 | 0x0   | RW | Upper output polarity<br>NORM = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.          |
| 28  | TMRB5TINV  | 0x0   | RW | Counter/Timer B5 Invert on trigger.<br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger        |

Table 900: AUX5 Register Bits

| Bit   | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------|--------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27    | TMRB5NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 26:23 | TMRB5TRIG    | 0x0   | RW | Counter/Timer B5 Trigger Select.<br><br>DIS = 0x0 - Trigger source is disabled.<br>A5OUT = 0x1 - Trigger source is CTIMERA5 OUT.<br>B3OUT = 0x2 - Trigger source is CTIMERB3 OUT.<br>A3OUT = 0x3 - Trigger source is CTIMERA3 OUT.<br>A6OUT = 0x4 - Trigger source is CTIMERA6 OUT.<br>B6OUT = 0x5 - Trigger source is CTIMERB6 OUT.<br>A1OUT = 0x6 - Trigger source is CTIMERA1 OUT.<br>B1OUT = 0x7 - Trigger source is CTIMERB1 OUT.<br>B3OUT2 = 0x8 - Trigger source is CTIMERB3 OUT2.<br>A3OUT2 = 0x9 - Trigger source is CTIMERA3 OUT2.<br>A0OUT2 = 0xA - Trigger source is CTIMERA0 OUT2.<br>B0OUT2 = 0xB - Trigger source is CTIMERB0 OUT2.<br>A6OUT2DUAL = 0xC - Trigger source is CTIMERA6 OUT2, dual edge.<br>A7OUT2DUAL = 0xD - Trigger source is CTIMERA7 OUT2, dual edge.<br>B4OUT2DUAL = 0xE - Trigger source is CTIMERB4 OUT2, dual edge.<br>A4OUT2DUAL = 0xF - Trigger source is CTIMERA4 OUT2, dual edge.<br>STIMERCAP0 = 0x4 - Trigger source is STimer Capture0 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0)<br>STIMERCAP1 = 0x5 - Trigger source is STimer Capture1 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0)<br>STIMERCAP2 = 0x6 - Trigger source is STimer Capture2 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0)<br>STIMERCAP3 = 0x7 - Trigger source is STimer Capture3 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0)<br>STIMERCMP0 = 0x8 - Trigger source is STimer Compare0 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0)<br>STIMERCMP1 = 0x9 - Trigger source is STimer Compare1 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0)<br>STIMERCMP2 = 0xA - Trigger source is STimer Compare2 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0)<br>STIMERCMP3 = 0xB - Trigger source is STimer Compare3 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0)<br>STIMERCMP4 = 0xC - Trigger source is STimer Compare4 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0)<br>STIMERCMP5 = 0xD - Trigger source is STimer Compare5 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0)<br>STIMERCMP6 = 0xE - Trigger source is STimer Compare6 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0)<br>STIMERCMP7 = 0xF - Trigger source is STimer Compare7 Interrupt. When CTLINK==1 and TMRA5TRIG==1. (Apollo3 - B0) |
| 22    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 21:16 | TMRB5LMT     | 0x0   | RW | Counter/Timer B5 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 15    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 14    | TMRA5EN23    | 0x0   | RW | Counter/Timer A5 Upper compare enable.<br><br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

**Table 900: AUX5 Register Bits**

| Bit  | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|--------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13   | TMRA5POL23   | 0x0   | RW | Counter/Timer A5 Upper output polarity<br>NORMAL = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 12   | TMRA5TINV    | 0x0   | RW | Counter/Timer A5 Invert on trigger.<br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 11   | TMRA5NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 10:7 | TMRA5TRIG    | 0x0   | RW | Counter/Timer A5 Trigger Select.<br><br>DIS = 0x0 - Trigger source is disabled.<br>STIMER = 0x1 - Trigger source is STimer Interrupt. Only Active When CTLINK==1 and TMRB5TRIG!=0. TMRB5TRIG selects an STIMER interrupt<br>B5OUT = 0x1 - Trigger source is CTIMERB5 OUT.<br>B3OUT = 0x2 - Trigger source is CTIMERB3 OUT.<br>A3OUT = 0x3 - Trigger source is CTIMERA3 OUT.<br>A4OUT = 0x4 - Trigger source is CTIMERA4 OUT.<br>B4OUT = 0x5 - Trigger source is CTIMERB4 OUT.<br>A2OUT = 0x6 - Trigger source is CTIMERA2 OUT.<br>B2OUT = 0x7 - Trigger source is CTIMERB2 OUT.<br>B3OUT2 = 0x8 - Trigger source is CTIMERB3 OUT2.<br>A3OUT2 = 0x9 - Trigger source is CTIMERA3 OUT2.<br>A0OUT2 = 0xA - Trigger source is CTIMERA0 OUT2.<br>B0OUT2 = 0xB - Trigger source is CTIMERB0 OUT2.<br>A6OUT2DUAL = 0xC - Trigger source is CTIMERA6 OUT2, dual edge.<br>A7OUT2DUAL = 0xD - Trigger source is CTIMERA7 OUT2, dual edge.<br>B4OUT2DUAL = 0xE - Trigger source is CTIMERB4 OUT2, dual edge.<br>A4OUT2DUAL = 0xF - Trigger source is CTIMERA4 OUT2, dual edge. |
| 6:0  | TMRA5LMT     | 0x0   | RW | Counter/Timer A5 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

**13.20.2.43TMR6 Register****Counter/Timer 6****OFFSET:** 0x000000C0**INSTANCE 0 ADDRESS:** 0x400080C0

Counter/Timer 6

**Table 901: TMR6 Register**

|         |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1       | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9       | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 |
| CTTMRB6 |   |   |   |   |   |   |   |   |   |   |   | CTTMRA6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 902: TMR6 Register Bits

| Bit   | Name    | Reset | RW | Description       |
|-------|---------|-------|----|-------------------|
| 31:16 | CTTMRB6 | 0x0   | RO | Counter/Timer B6. |
| 15:0  | CTTMRA6 | 0x0   | RO | Counter/Timer A6. |

**13.20.2.44CMPRA6 Register****Counter/Timer A6 Compare****OFFSET:** 0x000000C4**INSTANCE 0 ADDRESS:** 0x400080C4

This register holds the compare limits for timer half A.

Table 903: CMPRA6 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1A6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0A6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 904: CMPRA6 Register Bits

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1A6 | 0x0   | RW | Counter/Timer A6 Compare Register 1. |
| 15:0  | CMPR0A6 | 0x0   | RW | Counter/Timer A6 Compare Register 0. |

**13.20.2.45CMPRB6 Register****Counter/Timer B6 Compare****OFFSET:** 0x000000C8**INSTANCE 0 ADDRESS:** 0x400080C8

This register holds the compare limits for timer half B.

Table 905: CMPRB6 Register

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1B6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0B6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1B6 | 0x0   | RW | Counter/Timer B6 Compare Register 1. |
| 15:0  | CMPR0B6 | 0x0   | RW | Counter/Timer B6 Compare Register 0. |

This register holds the control bit fields for both halves of timer 6.

[illegible]

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                        |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | CTLINK6  | 0x0   | RW | Counter/Timer A6/B6 Link bit.<br><br>TWO_16BIT_TIMERS = 0x0 - Use A6/B6 timers as two independent 16-bit timers (default).<br>32BIT_TIMER = 0x1 - Link A6/B6 timers into a single 32-bit timer.                    |
| 30:29 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                           |
| 28    | TMRB6POL | 0x0   | RW | Counter/Timer B6 output polarity.<br><br>NORMAL = 0x0 - The polarity of the TMRPINB6 pin is the same as the timer output.<br>INVERTED = 0x1 - The polarity of the TMRPINB6 pin is the inverse of the timer output. |
| 27    | TMRB6CLR | 0x0   | RW | Counter/Timer B6 Clear bit.<br><br>RUN = 0x0 - Allow counter/timer B6 to run<br>CLEAR = 0x1 - Holds counter/timer B6 at 0x0000.                                                                                    |

**Table 908: CTRL6 Register Bits**

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26    | TMRB6IE1 | 0x0   | RW | Counter/Timer B6 Interrupt Enable bit for COMPR1.<br><br>DIS = 0x0 - Disable counter/timer B6 from generating an interrupt based on COMPR1.<br>EN = 0x1 - Enable counter/timer B6 to generate an interrupt based on COMPR1.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 25    | TMRB6IE0 | 0x0   | RW | Counter/Timer B6 Interrupt Enable bit for COMPR0.<br><br>DIS = 0x0 - Disable counter/timer B6 from generating an interrupt based on COMPR0.<br>EN = 0x1 - Enable counter/timer B6 to generate an interrupt based on COMPR0                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 24:22 | TMRB6FN  | 0x0   | RW | Counter/Timer B6 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0B6, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0B6, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0B6, assert, count to CMPR1B6, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0B6, assert, count to CMPR1B6, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM |

Table 908: CTRL6 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------|----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:17 | TMRB6CLK | 0x0   | RW | <p>Counter/Timer B6 Clock Select.</p> <p>TMRPIN = 0x0 - Clock source is TMRPINB.</p> <p>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4</p> <p>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16</p> <p>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256</p> <p>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024</p> <p>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096</p> <p>XT = 0x6 - Clock source is the XT (uncalibrated).</p> <p>XT_DIV2 = 0x7 - Clock source is XT / 2</p> <p>XT_DIV16 = 0x8 - Clock source is XT / 16</p> <p>XT_DIV128 = 0x9 - Clock source is XT / 128</p> <p>LFRC_DIV2 = 0xA - Clock source is LFRC / 2</p> <p>LFRC_DIV32 = 0xB - Clock source is LFRC / 32</p> <p>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024</p> <p>LFRC = 0xD - Clock source is LFRC</p> <p>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.</p> <p>HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)</p> <p>XT_DIV4 = 0x10 - Clock source is XT / 4</p> <p>XT_DIV8 = 0x11 - Clock source is XT / 8</p> <p>XT_DIV32 = 0x12 - Clock source is XT / 32</p> <p>RSVD = 0x13 - Clock source is Reserved.</p> <p>CTMRA6 = 0x14 - Clock source is CTIMERA6 OUT.</p> <p>CTMRA3 = 0x15 - Clock source is CTIMERA3 OUT.</p> <p>CTMRB3 = 0x16 - Clock source is CTIMERB3 OUT.</p> <p>CTMRA7 = 0x17 - Clock source is CTIMERA7 OUT.</p> <p>CTMRB7 = 0x18 - Clock source is CTIMERB7 OUT.</p> <p>CTMRB0 = 0x19 - Clock source is CTIMERB0 OUT.</p> <p>CTMRB1 = 0x1A - Clock source is CTIMERB1 OUT.</p> <p>CTMRB2 = 0x1B - Clock source is CTIMERB2 OUT.</p> <p>CTMRB4 = 0x1C - Clock source is CTIMERB4 OUT.</p> <p>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.</p> <p>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.</p> <p>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses.</p> |
| 16    | TMRB6EN  | 0x0   | RW | <p>Counter/Timer B6 Enable bit.</p> <p>DIS = 0x0 - Counter/Timer B6 Disable.</p> <p>EN = 0x1 - Counter/Timer B6 Enable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 15:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 12    | TMRA6POL | 0x0   | RW | <p>Counter/Timer A6 output polarity.</p> <p>NORMAL = 0x0 - The polarity of the TMRPINA6 pin is the same as the timer output.</p> <p>INVERTED = 0x1 - The polarity of the TMRPINA6 pin is the inverse of the timer output.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 11    | TMRA6CLR | 0x0   | RW | <p>Counter/Timer A6 Clear bit.</p> <p>RUN = 0x0 - Allow counter/timer A6 to run</p> <p>CLEAR = 0x1 - Holds counter/timer A6 at 0x0000.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 10    | TMRA6IE1 | 0x0   | RW | <p>Counter/Timer A6 Interrupt Enable bit based on COMP1.</p> <p>DIS = 0x0 - Disable counter/timer A6 from generating an interrupt based on COMP1.</p> <p>EN = 0x1 - Enable counter/timer A6 to generate an interrupt based on COMP1.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

Table 908: CTRL6 Register Bits

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9   | TMRA6IE0 | 0x0   | RW | Counter/Timer A6 Interrupt Enable bit based on COMP0.<br><br>DIS = 0x0 - Disable counter/timer A6 from generating an interrupt based on COMP0.<br>EN = 0x1 - Enable counter/timer A6 to generate an interrupt based on COMP0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 8:6 | TMRA6FN  | 0x0   | RW | Counter/Timer A6 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to COMP0A6, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to COMP0A6, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to COMP0A6, assert, count to COMP1A6, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to COMP0A6, assert, count to COMP1A6, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 5:1 | TMRA6CLK | 0x0   | RW | Counter/Timer A6 Clock Select.<br><br>TMRPIN = 0x0 - Clock source is TMRPINA.<br>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br>XT = 0x6 - Clock source is the XT (uncalibrated).<br>XT_DIV2 = 0x7 - Clock source is XT / 2<br>XT_DIV16 = 0x8 - Clock source is XT / 16<br>XT_DIV128 = 0x9 - Clock source is XT / 128<br>LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br>LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br>LFRC = 0xD - Clock source is LFRC<br>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br>HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br>XT_DIV4 = 0x10 - Clock source is XT / 4<br>XT_DIV8 = 0x11 - Clock source is XT / 8<br>XT_DIV32 = 0x12 - Clock source is XT / 32<br>RSVD = 0x13 - Clock source is Reserved.<br>CTMRB6 = 0x14 - Clock source is CTIMERA6 OUT.<br>CTMRA3 = 0x15 - Clock source is CTIMERA3 OUT.<br>CTMRB3 = 0x16 - Clock source is CTIMERA3 OUT.<br>CTMRA7 = 0x17 - Clock source is CTIMERA7 OUT.<br>CTMRB7 = 0x18 - Clock source is CTIMERA7 OUT.<br>CTMRB0 = 0x19 - Clock source is CTIMERA0 OUT.<br>CTMRB1 = 0x1A - Clock source is CTIMERA1 OUT.<br>CTMRB2 = 0x1B - Clock source is CTIMERA2 OUT.<br>CTMRB4 = 0x1C - Clock source is CTIMERA4 OUT.<br>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses. |



| Bit | Name    | Reset | RW | Description                                                                                                      |
|-----|---------|-------|----|------------------------------------------------------------------------------------------------------------------|
| 0   | TMRA6EN | 0x0   | RW | Counter/Timer A6 Enable bit.<br><br>DIS = 0x0 - Counter/Timer A6 Disable.<br>EN = 0x1 - Counter/Timer A6 Enable. |

Enhanced compare limits for timer half A.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR3A6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2A6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3A6 | 0x0   | RW | Counter/Timer A6 Compare Register 3. Holds the upper limit for timer half A. |
| 15:0  | CMPR2A6 | 0x0   | RW | Counter/Timer A6 Compare Register 2. Holds the lower limit for timer half A. |

Enhanced compare limits for timer half B.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR3B6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2B6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3B6 | 0x0   | RW | Counter/Timer B6 Compare Register 3. Holds the upper limit for timer half B. |
| 15:0  | CMPR2B6 | 0x0   | RW | Counter/Timer B6 Compare Register 2. Holds the lower limit for timer half B. |

Control bit fields for both halves of timer 0.

[illegible]

| Bit | Name       | Reset | RW | Description                                                                                                                |
|-----|------------|-------|----|----------------------------------------------------------------------------------------------------------------------------|
| 31  | RSVD       | 0x0   | RO | RESERVED                                                                                                                   |
| 30  | TMRB6EN23  | 0x0   | RW | Counter/Timer B6 Upper compare enable.<br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions. |
| 29  | TMRB6POL23 | 0x0   | RW | Upper output polarity<br>NORM = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.          |
| 28  | TMRB6TINV  | 0x0   | RW | Counter/Timer B6 Invert on trigger.<br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger        |

Table 914: AUX6 Register Bits

| Bit   | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|--------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27    | TMRB6NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 26:23 | TMRB6TRIG    | 0x0   | RW | Counter/Timer B6 Trigger Select.<br><br>DIS = 0x0 - Trigger source is disabled.<br>A6OUT = 0x1 - Trigger source is CTIMERA6 OUT.<br>B3OUT = 0x2 - Trigger source is CTIMERB3 OUT.<br>A3OUT = 0x3 - Trigger source is CTIMERA3 OUT.<br>A4OUT = 0x4 - Trigger source is CTIMERA4 OUT.<br>B4OUT = 0x5 - Trigger source is CTIMERB4 OUT.<br>A1OUT = 0x6 - Trigger source is CTIMERA1 OUT.<br>B1OUT = 0x7 - Trigger source is CTIMERB1 OUT.<br>B3OUT2 = 0x8 - Trigger source is CTIMERB3 OUT2.<br>A3OUT2 = 0x9 - Trigger source is CTIMERA3 OUT2.<br>A2OUT2 = 0xA - Trigger source is CTIMERA2 OUT2.<br>B2OUT2 = 0xB - Trigger source is CTIMERB2 OUT2.<br>A6OUT2DUAL = 0xC - Trigger source is CTIMERA6 OUT2, dual edge.<br>A7OUT2DUAL = 0xD - Trigger source is CTIMERA7 OUT2, dual edge.<br>B0OUT2DUAL = 0xE - Trigger source is CTIMERB0 OUT2, dual edge.<br>A0OUT2DUAL = 0xF - Trigger source is CTIMERA0 OUT2, dual edge. |
| 22    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 21:16 | TMRB6LMT     | 0x0   | RW | Counter/Timer B6 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 15    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 14    | TMRA6EN23    | 0x0   | RW | Counter/Timer A6 Upper compare enable.<br><br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 13    | TMRA6POL23   | 0x0   | RW | Counter/Timer A6 Upper output polarity<br><br>NORM = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 12    | TMRA6TINV    | 0x0   | RW | Counter/Timer A6 Invert on trigger.<br><br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 11    | TMRA6NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Bit  | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------|-----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10:7 | TMRA6TRIG | 0x0   | RW | <p>Counter/Timer A6 Trigger Select.</p> <p>DIS = 0x0 - Trigger source is disabled.<br/> B6OUT = 0x1 - Trigger source is CTIMERB6 OUT.<br/> B3OUT = 0x2 - Trigger source is CTIMERB3 OUT.<br/> A3OUT = 0x3 - Trigger source is CTIMERA3 OUT.<br/> A5OUT = 0x4 - Trigger source is CTIMERA5 OUT.<br/> B5OUT = 0x5 - Trigger source is CTIMERB5 OUT.<br/> A1OUT = 0x6 - Trigger source is CTIMERA1 OUT.<br/> B1OUT = 0x7 - Trigger source is CTIMERB1 OUT.<br/> B3OUT2 = 0x8 - Trigger source is CTIMERB3 OUT2.<br/> A3OUT2 = 0x9 - Trigger source is CTIMERA3 OUT2.<br/> A2OUT2 = 0xA - Trigger source is CTIMERA2 OUT2.<br/> B2OUT2 = 0xB - Trigger source is CTIMERBb OUT2.<br/> A5OUT2DUAL = 0xC - Trigger source is CTIMERA5 OUT2, dual edge.<br/> A7OUT2DUAL = 0xD - Trigger source is CTIMERA7 OUT2, dual edge.<br/> B0OUT2DUAL = 0xE - Trigger source is CTIMERB0 OUT2, dual edge.<br/> A0OUT2DUAL = 0xF - Trigger source is CTIMERA0 OUT2, dual edge.</p> |
| 6:0  | TMRA6LMT  | 0x0   | RW | Counter/Timer A6 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## Counter/Timer 7

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1        | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5        | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CTTMRB7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CTTMR A7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description       |
|-------|---------|-------|----|-------------------|
| 31:16 | CTTMRB7 | 0x0   | RO | Counter/Timer B7. |
| 15:0  | CTTMRA7 | 0x0   | RO | Counter/Timer A7. |

**INSTANCE 0 ADDRESS: 0x400080E4**

This register holds the compare limits for timer half A.

**Table 917: CMPRA7 Register**

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1A7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0A7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 918: CMPRA7 Register Bits**

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1A7 | 0x0   | RW | Counter/Timer A7 Compare Register 1. |
| 15:0  | CMPR0A7 | 0x0   | RW | Counter/Timer A7 Compare Register 0. |

### 13.20.2.52CMPRB7 Register

Counter/Timer B7 Compare

OFFSET: 0x000000E8

INSTANCE 0 ADDRESS: 0x400080E8

This register holds the compare limits for timer half B.

**Table 919: CMPRB7 Register**

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMPR1B7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR0B7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 920: CMPRB7 Register Bits**

| Bit   | Name    | Reset | RW | Description                          |
|-------|---------|-------|----|--------------------------------------|
| 31:16 | CMPR1B7 | 0x0   | RW | Counter/Timer B3 Compare Register 1. |
| 15:0  | CMPR0B7 | 0x0   | RW | Counter/Timer B3 Compare Register 0. |

### 13.20.2.53CTRL7 Register

Counter/Timer 7 Control

OFFSET: 0x000000EC

INSTANCE 0 ADDRESS: 0x400080EC

This register holds the control bit fields for both halves of timer 7.

Table 921: CTRL7 Register

|         |      |          |          |          |          |         |          |   |   |   |         |      |          |          |          |          |         |          |   |   |   |         |   |   |   |   |   |   |
|---------|------|----------|----------|----------|----------|---------|----------|---|---|---|---------|------|----------|----------|----------|----------|---------|----------|---|---|---|---------|---|---|---|---|---|---|
| 3       | 3    | 2        | 2        | 2        | 2        | 2       | 2        | 2 | 2 | 2 | 1       | 1    | 1        | 1        | 1        | 1        | 1       | 1        | 0 | 0 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0    | 9        | 8        | 7        | 6        | 5       | 4        | 3 | 2 | 1 | 0       | 9    | 8        | 7        | 6        | 5        | 4       | 3        | 2 | 1 | 0 | 9       | 8 | 7 | 6 | 5 | 4 | 3 |
| CTLINK7 | RSVD | TMRB7POL | TMRB7CLR | TMRB7IE1 | TMRB7IE0 | TMRB7FN | TMRB7CLK |   |   |   | TMRB7EN | RSVD | TMRA7POL | TMRA7CLR | TMRA7IE1 | TMRA7IE0 | TMRA7FN | TMRA7CLK |   |   |   | TMRA7EN |   |   |   |   |   |   |

Table 922: CTRL7 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                             |
|-------|----------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | CTLINK7  | 0x0   | RW | Counter/Timer A7/B7 Link bit.<br>TWO_16BIT_TIMERS = 0x0 - Use A7/B7 timers as two independent 16-bit timers (default).<br>32BIT_TIMER = 0x1 - Link A7/B7 timers into a single 32-bit timer.                             |
| 30:29 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                |
| 28    | TMRB7POL | 0x0   | RW | Counter/Timer B7 output polarity.<br>NORMAL = 0x0 - The polarity of the TMRPINB7 pin is the same as the timer output.<br>INVERTED = 0x1 - The polarity of the TMRPINB7 pin is the inverse of the timer output.          |
| 27    | TMRB7CLR | 0x0   | RW | Counter/Timer B7 Clear bit.<br>RUN = 0x0 - Allow counter/timer B7 to run<br>CLEAR = 0x1 - Holds counter/timer B7 at 0x0000.                                                                                             |
| 26    | TMRB7IE1 | 0x0   | RW | Counter/Timer B7 Interrupt Enable bit for COMPR1.<br>DIS = 0x0 - Disable counter/timer B7 from generating an interrupt based on COMPR1.<br>EN = 0x1 - Enable counter/timer B7 to generate an interrupt based on COMPR1. |
| 25    | TMRB7IE0 | 0x0   | RW | Counter/Timer B7 Interrupt Enable bit for COMPR0.<br>DIS = 0x0 - Disable counter/timer B7 from generating an interrupt based on COMPR0.<br>EN = 0x1 - Enable counter/timer B7 to generate an interrupt based on COMPR0. |

Table 922: CTRL7 Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24:22 | TMRB7FN  | 0x0   | RW | Counter/Timer B7 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0B7, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0B7, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0B7, assert, count to CMPR1B7, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0B7, assert, count to CMPR1B7, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 21:17 | TMRB7CLK | 0x0   | RW | Counter/Timer B7 Clock Select.<br><br>TMRPIN = 0x0 - Clock source is TMRPINB.<br>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br>XT = 0x6 - Clock source is the XT (uncalibrated).<br>XT_DIV2 = 0x7 - Clock source is XT / 2<br>XT_DIV16 = 0x8 - Clock source is XT / 16<br>XT_DIV128 = 0x9 - Clock source is XT / 128<br>LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br>LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br>LFRC = 0xD - Clock source is LFRC<br>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br>HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br>XT_DIV4 = 0x10 - Clock source is XT / 4<br>XT_DIV8 = 0x11 - Clock source is XT / 8<br>XT_DIV32 = 0x12 - Clock source is XT / 32<br>RSVD = 0x13 - Clock source is Reserved.<br>CTMRA7 = 0x14 - Clock source is CTIMERA7 OUT.<br>CTMRA2 = 0x15 - Clock source is CTIMERA2 OUT.<br>CTMRB2 = 0x16 - Clock source is CTIMERB2 OUT.<br>CTMRA0 = 0x17 - Clock source is CTIMERA0 OUT.<br>CTMRB0 = 0x18 - Clock source is CTIMERB0 OUT.<br>CTMRB1 = 0x19 - Clock source is CTIMERB1 OUT.<br>CTMRB3 = 0x1A - Clock source is CTIMERB3 OUT.<br>CTMRB4 = 0x1B - Clock source is CTIMERB4 OUT.<br>CTMRB5 = 0x1C - Clock source is CTIMERB5 OUT.<br>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses. |
| 16    | TMRB7EN  | 0x0   | RW | Counter/Timer B7 Enable bit.<br><br>DIS = 0x0 - Counter/Timer B7 Disable.<br>EN = 0x1 - Counter/Timer B7 Enable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 15:13 | RSVD     | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

Table 922: CTRL7 Register Bits

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----|----------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12  | TMRA7POL | 0x0   | RW | Counter/Timer A7 output polarity.<br><br>NORMAL = 0x0 - The polarity of the TMRPINA7 pin is the same as the timer output.<br>INVERTED = 0x1 - The polarity of the TMRPINA7 pin is the inverse of the timer output.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 11  | TMRA7CLR | 0x0   | RW | Counter/Timer A7 Clear bit.<br><br>RUN = 0x0 - Allow counter/timer A7 to run<br>CLEAR = 0x1 - Holds counter/timer A7 at 0x0000.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 10  | TMRA7IE1 | 0x0   | RW | Counter/Timer A7 Interrupt Enable bit based on COMP1.<br><br>DIS = 0x0 - Disable counter/timer A7 from generating an interrupt based on COMP1.<br>EN = 0x1 - Enable counter/timer A7 to generate an interrupt based on COMP1.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 9   | TMRA7IE0 | 0x0   | RW | Counter/Timer A7 Interrupt Enable bit based on COMP0.<br><br>DIS = 0x0 - Disable counter/timer A7 from generating an interrupt based on COMP0.<br>EN = 0x1 - Enable counter/timer A7 to generate an interrupt based on COMP0.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 8:6 | TMRA7FN  | 0x0   | RW | Counter/Timer A7 Function Select.<br><br>SINGLECOUNT = 0x0 - Single count (output toggles and sticks). Count to CMPR0A7, stop.<br>REPEATEDCOUNT = 0x1 - Repeated count (periodic 1-clock-cycle-wide pulses). Count to CMPR0A7, restart.<br>PULSE_ONCE = 0x2 - Pulse once (aka one-shot). Count to CMPR0A7, assert, count to CMPR1A7, deassert, stop.<br>PULSE_CONT = 0x3 - Pulse continuously. Count to CMPR0A7, assert, count to CMPR1A7, deassert, restart.<br>SINGLEPATTERN = 0x4 - Single pattern.<br>REPEATPATTERN = 0x5 - Repeated pattern.<br>CONTINUOUS = 0x6 - Continuous run (aka Free Run). Count continuously.<br>ALTPWN = 0x7 - Alternate PWM |



Table 922: CTRL7 Register Bits

| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----|----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5:1 | TMRA7CLK | 0x0   | RW | Counter/Timer A7 Clock Select.<br><br>TMRPIN = 0x0 - Clock source is TMRPINA.<br>HFRC_DIV4 = 0x1 - Clock source is the HFRC / 4<br>HFRC_DIV16 = 0x2 - Clock source is HFRC / 16<br>HFRC_DIV256 = 0x3 - Clock source is HFRC / 256<br>HFRC_DIV1024 = 0x4 - Clock source is HFRC / 1024<br>HFRC_DIV4K = 0x5 - Clock source is HFRC / 4096<br>XT = 0x6 - Clock source is the XT (uncalibrated).<br>XT_DIV2 = 0x7 - Clock source is XT / 2<br>XT_DIV16 = 0x8 - Clock source is XT / 16<br>XT_DIV128 = 0x9 - Clock source is XT / 128<br>LFRC_DIV2 = 0xA - Clock source is LFRC / 2<br>LFRC_DIV32 = 0xB - Clock source is LFRC / 32<br>LFRC_DIV1K = 0xC - Clock source is LFRC / 1024<br>LFRC = 0xD - Clock source is LFRC<br>RTC_100HZ = 0xE - Clock source is 100 Hz from the current RTC oscillator.<br>HCLK_DIV4 = 0xF - Clock source is HCLK / 4 (note: this clock is only available when MCU is in active mode)<br>XT_DIV4 = 0x10 - Clock source is XT / 4<br>XT_DIV8 = 0x11 - Clock source is XT / 8<br>XT_DIV32 = 0x12 - Clock source is XT / 32<br>RSVD = 0x13 - Clock source is Reserved.<br>CTMRB7 = 0x14 - Clock source is CTIMERB7 OUT.<br>CTMRA2 = 0x15 - Clock source is CTIMERA2 OUT.<br>CTMRB2 = 0x16 - Clock source is CTIMERB2 OUT.<br>CTMRA0 = 0x17 - Clock source is CTIMERA0 OUT.<br>CTMRB0 = 0x18 - Clock source is CTIMERB0 OUT.<br>CTMRB1 = 0x19 - Clock source is CTIMERB1 OUT.<br>CTMRB3 = 0x1A - Clock source is CTIMERB3 OUT.<br>CTMRB4 = 0x1B - Clock source is CTIMERB4 OUT.<br>CTMRB5 = 0x1C - Clock source is CTIMERB5 OUT.<br>BUCKBLE = 0x1D - Clock source is BLE buck converter TON pulses.<br>BUCKB = 0x1E - Clock source is Memory buck converter TON pulses.<br>BUCKA = 0x1F - Clock source is CPU buck converter TON pulses. |
| 0   | TMRA7EN  | 0x0   | RW | Counter/Timer A7 Enable bit.<br><br>DIS = 0x0 - Counter/Timer A7 Disable.<br>EN = 0x1 - Counter/Timer A7 Enable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

**13.20.2.54CMPRAUXA7 Register****Counter/Timer A7 Auxiliary Compare****OFFSET:** 0x000000F4**INSTANCE 0 ADDRESS:** 0x400080F4

Enhanced compare limits for timer half A.

Table 923: CMPRAUXA7 Register

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1      | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5      | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CMR3A7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMR2A7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3A7 | 0x0   | RW | Counter/Timer A7 Compare Register 3. Holds the upper limit for timer half A. |
| 15:0  | CMPR2A7 | 0x0   | RW | Counter/Timer A7 Compare Register 2. Holds the lower limit for timer half A. |

Enhanced compare limits for timer half B.

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5       | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |
| CMPR3B7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CMPR2B7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name    | Reset | RW | Description                                                                  |
|-------|---------|-------|----|------------------------------------------------------------------------------|
| 31:16 | CMPR3B7 | 0x0   | RW | Counter/Timer B7 Compare Register 3. Holds the upper limit for timer half B. |
| 15:0  | CMPR2B7 | 0x0   | RW | Counter/Timer B7 Compare Register 2. Holds the lower limit for timer half B. |

Control bit fields for both halves of timer 0.



Table 928: AUX7 Register Bits

| Bit   | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|--------------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21:16 | TMRB7LMT     | 0x0   | RW | Counter/Timer B7 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 15    | RSVD         | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 14    | TMRA7EN23    | 0x0   | RW | Counter/Timer A7 Upper compare enable.<br>DIS = 0x1 - Disable enhanced functions.<br>EN = 0x0 - Enable enhanced functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 13    | TMRA7POL23   | 0x0   | RW | Counter/Timer A7 Upper output polarity<br>NORM = 0x0 - Upper output normal polarity<br>INV = 0x1 - Upper output inverted polarity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 12    | TMRA7TINV    | 0x0   | RW | Counter/Timer A7 Invert on trigger.<br>DIS = 0x0 - Disable invert on trigger<br>EN = 0x1 - Enable invert on trigger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 11    | TMRA7NO-SYNC | 0x0   | RW | Source clock synchronization control.<br>DIS = 0x0 - Synchronization on source clock<br>NOSYNC = 0x1 - No synchronization on source clock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 10:7  | TMRA7TRIG    | 0x0   | RW | Counter/Timer A7 Trigger Select.<br><br>DIS = 0x0 - Trigger source is disabled.<br>B7OUT = 0x1 - Trigger source is CTIMERB7 OUT.<br>B3OUT = 0x2 - Trigger source is CTIMERB3 OUT.<br>A3OUT = 0x3 - Trigger source is CTIMERA3 OUT.<br>A1OUT = 0x4 - Trigger source is CTIMERA1 OUT.<br>B1OUT = 0x5 - Trigger source is CTIMERB1 OUT.<br>A4OUT = 0x6 - Trigger source is CTIMERA4 OUT.<br>B4OUT = 0x7 - Trigger source is CTIMERB4 OUT.<br>B3OUT2 = 0x8 - Trigger source is CTIMERB3 OUT2.<br>A3OUT2 = 0x9 - Trigger source is CTIMERA3 OUT2.<br>A2OUT2 = 0xA - Trigger source is CTIMERA2 OUT2.<br>B2OUT2 = 0xB - Trigger source is CTIMERB2 OUT2.<br>A6OUT2DUAL = 0xC - Trigger source is CTIMERA6 OUT2, dual edge.<br>A5OUT2DUAL = 0xD - Trigger source is CTIMERA5 OUT2, dual edge.<br>B4OUT2DUAL = 0xE - Trigger source is CTIMERB4 OUT2, dual edge.<br>A4OUT2DUAL = 0xF - Trigger source is CTIMERA4 OUT2, dual edge. |
| 6:0   | TMRA7LMT     | 0x0   | RW | Counter/Timer A7 Pattern Limit Count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

**13.20.2.57GLOBEN Register****Counter/Timer Global Enable****OFFSET:** 0x00000100**INSTANCE 0 ADDRESS:** 0x40008100

Alternate enables for all CTIMERs.



| Bit | Name | Reset | RW | Description                                                                             |
|-----|------|-------|----|-----------------------------------------------------------------------------------------|
| 6   | ENA3 | 0x1   | RW | Alternate enable for A3<br>LCO = 0x1 - Use local enable.<br>DIS = 0x0 - Disable CTIMER. |
| 5   | ENB2 | 0x1   | RW | Alternate enable for B2<br>LCO = 0x1 - Use local enable.<br>DIS = 0x0 - Disable CTIMER. |
| 4   | ENA2 | 0x1   | RW | Alternate enable for A2<br>LCO = 0x1 - Use local enable.<br>DIS = 0x0 - Disable CTIMER. |
| 3   | ENB1 | 0x1   | RW | Alternate enable for B1<br>LCO = 0x1 - Use local enable.<br>DIS = 0x0 - Disable CTIMER. |
| 2   | ENA1 | 0x1   | RW | Alternate enable for A1<br>LCO = 0x1 - Use local enable.<br>DIS = 0x0 - Disable CTIMER. |
| 1   | ENB0 | 0x1   | RW | Alternate enable for B0<br>LCO = 0x1 - Use local enable.<br>DIS = 0x0 - Disable CTIMER. |
| 0   | ENA0 | 0x1   | RW | Alternate enable for A0<br>LCO = 0x1 - Use local enable.<br>DIS = 0x0 - Disable CTIMER. |

### Counter/Timer Output Config 0

**INSTANCE 0 ADDRESS: 0x40008104**

|      |      |   |   |      |   |   |      |   |   |      |   |   |      |   |   |      |      |   |   |      |   |   |      |   |   |      |   |   |      |   |   |   |
|------|------|---|---|------|---|---|------|---|---|------|---|---|------|---|---|------|------|---|---|------|---|---|------|---|---|------|---|---|------|---|---|---|
| 3    | 3    | 2 | 2 | 2    | 2 | 2 | 2    | 2 | 2 | 2    | 1 | 1 | 1    | 1 | 1 | 1    | 1    | 1 | 0 | 0    | 0 | 0 | 0    | 0 | 0 | 0    | 0 | 0 | 0    | 0 | 0 | 0 |
| 1    | 0    | 9 | 8 | 7    | 6 | 5 | 4    | 3 | 2 | 1    | 0 | 9 | 8    | 7 | 6 | 5    | 4    | 3 | 2 | 1    | 0 | 9 | 8    | 7 | 6 | 5    | 4 | 3 | 2    | 1 | 0 |   |
| RSVD | CFG9 |   |   | CFG8 |   |   | CFG7 |   |   | CFG6 |   |   | CFG5 |   |   | RSVD | CFG4 |   |   | CFG3 |   |   | CFG2 |   |   | CFG1 |   |   | CFG0 |   |   |   |

Table 932: OUTCFG0 Register Bits

| Bit   | Name | Reset | RW | Description                                                                                                                                                                                                                                                                                                          |
|-------|------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | RSVD | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                             |
| 30:28 | CFG9 | 0x2   | RW | Pad output 9 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B0OUT = 0x5 - Output is B0OUT.<br>A4OUT = 0x4 - Output is A4OUT.<br>A2OUT = 0x3 - Output is A2OUT.<br>A2OUT2 = 0x2 - Output is A2OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0  |
| 27:25 | CFG8 | 0x2   | RW | Pad output 8 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B6OUT = 0x5 - Output is B6OUT.<br>A4OUT2 = 0x4 - Output is A4OUT2.<br>A3OUT2 = 0x3 - Output is A3OUT.<br>A2OUT = 0x2 - Output is A2OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 24:22 | CFG7 | 0x2   | RW | Pad output 7 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A7OUT = 0x5 - Output is A7OUT.<br>B5OUT = 0x4 - Output is B5OUT.<br>B1OUT = 0x3 - Output is B1OUT.<br>B1OUT2 = 0x2 - Output is B1OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0  |
| 21:19 | CFG6 | 0x2   | RW | Pad output 6 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B7OUT = 0x5 - Output is B7OUT.<br>B5OUT2 = 0x4 - Output is B5OUT2.<br>A1OUT = 0x3 - Output is A1OUT.<br>B1OUT = 0x2 - Output is B1OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0  |
| 18:16 | CFG5 | 0x2   | RW | Pad output 5 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A7OUT = 0x5 - Output is A7OUT.<br>B6OUT = 0x4 - Output is A5OUT.<br>A1OUT = 0x3 - Output is A1OUT.<br>A1OUT2 = 0x2 - Output is A1OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0  |
| 15    | RSVD | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                             |

**Table 932: OUTCFG0 Register Bits**

| Bit   | Name | Reset | RW | Description                                                                                                                                                                                                                                                                                                           |
|-------|------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14:12 | CFG4 | 0x2   | RW | Pad output 4 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B5OUT = 0x5 - Output is B5OUT.<br>A5OUT2 = 0x4 - Output is A5OUT2.<br>A2OUT2 = 0x3 - Output is A2OUT2.<br>A1OUT = 0x2 - Output is A1OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 11:9  | CFG3 | 0x1   | RW | Pad output 3 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A6OUT = 0x5 - Output is A6OUT.<br>A1OUT = 0x4 - Output is A1OUT.<br>B0OUT = 0x3 - Output is B0OUT.<br>B0OUT2 = 0x2 - Output is B0OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0   |
| 8:6   | CFG2 | 0x2   | RW | Pad output 2 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A7OUT = 0x5 - Output is A7OUT.<br>B6OUT2 = 0x4 - Output is B6OUT2.<br>B1OUT2 = 0x3 - Output is B1OUT2.<br>B0OUT = 0x2 - Output is B0OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 5:3   | CFG1 | 0x2   | RW | Pad output 1 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B7OUT2 = 0x5 - Output is B7OUT2.<br>A5OUT = 0x4 - Output is A5OUT.<br>A0OUT = 0x3 - Output is A0OUT.<br>A0OUT2 = 0x2 - Output is A0OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 2:0   | CFG0 | 0x2   | RW | Pad output 0 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A6OUT = 0x5 - Output is A6OUT.<br>A5OUT2 = 0x4 - Output is A5OUT2.<br>B2OUT2 = 0x3 - Output is B2OUT2.<br>A0OUT = 0x2 - Output is A0OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |

**13.20.2.59OUTCFG1 Register****Counter/Timer Output Config 1****OFFSET:** 0x00000108**INSTANCE 0 ADDRESS:** 0x40008108





Table 934: OUTCFG1 Register Bits

| Bit   | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                        |
|-------|-------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18:16 | CFG15 | 0x2   | RW | Pad output 15 configuration<br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A4OUT2 = 0x5 - Output is A4OUT2.<br>A7OUT = 0x4 - Output is A7OUT.<br>B3OUT = 0x3 - Output is B3OUT.<br>B3OUT2 = 0x2 - Output is B3OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 15    | RSVD  | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                           |
| 14:12 | CFG14 | 0x2   | RW | Pad output 14 configuration<br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A7OUT = 0x5 - Output is A7OUT.<br>B7OUT2 = 0x4 - Output is B7OUT2.<br>B1OUT = 0x3 - Output is B1OUT.<br>B3OUT = 0x2 - Output is B3OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0   |
| 11:9  | CFG13 | 0x1   | RW | Pad output 13 configuration<br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B4OUT2 = 0x5 - Output is B4OUT2.<br>A6OUT = 0x4 - Output is A6OUT.<br>A3OUT = 0x3 - Output is A3OUT.<br>A3OUT2 = 0x2 - Output is A3OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 8:6   | CFG12 | 0x2   | RW | Pad output 12 configuration<br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B6OUT2 = 0x5 - Output is B6OUT2.<br>B0OUT2 = 0x4 - Output is B0OUT2.<br>B1OUT = 0x3 - Output is B1OUT.<br>A3OUT = 0x2 - Output is A3OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 5:3   | CFG11 | 0x2   | RW | Pad output 11 configuration<br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B5OUT2 = 0x5 - Output is B5OUT2.<br>B4OUT = 0x4 - Output is B4OUT.<br>B2OUT = 0x3 - Output is B2OUT.<br>B2OUT2 = 0x2 - Output is B2OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |

| Bit | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                            |
|-----|-------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2:0 | CFG10 | 0x2   | RW | Pad output 10 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A6OUT = 0x5 - Output is A6OUT.<br>B4OUT2 = 0x4 - Output is B4OUT2.<br>B3OUT2 = 0x3 - Output is B3OUT2.<br>B2OUT = 0x2 - Output is B2OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |

### Pad output configuration 2.

|      |       |       |       |       |       |      |       |       |       |       |       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3     | 2     | 2     | 2     | 2     | 2    | 2     | 2     | 2     | 2     | 1     | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0     | 9     | 8     | 7     | 6     | 5    | 4     | 3     | 2     | 1     | 0     | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |
| RSVD | CFG29 | CFG28 | CFG27 | CFG26 | CFG25 | RSVD | CFG24 | CFG23 | CFG22 | CFG21 | CFG20 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                            |
|-------|-------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | RSVD  | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                               |
| 30:28 | CFG29 | 0x2   | RW | Pad output 29 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A3OUT2 = 0x5 - Output is A3OUT2.<br>A7OUT = 0x4 - Output is A7OUT.<br>A1OUT = 0x3 - Output is A1OUT.<br>B5OUT2 = 0x2 - Output is B5OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |

Table 936: OUTCFG2 Register Bits

| Bit   | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                        |
|-------|-------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27:25 | CFG28 | 0x2   | RW | Pad output 28 configuration<br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B0OUT2 = 0x5 - Output is B0OUT2.<br>A5OUT2 = 0x4 - Output is A5OUT2.<br>A3OUT = 0x3 - Output is A3OUT.<br>A7OUT = 0x2 - Output is A7OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 24:22 | CFG27 | 0x2   | RW | Pad output 27 configuration<br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B2OUT2 = 0x5 - Output is B2OUT2.<br>B6OUT = 0x4 - Output is B6OUT.<br>A1OUT = 0x3 - Output is A1OUT.<br>B6OUT2 = 0x2 - Output is B6OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 21:19 | CFG26 | 0x2   | RW | Pad output 26 configuration<br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A1OUT2 = 0x5 - Output is A1OUT2.<br>A5OUT = 0x4 - Output is A5OUT.<br>B2OUT = 0x3 - Output is B2OUT.<br>B6OUT = 0x2 - Output is B6OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0   |
| 18:16 | CFG25 | 0x2   | RW | Pad output 25 configuration<br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A2OUT2 = 0x5 - Output is A2OUT2.<br>A6OUT = 0x4 - Output is A6OUT.<br>B2OUT = 0x3 - Output is B2OUT.<br>B4OUT2 = 0x2 - Output is B4OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 15    | RSVD  | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                           |
| 14:12 | CFG24 | 0x2   | RW | Pad output 24 configuration<br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B1OUT2 = 0x5 - Output is B1OUT2.<br>A1OUT = 0x4 - Output is A1OUT.<br>A2OUT = 0x3 - Output is A2OUT.<br>A6OUT = 0x2 - Output is A6OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0   |

**Table 936: OUTCFG2 Register Bits**

| Bit  | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                            |
|------|-------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11:9 | CFG23 | 0x1   | RW | Pad output 23 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B0OUT2 = 0x5 - Output is B0OUT2.<br>A5OUT = 0x4 - Output is A5OUT.<br>A7OUT = 0x3 - Output is A7OUT.<br>B5OUT2 = 0x2 - Output is B5OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 8:6  | CFG22 | 0x2   | RW | Pad output 22 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A2OUT2 = 0x5 - Output is A2OUT2.<br>A1OUT = 0x4 - Output is A1OUT.<br>A6OUT = 0x3 - Output is A6OUT.<br>B5OUT = 0x2 - Output is B5OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0   |
| 5:3  | CFG21 | 0x2   | RW | Pad output 21 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A0OUT2 = 0x5 - Output is A0OUT2.<br>B5OUT = 0x4 - Output is B5OUT.<br>A1OUT = 0x3 - Output is A1OUT.<br>A5OUT2 = 0x2 - Output is A5OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 2:0  | CFG20 | 0x2   | RW | Pad output 20 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B2OUT2 = 0x5 - Output is B2OUT2.<br>A1OUT2 = 0x4 - Output is A1OUT2.<br>A1OUT = 0x3 - Output is A1OUT.<br>A5OUT = 0x2 - Output is A5OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |

**13.20.2.61OUTCFG3 Register****Counter/Timer Output Config 3****OFFSET:** 0x00000114**INSTANCE 0 ADDRESS:** 0x40008114

Pad output configuration 3.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |       |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|-------|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0     | 0 | 0 | 0     | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7     | 6 | 5 | 4     | 3 | 2 | 1 | 0 |   |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CFG31 |   |   | CFG30 |   |   |   |   |   |

| Bit  | Name  | Reset | RW | Description                                                                                                                                                                                                                                                                                                            |
|------|-------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:6 | RSVD  | 0x0   | RO | RESERVED                                                                                                                                                                                                                                                                                                               |
| 5:3  | CFG31 | 0x2   | RW | Pad output 31 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>B3OUT2 = 0x5 - Output is B3OUT2.<br>B7OUT = 0x4 - Output is B7OUT.<br>A6OUT = 0x3 - Output is A6OUT.<br>B7OUT2 = 0x2 - Output is B7OUT2<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |
| 2:0  | CFG30 | 0x2   | RW | Pad output 30 configuration<br><br>A7OUT2 = 0x7 - Output is A7OUT2.<br>A6OUT2 = 0x6 - Output is A6OUT2.<br>A0OUT2 = 0x5 - Output is A0OUT2.<br>A4OUT2 = 0x4 - Output is A4OUT2.<br>B3OUT = 0x3 - Output is B3OUT.<br>B7OUT = 0x2 - Output is B7OUT<br>ONE = 0x1 - Force output to 1.<br>ZERO = 0x0 - Force output to 0 |

### Counter/Timer Input Config

**INSTANCE 0 ADDRESS: 0x40008118**

### Pad input configuration.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1    | 1    | 1    | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |      |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5    | 4    | 3    | 2    | 1    | 0    | 9    | 8    | 7    | 6    | 5    | 4    | 3    | 2    | 1    | 0    |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | CFG7 | CFG7 | CFG6 | CFG6 | CFG5 | CFG5 | CFG4 | CFG4 | CFG3 | CFG3 | CFG2 | CFG2 | CFG1 | CFG1 | CFG0 | CFG0 |

Table 940: INCFG Register Bits

| Bit   | Name  | Reset | RW | Description                                                                               |
|-------|-------|-------|----|-------------------------------------------------------------------------------------------|
| 31:16 | RSVD  | 0x0   | RO | RESERVED                                                                                  |
| 15    | CFGB7 | 0x0   | RW | CTIMER B7 input configuration<br>CT31 = 0x1 - Input is CT31<br>CT30 = 0x0 - Input is CT30 |
| 14    | CFGA7 | 0x0   | RW | CTIMER A7 input configuration<br>CT29 = 0x1 - Input is CT29<br>CT28 = 0x0 - Input is CT28 |
| 13    | CFGB6 | 0x0   | RW | CTIMER B6 input configuration<br>CT27 = 0x1 - Input is CT27<br>CT26 = 0x0 - Input is CT26 |
| 12    | CFGA6 | 0x0   | RW | CTIMER A6 input configuration<br>CT25 = 0x1 - Input is CT25<br>CT24 = 0x0 - Input is CT24 |
| 11    | CFGB5 | 0x0   | RW | CTIMER B5 input configuration<br>CT23 = 0x1 - Input is CT23<br>CT22 = 0x0 - Input is CT22 |
| 10    | CFGA5 | 0x0   | RW | CTIMER A5 input configuration<br>CT21 = 0x1 - Input is CT21<br>CT20 = 0x0 - Input is CT20 |
| 9     | CFGB4 | 0x0   | RW | CTIMER B4 input configuration<br>CT19 = 0x1 - Input is CT19<br>CT18 = 0x0 - Input is CT18 |
| 8     | CFGA4 | 0x0   | RW | CTIMER A4 input configuration<br>CT17 = 0x1 - Input is CT17<br>CT16 = 0x0 - Input is CT16 |
| 7     | CFGB3 | 0x0   | RW | CTIMER B3 input configuration<br>CT15 = 0x1 - Input is CT15<br>CT14 = 0x0 - Input is CT14 |
| 6     | CFGA3 | 0x0   | RW | CTIMER A3 input configuration<br>CT13 = 0x1 - Input is CT13<br>CT12 = 0x0 - Input is CT12 |
| 5     | CFGB2 | 0x0   | RW | CTIMER B2 input configuration<br>CT11 = 0x1 - Input is CT11<br>CT10 = 0x0 - Input is CT10 |
| 4     | CFGA2 | 0x0   | RW | CTIMER A2 input configuration<br>CT9 = 0x1 - Input is CT9<br>CT8 = 0x0 - Input is CT8     |

| Bit | Name  | Reset | RW | Description                                                                           |
|-----|-------|-------|----|---------------------------------------------------------------------------------------|
| 3   | CFGB1 | 0x0   | RW | CTIMER B1 input configuration<br>CT7 = 0x1 - Input is CT7<br>CT6 = 0x0 - Input is CT6 |
| 2   | CFGA1 | 0x0   | RW | CTIMER A1 input configuration<br>CT5 = 0x1 - Input is CT5<br>CT4 = 0x0 - Input is CT4 |
| 1   | CFGB0 | 0x0   | RW | CTIMER B0 input configuration<br>CT3 = 0x1 - Input is CT3<br>CT2 = 0x0 - Input is CT2 |
| 0   | CFGA0 | 0x0   | RW | CTIMER A0 input configuration<br>CT1 = 0x1 - Input is CT1<br>CT0 = 0x0 - Input is CT0 |

Set bits in this register to allow this module to generate the corresponding interrupt.

[illegible]

| Bit | Name        | Reset | RW | Description                                |
|-----|-------------|-------|----|--------------------------------------------|
| 31  | CTMRB7C1INT | 0x0   | RW | Counter/Timer B7 interrupt based on COMP1. |
| 30  | CTMRA7C1INT | 0x0   | RW | Counter/Timer A7 interrupt based on COMP1. |
| 29  | CTMRB6C1INT | 0x0   | RW | Counter/Timer B6 interrupt based on COMP1. |
| 28  | CTMRA6C1INT | 0x0   | RW | Counter/Timer A6 interrupt based on COMP1. |



Table 942: INTEN Register Bits

| Bit | Name        | Reset | RW | Description                                 |
|-----|-------------|-------|----|---------------------------------------------|
| 27  | CTMRB5C1INT | 0x0   | RW | Counter/Timer B5 interrupt based on COMPR1. |
| 26  | CTMRA5C1INT | 0x0   | RW | Counter/Timer A5 interrupt based on COMPR1. |
| 25  | CTMRB4C1INT | 0x0   | RW | Counter/Timer B4 interrupt based on COMPR1. |
| 24  | CTMRA4C1INT | 0x0   | RW | Counter/Timer A4 interrupt based on COMPR1. |
| 23  | CTMRB3C1INT | 0x0   | RW | Counter/Timer B3 interrupt based on COMPR1. |
| 22  | CTMRA3C1INT | 0x0   | RW | Counter/Timer A3 interrupt based on COMPR1. |
| 21  | CTMRB2C1INT | 0x0   | RW | Counter/Timer B2 interrupt based on COMPR1. |
| 20  | CTMRA2C1INT | 0x0   | RW | Counter/Timer A2 interrupt based on COMPR1. |
| 19  | CTMRB1C1INT | 0x0   | RW | Counter/Timer B1 interrupt based on COMPR1. |
| 18  | CTMRA1C1INT | 0x0   | RW | Counter/Timer A1 interrupt based on COMPR1. |
| 17  | CTMRB0C1INT | 0x0   | RW | Counter/Timer B0 interrupt based on COMPR1. |
| 16  | CTMRA0C1INT | 0x0   | RW | Counter/Timer A0 interrupt based on COMPR1. |
| 15  | CTMRB7C0INT | 0x0   | RW | Counter/Timer B7 interrupt based on COMPR0. |
| 14  | CTMRA7C0INT | 0x0   | RW | Counter/Timer A7 interrupt based on COMPR0. |
| 13  | CTMRB6C0INT | 0x0   | RW | Counter/Timer B6 interrupt based on COMPR0. |
| 12  | CTMRA6C0INT | 0x0   | RW | Counter/Timer A6 interrupt based on COMPR0. |
| 11  | CTMRB5C0INT | 0x0   | RW | Counter/Timer B5 interrupt based on COMPR0. |
| 10  | CTMRA5C0INT | 0x0   | RW | Counter/Timer A5 interrupt based on COMPR0. |
| 9   | CTMRB4C0INT | 0x0   | RW | Counter/Timer B4 interrupt based on COMPR0. |
| 8   | CTMRA4C0INT | 0x0   | RW | Counter/Timer A4 interrupt based on COMPR0. |
| 7   | CTMRB3C0INT | 0x0   | RW | Counter/Timer B3 interrupt based on COMPR0. |
| 6   | CTMRA3C0INT | 0x0   | RW | Counter/Timer A3 interrupt based on COMPR0. |
| 5   | CTMRB2C0INT | 0x0   | RW | Counter/Timer B2 interrupt based on COMPR0. |

| Bit | Name        | Reset | RW | Description                                 |
|-----|-------------|-------|----|---------------------------------------------|
| 4   | CTMRA2C0INT | 0x0   | RW | Counter/Timer A2 interrupt based on COMPR0. |
| 3   | CTMRB1C0INT | 0x0   | RW | Counter/Timer B1 interrupt based on COMPR0. |
| 2   | CTMRA1C0INT | 0x0   | RW | Counter/Timer A1 interrupt based on COMPR0. |
| 1   | CTMRB0C0INT | 0x0   | RW | Counter/Timer B0 interrupt based on COMPR0. |
| 0   | CTMRA0C0INT | 0x0   | RW | Counter/Timer A0 interrupt based on COMPR0. |

## Counter/Timer Interrupts: Status

**INSTANCE 0 ADDRESS: 0x40008204**

Read bits from this register to discover the cause of a recent interrupt.

|             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| CTMRB7C1INT | CTMRA7C1INT | CTMRB6C1INT | CTMRA6C1INT | CTMRB5C1INT | CTMRA5C1INT | CTMRB4C1INT | CTMRA4C1INT | CTMRB3C1INT | CTMRA3C1INT | CTMRB2C1INT | CTMRA2C1INT | CTMRB1C1INT | CTMRA1C1INT | CTMRB0C1INT | CTMRA0C1INT | CTMRB7C0INT | CTMRA7C0INT | CTMRB6C0INT | CTMRA6C0INT | CTMRB5C0INT | CTMRA5C0INT | CTMRB4C0INT | CTMRA4C0INT | CTMRB3C0INT | CTMRA3C0INT | CTMRB2C0INT | CTMRA2C0INT | CTMRB1C0INT | CTMRA1C0INT | CTMRB0C0INT | CTMRA0C0INT |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|

| Bit | Name        | Reset | RW | Description                                |
|-----|-------------|-------|----|--------------------------------------------|
| 31  | CTMRB7C1INT | 0x0   | RW | Counter/Timer B7 interrupt based on COMP1. |
| 30  | CTMRA7C1INT | 0x0   | RW | Counter/Timer A7 interrupt based on COMP1. |
| 29  | CTMRB6C1INT | 0x0   | RW | Counter/Timer B6 interrupt based on COMP1. |
| 28  | CTMRA6C1INT | 0x0   | RW | Counter/Timer A6 interrupt based on COMP1. |
| 27  | CTMRB5C1INT | 0x0   | RW | Counter/Timer B5 interrupt based on COMP1. |
| 26  | CTMRA5C1INT | 0x0   | RW | Counter/Timer A5 interrupt based on COMP1. |

Table 944: INTSTAT Register Bits

| Bit | Name        | Reset | RW | Description                                 |
|-----|-------------|-------|----|---------------------------------------------|
| 25  | CTMRB4C1INT | 0x0   | RW | Counter/Timer B4 interrupt based on COMPR1. |
| 24  | CTMRA4C1INT | 0x0   | RW | Counter/Timer A4 interrupt based on COMPR1. |
| 23  | CTMRB3C1INT | 0x0   | RW | Counter/Timer B3 interrupt based on COMPR1. |
| 22  | CTMRA3C1INT | 0x0   | RW | Counter/Timer A3 interrupt based on COMPR1. |
| 21  | CTMRB2C1INT | 0x0   | RW | Counter/Timer B2 interrupt based on COMPR1. |
| 20  | CTMRA2C1INT | 0x0   | RW | Counter/Timer A2 interrupt based on COMPR1. |
| 19  | CTMRB1C1INT | 0x0   | RW | Counter/Timer B1 interrupt based on COMPR1. |
| 18  | CTMRA1C1INT | 0x0   | RW | Counter/Timer A1 interrupt based on COMPR1. |
| 17  | CTMRB0C1INT | 0x0   | RW | Counter/Timer B0 interrupt based on COMPR1. |
| 16  | CTMRA0C1INT | 0x0   | RW | Counter/Timer A0 interrupt based on COMPR1. |
| 15  | CTMRB7C0INT | 0x0   | RW | Counter/Timer B7 interrupt based on COMPR0. |
| 14  | CTMRA7C0INT | 0x0   | RW | Counter/Timer A7 interrupt based on COMPR0. |
| 13  | CTMRB6C0INT | 0x0   | RW | Counter/Timer B6 interrupt based on COMPR0. |
| 12  | CTMRA6C0INT | 0x0   | RW | Counter/Timer A6 interrupt based on COMPR0. |
| 11  | CTMRB5C0INT | 0x0   | RW | Counter/Timer B5 interrupt based on COMPR0. |
| 10  | CTMRA5C0INT | 0x0   | RW | Counter/Timer A5 interrupt based on COMPR0. |
| 9   | CTMRB4C0INT | 0x0   | RW | Counter/Timer B4 interrupt based on COMPR0. |
| 8   | CTMRA4C0INT | 0x0   | RW | Counter/Timer A4 interrupt based on COMPR0. |
| 7   | CTMRB3C0INT | 0x0   | RW | Counter/Timer B3 interrupt based on COMPR0. |
| 6   | CTMRA3C0INT | 0x0   | RW | Counter/Timer A3 interrupt based on COMPR0. |
| 5   | CTMRB2C0INT | 0x0   | RW | Counter/Timer B2 interrupt based on COMPR0. |
| 4   | CTMRA2C0INT | 0x0   | RW | Counter/Timer A2 interrupt based on COMPR0. |
| 3   | CTMRB1C0INT | 0x0   | RW | Counter/Timer B1 interrupt based on COMPR0. |

| Bit | Name        | Reset | RW | Description                                 |
|-----|-------------|-------|----|---------------------------------------------|
| 2   | CTMRA1C0INT | 0x0   | RW | Counter/Timer A1 interrupt based on COMPR0. |
| 1   | CTMRB0C0INT | 0x0   | RW | Counter/Timer B0 interrupt based on COMPR0. |
| 0   | CTMRA0C0INT | 0x0   | RW | Counter/Timer A0 interrupt based on COMPR0. |

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

[illegible]

| Bit | Name        | Reset | RW | Description                                 |
|-----|-------------|-------|----|---------------------------------------------|
| 31  | CTMRB7C1INT | 0x0   | RW | Counter/Timer B7 interrupt based on COMPR1. |
| 30  | CTMRA7C1INT | 0x0   | RW | Counter/Timer A7 interrupt based on COMPR1. |
| 29  | CTMRB6C1INT | 0x0   | RW | Counter/Timer B6 interrupt based on COMPR1. |
| 28  | CTMRA6C1INT | 0x0   | RW | Counter/Timer A6 interrupt based on COMPR1. |
| 27  | CTMRB5C1INT | 0x0   | RW | Counter/Timer B5 interrupt based on COMPR1. |
| 26  | CTMRA5C1INT | 0x0   | RW | Counter/Timer A5 interrupt based on COMPR1. |
| 25  | CTMRB4C1INT | 0x0   | RW | Counter/Timer B4 interrupt based on COMPR1. |
| 24  | CTMRA4C1INT | 0x0   | RW | Counter/Timer A4 interrupt based on COMPR1. |

Table 946: INTCLR Register Bits

| Bit | Name        | Reset | RW | Description                                 |
|-----|-------------|-------|----|---------------------------------------------|
| 23  | CTMRB3C1INT | 0x0   | RW | Counter/Timer B3 interrupt based on COMPR1. |
| 22  | CTMRA3C1INT | 0x0   | RW | Counter/Timer A3 interrupt based on COMPR1. |
| 21  | CTMRB2C1INT | 0x0   | RW | Counter/Timer B2 interrupt based on COMPR1. |
| 20  | CTMRA2C1INT | 0x0   | RW | Counter/Timer A2 interrupt based on COMPR1. |
| 19  | CTMRB1C1INT | 0x0   | RW | Counter/Timer B1 interrupt based on COMPR1. |
| 18  | CTMRA1C1INT | 0x0   | RW | Counter/Timer A1 interrupt based on COMPR1. |
| 17  | CTMRB0C1INT | 0x0   | RW | Counter/Timer B0 interrupt based on COMPR1. |
| 16  | CTMRA0C1INT | 0x0   | RW | Counter/Timer A0 interrupt based on COMPR1. |
| 15  | CTMRB7C0INT | 0x0   | RW | Counter/Timer B7 interrupt based on COMPR0. |
| 14  | CTMRA7C0INT | 0x0   | RW | Counter/Timer A7 interrupt based on COMPR0. |
| 13  | CTMRB6C0INT | 0x0   | RW | Counter/Timer B6 interrupt based on COMPR0. |
| 12  | CTMRA6C0INT | 0x0   | RW | Counter/Timer A6 interrupt based on COMPR0. |
| 11  | CTMRB5C0INT | 0x0   | RW | Counter/Timer B5 interrupt based on COMPR0. |
| 10  | CTMRA5C0INT | 0x0   | RW | Counter/Timer A5 interrupt based on COMPR0. |
| 9   | CTMRB4C0INT | 0x0   | RW | Counter/Timer B4 interrupt based on COMPR0. |
| 8   | CTMRA4C0INT | 0x0   | RW | Counter/Timer A4 interrupt based on COMPR0. |
| 7   | CTMRB3C0INT | 0x0   | RW | Counter/Timer B3 interrupt based on COMPR0. |
| 6   | CTMRA3C0INT | 0x0   | RW | Counter/Timer A3 interrupt based on COMPR0. |
| 5   | CTMRB2C0INT | 0x0   | RW | Counter/Timer B2 interrupt based on COMPR0. |
| 4   | CTMRA2C0INT | 0x0   | RW | Counter/Timer A2 interrupt based on COMPR0. |
| 3   | CTMRB1C0INT | 0x0   | RW | Counter/Timer B1 interrupt based on COMPR0. |
| 2   | CTMRA1C0INT | 0x0   | RW | Counter/Timer A1 interrupt based on COMPR0. |
| 1   | CTMRB0C0INT | 0x0   | RW | Counter/Timer B0 interrupt based on COMPR0. |

| Bit | Name        | Reset | RW | Description                                 |
|-----|-------------|-------|----|---------------------------------------------|
| 0   | CTMRA0C0INT | 0x0   | RW | Counter/Timer A0 interrupt based on COMPR0. |

## Counter/Timer Interrupts: Set

**INSTANCE 0 ADDRESS: 0x4000820C**

|             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 3           | 3           | 2           | 2           | 2           | 2           | 2           | 2           | 2           | 2           | 2           | 2           | 1           | 1           | 1           | 1           | 1           | 1           | 1           | 1           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           |             |             |
| 1           | 0           | 9           | 8           | 7           | 6           | 5           | 4           | 3           | 2           | 1           | 0           | 9           | 8           | 7           | 6           | 5           | 4           | 3           | 2           | 1           | 0           | 9           | 8           | 7           | 6           | 5           | 4           | 3           | 2           | 1           | 0           |
| CTMRB7C1INT | CTMRA7C1INT | CTMRB6C1INT | CTMRA6C1INT | CTMRB5C1INT | CTMRA5C1INT | CTMRB4C1INT | CTMRA4C1INT | CTMRB3C1INT | CTMRA3C1INT | CTMRB2C1INT | CTMRA2C1INT | CTMRB1C1INT | CTMRA1C1INT | CTMRB0C1INT | CTMRA0C1INT | CTMRB7C0INT | CTMRA7C0INT | CTMRB6C0INT | CTMRA6C0INT | CTMRB5C0INT | CTMRA5C0INT | CTMRB4C0INT | CTMRA4C0INT | CTMRB3C0INT | CTMRA3C0INT | CTMRB2C0INT | CTMRA2C0INT | CTMRB1C0INT | CTMRA1C0INT | CTMRB0C0INT | CTMRA0C0INT |

| Bit | Name        | Reset | RW | Description                                |
|-----|-------------|-------|----|--------------------------------------------|
| 31  | CTMRB7C1INT | 0x0   | RW | Counter/Timer B7 interrupt based on COMP1. |
| 30  | CTMRA7C1INT | 0x0   | RW | Counter/Timer A7 interrupt based on COMP1. |
| 29  | CTMRB6C1INT | 0x0   | RW | Counter/Timer B6 interrupt based on COMP1. |
| 28  | CTMRA6C1INT | 0x0   | RW | Counter/Timer A6 interrupt based on COMP1. |
| 27  | CTMRB5C1INT | 0x0   | RW | Counter/Timer B5 interrupt based on COMP1. |
| 26  | CTMRA5C1INT | 0x0   | RW | Counter/Timer A5 interrupt based on COMP1. |
| 25  | CTMRB4C1INT | 0x0   | RW | Counter/Timer B4 interrupt based on COMP1. |
| 24  | CTMRA4C1INT | 0x0   | RW | Counter/Timer A4 interrupt based on COMP1. |
| 23  | CTMRB3C1INT | 0x0   | RW | Counter/Timer B3 interrupt based on COMP1. |
| 22  | CTMRA3C1INT | 0x0   | RW | Counter/Timer A3 interrupt based on COMP1. |

Table 948: INTSET Register Bits

| Bit | Name        | Reset | RW | Description                                 |
|-----|-------------|-------|----|---------------------------------------------|
| 21  | CTMRB2C1INT | 0x0   | RW | Counter/Timer B2 interrupt based on COMPR1. |
| 20  | CTMRA2C1INT | 0x0   | RW | Counter/Timer A2 interrupt based on COMPR1. |
| 19  | CTMRB1C1INT | 0x0   | RW | Counter/Timer B1 interrupt based on COMPR1. |
| 18  | CTMRA1C1INT | 0x0   | RW | Counter/Timer A1 interrupt based on COMPR1. |
| 17  | CTMRB0C1INT | 0x0   | RW | Counter/Timer B0 interrupt based on COMPR1. |
| 16  | CTMRA0C1INT | 0x0   | RW | Counter/Timer A0 interrupt based on COMPR1. |
| 15  | CTMRB7C0INT | 0x0   | RW | Counter/Timer B7 interrupt based on COMPR0. |
| 14  | CTMRA7C0INT | 0x0   | RW | Counter/Timer A7 interrupt based on COMPR0. |
| 13  | CTMRB6C0INT | 0x0   | RW | Counter/Timer B6 interrupt based on COMPR0. |
| 12  | CTMRA6C0INT | 0x0   | RW | Counter/Timer A6 interrupt based on COMPR0. |
| 11  | CTMRB5C0INT | 0x0   | RW | Counter/Timer B5 interrupt based on COMPR0. |
| 10  | CTMRA5C0INT | 0x0   | RW | Counter/Timer A5 interrupt based on COMPR0. |
| 9   | CTMRB4C0INT | 0x0   | RW | Counter/Timer B4 interrupt based on COMPR0. |
| 8   | CTMRA4C0INT | 0x0   | RW | Counter/Timer A4 interrupt based on COMPR0. |
| 7   | CTMRB3C0INT | 0x0   | RW | Counter/Timer B3 interrupt based on COMPR0. |
| 6   | CTMRA3C0INT | 0x0   | RW | Counter/Timer A3 interrupt based on COMPR0. |
| 5   | CTMRB2C0INT | 0x0   | RW | Counter/Timer B2 interrupt based on COMPR0. |
| 4   | CTMRA2C0INT | 0x0   | RW | Counter/Timer A2 interrupt based on COMPR0. |
| 3   | CTMRB1C0INT | 0x0   | RW | Counter/Timer B1 interrupt based on COMPR0. |
| 2   | CTMRA1C0INT | 0x0   | RW | Counter/Timer A1 interrupt based on COMPR0. |
| 1   | CTMRB0C0INT | 0x0   | RW | Counter/Timer B0 interrupt based on COMPR0. |
| 0   | CTMRA0C0INT | 0x0   | RW | Counter/Timer A0 interrupt based on COMPR0. |

## 14. System Timer Module

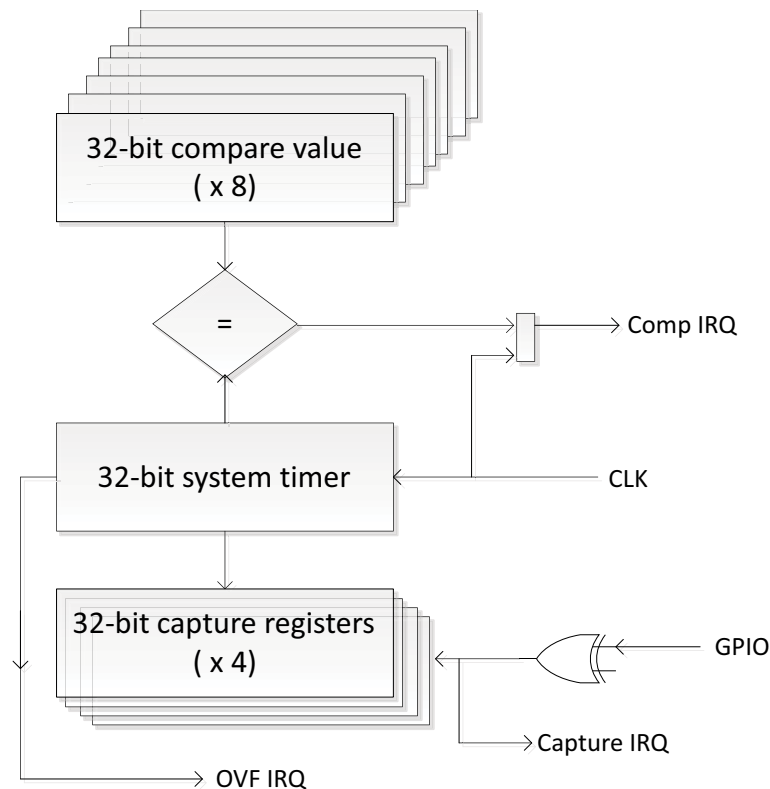


**Figure 83. Block Diagram for the System Timer**

### 14.1 Functional Overview

The Apollo3 Blue SoC System Timer (STIMER), shown above in Figure 83, tracks the global synchronized counter. It can be used for RTOS scheduling and real-time system tracking. This timer is provided in addition to the other timer peripherals to enable software/firmware to have a simple, globally synchronized timer source.

The System Timer (STIMER) Module provides real time measurement for all task scheduling, sensor sample rate calibration, and tracking of real time and calendar maintenance. Key features are:

- 32-bit binary counter used for RTOS scheduling decisions.
- Eight 32-bit compare and interrupt registers to facilitate light weight scheduling (designs without RTOS).
- Accurate scheduling of comparator interrupts
- Only offsets from “NOW” are written to comparator registers.
- Maintains real time epoch for applications.
- Overflow interrupt to allow firmware to keep the extended part (more than 32-bits) of real time epoch.
- Time stamping hardware for multiple sensor streams (4 capture registers).
- Firmware handling of odd calculations such as Leap Second. It also handles things like surprise/legislated changes to the daylight savings time transition dates.
- Firmware handling of 1024 versus 1000 scaling of real time conversions.



- Only reset by POA (Power On Analog - system cold reset) so that it retains time across all POI and POR (system warm reset) events except full power cycles.
- Contains three 32-bit NVRAM registers that are only reset by POA to maintain real time offset from epoch.

The heart of the STIMER is a single 32-bit counter that keeps track of current time for the application running on the Apollo3 Blue SoC. This counter is reset at the actual power cycle reset of the SoC. It is generally never reset or changed again. Up to eight 32-bit comparator registers can be loaded each of which can generate an interrupt signal to the NVIC. Comparators A through H generate interrupt A through H while capture registers A through D and the overflow event generate interrupt I, all the way to the NVIC. Thus the scheduler can run these 9 interrupts at different priorities in the NVIC.

The comparator interrupts are each used to schedule a function (task) to run for the application. Thus these tasks run on interrupt levels at priorities lower than the I/O interrupts. The overflow interrupt allows firmware to keep track of real time beyond that maintained in the 32-bit timer.

#### NOTE

In Apollo3 Blue SoC silicon revision B0, there is capability to enable an STIMER capture/compare event to trigger a GPIO transition primarily for system synchronization without CPU involvement. The CTIMER is used to enable this linkage between an STIMER event and GPIO action by accepting a CTIMER interrupt request as a trigger for one of its timers. To implement this, the CTIMER must be configured to have the two channels of either CTIMER4 or CTIMER5 linked to form a 32-bit timer (CTIMER\_CTRLn\_CTLINKn = 1, n = 4 or 5 only), making the CTIMER\_AUXn\_TMRBnTRIG field unused for setting a trigger. In this configuration:

- if the CTIMER\_AUXn\_TMRBnTRIG field is set to 0 (default), then the timer uses the selected CTIMER trigger source as specified in the CTIMER\_AUXn\_TMRAnTRIG field.
- If the CTIMER\_AUXn\_TMRBnTRIG field is set to anything but 0, and the CTIMER\_AUXn\_TMRAnTRIG field is set to 1, then the timer uses the selected STIMER interrupt as specified in the CTIMER\_AUXn\_TMRBnTRIG field as the trigger source, where valid settings in the CTIMER\_AUXn\_TMRBnTRIG field are 0x4-0xF.

When the two timer channels are *not* linked for 32-bit timer operation (CTIMER\_AUXn\_TMRAnTRIG = 0) and channel B is used as a 16-bit timer, then the STIMER settings in the CTIMER\_AUXn\_TMRBnTRIG field (0x4-0xF) are not valid selections as a trigger for timer channel B.

## 14.2 STIMER Registers

### System Timer

**INSTANCE 0 BASE ADDRESS:**0x40008000

The System Timer block contains a 32-bit counter for system timer functions. This counter is the source for timestamping events when performing capture or compare functions.

### 14.2.1 Register Memory Map

**Table 949: STIMER Register Map**

| Address(s) | Register Name  | Description                            |
|------------|----------------|----------------------------------------|
| 0x40008140 | STCFG          | ST Configuration                       |
| 0x40008144 | STTMR          | System Timer Count (Real Time Counter) |
| 0x40008148 | CAPTURECONTROL | Capture Control                        |
| 0x40008150 | SCMPR0         | Compare A                              |
| 0x40008154 | SCMPR1         | Compare B                              |
| 0x40008158 | SCMPR2         | Compare C                              |
| 0x4000815C | SCMPR3         | Compare D                              |
| 0x40008160 | SCMPR4         | Compare E                              |
| 0x40008164 | SCMPR5         | Compare F                              |
| 0x40008168 | SCMPR6         | Compare G                              |
| 0x4000816C | SCMPR7         | Compare H                              |
| 0x400081E0 | SCAPT0         | Capture A                              |
| 0x400081E4 | SCAPT1         | Capture B                              |
| 0x400081E8 | SCAPT2         | Capture C                              |
| 0x400081EC | SCAPT3         | Capture D                              |
| 0x400081F0 | SNVR0          | System Timer NVRAM_A                   |
| 0x400081F4 | SNVR1          | System Timer NVRAM_B                   |
| 0x400081F8 | SNVR2          | System Timer NVRAM_C                   |
| 0x400081FC | SNVR3          | System Timer NVRAM_D                   |
| 0x40008300 | STMINTEN       | STIMER Interrupts: Enable              |
| 0x40008304 | STMINTSTAT     | STIMER Interrupts: Status              |
| 0x40008308 | STMINTCLR      | STIMER Interrupts: Clear               |
| 0x4000830C | STMINTSET      | STIMER Interrupts: Set                 |

## 14.2.2 STIMER Registers

### 14.2.2.1 STCFG Register

#### ST Configuration

**OFFSET:** 0x00000140

**INSTANCE 0 ADDRESS:** 0x40008140

The STIMER Configuration Register contains the software control for selecting the clock divider and source feeding the system timer.

**Table 950: STCFG Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |              |              |              |              |              |              |              |              |        |        |        |        |        |        |        |        |  |  |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5       | 1<br>4       | 1<br>3       | 1<br>2       | 1<br>1       | 1<br>0       | 0<br>9       | 0<br>8       | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |  |  |
| FREEZE | CLEAR  | RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        | COMPARE_H_EN | COMPARE_G_EN | COMPARE_F_EN | COMPARE_E_EN | COMPARE_D_EN | COMPARE_C_EN | COMPARE_B_EN | COMPARE_A_EN | RSVD   |        |        |        |        | CLKSEL |        |        |  |  |

**Table 951: STCFG Register Bits**

| Bit   | Name         | Reset | RW | Description                                                                                                                                                                                                                                                                                                                  |
|-------|--------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31    | FREEZE       | 0x1   | RW | Set this bit to one to freeze the clock input to the COUNTER register. Once frozen, the value can be safely written from the MCU. Unfreeze to resume.<br><br>THAW = 0x0 - Let the COUNTER register run on its input clock.<br>FREEZE = 0x1 - Stop the COUNTER register for loading.                                          |
| 30    | CLEAR        | 0x0   | RW | Set this bit to one to clear the System Timer register. If this bit is set to '1', the system timer register will stay cleared. It needs to be set to '0' for the system timer to start running.<br><br>RUN = 0x0 - Let the COUNTER register run on its input clock.<br>CLEAR = 0x1 - Stop the COUNTER register for loading. |
| 29:16 | RSVD         | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                    |
| 15    | COMPARE_H_EN | 0x0   | RW | Selects whether compare is enabled for the corresponding SCMPR register. If compare is enabled, the interrupt status is set once the comparison is met.<br><br>DISABLE = 0x0 - Compare H disabled.<br>ENABLE = 0x1 - Compare H enabled.                                                                                      |
| 14    | COMPARE_G_EN | 0x0   | RW | Selects whether compare is enabled for the corresponding SCMPR register. If compare is enabled, the interrupt status is set once the comparison is met.<br><br>DISABLE = 0x0 - Compare G disabled.<br>ENABLE = 0x1 - Compare G enabled.                                                                                      |

**Table 951: STCFG Register Bits**

| Bit | Name          | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----|---------------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13  | COM-PARE_F_EN | 0x0   | RW | Selects whether compare is enabled for the corresponding SCMPR register. If compare is enabled, the interrupt status is set once the comparison is met.<br><br>DISABLE = 0x0 - Compare F disabled.<br>ENABLE = 0x1 - Compare F enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 12  | COM-PARE_E_EN | 0x0   | RW | Selects whether compare is enabled for the corresponding SCMPR register. If compare is enabled, the interrupt status is set once the comparison is met.<br><br>DISABLE = 0x0 - Compare E disabled.<br>ENABLE = 0x1 - Compare E enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 11  | COM-PARE_D_EN | 0x0   | RW | Selects whether compare is enabled for the corresponding SCMPR register. If compare is enabled, the interrupt status is set once the comparison is met.<br><br>DISABLE = 0x0 - Compare D disabled.<br>ENABLE = 0x1 - Compare D enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 10  | COM-PARE_C_EN | 0x0   | RW | Selects whether compare is enabled for the corresponding SCMPR register. If compare is enabled, the interrupt status is set once the comparison is met.<br><br>DISABLE = 0x0 - Compare C disabled.<br>ENABLE = 0x1 - Compare C enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 9   | COM-PARE_B_EN | 0x0   | RW | Selects whether compare is enabled for the corresponding SCMPR register. If compare is enabled, the interrupt status is set once the comparison is met.<br><br>DISABLE = 0x0 - Compare B disabled.<br>ENABLE = 0x1 - Compare B enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 8   | COM-PARE_A_EN | 0x0   | RW | Selects whether compare is enabled for the corresponding SCMPR register. If compare is enabled, the interrupt status is set once the comparison is met.<br><br>DISABLE = 0x0 - Compare A disabled.<br>ENABLE = 0x1 - Compare A enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 7:4 | RSVD          | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 3:0 | CLKSEL        | 0x0   | RW | Selects an appropriate clock source and divider to use for the System Timer clock.<br><br>NOCLK = 0x0 - No clock enabled.<br>HFRC_DIV16 = 0x1 - 3MHz from the HFRC clock divider.<br>HFRC_DIV256 = 0x2 - 187.5KHz from the HFRC clock divider.<br>XTAL_DIV1 = 0x3 - 32768Hz from the crystal oscillator.<br>XTAL_DIV2 = 0x4 - 16384Hz from the crystal oscillator.<br>XTAL_DIV32 = 0x5 - 1024Hz from the crystal oscillator.<br>LFRC_DIV1 = 0x6 - Approximately 1KHz from the LFRC oscillator (uncalibrated).<br>CTIMER0A = 0x7 - Use CTIMER 0 section A as a prescaler for the clock source.<br>CTIMER0B = 0x8 - Use CTIMER 0 section B (or A and B linked together) as a prescaler for the clock source. |

**14.2.2.2 STTMR Register****System Timer Count (Real Time Counter)****OFFSET:** 0x00000144**INSTANCE 0 ADDRESS:** 0x40008144



| Bit | Name     | Reset | RW | Description                                                                                                                                                          |
|-----|----------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2   | CAPTURE2 | 0x0   | RW | Selects whether capture is enabled for the specified capture register.<br><br>DISABLE = 0x0 - Capture function disabled.<br>ENABLE = 0x1 - Capture function enabled. |
| 1   | CAPTURE1 | 0x0   | RW | Selects whether capture is enabled for the specified capture register.<br><br>DISABLE = 0x0 - Capture function disabled.<br>ENABLE = 0x1 - Capture function enabled. |
| 0   | CAPTURE0 | 0x0   | RW | Selects whether capture is enabled for the specified capture register.<br><br>DISABLE = 0x0 - Capture function disabled.<br>ENABLE = 0x1 - Capture function enabled. |

## Compare A

**INSTANCE 0 ADDRESS: 0x40008150**

The VALUE in this bit field is used to compare against the VALUE in the COUNTER register. If the match criterion in the configuration register is met then a corresponding interrupt status bit is set. The match criterion is defined as COUNTER equal to COMPARE. To establish a desired value in this COMPARE register, write the number of ticks in the future to this register to indicate when to interrupt. The hardware does the addition to the COUNTER value in the STIMER clock domain so that the math is precise. Reading this register shows the COUNTER value at which this interrupt will occur.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SCMPR0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                     |
|------|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SCMPR0 | 0x0   | RW | Compare this value to the value in the COUNTER register according to the match criterion, as selected in the COMPARE_A_EN bit in the REG_CTIMER_STCGF register. |

### Compare B

**INSTANCE 0 ADDRESS: 0x40008154**



| Bit  | Name   | Reset | RW | Description                                                                                                                                                     |
|------|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SCMPR2 | 0x0   | RW | Compare this value to the value in the COUNTER register according to the match criterion, as selected in the COMPARE_C_EN bit in the REG_CTIMER_STCGF register. |

## Compare D

**INSTANCE 0 ADDRESS: 0x4000815C**

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SCMPR3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                     |
|------|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SCMPR3 | 0x0   | RW | Compare this value to the value in the COUNTER register according to the match criterion, as selected in the COMPARE_D_EN bit in the REG_CTIMER_STCGF register. |

### Compare E

**INSTANCE 0 ADDRESS: 0x40008160**



|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SCMPR4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                     |
|------|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SCMPR4 | 0x0   | RW | Compare this value to the value in the COUNTER register according to the match criterion, as selected in the COMPARE_E_EN bit in the REG_CTIMER_STCGF register. |

## Compare F

**INSTANCE 0 ADDRESS: 0x40008164**

The **VALUE** in this bit field is used to compare against the **VALUE** in the **COUNTER** register. If the match criterion in the configuration register is met then a corresponding interrupt status bit is set. The match criterion is defined as **COUNTER** equal to **COMPARE**. To establish a desired value in this **COMPARE** register, write the number of ticks in the future to this register to indicate when to interrupt. The hardware does the addition to the **COUNTER** value in the **STIMER** clock domain so that the math is precise. Reading this register shows the **COUNTER** value at which this interrupt will occur.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SCMPR5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                     |
|------|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SCMPR5 | 0x0   | RW | Compare this value to the value in the COUNTER register according to the match criterion, as selected in the COMPARE_F_EN bit in the REG_CTIMER_STCGF register. |

## Compare G

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| Bit  | Name   | Reset | RW | Description                                                                                                                                                     |
|------|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SCMPR7 | 0x0   | RW | Compare this value to the value in the COUNTER register according to the match criterion, as selected in the COMPARE_H_EN bit in the REG_CTIMER_STCGF register. |

The STIMER Capture Register A grabs the VALUE in the COUNTER register whenever capture condition (event) A is asserted. This register holds a time stamp for the event.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SCAPT0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                                                                                                                              |
|------|--------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SCAPT0 | 0x0   | RO | Whenever the event is detected, the value in the COUNTER is copied into this register and the corresponding interrupt status bit is set. |

The STIMER Capture Register B grabs the VALUE in the COUNTER register whenever capture condition (event) B is asserted. This register holds a time stamp for the event.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 |   |
| SCAPT1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                                                                                                                              |
|------|--------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SCAPT1 | 0x0   | RO | Whenever the event is detected, the value in the COUNTER is copied into this register and the corresponding interrupt status bit is set. |

The STIMER Capture Register C grabs the VALUE in the COUNTER register whenever capture condition (event) C is asserted. This register holds a time stamp for the event.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SCAPT2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                                                                                                                              |
|------|--------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SCAPT2 | 0x0   | RO | Whenever the event is detected, the value in the COUNTER is copied into this register and the corresponding interrupt status bit is set. |

The STIMER Capture Register D grabs the VALUE in the COUNTER register whenever capture condition (event) D is asserted. This register holds a time stamp for the event.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 |   |
| SCAPT3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset | RW | Description                                                                                                                              |
|------|--------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SCAPT3 | 0x0   | RO | Whenever the event is detected, the value in the COUNTER is copied into this register and the corresponding interrupt status bit is set. |

The NVRAM\_A Register contains a portion of the stored epoch offset associated with the time in the COUNTER register. This register is only reset by POI not by HRESETn. Its contents are intended to survive all reset level except POI and full power cycles.

|       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SNVR0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name  | Reset | RW | Description                                   |
|------|-------|-------|----|-----------------------------------------------|
| 31:0 | SNVR0 | 0x0   | RW | Value of the 32-bit counter as it ticks over. |

**INSTANCE 0 ADDRESS: 0x400081F4**

The NVRAM\_B Register contains a portion of the stored epoch offset associated with the time in the COUNTER register. This register is only reset by POI not by HRESETn. Its contents are intended to survive all reset level except POI and full power cycles.

|       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SNVR1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name  | Reset | RW | Description                                   |
|------|-------|-------|----|-----------------------------------------------|
| 31:0 | SNVR1 | 0x0   | RW | Value of the 32-bit counter as it ticks over. |

## System Timer NVRAM\_C

**INSTANCE 0 ADDRESS: 0x400081F8**

The NVRAM\_C Register contains a portion of the stored epoch offset associated with the time in the COUNTER register. This register is only reset by POI not by HRESETn. Its contents are intended to survive all reset level except POI and full power cycles.

|       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 |
| SNVR2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name  | Reset | RW | Description                                   |
|------|-------|-------|----|-----------------------------------------------|
| 31:0 | SNVR2 | 0x0   | RW | Value of the 32-bit counter as it ticks over. |

## System Timer NVRAM\_D

**INSTANCE 0 ADDRESS: 0x400081FC**

The NVRAM\_D Register contains a portion of the stored epoch offset associated with the time in the COUNTER register. This register is only reset by POI not by HRESETn. Its contents are intended to survive all reset level except POI and full power cycles.

|       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SNVR3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name  | Reset | RW | Description                                   |
|------|-------|-------|----|-----------------------------------------------|
| 31:0 | SNVR3 | 0x0   | RW | Value of the 32-bit counter as it ticks over. |

## STIMER Interrupts: Enable

**INSTANCE 0 ADDRESS: 0x40008300**

Set bits in this register to allow this module to generate the corresponding interrupt.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |          |          |          |          |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1   | 1<br>0   | 0<br>9   | 0<br>8   | 0<br>7   | 0<br>6   | 0<br>5   | 0<br>4   | 0<br>3   | 0<br>2   | 0<br>1   | 0<br>0   |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CAPTURED | CAPTUREC | CAPTUREB | CAPTUREA | OVERFLOW | COMPAREH | COMPAREG | COMPAREF | COMPAREE | COMPARED | COMPAREC | COMPAREB | COMPAREA |

| Bit   | Name     | Reset | RW | Description                                                                                                                    |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------|
| 31:13 | RSVD     | 0x0   | RO | RESERVED.                                                                                                                      |
| 12    | CAPTURED | 0x0   | RW | CAPTURE register D has grabbed the value in the counter<br>CAPD_INT = 0x1 - Capture D interrupt status bit was set.            |
| 11    | CAPTUREC | 0x0   | RW | CAPTURE register C has grabbed the value in the counter<br>CAPC_INT = 0x1 - CAPTURE C interrupt status bit was set.            |
| 10    | CAPTUREB | 0x0   | RW | CAPTURE register B has grabbed the value in the counter<br>CAPB_INT = 0x1 - CAPTURE B interrupt status bit was set.            |
| 9     | CAPTUREA | 0x0   | RW | CAPTURE register A has grabbed the value in the counter<br>CAPA_INT = 0x1 - CAPTURE A interrupt status bit was set.            |
| 8     | OVERFLOW | 0x0   | RW | COUNTER over flowed from 0xFFFFFFFF back to 0x00000000.<br>OFLOW_INT = 0x1 - Overflow interrupt status bit was set.            |
| 7     | COMPAREH | 0x0   | RW | COUNTER is greater than or equal to COMPARE register H.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |

**Table 989: STMINTEN Register Bits**

| Bit | Name     | Reset | RW | Description                                                                                                                    |
|-----|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------|
| 6   | COMPAREG | 0x0   | RW | COUNTER is greater than or equal to COMPARE register G.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 5   | COMPAREF | 0x0   | RW | COUNTER is greater than or equal to COMPARE register F.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 4   | COMPAREE | 0x0   | RW | COUNTER is greater than or equal to COMPARE register E.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 3   | COMPARED | 0x0   | RW | COUNTER is greater than or equal to COMPARE register D.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 2   | COMPAREC | 0x0   | RW | COUNTER is greater than or equal to COMPARE register C.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 1   | COMPAREB | 0x0   | RW | COUNTER is greater than or equal to COMPARE register B.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 0   | COMPAREA | 0x0   | RW | COUNTER is greater than or equal to COMPARE register A.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |

**14.2.2.21 STMINTSTAT Register****STIMER Interrupts: Status****OFFSET:** 0x00000304**INSTANCE 0 ADDRESS:** 0x40008304

Read bits from this register to discover the cause of a recent interrupt.

**Table 990: STMINTSTAT Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |          |          |          |          |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1   | 1<br>0   | 0<br>9   | 0<br>8   | 0<br>7   | 0<br>6   | 0<br>5   | 0<br>4   | 0<br>3   | 0<br>2   | 0<br>1   | 0<br>0   |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CAPTURED | CAPTUREC | CAPTUREB | CAPTUREA | OVERFLOW | COMPAREH | COMPAREG | COMPAREF | COMPAREE | COMPARED | COMPAREC | COMPAREB | COMPAREA |



Table 991: STMINTSTAT Register Bits

| Bit   | Name     | Reset | RW | Description                                                                                                                    |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------|
| 31:13 | RSVD     | 0x0   | RO | RESERVED.                                                                                                                      |
| 12    | CAPTURED | 0x0   | RW | CAPTURE register D has grabbed the value in the counter<br>CAPD_INT = 0x1 - Capture D interrupt status bit was set.            |
| 11    | CAPTUREC | 0x0   | RW | CAPTURE register C has grabbed the value in the counter<br>CAPC_INT = 0x1 - CAPTURE C interrupt status bit was set.            |
| 10    | CAPTUREB | 0x0   | RW | CAPTURE register B has grabbed the value in the counter<br>CAPB_INT = 0x1 - CAPTURE B interrupt status bit was set.            |
| 9     | CAPTUREA | 0x0   | RW | CAPTURE register A has grabbed the value in the counter<br>CAPA_INT = 0x1 - CAPTURE A interrupt status bit was set.            |
| 8     | OVERFLOW | 0x0   | RW | COUNTER over flowed from 0xFFFFFFFF back to 0x00000000.<br>OFLOW_INT = 0x1 - Overflow interrupt status bit was set.            |
| 7     | COMPAREH | 0x0   | RW | COUNTER is greater than or equal to COMPARE register H.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 6     | COMPAREG | 0x0   | RW | COUNTER is greater than or equal to COMPARE register G.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 5     | COMPAREF | 0x0   | RW | COUNTER is greater than or equal to COMPARE register F.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 4     | COMPAREE | 0x0   | RW | COUNTER is greater than or equal to COMPARE register E.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 3     | COMPARED | 0x0   | RW | COUNTER is greater than or equal to COMPARE register D.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 2     | COMPAREC | 0x0   | RW | COUNTER is greater than or equal to COMPARE register C.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 1     | COMPAREB | 0x0   | RW | COUNTER is greater than or equal to COMPARE register B.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 0     | COMPAREA | 0x0   | RW | COUNTER is greater than or equal to COMPARE register A.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |

**14.2.2.22 STMINTCLR Register****STIMER Interrupts: Clear****OFFSET:** 0x00000308**INSTANCE 0 ADDRESS:** 0x40008308

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

**Table 992: STMINTCLR Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |          |          |          |          |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1   | 1<br>0   | 0<br>9   | 0<br>8   | 0<br>7   | 0<br>6   | 0<br>5   | 0<br>4   | 0<br>3   | 0<br>2   | 0<br>1   | 0<br>0   |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CAPTURED | CAPTUREC | CAPTUREB | CAPTUREA | OVERFLOW | COMPAREH | COMPAREG | COMPAREF | COMPAREE | COMPARED | COMPAREC | COMPAREB | COMPAREA |

**Table 993: STMINTCLR Register Bits**

| Bit   | Name     | Reset | RW | Description                                                                                                                    |
|-------|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------|
| 31:13 | RSVD     | 0x0   | RO | RESERVED.                                                                                                                      |
| 12    | CAPTURED | 0x0   | RW | CAPTURE register D has grabbed the value in the counter<br>CAPD_INT = 0x1 - Capture D interrupt status bit was set.            |
| 11    | CAPTUREC | 0x0   | RW | CAPTURE register C has grabbed the value in the counter<br>CAPC_INT = 0x1 - CAPTURE C interrupt status bit was set.            |
| 10    | CAPTUREB | 0x0   | RW | CAPTURE register B has grabbed the value in the counter<br>CAPB_INT = 0x1 - CAPTURE B interrupt status bit was set.            |
| 9     | CAPTUREA | 0x0   | RW | CAPTURE register A has grabbed the value in the counter<br>CAPA_INT = 0x1 - CAPTURE A interrupt status bit was set.            |
| 8     | OVERFLOW | 0x0   | RW | COUNTER over flowed from 0xFFFFFFFF back to 0x00000000.<br>OFLOW_INT = 0x1 - Overflow interrupt status bit was set.            |
| 7     | COMPAREH | 0x0   | RW | COUNTER is greater than or equal to COMPARE register H.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 6     | COMPAREG | 0x0   | RW | COUNTER is greater than or equal to COMPARE register G.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 5     | COMPAREF | 0x0   | RW | COUNTER is greater than or equal to COMPARE register F.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |

| Bit | Name     | Reset | RW | Description                                                                                                                    |
|-----|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------|
| 4   | COMPAREE | 0x0   | RW | COUNTER is greater than or equal to COMPARE register E.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 3   | COMPARED | 0x0   | RW | COUNTER is greater than or equal to COMPARE register D.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 2   | COMPAREC | 0x0   | RW | COUNTER is greater than or equal to COMPARE register C.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 1   | COMPAREB | 0x0   | RW | COUNTER is greater than or equal to COMPARE register B.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 0   | COMPAREA | 0x0   | RW | COUNTER is greater than or equal to COMPARE register A.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |

## STIMER Interrupts: Set

**INSTANCE 0 ADDRESS: 0x4000830C**

Write a 1 to a bit in this register to instantly generate an interrupt from this module. (Generally used for testing purposes).

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |          |          |          |          |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2   | 1<br>1   | 1<br>0   | 0<br>9   | 0<br>8   | 0<br>7   | 0<br>6   | 0<br>5   | 0<br>4   | 0<br>3   | 0<br>2   | 0<br>1   | 0<br>0   |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CAPTURED | CAPTUREC | CAPTUREB | CAPTUREA | OVERFLOW | COMPAREH | COMPAREG | COMPAREF | COMPAREE | COMPARED | COMPAREC | COMPAREB | COMPAREA |

| Bit   | Name     | Reset | RW | Description                                                                                                         |
|-------|----------|-------|----|---------------------------------------------------------------------------------------------------------------------|
| 31:13 | RSVD     | 0x0   | RO | RESERVED.                                                                                                           |
| 12    | CAPTURED | 0x0   | RW | CAPTURE register D has grabbed the value in the counter<br>CAPD_INT = 0x1 - Capture D interrupt status bit was set. |

**Table 995: STMINTSET Register Bits**

| Bit | Name     | Reset | RW | Description                                                                                                                    |
|-----|----------|-------|----|--------------------------------------------------------------------------------------------------------------------------------|
| 11  | CAPTUREC | 0x0   | RW | CAPTURE register C has grabbed the value in the counter<br>CAPC_INT = 0x1 - CAPTURE C interrupt status bit was set.            |
| 10  | CAPTUREB | 0x0   | RW | CAPTURE register B has grabbed the value in the counter<br>CAPB_INT = 0x1 - CAPTURE B interrupt status bit was set.            |
| 9   | CAPTUREA | 0x0   | RW | CAPTURE register A has grabbed the value in the counter<br>CAPA_INT = 0x1 - CAPTURE A interrupt status bit was set.            |
| 8   | OVERFLOW | 0x0   | RW | COUNTER over flowed from 0xFFFFFFFF back to 0x00000000.<br>OFLOW_INT = 0x1 - Overflow interrupt status bit was set.            |
| 7   | COMPAREH | 0x0   | RW | COUNTER is greater than or equal to COMPARE register H.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 6   | COMPAREG | 0x0   | RW | COUNTER is greater than or equal to COMPARE register G.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 5   | COMPAREF | 0x0   | RW | COUNTER is greater than or equal to COMPARE register F.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 4   | COMPAREE | 0x0   | RW | COUNTER is greater than or equal to COMPARE register E.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 3   | COMPARED | 0x0   | RW | COUNTER is greater than or equal to COMPARE register D.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 2   | COMPAREC | 0x0   | RW | COUNTER is greater than or equal to COMPARE register C.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 1   | COMPAREB | 0x0   | RW | COUNTER is greater than or equal to COMPARE register B.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |
| 0   | COMPAREA | 0x0   | RW | COUNTER is greater than or equal to COMPARE register A.<br>COMPARED = 0x1 - COUNTER greater than or equal to COMPARE register. |

## 15. Watchdog Timer Module

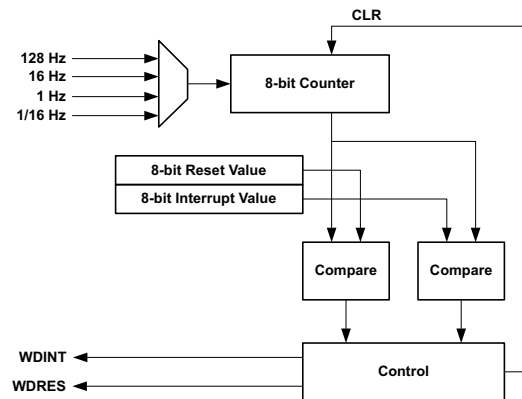


Figure 84. Block Diagram for the Watchdog Timer Module

### 15.1 Functional Overview

The Watchdog Timer (WDT), shown in Figure 84, is used to ensure that software is operational, by resetting the Apollo3 Blue SoC if the WDT reaches a configurable value before being cleared by software. The WDT can be clocked by one of four selectable prescalers of the always active low-power LFRC clock, but is nominally clocked at 128 Hz. The WDT may be locked to ensure that software cannot disable its functionality, in which case the WDTCFG register cannot be updated. An interrupt can also be generated at a different counter value to implement an early warning function.

#### NOTE

The RESEN bit in the WDTCFG register must be set and the WDREN bit in the RSTCFG register must be set to enable a watchdog timer reset condition.

### 15.2 WDT Registers

#### Watchdog Timer

INSTANCE 0 BASE ADDRESS:0x40024000

### 15.2.1 Register Memory Map

**Table 996: WDT Register Map**

| Address(s) | Register Name | Description                   |
|------------|---------------|-------------------------------|
| 0x40024000 | CFG           | Configuration                 |
| 0x40024004 | RSTRT         | Restart the watchdog timer.   |
| 0x40024008 | LOCK          | Locks the WDT                 |
| 0x4002400C | COUNT         | Current Counter Value for WDT |
| 0x40024200 | INTEN         | WDT Interrupt: Enable         |
| 0x40024204 | INTSTAT       | WDT Interrupt: Status         |
| 0x40024208 | INTCLR        | WDT Interrupt: Clear          |
| 0x4002420C | INTSET        | WDT Interrupt: Set            |

## 15.2.2 WDT Registers

### 15.2.2.1 CFG Register

#### Configuration

**OFFSET:** 0x00000000

**INSTANCE 0 ADDRESS:** 0x40024000

This is the configuration register for the watch dog timer. It controls the enable, interrupt set, clocks for the timer, the compare values for the counters to trigger a reset or interrupt. This register can only be written to if the watch dog timer is unlocked (WDTLOCK is not set).

**Table 997: CFG Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        | CLKSEL |        | INTVAL |        |        |        |        |        | RESVAL |        |        |        |        |        | RSVD   |        |        |        | RESEN  | INTEN  | WDTEN  |        |        |        |        |        |        |        |

**Table 998: CFG Register Bits**

| Bit   | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                  |
|-------|--------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:27 | RSVD   | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                                                                                                   |
| 26:24 | CLKSEL | 0x0   | RW | Select the frequency for the WDT. All values not enumerated below are undefined.<br><br>OFF = 0x0 - Low Power Mode. This setting disables the watch dog timer.<br>128HZ = 0x1 - 128 Hz LFRC clock.<br>16HZ = 0x2 - 16 Hz LFRC clock.<br>1HZ = 0x3 - 1 Hz LFRC clock.<br>1_16HZ = 0x4 - 1/16th Hz LFRC clock. |
| 23:16 | INTVAL | 0xff  | RW | This bit field is the compare value for counter bits 7:0 to generate a watch-dog interrupt.                                                                                                                                                                                                                  |
| 15:8  | RESVAL | 0xff  | RW | This bit field is the compare value for counter bits 7:0 to generate a watch-dog reset. This will cause a software reset.                                                                                                                                                                                    |
| 7:3   | RSVD   | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                                                                                                   |
| 2     | RESEN  | 0x0   | RW | This bit field enables the WDT reset. This needs to be set together with the WDREN bit in REG_RSTGEN_CFG register (in reset gen) to trigger the reset.                                                                                                                                                       |
| 1     | INTEN  | 0x0   | RW | This bit field enables the WDT interrupt. Note : This bit must be set before the interrupt status bit will reflect a watchdog timer expiration. The IER interrupt register must also be enabled for a WDT interrupt to be sent to the NVIC.                                                                  |

Table 998: CFG Register Bits

| Bit | Name  | Reset | RW | Description                     |
|-----|-------|-------|----|---------------------------------|
| 0   | WDTEN | 0x0   | RW | This bit field enables the WDT. |

**15.2.2.2 RSTRT Register**

Restart the watchdog timer.

OFFSET: 0x00000004

INSTANCE 0 ADDRESS: 0x40024004

This register will Restart the watchdog timer. Writing a special key value into this register will result in the watch dog timer being reset, so that the count will start again. It is expected that the software will periodically write to this register to indicate that the system is functional. The watch dog timer can continue running when the system is in deep sleep, and the interrupt will trigger the wake. After the wake, the core can reset the watch dog timer.

Table 999: RSTRT Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0     | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | RSTRT |   |   |   |   |   |   |   |   |   |   |

Table 1000: RSTRT Register Bits

| Bit  | Name  | Reset | RW | Description                                                                                                                                                                                                                                                |
|------|-------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD  | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                                                 |
| 7:0  | RSTRT | 0x0   | WO | Writing 0xB2 to WDTRSTRT restarts the watchdog timer. This is a write only register. Reading this register will only provide all 0.<br><br>KEYVALUE = 0xB2 - This is the key value to write to WDTRSTRT to restart the WDT. This is a write only register. |

**15.2.2.3 LOCK Register**

Locks the WDT

OFFSET: 0x00000008

INSTANCE 0 ADDRESS: 0x40024008

This register locks the watch dog timer. Once it is locked, the configuration register (WDTCFG) for watch dog timer cannot be written to.



**Table 1001: LOCK Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0    | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9    | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | LOCK |   |   |   |   |   |   |   |   |   |

**Table 1002: LOCK Register Bits**

| Bit  | Name | Reset | RW | Description                                                                                                                                                                                |
|------|------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                 |
| 7:0  | LOCK | 0x0   | WO | Writing 0x3A locks the watchdog timer. Once locked, the WDTCFG reg cannot be written and WDTEN is set.<br><br>KEYVALUE = 0x3A - This is the key value to write to WDTLOCK to lock the WDT. |

**15.2.2.4 COUNT Register****Current Counter Value for WDT****OFFSET:** 0x0000000C**INSTANCE 0 ADDRESS:** 0x4002400C

This register holds the current count for the watch dog timer. This is a read only register. SW cannot set the value in the counter, but can reset it.

**Table 1003: COUNT Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9     | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | COUNT |   |   |   |   |   |   |   |   |   |

**Table 1004: COUNT Register Bits**

| Bit  | Name  | Reset | RW | Description                                |
|------|-------|-------|----|--------------------------------------------|
| 31:8 | RSVD  | 0x0   | RO | This bit field is reserved for future use. |
| 7:0  | COUNT | 0x0   | RO | Read-Only current value of the WDT counter |

**15.2.2.5 INTEN Register****WDT Interrupt: Enable****OFFSET:** 0x00000200





**Table 1012: INTSET Register Bits**

| Bit  | Name   | Reset | RW | Description                                |
|------|--------|-------|----|--------------------------------------------|
| 31:1 | RSVD   | 0x0   | RO | This bit field is reserved for future use. |
| 0    | WDTINT | 0x0   | RW | Watchdog Timer Interrupt.                  |

## 16. Reset Generator Module

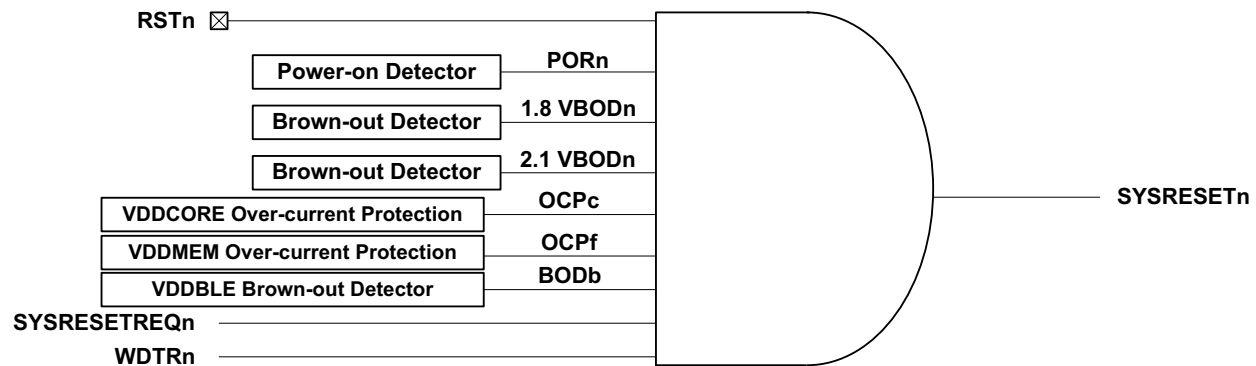


Figure 85. Block diagram for the Reset Generator Module

### 16.1 Functional Overview

The Reset Generator Module (RSTGEN) monitors a variety of reset signals and asserts the active low system reset (SYSRESETn) accordingly. A reset causes the entire system to be re-initialized, and the cause of the most recent reset is indicated by the STAT register.

Reset sources are described in the subsequent sections and include:

- External reset pin (RSTn)
- Power-on event
- Brown-out events
- Software request (SYSRESETREQn)
- Watchdog expiration

### 16.2 External Reset Pin

The active-low RSTn pin can be used to generate a reset using an off-chip component (e.g., a push-button). An internal pull-up resistor in the RSTn pad enables optional floating of the RSTn pin, and a debounce circuit ensures that bounce glitches on RSTn does not cause unintentional resets. The RSTn pin is not maskable. An internal pull-down device will be active during a brownout event pulling the RSTn pin low. See Figure 86.

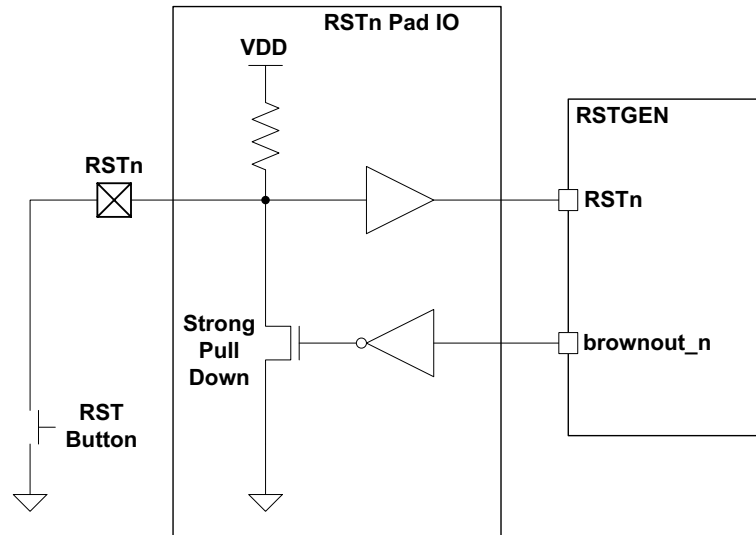


Figure 86. Block diagram of circuitry for Reset pin

### 16.3 Power-on Event

An integrated power-on detector monitors the supply voltage and keeps SYSRESETn asserted while VDD is below the rising power-on voltage,  $V_{POR} + 1.755$ . When VDD rises above  $V_{POR}$  at initial power on, the reset module will initialize the low power analog circuitry followed by de-assertion of SYSRESETn, and normal operation proceeds. SYSRESETn is re-asserted as soon as VDD falls below the falling power-on voltage,  $V_{POR} - 1.755$ . The power-on reset signal, PORn, is not maskable.

### 16.4 Brown-out Events

#### NOTE

WARNING: The brown out high reset should not be enabled if the supply voltage is lower than the BODH reset level (2.1V). Enabling this reset (RSTGEN\_CFG\_BODHREN = 1) in this situation causes repeated resets.

There are multiple brownout detectors in Apollo3. primary 1.7552.1In addition, there are individual brownout detector monitors integrated within the core/memory and BLE supply regulators which cause separate/maskable reset assertions when the voltage falls below critical level for the respective voltage rails. primary 1.7552.1or any of the core/memory/Bluetooth Low Energy Controller thresholds 1.7552.1In the event of a brownout detection, the following functionality is maintained until a power down detection occurs.

- All RTC registers retain state
- RTC and STIMER counters continue operation from 32 kHz XTAL or from LFRC (if below BODL). If clock sources stop oscillating at very low voltage, the RTC and STIMER will continue to maintain state.
- Clock configuration registers retain state

## 16.5 Software Reset

A reset may be generated via software using the Application Interrupt and Reset Control Register (AIRCR) defined in the Cortex-M4. For additional information on the AIRCR, see the Arm document titled “Cortex-M4 Devices Generic User Guide.” The software reset request is not maskable. A second source for the identical software reset functionality is made available through the SWPOR register in the RSTGEN peripheral module.

## 16.6 Software Power On Initialization

The SWPOI register enables the capability for software to perform a substantial reset that includes reloading the low power analog circuitry trim settings set in the flash information space. These values are not re-loaded from flash info space for Software Reset or External Reset events.

## 16.7 Watchdog Reset

The Watchdog Timer sub-module generates an interrupt if it has not been properly managed by software within a pre-defined time. The watchdog reset is maskable.

## 16.8 RSTGEN Registers

### MCU Reset Generator

INSTANCE 0 BASE ADDRESS:0x40000000

### 16.8.1 Register Memory Map

Table 1013: RSTGEN Register Map

| Address(s) | Register Name | Description                      |
|------------|---------------|----------------------------------|
| 0x40000000 | CFG           | Configuration                    |
| 0x40000004 | SWPOI         | Software POI Reset               |
| 0x40000008 | SWPOR         | Software POR Reset               |
| 0x40000014 | TPIURST       | TPIU reset                       |
| 0x40000200 | INTEN         | Reset Interrupt register: Enable |
| 0x40000204 | INTSTAT       | Reset Interrupt register: Status |
| 0x40000208 | INTCLR        | Reset Interrupt register: Clear  |
| 0x4000020C | INTSET        | Reset Interrupt register: Set    |
| 0x4FFF000  | STAT          | Status (SBL)                     |

## 16.8.2 RSTGEN Registers

### 16.8.2.1 CFG Register

#### Configuration

**OFFSET:** 0x00000000

**INSTANCE 0 ADDRESS:** 0x40000000

Reset configuration register. This controls the reset enables for brownout condition, and for the expiration of the watch dog timer.

**Table 1014: CFG Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1  | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | WDREN  | BODHREN |        |

**Table 1015: CFG Register Bits**

| Bit  | Name    | Reset | RW | Description                                                                                                                                                                |
|------|---------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:2 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                  |
| 1    | WDREN   | 0x0   | RW | Watchdog Timer Reset Enable. NOTE: The WDT module must also be configured for WDT reset. This includes enabling the RESEN bit in WDTCFG register in Watch dog timer block. |
| 0    | BODHREN | 0x0   | RW | Brown out high (2.1 V) reset enable.                                                                                                                                       |

### 16.8.2.2 SWPOI Register

#### Software POI Reset

**OFFSET:** 0x00000004

**INSTANCE 0 ADDRESS:** 0x40000004

This is the software POI reset. writing the key value to this register will trigger a POI to the system. This will cause a reset to all blocks except for registers in clock gen, RTC and the STIMER.

**Table 1016: SWPOI Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0        | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9        | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | SWPOIKEY |   |   |   |   |   |   |   |   |   |



| Bit  | Name     | Reset | RW | Description                                                                                                                                                                                             |
|------|----------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD     | 0x0   | RO | RESERVED.                                                                                                                                                                                               |
| 7:0  | SWPOIKEY | 0x0   | WO | 0x1B generates a software POI reset. This is a write-only register. Reading from this register will yield only all 0's.<br><br>KEYVALUE = 0x1B - Writing 0x1B key value generates a software POI reset. |

## Software POR Reset

**INSTANCE 0 ADDRESS: 0x40000008**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |          |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|---|--|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0        | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9        | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |  |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | SWPORKEY |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |

| Bit  | Name     | Reset | RW | Description                                                                                                          |
|------|----------|-------|----|----------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD     | 0x0   | RO | RESERVED.                                                                                                            |
| 7:0  | SWPORKEY | 0x0   | WO | 0xD4 generates a software POR reset.<br><br>KEYVALUE = 0xD4 - Writing 0xD4 key value generates a software POR reset. |

## TPIU reset

**INSTANCE 0 ADDRESS: 0x40000014**

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 |
| RSVD    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| TPIURST |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name    | Reset | RW | Description                                                                                       |
|------|---------|-------|----|---------------------------------------------------------------------------------------------------|
| 31:1 | RSVD    | 0x0   | RW | RESERVED.                                                                                         |
| 0    | TPIURST | 0x0   | RW | Static reset for the TPIU. Write to '1' to assert reset to TPIU. Write to '0' to clear the reset. |

Set bits in this register to allow this module to generate the corresponding interrupt.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| BODH |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name | Reset | RW | Description                                                      |
|------|------|-------|----|------------------------------------------------------------------|
| 31:1 | RSVD | 0x0   | RO | RESERVED.                                                        |
| 0    | BODH | 0x0   | RW | Enables an interrupt that triggers when VCC is below BODH level. |

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Table 1031: STAT Register Bits

| Bit   | Name     | Reset | RW | Description                                                                      |
|-------|----------|-------|----|----------------------------------------------------------------------------------|
| 31    | SBOOT    | 0x0   | RW | Set when booting securely (SBL).                                                 |
| 30    | FBOOT    | 0x0   | RW | Set if current boot was initiated by soft reset and resulted in Fast Boot (SBL). |
| 29:11 | RSVD     | 0x0   | RW | RESERVED.                                                                        |
| 10    | BOBSTAT  | 0x0   | RW | A BLE/Burst Regulator Brownout Event occurred (SBL).                             |
| 9     | BOFSTAT  | 0x0   | RW | A Memory Regulator Brownout Event occurred (SBL).                                |
| 8     | BOCSTAT  | 0x0   | RW | A Core Regulator Brownout Event occurred (SBL).                                  |
| 7     | BOUSTAT  | 0x0   | RW | An Unregulated Supply Brownout Event occurred (SBL).                             |
| 6     | WDRSTAT  | 0x0   | RW | Reset was initiated by a Watchdog Timer Reset (SBL).                             |
| 5     | DBGRSTAT | 0x0   | RW | Reset was a initiated by Debugger Reset (SBL).                                   |
| 4     | POIRSTAT | 0x0   | RW | Reset was a initiated by Software POI Reset (SBL).                               |
| 3     | SWRSTAT  | 0x0   | RW | Reset was a initiated by SW POR or AIRCR Reset (SBL).                            |
| 2     | BORSTAT  | 0x0   | RW | Reset was initiated by a Brown-Out Reset (SBL).                                  |
| 1     | PORSTAT  | 0x0   | RW | Reset was initiated by a Power-On Reset (SBL).                                   |
| 0     | EXRSTAT  | 0x0   | RW | Reset was initiated by an External Reset (SBL).                                  |

## 17. UART Module

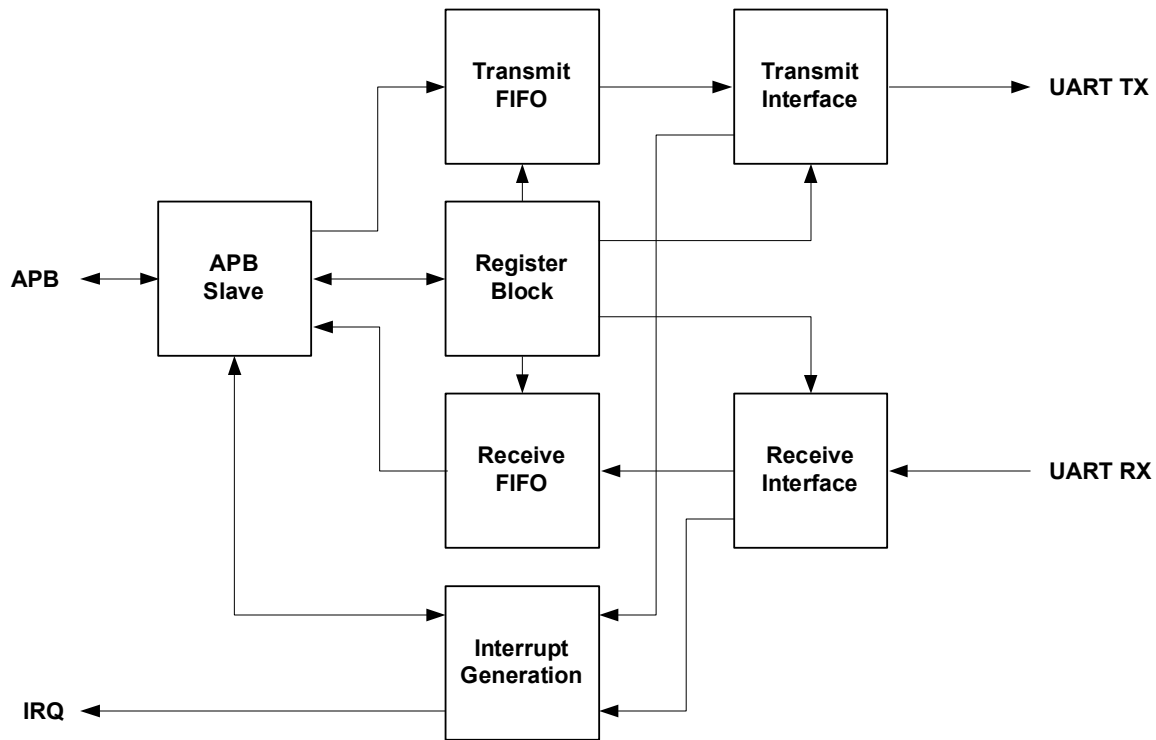


Figure 87. Block Diagram for the UART Module

### 17.1 Features

The UART Module includes the following key features:

- Operates independently, allowing the SoC to enter a low power sleep mode during communication
- 32 x 8 transmit FIFO and 32 x 12 receive FIFO to reduce MCU computational load
- Programmable baud rate generator
- Fully programmable data size, parity, and stop bit length
- Programmable hardware flow control
- Support for full-duplex and half-duplex communication
- Loop back functionality for diagnostics and testing

### 17.2 Functional Overview

Shown in Figure 87, the UART Module converts parallel data written through the APB Slave port into serial data which is transmitted to an external device. It also receives serial data from an external device and converts it to parallel data, which is then stored in a buffer until the CPU reads the data.

The UART Module includes a programmable baud rate generator. An interrupt generator will optionally send interrupts to the CPU core for transmit, receive and error events.

Internally, the UART Module maintains two FIFOs. The transmit FIFO is 1-byte wide with 32 locations. The receive FIFO is 12-bits wide with 32 locations. The extra four bits in the receive FIFO are used to capture any error status information that the MCU needs to analyze. Clocking to the UART serial logic is generated by a dedicated UARTCLK from the Clock Generator Module. The frequency of this clock is determined by

the desired baud rate. For maximum baud rates, this clock would be clocked at the 24 MHz maximum as generated by the HFRC.

The major functional blocks of the UART are discussed briefly in the subsequent sections.

### 17.3 Enabling and Selecting the UART Clock

The UART module receives two clocks - UART\_clk which is used to derive the UART serial clock and UART\_hclk, which is the bus interface clock of the UART module. Unlike other Apollo3 Blue SoC modules, the UART requires a bus clock whenever it is transmitting or receiving, so special controls are required when the UART is to transfer data while the Apollo3 Blue SoC is in a sleep mode and its normal bus clocks are not operating.

UART\_clk is selected in the UARTx\_CR\_CLKSEL field, with values from 24 MHz to 3 MHz plus a disabled value NOCLK, and is enabled by the UARTx\_CR\_CLKEN bit. If the UART is inactive, CLKSEL should be set to the NOCLK value (0) to minimize power, and the CLKEN bit should be 0. When the UART is active, the serial clock is created by the baud rate generator based on UART\_clk. A higher UART\_clk frequency can produce more precise serial clock frequencies, but will cause the UART to use more power. It is thus recommended that UART\_clk be set to the minimum frequency which produces acceptable serial clocks.

When software is accessing the UART, UART\_hclk must be equivalent to the Apollo3 Blue SoC bus clock frequency of 48 MHz, but for transmit and receive purposes UART\_hclk is only required to be at least as fast as UART\_clk. It is thus possible to manage the frequency of UART\_hclk to minimize power used by the UART. This is controlled by the CLKGEN\_UARTEN\_UARTxEN fields, as defined in the table below.

**Table 1032: UART Bus Interface Clock Selection**

| UARTxEN | UART_hclk Function                                                                                                                                                                                                                             |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0       | Disable UART_hclk. Select this when the UART is inactive.                                                                                                                                                                                      |
| 1       | Force UART_hclk to 48MHz. This is not a recommended mode.                                                                                                                                                                                      |
| 2       | Force UART_hclk to match UART_clk. This mode may be used when the UART is actively transmitting or receiving, or is expected to receive a transmission. This minimizes power in the UART but does not allow software access to UART registers. |
| 3       | Automatic. In this mode, UART_hclk will be set to 48 MHz when Apollo3 Blue SoC is awake and set to match UART_clk when Apollo3 Blue SoC is in a sleep mode. This is a normal safe mode of operation.                                           |

In general, it is safe to leave the UARTxEN field at 3, which will minimize UART power in sleep modes but always allow UART register access. Power will be improved if UARTxEN is normally left at 2, and shifted to 3 whenever UART register access is required. Note that the UARTEN register is in the CLKGEN module which always has bus access enabled.

### 17.4 Configuration

The UART Register Block in Figure 87 may be set to configure the UART Module. The data width, number of stop bits, and parity may all be configured using the UART\_LCRH register.

The baud rate is configured using the integer UART\_IBRD and UART\_FBRD registers. The correct values for UART\_IBRD and UART\_FBRD may be determined according to the following equation:

$$F_{\text{UART}}/(16 \cdot \text{BR}) = \text{IBRD} + \text{FBRD}$$

$F_{\text{UART}}$  is the frequency of the UART clock. BR is the desired baud rate. IBRD is the integer portion of the baud rate divisor. FBRD is the fractional portion of the baud rate divisor.

The UART Module supports independent CTS and RTS hardware flow control. All flow control configuration may be set using the UART\_CR register.

## 17.5 Transmit FIFO and Receive FIFO

The transmit and receive FIFOs may both be accessed via the same 8-bit word in the UART\_DR register. The transmit FIFO stores up to 32 8-bit words and can be written using writes to UART\_DR. The receive FIFO stores up to 32 12-bit words and can be read using reads to UART\_DR. Note that each 12-bit receive FIFO word includes an 8-bit data word and a 4-bit error status word.

## 17.6 UART Registers

### Serial UART

**INSTANCE 0 BASE ADDRESS:**0x4001C000

**INSTANCE 1 BASE ADDRESS:**0x4001D000



### 17.6.1 Register Memory Map

**Table 1033: UART Register Map**

| Address(s)               | Register Name | Description                  |
|--------------------------|---------------|------------------------------|
| 0x4001C000<br>0x4001D000 | DR            | UART Data                    |
| 0x4001C004<br>0x4001D004 | RSR           | UART Status                  |
| 0x4001C018<br>0x4001D018 | FR            | Flag                         |
| 0x4001C020<br>0x4001D020 | ILPR          | IrDA Counter                 |
| 0x4001C024<br>0x4001D024 | IBRD          | Integer Baud Rate Divisor    |
| 0x4001C028<br>0x4001D028 | FBRD          | Fractional Baud Rate Divisor |
| 0x4001C02C<br>0x4001D02C | LCRH          | Line Control High            |
| 0x4001C030<br>0x4001D030 | CR            | Control                      |
| 0x4001C034<br>0x4001D034 | IFLS          | FIFO Interrupt Level Select  |
| 0x4001C038<br>0x4001D038 | IER           | Interrupt Enable             |
| 0x4001C03C<br>0x4001D03C | IES           | Interrupt Status             |
| 0x4001C040<br>0x4001D040 | MIS           | Masked Interrupt Status      |
| 0x4001C044<br>0x4001D044 | IEC           | Interrupt Clear              |

## 17.6.2 UART Registers

### 17.6.2.1 DR Register

#### UART Data

**OFFSET:** 0x00000000

**INSTANCE 0 ADDRESS:** 0x4001C000

**INSTANCE 1 ADDRESS:** 0x4001D000

#### UART Data

**Table 1034: DR Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |        |        |        |      |   |   |   |   |   |   |   |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|--------|--------|--------|------|---|---|---|---|---|---|---|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1      | 0      | 0      | 0      | 0    | 0 | 0 | 0 | 0 | 0 | 0 |   |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1      | 0      | 9      | 8      | 7    | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | OEDATA | BEDATA | PEDATA | FEDATA | DATA |   |   |   |   |   |   |   |  |  |  |  |

**Table 1035: DR Register Bits**

| Bit   | Name   | Reset | RW | Description                                                                                                                                                           |
|-------|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:12 | RSVD   | 0x0   | RO | This bit field is reserved for future use.                                                                                                                            |
| 11    | OEDATA | 0x0   | RO | This is the overrun error indicator.<br>NOERR = 0x0 - No error on UART OEDATA, overrun error indicator.<br>ERR = 0x1 - Error on UART OEDATA, overrun error indicator. |
| 10    | BEDATA | 0x0   | RO | This is the break error indicator.<br>NOERR = 0x0 - No error on UART BEDATA, break error indicator.<br>ERR = 0x1 - Error on UART BEDATA, break error indicator.       |
| 9     | PEDATA | 0x0   | RO | This is the parity error indicator.<br>NOERR = 0x0 - No error on UART PEDATA, parity error indicator.<br>ERR = 0x1 - Error on UART PEDATA, parity error indicator.    |
| 8     | FEDATA | 0x0   | RO | This is the framing error indicator.<br>NOERR = 0x0 - No error on UART FEDATA, framing error indicator.<br>ERR = 0x1 - Error on UART FEDATA, framing error indicator. |
| 7:0   | DATA   | 0x0   | RW | This is the UART data port.                                                                                                                                           |

### 17.6.2.2 RSR Register

#### UART Status

**OFFSET:** 0x00000004

**INSTANCE 0 ADDRESS:** 0x4001C004



**Table 1038: FR Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |      |      |      |      |      |     |     |     |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|------|------|------|------|------|-----|-----|-----|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0      | 0    | 0    | 0    | 0    | 0    | 0   | 0   |     |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0      | 9    | 8    | 7    | 6    | 5    | 4   | 3   | 2   | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | TXBUSY | TXFE | RXFF | TXFF | RXFE | BUSY | DCD | DSR | CTS |   |   |

**Table 1039: FR Register Bits**

| Bit  | Name   | Reset | RW | Description                                                                                         |
|------|--------|-------|----|-----------------------------------------------------------------------------------------------------|
| 31:9 | RSVD   | 0x0   | RO | This bit field is reserved for future use.                                                          |
| 8    | TXBUSY | 0x0   | RO | This bit holds the transmit BUSY indicator.                                                         |
| 7    | TXFE   | 0x0   | RO | This bit holds the transmit FIFO empty indicator.<br>XMTFIFO_EMPTY = 0x1 - Transmit FIFO is empty.  |
| 6    | RXFF   | 0x0   | RO | This bit holds the receive FIFO full indicator.<br>RCVFIFO_FULL = 0x1 - Receive FIFO is full.       |
| 5    | TXFF   | 0x0   | RO | This bit holds the transmit FIFO full indicator.<br>XMTFIFO_FULL = 0x1 - Transmit FIFO is full.     |
| 4    | RXFE   | 0x0   | RO | This bit holds the receive FIFO empty indicator.<br>RCVFIFO_EMPTY = 0x1 - Receive FIFO is empty.    |
| 3    | BUSY   | 0x0   | RO | This bit holds the busy indicator.<br>BUSY = 0x1 - UART busy indicator.                             |
| 2    | DCD    | 0x0   | RO | This bit holds the data carrier detect indicator.<br>DETECTED = 0x1 - Data carrier detect detected. |
| 1    | DSR    | 0x0   | RO | This bit holds the data set ready indicator.<br>READY = 0x1 - Data set ready.                       |
| 0    | CTS    | 0x0   | RO | This bit holds the clear to send indicator.<br>CLEARTOSEND = 0x1 - Clear to send is indicated.      |

**17.6.2.4 ILPR Register****IrDA Counter****OFFSET:** 0x00000020**INSTANCE 0 ADDRESS:** 0x4001C020**INSTANCE 1 ADDRESS:** 0x4001D020

IrDA Counter

Table 1040: ILPR Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|---|--|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9       | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |  |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ILPDVSR |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |

Table 1041: ILPR Register Bits

| Bit  | Name    | Reset | RW | Description                                |
|------|---------|-------|----|--------------------------------------------|
| 31:8 | RSVD    | 0x0   | RO | This bit field is reserved for future use. |
| 7:0  | ILPDVSR | 0x0   | RW | These bits hold the IrDA counter divisor.  |

**17.6.2.5 IBRD Register****Integer Baud Rate Divisor****OFFSET:** 0x00000024**INSTANCE 0 ADDRESS:** 0x4001C024**INSTANCE 1 ADDRESS:** 0x4001D024

Integer Baud Rate Divisor

Table 1042: IBRD Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1      | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6      | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DIVINT |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1043: IBRD Register Bits

| Bit   | Name   | Reset | RW | Description                                |
|-------|--------|-------|----|--------------------------------------------|
| 31:16 | RSVD   | 0x0   | RO | This bit field is reserved for future use. |
| 15:0  | DIVINT | 0x0   | RW | These bits hold the baud integer divisor.  |

**17.6.2.6 FBRD Register****Fractional Baud Rate Divisor****OFFSET:** 0x00000028**INSTANCE 0 ADDRESS:** 0x4001C028**INSTANCE 1 ADDRESS:** 0x4001D028

## Fractional Baud Rate Divisor

Table 1044: FBRD Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |   |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|---|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9       | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DIVFRAC |   |   |   |   |   |   |   |   |   |  |  |  |  |

Table 1045: FBRD Register Bits

| Bit  | Name    | Reset | RW | Description                                  |
|------|---------|-------|----|----------------------------------------------|
| 31:6 | RSVD    | 0x0   | RO | This bit field is reserved for future use.   |
| 5:0  | DIVFRAC | 0x0   | RW | These bits hold the baud fractional divisor. |

## 17.6.2.7 LCRH Register

## Line Control High

OFFSET: 0x0000002C

INSTANCE 0 ADDRESS: 0x4001C02C

INSTANCE 1 ADDRESS: 0x4001D02C

## Line Control High

Table 1046: LCRH Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |     |      |     |      |     |     |     |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----|------|-----|------|-----|-----|-----|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0   | 0    | 0   | 0    | 0   | 0   | 0   | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0   | 9    | 8   | 7    | 6   | 5   | 4   | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | SPS | WLEN | FEN | STP2 | EPS | PEN | BRK |   |   |   |   |

Table 1047: LCRH Register Bits

| Bit  | Name | Reset | RW | Description                                |
|------|------|-------|----|--------------------------------------------|
| 31:8 | RSVD | 0x0   | RO | This bit field is reserved for future use. |
| 7    | SPS  | 0x0   | RW | This bit holds the stick parity select.    |
| 6:5  | WLEN | 0x0   | RW | These bits hold the write length.          |
| 4    | FEN  | 0x0   | RW | This bit holds the FIFO enable.            |

| Bit | Name | Reset | RW | Description                              |
|-----|------|-------|----|------------------------------------------|
| 3   | STP2 | 0x0   | RW | This bit holds the two stop bits select. |
| 2   | EPS  | 0x0   | RW | This bit holds the even parity select.   |
| 1   | PEN  | 0x0   | RW | This bit holds the parity enable.        |
| 0   | BRK  | 0x0   | RW | This bit holds the break set.            |

## Control

**INSTANCE 0 ADDRESS: 0x4001C030**

Control

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | CTSEN  | RTSEN  | OUT2   | OUT1   | RTS    | DTR    | RXE    | TXE    | LBE    | CLKSEL |        |        | CLKEN  | SIRLP  | SIREN  | UARTEN |

| Bit   | Name  | Reset | RW | Description                                 |
|-------|-------|-------|----|---------------------------------------------|
| 31:16 | RSVD  | 0x0   | RO | This bit field is reserved for future use.  |
| 15    | CTSEN | 0x0   | RW | This bit enables CTS hardware flow control. |
| 14    | RTSEN | 0x0   | RW | This bit enables RTS hardware flow control. |
| 13    | OUT2  | 0x0   | RW | This bit holds modem Out2.                  |
| 12    | OUT1  | 0x0   | RW | This bit holds modem Out1.                  |
| 11    | RTS   | 0x0   | RW | This bit enables request to send.           |
| 10    | DTR   | 0x0   | RW | This bit enables data transmit ready.       |

| Bit | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                          |
|-----|--------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9   | RXE    | 0x1   | RW | This bit is the receive enable.                                                                                                                                                                                                                                                                                      |
| 8   | TXE    | 0x1   | RW | This bit is the transmit enable.                                                                                                                                                                                                                                                                                     |
| 7   | LBE    | 0x0   | RW | This bit is the loopback enable.                                                                                                                                                                                                                                                                                     |
| 6:4 | CLKSEL | 0x0   | RW | This bit field is the UART clock select.<br><br>NOCLK = 0x0 - No UART clock. This is the low power default.<br>24MHZ = 0x1 - 24 MHz clock.<br>12MHZ = 0x2 - 12 MHz clock.<br>6MHZ = 0x3 - 6 MHz clock.<br>3MHZ = 0x4 - 3 MHz clock.<br>RSVD5 = 0x5 - Reserved.<br>RSVD6 = 0x6 - Reserved.<br>RSVD7 = 0x7 - Reserved. |
| 3   | CLKEN  | 0x0   | RW | This bit is the UART clock enable.                                                                                                                                                                                                                                                                                   |
| 2   | SIRLP  | 0x0   | RW | This bit is the SIR low power select.                                                                                                                                                                                                                                                                                |
| 1   | SIREN  | 0x0   | RW | This bit is the SIR ENDEC enable.                                                                                                                                                                                                                                                                                    |
| 0   | UARTEN | 0x0   | RW | This bit is the UART enable.                                                                                                                                                                                                                                                                                         |

## FIFO Interrupt Level Select

**INSTANCE 0 ADDRESS: 0x4001C034**

## FIFO Interrupt Level Select

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |         |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|---------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5  | 0<br>4 | 0<br>3  | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | RXFLSEL |        | TXFLSEL |        |        |        |



**Table 1051: IFLS Register Bits**

| Bit  | Name     | Reset | RW | Description                                        |
|------|----------|-------|----|----------------------------------------------------|
| 31:6 | RSVD     | 0x0   | RO | This bit field is reserved for future use.         |
| 5:3  | RXIFLSEL | 0x2   | RW | These bits hold the receive FIFO interrupt level.  |
| 2:0  | TXIFLSEL | 0x2   | RW | These bits hold the transmit FIFO interrupt level. |

**17.6.2.10IER Register****Interrupt Enable****OFFSET:** 0x00000038**INSTANCE 0 ADDRESS:** 0x4001C038**INSTANCE 1 ADDRESS:** 0x4001D038

Interrupt Enable

**Table 1052: IER Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0   |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | OEIM   | BEIM   | PEIM   | FEIM   | RTIM   | TXIM   | RXIM   | DSRMIM | DCDMIM | CTSMIM | TXCMPMIM |

**Table 1053: IER Register Bits**

| Bit   | Name | Reset | RW | Description                                          |
|-------|------|-------|----|------------------------------------------------------|
| 31:11 | RSVD | 0x0   | RO | This bit field is reserved for future use.           |
| 10    | OEIM | 0x0   | RW | This bit holds the overflow interrupt enable.        |
| 9     | BEIM | 0x0   | RW | This bit holds the break error interrupt enable.     |
| 8     | PEIM | 0x0   | RW | This bit holds the parity error interrupt enable.    |
| 7     | FEIM | 0x0   | RW | This bit holds the framing error interrupt enable.   |
| 6     | RTIM | 0x0   | RW | This bit holds the receive timeout interrupt enable. |
| 5     | TXIM | 0x0   | RW | This bit holds the transmit interrupt enable.        |

**Table 1053: IER Register Bits**

| Bit | Name     | Reset | RW | Description                                      |
|-----|----------|-------|----|--------------------------------------------------|
| 4   | RXIM     | 0x0   | RW | This bit holds the receive interrupt enable.     |
| 3   | DSRMIM   | 0x0   | RW | This bit holds the modem DSR interrupt enable.   |
| 2   | DCDMIM   | 0x0   | RW | This bit holds the modem DCD interrupt enable.   |
| 1   | CTSMIM   | 0x0   | RW | This bit holds the modem CTS interrupt enable.   |
| 0   | TXCMPMIM | 0x0   | RW | This bit holds the modem TXCMP interrupt enable. |

**17.6.2.11 IES Register****Interrupt Status****OFFSET:** 0x0000003C**INSTANCE 0 ADDRESS:** 0x4001C03C**INSTANCE 1 ADDRESS:** 0x4001D03C

Interrupt Status

**Table 1054: IES Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |         |         |           |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|---------|-----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3  | 0<br>2  | 0<br>1  | 0<br>0    |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | OERIS  | BERIS  | PERIS  | FERIS  | RTRIS  | TXRIS  | RXRIS  | DSRMRIS | DCDMRIS | CTSMRIS | TXCMPMRIS |

**Table 1055: IES Register Bits**

| Bit   | Name  | Reset | RW | Description                                          |
|-------|-------|-------|----|------------------------------------------------------|
| 31:11 | RSVD  | 0x0   | RO | This bit field is reserved for future use.           |
| 10    | OERIS | 0x0   | RO | This bit holds the overflow interrupt status.        |
| 9     | BERIS | 0x0   | RO | This bit holds the break error interrupt status.     |
| 8     | PERIS | 0x0   | RO | This bit holds the parity error interrupt status.    |
| 7     | FERIS | 0x0   | RO | This bit holds the framing error interrupt status.   |
| 6     | RTRIS | 0x0   | RO | This bit holds the receive timeout interrupt status. |

| Bit | Name      | Reset | RW | Description                                      |
|-----|-----------|-------|----|--------------------------------------------------|
| 5   | TXRIS     | 0x0   | RO | This bit holds the transmit interrupt status.    |
| 4   | RXRIS     | 0x0   | RO | This bit holds the receive interrupt status.     |
| 3   | DSRMRIS   | 0x0   | RO | This bit holds the modem DSR interrupt status.   |
| 2   | DCDMRIS   | 0x0   | RO | This bit holds the modem DCD interrupt status.   |
| 1   | CTSMRIS   | 0x0   | RO | This bit holds the modem CTS interrupt status.   |
| 0   | TXCMPMRIS | 0x0   | RO | This bit holds the modem TXCMP interrupt status. |

## Masked Interrupt Status

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |         |        |           |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|--------|-----------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3  | 0<br>2  | 0<br>1 | 0<br>0    |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | OEMIS  | BEMIS  | PEMIS  | FEMIS  | RTMIS  | TXMIS  | RXMIS  | DSRMMIS | DCDMMIS | CTSMMS | TXCMPMMIS |

| Bit   | Name  | Reset | RW | Description                                               |
|-------|-------|-------|----|-----------------------------------------------------------|
| 31:11 | RSVD  | 0x0   | RO | This bit field is reserved for future use.                |
| 10    | OEMIS | 0x0   | RO | This bit holds the overflow interrupt status masked.      |
| 9     | BEMIS | 0x0   | RO | This bit holds the break error interrupt status masked.   |
| 8     | PEMIS | 0x0   | RO | This bit holds the parity error interrupt status masked.  |
| 7     | FEMIS | 0x0   | RO | This bit holds the framing error interrupt status masked. |

| Bit | Name      | Reset | RW | Description                                                 |
|-----|-----------|-------|----|-------------------------------------------------------------|
| 6   | RTMIS     | 0x0   | RO | This bit holds the receive timeout interrupt status masked. |
| 5   | TXMIS     | 0x0   | RO | This bit holds the transmit interrupt status masked.        |
| 4   | RXMIS     | 0x0   | RO | This bit holds the receive interrupt status masked.         |
| 3   | DSRMMIS   | 0x0   | RO | This bit holds the modem DSR interrupt status masked.       |
| 2   | DCDMMIS   | 0x0   | RO | This bit holds the modem DCD interrupt status masked.       |
| 1   | CTSMMIS   | 0x0   | RO | This bit holds the modem CTS interrupt status masked.       |
| 0   | TXCMPMMIS | 0x0   | RO | This bit holds the modem TXCMP interrupt status masked.     |

## Interrupt Clear

**INSTANCE 0 ADDRESS: 0x4001C044**

## Interrupt Clear

|      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |        |        |        |          |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|------|------|------|------|------|------|------|--------|--------|--------|----------|
| 31   | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10   | 9    | 8    | 7    | 6    | 5    | 4    | 3      | 2      | 1      | 0        |
| RSVD |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | OEIC | BEIC | PEIC | FEIC | RTIC | TXIC | RXIC | DSRMIC | DCDMIC | CTSMIC | TXCMPMIC |

| Bit   | Name | Reset | RW | Description                                      |
|-------|------|-------|----|--------------------------------------------------|
| 31:11 | RSVD | 0x0   | RO | This bit field is reserved for future use.       |
| 10    | OEIC | 0x0   | WO | This bit holds the overflow interrupt clear.     |
| 9     | BEIC | 0x0   | WO | This bit holds the break error interrupt clear.  |
| 8     | PEIC | 0x0   | WO | This bit holds the parity error interrupt clear. |

**Table 1059: IEC Register Bits**

| Bit | Name     | Reset | RW | Description                                         |
|-----|----------|-------|----|-----------------------------------------------------|
| 7   | FEIC     | 0x0   | WO | This bit holds the framing error interrupt clear.   |
| 6   | RTIC     | 0x0   | WO | This bit holds the receive timeout interrupt clear. |
| 5   | TXIC     | 0x0   | WO | This bit holds the transmit interrupt clear.        |
| 4   | RXIC     | 0x0   | WO | This bit holds the receive interrupt clear.         |
| 3   | DSRMIC   | 0x0   | WO | This bit holds the modem DSR interrupt clear.       |
| 2   | DCDMIC   | 0x0   | WO | This bit holds the modem DCD interrupt clear.       |
| 1   | CTSMIC   | 0x0   | WO | This bit holds the modem CTS interrupt clear.       |
| 0   | TXCMPMIC | 0x0   | WO | This bit holds the modem TXCMP interrupt clear.     |

## 18. SCARD Module



**Figure 88. Block Diagram for the Secure Card Module**

### 18.1 Features

The SCARD Module includes the following key features:

- Operates independently, allowing the MCU to enter a low power sleep mode during communication
- Compatible with ISO/IEC 7816-3 T = 0 and T = 1 transport protocols.

### 18.2 Functional Overview

The Secure Card Controller (SCC) is used to read/write the contact IC card and follows the 7816 protocol. The controller is compatible with ISO/IEC 7816-3 T = 0 and T = 1 transport protocols.

The main function of Secure Card Controller is to receive data from the smart card or to send data to the smart card. When transmitting data, the SCARD Controller adds a specific sequence to the bit flow for the data moved to the FIFO by the CPU from system SRAM and sends it to the smart card via 7816 interface. When receiving data, the SCARD Controller stores the data from the smart card to the FIFO and generates the interrupt signal to indicate CPU to read data from FIFO.

### 18.2.1 Data Transmit

Figure 89 shows the flow of the SCC sending n bytes of data and may be referenced when configuring the registers to send data.

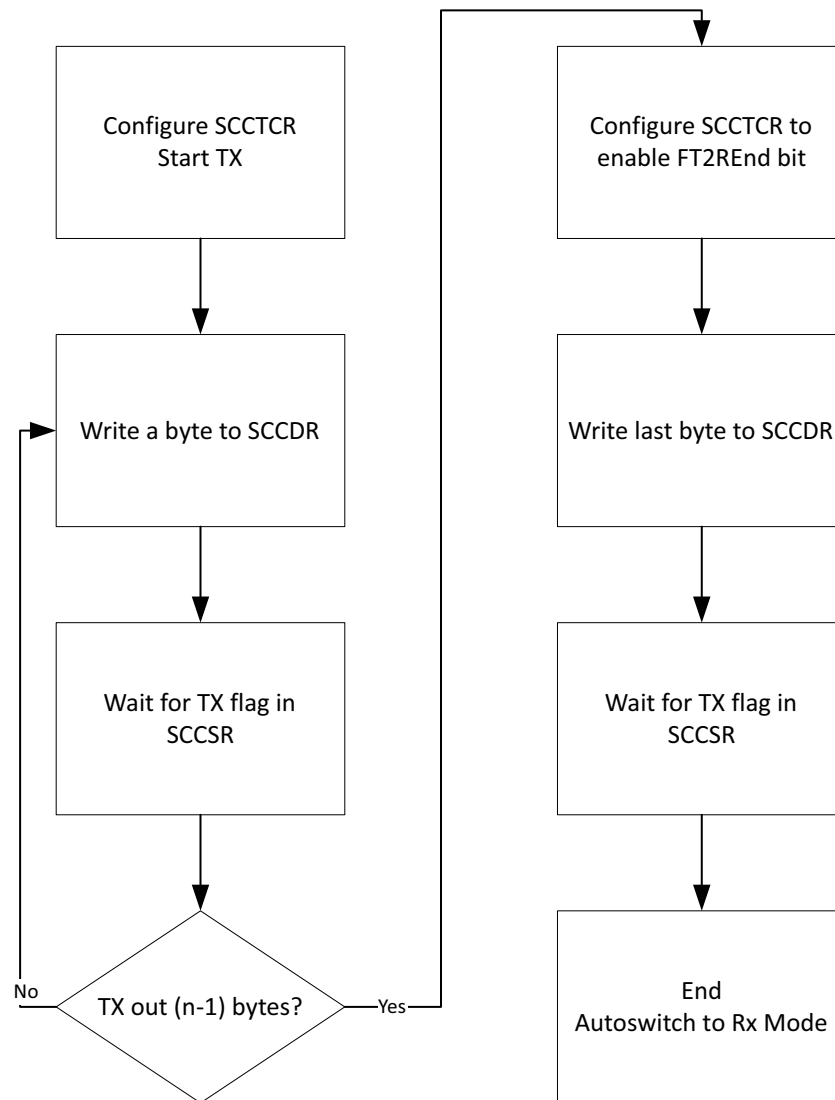


Figure 89. Secure Card TX Flow

### 18.2.2 Data Receive

Figure 90 shows the flow of SCARD Controller receiving n bytes of data, and may be referenced when configuring the register to receive data.

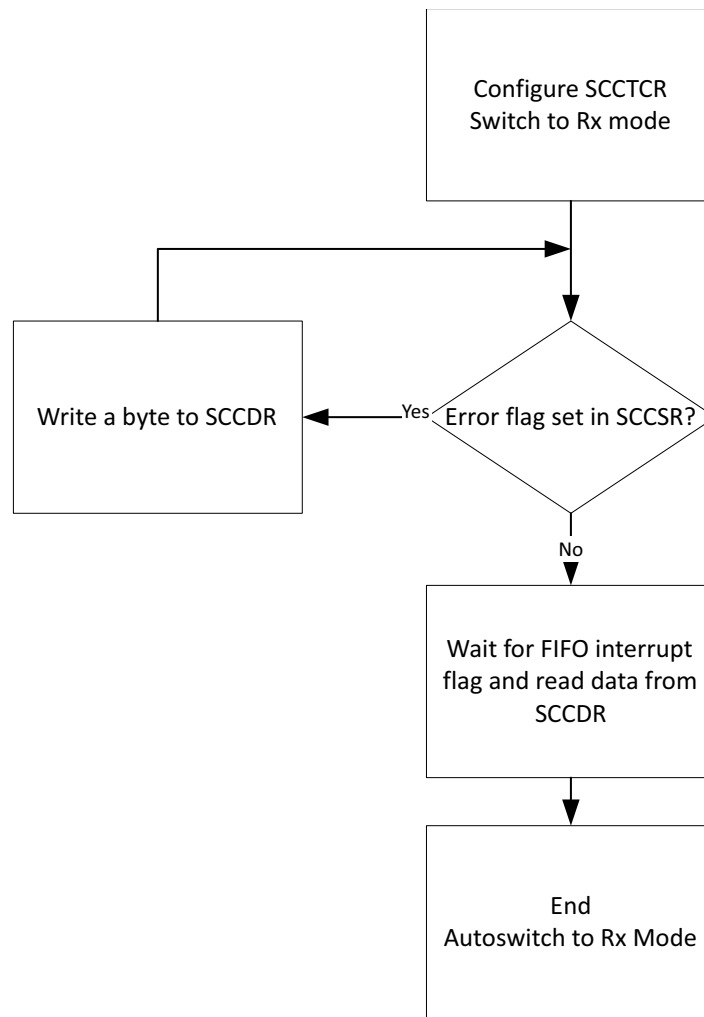


**Figure 90. Secure Card RX Flow**



## 18.3 SCARD Registers

Serial ISO7816

INSTANCE 0 BASE ADDRESS:0x40080000

### 18.3.1 Register Memory Map

Table 1060: SCARD Register Map

| Address(s) | Register Name | Description                      |
|------------|---------------|----------------------------------|
| 0x40080000 | SR            | ISO7816 interrupt status         |
| 0x40080004 | IER           | ISO7816 interrupt enable         |
| 0x40080008 | TCR           | ISO7816 transmit control         |
| 0x4008000C | UCR           | ISO7816 user control             |
| 0x40080010 | DR            | ISO7816 data                     |
| 0x40080014 | BPRL          | ISO7816 baud rate low            |
| 0x40080018 | BPRH          | ISO7816 baud rate high           |
| 0x4008001C | UCR1          | ISO7816 user control 1           |
| 0x40080020 | SR1           | ISO7816 interrupt status 1       |
| 0x40080024 | IER1          | ISO7816 interrupt enable 1       |
| 0x40080028 | ECNTL         | ETU counter low                  |
| 0x4008002C | ECNTH         | ETU counter high                 |
| 0x40080030 | GTR           | ISO7816 guard time configuration |
| 0x40080034 | RETXCNT       | ISO7816 resend count             |
| 0x40080038 | RETXCNTRMI    | ISO7816 resent count inquiry     |
| 0x40080100 | CLKCTRL       | Clock Control                    |

## 18.3.2 SCARD Registers

### 18.3.2.1 SR Register

ISO7816 interrupt status

OFFSET: 0x00000000

INSTANCE 0 ADDRESS: 0x40080000

ISO7816 interrupt status

**Table 1061: SR Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |     |         |    |     |     |        |     |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----|---------|----|-----|-----|--------|-----|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0   | 0       | 0  | 0   | 0   | 0      | 0   | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9   | 8       | 7  | 6   | 5   | 4      | 3   | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | FHF | FT2REND | PE | OVR | FER | TBERBF | FNE |   |   |   |

**Table 1062: SR Register Bits**

| Bit  | Name    | Reset | RW | Description                                                                                                                                                                                                                          |
|------|---------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:7 | RSVD    | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                           |
| 6    | FHF     | 0x0   | RW | FIFO Half Full.<br>HALFFULL = 0x1 - FIFO is half full.                                                                                                                                                                               |
| 5    | FT2REND | 0x0   | RW | TX to RX finished.<br>CMPL = 0x1 - TX to RX completed.<br>NOTCMPL = 0x0 - TX to RX not completed.                                                                                                                                    |
| 4    | PE      | 0x0   | RW | Parity Error.<br>PEERR = 0x1 - Parity error.<br>PENONE = 0x0 - No parity error.                                                                                                                                                      |
| 3    | OVR     | 0x0   | RW | RX FIFO overflow.<br>RXOVR = 0x1 - RX FIFO overflow.<br>RXOVRNONE = 0x0 - RX FIFO no overflow.                                                                                                                                       |
| 2    | FER     | 0x0   | RW | Framing error.<br>FRAMINGERR = 0x1 - Framing error.<br>NOFRAMINGERR = 0x0 - No framing error detected.                                                                                                                               |
| 1    | TBERBF  | 0x0   | RO | FIFO empty (transmit) or full (receive).<br>TXFIFOEMPTY = 0x1 - Transmit: FIFO empty.<br>RXFIFOFULL = 0x1 - Receive: FIFO full.<br>TXFIFONOTEMPTY = 0x0 - Transmit: FIFO not empty.<br>RXFIFONOTFULL = 0x0 - Receive: FIFO not full. |

| Bit | Name | Reset | RW | Description                                                                                    |
|-----|------|-------|----|------------------------------------------------------------------------------------------------|
| 0   | FNE  | 0x0   | RO | RX FIFO not empty.<br><br>NOTEEMPTY = 0x1 - RX FIFO not empty.<br>EMPTY = 0x0 - RX FIFO empty. |

## ISO7816 interrupt enable

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |       |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|-------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |          |       |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | FHFEN  | FT2REN | PEEN   | OVREN  | FEREN  | TBERBFEN | FNEEN |

| Bit  | Name      | Reset | RW | Description                                               |
|------|-----------|-------|----|-----------------------------------------------------------|
| 31:7 | RSVD      | 0x0   | RO | This bit field is reserved for future use.                |
| 6    | FHFEN     | 0x0   | RW | FIFO Half Full interrupt enable.                          |
| 5    | FT2RENDEN | 0x0   | RW | TX to RX finished interrupt enable.                       |
| 4    | PEEN      | 0x0   | RW | Parity Error interrupt enable.                            |
| 3    | OVREN     | 0x0   | RW | RX FIFOI overflow interrupt enable.                       |
| 2    | FEREN     | 0x0   | RW | Framing error interrupt enable.                           |
| 1    | TBERBFEN  | 0x0   | RW | FIFO empty (transmit) or full (receive) interrupt enable. |
| 0    | FNEEN     | 0x0   | RW | RX FIFO not empty interrupt enable.                       |

**18.3.2.3 TCR Register****ISO7816 transmit control****OFFSET:** 0x00000008**INSTANCE 0 ADDRESS:** 0x40080008

ISO7816 transmit control

**Table 1065: TCR Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5   | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DMAMD  | FIP    | AUTOCONV | PROT   | TR     | LCT    | SS     | CONV   |

**Table 1066: TCR Register Bits**

| Bit  | Name     | Reset | RW | Description                                |
|------|----------|-------|----|--------------------------------------------|
| 31:8 | RSVD     | 0x0   | RO | This bit field is reserved for future use. |
| 7    | DMAMD    | 0x0   | RW | DMA direction.                             |
| 6    | FIP      | 0x0   | RW | Parity select.                             |
| 5    | AUTOCONV | 0x0   | RW | Automatic conversion.                      |
| 4    | PROT     | 0x0   | RW | PROT control.                              |
| 3    | TR       | 0x0   | RW | Transmit/receive mode.                     |
| 2    | LCT      | 0x0   | RW | Fast TX to RX.                             |
| 1    | SS       | 0x1   | RW | Use first byte to configure conversion.    |
| 0    | CONV     | 0x0   | RW | Conversion inversion control.              |

**18.3.2.4 UCR Register****ISO7816 user control****OFFSET:** 0x0000000C**INSTANCE 0 ADDRESS:** 0x4008000C

ISO7816 user control

|      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |        |       |     |     |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--------|-------|-----|-----|
| 31   | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 09 | 08 | 07 | 06 | 05 | 04 | 03     | 02    | 01  | 00  |
| RSVD |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | RETXEN | RSTIN | RIU | CST |

| Bit  | Name   | Reset | RW | Description                                |
|------|--------|-------|----|--------------------------------------------|
| 31:4 | RSVD   | 0x0   | RO | This bit field is reserved for future use. |
| 3    | RETXEN | 0x1   | RW | Enable TX/RX time configuration.           |
| 2    | RSTIN  | 0x0   | RW | Reset polarity.                            |
| 1    | RIU    | 0x0   | WO | ISO7816 reset. This bit is write-only.     |
| 0    | CST    | 0x0   | RW | Clock control.                             |

## ISO7816 data

**INSTANCE 0 ADDRESS: 0x40080010**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|---|---|---|--|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |  |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0  | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DR |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |

| Bit  | Name | Reset | RW | Description                                |
|------|------|-------|----|--------------------------------------------|
| 31:8 | RSVD | 0x0   | RO | This bit field is reserved for future use. |
| 7:0  | DR   | 0x0   | RW | Data register.                             |

**18.3.2.6 BPRL Register**

ISO7816 baud rate low

OFFSET: 0x00000014

INSTANCE 0 ADDRESS: 0x40080014

ISO7816 baud rate low

**Table 1071: BPRL Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |   |   |   |   |   |   |   |   |   |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------|---|---|---|---|---|---|---|---|---|---|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0    | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0    | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | BPRL |   |   |   |   |   |   |   |   |   |   |  |

**Table 1072: BPRL Register Bits**

| Bit  | Name | Reset | RW | Description                                |
|------|------|-------|----|--------------------------------------------|
| 31:8 | RSVD | 0x0   | RO | This bit field is reserved for future use. |
| 7:0  | BPRL | 0x74  | RW | Baud rate low                              |

**18.3.2.7 BPRH Register**

ISO7816 baud rate high

OFFSET: 0x00000018

INSTANCE 0 ADDRESS: 0x40080018

ISO7816 baud rate high

**Table 1073: BPRH Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0    | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7    | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | BPRH |   |   |   |   |   |   |   |

**Table 1074: BPRH Register Bits**

| Bit  | Name | Reset | RW | Description                                |
|------|------|-------|----|--------------------------------------------|
| 31:4 | RSVD | 0x0   | RO | This bit field is reserved for future use. |
| 3:0  | BPRH | 0x1   | RW | Baud rate high                             |

**18.3.2.8 UCR1 Register****ISO7816 user control 1****OFFSET:** 0x0000001C**INSTANCE 0 ADDRESS:** 0x4008001C

ISO7816 user control 1

**Table 1075: UCR1 Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |        |         |      |      |    |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|--------|---------|------|------|----|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0       | 0      | 0       | 0    | 0    | 0  | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7       | 6      | 5       | 4    | 3    | 2  | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ENLASTB | CLKIOV | T1PAREN | STSP | RSVD | PR |   |   |

**Table 1076: UCR1 Register Bits**

| Bit  | Name    | Reset | RW | Description                                  |
|------|---------|-------|----|----------------------------------------------|
| 31:6 | RSVD    | 0x0   | RO | This bit field is reserved for future use.   |
| 5    | ENLASTB | 0x1   | RW | Enable last byte function.                   |
| 4    | CLKIOV  | 0x1   | RW | Output clock level.                          |
| 3    | T1PAREN | 0x0   | RW | Parity check control.                        |
| 2    | STSP    | 0x0   | WO | ETU counter control. This bit is write-only. |
| 1    | RSVD    | 0x0   | RO | This bit field is reserved for future use.   |
| 0    | PR      | 0x0   | RW | Query Card Detect.                           |

**18.3.2.9 SR1 Register****ISO7816 interrupt status 1****OFFSET:** 0x00000020**INSTANCE 0 ADDRESS:** 0x40080020

ISO7816 interrupt status 1

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |         |     |          |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------|---------|-----|----------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0    | 0       | 0   | 0        |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5    | 4       | 3   | 2        |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | IDLE | SYNCEND | PRL | ECNTOVER |

| Bit  | Name     | Reset | RW | Description                                                                                             |
|------|----------|-------|----|---------------------------------------------------------------------------------------------------------|
| 31:4 | RSVD     | 0x0   | RO | This bit field is reserved for future use.                                                              |
| 3    | IDLE     | 0x1   | RO | ISO7816 idle.<br>IDLE = 0x1 - ISO7816 idle.<br>ACTIVE = 0x0 - ISO7816 active.                           |
| 2    | SYNCEND  | 0x0   | RW | Write complete synchronization.<br>CMPL = 0x1 - Synchronization complete.<br>INCMPL = 0x0 - Incomplete. |
| 1    | PRL      | 0x0   | RW | Card insert/remove.<br>INSREM = 0x1 - Card inserted/removed.                                            |
| 0    | ECNTOVER | 0x0   | RW | ETU counter overflow.<br>OVR = 0x1 - ETU overflow.                                                      |

## ISO7816 interrupt enable 1

|                                                                          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3                                                                        | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1                                                                        | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 |
| RSVD                                                                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| <div> <div>SYNCENDEN</div> <div>PRLEN</div> <div>ECNTOVEREN</div> </div> |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |



| Bit  | Name       | Reset | RW | Description                                      |
|------|------------|-------|----|--------------------------------------------------|
| 31:3 | RSVD       | 0x0   | RO | This bit field is reserved for future use.       |
| 2    | SYNCENDEN  | 0x0   | RW | Write complete synchronization interrupt enable. |
| 1    | PRLN       | 0x0   | RW | Card insert/remove interrupt enable.             |
| 0    | ECNTOVEREN | 0x0   | RW | ETU counter overflow interrupt enable.           |

## ETU counter low

**INSTANCE 0 ADDRESS: 0x40080028**

ETU counter low

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |   |  |  |  |  |  |  |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|---|--|--|--|--|--|--|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0     | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |  |  |  |  |  |  |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9     | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |  |  |  |  |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ECNTL |   |   |   |   |   |   |   |   |   |  |  |  |  |  |  |

| Bit  | Name  | Reset | RW | Description                                |
|------|-------|-------|----|--------------------------------------------|
| 31:8 | RSVD  | 0x0   | RO | This bit field is reserved for future use. |
| 7:0  | ECNTL | 0x0   | RW | ETU counter low register.                  |

## ETU counter high

**INSTANCE 0 ADDRESS: 0x4008002C**

ETU counter high

Table 1083: ECNTH Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |       |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9     | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ECNTH |   |   |   |   |   |   |   |   |   |

Table 1084: ECNTH Register Bits

| Bit  | Name  | Reset | RW | Description                                |
|------|-------|-------|----|--------------------------------------------|
| 31:8 | RSVD  | 0x0   | RO | This bit field is reserved for future use. |
| 7:0  | ECNTH | 0x0   | RW | ETU counter high register.                 |

**18.3.2.13GTR Register**

ISO7816 guard time configuration

OFFSET: 0x00000030

INSTANCE 0 ADDRESS: 0x40080030

ISO7816 guard time configuration

Table 1085: GTR Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |     |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0   | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | GTR |   |   |   |   |   |   |   |   |   |   |

Table 1086: GTR Register Bits

| Bit  | Name | Reset | RW | Description                                |
|------|------|-------|----|--------------------------------------------|
| 31:8 | RSVD | 0x0   | RO | This bit field is reserved for future use. |
| 7:0  | GTR  | 0xff  | RW | Guard time configuration register.         |

**18.3.2.14RETXCNT Register**

ISO7816 resend count

OFFSET: 0x00000034

INSTANCE 0 ADDRESS: 0x40080034

ISO7816 resend count

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7       | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | RETXCNT |   |   |   |   |   |   |   |   |

| Bit  | Name    | Reset | RW | Description                                |
|------|---------|-------|----|--------------------------------------------|
| 31:4 | RSVD    | 0x0   | RO | This bit field is reserved for future use. |
| 3:0  | RETXCNT | 0x4   | RW | Resend count register.                     |

## ISO7816 resent count inquiry

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |            |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------------|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0          | 0 | 0 | 0 | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7          | 6 | 5 | 4 | 3 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | RETxCNTRMI |   |   |   |   |

| Bit  | Name       | Reset | RW | Description                                |
|------|------------|-------|----|--------------------------------------------|
| 31:4 | RSVD       | 0x0   | RO | This bit field is reserved for future use. |
| 3:0  | RETXCNTRMI | 0x0   | RW | Resent count inquiry register.             |

**OFFSET:** 0x00000100

**INSTANCE 0 ADDRESS:** 0x40080100

SCARD external clock control

**Table 1091: CLKCTRL Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1   | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | APBCLKEN | CLKEN  |

**Table 1092: CLKCTRL Register Bits**

| Bit  | Name     | Reset | RW | Description                                     |
|------|----------|-------|----|-------------------------------------------------|
| 31:2 | RSVD     | 0x0   | RO | This bit field is reserved for future use.      |
| 1    | APBCLKEN | 0x0   | RW | Enable the SCARD APB clock to run continuously. |
| 0    | CLKEN    | 0x0   | RW | Enable the serial source clock for SCARD.       |

## 19. ADC and Temperature Sensor Module

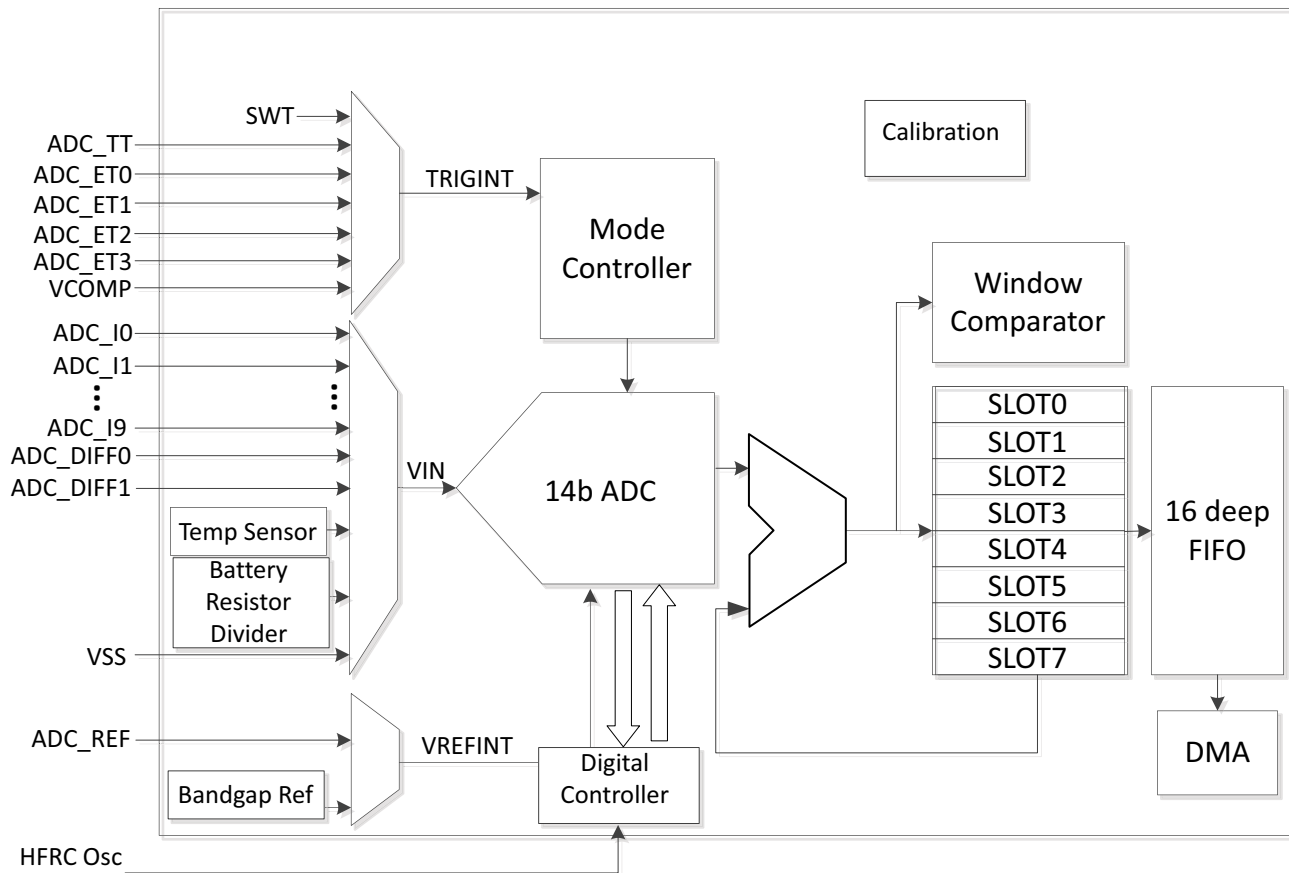


**Figure 91. Block Diagram for ADC and Temperature Sensor**

### 19.1 Features

The Analog-to-Digital Converter (ADC) and Temperature Sensor Module includes a single-ended 14 bit multi-channel Successive Approximation Register (SAR) ADC as shown in Figure 91.

Key features include:

- 14 user-selectable channels with sources including:
  - External pins
    - 10 single ended external pins
    - 2 differential pairs
  - Internal voltage (VSS)
  - Voltage divider (battery)
  - Temperature sensor
- Configurable automatic low power control between scans
- Optional Battery load enable for voltage divider measurement
- Configurable for 14 / 12 / 10 / 8 bit ADC Precision Modes
- User-selectable on-chip and off-chip reference voltages

- Single shot, repeating single shot, scan, and repeating scan modes
- User-selectable clock source for variable sampling rates
- Automatically accumulate and scale module for hardware averaging of samples
- A 16-entry FIFO and DMA capability for storing measurement results and maximizing MCU sleep time
- Up to 2.67 MS/s effective continuous, multi-slot sampling rate
- Interrupts for FIFO full, FIFO almost full, Scan Complete, Conversion Complete, Window Incursion Window Excursion

## 19.2 Functional Overview

The Apollo3 Blue SoC integrates a sophisticated 14-bit successive approximation Analog to Digital Converter (ADC) block for sensing both internal and external voltages. The block provides eight separately managed conversion requests, called slots. The result of each conversion requests is delivered to a 16 deep FIFO. Firmware can utilize various interrupt notifications to determine when to collect the sampled data from the FIFO. This block is extremely effective at automatically managing its power states and its clock sources.

### 19.2.1 Clock Source and Dividers

When the ADC block is enabled and has an active scan in progress, it requests a clock source. There is an automatic hardware hand shake between the clock generator and the ADC. If the ADC is the only block requesting an HFRC based clock, then the HFRC will be automatically started. The ADC can be configured to completely power down the HFRC between scans if the startup latency is acceptable or it can leave the HFRC powered on between scans if the application requires low latency between successive conversions.

The ADC supports 2 HFRC clock frequency modes: 24MHz and 48MHz HFRC. 48MHz mode is the default mode of operation.

### 19.2.2 Channel Analog Mux

As shown in Figure 91, the ADC block contains a channel analog multiplexer on the input port to the analog to digital converter. Twelve (12) of the GPIO pins on the Apollo3 Blue SoC can be selected as analog inputs to the ADC through a combination of settings in the PAD configuration registers in the GPIO block and settings in the configuration registers described below.

The analog mux channels are connected as follows:

1. ADC\_EXT0 external GPIO pin connection.
2. ADC\_EXT1 external GPIO pin connection.
3. ADC\_EXT2 external GPIO pin connection.
4. ADC\_EXT3 external GPIO pin connection.
5. ADC\_EXT4 external GPIO pin connection.
6. ADC\_EXT5 external GPIO pin connection.
7. ADC\_EXT6 external GPIO pin connection.
8. ADC\_EXT7 external GPIO pin connection.
9. ADC\_EXT8 external GPIO pin connection.
10. ADC\_EXT9 external GPIO pin connection.
11. ADC\_EXT\_DIFF0P external GPIO connection (muxed with EXT8)  
ADC\_EXT\_DIFF0N external GPIO connection (muxed with EXT9)

12. ADC\_EXTDIFF1P external GPIO pin connection.  
ADC\_EXT DIFF1N external GPIO pin connection.
13. ADC\_TEMP internal temperature sensor.
14. ADC\_DIV3 internal voltage divide by 3 connection to the input power rail.
15. ADC\_VSS internal ground connection.

EXT8-9 can be configured as a differential pair providing an additional differential pair or up to 2 single-ended inputs from GPIO.

Refer to the detailed register information below for the exact coding of the channel selection bit field. Also the use of the voltage divider and switchable load resistor are detailed below.

### 19.2.3 Triggering and Trigger Sources

The ADC block can be initially triggered from one of six sources. Once triggered, it can be repetitively triggered from counter/timer number three (3). Four of the GPIO pins on the Apollo3 Blue SoC can be selected as trigger inputs to the ADC through a combination of settings in the PAD configuration registers in the GPIO block and settings in SLOT configuration registers described below. In addition, there is a software trigger and a VCOMP trigger source. The trigger sources are as follows:

0. ADC\_EXT0 (TRIG0) external GPIO pin connection.
1. ADC\_EXT1 (TRIG1) external GPIO pin connection.
2. ADC\_EXT2 (TRIG2) ADC\_EXT3 (TRIG3) VCOMP Voltage Comparator trigger.
3. <Reserved>
4. <Reserved>
5. ADC\_SWT software trigger.

Refer to the ADC Configuration Register in the detailed register information section below. The initial trigger source is selected in the TRIGSEL field, as shown below. In addition, one can select a trigger polarity in this register applicable for any of the trigger sources except the software trigger. A number of GPIO pin trigger sources are provided to allow pin configuration flexibility at the system definition and board layout phases of development.

The software trigger is effected by writing 0x37 to the software trigger register in the ADC block. Note that writing 0x37 to the software trigger register will initiate a scan regardless of which trigger source is selected. However, a hardware trigger source will not initiate a scan if the software trigger has been selected.

When the ADC is configured for repeat mode, the initial trigger must be initiated by a software trigger and subsequent scans will be initiated at a repeating rate set by the counter/timer3 configuration. The discussion of the use of counter/timer three as a source for repetitive triggering is deferred until later in this chapter.

#### NOTE

A trigger event applies to all enabled slots as a whole. Individual slots can not be separately triggered.

### 19.3 Voltage Reference Sources

The Apollo3 Blue SoC ADC supports one of two reference sources each with two different voltage options to be used for the analog to digital conversion step:

- Internal 2.0V reference source
- Internal 1.5V reference source
- External 2.0V reference source
- External 1.5V reference source

#### 19.3.1 Eight Automatically Managed Conversion Slots

The ADC block contains eight conversion slot control registers, one for each of the eight slots. These can be thought of as time slots in the conversion process. When a slot is enabled, it participates in a conversion cycle. The ADC's mode controller cycles through up to eight time slots each time it is triggered. For each slot that is enabled, a conversion cycle is performed based on the settings in the slot configuration register for that slot. Slots are enabled when the LSB of the slot configuration is set to one. See "One SLOT Configuration Register" on page 750.

**Table 1093: One SLOT Configuration Register**

|          |        |        |        |                              |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |                   |        |          |        |        |        |             |             |        |        |        |        |
|----------|--------|--------|--------|------------------------------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------------|--------|----------|--------|--------|--------|-------------|-------------|--------|--------|--------|--------|
| 3<br>1   | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7                       | 2<br>6 | 2<br>5   | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1            | 1<br>0 | 0<br>9   | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5      | 0<br>4      | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| Reserved |        |        |        | #<br>Samples<br>to<br>Accum. |        | Reserved |        |        |        |        |        |        |        |        |        |        |        |        |        | CHANNEL<br>SELECT |        | Reserved |        |        |        | WINDOW_COMP | SLOT_ENABLE |        |        |        |        |

The window comparator enable will be discussed in a subsequent section, below. See "DMA" on page 754. The number of samples to accumulate will also be explained in a subsequent section. See "Automatic Sample Accumulation and Scaling" on page 751.

As described above, the channel select bit field specifies which one of the analog multiplexer channels will be used for the conversions requested for an individual slot. See "Channel Analog Mux" on page 748.

Each of the eight conversion slots can independently specify:

- Analog Multiplexer Channel Selection
- Participation in Window Comparisons
- Automatic Sample Accumulation

#### 19.3.2 ADC Sample-and-Hold Time

The ADC on the Apollo3 Blue is a successive approximation register (SAR) ADC with 4 pF input capacitance. If there is large input impedance to the ADC input, then the sample-and-hold time must be increased to ensure the 4 pF sampling capacitor has time to settle.

The Apollo3 Blue ADC sample-and-hold time is fixed at 5 ADC clock cycles. The ADC has two options for ADC sampling clock, HFRC or HFRC/2. This results in a sample-and-hold time of approximately 0.2  $\mu$ s for 24 MHz HFRC/2 ADC clock or about 0.1  $\mu$ s for the default 48 MHz HFRC ADC clock.

For high impedance signal sources, the maximum 0.2  $\mu$ s sample time may not be long enough to charge the internal sampling capacitor. One option for working with large impedance sources such as a large resistor divider is to add a 100 nF or larger cap to the ADC pin. This cap will buffer the voltage level so that the ADC sampling cap will take its charge from this cap. A 100 nF cap is large enough that the 4pF sampling cap should not perturb the voltage on the cap in any significant way. This is effective for



measuring stable or slow changing signals such as battery voltage. For fast signals, the 100 nF capacitor will work with the source impedance to act as an RC filter which will limit the effective input frequency.

Another option for measuring high impedance source is to add an external buffer.

### 19.3.3 Automatic Sample Accumulation and Scaling

The ADC block offers a facility for the automatic accumulation of samples without requiring core involvement. Thus up to 128 samples per slot can be accumulated without waking the core. This facilitates averaging algorithms to smooth out the data samples. Each slot can request from 1 to 128 samples to be accumulated before producing a result in the FIFO.

#### NOTE

Each slot can independently specify how many samples to accumulate so results can enter the FIFO from different slots at different rates.

All slots write their accumulated results to the FIFO in exactly the same format regardless of how many samples were accumulated to produce the results. Table 1094 shows the format that is used by all conversions. This is a scaled integer format with a 6-bit fractional part. The precision mode for each determines the format for the FIFO data. 14-bit, 12-bit, 10-bit and 8-bit precision modes respectively correspond to 14.6, 12.6, 10.6 and 8.6 formats.

#### NOTE

If the accumulation control for a slot is set for one sample with 14-bit precision, then the 14-bit value coming from the ADC will be inserted into bits 6 through 19 in this format and the lower 6 bits are zero'd. If the accumulation control for a slot is set for two samples with 8-bit precision, then the 8-bit average integer value will be placed in bits 6 through 13, the 1 bit fractional number is placed in bit 5 and the lower 5 fractional bits are zero'd.

**Table 1094: 14.6 ADC Sample Format**

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|----------------|---|---|---|---|---|
| 1              | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0              | 0 | 0 | 0 | 0 | 0 |
| 9              | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5              | 4 | 3 | 2 | 1 | 0 |
| 14-bit Integer |   |   |   |   |   |   |   |   |   |   |   |   |   | 6-bit Fraction |   |   |   |   |   |

Each slot contains a 21-bit accumulator as shown in Table 1095, "Per Slot Sample Accumulator," on page 752. When the ADC is triggered for the last sample of an accumulation, the accumulator is cleared and the FIFO will be written with the final average value. When each active slot obtains a sample from the ADC, it is added to the value in its accumulator.

If a slot is set to accumulate 128 samples per result then the accumulator could reach a maximum value of:

$$128 \cdot (2^{14} - 1) = 128 \cdot 16383 = 2097024 = 2^{21} - 128, \text{ hence the 21 bit accumulator.}$$

### Table 1095: Per Slot Sample Accumulator

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2           | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0           | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 |
| Accumulator |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1096 shows the maximum possible accumulated values. Note that 64 sample accumulation produces a result that is exactly correct for the 14.6 format results so it is copied unscaled in to the FIFO.

Furthermore, note that 128 sample accumulation can produce a result that is too large for the 14.6 format since it may result in 7 bits of valid fractional data. All of the remaining sample accumulation settings must have their results left shifted to produce the desired 14.6 format.

Finally, note that for the 128 sample accumulation case, the LSB of the accumulator is discarded when the results are written to the FIFO.

Most importantly, note that for the 1 sample accumulation case, the 14-bit converter value is shifted left by six to produce the 14.6 format to write into the FIFO.

### Table 1096: Accumulator Scaling

[illegible]

### 19.3.4 Sixteen Entry Result FIFO

All results written to the FIFO have exactly the same format as shown in Table 1097. The properly scaled accumulation results are written the lower half word in the aforementioned 14.6 format. Since each slot can produce results at a different rate, the slot number generating the result is also written to the FIFO along with the total valid entry count within the FIFO.

### Table 1097: FIFO Register

|             |                 |            |        |        |        |        |        |        |        |        |        |        |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
|-------------|-----------------|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|--|--|--|
| 3<br>1      | 3<br>0          | 2<br>9     | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8    | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |  |  |  |  |  |
| R<br>S<br>V | Slot<br>Number. | FIFO Count |        |        |        |        |        |        |        |        |        |        | FIFO DATA |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |

Table 1098: 14-bit FIFO Data Format

| # Samples | 1    | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-----------|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 128       | 14.6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 64        | 14.6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 32        | 14.5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | X |   |
| 16        | 14.4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | X | X |   |
| 8         | 14.3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | X | X | X |   |
| 4         | 14.2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | X | X | X | X |
| 2         | 14.1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   | X | X | X | X | X |
| 1         | 14   |   |   |   |   |   |   |   |   |   |   |   |   |   | X | X | X | X | X | X |

Table 1099: 12-bit FIFO Data Format

| # Samples | 1 | 1 | 1    | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-----------|---|---|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 128       | 0 | 0 | 12.6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 64        | 0 | 0 | 12.6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 32        | 0 | 0 | 12.5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | X |   |
| 16        | 0 | 0 | 12.4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   | X | X |   |
| 8         | 0 | 0 | 12.3 |   |   |   |   |   |   |   |   |   |   |   |   |   | X | X | X |   |
| 4         | 0 | 0 | 12.2 |   |   |   |   |   |   |   |   |   |   |   |   |   | X | X | X | X |
| 2         | 0 | 0 | 12.1 |   |   |   |   |   |   |   |   |   |   |   |   | X | X | X | X | X |
| 1         | 0 | 0 | 12   |   |   |   |   |   |   |   |   |   |   |   | X | X | X | X | X | X |

Table 1100: 10-bit FIFO Data Format

| # Samples | 1 | 1 | 1 | 1 | 1  | 1 | 1 | 1 | 1 | 1 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-----------|---|---|---|---|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 128       | 0 | 0 | 0 | 0 | 10 |   |   |   |   |   |   |   |   |   | 6 |   |   |   |   |   |
| 64        | 0 | 0 | 0 | 0 | 10 |   |   |   |   |   |   |   |   |   | 6 |   |   |   |   |   |
| 32        | 0 | 0 | 0 | 0 | 10 |   |   |   |   |   |   |   |   |   | 5 |   |   |   | X |   |
| 16        | 0 | 0 | 0 | 0 | 10 |   |   |   |   |   |   |   |   |   | 4 |   |   | X | X |   |
| 8         | 0 | 0 | 0 | 0 | 10 |   |   |   |   |   |   |   |   |   | 3 |   | X | X | X |   |
| 4         | 0 | 0 | 0 | 0 | 10 |   |   |   |   |   |   |   |   |   | 2 | X | X | X | X |   |
| 2         | 0 | 0 | 0 | 0 | 10 |   |   |   |   |   |   |   |   |   | 1 | X | X | X | X | X |
| 1         | 0 | 0 | 0 | 0 | 10 |   |   |   |   |   |   |   |   |   | X | X | X | X | X | X |

**Table 1101: 8-bit FIFO Data Format**

| # Samples | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9   | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-----------|---|---|---|---|---|---|---|---|---|---|-----|---|---|---|---|---|---|---|---|---|
| 128       | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |   | 8.6 |   |   |   |   |   |   |   |   |   |
| 64        | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |   | 8.6 |   |   |   |   |   |   |   |   |   |
| 32        | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |   | 8.5 |   |   |   |   |   |   |   |   | X |
| 16        | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |   | 8.4 |   |   |   |   |   |   |   | X | X |
| 8         | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |   | 8.3 |   |   |   |   |   |   | X | X | X |
| 4         | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |   | 8.2 |   |   |   |   |   | X | X | X | X |
| 2         | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |   | 8.1 |   |   |   | X | X | X | X | X | X |
| 1         | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |   | 8   |   |   | X | X | X | X | X | X | X |

Software accesses the contents of the FIFO through the ADCFIFO register. This register will be written by the ADC digital controller simultaneous with the conversion complete interrupt (if enabled) after accumulating the number of samples to average configured for the slot. The ADCFIFO register contains the earliest written data, the number of valid entries within the FIFO and the slot number associated with the FIFO data. Thus the interrupt handler servicing ADC interrupts can easily distribute results to different RTOS tasks by simply looking up the target task using the slot number from the FIFO register.

Three other features greatly simplify the task faced by firmware developers of interrupt service routines for the ADC block:

1. The FIFO count bit field is not really stored in the FIFO. Instead it is a live count of the number of valid entries currently residing in the FIFO. If the interrupt service routine was entered because of a conversion then this value will be at least one. When the interrupts routine is entered it can pull successive sample values from the FIFO until this bit field goes to zero. Thus avoiding wasteful re-entry of the interrupt service routine. Note that no further I/O bus read is required to determine the FIFO depth.
2. This FIFO has no read side effects. This is important to firmware for a number of reasons. One important result is that the FIFO register can be freely read repetitively by a debugger without affecting the state of the FIFO. In order to pop this FIFO and look at the next result, if any, one simply writes any value to this register. Any time the FIFO is read, then the compiler has gone to the trouble of generating an address for the read. To pop the FIFO, one simply writes to that same address with any value. This give firmware a positive handshake mechanism to control exactly when the FIFO pops.
3. When a conversion completes resulting in hardware populating the 12th valid FIFO entry, the FIFO\_OVR1 (FIFO 75% full) interrupt status bit will be set. When a conversion completes resulting in hardware populating the 8th valid FIFO entry, the FIFO\_OVR2 interrupt status bit will be set. In a FIFO full condition with 16 valid entries, the ADC will not overwrite existing valid FIFO contents. Before subsequent conversions will populate the FIFO with conversion data, software must free an open FIFO entry by writing to the FIFO Register or by resetting the ADC by disabling and enabling the ADC using the ADC\_CFG register.

### 19.3.5 DMA

When enabled, the ADC can use DMA to keep its FIFO serviced and transfers samples to SRAM. Generally, DMA should be used when the desired use case is autonomous recording of samples to a pre-allocated buffer in SRAM. The buffer may be byte-aligned but must be a word-multiple in size.

The general steps to enabling ADC DMA are as follows:

1. Ensure SRAM target(s) are powered up.

2. Power up the ADC if it's not already on.
3. Configure ADC slots and ADCCFG register.
4. Set DMATOTCOUNT to the total amount of data to transfer. While the DMA is in progress, this register contains a live count of the remaining data to transfer.
5. Configure DMATARGADDR, the SRAM target byte address, for the location in memory of the first sample to be written by DMA.
6. Select a DMA trigger level by configuring DMATRIGEN to either FIFO 100% full or FIFO 75% full. This defines what conditions will initiate a DMA transfer.
7. Configure DMACFG, including setting DMAEN.
8. Trigger the ADC multiple times, using either the timer trigger (when using repeat mode), multiple SW triggers, or multiple external triggers.

Each time the FIFO fills to the appropriate level, the DMA will start and the FIFO will be drained. During this time, depending on the particular use case, it may be appropriate to put the MCU to sleep or deep sleep.

To monitor progress of the DMA, there is a DMASTAT status register. When the DMA is actively transferring data from the ADC FIFO to SRAM, DMATIP will be asserted. At the end of an entire transfer (DMATOTCOUNT reaches 0), then DMACPL will be set. Last, but not least, if an error occurs due to the DMA being asked to perform an illegal operation, DMAERR will be asserted. Causes of a DMA error include:

- DMA transfers to address outside SRAM memory region
- Popping from the FIFO while the DMA is underway

Care must be taken to avoid powering down SRAM that the DMA wants to write to.

If the DMA complete interrupt is enabled, this can be used to wake the MCU from sleep or deep sleep and communicate that the SRAM buffer has been filled and is ready for processing. The DMA error interrupt may also be used to signal the MCU that there is a problem with the DMA configuration.

To recover from a DMA error, disable any repeating trigger, disable the DMA via DMACFG's DMAEN field, and manually drain the ADC FIFO. Then follow the procedure described above for enabling ADC DMA while correcting the configuration issue.

Some additional capabilities of the DMA include:

- ADC auto-power-off upon DMA completion: This feature, enabled via the DMACFG register's DPWROFF field, allows the ADC to power off once DMATOTCOUNT reaches zero. Note that this feature is incompatible with waking the MCU from sleep or deep sleep using the DMA complete interrupt.
- Masking FIFOCNT and SLOTNUM data from FIFO data: The DMA engine can be configured to write only samples to SRAM without the FIFOCNT and SLOTNUM data. This allows the MCU to skip the manual process of masking the potentially undesirable upper bits of each data value written to SRAM.

### 19.3.6 Window Comparator

A window comparator is provided which can generate an interrupt whenever a sample is determined to be inside the window limits or outside the window limits. These are two separate interrupts with separate interrupt enables. Thus one can request an interrupt any time a specified slot makes an excursion outside the window comparator limits.

The window comparison function has an option for comparing the contents of the limits registers directly with the FIFO data (default) or for scaling the limits register depending on the precision mode selected for the slots.

Firmware has to participate in the determination of whether an actual excursion occurred. The window comparator interrupts set their corresponding interrupt status bits continuously whenever the inside or outside condition is true. Thus if one enables and receives an “excursion” interrupt then the status bit can't

be usefully cleared while the ADC slot is sampling values outside the limits. That is, if one receives an excursion interrupt and clears the status bit, it will immediately set again if the next ADC sample is still outside the limits. Thus firmware should reconfigure the interrupt enables upon receiving an excursion interrupt so that the next interrupt will occur when an ADC sample ultimately goes back inside the window limits. Firmware may also want to change the windows comparator limit at that time to utilize a little hysteresis in these window comparator decisions.

**Table 1102: Window Comparator Lower Limit Register**

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1           | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9           | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Lower Limit |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 1103: Window Comparator Upper Limit Register**

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1           | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9           | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Upper Limit |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

The determination of whether a sample is *inside* or *outside* of the window limits is made by comparing the data format of the slot result written to the FIFO with the 20 bit window limits. An ADC sample is inside if the following relation is true:

$$14.6 \text{ Lower Limit} \leq \text{ADC SAMPLE} \leq 14.6 \text{ Upper Limit}$$

Thus setting both limits to the same value, say 700.0 (0x2BC<<6 = 0xAF00), will only produce an inside interrupt when the ADC sample is exactly 700.0 (0xAF00). Furthermore, note that if the lower limit is set to zero (0x00000) and the upper limit is set to 0xFFFFF then all accumulated results from the ADC will be inside the window limits and no excursion interrupts can ever be generated. In fact, in this case, the incursion interrupt status bit will be set for every sample from any active slot with its window comparator bit enabled. If the incursion interrupt is enabled then an interrupt will be generated for every such sample written to the FIFO.

The window comparator limits are a shared resource and apply to all active slots which have their window comparator bits enabled. If window limits are enabled for multiple enabled slots with different precision modes, the window comparison function can be configured to automatically scale the 14.6 upper and lower limits value to match the corresponding precision mode format for the enabled slots through the ADCSCWLIM register.

## 19.4 Operating Modes and the Mode Controller

The mode controller of Figure 91 is a sophisticated state machine that manages not only the time slot conversions but also the power state of the ADC analog components and the hand shake with the clock generator to start the HFRC clock source if required. Thus once the various control registers are initialized, the core can go to sleep and only wake up when there are valid samples in the FIFO for the interrupt service routine to distribute. Firmware does not have to keep track of which block is using the HFRC clock source since the devices in conjunction with the clock generator manage this automatically. The ADC block's mode controller participates in this clock management protocol.

From a firmware perspective, the ADC mode controller is controlled from bit fields in the ADC configuration register and from the various bit fields in the eight slot configuration registers.

The most over-riding control is the ADC enable bit in the PWR\_CTRL\_DEVICE\_EN register of the power control block. This bit must be set to '1' to enable power to the ADC subsystem. Furthermore, the ADCEN bit in the ADC configuration register is a global functional enable bit for general ADC operation. Setting this bit to zero has many of the effects of a software reset, such as resetting the FIFO pointers. Setting this bit to one enables the mode controller to examine its inputs and proceed to autonomously handle analog to digital conversions.

An ADC scan is the process of sampling the analog voltages at each input of the ADC of Figure 91 following a trigger event. If the ADC is enabled and one or more slots are enabled, a scan is initiated after the ADC receives a trigger through one of the configured trigger sources. The scan flowchart diagram can be found in Figure 92

An ADC conversion is the process of averaging measurements following one or more scans for each slot that is enabled.

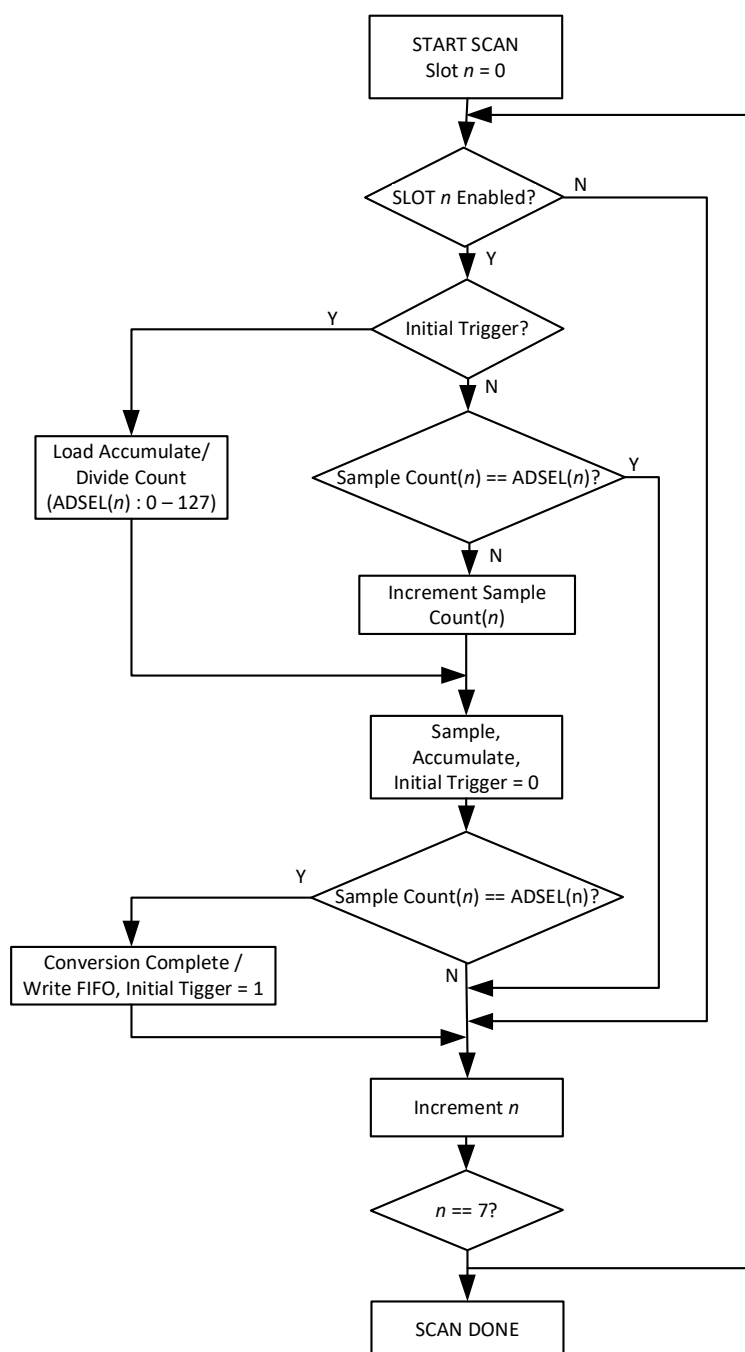


Figure 92. Scan Flowchart

### 19.4.1 Single Mode

In single mode, one trigger event produces one scan of all enabled slots. Depending on the settings of the accumulate and scale bit field for the active slots, this may or may not result in writing a result to the FIFO. When the trigger source is an external pin then one external pin transition of the proper polarity will result in one complete scan of all enabled slots. If the external pin is connected to a repetitive pulse source then repeating scans of all enabled slots are run at the input trigger rate.



### 19.4.2 Repeat Mode

Counter/Timer 3A has a bit in its configuration register that allows it to be a source of repetitive triggers for the ADC. If counter/timer 3 is initialized for this purpose then one only needs to turn on the RPTEN bit in the ADC configuration registers to enable this mode in the ADC.

#### NOTE

The mode controller does **not** process these repetitive triggers from the counter/timer until a first triggering event occurs from the normal trigger sources. Thus one can select software triggering in the TRIGSEL field and set up all of the other ADC registers for the desired sample acquisitions. Then one can write to the software trigger register and the mode controller will enter REPEAT mode. In repeat mode, the mode controller waits only for each successive counter/timer 3A input to launch a scan of all enabled slots.

### 19.4.3 Low Power Modes

An application may use the ADC in one of three power modes. Each mode has different implications from overall energy perspective relative to the startup latency from trigger-to-data as well as the standby power consumed. The table below is intended to provide guidance on which mode may be more effective based on latency tolerance. This table should only be used as a reference.

**Table 1104: ADC Power Modes**

| LPMODE | Definition                                                                                                                         | Entry Latency                           |
|--------|------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| 0      | ADC is kept active continuously (used in continuous sampling scenarios)                                                            | 0<br>(requires initial calibration)     |
| 1      | ADC is mostly powered off between samples, HFRC is duty cycled between samples. No calibration required after initial calibration) | <70μs<br>(shorter for lower resolution) |
| 2      | ADC is completely powered off between samples, HFRC is duty cycled between samples. Requires recalibration for each conversion.    | <660μs                                  |

#### 19.4.3.1 Low Power Mode 0

Low Power Mode 0 (LPMODE0) enables the lowest latency from trigger to conversion data available. This mode leaves the reference buffer powered on between scans to bypass any startup latency between triggers<sup>1</sup>.

#### 19.4.3.2 Low Power Mode 1

Low power mode 1 (LPMODE1) is a power mode whereby the ADC Digital Controller will automatically power off the ADC clocks, analog ADC and reference buffer between scans while maintaining ADC calibration data. This mode may operate autonomously without CPU interaction, even while the CPU is in sleep or deep sleep mode for repeat mode triggers or hardware triggers. While operating in this mode, the ADC Digital Controller may be used to burst through multiple scans enabling max sample rate data collection if the triggers are running at a rate at least 2x the maximum sample rate until the final scan has completed. When a scan completes without a pending trigger latched, the ADC subsystem will enter a low power state until the next trigger event.

1. The reference buffer will not be powered on when the ADC is configured for external reference

### 19.4.3.3 Low Power Mode 2

If desirable, for applications requiring infrequent conversions, software may choose to operate the ADC in LPMODE2, whereby the full ADC Analog and Digital subsystem remains completely powered off between samples. In this use case, the software configures the power control ADC enable register followed by configuring the ADC slots and the ADC configuration register between conversion data collections, followed by disabling the ADC in the power control ADC enable register. Although this mode provides extremely low power operation, using the ADC in this mode will result in a cold start latency including reference buffer stabilization delay and a calibration sequence 100's of microseconds, nominally. In this mode, the ADC must be reconfigured prior to any subsequent ADC operation.

## 19.5 Interrupts

The ADC has 6 interrupt status bits with corresponding interrupt enable bits, as follows:

1. Conversion Complete Interrupt
2. Scan Complete Interrupt
3. FIFO Overflow Level 1
4. FIFO Overflow Level 2
5. Window Comparator Excursion Interrupt (a.k.a. outside interrupt)
6. Window Comparator Incursion Interrupt (a.k.a. inside interrupt)
7. DMA transfer complete
8. DMA error condition

The window comparator interrupts are discussed above. See “Window Comparator” on page 755.

There are two interrupts based on the *fullness* of the FIFO. When the respective interrupts are enabled, Overflow 1 fires when the FIFO reaches 75% full, viz. 6 entries. Overflow 2 fires when the FIFO is completely full.

When enabled, the conversion complete interrupt fires when a single slot completes its conversion and the resulting conversion data is pushed into the FIFO.

When enabled, the scan complete interrupt indicates that all enabled slots have sampled their respective channels following a trigger event.

When a single slot is enabled and programmed to average over exactly one measurement and the scan complete and conversion complete interrupts are enabled, a trigger event will result in the conversion complete and scan complete interrupts firing simultaneously upon completion of the ADC scan. Again, if both respective interrupts are enabled and a single slot is enabled and programmed to average over 128 measurements, 128 trigger events result in 128 scan complete interrupts and exactly one conversion complete interrupt following the 128 ADC scans. When multiple slots are enabled with different settings for the number of measurements to average, the conversion complete interrupt signifies that one or more of the conversions have completed and the FIFO contains valid data for one or more of the slot conversions.

The DMA transfer complete interrupt is triggered upon completion of the currently configured DMA.

The DMA error interrupt is triggered if the DMA has been instructed to perform an illegal operation such as:

- writing outside SRAM
- writing to powered-down SRAM
- popping from the FIFO while the DMA is underway

The DMA supports none of these features.

## 19.6 Voltage Divider and Switchable Battery Load

The Apollo3 Blue SoC's ADC includes a switchable voltage divider that enables the ADC to measure the input voltage to the VDD rail. In most systems this will be the battery voltage applied to the SoC. The voltage divider is only switched on when one of the active slots is selecting analog mux channel 15. That is only when the mode controller is ultimately triggered and powers up the ADC block for a conversion scan of all active slots. Otherwise, the voltage divider is turned off.

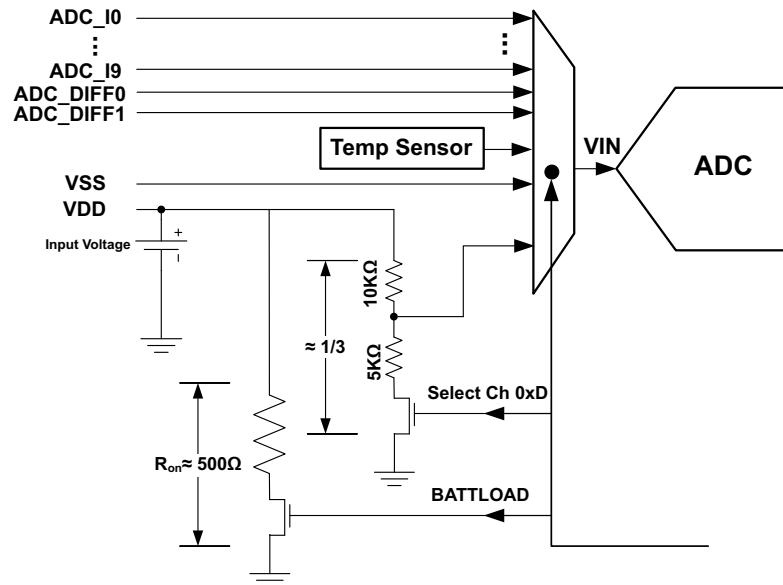


**Figure 93. Switchable Battery Load**

The switchable load resistor is enabled by the BATTLOAD bit as shown in the ADCBATTLOAD Register of the MCUCTRL Registers.

This feature is used to help estimate the health of the battery chemistry by estimating the internal resistance of the battery.

## 19.7 ADC Registers

### Analog Digital Converter Control

**INSTANCE 0 BASE ADDRESS:**0x50010000

This is the detailed description of the Analog Digital Converter Register Block. The ADC Register Block contains the software control for enablement, slot configuration, clock configuration, trigger configuration, temperature sensor enablement, power modes, accumulate/divide, window comparison and interrupt control for the ADC functional unit.

### 19.7.1 Register Memory Map

**Table 1105: ADC Register Map**

| Address(s) | Register Name | Description                             |
|------------|---------------|-----------------------------------------|
| 0x50010000 | CFG           | Configuration Register                  |
| 0x50010004 | STAT          | ADC Power Status                        |
| 0x50010008 | SWT           | Software trigger                        |
| 0x5001000C | SL0CFG        | Slot 0 Configuration Register           |
| 0x50010010 | SL1CFG        | Slot 1 Configuration Register           |
| 0x50010014 | SL2CFG        | Slot 2 Configuration Register           |
| 0x50010018 | SL3CFG        | Slot 3 Configuration Register           |
| 0x5001001C | SL4CFG        | Slot 4 Configuration Register           |
| 0x50010020 | SL5CFG        | Slot 5 Configuration Register           |
| 0x50010024 | SL6CFG        | Slot 6 Configuration Register           |
| 0x50010028 | SL7CFG        | Slot 7 Configuration Register           |
| 0x5001002C | WULIM         | Window Comparator Upper Limits Register |
| 0x50010030 | WLLIM         | Window Comparator Lower Limits Register |
| 0x50010034 | SCWLIM        | Scale Window Comparator Limits          |
| 0x50010038 | FIFO          | FIFO Data and Valid Count Register      |
| 0x5001003C | FIFOPR        | FIFO Data and Valid Count Register      |
| 0x50010200 | INTEN         | ADC Interrupt registers: Enable         |
| 0x50010204 | INTSTAT       | ADC Interrupt registers: Status         |
| 0x50010208 | INTCLR        | ADC Interrupt registers: Clear          |
| 0x5001020C | INTSET        | ADC Interrupt registers: Set            |
| 0x50010240 | DMATRIGEN     | DMA Trigger Enable Register             |
| 0x50010244 | DMATRIGSTAT   | DMA Trigger Status Register             |
| 0x50010280 | DMACFG        | DMA Configuration Register              |
| 0x50010288 | DMATOTCOUNT   | DMA Total Transfer Count                |
| 0x5001028C | DMATARGADDR   | DMA Target Address Register             |
| 0x50010290 | DMASTAT       | DMA Status Register                     |

## 19.7.2 ADC Registers

### 19.7.2.1 CFG Register

#### Configuration Register

**OFFSET:** 0x00000000

**INSTANCE 0 ADDRESS:** 0x50010000

The ADC Configuration Register contains the software control for selecting the clock frequency used for the SAR conversions, the trigger polarity, the trigger select, the reference voltage select, the low power mode, the operating mode (single scan per trigger vs. repeating mode) and ADC enable.

**Table 1106: CFG Register**

|        |        |        |        |        |        |        |        |        |        |        |        |         |         |        |        |        |        |           |        |        |        |        |        |        |        |        |        |        |        |        |        |       |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|--------|--------|--------|--------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9  | 1<br>8  | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3    | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |       |
| RSVD   |        |        |        |        |        | CLKSEL | RSVD   |        |        |        |        | TRIGPOL | TRIGSEL |        |        | RSVD   |        | DFIFORDEN | RSVD   |        | REFSEL |        | RSVD   |        |        |        |        | CKMODE | LPMODE | RPTEN  | RSVD   | ADCEN |

**Table 1107: CFG Register Bits**

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|---------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:26 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 25:24 | CLKSEL  | 0x0   | RW | Select the source and frequency for the ADC clock. All values not enumerated below are undefined.<br><br>OFF = 0x0 - Off mode. The HFRC or HFRC_DIV2 clock must be selected for the ADC to function. The ADC controller automatically shuts off the clock in it's low power modes. When setting ADCEN to '0', the CLKSEL should remain set to one of the two clock selects for proper power down sequencing.<br>HFRC = 0x1 - HFRC Core Clock divided by (CORESEL+1)<br>HFRC_DIV2 = 0x2 - HFRC Core Clock / 2 further divided by (CORESEL+1) |
| 23:20 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 19    | TRIGPOL | 0x0   | RW | This bit selects the ADC trigger polarity for external off chip triggers.<br><br>RISING_EDGE = 0x0 - Trigger on rising edge.<br>FALLING_EDGE = 0x1 - Trigger on falling edge.                                                                                                                                                                                                                                                                                                                                                               |
| 18:16 | TRIGSEL | 0x0   | RW | Select the ADC trigger source.<br><br>EXT0 = 0x0 - Off chip External Trigger0 (ADC_ET0)<br>EXT1 = 0x1 - Off chip External Trigger1 (ADC_ET1)<br>EXT2 = 0x2 - Off chip External Trigger2 (ADC_ET2)<br>EXT3 = 0x3 - Off chip External Trigger3 (ADC_ET3)<br>VCOMP = 0x4 - Voltage Comparator Output<br>SWT = 0x7 - Software Trigger                                                                                                                                                                                                           |

Table 1107: CFG Register Bits

| Bit   | Name      | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------|-----------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15:13 | RSVD      | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 12    | DFIFORDEN | 0x0   | RW | Destructive FIFO Read Enable. Setting this will enable FIFO pop upon reading the FIFOPR register.<br><br>DIS = 0x0 - Destructive Reads are prevented. Reads to the FIFOPR register will not POP an entry off the FIFO.<br>EN = 0x1 - Reads to the FIFOPR register will automatically pop an entry off the FIFO.                                                                                                                                                                                                                               |
| 11:10 | RSVD      | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 9:8   | REFSEL    | 0x0   | RW | Select the ADC reference voltage.<br><br>INT2P0 = 0x0 - Internal 2.0V Bandgap Reference Voltage<br>INT1P5 = 0x1 - Internal 1.5V Bandgap Reference Voltage<br>EXT2P0 = 0x2 - Off Chip 2.0V Reference<br>EXT1P5 = 0x3 - Off Chip 1.5V Reference                                                                                                                                                                                                                                                                                                 |
| 7:5   | RSVD      | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 4     | CKMODE    | 0x0   | RW | Clock mode register<br><br>LPCKMODE = 0x0 - Disable the clock between scans for LPMODE0. Set LPCKMODE to 0x1 while configuring the ADC.<br>LLCKMODE = 0x1 - Low Latency Clock Mode. When set, HFRC and the adc_clk will remain on while in functioning in LPMODE0.                                                                                                                                                                                                                                                                            |
| 3     | LPMODE    | 0x0   | RW | Select power mode to enter between active scans.<br><br>MODE0 = 0x0 - Low Power Mode 0. Leaves the ADC fully powered between scans with minimum latency between a trigger event and sample data collection.<br>MODE1 = 0x1 - Low Power Mode 1. Powers down all circuitry and clocks associated with the ADC until the next trigger event. Between scans, the reference buffer requires up to 50us of delay from a scan trigger event before the conversion will commence while operating in this mode.                                        |
| 2     | RPTEN     | 0x0   | RW | This bit enables Repeating Scan Mode.<br><br>SINGLE_SCAN = 0x0 - In Single Scan Mode, the ADC will complete a single scan upon each trigger event.<br>REPEATING_SCAN = 0x1 - In Repeating Scan Mode, the ADC will complete it's first scan upon the initial trigger event and all subsequent scans will occur at regular intervals defined by the configuration programmed for the CTTMRA3 internal timer until the timer is disabled or the ADC is disabled. When disabling the ADC (setting ADCEN to '0'), the RPTEN bit should be cleared. |
| 1     | RSVD      | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 0     | ADCEN     | 0x0   | RW | This bit enables the ADC module. While the ADC is enabled, the ADCCFG and SLOT Configuration register settings must remain stable and unchanged. All configuration register settings, slot configuration settings and window comparison settings should be written prior to setting the ADCEN bit to '1'.<br><br>DIS = 0x0 - Disable the ADC module.<br>EN = 0x1 - Enable the ADC module.                                                                                                                                                     |



**Table 1111: SWT Register Bits**

| Bit  | Name | Reset | RW | Description                                                                                                                             |
|------|------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD | 0x0   | RO | RESERVED.                                                                                                                               |
| 7:0  | SWT  | 0x0   | RW | Writing 0x37 to this register generates a software trigger.<br>GEN_SW_TRIGGER = 0x37 - Writing this value generates a software trigger. |

**19.7.2.4 SL0CFG Register****Slot 0 Configuration Register****OFFSET:** 0x0000000C**INSTANCE 0 ADDRESS:** 0x5001000C

Slot 0 Configuration Register

**Table 1112: SL0CFG Register**

|        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1  | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        | ADSELO |        | RSVD   |        |        |        | PRMODE0 |        | RSVD   |        |        |        | CHSELO |        |        |        | RSVD   |        |        |        | WCEN0  |        | SLEN0  |        |        |        |        |        |

**Table 1113: SL0CFG Register Bits**

| Bit   | Name | Reset | RW | Description |
|-------|------|-------|----|-------------|
| 31:27 | RSVD | 0x0   | RO | RESERVED.   |



Table 1113: SL0CFG Register Bits

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|---------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26:24 | ADSEL0  | 0x0   | RW | <p>Select the number of measurements to average in the accumulate divide module for this slot.</p> <p>AVG_1_MSRMT = 0x0 - Average in 1 measurement in the accumulate divide module for this slot.</p> <p>AVG_2_MSRMTS = 0x1 - Average in 2 measurements in the accumulate divide module for this slot.</p> <p>AVG_4_MSRMTS = 0x2 - Average in 4 measurements in the accumulate divide module for this slot.</p> <p>AVG_8_MSRMT = 0x3 - Average in 8 measurements in the accumulate divide module for this slot.</p> <p>AVG_16_MSRMTS = 0x4 - Average in 16 measurements in the accumulate divide module for this slot.</p> <p>AVG_32_MSRMTS = 0x5 - Average in 32 measurements in the accumulate divide module for this slot.</p> <p>AVG_64_MSRMTS = 0x6 - Average in 64 measurements in the accumulate divide module for this slot.</p> <p>AVG_128_MSRMTS = 0x7 - Average in 128 measurements in the accumulate divide module for this slot.</p>                                                                                                                          |
| 23:18 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 17:16 | PRMODE0 | 0x0   | RW | <p>Set the Precision Mode For Slot.</p> <p>P14B = 0x0 - 14-bit precision mode</p> <p>P12B = 0x1 - 12-bit precision mode</p> <p>P10B = 0x2 - 10-bit precision mode</p> <p>P8B = 0x3 - 8-bit precision mode</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 15:12 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 11:8  | CHSEL0  | 0x0   | RW | <p>Select one of the 14 channel inputs for this slot.</p> <p>SE0 = 0x0 - single ended external GPIO connection to pad16.</p> <p>SE1 = 0x1 - single ended external GPIO connection to pad29.</p> <p>SE2 = 0x2 - single ended external GPIO connection to pad11.</p> <p>SE3 = 0x3 - single ended external GPIO connection to pad31.</p> <p>SE4 = 0x4 - single ended external GPIO connection to pad32.</p> <p>SE5 = 0x5 - single ended external GPIO connection to pad33.</p> <p>SE6 = 0x6 - single ended external GPIO connection to pad34.</p> <p>SE7 = 0x7 - single ended external GPIO connection to pad35.</p> <p>SE8 = 0x8 - single ended external GPIO connection to pad13.</p> <p>SE9 = 0x9 - single ended external GPIO connection to pad12.</p> <p>DF0 = 0xA - differential external GPIO connections to pad12(N) and pad13(P).</p> <p>DF1 = 0xB - differential external GPIO connections to pad15(N) and pad14(P).</p> <p>TEMP = 0xC - internal temperature sensor.</p> <p>BATT = 0xD - internal voltage divide-by-3 connection.</p> <p>VSS = 0xE - Input VSS</p> |
| 7:2   | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 1     | WCEN0   | 0x0   | RW | <p>This bit enables the window compare function for slot 0.</p> <p>WCEN = 0x1 - Enable the window compare for slot 0.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 0     | SLEN0   | 0x0   | RW | <p>This bit enables slot 0 for ADC conversions.</p> <p>SLEN = 0x1 - Enable slot 0 for ADC conversions.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

**19.7.2.5 SL1CFG Register****Slot 1 Configuration Register****OFFSET:** 0x00000010**INSTANCE 0 ADDRESS:** 0x50010010

Slot 1 Configuration Register

**Table 1114: SL1CFG Register**

|        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1  | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        | ADSEL1 |        | RSVD   |        |        |        | PRMODE1 |        | RSVD   |        |        |        | CHSEL1 |        |        |        | RSVD   |        |        |        | WCEN1  |        | SLEN1  |        |        |        |        |        |

**Table 1115: SL1CFG Register Bits**

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|---------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:27 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 26:24 | ADSEL1  | 0x0   | RW | <p>Select the number of measurements to average in the accumulate divide module for this slot.</p> <p>AVG_1_MSRMT = 0x0 - Average in 1 measurement in the accumulate divide module for this slot.</p> <p>AVG_2_MSRMTS = 0x1 - Average in 2 measurements in the accumulate divide module for this slot.</p> <p>AVG_4_MSRMTS = 0x2 - Average in 4 measurements in the accumulate divide module for this slot.</p> <p>AVG_8_MSRMT = 0x3 - Average in 8 measurements in the accumulate divide module for this slot.</p> <p>AVG_16_MSRMTS = 0x4 - Average in 16 measurements in the accumulate divide module for this slot.</p> <p>AVG_32_MSRMTS = 0x5 - Average in 32 measurements in the accumulate divide module for this slot.</p> <p>AVG_64_MSRMTS = 0x6 - Average in 64 measurements in the accumulate divide module for this slot.</p> <p>AVG_128_MSRMTS = 0x7 - Average in 128 measurements in the accumulate divide module for this slot.</p> |
| 23:18 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 17:16 | PRMODE1 | 0x0   | RW | <p>Set the Precision Mode For Slot.</p> <p>P14B = 0x0 - 14-bit precision mode</p> <p>P12B = 0x1 - 12-bit precision mode</p> <p>P10B = 0x2 - 10-bit precision mode</p> <p>P8B = 0x3 - 8-bit precision mode</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 15:12 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**Table 1115: SL1CFG Register Bits**

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|--------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11:8 | CHSEL1 | 0x0   | RW | Select one of the 14 channel inputs for this slot.<br><br>SE0 = 0x0 - single ended external GPIO connection to pad16.<br>SE1 = 0x1 - single ended external GPIO connection to pad29.<br>SE2 = 0x2 - single ended external GPIO connection to pad11.<br>SE3 = 0x3 - single ended external GPIO connection to pad31.<br>SE4 = 0x4 - single ended external GPIO connection to pad32.<br>SE5 = 0x5 - single ended external GPIO connection to pad33.<br>SE6 = 0x6 - single ended external GPIO connection to pad34.<br>SE7 = 0x7 - single ended external GPIO connection to pad35.<br>SE8 = 0x8 - single ended external GPIO connection to pad13.<br>SE9 = 0x9 - single ended external GPIO connection to pad12.<br>DF0 = 0xA - differential external GPIO connections to pad12(N) and pad13(P).<br>DF1 = 0xB - differential external GPIO connections to pad15(N) and pad14(P).<br>TEMP = 0xC - internal temperature sensor.<br>BATT = 0xD - internal voltage divide-by-3 connection.<br>VSS = 0xE - Input VSS |
| 7:2  | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 1    | WCEN1  | 0x0   | RW | This bit enables the window compare function for slot 1.<br><br>WCEN = 0x1 - Enable the window compare for slot 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 0    | SLEN1  | 0x0   | RW | This bit enables slot 1 for ADC conversions.<br><br>SLEN = 0x1 - Enable slot 1 for ADC conversions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**19.7.2.6 SL2CFG Register****Slot 2 Configuration Register****OFFSET:** 0x00000014**INSTANCE 0 ADDRESS:** 0x50010014

Slot 2 Configuration Register

**Table 1116: SL2CFG Register**

|      |   |   |   |        |   |      |   |   |   |         |   |      |   |        |   |      |   |   |   |       |   |       |   |   |   |   |   |   |   |   |   |
|------|---|---|---|--------|---|------|---|---|---|---------|---|------|---|--------|---|------|---|---|---|-------|---|-------|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2      | 2 | 2    | 2 | 2 | 2 | 2       | 1 | 1    | 1 | 1      | 1 | 1    | 1 | 1 | 0 | 0     | 0 | 0     | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1    | 0 | 9 | 8 | 7      | 6 | 5    | 4 | 3 | 2 | 1       | 0 | 9    | 8 | 7      | 6 | 5    | 4 | 3 | 2 | 1     | 0 | 9     | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD |   |   |   | ADSEL2 |   | RSVD |   |   |   | PRMODE2 |   | RSVD |   | CHSEL2 |   | RSVD |   |   |   | WCEN2 |   | SLEN2 |   |   |   |   |   |   |   |   |   |

Table 1117: SL2CFG Register Bits

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|---------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:27 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 26:24 | ADSEL2  | 0x0   | RW | <p>Select the number of measurements to average in the accumulate divide module for this slot.</p> <p>AVG_1_MSRMT = 0x0 - Average in 1 measurement in the accumulate divide module for this slot.</p> <p>AVG_2_MSRMTS = 0x1 - Average in 2 measurements in the accumulate divide module for this slot.</p> <p>AVG_4_MSRMTS = 0x2 - Average in 4 measurements in the accumulate divide module for this slot.</p> <p>AVG_8_MSRMT = 0x3 - Average in 8 measurements in the accumulate divide module for this slot.</p> <p>AVG_16_MSRMTS = 0x4 - Average in 16 measurements in the accumulate divide module for this slot.</p> <p>AVG_32_MSRMTS = 0x5 - Average in 32 measurements in the accumulate divide module for this slot.</p> <p>AVG_64_MSRMTS = 0x6 - Average in 64 measurements in the accumulate divide module for this slot.</p> <p>AVG_128_MSRMTS = 0x7 - Average in 128 measurements in the accumulate divide module for this slot.</p>                                                                                                                          |
| 23:18 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 17:16 | PRMODE2 | 0x0   | RW | <p>Set the Precision Mode For Slot.</p> <p>P14B = 0x0 - 14-bit precision mode</p> <p>P12B = 0x1 - 12-bit precision mode</p> <p>P10B = 0x2 - 10-bit precision mode</p> <p>P8B = 0x3 - 8-bit precision mode</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 15:12 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 11:8  | CHSEL2  | 0x0   | RW | <p>Select one of the 14 channel inputs for this slot.</p> <p>SE0 = 0x0 - single ended external GPIO connection to pad16.</p> <p>SE1 = 0x1 - single ended external GPIO connection to pad29.</p> <p>SE2 = 0x2 - single ended external GPIO connection to pad11.</p> <p>SE3 = 0x3 - single ended external GPIO connection to pad31.</p> <p>SE4 = 0x4 - single ended external GPIO connection to pad32.</p> <p>SE5 = 0x5 - single ended external GPIO connection to pad33.</p> <p>SE6 = 0x6 - single ended external GPIO connection to pad34.</p> <p>SE7 = 0x7 - single ended external GPIO connection to pad35.</p> <p>SE8 = 0x8 - single ended external GPIO connection to pad13.</p> <p>SE9 = 0x9 - single ended external GPIO connection to pad12.</p> <p>DF0 = 0xA - differential external GPIO connections to pad12(N) and pad13(P).</p> <p>DF1 = 0xB - differential external GPIO connections to pad15(N) and pad14(P).</p> <p>TEMP = 0xC - internal temperature sensor.</p> <p>BATT = 0xD - internal voltage divide-by-3 connection.</p> <p>VSS = 0xE - Input VSS</p> |
| 7:2   | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Bit | Name  | Reset | RW | Description                                                                                                    |
|-----|-------|-------|----|----------------------------------------------------------------------------------------------------------------|
| 1   | WCEN2 | 0x0   | RW | This bit enables the window compare function for slot 2.<br>WCEN = 0x1 - Enable the window compare for slot 2. |
| 0   | SLEN2 | 0x0   | RW | This bit enables slot 2 for ADC conversions.<br>SLEN = 0x1 - Enable slot 2 for ADC conversions.                |

### Slot 3 Configuration Register

**INSTANCE 0 ADDRESS: 0x50010018**

### Slot 3 Configuration Register

|        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2  | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        | ADSEL3 | RSVD   |        |        |        | PRMODE3 | RSVD   |        | CHSEL3 |        |        | RSVD   |        |        |        | WCEN3  | SLEN3  |        |        |        |        |        |        |        |        |        |        |        |

| Bit   | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|--------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:27 | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 26:24 | ADSEL3 | 0x0   | RW | <p>Select the number of measurements to average in the accumulate divide module for this slot.</p> <p>AVG_1_MSRMT = 0x0 - Average in 1 measurement in the accumulate divide module for this slot.</p> <p>AVG_2_MSRMTS = 0x1 - Average in 2 measurements in the accumulate divide module for this slot.</p> <p>AVG_4_MSRMTS = 0x2 - Average in 4 measurements in the accumulate divide module for this slot.</p> <p>AVG_8_MSRMT = 0x3 - Average in 8 measurements in the accumulate divide module for this slot.</p> <p>AVG_16_MSRMTS = 0x4 - Average in 16 measurements in the accumulate divide module for this slot.</p> <p>AVG_32_MSRMTS = 0x5 - Average in 32 measurements in the accumulate divide module for this slot.</p> <p>AVG_64_MSRMTS = 0x6 - Average in 64 measurements in the accumulate divide module for this slot.</p> <p>AVG_128_MSRMTS = 0x7 - Average in 128 measurements in the accumulate divide module for this slot.</p> |

Table 1119: SL3CFG Register Bits

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|---------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23:18 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 17:16 | PRMODE3 | 0x0   | RW | Set the Precision Mode For Slot.<br>P14B = 0x0 - 14-bit precision mode<br>P12B = 0x1 - 12-bit precision mode<br>P10B = 0x2 - 10-bit precision mode<br>P8B = 0x3 - 8-bit precision mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 15:12 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 11:8  | CHSEL3  | 0x0   | RW | Select one of the 14 channel inputs for this slot.<br><br>SE0 = 0x0 - single ended external GPIO connection to pad16.<br>SE1 = 0x1 - single ended external GPIO connection to pad29.<br>SE2 = 0x2 - single ended external GPIO connection to pad11.<br>SE3 = 0x3 - single ended external GPIO connection to pad31.<br>SE4 = 0x4 - single ended external GPIO connection to pad32.<br>SE5 = 0x5 - single ended external GPIO connection to pad33.<br>SE6 = 0x6 - single ended external GPIO connection to pad34.<br>SE7 = 0x7 - single ended external GPIO connection to pad35.<br>SE8 = 0x8 - single ended external GPIO connection to pad13.<br>SE9 = 0x9 - single ended external GPIO connection to pad12.<br>DF0 = 0xA - differential external GPIO connections to pad12(N) and pad13(P).<br>DF1 = 0xB - differential external GPIO connections to pad15(N) and pad14(P).<br>TEMP = 0xC - internal temperature sensor.<br>BATT = 0xD - internal voltage divide-by-3 connection.<br>VSS = 0xE - Input VSS |
| 7:2   | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 1     | WCEN3   | 0x0   | RW | This bit enables the window compare function for slot 3.<br><br>WCEN = 0x1 - Enable the window compare for slot 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 0     | SLEN3   | 0x0   | RW | This bit enables slot 3 for ADC conversions.<br><br>SLEN = 0x1 - Enable slot 3 for ADC conversions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**19.7.2.8 SL4CFG Register****Slot 4 Configuration Register****OFFSET:** 0x0000001C**INSTANCE 0 ADDRESS:** 0x5001001C

Slot 4 Configuration Register

Table 1120: SL4CFG Register

|      |   |   |   |        |   |   |   |      |   |   |   |         |   |   |   |      |   |   |   |        |   |   |   |      |   |   |   |       |       |
|------|---|---|---|--------|---|---|---|------|---|---|---|---------|---|---|---|------|---|---|---|--------|---|---|---|------|---|---|---|-------|-------|
| 3    | 3 | 2 | 2 | 2      | 2 | 2 | 2 | 2    | 2 | 2 | 1 | 1       | 1 | 1 | 1 | 1    | 1 | 0 | 0 | 0      | 0 | 0 | 0 | 0    | 0 | 0 | 0 | 0     | 0     |
| 1    | 0 | 9 | 8 | 7      | 6 | 5 | 4 | 3    | 2 | 1 | 0 | 9       | 8 | 7 | 6 | 5    | 4 | 3 | 2 | 1      | 0 | 9 | 8 | 7    | 6 | 5 | 4 | 3     | 2     |
| RSVD |   |   |   | ADSEL4 |   |   |   | RSVD |   |   |   | PRMODE4 |   |   |   | RSVD |   |   |   | CHSEL4 |   |   |   | RSVD |   |   |   | WCEN4 | SLEN4 |

Table 1121: SL4CFG Register Bits

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|---------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:27 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 26:24 | ADSEL4  | 0x0   | RW | <p>Select the number of measurements to average in the accumulate divide module for this slot.</p> <p>AVG_1_MSRMT = 0x0 - Average in 1 measurement in the accumulate divide module for this slot.</p> <p>AVG_2_MSRMTS = 0x1 - Average in 2 measurements in the accumulate divide module for this slot.</p> <p>AVG_4_MSRMTS = 0x2 - Average in 4 measurements in the accumulate divide module for this slot.</p> <p>AVG_8_MSRMT = 0x3 - Average in 8 measurements in the accumulate divide module for this slot.</p> <p>AVG_16_MSRMTS = 0x4 - Average in 16 measurements in the accumulate divide module for this slot.</p> <p>AVG_32_MSRMTS = 0x5 - Average in 32 measurements in the accumulate divide module for this slot.</p> <p>AVG_64_MSRMTS = 0x6 - Average in 64 measurements in the accumulate divide module for this slot.</p> <p>AVG_128_MSRMTS = 0x7 - Average in 128 measurements in the accumulate divide module for this slot.</p> |
| 23:18 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 17:16 | PRMODE4 | 0x0   | RW | <p>Set the Precision Mode For Slot.</p> <p>P14B = 0x0 - 14-bit precision mode</p> <p>P12B = 0x1 - 12-bit precision mode</p> <p>P10B = 0x2 - 10-bit precision mode</p> <p>P8B = 0x3 - 8-bit precision mode</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 15:12 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**Table 1121: SL4CFG Register Bits**

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|--------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11:8 | CHSEL4 | 0x0   | RW | Select one of the 14 channel inputs for this slot.<br><br>SE0 = 0x0 - single ended external GPIO connection to pad16.<br>SE1 = 0x1 - single ended external GPIO connection to pad29.<br>SE2 = 0x2 - single ended external GPIO connection to pad11.<br>SE3 = 0x3 - single ended external GPIO connection to pad31.<br>SE4 = 0x4 - single ended external GPIO connection to pad32.<br>SE5 = 0x5 - single ended external GPIO connection to pad33.<br>SE6 = 0x6 - single ended external GPIO connection to pad34.<br>SE7 = 0x7 - single ended external GPIO connection to pad35.<br>SE8 = 0x8 - single ended external GPIO connection to pad13.<br>SE9 = 0x9 - single ended external GPIO connection to pad12.<br>DF0 = 0xA - differential external GPIO connections to pad12(N) and pad13(P).<br>DF1 = 0xB - differential external GPIO connections to pad15(N) and pad14(P).<br>TEMP = 0xC - internal temperature sensor.<br>BATT = 0xD - internal voltage divide-by-3 connection.<br>VSS = 0xE - Input VSS |
| 7:2  | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 1    | WCEN4  | 0x0   | RW | This bit enables the window compare function for slot 4.<br><br>WCEN = 0x1 - Enable the window compare for slot 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 0    | SLEN4  | 0x0   | RW | This bit enables slot 4 for ADC conversions.<br><br>SLEN = 0x1 - Enable slot 4 for ADC conversions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**19.7.2.9 SL5CFG Register****Slot 5 Configuration Register****OFFSET:** 0x00000020**INSTANCE 0 ADDRESS:** 0x50010020

Slot 5 Configuration Register

**Table 1122: SL5CFG Register**

|        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1  | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        | ADSEL5 |        | RSVD   |        |        |        | PRMODE5 |        | RSVD   |        | CHSEL5 |        | RSVD   |        |        |        | WCEN5  |        | SLEN5  |        |        |        |        |        |        |        |        |        |



Table 1123: SL5CFG Register Bits

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|---------|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:27 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 26:24 | ADSEL5  | 0x0   | RW | <p>Select number of measurements to average in the accumulate divide module for this slot.</p> <p>AVG_1_MSRMT = 0x0 - Average in 1 measurement in the accumulate divide module for this slot.</p> <p>AVG_2_MSRMTS = 0x1 - Average in 2 measurements in the accumulate divide module for this slot.</p> <p>AVG_4_MSRMTS = 0x2 - Average in 4 measurements in the accumulate divide module for this slot.</p> <p>AVG_8_MSRMT = 0x3 - Average in 8 measurements in the accumulate divide module for this slot.</p> <p>AVG_16_MSRMTS = 0x4 - Average in 16 measurements in the accumulate divide module for this slot.</p> <p>AVG_32_MSRMTS = 0x5 - Average in 32 measurements in the accumulate divide module for this slot.</p> <p>AVG_64_MSRMTS = 0x6 - Average in 64 measurements in the accumulate divide module for this slot.</p> <p>AVG_128_MSRMTS = 0x7 - Average in 128 measurements in the accumulate divide module for this slot.</p>                                                                                                                              |
| 23:18 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 17:16 | PRMODE5 | 0x0   | RW | <p>Set the Precision Mode For Slot.</p> <p>P14B = 0x0 - 14-bit precision mode</p> <p>P12B = 0x1 - 12-bit precision mode</p> <p>P10B = 0x2 - 10-bit precision mode</p> <p>P8B = 0x3 - 8-bit precision mode</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 15:12 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 11:8  | CHSEL5  | 0x0   | RW | <p>Select one of the 14 channel inputs for this slot.</p> <p>SE0 = 0x0 - single ended external GPIO connection to pad16.</p> <p>SE1 = 0x1 - single ended external GPIO connection to pad29.</p> <p>SE2 = 0x2 - single ended external GPIO connection to pad11.</p> <p>SE3 = 0x3 - single ended external GPIO connection to pad31.</p> <p>SE4 = 0x4 - single ended external GPIO connection to pad32.</p> <p>SE5 = 0x5 - single ended external GPIO connection to pad33.</p> <p>SE6 = 0x6 - single ended external GPIO connection to pad34.</p> <p>SE7 = 0x7 - single ended external GPIO connection to pad35.</p> <p>SE8 = 0x8 - single ended external GPIO connection to pad13.</p> <p>SE9 = 0x9 - single ended external GPIO connection to pad12.</p> <p>DF0 = 0xA - differential external GPIO connections to pad12(N) and pad13(P).</p> <p>DF1 = 0xB - differential external GPIO connections to pad15(N) and pad14(P).</p> <p>TEMP = 0xC - internal temperature sensor.</p> <p>BATT = 0xD - internal voltage divide-by-3 connection.</p> <p>VSS = 0xE - Input VSS</p> |
| 7:2   | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Bit | Name  | Reset | RW | Description                                                                                                    |
|-----|-------|-------|----|----------------------------------------------------------------------------------------------------------------|
| 1   | WCEN5 | 0x0   | RW | This bit enables the window compare function for slot 5.<br>WCEN = 0x1 - Enable the window compare for slot 5. |
| 0   | SLEN5 | 0x0   | RW | This bit enables slot 5 for ADC conversions.<br>SLEN = 0x1 - Enable slot 5 for ADC conversions.                |

## Slot 6 Configuration Register

**INSTANCE 0 ADDRESS: 0x50010024**

### Slot 6 Configuration Register

|        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2  | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        | ADSEL6 | RSVD   |        |        |        | PRMODE6 | RSVD   |        | CHSEL6 |        | RSVD   |        |        |        | WCEN6  | SLEN6  |        |        |        |        |        |        |        |        |        |        |        |        |

| Bit   | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|--------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:27 | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 26:24 | ADSEL6 | 0x0   | RW | <p>Select the number of measurements to average in the accumulate divide module for this slot.</p> <p>AVG_1_MSRMT = 0x0 - Average in 1 measurement in the accumulate divide module for this slot.</p> <p>AVG_2_MSRMTS = 0x1 - Average in 2 measurements in the accumulate divide module for this slot.</p> <p>AVG_4_MSRMTS = 0x2 - Average in 4 measurements in the accumulate divide module for this slot.</p> <p>AVG_8_MSRMT = 0x3 - Average in 8 measurements in the accumulate divide module for this slot.</p> <p>AVG_16_MSRMTS = 0x4 - Average in 16 measurements in the accumulate divide module for this slot.</p> <p>AVG_32_MSRMTS = 0x5 - Average in 32 measurements in the accumulate divide module for this slot.</p> <p>AVG_64_MSRMTS = 0x6 - Average in 64 measurements in the accumulate divide module for this slot.</p> <p>AVG_128_MSRMTS = 0x7 - Average in 128 measurements in the accumulate divide module for this slot.</p> |

**Table 1125: SL6CFG Register Bits**

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|---------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23:18 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 17:16 | PRMODE6 | 0x0   | RW | Set the Precision Mode For Slot.<br>P14B = 0x0 - 14-bit precision mode<br>P12B = 0x1 - 12-bit precision mode<br>P10B = 0x2 - 10-bit precision mode<br>P8B = 0x3 - 8-bit precision mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 15:12 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 11:8  | CHSEL6  | 0x0   | RW | Select one of the 14 channel inputs for this slot.<br><br>SE0 = 0x0 - single ended external GPIO connection to pad16.<br>SE1 = 0x1 - single ended external GPIO connection to pad29.<br>SE2 = 0x2 - single ended external GPIO connection to pad11.<br>SE3 = 0x3 - single ended external GPIO connection to pad31.<br>SE4 = 0x4 - single ended external GPIO connection to pad32.<br>SE5 = 0x5 - single ended external GPIO connection to pad33.<br>SE6 = 0x6 - single ended external GPIO connection to pad34.<br>SE7 = 0x7 - single ended external GPIO connection to pad35.<br>SE8 = 0x8 - single ended external GPIO connection to pad13.<br>SE9 = 0x9 - single ended external GPIO connection to pad12.<br>DF0 = 0xA - differential external GPIO connections to pad12(N) and pad13(P).<br>DF1 = 0xB - differential external GPIO connections to pad15(N) and pad14(P).<br>TEMP = 0xC - internal temperature sensor.<br>BATT = 0xD - internal voltage divide-by-3 connection.<br>VSS = 0xE - Input VSS |
| 7:2   | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 1     | WCEN6   | 0x0   | RW | This bit enables the window compare function for slot 6.<br><br>WCEN = 0x1 - Enable the window compare for slot 6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 0     | SLEN6   | 0x0   | RW | This bit enables slot 6 for ADC conversions.<br><br>SLEN = 0x1 - Enable slot 6 for ADC conversions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**19.7.2.11SL7CFG Register****Slot 7 Configuration Register****OFFSET:** 0x00000028**INSTANCE 0 ADDRESS:** 0x50010028

Slot 7 Configuration Register

Table 1126: SL7CFG Register

|      |   |   |   |        |   |   |   |      |   |   |   |         |   |   |   |      |   |   |   |        |   |   |   |      |   |   |   |       |      |
|------|---|---|---|--------|---|---|---|------|---|---|---|---------|---|---|---|------|---|---|---|--------|---|---|---|------|---|---|---|-------|------|
| 3    | 3 | 2 | 2 | 2      | 2 | 2 | 2 | 2    | 2 | 2 | 1 | 1       | 1 | 1 | 1 | 1    | 1 | 0 | 0 | 0      | 0 | 0 | 0 | 0    | 0 | 0 | 0 | 0     | 0    |
| 1    | 0 | 9 | 8 | 7      | 6 | 5 | 4 | 3    | 2 | 1 | 0 | 9       | 8 | 7 | 6 | 5    | 4 | 3 | 2 | 1      | 0 | 9 | 8 | 7    | 6 | 5 | 4 | 3     | 2    |
| RSVD |   |   |   | ADSEL7 |   |   |   | RSVD |   |   |   | PRMODE7 |   |   |   | RSVD |   |   |   | CHSEL7 |   |   |   | RSVD |   |   |   | WCEN7 | SLN7 |

Table 1127: SL7CFG Register Bits

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|---------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:27 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 26:24 | ADSEL7  | 0x0   | RW | <p>Select the number of measurements to average in the accumulate divide module for this slot.</p> <p>AVG_1_MSRMT = 0x0 - Average in 1 measurement in the accumulate divide module for this slot.</p> <p>AVG_2_MSRMTS = 0x1 - Average in 2 measurements in the accumulate divide module for this slot.</p> <p>AVG_4_MSRMTS = 0x2 - Average in 4 measurements in the accumulate divide module for this slot.</p> <p>AVG_8_MSRMT = 0x3 - Average in 8 measurements in the accumulate divide module for this slot.</p> <p>AVG_16_MSRMTS = 0x4 - Average in 16 measurements in the accumulate divide module for this slot.</p> <p>AVG_32_MSRMTS = 0x5 - Average in 32 measurements in the accumulate divide module for this slot.</p> <p>AVG_64_MSRMTS = 0x6 - Average in 64 measurements in the accumulate divide module for this slot.</p> <p>AVG_128_MSRMTS = 0x7 - Average in 128 measurements in the accumulate divide module for this slot.</p> |
| 23:18 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 17:16 | PRMODE7 | 0x0   | RW | <p>Set the Precision Mode For Slot.</p> <p>P14B = 0x0 - 14-bit precision mode</p> <p>P12B = 0x1 - 12-bit precision mode</p> <p>P10B = 0x2 - 10-bit precision mode</p> <p>P8B = 0x3 - 8-bit precision mode</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 15:12 | RSVD    | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

| Bit  | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|--------|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11:8 | CHSEL7 | 0x0   | RW | <p>Select one of the 14 channel inputs for this slot.</p> <p>SE0 = 0x0 - single ended external GPIO connection to pad16.<br/> SE1 = 0x1 - single ended external GPIO connection to pad29.<br/> SE2 = 0x2 - single ended external GPIO connection to pad11.<br/> SE3 = 0x3 - single ended external GPIO connection to pad31.<br/> SE4 = 0x4 - single ended external GPIO connection to pad32.<br/> SE5 = 0x5 - single ended external GPIO connection to pad33.<br/> SE6 = 0x6 - single ended external GPIO connection to pad34.<br/> SE7 = 0x7 - single ended external GPIO connection to pad35.<br/> SE8 = 0x8 - single ended external GPIO connection to pad13.<br/> SE9 = 0x9 - single ended external GPIO connection to pad12.<br/> DF0 = 0xA - differential external GPIO connections to pad12(N) and pad13(P).<br/> DF1 = 0xB - differential external GPIO connections to pad15(N) and pad14(P).<br/> TEMP = 0xC - internal temperature sensor.<br/> BATT = 0xD - internal voltage divide-by-3 connection.<br/> VSS = 0xE - Input VSS</p> |
| 7:2  | RSVD   | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 1    | WCEN7  | 0x0   | RW | <p>This bit enables the window compare function for slot 7.</p> <p>WCEN = 0x1 - Enable the window compare for slot 7.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 0    | SLEN7  | 0x0   | RW | <p>This bit enables slot 7 for ADC conversions.</p> <p>SLEN = 0x1 - Enable slot 7 for ADC conversions.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

## Window Comparator Upper Limits Register

**INSTANCE 0 ADDRESS: 0x5001002C**

## Window Comparator Upper Limits Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        | ULIM   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

| Bit   | Name | Reset | RW | Description                                     |
|-------|------|-------|----|-------------------------------------------------|
| 31:20 | RSVD | 0x0   | RO | RESERVED.                                       |
| 19:0  | ULIM | 0x0   | RW | Sets the upper limit for the window comparator. |



| Bit | Name     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                   |
|-----|----------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | SCWLIMEN | 0x0   | RW | Scale the window limits compare values per precision mode. When set to 0x0 (default), the values in the 20-bit limits registers will compare directly with the FIFO values regardless of the precision mode the slot is configured to. When set to 0x1, the compare values will be divided by the difference in precision bits while performing the window limit comparisons. |

## FIFO Data and Valid Count Register

**INSTANCE 0 ADDRESS: 0x50010038**

| <b>3</b> | <b>3</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> |          |          |          |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>1</b> | <b>0</b> | <b>9</b> | <b>8</b> | <b>7</b> | <b>6</b> | <b>5</b> | <b>4</b> | <b>3</b> | <b>2</b> | <b>1</b> | <b>0</b> | <b>9</b> | <b>8</b> | <b>7</b> | <b>6</b> | <b>5</b> | <b>4</b> | <b>3</b> | <b>2</b> | <b>1</b> | <b>0</b> | <b>9</b> | <b>8</b> | <b>7</b> | <b>6</b> | <b>5</b> | <b>4</b> | <b>3</b> | <b>2</b> | <b>1</b> | <b>0</b> |
| RSVD     | SLOTNUM  | COUNT    |          |          |          |          |          |          |          |          |          |          | DATA     |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

| Bit   | Name    | Reset | RW | Description                                 |
|-------|---------|-------|----|---------------------------------------------|
| 31    | RSVD    | 0x0   | RO | RESERVED.                                   |
| 30:28 | SLOTNUM | 0x0   | RO | Slot number associated with this FIFO data. |
| 27:20 | COUNT   | 0x0   | RO | Number of valid entries in the ADC FIFO.    |
| 19:0  | DATA    | 0x0   | RO | Oldest data in the FIFO.                    |

## FIFO Data and Valid Count Register

**INSTANCE 0 ADDRESS: 0x5001003C**

|        |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0    | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVDPR | SLOTNUMPR | COUNT  |        |        |        |        |        |        |        |        |        | DATA   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

| Bit   | Name      | Reset | RW | Description                                 |
|-------|-----------|-------|----|---------------------------------------------|
| 31    | RSVDPR    | 0x0   | RO | RESERVED.                                   |
| 30:28 | SLOTNUMPR | 0x0   | RO | Slot number associated with this FIFO data. |
| 27:20 | COUNT     | 0x0   | RO | Number of valid entries in the ADC FIFO.    |
| 19:0  | DATA      | 0x0   | RO | Oldest data in the FIFO.                    |

Set bits in this register to allow this module to generate the corresponding interrupt.

|      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |      |       |       |         |         |        |        |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|------|------|-------|-------|---------|---------|--------|--------|
| 31   | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 09 | 08 | 07   | 06   | 05    | 04    | 03      | 02      | 01     | 00     |
| RSVD |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | DERR | DCMP | WCINC | WCEXC | FIFOVR2 | FIFOVR1 | SCNCMP | CNVCMP |

| Bit  | Name | Reset | RW | Description |
|------|------|-------|----|-------------|
| 31:8 | RSVD | 0x0   | RO | RESERVED.   |



| Bit | Name    | Reset | RW | Description                                                                                                       |
|-----|---------|-------|----|-------------------------------------------------------------------------------------------------------------------|
| 7   | DERR    | 0x0   | RW | DMA Error Condition<br>DMAERROR = 0x1 - DMA Error Condition Occurred                                              |
| 6   | DCMP    | 0x0   | RW | DMA Transfer Complete<br>DMACOMPLETE = 0x1 - DMA Completed a transfer                                             |
| 5   | WCINC   | 0x0   | RW | Window comparator voltage incursion interrupt.<br>WCINCINT = 0x1 - Window comparator voltage incursion interrupt. |
| 4   | WCEXC   | 0x0   | RW | Window comparator voltage excursion interrupt.<br>WCEXCINT = 0x1 - Window comparator voltage excursion interrupt. |
| 3   | FIFOVR2 | 0x0   | RW | FIFO 100 percent full interrupt.<br>FIFOFULLINT = 0x1 - FIFO 100 percent full interrupt.                          |
| 2   | FIFOVR1 | 0x0   | RW | FIFO 75 percent full interrupt.<br>FIFO75INT = 0x1 - FIFO 75 percent full interrupt.                              |
| 1   | SCNCMP  | 0x0   | RW | ADC scan complete interrupt.<br>SCNCMPINT = 0x1 - ADC scan complete interrupt.                                    |
| 0   | CNVCMP  | 0x0   | RW | ADC conversion complete interrupt.<br>CNVCMPINT = 0x1 - ADC conversion complete interrupt.                        |

### ADC Interrupt registers: Status

**INSTANCE 0 ADDRESS: 0x50010204**

Read bits from this register to discover the cause of a recent interrupt.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |         |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3  | 0<br>2  | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DERR   | DCMP   | WCING  | WCXC   | FIFOVR2 | FIFOVR1 | SCNCMP | CNVCMP |

| Bit  | Name | Reset | RW | Description |
|------|------|-------|----|-------------|
| 31:8 | RSVD | 0x0   | RO | RESERVED.   |

| Bit | Name    | Reset | RW | Description                                                                                                       |
|-----|---------|-------|----|-------------------------------------------------------------------------------------------------------------------|
| 7   | DERR    | 0x0   | RW | DMA Error Condition<br>DMAERROR = 0x1 - DMA Error Condition Occurred                                              |
| 6   | DCMP    | 0x0   | RW | DMA Transfer Complete<br>DMACOMPLETE = 0x1 - DMA Completed a transfer                                             |
| 5   | WCINC   | 0x0   | RW | Window comparator voltage incursion interrupt.<br>WCINCINT = 0x1 - Window comparator voltage incursion interrupt. |
| 4   | WCEXC   | 0x0   | RW | Window comparator voltage excursion interrupt.<br>WCEXCINT = 0x1 - Window comparator voltage excursion interrupt. |
| 3   | FIFOVR2 | 0x0   | RW | FIFO 100 percent full interrupt.<br>FIFOFULLINT = 0x1 - FIFO 100 percent full interrupt.                          |
| 2   | FIFOVR1 | 0x0   | RW | FIFO 75 percent full interrupt.<br>FIFO75INT = 0x1 - FIFO 75 percent full interrupt.                              |
| 1   | SCNCMP  | 0x0   | RW | ADC scan complete interrupt.<br>SCNCMPINT = 0x1 - ADC scan complete interrupt.                                    |
| 0   | CNVCMP  | 0x0   | RW | ADC conversion complete interrupt.<br>CNVCMPINT = 0x1 - ADC conversion complete interrupt.                        |

### ADC Interrupt registers: Clear

**INSTANCE 0 ADDRESS: 0x50010208**

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |         |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3  | 0<br>2  | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DERR   | DCMP   | WCINC  | WCXC   | FIFOVR2 | FIFOVR1 | SCNCMP | CNVCMP |

| Bit  | Name | Reset | RW | Description |
|------|------|-------|----|-------------|
| 31:8 | RSVD | 0x0   | RO | RESERVED.   |

**Table 1143: INTCLR Register Bits**

| Bit | Name    | Reset | RW | Description                                                                                                       |
|-----|---------|-------|----|-------------------------------------------------------------------------------------------------------------------|
| 7   | DERR    | 0x0   | RW | DMA Error Condition<br>DMAERROR = 0x1 - DMA Error Condition Occurred                                              |
| 6   | DCMP    | 0x0   | RW | DMA Transfer Complete<br>DMACOMPLETE = 0x1 - DMA Completed a transfer                                             |
| 5   | WCINC   | 0x0   | RW | Window comparator voltage incursion interrupt.<br>WCINCINT = 0x1 - Window comparator voltage incursion interrupt. |
| 4   | WCEXC   | 0x0   | RW | Window comparator voltage excursion interrupt.<br>WCEXCINT = 0x1 - Window comparator voltage excursion interrupt. |
| 3   | FIFOVR2 | 0x0   | RW | FIFO 100 percent full interrupt.<br>FIFOFULLINT = 0x1 - FIFO 100 percent full interrupt.                          |
| 2   | FIFOVR1 | 0x0   | RW | FIFO 75 percent full interrupt.<br>FIFO75INT = 0x1 - FIFO 75 percent full interrupt.                              |
| 1   | SCNCMP  | 0x0   | RW | ADC scan complete interrupt.<br>SCNCMPINT = 0x1 - ADC scan complete interrupt.                                    |
| 0   | CNVCMP  | 0x0   | RW | ADC conversion complete interrupt.<br>CNVCMPINT = 0x1 - ADC conversion complete interrupt.                        |

**19.7.2.20INTSET Register****ADC Interrupt registers: Set****OFFSET:** 0x0000020C**INSTANCE 0 ADDRESS:** 0x5001020C

Write a 1 to a bit in this register to instantly generate an interrupt from this module. (Generally used for testing purposes).

**Table 1144: INTSET Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |      |       |       |         |         |        |        |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------|------|-------|-------|---------|---------|--------|--------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0    | 0    | 0     | 0     | 0       | 0       | 0      | 0      |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0    | 9    | 8     | 7     | 6       | 5       | 4      | 3      |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DERR | DCMP | WCINC | WCEXC | FIFOVR2 | FIFOVR1 | SCNCMP | CNVCMP |

| Bit  | Name     | Reset | RW | Description                                                                                                       |
|------|----------|-------|----|-------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD     | 0x0   | RO | RESERVED.                                                                                                         |
| 7    | DERR     | 0x0   | RW | DMA Error Condition<br>DMAERROR = 0x1 - DMA Error Condition Occurred                                              |
| 6    | DCMP     | 0x0   | RW | DMA Transfer Complete<br>DMACOMPLETE = 0x1 - DMA Completed a transfer                                             |
| 5    | WCINC    | 0x0   | RW | Window comparator voltage incursion interrupt.<br>WCINCINT = 0x1 - Window comparator voltage incursion interrupt. |
| 4    | WCEXC    | 0x0   | RW | Window comparator voltage excursion interrupt.<br>WCEXCINT = 0x1 - Window comparator voltage excursion interrupt. |
| 3    | FIFOOVR2 | 0x0   | RW | FIFO 100 percent full interrupt.<br>FIFOFULLINT = 0x1 - FIFO 100 percent full interrupt.                          |
| 2    | FIFOOVR1 | 0x0   | RW | FIFO 75 percent full interrupt.<br>FIFO75INT = 0x1 - FIFO 75 percent full interrupt.                              |
| 1    | SCNCMP   | 0x0   | RW | ADC scan complete interrupt.<br>SCNCMPINT = 0x1 - ADC scan complete interrupt.                                    |
| 0    | CNVCMP   | 0x0   | RW | ADC conversion complete interrupt.<br>CNVCMPINT = 0x1 - ADC conversion complete interrupt.                        |

## DMA Trigger Enable Register

**INSTANCE 0 ADDRESS: 0x50010240**

## DMA Trigger Enable Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |         |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|---------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2    | 0<br>1  | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DFIFOFULL | DFIFO75 |        |

| Bit  | Name      | Reset | RW | Description                            |
|------|-----------|-------|----|----------------------------------------|
| 31:2 | RSVD      | 0x0   | RO | RESERVED.                              |
| 1    | DFIFOFULL | 0x0   | RW | Trigger DMA upon FIFO 100 percent Full |
| 0    | DFIFO75   | 0x0   | RW | Trigger DMA upon FIFO 75 percent Full  |

## DMA Trigger Status Register

**INSTANCE 0 ADDRESS: 0x50010244**

## DMA Trigger Status Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |         |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|---------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2    | 0<br>1  | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DFULLSTAT | D75STAT |        |

| Bit  | Name      | Reset | RW | Description                              |
|------|-----------|-------|----|------------------------------------------|
| 31:2 | RSVD      | 0x0   | RO | RESERVED.                                |
| 1    | DFULLSTAT | 0x0   | RO | Triggered DMA from FIFO 100 percent Full |
| 0    | D75STAT   | 0x0   | RO | Triggered DMA from FIFO 75 percent Full  |

## DMA Configuration Register

**INSTANCE 0 ADDRESS: 0x50010280**

## DMA Configuration Register

Table 1150: DMACFG Register

|        |        |        |        |        |        |        |        |        |        |        |        |         |        |            |        |        |        |        |        |           |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|------------|--------|--------|--------|--------|--------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9  | 1<br>8 | 1<br>7     | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1    | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        | DPWROFF | DMAMSK | DMAHONSTAT | RSVD   |        |        |        |        | DMADYNPRI | DMAPRI | RSVD   |        |        |        |        | DMADIR | RSVD   | DMAEN  |        |        |

Table 1151: DMACFG Register Bits

| Bit   | Name       | Reset | RW | Description                                                                                                                                                                                                                                                                                   |
|-------|------------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:19 | RSVD       | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                     |
| 18    | DPWROFF    | 0x0   | RW | Power Off the ADC System upon DMACPL.                                                                                                                                                                                                                                                         |
| 17    | DMAMSK     | 0x0   | RW | Mask the FIFOCNT and SLOTNUM when transferring FIFO contents to memory<br>DIS = 0x0 - FIFO Contents are copied directly to memory without modification.<br>EN = 0x1 - Only the FIFODATA contents are copied to memory on DMA transfers. The SLOTNUM and FIFOCNT contents are cleared to zero. |
| 16    | DMAHONSTAT | 0x0   | RW | Halt New ADC conversions until DMA Status DMAERR and DMACPL Cleared.<br>DIS = 0x0 - ADC conversions will continue regardless of DMA status register<br>EN = 0x1 - ADC conversions will not progress if DMAERR or DMACPL bits in DMA status register are set.                                  |
| 15:10 | RSVD       | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                     |
| 9     | DMADYNPRI  | 0x0   | RW | Enables dynamic priority based on FIFO fullness. When FIFO is full, priority is automatically set to HIGH. Otherwise, DMAPRI is used.<br>DIS = 0x0 - Disable dynamic priority (use DMAPRI setting only)<br>EN = 0x1 - Enable dynamic priority                                                 |
| 8     | DMAPRI     | 0x0   | RW | Sets the Priority of the DMA request<br>LOW = 0x0 - Low Priority (service as best effort)<br>HIGH = 0x1 - High Priority (service immediately)                                                                                                                                                 |
| 7:3   | RSVD       | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                     |
| 2     | DMADIR     | 0x0   | RO | Direction<br>P2M = 0x0 - Peripheral to Memory (SRAM) transaction<br>M2P = 0x1 - Memory to Peripheral transaction                                                                                                                                                                              |
| 1     | RSVD       | 0x0   | RO | RESERVED.                                                                                                                                                                                                                                                                                     |

| Bit | Name  | Reset | RW | Description                                                                          |
|-----|-------|-------|----|--------------------------------------------------------------------------------------|
| 0   | DMAEN | 0x0   | RW | DMA Enable<br><br>DIS = 0x0 - Disable DMA Function<br>EN = 0x1 - Enable DMA Function |

## DMA Total Transfer Count

**INSTANCE 0 ADDRESS: 0x50010288**

DMA Total Transfer Count

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |           |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7   | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3    | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        | TOTCOUNT |        |        |        |        |        |        |        |        |        |        |        |        |        | BTOTCOUNT |        |        |        |

| Bit   | Name      | Reset | RW | Description          |
|-------|-----------|-------|----|----------------------|
| 31:18 | RSVD      | 0x0   | RO | RESERVED.            |
| 17:2  | TOTCOUNT  | 0x0   | RW | Total Transfer Count |
| 1:0   | BTOTCOUNT | 0x0   | RO | RESERVED.            |

## DMA Target Address Register

**INSTANCE 0 ADDRESS: 0x5001028C**

## DMA Target Address Register

|           |   |   |   |   |   |   |   |   |   |   |           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-----------|---|---|---|---|---|---|---|---|---|---|-----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3         | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1         | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1         | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0         | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| UTARGADDR |   |   |   |   |   |   |   |   |   |   | LTARGADDR |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit   | Name      | Reset | RW | Description        |
|-------|-----------|-------|----|--------------------|
| 31:20 | UTARGADDR | 0x100 | RO | SRAM Target        |
| 19:0  | LTARGADDR | 0x0   | RW | DMA Target Address |

## DMA Status Register

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |        |         |        |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--------|---------|--------|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0      | 0       | 0      | 0 |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6      | 5       | 4      | 3 |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | DMAERR | DMA CPL | DMATIP |   |

| Bit  | Name   | Reset | RW | Description              |
|------|--------|-------|----|--------------------------|
| 31:3 | RSVD   | 0x0   | RO | RESERVED.                |
| 2    | DMAERR | 0x0   | RW | DMA Error                |
| 1    | DMACPL | 0x0   | RW | DMA Transfer Complete    |
| 0    | DMATIP | 0x0   | RW | DMA Transfer In Progress |





## 20. Voltage Comparator Module

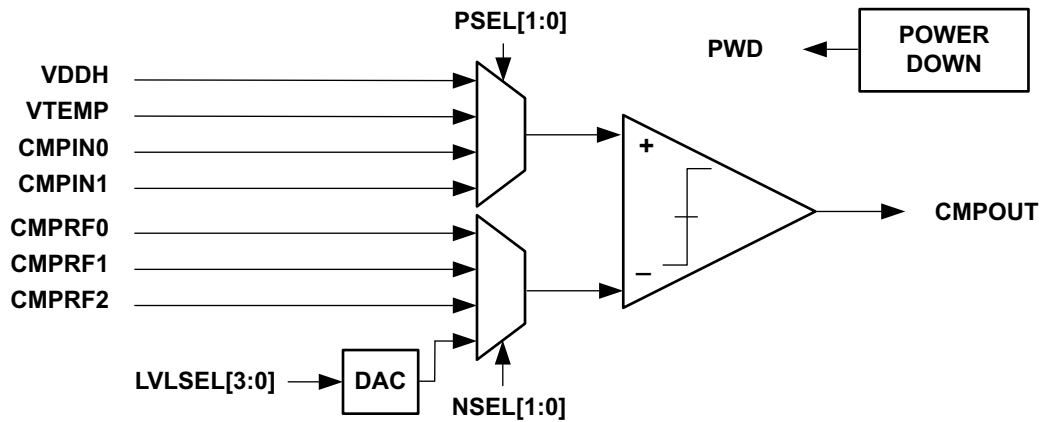


Figure 94. Block diagram for the Voltage Comparator Module

### 20.1 Functional Overview

The Voltage Comparator Module, shown in Figure 94, measures a user-selectable voltage at all times. It provides interrupt and software access to the comparator output with multiple options for input and reference voltages. It can be configured to generate an interrupt when the monitored voltage rises above a user-configurable threshold or when the monitored voltage drops below a user-configurable threshold.

The voltage to be monitored is selected by programming the comparator's positive terminal signal, PSEL[1:0], and may be any of:

1. The supply voltage (VDDH), or
2. The PTAT voltage from the temperature sensor (VTEMP), or
3. Two external voltage channels (CMPIN0 or CMPIN1), or
4. The filtered PGA outputs (PGA\_A0, PGA\_A1, PGA\_B0, PGA\_B1)

The reference voltage is selected by programming the comparator's negative terminal, NSEL[1:0] and may be any of:

1. Three external voltage channels (CMPRF0, CMPRF1 or CMPRF2), or
2. The internally generated reference (VREFINT)

The internal reference voltage is tuned using an on-chip DAC with level select signal LVLSEL[3:0]. When using external inputs or reference inputs, the associated pads must be configured using the GPIO function selects explained in the GPIO document section.

The Voltage Comparator CMPOUT output will remain high while the voltage at the positive input is above the voltage at reference input. The CMPOUT output will transition low when the voltage at the positive input to the comparator falls below the reference input taking into account hysteresis (see Section 22.11 for hysteresis range). The CMPOUT output is directly accessible by software by reading the CMPOUT field in the status register. The OUTHI interrupt will be set if enabled and the CMPOUT transitions high or if it is high at the time the interrupt is enabled. Similarly, the OUTLOW interrupt will be set if enabled and the CMPOUT output transitions low or if it is low at the time the interrupt is enabled.

The Voltage Comparator Module is enabled by default and may be powered off by writing 0x37 to the PWDKEY register.

## 20.2 VCOMP Registers

### Voltage Comparator

**INSTANCE 0 BASE ADDRESS:**0x4000C000

This is the detailed description of the Voltage Comparator Register Block. The Voltage Comparator Register Block contains the software control for selecting the comparator inputs, power-down control, observing comparator output status and enabling interrupts.

#### 20.2.1 Register Memory Map

**Table 1158: VCOMP Register Map**

| Address(s) | Register Name | Description                                    |
|------------|---------------|------------------------------------------------|
| 0x4000C000 | CFG           | Configuration                                  |
| 0x4000C004 | STAT          | Status                                         |
| 0x4000C008 | PWDKEY        | Key for Powering Down the Voltage Comparator   |
| 0x4000C200 | INTEN         | Voltage Comparator Interrupt registers: Enable |
| 0x4000C204 | INTSTAT       | Voltage Comparator Interrupt registers: Status |
| 0x4000C208 | INTCLR        | Voltage Comparator Interrupt registers: Clear  |
| 0x4000C20C | INTSET        | Voltage Comparator Interrupt registers: Set    |

## 20.2.2 VCOMP Registers

### 20.2.2.1 CFG Register

#### Configuration

**OFFSET:** 0x00000000

**INSTANCE 0 ADDRESS:** 0x4000C000

The Voltage Comparator Configuration Register contains the software control for selecting between the 4 options for the positive input as well as the multiple options for the reference input.

**Table 1159: CFG Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        | LVLSEL |        |        |        | RSVD   |        |        |        | NSEL   | RSVD   |        |        |        |        |        | PSEL   |        |        |        |        |

**Table 1160: CFG Register Bits**

| Bit   | Name   | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|--------|-------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:20 | RSVD   | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 19:16 | LVLSEL | 0x0   | RW | <p>When the reference input NSEL is set to NSEL_DAC, this bit field selects the voltage level for the negative input to the comparator.</p> <p>0P58V = 0x0 - Set Reference input to 0.58 Volts.<br/>           0P77V = 0x1 - Set Reference input to 0.77 Volts.<br/>           0P97V = 0x2 - Set Reference input to 0.97 Volts.<br/>           1P16V = 0x3 - Set Reference input to 1.16 Volts.<br/>           1P35V = 0x4 - Set Reference input to 1.35 Volts.<br/>           1P55V = 0x5 - Set Reference input to 1.55 Volts.<br/>           1P74V = 0x6 - Set Reference input to 1.74 Volts.<br/>           1P93V = 0x7 - Set Reference input to 1.93 Volts.<br/>           2P13V = 0x8 - Set Reference input to 2.13 Volts.<br/>           2P32V = 0x9 - Set Reference input to 2.32 Volts.<br/>           2P51V = 0xA - Set Reference input to 2.51 Volts.<br/>           2P71V = 0xB - Set Reference input to 2.71 Volts.<br/>           2P90V = 0xC - Set Reference input to 2.90 Volts.<br/>           3P09V = 0xD - Set Reference input to 3.09 Volts.<br/>           3P29V = 0xE - Set Reference input to 3.29 Volts.<br/>           3P48V = 0xF - Set Reference input to 3.48 Volts.</p> |
| 15:10 | RSVD   | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 9:8   | NSEL   | 0x0   | RW | <p>This bit field selects the negative input to the comparator.</p> <p>VREFEXT1 = 0x0 - Use external reference 1 for reference input.<br/>           VREFEXT2 = 0x1 - Use external reference 2 for reference input.<br/>           VREFEXT3 = 0x2 - Use external reference 3 for reference input.<br/>           DAC = 0x3 - Use DAC output selected by LVLSEL for reference input.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 7:2   | RSVD   | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

| Bit | Name | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----|------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1:0 | PSEL | 0x0   | RW | <p>This bit field selects the positive input to the comparator.</p> <p>VDDADJ = 0x0 - Use VDDADJ for the positive input.</p> <p>VTEMP = 0x1 - Use the temperature sensor output for the positive input.</p> <p>Note: If this channel is selected for PSEL, the bandgap circuit required for temperature comparisons will automatically turn on. The bandgap circuit requires 11 us to stabilize.</p> <p>VEXT1 = 0x2 - Use external voltage 0 for positive input.</p> <p>VEXT2 = 0x3 - Use external voltage 1 for positive input.</p> |

## Status

**INSTANCE 0 ADDRESS: 0x4000C004**

## Status

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2  | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | PWDSTAT | CMPOUT |        |

| Bit  | Name    | Reset | RW | Description                                                                                                                                                                                                                                                                          |
|------|---------|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:2 | RSVD    | 0x0   | RO | This bit field is reserved for future use.                                                                                                                                                                                                                                           |
| 1    | PWDSTAT | 0x0   | RO | This bit indicates the power down state of the voltage comparator.<br>POWERED_DOWN = 0x1 - The voltage comparator is powered down.                                                                                                                                                   |
| 0    | CMPOUT  | 0x0   | RO | This bit is 1 if the positive input of the comparator is greater than the negative input.<br>VOUT_LOW = 0x0 - The negative input of the comparator is greater than the positive input.<br>VOUT_HIGH = 0x1 - The positive input of the comparator is greater than the negative input. |

### Key for Powering Down the Voltage Comparator

**INSTANCE 0 ADDRESS: 0x4000C008**



**INSTANCE 0 ADDRESS:** 0x4000C204

Read bits from this register to discover the cause of a recent interrupt.

**Table 1167: INTSTAT Register**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |      |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |      |        |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | OUTH | OUTLOW |

**Table 1168: INTSTAT Register Bits**

| Bit  | Name   | Reset | RW | Description                                |
|------|--------|-------|----|--------------------------------------------|
| 31:2 | RSVD   | 0x0   | RO | This bit field is reserved for future use. |
| 1    | OUTH   | 0x0   | RW | This bit is the vcompout high interrupt.   |
| 0    | OUTLOW | 0x0   | RW | This bit is the vcompout low interrupt.    |

### 20.2.2.6 INTCLR Register

**Voltage Comparator Interrupt registers: Clear**

**OFFSET:** 0x00000208

**INSTANCE 0 ADDRESS:** 0x4000C208

Write a 1 to a bit in this register to clear the interrupt status associated with that bit.

**Table 1169: INTCLR Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |      |        |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------|--------|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0    | 0      |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0    | 0      |
| RSVD |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | OUTH | OUTLOW |

**Table 1170: INTCLR Register Bits**

| Bit  | Name | Reset | RW | Description                                |
|------|------|-------|----|--------------------------------------------|
| 31:2 | RSVD | 0x0   | RO | This bit field is reserved for future use. |
| 1    | OUTH | 0x0   | RW | This bit is the vcompout high interrupt.   |

| Bit | Name   | Reset | RW | Description                             |
|-----|--------|-------|----|-----------------------------------------|
| 0   | OUTLOW | 0x0   | RW | This bit is the vcompout low interrupt. |

### Voltage Comparator Interrupt registers: Set

**INSTANCE 0 ADDRESS: 0x4000C20C**

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | OUTH   | OUTLOW |        |

| Bit  | Name   | Reset | RW | Description                                |
|------|--------|-------|----|--------------------------------------------|
| 31:2 | RSVD   | 0x0   | RO | This bit field is reserved for future use. |
| 1    | OUTH1  | 0x0   | RW | This bit is the vcompout high interrupt.   |
| 0    | OUTLOW | 0x0   | RW | This bit is the vcompout low interrupt.    |



## 21. Voltage Regulator Module

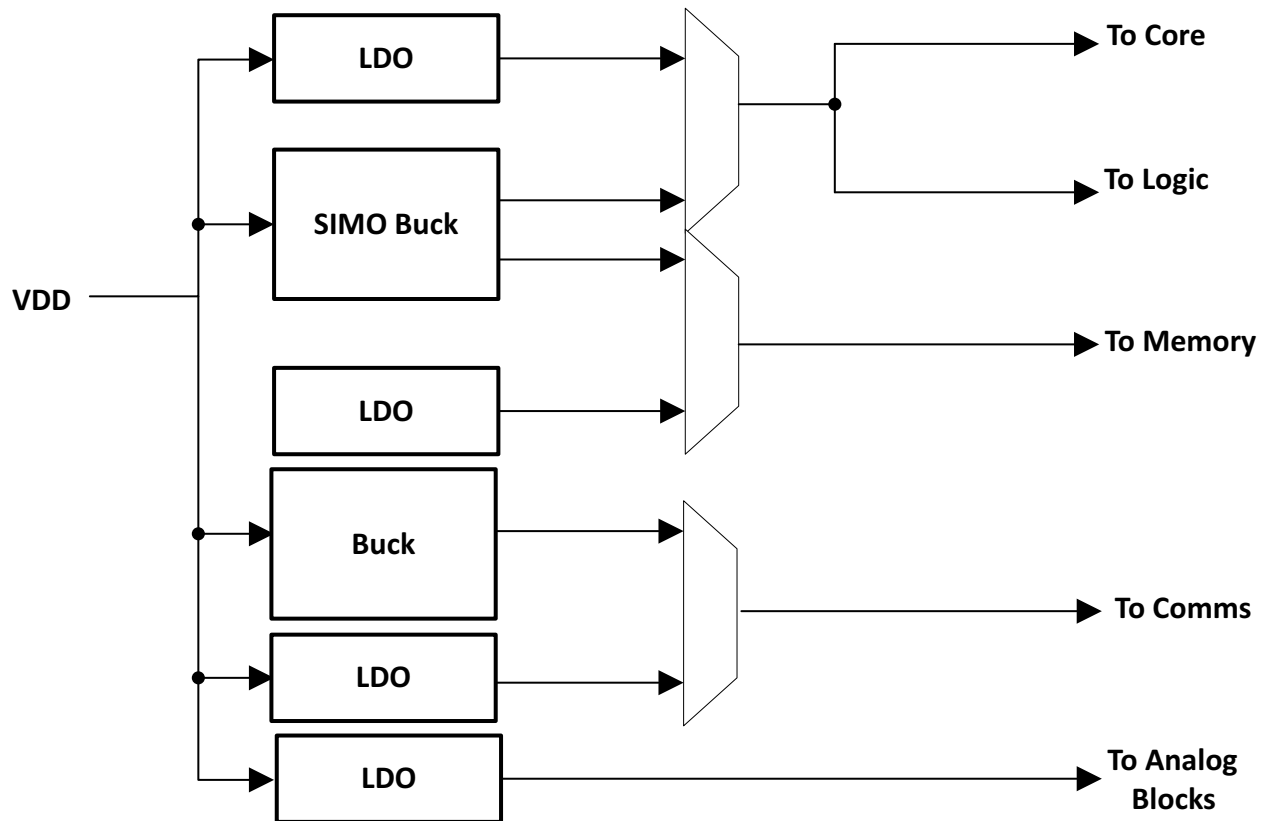


Figure 95. Block Diagram for the Voltage Regulator Module

### 21.1 Functional Overview

The Voltage Regulator Module down-converts and regulates the supply voltage, VDD, with extremely high efficiency. A pair of Buck Converters enables down-conversion from the power supply input (e.g., a battery or external regulator) at efficiency of > 80%. With ultra-low quiescent current, the Buck Converters are optimized for low power environments. There are also integrated low dropout linear regulators (LDOs) which are used in very low power modes and can also be utilized to provide a lower cost system solution by eliminating the need for the external inductors required in buck mode. The VDDC and VDDF capacitors are still required for the internal LDOs.

The Buck Converters and LDOs of the Voltage Regulator Module are tightly coupled to the various low power modes in the Apollo3 Blue SoC. When the Apollo3 Blue SoC enters deep sleep mode, the Buck Converters will switch into a low power mode to provide very high efficiency at low quiescent current.

### 21.2 SIMO Buck

The SIMO buck sources the primary supplies for the core and memory domains. This buck is a very high efficiency, single-inductor/multiple-output design. The SIMO buck is enabled via an OTP CUSTOMER\_TRIM setting. Upon initial reset, if enabled, the SIMO buck will be power up and stabilized through hardware control. The status of the SIMO buck can be queried via the PWRCTRL\_SUPPLYSTATUS register (See Section 3.6.3.1.2.2 on page 84). The SIMO buck has an

efficient ultra-low power mode that is entered automatically via hardware control based on active load current of the system.

For cost/area constrained designs, the SIMO buck can be disabled and on-die LDO regulators can be used. In this configuration, the OTP CUSTOMER\_TRIM setting must have the SIMO\_BUCK\_enable set to '0'. In this configuration, the SIMO buck will remain powered down.

There is also a zero length detect circuit to ensure the regulated voltages from the SIMO buck do not drop out.

## 21.3 BLE/Burst Buck

The BLE/Burst buck sources the supplies to the BLE radio subsystem as well as the higher voltage required to support the TurboSPOT Mode operation. The BLE/Burst buck must be enabled prior to enabling either the BLE or the TurboSPOT Mode features. The BLEBUCKEN bit (Section 3.6.3.1.2.1 on page 84) can be set at any point after reset in software but should be set prior to enabling either the BLE or TurboSPOT mode features. The status of the BLE/Burst buck can be queried via the PWRCTRL\_SUPPLYSTATUS register (See Section 3.6.3.1.2.2 on page 84).

For systems that require fast ramp times for the BLE subsystem, the BLE/Burst buck can be enabled by default at reset by setting the BLE\_BUCK\_enable and BLE\_FEATURE\_enable bits in the OTP CUSTOMER\_TRIM field. If set, hardware will control powering up the buck and sequencing the regulation circuitry as needed at initial power on.

The BLE and TurboSPOT Mode features can be enabled via the FEATUREENABLE register (See Section 3.9.2.7 on page 136). Once enabled, hardware controls all sequencing required to enter/exit the various power modes of the BLE/Burst regulators regardless of the configuration.

For cost/area constrained designs, the BLE/Burst buck can be disabled and on-die LDO regulators can be used. In this configuration, the OTP CUSTOMER\_TRIM setting must have the BLE\_BUCK\_enable set to '0'. In this configuration, the BLE buck will remain powered down.

### 21.3.1 BLE/Burst Buck Ton Adjustment

Calibration logic within the clock generator block works to check the frequency of the Ton clocks going to the Buck. If the frequency of the Ton clocks is lower than the configured threshold, then the adjustment logic will reduce the Buck charging time for each cycle, which has the effect of increasing the frequency of the charging cycles. If the Ton clocks are higher than the configured threshold, then the adjustment logic will increase the Buck charging time, which has the effect of reducing the frequency of the charging cycle.

The following steps are required to enable the BLE Ton Adjustment:

1. Set the TONADJUSTEN bit field in CLKGEN\_BLEBUCKTONADJ to 0. This will disable the Adjustment until the programming is done.
2. Set the TONADJUSTPERIOD bits field to the adjustment period required. The longer the adjustment period, the more accurate is the adjustment. The shorter the adjustment period, the faster will be the adjustment.
3. Based on the TONADJUSTPERIOD, set the TONHIGHTHRESHOLD and TONLOWTHRESHOLD. The suggested values for the high threshold are #15(94kHz) #2A(47Khz) #A6(12Khz) #29A(3Khz). The suggested values for the low threshold are #A(94kHz) #15(47kHz) #53(12Khz) #14D(3Khz).

Set the TONADJUSTEN bit field in CLKGEN\_BLEBUCKTONADJ to 1. This will enable the Adjustment to start.

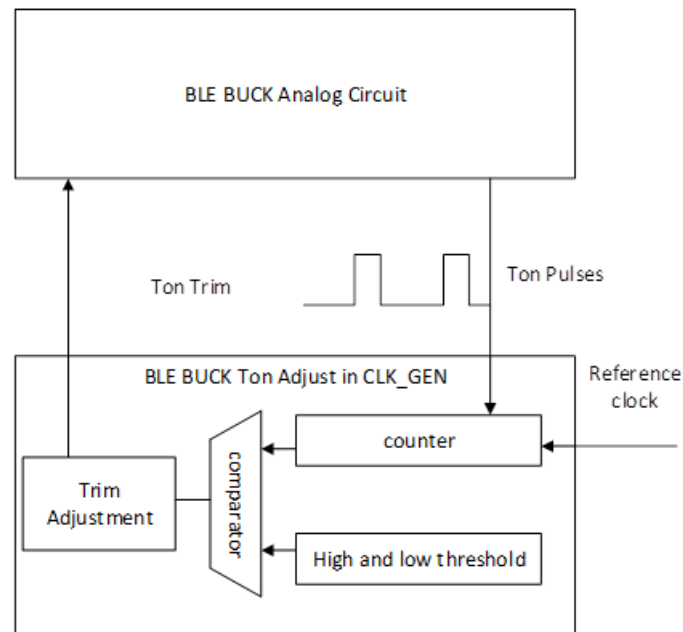


**Figure 96. BLE/Burst Buck Ton Adjustment Diagram**

### 21.3.2 BLE/Burst Buck zero length detect

In addition to the Ton adjustment, there is a zero length detect circuit to ensure the regulated voltage does not drop out. The zero length detect is a mechanism to detect the length of time the buck is indicating that the buck voltage is below a certain threshold. If the indicator is continuously asserted beyond a certain time, this indicates that the Buck has not been able to pull the voltage above the threshold. The zero length detect logic will send a flag to the reset generator logic. This will result in either a reset, or an interrupt. The MCU\_CTRL\_BO\_DISABLE register (BODBRDE) controls the BLE/Burst buck local brown out disables.

## 22. Electrical Characteristics

For all tables  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , Typical values at  $25^{\circ}\text{C}$ , 1.8 V, unless otherwise specified.

### 22.1 Absolute Maximum Ratings

The absolute maximum ratings are the limits to which the device can be subjected without permanently damaging the device and are stress ratings only. Device reliability may be adversely affected by exposure to absolute maximum ratings for extended periods. Functional operation of the device at the absolute maximum ratings or any other conditions beyond the recommended operating conditions is not implied.

**Table 1173: Absolute Maximum Ratings**

| Symbol          | Parameter                                                       | Test Conditions                                                                                                                 | Min  | Max             | Unit                        |
|-----------------|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------|-----------------|-----------------------------|
| $V_{DDP}$       | Pad supply voltage                                              |                                                                                                                                 | -    | 3.63            | V                           |
| $V_{DDH}$       | Digital supply voltage                                          |                                                                                                                                 | -    | 3.63            | V                           |
| $V_{DDA}$       | Analog supply voltage                                           |                                                                                                                                 | -    | 3.63            | V                           |
| $V_{IO}$        | Voltage on all input and output pins                            |                                                                                                                                 | -0.3 | $V_{DDH} + 0.3$ | V                           |
| $I_{SRC\_STD}$  | Standard output pin source continuous current                   |                                                                                                                                 | -    | 16              | mA                          |
| $I_{SINK\_STD}$ | Standard output pin sink continuous current                     |                                                                                                                                 | -    | 16              | mA                          |
| $I_{HSC\_PWR}$  | High side power switch continuous source current <sup>(1)</sup> |                                                                                                                                 | -    | 50              | mA                          |
| $I_{LSC\_PWR}$  | Low side power switch continuous sink current <sup>(2)</sup>    |                                                                                                                                 | -    | 50              | mA                          |
| $I_{HSP\_PWR}$  | High side power switch pulsed source current <sup>(1)</sup>     | 100 ms pulse, 1% duty cycle                                                                                                     | -    | 100             | mA                          |
| $I_{LSP\_PWR}$  | Low side power switch pulsed sink current <sup>(2)</sup>        | 100 ms pulse, 1% duty cycle                                                                                                     | -    | 100             | mA                          |
| $T_S$           | Storage temperature                                             |                                                                                                                                 | -55  | 125             | $^{\circ}\text{C}$          |
| $T_J$           | Junction temperature                                            | Calculated assuming worst-case power consumption running Core-mark, plus two high-side switches passing maximum static current. | -    | 85.7            | $^{\circ}\text{C}$          |
| $T_{OP}$        | Operating temperature                                           |                                                                                                                                 | -40  | 85              | $^{\circ}\text{C}$          |
| $\theta_{JA}$   | Thermal resistance, junction to ambient                         | BGA Package on 4 layer PCB in still air, 3mW power dissipation                                                                  | -    | 61.3            | $^{\circ}\text{C}/\text{W}$ |
| $\theta_{JC}$   | Thermal resistance, junction to package case                    | BGA Package on 4 layer PCB in still air, 3mW power dissipation                                                                  | -    | 10.4            | $^{\circ}\text{C}/\text{W}$ |
| $T_{REFLOW}$    | Reflow temperature                                              | Reflow Profile per JEDEC J-STD-020D.1                                                                                           | -    | 260             | $^{\circ}\text{C}$          |
| $I_{LU}$        | Latch-up current                                                |                                                                                                                                 | -    | 100             | mA                          |
| $V_{ESDHBM}$    | ESD Human Body Model (HBM)                                      |                                                                                                                                 | -    | 2000            | V                           |
| $V_{ESDCDM}$    | ESD Charged Device Model (CDM)                                  |                                                                                                                                 | -    | 250             | V                           |

**Table 1173: Absolute Maximum Ratings**

|          |                                              |                             |   |     |    |
|----------|----------------------------------------------|-----------------------------|---|-----|----|
| IHSP_PWR | High side power switch pulsed source current | 100 ms pulse, 1% duty cycle | - | 100 | mA |
| ILSP_PWR | Low side power switch pulsed source current  | 100 ms pulse, 1% duty cycle | - | 100 | mA |

<sup>(1)</sup> High side power switches are available on PAD3 and PAD36

<sup>(2)</sup> A low side power switch is available on PAD37 and PAD41

## 22.2 Recommended Operating Conditions

**Table 1174: Recommended Operating Conditions<sup>a</sup>**

| Symbol              | Parameter                                                                       | Min   | Typ    | Max  | Unit |
|---------------------|---------------------------------------------------------------------------------|-------|--------|------|------|
| V <sub>DDP</sub>    | Pad supply voltage                                                              | 1.755 | -      | 3.63 | V    |
| V <sub>DDH</sub>    | Digital supply voltage                                                          | 1.755 | -      | 3.63 | V    |
| V <sub>DDA</sub>    | Analog supply voltage                                                           | 1.755 | -      | 3.63 | V    |
| V <sub>DDB</sub>    | BLE/Burst Buck Converter supply voltage                                         | 1.755 | -      | 3.63 | V    |
| V <sub>CC</sub>     | RF supply voltage                                                               | 1.755 | -      | 3.63 | V    |
| T <sub>A</sub>      | Ambient operating temperature                                                   | -40   | -      | 85   | °C   |
| F <sub>HFRCLP</sub> | High Frequency RC (HFRC) oscillator frequency - Low Power                       | -     | 48     | -    | MHz  |
| F <sub>HFRCLP</sub> | High Frequency RC (HFRC) oscillator frequency - High Performance TurboSPOT Mode | -     | 96     | -    | MHz  |
| F <sub>LFRC</sub>   | Low Frequency RC oscillator frequency (LFRC)                                    | -     | 1.024  | -    | kHz  |
| F <sub>XTAL</sub>   | Crystal frequency                                                               | -     | 32.768 | -    | kHz  |

a. V<sub>DD</sub> = V<sub>DDP</sub> = V<sub>DDA</sub> = V<sub>DDH</sub>

## 22.3 Current Consumption

**Table 1175: Current Consumption**

| Symbol                      | Parameter                                                       | Test Conditions <sup>a,b</sup>                                                                                                                                          | VDD (V) | Min | Typ  | Max | Unit                     |
|-----------------------------|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----|------|-----|--------------------------|
| $I_{\text{RUNLPFB}}$        | Flash program run current, bucks enabled, Low Power Mode        | Executing Coremark from internal Flash memory, cache enabled, HFRC = 48 MHz, all peripherals disabled, buck converters enabled, 8kB SRAM, Flash1 OFF                    | 3.3     | -   | 10.3 | -   | $\mu\text{A}/\text{MHz}$ |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 18.2 | -   | $\mu\text{A}/\text{MHz}$ |
| $I_{\text{RUNHPFB}}$        | Flash program run current, bucks enabled, High Performance Mode | Executing Coremark from internal Flash memory, cache enabled, HFRC = 96 MHz, all peripherals disabled, buck converters enabled, 8kB SRAM, Flash1 OFF                    | 3.3     | -   | 27   | -   | $\mu\text{A}/\text{MHz}$ |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 41   | -   | $\mu\text{A}/\text{MHz}$ |
| $I_{\text{RUNLPFB}}$        | Flash program run current, bucks enabled, Low Power Mode        | Executing Prime Number factorization from internal Flash Memory, cache enabled, HFRC = 48 MHz, all peripherals disabled, buck converters enabled, 8kB SRAM, Flash1 OFF  | 3.3     | -   | 8    | -   | $\mu\text{A}/\text{MHz}$ |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 14   | -   | $\mu\text{A}/\text{MHz}$ |
| $I_{\text{RUNHPFB}}$        | Flash program run current, bucks enabled, High Performance Mode | Executing Prime Number factorization from internal Flash Memory, cache enabled, HFRC = 96 MHz, all peripherals disabled, buck converters enabled, 8 kB SRAM, Flash1 OFF | 3.3     | -   | 23   | -   | $\mu\text{A}/\text{MHz}$ |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 34   | -   | $\mu\text{A}/\text{MHz}$ |
| $I_{\text{RUNWLFPB}}$       | Flash program run current, bucks enabled, Low Power Mode        | Executing while loop from internal Flash Memory, cache enabled, HFRC = 48 MHz, all peripherals disabled, buck converters enabled, 8 kB SRAM, Flash1 OFF                 | 3.3     | -   | 6    | -   | $\mu\text{A}/\text{MHz}$ |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 10   | -   | $\mu\text{A}/\text{MHz}$ |
| $I_{\text{SS2}}$            | Sleep mode 2 current                                            | WFI instruction with SLEEP=1, clocks gated, OSC ON, buck converters enabled, all I/O power domains powered OFF, Flash1 OFF, 8 kB SRAM.                                  | 3.3     | -   | 69   | -   | $\mu\text{A}$            |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 89   | -   | $\mu\text{A}$            |
| $I_{\text{SDS2-384RET}}$    | System Deep Sleep mode 2 current w/ 384kB retention             | WFI instruction with SLEEPDEEP=1, XTAL ON, buck converters enabled in LP mode, all I/O power domains powered OFF, BLE OFF, 384 kB SRAM in retention.                    | 3.3     | -   | 4.1  | -   | $\mu\text{A}$            |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 4.7  | -   | $\mu\text{A}$            |
| $I_{\text{SDS2-8RET}}$      | System Deep Sleep mode 2 current w/ 8kB retention               | WFI instruction with SLEEPDEEP=1, XTAL ON, buck converters enabled in LP mode, all I/O power domains powered OFF, BLE OFF, 8 kB SRAM in retention.                      | 3.3     | -   | 2.3  | -   | $\mu\text{A}$            |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 1.9  | -   | $\mu\text{A}$            |
| $I_{\text{SDS3}}$           | System Deep Sleep mode 3 current                                | WFI instruction with SLEEPDEEP=1, XTAL OFF, buck converters enabled in LP mode, all I/O power domains powered OFF, BLE OFF, all SRAM OFF.                               | 3.3     | -   | 2.0  | -   | $\mu\text{A}$            |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 1.6  | -   | $\mu\text{A}$            |
| $I_{\text{Active\_RX\_95}}$ | VDDDB Radio Rx current                                          | Sensitivity = -95 dBm, Receiver active. Buck mode.                                                                                                                      | 3.3     | -   | 3.2  | -   | mA                       |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 5.4  | -   | mA                       |
| $I_{\text{Active\_TX\_0}}$  | VDDDB Radio TX current                                          | Measured at 0 dBm, Transmitter active, Buck mode.                                                                                                                       | 3.3     | -   | 4.3  | -   | mA                       |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 7.2  | -   | mA                       |
| $I_{\text{Active\_TX\_4}}$  | VDDDB Radio TX current                                          | Measured at +4 dBm, Transmitter active, Buck mode.                                                                                                                      | 3.3     | -   | 5.8  | -   | mA                       |
|                             |                                                                 |                                                                                                                                                                         | 1.8     | -   | 10   | -   | mA                       |

Table 1175: Current Consumption

| Symbol                                | Parameter                                        | Test Conditions <sup>a,b</sup> | VDD (V) | Min | Typ | Max | Unit |
|---------------------------------------|--------------------------------------------------|--------------------------------|---------|-----|-----|-----|------|
| <b>Flash Memory Operating Current</b> |                                                  |                                |         |     |     |     |      |
| I <sub>PROGRAMB</sub>                 | Supply current during a page program - Buck Mode | Buck Mode                      | 3.3     | -   | 4.6 | 5.3 | mA   |
|                                       |                                                  |                                | 1.8     | -   | 3.4 | 3.7 | mA   |
| I <sub>PROGRAML</sub>                 | Supply current during a page program - LDO Mode  | LDO Mode                       | 3.3     | -   | 4.6 | 5.3 | mA   |
|                                       |                                                  |                                | 1.8     | -   | 4.2 | 5.1 | mA   |
| I <sub>ERASEB</sub>                   | Supply current during a page erase - Buck Mode   | Buck Mode                      | 3.3     | -   | 2.4 | 2.7 | mA   |
|                                       |                                                  |                                | 1.8     | -   | 2.5 | 2.8 | mA   |
| I <sub>ERASEL</sub>                   | Supply current during a page erase - LDO Mode    | LDO Mode                       | 3.3     | -   | 3.8 | 4.4 | mA   |
|                                       |                                                  |                                | 1.8     | -   | 3.5 | 4.2 | mA   |
| I <sub>MASSERASEB</sub>               | Supply current during a mass erase - Buck Mode   | Buck Mode                      | 3.3     | -   | 2.4 | 2.7 | mA   |
|                                       |                                                  |                                | 1.8     | -   | 2.5 | 3.1 | mA   |
| I <sub>MASSERASEL</sub>               | Supply current during a mass erase - LDO Mode    | LDO Mode                       | 3.3     | -   | 3.8 | 4.4 | mA   |
|                                       |                                                  |                                | 1.8     | -   | 3.5 | 4.2 | mA   |

a. Core clock (HCLK) is 48 MHz for each parameter unless otherwise noted.

b. All values measured at 25°C



## 22.4 Power Mode Transitions

**Table 1176: Power Mode Transitions**

| Symbol                        | Parameter                                   | Min | Typ | Max | Unit |
|-------------------------------|---------------------------------------------|-----|-----|-----|------|
| Buck mode                     |                                             |     |     |     |      |
| T <sub>RUN_TO_SLEEP</sub>     | Run to Sleep mode transition time           | -   | 850 | -   | ns   |
| T <sub>RUN_TO_DEEPSLEEP</sub> | Run mode to Deep Sleep mode transition time | -   | 850 | -   | ns   |
| T <sub>SLEEP_TO_RUN</sub>     | Sleep to Run mode transition time           | -   | 220 | -   | ns   |
| T <sub>DEEPSLEEP_TO_RUN</sub> | Deep-Sleep to Run mode transition time      | -   | 25  | -   | μs   |
| LDO mode                      |                                             |     |     |     |      |
| T <sub>RUN_TO_SLEEP</sub>     | Run to Sleep mode transition time           | -   | 850 | -   | ns   |
| T <sub>RUN_TO_DEEPSLEEP</sub> | Run mode to Deep Sleep mode transition time | -   | 850 | -   | ns   |
| T <sub>SLEEP_TO_RUN</sub>     | Sleep to Run mode transition time           | -   | 220 | -   | ns   |
| T <sub>DEEPSLEEP_TO_RUN</sub> | Deep-Sleep to Run mode transition time      | -   | 20  | -   | μs   |

## 22.5 Clocks/Oscillators

**Table 1177: Clocks/Oscillators**

| Symbol                   | Parameter                                      | Test Conditions                 | Min  | Typ    | Max  | Unit |
|--------------------------|------------------------------------------------|---------------------------------|------|--------|------|------|
| F <sub>HFRC</sub>        | HFRC frequency                                 |                                 | 46.8 | 48     | 49.7 | MHz  |
| F <sub>LFRC</sub>        | LFRC frequency                                 |                                 | 860  | 1024   | 1350 | Hz   |
| F <sub>XT</sub>          | XT frequency                                   |                                 | -    | 32.768 | -    | kHz  |
| DC <sub>HFRC</sub>       | HFRC duty cycle                                | CLKGEN_CLKOUT_CKSEL = LFRC_DIV2 | 45   | 50     | 55   | %    |
| DC <sub>LFRC</sub>       | LFRC duty cycle                                | CLKGEN_CLKOUT_CKSEL = LFRC_DIV2 | 45   | 50     | 55   | %    |
| DC <sub>XT</sub>         | XT duty cycle                                  |                                 | 45   | 52     | 60   | %    |
| C <sub>INX</sub>         | Internal XI/XO pin capacitance                 |                                 | -    | 3.4    | -    | pF   |
| C <sub>EXT_X-T_TOL</sub> | Allowed external XI/XO pin capacitance per pin |                                 | -    |        | 7    | pF   |
| F <sub>OF</sub>          | XT oscillator failure detection frequency      |                                 | -    | 8      | -    | kHz  |

**Table 1178: BLE Crystal Oscillator**

| Symbol             | Parameter                    | Test Conditions                                              | Min | Typ | Max | Unit |
|--------------------|------------------------------|--------------------------------------------------------------|-----|-----|-----|------|
| F <sub>XTAL</sub>  | Crystal frequency            |                                                              | -   | 32  | -   | MHz  |
| ΔF <sub>XTAL</sub> | Frequency tolerance          | Untrimmed; include initial tolerance/aging/temperature drift | -40 | -   | 40  | ppm  |
| C <sub>L</sub>     | Crystal load capacitance     |                                                              | -   | 8   | -   | pF   |
| ESR                | Equivalent serial resistance |                                                              | -   | -   | 100 | Ohms |
| T <sub>XTAL</sub>  | Startup time                 |                                                              | -   | 1   | -   | ms   |

## 22.6 Bluetooth Low Energy Controller

| Symbol                         | Parameter <sup>a</sup>                      | Test Conditions                                                                                                                        | Min  | Typ | Max | Unit |
|--------------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------|-----|-----|------|
| <b>AC Characteristics - RX</b> |                                             |                                                                                                                                        |      |     |     |      |
| R <sub>SENS</sub>              | Receiver sensitivity                        | 1 Mbps BLE ideal transmitter, <=37 bytes, PER < 30.8%                                                                                  | -    | -93 | -   | dBm  |
| C/Ico-channel                  | Co-channel interference                     | Wanted signal at – 67dBm, modulated interferer in channel, PER < 30.8%                                                                 | 7    | -   | -   | dB   |
| PB                             | Out of band blocking: 30 MHz to 2000 MHz    | Modulated RF carrier input signal power level of -67dBm. Blocking signal power level swept from 20-2000MHz. Packet error rate < 30%.   | -5   | -   | -   | dBm  |
|                                | Out of band blocking: 2003 MHz to 2399 MHz  | Modulated RF carrier input signal power level of -67dBm. Blocking signal power level swept from 2003-2399MHz. Packet error rate < 30%. | -15  | -   | -   | dBm  |
|                                | Out of band blocking: 2484 MHz to 2997 MHz  | Modulated RF carrier input signal power level of -67dBm. Blocking signal power level swept from 2484-2997MHz. Packet error rate < 30%. | -15  | -   | -   | dBm  |
|                                | Out of band blocking: 3000 MHz to 12.75 GHz | Modulated RF carrier input signal power level of -67dBm. Blocking signal power level swept from 3.0-12.75GHz. Packet error rate < 30%. | -5   | -   | -   | dBm  |
| F <sub>ET</sub>                | Frequency error tolerance                   |                                                                                                                                        | -125 | -   | 125 | kHz  |
| <b>AC Characteristics - TX</b> |                                             |                                                                                                                                        |      |     |     |      |
| P <sub>OUT_PEAK</sub>          | Peak output power                           |                                                                                                                                        | 3    | 3.5 | 4   | dBm  |
| P <sub>OUT_HD2</sub>           | Second harmonic output power level          |                                                                                                                                        | -    | -40 | -27 | dBm  |
| P <sub>OUT_HD3</sub>           | Third harmonic output power level           |                                                                                                                                        | -    | -40 | -27 | dBm  |
| P <sub>OUT_HD4</sub>           | Fourth harmonic output power level          |                                                                                                                                        | -    | -40 | -27 | dBm  |

a. FCC and BQB test reports are available upon request.

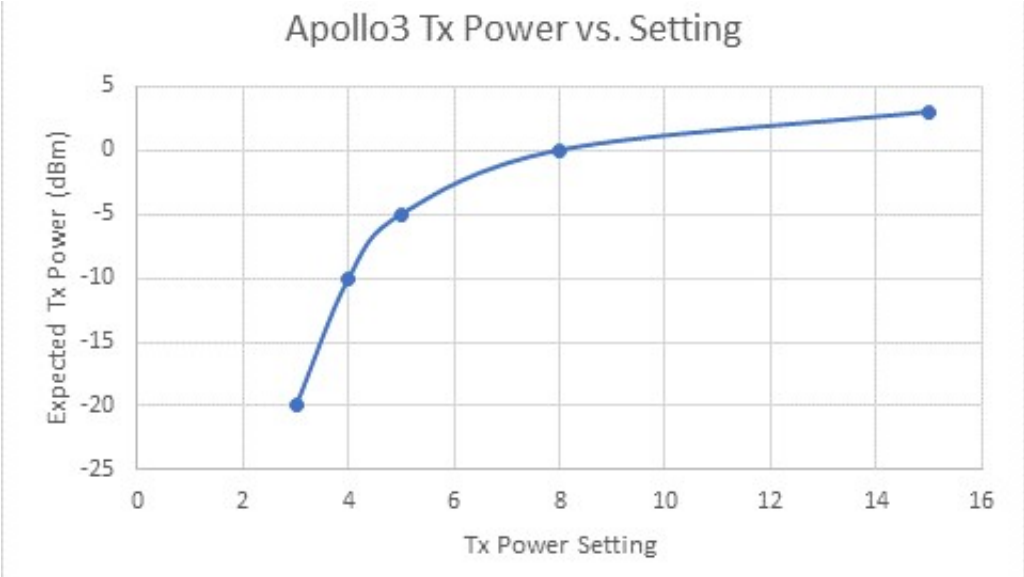


Figure 97. Apollo3 Blue Bluetooth Low Energy Transmit Power per Power Setting

## 22.7 Analog-to-Digital Converter (ADC)

**Table 1179: Analog to Digital Converter (ADC)**

| Symbol                                     | Parameter                                                             | Test Conditions                                 | Min                    | Typ                                              | Max                    | Unit          |
|--------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------|------------------------|--------------------------------------------------|------------------------|---------------|
| <b>ANALOG INPUT</b>                        |                                                                       |                                                 |                        |                                                  |                        |               |
| $V_{\text{ADCIN}}$                         | Input voltage range single-ended input                                |                                                 | 0                      | -                                                | $V_{\text{ADCREf}}$    | V             |
| $V_{\text{ADCIN\_DIFF}}$                   | Input voltage range in differential mode                              |                                                 | $-V_{\text{ADCREf}}/2$ | -                                                | $+V_{\text{ADCREf}}/2$ | V             |
| $V_{\text{ADCINN}}$<br>$V_{\text{ADCINP}}$ | Absolute differential input voltage range                             |                                                 | 0                      | -                                                | VDDH                   | V             |
| $V_{\text{ADCREf\_15E}}$                   | External reference voltage range (1.5v mode)                          |                                                 | 1.425                  | 1.5                                              | 1.575                  | V             |
| $V_{\text{ADCREf\_20E}}$                   | External reference voltage range (2.0v mode)                          |                                                 | 1.9                    | 2.0                                              | 2.1                    | V             |
| $V_{\text{ADCREf\_15I}}$                   | Internal reference voltage range (1.5v mode)                          |                                                 | 1.475                  | 1.5                                              | 1.525                  | V             |
| $V_{\text{ADCREf\_20I}}$                   | Internal reference voltage range (2.0v mode)                          |                                                 | 1.975                  | 2.0                                              | 2.025                  | V             |
| $I_{\text{ADCIN}}$                         | ADC channel pin input leakage current (static)                        | Measured on ADC0 - ADC7 inputs at 3.63V         | -                      | 1                                                | 50                     | nA            |
| $C_{\text{ADCIN}}$                         | Input source capacitance                                              | GPIO16 (ADC Channel 0)                          | -                      | 4                                                | -                      | pF            |
| $C_{\text{ADCVREF}}$                       | External ADC capacitance for internal reference                       |                                                 | 400                    | 470                                              | 540                    | nF            |
| <b>SAMPLING DYNAMICS</b>                   |                                                                       |                                                 |                        |                                                  |                        |               |
| RES                                        | Resolution                                                            |                                                 | 8                      | -                                                | 14                     | bit           |
| $F_{\text{ADCONV}}$                        | Conversion rate                                                       | External ADC capacitance for internal reference | -                      | 1.2 (14b)<br>1.6 (12b)<br>2.0 (10b)<br>2.66 (8b) | -                      | MS/s          |
| $T_{\text{SAMPLE\_HOLD}}$                  | Fixed sample-and-hold time                                            |                                                 | -                      | 5                                                | -                      | cycles        |
| $T_{\text{SCAN\_START\_TO\_SAMPLE}}$       | Fixed start-of-scan to sampling delay                                 |                                                 | -                      | 2                                                | -                      | cycles        |
| $T_{\text{TRIG\_CSTART\_REF0}}$            | Delay from cold start trigger to start of scan, Internal Ref          |                                                 | -                      | 652                                              | -                      | $\mu\text{s}$ |
| $T_{\text{TRIG\_CSTART\_REF1}}$            | Delay from cold start trigger to start of scan, External Ref          |                                                 | -                      | 137                                              | -                      | $\mu\text{s}$ |
| $T_{\text{TRIG\_WSTART\_LP1\_REF0}}$       | Delay from warm start trigger to start of scan, LPMODE1, Internal Ref |                                                 | -                      | 65.6                                             | -                      | $\mu\text{s}$ |
| $T_{\text{TRIG\_WSTART\_LP1\_REF1}}$       | Delay from warm start trigger to start of scan, LPMODE1, External Ref |                                                 | -                      | 1.52                                             | -                      | $\mu\text{s}$ |

| Symbol                                                                                                                                                      | Parameter                                                             | Test Conditions | Min   | Typ   | Max   | Unit    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------|-------|-------|-------|---------|
| $T_{TRIG\_WSTART\_LP0\_REF0}$                                                                                                                               | Delay from warm start trigger to start of scan, LPMODE0, Internal Ref |                 | -     | 0     | -     | $\mu s$ |
| $T_{TRIG\_WSTART\_LP0\_REF1}$                                                                                                                               | Delay from warm start trigger to start of scan, LPMODE0, External Ref |                 | -     | 0     | -     | $\mu s$ |
| $T_{SNGLSLOT\_SCNCMP\_PM14}$                                                                                                                                | Delay from scan start to scan complete, precision mode 14             |                 | -     | 40    | -     | cycles  |
| $T_{SNGLSLOT\_SCNCMP\_PM12}$                                                                                                                                | Delay from scan start to scan complete, precision mode 12             |                 | -     | 28    | -     | cycles  |
| $T_{SNGLSLOT\_SCNCMP\_PM10}$                                                                                                                                | Delay from scan start to scan complete, precision mode 10             |                 | -     | 22    | -     | cycles  |
| $T_{SNGLSLOT\_SCNCMP\_PM8}$                                                                                                                                 | Delay from scan start to scan complete, precision mode 8              |                 | -     | 18    | -     | cycles  |
| $T_{CAL}$                                                                                                                                                   | Calibration Period                                                    |                 | -     | 6415  | -     | cycles  |
| <b>DYNAMIC CHARACTERISTICS, External 2v Reference<br/>(LDO or Buck Mode<sup>a</sup>, Single/Diff. Ended Input, 1 kHz Input, ADC Running in 14-bit Mode)</b> |                                                                       |                 |       |       |       |         |
| $ENOB_{CAL}$                                                                                                                                                | Calibrated ENOB                                                       | 3.0V            | 10.3  | 10.9  | -     | ENOB    |
| $THD_{ADC}$                                                                                                                                                 | Total harmonic distortion (THD)<br>- 1st 7 harmonics                  | 3.0V            | -     | -80.4 | -71.7 | dB      |
| $SNR_{ADC}$                                                                                                                                                 | Signal-to-noise ratio (SNR)                                           | 3.0V            | 64.1  | 68    | -     | dB      |
| $SFDR_{ADC}$                                                                                                                                                | Spurious-free dynamic range (SFDR)                                    | 3.0V            | 78.55 | 85.9  | -     | dB      |
| $SINAD_{ADC}$                                                                                                                                               | Signal-to-noise and distortion ratio (SINAD)                          | 3.0V            | 64    | 67.7  | -     | dB      |
| <b>DYNAMIC CHARACTERISTICS, External 1.5v Reference<br/>(Buck Mode<sup>a</sup>, Single/Diff. Ended Input, 1 kHz Input, ADC Running in 14-bit Mode)</b>      |                                                                       |                 |       |       |       |         |
| $ENOB_{CAL}$                                                                                                                                                | Calibrated ENOB                                                       | 1.8V            | 10.1  | 10.5  | -     | ENOB    |
| $THD_{ADC}$                                                                                                                                                 | Total harmonic distortion (THD)<br>- 1st 7 harmonics                  | 1.8V            | -     | -81   | -75   | dB      |
| $SNR_{ADC}$                                                                                                                                                 | Signal-to-noise ratio (SNR)                                           | 1.8V            | 62    | 65    | -     | dB      |
| $SFDR_{ADC}$                                                                                                                                                | Spurious-free dynamic range (SFDR)                                    | 1.8V            | 75    | 77    | -     | dB      |
| $SINAD_{ADC}$                                                                                                                                               | Signal-to-noise and distortion ratio (SINAD)                          | 1.8V            | 62    | 65    | -     | dB      |
| <b>DYNAMIC CHARACTERISTICS, Internal 1.5V Reference<br/>(LDO Mode, Single/Diff. Ended Input, 1 kHz Input, ADC Running in 14-bit Mode)</b>                   |                                                                       |                 |       |       |       |         |
| $ENOB_{CAL}$                                                                                                                                                | Calibrated ENOB                                                       | 1.8V            | 10.6  | 10.9  | -     | ENOB    |
| $THD_{ADC}$                                                                                                                                                 | Total harmonic distortion (THD)<br>- 1st 7 harmonics                  | 1.8V            | -     | -73.9 | -65   | dB      |
| $SNR_{ADC}$                                                                                                                                                 | Signal-to-noise ratio (SNR)                                           | 1.8V            | -     | 67.5  | -     | dB      |
| $SFDR_{ADC}$                                                                                                                                                | Spurious-free dynamic range (SFDR)                                    | 1.8V            | 70.7  | 76.1  | -     | dB      |

| Symbol                                                                                                                                           | Parameter                                            | Test Conditions  | Min    | Typ                      | Max    | Unit  |
|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------------------|--------|--------------------------|--------|-------|
| SINAD <sub>ADC</sub>                                                                                                                             | Signal-to-noise and distortion ratio (SINAD)         | 1.8V             | 65.7   | 67.2                     | -      | dB    |
| DYNAMIC CHARACTERISTICS, Internal 1.5V Reference<br>(Buck Mode <sup>a</sup> , Single/Diff. Ended Input, 1 kHz Input, ADC Running in 14-bit Mode) |                                                      |                  |        |                          |        |       |
| ENOB <sub>CAL</sub>                                                                                                                              | Calibrated ENOB                                      | 3.0V             | 9.6    | 10.2                     | -      | ENOB  |
|                                                                                                                                                  |                                                      | 1.8V             | 9.4    | 10.1                     | -      | ENOB  |
| THD <sub>ADC</sub>                                                                                                                               | Total harmonic distortion (THD)<br>- 1st 7 harmonics | 3.0V             | -      | -70                      | -60    | dB    |
|                                                                                                                                                  |                                                      | 1.8V             | -      | -74                      | -64    | dB    |
| SNR <sub>ADC</sub>                                                                                                                               | Signal-to-noise ratio (SNR)                          | 3.0V             | -      | 63.4                     | -      | dB    |
|                                                                                                                                                  |                                                      | 1.8V             | -      | 63.2                     | -      | dB    |
| SFDR <sub>ADC</sub>                                                                                                                              | Spurious-free dynamic range (SFDR)                   | 3.0V             | 65.6   | 72.7                     | -      | dB    |
|                                                                                                                                                  |                                                      | 1.8V             | 64.7   | 75.3                     | -      | dB    |
| SINAD <sub>ADC</sub>                                                                                                                             | Signal-to-noise and distortion ratio (SINAD)         | 3.0V             | 59.8   | 63.1                     | -      | dB    |
|                                                                                                                                                  |                                                      | 1.8V             | 58.2   | 62.9                     | -      | dB    |
| PERFORMANCE                                                                                                                                      |                                                      |                  |        |                          |        |       |
| NMC <sub>ADC</sub>                                                                                                                               | No missing codes                                     |                  | -      | 14                       | -      | bits  |
| INL <sub>ADC</sub>                                                                                                                               | Integral nonlinearity                                | Full input range | -      | ±2.4                     | ±3.5   | LSB   |
| DNL <sub>ADC</sub>                                                                                                                               | Differential nonlinearity                            | Full input range | -      | ±0.9                     | ±1.7   | LSB   |
| E <sub>ADC_OFFSET</sub>                                                                                                                          | Offset error                                         |                  | 1      | -                        | 1      | %FS   |
| E <sub>ADC_GAIN</sub>                                                                                                                            | Gain error                                           |                  | -      | -                        | 1      | %FS   |
| INTERNAL TEMPERATURE SENSOR                                                                                                                      |                                                      |                  |        |                          |        |       |
| E <sub>TEMP</sub>                                                                                                                                | Temperature sensor accuracy                          |                  | -      | ±3                       | -      | °C    |
| S <sub>TEMP</sub>                                                                                                                                | Temperature sensor slope                             |                  | -      | 3.38                     | -      | mV/°C |
| BATTERY RESISTANCE                                                                                                                               |                                                      |                  |        |                          |        |       |
| R <sub>BATT</sub>                                                                                                                                | Internal resistance for Battery Measurement          |                  | 487.32 | 524                      | 560.68 | Ω     |
| V <sub>BATTDIV</sub>                                                                                                                             | Battery divider voltage                              |                  | -2.5%  | 0.333 * V <sub>DDH</sub> | +1.5%  | V     |

a. Buck Mode not supported on wafer package

## 22.8 Buck Converter

**Table 1180: SIMO Buck Converter**

| Symbol                      | Parameter                                                                  | Test Conditions             | Min | Typ | Max | Unit          |
|-----------------------------|----------------------------------------------------------------------------|-----------------------------|-----|-----|-----|---------------|
| $L_{\text{SBUCK}}$          | Buck converter inductance ( $V_{\text{SIMO}}$ )                            |                             | -   | 2.2 | -   | $\mu\text{H}$ |
| $C_{\text{BUCK}}$           | Buck converter output capacitance (2) ( $V_{\text{DDC}}, V_{\text{DDF}}$ ) |                             | -   | 2.2 | -   | $\mu\text{F}$ |
| $C_{\text{PFC}}^{\text{a}}$ | VDDP-to-VDDF bootstrap capacitance                                         | VDDP/VDDH = 2.72 V to 3.6 V | -   | 1.5 | -   | $\mu\text{F}$ |
|                             |                                                                            | VDDP/VDDH = 2.1 V to 2.75 V | -   | 1.8 | -   | $\mu\text{F}$ |
|                             |                                                                            | VDDP/VDDH = 1.75 V to 2.2 V | -   | 2.2 | -   | $\mu\text{F}$ |
| $C_{\text{PB}}$             | VDDP bypass capacitance                                                    |                             | -   | 1.0 | -   | $\mu\text{F}$ |

a. This capacitance is highly recommended to ensure that the VDDH/VDDP ramp-up time is 10 ms or less. See errata ERR029 for details.

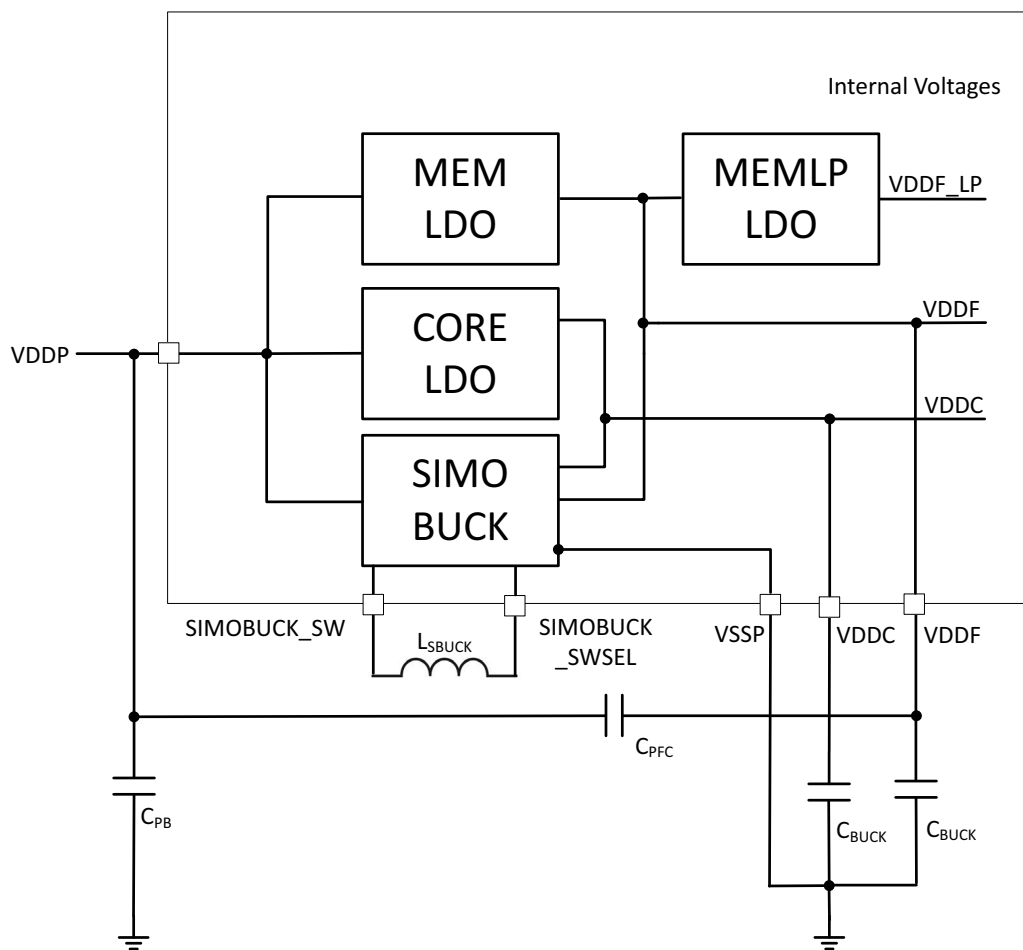


**Figure 98. External Components for SIMO Buck**



Table 1181: BLE Buck Converter

| Symbol        | Parameter                                        | Test Conditions | Min | Typ | Max | Unit    |
|---------------|--------------------------------------------------|-----------------|-----|-----|-----|---------|
| $L_{BLEBUCK}$ | Buck converter inductance ( $V_{DDBH}$ )         |                 | -   | 1.0 | -   | $\mu H$ |
| $C_{BLEBUCK}$ | Buck converter output capacitance ( $V_{DDBH}$ ) |                 | -   | 4.7 | -   | $\mu F$ |
| $C_{DCDCRF}$  | BLE ref voltage capacitance ( $V_{DCDCRF}$ )     |                 | -   | 1.0 | -   | $\mu F$ |

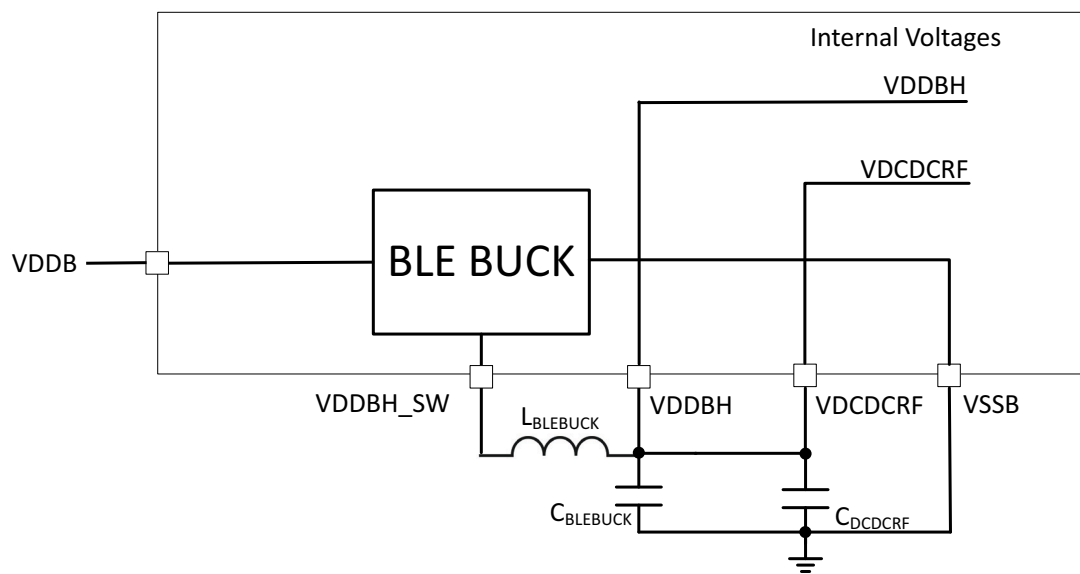


Figure 99. External Components for BLE Buck

## 22.9 Power-On RESET (POR) and Brown-Out Detector (BOD)

**Table 1182: Power-On Reset (POR) and Brown-Out Detector (BOD)**

| Symbol                    | Parameter                                        | Min | Typ | Max  | Unit |
|---------------------------|--------------------------------------------------|-----|-----|------|------|
| V <sub>POR_RISING</sub>   | POR rising threshold voltage                     | 1.6 | -   | 1.75 | V    |
| V <sub>BODL_FALLING</sub> | Brownout detection low falling threshold voltage | 1.6 | -   | 1.75 | V    |

## 22.10 Resets

**Table 1183: Resets**

| Symbol                | Parameter                                         | Test Conditions                | Min | Typ | Max | Unit |
|-----------------------|---------------------------------------------------|--------------------------------|-----|-----|-----|------|
| T <sub>RST</sub>      | nRST pulse width to guarantee reset assertion     |                                | 4.5 | -   | -   | ms   |
| T <sub>POR</sub>      | POR detect to nRST deassertion delay              |                                | -   | 30  | 35  | ms   |
| T <sub>POR2HRST</sub> | Delay from nRST deassertion to HRESET deassertion |                                | 1.2 | -   | 3.5 | ms   |
| T <sub>RSTDLY</sub>   | nRST reset delay from internal BODL               | 2KV/s supply falling slew rate | -   | 2.5 | 4.0 | ms   |
| T <sub>SOFT</sub>     | Software initiated reset delay                    |                                | 4.5 | 5   | 6.1 | ms   |

## 22.11 Voltage Comparator (VCOMP)

**Table 1184: Voltage Comparator (VCOMP)**

| Symbol                    | Parameter                             | Test Conditions                       | Min | Typ | Max              | Unit |
|---------------------------|---------------------------------------|---------------------------------------|-----|-----|------------------|------|
| V <sub>COMPIN</sub>       | Input voltage range                   |                                       | 0   | -   | V <sub>DDA</sub> | V    |
| T <sub>COMP_RTRIG</sub>   | Rising voltage trigger response time  | 1.0V on comparator input              | -   | -   | 38               | μs   |
| T <sub>COMP_FTRIG</sub>   | Falling voltage trigger response time | Falling voltage trigger response time | -   | -   | 12               | μs   |
| V <sub>HYST_RISING</sub>  | Hysteresis Rising                     |                                       | 30  | -   | -                | mV   |
| V <sub>HYST_FALLING</sub> | Hysteresis Falling                    |                                       | 30  | -   | -                | mV   |

## 22.12 Multi-bit SPI (MSPI) Interface

**Table 1185: MSPI Interface<sup>a</sup>**

| Symbol               | Parameter                  | Min | Typ | Max             | Unit |
|----------------------|----------------------------|-----|-----|-----------------|------|
| $f_{\text{MSPICLK}}$ | MSPI clock frequency range | -   | -   | 48 <sup>b</sup> | MHz  |

a. Each MSPI controller is limited to clock polarity/phase mode 0 operation. Mode 0 specifies a clock polarity setting where the inactive state is low (CPOL=0), and a clock phase setting where the clock toggles in the middle of the data bit (CPHA=0). The other three clock polarity/phase modes (1-3) are not supported.

b. 24 MHz max clock for revision A1 (all modes), and for octal mode on revision B0

## 22.13 Inter-Integrated Circuit (I<sup>2</sup>C) Interface

Table 1186: Inter-Integrated Circuit (I<sup>2</sup>C) Interface

| Symbol              | Parameter                               | Test Conditions                                                           | VDD           | Min | Typ | Max  | Unit |
|---------------------|-----------------------------------------|---------------------------------------------------------------------------|---------------|-----|-----|------|------|
| f <sub>SCL</sub>    | SCL input clock frequency               |                                                                           | 1.7 V - 3.6 V | 10  | -   | 1000 | kHz  |
| t <sub>LOW</sub>    | Low period of SCL clock                 |                                                                           | 1.7 V - 3.6 V | 1.3 | -   | -    | μs   |
| t <sub>HIGH</sub>   | High period of SCL clock                |                                                                           | 1.7 V - 3.6 V | 600 | -   | -    | ns   |
| t <sub>RISE</sub>   | Rise time of SDA and SCL                |                                                                           | 1.7 V - 3.6 V | -   | -   | 300  | ns   |
| t <sub>FALL</sub>   | Fall time of SDA and SCL                |                                                                           | 1.7 V - 3.6 V | -   | -   | 300  | ns   |
| t <sub>HD:STA</sub> | START condition hold time               |                                                                           | 1.7 V - 3.6 V | 600 | -   | -    | ns   |
| t <sub>SU:STA</sub> | START condition setup time              |                                                                           | 1.7 V - 3.6 V | 600 | -   | -    | ns   |
| t <sub>SU:DAT</sub> | SDA setup time                          |                                                                           | 1.7 V - 3.6 V | 100 | -   | -    | ns   |
| t <sub>HD:DAT</sub> | SDA hold time                           |                                                                           | 1.7 V - 3.6 V | 0   | -   | -    | ns   |
| t <sub>VD:DAT</sub> | SDA data valid time                     | 1.5 kΩ internal pull-up resistor and 100 pF total SDA capacitive loading. | 1.7 V - 3.6 V | -   | -   | 450  | ns   |
| t <sub>SU:STO</sub> | STOP condition setup time               |                                                                           | 1.7 V - 3.6 V | 600 | -   | -    | ns   |
| t <sub>BUF</sub>    | Bus free time before a new transmission |                                                                           | 1.7 V - 3.6 V | 1.3 | -   | -    | μs   |

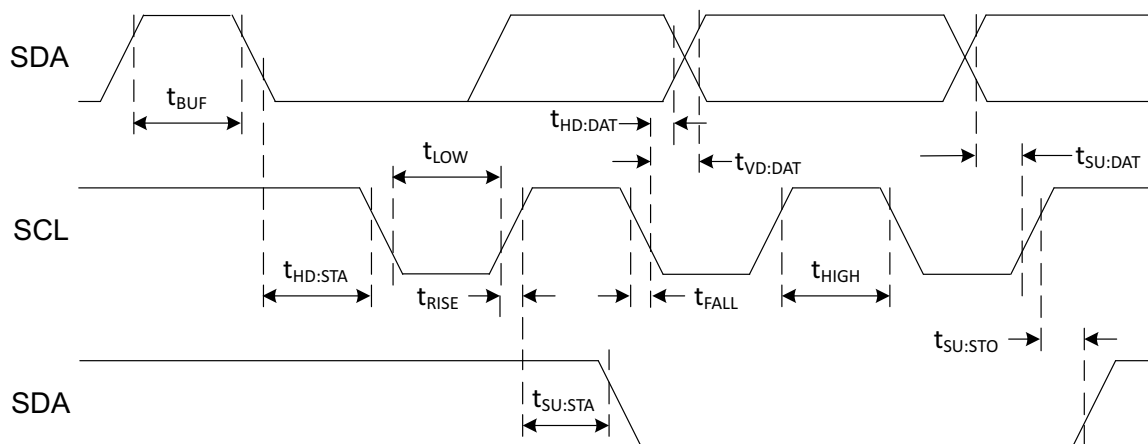


Figure 100. I<sup>2</sup>C Timing

## 22.14 Serial Peripheral Interface (SPI) Master Interface

**Table 1187: Serial Peripheral Interface (SPI) Master Interface**

| Symbol         | Parameter                   | Test Conditions                      | VDD | Min                        | Typ                   | Max             | Unit  |
|----------------|-----------------------------|--------------------------------------|-----|----------------------------|-----------------------|-----------------|-------|
| $F_{SCLK}$     | SCLK frequency range        |                                      | -   | -                          | 8                     | 48 <sup>a</sup> | MHz   |
| $B_{FIFO}$     | FIFO size (each direction)  |                                      | -   | 32                         |                       |                 | Bytes |
| $T_{SCLK\_LO}$ | Clock low time              |                                      | -   | $\frac{1}{2}F_{SCLK(max)}$ | -                     | -               | s     |
| $T_{SCLK\_HI}$ | Clock high time             |                                      | -   | $\frac{1}{2}F_{SCLK(max)}$ | -                     | -               | s     |
| $T_{SCLK\_R}$  | Clock rise time             | 35pF load, max drive strength, GPIOx | 3   | -                          | 2.6                   | -               | ns    |
| $T_{SCLK\_F}$  | Clock fall time             | 35pF load, max drive strength, GPIOx | 3   | -                          | 1.7                   | -               | ns    |
| $T_{SCLK\_R}$  | Clock rise time             | 35pF load, max drive strength, GPIOx | 2   | -                          | 2.7                   | -               | ns    |
| $T_{SCLK\_F}$  | Clock fall time             | 35pF load, max drive strength, GPIOx | 2   | -                          | 2.2                   | -               | ns    |
| $T_{SU\_MI}$   | MISO input data setup time  |                                      | -   | 5.5                        | 3                     | -               | ns    |
| $T_{HD\_MI}$   | MISO input data hold time   |                                      | -   | 5.5                        | 3                     | -               | ns    |
| $T_{HD\_MO}$   | MOSI output data hold time  |                                      | -   | -                          | $\frac{1}{2}F_{SCLK}$ | -               | ns    |
| $T_{VALID,MO}$ | MOSI output data valid time |                                      | -   | -                          | 3                     | 5               | ns    |

a. Silicon revision A1 limits the  $F_{SCLK}$  to 24MHz

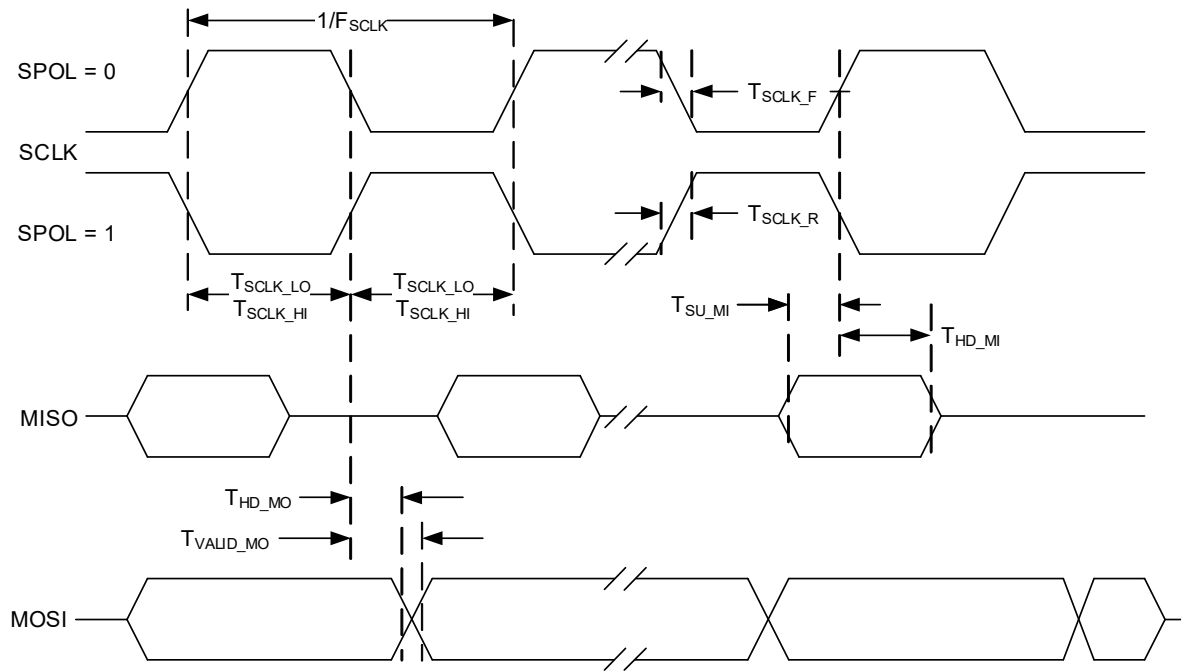


Figure 101. SPI Master Mode, Phase = 0

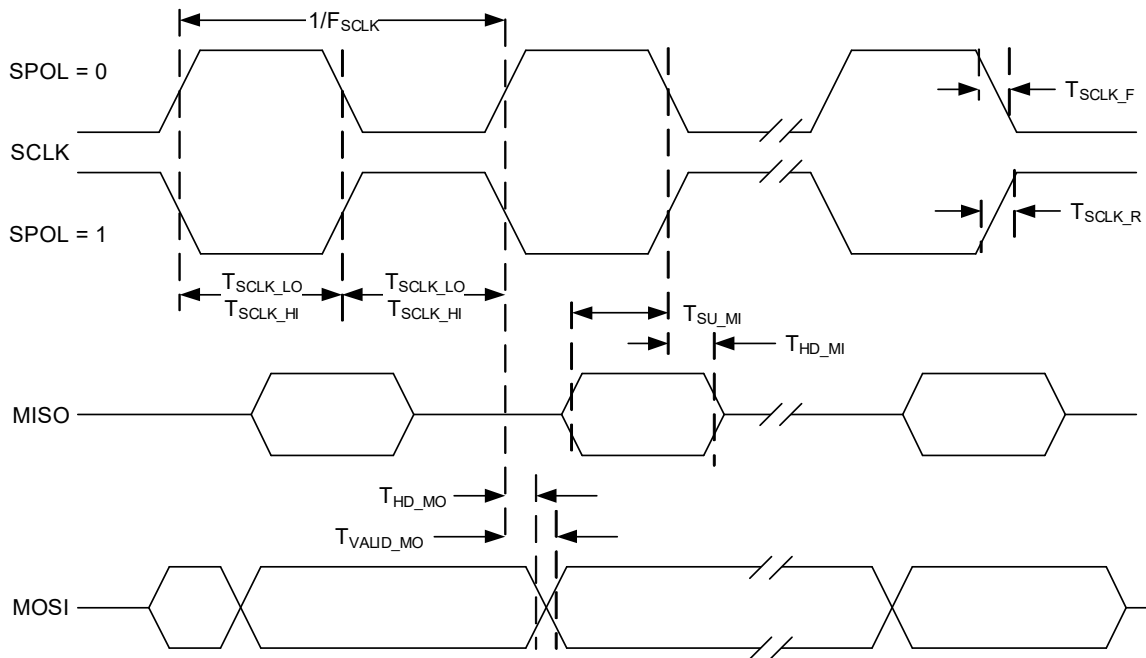


Figure 102. SPI Master Mode, Phase = 1



## 22.15 Serial Peripheral Interface (SPI) Slave Interface

**Table 1188: Serial Peripheral Interface (SPI) Slave Interface**

| Symbol                | Parameter                          | Test Conditions                      | Min | Typ                  | Max | Unit  |
|-----------------------|------------------------------------|--------------------------------------|-----|----------------------|-----|-------|
| F <sub>SCLK</sub>     | SCLK frequency range               |                                      | -   | -                    | 12  | MHz   |
| B <sub>FIFO</sub>     | FIFO size                          |                                      | 256 |                      |     | Bytes |
| T <sub>SCLK_LO</sub>  | Clock low time                     |                                      | -   | 1/2F <sub>SCLK</sub> | -   | s     |
| T <sub>SCLK_HI</sub>  | Clock high time                    |                                      | -   | 1/2F <sub>SCLK</sub> | -   | s     |
| T <sub>CE_LEAD</sub>  | Chip enable low to first SCLK edge |                                      | 10  | -                    | -   | ns    |
| T <sub>CE_LAG</sub>   | Chip enable high to last SCLK edge |                                      | 7   | -                    | -   | ns    |
| T <sub>SU_SI</sub>    | MOSI input data setup time         |                                      | 5   | -                    | -   | ns    |
| T <sub>HD_SI</sub>    | MOSI input data hold time          |                                      | 4   | -                    | -   | ns    |
| T <sub>HD_SO</sub>    | MISO output data hold time         | 15pF load, max drive strength, GPIOx | 0   | -                    | -   | ns    |
| T <sub>VALID,SO</sub> | MISO output data valid time        | 15pF load, max drive strength, GPIOx | -   | -                    | 4   | ns    |

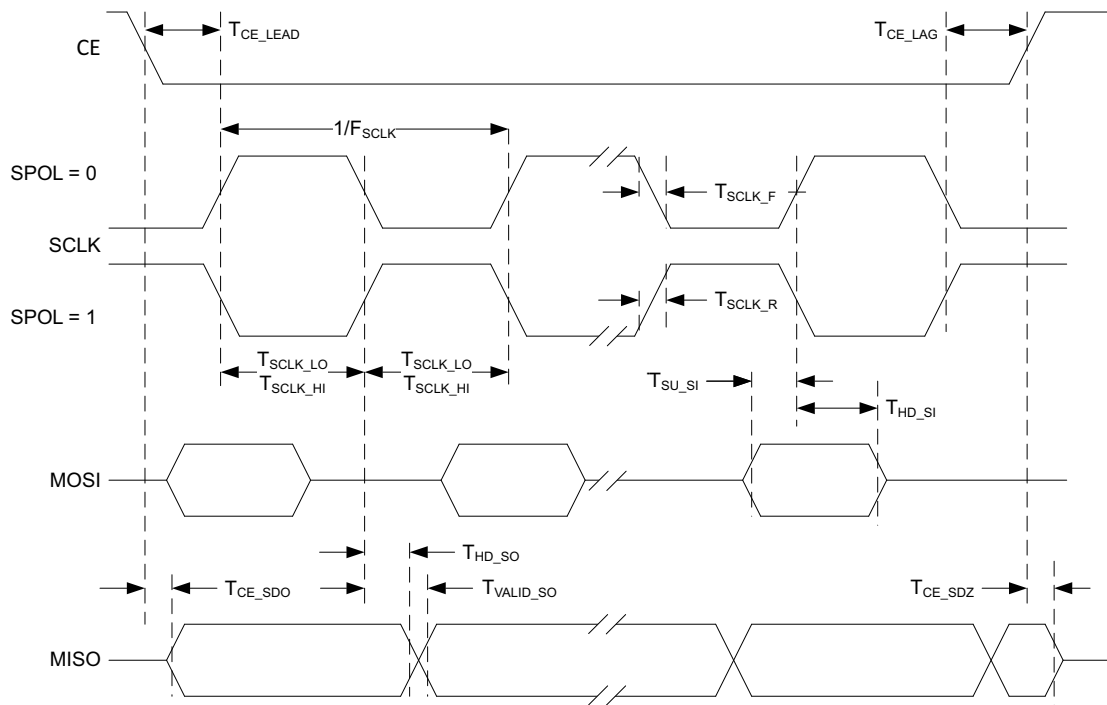


Figure 103. SPI Slave Mode, Phase = 0

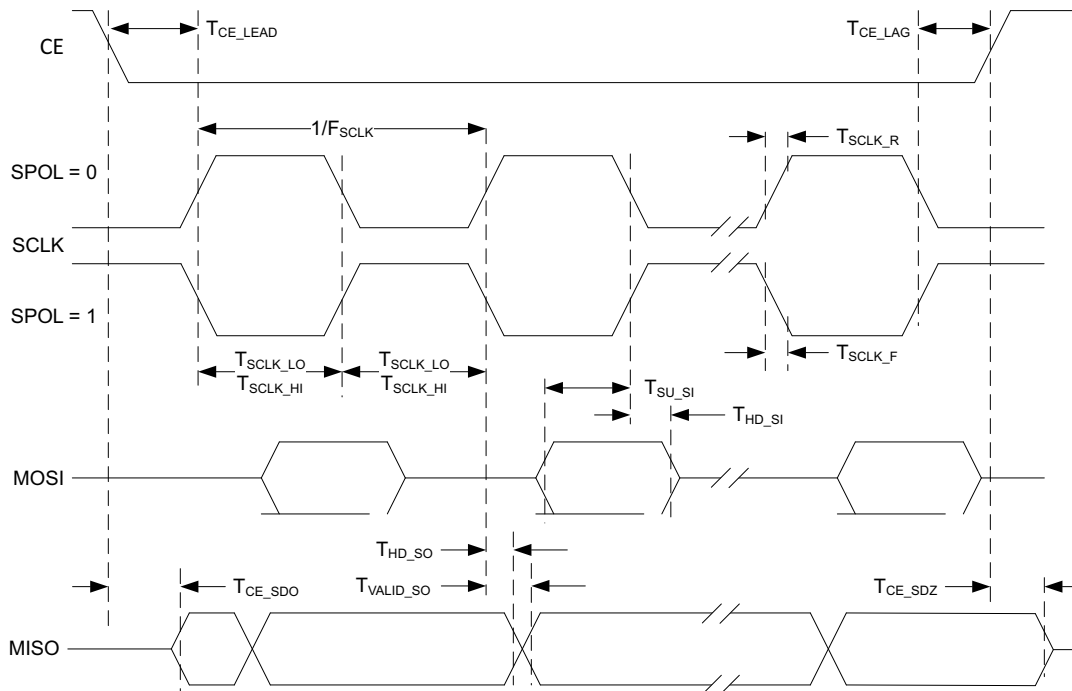


Figure 104. SPI Slave Mode, Phase = 1

## 22.16 PDM Interface

**Table 1189: Pulse Density Modulation (PDM) Interface**

| Symbol                | Parameter                         | Test Conditions                      | VDD | Min | Typ | Max | Unit |
|-----------------------|-----------------------------------|--------------------------------------|-----|-----|-----|-----|------|
| F <sub>PDMCLK</sub>   | PDM output clock frequency range  |                                      | -   | -   | 1.5 | 12  | MHz  |
| DC <sub>PDMCLK</sub>  | PDM clock duty cycle <sup>a</sup> |                                      | -   | 45  | -   | 55  | %    |
| T <sub>PDM_RISE</sub> | PDM clock and data rise time      | 35pF load, max drive strength, GPIOx | 3   | -   | 2.6 | -   | ns   |
| T <sub>PDM_FALL</sub> | PDM clock and data fall time      | 35pF load, max drive strength, GPIOx | 3   | -   | 1.7 | -   | ns   |
| T <sub>PDM_RISE</sub> | PDM clock and data rise time      | 35pF load, max drive strength, GPIOx | 2   | -   | 2.7 | -   | ns   |
| T <sub>PDM_FALL</sub> | PDM clock and data fall time      | 35pF load, max drive strength, GPIOx | 2   | -   | 2.2 | -   | ns   |
| T <sub>SU_PDM</sub>   | PDM input data setup time         | 35pF load, max drive strength, GPIOx | -   | 20  | -   | -   | ns   |
| T <sub>HD_PDM</sub>   | PDM input data hold time          | 35pF load, max drive strength, GPIOx | -   | 20  | -   | -   | ns   |

a.Applicable when F<sub>PDMCLK</sub> ≤ 2.4 MHz and PDM\_PCFG\_MCLKDIV set to MCKDIV1, MCKDIV2 or MCKDIV4 only. PDM\_PCFG\_MCLKDIV setting of MCKDIV3 has a duty cycle of 67%.

## 22.17 Universal Asynchronous Receiver/Transmitter (UART)

Table 1190: Universal Asynchronous Receiver/Transmitter (UART)

| Symbol            | Parameter      | Min | Typ | Max     | Unit |
|-------------------|----------------|-----|-----|---------|------|
| F <sub>BAUD</sub> | UART baud rate | -   | -   | 921,600 | bps  |

## 22.18 Counter/Timer (CTIMER)

Table 1191: Counter/Timer (CTIMER)

| Symbol              | Parameter           | Min | Typ | Max | Unit |
|---------------------|---------------------|-----|-----|-----|------|
| F <sub>CTIMER</sub> | Input frequency     | -   | -   | 24  | MHz  |
| T <sub>CTIMER</sub> | Capture pulse width | -   | TBD | TBD | μs   |

## 22.19 System Timer (STIMER)

Table 1192: System Timer (STIMER)

| Symbol              | Parameter       | Min | Typ | Max                   | Unit |
|---------------------|-----------------|-----|-----|-----------------------|------|
| F <sub>STIMER</sub> | Input frequency | -   | -   | F <sub>HFRQ</sub> /16 | MHz  |

## 22.20 Watchdog Timer (WDT)

Table 1193: Watchdog Timer (WDT)

| Symbol          | Parameter                 | Min | Typ | Max | Unit |
|-----------------|---------------------------|-----|-----|-----|------|
| T <sub>WD</sub> | Watchdog timer resolution | 107 | 128 | 169 | Hz   |

## 22.21 Flash Memory

Table 1194: Flash Memory

| Symbol                  | Parameter                           | Min    | Typ | Max | Unit   |
|-------------------------|-------------------------------------|--------|-----|-----|--------|
| PE <sub>CYC</sub>       | Program/erase cycles before failure | 10,000 | -   | -   | cycles |
| T <sub>FDR</sub>        | Data retention @85C                 | 10     | -   | -   | years  |
| T <sub>PAGE_ERASE</sub> | Single page erase time (8192 bytes) | -      | 15  | 20  | ms     |
| T <sub>MASS_ERASE</sub> | Mass erase time                     | -      | 15  | 20  | ms     |

## 22.22 General Purpose Input/Output (GPIO)

All GPIOs have Schmitt trigger inputs.

| Symbol                            | Parameter                               |                                       | VDD | Min             | TYP             | Max             | Unit       |
|-----------------------------------|-----------------------------------------|---------------------------------------|-----|-----------------|-----------------|-----------------|------------|
| <b>ALL GPIOs</b>                  |                                         |                                       |     |                 |                 |                 |            |
| $V_{OH}$                          | High-level output voltage               |                                       | -   | $0.8 * V_{DDH}$ | -               | -               | V          |
| $V_{OL}$                          | Low-level output voltage                |                                       | -   | -               | -               | $0.2 * V_{DDH}$ | V          |
| $V_{IH}$                          | Positive going input threshold voltage  |                                       | -   | $0.7 * V_{DDH}$ | -               | -               | V          |
| $V_{IL}$                          | Negative going input threshold voltage  |                                       | -   | -               | -               | $0.3 * V_{DDH}$ | V          |
| $V_{HYS}$                         | Input Hysteresis                        |                                       | -   | -               | $0.1 * V_{DDH}$ | -               | V          |
| $C_{GPI}$                         | Input capacitance                       |                                       | -   | -               | 3               | 6               | pF         |
| $R_{PU}$                          | Pull-up resistance                      |                                       | -   | 13              | 20              | 27              | k $\Omega$ |
| $R_{PD}$                          | Pull-down resistance                    |                                       | -   | 26              | 33              | 40              | k $\Omega$ |
| $R_{PUI2C00}$                     | I2C pad pull-up resistance, RSEL = 0x00 |                                       | -   | 1.3             | 1.5             | 1.7             | k $\Omega$ |
| $R_{PUI2C01}$                     | I2C pad pull-up resistance, RSEL = 0x01 |                                       | -   | 5               | 5.5             | 6               | k $\Omega$ |
| $R_{PUI2C10}$                     | I2C pad pull-up resistance, RSEL = 0x10 |                                       | -   | 10              | 11.7            | 13              | k $\Omega$ |
| $R_{PUI2C11}$                     | I2C pad pull-up resistance, RSEL = 0x11 |                                       | -   | 22              | 25              | 28              | k $\Omega$ |
| $I_{IN}$                          | Input pin leakage current               |                                       | -   | -               | 1.5             | 50              | nA         |
| $I_{INOD}$                        | Open drain output leakage current       |                                       | -   | -               | 1.5             | 50              | nA         |
| <b>STANDARD GPIOs<sup>a</sup></b> |                                         |                                       |     |                 |                 |                 |            |
| $T_{RISE\_STD\_12}$               | Rise time                               | 35pF load, 12mA drive strength, GPIOx | 3   | -               | 2.6             | -               | ns         |
| $T_{FALL\_STD\_12}$               | Fall time                               | 35pF load, 12mA drive strength, GPIOx | 3   | -               | 1.7             | -               | ns         |
| $T_{RISE\_STD\_8}$                | Rise time                               | 35pF load, 8mA drive strength, GPIOx  | 3   | -               | 2.8             | -               | ns         |
| $T_{FALL\_STD\_8}$                | Fall time                               | 35pF load, 8mA drive strength, GPIOx  | 3   | -               | 1.9             | -               | ns         |
| $T_{RISE\_STD\_4}$                | Rise time                               | 35pF load, 4mA drive strength, GPIOx  | 3   | -               | 3.7             | -               | ns         |
| $T_{FALL\_STD\_4}$                | Fall time                               | 35pF load, 4mA drive strength, GPIOx  | 3   | -               | 2.6             | -               | ns         |
| $T_{RISE\_STD\_2}$                | Rise time                               | 35pF load, 2mA drive strength, GPIOx  | 3   | -               | 12              | -               | ns         |
| $T_{FALL\_STD\_2}$                | Fall time                               | 35pF load, 2mA drive strength, GPIOx  | 3   | -               | 9.5             | -               | ns         |
| $T_{RISE\_STD\_12}$               | Rise time                               | 35pF load, 12mA drive strength, GPIOx | 2   | -               | 2.7             | -               | ns         |
| $T_{FALL\_STD12\_}$               | Fall time                               | 35pF load, 12mA drive strength, GPIOx | 2   | -               | 2.2             | -               | ns         |

|                           |                                               |                                      |   |   |      |     |    |
|---------------------------|-----------------------------------------------|--------------------------------------|---|---|------|-----|----|
| T <sub>RISE_STD_8</sub>   | Rise time                                     | 35pF load, 8mA drive strength, GPIOx | 2 | - | 3.0  | -   | ns |
| T <sub>FALL_STD_8</sub>   | Fall time                                     | 35pF load, 8mA drive strength, GPIOx | 2 | - | 2.5  | -   | ns |
| T <sub>RISE_STD_4</sub>   | Rise time                                     | 35pF load, 4mA drive strength, GPIOx | 2 | - | 4.2  | -   | ns |
| T <sub>FALL_STD_4</sub>   | Fall time                                     | 35pF load, 4mA drive strength, GPIOx | 2 | - | 3.8  | -   | ns |
| T <sub>RISE_STD_2</sub>   | Rise time                                     | 35pF load, 2mA drive strength, GPIOx | 2 | - | 14.1 | -   | ns |
| T <sub>FALL_STD_2</sub>   | Fall time                                     | 35pF load, 2mA drive strength, GPIOx | 2 | - | 11.5 | -   | ns |
| <b>POWER SWITCH GPIOs</b> |                                               |                                      |   |   |      |     |    |
| I <sub>SRC_PWR</sub>      | High side power switch source current         |                                      | - | - | -    | 100 | mA |
| I <sub>SRC_PWR_LKG</sub>  | High side power switch source leakage current |                                      | - | - | 32   | 200 | nA |
| I <sub>SNK_PWR</sub>      | Low side power switch sink current            |                                      | - | - | -    | 100 | mA |
| I <sub>SNK_PWR_LKG</sub>  | Low side power switch source leakage current  |                                      | - | - | 32   | 200 | nA |

- a. To support 48MHz operation on the MSPI and IOM interfaces, all pads used for MSPI as well as the SCLK and MOSI pins for the IOM interfaces have been upgraded on revision B0 to support 16mA for 48MHz signal carrying capacity. All other 12ma-capable drivers remain the same.

## 22.23 Serial Wire Debug (SWD)

Table 1195: Serial Wire Debug (SWD)

| Symbol                 | Parameter                                            | Test Conditions  | Min | Typ | Max | Unit |
|------------------------|------------------------------------------------------|------------------|-----|-----|-----|------|
| $T_{\text{SWDCK\_HI}}$ | SWDCK clock high period                              |                  | -   | -   | 50  | ns   |
| $T_{\text{SWDCK\_LO}}$ | SWDCK clock low period                               |                  | -   | -   | 50  | ns   |
| $T_{\text{OS\_SWD}}$   | SWDIO output skew to rising edge of SWDCLK           | 10 MHz operation | -   | -   | 20  | ns   |
| $T_{\text{SU\_SWD}}$   | Input setup time between SWDIO and rising edge SWDCK |                  | 30  | -   | -   | ns   |
| $T_{\text{HD\_SWD}}$   | Input hold time between SWDIO and rising edge SWDCK  | 10 MHz operation | -   | 50  | -   | ns   |

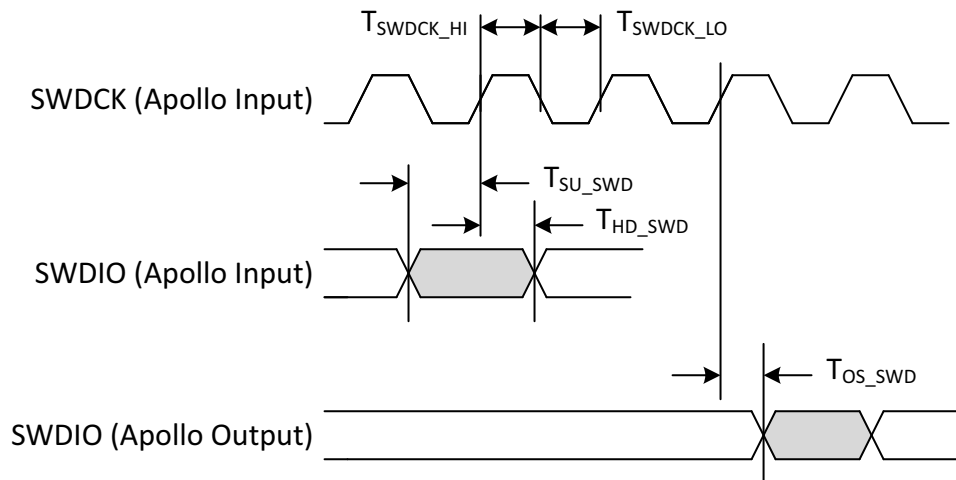
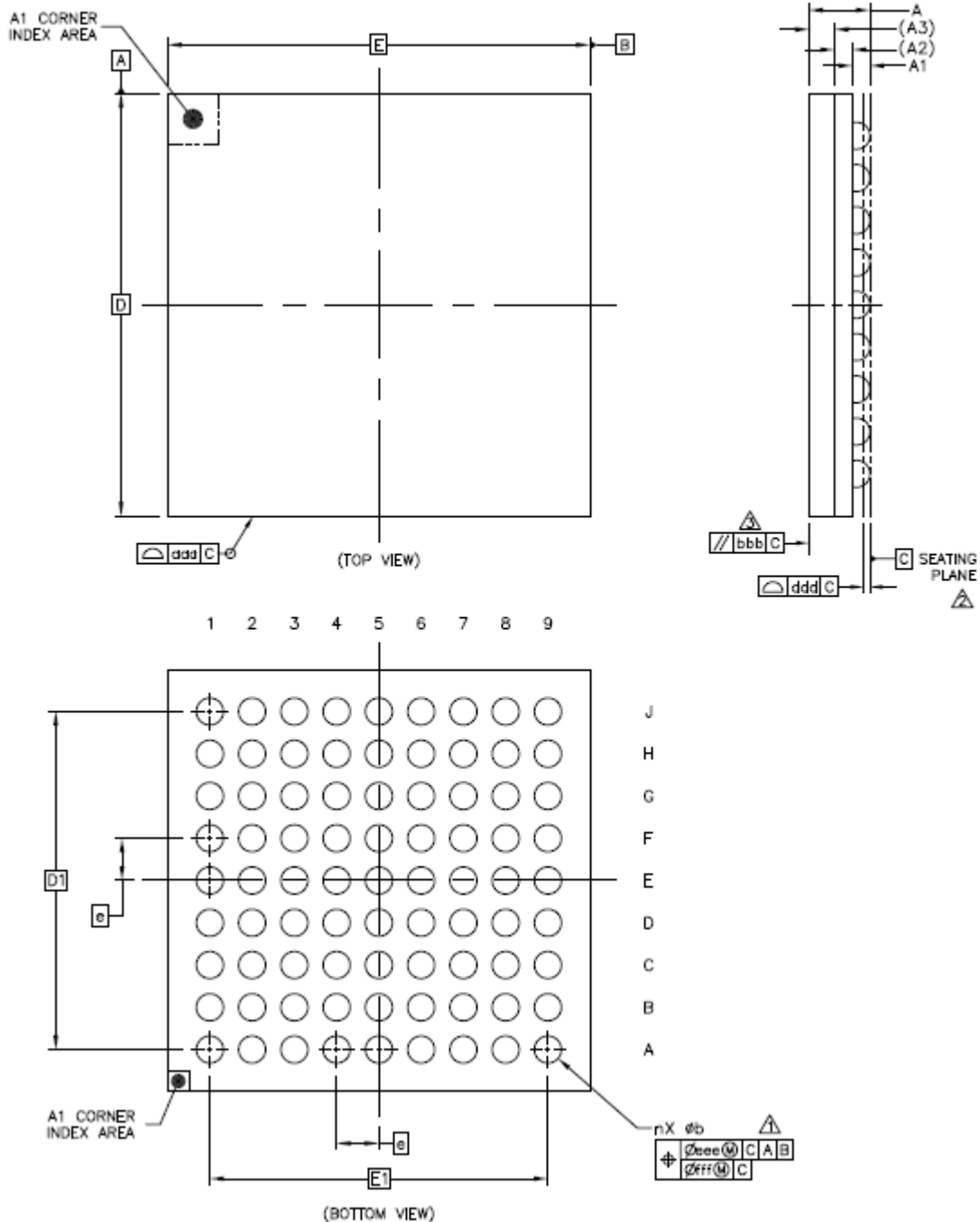


Figure 105. Serial Wire Debug Timing

## 23. Package Mechanical Information

### 23.1 BGA Package<sup>1</sup>



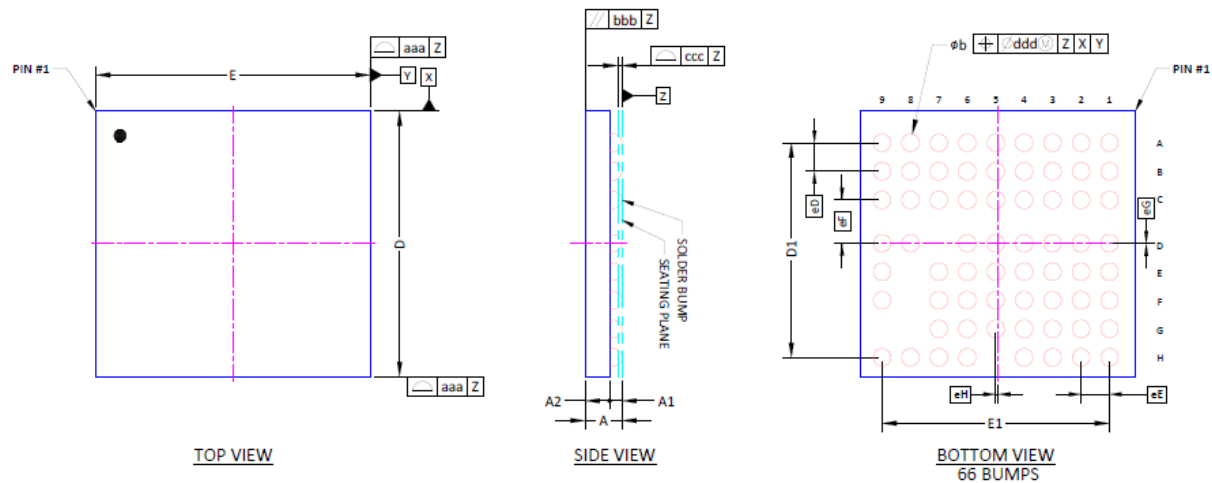
1. All dimensions in mm unless otherwise noted.



|                             | SYMBOL | COMMON DIMENSIONS |       |       |
|-----------------------------|--------|-------------------|-------|-------|
|                             |        | MIN.              | NOR.  | MAX.  |
| TOTAL THICKNESS             | A      | 0.535             | 0.665 | 0.8   |
| STAND OFF                   | A1     | 0.105             | 0.155 | 0.205 |
| SUBSTRATE THICKNESS         | A2     | 0.21 REF          |       |       |
| MOLD THICKNESS              | A3     | 0.3 REF           |       |       |
| BODY SIZE                   | D      | 5 BSC             |       |       |
|                             | E      | 5 BSC             |       |       |
| BALL DIAMETER               |        | 0.25              |       |       |
| BALL OPENING                |        | 0.275             |       |       |
| BALL WIDTH                  | b      | 0.225             | ---   | 0.325 |
| BALL PITCH                  | e      | 0.5 BSC           |       |       |
| BALL COUNT                  | n      | 81                |       |       |
| EDGE BALL CENTER TO CENTER  | D1     | 4 BSC             |       |       |
|                             | E1     | 4 BSC             |       |       |
| BODY CENTER TO CONTACT BALL | SD     | --- BSC           |       |       |
|                             | SE     | --- BSC           |       |       |
| PACKAGE EDGE TOLERANCE      | aaa    | 0.1               |       |       |
| MOLD FLATNESS               | bbb    | 0.1               |       |       |
| COPLANARITY                 | ddd    | 0.08              |       |       |
| BALL OFFSET (PACKAGE)       | eee    | 0.15              |       |       |
| BALL OFFSET (BALL)          | fff    | 0.05              |       |       |
|                             |        |                   |       |       |
|                             |        |                   |       |       |
|                             |        |                   |       |       |
|                             |        |                   |       |       |
|                             |        |                   |       |       |
|                             |        |                   |       |       |

Figure 106. BGA Package Drawing

## 23.2 CSP Package<sup>1</sup>



Control dimensions are in millimeter

| Symbol | Dimension in mm |        |        | Dimension in inch |       |        |
|--------|-----------------|--------|--------|-------------------|-------|--------|
|        | Min             | Nom    | Max    | Min               | Nom   | Max    |
| A      | 0.397           | 0.452  | 0.507  | 0.016             | 0.018 | 0.020  |
| A1     | 0.122           | 0.152  | 0.182  | 0.005             | 0.006 | 0.007  |
| A2     | 0.275           | 0.300  | 0.325  | 0.011             | 0.012 | 0.013  |
| D      | 3.2320          | 3.2520 | 3.2720 | 0.127             | 0.128 | 0.129  |
| E      | 3.3554          | 3.3754 | 3.3954 | 0.132             | 0.133 | 0.134  |
| D1     | -               | 2.629  | -      | -                 | 0.103 | -      |
| E1     | -               | 2.797  | -      | -                 | 0.110 | -      |
| eD, eE | -               | 0.350  | -      | -                 | 0.014 | -      |
| eF     | -               | 0.531  | -      | -                 | 0.021 | -      |
| eG     | -0.004          | 0.006  | 0.016  | -0.0002           | 0.000 | 0.0006 |
| eH     | 0.022           | 0.032  | 0.042  | 0.0009            | 0.001 | 0.0017 |
| b      | 0.193           | 0.218  | 0.243  | 0.008             | 0.009 | 0.010  |
| aaa    | 0.10            |        |        | 0.004             |       |        |
| bbb    | 0.10            |        |        | 0.004             |       |        |
| ccc    | 0.05            |        |        | 0.002             |       |        |
| ddd    | 0.05            |        |        | 0.002             |       |        |

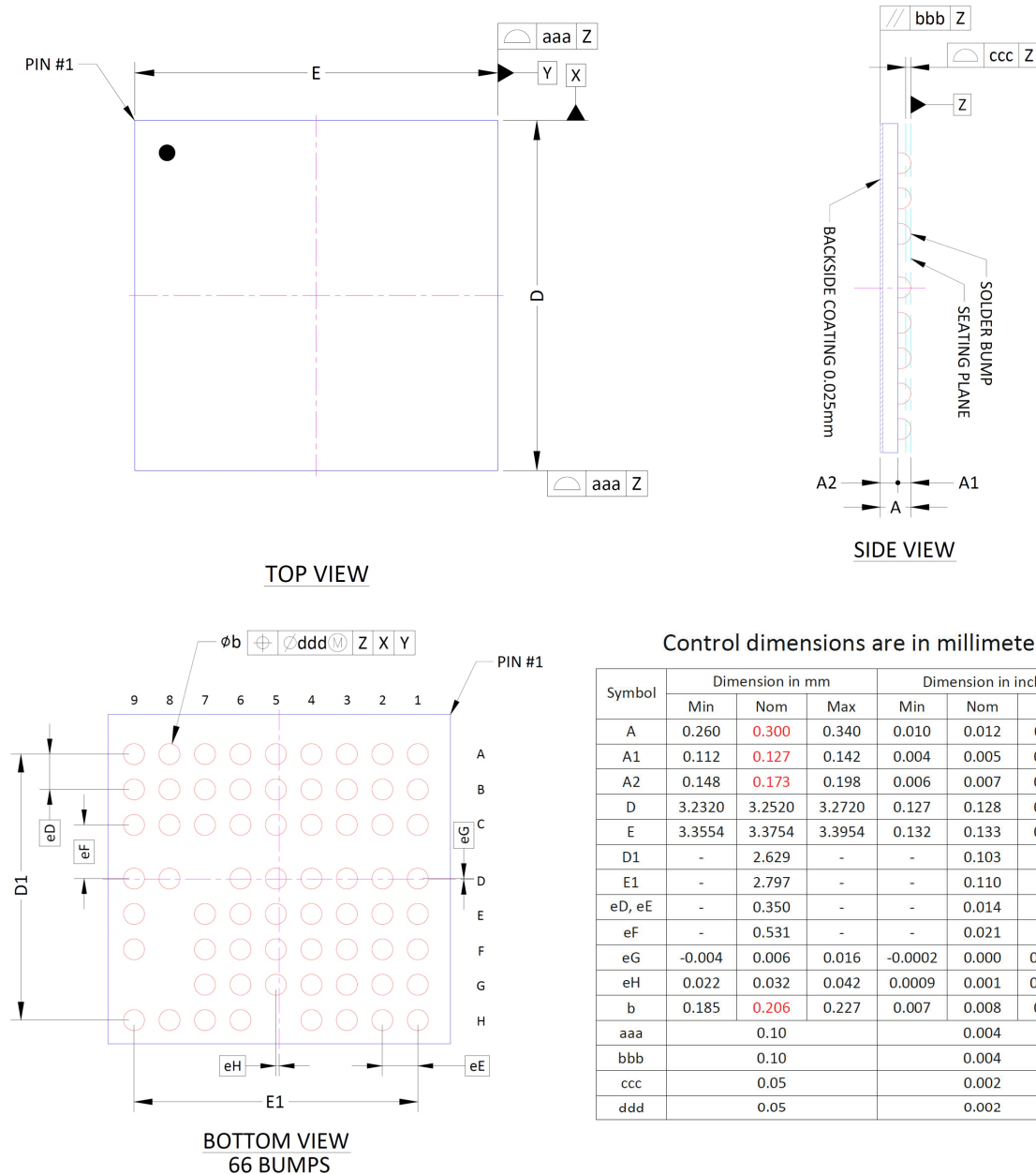
### Notes:

1. Dimension b is measured at the maximum solder bump diameter, parallel to primary datum C.
2. This pod is for device Apollo3 without backside coating.
3. eF is the distance between the center lines of row C and row D of balls.
4. eG is the vertical offset from center of package to center of D5 ball.
5. eH is the horizontal offset from center of package to center of D5 ball.
6. In the bottom view, the D5 ball center is above and to the left of the center of package, making the overall D5 offset from the center of package toward the top-left quadrant (A9 corner) of the package.

Figure 107. CSP Package Drawing

1. The Apollo3 Blue CSP package is sensitive to light incident on either the backside or edges of the die. Light exposure can result in increased current and erratic behavior which may include system crash or reset. To prevent exposure of the die to light, the recommendation is to apply an opaque epoxy coating (or similar) over the Apollo3 CSP unless the MCU will be in an enclosure that blocks all light.

## 23.3 Thin WLCSP Package



### NOTE:

1. DIMENSION b IS MEASURED AT THE MAXIMUM SOLDER BUMP DIAMETER, PARALLEL TO PRIMARY DATUM C. PRIMARY DATUM C.
2. THIS POD IS FOR DEVICE APOLLO3 WITH BACKSIDE COATING
3. eF IS THE DISTANCE BETWEEN THE CENTER LINE OF ROW-C & ROW-D OF BALLS
4. eG, eH IS THE VERTICAL & HORIZONTAL OFFSET FROM CENTER OF PACKAGE TO CENTER OF BUMP PATTERN (D5 BALL) RESPECTIVELY  
OVERALL OFFSET OF BUMP PATTERN (D5) RELATIVE TO PACKAGE CENTER IS TOWARD A9 BALL CORNER OF THE PACKAGE (IE.:TOWARD 2ND (TOP-LEFT) QUADRANT OF PACKAGE WHEN VIEWING FROM PACKAGE BOTTOM VIEW)

**Figure 108. WLCSP Package Drawing**

## 23.4 Reflow Profile

Table 1196 lists the reflow conditions for the lead-free package. Reference IR Reflow Profile for Moisture Sensitivity Test (J-STD-020).

Reflow times: 3 cycles

**Table 1196: Reflow Condition (260 °C) for Pb-free package**

| Profile Features                              | Pb-Free Assembly  |
|-----------------------------------------------|-------------------|
| Average ramp-up rate (include 217 °C to Peak) | 3 °C/second max.  |
| Temperature maintained above 217 °C           | 60 to 150 seconds |
| Time within 5 °C of actual peak temperature   | 20 - 40 seconds   |
| Peak temperature (minimum)                    | 260 +0/-5 °C      |
| Ramp-down rate                                | 6 °C /second max. |
| Time 25 °C to peak temperature                | 8 minutes max.    |

Figure illustrates the temperature profile for reflow soldering requirements.

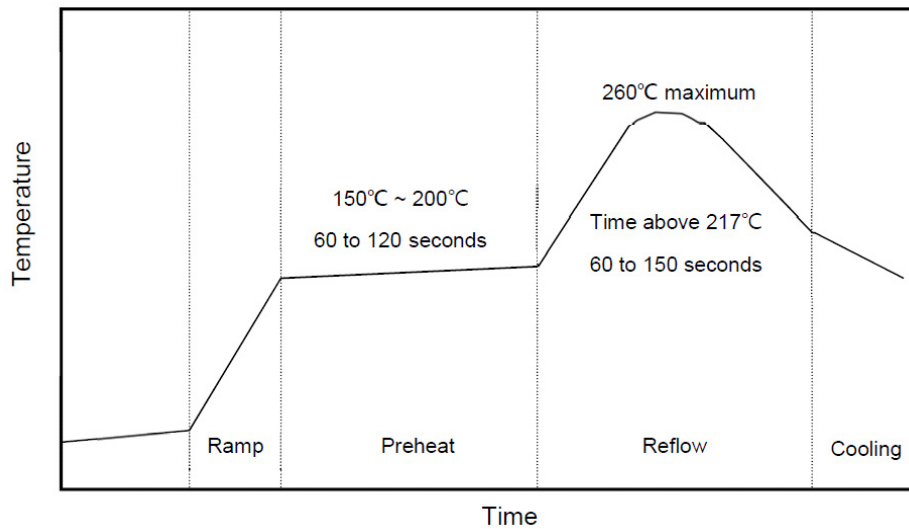


**Figure 109. Reflow Profile**

## 24. Appendix 1. Flash OTP 0 Customer Info Space (Info0)

**NOTE**

Although the Info0 space is referred to as “OTP”, it is actually reprogrammable Flash but configurable as one-time programmable.

### 24.1 Flash OTP INSTANCE0 INFO0 Words

**Customer OTP Block 0 of Instance 0.**

**INSTANCE 0 BASE ADDRESS:**0x50020000

This is the detailed description of the contents of the Customer OTP for Apollo3 Blue MCU.

### 24.1.1 Register Memory Map

**Table 1197: Flash OTP INSTANCE0 INFO0 Register Map**

| Address(s) | Register Name           | Description                                  |
|------------|-------------------------|----------------------------------------------|
| 0x50020000 | SIGNATURE0              | INFO0 Signature                              |
| 0x50020004 | SIGNATURE1              | INFO0 Signature                              |
| 0x50020008 | SIGNATURE2              | INFO0 Signature                              |
| 0x5002000C | SIGNATURE3              | INFO0 Signature                              |
| 0x50020010 | SECURITY                | Security protection bits                     |
| 0x50020014 | CUSTOMER_TRIM           | Customer trim values                         |
| 0x50020018 | CUSTOMER_TRIM2          | Customer trim values word2                   |
| 0x50020020 | SECURITY_OVR            | Security Override configuration bits         |
| 0x50020024 | SECURITY_WIRED_CFG      | Security Wired configuration bits            |
| 0x50020028 | SECURITY_WIRED_IFC_CFG0 | Security Wired Interface configuration word0 |
| 0x5002002C | SECURITY_WIRED_IFC_CFG1 | Security Wired Interface configuration word1 |
| 0x50020030 | SECURITY_WIRED_IFC_CFG2 | Security Wired Interface configuration word2 |
| 0x50020034 | SECURITY_WIRED_IFC_CFG3 | Security Wired Interface configuration word3 |
| 0x50020038 | SECURITY_WIRED_IFC_CFG4 | Security Wired Interface configuration word4 |
| 0x5002003C | SECURITY_WIRED_IFC_CFG5 | Security Wired Interface configuration word5 |
| 0x50020040 | SECURITY_VERSION        | Security version field                       |
| 0x50020050 | SECURITY_SRAM_RESV      | SRAM Reserved for Application Scratch space  |
| 0x500201F8 | WRITE_PROTECT_L         | Flash write-protection bits.                 |
| 0x500201FC | WRITE_PROTECT_H         | Flash write-protection bits.                 |
| 0x50020200 | COPY_PROTECT_L          | Flash copy/read-protection bits.             |
| 0x50020204 | COPY_PROTECT_H          | Flash copy/read-protection bits.             |
| 0x500209F8 | WRITE_PROTECT_SBL_L     | Flash write-protection bits.                 |
| 0x500209FC | WRITE_PROTECT_SBL_H     | Flash write-protection bits.                 |
| 0x50020A00 | COPY_PROTECT_SBL_L      | Flash copy/read-protection bits.             |
| 0x50020A04 | COPY_PROTECT_SBL_H      | Flash copy/read-protection bits.             |
| 0x50020C00 | MAIN_PTR0               | main firmware pointer 0                      |
| 0x50020C04 | MAIN_PTR1               | main firmware pointer 1                      |
| 0x50020C08 | KREVTRACK               | KEK Revocation Tracker                       |
| 0x50020C0C | AREVTRACK               | AUTH Revocation Tracker                      |
| 0x50020FF8 | MAIN_CNT0               | main Index Counter 0                         |
| 0x50020FFC | MAIN_CNT1               | main Index Counter 1                         |
| 0x50021800 | CUST_KEK_W0             | Customer KEK Word0                           |
| 0x50021804 | CUST_KEK_W1             | Customer KEK Word1                           |
| 0x50021808 | CUST_KEK_W2             | Customer KEK Word2                           |
| 0x5002180C | CUST_KEK_W3             | Customer KEK Word3                           |
| 0x50021810 | CUST_KEK_W4             | Customer KEK Word4                           |

**Table 1197: Flash OTP INSTANCE0 INFO0 Register Map**

| Address(s) | Register Name | Description              |
|------------|---------------|--------------------------|
| 0x50021814 | CUST_KEK_W5   | Customer KEK Word5       |
| 0x50021818 | CUST_KEK_W6   | Customer KEK Word6       |
| 0x5002181C | CUST_KEK_W7   | Customer KEK Word7       |
| 0x50021820 | CUST_KEK_W8   | Customer KEK Word0       |
| 0x50021824 | CUST_KEK_W9   | Customer KEK Word9       |
| 0x50021828 | CUST_KEK_W10  | Customer KEK Word10      |
| 0x5002182C | CUST_KEK_W11  | Customer KEK Word11      |
| 0x50021830 | CUST_KEK_W12  | Customer KEK Word12      |
| 0x50021834 | CUST_KEK_W13  | Customer KEK Word13      |
| 0x50021838 | CUST_KEK_W14  | Customer KEK Word14      |
| 0x5002183C | CUST_KEK_W15  | Customer KEK Word15      |
| 0x50021840 | CUST_KEK_W16  | Customer KEK Word16      |
| 0x50021844 | CUST_KEK_W17  | Customer KEK Word17      |
| 0x50021848 | CUST_KEK_W18  | Customer KEK Word18      |
| 0x5002184C | CUST_KEK_W19  | Customer KEK Word19      |
| 0x50021850 | CUST_KEK_W20  | Customer KEK Word20      |
| 0x50021854 | CUST_KEK_W21  | Customer KEK Word21      |
| 0x50021858 | CUST_KEK_W22  | Customer KEK Word22      |
| 0x5002185C | CUST_KEK_W23  | Customer KEK Word23      |
| 0x50021860 | CUST_KEK_W24  | Customer KEK Word24      |
| 0x50021864 | CUST_KEK_W25  | Customer KEK Word25      |
| 0x50021868 | CUST_KEK_W26  | Customer KEK Word26      |
| 0x5002186C | CUST_KEK_W27  | Customer KEK Word27      |
| 0x50021870 | CUST_KEK_W28  | Customer KEK Word28      |
| 0x50021874 | CUST_KEK_W29  | Customer KEK Word29      |
| 0x50021878 | CUST_KEK_W30  | Customer KEK Word30      |
| 0x5002187C | CUST_KEK_W31  | Customer KEK Word31      |
| 0x50021880 | CUST_AUTH_W0  | Customer AUTH Key Word0  |
| 0x50021884 | CUST_AUTH_W1  | Customer AUTH Key Word1  |
| 0x50021888 | CUST_AUTH_W2  | Customer AUTH Key Word2  |
| 0x5002188C | CUST_AUTH_W3  | Customer AUTH Key Word3  |
| 0x50021890 | CUST_AUTH_W4  | Customer AUTH Key Word4  |
| 0x50021894 | CUST_AUTH_W5  | Customer AUTH Key Word5  |
| 0x50021898 | CUST_AUTH_W6  | Customer AUTH Key Word6  |
| 0x5002189C | CUST_AUTH_W7  | Customer AUTH Key Word7  |
| 0x500218A0 | CUST_AUTH_W8  | Customer AUTH Key Word0  |
| 0x500218A4 | CUST_AUTH_W9  | Customer AUTH Key Word9  |
| 0x500218A8 | CUST_AUTH_W10 | Customer AUTH Key Word10 |

**Table 1197: Flash OTP INSTANCE0 INFO0 Register Map**

| Address(s) | Register Name   | Description                |
|------------|-----------------|----------------------------|
| 0x500218AC | CUST_AUTH_W11   | Customer AUTH Key Word11   |
| 0x500218B0 | CUST_AUTH_W12   | Customer AUTH Key Word12   |
| 0x500218B4 | CUST_AUTH_W13   | Customer AUTH Key Word13   |
| 0x500218B8 | CUST_AUTH_W14   | Customer AUTH Key Word14   |
| 0x500218BC | CUST_AUTH_W15   | Customer AUTH Key Word15   |
| 0x500218C0 | CUST_AUTH_W16   | Customer AUTH Key Word16   |
| 0x500218C4 | CUST_AUTH_W17   | Customer AUTH Key Word17   |
| 0x500218C8 | CUST_AUTH_W18   | Customer AUTH Key Word18   |
| 0x500218CC | CUST_AUTH_W19   | Customer AUTH Key Word19   |
| 0x500218D0 | CUST_AUTH_W20   | Customer AUTH Key Word20   |
| 0x500218D4 | CUST_AUTH_W21   | Customer AUTH Key Word21   |
| 0x500218D8 | CUST_AUTH_W22   | Customer AUTH Key Word22   |
| 0x500218DC | CUST_AUTH_W23   | Customer AUTH Key Word23   |
| 0x500218E0 | CUST_AUTH_W24   | Customer AUTH Key Word24   |
| 0x500218E4 | CUST_AUTH_W25   | Customer AUTH Key Word25   |
| 0x500218E8 | CUST_AUTH_W26   | Customer AUTH Key Word26   |
| 0x500218EC | CUST_AUTH_W27   | Customer AUTH Key Word27   |
| 0x500218F0 | CUST_AUTH_W28   | Customer AUTH Key Word28   |
| 0x500218F4 | CUST_AUTH_W29   | Customer AUTH Key Word29   |
| 0x500218F8 | CUST_AUTH_W30   | Customer AUTH Key Word30   |
| 0x500218FC | CUST_AUTH_W31   | Customer AUTH Key Word31   |
| 0x50021900 | CUST_PUBKEY_W0  | Customer Public Key Word0  |
| 0x50021904 | CUST_PUBKEY_W1  | Customer Public Key Word1  |
| 0x50021908 | CUST_PUBKEY_W2  | Customer Public Key Word2  |
| 0x5002190C | CUST_PUBKEY_W3  | Customer Public Key Word3  |
| 0x50021910 | CUST_PUBKEY_W4  | Customer Public Key Word4  |
| 0x50021914 | CUST_PUBKEY_W5  | Customer Public Key Word5  |
| 0x50021918 | CUST_PUBKEY_W6  | Customer Public Key Word6  |
| 0x5002191C | CUST_PUBKEY_W7  | Customer Public Key Word7  |
| 0x50021920 | CUST_PUBKEY_W8  | Customer Public Key Word0  |
| 0x50021924 | CUST_PUBKEY_W9  | Customer Public Key Word9  |
| 0x50021928 | CUST_PUBKEY_W10 | Customer Public Key Word10 |
| 0x5002192C | CUST_PUBKEY_W11 | Customer Public Key Word11 |
| 0x50021930 | CUST_PUBKEY_W12 | Customer Public Key Word12 |
| 0x50021934 | CUST_PUBKEY_W13 | Customer Public Key Word13 |
| 0x50021938 | CUST_PUBKEY_W14 | Customer Public Key Word14 |
| 0x5002193C | CUST_PUBKEY_W15 | Customer Public Key Word15 |
| 0x50021940 | CUST_PUBKEY_W16 | Customer Public Key Word16 |



**Table 1197: Flash OTP INSTANCE0 INFO0 Register Map**

| Address(s) | Register Name   | Description                |
|------------|-----------------|----------------------------|
| 0x50021944 | CUST_PUBKEY_W17 | Customer Public Key Word17 |
| 0x50021948 | CUST_PUBKEY_W18 | Customer Public Key Word18 |
| 0x5002194C | CUST_PUBKEY_W19 | Customer Public Key Word19 |
| 0x50021950 | CUST_PUBKEY_W20 | Customer Public Key Word20 |
| 0x50021954 | CUST_PUBKEY_W21 | Customer Public Key Word21 |
| 0x50021958 | CUST_PUBKEY_W22 | Customer Public Key Word22 |
| 0x5002195C | CUST_PUBKEY_W23 | Customer Public Key Word23 |
| 0x50021960 | CUST_PUBKEY_W24 | Customer Public Key Word24 |
| 0x50021964 | CUST_PUBKEY_W25 | Customer Public Key Word25 |
| 0x50021968 | CUST_PUBKEY_W26 | Customer Public Key Word26 |
| 0x5002196C | CUST_PUBKEY_W27 | Customer Public Key Word27 |
| 0x50021970 | CUST_PUBKEY_W28 | Customer Public Key Word28 |
| 0x50021974 | CUST_PUBKEY_W29 | Customer Public Key Word29 |
| 0x50021978 | CUST_PUBKEY_W30 | Customer Public Key Word30 |
| 0x5002197C | CUST_PUBKEY_W31 | Customer Public Key Word31 |
| 0x50021980 | CUST_PUBKEY_W32 | Customer Public Key Word32 |
| 0x50021984 | CUST_PUBKEY_W33 | Customer Public Key Word33 |
| 0x50021988 | CUST_PUBKEY_W34 | Customer Public Key Word34 |
| 0x5002198C | CUST_PUBKEY_W35 | Customer Public Key Word35 |
| 0x50021990 | CUST_PUBKEY_W36 | Customer Public Key Word36 |
| 0x50021994 | CUST_PUBKEY_W37 | Customer Public Key Word37 |
| 0x50021998 | CUST_PUBKEY_W38 | Customer Public Key Word38 |
| 0x5002199C | CUST_PUBKEY_W39 | Customer Public Key Word39 |
| 0x500219A0 | CUST_PUBKEY_W40 | Customer Public Key Word40 |
| 0x500219A4 | CUST_PUBKEY_W41 | Customer Public Key Word41 |
| 0x500219A8 | CUST_PUBKEY_W42 | Customer Public Key Word42 |
| 0x500219AC | CUST_PUBKEY_W43 | Customer Public Key Word43 |
| 0x500219B0 | CUST_PUBKEY_W44 | Customer Public Key Word44 |
| 0x500219B4 | CUST_PUBKEY_W45 | Customer Public Key Word45 |
| 0x500219B8 | CUST_PUBKEY_W46 | Customer Public Key Word46 |
| 0x500219BC | CUST_PUBKEY_W47 | Customer Public Key Word47 |
| 0x500219C0 | CUST_PUBKEY_W48 | Customer Public Key Word48 |
| 0x500219C4 | CUST_PUBKEY_W49 | Customer Public Key Word49 |
| 0x500219C8 | CUST_PUBKEY_W50 | Customer Public Key Word50 |
| 0x500219CC | CUST_PUBKEY_W51 | Customer Public Key Word51 |
| 0x500219D0 | CUST_PUBKEY_W52 | Customer Public Key Word52 |
| 0x500219D4 | CUST_PUBKEY_W53 | Customer Public Key Word53 |
| 0x500219D8 | CUST_PUBKEY_W54 | Customer Public Key Word54 |

**Table 1197: Flash OTP INSTANCE0 INFO0 Register Map**

| Address(s) | Register Name   | Description                    |
|------------|-----------------|--------------------------------|
| 0x500219DC | CUST_PUBKEY_W55 | Customer Public Key Word55     |
| 0x500219E0 | CUST_PUBKEY_W56 | Customer Public Key Word56     |
| 0x500219E4 | CUST_PUBKEY_W57 | Customer Public Key Word57     |
| 0x500219E8 | CUST_PUBKEY_W58 | Customer Public Key Word58     |
| 0x500219EC | CUST_PUBKEY_W59 | Customer Public Key Word59     |
| 0x500219F0 | CUST_PUBKEY_W60 | Customer Public Key Word60     |
| 0x500219F4 | CUST_PUBKEY_W61 | Customer Public Key Word61     |
| 0x500219F8 | CUST_PUBKEY_W62 | Customer Public Key Word62     |
| 0x500219FC | CUST_PUBKEY_W63 | Customer Public Key Word63     |
| 0x50021A00 | CUSTOMER_KEY0   | 128-bit customer key           |
| 0x50021A04 | CUSTOMER_KEY1   | 128-bit customer key           |
| 0x50021A08 | CUSTOMER_KEY2   | 128-bit customer key           |
| 0x50021A0C | CUSTOMER_KEY3   | 128-bit customer key           |
| 0x50021A10 | CUST_PUBHASH_W0 | Customer Public Key Hash Word0 |
| 0x50021A14 | CUST_PUBHASH_W1 | Customer Public Key Hash Word1 |
| 0x50021A18 | CUST_PUBHASH_W2 | Customer Public Key Hash Word2 |
| 0x50021A1C | CUST_PUBHASH_W3 | Customer Public Key Hash Word3 |
| 0x50021A20 | CUSTID          | Customer ID                    |



| Bit  | Name | Reset      | RW | Description                                                                                                                                                                                                       |
|------|------|------------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SIG1 | 0x7B9C8674 |    | Word 1 (bits 63:32) of the 128-bit INFO0 signature. The value in SIGNATURE* determines if the rest of INFO0 is valid. The reset value is the uninitialized signature for SIG1. The valid signature is 0xC9705737. |

**INFO0 Signature****INSTANCE 0 ADDRESS: 0x50020008**

Word 2 (bits 95:64) of the 128-bit INFO0 signature.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SIG2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name | Reset      | RW | Description                                                                                                                                                                                                       |
|------|------|------------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SIG2 | 0x869A96FE |    | Word 2 (bits 95:64) of the 128-bit INFO0 signature. The value in SIGNATURE* determines if the rest of INFO0 is valid. The reset value is the uninitialized signature for SIG2. The valid signature is 0x0A6B8458. |

**INFO0 Signature**

**INSTANCE 0 ADDRESS: 0x5002000C**

Word 3 (high word, bits 127:96) of the 128-bit INFO0 signature.

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| SIG3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1205: SIGNATURE3 Register Bits

| Bit  | Name | Reset      | RW | Description                                                                                                                                                                                                                   |
|------|------|------------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:0 | SIG3 | 0xAEC90860 |    | Word 3 (high word, bits 127:96) of the 128-bit INFO0 signature. The value in SIGNATURE* determines if the rest of INFO0 is valid. The reset value is the uninitialized signature for SIG3. The valid signature is 0xE41A9D74. |

#### 24.1.2.5 SECURITY Register

##### Security protection bits

**OFFSET:** 0x00000010

**INSTANCE 0 ADDRESS:** 0x50020010

This 32-bit word contains the customer programmable security.

Table 1206: SECURITY Register

|        |        |        |        |        |        |        |        |         |        |        |        |        |             |        |        |        |        |         |        |        |        |          |        |        |                                           |        |                   |        |        |        |             |  |        |        |            |
|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|-------------|--------|--------|--------|--------|---------|--------|--------|--------|----------|--------|--------|-------------------------------------------|--------|-------------------|--------|--------|--------|-------------|--|--------|--------|------------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3  | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8      | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3  | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9   | 0<br>8 | 0<br>7 | 0<br>6                                    | 0<br>5 | 0<br>4            | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0      |  |        |        |            |
| RSVD   |        |        |        | SECPOL |        |        |        | KEYWRAP |        |        |        | RSVD   | SECBOOTNRST |        |        |        | RSVD   | SECBOOT |        |        |        | PLONEXIT |        | SDBG   | BOOTLOADER_AT_RESET<br>EN_CUST_INFO_ERASE |        | EN_CUST_INFO_PROG |        |        |        | SECURE_LOCK |  | RSVD02 | RSVD01 | DEBUG_PROT |

Table 1207: SECURITY Register Bits

| Bit   | Name    | Reset | RW | Description                                                                                                                                                                                                                                                       |
|-------|---------|-------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31:27 | RSVD    | 0x1F  |    | Reserved.                                                                                                                                                                                                                                                         |
| 26:24 | SECPOL  | 0x7   |    | Defines the minimum security level required<br><br>DIS = 0x0 - No policy enforced<br>AUTH = 0x1 - If bit[0] is set, Authentication is required<br>ENC = 0x2 - If bit[1] is set, Encryption is required<br>ARB = 0x4 - If bit[2] is set, Anti-Rollback is required |
| 23:20 | KEYWRAP | 0xF   |    | Key wrap method used to validate customer program image. (used by boot-loader SW)<br><br>NOWRAP = 0x0 - No key wrap<br>XORWRAP = 0x1 - XOR based key wrap<br>AES128WRAP = 0x2 - AES-128 based key wrap                                                            |
| 19    | RSVD19  | 0x1   |    | Reserved                                                                                                                                                                                                                                                          |

**Table 1207: SECURITY Register Bits**

| Bit   | Name                     | Reset | RW | Description                                                                                                                                                                                                                                                                                                                                                                           |
|-------|--------------------------|-------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18:16 | SEC-<br>BOOTONRST        | 0x7   |    | Enable secure boot at warm reset. All other encodings not listed will result in an error.<br><br>SBOREN = 0x2 - Secure boot on reset enable<br>SBORDIS = 0x5 - Secure boot on reset disabled                                                                                                                                                                                          |
| 15    | RSVD15                   | 0x1   |    | Reserved                                                                                                                                                                                                                                                                                                                                                                              |
| 14:12 | SECBOOT                  | 0x7   |    | Enable secure boot. All other encodings not listed will result in an error.<br><br>SBEN = 0x2 - Secure boot enable<br>SBDIS = 0x5 - Secure boot disabled                                                                                                                                                                                                                              |
| 11    | PLONEXIT                 | 0x1   |    | Flash Protection Lock on bootloader exit. (used by bootloader SW)<br><br>PLNS = 0x0 - Protection lock will remain not set, allowing customer firmware to set. This is also an indication that there is a secondary bootloader installed, and hence the INFO0 keybank is kept open on SBL exit..<br>PLS = 0x1 - Flash Protection lock will be set before handoff to customer firmware. |
| 10    | SDBG                     | 0x1   |    | Secure Debug Lock. Should be set to 0 for production parts. (used by bootloader SW)<br><br>LOCK = 0x0 - Prevents debugger control while PROTLCK is not set.<br>UNLOCK = 0x1 - Debugger is allowed to connect during secure boot stage.                                                                                                                                                |
| 9     | BOOTLOAD-<br>ER_AT_RESET | 0x1   |    | Enable bootloader action at reset.<br><br>BARDS = 0x0 - bootloader can go to sleep.<br>BARNODS = 0x1 - bootloader spins in an infinite while loop                                                                                                                                                                                                                                     |
| 8     | EN_CUST_IN-<br>FO_ERASE  | 0x1   |    | Enable customer INFO space erasing.                                                                                                                                                                                                                                                                                                                                                   |
| 7:4   | EN_CUST_IN-<br>FO_PROG   | 0xF   |    | Enable customer INFO space programming.                                                                                                                                                                                                                                                                                                                                               |
| 3     | SECURE_LOCK              | 0x1   |    | This field must be kept at 1.                                                                                                                                                                                                                                                                                                                                                         |
| 2     | RSVD02                   | 0x1   |    | This field must be kept at 1.                                                                                                                                                                                                                                                                                                                                                         |
| 1     | RSVD01                   | 0x1   |    | This field must be kept at 1.                                                                                                                                                                                                                                                                                                                                                         |
| 0     | DEBUG_PROT               | 0x1   |    | Debugger protection.                                                                                                                                                                                                                                                                                                                                                                  |

**24.1.2.6 CUSTOMER\_TRIM Register****Customer trim values****OFFSET:** 0x00000014**INSTANCE 0 ADDRESS:** 0x50020014

Customer Programmable trim overrides. Bits in this register are loaded into hardware registers at reset.

[illegible]

---

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

INSTANCE ADDRESS : 50000010

[illegible]

|  |  |
|--|--|
|  |  |
|--|--|

Table 1211: CUSTOMER\_TRIM2 Register Bits

| Bit   | Name             | Reset     | RW | Description                                                                                                                                  |
|-------|------------------|-----------|----|----------------------------------------------------------------------------------------------------------------------------------------------|
| 31:11 | RSVD             | 0x1FFFFFF |    | Reserved                                                                                                                                     |
| 10:0  | XO32M_FRE-Q_TRIM | 0x7FF     |    | XO32 frequency trim. This field can optionally be adjusted to provide better interoperability performance based on crystal and board design. |

**24.1.2.8 SECURITY\_OVR Register**

Security Override configuration bits

OFFSET: 0x00000020

INSTANCE 0 ADDRESS: 0x50020020

This 32-bit word contains the override configuration for forcing GPIO-based firmware update.

Table 1212: SECURITY\_OVR Register

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7 | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8 | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | POL    | GPIO   |        |        |        |        |        |        |        |

Table 1213: SECURITY\_OVR Register Bits

| Bit  | Name | Reset      | RW | Description                                                                                                                             |
|------|------|------------|----|-----------------------------------------------------------------------------------------------------------------------------------------|
| 31:8 | RSVD | 0xFFFFFFFF |    | Reserved                                                                                                                                |
| 7    | POL  | 0x1        |    | GPIO polarity to indicate update.<br>POL_HIGH = 0x1 - Polarity set to High or Logic 1<br>POL_LOW = 0x0 - Polarity set to Low or Logic 0 |
| 6:0  | GPIO | 0x7F       |    | GPIO port to be used to indicate forced update. A value of 0x7F disables this feature.                                                  |

**24.1.2.9 SECURITY\_WIRED\_CFG Register**

Security Wired configuration bits

OFFSET: 0x00000024

INSTANCE 0 ADDRESS: 0x50020024

This 32-bit word contains the configuration for the wired update interface.



|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |         |   |   |   |   |           |   |   |   |   |     |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---------|---|---|---|---|-----------|---|---|---|---|-----|---|---|---|---|---|---|
| 3       | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 0 | 0         | 0 | 0 | 0 | 0 | 0   | 0 | 0 | 0 | 0 | 0 |   |
| 1       | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6       | 5 | 4 | 3 | 2 | 1         | 0 | 9 | 8 | 7 | 6   | 5 | 4 | 3 | 2 | 1 | 0 |
| TIMEOUT |   |   |   |   |   |   |   |   |   |   |   |   |   |   | I2CADDR |   |   |   |   | SLVINTPIN |   |   |   |   | IFC |   |   |   |   |   |   |

| Bit   | Name      | Reset  | RW | Description                                                                                                                            |
|-------|-----------|--------|----|----------------------------------------------------------------------------------------------------------------------------------------|
| 31:16 | TIMEOUT   | 0xFFFF |    | Timeout for wired interface poll (in milliseconds)                                                                                     |
| 15:9  | I2CADDR   | 0x7F   |    | I2C Address                                                                                                                            |
| 8:3   | SLVINTPIN | 0x3F   |    | Slave interrupt pin                                                                                                                    |
| 2:0   | IFC       | 0x7    |    | Wired interface configuration<br><br>IFC_UART = 0x1 - UART interface<br>IFC_SPI = 0x2 - SPI interface<br>IFC_I2C = 0x4 - I2C interface |

### Security Wired Interface configuration word0

**INSTANCE 0 ADDRESS: 0x50020028**

This 32-bit word contains the interface configuration word0 for the UART wired update.

|        |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| 3<br>1 | 3<br>0 | 2<br>9 | 2<br>8 | 2<br>7   | 2<br>6 | 2<br>5 | 2<br>4 | 2<br>3 | 2<br>2 | 2<br>1 | 2<br>0 | 1<br>9 | 1<br>8 | 1<br>7 | 1<br>6 | 1<br>5 | 1<br>4 | 1<br>3 | 1<br>2 | 1<br>1 | 1<br>0 | 0<br>9 | 0<br>8  | 0<br>7 | 0<br>6 | 0<br>5 | 0<br>4 | 0<br>3 | 0<br>2 | 0<br>1 | 0<br>0 |
| RSVD   |        |        |        | BAUDRATE |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | DATALEN | 2STOP  | EVEN   | PAR    | CTS    | RTS    | UART   |        |        |
|        |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |

| Bit   | Name     | Reset   | RW | Description   |
|-------|----------|---------|----|---------------|
| 31:28 | RSVD     | 0xF     |    | Reserved      |
| 27:8  | BAUDRATE | 0xFFFFF |    | UART Baudrate |

**Table 1217: SECURITY\_WIRED\_IFC\_CFG0 Register Bits**

| Bit | Name    | Reset | RW | Description                                                                                                 |
|-----|---------|-------|----|-------------------------------------------------------------------------------------------------------------|
| 7:6 | DATALEN | 0x3   |    | Number of Data Bits<br>5BIT = 0x0 - 5 bit<br>6BIT = 0x1 - 6 bit<br>7BIT = 0x2 - 7 bit<br>8BIT = 0x3 - 8 bit |
| 5   | 2STOP   | 0x1   |    | 2 Stop Bits                                                                                                 |
| 4   | EVEN    | 0x1   |    | Even Parity                                                                                                 |
| 3   | PAR     | 0x1   |    | Enable Parity                                                                                               |
| 2   | CTS     | 0x1   |    | Enable CTS                                                                                                  |
| 1   | RTS     | 0x1   |    | Enable RTS                                                                                                  |
| 0   | UART    | 0x1   |    | UART Module                                                                                                 |

**24.1.2.11 SECURITY\_WIRED\_IFC\_CFG1 Register****Security Wired Interface configuration word1****OFFSET:** 0x0000002C**INSTANCE 0 ADDRESS:** 0x5002002C

This 32-bit word contains the interface configuration word1 for the UART wired update.

**Table 1218: SECURITY\_WIRED\_IFC\_CFG1 Register**

|      |   |   |   |   |   |   |   |      |   |   |   |   |   |   |   |      |   |   |   |   |   |   |   |      |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|------|---|---|---|---|---|---|---|------|---|---|---|---|---|---|---|------|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2    | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1    | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0    | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3    | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5    | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7    | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| PIN3 |   |   |   |   |   |   |   | PIN2 |   |   |   |   |   |   |   | PIN1 |   |   |   |   |   |   |   | PIN0 |   |   |   |   |   |   |   |

**Table 1219: SECURITY\_WIRED\_IFC\_CFG1 Register Bits**

| Bit   | Name | Reset | RW | Description              |
|-------|------|-------|----|--------------------------|
| 31:24 | PIN3 | 0xFF  |    | Pin 3 for UART interface |
| 23:16 | PIN2 | 0xFF  |    | Pin 2 for UART interface |
| 15:8  | PIN1 | 0xFF  |    | Pin 1 for UART interface |
| 7:0   | PIN0 | 0xFF  |    | Pin 0 for UART interface |

**24.1.2.12 SECURITY\_WIRED\_IFC\_CFG2 Register****Security Wired Interface configuration word2****OFFSET: 0x00000030****INSTANCE 0 ADDRESS: 0x50020030**

This 32-bit word contains the raw Pin configuration for the UART wired interface pin 0.

**Table 1220: SECURITY\_WIRED\_IFC\_CFG2 Register**

|       |   |   |   |   |   |   |   |           |   |   |   |   |   |   |   |       |   |   |   |         |   |   |   |        |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|-----------|---|---|---|---|---|---|---|-------|---|---|---|---------|---|---|---|--------|---|---|---|---|---|---|---|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2         | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1     | 1 | 1 | 1 | 1       | 0 | 0 | 0 | 0      | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3         | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5     | 4 | 3 | 2 | 1       | 0 | 9 | 8 | 7      | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD2 |   |   |   |   |   |   |   | ALTPADCFG |   |   |   |   |   |   |   | RSVD1 |   |   |   | GPIOCFG |   |   |   | PADCFG |   |   |   |   |   |   |   |

**Table 1221: SECURITY\_WIRED\_IFC\_CFG2 Register Bits**

| Bit   | Name      | Reset | RW | Description                                                  |
|-------|-----------|-------|----|--------------------------------------------------------------|
| 31:24 | RSVD2     | 0xFF  |    | Reserved                                                     |
| 23:16 | ALTPADCFG | 0xFF  |    | 8 bit value representing the raw ALTPADCFG bits for this pin |
| 15:12 | RSVD1     | 0xF   |    | Reserved                                                     |
| 11:8  | GPIOCFG   | 0xF   |    | 4 bit value representing the raw GPIOCFG bits for this pin   |
| 7:0   | PADCFG    | 0xFF  |    | 8 bit value representing the raw PADREG bits for this pin    |

**24.1.2.13 SECURITY\_WIRED\_IFC\_CFG3 Register****Security Wired Interface configuration word3****OFFSET: 0x00000034****INSTANCE 0 ADDRESS: 0x50020034**

This 32-bit word contains the raw Pin configuration for the UART wired interface pin 1.

**Table 1222: SECURITY\_WIRED\_IFC\_CFG3 Register**

|       |   |   |   |   |   |   |   |           |   |   |   |   |   |   |   |       |   |   |   |         |   |   |   |        |   |   |   |   |   |  |  |
|-------|---|---|---|---|---|---|---|-----------|---|---|---|---|---|---|---|-------|---|---|---|---------|---|---|---|--------|---|---|---|---|---|--|--|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2         | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1     | 1 | 1 | 1 | 0       | 0 | 0 | 0 | 0      | 0 | 0 | 0 | 0 | 0 |  |  |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3         | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5     | 4 | 3 | 2 | 1       | 0 | 9 | 8 | 7      | 6 | 5 | 4 | 3 | 2 |  |  |
| RSVD2 |   |   |   |   |   |   |   | ALTPADCFG |   |   |   |   |   |   |   | RSVD1 |   |   |   | GPIOCFG |   |   |   | PADCFG |   |   |   |   |   |  |  |

**Table 1223: SECURITY\_WIRED\_IFC\_CFG3 Register Bits**

| Bit   | Name      | Reset | RW | Description                                                  |
|-------|-----------|-------|----|--------------------------------------------------------------|
| 31:24 | RSVD2     | 0xFF  |    | Reserved                                                     |
| 23:16 | ALTPADCFG | 0xFF  |    | 8 bit value representing the raw ALTPADCFG bits for this pin |
| 15:12 | RSVD1     | 0xF   |    | Reserved                                                     |
| 11:8  | GPIOCFG   | 0xF   |    | 4 bit value representing the raw GPIOCFG bits for this pin   |
| 7:0   | PADCFG    | 0xFF  |    | 8 bit value representing the raw PADREG bits for this pin    |

**24.1.2.14 SECURITY\_WIRED\_IFC\_CFG4 Register****Security Wired Interface configuration word4****OFFSET: 0x00000038****INSTANCE 0 ADDRESS: 0x50020038**

This 32-bit word contains the raw Pin configuration for the UART wired interface pin 2.

**Table 1224: SECURITY\_WIRED\_IFC\_CFG4 Register**

|       |   |   |   |   |   |   |   |           |   |   |   |   |   |   |   |       |   |   |   |         |   |   |   |        |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|-----------|---|---|---|---|---|---|---|-------|---|---|---|---------|---|---|---|--------|---|---|---|---|---|---|---|
| 3     | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2         | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1     | 1 | 1 | 0 | 0       | 0 | 0 | 0 | 0      | 0 | 0 | 0 | 0 | 0 |   |   |
| 1     | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3         | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5     | 4 | 3 | 2 | 1       | 0 | 9 | 8 | 7      | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RSVD2 |   |   |   |   |   |   |   | ALTPADCFG |   |   |   |   |   |   |   | RSVD1 |   |   |   | GPIOCFG |   |   |   | PADCFG |   |   |   |   |   |   |   |

**Table 1225: SECURITY\_WIRED\_IFC\_CFG4 Register Bits**

| Bit   | Name      | Reset | RW | Description                                                  |
|-------|-----------|-------|----|--------------------------------------------------------------|
| 31:24 | RSVD2     | 0xFF  |    | Reserved                                                     |
| 23:16 | ALTPADCFG | 0xFF  |    | 8 bit value representing the raw ALTPADCFG bits for this pin |
| 15:12 | RSVD1     | 0xF   |    | Reserved                                                     |
| 11:8  | GPIOCFG   | 0xF   |    | 4 bit value representing the raw GPIOCFG bits for this pin   |
| 7:0   | PADCFG    | 0xFF  |    | 8 bit value representing the raw PADREG bits for this pin    |

**24.1.2.15 SECURITY\_WIRED\_IFC\_CFG5 Register****Security Wired Interface configuration word5****OFFSET: 0x0000003C**



**24.1.2.17 SECURITY\_SRAM\_RESV Register****SRAM Reserved for Application Scratch space****OFFSET: 0x00000050****INSTANCE 0 ADDRESS: 0x50020050**

This 16-bit word indicates the amount of SRAM to keep reserved for application scratch space. This reserves the specified memory at the top end of SRAM memory address range. This memory is not disturbed by the Secure Boot Loader. Please note that future releases of SBL may increase the width of this field to 18 bits.

**Table 1230: SECURITY\_SRAM\_RESV Register**

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3    | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1         | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1    | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5         | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| RESV |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | SRAM_RESV |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 1231: SECURITY\_SRAM\_RESV Register Bits**

| Bit   | Name      | Reset  | RW | Description                                                                        |
|-------|-----------|--------|----|------------------------------------------------------------------------------------|
| 31:16 | RESV      | 0xFFFF |    | Reserved                                                                           |
| 15:0  | SRAM_RESV | 0xFFFF |    | SRAM Reservation. NOTE: This feature was added with later versions of Apollo3 SBL. |

**24.1.2.18 WRITE\_PROTECT\_L Register****Flash write-protection bits.****OFFSET: 0x000001F8****INSTANCE 0 ADDRESS: 0x500201F8**

These bits write-protect flash in 16KB chunks.

**Table 1232: WRITE\_PROTECT\_L Register**

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CHUNKS |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 1233: WRITE\_PROTECT\_L Register Bits**

| Bit  | Name   | Reset      | RW | Description                                                                                                          |
|------|--------|------------|----|----------------------------------------------------------------------------------------------------------------------|
| 31:0 | CHUNKS | 0xFFFFFFFF |    | Write protect flash 0x00000000 - 0x0007FFFF. Each bit provides write protection for 16KB chunks of flash data space. |

























Table 1274: CUST\_KEK\_W6 Register

|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3          | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1          | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTKEK_W6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1275: CUST\_KEK\_W6 Register Bits

| Bit  | Name       | Reset      | RW | Description        |
|------|------------|------------|----|--------------------|
| 31:0 | CUSTKEK_W6 | 0xFFFFFFFF |    | Customer KEK Word6 |

**24.1.2.40 CUST\_KEK\_W7 Register****Customer KEK Word7****OFFSET:** 0x0000181C**INSTANCE 0 ADDRESS:** 0x5002181C

This is the Customer KEK Word7.

Table 1276: CUST\_KEK\_W7 Register

|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3          | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1          | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTKEK_W7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1277: CUST\_KEK\_W7 Register Bits

| Bit  | Name       | Reset      | RW | Description        |
|------|------------|------------|----|--------------------|
| 31:0 | CUSTKEK_W7 | 0xFFFFFFFF |    | Customer KEK Word7 |

**24.1.2.41 CUST\_KEK\_W8 Register****Customer KEK Word0****OFFSET:** 0x00001820**INSTANCE 0 ADDRESS:** 0x50021820

This is the Customer KEK Word8.

Table 1278: CUST\_KEK\_W8 Register

|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|
| 3          | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |
| 1          | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |
| CUSTKEK_W8 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |

Table 1279: CUST\_KEK\_W8 Register Bits

| Bit  | Name       | Reset      | RW | Description        |
|------|------------|------------|----|--------------------|
| 31:0 | CUSTKEK_W8 | 0xFFFFFFFF |    | Customer KEK Word8 |

**24.1.2.42CUST\_KEK\_W9 Register****Customer KEK Word9****OFFSET:** 0x00001824**INSTANCE 0 ADDRESS:** 0x50021824

This is the Customer KEK Word9.

Table 1280: CUST\_KEK\_W9 Register

|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3          | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1          | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |
| CUSTKEK_W9 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1281: CUST\_KEK\_W9 Register Bits

| Bit  | Name       | Reset      | RW | Description        |
|------|------------|------------|----|--------------------|
| 31:0 | CUSTKEK_W9 | 0xFFFFFFFF |    | Customer KEK Word9 |

**24.1.2.43CUST\_KEK\_W10 Register****Customer KEK Word10****OFFSET:** 0x00001828**INSTANCE 0 ADDRESS:** 0x50021828

This is the Customer KEK Word10.

This is the Customer KEK Word12.

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 |   |
| CUSTKEK_W12 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name        | Reset      | RW | Description         |
|------|-------------|------------|----|---------------------|
| 31:0 | CUSTKEK_W12 | 0xFFFFFFFF |    | Customer KEK Word12 |

### Customer KEK Word13

**INSTANCE 0 ADDRESS: 0x50021834**

This is the Customer KEK Word13.

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 |   |
| CUSTKEK_W13 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name        | Reset      | RW | Description         |
|------|-------------|------------|----|---------------------|
| 31:0 | CUSTKEK_W13 | 0xFFFFFFFF |    | Customer KEK Word13 |

**Customer KEK Word14****INSTANCE 0 ADDRESS: 0x50021838**

This is the Customer KEK Word14.

Table 1290: CUST\_KEK\_W14 Register

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |
| CUSTKEK_W14 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |

Table 1291: CUST\_KEK\_W14 Register Bits

| Bit  | Name        | Reset      | RW | Description         |
|------|-------------|------------|----|---------------------|
| 31:0 | CUSTKEK_W14 | 0xFFFFFFFF |    | Customer KEK Word14 |

**24.1.2.48 CUST\_KEK\_W15 Register****Customer KEK Word15****OFFSET:** 0x0000183C**INSTANCE 0 ADDRESS:** 0x5002183C

This is the Customer KEK Word15.

Table 1292: CUST\_KEK\_W15 Register

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTKEK_W15 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1293: CUST\_KEK\_W15 Register Bits

| Bit  | Name        | Reset      | RW | Description         |
|------|-------------|------------|----|---------------------|
| 31:0 | CUSTKEK_W15 | 0xFFFFFFFF |    | Customer KEK Word15 |

**24.1.2.49 CUST\_KEK\_W16 Register****Customer KEK Word16****OFFSET:** 0x00001840**INSTANCE 0 ADDRESS:** 0x50021840

This is the Customer KEK Word16.

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTKEK_W16 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name        | Reset      | RW | Description         |
|------|-------------|------------|----|---------------------|
| 31:0 | CUSTKEK_W16 | 0xFFFFFFFF |    | Customer KEK Word16 |

This is the Customer KEK Word17.

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTKEK_W17 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name        | Reset      | RW | Description         |
|------|-------------|------------|----|---------------------|
| 31:0 | CUSTKEK_W17 | 0xFFFFFFFF |    | Customer KEK Word17 |

This is the Customer KEK Word18.











Table 1314: CUST\_KEK\_W26 Register

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTKEK_W26 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1315: CUST\_KEK\_W26 Register Bits

| Bit  | Name        | Reset      | RW | Description         |
|------|-------------|------------|----|---------------------|
| 31:0 | CUSTKEK_W26 | 0xFFFFFFFF |    | Customer KEK Word26 |

**24.1.2.60 CUST\_KEK\_W27 Register****Customer KEK Word27****OFFSET:** 0x0000186C**INSTANCE 0 ADDRESS:** 0x5002186C

This is the Customer KEK Word27.

Table 1316: CUST\_KEK\_W27 Register

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTKEK_W27 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1317: CUST\_KEK\_W27 Register Bits

| Bit  | Name        | Reset      | RW | Description         |
|------|-------------|------------|----|---------------------|
| 31:0 | CUSTKEK_W27 | 0xFFFFFFFF |    | Customer KEK Word27 |

**24.1.2.61 CUST\_KEK\_W28 Register****Customer KEK Word28****OFFSET:** 0x00001870**INSTANCE 0 ADDRESS:** 0x50021870

This is the Customer KEK Word28.



This is the Customer AUTH Key Word0. Keys are represented using key Index. Valid values for OEM key indices are 8-15. Each key index comprises of 128 bits (4 words) in the keybank, with words CUST AUTH W0-3 representing key index 8, and so on.





Table 1334: CUST\_AUTH\_W4 Register

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTAUTH_W4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1335: CUST\_AUTH\_W4 Register Bits

| Bit  | Name        | Reset      | RW | Description             |
|------|-------------|------------|----|-------------------------|
| 31:0 | CUSTAUTH_W4 | 0xFFFFFFFF |    | Customer AUTH Key Word4 |

**24.1.2.70 CUST\_AUTH\_W5 Register****Customer AUTH Key Word5****OFFSET:** 0x00001894**INSTANCE 0 ADDRESS:** 0x50021894

This is the Customer AUTH Key Word5.

Table 1336: CUST\_AUTH\_W5 Register

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTAUTH_W5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1337: CUST\_AUTH\_W5 Register Bits

| Bit  | Name        | Reset      | RW | Description             |
|------|-------------|------------|----|-------------------------|
| 31:0 | CUSTAUTH_W5 | 0xFFFFFFFF |    | Customer AUTH Key Word5 |

**24.1.2.71 CUST\_AUTH\_W6 Register****Customer AUTH Key Word6****OFFSET:** 0x00001898**INSTANCE 0 ADDRESS:** 0x50021898

This is the Customer AUTH Key Word6.





Table 1342: CUST\_AUTH\_W8 Register

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTAUTH_W8 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1343: CUST\_AUTH\_W8 Register Bits

| Bit  | Name        | Reset      | RW | Description             |
|------|-------------|------------|----|-------------------------|
| 31:0 | CUSTAUTH_W8 | 0xFFFFFFFF |    | Customer AUTH Key Word8 |

**24.1.2.74 CUST\_AUTH\_W9 Register****Customer AUTH Key Word9****OFFSET:** 0x000018A4**INSTANCE 0 ADDRESS:** 0x500218A4

This is the Customer AUTH Key Word9.

Table 1344: CUST\_AUTH\_W9 Register

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3           | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1           | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTAUTH_W9 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1345: CUST\_AUTH\_W9 Register Bits

| Bit  | Name        | Reset      | RW | Description             |
|------|-------------|------------|----|-------------------------|
| 31:0 | CUSTAUTH_W9 | 0xFFFFFFFF |    | Customer AUTH Key Word9 |

**24.1.2.75 CUST\_AUTH\_W10 Register****Customer AUTH Key Word10****OFFSET:** 0x000018A8**INSTANCE 0 ADDRESS:** 0x500218A8

This is the Customer AUTH Key Word10.







This is the Customer AUTH Key Word18.



Table 1366: CUST\_AUTH\_W20 Register

|              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3            | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1            | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTAUTH_W20 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1367: CUST\_AUTH\_W20 Register Bits

| Bit  | Name         | Reset      | RW | Description              |
|------|--------------|------------|----|--------------------------|
| 31:0 | CUSTAUTH_W20 | 0xFFFFFFFF |    | Customer AUTH Key Word20 |

**24.1.2.86 CUST\_AUTH\_W21 Register****Customer AUTH Key Word21****OFFSET:** 0x000018D4**INSTANCE 0 ADDRESS:** 0x500218D4

This is the Customer AUTH Key Word21.

Table 1368: CUST\_AUTH\_W21 Register

|              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3            | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1            | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTAUTH_W21 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1369: CUST\_AUTH\_W21 Register Bits

| Bit  | Name         | Reset      | RW | Description              |
|------|--------------|------------|----|--------------------------|
| 31:0 | CUSTAUTH_W21 | 0xFFFFFFFF |    | Customer AUTH Key Word21 |

**24.1.2.87 CUST\_AUTH\_W22 Register****Customer AUTH Key Word22****OFFSET:** 0x000018D8**INSTANCE 0 ADDRESS:** 0x500218D8

This is the Customer AUTH Key Word22.







|              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3            | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1            | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTAUTH_W26 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name         | Reset      | RW | Description              |
|------|--------------|------------|----|--------------------------|
| 31:0 | CUSTAUTH_W26 | 0xFFFFFFFF |    | Customer AUTH Key Word26 |

This is the Customer AUTH Key Word27.

|              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3            | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1            | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTAUTH_W27 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name         | Reset      | RW | Description              |
|------|--------------|------------|----|--------------------------|
| 31:0 | CUSTAUTH_W27 | 0xFFFFFFFF |    | Customer AUTH Key Word27 |

This is the Customer AUTH Key Word28.







Table 1394: CUST\_PUBKEY\_W2 Register

|               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3             | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1             | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1395: CUST\_PUBKEY\_W2 Register Bits

| Bit  | Name           | Reset      | RW | Description               |
|------|----------------|------------|----|---------------------------|
| 31:0 | CUSTPUB-KEY_W2 | 0xFFFFFFFF |    | Customer Public Key Word2 |

**24.1.2.100CUST\_PUBKEY\_W3 Register****Customer Public Key Word3****OFFSET:** 0x0000190C**INSTANCE 0 ADDRESS:** 0x5002190C

This is the Customer Public Key Word3.

Table 1396: CUST\_PUBKEY\_W3 Register

|               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3             | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1             | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1397: CUST\_PUBKEY\_W3 Register Bits

| Bit  | Name           | Reset      | RW | Description               |
|------|----------------|------------|----|---------------------------|
| 31:0 | CUSTPUB-KEY_W3 | 0xFFFFFFFF |    | Customer Public Key Word3 |

**24.1.2.101CUST\_PUBKEY\_W4 Register****Customer Public Key Word4****OFFSET:** 0x00001910**INSTANCE 0 ADDRESS:** 0x50021910

This is the Customer Public Key Word4.

|               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3             | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1             | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name           | Reset      | RW | Description               |
|------|----------------|------------|----|---------------------------|
| 31:0 | CUSTPUB-KEY_W4 | 0xFFFFFFFF |    | Customer Public Key Word4 |

**Customer Public Key Word5**

**INSTANCE 0 ADDRESS: 0x50021914**

This is the Customer Public Key Word5.

|               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3             | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1             | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name           | Reset      | RW | Description               |
|------|----------------|------------|----|---------------------------|
| 31:0 | CUSTPUB-KEY_W5 | 0xFFFFFFFF |    | Customer Public Key Word5 |

**Customer Public Key Word6****INSTANCE 0 ADDRESS: 0x50021918**

This is the Customer Public Key Word6.



Table 1402: CUST\_PUBKEY\_W6 Register

|               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3             | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1             | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 |
| CUSTPUBKEY_W6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1403: CUST\_PUBKEY\_W6 Register Bits

| Bit  | Name           | Reset      | RW | Description               |
|------|----------------|------------|----|---------------------------|
| 31:0 | CUSTPUB-KEY_W6 | 0xFFFFFFFF |    | Customer Public Key Word6 |

**24.1.2.104CUST\_PUBKEY\_W7 Register****Customer Public Key Word7****OFFSET:** 0x0000191C**INSTANCE 0 ADDRESS:** 0x5002191C

This is the Customer Public Key Word7.

Table 1404: CUST\_PUBKEY\_W7 Register

|               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3             | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1             | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 |
| CUSTPUBKEY_W7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1405: CUST\_PUBKEY\_W7 Register Bits

| Bit  | Name           | Reset      | RW | Description               |
|------|----------------|------------|----|---------------------------|
| 31:0 | CUSTPUB-KEY_W7 | 0xFFFFFFFF |    | Customer Public Key Word7 |

**24.1.2.105CUST\_PUBKEY\_W8 Register****Customer Public Key Word0****OFFSET:** 0x00001920**INSTANCE 0 ADDRESS:** 0x50021920

This is the Customer Public Key Word8.

|               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3             | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1             | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W8 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name           | Reset      | RW | Description               |
|------|----------------|------------|----|---------------------------|
| 31:0 | CUSTPUB-KEY_W8 | 0xFFFFFFFF |    | Customer Public Key Word8 |

**Customer Public Key Word9**

**INSTANCE 0 ADDRESS: 0x50021924**

This is the Customer Public Key Word9.

|               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3             | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1             | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W9 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name           | Reset      | RW | Description               |
|------|----------------|------------|----|---------------------------|
| 31:0 | CUSTPUB-KEY_W9 | 0xFFFFFFFF |    | Customer Public Key Word9 |

**Customer Public Key Word10****INSTANCE 0 ADDRESS: 0x50021928**

This is the Customer Public Key Word10.

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W10 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W10 | 0xFFFFFFFF |    | Customer Public Key Word10 |

**Customer Public Key Word11**

**INSTANCE 0 ADDRESS: 0x5002192C**

This is the Customer Public Key Word11.

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |
| CUSTPUBKEY_W11 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W11 | 0xFFFFFFFF |    | Customer Public Key Word11 |

**Customer Public Key Word12**

**INSTANCE 0 ADDRESS: 0x50021930**

This is the Customer Public Key Word12.

Table 1414: CUST\_PUBKEY\_W12 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W12 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1415: CUST\_PUBKEY\_W12 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W12 | 0xFFFFFFFF |    | Customer Public Key Word12 |

**24.1.2.110CUST\_PUBKEY\_W13 Register****Customer Public Key Word13****OFFSET:** 0x00001934**INSTANCE 0 ADDRESS:** 0x50021934

This is the Customer Public Key Word13.

Table 1416: CUST\_PUBKEY\_W13 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W13 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1417: CUST\_PUBKEY\_W13 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W13 | 0xFFFFFFFF |    | Customer Public Key Word13 |

**24.1.2.111CUST\_PUBKEY\_W14 Register****Customer Public Key Word14****OFFSET:** 0x00001938**INSTANCE 0 ADDRESS:** 0x50021938

This is the Customer Public Key Word14.

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W14 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W14 | 0xFFFFFFFF |    | Customer Public Key Word14 |

### Customer Public Key Word15

**INSTANCE 0 ADDRESS: 0x5002193C**

This is the Customer Public Key Word15.

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W15 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W15 | 0xFFFFFFFF |    | Customer Public Key Word15 |

**Customer Public Key Word16**

**INSTANCE 0 ADDRESS: 0x50021940**

This is the Customer Public Key Word16.

Table 1422: CUST\_PUBKEY\_W16 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W16 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1423: CUST\_PUBKEY\_W16 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W16 | 0xFFFFFFFF |    | Customer Public Key Word16 |

**24.1.2.114CUST\_PUBKEY\_W17 Register****Customer Public Key Word17****OFFSET:** 0x00001944**INSTANCE 0 ADDRESS:** 0x50021944

This is the Customer Public Key Word17.

Table 1424: CUST\_PUBKEY\_W17 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W17 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1425: CUST\_PUBKEY\_W17 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W17 | 0xFFFFFFFF |    | Customer Public Key Word17 |

**24.1.2.115CUST\_PUBKEY\_W18 Register****Customer Public Key Word18****OFFSET:** 0x00001948**INSTANCE 0 ADDRESS:** 0x50021948

This is the Customer Public Key Word18.

Table 1426: CUST\_PUBKEY\_W18 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W18 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1427: CUST\_PUBKEY\_W18 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W18 | 0xFFFFFFFF |    | Customer Public Key Word18 |

**24.1.2.116 CUST\_PUBKEY\_W19 Register****Customer Public Key Word19****OFFSET:** 0x0000194C**INSTANCE 0 ADDRESS:** 0x5002194C

This is the Customer Public Key Word19.

Table 1428: CUST\_PUBKEY\_W19 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W19 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1429: CUST\_PUBKEY\_W19 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W19 | 0xFFFFFFFF |    | Customer Public Key Word19 |

**24.1.2.117 CUST\_PUBKEY\_W20 Register****Customer Public Key Word20****OFFSET:** 0x00001950**INSTANCE 0 ADDRESS:** 0x50021950

This is the Customer Public Key Word20.





Table 1434: CUST\_PUBKEY\_W22 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W22 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1435: CUST\_PUBKEY\_W22 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W22 | 0xFFFFFFFF |    | Customer Public Key Word22 |

**24.1.2.120 CUST\_PUBKEY\_W23 Register****Customer Public Key Word23****OFFSET:** 0x0000195C**INSTANCE 0 ADDRESS:** 0x5002195C

This is the Customer Public Key Word23.

Table 1436: CUST\_PUBKEY\_W23 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W23 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1437: CUST\_PUBKEY\_W23 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W23 | 0xFFFFFFFF |    | Customer Public Key Word23 |

**24.1.2.121 CUST\_PUBKEY\_W24 Register****Customer Public Key Word24****OFFSET:** 0x00001960**INSTANCE 0 ADDRESS:** 0x50021960

This is the Customer Public Key Word24.

Table 1438: CUST\_PUBKEY\_W24 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W24 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1439: CUST\_PUBKEY\_W24 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W24 | 0xFFFFFFFF |    | Customer Public Key Word24 |

**24.1.2.122CUST\_PUBKEY\_W25 Register****Customer Public Key Word25****OFFSET:** 0x00001964**INSTANCE 0 ADDRESS:** 0x50021964

This is the Customer Public Key Word25.

Table 1440: CUST\_PUBKEY\_W25 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W25 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1441: CUST\_PUBKEY\_W25 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W25 | 0xFFFFFFFF |    | Customer Public Key Word25 |

**24.1.2.123CUST\_PUBKEY\_W26 Register****Customer Public Key Word26****OFFSET:** 0x00001968**INSTANCE 0 ADDRESS:** 0x50021968

This is the Customer Public Key Word26.







Table 1454: CUST\_PUBKEY\_W32 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W32 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1455: CUST\_PUBKEY\_W32 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W32 | 0xFFFFFFFF |    | Customer Public Key Word32 |

**24.1.2.130 CUST\_PUBKEY\_W33 Register****Customer Public Key Word33****OFFSET:** 0x00001984**INSTANCE 0 ADDRESS:** 0x50021984

This is the Customer Public Key Word33.

Table 1456: CUST\_PUBKEY\_W33 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W33 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1457: CUST\_PUBKEY\_W33 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W33 | 0xFFFFFFFF |    | Customer Public Key Word33 |

**24.1.2.131 CUST\_PUBKEY\_W34 Register****Customer Public Key Word34****OFFSET:** 0x00001988**INSTANCE 0 ADDRESS:** 0x50021988

This is the Customer Public Key Word34.

Table 1458: CUST\_PUBKEY\_W34 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W34 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1459: CUST\_PUBKEY\_W34 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W34 | 0xFFFFFFFF |    | Customer Public Key Word34 |

**24.1.2.132CUST\_PUBKEY\_W35 Register****Customer Public Key Word35****OFFSET:** 0x0000198C**INSTANCE 0 ADDRESS:** 0x5002198C

This is the Customer Public Key Word35.

Table 1460: CUST\_PUBKEY\_W35 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W35 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1461: CUST\_PUBKEY\_W35 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W35 | 0xFFFFFFFF |    | Customer Public Key Word35 |

**24.1.2.133CUST\_PUBKEY\_W36 Register****Customer Public Key Word36****OFFSET:** 0x00001990**INSTANCE 0 ADDRESS:** 0x50021990

This is the Customer Public Key Word36.

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W36 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W36 | 0xFFFFFFFF |    | Customer Public Key Word36 |

**Customer Public Key Word37****INSTANCE 0 ADDRESS: 0x50021994**

This is the Customer Public Key Word37.

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W37 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W37 | 0xFFFFFFFF |    | Customer Public Key Word37 |

**Customer Public Key Word38****INSTANCE 0 ADDRESS: 0x50021998**

This is the Customer Public Key Word38.



|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |  |
| CUSTPUBKEY_W38 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W38 | 0xFFFFFFFF |    | Customer Public Key Word38 |

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W39 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W39 | 0xFFFFFFFF |    | Customer Public Key Word39 |

Table 1470: CUST\_PUBKEY\_W40 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W40 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1471: CUST\_PUBKEY\_W40 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W40 | 0xFFFFFFFF |    | Customer Public Key Word40 |

**24.1.2.138CUST\_PUBKEY\_W41 Register****Customer Public Key Word41****OFFSET:** 0x000019A4**INSTANCE 0 ADDRESS:** 0x500219A4

This is the Customer Public Key Word41.

Table 1472: CUST\_PUBKEY\_W41 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W41 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1473: CUST\_PUBKEY\_W41 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W41 | 0xFFFFFFFF |    | Customer Public Key Word41 |

**24.1.2.139CUST\_PUBKEY\_W42 Register****Customer Public Key Word42****OFFSET:** 0x000019A8**INSTANCE 0 ADDRESS:** 0x500219A8

This is the Customer Public Key Word42.

Table 1474: CUST\_PUBKEY\_W42 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |
| CUSTPUBKEY_W42 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |

Table 1475: CUST\_PUBKEY\_W42 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W42 | 0xFFFFFFFF |    | Customer Public Key Word42 |

**24.1.2.140 CUST\_PUBKEY\_W43 Register****Customer Public Key Word43****OFFSET:** 0x000019AC**INSTANCE 0 ADDRESS:** 0x500219AC

This is the Customer Public Key Word43.

Table 1476: CUST\_PUBKEY\_W43 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |
| CUSTPUBKEY_W43 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1477: CUST\_PUBKEY\_W43 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W43 | 0xFFFFFFFF |    | Customer Public Key Word43 |

**24.1.2.141 CUST\_PUBKEY\_W44 Register****Customer Public Key Word44****OFFSET:** 0x000019B0**INSTANCE 0 ADDRESS:** 0x500219B0

This is the Customer Public Key Word44.



This is the Customer Public Key Word48.





**Table 1494: CUST\_PUBKEY\_W52 Register**

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W52 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 1495: CUST\_PUBKEY\_W52 Register Bits**

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W52 | 0xFFFFFFFF |    | Customer Public Key Word52 |

**24.1.2.150 CUST\_PUBKEY\_W53 Register****Customer Public Key Word53****OFFSET:** 0x000019D4**INSTANCE 0 ADDRESS:** 0x500219D4

This is the Customer Public Key Word53.

**Table 1496: CUST\_PUBKEY\_W53 Register**

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W53 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 1497: CUST\_PUBKEY\_W53 Register Bits**

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W53 | 0xFFFFFFFF |    | Customer Public Key Word53 |

**24.1.2.151 CUST\_PUBKEY\_W54 Register****Customer Public Key Word54****OFFSET:** 0x000019D8**INSTANCE 0 ADDRESS:** 0x500219D8

This is the Customer Public Key Word54.





Table 1502: CUST\_PUBKEY\_W56 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |
| CUSTPUBKEY_W56 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |

Table 1503: CUST\_PUBKEY\_W56 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W56 | 0xFFFFFFFF |    | Customer Public Key Word56 |

**24.1.2.154 CUST\_PUBKEY\_W57 Register****Customer Public Key Word57****OFFSET:** 0x000019E4**INSTANCE 0 ADDRESS:** 0x500219E4

This is the Customer Public Key Word57.

Table 1504: CUST\_PUBKEY\_W57 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |
| CUSTPUBKEY_W57 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |

Table 1505: CUST\_PUBKEY\_W57 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W57 | 0xFFFFFFFF |    | Customer Public Key Word57 |

**24.1.2.155 CUST\_PUBKEY\_W58 Register****Customer Public Key Word58****OFFSET:** 0x000019E8**INSTANCE 0 ADDRESS:** 0x500219E8

This is the Customer Public Key Word58.

Table 1506: CUST\_PUBKEY\_W58 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W58 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1507: CUST\_PUBKEY\_W58 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W58 | 0xFFFFFFFF |    | Customer Public Key Word58 |

**24.1.2.156 CUST\_PUBKEY\_W59 Register****Customer Public Key Word59****OFFSET:** 0x000019EC**INSTANCE 0 ADDRESS:** 0x500219EC

This is the Customer Public Key Word59.

Table 1508: CUST\_PUBKEY\_W59 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W59 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1509: CUST\_PUBKEY\_W59 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W59 | 0xFFFFFFFF |    | Customer Public Key Word59 |

**24.1.2.157 CUST\_PUBKEY\_W60 Register****Customer Public Key Word60****OFFSET:** 0x000019F0**INSTANCE 0 ADDRESS:** 0x500219F0

This is the Customer Public Key Word60.

This is the Customer Public Key Word62.

Table 1514: CUST\_PUBKEY\_W62 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W62 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1515: CUST\_PUBKEY\_W62 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W62 | 0xFFFFFFFF |    | Customer Public Key Word62 |

**24.1.2.160 CUST\_PUBKEY\_W63 Register****Customer Public Key Word63****OFFSET:** 0x000019FC**INSTANCE 0 ADDRESS:** 0x500219FC

This is the Customer Public Key Word63.

Table 1516: CUST\_PUBKEY\_W63 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBKEY_W63 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1517: CUST\_PUBKEY\_W63 Register Bits

| Bit  | Name            | Reset      | RW | Description                |
|------|-----------------|------------|----|----------------------------|
| 31:0 | CUSTPUB-KEY_W63 | 0xFFFFFFFF |    | Customer Public Key Word63 |

**24.1.2.161 CUSTOMER\_KEY0 Register****Word 0 of 128-bit customer key.****OFFSET:** 0x00001A00**INSTANCE 0 ADDRESS:** 0x50021A00**customer\_key[31:0].** Customer SW can access the protected upper half of Info0 by writing this key value into the security lock register.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CHUNKS |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset      | RW | Description                 |
|------|--------|------------|----|-----------------------------|
| 31:0 | CHUNKS | 0xFFFFFFFF |    | Word 0 of the customer key. |

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 |
| CHUNKS |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset      | RW | Description                 |
|------|--------|------------|----|-----------------------------|
| 31:0 | CHUNKS | 0xFFFFFFFF |    | Word 1 of the customer key. |

customer\_key[95:64]

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |   |
| CHUNKS |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset      | RW | Description                 |
|------|--------|------------|----|-----------------------------|
| 31:0 | CHUNKS | 0xFFFFFFFF |    | Word 2 of the customer key. |

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3      | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1      | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 0 |
| CHUNKS |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| Bit  | Name   | Reset      | RW | Description                 |
|------|--------|------------|----|-----------------------------|
| 31:0 | CHUNKS | 0xFFFFFFFF |    | Word 3 of the customer key. |

This is the Customer Public Key Hash Word0.

Table 1526: CUST\_PUBHASH\_W0 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBHASH_W0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1527: CUST\_PUBHASH\_W0 Register Bits

| Bit  | Name            | Reset      | RW | Description                    |
|------|-----------------|------------|----|--------------------------------|
| 31:0 | CUSTPUB-HASH_W0 | 0xFFFFFFFF |    | Customer Public Key Hash Word0 |

**24.1.2.166 CUST\_PUBHASH\_W1 Register****Customer Public Key Hash Word1****OFFSET:** 0x00001A14**INSTANCE 0 ADDRESS:** 0x50021A14

This is the Customer Public Key Hash Word1.

Table 1528: CUST\_PUBHASH\_W1 Register

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBHASH_W1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 1529: CUST\_PUBHASH\_W1 Register Bits

| Bit  | Name            | Reset      | RW | Description                    |
|------|-----------------|------------|----|--------------------------------|
| 31:0 | CUSTPUB-HASH_W1 | 0xFFFFFFFF |    | Customer Public Key Hash Word1 |

**24.1.2.167 CUST\_PUBHASH\_W2 Register****Customer Public Key Hash Word2****OFFSET:** 0x00001A18**INSTANCE 0 ADDRESS:** 0x50021A18

This is the Customer Public Key Hash Word2.



**Table 1530: CUST\_PUBHASH\_W2 Register**

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBHASH_W2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 1531: CUST\_PUBHASH\_W2 Register Bits**

| Bit  | Name            | Reset      | RW | Description                    |
|------|-----------------|------------|----|--------------------------------|
| 31:0 | CUSTPUB-HASH_W2 | 0xFFFFFFFF |    | Customer Public Key Hash Word2 |

**24.1.2.168CUST\_PUBHASH\_W3 Register****Customer Public Key Hash Word3****OFFSET:** 0x00001A1C**INSTANCE 0 ADDRESS:** 0x50021A1C

This is the Customer Public Key Hash Word3.

**Table 1532: CUST\_PUBHASH\_W3 Register**

|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3              | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| 1              | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| CUSTPUBHASH_W3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Table 1533: CUST\_PUBHASH\_W3 Register Bits**

| Bit  | Name            | Reset      | RW | Description                    |
|------|-----------------|------------|----|--------------------------------|
| 31:0 | CUSTPUB-HASH_W3 | 0xFFFFFFFF |    | Customer Public Key Hash Word3 |

**24.1.2.169CUSTID Register****Customer ID****OFFSET:** 0x00001A20**INSTANCE 0 ADDRESS:** 0x50021A20

This is the Ambiq assigned Customer ID. This field should be initialized with a unique (OEM-specific) value, supplied by Ambiq as a precondition to enabling Secure Boot support.

[illegible]

---

| BU | U | BU + U | BM | BU + BM |
|----|---|--------|----|---------|
|----|---|--------|----|---------|

|  |  |  |  |  |  |
|--|--|--|--|--|--|
|  |  |  |  |  |  |
|--|--|--|--|--|--|

## 25. Appendix 2. Configuring the Apollo3 Blue MCU for Non-BLE Operation

### 25.1 Introduction

This appendix describes the recommended hardware connections and software configuration for Apollo3 MCU applications which do not need the on-chip BLE functionality.

### 25.2 Circuit Requirements

The circuit schematic in Figure 110 shows the connections and terminations for all Apollo3 package pins. Note that all pins available on the BGA package are shown in the schematic. If using CSP, then disregard any pins which are not brought out for that package. Also note that the connections and external components used to enable BLE Buck mode are retained in the design to still be able to utilize TurboSPOT, or burst, mode.

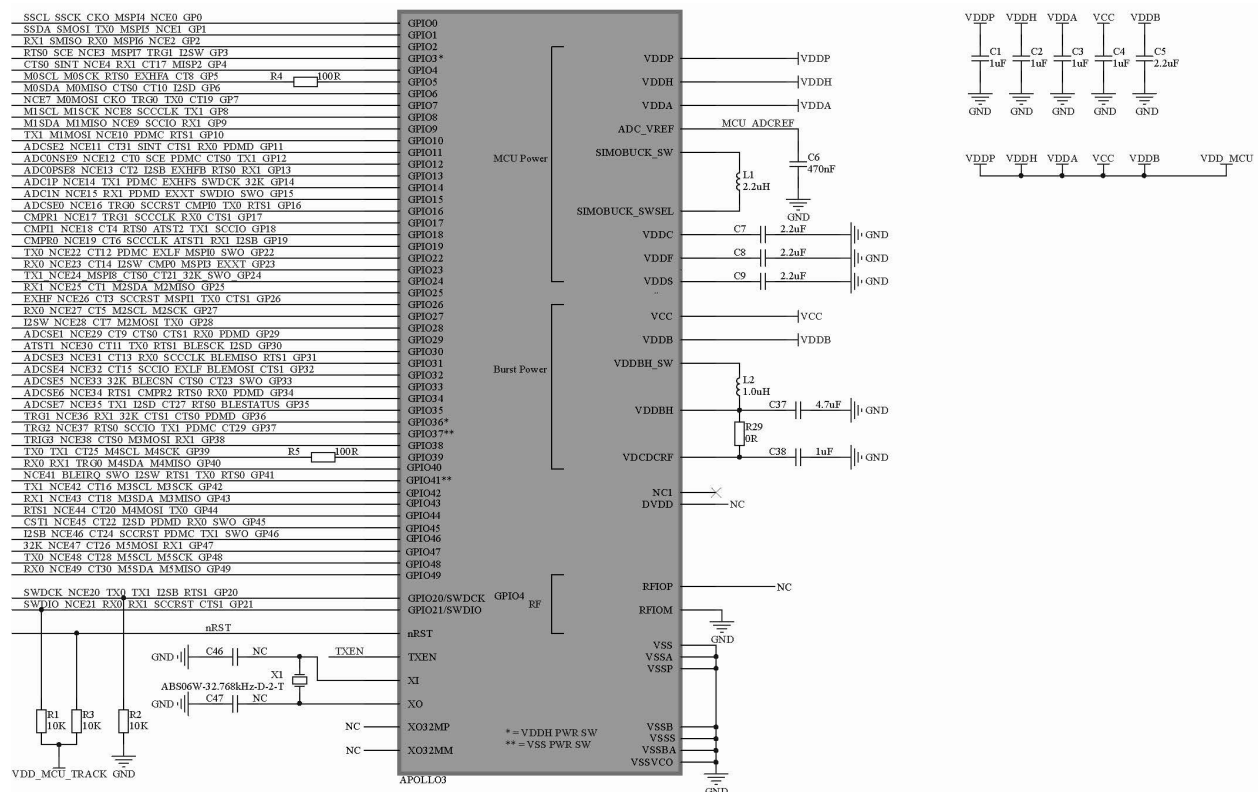


**Figure 110. Circuit Schematic for No-BLE Apollo3 MCU Application**

The modifications to the circuit to simplify the design and in some cases reduce the BOM when not using BLE are the following:

- The DVDD rail is not supplied and the DVDD pin is not connected. Its bypass cap is not needed.
- No need for a special VCC supply. Tie the VCC pin to the other supplies (VDDP, VDDH, VDDA and VDDB).
- The 32 MHz crystal circuit is removed; XO32MP and XO32MM pins are not connected.
- The antenna circuit is not needed; RFIOP pin is not connected, RFIOM is connect to PCB GND.
- All VSS pins, including VSSB, are tied to PCB GND .

## 25.3 Software Configuration

Power and enablement of the BLE module are disabled by default. There is no configuration required to disable the module for this non-BLE mode of operation.

Note that the BLE module and functionality are disabled by default in the BLEREQ field of the MCUCTRL\_FEATUREENABLE register. However, to guarantee lowest power operation of the MCU at supply voltages greater than 3.3V and/or low temperatures, the BLE should be brought up and put into deepsleep in an appropriate manner to prevent leakage.

A function, `am_bsp_ble_3p3v_low_power_mode()`, has been added to the AmbiqSuite SDK release 2.5. For lowest power operation, this function should be included in user code and executed when the application does not include BLE functionality and the system is run at 3.3V or higher.

## 25.4 Non-use of 96 MHz TurboSPOT (Burst) Mode

If TurboSPOT mode is not to be used, there can be further modifications made to reduce the MCU circuit and BOM.

- Remove 1  $\mu$ H inductor and VDCDCRF's 1  $\mu$ F bypass cap but keep the 4.7  $\mu$ F cap on VDDBH; connect VDDBH\_SW, VDDBH and VDCDCRF together.

Note that TurboSPOT mode is disabled by default in the BURSTREQ field of the MCUCTRL\_FEATUREENABLE register, and should be kept disabled in this mode.

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## 26. Ordering Information

**Table 1536: Ordering Information**

| Orderable Part Number <sup>1</sup> | Flash | RAM    | BLE | Package      | Packing       | Temperature Range | Availability |
|------------------------------------|-------|--------|-----|--------------|---------------|-------------------|--------------|
| AMA3B1KK-KBR-B0                    | 1 MB  | 384 kB | Yes | 81-pin BGA   | Tape and Reel | –40 to 85°C       | Now          |
| AMA3B1KK-KCR-B0                    | 1 MB  | 384 kB | Yes | 66-pin CSP   | Tape and Reel | –40 to 85°C       | Now          |
| AMAP31KK-KCR <sup>2</sup>          | 1 MB  | 384 kB | No  | 66-pin CSP   | Tape and Reel | –40 to 85°C       | Now          |
| AMA3B1KK-KCR-TB                    | 1 MB  | 384 kB | Yes | 66-pin WLCSP | Tape and Reel | –40 to 85°C       | Now          |

1. The silicon revision is identified by the first letter in the bottom row of the package's top marking: C = revision A1, F = revision B0.

2. Please reference Appendix 2 for non-BLE configuration.

## 27. Document Revision History

**Table 1537: Document Revision List**

| Revision | Date      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.6      | Feb 2018  | Initial alpha release<br>- Updated Appendix                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 0.7      | Jun 2018  | Pin Cfg:<br>- VDDA pin on CSP package corrected in Pin List and Function Table<br>- DVDD pin added in BGA and CSP pkg diagrams and in Pin List and Function Table<br>I2C/SPI Master Module: Functional Description details added<br>ADC: ADC register set expanded to include DMA control/status registers<br>CTIMER: Corrected CTIMER Pad Input Connections table<br>GPIO: PADREGA corrected for SLMISO/SLMOSI function selections for PAD1 and PAD2<br>Electrical:<br>- Updated VESDCDM - ESD Charged Device Model (CDM)<br>- Updated VESDHBM - ESD Human Body Model (HBM)<br>- Updated Latch-up Current |
| 0.8      | Aug 2018  | Package: CSP Package Drawing added<br>Appendix: Info0 information updated<br>Electrical: BLE specifications updated                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 0.9      | Feb 2019  | PinCfg: For CSP Pin Configuration Diagram and Pin List and Function Table, VSSB (C7) and VDDBH_SW (C8) have been interchanged, CSP balls for GPIO4, 9, 10, 13, 14, 15, 21, 23, 24, 40 and 41 have been updated. Preliminary designation removed.<br>System Core (flash): Updated note about allowable number of program cycles between erase cycles.<br>Clock Gen: Clock tree diagram added.<br>Reset Module: Updated Block diagram for the Reset Generator Module<br>Electricals:<br>- ADC specifications updated<br>- Coremark current at 3.3V/48MHz corrected                                           |
| 0.9.1    | Feb 2019  | MSPI: Pin Muxing table corrected<br>Ordering Information: CSP package added; B0 packages added                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 0.9.2    | May 2019  | BLE: Corrected number of supported concurrent BLE connections                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 0.10.0   | July 2019 | Silicon Revision B0 upgrades documented throughout<br>MSPI: Deprecated Paired Quad mode.<br>IOM: Corrected FIFO size in Full Duplex Operations section. Deprecated CMDRPT functionality.<br>GPIO: Corrected PADnINPEN settings for I2S Connections<br>CTIMER/STIMER: Added description of STIMER event output on GPIO through CTIMER<br>Package: Added reflow profile for BGA package                                                                                                                                                                                                                      |



| Revision | Date           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.11.0   | April 2020     | <p>CTIMER/STIMER: Added description of STIMER event output on GPIO through CTIMER System Core - Sections 3.5 and 3.5.1.1 - note added about the need to transition from burst mode to active mode before going into a sleep mode.</p> <p>MSPI:</p> <ul style="list-style-type: none"> <li>- Functional Overview and other sections updated.</li> <li>- Notation added for support for only mode 0 CPOL/CPHA operation.</li> </ul> <p>IOM:</p> <ul style="list-style-type: none"> <li>- Updated "Recommended Mode Settings for Standard I2C Clock Speeds" table.</li> <li>- Full Duplex Operations section removed. Functionality deprecated.</li> </ul> <p>PDM:</p> <ul style="list-style-type: none"> <li>- Corrected High-pass Filter formula in 10.2.8.</li> <li>- Corrected enums for ADCHPD field's bit values in PCFG register.</li> </ul> <p>Electricals:</p> <ul style="list-style-type: none"> <li>- Footnotes about restrictions added to MSPI section (21.12)</li> <li>- BLE - Out-of-band blocking specs updated.</li> <li>- MSPI - Limitations for max clock and operating modes added as footnotes to table.</li> </ul> <p>Appendix 1: Updated WRITE_PROTECT and COPY_PROTECT registers.</p> <p>Appendix 2: Added for non-BLE MCU version (Apollo3 MCU - AMAP31KK-KCR)</p> |
| 0.12.0   | June 2020      | <p>DMA: Added note in Functional Overview that</p> <p>GPIO:</p> <ul style="list-style-type: none"> <li>- Total GPIO reference corrected in sec. 11.2.</li> <li>- Counter/Timer Pad Configuration table removed and replaced with link to same table in CTIMER chapter.</li> </ul> <p>CTIMER: Section 23 - corrected register reference in the Counter/Timer Output Pad Configuration table</p> <p>Electricals: Updated IOM-SPI, PDM, SWD and GPIO specifications</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 0.12.1   | July 2020      | Electricals: Updated IOM-SPI and SWD min timing spec and diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 0.13.0   | September 2020 | <p>General: Apollo3 Blue Thin package added</p> <p>IOM: Corrected APB_CLK frequency to 24 MHz</p> <p>VREG: Clarified need for VDDC and VDDF capacitors for internal LDOs.</p> <p>Package Mechanical: Dimension Drawings added for Apollo3 Blue Thin MCU</p> <p>Ordering Information: Apollo3 Blue Thin MCU added</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 0.14.0   | October 2020   | <p>Electricals updated:</p> <ul style="list-style-type: none"> <li>-Reset timing</li> <li>-Power Mode Transitions timing</li> <li>-Flash Memory program/erase cycle limit and data retention</li> <li>-SPI Slave timing</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 0.15.0   | May 2021       | <p>GPIO: Recovered missing UART1 TX/RX Connections table.</p> <p>Package Mechanical Information: BGA package dimension table updated with corrected D1/E1 dimensions.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1.0.0    | Dec 2021       | <p>System Core:</p> <ul style="list-style-type: none"> <li>- Changed MCUCTRL_XTALCTRL_XTALICOMPTRIM field's reset value to 0x1.</li> </ul> <p>GPIO:</p> <ul style="list-style-type: none"> <li>- Corrected Pad Function Mapping Table - changed GPIO18 FNCSEL7 from SCCIO to SCCCLK and changed GPIO19 FNCSEL4 from SCCCLK to SCCIO. Updated the Pin List and Function Table of Chapter 1 with these corrections.</li> <li>- Corrected Special Pad Types Table - Removed incorrect entries.</li> </ul> <p>Electricals:</p> <ul style="list-style-type: none"> <li>- Updated/populated specifications: Current Consumption table.</li> <li>- Added "BLE Transmit Power per Power Setting" graph in BLE section.</li> </ul> <p>Appendix: INFO0 register set updated.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 1.0.1    | Jan 2022       | <p>Electricals:</p> <ul style="list-style-type: none"> <li>- Updated "SPI Master Mode, Phase = 0" timing diagram</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 1.0.2    | Feb 2022       | <p>Appendix:</p> <ul style="list-style-type: none"> <li>- Updated SIGNATURE, CUSTOMER_TRIM1 AND KREVTRACK register descriptions.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| Revision | Date     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.0.3    | Jul 2022 | <p>Front-page feature list, Bluetooth Low Energy Controller and Electricals:</p> <ul style="list-style-type: none"> <li>- Updated Bluetooth Low Energy Controller performance and current consumption specifications.</li> </ul> <p>IOM:</p> <ul style="list-style-type: none"> <li>- Maximum I2C transfer size updated to 512 bytes.</li> </ul> <p>Electricals:</p> <ul style="list-style-type: none"> <li>- Sleep and Deep Sleep current numbers added.</li> <li>- SIMO Buck table and external components diagram updated.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 1.1.0    | Sep 2022 | <p>Electricals:</p> <ul style="list-style-type: none"> <li>▪ Current Consumption table: <ul style="list-style-type: none"> <li>- IPROGRAMB (Supply current during a page program - Buck Mode) updated.</li> </ul> </li> <li>▪ Analog to Digital Converter table: <ul style="list-style-type: none"> <li>- Absolute differential input voltage range</li> <li>- External reference voltage range (1.5v mode)</li> <li>- External reference voltage range (2.0v mode)</li> <li>- Internal reference voltage range (1.5v mode)</li> <li>- Internal reference voltage range (2.0v mode)</li> <li>- F<sub>ADCONV</sub> (Conversion rate)</li> <li>- DYNAMIC CHARACTERISTICS for External 2v Reference, External 1.5v Reference, Internal 1.5v Reference updated.</li> <li>- Integral nonlinearity, Differential nonlinearity, Offset error, Gain error added.</li> </ul> </li> <li>▪ Voltage Comparator table: <ul style="list-style-type: none"> <li>- Rising voltage trigger response time, Falling voltage trigger response time, Hysteresis Rising, Hysteresis Falling added.</li> </ul> </li> <li>▪ I2S table: All.</li> <li>▪ Flash Memory table: <ul style="list-style-type: none"> <li>- Single page erase time (8192 bytes), Mass erase time added.</li> </ul> </li> <li>▪ GPIO table: <ul style="list-style-type: none"> <li>- VIH, VIL, VHYS added.</li> <li>- R<sub>PUI2C10</sub> (I2C pad pull-up resistance, RSEL = 0x10) and R<sub>PUI2C11</sub> (I2C pad pull-up resistance, RSEL = 0x11) updated.</li> </ul> </li> </ul> |
| 1.2.0    | Nov 2022 | <p>Electricals:</p> <ul style="list-style-type: none"> <li>▪ HFRC/LFRC min/max frequency added.</li> <li>▪ BLE current consumption added.</li> <li>▪ I<sub>ADCIN</sub> leakage current added.</li> <li>▪ I<sup>2</sup>C section: Added t<sub>VD:DAT</sub> parameter to table and timing diagram.</li> <li>▪ SPI Slave section: Updated value of T<sub>HD_SO</sub> timing parameter.</li> <li>▪ Watchdog timer resolution added.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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