



**THE DATASHEET OF
CY96F386RSCPMC-GS149UJE2**



F²MC-16FX 16-bit Proprietary Microcontroller

CY96380 series is based on Cypress advanced 16FX architecture (16-bit with instruction pipeline for RISC-like performance). The CPU uses the same instruction set as the established 16LX series - thus allowing for easy migration of 16LX Software to the new 16FX products. 16FX improvements compared to the previous generation include significantly improved performance - even at the same operation frequency, reduced power consumption and faster start-up time.

For highest processing speed at optimized power consumption an internal PLL can be selected to supply the CPU with up to 56MHz operation frequency from an external 4MHz resonator. The result is a minimum instruction cycle time of 17.8ns going together with excellent EMI behavior. An on-chip clock modulation circuit significantly reduces emission peaks in the frequency spectrum. The emitted power is minimized by the on-chip voltage regulator that reduces the internal CPU voltage. A flexible clock tree allows to select suitable operation frequencies for peripheral resources independent of the CPU speed.

Features

Technology

- 0.18 μ m CMOS

CPU

- F²MC-16FX CPU
- Up to 56 MHz internal, 17.8 ns instruction cycle time
- Optimized instruction set for controller applications (bit, byte, word and long-word data types; 23 different addressing modes; barrel shift; variety of pointers)
- 8-byte instruction execution queue
- Signed multiply (16-bit \cdot 16-bit) and divide (32-bit/16-bit) instructions available

System Clock

- On-chip PLL clock multiplier (x1 - x25, x1 when PLL stop)
- 3 MHz - 16 MHz external crystal oscillator clock (maximum frequency when using ceramic resonator depends on Q-factor).
- Up to 56 MHz external clock for devices with fast clock input feature
- 32-100 kHz subsystem quartz clock
- 100 kHz/2 MHz internal RC clock for quick and safe startup, oscillator stop detection, watchdog
- Clock source selectable from main- and subclock oscillator (part number suffix "W") and on-chip RC oscillator, independently for CPU and 2 clock domains of peripherals.
- Low Power Consumption - 13 operating modes : (different Run, Sleep, Timer modes, Stop mode)
- Clock modulator

On-chip Voltage Regulator

- Internal voltage regulator supports reduced internal MCU voltage, offering low EMI and low power consumption figures

Low Voltage Reset

- Reset is generated when supply voltage is below minimum.

Code Security

- Protects ROM content from unintended read-out

Memory Patch Function

- Replaces ROM content
- Can also be used to implement embedded debug support

DMA

- Automatic transfer function independent of CPU, can be assigned freely to resources

Interrupts

- Fast Interrupt processing
- 8 programmable priority levels
- Non-Maskable Interrupt (NMI)

Timers

- Three independent clock timers (23-bit RC clock timer, 23-bit Main clock timer, 17-bit Sub clock timer)
- Watchdog Timer

CAN

- Supports CAN protocol version 2.0 part A and B
- ISO16845 certified
- Bit rates up to 1 Mbit/s
- 32 message objects
- Each message object has its own identifier mask
- Programmable FIFO mode (concatenation of message objects)
- Maskable interrupt
- Disabled Automatic Retransmission mode for Time Triggered CAN applications
- Programmable loop-back mode for self-test operation

USART

- Full duplex USARTs (SCI/LIN)
- Wide range of baud rate settings using a dedicated reload timer
- Special synchronous options for adapting to different synchronous serial protocols
- LIN functionality working either as master or slave LIN device

I²C

- Up to 400 kbps
- Master and Slave functionality, 8-bit and 10-bit addressing

A/D Converter

- SAR-type
- 10-bit resolution
- Signals interrupt on conversion end, single conversion mode, continuous conversion mode, stop conversion mode, activation by software, external trigger or reload timer

A/D Converter Reference Voltage switch

- 2 independent positive A/D converter reference voltages available

Reload Timers

- 16-bit wide
- Prescaler with $1/2^1$, $1/2^2$, $1/2^3$, $1/2^4$, $1/2^5$, $1/2^6$ of peripheral clock frequency
- Event count function

Free Running Timers

- Signals an interrupt on overflow, supports timer clear upon match with Output Compare (0, 4), Prescaler with 1 , $1/2^1$, $1/2^2$, $1/2^3$, $1/2^4$, $1/2^5$, $1/2^6$, $1/2^7$, $1/2^8$ of peripheral clock frequency

Input Capture Units

- 16-bit wide
- Signals an interrupt upon external event
- Rising edge, falling edge or rising & falling edge sensitive

Output Compare Units

- 16-bit wide
- Signals an interrupt when a match with 16-bit I/O Timer occurs
- A pair of compare registers can be used to generate an output signal.

Programmable Pulse Generator

- 16-bit down counter, cycle and duty setting registers
- Interrupt at trigger, counter borrow and/or duty match
- PWM operation and one-shot operation
- Internal prescaler allows 1 , $1/4$, $1/16$, $1/64$ of peripheral clock as counter clock and Reload timer overflow as clock input
- Can be triggered by software or reload timer

Stepper Motor Controller

- Stepper Motor Controller with integrated high current output drivers
- Four high current outputs for each channel
- Two synchronized 8/10-bit PWMs per channel
- Internal prescaling for PWM clock: 1 , $1/4$, $1/5$, $1/6$, $1/8$, $1/10$, $1/12$, $1/16$ of peripheral clock
- Separate power supply for high current output drivers

LCD Controller

- LCD controller with up to 4 COM × 65 SEG
- Internal or external voltage generation
- Duty cycle: Selectable from options: $1/2$, $1/3$ and $1/4$
- Fixed $1/3$ bias
- Programmable frame period
- Clock source selectable from three options (peripheral clock, subclock or RC oscillator clock)
- On-chip drivers for internal divider resistors or external divider resistors
- On-chip data memory for display
- LCD display can be operated in Timer Mode
- Blank display: selectable
- All SEG, COM and V pins can be switched between general and specialized purposes
- External divided resistors can be also used to shut off the current when LCD is deactivated

Sound Generator

- 8-bit PWM signal is mixed with tone frequency from 16-bit reload counter
- PWM clock by internal prescaler: 1, 1/2, 1/4, 1/8 of peripheral clock

Real Time Clock

- Can be clocked either from sub oscillator (devices with part number suffix "W"), main oscillator or from the RC oscillator
- Facility to correct oscillation deviation of Sub clock or RC oscillator clock (clock calibration)
- Read/write accessible second/minute/hour registers
- Can signal interrupts every half second/second/minute/hour/day
- Internal clock divider and prescaler provide exact 1s clock

External Interrupts

- Edge sensitive or level sensitive
- Interrupt mask and pending bit per channel
- Each available CAN channel RX has an external interrupt for wake-up
- Selected USART channels SIN have an external interrupt for wake-up

Non Maskable Interrupt

- Disabled after reset
- Once enabled, can not be disabled other than by reset.
- Level high or level low sensitive
- Pin shared with external interrupt 0.

External Bus Interface

- 8-bit or 16-bit bidirectional data
- Up to 24-bit addresses
- 6 chip select signals
- Multiplexed address/data lines
- Non-multiplexed address/data lines
- Wait state request
- External bus master possible
- Timing programmable

Alarm Comparator

- Monitors an external voltage and generates an interrupt in case of a voltage lower or higher than the defined thresholds
- Threshold voltages defined externally or generated internally
- Status is readable, interrupts can be masked separately

I/O Ports

- Virtually all external pins can be used as general purpose I/O
- All push-pull outputs (except when used as I2C SDA/SCL line)
- Bit-wise programmable as input/output or peripheral signal
- Bit-wise programmable input enable
- Bit-wise programmable input levels: Automotive / CMOS-Schmitt trigger / TTL
- Bit-wise programmable pull-up resistor
- Bit-wise programmable output driving strength for EMI optimization

Package

- 120-pin plastic LQFP

Flash Memory

- Supports automatic programming, Embedded Algorithm
- Write/Erase/Erase-Suspend/Resume commands
- A flag indicating completion of the algorithm
- Number of erase cycles: 10,000 times
- Data retention time: 20 years
- Erase can be performed on each sector individually
- Sector protection
- Flash Security feature to protect the content of the Flash
- Low voltage detection during Flash erase

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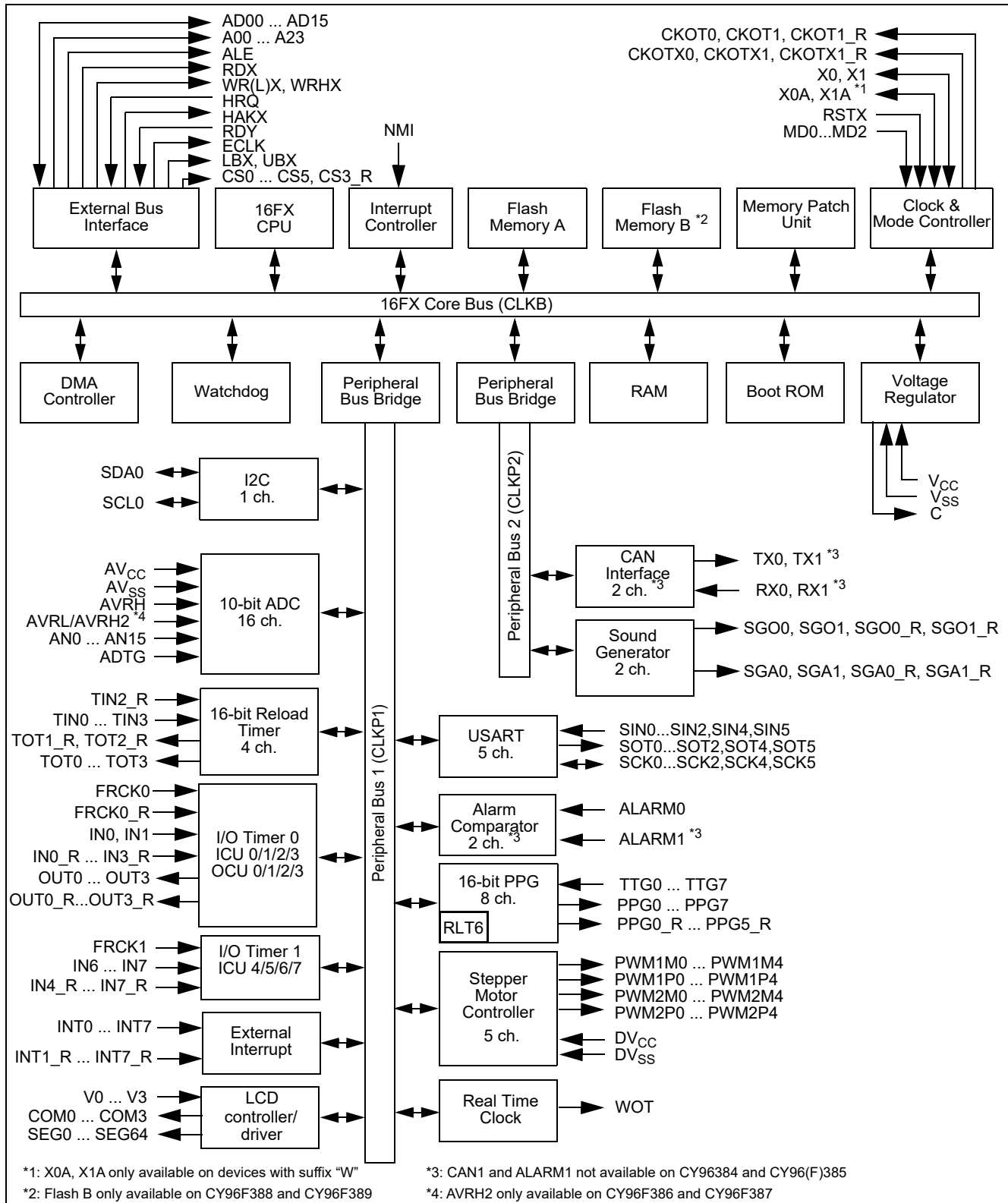
1. Product Lineup

| Features | | CY96V300B | CY96(F)38x |
|---|-------|---|---|
| Product type | | Evaluation sample | Flash product: CY96F38x Mask ROM product: CY9638x |
| Product options | | | |
| YS | | NA | Low voltage reset persistently on / Single clock |
| RS | | | Low voltage reset can be disabled / Single clock |
| YW | | | Low voltage reset persistently on / Dual clock |
| RW | | | Low voltage reset can be disabled / Dual clock |
| TS | | | indep. 32 KB Flash / Low voltage reset persistently on / Single clock |
| HS | | | indep. 32 KB Flash / Low voltage reset can be disabled / Single clock |
| TW | | | indep. 32 KB Flash / Low voltage reset persistently on / Dual clock |
| HW | | | indep. 32 KB Flash / Low voltage reset can be disabled / Dual clock |
| Flash/ROM | RAM | | |
| 128 KB | 6 KB | ROM/Flash memory emulation by external RAM, 92KB internal RAM | CY96384Y, CY96384R |
| 160 KB | 8 KB | | CY96385Y, CY96385R, CY96F385Y, CY96F385R |
| 288 KB | 16 KB | | CY96F386Y, CY96F386R |
| 416 KB | 16 KB | | CY96F387Y, CY96F387R |
| 576 KB [Flash A: 544 KB, Flash B: 32 KB] | 28 KB | | CY96F388T, CY96F388H |
| 832 KB [Flash A: 544 KB, Flash B: 288 KB] | 32 KB | | CY96F389Y, CY96F389R |
| Package | | BGA416 | LQM120 |
| DMA | | 16 channels | 7 channels |
| USART | | 10 channels | 5 channels |
| I ² C | | 2 channels | 1 channel |
| A/D Converter | | 40 channels | 16 channels |
| A/D Converter Reference Voltage switch | | yes | Only for CY96F386Y, CY96F386R, CY96F387Y, CY96F387R |
| 16-bit Reload Timer | | 6 channels + 1 channel (for PPG) | 4 channels + 1 channel (for PPG) |
| 16-bit Free-Running Timer | | 4 channels | 2 channels |
| 16-bit Output Compare | | 12 channels | 4 channels |

| Features | CY96V300B | CY96(F)38x |
|-------------------------------------|----------------|--|
| 16-bit Input Capture | 12 channels | 8 channels |
| 16-bit Programmable Pulse Generator | 20 channels | 8 channels |
| CAN Interface | 5 channels | Other than below: 2 channels CY96384Y, CY96384R, CY96(F)385Y, CY96(F)385R, : 1 channel |
| Stepping Motor Controller | 6 channels | 5 channels |
| External Interrupts | 16 channels | 8 channels |
| Non-Maskable Interrupt | 1 channel | |
| Sound generator | 2 channels | 2 channels |
| LCD Controller | 4 COM x 72 SEG | 4 COM x 65 SEG |
| Real Time Clock | 1 | |
| I/O Ports | 136 | 94 for part number with suffix "W", 96 for part number with suffix "S" |
| Alarm comparator | 2 channels | Other than below: 2 channels CY96384Y, CY96384R, CY96(F)385Y, CY96(F)385R, : 1 channel |
| External bus interface | Yes | |
| Chip select | 6 signals | |
| Clock output function | 2 channels | |
| Low voltage reset | Yes | |
| On-chip RC-oscillator | Yes | |

2. Block Diagram

Block Diagram of CY96(F)38x



3. Pin Assignment

Pin Assignment of CY96(F)38x



*1: Devices with suffix W: X0A, X1A
Devices with suffix S: P04_0, P04_1
*2: Alarm1 not available on CY96384 and CY96(F)385
*3: TX1 resp. RX1 not available on CY96384 and CY96(F)385
*4: AVRHL only available on CY96F386 and CY96F387

(LQM120)

4. Pin Function Description

Pin Function Description (1 of 3)

| Pin name | Feature | Description |
|------------------|-----------------------|--|
| ADn | External bus | External bus interface (non multiplexed mode) data input/output. External bus interface (multiplexed mode) address output and data input/output |
| ADTG | ADC | A/D converter trigger input |
| ALARMn | Alarm comparator | Alarm Comparator n input |
| ALE | External bus | External bus Address Latch Enable output |
| An | External bus | External bus non-multiplexed address output |
| ANn | ADC | A/D converter channel n input |
| AV _{CC} | Supply | Analog circuits power supply |
| AVRH | ADC | A/D converter high reference voltage input |
| AVRH2 | ADC | Alternative A/D converter high reference voltage input |
| AVRL | ADC | A/D converter low reference voltage input |
| AV _{SS} | Supply | Analog circuits power supply |
| C | Voltage regulator | Internally regulated power supply stabilization capacitor pin |
| CKOTn | Clock output function | Clock Output function n output |
| CKOTn_R | Clock output function | Relocated Clock Output function n output |
| CKOTXn | Clock output function | Clock Output function n inverted output |
| CKOTXn_R | Clock output function | Relocated Clock Output function n inverted output |
| COMn | LCD | LCD COM pins |
| ECLK | External bus | External bus clock output |
| CSn | External bus | External bus chip select n output |
| CSn_R | External bus | Relocated External bus chip select n output |
| DV _{CC} | Supply | SMC pins power supply |
| FRCKn | Free Running Timer | Free Running Timer n input |
| FRCKn_R | Free Running Timer | Relocated Free Running Timer n input |
| HAKX | External bus | External bus Hold Acknowledge |
| HRQ | External bus | External bus Hold Request |
| INn | ICU | Input Capture Unit n input |
| INn_R | ICU | Relocated Input Capture Unit n input |
| INTn | External Interrupt | External Interrupt n input |

Pin Function Description (2 of 3)

| Pin name | Feature | Description |
|----------|--------------------|--|
| INTn_R | External Interrupt | Relocated External Interrupt n input |
| LBX | External bus | External Bus Interface Lower Byte select strobe output |
| MDn | Core | Input pins for specifying the operating mode. |
| NMI | External Interrupt | Non-Maskable Interrupt input |
| OUTn | OCU | Output Compare Unit n waveform output |
| OUTn_R | OCU | Relocated Output Compare Unit n waveform output |
| Pxx_n | GPIO | General purpose IO |
| PPGn | PPG | Programmable Pulse Generator n output |
| PPGn_R | PPG | Relocated Programmable Pulse Generator n output |
| PWMn | SMC | SMC PWM high current |
| RDX | External bus | External bus interface read strobe output |
| RDY | External bus | External bus interface external wait state request input |
| RSTX | Core | Reset input |
| RXn | CAN | CAN interface n RX input |
| SCKn | USART | USART n serial clock input/output |
| SCLn | I2C | I2C interface n clock I/O input/output |
| SDAn | I2C | I2C interface n serial data I/O input/output |
| SEGn | LCD | LCD segment n |
| SGA | Sound Generator | SG amplitude output |
| SGO | Sound Generator | SG sound/tone output |
| SGA_R | Sound Generator | Relocated SG amplitude output |
| SGO_R | Sound Generator | Relocated SG sound/tone output |
| SINn | USART | USART n serial data input |
| SOTn | USART | USART n serial data output |
| TINn | Reload Timer | Reload Timer n event input |
| TINn_R | Reload Timer | Relocated Reload Timer n event input |
| TOTn | Reload Timer | Reload Timer n output |
| TOTn_R | Reload Timer | Relocated Reload Timer n output |
| TTGn | PPG | Programmable Pulse Generator n trigger input |
| TXn | CAN | CAN interface n TX output |
| UBX | External bus | External Bus Interface Upper Byte select strobe output |

Pin Function Description (3 of 3)

| Pin name | Feature | Description |
|-----------------|--------------|---|
| V _n | LCD | LCD voltage references |
| V _{CC} | Supply | Power supply |
| V _{SS} | Supply | Power supply |
| WOT | RTC | Real Timer clock output |
| WRHX | External bus | External bus High byte write strobe output |
| WRLX/WRX | External bus | External bus Low byte / Word write strobe output |
| X0 | Clock | Oscillator input |
| X0A | Clock | Subclock Oscillator input (only for devices with suffix "W") |
| X1 | Clock | Oscillator output |
| X1A | Clock | Subclock Oscillator output (only for devices with suffix "W") |

5. Pin Circuit Type

Pin Circuit Types (1 of 2)

| LQM120 | |
|------------|----------------------------|
| Pin No. | Circuit Type ^{*1} |
| 1 | Supply |
| 2 | F |
| 3 to 11 | J |
| 12,13 | N |
| 14 to 21 | K |
| 22 | Supply |
| 23 to 24 | G |
| 25 | Supply |
| 26 to 29 | K |
| 30,31 | Supply |
| 32 to 35 | K |
| 36 to 40 | M |
| 41,42 | Supply |
| 43 to 52 | M |
| 53,54 | Supply |
| 55 to 59 | M |
| 60, 61 | Supply |
| 62 to 64 | C |
| 65, 66 | A |
| 67 | Supply |
| 68,69 | B ^{*2} |
| 68,69 | H ^{*3} |
| 70 | E |
| 71 to 89 | J |
| 90 to 91 | Supply |
| 92 to 112 | J |
| 113 to 116 | L |

Pin Circuit Types (2 of 2)

| LQM120 | |
|------------|----------------------------|
| Pin No. | Circuit Type ^{*1} |
| 117 to 119 | H |
| 120 | Supply |

- *1: See 6. "I/O Circuit Type" for details on the I/O circuit types
- *2: Devices with suffix "W"
- *3: Devices without suffix "W"

6. I/O Circuit Type

| Type | Circuit | Remarks |
|------|---------|---|
| A | | <p>High-speed oscillation circuit:</p> <ul style="list-style-type: none"> • Programmable between oscillation mode (external crystal or resonator connected to X0/X1 pins) and Fast external Clock Input (FCI) mode (external clock connected to X0 pin) • Programmable feedback resistor = approx. $2 * 0.5 \text{ M}\Omega$. Feedback resistor is grounded in the center when the oscillator is disabled or in FCI mode |
| B | | <p>Low-speed oscillation circuit:</p> <ul style="list-style-type: none"> • Programmable feedback resistor = approx. $2 * 5 \text{ M}\Omega$. Feedback resistor is grounded in the center when the oscillator is disabled |
| C | | <ul style="list-style-type: none"> • Mask ROM and EVA device: CMOS Hysteresis input pin • Flash device: CMOS input pin |
| E | | <ul style="list-style-type: none"> • CMOS Hysteresis input pin • Pull-up resistor value: approx. $50 \text{ k}\Omega$ |

| Type | Circuit | Remarks |
|------|--|--|
| F |  | <ul style="list-style-type: none"> • Power supply input protection circuit |
| G |  | <ul style="list-style-type: none"> • A/D converter ref+ (AVRH/AVRH2) power supply input pin with protection circuit • Flash devices do not have a protection circuit against VCC for pins AVRH/AVRH2 • Devices without AVRH reference switch do not have an analog switch for the AVRL pin |
| H |  | <ul style="list-style-type: none"> • CMOS level output (programmable $I_{OL} = 5 \text{ mA}$, $I_{OH} = -5 \text{ mA}$ and $I_{OL} = 2 \text{ mA}$, $I_{OH} = -2 \text{ mA}$) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function • Programmable pull-up resistor: 50 kΩ approx. |

| Type | Circuit | Remarks |
|------|--|---|
| J | <p>pull-up control</p> <p>Pout</p> <p>Nout</p> <p>R</p> <p>Standby control for input shutdown</p> <p>Hysteresis input</p> <p>Hysteresis input</p> <p>Automotive input</p> <p>TTL input</p> <p>SEG, COM output</p> | <ul style="list-style-type: none"> • CMOS level output (programmable $I_{OL} = 5\text{ mA}$, $I_{OH} = -5\text{ mA}$ and $I_{OL} = 2\text{ mA}$, $I_{OH} = -2\text{ mA}$) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function • Programmable pull-up resistor: 50 kΩ approx. • SEG or COM output |
| K | <p>pull-up control</p> <p>Pout</p> <p>Nout</p> <p>R</p> <p>Standby control for input shutdown</p> <p>Hysteresis input</p> <p>Hysteresis input</p> <p>Automotive input</p> <p>TTL input</p> <p>Analog input</p> <p>SEG output</p> | <ul style="list-style-type: none"> • CMOS level output (programmable $I_{OL} = 5\text{ mA}$, $I_{OH} = -5\text{ mA}$ and $I_{OL} = 2\text{ mA}$, $I_{OH} = -2\text{ mA}$) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function. • Programmable pull-up resistor: 50 kΩ approx. • Analog input • SEG output |

| Type | Circuit | Remarks |
|------|--|---|
| L |  <p>The diagram for Type L shows a pull-up control circuit connected to a node. This node is connected to the gates of two transistors, Pout and Nout. The gates of Pout and Nout are also connected to a pull-up resistor R. The node is also connected to four OR gates. The inputs to these OR gates are: Standby control for input shutdown, Hysteresis input, Automotive input, and TTL input. The outputs of these OR gates are connected to the gates of Pout and Nout. The node is also connected to an Analog input, a SEG output, and a Vx input.</p> | <ul style="list-style-type: none"> • CMOS level output (programmable $I_{OL} = 5\text{ mA}$, $I_{OH} = -5\text{ mA}$ and $I_{OL} = 2\text{ mA}$, $I_{OH} = -2\text{ mA}$) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function • Programmable pull-up resistor: 50 kΩ approx. • Analog input • Vx input • SEG output |
| M |  <p>The diagram for Type M shows a pull-up control circuit connected to a node. This node is connected to the gates of two transistors, Pout and Nout. The gates of Pout and Nout are also connected to a pull-up resistor R. The node is also connected to four OR gates. The inputs to these OR gates are: Standby control for input shutdown, Hysteresis input, Automotive input, and TTL input. The outputs of these OR gates are connected to the gates of Pout and Nout. The node is also connected to an Analog input, a SEG output, and a Vx input.</p> | <ul style="list-style-type: none"> • CMOS level output (programmable $I_{OL} = 5\text{ mA}$, $I_{OH} = -5\text{ mA}$ and $I_{OL} = 2\text{ mA}$, $I_{OH} = -2\text{ mA}$, $I_{OL} = 30\text{ mA}$, $I_{OH} = -30\text{ mA}$) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function • Programmable pull-up resistor: 50 kΩ approx. |

| Type | Circuit | Remarks |
|------|---|---|
| N |  <p>The diagram shows an input pin circuit. A pull-up resistor is connected to the input node, controlled by a 'pull-up control' signal. The input node is also connected to a programmable resistor 'R'. The output of the pin is labeled 'Pout' and 'Nout'. Four input types are shown: two 'Hysteresis input' types, an 'Automotive input', and a 'TTL input'. Each input type has a 'Standby control for input shutdown' signal connected to it.</p> | <ul style="list-style-type: none"> • CMOS level output ($I_{OL} = 3 \text{ mA}$, $I_{OH} = -3 \text{ mA}$) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function • Programmable pull-up resistor: 50 kΩ approx. |

7. Memory Map

| | CY96V300B | | CY96(F)38x | |
|--------------------------|---------------------|--|---|--|
| FF:FFF _H | Emulation ROM | | USER ROM / External Bus ^{*4} | |
| DE:000 _H | External Bus | | External Bus | |
| 10:000 _H | Boot-ROM | | Boot-ROM | |
| 0F:E00 _H | Reserved | | Reserved | |
| 0E:000 _H | External RAM | | Reserved | |
| 02:000 _H | Internal RAM bank 1 | RAMEND1 ^{*2} RAMSTART1 ^{*2} | Reserved Internal RAM bank 1 Reserved | RAM availability depending on the device |
| 01:000 _H | ROM/RAM MIRROR | | ROM/RAM MIRROR | |
| 00:800 _H | Internal RAM bank 0 | RAMSTART0 ^{*2} | Internal RAM bank 0 Reserved | External Bus end address ^{*2} |
| RAM-START0 ^{*3} | External Bus | | External Bus | |
| 00:0C0 _H | Peripherals | | Peripherals | |
| 00:038 _H | GPR ^{*1} | | GPR ^{*1} | |
| 00:018 _H | DMA | | DMA | |
| 00:010 _H | External Bus | | External Bus | |
| 00:00F _H | Peripheral | | Peripheral | |
| 00:000 _H | | | | |

*1: Unused GPR banks can be used as RAM area

*2: For External Bus end address and RAMSTART/END addresses, please refer to the table on the next page.

*3: For EVA device, RAMSTART0 depends on the configuration of the emulated device.

*4: For details about USER ROM area, see the 9. "User ROM Memory Map for Flash Devices" and 10. "User ROM Memory Map for Mask Rom Devices" on the following pages.

The External Bus area and DMA area are only available if the device contains the corresponding resource.

The available RAM and ROM area depends on the device.

8. RAMSTART/END and External Bus End Addresses

| Devices | Bank 0 RAM size | Bank 1 RAM size | External Bus end address | RAMSTART0 | RAMSTART1 | RAMEND1 |
|--------------------|-----------------|-----------------|--------------------------|----------------------|----------------------|----------------------|
| CY96384 | 6 KByte | - | 00:61FF _H | 00:6A40 _H | - | - |
| CY96385/F385 | 8 KByte | - | 00:61FF _H | 00:6240 _H | - | - |
| CY96F386, CY96F387 | 16 KByte | - | 00:41FF _H | 00:4240 _H | - | - |
| CY96F388 | 28 KByte | - | 00:11FF _H | 00:1240 _H | - | - |
| CY96F389 | 28 KByte | 4KByte | 00:11FF _H | 00:1240 _H | 01:8000 _H | 01:8FFF _H |

9. User ROM Memory Map for Flash Devices

| Alternative mode CPU address | Flash memory mode address | CY96F385R CY96F385Y | CY96F386R CY96F386Y | CY96F387R CY96F387Y | | | | |
|---------------------------------|------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---------|
| | | Flash size 160kByte | Flash size 288kByte | Flash size 416kByte | | | | |
| FF:FFFF _H | 3F:FFFF _H | S39 - 64K | S39 - 64K | S39 - 64K | Flash A | | | |
| FF:0000 _H | 3F:0000 _H | S38 - 64K | S38 - 64K | S38 - 64K | | | | |
| FE:FFFF _H | 3E:FFFF _H | | | | | | | |
| FE:0000 _H | 3E:0000 _H | S37 - 64K | S37 - 64K | S37 - 64K | | | | |
| FD:FFFF _H | 3D:FFFF _H | | | | | | | |
| FD:0000 _H | 3D:0000 _H | S36 - 64K | S36 - 64K | S36 - 64K | | | | |
| FC:FFFF _H | 3C:FFFF _H | | | | | | | |
| FC:0000 _H | 3C:0000 _H | S35 - 64K | S35 - 64K | S35 - 64K | | | | |
| FB:FFFF _H | 3B:FFFF _H | | | | | | | |
| FB:0000 _H | 3B:0000 _H | S34 - 64K | S34 - 64K | S34 - 64K | | | | |
| FA:FFFF _H | 3A:FFFF _H | | | | | | | |
| FA:0000 _H | 3A:0000 _H | External bus | External bus | External bus | | | | |
| F9:FFFF _H | 39:FFFF _H | | | | | | | |
| F9:0000 _H | 39:0000 _H | | | | | | | |
| F8:FFFF _H | 38:FFFF _H | | | | | | | |
| F8:0000 _H | 38:0000 _H | | | | | | | |
| F7:FFFF _H | 37:FFFF _H | | | | | | | |
| F7:0000 _H | 37:0000 _H | | | | | | | |
| F6:FFFF _H | 36:FFFF _H | | | | | | | |
| F6:0000 _H | 36:0000 _H | | | | | | | |
| F5:FFFF _H | 35:FFFF _H | | | | | | | |
| F5:0000 _H | 35:0000 _H | | | | | | | |
| F4:FFFF _H | 34:FFFF _H | | | | | | | |
| F4:0000 _H | 34:0000 _H | | | | | | | |
| F3:FFFF _H | 33:FFFF _H | | | | | | | |
| F3:0000 _H | 33:0000 _H | | | | | | | |
| F2:FFFF _H | 32:FFFF _H | | | | | | | |
| F2:0000 _H | 32:0000 _H | | | | | | | |
| F1:FFFF _H | 31:FFFF _H | | | | | | | |
| F1:0000 _H | 31:0000 _H | | | | | | | |
| F0:FFFF _H | 30:FFFF _H | | | | | | | |
| F0:0000 _H | 30:0000 _H | | | | | | | |
| E0:FFFF _H | | Reserved | Reserved | Reserved | | | | |
| E0:0000 _H | | | | | | | | |
| DF:FFFF _H | | | | | | | | |
| DF:8000 _H | | | | | | | | |
| DF:7FFF _H | 1F:7FFF _H | | | | SA3 - 8K | SA3 - 8K | SA3 - 8K | Flash A |
| DF:6000 _H | 1F:6000 _H | | | | SA2 - 8K | SA2 - 8K | SA2 - 8K | |
| DF:5FFF _H | 1F:5FFF _H | | | | SA1 - 8K | SA1 - 8K | SA1 - 8K | |
| DF:4000 _H | 1F:4000 _H | | | | SA0 - 8K ^{*1} | SA0 - 8K ^{*1} | SA0 - 8K ^{*1} | |
| DF:3FFF _H | 1F:3FFF _H | | | | Reserved | Reserved | Reserved | |
| DF:2000 _H | 1F:2000 _H | | | | | | | |
| DF:1FFF _H | 1F:1FFF _H | | | | | | | |
| DF:0000 _H | 1F:0000 _H | | | | | | | |
| DE:FFFF _H | | | | | Reserved | Reserved | Reserved | |
| DE:0000 _H | | | | | | | | |

*1: Sector SA0 contains the ROM Configuration Block RCBA at CPU address DF:0000_H - DF:007F_H

| | | CY96F388T CY96F388H | CY96F389R CY96F389Y | |
|---------------------------------|------------------------------|------------------------|------------------------|---------|
| Alternative mode CPU address | Flash memory mode address | Flash size 576kByte | Flash size 832kByte | |
| FF:FFF _H | 3F:FFF _H | S39 - 64K | S39 - 64K | Flash A |
| FF:000 _H | 3F:000 _H | | | |
| FE:FFF _H | 3E:FFF _H | S38 - 64K | S38 - 64K | |
| FE:000 _H | 3E:000 _H | | | |
| FD:FFF _H | 3D:FFF _H | S37 - 64K | S37 - 64K | |
| FD:000 _H | 3D:000 _H | | | |
| FC:FFF _H | 3C:FFF _H | S36 - 64K | S36 - 64K | |
| FC:000 _H | 3C:000 _H | | | |
| FB:FFF _H | 3B:FFF _H | S35 - 64K | S35 - 64K | |
| FB:000 _H | 3B:000 _H | | | |
| FA:FFF _H | 3A:FFF _H | S34 - 64K | S34 - 64K | Flash B |
| FA:000 _H | 3A:000 _H | | | |
| F9:FFF _H | 39:FFF _H | S33 - 64K | S33 - 64K | |
| F9:000 _H | 39:000 _H | | | |
| F8:FFF _H | 38:FFF _H | S32 - 64K | S32 - 64K | |
| F8:000 _H | 38:000 _H | | | |
| F7:FFF _H | 37:FFF _H | External bus | S31 - 64K | |
| F7:000 _H | 37:000 _H | | | |
| F6:FFF _H | 36:FFF _H | | | |
| F6:000 _H | 36:000 _H | | | |
| F5:FFF _H | 35:FFF _H | | S29 - 64K | |
| F5:000 _H | 35:000 _H | | | |
| F4:FFF _H | 34:FFF _H | | S28 - 64K | |
| F4:000 _H | 34:000 _H | | | |
| F3:FFF _H | 33:FFF _H | External bus | External bus | |
| F3:000 _H | 33:000 _H | | | |
| F2:FFF _H | 32:FFF _H | | | |
| F2:000 _H | 32:000 _H | | | |
| F1:FFF _H | 31:FFF _H | | | |
| F1:000 _H | 31:000 _H | | | |
| F0:FFF _H | 30:FFF _H | | | |
| F0:000 _H | 30:000 _H | | | |
| E0:FFF _H | | | | |
| E0:000 _H | | Reserved | Reserved | |
| DF:FFF _H | | | | |
| DF:800 _H | | | | |
| DF:7FF _H | 1F:7FF _H | SA3 - 8K | SA3 - 8K | Flash A |
| DF:600 _H | 1F:600 _H | | | |
| DF:5FF _H | 1F:5FF _H | SA2 - 8K | SA2 - 8K | |
| DF:400 _H | 1F:400 _H | | | |
| DF:3FF _H | 1F:3FF _H | SA1 - 8K | SA1 - 8K | |
| DF:200 _H | 1F:200 _H | | | |
| DF:1FF _H | 1F:1FF _H | SA0 - 8K *1 | SA0 - 8K *1 | |
| DF:000 _H | 1F:000 _H | | | |
| DE:FFF _H | | Reserved | Reserved | |
| DE:800 _H | | | | |
| DE:7FF _H | 1E:7FF _H | SB3 - 8K | SB3 - 8K | Flash B |
| DE:600 _H | 1E:600 _H | | | |
| DE:5FF _H | 1E:5FF _H | SB2 - 8K | SB2 - 8K | |
| DE:400 _H | 1E:400 _H | | | |
| DE:3FF _H | 1E:3FF _H | SB1 - 8K | SB1 - 8K | |
| DE:200 _H | 1E:200 _H | | | |
| DE:1FF _H | 1E:1FF _H | SB0 - 8K *2 | SB0 - 8K *2 | |
| DE:000 _H | 1E:000 _H | | | |

*1: Sector SA0 contains the ROM Configuration Block RCBA at CPU address DF:0000_H - DF:007F_H
 *2: Sector SB0 contains the ROM Configuration Block RCBB at CPU address DE:0000_H - DE:002F_H

10. User ROM Memory Map for Mask Rom Devices

| | CY96384 | CY96385 |
|--|--------------------------------|--------------------------------|
| CPU address | ROM size 128kByte | ROM size 160kByte |
| FF:FFF _H FF:000 _H | 128K ROM | 128K ROM |
| FE:FFF _H FE:000 _H | | |
| FD:FFF _H | External bus | External bus |
| DF:FFF _H DF:800 _H | Reserved | Reserved |
| DF:7FF _H DF:008 _H | | 32K ROM |
| DF:007 _H DF:000 _H | ROM configuration block RCB | ROM configuration block RCB |
| DE:FFF _H DE:000 _H | Reserved | Reserved |

11. Serial Programming Communication Interface

USART Pins for Flash Serial Programming (MD[2:0] = 010, Serial Communication Mode)

| CY96F38x | | |
|------------|--------------|-----------------|
| Pin Number | USART Number | Normal Function |
| LQFP-120 | | |
| 8 | USART0 | SIN0 |
| 9 | | SOT0 |
| 10 | | SCK0 |
| 3 | USART1 | SIN1 |
| 4 | | SOT1 |
| 5 | | SCK1 |
| 56 | USART2 | SIN2 |
| 57 | | SOT2 |
| 58 | | SCK2 |

Note: If a Flash programmer and its software needs to use a handshaking pin, Cypress suggests to the tool vendor to support at least port P00_1 on pin 88.

If handshaking is used by the tool but P00_1 is not available in customer's application, Cypress suggests to the customer to check the tool manual or to contact the tool vendor for alternative handshaking pins.

12. I/O Map

I/O Map CY96(F)38x (Sheet 1 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|------------------------------|-------------------------------|--------|
| 000000 _H | I/O Port P00 - Port Data Register | PDR00 | - | R/W |
| 000001 _H | I/O Port P01 - Port Data Register | PDR01 | - | R/W |
| 000002 _H | I/O Port P02 - Port Data Register | PDR02 | - | R/W |
| 000003 _H | I/O Port P03 - Port Data Register | PDR03 | - | R/W |
| 000004 _H | I/O Port P04 - Port Data Register | PDR04 | - | R/W |
| 000005 _H | I/O Port P05 - Port Data Register | PDR05 | - | R/W |
| 000006 _H | I/O Port P06 - Port Data Register | PDR06 | - | R/W |
| 000007 _H | Reserved | - | - | - |
| 000008 _H | I/O Port P08 - Port Data Register | PDR08 | - | R/W |
| 000009 _H | I/O Port P09 - Port Data Register | PDR09 | - | R/W |
| 00000A _H | I/O Port P10 - Port Data Register | PDR10 | - | R/W |
| 00000B _H | I/O Port P11 - Port Data Register | PDR11 | - | R/W |
| 00000C _H | I/O Port P12 - Port Data Register | PDR12 | - | R/W |
| 00000D _H | I/O Port P13 - Port Data Register | PDR13 | - | R/W |
| 00000E _H - 000017 _H | Reserved | - | - | - |
| 000018 _H | ADC0 - Control Status register Low | ADCSL | ADCS | R/W |
| 000019 _H | ADC0 - Control Status register High | ADCSH | - | R/W |
| 00001A _H | ADC0 - Data Register Low | ADCRL | ADCR | R |
| 00001B _H | ADC0 - Data Register High | ADCRH | - | R |
| 00001C _H | ADC0 - Setting Register | - | ADSR | R/W |
| 00001D _H | ADC0 - Setting Register | - | - | R/W |
| 00001E _H | ADC0 - Extended Configuration Register | ADECR | - | R/W |
| 00001F _H | Reserved | - | - | - |
| 000020 _H | FRT0 - Data register of free-running timer | - | TCDT0 | R/W |
| 000021 _H | FRT0 - Data register of free-running timer | - | - | R/W |
| 000022 _H | FRT0 - Control status register of free-running timer Low | TCCSL0 | TCCS0 | R/W |
| 000023 _H | FRT0 - Control status register of free-running timer High | TCCSH0 | - | R/W |
| 000024 _H | FRT1 - Data register of free-running timer | - | TCDT1 | R/W |
| 000025 _H | FRT1 - Data register of free-running timer | - | - | R/W |

I/O Map CY96(F)38x (Sheet 2 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 000026 _H | FRT1 - Control status register of free-running timer Low | TCCSL1 | TCCS1 | R/W |
| 000027 _H | FRT1 - Control status register of free-running timer High | TCCSH1 | - | R/W |
| 000028 _H | OCU0 - Output Compare Control Status | OCS0 | - | R/W |
| 000029 _H | OCU1 - Output Compare Control Status | OCS1 | - | R/W |
| 00002A _H | OCU0 - Compare Register | - | OCCP0 | R/W |
| 00002B _H | OCU0 - Compare Register | - | - | R/W |
| 00002C _H | OCU1 - Compare Register | - | OCCP1 | R/W |
| 00002D _H | OCU1 - Compare Register | - | - | R/W |
| 00002E _H | OCU2 - Output Compare Control Status | OCS2 | - | R/W |
| 00002F _H | OCU3 - Output Compare Control Status | OCS3 | - | R/W |
| 000030 _H | OCU2 - Compare Register | - | OCCP2 | R/W |
| 000031 _H | OCU2 - Compare Register | - | - | R/W |
| 000032 _H | OCU3 - Compare Register | - | OCCP3 | R/W |
| 000033 _H | OCU3 - Compare Register | - | - | R/W |
| 000034 _H - 00003F _H | Reserved | - | - | - |
| 000040 _H | ICU0/ICU1 - Control Status Register | ICS01 | - | R/W |
| 000041 _H | ICU0/ICU1 - Edge register | ICE01 | - | R/W |
| 000042 _H | ICU0 - Capture Register Low | IPCPL0 | IPCP0 | R |
| 000043 _H | ICU0 - Capture Register High | IPCPL0 | - | R |
| 000044 _H | ICU1 - Capture Register Low | IPCPL1 | IPCP1 | R |
| 000045 _H | ICU1 - Capture Register High | IPCPL1 | - | R |
| 000046 _H | ICU2/ICU3 - Control Status Register | ICS23 | - | R/W |
| 000047 _H | ICU2/ICU3 - Edge register | ICE23 | - | R/W |
| 000048 _H | ICU2 - Capture Register Low | IPCPL2 | IPCP2 | R |
| 000049 _H | ICU2 - Capture Register High | IPCPL2 | - | R |
| 00004A _H | ICU3 - Capture Register Low | IPCPL3 | IPCP3 | R |
| 00004B _H | ICU3 - Capture Register High | IPCPL3 | - | R |
| 00004C _H | ICU4/ICU5 - Control Status Register | ICS45 | - | R/W |
| 00004D _H | ICU4/ICU5 - Edge register | ICE45 | - | R/W |
| 00004E _H | ICU4 - Capture Register Low | IPCPL4 | IPCP4 | R |

I/O Map CY96(F)38x (Sheet 3 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 00004F _H | ICU4 - Capture Register High | IPCPH4 | - | R |
| 000050 _H | ICU5 - Capture Register Low | IPCPL5 | IPCP5 | R |
| 000051 _H | ICU5 - Capture Register High | IPCPH5 | - | R |
| 000052 _H | ICU6/ICU7 - Control Status Register | ICS67 | - | R/W |
| 000053 _H | ICU6/ICU7 - Edge register | ICE67 | - | R/W |
| 000054 _H | ICU6 - Capture Register Low | IPCPL6 | IPCP6 | R |
| 000055 _H | ICU6 - Capture Register High | IPCPH6 | - | R |
| 000056 _H | ICU7 - Capture Register Low | IPCPL7 | IPCP7 | R |
| 000057 _H | ICU7 - Capture Register High | IPCPH7 | - | R |
| 000058 _H | EXTINT0 - External Interrupt Enable Register | ENIR0 | - | R/W |
| 000059 _H | EXTINT0 - External Interrupt Interrupt request Register | EIRR0 | - | R/W |
| 00005A _H | EXTINT0 - External Interrupt Level Select Low | ELVRL0 | ELVR0 | R/W |
| 00005B _H | EXTINT0 - External Interrupt Level Select High | ELVRH0 | - | R/W |
| 00005C _H - 00005F _H | Reserved | - | - | - |
| 000060 _H | RLT0 - Timer Control Status Register Low | TMCSRL0 | TMCSR0 | R/W |
| 000061 _H | RLT0 - Timer Control Status Register High | TMCSRH0 | - | R/W |
| 000062 _H | RLT0 - Reload Register - for writing | - | TMRLR0 | W |
| 000062 _H | RLT0 - Reload Register - for reading | - | TMR0 | R |
| 000063 _H | RLT0 - Reload Register - for writing | - | - | W |
| 000063 _H | RLT0 - Reload Register - for reading | - | - | R |
| 000064 _H | RLT1 - Timer Control Status Register Low | TMCSRL1 | TMCSR1 | R/W |
| 000065 _H | RLT1 - Timer Control Status Register High | TMCSRH1 | - | R/W |
| 000066 _H | RLT1 - Reload Register - for writing | - | TMRLR1 | W |
| 000066 _H | RLT1 - Reload Register - for reading | - | TMR1 | R |
| 000067 _H | RLT1 - Reload Register - for writing | - | - | W |
| 000067 _H | RLT1 - Reload Register - for reading | - | - | R |
| 000068 _H | RLT2 - Timer Control Status Register Low | TMCSRL2 | TMCSR2 | R/W |
| 000069 _H | RLT2 - Timer Control Status Register High | TMCSRH2 | - | R/W |
| 00006A _H | RLT2 - Reload Register - for writing | - | TMRLR2 | W |
| 00006A _H | RLT2 - Reload Register - for reading | - | TMR2 | R |

I/O Map CY96(F)38x (Sheet 4 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|---------------------|--|---------------------------|----------------------------|--------|
| 00006B _H | RLT2 - Reload Register - for writing | - | - | W |
| 00006B _H | RLT2 - Reload Register - for reading | | | R |
| 00006C _H | RLT3 - Timer Control Status Register Low | TMCSRL3 | TMCSR3 | R/W |
| 00006D _H | RLT3 - Timer Control Status Register High | TMCSRH3 | - | R/W |
| 00006E _H | RLT3 - Reload Register - for writing | - | TMRLR3 | W |
| 00006E _H | RLT3 - Reload Register - for reading | - | TMR3 | R |
| 00006F _H | RLT3 - Reload Register - for writing | - | - | W |
| 00006F _H | RLT3 - Reload Register - for reading | | | R |
| 000070 _H | RLT6 - Timer Control Status Register Low (dedic. RLT for PPG) | TMCSRL6 | TMCSR6 | R/W |
| 000071 _H | RLT6 - Timer Control Status Register High (dedic. RLT for PPG) | TMCSRH6 | - | R/W |
| 000072 _H | RLT6 - Reload Register (dedic. RLT for PPG) - for writing | - | TMRLR6 | W |
| 000072 _H | RLT6 - Reload Register (dedic. RLT for PPG) - for reading | - | TMR6 | R |
| 000073 _H | RLT6 - Reload Register (dedic. RLT for PPG) - for writing | - | - | W |
| 000073 _H | RLT6 - Reload Register (dedic. RLT for PPG) - for reading | - | - | R |
| 000074 _H | PPG3-PPG0 - General Control register 1 Low | GCN1L0 | GCN10 | R/W |
| 000075 _H | PPG3-PPG0 - General Control register 1 High | GCN1H0 | - | R/W |
| 000076 _H | PPG3-PPG0 - General Control register 2 Low | GCN2L0 | GCN20 | R/W |
| 000077 _H | PPG3-PPG0 - General Control register 2 High | GCN2H0 | - | R/W |
| 000078 _H | PPG0 - Timer register | - | PTMR0 | R |
| 000079 _H | PPG0 - Timer register | - | - | R |
| 00007A _H | PPG0 - Period setting register | - | PCSR0 | W |
| 00007B _H | PPG0 - Period setting register | - | - | W |
| 00007C _H | PPG0 - Duty cycle register | - | PDUT0 | W |
| 00007D _H | PPG0 - Duty cycle register | - | - | W |
| 00007E _H | PPG0 - Control status register Low | PCNL0 | PCN0 | R/W |
| 00007F _H | PPG0 - Control status register High | PCNH0 | - | R/W |
| 000080 _H | PPG1 - Timer register | - | PTMR1 | R |
| 000081 _H | PPG1 - Timer register | - | - | R |
| 000082 _H | PPG1 - Period setting register | - | PCSR1 | W |

I/O Map CY96(F)38x (Sheet 5 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|---------------------|---|---------------------------|----------------------------|--------|
| 000083 _H | PPG1 - Period setting register | - | - | W |
| 000084 _H | PPG1 - Duty cycle register | - | PDUT1 | W |
| 000085 _H | PPG1 - Duty cycle register | - | - | W |
| 000086 _H | PPG1 - Control status register Low | PCNL1 | PCN1 | R/W |
| 000087 _H | PPG1 - Control status register High | PCNH1 | - | R/W |
| 000088 _H | PPG2 - Timer register | - | PTMR2 | R |
| 000089 _H | PPG2 - Timer register | - | - | R |
| 00008A _H | PPG2 - Period setting register | - | PCSR2 | W |
| 00008B _H | PPG2 - Period setting register | - | - | W |
| 00008C _H | PPG2 - Duty cycle register | - | PDUT2 | W |
| 00008D _H | PPG2 - Duty cycle register | - | - | W |
| 00008E _H | PPG2 - Control status register Low | PCNL2 | PCN2 | R/W |
| 00008F _H | PPG2 - Control status register High | PCNH2 | - | R/W |
| 000090 _H | PPG3 - Timer register | - | PTMR3 | R |
| 000091 _H | PPG3 - Timer register | - | - | R |
| 000092 _H | PPG3 - Period setting register | - | PCSR3 | W |
| 000093 _H | PPG3 - Period setting register | - | - | W |
| 000094 _H | PPG3 - Duty cycle register | - | PDUT3 | W |
| 000095 _H | PPG3 - Duty cycle register | - | - | W |
| 000096 _H | PPG3 - Control status register Low | PCNL3 | PCN3 | R/W |
| 000097 _H | PPG3 - Control status register High | PCNH3 | - | R/W |
| 000098 _H | PPG7-PPG4 - General Control register 1 Low | GCN1L1 | GCN11 | R/W |
| 000099 _H | PPG7-PPG4 - General Control register 1 High | GCN1H1 | - | R/W |
| 00009A _H | PPG7-PPG4 - General Control register 2 Low | GCN2L1 | GCN21 | R/W |
| 00009B _H | PPG7-PPG4 - General Control register 2 High | GCN2H1 | - | R/W |
| 00009C _H | PPG4 - Timer register | - | PTMR4 | R |
| 00009D _H | PPG4 - Timer register | - | - | R |
| 00009E _H | PPG4 - Period setting register | - | PCSR4 | W |
| 00009F _H | PPG4 - Period setting register | - | - | W |
| 0000A0 _H | PPG4 - Duty cycle register | - | PDUT4 | W |

I/O Map CY96(F)38x (Sheet 6 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|--|---------------------------|----------------------------|--------|
| 0000A1 _H | PPG4 - Duty cycle register | - | - | W |
| 0000A2 _H | PPG4 - Control status register Low | PCNL4 | PCN4 | R/W |
| 0000A3 _H | PPG4 - Control status register High | PCNH4 | - | R/W |
| 0000A4 _H | PPG5 - Timer register | - | PTMR5 | R |
| 0000A5 _H | PPG5 - Timer register | - | - | R |
| 0000A6 _H | PPG5 - Period setting register | - | PCSR5 | W |
| 0000A7 _H | PPG5 - Period setting register | - | - | W |
| 0000A8 _H | PPG5 - Duty cycle register | - | PDUT5 | W |
| 0000A9 _H | PPG5 - Duty cycle register | - | - | W |
| 0000AA _H | PPG5 - Control status register Low | PCNL5 | PCN5 | R/W |
| 0000AB _H | PPG5 - Control status register High | PCNH5 | - | R/W |
| 0000AC _H | I2C0 - Bus Status Register | IBSR0 | - | R |
| 0000AD _H | I2C0 - Bus Control Register | IBCR0 | - | R/W |
| 0000AE _H | I2C0 - Ten bit Slave address Register Low | ITBAL0 | ITBA0 | R/W |
| 0000AF _H | I2C0 - Ten bit Slave address Register High | ITBAH0 | - | R/W |
| 0000B0 _H | I2C0 - Ten bit Address mask Register Low | ITMKL0 | ITMK0 | R/W |
| 0000B1 _H | I2C0 - Ten bit Address mask Register High | ITMKH0 | - | R/W |
| 0000B2 _H | I2C0 - Seven bit Slave address Register | ISBA0 | - | R/W |
| 0000B3 _H | I2C0 - Seven bit Address mask Register | ISMK0 | - | R/W |
| 0000B4 _H | I2C0 - Data Register | IDAR0 | - | R/W |
| 0000B5 _H | I2C0 - Clock Control Register | ICCR0 | - | R/W |
| 0000B6 _H - 0000BF _H | Reserved | - | - | - |
| 0000C0 _H | USART0 - Serial Mode Register | SMR0 | - | R/W |
| 0000C1 _H | USART0 - Serial Control Register | SCR0 | - | R/W |
| 0000C2 _H | USART0 - TX Register | TDR0 | - | W |
| 0000C2 _H | USART0 - RX Register | RDR0 | - | R |
| 0000C3 _H | USART0 - Serial Status | SSR0 | - | R/W |
| 0000C4 _H | USART0 - Control/Com. Register | ECCR0 | - | R/W |
| 0000C5 _H | USART0 - Ext. Status Register | ESCR0 | - | R/W |
| 0000C6 _H | USART0 - Baud Rate Generator Register Low | BGRL0 | BGR0 | R/W |

I/O Map CY96(F)38x (Sheet 7 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 0000C7 _H | USART0 - Baud Rate Generator Register High | BGRH0 | - | R/W |
| 0000C8 _H | USART0 - Extended Serial Interrupt Register | ESIR0 | - | R/W |
| 0000C9 _H | Reserved | - | - | - |
| 0000CA _H | USART1 - Serial Mode Register | SMR1 | - | R/W |
| 0000CB _H | USART1 - Serial Control Register | SCR1 | - | R/W |
| 0000CC _H | USART1 - TX Register | TDR1 | - | W |
| 0000CC _H | USART1 - RX Register | RDR1 | - | R |
| 0000CD _H | USART1 - Serial Status | SSR1 | - | R/W |
| 0000CE _H | USART1 - Control/Com. Register | ECCR1 | - | R/W |
| 0000CF _H | USART1 - Ext. Status Register | ESCR1 | - | R/W |
| 0000D0 _H | USART1 - Baud Rate Generator Register Low | BGRL1 | BGR1 | R/W |
| 0000D1 _H | USART1 - Baud Rate Generator Register High | BGRH1 | - | R/W |
| 0000D2 _H | USART1 - Extended Serial Interrupt Register | ESIR1 | - | R/W |
| 0000D3 _H | Reserved | - | - | - |
| 0000D4 _H | USART2 - Serial Mode Register | SMR2 | - | R/W |
| 0000D5 _H | USART2 - Serial Control Register | SCR2 | - | R/W |
| 0000D6 _H | USART2 - TX Register | TDR2 | - | W |
| 0000D6 _H | USART2 - RX Register | RDR2 | - | R |
| 0000D7 _H | USART2 - Serial Status | SSR2 | - | R/W |
| 0000D8 _H | USART2 - Control/Com. Register | ECCR2 | - | R/W |
| 0000D9 _H | USART2 - Ext. Status Register | ESCR2 | - | R/W |
| 0000DA _H | USART2 - Baud Rate Generator Register Low | BGRL2 | BGR2 | R/W |
| 0000DB _H | USART2 - Baud Rate Generator Register High | BGRH2 | - | R/W |
| 0000DC _H | USART2 - Extended Serial Interrupt Register | ESIR2 | - | R/W |
| 0000DD _H - 0000EF _H | Reserved | - | - | - |
| 0000F0 _H - 0000FF _H | External Bus area | EXTBUS0 | - | R/W |
| 000100 _H | DMA0 - Buffer address pointer low byte | BAPL0 | - | R/W |
| 000101 _H | DMA0 - Buffer address pointer middle byte | BAPM0 | - | R/W |
| 000102 _H | DMA0 - Buffer address pointer high byte | BAPH0 | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|---------------------|---|---------------------------|----------------------------|--------|
| 000103 _H | DMA0 - DMA control register | DMACS0 | - | R/W |
| 000104 _H | DMA0 - I/O register address pointer low byte | IOAL0 | IOA0 | R/W |
| 000105 _H | DMA0 - I/O register address pointer high byte | IOAH0 | - | R/W |
| 000106 _H | DMA0 - Data counter low byte | DCTL0 | DCT0 | R/W |
| 000107 _H | DMA0 - Data counter high byte | DCTH0 | - | R/W |
| 000108 _H | DMA1 - Buffer address pointer low byte | BAPL1 | - | R/W |
| 000109 _H | DMA1 - Buffer address pointer middle byte | BAPM1 | - | R/W |
| 00010A _H | DMA1 - Buffer address pointer high byte | BAPH1 | - | R/W |
| 00010B _H | DMA1 - DMA control register | DMACS1 | - | R/W |
| 00010C _H | DMA1 - I/O register address pointer low byte | IOAL1 | IOA1 | R/W |
| 00010D _H | DMA1 - I/O register address pointer high byte | IOAH1 | - | R/W |
| 00010E _H | DMA1 - Data counter low byte | DCTL1 | DCT1 | R/W |
| 00010F _H | DMA1 - Data counter high byte | DCTH1 | - | R/W |
| 000110 _H | DMA2 - Buffer address pointer low byte | BAPL2 | - | R/W |
| 000111 _H | DMA2 - Buffer address pointer middle byte | BAPM2 | - | R/W |
| 000112 _H | DMA2 - Buffer address pointer high byte | BAPH2 | - | R/W |
| 000113 _H | DMA2 - DMA control register | DMACS2 | - | R/W |
| 000114 _H | DMA2 - I/O register address pointer low byte | IOAL2 | IOA2 | R/W |
| 000115 _H | DMA2 - I/O register address pointer high byte | IOAH2 | - | R/W |
| 000116 _H | DMA2 - Data counter low byte | DCTL2 | DCT2 | R/W |
| 000117 _H | DMA2 - Data counter high byte | DCTH2 | - | R/W |
| 000118 _H | DMA3 - Buffer address pointer low byte | BAPL3 | - | R/W |
| 000119 _H | DMA3 - Buffer address pointer middle byte | BAPM3 | - | R/W |
| 00011A _H | DMA3 - Buffer address pointer high byte | BAPH3 | - | R/W |
| 00011B _H | DMA3 - DMA control register | DMACS3 | - | R/W |
| 00011C _H | DMA3 - I/O register address pointer low byte | IOAL3 | IOA3 | R/W |
| 00011D _H | DMA3 - I/O register address pointer high byte | IOAH3 | - | R/W |
| 00011E _H | DMA3 - Data counter low byte | DCTL3 | DCT3 | R/W |
| 00011F _H | DMA3 - Data counter high byte | DCTH3 | - | R/W |
| 000120 _H | DMA4 - Buffer address pointer low byte | BAPL4 | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 000121 _H | DMA4 - Buffer address pointer middle byte | BAPM4 | - | R/W |
| 000122 _H | DMA4 - Buffer address pointer high byte | BAPH4 | - | R/W |
| 000123 _H | DMA4 - DMA control register | DMACS4 | - | R/W |
| 000124 _H | DMA4 - I/O register address pointer low byte | IOAL4 | IOA4 | R/W |
| 000125 _H | DMA4 - I/O register address pointer high byte | IOAH4 | - | R/W |
| 000126 _H | DMA4 - Data counter low byte | DCTL4 | DCT4 | R/W |
| 000127 _H | DMA4 - Data counter high byte | DCTH4 | - | R/W |
| 000128 _H | DMA5 - Buffer address pointer low byte | BAPL5 | - | R/W |
| 000129 _H | DMA5 - Buffer address pointer middle byte | BAPM5 | - | R/W |
| 00012A _H | DMA5 - Buffer address pointer high byte | BAPH5 | - | R/W |
| 00012B _H | DMA5 - DMA control register | DMACS5 | - | R/W |
| 00012C _H | DMA5 - I/O register address pointer low byte | IOAL5 | IOA5 | R/W |
| 00012D _H | DMA5 - I/O register address pointer high byte | IOAH5 | - | R/W |
| 00012E _H | DMA5 - Data counter low byte | DCTL5 | DCT5 | R/W |
| 00012F _H | DMA5 - Data counter high byte | DCTH5 | - | R/W |
| 000130 _H | DMA6 - Buffer address pointer low byte | BAPL6 | - | R/W |
| 000131 _H | DMA6 - Buffer address pointer middle byte | BAPM6 | - | R/W |
| 000132 _H | DMA6 - Buffer address pointer high byte | BAPH6 | - | R/W |
| 000133 _H | DMA6 - DMA control register | DMACS6 | - | R/W |
| 000134 _H | DMA6 - I/O register address pointer low byte | IOAL6 | IOA6 | R/W |
| 000135 _H | DMA6 - I/O register address pointer high byte | IOAH6 | - | R/W |
| 000136 _H | DMA6 - Data counter low byte | DCTL6 | DCT6 | R/W |
| 000137 _H | DMA6 - Data counter high byte | DCTH6 | - | R/W |
| 000138 _H - 00017F _H | Reserved | - | - | - |
| 000180 _H - 00037F _H | CPU - General Purpose registers (RAM access) | GPR_RAM | - | R/W |
| 000380 _H | DMA0 - Interrupt select | DISEL0 | - | R/W |
| 000381 _H | DMA1 - Interrupt select | DISEL1 | - | R/W |
| 000382 _H | DMA2 - Interrupt select | DISEL2 | - | R/W |
| 000383 _H | DMA3 - Interrupt select | DISEL3 | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 000384 _H | DMA4 - Interrupt select | DISEL4 | - | R/W |
| 000385 _H | DMA5 - Interrupt select | DISEL5 | - | R/W |
| 000386 _H | DMA6 - Interrupt select | DISEL6 | - | R/W |
| 000387 _H 00038F _H | Reserved | - | - | - |
| 000390 _H | DMA - Status register low byte | DSRL | DSR | R/W |
| 000391 _H | DMA - Status register high byte | DSRH | - | R/W |
| 000392 _H | DMA - Stop status register low byte | DSSRL | DSSR | R/W |
| 000393 _H | DMA - Stop status register high byte | DSSRH | - | R/W |
| 000394 _H | DMA - Enable register low byte | DERL | DER | R/W |
| 000395 _H | DMA - Enable register high byte | DERH | - | R/W |
| 000396 _H 00039F _H | Reserved | - | - | - |
| 0003A0 _H | Interrupt level register | ILR | ICR | R/W |
| 0003A1 _H | Interrupt index register | IDX | - | R/W |
| 0003A2 _H | Interrupt vector table base register Low | TBRL | TBR | R/W |
| 0003A3 _H | Interrupt vector table base register High | TBRH | - | R/W |
| 0003A4 _H | Delayed Interrupt register | DIRR | - | R/W |
| 0003A5 _H | Non Maskable Interrupt register | NMI | - | R/W |
| 0003A6 _H 0003AB _H | Reserved | - | - | - |
| 0003AC _H | EDSU communication interrupt selection Low | EDSU2L | EDSU2 | R/W |
| 0003AD _H | EDSU communication interrupt selection High | EDSU2H | - | R/W |
| 0003AE _H | ROM mirror control register | ROMM | - | R/W |
| 0003AF _H | EDSU configuration register | EDSU | - | R/W |
| 0003B0 _H | Memory patch control/status register ch 0/1 | - | PFCS0 | R/W |
| 0003B1 _H | Memory patch control/status register ch 0/1 | - | - | R/W |
| 0003B2 _H | Memory patch control/status register ch 2/3 | - | PFCS1 | R/W |
| 0003B3 _H | Memory patch control/status register ch 2/3 | - | - | R/W |
| 0003B4 _H | Memory patch control/status register ch 4/5 | - | PFCS2 | R/W |
| 0003B5 _H | Memory patch control/status register ch 4/5 | - | - | R/W |
| 0003B6 _H | Memory patch control/status register ch 6/7 | - | PFCS3 | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|---------------------|--|------------------------------|-------------------------------|--------|
| 0003B7 _H | Memory patch control/status register ch 6/7 | - | - | R/W |
| 0003B8 _H | Memory Patch function - Patch address 0 low | PFAL0 | - | R/W |
| 0003B9 _H | Memory Patch function - Patch address 0 middle | PFAM0 | - | R/W |
| 0003BA _H | Memory Patch function - Patch address 0 high | PFAH0 | - | R/W |
| 0003BB _H | Memory Patch function - Patch address 1 low | PFAL1 | - | R/W |
| 0003BC _H | Memory Patch function - Patch address 1 middle | PFAM1 | - | R/W |
| 0003BD _H | Memory Patch function - Patch address 1 high | PFAH1 | - | R/W |
| 0003BE _H | Memory Patch function - Patch address 2 low | PFAL2 | - | R/W |
| 0003BF _H | Memory Patch function - Patch address 2 middle | PFAM2 | - | R/W |
| 0003C0 _H | Memory Patch function - Patch address 2 high | PFAH2 | - | R/W |
| 0003C1 _H | Memory Patch function - Patch address 3 low | PFAL3 | - | R/W |
| 0003C2 _H | Memory Patch function - Patch address 3 middle | PFAM3 | - | R/W |
| 0003C3 _H | Memory Patch function - Patch address 3 high | PFAH3 | - | R/W |
| 0003C4 _H | Memory Patch function - Patch address 4 low | PFAL4 | - | R/W |
| 0003C5 _H | Memory Patch function - Patch address 4 middle | PFAM4 | - | R/W |
| 0003C6 _H | Memory Patch function - Patch address 4 high | PFAH4 | - | R/W |
| 0003C7 _H | Memory Patch function - Patch address 5 low | PFAL5 | - | R/W |
| 0003C8 _H | Memory Patch function - Patch address 5 middle | PFAM5 | - | R/W |
| 0003C9 _H | Memory Patch function - Patch address 5 high | PFAH5 | - | R/W |
| 0003CA _H | Memory Patch function - Patch address 6 low | PFAL6 | - | R/W |
| 0003CB _H | Memory Patch function - Patch address 6 middle | PFAM6 | - | R/W |
| 0003CC _H | Memory Patch function - Patch address 6 high | PFAH6 | - | R/W |
| 0003CD _H | Memory Patch function - Patch address 7 low | PFAL7 | - | R/W |
| 0003CE _H | Memory Patch function - Patch address 7 middle | PFAM7 | - | R/W |
| 0003CF _H | Memory Patch function - Patch address 7 high | PFAH7 | - | R/W |
| 0003D0 _H | Memory Patch function - Patch data 0 Low | PFDL0 | PFD0 | R/W |
| 0003D1 _H | Memory Patch function - Patch data 0 High | PFDH0 | - | R/W |
| 0003D2 _H | Memory Patch function - Patch data 1 Low | PFDL1 | PFD1 | R/W |
| 0003D3 _H | Memory Patch function - Patch data 1 High | PFDH1 | - | R/W |
| 0003D4 _H | Memory Patch function - Patch data 2 Low | PFDL2 | PFD2 | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 0003D5 _H | Memory Patch function - Patch data 2 High | PFDH2 | - | R/W |
| 0003D6 _H | Memory Patch function - Patch data 3 Low | PFDL3 | PFD3 | R/W |
| 0003D7 _H | Memory Patch function - Patch data 3 High | PFDH3 | - | R/W |
| 0003D8 _H | Memory Patch function - Patch data 4 Low | PFDL4 | PFD4 | R/W |
| 0003D9 _H | Memory Patch function - Patch data 4 High | PFDH4 | - | R/W |
| 0003DA _H | Memory Patch function - Patch data 5 Low | PFDL5 | PFD5 | R/W |
| 0003DB _H | Memory Patch function - Patch data 5 High | PFDH5 | - | R/W |
| 0003DC _H | Memory Patch function - Patch data 6 Low | PFDL6 | PFD6 | R/W |
| 0003DD _H | Memory Patch function - Patch data 6 High | PFDH6 | - | R/W |
| 0003DE _H | Memory Patch function - Patch data 7 Low | PFDL7 | PFD7 | R/W |
| 0003DF _H | Memory Patch function - Patch data 7 High | PFDH7 | - | R/W |
| 0003E0 _H - 0003F0 _H | Reserved | - | - | - |
| 0003F1 _H | Memory Control Status Register A | MCSRA | - | R/W |
| 0003F2 _H | Memory Timing Configuration Register A Low | MTCRAL | MTCRA | R/W |
| 0003F3 _H | Memory Timing Configuration Register A High | MTCRAH | - | R/W |
| 0003F4 _H | Reserved | - | - | - |
| 0003F5 _H | Memory Control Status Register B | MCSRB | - | R/W |
| 0003F6 _H | Memory Timing Configuration Register B Low | MTCRBL | MTCRB | R/W |
| 0003F7 _H | Memory Timing Configuration Register B High | MTCRBH | - | R/W |
| 0003F8 _H | Flash Memory Write Control register 0 | FMWC0 | - | R/W |
| 0003F9 _H | Flash Memory Write Control register 1 | FMWC1 | - | R/W |
| 0003FA _H | Flash Memory Write Control register 2 | FMWC2 | - | R/W |
| 0003FB _H | Flash Memory Write Control register 3 | FMWC3 | - | R/W |
| 0003FC _H | Flash Memory Write Control register 4 | FMWC4 | - | R/W |
| 0003FD _H | Flash Memory Write Control register 5 | FMWC5 | - | R/W |
| 0003FE _H - 0003FF _H | Reserved | - | - | - |
| 000400 _H | Standby Mode control register | SMCR | - | R/W |
| 000401 _H | Clock select register | CKSR | - | R/W |
| 000402 _H | Clock Stabilisation select register | CKSSR | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 000403 _H | Clock monitor register | CKMR | - | R |
| 000404 _H | Clock Frequency control register Low | CKFCRL | CKFCR | R/W |
| 000405 _H | Clock Frequency control register High | CKFCRH | - | R/W |
| 000406 _H | PLL Control register Low | PLLCLL | PLLCLH | R/W |
| 000407 _H | PLL Control register High | PLLCLH | - | R/W |
| 000408 _H | RC clock timer control register | RCTCR | - | R/W |
| 000409 _H | Main clock timer control register | MCTCR | - | R/W |
| 00040A _H | Sub clock timer control register | SCTCR | - | R/W |
| 00040B _H | Reset cause and clock status register with clear function | RCCSRC | - | R |
| 00040C _H | Reset configuration register | RRCR | - | R/W |
| 00040D _H | Reset cause and clock status register | RCCSR | - | R |
| 00040E _H | Watch dog timer configuration register | WDTC | - | R/W |
| 00040F _H | Watch dog timer clear pattern register | WDTCP | - | W |
| 000410 _H - 000414 _H | Reserved | - | - | - |
| 000415 _H | Clock output activation register | COAR | - | R/W |
| 000416 _H | Clock output configuration register 0 | COCR0 | - | R/W |
| 000417 _H | Clock output configuration register 1 | COCR1 | - | R/W |
| 000418 _H | Clock Modulator control register | CMCR | - | R/W |
| 000419 _H | Reserved | - | - | - |
| 00041A _H | Clock Modulator Parameter register Low | CMPLL | CMPLH | R/W |
| 00041B _H | Clock Modulator Parameter register High | CMPLH | - | R/W |
| 00041C _H - 00042B _H | Reserved | - | - | - |
| 00042C _H | Voltage Regulator Control register | VRCR | - | R/W |
| 00042D _H | Clock Input and LVD Control Register | CILCR | - | R/W |
| 00042E _H - 00042F _H | Reserved | - | - | - |
| 000430 _H | I/O Port P00 - Data Direction Register | DDR00 | - | R/W |
| 000431 _H | I/O Port P01 - Data Direction Register | DDR01 | - | R/W |
| 000432 _H | I/O Port P02 - Data Direction Register | DDR02 | - | R/W |
| 000433 _H | I/O Port P03 - Data Direction Register | DDR03 | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 000434 _H | I/O Port P04 - Data Direction Register | DDR04 | - | R/W |
| 000435 _H | I/O Port P05 - Data Direction Register | DDR05 | - | R/W |
| 000436 _H | I/O Port P06 - Data Direction Register | DDR06 | - | R/W |
| 000437 _H | Reserved | - | - | - |
| 000438 _H | I/O Port P08 - Data Direction Register | DDR08 | - | R/W |
| 000439 _H | I/O Port P09 - Data Direction Register | DDR09 | - | R/W |
| 00043A _H | I/O Port P10 - Data Direction Register | DDR10 | - | R/W |
| 00043B _H | I/O Port P11 - Data Direction Register | DDR11 | - | R/W |
| 00043C _H | I/O Port P12 - Data Direction Register | DDR12 | - | R/W |
| 00043D _H | I/O Port P13 - Data Direction Register | DDR13 | - | R/W |
| 00043E _H - 000443 _H | Reserved | - | - | - |
| 000444 _H | I/O Port P00 - Port Input Enable Register | PIER00 | - | R/W |
| 000445 _H | I/O Port P01 - Port Input Enable Register | PIER01 | - | R/W |
| 000446 _H | I/O Port P02 - Port Input Enable Register | PIER02 | - | R/W |
| 000447 _H | I/O Port P03 - Port Input Enable Register | PIER03 | - | R/W |
| 000448 _H | I/O Port P04 - Port Input Enable Register | PIER04 | - | R/W |
| 000449 _H | I/O Port P05 - Port Input Enable Register | PIER05 | - | R/W |
| 00044A _H | I/O Port P06 - Port Input Enable Register | PIER06 | - | R/W |
| 00044B _H | Reserved | - | - | - |
| 00044C _H | I/O Port P08 - Port Input Enable Register | PIER08 | - | R/W |
| 00044D _H | I/O Port P09 - Port Input Enable Register | PIER09 | - | R/W |
| 00044E _H | I/O Port P10 - Port Input Enable Register | PIER10 | - | R/W |
| 00044F _H | I/O Port P11 - Port Input Enable Register | PIER11 | - | R/W |
| 000450 _H | I/O Port P12 - Port Input Enable Register | PIER12 | - | R/W |
| 000451 _H | I/O Port P13 - Port Input Enable Register | PIER13 | - | R/W |
| 000452 _H - 000457 _H | Reserved | - | - | - |
| 000458 _H | I/O Port P00 - Port Input Level Register | PILR00 | - | R/W |
| 000459 _H | I/O Port P01 - Port Input Level Register | PILR01 | - | R/W |
| 00045A _H | I/O Port P02 - Port Input Level Register | PILR02 | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|------------------------------|-------------------------------|--------|
| 00045B _H | I/O Port P03 - Port Input Level Register | PILR03 | - | R/W |
| 00045C _H | I/O Port P04 - Port Input Level Register | PILR04 | - | R/W |
| 00045D _H | I/O Port P05 - Port Input Level Register | PILR05 | - | R/W |
| 00045E _H | I/O Port P06 - Port Input Level Register | PILR06 | - | R/W |
| 00045F _H | Reserved | - | - | - |
| 000460 _H | I/O Port P08 - Port Input Level Register | PILR08 | - | R/W |
| 000461 _H | I/O Port P09 - Port Input Level Register | PILR09 | - | R/W |
| 000462 _H | I/O Port P10 - Port Input Level Register | PILR10 | - | R/W |
| 000463 _H | I/O Port P11 - Port Input Level Register | PILR11 | - | R/W |
| 000464 _H | I/O Port P12 - Port Input Level Register | PILR12 | - | R/W |
| 000465 _H | I/O Port P13 - Port Input Level Register | PILR13 | - | R/W |
| 000466 _H - 00046B _H | Reserved | - | - | - |
| 00046C _H | I/O Port P00 - Extended Port Input Level Register | EPILR00 | - | R/W |
| 00046D _H | I/O Port P01 - Extended Port Input Level Register | EPILR01 | - | R/W |
| 00046E _H | I/O Port P02 - Extended Port Input Level Register | EPILR02 | - | R/W |
| 00046F _H | I/O Port P03 - Extended Port Input Level Register | EPILR03 | - | R/W |
| 000470 _H | I/O Port P04 - Extended Port Input Level Register | EPILR04 | - | R/W |
| 000471 _H | I/O Port P05 - Extended Port Input Level Register | EPILR05 | - | R/W |
| 000472 _H | I/O Port P06 - Extended Port Input Level Register | EPILR06 | - | R/W |
| 000473 _H | Reserved | - | - | - |
| 000474 _H | I/O Port P08 - Extended Port Input Level Register | EPILR08 | - | R/W |
| 000475 _H | I/O Port P09 - Extended Port Input Level Register | EPILR09 | - | R/W |
| 000476 _H | I/O Port P10 - Extended Port Input Level Register | EPILR10 | - | R/W |
| 000477 _H | I/O Port P11 - Extended Port Input Level Register | EPILR11 | - | R/W |
| 000478 _H | I/O Port P12 - Extended Port Input Level Register | EPILR12 | - | R/W |
| 000479 _H | I/O Port P13 - Extended Port Input Level Register | EPILR13 | - | R/W |
| 00047A _H - 00047F _H | Reserved | - | - | - |
| 000480 _H | I/O Port P00 - Port Output Drive Register | PODR00 | - | R/W |
| 000481 _H | I/O Port P01 - Port Output Drive Register | PODR01 | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|--|---------------------------|----------------------------|--------|
| 000482 _H | I/O Port P02 - Port Output Drive Register | PODR02 | - | R/W |
| 000483 _H | I/O Port P03 - Port Output Drive Register | PODR03 | - | R/W |
| 000484 _H | I/O Port P04 - Port Output Drive Register | PODR04 | - | R/W |
| 000485 _H | I/O Port P05 - Port Output Drive Register | PODR05 | - | R/W |
| 000486 _H | I/O Port P06 - Port Output Drive Register | PODR06 | - | R/W |
| 000487 _H | Reserved | - | - | - |
| 000488 _H | I/O Port P08 - Port Output Drive Register | PODR08 | - | R/W |
| 000489 _H | I/O Port P09 - Port Output Drive Register | PODR09 | - | R/W |
| 00048A _H | I/O Port P10 - Port Output Drive Register | PODR10 | - | R/W |
| 00048B _H | I/O Port P11 - Port Output Drive Register | PODR11 | - | R/W |
| 00048C _H | I/O Port P12 - Port Output Drive Register | PODR12 | - | R/W |
| 00048D _H | I/O Port P13 - Port Output Drive Register | PODR13 | - | R/W |
| 00048E _H - 00049B _H | Reserved | - | - | - |
| 00049C _H | I/O Port P08 - Port High Drive Register | PHDR08 | - | R/W |
| 00049D _H | I/O Port P09 - Port High Drive Register | PHDR09 | - | R/W |
| 00049E _H | I/O Port P10 - Port High Drive Register | PHDR10 | - | R/W |
| 00049F _H - 0004A7 _H | Reserved | - | - | - |
| 0004A8 _H | I/O Port P00 - Pull-Up resistor Control Register | PUCR00 | - | R/W |
| 0004A9 _H | I/O Port P01 - Pull-Up resistor Control Register | PUCR01 | - | R/W |
| 0004AA _H | I/O Port P02 - Pull-Up resistor Control Register | PUCR02 | - | R/W |
| 0004AB _H | I/O Port P03 - Pull-Up resistor Control Register | PUCR03 | - | R/W |
| 0004AC _H | I/O Port P04 - Pull-Up resistor Control Register | PUCR04 | - | R/W |
| 0004AD _H | I/O Port P05 - Pull-Up resistor Control Register | PUCR05 | - | R/W |
| 0004AE _H | I/O Port P06 - Pull-Up resistor Control Register | PUCR06 | - | R/W |
| 0004AF _H | Reserved | - | - | - |
| 0004B0 _H | I/O Port P08 - Pull-Up resistor Control Register | PUCR08 | - | R/W |
| 0004B1 _H | I/O Port P09 - Pull-Up resistor Control Register | PUCR09 | - | R/W |
| 0004B2 _H | I/O Port P10 - Pull-Up resistor Control Register | PUCR10 | - | R/W |
| 0004B3 _H | I/O Port P11 - Pull-Up resistor Control Register | PUCR11 | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|--|---------------------------|----------------------------|--------|
| 0004B4 _H | I/O Port P12 - Pull-Up resistor Control Register | PUCR12 | - | R/W |
| 0004B5 _H | I/O Port P13 - Pull-Up resistor Control Register | PUCR13 | - | R/W |
| 0004B6 _H - 0004BB _H | Reserved | - | - | - |
| 0004BC _H | I/O Port P00 - External Pin State Register | EPSR00 | - | R |
| 0004BD _H | I/O Port P01 - External Pin State Register | EPSR01 | - | R |
| 0004BE _H | I/O Port P02 - External Pin State Register | EPSR02 | - | R |
| 0004BF _H | I/O Port P03 - External Pin State Register | EPSR03 | - | R |
| 0004C0 _H | I/O Port P04 - External Pin State Register | EPSR04 | - | R |
| 0004C1 _H | I/O Port P05 - External Pin State Register | EPSR05 | - | R |
| 0004C2 _H | I/O Port P06 - External Pin State Register | EPSR06 | - | R |
| 0004C3 _H | Reserved | - | - | - |
| 0004C4 _H | I/O Port P08 - External Pin State Register | EPSR08 | - | R |
| 0004C5 _H | I/O Port P09 - External Pin State Register | EPSR09 | - | R |
| 0004C6 _H | I/O Port P10 - External Pin State Register | EPSR10 | - | R |
| 0004C7 _H | I/O Port P11 - External Pin State Register | EPSR11 | - | R |
| 0004C8 _H | I/O Port P12 - External Pin State Register | EPSR12 | - | R |
| 0004C9 _H | I/O Port P13 - External Pin State Register | EPSR13 | - | R |
| 0004CA _H - 0004CF _H | Reserved | - | - | - |
| 0004D0 _H | ADC analog input enable register 0 | ADER0 | - | R/W |
| 0004D1 _H | ADC analog input enable register 1 | ADER1 | - | R/W |
| 0004D2 _H | ADC analog input enable register 2 | ADER2 | - | R/W |
| 0004D3 _H | ADC analog input enable register 3 | ADER3 | - | R/W |
| 0004D4 _H | ADC analog input enable register 4 | ADER4 | - | R/W |
| 0004D5 _H | Reserved | - | - | - |
| 0004D6 _H | Peripheral Resource Relocation Register 0 | PRRR0 | - | R/W |
| 0004D7 _H | Peripheral Resource Relocation Register 1 | PRRR1 | - | R/W |
| 0004D8 _H | Peripheral Resource Relocation Register 2 | PRRR2 | - | R/W |
| 0004D9 _H | Peripheral Resource Relocation Register 3 | PRRR3 | - | R/W |
| 0004DA _H | Peripheral Resource Relocation Register 4 | PRRR4 | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 0004DB _H | Peripheral Resource Relocation Register 5 | PRRR5 | - | R/W |
| 0004DC _H | Peripheral Resource Relocation Register 6 | PRRR6 | - | R/W |
| 0004DD _H | Peripheral Resource Relocation Register 7 | PRRR7 | - | R/W |
| 0004DE _H | Peripheral Resource Relocation Register 8 | PRRR8 | - | R/W |
| 0004DF _H | Peripheral Resource Relocation Register 9 | PRRR9 | - | R/W |
| 0004E0 _H | RTC - Sub Second Register L | WTBRL0 | WTBR0 | R/W |
| 0004E1 _H | RTC - Sub Second Register M | WTBRH0 | - | R/W |
| 0004E2 _H | RTC - Sub-Second Register H | WTBR1 | - | R/W |
| 0004E3 _H | RTC - Second Register | WTSR | - | R/W |
| 0004E4 _H | RTC - Minutes | WTMR | - | R/W |
| 0004E5 _H | RTC - Hour | WTHR | - | R/W |
| 0004E6 _H | RTC - Timer Control Extended Register | WTCER | - | R/W |
| 0004E7 _H | RTC - Clock select register | WTCKSR | - | R/W |
| 0004E8 _H | RTC - Timer Control Register Low | WTCRL | WTCR | R/W |
| 0004E9 _H | RTC - Timer Control Register High | WTCRH | - | R/W |
| 0004EA _H | CAL - Calibration unit Control register | CUCR | - | R/W |
| 0004EB _H | Reserved | - | - | - |
| 0004EC _H | CAL - Duration Timer Data Register Low | CUTDL | CUTD | R/W |
| 0004ED _H | CAL - Duration Timer Data Register High | CUTDH | - | R/W |
| 0004EE _H | CAL - Calibration Timer Register 2 Low | CUTR2L | CUTR2 | R |
| 0004EF _H | CAL - Calibration Timer Register 2 High | CUTR2H | - | R |
| 0004F0 _H | CAL - Calibration Timer Register 1 Low | CUTR1L | CUTR1 | R |
| 0004F1 _H | CAL - Calibration Timer Register 1 High | CUTR1H | - | R |
| 0004F2 _H - 0004F9 _H | Reserved | - | - | - |
| 0004FA _H | RLT - Timer input select (for Cascading) | TMISR | - | R/W |
| 0004FB _H - 00051F _H | Reserved | - | - | - |
| 000520 _H | USART4 - Serial Mode Register | SMR4 | - | R/W |
| 000521 _H | USART4 - Serial Control Register | SCR4 | - | R/W |
| 000522 _H | USART4 - TX Register | TDR4 | - | W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 000522 _H | USART4 - RX Register | RDR4 | - | R |
| 000523 _H | USART4 - Serial Status | SSR4 | - | R/W |
| 000524 _H | USART4 - Control/Com. Register (internal) | ECCR4 | - | R/W |
| 000525 _H | USART4 - Ext. Status Register | ESCR4 | - | R/W |
| 000526 _H | USART4 - Baud Rate Generator Register Low | BGRL4 | BGR4 | R/W |
| 000527 _H | USART4 - Baud Rate Generator Register High | BGRH4 | - | R/W |
| 000528 _H | USART4 - Extended Serial Interrupt Register | ESIR4 | - | R/W |
| 000529 _H | Reserved | - | - | - |
| 00052A _H | USART5 - Serial Mode Register | SMR5 | - | R/W |
| 00052B _H | USART5 - Serial Control Register | SCR5 | - | R/W |
| 00052C _H | USART5 - RX Register | TDR5 | - | W |
| 00052C _H | USART5 - TX Register | RDR5 | - | R |
| 00052D _H | USART5 - Serial Status | SSR5 | - | R/W |
| 00052E _H | USART5 - Control/Com. Register | ECCR5 | - | R/W |
| 00052F _H | USART5 - Ext. Status Register | ESCR5 | - | R/W |
| 000530 _H | USART5 - Baud Rate Generator Register Low | BGRL5 | BGR5 | R/W |
| 000531 _H | USART5 - Baud Rate Generator Register High | BGRH5 | - | R/W |
| 000532 _H | USART5 - Extended Serial Interrupt Register | ESIR5 | - | R/W |
| 000533 _H - 00055F _H | Reserved | - | - | - |
| 000560 _H | ALARM0 - Control Status Register | ACSR0 | - | R/W |
| 000561 _H | ALARM0 - Extended Control Status Register | AECSR0 | - | R/W |
| 000562 _H | ALARM1 - Control Status Register | ACSR1 | - | R/W |
| 000563 _H | ALARM1 - Extended Control Status Register | AECSR1 | - | R/W |
| 000564 _H | PPG6 - Timer register | - | PTMR6 | R |
| 000565 _H | PPG6 - Timer register | - | - | R |
| 000566 _H | PPG6 - Period setting register | - | PCSR6 | W |
| 000567 _H | PPG6 - Period setting register | - | - | W |
| 000568 _H | PPG6 - Duty cycle register | - | PDUT6 | W |
| 000569 _H | PPG6 - Duty cycle register | - | - | W |
| 00056A _H | PPG6 - Control status register Low | PCNL6 | PCN6 | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|--|------------------------------|-------------------------------|--------|
| 00056B _H | PPG6 - Control status register High | PCNH6 | - | R/W |
| 00056C _H | PPG7 - Timer register | - | PTMR7 | R |
| 00056D _H | PPG7 - Timer register | - | - | R |
| 00056E _H | PPG7 - Period setting register | - | PCSR7 | W |
| 00056F _H | PPG7 - Period setting register | - | | W |
| 000570 _H | PPG7 - Duty cycle register | - | PDUT7 | W |
| 000571 _H | PPG7 - Duty cycle register | - | - | W |
| 000572 _H | PPG7 - Control status register Low | PCNL7 | PCN7 | R/W |
| 000573 _H | PPG7 - Control status register High | PCNH7 | - | R/W |
| 000574 _H 0005DF _H | Reserved | - | - | - |
| 0005E0 _H | SMC0 - PWM control register | PWC0 | - | R/W |
| 0005E1 _H | SMC0 - Extended control register (Output enable) | PWEC0 | - | R/W |
| 0005E2 _H | SMC0 - PWM compare register PWM 1 | - | PWC10 | R/W |
| 0005E3 _H | SMC0 - PWM compare register PWM 1 | - | - | R/W |
| 0005E4 _H | SMC0 - PWM compare register PWM 2 | - | PWC20 | R/W |
| 0005E5 _H | SMC0 - PWM compare register PWM 2 | - | - | R/W |
| 0005E6 _H | SMC0 - PWM Select register | PWS10 | - | R/W |
| 0005E7 _H | SMC0 - PWM Select register | PWS20 | - | R/W |
| 0005E8 _H 0005E9 _H | Reserved | - | - | - |
| 0005EA _H | SMC1 - PWM control register | PWC1 | - | R/W |
| 0005EB _H | SMC1 - Extended control register (Output enable) | PWEC1 | - | R/W |
| 0005EC _H | SMC1 - PWM compare register PWM 1 | - | PWC11 | R/W |
| 0005ED _H | SMC1 - PWM compare register PWM 1 | - | - | R/W |
| 0005EE _H | SMC1 - PWM compare register PWM 2 | - | PWC21 | R/W |
| 0005EF _H | SMC1 - PWM compare register PWM 2 | - | - | R/W |
| 0005F0 _H | SMC1 - PWM Select register | PWS11 | - | R/W |
| 0005F1 _H | SMC1 - PWM Select register | PWS21 | - | R/W |
| 0005F2 _H 0005F3 _H | Reserved | - | - | - |
| 0005F4 _H | SMC2 - PWM control register | PWC2 | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|--|---------------------------|----------------------------|--------|
| 0005F5 _H | SMC2 - Extended control register (Output enable) | PWEC2 | - | R/W |
| 0005F6 _H | SMC2 - PWM compare register PWM 1 | - | PWC12 | R/W |
| 0005F7 _H | SMC2 - PWM compare register PWM 1 | - | - | R/W |
| 0005F8 _H | SMC2 - PWM compare register PWM 2 | - | PWC22 | R/W |
| 0005F9 _H | SMC2 - PWM compare register PWM 2 | - | - | R/W |
| 0005FA _H | SMC2 - PWM Select register | PWS12 | - | R/W |
| 0005FB _H | SMC2 - PWM Select register | PWS22 | - | R/W |
| 0005FC _H - 0005FD _H | Reserved | - | - | - |
| 0005FE _H | SMC3 - PWM control register | PWC3 | - | R/W |
| 0005FF _H | SMC3 - Extended control register (Output enable) | PWEC3 | - | R/W |
| 000600 _H | SMC3 - PWM compare register PWM 1 | - | PWC13 | R/W |
| 000601 _H | SMC3 - PWM compare register PWM 1 | - | - | R/W |
| 000602 _H | SMC3 - PWM compare register PWM 2 | - | PWC23 | R/W |
| 000603 _H | SMC3 - PWM compare register PWM 2 | - | - | R/W |
| 000604 _H | SMC3 - PWM Select register | PWS13 | - | R/W |
| 000605 _H | SMC3 - PWM Select register | PWS23 | - | R/W |
| 000606 _H - 000607 _H | Reserved | - | - | - |
| 000608 _H | SMC4 - PWM control register | PWC4 | - | R/W |
| 000609 _H | SMC4 - Extended control register (Output enable) | PWEC4 | - | R/W |
| 00060A _H | SMC4 - PWM compare register PWM 1 | - | PWC14 | R/W |
| 00060B _H | SMC4 - PWM compare register PWM 1 | - | - | R/W |
| 00060C _H | SMC4 - PWM compare register PWM 2 | - | PWC24 | R/W |
| 00060D _H | SMC4 - PWM compare register PWM 2 | - | - | R/W |
| 00060E _H | SMC4 - PWM Select register | PWS14 | - | R/W |
| 00060F _H | SMC4 - PWM Select register | PWS24 | - | R/W |
| 000610 _H - 00061B _H | Reserved | - | - | - |
| 00061C _H | LCD - Output Enable Register 0 (Seg 7-0) | LCDER0 | - | R/W |
| 00061D _H | LCD - Output Enable Register 1 (Seg 15-8) | LCDER1 | - | R/W |
| 00061E _H | LCD - Output Enable Register 2 (Seg 23-16) | LCDER2 | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|---------------------|--|---------------------------|----------------------------|--------|
| 00061F _H | LCD - Output Enable Register 3 (Seg 31-24) | LCDER3 | - | R/W |
| 000620 _H | LCD - Output Enable Register 4 (Seg 39-32) | LCDER4 | - | R/W |
| 000621 _H | LCD - Output Enable Register 5 (Seg 47-40) | LCDER5 | - | R/W |
| 000622 _H | LCD - Output Enable Register 6 (Seg 55-48) | LCDER6 | - | R/W |
| 000623 _H | LCD - Output Enable Register 7 (Seg 63-56) | LCDER7 | - | R/W |
| 000624 _H | LCD - Output Enable Register 8 (Seg 71-64) | LCDER8 | - | R/W |
| 000625 _H | Reserved | - | - | - |
| 000626 _H | LCD - Output Enable Register V (Vx) | LCDVER | - | R/W |
| 000627 _H | LCD - Extended Control Register | LECR | - | R/W |
| 000628 _H | LCD - Common pin switching register | LCDCMR | - | R/W |
| 000629 _H | LCD - Control Register | LCR | - | R/W |
| 00062A _H | LCD - Data register for Segment 1-0 | VRAM0 | - | R/W |
| 00062B _H | LCD - Data register for Segment 3-2 | VRAM1 | - | R/W |
| 00062C _H | LCD - Data register for Segment 5-4 | VRAM2 | - | R/W |
| 00062D _H | LCD - Data register for Segment 7-6 | VRAM3 | - | R/W |
| 00062E _H | LCD - Data register for Segment 9-8 | VRAM4 | - | R/W |
| 00062F _H | LCD - Data register for Segment 11-10 | VRAM5 | - | R/W |
| 000630 _H | LCD - Data register for Segment 13-12 | VRAM6 | - | R/W |
| 000631 _H | LCD - Data register for Segment 15-14 | VRAM7 | - | R/W |
| 000632 _H | LCD - Data register for Segment 17-16 | VRAM8 | - | R/W |
| 000633 _H | LCD - Data register for Segment 19-18 | VRAM9 | - | R/W |
| 000634 _H | LCD - Data register for Segment 21-20 | VRAM10 | - | R/W |
| 000635 _H | LCD - Data register for Segment 23-22 | VRAM11 | - | R/W |
| 000636 _H | LCD - Data register for Segment 25-24 | VRAM12 | - | R/W |
| 000637 _H | LCD - Data register for Segment 27-26 | VRAM13 | - | R/W |
| 000638 _H | LCD - Data register for Segment 29-28 | VRAM14 | - | R/W |
| 000639 _H | LCD - Data register for Segment 31-30 | VRAM15 | - | R/W |
| 00063A _H | LCD - Data register for Segment 33-32 | VRAM16 | - | R/W |
| 00063B _H | LCD - Data register for Segment 35-34 | VRAM17 | - | R/W |
| 00063C _H | LCD - Data register for Segment 37-36 | VRAM18 | - | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 00063D _H | LCD - Data register for Segment 39-38 | VRAM19 | - | R/W |
| 00063E _H | LCD - Data register for Segment 41-40 | VRAM20 | - | R/W |
| 00063F _H | LCD - Data register for Segment 43-42 | VRAM21 | - | R/W |
| 000640 _H | LCD - Data register for Segment 45-44 | VRAM22 | - | R/W |
| 000641 _H | LCD - Data register for Segment 47-46 | VRAM23 | - | R/W |
| 000642 _H | LCD - Data register for Segment 49-48 | VRAM24 | - | R/W |
| 000643 _H | LCD - Data register for Segment 51-50 | VRAM25 | - | R/W |
| 000644 _H | LCD - Data register for Segment 53-52 | VRAM26 | - | R/W |
| 000645 _H | LCD - Data register for Segment 55-54 | VRAM27 | - | R/W |
| 000646 _H | LCD - Data register for Segment 57-56 | VRAM28 | - | R/W |
| 000647 _H | LCD - Data register for Segment 59-58 | VRAM29 | - | R/W |
| 000648 _H | LCD - Data register for Segment 61-60 | VRAM30 | - | R/W |
| 000649 _H | LCD - Data register for Segment 63-62 | VRAM31 | - | R/W |
| 00064A _H | LCD - Data register for Segment 65-64 | VRAM32 | - | R/W |
| 00064B _H - 00065F _H | Reserved | - | - | - |
| 000660 _H | Peripheral Resource Relocation Register 10 | PRRR10 | - | R/W |
| 000661 _H | Peripheral Resource Relocation Register 11 | PRRR11 | - | R/W |
| 000662 _H | Peripheral Resource Relocation Register 12 | PRRR12 | - | R/W |
| 000663 _H | Peripheral Resource Relocation Register 13 | PRRR13 | - | W |
| 000664 _H - 0006DF _H | Reserved | - | - | - |
| 0006E0 _H | External Bus - Area configuration register 0 Low | EACL0 | EAC0 | R/W |
| 0006E1 _H | External Bus - Area configuration register 0 High | EACH0 | - | R/W |
| 0006E2 _H | External Bus - Area configuration register 1 Low | EACL1 | EAC1 | R/W |
| 0006E3 _H | External Bus - Area configuration register 1 High | EACH1 | - | R/W |
| 0006E4 _H | External Bus - Area configuration register 2 Low | EACL2 | EAC2 | R/W |
| 0006E5 _H | External Bus - Area configuration register 2 High | EACH2 | - | R/W |
| 0006E6 _H | External Bus - Area configuration register 3 Low | EACL3 | EAC3 | R/W |
| 0006E7 _H | External Bus - Area configuration register 3 High | EACH3 | - | R/W |
| 0006E8 _H | External Bus - Area configuration register 4 Low | EACL4 | EAC4 | R/W |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 0006E9 _H | External Bus - Area configuration register 4 High | EACH4 | - | R/W |
| 0006EA _H | External Bus - Area configuration register 5 Low | EACL5 | EAC5 | R/W |
| 0006EB _H | External Bus - Area configuration register 5 High | EACH5 | - | R/W |
| 0006EC _H | External Bus - Area select register 2 | EAS2 | - | R/W |
| 0006ED _H | External Bus - Area select register 3 | EAS3 | - | R/W |
| 0006EE _H | External Bus - Area select register 4 | EAS4 | - | R/W |
| 0006EF _H | External Bus - Area select register 5 | EAS5 | - | R/W |
| 0006F0 _H | External Bus - Mode register | EBM | - | R/W |
| 0006F1 _H | External Bus - Clock and Function register | EBCF | - | R/W |
| 0006F2 _H | External Bus - Address output enable register 0 | EBAE0 | - | R/W |
| 0006F3 _H | External Bus - Address output enable register 1 | EBAE1 | - | R/W |
| 0006F4 _H | External Bus - Address output enable register 2 | EBAE2 | - | R/W |
| 0006F5 _H | External Bus - Control signal register | EBCS | - | R/W |
| 0006F6 _H - 0006FF _H | Reserved | - | - | - |
| 000700 _H | CAN0 - Control register Low | CTRLRL0 | CTRLR0 | R/W |
| 000701 _H | CAN0 - Control register High (reserved) | CTRLRH0 | - | R |
| 000702 _H | CAN0 - Status register Low | STATRL0 | STATR0 | R/W |
| 000703 _H | CAN0 - Status register High (reserved) | STATRH0 | - | R |
| 000704 _H | CAN0 - Error Counter Low (Transmit) | ERRCNTL0 | ERRCNT0 | R |
| 000705 _H | CAN0 - Error Counter High (Receive) | ERRCNTH0 | - | R |
| 000706 _H | CAN0 - Bit Timing Register Low | BTRL0 | BTR0 | R/W |
| 000707 _H | CAN0 - Bit Timing Register High | BTRH0 | - | R/W |
| 000708 _H | CAN0 - Interrupt Register Low | INTRL0 | INTR0 | R |
| 000709 _H | CAN0 - Interrupt Register High | INTRH0 | - | R |
| 00070A _H | CAN0 - Test Register Low | TESTRL0 | TESTR0 | R/W |
| 00070B _H | CAN0 - Test Register High (reserved) | TESTRH0 | - | R |
| 00070C _H | CAN0 - BRP Extension register Low | BRPERL0 | BRPER0 | R/W |
| 00070D _H | CAN0 - BRP Extension register High (reserved) | BRPERH0 | - | R |
| 00070E _H - 00070F _H | Reserved | - | - | - |

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| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|--|---------------------------|----------------------------|--------|
| 000710 _H | CAN0 - IF1 Command request register Low | IF1CREQL0 | IF1CREQ0 | R/W |
| 000711 _H | CAN0 - IF1 Command request register High | IF1CREQH0 | - | R/W |
| 000712 _H | CAN0 - IF1 Command Mask register Low | IF1CMSKL0 | IF1CMSK0 | R/W |
| 000713 _H | CAN0 - IF1 Command Mask register High (reserved) | IF1CMSKH0 | - | R |
| 000714 _H | CAN0 - IF1 Mask 1 Register Low | IF1MSK1L0 | IF1MSK10 | R/W |
| 000715 _H | CAN0 - IF1 Mask 1 Register High | IF1MSK1H0 | - | R/W |
| 000716 _H | CAN0 - IF1 Mask 2 Register Low | IF1MSK2L0 | IF1MSK20 | R/W |
| 000717 _H | CAN0 - IF1 Mask 2 Register High | IF1MSK2H0 | - | R/W |
| 000718 _H | CAN0 - IF1 Arbitration 1 Register Low | IF1ARB1L0 | IF1ARB10 | R/W |
| 000719 _H | CAN0 - IF1 Arbitration 1 Register High | IF1ARB1H0 | - | R/W |
| 00071A _H | CAN0 - IF1 Arbitration 2 Register Low | IF1ARB2L0 | IF1ARB20 | R/W |
| 00071B _H | CAN0 - IF1 Arbitration 2 Register High | IF1ARB2H0 | - | R/W |
| 00071C _H | CAN0 - IF1 Message Control Register Low | IF1MCTRL0 | IF1MCTR0 | R/W |
| 00071D _H | CAN0 - IF1 Message Control Register High | IF1MCTRH0 | - | R/W |
| 00071E _H | CAN0 - IF1 Data A1 Low | IF1DTA1L0 | IF1DTA10 | R/W |
| 00071F _H | CAN0 - IF1 Data A1 High | IF1DTA1H0 | - | R/W |
| 000720 _H | CAN0 - IF1 Data A2 Low | IF1DTA2L0 | IF1DTA20 | R/W |
| 000721 _H | CAN0 - IF1 Data A2 High | IF1DTA2H0 | - | R/W |
| 000722 _H | CAN0 - IF1 Data B1 Low | IF1DTB1L0 | IF1DTB10 | R/W |
| 000723 _H | CAN0 - IF1 Data B1 High | IF1DTB1H0 | - | R/W |
| 000724 _H | CAN0 - IF1 Data B2 Low | IF1DTB2L0 | IF1DTB20 | R/W |
| 000725 _H | CAN0 - IF1 Data B2 High | IF1DTB2H0 | - | R/W |
| 000726 _H - 00073F _H | Reserved | - | - | - |
| 000740 _H | CAN0 - IF2 Command request register Low | IF2CREQL0 | IF2CREQ0 | R/W |
| 000741 _H | CAN0 - IF2 Command request register High | IF2CREQH0 | - | R/W |
| 000742 _H | CAN0 - IF2 Command Mask register Low | IF2CMSKL0 | IF2CMSK0 | R/W |
| 000743 _H | CAN0 - IF2 Command Mask register High (reserved) | IF2CMSKH0 | - | R |
| 000744 _H | CAN0 - IF2 Mask 1 Register Low | IF2MSK1L0 | IF2MSK10 | R/W |
| 000745 _H | CAN0 - IF2 Mask 1 Register High | IF2MSK1H0 | - | R/W |

I/O Map CY96(F)38x (Sheet 26 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 000746 _H | CAN0 - IF2 Mask 2 Register Low | IF2MSK2L0 | IF2MSK20 | R/W |
| 000747 _H | CAN0 - IF2 Mask 2 Register High | IF2MSK2H0 | - | R/W |
| 000748 _H | CAN0 - IF2 Arbitration 1 Register Low | IF2ARB1L0 | IF2ARB10 | R/W |
| 000749 _H | CAN0 - IF2 Arbitration 1 Register High | IF2ARB1H0 | - | R/W |
| 00074A _H | CAN0 - IF2 Arbitration 2 Register Low | IF2ARB2L0 | IF2ARB20 | R/W |
| 00074B _H | CAN0 - IF2 Arbitration 2 Register High | IF2ARB2H0 | - | R/W |
| 00074C _H | CAN0 - IF2 Message Control Register Low | IF2MCTRL0 | IF2MCTR0 | R/W |
| 00074D _H | CAN0 - IF2 Message Control Register High | IF2MCTRH0 | - | R/W |
| 00074E _H | CAN0 - IF2 Data A1 Low | IF2DTA1L0 | IF2DTA10 | R/W |
| 00074F _H | CAN0 - IF2 Data A1 High | IF2DTA1H0 | - | R/W |
| 000750 _H | CAN0 - IF2 Data A2 Low | IF2DTA2L0 | IF2DTA20 | R/W |
| 000751 _H | CAN0 - IF2 Data A2 High | IF2DTA2H0 | - | R/W |
| 000752 _H | CAN0 - IF2 Data B1 Low | IF2DTB1L0 | IF2DTB10 | R/W |
| 000753 _H | CAN0 - IF2 Data B1 High | IF2DTB1H0 | - | R/W |
| 000754 _H | CAN0 - IF2 Data B2 Low | IF2DTB2L0 | IF2DTB20 | R/W |
| 000755 _H | CAN0 - IF2 Data B2 High | IF2DTB2H0 | - | R/W |
| 000756 _H - 00077F _H | Reserved | - | - | - |
| 000780 _H | CAN0 - Transmission Request 1 Register Low | TREQR1L0 | TREQR10 | R |
| 000781 _H | CAN0 - Transmission Request 1 Register High | TREQR1H0 | - | R |
| 000782 _H | CAN0 - Transmission Request 2 Register Low | TREQR2L0 | TREQR20 | R |
| 000783 _H | CAN0 - Transmission Request 2 Register High | TREQR2H0 | - | R |
| 000784 _H - 00078F _H | Reserved | - | - | - |
| 000790 _H | CAN0 - New Data 1 Register Low | NEWDT1L0 | NEWDT10 | R |
| 000791 _H | CAN0 - New Data 1 Register High | NEWDT1H0 | - | R |
| 000792 _H | CAN0 - New Data 2 Register Low | NEWDT2L0 | NEWDT20 | R |
| 000793 _H | CAN0 - New Data 2 Register High | NEWDT2H0 | - | R |
| 000794 _H - 00079F _H | Reserved | - | - | - |
| 0007A0 _H | CAN0 - Interrupt Pending 1 Register Low | INTPND1L0 | INTPND10 | R |
| 0007A1 _H | CAN0 - Interrupt Pending 1 Register High | INTPND1H0 | - | R |

I/O Map CY96(F)38x (Sheet 27 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 0007A2 _H | CAN0 - Interrupt Pending 2 Register Low | INTPND2L0 | INTPND20 | R |
| 0007A3 _H | CAN0 - Interrupt Pending 2 Register High | INTPND2H0 | - | R |
| 0007A4 _H - 0007AF _H | Reserved | - | - | - |
| 0007B0 _H | CAN0 - Message Valid 1 Register Low | MSGVAL1L0 | MSGVAL10 | R |
| 0007B1 _H | CAN0 - Message Valid 1 Register High | MSGVAL1H0 | - | R |
| 0007B2 _H | CAN0 - Message Valid 2 Register Low | MSGVAL2L0 | MSGVAL20 | R |
| 0007B3 _H | CAN0 - Message Valid 2 Register High | MSGVAL2H0 | - | R |
| 0007B4 _H - 0007CD _H | Reserved | - | - | - |
| 0007CE _H | CAN0 - Output enable register | COER0 | - | R/W |
| 0007CF _H | Reserved | - | - | - |
| 0007D0 _H | SG0 - Sound Generator Control Register Low | SGCRL0 | SGCR0 | R/W |
| 0007D1 _H | SG0 - Sound Generator Control Register High | SGCRH0 | - | R/W |
| 0007D2 _H | SG0 - Sound Generator Frequency Register | SGFR0 | - | R/W |
| 0007D3 _H | SG0 - Sound Generator Amplitude Register | SGAR0 | - | R/W |
| 0007D4 _H | SG0 - Sound Generator Decrement Register | SGDR0 | - | R/W |
| 0007D5 _H | SG0 - Sound Generator Tone Register | SGTR0 | - | R/W |
| 0007D6 _H | SG1 - Sound Generator Control Register Low | SGCRL1 | SGCR1 | R/W |
| 0007D7 _H | SG1 - Sound Generator Control Register High | SGCRH1 | - | R/W |
| 0007D8 _H | SG1 - Sound Generator Frequency Register | SGFR1 | - | R/W |
| 0007D9 _H | SG1 - Sound Generator Amplitude Register | SGAR1 | - | R/W |
| 0007DA _H | SG1 - Sound Generator Decrement Register | SGDR1 | - | R/W |
| 0007DB _H | SG1 - Sound Generator Tone Register | SGTR1 | - | R/W |
| 0007DC _H - 0007FF _H | Reserved | - | - | - |
| 000800 _H | CAN1 - Control register Low | CTRLRL1 | CTRLR1 | R/W |
| 000801 _H | CAN1 - Control register High (reserved) | CTRLRH1 | - | R |
| 000802 _H | CAN1 - Status register Low | STATRL1 | STATR1 | R/W |
| 000803 _H | CAN1 - Status register High (reserved) | STATRH1 | - | R |
| 000804 _H | CAN1 - Error Counter Low (Transmit) | ERRCNTL1 | ERRCNT1 | R |
| 000805 _H | CAN1 - Error Counter High (Receive) | ERRCNTH1 | - | R |

I/O Map CY96(F)38x (Sheet 28 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|--|---------------------------|----------------------------|--------|
| 000806 _H | CAN1 - Bit Timing Register Low | BTRL1 | BTR1 | R/W |
| 000807 _H | CAN1 - Bit Timing Register High | BTRH1 | - | R/W |
| 000808 _H | CAN1 - Interrupt Register Low | INTRL1 | INTR1 | R |
| 000809 _H | CAN1 - Interrupt Register High | INTRH1 | - | R |
| 00080A _H | CAN1 - Test Register Low | TESTRL1 | TESTR1 | R/W |
| 00080B _H | CAN1 - Test Register High (reserved) | TESTRH1 | - | R |
| 00080C _H | CAN1 - BRP Extension register Low | BRPERL1 | BRPER1 | R/W |
| 00080D _H | CAN1 - BRP Extension register High (reserved) | BRPERH1 | - | R |
| 00080E _H - 00080F _H | Reserved | - | - | - |
| 000810 _H | CAN1 - IF1 Command request register Low | IF1CREQL1 | IF1CREQ1 | R/W |
| 000811 _H | CAN1 - IF1 Command request register High | IF1CREQH1 | - | R/W |
| 000812 _H | CAN1 - IF1 Command Mask register Low | IF1CMSKL1 | IF1CMSK1 | R/W |
| 000813 _H | CAN1 - IF1 Command Mask register High (reserved) | IF1CMSKH1 | - | R |
| 000814 _H | CAN1 - IF1 Mask 1 Register Low | IF1MSK1L1 | IF1MSK11 | R/W |
| 000815 _H | CAN1 - IF1 Mask 1 Register High | IF1MSK1H1 | - | R/W |
| 000816 _H | CAN1 - IF1 Mask 2 Register Low | IF1MSK2L1 | IF1MSK21 | R/W |
| 000817 _H | CAN1 - IF1 Mask 2 Register High | IF1MSK2H1 | - | R/W |
| 000818 _H | CAN1 - IF1 Arbitration 1 Register Low | IF1ARB1L1 | IF1ARB11 | R/W |
| 000819 _H | CAN1 - IF1 Arbitration 1 Register High | IF1ARB1H1 | - | R/W |
| 00081A _H | CAN1 - IF1 Arbitration 2 Register Low | IF1ARB2L1 | IF1ARB21 | R/W |
| 00081B _H | CAN1 - IF1 Arbitration 2 Register High | IF1ARB2H1 | - | R/W |
| 00081C _H | CAN1 - IF1 Message Control Register Low | IF1MCTRL1 | IF1MCTR1 | R/W |
| 00081D _H | CAN1 - IF1 Message Control Register High | IF1MCTRH1 | - | R/W |
| 00081E _H | CAN1 - IF1 Data A1 Low | IF1DTA1L1 | IF1DTA11 | R/W |
| 00081F _H | CAN1 - IF1 Data A1 High | IF1DTA1H1 | - | R/W |
| 000820 _H | CAN1 - IF1 Data A2 Low | IF1DTA2L1 | IF1DTA21 | R/W |
| 000821 _H | CAN1 - IF1 Data A2 High | IF1DTA2H1 | - | R/W |
| 000822 _H | CAN1 - IF1 Data B1 Low | IF1DTB1L1 | IF1DTB11 | R/W |
| 000823 _H | CAN1 - IF1 Data B1 High | IF1DTB1H1 | - | R/W |

I/O Map CY96(F)38x (Sheet 29 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|--|---------------------------|----------------------------|--------|
| 000824 _H | CAN1 - IF1 Data B2 Low | IF1DTB2L1 | IF1DTB21 | R/W |
| 000825 _H | CAN1 - IF1 Data B2 High | IF1DTB2H1 | - | R/W |
| 000826 _H - 00083F _H | Reserved | - | - | - |
| 000840 _H | CAN1 - IF2 Command request register Low | IF2CREQL1 | IF2CREQ1 | R/W |
| 000841 _H | CAN1 - IF2 Command request register High | IF2CREQH1 | - | R/W |
| 000842 _H | CAN1 - IF2 Command Mask register Low | IF2CMSKL1 | IF2CMSK1 | R/W |
| 000843 _H | CAN1 - IF2 Command Mask register High (reserved) | IF2CMSKH1 | - | R |
| 000844 _H | CAN1 - IF2 Mask 1 Register Low | IF2MSK1L1 | IF2MSK11 | R/W |
| 000845 _H | CAN1 - IF2 Mask 1 Register High | IF2MSK1H1 | - | R/W |
| 000846 _H | CAN1 - IF2 Mask 2 Register Low | IF2MSK2L1 | IF2MSK21 | R/W |
| 000847 _H | CAN1 - IF2 Mask 2 Register High | IF2MSK2H1 | - | R/W |
| 000848 _H | CAN1 - IF2 Arbitration 1 Register Low | IF2ARB1L1 | IF2ARB11 | R/W |
| 000849 _H | CAN1 - IF2 Arbitration 1 Register High | IF2ARB1H1 | - | R/W |
| 00084A _H | CAN1 - IF2 Arbitration 2 Register Low | IF2ARB2L1 | IF2ARB21 | R/W |
| 00084B _H | CAN1 - IF2 Arbitration 2 Register High | IF2ARB2H1 | - | R/W |
| 00084C _H | CAN1 - IF2 Message Control Register Low | IF2MCTRL1 | IF2MCTR1 | R/W |
| 00084D _H | CAN1 - IF2 Message Control Register High | IF2MCTRH1 | - | R/W |
| 00084E _H | CAN1 - IF2 Data A1 Low | IF2DTA1L1 | IF2DTA11 | R/W |
| 00084F _H | CAN1 - IF2 Data A1 High | IF2DTA1H1 | - | R/W |
| 000850 _H | CAN1 - IF2 Data A2 Low | IF2DTA2L1 | IF2DTA21 | R/W |
| 000851 _H | CAN1 - IF2 Data A2 High | IF2DTA2H1 | - | R/W |
| 000852 _H | CAN1 - IF2 Data B1 Low | IF2DTB1L1 | IF2DTB11 | R/W |
| 000853 _H | CAN1 - IF2 Data B1 High | IF2DTB1H1 | - | R/W |
| 000854 _H | CAN1 - IF2 Data B2 Low | IF2DTB2L1 | IF2DTB21 | R/W |
| 000855 _H | CAN1 - IF2 Data B2 High | IF2DTB2H1 | - | R/W |
| 000856 _H - 00087F _H | Reserved | - | - | - |
| 000880 _H | CAN1 - Transmission Request 1 Register Low | TREQR1L1 | TREQR11 | R |
| 000881 _H | CAN1 - Transmission Request 1 Register High | TREQR1H1 | - | R |
| 000882 _H | CAN1 - Transmission Request 2 Register Low | TREQR2L1 | TREQR21 | R |

I/O Map CY96(F)38x (Sheet 30 of 30)

| Address | Register | Abbreviation 8-bit Access | Abbreviation 16-bit Access | Access |
|--|---|---------------------------|----------------------------|--------|
| 000883 _H | CAN1 - Transmission Request 2 Register High | TREQR2H1 | - | R |
| 000884 _H - 00088F _H | Reserved | - | - | - |
| 000890 _H | CAN1 - New Data 1 Register Low | NEWDT1L1 | NEWDT11 | R |
| 000891 _H | CAN1 - New Data 1 Register High | NEWDT1H1 | - | R |
| 000892 _H | CAN1 - New Data 2 Register Low | NEWDT2L1 | NEWDT21 | R |
| 000893 _H | CAN1 - New Data 2 Register High | NEWDT2H1 | - | R |
| 000894 _H - 00089F _H | Reserved | - | - | - |
| 0008A0 _H | CAN1 - Interrupt Pending 1 Register Low | INTPND1L1 | INTPND11 | R |
| 0008A1 _H | CAN1 - Interrupt Pending 1 Register High | INTPND1H1 | - | R |
| 0008A2 _H | CAN1 - Interrupt Pending 2 Register Low | INTPND2L1 | INTPND21 | R |
| 0008A3 _H | CAN1 - Interrupt Pending 2 Register High | INTPND2H1 | - | R |
| 0008A4 _H - 0008AF _H | Reserved | - | - | - |
| 0008B0 _H | CAN1 - Message Valid 1 Register Low | MSGVAL1L1 | MSGVAL11 | R |
| 0008B1 _H | CAN1 - Message Valid 1 Register High | MSGVAL1H1 | - | R |
| 0008B2 _H | CAN1 - Message Valid 2 Register Low | MSGVAL2L1 | MSGVAL21 | R |
| 0008B3 _H | CAN1 - Message Valid 2 Register High | MSGVAL2H1 | - | R |
| 0008B4 _H - 0008CD _H | Reserved | - | - | - |
| 0008CE _H | CAN1 - Output enable register | COER1 | - | R/W |
| 0008CF _H - 000BFF _H | Reserved | - | - | - |

Note: Any write access to reserved addresses in the I/O map should not be performed. A read access to a reserved address results in reading 'X'.

Registers of resources which are described in this table, but which are not supported by the device, should also be handled as "Reserved".

13. Interrupt Vector Table

Interrupt Vector Table CY96(F)38x (Sheet 1 of 3)

| Vector Number | Offset in Vector Table | Vector Name | Cleared by DMA | Index in ICR to Program | Description |
|---------------|------------------------|-------------|----------------|-------------------------|--------------------------------|
| 0 | 3FC _H | CALLV0 | No | - | |
| 1 | 3F8 _H | CALLV1 | No | - | |
| 2 | 3F4 _H | CALLV2 | No | - | |
| 3 | 3F0 _H | CALLV3 | No | - | |
| 4 | 3EC _H | CALLV4 | No | - | |
| 5 | 3E8 _H | CALLV5 | No | - | |
| 6 | 3E4 _H | CALLV6 | No | - | |
| 7 | 3E0 _H | CALLV7 | No | - | |
| 8 | 3DC _H | RESET | No | - | |
| 9 | 3D8 _H | INT9 | No | - | |
| 10 | 3D4 _H | EXCEPTION | No | - | |
| 11 | 3D0 _H | NMI | No | - | Non-Maskable Interrupt |
| 12 | 3CC _H | DLY | No | 12 | Delayed Interrupt |
| 13 | 3C8 _H | RC_TIMER | No | 13 | RC Timer |
| 14 | 3C4 _H | MC_TIMER | No | 14 | Main Clock Timer |
| 15 | 3C0 _H | SC_TIMER | No | 15 | Sub Clock Timer |
| 16 | 3BC _H | RESERVED | No | 16 | Reserved |
| 17 | 3B8 _H | EXTINT0 | Yes | 17 | External Interrupt 0 |
| 18 | 3B4 _H | EXTINT1 | Yes | 18 | External Interrupt 1 |
| 19 | 3B0 _H | EXTINT2 | Yes | 19 | External Interrupt 2 |
| 20 | 3AC _H | EXTINT3 | Yes | 20 | External Interrupt 3 |
| 21 | 3A8 _H | EXTINT4 | Yes | 21 | External Interrupt 4 |
| 22 | 3A4 _H | EXTINT5 | Yes | 22 | External Interrupt 5 |
| 23 | 3A0 _H | EXTINT6 | Yes | 23 | External Interrupt 6 |
| 24 | 39C _H | EXTINT7 | Yes | 24 | External Interrupt 7 |
| 25 | 398 _H | CAN0 | No | 25 | CAN Controller 0 |
| 26 | 394 _H | CAN1* | No | 26 | CAN Controller 1 |
| 27 | 390 _H | PPG0 | Yes | 27 | Programmable Pulse Generator 0 |
| 28 | 38C _H | PPG1 | Yes | 28 | Programmable Pulse Generator 1 |
| 29 | 388 _H | PPG2 | Yes | 29 | Programmable Pulse Generator 2 |
| 30 | 384 _H | PPG3 | Yes | 30 | Programmable Pulse Generator 3 |
| 31 | 380 _H | PPG4 | Yes | 31 | Programmable Pulse Generator 4 |
| 32 | 37C _H | PPG5 | Yes | 32 | Programmable Pulse Generator 5 |
| 33 | 378 _H | PPG6 | Yes | 33 | Programmable Pulse Generator 6 |
| 34 | 374 _H | PPG7 | Yes | 34 | Programmable Pulse Generator 7 |

Interrupt Vector Table CY96(F)38x (Sheet 2 of 3)

| Vector Number | Offset in Vector Table | Vector Name | Cleared by DMA | Index in ICR to Program | Description |
|---------------|------------------------|-------------|----------------|-------------------------|------------------------------------|
| 35 | 370 _H | RLT0 | Yes | 35 | Reload Timer 0 |
| 36 | 36C _H | RLT1 | Yes | 36 | Reload Timer 1 |
| 37 | 368 _H | RLT2 | Yes | 37 | Reload Timer 2 |
| 38 | 364 _H | RLT3 | Yes | 38 | Reload Timer 3 |
| 39 | 360 _H | PPGRLT | Yes | 39 | Reload Timer 6 - dedicated for PPG |
| 40 | 35C _H | ICU0 | Yes | 40 | Input Capture Unit 0 |
| 41 | 358 _H | ICU1 | Yes | 41 | Input Capture Unit 1 |
| 42 | 354 _H | ICU2 | Yes | 42 | Input Capture Unit 2 |
| 43 | 350 _H | ICU3 | Yes | 43 | Input Capture Unit 3 |
| 44 | 34C _H | ICU4 | Yes | 44 | Input Capture Unit 4 |
| 45 | 348 _H | ICU5 | Yes | 45 | Input Capture Unit 5 |
| 46 | 344 _H | ICU6 | Yes | 46 | Input Capture Unit 6 |
| 47 | 340 _H | ICU7 | Yes | 47 | Input Capture Unit 7 |
| 48 | 33C _H | OCU0 | Yes | 48 | Output Compare Unit 0 |
| 49 | 338 _H | OCU1 | Yes | 49 | Output Compare Unit 1 |
| 50 | 334 _H | OCU2 | Yes | 50 | Output Compare Unit 2 |
| 51 | 330 _H | OCU3 | Yes | 51 | Output Compare Unit 3 |
| 52 | 32C _H | FRT0 | Yes | 52 | Free Running Timer 0 |
| 53 | 328 _H | FRT1 | Yes | 53 | Free Running Timer 1 |
| 54 | 324 _H | RTC0 | No | 54 | Real Timer Clock |
| 55 | 320 _H | CAL0 | No | 55 | Clock Calibration Unit |
| 56 | 31C _H | SG0 | No | 56 | Sound Generator 0 |
| 57 | 318 _H | SG1 | No | 57 | Sound Generator 1 |
| 58 | 314 _H | IIC0 | Yes | 58 | I2C interface |
| 59 | 310 _H | ADC0 | Yes | 59 | A/D Converter |
| 60 | 30C _H | ALARM0 | No | 60 | Alarm Comparator 0 |
| 61 | 308 _H | ALARM1* | No | 61 | Alarm Comparator 1 |
| 62 | 304 _H | LINR0 | Yes | 62 | LIN USART 0 RX |
| 63 | 300 _H | LINT0 | Yes | 63 | LIN USART 0 TX |
| 64 | 2FC _H | LINR1 | Yes | 64 | LIN USART 1 RX |
| 65 | 2F8 _H | LINT1 | Yes | 65 | LIN USART 1 TX |
| 66 | 2F4 _H | LINR2 | Yes | 66 | LIN USART 2 RX |
| 67 | 2F0 _H | LINT2 | Yes | 67 | LIN USART 2 TX |
| 68 | 2EC _H | LINR4 | Yes | 68 | LIN USART 4 RX |
| 69 | 2E8 _H | LINT4 | Yes | 69 | LIN USART 4 TX |
| 70 | 2E4 _H | LINR5 | Yes | 70 | LIN USART 5 RX |
| 71 | 2E0 _H | LINT5 | Yes | 71 | LIN USART 5 TX |

Interrupt Vector Table CY96(F)38x (Sheet 3 of 3)

| Vector Number | Offset in Vector Table | Vector Name | Cleared by DMA | Index in ICR to Program | Description |
|---------------|------------------------|-------------|----------------|-------------------------|-------------------------------------|
| 72 | 2DC _H | FLASH_A | No | 72 | Flash memory A (only Flash devices) |
| 73 | 2D8 _H | FLASH_B | No | 73 | Flash memory B (only CY96F388/F389) |

*: ALARM1 and CAN1 are not included on CY96384 and CY96(F)385 devices

14. Handling Devices

Special care is required for the following when handling the device:

- Latch-up prevention
- Unused pins handling
- External clock usage
- Unused sub clock signal
- Notes on PLL clock mode operation
- Power supply pins (V_{CC}/V_{SS})
- Crystal oscillator circuit
- Turn on sequence of power supply to A/D converter and analog inputs
- Pin handling when not using the A/D converter
- Notes on energization
- Stabilization of power supply voltage
- SMC power supply pins
- Serial communication

14.1 Latch-up prevention

CMOS IC chips may suffer latch-up under the following conditions:

- A voltage higher than V_{CC} or lower than V_{SS} is applied to an input or output pin.
- A voltage higher than the rated voltage is applied between V_{CC} pins and V_{SS} pins.
- The AV_{CC} power supply is applied before the V_{CC} voltage.

Latch-up may increase the power supply current dramatically, causing thermal damages to the device.

For the same reason, extra care is required to not let the analog power-supply voltage (AV_{CC} , $AVRH$) exceed the digital power-supply voltage.

14.2 Unused pins handling

Unused input pins can be left open when the input is disabled (corresponding bit of Port Input Enable register $PIER = 0$).

Leaving unused input pins open when the input is enabled may result in misbehavior and possible permanent damage of the device. They must therefore be pulled up or pulled down through resistors. To prevent latch-up, those resistors should be more than $2\text{ k}\Omega$.

Unused bidirectional pins can be set either to the output state and be then left open, or to the input state with either input disabled or external pull-up/pull-down resistor as described above.

14.3 External clock usage

The permitted frequency range of an external clock depends on the oscillator type and configuration. See AC Characteristics for detailed modes and frequency limits. Single and opposite phase external clocks must be connected as follows:

1. Single phase external clock

- When using a single phase external clock, X0 pin must be driven and X1 pin left open.



2. Opposite phase external clock

- When using an opposite phase external clock, X1 (X1A) must be supplied with a clock signal which has the opposite phase to the X0 (X0A) pins.



14.4 Unused sub clock signal

If the pins X0A and X1A are not connected to an oscillator, a pull-down resistor must be connected on the X0A pin and the X1A pin must be left open.

14.5 Notes on PLL clock mode operation

If the PLL clock mode is selected and no external oscillator is operating or no external clock is supplied, the microcontroller attempts to work with the free oscillating PLL. Performance of this operation, however, cannot be guaranteed.

14.6 Power supply pins (V_{CC}/V_{SS})

It is required that all V_{CC} -level as well as all V_{SS} -level power supply pins are at the same potential. If there is more than one V_{CC} or V_{SS} level, the device may operate incorrectly or be damaged even within the guaranteed operating range.

V_{CC} and V_{SS} must be connected to the device from the power supply with lowest possible impedance.

As a measure against power supply noise, it is required to connect a bypass capacitor of about 0.1 μF between V_{CC} and V_{SS} as close as possible to V_{CC} and V_{SS} pins.

14.7 Crystal oscillator and ceramic resonator circuit

Noise at X0, X1 pins or X0A, X1A pins might cause abnormal operation. It is required to provide bypass capacitors with shortest possible distance to X0, X1 pins and X0A, X1A pins, crystal oscillator (or ceramic resonator) and ground lines, and, to the utmost effort, that the lines of oscillation circuit do not cross the lines of other circuits.

It is highly recommended to provide a printed circuit board art work surrounding X0, X1 pins and X0A, X1A pins with a ground area for stabilizing the operation.

It is highly recommended to evaluate the quartz/MCU or resonator/MCU system at the quartz or resonator manufacturer, especially when using low-Q resonators at higher frequencies.

14.8 Turn on sequence of power supply to A/D converter and analog inputs

It is required to turn the A/D converter power supply (AV_{CC} , AVRH, AVRL) and analog inputs (ANn) on after turning the digital power supply (V_{CC}) on.

It is also required to turn the digital power off after turning the A/D converter supply and analog inputs off. In this case, the voltage must not exceed AVRH or AV_{CC} (turning the analog and digital power supplies simultaneously on or off is acceptable).

14.9 Pin handling when not using the A/D converter

It is required to connect the unused pins of the A/D converter as $AV_{CC} = V_{CC}$, $AV_{SS} = AVRH = AVRL = V_{SS}$.

14.10 Notes on Power-on

To prevent malfunction of the internal voltage regulator, supply voltage profile while turning the power supply on should be slower than 50 μs from 0.2 V to 2.7 V.

14.11 Stabilization of power supply voltage

If the power supply voltage varies acutely even within the operation safety range of the V_{CC} power supply voltage, a malfunction may occur. The V_{CC} power supply voltage must therefore be stabilized. As stabilization guidelines, the power supply voltage must be stabilized in such a way that V_{CC} ripple fluctuations (peak to peak value) in the commercial frequencies (50 to 60 Hz) fall within 10% of the standard V_{CC} power supply voltage and the transient fluctuation rate becomes 0.1 $\text{V}/\mu\text{s}$ or less in instantaneous fluctuation for power supply switching.

14.12 SMC power supply pins

All DV_{SS} pins must be set to the same level as the V_{SS} pins.

The DV_{CC} power supply level can be set independently of the V_{CC} power supply level. However note that the SMC I/O pin state is undefined if DV_{CC} is powered on and V_{CC} is below 3 V. To avoid this, we recommend to always power V_{CC} before DV_{CC} .

14.13 Serial communication

There is a possibility to receive wrong data due to noise or other causes on the serial communication.

Therefore, design a printed circuit board so as to avoid noise.

Consider receiving of wrong data when designing the system. For example apply a checksum and retransmit the data if an error occurs.

15. Electrical Characteristics

15.1 Absolute Maximum Ratings

| Parameter | Symbol | Rating | | Unit | Remarks |
|--|----------------------|----------------|----------------|------|---|
| | | Min | Max | | |
| Power supply voltage | V_{CC} | $V_{SS} - 0.3$ | $V_{SS} + 6.0$ | V | |
| | AV_{CC} | $V_{SS} - 0.3$ | $V_{SS} + 6.0$ | V | $V_{CC} = AV_{CC}^{*1}$ |
| AD Converter voltage references | AVRH, AVRL | $V_{SS} - 0.3$ | $V_{SS} + 6.0$ | V | $AV_{CC} \geq AVRH$, $AV_{CC} \geq AVRL$, $AVRH > AVRL$, $AVRL \geq AV_{SS}$ |
| SMC Power supply | DV_{CC} | $V_{SS} - 0.3$ | $V_{SS} + 6.0$ | V | See *7 |
| LCD power supply voltage | V0 to V3 | $V_{SS} - 0.3$ | $V_{SS} + 6.0$ | V | V0 to V3 must not exceed V_{CC} |
| Input voltage | V_I | $V_{SS} - 0.3$ | $V_{SS} + 6.0$ | V | $V_I \leq (D)V_{CC} + 0.3 V^{*2}$ |
| Output voltage | V_O | $V_{SS} - 0.3$ | $V_{SS} + 6.0$ | V | $V_O \leq (D)V_{CC} + 0.3 V^{*2}$ |
| Maximum Clamp Current | I_{CLAMP} | -4.0 | +4.0 | mA | Applicable to general purpose I/O pins *3 |
| Total Maximum Clamp Current | $\Sigma I_{CLAMP} $ | - | 40 | mA | Applicable to general purpose I/O pins *3 |
| "L" level maximum output current | I_{OL1} | - | 15 | mA | Normal outputs with driving strength set to 5mA |
| | I_{OLSMC} | - | 40 | mA | High current outputs with driving strength set to 30mA |
| "L" level average output current | I_{OLAV1} | - | 5 | mA | Normal outputs with driving strength set to 5mA |
| | $I_{OLAVSMC}$ | - | 30 | mA | High current outputs with driving strength set to 30mA |
| "L" level maximum overall output current | ΣI_{OL1} | - | 100 | mA | Normal outputs |
| | ΣI_{OLSMC} | - | 330 | mA | High current outputs |
| "L" level average overall output current | ΣI_{OLAV1} | - | 50 | mA | Normal outputs |
| | $\Sigma I_{OLAVSMC}$ | - | 250 | mA | High current outputs |
| "H" level maximum output current | I_{OH1} | - | -15 | mA | Normal outputs with driving strength set to 5 mA |
| | I_{OHSMC} | - | -40 | mA | High current outputs with driving strength set to 30 mA |
| "H" level average output current | I_{OHAV1} | - | -5 | mA | Normal outputs with driving strength set to 5 mA |
| | $I_{OHAVSMC}$ | - | -30 | mA | High current outputs with driving strength set to 30 mA |
| "H" level maximum overall output current | ΣI_{OH1} | - | -100 | mA | Normal outputs |
| | ΣI_{OHSMC} | - | -330 | mA | High current outputs |
| "H" level average overall output current | ΣI_{OHAV1} | - | -50 | mA | Normal outputs |
| | ΣI_{OHASMC} | - | -250 | mA | High current outputs |

| Parameter | Symbol | Rating | | Unit | Remarks |
|--|------------------|--------|--------------------|------|--|
| | | Min | Max | | |
| Permitted Power dissipation (CY96F385) *4 | P _D | - | 295 ^{*5} | mW | T _A =105°C |
| | | - | 595 ^{*5} | mW | T _A =85°C |
| | | - | 820 ^{*5} | mW | T _A =70°C |
| | | - | 370 ^{*5} | mW | T _A =125°C, no Flash program/erase ^{*6} |
| | | - | 670 ^{*5} | mW | T _A =105°C, no Flash program/erase ^{*6} |
| Permitted Power dissipation (CY96F386/F387/F388/F389) *4 | P _D | - | 370 ^{*5} | mW | T _A =105°C |
| | | - | 740 ^{*5} | mW | T _A =85°C |
| | | - | 1000 ^{*5} | mW | T _A =70°C |
| | | - | 460 ^{*5} | mW | T _A =125°C, no Flash program/erase ^{*6} |
| | | - | 800 ^{*5} | mW | T _A =105°C, no Flash program/erase ^{*6} |
| Permitted Power dissipation (CY96384/385) *4 | P _D | - | 310 ^{*5} | mW | T _A =105°C |
| | | - | 625 ^{*5} | mW | T _A =85°C |
| | | - | 800 ^{*5} | mW | T _A =70°C |
| | | - | 390 ^{*5} | mW | T _A =125°C ^{*6} |
| | | - | 700 ^{*5} | mW | T _A =105°C ^{*6} |
| Operating ambient temperature | T _A | 0 | +70 | °C | CY96V300B |
| | | -40 | +105 | | |
| | | -40 | +125 | | ^{*6} |
| Storage temperature | T _{STG} | -55 | +150 | °C | |

*1: AV_{CC} and V_{CC} must be set to the same voltage. It is required that AV_{CC} does not exceed V_{CC} and that the voltage at the analog inputs does not exceed AV_{CC} neither when the power is switched on.

*2: V_I and V_O should not exceed (D)V_{CC} + 0.3 V. V_I should also not exceed the specified ratings. However if the maximum current to/from a input is limited by some means with external components, the I_{CLAMP} rating supersedes the V_I rating. Input/output voltages of high current ports depend on DV_{CC}. Input/output voltages of standard ports depend on V_{CC}.

- *3:
- Applicable to all general purpose I/O pins (Pnn_m) except I/O pins with SEG or COM functionality.
 - Use within recommended operating conditions.
 - Use at DC voltage (current)
 - The +B signal should always be applied a limiting resistance placed between the +B signal and the microcontroller.
 - The value of the limiting resistance should be set so that when the +B signal is applied the input current to the microcontroller pin does not exceed rated values, either instantaneously or for prolonged periods.
 - Note that when the microcontroller drive current is low, such as in the power saving modes, the +B input potential may pass through the protective diode and increase the potential at the VCC pin, and this may affect other devices.
 - Note that if a +B signal is input when the microcontroller power supply is off (not fixed at 0 V), the power supply is provided from the pins, so that incomplete operation may result.

- Note that if the +B input is applied during power-on, the power supply is provided from the pins and the resulting supply voltage may not be sufficient to operate the Power reset (except devices with persistent low voltage reset in internal vector mode).
- No +B signal must be applied to any LCD I/O pin (including unused SEG/COM pins).
- Sample recommended circuits:



- *4: The maximum permitted power dissipation depends on the ambient temperature, the air flow velocity and the thermal conductance of the package on the PCB.
 The actual power dissipation depends on the customer application and can be calculated as follows:
 $P_D = P_{IO} + P_{INT}$
 $P_{IO} = \sum (V_{OL} * I_{OL} + V_{OH} * I_{OH})$ (IO load power dissipation, sum is performed on all IO ports)
 $P_{INT} = V_{CC} * (I_{CC} + I_A)$ (internal power dissipation)
 I_{CC} is the total core current consumption into V_{CC} as described in the “DC characteristics” and depends on the selected operation mode and clock frequency and the usage of functions like Flash programming or the clock modulator.
 I_A is the analog current consumption into AV_{CC} .
- *5: Worst case value for a package mounted on single layer PCB at specified T_A without air flow.
- *6: Please contact Cypress for reliability limitations when using under these conditions.
- *7: If DV_{CC} is powered before V_{CC} , then SMC I/O pins state is undefined. To avoid this, we recommend to always power V_{CC} before DV_{CC} . It is not necessary to set V_{CC} and DV_{CC} to the same value.

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

15.2 Recommended Operating Conditions

| Parameter | Symbol | Value | | | Unit | Remarks |
|------------------------------|-------------------|-------|----------|-----|---------|--|
| | | Min | Typ | Max | | |
| Power supply voltage | V_{CC}, DV_{CC} | 3.0 | - | 5.5 | V | |
| Smoothing capacitor at C pin | C_S | 3.5 | 4.7 - 10 | 15 | μF | Use a low inductance capacitor (for example X7R ceramic capacitor) |

WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated within these ranges. Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure. No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their representatives beforehand.

15.3 DC characteristics
 $(T_A = -40^{\circ}\text{C to } 125^{\circ}\text{C}, V_{CC} = AV_{CC} = 3.0\text{V to } 5.5\text{V}, DV_{CC} = 3.0\text{V to } 5.5\text{V}, V_{SS} = AV_{SS} = DV_{SS} = 0\text{V})$

| Parameter | Symbol | Pin | Condition | Value | | | Unit | Remarks |
|-----------------|--------------------|----------------------|---|--|-------------------|-----------------------|---------------------|---|
| | | | | Min | Typ | Max | | |
| Input H voltage | V_{IH} | Port inputs Pnn_m | CMOS Hysteresis 0.8/0.2 input selected | 0.8 V_{CC} | - | (D) V_{CC} + 0.3 | V | |
| | | | CMOS Hysteresis 0.7/0.3 input selected | 0.7 V_{CC} | - | (D) V_{CC} + 0.3 | V | (D) $V_{CC} \geq 4.5\text{ V}$ |
| | | | | 0.74 V_{CC} | - | (D) V_{CC} + 0.3 | V | (D) $V_{CC} < 4.5\text{ V}$ |
| | | | AUTOMOTIVE Hysteresis input selected | 0.8 V_{CC} | - | (D) V_{CC} + 0.3 | V | |
| | TTL input selected | 2.0 | - | (D) V_{CC} + 0.3 | V | | | |
| | V_{IHx0F} | X0 | External clock in "Fast Clock Input mode" | 0.8 V_{CC} | - | $V_{CC} +$ 0.3 | V | Not available in CY96F386xxA/F387xxA |
| | V_{IHx0S} | X0,X1, X0A,X1A | External clock in "oscillation mode" | 2.5 | - | $V_{CC} +$ 0.3 | V | |
| | V_{IHR} | RSTX | - | 0.8 V_{CC} | - | $V_{CC} +$ 0.3 | V | CMOS Hysteresis input |
| V_{IHM} | MD2-MD0 | - | $V_{CC} -$ 0.3 | - | $V_{CC} +$ 0.3 | V | | |
| Input L voltage | V_{IL} | Port inputs Pnn_m | CMOS Hysteresis 0.8/0.2 input selected | $V_{SS} -$ 0.3 | - | 0.2 (D) V_{CC} | V | |
| | | | CMOS Hysteresis 0.7/0.3 input selected | $V_{SS} -$ 0.3 | - | 0.3 (D) V_{CC} | V | |
| | | | | AUTOMOTIVE Hysteresis input selected | $V_{SS} -$ 0.3 | - | 0.5 (D) V_{CC} | V |
| | | | | $V_{SS} -$ 0.3 | - | 0.46 (D) V_{CC} | | (D) $V_{CC} < 4.5\text{ V}$ |
| | | | TTL input selected | $V_{SS} -$ 0.3 | - | 0.8 | V | |
| | V_{ILx0F} | X0 | External clock in "Fast Clock Input mode" | $V_{SS} -$ 0.3 | - | 0.2 V_{CC} | V | Not available in CY96F386xxA/F387xxA |
| | V_{ILx0S} | X0,X1, X0A,X1A | External clock in "oscillation mode" | $V_{SS} -$ 0.3 | - | 0.4 | V | |
| | V_{ILR} | RSTX | - | $V_{SS} -$ 0.3 | - | 0.2 V_{CC} | V | CMOS Hysteresis input |
| | V_{ILM} | MD2-MD0 | - | $V_{SS} -$ 0.3 | - | $V_{SS} +$ 0.3 | V | |

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Pin | Condition | Value | | | Unit | Remarks |
|------------------|----------------------|---|--|-------------------|-----|-----|-------------------------------|------------------------------|
| | | | | Min | Typ | Max | | |
| Output H voltage | V_{OH2} | Normal and High Current outputs | $4.5\text{ V} \leq (D)V_{CC} \leq 5.5\text{ V}$ $I_{OH} = -2\text{ mA}$ | $(D)V_{CC} - 0.5$ | - | - | V | Driving strength set to 2 mA |
| | | | $3.0\text{ V} \leq (D)V_{CC} < 4.5\text{ V}$ $I_{OH} = -1.6\text{ mA}$ | | | | | |
| | V_{OH5} | Normal and High Current outputs | $4.5\text{ V} \leq (D)V_{CC} \leq 5.5\text{ V}$ $I_{OH} = -5\text{ mA}$ | $(D)V_{CC} - 0.5$ | - | - | V | Driving strength set to 5 mA |
| | | | $3.0\text{ V} \leq (D)V_{CC} < 4.5\text{ V}$ $I_{OH} = -3\text{ mA}$ | | | | | |
| V_{OH30} | High current outputs | $4.5\text{ V} \leq DV_{CC} \leq 5.5\text{ V}$ $I_{OH} = -30\text{ mA}$ | $DV_{CC} - 0.5$ | - | - | V | Driving strength set to 30 mA | |
| | | $3.0\text{ V} \leq DV_{CC} < 4.5\text{ V}$ $I_{OH} = -20\text{ mA}$ | | | | | | |
| V_{OH3} | 3mA outputs | $4.5\text{ V} \leq V_{CC} \leq 5.5\text{ V}$ $I_{OH} = -3\text{ mA}$ | $V_{CC} - 0.5$ | - | - | V | | |
| | | $3.0\text{ V} \leq V_{CC} < 4.5\text{ V}$ $I_{OH} = -2\text{ mA}$ | | | | | | |

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Pin | Condition | Value | | | Unit | Remarks |
|--------------------------------|----------------------|---|--|-------|-----|-----|-------------------------------|---|
| | | | | Min | Typ | Max | | |
| Output L voltage | V_{OL2} | Normal and High Current outputs | $4.5\text{ V} \leq (D)V_{CC} \leq 5.5\text{ V}$ $I_{OL} = +2\text{ mA}$ | - | - | 0.4 | V | Driving strength set to 2 mA |
| | | | $3.0\text{ V} \leq (D)V_{CC} < 4.5\text{ V}$ $I_{OL} = +1.6\text{ mA}$ | | | | | |
| | V_{OL5} | Normal and High Current outputs | $4.5\text{ V} \leq (D)V_{CC} \leq 5.5\text{ V}$ $I_{OL} = +5\text{ mA}$ | - | - | 0.4 | V | Driving strength set to 5 mA |
| | | | $3.0\text{ V} \leq (D)V_{CC} < 4.5\text{ V}$ $I_{OL} = +3\text{ mA}$ | | | | | |
| V_{OL30} | High current outputs | $4.5\text{ V} \leq DV_{CC} \leq 5.5\text{ V}$ $I_{OL} = +30\text{ mA}$ | - | - | 0.5 | V | Driving strength set to 30 mA | |
| | | $3.0\text{ V} \leq DV_{CC} < 4.5\text{ V}$ $I_{OL} = +20\text{ mA}$ | | | | | | |
| V_{OL3} | 3mA outputs | $3.0\text{ V} \leq V_{CC} \leq 5.5\text{ V}$ $I_{OL} = +3\text{ mA}$ | - | - | 0.4 | V | | |
| Input leak current | I_{IL} | Pnn_m | $V_{SS} < V_I < V_{CC}$ $AV_{SS}, AV_{RL} < V_I < AV_{CC}, AV_{RH}$ | -1 | - | +1 | μA | Single port pin |
| Total LCD leak current | $\sum I_{LCD} $ | all SEG/COM pins | $V_{CC} = 5.0\text{ V}$ | - | 0.5 | 10 | μA | Maximum leakage current of all LCD pins |
| Internal LCD divide resistance | R_{LCD} | Between V3 and V_{SS} | $V_{CC} = 5.0\text{ V}$ | 25 | 40 | 65 | $\text{k}\Omega$ | |
| Pull-up resistance | R_{UP} | Pnn_m, RSTX | $V_{CC} = 3.3\text{ V} \pm 10\%$ | 40 | 100 | 160 | $\text{k}\Omega$ | |
| | | | $V_{CC} = 5.0\text{ V} \pm 10\%$ | 25 | 50 | 100 | $\text{k}\Omega$ | |

Note: Input/output voltages of high current ports depend on DV_{CC} , of other ports on V_{CC} .

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Condition (at T_A) | Value | | | Remarks | |
|------------------------------------|-------------|---|--------|-----|------|---------|---|
| | | | Typ | Max | Unit | | |
| Power supply current in Run modes* | I_{CCPLL} | PLL Run mode with CLKS1/2 = 48 MHz, CLKB = CLKP1/2 = 24 MHz (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 35 | 44 | mA | CY96F385/F386/F387 at 0 Flash wait states |
| | | | +125°C | 36 | 47 | | |
| | | | +25°C | 38 | 46 | mA | CY96F388/F389 at 0 Flash wait states |
| | | | +125°C | 39 | 49 | | |
| | | | +25°C | 16 | 22 | mA | CY96384/385 at 0 ROM wait states |
| | | | +125°C | 17 | 23.5 | | |
| | | PLL Run mode with CLKS1/2 = CLKB = CLKP1 = 56 MHz, CLKP2 = 28 MHz (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 44 | 57 | mA | CY96F386/F387 at 2 Flash wait states |
| | | | +125°C | 45 | 60 | | |
| | | | +25°C | 24 | 34 | mA | CY96384/385 at 2 ROM wait states |
| | | | +125°C | 25 | 35.5 | | |
| | | PLL Run mode with CLKS1/2 = 72 MHz, CLKB = CLKP1 = 36 MHz, CLKP2 = 18 MHz (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 38 | 50 | mA | CY96F386/F387 at 1 Flash wait state |
| | | | +125°C | 39 | 53 | | |
| | | PLL Run mode with CLKS1/2 = 80 MHz, CLKB = CLKP1 = 40 MHz, CLKP2 = 20 MHz (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 43 | 55 | mA | CY96F385 at 1 Flash wait state |
| | | | +125°C | 44 | 57 | | |
| | | | +25°C | 48 | 60 | mA | CY96F388/F389 at 1 Flash wait state |
| | | | +125°C | 49 | 63 | | |
| | | PLL Run mode with CLKS1/2 = 96 MHz, CLKB = CLKP1 = 48 MHz, CLKP2 = 24 MHz (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 25 | 35 | mA | CY96384/385 at 1 ROM wait state |
| | | | +125°C | 26 | 36.5 | | |

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Condition (at T_A) | Value | | | Remarks | |
|------------------------------------|--------------|---|--------|------|------|--|---|
| | | | Typ | Max | Unit | | |
| Power supply current in Run modes* | I_{CCMAIN} | Main Run mode with CLKS1/2 = CLKB = CLKP1/2 = 4 MHz (CLKPLL, CLKSC and CLKRC stopped) | +25°C | 4.5 | 5.5 | mA | CY96F385 at 1 Flash wait state |
| | | | +125°C | 5.1 | 7.5 | | |
| | | | +25°C | 4.5 | 5.5 | mA | CY96F386/F387 at 1 Flash wait state |
| | | | +125°C | 5.1 | 8.5 | | |
| | | | +25°C | 4.8 | 6 | mA | CY96F388/F389 at 1 Flash wait state |
| | | | +125°C | 5.4 | 8.5 | | |
| | | | +25°C | 2.5 | 3.5 | mA | CY96384/385 at 1 ROM wait state |
| | | | +125°C | 3.1 | 5 | | |
| | I_{CCRCH} | RC Run mode with CLKS1/2 = CLKB = CLKP1/2 = 2 MHz (CLKMC, CLKPLL and CLKSC stopped) | +25°C | 2.5 | 3.6 | mA | CY96F385 at 1 Flash wait state |
| | | | +125°C | 3.1 | 5.1 | | |
| | | | +25°C | 2.9 | 4 | mA | CY96F386/F387/F388/F389 at 1 Flash wait state |
| | | | +125°C | 3.5 | 6.5 | | |
| | | | +25°C | 1.7 | 2.7 | mA | CY96384/385 at 1 ROM wait state |
| | | | +125°C | 2.3 | 4.2 | | |
| | I_{CCRCL} | RC Run mode with CLKS1/2 = CLKB = CLKP1/2 = 100 kHz, SMCR:LPMS = 0 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in high power mode) | +25°C | 0.4 | 0.6 | mA | CY96F386/F387 at 1 Flash wait state |
| | | | +125°C | 0.9 | 3.5 | | |
| | | | +25°C | 0.4 | 0.6 | | CY96F388/F389 at 1 Flash wait state |
| | | | +125°C | 0.9 | 2.9 | | |
| | | | +25°C | 0.4 | 0.6 | | CY96384/385/F385 at 1 ROM/Flash wait state |
| | | | +125°C | 0.9 | 2 | | |
| | | RC Run mode with CLKS1/2 = CLKB = CLKP1/2 = 100 kHz, SMCR:LPMS = 1 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in low power mode, no Flash programming/erasing allowed) | +25°C | 0.15 | 0.25 | mA | CY96F386/F387 at 1 Flash wait state |
| | | | +125°C | 0.65 | 3.2 | | |
| | | | +25°C | 0.15 | 0.25 | mA | CY96F388/F389 at 1 Flash wait state |
| | | | +125°C | 0.65 | 2.6 | | |
| +25°C | | | 0.15 | 0.25 | mA | CY96384/385/F385 at 1 ROM/Flash wait state | |
| +125°C | | | 0.65 | 1.75 | | | |

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Condition (at T_A) | Value | | | Remarks | |
|------------------------------------|-------------|---|--------|-----|------|---------|---|
| | | | Typ | Max | Unit | | |
| Power supply current in Run modes* | I_{CCSUB} | Sub Run mode with CLKS1/2 = CLKB = CLKP1/2 = 32 kHz (CLKMC, CLKPLL and CLKRC stopped, no Flash programming/erasing allowed) | +25°C | 0.1 | 0.2 | mA | CY96F386/F387 at 1 Flash wait state |
| | | | +125°C | 0.6 | 3 | | |
| | | | +25°C | 0.1 | 0.2 | mA | CY96F388/F389 at 1 Flash wait state |
| | | | +125°C | 0.6 | 2.4 | | |
| | | | +25°C | 0.1 | 0.2 | mA | CY96384/385/F385 at 1 ROM/Flash wait state |
| | | | +125°C | 0.6 | 1.7 | | |

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Condition (at T_A) | | Value | | | Remarks |
|--------------------------------------|--------------|--|--------|-------|------|------|------------------|
| | | | | Typ | Max | Unit | |
| Power supply current in Sleep modes* | I_{CCSPLL} | | +25°C | 7.5 | 9 | mA | CY96F385 |
| | | | +125°C | 8.2 | 10.5 | | |
| | | PLL Sleep mode with CLKS1/2 = 48 MHz, CLKP1/2 = 24 MHz (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 9 | 10.5 | mA | CY96F386/F387 |
| | | | +125°C | 9.7 | 13 | | |
| | | | +25°C | 11 | 13 | mA | CY96F388/F389 |
| | | | +125°C | 11.7 | 15.5 | | |
| | | | +25°C | 7 | 8.5 | mA | CY96384/385 |
| | | | +125°C | 7.7 | 10 | | |
| | | PLL Sleep mode with CLKS1/2 = CLKP1 = 56 MHz, CLKP2 = 28 MHz (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 14 | 15.5 | mA | CY96F386/F387 |
| | | | +125°C | 14.8 | 18 | | |
| | | | +25°C | 12 | 13.5 | mA | CY96384/385 |
| | | | +125°C | 12.8 | 15 | | |
| | | PLL Sleep mode with CLKS1/2 = 72 MHz, CLKP1 = 36 MHz, CLKP2 = 18 MHz (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 10.5 | 12 | mA | CY96F386/F387 |
| | | | +125°C | 11.3 | 14.5 | | |
| | | PLL Sleep mode with CLKS1/2 = 80 MHz, CLKP1 = 40 MHz, CLKP2 = 20 MHz (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 14 | 17 | mA | CY96F388/F389 |
| | | | +125°C | 14.8 | 19.5 | | |
| | | PLL Sleep mode with CLKS1/2 = 96 MHz, CLKP1 = 48 MHz, CLKP2 = 24 MHz (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 13 | 14.5 | mA | CY96384/385/F385 |
| | | | +125°C | 13.8 | 16 | | |

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Condition (at T_A) | | Value | | | Remarks |
|--------------------------------------|--------------|--|--------|-------|-----|------|------------------|
| | | | | Typ | Max | Unit | |
| Power supply current in Sleep modes* | I_{CCSMAN} | Main Sleep mode with CLKS1/2 = CLKP1/2 = 4 MHz (CLKPLL, CLKSC and CLKRC stopped) | +25°C | 1.5 | 1.8 | mA | CY96F386/F387 |
| | | | +125°C | 2 | 4.5 | | |
| | | | +25°C | 1.6 | 2 | mA | CY96F388/F389 |
| | | | +125°C | 2.1 | 4.2 | | |
| | | | +25°C | 1.5 | 1.8 | mA | CY96384/385/F385 |
| | | | +125°C | 2 | 3.3 | | |
| | I_{CCSRCH} | RC Sleep mode with CLKS1/2 = CLKP1/2 = 2 MHz (CLKMC, CLKPLL and CLKSC stopped) | +25°C | 0.9 | 1.4 | mA | CY96F386/F387 |
| | | | +125°C | 1.5 | 4 | | |
| | | | +25°C | 0.9 | 1.4 | mA | CY96F388/F389 |
| | | | +125°C | 1.5 | 3.5 | | |
| | | | +25°C | 0.9 | 1.4 | mA | CY96384/385/F385 |
| | | | +125°C | 1.5 | 2.8 | | |

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Condition (at T_A) | | Value | | | Remarks |
|--------------------------------------|--|---|--------|-------|------|------------------|------------------|
| | | | | Typ | Max | Unit | |
| Power supply current in Sleep modes* | I_{CCSRCL} | RC Sleep mode with $CLKS1/2 = CLKP1/2 = 100\text{ kHz}$, $SMCR:LPMSS = 0$ (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in high power mode) | +25°C | 0.3 | 0.5 | mA | CY96F386/F387 |
| | | | +125°C | 0.8 | 3.4 | | |
| | | | +25°C | 0.3 | 0.5 | mA | CY96F388/F389 |
| | | | +125°C | 0.8 | 2.8 | | |
| | | | +25°C | 0.3 | 0.5 | mA | CY96384/385/F385 |
| | | | +125°C | 0.8 | 2 | | |
| | I_{CCSRCL} | RC Sleep mode with $CLKS1/2 = CLKP1/2 = 100\text{ kHz}$, $SMCR:LPMSS = 1$ (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in low power mode) | +25°C | 0.06 | 0.15 | mA | CY96F386/F387 |
| | | | +125°C | 0.56 | 3 | | |
| | | | +25°C | 0.06 | 0.15 | mA | CY96F388/F389 |
| | | | +125°C | 0.56 | 2.4 | | |
| | | | +25°C | 0.06 | 0.15 | mA | CY96384/385/F385 |
| | | | +125°C | 0.56 | 1.6 | | |
| I_{CCSSUB} | Sub Sleep mode with $CLKS1/2 = CLKP1/2 = 32\text{ kHz}$ (CLKMC, CLKPLL and CLKRC stopped) | +25°C | 0.04 | 0.12 | mA | CY96F386/F387 | |
| | | +125°C | 0.54 | 2.9 | | | |
| | | +25°C | 0.04 | 0.12 | mA | CY96F388/F389 | |
| | | +125°C | 0.54 | 2.3 | | | |
| | | +25°C | 0.04 | 0.12 | mA | CY96384/385/F385 | |
| | | +125°C | 0.54 | 1.55 | | | |
| Power supply current in Timer modes* | I_{CCTPLL} | PLL Timer mode with $CLKMC = 4\text{MHz}$, $CLKPLL = 48\text{ MHz}$ (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 1.6 | 2 | mA | CY96F386/F387 |
| | | | +125°C | 2.1 | 4.8 | | |
| | | | +25°C | 1.6 | 2 | mA | CY96F388/F389 |
| | | | +125°C | 2.1 | 4.2 | | |
| | | | +25°C | 1.6 | 2 | mA | CY96384/385/F385 |
| | | | +125°C | 2.1 | 3.5 | | |

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Condition (at T_A) | | Value | | | Remarks |
|--------------------------------------|---------------|---|--------|-------|------|------|------------------|
| | | | | Typ | Max | Unit | |
| Power supply current in Timer modes* | $I_{CCTMAIN}$ | Main Timer mode with CLKMC = 4 MHz, SMCR:LPMSS = 0 (CLKPLL, CLKRC and CLKSC stopped. Voltage regulator in high power mode) | +25°C | 0.35 | 0.5 | mA | CY96F386/F387 |
| | | | +125°C | 0.85 | 3.3 | | |
| | | | +25°C | 0.35 | 0.5 | mA | CY96F388/F389 |
| | | | +125°C | 0.85 | 2.7 | | |
| | | | +25°C | 0.35 | 0.5 | mA | CY96384/385/F385 |
| | | | +125°C | 0.85 | 2 | | |
| | | Main Timer mode with CLKMC = 4 MHz, SMCR:LPMSS = 1 (CLKPLL, CLKRC and CLKSC stopped. Voltage regulator in low power mode) | +25°C | 0.1 | 0.15 | mA | CY96F386/F387 |
| | | | +125°C | 0.6 | 2.9 | | |
| | | | +25°C | 0.1 | 0.15 | mA | CY96F388/F389 |
| | | | +125°C | 0.6 | 2.3 | | |
| | | | +25°C | 0.1 | 0.18 | | CY96384/385/F385 |
| | | | +125°C | 0.6 | 1.6 | | |
| | I_{CCTRCH} | RC Timer mode with CLKRC = 2 MHz, SMCR:LPMSS = 0 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in high power mode) | +25°C | 0.35 | 0.5 | mA | CY9CY96F386/F387 |
| | | | +125°C | 0.85 | 3.3 | | |
| | | | +25°C | 0.35 | 0.5 | mA | CY96F388/F389 |
| | | | +125°C | 0.85 | 2.7 | | |
| | | | +25°C | 0.35 | 0.5 | mA | CY96384/385/F385 |
| | | | +125°C | 0.85 | 2 | | |
| | | RC Timer mode with CLKRC = 2 MHz, SMCR:LPMSS = 1 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in low power mode) | +25°C | 0.1 | 0.15 | mA | CY96F386/F387 |
| | | | +125°C | 0.6 | 2.9 | | |
| | | | +25°C | 0.1 | 0.15 | mA | CY96F388/F389 |
| | | | +125°C | 0.6 | 2.3 | | |
| | | | +25°C | 0.1 | 0.15 | mA | CY96384/385/F385 |
| | | | +125°C | 0.6 | 1.6 | | |

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Condition (at T_A) | | Value | | | Remarks |
|--------------------------------------|--------------|---|--------|-------|------|------------------|------------------|
| | | | | Typ | Max | Unit | |
| Power supply current in Timer modes* | I_{CCTRCL} | RC Timer mode with CLKRC = 100 kHz, SMCR:LPMSS = 0 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in high power mode) | +25°C | 0.3 | 0.45 | mA | CY96F386/F387 |
| | | | +125°C | 0.8 | 3.2 | | |
| | | | +25°C | 0.3 | 0.45 | mA | CY96F386/F387 |
| | | | +125°C | 0.8 | 2.6 | | |
| | | | +25°C | 0.3 | 0.45 | mA | CY96384/385/F385 |
| | | | +125°C | 0.8 | 1.95 | | |
| | | RC Timer mode with CLKRC = 100 kHz, SMCR:LPMSS = 1 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in low power mode) | +25°C | 0.05 | 0.1 | mA | CY96F386/F387 |
| | | | +125°C | 0.55 | 2.8 | | |
| | | | +25°C | 0.05 | 0.1 | mA | CY96F388/F389 |
| | | | +125°C | 0.55 | 2.2 | | |
| | I_{CCTSUB} | Sub Timer mode with CLKSC = 32 kHz (CLKMC, CLKPLL and CLKRC stopped) | +25°C | 0.03 | 0.1 | mA | CY96F386/F387 |
| | | | +125°C | 0.53 | 2.8 | | |
| | | | +25°C | 0.03 | 0.1 | mA | CY96F388/F389 |
| | | | +125°C | 0.53 | 2.2 | | |
| +25°C | | | 0.03 | 0.1 | mA | CY96384/385/F385 | |
| +125°C | | | 0.53 | 1.55 | | | |

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Condition (at T_A) | | Value | | | Remarks | | |
|--|---------------|--|--------|-------|------|---------------|--|---------------|------------------|
| | | | | Typ | Max | Unit | | | |
| Power supply current in Stop Mode | I_{CCH} | VRCR:LPMB[2:0] = 110 _B (Core voltage at 1.8 V) | +25°C | 0.02 | 0.08 | mA | CY96F386/F387 | | |
| | | | +125°C | 0.52 | 2.8 | | | | |
| | | | +25°C | 0.02 | 0.08 | mA | | CY96F388/F389 | |
| | | | +125°C | 0.52 | 2.2 | | | | |
| | | | +25°C | 0.02 | 0.08 | mA | | | CY96384/385/F385 |
| | | | +125°C | 0.52 | 1.5 | | | | |
| | | VRCR:LPMB[2:0] = 000 _B (Core voltage at 1.2 V) | +25°C | 0.015 | 0.06 | mA | CY96F386/F387 | | |
| | | | +125°C | 0.4 | 2.3 | | | | |
| | | | +25°C | 0.015 | 0.06 | mA | | CY96F388/F389 | |
| | | | +125°C | 0.4 | 1.65 | | | | |
| | | | +25°C | 0.015 | 0.06 | mA | | | CY96384/385/F385 |
| | | | +125°C | 0.4 | 1.2 | | | | |
| Power supply current for active Low Voltage detector | I_{CCLVD} | Low voltage detector enabled (RCR:LVDE = 1) | +25°C | 90 | 140 | μA | This current must be added to all Power supply currents above | | |
| | | | +125°C | 100 | 150 | | | | |
| Power supply current for active Clock modulator | I_{CCLOMO} | Clock modulator enabled (CM-CR:PDX = 1) | - | 3 | 4.5 | mA | Must be added to all current above | | |
| Flash Write/Erase current | $I_{CCFLASH}$ | Current for one Flash module | - | 15 | 40 | mA | Must be added to all current above | | |
| Input capacitance | C_{IN} | - | - | 15 | 30 | pF | High current outputs | | |
| Input capacitance | C_{IN} | - | - | 5 | 15 | pF | Other than C, AV_{CC} , AV_{SS} , $AVRH$, $AVRL$, V_{CC} , V_{SS} , DV_{CC} , DV_{SS} , High current outputs | | |

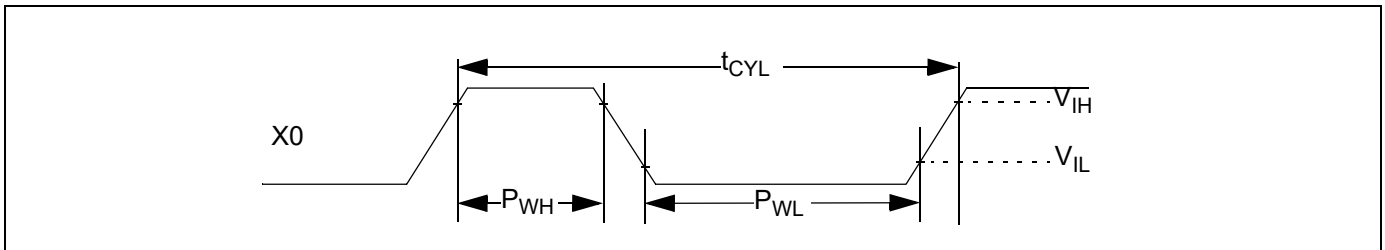
*: The power supply current is measured with a 4MHz external clock connected to the Main oscillator and a 32 kHz external clock connected to the Sub oscillator. See chapter "Standby mode and voltage regulator control circuit" of the Hardware Manual for further details about voltage regulator control.

15.4 AC Characteristics

Source Clock Timing

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Pin | Value | | | Unit | Remarks |
|-------------------------|--------------------|----------|-------|--------|---------|---------------|---|
| | | | Min | Typ | Max | | |
| Clock frequency | f_C | X0, X1 | 3 | - | 16 | MHz | When using a crystal oscillator, PLL off |
| | | | 0 | - | 16 | MHz | When using an opposite phase external clock, PLL off |
| | | | 3.5 | - | 16 | MHz | When using a crystal oscillator or opposite phase external clock, PLL on |
| Clock frequency | f_{FCI} | X0 | 0 | - | 56 | MHz | When using a single phase external clock in "Fast Clock Input mode" (not available in CY96F386xxA and CY96F387xxA), PLL off |
| | | | 3.5 | - | 56 | MHz | When using a single phase external clock in "Fast Clock Input mode" (not available in CY96F386xxA and CY96F387xxA), PLL on |
| Clock frequency | f_{CL} | X0A, X1A | 32 | 32.768 | 100 | kHz | When using an oscillation circuit |
| | | | 0 | - | 100 | kHz | When using an opposite phase external clock |
| | | X0A | 0 | - | 50 | kHz | When using a single phase external clock |
| Clock frequency | f_{CR} | - | 50 | 100 | 200 | kHz | When using slow frequency of RC oscillator |
| | | | 1 | 2 | 4 | MHz | When using fast frequency of RC oscillator |
| PLL Clock frequency | f_{CLKVCO} | - | 64 | - | 200 | MHz | Permitted VCO output frequency of PLL (CLKVCO) |
| PLL Phase Jitter | T_{PSKEW} | - | - | - | ± 5 | ns | For CLKMC (PLL input clock) ≥ 4 MHz |
| Input clock pulse width | P_{WH}, P_{WL} | X0,X1 | 8 | - | - | ns | Duty ratio is about 30% to 70% |
| Input clock pulse width | P_{WHL}, P_{WLL} | X0A,X1A | 5 | - | - | μs | |



Internal Clock Timing

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Core Voltage Settings | | | | Unit | Remarks |
|--|--------------------------------------|-----------------------|-----|-------|-----|------|--------------------|
| | | 1.8 V | | 1.9 V | | | |
| | | Min | Max | Min | Max | | |
| Internal System clock frequency (CLKS1 and CLKS2) | $f_{\text{CLKS1}}, f_{\text{CLKS2}}$ | 0 | 92 | 0 | 96 | MHz | Others than below |
| | | 0 | 72 | 0 | 80 | MHz | CY96F385/F388/F389 |
| | | 0 | 68 | 0 | 74 | MHz | CY96F386/F387 |
| Internal CPU clock frequency (CLKB), internal peripheral clock frequency (CLKP1) | $f_{\text{CLKB}}, f_{\text{CLKP1}}$ | 0 | 52 | 0 | 56 | MHz | Others than below |
| | | 0 | 36 | 0 | 40 | MHz | CY96F385/F388/F389 |
| Internal peripheral clock frequency (CLKP2) | f_{CLKP2} | 0 | 28 | 0 | 32 | MHz | Others than below |
| | | 0 | 26 | 0 | 28 | MHz | CY96F386/F387 |

External Reset Timing

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Pin | Value | | | Unit | Remarks |
|------------------|------------|------|-------|-----|-----|------|---------|
| | | | Min | Typ | Max | | |
| Reset input time | t_{RSTL} | RSTX | 500 | - | - | ns | |



Power On Reset Timing

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Pin | Value | | | Unit | Remarks |
|--------------------|-----------|-----|-------|-----|-----|------|---------|
| | | | Min | Typ | Max | | |
| Power on rise time | t_R | Vcc | 0.05 | - | 30 | ms | |
| Power off time | t_{OFF} | Vcc | 1 | - | - | ms | |



If the power supply is changed too rapidly, a power-on reset may occur. We recommend a smooth startup by restraining voltages when changing the power supply voltage during operation, as shown in the figure below.

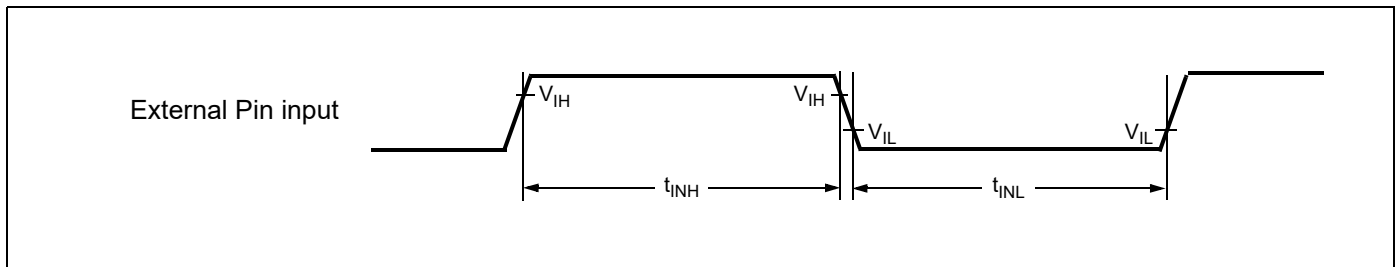


External Input Timing

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Pin | Condition | Value | | Unit | Used Pin input function |
|-------------------|------------------------|-----------|-----------|--|-----|------|-----------------------------------|
| | | | | Min | Max | | |
| Input pulse width | t_{INH} t_{INL} | INTn(_R) | — | 200 | — | ns | External Interrupt |
| | | NMI(_R) | | | | | NMI |
| | | Pnn_m | | $2 \cdot t_{CLKP1} + 200$ ($t_{CLKP1} = 1/f_{CLKP1}$) | — | ns | General Purpose IO |
| | | TINn(_R) | | | | | Reload Timer |
| | | TTGn(_R) | | | | | PPG Trigger input |
| | | ADTG(_R) | | | | | AD Converter Trigger |
| | | FRCKn(_R) | | | | | Free Running Timer external clock |
| | | INn(_R) | | | | | Input Capture |

Note : Relocated Resource Inputs have same characteristics

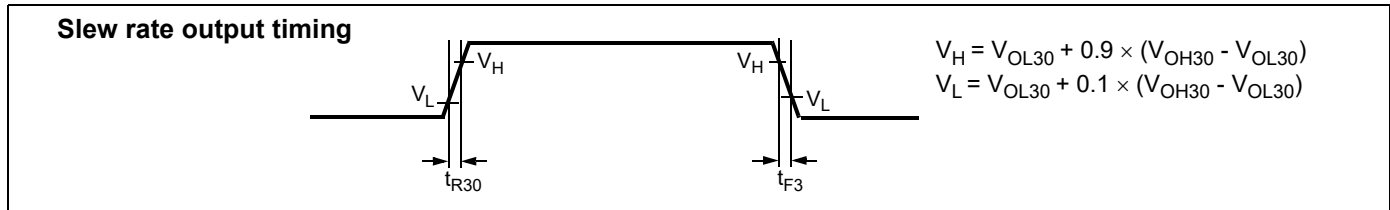


Slew Rate High Current Outputs

($T_A = -40^{\circ}\text{C}$ to 125°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

| Parameter | Symbol | Pin | Condition | Value | | Unit | Remarks |
|-----------------------|------------------------|--------------------|--|-------|-----|------|---------|
| | | | | Min | Max | | |
| Output rise/fall time | t_{R30} t_{F30} | I/O circuit type M | Output driving strength set to "30 mA" | 15 | — | ns | |

Note : Relocated Resource Inputs have same characteristics



External Bus Timing

Note: The values given below are for an I/O driving strength $IO_{drive} = 5\text{ mA}$. If IO_{drive} is 2 mA, all the maximum output timing described in the different tables must then be increased by 10 ns.

Basic Timing

($T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $V_{CC} = 5.0\text{ V} \pm 10\%$, $V_{SS} = 0.0\text{ V}$, $IO_{drive} = 5\text{ mA}$, $C_L = 50\text{ pF}$)

| Parameter | Symbol | Pin | Condition | Value | | Unit | Remarks |
|--|-------------|----------------------------------|-----------|---------------|---------------|------|---------|
| | | | | Min | Max | | |
| ECLK | t_{CYC} | ECLK | — | 25 | — | ns | |
| | t_{CHCL} | | | $t_{CYC}/2-5$ | $t_{CYC}/2+5$ | | |
| | t_{CLCH} | | | $t_{CYC}/2-5$ | $t_{CYC}/2+5$ | | |
| ECLK → UBX/ LBX / CSn time | t_{CHCBH} | CSn, UBX, LBX, ECLK | — | -20 | 20 | ns | |
| | t_{CHCBL} | | | -20 | 20 | | |
| | t_{CLCBH} | | | -20 | 20 | | |
| | t_{CLCBL} | | | -20 | 20 | | |
| ECLK → ALE time | t_{CHLH} | ALE, ECLK | — | -10 | 10 | ns | |
| | t_{CHLL} | | | -10 | 10 | | |
| | t_{CLLH} | | | -10 | 10 | | |
| | t_{CLLL} | | | -10 | 10 | | |
| ECLK → address valid time (non-multiplexed) | t_{CHAV} | A[23:0], ECLK | EBM:NMS=1 | -15 | 15 | ns | |
| | t_{CLAV} | | | -15 | 15 | | |
| ECLK → address valid time (multiplexed) | t_{CHAV} | A[23:16], ECLK | EBM:NMS=0 | -15 | 15 | ns | |
| | t_{CLAV} | | | -15 | 15 | | |
| | t_{CLADV} | AD[15:0], ECLK | EBM:NMS=0 | -15 | 15 | ns | |
| | t_{CHADV} | | | -15 | 15 | | |
| ECLK → RDX /WRX time | t_{CHRWH} | RDX, WRX, WRLX, WRHX, ECLK | — | -10 | 10 | ns | |
| | t_{CHRWL} | | | -10 | 10 | | |
| | t_{CLRWH} | | | -10 | 10 | | |
| | t_{CLRWL} | | | -10 | 10 | | |

($T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{CC} = 3.0$ to 4.5V , $V_{SS} = 0.0\text{V}$, $I_{Odrive} = 5\text{mA}$, $C_L = 50\text{pF}$)

| Parameter | Symbol | Pin | Condition | Value | | Unit | Remarks |
|--|-------------|----------------------------------|-----------|---------------|---------------|------|---------|
| | | | | Min | Max | | |
| ECLK | t_{CYC} | ECLK | — | 30 | — | ns | |
| | t_{CHCL} | | | $t_{CYC}/2-8$ | $t_{CYC}/2+8$ | | |
| | t_{CLCH} | | | $t_{CYC}/2-8$ | $t_{CYC}/2+8$ | | |
| ECLK → UBX/ LBX / CSn time | t_{CHCBH} | CSn, UBX, LBX, ECLK | — | -25 | 25 | ns | |
| | t_{CHCBL} | | | -25 | 25 | | |
| | t_{CLCBH} | | | -25 | 25 | | |
| | t_{CLCBL} | | | -25 | 25 | | |
| ECLK → ALE time | t_{CHLH} | ALE, ECLK | — | -15 | 15 | ns | |
| | t_{CHLL} | | | -15 | 15 | | |
| | t_{CLLH} | | | -15 | 15 | | |
| | t_{CLLL} | | | -15 | 15 | | |
| ECLK → address valid time (non-multiplexed) | t_{CHAV} | A[23:0], ECLK | EBM:NMS=1 | -20 | 20 | ns | |
| | t_{CLAV} | | | -20 | 20 | | |
| ECLK → address valid time (multiplexed) | t_{CHAV} | A[23:16], ECLK | EBM:NMS=0 | -20 | 20 | ns | |
| | t_{CLAV} | | | -20 | 20 | | |
| | t_{CLADV} | AD[15:0], ECLK | EBM:NMS=0 | -20 | 20 | ns | |
| | t_{CHADV} | | | -20 | 20 | | |
| ECLK → RDX /WRX time | t_{CHRWH} | RDX, WRX, WRLX, WRHX, ECLK | — | -15 | 15 | ns | |
| | t_{CHRWL} | | | -15 | 15 | | |
| | t_{CLRWH} | | | -15 | 15 | | |
| | t_{CLRWL} | | | -15 | 15 | | |



Bus Timing (Read)
 $(T_A = -40^{\circ}\text{C to } +125^{\circ}\text{C}, V_{CC} = 5.0\text{ V} \pm 10\%, V_{SS} = 0.0\text{ V}, I_{Odrive} = 5\text{mA}, C_L = 50\text{pF})$

| Parameter | Symbol | Pin | Conditions | Value | | Unit | Remarks |
|--|-------------|----------------------|------------------------------|-------------------|-----------------|------|------------------------|
| | | | | Min | Max | | |
| ALE pulse width (multiplexed) | t_{LHLL} | ALE | EACL:STS=0 and EACL:ACE=0 | $t_{CYC}/2 - 5$ | — | ns | EBM:NMS = 0 |
| | | | EACL:STS=1 | $t_{CYC} - 5$ | — | | |
| | | | EACL:STS=0 and EACL:ACE=1 | $3t_{CYC}/2 - 5$ | — | | |
| Valid address ⇒ ALE ↓ time (multiplexed) | t_{AVLL} | ALE, A[23:16], | EACL:STS=0 and EACL:ACE=0 | $t_{CYC} - 15$ | — | ns | |
| | | | EACL:STS=1 and EACL:ACE=0 | $3t_{CYC}/2 - 15$ | — | | |
| | | | EACL:STS=0 and EACL:ACE=1 | $2t_{CYC} - 15$ | — | | |
| | | | EACL:STS=1 and EACL:ACE=1 | $5t_{CYC}/2 - 15$ | — | | |
| | t_{ADVLL} | ALE, AD[15:0] | EACL:STS=0 and EACL:ACE=0 | $t_{CYC}/2 - 15$ | — | ns | |
| | | | EACL:STS=1 and EACL:ACE=0 | $t_{CYC} - 15$ | — | | |
| | | | EACL:STS=0 and EACL:ACE=1 | $3t_{CYC}/2 - 15$ | — | | |
| | | | EACL:STS=1 and EACL:ACE=1 | $2t_{CYC} - 15$ | — | | |
| ALE ↓ ⇒ Address valid time (multiplexed) | t_{LLAX} | ALE, AD[15:0] | EACL:STS=0 | $t_{CYC}/2 - 15$ | — | ns | |
| | | | EACL:STS=1 | -15 | — | | |
| Valid address ⇒ RDX ↓ time (non-multiplexed) | t_{AVRL} | RDX, A[23:0] | EBM:NMS= 1 | $t_{CYC}/2 - 15$ | — | ns | |
| Valid address ⇒ RDX ↓ time (multiplexed) | t_{AVRL} | RDX, A[23:16] | EACL:ACE=0 EBM:NMS=0 | $3t_{CYC}/2 - 15$ | — | ns | |
| | | | EACL:ACE=1 EBM:NMS=0 | $5t_{CYC}/2 - 15$ | — | | |
| | t_{ADVRL} | RDX, AD[15:0] | EACL:ACE=0 EBM:NMS=0 | $t_{CYC} - 15$ | — | ns | |
| | | | EACL:ACE=1 EBM:NMS=0 | $2t_{CYC} - 15$ | — | | |
| Valid address ⇒ Valid data input (non-multiplexed) | t_{AVDV} | A[23:0], AD[15:0] | EBM:NMS= 1 | — | $2t_{CYC} - 55$ | ns | w/o cycle extension |

($T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{CC} = 5.0\text{ V} \pm 10\%$, $V_{SS} = 0.0\text{ V}$, $I_{Odrive} = 5\text{mA}$, $C_L = 50\text{pF}$)

| Parameter | Symbol | Pin | Conditions | Value | | Unit | Remarks |
|--|--------------|-----------------------|------------------------------------|-------------------|--------------------|------|------------------------|
| | | | | Min | Max | | |
| Valid address ⇒ Valid data input (multiplexed) | t_{AVDV} | A[23:16], AD[15:0] | EACL:ACE=0 EBM:NMS=0 | — | $3t_{CYC} - 55$ | ns | w/o cycle extension |
| | | | EACL:ACE=1 EBM:NMS=0 | — | $4t_{CYC} - 55$ | | |
| | $t_{ADV DV}$ | AD[15:0] | EACL:ACE=0 EBM:NMS=0 | — | $5t_{CYC}/2 - 55$ | ns | w/o cycle extension |
| | | | EACL:ACE=1 EBM:NMS=0 | — | $7t_{CYC}/2 - 55$ | | |
| RDX pulse width | t_{RLRH} | RDX | — | $3 t_{CYC}/2 - 5$ | — | ns | w/o cycle extension |
| RDX ↓ ⇒ Valid data input | t_{RLDV} | RDX, AD[15:0] | — | — | $3 t_{CYC}/2 - 50$ | ns | w/o cycle extension |
| RDX ↑ ⇒ Data hold time | t_{RHDX} | RDX, AD[15:0] | — | 0 | — | ns | |
| Address valid ⇒ Data hold time | t_{AXDX} | A[23:0], AD[15:0] | — | 0 | — | ns | |
| RDX ↑ ⇒ ALE ↑ time | t_{RHLH} | RDX, ALE | EACL:STS=1 and EACL:ACE=1 | $3t_{CYC}/2 - 10$ | — | ns | |
| | | | other ECL:STS, EACL:ACE setting | $t_{CYC}/2 - 10$ | — | | |
| Valid address ⇒ ECLK ↑ time | t_{AVCH} | A[23:0], ECLK | — | $t_{CYC} - 15$ | — | ns | |
| | t_{ADVCH} | AD[15:0], ECLK | | $t_{CYC}/2 - 15$ | — | | |
| RDX ↓ ⇒ ECLK ↑ time | t_{RLCH} | RDX, ECLK | — | $t_{CYC}/2 - 10$ | — | ns | |
| ALE ↓ ⇒ RDX ↓ time | t_{LLRL} | ALE, RDX | EACL:STS=0 | $t_{CYC}/2 - 10$ | — | ns | |
| | | | EACL:STS=1 | - 10 | — | | |
| ECLK ↑ ⇒ Valid data input | t_{CHDV} | AD[15:0], ECLK | — | — | $t_{CYC} - 50$ | ns | |

($T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{CC} = 3.0$ to 4.5V , $V_{SS} = 0.0\text{V}$, $I_{Odrive} = 5\text{mA}$, $C_L = 50\text{pF}$)

| Parameter | Symbol | Pin | Conditions | Value | | Unit | Remarks |
|--|-------------|----------------------|------------------------------|-------------------|-----------------|------|------------------------|
| | | | | Min | Max | | |
| ALE pulse width (multiplexed) | t_{LHLL} | ALE | EACL:STS=0 and EACL:ACE=0 | $t_{CYC}/2 - 8$ | — | ns | EBM:NMS = 0 |
| | | | EACL:STS=1 | $t_{CYC} - 8$ | — | | |
| | | | EACL:STS=0 and EACL:ACE=1 | $3t_{CYC}/2 - 8$ | — | | |
| Valid address ⇒ ALE ↓ time (multiplexed) | t_{AVLL} | ALE, A[23:16], | EACL:STS=0 and EACL:ACE=0 | $t_{CYC} - 20$ | — | ns | |
| | | | EACL:STS=1 and EACL:ACE=0 | $3t_{CYC}/2 - 20$ | — | | |
| | | | EACL:STS=0 and EACL:ACE=1 | $2t_{CYC} - 20$ | — | | |
| | | | EACL:STS=1 and EACL:ACE=1 | $5t_{CYC}/2 - 20$ | — | | |
| | t_{ADVLL} | ALE, AD[15:0] | EACL:STS=0 and EACL:ACE=0 | $t_{CYC}/2 - 20$ | — | ns | |
| | | | EACL:STS=1 and EACL:ACE=0 | $t_{CYC} - 20$ | — | | |
| | | | EACL:STS=0 and EACL:ACE=1 | $3t_{CYC}/2 - 20$ | — | | |
| | | | EACL:STS=1 and EACL:ACE=1 | $2t_{CYC} - 20$ | — | | |
| ALE ↓ ⇒ Address valid time (multiplexed) | t_{LLAX} | ALE, AD[15:0] | EACL:STS=0 | $t_{CYC}/2 - 20$ | — | ns | |
| | | | EACL:STS=1 | -20 | — | | |
| Valid address ⇒ RDX ↓ time (non-multiplexed) | t_{AVRL} | RDX, A[23:0] | EBM:NMS= 1 | $t_{CYC}/2 - 20$ | — | ns | |
| Valid address ⇒ RDX ↓ time (multiplexed) | t_{AVRL} | RDX, A[23:16] | EACL:ACE=0 EBM:NMS=0 | $3t_{CYC}/2 - 20$ | — | ns | |
| | | | EACL:ACE=1 EBM:NMS=0 | $5t_{CYC}/2 - 20$ | — | | |
| | t_{ADVRL} | RDX, AD[15:0] | EACL:ACE=0 EBM:NMS=0 | $t_{CYC} - 20$ | — | ns | |
| | | | EACL:ACE=1 EBM:NMS=0 | $2t_{CYC} - 20$ | — | | |
| Valid address ⇒ Valid data input (non-multiplexed) | t_{AVDV} | A[23:0], AD[15:0] | EBM:NMS= 1 | — | $2t_{CYC} - 60$ | ns | w/o cycle extension |

($T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{CC} = 3.0$ to 4.5V , $V_{SS} = 0.0\text{V}$, $I_{Odrive} = 5\text{mA}$, $C_L = 50\text{pF}$)

| Parameter | Symbol | Pin | Conditions | Value | | Unit | Remarks |
|--|--------------|-----------------------|------------------------------------|-------------------|-------------------|------|------------------------|
| | | | | Min | Max | | |
| Valid address ⇒ Valid data input (multiplexed) | t_{AVDV} | A[23:16], AD[15:0] | EACL:ACE=0 EBM:NMS=0 | — | $3t_{CYC} - 60$ | ns | w/o cycle extension |
| | | | EACL:ACE=1 EBM:NMS=0 | — | $4t_{CYC} - 60$ | | |
| | t_{AD-VDV} | AD[15:0] | EACL:ACE=0 EBM:NMS=0 | — | $5t_{CYC}/2 - 60$ | ns | w/o cycle extension |
| | | | EACL:ACE=1 EBM:NMS=0 | — | $7t_{CYC}/2 - 60$ | | |
| RDX pulse width | t_{RLRH} | RDX | — | $3t_{CYC}/2 - 8$ | — | ns | w/o cycle extension |
| RDX ↓ ⇒ Valid data input | t_{RLDV} | RDX, AD[15:0] | — | — | $3t_{CYC}/2 - 55$ | ns | w/o cycle extension |
| RDX ↑ ⇒ Data hold time | t_{RHDX} | RDX, AD[15:0] | — | 0 | — | ns | |
| Address valid ⇒ Data hold time | t_{AXDX} | A[23:0] | — | 0 | — | ns | |
| RDX ↑ ⇒ ALE ↑ time | t_{RHLH} | RDX, ALE | EACL:STS=1 and EACL:ACE=1 | $3t_{CYC}/2 - 15$ | — | ns | |
| | | | other ECL:STS, EACL:ACE setting | $t_{CYC}/2 - 15$ | — | | |
| Valid address ⇒ ECLK ↑ time | t_{AVCH} | A[23:0], ECLK | — | $t_{CYC} - 20$ | — | ns | |
| | t_{AD-VCH} | AD[15:0], ECLK | | $t_{CYC}/2 - 20$ | — | | |
| RDX ↓ ⇒ ECLK ↑ time | t_{RLCH} | RDX, ECLK | — | $t_{CYC}/2 - 15$ | — | ns | |
| ALE ↓ ⇒ RDX ↓ time | t_{LLRL} | ALE, RDX | EACL:STS=0 | $t_{CYC}/2 - 15$ | — | ns | |
| | | | EACL:STS=1 | - 15 | — | | |
| ECLK ↑ ⇒ Valid data input | t_{CHDV} | AD[15:0], ECLK | — | — | $t_{CYC} - 55$ | ns | |



Bus Timing (Write)
 $(T_A = -40^\circ\text{C to } +125^\circ\text{C}, V_{CC} = 5.0\text{ V} \pm 10\%, V_{SS} = 0.0\text{ V}, I_{Odrive} = 5\text{mA}, C_L = 50\text{pF})$

| Parameter | Symbol | Pin | Condition | Value | | Unit | Remarks |
|--|-------------|--------------------------------|--|-------------------|-------------------|------|---------------------|
| | | | | Min | Max | | |
| Valid address ⇒ WRX ↓ time (non-multiplexed) | t_{AVWL} | WRX, WRLX, WRHX, A[23:0] | EACL:STS=0 EBM:NMS=1 | $t_{CYC}/2 - 15$ | — | ns | |
| | | | EACL:STS=1 EBM:NMS=1 | $t_{CYC} - 15$ | — | | |
| Valid address ⇒ WRX ↓ time (multiplexed) | t_{AVWL} | WRX, WRLX, WRHX, A[23:16] | EACL:ACE=0 EBM:NMS=0 | $3t_{CYC}/2 - 15$ | — | ns | |
| | | | EACL:ACE=1 EBM:NMS=0 | $5t_{CYC}/2 - 15$ | — | | |
| | t_{ADVWL} | WRX, WRLX, WRHX, AD[15:0] | EACL:ACE=0 EBM:NMS=0 | $t_{CYC} - 15$ | — | ns | |
| | | | EACL:ACE=1 EBM:NMS=0 | $2t_{CYC} - 15$ | — | | |
| WRX pulse width | t_{WLWH} | WRX, WRXL, WRHX | — | $t_{CYC} - 5$ | — | ns | w/o cycle extension |
| Valid data output ⇒ WRX ↑ time | t_{DVWH} | WRX, WRLX, WRHX, AD[15:0] | — | $t_{CYC} - 20$ | — | ns | w/o cycle extension |
| WRX ↑ ⇒ Data hold time | t_{WHDX} | WRX, WRLX, WRHX, AD[15:0] | — | $t_{CYC}/2 - 15$ | — | ns | |
| WRX ↑ ⇒ Address valid time (non-multiplexed) | t_{WHAX} | WRX, WRLX, WRHX, A[23:0] | EACL:STS=1 EBM:NMS=1 | - 15 | — | ns | |
| | | | EACL:STS=0 EBM:NMS=1 | $t_{CYC}/2 - 15$ | — | ns | |
| WRX ↑ ⇒ Address valid time (multiplexed) | t_{WHAX} | WRX, WRLX, WRHX, A[23:16] | EBM:NMS=0 | $t_{CYC}/2 - 15$ | — | ns | |
| WRX ↑ ⇒ ALE ↑ time (multiplexed) | t_{WHLH} | WRX, WRLX, WRHX, ALE | EBM:ACE=1 and EACL:STS=1 | $2t_{CYC} - 10$ | — | ns | EBM:NMS=0 |
| | | | other EBM:ACE and EACL:STS setting | $t_{CYC} - 10$ | — | | |
| WRX ↓ ⇒ ECLK ↑ time | t_{WLCH} | WRX, WRLX, WRHX, ECLK | — | $t_{CYC}/2 - 10$ | — | ns | |
| CSn ⇒ WRX time (non-multiplexed) | t_{CSLWL} | WRX, WRLX, WRHX, CSn | EACL:STS=0 EBM:NMS=1 | — | $t_{CYC}/2 - 15$ | ns | |
| | | | EACL:STS=1 EBM:NMS=1 | — | $t_{CYC} - 15$ | | |
| CSn ⇒ WRX time (multiplexed) | t_{CSLWL} | WRX, WRLX, WRHX, CSn | EACL:ACE=0 EBM:NMS=0 | — | $3t_{CYC}/2 - 15$ | ns | |
| | | | EACL:ACE=1 EBM:NMS=0 | — | $5t_{CYC}/2 - 15$ | | |

$(T_A = -40^{\circ}\text{C to } +125^{\circ}\text{C}, V_{CC} = 5.0\text{ V} \pm 10\%, V_{SS} = 0.0\text{ V}, I_{Odrive} = 5\text{ mA}, C_L = 50\text{ pF})$

| Parameter | Symbol | Pin | Condition | Value | | Unit | Remarks |
|---|-------------|-------------------------|-------------------------|------------------|-----|------|---------|
| | | | | Min | Max | | |
| WRX \Rightarrow CSn time (non-multiplexed) | t_{WHCSH} | WRX, WRLX, WRHX, CSn | EACL:STS=1 EBM:NMS=1 | - 15 | — | ns | |
| | | | EACL:STS=0 EBM:NMS=1 | $t_{CYC}/2 - 15$ | — | ns | |
| WRX \Rightarrow CSn time (multiplexed) | t_{WHCSH} | WRX, WRLX, WRHX, CSn | EBM:NMS=0 | $t_{CYC}/2 - 15$ | — | ns | |

 $(T_A = -40^{\circ}\text{C to } +125^{\circ}\text{C}, V_{CC} = 3.0\text{ to } 4.5\text{ V}, V_{SS} = 0.0\text{ V}, I_{Odrive} = 5\text{ mA}, C_L = 50\text{ pF})$

| Parameter | Symbol | Pin | Condition | Value | | Unit | Remarks |
|---|-------------|--------------------------------|--|-------------------|-----|------|---------------------|
| | | | | Min | Max | | |
| Valid address \Rightarrow WRX \downarrow time (non-multiplexed) | t_{AVWL} | WRX, WRLX, WRHX, A[23:0] | EACL:STS=0 EBM:NMS=1 | $t_{CYC}/2 - 20$ | — | ns | |
| | | | EACL:STS=1 EBM:NMS=1 | $t_{CYC} - 20$ | — | ns | |
| Valid address \Rightarrow WRX \downarrow time (multiplexed) | t_{AVWL} | WRX, WRLX, WRHX, A[23:16] | EACL:ACE=0 EBM:NMS=0 | $3t_{CYC}/2 - 20$ | — | ns | |
| | | | EACL:ACE=1 EBM:NMS=0 | $5t_{CYC}/2 - 20$ | — | ns | |
| | t_{ADVWL} | WRX, WRLX, WRHX, AD[15:0] | EACL:ACE=0 EBM:NMS=0 | $t_{CYC} - 20$ | — | ns | |
| | | | EACL:ACE=1 EBM:NMS=0 | $2t_{CYC} - 20$ | — | ns | |
| WRX pulse width | t_{WLWH} | WRX, WRXL, WRHX | — | $t_{CYC} - 8$ | — | ns | w/o cycle extension |
| Valid data output \Rightarrow WRX \uparrow time | t_{DVWH} | WRX, WRLX, WRHX, AD[15:0] | — | $t_{CYC} - 25$ | — | ns | w/o cycle extension |
| WRX \uparrow \Rightarrow Data hold time | t_{WHDX} | WRX, WRLX, WRHX, AD[15:0] | — | $t_{CYC}/2 - 20$ | — | ns | |
| WRX \uparrow \Rightarrow Address valid time (non-multiplexed) | t_{WHAX} | WRX, WRLX, WRHX, A[23:0] | EACL:STS=1 EBM:NMS=1 | - 20 | — | ns | |
| | | | EACL:STS=0 EBM:NMS=1 | $t_{CYC}/2 - 20$ | — | ns | |
| WRX \uparrow \Rightarrow Address valid time (multiplexed) | t_{WHAX} | WRX, WRLX, WRHX, A[23:16] | EBM:NMS=0 | $t_{CYC}/2 - 20$ | — | ns | |
| WRX $\uparrow \Rightarrow$ ALE \uparrow time (multiplexed) | t_{WHLH} | WRX, WRLX, WRHX, ALE | EBM:ACE=1 and EACL:STS=1 | $2t_{CYC} - 15$ | — | ns | EBM:NMS=0 |
| | | | other EBM:ACE and EACL:STS setting | $t_{CYC} - 15$ | — | ns | |
| WRX $\downarrow \Rightarrow$ ECLK \uparrow time | t_{WLCH} | WRX, WRLX, WRHX, ECLK | — | $t_{CYC}/2 - 15$ | — | ns | |

Ready Input Timing

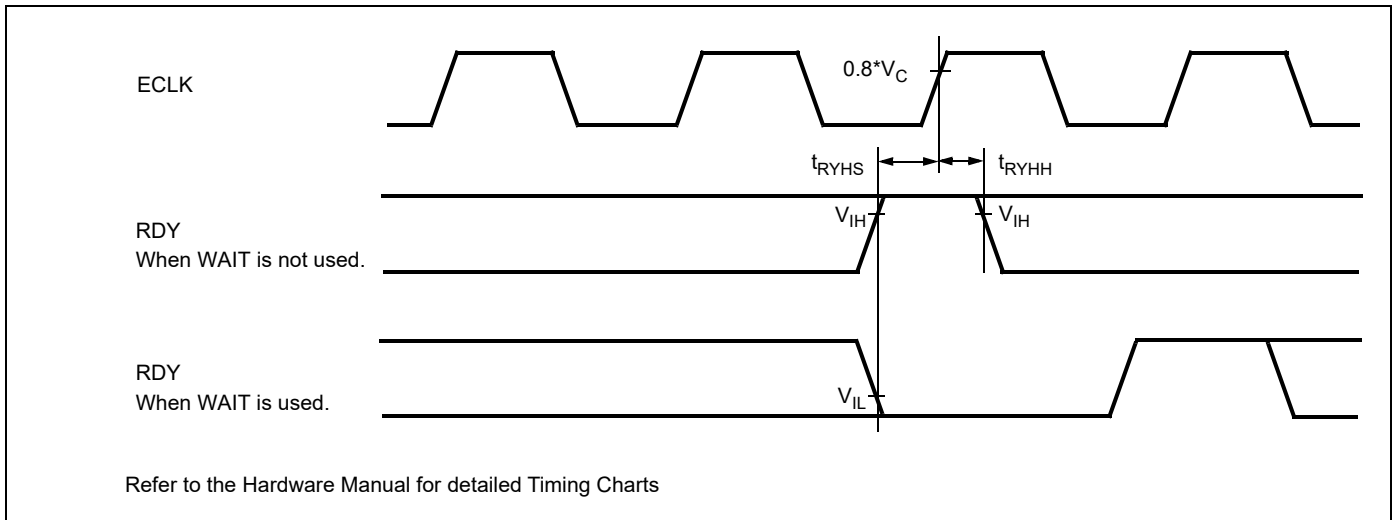
($T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{CC} = 5.0\text{ V} \pm 10\%$, $V_{SS} = 0.0\text{ V}$, $I_{Odrive} = 5\text{mA}$, $C_L = 50\text{pF}$)

| Parameter | Symbol | Pin | Test Condition | Rated Value | | Units | Remarks |
|----------------|------------|-----|----------------|-------------|-----|-------|---------|
| | | | | Min | Max | | |
| RDY setup time | t_{RYHS} | RDY | — | 35 | — | ns | |
| RDY hold time | t_{RYHH} | RDY | | 0 | — | ns | |

($T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{CC} = 3.0$ to 4.5V , $V_{SS} = 0.0\text{ V}$, $I_{Odrive} = 5\text{mA}$, $C_L = 50\text{pF}$)

| Parameter | Symbol | Pin | Test Condition | Rated Value | | Units | Remarks |
|----------------|------------|-----|----------------|-------------|-----|-------|---------|
| | | | | Min | Max | | |
| RDY setup time | t_{RYHS} | RDY | — | 45 | — | ns | |
| RDY hold time | t_{RYHH} | RDY | | 0 | — | ns | |

Note : If the RDY setup time is insufficient, use the auto-ready function.



Hold Timing

($T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{CC} = 5.0\text{ V} \pm 10\%$, $V_{SS} = 0.0\text{ V}$, $I_{Odrive} = 5\text{mA}$, $C_L = 50\text{pF}$)

| Parameter | Symbol | Pin | Condition | Value | | Units | Remarks |
|---|------------|------|-----------|----------------|----------------|-------|---------|
| | | | | Min | Max | | |
| Pin floating \Rightarrow HAKX \downarrow time | t_{XHAL} | HAKX | — | $t_{CYC} - 20$ | $t_{CYC} + 20$ | ns | |
| HAKX \uparrow time \Rightarrow Pin valid time | t_{HAHV} | HAKX | | $t_{CYC} - 20$ | $t_{CYC} + 20$ | ns | |

($T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{CC} = 3.0$ to 4.5V , $V_{SS} = 0.0\text{ V}$, $I_{Odrive} = 5\text{mA}$, $C_L = 50\text{pF}$)

| Parameter | Symbol | Pin | Condition | Value | | Units | Remarks |
|---|------------|------|-----------|----------------|----------------|-------|---------|
| | | | | Min | Max | | |
| Pin floating \Rightarrow HAKX \downarrow time | t_{XHAL} | HAKX | — | $t_{CYC} - 25$ | $t_{CYC} + 25$ | ns | |
| HAKX \uparrow time \Rightarrow Pin valid time | t_{HAHV} | HAKX | | $t_{CYC} - 25$ | $t_{CYC} + 25$ | ns | |



USART Timing

WARNING: The values given below are for an I/O driving strength $I_{O_{drive}} = 5\text{ mA}$. If $I_{O_{drive}}$ is 2 mA, all the maximum output timing described in the different tables must then be increased by 10 ns.

($T_A = -40^\circ\text{C}$ to 125°C , $V_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = 0\text{V}$, $I_{O_{drive}} = 5\text{mA}$, $C_L = 50\text{pF}$)

| Parameter | Symbol | Pin | Condition | $V_{CC} = AV_{CC} = 4.5\text{ V}$ to 5.5 V | | $V_{CC} = AV_{CC} = 3.0\text{ V}$ to 4.5 V | | Unit |
|------------------------------|-------------|---------------|------------------------------|--|--------------------|--|--------------------|------|
| | | | | Min | Max | Min | Max | |
| Serial clock cycle time | t_{SCYCI} | SCKn | Internal Shift Clock Mode | $4 t_{CLKP1}$ | — | $4 t_{CLKP1}$ | — | ns |
| SCK ↓ → SOT delay time | t_{SLOVI} | SCKn, SOTn | | -20 | +20 | -30 | +30 | ns |
| SOT → SCK ↑ delay time | t_{OVSHI} | SCKn, SOTn | | $N * t_{CLKP1} - 20^{*1}$ | — | $N * t_{CLKP1} - 30^{*1}$ | — | ns |
| Valid SIN → SCK ↑ | t_{IVSHI} | SCKn, SINn | | $t_{CLKP1} + 45$ | — | $t_{CLKP1} + 55$ | — | ns |
| SCK ↑ → Valid SIN hold time | t_{SHIXI} | SCKn, SINn | | 0 | — | 0 | — | ns |
| Serial clock “L” pulse width | t_{SLSHE} | SCKn | External Shift Clock Mode | $t_{CLKP1} + 10$ | — | $t_{CLKP1} + 10$ | — | ns |
| Serial clock “H” pulse width | t_{SHSLE} | SCKn | | $t_{CLKP1} + 10$ | — | $t_{CLKP1} + 10$ | — | ns |
| SCK ↓ → SOT delay time | t_{SLOVE} | SCKn, SOTn | | — | $2 t_{CLKP1} + 45$ | — | $2 t_{CLKP1} + 55$ | ns |
| Valid SIN → SCK ↑ | t_{IVSHE} | SCKn, SINn | | $t_{CLKP1}/2 + 10$ | — | $t_{CLKP1}/2 + 10$ | — | ns |
| SCK ↑ → Valid SIN hold time | t_{SHIXE} | SCKn, SINn | | $t_{CLKP1} + 10$ | — | $t_{CLKP1} + 10$ | — | ns |
| SCK fall time | t_{FE} | SCKn | | — | 20 | — | 20 | ns |
| SCK rise time | t_{RE} | SCKn | | — | 20 | — | 20 | ns |

- Notes:
- AC characteristic in CLK synchronized mode.
 - C_L is the load capacity value of pins when testing.
 - Depending on the used machine clock frequency, the maximum possible baud rate can be limited by some parameters. These parameters are shown in “CY96300 Super series Hardware Manual”
 - t_{CLKP1} is the cycle time of the peripheral clock 1 (CLKP1), Unit : ns

*1: Parameter N depends on t_{SCYCI} and can be calculated as follows:

- if $t_{SCYCI} = 2 * k * t_{CLKP1}$, then $N = k$, where k is an integer > 2
- if $t_{SCYCI} = (2 * k + 1) * t_{CLKP1}$, then $N = k + 1$, where k is an integer > 1

Examples:

| t_{scyci} | N |
|--------------------------------|-----|
| $4 * t_{CLKP1}$ | 2 |
| $5 * t_{CLKP1}, 6 * t_{CLKP1}$ | 3 |
| $7 * t_{CLKP1}, 8 * t_{CLKP1}$ | 4 |
| ... | ... |



I²C Timing

(T_A = -40°C to 125°C, V_{CC} = AV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = 0V)

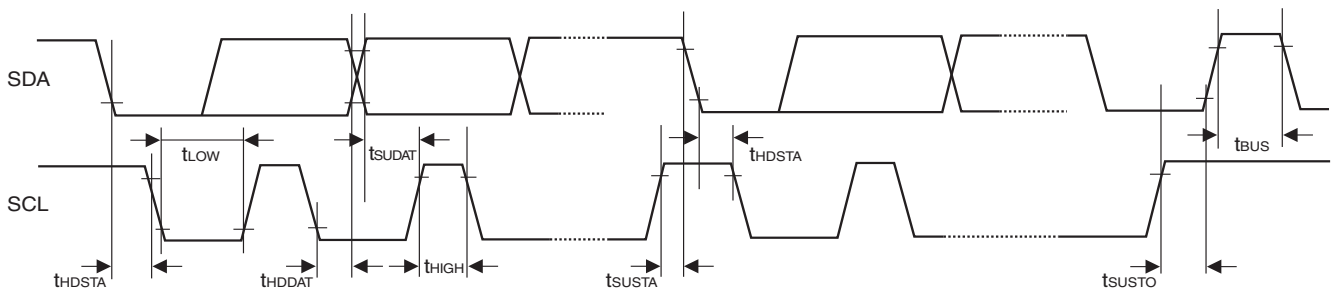
| Parameter | Symbol | Condition | Standard-mode | | Fast-mode* ⁴ | | Unit |
|---|--------------------|--|---------------|--------------------|-------------------------|-------------------|------|
| | | | Min | Max | Min | Max | |
| SCL clock frequency | f _{SCL} | R = 1.7 kΩ, C = 50 pF* ¹ | 0 | 100 | 0 | 400 | kHz |
| Hold time (repeated) START condition SDA↓→SCL↓ | t _{HDSTA} | | 4.0 | — | 0.6 | — | μs |
| "L" width of the SCL clock | t _{LOW} | | 4.7 | — | 1.3 | — | μs |
| "H" width of the SCL clock | t _{HIGH} | | 4.0 | — | 0.6 | — | μs |
| Set-up time for a repeated START condition SCL↑→SDA↓ | t _{SUSTA} | | 4.7 | — | 0.6 | — | μs |
| Data hold time SCL↓→SDA↑ | t _{HDDAT} | | 0 | 3.45* ² | 0 | 0.9* ³ | μs |
| Data set-up time SDA↓↑→SCL↑ | t _{SUDAT} | | 250 | — | 100 | — | ns |
| Set-up time for STOP condition SCL↑→SDA↑ | t _{SUSTO} | | 4.0 | — | 0.6 | — | μs |
| Bus free time between a STOP and START condition | t _{BUS} | | 4.7 | — | 1.3 | — | μs |

*1 : R, C : Pull-up resistor and load capacitor of the SCL and SDA lines.

*2 : The maximum t_{HDDAT} have only to be met if the device does not stretch the "L" width (t_{LOW}) of the SCL signal.

*3 : A Fast-mode I²C-bus device can be used in a Standard-mode I²C-bus system, but the requirement t_{SUDAT} ≥ 250 ns must then be met.

*4 : For use at over 100 kHz, set the peripheral clock 1 to at least 6 MHz.



15.5 Analog Digital Converter
 $(T_A = -40\text{ }^\circ\text{C to } +125\text{ }^\circ\text{C}, 3.0\text{ V} \leq \text{AVRH} - \text{AVRL}, V_{CC} = \text{AV}_{CC} = 3.0\text{V to } 5.5\text{V}, V_{SS} = \text{AV}_{SS} = 0\text{V})$

| Parameter | Symbol | Pin | Value | | | Unit | Remarks |
|--|-----------|------------------|-----------------------|--------------|-----------------------|---------------|--|
| | | | Min | Typ | Max | | |
| Resolution | - | - | - | - | 10 | bit | |
| Total error | - | - | -3 | - | +3 | LSB | |
| Nonlinearity error | - | - | -2.5 | - | +2.5 | LSB | |
| Differential nonlinearity error | - | - | -1.9 | - | +1.9 | LSB | |
| Zero reading voltage | V_{OT} | ANn | AVRL-1.5 LSB | AVRL+0.5 LSB | AVRL+2.5 LSB | V | |
| Full scale reading voltage | V_{FST} | ANn | AVRH-3.5 LSB | AVRH-1.5 LSB | AVRH+0.5 LSB | V | |
| Compare time | - | - | 1.0 | - | 16,500 | μs | $4.5\text{ V} \leq \text{AV}_{CC} \leq 5.5\text{ V}$ |
| | | | 2.0 | - | - | μs | $3.0\text{ V} \leq \text{AV}_{CC} < 4.5\text{ V}$ |
| Sampling time | - | - | 0.5 | - | - | μs | $4.5\text{ V} \leq \text{AV}_{CC} \leq 5.5\text{ V}$ |
| | | | 1.2 | - | - | μs | $3.0\text{ V} \leq \text{AV}_{CC} < 4.5\text{ V}$ |
| Analog port input current | I_{AIN} | ANn | -3 | - | +3 | μA | $\text{AV}_{SS}, \text{AVRL} < V_I < \text{AV}_{CC}, \text{AVRH}$ |
| Analog input leakage current (during conversion) | I_{AIN} | ANn | -1 | - | +1 | μA | $T_A = 25\text{ }^\circ\text{C}, \text{AV}_{SS}, \text{AVRL} < V_I < \text{AV}_{CC}, \text{AVRH}$ |
| | | | -3 | - | +3 | μA | $T_A = 125\text{ }^\circ\text{C}, \text{AV}_{SS}, \text{AVRL} < V_I < \text{AV}_{CC}, \text{AVRH}$ |
| Analog input voltage range | V_{AIN} | ANn | AVRL | - | AVRH | V | |
| Reference voltage range | AVRH | AVRH/AVRH2 | 0.75AV_{CC} | - | AV_{CC} | V | |
| | AVRL | AVRL | AV_{SS} | - | 0.25AV_{CC} | V | |
| Power supply current | I_A | AV_{CC} | - | 2.5 | 5 | mA | A/D Converter active |
| | I_{AH} | AV_{CC} | - | - | 5 | μA | A/D Converter not operated |
| Reference voltage current | I_R | AVRH/AVRL | - | 0.7 | 1 | mA | A/D Converter active |
| | I_{RH} | AVRH/AVRL | - | - | 5 | μA | A/D Converter not operated |
| Offset between input channels | - | ANn | - | - | 4 | LSB | |

Note: The accuracy gets worse as $|\text{AVRH} - \text{AVRL}|$ becomes smaller.

Definition of A/D Converter Terms

Resolution: Analog variation that is recognized by an A/D converter.

Total error: Difference between the actual value and the ideal value. The total error includes zero transition error, full-scale transition error and nonlinearity error.

Nonlinearity error: Deviation between a line across zero-transition line (“00 0000 0000” <--> “00 0000 0001”) and full-scale transition line (“11 1111 1110” <--> “11 1111 1111”) and actual conversion characteristics.

Differential nonlinearity error: Deviation of input voltage, which is required for changing output code by 1 LSB, from an ideal value.

Zero reading voltage: Input voltage which results in the minimum conversion value.

Full scale reading voltage: Input voltage which results in the maximum conversion value.



$$\text{Total error of digital output "N"} = \frac{V_{NT} - \{1 \text{ LSB} \times (N - 1) + 0.5 \text{ LSB}\}}{1 \text{ LSB}} \text{ [LSB]}$$

$$1 \text{ LSB} = (\text{Ideal value}) \frac{AVRH - AVRL}{1024} \text{ [V]}$$

N: A/D converter digital output value

$$V_{OT} (\text{Ideal value}) = AVRL + 0.5 \text{ LSB [V]}$$

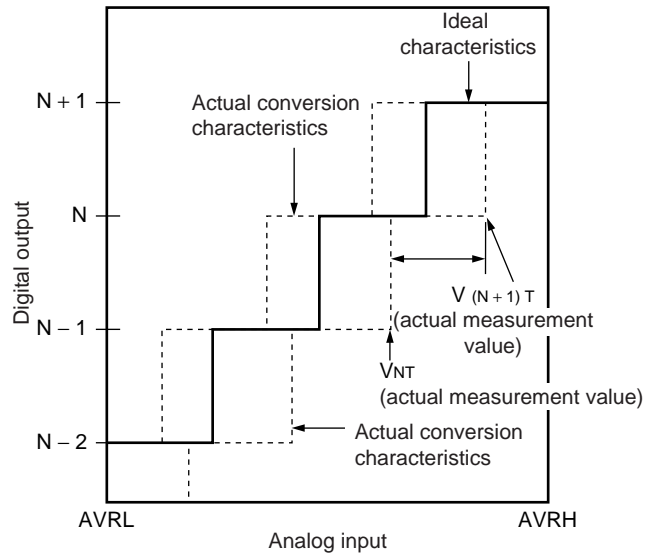
$$V_{FST} (\text{Ideal value}) = AVRH - 1.5 \text{ LSB [V]}$$

V_{NT} : A voltage at which digital output transitions from (N - 1) to N.

Nonlinearity error



Differential nonlinearity error



$$\text{Nonlinearity error of digital output } N = \frac{V_{NT} - \{1 \text{ LSB} \times (N - 1) + V_{OT}\}}{1 \text{ LSB}} \text{ [LSB]}$$

$$\text{Differential nonlinearity error of digital output } N = \frac{V_{(N+1)T} - V_{NT}}{1 \text{ LSB}} - 1 \text{ LSB [LSB]}$$

$$1 \text{ LSB} = \frac{V_{FST} - V_{OT}}{1022} \text{ [V]}$$

N : A/D converter digital output value

V_{OT} : Voltage at which digital output transits from “000_H” to “001_H.”

V_{FST} : Voltage at which digital output transits from “3FE_H” to “3FF_H.”

Notes on A/D Converter Section

- ²About the external impedance of the analog input and the sampling time of the A/D converter (with sample and hold circuit):
If the external impedance is too high to keep sufficient sampling time, the analog voltage charged to the internal sample and hold capacitor is insufficient, adversely affecting A/D conversion precision.

analog input circuit model:



Reference value:

- C = 8.5 pF (Max)

To satisfy the A/D conversion precision standard, the relationship between the external impedance and minimum sampling time must be considered and then either the resistor value and operating frequency must be adjusted or the external impedance must be decreased so that the sampling time (T_{samp}) is longer than the minimum value. Usually, this value is set to 7τ , where $\tau = RC$. If the external input resistance (R_{ext}) connected to the analog input is included, the sampling time is expressed as follows:

$$T_{\text{samp}} [\text{min}] = 7 \times (R_{\text{ext}} + 2.6 \text{ k}\Omega) \times C \text{ for } 4.5 \leq AV_{\text{CC}} \leq 5.5$$

$$T_{\text{samp}} [\text{min}] = 7 \times (R_{\text{ext}} + 12.1 \text{ k}\Omega) \times C \text{ for } 3.0 \leq AV_{\text{CC}} \leq 4.5$$

If the sampling time cannot be sufficient, connect a capacitor of about 0.1 μF to the analog input pin.

- ² About the error

The accuracy gets worse as $|AV_{\text{RH}} - AV_{\text{RL}}|$ becomes smaller.

15.6 Alarm Comparator
 $(T_A = -40\text{ }^\circ\text{C to } +125\text{ }^\circ\text{C}, V_{CC} = AV_{CC} = 3.0\text{V} - 5.5\text{V}, V_{SS} = AV_{SS} = 0\text{V})$

| Parameter | Symbol | Pin | Value | | | Unit | Remarks |
|---|----------------------------|-------------------|-------------------------|------------------------|-------------------------|--|---|
| | | | Min | Typ | Max | | |
| Power supply current | I_{A5ALMF} | AV_{CC} | - | 25 | 45 | μA | Alarm comparator enabled in fast mode (one channel) |
| | I_{A5ALMS} | | - | 7 | 13 | μA | Alarm comparator enabled in slow mode (one channel) |
| | I_{A5ALMH} | | - | - | 5 | μA | Alarm comparator disabled |
| ALARM pin input current | I_{ALIN} | ALARM0, ALARM1 | -1 | - | +1 | μA | $T_A = 25\text{ }^\circ\text{C}$ |
| | | | -3 | - | +3 | μA | $T_A = 125\text{ }^\circ\text{C}$ |
| ALARM pin input voltage range | V_{ALIN} | | 0 | - | AV_{CC} | V | |
| External low threshold high->low transition | $V_{EVTL(H\rightarrow L)}$ | | $0.36 * AV_{CC} - 0.25$ | $0.36 * AV_{CC} - 0.1$ | - | V | INTREF = 0 |
| External low threshold low->high transition | $V_{EVTL(L\rightarrow H)}$ | | - | $0.36 * AV_{CC} + 0.1$ | $0.36 * AV_{CC} + 0.25$ | V | |
| External high threshold high->low transition | $V_{EVTH(H\rightarrow L)}$ | | $0.78 * AV_{CC} - 0.25$ | $0.78 * AV_{CC} - 0.1$ | - | V | |
| External high threshold low->high transition | $V_{EVTH(L\rightarrow H)}$ | | - | $0.78 * AV_{CC} + 0.1$ | $0.78 * AV_{CC} + 0.25$ | V | |
| Internal low threshold high->low transition | $V_{IVTL(H\rightarrow L)}$ | | INTREF = 1 | 0.9 | 1.1 | - | V |
| Internal low threshold low->high transition | $V_{IVTL(L\rightarrow H)}$ | | | - | 1.3 | 1.55 | V |
| Internal high threshold high->low transition | $V_{IVTH(H\rightarrow L)}$ | | | 2.2 | 2.4 | - | V |
| Internal high threshold low->high transition | $V_{IVTH(L\rightarrow H)}$ | | | - | 2.6 | 2.85 | V |
| Switching hysteresis | V_{HYS} | | 50 | - | 300 | mV | |
| Comparison time | t_{COMPF} | - | 0.1 | 1 | μs | CMD = 1 (fast) | |
| | t_{COMPS} | - | 1 | 10 | μs | CMD = 0 (slow) | |
| Power-up stabilization time after enabling alarm comparator | t_{PD} | - | 1 | 5 | ms | Threshold levels specified above are not guaranteed within this time | |
| Slow/Fast mode transition time | t_{CMD} | - | 100 | 500 | μs | | |



15.7 Low Voltage Detector Characteristics

 (T_A = -40 °C to +125 °C, V_{CC} = AV_{CC} = 3.0V - 5.5V, V_{SS} = AV_{SS} = 0V)

| Parameter | Symbol | Value | | Unit | Remarks |
|--------------------|----------------------|----------|------|------|---|
| | | Min | Max | | |
| Stabilization time | T _{LVDSTAB} | - | 75 | μs | After power-up or change of detection level |
| Level 0 | V _{DL0} | 2.7 | 2.9 | V | CILCR:LVL[3:0]="0000" |
| Level 1 | V _{DL1} | 2.9 | 3.1 | V | CILCR:LVL[3:0]="0001" |
| Level 2 | V _{DL2} | 3.1 | 3.3 | V | CILCR:LVL[3:0]="0010" |
| Level 3 | V _{DL3} | 3.5 | 3.75 | V | CILCR:LVL[3:0]="0011" |
| Level 4 | V _{DL4} | 3.6 | 3.85 | V | CILCR:LVL[3:0]="0100" |
| Level 5 | V _{DL5} | 3.7 | 3.95 | V | CILCR:LVL[3:0]="0101" |
| Level 6 | V _{DL6} | 3.8 | 4.05 | V | CILCR:LVL[3:0]="0110" |
| Level 7 | V _{DL7} | 3.9 | 4.15 | V | CILCR:LVL[3:0]="0111" |
| Level 8 | V _{DL8} | 4.0 | 4.25 | V | CILCR:LVL[3:0]="1000" |
| Level 9 | V _{DL9} | 4.1 | 4.35 | V | CILCR:LVL[3:0]="1001" |
| Level 10 | V _{DL10} | not used | | | |
| Level 11 | V _{DL11} | not used | | | |
| Level 12 | V _{DL12} | not used | | | |
| Level 13 | V _{DL13} | not used | | | |
| Level 14 | V _{DL14} | not used | | | |
| Level 15 | V _{DL15} | not used | | | |

CILCR:LVL[3:0] are the low voltage detector level select bits of the CILCR register.

Levels 10 to 15 are not used in this device.

For correct detection, the slope of the voltage level must satisfy $\left| \frac{dV}{dt} \right| \leq 0.004 \frac{V}{\mu s}$.

Faster variations are regarded as noise and may not be detected.

The functional operation of the MCU is guaranteed down to the minimum low voltage detection level of V_{CC} = 2.7 V. The electrical characteristics however are only valid in the specified range (usually down to 3.0 V).

Low Voltage Detector Operation

In the following figure, the occurrence of a low voltage condition is illustrated. For a detailed description of the reset and startup behavior, please refer to the corresponding hardware manual chapter.



15.8 FLASH Memory Program/erase Characteristics

($T_A = -40^{\circ}\text{C}$ to 105°C , $V_{CC} = AV_{CC} = 3.0\text{V}$ to 5.5V , $DV_{CC} = 3.0\text{V}$ to 5.5V , $V_{SS} = AV_{SS} = DV_{SS} = 0\text{V}$)

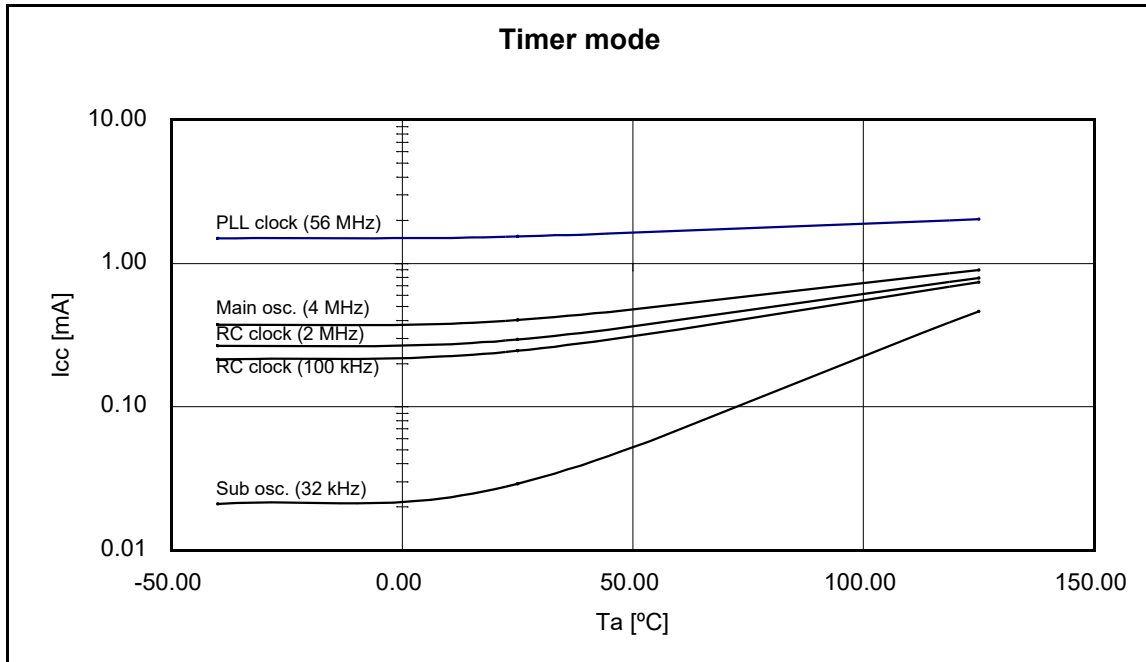
| Parameter | Value | | | Unit | Remarks |
|--------------------------------------|--------|-------|-------|-------|--|
| | Min | Typ | Max | | |
| Sector erase time | - | 0.9 | 3.6 | s | Without erasure pre-programming time |
| Chip erase time | - | n*0.9 | n*3.6 | s | Without erasure pre-programming time (n is the number of Flash sector of the device) |
| Word (16-bit width) programming time | - | 23 | 370 | us | Without overhead time for submitting write command |
| Program/Erase cycle | 10 000 | - | - | cycle | |
| Flash data retention time | 20 | - | - | year | *1 |

*1: This value was converted from the results of evaluating the reliability of the technology (using Arrhenius equation to convert high temperature measurements into normalized value at 85°C)

16. Example Characteristics

The diagrams below show the characteristics of one measured sample with typical process parameters.





Used Settings

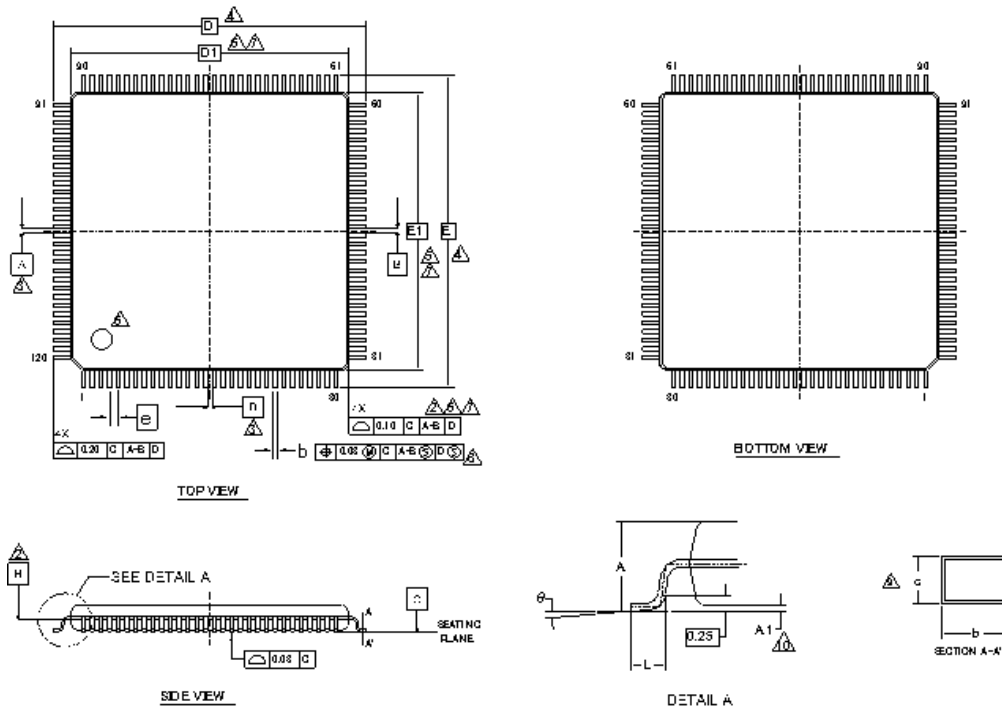
| Mode | Selected Source Clock | Clock/Regulator Settings |
|------------|-----------------------|--|
| Run mode | PLL | CLKS1 = CLKS2 = CLKB = CLKP1 = 56 MHz CLKP2 = 28 MHz Regulator in High Power Mode Core Voltage = 1.9 V |
| | Main osc. | CLKS1 = CLKS2 = CLKB = CLKP1 = CLKP2 = 4 MHz Regulator in High Power Mode Core Voltage = 1.8 V |
| | RC clock fast | CLKS1 = CLKS2 = CLKB = CLKP1 = CLKP2 = 2 MHz Regulator in High Power Mode Core Voltage = 1.8 V |
| | RC clock slow | CLKS1 = CLKS2 = CLKB = CLKP1 = CLKP2 = 100 kHz Regulator in High Power Mode Core Voltage = 1.8 V |
| | Sub osc. | CLKS1 = CLKS2 = CLKB = CLKP1 = CLKP2 = 32 kHz Regulator in Low Power Mode A Core Voltage = 1.8 V |
| Sleep mode | PLL | CLKS1 = CLKS2 = CLKP1 = 56 MHz CLKP2 = 28 MHz (CLKB is stopped in this mode) Regulator in High Power Mode Core Voltage = 1.9 V |
| | Main osc. | CLKS1 = CLKS2 = CLKP1 = CLKP2 = 4 MHz (CLKB is stopped in this mode) Regulator in High Power Mode Core Voltage = 1.8 V |
| | RC clock fast | CLKS1 = CLKS2 = CLKP1 = CLKP2 = 2 MHz (CLKB is stopped in this mode) Regulator in High Power Mode Core Voltage = 1.8 V |
| | RC clock slow | CLKS1 = CLKS2 = CLKP1 = CLKP2 = 100 kHz (CLKB is stopped in this mode) Regulator in High Power Mode Core Voltage = 1.8 V |
| | Sub osc. | CLKS1 = CLKS2 = CLKP1 = CLKP2 = 32 kHz (CLKB is stopped in this mode) Regulator in Low Power Mode A Core Voltage = 1.8 V |

Used Settings

| Mode | Selected Source Clock | Clock/Regulator Settings |
|------------|-----------------------|--|
| Timer mode | PLL | CLKMC = 4 MHz, CLKPLL = 56 MHz (System clocks are stopped in this mode) Regulator in High Power Mode, Core Voltage = 1.9 V |
| | Main osc. | CLKMC = 4 MHz (System clocks are stopped in this mode) Regulator in High Power Mode, Core Voltage = 1.8 V |
| | RC clock fast | CLKRC = 2 MHz (System clocks are stopped in this mode) Regulator in High Power Mode, Core Voltage = 1.8 V |
| | RC clock slow | CLKRC = 100 kHz (System clocks are stopped in this mode) Regulator in High Power Mode, Core Voltage = 1.8 V |
| | Sub osc. | CLKSC = 100 kHz (System clocks are stopped in this mode) Regulator in Low Power Mode A, Core Voltage = 1.8 V |
| Stop mode | stopped | (All clocks are stopped in this mode) Regulator in Low Power Mode B, Core Voltage = 1.8 V |

17. Package Dimension CY96(F)38x LQFP 120P

| Package Type | Package Code |
|--------------|--------------|
| LQFP 120 | LQM120 |



| SYMBOL | DIMENSIONS | | |
|--------|------------|------|-------|
| | MIN. | NOM. | MAX. |
| A | — | — | 1.70 |
| A1 | 0.05 | — | 0.15 |
| b | 0.17 | 0.22 | 0.27 |
| c | 0.115 | — | 0.195 |
| D | 18.00 BSC | | |
| D1 | 18.00 BSC | | |
| e | 0.50 BSC | | |
| E | 18.00 BSC | | |
| E1 | 18.00 BSC | | |
| L | 0.45 | 0.60 | 0.75 |
| θ | 0° | — | 8° |

NOTES

- ALL DIMENSIONS ARE IN MILLIMETERS.
- DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
- DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
- D TO BE DETERMINED AT SEATING PLANE C.
- DIMENSIONS D1 AND D2 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PER SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
- DETAILS OF PIN IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
- REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS, DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST PART OF THE BODY EXCEPT FOR MOLD DASH AND BURRS, BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
- DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. THE DAMBAR PROTRUSION (⊕) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED a MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RAJUS OF THE LEAD FOOT.
- THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
- A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

11 JEDOC SPECIFICATION NO. RFF-MA

002-16172 **

 PACKAGE OUTLINE, 120 LEAD LQFP
 18.0x18.0x1.7MM LQM 120 REV**

18. Ordering Information

| Part Number | Flash/ROM | Subclock | Persistent Low Voltage Reset | Package |
|------------------------|--------------------------------------|----------|------------------------------|-------------------------------|
| CY96384RSBPMC-GSE2 | ROM (128 KB) | No | No | 120-pin Plastic LQFP (LQM120) |
| CY96384RWBPMC-GSE2 | | Yes | | |
| CY96384RSCPMC-GSE2 | | No | No | 120-pin Plastic LQFP (LQM120) |
| CY96384RWCPMC-GSE2 | | Yes | | |
| CY96385RSCPMC-GSE2 | ROM (160 KB) | No | No | 120-pin Plastic LQFP (LQM120) |
| CY96F385RSAPMC-GS-UJE2 | Flash A (160 KB) | No | No | 120-pin Plastic LQFP (LQM120) |
| CY96F385RWAPMC-GS-UJE2 | | Yes | | |
| CY96F385RSBPMC-GS-UJE2 | | No | | |
| CY96F386RSBPMC-GS-UJE1 | Flash A (288 KB) | No | No | 120-pin Plastic LQFP (LQM120) |
| CY96F386RSBPMC-GS-UJE2 | | No | | |
| CY96F386RWBPMC-GS-UJE2 | | Yes | | |
| CY96F386RSCPMC-GS-UJE2 | | No | | |
| CY96F387RSBPMC-GS-UJE2 | Flash A (416 KB) | No | No | 120-pin Plastic LQFP (LQM120) |
| CY96F387RWBPMC-G-UJE2 | | Yes | | |
| CY96F387RSCPMC-GS-UJE2 | | No | | |
| CY96F388HWBPMC-GS-UJE2 | Flash A (544 KB) Flash B (32 KB) | Yes | No | 120-pin Plastic LQFP (LQM120) |
| CY96F389RSBPMC-GS-UJE2 | Flash A (544 KB) Flash B (288 KB) | No | No | 120-pin Plastic LQFP (LQM120) |

This datasheet is also valid for the following outdated devices:

CY96F386RSA, CY96F386RWA, CY96F387RSA, CY96F387RWA

19. Major Changes

| Page | Section | Change Result |
|-----------------|--|---|
| Rev *B | | |
| - | Marketing Part Numbers changed from an MB prefix to a CY prefix. | |
| 1 | - | Deleted the following comment. Note: MB96384/385/F385/F388/F389 devices are under development and specification is preliminary. These products under development may change its specification without notice. |
| 6 | 1. Product Lineup | Deleted the following comment. *1: These devices are under development and specification is preliminary. These products under development may change its specification without notice. |
| 8 112 113 | 3. Pin Assignment 17. Package Dimension 18. Ordering Information | Package description modified to JEDEC description. (before) FPT-120P-M21 (after) LQM120 |
| 113 | 18. Ordering Information | Deleted the following comment. *1: These devices are under development and specification is preliminary. These products under development may change its specification without notice. Deleted the following parts number. - MB96384YSBPMC-GSE2 - MB96384YWBPMC-GSE2 - MB96385YSBPMC-GSE2 - MB96385RSBPMC-GSE2 - MB96385YWBPMC-GSE2 - MB96385RWBPMC-GSE2 - MB96F385YSAPMC-GSE2 - MB96F385YWAPMC-GSE2 - MB96F386YSBPMC-GSE2 - MB96F386YWBPMC-GSE2 - MB96F387YSBPMC-GSE2 - MB96F387YWBPMC-GSE2 - MB96F388TSAPMC-GSE2 - MB96F388HSAPMC-GSE2 - MB96F388TWAPMC-GSE2 - MB96F388HWAPMC-GSE2 - MB96F389YSAPMC-GSE2 - MB96F389RSAPMC-GSE2 - MB96F389YWAPMC-GSE2 - MB96F389RWAPMC-GSE2 - MB96V300BRB-ES (for evaluation) |

| Page | Section | Change Result |
|------|--------------------------|---|
| 113 | 18. Ordering Information | <p>Revised the following parts number. (before)</p> <ul style="list-style-type: none"> - MB96384RSBPMC-GSE2 - MB96384RWBPMC-GSE2 - MB96F385RSAPMC-GSE2 - MB96F385RWAPMC-GSE2 - MB96F386RSBPMC-GSE2 - MB96F386RWBPMC-GSE2 - MB96F387RSBPMC-GSE2 - MB96F387RWBPMC-GSE2 <p>(after)</p> <ul style="list-style-type: none"> - CY96384RSBPMC-GSE2 - CY96384RWBPMC-GSE2 - CY96F385RSAPMC-GS-UJE2 - CY96F385RWAPMC-GS-UJE2 - CY96F386RSBPMC-GS-UJE2 - CY96F386RWBPMC-GS-UJE2 - CY96F387RSBPMC-GS-UJE2 - CY96F387RWBPMC-G-UJE2 <p>Added the following parts number.</p> <ul style="list-style-type: none"> - CY96384RSCPMC-GSE2 - CY96384RWCPMC-GSE2 - CY96385RSCPMC-GSE2 - CY96F385RSBPMC-GS-UJE2 - CY96F386RSBPMC-GS-UJE1 - CY96F386RSCPMC-GS-UJE1 - CY96F386RSCPMC-GS-UJE2 - CY96F387RSAPMC-GS-UJE2 - CY96F387RSCPMC-GS-UJE2 - CY96F388HSBPMC-GS-UJE1 - CY96F389RSBPMC-GS-UJE2 <p>Changed and deleted the parts number in Note. (before) MB96F386YSA, MB96F386RSA, MB96F386YWA, MB96F386RWA, MB96F387YSA, MB96F387RSA, MB96F387YWA, MB96F387RWA (after) CY96F386RSA, CY96F386RWA, CY96F387RSA, CY96F387RWA</p> |

20. Revision History

Spansion Publication Number: **DS07-13803-2E**

| Revision | Date | Modification |
|----------|------------|--|
| Prelim 1 | 2007-05-2 | Creation |
| Prelim 2 | 2007-05-24 | Electrical characteristics and memory description updates |
| Prelim 3 | 2007-08-09 | Typo errors corrections, Flash memory programming interface update |
| Prelim 4 | 2007-08-31 | Update of DC characteristics. new MB96F388 and MB96F389 added. LVD chapter added as well as an example characteristics chapter |
| Prelim 5 | 2007-09-06 | Updates of the DC characteristics, interrupt vector table update, update of the LVD characteristics |
| Prelim 6 | 2007-11-14 | Memory map for external bus modified. Modifications of the drawing of the pin circuits. Electrical characteristics updates. Rephrasing and typos corrections. Add Slew rate high current outputs chapter. Modification of the block diagram. Memory map modified for Flash. RAM memory map added. Pin circuit type corrected. Type L IO is now included. |
| Prelim 7 | 2007-12-12 | Memory IO map modified New Flash/ROM configuration presentation Ordering information: MB96300B used as reference. Block diagram modified to included relocated pins. Main Flash becomes Flash memory A and Satellite flash becomes Flash memory B |
| Prelim 8 | 2008-02-04 | <ul style="list-style-type: none"> • Devices under development added: MB96384/385/F385/F388/F389 • Block diagram corrected (existing resource pins) • Pin assignment: TTG8 -> TTG7 • Pin function table corrected • I/O circuit type diagrams corrected • Memory map cleaned up • "Flash sector configuration" replaced by corrected "User ROM Memory map for Flash devices", "ROM configuration" replaced by "User ROM Memory map for Mask ROM devices" • IO map table regenerated: <ul style="list-style-type: none"> - Port register: Naming style corrected - Memory control registers renamed (Main/Sat -> A/B) - addresses after 000BFFh removed • Absolute maximum ratings: Pd and Ta specified more precisely • Run and Sleep mode currents: more conditions added (1WS settings) • Run mode current spec in 48/24MHz mode corrected • Maximum CLKP2 frequency for MB96F386/F387 corrected • High current port input capacitance added • External bus timings: missing conditions added and readability improved • Alarm comparator spec updated (transition voltages defined) • MB96V300A removed • Ordering information updated • Typos and formatting corrected |

| Revision | Date | Modification |
|----------|------------|--|
| 9 | 2009-01-09 | <ul style="list-style-type: none"> • Format adjusted to official Fujitsu Microelectronics datasheet standard (mainly style changes and official notes and disclaimer added) • Numbering of Electrical Characteristics subchapters automated • Note about devices under development modified • I/O map: Note added about reserved addresses • Serial programming interface: Note about handshaking pins improved • ICCPLL for CLKS1/2=80MHz, CLKB=40MHz (F388/F389) increased by 5mA • ICCSPLL for CLKS1/2=80MHz, CLKB=40MHz (F388/F389) increased by 0.8mA (typ) and 1.3mA (max) • Updated ordering information: MB96384/385**A -> MB96384/385**B • Package code of MB96V300 corrected in ordering information • Internal LCD divider resistance value corrected: Typ 35kOhm -> 40kOhm, Max 50kOhm -> 65kOhm • Run and Sleep mode currents of ROM devices (MB96384/385) reduced • Added voltage condition to pull-up resistance and LCD divide resistance spec • Lineup: Term “Data Flash” replaced by “independent 32KB Flash” • Ordering information: column “Independent 32KB Data Flash” replaced by new column “Flash/ROM”, column “Remarks” removed • Official package dimension drawing with additional notes added • Empty pages removed • MB96384/385 and MB96F385/F388/F389 separated in DC spec and currents of these devices adjusted according to first evaluation results • Alarm comparator: Power supply current max values increased, comparison time reduced, mode transition time and power-up stabilization time newly added • Handling devices: Notes added about Serial communication and about using ceramic resonators. • Feature list and AC Characteristics: 16MHz maximum frequency is valid for crystal oscillators. For resonators, maximum frequency depends on Q-factor • AC characteristics: PLL phase skew spec added, CLKVCO min=64MHz • VOL3 spec improved: spec valid for 3mA load for full Vcc range • C-Pin cap spec updated: 4.7uF-10uF capacitor with tolerance permitted • “Preliminary” watermark removed |

NOTE: Please see “Document History” about later revised information.

Document History

| Document Title: CY96380 Series F ² MC-16FX 16-bit Proprietary Microcontroller Document Number: 002-04582 | | | |
|--|---------|-----------------|---|
| Revision | ECN | Submission Date | Description of Change |
| ** | — | 05/02/2007 | Migrated to Cypress and assigned document number 002-04582. No change to document contents or format. |
| *A | 5243006 | 04/28/2016 | Updated to Cypress template |
| *B | 6094799 | 03/12/2018 | Revised the following items: Marketing Part Numbers changed from an MB prefix to a CY prefix. 3.Pin Assignments 17.Package Dimension 18.Ordering Information Added 19. Major Changes For details, please see 19.Major Changes |
| *C | 6777565 | 01/22/2020 | Added the following part number on 18. Ordering Information. CY96F388HWBPMC-GS-UJE2 Deleted the following parts number on 18. Ordering Information. CY96F386RSCPMC-GS-UJE1 CY96F387RSAPMC-GS-UJE2 CY96F388HSBPMC-GS-UJE1 |

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