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### What is "[Embedded - Microcontrollers](#)"?

"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

### Applications of "[Embedded - Microcontrollers](#)"

#### Details

|                            |                                                                                                                                                                               |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Status             | Obsolete                                                                                                                                                                      |
| Core Processor             | F <sup>2</sup> MC-8FX                                                                                                                                                         |
| Core Size                  | 8-Bit                                                                                                                                                                         |
| Speed                      | 16MHz                                                                                                                                                                         |
| Connectivity               | I <sup>2</sup> C, SIO, UART/USART                                                                                                                                             |
| Peripherals                | LCD, POR, PWM, WDT                                                                                                                                                            |
| Number of I/O              | 59                                                                                                                                                                            |
| Program Memory Size        | 60KB (60K x 8)                                                                                                                                                                |
| Program Memory Type        | FLASH                                                                                                                                                                         |
| EEPROM Size                | -                                                                                                                                                                             |
| RAM Size                   | 1.98K x 8                                                                                                                                                                     |
| Voltage - Supply (Vcc/Vdd) | 2.4V ~ 5.5V                                                                                                                                                                   |
| Data Converters            | A/D 8x8/10b                                                                                                                                                                   |
| Oscillator Type            | External                                                                                                                                                                      |
| Operating Temperature      | -40°C ~ 85°C (TA)                                                                                                                                                             |
| Mounting Type              | Surface Mount                                                                                                                                                                 |
| Package / Case             | 64-LQFP                                                                                                                                                                       |
| Supplier Device Package    | 64-LQFP (12x12)                                                                                                                                                               |
| Purchase URL               | <a href="https://www.e-xfl.com/product-detail/infineon-technologies/mb95f478kpmc2-g-sne2">https://www.e-xfl.com/product-detail/infineon-technologies/mb95f478kpmc2-g-sne2</a> |

## 6. Pin Description (MB95410H Series)

| Pin no. | Pin name         | I/O circuit type* | Function                       |
|---------|------------------|-------------------|--------------------------------|
| 1       | AV <sub>CC</sub> | —                 | A/D converter power supply pin |
| 2       | P07              | S                 | General-purpose I/O port       |
|         | INT07            |                   | External interrupt input pin   |
|         | AN07             |                   | A/D analog input pin           |
|         | SEG30            |                   | LCDC SEG output pin            |
| 3       | P06              | S                 | General-purpose I/O port       |
|         | INT06            |                   | External interrupt input pin   |
|         | AN06             |                   | A/D analog input pin           |
|         | SEG31            |                   | LCDC SEG output pin            |
| 4       | P05              | S                 | General-purpose I/O port       |
|         | INT05            |                   | External interrupt input pin   |
|         | AN05             |                   | A/D analog input pin           |
|         | SEG32            |                   | LCDC SEG output pin            |
|         | UCK1             |                   | UART/SIO ch. 1 clock I/O pin   |
| 5       | P04              | V                 | General-purpose I/O port       |
|         | INT04            |                   | External interrupt input pin   |
|         | AN04             |                   | A/D analog input pin           |
|         | SEG33            |                   | LCDC SEG output pin            |
|         | UI1              |                   | UART/SIO ch. 1 data input pin  |
| 6       | P03              | S                 | General-purpose I/O port       |
|         | INT03            |                   | External interrupt input pin   |
|         | AN03             |                   | A/D analog input pin           |
|         | SEG34            |                   | LCDC SEG output pin            |
|         | UO1              |                   | UART/SIO ch. 1 data output pin |
| 7       | P02              | S                 | General-purpose I/O port       |
|         | INT02            |                   | External interrupt input pin   |
|         | AN02             |                   | A/D analog input pin           |
|         | SEG35            |                   | LCDC SEG output pin            |
|         | UCK2             |                   | UART/SIO ch. 2 clock I/O pin   |
| 8       | P01              | V                 | General-purpose I/O port       |
|         | INT01            |                   | External interrupt input pin   |
|         | AN01             |                   | A/D analog input pin           |
|         | SEG36            |                   | LCDC SEG output pin            |
|         | UI2              |                   | UART/SIO ch. 2 data input pin  |

(Continued)

| Pin no. | Pin name | I/O circuit type* | Function                                       |
|---------|----------|-------------------|------------------------------------------------|
| 9       | P00      | W                 | General-purpose I/O port                       |
|         | INT00    |                   | External interrupt input pin                   |
|         | AN00     |                   | A/D analog input pin                           |
|         | UO2      |                   | UART/SIO ch. 2 data output pin                 |
| 10      | P16      | Y                 | General-purpose I/O port                       |
|         | PPG10    |                   | 8/16-bit PPG ch. 1 output pin                  |
| 11      | P15      | Y                 | General-purpose I/O port                       |
|         | PPG11    |                   | 8/16-bit PPG ch. 1 output pin                  |
| 12      | P14      | H                 | General-purpose I/O port                       |
|         | UCK0     |                   | UART/SIO ch. 0 clock I/O pin                   |
| 13      | P13      | H                 | General-purpose I/O port                       |
|         | ADTG     |                   | A/D trigger input (ADTG) pin                   |
| 14      | P12      | D                 | General-purpose I/O port                       |
|         | DBG      |                   | DBG input pin                                  |
| 15      | P11      | H                 | General-purpose I/O port                       |
|         | UO0      |                   | UART/SIO ch. 0 data output pin                 |
| 16      | P10      | G                 | General-purpose I/O port                       |
|         | UI0      |                   | UART/SIO ch. 0 data input pin                  |
| 17      | P53      | H                 | General-purpose I/O port                       |
|         | TO0      |                   | 16-bit reload timer output pin                 |
| 18      | P52      | H                 | General-purpose I/O port                       |
|         | TI0      |                   | 16-bit reload timer input pin                  |
|         | TO00     |                   | 8/16-bit composite timer ch. 0 output pin      |
| 19      | P51      | H                 | General-purpose I/O port                       |
|         | EC0      |                   | 8/16-bit composite timer ch. 0 clock input pin |
| 20      | P50      | H                 | General-purpose I/O port                       |
|         | TO01     |                   | 8/16-bit composite timer ch. 0 output pin      |
| 21      | P23      | I                 | General-purpose I/O port                       |
|         | SDA      |                   | I <sup>2</sup> C data I/O pin                  |
| 22      | P22      | I                 | General-purpose I/O port                       |
|         | SCL      |                   | I <sup>2</sup> C clock I/O pin                 |
| 23      | P21      | T                 | General-purpose I/O port                       |
|         | PPG01    |                   | 8/16-bit PPG ch. 0 output pin                  |
|         | CMPP     |                   | Voltage comparator input pin                   |
| 24      | P20      | T                 | General-purpose I/O port                       |
|         | PPG00    |                   | 8/16-bit PPG ch. 0 output pin                  |
|         | CMPN     |                   | Voltage comparator input pin                   |

(Continued)

| Pin no. | Pin name        | I/O circuit type* | Function                    |
|---------|-----------------|-------------------|-----------------------------|
| 25      | P90             | R                 | General-purpose I/O port    |
|         | V4              |                   | LCDC drive power supply pin |
| 26      | P91             | R                 | General-purpose I/O port    |
|         | V3              |                   | LCDC drive power supply pin |
| 27      | P92             | R                 | General-purpose I/O port    |
|         | V2              |                   | LCDC drive power supply pin |
| 28      | P93             | R                 | General-purpose I/O port    |
|         | V1              |                   | LCDC drive power supply pin |
| 29      | P94             | R                 | General-purpose I/O port    |
|         | V0              |                   | LCDC drive power supply pin |
| 30      | PB2             | M                 | General-purpose I/O port    |
|         | SEG37           |                   | LCDC SEG output pin         |
| 31      | PB3             | M                 | General-purpose I/O port    |
|         | SEG38           |                   | LCDC SEG output pin         |
| 32      | PB4             | M                 | General-purpose I/O port    |
|         | SEG39           |                   | LCDC SEG output pin         |
| 33      | PA0             | M                 | General-purpose I/O port    |
|         | COM0            |                   | LCDC COM output pin         |
| 34      | PA1             | M                 | General-purpose I/O port    |
|         | COM1            |                   | LCDC COM output pin         |
| 35      | PA2             | M                 | General-purpose I/O port    |
|         | COM2            |                   | LCDC COM output pin         |
| 36      | PA3             | M                 | General-purpose I/O port    |
|         | COM3            |                   | LCDC COM output pin         |
| 37      | PA4             | M                 | General-purpose I/O port    |
|         | COM4            |                   | LCDC COM output pin         |
| 38      | PA5             | M                 | General-purpose I/O port    |
|         | COM5            |                   | LCDC COM output pin         |
| 39      | PA6             | M                 | General-purpose I/O port    |
|         | COM6            |                   | LCDC COM output pin         |
| 40      | PA7             | M                 | General-purpose I/O port    |
|         | COM7            |                   | LCDC COM output pin         |
| 41      | V <sub>SS</sub> | —                 | Power supply pin (GND)      |
| 42      | PF1             | B                 | General-purpose I/O port    |
|         | X1              |                   | Main clock oscillation pin  |
| 43      | PF0             | B                 | General-purpose I/O port    |
|         | X0              |                   | Main clock oscillation pin  |

*(Continued)*

(Continued)

| Pin no. | Pin name         | I/O circuit type* | Function                                       |
|---------|------------------|-------------------|------------------------------------------------|
| 79      | PE7              | M                 | General-purpose I/O port                       |
|         | SEG29            |                   | LCDC SEG output pin                            |
|         | EC1              |                   | 8/16-bit composite timer ch. 1 clock input pin |
| 80      | AV <sub>SS</sub> | —                 | A/D converter power supply pin (GND)           |

\*: For the I/O circuit types, see "8. I/O Circuit Type".

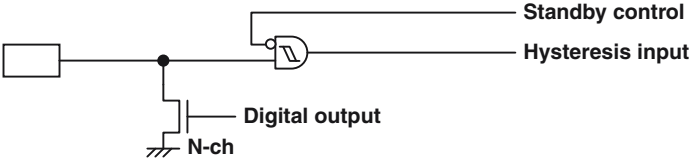
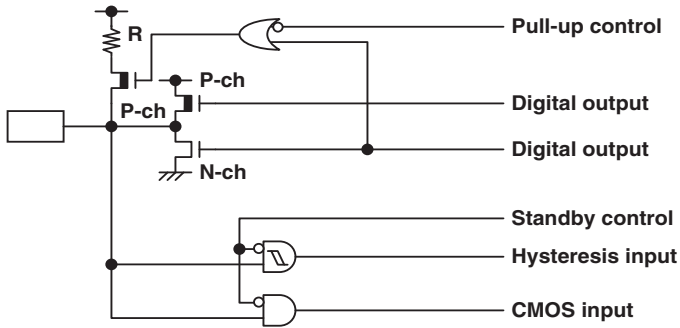
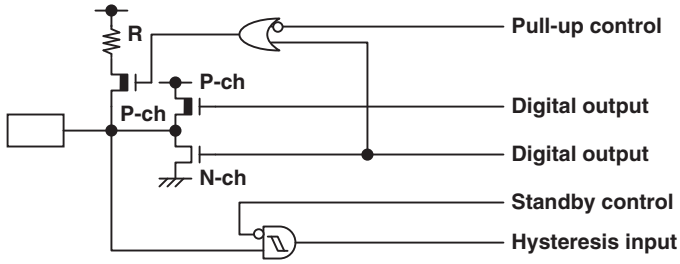
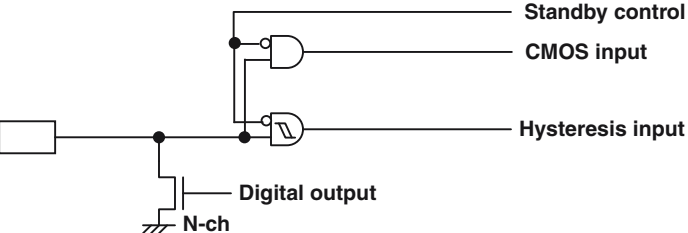
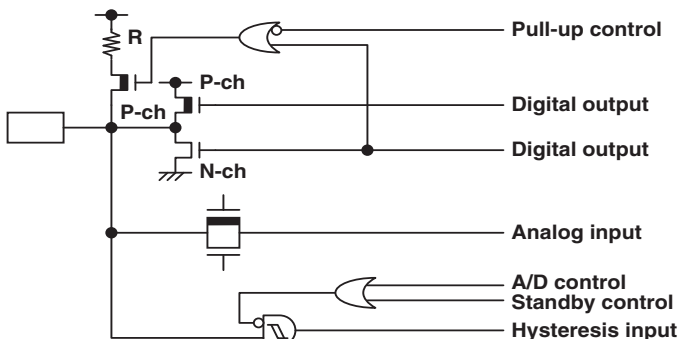
**7. Pin Description (MB95470H Series)**

| Pin no. | Pin name         | I/O circuit type* | Function                                  |
|---------|------------------|-------------------|-------------------------------------------|
| 1       | AV <sub>CC</sub> | —                 | A/D converter power supply pin            |
| 2       | P07              | S                 | General-purpose I/O port                  |
|         | INT07            |                   | External interrupt input pin              |
|         | AN07             |                   | A/D analog input pin                      |
|         | SEG22            |                   | LCDC SEG output pin                       |
| 3       | P06              | S                 | General-purpose I/O port                  |
|         | INT06            |                   | External interrupt input pin              |
|         | AN06             |                   | A/D analog input pin                      |
|         | SEG23            |                   | LCDC SEG output pin                       |
| 4       | P05              | S                 | General-purpose I/O port                  |
|         | INT05            |                   | External interrupt input pin              |
|         | AN05             |                   | A/D analog input pin                      |
|         | SEG24            |                   | LCDC SEG output pin                       |
|         | UCK1             |                   | UART/SIO ch. 1 clock I/O pin              |
| 5       | P04              | V                 | General-purpose I/O port                  |
|         | INT04            |                   | External interrupt input pin              |
|         | AN04             |                   | A/D analog input pin                      |
|         | SEG25            |                   | LCDC SEG output pin                       |
|         | UI1              |                   | UART/SIO ch. 1 data input pin             |
| 6       | P03              | S                 | General-purpose I/O port                  |
|         | INT03            |                   | External interrupt input pin              |
|         | AN03             |                   | A/D analog input pin                      |
|         | SEG26            |                   | LCDC SEG output pin                       |
|         | UO1              |                   | UART/SIO ch. 1 data output pin            |
| 7       | P02              | S                 | General-purpose I/O port                  |
|         | INT02            |                   | External interrupt input pin              |
|         | AN02             |                   | A/D analog input pin                      |
|         | SEG27            |                   | LCDC SEG output pin                       |
|         | UCK2             |                   | UART/SIO ch. 2 clock I/O pin              |
| 8       | P01              | V                 | General-purpose I/O port                  |
|         | INT01            |                   | External interrupt input pin              |
|         | AN01             |                   | A/D analog input pin                      |
|         | SEG28            |                   | LCDC SEG output pin                       |
|         | TO00             |                   | 8/16-bit composite timer ch. 0 output pin |
|         | UI2              |                   | UART/SIO ch. 2 data input pin             |

*(Continued)*

| Pin no. | Pin name        | I/O circuit type* | Function                                                   |
|---------|-----------------|-------------------|------------------------------------------------------------|
| 21      | P90             | R                 | General-purpose I/O port                                   |
|         | V4              |                   | LCDC drive power supply pin                                |
| 22      | P91             | R                 | General-purpose I/O port                                   |
|         | V3              |                   | LCDC drive power supply pin                                |
| 23      | P92             | R                 | General-purpose I/O port                                   |
|         | V2              |                   | LCDC drive power supply pin                                |
| 24      | P93             | R                 | General-purpose I/O port                                   |
|         | V1              |                   | LCDC drive power supply pin                                |
| 25      | PA0             | M                 | General-purpose I/O port                                   |
|         | COM0            |                   | LCDC COM output pin                                        |
| 26      | PA1             | M                 | General-purpose I/O port                                   |
|         | COM1            |                   | LCDC COM output pin                                        |
| 27      | PA2             | M                 | General-purpose I/O port                                   |
|         | COM2            |                   | LCDC COM output pin                                        |
| 28      | PA3             | M                 | General-purpose I/O port                                   |
|         | COM3            |                   | LCDC COM output pin                                        |
| 29      | PA4             | M                 | General-purpose I/O port                                   |
|         | COM4            |                   | LCDC COM output pin                                        |
| 30      | PA5             | M                 | General-purpose I/O port                                   |
|         | COM5            |                   | LCDC COM output pin                                        |
| 31      | PA6             | M                 | General-purpose I/O port                                   |
|         | COM6            |                   | LCDC COM output pin                                        |
| 32      | PA7             | M                 | General-purpose I/O port                                   |
|         | COM7            |                   | LCDC COM output pin                                        |
| 33      | V <sub>SS</sub> | —                 | Power supply pin (GND)                                     |
| 34      | PF1             | B                 | General-purpose I/O port                                   |
|         | X1              |                   | Main clock oscillation pin                                 |
| 35      | PF0             | B                 | General-purpose I/O port                                   |
|         | X0              |                   | Main clock oscillation pin                                 |
| 36      | C               | —                 | Capacitor connection pin                                   |
| 37      | PG2             | C                 | General-purpose I/O port                                   |
|         | X1A             |                   | Subclock oscillation pin (32 kHz)                          |
| 38      | PG1             | C                 | General-purpose I/O port                                   |
|         | X0A             |                   | Subclock oscillation pin (32 kHz)                          |
| 39      | V <sub>CC</sub> | —                 | Power supply pin                                           |
| 40      | PF2             | A                 | General-purpose I/O port                                   |
|         | RST             |                   | Reset pin<br>Dedicated reset pin for MB95F474H/F476H/F478H |

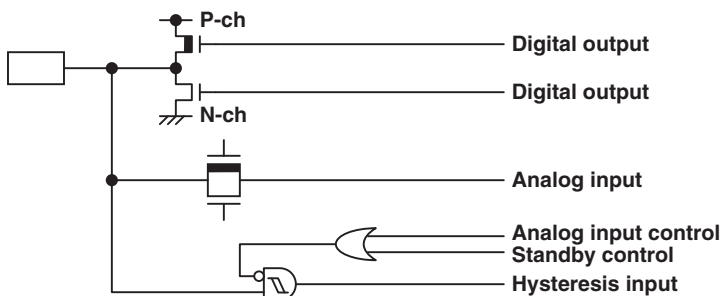
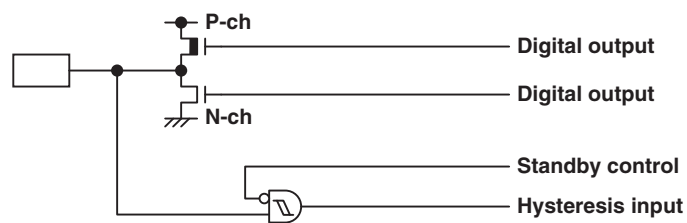
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| Type | Circuit                                                                                                                                                                                                                             | Remarks                                                                                                                                                  |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| D    |  <p>Standby control<br/>Hysteresis input<br/>Digital output<br/>N-ch</p>                                                                           | <ul style="list-style-type: none"> <li>• N-ch open drain output</li> <li>• Hysteresis input</li> </ul>                                                   |
| G    |  <p>Pull-up control<br/>Digital output<br/>Digital output<br/>N-ch<br/>Standby control<br/>Hysteresis input<br/>CMOS input</p>                     | <ul style="list-style-type: none"> <li>• CMOS output</li> <li>• Hysteresis input</li> <li>• CMOS input</li> <li>• Pull-up control available</li> </ul>   |
| H    |  <p>Pull-up control<br/>Digital output<br/>Digital output<br/>N-ch<br/>Standby control<br/>Hysteresis input</p>                                   | <ul style="list-style-type: none"> <li>• CMOS output</li> <li>• Hysteresis input</li> <li>• Pull-up control available</li> </ul>                         |
| I    |  <p>Standby control<br/>CMOS input<br/>Hysteresis input<br/>Digital output<br/>N-ch</p>                                                          | <ul style="list-style-type: none"> <li>• N-ch open drain output</li> <li>• CMOS input</li> <li>• Hysteresis input</li> </ul>                             |
| J    |  <p>Pull-up control<br/>Digital output<br/>Digital output<br/>N-ch<br/>Analog input<br/>A/D control<br/>Standby control<br/>Hysteresis input</p> | <ul style="list-style-type: none"> <li>• CMOS output</li> <li>• Hysteresis input</li> <li>• Analog input</li> <li>• Pull-up control available</li> </ul> |

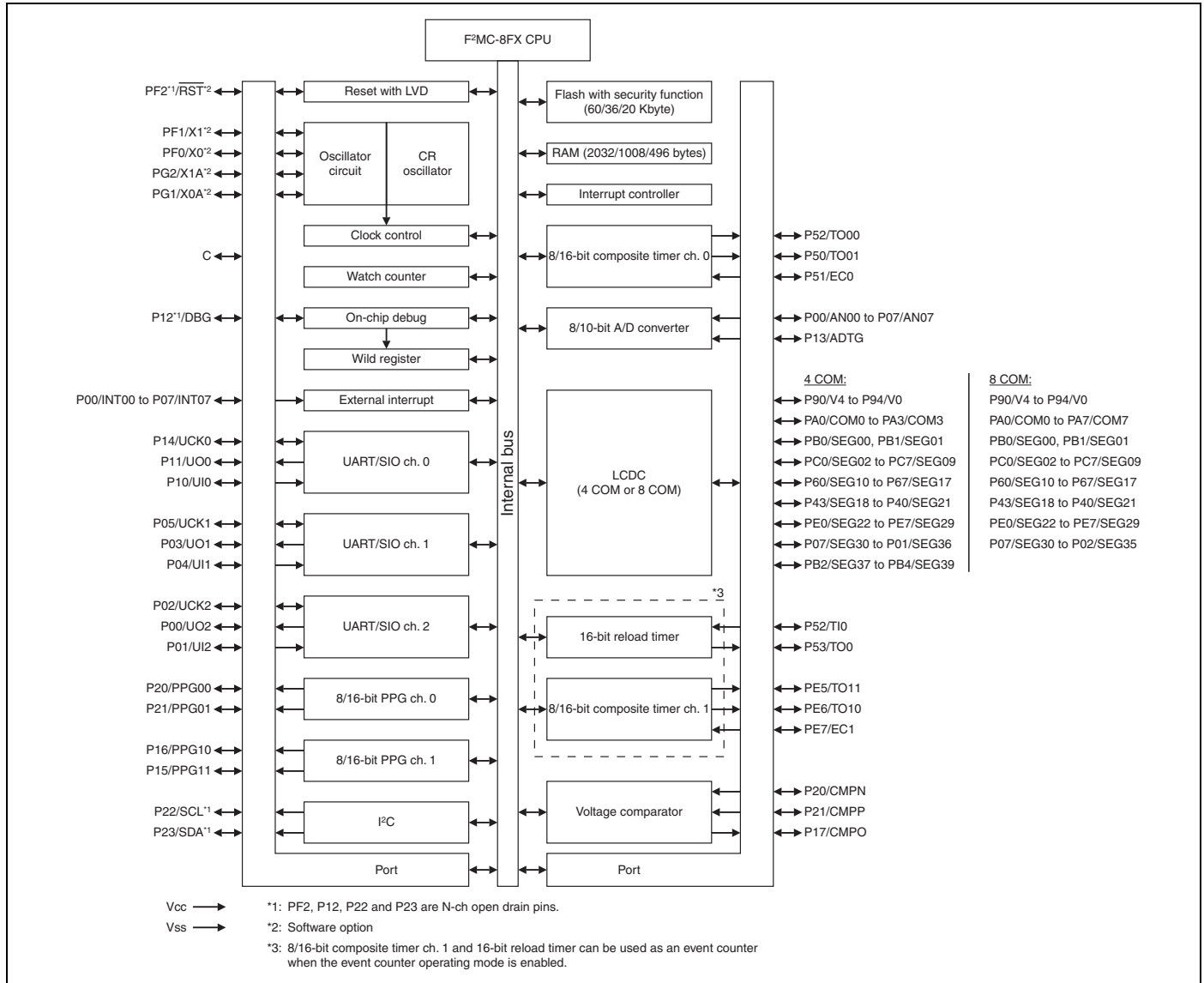
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| Type | Circuit                                                                                                                                                                                                                                              | Remarks                                                                                                             |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| W    |  <p>P-ch</p> <p>N-ch</p> <p>Digital output</p> <p>Digital output</p> <p>Analog input</p> <p>Analog input control</p> <p>Standby control</p> <p>Hysteresis input</p> | <ul style="list-style-type: none"> <li>• CMOS output</li> <li>• Hysteresis input</li> <li>• Analog input</li> </ul> |
| Y    |  <p>P-ch</p> <p>N-ch</p> <p>Digital output</p> <p>Digital output</p> <p>Standby control</p> <p>Hysteresis input</p>                                                 | <ul style="list-style-type: none"> <li>• CMOS output</li> <li>• Hysteresis input</li> </ul>                         |

## 11. Block Diagram (MB95410H Series)

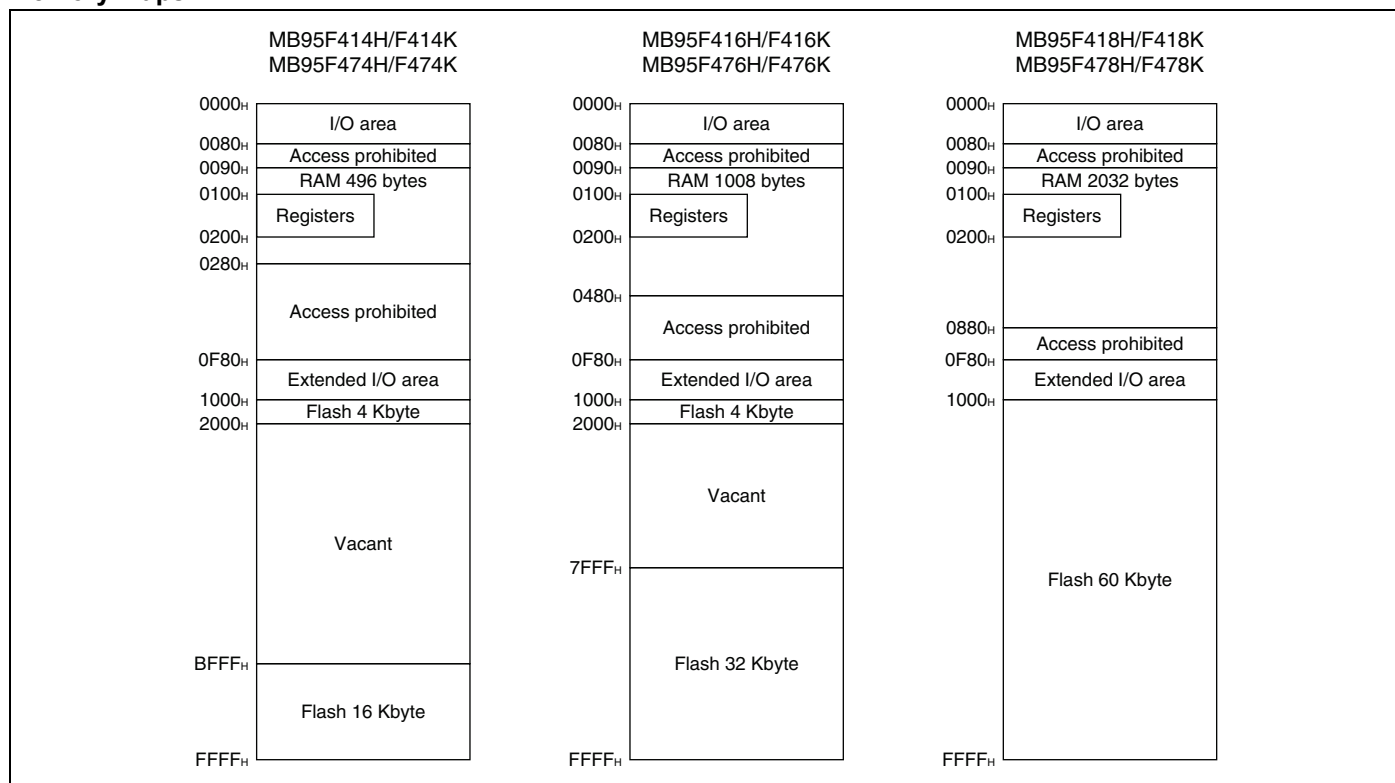


### 13. CPU Core

#### Memory Space

The memory space of the MB95410H/470H Series is 64 Kbyte in size, and consists of an I/O area, a data area, and a program area. The memory space includes areas intended for specific purposes such as general-purpose registers and a vector table. The memory maps of the MB95410H/470H Series are shown below.

#### Memory Maps



**14. I/O Map (MB95410H Series)**

| Address                                   | Register abbreviation | Register name                                        | R/W | Initial value         |
|-------------------------------------------|-----------------------|------------------------------------------------------|-----|-----------------------|
| 0000 <sub>H</sub>                         | PDR0                  | Port 0 data register                                 | R/W | 00000000 <sub>B</sub> |
| 0001 <sub>H</sub>                         | DDR0                  | Port 0 direction register                            | R/W | 00000000 <sub>B</sub> |
| 0002 <sub>H</sub>                         | PDR1                  | Port 1 data register                                 | R/W | 00000000 <sub>B</sub> |
| 0003 <sub>H</sub>                         | DDR1                  | Port 1 direction register                            | R/W | 00000000 <sub>B</sub> |
| 0004 <sub>H</sub>                         | —                     | (Disabled)                                           | —   | —                     |
| 0005 <sub>H</sub>                         | WATR                  | Oscillation stabilization wait time setting register | R/W | 11111111 <sub>B</sub> |
| 0006 <sub>H</sub>                         | PLLC                  | PLL control register                                 | R/W | 00000000 <sub>B</sub> |
| 0007 <sub>H</sub>                         | SYCC                  | System clock control register                        | R/W | XXXXXX11 <sub>B</sub> |
| 0008 <sub>H</sub>                         | STBC                  | Standby control register                             | R/W | 0000XXXX <sub>B</sub> |
| 0009 <sub>H</sub>                         | RSRR                  | Reset source register                                | R/W | 000XXXXX <sub>B</sub> |
| 000A <sub>H</sub>                         | TBTC                  | Time-base timer control register                     | R/W | 00000000 <sub>B</sub> |
| 000B <sub>H</sub>                         | WPCR                  | Watch prescaler control register                     | R/W | 00000000 <sub>B</sub> |
| 000C <sub>H</sub>                         | WDTC                  | Watchdog timer control register                      | R/W | 00000000 <sub>B</sub> |
| 000D <sub>H</sub>                         | SYCC2                 | System clock control register 2                      | R/W | XX100011 <sub>B</sub> |
| 000E <sub>H</sub>                         | PDR2                  | Port 2 data register                                 | R/W | 00000000 <sub>B</sub> |
| 000F <sub>H</sub>                         | DDR2                  | Port 2 direction register                            | R/W | 00000000 <sub>B</sub> |
| 0010 <sub>H</sub> ,<br>0011 <sub>H</sub>  | —                     | (Disabled)                                           | —   | —                     |
| 0012 <sub>H</sub>                         | PDR4                  | Port 4 data register                                 | R/W | 00000000 <sub>B</sub> |
| 0013 <sub>H</sub>                         | DDR4                  | Port 4 direction register                            | R/W | 00000000 <sub>B</sub> |
| 0014 <sub>H</sub>                         | PDR5                  | Port 5 data register                                 | R/W | 00000000 <sub>B</sub> |
| 0015 <sub>H</sub>                         | DDR5                  | Port 5 direction register                            | R/W | 00000000 <sub>B</sub> |
| 0016 <sub>H</sub>                         | PDR6                  | Port 6 data register                                 | R/W | 00000000 <sub>B</sub> |
| 0017 <sub>H</sub>                         | DDR6                  | Port 6 direction register                            | R/W | 00000000 <sub>B</sub> |
| 0018 <sub>H</sub> to<br>001B <sub>H</sub> | —                     | (Disabled)                                           | —   | —                     |
| 001C <sub>H</sub>                         | PDR9                  | Port 9 data register                                 | R/W | 00000000 <sub>B</sub> |
| 001D <sub>H</sub>                         | DDR9                  | Port 9 direction register                            | R/W | 00000000 <sub>B</sub> |
| 001E <sub>H</sub>                         | PDRA                  | Port A data register                                 | R/W | 00000000 <sub>B</sub> |
| 001F <sub>H</sub>                         | DDRA                  | Port A direction register                            | R/W | 00000000 <sub>B</sub> |
| 0020 <sub>H</sub>                         | PDRB                  | Port B data register                                 | R/W | 00000000 <sub>B</sub> |
| 0021 <sub>H</sub>                         | DDRB                  | Port B direction register                            | R/W | 00000000 <sub>B</sub> |
| 0022 <sub>H</sub>                         | PDRC                  | Port C data register                                 | R/W | 00000000 <sub>B</sub> |
| 0023 <sub>H</sub>                         | DDRC                  | Port C direction register                            | R/W | 00000000 <sub>B</sub> |
| 0024 <sub>H</sub> ,<br>0025 <sub>H</sub>  | —                     | (Disabled)                                           | —   | —                     |

*(Continued)*

(Continued)

| Address                                | Register abbreviation | Register name                  | R/W | Initial value         |
|----------------------------------------|-----------------------|--------------------------------|-----|-----------------------|
| 0FED <sub>H</sub>                      | —                     | (Disabled)                     | —   | —                     |
| 0FEE <sub>H</sub>                      | ILSR                  | Input level select register    | R/W | 00000000 <sub>B</sub> |
| 0FEF <sub>H</sub>                      | WICR                  | Interrupt pin control register | R/W | 01000000 <sub>B</sub> |
| 0FF0 <sub>H</sub> to 0FFF <sub>H</sub> | —                     | (Disabled)                     | —   | —                     |

#### R/W access symbols

R/W : Readable / Writable

R : Read only

#### Initial value symbols

0 : The initial value of this bit is “0”.

1 : The initial value of this bit is “1”.

X : The initial value of this bit is indeterminate.

Note: Do not write to an address that is “(Disabled)”. If a “(Disabled)” address is read, an indeterminate value is returned.

**17.3 DC Characteristics**
 $(V_{CC} = 5.0 \text{ V} \pm 10\%, V_{SS} = 0.0 \text{ V}, T_A = -40^\circ\text{C} \text{ to } +85^\circ\text{C})$ 

| Parameter                             | Symbol    | Pin name                                                                                                                                                                                                                                                     | Condition                | Value          |     |                | Unit | Remarks                                              |
|---------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------|-----|----------------|------|------------------------------------------------------|
|                                       |           |                                                                                                                                                                                                                                                              |                          | Min            | Typ | Max            |      |                                                      |
| "H" level input voltage               | $V_{IHI}$ | P01, P04, P10, P22, P23                                                                                                                                                                                                                                      | *1                       | $0.7 V_{CC}$   | —   | $V_{CC} + 0.3$ | V    | When CMOS input level (hysteresis input) is selected |
|                                       | $V_{IHS}$ | P00 to P07, P10 to P17, P20 to P23, P40 to P43 <sup>*2</sup> , P50 to P53 <sup>*2</sup> , P60 to P67, P90 to P93, P94 <sup>*2</sup> , PA0 to PA7, PB0, PB1, PB2 to PB4 <sup>*2</sup> , PC0 to PC3, PC4 to PC7 <sup>*2</sup> , PE0 to PE7, PF0, PF1, PG1, PG2 | *1                       | $0.8 V_{CC}$   | —   | $V_{CC} + 0.3$ | V    | Hysteresis input                                     |
|                                       | $V_{IHM}$ | PF2                                                                                                                                                                                                                                                          | —                        | $0.7 V_{CC}$   | —   | $V_{CC} + 0.3$ | V    | Hysteresis input                                     |
| "L" level input voltage               | $V_{IL}$  | P01, P04, P10, P22, P23                                                                                                                                                                                                                                      | *1                       | $V_{SS} - 0.3$ | —   | $0.3 V_{CC}$   | V    | When CMOS input level (hysteresis input) is selected |
|                                       | $V_{ILS}$ | P00 to P07, P10 to P17, P20 to P23, P40 to P43 <sup>*2</sup> , P50 to P53 <sup>*2</sup> , P60 to P67, P90 to P93, P94 <sup>*2</sup> , PA0 to PA7, PB0, PB1, PB2 to PB4 <sup>*2</sup> , PC0 to PC3, PC4 to PC7 <sup>*2</sup> , PE0 to PE7, PF0, PF1, PG1, PG2 | *1                       | $V_{SS} - 0.3$ | —   | $0.2 V_{CC}$   | V    | Hysteresis input                                     |
|                                       | $V_{ILM}$ | PF2                                                                                                                                                                                                                                                          | —                        | $V_{SS} - 0.3$ | —   | $0.3 V_{CC}$   | V    | Hysteresis input                                     |
| Open-drain output application voltage | $V_D$     | P12, P22, P23, PF2                                                                                                                                                                                                                                           | —                        | $V_{SS} - 0.3$ | —   | $V_{SS} + 5.5$ | V    |                                                      |
| "H" level output voltage              | $V_{OH1}$ | Output pins other than P12, P22, P23, PF2                                                                                                                                                                                                                    | $I_{OH} = -4 \text{ mA}$ | $V_{CC} - 0.5$ | —   | —              | V    |                                                      |

*(Continued)*

(Continued)

( $V_{CC} = 5.0 \text{ V} \pm 10\%$ ,  $V_{SS} = 0.0 \text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ )

| Parameter                          | Symbol     | Pin name                               | Condition                                                           | Value |                   |     | Unit          | Remarks |
|------------------------------------|------------|----------------------------------------|---------------------------------------------------------------------|-------|-------------------|-----|---------------|---------|
|                                    |            |                                        |                                                                     | Min   | Typ <sup>*4</sup> | Max |               |         |
| Power supply current <sup>*3</sup> | $I_{LVD}$  | $V_{CC}$                               | Current consumption of the low-voltage detection circuit            | —     | 31                | 54  | $\mu\text{A}$ |         |
|                                    | $I_{CRH}$  |                                        | Current consumption of the main CR oscillator                       | —     | 0.5               | 0.6 | mA            |         |
|                                    | $I_{CRL}$  |                                        | Current consumption of the sub-CR oscillator oscillating at 100 kHz | —     | 20                | 72  | $\mu\text{A}$ |         |
| LCD internal division resistance   | $R_{LCD}$  | —                                      | Between V4 and $V_{SS}$                                             | —     | 400               | —   | $k\Omega$     |         |
|                                    |            |                                        |                                                                     | —     | 40                | —   | $k\Omega$     |         |
| COM0 to COM7 output impedance      | $R_{VCOM}$ | COM0 to COM7                           | V1 to V4 = 4.1 V                                                    | —     | —                 | 5   | $k\Omega$     |         |
| SEG00 to SEG39 output impedance    | $R_{VSEG}$ | SEG00 to SEG39                         |                                                                     | —     | —                 | 7   | $k\Omega$     |         |
| LCD leakage current                | $I_{LCDL}$ | V0 to V4, COM0 to COM7, SEG00 to SEG39 | —                                                                   | -1    | —                 | +1  | $\mu\text{A}$ |         |

\*1: The input levels of P01, P04, P10, P22 and P23 can be switched between “CMOS input level” and “hysteresis input level”. The input level selection register (ILSR) is used to switch between the two input levels.

\*2: P40 to P43, P50 to P53, P94, PB2 to PB4 and PC4 to PC7 are only available on the MB95410H Series.

\*3: • The power supply current is determined by the external clock. When the low-voltage detection option is selected, the power-supply current will be the sum of adding the current consumption of the low-voltage detection circuit ( $I_{LVD}$ ) to one of the value from  $I_{CC}$  to  $I_{CCH}$ . In addition, when both the low-voltage detection option and the CR oscillator are selected, the power supply current will be the sum of adding up the current consumption of the low-voltage detection circuit, the current consumption of the CR oscillators ( $I_{CRH}$ ,  $I_{CRL}$ ) and a specified value. In on-chip debug mode, the CR oscillator ( $I_{CRH}$ ) and the low-voltage detection circuit are always enabled, and current consumption therefore increases accordingly.

• See “17.4. AC Characteristics: 17.4.1. Clock Timing” for  $F_{CH}$  and  $F_{CL}$ .

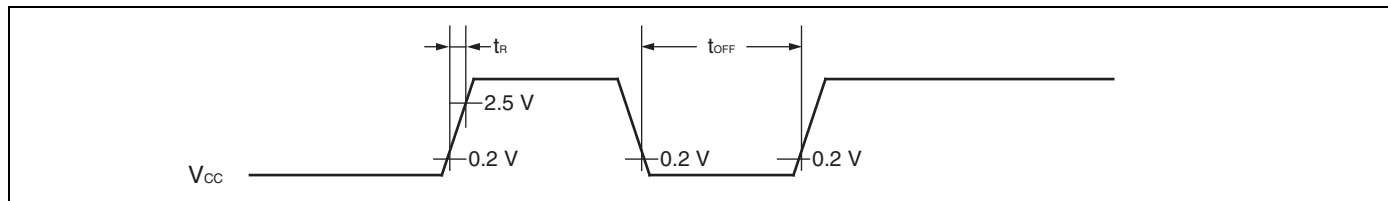
• See “17.4. AC Characteristics: 17.4.2. Source Clock/Machine Clock” for  $F_{MP}$  and  $F_{MPL}$ .

\*4:  $V_{CC} = 5.0 \text{ V}$ ,  $T_A = +25^\circ\text{C}$

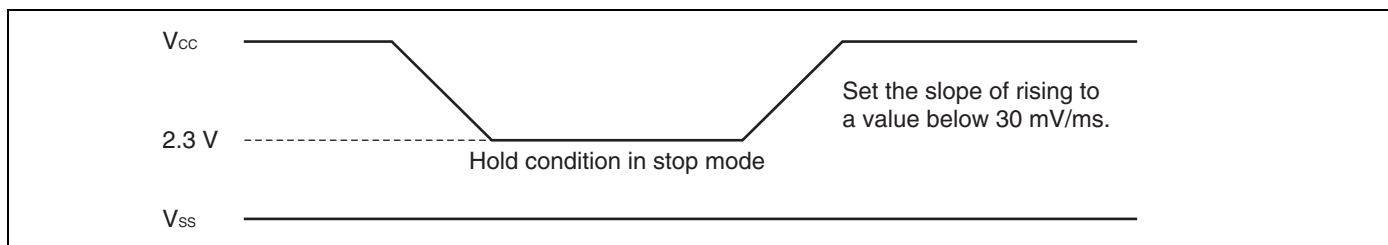
#### 17.4.4 Power-on Reset

( $V_{SS} = 0.0\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ )

| Parameter                | Symbol    | Condition | Value |     | Unit | Remarks                  |
|--------------------------|-----------|-----------|-------|-----|------|--------------------------|
|                          |           |           | Min   | Max |      |                          |
| Power supply rising time | $t_R$     | —         | —     | 50  | ms   |                          |
| Power supply cutoff time | $t_{OFF}$ | —         | 1     | —   | ms   | Wait time until power-on |



Note: A sudden change of power supply voltage may activate the power-on reset function. When changing the power supply voltage during the operation, set the slope of rising to a value below within 30 mV/ms as shown below.

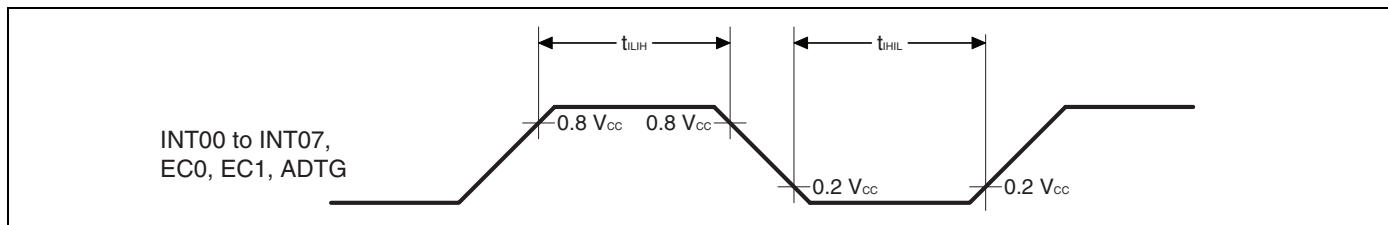


#### 17.4.5 Peripheral Input Timing

( $V_{CC} = 5.0\text{ V} \pm 10\%$ ,  $V_{SS} = 0.0\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ )

| Parameter                        | Symbol   | Pin name                       | Value          |     | Unit |
|----------------------------------|----------|--------------------------------|----------------|-----|------|
|                                  |          |                                | Min            | Max |      |
| Peripheral input "H" pulse width | $t_{LH}$ | INT00 to INT07, EC0, EC1, ADTG | $2 t_{MCLK}^*$ | —   | ns   |
| Peripheral input "L" pulse width | $t_{HL}$ |                                | $2 t_{MCLK}^*$ | —   | ns   |

\*: See "17.4.2. Source Clock/Machine Clock" for  $t_{MCLK}$ .





## 17.5 A/D Converter

### 17.5.1 A/D Converter Electrical Characteristics

( $AV_{CC} = V_{CC} = 4.0\text{ V to }5.5\text{ V}$ ,  $AV_{SS} = V_{SS} = 0.0\text{ V}$ ,  $T_A = -40^\circ\text{C to }+85^\circ\text{C}$ )

| Parameter                     | Symbol    | Value                      |                            |                            | Unit          | Remarks                                                                                       |
|-------------------------------|-----------|----------------------------|----------------------------|----------------------------|---------------|-----------------------------------------------------------------------------------------------|
|                               |           | Min                        | Typ                        | Max                        |               |                                                                                               |
| Resolution                    | —         | —                          | —                          | 10                         | bit           |                                                                                               |
| Total error                   |           | -3                         | —                          | +3                         | LSB           |                                                                                               |
| Linearity error               |           | -2.5                       | —                          | +2.5                       | LSB           |                                                                                               |
| Differential linear error     |           | -1.9                       | —                          | +1.9                       | LSB           |                                                                                               |
| Zero transition voltage       | $V_{OT}$  | $AV_{SS} - 1.5\text{ LSB}$ | $AV_{SS} + 0.5\text{ LSB}$ | $AV_{SS} + 2.5\text{ LSB}$ | V             |                                                                                               |
| Full-scale transition voltage | $V_{FST}$ | $AV_{CC} - 4.5\text{ LSB}$ | $AV_{CC} - 2\text{ LSB}$   | $AV_{CC} + 0.5\text{ LSB}$ | V             |                                                                                               |
| Compare time                  | —         | 0.9                        | —                          | 16500                      | $\mu\text{s}$ | $4.5\text{ V} \leq V_{CC} \leq 5.5\text{ V}$                                                  |
|                               |           | 1.8                        | —                          | 16500                      | $\mu\text{s}$ | $4.0\text{ V} \leq V_{CC} < 4.5\text{ V}$                                                     |
| Sampling time                 | —         | 0.6                        | —                          | $\infty$                   | $\mu\text{s}$ | $4.5\text{ V} \leq V_{CC} \leq 5.5\text{ V}$ , with external impedance $< 5.4\text{ k}\Omega$ |
|                               |           | 1.2                        | —                          | $\infty$                   | $\mu\text{s}$ | $4.0\text{ V} \leq V_{CC} < 4.5\text{ V}$ , with external impedance $< 2.4\text{ k}\Omega$    |
| Analog input current          | $I_{AIN}$ | -0.3                       | —                          | +0.3                       | $\mu\text{A}$ |                                                                                               |
| Analog input voltage          | $V_{AIN}$ | $AV_{SS}$                  | —                          | $AV_{CC}$                  | V             |                                                                                               |

### 17.5.3 Definitions of A/D Converter Terms

#### Resolution

It indicates the level of analog variation that can be distinguished by the A/D converter.  
When the number of bits is 10, analog voltage can be divided into  $2^{10} = 1024$ .

#### Linearity error (unit: LSB)

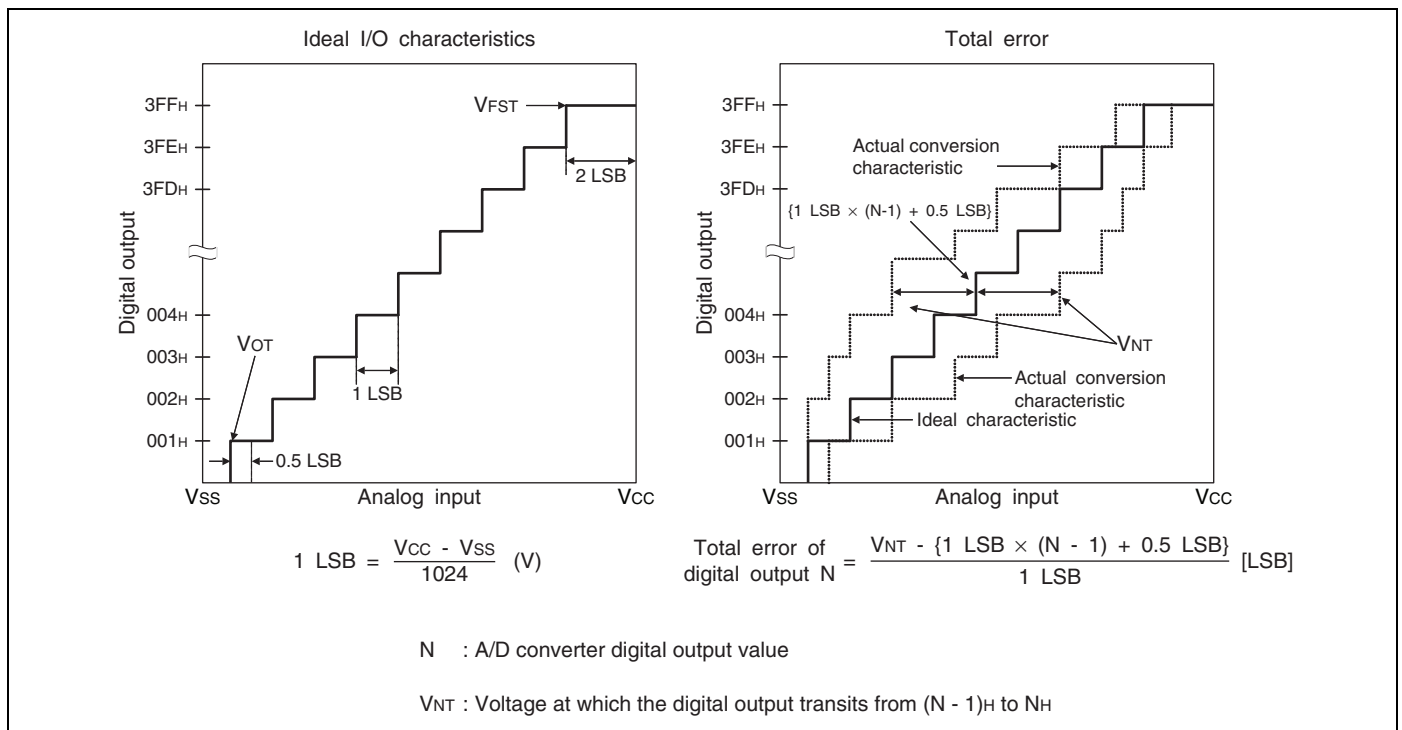
It indicates how much an actual conversion value deviates from the straight line connecting the zero transition point ("00 0000 0000"  $\leftrightarrow$  "00 0000 0001") of a device to the full-scale transition point ("11 1111 1111"  $\leftrightarrow$  "11 1111 1110") of the same device.

#### Differential linear error (unit: LSB)

It indicates how much the input voltage required to change the output code by 1 LSB deviates from an ideal value.

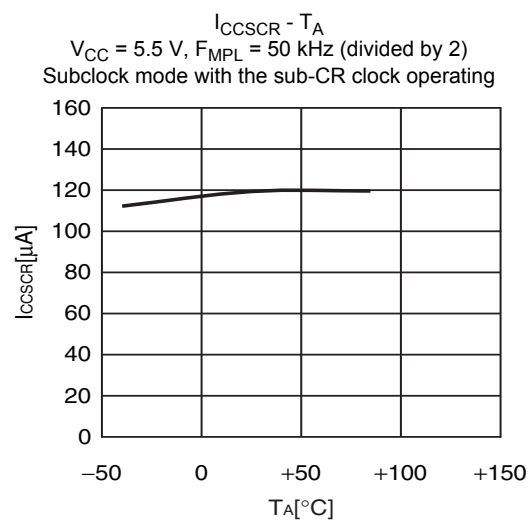
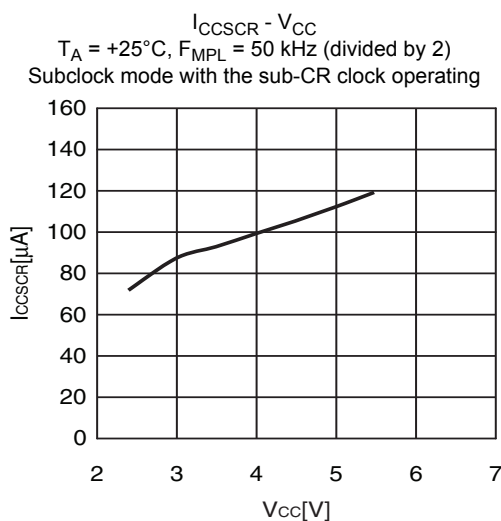
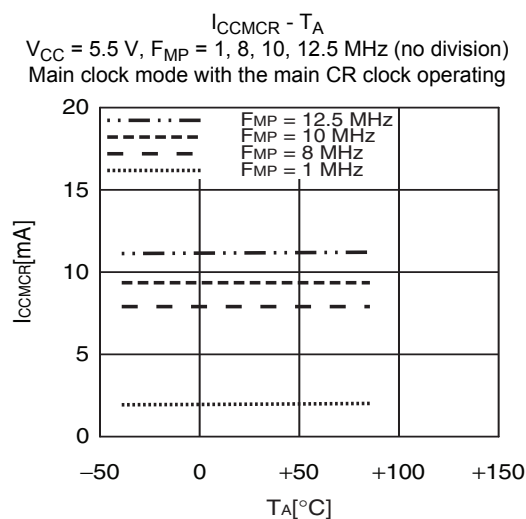
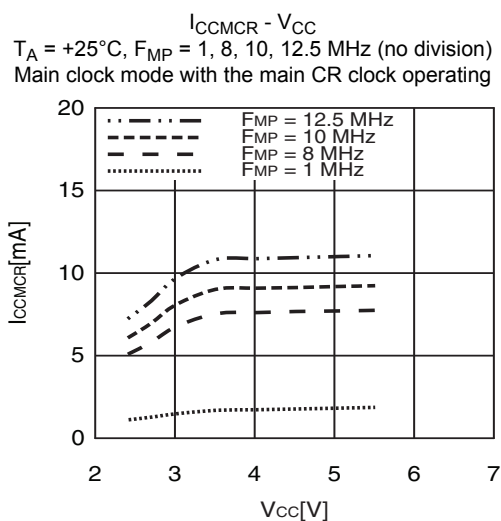
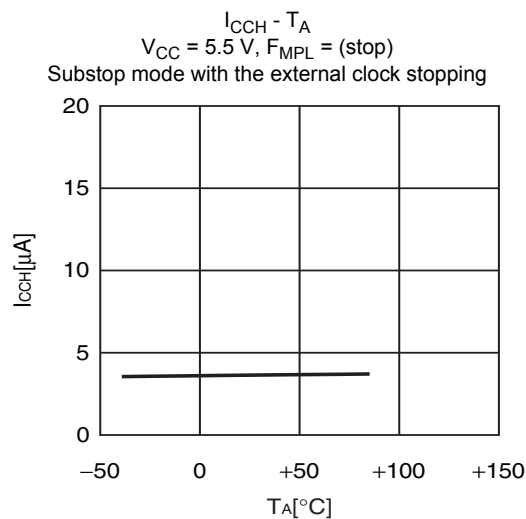
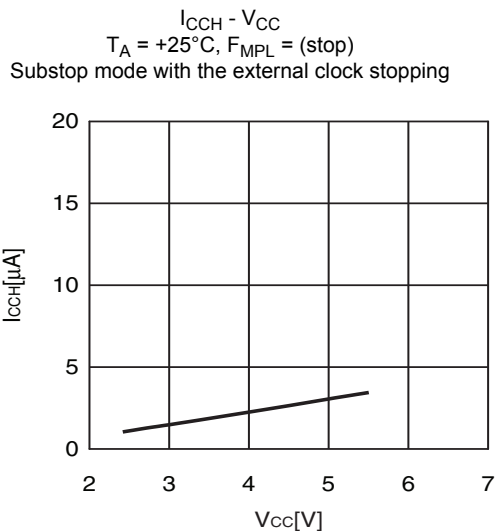
#### Total error (unit: LSB)

It indicates the difference between an actual value and a theoretical value. The error can be caused by a zero transition error, a full-scale transition errors, a linearity error, a quantum error, or noise.



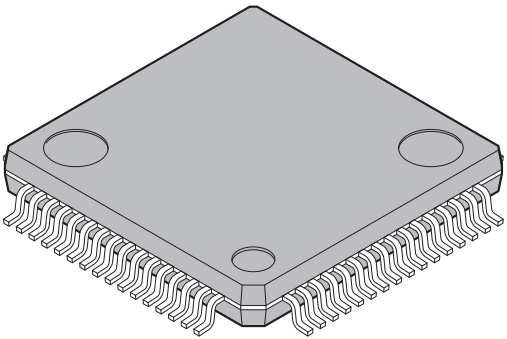
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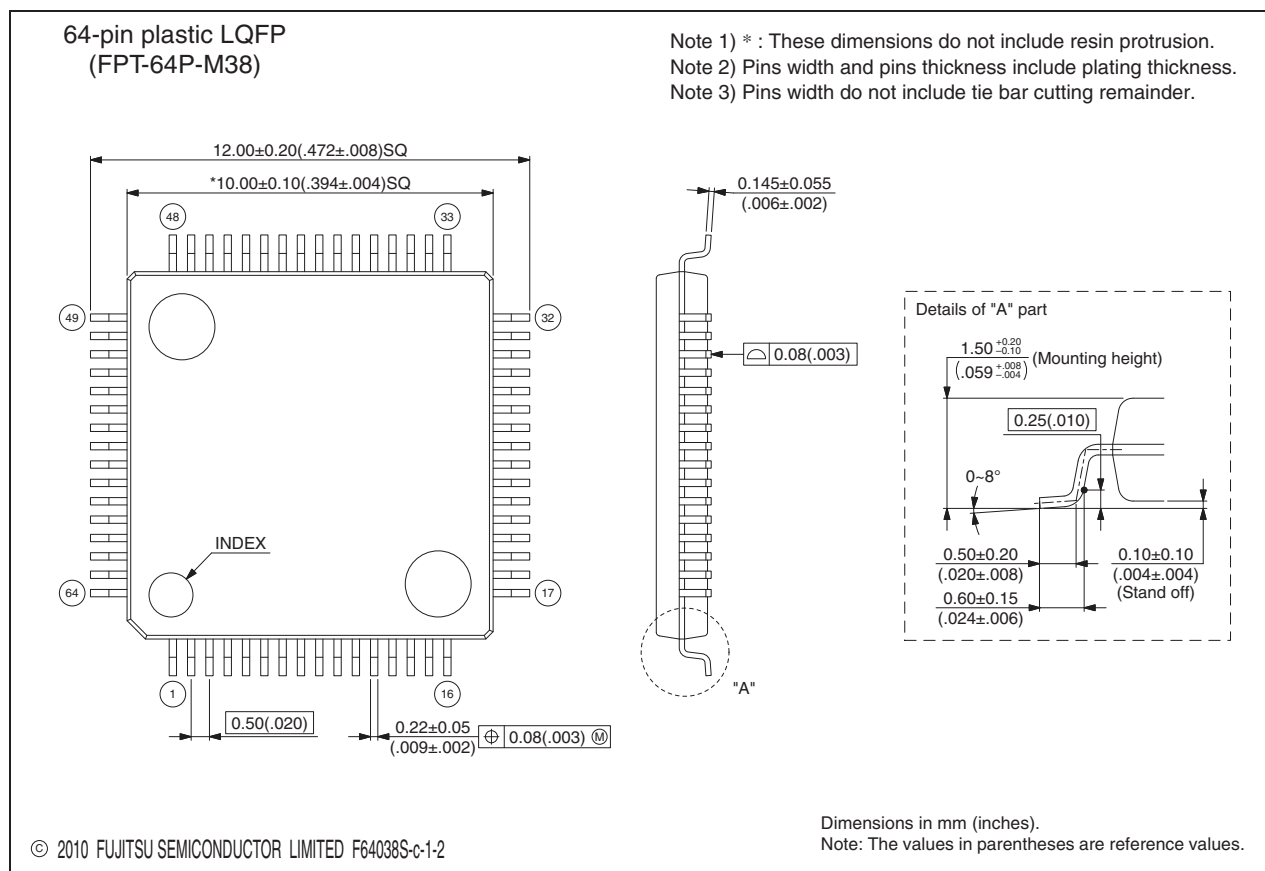
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**19. Mask Options**

| No. | Part Number                 | MB95F414H<br>MB95F416H<br>MB95F418H<br>MB95F474H<br>MB95F476H<br>MB95F478H | MB95F414K<br>MB95F416K<br>MB95F418K<br>MB95F474K<br>MB95F476K<br>MB95F478K |
|-----|-----------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|
|     | Selectable/Fixed            | Fixed                                                                      |                                                                            |
| 1   | Low-voltage detection reset | Without low-voltage detection reset                                        | With low-voltage detection reset                                           |
| 2   | Reset                       | With dedicated reset input                                                 | Without dedicated reset input                                              |

|                                                                                                                                   |                                |                     |
|-----------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------|
| <p>64-pin plastic LQFP</p>  <p>(FPT-64P-M38)</p> | Lead pitch                     | 0.50 mm             |
|                                                                                                                                   | Package width × package length | 10.00 mm × 10.00 mm |
|                                                                                                                                   | Lead shape                     | Gullwing            |
|                                                                                                                                   | Lead bend direction            | Normal bend         |
|                                                                                                                                   | Sealing method                 | Plastic mold        |
|                                                                                                                                   | Mounting height                | 1.70 mm MAX         |
|                                                                                                                                   | Weight                         | 0.32 g              |



(Continued)