# THE DATASHEET OF

# CY96F385RSBPMC-GS174UJE2

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# CY96380 Series

# 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 µm 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 · 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

### $I^2C$

- 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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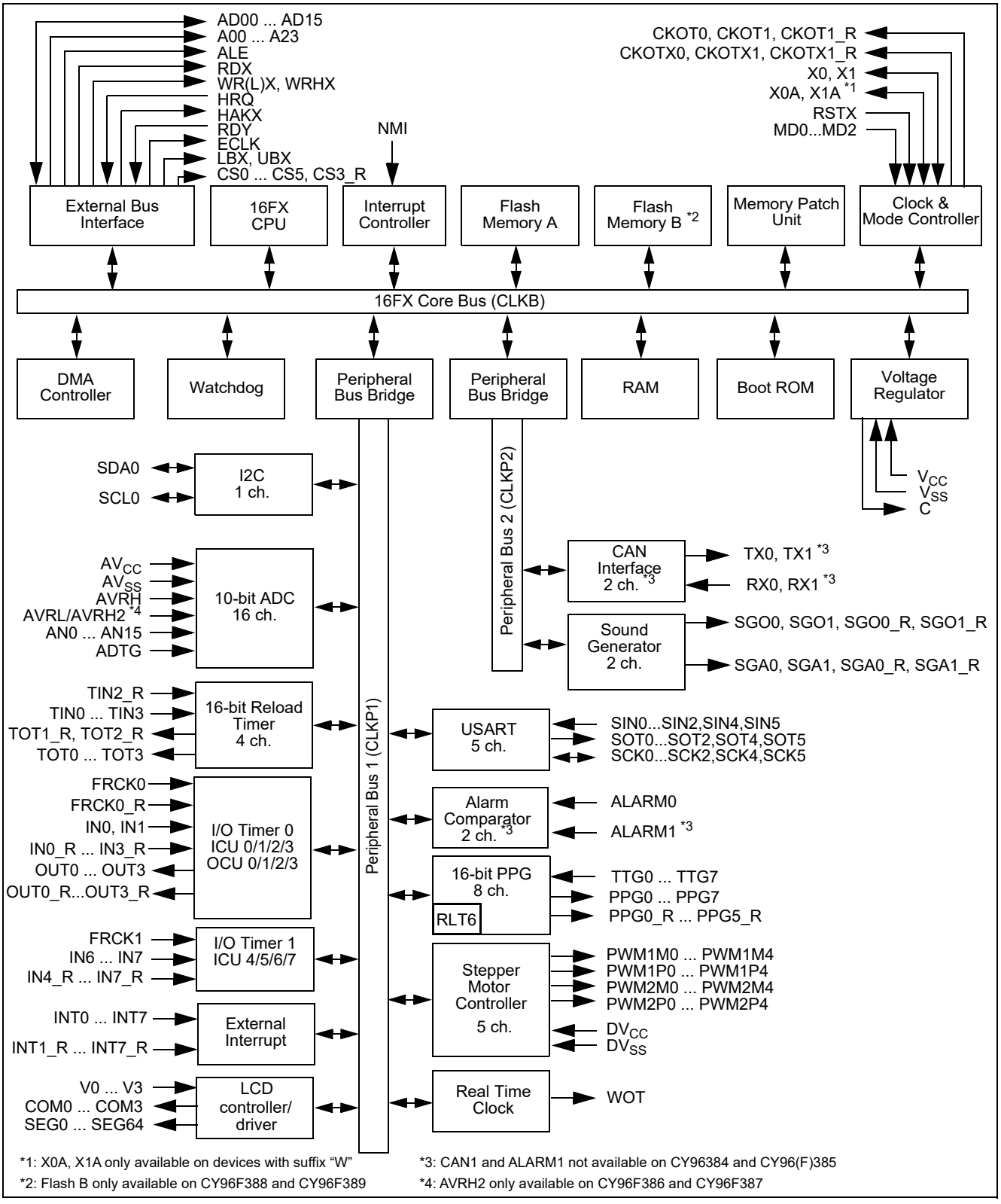
## 1. Product Lineup

| Features | | CY96V300B | CY96(F)38x |
|---|---|---|---|
| Product type | | Evaluation sample | Flash product: CY96F38x<br>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 |
| $I^2C$ | | 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<br>CY96384Y, CY96384R, CY96(F)385Y, CY96(F)385R,:<br>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<br>CY96384Y, CY96384R, CY96(F)385Y, CY96(F)385R,:<br>1 channel |
| External bus interface | Yes | |
| Chip select | 6 signals | |
| Clock output function | 2 channels | |
| Low voltage reset | Yes | |
| On-chip RC-oscillator | Yes | |

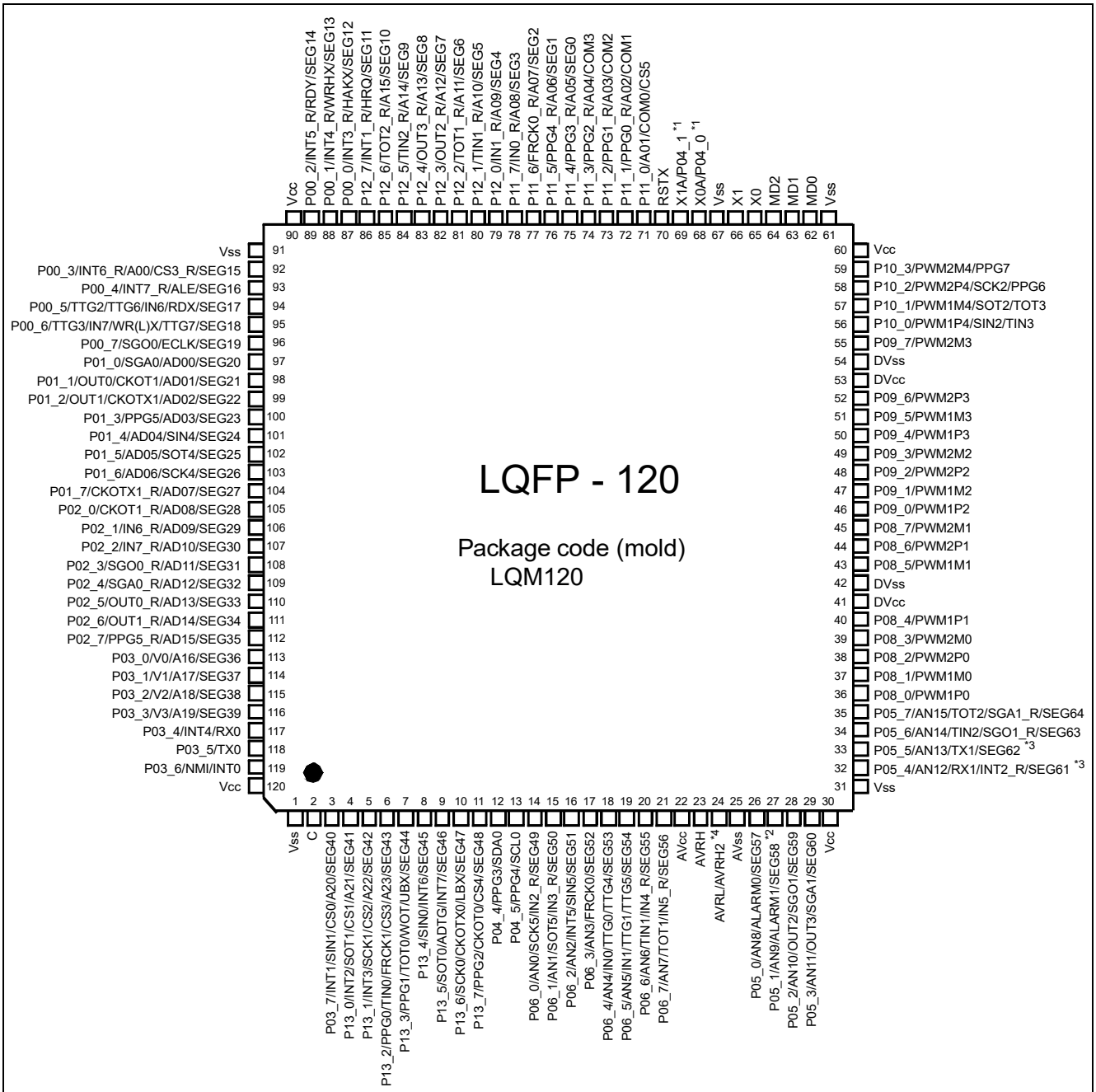
## 2. Block Diagram

**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: AVRH2 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 |
|---|---|---|
| Vn | 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)

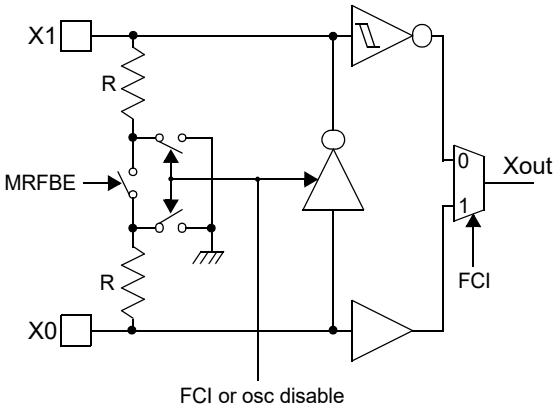
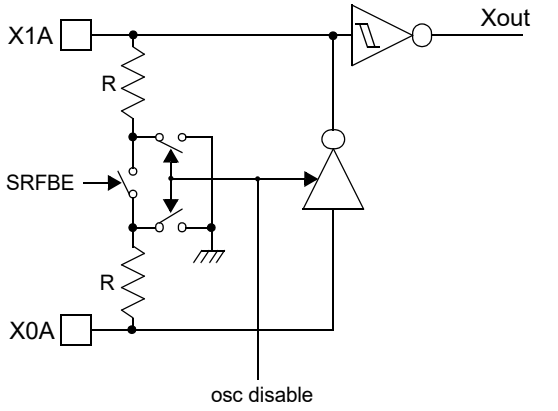
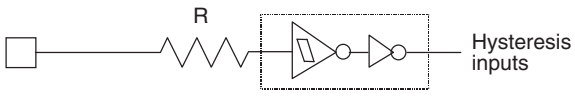
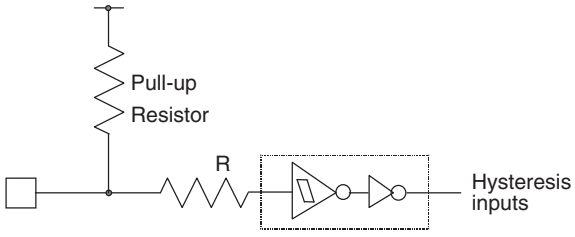
| LQM120 | |
|---|---|
| Pin No. | Circuit Type *1 |
| 1 | Supply |
| 2 | F |
| 3 to 11 | J |
| 12,13 | N |
| 14 to 21 | K |
| 22 | Supply |
| 23 to 24 | G |
| 25 | Supply |
| 26 to 29 | K |
| 30,31 | Supply |
| 32 to 35 | K |
| 36 to 40 | M |
| 41,42 | Supply |
| 43 to 52 | M |
| 53,54 | Supply |
| 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 |

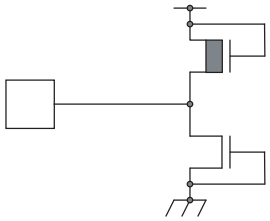
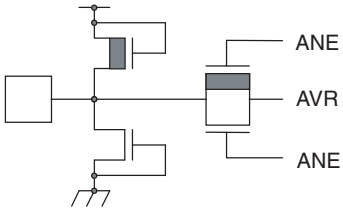
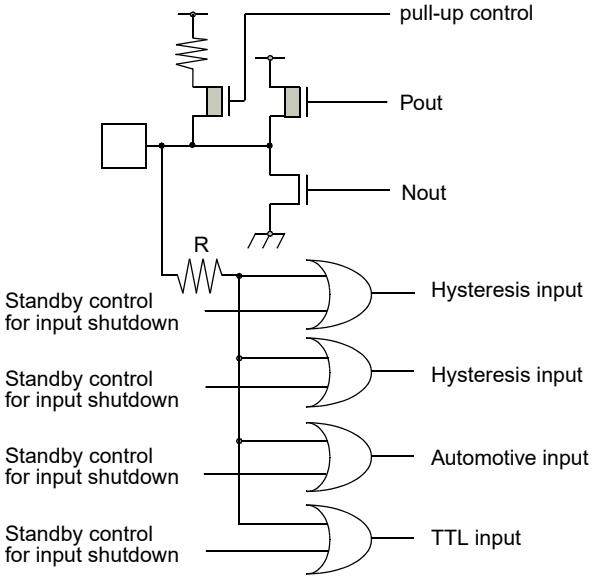
**Pin Circuit Types (2 of 2)**

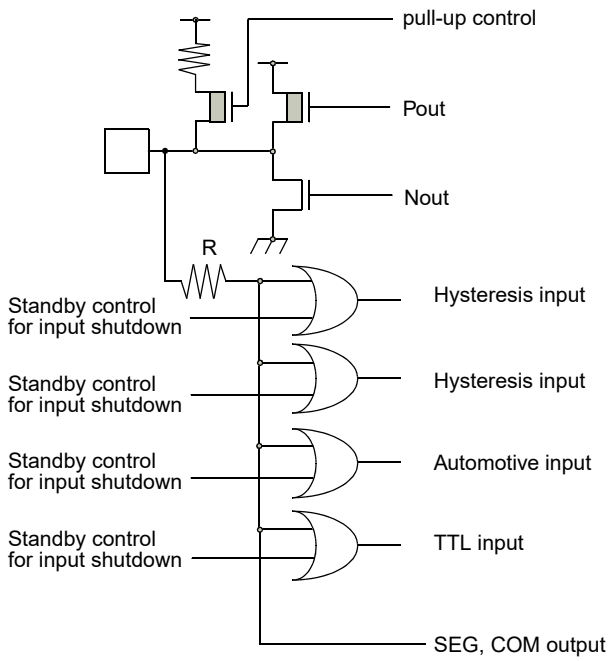
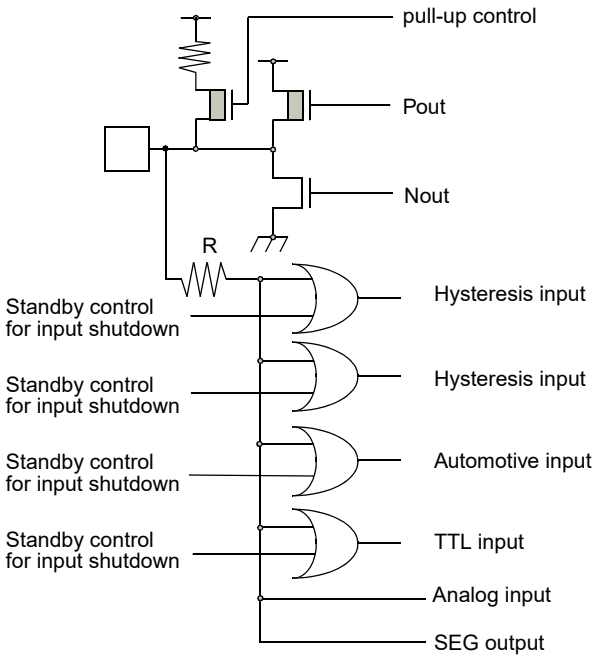
| LQM120 | |
|---|---|
| Pin No. | Circuit Type *1 |
| 117 to 119 | H |
| 120 | Supply |

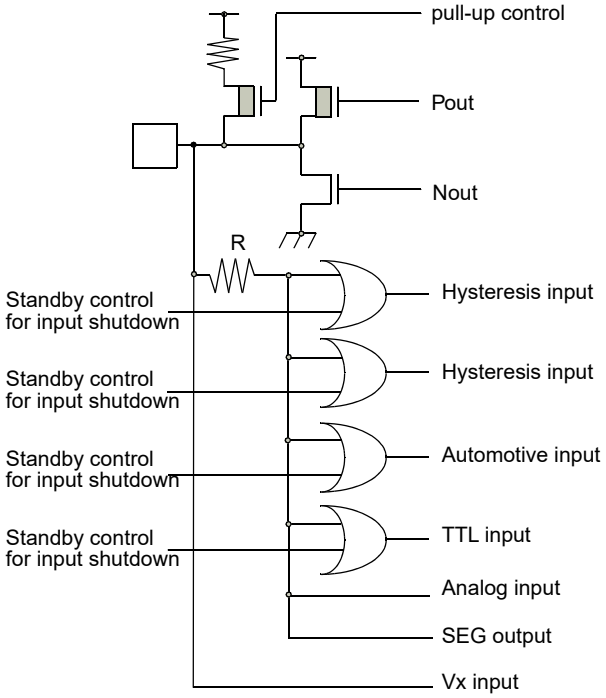
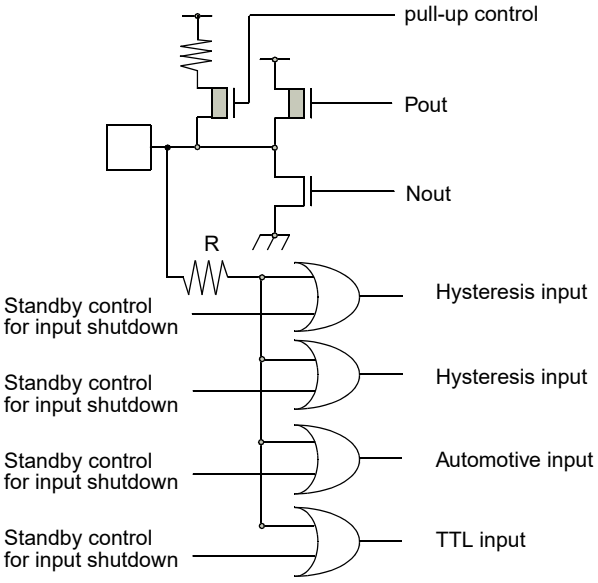
*1: See 6.“I/O Circuit Type” for details on the I/O circuit types
*2: Devices with suffix “W”
*3: Devices without suffix “W”

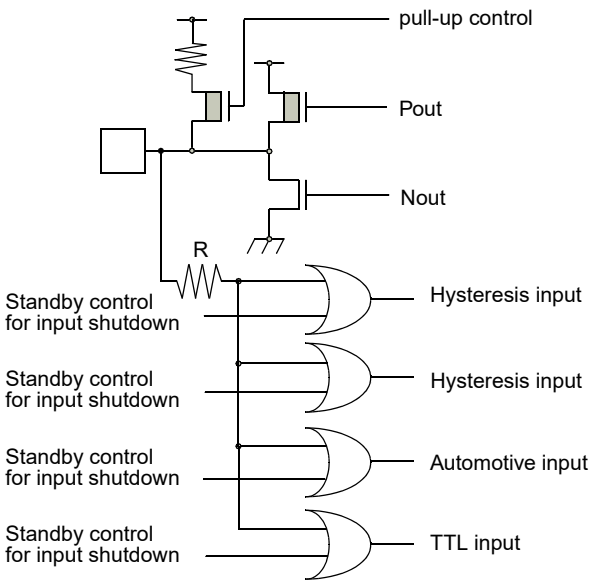
## 6. I/O Circuit Type

| Type | Circuit | Remarks |
|---|---|---|
| A |  | High-speed oscillation circuit:<br>• 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)<br>• Programmable feedback resistor = approx. 2 * 0.5 MΩ. Feedback resistor is grounded in the center when the oscillator is disabled or in FCI mode |
| B |  | Low-speed oscillation circuit:<br>• Programmable feedback resistor = approx. 2 * 5 MΩ. Feedback resistor is grounded in the center when the oscillator is disabled |
| C |  | • Mask ROM and EVA device: CMOS Hysteresis input pin<br>• Flash device: CMOS input pin |
| E |  | • CMOS Hysteresis input pin<br>• Pull-up resistor value: approx. 50 kΩ |

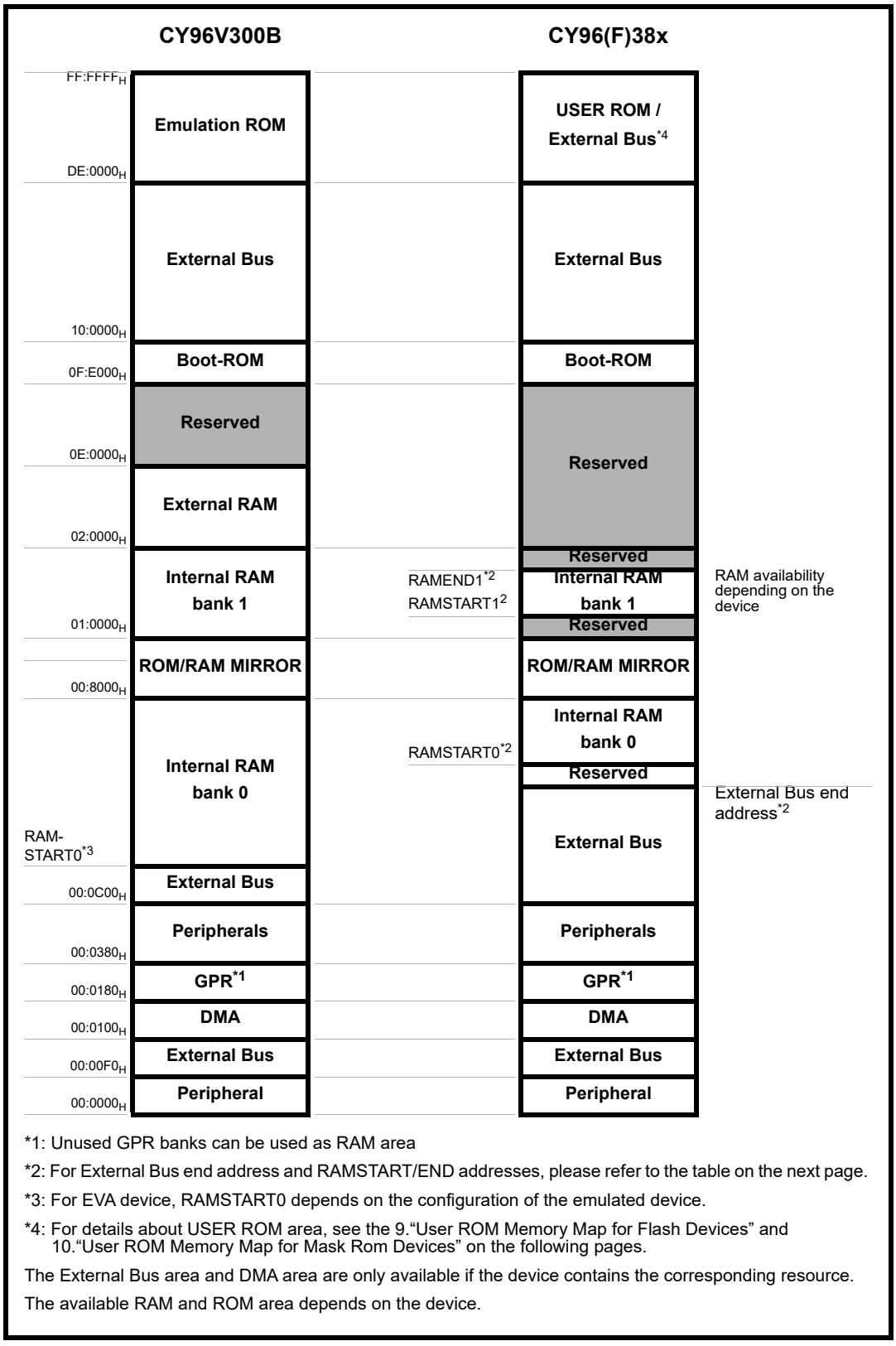
| Type | Circuit | Remarks |
|---|---|---|
| F |  | • Power supply input protection circuit |
| G |  | • A/D converter ref+ (AVRH/AVRH2) power supply input pin with protection circuit<br>• Flash devices do not have a protection circuit against VCC for pins AVRH/AVRH2<br>• Devices without AVRH reference switch do not have an analog switch for the AVRL pin |
| H |  | • CMOS level output (programmable $I_{OL}$ = 5 mA, $I_{OH}$ = -5 mA and $I_{OL}$ = 2 mA, $I_{OH}$ = -2 mA)<br>• 2 different CMOS hysteresis inputs with input shutdown function<br>• Automotive input with input shutdown function<br>• TTL input with input shutdown function<br>• Programmable pull-up resistor: 50 kΩ approx. |

| Type | Circuit | Remarks |
|---|---|---|
| J |  | • CMOS level output (programmable $I_{OL}$ = 5 mA, $I_{OH}$ = -5 mA and $I_{OL}$ = 2 mA, $I_{OH}$ = -2 mA)<br>• 2 different CMOS hysteresis inputs with input shutdown function<br>• Automotive input with input shutdown function<br>• TTL input with input shutdown function<br>• Programmable pull-up resistor: 50 kΩ approx.<br>• SEG or COM output |
| K |  | • CMOS level output (programmable $I_{OL}$ = 5 mA, $I_{OH}$ = -5 mA and $I_{OL}$ = 2 mA, $I_{OH}$ = -2 mA)<br>• 2 different CMOS hysteresis inputs with input shutdown function<br>• Automotive input with input shutdown function<br>• TTL input with input shutdown function.<br>• Programmable pull-up resistor: 50 kΩ approx.<br>• Analog input<br>• SEG output |

| Type | Circuit | Remarks |
|---|---|---|
| L |  | • CMOS level output (programmable $I_{OL}$ = 5 mA, $I_{OH}$ = -5 mA and $I_{OL}$ = 2 mA, $I_{OH}$ = -2 mA)<br>• 2 different CMOS hysteresis inputs with input shutdown function<br>• Automotive input with input shutdown function<br>• TTL input with input shutdown function<br>• Programmable pull-up resistor: 50 kΩ approx.<br>• Analog input<br>• Vx input<br>• SEG output |
| M |  | • CMOS level output (programmable $I_{OL}$ = 5 mA, $I_{OH}$ = -5 mA and $I_{OL}$ = 2 mA, $I_{OH}$ = -2 mA, $I_{OL}$ = 30 mA, $I_{OH}$ = -30 mA)<br>• 2 different CMOS hysteresis inputs with input shutdown function<br>• Automotive input with input shutdown function<br>• TTL input with input shutdown function<br>• Programmable pull-up resistor: 50 kΩ approx. |

| Type | Circuit | Remarks |
|---|---|---|
| N |  | • CMOS level output ($I_{OL}$ = 3 mA, $I_{OH}$ = -3 mA)<br>• 2 different CMOS hysteresis inputs with input shutdown function<br>• Automotive input with input shutdown function<br>• TTL input with input shutdown function<br>• Programmable pull-up resistor: 50 kΩ approx. |

## 7. Memory Map




*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.

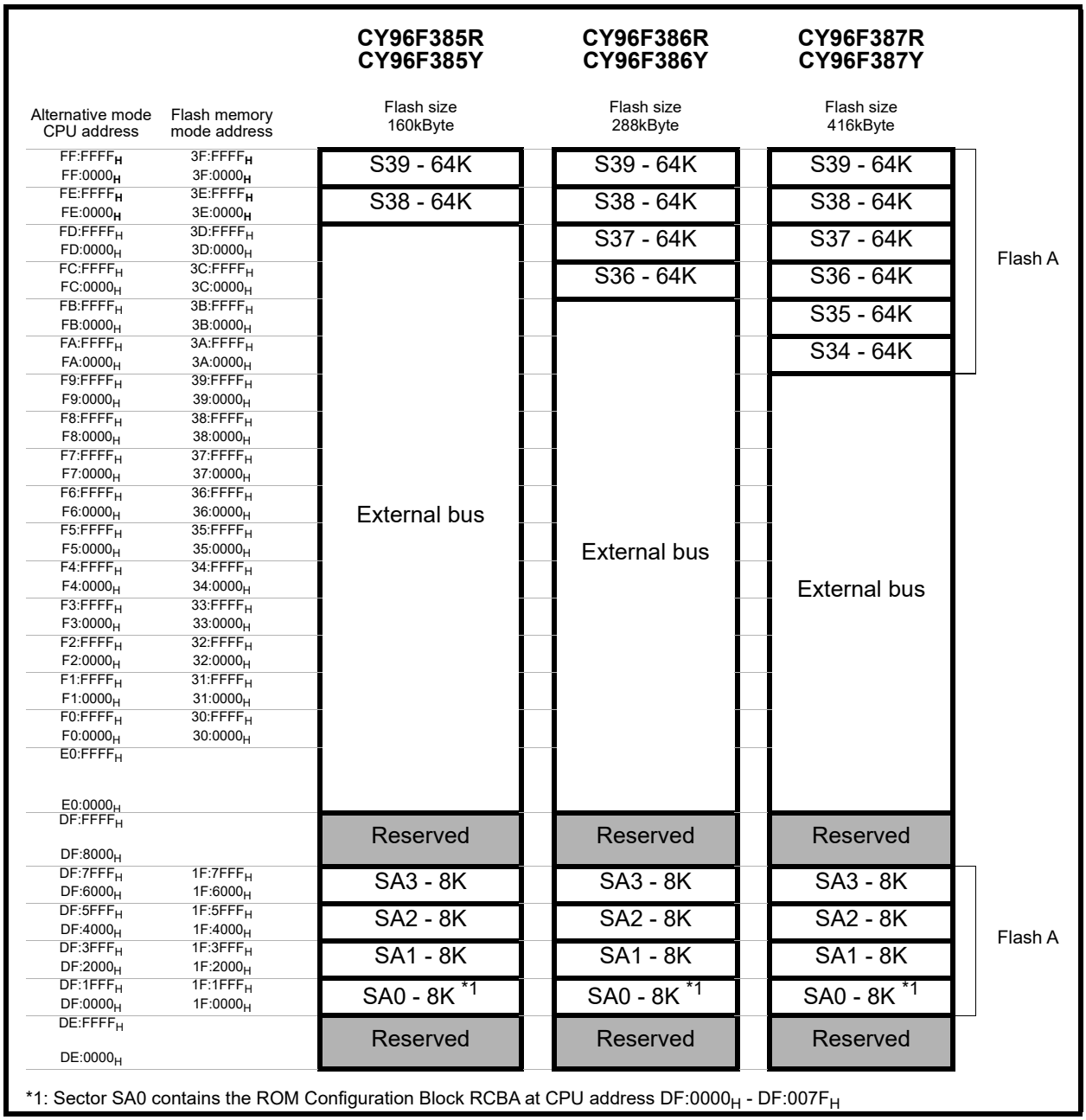
The External Bus area and DMA area are only available if the device contains the corresponding resource.

The available RAM and ROM area depends on the device.

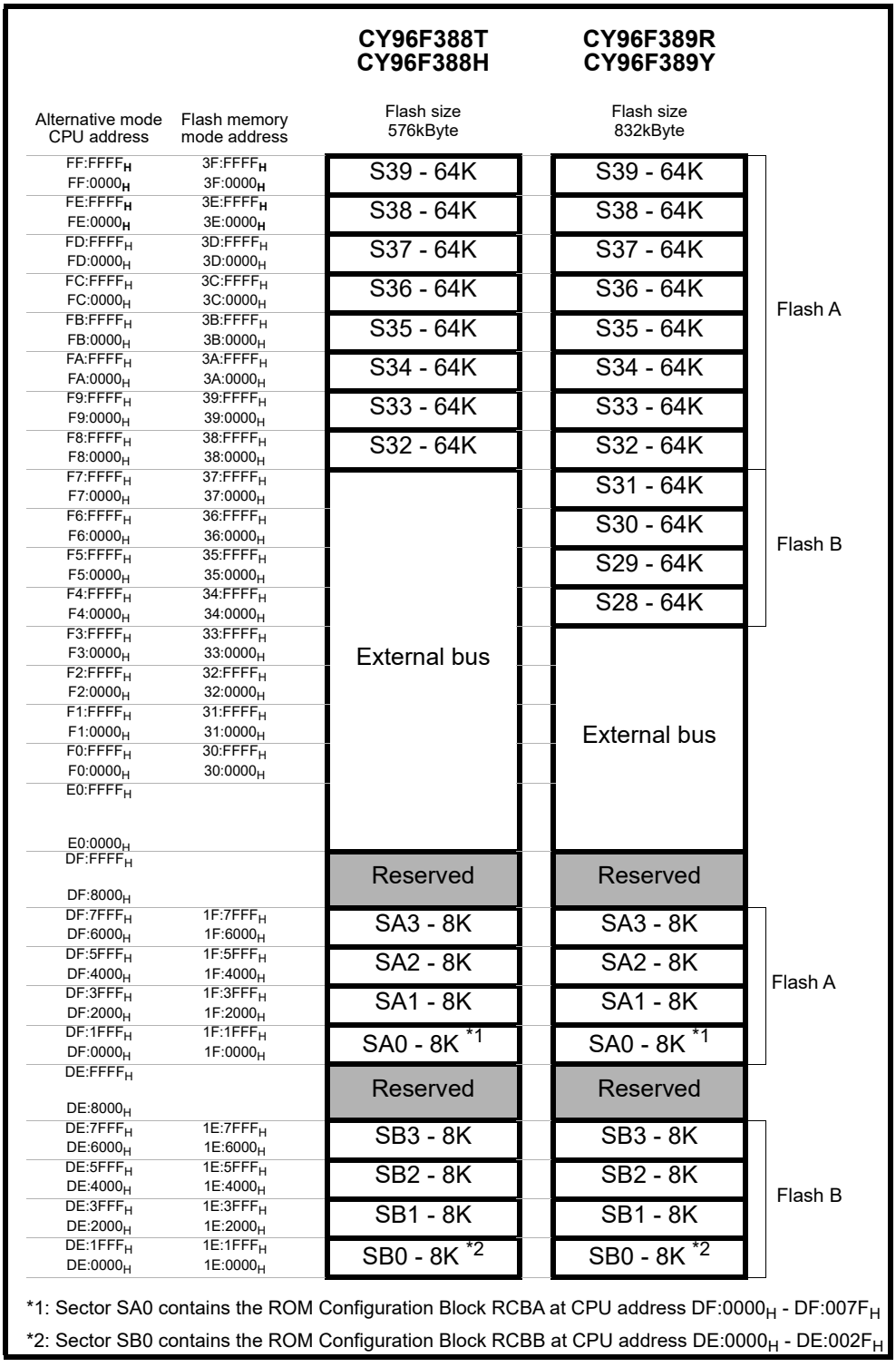
## 8. RAMSTART/END and External Bus End Addresses

| 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



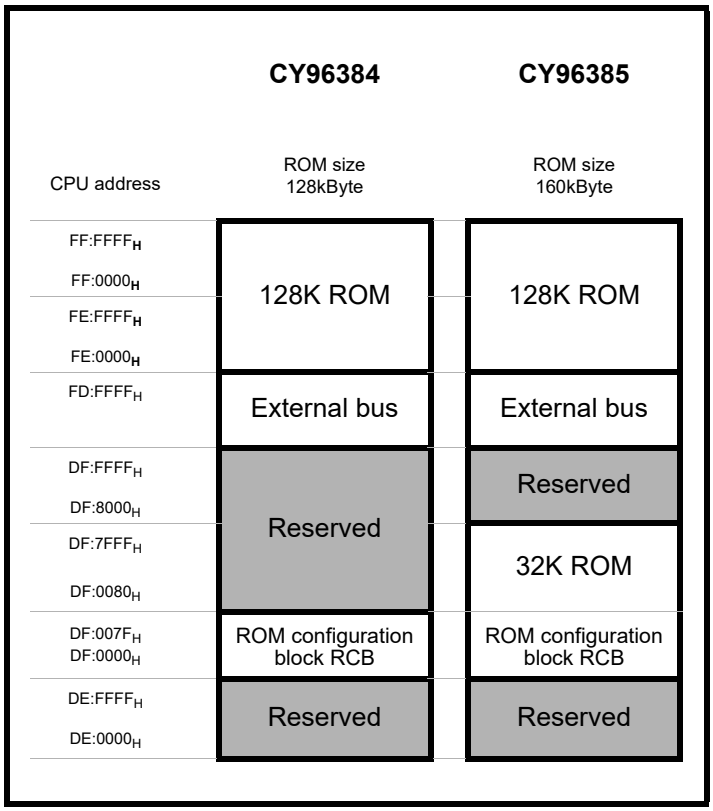

*1: Sector SA0 contains the ROM Configuration Block RCBA at CPU address DF:0000$_H$ - DF:007F$_H$




*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



## 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 | IPCPH0 | - | R |
| $000044_H$ | ICU1 - Capture Register Low | IPCPL1 | IPCP1 | R |
| $000045_H$ | ICU1 - Capture Register High | IPCPH1 | - | 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 | IPCPH2 | - | R |
| $00004A_H$ | ICU3 - Capture Register Low | IPCPL3 | IPCP3 | R |
| $00004B_H$ | ICU3 - Capture Register High | IPCPH3 | - | 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 | PLLCRL | PLLCR | R/W |
| $000407_H$ | PLL Control register High | PLLCRH | - | 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 | RCR | - | 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 | CMPRL | CMPR | R/W |
| $00041B_H$ | Clock Modulator Parameter register High | CMPRH | - | 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).

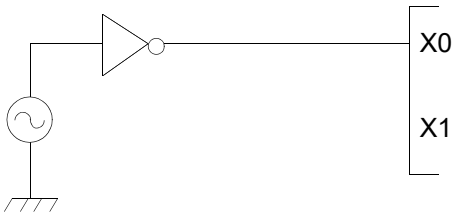
Leaving unused input pins open when the input is enabled may result in misbehavior and possible permanent damage of the device. They must therefore be pulled up or pulled down through resistors. To prevent latch-up, those resistors should be more than 2 kΩ.

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.

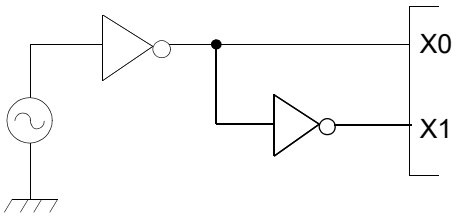
## 14.3 External clock usage

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 50µs 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 Vcc power supply voltage, a malfunction may occur. The Vcc power supply voltage must therefore be stabilized. As stabilization guidelines, the power supply voltage must be stabilized in such a way that Vcc ripple fluctuations (peak to peak value) in the commercial frequencies (50 to 60 Hz) fall within 10% of the standard Vcc power supply voltage and the transient fluctuation rate becomes 0.1 V/µs 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 | $\Sigma I_{OL1}$ | - | 100 | mA | Normal outputs |
| | $\Sigma I_{OLSMC}$ | - | 330 | mA | High current outputs |
| “L” level average overall output current | $\Sigma I_{OLAV1}$ | - | 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 | $\Sigma I_{OH1}$ | - | -100 | mA | Normal outputs |
| | $\Sigma I_{OHSMC}$ | - | -330 | mA | High current outputs |
| ”H” level average overall output current | $\Sigma I_{OHAV1}$ | - | -50 | mA | Normal outputs |
| | $\Sigma I_{OHASMC}$ | - | -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 | |

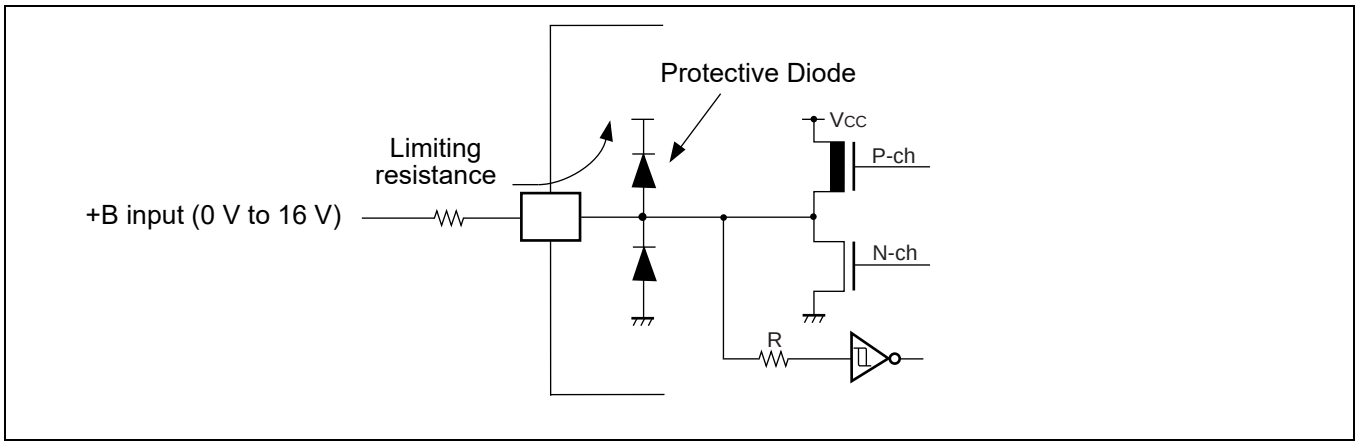
*1: $AV_{CC}$ and $V_{CC}$ must be set to the same voltage. It is required that $AV_{CC}$ does not exceed $V_{CC}$ and that the voltage at the analog inputs does not exceed $AV_{CC}$ neither when the power is switched on.

*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:
$P_D = P_{IO} + P_{INT}$
$P_{IO} = \Sigma (V_{OL} * I_{OL} + V_{OH} * I_{OH})$ (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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

| 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)$V_{CC}$ ≥ 4.5 V |
| | | | | 0.74 $V_{CC}$ | - | (D)$V_{CC}$ + 0.3 | V | (D)$V_{CC}$ < 4.5 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 | (D)$V_{CC}$ ≥ 4.5 V |
| | | | | $V_{SS}$ - 0.3 | - | 0.46 (D)$V_{CC}$ | | (D)$V_{CC}$ < 4.5 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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

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

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

| Parameter | Symbol | Pin | Condition | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| Output L voltage | $V_{OL2}$ | Normal and High Current outputs | 4.5 V ≤ (D)$V_{CC}$ ≤ 5.5 V<br>$I_{OL}$ = +2 mA<br>3.0 V ≤ (D)$V_{CC}$ < 4.5 V<br>$I_{OL}$ = +1.6 mA | - | - | 0.4 | V | Driving strength set to 2 mA |
| | $V_{OL5}$ | Normal and High Current outputs | 4.5 V ≤ (D)$V_{CC}$ ≤ 5.5 V<br>$I_{OL}$ = +5 mA<br>3.0 V ≤ (D)$V_{CC}$ < 4.5 V<br>$I_{OL}$ = +3 mA | - | - | 0.4 | V | Driving strength set to 5 mA |
| | $V_{OL30}$ | High current outputs | 4.5 V ≤ $DV_{CC}$ ≤ 5.5 V<br>$I_{OL}$ = +30 mA<br>3.0 V ≤ $DV_{CC}$ < 4.5 V<br>$I_{OL}$ = +20 mA | - | - | 0.5 | V | Driving strength set to 30 mA |
| | $V_{OL3}$ | 3mA outputs | 3.0 V ≤ $V_{CC}$ ≤ 5.5 V<br>$I_{OL}$ = +3 mA | - | - | 0.4 | V | |
| Input leak current | $I_{IL}$ | Pnn_m | $V_{SS}$ < $V_I$ < $V_{CC}$<br>$AV_{SS}$, AVRL < $V_I$ < $AV_{CC}$, AVRH | -1 | - | +1 | µA | Single port pin |
| Total LCD leak current | $\Sigma\|I_{ILCD}\|$ | all SEG/COM pins | $V_{CC}$ = 5.0 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 V | 25 | 40 | 65 | kΩ | |
| Pull-up resistance | $R_{UP}$ | Pnn_m, $\overline{RSTX}$ | $V_{CC}$ = 3.3 V ± 10% | 40 | 100 | 160 | kΩ | |
| | | | $V_{CC}$ = 5.0 V ± 10% | 25 | 50 | 100 | kΩ | |

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

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

| 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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

| 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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

| 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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

| Parameter | Symbol | Condition (at $T_A$) | | Value | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Typ | Max | Unit | |
| Power supply current in Sleep modes* | $I_{CCSPLL}$ | PLL Sleep mode with CLKS1/2 = 48 MHz, CLKP1/2 = 24 MHz (CLKRC and CLKSC stopped. Core voltage at 1.9 V) | +25°C | 7.5 | 9 | mA | CY96F385 |
| | | | +125°C | 8.2 | 10.5 | | |
| | | | +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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

| Parameter | Symbol | Condition (at $T_A$) | | Value | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Typ | Max | Unit | |
| Power supply current in Sleep modes* | $I_{CCSMAIN}$ | 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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

| 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 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 | | |
| | | RC Sleep mode with CLKS1/2 = CLKP1/2 = 100 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 | | |
| | $I_{CCSUB}$ | Sub Sleep mode with CLKS1/2 = CLKP1/2 = 32 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 = 4MHz, CLKPLL = 48 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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

| 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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

| 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 | | |
| | | | +25°C | 0.05 | 0.1 | mA | CY96384/385/F385 |
| | | | +125°C | 0.55 | 1.55 | | |
| | $I_{CCTSUB}$ | 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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

| 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 | $I_{CCCLOMO}$ | 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 |

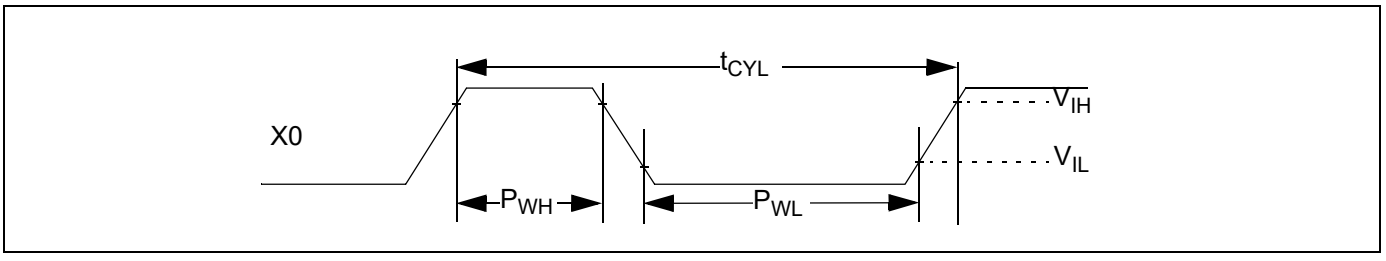
*: The power supply current is measured with a 4MHz external clock connected to the Main oscillator and a 32 kHz external clock connected to the Sub oscillator. See chapter “Standby mode and voltage regulator control circuit” of the Hardware Manual for further details about voltage regulator control.

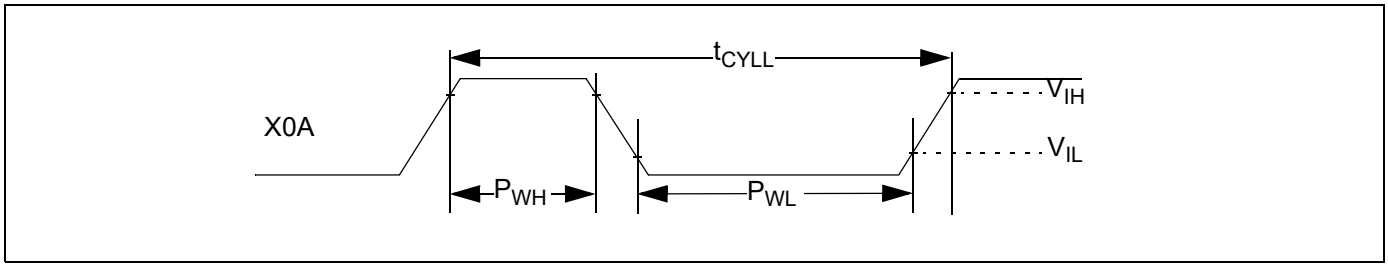
## 15.4 AC Characteristics

### Source Clock Timing

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

| 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

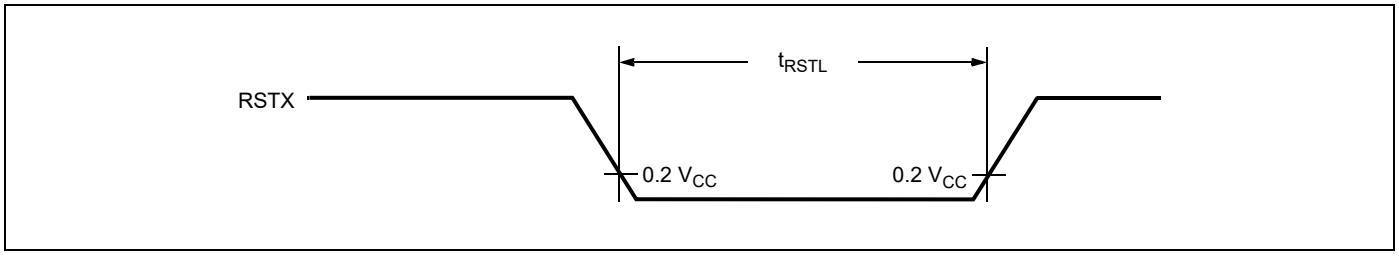
($T_A$ = -40°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

| Parameter | Symbol | Core Voltage Settings | | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | 1.8 V | | 1.9 V | | | |
| | | Min | Max | Min | Max | | |
| Internal System clock frequency (CLKS1 and CLKS2) | $f_{CLKS1}$, $f_{CLKS2}$ | 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) | $f_{CLKB}$, $f_{CLKP1}$ | 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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

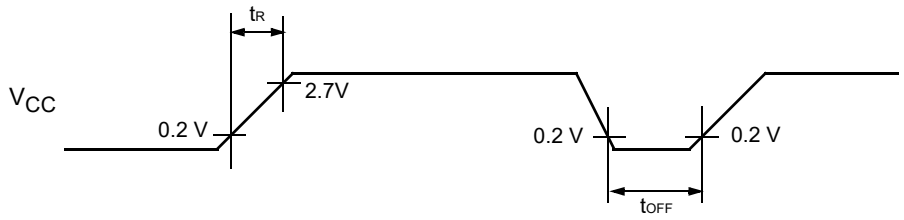
| Parameter | Symbol | Pin | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Reset input time | $t_{RSTL}$ | RSTX | 500 | - | - | ns | |



## Power On Reset Timing

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

| 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 | |



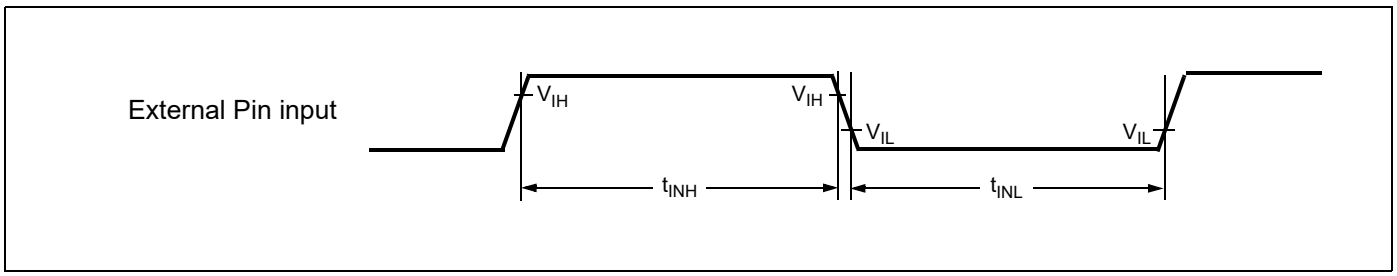

If the power supply is changed too rapidly, a power-on reset may occur.
We recommend a smooth startup by restraining voltages when changing the power supply voltage during operation, as shown in the figure below.

## External Input Timing

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

| 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 | | $2*t_{CLKP1}$ + 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°C to 125°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

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

Note : Relocated Resource Inputs have same characteristics

**Slew rate output timing**

$V_H = V_{OL30} + 0.9 \times (V_{OH30} - V_{OL30})$
$V_L = V_{OL30} + 0.1 \times (V_{OH30} - V_{OL30})$

## External Bus Timing

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

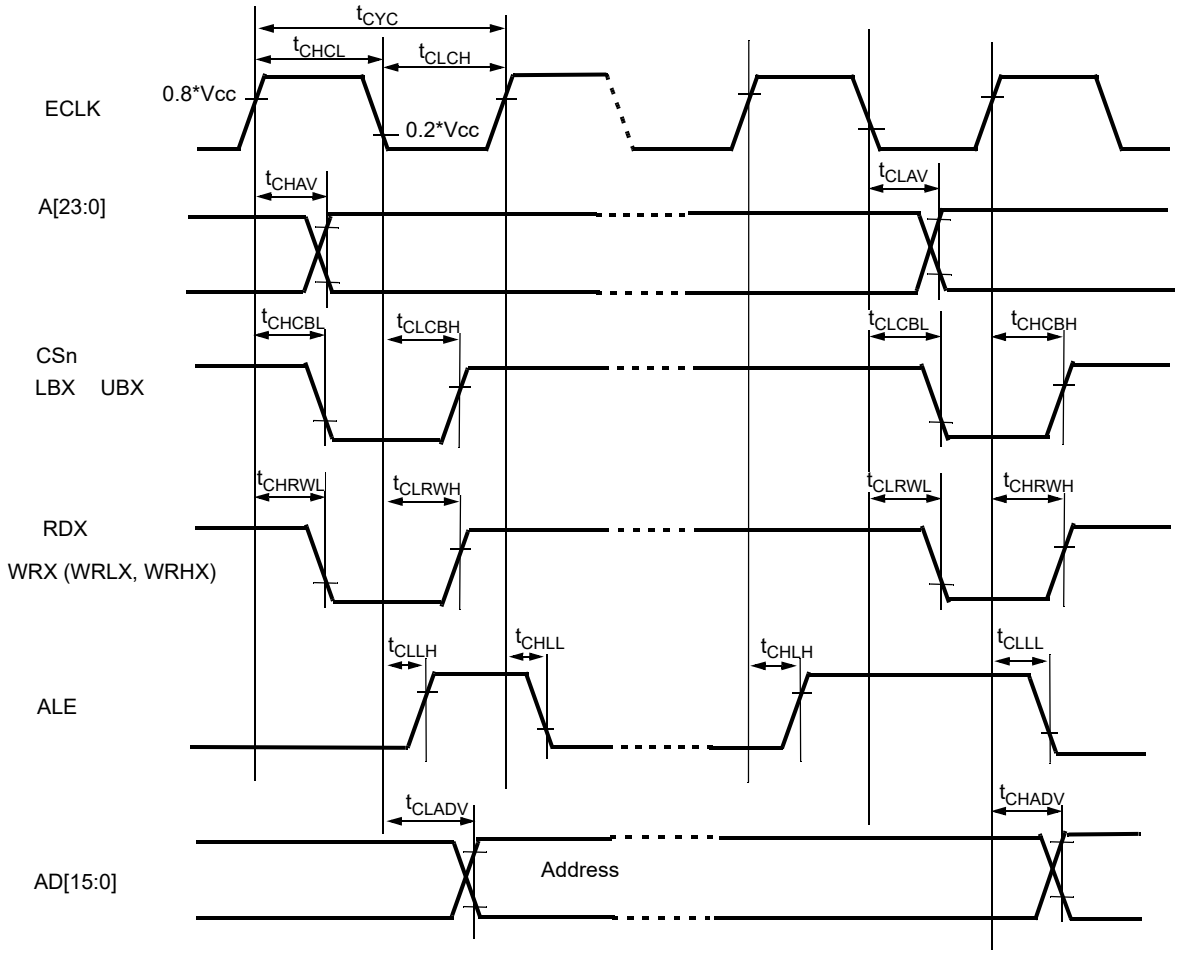
### Basic Timing

($T_A$ = −40°C to +125°C, $V_{CC}$ = 5.0 V ± 10%, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| 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°C to +125°C, $V_{CC}$ = 3.0 to 4.5V, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| 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 | | |




Refer to the Hardware Manual for detailed Timing Charts

## Bus Timing (Read)

($T_A$ = –40°C to +125°C, $V_{CC}$ = 5.0 V ± 10%, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| 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 | |
| | | | 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 | EBM:NMS = 0 |
| | | | 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°C to +125°C, $V_{CC}$ = 5.0 V ± 10%, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

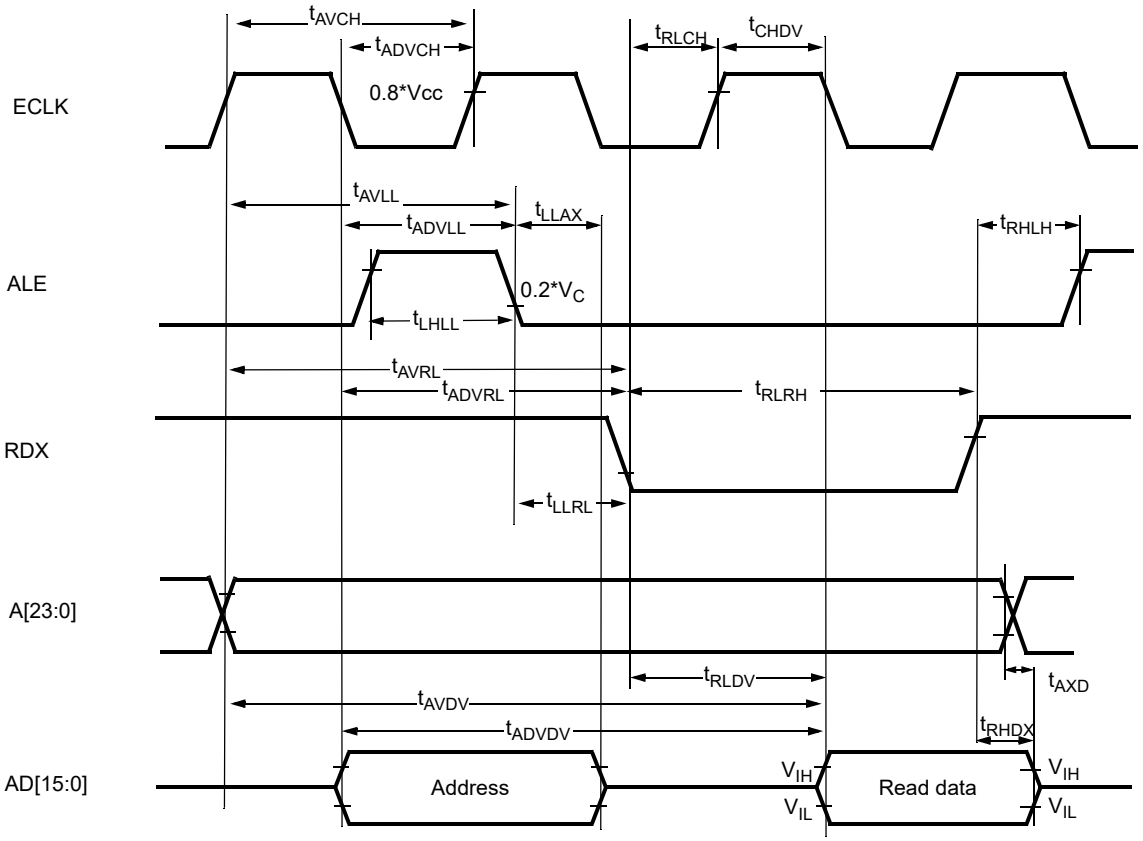
| Parameter | Symbol | Pin | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| Valid address ⇒ Valid data input (multiplexed) | $t_{AVDV}$ | A[23:16], AD[15:0] | EACL:ACE=0 EBM:NMS=0 | — | $3t_{CYC}$ – 55 | ns | w/o cycle extension |
| | | | EACL:ACE=1 EBM:NMS=0 | — | $4t_{CYC}$ – 55 | | |
| | $t_{ADVDV}$ | 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°C to +125°C, $V_{CC}$ = 3.0 to 4.5V, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| Parameter | Sym-bol | 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 | |
| | | | 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 | EBM:NMS = 0 |
| | | | 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°C to +125°C, $V_{CC}$ = 3.0 to 4.5V, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| Parameter | Sym-bol | 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 | |




Refer to the Hardware Manual for detailed Timing Charts

## Bus Timing (Write)

($T_A$ = −40°C to +125°C, $V_{CC}$ = 5.0 V ± 10%, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| 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°C to +125°C, $V_{CC}$ = 5.0 V ± 10%, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

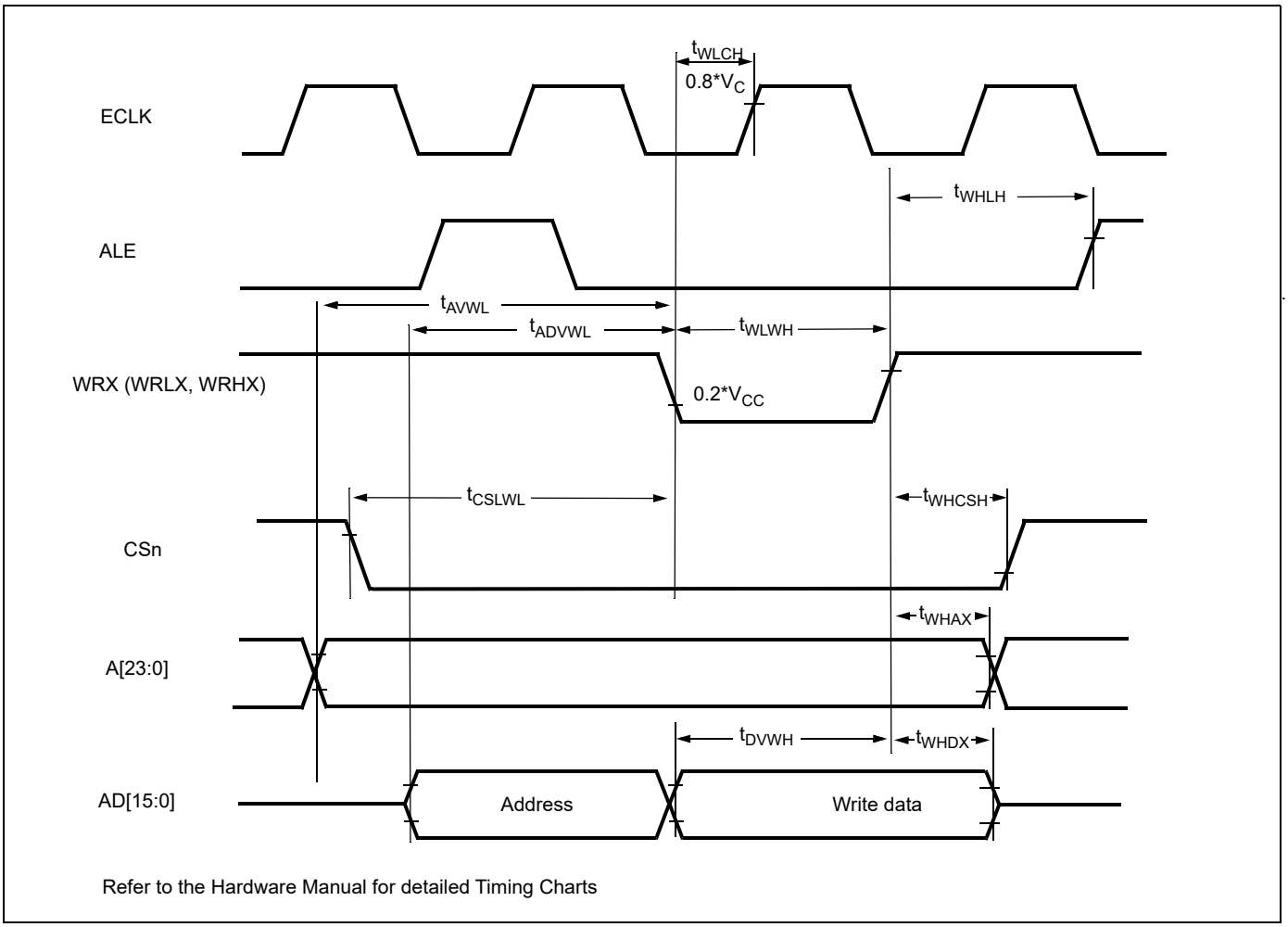
| Parameter | Symbol | Pin | Condition | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| WRX ⇒ CSn time (non-multiplexed) | $t_{WHCSH}$ | WRX, WRLX, WRHX, CSn | EACL:STS=1 EBM:NMS=1 | − 15 | — | ns | |
| | | | EACL:STS=0 EBM:NMS=1 | $t_{CYC}/2$ − 15 | — | ns |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

($T_A$ = −40°C to +125°C, $V_{CC}$ = 3.0 to 4.5V, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| 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 | $t_{CYC}/2$ − 20 | — | ns | |
| | | | EACL:STS=1 EBM:NMS=1 | $t_{CYC}$ − 20 | — | | |
| Valid address ⇒ WRX ↓ 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 | — | | |
| | $t_{ADVWL}$ | 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 | — | | |
| WRX pulse width | $t_{WLWH}$ | WRX, WRXL, WRHX | — | $t_{CYC}$ − 8 | — | ns | w/o cycle extension |
| Valid data output ⇒ WRX ↑ time | $t_{DVWH}$ | WRX, WRLX, WRHX, AD[15:0] | — | $t_{CYC}$ − 25 | — | ns | w/o cycle extension |
| WRX ↑ ⇒ Data hold time | $t_{WHDX}$ | WRX, WRLX, WRHX, AD[15:0] | — | $t_{CYC}/2$ − 20 | — | ns | |
| WRX ↑ ⇒ 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 ↑ ⇒ Address valid time (multiplexed) | $t_{WHAX}$ | WRX, WRLX, WRHX, A[23:16] | EBM:NMS=0 | $t_{CYC}/2$ − 20 | — | ns | |
| WRX ↑ ⇒ ALE ↑ 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 | — | | |
| WRX ↓ ⇒ ECLK ↑ time | $t_{WLCH}$ | WRX, WRLX, WRHX, ECLK | — | $t_{CYC}/2$ − 15 | — | ns | |

($T_A$ = −40°C to +125°C, $V_{CC}$ = 3.0 to 4.5V, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| Parameter | Symbol | Pin | Condition | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| CSn ⇒ WRX time (non-multiplexed) | $t_{CSLWL}$ | WRX, WRLX, WRHX, CSn | EACL:STS=0 EBM:NMS=1 | — | $t_{CYC}/2 - 20$ | ns | |
| | | | EACL:STS=1 EBM:NMS=1 | — | $t_{CYC} - 20$ | | |
| CSn ⇒ WRX time (multiplexed) | $t_{CSLWL}$ | WRX, WRLX, WRHX, CSn | EACL:ACE=0 EBM:NMS=0 | — | $3t_{CYC}/2 - 20$ | ns | |
| | | | EACL:ACE=1 EBM:NMS=0 | — | $5t_{CYC}/2 - 20$ | | |
| WRX ⇒ CSn time (non-multiplexed) | $t_{WHCSH}$ | WRX, WRLX, WRHX, CSn | EACL:STS=1 EBM:NMS=1 | − 20 | — | ns | |
| | | | EACL:STS=0 EBM:NMS=1 | $t_{CYC}/2 - 20$ | — | ns | |
| WRX ⇒ CSn time (multiplexed) | $t_{WHCSH}$ | WRX, WRLX, WRHX, CSn | EBM:NMS=0 | $t_{CYC}/2 - 20$ | — | ns | |




Refer to the Hardware Manual for detailed Timing Charts

### Ready Input Timing

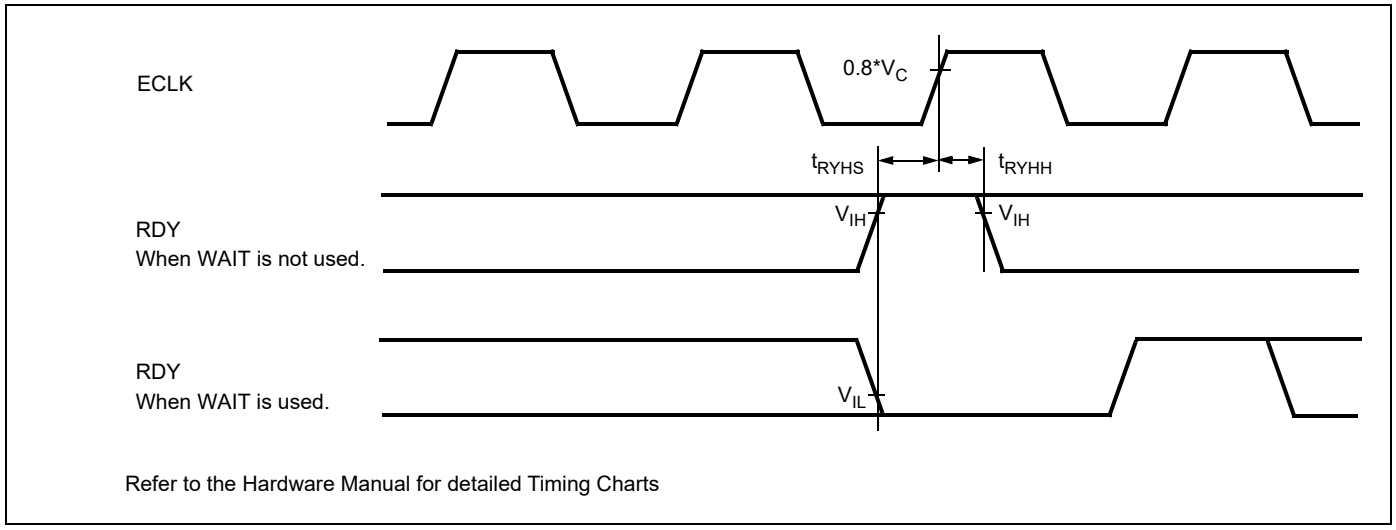
($T_A$ = –40°C to +125°C, $V_{CC}$ = 5.0 V ± 10%, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| 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°C to +125°C, $V_{CC}$ = 3.0 to 4.5V, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| 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.



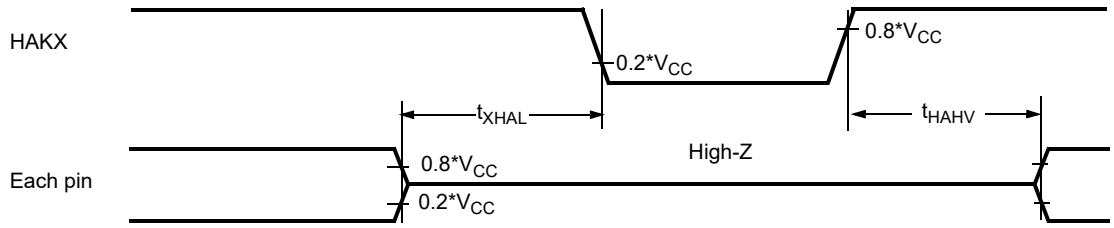
### Hold Timing

($T_A$ = –40°C to +125°C, $V_{CC}$ = 5.0 V ± 10%, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| Parameter | Symbol | Pin | Condition | Value | | Units | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| Pin floating ⇒ HAKX ↓ time | $t_{XHAL}$ | HAKX | — | $t_{CYC}$ – 20 | $t_{CYC}$ + 20 | ns | |
| HAKX ↑ time ⇒ Pin valid time | $t_{HAHV}$ | HAKX | | $t_{CYC}$ – 20 | $t_{CYC}$ + 20 | ns | |

($T_A$ = –40°C to +125°C, $V_{CC}$ = 3.0 to 4.5V, $V_{SS}$ = 0.0 V, $IO_{drive}$ = 5mA, $C_L$ = 50pF)

| Parameter | Symbol | Pin | Condition | Value | | Units | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| Pin floating ⇒ HAKX ↓ time | $t_{XHAL}$ | HAKX | — | $t_{CYC}$ – 25 | $t_{CYC}$ + 25 | ns | |
| HAKX ↑ time ⇒ Pin valid time | $t_{HAHV}$ | HAKX | | $t_{CYC}$ – 25 | $t_{CYC}$ + 25 | ns | |




Refer to the Hardware Manual for detailed Timing Charts

## USART Timing

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

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

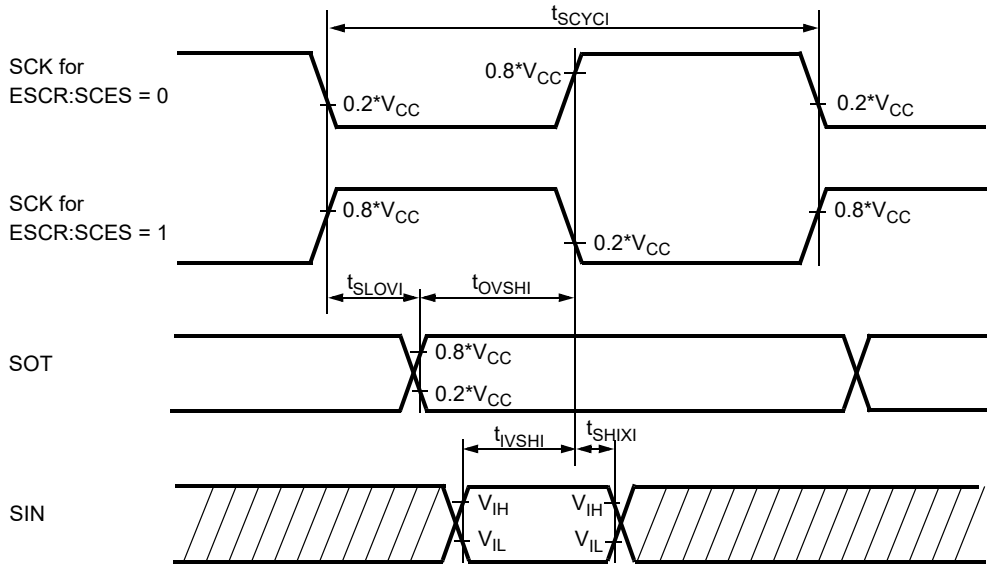
| Parameter | Symbol | Pin | Condition | $V_{CC}$ = $AV_{CC}$= 4.5 V to 5.5 V | | $V_{CC}$ = $AV_{CC}$= 3.0 V to 4.5 V | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Max | Min | Max | |
| Serial clock cycle time | $t_{SCYCI}$ | SCKn | Internal Shift Clock Mode | 4 $t_{CLKP1}$ | — | 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

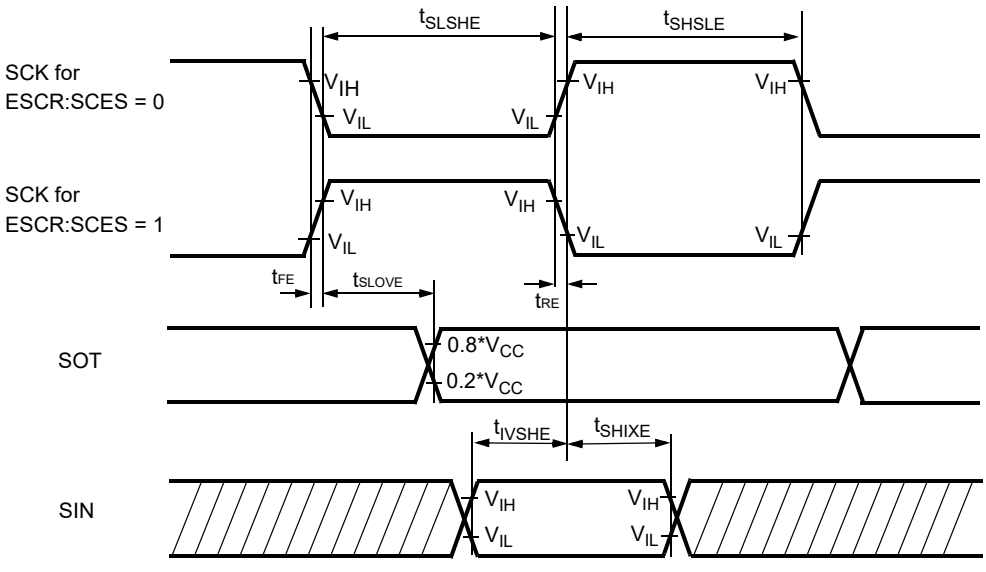
*1: Parameter N depends on $t_{SCYCI}$ and can be calculated as follows:
- if $t_{SCYCI}$ = 2*k*$t_{CLKP1}$, then N = k, where k is an integer > 2
- if $t_{SCYCI}$ = (2*k+1)*$t_{CLKP1}$, then N = k+1, where k is an integer > 1

Examples:

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




**Internal Shift Clock Mode**




**External Shift Clock Mode**

## I²C Timing

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

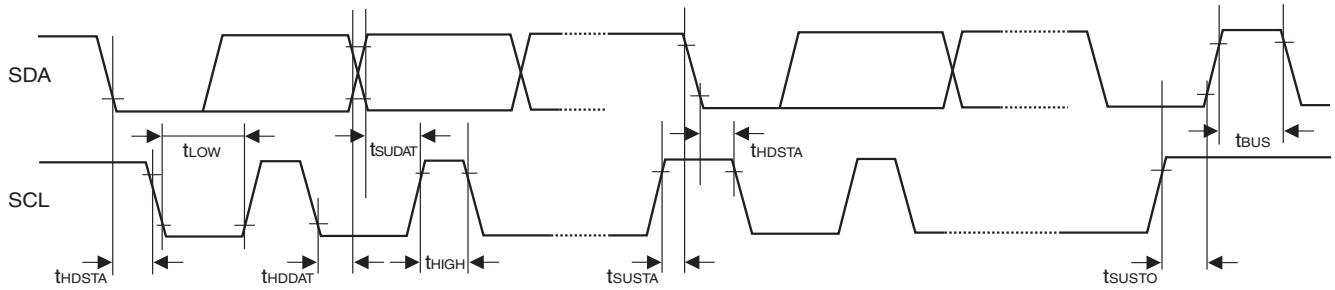
| Parameter | Symbol | Condition | Standard-mode | | Fast-mode*4 | | Unit |
|---|---|---|---|---|---|---|---|
| | | | Min | Max | Min | Max | |
| SCL clock frequency | $f_{SCL}$ | R = 1.7 kΩ, C = 50 pF*1 | 0 | 100 | 0 | 400 | kHz |
| Hold time (repeated) START condition SDA↓→SCL↓ | $t_{HDSTA}$ | | 4.0 | — | 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 °C to +125 °C, 3.0 V ≤ AVRH - AVRL, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = 0V)

| 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 V ≤ $AV_{CC}$ ≤ 5.5 V |
| | | | 2.0 | - | - | µs | 3.0 V ≤ $AV_{CC}$ < 4.5 V |
| Sampling time | - | - | 0.5 | - | - | µs | 4.5 V ≤ $AV_{CC}$ ≤ 5.5 V |
| | | | 1.2 | - | - | µs | 3.0 V ≤ $AV_{CC}$ < 4.5 V |
| Analog port input current | $I_{AIN}$ | ANn | -3 | - | +3 | µA | $AV_{SS}$, AVRL < $V_I$ < $AV_{CC}$, AVRH |
| Analog input leakage current (during conversion) | $I_{AIN}$ | ANn | -1 | - | +1 | µA | $T_A$ = 25°C, $AV_{SS}$, AVRL < $V_I$ < $AV_{CC}$, AVRH |
| | | | -3 | - | +3 | µA | $T_A$ = 125°C $AV_{SS}$, AVRL < $V_I$ < $AV_{CC}$, AVRH |
| Analog input voltage range | $V_{AIN}$ | ANn | AVRL | - | AVRH | V | |
| Reference voltage range | AVRH | AVRH/AVRH2 | 0.75 AVcc | - | AVcc | V | |
| | AVRL | AVRL | $AV_{SS}$ | - | 0.25 $AV_{CC}$ | V | |
| Power supply current | $I_A$ | AVcc | - | 2.5 | 5 | mA | A/D Converter active |
| | $I_{AH}$ | AVcc | - | - | 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 |AVRH - 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.

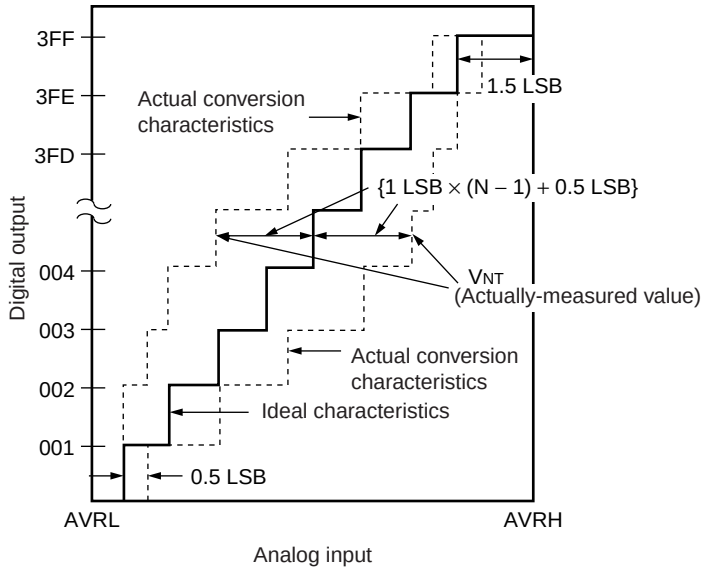
Nonlinearity error: Deviation between a line across zero-transition line (“00 0000 0000” <--> “00 0000 0001”) and full-scale transition line (“11 1111 1110” <--> “11 1111 1111”) and actual conversion characteristics.

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.

Total error




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

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

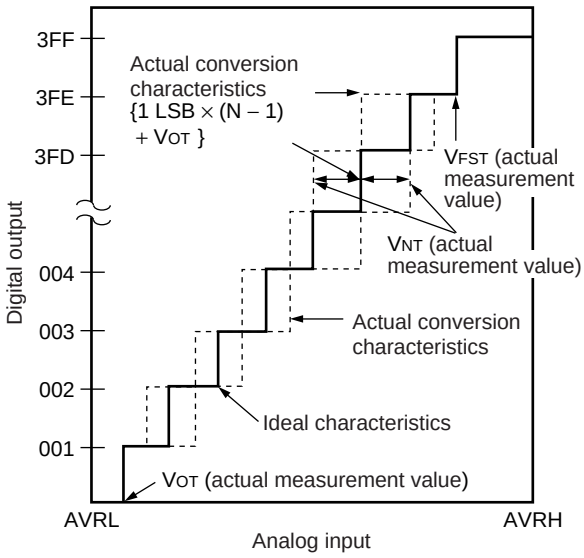
N: A/D converter digital output value

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

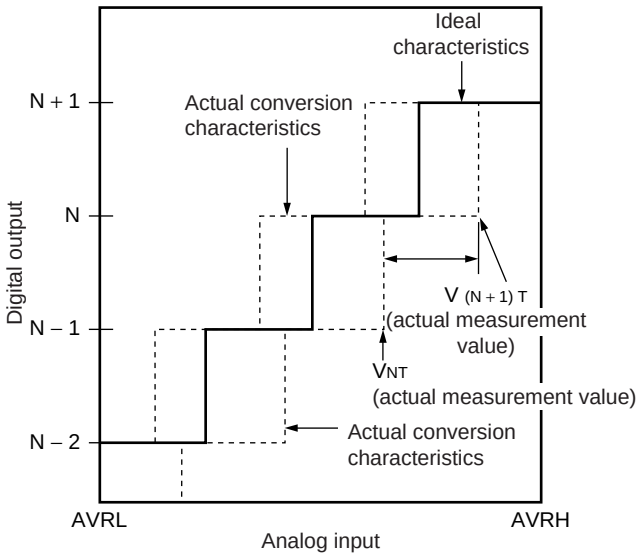
$V_{FST}$ (Ideal value) = AVRH − 1.5 LSB [V]

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

Nonlinearity error




Differential nonlinearity error




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

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

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

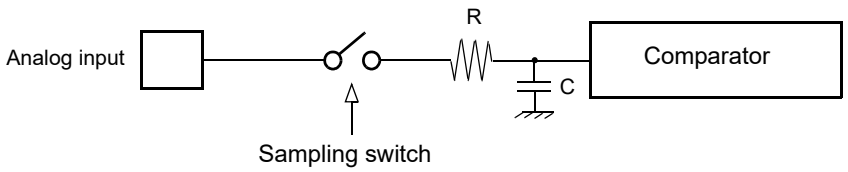
N : A/D converter digital output value
$V_{OT}$ : Voltage at which digital output transits from "$000_H$" to "$001_H$."
$V_{FST}$ : Voltage at which digital output transits from "$3FE_H$" to "$3FF_H$."

## Notes on A/D Converter Section

- ² About 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 7$\tau$, where $\tau$ = RC. If the external input resistance ($R_{ext}$) connected to the analog input is included, the sampling time is expressed as follows:

$T_{samp}$ [min] = 7 × ($R_{ext}$ + 2.6 kΩ) × C for 4.5 ≤ $AV_{cc}$ ≤ 5.5

$T_{samp}$ [min] = 7 × ($R_{ext}$ + 12.1 kΩ) × C for 3.0 ≤ $AV_{cc}$ ≤ 4.5

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

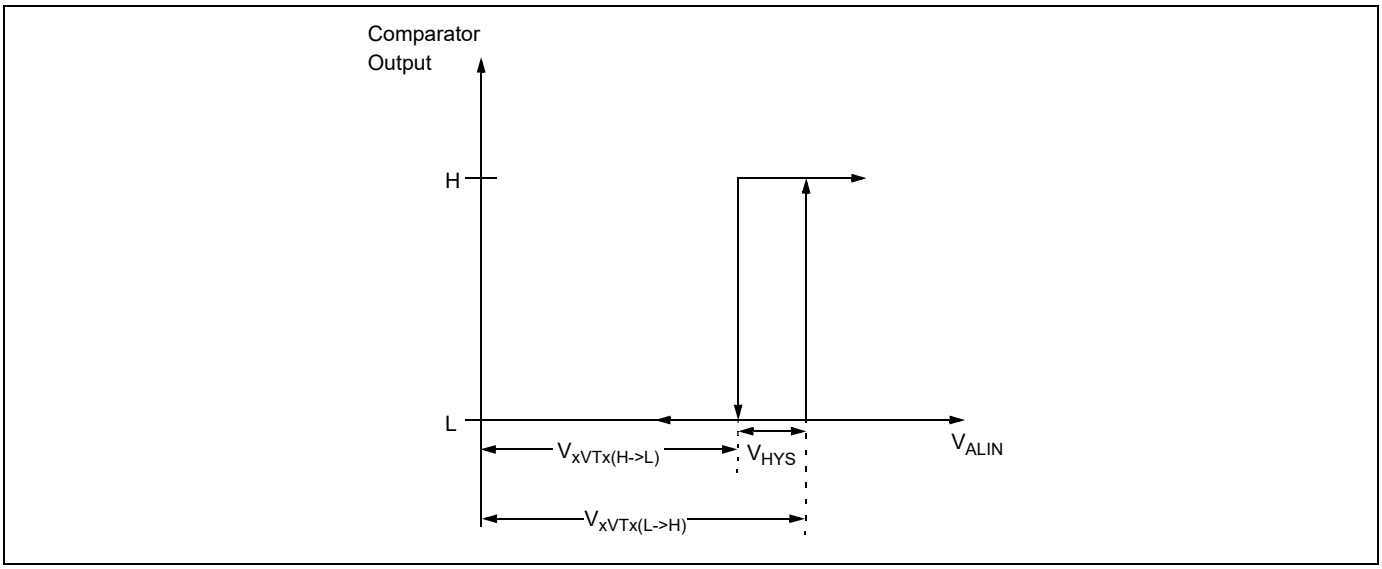
- ² About the error

The accuracy gets worse as |AVRH - AVRL| becomes smaller.

## 15.6 Alarm Comparator

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

| 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 °C |
| | | | -3 | - | +3 | µA | $T_A$ = 125 °C |
| ALARM pin input voltage range | $V_{ALIN}$ | | 0 | - | $AV_{CC}$ | V | |
| External low threshold high->low transition | $V_{EVTL(H->L)}$ | | 0.36 * $AV_{CC}$ -0.25 | 0.36 * $AV_{CC}$ -0.1 | - | V | INTREF = 0 |
| External low threshold low->high transition | $V_{EVTL(L->H)}$ | | - | 0.36 * $AV_{CC}$ +0.1 | 0.36 * $AV_{CC}$ +0.25 | V | |
| External high threshold high->low transition | $V_{EVTH(H->L)}$ | | 0.78 * $AV_{CC}$ -0.25 | 0.78 * $AV_{CC}$ -0.1 | - | V | |
| External high threshold low->high transition | $V_{EVTH(L->H)}$ | | | 0.78 * $AV_{CC}$ +0.1 | 0.78 * $AV_{CC}$ +0.25 | V | |
| Internal low threshold high->low transition | $V_{IVTL(H->L)}$ | | 0.9 | 1.1 | - | V | INTREF = 1 |
| Internal low threshold low->high transition | $V_{IVTL(L->H)}$ | | - | 1.3 | 1.55 | V | |
| Internal high threshold high->low transition | $V_{IVTH(H->L)}$ | | 2.2 | 2.4 | - | V | |
| Internal high threshold low->high transition | $V_{IVTH(L->H)}$ | | - | 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 | |


Comparator
Output
H
L
$V_{xVTx(H->L)}$
$V_{HYS}$
$V_{ALIN}$
$V_{xVTx(L->H)}$

## 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.

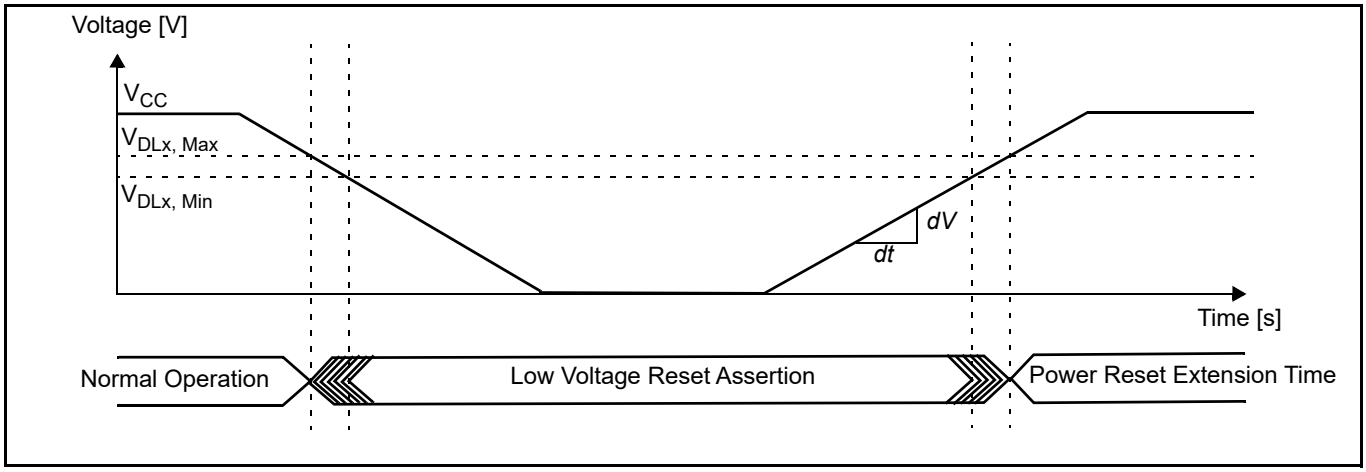
For correct detection, the slope of the voltage level must satisfy $\left|\frac{dV}{dt}\right| \leq 0.004 \frac{V}{\mu s}$ .

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 Vcc = 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

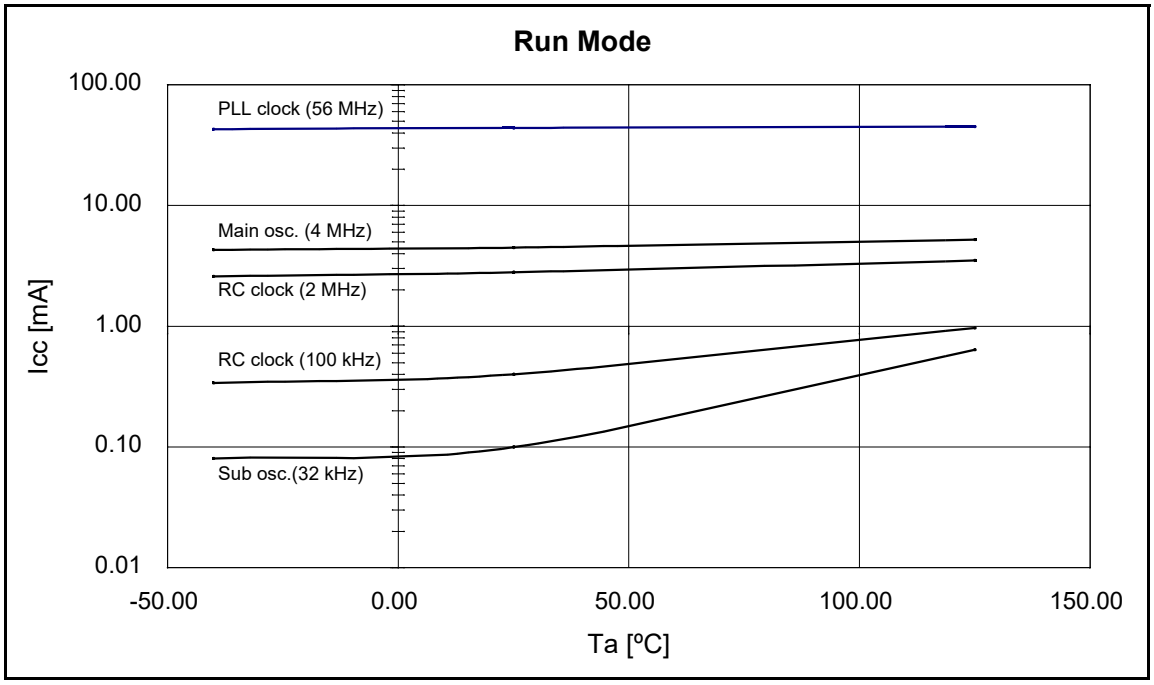
($T_A$ = -40°C to 105°C, $V_{CC}$ = $AV_{CC}$ = 3.0V to 5.5V, $DV_{CC}$ = 3.0V to 5.5V, $V_{SS}$ = $AV_{SS}$ = $DV_{SS}$ = 0V)

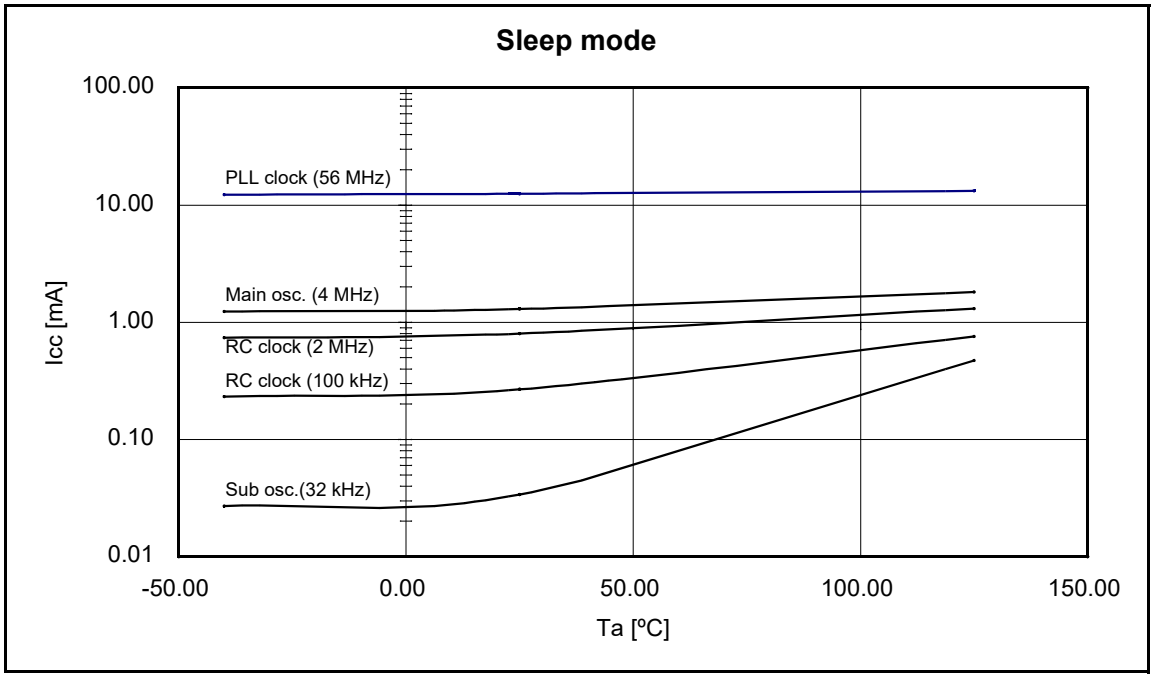
| Parameter | Value | | | Unit | Remarks |
|---|---|---|---|---|---|
| | Min | Typ | Max | | |
| Sector erase time | - | 0.9 | 3.6 | s | Without erasure pre-programming time |
| Chip erase time | - | n*0.9 | n*3.6 | s | Without erasure pre-programming time (n is the number of Flash sector of the device) |
| 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)

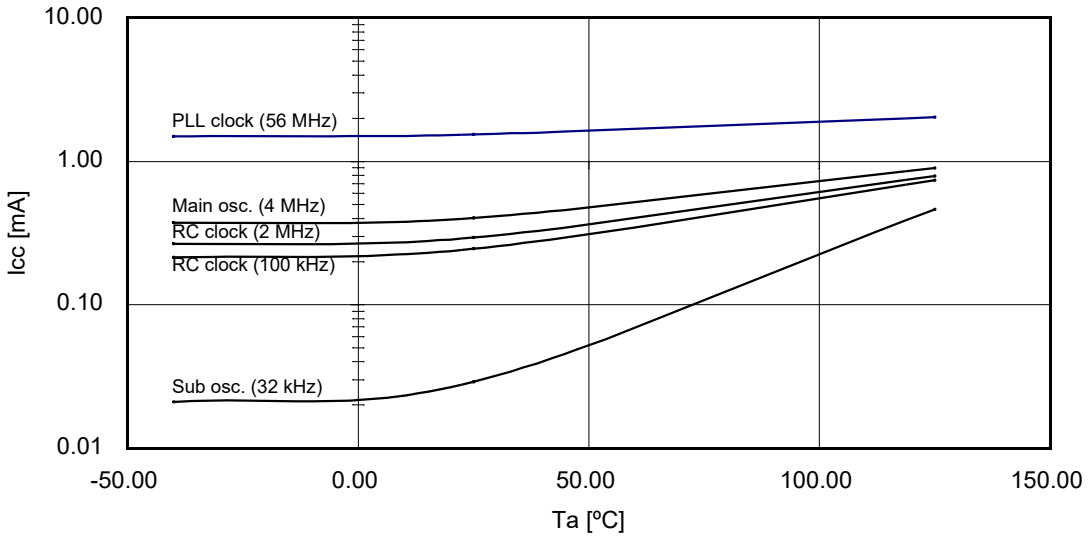
## 16. Example Characteristics

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

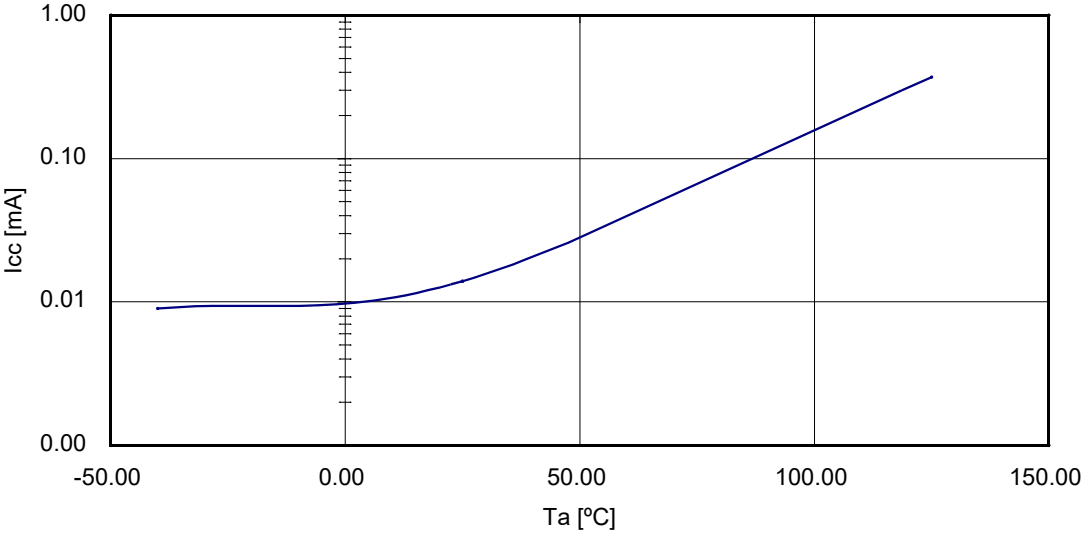


**Timer mode**




**Stop mode**



### Used Settings

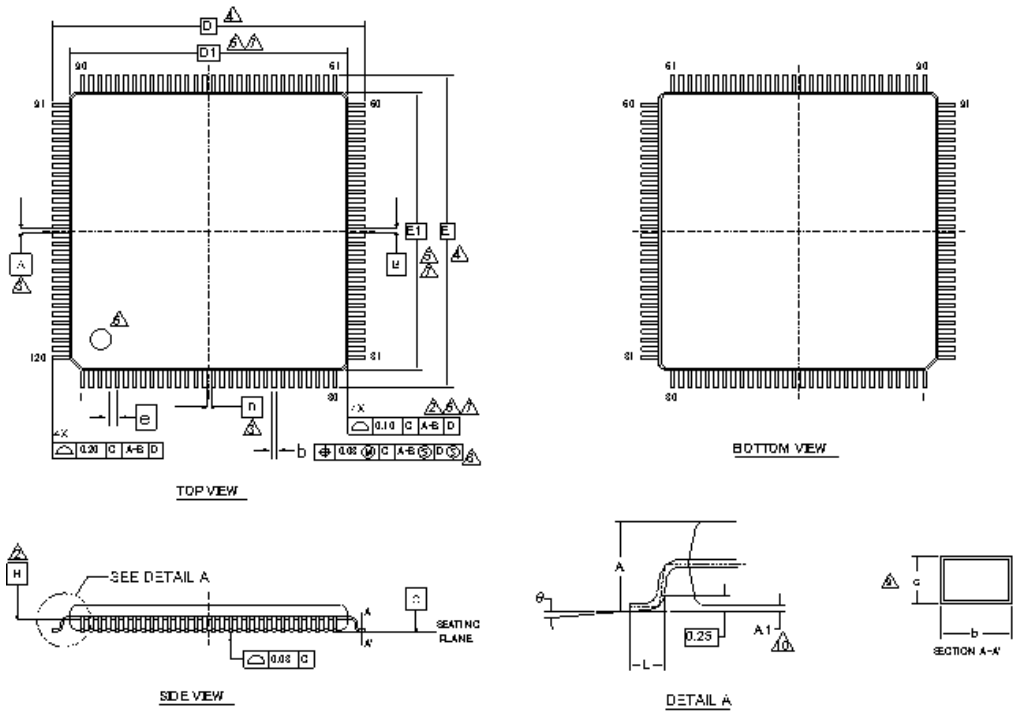
| Mode | Selected Source Clock | Clock/Regulator Settings |
|---|---|---|
| Run mode | PLL | CLKS1 = CLKS2 = CLKB = CLKP1 = 56 MHz<br>CLKP2 = 28 MHz<br>Regulator in High Power Mode<br>Core Voltage = 1.9 V |
| | Main osc. | CLKS1 = CLKS2 = CLKB = CLKP1 = CLKP2 = 4 MHz<br>Regulator in High Power Mode<br>Core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

### Used Settings

| Mode | Selected Source Clock | Clock/Regulator Settings |
|---|---|---|
| Timer mode | PLL | CLKMC = 4 MHz, CLKPLL = 56 MHz<br>(System clocks are stopped in this mode)<br>Regulator in High Power Mode, Core Voltage = 1.9 V |
| | Main osc. | CLKMC = 4 MHz<br>(System clocks are stopped in this mode)<br>Regulator in High Power Mode, Core Voltage = 1.8 V |
| | RC clock fast | CLKRC = 2 MHz<br>(System clocks are stopped in this mode)<br>Regulator in High Power Mode, Core Voltage = 1.8 V |
| | RC clock slow | CLKRC = 100 kHz<br>(System clocks are stopped in this mode)<br>Regulator in High Power Mode, Core Voltage = 1.8 V |
| | Sub osc. | CLKSC = 100 kHz<br>(System clocks are stopped in this mode)<br>Regulator in Low Power Mode A, Core Voltage = 1.8 V |
| Stop mode | stopped | (All clocks are stopped in this mode)<br>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 | 16.00 BSC | | |
| e | 0.50 BSC | | |
| E | 18.00 BSC | | |
| E1 | 16.00 BSC | | |
| L | 0.45 | 0.60 | 0.75 |
| θ | 0° | — | 8° |

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 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.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS, DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS, BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
10. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.
11. JEDEC SPECIFICATION NO. REF: N/A

002-16172 **

PACKAGE OUTLINE, 120 LEAD LQFP
18.0X18.0X1.7 MM LQM120 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.<br>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.<br>*1: These devices are under development and specification is preliminary. These products under development may change its specification without notice. |
| 8<br>112<br>113 | 3. Pin Assignment<br>17. Package Dimension<br>18. Ordering Information | Package description modified to JEDEC description.<br>(before) FPT-120P-M21<br>(after) LQM120 |
| 113 | 18. Ordering Information | Deleted the following comment.<br>*1: These devices are under development and specification is preliminary. These products under development may change its specification without notice.<br><br>Deleted the following parts number.<br>- MB96384YSBPMC-GSE2<br>- MB96384YWBPMC-GSE2<br>- MB96385YSBPMC-GSE2<br>- MB96385RSBPMC-GSE2<br>- MB96385YWBPMC-GSE2<br>- MB96385RWBPMC-GSE2<br>- MB96F385YSAPMC-GSE2<br>- MB96F385YWAPMC-GSE2<br>- MB96F386YSBPMC-GSE2<br>- MB96F386YWBPMC-GSE2<br>- MB96F387YSBPMC-GSE2<br>- MB96F387YWBPMC-GSE2<br>- MB96F388TSAPMC-GSE2<br>- MB96F388HSAPMC-GSE2<br>- MB96F388TWAPMC-GSE2<br>- MB96F388HWAPMC-GSE2<br>- MB96F389YSAPMC-GSE2<br>- MB96F389RSAPMC-GSE2<br>- MB96F389YWAPMC-GSE2<br>- MB96F389RWAPMC-GSE2<br>- MB96V300BRB-ES (for evaluation) |

| Page | Section | Change Result |
|---|---|---|
| 113 | 18. Ordering Information | Revised the following parts number.<br>(before)<br>- MB96384RSBPMC-GSE2<br>- MB96384RWBPMC-GSE2<br>- MB96F385RSAPMC-GSE2<br>- MB96F385RWAPMC-GSE2<br>- MB96F386RSBPMC-GSE2<br>- MB96F386RWBPMC-GSE2<br>- MB96F387RSBPMC-GSE2<br>- MB96F387RWBPMC-GSE2<br>(after)<br>- CY96384RSBPMC-GSE2<br>- CY96384RWBPMC-GSE2<br>- CY96F385RSAPMC-GS-UJE2<br>- CY96F385RWAPMC-GS-UJE2<br>- CY96F386RSBPMC-GS-UJE2<br>- CY96F386RWBPMC-GS-UJE2<br>- CY96F387RSBPMC-GS-UJE2<br>- CY96F387RWBPMC-G-UJE2<br><br>Added the following parts number.<br>- CY96384RSCPMC-GSE2<br>- CY96384RWCPMC-GSE2<br>- CY96385RSCPMC-GSE2<br>- CY96F385RSBPMC-GS-UJE2<br>- CY96F386RSBPMC-GS-UJE1<br>- CY96F386RSCPMC-GS-UJE1<br>- CY96F386RSCPMC-GS-UJE2<br>- CY96F387RSAPMC-GS-UJE2<br>- CY96F387RSCPMC-GS-UJE2<br>- CY96F388HSBPMC-GS-UJE1<br>- CY96F389RSBPMC-GS-UJE2<br><br>Changed and deleted the parts number in Note.<br>(before) MB96F386YSA, MB96F386RSA, MB96F386YWA, MB96F386RWA, MB96F387YSA, MB96F387RSA, MB96F387YWA, MB96F387RWA<br>(after) CY96F386RSA, CY96F386RWA, CY96F387RSA, CY96F387RWA |

## 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.<br>Modification of the block diagram.<br>Memory map modified for Flash. RAM memory map added.<br>Pin circuit type corrected. Type L IO is now included. |
| Prelim 7 | 2007-12-12 | Memory IO map modified<br>New Flash/ROM configuration presentation<br>Ordering information: MB96300B used as reference.<br>Block diagram modified to included relocated pins.<br>Main Flash becomes Flash memory A and Satellite flash becomes Flash memory B |
| Prelim 8 | 2008-02-04 | • Devices under development added: MB96384/385/F385/F388/F389<br>• Block diagram corrected (existing resource pins)<br>• Pin assignment: TTG8 -> TTG7<br>• Pin function table corrected<br>• I/O circuit type diagrams corrected<br>• Memory map cleaned up<br>• "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”<br>• IO map table regenerated:<br>- Port register: Naming style corrected<br>- Memory control registers renamed (Main/Sat -> A/B)<br>- addresses after 000BFFh removed<br>• Absolute maximum ratings: Pd and Ta specified more precisely<br>• Run and Sleep mode currents: more conditions added (1WS settings)<br>• Run mode current spec in 48/24MHz mode corrected<br>• Maximum CLKP2 frequency for MB96F386/F387 corrected<br>• High current port input capacitance added<br>• External bus timings: missing conditions added and readability improved<br>• Alarm comparator spec updated (transition voltages defined)<br>• MB96V300A removed<br>• Ordering information updated<br>• Typos and formatting corrected |

| Revision | Date | Modification |
|---|---|---|
| 9 | 2009-01-09 | • Format adjusted to official Fujitsu Microelectronics datasheet standard (mainly style changes and official notes and disclaimer added)<br>• Numbering of Electrical Characteristics subchapters automated<br>• Note about devices under development modified<br>• I/O map: Note added about reserved addresses<br>• Serial programming interface: Note about handshaking pins improved<br>• ICCPLL for CLKS1/2=80MHz, CLKB=40MHz (F388/F389) increased by 5mA<br>• ICCSPLL for CLKS1/2=80MHz, CLKB=40MHz (F388/F389) increased by 0.8mA (typ) and 1.3mA (max)<br>• Updated ordering information: MB96384/385**A -> MB96384/385**B<br>• Package code of MB96V300 corrected in ordering information<br>• Internal LCD divider resistance value corrected: Typ 35kOhm -> 40kOhm, Max 50kOhm -> 65kOhm<br>• Run and Sleep mode currents of ROM devices (MB96384/385) reduced<br>• Added voltage condition to pull-up resistance and LCD divide resistance spec<br>• Lineup: Term “Data Flash” replaced by “independent 32KB Flash”<br>• Ordering information: column “Independent 32KB Data Flash” replaced by new column “Flash/ROM”, column “Remarks” removed<br>• Official package dimension drawing with additional notes added<br>• Empty pages removed<br>• MB96384/385 and MB96F385/F388/F389 separated in DC spec and currents of these devices adjusted according to first evaluation results<br>• Alarm comparator: Power supply current max values increased, comparison time reduced, mode transition time and power-up stabilization time newly added<br>• Handling devices: Notes added about Serial communication and about using ceramic resonators.<br>• Feature list and AC Characteristics: 16MHz maximum frequency is valid for crystal oscillators. For resonators, maximum frequency depends on Q-factor<br>• AC characteristics: PLL phase skew spec added, CLKVCO min=64MHz<br>• VOL3 spec improved: spec valid for 3mA load for full Vcc range<br>• C-Pin cap spec updated: 4.7uF-10uF capacitor with tolerance permitted<br>• “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<br>Document Number: 002-04582 | | | |
|---|---|---|---|
| **Revision** | **ECN** | **Submission Date** | **Description of Change** |
| ** | — | 05/02/2007 | Migrated to Cypress and assigned document number 002-04582.<br>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:<br>Marketing Part Numbers changed from an MB prefix to a CY prefix.<br>3.Pin Assignments<br>17.Package Dimension<br>18.Ordering Information<br>Added 19. Major Changes<br>For details, please see 19.Major Changes |
| *C | 6777565 | 01/22/2020 | Added the following part number on 18. Ordering Information.<br>CY96F388HWBPMC-GS-UJE2<br>Deleted the following parts number on 18. Ordering Information.<br>CY96F386RSCPMC-GS-UJE1<br>CY96F387RSAPMC-GS-UJE2<br>CY96F388HSBPMC-GS-UJE1 |

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