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# F<sup>2</sup>MC-16FX 16-bit Proprietary Microcontroller

MB96330 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 48MHz operation frequency from an external 4MHz resonator. The result is a minimum instruction cycle time of 20.8ns 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.

**Note: MB96F336 and MB96F338 devices are under development and specification is preliminary. These products under development may change its specification without notice.**

## Features

### Technology

- 0.18µm CMOS

### CPU

- F<sup>2</sup>MC-16FX CPU
- Up to 48 MHz internal, 20.8 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 48 MHz external clock
- 32-100 kHz subsystem quartz clock
- 100kHz/2MHz 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<sup>2</sup>C**

- 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

## **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

## **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**

- 144-pin plastic LQFP M08

### **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

### **USB**

- USB function (corresponds to USB Full Speed)
- USB Mini-HOST function
- Supports up to 6 endpoints



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**1. Product Lineup**

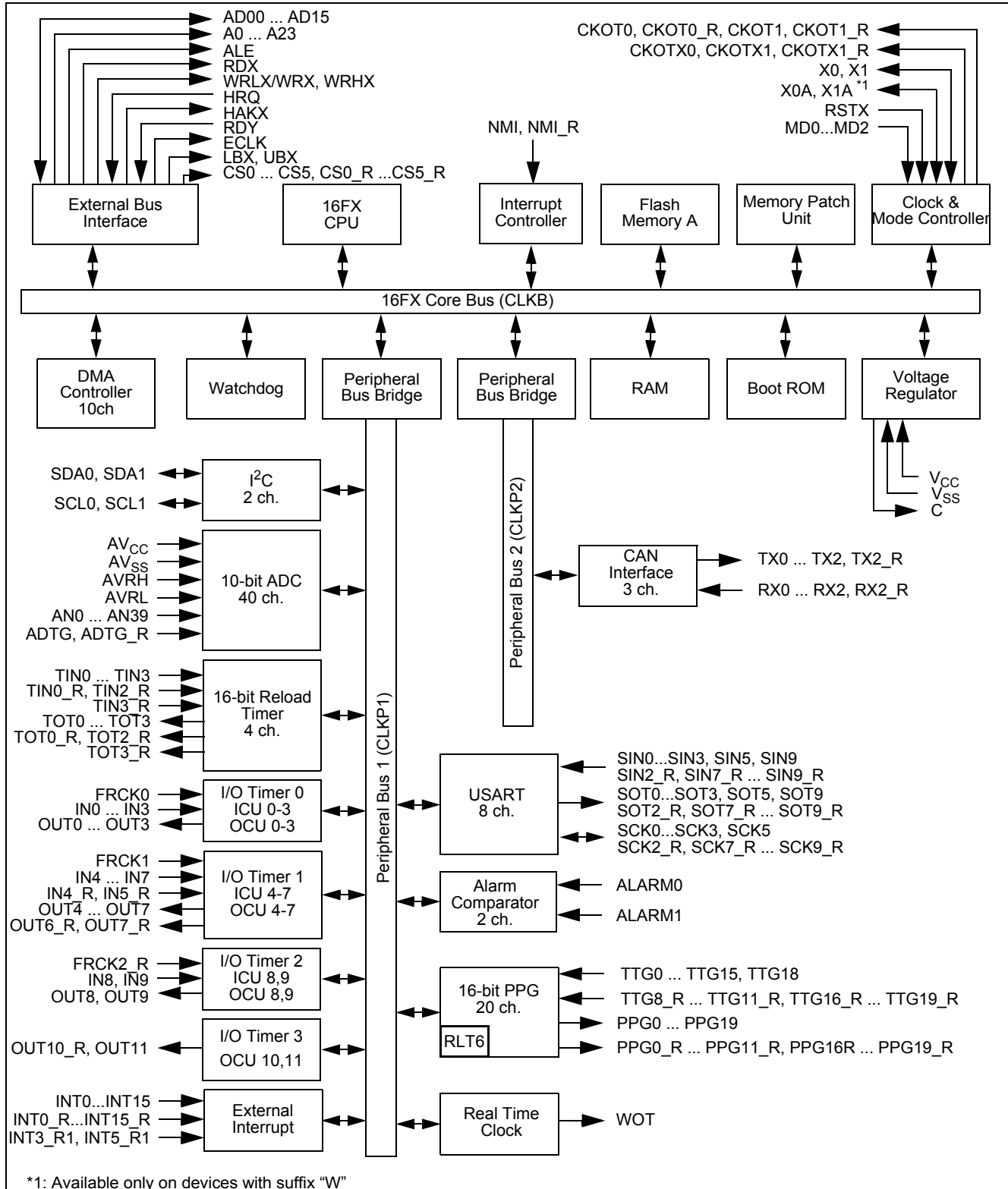
| Features                               |      | MB96V300  | MB96(F)33xY/R  | MB96(F)33xU  |
|--|------|---|--|--------------|
| Product type                           |      | Evaluation sample   | Flash product: MB96F33x<br>Mask ROM product: MB9633x           |              |
| Product options                        |      |   |  |              |
| YS                                     |      | NA  | Low voltage reset persistently on / Single clock devices       |              |
| RS                                     |      |   | Low voltage reset can be disabled / Single clock devices       |              |
| YW                                     |      |   | Low voltage reset persistently on / Dual clock devices         |              |
| RW                                     |      |   | Low voltage reset can be disabled / Dual clock devices         |              |
| US                                     |      |   | USB / Low voltage reset can be disabled / Single clock devices |              |
| UW                                     |      |   | USB / Low voltage reset can be disabled / Dual clock devices   |              |
| Flash/ROM                              | RAM  |   |  |              |
| 288KB                                  | 24KB | ROM/Flash memory emulation by external RAM, 92KB internal RAM |  | MB96F336U *1 |
| 544KB                                  | 32KB |   | MB96F338Y *1,<br>MB96F338R *1                                  | MB96F338U *1 |
| Package                                |      | BGA416  | FPT-144P-M08   |              |
| DMA                                    |      | 16 channels   | 10 channels  |              |
| USART                                  |      | 10 channels   | 8 channels   |              |
| I <sup>2</sup> C                       |      | 2 channels  |  |              |
| A/D Converter                          |      | 40 channels   | 40 channels  | 36 channels  |
| A/D Converter Reference Voltage switch |      | yes   | No   |              |
| 16-bit Reload Timer                    |      | 6 channels + 1 channel (for PPG)                              | 4 channels + 1 channel (for PPG)                               |              |
| 16-bit Free-Running Timer              |      | 4 channels  |  |              |
| 16-bit Output Compare                  |      | 12 channels   |  |              |
| 16-bit Input Capture                   |      | 10 channels   |  |              |
| 16-bit Programmable Pulse Generator    |      | 20 channels   |  |              |
| CAN Interface                          |      | 5 channels  | 3 channels (1 channel for MB96F336U)                           |              |
| USB                                    |      | No  | No   | 1 channel    |
| External Interrupts                    |      | 16 channels   |  |              |
| Non-Maskable Interrupt                 |      | 1 channel   |  |              |
| Real Time Clock                        |      | 1   |  |              |

| Features               | MB96V300   | MB96(F)33xY/R   | MB96(F)33xU   |
|------------------------|------------|---|---|
| I/O Ports              | 136        | 122 for part number with suffix "W",<br>124 for part number with suffix "S" | 118 for part number with suffix "W",<br>120 for part number with suffix "S" |
| Alarm comparator       | 2 channels |   |   |
| External bus interface | Yes        |   |   |
| Chip select            | 6 signals  |   |   |
| Clock output function  | 2 channels |   |   |
| Low voltage reset      | Yes        |   |   |
| On-chip RC-oscillator  | Yes        |   |   |

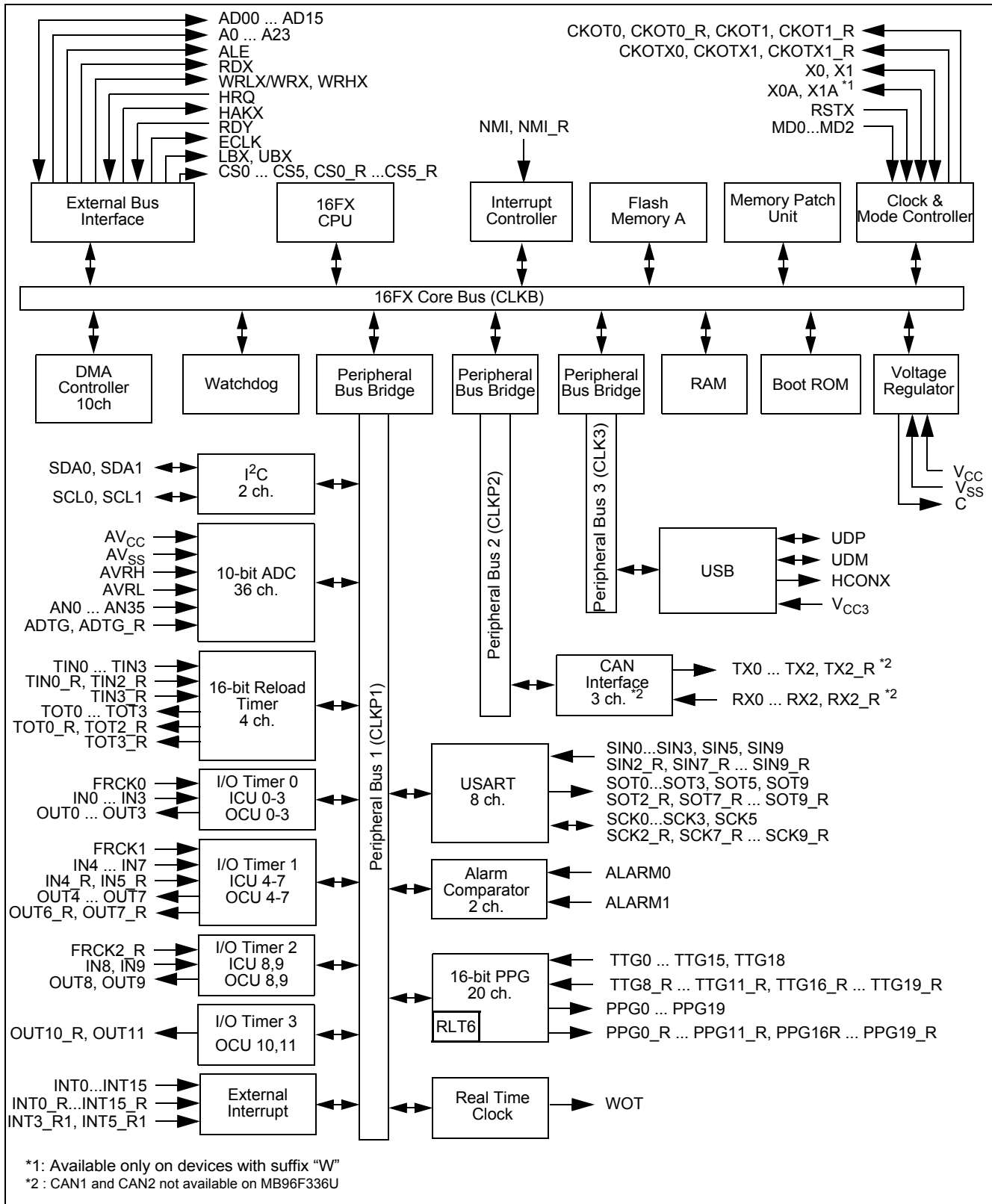
\*1: These devices are under development and specification is preliminary. These products under development may change its specification without notice.

**2. Block Diagram**

**Block diagram of MB96(F)33xY/R**

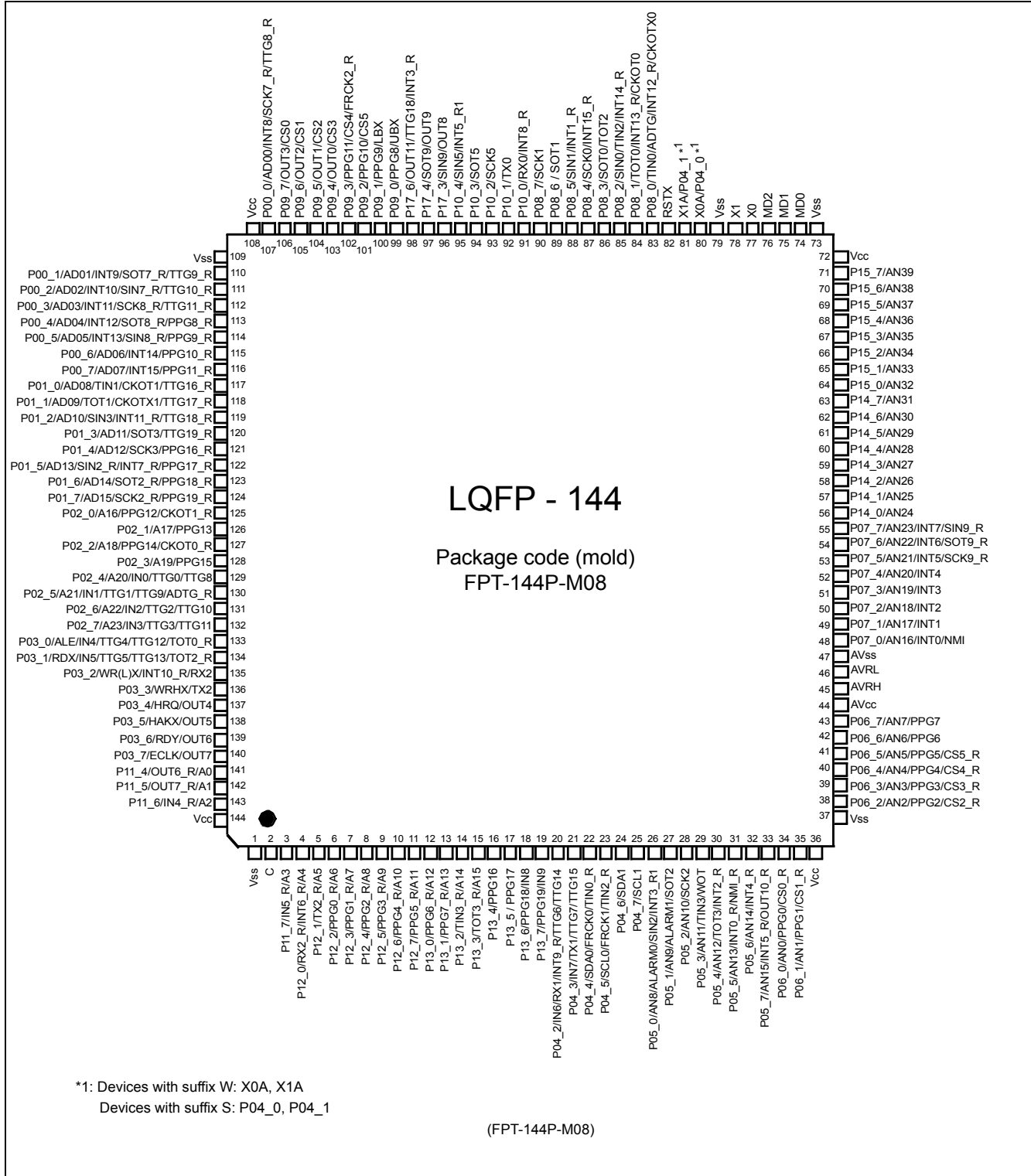


**Block diagram of MB96(F)33xU**

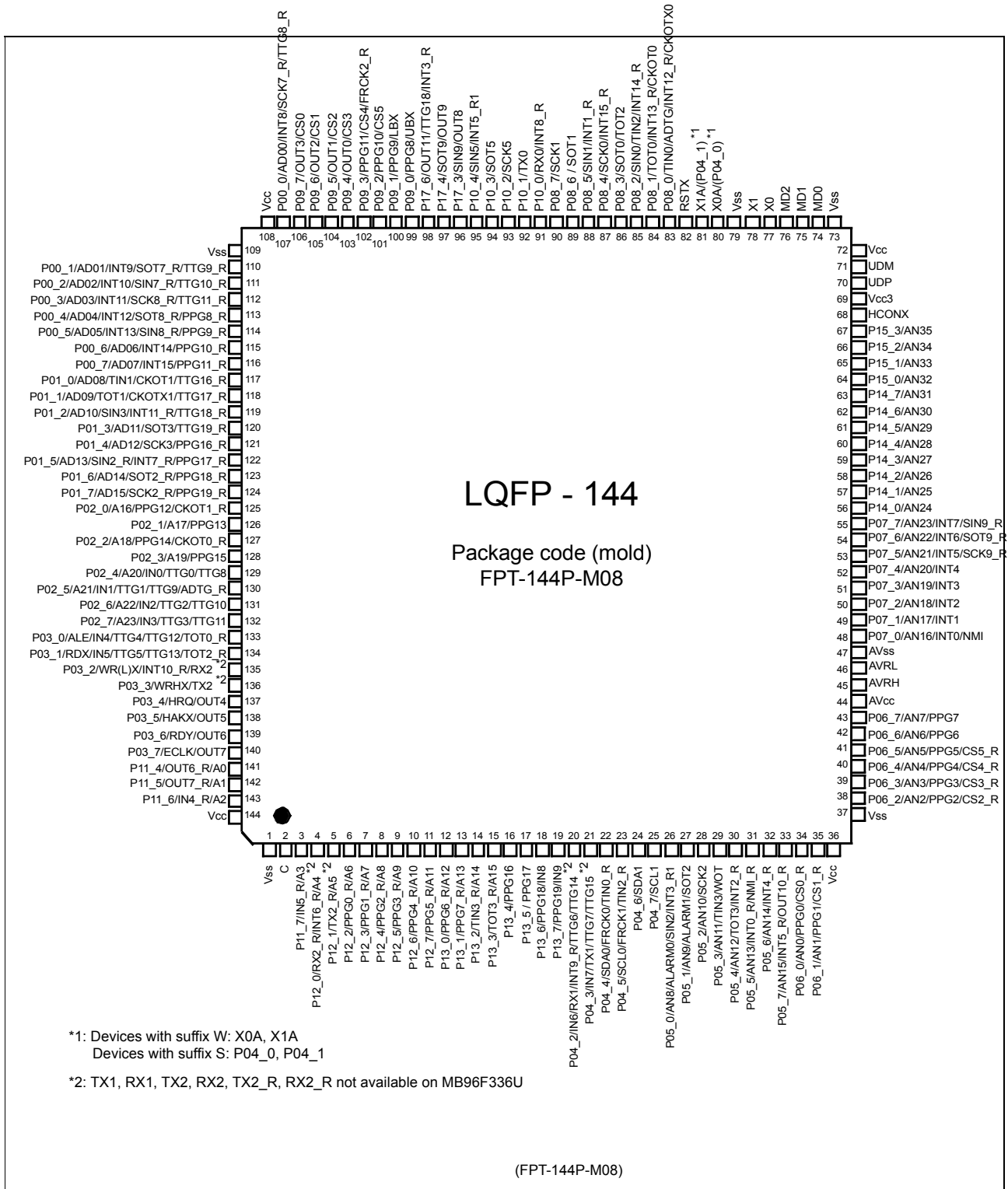


### 3. Pin Assignments

Pin assignment of M96F33xY/R (FPT-144P-M08)



Pin assignment of MB96F33xU (FPT-144P-M08) USB device



## 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   |
| ADTG_R           | ADC                   | Relocated 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 <sub>CC</sub> | Supply                | Analog circuits power supply  |
| AVRH             | ADC                   | A/D converter high reference voltage input  |
| AVRL             | ADC                   | A/D converter low reference voltage input   |
| AV <sub>SS</sub> | 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   |
| 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   |
| 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   |
| HCONX            | USB                   | USB connection to host or hub   |
| 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  |
| INTn_R           | External Interrupt    | Relocated External Interrupt n input  |
| LBX              | External bus          | External Bus Interface Lower Byte select strobe output  |



**Pin Function description (2 of 3)**

| Pin name | Feature            | Description   |
|----------|--------------------|---|
| MDn      | Core               | Input pins for specifying the operating mode.             |
| NMI      | External Interrupt | Non-Maskable Interrupt input                              |
| NMI_R    | External Interrupt | Relocated 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           |
| 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                                  |
| RXn_R    | CAN                | Relocated CAN interface n RX input                        |
| SCKn     | USART              | USART n serial clock input/output                         |
| SCKn_R   | USART              | Relocated USART n serial clock input/output               |
| SCLn     | I <sup>2</sup> C   | I <sup>2</sup> C interface n clock I/O input/output       |
| SDAn     | I <sup>2</sup> C   | I <sup>2</sup> C interface n serial data I/O input/output |
| SINn     | USART              | USART n serial data input                                 |
| SINn_R   | USART              | Relocated USART n serial data input                       |
| SOTn     | USART              | USART n serial data output                                |
| SOTn_R   | USART              | Relocated 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              |
| TTGn_R   | PPG                | Relocated Programmable Pulse Generator n trigger input    |
| TXn      | CAN                | CAN interface n TX output                                 |
| TXn_R    | CAN                | Relocated CAN interface n TX output                       |
| UBX      | External bus       | External Bus Interface Upper Byte select strobe output    |
| UDM      | USB                | USB minus   |

**Pin Function description (3 of 3)**

| Pin name         | Feature      | Description   |
|------------------|--------------|---|
| UDP              | USB          | USB plus  |
| V <sub>CC</sub>  | Supply       | Power supply  |
| V <sub>CC3</sub> | Supply       | USB Power supply  |
| V <sub>SS</sub>  | 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**

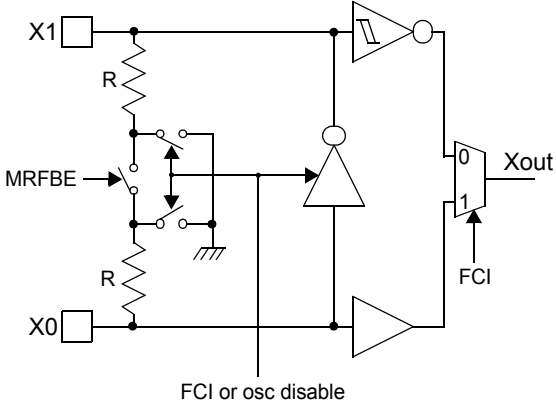
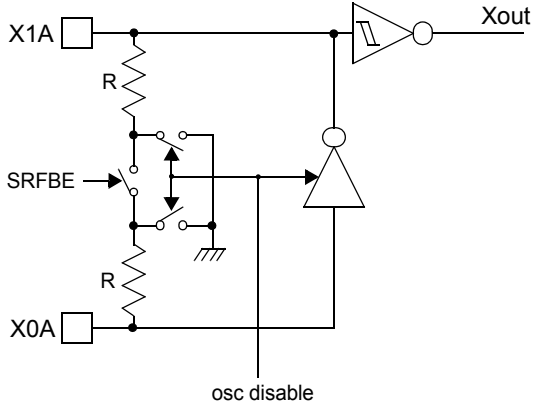
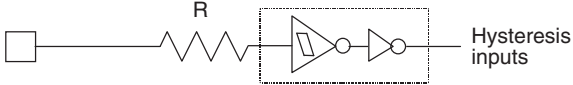
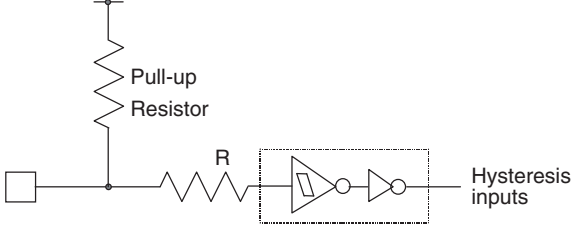
| Pin no.    | FPT-144P-M08               |                          |
|------------|----------------------------|--------------------------|
|            | Circuit type <sup>*1</sup> |                          |
|            | MB96(F)33xY/R              | MB96(F)33xU (USB device) |
| 1          | Supply                     |                          |
| 2          | F                          |                          |
| 3 to 21    | H                          |                          |
| 22 to 25   | N                          |                          |
| 26 to 35   | I                          |                          |
| 36, 37     | Supply                     |                          |
| 38 to 43   | I                          |                          |
| 44         | Supply                     |                          |
| 45         | G                          |                          |
| 46 to 47   | Supply                     |                          |
| 48 to 67   | I                          |                          |
| 68         | I                          | O                        |
| 69         | I                          | Supply (3.3V)            |
| 70, 71     | I                          | P                        |
| 72, 73     | Supply                     |                          |
| 74 to 76   | C                          |                          |
| 77, 78     | A                          |                          |
| 79         | Supply                     |                          |
| 80, 81     | B <sup>*2</sup>            |                          |
| 80, 81     | H <sup>*3</sup>            |                          |
| 82         | E                          |                          |
| 83 to 107  | H                          |                          |
| 108, 109   | Supply                     |                          |
| 110 to 143 | H                          |                          |
| 144        | Supply                     |                          |

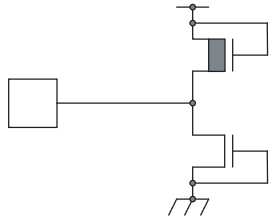
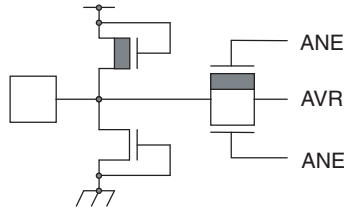
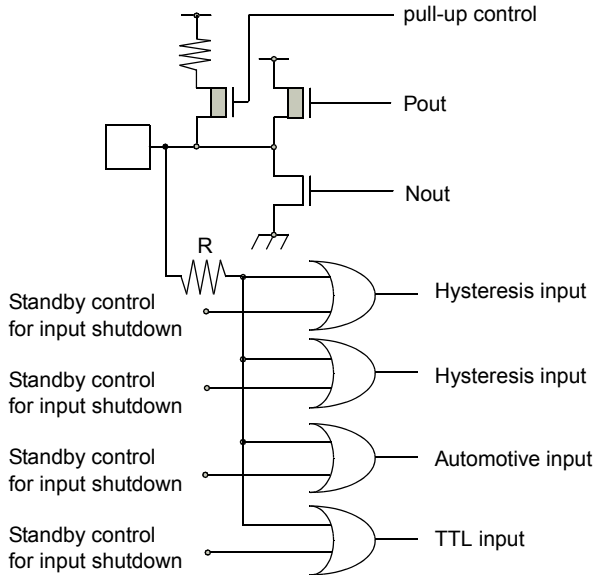
\*1: Please refer to 6. "I/O Circuit Type" for details on the I/O circuit types

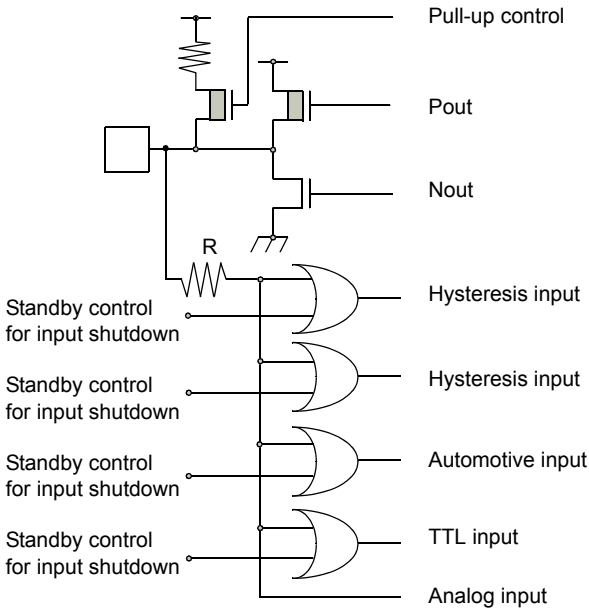
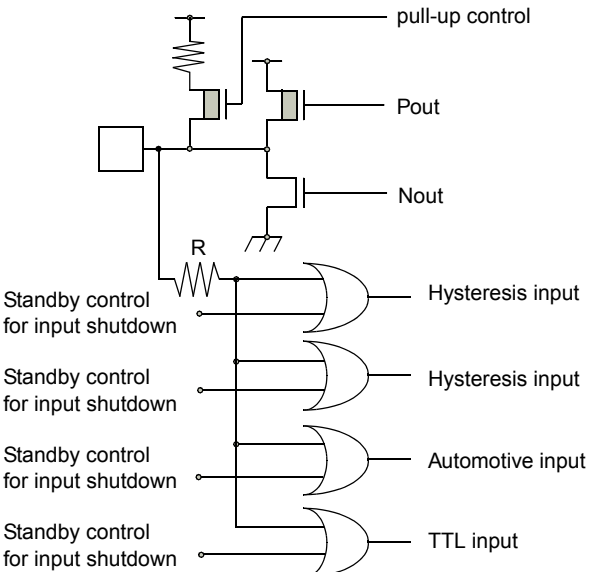
\*2: Devices with suffix "W"

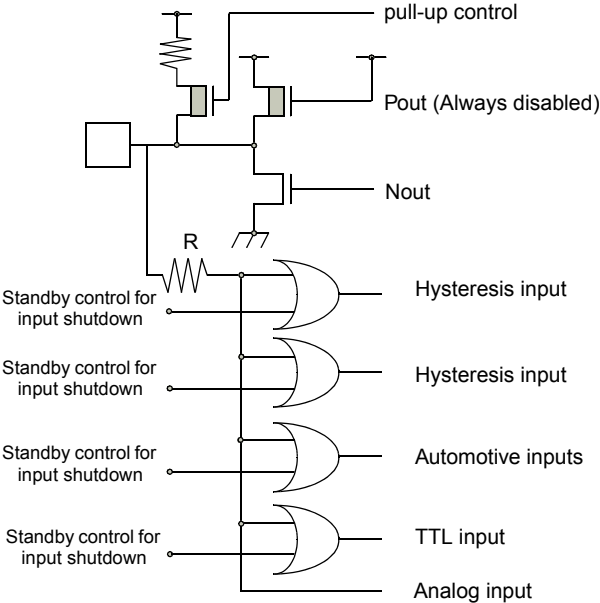
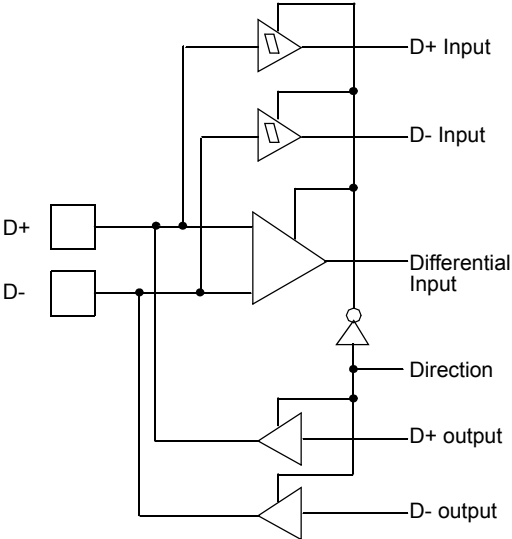
\*3: Devices without suffix "W"

### 6. I/O Circuit Type

| Type | Circuit   | Remarks   |
|------|---|---|
| A    |    | <p>High-speed oscillation circuit:</p> <ul style="list-style-type: none"> <li>• 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)</li> <li>• Programmable feedback resistor = approx. <math>2 * 0.5 \text{ M}\Omega</math>. Feedback resistor is grounded in the center when the oscillator is disabled or in FCI mode</li> </ul> |
| B    |   | <p>Low-speed oscillation circuit:</p> <ul style="list-style-type: none"> <li>• Programmable feedback resistor = approx. <math>20 \text{ M}\Omega</math> (X1A: <math>19.5 \text{ M}\Omega</math>, X0A: <math>0.5 \text{ M}\Omega</math>) Feedback resistor is grounded in the center when the oscillator is disabled</li> </ul>  |
| C    |  | <ul style="list-style-type: none"> <li>• Mask ROM and EVA device: CMOS Hysteresis input pin</li> <li>• Flash device: CMOS input pin</li> </ul>  |
| E    |  | <ul style="list-style-type: none"> <li>• CMOS Hysteresis input pin</li> <li>• Pull-up resistor value: approx. <math>50 \text{ k}\Omega</math></li> </ul>  |

| Type | Circuit  | Remarks   |
|------|--|---|
| F    |   | <ul style="list-style-type: none"> <li>• Power supply input protection circuit</li> </ul>   |
| G    |   | <ul style="list-style-type: none"> <li>• A/D converter ref+ (AVRH) power supply input pin with protection circuit</li> <li>• Flash devices do not have a protection circuit against VCC for pins AVRH</li> </ul>  |
| H    |  | <ul style="list-style-type: none"> <li>• CMOS level output (programmable <math>I_{OL} = 5\text{mA}</math>, <math>I_{OH} = -5\text{mA}</math> and <math>I_{OL} = 2\text{mA}</math>, <math>I_{OH} = -2\text{mA}</math>)</li> <li>• 2 different CMOS hysteresis inputs with input shutdown function</li> <li>• Automotive input with input shutdown function</li> <li>• TTL input with input shutdown function</li> <li>• Programmable pull-up resistor: 50kΩ approx.</li> </ul> |

| Type | Circuit   | Remarks   |
|------|---|---|
| I    |  <p>The diagram for Type I shows a pull-up control circuit with a resistor and a transistor. The output is split into Pout and Nout. Below, four input types are shown, each with a standby control for input shutdown: Hysteresis input, Hysteresis input, Automotive input, and TTL input. An Analog input is also shown.</p> | <ul style="list-style-type: none"> <li>• CMOS level output (programmable <math>I_{OL} = 5\text{mA}</math>, <math>I_{OH} = -5\text{mA}</math> and <math>I_{OL} = 2\text{mA}</math>, <math>I_{OH} = -2\text{mA}</math>)</li> <li>• 2 different CMOS hysteresis inputs with input shutdown function</li> <li>• Automotive input with input shutdown function</li> <li>• TTL input with input shutdown function.</li> <li>• Programmable pull-up resistor: <math>50\text{k}\Omega</math> approx.</li> <li>• Analog input</li> </ul> |
| N    |  <p>The diagram for Type N is similar to Type I but lacks the Analog input. It shows pull-up control, Pout, Nout, and four input types: Hysteresis input, Hysteresis input, Automotive input, and TTL input, each with a standby control for input shutdown.</p>   | <ul style="list-style-type: none"> <li>• CMOS level output (<math>I_{OL} = 3\text{mA}</math>, <math>I_{OH} = -3\text{mA}</math>)</li> <li>• 2 different CMOS hysteresis inputs with input shutdown function</li> <li>• Automotive input with input shutdown function</li> <li>• TTL input with input shutdown function</li> <li>• Programmable pull-up resistor: <math>50\text{k}\Omega</math> approx.</li> </ul>   |

| Type | Circuit   | Remarks   |
|------|---|---|
| O    |  <p>pull-up control</p> <p>Pout (Always disabled)</p> <p>Nout</p> <p>R</p> <p>Standby control for input shutdown</p> <p>Hysteresis input</p> <p>Hysteresis input</p> <p>Automotive inputs</p> <p>TTL input</p> <p>Analog input</p> | <p>HCONX</p> <ul style="list-style-type: none"> <li>Available only for device with suffix "U"</li> </ul>                    |
| P    |  <p>D+ Input</p> <p>D- Input</p> <p>Differential Input</p> <p>Direction</p> <p>D+ output</p> <p>D- output</p> <p>D+</p> <p>D-</p>  | <p>USB IO cell: UDP and UDM</p> <ul style="list-style-type: none"> <li>Available only for device with suffix "U"</li> </ul> |

**7. Memory Map**

| MB96V300B              |                     | MB96(F)33x                                       |   |
|------------------------|---------------------|--|---|
| FF:FFF <sub>H</sub>    | Emulation ROM       |  | USER ROM / External Bus <sup>*4</sup>       |
| DE:000 <sub>H</sub>    | External Bus        |  | External Bus                                |
| 10:000 <sub>H</sub>    | Boot-ROM            |  | Boot-ROM                                    |
| 0F:E00 <sub>H</sub>    | Reserved            |  | Reserved                                    |
| 0E:000 <sub>H</sub>    | External RAM        |  | Reserved                                    |
| 02:000 <sub>H</sub>    | Internal RAM bank 1 | RAMEND1 <sup>*2</sup><br>RAMSTART1 <sup>*2</sup> | Reserved<br>Internal RAM bank 1<br>Reserved |
| 01:000 <sub>H</sub>    | ROM/RAM MIRROR      |  | ROM/RAM MIRROR                              |
| 00:800 <sub>H</sub>    | Internal RAM bank 0 | RAMSTART0 <sup>*2</sup>                          | Internal RAM bank 0<br>Reserved             |
| RAMSTART0 <sup>*</sup> | External Bus        |  | External Bus                                |
| 00:0C0 <sub>H</sub>    | Peripherals         |  | Peripherals                                 |
| 00:038 <sub>H</sub>    | GPR <sup>*1</sup>   |  | GPR <sup>*1</sup>                           |
| 00:018 <sub>H</sub>    | DMA                 |  | DMA   |
| 00:010 <sub>H</sub>    | External Bus        |  | External Bus                                |
| 00:00F <sub>H</sub>    | Peripheral          |  | Peripheral                                  |
| 00:000 <sub>H</sub>    |                     |  |   |

RAM availability depending on the device

External Bus end address<sup>\*2</sup>

\*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" 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              |
|-------------------|-----------------|-----------------|--------------------------|----------------------|----------------------|----------------------|
| MB96F336          | 24KByte         | -               | 00:11FF <sub>H</sub>     | 00:2240 <sub>H</sub> | -                    | -                    |
| MB96F338, MB96338 | 28KByte         | 4kB             | 00:11FF <sub>H</sub>     | 00:1240 <sub>H</sub> | 01:8000 <sub>H</sub> | 01:8FFF <sub>H</sub> |

**9. User ROM Memory Map For Flash Devices**

|                                 |                              | <b>MB96F336U</b>       | <b>MB96F338Y<br/>MB96F338R<br/>MB96F338U</b> |         |
|---------------------------------|------------------------------|------------------------|--|---------|
| Alternative mode<br>CPU address | Flash memory<br>mode address | Flash size<br>288kByte | Flash size<br>544kByte                       |         |
| FF:FFFH                         | 3F:FFFH                      | S39 - 64K              | S39 - 64K                                    | Flash A |
| FF:000H                         | 3F:000H                      |                        |  |         |
| FE:FFFH                         | 3E:FFFH                      | S38 - 64K              | S38 - 64K                                    |         |
| FE:000H                         | 3E:000H                      |                        |  |         |
| FD:FFFH                         | 3D:FFFH                      | S37 - 64K              | S37 - 64K                                    |         |
| FD:000H                         | 3D:000H                      |                        |  |         |
| FC:FFFH                         | 3C:FFFH                      | S36 - 64K              | S36 - 64K                                    |         |
| FC:000H                         | 3C:000H                      |                        |  |         |
| FB:FFFH                         | 3B:FFFH                      |                        | S35 - 64K                                    |         |
| FB:000H                         | 3B:000H                      |                        |  |         |
| FA:FFFH                         | 3A:FFFH                      |                        | S34 - 64K                                    |         |
| FA:000H                         | 3A:000H                      |                        |  |         |
| F9:FFFH                         | 39:FFFH                      |                        | S33 - 64K                                    |         |
| F9:000H                         | 39:000H                      |                        |  |         |
| F8:FFFH                         | 38:FFFH                      |                        | S32 - 64K                                    |         |
| F8:000H                         | 38:000H                      |                        |  |         |
| F7:FFFH                         | 37:FFFH                      |                        |  | Flash A |
| F7:000H                         | 37:000H                      |                        |  |         |
| F6:FFFH                         | 36:FFFH                      |                        |  |         |
| F6:000H                         | 36:000H                      |                        |  |         |
| F5:FFFH                         | 35:FFFH                      | External bus           |  |         |
| F5:000H                         | 35:000H                      |                        |  |         |
| F4:FFFH                         | 34:FFFH                      |                        |  |         |
| F4:000H                         | 34:000H                      |                        |  |         |
| F3:FFFH                         | 33:FFFH                      |                        |  |         |
| F3:000H                         | 33:000H                      |                        |  |         |
| F2:FFFH                         | 32:FFFH                      |                        | External bus                                 |         |
| F2:000H                         | 32:000H                      |                        |  |         |
| F1:FFFH                         | 31:FFFH                      |                        |  |         |
| F1:000H                         | 31:000H                      |                        |  |         |
| F0:FFFH                         | 30:FFFH                      |                        |  |         |
| F0:000H                         | 30:000H                      |                        |  |         |
| E0:FFFH                         |                              |                        |  |         |
| E0:000H                         |                              | Reserved               | Reserved                                     |         |
| DF:FFFH                         |                              |                        |  |         |
| DF:800H                         |                              |                        |  | Flash A |
| DF:7FFFH                        | 1F:7FFFH                     | SA3 - 8K               | SA3 - 8K                                     |         |
| DF:6000H                        | 1F:6000H                     |                        |  |         |
| DF:5FFFH                        | 1F:5FFFH                     | SA2 - 8K               | SA2 - 8K                                     |         |
| DF:4000H                        | 1F:4000H                     |                        |  |         |
| DF:3FFFH                        | 1F:3FFFH                     | SA1 - 8K               | SA1 - 8K                                     |         |
| DF:2000H                        | 1F:2000H                     |                        |  |         |
| DF:1FFFH                        | 1F:1FFFH                     | SA0 - 8K *1            | SA0 - 8K *1                                  |         |
| DF:0000H                        | 1F:0000H                     |                        |  |         |
| DE:FFFH                         |                              |                        |  |         |
| DE:0000H                        |                              | Reserved               | Reserved                                     |         |

\*1: Sector SA0 contains the ROM Configuration Block RCBA at CPU address DF:0000H - DF:007FH

## 10. Serial Programming Communication Interface

### USART pins for Flash serial programming (MD[2:0] = 010)

| MB96F33x   |              |                 |
|------------|--------------|-----------------|
| Pin number | USART Number | Normal function |
| LQFP-144   |              |                 |
| 85         | USART0       | SIN0            |
| 86         |              | SOT0            |
| 87         |              | SCK0            |
| 88         | USART1       | SIN1            |
| 89         |              | SOT1            |
| 90         |              | SCK1            |
| 26         | USART2       | SIN2            |
| 27         |              | SOT2            |
| 28         |              | 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 110.

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.

## 11. I/O Map

### I/O map MB96(F)33x (1 of 40)

| Address                                      | Register                                   | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|--|------------------------------|-------------------------------|--------|
| 000000 <sub>H</sub>                          | I/O Port P00 - Port Data Register          | PDR00                        |                               | R/W    |
| 000001 <sub>H</sub>                          | I/O Port P01 - Port Data Register          | PDR01                        |                               | R/W    |
| 000002 <sub>H</sub>                          | I/O Port P02 - Port Data Register          | PDR02                        |                               | R/W    |
| 000003 <sub>H</sub>                          | I/O Port P03 - Port Data Register          | PDR03                        |                               | R/W    |
| 000004 <sub>H</sub>                          | I/O Port P04 - Port Data Register          | PDR04                        |                               | R/W    |
| 000005 <sub>H</sub>                          | I/O Port P05 - Port Data Register          | PDR05                        |                               | R/W    |
| 000006 <sub>H</sub>                          | I/O Port P06 - Port Data Register          | PDR06                        |                               | R/W    |
| 000007 <sub>H</sub>                          | I/O Port P07 - Port Data Register          | PDR07                        |                               | R/W    |
| 000008 <sub>H</sub>                          | I/O Port P08 - Port Data Register          | PDR08                        |                               | R/W    |
| 000009 <sub>H</sub>                          | I/O Port P09 - Port Data Register          | PDR09                        |                               | R/W    |
| 00000A <sub>H</sub>                          | I/O Port P10 - Port Data Register          | PDR10                        |                               | R/W    |
| 00000B <sub>H</sub>                          | I/O Port P11 - Port Data Register          | PDR11                        |                               | R/W    |
| 00000C <sub>H</sub>                          | I/O Port P12 - Port Data Register          | PDR12                        |                               | R/W    |
| 00000D <sub>H</sub>                          | I/O Port P13 - Port Data Register          | PDR13                        |                               | R/W    |
| 00000E <sub>H</sub>                          | I/O Port P14 - Port Data Register          | PDR14                        |                               | R/W    |
| 00000F <sub>H</sub>                          | I/O Port P15 - Port Data Register          | PDR15                        |                               | R/W    |
| 000010 <sub>H</sub>                          | Reserved                                   |                              |                               | -      |
| 000011 <sub>H</sub>                          | I/O Port P17 - Port Data Register          | PDR17                        |                               | R/W    |
| 000012 <sub>H</sub> -<br>000017 <sub>H</sub> | Reserved                                   |                              |                               | -      |
| 000018 <sub>H</sub>                          | ADC0 - Control Status register Low         | ADCSL                        | ADCS                          | R/W    |
| 000019 <sub>H</sub>                          | ADC0 - Control Status register High        | ADCSH                        |                               | R/W    |
| 00001A <sub>H</sub>                          | ADC0 - Data Register Low                   | ADCRL                        | ADCR                          | R      |
| 00001B <sub>H</sub>                          | ADC0 - Data Register High                  | ADCRH                        |                               | R      |
| 00001C <sub>H</sub>                          | ADC0 - Setting Register                    |                              | ADSR                          | R/W    |
| 00001D <sub>H</sub>                          | ADC0 - Setting Register                    |                              |                               | R/W    |
| 00001E <sub>H</sub>                          | ADC0 - Extended Configuration Register     | ADECR                        |                               | R/W    |
| 00001F <sub>H</sub>                          | Reserved                                   |                              |                               | -      |
| 000020 <sub>H</sub>                          | FRT0 - Data register of free-running timer |                              | TCDT0                         | R/W    |
| 000021 <sub>H</sub>                          | FRT0 - Data register of free-running timer |                              |                               | R/W    |

**I/O map MB96(F)33x (2 of 40)**

| Address             | Register  | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|---------------------|---|------------------------------|-------------------------------|--------|
| 000022 <sub>H</sub> | FRT0 - Control status register of free-running timer Low  | TCCSL0                       | TCCS0                         | R/W    |
| 000023 <sub>H</sub> | FRT0 - Control status register of free-running timer High | TCCSH0                       |                               | R/W    |
| 000024 <sub>H</sub> | FRT1 - Data register of free-running timer                |                              | TCDT1                         | R/W    |
| 000025 <sub>H</sub> | FRT1 - Data register of free-running timer                |                              |                               | R/W    |
| 000026 <sub>H</sub> | FRT1 - Control status register of free-running timer Low  | TCCSL1                       | TCCS1                         | R/W    |
| 000027 <sub>H</sub> | FRT1 - Control status register of free-running timer High | TCCSH1                       |                               | R/W    |
| 000028 <sub>H</sub> | OCU0 - Output Compare Control Status                      | OCS0                         |                               | R/W    |
| 000029 <sub>H</sub> | OCU1 - Output Compare Control Status                      | OCS1                         |                               | R/W    |
| 00002A <sub>H</sub> | OCU0 - Compare Register                                   |                              | OCCP0                         | R/W    |
| 00002B <sub>H</sub> | OCU0 - Compare Register                                   |                              |                               | R/W    |
| 00002C <sub>H</sub> | OCU1 - Compare Register                                   |                              | OCCP1                         | R/W    |
| 00002D <sub>H</sub> | OCU1 - Compare Register                                   |                              |                               | R/W    |
| 00002E <sub>H</sub> | OCU2 - Output Compare Control Status                      | OCS2                         |                               | R/W    |
| 00002F <sub>H</sub> | OCU3 - Output Compare Control Status                      | OCS3                         |                               | R/W    |
| 000030 <sub>H</sub> | OCU2 - Compare Register                                   |                              | OCCP2                         | R/W    |
| 000031 <sub>H</sub> | OCU2 - Compare Register                                   |                              |                               | R/W    |
| 000032 <sub>H</sub> | OCU3 - Compare Register                                   |                              | OCCP3                         | R/W    |
| 000033 <sub>H</sub> | OCU3 - Compare Register                                   |                              |                               | R/W    |
| 000034 <sub>H</sub> | OCU4 - Output Compare Control Status                      | OCS4                         |                               | R/W    |
| 000035 <sub>H</sub> | OCU5 - Output Compare Control Status                      | OCS5                         |                               | R/W    |
| 000036 <sub>H</sub> | OCU4 - Compare Register                                   |                              | OCCP4                         | R/W    |
| 000037 <sub>H</sub> | OCU4 - Compare Register                                   |                              |                               | R/W    |
| 000038 <sub>H</sub> | OCU5 - Compare Register                                   |                              | OCCP5                         | R/W    |
| 000039 <sub>H</sub> | OCU5 - Compare Register                                   |                              |                               | R/W    |
| 00003A <sub>H</sub> | OCU6 - Output Compare Control Status                      | OCS6                         |                               | R/W    |
| 00003B <sub>H</sub> | OCU7 - Output Compare Control Status                      | OCS7                         |                               | R/W    |
| 00003C <sub>H</sub> | OCU6 - Compare Register                                   |                              | OCCP6                         | R/W    |
| 00003D <sub>H</sub> | OCU6 - Compare Register                                   |                              |                               | R/W    |
| 00003E <sub>H</sub> | OCU7 - Compare Register                                   |                              | OCCP7                         | R/W    |
| 00003F <sub>H</sub> | OCU7 - Compare Register                                   |                              |                               | R/W    |

**I/O map MB96(F)33x (3 of 40)**

| Address             | Register  | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|---------------------|---|------------------------------|-------------------------------|--------|
| 000040 <sub>H</sub> | ICU0/ICU1 - Control Status Register                     | ICS01                        |                               | R/W    |
| 000041 <sub>H</sub> | ICU0/ICU1 - Edge register                               | ICE01                        |                               | R/W    |
| 000042 <sub>H</sub> | ICU0 - Capture Register Low                             | IPCPL0                       | IPCP0                         | R      |
| 000043 <sub>H</sub> | ICU0 - Capture Register High                            | IPCPL0                       |                               | R      |
| 000044 <sub>H</sub> | ICU1 - Capture Register Low                             | IPCPL1                       | IPCP1                         | R      |
| 000045 <sub>H</sub> | ICU1 - Capture Register High                            | IPCPL1                       |                               | R      |
| 000046 <sub>H</sub> | ICU2/ICU3 - Control Status Register                     | ICS23                        |                               | R/W    |
| 000047 <sub>H</sub> | ICU2/ICU3 - Edge register                               | ICE23                        |                               | R/W    |
| 000048 <sub>H</sub> | ICU2 - Capture Register Low                             | IPCPL2                       | IPCP2                         | R      |
| 000049 <sub>H</sub> | ICU2 - Capture Register High                            | IPCPL2                       |                               | R      |
| 00004A <sub>H</sub> | ICU3 - Capture Register Low                             | IPCPL3                       | IPCP3                         | R      |
| 00004B <sub>H</sub> | ICU3 - Capture Register High                            | IPCPL3                       |                               | R      |
| 00004C <sub>H</sub> | ICU4/ICU5 - Control Status Register                     | ICS45                        |                               | R/W    |
| 00004D <sub>H</sub> | ICU4/ICU5 - Edge register                               | ICE45                        |                               | R/W    |
| 00004E <sub>H</sub> | ICU4 - Capture Register Low                             | IPCPL4                       | IPCP4                         | R      |
| 00004F <sub>H</sub> | ICU4 - Capture Register High                            | IPCPL4                       |                               | R      |
| 000050 <sub>H</sub> | ICU5 - Capture Register Low                             | IPCPL5                       | IPCP5                         | R      |
| 000051 <sub>H</sub> | ICU5 - Capture Register High                            | IPCPL5                       |                               | R      |
| 000052 <sub>H</sub> | ICU6/ICU7 - Control Status Register                     | ICS67                        |                               | R/W    |
| 000053 <sub>H</sub> | ICU6/ICU7 - Edge register                               | ICE67                        |                               | R/W    |
| 000054 <sub>H</sub> | ICU6 - Capture Register Low                             | IPCPL6                       | IPCP6                         | R      |
| 000055 <sub>H</sub> | ICU6 - Capture Register High                            | IPCPL6                       |                               | R      |
| 000056 <sub>H</sub> | ICU7 - Capture Register Low                             | IPCPL7                       | IPCP7                         | R      |
| 000057 <sub>H</sub> | ICU7 - Capture Register High                            | IPCPL7                       |                               | R      |
| 000058 <sub>H</sub> | EXTINT0 - External Interrupt Enable Register            | ENIR0                        |                               | R/W    |
| 000059 <sub>H</sub> | EXTINT0 - External Interrupt Interrupt request Register | EIRR0                        |                               | R/W    |
| 00005A <sub>H</sub> | EXTINT0 - External Interrupt Level Select Low           | ELVRL0                       | ELVR0                         | R/W    |
| 00005B <sub>H</sub> | EXTINT0 - External Interrupt Level Select High          | ELVRL0                       |                               | R/W    |
| 00005C <sub>H</sub> | EXTINT1 - External Interrupt Enable Register            | ENIR1                        |                               | R/W    |
| 00005D <sub>H</sub> | EXTINT1 - External Interrupt Interrupt request Register | EIRR1                        |                               | R/W    |

**I/O map MB96(F)33x (4 of 40)**

| Address             | Register   | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|---------------------|--|---------------------------|----------------------------|--------|
| 00005E <sub>H</sub> | EXTINT1 - External Interrupt Level Select Low                  | ELVRL1                    | ELVR1                      | R/W    |
| 00005F <sub>H</sub> | EXTINT1 - External Interrupt Level Select High                 | ELVRH1                    |                            | R/W    |
| 000060 <sub>H</sub> | RLT0 - Timer Control Status Register Low                       | TMCSRL0                   | TMCSR0                     | R/W    |
| 000061 <sub>H</sub> | RLT0 - Timer Control Status Register High                      | TMCSRH0                   |                            | R/W    |
| 000062 <sub>H</sub> | RLT0 - Reload Register - for writing                           |                           | TMRLR0                     | W      |
| 000062 <sub>H</sub> | RLT0 - Reload Register - for reading                           |                           | TMR0                       | R      |
| 000063 <sub>H</sub> | RLT0 - Reload Register - for writing                           |                           |                            | W      |
| 000063 <sub>H</sub> | RLT0 - Reload Register - for reading                           |                           |                            | R      |
| 000064 <sub>H</sub> | RLT1 - Timer Control Status Register Low                       | TMCSRL1                   | TMCSR1                     | R/W    |
| 000065 <sub>H</sub> | RLT1 - Timer Control Status Register High                      | TMCSRH1                   |                            | R/W    |
| 000066 <sub>H</sub> | RLT1 - Reload Register - for writing                           |                           | TMRLR1                     | W      |
| 000066 <sub>H</sub> | RLT1 - Reload Register - for reading                           |                           | TMR1                       | R      |
| 000067 <sub>H</sub> | RLT1 - Reload Register - for writing                           |                           |                            | W      |
| 000067 <sub>H</sub> | RLT1 - Reload Register - for reading                           |                           |                            | R      |
| 000068 <sub>H</sub> | RLT2 - Timer Control Status Register Low                       | TMCSRL2                   | TMCSR2                     | R/W    |
| 000069 <sub>H</sub> | RLT2 - Timer Control Status Register High                      | TMCSRH2                   |                            | R/W    |
| 00006A <sub>H</sub> | RLT2 - Reload Register - for writing                           |                           | TMRLR2                     | W      |
| 00006A <sub>H</sub> | RLT2 - Reload Register - for reading                           |                           | TMR2                       | R      |
| 00006B <sub>H</sub> | RLT2 - Reload Register - for writing                           |                           |                            | W      |
| 00006B <sub>H</sub> | RLT2 - Reload Register - for reading                           |                           |                            | R      |
| 00006C <sub>H</sub> | RLT3 - Timer Control Status Register Low                       | TMCSRL3                   | TMCSR3                     | R/W    |
| 00006D <sub>H</sub> | RLT3 - Timer Control Status Register High                      | TMCSRH3                   |                            | R/W    |
| 00006E <sub>H</sub> | RLT3 - Reload Register - for writing                           |                           | TMRLR3                     | W      |
| 00006E <sub>H</sub> | RLT3 - Reload Register - for reading                           |                           | TMR3                       | R      |
| 00006F <sub>H</sub> | RLT3 - Reload Register - for writing                           |                           |                            | W      |
| 00006F <sub>H</sub> | RLT3 - Reload Register - for reading                           |                           |                            | R      |
| 000070 <sub>H</sub> | RLT6 - Timer Control Status Register Low (dedic. RLT for PPG)  | TMCSRL6                   | TMCSR6                     | R/W    |
| 000071 <sub>H</sub> | RLT6 - Timer Control Status Register High (dedic. RLT for PPG) | TMCSRH6                   |                            | R/W    |
| 000072 <sub>H</sub> | RLT6 - Reload Register (dedic. RLT for PPG) - for writing      |                           | TMRLR6                     | W      |

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| Address             | Register  | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|---------------------|---|------------------------------|-------------------------------|--------|
| 000072 <sub>H</sub> | RLT6 - Reload Register (dedic. RLT for PPG) - for reading |                              | TMR6                          | R      |
| 000073 <sub>H</sub> | RLT6 - Reload Register (dedic. RLT for PPG) - for writing |                              |                               | W      |
| 000073 <sub>H</sub> | RLT6 - Reload Register (dedic. RLT for PPG) - for reading |                              |                               | R      |
| 000074 <sub>H</sub> | PPG3-PPG0 - General Control register 1 Low                | GCN1L0                       | GCN10                         | R/W    |
| 000075 <sub>H</sub> | PPG3-PPG0 - General Control register 1 High               | GCN1H0                       |                               | R/W    |
| 000076 <sub>H</sub> | PPG3-PPG0 - General Control register 2 Low                | GCN2L0                       | GCN20                         | R/W    |
| 000077 <sub>H</sub> | PPG3-PPG0 - General Control register 2 High               | GCN2H0                       |                               | R/W    |
| 000078 <sub>H</sub> | PPG0 - Timer register                                     |                              | PTMR0                         | R      |
| 000079 <sub>H</sub> | PPG0 - Timer register                                     |                              |                               | R      |
| 00007A <sub>H</sub> | PPG0 - Period setting register                            |                              | PCSR0                         | W      |
| 00007B <sub>H</sub> | PPG0 - Period setting register                            |                              |                               | W      |
| 00007C <sub>H</sub> | PPG0 - Duty cycle register                                |                              | PDUT0                         | W      |
| 00007D <sub>H</sub> | PPG0 - Duty cycle register                                |                              |                               | W      |
| 00007E <sub>H</sub> | PPG0 - Control status register Low                        | PCNL0                        | PCN0                          | R/W    |
| 00007F <sub>H</sub> | PPG0 - Control status register High                       | PCNH0                        |                               | R/W    |
| 000080 <sub>H</sub> | PPG1 - Timer register                                     |                              | PTMR1                         | R      |
| 000081 <sub>H</sub> | PPG1 - Timer register                                     |                              |                               | R      |
| 000082 <sub>H</sub> | PPG1 - Period setting register                            |                              | PCSR1                         | W      |
| 000083 <sub>H</sub> | PPG1 - Period setting register                            |                              |                               | W      |
| 000084 <sub>H</sub> | PPG1 - Duty cycle register                                |                              | PDUT1                         | W      |
| 000085 <sub>H</sub> | PPG1 - Duty cycle register                                |                              |                               | W      |
| 000086 <sub>H</sub> | PPG1 - Control status register Low                        | PCNL1                        | PCN1                          | R/W    |
| 000087 <sub>H</sub> | PPG1 - Control status register High                       | PCNH1                        |                               | R/W    |
| 000088 <sub>H</sub> | PPG2 - Timer register                                     |                              | PTMR2                         | R      |
| 000089 <sub>H</sub> | PPG2 - Timer register                                     |                              |                               | R      |
| 00008A <sub>H</sub> | PPG2 - Period setting register                            |                              | PCSR2                         | W      |
| 00008B <sub>H</sub> | PPG2 - Period setting register                            |                              |                               | W      |
| 00008C <sub>H</sub> | PPG2 - Duty cycle register                                |                              | PDUT2                         | W      |
| 00008D <sub>H</sub> | PPG2 - Duty cycle register                                |                              |                               | W      |
| 00008E <sub>H</sub> | PPG2 - Control status register Low                        | PCNL2                        | PCN2                          | R/W    |



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| Address             | Register                                    | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|---------------------|---|---------------------------|----------------------------|--------|
| 00008F <sub>H</sub> | PPG2 - Control status register High         | PCNH2                     |                            | R/W    |
| 000090 <sub>H</sub> | PPG3 - Timer register                       |                           | PTMR3                      | R      |
| 000091 <sub>H</sub> | PPG3 - Timer register                       |                           |                            | R      |
| 000092 <sub>H</sub> | PPG3 - Period setting register              |                           | PCSR3                      | W      |
| 000093 <sub>H</sub> | PPG3 - Period setting register              |                           |                            | W      |
| 000094 <sub>H</sub> | PPG3 - Duty cycle register                  |                           | PDUT3                      | W      |
| 000095 <sub>H</sub> | PPG3 - Duty cycle register                  |                           |                            | W      |
| 000096 <sub>H</sub> | PPG3 - Control status register Low          | PCNL3                     | PCN3                       | R/W    |
| 000097 <sub>H</sub> | PPG3 - Control status register High         | PCNH3                     |                            | R/W    |
| 000098 <sub>H</sub> | PPG7-PPG4 - General Control register 1 Low  | GCN1L1                    | GCN11                      | R/W    |
| 000099 <sub>H</sub> | PPG7-PPG4 - General Control register 1 High | GCN1H1                    |                            | R/W    |
| 00009A <sub>H</sub> | PPG7-PPG4 - General Control register 2 Low  | GCN2L1                    | GCN21                      | R/W    |
| 00009B <sub>H</sub> | PPG7-PPG4 - General Control register 2 High | GCN2H1                    |                            | R/W    |
| 00009C <sub>H</sub> | PPG4 - Timer register                       |                           | PTMR4                      | R      |
| 00009D <sub>H</sub> | PPG4 - Timer register                       |                           |                            | R      |
| 00009E <sub>H</sub> | PPG4 - Period setting register              |                           | PCSR4                      | W      |
| 00009F <sub>H</sub> | PPG4 - Period setting register              |                           |                            | W      |
| 0000A0 <sub>H</sub> | PPG4 - Duty cycle register                  |                           | PDUT4                      | W      |
| 0000A1 <sub>H</sub> | PPG4 - Duty cycle register                  |                           |                            | W      |
| 0000A2 <sub>H</sub> | PPG4 - Control status register Low          | PCNL4                     | PCN4                       | R/W    |
| 0000A3 <sub>H</sub> | PPG4 - Control status register High         | PCNH4                     |                            | R/W    |
| 0000A4 <sub>H</sub> | PPG5 - Timer register                       |                           | PTMR5                      | R      |
| 0000A5 <sub>H</sub> | PPG5 - Timer register                       |                           |                            | R      |
| 0000A6 <sub>H</sub> | PPG5 - Period setting register              |                           | PCSR5                      | W      |
| 0000A7 <sub>H</sub> | PPG5 - Period setting register              |                           |                            | W      |
| 0000A8 <sub>H</sub> | PPG5 - Duty cycle register                  |                           | PDUT5                      | W      |
| 0000A9 <sub>H</sub> | PPG5 - Duty cycle register                  |                           |                            | W      |
| 0000AA <sub>H</sub> | PPG5 - Control status register Low          | PCNL5                     | PCN5                       | R/W    |
| 0000AB <sub>H</sub> | PPG5 - Control status register High         | PCNH5                     |                            | R/W    |
| 0000AC <sub>H</sub> | I <sup>2</sup> C0 - Bus Status Register     | IBSR0                     |                            | R      |

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| Address             | Register  | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|---------------------|---|------------------------------|-------------------------------|--------|
| 0000AD <sub>H</sub> | I <sup>2</sup> C0 - Bus Control Register                | IBCR0                        |                               | R/W    |
| 0000AE <sub>H</sub> | I <sup>2</sup> C0 - Ten bit Slave address Register Low  | ITBAL0                       | ITBA0                         | R/W    |
| 0000AF <sub>H</sub> | I <sup>2</sup> C0 - Ten bit Slave address Register High | ITBAH0                       |                               | R/W    |
| 0000B0 <sub>H</sub> | I <sup>2</sup> C0 - Ten bit Address mask Register Low   | ITMKL0                       | ITMK0                         | R/W    |
| 0000B1 <sub>H</sub> | I <sup>2</sup> C0 - Ten bit Address mask Register High  | ITMKH0                       |                               | R/W    |
| 0000B2 <sub>H</sub> | I <sup>2</sup> C0 - Seven bit Slave address Register    | ISBA0                        |                               | R/W    |
| 0000B3 <sub>H</sub> | I <sup>2</sup> C0 - Seven bit Address mask Register     | ISMK0                        |                               | R/W    |
| 0000B4 <sub>H</sub> | I <sup>2</sup> C0 - Data Register                       | IDAR0                        |                               | R/W    |
| 0000B5 <sub>H</sub> | I <sup>2</sup> C0 - Clock Control Register              | ICCR0                        |                               | R/W    |
| 0000B6 <sub>H</sub> | I <sup>2</sup> C1 - Bus Status Register                 | IBSR1                        |                               | R      |
| 0000B7 <sub>H</sub> | I <sup>2</sup> C1 - Bus Control Register                | IBCR1                        |                               | R/W    |
| 0000B8 <sub>H</sub> | I <sup>2</sup> C1 - Ten bit Slave address Register Low  | ITBAL1                       | ITBA1                         | R/W    |
| 0000B9 <sub>H</sub> | I <sup>2</sup> C1 - Ten bit Slave address Register High | ITBAH1                       |                               | R/W    |
| 0000BA <sub>H</sub> | I <sup>2</sup> C1 - Ten bit Address mask Register Low   | ITMKL1                       | ITMK1                         | R/W    |
| 0000BB <sub>H</sub> | I <sup>2</sup> C1 - Ten bit Address mask Register High  | ITMKH1                       |                               | R/W    |
| 0000BC <sub>H</sub> | I <sup>2</sup> C1 - Seven bit Slave address Register    | ISBA1                        |                               | R/W    |
| 0000BD <sub>H</sub> | I <sup>2</sup> C1 - Seven bit Address mask Register     | ISMK1                        |                               | R/W    |
| 0000BE <sub>H</sub> | I <sup>2</sup> C1 - Data Register                       | IDAR1                        |                               | R/W    |
| 0000BF <sub>H</sub> | I <sup>2</sup> C1 - Clock Control Register              | ICCR1                        |                               | R/W    |
| 0000C0 <sub>H</sub> | USART0 - Serial Mode Register                           | SMR0                         |                               | R/W    |
| 0000C1 <sub>H</sub> | USART0 - Serial Control Register                        | SCR0                         |                               | R/W    |
| 0000C2 <sub>H</sub> | USART0 - TX Register                                    | TDR0                         |                               | W      |
| 0000C2 <sub>H</sub> | USART0 - RX Register                                    | RDR0                         |                               | R      |
| 0000C3 <sub>H</sub> | USART0 - Serial Status                                  | SSR0                         |                               | R/W    |
| 0000C4 <sub>H</sub> | USART0 - Control/Com. Register                          | ECCR0                        |                               | R/W    |
| 0000C5 <sub>H</sub> | USART0 - Ext. Status Register                           | ESCR0                        |                               | R/W    |
| 0000C6 <sub>H</sub> | USART0 - Baud Rate Generator Register Low               | BGRL0                        | BGR0                          | R/W    |
| 0000C7 <sub>H</sub> | USART0 - Baud Rate Generator Register High              | BGRH0                        |                               | R/W    |
| 0000C8 <sub>H</sub> | USART0 - Extended Serial Interrupt Register             | ESIR0                        |                               | R/W    |
| 0000C9 <sub>H</sub> | Reserved  |                              |                               | -      |

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| Address             | Register                                    | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|---------------------|---|------------------------------|-------------------------------|--------|
| 0000CA <sub>H</sub> | USART1 - Serial Mode Register               | SMR1                         |                               | R/W    |
| 0000CB <sub>H</sub> | USART1 - Serial Control Register            | SCR1                         |                               | R/W    |
| 0000CC <sub>H</sub> | USART1 - TX Register                        | TDR1                         |                               | W      |
| 0000CC <sub>H</sub> | USART1 - RX Register                        | RDR1                         |                               | R      |
| 0000CD <sub>H</sub> | USART1 - Serial Status                      | SSR1                         |                               | R/W    |
| 0000CE <sub>H</sub> | USART1 - Control/Com. Register              | ECCR1                        |                               | R/W    |
| 0000CF <sub>H</sub> | USART1 - Ext. Status Register               | ESCR1                        |                               | R/W    |
| 0000D0 <sub>H</sub> | USART1 - Baud Rate Generator Register Low   | BGRL1                        | BGR1                          | R/W    |
| 0000D1 <sub>H</sub> | USART1 - Baud Rate Generator Register High  | BGRH1                        |                               | R/W    |
| 0000D2 <sub>H</sub> | USART1 - Extended Serial Interrupt Register | ESIR1                        |                               | R/W    |
| 0000D3 <sub>H</sub> | Reserved                                    |                              |                               | -      |
| 0000D4 <sub>H</sub> | USART2 - Serial Mode Register               | SMR2                         |                               | R/W    |
| 0000D5 <sub>H</sub> | USART2 - Serial Control Register            | SCR2                         |                               | R/W    |
| 0000D6 <sub>H</sub> | USART2 - TX Register                        | TDR2                         |                               | W      |
| 0000D6 <sub>H</sub> | USART2 - RX Register                        | RDR2                         |                               | R      |
| 0000D7 <sub>H</sub> | USART2 - Serial Status                      | SSR2                         |                               | R/W    |
| 0000D8 <sub>H</sub> | USART2 - Control/Com. Register              | ECCR2                        |                               | R/W    |
| 0000D9 <sub>H</sub> | USART2 - Ext. Status Register               | ESCR2                        |                               | R/W    |
| 0000DA <sub>H</sub> | USART2 - Baud Rate Generator Register Low   | BGRL2                        | BGR2                          | R/W    |
| 0000DB <sub>H</sub> | USART2 - Baud Rate Generator Register High  | BGRH2                        |                               | R/W    |
| 0000DC <sub>H</sub> | USART2 - Extended Serial Interrupt Register | ESIR2                        |                               | R/W    |
| 0000DD <sub>H</sub> | Reserved                                    |                              |                               | -      |
| 0000DE <sub>H</sub> | USART3 - Serial Mode Register               | SMR3                         |                               | R/W    |
| 0000DF <sub>H</sub> | USART3 - Serial Control Register            | SCR3                         |                               | R/W    |
| 0000E0 <sub>H</sub> | USART3 - TX Register                        | TDR3                         |                               | W      |
| 0000E0 <sub>H</sub> | USART3 - RX Register                        | RDR3                         |                               | R      |
| 0000E1 <sub>H</sub> | USART3 - Serial Status                      | SSR3                         |                               | R/W    |
| 0000E2 <sub>H</sub> | USART3 - Control/Com. Register              | ECCR3                        |                               | R/W    |
| 0000E3 <sub>H</sub> | USART3 - Ext. Status Register               | ESCR3                        |                               | R/W    |
| 0000E4 <sub>H</sub> | USART3 - Baud Rate Generator Register Low   | BGRL3                        | BGR3                          | R/W    |

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| Address                                      | Register                                      | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|---|------------------------------|-------------------------------|--------|
| 0000E5 <sub>H</sub>                          | USART3 - Baud Rate Generator Register High    | BGRH3                        |                               | R/W    |
| 0000E6 <sub>H</sub>                          | USART3 - Extended Serial Interrupt Register   | ESIR3                        |                               | R/W    |
| 0000E7 <sub>H</sub> -<br>0000EF <sub>H</sub> | Reserved                                      |                              |                               | -      |
| 0000F0 <sub>H</sub> -000<br>0FF <sub>H</sub> | External Bus area                             | EXTBUS0                      |                               | R/W    |
| 000100 <sub>H</sub>                          | DMA0 - Buffer address pointer low byte        | BAPL0                        |                               | R/W    |
| 000101 <sub>H</sub>                          | DMA0 - Buffer address pointer middle byte     | BAPM0                        |                               | R/W    |
| 000102 <sub>H</sub>                          | DMA0 - Buffer address pointer high byte       | BAPH0                        |                               | R/W    |
| 000103 <sub>H</sub>                          | DMA0 - DMA control register                   | DMACS0                       |                               | R/W    |
| 000104 <sub>H</sub>                          | DMA0 - I/O register address pointer low byte  | IOAL0                        | IOA0                          | R/W    |
| 000105 <sub>H</sub>                          | DMA0 - I/O register address pointer high byte | IOAH0                        |                               | R/W    |
| 000106 <sub>H</sub>                          | DMA0 - Data counter low byte                  | DCTL0                        | DCT0                          | R/W    |
| 000107 <sub>H</sub>                          | DMA0 - Data counter high byte                 | DCTH0                        |                               | R/W    |
| 000108 <sub>H</sub>                          | DMA1 - Buffer address pointer low byte        | BAPL1                        |                               | R/W    |
| 000109 <sub>H</sub>                          | DMA1 - Buffer address pointer middle byte     | BAPM1                        |                               | R/W    |
| 00010A <sub>H</sub>                          | DMA1 - Buffer address pointer high byte       | BAPH1                        |                               | R/W    |
| 00010B <sub>H</sub>                          | DMA1 - DMA control register                   | DMACS1                       |                               | R/W    |
| 00010C <sub>H</sub>                          | DMA1 - I/O register address pointer low byte  | IOAL1                        | IOA1                          | R/W    |
| 00010D <sub>H</sub>                          | DMA1 - I/O register address pointer high byte | IOAH1                        |                               | R/W    |
| 00010E <sub>H</sub>                          | DMA1 - Data counter low byte                  | DCTL1                        | DCT1                          | R/W    |
| 00010F <sub>H</sub>                          | DMA1 - Data counter high byte                 | DCTH1                        |                               | R/W    |
| 000110 <sub>H</sub>                          | DMA2 - Buffer address pointer low byte        | BAPL2                        |                               | R/W    |
| 000111 <sub>H</sub>                          | DMA2 - Buffer address pointer middle byte     | BAPM2                        |                               | R/W    |
| 000112 <sub>H</sub>                          | DMA2 - Buffer address pointer high byte       | BAPH2                        |                               | R/W    |
| 000113 <sub>H</sub>                          | DMA2 - DMA control register                   | DMACS2                       |                               | R/W    |
| 000114 <sub>H</sub>                          | DMA2 - I/O register address pointer low byte  | IOAL2                        | IOA2                          | R/W    |
| 000115 <sub>H</sub>                          | DMA2 - I/O register address pointer high byte | IOAH2                        |                               | R/W    |
| 000116 <sub>H</sub>                          | DMA2 - Data counter low byte                  | DCTL2                        | DCT2                          | R/W    |
| 000117 <sub>H</sub>                          | DMA2 - Data counter high byte                 | DCTH2                        |                               | R/W    |
| 000118 <sub>H</sub>                          | DMA3 - Buffer address pointer low byte        | BAPL3                        |                               | R/W    |

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| Address             | Register                                      | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|---------------------|---|------------------------------|-------------------------------|--------|
| 000119 <sub>H</sub> | DMA3 - Buffer address pointer middle byte     | BAPM3                        |                               | R/W    |
| 00011A <sub>H</sub> | DMA3 - Buffer address pointer high byte       | BAPH3                        |                               | R/W    |
| 00011B <sub>H</sub> | DMA3 - DMA control register                   | DMACS3                       |                               | R/W    |
| 00011C <sub>H</sub> | DMA3 - I/O register address pointer low byte  | IOAL3                        | IOA3                          | R/W    |
| 00011D <sub>H</sub> | DMA3 - I/O register address pointer high byte | IOAH3                        |                               | R/W    |
| 00011E <sub>H</sub> | DMA3 - Data counter low byte                  | DCTL3                        | DCT3                          | R/W    |
| 00011F <sub>H</sub> | DMA3 - Data counter high byte                 | DCTH3                        |                               | R/W    |
| 000120 <sub>H</sub> | DMA4 - Buffer address pointer low byte        | BAPL4                        |                               | R/W    |
| 000121 <sub>H</sub> | DMA4 - Buffer address pointer middle byte     | BAPM4                        |                               | R/W    |
| 000122 <sub>H</sub> | DMA4 - Buffer address pointer high byte       | BAPH4                        |                               | R/W    |
| 000123 <sub>H</sub> | DMA4 - DMA control register                   | DMACS4                       |                               | R/W    |
| 000124 <sub>H</sub> | DMA4 - I/O register address pointer low byte  | IOAL4                        | IOA4                          | R/W    |
| 000125 <sub>H</sub> | DMA4 - I/O register address pointer high byte | IOAH4                        |                               | R/W    |
| 000126 <sub>H</sub> | DMA4 - Data counter low byte                  | DCTL4                        | DCT4                          | R/W    |
| 000127 <sub>H</sub> | DMA4 - Data counter high byte                 | DCTH4                        |                               | R/W    |
| 000128 <sub>H</sub> | DMA5 - Buffer address pointer low byte        | BAPL5                        |                               | R/W    |
| 000129 <sub>H</sub> | DMA5 - Buffer address pointer middle byte     | BAPM5                        |                               | R/W    |
| 00012A <sub>H</sub> | DMA5 - Buffer address pointer high byte       | BAPH5                        |                               | R/W    |
| 00012B <sub>H</sub> | DMA5 - DMA control register                   | DMACS5                       |                               | R/W    |
| 00012C <sub>H</sub> | DMA5 - I/O register address pointer low byte  | IOAL5                        | IOA5                          | R/W    |
| 00012D <sub>H</sub> | DMA5 - I/O register address pointer high byte | IOAH5                        |                               | R/W    |
| 00012E <sub>H</sub> | DMA5 - Data counter low byte                  | DCTL5                        | DCT5                          | R/W    |
| 00012F <sub>H</sub> | DMA5 - Data counter high byte                 | DCTH5                        |                               | R/W    |
| 000130 <sub>H</sub> | DMA6 - Buffer address pointer low byte        | BAPL6                        |                               | R/W    |
| 000131 <sub>H</sub> | DMA6 - Buffer address pointer middle byte     | BAPM6                        |                               | R/W    |
| 000132 <sub>H</sub> | DMA6 - Buffer address pointer high byte       | BAPH6                        |                               | R/W    |
| 000133 <sub>H</sub> | DMA6 - DMA control register                   | DMACS6                       |                               | R/W    |
| 000134 <sub>H</sub> | DMA6 - I/O register address pointer low byte  | IOAL6                        | IOA6                          | R/W    |
| 000135 <sub>H</sub> | DMA6 - I/O register address pointer high byte | IOAH6                        |                               | R/W    |
| 000136 <sub>H</sub> | DMA6 - Data counter low byte                  | DCTL6                        | DCT6                          | R/W    |

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| Address                                      | Register                                      | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|---|------------------------------|-------------------------------|--------|
| 000137 <sub>H</sub>                          | DMA6 - Data counter high byte                 | DCTH6                        |                               | R/W    |
| 000138 <sub>H</sub>                          | DMA7 - Buffer address pointer low byte        | BAPL7                        |                               | R/W    |
| 000139 <sub>H</sub>                          | DMA7 - Buffer address pointer middle byte     | BAPM7                        |                               | R/W    |
| 00013A <sub>H</sub>                          | DMA7 - Buffer address pointer high byte       | BAPH7                        |                               | R/W    |
| 00013B <sub>H</sub>                          | DMA7 - DMA control register                   | DMACS7                       |                               | R/W    |
| 00013C <sub>H</sub>                          | DMA7 - I/O register address pointer low byte  | IOAL7                        | IOA7                          | R/W    |
| 00013D <sub>H</sub>                          | DMA7 - I/O register address pointer high byte | IOAH7                        |                               | R/W    |
| 00013E <sub>H</sub>                          | DMA7 - Data counter low byte                  | DCTL7                        | DCT7                          | R/W    |
| 00013F <sub>H</sub>                          | DMA7 - Data counter high byte                 | DCTH7                        |                               | R/W    |
| 000140 <sub>H</sub>                          | DMA8 - Buffer address pointer low byte        | BAPL8                        |                               | R/W    |
| 000141 <sub>H</sub>                          | DMA8 - Buffer address pointer middle byte     | BAPM8                        |                               | R/W    |
| 000142 <sub>H</sub>                          | DMA8 - Buffer address pointer high byte       | BAPH8                        |                               | R/W    |
| 000143 <sub>H</sub>                          | DMA8 - DMA control register                   | DMACS8                       |                               | R/W    |
| 000144 <sub>H</sub>                          | DMA8 - I/O register address pointer low byte  | IOAL8                        | IOA8                          | R/W    |
| 000145 <sub>H</sub>                          | DMA8 - I/O register address pointer high byte | IOAH8                        |                               | R/W    |
| 000146 <sub>H</sub>                          | DMA8 - Data counter low byte                  | DCTL8                        | DCT8                          | R/W    |
| 000147 <sub>H</sub>                          | DMA8 - Data counter high byte                 | DCTH8                        |                               | R/W    |
| 000148 <sub>H</sub>                          | DMA9 - Buffer address pointer low byte        | BAPL9                        |                               | R/W    |
| 000149 <sub>H</sub>                          | DMA9 - Buffer address pointer middle byte     | BAPM9                        |                               | R/W    |
| 00014A <sub>H</sub>                          | DMA9 - Buffer address pointer high byte       | BAPH9                        |                               | R/W    |
| 00014B <sub>H</sub>                          | DMA9 - DMA control register                   | DMACS9                       |                               | R/W    |
| 00014C <sub>H</sub>                          | DMA9 - I/O register address pointer low byte  | IOAL9                        | IOA9                          | R/W    |
| 00014D <sub>H</sub>                          | DMA9 - I/O register address pointer high byte | IOAH9                        |                               | R/W    |
| 00014E <sub>H</sub>                          | DMA9 - Data counter low byte                  | DCTL9                        | DCT9                          | R/W    |
| 00014F <sub>H</sub>                          | DMA9 - Data counter high byte                 | DCTH9                        |                               | R/W    |
| 000150 <sub>H</sub> -<br>00017F <sub>H</sub> | Reserved                                      |                              |                               | -      |
| 000180 <sub>H</sub> -<br>00037F <sub>H</sub> | CPU - General Purpose registers (RAM access)  | GPR_RAM                      |                               | R/W    |
| 000380 <sub>H</sub>                          | DMA0 - Interrupt select                       | DISEL0                       |                               | R/W    |
| 000381 <sub>H</sub>                          | DMA1 - Interrupt select                       | DISEL1                       |                               | R/W    |

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| Address                                      | Register                                    | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|---|---------------------------|----------------------------|--------|
| 000382 <sub>H</sub>                          | DMA2 - Interrupt select                     | DISEL2                    |                            | R/W    |
| 000383 <sub>H</sub>                          | DMA3 - Interrupt select                     | DISEL3                    |                            | R/W    |
| 000384 <sub>H</sub>                          | DMA4 - Interrupt select                     | DISEL4                    |                            | R/W    |
| 000385 <sub>H</sub>                          | DMA5 - Interrupt select                     | DISEL5                    |                            | R/W    |
| 000386 <sub>H</sub>                          | DMA6 - Interrupt select                     | DISEL6                    |                            | R/W    |
| 000387 <sub>H</sub>                          | DMA7 - Interrupt select                     | DISEL7                    |                            | R/W    |
| 000388 <sub>H</sub>                          | DMA8 - Interrupt select                     | DISEL8                    |                            | R/W    |
| 000389 <sub>H</sub>                          | DMA9 - Interrupt select                     | DISEL9                    |                            | R/W    |
| 00038A <sub>H</sub> -<br>00038F <sub>H</sub> | Reserved                                    |                           |                            | -      |
| 000390 <sub>H</sub>                          | DMA - Status register low byte              | DSRL                      | DSR                        | R/W    |
| 000391 <sub>H</sub>                          | DMA - Status register high byte             | DSRH                      |                            | R/W    |
| 000392 <sub>H</sub>                          | DMA - Stop status register low byte         | DSSRL                     | DSSR                       | R/W    |
| 000393 <sub>H</sub>                          | DMA - Stop status register high byte        | DSSRH                     |                            | R/W    |
| 000394 <sub>H</sub>                          | DMA - Enable register low byte              | DERL                      | DER                        | R/W    |
| 000395 <sub>H</sub>                          | DMA - Enable register high byte             | DERH                      |                            | R/W    |
| 000396 <sub>H</sub> -<br>00039F <sub>H</sub> | Reserved                                    |                           |                            | -      |
| 0003A0 <sub>H</sub>                          | Interrupt level register                    | ILR                       | ICR                        | R/W    |
| 0003A1 <sub>H</sub>                          | Interrupt index register                    | IDX                       |                            | R/W    |
| 0003A2 <sub>H</sub>                          | Interrupt vector table base register Low    | TBRL                      | TBR                        | R/W    |
| 0003A3 <sub>H</sub>                          | Interrupt vector table base register High   | TBRH                      |                            | R/W    |
| 0003A4 <sub>H</sub>                          | Delayed Interrupt register                  | DIRR                      |                            | R/W    |
| 0003A5 <sub>H</sub>                          | Non Maskable Interrupt register             | NMI                       |                            | R/W    |
| 0003A6 <sub>H</sub> -<br>0003AB <sub>H</sub> | Reserved                                    |                           |                            | -      |
| 0003AC <sub>H</sub>                          | EDSU communication interrupt selection Low  | EDSU2L                    | EDSU2                      | R/W    |
| 0003AD <sub>H</sub>                          | EDSU communication interrupt selection High | EDSU2H                    |                            | R/W    |
| 0003AE <sub>H</sub>                          | ROM mirror control register                 | ROMM                      |                            | R/W    |
| 0003AF <sub>H</sub>                          | EDSU configuration register                 | EDSU                      |                            | R/W    |
| 0003B0 <sub>H</sub>                          | Memory patch control/status register ch 0/1 |                           | PFCS0                      | R/W    |
| 0003B1 <sub>H</sub>                          | Memory patch control/status register ch 0/1 |                           |                            | R/W    |

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| Address             | Register                                       | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|---------------------|--|------------------------------|-------------------------------|--------|
| 0003B2 <sub>H</sub> | Memory patch control/status register ch 2/3    |                              | PFCS1                         | R/W    |
| 0003B3 <sub>H</sub> | Memory patch control/status register ch 2/3    |                              |                               | R/W    |
| 0003B4 <sub>H</sub> | Memory patch control/status register ch 4/5    |                              | PFCS2                         | R/W    |
| 0003B5 <sub>H</sub> | Memory patch control/status register ch 4/5    |                              |                               | R/W    |
| 0003B6 <sub>H</sub> | Memory patch control/status register ch 6/7    |                              | PFCS3                         | R/W    |
| 0003B7 <sub>H</sub> | Memory patch control/status register ch 6/7    |                              |                               | R/W    |
| 0003B8 <sub>H</sub> | Memory Patch function - Patch address 0 low    | PFAL0                        |                               | R/W    |
| 0003B9 <sub>H</sub> | Memory Patch function - Patch address 0 middle | PFAM0                        |                               | R/W    |
| 0003BA <sub>H</sub> | Memory Patch function - Patch address 0 high   | PFAH0                        |                               | R/W    |
| 0003BB <sub>H</sub> | Memory Patch function - Patch address 1 low    | PFAL1                        |                               | R/W    |
| 0003BC <sub>H</sub> | Memory Patch function - Patch address 1 middle | PFAM1                        |                               | R/W    |
| 0003BD <sub>H</sub> | Memory Patch function - Patch address 1 high   | PFAH1                        |                               | R/W    |
| 0003BE <sub>H</sub> | Memory Patch function - Patch address 2 low    | PFAL2                        |                               | R/W    |
| 0003BF <sub>H</sub> | Memory Patch function - Patch address 2 middle | PFAM2                        |                               | R/W    |
| 0003C0 <sub>H</sub> | Memory Patch function - Patch address 2 high   | PFAH2                        |                               | R/W    |
| 0003C1 <sub>H</sub> | Memory Patch function - Patch address 3 low    | PFAL3                        |                               | R/W    |
| 0003C2 <sub>H</sub> | Memory Patch function - Patch address 3 middle | PFAM3                        |                               | R/W    |
| 0003C3 <sub>H</sub> | Memory Patch function - Patch address 3 high   | PFAH3                        |                               | R/W    |
| 0003C4 <sub>H</sub> | Memory Patch function - Patch address 4 low    | PFAL4                        |                               | R/W    |
| 0003C5 <sub>H</sub> | Memory Patch function - Patch address 4 middle | PFAM4                        |                               | R/W    |
| 0003C6 <sub>H</sub> | Memory Patch function - Patch address 4 high   | PFAH4                        |                               | R/W    |
| 0003C7 <sub>H</sub> | Memory Patch function - Patch address 5 low    | PFAL5                        |                               | R/W    |
| 0003C8 <sub>H</sub> | Memory Patch function - Patch address 5 middle | PFAM5                        |                               | R/W    |
| 0003C9 <sub>H</sub> | Memory Patch function - Patch address 5 high   | PFAH5                        |                               | R/W    |
| 0003CA <sub>H</sub> | Memory Patch function - Patch address 6 low    | PFAL6                        |                               | R/W    |
| 0003CB <sub>H</sub> | Memory Patch function - Patch address 6 middle | PFAM6                        |                               | R/W    |
| 0003CC <sub>H</sub> | Memory Patch function - Patch address 6 high   | PFAH6                        |                               | R/W    |
| 0003CD <sub>H</sub> | Memory Patch function - Patch address 7 low    | PFAL7                        |                               | R/W    |
| 0003CE <sub>H</sub> | Memory Patch function - Patch address 7 middle | PFAM7                        |                               | R/W    |
| 0003CF <sub>H</sub> | Memory Patch function - Patch address 7 high   | PFAH7                        |                               | R/W    |



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| Address                                      | Register                                    | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|---|------------------------------|-------------------------------|--------|
| 0003D0 <sub>H</sub>                          | Memory Patch function - Patch data 0 Low    | PFDL0                        | PFD0                          | R/W    |
| 0003D1 <sub>H</sub>                          | Memory Patch function - Patch data 0 High   | PFDH0                        |                               | R/W    |
| 0003D2 <sub>H</sub>                          | Memory Patch function - Patch data 1 Low    | PFDL1                        | PFD1                          | R/W    |
| 0003D3 <sub>H</sub>                          | Memory Patch function - Patch data 1 High   | PFDH1                        |                               | R/W    |
| 0003D4 <sub>H</sub>                          | Memory Patch function - Patch data 2 Low    | PFDL2                        | PFD2                          | R/W    |
| 0003D5 <sub>H</sub>                          | Memory Patch function - Patch data 2 High   | PFDH2                        |                               | R/W    |
| 0003D6 <sub>H</sub>                          | Memory Patch function - Patch data 3 Low    | PFDL3                        | PFD3                          | R/W    |
| 0003D7 <sub>H</sub>                          | Memory Patch function - Patch data 3 High   | PFDH3                        |                               | R/W    |
| 0003D8 <sub>H</sub>                          | Memory Patch function - Patch data 4 Low    | PFDL4                        | PFD4                          | R/W    |
| 0003D9 <sub>H</sub>                          | Memory Patch function - Patch data 4 High   | PFDH4                        |                               | R/W    |
| 0003DA <sub>H</sub>                          | Memory Patch function - Patch data 5 Low    | PFDL5                        | PFD5                          | R/W    |
| 0003DB <sub>H</sub>                          | Memory Patch function - Patch data 5 High   | PFDH5                        |                               | R/W    |
| 0003DC <sub>H</sub>                          | Memory Patch function - Patch data 6 Low    | PFDL6                        | PFD6                          | R/W    |
| 0003DD <sub>H</sub>                          | Memory Patch function - Patch data 6 High   | PFDH6                        |                               | R/W    |
| 0003DE <sub>H</sub>                          | Memory Patch function - Patch data 7 Low    | PFDL7                        | PFD7                          | R/W    |
| 0003DF <sub>H</sub>                          | Memory Patch function - Patch data 7 High   | PFDH7                        |                               | R/W    |
| 0003E0 <sub>H</sub> -<br>0003F0 <sub>H</sub> | Reserved                                    |                              |                               | -      |
| 0003F1 <sub>H</sub>                          | Memory Control Status Register A            | MCSRA                        |                               | R/W    |
| 0003F2 <sub>H</sub>                          | Memory Timing Configuration Register A Low  | MTCRAL                       | MTCRA                         | R/W    |
| 0003F3 <sub>H</sub>                          | Memory Timing Configuration Register A High | MTCRAH                       |                               | R/W    |
| 0003F4 <sub>H</sub> -<br>0003F8 <sub>H</sub> | Reserved                                    |                              |                               | -      |
| 0003F9 <sub>H</sub>                          | Flash Memory Write Control register 1       | FMWC1                        |                               | R/W    |
| 0003FA <sub>H</sub>                          | Flash Memory Write Control register 2       | FMWC2                        |                               | R/W    |
| 0003FB <sub>H</sub>                          | Flash Memory Write Control register 3       | FMWC3                        |                               | R/W    |
| 0003FC <sub>H</sub>                          | Flash Memory Write Control register 4       | FMWC4                        |                               | R/W    |
| 0003FD <sub>H</sub>                          | Flash Memory Write Control register 5       | FMWC5                        |                               | R/W    |
| 0003FE <sub>H</sub> -<br>0003FF <sub>H</sub> | Reserved                                    |                              |                               | -      |
| 000400 <sub>H</sub>                          | Standby Mode control register               | SMCR                         |                               | R/W    |
| 000401 <sub>H</sub>                          | Clock select register                       | CKSR                         |                               | R/W    |

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| Address                                      | Register  | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|---|------------------------------|-------------------------------|--------|
| 000402 <sub>H</sub>                          | Clock Stabilization select register                       | CKSSR                        |                               | R/W    |
| 000403 <sub>H</sub>                          | Clock monitor register                                    | CKMR                         |                               | R      |
| 000404 <sub>H</sub>                          | Clock Frequency control register Low                      | CKFCRL                       | CKFCR                         | R/W    |
| 000405 <sub>H</sub>                          | Clock Frequency control register High                     | CKFCRH                       |                               | R/W    |
| 000406 <sub>H</sub>                          | PLL Control register Low                                  | PLLCRL                       | PLLCR                         | R/W    |
| 000407 <sub>H</sub>                          | PLL Control register High                                 | PLLCRH                       |                               | R/W    |
| 000408 <sub>H</sub>                          | RC clock timer control register                           | RCTCR                        |                               | R/W    |
| 000409 <sub>H</sub>                          | Main clock timer control register                         | MCTCR                        |                               | R/W    |
| 00040A <sub>H</sub>                          | Sub clock timer control register                          | SCTCR                        |                               | R/W    |
| 00040B <sub>H</sub>                          | Reset cause and clock status register with clear function | RCCSRC                       |                               | R      |
| 00040C <sub>H</sub>                          | Reset configuration register                              | RCR                          |                               | R/W    |
| 00040D <sub>H</sub>                          | Reset cause and clock status register                     | RCCSR                        |                               | R      |
| 00040E <sub>H</sub>                          | Watch dog timer configuration register                    | WDTC                         |                               | R/W    |
| 00040F <sub>H</sub>                          | Watch dog timer clear pattern register                    | WDTCP                        |                               | W      |
| 000410 <sub>H</sub> -<br>000414 <sub>H</sub> | Reserved  |                              |                               | -      |
| 000415 <sub>H</sub>                          | Clock output activation register                          | COAR                         |                               | R/W    |
| 000416 <sub>H</sub>                          | Clock output configuration register 0                     | COCR0                        |                               | R/W    |
| 000417 <sub>H</sub>                          | Clock output configuration register 1                     | COCR1                        |                               | R/W    |
| 000418 <sub>H</sub>                          | Clock Modulator control register                          | CMCR                         |                               | R/W    |
| 000419 <sub>H</sub>                          | Reserved  |                              |                               | -      |
| 00041A <sub>H</sub>                          | Clock Modulator Parameter register Low                    | CMPRL                        | CMPR                          | R/W    |
| 00041B <sub>H</sub>                          | Clock Modulator Parameter register High                   | CMPRH                        |                               | R/W    |
| 00041C <sub>H</sub> -<br>00042B <sub>H</sub> | Reserved  |                              |                               | -      |
| 00042C <sub>H</sub>                          | Voltage Regulator Control register                        | VRCR                         |                               | R/W    |
| 00042D <sub>H</sub>                          | Clock Input and LVD Control Register                      | CILCR                        |                               | R/W    |
| 00042E <sub>H</sub> -<br>00042F <sub>H</sub> | Reserved  |                              |                               | -      |
| 000430 <sub>H</sub>                          | I/O Port P00 - Data Direction Register                    | DDR00                        |                               | R/W    |
| 000431 <sub>H</sub>                          | I/O Port P01 - Data Direction Register                    | DDR01                        |                               | R/W    |
| 000432 <sub>H</sub>                          | I/O Port P02 - Data Direction Register                    | DDR02                        |                               | R/W    |

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| Address                                      | Register                                  | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|---|------------------------------|-------------------------------|--------|
| 000433 <sub>H</sub>                          | I/O Port P03 - Data Direction Register    | DDR03                        |                               | R/W    |
| 000434 <sub>H</sub>                          | I/O Port P04 - Data Direction Register    | DDR04                        |                               | R/W    |
| 000435 <sub>H</sub>                          | I/O Port P05 - Data Direction Register    | DDR05                        |                               | R/W    |
| 000436 <sub>H</sub>                          | I/O Port P06 - Data Direction Register    | DDR06                        |                               | R/W    |
| 000437 <sub>H</sub>                          | I/O Port P07 - Data Direction Register    | DDR07                        |                               | R/W    |
| 000438 <sub>H</sub>                          | I/O Port P08 - Data Direction Register    | DDR08                        |                               | R/W    |
| 000439 <sub>H</sub>                          | I/O Port P09 - Data Direction Register    | DDR09                        |                               | R/W    |
| 00043A <sub>H</sub>                          | I/O Port P10 - Data Direction Register    | DDR10                        |                               | R/W    |
| 00043B <sub>H</sub>                          | I/O Port P11 - Data Direction Register    | DDR11                        |                               | R/W    |
| 00043C <sub>H</sub>                          | I/O Port P12 - Data Direction Register    | DDR12                        |                               | R/W    |
| 00043D <sub>H</sub>                          | I/O Port P13 - Data Direction Register    | DDR13                        |                               | R/W    |
| 00043E <sub>H</sub>                          | I/O Port P14 - Data Direction Register    | DDR14                        |                               | R/W    |
| 00043F <sub>H</sub>                          | I/O Port P15 - Data Direction Register    | DDR15                        |                               | R/W    |
| 000440 <sub>H</sub>                          | Reserved                                  |                              |                               | -      |
| 000441 <sub>H</sub>                          | I/O Port P17 - Data Direction Register    | DDR17                        |                               | R/W    |
| 000442 <sub>H</sub> -<br>000443 <sub>H</sub> | Reserved                                  |                              |                               | -      |
| 000444 <sub>H</sub>                          | I/O Port P00 - Port Input Enable Register | PIER00                       |                               | R/W    |
| 000445 <sub>H</sub>                          | I/O Port P01 - Port Input Enable Register | PIER01                       |                               | R/W    |
| 000446 <sub>H</sub>                          | I/O Port P02 - Port Input Enable Register | PIER02                       |                               | R/W    |
| 000447 <sub>H</sub>                          | I/O Port P03 - Port Input Enable Register | PIER03                       |                               | R/W    |
| 000448 <sub>H</sub>                          | I/O Port P04 - Port Input Enable Register | PIER04                       |                               | R/W    |
| 000449 <sub>H</sub>                          | I/O Port P05 - Port Input Enable Register | PIER05                       |                               | R/W    |
| 00044A <sub>H</sub>                          | I/O Port P06 - Port Input Enable Register | PIER06                       |                               | R/W    |
| 00044B <sub>H</sub>                          | I/O Port P07 - Port Input Enable Register | PIER07                       |                               | R/W    |
| 00044C <sub>H</sub>                          | I/O Port P08 - Port Input Enable Register | PIER08                       |                               | R/W    |
| 00044D <sub>H</sub>                          | I/O Port P09 - Port Input Enable Register | PIER09                       |                               | R/W    |
| 00044E <sub>H</sub>                          | I/O Port P10 - Port Input Enable Register | PIER10                       |                               | R/W    |
| 00044F <sub>H</sub>                          | I/O Port P11 - Port Input Enable Register | PIER11                       |                               | R/W    |
| 000450 <sub>H</sub>                          | I/O Port P12 - Port Input Enable Register | PIER12                       |                               | R/W    |
| 000451 <sub>H</sub>                          | I/O Port P13 - Port Input Enable Register | PIER13                       |                               | R/W    |

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| Address                                      | Register  | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|---|------------------------------|-------------------------------|--------|
| 000452 <sub>H</sub>                          | I/O Port P14 - Port Input Enable Register         | PIER14                       |                               | R/W    |
| 000453 <sub>H</sub>                          | I/O Port P15 - Port Input Enable Register         | PIER15                       |                               | R/W    |
| 000454 <sub>H</sub>                          | Reserved  |                              |                               | -      |
| 000455 <sub>H</sub>                          | I/O Port P17 - Port Input Enable Register         | PIER17                       |                               | R/W    |
| 000456 <sub>H</sub> -<br>000457 <sub>H</sub> | Reserved  |                              |                               | -      |
| 000458 <sub>H</sub>                          | I/O Port P00 - Port Input Level Register          | PILR00                       |                               | R/W    |
| 000459 <sub>H</sub>                          | I/O Port P01 - Port Input Level Register          | PILR01                       |                               | R/W    |
| 00045A <sub>H</sub>                          | I/O Port P02 - Port Input Level Register          | PILR02                       |                               | R/W    |
| 00045B <sub>H</sub>                          | I/O Port P03 - Port Input Level Register          | PILR03                       |                               | R/W    |
| 00045C <sub>H</sub>                          | I/O Port P04 - Port Input Level Register          | PILR04                       |                               | R/W    |
| 00045D <sub>H</sub>                          | I/O Port P05 - Port Input Level Register          | PILR05                       |                               | R/W    |
| 00045E <sub>H</sub>                          | I/O Port P06 - Port Input Level Register          | PILR06                       |                               | R/W    |
| 00045F <sub>H</sub>                          | I/O Port P07 - Port Input Level Register          | PILR07                       |                               | R/W    |
| 000460 <sub>H</sub>                          | I/O Port P08 - Port Input Level Register          | PILR08                       |                               | R/W    |
| 000461 <sub>H</sub>                          | I/O Port P09 - Port Input Level Register          | PILR09                       |                               | R/W    |
| 000462 <sub>H</sub>                          | I/O Port P10 - Port Input Level Register          | PILR10                       |                               | R/W    |
| 000463 <sub>H</sub>                          | I/O Port P11 - Port Input Level Register          | PILR11                       |                               | R/W    |
| 000464 <sub>H</sub>                          | I/O Port P12 - Port Input Level Register          | PILR12                       |                               | R/W    |
| 000465 <sub>H</sub>                          | I/O Port P13 - Port Input Level Register          | PILR13                       |                               | R/W    |
| 000466 <sub>H</sub>                          | I/O Port P14 - Port Input Level Register          | PILR14                       |                               | R/W    |
| 000467 <sub>H</sub>                          | I/O Port P15 - Port Input Level Register          | PILR15                       |                               | R/W    |
| 000468 <sub>H</sub>                          | Reserved  |                              |                               | -      |
| 000469 <sub>H</sub>                          | I/O Port P17 - Port Input Level Register          | PILR17                       |                               | R/W    |
| 00046A <sub>H</sub> -<br>00046B <sub>H</sub> | Reserved  |                              |                               | -      |
| 00046C <sub>H</sub>                          | I/O Port P00 - Extended Port Input Level Register | EPILR00                      |                               | R/W    |
| 00046D <sub>H</sub>                          | I/O Port P01 - Extended Port Input Level Register | EPILR01                      |                               | R/W    |
| 00046E <sub>H</sub>                          | I/O Port P02 - Extended Port Input Level Register | EPILR02                      |                               | R/W    |
| 00046F <sub>H</sub>                          | I/O Port P03 - Extended Port Input Level Register | EPILR03                      |                               | R/W    |
| 000470 <sub>H</sub>                          | I/O Port P04 - Extended Port Input Level Register | EPILR04                      |                               | R/W    |

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| Address                                      | Register  | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|---|------------------------------|-------------------------------|--------|
| 000471 <sub>H</sub>                          | I/O Port P05 - Extended Port Input Level Register | EPILR05                      |                               | R/W    |
| 000472 <sub>H</sub>                          | I/O Port P06 - Extended Port Input Level Register | EPILR06                      |                               | R/W    |
| 000473 <sub>H</sub>                          | I/O Port P07 - Extended Port Input Level Register | EPILR07                      |                               | R/W    |
| 000474 <sub>H</sub>                          | I/O Port P08 - Extended Port Input Level Register | EPILR08                      |                               | R/W    |
| 000475 <sub>H</sub>                          | I/O Port P09 - Extended Port Input Level Register | EPILR09                      |                               | R/W    |
| 000476 <sub>H</sub>                          | I/O Port P10 - Extended Port Input Level Register | EPILR10                      |                               | R/W    |
| 000477 <sub>H</sub>                          | I/O Port P11 - Extended Port Input Level Register | EPILR11                      |                               | R/W    |
| 000478 <sub>H</sub>                          | I/O Port P12 - Extended Port Input Level Register | EPILR12                      |                               | R/W    |
| 000479 <sub>H</sub>                          | I/O Port P13 - Extended Port Input Level Register | EPILR13                      |                               | R/W    |
| 00047A <sub>H</sub>                          | I/O Port P14 - Extended Port Input Level Register | EPILR14                      |                               | R/W    |
| 00047B <sub>H</sub>                          | I/O Port P15 - Extended Port Input Level Register | EPILR15                      |                               | R/W    |
| 00047C <sub>H</sub>                          | Reserved  |                              |                               | -      |
| 00047D <sub>H</sub>                          | I/O Port P17 - Extended Port Input Level Register | EPILR17                      |                               | R/W    |
| 00047E <sub>H</sub> -<br>00047F <sub>H</sub> | Reserved  |                              |                               | -      |
| 000480 <sub>H</sub>                          | I/O Port P00 - Port Output Drive Register         | PODR00                       |                               | R/W    |
| 000481 <sub>H</sub>                          | I/O Port P01 - Port Output Drive Register         | PODR01                       |                               | R/W    |
| 000482 <sub>H</sub>                          | I/O Port P02 - Port Output Drive Register         | PODR02                       |                               | R/W    |
| 000483 <sub>H</sub>                          | I/O Port P03 - Port Output Drive Register         | PODR03                       |                               | R/W    |
| 000484 <sub>H</sub>                          | I/O Port P04 - Port Output Drive Register         | PODR04                       |                               | R/W    |
| 000485 <sub>H</sub>                          | I/O Port P05 - Port Output Drive Register         | PODR05                       |                               | R/W    |
| 000486 <sub>H</sub>                          | I/O Port P06 - Port Output Drive Register         | PODR06                       |                               | R/W    |
| 000487 <sub>H</sub>                          | I/O Port P07 - Port Output Drive Register         | PODR07                       |                               | R/W    |
| 000488 <sub>H</sub>                          | I/O Port P08 - Port Output Drive Register         | PODR08                       |                               | R/W    |
| 000489 <sub>H</sub>                          | I/O Port P09 - Port Output Drive Register         | PODR09                       |                               | R/W    |
| 00048A <sub>H</sub>                          | I/O Port P10 - Port Output Drive Register         | PODR10                       |                               | R/W    |
| 00048B <sub>H</sub>                          | I/O Port P11 - Port Output Drive Register         | PODR11                       |                               | R/W    |
| 00048C <sub>H</sub>                          | I/O Port P12 - Port Output Drive Register         | PODR12                       |                               | R/W    |
| 00048D <sub>H</sub>                          | I/O Port P13 - Port Output Drive Register         | PODR13                       |                               | R/W    |
| 00048E <sub>H</sub>                          | I/O Port P14 - Port Output Drive Register         | PODR14                       |                               | R/W    |
| 00048F <sub>H</sub>                          | I/O Port P15 - Port Output Drive Register         | PODR15                       |                               | R/W    |

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| Address                                      | Register   | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|--|------------------------------|-------------------------------|--------|
| 000490 <sub>H</sub>                          | Reserved   |                              |                               | -      |
| 000491 <sub>H</sub>                          | I/O Port P17 - Port Output Drive Register        | PODR17                       |                               | R/W    |
| 000492 <sub>H</sub> -<br>00049B <sub>H</sub> | Reserved   |                              |                               | -      |
| 00049C <sub>H</sub>                          | I/O Port P08 - Port High Drive Register          | PHDR08                       |                               | R/W    |
| 00049D <sub>H</sub>                          | I/O Port P09 - Port High Drive Register          | PHDR09                       |                               | R/W    |
| 00049E <sub>H</sub>                          | I/O Port P10 - Port High Drive Register          | PHDR10                       |                               | R/W    |
| 00049F <sub>H</sub> -<br>0004A7 <sub>H</sub> | Reserved   |                              |                               | -      |
| 0004A8 <sub>H</sub>                          | I/O Port P00 - Pull-Up resistor Control Register | PUCR00                       |                               | R/W    |
| 0004A9 <sub>H</sub>                          | I/O Port P01 - Pull-Up resistor Control Register | PUCR01                       |                               | R/W    |
| 0004AA <sub>H</sub>                          | I/O Port P02 - Pull-Up resistor Control Register | PUCR02                       |                               | R/W    |
| 0004AB <sub>H</sub>                          | I/O Port P03 - Pull-Up resistor Control Register | PUCR03                       |                               | R/W    |
| 0004AC <sub>H</sub>                          | I/O Port P04 - Pull-Up resistor Control Register | PUCR04                       |                               | R/W    |
| 0004AD <sub>H</sub>                          | I/O Port P05 - Pull-Up resistor Control Register | PUCR05                       |                               | R/W    |
| 0004AE <sub>H</sub>                          | I/O Port P06 - Pull-Up resistor Control Register | PUCR06                       |                               | R/W    |
| 0004AF <sub>H</sub>                          | I/O Port P07 - Pull-Up resistor Control Register | PUCR07                       |                               | R/W    |
| 0004B0 <sub>H</sub>                          | I/O Port P08 - Pull-Up resistor Control Register | PUCR08                       |                               | R/W    |
| 0004B1 <sub>H</sub>                          | I/O Port P09 - Pull-Up resistor Control Register | PUCR09                       |                               | R/W    |
| 0004B2 <sub>H</sub>                          | I/O Port P10 - Pull-Up resistor Control Register | PUCR10                       |                               | R/W    |
| 0004B3 <sub>H</sub>                          | I/O Port P11 - Pull-Up resistor Control Register | PUCR11                       |                               | R/W    |
| 0004B4 <sub>H</sub>                          | I/O Port P12 - Pull-Up resistor Control Register | PUCR12                       |                               | R/W    |
| 0004B5 <sub>H</sub>                          | I/O Port P13 - Pull-Up resistor Control Register | PUCR13                       |                               | R/W    |
| 0004B6 <sub>H</sub>                          | I/O Port P14 - Pull-Up resistor Control Register | PUCR14                       |                               | R/W    |
| 0004B7 <sub>H</sub>                          | I/O Port P15 - Pull-Up resistor Control Register | PUCR15                       |                               | R/W    |
| 0004B8 <sub>H</sub>                          | Reserved   |                              |                               | -      |
| 0004B9 <sub>H</sub>                          | I/O Port P17 - Pull-Up resistor Control Register | PUCR17                       |                               | R/W    |
| 0004BA <sub>H</sub> -<br>0004BB <sub>H</sub> | Reserved   |                              |                               | -      |
| 0004BC <sub>H</sub>                          | I/O Port P00 - External Pin State Register       | EPSR00                       |                               | R      |
| 0004BD <sub>H</sub>                          | I/O Port P01 - External Pin State Register       | EPSR01                       |                               | R      |
| 0004BE <sub>H</sub>                          | I/O Port P02 - External Pin State Register       | EPSR02                       |                               | R      |

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| Address                                      | Register                                   | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|--|---------------------------|----------------------------|--------|
| 0004BF <sub>H</sub>                          | I/O Port P03 - External Pin State Register | EPSR03                    |                            | R      |
| 0004C0 <sub>H</sub>                          | I/O Port P04 - External Pin State Register | EPSR04                    |                            | R      |
| 0004C1 <sub>H</sub>                          | I/O Port P05 - External Pin State Register | EPSR05                    |                            | R      |
| 0004C2 <sub>H</sub>                          | I/O Port P06 - External Pin State Register | EPSR06                    |                            | R      |
| 0004C3 <sub>H</sub>                          | I/O Port P07 - External Pin State Register | EPSR07                    |                            | R      |
| 0004C4 <sub>H</sub>                          | I/O Port P08 - External Pin State Register | EPSR08                    |                            | R      |
| 0004C5 <sub>H</sub>                          | I/O Port P09 - External Pin State Register | EPSR09                    |                            | R      |
| 0004C6 <sub>H</sub>                          | I/O Port P10 - External Pin State Register | EPSR10                    |                            | R      |
| 0004C7 <sub>H</sub>                          | I/O Port P11 - External Pin State Register | EPSR11                    |                            | R      |
| 0004C8 <sub>H</sub>                          | I/O Port P12 - External Pin State Register | EPSR12                    |                            | R      |
| 0004C9 <sub>H</sub>                          | I/O Port P13 - External Pin State Register | EPSR13                    |                            | R      |
| 0004CA <sub>H</sub>                          | I/O Port P14 - External Pin State Register | EPSR14                    |                            | R      |
| 0004CB <sub>H</sub>                          | I/O Port P15 - External Pin State Register | EPSR15                    |                            | R      |
| 0004CC <sub>H</sub>                          | Reserved                                   |                           |                            | -      |
| 0004CD <sub>H</sub>                          | I/O Port P17 - External Pin State Register | EPSR17                    |                            | R      |
| 0004CE <sub>H</sub> -<br>0004CF <sub>H</sub> | Reserved                                   |                           |                            | -      |
| 0004D0 <sub>H</sub>                          | ADC analog input enable register 0         | ADER0                     |                            | R/W    |
| 0004D1 <sub>H</sub>                          | ADC analog input enable register 1         | ADER1                     |                            | R/W    |
| 0004D2 <sub>H</sub>                          | ADC analog input enable register 2         | ADER2                     |                            | R/W    |
| 0004D3 <sub>H</sub>                          | ADC analog input enable register 3         | ADER3                     |                            | R/W    |
| 0004D4 <sub>H</sub>                          | ADC analog input enable register 4         | ADER4                     |                            | R/W    |
| 0004D5 <sub>H</sub>                          | Reserved                                   |                           |                            | -      |
| 0004D6 <sub>H</sub>                          | Peripheral Resource Relocation Register 0  | PRRR0                     |                            | R/W    |
| 0004D7 <sub>H</sub>                          | Peripheral Resource Relocation Register 1  | PRRR1                     |                            | R/W    |
| 0004D8 <sub>H</sub>                          | Peripheral Resource Relocation Register 2  | PRRR2                     |                            | R/W    |
| 0004D9 <sub>H</sub>                          | Peripheral Resource Relocation Register 3  | PRRR3                     |                            | R/W    |
| 0004DA <sub>H</sub>                          | Peripheral Resource Relocation Register 4  | PRRR4                     |                            | R/W    |
| 0004DB <sub>H</sub>                          | Peripheral Resource Relocation Register 5  | PRRR5                     |                            | R/W    |
| 0004DC <sub>H</sub>                          | Peripheral Resource Relocation Register 6  | PRRR6                     |                            | R/W    |
| 0004DD <sub>H</sub>                          | Peripheral Resource Relocation Register 7  | PRRR7                     |                            | R/W    |

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| Address                                      | Register  | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|---|------------------------------|-------------------------------|--------|
| 0004DE <sub>H</sub>                          | Peripheral Resource Relocation Register 8                 | PRRR8                        |                               | R/W    |
| 0004DF <sub>H</sub>                          | Peripheral Resource Relocation Register 9                 | PRRR9                        |                               | R/W    |
| 0004E0 <sub>H</sub>                          | RTC - Sub Second Register L                               | WTBRL0                       | WTBR0                         | R/W    |
| 0004E1 <sub>H</sub>                          | RTC - Sub Second Register M                               | WTBRH0                       |                               | R/W    |
| 0004E2 <sub>H</sub>                          | RTC - Sub-Second Register H                               | WTBR1                        |                               | R/W    |
| 0004E3 <sub>H</sub>                          | RTC - Second Register                                     | WTSR                         |                               | R/W    |
| 0004E4 <sub>H</sub>                          | RTC - Minutes   | WTMR                         |                               | R/W    |
| 0004E5 <sub>H</sub>                          | RTC - Hour  | WTHR                         |                               | R/W    |
| 0004E6 <sub>H</sub>                          | RTC - Timer Control Extended Register                     | WTCER                        |                               | R/W    |
| 0004E7 <sub>H</sub>                          | RTC - Clock select register                               | WTCKSR                       |                               | R/W    |
| 0004E8 <sub>H</sub>                          | RTC - Timer Control Register Low                          | WTCRL                        | WTCR                          | R/W    |
| 0004E9 <sub>H</sub>                          | RTC - Timer Control Register High                         | WTCRH                        |                               | R/W    |
| 0004EA <sub>H</sub>                          | CAL - Calibration unit Control register                   | CUCR                         |                               | R/W    |
| 0004EB <sub>H</sub>                          | Reserved  |                              |                               | -      |
| 0004EC <sub>H</sub>                          | CAL - Duration Timer Data Register Low                    | CUTDL                        | CUTD                          | R/W    |
| 0004ED <sub>H</sub>                          | CAL - Duration Timer Data Register High                   | CUTDH                        |                               | R/W    |
| 0004EE <sub>H</sub>                          | CAL - Calibration Timer Register 2 Low                    | CUTR2L                       | CUTR2                         | R      |
| 0004EF <sub>H</sub>                          | CAL - Calibration Timer Register 2 High                   | CUTR2H                       |                               | R      |
| 0004F0 <sub>H</sub>                          | CAL - Calibration Timer Register 1 Low                    | CUTR1L                       | CUTR1                         | R      |
| 0004F1 <sub>H</sub>                          | CAL - Calibration Timer Register 1 High                   | CUTR1H                       |                               | R      |
| 0004F2 <sub>H</sub> -<br>0004F9 <sub>H</sub> | Reserved  |                              |                               | -      |
| 0004FA <sub>H</sub>                          | RLT - Timer input select (for Cascading)                  | TMISR                        |                               | R/W    |
| 0004FB <sub>H</sub> -<br>0004FF <sub>H</sub> | Reserved  |                              |                               | -      |
| 000500 <sub>H</sub>                          | FRT2 - Data register of free-running timer                |                              | TCDT2                         | R/W    |
| 000501 <sub>H</sub>                          | FRT2 - Data register of free-running timer                |                              |                               | R/W    |
| 000502 <sub>H</sub>                          | FRT2 - Control status register of free-running timer Low  | TCCSL2                       | TCCS2                         | R/W    |
| 000503 <sub>H</sub>                          | FRT2 - Control status register of free-running timer High | TCCSH2                       |                               | R/W    |
| 000504 <sub>H</sub>                          | FRT3 - Data register of free-running timer                |                              | TCDT3                         | R/W    |
| 000505 <sub>H</sub>                          | FRT3 - Data register of free-running timer                |                              |                               | R/W    |



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| Address                                      | Register  | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|---|---------------------------|----------------------------|--------|
| 000506 <sub>H</sub>                          | FRT3 - Control status register of free-running timer Low  | TCCSL3                    | TCCS3                      | R/W    |
| 000507 <sub>H</sub>                          | FRT3 - Control status register of free-running timer High | TCCSH3                    |                            | R/W    |
| 000508 <sub>H</sub>                          | OCU8 - Output Compare Control Status                      | OCS8                      |                            | R/W    |
| 000509 <sub>H</sub>                          | OCU9 - Output Compare Control Status                      | OCS9                      |                            | R/W    |
| 00050A <sub>H</sub>                          | OCU8 - Compare Register                                   |                           | OCCP8                      | R/W    |
| 00050B <sub>H</sub>                          | OCU8 - Compare Register                                   |                           |                            | R/W    |
| 00050C <sub>H</sub>                          | OCU9 - Compare Register                                   |                           | OCCP9                      | R/W    |
| 00050D <sub>H</sub>                          | OCU9 - Compare Register                                   |                           |                            | R/W    |
| 00050E <sub>H</sub>                          | OCU10 - Output Compare Control Status                     | OCS10                     |                            | R/W    |
| 00050F <sub>H</sub>                          | OCU11 - Output Compare Control Status                     | OCS11                     |                            | R/W    |
| 000510 <sub>H</sub>                          | OCU10 - Compare Register                                  |                           | OCCP10                     | R/W    |
| 000511 <sub>H</sub>                          | OCU10 - Compare Register                                  |                           |                            | R/W    |
| 000512 <sub>H</sub>                          | OCU11 - Compare Register                                  |                           | OCCP11                     | R/W    |
| 000513 <sub>H</sub>                          | OCU11 - Compare Register                                  |                           |                            | R/W    |
| 000514 <sub>H</sub>                          | ICU8/ICU9 - Control Status Register                       | ICS89                     |                            | R/W    |
| 000515 <sub>H</sub>                          | ICU8/ICU9 - Edge Register                                 | ICE89                     |                            | R/W    |
| 000516 <sub>H</sub>                          | ICU8 - Capture Register Low                               | IPCPL8                    | IPCP8                      | R      |
| 000517 <sub>H</sub>                          | ICU8 - Capture Register High                              | IPCPL8                    |                            | R      |
| 000518 <sub>H</sub>                          | ICU9 - Capture Register Low                               | IPCPL9                    | IPCP9                      | R      |
| 000519 <sub>H</sub>                          | ICU9 - Capture Register High                              | IPCPL9                    |                            | R      |
| 00051A <sub>H</sub> -<br>000529 <sub>H</sub> | Reserved  |                           |                            | -      |
| 00052A <sub>H</sub>                          | USART5 - Serial Mode Register                             | SMR5                      |                            | R/W    |
| 00052B <sub>H</sub>                          | USART5 - Serial Control Register                          | SCR5                      |                            | R/W    |
| 00052C <sub>H</sub>                          | USART5 - RX Register                                      | TDR5                      |                            | W      |
| 00052C <sub>H</sub>                          | USART5 - TX Register                                      | RDR5                      |                            | R      |
| 00052D <sub>H</sub>                          | USART5 - Serial Status                                    | SSR5                      |                            | R/W    |
| 00052E <sub>H</sub>                          | USART5 - Control/Com. Register                            | ECCR5                     |                            | R/W    |
| 00052F <sub>H</sub>                          | USART5 - Ext. Status Register                             | ESCR5                     |                            | R/W    |
| 000530 <sub>H</sub>                          | USART5 - Baud Rate Generator Register Low                 | BGRL5                     | BGR5                       | R/W    |
| 000531 <sub>H</sub>                          | USART5 - Baud Rate Generator Register High                | BGRH5                     |                            | R/W    |

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| Address                                      | Register                                    | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|---|------------------------------|-------------------------------|--------|
| 000532 <sub>H</sub>                          | USART5 - Extended Serial Interrupt Register | ESIR5                        |                               | R/W    |
| 000533 <sub>H</sub> -<br>00053D <sub>H</sub> | Reserved                                    |                              |                               | -      |
| 00053E <sub>H</sub>                          | USART7 - Serial Mode Register               | SMR7                         |                               | R/W    |
| 00053F <sub>H</sub>                          | USART7 - Serial Control Register            | SCR7                         |                               | R/W    |
| 000540 <sub>H</sub>                          | USART7 - Serial TX Register                 | TDR7                         |                               | W      |
| 000540 <sub>H</sub>                          | USART7 - Serial RX Register                 | RDR7                         |                               | R      |
| 000541 <sub>H</sub>                          | USART7 - Serial Status Register             | SSR7                         |                               | R/W    |
| 000542 <sub>H</sub>                          | USART7 - Ext. Control/Com. Register         | ECCR7                        |                               | R/W    |
| 000543 <sub>H</sub>                          | USART7 - Ext. Status Com. Register          | ESCR7                        |                               | R/W    |
| 000544 <sub>H</sub>                          | USART7 - Baud Rate Generator Register Low   | BGRL7                        | BGR7                          | R/W    |
| 000545 <sub>H</sub>                          | USART7 - Baud Rate Generator Register High  | BGRH7                        |                               | R/W    |
| 000546 <sub>H</sub>                          | USART7 - Extended Serial Interrupt Register | ESIR7                        |                               | R/W    |
| 000547 <sub>H</sub>                          | Reserved                                    |                              |                               | -      |
| 000548 <sub>H</sub>                          | USART8 - Serial Mode Register               | SMR8                         |                               | R/W    |
| 000549 <sub>H</sub>                          | USART8 - Serial Control Register            | SCR8                         |                               | R/W    |
| 00054A <sub>H</sub>                          | USART8 - Serial TX Register                 | TDR8                         |                               | W      |
| 00054A <sub>H</sub>                          | USART8 - Serial RX Register                 | RDR8                         |                               | R      |
| 00054B <sub>H</sub>                          | USART8 - Serial Status Register             | SSR8                         |                               | R/W    |
| 00054C <sub>H</sub>                          | USART8 - Ext. Control/Com. Register         | ECCR8                        |                               | R/W    |
| 00054D <sub>H</sub>                          | USART8 - Ext. Status Com. Register          | ESCR8                        |                               | R/W    |
| 00054E <sub>H</sub>                          | USART8 - Baud Rate Generator Register Low   | BGRL8                        | BGR8                          | R/W    |
| 00054F <sub>H</sub>                          | USART8 - Baud Rate Generator Register High  | BGRH8                        |                               | R/W    |
| 000550 <sub>H</sub>                          | USART8 - Extended Serial Interrupt Register | ESIR8                        |                               | R/W    |
| 000551 <sub>H</sub>                          | Reserved                                    |                              |                               | -      |
| 000552 <sub>H</sub>                          | USART9 - Serial Mode Register               | SMR9                         |                               | R/W    |
| 000553 <sub>H</sub>                          | USART9 - Serial Control Register            | SCR9                         |                               | R/W    |
| 000554 <sub>H</sub>                          | USART9 - Serial TX Register                 | TDR9                         |                               | W      |
| 000554 <sub>H</sub>                          | USART9 - Serial RX Register                 | RDR9                         |                               | R      |
| 000555 <sub>H</sub>                          | USART9 - Serial Status Register             | SSR9                         |                               | R/W    |
| 000556 <sub>H</sub>                          | USART9 - Ext. Control/Com. Register         | ECCR9                        |                               | R/W    |

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| Address                                      | Register                                     | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|--|------------------------------|-------------------------------|--------|
| 000557 <sub>H</sub>                          | USART9 - Ext. Status Com. Register           | ESCR9                        |                               | R/W    |
| 000558 <sub>H</sub>                          | USART9 - Baud Rate Generator Register Low    | BGRL9                        | BGR9                          | R/W    |
| 000559 <sub>H</sub>                          | USART9 - Baud Rate Generator Register High   | BGRH9                        |                               | R/W    |
| 00055A <sub>H</sub>                          | USART9 - Extended Serial Interrupt Register  | ESIR9                        |                               | R/W    |
| 00055B <sub>H</sub> -<br>00055F <sub>H</sub> | Reserved                                     |                              |                               | -      |
| 000560 <sub>H</sub>                          | ALARM0 - Control Status Register             | ACSR0                        |                               | R/W    |
| 000561 <sub>H</sub>                          | ALARM0 - Extended Control Status Register    | AECSR0                       |                               | R/W    |
| 000562 <sub>H</sub>                          | ALARM1 - Control Status Register             | ACSR1                        |                               | R/W    |
| 000563 <sub>H</sub>                          | ALARM1 - Extended Control Status Register    | AECSR1                       |                               | R/W    |
| 000564 <sub>H</sub>                          | PPG6 - Timer register                        |                              | PTMR6                         | R      |
| 000565 <sub>H</sub>                          | PPG6 - Timer register                        |                              |                               | R      |
| 000566 <sub>H</sub>                          | PPG6 - Period setting register               |                              | PCSR6                         | W      |
| 000567 <sub>H</sub>                          | PPG6 - Period setting register               |                              |                               | W      |
| 000568 <sub>H</sub>                          | PPG6 - Duty cycle register                   |                              | PDUT6                         | W      |
| 000569 <sub>H</sub>                          | PPG6 - Duty cycle register                   |                              |                               | W      |
| 00056A <sub>H</sub>                          | PPG6 - Control status register Low           | PCNL6                        | PCN6                          | R/W    |
| 00056B <sub>H</sub>                          | PPG6 - Control status register High          | PCNH6                        |                               | R/W    |
| 00056C <sub>H</sub>                          | PPG7 - Timer register                        |                              | PTMR7                         | R      |
| 00056D <sub>H</sub>                          | PPG7 - Timer register                        |                              |                               | R      |
| 00056E <sub>H</sub>                          | PPG7 - Period setting register               |                              | PCSR7                         | W      |
| 00056F <sub>H</sub>                          | PPG7 - Period setting register               |                              |                               | W      |
| 000570 <sub>H</sub>                          | PPG7 - Duty cycle register                   |                              | PDUT7                         | W      |
| 000571 <sub>H</sub>                          | PPG7 - Duty cycle register                   |                              |                               | W      |
| 000572 <sub>H</sub>                          | PPG7 - Control status register Low           | PCNL7                        | PCN7                          | R/W    |
| 000573 <sub>H</sub>                          | PPG7 - Control status register High          | PCNH7                        |                               | R/W    |
| 000574 <sub>H</sub>                          | PPG11-PPG8 - General Control register 1 Low  | GCN1L2                       | GCN12                         | R/W    |
| 000575 <sub>H</sub>                          | PPG11-PPG8 - General Control register 1 High | GCN1H2                       |                               | R/W    |
| 000576 <sub>H</sub>                          | PPG11-PPG8 - General Control register 2 Low  | GCN2L2                       | GCN22                         | R/W    |
| 000577 <sub>H</sub>                          | PPG11-PPG8 - General Control register 2 High | GCN2H2                       |                               | R/W    |
| 000578 <sub>H</sub>                          | PPG8 - Timer register                        |                              | PTMR8                         | R      |

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| Address             | Register                             | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|---------------------|--------------------------------------|------------------------------|-------------------------------|--------|
| 000579 <sub>H</sub> | PPG8 - Timer register                |                              |                               | R      |
| 00057A <sub>H</sub> | PPG8 - Period setting register       |                              | PCSR8                         | W      |
| 00057B <sub>H</sub> | PPG8 - Period setting register       |                              |                               | W      |
| 00057C <sub>H</sub> | PPG8 - Duty cycle register           |                              | PDUT8                         | W      |
| 00057D <sub>H</sub> | PPG8 - Duty cycle register           |                              |                               | W      |
| 00057E <sub>H</sub> | PPG8 - Control status register Low   | PCNL8                        | PCN8                          | R/W    |
| 00057F <sub>H</sub> | PPG8 - Control status register High  | PCNH8                        |                               | R/W    |
| 000580 <sub>H</sub> | PPG9 - Timer register                |                              | PTMR9                         | R      |
| 000581 <sub>H</sub> | PPG9 - Timer register                |                              |                               | R      |
| 000582 <sub>H</sub> | PPG9 - Period setting register       |                              | PCSR9                         | W      |
| 000583 <sub>H</sub> | PPG9 - Period setting register       |                              |                               | W      |
| 000584 <sub>H</sub> | PPG9 - Duty cycle register           |                              | PDUT9                         | W      |
| 000585 <sub>H</sub> | PPG9 - Duty cycle register           |                              |                               | W      |
| 000586 <sub>H</sub> | PPG9 - Control status register Low   | PCNL9                        | PCN9                          | R/W    |
| 000587 <sub>H</sub> | PPG9 - Control status register High  | PCNH9                        |                               | R/W    |
| 000588 <sub>H</sub> | PPG10 - Timer register               |                              | PTMR10                        | R      |
| 000589 <sub>H</sub> | PPG10 - Timer register               |                              |                               | R      |
| 00058A <sub>H</sub> | PPG10 - Period setting register      |                              | PCSR10                        | W      |
| 00058B <sub>H</sub> | PPG10 - Period setting register      |                              |                               | W      |
| 00058C <sub>H</sub> | PPG10 - Duty cycle register          |                              | PDUT10                        | W      |
| 00058D <sub>H</sub> | PPG10 - Duty cycle register          |                              |                               | W      |
| 00058E <sub>H</sub> | PPG10 - Control status register Low  | PCNL10                       | PCN10                         | R/W    |
| 00058F <sub>H</sub> | PPG10 - Control status register High | PCNH10                       |                               | R/W    |
| 000590 <sub>H</sub> | PPG11 - Timer register               |                              | PTMR11                        | R      |
| 000591 <sub>H</sub> | PPG11 - Timer register               |                              |                               | R      |
| 000592 <sub>H</sub> | PPG11 - Period setting register      |                              | PCSR11                        | W      |
| 000593 <sub>H</sub> | PPG11 - Period setting register      |                              |                               | W      |
| 000594 <sub>H</sub> | PPG11 - Duty cycle register          |                              | PDUT11                        | W      |
| 000595 <sub>H</sub> | PPG11 - Duty cycle register          |                              |                               | W      |
| 000596 <sub>H</sub> | PPG11 - Control status register Low  | PCNL11                       | PCN11                         | R/W    |

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| Address             | Register                                      | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|---------------------|---|---------------------------|----------------------------|--------|
| 000597 <sub>H</sub> | PPG11 - Control status register High          | PCNH11                    |                            | R/W    |
| 000598 <sub>H</sub> | PPG15-PPG12 - General Control register 1 Low  | GCN1L3                    | GCN13                      | R/W    |
| 000599 <sub>H</sub> | PPG15-PPG12 - General Control register 1 High | GCN1H3                    |                            | R/W    |
| 00059A <sub>H</sub> | PPG15-PPG12 - General Control register 2 Low  | GCN2L3                    | GCN23                      | R/W    |
| 00059B <sub>H</sub> | PPG15-PPG12 - General Control register 2 High | GCN2H3                    |                            | R/W    |
| 00059C <sub>H</sub> | PPG12 - Timer register                        |                           | PTMR12                     | R      |
| 00059D <sub>H</sub> | PPG12 - Timer register                        |                           |                            | R      |
| 00059E <sub>H</sub> | PPG12 - Period setting register               |                           | PCSR12                     | W      |
| 00059F <sub>H</sub> | PPG12 - Period setting register               |                           |                            | W      |
| 0005A0 <sub>H</sub> | PPG12 - Duty cycle register                   |                           | PDUT12                     | W      |
| 0005A1 <sub>H</sub> | PPG12 - Duty cycle register                   |                           |                            | W      |
| 0005A2 <sub>H</sub> | PPG12 - Control status register Low           | PCNL12                    | PCN12                      | R/W    |
| 0005A3 <sub>H</sub> | PPG12 - Control status register High          | PCNH12                    |                            | R/W    |
| 0005A4 <sub>H</sub> | PPG13 - Timer register                        |                           | PTMR13                     | R      |
| 0005A5 <sub>H</sub> | PPG13 - Timer register                        |                           |                            | R      |
| 0005A6 <sub>H</sub> | PPG13 - Period setting register               |                           | PCSR13                     | W      |
| 0005A7 <sub>H</sub> | PPG13 - Period setting register               |                           |                            | W      |
| 0005A8 <sub>H</sub> | PPG13 - Duty cycle register                   |                           | PDUT13                     | W      |
| 0005A9 <sub>H</sub> | PPG13 - Duty cycle register                   |                           |                            | W      |
| 0005AA <sub>H</sub> | PPG13 - Control status register Low           | PCNL13                    | PCN13                      | R/W    |
| 0005AB <sub>H</sub> | PPG13 - Control status register High          | PCNH13                    |                            | R/W    |
| 0005AC <sub>H</sub> | PPG14 - Timer register                        |                           | PTMR14                     | R      |
| 0005AD <sub>H</sub> | PPG14 - Timer register                        |                           |                            | R      |
| 0005AE <sub>H</sub> | PPG14 - Period setting register               |                           | PCSR14                     | W      |
| 0005AF <sub>H</sub> | PPG14 - Period setting register               |                           |                            | W      |
| 0005B0 <sub>H</sub> | PPG14 - Duty cycle register                   |                           | PDUT14                     | W      |
| 0005B1 <sub>H</sub> | PPG14 - Duty cycle register                   |                           |                            | W      |
| 0005B2 <sub>H</sub> | PPG14 - Control status register Low           | PCNL14                    | PCN14                      | R/W    |
| 0005B3 <sub>H</sub> | PPG14 - Control status register High          | PCNH14                    |                            | R/W    |
| 0005B4 <sub>H</sub> | PPG15 - Timer register                        |                           | PTMR15                     | R      |

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| Address             | Register                                      | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|---------------------|---|---------------------------|----------------------------|--------|
| 0005B5 <sub>H</sub> | PPG15 - Timer register                        |                           |                            | R      |
| 0005B6 <sub>H</sub> | PPG15 - Period setting register               |                           | PCSR15                     | W      |
| 0005B7 <sub>H</sub> | PPG15 - Period setting register               |                           |                            | W      |
| 0005B8 <sub>H</sub> | PPG15 - Duty cycle register                   |                           | PDUT15                     | W      |
| 0005B9 <sub>H</sub> | PPG15 - Duty cycle register                   |                           |                            | W      |
| 0005BA <sub>H</sub> | PPG15 - Control status register Low           | PCNL15                    | PCN15                      | R/W    |
| 0005BB <sub>H</sub> | PPG15 - Control status register High          | PCNH15                    |                            | R/W    |
| 0005BC <sub>H</sub> | PPG19-PPG16 - General Control register 1 Low  | GCN1L4                    | GCN14                      | R/W    |
| 0005BD <sub>H</sub> | PPG19-PPG16 - General Control register 1 High | GCN1H4                    |                            | R/W    |
| 0005BE <sub>H</sub> | PPG19-PPG16 - General Control register 2 Low  | GCN2L4                    | GCN24                      | R/W    |
| 0005BF <sub>H</sub> | PPG19-PPG16 - General Control register 2 High | GCN2H4                    |                            | R/W    |
| 0005C0 <sub>H</sub> | PPG16 - Timer register                        |                           | PTMR16                     | R      |
| 0005C1 <sub>H</sub> | PPG16 - Timer register                        |                           |                            | R      |
| 0005C2 <sub>H</sub> | PPG16 - Period setting register               |                           | PCSR16                     | W      |
| 0005C3 <sub>H</sub> | PPG16 - Period setting register               |                           |                            | W      |
| 0005C4 <sub>H</sub> | PPG16 - Duty cycle register                   |                           | PDUT16                     | W      |
| 0005C5 <sub>H</sub> | PPG16 - Duty cycle register                   |                           |                            | W      |
| 0005C6 <sub>H</sub> | PPG16 - Control status register Low           | PCNL16                    | PCN16                      | R/W    |
| 0005C7 <sub>H</sub> | PPG16 - Control status register High          | PCNH16                    |                            | R/W    |
| 0005C8 <sub>H</sub> | PPG17 - Timer register                        |                           | PTMR17                     | R      |
| 0005C9 <sub>H</sub> | PPG17 - Timer register                        |                           |                            | R      |
| 0005CA <sub>H</sub> | PPG17 - Period setting register               |                           | PCSR17                     | W      |
| 0005CB <sub>H</sub> | PPG17 - Period setting register               |                           |                            | W      |
| 0005CC <sub>H</sub> | PPG17 - Duty cycle register                   |                           | PDUT17                     | W      |
| 0005CD <sub>H</sub> | PPG17 - Duty cycle register                   |                           |                            | W      |
| 0005CE <sub>H</sub> | PPG17 - Control status register Low           | PCNL17                    | PCN17                      | R/W    |
| 0005CF <sub>H</sub> | PPG17 - Control status register High          | PCNH17                    |                            | R/W    |
| 0005D0 <sub>H</sub> | PPG18 - Timer register                        |                           | PTMR18                     | R      |
| 0005D1 <sub>H</sub> | PPG18 - Timer register                        |                           |                            | R      |
| 0005D2 <sub>H</sub> | PPG18 - Period setting register               |                           | PCSR18                     | W      |

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| Address                                      | Register                                       | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|--|---------------------------|----------------------------|--------|
| 0005D3 <sub>H</sub>                          | PPG18 - Period setting register                |                           |                            | W      |
| 0005D4 <sub>H</sub>                          | PPG18 - Duty cycle register                    |                           | PDUT18                     | W      |
| 0005D5 <sub>H</sub>                          | PPG18 - Duty cycle register                    |                           |                            | W      |
| 0005D6 <sub>H</sub>                          | PPG18 - Control status register Low            | PCNL18                    | PCN18                      | R/W    |
| 0005D7 <sub>H</sub>                          | PPG18 - Control status register High           | PCNH18                    |                            | R/W    |
| 0005D8 <sub>H</sub>                          | PPG19 - Timer register                         |                           | PTMR19                     | R      |
| 0005D9 <sub>H</sub>                          | PPG19 - Timer register                         |                           |                            | R      |
| 0005DA <sub>H</sub>                          | PPG19 - Period setting register                |                           | PCSR19                     | W      |
| 0005DB <sub>H</sub>                          | PPG19 - Period setting register                |                           |                            | W      |
| 0005DC <sub>H</sub>                          | PPG19 - Duty cycle register                    |                           | PDUT19                     | W      |
| 0005DD <sub>H</sub>                          | PPG19 - Duty cycle register                    |                           |                            | W      |
| 0005DE <sub>H</sub>                          | PPG19 - Control status register Low            | PCNL19                    | PCN19                      | R/W    |
| 0005DF <sub>H</sub>                          | PPG19 - Control status register High           | PCNH19                    |                            | R/W    |
| 0005E0 <sub>H</sub> -<br>00065F <sub>H</sub> | Reserved                                       |                           |                            | -      |
| 000660 <sub>H</sub>                          | Peripheral Resource Relocation Register 10     | PRRR10                    |                            | R/W    |
| 000661 <sub>H</sub>                          | Peripheral Resource Relocation Register 11     | PRRR11                    |                            | R/W    |
| 000662 <sub>H</sub>                          | Peripheral Resource Relocation Register 12     | PRRR12                    |                            | R/W    |
| 000663 <sub>H</sub>                          | Peripheral Resource Relocation Register 13     | PRRR13                    |                            | W      |
| 000664 <sub>H</sub> -<br>00069F <sub>H</sub> | Reserved                                       |                           |                            | -      |
| 0006A0 <sub>H</sub>                          | USB - Host Control register Low                | HCNTL0                    | HCNT0                      | R/W    |
| 0006A1 <sub>H</sub>                          | USB - Host Control register High               | HCNTH0                    |                            | R/W    |
| 0006A2 <sub>H</sub>                          | USB - Host Interrupt Register                  | HIRQ0                     |                            | R/W    |
| 0006A3 <sub>H</sub>                          | USB - Host Error Status Register               | HERR0                     |                            | R/W    |
| 0006A4 <sub>H</sub>                          | USB - Host State Status Register               | HSTATE0                   |                            | R/W    |
| 0006A5 <sub>H</sub>                          | USB - Host SOF Int. Frame Compare Register     | HFCOMP0                   |                            | R/W    |
| 0006A6 <sub>H</sub>                          | USB - Host Retry Timer Setting Register Low    | HRTIMERL0                 |                            | R/W    |
| 0006A7 <sub>H</sub>                          | USB - Host Retry Timer Setting Register Middle | HRTIMERM0                 |                            | R/W    |
| 0006A8 <sub>H</sub>                          | USB - Host Retry Timer Setting Register High   | HRTIMERH0                 |                            | R/W    |
| 0006A9 <sub>H</sub>                          | USB - Host Address Register                    | HADR0                     |                            | R/W    |

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| Address             | Register                                     | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|---------------------|--|---------------------------|----------------------------|--------|
| 0006AA <sub>H</sub> | USB - Host EOF Setting Register Low          | HEOFL0                    | HEOF0                      | R/W    |
| 0006AB <sub>H</sub> | USB - Host EOF Setting Register High         | HEOFH0                    |                            | R/W    |
| 0006AC <sub>H</sub> | USB - Host Frame Register Low                | HFRAMELO                  | HFRAME0                    | R/W    |
| 0006AD <sub>H</sub> | USB - Host Frame Register High               | HFRAMEH0                  |                            | R/W    |
| 0006AE <sub>H</sub> | USB - Host Token End Point Register          | HTOKEN0                   |                            | R/W    |
| 0006AF <sub>H</sub> | Reserved                                     |                           |                            | -      |
| 0006B0 <sub>H</sub> | USB - UDC Control Register                   | UDCC0                     |                            | R/W    |
| 0006B1 <sub>H</sub> | Reserved                                     |                           |                            | -      |
| 0006B2 <sub>H</sub> | USB - EP0 Control Register Low               | EP0CL0                    | EP0C0                      | R/W    |
| 0006B3 <sub>H</sub> | USB - EP0 Control Register High              | EP0CH0                    |                            | R/W    |
| 0006B4 <sub>H</sub> | USB - EP1 Control Register Low               | EP1CL0                    | EP1C0                      | R/W    |
| 0006B5 <sub>H</sub> | USB - EP1 Control Register High - non public | EP1CH0                    |                            | R/W    |
| 0006B6 <sub>H</sub> | USB - EP2 Control Register Low               | EP2CL0                    | EP2C0                      | R/W    |
| 0006B7 <sub>H</sub> | USB - EP2 Control Register High              | EP2CH0                    |                            | R/W    |
| 0006B8 <sub>H</sub> | USB - EP3 Control Register Low               | EP3CL0                    | EP3C0                      | R/W    |
| 0006B9 <sub>H</sub> | USB - EP3 Control Register High              | EP3CH0                    |                            | R/W    |
| 0006BA <sub>H</sub> | USB - EP4 Control Register Low               | EP4CL0                    | EP4C0                      | R/W    |
| 0006BB <sub>H</sub> | USB - EP4 Control Register High              | EP4CH0                    |                            | R/W    |
| 0006BC <sub>H</sub> | USB - EP5 Control Register Low               | EP5CL0                    | EP5C0                      | R/W    |
| 0006BD <sub>H</sub> | USB - EP5 Control Register High              | EP5CH0                    |                            | R/W    |
| 0006BE <sub>H</sub> | USB - Timer Stamp Register Low               | TMSPL0                    | TMSP0                      | R/W    |
| 0006BF <sub>H</sub> | USB - Timer Stamp Register High              | TMSPH0                    |                            | R/W    |
| 0006C0 <sub>H</sub> | USB - UDC Status Register                    | UDCS0                     |                            | R/W    |
| 0006C1 <sub>H</sub> | USB - UDC Interrupt Enable Register          | UDCIE0                    |                            | R/W    |
| 0006C2 <sub>H</sub> | USB - EP0I Status Register Low               | EP0ISL0                   | EP0IS0                     | W      |
| 0006C3 <sub>H</sub> | USB - EP0I Status Register High              | EP0ISH0                   |                            | R/W    |
| 0006C4 <sub>H</sub> | USB - EP0O Status Register Low               | EP0OSL0                   | EP0OS0                     | R/W    |
| 0006C5 <sub>H</sub> | USB - EP0O Status Register High              | EP0OSH0                   |                            | R/W    |
| 0006C6 <sub>H</sub> | USB - EP1 Status Register Low                | EP1SL0                    | EP1S0                      | R/W    |
| 0006C7 <sub>H</sub> | USB - EP1 Status Register High               | EP1SH0                    |                            | R/W    |



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| Address                                      | Register  | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|---|---------------------------|----------------------------|--------|
| 0006C8 <sub>H</sub>                          | USB - EP2 Status Register Low                     | EP2SL0                    | EP2S0                      | R/W    |
| 0006C9 <sub>H</sub>                          | USB - EP2 Status Register High                    | EP2SH0                    |                            | R/W    |
| 0006CA <sub>H</sub>                          | USB - EP3 Status Register Low                     | EP3SL0                    | EP3S0                      | R/W    |
| 0006CB <sub>H</sub>                          | USB - EP3 Status Register High                    | EP3SH0                    |                            | R/W    |
| 0006CC <sub>H</sub>                          | USB - EP4 Status Register Low                     | EP4SL0                    | EP4S0                      | R/W    |
| 0006CD <sub>H</sub>                          | USB - EP4 Status Register High                    | EP4SH0                    |                            | R/W    |
| 0006CE <sub>H</sub>                          | USB - EP5 Status Register Low                     | EP5SL0                    | EP5S0                      | R/W    |
| 0006CF <sub>H</sub>                          | USB - EP5 Status Register High                    | EP5SH0                    |                            | R/W    |
| 0006D0 <sub>H</sub>                          | USB - EP0 Data register Low                       | EP0DTL0                   | EP0DT0                     | R/W    |
| 0006D1 <sub>H</sub>                          | USB - EP0 Data register High                      | EP0DTH0                   |                            | R/W    |
| 0006D2 <sub>H</sub>                          | USB - EP1 Data register Low                       | EP1DTL0                   | EP1DT0                     | R/W    |
| 0006D3 <sub>H</sub>                          | USB - EP1 Data register High                      | EP1DTH0                   |                            | R/W    |
| 0006D4 <sub>H</sub>                          | USB - EP2 Data register Low                       | EP2DTL0                   | EP2DT0                     | R/W    |
| 0006D5 <sub>H</sub>                          | USB - EP2 Data register High                      | EP2DTH0                   |                            | R/W    |
| 0006D6 <sub>H</sub>                          | USB - EP3 Data register Low                       | EP3DTL0                   | EP3DT0                     | R/W    |
| 0006D7 <sub>H</sub>                          | USB - EP3 Data register High                      | EP3DTH0                   |                            | R/W    |
| 0006D8 <sub>H</sub>                          | USB - EP4 Data register Low                       | EP4DTL0                   | EP4DT0                     | R/W    |
| 0006D9 <sub>H</sub>                          | USB - EP4 Data register High                      | EP4DTH0                   |                            | R/W    |
| 0006DA <sub>H</sub>                          | USB - EP5 Data register Low                       | EP5DTL0                   | EP5DT0                     | R/W    |
| 0006DB <sub>H</sub>                          | USB - EP5 Data register High                      | EP5DTH0                   |                            | R/W    |
| 0006DC <sub>H</sub> -<br>0006DF <sub>H</sub> | Reserved  |                           |                            | -      |
| 0006E0 <sub>H</sub>                          | External Bus - Area configuration register 0 Low  | EACL0                     | EAC0                       | R/W    |
| 0006E1 <sub>H</sub>                          | External Bus - Area configuration register 0 High | EACH0                     |                            | R/W    |
| 0006E2 <sub>H</sub>                          | External Bus - Area configuration register 1 Low  | EACL1                     | EAC1                       | R/W    |
| 0006E3 <sub>H</sub>                          | External Bus - Area configuration register 1 High | EACH1                     |                            | R/W    |
| 0006E4 <sub>H</sub>                          | External Bus - Area configuration register 2 Low  | EACL2                     | EAC2                       | R/W    |
| 0006E5 <sub>H</sub>                          | External Bus - Area configuration register 2 High | EACH2                     |                            | R/W    |
| 0006E6 <sub>H</sub>                          | External Bus - Area configuration register 3 Low  | EACL3                     | EAC3                       | R/W    |
| 0006E7 <sub>H</sub>                          | External Bus - Area configuration register 3 High | EACH3                     |                            | R/W    |
| 0006E8 <sub>H</sub>                          | 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 <sub>H</sub>                          | External Bus - Area configuration register 4 High | EACH4                     |                            | R/W    |
| 0006EA <sub>H</sub>                          | External Bus - Area configuration register 5 Low  | EACL5                     | EAC5                       | R/W    |
| 0006EB <sub>H</sub>                          | External Bus - Area configuration register 5 High | EACH5                     |                            | R/W    |
| 0006EC <sub>H</sub>                          | External Bus - Area select register 2             | EAS2                      |                            | R/W    |
| 0006ED <sub>H</sub>                          | External Bus - Area select register 3             | EAS3                      |                            | R/W    |
| 0006EE <sub>H</sub>                          | External Bus - Area select register 4             | EAS4                      |                            | R/W    |
| 0006EF <sub>H</sub>                          | External Bus - Area select register 5             | EAS5                      |                            | R/W    |
| 0006F0 <sub>H</sub>                          | External Bus - Mode register                      | EBM                       |                            | R/W    |
| 0006F1 <sub>H</sub>                          | External Bus - Clock and Function register        | EBCF                      |                            | R/W    |
| 0006F2 <sub>H</sub>                          | External Bus - Address output enable register 0   | EBAE0                     |                            | R/W    |
| 0006F3 <sub>H</sub>                          | External Bus - Address output enable register 1   | EBAE1                     |                            | R/W    |
| 0006F4 <sub>H</sub>                          | External Bus - Address output enable register 2   | EBAE2                     |                            | R/W    |
| 0006F5 <sub>H</sub>                          | External Bus - Control signal register            | EBCS                      |                            | R/W    |
| 0006F6 <sub>H</sub> -<br>0006FF <sub>H</sub> | Reserved  |                           |                            | -      |
| 000700 <sub>H</sub>                          | CAN0 - Control register Low                       | CTRLRL0                   | CTRLR0                     | R/W    |
| 000701 <sub>H</sub>                          | CAN0 - Control register High (reserved)           | CTRLRH0                   |                            | R      |
| 000702 <sub>H</sub>                          | CAN0 - Status register Low                        | STATRL0                   | STATR0                     | R/W    |
| 000703 <sub>H</sub>                          | CAN0 - Status register High (reserved)            | STATRH0                   |                            | R      |
| 000704 <sub>H</sub>                          | CAN0 - Error Counter Low (Transmit)               | ERRCNTL0                  | ERRCNT0                    | R      |
| 000705 <sub>H</sub>                          | CAN0 - Error Counter High (Receive)               | ERRCNTH0                  |                            | R      |
| 000706 <sub>H</sub>                          | CAN0 - Bit Timing Register Low                    | BTRL0                     | BTR0                       | R/W    |
| 000707 <sub>H</sub>                          | CAN0 - Bit Timing Register High                   | BTRH0                     |                            | R/W    |
| 000708 <sub>H</sub>                          | CAN0 - Interrupt Register Low                     | INTRL0                    | INTR0                      | R      |
| 000709 <sub>H</sub>                          | CAN0 - Interrupt Register High                    | INTRH0                    |                            | R      |
| 00070A <sub>H</sub>                          | CAN0 - Test Register Low                          | TESTRL0                   | TESTR0                     | R/W    |
| 00070B <sub>H</sub>                          | CAN0 - Test Register High (reserved)              | TESTRH0                   |                            | R      |
| 00070C <sub>H</sub>                          | CAN0 - BRP Extension register Low                 | BRPERL0                   | BRPER0                     | R/W    |
| 00070D <sub>H</sub>                          | CAN0 - BRP Extension register High (reserved)     | BRPERH0                   |                            | R      |
| 00070E <sub>H</sub> -<br>00070F <sub>H</sub> | Reserved  |                           |                            | -      |

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| Address                                      | Register   | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|--|---------------------------|----------------------------|--------|
| 000710 <sub>H</sub>                          | CAN0 - IF1 Command request register Low          | IF1CREQL0                 | IF1CREQ0                   | R/W    |
| 000711 <sub>H</sub>                          | CAN0 - IF1 Command request register High         | IF1CREQH0                 |                            | R/W    |
| 000712 <sub>H</sub>                          | CAN0 - IF1 Command Mask register Low             | IF1CMSKL0                 | IF1CMSK0                   | R/W    |
| 000713 <sub>H</sub>                          | CAN0 - IF1 Command Mask register High (reserved) | IF1CMSKH0                 |                            | R      |
| 000714 <sub>H</sub>                          | CAN0 - IF1 Mask 1 Register Low                   | IF1MSK1L0                 | IF1MSK10                   | R/W    |
| 000715 <sub>H</sub>                          | CAN0 - IF1 Mask 1 Register High                  | IF1MSK1H0                 |                            | R/W    |
| 000716 <sub>H</sub>                          | CAN0 - IF1 Mask 2 Register Low                   | IF1MSK2L0                 | IF1MSK20                   | R/W    |
| 000717 <sub>H</sub>                          | CAN0 - IF1 Mask 2 Register High                  | IF1MSK2H0                 |                            | R/W    |
| 000718 <sub>H</sub>                          | CAN0 - IF1 Arbitration 1 Register Low            | IF1ARB1L0                 | IF1ARB10                   | R/W    |
| 000719 <sub>H</sub>                          | CAN0 - IF1 Arbitration 1 Register High           | IF1ARB1H0                 |                            | R/W    |
| 00071A <sub>H</sub>                          | CAN0 - IF1 Arbitration 2 Register Low            | IF1ARB2L0                 | IF1ARB20                   | R/W    |
| 00071B <sub>H</sub>                          | CAN0 - IF1 Arbitration 2 Register High           | IF1ARB2H0                 |                            | R/W    |
| 00071C <sub>H</sub>                          | CAN0 - IF1 Message Control Register Low          | IF1MCTRL0                 | IF1MCTR0                   | R/W    |
| 00071D <sub>H</sub>                          | CAN0 - IF1 Message Control Register High         | IF1MCTRH0                 |                            | R/W    |
| 00071E <sub>H</sub>                          | CAN0 - IF1 Data A1 Low                           | IF1DTA1L0                 | IF1DTA10                   | R/W    |
| 00071F <sub>H</sub>                          | CAN0 - IF1 Data A1 High                          | IF1DTA1H0                 |                            | R/W    |
| 000720 <sub>H</sub>                          | CAN0 - IF1 Data A2 Low                           | IF1DTA2L0                 | IF1DTA20                   | R/W    |
| 000721 <sub>H</sub>                          | CAN0 - IF1 Data A2 High                          | IF1DTA2H0                 |                            | R/W    |
| 000722 <sub>H</sub>                          | CAN0 - IF1 Data B1 Low                           | IF1DTB1L0                 | IF1DTB10                   | R/W    |
| 000723 <sub>H</sub>                          | CAN0 - IF1 Data B1 High                          | IF1DTB1H0                 |                            | R/W    |
| 000724 <sub>H</sub>                          | CAN0 - IF1 Data B2 Low                           | IF1DTB2L0                 | IF1DTB20                   | R/W    |
| 000725 <sub>H</sub>                          | CAN0 - IF1 Data B2 High                          | IF1DTB2H0                 |                            | R/W    |
| 000726 <sub>H</sub> -<br>00073F <sub>H</sub> | Reserved   |                           |                            | -      |
| 000740 <sub>H</sub>                          | CAN0 - IF2 Command request register Low          | IF2CREQL0                 | IF2CREQ0                   | R/W    |
| 000741 <sub>H</sub>                          | CAN0 - IF2 Command request register High         | IF2CREQH0                 |                            | R/W    |
| 000742 <sub>H</sub>                          | CAN0 - IF2 Command Mask register Low             | IF2CMSKL0                 | IF2CMSK0                   | R/W    |
| 000743 <sub>H</sub>                          | CAN0 - IF2 Command Mask register High (reserved) | IF2CMSKH0                 |                            | R      |
| 000744 <sub>H</sub>                          | CAN0 - IF2 Mask 1 Register Low                   | IF2MSK1L0                 | IF2MSK10                   | R/W    |
| 000745 <sub>H</sub>                          | CAN0 - IF2 Mask 1 Register High                  | IF2MSK1H0                 |                            | R/W    |
| 000746 <sub>H</sub>                          | CAN0 - IF2 Mask 2 Register Low                   | IF2MSK2L0                 | IF2MSK20                   | R/W    |

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| Address                                      | Register                                    | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|---|---------------------------|----------------------------|--------|
| 000747 <sub>H</sub>                          | CAN0 - IF2 Mask 2 Register High             | IF2MSK2H0                 |                            | R/W    |
| 000748 <sub>H</sub>                          | CAN0 - IF2 Arbitration 1 Register Low       | IF2ARB1L0                 | IF2ARB10                   | R/W    |
| 000749 <sub>H</sub>                          | CAN0 - IF2 Arbitration 1 Register High      | IF2ARB1H0                 |                            | R/W    |
| 00074A <sub>H</sub>                          | CAN0 - IF2 Arbitration 2 Register Low       | IF2ARB2L0                 | IF2ARB20                   | R/W    |
| 00074B <sub>H</sub>                          | CAN0 - IF2 Arbitration 2 Register High      | IF2ARB2H0                 |                            | R/W    |
| 00074C <sub>H</sub>                          | CAN0 - IF2 Message Control Register Low     | IF2MCTRL0                 | IF2MCTR0                   | R/W    |
| 00074D <sub>H</sub>                          | CAN0 - IF2 Message Control Register High    | IF2MCTRH0                 |                            | R/W    |
| 00074E <sub>H</sub>                          | CAN0 - IF2 Data A1 Low                      | IF2DTA1L0                 | IF2DTA10                   | R/W    |
| 00074F <sub>H</sub>                          | CAN0 - IF2 Data A1 High                     | IF2DTA1H0                 |                            | R/W    |
| 000750 <sub>H</sub>                          | CAN0 - IF2 Data A2 Low                      | IF2DTA2L0                 | IF2DTA20                   | R/W    |
| 000751 <sub>H</sub>                          | CAN0 - IF2 Data A2 High                     | IF2DTA2H0                 |                            | R/W    |
| 000752 <sub>H</sub>                          | CAN0 - IF2 Data B1 Low                      | IF2DTB1L0                 | IF2DTB10                   | R/W    |
| 000753 <sub>H</sub>                          | CAN0 - IF2 Data B1 High                     | IF2DTB1H0                 |                            | R/W    |
| 000754 <sub>H</sub>                          | CAN0 - IF2 Data B2 Low                      | IF2DTB2L0                 | IF2DTB20                   | R/W    |
| 000755 <sub>H</sub>                          | CAN0 - IF2 Data B2 High                     | IF2DTB2H0                 |                            | R/W    |
| 000756 <sub>H</sub> -<br>00077F <sub>H</sub> | Reserved                                    |                           |                            | -      |
| 000780 <sub>H</sub>                          | CAN0 - Transmission Request 1 Register Low  | TREQR1L0                  | TREQR10                    | R      |
| 000781 <sub>H</sub>                          | CAN0 - Transmission Request 1 Register High | TREQR1H0                  |                            | R      |
| 000782 <sub>H</sub>                          | CAN0 - Transmission Request 2 Register Low  | TREQR2L0                  | TREQR20                    | R      |
| 000783 <sub>H</sub>                          | CAN0 - Transmission Request 2 Register High | TREQR2H0                  |                            | R      |
| 000784 <sub>H</sub> -<br>00078F <sub>H</sub> | Reserved                                    |                           |                            | -      |
| 000790 <sub>H</sub>                          | CAN0 - New Data 1 Register Low              | NEWDT1L0                  | NEWDT10                    | R      |
| 000791 <sub>H</sub>                          | CAN0 - New Data 1 Register High             | NEWDT1H0                  |                            | R      |
| 000792 <sub>H</sub>                          | CAN0 - New Data 2 Register Low              | NEWDT2L0                  | NEWDT20                    | R      |
| 000793 <sub>H</sub>                          | CAN0 - New Data 2 Register High             | NEWDT2H0                  |                            | R      |
| 000794 <sub>H</sub> -<br>00079F <sub>H</sub> | Reserved                                    |                           |                            | -      |
| 0007A0 <sub>H</sub>                          | CAN0 - Interrupt Pending 1 Register Low     | INTPND1L0                 | INTPND10                   | R      |
| 0007A1 <sub>H</sub>                          | CAN0 - Interrupt Pending 1 Register High    | INTPND1H0                 |                            | R      |
| 0007A2 <sub>H</sub>                          | CAN0 - Interrupt Pending 2 Register Low     | INTPND2L0                 | INTPND20                   | R      |

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| Address                                      | Register   | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|--|---------------------------|----------------------------|--------|
| 0007A3 <sub>H</sub>                          | CAN0 - Interrupt Pending 2 Register High         | INTPND2H0                 |                            | R      |
| 0007A4 <sub>H</sub> -<br>0007AF <sub>H</sub> | Reserved   |                           |                            | -      |
| 0007B0 <sub>H</sub>                          | CAN0 - Message Valid 1 Register Low              | MSGVAL1L0                 | MSGVAL10                   | R      |
| 0007B1 <sub>H</sub>                          | CAN0 - Message Valid 1 Register High             | MSGVAL1H0                 |                            | R      |
| 0007B2 <sub>H</sub>                          | CAN0 - Message Valid 2 Register Low              | MSGVAL2L0                 | MSGVAL20                   | R      |
| 0007B3 <sub>H</sub>                          | CAN0 - Message Valid 2 Register High             | MSGVAL2H0                 |                            | R      |
| 0007B4 <sub>H</sub> -<br>0007CD <sub>H</sub> | Reserved   |                           |                            | -      |
| 0007CE <sub>H</sub>                          | CAN0 - Output enable register                    | COER0                     |                            | R/W    |
| 0007CF <sub>H</sub> -<br>0007FF <sub>H</sub> | Reserved   |                           |                            | -      |
| 000800 <sub>H</sub>                          | CAN1 - Control register Low                      | CTRLRL1                   | CTRLR1                     | R/W    |
| 000801 <sub>H</sub>                          | CAN1 - Control register High (reserved)          | CTRLRH1                   |                            | R      |
| 000802 <sub>H</sub>                          | CAN1 - Status register Low                       | STATRL1                   | STATR1                     | R/W    |
| 000803 <sub>H</sub>                          | CAN1 - Status register High (reserved)           | STATRH1                   |                            | R      |
| 000804 <sub>H</sub>                          | CAN1 - Error Counter Low (Transmit)              | ERRCNTL1                  | ERRCNT1                    | R      |
| 000805 <sub>H</sub>                          | CAN1 - Error Counter High (Receive)              | ERRCNTH1                  |                            | R      |
| 000806 <sub>H</sub>                          | CAN1 - Bit Timing Register Low                   | BTRL1                     | BTR1                       | R/W    |
| 000807 <sub>H</sub>                          | CAN1 - Bit Timing Register High                  | BTRH1                     |                            | R/W    |
| 000808 <sub>H</sub>                          | CAN1 - Interrupt Register Low                    | INTRL1                    | INTR1                      | R      |
| 000809 <sub>H</sub>                          | CAN1 - Interrupt Register High                   | INTRH1                    |                            | R      |
| 00080A <sub>H</sub>                          | CAN1 - Test Register Low                         | TESTRL1                   | TESTR1                     | R/W    |
| 00080B <sub>H</sub>                          | CAN1 - Test Register High (reserved)             | TESTRH1                   |                            | R      |
| 00080C <sub>H</sub>                          | CAN1 - BRP Extension register Low                | BRPERL1                   | BRPER1                     | R/W    |
| 00080D <sub>H</sub>                          | CAN1 - BRP Extension register High (reserved)    | BRPERH1                   |                            | R      |
| 00080E <sub>H</sub> -<br>00080F <sub>H</sub> | Reserved   |                           |                            | -      |
| 000810 <sub>H</sub>                          | CAN1 - IF1 Command request register Low          | IF1CREQL1                 | IF1CREQ1                   | R/W    |
| 000811 <sub>H</sub>                          | CAN1 - IF1 Command request register High         | IF1CREQH1                 |                            | R/W    |
| 000812 <sub>H</sub>                          | CAN1 - IF1 Command Mask register Low             | IF1CMSKL1                 | IF1CMSK1                   | R/W    |
| 000813 <sub>H</sub>                          | CAN1 - IF1 Command Mask register High (reserved) | IF1CMSKH1                 |                            | R      |

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| Address                                      | Register   | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|--|---------------------------|----------------------------|--------|
| 000814 <sub>H</sub>                          | CAN1 - IF1 Mask 1 Register Low                   | IF1MSK1L1                 | IF1MSK11                   | R/W    |
| 000815 <sub>H</sub>                          | CAN1 - IF1 Mask 1 Register High                  | IF1MSK1H1                 |                            | R/W    |
| 000816 <sub>H</sub>                          | CAN1 - IF1 Mask 2 Register Low                   | IF1MSK2L1                 | IF1MSK21                   | R/W    |
| 000817 <sub>H</sub>                          | CAN1 - IF1 Mask 2 Register High                  | IF1MSK2H1                 |                            | R/W    |
| 000818 <sub>H</sub>                          | CAN1 - IF1 Arbitration 1 Register Low            | IF1ARB1L1                 | IF1ARB11                   | R/W    |
| 000819 <sub>H</sub>                          | CAN1 - IF1 Arbitration 1 Register High           | IF1ARB1H1                 |                            | R/W    |
| 00081A <sub>H</sub>                          | CAN1 - IF1 Arbitration 2 Register Low            | IF1ARB2L1                 | IF1ARB21                   | R/W    |
| 00081B <sub>H</sub>                          | CAN1 - IF1 Arbitration 2 Register High           | IF1ARB2H1                 |                            | R/W    |
| 00081C <sub>H</sub>                          | CAN1 - IF1 Message Control Register Low          | IF1MCTRL1                 | IF1MCTR1                   | R/W    |
| 00081D <sub>H</sub>                          | CAN1 - IF1 Message Control Register High         | IF1MCTRH1                 |                            | R/W    |
| 00081E <sub>H</sub>                          | CAN1 - IF1 Data A1 Low                           | IF1DTA1L1                 | IF1DTA11                   | R/W    |
| 00081F <sub>H</sub>                          | CAN1 - IF1 Data A1 High                          | IF1DTA1H1                 |                            | R/W    |
| 000820 <sub>H</sub>                          | CAN1 - IF1 Data A2 Low                           | IF1DTA2L1                 | IF1DTA21                   | R/W    |
| 000821 <sub>H</sub>                          | CAN1 - IF1 Data A2 High                          | IF1DTA2H1                 |                            | R/W    |
| 000822 <sub>H</sub>                          | CAN1 - IF1 Data B1 Low                           | IF1DTB1L1                 | IF1DTB11                   | R/W    |
| 000823 <sub>H</sub>                          | CAN1 - IF1 Data B1 High                          | IF1DTB1H1                 |                            | R/W    |
| 000824 <sub>H</sub>                          | CAN1 - IF1 Data B2 Low                           | IF1DTB2L1                 | IF1DTB21                   | R/W    |
| 000825 <sub>H</sub>                          | CAN1 - IF1 Data B2 High                          | IF1DTB2H1                 |                            | R/W    |
| 000826 <sub>H</sub> -<br>00083F <sub>H</sub> | Reserved   |                           |                            | -      |
| 000840 <sub>H</sub>                          | CAN1 - IF2 Command request register Low          | IF2CREQL1                 | IF2CREQ1                   | R/W    |
| 000841 <sub>H</sub>                          | CAN1 - IF2 Command request register High         | IF2CREQH1                 |                            | R/W    |
| 000842 <sub>H</sub>                          | CAN1 - IF2 Command Mask register Low             | IF2CMSKL1                 | IF2CMSK1                   | R/W    |
| 000843 <sub>H</sub>                          | CAN1 - IF2 Command Mask register High (reserved) | IF2CMSKH1                 |                            | R      |
| 000844 <sub>H</sub>                          | CAN1 - IF2 Mask 1 Register Low                   | IF2MSK1L1                 | IF2MSK11                   | R/W    |
| 000845 <sub>H</sub>                          | CAN1 - IF2 Mask 1 Register High                  | IF2MSK1H1                 |                            | R/W    |
| 000846 <sub>H</sub>                          | CAN1 - IF2 Mask 2 Register Low                   | IF2MSK2L1                 | IF2MSK21                   | R/W    |
| 000847 <sub>H</sub>                          | CAN1 - IF2 Mask 2 Register High                  | IF2MSK2H1                 |                            | R/W    |
| 000848 <sub>H</sub>                          | CAN1 - IF2 Arbitration 1 Register Low            | IF2ARB1L1                 | IF2ARB11                   | R/W    |
| 000849 <sub>H</sub>                          | CAN1 - IF2 Arbitration 1 Register High           | IF2ARB1H1                 |                            | R/W    |
| 00084A <sub>H</sub>                          | CAN1 - IF2 Arbitration 2 Register Low            | IF2ARB2L1                 | IF2ARB21                   | R/W    |

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| Address                                      | Register                                    | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|---|---------------------------|----------------------------|--------|
| 00084B <sub>H</sub>                          | CAN1 - IF2 Arbitration 2 Register High      | IF2ARB2H1                 |                            | R/W    |
| 00084C <sub>H</sub>                          | CAN1 - IF2 Message Control Register Low     | IF2MCTRL1                 | IF2MCTR1                   | R/W    |
| 00084D <sub>H</sub>                          | CAN1 - IF2 Message Control Register High    | IF2MCTRH1                 |                            | R/W    |
| 00084E <sub>H</sub>                          | CAN1 - IF2 Data A1 Low                      | IF2DTA1L1                 | IF2DTA11                   | R/W    |
| 00084F <sub>H</sub>                          | CAN1 - IF2 Data A1 High                     | IF2DTA1H1                 |                            | R/W    |
| 000850 <sub>H</sub>                          | CAN1 - IF2 Data A2 Low                      | IF2DTA2L1                 | IF2DTA21                   | R/W    |
| 000851 <sub>H</sub>                          | CAN1 - IF2 Data A2 High                     | IF2DTA2H1                 |                            | R/W    |
| 000852 <sub>H</sub>                          | CAN1 - IF2 Data B1 Low                      | IF2DTB1L1                 | IF2DTB11                   | R/W    |
| 000853 <sub>H</sub>                          | CAN1 - IF2 Data B1 High                     | IF2DTB1H1                 |                            | R/W    |
| 000854 <sub>H</sub>                          | CAN1 - IF2 Data B2 Low                      | IF2DTB2L1                 | IF2DTB21                   | R/W    |
| 000855 <sub>H</sub>                          | CAN1 - IF2 Data B2 High                     | IF2DTB2H1                 |                            | R/W    |
| 000856 <sub>H</sub> -<br>00087F <sub>H</sub> | Reserved                                    |                           |                            | -      |
| 000880 <sub>H</sub>                          | CAN1 - Transmission Request 1 Register Low  | TREQR1L1                  | TREQR11                    | R      |
| 000881 <sub>H</sub>                          | CAN1 - Transmission Request 1 Register High | TREQR1H1                  |                            | R      |
| 000882 <sub>H</sub>                          | CAN1 - Transmission Request 2 Register Low  | TREQR2L1                  | TREQR21                    | R      |
| 000883 <sub>H</sub>                          | CAN1 - Transmission Request 2 Register High | TREQR2H1                  |                            | R      |
| 000884 <sub>H</sub> -<br>00088F <sub>H</sub> | Reserved                                    |                           |                            | -      |
| 000890 <sub>H</sub>                          | CAN1 - New Data 1 Register Low              | NEWDT1L1                  | NEWDT11                    | R      |
| 000891 <sub>H</sub>                          | CAN1 - New Data 1 Register High             | NEWDT1H1                  |                            | R      |
| 000892 <sub>H</sub>                          | CAN1 - New Data 2 Register Low              | NEWDT2L1                  | NEWDT21                    | R      |
| 000893 <sub>H</sub>                          | CAN1 - New Data 2 Register High             | NEWDT2H1                  |                            | R      |
| 000894 <sub>H</sub> -<br>00089F <sub>H</sub> | Reserved                                    |                           |                            | -      |
| 0008A0 <sub>H</sub>                          | CAN1 - Interrupt Pending 1 Register Low     | INTPND1L1                 | INTPND11                   | R      |
| 0008A1 <sub>H</sub>                          | CAN1 - Interrupt Pending 1 Register High    | INTPND1H1                 |                            | R      |
| 0008A2 <sub>H</sub>                          | CAN1 - Interrupt Pending 2 Register Low     | INTPND2L1                 | INTPND21                   | R      |
| 0008A3 <sub>H</sub>                          | CAN1 - Interrupt Pending 2 Register High    | INTPND2H1                 |                            | R      |
| 0008A4 <sub>H</sub> -<br>0008AF <sub>H</sub> | Reserved                                    |                           |                            | -      |
| 0008B0 <sub>H</sub>                          | CAN1 - Message Valid 1 Register Low         | MSGVAL1L1                 | MSGVAL11                   | R      |

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| Address                                      | Register   | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|--|---------------------------|----------------------------|--------|
| 0008B1 <sub>H</sub>                          | CAN1 - Message Valid 1 Register High             | MSGVAL1H1                 |                            | R      |
| 0008B2 <sub>H</sub>                          | CAN1 - Message Valid 2 Register Low              | MSGVAL2L1                 | MSGVAL21                   | R      |
| 0008B3 <sub>H</sub>                          | CAN1 - Message Valid 2 Register High             | MSGVAL2H1                 |                            | R      |
| 0008B4 <sub>H</sub> -<br>0008CD <sub>H</sub> | Reserved   |                           |                            | -      |
| 0008CE <sub>H</sub>                          | CAN1 - Output enable register                    | COER1                     |                            | R/W    |
| 0008CF <sub>H</sub> -<br>0008FF <sub>H</sub> | Reserved   |                           |                            | -      |
| 000900 <sub>H</sub>                          | CAN2 - Control register Low                      | CTRLRL2                   | CTRLR2                     | R/W    |
| 000901 <sub>H</sub>                          | CAN2 - Control register High (reserved)          | CTRLRH2                   |                            | R      |
| 000902 <sub>H</sub>                          | CAN2 - Status register Low                       | STATRL2                   | STATR2                     | R/W    |
| 000903 <sub>H</sub>                          | CAN2 - Status register High (reserved)           | STATRH2                   |                            | R      |
| 000904 <sub>H</sub>                          | CAN2 - Error Counter Low (Transmit)              | ERRCNTL2                  | ERRCNT2                    | R      |
| 000905 <sub>H</sub>                          | CAN2 - Error Counter High (Receive)              | ERRCNTH2                  |                            | R      |
| 000906 <sub>H</sub>                          | CAN2 - Bit Timing Register Low                   | BTRL2                     | BTR2                       | R/W    |
| 000907 <sub>H</sub>                          | CAN2 - Bit Timing Register High                  | BTRH2                     |                            | R/W    |
| 000908 <sub>H</sub>                          | CAN2 - Interrupt Register Low                    | INTRL2                    | INTR2                      | R      |
| 000909 <sub>H</sub>                          | CAN2 - Interrupt Register High                   | INTRH2                    |                            | R      |
| 00090A <sub>H</sub>                          | CAN2 - Test Register Low                         | TESTRL2                   | TESTR2                     | R/W    |
| 00090B <sub>H</sub>                          | CAN2 - Test Register High (reserved)             | TESTRH2                   |                            | R      |
| 00090C <sub>H</sub>                          | CAN2 - BRP Extension register Low                | BRPERL2                   | BRPER2                     | R/W    |
| 00090D <sub>H</sub>                          | CAN2 - BRP Extension register High (reserved)    | BRPERH2                   |                            | R      |
| 00090E <sub>H</sub> -<br>00090F <sub>H</sub> | Reserved   |                           |                            | -      |
| 000910 <sub>H</sub>                          | CAN2 - IF1 Command request register Low          | IF1CREQL2                 | IF1CREQ2                   | R/W    |
| 000911 <sub>H</sub>                          | CAN2 - IF1 Command request register High         | IF1CREQH2                 |                            | R/W    |
| 000912 <sub>H</sub>                          | CAN2 - IF1 Command Mask register Low             | IF1CMSKL2                 | IF1CMSK2                   | R/W    |
| 000913 <sub>H</sub>                          | CAN2 - IF1 Command Mask register High (reserved) | IF1CMSKH2                 |                            | R      |
| 000914 <sub>H</sub>                          | CAN2 - IF1 Mask 1 Register Low                   | IF1MSK1L2                 | IF1MSK12                   | R/W    |
| 000915 <sub>H</sub>                          | CAN2 - IF1 Mask 1 Register High                  | IF1MSK1H2                 |                            | R/W    |
| 000916 <sub>H</sub>                          | CAN2 - IF1 Mask 2 Register Low                   | IF1MSK2L2                 | IF1MSK22                   | R/W    |
| 000917 <sub>H</sub>                          | CAN2 - IF1 Mask 2 Register High                  | IF1MSK2H2                 |                            | R/W    |



**I/O map MB96(F)33x (38 of 40)**

| Address                                      | Register   | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|--|--|---------------------------|----------------------------|--------|
| 000918 <sub>H</sub>                          | CAN2 - IF1 Arbitration 1 Register Low            | IF1ARB1L2                 | IF1ARB12                   | R/W    |
| 000919 <sub>H</sub>                          | CAN2 - IF1 Arbitration 1 Register High           | IF1ARB1H2                 |                            | R/W    |
| 00091A <sub>H</sub>                          | CAN2 - IF1 Arbitration 2 Register Low            | IF1ARB2L2                 | IF1ARB22                   | R/W    |
| 00091B <sub>H</sub>                          | CAN2 - IF1 Arbitration 2 Register High           | IF1ARB2H2                 |                            | R/W    |
| 00091C <sub>H</sub>                          | CAN2 - IF1 Message Control Register Low          | IF1MCTRL2                 | IF1MCTR2                   | R/W    |
| 00091D <sub>H</sub>                          | CAN2 - IF1 Message Control Register High         | IF1MCTRH2                 |                            | R/W    |
| 00091E <sub>H</sub>                          | CAN2 - IF1 Data A1 Low                           | IF1DTA1L2                 | IF1DTA12                   | R/W    |
| 00091F <sub>H</sub>                          | CAN2 - IF1 Data A1 High                          | IF1DTA1H2                 |                            | R/W    |
| 000920 <sub>H</sub>                          | CAN2 - IF1 Data A2 Low                           | IF1DTA2L2                 | IF1DTA22                   | R/W    |
| 000921 <sub>H</sub>                          | CAN2 - IF1 Data A2 High                          | IF1DTA2H2                 |                            | R/W    |
| 000922 <sub>H</sub>                          | CAN2 - IF1 Data B1 Low                           | IF1DTB1L2                 | IF1DTB12                   | R/W    |
| 000923 <sub>H</sub>                          | CAN2 - IF1 Data B1 High                          | IF1DTB1H2                 |                            | R/W    |
| 000924 <sub>H</sub>                          | CAN2 - IF1 Data B2 Low                           | IF1DTB2L2                 | IF1DTB22                   | R/W    |
| 000925 <sub>H</sub>                          | CAN2 - IF1 Data B2 High                          | IF1DTB2H2                 |                            | R/W    |
| 000926 <sub>H</sub> -<br>00093F <sub>H</sub> | Reserved   |                           |                            | -      |
| 000940 <sub>H</sub>                          | CAN2 - IF2 Command request register Low          | IF2CREQL2                 | IF2CREQ2                   | R/W    |
| 000941 <sub>H</sub>                          | CAN2 - IF2 Command request register High         | IF2CREQH2                 |                            | R/W    |
| 000942 <sub>H</sub>                          | CAN2 - IF2 Command Mask register Low             | IF2CMSKL2                 | IF2CMSK2                   | R/W    |
| 000943 <sub>H</sub>                          | CAN2 - IF2 Command Mask register High (reserved) | IF2CMSKH2                 |                            | R      |
| 000944 <sub>H</sub>                          | CAN2 - IF2 Mask 1 Register Low                   | IF2MSK1L2                 | IF2MSK12                   | R/W    |
| 000945 <sub>H</sub>                          | CAN2 - IF2 Mask 1 Register High                  | IF2MSK1H2                 |                            | R/W    |
| 000946 <sub>H</sub>                          | CAN2 - IF2 Mask 2 Register Low                   | IF2MSK2L2                 | IF2MSK22                   | R/W    |
| 000947 <sub>H</sub>                          | CAN2 - IF2 Mask 2 Register High                  | IF2MSK2H2                 |                            | R/W    |
| 000948 <sub>H</sub>                          | CAN2 - IF2 Arbitration 1 Register Low            | IF2ARB1L2                 | IF2ARB12                   | R/W    |
| 000949 <sub>H</sub>                          | CAN2 - IF2 Arbitration 1 Register High           | IF2ARB1H2                 |                            | R/W    |
| 00094A <sub>H</sub>                          | CAN2 - IF2 Arbitration 2 Register Low            | IF2ARB2L2                 | IF2ARB22                   | R/W    |
| 00094B <sub>H</sub>                          | CAN2 - IF2 Arbitration 2 Register High           | IF2ARB2H2                 |                            | R/W    |
| 00094C <sub>H</sub>                          | CAN2 - IF2 Message Control Register Low          | IF2MCTRL2                 | IF2MCTR2                   | R/W    |
| 00094D <sub>H</sub>                          | CAN2 - IF2 Message Control Register High         | IF2MCTRH2                 |                            | R/W    |
| 00094E <sub>H</sub>                          | CAN2 - IF2 Data A1 Low                           | IF2DTA1L2                 | IF2DTA12                   | R/W    |

**I/O map MB96(F)33x (39 of 40)**

| Address                                     | Register                                    | Abbreviation 8-bit access | Abbreviation 16-bit access | Access |
|---|---|---------------------------|----------------------------|--------|
| 00094 <sub>H</sub>                          | CAN2 - IF2 Data A1 High                     | IF2DTA1H2                 |                            | R/W    |
| 000950 <sub>H</sub>                         | CAN2 - IF2 Data A2 Low                      | IF2DTA2L2                 | IF2DTA22                   | R/W    |
| 000951 <sub>H</sub>                         | CAN2 - IF2 Data A2 High                     | IF2DTA2H2                 |                            | R/W    |
| 000952 <sub>H</sub>                         | CAN2 - IF2 Data B1 Low                      | IF2DTB1L2                 | IF2DTB12                   | R/W    |
| 000953 <sub>H</sub>                         | CAN2 - IF2 Data B1 High                     | IF2DTB1H2                 |                            | R/W    |
| 000954 <sub>H</sub>                         | CAN2 - IF2 Data B2 Low                      | IF2DTB2L2                 | IF2DTB22                   | R/W    |
| 000955 <sub>H</sub>                         | CAN2 - IF2 Data B2 High                     | IF2DTB2H2                 |                            | R/W    |
| 000956 <sub>H</sub> -<br>00097 <sub>F</sub> | Reserved                                    |                           |                            | -      |
| 000980 <sub>H</sub>                         | CAN2 - Transmission Request 1 Register Low  | TREQR1L2                  | TREQR12                    | R      |
| 000981 <sub>H</sub>                         | CAN2 - Transmission Request 1 Register High | TREQR1H2                  |                            | R      |
| 000982 <sub>H</sub>                         | CAN2 - Transmission Request 2 Register Low  | TREQR2L2                  | TREQR22                    | R      |
| 000983 <sub>H</sub>                         | CAN2 - Transmission Request 2 Register High | TREQR2H2                  |                            | R      |
| 000984 <sub>H</sub> -<br>00098 <sub>F</sub> | Reserved                                    |                           |                            | -      |
| 000990 <sub>H</sub>                         | CAN2 - New Data 1 Register Low              | NEWDT1L2                  | NEWDT12                    | R      |
| 000991 <sub>H</sub>                         | CAN2 - New Data 1 Register High             | NEWDT1H2                  |                            | R      |
| 000992 <sub>H</sub>                         | CAN2 - New Data 2 Register Low              | NEWDT2L2                  | NEWDT22                    | R      |
| 000993 <sub>H</sub>                         | CAN2 - New Data 2 Register High             | NEWDT2H2                  |                            | R      |
| 000994 <sub>H</sub> -<br>00099 <sub>F</sub> | Reserved                                    |                           |                            | -      |
| 0009A0 <sub>H</sub>                         | CAN2 - Interrupt Pending 1 Register Low     | INTPND1L2                 | INTPND12                   | R      |
| 0009A1 <sub>H</sub>                         | CAN2 - Interrupt Pending 1 Register High    | INTPND1H2                 |                            | R      |
| 0009A2 <sub>H</sub>                         | CAN2 - Interrupt Pending 2 Register Low     | INTPND2L2                 | INTPND22                   | R      |
| 0009A3 <sub>H</sub>                         | CAN2 - Interrupt Pending 2 Register High    | INTPND2H2                 |                            | R      |
| 0009A4 <sub>H</sub> -<br>0009A <sub>F</sub> | Reserved                                    |                           |                            | -      |
| 0009B0 <sub>H</sub>                         | CAN2 - Message Valid 1 Register Low         | MSGVAL1L2                 | MSGVAL12                   | R      |
| 0009B1 <sub>H</sub>                         | CAN2 - Message Valid 1 Register High        | MSGVAL1H2                 |                            | R      |
| 0009B2 <sub>H</sub>                         | CAN2 - Message Valid 2 Register Low         | MSGVAL2L2                 | MSGVAL22                   | R      |
| 0009B3 <sub>H</sub>                         | CAN2 - Message Valid 2 Register High        | MSGVAL2H2                 |                            | R      |

**I/O map MB96(F)33x (40 of 40)**

| Address                                      | Register                      | Abbreviation<br>8-bit access | Abbreviation<br>16-bit access | Access |
|--|-------------------------------|------------------------------|-------------------------------|--------|
| 0009B4 <sub>H</sub> -<br>0009CD <sub>H</sub> | Reserved                      |                              |                               | -      |
| 0009CE <sub>H</sub>                          | CAN2 - Output enable register | COER2                        |                               | R/W    |
| 0009CF <sub>H</sub> -<br>000BFF <sub>H</sub> | 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".

## 12. Interrupt Vector Table

Interrupt vector table MB96(F)33x (1 of 5)

| Vector number | Offset in vector table | Vector name | Cleared by DMA | Index in ICR to program | Description            |
|---------------|------------------------|-------------|----------------|-------------------------|------------------------|
| 0             | 3FC <sub>H</sub>       | CALLV0      | No             | -                       |                        |
| 1             | 3F8 <sub>H</sub>       | CALLV1      | No             | -                       |                        |
| 2             | 3F4 <sub>H</sub>       | CALLV2      | No             | -                       |                        |
| 3             | 3F0 <sub>H</sub>       | CALLV3      | No             | -                       |                        |
| 4             | 3EC <sub>H</sub>       | CALLV4      | No             | -                       |                        |
| 5             | 3E8 <sub>H</sub>       | CALLV5      | No             | -                       |                        |
| 6             | 3E4 <sub>H</sub>       | CALLV6      | No             | -                       |                        |
| 7             | 3E0 <sub>H</sub>       | CALLV7      | No             | -                       |                        |
| 8             | 3DC <sub>H</sub>       | RESET       | No             | -                       |                        |
| 9             | 3D8 <sub>H</sub>       | INT9        | No             | -                       |                        |
| 10            | 3D4 <sub>H</sub>       | EXCEPTION   | No             | -                       |                        |
| 11            | 3D0 <sub>H</sub>       | NMI         | No             | -                       | Non-Maskable Interrupt |
| 12            | 3CC <sub>H</sub>       | DLY         | No             | 12                      | Delayed Interrupt      |
| 13            | 3C8 <sub>H</sub>       | RC_TIMER    | No             | 13                      | RC Timer               |
| 14            | 3C4 <sub>H</sub>       | MC_TIMER    | No             | 14                      | Main Clock Timer       |
| 15            | 3C0 <sub>H</sub>       | SC_TIMER    | No             | 15                      | Sub Clock Timer        |
| 16            | 3BC <sub>H</sub>       | PLL_UNLOCK  | No             | 16                      | Reserved               |
| 17            | 3B8 <sub>H</sub>       | EXTINT0     | Yes            | 17                      | External Interrupt 0   |
| 18            | 3B4 <sub>H</sub>       | EXTINT1     | Yes            | 18                      | External Interrupt 1   |
| 19            | 3B0 <sub>H</sub>       | EXTINT2     | Yes            | 19                      | External Interrupt 2   |
| 20            | 3AC <sub>H</sub>       | EXTINT3     | Yes            | 20                      | External Interrupt 3   |
| 21            | 3A8 <sub>H</sub>       | EXTINT4     | Yes            | 21                      | External Interrupt 4   |
| 22            | 3A4 <sub>H</sub>       | EXTINT5     | Yes            | 22                      | External Interrupt 5   |
| 23            | 3A0 <sub>H</sub>       | EXTINT6     | Yes            | 23                      | External Interrupt 6   |
| 24            | 39C <sub>H</sub>       | EXTINT7     | Yes            | 24                      | External Interrupt 7   |
| 25            | 398 <sub>H</sub>       | EXTINT8     | Yes            | 25                      | External Interrupt 8   |
| 26            | 394 <sub>H</sub>       | EXTINT9     | Yes            | 26                      | External Interrupt 9   |

**Interrupt vector table MB96(F)33x (2 of 5)**

| Vector number | Offset in vector table | Vector name | Cleared by DMA | Index in ICR to program | Description                     |
|---------------|------------------------|-------------|----------------|-------------------------|---------------------------------|
| 27            | 390 <sub>H</sub>       | EXTINT10    | Yes            | 27                      | External Interrupt 10           |
| 28            | 38C <sub>H</sub>       | EXTINT11    | Yes            | 28                      | External Interrupt 11           |
| 29            | 388 <sub>H</sub>       | EXTINT12    | Yes            | 29                      | External Interrupt 12           |
| 30            | 384 <sub>H</sub>       | EXTINT13    | Yes            | 30                      | External Interrupt 13           |
| 31            | 380 <sub>H</sub>       | EXTINT14    | Yes            | 31                      | External Interrupt 14           |
| 32            | 37C <sub>H</sub>       | EXTINT15    | Yes            | 32                      | External Interrupt 15           |
| 33            | 378 <sub>H</sub>       | CAN0        | No             | 33                      | CAN Controller 0                |
| 34            | 374 <sub>H</sub>       | CAN1        | No             | 34                      | CAN Controller 1                |
| 35            | 370 <sub>H</sub>       | CAN2        | No             | 35                      | CAN Controller 2                |
| 36            | 36C <sub>H</sub>       | PPG0        | Yes            | 36                      | Programmable Pulse Generator 0  |
| 37            | 368 <sub>H</sub>       | PPG1        | Yes            | 37                      | Programmable Pulse Generator 1  |
| 38            | 364 <sub>H</sub>       | PPG2        | Yes            | 38                      | Programmable Pulse Generator 2  |
| 39            | 360 <sub>H</sub>       | PPG3        | Yes            | 39                      | Programmable Pulse Generator 3  |
| 40            | 35C <sub>H</sub>       | PPG4        | Yes            | 40                      | Programmable Pulse Generator 4  |
| 41            | 358 <sub>H</sub>       | PPG5        | Yes            | 41                      | Programmable Pulse Generator 5  |
| 42            | 354 <sub>H</sub>       | PPG6        | Yes            | 42                      | Programmable Pulse Generator 6  |
| 43            | 350 <sub>H</sub>       | PPG7        | Yes            | 43                      | Programmable Pulse Generator 7  |
| 44            | 34C <sub>H</sub>       | PPG8        | Yes            | 44                      | Programmable Pulse Generator 8  |
| 45            | 348 <sub>H</sub>       | PPG9        | Yes            | 45                      | Programmable Pulse Generator 9  |
| 46            | 344 <sub>H</sub>       | PPG10       | Yes            | 46                      | Programmable Pulse Generator 10 |
| 47            | 340 <sub>H</sub>       | PPG11       | Yes            | 47                      | Programmable Pulse Generator 11 |
| 48            | 33C <sub>H</sub>       | PPG12       | Yes            | 48                      | Programmable Pulse Generator 12 |
| 49            | 338 <sub>H</sub>       | PPG13       | Yes            | 49                      | Programmable Pulse Generator 13 |
| 50            | 334 <sub>H</sub>       | PPG14       | Yes            | 50                      | Programmable Pulse Generator 14 |
| 51            | 330 <sub>H</sub>       | PPG15       | Yes            | 51                      | Programmable Pulse Generator 15 |
| 52            | 32C <sub>H</sub>       | PPG16       | Yes            | 52                      | Programmable Pulse Generator 16 |
| 53            | 328 <sub>H</sub>       | PPG17       | Yes            | 53                      | Programmable Pulse Generator 17 |

**Interrupt vector table MB96(F)33x (3 of 5)**

| Vector number | Offset in vector table | Vector name | Cleared by DMA | Index in ICR to program | Description                        |
|---------------|------------------------|-------------|----------------|-------------------------|------------------------------------|
| 54            | 324 <sub>H</sub>       | PPG18       | Yes            | 54                      | Programmable Pulse Generator 18    |
| 55            | 320 <sub>H</sub>       | PPG19       | Yes            | 55                      | Programmable Pulse Generator 19    |
| 56            | 31C <sub>H</sub>       | RLT0        | Yes            | 56                      | Reload Timer 0                     |
| 57            | 318 <sub>H</sub>       | RLT1        | Yes            | 57                      | Reload Timer 1                     |
| 58            | 314 <sub>H</sub>       | RLT2        | Yes            | 58                      | Reload Timer 2                     |
| 59            | 310 <sub>H</sub>       | RLT3        | Yes            | 59                      | Reload Timer 3                     |
| 60            | 30C <sub>H</sub>       | PPGRLT      | Yes            | 60                      | Reload Timer 6 - dedicated for PPG |
| 61            | 308 <sub>H</sub>       | ICU0        | Yes            | 61                      | Input Capture Unit 0               |
| 62            | 304 <sub>H</sub>       | ICU1        | Yes            | 62                      | Input Capture Unit 1               |
| 63            | 300 <sub>H</sub>       | ICU2        | Yes            | 63                      | Input Capture Unit 2               |
| 64            | 2FC <sub>H</sub>       | ICU3        | Yes            | 64                      | Input Capture Unit 3               |
| 65            | 2F8 <sub>H</sub>       | ICU4        | Yes            | 65                      | Input Capture Unit 4               |
| 66            | 2F4 <sub>H</sub>       | ICU5        | Yes            | 66                      | Input Capture Unit 5               |
| 67            | 2F0 <sub>H</sub>       | ICU6        | Yes            | 67                      | Input Capture Unit 6               |
| 68            | 2EC <sub>H</sub>       | ICU7        | Yes            | 68                      | Input Capture Unit 7               |
| 69            | 2E8 <sub>H</sub>       | ICU8        | Yes            | 69                      | Input Capture Unit 8               |
| 70            | 2E4 <sub>H</sub>       | ICU9        | Yes            | 70                      | Input Capture Unit 9               |
| 71            | 2E0 <sub>H</sub>       | OCU0        | Yes            | 71                      | Output Compare Unit 0              |
| 72            | 2DC <sub>H</sub>       | OCU1        | Yes            | 72                      | Output Compare Unit 1              |
| 73            | 2D8 <sub>H</sub>       | OCU2        | Yes            | 73                      | Output Compare Unit 2              |
| 74            | 2D4 <sub>H</sub>       | OCU3        | Yes            | 74                      | Output Compare Unit 3              |
| 75            | 2D0 <sub>H</sub>       | OCU4        | Yes            | 75                      | Output Compare Unit 4              |
| 76            | 2CC <sub>H</sub>       | OCU5        | Yes            | 76                      | Output Compare Unit 5              |
| 77            | 2C8 <sub>H</sub>       | OCU6        | Yes            | 77                      | Output Compare Unit 6              |
| 78            | 2C4 <sub>H</sub>       | OCU7        | Yes            | 78                      | Output Compare Unit 7              |
| 79            | 2C0 <sub>H</sub>       | OCU8        | Yes            | 79                      | Output Compare Unit 8              |
| 80            | 2BC <sub>H</sub>       | OCU9        | Yes            | 80                      | Output Compare Unit 9              |

**Interrupt vector table MB96(F)33x (4 of 5)**

| Vector number | Offset in vector table | Vector name | Cleared by DMA | Index in ICR to program | Description                |
|---------------|------------------------|-------------|----------------|-------------------------|----------------------------|
| 81            | 2B8 <sub>H</sub>       | OCU10       | Yes            | 81                      | Output Compare Unit 10     |
| 82            | 2B4 <sub>H</sub>       | OCU11       | Yes            | 82                      | Output Compare Unit 11     |
| 83            | 2B0 <sub>H</sub>       | FRT0        | Yes            | 83                      | Free Running Timer 0       |
| 84            | 2AC <sub>H</sub>       | FRT1        | Yes            | 84                      | Free Running Timer 1       |
| 85            | 2A8 <sub>H</sub>       | FRT2        | Yes            | 85                      | Free Running Timer 2       |
| 86            | 2A4 <sub>H</sub>       | FRT3        | Yes            | 86                      | Free Running Timer 3       |
| 87            | 2A0 <sub>H</sub>       | RTC0        | No             | 87                      | Real Timer Clock           |
| 88            | 29C <sub>H</sub>       | CAL0        | No             | 88                      | Clock Calibration Unit     |
| 89            | 298 <sub>H</sub>       | IIC0        | Yes            | 89                      | I <sup>2</sup> C interface |
| 90            | 294 <sub>H</sub>       | IIC1        | Yes            | 90                      | I <sup>2</sup> C interface |
| 91            | 290 <sub>H</sub>       | ADC0        | Yes            | 91                      | A/D Converter              |
| 92            | 28C <sub>H</sub>       | ALARM0      | No             | 92                      | Alarm Comparator 0         |
| 93            | 288 <sub>H</sub>       | ALARM1      | No             | 93                      | Alarm Comparator 1         |
| 94            | 284 <sub>H</sub>       | LINR0       | Yes            | 94                      | LIN USART 0 RX             |
| 95            | 280 <sub>H</sub>       | LINT0       | Yes            | 95                      | LIN USART 0 TX             |
| 96            | 27C <sub>H</sub>       | LINR1       | Yes            | 96                      | LIN USART 1 RX             |
| 97            | 278 <sub>H</sub>       | LINT1       | Yes            | 97                      | LIN USART 1 TX             |
| 98            | 274 <sub>H</sub>       | LINR2       | Yes            | 98                      | LIN USART 2 RX             |
| 99            | 270 <sub>H</sub>       | LINT2       | Yes            | 99                      | LIN USART 2 TX             |
| 100           | 26C <sub>H</sub>       | LINR3       | Yes            | 100                     | LIN USART 3 RX             |
| 101           | 268 <sub>H</sub>       | LINT3       | Yes            | 101                     | LIN USART 3 TX             |
| 102           | 264 <sub>H</sub>       | LINR5       | Yes            | 102                     | LIN USART 5 RX             |
| 103           | 260 <sub>H</sub>       | LINT5       | Yes            | 103                     | LIN USART 5 TX             |
| 104           | 25C <sub>H</sub>       | LINR7       | Yes            | 104                     | LIN USART 7 RX             |
| 105           | 258 <sub>H</sub>       | LINT7       | Yes            | 105                     | LIN USART 7 TX             |
| 106           | 254 <sub>H</sub>       | LINR8       | Yes            | 106                     | LIN USART 8 RX             |
| 107           | 250 <sub>H</sub>       | LINT8       | Yes            | 107                     | LIN USART 8 TX             |

**Interrupt vector table MB96(F)33x (5 of 5)**

| Vector number | Offset in vector table | Vector name | Cleared by DMA | Index in ICR to program | Description                                      |
|---------------|------------------------|-------------|----------------|-------------------------|--|
| 108           | 24C <sub>H</sub>       | LINR9       | Yes            | 108                     | LIN USART 9 RX                                   |
| 109           | 248 <sub>H</sub>       | LINT9       | Yes            | 109                     | LIN USART 9 TX                                   |
| 110           | 244 <sub>H</sub>       | FLASH_A     | No             | 110                     | Main Flash memory interrupt (only Flash devices) |
| 111           | 240 <sub>H</sub>       | reserved    | -              | -                       | reserved   |
| 112           | 23C <sub>H</sub>       | USB_EP0IN0  | Yes            | 112                     | USB End point 0 IN                               |
| 113           | 238 <sub>H</sub>       | USB_EP0OUT0 | Yes            | 113                     | USB End point 0 OUT                              |
| 114           | 234 <sub>H</sub>       | USB_EP10    | Yes            | 114                     | USB End point 1                                  |
| 115           | 230 <sub>H</sub>       | USB_EP20    | Yes            | 115                     | USB End point 2                                  |
| 116           | 22C <sub>H</sub>       | USB_EP30    | Yes            | 116                     | USB End point 3                                  |
| 117           | 228 <sub>H</sub>       | USB_EP40    | Yes            | 117                     | USB End point 4                                  |
| 118           | 224 <sub>H</sub>       | USB_EP50    | Yes            | 118                     | USB End point 5                                  |
| 119           | 220 <sub>H</sub>       | USB_F10     | No             | 119                     | USB function Flags 1 (SUSP SOF BRST WKUP CONF)   |
| 120           | 21C <sub>H</sub>       | USB_F20     | No             | 120                     | USB function Flags 2 (SPK)                       |
| 121           | 218 <sub>H</sub>       | USB_H10     | No             | 121                     | USB MiniHost 1 (DIRQ CNNIRQ URIRQ RWKIRQ)        |
| 122           | 214 <sub>H</sub>       | USB_H20     | No             | 122                     | USB MiniHost 2 (SOFIRQ CMPIRQ)                   |



## 13. 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

### 13.1 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.

### 13.2 Unused pins handling

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

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

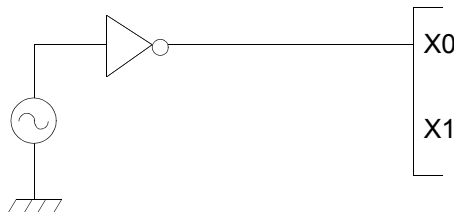
Unused bidirectional pins can be set either to the output state and be then left open, or to the input state with either input disabled or external pull-up/pull-down resistor as described above.

### 13.3 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:

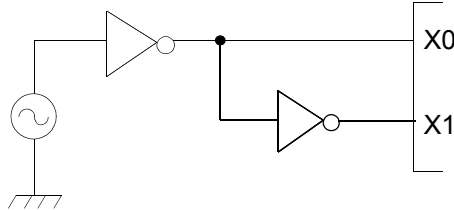
#### 1. Single phase external clock

- 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.



**13.4 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.

**13.5 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.

**13.6 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  $\mu\text{F}$  between  $V_{CC}$  and  $V_{SS}$  as close as possible to  $V_{CC}$  and  $V_{SS}$  pins.

**13.7 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.

**13.8 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).

**13.9 Pin handling when not using the A/D converter**

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

**13.10 Notes on Power-on**

To prevent malfunction of the internal voltage regulator, supply voltage profile while turning the power supply on should be slower than 50  $\mu\text{s}$  from 0.2 V to 2.7 V.

### **13.11 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 0.1V/μs or less in instantaneous fluctuation for power supply switching.

### **13.12 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.

## 14. Electrical Characteristics

### 14.1 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    | $V_{CC} = AV_{CC}^{*1}$   |
| USB power supply voltage                 | $V_{CC3}$          | $V_{SS} - 0.3$ | $V_{SS} + 4.0$ | V    | USB device only   |
| AD Converter voltage references          | AVRH,<br>AVRL      | $V_{SS} - 0.3$ | $V_{SS} + 6.0$ | V    | $AV_{CC} \geq AVRH$ , $AV_{CC} \geq AVRL$ , $AVRH > AVRL$ , $AVRL \geq AV_{SS}$ |
| Input voltage                            | $V_I$              | $V_{SS} - 0.3$ | $V_{SS} + 6.0$ | V    | $V_I \leq V_{CC} + 0.3V^{*2}$   |
| USB Input voltage                        | $V_{IUSB}$         | $V_{SS} - 0.5$ | $V_{SS} + 4.0$ | V    | $V_{IUSB} \leq V_{CC3} + 0.5$<br>(USB pins UDP, UDM)                            |
| Output voltage                           | $V_O$              | $V_{SS} - 0.3$ | $V_{SS} + 6.0$ | V    | $V_O \leq V_{CC} + 0.3V^{*2}$   |
| USB output voltage                       | $V_{OUSB}$         | $V_{SS} - 0.5$ | $V_{SS} + 4.0$ | V    | $V_{OUSB} \leq V_{CC3} + 0.5$<br>(USB pins UDP, UDM)                            |
| Maximum Clamp Current                    | $I_{CLAMP}$        | -4.0           | +4.0           | mA   | Applicable to general purpose I/O pins <sup>*3</sup>                            |
| Total Maximum Clamp Current              | $\sum  I_{CLAMP} $ | -              | 40             | mA   | Applicable to general purpose I/O pins <sup>*3</sup>                            |
| "L" level maximum output current         | $I_{OL1}$          | -              | 15             | mA   | Normal outputs with driving strength set to 5mA                                 |
|  | $I_{OLUSB}$        | -              | 36             | mA   | USB pins UDP, UDM   |
| "L" level average output current         | $I_{OLAV1}$        | -              | 5              | mA   | Normal outputs with driving strength set to 5mA                                 |
|  | $I_{OLAVUSB}$      | -              | 15             | mA   | USB pins UDP, UDM   |
| "L" level maximum overall output current | $\sum I_{OL1}$     | -              | 100            | mA   | Normal outputs  |
| "L" level average overall output current | $\sum I_{OLAV1}$   | -              | 50             | mA   | Normal outputs  |
| "H" level maximum output current         | $I_{OH1}$          | -              | -15            | mA   | Normal outputs with driving strength set to 5mA                                 |
|  | $I_{OHUSB}$        | -              | -36            | mA   | USB pins UDP, UDM   |
| "H" level average output current         | $I_{OHAV1}$        | -              | -5             | mA   | Normal outputs with driving strength set to 5mA                                 |
|  | $I_{OHAVUSB}$      | -              | -15            | mA   | USB pins UDP, UDM   |
| "H" level maximum overall output current | $\sum I_{OH1}$     | -              | -100           | mA   | Normal outputs  |
| "H" level average overall output current | $\sum I_{OHAV1}$   | -              | -50            | mA   | Normal outputs  |

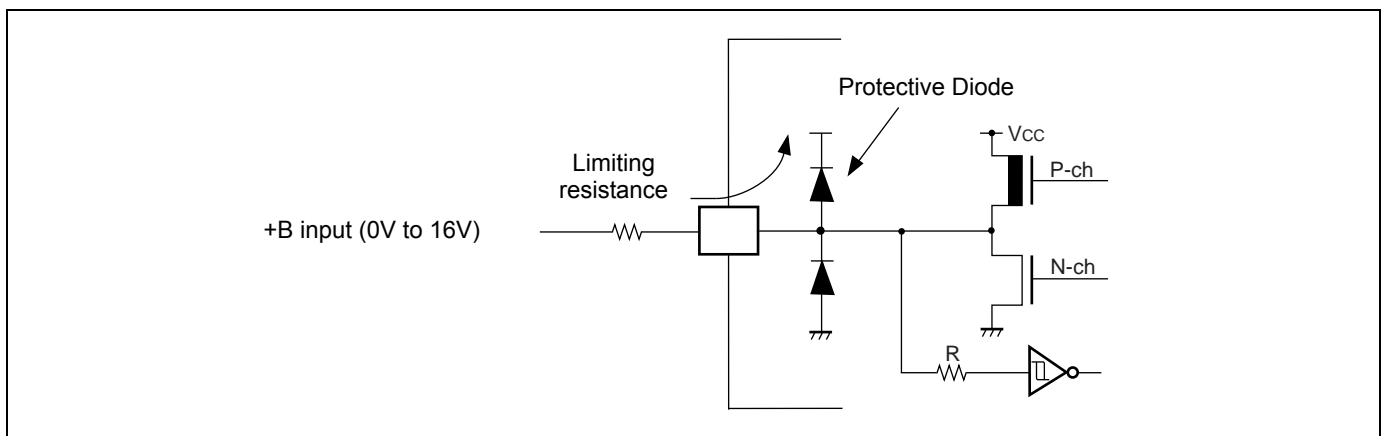
| Parameter                                      | Symbol           | Rating |       | Unit | Remarks  |
|--|------------------|--------|-------|------|--|
|  |                  | Min    | Max   |      |  |
| Permitted Power dissipation (Flash devices) *4 | P <sub>D</sub>   | -      | 370*5 | mW   | T <sub>A</sub> =105°C  |
|  |                  | -      | 740*5 | mW   | T <sub>A</sub> =85°C   |
|  |                  | -      | 460*5 | mW   | T <sub>A</sub> =125°C, no Flash program/erase, MB96(F)338Y/R only *6 |
|  |                  | -      | 550*5 | mW   | T <sub>A</sub> =120°C, no Flash program/erase, MB96(F)338Y/R only *6 |
| Operating ambient temperature                  | T <sub>A</sub>   | 0      | +70   | °C   | MB96V300B  |
|  |                  | -40    | +105  |      | MB96(F)33x   |
|  |                  | -40    | +125  |      | MB96(F)338Y/R*6  |
| Storage temperature                            | T <sub>STG</sub> | -55    | +150  | °C   |  |

\*1: AV<sub>CC</sub> and V<sub>CC</sub> must be set to the same voltage. It is required that AV<sub>CC</sub> does not exceed V<sub>CC</sub> and that the voltage at the analog inputs does not exceed AV<sub>CC</sub> neither when the power is switched on.

\*2: V<sub>I</sub> and V<sub>O</sub> should not exceed V<sub>CC</sub> + 0.3 V. V<sub>I</sub> should also not exceed the specified ratings. However if the maximum current to/from an input is limited by some means with external components, the I<sub>CLAMP</sub> rating supersedes the V<sub>I</sub> rating. Input/output voltages of standard ports depend on V<sub>CC</sub>.

- \*3:
- Applicable to all general purpose I/O pins (Pnn\_m)
  - 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).

• Sample recommended circuits:



\*4: The maximum permitted power dissipation depends on the ambient temperature, the air flow velocity and the thermal conductance of the package on the PCB.

The actual power dissipation depends on the customer application and can be calculated as follows:

$$P_D = P_{IO} + P_{INT}$$

$$P_{IO} = \sum (V_{OL} * I_{OL} + V_{OH} * I_{OH}) \text{ (IO load power dissipation, sum is performed on all IO ports)}$$

$$P_{INT} = V_{CC} * (I_{CC} + I_A) \text{ (internal power dissipation)}$$

$I_{CC}$  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.

**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.

**14.2 Recommended Operating Conditions**

| Parameter                    | Symbol    | Value |     |     | Unit    | Remarks  |
|------------------------------|-----------|-------|-----|-----|---------|--|
|                              |           | Min   | Typ | Max |         |  |
| Power supply voltage         | $V_{CC}$  | 3.0   | -   | 5.5 | V       |  |
| USB power supply voltage     | $V_{CC3}$ | 3.0   | 3.3 | 3.6 | V       | USB device only  |
| Smoothing capacitor at C pin | $C_S$     | 4.7   | -   | 10  | $\mu F$ | 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 Cypress representatives beforehand.

**14.3 DC characteristics**
 $(T_A = -40^{\circ}\text{C to } 125^{\circ}\text{C}, V_{CC} = AV_{CC} = 3.0\text{V to } 5.5\text{V}, V_{CC3} = 3.0\text{V to } 3.6\text{V}, V_{SS} = AV_{SS} = 0\text{V})$ 

| Parameter       | Symbol             | Pin                  | Condition                                       | Value            |                |                 | Unit | Remarks                   |
|-----------------|--------------------|----------------------|---|------------------|----------------|-----------------|------|---------------------------|
|                 |                    |                      |   | Min              | Typ            | Max             |      |                           |
| Input H voltage | $V_{IH}$           | Port inputs<br>Pnn_m | CMOS Hysteresis<br>0.8/0.2 input<br>selected    | 0.8<br>$V_{CC}$  | -              | $V_{CC} + 0.3$  | V    |                           |
|                 |                    |                      | CMOS Hysteresis<br>0.7/0.3 input<br>selected    | 0.7<br>$V_{CC}$  | -              | $V_{CC} + 0.3$  | V    | $V_{CC} \geq 4.5\text{V}$ |
|                 |                    |                      |   | 0.74<br>$V_{CC}$ | -              | $V_{CC} + 0.3$  | V    | $V_{CC} < 4.5\text{V}$    |
|                 |                    |                      | AUTOMOTIVE<br>Hysteresis input<br>selected      | 0.8<br>$V_{CC}$  | -              | $V_{CC} + 0.3$  | V    |                           |
|                 | TTL input selected | 2.0                  | -   | $V_{CC} + 0.3$   | V              |                 |      |                           |
|                 | $V_{IHUSB}$        | UDP, UDM             | -   | 2.0              | -              | $V_{CC3} + 0.3$ | V    | USB pins                  |
|                 | $V_{IHx0F}$        | X0                   | External clock in<br>"Fast Clock Input<br>mode" | 0.8<br>$V_{CC}$  | -              | $V_{CC} + 0.3$  | V    |                           |
|                 | $V_{IHx0S}$        | X0,X1,<br>X0A,X1A    | External clock in<br>"oscillation mode"         | 2.5              | -              | $V_{CC} + 0.3$  | V    |                           |
|                 | $V_{IHR}$          | RSTX                 | -   | 0.8<br>$V_{CC}$  | -              | $V_{CC} + 0.3$  | V    | CMOS Hysteresis input     |
| $V_{IHM}$       | MD2-MD0            | -                    | $V_{CC} - 0.3$                                  | -                | $V_{CC} + 0.3$ | V               |      |                           |



( $T_A = -40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ ,  $V_{CC} = AV_{CC} = 3.0\text{V}$  to  $5.5\text{V}$ ,  $V_{CC3} = 3.0\text{V}$  to  $3.6\text{V}$ ,  $V_{SS} = AV_{SS} = 0\text{V}$ )

| Parameter        | Symbol      | Pin  | Condition  | Value          |                |               | Unit                  | Remarks                        |
|------------------|-------------|--|--|----------------|----------------|---------------|-----------------------|--------------------------------|
|                  |             |  |  | Min            | Typ            | Max           |                       |                                |
| Input L voltage  | $V_{IL}$    | Port inputs<br>Pnn_m   | CMOS Hysteresis<br>0.8/0.2 input<br>selected                         | $V_{SS} - 0.3$ | -              | $0.2 V_{CC}$  | V                     |                                |
|                  |             |  | CMOS Hysteresis<br>0.7/0.3 input<br>selected                         | $V_{SS} - 0.3$ | -              | $0.3 V_{CC}$  | V                     |                                |
|                  |             |  | AUTOMOTIVE<br>Hysteresis input<br>selected                           | $V_{SS} - 0.3$ | -              | $0.5 V_{CC}$  | V                     | $V_{CC} \geq 4.5\text{V}$      |
|                  |             |  |  | $V_{SS} - 0.3$ | -              | $0.46 V_{CC}$ |                       | $V_{CC} < 4.5\text{V}$         |
|                  |             |  | TTL input selected   | $V_{SS} - 0.3$ | -              | 0.8           | V                     |                                |
|                  | $V_{ILUSB}$ | UDP, UDM   | -  | $V_{SS} - 0.3$ | -              | 0.8           | V                     | USB pins                       |
|                  | $V_{ILX0F}$ | X0   | External clock in<br>"Fast Clock Input<br>mode"                      | $V_{SS} - 0.3$ | -              | $0.2 V_{CC}$  | V                     |                                |
|                  | $V_{ILX0S}$ | X0,X1,<br>X0A,X1A  | External clock in<br>"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             |                       |                                |
| Output H voltage | $V_{OH2}$   | Normal out-<br>puts  | $4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$<br>$I_{OH} = -2\text{mA}$ | $V_{CC} - 0.5$ | -              | -             | V                     | Driving strength set to<br>2mA |
|                  |             |  | $3.0\text{V} \leq V_{CC} < 4.5\text{V}$<br>$I_{OH} = -1.6\text{mA}$  |                |                |               |                       |                                |
|                  | $V_{OH5}$   | Normal out-<br>puts  | $4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$<br>$I_{OH} = -5\text{mA}$ | $V_{CC} - 0.5$ | -              | -             | V                     | Driving strength set to<br>5mA |
|                  |             |  | $3.0\text{V} \leq V_{CC} < 4.5\text{V}$<br>$I_{OH} = -3\text{mA}$    |                |                |               |                       |                                |
| $V_{OH3}$        | 3mA outputs | $4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$<br>$I_{OH} = -3\text{mA}$ | $V_{CC} - 0.5$   | -              | -              | V             |                       |                                |
|                  |             | $3.0\text{V} \leq V_{CC} < 4.5\text{V}$<br>$I_{OH} = -2\text{mA}$    |  |                |                |               |                       |                                |
| $V_{OHUSB}$      | UDP, UDM    | $3.0\text{V} \leq V_{CC3} < 3.6\text{V}$<br>$I_{OH} = -20\text{mA}$  | $V_{CC3} - 0.4$  | -              | -              | V             | USB pins              |                                |

( $T_A = -40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ ,  $V_{CC} = AV_{CC} = 3.0\text{V}$  to  $5.5\text{V}$ ,  $V_{CC3} = 3.0\text{V}$  to  $3.6\text{V}$ ,  $V_{SS} = AV_{SS} = 0\text{V}$ )

| Parameter              | Symbol      | Pin  | Condition  | Value |     |     | Unit             | Remarks                     |                             |
|------------------------|-------------|--|--|-------|-----|-----|------------------|-----------------------------|-----------------------------|
|                        |             |  |  | Min   | Typ | Max |                  |                             |                             |
| Output L voltage       | $V_{OL2}$   | Normal outputs   | $4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$<br>$I_{OL} = +2\text{mA}$   | -     | -   | 0.4 | V                | Driving strength set to 2mA |                             |
|                        |             |  | $3.0\text{V} \leq V_{CC} < 4.5\text{V}$<br>$I_{OL} = +1.6\text{mA}$    |       |     |     |                  |                             |                             |
|                        | $V_{OL5}$   | Normal outputs   | $4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$<br>$I_{OL} = +5\text{mA}$   | -     | -   | 0.4 | V                |                             | Driving strength set to 5mA |
|                        |             |  | $3.0\text{V} \leq V_{CC} < 4.5\text{V}$<br>$I_{OL} = +3\text{mA}$      |       |     |     |                  |                             |                             |
| $V_{OL3}$              | 3mA outputs | $3.0\text{V} \leq V_{CC} \leq 5.5\text{V}$<br>$I_{OL} = +3\text{mA}$ | -  | -     | 0.4 | V   |                  |                             |                             |
| $V_{OLUSB}$            | UDP, UDM    | $3.0\text{V} \leq V_{CC3} < 3.6\text{V}$<br>$I_{OL} = +20\text{mA}$  | -  | -     | 0.4 | V   | USB pins         |                             |                             |
| Input leak current     | $I_{IL}$    | Pnn_m<br>(except USB pins)   | $V_{SS} < V_I < V_{CC}$<br>$AV_{SS}, AV_{RL} < V_I < AV_{CC}, AV_{RH}$ | -1    | -   | +1  | $\mu\text{A}$    | Single port pin             |                             |
| USB input leak current |             | UDP, UDM   | $V_{SS} < V_I < V_{CC3}$   | -5    | -   | +5  | $\mu\text{A}$    | USB pins                    |                             |
| Pull-up resistance     | $R_{UP}$    | Pnn_m,<br>RSTX   | $V_{CC} = 3.3\text{V} \pm 10\%$  | 40    | 100 | 160 | $\text{k}\Omega$ |                             |                             |
|                        |             |  | $V_{CC} = 5.0\text{V} \pm 10\%$  | 25    | 50  | 100 | $\text{k}\Omega$ |                             |                             |

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

| Parameter  | Symbol   | Condition (at $T_A$ )   |        | Value |     |  | Remarks   |   |
|--|--|---|--------|-------|-----|--|---|---|
|  |  |   |        | Typ   | Max | Unit   |   |   |
| Power supply current in Run modes*   | $I_{CCPLL}$  | PLL Run mode with<br>CLKS1/2 = 48MHz, CLKB =<br>CLKP1/2 = 24MHz,<br>CLKP3 = 48MHz | +25°C  | 39    | 47  | mA   | CLKRC and CLKSC stopped.<br>Core voltage at 1.9V<br>0 Flash/ROM wait states                           |   |
|  |  |   | +125°C | 40    | 50  |  |   |   |
|  |  | PLL Run mode with<br>CLKS1/2 = CLKB =<br>CLKP1/3 = 48MHz,<br>CLKP2 = 24MHz        | +25°C  | 45    | 57  | mA   |   | CLKRC and CLKSC stopped.<br>Core voltage at 1.9V<br>2 Flash/ROM wait states |
|  |  |   | +125°C | 46    | 60  |  |   |   |
|  |  | PLL Run mode with<br>CLKS1/2 = 96MHz,<br>CLKB = CLKP1/3 = 48MHz,<br>CLKP2 = 24MHz | +25°C  | 56    | 68  | mA   |   | CLKRC and CLKSC stopped.<br>Core voltage at 1.9V<br>1 Flash/ROM wait state  |
|  |  |   | +125°C | 57    | 71  |  |   |   |
|  | $I_{CCMAIN}$   | Main Run mode with<br>CLKS1/2 = CLKB =<br>CLKP1/2/3 = 4MHz                        | +25°C  | 5     | 6   | mA   | CLKPLL, CLKSC and CLKRC<br>stopped<br>1 Flash/ROM wait state  |   |
|  |  |   | +125°C | 5.6   | 9   |  |   |   |
|  | $I_{CCRCH}$  | RC Run mode with<br>CLKS1/2 = CLKB =<br>CLKP1/2/3 = 2MHz                          | +25°C  | 2.9   | 4   | mA   | CLKMC, CLKPLL and CLKSC<br>stopped<br>1 Flash/ROM wait state  |   |
|  |  |   | +125°C | 3.5   | 6.5 |  |   |   |
|  | $I_{CCRCL}$  | RC Run mode with<br>CLKS1/2 = CLKB =<br>CLKP1/2/3 = 100kHz,<br>SMCR:LPMS = 0      | +25°C  | 0.4   | 0.6 | mA   | CLKMC, CLKPLL and CLKSC<br>stopped. Voltage regulator in<br>high power mode<br>1 Flash/ROM wait state |   |
|  |  |   | +125°C | 0.9   | 3.5 |  |   |   |
| RC Run mode with<br>CLKS1/2 = CLKB =<br>CLKP1/2/3 = 100kHz,<br>SMCR:LPMS = 1 |  | +25°C   | 0.15   | 0.25  | mA  | CLKMC, CLKPLL and CLKSC<br>stopped. Voltage regulator in<br>low power mode, no Flash<br>programming/erasing allowed.<br>1 Flash/ROM wait state |   |   |
|  |  | +125°C  | 0.65   | 3.2   |     |  |   |   |
| $I_{CCSUB}$  | Sub Run mode with<br>CLKS1/2 = CLKB =<br>CLKP1/2/3 = 32kHz | +25°C   | 0.1    | 0.2   | mA  | CLKMC, CLKPLL and CLKRC<br>stopped, no Flash<br>programming/erasing allowed.<br>1 Flash/ROM wait state   |   |   |
|  |  | +125°C  | 0.6    | 3     |     |  |   |   |

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

| Parameter                            | Symbol  | Condition (at $T_A$ )  |        | Value |      |                                    | Remarks   |
|--------------------------------------|---|--|--------|-------|------|------------------------------------|---|
|                                      |   |  |        | Typ   | Max  | Unit                               |   |
| Power supply current in Sleep modes* | $I_{CCSPLL}$  | PLL Sleep mode with<br>CLKS1/2 = 48MHz,<br>CLKP1/2 = 24MHz<br>CLKP3 = 48MHz  | +25°C  | 12.5  | 15   | mA                                 | CLKRC and CLKSC stopped.<br>Core voltage at 1.9V                            |
|                                      |   |  | +125°C | 13.3  | 17.5 |                                    |   |
|                                      |   | PLL Sleep mode with<br>CLKS1/2 = CLKP1/3 =<br>48MHz,<br>CLKP2 = 24MHz        | +25°C  | 17    | 20   | mA                                 | CLKRC and CLKSC stopped.<br>Core voltage at 1.9V                            |
|                                      |   |  | +125°C | 17.8  | 22.5 |                                    |   |
|                                      |   | PLL Sleep mode with<br>CLKS1/2 = 96MHz,<br>CLKP1/3 = 48MHz,<br>CLKP2 = 24MHz | +25°C  | 19    | 22   | mA                                 | CLKRC and CLKSC stopped.<br>Core voltage at 1.9V                            |
|                                      |   |  | +125°C | 19.8  | 24.5 |                                    |   |
|                                      | $I_{CCSMAN}$  | Main Sleep mode with<br>CLKS1/2 = CLKP1/2/3 =<br>4MHz                        | +25°C  | 1.9   | 2.3  | mA                                 | CLKPLL, CLKSC and CLKRC<br>stopped  |
|                                      |   |  | +125°C | 2.4   | 5    |                                    |   |
|                                      | $I_{CCSRCH}$  | RC Sleep mode with<br>CLKS1/2 = CLKP1/2/3 =<br>2MHz                          | +25°C  | 0.9   | 1.4  | mA                                 | CLKMC, CLKPLL and CLKSC<br>stopped  |
|                                      |   |  | +125°C | 1.5   | 4.1  |                                    |   |
|                                      | $I_{CCSRCL}$  | RC Sleep mode with<br>CLKS1/2 = CLKP1/2/3 =<br>100kHz,<br>SMCR:LPMSS = 0     | +25°C  | 0.3   | 0.5  | mA                                 | CLKMC, CLKPLL and CLKSC<br>stopped. Voltage regulator in<br>high power mode |
|                                      |   |  | +125°C | 0.8   | 3.4  |                                    |   |
|                                      |   | RC Sleep mode with<br>CLKS1/2 = CLKP1/2/3 =<br>100kHz,<br>SMCR:LPMSS = 1     | +25°C  | 0.06  | 0.15 | mA                                 | CLKMC, CLKPLL and CLKSC<br>stopped. Voltage regulator in<br>low power mode  |
|                                      |   |  | +125°C | 0.56  | 3    |                                    |   |
| $I_{CCSSUB}$                         | Sub Sleep mode with<br>CLKS1/2 = CLKP1/2/3 =<br>32kHz | +25°C  | 0.04   | 0.12  | mA   | CLKMC, CLKPLL and CLKRC<br>stopped |   |
|                                      |   | +125°C   | 0.54   | 2.9   |      |                                    |   |

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

| Parameter                            | Symbol                               | Condition (at $T_A$ )                                   |        | Value |      |                                    | Remarks   |
|--------------------------------------|--------------------------------------|---|--------|-------|------|------------------------------------|---|
|                                      |                                      |   |        | Typ   | Max  | Unit                               |   |
| Power supply current in Timer modes* | $I_{\text{CCTPLL}}$                  | PLL Timer mode with<br>CLKMC = 4MHz,<br>CLKPLL = 48MHz  | +25°C  | 1.6   | 2    | mA                                 | CLKRC and CLKSC stopped.<br>Core voltage at 1.9V                            |
|                                      |                                      |   | +125°C | 2.1   | 4.8  |                                    |   |
|                                      | $I_{\text{CCTMAIN}}$                 | Main Timer mode with<br>CLKMC = 4MHz,<br>SMCR:LPMSS = 0 | +25°C  | 0.35  | 0.5  | mA                                 | CLKPLL, CLKRC and CLKSC<br>stopped. Voltage regulator in<br>high power mode |
|                                      |                                      |   | +125°C | 0.85  | 3.3  |                                    |   |
|                                      |                                      | Main Timer mode with<br>CLKMC = 4MHz,<br>SMCR:LPMSS = 1 | +25°C  | 0.1   | 0.15 | mA                                 | CLKPLL, CLKRC and CLKSC<br>stopped. Voltage regulator in<br>low power mode  |
|                                      |                                      |   | +125°C | 0.6   | 2.9  |                                    |   |
|                                      | $I_{\text{CCTRCH}}$                  | RC Timer mode with<br>CLKRC = 2MHz,<br>SMCR:LPMSS = 0   | +25°C  | 0.35  | 0.5  | mA                                 | CLKMC, CLKPLL and CLKSC<br>stopped. Voltage regulator in<br>high power mode |
|                                      |                                      |   | +125°C | 0.85  | 3.3  |                                    |   |
|                                      |                                      | RC Timer mode with<br>CLKRC = 2MHz,<br>SMCR:LPMSS = 1   | +25°C  | 0.1   | 0.15 | mA                                 | CLKMC, CLKPLL and CLKSC<br>stopped. Voltage regulator in<br>low power mode  |
|                                      |                                      |   | +125°C | 0.6   | 2.9  |                                    |   |
|                                      | $I_{\text{CCTRCL}}$                  | RC Timer mode with<br>CLKRC = 100kHz,<br>SMCR:LPMSS = 0 | +25°C  | 0.3   | 0.45 | mA                                 | CLKMC, CLKPLL and CLKSC<br>stopped. Voltage regulator in<br>high power mode |
|                                      |                                      |   | +125°C | 0.8   | 3.2  |                                    |   |
|                                      |                                      | RC Timer mode with<br>CLKRC = 100kHz,<br>SMCR:LPMSS = 1 | +25°C  | 0.05  | 0.1  | mA                                 | CLKMC, CLKPLL and CLKSC<br>stopped. Voltage regulator in<br>low power mode  |
|                                      |                                      |   | +125°C | 0.55  | 2.8  |                                    |   |
| $I_{\text{CCTSUB}}$                  | Sub Timer mode with<br>CLKSC = 32kHz | +25°C   | 0.03   | 0.1   | mA   | CLKMC, CLKPLL and CLKRC<br>stopped |   |
|                                      |                                      | +125°C  | 0.53   | 2.8   |      |                                    |   |

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

| Parameter  | Symbol        | Condition (at $T_A$ )                       |        | Value |      |               | Remarks   |
|--|---------------|---|--------|-------|------|---------------|---|
|  |               |   |        | Typ   | Max  | Unit          |   |
| Stop Mode  | $I_{CCH}$     | VRCR:LPMB[2:0] = 110 <sub>B</sub>           | +25°C  | 0.02  | 0.08 | mA            | Core voltage at 1.8V  |
|  |               |   | +125°C | 0.52  | 2.8  |               |   |
|  |               | VRCR:LPMB[2:0] = 000 <sub>B</sub>           | +25°C  | 0.015 | 0.06 | mA            | Core voltage at 1.2V  |
|  |               |   | +125°C | 0.4   | 2.3  |               |   |
| Power supply current for active Low Voltage detector | $I_{CCLVD}$   | Low voltage detector enabled (RCR:LVDE = 1) | +25°C  | 90    | 140  | $\mu\text{A}$ | This current must be added to all Power supply currents above               |
|  |               |   | +125°C | 100   | 150  |               |   |
| Clock modulator current                              | $I_{CCLOMO}$  | Clock modulator enabled (CMCR: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                                    | $C_{IN}$      | -   | -      | 5     | 15   | pF            | Other than C, $AV_{CC}$ , $AV_{SS}$ , $AVRH$ , $AVRL$ , $V_{CC}$ , $V_{SS}$ |

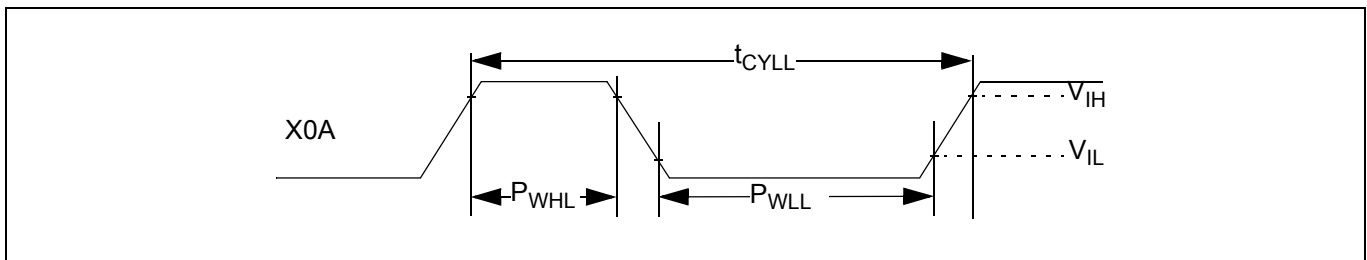
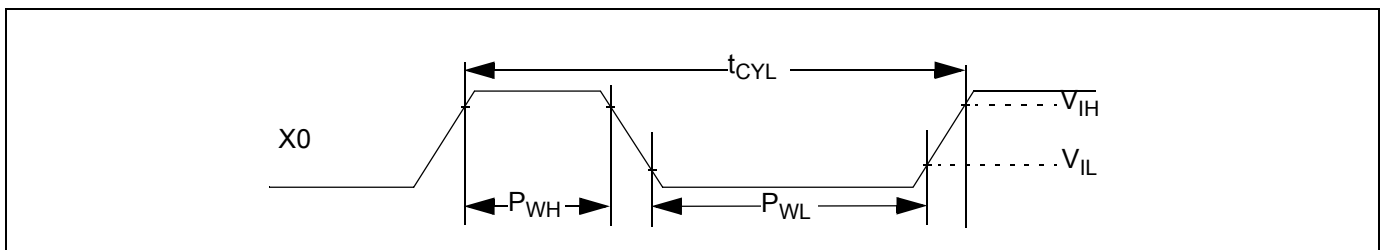
\*: The power supply current is measured with a 4MHz external clock connected to the Main oscillator and a 32kHz external clock connected to the Sub oscillator. See chapter "Standby mode and voltage regulator control circuit" of the Hardware Manual for further details about voltage regulator control.

**14.4 AC Characteristics**

**Source Clock timing**

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

| Parameter               | Symbol             | Pin      | Value |        |         | Unit          | Remarks  |
|-------------------------|--------------------|----------|-------|--------|---------|---------------|--|
|                         |                    |          | Min   | Typ    | Max     |               |  |
| Clock frequency         | $f_C$              | X0, X1   | 3     | -      | 16      | MHz           | When using a crystal oscillator, PLL off                                     |
|                         |                    |          | 0     | -      | 16      | MHz           | When using an opposite phase external clock, PLL off                         |
|                         |                    |          | 3.5   | -      | 16      | MHz           | When using a crystal oscillator or opposite phase external clock, PLL on     |
| Clock frequency         | $f_{FCI}$          | X0       | 0     | -      | 56      | MHz           | When using a single phase external clock in "Fast Clock Input mode", PLL off |
|                         |                    |          | 3.5   | -      | 56      | MHz           | When using a single phase external clock in "Fast Clock Input mode". 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        | $T_{PSKEW}$        | -        | -     | -      | $\pm 5$ | ns            | For CLKMC (PLL input clock) $\geq 4\text{MHz}$                               |
| 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     | -      | -       | $\mu\text{s}$ |  |



**Internal Clock timing**

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

| Parameter  | Symbol                               | Core Voltage Settings |      |      |     | Unit | Remarks           |
|--|--------------------------------------|-----------------------|------|------|-----|------|-------------------|
|  |                                      | 1.8V                  |      | 1.9V |     |      |                   |
|  |                                      | Min                   | Max  | Min  | Max |      |                   |
| Internal System clock frequency (CLKS1 and CLKS2)                                | $f_{\text{CLKS1}}, f_{\text{CLKS2}}$ | 0                     | 92   | 0    | 96  | MHz  | Others than below |
|  |                                      | 0                     | 90   | 0    | 96  | MHz  | MB96F33x          |
| Internal CPU clock frequency (CLKB), internal peripheral clock frequency (CLKP1) | $f_{\text{CLKB}}, f_{\text{CLKP1}}$  | 0                     | 52   | 0    | 56  | MHz  | Others than below |
|  |                                      | 0                     | 43.5 | 0    | 48  | MHz  | MB96F33x          |
| Internal peripheral clock frequency (CLKP2)                                      | $f_{\text{CLKP2}}$                   | 0                     | 28   | 0    | 32  | MHz  |                   |
| Internal peripheral clock frequency (Clock CLKP3)                                | $f_{\text{CLKP3}}$                   | 0                     | 43.5 | 0    | 48  | MHz  | MB96F33x          |

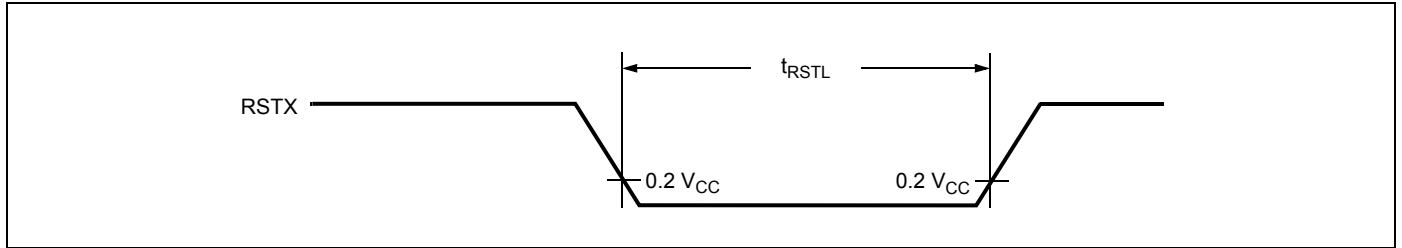
**WARNING:** For USB usage, it is important to change the voltage regulator setting to output 1.9V. Please refer to the chapter Standby Mode and Voltage Regulator control circuit of the hardware manual to perform such setting.



**External Reset timing**

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

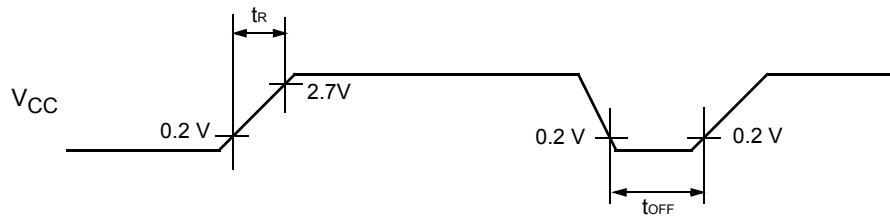
| Parameter        | Symbol     | Pin  | Value |     |     | Unit | Remarks |
|------------------|------------|------|-------|-----|-----|------|---------|
|                  |            |      | Min   | Typ | Max |      |         |
| Reset input time | $t_{RSTL}$ | RSTX | 500   | -   | -   | ns   |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



**Power On Reset timing**

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

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



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

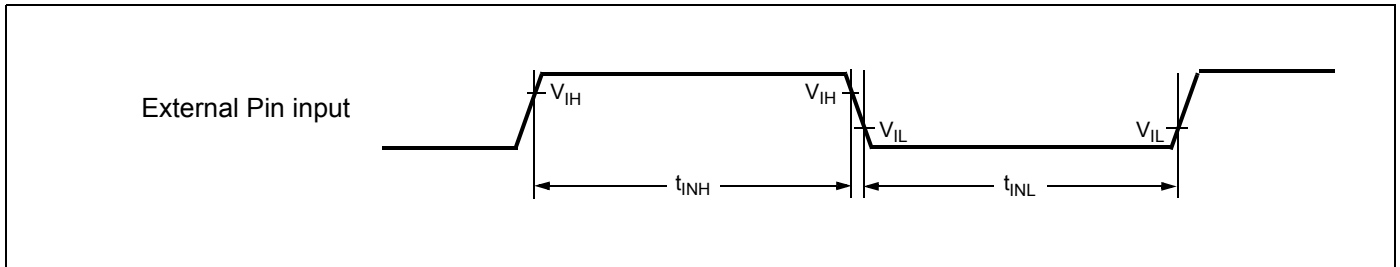


**External Input timing**

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

| Parameter         | Symbol                 | Pin       | Condition | Value  |     | Unit | Used Pin input function           |
|-------------------|------------------------|-----------|-----------|--|-----|------|-----------------------------------|
|                   |                        |           |           | Min  | Max |      |                                   |
| Input pulse width | $t_{INH}$<br>$t_{INL}$ | INTn(_R)  | —         | 200  | —   | ns   | External Interrupt                |
|                   |                        | NMI(_R)   |           |  |     |      | NMI                               |
|                   |                        | Pnn_m     |           | $2 \cdot t_{CLKP1} + 200$<br>( $t_{CLKP1} = 1/f_{CLKP1}$ ) | —   | 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



**External Bus timing**

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

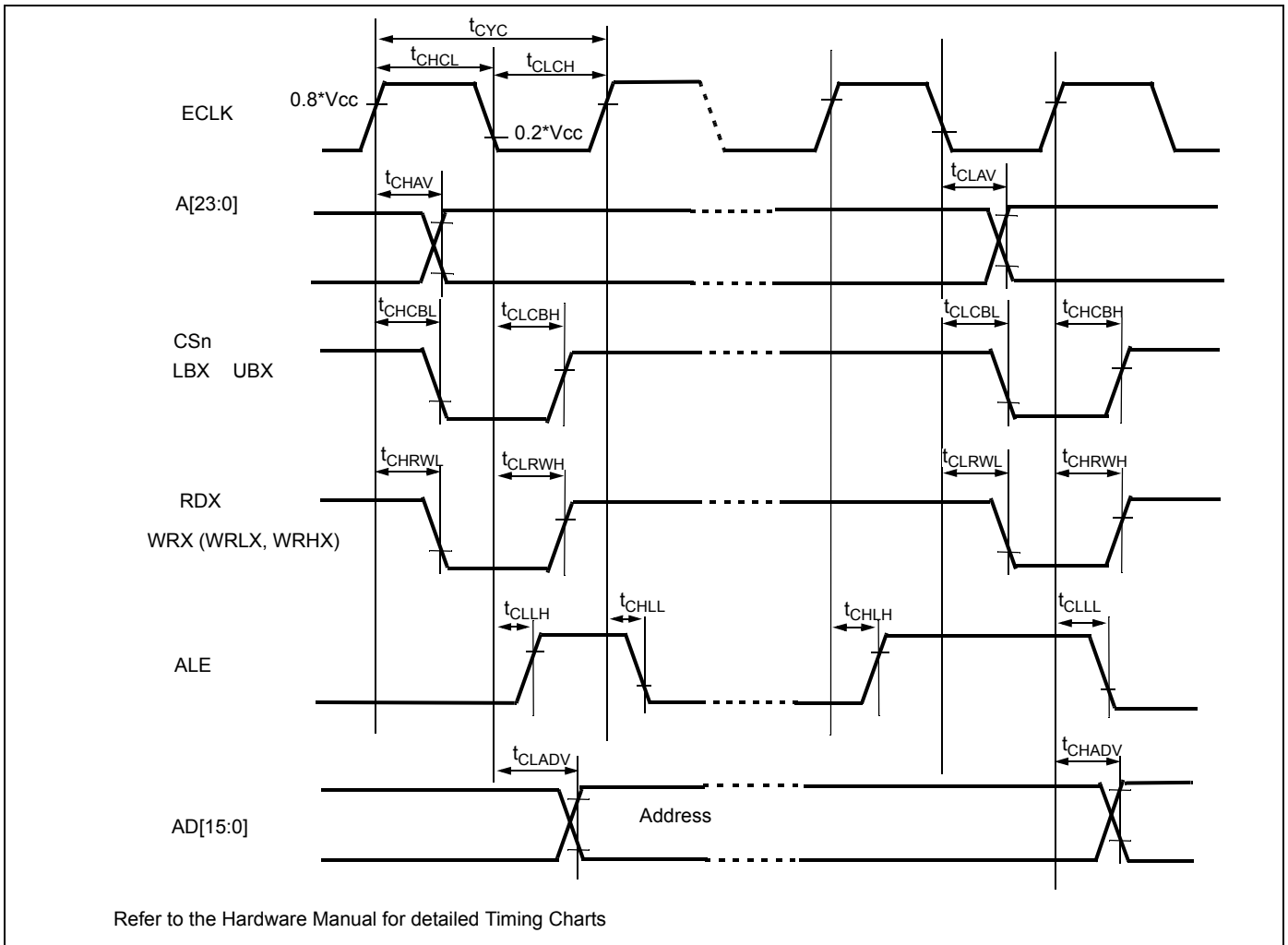
**Basic Timing**

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

| 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 →<br>UBX/ LBX / CSn time                  | $t_{CHCBH}$ | CSn, UBX,<br>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<br>(non-multiplexed) | $t_{CHAV}$  | A[23:0], ECLK                    | EBM:NMS=1 | -15           | 15            | ns   |         |
|  | $t_{CLAV}$  |                                  |           | -15           | 15            |      |         |
| ECLK → address valid time<br>(multiplexed)     | $t_{CHAV}$  | A[23:16], ECLK                   | EBM:NMS=0 | -15           | 15            | ns   |         |
|  | $t_{CLAV}$  |                                  |           | -15           | 15            |      |         |
|  | $t_{CLADV}$ | AD[15:0],<br>ECLK                | EBM:NMS=0 | -15           | 15            | ns   |         |
|  | $t_{CHADV}$ |                                  |           | -15           | 15            |      |         |
| ECLK → RDX /WRX time                           | $t_{CHRWH}$ | RDX, WRX,<br>WRLX, WRHX,<br>ECLK | —         | -10           | 10            | ns   |         |
|  | $t_{CHRWL}$ |                                  |           | -10           | 10            |      |         |
|  | $t_{CLRWH}$ |                                  |           | -10           | 10            |      |         |
|  | $t_{CLRWL}$ |                                  |           | -10           | 10            |      |         |

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

| Parameter                                      | Symbol      | Pin                              | Condition | Value         |               | Unit | Remarks |
|--|-------------|----------------------------------|-----------|---------------|---------------|------|---------|
|  |             |                                  |           | Min           | Max           |      |         |
| 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 →<br>UBX/ LBX / CSn time                  | $t_{CHCBH}$ | CSn, UBX, LBX,<br>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<br>(non-multiplexed) | $t_{CHAV}$  | A[23:0], ECLK                    | EBM:NMS=1 | -20           | 20            | ns   |         |
|  | $t_{CLAV}$  |                                  |           | -20           | 20            |      |         |
| ECLK → address valid time<br>(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,<br>WRLX, WRHX,<br>ECLK | —         | -15           | 15            | ns   |         |
|  | $t_{CHRWL}$ |                                  |           | -15           | 15            |      |         |
|  | $t_{CLRWH}$ |                                  |           | -15           | 15            |      |         |
|  | $t_{CLRWL}$ |                                  |           | -15           | 15            |      |         |



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

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

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

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

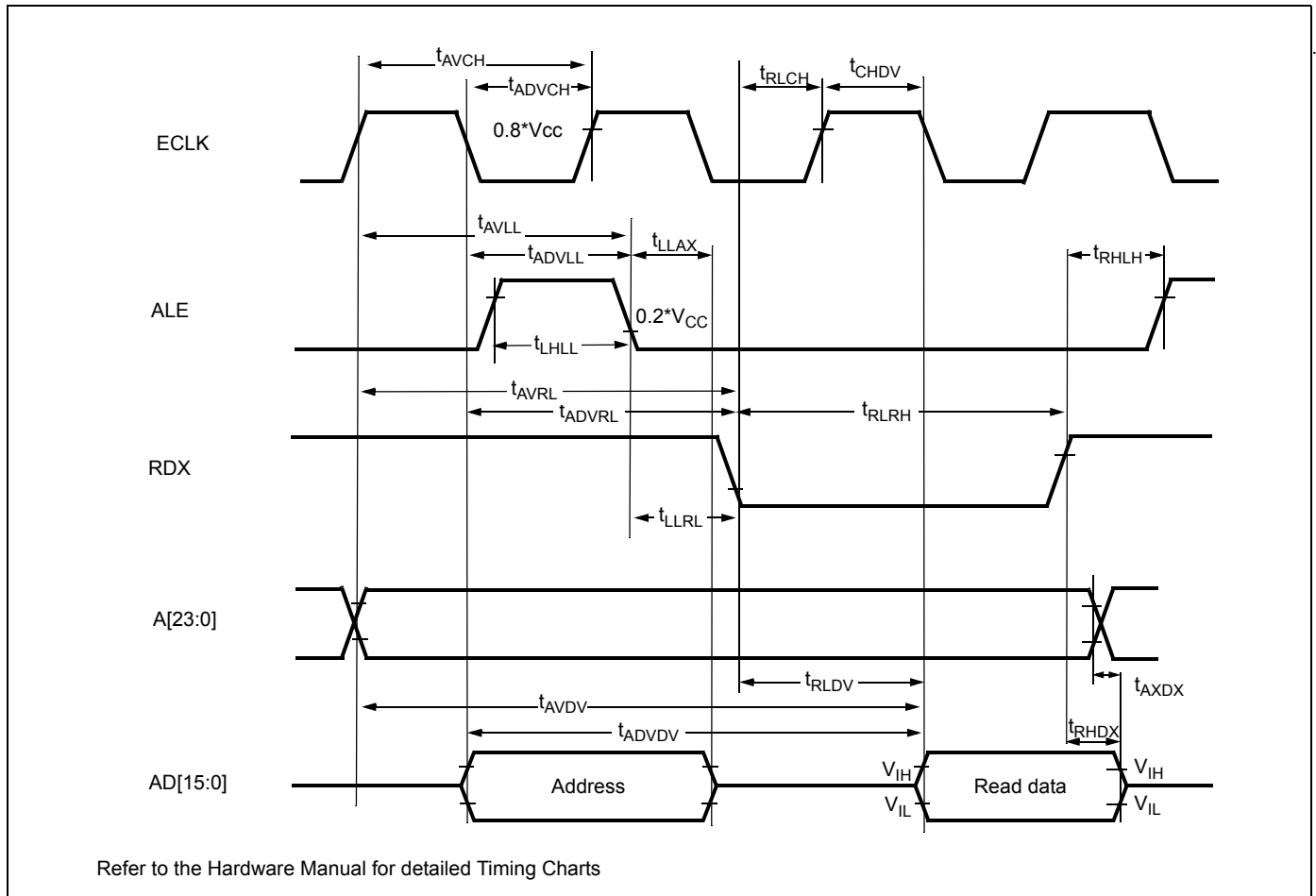


( $T_A = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $V_{CC} = 3.0$  to  $4.5\text{V}$ ,  $V_{SS} = 0.0\text{V}$ ,  $I_{Odrive} = 5\text{mA}$ ,  $C_L = 50\text{pF}$ )

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

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

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



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

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

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

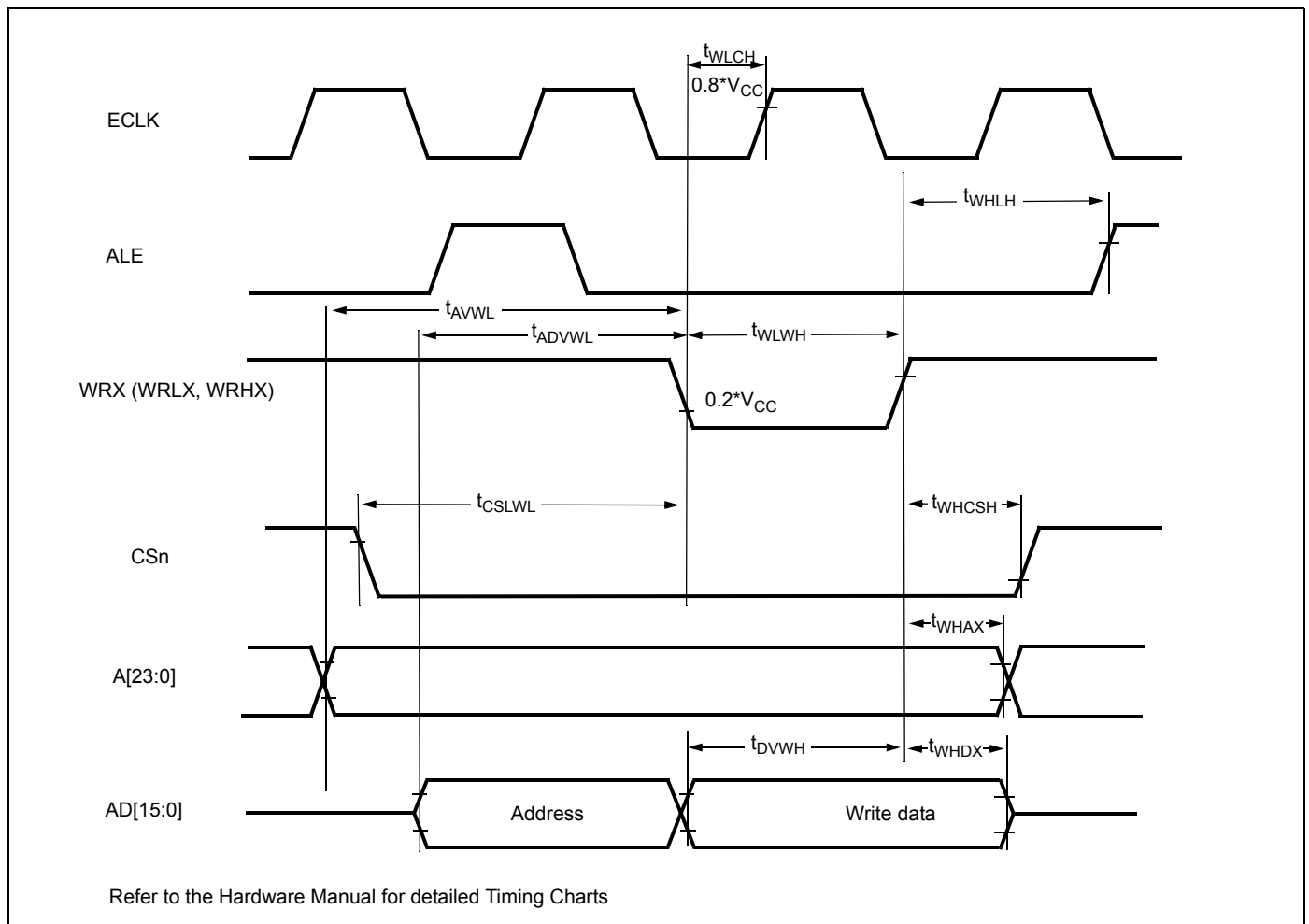
| Parameter                                       | Symbol      | Pin                     | Condition               | Value            |     | Unit | Remarks |
|---|-------------|-------------------------|-------------------------|------------------|-----|------|---------|
|   |             |       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

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

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

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

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



**Ready Input Timing**

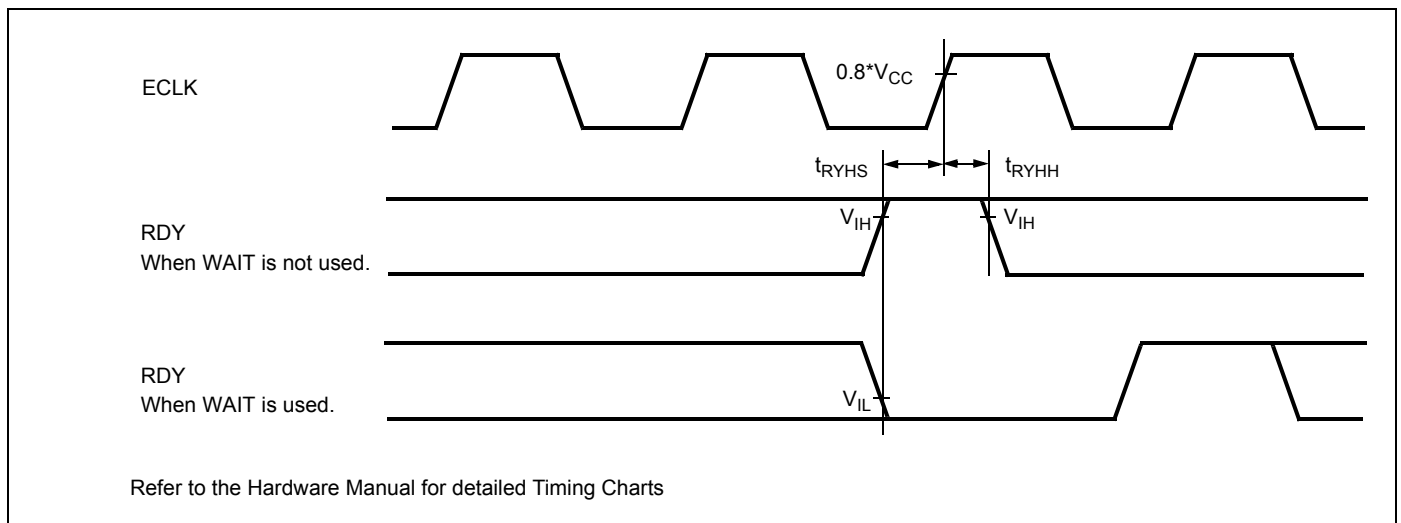
( $T_A = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $V_{CC} = 5.0\text{ V} \pm 10\%$ ,  $V_{SS} = 0.0\text{ V}$ ,  $I_{Odrive} = 5\text{mA}$ ,  $C_L = 50\text{pF}$ )

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

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

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

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

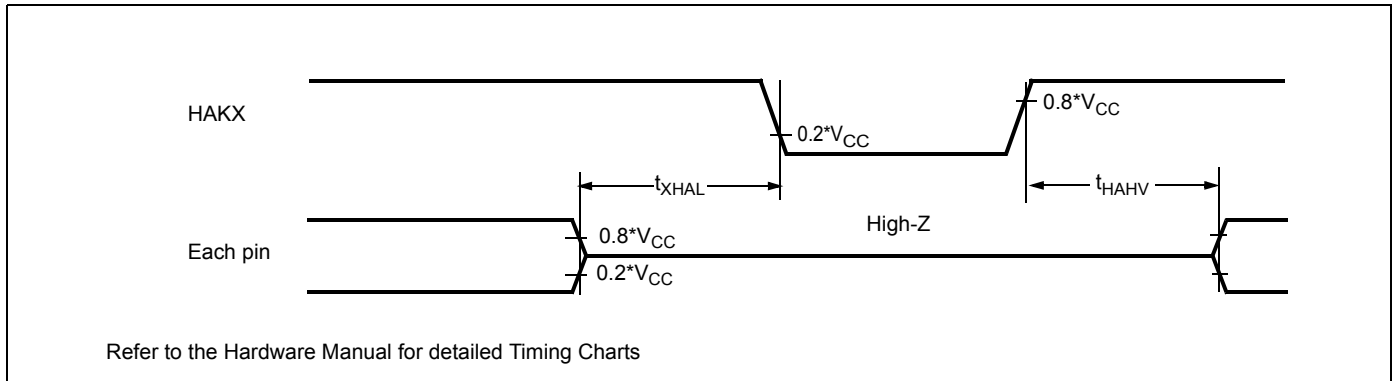


**Hold Timing**
 $(T_A = -40^{\circ}\text{C to } +125^{\circ}\text{C}, V_{CC} = 5.0\text{ V} \pm 10\%, V_{SS} = 0.0\text{ V}, I_{O_{drive}} = 5\text{mA}, C_L = 50\text{pF})$ 

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

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

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





**USART timing**

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

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

| Parameter                    | Symbol      | Pin        | Condition                 | $V_{CC} = AV_{CC} = 4.5V$<br>to $5.5V$ |                    | $V_{CC} = AV_{CC} = 3.0V$ to $4.5V$ |                    | 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 |                           | $N * t_{CLKP1} - 20$                   | —                  | $N * t_{CLKP1} - 30$                | —                  | 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   |

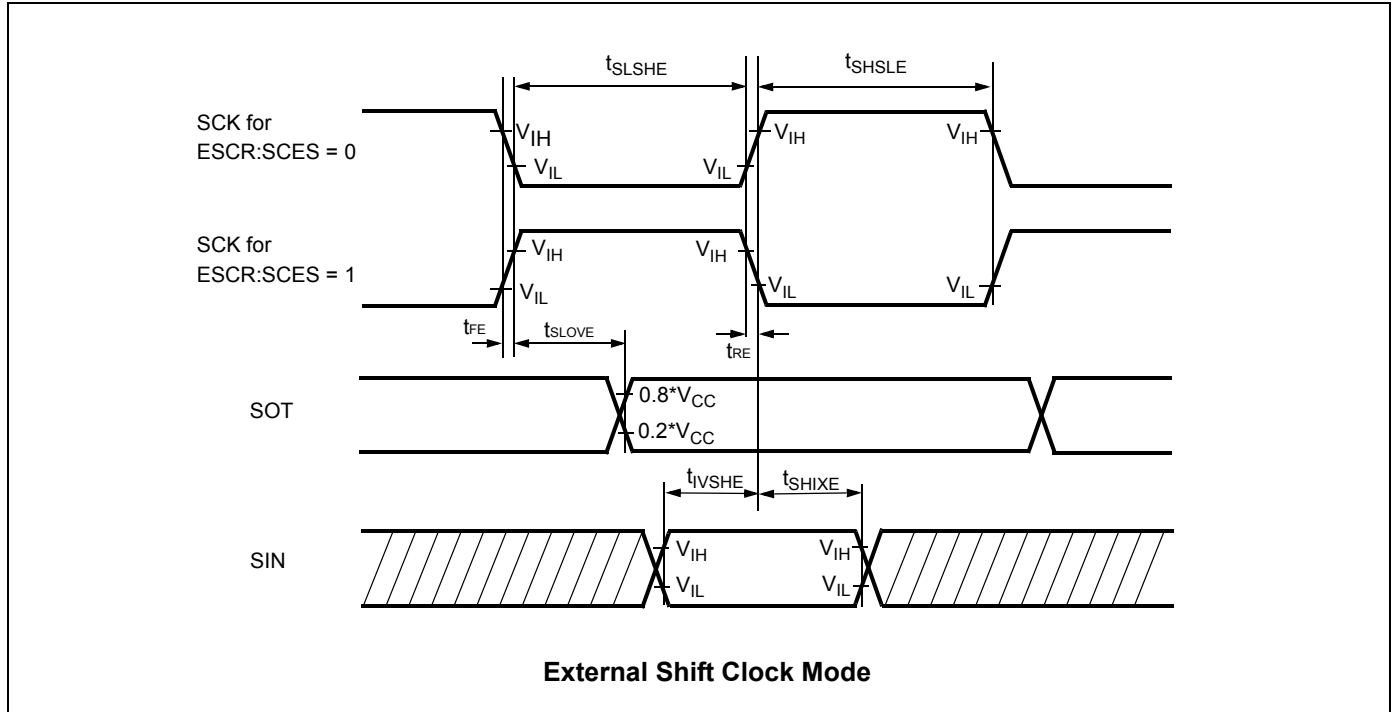
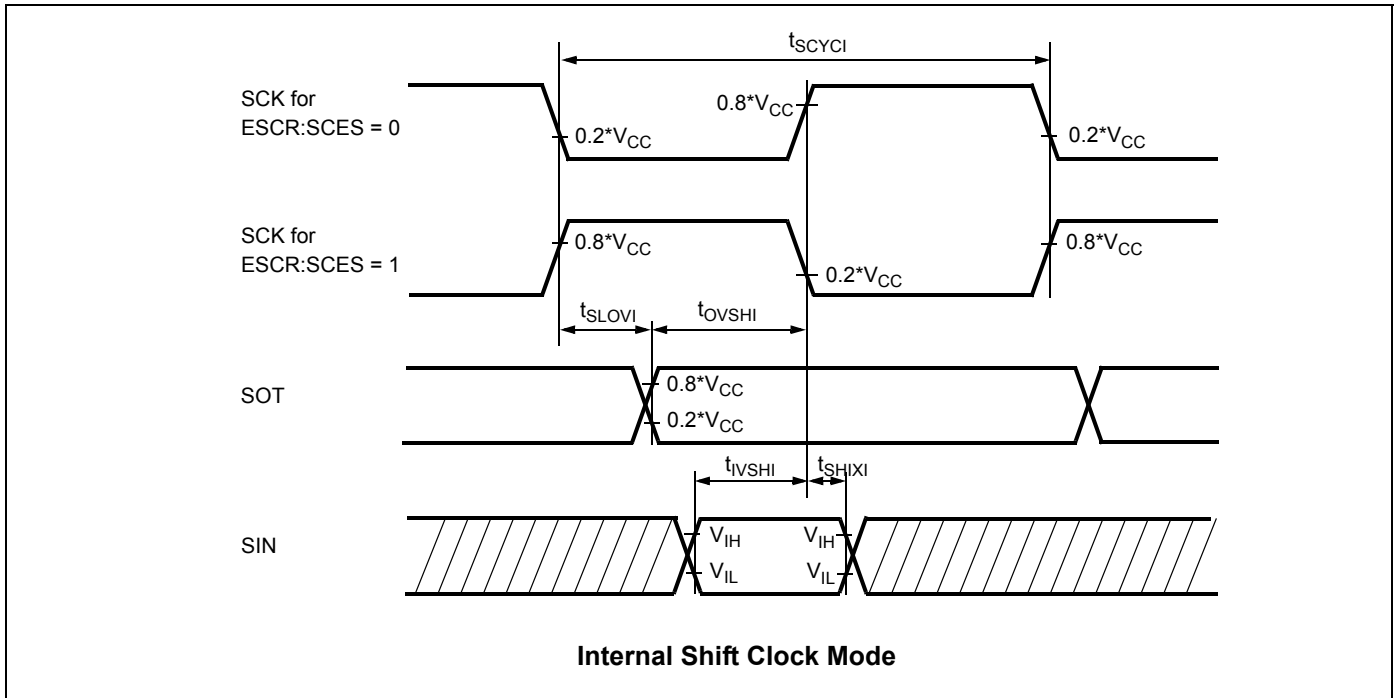
- Notes:
- AC characteristic in CLK synchronized mode.
  - $C_L$  is the load capacity value of pins when testing.
  - Depending on the used machine clock frequency, the maximum possible baud rate can be limited by some parameters. These parameters are shown in “MB96330 Super series Hardware Manual”
  - $t_{CLKP1}$  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   |
| ...                            | ... |



**I<sup>2</sup>C Timing**

(T<sub>A</sub> = -40°C to 125°C, V<sub>CC</sub> = AV<sub>CC</sub> = 3.0V to 5.5V, V<sub>SS</sub> = AV<sub>SS</sub> = 0V)

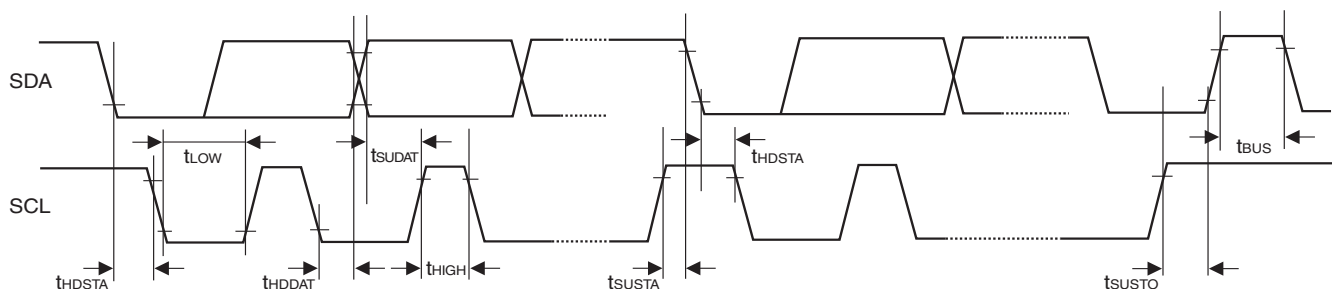
| Parameter   | Symbol             | Condition                              | Standard-mode |                    | Fast-mode* <sup>4</sup> |                   | Unit |
|---|--------------------|--|---------------|--------------------|-------------------------|-------------------|------|
|   |       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

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

\*2 : The maximum t<sub>HDDAT</sub> have only to be met if the device does not stretch the “L” width (t<sub>LOW</sub>) of the SCL signal.

\*3 : A Fast-mode I<sup>2</sup>C-bus device can be used in a Standard-mode I<sup>2</sup>C-bus system, but the requirement t<sub>SUDAT</sub> ≥ 250 ns must then be met.

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



**14.5 USB Characteristics**

( $T_A = -40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$ ,  $V_{CC} = AV_{CC} = 3.0\text{V}$  to  $5.5\text{V}$ ,  $V_{SS} = AV_{SS} = 0\text{V}$ ,  $V_{CC3} = 3.0\text{V}$  to  $3.6\text{V}$ , USB pins UDP and UDM)

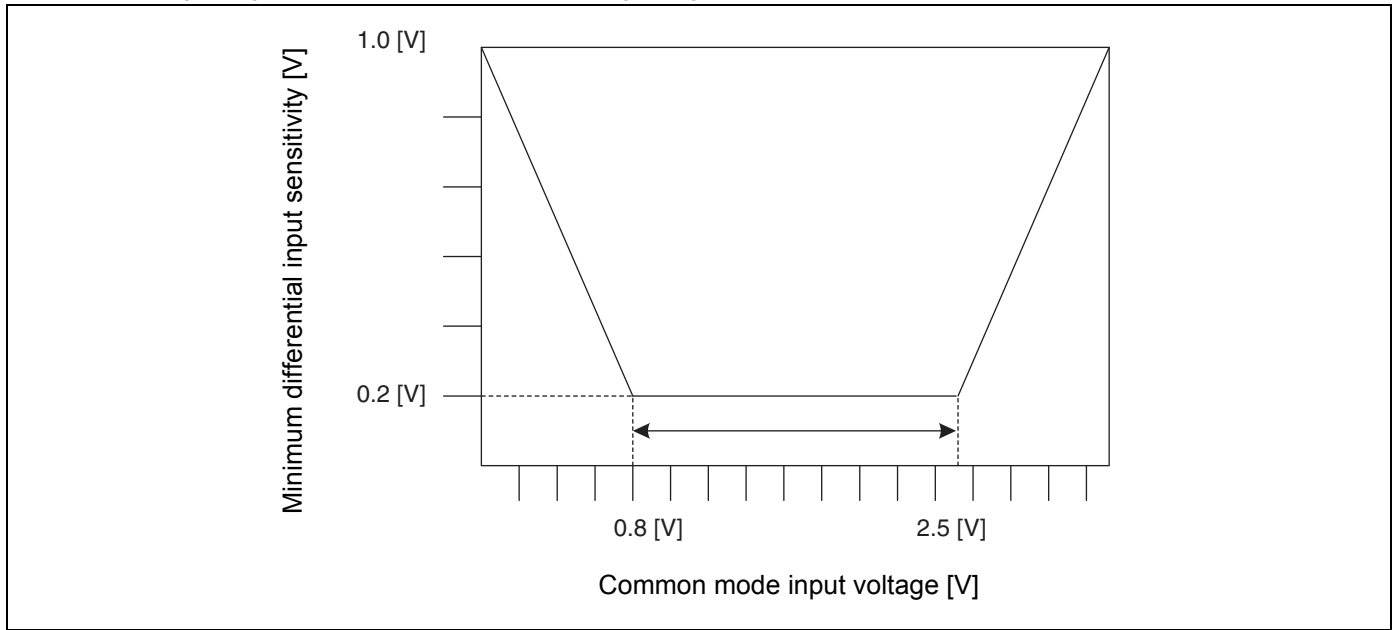
| Parameter              | Symbol                                    | Conditions | Value   |                | Unit           | Remarks  |                                 |
|------------------------|---|------------|---|----------------|----------------|----------|---------------------------------|
|                        |   |            | Min   | Max            |                |          |                                 |
| Input characteristics  | Input High level voltage                  | $V_{IH}$   | —   | 2.0            | $V_{CC} + 0.3$ | V        | *1                              |
|                        | Input Low level voltage                   | $V_{IL}$   | —   | $V_{SS} - 0.3$ | 0.8            | V        | *1                              |
|                        | Differential input sensitivity            | $V_{DI}$   | —   | 0.2            | —              | V        | *2                              |
|                        | Differential common mode input voltage    | $V_{CM}$   | —   | 0.8            | 2.5            | V        | *2                              |
| Output characteristics | Output High level voltage                 | $V_{OH}$   | External pull-down resistance = $15\text{ k}\Omega$ | 2.8            | 3.6            | V        | *3                              |
|                        | Output Low level voltage                  | $V_{OL}$   | External pull-up resistance = $1.5\text{ k}\Omega$  | 0.0            | 0.3            | V        | *3                              |
|                        | Crossover voltage                         | $V_{CRS}$  | —   | 1.3            | 2.0            | V        | *4                              |
|                        | Rise time                                 | $t_{FR}$   | —   | 4              | 20             | nS       | *5                              |
|                        | Fall time                                 | $t_{FF}$   | —   | 4              | 20             | nS       | *5                              |
|                        | Rise/fall time matching                   | $t_{RFM}$  | —   | 90             | 111.11         | %        | *5                              |
|                        | Output impedance                          | $Z_{DRV}$  | —   | 28             | 44             | $\Omega$ | Including $R_s = 27\ \Omega$    |
| Input capacitance      | Transceiver edge rate control capacitance | $C_{EDGE}$ | —   | —              | 75             | pF       | *6                              |
| Series resistance      |   | $R_S$      | —   | 25             | 30             | $\Omega$ | Recommended value: $27\ \Omega$ |

\*1 : The switching threshold voltage of Single-End-Receiver of USB I/O buffer is set as within  $V_{IL}$  (Max) = 0.8 [V],  $V_{IH}$  (Min) = 2.0 [V] (TTL input standard).  
There are some hystereses to lower noise sensitivity.

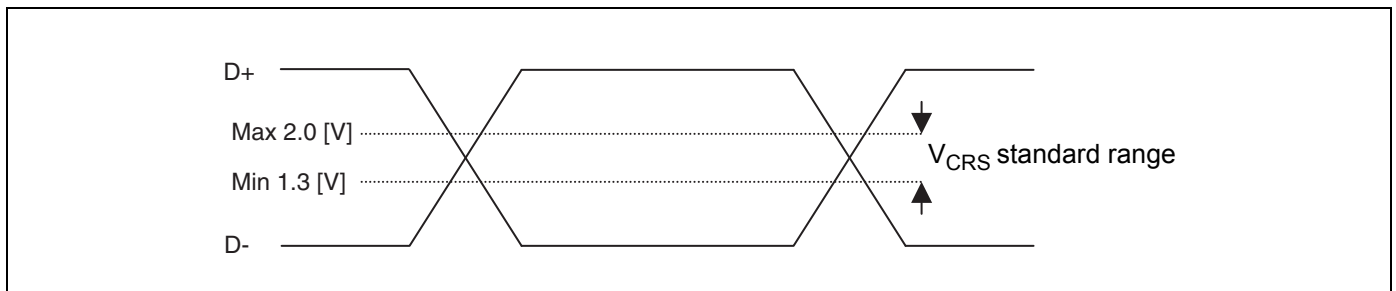
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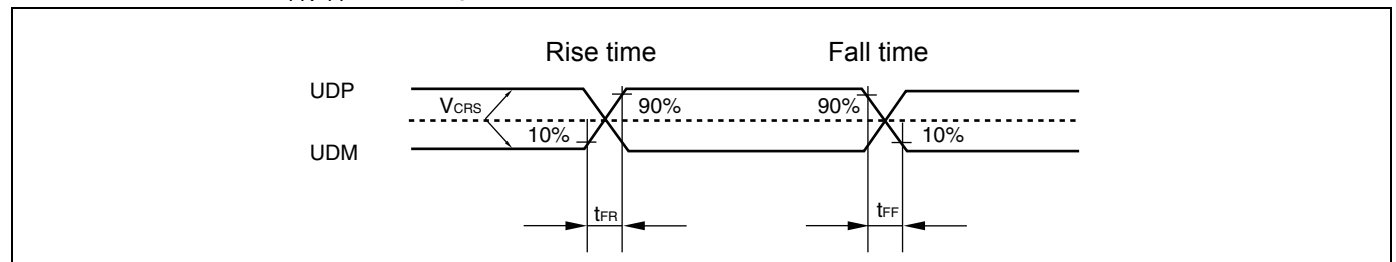
- \*2 : Use differential-Receiver to receive USB differential data signal.  
 Differential-Receiver has 200 [mV] of differential input sensitivity when the differential data input is within 0.8 [V] to 2.5 [V] to the local ground reference level.  
 Above voltage range is the common mode input voltage range.



- \*3 : The output drive capability of the driver is below 0.3 [V] at Low-State ( $V_{OL}$ ) (to 3.6 [V] and 1.5 k $\Omega$  load), and 2.8 [V] or above (to the  $V_{SS}$  and 1.5 k $\Omega$  load).
- \*4 : The cross voltage of the external differential output signal ( $D + /D -$ ) of USB I/O buffer is within 1.3 [V] to 2.0 [V].



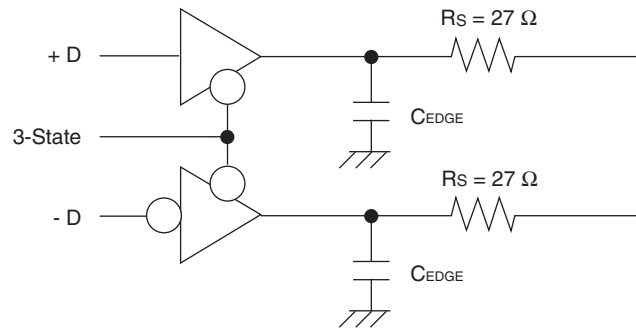
- \*5 : Regarding  $t_{FR}$ ,  $t_{FF}$ ,  $t_{RFM}$   
 They indicate rise time ( $T_{rise}$ ) and fall time ( $T_{fall}$ ) of the differential data signal.  
 They are defined by the time between 10% to 90% of the output signal voltage.  
 For full-speed buffer,  $t_{FR}/t_{FF}$  ratio is regulated as within  $\pm 10\%$  to minimize RFI emission.



(Continued)

(Continued)

\*6 : The place to connect transceiver edge rate control capacitance  $C_{EDGE}$   
 For this USB I/O, it is recommended to use  $C_{EDGE}$  control capacitor.  
 For USB Max standard as 75 pF, please control the edge characteristic of output waveform by connecting 30 to 50 [pF] (recommended value : 47 [pF]  $\approx$  50[pF]) to D + and D – lines when implementing on the board.



Driver output impedance  $3 \Omega$  to  $19 \Omega$   
 $R_s$  serial resistance value  $25 \Omega$  to  $30 \Omega$   
 Please apply  $27 \Omega$  of serial resistance value as a recommended value.

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

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

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

**Definition of A/D Converter Terms**

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

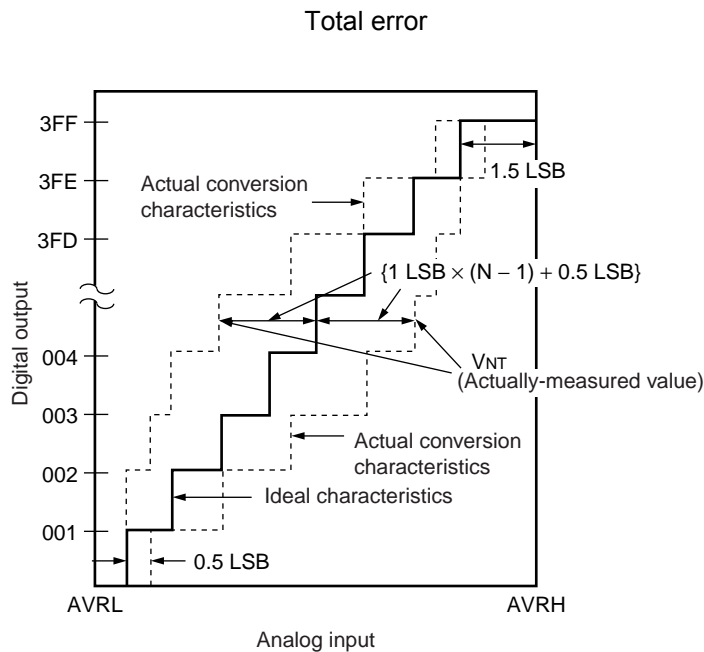
Total error: Difference between the actual value and the ideal value. The total error includes zero transition error, full-scale transition error and nonlinearity error.

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

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

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

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



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

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

N: A/D converter digital output value

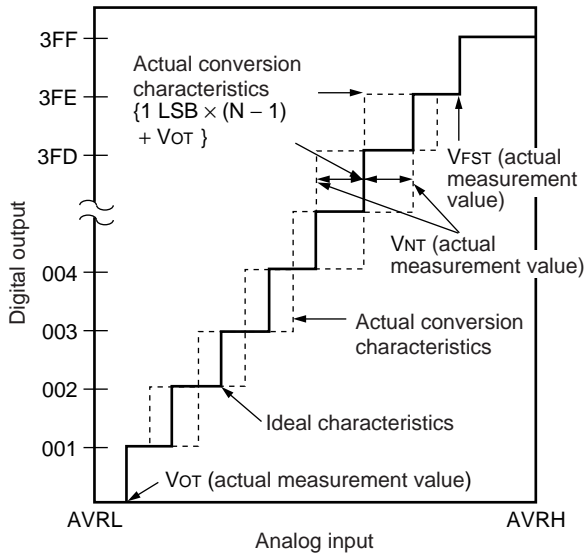
$$V_{OT} (\text{Ideal value}) = AVRL + 0.5 \text{ LSB [V]}$$

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

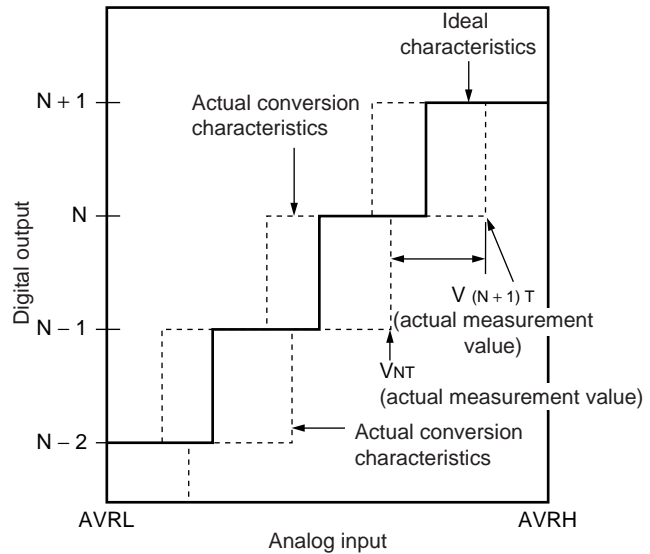
$V_{NT}$  : A voltage at which digital output transitions from (N - 1) to N.



Nonlinearity error



Differential nonlinearity error



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

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

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

N : A/D converter digital output value

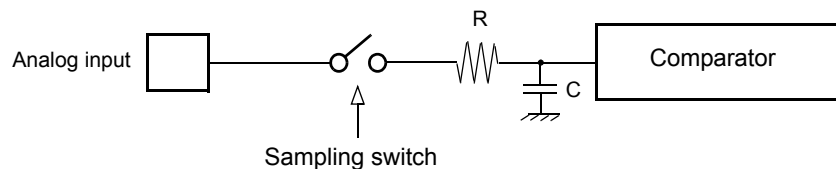
V<sub>OT</sub> : Voltage at which digital output transits from “000<sub>H</sub>” to “001<sub>H</sub>.”

V<sub>FST</sub> : Voltage at which digital output transits from “3FE<sub>H</sub>” to “3FF<sub>H</sub>.”

**Notes on A/D Converter Section**

• 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 ( $T_{\text{samp}}$ ) is longer than the minimum value. Usually, this value is set to  $7\tau$ , where  $\tau = RC$ . If the external input resistance ( $R_{\text{ext}}$ ) connected to the analog input is included, the sampling time is expressed as follows:

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

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

If the sampling time cannot be sufficient, connect a capacitor of about 0.1  $\mu\text{F}$  to the analog input pin.

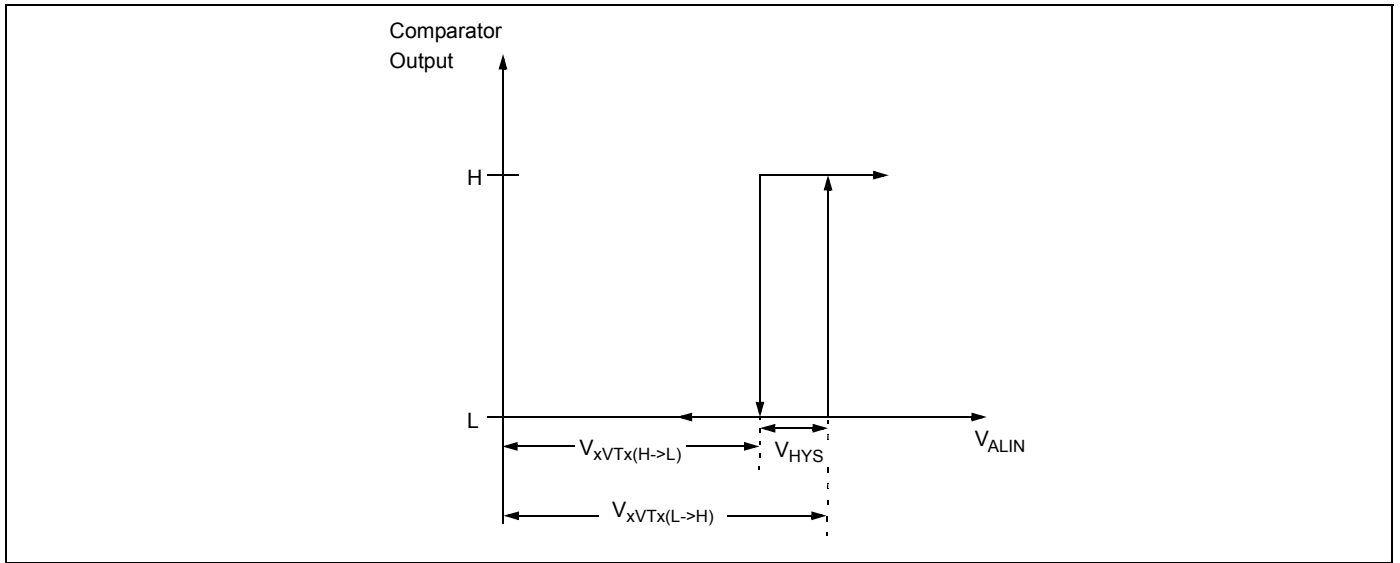
### About the error

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

**14.7 Alarm Comparator**

 (T<sub>A</sub> = -40 °C to +125 °C, V<sub>CC</sub> = AV<sub>CC</sub> = 3.0V - 5.5V, V<sub>SS</sub> = AV<sub>SS</sub> = 0V)

| Parameter                                    | Symbol                     | Pin               | Value                            |                                 |                                  | Unit   | Remarks   |
|--|----------------------------|-------------------|----------------------------------|---------------------------------|----------------------------------|--|---|
|  |                            |                   | Min                              | Typ                             | Max                              |  |   |
| Power supply current                         | I <sub>A5ALMF</sub>        | AV <sub>CC</sub>  | -                                | 25                              | 45                               | μA   | Alarm comparator enabled in fast mode (one channel) |
|  | I <sub>A5ALMS</sub>        |                   | -                                | 7                               | 13                               | μA   | Alarm comparator enabled in slow mode (one channel) |
|  | I <sub>A5ALMH</sub>        |                   | -                                | -                               | 5                                | μA   | Alarm comparator disabled                           |
| ALARM pin input current                      | I <sub>ALIN</sub>          | ALARM0,<br>ALARM1 | -1                               | -                               | +1                               | μA   | T <sub>A</sub> = 25 °C                              |
|  |                            |                   | -3                               | -                               | +3                               | μA   | T <sub>A</sub> = 125 °C                             |
| ALARM pin input voltage range                | V <sub>ALIN</sub>          |                   | 0                                | -                               | AV <sub>CC</sub>                 | V  |   |
| External low threshold high->low transition  | V <sub>EVTL(H-&gt;L)</sub> |                   | 0.36 * AV <sub>CC</sub><br>-0.25 | 0.36 * AV <sub>CC</sub><br>-0.1 | -                                | V  | INTREF = 0  |
| External low threshold low->high transition  | V <sub>EVTL(L-&gt;H)</sub> |                   | -                                | 0.36 * AV <sub>CC</sub><br>+0.1 | 0.36 * AV <sub>CC</sub><br>+0.25 | V  |   |
| External high threshold high->low transition | V <sub>EVTH(H-&gt;L)</sub> |                   | 0.78 * AV <sub>CC</sub><br>-0.25 | 0.78 * AV <sub>CC</sub><br>-0.1 | -                                | V  |   |
| External high threshold low->high transition | V <sub>EVTH(L-&gt;H)</sub> |                   | -                                | 0.78 * AV <sub>CC</sub><br>+0.1 | 0.78 * AV <sub>CC</sub><br>+0.25 | V  |   |
| Internal low threshold high->low transition  | V <sub>IVTL(H-&gt;L)</sub> |                   | 0.9                              | 1.1                             | -                                | V  | INTREF = 1  |
| Internal low threshold low->high transition  | V <sub>IVTL(L-&gt;H)</sub> |                   | -                                | 1.3                             | 1.55                             | V  |   |
| Internal high threshold high->low transition | V <sub>IVTH(H-&gt;L)</sub> |                   | 2.2                              | 2.4                             | -                                | V  |   |
| Internal high threshold low->high transition | V <sub>IVTH(L-&gt;H)</sub> |                   | -                                | 2.6                             | 2.85                             | V  |   |
| Switching hysteresis                         | V <sub>HYS</sub>           |                   | 50                               | -                               | 300                              | mV   |   |
| Comparison time                              | t <sub>COMPF</sub>         | -                 | 0.1                              | 1                               | μs                               | CMD = 1 (fast)   |   |
|  | t <sub>COMPS</sub>         | -                 | 1                                | 10                              | μs                               | CMD = 0 (slow)   |   |
| Slow/Fast mode transition time               | t <sub>CMD</sub>           | -                 | 100                              | 500                             | μs                               | Threshold levels specified above are not guaranteed within this time |   |



**14.8 Low Voltage Detector characteristics**

 (T<sub>A</sub> = -40 °C to +125 °C, V<sub>CC</sub> = AV<sub>CC</sub> = 3.0V - 5.5V, V<sub>SS</sub> = AV<sub>SS</sub> = 0V)

| Parameter          | Symbol               | Value    |      | Unit | Remarks               |
|--------------------|----------------------|----------|------|------|-----------------------|
|                    |                      | Min      | Max  |      |                       |
| Stabilization time | T <sub>LVDSTAB</sub> | 60       | 75   | μs   |                       |
| Level 0            | V <sub>DL0</sub>     | 2.7      | 2.9  | V    | CILCR:LVL[3:0]="0000" |
| Level 1            | V <sub>DL1</sub>     | 2.9      | 3.1  | V    | CILCR:LVL[3:0]="0001" |
| Level 2            | V <sub>DL2</sub>     | 3.1      | 3.3  | V    | CILCR:LVL[3:0]="0010" |
| Level 3            | V <sub>DL3</sub>     | 3.5      | 3.75 | V    | CILCR:LVL[3:0]="0011" |
| Level 4            | V <sub>DL4</sub>     | 3.6      | 3.85 | V    | CILCR:LVL[3:0]="0100" |
| Level 5            | V <sub>DL5</sub>     | 3.7      | 3.95 | V    | CILCR:LVL[3:0]="0101" |
| Level 6            | V <sub>DL6</sub>     | 3.8      | 4.05 | V    | CILCR:LVL[3:0]="0110" |
| Level 7            | V <sub>DL7</sub>     | 3.9      | 4.15 | V    | CILCR:LVL[3:0]="0111" |
| Level 8            | V <sub>DL8</sub>     | 4.0      | 4.25 | V    | CILCR:LVL[3:0]="1000" |
| Level 9            | V <sub>DL9</sub>     | 4.1      | 4.35 | V    | CILCR:LVL[3:0]="1001" |
| Level 10           | V <sub>DL10</sub>    | not used |      |      |                       |
| Level 11           | V <sub>DL11</sub>    | not used |      |      |                       |
| Level 12           | V <sub>DL12</sub>    | not used |      |      |                       |
| Level 13           | V <sub>DL13</sub>    | not used |      |      |                       |
| Level 14           | V <sub>DL14</sub>    | not used |      |      |                       |
| Level 15           | V <sub>DL15</sub>    | not used |      |      |                       |

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

Levels 10 to 15 are not used in this device.

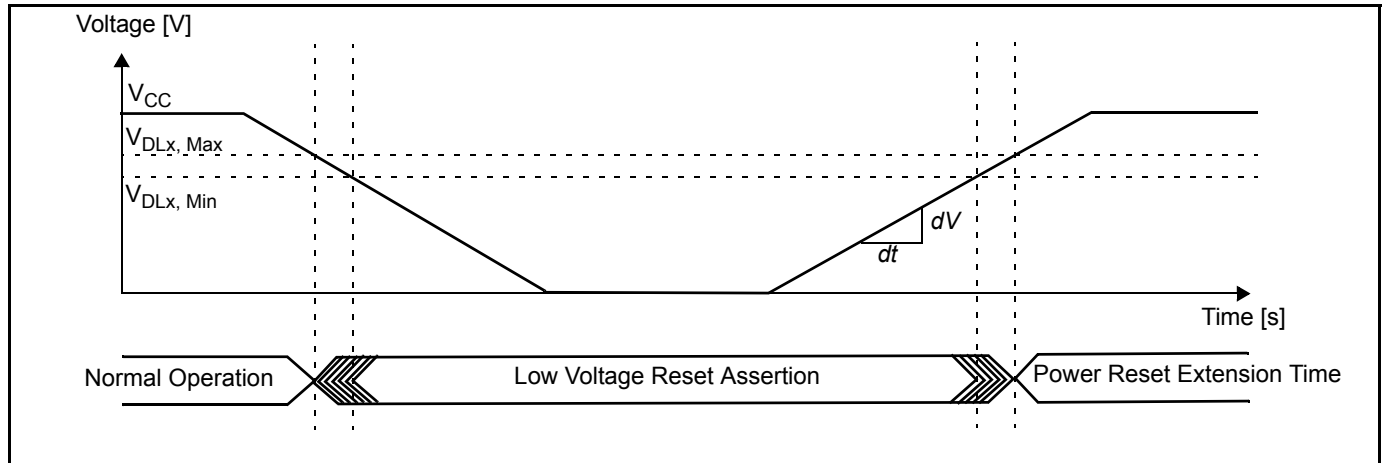
For correct detection, the slope of the voltage level must satisfy  $\left| \frac{dV}{dt} \right| \leq 0.004 \frac{V}{\mu s}$ .

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

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

**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.



**14.9 FLASH memory program/erase characteristics**

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

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

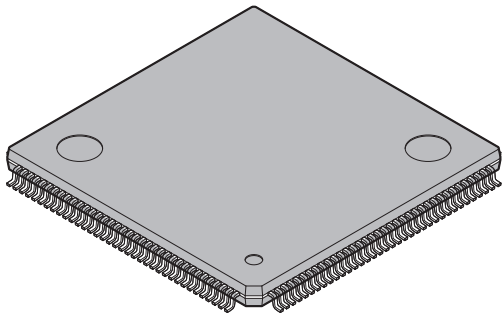
\*1: This value was converted from the results of evaluating the reliability of the technology (using Arrhenius equation to convert high temperature measurements into normalized value at  $85^{\circ}\text{C}$ )

## **15. Example Characteristics**

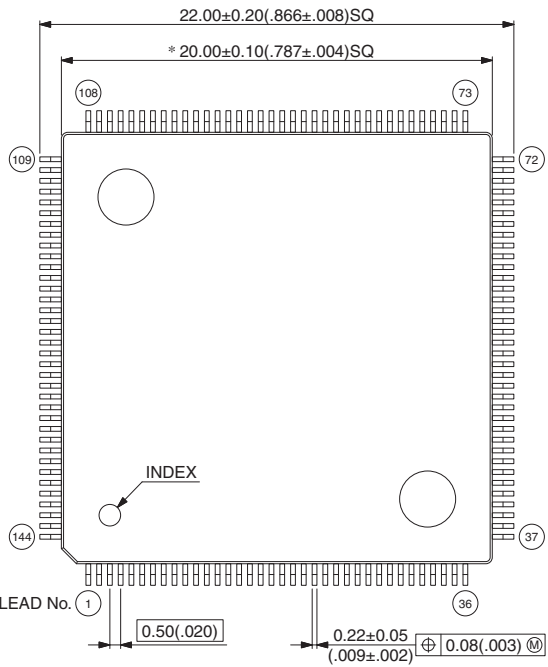
To be prepared



**16. Package Dimension MB96(F)33x LQFP 144P**

|   |                                |                       |
|---|--------------------------------|-----------------------|
| <p>144-pin plastic LQFP</p>  <p>(FPT-144P-M08)</p> | Lead pitch                     | 0.50 mm               |
|   | Package width × package length | 20.0 × 20.0 mm        |
|   | Lead shape                     | Gullwing              |
|   | Sealing method                 | Plastic mold          |
|   | Mounting height                | 1.70 mm MAX           |
|   | Weight                         | 1.20g                 |
|   | Code (Reference)               | P-LFQFP144-20×20-0.50 |

144-pin plastic LQFP  
(FPT-144P-M08)



LEAD No. 1

0.50(.020)

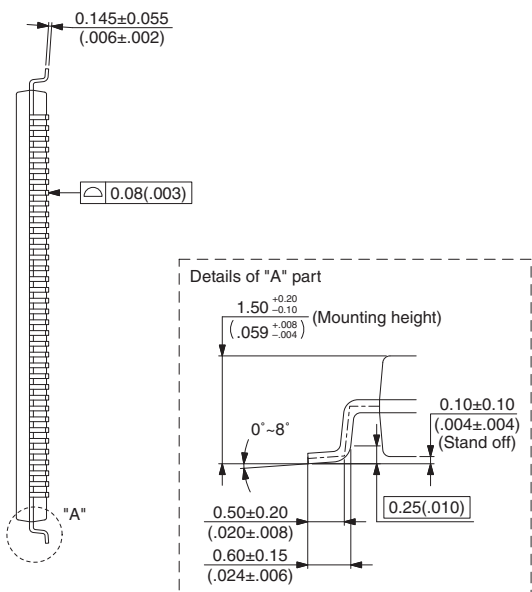
0.22±0.05  
(.009±.002)

0.08(.003) Ⓜ

Note 1) \*:Values do not include resin protrusion.  
Resin protrusion is +0.25(.010)Max(each side).

Note 2) Pins width and pins thickness include plating thickness.

Note 3) Pins width do not include tie bar cutting remainder.



0.145±0.055  
(.006±.002)

0.08(.003)

Details of "A" part

1.50<sup>+0.20</sup><sub>-0.10</sub>  
(.059<sup>+0.008</sup><sub>-.004</sub>) (Mounting height)

0°-8°

0.10±0.10  
(.004±.004) (Stand off)

0.25(.010)

0.50±0.20  
(.020±.008)

0.60±0.15  
(.024±.006)

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Dimensions in mm (inches).  
Note: The values in parentheses are reference values.

**17. Ordering Information**

| Part number                     | Flash/ROM            | Subclock | Persistent Low Voltage Reset | Package                             | Remarks  |
|---------------------------------|----------------------|----------|------------------------------|-------------------------------------|----------|
| MB96F336USA PMC-GSE2 *1         | Flash A (288KB)      | No       | No                           | 144 pin Plastic LQFP (FPT-144P-M08) | with USB |
| MB96F336UWA PMC-GSE2 *1         |                      | Yes      |                              |                                     |          |
| MB96F338YSA PMC-GSE2 *1         | Flash A (544KB)      | No       | Yes                          | 144 pin Plastic LQFP (FPT-144P-M08) |          |
| MB96F338RSA PMC-GSE2 *1         |                      |          | No                           |                                     |          |
| MB96F338YWA PMC-GSE2 *1         |                      | Yes      | Yes                          |                                     |          |
| MB96F338RWA PMC-GSE2 *1         |                      |          | No                           |                                     |          |
| MB96F338USA PMC-GSE2 *1         | Flash A (544KB)      | No       | No                           | 144 pin Plastic LQFP (FPT-144P-M08) | with USB |
| MB96F338UWA PMC-GSE2 *1         |                      | Yes      |                              |                                     |          |
| MB96V300BRB-ES (for evaluation) | Emulated by ext. RAM | Yes      | No                           | 416 pin Plastic BGA (BGA-416P-M02)  |          |

\*1: These devices are under development and specification is preliminary. These products under development may change its specification without notice.

**18. Revision History**

| Revision   | Date       | Modification  |
|------------|------------|---|
| Prelim 0.1 | 2007-05-23 | Creation  |
| Prelim 0.2 | 2007-08-14 | - information about MB96F338U (with USB function) is added<br>- DMA 8ch --> 16ch<br>- ADC reference switch is removed   |
| Prelim 0.3 | 2007-09-11 | - Circuit Type of Device with "U" suffix is added<br>- Circuit Type diagram: TTL input cell type was changed from NOR to NAND<br>- IO Map, IRQ table are updated<br>- Parallel Programing Flash Memory Control Signals is updated<br>- DC/AC spec of USB I/O is added   |
| Prelim 0.4 | 2007-09-24 | - Block diagram for MB96F338U was corrected: USB PB1 -> PB3<br>- IRQ table was modified: Vector number 111 was inserted (reserved)<br>- Pin assignment was corrected: not used resource name was removed  |
| Prelim 0.5 | 2007-11-02 | - Internal Max Freq 56MHz --> 48MHz<br>- DMA 12ch --> 10ch<br>- FPT-144P-M12 package was removed  |
| Prelim 1   | 2007-12-20 | Update of the block diagram to include USB block.<br>Update DC characteristics to include all USB pins characteristics.<br>IOMAP regenerated.<br>Memory maps and Flash configuration reworked.<br>Typos corrected across the document.<br>Renaming of the Flash banks.  |
| Prelim 2   | 2008-02-07 | <ul style="list-style-type: none"> <li>• Features: <ul style="list-style-type: none"> <li>- Removed ADC reference switch</li> <li>- changed USB description</li> </ul> </li> <li>• Lineup: <ul style="list-style-type: none"> <li>- option description added</li> <li>- Part number names corrected</li> <li>- Flash B removed</li> <li>- RLT6 added</li> </ul> </li> <li>• Block diagrams: <ul style="list-style-type: none"> <li>- Flash B removed</li> <li>- OUT5_R -&gt; OUT6_R</li> <li>- TX2_R, RX2_R added</li> <li>- SIN2_R, SOT2_R, SCK2_R and SOT9 added</li> <li>- not existing TTGx, TTGx_R and PPGx_R pins deleted</li> <li>- RLT6 added</li> </ul> </li> <li>• Pin function description: relocated clock output and CAN pins added</li> <li>• I/O circuit types updated</li> <li>• Memory maps replaced by new standard maps</li> <li>• Parallel Flash programming pinning removed</li> <li>• IOMAP regenerated (naming style changed, all reserved registers added)</li> <li>• DC current limits updated with new setting and corrected frequencies</li> <li>• External bus timings: missing conditions added and readability improved</li> <li>• Alarm comparator spec updated (transition voltages defined)</li> <li>• Ordering information updated</li> <li>• Typos and formatting corrected</li> </ul> |

| Revision | Date       | Modification  |
|----------|------------|---|
| Prelim 3 | 2008-11-24 | <ul style="list-style-type: none"> <li>• Format adjusted to official Fujitsu Microelectronics datasheet standard (mainly style changes and official notes and disclaimer added)</li> <li>• Note about devices under development modified</li> <li>• I/O map: Note added about reserved addresses</li> <li>• Serial programming interface: Note about handshaking pins improved</li> <li>• specified AD converter channel offset to 4LSB</li> <li>• package code of MB96V300 corrected in ordering information</li> <li>• Added voltage condition to pull-up resistance spec</li> <li>• ROM devices removed from lineup, memory map and ordering information</li> <li>• Ordering information: column "Flash/ROM added"</li> <li>• Official package dimension drawing with additional notes added</li> <li>• Empty pages removed</li> <li>• adjusted Run and Sleep mode specifications according to evaluation results</li> <li>• Absolute maximum ratings: <math>V_{IUSB}</math> and <math>V_{OUSB}</math> corrected, permitted power dissipation spec added</li> <li>• DC characteristics: Output H/L voltage for USB pins: specified for load of 20mA</li> <li>• USB characteristics: updated according to MB91660 series</li> <li>• Alarm comparator: Power supply current max values increased, comparison time reduced, mode transition time newly added</li> <li>• Handling devices: Notes added about Serial communication and about using ceramic resonators.</li> <li>• Feature list and AC Characteristics: 16MHz maximum frequency is valid for crystal oscillators. For resonators, maximum frequency depends on Q-factor</li> <li>• AC characteristics: PLL phase skew spec added, CLKVCO min=64MHz</li> <li>• New family member MB96F336U added</li> <li>• VOL3 spec improved: spec valid for 3mA load for full Vcc range</li> </ul> |

## 19. Major Changes

Spanion Publication Number: DS07-13805-1E

| Page | Section   | Change Results  |
|------|---|---|
| 108  | Electrical Characteristics<br>5. Analog Digital Converter | Changed the item for “Zero reading voltage” and “Full scale reading voltage”. |

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

**Document History**

| Document Title: MB96330 Series F <sup>2</sup> MC-16FX 16-bit Proprietary Microcontroller<br>Document Number: 002-04586 |         |                 |                 |  |
|--|---------|-----------------|-----------------|--|
| Revision   | ECN     | Orig. of Change | Submission Date | Description of Change  |
| **   | —       | AKIH            | 05/23/2007      | Migrated to Cypress and assigned document number 002-04586.<br>No change to document contents or format. |
| *A   | 5245336 | AKIH            | 05/13/2016      | Updated to Cypress template  |

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