THE DATASHEET OF

TMS320C6742BZWTA2

www.win-source.net 0086-755-83957316

TMS320C6742™ Fixed- and Floating-Point DSP

1 Device Overview

1.1 Features

- 200-MHz C674x Fixed- and Floating-Point VLIW DSP
- C674x Instruction Set Features
  - Superset of the C67x+ and C64x+ ISAs
  - Up to 1600 MIPS and 1200 MFLOPS
  - Byte-Addressable (8-, 16-, 32-, and 64-Bit Data)
  - 8-Bit Overflow Protection
  - Bit-Field Extract, Set, Clear
  - Normalization, Saturation, Bit-Counting
  - Compact 16-Bit Instructions
- C674x Two-Level Cache Memory Architecture
  - 32KB of L1P Program RAM/Cache
  - 32KB of L1D Data RAM/Cache
  - 64KB of L2 Unified Mapped RAM/Cache
  - Flexible RAM/Cache Partition (L1 and L2)
- Enhanced Direct Memory Access Controller 3 (EDMA3):
  - 2 Channel Controllers
  - 3 Transfer Controllers
  - 64 Independent DMA Channels
  - 16 Quick DMA Channels
  - Programmable Transfer Burst Size
- TMS320C674x Floating-Point VLIW DSP Core
  - Load-Store Architecture With Nonaligned Support
  - 64 General-Purpose Registers (32-Bit)
  - Six ALU (32- and 40-Bit) Functional Units
    - Supports 32-Bit Integer, SP (IEEE Single Precision/32-Bit) and DP (IEEE Double Precision/64-Bit) Floating Point
    - Supports up to Four SP Additions Per Clock, Four DP Additions Every Two Clocks
    - Supports up to Two Floating-Point (SP or DP) Reciprocal Approximation (RCPxP) and Square-Root Reciprocal Approximation (RSQRxP) Operations Per Cycle
  - Two Multiply Functional Units:
    - Mixed-Precision IEEE Floating-Point Multiply Supported up to:
      - 2 SP × SP → SP Per Clock
      - 2 SP × SP → DP Every Two Clocks
      - 2 SP × DP → DP Every Three Clocks
      - 2 DP × DP → DP Every Four Clocks
    - Fixed-Point Multiply Supports Two 32 × 32-Bit Multiplies, Four 16 × 16-Bit Multiplies, or Eight 8 × 8-Bit Multiplies per Clock Cycle, and Complex Multiples
  - Instruction Packing Reduces Code Size
  - All Instructions Conditional
  - Hardware Support for Modulo Loop Operation
  - Protected Mode Operation
  - Exceptions Support for Error Detection and Program Redirection
- Software Support
  - TI DSP BIOS™
  - Chip Support Library and DSP Library
- 1.8-V or 3.3-V LVCMOS I/Os (Except for DDR2 Interfaces)
- Two External Memory Interfaces:
  - EMIFA
    - NOR (8- or 16-Bit-Wide Data)
    - NAND (8- or 16-Bit-Wide Data)
    - 16-Bit SDRAM With 128-MB Address Space
  - DDR2/Mobile DDR Memory Controller With one of the Following:
    - 16-Bit DDR2 SDRAM With 256-MB Address Space
    - 16-Bit mDDR SDRAM With 256-MB Address Space
- One Configurable 16550-Type UART Module:
  - With Modem Control Signals
  - 16-Byte FIFO
  - 16x or 13x Oversampling Option
- One Serial Peripheral Interface (SPI) With Multiple Chip Selects
- Two Master and Slave Inter-Integrated Circuits (I^2C Bus™)
- One Host-Port Interface (HPI) With 16-Bit-Wide Muxed Address and Data Bus For High Bandwidth

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- One Multichannel Audio Serial Port (McASP):
  - Two Clock Zones and 16 Serial Data Pins
  - Supports TDM, I2S, and Similar Formats
  - DIT-Capable
  - FIFO Buffers for Transmit and Receive
- One Multichannel Buffered Serial Port (McBSPs):
  - Supports TDM, I2S, and Similar Formats
  - AC97 Audio Codec Interface
  - Telecom Interfaces (ST-Bus, H100)
  - 128-Channel TDM
  - FIFO Buffers for Transmit and Receive
- Real-Time Clock (RTC) With 32-kHz Oscillator and Separate Power Rail
- One 64-Bit General-Purpose Timer (Configurable as Two 32-Bit Timers)
- One 64-Bit General-Purpose or Watchdog Timer (Configurable as Two 32-Bit General-Purpose Timers)
- Two Enhanced High-Resolution Pulse Width Modulators (eHRPWMs):
  - Dedicated 16-Bit Time-Base Counter With Period and Frequency Control
  - 6 Single-Edge Outputs, 6 Dual-Edge Symmetric Outputs, or 3 Dual-Edge Asymmetric Outputs
  - Dead-Band Generation
  - PWM Chopping by High-Frequency Carrier
  - Trip Zone Input
- Three 32-Bit Enhanced Capture (eCAP) Modules:
  - Configurable as 3 Capture Inputs or 3 Auxiliary Pulse Width Modulator (APWM) Outputs
  - Single-Shot Capture of up to Four Event Timestamps
- Packages:
  - 361-Ball Pb-Free Plastic Ball Grid Array (PBGA) [ZCE Suffix], 0.65-mm Ball Pitch
  - 361-Ball Pb-Free PBGA [ZWT Suffix], 0.80-mm Ball Pitch
- Commercial or Extended Temperature

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1.2 Applications

- Currency Inspection
- Biometric Identification
- Machine Vision (Low-End)

1.3 Description

The TMS320C6742 fixed- and floating-point DSP is a low-power applications processor based on a C674x DSP core. This DSP provides significantly lower power than other members of the TMS320C6000™ platform of DSPs.

The device enables original-equipment manufacturers (OEMs) and original-design manufacturers (ODMs) to quickly bring to market devices with robust operating systems, rich user interfaces, and high processor performance through the maximum flexibility of a fully integrated, mixed processor solution.

The device DSP core uses a 2-level cache-based architecture. The level 1 program cache (L1P) is a 32-KB direct mapped cache, and the level 1 data cache (L1D) is a 32-KB 2-way, set-associative cache. The level 2 program cache (L2P) consists of a 64-KB memory space that is shared between program and data space. L2 memory can be configured as mapped memory, cache, or combinations of the two.

The peripheral set includes: one I^2C Bus interface; one multichannel audio serial port (McASP) with 16 serializers and FIFO buffers; one multichannel buffered serial port (McBSP) with FIFO buffers; one serial peripheral interface (SPI) with multiple chip selects; two 64-bit general-purpose timers each configurable (one configurable as a watchdog); a configurable 16-bit host-port interface (HPI); up to 9 banks of general-purpose input/output (GPIO) pins, with each bank containing 16 pins with programmable interrupt and event generation modes, multiplexed with other peripherals; one UART interface (with $\overline{\text{RTS}}$ and $\overline{\text{CTS}}$); two enhanced high-resolution pulse width modulator (eHRPWM) peripherals; three 32-bit enhanced capture (eCAP) module peripherals which can be configured as 3 capture inputs or 3 APWM outputs; two external memory interfaces: an asynchronous and SDRAM external memory interface (EMIFA) for slower memories or peripherals; and a higher speed DDR2/Mobile DDR controller.

The rich peripheral set provides the ability to control external peripheral devices and communicate with external processors. For details on each peripheral, see the related sections in this document and the associated peripheral reference guides.

The device has a complete set of development tools for the DSP. These tools include C compilers, a DSP assembly optimizer to simplify programming and scheduling, and a Windows® debugger interface for visibility into source code execution.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE
TMS320C6742ZCE	NFBGA (361)	13,00 mm x 13,00 mm
TMS320C6742ZWT	NFBGA (361)	16,00 mm x 16,00 mm

(1) For more information on these devices, see Section 8.

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1.4 Functional Block Diagram

Figure 1-1 shows the functional block diagram of the device.

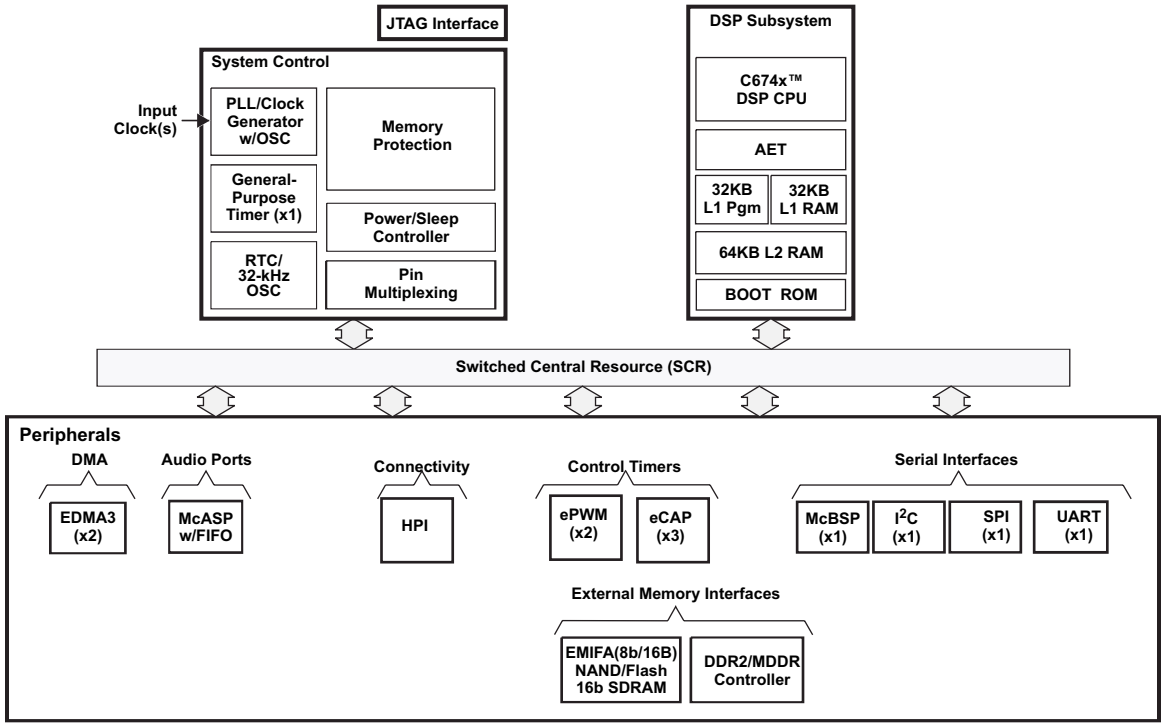

Figure 1-1. Functional Block Diagram

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2 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from March 31, 2014 to January 31, 2017	Page
• Removed internal pullup designation from $\overline{\text{RESET}}$ in Table 3-5	25
• Added footnote to CLKOUT Description in Table 3-6	26

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3 Device Comparison

3.1 Device Characteristics

Table 3-1 provides an overview of the device. The table shows significant features of the device, including the capacity of on-chip RAM, peripherals, and the package type with pin count.

Table 3-1. Characteristics of C6742

HARDWARE FEATURES		C6742
Peripherals Not all peripherals pins are available at the same time (for more detail, see the Device Configurations section).	DDR2/mDDR Memory Controller	DDR2, 16-bit bus width, up to 156 MHz Mobile DDR, 16-bit bus width, up to 150 MHz
	EMIFA	Asynchronous (8/16-bit bus width) RAM, Flash, 16-bit SDRAM, NOR, NAND
	EDMA3	64 independent channels, 16 QDMA channels, 2 channel controllers, 3 transfer controllers
	Timers	2 64-Bit General Purpose (each configurable as 2 separate 32-bit timers, one configurable as Watch Dog)
	UART	1 (with RTS and CTS flow control)
	SPI	1 (with one hardware chip select)
	I^2C	1 (Master/Slave)
	Multichannel Audio Serial Port [McASP]	1 (each with transmit/receive, FIFO buffer, 16 serializers)
	Multichannel Buffered Serial Port [McBSP]	1 (with transmit/receive, FIFO buffer, 16)
	eHRPWM	4 Single Edge, 4 Dual Edge Symmetric, or 2 Dual Edge Asymmetric Outputs
	eCAP	3 32-bit capture inputs or 3 32-bit auxiliary PWM outputs
	UHPI	1 (16-bit multiplexed address/data)
	General-Purpose Input/Output Port	9 banks of 16-bit
On-Chip Memory	Size (Bytes)	128KB RAM
	Organization	**DSP** 32KB L1 Program (L1P)/Cache (up to 32KB) 32KB L1 Data (L1D)/Cache (up to 32KB) 64KB Unified Mapped RAM/Cache (L2) DSP Memories can be made accessible to EDMA3 and other peripherals.
C674x CPU ID + CPU Rev ID	Control Status Register (CSR.[31:16])	0x1400
C674x Megamodule Revision	Revision ID Register (MM_REVID[15:0])	0x0000
JTAG BSDL_ID	DEVIDR0 Register	see Section 6.24.4.1, *JTAG Peripheral Register Description*
CPU Frequency	MHz	674x DSP 200 MHz
Voltage	Core (V)	Variable (1.2 V - 1.0V)
	I/O (V)	1.8V or 3.3 V
Packages		13 mm x 13 mm, 361-Ball 0.65 mm pitch, PBGA (ZCE)
		16 mm x 16 mm, 361-Ball 0.80 mm pitch, PBGA (ZWT)
Product Status(1)	Product Preview (PP), Advance Information (AI), or Production Data (PD)	PD

(1) ADVANCE INFORMATION concerns new products in the sampling or preproduction phase of development. Characteristic data and other specifications are subject to change without notice. PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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3.2 Device Compatibility

The C674x DSP core is code-compatible with the C6000™ DSP platform and supports features of both the C64x+ and C67x+ DSP families.

3.3 DSP Subsystem

The DSP Subsystem includes the following features:

- C674x DSP CPU
- 32KB L1 Program (L1P)/Cache (up to 32KB)
- 32KB L1 Data (L1D)/Cache (up to 32KB)
- 64KB Unified Mapped RAM/Cache (L2)
- Boot ROM (cannot be used for application code)
- Little endian

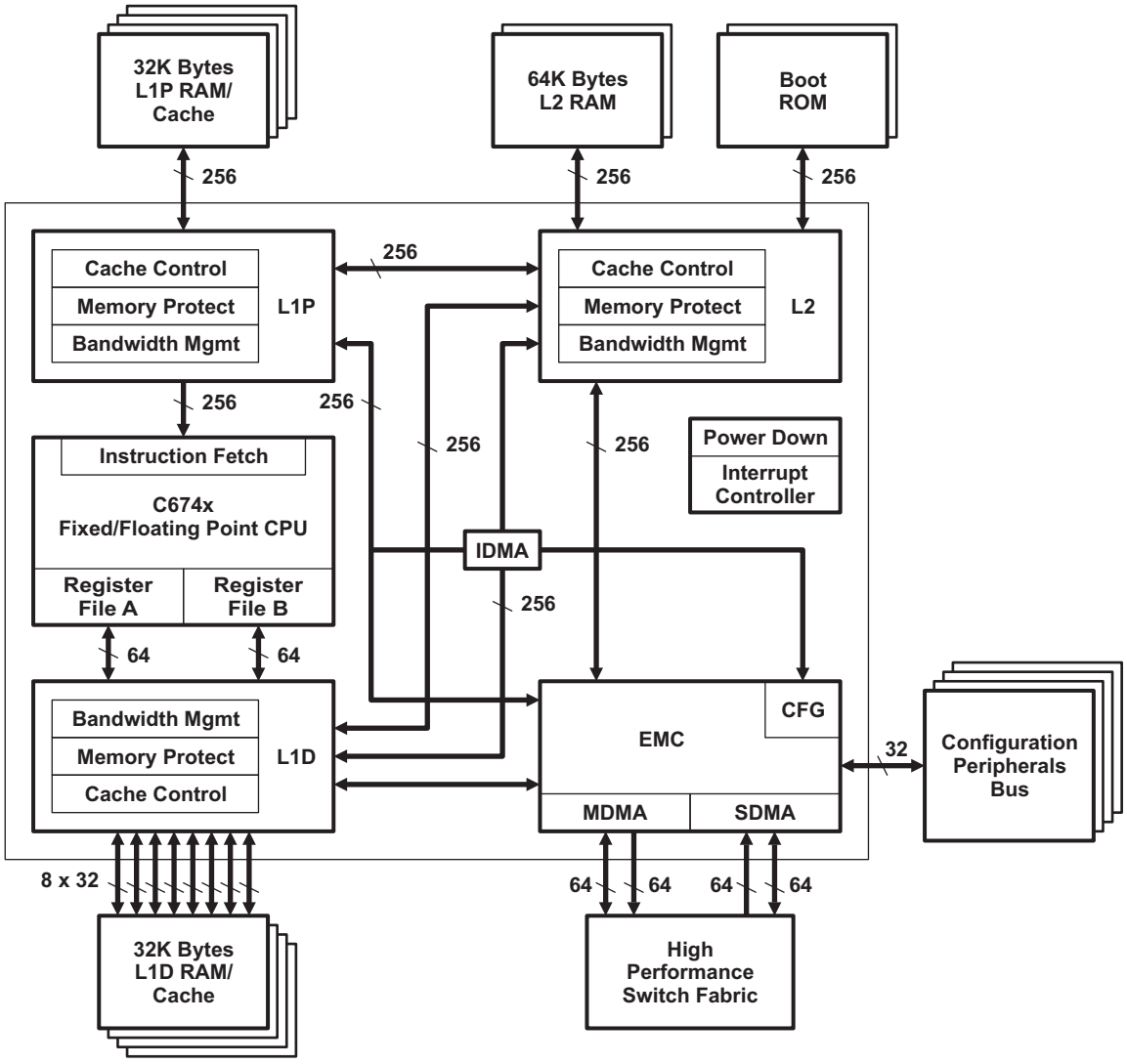

Figure 3-1. C674xMegamodule Block Diagram

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3.3.1 C674x DSP CPU Description

The C674x Central Processing Unit (CPU) consists of eight functional units, two register files, and two data paths as shown in Figure 3-2. The two general-purpose register files (A and B) each contain 32 32-bit registers for a total of 64 registers. The general-purpose registers can be used for data or can be data address pointers. The data types supported include packed 8-bit data, packed 16-bit data, 32-bit data, 40-bit data, and 64-bit data. Values larger than 32 bits, such as 40-bit-long or 64-bit-long values are stored in register pairs, with the 32 LSBs of data placed in an even register and the remaining 8 or 32 MSBs in the next upper register (which is always an odd-numbered register).

The eight functional units (.M1, .L1, .D1, .S1, .M2, .L2, .D2, and .S2) are each capable of executing one instruction every clock cycle. The .M functional units perform all multiply operations. The .S and .L units perform a general set of arithmetic, logical, and branch functions. The .D units primarily load data from memory to the register file and store results from the register file into memory.

The C674x CPU combines the performance of the C64x+ core with the floating-point capabilities of the C67x+ core.

Each C674x .M unit can perform one of the following each clock cycle: one 32 x 32 bit multiply, one 16 x 32 bit multiply, two 16 x 16 bit multiplies, two 16 x 32 bit multiplies, two 16 x 16 bit multiplies with add/subtract capabilities, four 8 x 8 bit multiplies, four 8 x 8 bit multiplies with add operations, and four 16 x 16 multiplies with add/subtract capabilities (including a complex multiply). There is also support for Galois field multiplication for 8-bit and 32-bit data. Many communications algorithms such as FFTs and modems require complex multiplication. The complex multiply (CMPY) instruction takes for 16-bit inputs and produces a 32-bit real and a 32-bit imaginary output. There are also complex multiplies with rounding capability that produces one 32-bit packed output that contain 16-bit real and 16-bit imaginary values. The 32 x 32 bit multiply instructions provide the extended precision necessary for high-precision algorithms on a variety of signed and unsigned 32-bit data types.

The .L or (Arithmetic Logic Unit) now incorporates the ability to do parallel add/subtract operations on a pair of common inputs. Versions of this instruction exist to work on 32-bit data or on pairs of 16-bit data performing dual 16-bit add and subtracts in parallel. There are also saturated forms of these instructions.

The C674x core enhances the .S unit in several ways. On the previous cores, dual 16-bit MIN2 and MAX2 comparisons were only available on the .L units. On the C674x core they are also available on the .S unit which increases the performance of algorithms that do searching and sorting. Finally, to increase data packing and unpacking throughput, the .S unit allows sustained high performance for the quad 8-bit/16-bit and dual 16-bit instructions. Unpack instructions prepare 8-bit data for parallel 16-bit operations. Pack instructions return parallel results to output precision including saturation support.

Other new features include:

- **SPLOOP** - A small instruction buffer in the CPU that aids in creation of software pipelining loops where multiple iterations of a loop are executed in parallel. The SPLOOP buffer reduces the code size associated with software pipelining. Furthermore, loops in the SPLOOP buffer are fully interruptible.
- **Compact Instructions** - The native instruction size for the C6000 devices is 32 bits. Many common instructions such as MPY, AND, OR, ADD, and SUB can be expressed as 16 bits if the C674x compiler can restrict the code to use certain registers in the register file. This compression is performed by the code generation tools.
- **Instruction Set Enhancement** - As noted above, there are new instructions such as 32-bit multiplications, complex multiplications, packing, sorting, bit manipulation, and 32-bit Galois field multiplication.
- **Exceptions Handling** - Intended to aid the programmer in isolating bugs. The C674x CPU is able to detect and respond to exceptions, both from internally detected sources (such as illegal op-codes) and from system events (such as a watchdog time expiration).
- **Privilege** - Defines user and supervisor modes of operation, allowing the operating system to give a basic level of protection to sensitive resources. Local memory is divided into multiple pages, each with read, write, and execute permissions.

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- **Time-Stamp Counter** - Primarily targeted for Real-Time Operating System (RTOS) robustness, a free-running time-stamp counter is implemented in the CPU which is ***not*** sensitive to system stalls.

For more details on the C674x CPU and its enhancements over the C64x architecture, see the following documents:

- *TMS320C64x/C64x+ DSP CPU and Instruction Set Reference Guide* (literature number SPRUFE8)
- *TMS320C64x Technical Overview* (literature number SPRU395)

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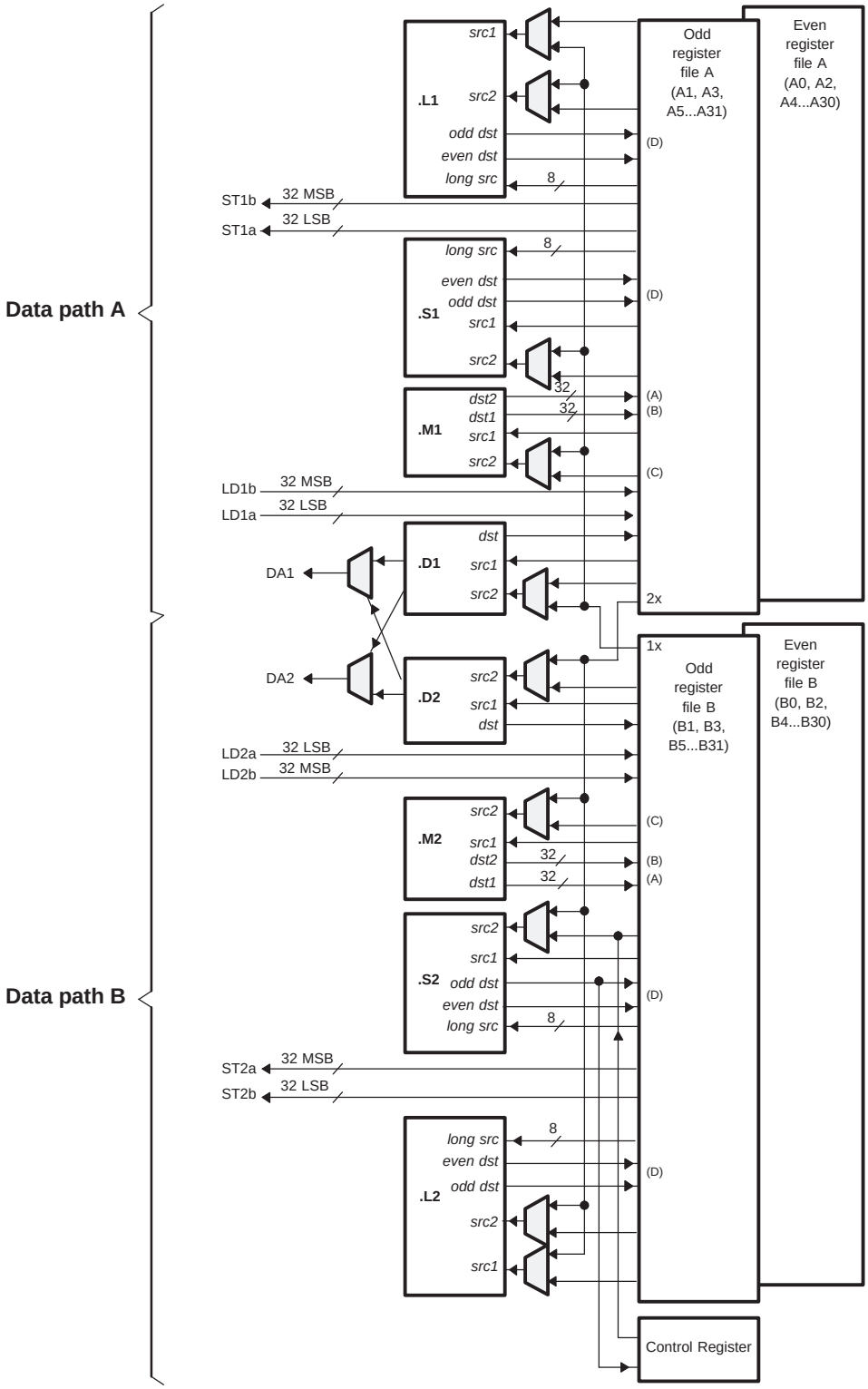

A. On .M unit, *dst2* is 32 MSB.
B. On .M unit, *dst1* is 32 LSB.
C. On C64x CPU .M unit, *src2* is 32 bits; on C64x+ CPU .M unit, *src2* is 64 bits.
D. On .L and .S units, *odd dst* connects to odd register files and *even dst* connects to even register files.

Figure 3-2. TMS320C674x CPU (DSP Core) Data Paths

3.3.2 DSP Memory Mapping

The DSP memory map is shown in Section 3.4.

By default the DSP also has access to most on and off chip memory areas.

Additionally, the DSP megamodule includes the capability to limit access to its internal memories through its SDMA port; without needing an external MPU unit.

3.3.2.1 External Memories

The DSP has access to the following External memories:

- Asynchronous EMIF / SDRAM / NAND / NOR Flash (EMIFA)
- SDRAM (DDR2)

3.3.2.2 DSP Internal Memories

The DSP has access to the following DSP memories:

- L2 RAM
- L1P RAM
- L1D RAM

3.3.2.3 C674x CPU

The C674x core uses a two-level cache-based architecture. The Level 1 Program cache (L1P) is 32 KB direct mapped cache and the Level 1 Data cache (L1D) is 32 KB 2-way set associated cache. The Level 2 memory/cache (L2) consists of a 64 KB memory space that is shared between program and data space. L2 memory can be configured as mapped memory, cache, or a combination of both.

Table 3-2 shows a memory map of the C674x CPU cache registers for the device.

Table 3-2. C674x Cache Registers

Byte Address	Register Name	Register Description
0x0184 0000	L2CFG	L2 Cache configuration register
0x0184 0020	L1PCFG	L1P Size Cache configuration register
0x0184 0024	L1PCC	L1P Freeze Mode Cache configuration register
0x0184 0040	L1DCFG	L1D Size Cache configuration register
0x0184 0044	L1DCC	L1D Freeze Mode Cache configuration register
0x0184 0048 - 0x0184 0FFC	-	Reserved
0x0184 1000	EDMAWEIGHT	L2 EDMA access control register
0x0184 1004 - 0x0184 1FFC	-	Reserved
0x0184 2000	L2ALLOC0	L2 allocation register 0
0x0184 2004	L2ALLOC1	L2 allocation register 1
0x0184 2008	L2ALLOC2	L2 allocation register 2
0x0184 200C	L2ALLOC3	L2 allocation register 3
0x0184 2010 - 0x0184 3FFF	-	Reserved
0x0184 4000	L2WBAR	L2 writeback base address register
0x0184 4004	L2WWC	L2 writeback word count register
0x0184 4010	L2WIBAR	L2 writeback invalidate base address register
0x0184 4014	L2WIWC	L2 writeback invalidate word count register
0x0184 4018	L2IBAR	L2 invalidate base address register
0x0184 401C	L2IWC	L2 invalidate word count register
0x0184 4020	L1PIBAR	L1P invalidate base address register
0x0184 4024	L1PIWC	L1P invalidate word count register
0x0184 4030	L1DWIBAR	L1D writeback invalidate base address register

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Table 3-2. C674x Cache Registers (continued)

Byte Address	Register Name	Register Description
0x0184 4034	L1DWIWC	L1D writeback invalidate word count register
0x0184 4038	-	Reserved
0x0184 4040	L1DWBAR	L1D Block Writeback
0x0184 4044	L1DWWC	L1D Block Writeback
0x0184 4048	L1DIBAR	L1D invalidate base address register
0x0184 404C	L1DIWC	L1D invalidate word count register
0x0184 4050 - 0x0184 4FFF	-	Reserved
0x0184 5000	L2WB	L2 writeback all register
0x0184 5004	L2WBINV	L2 writeback invalidate all register
0x0184 5008	L2INV	L2 Global Invalidate without writeback
0x0184 500C - 0x0184 5027	-	Reserved
0x0184 5028	L1PINV	L1P Global Invalidate
0x0184 502C - 0x0184 5039	-	Reserved
0x0184 5040	L1DWB	L1D Global Writeback
0x0184 5044	L1DWBINV	L1D Global Writeback with Invalidate
0x0184 5048	L1DINV	L1D Global Invalidate without writeback
0x0184 8000 – 0x0184 80FF	MAR0 - MAR63	Reserved 0x0000 0000 – 0x3FFF FFFF
0x0184 8100 – 0x0184 817F	MAR64 – MAR95	Memory Attribute Registers for EMIFA SDRAM Data (CS0) External memory addresses 0x4000 0000 – 0x5FFF FFFF
0x0184 8180 – 0x0184 8187	MAR96 - MAR97	Memory Attribute Registers for EMIFA Async Data (CS2) External memory addresses 0x6000 0000 – 0x61FF FFFF
0x0184 8188 – 0x0184 818F	MAR98 – MAR99	Memory Attribute Registers for EMIFA Async Data (CS3) External memory addresses 0x6200 0000 – 0x63FF FFFF
0x0184 8190 – 0x0184 8197	MAR100 – MAR101	Memory Attribute Registers for EMIFA Async Data (CS4) External memory addresses 0x6400 0000 – 0x65FF FFFF
0x0184 8198 – 0x0184 819F	MAR102 – MAR103	Memory Attribute Registers for EMIFA Async Data (CS5) External memory addresses 0x6600 0000 – 0x67FF FFFF
0x0184 81A0 – 0x0184 81FF	MAR104 – MAR127	Reserved 0x6800 0000 – 0x7FFF FFFF
0x0184 8200	MAR128	Reserved 0x8000 0000 - 0x81FF FFFF
0x0184 8204 – 0x0184 82FF	MAR129 – MAR191	Reserved 0x8200 0000 – 0xBFFF FFFF
0x0184 8300 – 0x0184 837F	MAR192 – MAR223	Memory Attribute Registers for DDR2 Data (CS2) External memory addresses 0xC000 0000 – 0xDFFF FFFF
0x0184 8380 – 0x0184 83FF	MAR224 – MAR255	Reserved 0xE000 0000 – 0xFFFF FFFF

Table 3-3. C674x L1/L2 Memory Protection Registers

HEX ADDRESS RANGE	REGISTER ACRONYM	DESCRIPTION
0x0184 A000	L2MPFAR	L2 memory protection fault address register
0x0184 A004	L2MPFSR	L2 memory protection fault status register
0x0184 A008	L2MPFCR	L2 memory protection fault command register
0x0184 A00C - 0x0184 A0FF	-	Reserved
0x0184 A100	L2MPLK0	L2 memory protection lock key bits [31:0]
0x0184 A104	L2MPLK1	L2 memory protection lock key bits [63:32]
0x0184 A108	L2MPLK2	L2 memory protection lock key bits [95:64]
0x0184 A10C	L2MPLK3	L2 memory protection lock key bits [127:96]
0x0184 A110	L2MPLKCMD	L2 memory protection lock key command register
0x0184 A114	L2MPLKSTAT	L2 memory protection lock key status register
0x0184 A118 - 0x0184 A1FF	-	Reserved
0x0184 A200	L2MPPA0	L2 memory protection page attribute register 0 (controls memory address 0x0080 0000 - 0x0080 1FFF)

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Table 3-3. C674x L1/L2 Memory Protection Registers (continued)

HEX ADDRESS RANGE	REGISTER ACRONYM	DESCRIPTION
0x0184 A204	L2MPPA1	L2 memory protection page attribute register 1 (controls memory address 0x0080 2000 - 0x0080 3FFF)
0x0184 A208	L2MPPA2	L2 memory protection page attribute register 2 (controls memory address 0x0080 4000 - 0x0080 5FFF)
0x0184 A20C	L2MPPA3	L2 memory protection page attribute register 3 (controls memory address 0x0080 6000 - 0x0080 7FFF)
0x0184 A210	L2MPPA4	L2 memory protection page attribute register 4 (controls memory address 0x0080 8000 - 0x0080 9FFF)
0x0184 A214	L2MPPA5	L2 memory protection page attribute register 5 (controls memory address 0x0080 A000 - 0x0080 BFFF)
0x0184 A218	L2MPPA6	L2 memory protection page attribute register 6 (controls memory address 0x0080 C000 - 0x0080 DFFF)
0x0184 A21C	L2MPPA7	L2 memory protection page attribute register 7 (controls memory address 0x0080 E000 - 0x0080 FFFF)
0x0184 A220	L2MPPA8	L2 memory protection page attribute register 8 (controls memory address 0x0081 0000 - 0x0081 1FFF)
0x0184 A224	L2MPPA9	L2 memory protection page attribute register 9 (controls memory address 0x0081 2000 - 0x0081 3FFF)
0x0184 A228	L2MPPA10	L2 memory protection page attribute register 10 (controls memory address 0x0081 4000 - 0x0081 5FFF)
0x0184 A22C	L2MPPA11	L2 memory protection page attribute register 11 (controls memory address 0x0081 6000 - 0x0081 7FFF)
0x0184 A230	L2MPPA12	L2 memory protection page attribute register 12 (controls memory address 0x0081 8000 - 0x0081 9FFF)
0x0184 A234	L2MPPA13	L2 memory protection page attribute register 13 (controls memory address 0x0081 A000 - 0x0081 BFFF)
0x0184 A238	L2MPPA14	L2 memory protection page attribute register 14 (controls memory address 0x0081 C000 - 0x0081 DFFF)
0x0184 A23C	L2MPPA15	L2 memory protection page attribute register 15 (controls memory address 0x0081 E000 - 0x0081 FFFF)
0x0184 A240	L2MPPA16	L2 memory protection page attribute register 16 (controls memory address 0x0082 0000 - 0x0082 1FFF)
0x0184 A244	L2MPPA17	L2 memory protection page attribute register 17 (controls memory address 0x0082 2000 - 0x0082 3FFF)
0x0184 A248	L2MPPA18	L2 memory protection page attribute register 18 (controls memory address 0x0082 4000 - 0x0082 5FFF)
0x0184 A24C	L2MPPA19	L2 memory protection page attribute register 19 (controls memory address 0x0082 6000 - 0x0082 7FFF)
0x0184 A250	L2MPPA20	L2 memory protection page attribute register 20 (controls memory address 0x0082 8000 - 0x0082 9FFF)
0x0184 A254	L2MPPA21	L2 memory protection page attribute register 21 (controls memory address 0x0082 A000 - 0x0082 BFFF)
0x0184 A258	L2MPPA22	L2 memory protection page attribute register 22 (controls memory address 0x0082 C000 - 0x0082 DFFF)
0x0184 A25C	L2MPPA23	L2 memory protection page attribute register 23 (controls memory address 0x0082 E000 - 0x0082 FFFF)
0x0184 A260	L2MPPA24	L2 memory protection page attribute register 24 (controls memory address 0x0083 0000 - 0x0083 1FFF)
0x0184 A264	L2MPPA25	L2 memory protection page attribute register 25 (controls memory address 0x0083 2000 - 0x0083 3FFF)
0x0184 A268	L2MPPA26	L2 memory protection page attribute register 26 (controls memory address 0x0083 4000 - 0x0083 5FFF)
0x0184 A26C	L2MPPA27	L2 memory protection page attribute register 27 (controls memory address 0x0083 6000 - 0x0083 7FFF)
0x0184 A270	L2MPPA28	L2 memory protection page attribute register 28 (controls memory address 0x0083 8000 - 0x0083 9FFF)

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Table 3-3. C674x L1/L2 Memory Protection Registers (continued)

HEX ADDRESS RANGE	REGISTER ACRONYM	DESCRIPTION
0x0184 A274	L2MPPA29	L2 memory protection page attribute register 29 (controls memory address 0x0083 A000 - 0x0083 BFFF)
0x0184 A278	L2MPPA30	L2 memory protection page attribute register 30 (controls memory address 0x0083 C000 - 0x0083 DFFF)
0x0184 A27C	L2MPPA31	L2 memory protection page attribute register 31 (controls memory address 0x0083 E000 - 0x0083 FFFF)
0x0184 A280	L2MPPA32	L2 memory protection page attribute register 32 (controls memory address 0x0070 0000 - 0x0070 7FFF)
0x0184 A284	L2MPPA33	L2 memory protection page attribute register 33 (controls memory address 0x0070 8000 - 0x0070 FFFF)
0x0184 A288	L2MPPA34	L2 memory protection page attribute register 34 (controls memory address 0x0071 0000 - 0x0071 7FFF)
0x0184 A28C	L2MPPA35	L2 memory protection page attribute register 35 (controls memory address 0x0071 8000 - 0x0071 FFFF)
0x0184 A290	L2MPPA36	L2 memory protection page attribute register 36 (controls memory address 0x0072 0000 - 0x0072 7FFF)
0x0184 A294	L2MPPA37	L2 memory protection page attribute register 37 (controls memory address 0x0072 8000 - 0x0072 FFFF)
0x0184 A298	L2MPPA38	L2 memory protection page attribute register 38 (controls memory address 0x0073 0000 - 0x0073 7FFF)
0x0184 A29C	L2MPPA39	L2 memory protection page attribute register 39 (controls memory address 0x0073 8000 - 0x0073 FFFF)
0x0184 A2A0	L2MPPA40	L2 memory protection page attribute register 40 (controls memory address 0x0074 0000 - 0x0074 7FFF)
0x0184 A2A4	L2MPPA41	L2 memory protection page attribute register 41 (controls memory address 0x0074 8000 - 0x0074 FFFF)
0x0184 A2A8	L2MPPA42	L2 memory protection page attribute register 42 (controls memory address 0x0075 0000 - 0x0075 7FFF)
0x0184 A2AC	L2MPPA43	L2 memory protection page attribute register 43 (controls memory address 0x0075 8000 - 0x0075 FFFF)
0x0184 A2B0	L2MPPA44	L2 memory protection page attribute register 44 (controls memory address 0x0076 0000 - 0x0076 7FFF)
0x0184 A2B4	L2MPPA45	L2 memory protection page attribute register 45 (controls memory address 0x0076 8000 - 0x0076 FFFF)
0x0184 A2B8	L2MPPA46	L2 memory protection page attribute register 46 (controls memory address 0x0077 0000 - 0x0077 7FFF)
0x0184 A2BC	L2MPPA47	L2 memory protection page attribute register 47 (controls memory address 0x0077 8000 - 0x0077 FFFF)
0x0184 A2C0	L2MPPA48	L2 memory protection page attribute register 48 (controls memory address 0x0078 0000 - 0x0078 7FFF)
0x0184 A2C4	L2MPPA49	L2 memory protection page attribute register 49 (controls memory address 0x0078 8000 - 0x0078 FFFF)
0x0184 A2C8	L2MPPA50	L2 memory protection page attribute register 50 (controls memory address 0x0079 0000 - 0x0079 7FFF)
0x0184 A2CC	L2MPPA51	L2 memory protection page attribute register 51 (controls memory address 0x0079 8000 - 0x0079 FFFF)
0x0184 A2D0	L2MPPA52	L2 memory protection page attribute register 52 (controls memory address 0x007A 0000 - 0x007A 7FFF)
0x0184 A2D4	L2MPPA53	L2 memory protection page attribute register 53 (controls memory address 0x007A 8000 - 0x007A FFFF)
0x0184 A2D8	L2MPPA54	L2 memory protection page attribute register 54 (controls memory address 0x007B 0000 - 0x007B 7FFF)
0x0184 A2DC	L2MPPA55	L2 memory protection page attribute register 55 (controls memory address 0x007B 8000 - 0x007B FFFF)
0x0184 A2E0	L2MPPA56	L2 memory protection page attribute register 56 (controls memory address 0x007C 0000 - 0x007C 7FFF)

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Table 3-3. C674x L1/L2 Memory Protection Registers (continued)

HEX ADDRESS RANGE	REGISTER ACRONYM	DESCRIPTION
0x0184 A2E4	L2MPPA57	L2 memory protection page attribute register 57 (controls memory address 0x007C 8000 - 0x007C FFFF)
0x0184 A2E8	L2MPPA58	L2 memory protection page attribute register 58 (controls memory address 0x007D 0000 - 0x007D 7FFF)
0x0184 A2EC	L2MPPA59	L2 memory protection page attribute register 59 (controls memory address 0x007D 8000 - 0x007D FFFF)
0x0184 A2F0	L2MPPA60	L2 memory protection page attribute register 60 (controls memory address 0x007E 0000 - 0x007E 7FFF)
0x0184 A2F4	L2MPPA61	L2 memory protection page attribute register 61 (controls memory address 0x007E 8000 - 0x007E FFFF)
0x0184 A2F8	L2MPPA62	L2 memory protection page attribute register 62 (controls memory address 0x007F 0000 - 0x007F 7FFF)
0x0184 A2FC	L2MPPA63	L2 memory protection page attribute register 63 (controls memory address 0x007F 8000 - 0x007F FFFF)
0x0184 A300 - 0x0184 A3FF	-	Reserved
0x0184 A400	L1PMPFAR	L1P memory protection fault address register
0x0184 A404	L1PMPFSR	L1P memory protection fault status register
0x0184 A408	L1PMPFCR	L1P memory protection fault command register
0x0184 A40C - 0x0184 A4FF	-	Reserved
0x0184 A500	L1PMPLK0	L1P memory protection lock key bits [31:0]
0x0184 A504	L1PMPLK1	L1P memory protection lock key bits [63:32]
0x0184 A508	L1PMPLK2	L1P memory protection lock key bits [95:64]
0x0184 A50C	L1PMPLK3	L1P memory protection lock key bits [127:96]
0x0184 A510	L1PMPLKCMD	L1P memory protection lock key command register
0x0184 A514	L1PMPLKSTAT	L1P memory protection lock key status register
0x0184 A518 - 0x0184 A5FF	-	Reserved
0x0184 A600 - 0x0184 A63F	-	Reserved (1)
0x0184 A640	L1PMPPA16	L1P memory protection page attribute register 16 (controls memory address 0x00E0 0000 - 0x00E0 07FF)
0x0184 A644	L1PMPPA17	L1P memory protection page attribute register 17 (controls memory address 0x00E0 0800 - 0x00E0 0FFF)
0x0184 A648	L1PMPPA18	L1P memory protection page attribute register 18 (controls memory address 0x00E0 1000 - 0x00E0 17FF)
0x0184 A64C	L1PMPPA19	L1P memory protection page attribute register 19 (controls memory address 0x00E0 1800 - 0x00E0 1FFF)
0x0184 A650	L1PMPPA20	L1P memory protection page attribute register 20 (controls memory address 0x00E0 2000 - 0x00E0 27FF)
0x0184 A654	L1PMPPA21	L1P memory protection page attribute register 21 (controls memory address 0x00E0 2800 - 0x00E0 2FFF)
0x0184 A658	L1PMPPA22	L1P memory protection page attribute register 22 (controls memory address 0x00E0 3000 - 0x00E0 37FF)
0x0184 A65C	L1PMPPA23	L1P memory protection page attribute register 23 (controls memory address 0x00E0 3800 - 0x00E0 3FFF)
0x0184 A660	L1PMPPA24	L1P memory protection page attribute register 24 (controls memory address 0x00E0 4000 - 0x00E0 47FF)
0x0184 A664	L1PMPPA25	L1P memory protection page attribute register 25 (controls memory address 0x00E0 4800 - 0x00E0 4FFF)
0x0184 A668	L1PMPPA26	L1P memory protection page attribute register 26 (controls memory address 0x00E0 5000 - 0x00E0 57FF)
0x0184 A66C	L1PMPPA27	L1P memory protection page attribute register 27 (controls memory address 0x00E0 5800 - 0x00E0 5FFF)

(1) These addresses correspond to the L1P memory protection page attribute registers 0-15 (L1PMPPA0-L1PMPPA15) of the C674x megamaodule. These registers are not supported for this device.

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Table 3-3. C674x L1/L2 Memory Protection Registers (continued)

HEX ADDRESS RANGE	REGISTER ACRONYM	DESCRIPTION
0x0184 A670	L1PMPPA28	L1P memory protection page attribute register 28 (controls memory address 0x00E0 6000 - 0x00E0 67FF)
0x0184 A674	L1PMPPA29	L1P memory protection page attribute register 29 (controls memory address 0x00E0 6800 - 0x00E0 6FFF)
0x0184 A678	L1PMPPA30	L1P memory protection page attribute register 30 (controls memory address 0x00E0 7000 - 0x00E0 77FF)
0x0184 A67C	L1PMPPA31	L1P memory protection page attribute register 31 (controls memory address 0x00E0 7800 - 0x00E0 7FFF)
0x0184 A67F – 0x0184 ABFF	-	Reserved
0x0184 AC00	L1DMPFAR	L1D memory protection fault address register
0x0184 AC04	L1DMPFSR	L1D memory protection fault status register
0x0184 AC08	L1DMPFCR	L1D memory protection fault command register
0x0184 AC0C - 0x0184 ACFF	-	Reserved
0x0184 AD00	L1DMPLK0	L1D memory protection lock key bits [31:0]
0x0184 AD04	L1DMPLK1	L1D memory protection lock key bits [63:32]
0x0184 AD08	L1DMPLK2	L1D memory protection lock key bits [95:64]
0x0184 AD0C	L1DMPLK3	L1D memory protection lock key bits [127:96]
0x0184 AD10	L1DMPLKCMD	L1D memory protection lock key command register
0x0184 AD14	L1DMPLKSTAT	L1D memory protection lock key status register
0x0184 AD18 - 0x0184 ADFF	-	Reserved
0x0184 AE00 - 0x0184 AE3F	-	Reserved (2)
0x0184 AE40	L1DMPPA16	L1D memory protection page attribute register 16 (controls memory address 0x00F0 0000 - 0x00F0 07FF)
0x0184 AE44	L1DMPPA17	L1D memory protection page attribute register 17 (controls memory address 0x00F0 0800 - 0x00F0 0FFF)
0x0184 AE48	L1DMPPA18	L1D memory protection page attribute register 18 (controls memory address 0x00F0 1000 - 0x00F0 17FF)
0x0184 AE4C	L1DMPPA19	L1D memory protection page attribute register 19 (controls memory address 0x00F0 1800 - 0x00F0 1FFF)
0x0184 AE50	L1DMPPA20	L1D memory protection page attribute register 20 (controls memory address 0x00F0 2000 - 0x00F0 27FF)
0x0184 AE54	L1DMPPA21	L1D memory protection page attribute register 21 (controls memory address 0x00F0 2800 - 0x00F0 2FFF)
0x0184 AE58	L1DMPPA22	L1D memory protection page attribute register 22 (controls memory address 0x00F0 3000 - 0x00F0 37FF)
0x0184 AE5C	L1DMPPA23	L1D memory protection page attribute register 23 (controls memory address 0x00F0 3800 - 0x00F0 3FFF)
0x0184 AE60	L1DMPPA24	L1D memory protection page attribute register 24 (controls memory address 0x00F0 4000 - 0x00F0 47FF)
0x0184 AE64	L1DMPPA25	L1D memory protection page attribute register 25 (controls memory address 0x00F0 4800 - 0x00F0 4FFF)
0x0184 AE68	L1DMPPA26	L1D memory protection page attribute register 26 (controls memory address 0x00F0 5000 - 0x00F0 57FF)
0x0184 AE6C	L1DMPPA27	L1D memory protection page attribute register 27 (controls memory address 0x00F0 5800 - 0x00F0 5FFF)
0x0184 AE70	L1DMPPA28	L1D memory protection page attribute register 28 (controls memory address 0x00F0 6000 - 0x00F0 67FF)
0x0184 AE74	L1DMPPA29	L1D memory protection page attribute register 29 (controls memory address 0x00F0 6800 - 0x00F0 6FFF)
0x0184 AE78	L1DMPPA30	L1D memory protection page attribute register 30 (controls memory address 0x00F0 7000 - 0x00F0 77FF)

(2) These addresses correspond to the L1D memory protection page attribute registers 0-15 (L1DMPPA0-L1DMPPA15) of the C674x megamaodule. These registers are not supported for this device.

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Table 3-3. C674x L1/L2 Memory Protection Registers (continued)

HEX ADDRESS RANGE	REGISTER ACRONYM	DESCRIPTION
0x0184 AE7C	L1DMPPA31	L1D memory protection page attribute register 31 (controls memory address 0x00F0 7800 - 0x00F0 7FFF)
0x0184 AE80 – 0x0185 FFFF	-	Reserved

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3.4 Memory Map Summary

Note: Read/Write accesses to illegal or reserved addresses in the memory map may cause undefined behavior.

Table 3-4. C6742 Top Level Memory Map

Start Address	End Address	Size	DSP Mem Map	EDMA Mem Map	Master Peripheral Mem Map
0x0000 0000	0x006F FFFF				
0x0070 0000	0x007F FFFF	1024K	DSP L2 ROM(1)		
0x0080 0000	0x0080 FFFF	64K	DSP L2 RAM		
0x0081 0000	0x00DF FFFF				
0x00E0 0000	0x00E0 7FFF	32K	DSP L1P RAM		
0x00E0 8000	0x00EF FFFF				
0x00F0 0000	0x00F0 7FFF	32K	DSP L1D RAM		
0x00F0 8000	0x017F FFFF				
0x0180 0000	0x0180 FFFF	64K	DSP Interrupt Controller		
0x0181 0000	0x0181 0FFF	4K	DSP Powerdown Controller		
0x0181 1000	0x0181 1FFF	4K	DSP Security ID		
0x0181 2000	0x0181 2FFF	4K	DSP Revision ID		
0x0181 3000	0x0181 FFFF	52K			
0x0182 0000	0x0182 FFFF	64K	DSP EMC		
0x0183 0000	0x0183 FFFF	64K	DSP Internal Reserved		
0x0184 0000	0x0184 FFFF	64K	DSP Memory System		
0x0185 0000	0x01BF FFFF				
0x01C0 0000	0x01C0 7FFF	32K	EDMA3 CC		
0x01C0 8000	0x01C0 83FF	1K	EDMA3 TC0		
0x01C0 8400	0x01C0 87FF	1K	EDMA3 TC1		
0x01C0 8800	0x01C0 FFFF				
0x01C1 0000	0x01C1 0FFF	4K	PSC 0		
0x01C1 1000	0x01C1 1FFF	4K	PLL Controller 0		
0x01C1 2000	0x01C1 3FFF				
0x01C1 4000	0x01C1 4FFF	4K	SYSCFG0		
0x01C1 5000	0x01C1 FFFF				
0x01C2 0000	0x01C2 0FFF	4K	Timer0		
0x01C2 1000	0x01C2 1FFF	4K	Timer1		
0x01C2 2000	0x01C2 2FFF	4K	I2C 0		
0x01C2 3000	0x01C2 3FFF	4K	RTC		
0x01C2 4000	0x01C4 FFFF				
0x01C4 2000	0x01C4 2FFF	4K	UART 0		
0x01C4 3000	0x01CF FFFF				
0x01D0 0000	0x01D0 0FFF	4K	McASP 0 Control		
0x01D0 1000	0x01D0 1FFF	4K	McASP 0 AFIFO Ctrl		
0x01D0 2000	0x01D0 2FFF	4K	McASP 0 Data		
0x01D0 3000	0x01D1 0FFF				
0x01D1 1000	0x01D1 17FF	2K	McBSP1		
0x01D1 1800	0x01D1 1FFF	2K	McBSP1 FIFO Ctrl		
0x01D1 2000	0x01E0 FFFF				
0x01E1 0000	0x01E1 0FFF	4K	UHPI		
0x01E1 1000	0x01E1 3FFF				

(1) The DSP L2 ROM is used for boot purposes and cannot be programmed with application code

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Table 3-4. C6742 Top Level Memory Map (continued)

Start Address	End Address	Size	DSP Mem Map	EDMA Mem Map	Master Peripheral Mem Map
0x01E1 4000	0x01E1 4FFF	4K	Memory Protection Unit 1 (MPU 1)		
0x01E1 5000	0x01E1 5FFF	4K	Memory Protection Unit 2 (MPU 2)		
0x01E1 6000	0x01E1 9FFF				
0x01E1 A000	0x01E1 AFFF	4K	PLL Controller 1		
0x01E1 B000	0x01E2 5FFF				
0x01E2 6000	0x01E2 6FFF	4K	GPIO		
0x01E2 7000	0x01E2 7FFF	4K	PSC 1		
0x01E2 8000	0x01E2 BFFF				
0x01E2 C000	0x01E2 CFFF	4K	SYSCFG1		
0x01E2 D000	0x01E2 FFFF				
0x01E3 0000	0x01E3 7FFF	32K	EDMA3 CC1		
0x01E3 8000	0x01E3 83FF	1K	EDMA3 TC2		
0x01E3 8400	0x01EF FFFF				
0x01F0 0000	0x01F0 0FFF	4K	eHRPWM 0		
0x01F0 1000	0x01F0 1FFF	4K	HRPWM 0		
0x01F0 2000	0x01F0 2FFF	4K	eHRPWM 1		
0x01F0 3000	0x01F0 3FFF	4K	HRPWM 1		
0x01F0 4000	0x01F0 5FFF				
0x01F0 6000	0x01F0 6FFF	4K	ECAP 0		
0x01F0 7000	0x01F0 7FFF	4K	ECAP 1		
0x01F0 8000	0x01F0 8FFF	4K	ECAP 2		
0x01F0 9000	0x01F0 DFFF				
0x01F0 E000	0x01F0 EFFF	4K	SPI1		
0x01F0 F000	0x01F1 FFFF				
0x01F1 1000	0x01F1 1FFF	4K	McBSP1 FIFO Data		
0x01F1 2000	0x116F FFFF				
0x1170 0000	0x117F FFFF	1024K	DSP L2 ROM(1)		
0x1180 0000	0x1180 FFFF	64K	DSP L2 RAM		
0x1181 0000	0x11DF FFFF				
0x11E0 0000	0x11E0 7FFF	32K	DSP L1P RAM		
0x11E0 8000	0x11EF FFFF				
0x11F0 0000	0x11F0 7FFF	32K	DSP L1D RAM		
0x11F0 8000	0x3FFF FFFF				
0x4000 0000	0x5FFF FFFF	512M	EMIFA SDRAM data (CS0)		
0x6000 0000	0x61FF FFFF	32M	EMIFA async data (CS2)		
0x6200 0000	0x63FF FFFF	32M	EMIFA async data (CS3)		
0x6400 0000	0x65FF FFFF	32M	EMIFA async data (CS4)		
0x6600 0000	0x67FF FFFF	32M	EMIFA async data (CS5)		
0x6800 0000	0x6800 7FFF	32K	EMIFA Control Regs		
0x6800 8000	0xAFFF FFFF				
0xB000 0000	0xB000 7FFF	32K	DDR2/mDDR Control Regs		
0xB000 8000	0xBFFF FFFF				
0xC000 0000	0xCFFF FFFF	256M	DDR2/mDDR Data		
0xD000 0000	0xFFFF FFFF				

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3.5 Pin Assignments

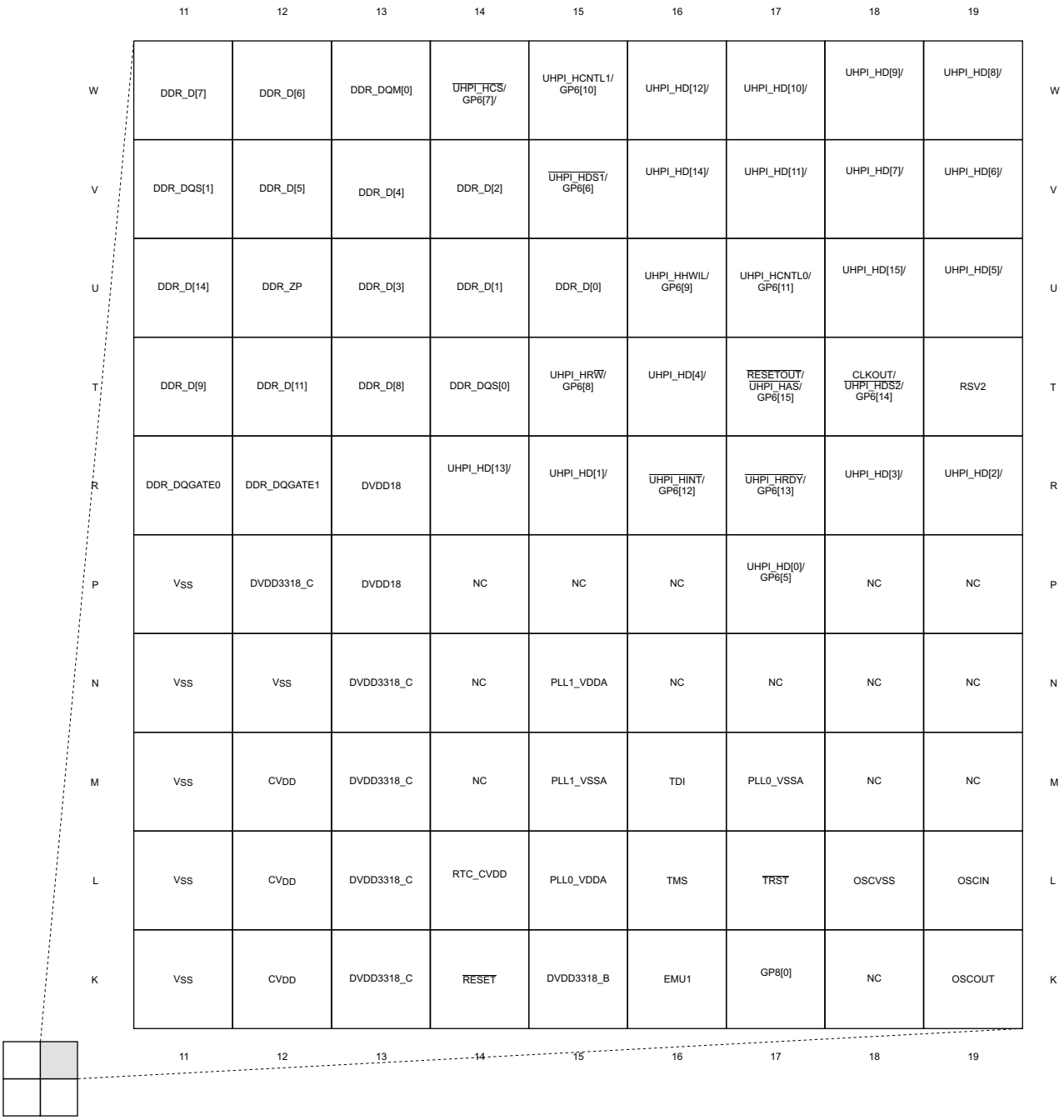
Extensive use of pin multiplexing is used to accommodate the largest number of peripheral functions in the smallest possible package. Pin multiplexing is controlled using a combination of hardware configuration at device reset and software programmable register settings.

3.5.1 Pin Map (Bottom View)

The following graphics show the bottom view of the ZCE and ZWT packages pin assignments in four quadrants (A, B, C, and D). The pin assignments for both packages are identical.

	1	2	3	4	5	6	7	8	9	10	
W	GP7[8]	GP7[9]	GP7[10]	DDR_A[10]	DDR_A[6]	DDR_A[2]	$\overline{\text{DDR_CLKN}}$	DDR_CLKP	$\overline{\text{DDR_RAS}}$	DDR_D[15]	W
V	GP7[11]	GP7[12]	GP7[13]	DDR_A[12]	DDR_A[5]	DDR_A[3]	DDR_CKE	DDR_BA[0]	$\overline{\text{DDR_CS}}$	DDR_D[13]	V
U	GP7[14]	GP7[15]	GP7[0]/ BOOT[0]	DDR_A[8]	DDR_A[4]	DDR_A[7]	DDR_A[0]	DDR_BA[2]	$\overline{\text{DDR_CAS}}$	DDR_D[12]	U
T	GP7[1]/ BOOT[1]	GP7[2]/ BOOT[2]	GP7[3]/ BOOT[3]	DDR_A[11]	DDR_A[13]	DDR_A[9]	DDR_A[1]	$\overline{\text{DDR_WE}}$	DDR_BA[1]	DDR_D[10]	T
R	GP7[4]/ BOOT[4]	GP7[5]/ BOOT[5]	GP7[6]/ BOOT[6]	DVDD3318_C	GP6[0]	DDR_VREF	DDR_DVDD18	DDR_DVDD18	DDR_DVDD18	DDR_DQM[1]	R
P	RSV3	RSV3	NC	GP7[7]/ BOOT[7]	DVDD3318_C	DVDD3318_C	DDR_DVDD18	DDR_DVDD18	DDR_DVDD18	DDR_DVDD18	P
N	NC	NC	NC	RSV3	V_{SS}	DDR_DVDD18	RV_{DD}	CV_{DD}	DDR_DVDD18	DDR_DVDD18	N
M	V_{SS}	RSV3	NC	V_{SS}	V_{SS}	V_{SS}	V_{SS}	CV_{DD}	CV_{DD}	V_{SS}	M
L	NC	NC	V_{SS}	DV_{DD3318_C}	V_{SS}	DV_{DD18}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	L
K	V_{SS}	V_{SS}	GP6[3]	GP6[1]	DV_{DD18}	CV_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	K
	1	2	3	4	5	6	7	8	9	10	

Figure 3-3. Pin Map (Quad A)



	11	12	13	14	15	16	17	18	19	
W	DDR_D[7]	DDR_D[6]	DDR_DQM[0]	UHPI_HCS/ GP6[7]/	UHPI_HCNTL1/ GP6[10]	UHPI_HD[12]/	UHPI_HD[10]/	UHPI_HD[9]/	UHPI_HD[8]/	W
V	DDR_DQS[1]	DDR_D[5]	DDR_D[4]	DDR_D[2]	UHPI_HDS1/ GP6[6]	UHPI_HD[14]/	UHPI_HD[11]/	UHPI_HD[7]/	UHPI_HD[6]/	V
U	DDR_D[14]	DDR_ZP	DDR_D[3]	DDR_D[1]	DDR_D[0]	UHPI_HHWIL/ GP6[9]	UHPI_HCNTL0/ GP6[11]	UHPI_HD[15]/	UHPI_HD[5]/	U
T	DDR_D[9]	DDR_D[11]	DDR_D[8]	DDR_DQS[0]	UHPI_HRW/ GP6[8]	UHPI_HD[4]/	RESETOUT/ UHPI_HAS/ GP6[15]	CLKOUT/ UHPI_HDS2/ GP6[14]	RSV2	T
R	DDR_DQGATE0	DDR_DQGATE1	DVDD18	UHPI_HD[13]/	UHPI_HD[1]/	UHPI_HINT/ GP6[12]	UHPI_HRDY/ GP6[13]	UHPI_HD[3]/	UHPI_HD[2]/	R
P	V_{SS}	DVDD3318_C	DVDD18	NC	NC	NC	UHPI_HD[0]/ GP6[5]	NC	NC	P
N	V_{SS}	V_{SS}	DVDD3318_C	NC	PLL1_VDDA	NC	NC	NC	NC	N
M	V_{SS}	CV_{DD}	DVDD3318_C	NC	PLL1_VSSA	TDI	PLL0_VSSA	NC	NC	M
L	V_{SS}	CV_{DD}	DVDD3318_C	RTC_CVDD	PLL0_VDDA	TMS	TRST	OSCVSS	OSCIN	L
K	V_{SS}	CV_{DD}	DVDD3318_C	RESET	DVDD3318_B	EMU1	GP8[0]	NC	OSCOUT	K
	11	12	13	14	15	16	17	18	19	

Figure 3-4. Pin Map (Quad B)

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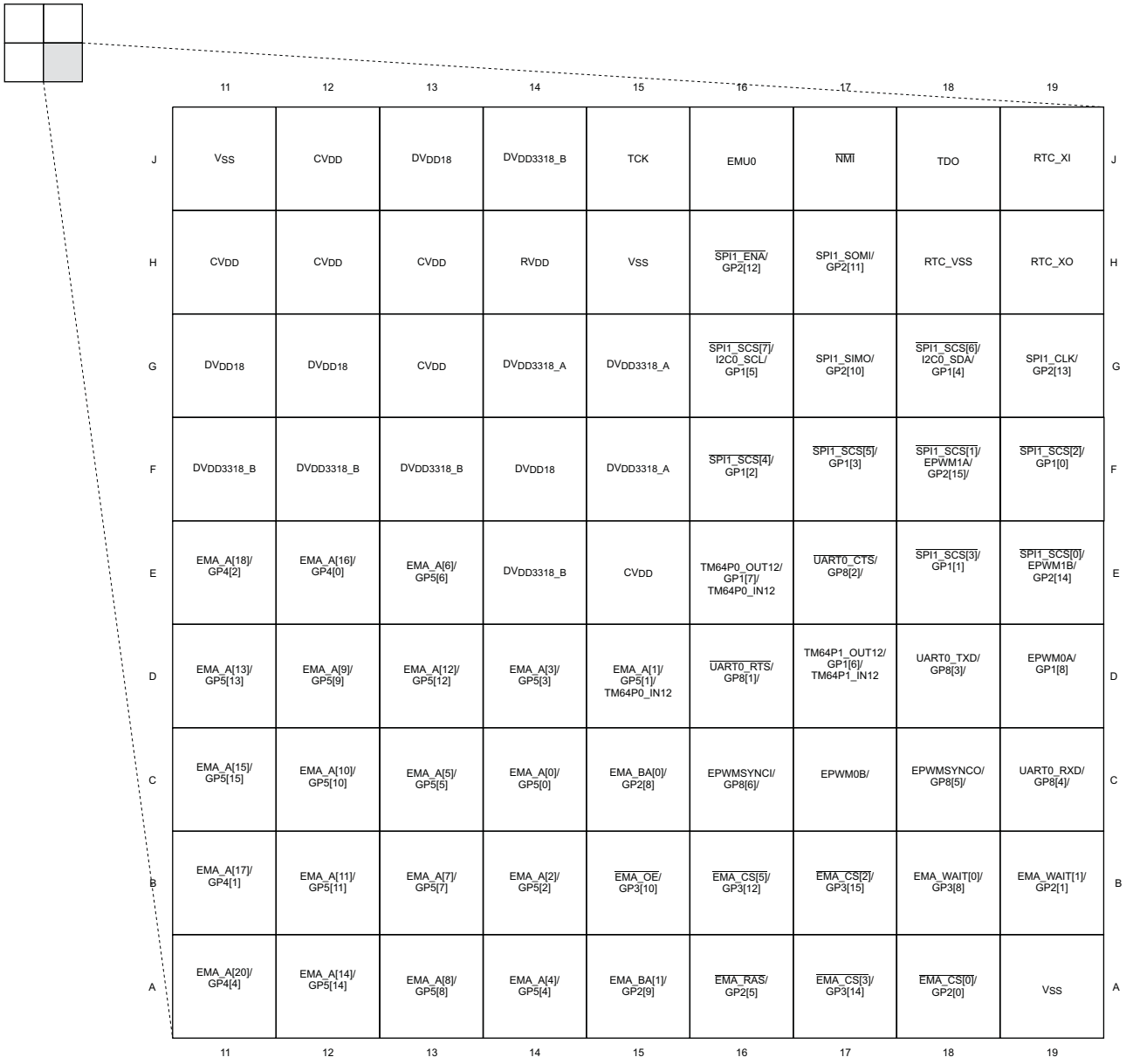
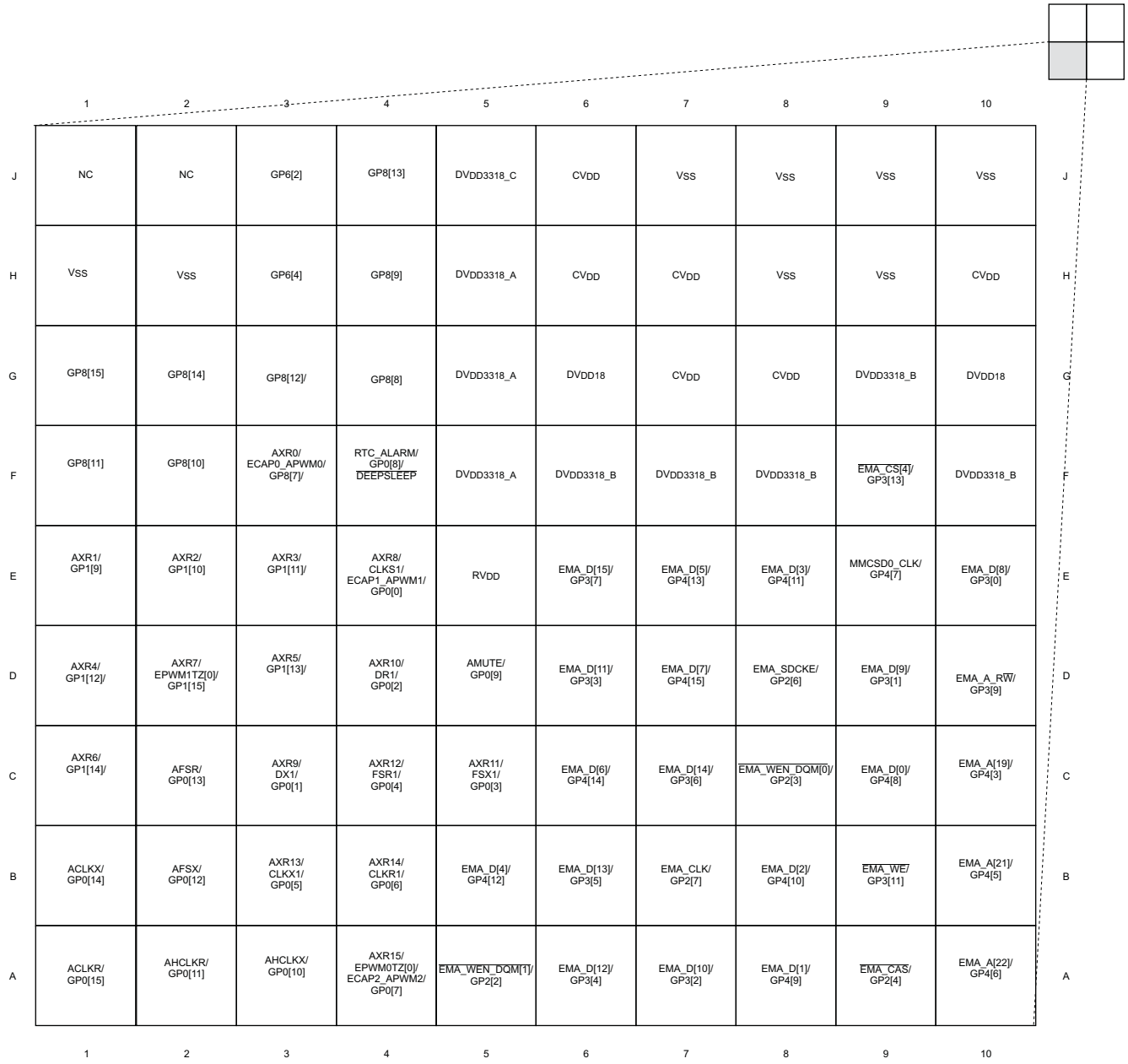


	11	12	13	14	15	16	17	18	19	
J	V_{SS}	CV_{DD}	DV_{DD18}	DV_{DD3318_B}	TCK	EMU0	$\overline{NMI}$	TDO	RTC_XI	J
H	CV_{DD}	CV_{DD}	CV_{DD}	RV_{DD}	V_{SS}	$\overline{SPI1_ENA}$/ GP2[12]	SPI1_SOMI/ GP2[11]	RTC_VSS	RTC_XO	H
G	DV_{DD18}	DV_{DD18}	CV_{DD}	DV_{DD3318_A}	DV_{DD3318_A}	$\overline{SPI1_SCS[7]}$/ I2C0_SCL/ GP1[5]	SPI1_SIMO/ GP2[10]	$\overline{SPI1_SCS[6]}$/ I2C0_SDA/ GP1[4]	SPI1_CLK/ GP2[13]	G
F	DV_{DD3318_B}	DV_{DD3318_B}	DV_{DD3318_B}	DV_{DD18}	DV_{DD3318_A}	$\overline{SPI1_SCS[4]}$/ GP1[2]	$\overline{SPI1_SCS[5]}$/ GP1[3]	$\overline{SPI1_SCS[1]}$/ EPWM1A/ GP2[15]/	$\overline{SPI1_SCS[2]}$/ GP1[0]	F
E	EMA_A[18]/ GP4[2]	EMA_A[16]/ GP4[0]	EMA_A[6]/ GP5[6]	DV_{DD3318_B}	CV_{DD}	TM64P0_OUT12/ GP1[7]/ TM64P0_IN12	$\overline{UART0_CTS}$/ GP8[2]/	$\overline{SPI1_SCS[3]}$/ GP1[1]	$\overline{SPI1_SCS[0]}$/ EPWM1B/ GP2[14]	E
D	EMA_A[13]/ GP5[13]	EMA_A[9]/ GP5[9]	EMA_A[12]/ GP5[12]	EMA_A[3]/ GP5[3]	EMA_A[1]/ GP5[1]/ TM64P0_IN12	$\overline{UART0_RTS}$/ GP8[1]/	TM64P1_OUT12/ GP1[6]/ TM64P1_IN12	UART0_TXD/ GP8[3]/	EPWM0A/ GP1[8]	D
C	EMA_A[15]/ GP5[15]	EMA_A[10]/ GP5[10]	EMA_A[5]/ GP5[5]	EMA_A[0]/ GP5[0]	EMA_BA[0]/ GP2[8]	EPWMSYNCI/ GP8[6]/	EPWM0B/	EPWMSYNCO/ GP8[5]/	UART0_RXD/ GP8[4]/	C
B	EMA_A[17]/ GP4[1]	EMA_A[11]/ GP5[11]	EMA_A[7]/ GP5[7]	EMA_A[2]/ GP5[2]	$\overline{EMA_OE}$/ GP3[10]	$\overline{EMA_CS[5]}$/ GP3[12]	$\overline{EMA_CS[2]}$/ GP3[15]	EMA_WAIT[0]/ GP3[8]	EMA_WAIT[1]/ GP2[1]	B
A	EMA_A[20]/ GP4[4]	EMA_A[14]/ GP5[14]	EMA_A[8]/ GP5[8]	EMA_A[4]/ GP5[4]	EMA_BA[1]/ GP2[9]	$\overline{EMA_RAS}$/ GP2[5]	$\overline{EMA_CS[3]}$/ GP3[14]	$\overline{EMA_CS[0]}$/ GP2[0]	V_{SS}	A
	11	12	13	14	15	16	17	18	19	

Figure 3-5. Pin Map (Quad C)



	1	2	3	4	5	6	7	8	9	10	
J	NC	NC	GP6[2]	GP8[13]	DVDD3318_C	CVDD	VSS	VSS	VSS	VSS	J
H	VSS	VSS	GP6[4]	GP8[9]	DVDD3318_A	CVDD	CVDD	VSS	VSS	CVDD	H
G	GP8[15]	GP8[14]	GP8[12]/	GP8[8]	DVDD3318_A	DVDD18	CVDD	CVDD	DVDD3318_B	DVDD18	G
F	GP8[11]	GP8[10]	AXR0/ ECAP0_APWM0/ GP8[7]/	RTC_ALARM/ GP0[8]/ DEEPSLEEP	DVDD3318_A	DVDD3318_B	DVDD3318_B	DVDD3318_B	EMA_CS[4]/ GP3[13]	DVDD3318_B	F
E	AXR1/ GP1[9]	AXR2/ GP1[10]	AXR3/ GP1[11]/	AXR8/ CLKS1/ ECAP1_APWM1/ GP0[0]	RVDD	EMA_D[15]/ GP3[7]	EMA_D[5]/ GP4[13]	EMA_D[3]/ GP4[11]	MMCSD0_CLK/ GP4[7]	EMA_D[8]/ GP3[0]	E
D	AXR4/ GP1[12]/	AXR7/ EPWM1TZ[0]/ GP1[15]	AXR5/ GP1[13]/	AXR10/ DR1/ GP0[2]	AMUTE/ GP0[9]	EMA_D[11]/ GP3[3]	EMA_D[7]/ GP4[15]	EMA_SDCKE/ GP2[6]	EMA_D[9]/ GP3[1]	EMA_A_RW/ GP3[9]	D
C	AXR6/ GP1[14]/	AFSR/ GP0[13]	AXR9/ DX1/ GP0[1]	AXR12/ FSR1/ GP0[4]	AXR11/ FSX1/ GP0[3]	EMA_D[6]/ GP4[14]	EMA_D[14]/ GP3[6]	EMA_WEN_DQM[0]/ GP2[3]	EMA_D[0]/ GP4[8]	EMA_A[19]/ GP4[3]	C
B	ACLKX/ GP0[14]	AFSX/ GP0[12]	AXR13/ CLKX1/ GP0[5]	AXR14/ CLKR1/ GP0[6]	EMA_D[4]/ GP4[12]	EMA_D[13]/ GP3[5]	EMA_CLK/ GP2[7]	EMA_D[2]/ GP4[10]	EMA_WE/ GP3[11]	EMA_A[21]/ GP4[5]	B
A	ACLKR/ GP0[15]	AHCLKR/ GP0[11]	AHCLKX/ GP0[10]	AXR15/ EPWM0TZ[0]/ ECAP2_APWM2/ GP0[7]	EMA_WEN_DQM[1]/ GP2[2]	EMA_D[12]/ GP3[4]	EMA_D[10]/ GP3[2]	EMA_D[1]/ GP4[9]	EMA_CAS/ GP2[4]	EMA_A[22]/ GP4[6]	A
	1	2	3	4	5	6	7	8	9	10	

Figure 3-6. Pin Map (Quad D)

3.6 Pin Multiplexing Control

Device level pin multiplexing is controlled by registers PINMUX0 - PINMUX19 in the SYSCFG module.

For the device family, pin multiplexing can be controlled on a pin-by-pin basis. Each pin that is multiplexed with several different functions has a corresponding 4-bit field in one of the PINMUX registers.

Pin multiplexing selects which of several peripheral pin functions controls the pin's IO buffer **output** data and **output enable** values only. The default pin multiplexing control for almost every pin is to select 'none' of the peripheral functions in which case the pin's IO buffer is held tri-stated.

Note that the **input** from each pin is always routed to **all** of the peripherals that share the pin; the PINMUX registers have no effect on input from a pin.

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3.7 Terminal Functions

Table 3-5 to Table 3-23 identify the external signal names, the associated pin/ball numbers along with the mechanical package designator, the pin type (I, O, IO, OZ, or PWR), whether the pin/ball has any internal pullup/pulldown resistors, whether the pin/ball is configurable as an IO in GPIO mode, and a functional pin description.

3.7.1 Device Reset, NMI and JTAG

Table 3-5. Reset, NMI and JTAG Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
RESET					
$\overline{\text{RESET}}$	K14	I	—	B	Device reset input
$\overline{\text{NMI}}$	J17	I	IPU	B	Non-Maskable Interrupt
$\overline{\text{RESETOUT}}$ / $\overline{\text{UHPI_HAS}}$ / GP6[15]	T17	O(4)	CP[21]	C	Reset output
JTAG					
TMS	L16	I	IPU	B	JTAG test mode select
TDI	M16	I	IPU	B	JTAG test data input
TDO	J18	O	IPU	B	JTAG test data output
TCK	J15	I	IPU	B	JTAG test clock
$\overline{\text{TRST}}$	L17	I	IPD	B	JTAG test reset
EMU0	J16	I/O	IPU	B	Emulation pin
EMU1	K16	I/O	IPU	B	Emulation pin

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.
(2) IPD = Internal Pulldown resistor, IPU = Internal Pullup resistor. CP[n] = configurable pull-up/pull-down (where n is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.
(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.
(4) Open drain mode for $\overline{\text{RESETOUT}}$ function.

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3.7.2 High-Frequency Oscillator and PLL

Table 3-6. High-Frequency Oscillator and PLL Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
CLKOUT / $\overline{\text{UHPI_HDS2}}$ / GP6[14]	T18	O	CP[22]	C	PLL Observation Clock(4)
1.2-V OSCILLATOR					
OSCIN	L19	I	—	—	Oscillator input
OSCOUT	K19	O	—	—	Oscillator output
OSCVSS	L18	GND	—	—	Oscillator ground
1.2-V PLL0					
PLL0_VDDA	L15	PWR	—	—	PLL analog V_{DD} (1.2-V filtered supply)
PLL0_VSSA	M17	GND	—	—	PLL analog V_{SS} (for filter)
1.2-V PLL1					
PLL1_VDDA	N15	PWR	—	—	PLL analog V_{DD} (1.2-V filtered supply)
PLL1_VSSA	M15	GND	—	—	PLL analog V_{SS} (for filter)

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

(4) **Note**: The CLKOUT clock output is provided as PLL observation clock, and is provided for debug purposes only. It may be routed to a test point, but should never be connected to a load.

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3.7.3 Real-Time Clock and 32-kHz Oscillator

Table 3-7. Real-Time Clock (RTC) and 1.2-V, 32-kHz Oscillator Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
RTC_XI	J19	I	—	—	RTC 32-kHz oscillator input
RTC_XO	H19	O	—	—	RTC 32-kHz oscillator output
RTC_ALARM / GP0[8] / $\overline{\text{DEEPSLEEP}}$	F4	O	CP[0]	A	RTC Alarm
RTC_CVDD	L14	PWR	—	—	RTC module core power (isolated from chip CV_{DD})
RTC_V_{ss}	H18	GND	—	—	Oscillator ground

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.
(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.
(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

3.7.4 DEEPSLEEP Power Control

Table 3-8. DEEPSLEEP Power Control Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
RTC_ALARM / GP0[8] / **$\overline{\text{DEEPSLEEP}}$**	F4	I	CP[0]	A	DEEPSLEEP power control output

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.
(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.
(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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3.7.5 External Memory Interface A (EMIFA)

Table 3-9. External Memory Interface A (EMIFA) Terminal Functions

SIGNAL		TYPE[1]	PULL[2]	POWER GROUP[3]	DESCRIPTION
NAME	NO.				
EMA_D[15] / GP3[7]	E6	I/O	CP[17]	B	EMIFA data bus
EMA_D[14] / GP3[6]	C7	I/O	CP[17]	B	
EMA_D[13] / GP3[5]	B6	I/O	CP[17]	B	
EMA_D[12] / GP3[4]	A6	I/O	CP[17]	B	
EMA_D[11] / GP3[3]	D6	I/O	CP[17]	B	
EMA_D[10] / GP3[2]	A7	I/O	CP[17]	B	
EMA_D[9] / GP3[1]	D9	I/O	CP[17]	B	
EMA_D[8] / GP3[0]	E10	I/O	CP[17]	B	
EMA_D[7] / GP4[15]	D7	I/O	CP[17]	B	
EMA_D[6] / GP4[14]	C6	I/O	CP[17]	B	
EMA_D[5] / GP4[13]	E7	I/O	CP[17]	B	
EMA_D[4] / GP4[12]	B5	I/O	CP[17]	B	
EMA_D[3] / GP4[11]	E8	I/O	CP[17]	B	
EMA_D[2] / GP4[10]	B8	I/O	CP[17]	B	
EMA_D[1] / GP4[9]	A8	I/O	CP[17]	B	
EMA_D[0] / GP4[8]	C9	I/O	CP[17]	B	
EMA_A[22] / GP4[6]	A10	O	CP[18]	B	EMIFA address bus
EMA_A[21] / GP4[5]	B10	O	CP[18]	B	
EMA_A[20] / GP4[4]	A11	O	CP[18]	B	
EMA_A[19] / GP4[3]	C10	O	CP[18]	B	
EMA_A[18] / GP4[2]	E11	O	CP[18]	B	
EMA_A[17] / GP4[1]	B11	O	CP[18]	B	
EMA_A[16] / GP4[0]	E12	O	CP[18]	B	
EMA_A[15] / GP5[15]	C11	O	CP[19]	B	
EMA_A[14] / GP5[14]	A12	O	CP[19]	B	
EMA_A[13] / GP5[13]	D11	O	CP[19]	B	
EMA_A[12] / GP5[12]	D13	O	CP[19]	B	

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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Table 3-9. External Memory Interface A (EMIFA) Terminal Functions (continued)

SIGNAL		TYPE[1]	PULL[2]	POWER GROUP[3]	DESCRIPTION
NAME	NO.				
EMA_A[11] / GP5[11]	B12	O	CP[19]	B	EMIFA address bus
EMA_A[10] / GP5[10]	C12	O	CP[19]	B	
EMA_A[9] / GP5[9]	D12	O	CP[19]	B	
EMA_A[8] / GP5[8]	A13	O	CP[19]	B	
EMA_A[7] / GP5[7]	B13	O	CP[20]	B	
EMA_A[6] / GP5[6]	E13	O	CP[20]	B	
EMA_A[5] / GP5[5]	C13	O	CP[20]	B	
EMA_A[4] / GP5[4]	A14	O	CP[20]	B	
EMA_A[3] / GP5[3]	D14	O	CP[20]	B	
EMA_A[2] / GP5[2]	B14	O	CP[20]	B	
EMA_A[1] / GP5[1]	D15	O	CP[20]	B	
EMA_A[0] / GP5[0]	C14	O	CP[20]	B	
EMA_BA[0] / GP2[8]	C15	O	CP[16]	B	EMIFA bank address
EMA_BA[1] / GP2[9]	A15	O	CP[16]	B	
EMA_CLK / GP2[7]	B7	O	CP[16]	B	EMIFA clock
EMA_SDCKE / GP2[6]	D8	O	CP[16]	B	EMIFA SDRAM clock enable
$\overline{\text{EMA_RAS}}$ / GP2[5]	A16	O	CP[16]	B	EMIFA SDRAM row address strobe
$\overline{\text{EMA_CAS}}$ / GP2[4]	A9	O	CP[16]	B	EMIFA SDRAM column address strobe
$\overline{\text{EMA_CS[0]}}$ / GP2[0]	A18	O	CP[16]	B	EMIFA SDRAM Chip Select
$\overline{\text{EMA_CS[2]}}$ / GP3[15]	B17	O	CP[16]	B	EMIFA Async chip select
$\overline{\text{EMA_CS[3]}}$ / GP3[14]	A17	O	CP[16]	B	
$\overline{\text{EMA_CS[4]}}$ / GP3[13]	F9	O	CP[16]	B	
$\overline{\text{EMA_CS[5]}}$ / GP3[12]	B16	O	CP[16]	B	
EMA_A_$\overline{\text{RW}}$ / GP3[9]	D10	O	CP[16]	B	EMIFA Async Read/Write control
$\overline{\text{EMA_WE}}$ / GP3[11]	B9	O	CP[16]	B	EMIFA SDRAM write enable
$\overline{\text{EMA_WEN_DQM[1]}}$ / GP2[2]	A5	O	CP[16]	B	EMIFA write enable/data mask for EMA_D[15:8]
$\overline{\text{EMA_WEN_DQM[0]}}$ / GP2[3]	C8	O	CP[16]	B	EMIFA write enable/data mask for EMA_D[7:0]
$\overline{\text{EMA_OE}}$ / GP3[10]	B15	O	CP[16]	B	EMIFA output enable
EMA_WAIT[0] / GP3[8]	B18	I	CP[16]	B	EMIFA wait input/interrupt
EMA_WAIT[1] / GP2[1]	B19	I	CP[16]	B	

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3.7.6 DDR2/mDDR Controller

Table 3-10. DDR2/mDDR Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	DESCRIPTION
NAME	NO.			
DDR_D[15]	W10	I/O	IPD	DDR2 SDRAM data bus
DDR_D[14]	U11	I/O	IPD	
DDR_D[13]	V10	I/O	IPD	
DDR_D[12]	U10	I/O	IPD	
DDR_D[11]	T12	I/O	IPD	
DDR_D[10]	T10	I/O	IPD	
DDR_D[9]	T11	I/O	IPD	
DDR_D[8]	T13	I/O	IPD	
DDR_D[7]	W11	I/O	IPD	
DDR_D[6]	W12	I/O	IPD	
DDR_D[5]	V12	I/O	IPD	
DDR_D[4]	V13	I/O	IPD	
DDR_D[3]	U13	I/O	IPD	
DDR_D[2]	V14	I/O	IPD	
DDR_D[1]	U14	I/O	IPD	
DDR_D[0]	U15	I/O	IPD	
DDR_A[13]	T5	O	IPD	DDR2 row/column address
DDR_A[12]	V4	O	IPD	
DDR_A[11]	T4	O	IPD	
DDR_A[10]	W4	O	IPD	
DDR_A[9]	T6	O	IPD	
DDR_A[8]	U4	O	IPD	
DDR_A[7]	U6	O	IPD	
DDR_A[6]	W5	O	IPD	
DDR_A[5]	V5	O	IPD	
DDR_A[4]	U5	O	IPD	
DDR_A[3]	V6	O	IPD	
DDR_A[2]	W6	O	IPD	
DDR_A[1]	T7	O	IPD	
DDR_A[0]	U7	O	IPD	
DDR_CLKP	W8	O	IPD	DDR2 clock (positive)
$\overline{\text{DDR_CLKN}}$	W7	O	IPD	DDR2 clock (negative)
DDR_CKE	V7	O	IPD	DDR2 clock enable
$\overline{\text{DDR_WE}}$	T8	O	IPD	DDR2 write enable
$\overline{\text{DDR_RAS}}$	W9	O	IPD	DDR2 row address strobe
$\overline{\text{DDR_CAS}}$	U9	O	IPD	DDR2 column address strobe
$\overline{\text{DDR_CS}}$	V9	O	IPD	DDR2 chip select

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

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Table 3-10. DDR2/mDDR Terminal Functions (continued)

SIGNAL		TYPE(1)	PULL(2)	DESCRIPTION
NAME	NO.			
DDR_DQM[0]	W13	O	IPD	DDR2 data mask outputs
DDR_DQM[1]	R10	O	IPD	
DDR_DQS[0]	T14	I/O	IPD	DDR2 data strobe inputs/outputs
DDR_DQS[1]	V11	I/O	IPD	
DDR_BA[2]	U8	O	IPD	DDR2 SDRAM bank address
DDR_BA[1]	T9	O	IPD	
DDR_BA[0]	V8	O	IPD	
DDR_DQGATE0	R11	O	IPD	DDR2 loopback signal for external DQS gating. Route to DDR and back to DDR_DQGATE1 with same constraints as used for DDR clock and data.
DDR_DQGATE1	R12	I	IPD	DDR2 loopback signal for external DQS gating. Route to DDR and back to DDR_DQGATE0 with same constraints as used for DDR clock and data.
DDR_ZP	U12	O	—	DDR2 reference output for drive strength calibration of N and P channel outputs. Tie to ground via 50 ohm resistor @ 5% tolerance.
DDR_VREF	R6	I	—	DDR voltage input for the DDR2/mDDR I/O buffers. Note even in the case of mDDR an external resistor divider connected to this pin is necessary.
DDR_DVDD18	N6, N9, N10, P7, P8, P9, P10, R7, R8, R9	PWR	—	DDR PHY 1.8V power supply pins

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3.7.7 Serial Peripheral Interface Modules (SPI)

Table 3-11. Serial Peripheral Interface (SPI) Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
SPI1					
SPI1_CLK / GP2[13]	G19	I/O	CP[15]	A	SPI1 clock
$\overline{\text{SPI1_ENA}}$ / GP2[12]	H16	I/O	CP[15]	A	SPI1 enable
$\overline{\text{SPI1_SCS[0]}}$ / EPWM1B / GP2[14]	E19	I/O	CP[14]	A	SPI1 chip selects
$\overline{\text{SPI1_SCS[1]}}$ / EPWM1A / GP2[15]	F18	I/O	CP[14]	A	
$\overline{\text{SPI1_SCS[2]}}$ / GP1[0]	F19	I/O	CP[13]	A	
$\overline{\text{SPI1_SCS[3]}}$ / GP1[1]	E18	I/O	CP[13]	A	
$\overline{\text{SPI1_SCS[4]}}$ / GP1[2]	F16	I/O	CP[12]	A	
$\overline{\text{SPI1_SCS[5]}}$ / GP1[3]	F17	I/O	CP[12]	A	
$\overline{\text{SPI1_SCS[6]}}$ / I2C0_SDA / GP1[4]	G18	I/O	CP[11]	A	
$\overline{\text{SPI1_SCS[7]}}$ / I2C0_SCL / GP1[5]	G16	I/O	CP[11]	A	
SPI1_SIMO / GP2[10]	G17	I/O	CP[15]	A	SPI1 data slave-in-master-out
SPI1_SOMI / GP2[11]	H17	I/O	CP[15]	A	SPI1 data slave-out-master-in

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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3.7.8 Enhanced Capture/Auxiliary PWM Modules (eCAP0)

The eCAP Module pins function as either input captures or auxiliary PWM 32-bit outputs, depending upon how the eCAP module is programmed.

Table 3-12. Enhanced Capture Module (eCAP) Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
eCAP0					
AXR0 / **ECAP0_APWM0** / GP8[7]	F3	I/O	CP[6]	A	enhanced capture 0 input or auxiliary PWM 0 output
eCAP1					
AXR8 / CLKS1 / **ECAP1_APWM1** / GP0[0]	E4	I/O	CP[3]	A	enhanced capture 1 input or auxiliary PWM 1 output
eCAP2					
AXR15 / EPWM0TZ[0] / **ECAP2_APWM2** / GP0[7]	A4	I/O	CP[1]	A	enhanced capture 2 input or auxiliary PWM 2 output

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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3.7.9 Enhanced Pulse Width Modulators (eHRPWM)

Table 3-13. Enhanced Pulse Width Modulator (eHRPWM) Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
eHRPWM0					
EPWM0A / GP1[8]	D19	I/O	CP[7]	A	eHRPWM0 A output (with high-resolution)
EPWM0B	C17	I/O	CP[7]	A	eHRPWM0 B output
AXR15 / **EPWM0TZ[0]** / ECAP2_APWM2 / GP0[7]	A4	I	CP[1]	A	eHRPWM0 trip zone input
EPWMSYNCI / GP8[6]	C16	I	CP[7]	A	eHRPWM0 sync input
EPWMSYNCO / GP8[5]	C18	I/O	CP[7]	A	eHRPWM0 sync output
eHRPWM1					
$\overline{\text{SPI1_SCS[1]}}$ / **EPWM1A** / GP2[15]	F18	I/O	CP[14]	A	eHRPWM1 A output (with high-resolution)
$\overline{\text{SPI1_SCS[0]}}$ / **EPWM1B** / GP2[14]	E19	I/O	CP[14]	A	eHRPWM1 B output
AXR7 / **EPWM1TZ[0]** / GP1[15]	D2	I	CP[4]	A	eHRPWM1 trip zone input

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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3.7.10 Boot

Table 3-14. Boot Mode Selection Terminal Functions(1)

SIGNAL		TYPE(2)	PULL(3)	POWER GROUP(4)	DESCRIPTION
NAME	NO.				
GP7[7] / **BOOT[7]**	P4	I	CP[29]	C	Boot Mode Selection Pins
GP7[6] / **BOOT[6]**	R3	I	CP[29]	C	
GP7[5] / **BOOT[5]**	R2	I	CP[29]	C	
GP7[4] / **BOOT[4]**	R1	I	CP[29]	C	
GP7[3] / **BOOT[3]**	T3	I	CP[29]	C	
GP7[2] / **BOOT[2]**	T2	I	CP[29]	C	
GP7[1] / **BOOT[1]**	T1	I	CP[29]	C	
GP7[0] / **BOOT[0]**	U3	I	CP[29]	C	

(1) Boot decoding is defined in the bootloader application report.
(2) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.
(3) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.
(4) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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3.7.11 Universal Asynchronous Receiver/Transmitters (UART0)

Table 3-15. Universal Asynchronous Receiver/Transmitter (UART) Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
UART0					
UART0_RXD / GP8[4]	C19	I	CP[8]	A	UART0 receive data
UART0_TXD / GP8[3]	D18	O	CP[8]	A	UART0 transmit data
$\overline{\text{UART0_RTS}}$ / GP8[1]	D16	O	CP[9]	A	UART0 ready-to-send output
$\overline{\text{UART0_CTS}}$ / GP8[2]	E17	I	CP[9]	A	UART0 clear-to-send input

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module.The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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3.7.12 Inter-Integrated Circuit Modules(I2C0)

Table 3-16. Inter-Integrated Circuit (I2C) Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
I2C0					
$\overline{\text{SPI1_SCS[6]}}$ / **I2C0_SDA** / GP1[4]	G18	I/O	CP[11]	A	I2C0 serial data
$\overline{\text{SPI1_SCS[7]}}$ / **I2C0_SCL** / GP1[5]	G16	I/O	CP[11]	A	I2C0 serial clock

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module.The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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3.7.13 Timers

Table 3-17. Timers Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
TIMER0					
TM64P0_OUT12 / GP1[7] /**TM64P0_IN12**	E16	I	CP[10]	A	Timer0 lower input
TM64P0_OUT12 / GP1[7] / TM64P0_IN12	E16	O	CP[10]	A	Timer0 lower output
TIMER1 (Watchdog)					
TM64P1_OUT12 / GP1[6] / **TM64P1_IN12**	D17	I	CP[10]	A	Timer1 lower input
TM64P1_OUT12 / GP1[6] / TM64P1_IN12	D17	O	CP[10]	A	Timer1 lower output

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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3.7.14 Multichannel Audio Serial Ports (McASP)

Table 3-18. Multichannel Audio Serial Ports Terminal Functions

SIGNAL NAME	SIGNAL NO.	TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
McASP0					
AXR15 / EPWM0TZ[0] / ECAP2_APWM2 / GP0[7]	A4	I/O	CP[1]	A	McASP0 serial data
AXR14 / CLKR1 / GP0[6]	B4	I/O	CP[2]	A	
AXR13 / CLKX1 / GP0[5]	B3	I/O	CP[2]	A	
AXR12 / FSR1 / GP0[4]	C4	I/O	CP[2]	A	
AXR11 / FSX1 / GP0[3]	C5	I/O	CP[2]	A	
AXR10 / DR1 / GP0[2]	D4	I/O	CP[2]	A	
AXR9 / DX1 / GP0[1]	C3	I/O	CP[2]	A	
AXR8 / CLKS1 / ECAP1_APWM1 / GP0[0]	E4	I/O	CP[3]	A	
AXR7 / EPWM1TZ[0] / GP1[15]	D2	I/O	CP[4]	A	
AXR6 / GP1[14]	C1	I/O	CP[5]	A	
AXR5 / GP1[13]	D3	I/O	CP[5]	A	
AXR4 / GP1[12]	D1	I/O	CP[5]	A	
AXR3 / GP1[11]	E3	I/O	CP[5]	A	
AXR2 / GP1[10]	E2	I/O	CP[5]	A	
AXR1 / GP1[9]	E1	I/O	CP[5]	A	
AXR0 / ECAP0_APWM0 / GP8[7]	F3	I/O	CP[6]	A	
AHCLKX / GP0[10]	A3	I/O	CP[0]	A	McASP0 transmit master clock
ACLKX / GP0[14]	B1	I/O	CP[0]	A	McASP0 transmit bit clock
AFSX / GP0[12]	B2	I/O	CP[0]	A	McASP0 transmit frame sync
AHCLKR / GP0[11]	A2	I/O	CP[0]	A	McASP0 receive master clock
ACLKR / GP0[15]	A1	I/O	CP[0]	A	McASP0 receive bit clock
AFSR / GP0[13]	C2	I/O	CP[0]	A	McASP0 receive frame sync
AMUTE / GP0[9]	D5	I/O	CP[0]	A	McASP0 mute output

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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3.7.15 Multichannel Buffered Serial Ports (McBSP)

Table 3-19. Multichannel Buffered Serial Ports (McBSPs) Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
McBSP1					
AXR8 / **CLKS1** / ECAP1_APWM1 / GP0[0]	E4	I	CP[3]	A	McBSP1 sample rate generator clock input
AXR14 / **CLKR1** / GP0[6]	B4	I/O	CP[2]	A	McBSP1 receive clock
AXR12 / **FSR1** / GP0[4]	C4	I/O	CP[2]	A	McBSP1 receive frame sync
AXR10 / **DR1** / GP0[2]	D4	I	CP[2]	A	McBSP1 receive data
AXR13 / **CLKX1** / GP0[5]	B3	I/O	CP[2]	A	McBSP1 transmit clock
AXR11 / **FSX1** / GP0[3]	C5	I/O	CP[2]	A	McBSP1 transmit frame sync
AXR9 / **DX1** / GP0[1]	C3	O	CP[2]	A	McBSP1 transmit data

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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3.7.16 Universal Host-Port Interface (UHPI)

Table 3-20. Universal Host-Port Interface (UHPI) Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
UHPI_HD[15]	U18	I/O	CP[26]	C	UHPI data bus
UHPI_HD[14]	V16	I/O	CP[26]	C	
UHPI_HD[13]	R14	I/O	CP[26]	C	
UHPI_HD[12]	W16	I/O	CP[26]	C	
UHPI_HD[11]	V17	I/O	CP[26]	C	
UHPI_HD[10]	W17	I/O	CP[26]	C	
UHPI_HD[9]	W18	I/O	CP[26]	C	
UHPI_HD[8]	W19	I/O	CP[26]	C	
UHPI_HD[7]	V18	I/O	CP[27]	C	
UHPI_HD[6]	V19	I/O	CP[27]	C	
UHPI_HD[5]	U19	I/O	CP[27]	C	
UHPI_HD[4]	T16	I/O	CP[27]	C	
UHPI_HD[3]	R18	I/O	CP[27]	C	
UHPI_HD[2]	R19	I/O	CP[27]	C	
UHPI_HD[1]	R15	I/O	CP[27]	C	
UHPI_HD[0] / GP6[5]	P17	I/O	CP[27]	C	
UHPI_HCNTL0 / GP6[11]	U17	I	CP[24]	C	UHPI access control
UHPI_HCNTL1 / GP6[10]	W15	I	CP[24]	C	
UHPI_HHWIL / GP6[9]	U16	I	CP[24]	C	UHPI half-word identification control
UHPI_HR$\overline{W}$ / GP6[8]	T15	I	CP[24]	C	UHPI read/write
$\overline{UHPI_HCS}$ / GP6[7]	W14	I	CP[25]	C	UHPI chip select
$\overline{UHPI_HDS1}$ / GP6[6]	V15	I	CP[25]	C	UHPI data strobe
CLKOUT / **$\overline{UHPI_HDS2}$** / GP6[14]	T18	I	CP[22]	C	
$\overline{UHPI_HINT}$ / GP6[12]	R16	O	CP[23]	C	UHPI host interrupt
$\overline{UHPI_HRDY}$ / GP6[13]	R17	O	CP[23]	C	UHPI ready
$\overline{RESETOUT}$ / **$\overline{UHPI_HAS}$** / GP6[15]	T17	I	CP[21]	C	UHPI address strobe

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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3.7.17 General Purpose Input Output

Table 3-21. General Purpose Input Output Terminal Functions

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
GP0					
ACLKR / **GP0[15]**	A1	I/O	CP[0]	A	GPIO Bank 0
ACLKX / **GP0[14]**	B1	I/O	CP[0]	A	
AFSR / **GP0[13]**	C2	I/O	CP[0]	A	
AFSX / **GP0[12]**	B2	I/O	CP[0]	A	
AHCLKR**GP0[11]**	A2	I/O	CP[0]	A	
AHCLKX / **GP0[10]**	A3	I/O	CP[0]	A	
AMUTE **GP0[9]**	D5	I/O	CP[0]	A	
RTC_ALARM / **GP0[8]** / $\overline{\text{DEEPSLEEP}}$	F4	I/O	CP[0]	A	
AXR15 / EPWM0TZ[0] / ECAP2_APWM2 / **GP0[7]**	A4	I/O	CP[1]	A	
AXR14 / CLKR1 / **GP0[6]**	B4	I/O	CP[2]	A	
AXR13 / CLKX1 / **GP0[5]**	B3	I/O	CP[2]	A	
AXR12 / FSR1 / **GP0[4]**	C4	I/O	CP[2]	A	
AXR11 / FSX1 / **GP0[3]**	C5	I/O	CP[2]	A	
AXR10 / DR1 / **GP0[2]**	D4	I/O	CP[2]	A	
AXR9 / DX1 / **GP0[1]**	C3	I/O	CP[2]	A	
AXR8 / CLKS1 / ECAP1_APWM1 /**GP0[0]**	E4	I/O	CP[3]	A	

(1) I = Input, O = Output, I/O = Bidirectional, Z = High impedance, PWR = Supply voltage, GND = Ground, A = Analog signal.
Note: The pin type shown refers to the input, output or high-impedance state of the pin function when configured as the signal name highlighted in bold. All multiplexed signals may enter a high-impedance state when the configured function is input-only or the configured function supports high-Z operation. All GPIO signals can be used as input or output. For multiplexed pins where functions have different types (ie., input versus output), the table reflects the pin function direction for that particular peripheral.

(2) IPD = Internal Pulldown resistor; IPU = Internal Pullup resistor; CP[*n*] = configurable pull-up/pull-down (where *n* is the pin group) using the PUPDENA and PUPDSEL registers in the System Module. The pull-up and pull-down control of these pins is not active until the device is out of reset. During reset, all of the pins associated with these registers are pulled down. If the application requires a pull-up, an external pull-up can be used. For more detailed information on pullup/pulldown resistors and situations where external pullup/pulldown resistors are required, see the Device Configuration section. For electrical specifications on pullup and internal pulldown circuits, see the Device Operating Conditions section.

(3) This signal is part of a dual-voltage IO group (A, B or C). These groups can be operated at 3.3V or 1.8V nominal. The three groups can be operated at independent voltages but all pins withina group will operate at the same voltage. Group A operates at the voltage of power supply DVDD3318_A. Group B operates at the voltage of power supply DVDD3318_B. Group C operates at the voltage of power supply DVDD3318_C.

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Table 3-21. General Purpose Input Output Terminal Functions (continued)

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
GP1					
AXR7 / EPWM1TZ[0] / **GP1[15]**	D2	I/O	CP[4]	A	GPIO Bank 1
AXR6 / **GP1[14]**	C1	I/O	CP[5]	A	
AXR5 / **GP1[13]**	D3	I/O	CP[5]	A	
AXR4 / **GP1[12]**	D1	I/O	CP[5]	A	
AXR3 / **GP1[11]**	E3	I/O	CP[5]	A	
AXR2 / **GP1[10]**	E2	I/O	CP[5]	A	
AXR1 / **GP1[9]**	E1	I/O	CP[5]	A	
EPWM0A / **GP1[8]**	D19	I/O	CP[7]	A	
TM64P0_OUT12 / **GP1[7]** / TM64P0_IN12	E16	I/O	CP[10]	A	
TM64P1_OUT12 / **GP1[6]** / TM64P1_IN12	D17	I/O	CP[10]	A	
$\overline{\text{SPI1_SCS[7]}}$ / I2C0_SCL / **GP1[5]**	G16	I/O	CP[11]	A	
$\overline{\text{SPI1_SCS[6]}}$ / I2C0_SDA / **GP1[4]**	G18	I/O	CP[11]	A	
$\overline{\text{SPI1_SCS[5]}}$ / **GP1[3]**	F17	I/O	CP[12]	A	
$\overline{\text{SPI1_SCS[4]}}$ / **GP1[2]**	F16	I/O	CP[12]	A	
$\overline{\text{SPI1_SCS[3]}}$ / **GP1[1]**	E18	I/O	CP[13]	A	
$\overline{\text{SPI1_SCS[2]}}$ / **GP1[0]**	F19	I/O	CP[13]	A	

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Table 3-21. General Purpose Input Output Terminal Functions (continued)

SIGNAL		TYPE[1]	PULL[2]	POWER GROUP[3]	DESCRIPTION
NAME	NO.				
GP2					
$\overline{\text{SPI1_SCS[1]}}$ / EPWM1A / **GP2[15]**	F18	I/O	CP[14]	A	GPIO Bank 2
$\overline{\text{SPI1_SCS[0]}}$ / EPWM1B / **GP2[14]**	E19	I/O	CP[14]	A	
SPI1_CLK / **GP2[13]**	G19	I/O	CP[15]	A	
$\overline{\text{SPI1_ENA}}$ / **GP2[12]**	H16	I/O	CP[15]	A	
SPI1_SOMI / **GP2[11]**	H17	I/O	CP[15]	A	
SPI1_SIMO / **GP2[10]**	G17	I/O	CP[15]	A	
EMA_BA[1] / **GP2[9]**	A15	I/O	CP[16]	B	
EMA_BA[0] / **GP2[8]**	C15	I/O	CP[16]	B	
EMA_CLK / **GP2[7]**	B7	I/O	CP[16]	B	
EMA_SDCKE / **GP2[6]**	D8	I/O	CP[16]	B	
$\overline{\text{EMA_RAS}}$ / **GP2[5]**	A16	I/O	CP[16]	B	
$\overline{\text{EMA_CAS}}$ / **GP2[4]**	A9	I/O	CP[16]	B	
$\overline{\text{EMA_WEN_DQM[0]}}$ / **GP2[3]**	C8	I/O	CP[16]	B	
$\overline{\text{EMA_WEN_DQM[1]}}$ / **GP2[2]**	A5	I/O	CP[16]	B	
EMA_WAIT[1] / **GP2[1]**	B19	I/O	CP[16]	B	
$\overline{\text{EMA_CS[0]}}$ / **GP2[0]**	A18	I/O	CP[16]	B	
GP3					
$\overline{\text{EMA_CS[2]}}$ / **GP3[15]**	B17	I/O	CP[16]	B	GPIO Bank 3
$\overline{\text{EMA_CS[3]}}$ / **GP3[14]**	A17	I/O	CP[16]	B	
$\overline{\text{EMA_CS[4]}}$ / **GP3[13]**	F9	I/O	CP[16]	B	
$\overline{\text{EMA_CS[5]}}$ / **GP3[12]**	B16	I/O	CP[16]	B	
$\overline{\text{EMA_WE}}$ / **GP3[11]**	B9	I/O	CP[16]	B	
$\overline{\text{EMA_OE}}$ / **GP3[10]**	B15	I/O	CP[16]	B	
EMA_A_$\overline{\text{RW}}$ / **GP3[9]**	D10	I/O	CP[16]	B	
EMA_WAIT[0] / **GP3[8]**	B18	I/O	CP[16]	B	
EMA_D[15] / **GP3[7]**	E6	I/O	CP[17]	B	
EMA_D[14] / **GP3[6]**	C7	I/O	CP[17]	B	
EMA_D[13] / **GP3[5]**	B6	I/O	CP[17]	B	
EMA_D[12] / **GP3[4]**	A6	I/O	CP[17]	B	
EMA_D[11] / **GP3[3]**	D6	I/O	CP[17]	B	
EMA_D[10] / **GP3[2]**	A7	I/O	CP[17]	B	
EMA_D[9] / **GP3[1]**	D9	I/O	CP[17]	B	
EMA_D[8] / **GP3[0]**	E10	I/O	CP[17]	B	

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Table 3-21. General Purpose Input Output Terminal Functions (continued)

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
GP4					
EMA_D[7] / **GP4[15]**	D7	I/O	CP[17]	B	GPIO Bank 4
EMA_D[6] / **GP4[14]**	C6	I/O	CP[17]	B	
EMA_D[5] / **GP4[13]**	E7	I/O	CP[17]	B	
EMA_D[4] / **GP4[12]**	B5	I/O	CP[17]	B	
EMA_D[3] / **GP4[11]**	E8	I/O	CP[17]	B	
EMA_D[2] / **GP4[10]**	B8	I/O	CP[17]	B	
EMA_D[1] / **GP4[9]**	A8	I/O	CP[17]	B	
EMA_D[0] / **GP4[8]**	C9	I/O	CP[17]	B	
GP4[7]	E9	I/O	CP[18]	B	
EMA_A[22] / **GP4[6]**	A10	I/O	CP[18]	B	
EMA_A[21] / **GP4[5]**	B10	I/O	CP[18]	B	
EMA_A[20] / **GP4[4]**	A11	I/O	CP[18]	B	
EMA_A[19] / **GP4[3]**	C10	I/O	CP[18]	B	
EMA_A[18] / **GP4[2]**	E11	I/O	CP[18]	B	
EMA_A[17] / **GP4[1]**	B11	I/O	CP[18]	B	
EMA_A[16] / **GP4[0]**	E12	I/O	CP[18]	B	
GP5					
EMA_A[15] / **GP5[15]**	C11	I/O	CP[19]	B	GPIO Bank 5
EMA_A[14] / **GP5[14]**	A12	I/O	CP[19]	B	
EMA_A[13] / **GP5[13]**	D11	I/O	CP[19]	B	
EMA_A[12] / **GP5[12]**	D13	I/O	CP[19]	B	
EMA_A[11] / **GP5[11]**	B12	I/O	CP[19]	B	
EMA_A[10] / **GP5[10]**	C12	I/O	CP[19]	B	
EMA_A[9] / **GP5[9]**	D12	I/O	CP[19]	B	
EMA_A[8] / **GP5[8]**	A13	I/O	CP[19]	B	
EMA_A[7] / **GP5[7]**	B13	I/O	CP[20]	B	
EMA_A[6] / **GP5[6]**	E13	I/O	CP[20]	B	
EMA_A[5] / **GP5[5]**	C13	I/O	CP[20]	B	
EMA_A[4] / **GP5[4]**	A14	I/O	CP[20]	B	
EMA_A[3] / **GP5[3]**	D14	I/O	CP[20]	B	
EMA_A[2] / **GP5[2]**	B14	I/O	CP[20]	B	
EMA_A[1] / **GP5[1]**	D15	I/O	CP[20]	B	
EMA_A[0] / **GP5[0]**	C14	I/O	CP[20]	B	

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Table 3-21. General Purpose Input Output Terminal Functions (continued)

SIGNAL		TYPE(1)	PULL(2)	POWER GROUP(3)	DESCRIPTION
NAME	NO.				
GP6					
$\overline{\text{RESETOUT}}$ / $\overline{\text{UHPI_HAS}}$ / **GP6[15]**	T17	I/O	CP[21]	C	GPIO Bank 6
CLKOUT / $\overline{\text{UHPI_HDS2}}$ / **GP6[14]**	T18	I/O	CP[22]	C	
$\overline{\text{UHPI_HRDY}}$ / **GP6[13]**	R17	I/O	CP[23]	C	
$\overline{\text{UHPI_HINT}}$ / **GP6[12]**	R16	I/O	CP[23]	C	
UHPI_HCNTL0 / **GP6[11]**	U17	I/O	CP[24]	C	
UHPI_HCNTL1 / **GP6[10]**	W15	I/O	CP[24]	C	
UHPI_HHWIL / **GP6[9]**	U16	I/O	CP[24]	C	
UHPI_HR$\overline{\text{W}}$ **/GP6[8]**	T15	I/O	CP[24]	C	
$\overline{\text{UHPI_HCS}}$ **GP6[7]**	W14	I/O	CP[25]	C	
$\overline{\text{UHPI_HDS1}}$ / **GP6[6]**	V15	I/O	CP[25]	C	
UHPI_HD[0] / **GP6[5]**	P17	I/O	CP[27]	C	
GP6[4]	H3	I/O	CP[30]	C	
GP6[3]	K3	I/O	CP[30]	C	
GP6[2]	J3	I/O	CP[30]	C	
GP6[1]	K4	I/O	CP[30]	C	
GP6[0]	R5	I/O	CP[31]	C	
GP7					
GP7[15]	U2	I/O	CP[28]	C	GPIO Bank 7
GP7[14]	U1	I/O	CP[28]	C	
GP7[13]	V3	I/O	CP[28]	C	
GP7[12]	V2	I/O	CP[28]	C	
GP7[11]	V1	I/O	CP[28]	C	
GP7[10]	W3	I/O	CP[28]	C	
GP7[9]	W2	I/O	CP[28]	C	
GP7[8]	W1	I/O	CP[28]	C	
GP7[7] / BOOT[7]	P4	I/O	CP[29]	C	
GP7[6] / BOOT[6]	R3	I/O	CP[29]	C	
GP7[5]/ BOOT[5]	R2	I/O	CP[29]	C	
GP7[4] / BOOT[4]	R1	I/O	CP[29]	C	
GP7[3] / BOOT[3]	T3	I/O	CP[29]	C	
GP7[2] / BOOT[2]	T2	I/O	CP[29]	C	
GP7[1] / BOOT[1]	T1	I/O	CP[29]	C	
GP7[0] / BOOT[0]	U3	I/O	CP[29]	C	

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Table 3-21. General Purpose Input Output Terminal Functions (continued)

SIGNAL		TYPE[1]	PULL[2]	POWER GROUP[3]	DESCRIPTION
NAME	NO.				
GP8					
GP8[15]	G1	I/O	CP30]	C	GPIO Bank 8
GP8[14]	G2	I/O	CP[30]	C	
GP8[13]	J4	I/O	CP[30]	C	
GP8[12]	G3	I/O	CP[30]	C	
GP8[11]	F1	I/O	CP[31]	C	
GP8[10]	F2	I/O	CP[31]	C	
GP8[9]	H4	I/O	CP[31]	C	
GP8[8]	G4	I/O	CP[31]	C	
AXR0 / ECAP0_APWM0 / **GP8[7]**	F3	I/O	CP[6]	A	
EPWMSYNCI / **GP8[6]**	C16	I/O	CP[7]	A	
EPWMSYNCO / **GP8[5]**	C18	I/O	CP[7]	A	
UART0_RXD / **GP8[4]**	C19	I/O	CP[8]	A	
UART0_TXD / **GP8[3]**	D18	I/O	CP[8]	A	
$\overline{\text{UART0_CTS}}$ / **GP8[2]**	E17	I/O	CP[9]	A	
$\overline{\text{UART0_RTS}}$ / **GP8[1]**	D16	I/O	CP[9]	A	
GP8[0][4]	K17	I/O	IPD	B	

(4) GP8[0] is initially configured as a reserved function after reset and will not be in a predictable state. This signal will only be stable after the GPIO configuration for this pin has been completed. Users should carefully consider the system implications of this pin being in an unknown state after reset.

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3.7.18 Reserved and No Connect

Table 3-22. Reserved and No Connect Terminal Functions

SIGNAL		TYPE(1)	DESCRIPTION
NAME	NO.		
RSV2	T19	PWR	Reserved. For proper device operation, this pin must be tied either directly to CVDD or left unconnected (do not connect to ground).
RSV3	M2, N4, P1, P2	PWR	Reserved. On revision 1.x silicon, these pins must be tied to a static 1.2V supply. On revision 2.x silicon and later, these pins may be either tied to a static 1.2V supply or left unconnected.
NC	M3, M14, N16		Pin M3 should be left unconnected (***do not*** connect to power or ground) Pins M14 and N16 may be left unconnected or connected to ground (VSS)
NC	J1, J2, K18, L1, L2, M18, M19, N1, N2, N3, N14, N17, N18, N19, P3, P14, P15, P16 P18, P19	—	These pins should be left unconnected.

(1) PWR = Supply voltage.

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3.7.19 Supply and Ground

Table 3-23. Supply and Ground Terminal Functions

SIGNAL		TYPE(1)	DESCRIPTION
NAME	NO.		
CVDD (Core supply)	E15, G7, G8, G13, H6, H7, H10, H11, H12, H13, J6, J12, K6, K12, L12, M8, M9, N8, M12	PWR	Variable (1.2V - 1.0V) core supply voltage pins
RVDD (Internal RAM supply)	E5, H14, N7	PWR	1.2V internal ram supply voltage pins
DVDD18 (I/O supply)	F14, G6, G10, G11, G12, J13, K5, L6, P13, R13	PWR	1.8V I/O supply voltage pins. DVDD18 must be powered even if all of the DVDD3318_x supplies are operated at 3.3V.
DVDD3318_A (I/O supply)	F5, F15, G5, G14, G15, H5	PWR	1.8V or 3.3-V dual-voltage LVCMOS I/O supply voltage pins, Group A
DVDD3318_B (I/O supply)	E14, F6, F7, F8, F10, F11, F12, F13, G9, J14, K15	PWR	1.8V or 3.3-V dual-voltage LVCMOS I/O supply voltage pins, Group B
DVDD3318_C (I/O supply)	J5, K13, L4, L13, M13, N13, P5, P6, P12, R4	PWR	1.8V or 3.3-V dual-voltage LVCMOS I/O supply voltage pins, Group C
VSS (Ground)	A19, H8, H9, H15, J7, J8, J9, J10, J11, K7, K8, K9, K10, K11, L5, L7, L8, L9, L10, L11, M4, M5, M6, M7, M10, M11, N5, N11, N12, P11	GND	Ground pins.
DDR_DVDD18	N6, N9, N10, P7, P8, P9, P10, R7, R8, R9	PWR	DDR PHY 1.8V power supply pins

(1) PWR = Supply voltage, GND - Ground.

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3.8 Unused Pin Configurations

All signals multiplexed with multiple functions may be used as an alternate function if a given peripheral is not used. Unused non-multiplexed signals and some other specific signals should be handled as specified in the tables below.

If NMI is unused, it should be pulled-high externally through a 10k-ohm resistor to supply DVDD3318_B.

Table 3-24. Unused RTC Signal Configuration

SIGNAL NAME	Configuration
RTC_XI	May be held high (CVDD) or low
$\overline{\text{RTC_XO}}$	No Connect
RTC_ALARM	May be used as GPIO or other peripheral function
RTC_CVDD	Connect to CVDD
RTC_VSS	VSS

Table 3-25. Unused DDR2/mDDR Memory Controller Signal Configuration

SIGNAL NAME	Configuration (1)
DDR_D[15:0]	No Connect
DDR_A[13:0]	No Connect
DDR_CLKP	No Connect
DDR_CLKN	No Connect
DDR_CKE	No Connect
DDR_WE	No Connect
DDR_RAS	No Connect
DDR_CAS	No Connect
DDS_CS	No Connect
DDR_DQM[1:0]	No Connect
DDR_DQS[1:0]	No Connect
DDR_BA[2:0]	No Connect
DDR_DQGATE0	No Connect
DDR_DQGATE1	No Connect
DDR_ZP	No Connect
DDR_VREF	No Connect
DDR_DVDD18	No Connect

(1) The DDR2/mDDR input buffers are enabled by default on device power up and a maximum current draw of 25mA can result on the 1.8V supply. To minimize power consumption, the DDR2/mDDR controller input receivers should be placed in power-down mode by setting VTPIO[14] = 1.

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4 Device Configuration

4.1 Boot Modes

This device supports a variety of boot modes through an internal DSP ROM bootloader. This device does not support dedicated hardware boot modes; therefore, all boot modes utilize the internal DSP ROM. The input states of the BOOT pins are sampled and latched into the BOOTCFG register, which is part of the system configuration (SYSCFG) module, when device reset is deasserted. Boot mode selection is determined by the values of the BOOT pins.

See *Using the TMS320C6748/C6746/C6742 Bootloader* (SPRAAT2) for more details on the ROM Boot Loader.

The following boot modes are supported:

- NAND Flash boot
  - 8-bit NAND
  - 16-bit NAND (supported on ROM revisions after d800k002 -- see the bootloader documents mentioned above to determine the ROM revision)
- NOR Flash boot
  - NOR Direct boot (8-bit or 16-bit)
  - NOR Legacy boot (8-bit or 16-bit)
  - NOR AIS boot (8-bit or 16-bit)
- HPI Boot
- I2C0 Boot
  - EEPROM (Master Mode)
  - External Host (Slave Mode)
- SPI1 Boot
  - Serial Flash (Master Mode)
  - SERIAL EEPROM (Master Mode)
  - External Host (Slave Mode)
- UART0 Boot
  - External Host

4.2 SYSCFG Module

The following system level features of the chip are controlled by the SYSCFG peripheral:

- Readable Device, Die, and Chip Revision ID
- Control of Pin Multiplexing
- Priority of bus accesses different bus masters in the system
- Capture at power on reset the chip BOOT pin values and make them available to software
- Control of the DeepSleep power management function
- Enable and selection of the programmable pin pullups and pulldowns
- Special case settings for peripherals:
  - Locking of PLL controller settings
  - Default burst sizes for EDMA3 transfer controllers
  - Selection of the source for the eCAP module input capture (including on chip sources)
  - McASP AMUTEIN selection and clearing of AMUTE status for the McASP
  - Clock source selection for EMIFA
  - DDR2 Controller PHY settings
- Selects the source of emulation suspend signal (from DSP) of peripherals supporting this function.

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Many registers are accessible only by a host (DSP) when it is operating in its privileged mode. (ex. from the kernel, but not from user space code).

Table 4-1. System Configuration (SYSCFG) Module Register Access

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION	REGISTER ACCESS
0x01C1 4000	REVID	Revision Identification Register	—
0x01C1 4008	DIEIDR0	Device Identification Register 0	—
0x01C1 400C	DIEIDR1	Device Identification Register 1	—
0x01C1 4010	DIEIDR2	Device Identification Register 2	—
0x01C1 4014	DIEIDR3	Device Identification Register 3	—
0x01C1 4020	BOOTCFG	Boot Configuration Register	Privileged mode
0x01C1 4038	KICK0R	Kick 0 Register	Privileged mode
0x01C1 403C	KICK1R	Kick 1 Register	Privileged mode
0x01C1 4044	HOST1CFG	Host 1 Configuration Register	—
0x01C1 40E0	IRAWSTAT	Interrupt Raw Status/Set Register	Privileged mode
0x01C1 40E4	IENSTAT	Interrupt Enable Status/Clear Register	Privileged mode
0x01C1 40E8	IENSET	Interrupt Enable Register	Privileged mode
0x01C1 40EC	IENCLR	Interrupt Enable Clear Register	Privileged mode
0x01C1 40F0	EOI	End of Interrupt Register	Privileged mode
0x01C1 40F4	FLTADDRR	Fault Address Register	Privileged mode
0x01C1 40F8	FLTSTAT	Fault Status Register	—
0x01C1 4110	MSTPRI0	Master Priority 0 Registers	Privileged mode
0x01C1 4114	MSTPRI1	Master Priority 1 Registers	Privileged mode
0x01C1 4118	MSTPRI2	Master Priority 2 Registers	Privileged mode
0x01C1 4120	PINMUX0	Pin Multiplexing Control 0 Register	Privileged mode
0x01C1 4124	PINMUX1	Pin Multiplexing Control 1 Register	Privileged mode
0x01C1 4128	PINMUX2	Pin Multiplexing Control 2 Register	Privileged mode
0x01C1 412C	PINMUX3	Pin Multiplexing Control 3 Register	Privileged mode
0x01C1 4130	PINMUX4	Pin Multiplexing Control 4 Register	Privileged mode
0x01C1 4134	PINMUX5	Pin Multiplexing Control 5 Register	Privileged mode
0x01C1 4138	PINMUX6	Pin Multiplexing Control 6 Register	Privileged mode
0x01C1 413C	PINMUX7	Pin Multiplexing Control 7 Register	Privileged mode
0x01C1 4140	PINMUX8	Pin Multiplexing Control 8 Register	Privileged mode
0x01C1 4144	PINMUX9	Pin Multiplexing Control 9 Register	Privileged mode
0x01C1 4148	PINMUX10	Pin Multiplexing Control 10 Register	Privileged mode
0x01C1 414C	PINMUX11	Pin Multiplexing Control 11 Register	Privileged mode
0x01C1 4150	PINMUX12	Pin Multiplexing Control 12 Register	Privileged mode
0x01C1 4154	PINMUX13	Pin Multiplexing Control 13 Register	Privileged mode
0x01C1 4158	PINMUX14	Pin Multiplexing Control 14 Register	Privileged mode
0x01C1 415C	PINMUX15	Pin Multiplexing Control 15 Register	Privileged mode
0x01C1 4160	PINMUX16	Pin Multiplexing Control 16 Register	Privileged mode
0x01C1 4164	PINMUX17	Pin Multiplexing Control 17 Register	Privileged mode
0x01C1 4168	PINMUX18	Pin Multiplexing Control 18 Register	Privileged mode
0x01C1 416C	PINMUX19	Pin Multiplexing Control 19 Register	Privileged mode
0x01C1 4170	SUSPSRC	Suspend Source Register	Privileged mode
0x01C1 4174	CHIPSIG	Chip Signal Register	—
0x01C1 4178	CHIPSIG_CLR	Chip Signal Clear Register	—
0x01C1 417C	CFGCHIP0	Chip Configuration 0 Register	Privileged mode
0x01C1 4180	CFGCHIP1	Chip Configuration 1 Register	Privileged mode

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Table 4-1. System Configuration (SYSCFG) Module Register Access (continued)

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION	REGISTER ACCESS
0x01C1 4188	CFGCHIP3	Chip Configuration 3 Register	Privileged mode
0x01C1 418C	CFGCHIP4	Chip Configuration 4 Register	Privileged mode
0x01E2 C000	VTPIO_CTL	VTPIO COntrol Register	Privileged mode
0x01E2 C004	DDR_SLEW	DDR Slew Register	Privileged mode
0x01E2 C008	DeepSleep	DeepSleep Register	Privileged mode
0x01E2 C00C	PUPD_ENA	Pullup / Pulldown Enable Register	Privileged mode
0x01E2 C010	PUPD_SEL	Pullup / Pulldown Selection Register	Privileged mode
0x01E2 C014	RXACTIVE	RXACTIVE Control Register	Privileged mode

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4.3 Pullup/Pulldown Resistors

Proper board design should ensure that input pins to the device always be at a valid logic level and not floating. This may be achieved via pullup/pulldown resistors. The device features internal pullup (IPU) and internal pulldown (IPD) resistors on most pins to eliminate the need, unless otherwise noted, for external pullup/pulldown resistors.

An external pullup/pulldown resistor needs to be used in the following situations:

- Boot and Configuration Pins: If the pin is both routed out and 3-stated (not driven), an external pullup/pulldown resistor is strongly recommended, even if the IPU/IPD matches the desired value/state.
- Other Input Pins: If the IPU/IPD does not match the desired value/state, use an external pullup/pulldown resistor to pull the signal to the opposite rail.

For the boot and configuration pins, if they are both routed out and 3-stated (not driven), it is strongly recommended that an external pullup/pulldown resistor be implemented. Although, internal pullup/pulldown resistors exist on these pins and they may match the desired configuration value, providing external connectivity can help ensure that valid logic levels are latched on these device boot and configuration pins. In addition, applying external pullup/pulldown resistors on the boot and configuration pins adds convenience to the user in debugging and flexibility in switching operating modes.

Tips for choosing an external pullup/pulldown resistor:

- Consider the total amount of current that may pass through the pullup or pulldown resistor. Make sure to include the leakage currents of all the devices connected to the net, as well as any internal pullup or pulldown resistors.
- Decide a target value for the net. For a pulldown resistor, this should be below the lowest V_{IL} level of all inputs connected to the net. For a pullup resistor, this should be above the highest V_{IH} level of all inputs on the net. A reasonable choice would be to target the V_{OL} or V_{OH} levels for the logic family of the limiting device; which, by definition, have margin to the V_{IL} and V_{IH} levels.
- Select a pullup/pulldown resistor with the largest possible value; but, which can still ensure that the net will reach the target pulled value when maximum current from all devices on the net is flowing through the resistor. The current to be considered includes leakage current plus, any other internal and external pullup/pulldown resistors on the net.
- For bidirectional nets, there is an additional consideration which sets a lower limit on the resistance value of the external resistor. Verify that the resistance is small enough that the weakest output buffer can drive the net to the opposite logic level (including margin).
- Remember to include tolerances when selecting the resistor value.
- For pullup resistors, also remember to include tolerances on the IO supply rail.
- For most systems, a 1-kΩ resistor can be used to oppose the IPU/IPD while meeting the above criteria. Users should confirm this resistor value is correct for their specific application.
- For most systems, a 20-kΩ resistor can be used to compliment the IPU/IPD on the boot and configuration pins while meeting the above criteria. Users should confirm this resistor value is correct for their specific application.
- For more detailed information on input current (I_I), and the low-/high-level input voltages (V_{IL} and V_{IH}) for the device, see Section 5.3, Recommended Operating Conditions.
- For the internal pullup/pulldown resistors for all device pins, see the peripheral/system-specific terminal functions table.

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5 Specifications

5.1 Absolute Maximum Ratings Over Operating Junction Temperature Range (Unless Otherwise Noted) (1)

Supply voltage ranges	Core Logic, Variable and Fixed (CVDD, RVDD, RTC_CVDD, PLL0_VDDA , PLL1_VDDA) (2)	-0.5 V to 1.4 V
	I/O, 1.8V (DDR_DVDD18) (2)	-0.5 V to 2 V
	I/O, 3.3V (DVDD3318_A, DVDD3318_B, DVDD3318_C) (2)	-0.5 V to 3.8V
Input voltage (V_I) ranges	Oscillator inputs (OSCIN, RTC_XI), 1.2V	-0.3 V to CVDD + 0.3V
	Dual-voltage LVCMOS inputs, 3.3V or 1.8V (Steady State)	-0.3V to DVDD + 0.3V
	Dual-voltage LVCMOS inputs, 3.3V or 1.8V (Transient Overshoot/Undershoot)	DVDD + 20% up to 20% of Signal Period
Output voltage (V_O) ranges	Dual-voltage LVCMOS outputs, 3.3V or 1.8V (Steady State)	-0.3 V to DVDD + 0.3V
	Dual-voltage LVCMOS outputs, operated at 3.3V (Transient Overshoot/Undershoot)	DVDD + 20% up to 20% of Signal Period
	Dual-voltage LVCMOS outputs, operated at 1.8V (Transient Overshoot/Undershoot)	DVDD + 30% up to 30% of Signal Period
Clamp Current	Input or Output Voltages 0.3V above or below their respective power rails. Limit clamp current that flows through the I/O's internal diode protection cells.	±20mA
Operating Junction Temperature ranges, T_J	Commercial (default)	0°C to 90°C
	Extended (A version)	-40°C to 105°C

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values are with respect to VSS, PLL0_VSSA, OSCVSS, RTC_VSS

5.2 Handling Ratings

		MIN	MAX	UNIT
Storage temperature range, T_{stg}	(default)	-55	150	°C
ESD Stress Voltage, V_{ESD} (1)	Human Body Model (HBM)	>1	>1	kV
	Charged Device Model (CDM)	>500	>500	V

(1) Electrostatic discharge (ESD) to measure device sensitivity/immunity to damage caused by electrostatic discharges into the device.

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5.3 Recommended Operating Conditions

	NAME	DESCRIPTION	CONDITION	MIN	NOM	MAX	UNIT
Supply Voltage	CVDD	Core Logic Supply Voltage (variable)	1.2V operating point	1.14	1.2	1.32	V
			1.1V operating point	1.05	1.1	1.16	V
			1.0V operating point	0.95	1.0	1.05	V
	RVDD	Internal RAM Supply Voltage		1.14	1.2	1.32	V
	RTC_CVDD(1)	RTC Core Logic Supply Voltage		0.9	1.2	1.32	V
	PLL0_VDDA	PLL0 Supply Voltage		1.14	1.2	1.32	V
	PLL1_VDDA	PLL1 Supply Voltage		1.14	1.2	1.32	V
	DVDD18(2)	1.8V Supply Voltage		1.71	1.8	1.89	V
	DDR_DVDD18 (2)	DDR2 PHY Supply Voltage		1.71	1.8	1.89	V
	DDR_VREF	DDR2/mDDR reference voltage		0.49* DDR_DVDD18	0.5* DDR_DVDD18	0.51* DDR_DVDD18	V
	DDR_ZP	DDR2/mDDR impedance control, connected via 50Ω resistor to Vss			Vss		V
	DVDD3318_A	Power Group A Dual-voltage IO Supply Voltage	1.8V operating point	1.71	1.8	1.89	V
			3.3V operating point	3.15	3.3	3.45	V
	DVDD3318_B	Power Group B Dual-voltage IO Supply Voltage	1.8V operating point	1.71	1.8	1.89	V
			3.3V operating point	3.15	3.3	3.45	V
	DVDD3318_C	Power Group C Dual-voltage IO Supply Voltage	1.8V operating point	1.71	1.8	1.89	V
			3.3V operating point	3.15	3.3	3.45	V
Supply Ground	VSS	Core Logic Digital Ground		0	0	0	V
	PLL0_VSSA	PLL0 Ground					
	PLL1_VSSA	PLL1 Ground					
	OSCVSS(3)	Oscillator Ground					
	RTC_VSS(3)	RTC Oscillator Ground					
Voltage Input High	V_{IH}	High-level input voltage, Dual-voltage I/O, 3.3V(4)		2			V
		High-level input voltage, Dual-voltage I/O, 1.8V (4)		0.65*DVDD			V
		High-level input voltage, RTC_XI		0.8*RTC_CVDD			V
		High-level input voltage, OSCIN		0.8*CVDD			V
Voltage Input Low	V_{IL}	Low-level input voltage, Dual-voltage I/O, 3.3V(4)				0.8	V
		Low-level input voltage, Dual-voltage I/O, 1.8V (4)				0.35*DVDD	V
		Low-level input voltage, RTC_XI				0.2*RTC_CVDD	V
		Low-level input voltage, OSCIN				0.2*CVDD	V
Transition Time	t_t	Transition time, 10%-90%, All Inputs (unless otherwise specified in the electrical data sections)				0.25P or 10 (5)	ns
Operating Frequency	$F_{PLL0_SYSCLK1,6}$	Commercial temperature grade (default)	CVDD = 1.2V operating point	0		200	MHz
			CVDD = 1.1V operating point	0		150	
			CVDD = 1.0V operating point	0		100	
		Extended temperature grade (A suffix)	CVDD = 1.2V operating point	0		200	MHz
			CVDD = 1.1V operating point	0		150	
			CVDD = 1.0V operating point	0		100	

(1) The RTC provides an option for isolating the RTC_CVDD from the CVDD to reduce current leakage when the RTC is powered independently. If these power supplies are not isolated (CTRL.SPLITPOWER=0), RTC_CVDD must be equal to or greater than CVDD. If these power supplies are isolated (CTRL.SPLITPOWER=1), RTC_CVDD may be lower than CVDD.
(2) DVDD18 must be powered even if all of the DVDD3318_x x supplies are operated at 3.3V.
(3) When an external crystal is used oscillator (OSC_VSS, RTC_VSS) ground must be kept separate from other grounds and connected directly to the crystal load capacitor ground. These pins are shorted to VSS on the device itself and should not be connected to VSS on the circuit board. If a crystal is not used and the clock input is driven directly, then the oscillator VSS may be connected to board ground.
(4) These IO specifications apply to the dual-voltage IOs only and do not apply to DDR2/mDDR . DDR2/mDDR IOs are 1.8V IOs and adhere to the JESD79-2A standard.
(5) Whichever is smaller. P = the period of the applied signal. Maintaining transition times as fast as possible is recommended to improve noise immunity on input signals.

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5.4 Notes on Recommended Power-On Hours (POH)

The information in the section below is provided solely for your convenience and does not extend or modify the warranty provided under TI's standard terms and conditions for TI semiconductor products.

To avoid significant degradation, the device power-on hours (POH) must be limited to the following:

Table 5-1. Recommended Power-On Hours

Silicon Revision	Speed Grade	Operating Junction Temperature (Tj)	Nominal CVDD Voltage (V)	Power-On Hours [POH] (hours)
A	200 MHz	0 to 90 °C	1.2V	100,000
B/E	200 MHz	0 to 90 °C	1.2V	100,000
B/E	200 MHz	-40 to 105 °C	1.2V	100,000

Note: Logic functions and parameter values are not assured out of the range specified in the recommended operating conditions.

The above notations cannot be deemed a warranty or deemed to extend or modify the warranty under TI's standard terms and conditions for TI semiconductor products.

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5.5 Electrical Characteristics Over Recommended Ranges of Supply Voltage and Operating Junction Temperature (Unless Otherwise Noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage (dual-voltage LVCMOS IOs at 3.3V)(1)	DVDD= 3.15V, I_{OH} = -2 mA	2.4			V
		DVDD= 3.15V, I_{OH} = -100 µA	2.95			V
	High-level output voltage (dual-voltage LVCMOS IOs at 1.8V)(1)	DVDD= 1.71V, I_{OH} = -2 mA	DVDD-0.45			V
V_{OL}	Low-level output voltage (dual-voltage LVCMOS I/Os at 3.3V)(1)	DVDD= 3.15V, I_{OL} = 2mA			0.4	V
		DVDD= 3.15V, I_{OL} = 100 µA			0.2	V
	Low-level output voltage (dual-voltage LVCMOS I/Os at 1.8V)(1)	DVDD= 1.71V, I_{OL} = 2mA			0.45	V
I_I (2)	Input current(1) (dual-voltage LVCMOS I/Os)	V_I = VSS to DVDD without opposing internal resistor			±9	µA
		V_I = VSS to DVDD with opposing internal pullup resistor (3)	70		310	µA
		V_I = VSS to DVDD with opposing internal pulldown resistor (3)	-75		-270	µA
	Input current (DDR2/mDDR I/Os)	V_I = VSS to DVDD with opposing internal pulldown resistor (3)	-77		-286	µA
I_{OH}	High-level output current(1) (dual-voltage LVCMOS I/Os)				-6	mA
I_{OL}	Low-level output current(1) (dual-voltage LVCMOS I/Os)				6	mA
Capacitance	Input capacitance (dual-voltage LVCMOS)			3		pF
	Output capacitance (dual-voltage LVCMOS)			3		pF

(1) These IO specifications apply to the dual-voltage IOs only and do not apply to the DDR2/mDDR interface. DDR2/mDDR IOs are 1.8V IOs and adhere to the JESD79-2A standard.
(2) I_I applies to input-only pins and bi-directional pins. For input-only pins, I_I indicates the input leakage current. For bi-directional pins, I_I indicates the input leakage current and off-state (Hi-Z) output leakage current.
(3) Applies only to pins with an internal pullup (IPU) or pulldown (IPD) resistor. The pull-up and pull-down strengths shown represent the minimum and maximum strength across process variation.

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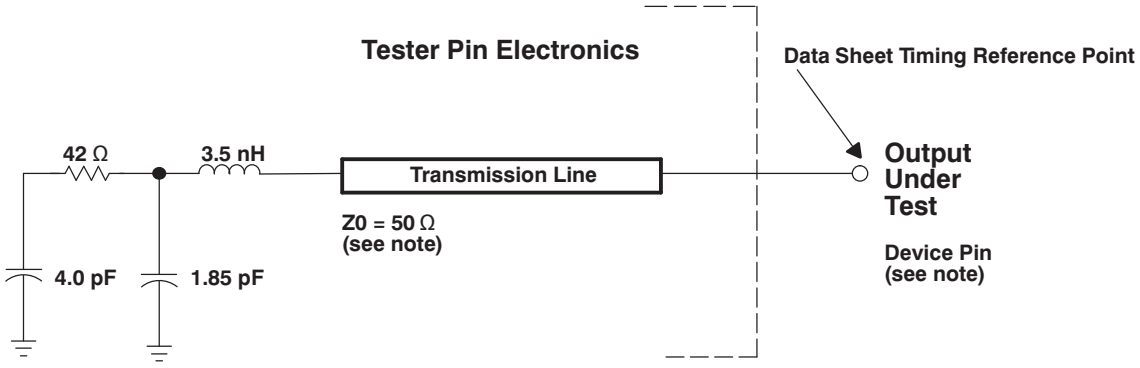
6 Peripheral Information and Electrical Specifications

6.1 Parameter Information

6.1.1 Parameter Information Device-Specific Information



A. The data sheet provides timing at the device pin. For output timing analysis, the tester pin electronics and its transmission line effects must be taken into account. A transmission line with a delay of 2 ns or longer can be used to produce the desired transmission line effect. The transmission line is intended as a load only. It is not necessary to add or subtract the transmission line delay (2 ns or longer) from the data sheet timings.
Input requirements in this data sheet are tested with an input slew rate of < 4 Volts per nanosecond (4 V/ns) at the device pin and the input signals are driven between 0V and the appropriate IO supply rail for the signal.

Figure 6-1. Test Load Circuit for AC Timing Measurements

The load capacitance value stated is only for characterization and measurement of AC timing signals. This load capacitance value does not indicate the maximum load the device is capable of driving.

6.1.1.1 Signal Transition Levels

All input and output timing parameters are referenced to V_{ref} for both "0" and "1" logic levels.

For 3.3 V I/O, V_{ref} = 1.65 V.

For 1.8 V I/O, V_{ref} = 0.9 V.

For 1.2 V I/O, V_{ref} = 0.6 V.

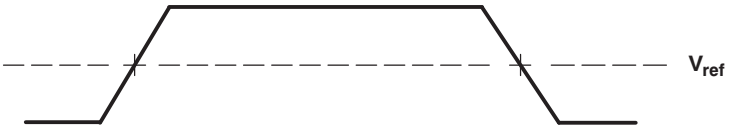


Figure 6-2. Input and Output Voltage Reference Levels for AC Timing Measurements

All rise and fall transition timing parameters are referenced to V_{IL} MAX and V_{IH} MIN for input clocks, V_{OL}MAX and V_{OH} MIN for output clocks

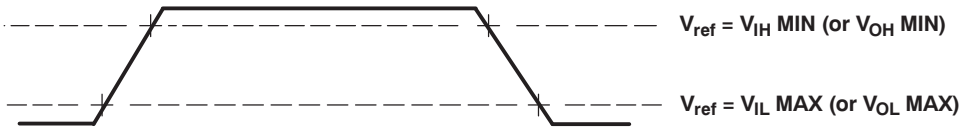


Figure 6-3. Rise and Fall Transition Time Voltage Reference Levels

6.2 Recommended Clock and Control Signal Transition Behavior

All clocks and control signals ***must*** transition between V_{IH} and V_{IL} (or between V_{IL} and V_{IH}) in a monotonic manner.

6.3 Power Supplies

6.3.1 Power-On Sequence

The device should be powered-on in the following order:

1. RTC (RTC_CVDD) may be powered from an external device (such as a battery) prior to all other supplies being applied or powered-up at the same time as CVDD. If the RTC is not used, RTC_CVDD should be connected to CVDD. RTC_CVDD should not be left unpowered while CVDD is powered.
2. Core logic supplies:
   (a) All variable 1.2V - 1.0V core logic supplies (CVDD)
   (b) All static core logic supplies (RVDD, PLL0_VDDA, PLL1_VDDA). If voltage scaling is not used on the device, groups 2a) and 2b) can be controlled from the same power supply and powered up together.
3. All static 1.8V IO supplies (DVDD18, DDR_DVDD18) and any of the LVCMOS IO supply groups used at 1.8V nominal (DVDD3318_A, DVDD3318_B, or DVDD3318_C).
4. LVCMOS IO supply groups used at 3.3V nominal (DVDD3318_A, DVDD3318_B, or DVDD3318_C).

There is no specific required voltage ramp rate for any of the supplies as long as the LVCMOS supplies operated at 3.3V (DVDD3318_A, DVDD3318_B, or DVDD3318_C) never exceed the STATIC 1.8V supplies by more than 2 volts.

RESET must be maintained active until all power supplies have reached their nominal values.

6.3.2 Power-Off Sequence

The power supplies can be powered-off in any order as long as LVCMOS supplies operated at 3.3V (DVDD3318_A, DVDD3318_B, or DVDD3318_C) never exceed static 1.8V supplies by more than 2 volts. There is no specific required voltage ramp down rate for any of the supplies (except as required to meet the above mentioned voltage condition).

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6.4 Reset

6.4.1 Power-On Reset (POR)

A power-on reset (POR) is required to place the device in a known good state after power-up. Power-On Reset is initiated by bringing RESET and TRST low at the same time. POR sets all of the device internal logic to its default state. All pins are tri-stated with the exception of RESETOUT which remains active through the reset sequence, and RTCK/GP8[0]. During reset, GP8[0] is configured as a reserved function, and its behavior is not deterministic; the user should be aware that this pin will drive a level, and fact may toggle, during reset. RESETOUT in an output for use by other controllers in the system that indicates the device is currently in reset.

While both TRST and RESET need to be asserted upon power up, only RESET needs to be released for the device to boot properly. TRST may be asserted indefinitely for normal operation, keeping the JTAG port interface and device's emulation logic in the reset state.

TRST only needs to be released when it is necessary to use a JTAG controller to debug the device or exercise the device's boundary scan functionality. Note: TRST is synchronous and must be clocked by TCK; otherwise, the boundary scan logic may not respond as expected after TRST is asserted.

RESET must be released only in order for boundary-scan JTAG to read the variant field of IDCODE correctly. Other boundary-scan instructions work correctly independent of current state of RESET. For maximum reliability, the device includes an internal pulldown on the TRST pin to ensure that TRST will always be asserted upon power up and the device's internal emulation logic will always be properly initialized.

JTAG controllers from Texas Instruments actively drive TRST high. However, some third-party JTAG controllers may not drive TRST high but expect the use of a pullup resistor on TRST. When using this type of JTAG controller, assert TRST to intialize the device after powerup and externally drive TRST high before attempting any emulation or boundary scan operations.

A summary of the effects of Power-On Reset is given below:

- All internal logic (including emulation logic and the PLL logic) is reset to its default state
- Internal memory is not maintained through a POR
- RESETOUT goes active
- All device pins go to a high-impedance state
- The RTC peripheral is not reset during a POR. A software sequence is required to reset the RTC

CAUTION: A watchdog reset triggers a POR.

6.4.2 Warm Reset

A warm reset provides a limited reset to the device. Warm Reset is initiated by bringing only RESET low (TRST is maintained high through a warm reset). Warm reset sets certain portions of the device to their default state while leaving others unaltered. All pins are tri-stated with the exception of RESETOUT which remains active through the reset sequence, and RTCK/GP8[0]. During reset, GP8[0] is configured as a reserved function, and its behavior is not deterministic; the user should be aware that this pin will drive a level, and fact may toggle, during reset. RESETOUT is an output for use by other controllers in the system that indicates the device is currently in reset.

During an emulation, the emulator will maintain TRST high and hence only warm reset (not POR) is available during emulation debug and development.

A summary of the effects of Warm Reset is given below:

- All internal logic (except for the emulation logic and the PLL logic) is reset to its default state
- Internal memory is maintained through a warm reset
- RESETOUT goes active
- All device pins go to a high-impedance state

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- The RTC peripheral is not reset during a warm reset. A software sequence is required to reset the RTC

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6.4.3 Reset Electrical Data Timings

Table 6-1 assumes testing over the recommended operating conditions.

Table 6-1. Reset Timing Requirements ((1), (2))

NO.			1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
1	$t_{w(RSTL)}$	Pulse width, $\overline{RESET}$/$\overline{TRST}$ low	100		100		100		ns
2	$t_{su(BPV-RSTH)}$	Setup time, boot pins valid before $\overline{RESET}$/$\overline{TRST}$ high	20		20		20		ns
3	$t_{h(RSTH-BPV)}$	Hold time, boot pins valid after $\overline{RESET}$/$\overline{TRST}$ high	20		20		20		ns
4	$t_{d(RSTH-RESETOUTH)}$	$\overline{RESET}$ high to $\overline{RESETOUT}$ high; Warm reset	4096		4096		4096		cycles (3)
		$\overline{RESET}$ high to $\overline{RESETOUT}$ high; Power-on Reset	6169		6169		6169		
5	$t_{d(RSTL-RESETOUTL)}$	Delay time, $\overline{RESET}$/$\overline{TRST}$ low to $\overline{RESETOUT}$ low		14		16		20	ns

(1) $\overline{RESETOUT}$ is multiplexed with other pin functions. See the Terminal Functions table, Table 3-5 for details.
(2) For power-on reset (POR), the reset timings in this table refer to $\overline{RESET}$ and $\overline{TRST}$ together. For warm reset, the reset timings in this table refer to $\overline{RESET}$ only ($\overline{TRST}$ is held high).
(3) OSCIN cycles.

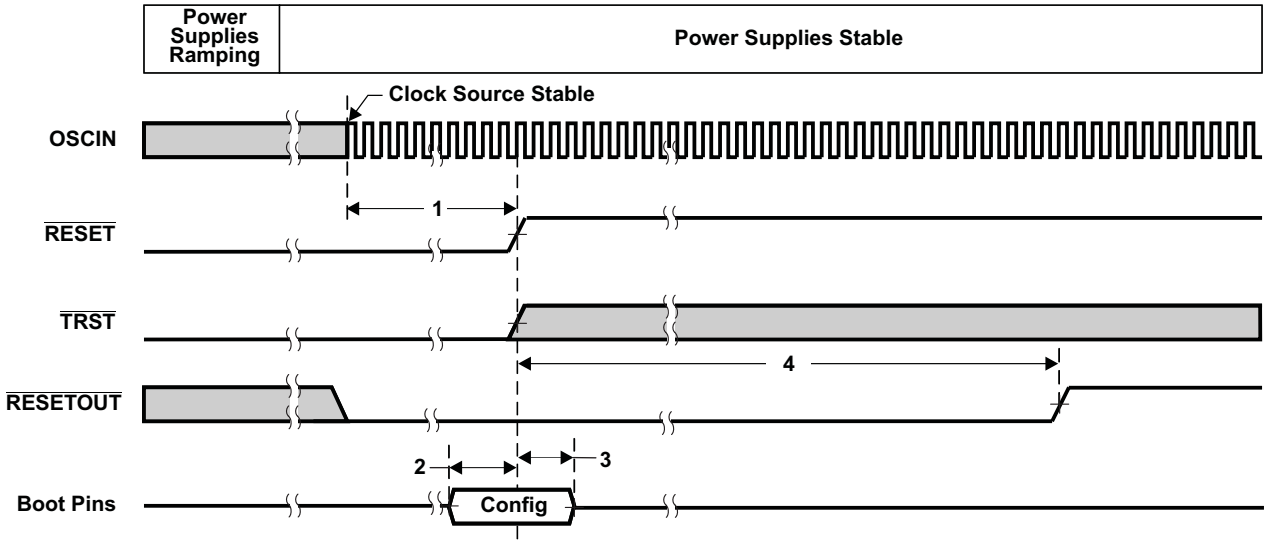

Figure 6-4. Power-On Reset ($\overline{RESET}$ and $\overline{TRST}$ active) Timing

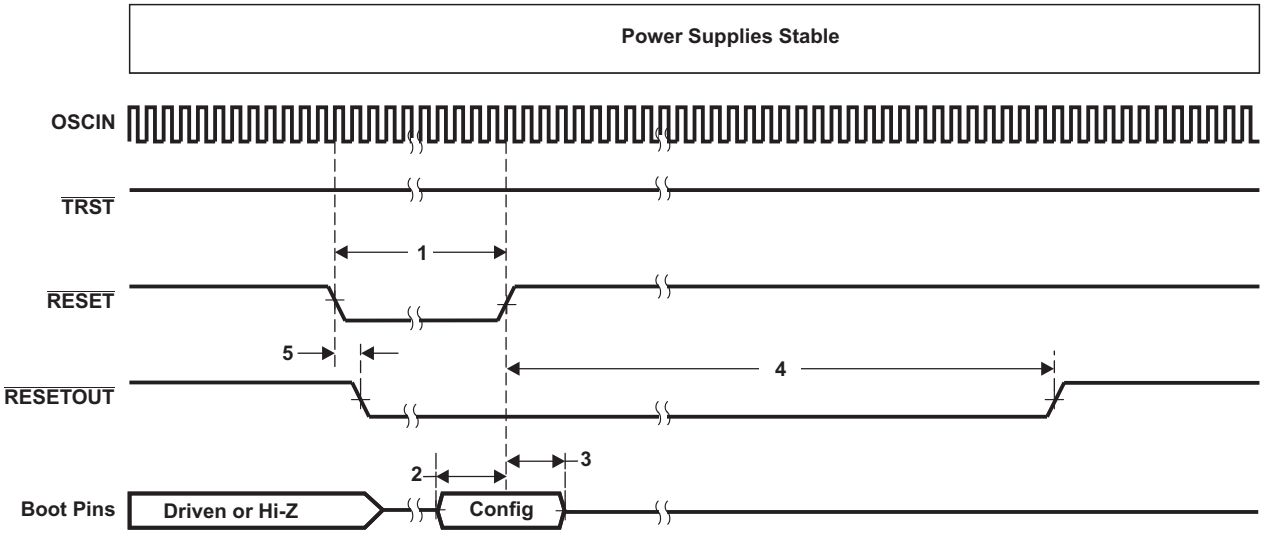

Figure 6-5. Warm Reset (RESET active, TRST high) Timing

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6.5 Crystal Oscillator or External Clock Input

The device includes two choices to provide an external clock input, which is fed to the on-chip PLLs to generate

high-frequency system clocks. These options are illustrated in Figure 6-6 and Figure 6-7. For input clock frequencies between 12 and 20 MHz, a crystal with 80 ohm max ESR is recommended. For input clock frequencies between 20 and 30 MHz, a crystal with 60 ohm max ESR is recommended. Typical load capacitance values are 10-20 pF, where the load capacitance is the series combination of C1 and C2.

The CLKMODE bit in the PLLCTL register must be 0 to use the on-chip oscillator. If CLKMODE is set to 1, the internal oscillator is disabled.

Figure 6-6 illustrates the option that uses on-chip 1.2V oscillator with external crystal circuit. Figure 6-7 illustrates the option that uses an external 1.2V clock input.

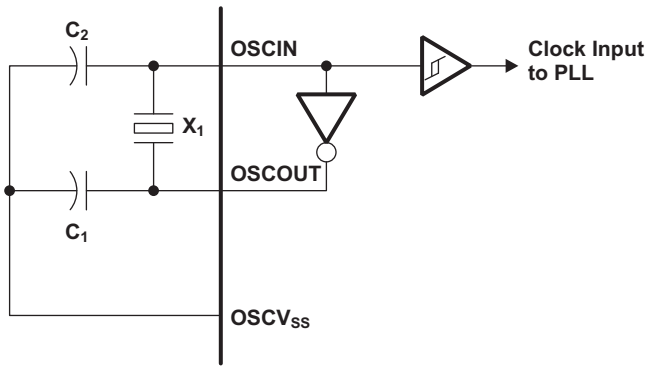

Figure 6-6. On-Chip Oscillator

Table 6-2. Oscillator Timing Requirements

PARAMETER		MIN	MAX	UNIT
f_{osc}	Oscillator frequency range (OSCIN/OSCOUT)	12	30	MHz

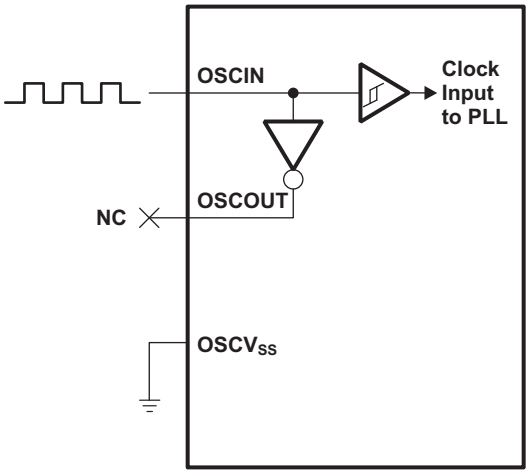

Figure 6-7. External 1.2V Clock Source

Table 6-3. OSCIN Timing Requirements for an Externally Driven Clock

PARAMETER		MIN	MAX	UNIT
f_{OSCIN}	OSCIN frequency range	12	50	MHz
$t_{c(OSCIN)}$	Cycle time, external clock driven on OSCIN	20		ns
$t_{w(OSCINH)}$	Pulse width high, external clock on OSCIN	0.4 $t_{c(OSCIN)}$		ns
$t_{w(OSCINL)}$	Pulse width low, external clock on OSCIN	0.4 $t_{c(OSCIN)}$		ns
$t_{t(OSCIN)}$	Transition time, OSCIN		0.25P or 10 (1)	ns
$t_{j(OSCIN)}$	Period jitter, OSCIN		0.02P	ns

(1) Whichever is smaller. P = the period of the applied signal. Maintaining transition times as fast as possible is recommended to improve noise immunity on input signals.

6.6 Clock PLLs

The device has two PLL controllers that provide clocks to different parts of the system. PLL0 provides clocks (though various dividers) to most of the components of the device. PLL1 provides clocks to the DDR2/mDDR Controller and provides an alternate clock source for the ASYNC3 clock domain. This allows the peripherals on the ASYNC3 clock domain to be immune to frequency scaling operation on PLL0.

The PLL controller provides the following:

- Glitch-Free Transitions (on changing clock settings)
- Domain Clocks Alignment
- Clock Gating
- PLL power down

The various clock outputs given by the controller are as follows:

- Domain Clocks: SYSCLK [1:n]
- Auxiliary Clock from reference clock source: AUXCLK

Various dividers that can be used are as follows:

- Post-PLL Divider: POSTDIV
- SYSCLK Divider: D1, ¼, Dn

Various other controls supported are as follows:

- PLL Multiplier Control: PLLM
- Software programmable PLL Bypass: PLLEN

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6.6.1 PLL Device-Specific Information

The device DSP generates the high-frequency internal clocks it requires through an on-chip PLL.

The PLL requires some external filtering components to reduce power supply noise as shown in Figure 6-8.

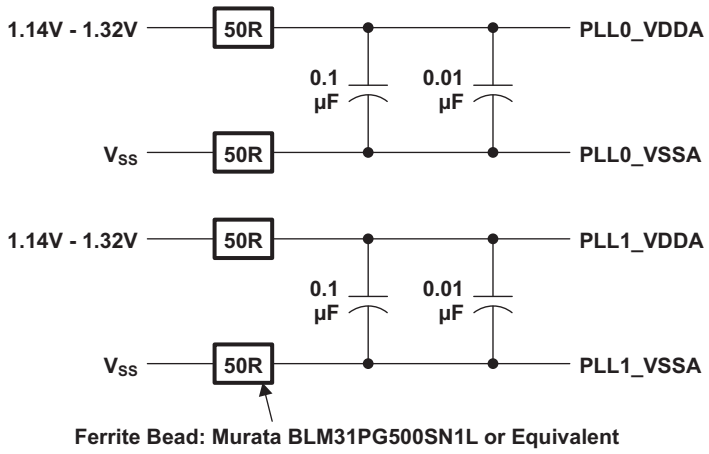

Figure 6-8. PLL External Filtering Components

The external filtering components shown above provide noise immunity for the PLLs. PLL0_VDDA and PLL1_VDDA should not be connected together to provide noise immunity between the two PLLs. Likewise, PLL0_VSSA and PLL1_VSSA should not be connected together.

The input to the PLL is either from the on-chip oscillator or from an external clock on the OSCIN pin. PLL0 outputs seven clocks that have programmable divider options. PLL1 outputs three clocks that have programmable divider options. Figure 6-9 illustrates the high-level view of the PLL Topology.

The PLLs are disabled by default after a device reset. They must be configured by software according to the allowable operating conditions listed in Table 6-4 before enabling the device to run from the PLL by setting PLLEN = 1.

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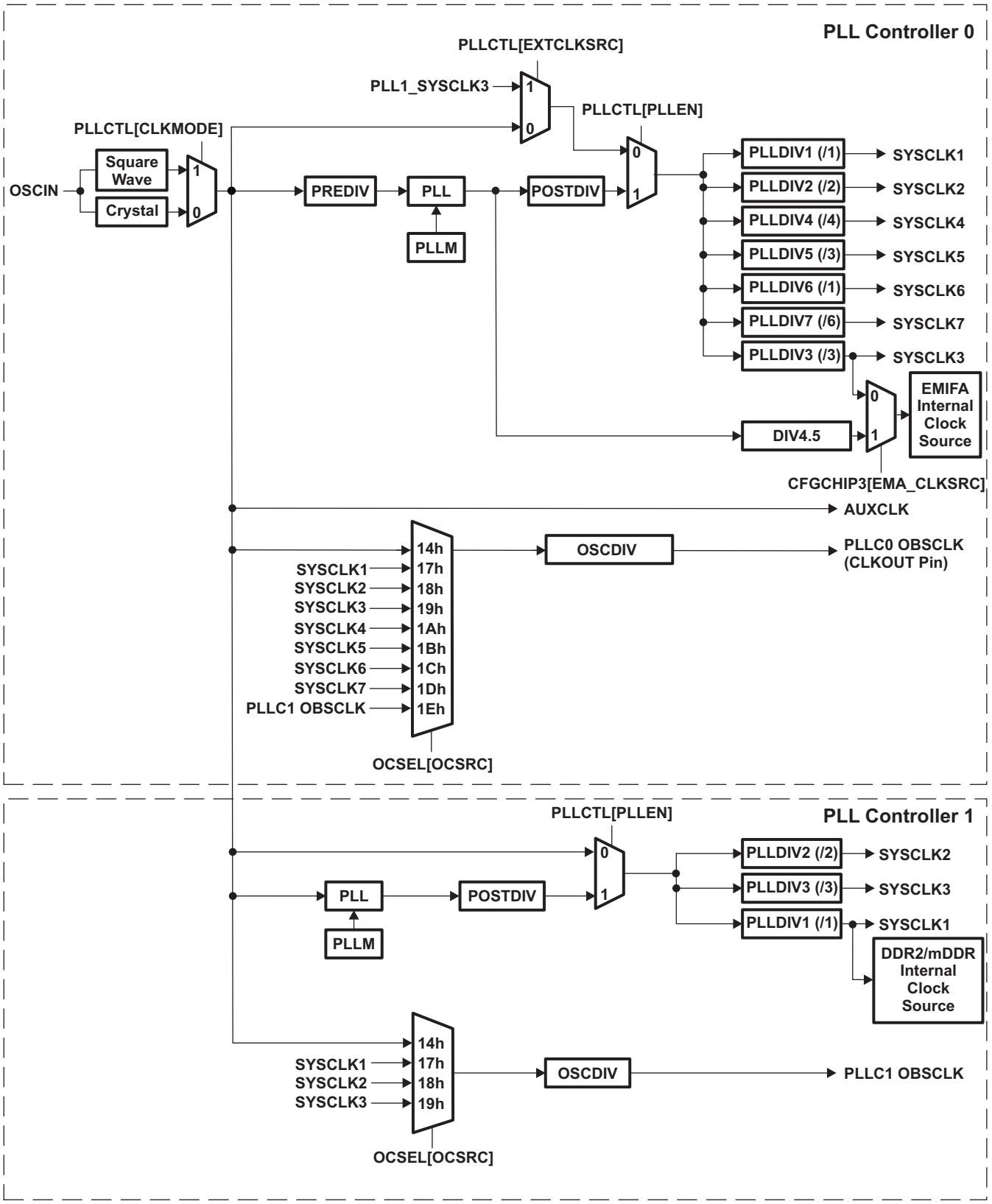

Figure 6-9. PLL Topology

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Table 6-4. Allowed PLL Operating Conditions (PLL0 and PLL1)

NO.	PARAMETER	Default Value	MIN	MAX	UNIT
1	**PLLRST**: Assertion time during initialization	N/A	1000	N/A	ns
2	**Lock time**: The time that the application has to wait for the PLL to acquire lock before setting PLLEN, after changing PREDIV, PLLM, or OSCIN	N/A	N/A	Max PLL Lock Time = $\frac{2000\,N}{\sqrt{m}}$ where N = Pre-Divider Ratio M = PLL Multiplier (1)	OSCIN cycles
3	**PREDIV**: Pre-divider value	/1	/1	/32	-
4	**PLLREF**: PLL input frequency		12	30 (if internal oscillator is used) 50 (if external clock is used)	MHz
5	**PLLM**: PLL multiplier values	x20	x4	x32	
6	**PLLOUT**: PLL output frequency	N/A	300	600	MHz
7	**POSTDIV**: Post-divider value	/1	/1	/32	-

(1) The multiplier values must be chosen such that the PLL output frequency (at PLLOUT) is between 300 and 600 MHz, but the frequency going into the SYSCLK dividers (after the post divider) cannot exceed the maximum clock frequency defined for the device at a given voltage operating point.

6.6.2 Device Clock Generation

PLL0 is controlled by PLL Controller 0 and PLL1 is controlled by PLL Controller 1. PLLC0 and PLLC1 manage the clock ratios, alignment, and gating for the system clocks to the chip. The PLLCs are responsible for controlling all modes of the PLL through software, in terms of pre-division of the clock inputs (PLLC0 only), multiply factors within the PLLs, and post-division for each of the chip-level clocks from the PLLs outputs. PLLC0 also controls reset propagation through the chip, clock alignment, and test points.

PLLC0 provides clocks for the majority of the system but PLLC1 provides clocks to the DDR2/mDDR Controller and the ASYNC3 clock domain to provide frequency scaling immunity to a defined set or peripherals. The ASYNC3 clock domain can either derive its clock from PLL1_SYSCLK2 (for frequency scaling immunity from PLL0) or from PLL0_SYSCLK2 (for synchronous timing with PLL0) depending on the application requirements. In addition, some peripherals have specific clock options independent of the ASYNC clock domain.

6.6.3 Dynamic Voltage and Frequency Scaling (DVFS)

The processor supports multiple operating points by scaling voltage and frequency to minimize power consumption for a given level of processor performance.

Frequency scaling is achieved by modifying the setting of the PLL controllers' multipliers, post-dividers (POSTDIV), and system clock dividers (SYSCLKn). Modification of the POSTDIV and SYSCLK values does not require relocking the PLL and provides lower latency to switch between operating points, but at the expense of the frequencies being limited by the integer divide values (only the divide values are altered the PLL multiplier is left unmodified). Non integer divide frequency values can be achieved by changing both the multiplier and the divide values, but when the PLL multiplier is changed the PLL must relock, incurring additional latency to change between operating points. Detailed information on modifying the PLL Controller settings can be found in the *TMS320C6742 DSP System Reference Guide* (SPRUGM5).

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Voltage scaling is enabled from outside the device by controlling an external voltage regulator. The processor may communicate with the regulator using GPIOs, I2C or some other interface. When switching between voltage-frequency operating points, the voltage must always support the desired frequency. When moving from a high-performance operating point to a lower performance operating point, the frequency should be lowered first followed by the voltage. When moving from a low-performance operating point to a higher performance operating point, the voltage should be raised first followed by the frequency. Voltage operating points refer to the CVdd voltage at that point. Other static supplies must be maintained at their nominal voltages at all operating points.

The maximum voltage slew rate for CVdd supply changes is 1 mV/us.

For additional information on power management solutions from TI for this processor, follow the Power Management link in the Product Folder on www.ti.com for this processor.

The processor supports multiple clock domains some of which have clock ratio requirements to each other. SYSCLK1:SYSCLK2:SYSCLK4:SYSCLK6 are synchronous to each other and the SYSCLKn dividers must always be configured such that the ratio between these domains is 1:2:4:1. The ASYNC and ASYNC3 clock domains are asynchronous to the other clock domains and have no specific ratio requirement.

Table 6-5 summarizes the maximum internal clock frequencies at each of the voltage operating points.

Table 6-5. Maximum Internal Clock Frequencies at Each Voltage Operating Point

CLOCK SOURCE	CLOCK DOMAIN		1.2V NOM	1.1V NOM	1.0V NOM
PLL0_SYSCLK1	DSP subsystem		200 MHz	150 MHz	100 MHz
PLL0_SYSCLK2	SYSCLK2 clock domain peripherals and optional clock source for ASYNC3 clock domain peripherals		100 MHz	75 MHz	50 MHz
PLL0_SYSCLK3	Optional clock for ASYNC1 clock domain (See ASYNC1 row)				
PLL0_SYSCLK4	SYSCLK4 domain peripherals		50 MHz	37.5 MHz	25 MHz
PLL0_SYSCLK5	Not used on this processor		-	-	-
PLL0_SYSCLK6	Not used on this processor		-	-	-
PLL0_SYSCLK7	Not used on this processor		-	-	-
PLL1_SYSCLK1	DDR2/mDDR Interface clock source (memory interface clock is one-half of the value shown)		312 MHz	300 MHz	266 MHz
PLL1_SYSCLK2	Optional clock source for ASYNC3 clock domain peripherals		150 MHz	100 MHz	75 MHz
PLL1_SYSCLK3	Alternate clock source input to PLL Controller 0		75 MHz	75 MHz	75 MHz
McASP AUXCLK	Bypass clock source for the McASP		50 MHz	50 MHz	50 MHz
PLL0_AUXCLK	Not used on this processor		-	-	-
ASYNC1	ASYNC Clock Domain (EMIFA)	Async Mode	148 MHz	75 MHz	50 MHz
		SDRAM Mode	100 MHz	66.6 MHz	50 MHz
ASYNC2	ASYNC2 Clock Domain (multiple peripherals)		50 MHz	50 MHz	50 MHz

Some interfaces have specific limitations on supported modes/speeds at each operating point. See the corresponding peripheral sections of this document for more information.

TI provides software components (called the Power Manager) to perform DVFS and abstract the task from the user. The Power Manager controls changing operating points (both frequency and voltage) and handles the related tasks involved such as informing/controlling peripherals to provide graceful transitions between operating points. The Power Manager is bundled as a component of DSP/BIOS.

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6.7 Interrupts

The device has a large number of interrupts to service the needs of its many peripherals and subsystems.

6.7.1 DSP Interrupts

The C674x DSP interrupt controller combines device events into 12 prioritized interrupts. The source for each of the 12 CPU interrupts is user programmable and is listed in Table 6-6. Also, the interrupt controller controls the generation of the CPU exceptions, NMI, and emulation interrupts. Table 6-7 summarizes the C674x interrupt controller registers and memory locations.

Refer to the *C674x DSP MegaModule Reference Guide* (SPRUFK5) and the *TMS320C674x DSP CPU and Instruction Set Reference Guide* (SPRUFE8) for details of the C674x interrupts.

Table 6-6. C6742 DSP Interrupts

EVT#	Interrupt Name	Source
0	EVT0	C674x Int Ctl 0
1	EVT1	C674x Int Ctl 1
2	EVT2	C674x Int Ctl 2
3	EVT3	C674x Int Ctl 3
4	T64P0_TINT12	Timer64P0 - TINT12
5	SYSCFG_CHIPINT2	SYSCFG CHIPSIG Register
6	-	Reserved
7	EHRPWM0	HiResTimer/PWM0 Interrupt
8	EDMA3_0_CC0_INT1	EDMA3_0 Channel Controller 0 Shadow Region 1 Transfer Completion Interrupt
9	EMU_DTDMA	C674x-ECM
10	EHRPWM0TZ	HiResTimer/PWM0 Trip Zone Interrupt
11	EMU_RTDXRX	C674x-RTDX
12	EMU_RTDXTX	C674x-RTDX
13	IDMAINT0	C674x-EMC
14	IDMAINT1	C674x-EMC
15-17	-	Reserved
18	EHRPWM1	HiResTimer/PWM1 Interrupt
19-22	-	Reserved
22	-	Reserved
23	EHRPWM1TZ	HiResTimer/PWM1 Trip Zone Interrupt
24-33	-	Reserved
34	UHPI_DSPINT	UHPI DSP Interrupt
35	-	Reserved
36	IIC0_INT	I2C0
37	-	Reserved
38	UART0_INT	UART0
39	-	Reserved
40	T64P1_TINT12	Timer64P1 Interrupt 12
41	GPIO_B1INT	GPIO Bank 1 Interrupt
42	-	Reserved
43	SPI1_INT	SPI1
44	-	Reserved
45	ECAP0	ECAP0
46	-	Reserved
47	ECAP1	ECAP1

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Table 6-6. C6742 DSP Interrupts (continued)

EVT#	Interrupt Name	Source
48	T64P1_TINT34	Timer64P1 Interrupt 34
49	GPIO_B2INT	GPIO Bank 2 Interrupt
50	-	Reserved
51	ECAP2	ECAP2
52	GPIO_B3INT	GPIO Bank 3 Interrupt
53	-	Reserved
54	GPIO_B4INT	GPIO Bank 4 Interrupt
55	EMIFA_INT	EMIFA
56	EDMA3_0_CC0_ERRINT	EDMA3_0 Channel Controller 0 Error Interrupt
57	EDMA3_0_TC0_ERRINT	EDMA3_0 Transfer Controller 0 Error Interrupt
58	EDMA3_0_TC1_ERRINT	EDMA3_0 Transfer Controller 1 Error Interrupt
59	GPIO_B5INT	GPIO Bank 5 Interrupt
60	DDR2_MEMERR	DDR2 Memory Error Interrupt
61	MCASP0_INT	McASP0 Combined RX/TX Interrupts
62	GPIO_B6INT	GPIO Bank 6 Interrupt
63	RTC_IRQS	RTC Combined
64	T64P0_TINT34	Timer64P0 Interrupt 34
65	GPIO_B0INT	GPIO Bank 0 Interrupt
66	-	Reserved
67	SYSCFG_CHIPINT3	SYSCFG_CHIPSIG Register
68	-	Reserved
69	-	Reserved
70	PSC0_ALLINT	PSC0
71	PSC1_ALLINT	PSC1
72	GPIO_B7INT	GPIO Bank 7 Interrupt
73	-	Reserved
74	PROTERR	SYSCFG Protection Shared Interrupt
75	GPIO_B8INT	GPIO Bank 8 Interrupt
76-88	-	Reserved
89	MCBSP1_RINT	McBSP1 Receive Interrupt
90	MCBSP1_XINT	McBSP1 Transmit Interrupt
91	EDMA3_1_CC0_INT1	EDMA3_1 Channel Controller 0 Shadow Region 1 Transfer Completion Interrupt
92	EDMA3_1_CC0_ERRINT	EDMA3_1 Channel Controller 0 Error Interrupt
93	EDMA3_1_TC0_ERRINT	EDMA3_1 Transfer Controller 0 Error Interrupt
94-95	-	Reserved
96	INTERR	C674x-Int Ctl
97	EMC_IDMAERR	C674x-EMC
98 - 112	-	Reserved
113	PMC_ED	C674x-PMC
114 - 115	-	Reserved
116	UMC_ED1	C674x-UMC
117	UMC_ED2	C674x-UMC
118	PDC_INT	C674x-PDC
119	SYS_CMPA	C674x-SYS
120	PMC_CMPA	C674x-PMC
121	PMC_CMPA	C674x-PMC
122	DMC_CMPA	C674x-DMC

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Table 6-6. C6742 DSP Interrupts (continued)

EVT#	Interrupt Name	Source
123	DMC_CMPA	C674x-DMC
124	UMC_CMPA	C674x-UMC
125	UMC_CMPA	C674x-UMC
126	EMC_CMPA	C674x-EMC
127	EMC_BUSERR	C674x-EMC

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Table 6-7. C674x DSP Interrupt Controller Registers

BYTE ADDRESS	ACRONYM	DESCRIPTION
0x0180 0000	EVTFLAG0	Event flag register 0
0x0180 0004	EVTFLAG1	Event flag register 1
0x0180 0008	EVTFLAG2	Event flag register 2
0x0180 000C	EVTFLAG3	Event flag register 3
0x0180 0020	EVTSET0	Event set register 0
0x0180 0024	EVTSET1	Event set register 1
0x0180 0028	EVTSET2	Event set register 2
0x0180 002C	EVTSET3	Event set register 3
0x0180 0040	EVTCLR0	Event clear register 0
0x0180 0044	EVTCLR1	Event clear register 1
0x0180 0048	EVTCLR2	Event clear register 2
0x0180 004C	EVTCLR3	Event clear register 3
0x0180 0080	EVTMASK0	Event mask register 0
0x0180 0084	EVTMASK1	Event mask register 1
0x0180 0088	EVTMASK2	Event mask register 2
0x0180 008C	EVTMASK3	Event mask register 3
0x0180 00A0	MEVTFLAG0	Masked event flag register 0
0x0180 00A4	MEVTFLAG1	Masked event flag register 1
0x0180 00A8	MEVTFLAG2	Masked event flag register 2
0x0180 00AC	MEVTFLAG3	Masked event flag register 3
0x0180 00C0	EXPMASK0	Exception mask register 0
0x0180 00C4	EXPMASK1	Exception mask register 1
0x0180 00C8	EXPMASK2	Exception mask register 2
0x0180 00CC	EXPMASK3	Exception mask register 3
0x0180 00E0	MEXPFLAG0	Masked exception flag register 0
0x0180 00E4	MEXPFLAG1	Masked exception flag register 1
0x0180 00E8	MEXPFLAG2	Masked exception flag register 2
0x0180 00EC	MEXPFLAG3	Masked exception flag register 3
0x0180 0104	INTMUX1	Interrupt mux register 1
0x0180 0108	INTMUX2	Interrupt mux register 2
0x0180 010C	INTMUX3	Interrupt mux register 3
0x0180 0140 - 0x0180 0144	-	Reserved
0x0180 0180	INTXSTAT	Interrupt exception status
0x0180 0184	INTXCLR	Interrupt exception clear
0x0180 0188	INTDMASK	Dropped interrupt mask register
0x0180 01C0	EVTASRT	Event assert register

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6.8 Power and Sleep Controller (PSC)

The Power and Sleep Controllers (PSC) are responsible for managing transitions of system power on/off, clock on/off, resets (device level and module level). It is used primarily to provide granular power control for on chip modules (peripherals and CPU). A PSC module consists of a Global PSC (GPSC) and a set of Local PSCs (LPSCs). The GPSC contains memory mapped registers, PSC interrupts, a state machine for each peripheral/module it controls. An LPSC is associated with every module that is controlled by the PSC and provides clock and reset control.

The PSC includes the following features:

- Provides a software interface to:
  - Control module clock enable/disable
  - Control module reset
  - Control CPU local reset
- Supports IcePick emulation features: power, clock and reset

  PSC0 controls 16 local PSCs.

  PSC1 controls 32 local PSCs.

Table 6-8. Power and Sleep Controller (PSC) Registers

PSC0 BYTE ADDRESS	PSC1 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01C1 0000	0x01E2 7000	REVID	Peripheral Revision and Class Information Register
0x01C1 0018	0x01E2 7018	INTEVAL	Interrupt Evaluation Register
0x01C1 0040	0x01E2 7040	MERRPR0	Module Error Pending Register 0 (module 0-15) (PSC0) Module Error Pending Register 0 (module 0-31) (PSC1)
0x01C1 0050	0x01E2 7050	MERRCR0	Module Error Clear Register 0 (module 0-15) (PSC0) Module Error Clear Register 0 (module 0-31) (PSC1)
0x01C1 0060	0x01E2 7060	PERRPR	Power Error Pending Register
0x01C1 0068	0x01E2 7068	PERRCR	Power Error Clear Register
0x01C1 0120	0x01E2 7120	PTCMD	Power Domain Transition Command Register
0x01C1 0128	0x01E2 7128	PTSTAT	Power Domain Transition Status Register
0x01C1 0200	0x01E2 7200	PDSTAT0	Power Domain 0 Status Register
0x01C1 0204	0x01E2 7204	PDSTAT1	Power Domain 1 Status Register
0x01C1 0300	0x01E2 7300	PDCTL0	Power Domain 0 Control Register
0x01C1 0304	0x01E2 7304	PDCTL1	Power Domain 1 Control Register
0x01C1 0400	0x01E2 7400	PDCFG0	Power Domain 0 Configuration Register
0x01C1 0404	0x01E2 7404	PDCFG1	Power Domain 1 Configuration Register
0x01C1 0800	0x01E2 7800	MDSTAT0	Module 0 Status Register
0x01C1 0804	0x01E2 7804	MDSTAT1	Module 1 Status Register
0x01C1 0808	0x01E2 7808	MDSTAT2	Module 2 Status Register
0x01C1 080C	0x01E2 780C	MDSTAT3	Module 3 Status Register
0x01C1 0810	0x01E2 7810	MDSTAT4	Module 4 Status Register
0x01C1 0814	0x01E2 7814	MDSTAT5	Module 5 Status Register
0x01C1 0818	0x01E2 7818	MDSTAT6	Module 6 Status Register
0x01C1 081C	0x01E2 781C	MDSTAT7	Module 7 Status Register
0x01C1 0820	0x01E2 7820	MDSTAT8	Module 8 Status Register
0x01C1 0824	0x01E2 7824	MDSTAT9	Module 9 Status Register
0x01C1 0828	0x01E2 7828	MDSTAT10	Module 10 Status Register
0x01C1 082C	0x01E2 782C	MDSTAT11	Module 11 Status Register
0x01C1 0830	0x01E2 7830	MDSTAT12	Module 12 Status Register
0x01C1 0834	0x01E2 7834	MDSTAT13	Module 13 Status Register

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Table 6-8. Power and Sleep Controller (PSC) Registers (continued)

PSC0 BYTE ADDRESS	PSC1 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01C1 0838	0x01E2 7838	MDSTAT14	Module 14 Status Register
0x01C1 083C	0x01E2 783C	MDSTAT15	Module 15 Status Register
-	0x01E2 7840	MDSTAT16	Module 16 Status Register
-	0x01E2 7844	MDSTAT17	Module 17 Status Register
-	0x01E2 7848	MDSTAT18	Module 18 Status Register
-	0x01E2 784C	MDSTAT19	Module 19 Status Register
-	0x01E2 7850	MDSTAT20	Module 20 Status Register
-	0x01E2 7854	MDSTAT21	Module 21 Status Register
-	0x01E2 7858	MDSTAT22	Module 22 Status Register
-	0x01E2 785C	MDSTAT23	Module 23 Status Register
-	0x01E2 7860	MDSTAT24	Module 24 Status Register
-	0x01E2 7864	MDSTAT25	Module 25 Status Register
-	0x01E2 7868	MDSTAT26	Module 26 Status Register
-	0x01E2 786C	MDSTAT27	Module 27 Status Register
-	0x01E2 7870	MDSTAT28	Module 28 Status Register
-	0x01E2 7874	MDSTAT29	Module 29 Status Register
-	0x01E2 7878	MDSTAT30	Module 30 Status Register
-	0x01E2 787C	MDSTAT31	Module 31 Status Register
0x01C1 0A00	0x01E2 7A00	MDCTL0	Module 0 Control Register
0x01C1 0A04	0x01E2 7A04	MDCTL1	Module 1 Control Register
0x01C1 0A08	0x01E2 7A08	MDCTL2	Module 2 Control Register
0x01C1 0A0C	0x01E2 7A0C	MDCTL3	Module 3 Control Register
0x01C1 0A10	0x01E2 7A10	MDCTL4	Module 4 Control Register
0x01C1 0A14	0x01E2 7A14	MDCTL5	Module 5 Control Register
0x01C1 0A18	0x01E2 7A18	MDCTL6	Module 6 Control Register
0x01C1 0A1C	0x01E2 7A1C	MDCTL7	Module 7 Control Register
0x01C1 0A20	0x01E2 7A20	MDCTL8	Module 8 Control Register
0x01C1 0A24	0x01E2 7A24	MDCTL9	Module 9 Control Register
0x01C1 0A28	0x01E2 7A28	MDCTL10	Module 10 Control Register
0x01C1 0A2C	0x01E2 7A2C	MDCTL11	Module 11 Control Register
0x01C1 0A30	0x01E2 7A30	MDCTL12	Module 12 Control Register
0x01C1 0A34	0x01E2 7A34	MDCTL13	Module 13 Control Register
0x01C1 0A38	0x01E2 7A38	MDCTL14	Module 14 Control Register
0x01C1 0A3C	0x01E2 7A3C	MDCTL15	Module 15 Control Register
-	0x01E2 7A40	MDCTL16	Module 16 Control Register
-	0x01E2 7A44	MDCTL17	Module 17 Control Register
-	0x01E2 7A48	MDCTL18	Module 18 Control Register
-	0x01E2 7A4C	MDCTL19	Module 19 Control Register
-	0x01E2 7A50	MDCTL20	Module 20 Control Register
-	0x01E2 7A54	MDCTL21	Module 21 Control Register
-	0x01E2 7A58	MDCTL22	Module 22 Control Register
-	0x01E2 7A5C	MDCTL23	Module 23 Control Register
-	0x01E2 7A60	MDCTL24	Module 24 Control Register
-	0x01E2 7A64	MDCTL25	Module 25 Control Register
-	0x01E2 7A68	MDCTL26	Module 26 Control Register
-	0x01E2 7A6C	MDCTL27	Module 27 Control Register
-	0x01E2 7A70	MDCTL28	Module 28 Control Register

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Table 6-8. Power and Sleep Controller (PSC) Registers (continued)

PSC0 BYTE ADDRESS	PSC1 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
-	0x01E2 7A74	MDCTL29	Module 29 Control Register
-	0x01E2 7A78	MDCTL30	Module 30 Control Register
-	0x01E2 7A7C	MDCTL31	Module 31 Control Register

6.8.1 Power Domain and Module Topology

The device includes two PSC modules.

Each PSC module controls clock states for several of the on chip modules, controllers and interconnect components. Table 6-9 and Table 6-10 lists the set of peripherals/modules that are controlled by the PSC, the power domain they are associated with, the LPSC assignment and the default (power-on reset) module states. The module states and terminology are defined in Section 6.8.1.2.

Table 6-9. PSC0 Default Module Configuration

LPSC Number	Module Name	Power Domain	Default Module State	Auto Sleep/Wake Only
0	EDMA3 Channel Controller 0	AlwaysON (PD0)	SwRstDisable	—
1	EDMA3 Transfer Controller 0	AlwaysON (PD0)	SwRstDisable	—
2	EDMA3 Transfer Controller 1	AlwaysON (PD0)	SwRstDisable	—
3	EMIFA (Br7)	AlwaysON (PD0)	SwRstDisable	—
4	—	—	—	—
5	—	—	—	—
6	—	—	—	—
7	—	—	—	—
8	—	—	—	—
9	UART 0	AlwaysON (PD0)	SwRstDisable	—
10	SCR0 (Br 0, Br 1, Br 2, Br 8)	AlwaysON (PD0)	Enable	Yes
11	SCR1 (Br 4)	AlwaysON (PD0)	Enable	Yes
12	SCR2 (Br 3, Br 5, Br 6)	AlwaysON (PD0)	Enable	Yes
13	—	—	—	—
14	—	—	—	—
15	DSP	PD_DSP (PD1)	Enable	—

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Table 6-10. PSC1 Default Module Configuration

LPSC Number	Module Name	Power Domain	Default Module State	Auto Sleep/Wake Only
0	EDMA3 Channel Controller 1	AlwaysON (PD0)	SwRstDisable	—
1	—	—	—	—
2	—	—	—	—
3	GPIO	AlwaysON (PD0)	SwRstDisable	—
4	UHPI	AlwaysON (PD0)	SwRstDisable	—
5	—	—	—	—
6	DDR2 (and SCR_F3)	AlwaysON (PD0)	SwRstDisable	—
7	McASP0 (+ McASP0 FIFO)	AlwaysON (PD0)	SwRstDisable	—
8	—	—	—	—
9	—	—	—	—
10	SPI 1	AlwaysON (PD0)	SwRstDisable	—
11	—	—	—	—
12	—	—	—	—
13	—	—	—	—
14	—	—	—	—
15	McBSP1 (+ McBSP1 FIFO)	AlwaysON (PD0)	SwRstDisable	—
16	—	—	—	—
17	eHRPWM0/1	AlwaysON (PD0)	SwRstDisable	—
18	—	—	—	—
19	—	—	—	—
20	ECAP0/1/2	AlwaysON (PD0)	SwRstDisable	—
21	EDMA3 Transfer Controller 2	AlwaysON (PD0)	SwRstDisable	—
22	—	—	—	—
23	—	—	—	—
24	SCR_F0 (and bridge F0)	AlwaysON (PD0)	Enable	Yes
25	SCR_F1 (and bridge F1)	AlwaysON (PD0)	Enable	Yes
26	SCR_F2 (and bridge F2)	AlwaysON (PD0)	Enable	Yes
27	SCR_F6 (and bridge F3)	AlwaysON (PD0)	Enable	Yes
28	SCR_F7 (and bridge F4)	AlwaysON (PD0)	Enable	Yes
29	SCR_F8 (and bridge F5)	AlwaysON (PD0)	Enable	Yes
30	Bridge F7 (DDR Controller path)	AlwaysON (PD0)	Enable	Yes
31	—	—	—	—

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6.8.1.1 Power Domain States

A power domain can only be in one of the two states: ON or OFF, defined as follows:

- ON: power to the domain is on
- OFF: power to the domain is off

For both PSC0 and PSC1, the Always ON domain, or PD0 power domain, is always in the ON state when the chip is powered-on. This domain is not programmable to OFF state.

- On PSC0 PD1/PD_DSP Domain: Controls the sleep state for DSP L1 and L2 Memories

6.8.1.2 Module States

The PSC defines several possible states for a module. This states are essentially a combination of the module reset asserted or de-asserted and module clock on/enabled or off/disabled. The module states are defined in Table 6-11.

Table 6-11. Module States

Module State	Module Reset	Module Clock	Module State Definition
Enable	De-asserted	On	A module in the enable state has its module reset de-asserted and it has its clock on. This is the normal operational state for a given module
Disable	De-asserted	Off	A module in the disabled state has its module reset de-asserted and it has its module clock off. This state is typically used for disabling a module clock to save power. The device is designed in full static CMOS, so when you stop a module clock, it retains the module's state. When the clock is restarted, the module resumes operating from the stopping point.
SyncReset	Asserted	On	A module state in the SyncReset state has its module reset asserted and it has its clock on. Generally, software is not expected to initiate this state
SwRstDisable	Asserted	Off	A module in the SwResetDisable state has its module reset asserted and it has its clock disabled. After initial power-on, several modules come up in the SwRstDisable state. Generally, software is not expected to initiate this state
Auto Sleep	De-asserted	Off	A module in the Auto Sleep state also has its module reset de-asserted and its module clock disabled, similar to the Disable state. However this is a special state, once a module is configured in this state by software, it can "automatically" transition to "Enable" state whenever there is an internal read/write request made to it, and after servicing the request it will "automatically" transition into the sleep state (with module reset re de-asserted and module clock disabled), without any software intervention. The transition from sleep to enabled and back to sleep state has some cycle latency associated with it. It is not envisioned to use this mode when peripherals are fully operational and moving data.
Auto Wake	De-asserted	Off	A module in the Auto Wake state also has its module reset de-asserted and its module clock disabled, similar to the Disable state. However this is a special state, once a module is configured in this state by software, it will "automatically" transition to "Enable" state whenever there is an internal read/write request made to it, and will remain in the "Enabled" state from then on (with module reset re de-asserted and module clock on), without any software intervention. The transition from sleep to enabled state has some cycle latency associated with it. It is not envisioned to use this mode when peripherals are fully operational and moving data.

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6.9 Enhanced Direct Memory Access Controller (EDMA3)

The EDMA3 controller handles all data transfers between memories and the device slave peripherals on the device. These data transfers include cache servicing, non-cacheable memory accesses, user-programmed data transfers, and host accesses.

6.9.1 EDMA3 Channel Synchronization Events

Each EDMA3 channel controller supports up to 32 channels which service peripherals and memory. Table 6-12 lists the source of the EDMA3 synchronization events associated with each of the programmable EDMA channels.

Table 6-12. EDMA Synchronization Events

EDMA3 Channel Controller 0			
Event	**Event Name / Source**	**Event**	**Event Name / Source**
0	McASP0 Receive	16	Reserved
1	McASP0 Transmit	17	Reserved
2	Reserved	18	SPI1 Receive
3	Reserved	19	SPI1 Transmit
4	McBSP1 Receive	20	Reserved
5	McBSP1 Transmit	21	Reserved
6	GPIO Bank 0 Interrupt	22	GPIO Bank 2 Interrupt
7	GPIO Bank 1 Interrupt	23	GPIO Bank 3 Interrupt
8	UART0 Receive	24	I2C0 Receive
9	UART0 Transmit	25	I2C0 Transmit
10	Timer64P0 Event Out 12	26	Reserved
11	Timer64P0 Event Out 34	27	Reserved
12	Reserved	28	GPIO Bank 4 Interrupt
13	Reserved	29	GPIO Bank 5 Interrupt
14-15	Reserved	30-31	Reserved
EDMA3 Channel Controller 1			
Event	Event Name / Source	Event	Event Name / Source
0	Reserved	16	GPIO Bank 6 Interrupt
1	Reserved	17	GPIO Bank 7 Interrupt
2	Reserved	18	GPIO Bank 8 Interrupt
3-15	Reserved	19-31	Reserved

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6.9.2 EDMA3 Peripheral Register Descriptions

Table 6-13 is the list of EDMA3 Channel Controller Registers and Table 6-14 is the list of EDMA3 Transfer Controller registers.

Table 6-13. EDMA3 Channel Controller (EDMA3CC) Registers

EDMA3_0 Channel Controller 0 BYTE ADDRESS	EDMA3_1 Channel Controller 0 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01C0 0000	0x01E3 0000	PID	Peripheral Identification Register
0x01C0 0004	0x01E3 0004	CCCFG	EDMA3CC Configuration Register
Global Registers			
0x01C0 0200	0x01E3 0200	QCHMAP0	QDMA Channel 0 Mapping Register
0x01C0 0204	0x01E3 0204	QCHMAP1	QDMA Channel 1 Mapping Register
0x01C0 0208	0x01E3 0208	QCHMAP2	QDMA Channel 2 Mapping Register
0x01C0 020C	0x01E3 020C	QCHMAP3	QDMA Channel 3 Mapping Register
0x01C0 0210	0x01E3 0210	QCHMAP4	QDMA Channel 4 Mapping Register
0x01C0 0214	0x01E3 0214	QCHMAP5	QDMA Channel 5 Mapping Register
0x01C0 0218	0x01E3 0218	QCHMAP6	QDMA Channel 6 Mapping Register
0x01C0 021C	0x01E3 021C	QCHMAP7	QDMA Channel 7 Mapping Register
0x01C0 0240	0x01E3 0240	DMAQNUM0	DMA Channel Queue Number Register 0
0x01C0 0244	0x01E3 0244	DMAQNUM1	DMA Channel Queue Number Register 1
0x01C0 0248	0x01E3 0248	DMAQNUM2	DMA Channel Queue Number Register 2
0x01C0 024C	0x01E3 024C	DMAQNUM3	DMA Channel Queue Number Register 3
0x01C0 0260	0x01E3 0260	QDMAQNUM	QDMA Channel Queue Number Register
0x01C0 0284	0x01E3 0284	QUEPRI	Queue Priority Register(1)
0x01C0 0300	0x01E3 0300	EMR	Event Missed Register
0x01C0 0308	0x01E3 0308	EMCR	Event Missed Clear Register
0x01C0 0310	0x01E3 0310	QEMR	QDMA Event Missed Register
0x01C0 0314	0x01E3 0314	QEMCR	QDMA Event Missed Clear Register
0x01C0 0318	0x01E3 0318	CCERR	EDMA3CC Error Register
0x01C0 031C	0x01E3 031C	CCERRCLR	EDMA3CC Error Clear Register
0x01C0 0320	0x01E3 0320	EEVAL	Error Evaluate Register
0x01C0 0340	0x01E3 0340	DRAE0	DMA Region Access Enable Register for Region 0
0x01C0 0348	0x01E3 0348	DRAE1	DMA Region Access Enable Register for Region 1
0x01C0 0350	0x01E3 0350	DRAE2	DMA Region Access Enable Register for Region 2
0x01C0 0358	0x01E3 0358	DRAE3	DMA Region Access Enable Register for Region 3
0x01C0 0380	0x01E3 0380	QRAE0	QDMA Region Access Enable Register for Region 0
0x01C0 0384	0x01E3 0384	QRAE1	QDMA Region Access Enable Register for Region 1
0x01C0 0388	0x01E3 0388	QRAE2	QDMA Region Access Enable Register for Region 2
0x01C0 038C	0x01E3 038C	QRAE3	QDMA Region Access Enable Register for Region 3
0x01C0 0400 - 0x01C0 043C	0x01E3 0400 - 0x01E3 043C	Q0E0-Q0E15	Event Queue Entry Registers Q0E0-Q0E15
0x01C0 0440 - 0x01C0 047C	0x01E3 0440 - 0x01E3 047C	Q1E0-Q1E15	Event Queue Entry Registers Q1E0-Q1E15
0x01C0 0600	0x01E3 0600	QSTAT0	Queue 0 Status Register
0x01C0 0604	0x01E3 0604	QSTAT1	Queue 1 Status Register
0x01C0 0620	0x01E3 0620	QWMTHRA	Queue Watermark Threshold A Register
0x01C0 0640	0x01E3 0640	CCSTAT	EDMA3CC Status Register

(1) On previous architectures, the EDMA3TC priority was controlled by the queue priority register (QUEPRI) in the EDMA3CC memory-map. However for this device, the priority control for the transfer controllers is controlled by the chip-level registers in the System Configuration Module. You should use the chip-level registers and not QUEPRI to configure the TC priority.

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Table 6-13. EDMA3 Channel Controller (EDMA3CC) Registers (continued)

EDMA3_0 Channel Controller 0 BYTE ADDRESS	EDMA3_1 Channel Controller 0 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
Global Channel Registers			
0x01C0 1000	0x01E3 1000	ER	Event Register
0x01C0 1008	0x01E3 1008	ECR	Event Clear Register
0x01C0 1010	0x01E3 1010	ESR	Event Set Register
0x01C0 1018	0x01E3 1018	CER	Chained Event Register
0x01C0 1020	0x01E3 1020	EER	Event Enable Register
0x01C0 1028	0x01E3 1028	EECR	Event Enable Clear Register
0x01C0 1030	0x01E3 1030	EESR	Event Enable Set Register
0x01C0 1038	0x01E3 1038	SER	Secondary Event Register
0x01C0 1040	0x01E3 1040	SECR	Secondary Event Clear Register
0x01C0 1050	0x01E3 1050	IER	Interrupt Enable Register
0x01C0 1058	0x01E3 1058	IECR	Interrupt Enable Clear Register
0x01C0 1060	0x01E3 1060	IESR	Interrupt Enable Set Register
0x01C0 1068	0x01E3 1068	IPR	Interrupt Pending Register
0x01C0 1070	0x01E3 1070	ICR	Interrupt Clear Register
0x01C0 1078	0x01E3 1078	IEVAL	Interrupt Evaluate Register
0x01C0 1080	0x01E3 1080	QER	QDMA Event Register
0x01C0 1084	0x01E3 1084	QEER	QDMA Event Enable Register
0x01C0 1088	0x01E3 1088	QEECR	QDMA Event Enable Clear Register
0x01C0 108C	0x01E3 108C	QEESR	QDMA Event Enable Set Register
0x01C0 1090	0x01E3 1090	QSER	QDMA Secondary Event Register
0x01C0 1094	0x01E3 1094	QSECR	QDMA Secondary Event Clear Register
Shadow Region 0 Channel Registers			
0x01C0 2000	0x01E3 2000	ER	Event Register
0x01C0 2008	0x01E3 2008	ECR	Event Clear Register
0x01C0 2010	0x01E3 2010	ESR	Event Set Register
0x01C0 2018	0x01E3 2018	CER	Chained Event Register
0x01C0 2020	0x01E3 2020	EER	Event Enable Register
0x01C0 2028	0x01E3 2028	EECR	Event Enable Clear Register
0x01C0 2030	0x01E3 2030	EESR	Event Enable Set Register
0x01C0 2038	0x01E3 2038	SER	Secondary Event Register
0x01C0 2040	0x01E3 2040	SECR	Secondary Event Clear Register
0x01C0 2050	0x01E3 2050	IER	Interrupt Enable Register
0x01C0 2058	0x01E3 2058	IECR	Interrupt Enable Clear Register
0x01C0 2060	0x01E3 2060	IESR	Interrupt Enable Set Register
0x01C0 2068	0x01E3 2068	IPR	Interrupt Pending Register
0x01C0 2070	0x01E3 2070	ICR	Interrupt Clear Register
0x01C0 2078	0x01E3 2078	IEVAL	Interrupt Evaluate Register
0x01C0 2080	0x01E3 2080	QER	QDMA Event Register
0x01C0 2084	0x01E3 2084	QEER	QDMA Event Enable Register
0x01C0 2088	0x01E3 2088	QEECR	QDMA Event Enable Clear Register
0x01C0 208C	0x01E3 208C	QEESR	QDMA Event Enable Set Register
0x01C0 2090	0x01E3 2090	QSER	QDMA Secondary Event Register
0x01C0 2094	0x01E3 2094	QSECR	QDMA Secondary Event Clear Register

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Table 6-13. EDMA3 Channel Controller (EDMA3CC) Registers (continued)

EDMA3_0 Channel Controller 0 BYTE ADDRESS	EDMA3_1 Channel Controller 0 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
Shadow Region 1 Channel Registers			
0x01C0 2200	0x01E3 2200	ER	Event Register
0x01C0 2208	0x01E3 2208	ECR	Event Clear Register
0x01C0 2210	0x01E3 2210	ESR	Event Set Register
0x01C0 2218	0x01E3 2218	CER	Chained Event Register
0x01C0 2220	0x01E3 2220	EER	Event Enable Register
0x01C0 2228	0x01E3 2228	EECR	Event Enable Clear Register
0x01C0 2230	0x01E3 2230	EESR	Event Enable Set Register
0x01C0 2238	0x01E3 2238	SER	Secondary Event Register
0x01C0 2240	0x01E3 2240	SECR	Secondary Event Clear Register
0x01C0 2250	0x01E3 2250	IER	Interrupt Enable Register
0x01C0 2258	0x01E3 2258	IECR	Interrupt Enable Clear Register
0x01C0 2260	0x01E3 2260	IESR	Interrupt Enable Set Register
0x01C0 2268	0x01E3 2268	IPR	Interrupt Pending Register
0x01C0 2270	0x01E3 2270	ICR	Interrupt Clear Register
0x01C0 2278	0x01E3 2278	IEVAL	Interrupt Evaluate Register
0x01C0 2280	0x01E3 2280	QER	QDMA Event Register
0x01C0 2284	0x01E3 2284	QEER	QDMA Event Enable Register
0x01C0 2288	0x01E3 2288	QEECR	QDMA Event Enable Clear Register
0x01C0 228C	0x01E3 228C	QEESR	QDMA Event Enable Set Register
0x01C0 2290	0x01E3 2290	QSER	QDMA Secondary Event Register
0x01C0 2294	0x01E3 2294	QSECR	QDMA Secondary Event Clear Register
0x01C0 4000 - 0x01C0 4FFF	0x01E3 4000 - 0x01E3 4FFF	—	Parameter RAM (PaRAM)

Table 6-14. EDMA3 Transfer Controller (EDMA3TC) Registers

EDMA3_0 Transfer Controller 0 BYTE ADDRESS	EDMA3_0 Transfer Controller 1 BYTE ADDRESS	EDMA3_1 Transfer Controller 0 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01C0 8000	0x01C0 8400	0x01E3 8000	PID	Peripheral Identification Register
0x01C0 8004	0x01C0 8404	0x01E3 8004	TCCFG	EDMA3TC Configuration Register
0x01C0 8100	0x01C0 8500	0x01E3 8100	TCSTAT	EDMA3TC Channel Status Register
0x01C0 8120	0x01C0 8520	0x01E3 8120	ERRSTAT	Error Status Register
0x01C0 8124	0x01C0 8524	0x01E3 8124	ERREN	Error Enable Register
0x01C0 8128	0x01C0 8528	0x01E3 8128	ERRCLR	Error Clear Register
0x01C0 812C	0x01C0 852C	0x01E3 812C	ERRDET	Error Details Register
0x01C0 8130	0x01C0 8530	0x01E3 8130	ERRCMD	Error Interrupt Command Register
0x01C0 8140	0x01C0 8540	0x01E3 8140	RDRATE	Read Command Rate Register
0x01C0 8240	0x01C0 8640	0x01E3 8240	SAOPT	Source Active Options Register
0x01C0 8244	0x01C0 8644	0x01E3 8244	SASRC	Source Active Source Address Register
0x01C0 8248	0x01C0 8648	0x01E3 8248	SACNT	Source Active Count Register
0x01C0 824C	0x01C0 864C	0x01E3 824C	SADST	Source Active Destination Address Register
0x01C0 8250	0x01C0 8650	0x01E3 8250	SABIDX	Source Active B-Index Register
0x01C0 8254	0x01C0 8654	0x01E3 8254	SAMPPRXY	Source Active Memory Protection Proxy Register
0x01C0 8258	0x01C0 8658	0x01E3 8258	SACNTRLD	Source Active Count Reload Register
0x01C0 825C	0x01C0 865C	0x01E3 825C	SASRCBREF	Source Active Source Address B-Reference Register
0x01C0 8260	0x01C0 8660	0x01E3 8260	SADSTBREF	Source Active Destination Address B-Reference Register

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Table 6-14. EDMA3 Transfer Controller (EDMA3TC) Registers (continued)

EDMA3_0 Transfer Controller 0 BYTE ADDRESS	EDMA3_0 Transfer Controller 1 BYTE ADDRESS	EDMA3_1 Transfer Controller 0 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01C0 8280	0x01C0 8680	0x01E3 8280	DFCNTRLD	Destination FIFO Set Count Reload Register
0x01C0 8284	0x01C0 8684	0x01E3 8284	DFSRCBREF	Destination FIFO Set Source Address B-Reference Register
0x01C0 8288	0x01C0 8688	0x01E3 8288	DFDSTBREF	Destination FIFO Set Destination Address B-Reference Register
0x01C0 8300	0x01C0 8700	0x01E3 8300	DFOPT0	Destination FIFO Options Register 0
0x01C0 8304	0x01C0 8704	0x01E3 8304	DFSRC0	Destination FIFO Source Address Register 0
0x01C0 8308	0x01C0 8708	0x01E3 8308	DFCNT0	Destination FIFO Count Register 0
0x01C0 830C	0x01C0 870C	0x01E3 830C	DFDST0	Destination FIFO Destination Address Register 0
0x01C0 8310	0x01C0 8710	0x01E3 8310	DFBIDX0	Destination FIFO B-Index Register 0
0x01C0 8314	0x01C0 8714	0x01E3 8314	DFMPPRXY0	Destination FIFO Memory Protection Proxy Register 0
0x01C0 8340	0x01C0 8740	0x01E3 8340	DFOPT1	Destination FIFO Options Register 1
0x01C0 8344	0x01C0 8744	0x01E3 8344	DFSRC1	Destination FIFO Source Address Register 1
0x01C0 8348	0x01C0 8748	0x01E3 8348	DFCNT1	Destination FIFO Count Register 1
0x01C0 834C	0x01C0 874C	0x01E3 834C	DFDST1	Destination FIFO Destination Address Register 1
0x01C0 8350	0x01C0 8750	0x01E3 8350	DFBIDX1	Destination FIFO B-Index Register 1
0x01C0 8354	0x01C0 8754	0x01E3 8354	DFMPPRXY1	Destination FIFO Memory Protection Proxy Register 1
0x01C0 8380	0x01C0 8780	0x01E3 8380	DFOPT2	Destination FIFO Options Register 2
0x01C0 8384	0x01C0 8784	0x01E3 8384	DFSRC2	Destination FIFO Source Address Register 2
0x01C0 8388	0x01C0 8788	0x01E3 8388	DFCNT2	Destination FIFO Count Register 2
0x01C0 838C	0x01C0 878C	0x01E3 838C	DFDST2	Destination FIFO Destination Address Register 2
0x01C0 8390	0x01C0 8790	0x01E3 8390	DFBIDX2	Destination FIFO B-Index Register 2
0x01C0 8394	0x01C0 8794	0x01E3 8394	DFMPPRXY2	Destination FIFO Memory Protection Proxy Register 2
0x01C0 83C0	0x01C0 87C0	0x01E3 83C0	DFOPT3	Destination FIFO Options Register 3
0x01C0 83C4	0x01C0 87C4	0x01E3 83C4	DFSRC3	Destination FIFO Source Address Register 3
0x01C0 83C8	0x01C0 87C8	0x01E3 83C8	DFCNT3	Destination FIFO Count Register 3
0x01C0 83CC	0x01C0 87CC	0x01E3 83CC	DFDST3	Destination FIFO Destination Address Register 3
0x01C0 83D0	0x01C0 87D0	0x01E3 83D0	DFBIDX3	Destination FIFO B-Index Register 3
0x01C0 83D4	0x01C0 87D4	0x01E3 83D4	DFMPPRXY3	Destination FIFO Memory Protection Proxy Register 3

Table 6-15 shows an abbreviation of the set of registers which make up the parameter set for each of 128 EDMA3 events. Each of the parameter register sets consist of 8 32-bit word entries. Table 6-16 shows the parameter set entry registers with relative memory address locations within each of the parameter sets.

Table 6-15. EDMA3 Parameter Set RAM

EDMA3_0 Channel Controller 0 BYTE ADDRESS RANGE	EDMA3_1 Channel Controller 0 BYTE ADDRESS RANGE	DESCRIPTION
0x01C0 4000 - 0x01C0 401F	0x01E3 4000 - 0x01E3 401F	Parameters Set 0 (8 32-bit words)
0x01C0 4020 - 0x01C0 403F	0x01E3 4020 - 0x01E3 403F	Parameters Set 1 (8 32-bit words)
0x01C0 4040 - 0x01CC0 405F	0x01E3 4040 - 0x01CE3 405F	Parameters Set 2 (8 32-bit words)
0x01C0 4060 - 0x01C0 407F	0x01E3 4060 - 0x01E3 407F	Parameters Set 3 (8 32-bit words)
0x01C0 4080 - 0x01C0 409F	0x01E3 4080 - 0x01E3 409F	Parameters Set 4 (8 32-bit words)
0x01C0 40A0 - 0x01C0 40BF	0x01E3 40A0 - 0x01E3 40BF	Parameters Set 5 (8 32-bit words)
...	...	...
0x01C0 4FC0 - 0x01C0 4FDF	0x01E3 4FC0 - 0x01E3 4FDF	Parameters Set 126 (8 32-bit words)
0x01C0 4FE0 - 0x01C0 4FFF	0x01E3 4FE0 - 0x01E3 4FFF	Parameters Set 127 (8 32-bit words)

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Table 6-16. Parameter Set Entries

OFFSET BYTE ADDRESS WITHIN THE PARAMETER SET	ACRONYM	PARAMETER ENTRY
0x0000	OPT	Option
0x0004	SRC	Source Address
0x0008	A_B_CNT	A Count, B Count
0x000C	DST	Destination Address
0x0010	SRC_DST_BIDX	Source B Index, Destination B Index
0x0014	LINK_BCNTRLD	Link Address, B Count Reload
0x0018	SRC_DST_CIDX	Source C Index, Destination C Index
0x001C	CCNT	C Count

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6.10 External Memory Interface A (EMIFA)

EMIFA is one of two external memory interfaces supported on the device. It is primarily intended to support asynchronous memory types, such as NAND and NOR flash and Asynchronous SRAM. However on this device, EMIFA also provides a secondary interface to SDRAM.

6.10.1 EMIFA Asynchronous Memory Support

EMIFA supports asynchronous:

- SRAM memories
- NAND Flash memories
- NOR Flash memories

The EMIFA data bus width is up to 16-bits.The device supports up to 23 address lines and two external wait/interrupt inputs. Up to four asynchronous chip selects are supported by EMIFA ($\overline{\text{EMA_CS[5:2]}}$).

Each chip select has the following individually programmable attributes:

- Data Bus Width
- Read cycle timings: setup, hold, strobe
- Write cycle timings: setup, hold, strobe
- Bus turn around time
- Extended Wait Option With Programmable Timeout
- Select Strobe Option
- NAND flash controller supports 1-bit and 4-bit ECC calculation on blocks of 512 bytes.

6.10.2 EMIFA Synchronous DRAM Memory Support

The device supports 16-bit SDRAM in addition to the asynchronous memories listed in Section 6.10.1. It has a single SDRAM chip select (EMA_CS[0]). SDRAM configurations that are supported are:

- One, Two, and Four Bank SDRAM devices
- Devices with Eight, Nine, Ten, and Eleven Column Address
- CAS Latency of two or three clock cycles
- Sixteen Bit Data Bus Width

Additionally, the SDRAM interface of EMIFA supports placing the SDRAM in Self Refresh and Powerdown Modes. Self Refresh mode allows the SDRAM to be put into a low power state while still retaining memory contents; since the SDRAM will continue to refresh itself even without clocks from the device. Powerdown mode achieves even lower power, except the device must periodically wake the SDRAM up and issue refreshes if data retention is required.

Finally, note that the EMIFA does not support Mobile SDRAM devices.

Table 6-17 shows the supported SDRAM configurations for EMIFA.

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Table 6-17. EMIFA Supported SDRAM Configurations(1)

SDRAM Memory Data Bus Width (bits)	Number of Memories	EMIFA Data Bus Size (bits)	Rows	Columns	Banks	Total Memory (Mbits)	Total Memory (Mbytes)	Memory Density (Mbits)
16	1	16	16	8	1	256	32	256
	1	16	16	8	2	512	64	512
	1	16	16	8	4	1024	128	1024
	1	16	16	9	1	512	64	512
	1	16	16	9	2	1024	128	1024
	1	16	16	9	4	2048	256	2048
	1	16	16	10	1	1024	128	1024
	1	16	16	10	2	2048	256	2048
	1	16	16	10	4	4096	512	4096
	1	16	16	11	1	2048	256	2048
	1	16	16	11	2	4096	512	4096
	1	16	15	11	4	4096	512	4096
8	2	16	16	8	1	256	32	128
	2	16	16	8	2	512	64	256
	2	16	16	8	4	1024	128	512
	2	16	16	9	1	512	64	256
	2	16	16	9	2	1024	128	512
	2	16	16	9	4	2048	256	1024
	2	16	16	10	1	1024	128	512
	2	16	16	10	2	2048	256	1024
	2	16	16	10	4	4096	512	2048
	2	16	16	11	1	2048	256	1024
	2	16	16	11	2	4096	512	2048
	2	16	15	11	4	4096	512	2048

(1) The shaded cells indicate configurations that are possible on the EMIFA interface but as of this writing SDRAM memories capable of supporting these densities are not available in the market.

6.10.3 EMIFA SDRAM Loading Limitations

EMIFA supports SDRAM up to 100 MHz with up to two SDRAM or asynchronous memory loads. Additional loads will limit the SDRAM operation to lower speeds and the maximum speed should be confirmed by board simulation using IBIS models.

6.10.4 EMIFA Connection Examples

Figure 6-10 illustrates an example of how SDRAM, NOR, and NAND flash devices might be connected to EMIFA simultaneously. The SDRAM chip select must be EMA_CS[0]. Note that the NOR flash is connected to EMA_CS[2] and the NAND flash is connected to EMA_CS[3] in this example. Note that any type of asynchronous memory may be connected to EMA_CS[5:2].

The on-chip bootloader makes some assumptions on which chip select the contains the boot image, and this depends on the boot mode. For NOR boot mode; the on-chip bootloader requires that the image be stored in NOR flash on EMA_CS[2]. For NAND boot mode, the bootloader requires that the boot image is stored in NAND flash on EMA_CS[3]. It is always possible to have the image span multiple chip selects, but this must be supported by second stage boot code stored in the external flash.

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A likely use case with more than one EMIFA chip select used for NAND flash is illustrated in Figure 6-11. This figure shows how two multiplane NAND flash devices with two chip selects each would connect to the EMIFA. In this case if NAND is the boot memory, then the boot image needs to be stored in the NAND area selected by EMA_CS[3]. Part of the application image could spill over into the NAND regions selected by other EMIFA chip selects; but would rely on the code stored in the EMA_CS[3] area to bootload it.

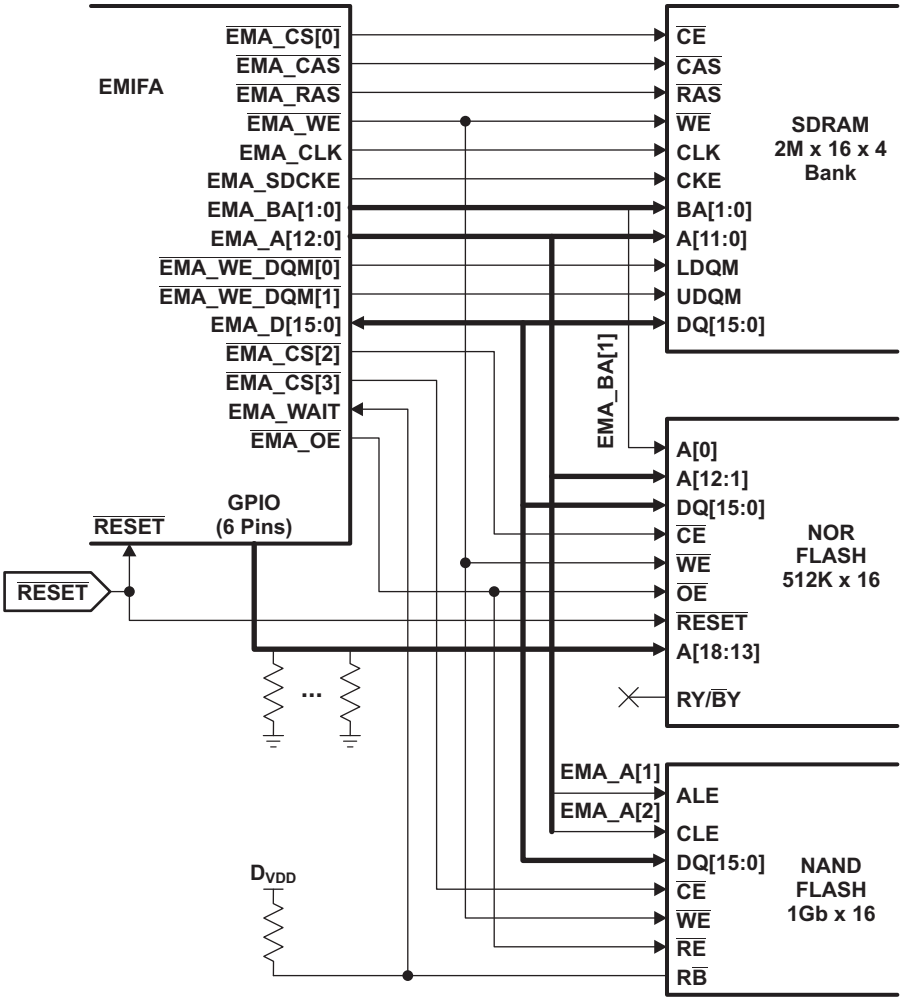

Figure 6-10. Connection Diagram: SDRAM, NOR, NAND

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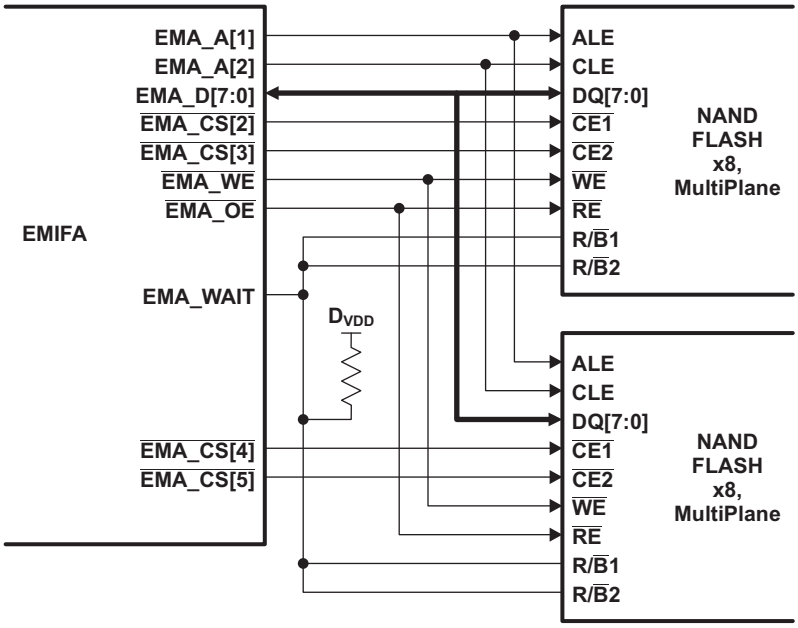

Figure 6-11. EMIFA Connection Diagram: Multiple NAND Flash Planes

6.10.5 External Memory Interface Register Descriptions

Table 6-18. External Memory Interface (EMIFA) Registers

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x6800 0000	MIDR	Module ID Register
0x6800 0004	AWCC	Asynchronous Wait Cycle Configuration Register
0x6800 0008	SDCR	SDRAM Configuration Register
0x6800 000C	SDRCR	SDRAM Refresh Control Register
0x6800 0010	CE2CFG	Asynchronous 1 Configuration Register
0x6800 0014	CE3CFG	Asynchronous 2 Configuration Register
0x6800 0018	CE4CFG	Asynchronous 3 Configuration Register
0x6800 001C	CE5CFG	Asynchronous 4 Configuration Register
0x6800 0020	SDTIMR	SDRAM Timing Register
0x6800 003C	SDSRETR	SDRAM Self Refresh Exit Timing Register
0x6800 0040	INTRAW	EMIFA Interrupt Raw Register
0x6800 0044	INTMSK	EMIFA Interrupt Mask Register
0x6800 0048	INTMSKSET	EMIFA Interrupt Mask Set Register
0x6800 004C	INTMSKCLR	EMIFA Interrupt Mask Clear Register
0x6800 0060	NANDFCR	NAND Flash Control Register
0x6800 0064	NANDFSR	NAND Flash Status Register
0x6800 0070	NANDF1ECC	NAND Flash 1 ECC Register (CS2 Space)
0x6800 0074	NANDF2ECC	NAND Flash 2 ECC Register (CS3 Space)
0x6800 0078	NANDF3ECC	NAND Flash 3 ECC Register (CS4 Space)
0x6800 007C	NANDF4ECC	NAND Flash 4 ECC Register (CS5 Space)
0x6800 00BC	NAND4BITECCLOAD	NAND Flash 4-Bit ECC Load Register
0x6800 00C0	NAND4BITECC1	NAND Flash 4-Bit ECC Register 1
0x6800 00C4	NAND4BITECC2	NAND Flash 4-Bit ECC Register 2
0x6800 00C8	NAND4BITECC3	NAND Flash 4-Bit ECC Register 3
0x6800 00CC	NAND4BITECC4	NAND Flash 4-Bit ECC Register 4
0x6800 00D0	NANDERRADD1	NAND Flash 4-Bit ECC Error Address Register 1
0x6800 00D4	NANDERRADD2	NAND Flash 4-Bit ECC Error Address Register 2
0x6800 00D8	NANDERRVAL1	NAND Flash 4-Bit ECC Error Value Register 1
0x6800 00DC	NANDERRVAL2	NAND Flash 4-Bit ECC Error Value Register 2

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6.10.6 EMIFA Electrical Data/Timing

Table 6-19 through Table 6-22 assume testing over recommended operating conditions.

Table 6-19. Timing Requirements for EMIFA SDRAM Interface

NO.			1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
19	$t_{su(EMA_DV-EM_CLKH)}$	Input setup time, read data valid on EMA_D[15:0] before EMA_CLK rising	2		3		3		ns
20	$t_{h(CLKH-DIV)}$	Input hold time, read data valid on EMA_D[15:0] after EMA_CLK rising	1.6		1.6		1.6		ns

Table 6-20. Switching Characteristics for EMIFA SDRAM Interface

NO.	PARAMETER		1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
1	$t_{c(CLK)}$	Cycle time, EMIF clock EMA_CLK	10		15		20		ns
2	$t_{w(CLK)}$	Pulse width, EMIF clock EMA_CLK high or low	3		5		8		ns
3	$t_{d(CLKH-CSV)}$	Delay time, EMA_CLK rising to $\overline{EMA_CS[0]}$ valid		7		9.5		13	ns
4	$t_{oh(CLKH-CSIV)}$	Output hold time, EMA_CLK rising to $\overline{EMA_CS[0]}$ invalid	1		1		1		ns
5	$t_{d(CLKH-DQMV)}$	Delay time, EMA_CLK rising to EMA_$\overline{WE}$_DQM[1:0] valid		7		9.5		13	ns
6	$t_{oh(CLKH-DQMIV)}$	Output hold time, EMA_CLK rising to EMA_$\overline{WE}$_DQM[1:0] invalid	1		1		1		ns
7	$t_{d(CLKH-AV)}$	Delay time, EMA_CLK rising to EMA_A[12:0] and EMA_BA[1:0] valid		7		9.5		13	ns
8	$t_{oh(CLKH-AIV)}$	Output hold time, EMA_CLK rising to EMA_A[12:0] and EMA_BA[1:0] invalid	1		1		1		ns
9	$t_{d(CLKH-DV)}$	Delay time, EMA_CLK rising to EMA_D[15:0] valid		7		9.5		13	ns
10	$t_{oh(CLKH-DIV)}$	Output hold time, EMA_CLK rising to EMA_D[15:0] invalid	1		1		1		ns
11	$t_{d(CLKH-RASV)}$	Delay time, EMA_CLK rising to $\overline{EMA_RAS}$ valid		7		9.5		13	ns
12	$t_{oh(CLKH-RASIV)}$	Output hold time, EMA_CLK rising to $\overline{EMA_RAS}$ invalid	1		1		1		ns
13	$t_{d(CLKH-CASV)}$	Delay time, EMA_CLK rising to $\overline{EMA_CAS}$ valid		7		9.5		13	ns
14	$t_{oh(CLKH-CASIV)}$	Output hold time, EMA_CLK rising to $\overline{EMA_CAS}$ invalid	1		1		1		ns
15	$t_{d(CLKH-WEV)}$	Delay time, EMA_CLK rising to $\overline{EMA_WE}$ valid		7		9.5		13	ns
16	$t_{oh(CLKH-WEIV)}$	Output hold time, EMA_CLK rising to $\overline{EMA_WE}$ invalid	1		1		1		ns
17	$t_{dis(CLKH-DHZ)}$	Delay time, EMA_CLK rising to EMA_D[15:0] tri-stated		7		9.5		13	ns
18	$t_{ena(CLKH-DLZ)}$	Output hold time, EMA_CLK rising to EMA_D[15:0] driving	1		1		1		ns

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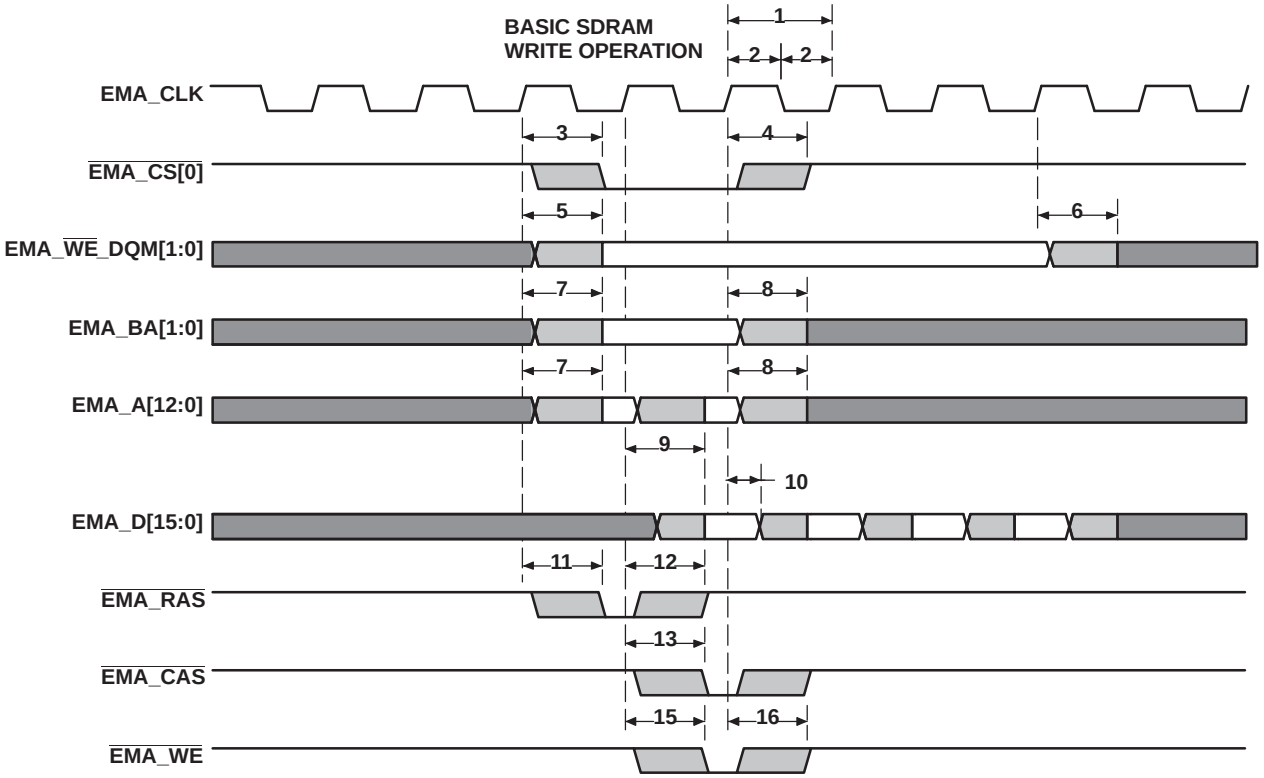

Figure 6-12. EMIFA Basic SDRAM Write Operation

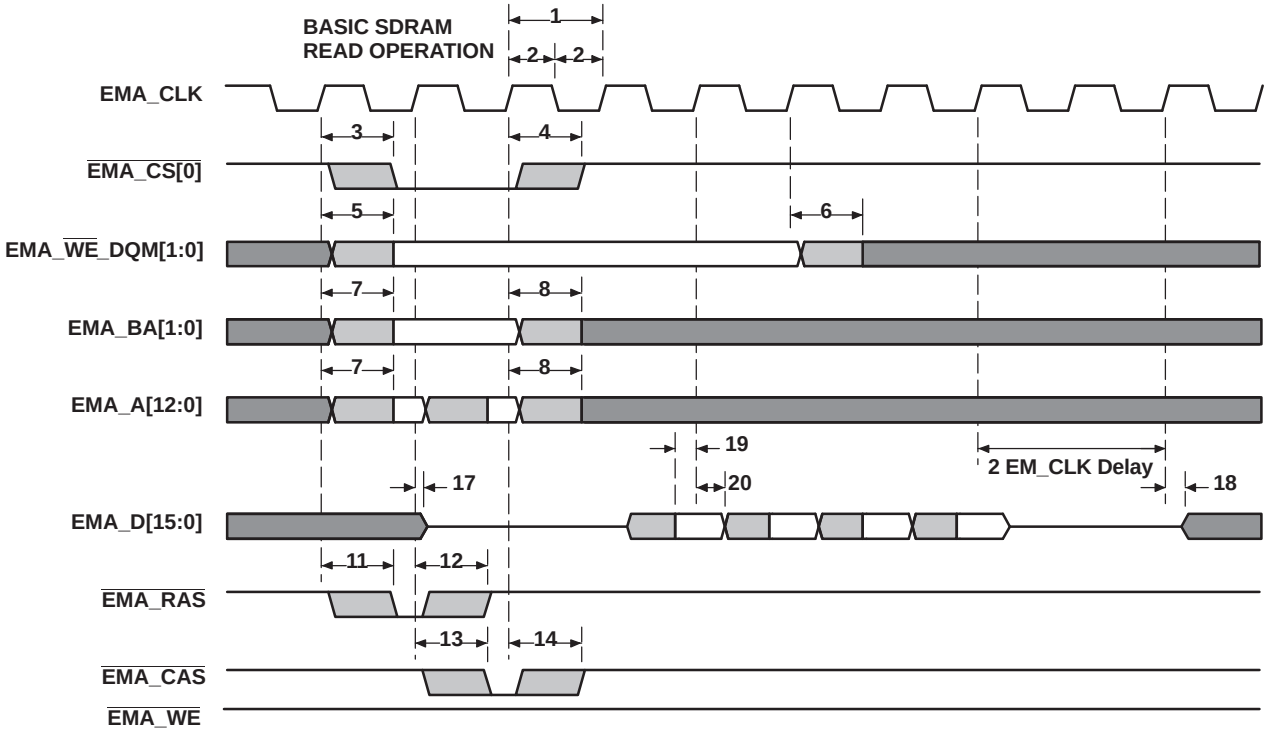

Figure 6-13. EMIFA Basic SDRAM Read Operation

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Table 6-21. Timing Requirements for EMIFA Asynchronous Memory Interface (1)

NO.			1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
READS and WRITES									
E	$t_{c(CLK)}$	Cycle time, EMIFA module clock	6.75		13.33		20		ns
2	$t_{w(EM_WAIT)}$	Pulse duration, EM_WAIT assertion and deassertion	2E		2E		2E		ns
READS									
12	$t_{su(EMDV-EMOEH)}$	Setup time, EM_D[15:0] valid before $\overline{EM_OE}$ high	3		5		7		ns
13	$t_{h(EMOEH-EMDIV)}$	Hold time, EM_D[15:0] valid after $\overline{EM_OE}$ high	0		0		0		ns
14	$t_{su\ (EMOEL-EMWAIT)}$	Setup Time, EM_WAIT asserted before end of Strobe Phase (2)	4E+3		4E+3		4E+3		ns
WRITES									
28	$t_{su\ (EMWEL-EMWAIT)}$	Setup Time, EM_WAIT asserted before end of Strobe Phase (2)	4E+3		4E+3		4E+3		ns

(1) E = EMA_CLK period or in ns. EMA_CLK is selected either as SYSCLK3 or the PLL0 output clock divided by 4.5. As an example, when SYSCLK3 is selected and set to 100MHz, E=10ns

(2) Setup before end of STROBE phase (if no extended wait states are inserted) by which EM_WAIT must be asserted to add extended wait states. Figure 6-16 and Figure 6-17 describe EMIF transactions that include extended wait states inserted during the STROBE phase. However, cycles inserted as part of this extended wait period should not be counted; the 4E requirement is to the start of where the HOLD phase would begin if there were no extended wait cycles.

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Table 6-22. Switching Characteristics for EMIFA Asynchronous Memory Interface (1) (2) (3)

NO.	PARAMETER		1.2V, 1.1V, 1.0V			UNIT
			MIN	Nom	MAX	
READS and WRITES						
1	$t_{d(TURNAROUND)}$	Turn around time	(TA)*E - 3	(TA)*E	(TA)*E + 3	ns
READS						
3	$t_{c(EMRCYCLE)}$	EMIF read cycle time (EW = 0)	(RS+RST+RH)*E - 3	(RS+RST+RH)*E	(RS+RST+RH)*E + 3	ns
		EMIF read cycle time (EW = 1)	(RS+RST+RH+EWC)*E - 3	(RS+RST+RH+EWC)*E	(RS+RST+RH+EWC)*E + 3	ns
4	$t_{su(EMCEL-EMOEL)}$	Output setup time, $\overline{EMA_CE[5:2]}$ low to $\overline{EMA_OE}$ low (SS = 0)	(RS)*E-3	(RS)*E	(RS)*E+3	ns
		Output setup time, $\overline{EMA_CE[5:2]}$ low to $\overline{EMA_OE}$ low (SS = 1)	-3	0	+3	ns
5	$t_{h(EMOEH-EMCEH)}$	Output hold time, $\overline{EMA_OE}$ high to $\overline{EMA_CE[5:2]}$ high (SS = 0)	(RH)*E - 3	(RH)*E	(RH)*E + 3	ns
		Output hold time, $\overline{EMA_OE}$ high to $\overline{EMA_CE[5:2]}$ high (SS = 1)	-3	0	+3	ns
6	$t_{su(EMBAV-EMOEL)}$	Output setup time, $\overline{EMA_BA[1:0]}$ valid to $\overline{EMA_OE}$ low	(RS)*E-3	(RS)*E	(RS)*E+3	ns
7	$t_{h(EMOEH-EMBAIV)}$	Output hold time, $\overline{EMA_OE}$ high to $\overline{EMA_BA[1:0]}$ invalid	(RH)*E-3	(RH)*E	(RH)*E+3	ns
8	$t_{su(EMBAV-EMOEL)}$	Output setup time, $\overline{EMA_A[13:0]}$ valid to $\overline{EMA_OE}$ low	(RS)*E-3	(RS)*E	(RS)*E+3	ns
9	$t_{h(EMOEH-EMAIV)}$	Output hold time, $\overline{EMA_OE}$ high to $\overline{EMA_A[13:0]}$ invalid	(RH)*E-3	(RH)*E	(RH)*E+3	ns
10	$t_{w(EMOEL)}$	$\overline{EMA_OE}$ active low width (EW = 0)	(RST)*E-3	(RST)*E	(RST)*E+3	ns
		$\overline{EMA_OE}$ active low width (EW = 1)	(RST+EWC)*E-3	(RST+EWC)*E	(RST+EWC)*E+3	ns
11	$t_{d(EMWAITH-EMOEH)}$	Delay time from EMA_WAIT deasserted to $\overline{EMA_OE}$ high	3E-3	4E	4E+3	ns
28	$t_{su(EMARW-EMOEL)}$	Output setup time, EMA_A_$\overline{RW}$ valid to $\overline{EMA_OE}$ low	(RS)*E-3	(RS)*E	(RS)*E+3	ns
29	$t_{h(EMOEH-EMARW)}$	Output hold time, $\overline{EMA_OE}$ high to EMA_A_$\overline{RW}$ invalid	(RH)*E-3	(RH)*E	(RH)*E+3	ns
WRITES						
15	$t_{c(EMWCYCLE)}$	EMIF write cycle time (EW = 0)	(WS+WST+WH)*E-3	(WS+WST+WH)*E	(WS+WST+WH)*E+3	ns
		EMIF write cycle time (EW = 1)	(WS+WST+WH+EWC)*E - 3	(WS+WST+WH+EWC)*E	(WS+WST+WH+EWC)*E + 3	ns
16	$t_{su(EMCEL-EMWEL)}$	Output setup time, $\overline{EMA_CE[5:2]}$ low to $\overline{EMA_WE}$ low (SS = 0)	(WS)*E - 3	(WS)*E	(WS)*E + 3	ns
		Output setup time, $\overline{EMA_CE[5:2]}$ low to $\overline{EMA_WE}$ low (SS = 1)	-3	0	+3	ns
17	$t_{h(EMWEH-EMCEH)}$	Output hold time, $\overline{EMA_WE}$ high to $\overline{EMA_CE[5:2]}$ high (SS = 0)	(WH)*E-3	(WH)*E	(WH)*E+3	ns
		Output hold time, $\overline{EMA_WE}$ high to $\overline{EMA_CE[5:2]}$ high (SS = 1)	-3	0	+3	ns
18	$t_{su(EMDQMV-EMWEL)}$	Output setup time, $\overline{EMA_BA[1:0]}$ valid to $\overline{EMA_WE}$ low	(WS)*E-3	(WS)*E	(WS)*E+3	ns
19	$t_{h(EMWEH-EMDQMIV)}$	Output hold time, $\overline{EMA_WE}$ high to $\overline{EMA_BA[1:0]}$ invalid	(WH)*E-3	(WH)*E	(WH)*E+3	ns
20	$t_{su(EMBAV-EMWEL)}$	Output setup time, $\overline{EMA_BA[1:0]}$ valid to $\overline{EMA_WE}$ low	(WS)*E-3	(WS)*E	(WS)*E+3	ns
21	$t_{h(EMWEH-EMBAIV)}$	Output hold time, $\overline{EMA_WE}$ high to $\overline{EMA_BA[1:0]}$ invalid	(WH)*E-3	(WH)*E	(WH)*E+3	ns

(1) TA = Turn around, RS = Read setup, RST = Read strobe, RH = Read hold, WS = Write setup, WST = Write strobe, WH = Write hold, MEWC = Maximum external wait cycles. These parameters are programmed via the Asynchronous Bank and Asynchronous Wait Cycle Configuration Registers. These support the following range of values: TA[4-1], RS[16-1], RST[64-1], RH[8-1], WS[16-1], WST[64-1], WH[8-1], and MEW[1-256].

(2) E = EMA_CLK period or in ns. EMA_CLK is selected either as SYSCLK3 or the PLL0 output clock divided by 4.5. As an example, when SYSCLK3 is selected and set to 100MHz, E=10ns.

(3) EWC = external wait cycles determined by EMA_WAIT input signal. EWC supports the following range of values EWC[256-1]. Note that the maximum wait time before timeout is specified by bit field MEWC in the Asynchronous Wait Cycle Configuration Register.

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Table 6-22. Switching Characteristics for EMIFA Asynchronous Memory Interface (1) (2) (3) (continued)

NO.	PARAMETER		1.2V, 1.1V, 1.0V			UNIT
			MIN	Nom	MAX	
22	$t_{su(EMAV-EMWEL)}$	Output setup time, $\overline{EMA_A[13:0]}$ valid to $\overline{EMA_WE}$ low	(WS)*E-3	(WS)*E	(WS)*E+3	ns
23	$t_{h(EMWEH-EMAIV)}$	Output hold time, $\overline{EMA_WE}$ high to $\overline{EMA_A[13:0]}$ invalid	(WH)*E-3	(WH)*E	(WH)*E+3	ns
24	$t_{w(EMWEL)}$	$\overline{EMA_WE}$ active low width (EW = 0)	(WST)*E-3	(WST)*E	(WST)*E+3	ns
		$\overline{EMA_WE}$ active low width (EW = 1)	(WST+EWC)*E-3	(WST+EWC)*E	(WST+EWC)*E+3	ns
25	$t_{d(EMWAITH-EMWEH)}$	Delay time from EMA_WAIT deasserted to $\overline{EMA_WE}$ high	3E-3	4E	4E+3	ns
26	$t_{su(EMDV-EMWEL)}$	Output setup time, $\overline{EMA_D[15:0]}$ valid to $\overline{EMA_WE}$ low	(WS)*E-3	(WS)*E	(WS)*E+3	ns
27	$t_{h(EMWEH-EMDIV)}$	Output hold time, $\overline{EMA_WE}$ high to $\overline{EMA_D[15:0]}$ invalid	(WH)*E-3	(WH)*E	(WH)*E+3	ns
30	$t_{su(EMARW-EMWEL)}$	Output setup time, EMA_A_$\overline{RW}$ valid to $\overline{EMA_WE}$ low	(WS)*E-3	(WS)*E	(WS)*E+3	ns
31	$t_{h(EMWEH-EMARW)}$	Output hold time, $\overline{EMA_WE}$ high to EMA_A_$\overline{RW}$ invalid	(WH)*E-3	(WH)*E	(WH)*E+3	ns

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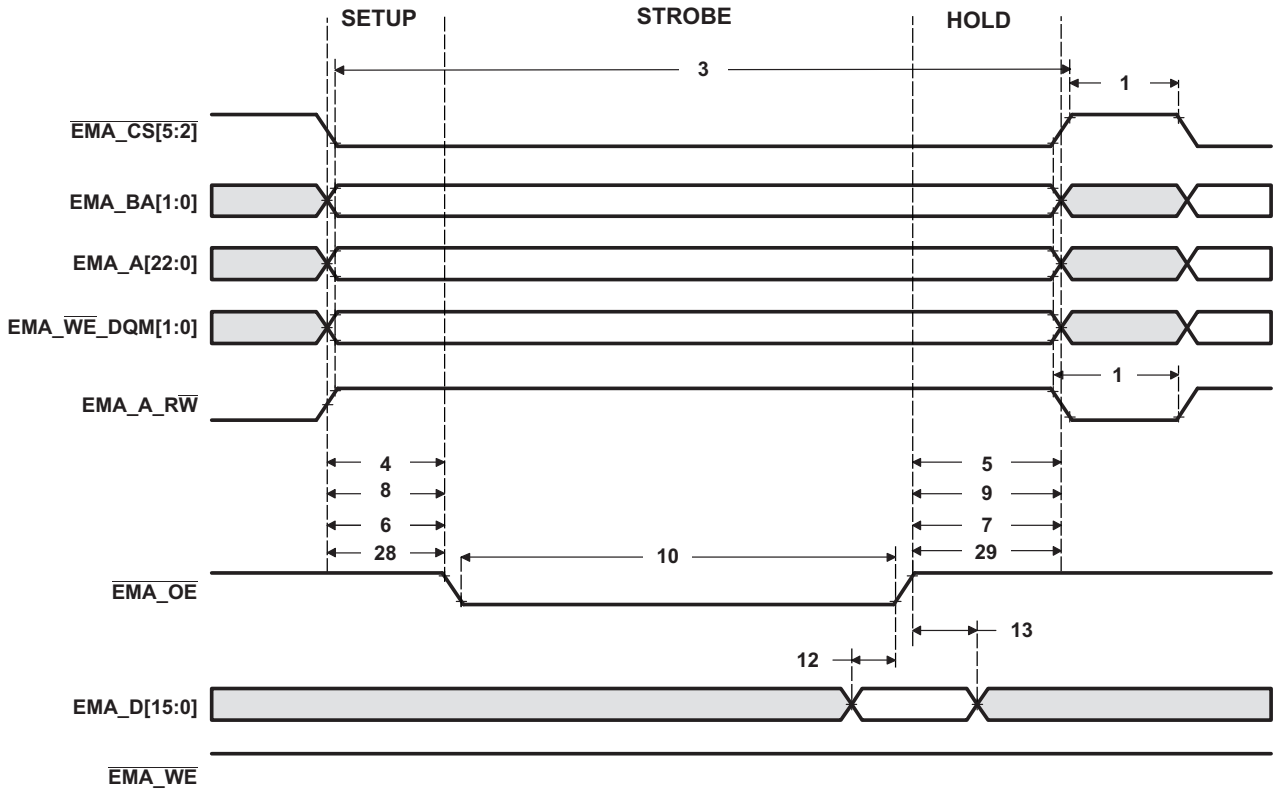

Figure 6-14. Asynchronous Memory Read Timing for EMIFA

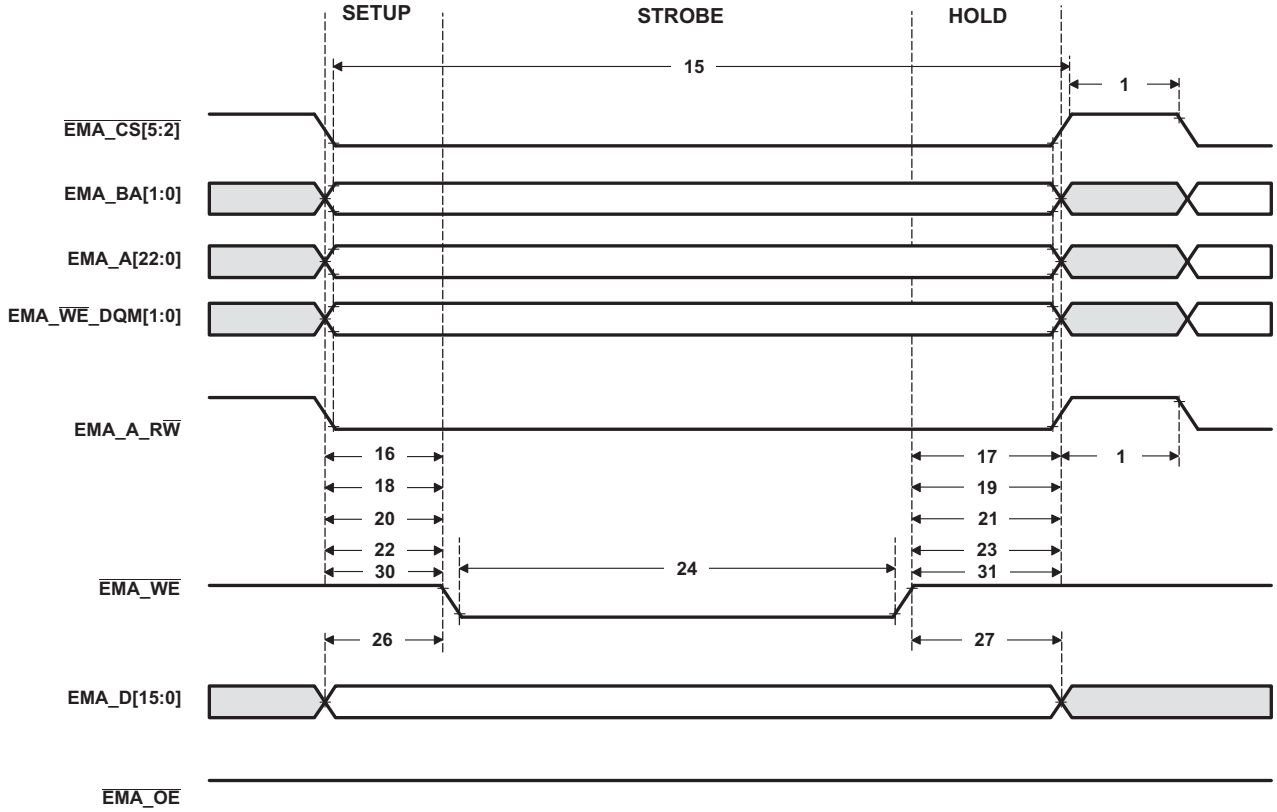

Figure 6-15. Asynchronous Memory Write Timing for EMIFA

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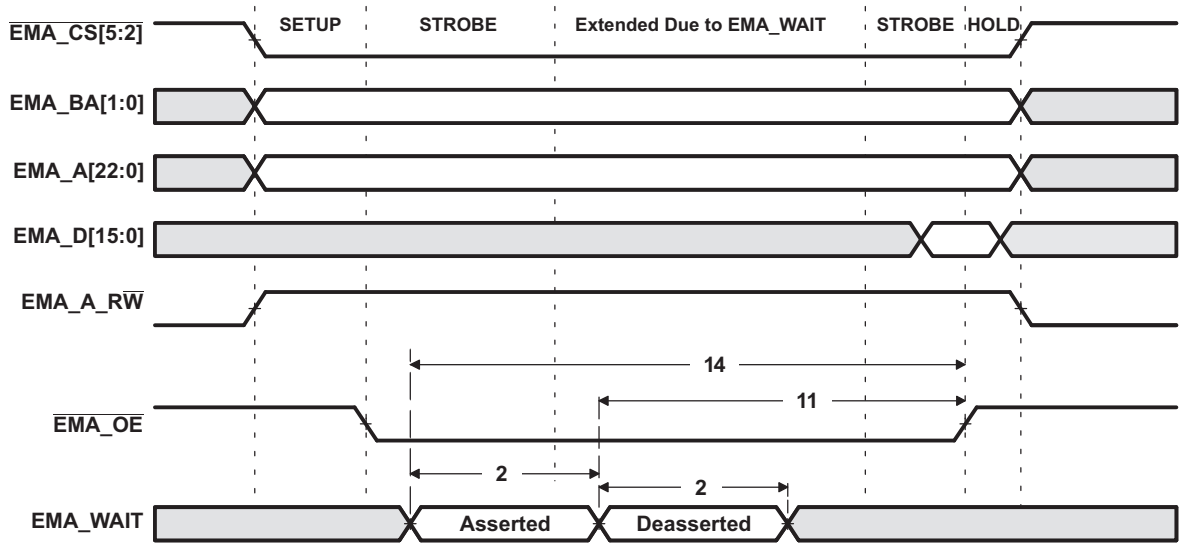

Figure 6-16. EMA_WAIT Read Timing Requirements

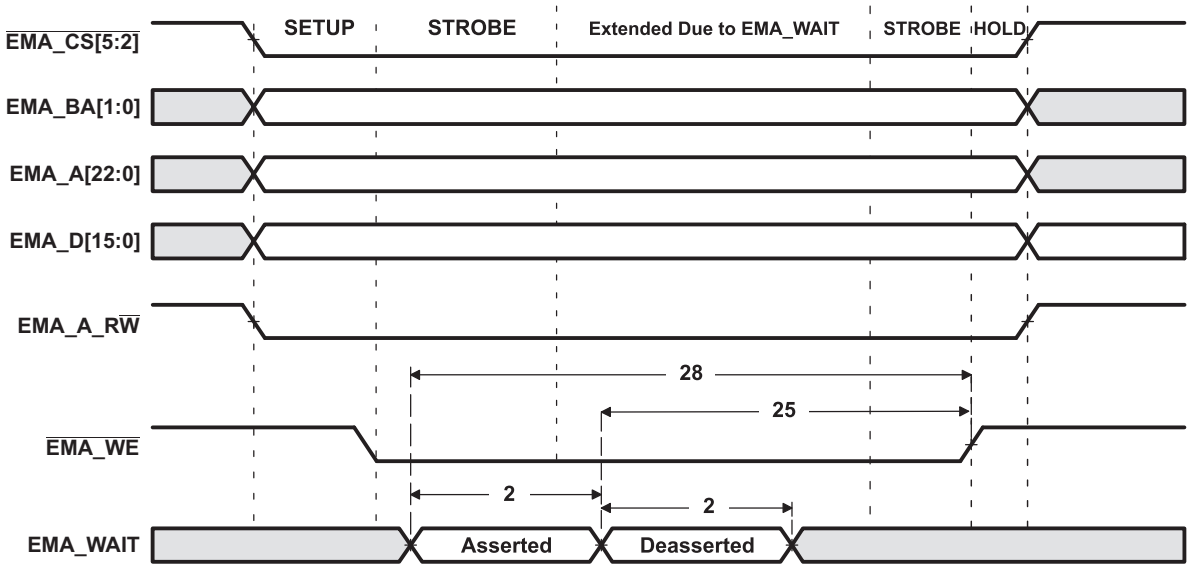

Figure 6-17. EMA_WAIT Write Timing Requirements

6.11 DDR2/mDDR Memory Controller

The DDR2/mDDR Memory Controller is a dedicated interface to DDR2/mDDR SDRAM. It supports JESD79-2A standard compliant DDR2 SDRAM devices and compliant Mobile DDR SDRAM devices.

The DDR2/mDDR Memory Controller support the following features:

- JESD79-2A standard compliant DDR2 SDRAM
- Mobile DDR SDRAM
- 256 MByte memory space for DDR2
- 256 MByte memory space for mDDR
- CAS latencies:
  - DDR2: 2, 3, 4 and 5
  - mDDR: 2 and 3
- Internal banks:
  - DDR2: 1, 2, 4 and 8
  - mDDR:1, 2 and 4
- Burst length: 8
- Burst type: sequential
- 1 chip select (CS) signal
- Page sizes: 256, 512, 1024, and 2048
- SDRAM autoinitialization
- Self-refresh mode
- Partial array self-refresh (for mDDR)
- Power down mode
- Prioritized refresh
- Programmable refresh rate and backlog counter
- Programmable timing parameters
- Little endian

6.11.1 DDR2/mDDR Memory Controller Electrical Data/Timing

Table 6-23. Switching Characteristics Over Recommended Operating Conditions for DDR2/mDDR Memory Controller

No.	PARAMETER			1.2V		1.1V		1.0V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
1	$t_{c(DDR_CLK)}$	Cycle time, DDR_CLKP / DDR_CLKN	DDR2	125	156	125	150	—(1)	—(1)	MHz
			mDDR	105	150	100	133	95	133	

(1) DDR2 is not supported at this voltage operating point.

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6.11.2 DDR2/mDDR Memory Controller Register Description(s)

Table 6-24. DDR2/mDDR Memory Controller Registers

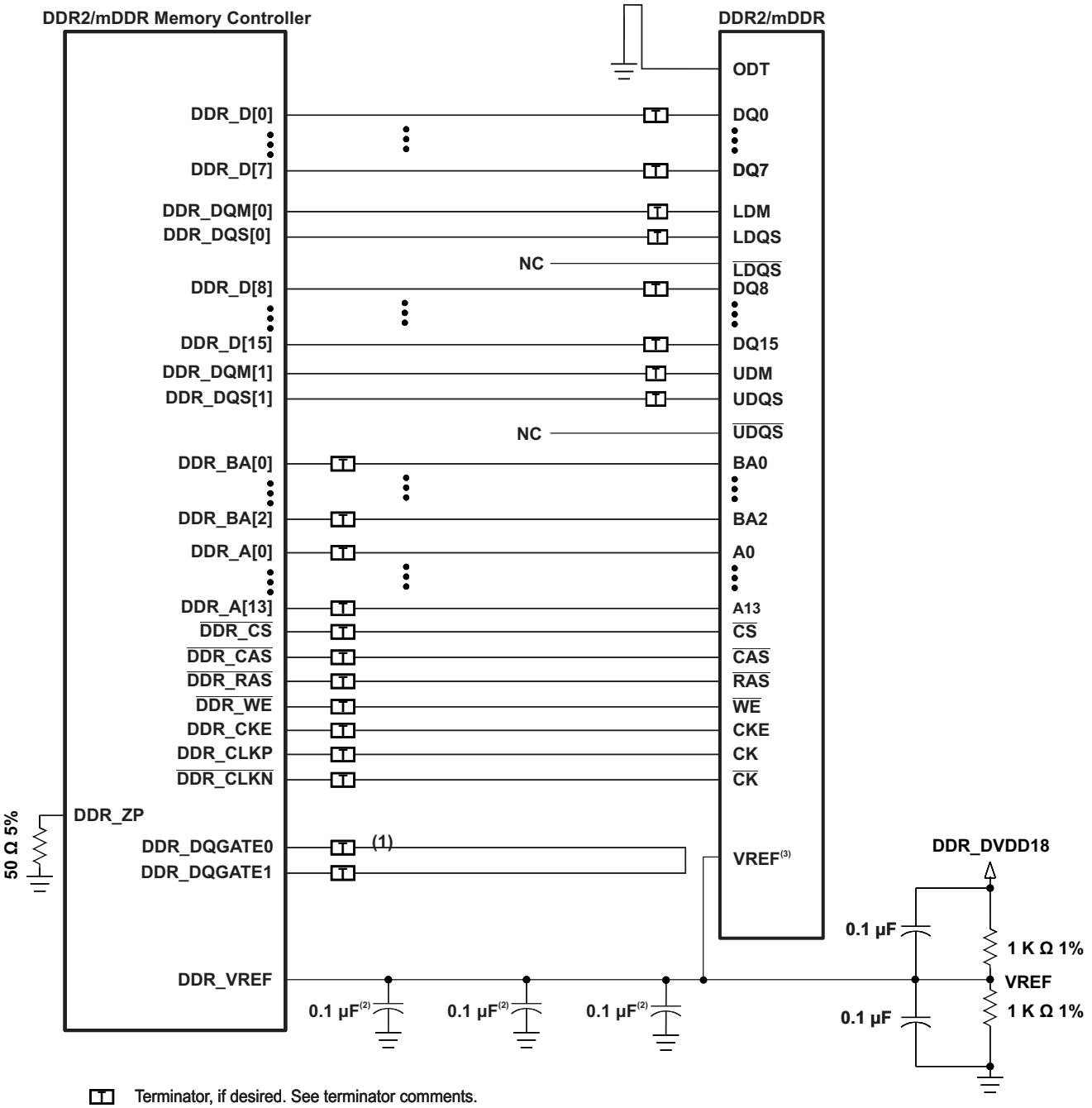
BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0xB000 0000	REVID	Revision ID Register
0xB000 0004	SDRSTAT	SDRAM Status Register
0xB000 0008	SDCR	SDRAM Configuration Register
0xB000 000C	SDRCR	SDRAM Refresh Control Register
0xB000 0010	SDTIMR1	SDRAM Timing Register 1
0xB000 0014	SDTIMR2	SDRAM Timing Register 2
0xB000 001C	SDCR2	SDRAM Configuration Register 2
0xB000 0020	PBBPR	Peripheral Bus Burst Priority Register
0xB000 0040	PC1	Performance Counter 1 Registers
0xB000 0044	PC2	Performance Counter 2 Register
0xB000 0048	PCC	Performance Counter Configuration Register
0xB000 004C	PCMRS	Performance Counter Master Region Select Register
0xB000 0050	PCT	Performance Counter Time Register
0xB000 00C0	IRR	Interrupt Raw Register
0xB000 00C4	IMR	Interrupt Mask Register
0xB000 00C8	IMSR	Interrupt Mask Set Register
0xB000 00CC	IMCR	Interrupt Mask Clear Register
0xB000 00E4	DRPYC1R	DDR PHY Control Register 1
0x01E2 C000	VTPIO_CTL	VTP IO Control Register

6.11.3 DDR2/mDDR Interface

This section provides the timing specification for the DDR2/mDDR interface as a PCB design and manufacturing specification. The design rules constrain PCB trace length, PCB trace skew, signal integrity, cross-talk, and signal timing. These rules, when followed, result in a reliable DDR2/mDDR memory system without the need for a complex timing closure process. For more information regarding guidelines for using this DDR2/mDDR specification, *Understanding TI's PCB Routing Rule-Based DDR2 Timing Specification* (SPRAAV0).

6.11.3.1 DDR2/mDDR Interface Schematic

Figure 6-18 shows the DDR2/mDDR interface schematic for a single-memory DDR2/mDDR system. The dual-memory system shown in Figure 6-19. Pin numbers for the device can be obtained from the pin description section.



(1) See Figure 6-25 for DQGATE routing specifications.

(2) For DDR2, one of these capacitors can be eliminated if the divider and its capacitors are placed near a device VREF pin. For mDDR, these capacitors can be eliminated completely.

(3) VREF applies in the case of DDR2 memories. For mDDR, the DDR_VREF pin still needs to be connected to the divider circuit.

Figure 6-18. DDR2/mDDR Single-Memory High Level Schematic

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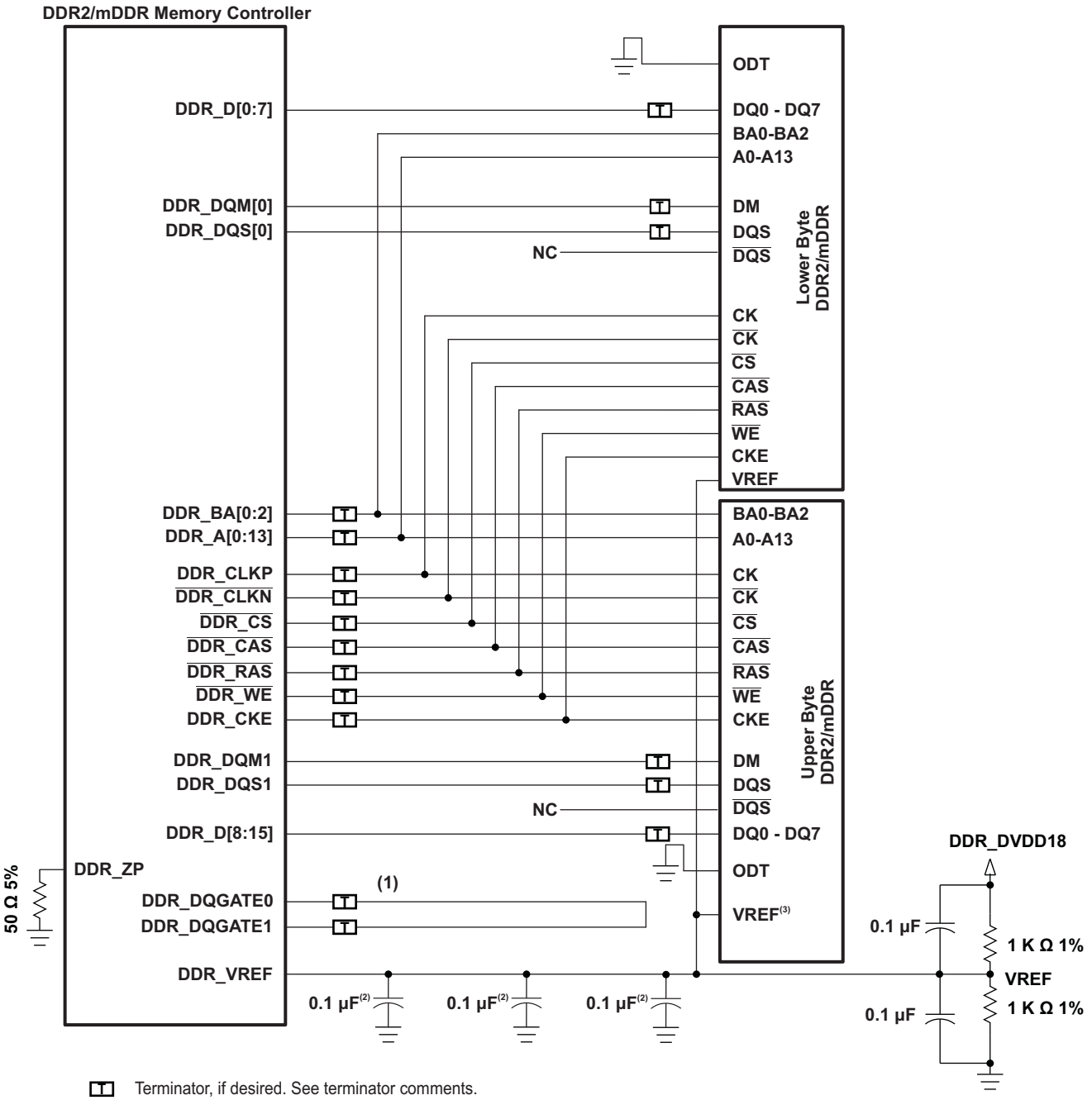

(1) See Figure 6-25 for DQGATE routing specifications.

(2) For DDR2, one of these capacitors can be eliminated if the divider and its capacitors are placed near a device VREF pin. For mDDR, these capacitors can be eliminated completely.

(3) VREF applies in the case of DDR2 memories. For mDDR, the DDR_VREF pin still needs to be connected to the divider circuit.

Figure 6-19. DDR2/mDDR Dual-Memory High Level Schematic

6.11.3.2 Compatible JEDEC DDR2/mDDR Devices

Table 6-25 shows the parameters of the JEDEC DDR2/mDDR devices that are compatible with this interface. Generally, the DDR2/mDDR interface is compatible with x16 DDR2-400/mDDR-200 speed grade DDR2/mDDR devices.

The device also supports JEDEC DDR2/mDDR x8 devices in the dual chip configuration. In this case, one chip supplies the upper byte and the second chip supplies the lower byte. Addresses and most control signals are shared just like regular dual chip memory configurations.

Table 6-25. Compatible JEDEC DDR2/mDDR Devices

NO.	PARAMETER	MIN	MAX	UNIT
1	JEDEC DDR2/mDDR Device Speed Grade(1)	DDR2-400/mDDR-200		
2	JEDEC DDR2/mDDR Device Bit Width	x8	x16	Bits
3	JEDEC DDR2/mDDR Device Count(2)	1	2	Devices

(1) Higher DDR2/mDDR speed grades are supported due to inherent JEDEC DDR2/mDDR backwards compatibility.
(2) Supported configurations are one 16-bit DDR2/mDDR memory or two 8-bit DDR2/mDDR memories

6.11.3.3 PCB Stackup

The minimum stackup required for routing the device is a six layer stack as shown in Table 6-26. Additional layers may be added to the PCB stack up to accommodate other circuitry or to reduce the size of the PCB footprint.Complete stack up specifications are provided in Table 6-27.

Table 6-26. Device Minimum PCB Stack Up

LAYER	TYPE	DESCRIPTION
1	Signal	Top Routing Mostly Horizontal
2	Plane	Ground
3	Plane	Power
4	Signal	Internal Routing
5	Plane	Ground
6	Signal	Bottom Routing Mostly Vertical

Table 6-27. PCB Stack Up Specifications

NO.	PARAMETER	MIN	TYP	MAX	UNIT
1	PCB Routing/Plane Layers	6			
2	Signal Routing Layers	3			
3	Full ground layers under DDR2/mDDR routing region	2			
4	Number of ground plane cuts allowed within DDR routing region			0	
5	Number of ground reference planes required for each DDR2/mDDR routing layer	1			
6	Number of layers between DDR2/mDDR routing layer and reference ground plane			0	
7	PCB Routing Feature Size		4		Mils
8	PCB Trace Width w		4		Mils
8	PCB BGA escape via pad size		18		Mils
9	PCB BGA escape via hole size		8		Mils
10	Device BGA pad size(1)				
11	DDR2/mDDR Device BGA pad size(2)				
12	Single Ended Impedance, Zo	50		75	Ω
13	Impedance Control(3)	Z-5	Z	Z+5	Ω

(1) Please refer to the *Flip Chip Ball Grid Array Package Reference Guide* (SPRU811) for device BGA pad size.
(2) Please refer to the DDR2/mDDR device manufacturer documentation for the DDR2/mDDR device BGA pad size.
(3) Z is the nominal singled ended impedance selected for the PCB specified by item 12.

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6.11.3.4 Placement

Figure 6-19 shows the required placement for the device as well as the DDR2/mDDR devices. The dimensions for Figure 6-20 are defined in Table 6-28. The placement does not restrict the side of the PCB that the devices are mounted on. The ultimate purpose of the placement is to limit the maximum trace lengths and allow for proper routing space. For single-memory DDR2/mDDR systems, the second DDR2/mDDR device is omitted from the placement.

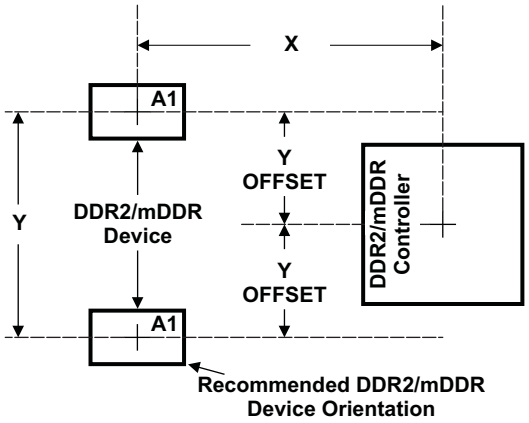

Figure 6-20. C6742 and DDR2/mDDR Device Placement

Table 6-28. Placement Specifications(1)(2)

NO.	PARAMETER	MIN	MAX	UNIT
1	X		1750	Mils
2	Y		1280	Mils
3	Y Offset		(3)650	Mils
4	Clearance from non-DDR2/mDDR signal to DDR2/mDDR Keepout Region(4)	4		w(5)

(1) See Figure 6-20 for dimension definitions.
(2) Measurements from center of device to center of DDR2/mDDR device.
(3) For single memory systems it is recommended that Y Offset be as small as possible.
(4) Non-DDR2/mDDR signals allowed within DDR2/mDDR keepout region provided they are separated from DDR2/mDDR routing layers by a ground plane.
(5) w = PCB trace width as defined in Table 6-27.

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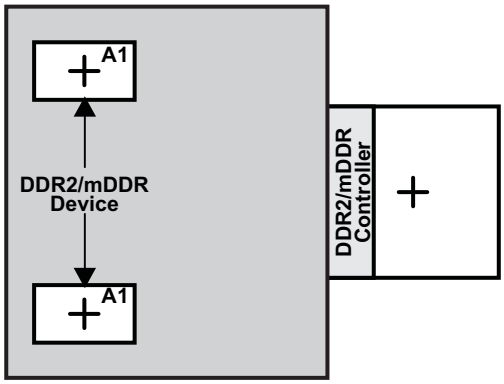
6.11.3.5 DDR2/mDDR Keep Out Region

The region of the PCB used for the DDR2/mDDR circuitry must be isolated from other signals. The DDR2/mDDR keep out region is defined for this purpose and is shown in Figure 6-21. The size of this region varies with the placement and DDR routing. Additional clearances required for the keep out region are shown in Table 6-28.



Region should encompass all DDR2/mDDR circuitry and varies depending on placement. Non-DDR2/mDDR signals should not be routed on the DDR signal layers within the DDR2/mDDR keep out region. Non-DDR2/mDDR signals may be routed in the region provided they are routed on layers separated from DDR2/mDDR signal layers by a ground layer. No breaks should be allowed in the reference ground layers in this region. In addition, the 1.8 V power plane should cover the entire keep out region.

Figure 6-21. DDR2/mDDR Keepout Region

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6.11.3.6 Bulk Bypass Capacitors

Bulk bypass capacitors are required for moderate speed bypassing of the DDR2/mDDR and other circuitry. Table 6-29 contains the minimum numbers and capacitance required for the bulk bypass capacitors. Note that this table only covers the bypass needs of the DSP and DDR2/mDDR interfaces. Additional bulk bypass capacitance may be needed for other circuitry.

Table 6-29. Bulk Bypass Capacitors

NO.	PARAMETER	MIN	MAX	UNIT
1	DDR_DVDD18 Supply Bulk Bypass Capacitor Count(1)	3		Devices
2	DDR_DVDD18 Supply Bulk Bypass Total Capacitance	30		µF
3	DDR#1 Bulk Bypass Capacitor Count(1)	1		Devices
4	DDR#1 Bulk Bypass Total Capacitance	22		µF
5	DDR#2 Bulk Bypass Capacitor Count(1)(2)	1		Devices
6	DDR#2 Bulk Bypass Total Capacitance(2)	22		µF

(1) These devices should be placed near the device they are bypassing, but preference should be given to the placement of the high-speed (HS) bypass caps.
(2) Only used on dual-memory systems.

6.11.3.7 High-Speed Bypass Capacitors

High-speed (HS) bypass capacitors are critical for proper DDR2/mDDR interface operation. It is particularly important to minimize the parasitic series inductance of the HS bypass cap, DSP/DDR2/mDDR power, and DSP/DDR2/mDDR ground connections. Table 6-30 contains the specification for the HS bypass capacitors as well as for the power connections on the PCB.

Table 6-30. High-Speed Bypass Capacitors

NO.	PARAMETER	MIN	MAX	UNIT
1	HS Bypass Capacitor Package Size(1)		0402	10 Mils
2	Distance from HS bypass capacitor to device being bypassed		250	Mils
3	Number of connection vias for each HS bypass capacitor	2(2)		Vias
4	Trace length from bypass capacitor contact to connection via	1	30	Mils
5	Number of connection vias for each DDR2/mDDR device power or ground balls	1		Vias
6	Trace length from DDR2/mDDR device power ball to connection via		35	Mils
7	DDR_DVDD18 Supply HS Bypass Capacitor Count(3)	10		Devices
8	DDR_DVDD18 Supply HS Bypass Capacitor Total Capacitance	0.6		µF
9	DDR#1 HS Bypass Capacitor Count(3)	8		Devices
10	DDR#1 HS Bypass Capacitor Total Capacitance	0.4		µF
11	DDR#2 HS Bypass Capacitor Count(3)(4)	8		Devices
12	DDR#2 HS Bypass Capacitor Total Capacitance(4)	0.4		µF

(1) LxW, 10 mil units, i.e., a 0402 is a 40x20 mil surface mount capacitor
(2) An additional HS bypass capacitor can share the connection vias only if it is mounted on the opposite side of the board.
(3) These devices should be placed as close as possible to the device being bypassed.
(4) Only used on dual-memory systems.

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6.11.3.8 Net Classes

Table 6-31 lists the clock net classes for the DDR2/mDDR interface. Table 6-32 lists the signal net classes, and associated clock net classes, for the signals in the DDR2/mDDR interface. These net classes are used for the termination and routing rules that follow.

Table 6-31. Clock Net Class Definitions

CLOCK NET CLASS	DSP PIN NAMES
CK	DDR_CLKP / DDR_CLKN
DQS0	DDR_DQS[0]
DQS1	DDR_DQS[1]

Table 6-32. Signal Net Class Definitions

SIGNAL NET CLASS	ASSOCIATED CLOCK NET CLASS	DSP PIN NAMES
ADDR_CTRL	CK	DDR_BA[2:0], DDR_A[13:0], DDR_CS, DDR_CAS, DDR_RAS, DDR_WE, DDR_CKE
D0	DQS0	DDR_D[7:0], DDR_DQM0
D1	DQS1	DDR_D[15:8], DDR_DQM1
DQGATE	CK, DQS0, DQS1	DDR_DQGATE0, DDR_DQGATE1

6.11.3.9 DDR2/mDDR Signal Termination

No terminations of any kind are required in order to meet signal integrity and overshoot requirements. Serial terminators are permitted, if desired, to reduce EMI risk; however, serial terminations are the only type permitted. Table 6-33 shows the specifications for the series terminators.

Table 6-33. DDR2/mDDR Signal Terminations(1)(2)(3)

NO.	PARAMETER	MIN	TYP	MAX	UNIT
1	CK Net Class	0		10	Ω
2	ADDR_CTRL Net Class	0	22	Zo	Ω
3	Data Byte Net Classes (DQS[0], DQS[1], D0, D1)(4)	0	22	Zo	Ω
4	DQGATE Net Class (DQGATE)	0	10	Zo	Ω

(1) Only series termination is permitted, parallel or SST specifically disallowed.
(2) Terminator values larger than typical only recommended to address EMI issues.
(3) Termination value should be uniform across net class.
(4) When no termination is used on data lines (0 Ω), the DDR2/mDDR devices must be programmed to operate in 60% strength mode.

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6.11.3.10 VREF Routing

VREF is used as a reference by the input buffers of the DDR2/mDDR memories as well as the C6742 . VREF is intended to be half the DDR2/mDDR power supply voltage and should be created using a resistive divider as shown in Figure 6-18. Other methods of creating VREF are not recommended. Figure 6-22 shows the layout guidelines for VREF.

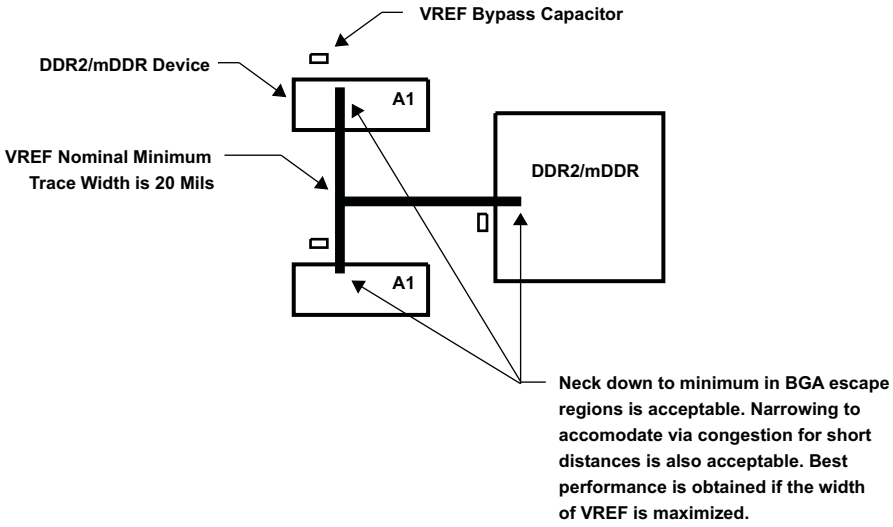

Figure 6-22. VREF Routing and Topology

6.11.3.11 DDR2/mDDR CK and ADDR_CTRL Routing

Figure 6-23 shows the topology of the routing for the CK and ADDR_CTRL net classes. The route is a balanced *T* as it is intended that the length of segments B and C be equal. In addition, the length of A should be maximized.

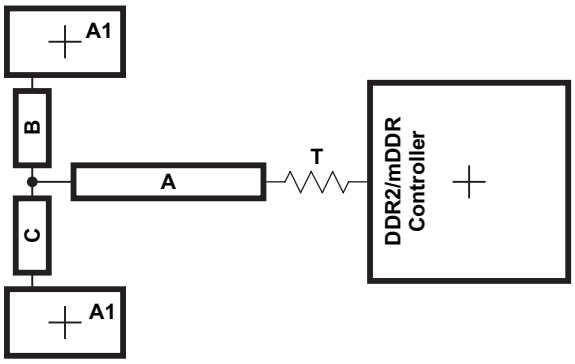

Figure 6-23. CK and ADDR_CTRL Routing and Topology

Table 6-34. CK and ADDR_CTRL Routing Specification

NO.	PARAMETER	MIN	TYP	MAX	UNIT
1	Center to Center CK-CKN Spacing(1)			2w(2)	
2	CK A to B/A to C Skew Length Mismatch(3)			25	Mils
3	CK B to C Skew Length Mismatch			25	Mils
4	Center to center CK to other DDR2/mDDR trace spacing(1)	4w(2)			
5	CK/ADDR_CTRL nominal trace length(4)	CACLM-50	CACLM	CACLM+50	Mils
6	ADDR_CTRL to CK Skew Length Mismatch			100	Mils
7	ADDR_CTRL to ADDR_CTRL Skew Length Mismatch			100	Mils
8	Center to center ADDR_CTRL to other DDR2/mDDR trace spacing(1)	4w(2)			
9	Center to center ADDR_CTRL to other ADDR_CTRL trace spacing(1)	3w (2)			
10	ADDR_CTRL A to B/A to C Skew Length Mismatch(3)			100	Mils
11	ADDR_CTRL B to C Skew Length Mismatch			100	Mils

(1) Center to center spacing is allowed to fall to minimum (w) for up to 500 mils of routed length to accommodate BGA escape and routing congestion.
(2) w = PCB trace width as defined in Table 6-27.
(3) Series terminator, if used, should be located closest to device.
(4) CACLM is the longest Manhattan distance of the CK and ADDR_CTRL net classes.

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Figure 6-24 shows the topology and routing for the DQS and D net class; the routes are point to point. Skew matching across bytes is not needed nor recommended.

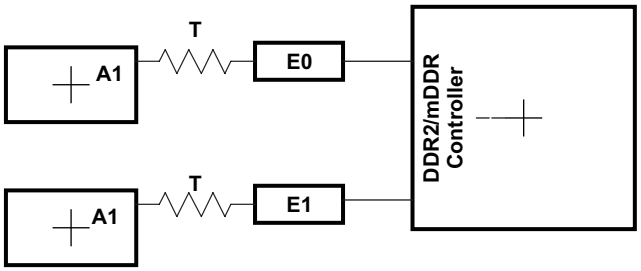

Figure 6-24. DQS and D Routing and Topology

Table 6-35. DQS and D Routing Specification

NO.	PARAMETER	MIN	TYP	MAX	UNIT
1	Center to center DQS to other DDR2/mDDR trace spacing(1)	4w(2)			
2	DQS/D nominal trace length(3)(4)	DQLM-50	DQLM	DQLM+50	Mils
3	D to DQS Skew Length Mismatch(4)			100	Mils
4	D to D Skew Length Mismatch(4)			100	Mils
5	Center to center D to other DDR2/mDDR trace spacing(1)(5)	4w(2)			
6	Center to Center D to other D trace spacing(1)(6)	3w(2)			

(1) Center to center spacing is allowed to fall to minimum (w) for up to 500 mils of routed length to accommodate BGA escape and routing congestion.
(2) w = PCB trace width as defined in Table 6-27.
(3) Series terminator, if used, should be located closest to DDR.
(4) There is no need and it is not recommended to skew match across data bytes, i.e., from DQS0 and data byte 0 to DQS1 and data byte 1.
(5) D's from other DQS domains are considered *other DDR2/mDDR trace*.
(6) DQLM is the longest Manhattan distance of each of the DQS and D net class.

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Figure 6-25 shows the routing for the DQGATE net class. Table 6-36 contains the routing specification.

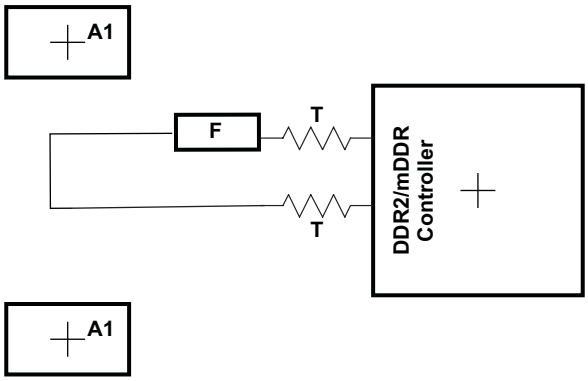

Figure 6-25. DQGATE Routing

Table 6-36. DQGATE Routing Specification

NO.	PARAMETER	MIN	TYP	MAX	UNIT
1	DQGATE Length F		CKB0B(1)		
2	Center to center DQGATE to any other trace spacing	4w(2)			
3	DQS/D nominal trace length	DQLM-50	DQLM	DQLM+50	Mils
4	DQGATE Skew(3)			100	Mils

(1) CKB0B1 is the sum of the length of the CK net plus the average length of the DQS0 and DQS1 nets.
(2) w = PCB trace width as defined in Table 6-27.
(3) Skew from CKB0B1

6.11.3.12 DDR2/mDDR Boundary Scan Limitations

Due to DDR implementation and timing restrictions, it was not possible to place boundary scan cells between core logic and the IO like boundary scan cells for other IO. Instead, the boundary scan cells are tapped-off to the DDR PHY and there is the equivalent of a multiplexer inside the DDR PHY which selects between functional and boundary scan paths.

The implication for boundary scan is that the DDR pins will not support the SAMPLE function of the output enable cells on the DDR pins and this is a violation of IEEE 1149.1. Full EXTEST and PRELOAD capability is still available.

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6.12 Memory Protection Units

The MPU performs memory protection checking. It receives requests from a bus master in the system and checks the address against the fixed and programmable regions to see if the access is allowed. If allowed, the transfer is passed unmodified to its output bus (to the targeted address). If the transfer is illegal (fails the protection check) then the MPU does not pass the transfer to the output bus but rather services the transfer internally back to the input bus (to prevent a hang) returning the fault status to the requestor as well as generating an interrupt about the fault. The following features are supported by the MPU:

- Provides memory protection for fixed and programmable address ranges.
- Supports multiple programmable address region.
- Supports secure and debug access privileges.
- Supports read, write, and execute access privileges.
- Supports privid(8) associations with ranges.
- Generates an interrupt when there is a protection violation, and saves violating transfer parameters.
- MMR access is also protected.

Table 6-37. MPU1 Configuration Registers

MPU1 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01E1 4000	REVID	Revision ID
0x01E1 4004	CONFIG	Configuration
0x01E1 4010	IRAWSTAT	Interrupt raw status/set
0x01E1 4014	IENSTAT	Interrupt enable status/clear
0x01E1 4018	IENSET	Interrupt enable
0x01E1 401C	IENCLR	Interrupt enable clear
0x01E1 4020 - 0x01E1 41FF	-	Reserved
0x01E1 4200	PROG1_MPSAR	Programmable range 1, start address
0x01E1 4204	PROG1_MPEAR	Programmable range 1, end address
0x01E1 4208	PROG1_MPPA	Programmable range 1, memory page protection attributes
0x01E1 420C - 0x01E1 420F	-	Reserved
0x01E1 4210	PROG2_MPSAR	Programmable range 2, start address
0x01E1 4214	PROG2_MPEAR	Programmable range 2, end address
0x01E1 4218	PROG2_MPPA	Programmable range 2, memory page protection attributes
0x01E1 421C - 0x01E1 421F	-	Reserved
0x01E1 4220	PROG3_MPSAR	Programmable range 3, start address
0x01E1 4224	PROG3_MPEAR	Programmable range 3, end address
0x01E1 4228	PROG3_MPPA	Programmable range 3, memory page protection attributes
0x01E1 422C - 0x01E1 422F	-	Reserved
0x01E1 4230	PROG4_MPSAR	Programmable range 4, start address
0x01E1 4234	PROG4_MPEAR	Programmable range 4, end address
0x01E1 4238	PROG4_MPPA	Programmable range 4, memory page protection attributes
0x01E1 423C - 0x01E1 423F	-	Reserved
0x01E1 4240	PROG5_MPSAR	Programmable range 5, start address
0x01E1 4244	PROG5_MPEAR	Programmable range 5, end address
0x01E1 4248	PROG5_MPPA	Programmable range 5, memory page protection attributes
0x01E1 424C - 0x01E1 424F	-	Reserved
0x01E1 4250	PROG6_MPSAR	Programmable range 6, start address
0x01E1 4254	PROG6_MPEAR	Programmable range 6, end address
0x01E1 4258	PROG6_MPPA	Programmable range 6, memory page protection attributes
0x01E1 425C - 0x01E1 42FF	-	Reserved

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Table 6-37. MPU1 Configuration Registers (continued)

MPU1 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01E1 4300	FLTADDRR	Fault address
0x01E1 4304	FLTSTAT	Fault status
0x01E1 4308	FLTCLR	Fault clear
0x01E1 430C - 0x01E1 4FFF	-	Reserved

Table 6-38. MPU2 Configuration Registers

MPU2 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01E1 5000	REVID	Revision ID
0x01E1 5004	CONFIG	Configuration
0x01E1 5010	IRAWSTAT	Interrupt raw status/set
0x01E1 5014	IENSTAT	Interrupt enable status/clear
0x01E1 5018	IENSET	Interrupt enable
0x01E1 501C	IENCLR	Interrupt enable clear
0x01E1 5020 - 0x01E1 51FF	-	Reserved
0x01E1 5200	PROG1_MPSAR	Programmable range 1, start address
0x01E1 5204	PROG1_MPEAR	Programmable range 1, end address
0x01E1 5208	PROG1_MPPA	Programmable range 1, memory page protection attributes
0x01E1 520C - 0x01E1 520F	-	Reserved
0x01E1 5210	PROG2_MPSAR	Programmable range 2, start address
0x01E1 5214	PROG2_MPEAR	Programmable range 2, end address
0x01E1 5218	PROG2_MPPA	Programmable range 2, memory page protection attributes
0x01E1 521C - 0x01E1 521F	-	Reserved
0x01E1 5220	PROG3_MPSAR	Programmable range 3, start address
0x01E1 5224	PROG3_MPEAR	Programmable range 3, end address
0x01E1 5228	PROG3_MPPA	Programmable range 3, memory page protection attributes
0x01E1 522C - 0x01E1 522F	-	Reserved
0x01E1 5230	PROG4_MPSAR	Programmable range 4, start address
0x01E1 5234	PROG4_MPEAR	Programmable range 4, end address
0x01E1 5238	PROG4_MPPA	Programmable range 4, memory page protection attributes
0x01E1 523C - 0x01E1 523F	-	Reserved
0x01E1 5240	PROG5_MPSAR	Programmable range 5, start address
0x01E1 5244	PROG5_MPEAR	Programmable range 5, end address
0x01E1 5248	PROG5_MPPA	Programmable range 5, memory page protection attributes
0x01E1 524C - 0x01E1 524F	-	Reserved
0x01E1 5250	PROG6_MPSAR	Programmable range 6, start address
0x01E1 5254	PROG6_MPEAR	Programmable range 6, end address
0x01E1 5258	PROG6_MPPA	Programmable range 6, memory page protection attributes
0x01E1 525C - 0x01E1 525F	-	Reserved
0x01E1 5260	PROG7_MPSAR	Programmable range 7, start address
0x01E1 5264	PROG7_MPEAR	Programmable range 7, end address
0x01E1 5268	PROG7_MPPA	Programmable range 7, memory page protection attributes
0x01E1 526C - 0x01E1 526F	-	Reserved
0x01E1 5270	PROG8_MPSAR	Programmable range 8, start address
0x01E1 5274	PROG8_MPEAR	Programmable range 8, end address
0x01E1 5278	PROG8_MPPA	Programmable range 8, memory page protection attributes
0x01E1 527C - 0x01E1 527F	-	Reserved

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Table 6-38. MPU2 Configuration Registers (continued)

MPU2 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01E1 5280	PROG9_MPSAR	Programmable range 9, start address
0x01E1 5284	PROG9_MPEAR	Programmable range 9, end address
0x01E1 5288	PROG9_MPPA	Programmable range 9, memory page protection attributes
0x01E1 528C - 0x01E1 528F	-	Reserved
0x01E1 5290	PROG10_MPSAR	Programmable range 10, start address
0x01E1 5294	PROG10_MPEAR	Programmable range 10, end address
0x01E1 5298	PROG10_MPPA	Programmable range 10, memory page protection attributes
0x01E1 529C - 0x01E1 529F	-	Reserved
0x01E1 52A0	PROG11_MPSAR	Programmable range 11, start address
0x01E1 52A4	PROG11_MPEAR	Programmable range 11, end address
0x01E1 52A8	PROG11_MPPA	Programmable range 11, memory page protection attributes
0x01E1 52AC - 0x01E1 52AF	-	Reserved
0x01E1 52B0	PROG12_MPSAR	Programmable range 12, start address
0x01E1 52B4	PROG12_MPEAR	Programmable range 12, end address
0x01E1 52B8	PROG12_MPPA	Programmable range 12, memory page protection attributes
0x01E1 52BC - 0x01E1 52FF	-	Reserved
0x01E1 5300	FLTADDRR	Fault address
0x01E1 5304	FLTSTAT	Fault status
0x01E1 5308	FLTCLR	Fault clear
0x01E1 530C - 0x01E1 5FFF	-	Reserved

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6.13 Multichannel Audio Serial Port (McASP)

The McASP serial port is specifically designed for multichannel audio applications. Its key features are:

- Flexible clock and frame sync generation logic and on-chip dividers
- Up to sixteen transmit or receive data pins and serializers
- Large number of serial data format options, including:
  - TDM Frames with 2 to 32 time slots per frame (periodic) or 1 slot per frame (burst)
  - Time slots of 8,12,16, 20, 24, 28, and 32 bits
  - First bit delay 0, 1, or 2 clocks
  - MSB or LSB first bit order
  - Left- or right-aligned data words within time slots
- DIT Mode with 384-bit Channel Status and 384-bit User Data registers
- Extensive error checking and mute generation logic
- All unused pins GPIO-capable
- Transmit & Receive FIFO Buffers allow the McASP to operate at a higher sample rate by making it more tolerant to DMA latency.
- Dynamic Adjustment of Clock Dividers
  - Clock Divider Value may be changed without resetting the McASP

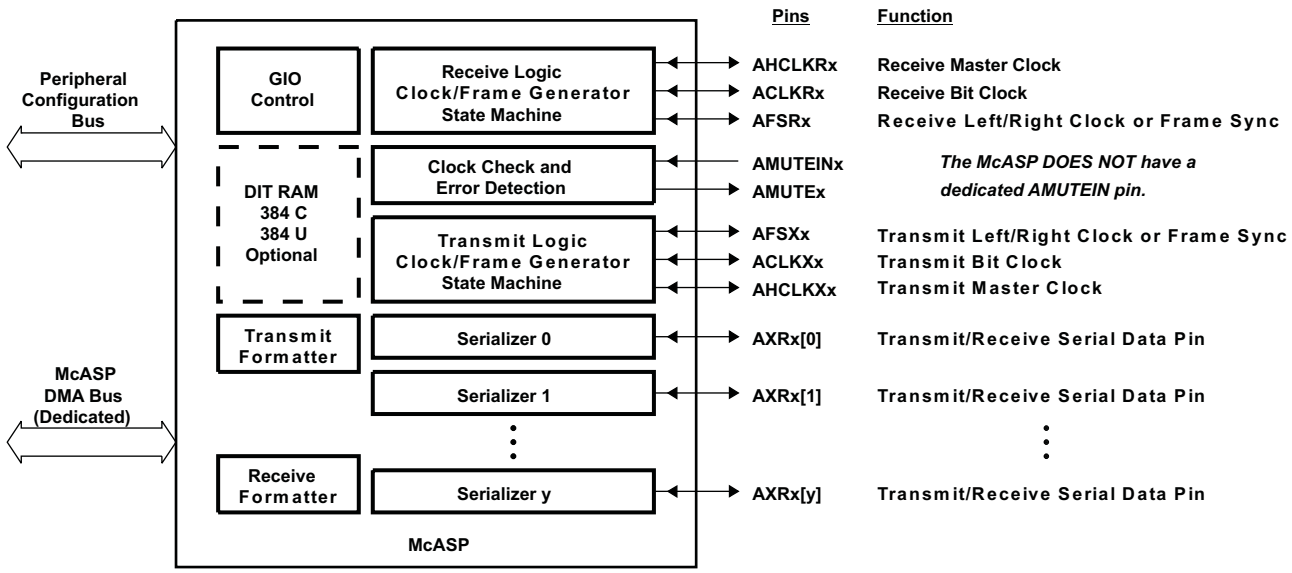

Figure 6-26. McASP Block Diagram

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6.13.1 McASP Peripheral Registers Description(s)

Registers for the McASP are summarized in Table 6-39. The registers are accessed through the peripheral configuration port. The receive buffer registers (RBUF) and transmit buffer registers (XBUF) can also be accessed through the DMA port, as listed in Table 6-40

Registers for the McASP Audio FIFO (AFIFO) are summarized in Table 6-41. Note that the AFIFO Write FIFO (WFIFO) and Read FIFO (RFIFO) have independent control and status registers. The AFIFO control registers are accessed through the peripheral configuration port.

Table 6-39. McASP Registers Accessed Through Peripheral Configuration Port

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01D0 0000	REV	Revision identification register
0x01D0 0010	PFUNC	Pin function register
0x01D0 0014	PDIR	Pin direction register
0x01D0 0018	PDOUT	Pin data output register
0x01D0 001C	PDIN	Read returns: Pin data input register
0x01D0 001C	PDSET	Writes affect: Pin data set register (alternate write address: PDOUT)
0x01D0 0020	PDCLR	Pin data clear register (alternate write address: PDOUT)
0x01D0 0044	GBLCTL	Global control register
0x01D0 0048	AMUTE	Audio mute control register
0x01D0 004C	DLBCTL	Digital loopback control register
0x01D0 0050	DITCTL	DIT mode control register
0x01D0 0060	RGBLCTL	Receiver global control register: Alias of GBLCTL, only receive bits are affected - allows receiver to be reset independently from transmitter
0x01D0 0064	RMASK	Receive format unit bit mask register
0x01D0 0068	RFMT	Receive bit stream format register
0x01D0 006C	AFSRCTL	Receive frame sync control register
0x01D0 0070	ACLKRCTL	Receive clock control register
0x01D0 0074	AHCLKRCTL	Receive high-frequency clock control register
0x01D0 0078	RTDM	Receive TDM time slot 0-31 register
0x01D0 007C	RINTCTL	Receiver interrupt control register
0x01D0 0080	RSTAT	Receiver status register
0x01D0 0084	RSLOT	Current receive TDM time slot register
0x01D0 0088	RCLKCHK	Receive clock check control register
0x01D0 008C	REVTCTL	Receiver DMA event control register
0x01D0 00A0	XGBLCTL	Transmitter global control register. Alias of GBLCTL, only transmit bits are affected - allows transmitter to be reset independently from receiver
0x01D0 00A4	XMASK	Transmit format unit bit mask register
0x01D0 00A8	XFMT	Transmit bit stream format register
0x01D0 00AC	AFSXCTL	Transmit frame sync control register
0x01D0 00B0	ACLKXCTL	Transmit clock control register
0x01D0 00B4	AHCLKXCTL	Transmit high-frequency clock control register
0x01D0 00B8	XTDM	Transmit TDM time slot 0-31 register
0x01D0 00BC	XINTCTL	Transmitter interrupt control register
0x01D0 00C0	XSTAT	Transmitter status register
0x01D0 00C4	XSLOT	Current transmit TDM time slot register
0x01D0 00C8	XCLKCHK	Transmit clock check control register
0x01D0 00CC	XEVTCTL	Transmitter DMA event control register
0x01D0 0100	DITCSRA0	Left (even TDM time slot) channel status register (DIT mode) 0
0x01D0 0104	DITCSRA1	Left (even TDM time slot) channel status register (DIT mode) 1
0x01D0 0108	DITCSRA2	Left (even TDM time slot) channel status register (DIT mode) 2

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Table 6-39. McASP Registers Accessed Through Peripheral Configuration Port (continued)

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01D0 010C	DITCSRA3	Left (even TDM time slot) channel status register (DIT mode) 3
0x01D0 0110	DITCSRA4	Left (even TDM time slot) channel status register (DIT mode) 4
0x01D0 0114	DITCSRA5	Left (even TDM time slot) channel status register (DIT mode) 5
0x01D0 0118	DITCSRB0	Right (odd TDM time slot) channel status register (DIT mode) 0
0x01D0 011C	DITCSRB1	Right (odd TDM time slot) channel status register (DIT mode) 1
0x01D0 0120	DITCSRB2	Right (odd TDM time slot) channel status register (DIT mode) 2
0x01D0 0124	DITCSRB3	Right (odd TDM time slot) channel status register (DIT mode) 3
0x01D0 0128	DITCSRB4	Right (odd TDM time slot) channel status register (DIT mode) 4
0x01D0 012C	DITCSRB5	Right (odd TDM time slot) channel status register (DIT mode) 5
0x01D0 0130	DITUDRA0	Left (even TDM time slot) channel user data register (DIT mode) 0
0x01D0 0134	DITUDRA1	Left (even TDM time slot) channel user data register (DIT mode) 1
0x01D0 0138	DITUDRA2	Left (even TDM time slot) channel user data register (DIT mode) 2
0x01D0 013C	DITUDRA3	Left (even TDM time slot) channel user data register (DIT mode) 3
0x01D0 0140	DITUDRA4	Left (even TDM time slot) channel user data register (DIT mode) 4
0x01D0 0144	DITUDRA5	Left (even TDM time slot) channel user data register (DIT mode) 5
0x01D0 0148	DITUDRB0	Right (odd TDM time slot) channel user data register (DIT mode) 0
0x01D0 014C	DITUDRB1	Right (odd TDM time slot) channel user data register (DIT mode) 1
0x01D0 0150	DITUDRB2	Right (odd TDM time slot) channel user data register (DIT mode) 2
0x01D0 0154	DITUDRB3	Right (odd TDM time slot) channel user data register (DIT mode) 3
0x01D0 0158	DITUDRB4	Right (odd TDM time slot) channel user data register (DIT mode) 4
0x01D0 015C	DITUDRB5	Right (odd TDM time slot) channel user data register (DIT mode) 5
0x01D0 0180	SRCTL0	Serializer control register 0
0x01D0 0184	SRCTL1	Serializer control register 1
0x01D0 0188	SRCTL2	Serializer control register 2
0x01D0 018C	SRCTL3	Serializer control register 3
0x01D0 0190	SRCTL4	Serializer control register 4
0x01D0 0194	SRCTL5	Serializer control register 5
0x01D0 0198	SRCTL6	Serializer control register 6
0x01D0 019C	SRCTL7	Serializer control register 7
0x01D0 01A0	SRCTL8	Serializer control register 8
0x01D0 01A4	SRCTL9	Serializer control register 9
0x01D0 01A8	SRCTL10	Serializer control register 10
0x01D0 01AC	SRCTL11	Serializer control register 11
0x01D0 01B0	SRCTL12	Serializer control register 12
0x01D0 01B4	SRCTL13	Serializer control register 13
0x01D0 01B8	SRCTL14	Serializer control register 14
0x01D0 01BC	SRCTL15	Serializer control register 15

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Table 6-39. McASP Registers Accessed Through Peripheral Configuration Port (continued)

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01D0 0200	XBUF0(1)	Transmit buffer register for serializer 0
0x01D0 0204	XBUF1(1)	Transmit buffer register for serializer 1
0x01D0 0208	XBUF2(1)	Transmit buffer register for serializer 2
0x01D0 020C	XBUF3(1)	Transmit buffer register for serializer 3
0x01D0 0210	XBUF4(1)	Transmit buffer register for serializer 4
0x01D0 0214	XBUF5(1)	Transmit buffer register for serializer 5
0x01D0 0218	XBUF6(1)	Transmit buffer register for serializer 6
0x01D0 021C	XBUF7(1)	Transmit buffer register for serializer 7
0x01D0 0220	XBUF8(1)	Transmit buffer register for serializer 8
0x01D0 0224	XBUF9(1)	Transmit buffer register for serializer 9
0x01D0 0228	XBUF10(1)	Transmit buffer register for serializer 10
0x01D0 022C	XBUF11(1)	Transmit buffer register for serializer 11
0x01D0 0230	XBUF12(1)	Transmit buffer register for serializer 12
0x01D0 0234	XBUF13(1)	Transmit buffer register for serializer 13
0x01D0 0238	XBUF14(1)	Transmit buffer register for serializer 14
0x01D0 023C	XBUF15(1)	Transmit buffer register for serializer 15
0x01D0 0280	RBUF0(2)	Receive buffer register for serializer 0
0x01D0 0284	RBUF1(2)	Receive buffer register for serializer 1
0x01D0 0288	RBUF2(2)	Receive buffer register for serializer 2
0x01D0 028C	RBUF3(2)	Receive buffer register for serializer 3
0x01D0 0290	RBUF4(2)	Receive buffer register for serializer 4
0x01D0 0294	RBUF5(2)	Receive buffer register for serializer 5
0x01D0 0298	RBUF6(2)	Receive buffer register for serializer 6
0x01D0 029C	RBUF7(2)	Receive buffer register for serializer 7
0x01D0 02A0	RBUF8(2)	Receive buffer register for serializer 8
0x01D0 02A4	RBUF9(2)	Receive buffer register for serializer 9
0x01D0 02A8	RBUF10(2)	Receive buffer register for serializer 10
0x01D0 02AC	RBUF11(2)	Receive buffer register for serializer 11
0x01D0 02B0	RBUF12(2)	Receive buffer register for serializer 12
0x01D0 02B4	RBUF13(2)	Receive buffer register for serializer 13
0x01D0 02B8	RBUF14(2)	Receive buffer register for serializer 14
0x01D0 02BC	RBUF15(2)	Receive buffer register for serializer 15

(1) Writes to XRBUF originate from peripheral configuration port only when XBUSEL = 1 in XFMT.
(2) Reads from XRBUF originate on peripheral configuration port only when RBUSEL = 1 in RFMT.

Table 6-40. McASP Registers Accessed Through DMA Port

ACCESS TYPE	BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
Read Accesses	0x01D0 2000	RBUF	Receive buffer DMA port address. Cycles through receive serializers, skipping over transmit serializers and inactive serializers. Starts at the lowest serializer at the beginning of each time slot. Reads from DMA port only if XBUSEL = 0 in XFMT.
Write Accesses	0x01D0 2000	XBUF	Transmit buffer DMA port address. Cycles through transmit serializers, skipping over receive and inactive serializers. Starts at the lowest serializer at the beginning of each time slot. Writes to DMA port only if RBUSEL = 0 in RFMT.

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Table 6-41. McASP AFIFO Registers Accessed Through Peripheral Configuration Port

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01D0 1000	AFIFOREV	AFIFO revision identification register
0x01D0 1010	WFIFOCTL	Write FIFO control register
0x01D0 1014	WFIFOSTS	Write FIFO status register
0x01D0 1018	RFIFOCTL	Read FIFO control register
0x01D0 101C	RFIFOSTS	Read FIFO status register

6.13.2 McASP Electrical Data/Timing

6.13.2.1 Multichannel Audio Serial Port 0 (McASP0) Timing

Table 6-42 and Table 6-44 assume testing over recommended operating conditions (see Figure 6-27 and Figure 6-28).

Table 6-42. Timing Requirements for McASP0 (1.2V, 1.1V)(1)(2)

NO.				1.2V		1.1V		UNIT
				MIN	MAX	MIN	MAX	
1	$t_{c(AHCLKRX)}$	Cycle time, AHCLKR/X		25		28		ns
2	$t_{w(AHCLKRX)}$	Pulse duration, AHCLKR/X high or low		12.5		14		ns
3	$t_{c(ACLKRX)}$	Cycle time, ACLKR/X	AHCLKR/X ext	25(3)		28(3)		ns
4	$t_{w(ACLKRX)}$	Pulse duration, ACLKR/W high or low	AHCLKR/X ext	12.5		14		ns
5	$t_{su(AFSRX-ACLKRX)}$	Setup time, AFSR/X input to ACLKR/X(4)	AHCLKR/X int	11.5		12		ns
			AHCLKR/X ext input	4		5		ns
			AHCLKR/X ext output	4		5		ns
6	$t_{h(ACLKRX-AFSRX)}$	Hold time, AFSR/X input after ACLKR/X(4)	AHCLKR/X int	-1		-2		ns
			AHCLKR/X ext input	1		1		ns
			AHCLKR/X ext output	1		1		ns
7	$t_{su(AXR-ACLKRX)}$	Setup time, AXR0[n] input to ACLKR/X(4)(5)	AHCLKR/X int	11.5		12		ns
			AHCLKR/X ext	4		5		ns
8	$t_{h(ACLKRX-AXR)}$	Hold time, AXR0[n] input after ACLKR/X(4)(5)	AHCLKR/X int	-1		-2		ns
			AHCLKR/X ext input	3		4		ns
			AHCLKR/X ext output	3		4		ns

(1) ACLKX0 internal – McASP0 ACLKXCTL.CLKXM = 1, PDIR.ACLKX = 1
ACLKX0 external input – McASP0 ACLKXCTL.CLKXM = 0, PDIR.ACLKX = 0
ACLKX0 external output – McASP0 ACLKXCTL.CLKXM = 0, PDIR.ACLKX = 1
ACLKR0 internal – McASP0 ACLKRCTL.CLKRM = 1, PDIR.ACLKR =1
ACLKR0 external input – McASP0 ACLKRCTL.CLKRM = 0, PDIR.ACLKR = 0
ACLKR0 external output – McASP0 ACLKRCTL.CLKRM = 0, PDIR.ACLKR = 1
(2) P = SYSCLK2 period
(3) This timing is limited by the timing shown or 2P, whichever is greater.
(4) McASP0 ACLKXCTL.ASYNC=1: Receiver is clocked by its own ACLKR0
(5) McASP0 ACLKXCTL.ASYNC=0: Receiver is clocked by transmitter's ACLKX0

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Table 6-43. Timing Requirements for McASP0 (1.0V)(1)(2)

NO.				1.0V		UNIT
				MIN	MAX	
1	$t_{c(AHCLKRX)}$	Cycle time, AHCLKR/X		35		ns
2	$t_{w(AHCLKRX)}$	Pulse duration, AHCLKR/X high or low		17.5		ns
3	$t_{c(ACLKRX)}$	Cycle time, ACLKR/X	AHCLKR/X ext	35(3)		ns
4	$t_{w(ACLKRX)}$	Pulse duration, ACLKR/W high or low	AHCLKR/X ext	17.5		ns
5	$t_{su(AFSRX-ACLKRX)}$	Setup time, AFSR/X input to ACLKR/X(4)	AHCLKR/X int	16		ns
			AHCLKR/X ext input	5.5		ns
			AHCLKR/X ext output	5.5		ns
6	$t_{h(ACLKRX-AFSRX)}$	Hold time, AFSR/X input after ACLKR/X(4)	AHCLKR/X int	-2		ns
			AHCLKR/X ext input	1		ns
			AHCLKR/X ext output	1		ns
7	$t_{su(AXR-ACLKRX)}$	Setup time, AXR0[n] input to ACLKR/X(4)(5)	AHCLKR/X int	16		ns
			AHCLKR/X ext	5.5		ns
8	$t_{h(ACLKRX-AXR)}$	Hold time, AXR0[n] input after ACLKR/X(4)(5)	AHCLKR/X int	-2		ns
			AHCLKR/X ext input	5		ns
			AHCLKR/X ext output	5		ns

(1) ACLKX0 internal – McASP0 ACLKXCTL.CLKXM = 1, PDIR.ACLKX = 1
ACLKX0 external input – McASP0 ACLKXCTL.CLKXM = 0, PDIR.ACLKX = 0
ACLKX0 external output – McASP0 ACLKXCTL.CLKXM = 0, PDIR.ACLKX = 1
ACLKR0 internal – McASP0 ACLKRCTL.CLKRM = 1, PDIR.ACLKR =1
ACLKR0 external input – McASP0 ACLKRCTL.CLKRM = 0, PDIR.ACLKR = 0
ACLKR0 external output – McASP0 ACLKRCTL.CLKRM = 0, PDIR.ACLKR = 1
(2) P = SYSCLK2 period
(3) This timing is limited by the timing shown or 2P, whichever is greater.
(4) McASP0 ACLKXCTL.ASYNC=1: Receiver is clocked by its own ACLKR0
(5) McASP0 ACLKXCTL.ASYNC=0: Receiver is clocked by transmitter's ACLKX0

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Table 6-44. Switching Characteristics for McASP0 (1.2V, 1.1V)(1)

NO.	PARAMETER			1.2V		1.1V		UNIT
				MIN	MAX	MIN	MAX	
9	$t_{c(AHCLKRX)}$	Cycle time, AHCLKR/X		25		28		ns
10	$t_{w(AHCLKRX)}$	Pulse duration, AHCLKR/X high or low		AH – 2.5(2)		AH – 2.5(2)		ns
11	$t_{c(ACLKRX)}$	Cycle time, ACLKR/X	ACLKR/X int	25(3)(4)		28(3)(4)		ns
12	$t_{w(ACLKRX)}$	Pulse duration, ACLKR/X high or low	ACLKR/X int	A – 2.5(5)		A – 2.5(5)		ns
13	$t_{d(ACLKRX-AFSRX)}$	Delay time, ACLKR/X transmit edge to AFSX/R output valid(6)	ACLKR/X int	-1	6	-1	8	ns
			ACLKR/X ext input	2	13.5	2	14.5	ns
			ACLKR/X ext output	2	13.5	2	14.5	ns
14	$t_{d(ACLKX-AXRV)}$	Delay time, ACLKX transmit edge to AXR output valid	ACLKR/X int	-1	6	-1	8	ns
			ACLKR/X ext input	2	13.5	2	15	ns
			ACLKR/X ext output	2	13.5	2	15	ns
15	$t_{dis(ACLKX-AXRHZ)}$	Disable time, ACLKR/X transmit edge to AXR high impedance following last data bit	ACLKR/X int	0	6	0	8	ns
			ACLKR/X ext	2	13.5	2	15	ns

(1) McASP0 ACLKX0 internal – ACLKXCTL.CLKXM = 1, PDIR.ACLKX = 1
ACLKX0 external input – McASP0 ACLKXCTL.CLKXM = 0, PDIR.ACLKX = 0
ACLKX0 external output – McASP0ACLKXCTL.CLKXM = 0, PDIR.ACLKX = 1
ACLKR0 internal – McASP0 ACLKR0CTL.CLKRM = 1, PDIR.ACLKR =1
ACLKR0 external input – McASP0 ACLKRCTL.CLKRM = 0, PDIR.ACLKR = 0
ACLKR0 external output – McASP0 ACLKRCTL.CLKRM = 0, PDIR.ACLKR = 1
(2) AH = (AHCLKR/X period)/2 in ns. For example, when AHCLKR/X period is 25 ns, use AH = 12.5 ns.
(3) P = SYSCLK2 period
(4) This timing is limited by the timing shown or 2P, whichever is greater.
(5) A = (ACLKR/X period)/2 in ns. For example, when AHCLKR/X period is 25 ns, use AH = 12.5 ns.
(6) McASP0 ACLKXCTL.ASYNC=1: Receiver is clocked by its own ACLKR0

Table 6-45. Switching Characteristics for McASP0 (1.0V)(1)

NO.	PARAMETER			1.0V		UNIT
				MIN	MAX	
9	$t_{c(AHCLKRX)}$	Cycle time, AHCLKR/X		35		ns
10	$t_{w(AHCLKRX)}$	Pulse duration, AHCLKR/X high or low		AH – 2.5(2)		ns
11	$t_{c(ACLKRX)}$	Cycle time, ACLKR/X	ACLKR/X int	35(3)(4)		ns
12	$t_{w(ACLKRX)}$	Pulse duration, ACLKR/X high or low	ACLKR/X int	A – 2.5(5)		ns
13	$t_{d(ACLKRX-AFSRX)}$	Delay time, ACLKR/X transmit edge to AFSX/R output valid(6)	ACLKR/X int	-0.5	10	ns
			ACLKR/X ext input	2	19	ns
			ACLKR/X ext output	2	19	ns
14	$t_{d(ACLKX-AXRV)}$	Delay time, ACLKX transmit edge to AXR output valid	ACLKR/X int	-0.5	10	ns
			ACLKR/X ext input	2	19	ns
			ACLKR/X ext output	2	19	ns
15	$t_{dis(ACLKX-AXRHZ)}$	Disable time, ACLKR/X transmit edge to AXR high impedance following last data bit	ACLKR/X int	0	10	ns
			ACLKR/X ext	2	19	ns

(1) McASP0 ACLKX0 internal – ACLKXCTL.CLKXM = 1, PDIR.ACLKX = 1
ACLKX0 external input – McASP0 ACLKXCTL.CLKXM = 0, PDIR.ACLKX = 0
ACLKX0 external output – McASP0ACLKXCTL.CLKXM = 0, PDIR.ACLKX = 1
ACLKR0 internal – McASP0 ACLKR0CTL.CLKRM = 1, PDIR.ACLKR =1
ACLKR0 external input – McASP0 ACLKRCTL.CLKRM = 0, PDIR.ACLKR = 0
ACLKR0 external output – McASP0 ACLKRCTL.CLKRM = 0, PDIR.ACLKR = 1
(2) AH = (AHCLKR/X period)/2 in ns. For example, when AHCLKR/X period is 25 ns, use AH = 12.5 ns.
(3) P = SYSCLK2 period
(4) This timing is limited by the timing shown or 2P, whichever is greater.
(5) A = (ACLKR/X period)/2 in ns. For example, when AHCLKR/X period is 25 ns, use AH = 12.5 ns.
(6) McASP0 ACLKXCTL.ASYNC=1: Receiver is clocked by its own ACLKR0

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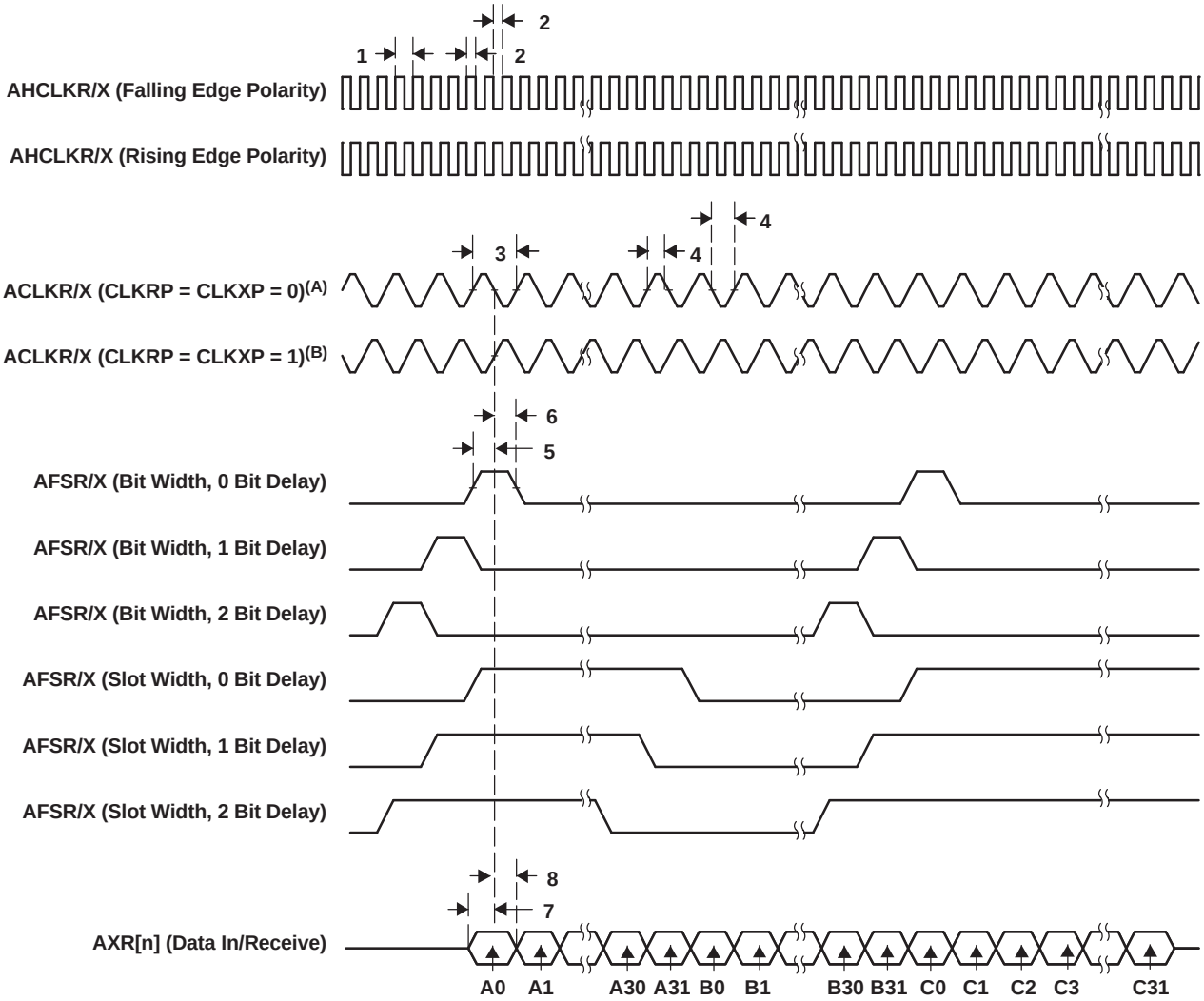
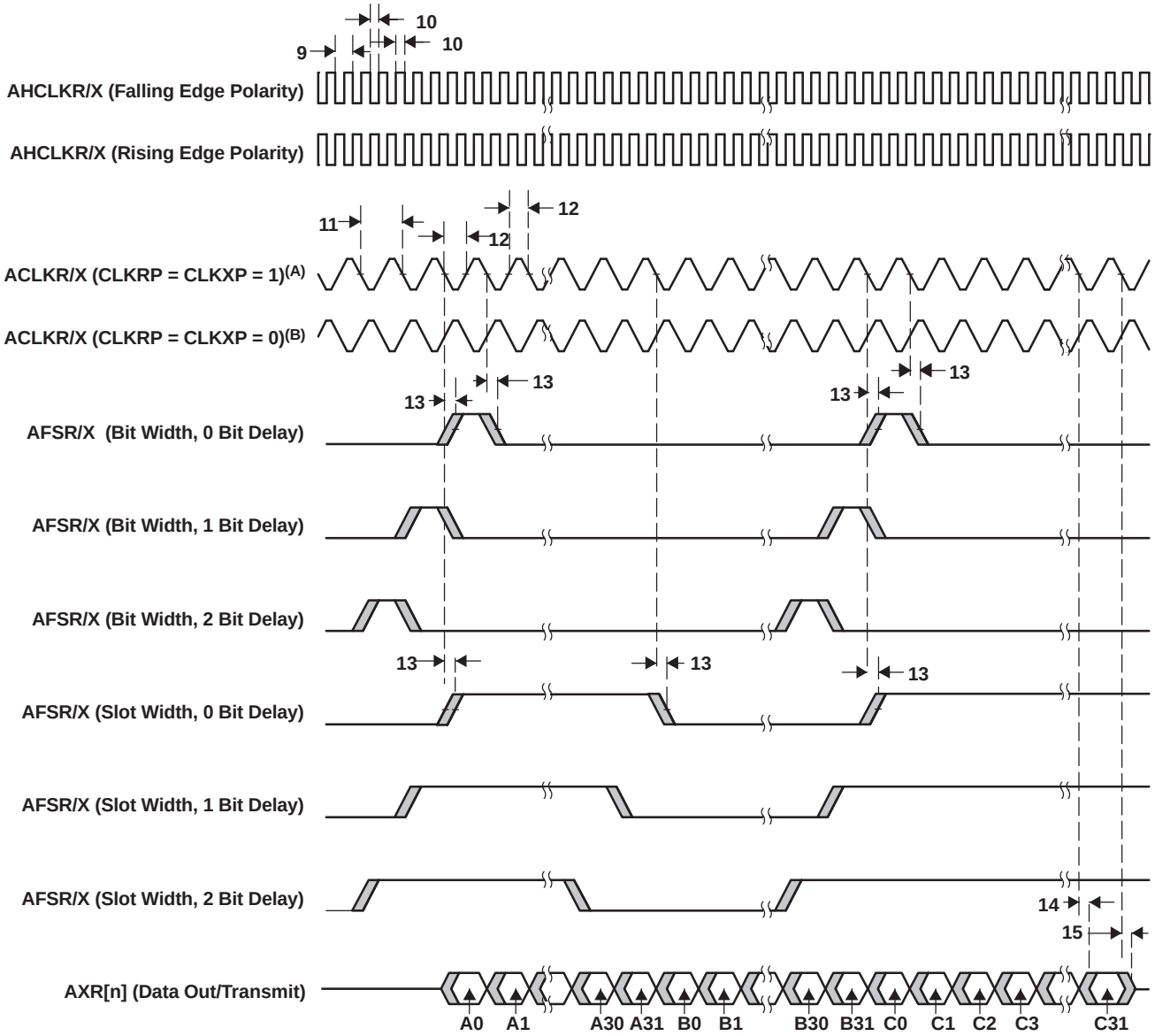


A. For CLKRP = CLKXP = 0, the McASP transmitter is configured for rising edge (to shift data out) and the McASP receiver is configured for falling edge (to shift data in).

B. For CLKRP = CLKXP = 1, the McASP transmitter is configured for falling edge (to shift data out) and the McASP receiver is configured for rising edge (to shift data in).

Figure 6-27. McASP Input Timings



A. For CLKRP = CLKXP = 1, the McASP transmitter is configured for falling edge (to shift data out) and the McASP receiver is configured for rising edge (to shift data in).

B. For CLKRP = CLKXP = 0, the McASP transmitter is configured for rising edge (to shift data out) and the McASP receiver is configured for falling edge (to shift data in).

Figure 6-28. McASP Output Timings

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6.14 Multichannel Buffered Serial Port (McBSP)

The McBSP provides these functions:

- Full-duplex communication
- Double-buffered data registers, which allow a continuous data stream
- Independent framing and clocking for receive and transmit
- Direct interface to industry-standard codecs, analog interface chips (AICs), and other serially connected analog-to-digital (A/D) and digital-to-analog (D/A) devices
- External shift clock or an internal, programmable frequency shift clock for data transfer
- Transmit & Receive FIFO Buffers allow the McBSP to operate at a higher sample rate by making it more tolerant to DMA latency

If internal clock source is used, the CLKGDV field of the Sample Rate Generator Register (SRGR) must always be set to a value of 1 or greater.

6.14.1 McBSP Peripheral Register Description(s)

Table 6-46. McBSP/FIFO Registers

McBSP1 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
McBSP Registers		
0x01D1 1000	DRR	McBSP Data Receive Register (read-only)
0x01D1 1004	DXR	McBSP Data Transmit Register
0x01D1 1008	SPCR	McBSP Serial Port Control Register
0x01D1 100C	RCR	McBSP Receive Control Register
0x01D1 1010	XCR	McBSP Transmit Control Register
0x01D1 1014	SRGR	McBSP Sample Rate Generator register
0x01D1 1018	MCR	McBSP Multichannel Control Register
0x01D1 101C	RCERE0	McBSP Enhanced Receive Channel Enable Register 0 Partition A/B
0x01D1 1020	XCERE0	McBSP Enhanced Transmit Channel Enable Register 0 Partition A/B
0x01D1 1024	PCR	McBSP Pin Control Register
0x01D1 1028	RCERE1	McBSP Enhanced Receive Channel Enable Register 1 Partition C/D
0x01D1 102C	XCERE1	McBSP Enhanced Transmit Channel Enable Register 1 Partition C/D
0x01D1 1030	RCERE2	McBSP Enhanced Receive Channel Enable Register 2 Partition E/F
0x01D1 1034	XCERE2	McBSP Enhanced Transmit Channel Enable Register 2 Partition E/F
0x01D1 1038	RCERE3	McBSP Enhanced Receive Channel Enable Register 3 Partition G/H
0x01D1 103C	XCERE3	McBSP Enhanced Transmit Channel Enable Register 3 Partition G/H
McBSP FIFO Control and Status Registers		
0x01D1 1800	BFIFOREV	BFIFO Revision Identification Register
0x01D1 1810	WFIFOCTL	Write FIFO Control Register
0x01D1 1814	WFIFOSTS	Write FIFO Status Register
0x01D1 1818	RFIFOCTL	Read FIFO Control Register
0x01D1 181C	RFIFOSTS	Read FIFO Status Register
McBSP FIFO Data Registers		
0x01F1 1000	RBUF	McBSP FIFO Receive Buffer
0x01F1 1000	XBUF	McBSP FIFO Transmit Buffer

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6.14.2 McBSP Electrical Data/Timing

The following assume testing over recommended operating conditions.

6.14.2.1 Multichannel Buffered Serial Port (McBSP) Timing

Table 6-47. Timing Requirements for McBSP1 [1.2V, 1.1V](1) (see Figure 6-29)

NO.				1.2V		1.1V		UNIT
				MIN	MAX	MIN	MAX	
2	$t_{c(CKRX)}$	Cycle time, CLKR/X	CLKR/X ext	2P or 20(2)(3)		2P or 25(2)		ns
3	$t_{w(CKRX)}$	Pulse duration, CLKR/X high or CLKR/X low	CLKR/X ext	P - 1		P - 1(4)		ns
5	$t_{su(FRH-CKRL)}$	Setup time, external FSR high before CLKR low	CLKR int	15		18		ns
			CLKR ext	5		5		
6	$t_{h(CKRL-FRH)}$	Hold time, external FSR high after CLKR low	CLKR int	6		6		ns
			CLKR ext	3		3		
7	$t_{su(DRV-CKRL)}$	Setup time, DR valid before CLKR low	CLKR int	15		18		ns
			CLKR ext	5		5		
8	$t_{h(CKRL-DRV)}$	Hold time, DR valid after CLKR low	CLKR int	3		3		ns
			CLKR ext	3		3		
10	$t_{su(FXH-CKXL)}$	Setup time, external FSX high before CLKX low	CLKX int	15		18		ns
			CLKX ext	5		5		
11	$t_{h(CKXL-FXH)}$	Hold time, external FSX high after CLKX low	CLKX int	6		6		ns
			CLKX ext	3		3		

(1) CLKRP = CLKXP = FSRP = FSXP = 0. If polarity of any of the signals is inverted, then the timing references of that signal are also inverted.
(2) P = ASYNC3 period in ns. For example, when the ASYNC clock domain is running at 100 MHz, use 10 ns.
(3) Use whichever value is greater. Minimum CLKR/X cycle times *must* be met, even when CLKR/X is generated by an internal clock source. The minimum CLKR/X cycle times are based on internal logic speed; the maximum usable speed may be lower due to EDMA limitations and AC timing requirements.
(4) This parameter applies to the maximum McBSP frequency. Operate serial clocks (CLKR/X) in the reasonable range of 40/60 duty cycle.

Table 6-48. Timing Requirements for McBSP1 [1.0V](1) (see Figure 6-29)

NO.				1.0V		UNIT
				MIN	MAX	
2	$t_{c(CKRX)}$	Cycle time, CLKR/X	CLKR/X ext	2P or 26.6(2)(3)		ns
3	$t_{w(CKRX)}$	Pulse duration, CLKR/X high or CLKR/X low	CLKR/X ext	P - 1(4)		ns
5	$t_{su(FRH-CKRL)}$	Setup time, external FSR high before CLKR low	CLKR int	21		ns
			CLKR ext	10		
6	$t_{h(CKRL-FRH)}$	Hold time, external FSR high after CLKR low	CLKR int	6		ns
			CLKR ext	3		
7	$t_{su(DRV-CKRL)}$	Setup time, DR valid before CLKR low	CLKR int	21		ns
			CLKR ext	10		
8	$t_{h(CKRL-DRV)}$	Hold time, DR valid after CLKR low	CLKR int	3		ns
			CLKR ext	3		
10	$t_{su(FXH-CKXL)}$	Setup time, external FSX high before CLKX low	CLKX int	21		ns
			CLKX ext	10		

(1) CLKRP = CLKXP = FSRP = FSXP = 0. If polarity of any of the signals is inverted, then the timing references of that signal are also inverted.
(2) P = ASYNC3 period in ns. For example, when the ASYNC clock domain is running at 100 MHz, use 10 ns.
(3) Use whichever value is greater. Minimum CLKR/X cycle times *must* be met, even when CLKR/X is generated by an internal clock source. The minimum CLKR/X cycle times are based on internal logic speed; the maximum usable speed may be lower due to EDMA limitations and AC timing requirements.
(4) This parameter applies to the maximum McBSP frequency. Operate serial clocks (CLKR/X) in the reasonable range of 40/60 duty cycle.

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Table 6-48. Timing Requirements for McBSP1 [1.0V](1) (see Figure 6-29) (continued)

NO.			1.0V		UNIT
			MIN	MAX	
11	$t_{h(CKXL-FXH)}$ Hold time, external FSX high after CLKX low	CLKX int	6		ns
		CLKX ext	3		

Table 6-49. Switching Characteristics for McBSP1 [1.2V, 1.1V](1) (2) (see Figure 6-29)

NO.	PARAMETER			1.2V		1.1V		UNIT
				MIN	MAX	MIN	MAX	
1	$t_{d(CKSH-CKRXH)}$	Delay time, CLKS high to CLKR/X high for internal CLKR/X generated from CLKS input		0.5	16.5	1.5	18	ns
2	$t_{c(CKRX)}$	Cycle time, CLKR/X	CLKR/X int	2P or 20(3)(4)		2P or 25(3) (4)		ns
3	$t_{w(CKRX)}$	Pulse duration, CLKR/X high or CLKR/X low	CLKR/X int	C - 2(5)	C + 2(5)	C - 2(5)	C + 2(5)	ns
4	$t_{d(CKRH-FRV)}$	Delay time, CLKR high to internal FSR valid	CLKR int	-4	6.5	-4	13	ns
			CLKR ext	1	16.5	1	18	
9	$t_{d(CKXH-FXV)}$	Delay time, CLKX high to internal FSX valid	CLKX int	-4	6.5	-4	13	ns
			CLKX ext	1	16.5	1	18	
12	$t_{dis(CKXH-DXHZ)}$	Disable time, DX high impedance following last data bit from CLKX high	CLKX int	-4	6.5	-4	13	ns
			CLKX ext	-2	16.5	-2	18	
13	$t_{d(CKXH-DXV)}$	Delay time, CLKX high to DX valid	CLKX int	-4 + D1(6)	6.5 + D2(6)	-4 + D1(6)	13 + D2(6)	ns
			CLKX ext	1 + D1(6)	16.5 + D2(6)	1 + D1(6)	18 + D2(6)	
14	$t_{d(FXH-DXV)}$	Delay time, FSX high to DX valid ONLY applies when in data delay 0 (XDATDLY = 00b) mode	FSX int	-4(7)	6.5(7)	-4(7)	13(7)	ns
			FSX ext	-2(7)	16.5(7)	-2(7)	18	

(1) CLKRP = CLKXP = FSRP = FSXP = 0. If polarity of any of the signals is inverted, then the timing references of that signal are also inverted.
(2) Minimum delay times also represent minimum output hold times.
(3) P = ASYNC3 period in ns. For example, when the ASYNC clock domain is running at 100 MHz, use 10 ns.
(4) Use whichever value is greater.
(5) C = H or L
S = sample rate generator input clock = P if CLKSM = 1 (P = ASYNC period)
S = sample rate generator input clock = P_clks if CLKSM = 0 (P_clks = CLKS period)
H = CLKX high pulse width = (CLKGDV/2 + 1) * S if CLKGDV is even
H = (CLKGDV + 1)/2 * S if CLKGDV is odd
L = CLKX low pulse width = (CLKGDV/2) * S if CLKGDV is even
L = (CLKGDV + 1)/2 * S if CLKGDV is odd
CLKGDV should be set appropriately to ensure the McBSP bit rate does not exceed the maximum limit (see (4) above).
(6) Extra delay from CLKX high to DX valid **applies *only* to the first data bit of a device**, if and only if DXENA = 1 in SPCR.
if DXENA = 0, then D1 = D2 = 0
if DXENA = 1, then D1 = 6P, D2 = 12P
(7) Extra delay from FSX high to DX valid **applies *only* to the first data bit of a device**, if and only if DXENA = 1 in SPCR.
if DXENA = 0, then D1 = D2 = 0
if DXENA = 1, then D1 = 6P, D2 = 12P

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Table 6-50. Switching Characteristics for McBSP1 [1.0V](1) (2) (see Figure 6-29)

NO.	PARAMETER			1.0V		UNIT
				MIN	MAX	
1	$t_{d(CKSH-CKRXH)}$	Delay time, CLKS high to CLKR/X high for internal CLKR/X generated from CLKS input		1.5	23	ns
2	$t_{c(CKRX)}$	Cycle time, CLKR/X	CLKR/X int	2P or 26.6(3)(4)(5)		ns
3	$t_{w(CKRX)}$	Pulse duration, CLKR/X high or CLKR/X low	CLKR/X int	C - 2(6)	C + 2(6)	ns
4	$t_{d(CKRH-FRV)}$	Delay time, CLKR high to internal FSR valid	CLKR int	-4	13	ns
			CLKR ext	2.5	23	
9	$t_{d(CKXH-FXV)}$	Delay time, CLKX high to internal FSX valid	CLKX int	-4	13	ns
			CLKX ext	1	23	
12	$t_{dis(CKXH-DXHZ)}$	Disable time, DX high impedance following last data bit from CLKX high	CLKX int	-4	13	ns
			CLKX ext	-2	23	
13	$t_{d(CKXH-DXV)}$	Delay time, CLKX high to DX valid	CLKX int	-4 + D1	13 + D2(7)	ns
			CLKX ext	1 + D1(7)	23 + D2(7)	
14	$t_{d(FXH-DXV)}$	Delay time, FSX high to DX valid ONLY applies when in data delay 0 (XDATDLY = 00b) mode	FSX int	-4(8)	13(8)	ns
			FSX ext	-2(8)	23(8)	

(1) CLKRP = CLKXP = FSRP = FSXP = 0. If polarity of any of the signals is inverted, then the timing references of that signal are also inverted.
(2) Minimum delay times also represent minimum output hold times.
(3) Minimum CLKR/X cycle times must be met, even when CLKR/X is generated by an internal clock source. Minimum CLKR/X cycle times are based on internal logic speed; the maximum usable speed may be lower due to EDMA limitations and AC timing requirements.
(4) P = ASYNC3 period in ns. For example, when the ASYNC clock domain is running at 100 MHz, use 10 ns.
(5) Use whichever value is greater.
(6) C = H or L
S = sample rate generator input clock = P if CLKSM = 1 (P = ASYNC period)
S = sample rate generator input clock = P_clks if CLKSM = 0 (P_clks = CLKS period)
H = CLKX high pulse width = (CLKGDV/2 + 1) * S if CLKGDV is even
H = (CLKGDV + 1)/2 * S if CLKGDV is odd
L = CLKX low pulse width = (CLKGDV/2) * S if CLKGDV is even
L = (CLKGDV + 1)/2 * S if CLKGDV is odd
CLKGDV should be set appropriately to ensure the McBSP bit rate does not exceed the maximum limit (see (4) above).
(7) Extra delay from CLKX high to DX valid **applies *only* to the first data bit of a device**, if and only if DXENA = 1 in SPCR.
if DXENA = 0, then D1 = D2 = 0
if DXENA = 1, then D1 = 6P, D2 = 12P
(8) Extra delay from FSX high to DX valid **applies *only* to the first data bit of a device**, if and only if DXENA = 1 in SPCR.
if DXENA = 0, then D1 = D2 = 0
if DXENA = 1, then D1 = 6P, D2 = 12P

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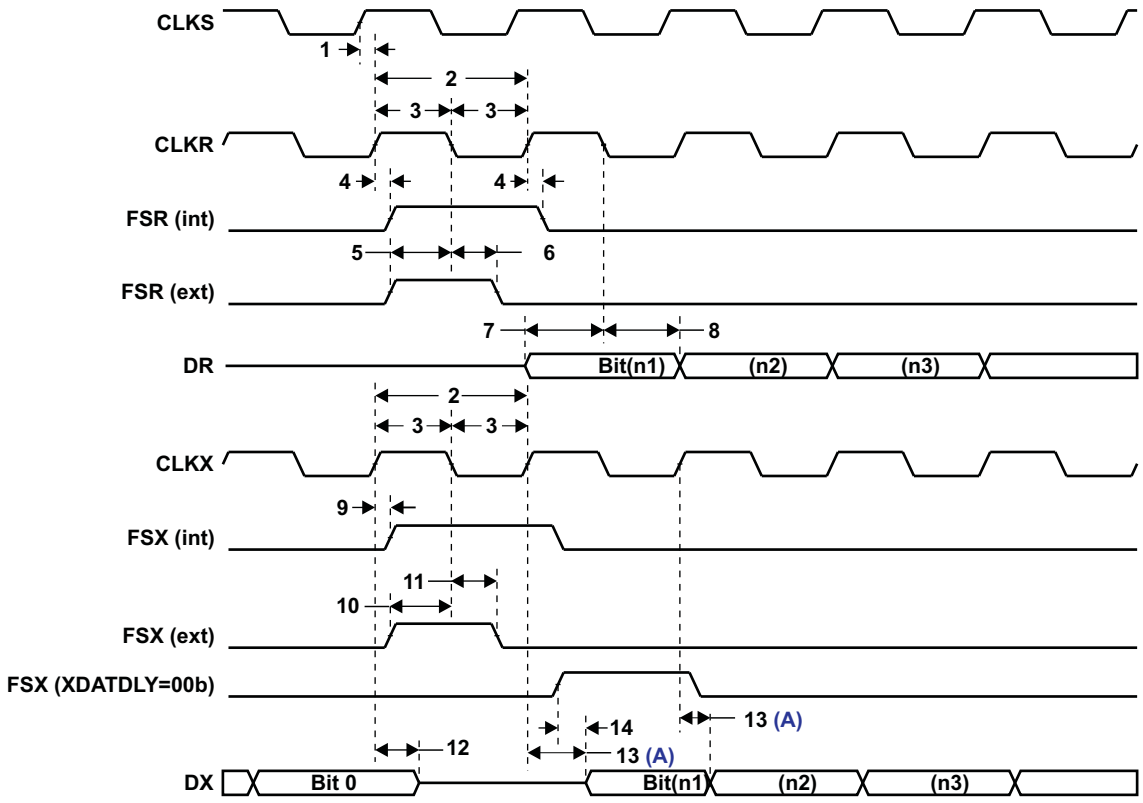

A. No. 13 applies to the first data bit only when XDATDLY ≠ 0.

Figure 6-29. McBSP Timing

Table 6-51. Timing Requirements for McBSP1 FSR When GSYNC = 1 (see Figure 6-30)

NO.			1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
1	$t_{su(FRH-CKSH)}$	Setup time, FSR high before CLKS high	5		5		10		ns
2	$t_{h(CKSH-FRH)}$	Hold time, FSR high after CLKS high	4		4		4		ns

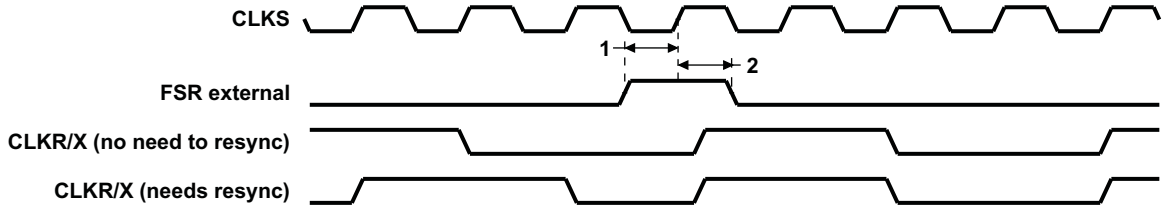

Figure 6-30. FSR Timing When GSYNC = 1

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6.15 Serial Peripheral Interface Ports (SPI1)

Figure 6-31 is a block diagram of the SPI module, which is a simple shift register and buffer plus control logic. Data is written to the shift register before transmission occurs and is read from the buffer at the end of transmission. The SPI can operate either as a master, in which case, it initiates a transfer and drives the SPIx_CLK pin, or as a slave. Four clock phase and polarity options are supported as well as many data formatting options.

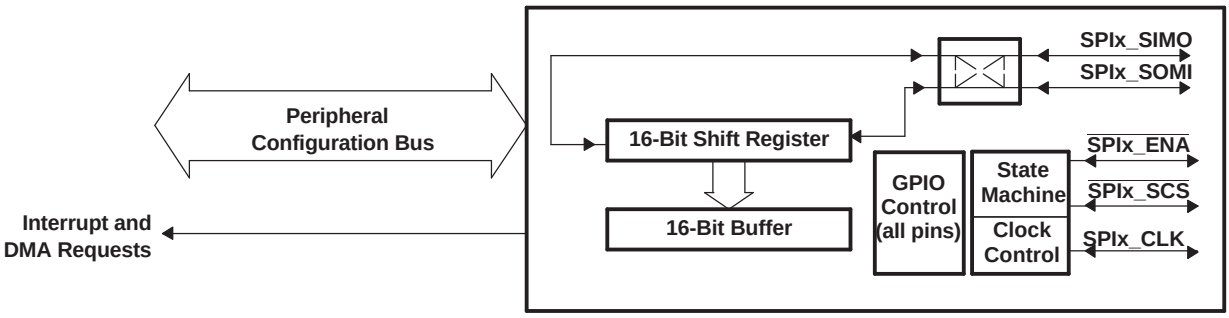

Figure 6-31. Block Diagram of SPI Module

The SPI supports 3-, 4-, and 5-pin operation with three basic pins (SPIx_CLK, SPIx_SIMO, and SPIx_SOMI) and two optional pins ($\overline{\text{SPIx_SCS}}$, $\overline{\text{SPIx_ENA}}$).

The optional $\overline{\text{SPIx_SCS}}$ (Slave Chip Select) pin is most useful to enable in slave mode when there are other slave devices on the same SPI port. The device will only shift data and drive the SPIx_SOMI pin when $\overline{\text{SPIx_SCS}}$ is held low.

In slave mode, $\overline{\text{SPIx_ENA}}$ is an optional output. The $\overline{\text{SPIx_ENA}}$ output provides the status of the internal transmit buffer (SPIDAT0/1 registers). In four-pin mode with the enable option, $\overline{\text{SPIx_ENA}}$ is asserted only when the transmit buffer is full, indicating that the slave is ready to begin another transfer. In five-pin mode, the $\overline{\text{SPIx_ENA}}$ is additionally qualified by $\overline{\text{SPIx_SCS}}$ being asserted. This allows a single handshake line to be shared by multiple slaves on the same SPI bus.

In master mode, the $\overline{\text{SPIx_ENA}}$ pin is an optional input and the master can be configured to delay the start of the next transfer until the slave asserts $\overline{\text{SPIx_ENA}}$. The addition of this handshake signal simplifies SPI communications and, on average, increases SPI bus throughput since the master does not need to delay each transfer long enough to allow for the worst-case latency of the slave device. Instead, each transfer can begin as soon as both the master and slave have actually serviced the previous SPI transfer.

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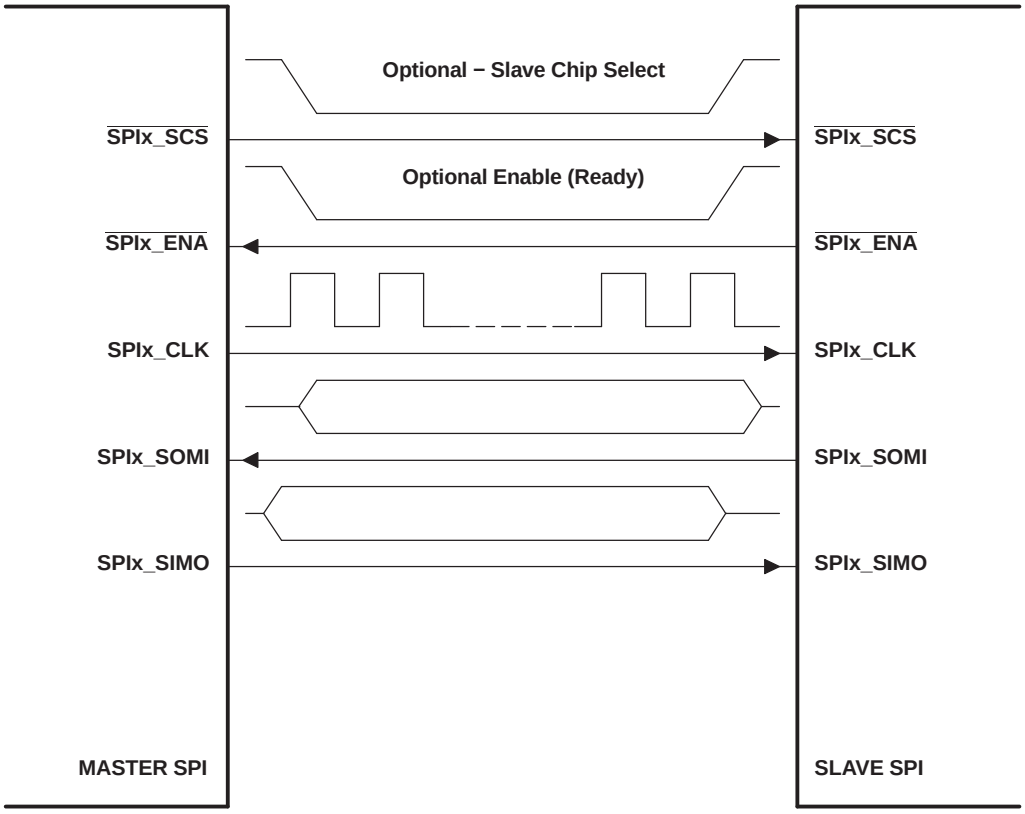

Figure 6-32. Illustration of SPI Master-to-SPI Slave Connection

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6.15.1 SPI Peripheral Registers Description(s)

Table 6-52is a list of the SPI registers.

Table 6-52. SPIx Configuration Registers

SPI1 BYTE ADDRESS	REGISTER NAME	DESCRIPTION
0x01F0 E000	SPIGCR0	Global Control Register 0
0x01F0 E004	SPIGCR1	Global Control Register 1
0x01F0 E008	SPIINT0	Interrupt Register
0x01F0 E00C	SPILVL	Interrupt Level Register
0x01F0 E010	SPIFLG	Flag Register
0x01F0 E014	SPIPC0	Pin Control Register 0 (Pin Function)
0x01F0 E018	SPIPC1	Pin Control Register 1 (Pin Direction)
0x01F0 E01C	SPIPC2	Pin Control Register 2 (Pin Data In)
0x01F0 E020	SPIPC3	Pin Control Register 3 (Pin Data Out)
0x01F0 E024	SPIPC4	Pin Control Register 4 (Pin Data Set)
0x01F0 E028	SPIPC5	Pin Control Register 5 (Pin Data Clear)
0x01F0 E02C	Reserved	Reserved - Do not write to this register
0x01F0 E030	Reserved	Reserved - Do not write to this register
0x01F0 E034	Reserved	Reserved - Do not write to this register
0x01F0 E038	SPIDAT0	Shift Register 0 (without format select)
0x01F0 E03C	SPIDAT1	Shift Register 1 (with format select)
0x01F0 E040	SPIBUF	Buffer Register
0x01F0 E044	SPIEMU	Emulation Register
0x01F0 E048	SPIDELAY	Delay Register
0x01F0 E04C	SPIDEF	Default Chip Select Register
0x01F0 E050	SPIFMT0	Format Register 0
0x01F0 E054	SPIFMT1	Format Register 1
0x01F0 E058	SPIFMT2	Format Register 2
0x01F0 E05C	SPIFMT3	Format Register 3
0x01F0 E060	INTVEC0	Interrupt Vector for SPI INT0
0x01F0 E064	INTVEC1	Interrupt Vector for SPI INT1

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6.15.2 SPI Electrical Data/Timing

6.15.2.1 Serial Peripheral Interface (SPI) Timing

The following tables and timing diagrams assume testing over recommended operating conditions.

Table 6-53. General Timing Requirements for SPI1 Master Modes(1)

NO.				1.2V		1.1V		1.0V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
1	$t_{c(SPC)M}$	Cycle Time, SPI1_CLK, All Master Modes		20(2)	256P	30(2)	256P	40(2)	256P	ns
2	$t_{w(SPCH)M}$	Pulse Width High, SPI1_CLK, All Master Modes		0.5M-1		0.5M-1		0.5M-1		ns
3	$t_{w(SPCL)M}$	Pulse Width Low, SPI1_CLK, All Master Modes		0.5M-1		0.5M-1		0.5M-1		ns
4	$t_{d(SIMO_SPC)M}$	Delay, initial data bit valid on SPI1_SIMO to initial edge on SPI1_CLK(3)	Polarity = 0, Phase = 0, to SPI1_CLK rising		5		5		6	ns
			Polarity = 0, Phase = 1, to SPI1_CLK rising		-0.5M+5		-0.5M+5		-0.5M+6	
			Polarity = 1, Phase = 0, to SPI1_CLK falling		5		5		6	
			Polarity = 1, Phase = 1, to SPI1_CLK falling		-0.5M+5		-0.5M+5		-0.5M+6	
5	$t_{d(SPC_SIMO)M}$	Delay, subsequent bits valid on SPI1_SIMO after transmit edge of SPI1_CLK	Polarity = 0, Phase = 0, from SPI1_CLK rising		5		5		6	ns
			Polarity = 0, Phase = 1, from SPI1_CLK falling		5		5		6	
			Polarity = 1, Phase = 0, from SPI1_CLK falling		5		5		6	
			Polarity = 1, Phase = 1, from SPI1_CLK rising		5		5		6	
6	$t_{oh(SPC_SIMO)M}$	Output hold time, SPI1_SIMO valid after receive edge of SPI1_CLK	Polarity = 0, Phase = 0, from SPI1_CLK falling	0.5M-3		0.5M-3		0.5M-3		ns
			Polarity = 0, Phase = 1, from SPI1_CLK rising	0.5M-3		0.5M-3		0.5M-3		
			Polarity = 1, Phase = 0, from SPI1_CLK rising	0.5M-3		0.5M-3		0.5M-3		
			Polarity = 1, Phase = 1, from SPI1_CLK falling	0.5M-3		0.5M-3		0.5M-3		
7	$t_{su(SOMI_SPC)M}$	Input Setup Time, SPI1_SOMI valid before receive edge of SPI1_CLK	Polarity = 0, Phase = 0, to SPI1_CLK falling	1.5		1.5		1.5		ns
			Polarity = 0, Phase = 1, to SPI1_CLK rising	1.5		1.5		1.5		
			Polarity = 1, Phase = 0, to SPI1_CLK rising	1.5		1.5		1.5		
			Polarity = 1, Phase = 1, to SPI1_CLK falling	1.5		1.5		1.5		
8	$t_{ih(SPC_SOMI)M}$	Input Hold Time, SPI1_SOMI valid after receive edge of SPI1_CLK	Polarity = 0, Phase = 0, from SPI1_CLK falling	4		5		6		ns
			Polarity = 0, Phase = 1, from SPI1_CLK rising	4		5		6		
			Polarity = 1, Phase = 0, from SPI1_CLK rising	4		5		6		
			Polarity = 1, Phase = 1, from SPI1_CLK falling	4		5		6		

(1) P = SYSCLK2 period; M = $t_{c(SPC)M}$ (SPI master bit clock period)
(2) This timing is limited by the timing shown or 3P, whichever is greater.
(3) First bit may be MSB or LSB depending upon SPI configuration. MO(0) refers to first bit and MO(n) refers to last bit output on SPI1_SIMO. MI(0) refers to the first bit input and MI(n) refers to the last bit input on SPI1_SOMI.

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Table 6-54. General Timing Requirements for SPI1 Slave Modes(1)

NO.				1.2V		1.1V		1.0V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
9	$t_{c(SPC)S}$	Cycle Time, SPI1_CLK, All Slave Modes		40(2)		50(2)		60(2)		ns
10	$t_{w(SPCH)S}$	Pulse Width High, SPI1_CLK, All Slave Modes		18		22		27		ns
11	$t_{w(SPCL)S}$	Pulse Width Low, SPI1_CLK, All Slave Modes		18		22		27		ns
12	$t_{su(SOMI_SPC)S}$	Setup time, transmit data written to SPI before initial clock edge from master.(3)(4)	Polarity = 0, Phase = 0, to SPI1_CLK rising	2P		2P		2P		ns
			Polarity = 0, Phase = 1, to SPI1_CLK rising	2P		2P		2P		
			Polarity = 1, Phase = 0, to SPI1_CLK falling	2P		2P		2P		
			Polarity = 1, Phase = 1, to SPI1_CLK falling	2P		2P		2P		
13	$t_{d(SPC_SOMI)S}$	Delay, subsequent bits valid on SPI1_SOMI after transmit edge of SPI1_CLK	Polarity = 0, Phase = 0, from SPI1_CLK rising		15		17		19	ns
			Polarity = 0, Phase = 1, from SPI1_CLK falling		15		17		19	
			Polarity = 1, Phase = 0, from SPI1_CLK falling		15		17		19	
			Polarity = 1, Phase = 1, from SPI1_CLK rising		15		17		19	
14	$t_{oh(SPC_SOMI)S}$	Output hold time, SPI1_SOMI valid after receive edge of SPI1_CLK	Polarity = 0, Phase = 0, from SPI1_CLK falling	0.5S-4		0.5S-10		0.5S-12		ns
			Polarity = 0, Phase = 1, from SPI1_CLK rising	0.5S-4		0.5S-10		0.5S-12		
			Polarity = 1, Phase = 0, from SPI1_CLK rising	0.5S-4		0.5S-10		0.5S-12		
			Polarity = 1, Phase = 1, from SPI1_CLK falling	0.5S-4		0.5S-10		0.5S-12		
15	$t_{su(SIMO_SPC)S}$	Input Setup Time, SPI1_SIMO valid before receive edge of SPI1_CLK	Polarity = 0, Phase = 0, to SPI1_CLK falling	1.5		1.5		1.5		ns
			Polarity = 0, Phase = 1, to SPI1_CLK rising	1.5		1.5		1.5		
			Polarity = 1, Phase = 0, to SPI1_CLK rising	1.5		1.5		1.5		
			Polarity = 1, Phase = 1, to SPI1_CLK falling	1.5		1.5		1.5		
16	$t_{ih(SPC_SIMO)S}$	Input Hold Time, SPI1_SIMO valid after receive edge of SPI1_CLK	Polarity = 0, Phase = 0, from SPI1_CLK falling	4		5		6		ns
			Polarity = 0, Phase = 1, from SPI1_CLK rising	4		5		6		
			Polarity = 1, Phase = 0, from SPI1_CLK rising	4		5		6		
			Polarity = 1, Phase = 1, from SPI1_CLK falling	4		5		6		

(1) P = SYSCLK2 period; S = $t_{c(SPC)S}$ (SPI slave bit clock period)
(2) This timing is limited by the timing shown or 3P, whichever is greater.
(3) First bit may be MSB or LSB depending upon SPI configuration. SO(0) refers to first bit and SO(n) refers to last bit output on SPI1_SOMI. SI(0) refers to the first bit input and SI(n) refers to the last bit input on SPI1_SIMO.
(4) Measured from the termination of the write of new data to the SPI module, In analyzing throughput requirements, additional internal bus cycles must be accounted for to allow data to be written to the SPI module by the CPU.

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Table 6-55. Additional[1] SPI1 Master Timings, 4-Pin Enable Option[2][3]

NO.	PARAMETER			1.2V		1.1V		1.0V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
17	$t_{d(EN\ A_SPC)M}$	Delay from slave assertion of SPI1_ENA active to first SPI1_CLK from master.[4]	Polarity = 0, Phase = 0, to SPI1_CLK rising		3P+5		3P+5		3P+6	ns
			Polarity = 0, Phase = 1, to SPI1_CLK rising		0.5M+3P+5		0.5M+3P+5		0.5M+3P+6	
			Polarity = 1, Phase = 0, to SPI1_CLK falling		3P+5		3P+5		3P+6	
			Polarity = 1, Phase = 1, to SPI1_CLK falling		0.5M+3P+5		0.5M+3P+5		0.5M+3P+6	
18	$t_{d(SPC_ENA)M}$	Max delay for slave to deassert SPI1_ENA after final SPI1_CLK edge to ensure master does not begin the next transfer.[5]	Polarity = 0, Phase = 0, from SPI1_CLK falling		0.5M+P+5		0.5M+P+5		0.5M+P+6	ns
			Polarity = 0, Phase = 1, from SPI1_CLK falling		P+5		P+5		P+6	
			Polarity = 1, Phase = 0, from SPI1_CLK rising		0.5M+P+5		0.5M+P+5		0.5M+P+6	
			Polarity = 1, Phase = 1, from SPI1_CLK rising		P+5		P+5		P+6	

(1) These parameters are in addition to the general timings for SPI master modes (Table 6-53).
(2) P = SYSCLK2 period; M = $t_{c(SPC)M}$ (SPI master bit clock period)
(3) Figure shows only Polarity = 0, Phase = 0 as an example. Table gives parameters for all four master clocking modes.
(4) In the case where the master SPI is ready with new data before SPI1_ENA assertion.
(5) In the case where the master SPI is ready with new data before SPI1_ENA deassertion.

Table 6-56. Additional[1] SPI1 Master Timings, 4-Pin Chip Select Option[2] [3]

NO.	PARAMETER			1.2V		1.1V		1.0V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
19	$t_{d(SCS_SPC)M}$	Delay from SPI1_SCS active to first SPI1_CLK[4] [5]	Polarity = 0, Phase = 0, to SPI1_CLK rising	2P-1		2P-5		2P-6		ns
			Polarity = 0, Phase = 1, to SPI1_CLK rising	0.5M+2P-1		0.5M+2P-5		0.5M+2P-6		
			Polarity = 1, Phase = 0, to SPI1_CLK falling	2P-1		2P-5		2P-6		
			Polarity = 1, Phase = 1, to SPI1_CLK falling	0.5M+2P-1		0.5M+2P-5		0.5M+2P-6		
20	$t_{d(SPC_SCS)M}$	Delay from final SPI1_CLK edge to master deasserting SPI1_SCS[6] [7]	Polarity = 0, Phase = 0, from SPI1_CLK falling	0.5M+P-1		0.5M+P-5		0.5M+P-6		ns
			Polarity = 0, Phase = 1, from SPI1_CLK falling	P-1		P-5		P-6		
			Polarity = 1, Phase = 0, from SPI1_CLK rising	0.5M+P-1		0.5M+P-5		0.5M+P-6		
			Polarity = 1, Phase = 1, from SPI1_CLK rising	P-1		P-5		P-6		

(1) These parameters are in addition to the general timings for SPI master modes (Table 6-53).
(2) P = SYSCLK2 period; M = $t_{c(SPC)M}$ (SPI master bit clock period)
(3) Figure shows only Polarity = 0, Phase = 0 as an example. Table gives parameters for all four master clocking modes.
(4) In the case where the master SPI is ready with new data before SPI1_SCS assertion.
(5) This delay can be increased under software control by the register bit field SPIDELAY.C2TDELAY[4:0].
(6) Except for modes when SPIDAT1.CSHOLD is enabled and there is additional data to transmit. In this case, SPI1_SCS will remain asserted.
(7) This delay can be increased under software control by the register bit field SPIDELAY.T2CDELAY[4:0].

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Table 6-57. Additional(1) SPI1 Master Timings, 5-Pin Option(2)(3)

NO.	PARAMETER			1.2V		1.1V		1.0V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
18	$t_{d(SPC_ENA)M}$	Max delay for slave to deassert SPI1_ENA after final SPI1_CLK edge to ensure master does not begin the next transfer.(4)	Polarity = 0, Phase = 0, from SPI1_CLK falling		0.5M+P+5		0.5M+P+5		0.5M+P+6	ns
			Polarity = 0, Phase = 1, from SPI1_CLK falling		P+5		P+5		P+6	
			Polarity = 1, Phase = 0, from SPI1_CLK rising		0.5M+P+5		0.5M+P+5		0.5M+P+6	
			Polarity = 1, Phase = 1, from SPI1_CLK rising		P+5		P+5		P+6	
20	$t_{d(SPC_SCS)M}$	Delay from final SPI1_CLK edge to master deasserting SPI1_SCS (5)(6)	Polarity = 0, Phase = 0, from SPI1_CLK falling	0.5M+P-1		0.5M+P-5		0.5M+P-6		ns
			Polarity = 0, Phase = 1, from SPI1_CLK falling	P-1		P-5		P-6		
			Polarity = 1, Phase = 0, from SPI1_CLK rising	0.5M+P-1		0.5M+P-5		0.5M+P-6		
			Polarity = 1, Phase = 1, from SPI1_CLK rising	P-1		P-5		P-6		
21	$t_{d(SCSL_ENAL)M}$	Max delay for slave SPI to drive SPI1_ENA valid after master asserts SPI1_SCS to delay the master from beginning the next transfer,			C2TDELAY+P		C2TDELAY+P		C2TDELAY+P	ns
22	$t_{d(SCS_SPC)M}$	Delay from SPI1_SCS active to first SPI1_CLK(7)(8)(9)	Polarity = 0, Phase = 0, to SPI1_CLK rising	2P-1		2P-5		2P-6		ns
			Polarity = 0, Phase = 1, to SPI1_CLK rising	0.5M+2P-1		0.5M+2P-5		0.5M+2P-6		
			Polarity = 1, Phase = 0, to SPI1_CLK falling	2P-1		2P-5		2P-6		
			Polarity = 1, Phase = 1, to SPI1_CLK falling	0.5M+2P-1		0.5M+2P-5		0.5M+2P-6		

(1) These parameters are in addition to the general timings for SPI master modes (Table 6-54).
(2) P = SYSCLK2 period; M = $t_{c(SPC)M}$ (SPI master bit clock period)
(3) Figure shows only Polarity = 0, Phase = 0 as an example. Table gives parameters for all four master clocking modes.
(4) In the case where the master SPI is ready with new data before SPI1_ENA deassertion.
(5) Except for modes when SPIDAT1.CSHOLD is enabled and there is additional data to transmit. In this case, SPI1_SCS will remain asserted.
(6) This delay can be increased under software control by the register bit field SPIDELAY.T2CDELAY[4:0].
(7) If SPI1_ENA is asserted immediately such that the transmission is not delayed by SPI1_ENA.
(8) In the case where the master SPI is ready with new data before SPI1_SCS assertion.
(9) This delay can be increased under software control by the register bit field SPIDELAY.C2TDELAY[4:0].

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Table 6-57. Additional[1] SPI1 Master Timings, 5-Pin Option[2][3] (continued)

NO.	PARAMETER		1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
23	$t_{d(ENA_SPC)M}$	Delay from assertion of $\overline{SPI1_ENA}$ low to first SPI1_CLK edge.[10]	Polarity = 0, Phase = 0, to SPI1_CLK rising	3P+5		3P+5		3P+6	ns
			Polarity = 0, Phase = 1, to SPI1_CLK rising	0.5M+3P+5		0.5M+3P+5		0.5M+3P+6	
			Polarity = 1, Phase = 0, to SPI1_CLK falling	3P+5		3P+5		3P+6	
			Polarity = 1, Phase = 1, to SPI1_CLK falling	0.5M+3P+5		0.5M+3P+5		0.5M+3P+6	

(10) If $\overline{SPI1_ENA}$ was initially deasserted high and SPI1_CLK is delayed.

Table 6-58. Additional[1] SPI1 Slave Timings, 4-Pin Enable Option[2][3]

NO.	PARAMETER		1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
24	$t_{d(SPC_ENAH)S}$	Delay from final SPI1_CLK edge to slave deasserting $\overline{SPI1_ENA}$.	Polarity = 0, Phase = 0, from SPI1_CLK falling	1.5P-3	2.5P+15	1.5P-10	2.5P+17	1.5P-12	2.5P+19	ns
			Polarity = 0, Phase = 1, from SPI1_CLK falling	–0.5M+1.5P-3	–0.5M+2.5P+15	–0.5M+1.5P-10	–0.5M+2.5P+17	–0.5M+1.5P-12	–0.5M+2.5P+19	
			Polarity = 1, Phase = 0, from SPI1_CLK rising	1.5P-3	2.5P+15	1.5P-10	2.5P+17	1.5P-12	2.5P+19	
			Polarity = 1, Phase = 1, from SPI1_CLK rising	–0.5M+1.5P-3	–0.5M+2.5P+15	–0.5M+1.5P-10	–0.5M+2.5P+17	–0.5M+1.5P-12	–0.5M+2.5P+19	

(1) These parameters are in addition to the general timings for SPI slave modes (Table 6-54).
(2) P = SYSCLK2 period; M = $t_{c(SPC)M}$ (SPI master bit clock period)
(3) Figure shows only Polarity = 0, Phase = 0 as an example. Table gives parameters for all four slave clocking modes.

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Table 6-59. Additional(1) SPI1 Slave Timings, 4-Pin Chip Select Option(2)(3)

NO.	PARAMETER		1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
25	$t_{d(SCSL_SPC)S}$	Required delay from $\overline{SPI1_SCS}$ asserted at slave to first SPI1_CLK edge at slave.	P+1.5		P+1.5		P+1.5		ns
26	$t_{d(SPC_SCSH)S}$	Required delay from final SPI1_CLK edge before $\overline{SPI1_SCS}$ is deasserted. Polarity = 0, Phase = 0, from SPI1_CLK falling	0.5M+P+4		0.5M+P+5		0.5M+P+6		ns
		Polarity = 0, Phase = 1, from SPI1_CLK falling	P+4		P+5		P+6		
		Polarity = 1, Phase = 0, from SPI1_CLK rising	0.5M+P+4		0.5M+P+5		0.5M+P+6		
		Polarity = 1, Phase = 1, from SPI1_CLK rising	P+4		P+5		P+6		
27	$t_{ena(SCSL_SOMI)S}$	Delay from master asserting $\overline{SPI1_SCS}$ to slave driving SPI1_SOMI valid		P+15		P+17		P+19	ns
28	$t_{dis(SCSH_SOMI)S}$	Delay from master deasserting $\overline{SPI1_SCS}$ to slave 3-stating SPI1_SOMI		P+15		P+17		P+19	ns

(1) These parameters are in addition to the general timings for SPI slave modes (Table 6-54).
(2) P = SYSCLK2 period; M = $t_{c(SPC)M}$ (SPI master bit clock period)
(3) Figure shows only Polarity = 0, Phase = 0 as an example. Table gives parameters for all four slave clocking modes.

Table 6-60. Additional(1) SPI1 Slave Timings, 5-Pin Option(2)(3)

NO.	PARAMETER		1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
25	$t_{d(SCSL_SPC)S}$	Required delay from $\overline{SPI1_SCS}$ asserted at slave to first SPI1_CLK edge at slave.	P+1.5		P+1.5		P+1.5		ns
26	$t_{d(SPC_SCSH)S}$	Required delay from final SPI1_CLK edge before $\overline{SPI1_SCS}$ is deasserted. Polarity = 0, Phase = 0, from SPI1_CLK falling	0.5M+P+4		0.5M+P+5		0.5M+P+6		ns
		Polarity = 0, Phase = 1, from SPI1_CLK falling	P+4		P+5		P+6		
		Polarity = 1, Phase = 0, from SPI1_CLK rising	0.5M+P+4		0.5M+P+5		0.5M+P+6		
		Polarity = 1, Phase = 1, from SPI1_CLK rising	P+4		P+5		P+6		
27	$t_{ena(SCSL_SOMI)S}$	Delay from master asserting $\overline{SPI1_SCS}$ to slave driving SPI1_SOMI valid		P+15		P+17		P+19	ns
28	$t_{dis(SCSH_SOMI)S}$	Delay from master deasserting $\overline{SPI1_SCS}$ to slave 3-stating SPI1_SOMI		P+15		P+17		P+19	ns
29	$t_{ena(SCSL_ENA)S}$	Delay from master deasserting $\overline{SPI1_SCS}$ to slave driving $\overline{SPI1_ENA}$ valid		15		17		19	ns

(1) These parameters are in addition to the general timings for SPI slave modes (Table 6-54).
(2) P = SYSCLK2 period; M = $t_{c(SPC)M}$ (SPI master bit clock period)
(3) Figure shows only Polarity = 0, Phase = 0 as an example. Table gives parameters for all four slave clocking modes.

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Table 6-60. Additional[1] SPI1 Slave Timings, 5-Pin Option[2][3] (continued)

NO.	PARAMETER			1.2V		1.1V		1.0V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
30	$t_{dis(SPC_ENA)S}$	Delay from final clock receive edge on SPI1_CLK to slave 3-stating or driving high $\overline{SPI1_ENA}$.[4]	Polarity = 0, Phase = 0, from SPI1_CLK falling		2.5P+15		2.5P+17		2.5P+19	ns
			Polarity = 0, Phase = 1, from SPI1_CLK rising		2.5P+15		2.5P+17		2.5P+19	
			Polarity = 1, Phase = 0, from SPI1_CLK rising		2.5P+15		2.5P+17		2.5P+19	
			Polarity = 1, Phase = 1, from SPI1_CLK falling		2.5P+15		2.5P+17		2.5P+19	

(4) $\overline{SPI1_ENA}$ is driven low after the transmission completes if the SPIINT0.ENABLE_HIGHZ bit is programmed to 0. Otherwise it is tri-stated. If tri-stated, an external pullup resistor should be used to provide a valid level to the master. This option is useful when tying several SPI slave devices to a single master.

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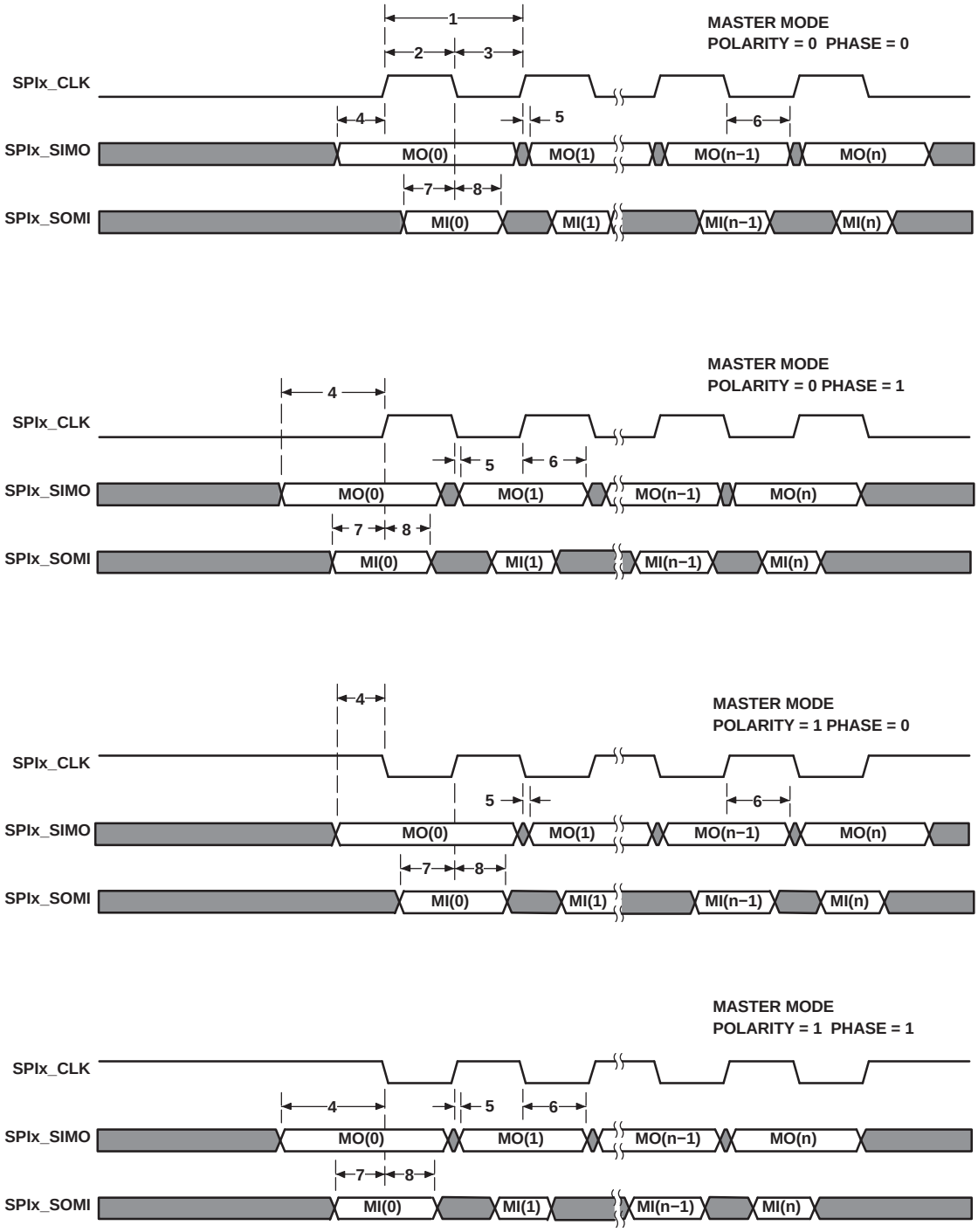

Figure 6-33. SPI Timings—Master Mode

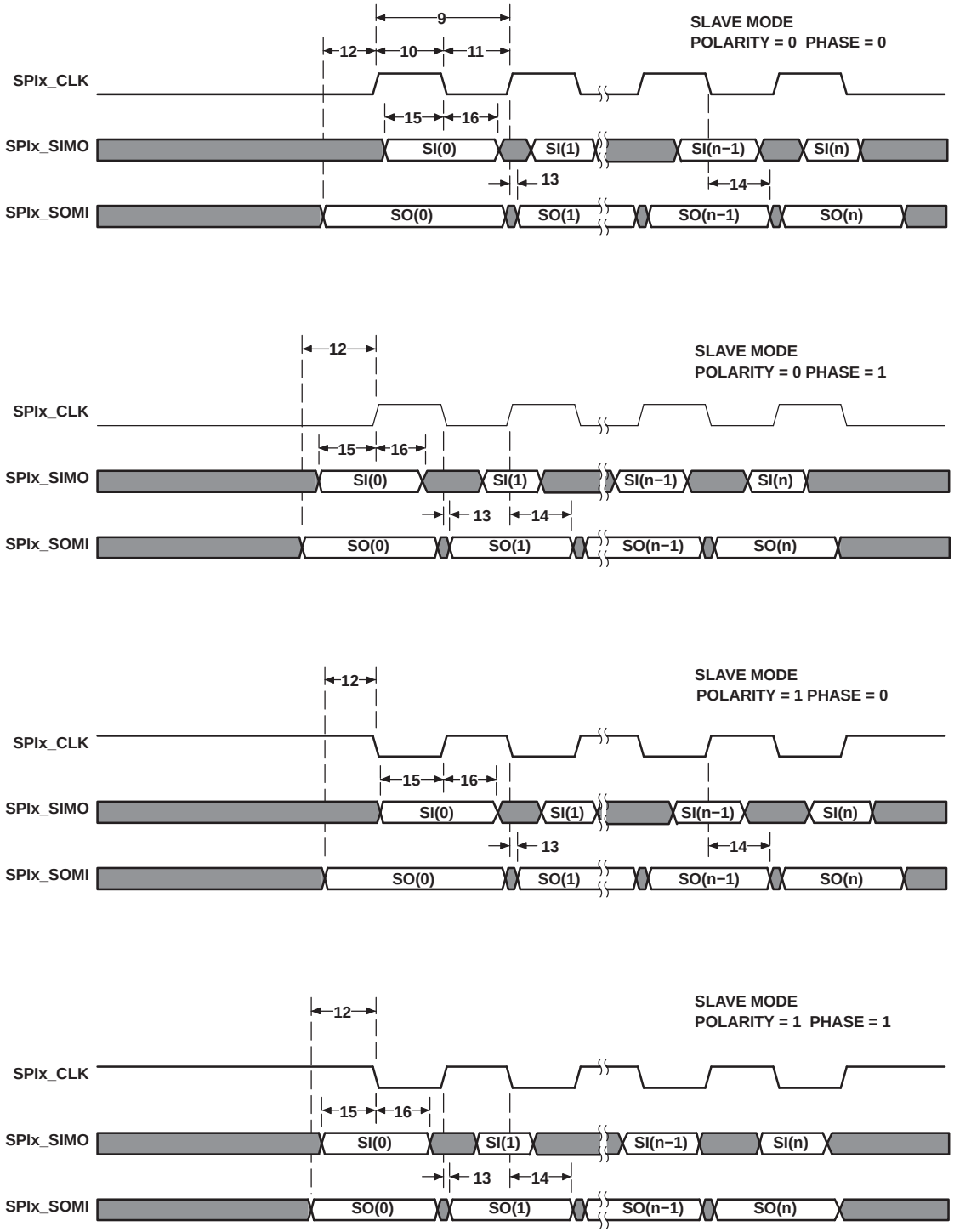

Figure 6-34. SPI Timings—Slave Mode

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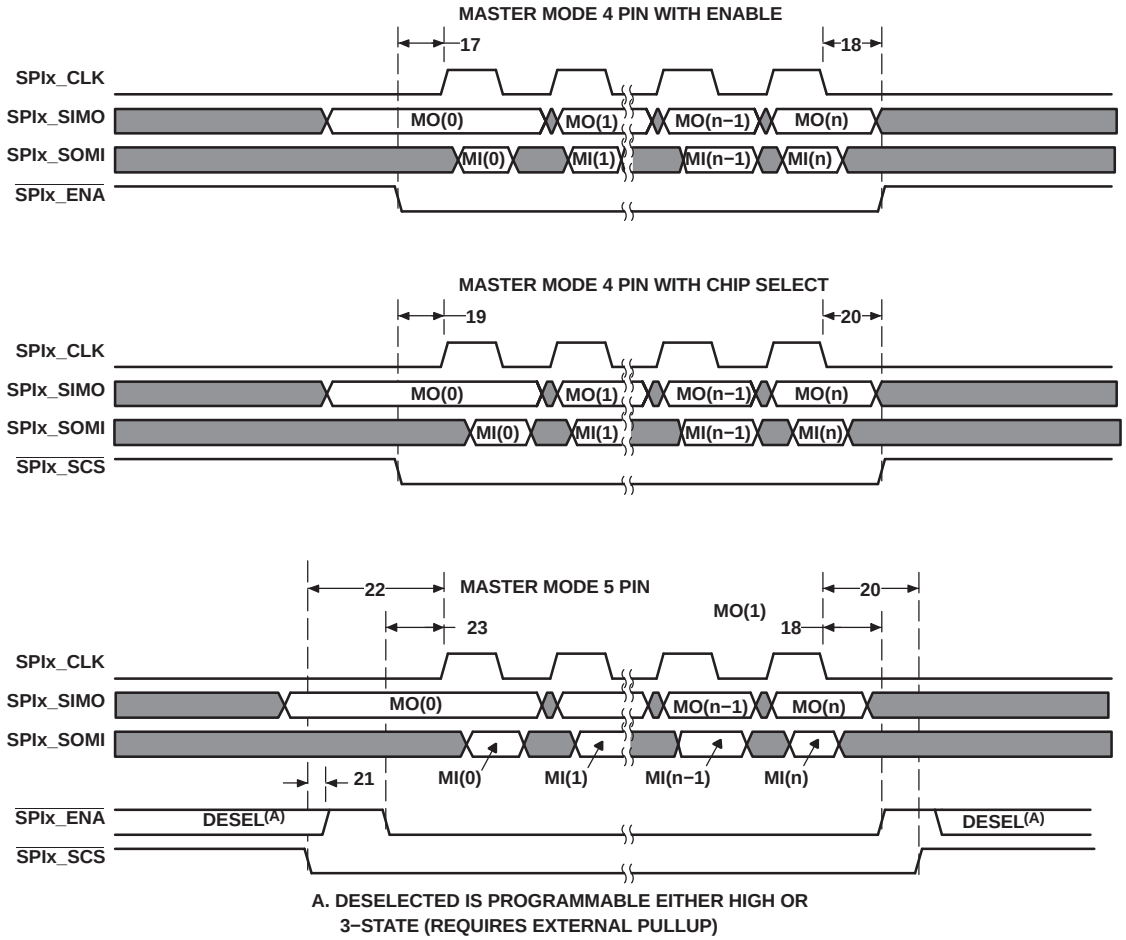

Figure 6-35. SPI Timings—Master Mode (4-Pin and 5-Pin)

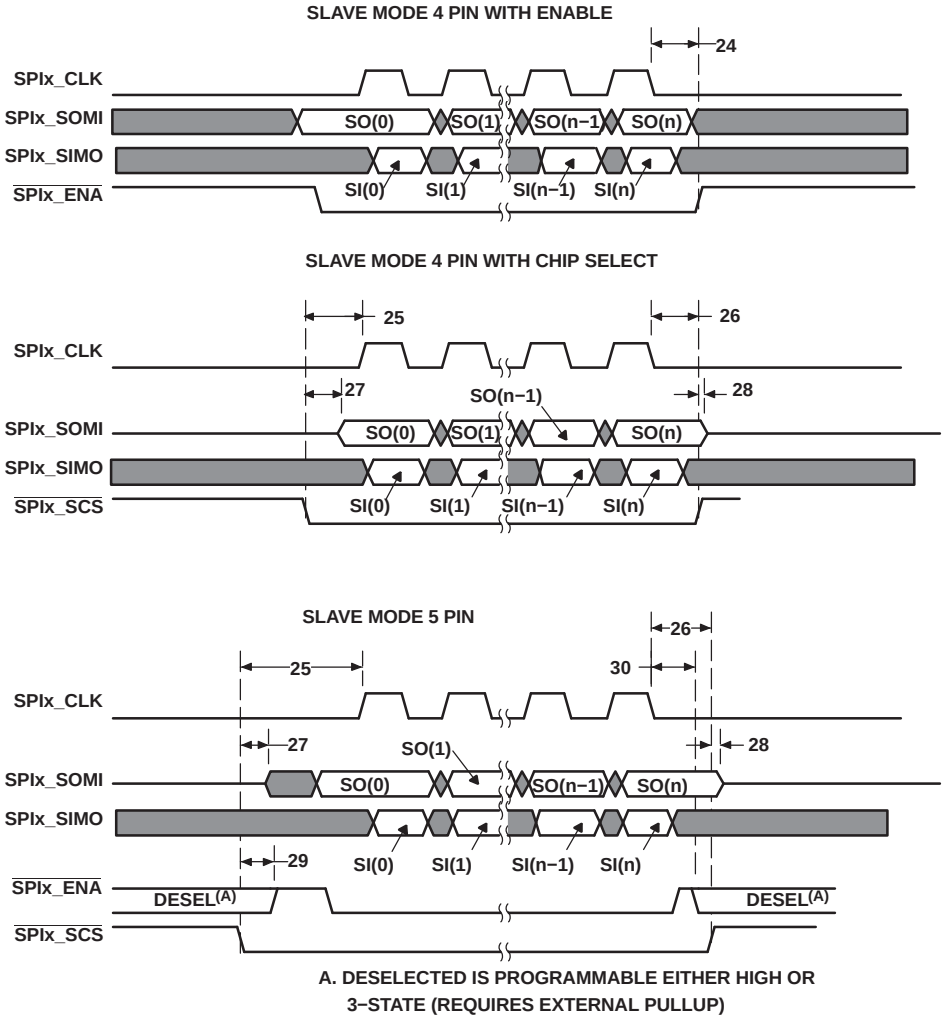

Figure 6-36. SPI Timings—Slave Mode (4-Pin and 5-Pin)

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6.16 Inter-Integrated Circuit Serial Ports (I2C)

6.16.1 I2C Device-Specific Information

I2C port supports:

- Compatible with Philips® I2C Specification Revision 2.1 (January 2000)
- Fast Mode up to 400 Kbps (no fail-safe I/O buffers)
- Noise Filter to Remove Noise 50 ns or less
- Seven- and Ten-Bit Device Addressing Modes
- Master (Transmit/Receive) and Slave (Transmit/Receive) Functionality
- Events: DMA, Interrupt, or Polling
- General-Purpose I/O Capability if not used as I2C

Figure 6-37 is block diagram of the device I2C Module.

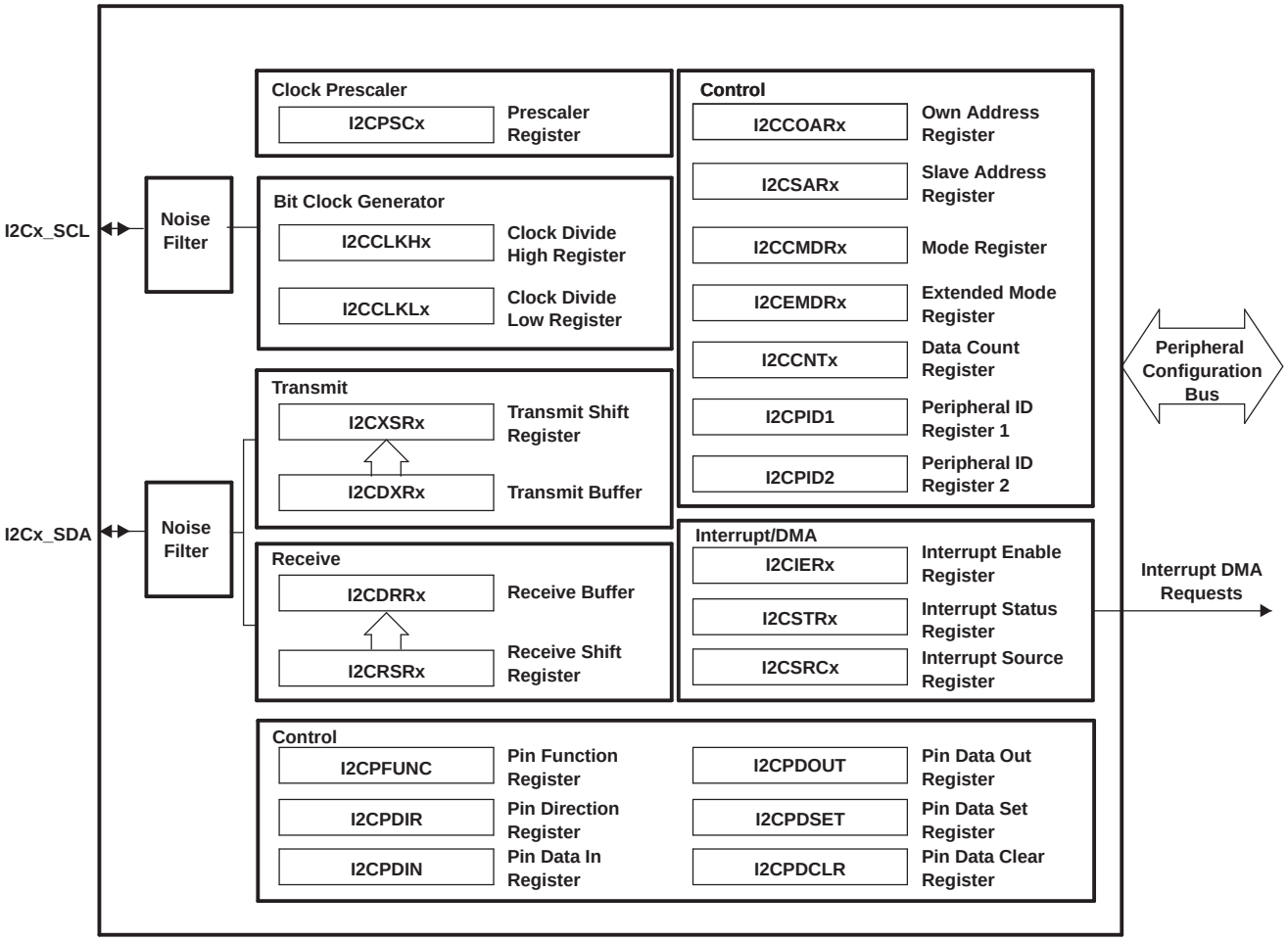

Figure 6-37. I2C Module Block Diagram

6.16.2 I2C Peripheral Registers Description(s)

Table 6-61 is the list of the I2C registers.

Table 6-61. Inter-Integrated Circuit (I2C) Registers

I2C0 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01C2 2000	ICOAR	I2C Own Address Register
0x01C2 2004	ICIMR	I2C Interrupt Mask Register
0x01C2 2008	ICSTR	I2C Interrupt Status Register
0x01C2 200C	ICCLKL	I2C Clock Low-Time Divider Register
0x01C2 2010	ICCLKH	I2C Clock High-Time Divider Register
0x01C2 2014	ICCNT	I2C Data Count Register
0x01C2 2018	ICDRR	I2C Data Receive Register
0x01C2 201C	ICSAR	I2C Slave Address Register
0x01C2 2020	ICDXR	I2C Data Transmit Register
0x01C2 2024	ICMDR	I2C Mode Register
0x01C2 2028	ICIVR	I2C Interrupt Vector Register
0x01C2 202C	ICEMDR	I2C Extended Mode Register
0x01C2 2030	ICPSC	I2C Prescaler Register
0x01C2 2034	REVID1	I2C Revision Identification Register 1
0x01C2 2038	REVID2	I2C Revision Identification Register 2
0x01C2 2048	ICPFUNC	I2C Pin Function Register
0x01C2 204C	ICPDIR	I2C Pin Direction Register
0x01C2 2050	ICPDIN	I2C Pin Data In Register
0x01C2 2054	ICPDOUT	I2C Pin Data Out Register
0x01C2 2058	ICPDSET	I2C Pin Data Set Register
0x01C2 205C	ICPDCLR	I2C Pin Data Clear Register

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6.16.3 I2C Electrical Data/Timing

6.16.3.1 Inter-Integrated Circuit (I2C) Timing

Table 6-62 and Table 6-63 assume testing over recommended operating conditions (see Figure 6-38 and Figure 6-39).

Table 6-62. Timing Requirements for I2C Input

NO.			1.2V, 1.1V, 1.0V				UNIT
			Standard Mode		Fast Mode		
			MIN	MAX	MIN	MAX	
1	$t_{c(SCL)}$	Cycle time, I2Cx_SCL	10		2.5		µs
2	$t_{su(SCLH-SDAL)}$	Setup time, I2Cx_SCL high before I2Cx_SDA low	4.7		0.6		µs
3	$t_{h(SCLL-SDAL)}$	Hold time, I2Cx_SCL low after I2Cx_SDA low	4		0.6		µs
4	$t_{w(SCLL)}$	Pulse duration, I2Cx_SCL low	4.7		1.3		µs
5	$t_{w(SCLH)}$	Pulse duration, I2Cx_SCL high	4		0.6		µs
6	$t_{su(SDA-SCLH)}$	Setup time, I2Cx_SDA before I2Cx_SCL high	250		100		ns
7	$t_{h(SDA-SCLL)}$	Hold time, I2Cx_SDA after I2Cx_SCL low	0		0	0.9	µs
8	$t_{w(SDAH)}$	Pulse duration, I2Cx_SDA high	4.7		1.3		µs
9	$t_{r(SDA)}$	Rise time, I2Cx_SDA		1000	$20 + 0.1C_b$	300	ns
10	$t_{r(SCL)}$	Rise time, I2Cx_SCL		1000	$20 + 0.1C_b$	300	ns
11	$t_{f(SDA)}$	Fall time, I2Cx_SDA		300	$20 + 0.1C_b$	300	ns
12	$t_{f(SCL)}$	Fall time, I2Cx_SCL		300	$20 + 0.1C_b$	300	ns
13	$t_{su(SCLH-SDAH)}$	Setup time, I2Cx_SCL high before I2Cx_SDA high	4		0.6		µs
14	$t_{w(SP)}$	Pulse duration, spike (must be suppressed)	N/A		0	50	ns
15	C_b	Capacitive load for each bus line		400		400	pF

Table 6-63. Switching Characteristics for I2C (1)

NO.	PARAMETER		1.2V, 1.1V, 1.0V				UNIT
			Standard Mode		Fast Mode		
			MIN	MAX	MIN	MAX	
16	$t_{c(SCL)}$	Cycle time, I2Cx_SCL	10		2.5		µs
17	$t_{su(SCLH-SDAL)}$	Setup time, I2Cx_SCL high before I2Cx_SDA low	4.7		0.6		µs
18	$t_{h(SDAL-SCLL)}$	Hold time, I2Cx_SCL low after I2Cx_SDA low	4		0.6		µs
19	$t_{w(SCLL)}$	Pulse duration, I2Cx_SCL low	4.7		1.3		µs
20	$t_{w(SCLH)}$	Pulse duration, I2Cx_SCL high	4		0.6		µs
21	$t_{su(SDAV-SCLH)}$	Setup time, I2Cx_SDA valid before I2Cx_SCL high	250		100		ns
22	$t_{h(SCLL-SDAV)}$	Hold time, I2Cx_SDA valid after I2Cx_SCL low	0		0	0.9	µs
23	$t_{w(SDAH)}$	Pulse duration, I2Cx_SDA high	4.7		1.3		µs
28	$t_{su(SCLH-SDAH)}$	Setup time, I2Cx_SCL high before I2Cx_SDA high	4		0.6		µs

(1) I2C must be configured correctly to meet the timings in Table 6-63.

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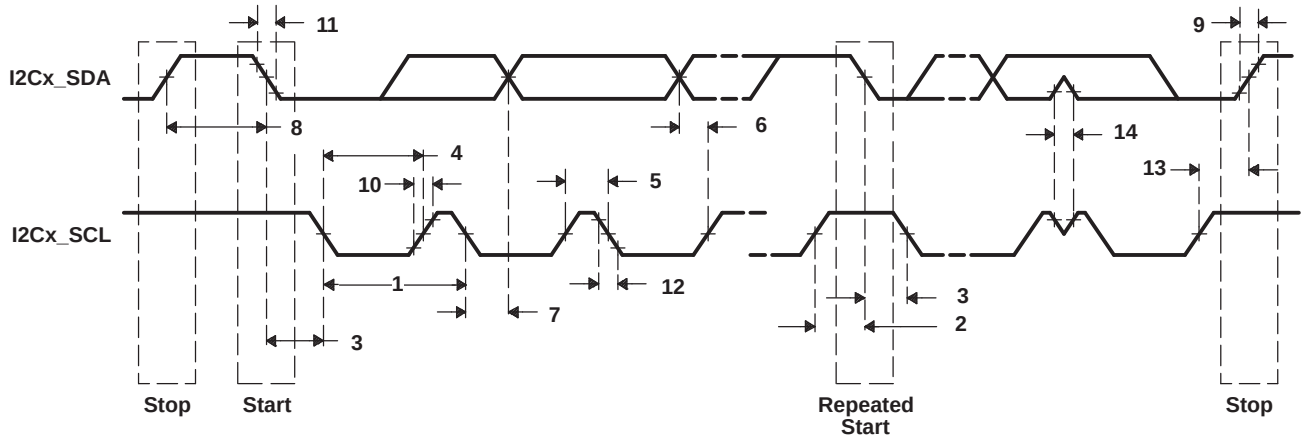

Figure 6-38. I2C Receive Timings

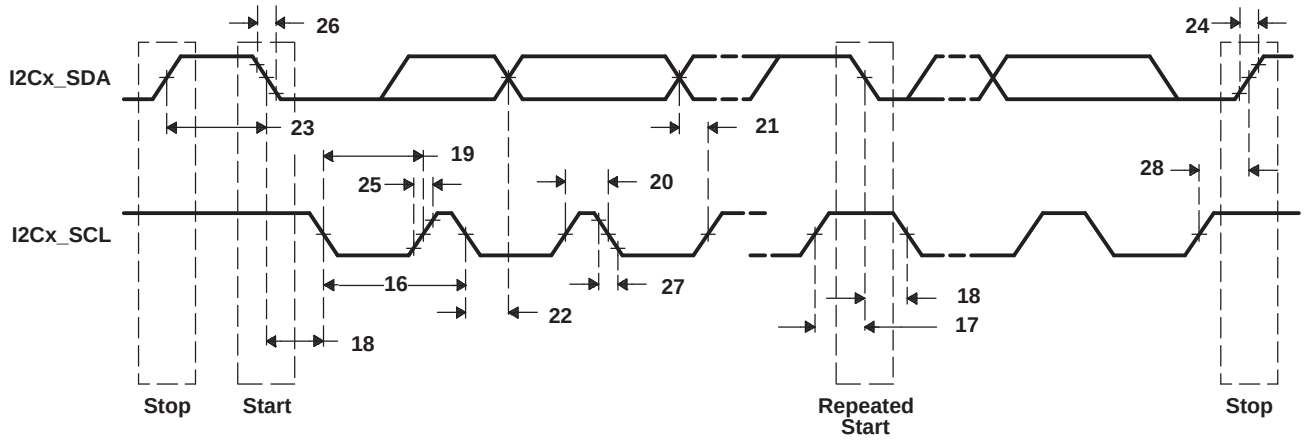

Figure 6-39. I2C Transmit Timings

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6.17 Universal Asynchronous Receiver/Transmitter (UART)

The UART has the following features:

- 16-byte storage space for both the transmitter and receiver FIFOs
- 1, 4, 8, or 14 byte selectable receiver FIFO trigger level for autoflow control and DMA
- DMA signaling capability for both received and transmitted data
- Programmable auto-rts and auto-cts for autoflow control
- Programmable Baud Rate up to 12 MBaud
- Programmable Oversampling Options of x13 and x16
- Frequency pre-scale values from 1 to 65,535 to generate appropriate baud rates
- Prioritized interrupts
- Programmable serial data formats
  - 5, 6, 7, or 8-bit characters
  - Even, odd, or no parity bit generation and detection
  - 1, 1.5, or 2 stop bit generation
- False start bit detection
- Line break generation and detection
- Internal diagnostic capabilities
  - Loopback controls for communications link fault isolation
  - Break, parity, overrun, and framing error simulation
- Modem control functions (CTS, RTS)

The UART registers are listed in Section 6.17.1

6.17.1 UART Peripheral Registers Description(s)

Table 6-64 is the list of UART registers.

Table 6-64. UART Registers

UART0 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01C4 2000	RBR	Receiver Buffer Register (read only)
0x01C4 2000	THR	Transmitter Holding Register (write only)
0x01C4 2004	IER	Interrupt Enable Register
0x01C4 2008	IIR	Interrupt Identification Register (read only)
0x01C4 2008	FCR	FIFO Control Register (write only)
0x01C4 200C	LCR	Line Control Register
0x01C4 2010	MCR	Modem Control Register
0x01C4 2014	LSR	Line Status Register
0x01C4 2018	MSR	Modem Status Register
0x01C4 201C	SCR	Scratchpad Register
0x01C4 2020	DLL	Divisor LSB Latch
0x01C4 2024	DLH	Divisor MSB Latch
0x01C4 2028	REVID1	Revision Identification Register 1
0x01C4 2030	PWREMU_MGMT	Power and Emulation Management Register
0x01C4 2034	MDR	Mode Definition Register

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6.17.2 UART Electrical Data/Timing

Table 6-65. Timing Requirements for UART Receive(1) (see Figure 6-40)

NO.			1.2V, 1.1V, 1.0V		UNIT
			MIN	MAX	
4	$t_{w(URXDB)}$	Pulse duration, receive data bit (RXDn)	0.96U	1.05U	ns
5	$t_{w(URXSB)}$	Pulse duration, receive start bit	0.96U	1.05U	ns

(1) U = UART baud time = 1/programmed baud rate.

Table 6-66. Switching Characteristics Over Recommended Operating Conditions for UARTx Transmit(1) (see Figure 6-40)

NO.	PARAMETER		1.2V, 1.1V, 1.0V		UNIT
			MIN	MAX	
1	$f_{(baud)}$	Maximum programmable baud rate		D/E (2) (3)	MBaud (4)
2	$t_{w(UTXDB)}$	Pulse duration, transmit data bit (TXDn)	U - 2	U + 2	ns
3	$t_{w(UTXSB)}$	Pulse duration, transmit start bit	U - 2	U + 2	ns

(1) U = UART baud time = 1/programmed baud rate.
(2) D = UART input clock in MHz.
(3) E = UART divisor x UART sampling rate. The UART divisor is set through the UART divisor latch registers (DLL and DLH). The UART sampling rate is set through the over-sampling mode select bit (OSM_SEL) of the UART mode definition register (MDR).
(4) Baud rate is not indicative of data rate. Actual data rate will be limited by system factors such as EDMA loading, EMIF/DDR loading, system frequency, etc.

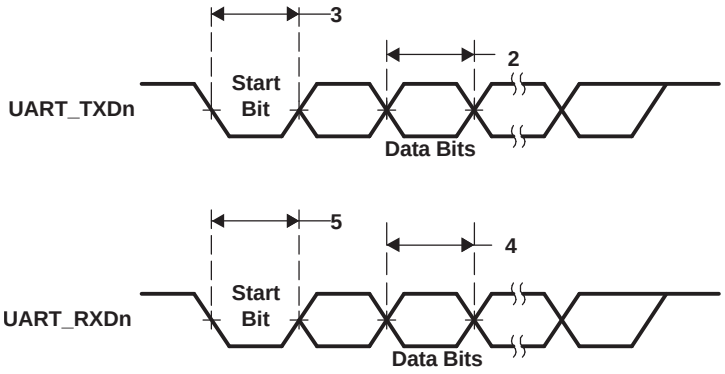

Figure 6-40. UART Transmit/Receive Timing

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6.18 Host-Port Interface (UHPI)

6.18.1 HPI Device-Specific Information

The device includes a user-configurable 16-bit Host-port interface (HPI16).

The host port interface (UHPI) provides a parallel port interface through which an external host processor can directly access the processor's resources (configuration and program/data memories). The external host device is asynchronous to the CPU clock and functions as a master to the HPI interface. The UHPI enables a host device and the processor to exchange information via internal or external memory. Dedicated address (HPIA) and data (HPID) registers within the UHPI provide the data path between the external host interface and the processor resources. A UHPI control register (HPIC) is available to the host and the CPU for various configuration and interrupt functions.

6.18.2 HPI Peripheral Register Description(s)

Table 6-67. HPI Control Registers

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION	COMMENTS
0x01E1 0000	PID	Peripheral Identification Register	
0x01E1 0004	PWREMU_MGMT	HPI power and emulation management register	The CPU has read/write access to the PWREMU_MGMT register.
0x01E1 0008	-	Reserved	
0x01E1 000C	GPIO_EN	General Purpose IO Enable Register	
0x01E1 0010	GPIO_DIR1	General Purpose IO Direction Register 1	
0x01E1 0014	GPIO_DAT1	General Purpose IO Data Register 1	
0x01E1 0018	GPIO_DIR2	General Purpose IO Direction Register 2	
0x01E1 001C	GPIO_DAT2	General Purpose IO Data Register 2	
0x01E1 0020	GPIO_DIR3	General Purpose IO Direction Register 3	
0x01E1 0024	GPIO_DAT3	General Purpose IO Data Register 3	
01E1 0028	-	Reserved	
01E1 002C	-	Reserved	
01E1 0030	HPIC	HPI control register	The Host and the CPU both have read/write access to the HPIC register.
01E1 0034	HPIA (HPIAW)(1)	HPI address register (Write)	The Host has read/write access to the HPIA registers. The CPU has only read access to the HPIA registers.
01E1 0038	HPIA (HPIAR)(1)	HPI address register (Read)	
01E1 000C - 01E1 07FF	-	Reserved	

(1) There are two 32-bit HPIA registers: HPIAR for read operations and HPIAW for write operations. The HPI can be configured such that HPIAR and HPIAW act as a single 32-bit HPIA (single-HPIA mode) or as two separate 32-bit HPIAs (dual-HPIA mode) from the perspective of the Host. The CPU can access HPIAW and HPIAR independently.

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6.18.3 HPI Electrical Data/Timing

Table 6-68. Timing Requirements for Host-Port Interface [1.2V, 1.1V](1) (2)

NO.			1.2V, 1.1V, 1.0V		UNIT
			MIN	MAX	
1	$t_{su(SELV-HSTBL)}$	Setup time, select signals(3) valid before $\overline{\text{UHPI_HSTROBE}}$ low	5		ns
2	$t_{h(HSTBL-SELV)}$	Hold time, select signals(3) valid after $\overline{\text{UHPI_HSTROBE}}$ low	2		ns
3	$t_{w(HSTBL)}$	Pulse duration, $\overline{\text{UHPI_HSTROBE}}$ active low	15		ns
4	$t_{w(HSTBH)}$	Pulse duration, $\overline{\text{UHPI_HSTROBE}}$ inactive high between consecutive accesses	2M		ns
9	$t_{su(SELV-HASL)}$	Setup time, selects signals valid before $\overline{\text{UHPI_HAS}}$ low	5		ns
10	$t_{h(HASL-SELV)}$	Hold time, select signals valid after $\overline{\text{UHPI_HAS}}$ low	2		ns
11	$t_{su(HDV-HSTBH)}$	Setup time, host data valid before $\overline{\text{UHPI_HSTROBE}}$ high	5		ns
12	$t_{h(HSTBH-HDV)}$	Hold time, host data valid after $\overline{\text{UHPI_HSTROBE}}$ high	2		ns
13	$t_{h(HRDYL-HSTBH)}$	Hold time, $\overline{\text{UHPI_HSTROBE}}$ high after $\overline{\text{UHPI_HRDY}}$ low. $\overline{\text{UHPI_HSTROBE}}$ should not be inactivated until $\overline{\text{UHPI_HRDY}}$ is active (low); otherwise, HPI writes will not complete properly.	2		ns
16	$t_{su(HASL-HSTBL)}$	Setup time, $\overline{\text{UHPI_HAS}}$ low before $\overline{\text{UHPI_HSTROBE}}$ low	5		ns
17	$t_{h(HSTBL-HASH)}$	Hold time, $\overline{\text{UHPI_HAS}}$ low after $\overline{\text{UHPI_HSTROBE}}$ low	2		ns

(1) $\overline{\text{UHPI_HSTROBE}}$ refers to the following logical operation on $\overline{\text{UHPI_HCS}}$, $\overline{\text{UHPI_HDS1}}$, and $\overline{\text{UHPI_HDS2}}$: [NOT($\overline{\text{UHPI_HDS1}}$ XOR $\overline{\text{UHPI_HDS2}}$)] OR $\overline{\text{UHPI_HCS}}$.
(2) M=SYSCLK2 period in ns.
(3) Select signals include: HCNTL[1:0], HR/$\overline{\text{W}}$ and HHWIL.

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Table 6-69. Switching Characteristics Over Recommended Operating Conditions for Host-Port Interface [1.2V, 1.1V](1) (2) (3)

NO.	PARAMETER			1.2V		1.1V		UNIT
				MIN	MAX	MIN	MAX	
5	$t_{d(HSTBL-HRDYV)}$	Delay time, HSTROBE low to HRDY valid	For HPI Write, HRDY can go high (*not ready*) for these HPI Write conditions; otherwise, HRDY stays low (*ready*): *Case 1*: Back-to-back HPIA writes (can be either first or second half-word) *Case 2*: HPIA write following a PREFETCH command (can be either first or second half-word) *Case 3*: HPID write when FIFO is full or flushing (can be either first or second half-word) *Case 4*: HPIA write and Write FIFO not empty For HPI Read, HRDY can go high (*not ready*) for these HPI Read conditions: *Case 1*: HPID read (with auto-increment) and data not in Read FIFO (can only happen to first half-word of HPID access) *Case 2*: First half-word access of HPID Read without auto-increment For HPI Read, HRDY stays low (*ready*) for these HPI Read conditions: *Case 1*: HPID read with auto-increment and data is already in Read FIFO (applies to either half-word of HPID access) *Case 2*: HPID read without auto-increment and data is already in Read FIFO (always applies to second half-word of HPID access) *Case 3*: HPIC or HPIA read (applies to either half-word access)		15		17	ns
5a	$t_{d(HASL-HRDYV)}$	Delay time, HAS low to HRDY valid			15		17	ns
6	$t_{en(HSTBL-HDLZ)}$	Enable time, HD driven from HSTROBE low		1.5		1.5		ns
7	$t_{d(HRDYL-HDV)}$	Delay time, HRDY low to HD valid			0		0	ns
8	$t_{oh(HSTBH-HDV)}$	Output hold time, HD valid after HSTROBE high		1.5		1.5		ns
14	$t_{dis(HSTBH-HDHZ)}$	Disable time, HD high-impedance from HSTROBE high			15		17	ns
15	$t_{d(HSTBL-HDV)}$	Delay time, HSTROBE low to HD valid	For HPI Read. Applies to conditions where data is already residing in HPID/FIFO: *Case 1*: HPIC or HPIA read *Case 2*: First half-word of HPID read with auto-increment and data is already in Read FIFO *Case 3*: Second half-word of HPID read with or without auto-increment		15		17	ns
18	$t_{d(HSTBH-HRDYV)}$	Delay time, HSTROBE high to HRDY valid	For HPI Write, HRDY can go high (*not ready*) for these HPI Write conditions; otherwise, HRDY stays low (*ready*): *Case 1*: HPID write when Write FIFO is full (can happen to either half-word) *Case 2*: HPIA write (can happen to either half-word) *Case 3*: HPID write without auto-increment (only happens to second half-word)		15		17	ns

(1) M=SYSCLK2 period in ns.
(2) HSTROBE refers to the following logical operation on HCS, HDS1, and HDS2: [NOT(HDS1 XOR HDS2)] OR HCS.
(3) By design, whenever HCS is driven inactive (high), HPI will drive HRDY active (low).

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Table 6-70. Switching Characteristics Over Recommended Operating Conditions for Host-Port Interface [1.0V](1) (2) (3)

NO.	PARAMETER			1.0V		UNIT
				MIN	MAX	
5	$t_{d(HSTBL-HRDYV)}$	Delay time, HSTROBE low to HRDY valid	For HPI Write, HRDY can go high (*not ready*) for these HPI Write conditions; otherwise, HRDY stays low (*ready*): *Case 1*: Back-to-back HPIA writes (can be either first or second half-word) *Case 2*: HPIA write following a PREFETCH command (can be either first or second half-word) *Case 3*: HPID write when FIFO is full or flushing (can be either first or second half-word) *Case 4*: HPIA write and Write FIFO not empty For HPI Read, HRDY can go high (*not ready*) for these HPI Read conditions: *Case 1*: HPID read (with auto-increment) and data not in Read FIFO (can only happen to first half-word of HPID access) *Case 2*: First half-word access of HPID Read without auto-increment For HPI Read, HRDY stays low (*ready*) for these HPI Read conditions: *Case 1*: HPID read with auto-increment and data is already in Read FIFO (applies to either half-word of HPID access) *Case 2*: HPID read without auto-increment and data is already in Read FIFO (always applies to second half-word of HPID access) *Case 3*: HPIC or HPIA read (applies to either half-word access)		22	ns
5a	$t_{d(HASL-HRDYV)}$	Delay time, HAS low to HRDY valid			22	ns
6	$t_{en(HSTBL-HDLZ)}$	Enable time, HD driven from HSTROBE low		1.5		ns
7	$t_{d(HRDYL-HDV)}$	Delay time, HRDY low to HD valid			0	ns
8	$t_{oh(HSTBH-HDV)}$	Output hold time, HD valid after HSTROBE high		1.5		ns
14	$t_{dis(HSTBH-HDHZ)}$	Disable time, HD high-impedance from HSTROBE high			22	ns
15	$t_{d(HSTBL-HDV)}$	Delay time, HSTROBE low to HD valid	For HPI Read. Applies to conditions where data is already residing in HPID/FIFO: *Case 1*: HPIC or HPIA read *Case 2*: First half-word of HPID read with auto-increment and data is already in Read FIFO *Case 3*: Second half-word of HPID read with or without auto-increment		22	ns
18	$t_{d(HSTBH-HRDYV)}$	Delay time, HSTROBE high to HRDY valid	For HPI Write, HRDY can go high (*not ready*) for these HPI Write conditions; otherwise, HRDY stays low (*ready*): *Case 1*: HPID write when Write FIFO is full (can happen to either half-word) *Case 2*: HPIA write (can happen to either half-word) *Case 3*: HPID write without auto-increment (only happens to second half-word)		22	ns

(1) M=SYSCLK2 period in ns.
(2) HSTROBE refers to the following logical operation on HCS, HDS1, and HDS2: [NOT(HDS1 XOR HDS2)] OR HCS.
(3) By design, whenever HCS is driven inactive (high), HPI will drive HRDY active (low).

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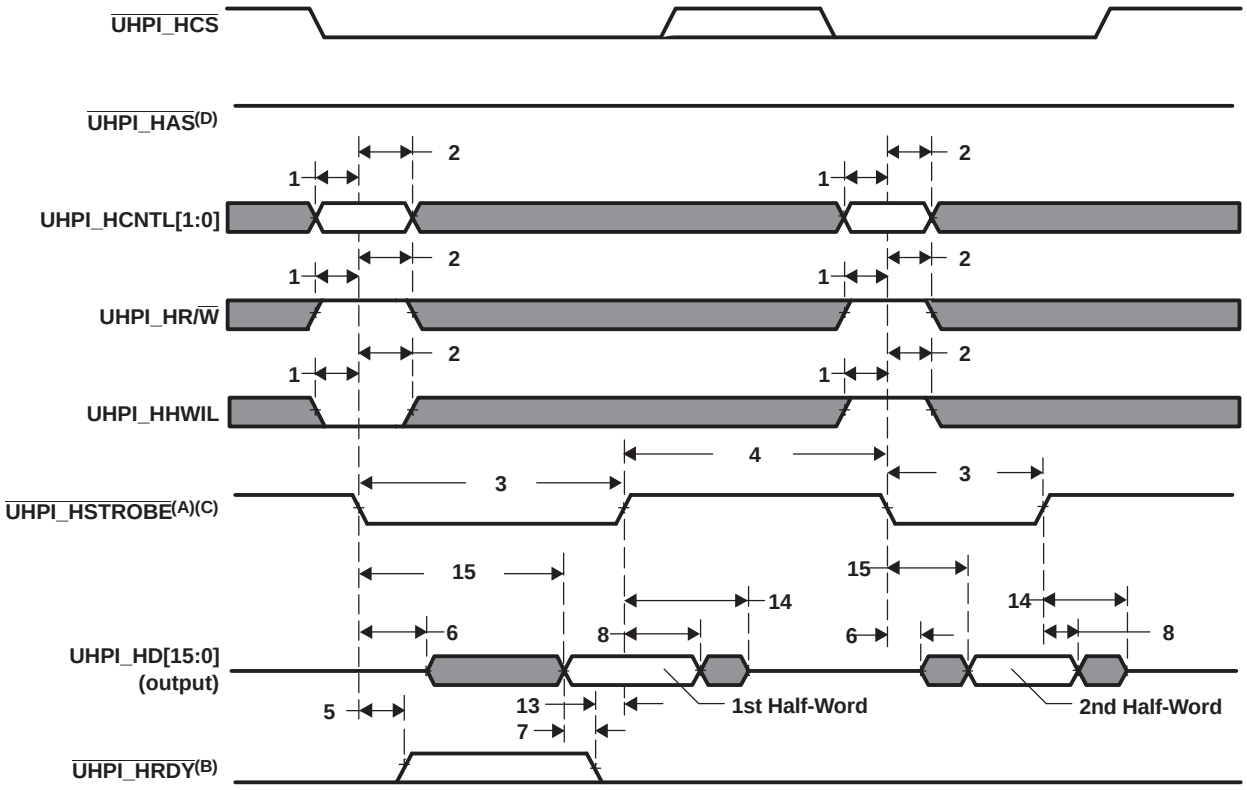
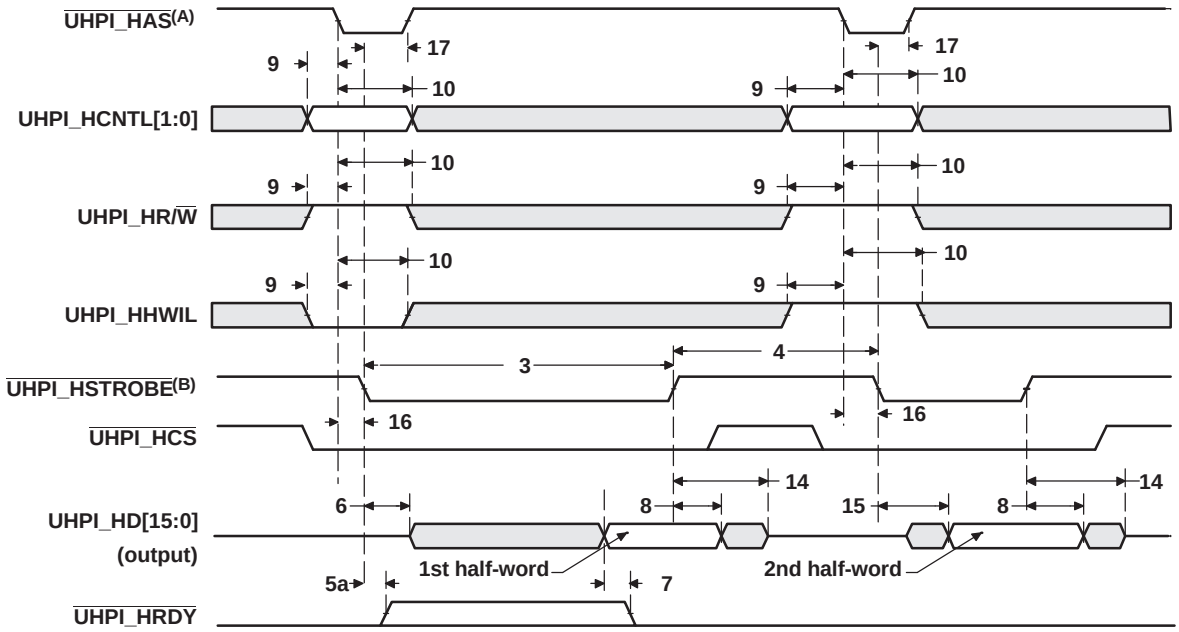


A. UHPI_HSTROBE refers to the following logical operation on UHPI_HCS, UHPI_HDS1, and UHPI_HDS2: [NOT(HDS1 XOR HDS2)] OR UHPI_HCS.
B. Depending on the type of write or read operation (HPID without auto-incrementing; HPIA, HPIC, or HPID with auto-incrementing) and the state of the FIFO, transitions on UHPI_HRDY may or may not occur.
C. UHPI_HCS reflects typical UHPI_HCS behavior when UHPI_HSTROBE assertion is caused by UHPI_HDS1 or UHPI_HDS2. UHPI_HCS timing requirements are reflected by parameters for UHPI_HSTROBE.
D The diagram above assumes UHPI_HAS has been pulled high.

Figure 6-41. UHPI Read Timing (HAS Not Used, Tied High)



A. For correct operation, strobe the UHPI_HAS signal only once per UHPI_HSTROBE active cycle.

B. UHPI_HSTROBE refers to the following logical operation on UHPI_HCS, UHPI_HDS1, and UHPI_HDS2: [NOT(UHPI_HDS1 XOR UHPI_HDS2)] OR UHPI_HCS.

Figure 6-42. UHPI Read Timing (HAS Used)

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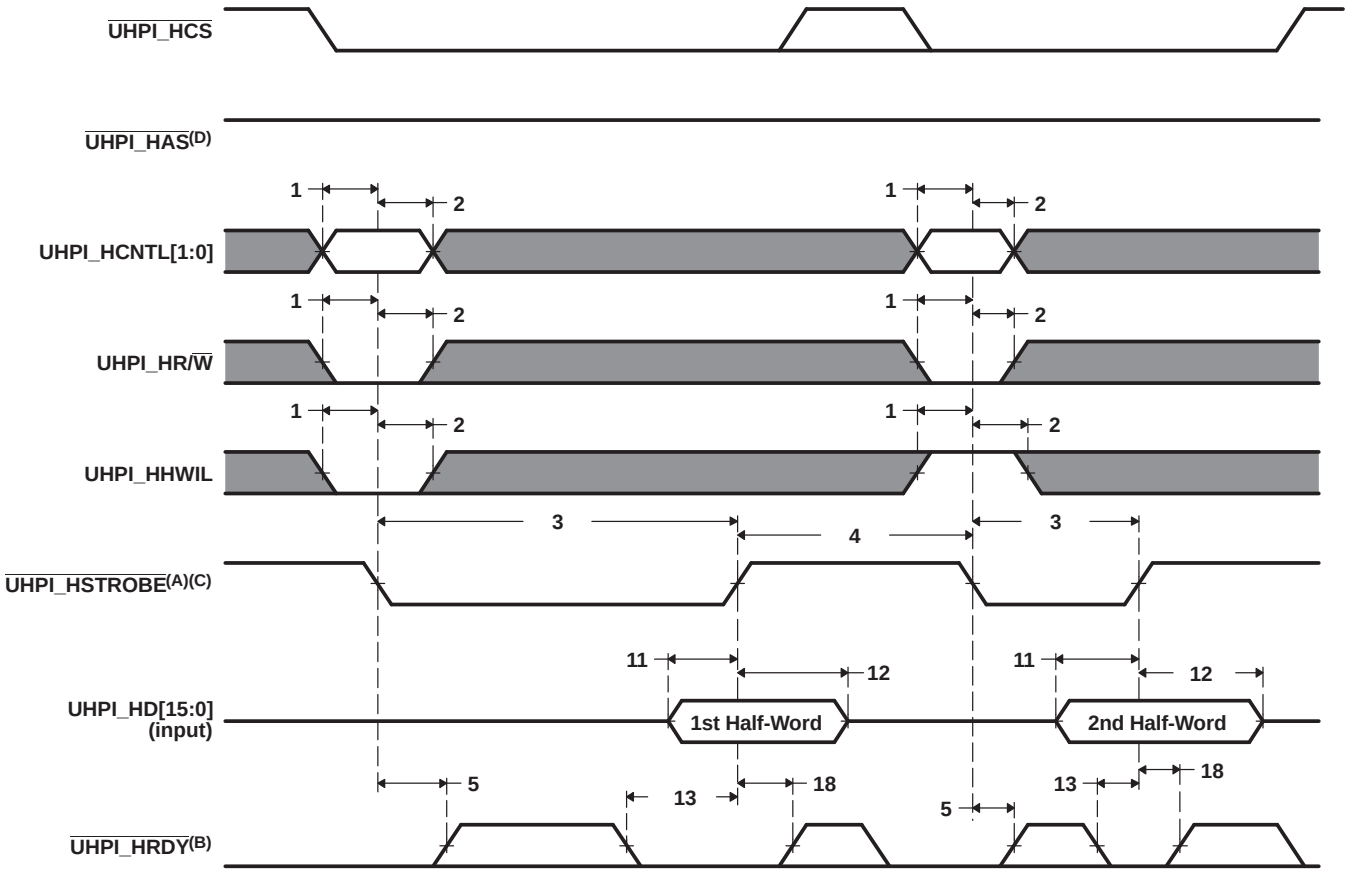
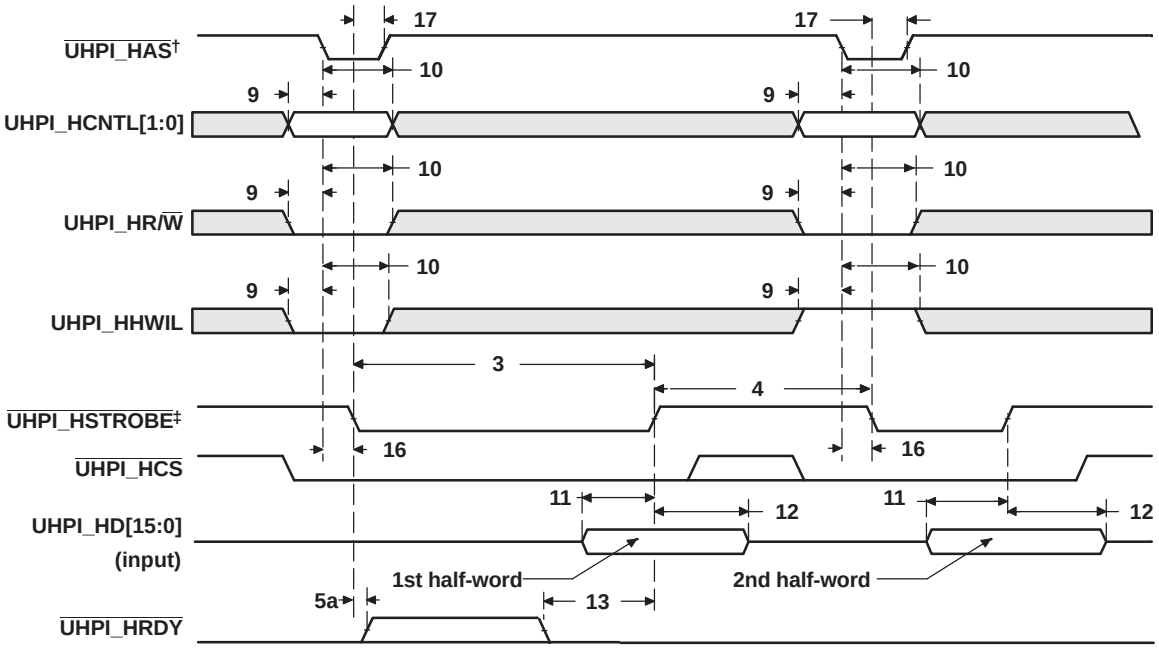


A. UHPI_HSTROBE refers to the following logical operation on UHPI_HCS, UHPI_HDS1, and UHPI_HDS2: [NOT(HDS1 XOR HDS2)] OR UHPI_HCS.
B. Depending on the type of write or read operation (HPID without auto-incrementing; HPIA, HPIC, or HPID with auto-incrementing) and the state of the FIFO, transitions on UHPI_HRDY may or may not occur.
C. UHPI_HCS reflects typical UHPI_HCS behavior when UHPI_HSTROBE assertion is caused by UHPI_HDS1 or UHPI_HDS2. UHPI_HCS timing requirements are reflected by parameters for UHPI_HSTROBE.
D The diagram above assumes UHPI_HAS has been pulled high.

Figure 6-43. UHPI Write Timing (HAS Not Used, Tied High)



A. For correct operation, strobe the UHPI_HAS signal only once per UHPI_HSTROBE active cycle.
B. UHPI_HSTROBE refers to the following logical operation on UHPI_HCS, UHPI_HDS1, and UHPI_HDS2: [NOT(UHPI_HDS1 XOR UHPI_HDS2)] OR UHPI_HCS.

Figure 6-44. UHPI Write Timing (HAS Used)

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6.19 Enhanced Capture (eCAP) Peripheral

The device contains up to three enhanced capture (eCAP) modules. Figure 6-45 shows a functional block diagram of a module.

Uses for ECAP include:

- Speed measurements of rotating machinery (e.g. toothed sprockets sensed via Hall sensors)
- Elapsed time measurements between position sensor triggers
- Period and duty cycle measurements of pulse train signals
- Decoding current or voltage amplitude derived from duty cycle encoded current/voltage sensors

The ECAP module described in this specification includes the following features:

- 32 bit time base
- 4 event time-stamp registers (each 32 bits)
- Edge polarity selection for up to 4 sequenced time-stamp capture events
- Interrupt on either of the 4 events
- Single shot capture of up to 4 event time-stamps
- Continuous mode capture of time-stamps in a 4 deep circular buffer
- Absolute time-stamp capture
- Difference mode time-stamp capture
- All the above resources are dedicated to a single input pin

The eCAP modules are clocked at the ASYNC3 clock domain rate.

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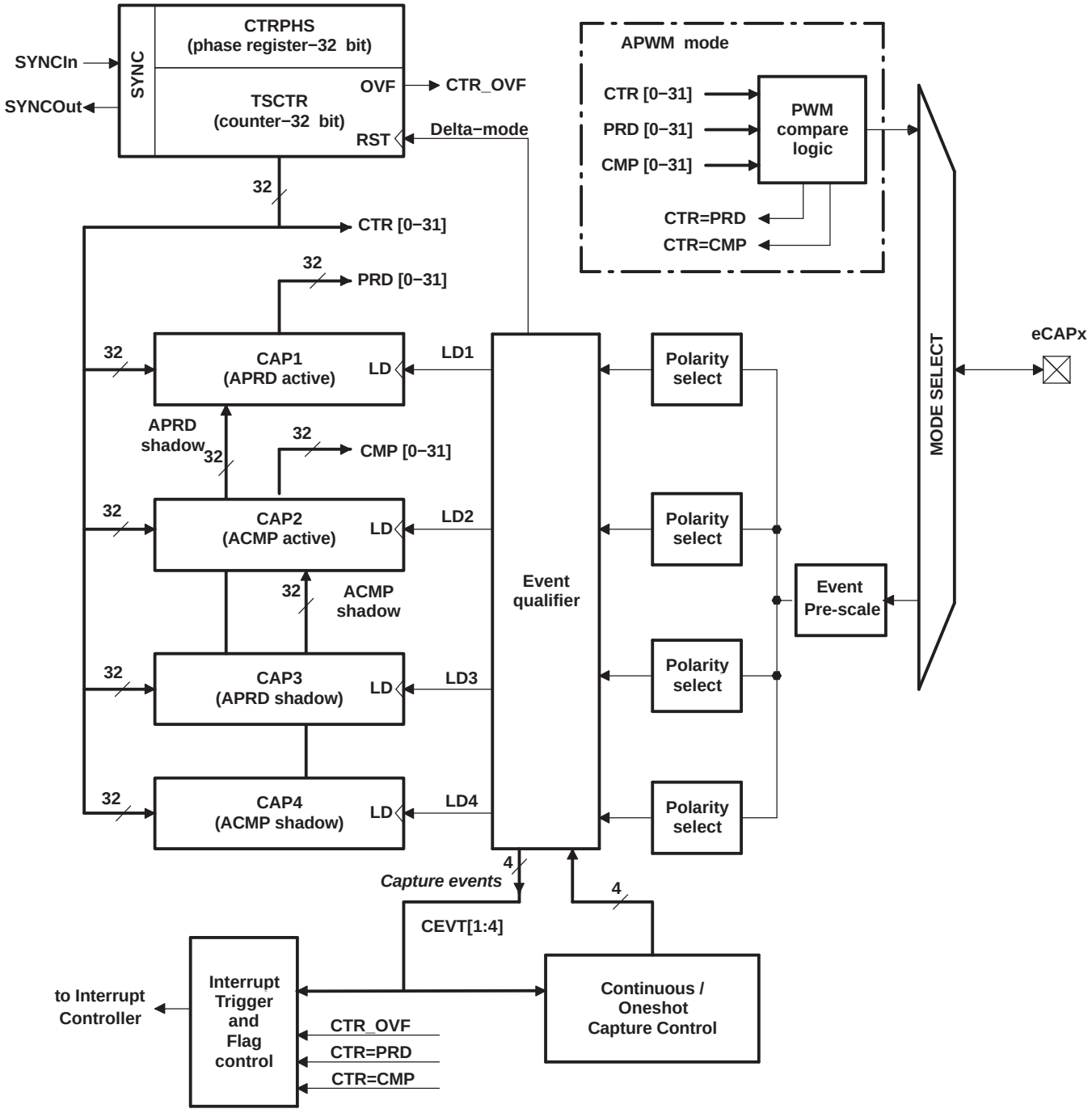

Figure 6-45. eCAP Functional Block Diagram

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Table 6-71 is the list of the ECAP registers.

Table 6-71. ECAPx Configuration Registers

ECAP0 BYTE ADDRESS	ECAP1 BYTE ADDRESS	ECAP2 BYTE ADDRESS	ACRONYM	DESCRIPTION
0x01F0 6000	0x01F0 7000	0x01F0 8000	TSCTR	Time-Stamp Counter
0x01F0 6004	0x01F0 7004	0x01F0 8004	CTRPHS	Counter Phase Offset Value Register
0x01F0 6008	0x01F0 7008	0x01F0 8008	CAP1	Capture 1 Register
0x01F0 600C	0x01F0 700C	0x01F0 800C	CAP2	Capture 2 Register
0x01F0 6010	0x01F0 7010	0x01F0 8010	CAP3	Capture 3 Register
0x01F0 6014	0x01F0 7014	0x01F0 8014	CAP4	Capture 4 Register
0x01F0 6028	0x01F0 7028	0x01F0 8028	ECCTL1	Capture Control Register 1
0x01F0 602A	0x01F0 702A	0x01F0 802A	ECCTL2	Capture Control Register 2
0x01F0 602C	0x01F0 702C	0x01F0 802C	ECEINT	Capture Interrupt Enable Register
0x01F0 602E	0x01F0 702E	0x01F0 802E	ECFLG	Capture Interrupt Flag Register
0x01F0 6030	0x01F0 7030	0x01F0 8030	ECCLR	Capture Interrupt Clear Register
0x01F0 6032	0x01F0 7032	0x01F0 8032	ECFRC	Capture Interrupt Force Register
0x01F0 605C	0x01F0 705C	0x01F0 805C	REVID	Revision ID

Table 6-72 shows the eCAP timing requirement and Table 6-73 shows the eCAP switching characteristics.

Table 6-72. Timing Requirements for Enhanced Capture (eCAP)

		TEST CONDITIONS	1.2V, 1.1V, 1.0V		UNIT
			MIN	MAX	
$t_{w(CAP)}$	Capture input pulse width	Asynchronous	$2t_{c(SCO)}$		cycles
		Synchronous	$2t_{c(SCO)}$		cycles

Table 6-73. Switching Characteristics Over Recommended Operating Conditions for eCAP

PARAMETER		1.2V		1.1V		1.0V		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
$t_{w(APWM)}$	Pulse duration, APWMx output high/low	20		20		20		ns

6.20 Enhanced High-Resolution Pulse-Width Modulator (eHRPWM)

The device contains two enhanced PWM Modules (eHRPWM). Figure 6-46 shows a block diagram of multiple eHRPWM modules. Figure 6-46 shows the signal interconnections with the eHRPWM.

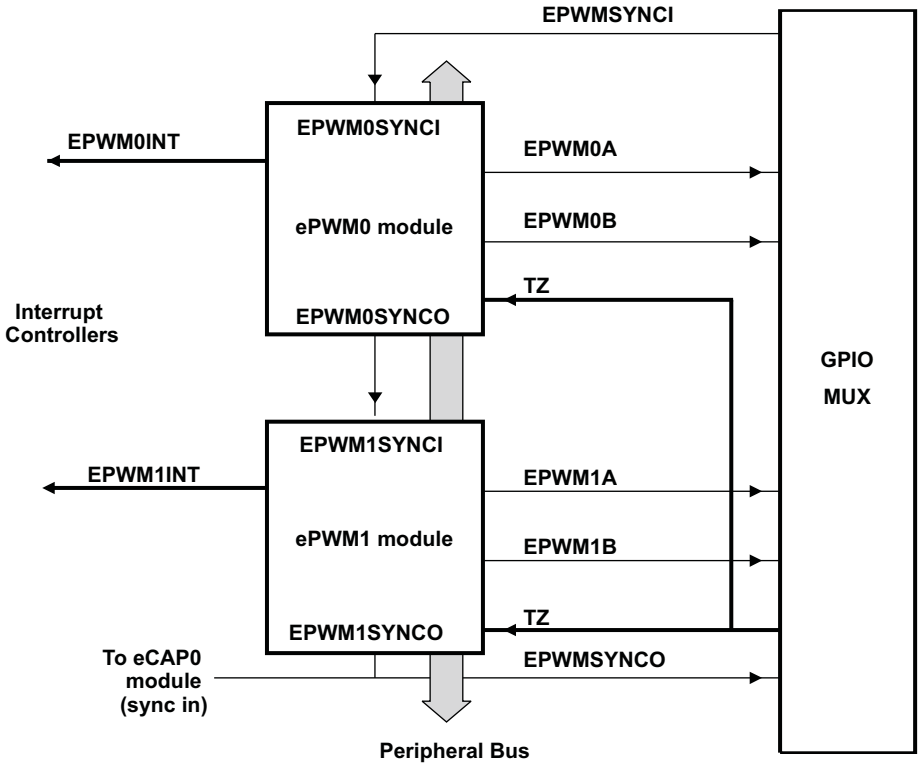

Figure 6-46. Multiple PWM Modules in a C6742 System

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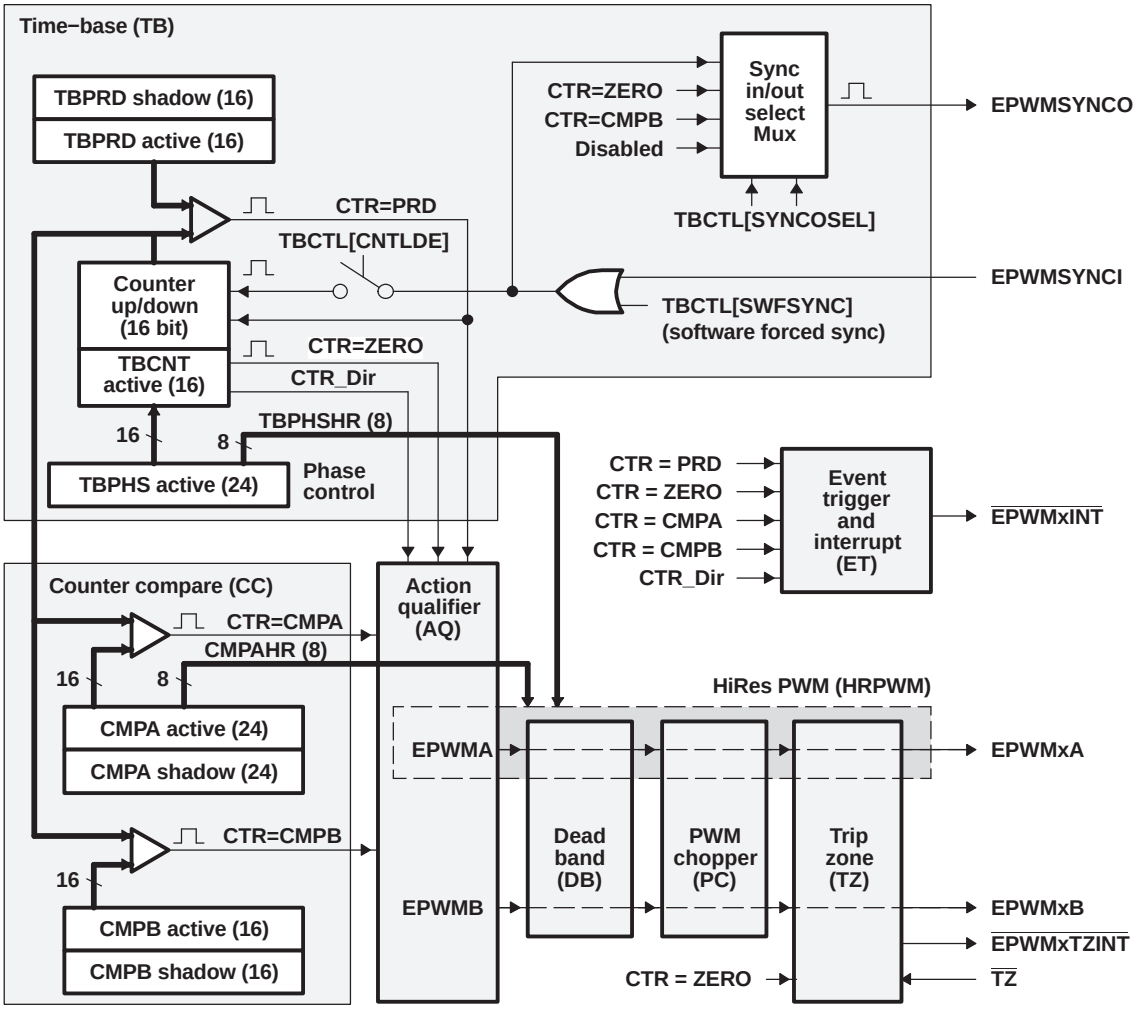

Figure 6-47. eHRPWM Sub-Modules Showing Critical Internal Signal Interconnections

Table 6-74. eHRPWM Module Control and Status Registers Grouped by Submodule

eHRPWM0 BYTE ADDRESS	eHRPWM1 BYTE ADDRESS	ACRONYM	SHADOW	REGISTER DESCRIPTION
Time-Base Submodule Registers				
0x01F0 0000	0x01F0 2000	TBCTL	No	Time-Base Control Register
0x01F0 0002	0x01F0 2002	TBSTS	No	Time-Base Status Register
0x01F0 0004	0x01F0 2004	TBPHSHR	No	Extension for HRPWM Phase Register(1)
0x01F0 0006	0x01F0 2006	TBPHS	No	Time-Base Phase Register
0x01F0 0008	0x01F0 2008	TBCNT	No	Time-Base Counter Register
0x01F0 000A	0x01F0 200A	TBPRD	Yes	Time-Base Period Register
Counter-Compare Submodule Registers				
0x01F0 000E	0x01F0 200E	CMPCTL	No	Counter-Compare Control Register
0x01F0 0010	0x01F0 2010	CMPAHR	No	Extension for HRPWM Counter-Compare A Register(1)
0x01F0 0012	0x01F0 2012	CMPA	Yes	Counter-Compare A Register
0x01F0 0014	0x01F0 2014	CMPB	Yes	Counter-Compare B Register
Action-Qualifier Submodule Registers				
0x01F0 0016	0x01F0 2016	AQCTLA	No	Action-Qualifier Control Register for Output A (eHRPWMxA)
0x01F0 0018	0x01F0 2018	AQCTLB	No	Action-Qualifier Control Register for Output B (eHRPWMxB)
0x01F0 001A	0x01F0 201A	AQSFRC	No	Action-Qualifier Software Force Register
0x01F0 001C	0x01F0 201C	AQCSFRC	Yes	Action-Qualifier Continuous S/W Force Register Set
Dead-Band Generator Submodule Registers				
0x01F0 001E	0x01F0 201E	DBCTL	No	Dead-Band Generator Control Register
0x01F0 0020	0x01F0 2020	DBRED	No	Dead-Band Generator Rising Edge Delay Count Register
0x01F0 0022	0x01F0 2022	DBFED	No	Dead-Band Generator Falling Edge Delay Count Register
PWM-Chopper Submodule Registers				
0x01F0 003C	0x01F0 203C	PCCTL	No	PWM-Chopper Control Register
Trip-Zone Submodule Registers				
0x01F0 0024	0x01F0 2024	TZSEL	No	Trip-Zone Select Register
0x01F0 0028	0x01F0 2028	TZCTL	No	Trip-Zone Control Register
0x01F0 002A	0x01F0 202A	TZEINT	No	Trip-Zone Enable Interrupt Register
0x01F0 002C	0x01F0 202C	TZFLG	No	Trip-Zone Flag Register
0x01F0 002E	0x01F0 202E	TZCLR	No	Trip-Zone Clear Register
0x01F0 0030	0x01F0 2030	TZFRC	No	Trip-Zone Force Register
Event-Trigger Submodule Registers				
0x01F0 0032	0x01F0 2032	ETSEL	No	Event-Trigger Selection Register
0x01F0 0034	0x01F0 2034	ETPS	No	Event-Trigger Pre-Scale Register
0x01F0 0036	0x01F0 2036	ETFLG	No	Event-Trigger Flag Register
0x01F0 0038	0x01F0 2038	ETCLR	No	Event-Trigger Clear Register
0x01F0 003A	0x01F0 203A	ETFRC	No	Event-Trigger Force Register
High-Resolution PWM (HRPWM) Submodule Registers				
0x01F0 1040	0x01F0 3040	HRCNFG	No	HRPWM Configuration Register (1)

(1) These registers are only available on eHRPWM instances that include the high-resolution PWM (HRPWM) extension; otherwise, these locations are reserved.

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6.20.1 Enhanced Pulse Width Modulator (eHRPWM) Timing

PWM refers to PWM outputs on eHRPWM1-6. Table 6-75 shows the PWM timing requirements and Table 6-76, switching characteristics.

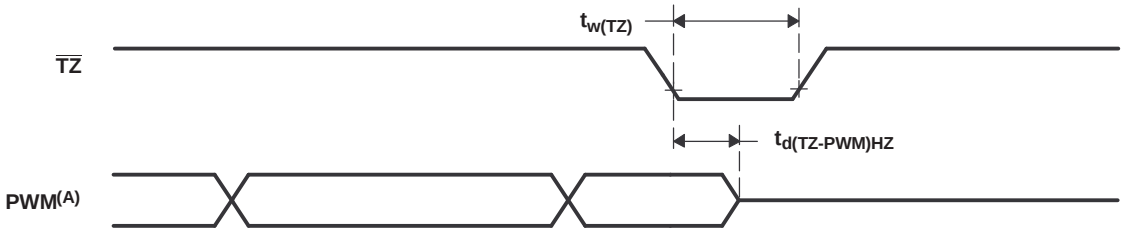
Table 6-75. Timing Requirements for eHRPWM

		TEST CONDITIONS	1.2V, 1.1V, 1.0V		UNIT
			MIN	MAX	
$t_{w(SYNCIN)}$	Sync input pulse width	Asynchronous	$2t_{c(SCO)}$		cycles
		Synchronous	$2t_{c(SCO)}$		cycles

Table 6-76. Switching Characteristics Over Recommended Operating Conditions for eHRPWM

PARAMETER		TEST CONDITIONS	1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
$t_{w(PWM)}$	Pulse duration, PWMx output high/low		20		20		26.6		ns
$t_{w(SYNCOUT)}$	Sync output pulse width		$8t_{c(SCO)}$		$8t_{c(SCO)}$		$8t_{c(SCO)}$		cycles
$t_{d(PWM)TZA}$	Delay time, trip input active to PWM forced high Delay time, trip input active to PWM forced low	no pin load; no additional programmable delay		25		25		25	ns
$t_{d(TZ-PWM)HZ}$	Delay time, trip input active to PWM Hi-Z	no additional programmable delay		20		20		20	ns

6.20.2 Trip-Zone Input Timing



A. PWM refers to all the PWM pins in the device. The state of the PWM pins after $\overline{TZ}$ is taken high depends on the PWM recovery software.

Figure 6-48. PWM Hi-Z Characteristics

Table 6-77. Trip-Zone input Timing Requirements

		TEST CONDITIONS	1.2V, 1.1V, 1.0V		UNIT
			MIN	MAX	
$t_{w(TZ)}$	Pulse duration, $\overline{TZ}$x input low	Asynchronous	$1t_{c(SCO)}$		cycles
		Synchronous	$2t_{c(SCO)}$		cycles

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6.21 Timers

The timers support the following features:

- Configurable as single 64-bit timer or two 32-bit timers
- Period timeouts generate interrupts, DMA events or external pin events
- 8 32-bit compare registers
- Compare matches generate interrupt events
- Capture capability
- 64-bit Watchdog capability (Timer64P1 only)

Table 6-78 lists the timer registers.

Table 6-78. Timer Registers

TIMER64P 0 BYTE ADDRESS	TIMER64P 1 BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01C2 0000	0x01C2 1000	REV	Revision Register
0x01C2 0004	0x01C2 1004	EMUMGT	Emulation Management Register
0x01C2 0008	0x01C2 1008	GPINTGPEN	GPIO Interrupt and GPIO Enable Register
0x01C2 000C	0x01C2 100C	GPDATGPDIR	GPIO Data and GPIO Direction Register
0x01C2 0010	0x01C2 1010	TIM12	Timer Counter Register 12
0x01C2 0014	0x01C2 1014	TIM34	Timer Counter Register 34
0x01C2 0018	0x01C2 1018	PRD12	Timer Period Register 12
0x01C2 001C	0x01C2 101C	PRD34	Timer Period Register 34
0x01C2 0020	0x01C2 1020	TCR	Timer Control Register
0x01C2 0024	0x01C2 1024	TGCR	Timer Global Control Register
0x01C2 0028	0x01C2 1028	WDTCR	Watchdog Timer Control Register
0x01C2 0034	0x01C2 1034	REL12	Timer Reload Register 12
0x01C2 0038	0x01C2 1038	REL34	Timer Reload Register 34
0x01C2 003C	0x01C2 103C	CAP12	Timer Capture Register 12
0x01C2 0040	0x01C2 1040	CAP34	Timer Capture Register 34
0x01C2 0044	0x01C2 1044	INTCTLSTAT	Timer Interrupt Control and Status Register
0x01C2 0060	0x01C2 1060	CMP0	Compare Register 0
0x01C2 0064	0x01C2 1064	CMP1	Compare Register 1
0x01C2 0068	0x01C2 1068	CMP2	Compare Register 2
0x01C2 006C	0x01C2 106C	CMP3	Compare Register 3
0x01C2 0070	0x01C2 1070	CMP4	Compare Register 4
0x01C2 0074	0x01C2 1074	CMP5	Compare Register 5
0x01C2 0078	0x01C2 1078	CMP6	Compare Register 6
0x01C2 007C	0x01C2 107C	CMP7	Compare Register 7

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6.21.1 Timer Electrical Data/Timing

Table 6-79. Timing Requirements for Timer Input(1) (2) (see Figure 6-49)

NO.			1.2V, 1.1V, 1.0V		UNIT
			MIN	MAX	
1	$t_{c(TM64Px_IN12)}$	Cycle time, TM64Px_IN12	4P		ns
2	$t_{w(TINPH)}$	Pulse duration, TM64Px_IN12 high	0.45C	0.55C	ns
3	$t_{w(TINPL)}$	Pulse duration, TM64Px_IN12 low	0.45C	0.55C	ns
4	$t_{t(TM64Px_IN12)}$	Transition time, TM64Px_IN12		0.25P or 10 (3)	ns

(1) P = OSCIN cycle time in ns.
(2) C = TM64P0_IN12 cycle time in ns.
(3) Whichever is smaller. P = the period of the applied signal. Maintaining transition times as fast as possible is recommended to improve noise immunity on input signals.

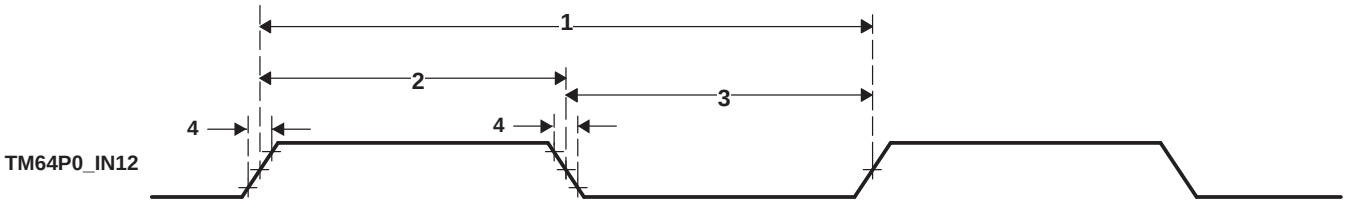

Figure 6-49. Timer Timing

Table 6-80. Switching Characteristics Over Recommended Operating Conditions for Timer Output (1)

NO.	PARAMETER		1.2V, 1.1V, 1.0V		UNIT
			MIN	MAX	
5	$t_{w(TOUTH)}$	Pulse duration, TM64P0_OUT12 high	4P		ns
6	$t_{w(TOUTL)}$	Pulse duration, TM64P0_OUT12 low	4P		ns

(1) P = OSCIN cycle time in ns. For example, when OSCIN frequency is 27 MHz, use P = 37.0$\overline{37}$ ns.

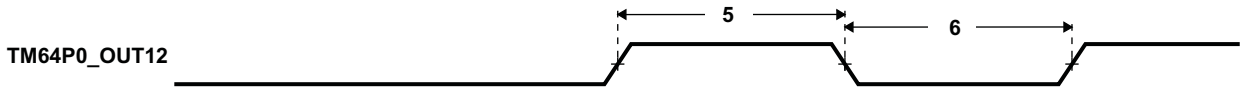

Figure 6-50. Timer Timing

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6.22 Real Time Clock (RTC)

The RTC provides a time reference to an application running on the device. The current date and time is tracked in a set of counter registers that update once per second. The time can be represented in 12-hour or 24-hour mode. The calendar and time registers are buffered during reads and writes so that updates do not interfere with the accuracy of the time and date.

Alarms are available to interrupt the CPU at a particular time, or at periodic time intervals, such as once per minute or once per day. In addition, the RTC can interrupt the CPU every time the calendar and time registers are updated, or at programmable periodic intervals.

The real-time clock (RTC) provides the following features:

- 100-year calendar (xx00 to xx99)
- Counts seconds, minutes, hours, day of the week, date, month, and year with leap year compensation
- Binary-coded-decimal (BCD) representation of time, calendar, and alarm
- 12-hour clock mode (with AM and PM) or 24-hour clock mode
- Alarm interrupt
- Periodic interrupt
- Single interrupt to the CPU
- Supports external 32.768-kHz crystal or external clock source of the same frequency
- Separate isolated power supply

Figure 6-51 shows a block diagram of the RTC.

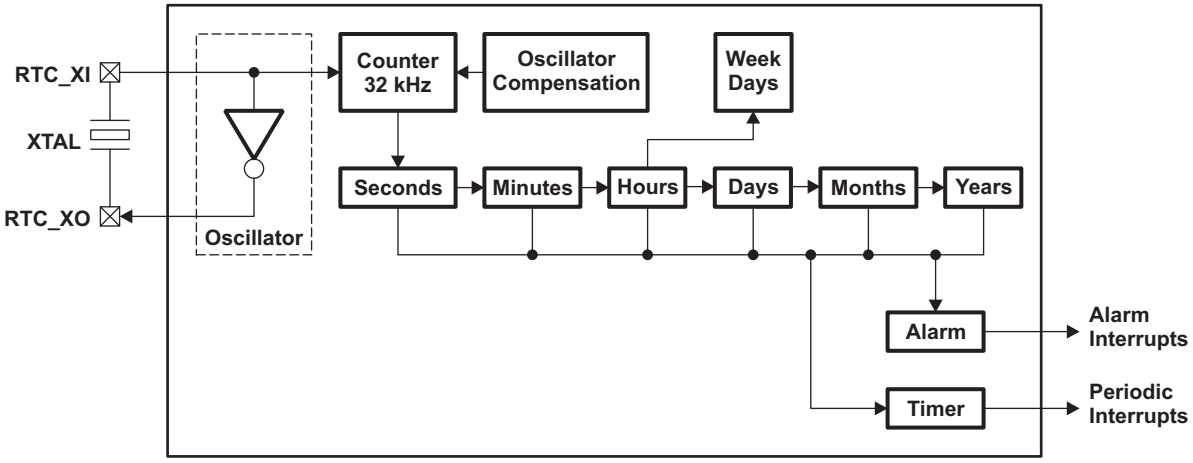

Figure 6-51. Real-Time Clock Block Diagram

6.22.1 Clock Source

The clock reference for the RTC is an external 32.768-kHz crystal or an external clock source of the same frequency. The RTC also has a separate power supply that is isolated from the rest of the system. When the CPU and other peripherals are without power, the RTC can remain powered to preserve the current time and calendar information. Even if the RTC is not used, it must remain powered when the rest of the device is powered.

The source for the RTC reference clock may be provided by a crystal or by an external clock source. The RTC has an internal oscillator buffer to support direct operation with a crystal. The crystal is connected between pins RTC_XI and RTC_XO. RTC_XI is the input to the on-chip oscillator and RTC_XO is the output from the oscillator back to the crystal.

An external 32.768-kHz clock source may be used instead of a crystal. In such a case, the clock source is connected to RTC_XI, and RTC_XO is left unconnected.

If the RTC is not used, the RTC_XI pin should be held either low or high, RTC_XO should be left unconnected, RTC_CVDD should be connected to the device CVDD, and RTC_VSS should remain grounded.

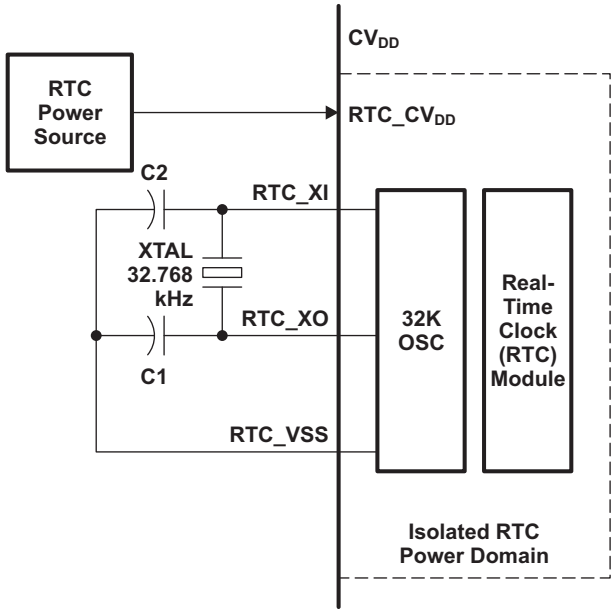

Figure 6-52. Clock Source

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6.22.2 Real-Time Clock Register Descriptions

Table 6-81. Real-Time Clock (RTC) Registers

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01C2 3000	SECOND	Seconds Register
0x01C2 3004	MINUTE	Minutes Register
0x01C2 3008	HOUR	Hours Register
0x01C2 300C	DAY	Day of the Month Register
0x01C2 3010	MONTH	Month Register
0x01C2 3014	YEAR	Year Register
0x01C2 3018	DOTW	Day of the Week Register
0x01C2 3020	ALARMSECOND	Alarm Seconds Register
0x01C2 3024	ALARMMINUTE	Alarm Minutes Register
0x01C2 3028	ALARMHOUR	Alarm Hours Register
0x01C2 302C	ALARMDAY	Alarm Days Register
0x01C2 3030	ALARMMONTH	Alarm Months Register
0x01C2 3034	ALARMYEAR	Alarm Years Register
0x01C2 3040	CTRL	Control Register
0x01C2 3044	STATUS	Status Register
0x01C2 3048	INTERRUPT	Interrupt Enable Register
0x01C2 304C	COMPLSB	Compensation (LSB) Register
0x01C2 3050	COMPMSB	Compensation (MSB) Register
0x01C2 3054	OSC	Oscillator Register
0x01C2 3060	SCRATCH0	Scratch 0 (General-Purpose) Register
0x01C2 3064	SCRATCH1	Scratch 1 (General-Purpose) Register
0x01C2 3068	SCRATCH2	Scratch 2 (General-Purpose) Register
0x01C2 306C	KICK0	Kick 0 (Write Protect) Register
0x01C2 3070	KICK1	Kick 1 (Write Protect) Register

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6.23 General-Purpose Input/Output (GPIO)

The GPIO peripheral provides general-purpose pins that can be configured as either inputs or outputs. When configured as an output, a write to an internal register can control the state driven on the output pin. When configured as an input, the state of the input is detectable by reading the state of an internal register. In addition, the GPIO peripheral can produce CPU interrupts and EDMA events in different interrupt/event generation modes. The GPIO peripheral provides generic connections to external devices. The GPIO pins are grouped into banks of 16 pins per bank (i.e., bank 0 consists of GPIO [0:15]).

The device GPIO peripheral supports the following:

- Up to 144 Pins configurable as GPIO
- External Interrupt and DMA request Capability
  - Every GPIO pin may be configured to generate an interrupt request on detection of rising and/or falling edges on the pin.
  - The interrupt requests within each bank are combined (logical or) to create eight unique bank level interrupt requests.
  - The bank level interrupt service routine may poll the INTSTATx register for its bank to determine which pin(s) have triggered the interrupt.
  - GPIO Banks 0, 1, 2, 3, 4, 5, 6, 7, and 8 Interrupts assigned to DSP Events 65, 41, 49, 52, 54, 59, 62, 72, and 75 respectively
  - GPIO Banks 0, 1, 2, 3, 4, and 5 are assigned to EDMA events 6, 7, 22, 23, 28, 29, and 29 respectively on Channel Controller 0 and GPIO Banks 6, 7, and 8 are assigned to EDMA events 16, 17, and 18 respectively on Channel Controller 1.
- Set/clear functionality: Firmware writes 1 to corresponding bit position(s) to set or to clear GPIO signal(s). This allows multiple firmware processes to toggle GPIO output signals without critical section protection (disable interrupts, program GPIO, re-enable interrupts, to prevent context switching to anther process during GPIO programming).
- Separate Input/Output registers
- Output register in addition to set/clear so that, if preferred by firmware, some GPIO output signals can be toggled by direct write to the output register(s).
- Output register, when read, reflects output drive status. This, in addition to the input register reflecting pin status and open-drain I/O cell, allows wired logic be implemented.

The memory map for the GPIO registers is shown in Table 6-82.

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6.23.1 GPIO Register Description(s)

Table 6-82. GPIO Registers

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
0x01E2 6000	REV	Peripheral Revision Register
0x01E2 6004	RESERVED	Reserved
0x01E2 6008	BINTEN	GPIO Interrupt Per-Bank Enable Register
GPIO Banks 0 and 1		
0x01E2 6010	DIR01	GPIO Banks 0 and 1 Direction Register
0x01E2 6014	OUT_DATA01	GPIO Banks 0 and 1 Output Data Register
0x01E2 6018	SET_DATA01	GPIO Banks 0 and 1 Set Data Register
0x01E2 601C	CLR_DATA01	GPIO Banks 0 and 1 Clear Data Register
0x01E2 6020	IN_DATA01	GPIO Banks 0 and 1 Input Data Register
0x01E2 6024	SET_RIS_TRIG01	GPIO Banks 0 and 1 Set Rising Edge Interrupt Register
0x01E2 6028	CLR_RIS_TRIG01	GPIO Banks 0 and 1 Clear Rising Edge Interrupt Register
0x01E2 602C	SET_FAL_TRIG01	GPIO Banks 0 and 1 Set Falling Edge Interrupt Register
0x01E2 6030	CLR_FAL_TRIG01	GPIO Banks 0 and 1 Clear Falling Edge Interrupt Register
0x01E2 6034	INTSTAT01	GPIO Banks 0 and 1 Interrupt Status Register
GPIO Banks 2 and 3		
0x01E2 6038	DIR23	GPIO Banks 2 and 3 Direction Register
0x01E2 603C	OUT_DATA23	GPIO Banks 2 and 3 Output Data Register
0x01E2 6040	SET_DATA23	GPIO Banks 2 and 3 Set Data Register
0x01E2 6044	CLR_DATA23	GPIO Banks 2 and 3 Clear Data Register
0x01E2 6048	IN_DATA23	GPIO Banks 2 and 3 Input Data Register
0x01E2 604C	SET_RIS_TRIG23	GPIO Banks 2 and 3 Set Rising Edge Interrupt Register
0x01E2 6050	CLR_RIS_TRIG23	GPIO Banks 2 and 3 Clear Rising Edge Interrupt Register
0x01E2 6054	SET_FAL_TRIG23	GPIO Banks 2 and 3 Set Falling Edge Interrupt Register
0x01E2 6058	CLR_FAL_TRIG23	GPIO Banks 2 and 3 Clear Falling Edge Interrupt Register
0x01E2 605C	INTSTAT23	GPIO Banks 2 and 3 Interrupt Status Register
GPIO Banks 4 and 5		
0x01E2 6060	DIR45	GPIO Banks 4 and 5 Direction Register
0x01E2 6064	OUT_DATA45	GPIO Banks 4 and 5 Output Data Register
0x01E2 6068	SET_DATA45	GPIO Banks 4 and 5 Set Data Register
0x01E2 606C	CLR_DATA45	GPIO Banks 4 and 5 Clear Data Register
0x01E2 6070	IN_DATA45	GPIO Banks 4 and 5 Input Data Register
0x01E2 6074	SET_RIS_TRIG45	GPIO Banks 4 and 5 Set Rising Edge Interrupt Register
0x01E2 6078	CLR_RIS_TRIG45	GPIO Banks 4 and 5 Clear Rising Edge Interrupt Register
0x01E2 607C	SET_FAL_TRIG45	GPIO Banks 4 and 5 Set Falling Edge Interrupt Register
0x01E2 6080	CLR_FAL_TRIG45	GPIO Banks 4 and 5 Clear Falling Edge Interrupt Register
0x01E2 6084	INTSTAT45	GPIO Banks 4 and 5 Interrupt Status Register

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Table 6-82. GPIO Registers (continued)

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION
GPIO Banks 6 and 7		
0x01E2 6088	DIR67	GPIO Banks 6 and 7 Direction Register
0x01E2 608C	OUT_DATA67	GPIO Banks 6 and 7 Output Data Register
0x01E2 6090	SET_DATA67	GPIO Banks 6 and 7 Set Data Register
0x01E2 6094	CLR_DATA67	GPIO Banks 6 and 7 Clear Data Register
0x01E2 6098	IN_DATA67	GPIO Banks 6 and 7 Input Data Register
0x01E2 609C	SET_RIS_TRIG67	GPIO Banks 6 and 7 Set Rising Edge Interrupt Register
0x01E2 60A0	CLR_RIS_TRIG67	GPIO Banks 6 and 7 Clear Rising Edge Interrupt Register
0x01E2 60A4	SET_FAL_TRIG67	GPIO Banks 6 and 7 Set Falling Edge Interrupt Register
0x01E2 60A8	CLR_FAL_TRIG67	GPIO Banks 6 and 7 Clear Falling Edge Interrupt Register
0x01E2 60AC	INTSTAT67	GPIO Banks 6 and 7 Interrupt Status Register
GPIO Bank 8		
0x01E2 60B0	DIR8	GPIO Bank 8 Direction Register
0x01E2 60B4	OUT_DATA8	GPIO Bank 8 Output Data Register
0x01E2 60B8	SET_DATA8	GPIO Bank 8 Set Data Register
0x01E2 60BC	CLR_DATA8	GPIO Bank 8 Clear Data Register
0x01E2 60C0	IN_DATA8	GPIO Bank 8 Input Data Register
0x01E2 60C4	SET_RIS_TRIG8	GPIO Bank 8 Set Rising Edge Interrupt Register
0x01E2 60C8	CLR_RIS_TRIG8	GPIO Bank 8 Clear Rising Edge Interrupt Register
0x01E2 60CC	SET_FAL_TRIG8	GPIO Bank 8 Set Falling Edge Interrupt Register
0x01E2 60D0	CLR_FAL_TRIG8	GPIO Bank 8 Clear Falling Edge Interrupt Register
0x01E2 60D4	INTSTAT8	GPIO Bank 8 Interrupt Status Register

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6.23.2 GPIO Peripheral Input/Output Electrical Data/Timing

Table 6-83. Timing Requirements for GPIO Inputs(1) (see Figure 6-53)

NO.			1.2V, 1.1V, 1.0V		UNIT
			MIN	MAX	
1	$t_{w(GPIH)}$	Pulse duration, GP*n*[*m*] as input high	2C(1) (2)		ns
2	$t_{w(GPIL)}$	Pulse duration, GP*n*[*m*] as input low	2C(1) (2)		ns

(1) The pulse width given is sufficient to generate a CPU interrupt or an EDMA event. However, if a user wants to have the device recognize the GPIx changes through software polling of the GPIO register, the GPIx duration must be extended to allow the device enough time to access the GPIO register through the internal bus.
(2) C=SYSCLK4 period in ns.

Table 6-84. Switching Characteristics Over Recommended Operating Conditions for GPIO Outputs (see Figure 6-53)

NO.	PARAMETER		1.2V, 1.1V, 1.0V		UNIT
			MIN	MAX	
3	$t_{w(GPOH)}$	Pulse duration, GP*n*[*m*] as output high	2C(1) (2)		ns
4	$t_{w(GPOL)}$	Pulse duration, GP*n*[*m*] as output low	2C(1) (2)		ns

(1) This parameter value should not be used as a maximum performance specification. Actual performance of back-to-back accesses of the GPIO is dependent upon internal bus activity.
(2) C=SYSCLK4 period in ns.

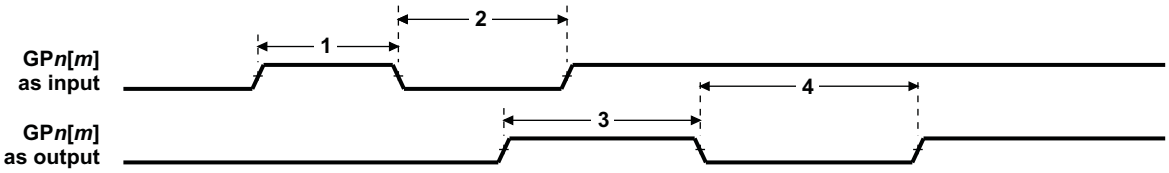

Figure 6-53. GPIO Port Timing

6.23.3 GPIO Peripheral External Interrupts Electrical Data/Timing

Table 6-85. Timing Requirements for External Interrupts(1) (see Figure 6-54)

NO.			1.2V, 1.1V, 1.0V		UNIT
			MIN	MAX	
1	$t_{w(ILOW)}$	Width of the external interrupt pulse low	2C(1) (2)		ns
2	$t_{w(IHIGH)}$	Width of the external interrupt pulse high	2C(1) (2)		ns

(1) The pulse width given is sufficient to generate an interrupt or an EDMA event. However, if a user wants to have the device recognize the GPIO changes through software polling of the GPIO register, the GPIO duration must be extended to allow the device enough time to access the GPIO register through the internal bus.
(2) C=SYSCLK4 period in ns.

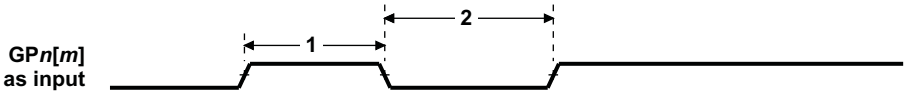

Figure 6-54. GPIO External Interrupt Timing

6.24 Emulation Logic

The debug capabilities and features for DSP are as shown below.

DSP:

- Basic Debug
  - Execution Control
  - System Visibility
- Real-Time Debug
  - Interrupts serviced while halted
  - Low/non-intrusive system visibility while running
- Advanced Debug
  - Global Start
  - Global Stop
  - Specify targeted memory level(s) during memory accesses
  - HSRTDX (High Speed Real Time Data eXchange)
- Advanced System Control
  - Subsystem reset via debug
  - Peripheral notification of debug events
  - Cache-coherent debug accesses
- Analysis Actions
  - Stop program execution
  - Generate debug interrupt
  - Benchmarking with counters
  - External trigger generation
  - Debug state machine state transition
  - Combinational and Sequential event generation
- Analysis Events
  - Program event detection
  - Data event detection
  - External trigger Detection
  - System event detection (i.e. cache miss)
  - Debug state machine state detection
- Analysis Configuration
  - Application access
  - Debugger access

Table 6-86. DSP Debug Features

Category	Hardware Feature	Availability
Basic Debug	Software breakpoint	Unlimited
	Hardware breakpoint	Up to 10 HWBPs, including: 4 precise(1) HWBPs inside DSP core and one of them is associated with a counter. 2 imprecise(1) HWBPs from AET. 4 imprecise(1) HWBPs from AET which are shared for watch point.

(1) Precise hardware breakpoints will halt the processor immediately prior to the execution of the selected instruction. Imprecise breakpoints will halt the processor some number of cycles after the selected instruction depending on device conditions.

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Table 6-86. DSP Debug Features (continued)

Category	Hardware Feature	Availability
Analysis	Watch point	Up to 4 watch points, which are shared with HWBPs, and can also be used as 2 watch points with data (32 bits)
	Watch point with Data	Up to 2, Which can also be used as 4 watch points.
	Counters/timers	1x64-bits (cycle only) + 2x32-bits (water mark counters)
	External Event Trigger In	1
	External Event Trigger Out	1

6.24.1 JTAG Port Description

The device target debug interface uses the five standard IEEE 1149.1(JTAG) signals ($\overline{\text{TRST}}$, TCK, TMS, TDI, and TDO).

$\overline{\text{TRST}}$ holds the debug and boundary scan logic in reset (normal DSP operation) when pulled low (its default state). Since $\overline{\text{TRST}}$ has an internal pull-down resistor, this ensures that at power up the device functions in its normal (non-test) operation mode if $\overline{\text{TRST}}$ is not connected. Otherwise, $\overline{\text{TRST}}$ should be driven inactive by the emulator or boundary scan controller. Boundary scan test cannot be performed while the $\overline{\text{TRST}}$ pin is pulled low.

Table 6-87. JTAG Port Description

PIN	TYPE	NAME	DESCRIPTION
$\overline{\text{TRST}}$	I	Test Logic Reset	When asserted (active low) causes all test and debug logic in the device to be reset along with the IEEE 1149.1 interface
TCK	I	Test Clock	This is the test clock used to drive an IEEE 1149.1 TAP state machine and logic.
TMS	I	Test Mode Select	Directs the next state of the IEEE 1149.1 test access port state machine
TDI	I	Test Data Input	Scan data input to the device
TDO	O	Test Data Output	Scan data output of the device
EMU0	I/O	Emulation 0	Channel 0 trigger + HSRTDX
EMU1	I/O	Emulation 1	Channel 1 trigger + HSRTDX

6.24.2 Scan Chain Configuration Parameters

Table 6-88 shows the TAP configuration details required to configure the router/emulator for this device.

Table 6-88. JTAG Port Description

Router Port ID	Default TAP	TAP Name	Tap IR Length
17	No	C674x	38
19	No	ETB	4

The router is revision C and has a 6-bit IR length.

6.24.3 Initial Scan Chain Configuration

The first level of debug interface that sees the scan controller is the TAP router module. The debugger can configure the TAP router for serially linking up to 16 TAP controllers or individually scanning one of the TAP controllers without disrupting the IR state of the other TAPs.

6.24.4 IEEE 1149.1 JTAG

The JTAG (1) interface is used for BSDL testing and emulation of the device.

The device requires that both $\overline{\text{TRST}}$ and $\overline{\text{RESET}}$ be asserted upon power up to be properly initialized. While $\overline{\text{RESET}}$ initializes the device, $\overline{\text{TRST}}$ initializes the device's emulation logic. Both resets are required for proper operation.

(1) IEEE Standard 1149.1-1990 Standard-Test-Access Port and Boundary Scan Architecture.

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While both TRST and RESET need to be asserted upon power up, only RESET needs to be released for the device to boot properly. TRST may be asserted indefinitely for normal operation, keeping the JTAG port interface and device's emulation logic in the reset state.

TRST only needs to be released when it is necessary to use a JTAG controller to debug the device or exercise the device's boundary scan functionality. Note: TRST is synchronous and ***must*** be clocked by TCK; otherwise, the boundary scan logic may not respond as expected after TRST is asserted.

RESET must be released only in order for boundary-scan JTAG to read the variant field of IDCODE correctly. Other boundary-scan instructions work correctly independent of current state of RESET.

For maximum reliability, the device includes an internal pulldown (IPD) on the TRST pin to ensure that TRST will always be asserted upon power up and the device's internal emulation logic will always be properly initialized.

JTAG controllers from Texas Instruments actively drive TRST high. However, some third-party JTAG controllers may not drive TRST high but expect the use of a pullup resistor on TRST.

When using this type of JTAG controller, assert TRST to initialize the device after powerup and externally drive TRST high before attempting any emulation or boundary scan operations.

6.24.4.1 JTAG Peripheral Register Description(s) – JTAG ID Register (DEVIDR0)

Table 6-89. DEVIDR0 Register

BYTE ADDRESS	ACRONYM	REGISTER DESCRIPTION	COMMENTS
0x01C1 4018	DEVIDR0	JTAG Identification Register	Read-only. Provides 32-bit JTAG ID of the device.

The JTAG ID register is a read-only register that identifies the JTAG/Device ID. For the device, the JTAG ID register resides at address location 0x01C1 4018. The register hex value for each silicon revision is:

- 0x0B7D 102F for silicon revision 1.x
- 0x1B7D 102F for silicon revision 2.x

For the actual register bit names and their associated bit field descriptions, see Figure 6-55 and Table 6-90.

Figure 6-55. JTAG ID (DEVIDR0) Register Description - Register Value

31-28	27-12	11-1	0
VARIANT (4-Bit)	PART NUMBER (16-Bit)	MANUFACTURER (11-Bit)	LSB
R-xxxx	R-1011 0111 1101 0001	R-0000 0010 111	R-1

LEGEND: R = Read, W = Write, n = value at reset

Table 6-90. JTAG ID Register Selection Bit Descriptions

BIT	NAME	DESCRIPTION
31:28	VARIANT	Variant (4-Bit) value
27:12	PART NUMBER	Part Number (16-Bit) value
11-1	MANUFACTURER	Manufacturer (11-Bit) value
0	LSB	LSB. This bit is read as a "1".

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6.24.4.2 JTAG Test-Port Electrical Data/Timing

Table 6-91. Timing Requirements for JTAG Test Port (see Figure 6-56)

No.			1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
1	$t_{c(TCK)}$	Cycle time, TCK	40		50		66.6		ns
2	$t_{w(TCKH)}$	Pulse duration, TCK high	16		20		26.6		ns
3	$t_{w(TCKL)}$	Pulse duration, TCK low	16		20		26.6		ns
4	$t_{su(TDIV-TCKH)}$	Setup time, TDI/TMS/$\overline{TRST}$ valid before TCK high	4		4		4		ns
5	$t_{h(TCLKH-TDIV)}$	Hold time, TDI/TMS/$\overline{TRST}$ valid after TCK high	4		6		8		ns

Table 6-92. Switching Characteristics Over Recommended Operating Conditions for JTAG Test Port (see Figure 6-56)

No.	PARAMETER		1.2V		1.1V		1.0V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
6	$t_{d(TCKL-TDOV)}$	Delay time, TCK low to TDO valid		18		23		31	ns

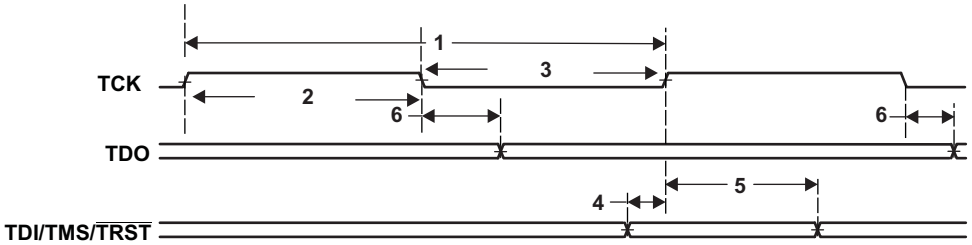

Figure 6-56. JTAG Test-Port Timing

6.24.5 JTAG 1149.1 Boundary Scan Considerations

To use boundary scan, the following sequence should be followed:

- Execute a valid reset sequence and exit reset
- Wait at least 6000 OSCIN clock cycles
- Enter boundary scan mode using the JTAG pins

No specific value is required on the EMU0 and EMU1 pins for boundary scan testing. If TRST is not driven by the boundary scan tool or tester, TRST should be externally pulled high during boundary scan testing.

7 Device and Documentation Support

TI offers an extensive line of development tools for the device platform, including tools to evaluate the performance of the processors, generate code, develop algorithm implementations, and fully integrate and debug software and hardware modules. The tool's support documentation is electronically available within the Code Composer Studio™ Integrated Development Environment (IDE).

The following products support development of the device applications:

7.1 Device Nomenclature

To designate the stages in the product development cycle, TI assigns prefixes to the part numbers of all DSP devices and support tools. Each DSP commercial family member has one of three prefixes: TMX, TMP, or TMS (e.g., TMS320C6745). Texas Instruments recommends two of three possible prefix designators for its support tools: TMDX and TMDS. These prefixes represent evolutionary stages of product development from engineering prototypes (TMX/TMDX) through fully qualified production devices/tools (TMS/TMDS).

Device development evolutionary flow:

TMX Experimental device that is not necessarily representative of the final device's electrical specifications.

TMP Final silicon die that conforms to the device's electrical specifications but has not completed quality and reliability verification.

TMS Fully-qualified production device.

Support tool development evolutionary flow:

TMDX Development-support product that has not yet completed Texas Instruments internal qualification testing.

TMDS Fully qualified development-support product.

TMX and TMP devices and TMDX development-support tools are shipped against the following disclaimer:

"Developmental product is intended for internal evaluation purposes."

TMS devices and TMDS development-support tools have been characterized fully, and the quality and reliability of the device have been demonstrated fully. TI's standard warranty applies.

Predictions show that prototype devices (TMX or TMP) have a greater failure rate than the standard production devices. Texas Instruments recommends that these devices not be used in any production system because their expected end-use failure rate still is undefined. Only qualified production devices are to be used.

TI device nomenclature also includes a suffix with the device family name. This suffix indicates the package type (for example, ZWT), the temperature range (for example, "Blank" is the commercial temperature range), and the device speed range in megahertz (for example, "Blank" is the default).

Figure 7-1 provides a legend for reading the complete device.

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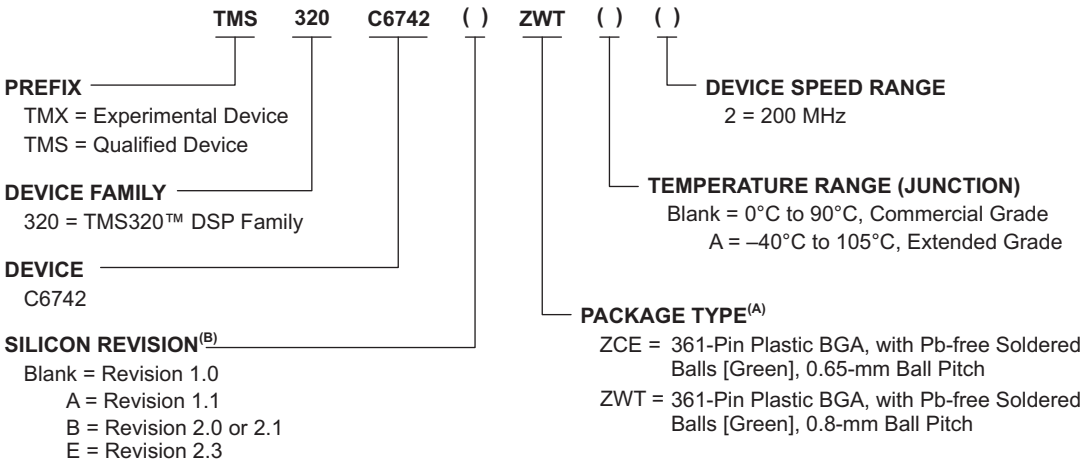

A. BGA = Ball Grid Array
B. Parts marked revision B are silicon revision 2.1 if '21' is marked on the package, and silicon revision 2.0 if there is no '21' marking.

Figure 7-1. Device Nomenclature

7.2 Tools and Software

Software

Code Composer Studio™ Integrated Development Environment (IDE): including Editor C/C++/Assembly Code Generation, and Debug plus additional development tools

Scalable, Real-Time Foundation Software (DSP/BIOS™) provides the basic run-time target software needed to support any application.

Development Tools

Extended Development System (XDS™) Emulator For a complete listing of development-support tools for the device, visit the Texas Instruments web site on the Worldwide Web at http://www.ti.com uniform resource locator (URL). For information on pricing and availability, contact the nearest TI field sales office or authorized distributor.

7.3 Documentation Support

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

The current documentation that describes the DSP, related peripherals, and other technical collateral is listed below.

User's Guides

SPRUG82 ***TMS320C674x DSP Cache User's Guide.*** Explains the fundamentals of memory caches and describes how the two-level cache-based internal memory architecture in the TMS320C674x digital signal processor (DSP) can be efficiently used in DSP applications. Shows how to maintain coherence with external memory, how to use DMA to reduce memory latencies, and how to optimize your code to improve cache efficiency. The internal memory architecture in the C674x DSP is organized in a two-level hierarchy consisting of a dedicated program cache (L1P) and a dedicated data cache (L1D) on the first level. Accesses by the CPU to the these first level caches can complete without CPU pipeline stalls. If the data requested by the CPU is not contained in cache, it is fetched from the next lower memory level, L2 or external memory.

SPRUFE8 ***TMS320C674x DSP CPU and Instruction Set Reference Guide***. Describes the CPU architecture, pipeline, instruction set, and interrupts for the TMS320C674x digital signal processors (DSPs). The C674x DSP is an enhancement of the C64x+ and C67x+ DSPs with added functionality and an expanded instruction set.

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SPRUFK5 ***TMS320C674x DSP Megamodule Reference Guide***. Describes the TMS320C674x digital signal processor (DSP) megamodule. Included is a discussion on the internal direct memory access (IDMA) controller, the interrupt controller, the power-down controller, memory protection, bandwidth management, and the memory and cache.

SPRUFK9 ***TMS320C674x/OMAP-L1x Processor Peripherals Overview Reference Guide***. Provides an overview and briefly describes the peripherals available on the device.

SPRUGM5 ***TMS320C6742 DSP System Reference Guide***. Describes the System-on-Chip (SoC) system. The SoC system includes TI's standard TMS320C674x Megamodule and several blocks of internal memory (L1P, L1D, and L2).

Technical Reference Manuals

7.4 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E™ Online Community The TI engineer-to-engineer (E2E) community was created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

TI Embedded Processors Wiki Established to help developers get started with Embedded Processors from Texas Instruments and to foster innovation and growth of general knowledge about the hardware and software surrounding these devices.

7.5 Trademarks

TMS320C6742, BIOS, E2E are trademarks of Texas Instruments.
Windows is a registered trademark of Microsoft.
All other trademarks are the property of their respective owners.

7.6 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

7.7 Export Control Notice

Recipient agrees to not knowingly export or re-export, directly or indirectly, any product or technical data (as defined by the U.S., EU, and other Export Administration Regulations) including software, or any controlled product restricted by other applicable national regulations, received from disclosing party under nondisclosure obligations (if any), or any direct product of such technology, to any destination to which such export or re-export is restricted or prohibited by U.S. or other applicable laws, without obtaining prior authorization from U.S. Department of Commerce and other competent Government authorities to the extent required by those laws.

7.8 Glossary

TI Glossary This glossary lists and explains terms, acronyms, and definitions.

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8 Mechanical Packaging and Orderable Information

This section describes the orderable part numbers, packaging options, materials, thermal and mechanical parameters.

8.1 Thermal Data for ZCE Package

The following table shows the thermal resistance characteristics for the PBGA–ZCE mechanical package.

Table 8-1. Thermal Resistance Characteristics (PBGA Package) [ZCE]

NO.			°C/W(1)	AIR FLOW (m/s)(2)
1	$R\Theta_{JC}$	Junction-to-case	7.6	N/A
2	$R\Theta_{JB}$	Junction-to-board	11.3	N /A
3	$R\Theta_{JA}$	Junction-to-free air	23.9	0.00
4	$R\Theta_{JMA}$	Junction-to-moving air	21.2	0.50
5			20.3	1.00
6			19.5	2.00
7			18.6	4.00
8	Psi_{JT}	Junction-to-package top	0.2	0.00
9			0.3	0.50
10			0.3	1.00
11			0.4	2.00
12			0.5	4.00
13	Psi_{JB}	Junction-to-board	11.2	0.00
14			11.1	0.50
15			11.1	1.00
16			11.0	2.00
17			10.9	4.00

(1) These measurements were conducted in a JEDEC defined 2S2P system and will change based on environment as well as application. For more information, see these EIA/JEDEC standards – EIA/JESD51-2, *Integrated Circuits Thermal Test Method Environment Conditions - Natural Convection (Still Air)* and JESD51-7, *High Effective Thermal Conductivity Test Board for Leaded Surface Mount Packages*. Power dissipation of 500 mW and ambient temp of 70C assumed. PCB with 2oz (70um) top and bottom copper thickness and 1.5oz (50um) inner copper thickness

(2) m/s = meters per second

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8.2 Thermal Data for ZWT Package

The following table shows the thermal resistance characteristics for the PBGA–ZWT mechanical package.

Table 8-2. Thermal Resistance Characteristics (PBGA Package) [ZWT]

NO.			°C/W(1)	AIR FLOW (m/s)(2)
1	$R\Theta_{JC}$	Junction-to-case	7.3	N/A
2	$R\Theta_{JB}$	Junction-to-board	12.4	N /A
3	$R\Theta_{JA}$	Junction-to-free air	23.7	0.00
4	$R\Theta_{JMA}$	Junction-to-moving air	21.0	0.50
5			20.1	1.00
6			19.3	2.00
7			18.4	4.00
8	Psi_{JT}	Junction-to-package top	0.2	0.00
9			0.3	0.50
10			0.3	1.00
11			0.4	2.00
12			0.5	4.00
13	Psi_{JB}	Junction-to-board	12.3	0.00
14			12.2	0.50
15			12.1	1.00
16			12.0	2.00
17			11.9	4.00

(1) These measurements were conducted in a JEDEC defined 2S2P system and will change based on environment as well as application. For more information, see these EIA/JEDEC standards – EIA/JESD51-2, *Integrated Circuits Thermal Test Method Environment Conditions - Natural Convection (Still Air)* and JESD51-7, *High Effective Thermal Conductivity Test Board for Leaded Surface Mount Packages*. Power dissipation of 1W and ambient temp of 70C assumed. PCB with 2oz (70um) top and bottom copper thickness and 1.5oz (50um) inner copper thickness

(2) m/s = meters per second

8.3 Packaging Information

The following packaging information and addendum reflect the most current data available for the designated device(s). This data is subject to change without notice and without revision of this document.

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TMS320C6742EZWT2	ACTIVE	NFBGA	ZWT	361	90	RoHS & Green	SNAGCU	Level-3-260C-168 HR	0 to 90	TMS320 C6742EZWT 200	Samples
TMS320C6742EZWTA2	ACTIVE	NFBGA	ZWT	361	90	RoHS & Green	SNAGCU	Level-3-260C-168 HR	-40 to 105	TMS320 C6742EZWT A200	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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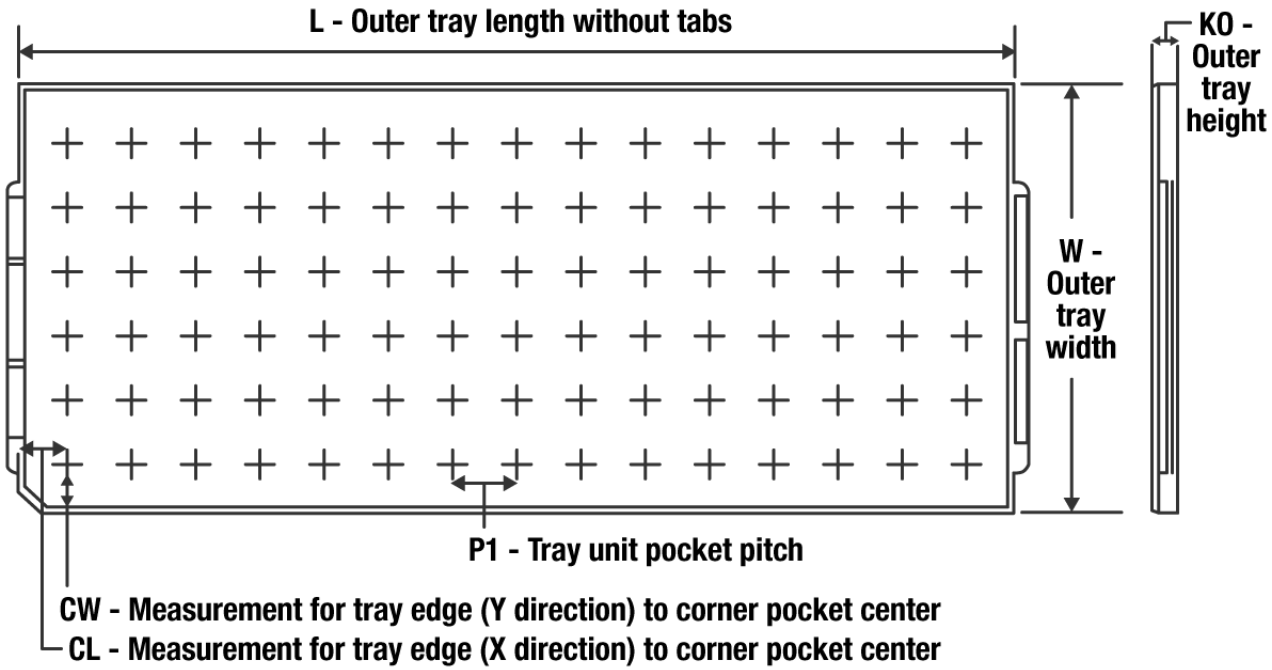
TRAY



Chamfer on Tray corner indicates Pin 1 orientation of packed units.

*All dimensions are nominal

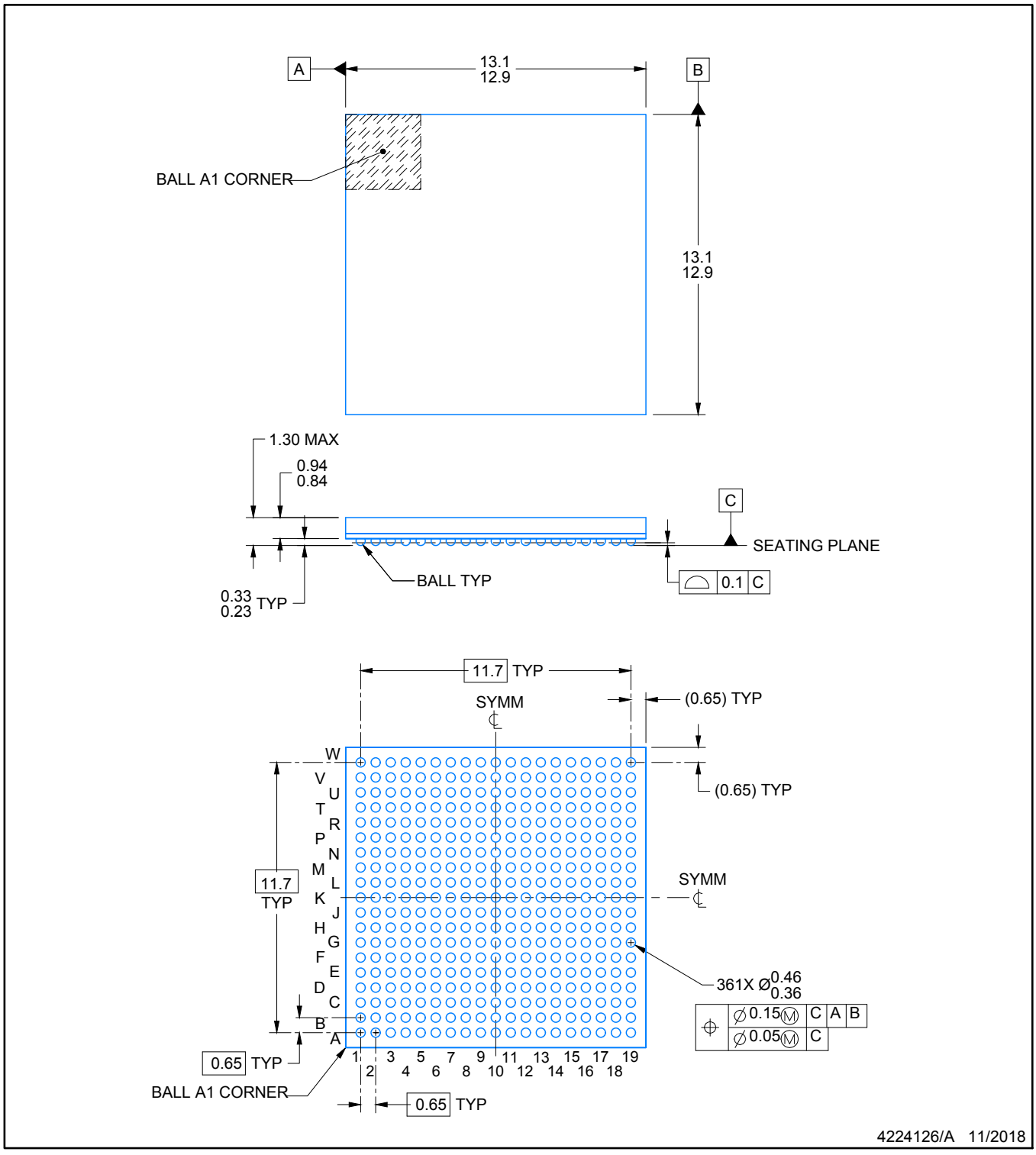
Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (µm)	P1 (mm)	CL (mm)	CW (mm)
TMS320C6742EZWT2	ZWT	NFBGA	361	90	6 X 15	150	315	135.9	7620	20	17.5	15.45
TMS320C6742EZWTA2	ZWT	NFBGA	361	90	6 X 15	150	315	135.9	7620	20	17.5	15.45

PACKAGE OUTLINE

ZCE0361A

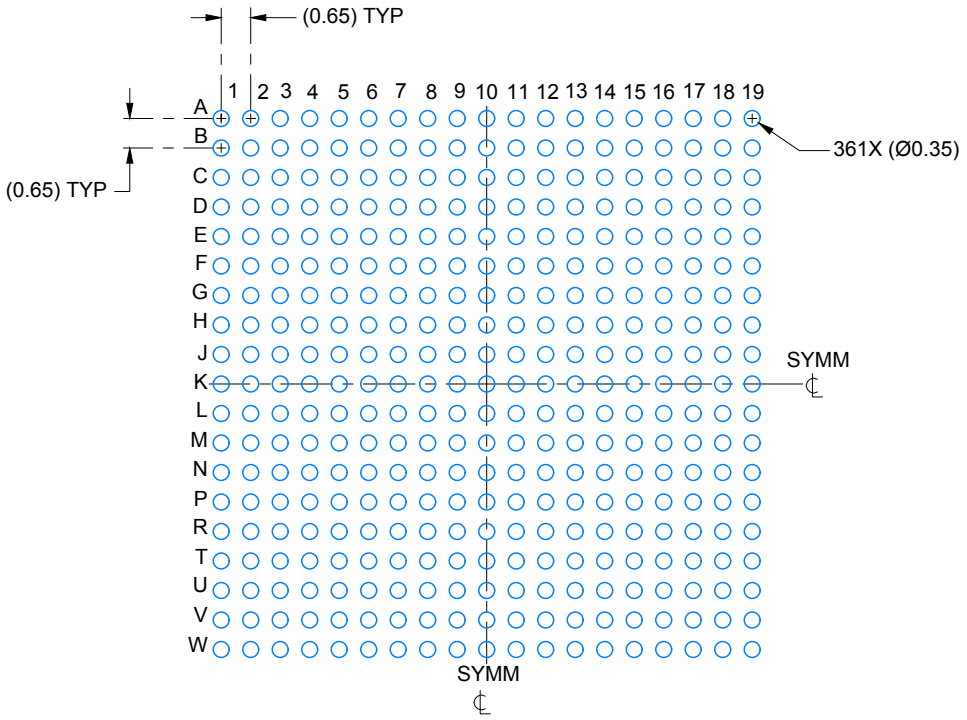
NFBGA - 1.30 mm max height

PLASTIC BALL GRID ARRAY



NOTES:

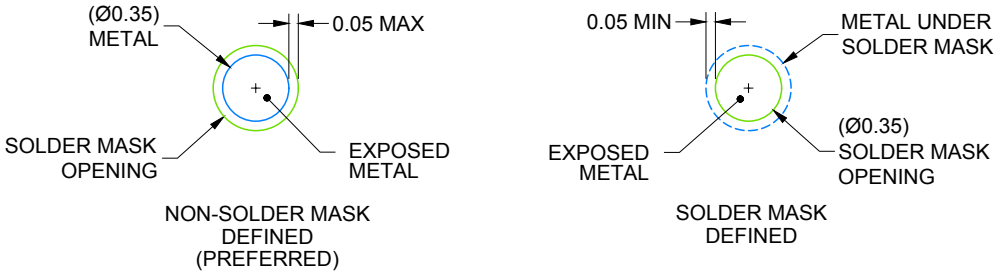
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



LAND PATTERN EXAMPLE

EXPOSED METAL SHOWN

SCALE: 6X



SOLDER MASK DETAILS

NOT TO SCALE

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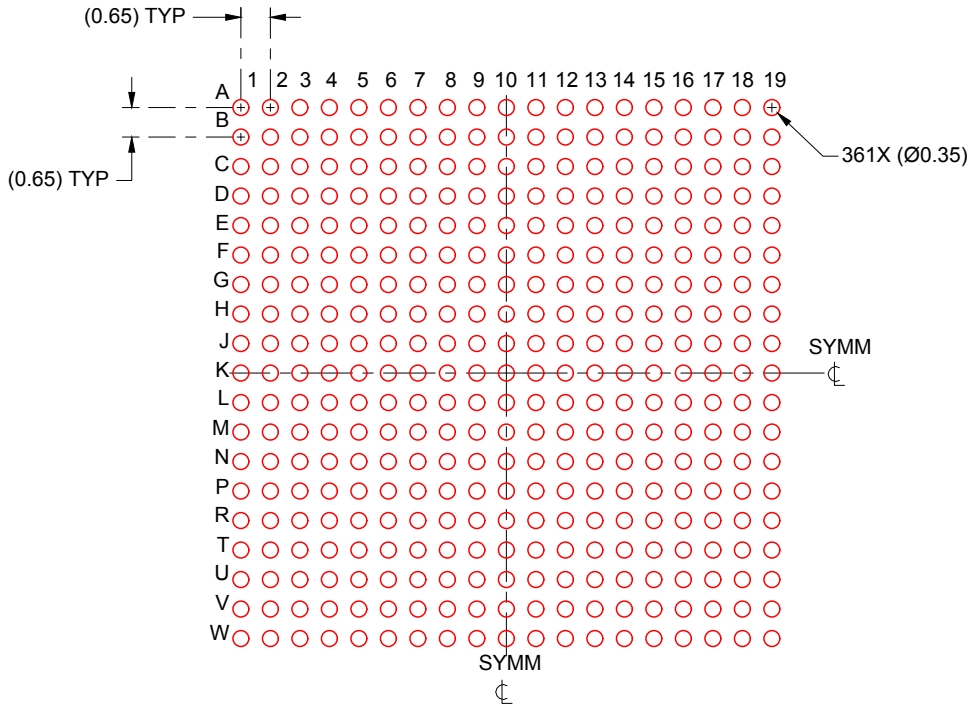
NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For information, see Texas Instruments literature number SPRAA99 (www.ti.com/lit/spraa99).



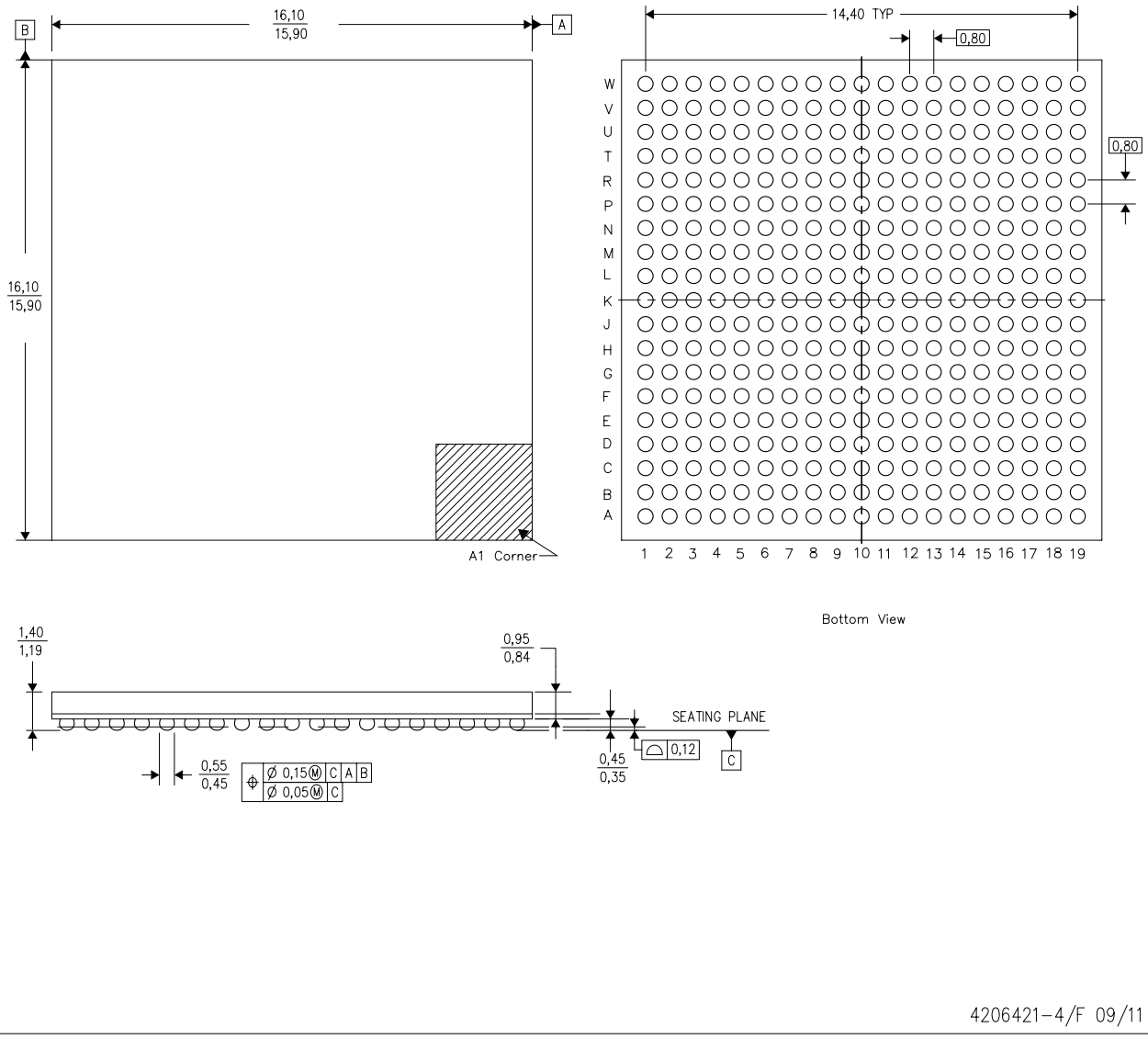
SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

4224126/A 11/2018

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

ZWT (S–PBGA–N361) PLASTIC BALL GRID ARRAY



NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. This is a Pb–free solder ball design.
D. Falls within JEDEC MO–275.

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