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# MB9A1A0N Series

# 32-bit Arm® Cortex®-M3 FM3 Microcontroller

The MB9A1A0N Series are highly integrated 32-bit microcontrollers that dedicated for embedded controllers with low-power consumption mode and competitive cost.

The MB9A1A0N Series are based on the Arm® Cortex® -M3 Processor with on-chip Flash memory and SRAM, and have peripheral functions such as Motor Control Timers, ADCs, DACs and Communication Interfaces (UART, CSIO, I²C).

The products which are described in this data sheet are placed into TYPE7 product categories in FM3 Family Peripheral Manual.

## Features

### 32-bit Arm® Cortex®-M3 Core

- Processor version: r2p1
- Up to 20 MHz Operation Frequency
- Integrated Nested Vectored Interrupt Controller (NVIC): 1 channel NMI (non-maskable interrupt) and 32 channels' peripheral interrupts and 8 priority levels
- 24-bit System timer (Sys Tick): System timer for OS task management

### On-chip Memories

### [Flash memory]

- Up to 128 Kbytes
- Read cycle: 0 wait-cycle
- Security function for code protection

### [SRAM]

This series contains a total of up to 16 Kbyte on-chip SRAM that is connected to System bus of Cortex-M3 core.

- SRAM1: Up to 16 Kbytes

### Multi-function Serial Interface (Max 8 channels)

Operation mode is selectable from the followings for each channel.

- UART
- CSIO
- I²C

### [UART]

- Full duplex double buffer
- Selection with or without parity supported
- Built-in dedicated baud rate generator
- External clock available as a serial clock
- Various error detection functions available (parity errors, framing errors, and overrun errors)

### [CSIO]

- Full duplex double buffer
- Built-in dedicated baud rate generator
- Overrun error detection function available

### [I²C]

Standard-mode (Max 100 kbps) / Fast-mode (Max 400 kbps) supported

### A/D Converter (Max 16 channels)

### [12-bit A/D Converter]

- Successive Approximation type
- Conversion time: Min 1.0 µs
- Priority conversion available (priority at 2levels)
- Scanning conversion mode
- Built-in FIFO for conversion data storage (for SCAN conversion: 16steps, for Priority conversion: 4steps)

### D/A Converter (Max 2 channels)

- R-2R type
- 10-bit resolution

### Base Timer (Max 8 channels)

Operation mode is selectable from the followings for each channel.

- 16-bit PWM timer
- 16-bit PPG timer
- 16-/32-bit reload timer
- 16-/32-bit PWC timer

### General-Purpose I/O Port

This series can use its pins as general-purpose I/O ports when they are not used for peripherals. Moreover, the port relocate function is built in. It can set which I/O port the peripheral function can be allocated to.

- Capable of pull-up control per pin
- Capable of reading pin level directly
- Built-in the port relocate function
- Up to 84 high-speed general-purpose I/O Ports@100 pin Package
- Some ports are 5 V tolerant I/O
  See List of Pin Functions and I/O Circuit Type to confirm the corresponding pins.

### Multi-function Timer

The Multi-function timer is composed of the following blocks.

- 16-bit free-run timer × 3ch.
- Input capture × 4ch.
- Output compare × 6ch.
- A/D activation compare × 1ch.
- Waveform generator × 3ch.
- 16-bit PPG timer × 3ch.
  IGBT mode is contained

The following function can be used to achieve the motor control.

- PWM signal output function
- DC chopper waveform output function
- Dead time function
- Input capture function
- A/D convertor activate function
- DTIF (Motor emergency stop) interrupt function

### HDMI-CEC/Remote Control Receiver (Up to 2 channels)

### HDMI- CEC receiver / Remote control receiver

- Operating modes supporting the following standards can be selected
  - SIRCS
  - NEC/Association for Electric Home Appliances
  - HDMI-CEC
- Capable of adjusting detection timings for start bit and data bit
- Equipped with noise filter

### HDMI-CEC transmitter

- Header block automatic transmission by judging Signal free
- Generating status interrupt by detecting Arbitration lost
- Generating START, EOM, ACK automatically to output CEC transmission by setting 1 byte data
- Generating transmission status interrupt when transmitting 1 block (1 byte data and EOM/ACK)

### Real-time clock (RTC)

The Real-time clock can count Year/Month/Day/Hour/Minute/Second/A day of the week from 00 to 99.

- The interrupt function with specifying date and time (Year/Month/Day/Hour/Minute) is available. This function is also available by specifying only Year, Month, Day, Hour or Minute.
- Timer interrupt function after set time or each set time.
- Capable of rewriting the time with continuing the time count.
- Leap year automatic count is available.

### External Interrupt Controller Unit

- Up to 16 external interrupt input pins
- Include one non-maskable interrupt (NMI) input pin

### Watchdog Timer (2 channels)

A watchdog timer can generate interrupts or a reset when a time-out value is reached.

This series consists of two different watchdogs, a Hardware watchdog and a Software watchdog.

The Hardware watchdog timer is clocked by the built-in Low-speed CR oscillator. Therefore, the Hardware watchdog is active in any low-power consumption mode except RTC, Stop, Deep Standby RTC and Deep Standby Stop modes.

### Clock and Reset

### [Clocks]

Selectable from five clock sources (2 external oscillators, 2 built-in CR oscillators, and Main PLL).

- Main Clock: 4 MHz to 20 MHz
- Sub Clock: 32.768 kHz
- Built-in High-speed CR Clock: 4 MHz
- Built-in Low-speed CR Clock: 100 kHz
- Main PLL Clock

### [Resets]

- Reset requests from INITX pin
- Power-on reset
- Software reset
- Watchdog timers reset
- Low-voltage detection reset
- Clock Super Visor reset

### Clock Super Visor (CSV)

Clocks generated by built-in CR oscillators are used to supervise abnormality of the external clocks.

- If external clock failure (clock stop) is detected, reset is asserted.
- If external frequency anomaly is detected, interrupt or reset is asserted.

### Low-Voltage Detector (LVD)

This Series includes 2-stage monitoring of voltage on the VCC. When the voltage falls below the voltage that has been set, Low-Voltage Detector generates an interrupt or reset.

- LVD1: error reporting via interrupt
- LVD2: auto-reset operation

### Low-Power Consumption Mode

Six low-power consumption modes supported.

- Sleep
- Timer
- RTC
- Stop
- Deep Standby RTC
- Deep Standby Stop

The back up register is 16 bytes.

### Debug

Serial Wire JTAG Debug Port (SWJ-DP)

### Power Supply

Wide range voltage: VCC = 1.8 V to 5.5 V

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# 1. Product Lineup

**Memory size**

| Product name | | MB9AF1A1L/M/N | MB9AF1A2L/M/N |
|---|---|---|---|
| On-chip Flash memory | | 64 Kbytes | 128 Kbytes |
| On-chip SRAM | SRAM1 | 12 Kbytes | 16 Kbytes |

**Function**

| Product name | | | MB9AF1A1L<br>MB9AF1A2L | MB9AF1A1M<br>MB9AF1A2M | MB9AF1A1N<br>MB9AF1A2N |
|---|---|---|---|---|---|
| Pin count | | | 64 | 80 | 100 |
| CPU | | | Cortex-M3 | | |
| | Freq. | | 20 MHz | | |
| Power supply voltage range | | | 1.8 V to 5.5 V | | |
| Multi-function Serial Interface (UART/CSIO/I²C) | | | 8ch. (Max) | | |
| Base Timer (PWC/ Reload timer/PWM/PPG) | | | 8ch. (Max) | | |
| MF-Timer | A/D activation compare | 1ch. | 1 unit (Max) | | |
| | Input capture | 4ch. | | | |
| | Free-run timer | 3ch. | | | |
| | Output compare | 6ch. | | | |
| | Waveform generator | 3ch. | | | |
| | PPG (IGBT mode) | 3ch. | | | |
| HDMI-CEC/ Remote Control Receiver | | | 2ch. (Max) | | |
| Real-time clock (RTC) | | | 1 unit | | |
| Watchdog timer | | | 1ch. (SW) + 1ch. (HW) | | |
| External Interrupts | | | 8 pins (Max)+ NMI × 1 | 11 pins (Max)+ NMI × 1 | 16 pins (Max)+ NMI × 1 |
| General-purpose I/O ports | | | 52 pins (Max) | 67 pins (Max) | 84 pins (Max) |
| 12-bit A/D converter | | | 9ch. (1 unit) | 12ch. (1 unit) | 16ch. (1 unit) |
| 10-bit D/A converter | | | 2ch. (Max) | | |
| CSV (Clock Super Visor) | | | Yes | | |
| LVD (Low-Voltage Detector) | | | 2ch. | | |
| Built-in CR | High-speed | | 4 MHz | | |
| | Low-speed | | 100 kHz | | |
| Debug Function | | | SWJ-DP | | |

***Note:***

- *All signals of the peripheral function in each product cannot be allocated by limiting the pins of package. It is necessary to use the port relocate function of the I/O port according to your function use. See Electrical Characteristics 12.4 AC Characteristics 12.4.3 Built-in CR Oscillation Characteristics for accuracy of built-in CR.*

## 2. Packages

| Package \ Product name | MB9AF1A1L<br>MB9AF1A2L | MB9AF1A1M<br>MB9AF1A2M | MB9AF1A1N<br>MB9AF1A2N |
|---|---|---|---|
| LQFP: LQD064 (0.5mm pitch) | ❍ | - | - |
| LQFP: LQG064 (0.65mm pitch) | ❍ | - | - |
| LQFP: LQH080 (0.5mm pitch) | - | ❍ | - |
| LQFP: LQJ080 (0.65mm pitch) | - | ❍ | - |
| LQFP: LQI100 (0.5mm pitch) | - | - | ❍ |
| QFP: PQH100 (0.65mm pitch) | - | - | ❍ |

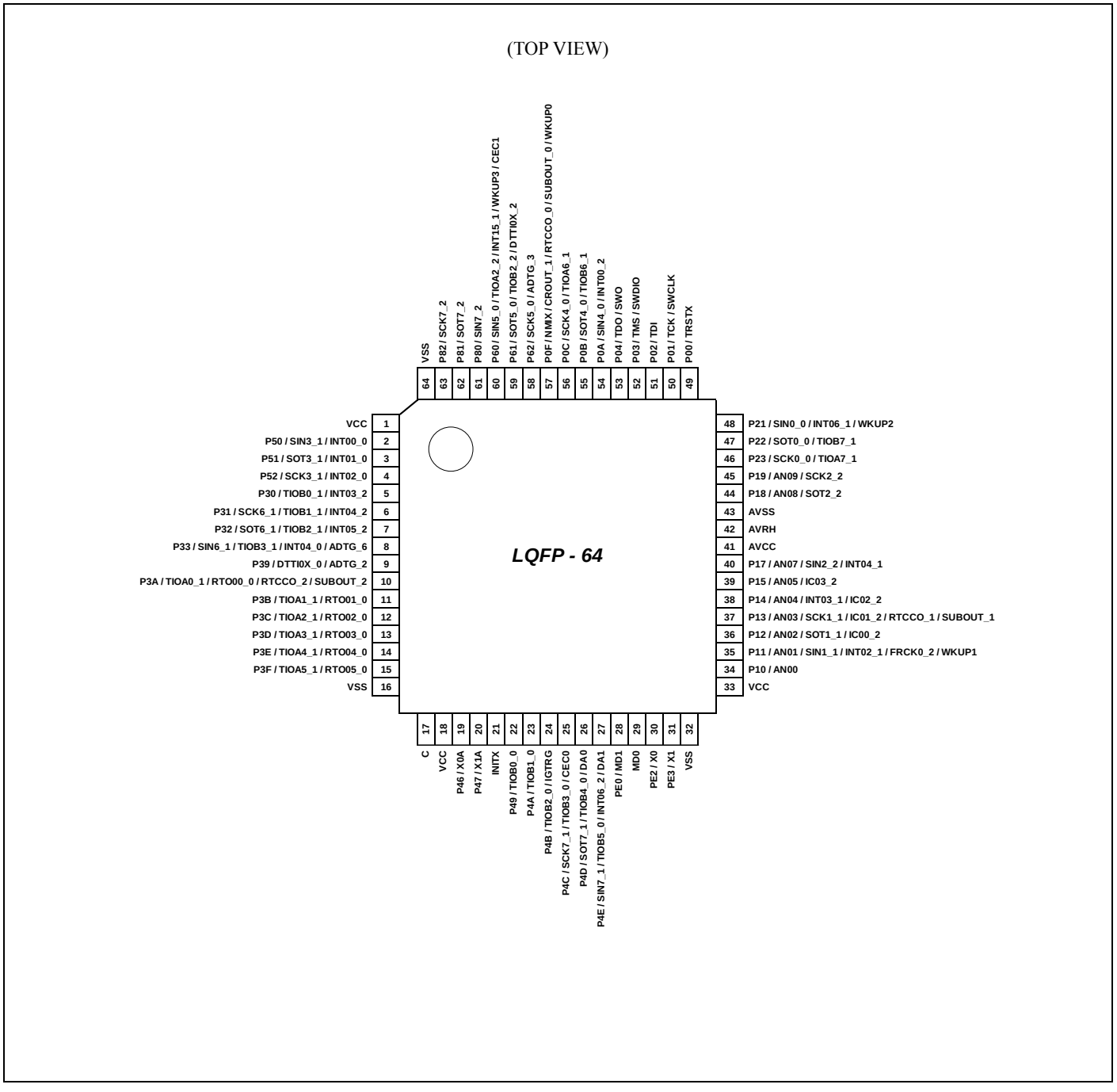
❍: Supported

***Note:***

- *See Package Dimensions for detailed information on each package.*

## 3. Pin Assignment

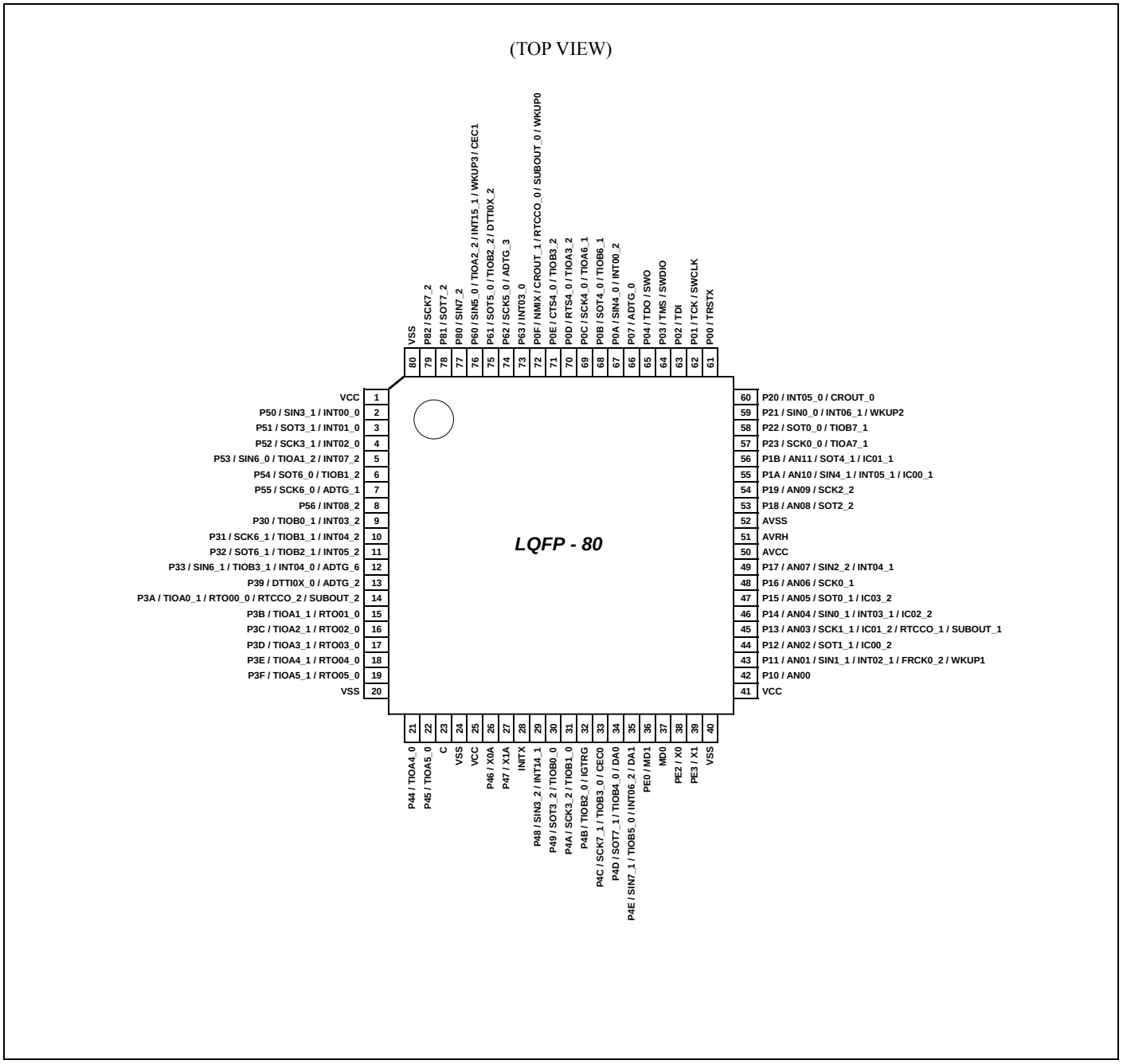
### LQD064/LQG064




***Note:***

- *The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.*

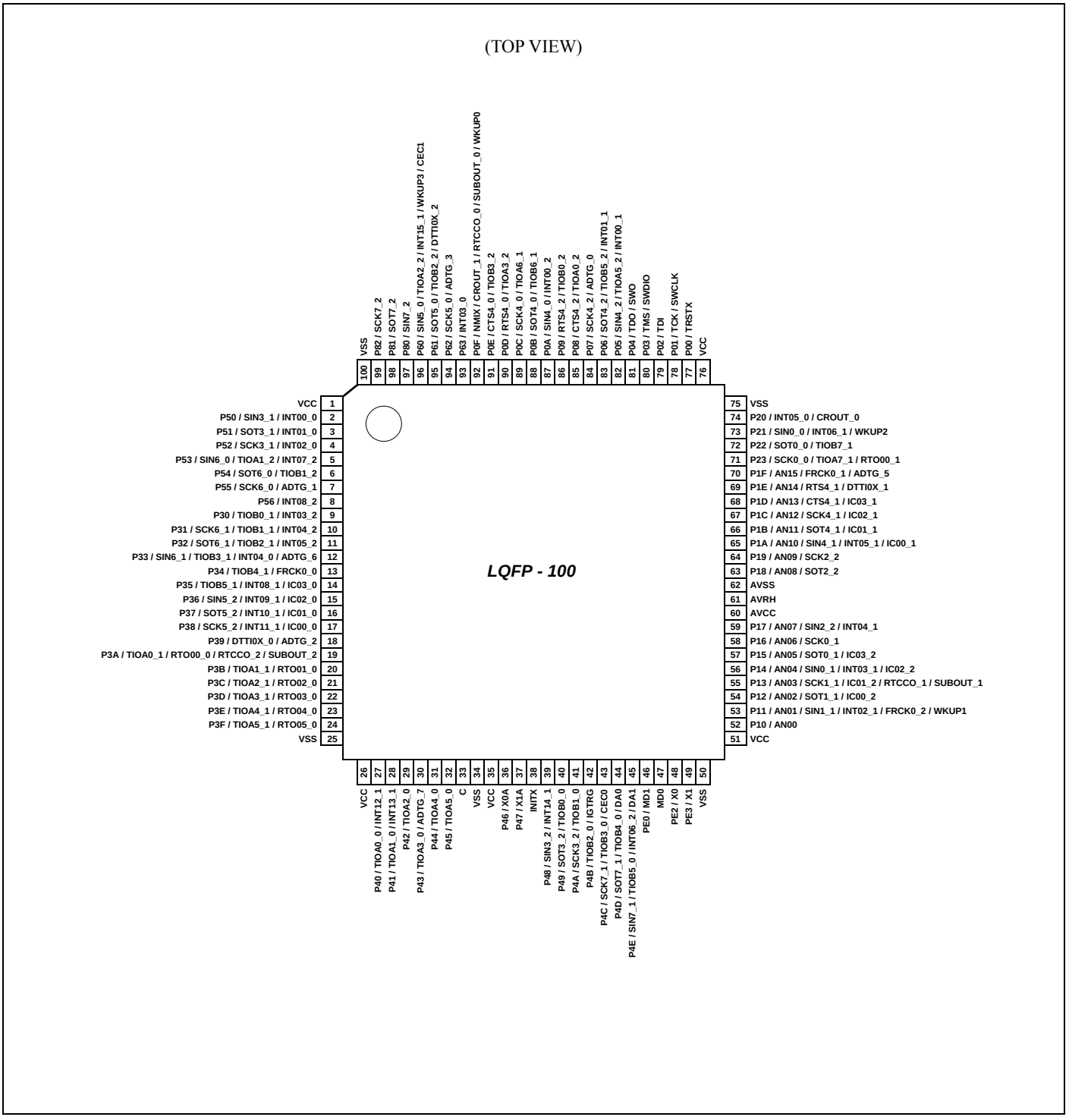
## LQH080/LQJ080




***Note:***

- *The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.*

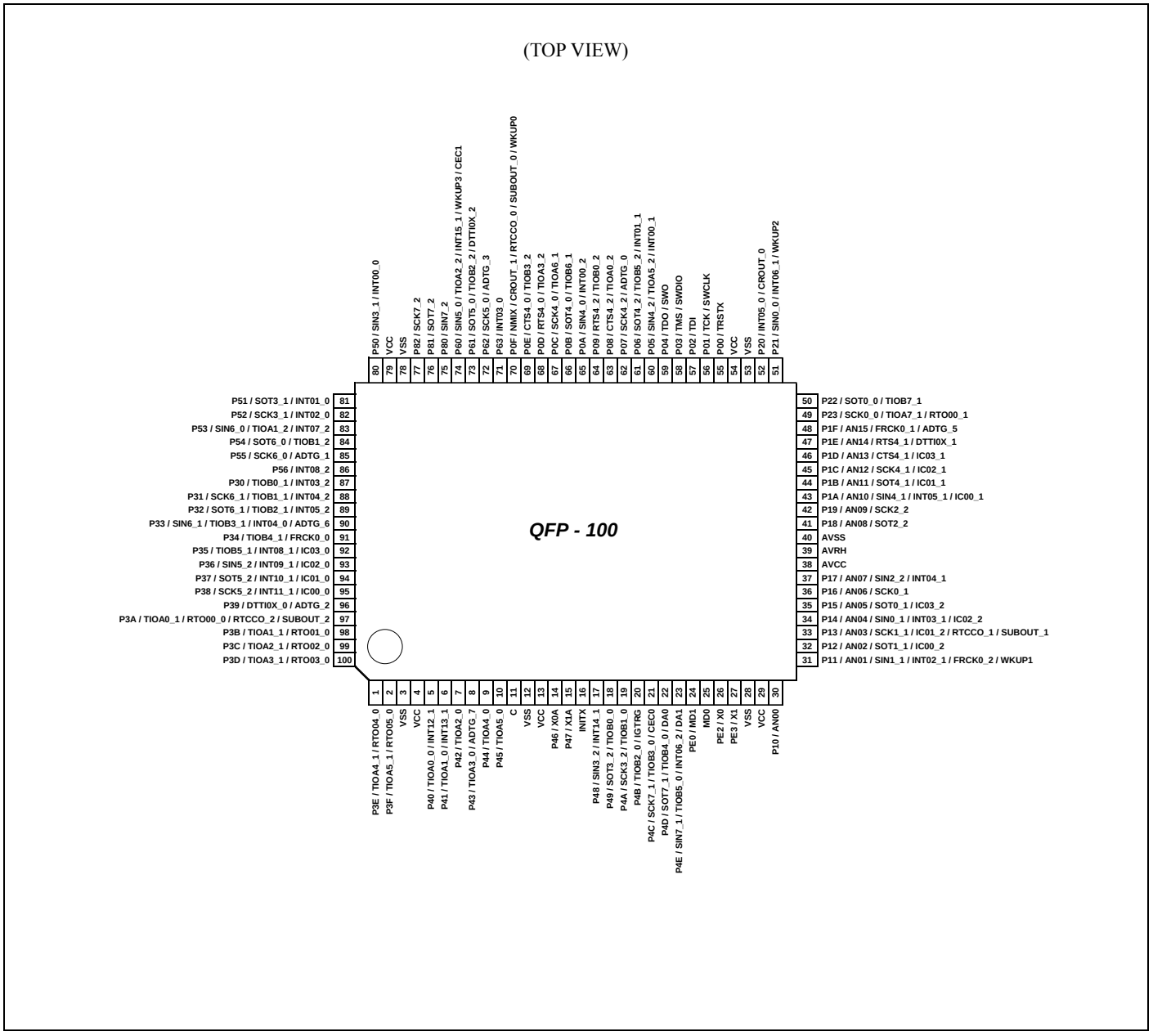
## LQI100




***Note:***

- *The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.*

## PQH100




***Note:***

- *The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.*

# 4. List of Pin Functions

### List of pin numbers

The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.

| Pin No | | | | Pin name | I/O circuit type | Pin state type |
|---|---|---|---|---|---|---|
| LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 | | | |
| 1 | 1 | 1 | 79 | VCC | - | |
| 2 | 2 | 2 | 80 | P50<br>INT00_0<br>SIN3_1 | E | F |
| 3 | 3 | 3 | 81 | P51<br>INT01_0<br>SOT3_1<br>(SDA3_1) | E | F |
| 4 | 4 | 4 | 82 | P52<br>INT02_0<br>SCK3_1<br>(SCL3_1) | E | F |
| - | 5 | 5 | 83 | P53<br>SIN6_0<br>TIOA1_2<br>INT07_2 | E | F |
| - | 6 | 6 | 84 | P54<br>SOT6_0<br>(SDA6_0)<br>TIOB1_2 | E | H |
| - | 7 | 7 | 85 | P55<br>SCK6_0<br>(SCL6_0)<br>ADTG_1 | E | H |
| - | 8 | 8 | 86 | P56<br>INT08_2 | E | O |
| 5 | 9 | 9 | 87 | P30<br>TIOB0_1<br>INT03_2 | E | F |
| 6 | 10 | 10 | 88 | P31<br>TIOB1_1<br>SCK6_1<br>(SCL6_1)<br>INT04_2 | E | F |
| 7 | 11 | 11 | 89 | P32<br>TIOB2_1<br>SOT6_1<br>(SDA6_1)<br>INT05_2 | E | F |

| Pin No | | | | Pin name | I/O circuit type | Pin state type |
|---|---|---|---|---|---|---|
| LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 | | | |
| 8 | 12 | 12 | 90 | P33<br>INT04_0<br>TIOB3_1<br>SIN6_1<br>ADTG_6 | E | F |
| - | - | 13 | 91 | P34<br>FRCK0_0<br>TIOB4_1 | E | H |
| - | - | 14 | 92 | P35<br>IC03_0<br>TIOB5_1<br>INT08_1 | E | F |
| - | - | 15 | 93 | P36<br>IC02_0<br>SIN5_2<br>INT09_1 | E | F |
| - | - | 16 | 94 | P37<br>IC01_0<br>SOT5_2<br>(SDA5_2)<br>INT10_1 | E | F |
| - | - | 17 | 95 | P38<br>IC00_0<br>SCK5_2<br>(SCL5_2)<br>INT11_1 | E | F |
| 9 | 13 | 18 | 96 | P39<br>DTTI0X_0<br>ADTG_2 | E | H |
| 10 | 14 | 19 | 97 | P3A<br>RTO00_0<br>(PPG00_0)<br>TIOA0_1<br>RTCCO_2<br>SUBOUT_2 | E | H |
| 11 | 15 | 20 | 98 | P3B<br>RTO01_0<br>(PPG00_0)<br>TIOA1_1 | E | H |
| 12 | 16 | 21 | 99 | P3C<br>RTO02_0<br>(PPG02_0)<br>TIOA2_1 | E | H |

| Pin No | | | | Pin name | I/O circuit type | Pin state type |
|---|---|---|---|---|---|---|
| LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 | | | |
| 13 | 17 | 22 | 100 | P3D<br>RTO03_0 (PPG02_0)<br>TIOA3_1 | E | H |
| 14 | 18 | 23 | 1 | P3E<br>RTO04_0 (PPG04_0)<br>TIOA4_1 | E | H |
| 15 | 19 | 24 | 2 | P3F<br>RTO05_0 (PPG04_0)<br>TIOA5_1 | E | H |
| 16 | 20 | 25 | 3 | VSS | - | |
| - | - | 26 | 4 | VCC | - | |
| - | - | 27 | 5 | P40<br>TIOA0_0<br>INT12_1 | E | F |
| - | - | 28 | 6 | P41<br>TIOA1_0<br>INT13_1 | E | F |
| - | - | 29 | 7 | P42<br>TIOA2_0 | E | H |
| - | - | 30 | 8 | P43<br>TIOA3_0<br>ADTG_7 | E | H |
| - | 21 | 31 | 9 | P44<br>TIOA4_0 | E | H |
| - | 22 | 32 | 10 | P45<br>TIOA5_0 | E | H |
| 17 | 23 | 33 | 11 | C | - | |
| - | 24 | 34 | 12 | VSS | - | |
| 18 | 25 | 35 | 13 | VCC | - | |
| 19 | 26 | 36 | 14 | P46<br>X0A | D | M |
| 20 | 27 | 37 | 15 | P47<br>X1A | D | N |
| 21 | 28 | 38 | 16 | INITX | B | C |
| - | 29 | 39 | 17 | P48<br>INT14_1<br>SIN3_2 | E | F |

| Pin No | | | | Pin name | I/O circuit type | Pin state type |
|---|---|---|---|---|---|---|
| LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 | | | |
| 22 | 30 | 40 | 18 | P49 | E | H |
| | | | | TIOB0_0 | | |
| - | | | | SOT3_2 (SDA3_2) | | |
| 23 | 31 | 41 | 19 | P4A | E | H |
| | | | | TIOB1_0 | | |
| - | | | | SCK3_2 (SCL3_2) | | |
| 24 | 32 | 42 | 20 | P4B | E | H |
| | | | | TIOB2_0 | | |
| | | | | IGTRG | | |
| 25 | 33 | 43 | 21 | P4C | G | Q |
| | | | | TIOB3_0 | | |
| | | | | SCK7_1 (SCL7_1) | | |
| | | | | CEC0 | | |
| 26 | 34 | 44 | 22 | P4D | J | T |
| | | | | TIOB4_0 | | |
| | | | | SOT7_1 (SDA7_1) | | |
| | | | | DA0 | | |
| 27 | 35 | 45 | 23 | P4E | J | S |
| | | | | TIOB5_0 | | |
| | | | | INT06_2 | | |
| | | | | SIN7_1 | | |
| | | | | DA1 | | |
| 28 | 36 | 46 | 24 | PE0 | C | P |
| | | | | MD1 | | |
| 29 | 37 | 47 | 25 | MD0 | H | D |
| 30 | 38 | 48 | 26 | PE2 | A | A |
| | | | | X0 | | |
| 31 | 39 | 49 | 27 | PE3 | A | B |
| | | | | X1 | | |
| 32 | 40 | 50 | 28 | VSS | - | |
| 33 | 41 | 51 | 29 | VCC | - | |
| 34 | 42 | 52 | 30 | P10 | F | J |
| | | | | AN00 | | |
| 35 | 43 | 53 | 31 | P11 | F | L |
| | | | | AN01 | | |
| | | | | SIN1_1 | | |
| | | | | INT02_1 | | |
| | | | | FRCK0_2 | | |
| | | | | WKUP1 | | |

| Pin No | | | | Pin name | I/O circuit type | Pin state type |
|---|---|---|---|---|---|---|
| LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 | | | |
| 36 | 44 | 54 | 32 | P12<br>AN02<br>SOT1_1 (SDA1_1)<br>IC00_2 | F | J |
| 37 | 45 | 55 | 33 | P13<br>AN03<br>SCK1_1 (SCL1_1)<br>IC01_2<br>RTCCO_1<br>SUBOUT_1 | F | J |
| 38 | 46 | 56 | 34 | P14<br>AN04<br>IC02_2<br>INT03_1 | F | K |
| - | | | | SIN0_1 | | |
| 39 | 47 | 57 | 35 | P15<br>AN05<br>IC03_2 | F | J |
| - | | | | SOT0_1 (SDA0_1) | | |
| - | 48 | 58 | 36 | P16<br>AN06<br>SCK0_1 (SCL0_1) | F | J |
| 40 | 49 | 59 | 37 | P17<br>AN07<br>SIN2_2<br>INT04_1 | F | K |
| 41 | 50 | 60 | 38 | AVCC | - | |
| 42 | 51 | 61 | 39 | AVRH | - | |
| 43 | 52 | 62 | 40 | AVSS | - | |
| 44 | 53 | 63 | 41 | P18<br>AN08<br>SOT2_2 (SDA2_2) | F | J |
| 45 | 54 | 64 | 42 | P19<br>AN09<br>SCK2_2 (SCL2_2) | F | J |

| Pin No | | | | Pin name | I/O circuit type | Pin state type |
|---|---|---|---|---|---|---|
| LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 | | | |
| - | 55 | 65 | 43 | P1A<br>AN10<br>SIN4_1<br>INT05_1<br>IC00_1 | F | K |
| - | 56 | 66 | 44 | P1B<br>AN11<br>SOT4_1<br>(SDA4_1)<br>IC01_1 | F | J |
| - | - | 67 | 45 | P1C<br>AN12<br>SCK4_1<br>(SCL4_1)<br>IC02_1 | F | J |
| - | - | 68 | 46 | P1D<br>AN13<br>CTS4_1<br>IC03_1 | F | J |
| - | - | 69 | 47 | P1E<br>AN14<br>RTS4_1<br>DTTI0X_1 | F | J |
| - | - | 70 | 48 | P1F<br>AN15<br>ADTG_5<br>FRCK0_1 | F | J |
| 46 | 57 | 71 | 49 | P23<br>SCK0_0<br>(SCL0_0)<br>TIOA7_1 | E | H |
| - | - | | | RTO00_1 | | |
| 47 | 58 | 72 | 50 | P22<br>SOT0_0<br>(SDA0_0)<br>TIOB7_1 | E | H |
| 48 | 59 | 73 | 51 | P21<br>SIN0_0<br>INT06_1<br>WKUP2 | E | G |
| - | 60 | 74 | 52 | P20<br>INT05_0<br>CROUT_0 | E | F |

| Pin No | | | | Pin name | I/O circuit type | Pin state type |
|---|---|---|---|---|---|---|
| LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 | | | |
| - | - | 75 | 53 | VSS | - | |
| - | - | 76 | 54 | VCC | - | |
| 49 | 61 | 77 | 55 | P00<br>TRSTX | E | E |
| 50 | 62 | 78 | 56 | P01<br>TCK<br>SWCLK | E | E |
| 51 | 63 | 79 | 57 | P02<br>TDI | E | E |
| 52 | 64 | 80 | 58 | P03<br>TMS<br>SWDIO | E | E |
| 53 | 65 | 81 | 59 | P04<br>TDO<br>SWO | E | E |
| - | - | 82 | 60 | P05<br>TIOA5_2<br>SIN4_2<br>INT00_1 | E | F |
| - | - | 83 | 61 | P06<br>TIOB5_2<br>SOT4_2<br>(SDA4_2)<br>INT01_1 | E | F |
| - | 66<br>- | 84 | 62 | P07<br>ADTG_0<br>SCK4_2<br>(SCL4_2) | E | H |
| - | - | 85 | 63 | P08<br>TIOA0_2<br>CTS4_2 | E | H |
| - | - | 86 | 64 | P09<br>TIOB0_2<br>RTS4_2 | E | H |
| 54 | 67 | 87 | 65 | P0A<br>SIN4_0<br>INT00_2 | G | F |
| 55 | 68 | 88 | 66 | P0B<br>SOT4_0<br>(SDA4_0)<br>TIOB6_1 | G | H |
| 56 | 69 | 89 | 67 | P0C<br>SCK4_0<br>(SCL4_0)<br>TIOA6_1 | G | H |

| Pin No | | | | Pin name | I/O circuit type | Pin state type |
|---|---|---|---|---|---|---|
| LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 | | | |
| - | 70 | 90 | 68 | P0D<br>RTS4_0<br>TIOA3_2 | E | H |
| - | 71 | 91 | 69 | P0E<br>CTS4_0<br>TIOB3_2 | E | H |
| 57 | 72 | 92 | 70 | P0F<br>NMIX<br>CROUT_1<br>RTCCO_0<br>SUBOUT_0<br>WKUP0 | E | I |
| - | 73 | 93 | 71 | P63<br>INT03_0 | E | O |
| 58 | 74 | 94 | 72 | P62<br>SCK5_0<br>(SCL5_0)<br>ADTG_3 | E | H |
| 59 | 75 | 95 | 73 | P61<br>SOT5_0<br>(SDA5_0)<br>TIOB2_2<br>DTTI0X_2 | E | H |
| 60 | 76 | 96 | 74 | P60<br>SIN5_0<br>TIOA2_2<br>INT15_1<br>WKUP3<br>CEC1 | G | R |
| 61 | 77 | 97 | 75 | P80<br>SIN7_2 | G | H |
| 62 | 78 | 98 | 76 | P81<br>SOT7_2<br>(SDA7_2) | G | H |
| 63 | 79 | 99 | 77 | P82<br>SCK7_2<br>(SCL7_2) | G | H |
| 64 | 80 | 100 | 78 | VSS | - | |

## List of pin functions

The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.

| Pin function | Pin name | Function description | Pin No | | | |
|---|---|---|---|---|---|---|
| | | | LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 |
| ADC | ADTG_0 | A/D converter external trigger input pin | - | 66 | 84 | 62 |
| | ADTG_1 | | - | 7 | 7 | 85 |
| | ADTG_2 | | 9 | 13 | 18 | 96 |
| | ADTG_3 | | 58 | 74 | 94 | 72 |
| | ADTG_4 | | - | - | - | - |
| | ADTG_5 | | - | - | 70 | 48 |
| | ADTG_6 | | 8 | 12 | 12 | 90 |
| | ADTG_7 | | - | - | 30 | 8 |
| | ADTG_8 | | - | - | - | - |
| | AN00 | A/D converter analog input pin. ANxx describes ADC ch.xx. | 34 | 42 | 52 | 30 |
| | AN01 | | 35 | 43 | 53 | 31 |
| | AN02 | | 36 | 44 | 54 | 32 |
| | AN03 | | 37 | 45 | 55 | 33 |
| | AN04 | | 38 | 46 | 56 | 34 |
| | AN05 | | 39 | 47 | 57 | 35 |
| | AN06 | | - | 48 | 58 | 36 |
| | AN07 | | 40 | 49 | 59 | 37 |
| | AN08 | | 44 | 53 | 63 | 41 |
| | AN09 | | 45 | 54 | 64 | 42 |
| | AN10 | | - | 55 | 65 | 43 |
| | AN11 | | - | 56 | 66 | 44 |
| | AN12 | | - | - | 67 | 45 |
| | AN13 | | - | - | 68 | 46 |
| | AN14 | | - | - | 69 | 47 |
| | AN15 | | - | - | 70 | 48 |

| Pin function | Pin name | Function description | Pin No | | | |
|---|---|---|---|---|---|---|
| | | | LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 |
| Base Timer 0 | TIOA0_0 | Base timer ch.0 TIOA pin | - | - | 27 | 5 |
| | TIOA0_1 | | 10 | 14 | 19 | 97 |
| | TIOA0_2 | | - | - | 85 | 63 |
| | TIOB0_0 | Base timer ch.0 TIOB pin | 22 | 30 | 40 | 18 |
| | TIOB0_1 | | 5 | 9 | 9 | 87 |
| | TIOB0_2 | | - | - | 86 | 64 |
| Base Timer 1 | TIOA1_0 | Base timer ch.1 TIOA pin | - | - | 28 | 6 |
| | TIOA1_1 | | 11 | 15 | 20 | 98 |
| | TIOA1_2 | | - | 5 | 5 | 83 |
| | TIOB1_0 | Base timer ch.1 TIOB pin | 23 | 31 | 41 | 19 |
| | TIOB1_1 | | 6 | 10 | 10 | 88 |
| | TIOB1_2 | | - | 6 | 6 | 84 |
| Base Timer 2 | TIOA2_0 | Base timer ch.2 TIOA pin | - | - | 29 | 7 |
| | TIOA2_1 | | 12 | 16 | 21 | 99 |
| | TIOA2_2 | | 60 | 76 | 96 | 74 |
| | TIOB2_0 | Base timer ch.2 TIOB pin | 24 | 32 | 42 | 20 |
| | TIOB2_1 | | 7 | 11 | 11 | 89 |
| | TIOB2_2 | | 59 | 75 | 95 | 73 |
| Base Timer 3 | TIOA3_0 | Base timer ch.3 TIOA pin | - | - | 30 | 8 |
| | TIOA3_1 | | 13 | 17 | 22 | 100 |
| | TIOA3_2 | | - | 70 | 90 | 68 |
| | TIOB3_0 | Base timer ch.3 TIOB pin | 25 | 33 | 43 | 21 |
| | TIOB3_1 | | 8 | 12 | 12 | 90 |
| | TIOB3_2 | | - | 71 | 91 | 69 |
| Base Timer 4 | TIOA4_0 | Base timer ch.4 TIOA pin | - | 21 | 31 | 9 |
| | TIOA4_1 | | 14 | 18 | 23 | 1 |
| | TIOA4_2 | | - | - | - | - |
| | TIOB4_0 | Base timer ch.4 TIOB pin | 26 | 34 | 44 | 22 |
| | TIOB4_1 | | - | - | 13 | 91 |
| | TIOB4_2 | | - | - | - | - |
| Base Timer 5 | TIOA5_0 | Base timer ch.5 TIOA pin | - | 22 | 32 | 10 |
| | TIOA5_1 | | 15 | 19 | 24 | 2 |
| | TIOA5_2 | | - | - | 82 | 60 |
| | TIOB5_0 | Base timer ch.5 TIOB pin | 27 | 35 | 45 | 23 |
| | TIOB5_1 | | - | - | 14 | 92 |
| | TIOB5_2 | | - | - | 83 | 61 |
| Base Timer 6 | TIOA6_1 | Base timer ch.6 TIOA pin | 56 | 69 | 89 | 67 |
| | TIOB6_1 | Base timer ch.6 TIOB pin | 55 | 68 | 88 | 66 |
| Base Timer 7 | TIOA7_0 | Base timer ch.7 TIOA pin | - | - | - | - |
| | TIOA7_1 | | 46 | 57 | 71 | 49 |
| | TIOA7_2 | | - | - | - | - |
| | TIOB7_0 | Base timer ch.7 TIOB pin | - | - | - | - |
| | TIOB7_1 | | 47 | 58 | 72 | 50 |
| | TIOB7_2 | | - | - | - | - |

| Pin function | Pin name | Function description | Pin No | | | |
|---|---|---|---|---|---|---|
| | | | LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 |
| Debugger | SWCLK | Serial wire debug interface clock input pin | 50 | 62 | 78 | 56 |
| | SWDIO | Serial wire debug interface data input / output pin | 52 | 64 | 80 | 58 |
| | SWO | Serial wire viewer output pin | 53 | 65 | 81 | 59 |
| | TRSTX | JTAG reset input pin | 49 | 61 | 77 | 55 |
| | TCK | JTAG test clock input pin | 50 | 62 | 78 | 56 |
| | TDI | JTAG test data input pin | 51 | 63 | 79 | 57 |
| | TMS | JTAG test mode state input/output pin | 52 | 64 | 80 | 58 |
| | TDO | JTAG debug data output pin | 53 | 65 | 81 | 59 |
| External Interrupt | INT00_0 | External interrupt request 00 input pin | 2 | 2 | 2 | 80 |
| | INT00_1 | | - | - | 82 | 60 |
| | INT00_2 | | 54 | 67 | 87 | 65 |
| | INT01_0 | External interrupt request 01 input pin | 3 | 3 | 3 | 81 |
| | INT01_1 | | - | - | 83 | 61 |
| | INT02_0 | External interrupt request 02 input pin | 4 | 4 | 4 | 82 |
| | INT02_1 | | 35 | 43 | 53 | 31 |
| | INT03_0 | External interrupt request 03 input pin | - | 73 | 93 | 71 |
| | INT03_1 | | 38 | 46 | 56 | 34 |
| | INT03_2 | | 5 | 9 | 9 | 87 |
| | INT04_0 | External interrupt request 04 input pin | 8 | 12 | 12 | 90 |
| | INT04_1 | | 40 | 49 | 59 | 37 |
| | INT04_2 | | 6 | 10 | 10 | 88 |
| | INT05_0 | External interrupt request 05 input pin | - | 60 | 74 | 52 |
| | INT05_1 | | - | 55 | 65 | 43 |
| | INT05_2 | | 7 | 11 | 11 | 89 |
| | INT06_1 | External interrupt request 06 input pin | 48 | 59 | 73 | 51 |
| | INT06_2 | | 27 | 35 | 45 | 23 |
| | INT07_2 | External interrupt request 07 input pin | - | 5 | 5 | 83 |
| | INT08_1 | External interrupt request 08 input pin | - | - | 14 | 92 |
| | INT08_2 | | - | 8 | 8 | 86 |
| | INT09_1 | External interrupt request 09 input pin | - | - | 15 | 93 |
| | INT10_1 | External interrupt request 10 input pin | - | - | 16 | 94 |
| | INT11_1 | External interrupt request 11 input pin | - | - | 17 | 95 |
| | INT12_1 | External interrupt request 12 input pin | - | - | 27 | 5 |
| | INT13_1 | External interrupt request 13 input pin | - | - | 28 | 6 |
| | INT14_1 | External interrupt request 14 input pin | - | 29 | 39 | 17 |
| | INT15_1 | External interrupt request 15 input pin | 60 | 76 | 96 | 74 |
| | NMIX | Non-Maskable Interrupt input pin | 57 | 72 | 92 | 70 |

| Pin function | Pin name | Function description | Pin No | | | |
|---|---|---|---|---|---|---|
| | | | LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 |
| GPIO | P00 | General-purpose I/O port 0 | 49 | 61 | 77 | 55 |
| | P01 | | 50 | 62 | 78 | 56 |
| | P02 | | 51 | 63 | 79 | 57 |
| | P03 | | 52 | 64 | 80 | 58 |
| | P04 | | 53 | 65 | 81 | 59 |
| | P05 | | - | - | 82 | 60 |
| | P06 | | - | - | 83 | 61 |
| | P07 | | - | 66 | 84 | 62 |
| | P08 | | - | - | 85 | 63 |
| | P09 | | - | - | 86 | 64 |
| | P0A | | 54 | 67 | 87 | 65 |
| | P0B | | 55 | 68 | 88 | 66 |
| | P0C | | 56 | 69 | 89 | 67 |
| | P0D | | - | 70 | 90 | 68 |
| | P0E | | - | 71 | 91 | 69 |
| | P0F | | 57 | 72 | 92 | 70 |
| | P10 | General-purpose I/O port 1 | 34 | 42 | 52 | 30 |
| | P11 | | 35 | 43 | 53 | 31 |
| | P12 | | 36 | 44 | 54 | 32 |
| | P13 | | 37 | 45 | 55 | 33 |
| | P14 | | 38 | 46 | 56 | 34 |
| | P15 | | 39 | 47 | 57 | 35 |
| | P16 | | - | 48 | 58 | 36 |
| | P17 | | 40 | 49 | 59 | 37 |
| | P18 | | 44 | 53 | 63 | 41 |
| | P19 | | 45 | 54 | 64 | 42 |
| | P1A | | - | 55 | 65 | 43 |
| | P1B | | - | 56 | 66 | 44 |
| | P1C | | - | - | 67 | 45 |
| | P1D | | - | - | 68 | 46 |
| | P1E | | - | - | 69 | 47 |
| | P1F | | - | - | 70 | 48 |
| | P20 | General-purpose I/O port 2 | - | 60 | 74 | 52 |
| | P21 | | 48 | 59 | 73 | 51 |
| | P22 | | 47 | 58 | 72 | 50 |
| | P23 | | 46 | 57 | 71 | 49 |

| Pin function | Pin name | Function description | Pin No | | | |
|---|---|---|---|---|---|---|
| | | | LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 |
| GPIO | P30 | General-purpose I/O port 3 | 5 | 9 | 9 | 87 |
| | P31 | | 6 | 10 | 10 | 88 |
| | P32 | | 7 | 11 | 11 | 89 |
| | P33 | | 8 | 12 | 12 | 90 |
| | P34 | | - | - | 13 | 91 |
| | P35 | | - | - | 14 | 92 |
| | P36 | | - | - | 15 | 93 |
| | P37 | | - | - | 16 | 94 |
| | P38 | | - | - | 17 | 95 |
| | P39 | | 9 | 13 | 18 | 96 |
| | P3A | | 10 | 14 | 19 | 97 |
| | P3B | | 11 | 15 | 20 | 98 |
| | P3C | | 12 | 16 | 21 | 99 |
| | P3D | | 13 | 17 | 22 | 100 |
| | P3E | | 14 | 18 | 23 | 1 |
| | P3F | | 15 | 19 | 24 | 2 |
| | P40 | General-purpose I/O port 4 | - | - | 27 | 5 |
| | P41 | | - | - | 28 | 6 |
| | P42 | | - | - | 29 | 7 |
| | P43 | | - | - | 30 | 8 |
| | P44 | | - | 21 | 31 | 9 |
| | P45 | | - | 22 | 32 | 10 |
| | P46 | | 19 | 26 | 36 | 14 |
| | P47 | | 20 | 27 | 37 | 15 |
| | P48 | | - | 29 | 39 | 17 |
| | P49 | | 22 | 30 | 40 | 18 |
| | P4A | | 23 | 31 | 41 | 19 |
| | P4B | | 24 | 32 | 42 | 20 |
| | P4C | | 25 | 33 | 43 | 21 |
| | P4D | | 26 | 34 | 44 | 22 |
| | P4E | | 27 | 35 | 45 | 23 |
| | P50 | General-purpose I/O port 5 | 2 | 2 | 2 | 80 |
| | P51 | | 3 | 3 | 3 | 81 |
| | P52 | | 4 | 4 | 4 | 82 |
| | P53 | | - | 5 | 5 | 83 |
| | P54 | | - | 6 | 6 | 84 |
| | P55 | | - | 7 | 7 | 85 |
| | P56 | | - | 8 | 8 | 86 |
| | P60 | General-purpose I/O port 6 | 60 | 76 | 96 | 74 |
| | P61 | | 59 | 75 | 95 | 73 |
| | P62 | | 58 | 74 | 94 | 72 |
| | P63 | | - | 73 | 93 | 71 |
| | P80 | General-purpose I/O port 8 | 61 | 77 | 97 | 75 |
| | P81 | | 62 | 78 | 98 | 76 |
| | P82 | | 63 | 79 | 99 | 77 |
| | PE0 | General-purpose I/O port E | 28 | 36 | 46 | 24 |
| | PE2 | | 30 | 38 | 48 | 26 |
| | PE3 | | 31 | 39 | 49 | 27 |

| Pin function | Pin name | Function description | Pin No | | | |
|---|---|---|---|---|---|---|
| | | | LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 |
| Multi-function Serial 0 | SIN0_0 | Multi-function serial interface ch.0 input pin | 48 | 59 | 73 | 51 |
| | SIN0_1 | | - | 46 | 56 | 34 |
| | SOT0_0 (SDA0_0) | Multi-function serial interface ch.0 output pin. This pin operates as SOT0 when it is used in a UART/CSIO (operation modes 0 to 2) and as SDA0 when it is used in an $I^2C$ (operation mode 4). | 47 | 58 | 72 | 50 |
| | SOT0_1 (SDA0_1) | | - | 47 | 57 | 35 |
| | SCK0_0 (SCL0_0) | Multi-function serial interface ch.0 clock I/O pin. This pin operates as SCK0 when it is used in a UART/CSIO (operation modes 0 to 2) and as SCL0 when it is used in an $I^2C$ (operation mode 4). | 46 | 57 | 71 | 49 |
| | SCK0_1 (SCL0_1) | | - | 48 | 58 | 36 |
| Multi-function Serial 1 | SIN1_1 | Multi-function serial interface ch.1 input pin | 35 | 43 | 53 | 31 |
| | SOT1_1 (SDA1_1) | Multi-function serial interface ch.1 output pin. This pin operates as SOT1 when it is used in a UART/CSIO (operation modes 0 to 2) and as SDA1 when it is used in an $I^2C$ (operation mode 4). | 36 | 44 | 54 | 32 |
| | SCK1_1 (SCL1_1) | Multi-function serial interface ch.1 clock I/O pin. This pin operates as SCK1 when it is used in a UART/CSIO (operation modes 0 to 2) and as SCL1 when it is used in an $I^2C$ (operation mode 4). | 37 | 45 | 55 | 33 |
| Multi-function Serial 2 | SIN2_2 | Multi-function serial interface ch.2 input pin | 40 | 49 | 59 | 37 |
| | SOT2_2 (SDA2_2) | Multi-function serial interface ch.2 output pin. This pin operates as SOT2 when it is used in a UART/CSIO (operation modes 0 to 2) and as SDA2 when it is used in an $I^2C$ (operation mode 4). | 44 | 53 | 63 | 41 |
| | SCK2_2 (SCL2_2) | Multi-function serial interface ch.2 clock I/O pin. This pin operates as SCK2 when it is used in a UART/CSIO (operation modes 0 to 2) and as SCL2 when it is used in an $I^2C$ (operation mode 4). | 45 | 54 | 64 | 42 |

| Pin function | Pin name | Function description | Pin No | | | |
|---|---|---|---|---|---|---|
| | | | LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 |
| Multi-function Serial 3 | SIN3_1 | Multi-function serial interface ch.3 input pin | 2 | 2 | 2 | 80 |
| | SIN3_2 | | - | 29 | 39 | 17 |
| | SOT3_1 (SDA3_1) | Multi-function serial interface ch.3 output pin. This pin operates as SOT3 when it is used in a UART/CSIO (operation modes 0 to 2) and as SDA3 when it is used in an $I^2C$ (operation mode 4). | 3 | 3 | 3 | 81 |
| | SOT3_2 (SDA3_2) | | - | 30 | 40 | 18 |
| | SCK3_1 (SCL3_1) | Multi-function serial interface ch.3 clock I/O pin. This pin operates as SCK3 when it is used in a UART/CSIO (operation modes 0 to 2) and as SCL3 when it is used in an $I^2C$ (operation mode 4). | 4 | 4 | 4 | 82 |
| | SCK3_2 (SCL3_2) | | - | 31 | 41 | 19 |
| Multi-function Serial 4 | SIN4_0 | Multi-function serial interface ch.4 input pin | 54 | 67 | 87 | 65 |
| | SIN4_1 | | - | 55 | 65 | 43 |
| | SIN4_2 | | - | - | 82 | 60 |
| | SOT4_0 (SDA4_0) | Multi-function serial interface ch.4 output pin. This pin operates as SOT4 when it is used in a UART/CSIO (operation modes 0 to 2) and as SDA4 when it is used in an $I^2C$ (operation mode 4). | 55 | 68 | 88 | 66 |
| | SOT4_1 (SDA4_1) | | - | 56 | 66 | 44 |
| | SOT4_2 (SDA4_2) | | - | - | 83 | 61 |
| | SCK4_0 (SCL4_0) | Multi-function serial interface ch.4 clock I/O pin. This pin operates as SCK4 when it is used in a UART/CSIO (operation modes 0 to 2) and as SCL4 when it is used in an $I^2C$ (operation mode 4). | 56 | 69 | 89 | 67 |
| | SCK4_1 (SCL4_1) | | - | - | 67 | 45 |
| | SCK4_2 (SCL4_2) | | - | - | 84 | 62 |
| | RTS4_0 | Multi-function serial interface ch.4 RTS output pin | - | 70 | 90 | 68 |
| | RTS4_1 | | - | - | 69 | 47 |
| | RTS4_2 | | - | - | 86 | 64 |
| | CTS4_0 | Multi-function serial interface ch.4 CTS input pin | - | 71 | 91 | 69 |
| | CTS4_1 | | - | - | 68 | 46 |
| | CTS4_2 | | - | - | 85 | 63 |

| Pin function | Pin name | Function description | Pin No | | | |
|---|---|---|---|---|---|---|
| | | | LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 |
| Multi-function Serial 5 | SIN5_0 | Multi-function serial interface ch.5 input pin | 60 | 76 | 96 | 74 |
| | SIN5_2 | | - | - | 15 | 93 |
| | SOT5_0 (SDA5_0) | Multi-function serial interface ch.5 output pin. This pin operates as SOT5 when it is used in a UART/CSIO (operation modes 0 to 2) and as SDA5 when it is used in an I²C (operation mode 4). | 59 | 75 | 95 | 73 |
| | SOT5_2 (SDA5_2) | | - | - | 16 | 94 |
| | SCK5_0 (SCL5_0) | Multi-function serial interface ch.5 clock I/O pin. This pin operates as SCK5 when it is used in a UART/CSIO (operation modes 0 to 2) and as SCL5 when it is used in an I²C (operation mode 4). | 58 | 74 | 94 | 72 |
| | SCK5_2 (SCL5_2) | | - | - | 17 | 95 |
| Multi-function Serial 6 | SIN6_0 | Multi-function serial interface ch.6 input pin | - | 5 | 5 | 83 |
| | SIN6_1 | | 8 | 12 | 12 | 90 |
| | SOT6_0 (SDA6_0) | Multi-function serial interface ch.6 output pin. This pin operates as SOT6 when it is used in a UART/CSIO (operation modes 0 to 2) and as SDA6 when it is used in an I²C (operation mode 4). | - | 6 | 6 | 84 |
| | SOT6_1 (SDA6_1) | | 7 | 11 | 11 | 89 |
| | SCK6_0 (SCL6_0) | Multi-function serial interface ch.6 clock I/O pin. This pin operates as SCK6 when it is used in a UART/CSIO (operation modes 0 to 2) and as SCL6 when it is used in an I²C (operation mode 4). | - | 7 | 7 | 85 |
| | SCK6_1 (SCL6_1) | | 6 | 10 | 10 | 88 |
| Multi-function Serial 7 | SIN7_1 | Multi-function serial interface ch.7 input pin | 27 | 35 | 45 | 23 |
| | SIN7_2 | | 61 | 77 | 97 | 75 |
| | SOT7_1 (SDA7_1) | Multi-function serial interface ch.7 output pin. This pin operates as SOT7 when it is used in a UART/CSIO (operation modes 0 to 2) and as SDA7 when it is used in an I²C (operation mode 4). | 26 | 34 | 44 | 22 |
| | SOT7_2 (SDA7_2) | | 62 | 78 | 98 | 76 |
| | SCK7_1 (SCL7_1) | Multi-function serial interface ch.7 clock I/O pin. This pin operates as SCK7 when it is used in a UART/CSIO (operation modes 0 to 2) and as SCL7 when it is used in an I²C (operation mode 4). | 25 | 33 | 43 | 21 |
| | SCK7_2 (SCL7_2) | | 63 | 79 | 99 | 77 |

| Pin function | Pin name | Function description | Pin No | | | |
|---|---|---|---|---|---|---|
| | | | LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 |
| Multi-function Timer 0 | DTTI0X_0 | Input signal of waveform generator to control outputs RTO00 to RTO05 of Multi-function timer 0 | 9 | 13 | 18 | 96 |
| | DTTI0X_1 | | - | - | 69 | 47 |
| | DTTI0X_2 | | 59 | 75 | 95 | 73 |
| | FRCK0_0 | 16-bit free-run timer ch.0 external clock input pin | - | - | 13 | 91 |
| | FRCK0_1 | | - | - | 70 | 48 |
| | FRCK0_2 | | 35 | 43 | 53 | 31 |
| | IC00_0 | 16-bit input capture input pin of Multi-function timer 0. ICxx describes a channel number. | - | - | 17 | 95 |
| | IC00_1 | | - | 55 | 65 | 43 |
| | IC00_2 | | 36 | 44 | 54 | 32 |
| | IC01_0 | | - | - | 16 | 94 |
| | IC01_1 | | - | 56 | 66 | 44 |
| | IC01_2 | | 37 | 45 | 55 | 33 |
| | IC02_0 | | - | - | 15 | 93 |
| | IC02_1 | | - | - | 67 | 45 |
| | IC02_2 | | 38 | 46 | 56 | 34 |
| | IC03_0 | | - | - | 14 | 92 |
| | IC03_1 | | - | - | 68 | 46 |
| | IC03_2 | | 39 | 47 | 57 | 35 |
| | RTO00_0 (PPG00_0) | Waveform generator output pin of Multi-function timer 0. This pin operates as PPG00 when it is used in PPG0 output mode. | 10 | 14 | 19 | 97 |
| | RTO00_1 (PPG00_1) | | - | - | 71 | 49 |
| | RTO01_0 (PPG00_0) | Waveform generator output pin of Multi-function timer 0. This pin operates as PPG00 when it is used in PPG0 output mode. | 11 | 15 | 20 | 98 |
| | RTO02_0 (PPG02_0) | Waveform generator output pin of Multi-function timer 0. This pin operates as PPG02 when it is used in PPG0 output mode. | 12 | 16 | 21 | 99 |
| | RTO03_0 (PPG02_0) | Waveform generator output pin of Multi-function timer 0. This pin operates as PPG02 when it is used in PPG0 output mode. | 13 | 17 | 22 | 100 |
| | RTO04_0 (PPG04_0) | Waveform generator output pin of Multi-function timer 0. This pin operates as PPG04 when it is used in PPG0 output mode. | 14 | 18 | 23 | 1 |
| | RTO05_0 (PPG04_0) | Waveform generator output pin of Multi-function timer 0. This pin operates as PPG04 when it is used in PPG0 output mode. | 15 | 19 | 24 | 2 |
| | IGTRG | PPG IGBT mode external trigger input pin | 24 | 32 | 42 | 20 |

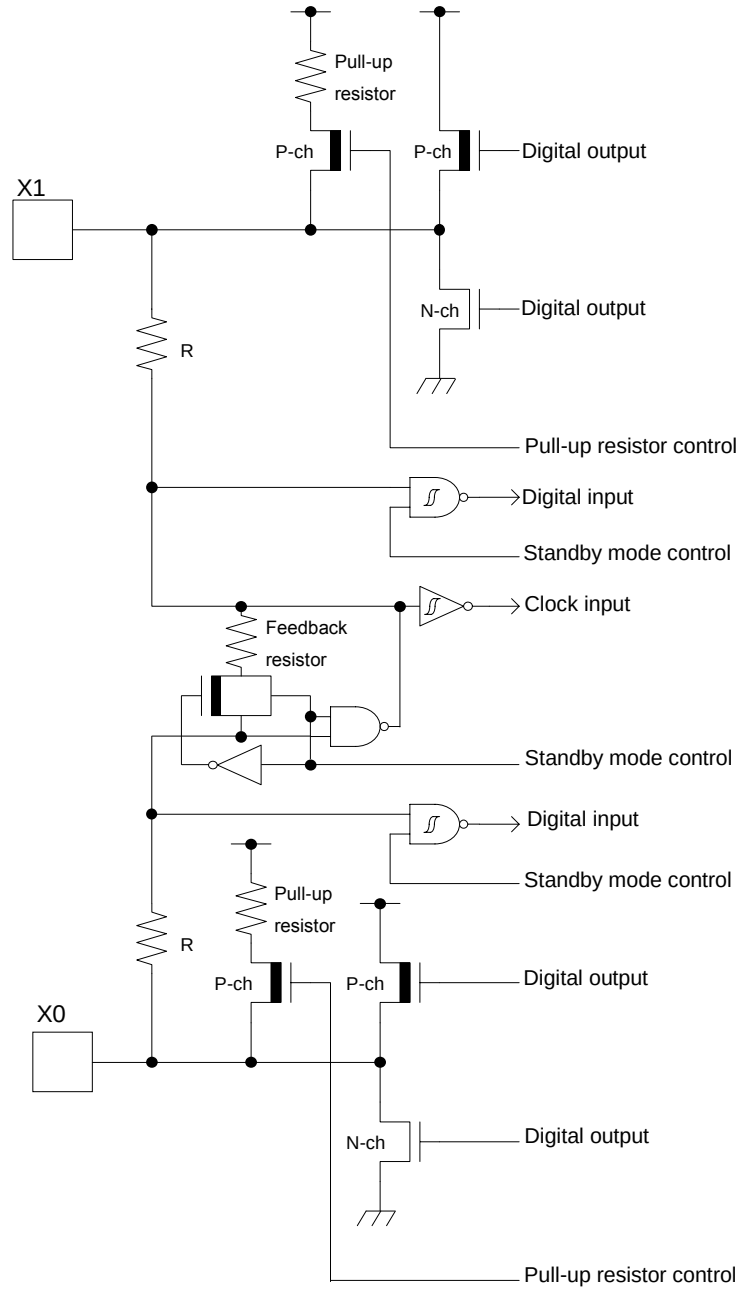
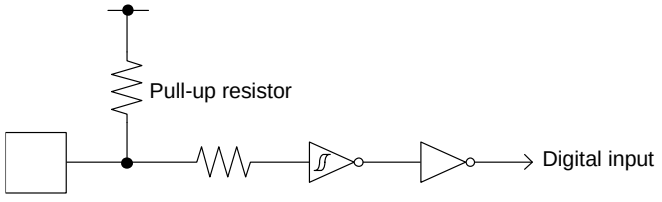
| Pin function | Pin name | Function description | Pin No | | | |
|---|---|---|---|---|---|---|
| | | | LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 |
| Real-time clock | RTCCO_0 | Pulse output pin of Real-time clock | 57 | 72 | 92 | 70 |
| | RTCCO_1 | | 37 | 45 | 55 | 33 |
| | RTCCO_2 | | 10 | 14 | 19 | 97 |
| | SUBOUT_0 | Sub clock output pin | 57 | 72 | 92 | 70 |
| | SUBOUT_1 | | 37 | 45 | 55 | 33 |
| | SUBOUT_2 | | 10 | 14 | 19 | 97 |
| Low-Power Consumption Mode | WKUP0 | Deep standby mode return signal input pin 0 | 57 | 72 | 92 | 70 |
| | WKUP1 | Deep standby mode return signal input pin 1 | 35 | 43 | 53 | 31 |
| | WKUP2 | Deep standby mode return signal input pin 2 | 48 | 59 | 73 | 51 |
| | WKUP3 | Deep standby mode return signal input pin 3 | 60 | 76 | 96 | 74 |
| DAC | DA0 | D/A converter ch.0 analog output pin | 26 | 34 | 44 | 22 |
| | DA1 | D/A converter ch.1 analog output pin | 27 | 35 | 45 | 23 |
| HDMI-CEC | CEC0 | HDMI-CEC ch.0 pin | 25 | 33 | 43 | 21 |
| | CEC1 | HDMI-CEC ch.1 pin | 60 | 76 | 96 | 74 |

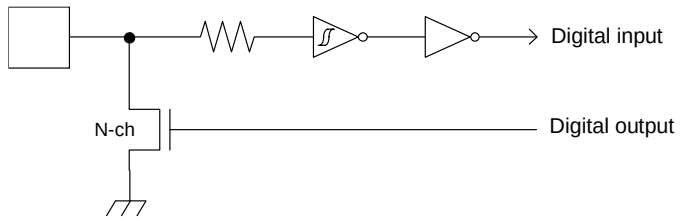
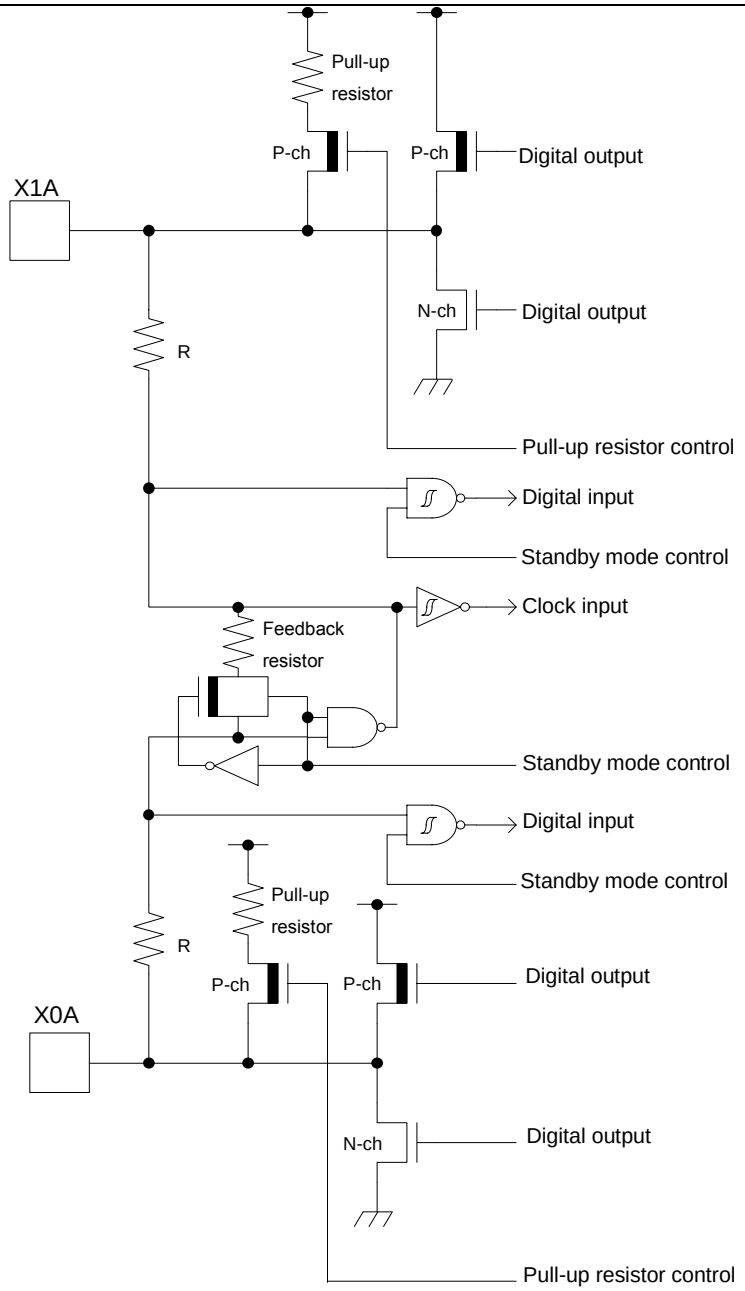
| Pin function | Pin name | Function description | Pin No | | | |
|---|---|---|---|---|---|---|
| | | | LQFP-64 | LQFP-80 | LQFP-100 | QFP-100 |
| Reset | INITX | External Reset Input Pin.<br>A reset is valid when INITX = L. | 21 | 28 | 38 | 16 |
| Mode | MD0 | Mode 0 pin.<br>During normal operation, MD0 = L must be input.<br>During serial programming to Flash memory, MD0 = H must be input. | 29 | 37 | 47 | 25 |
| | MD1 | Mode 1 pin.<br>During normal operation, input is not needed. During serial programming to Flash memory, MD1 = L must be input. | 28 | 36 | 46 | 24 |
| Power | VCC | Power supply pin | 1 | 1 | 1 | 79 |
| | | | - | - | 26 | 4 |
| | | | 18 | 25 | 35 | 13 |
| | | | 33 | 41 | 51 | 29 |
| | | | - | - | 76 | 54 |
| GND | VSS | GND pin | 16 | 20 | 25 | 3 |
| | | | - | 24 | 34 | 12 |
| | | | 32 | 40 | 50 | 28 |
| | | | - | - | 75 | 53 |
| | | | 64 | 80 | 100 | 78 |
| Clock | X0 | Main clock (oscillation) input pin | 30 | 38 | 48 | 26 |
| | X0A | Sub clock (oscillation) input pin | 19 | 26 | 36 | 14 |
| | X1 | Main clock (oscillation) I/O pin | 31 | 39 | 49 | 27 |
| | X1A | Sub clock (oscillation) I/O pin | 20 | 27 | 37 | 15 |
| | CROUT_0 | Built-in High-speed CR-osc clock output port | - | 60 | 74 | 52 |
| | CROUT_1 | | 57 | 72 | 92 | 70 |
| Analog Power | AVCC | A/D converter and D/A converter analog power supply pin | 41 | 50 | 60 | 38 |
| | AVRH | A/D converter analog reference voltage input pin | 42 | 51 | 61 | 39 |
| Analog GND | AVSS | A/D converter and D/A converter GND pin | 43 | 52 | 62 | 40 |
| C pin | C | Power supply stabilization capacity pin | 17 | 23 | 33 | 11 |

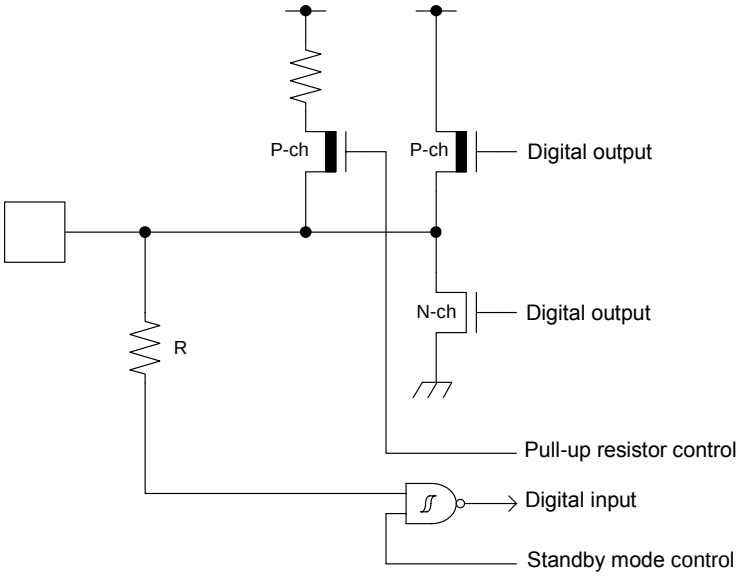
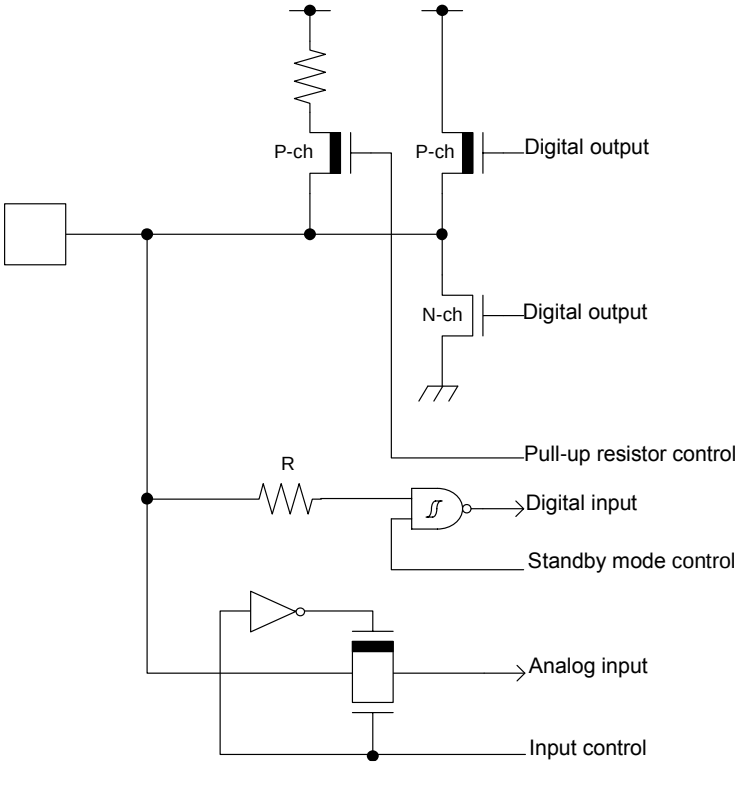
***Note:***

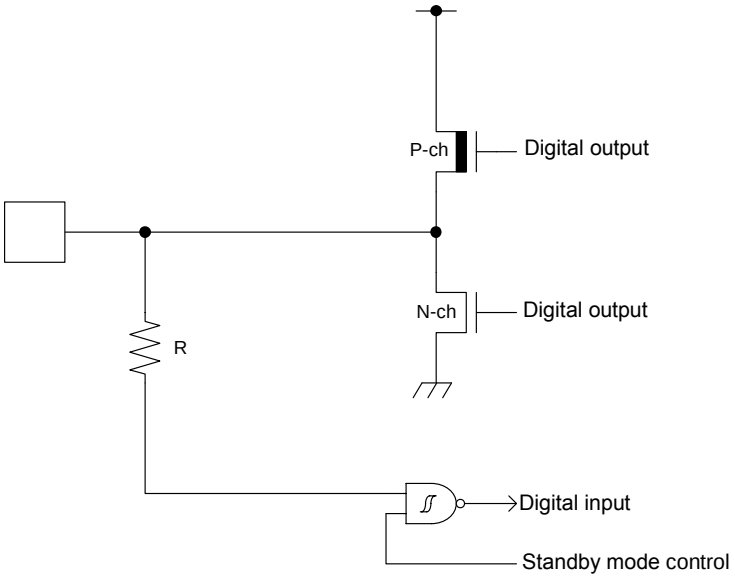
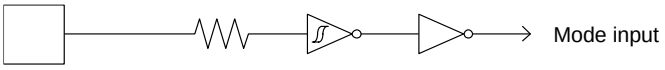
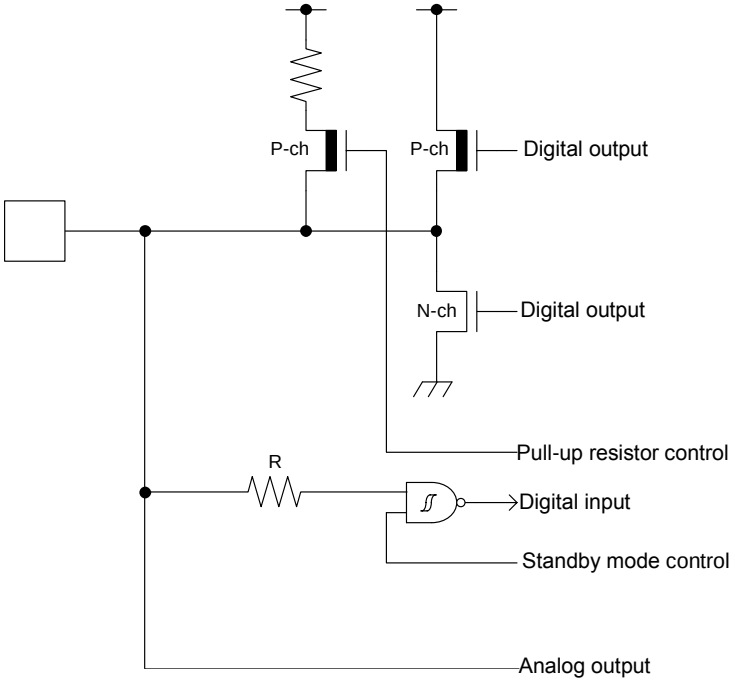
- *While this device contains a Test Access Port (TAP) based on the IEEE 1149.1-2001 JTAG standard, it is not fully compliant to all requirements of that standard. This device may contain a 32-bit device ID that is the same as the 32-bit device ID in other devices with different functionality. The TAP pins may also be configurable for purposes other than access to the TAP controller.*

## 5. I/O Circuit Type

| Type | Circuit | Remarks |
|---|---|---|
| A |  | It is possible to select the main oscillation / GPIO function.<br><br>When the main oscillation is selected.<br>• Oscillation feedback resistor : Approximately 1 MΩ<br>• With standby mode control<br><br>When the GPIO is selected.<br>• CMOS level output.<br>• CMOS level hysteresis input<br>• With pull-up resistor control<br>• With standby mode control<br>• Pull-up resistor : Approximately 50 kΩ<br>• $I_{OH}$ = -4 mA, $I_{OL}$ = 4 mA |
| B |  | • CMOS level hysteresis input<br>• Pull-up resistor : Approximately 50 kΩ |

| Type | Circuit | Remarks |
|---|---|---|
| C |  | • Open drain output<br>• CMOS level hysteresis input |
| D |  | It is possible to select the sub oscillation / GPIO function<br>When the sub oscillation is selected.<br>• Oscillation feedback resistor : Approximately 5 MΩ<br>• With standby mode control<br><br>When the GPIO is selected.<br>• CMOS level output.<br>• CMOS level hysteresis input<br>• With pull-up resistor control<br>• With standby mode control<br>• Pull-up resistor : Approximately 50 kΩ<br>• $I_{OH}$ = -4 mA, $I_{OL}$ = 4 mA |

| Type | Circuit | Remarks |
|---|---|---|
| E |  | • CMOS level output<br>• CMOS level hysteresis input<br>• With pull-up resistor control<br>• With standby mode control<br>• Pull-up resistor<br>: Approximately 50 kΩ<br>• $I_{OH}$ = -4 mA, $I_{OL}$ = 4 mA<br>• When this pin is used as an $I^2C$ pin, the digital output P-ch transistor is always off |
| F |  | • CMOS level output<br>• CMOS level hysteresis input<br>• With input control<br>• Analog input<br>• With pull-up resistor control<br>• With standby mode control<br>• Pull-up resistor<br>: Approximately 50 kΩ<br>• $I_{OH}$ = -4 mA, $I_{OL}$ = 4 mA<br>• When this pin is used as an $I^2C$ pin, the digital output P-ch transistor is always off |

| Type | Circuit | Remarks |
|---|---|---|
| G |  | • CMOS level output<br>• CMOS level hysteresis input<br>• With standby mode control<br>• 5 V tolerant input<br>• $I_{OH}$ = -4 mA, $I_{OL}$ = 4 mA<br>• Available to control PZR registers. P0B, P0C, P4C, P60, P81, P82 only.<br>• When this pin is used as an $I^2C$ pin, the digital output P-ch transistor is always off |
| H |  | CMOS level hysteresis input |
| J |  | • CMOS level output<br>• CMOS level hysteresis input<br>• With input control<br>• Analog output<br>• With pull-up resistor control<br>• With standby mode control<br>• Pull-up resistor<br>: Approximately 50 kΩ<br>• $I_{OH}$ = -4 mA, $I_{OL}$ = 4 mA<br>• When this pin is used as an $I^2C$ pin, the digital output P-ch transistor is always off |

# 6. Handling Precautions

Any semiconductor devices have inherently a certain rate of failure. The possibility of failure is greatly affected by the conditions in which they are used (circuit conditions, environmental conditions, etc.). This page describes precautions that must be observed to minimize the chance of failure and to obtain higher reliability from your Cypress semiconductor devices.

## 6.1 Precautions for Product Design

This section describes precautions when designing electronic equipment using semiconductor devices.

### Absolute Maximum Ratings

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

### Recommended Operating Conditions

Recommended operating conditions are normal operating ranges for the semiconductor device. All the device's electrical characteristics are warranted when operated within these ranges.

Always use semiconductor devices within the recommended operating conditions. 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 sales representative beforehand.

### Processing and Protection of Pins

These precautions must be followed when handling the pins which connect semiconductor devices to power supply and input/output functions.

1. Preventing Over-Voltage and Over-Current Conditions

   Exposure to voltage or current levels in excess of maximum ratings at any pin is likely to cause deterioration within the device, and in extreme cases leads to permanent damage of the device. Try to prevent such overvoltage or over-current conditions at the design stage.
2. Protection of Output Pins

   Shorting of output pins to supply pins or other output pins, or connection to large capacitance can cause large current flows. Such conditions if present for extended periods of time can damage the device.
   Therefore, avoid this type of connection.
3. Handling of Unused Input Pins

   Unconnected input pins with very high impedance levels can adversely affect stability of operation. Such pins should be connected through an appropriate resistance to a power supply pin or ground pin.

### Latch-up

Semiconductor devices are constructed by the formation of P-type and N-type areas on a substrate. When subjected to abnormally high voltages, internal parasitic PNPN junctions (called thyristor structures) may be formed, causing large current levels in excess of several hundred mA to flow continuously at the power supply pin. This condition is called latch-up.

CAUTION: The occurrence of latch-up not only causes loss of reliability in the semiconductor device, but can cause injury or damage from high heat, smoke or flame. To prevent this from happening, do the following:

1. Be sure that voltages applied to pins do not exceed the absolute maximum ratings. This should include attention to abnormal noise, surge levels, etc.
2. Be sure that abnormal current flows do not occur during the power-on sequence.

### Observance of Safety Regulations and Standards

Most countries in the world have established standards and regulations regarding safety, protection from electromagnetic interference, etc. Customers are requested to observe applicable regulations and standards in the design of products.

### Fail-Safe Design

Any semiconductor devices have inherently a certain rate of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.

### Precautions Related to Usage of Devices

Cypress semiconductor devices are intended for use in standard applications (computers, office automation and other office equipment, industrial, communications, and measurement equipment, personal or household devices, etc.).

CAUTION: Customers considering the use of our products in special applications where failure or abnormal operation may directly affect human lives or cause physical injury or property damage, or where extremely high levels of reliability are demanded (such as aerospace systems, atomic energy controls, sea floor repeaters, vehicle operating controls, medical devices for life support, etc.) are requested to consult with sales representatives before such use. The company will not be responsible for damages arising from such use without prior approval.

## 6.2 Precautions for Package Mounting

Package mounting may be either lead insertion type or surface mount type. In either case, for heat resistance during soldering, you should only mount under Cypress' recommended conditions. For detailed information about mount conditions, contact your sales representative.

### Lead Insertion Type

Mounting of lead insertion type packages onto printed circuit boards may be done by two methods: direct soldering on the board, or mounting by using a socket.

Direct mounting onto boards normally involves processes for inserting leads into through-holes on the board and using the flow soldering (wave soldering) method of applying liquid solder. In this case, the soldering process usually causes leads to be subjected to thermal stress in excess of the absolute ratings for storage temperature. Mounting processes should conform to Cypress recommended mounting conditions.

If socket mounting is used, differences in surface treatment of the socket contacts and IC lead surfaces can lead to contact deterioration after long periods. For this reason it is recommended that the surface treatment of socket contacts and IC leads be verified before mounting.

### Surface Mount Type

Surface mount packaging has longer and thinner leads than lead-insertion packaging, and therefore leads are more easily deformed or bent. The use of packages with higher pin counts and narrower pin pitch results in increased susceptibility to open connections caused by deformed pins, or shorting due to solder bridges.

You must use appropriate mounting techniques. Cypress Inc. recommends the solder reflow method, and has established a ranking of mounting conditions for each product. Users are advised to mount packages in accordance with Cypress ranking of recommended conditions.

### Lead-Free Packaging

CAUTION: When ball grid array (BGA) packages with Sn-Ag-Cu balls are mounted using Sn-Pb eutectic soldering, junction strength may be reduced under some conditions of use.

### Storage of Semiconductor Devices

Because plastic chip packages are formed from plastic resins, exposure to natural environmental conditions will cause absorption of moisture. During mounting, the application of heat to a package that has absorbed moisture can cause surfaces to peel, reducing moisture resistance and causing packages to crack. To prevent, do the following:

1. Avoid exposure to rapid temperature changes, which cause moisture to condense inside the product. Store products in locations where temperature changes are slight.
2. Use dry boxes for product storage. Products should be stored below 70% relative humidity, and at temperatures between 5°C and 30°C.
   When you open Dry Package that recommends humidity 40% to 70% relative humidity.
3. When necessary, Cypress Inc. packages semiconductor devices in highly moisture-resistant aluminum laminate bags, with a silica gel desiccant. Devices should be sealed in their aluminum laminate bags for storage.
4. Avoid storing packages where they are exposed to corrosive gases or high levels of dust.

### Baking

Packages that have absorbed moisture may be de-moisturized by baking (heat drying). Follow the Cypress recommended conditions for baking.

Condition: 125°C/24 h

### Static Electricity

Because semiconductor devices are particularly susceptible to damage by static electricity, you must take the following precautions:

1. Maintain relative humidity in the working environment between 40% and 70%. Use of an apparatus for ion generation may be needed to remove electricity.
2. Electrically ground all conveyors, solder vessels, soldering irons and peripheral equipment.
3. Eliminate static body electricity by the use of rings or bracelets connected to ground through high resistance (on the level of 1 MΩ).
   Wearing of conductive clothing and shoes, use of conductive floor mats and other measures to minimize shock loads is recommended.
4. Ground all fixtures and instruments, or protect with anti-static measures.
5. Avoid the use of styrofoam or other highly static-prone materials for storage of completed board assemblies.

## 6.3 Precautions for Use Environment

Reliability of semiconductor devices depends on ambient temperature and other conditions as described above.

For reliable performance, do the following:

1. Humidity

   Prolonged use in high humidity can lead to leakage in devices as well as printed circuit boards. If high humidity levels are anticipated, consider anti-humidity processing.
2. Discharge of Static Electricity

   When high-voltage charges exist close to semiconductor devices, discharges can cause abnormal operation. In such cases, use anti-static measures or processing to prevent discharges.
3. Corrosive Gases, Dust, or Oil

   Exposure to corrosive gases or contact with dust or oil may lead to chemical reactions that will adversely affect the device. If you use devices in such conditions, consider ways to prevent such exposure or to protect the devices.
4. Radiation, Including Cosmic Radiation

   Most devices are not designed for environments involving exposure to radiation or cosmic radiation. Users should provide shielding as appropriate.
5. Smoke, Flame

   CAUTION: Plastic molded devices are flammable, and therefore should not be used near combustible substances. If devices begin to smoke or burn, there is danger of the release of toxic gases.

Customers considering the use of Cypress products in other special environmental conditions should consult with sales representatives.

# 7. Handling Devices

### Power supply pins

In products with multiple VCC and VSS pins, respective pins at the same potential are interconnected within the device in order to prevent malfunctions such as latch-up. However, all of these pins should be connected externally to the power supply or ground lines in order to reduce electromagnetic emission levels, to prevent abnormal operation of strobe signals caused by the rise in the ground level, and to conform to the total output current rating.

Moreover, connect the current supply source with each Power supply pins and GND pins of this device at low impedance. It is also advisable that a ceramic capacitor of approximately 0.1 µF be connected as a bypass capacitor between each Power supply pin and GND pin, between AVCC pin and AVSS pin near this device.

### Stabilizing power supply voltage

A malfunction may occur when the power supply voltage fluctuates rapidly even though the fluctuation is within the recommended operating conditions of the VCC power supply voltage. As a rule, with voltage stabilization, suppress the voltage fluctuation so that the fluctuation in VCC ripple (peak-to-peak value) at the commercial frequency (50 Hz/60 Hz) does not exceed 10% of the VCC value in the recommended operating conditions, and the transient fluctuation rate does not exceed 0.1 V/µs when there is a momentary fluctuation on switching the power supply.

### Crystal oscillator circuit

Noise near the X0/X1 and X0A/X1A pins may cause the device to malfunction. Design the printed circuit board so that X0/X1, X0A/X1A pins, the crystal oscillator, and the bypass capacitor to ground are located as close to the device as possible.

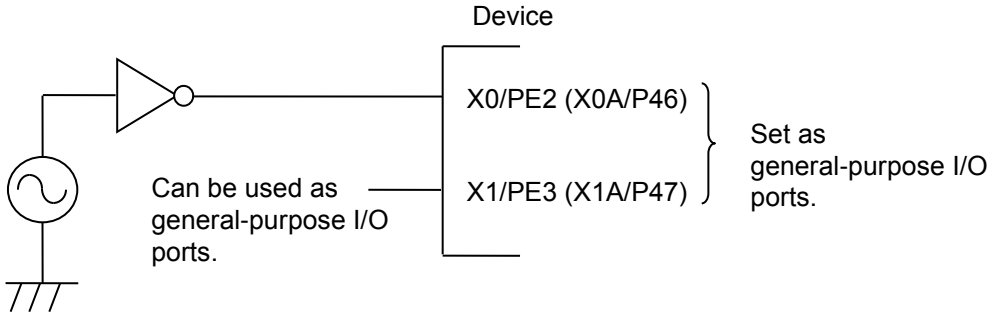
It is strongly recommended that the PC board artwork be designed such that the X0/X1 and X0A/X1A pins are surrounded by ground plane as this is expected to produce stable operation.

Evaluate oscillation of your using crystal oscillator by your mount board.

### Using an external clock

To use the external clock, set general-purpose I/O ports to input the clock to X0/PE2 and X0A/P46 pin.

- Example of Using an External Clock

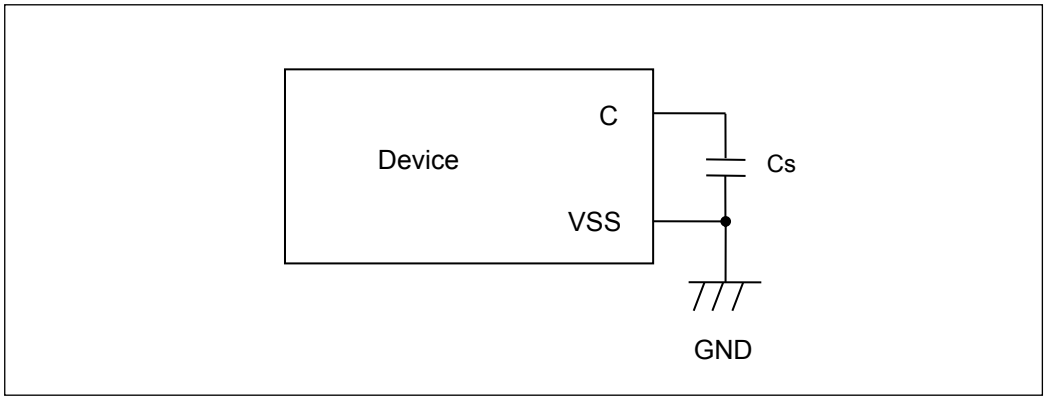



### Handling when using Multi-function serial pin as I²C pin

If it is using the multi-function serial pin as I²C pins, P-ch transistor of digital output is always disabled. However, I²C pins need to keep the electrical characteristic like other pins and not to connect to the external I²C bus system with power OFF.

### C Pin

This series contains the regulator. Be sure to connect a smoothing capacitor (CS) for the regulator between the C pin and the GND pin. Please use a ceramic capacitor or a capacitor of equivalent frequency characteristics as a smoothing capacitor.
However, some laminated ceramic capacitors have the characteristics of capacitance variation due to thermal fluctuation (F characteristics and Y5V characteristics). Please select the capacitor that meets the specifications in the operating conditions to use by evaluating the temperature characteristics of a capacitor.
A smoothing capacitor of about 4.7µF would be recommended for this series.




### Mode pins (MD0, MD1)

Connect the MD pin (MD0, MD1) directly to VCC or VSS pins. Design the printed circuit board such that the pull-up/down resistance stays low, as well as the distance between the mode pins and VCC pins or VSS pins is as short as possible and the connection impedance is low, when the pins are pulled-up/down such as for switching the pin level and rewriting the Flash memory data. It is because of preventing the device erroneously switching to test mode due to noise.

### Notes on power-on

Turn power on/off in the following order or at the same time.
If not using the A/D converter, connect AVCC = VCC and AVSS = VSS.

Turning on: VCC → AVCC → AVRH

Turning off: AVRH → AVCC → VCC

### Serial Communication

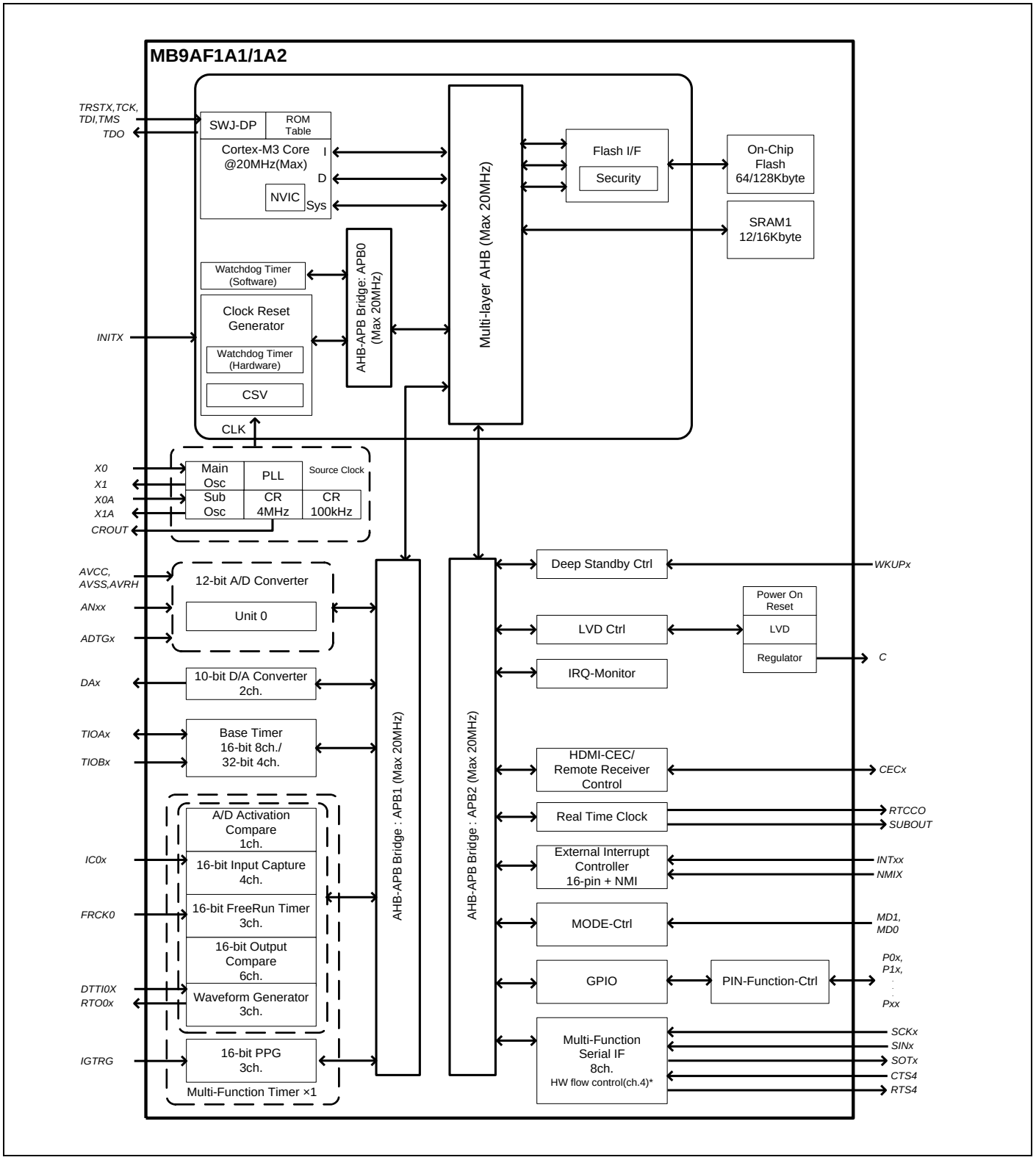
There is a possibility to receive wrong data due to the noise or other causes on the serial communication.
Therefore, design a printed circuit board so as to avoid noise.
Consider the case of receiving wrong data due to noise, perform error detection such as by applying a checksum of data at the end.
If an error is detected, retransmit the data.

### Differences in features among the products with different memory sizes and between Flash memory products and MASK products

The electric characteristics including power consumption, ESD, latch-up, noise characteristics, and oscillation characteristics among the products with different memory sizes and between Flash memory products and MASK products are different because chip layout and memory structures are different.

If you are switching to use a different product of the same series, please make sure to evaluate the electric characteristics.

## 8. Block Diagram



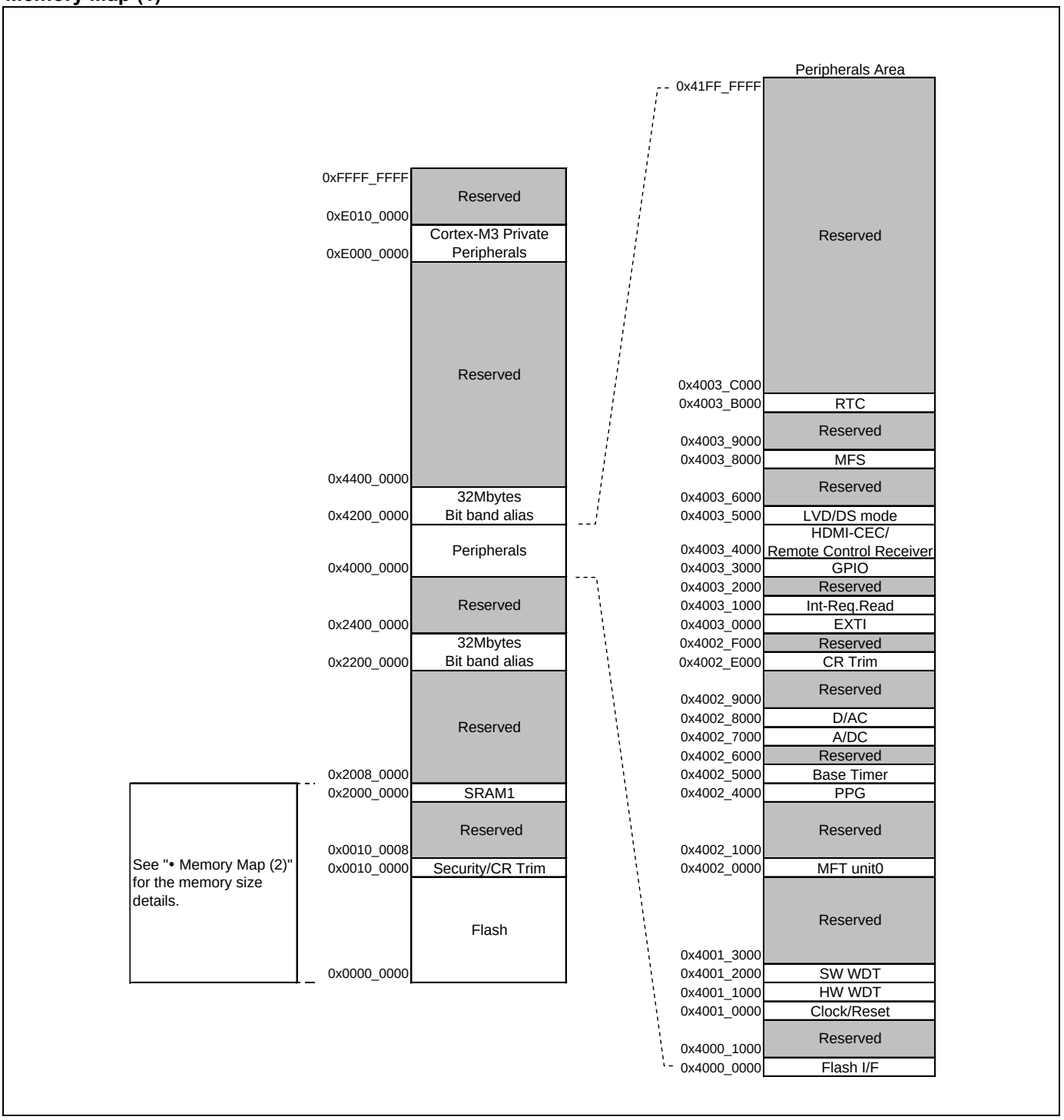

*: For the MB9AF1A1L and MB9AF1A2L, Multi-function Serial Interface does not support hardware flow control in these products.

## 9. Memory Size

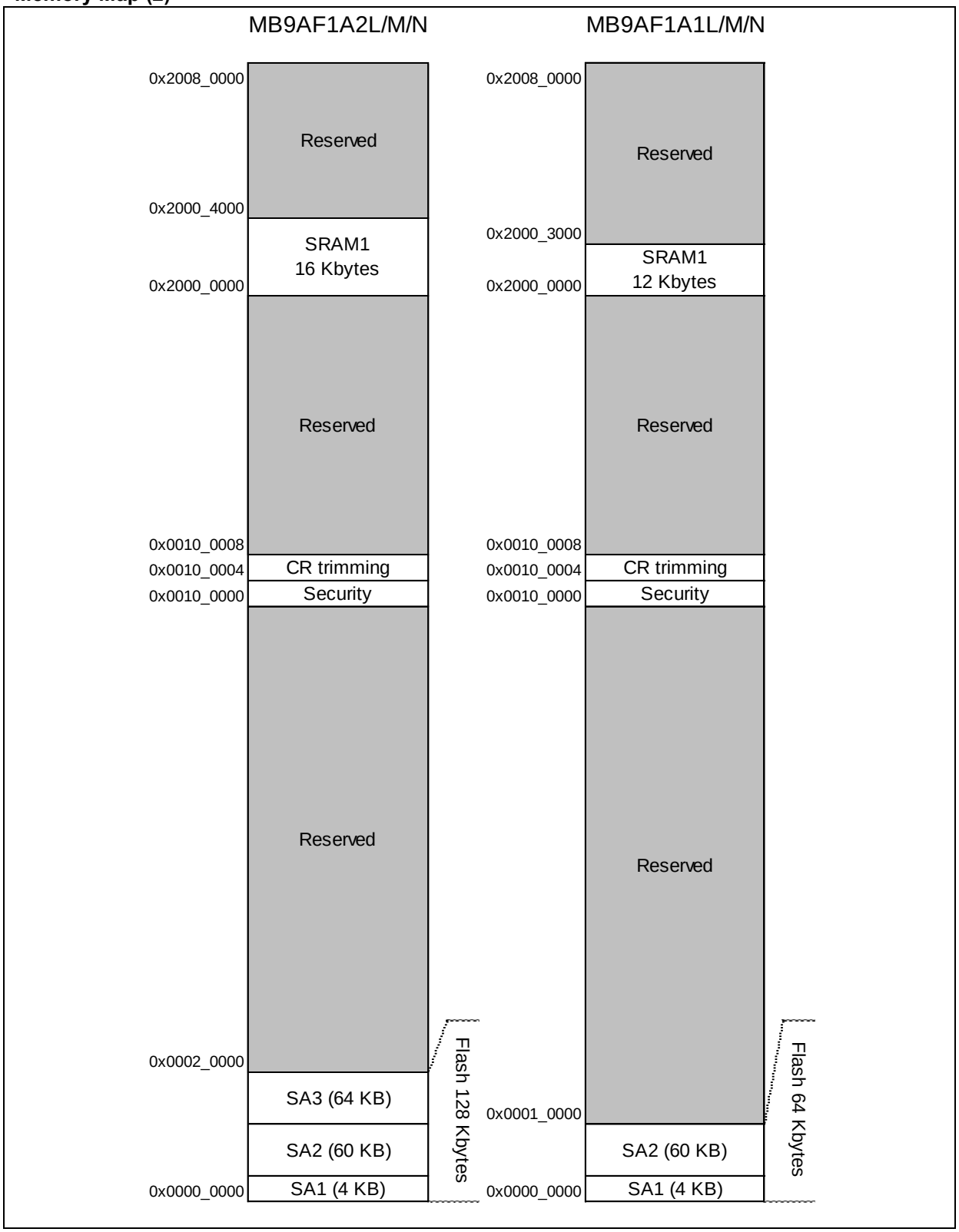
See Memory size in Product Lineup to confirm the memory size.

## 10. Memory Map

### Memory Map (1)



**Memory Map (2)**




*: See MB9AAA0N/1A0N/A30N/130N/130L Series Flash Programming Manual to confirm the detail of Flash memory.

## Peripheral Address Map

| Start address | End address | Bus | Peripherals |
|---|---|---|---|
| 0x4000_0000 | 0x4000_0FFF | AHB | Flash memory I/F register |
| 0x4000_1000 | 0x4000_FFFF | | Reserved |
| 0x4001_0000 | 0x4001_0FFF | APB0 | Clock/Reset Control |
| 0x4001_1000 | 0x4001_1FFF | | Hardware Watchdog timer |
| 0x4001_2000 | 0x4001_2FFF | | Software Watchdog timer |
| 0x4001_3000 | 0x4001_4FFF | | Reserved |
| 0x4001_5000 | 0x4001_5FFF | | Reserved |
| 0x4001_6000 | 0x4001_FFFF | | Reserved |
| 0x4002_0000 | 0x4002_0FFF | APB1 | Multi-function timer unit0 |
| 0x4002_1000 | 0x4002_1FFF | | Reserved |
| 0x4002_2000 | 0x4002_3FFF | | Reserved |
| 0x4002_4000 | 0x4002_4FFF | | PPG |
| 0x4002_5000 | 0x4002_5FFF | | Base Timer |
| 0x4002_6000 | 0x4002_6FFF | | Reserved |
| 0x4002_7000 | 0x4002_7FFF | | A/D Converter |
| 0x4002_8000 | 0x4002_8FFF | | D/A Converter |
| 0x4002_9000 | 0x4002_DFFF | | Reserved |
| 0x4002_E000 | 0x4002_EFFF | | Built-in CR trimming |
| 0x4002_F000 | 0x4002_FFFF | | Reserved |
| 0x4003_0000 | 0x4003_0FFF | APB2 | External Interrupt |
| 0x4003_1000 | 0x4003_1FFF | | Interrupt Source Check Register |
| 0x4003_2000 | 0x4003_2FFF | | Reserved |
| 0x4003_3000 | 0x4003_3FFF | | GPIO |
| 0x4003_4000 | 0x4003_4FFF | | HDMI-CEC/ Remote Control Receiver |
| 0x4003_5000 | 0x4003_50FF | | Low-Voltage Detector |
| 0x4003_5100 | 0x4003_5FFF | | Deep standby mode Controller |
| 0x4003_6000 | 0x4003_6FFF | | Reserved |
| 0x4003_7000 | 0x4003_7FFF | | Reserved |
| 0x4003_8000 | 0x4003_8FFF | | Multi-function serial |
| 0x4003_9000 | 0x4003_9FFF | | Reserved |
| 0x4003_A000 | 0x4003_AFFF | | Reserved |
| 0x4003_B000 | 0x4003_BFFF | | Real-time clock |
| 0x4003_C000 | 0x4003_FFFF | | Reserved |
| 0x4004_0000 | 0x4004_FFFF | AHB | Reserved |
| 0x4005_0000 | 0x4005_FFFF | | Reserved |
| 0x4006_0000 | 0x4006_0FFF | | Reserved |
| 0x4006_1000 | 0x4006_1FFF | | Reserved |
| 0x4006_2000 | 0x4006_2FFF | | Reserved |
| 0x4006_3000 | 0x4006_3FFF | | Reserved |
| 0x4006_4000 | 0x41FF_FFFF | | Reserved |

## 11. Pin Status in Each CPU State

The terms used for pin status have the following meanings.

■INITX = 0

This is the period when the INITX pin is the L level.

■INITX = 1

This is the period when the INITX pin is the H level.

■SPL = 0

This is the status that the standby pin level setting bit (SPL) in the standby mode control register (STB_CTL) is set to 0.

■SPL = 1

This is the status that the standby pin level setting bit (SPL) in the standby mode control register (STB_CTL) is set to 1.

■Input enabled

Indicates that the input function can be used.

■Internal input fixed at 0

This is the status that the input function cannot be used. Internal input is fixed at L.

■Hi-Z

Indicates that the pin drive transistor is disabled and the pin is put in the Hi-Z state.

■Setting disabled

Indicates that the setting is disabled.

■Maintain previous state

Maintains the state that was immediately prior to entering the current mode.
If a built-in peripheral function is operating, the output follows the peripheral function.
If the pin is being used as a port, that output is maintained.

■Analog input is enabled

Indicates that the analog input is enabled.

■Trace output

Indicates that the trace function can be used.

■GPIO selected

In Deep Standby mode, pins switch to the general-purpose I/O port.

## List of Pin Status

| Pin status type | Function group | Power-on reset or low-voltage detection state | INITX input state | Device internal reset state | Run mode or Sleep mode state | Timer mode, RTC mode, or Stop mode state | | Deep Standby RTC mode or Deep Standby Stop mode state | | Return from Deep Standby mode state |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Power supply unstable | Power supply stable | | Power supply stable | Power supply stable | | Power supply stable | | Power supply stable |
| | | - | INITX = 0 | INITX = 1 | INITX = 1 | INITX = 1 | | INITX = 1 | | INITX = 1 |
| | | - | - | - | - | SPL = 0 | SPL = 1 | SPL = 0 | SPL = 1 | - |
| A | Main crystal oscillator input pin | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled |
| | External main clock input selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state / When oscillation stops*1, output maintains previous state / Internal input fixed at 0 | Hi-Z / Input enabled / When oscillation stops*1, Hi-Z / Internal input fixed at 0 | Output maintains previous state / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | GPIO selected |
| | GPIO selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Output maintains previous state / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | Output maintains previous state / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | Maintain previous state |
| B | Main crystal oscillator output pin | Hi-Z / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | Maintain previous state / When oscillation stops*1, Hi-Z output / Internal input fixed at 0 | Maintain previous state / When oscillation stops*1, Hi-Z output / Internal input fixed at 0 | Maintain previous state / When oscillation stops*1, Hi-Z output / Internal input fixed at 0 | Maintain previous state / When oscillation stops*1, Hi-Z output / Internal input fixed at 0 | Maintain previous state / When oscillation stops*1, Hi-Z output / Internal input fixed at 0 | Maintain previous state / When oscillation stops*1, Hi-Z output / Internal input fixed at 0 |
| | GPIO selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Hi-Z / Internal input fixed at 0 | Output maintains previous state / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | Maintain previous state |
| C | INITX input pin | Pull-up / Input enabled | Pull-up / Input enabled | Pull-up / Input enabled | Pull-up / Input enabled | Pull-up / Input enabled | Pull-up / Input enabled | Pull-up / Input enabled | Pull-up / Input enabled | Pull-up / Input enabled |

| Pin status type | Function group | Power-on reset or low-voltage detection state | INITX input state | Device internal reset state | Run mode or Sleep mode state | Timer mode, RTC mode, or Stop mode state | | Deep Standby RTC mode or Deep Standby Stop mode state | | Return from Deep Standby mode state |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Power supply unstable | Power supply stable | | Power supply stable | Power supply stable | | Power supply stable | | Power supply stable |
| | | - | INITX = 0 | INITX = 1 | INITX = 1 | INITX = 1 | | INITX = 1 | | INITX = 1 |
| | | - | - | - | - | SPL = 0 | SPL = 1 | SPL = 0 | SPL = 1 | - |
| D | Mode input pin | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled |
| E | JTAG selected | Hi-Z | Pull-up / Input enabled | Pull-up / Input enabled | Maintain previous state | Maintain previous state | Maintain previous state | Maintain previous state | Maintain previous state | Maintain previous state |
| | GPIO selected | Setting disabled | Setting disabled | Setting disabled | | | Hi-Z / Internal input fixed at 0 | | Hi-Z / Internal input fixed at 0 | |
| F | External interrupt enabled selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Maintain previous state | GPIO selected Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | GPIO selected |
| | Resource other than above selected | Hi-Z | Hi-Z / Input enabled | Hi-Z / Input enabled | | | Hi-Z / Internal input fixed at 0 | | | |
| | GPIO selected | | | | | | | Output maintains previous state / Internal input fixed at 0 | | Maintain previous state |
| G | WKUP enabled | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Hi-Z / Internal input fixed at 0 | WKUP input enabled | Hi-Z / WKUP input enabled | GPIO selected |
| | External interrupt enabled selected | Setting disabled | Setting disabled | Setting disabled | | | Maintain previous state | GPIO selected Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | |
| | Resource other than above selected | Hi-Z | Hi-Z / Input enabled | Hi-Z / Input enabled | | | Hi-Z / Internal input fixed at 0 | | | |
| | GPIO selected | | | | | | | Output maintains previous state / Internal input fixed at 0 | | Maintain previous state |

| Pin status type | Function group | Power-on reset or low-voltage detection state | INITX input state | Device internal reset state | Run mode or Sleep mode state | Timer mode, RTC mode, or Stop mode state | | Deep Standby RTC mode or Deep Standby Stop mode state | | Return from Deep Standby mode state |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Power supply unstable | Power supply stable | | Power supply stable | Power supply stable | | Power supply stable | | Power supply stable |
| | | - | INITX = 0 | INITX = 1 | INITX = 1 | INITX = 1 | | INITX = 1 | | INITX = 1 |
| | | - | - | - | - | SPL = 0 | SPL = 1 | SPL = 0 | SPL = 1 | - |
| H | Resource selected | Hi-Z | Hi-Z / Input enabled | Hi-Z / Input enabled | Maintain previous state | Maintain previous state | Hi-Z / Internal input fixed at 0 | GPIO selected Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | GPIO selected |
| | GPIO selected | | | | | | | Output maintains previous state / Internal input fixed at 0 | | Maintain previous state |
| I | NMIX selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Maintain previous state | WKUP input enabled | Hi-Z / WKUP input enabled | GPIO selected |
| | Resource other than above selected | Hi-Z | Hi-Z / Input enabled | Hi-Z / Input enabled | | | Hi-Z / Internal input fixed at 0 | | | |
| | GPIO selected | | | | | | | | | Maintain previous state |
| J | Analog input selected | Hi-Z | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled |
| | Resource other than above selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Hi-Z / Internal input fixed at 0 | GPIO selected Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | GPIO selected |
| | GPIO selected | | | | | | | Output maintains previous state / Internal input fixed at 0 | | Maintain previous state |

| Pin status type | Function group | Power-on reset or low-voltage detection state | INITX input state | Device internal reset state | Run mode or Sleep mode state | Timer mode, RTC mode, or Stop mode state | | Deep Standby RTC mode or Deep Standby Stop mode state | | Return from Deep Standby mode state |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Power supply unstable | Power supply stable | | Power supply stable | Power supply stable | | Power supply stable | | Power supply stable |
| | | - | INITX = 0 | INITX = 1 | INITX = 1 | INITX = 1 | | INITX = 1 | | INITX = 1 |
| | | - | - | - | - | SPL = 0 | SPL = 1 | SPL = 0 | SPL = 1 | - |
| K | Analog input selected | Hi-Z | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled |
| | External interrupt enabled selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Maintain previous state | GPIO selected Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | GPIO selected |
| | Resource other than above selected | | | | | | Hi-Z / Internal input fixed at 0 | | | |
| | GPIO selected | | | | | | | Output maintains previous state / Internal input fixed at 0 | | Maintain previous state |
| L | Analog input selected | Hi-Z | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled | Hi-Z / Internal input fixed at 0 / Analog input enabled |
| | WKUP enabled | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Hi-Z / Internal input fixed at 0 | WKUP input enabled | Hi-Z / WKUP input enabled | GPIO selected |
| | External interrupt enabled selected | | | | | | Maintain previous state | GPIO selected Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | |
| | Resource other than above selected | | | | | | Hi-Z / Internal input fixed at 0 | | | |
| | GPIO selected | | | | | | | Output maintains previous state / Internal input fixed at "0" | | Maintain previous state |

| Pin status type | Function group | Power-on reset or low-voltage detection state | INITX input state | Device internal reset state | Run mode or Sleep mode state | Timer mode, RTC mode, or Stop mode state | | Deep Standby RTC mode or Deep Standby Stop mode state | | Return from Deep Standby mode state |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Power supply unstable | Power supply stable | | Power supply stable | Power supply stable | | Power supply stable | | Power supply stable |
| | | - | INITX = 0 | INITX = 1 | INITX = 1 | INITX = 1 | | INITX = 1 | | INITX = 1 |
| | | - | - | - | - | SPL = 0 | SPL = 1 | SPL = 0 | SPL = 1 | - |
| M | Sub crystal oscillator input pin | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled |
| | External sub clock input selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state / When oscillation stops*2, output maintains previous state / Internal input fixed at 0 | Hi-Z / Input enabled / When oscillation stops*2, Hi-Z / Internal input fixed at 0 | Maintain previous state / When oscillation stops*2, output maintains previous state / Internal input fixed at 0 | Hi-Z / Input enabled / When oscillation stops*2, Hi-Z / Internal input fixed at 0 | Maintain previous state / When Return from Deep Standby STOP mode, GPIO is selected |
| | GPIO selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Output maintains previous state / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | Output maintains previous state / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | Maintain previous state |
| N | Sub crystal oscillator output pin | Hi-Z / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | Maintain previous state | Maintain previous state / When oscillation stops*2, Hi-Z / Internal input fixed at 0 | Maintain previous state / When oscillation stops*2, Hi-Z / Internal input fixed at 0 | Maintain previous state / When oscillation stops*2, Hi-Z / Internal input fixed at 0 | Maintain previous state / When oscillation stops*2, Hi-Z / Internal input fixed at 0 | Maintain previous state / When oscillation stops*2, Hi-Z / Internal input fixed at 0 |
| | GPIO selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Hi-Z / Internal input fixed at 0 | Output maintains previous state / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | Maintain previous state |
| O | External interrupt enabled selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Maintain previous state | GPIO selected / Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | GPIO selected |
| | GPIO selected | Hi-Z | Hi-Z / Input enabled | Hi-Z / Input enabled | | | Hi-Z / Internal input fixed at 0 | Output maintains previous state / Internal input fixed at 0 | | Maintain previous state |

| Pin status type | Function group | Power-on reset or low-voltage detection state | INITX input state | Device internal reset state | Run mode or Sleep mode state | Timer mode, RTC mode, or Stop mode state | | Deep Standby RTC mode or Deep Standby Stop mode state | | Return from Deep Standby mode state |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Power supply unstable | Power supply stable | | Power supply stable | Power supply stable | | Power supply stable | | Power supply stable |
| | | - | INITX = 0 | INITX = 1 | INITX = 1 | INITX = 1 | | INITX = 1 | | INITX = 1 |
| | | - | - | - | - | SPL = 0 | SPL = 1 | SPL = 0 | SPL = 1 | - |
| P | Mode input pin | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled | Input enabled |
| | GPIO selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Hi-Z / input enabled | Maintain previous state | Hi-Z / input enabled | Maintain previous state |
| Q | CEC enabled | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Maintain previous state | Maintain previous state | Maintain previous state | Maintain previous state |
| | Resource other than above selected | Hi-Z | Hi-Z / Input enabled | Hi-Z / Input enabled | Maintain previous state | Maintain previous state | Hi-Z / Internal input fixed at 0 | GPIO selected Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | GPIO selected |
| | GPIO selected | | | | | | | Output maintains previous state / Internal input fixed at 0 | | Maintain previous state |
| R | CEC enabled | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Maintain previous state | Maintain previous state | Maintain previous state | Maintain previous state |
| | WKUP enabled | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | Maintain previous state | Hi-Z / Internal input fixed at 0 | WKUP input enabled | Hi-Z / WKUP input enabled | GPIO selected |
| | External interrupt enabled selected | | | | | | Maintain previous state | GPIO selected Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | |
| | Resource other than above selected | Hi-Z | Hi-Z / Input enabled | Hi-Z / Input enabled | | | Hi-Z / Internal input fixed at 0 | | | |
| | GPIO selected | | | | | | | Output maintains previous state / Internal input fixed at 0 | | Maintain previous state |

| Pin status type | Function group | Power-on reset or low-voltage detection state | INITX input state | Device internal reset state | Run mode or Sleep mode state | Timer mode, RTC mode, or Stop mode state | | Deep Standby RTC mode or Deep Standby Stop mode state | | Return from Deep Standby mode state |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Power supply unstable | Power supply stable | | Power supply stable | Power supply stable | | Power supply stable | | Power supply stable |
| | | - | INITX = 0 | INITX = 1 | INITX = 1 | INITX = 1 | | INITX = 1 | | INITX = 1 |
| | | - | - | - | - | SPL = 0 | SPL = 1 | SPL = 0 | SPL = 1 | - |
| S | Analog output selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | *3 | *4 | GPIO selected Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | GPIO selected |
| | External interrupt enabled selected | Setting disabled | Setting disabled | Setting disabled | | Maintain previous state | Maintain previous state | | | |
| | Resource other than above selected | Hi-Z | Hi-Z / Input enabled | Hi-Z / Input enabled | | | Hi-Z / Internal input fixed at 0 | | | |
| | GPIO selected | | | | | | | Output maintains previous state / Internal input fixed at 0 | | Maintain previous state |
| T | Analog output selected | Setting disabled | Setting disabled | Setting disabled | Maintain previous state | *3 | *4 | GPIO selected Internal input fixed at 0 | Hi-Z / Internal input fixed at 0 | GPIO selected |
| | Resource other than above selected | Hi-Z | Hi-Z / Input enabled | Hi-Z / Input enabled | | Maintain previous state | Hi-Z / Internal input fixed at 0 | | | |
| | GPIO selected | | | | | | | Output maintains previous state / Internal input fixed at 0 | | Maintain previous state |

*1: Oscillation is stopped at Sub run mode, Low-speed CR Run mode, Sub Sleep mode, Low-speed CR Sleep mode, Sub Timer mode, Low-speed CR Timer mode, RTC mode, Stop mode, Deep Standby RTC mode, and Deep Standby Stop mode.

*2: Oscillation is stopped at Stop mode and Deep Standby Stop mode.

*3: Maintain previous state at Timer mode. GPIO selected Internal input fixed at 0 at RTC mode, Stop mode.

*4: Maintain previous state at Timer mode. Hi-Z/Internal input fixed at 0 at RTC mode, Stop mode.

# 12. Electrical Characteristics

## 12.1 Absolute Maximum Ratings

| Parameter | Symbol | Rating | | Unit | Remarks |
|---|---|---|---|---|---|
| | | Min | Max | | |
| Power supply voltage*1,*2 | $V_{CC}$ | $V_{SS}$ - 0.5 | $V_{SS}$ + 6.5 | V | |
| Analog power supply voltage*1,*3 | $AV_{CC}$ | $V_{SS}$ - 0.5 | $V_{SS}$ + 6.5 | V | |
| Analog reference voltage*1,*3 | AVRH | $V_{SS}$ - 0.5 | $V_{SS}$ + 6.5 | V | |
| Input voltage*1 | $V_I$ | $V_{SS}$ - 0.5 | $V_{CC}$ + 0.5 (≤ 6.5 V) | V | |
| | | $V_{SS}$ - 0.5 | $V_{SS}$ + 6.5 | V | 5V tolerant |
| Analog pin input voltage*1 | $V_{IA}$ | $V_{SS}$ - 0.5 | $AV_{CC}$ + 0.5 (≤ 6.5 V) | V | |
| Output voltage*1 | $V_O$ | $V_{SS}$ - 0.5 | $V_{CC}$ + 0.5 (≤ 6.5 V) | V | |
| L level maximum output current*4 | $I_{OL}$ | - | 10 | mA | |
| L level average output current*5 | $I_{OLAV}$ | - | 4 | mA | |
| L level total maximum output current | $\sum I_{OL}$ | - | 100 | mA | |
| L level total average output current*6 | $\sum I_{OLAV}$ | - | 50 | mA | |
| H level maximum output current*4 | $I_{OH}$ | - | - 10 | mA | |
| H level average output current*5 | $I_{OHAV}$ | - | - 4 | mA | |
| H level total maximum output current | $\sum I_{OH}$ | - | - 100 | mA | |
| H level total average output current*6 | $\sum I_{OHAV}$ | - | - 50 | mA | |
| Power consumption | $P_D$ | - | 400 | mW | |
| Storage temperature | $T_{STG}$ | - 55 | + 150 | °C | |

*1: These parameters are based on the condition that $V_{SS} = AV_{SS} = 0$ V.
*2: $V_{CC}$ must not drop below $V_{SS}$ - 0.5 V.
*3: Be careful not to exceed $V_{CC}$ + 0.5 V, for example, when the power is turned on.
*4: The maximum output current is defined as the value of the peak current flowing through any one of the corresponding pins.
*5: The average output current is defined as the average current value flowing through any one of the corresponding pins for a 100 ms period.
*6: The total average output current is defined as the average current value flowing through all of corresponding pins for a 100 ms.

***WARNING:***

- *Semiconductor devices may be permanently damaged by application of stress (including, without limitation, voltage, current or temperature) in excess of absolute maximum ratings.*
  *Do not exceed any of these ratings.*

## 12.2 Recommended Operating Conditions

($V_{SS}$ = $AV_{SS}$ = 0.0V)

| Parameter | | Symbol | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| Power supply voltage | | $V_{CC}$ | - | 1.8 | 5.5 | V | |
| Analog power supply voltage | | $AV_{CC}$ | - | 1.8 | 5.5 | V | $AV_{CC}$ = $V_{CC}$ |
| Analog reference voltage | | AVRH | - | 2.7 | $AV_{CC}$ | V | $AV_{CC}$ ≥ 2.7 V |
| | | | | $AV_{CC}$ | | | $AV_{CC}$ < 2.7 V |
| Smoothing capacitor | | $C_S$ | - | 1 | 10 | µF | For built-in Regulator * |
| Operating Temperature | LQD064, LQG064, LQH080, LQJ080, LQI100, PQH100 | $T_A$ | - | - 40 | + 85 | °C | |

*: See C Pin in Handling Devices for the smoothing 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 under these conditions.*
  *Any use of semiconductor devices will be under their recommended operating condition.*
  *Operation under any conditions other than these conditions may adversely affect reliability of device and could result in device failure.*
  *No warranty is made with respect to any use, operating conditions or combinations not represented on this data sheet. If you are considering application under any conditions other than listed herein, please contact sales representatives beforehand.*

## 12.3 DC Characteristics

### *12.3.1 Current Rating*

($V_{CC}$ = $AV_{CC}$ = 1.8 V to 5.5 V, $V_{SS}$ = $AV_{SS}$ = 0 V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Conditions | | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | Typ*3 | Max*4 | | |
| Power supply current | $I_{CC}$ | VCC | PLL Run mode | CPU: 20 MHz, Peripheral: 20 MHz, Flash memory 0 Wait, FRWTR.RWT = 00, FSYNDN.SD = 000 | 19 | 24 | mA | *1, *5 |
| | | | | CPU: 20 MHz, Peripheral: clock stopped, NOP operation | 9.5 | 12.5 | mA | *1, *5 |
| | | | High-speed CR Run mode | CPU/Peripheral: 4 MHz*2 Flash memory 0 Wait FRWTR.RWT = 00 FSYNDN.SD = 000 | 4.5 | 5 | mA | *1 |
| | | | Sub Run mode | CPU/Peripheral: 32 kHz, Flash memory 0 Wait, FRWTR.RWT = 00, FSYNDN.SD = 000 | 0.25 | 0.55 | mA | *1, *6 |
| | | | Low-speed CR Run mode | CPU/Peripheral: 100 kHz, Flash memory 0 Wait, FRWTR.RWT = 00, FSYNDN.SD = 000 | 0.3 | 0.95 | mA | *1 |
| | $I_{CCS}$ | | PLL Sleep mode | Peripheral: 20 MHz | 8 | 10.5 | mA | *1, *5 |
| | | | High-speed CR Sleep mode | Peripheral: 4 MHz*2 | 2 | 2.5 | mA | *1 |
| | | | Sub Sleep mode | Peripheral: 32 kHz | 0.2 | 0.45 | mA | *1, *6 |
| | | | Low-speed CR Sleep mode | Peripheral: 100 kHz | 0.25 | 0.65 | mA | *1 |

*1: When all ports are fixed.

*2: When setting it to 4 MHz by trimming.

*3: $T_A$=+25°C, $V_{CC}$=3.3 V

*4: $T_A$=+85°C, $V_{CC}$=5.5 V

*5: When using the crystal oscillator of 4 MHz(Including the current consumption of the oscillation circuit)

*6: When using the crystal oscillator of 32 kHz(Including the current consumption of the oscillation circuit)

| Parameter | Symbol | Pin name | Conditions | | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | Typ*2 | Max*3 | | |
| Power supply current | $I_{CCT}$ | VCC | Main Timer mode | $T_A$ = + 25°C, When LVD is off | 0.9 | 3.3 | mA | *1, *4 |
| | | | | $T_A$ = + 85°C, When LVD is off | 1.5 | 3.5 | mA | *1, *4 |
| | | | Sub Timer mode | $T_A$ = + 25°C, When LVD is off | 7.5 | 60 | µA | *1, *5 |
| | | | | $T_A$ = + 85°C, When LVD is off | 16 | 150 | µA | *1, *5 |
| | $I_{CCR}$ | | RTC mode | $T_A$ = + 25°C, When LVD is off | 1.5 | 6.5 | µA | *1, *5 |
| | | | | $T_A$ = + 85°C, When LVD is off | 6 | 79 | µA | *1, *5 |
| | $I_{CCH}$ | | Stop mode | $T_A$ = + 25°C, When LVD is off | 0.6 | 5 | µA | *1 |
| | | | | $T_A$ = + 85°C, When LVD is off | 4.2 | 77 | µA | *1 |
| | $I_{CCRD}$ | | Deep Standby RTC mode | $T_A$ = + 25°C, When LVD is off | 1.3 | 4.5 | µA | *1, *5 |
| | | | | $T_A$ = + 85°C, When LVD is off | 3 | 22 | µA | *1, *5 |
| | $I_{CCHD}$ | | Deep Standby Stop mode | $T_A$ = + 25°C, When LVD is off | 0.4 | 3 | µA | *1 |
| | | | | $T_A$ = + 85°C, When LVD is off | 1.4 | 20 | µA | *1 |

*1: When all ports are fixed.

*2: $V_{CC}$=3.3 V

*3: $V_{CC}$=5.5 V

*4: When using the crystal oscillator of 4 MHz(Including the current consumption of the oscillation circuit)

*5: When using the crystal oscillator of 32 kHz(Including the current consumption of the oscillation circuit)

### Low Voltage Detection Current

($V_{CC}$ = $AV_{CC}$ = 1.8 V to 5.5 V, $V_{SS}$ = $AV_{SS}$ = 0 V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Typ* | Max | | |
| Low-voltage detection circuit (LVD) power supply current | $I_{CCLVD}$ | VCC | For occurrence of reset or for occurrence of interrupt in normal mode operation | 10 | 20 | µA | When not detected |
| | | | For occurrence of reset and for occurrence of interrupt in normal mode operation | 14 | 30 | µA | |
| | | | For occurrence of interrupt in low-power mode operation | 0.3 | 2 | µA | When not detected |

*: When $V_{CC}$ = 3.3 V

### Flash Memory Current

($V_{CC}$ = 1.8 V to 5.5 V, $V_{SS}$ = 0 V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Typ | Max | | |
| Flash memory write/erase current | $I_{CCFLASH}$ | VCC | At Write/Erase | 10.8 | 11.9 | mA | |

### A/D Converter Current

($V_{CC}$ = $AV_{CC}$ = 1.8 V to 5.5 V, $V_{SS}$ = $AV_{SS}$ = 0 V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Typ | Max | | |
| Power supply current | $I_{CCAD}$ | AVCC | At 1unit operation | 1.4 | 2.5 | mA | |
| | | | At stop | 0.1 | 0.35 | µA | |
| Reference power supply current | $I_{CCAVRH}$ | AVRH | At 1unit operation AVRH=5.5 V | 0.5 | 1.5 | mA | |
| | | | At stop | 0.1 | 0.3 | µA | |

### D/A Converter Current

($V_{CC}$ = $AV_{CC}$ = 1.8 V to 5.5 V, $V_{SS}$ = $AV_{SS}$ = 0 V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Typ | Max | | |
| Power supply current | $I_{DDA}$ | AVCC | At D/A 1ch. operation $AV_{CC}$=3.3 V | 314 | 440 | µA | *1, *2 |
| | | | At D/A 1ch. operation $AV_{CC}$=5.0 V | 476 | 670 | µA | *1, *2 |
| | $I_{DSA}$ | | At D/A stop | - | 1.0 | µA | *1 |

*1: No-load

*2: Generates the max current by the CODE about 0x200

### 12.3.2 Pin Characteristics

($V_{CC}$ = $AV_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = $AV_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Conditions | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| H level input voltage (hysteresis input) | $V_{IHS}$ | MD0, MD1, PE0, PE2, PE3, P46, P47, P3A, P3B, P3C, P3D, P3E, P3F, INITX | - | $V_{CC}$ × 0.8 | - | $V_{CC}$ + 0.3 | V | |
| | | P0A, P0B, P0C, P4C, P60, P80, P81, P82 | - | $V_{CC}$ × 0.7 | - | $V_{SS}$ + 5.5 | V | 5V tolerant |
| | | CMOS hysteresis input pins other than the above | - | $V_{CC}$ × 0.7 | - | $V_{CC}$ + 0.3 | V | |
| L level input voltage (hysteresis input) | $V_{ILS}$ | MD0, MD1, PE0, PE2, PE3, P46, P47, INITX | - | $V_{SS}$ - 0.3 | - | $V_{CC}$ × 0.2 | V | |
| | | CMOS hysteresis input pins other than the above | - | $V_{SS}$ - 0.3 | - | $V_{CC}$ × 0.3 | V | |
| H level output voltage | $V_{OH}$ | Pxx | $V_{CC}$ ≥ 4.5 V, $I_{OH}$ = - 4 mA | $V_{CC}$ - 0.5 | - | $V_{CC}$ | V | |
| | | | $V_{CC}$ < 4.5 V, $I_{OH}$ = - 1 mA | | | | | |
| L level output voltage | $V_{OL}$ | Pxx | $V_{CC}$ ≥ 4.5 V, $I_{OL}$ = 4 mA | $V_{SS}$ | - | 0.4 | V | |
| | | | $V_{CC}$ < 4.5 V, $I_{OL}$ = 2 mA | | | | | |
| Input leak current | $I_{IL}$ | - | - | - 5 | - | + 5 | µA | |
| | | CEC0, CEC1 | $V_{CC}$ = $AV_{CC}$ = AVRH = $V_{SS}$ = $AV_{SS}$ = 0.0 V | - | - | + 1.8 | | |
| Pull-up resistor value | $R_{PU}$ | Pull-up pin | $V_{CC}$ ≥ 4.5 V | 25 | 50 | 100 | kΩ | |
| | | | $V_{CC}$ < 4.5 V | 40 | 100 | 400 | | |
| Input capacitance | $C_{IN}$ | Other than VCC, VSS, AVCC, AVSS, AVRH | - | - | 5 | 15 | pF | |

## 12.4 AC Characteristics

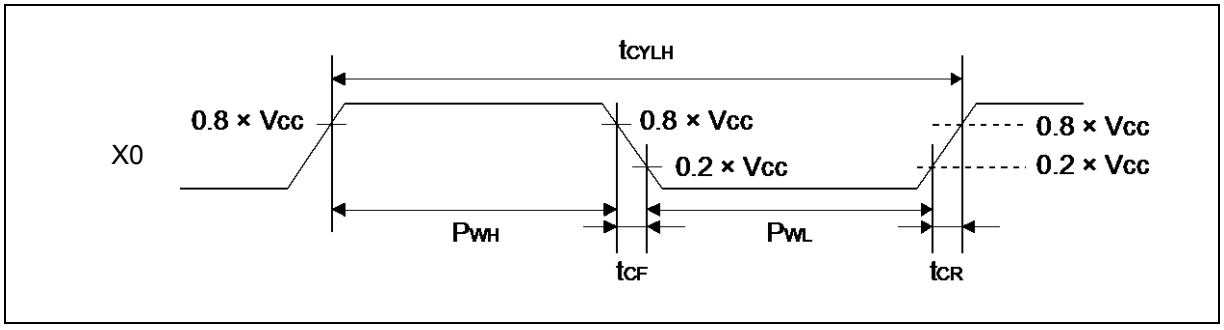
### *12.4.1 Main Clock Input Characteristics*

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| Input frequency | $f_{CH}$ | X0, X1 | $V_{CC} \geq 2.0$ V | 4 | 20 | MHz | When crystal oscillator is connected |
| | | | $V_{CC} < 2.0$ V | 4 | 4 | MHz | |
| | | | $V_{CC} \geq 4.5$ V | 4 | 20 | MHz | When using external clock |
| | | | $V_{CC} < 4.5$ V | 4 | 16 | MHz | |
| Input clock cycle | $t_{CYLH}$ | | $V_{CC} \geq 4.5$ V | 50 | 250 | ns | When using external clock |
| | | | $V_{CC} < 4.5$ V | 62.5 | 250 | ns | |
| Input clock pulse width | - | | $P_{WH}/t_{CYLH}$, $P_{WL}/t_{CYLH}$ | 45 | 55 | % | When using external clock |
| Input clock rising time and falling time | $t_{CF}$, $t_{CR}$ | | - | - | 5 | ns | When using external clock |
| Internal operating clock*1 frequency | $f_{CM}$ | - | - | - | 20 | MHz | Master clock |
| | $f_{CC}$ | - | - | - | 20 | MHz | Base clock (HCLK/FCLK) |
| | $f_{CP0}$ | - | - | - | 20 | MHz | APB0 bus clock*2 |
| | $f_{CP1}$ | - | - | - | 20 | MHz | APB1 bus clock*2 |
| | $f_{CP2}$ | - | - | - | 20 | MHz | APB2 bus clock*2 |
| Internal operating clock*1 cycle time | $t_{CYCC}$ | - | - | 50 | - | ns | Base clock (HCLK/FCLK) |
| | $t_{CYCP0}$ | - | - | 50 | - | ns | APB0 bus clock*2 |
| | $t_{CYCP1}$ | - | - | 50 | - | ns | APB1 bus clock*2 |
| | $t_{CYCP2}$ | - | - | 50 | - | ns | APB2 bus clock*2 |

*1: For more information about each internal operating clock, see Chapter 2-1: Clock in FM3 Family Peripheral Manual.

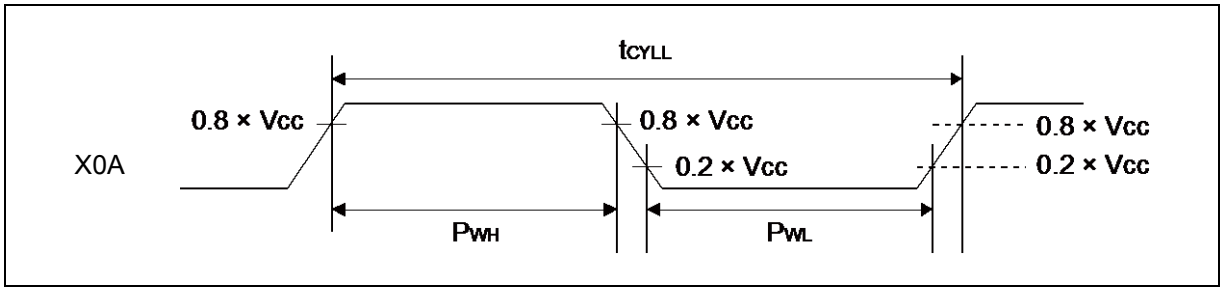
*2: For about each APB bus which each peripheral is connected to, see Block Diagram in this data sheet.



### 12.4.2 Sub Clock Input Characteristics

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Conditions | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| Input frequency | $f_{CL}$ | X0A, X1A | - | - | 32.768 | - | kHz | When crystal oscillator is connected |
| | | | - | 32 | - | 100 | kHz | When using external clock |
| Input clock cycle | $t_{CYLL}$ | | - | 10 | - | 31.25 | µs | When using external clock |
| Input clock pulse width | - | | $P_{WH}/t_{CYLL}$, $P_{WL}/t_{CYLL}$ | 45 | - | 55 | % | When using external clock |




### 12.4.3 Built-in CR Oscillation Characteristics

#### Built-in High-speed CR

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Conditions | | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| Clock frequency | $f_{CRH}$ | $V_{CC} \geq$ 2.2 V | $T_A$ = + 25°C | 3.92 | 4 | 4.08 | MHz | When trimming*1 |
| | | | $T_A$ = - 40°C to + 85°C | 3.8 | 4 | 4.2 | | |
| | | | $T_A$ = - 40°C to + 85°C | 2.3 | - | 7.03 | | When not trimming |
| | | $V_{CC}$ < 2.2 V | $T_A$ = + 25°C | 3.4 | 4 | 4.6 | MHz | When trimming*1 |
| | | | $T_A$ = - 40°C to + 85°C | 3.16 | 4 | 4.84 | | |
| | | | $T_A$ = - 40°C to + 85°C | 2.3 | - | 7.03 | | When not trimming |
| Frequency stabilization time | $t_{CRWT}$ | - | | - | - | 10 | µs | *2 |

*1: In the case of using the values in CR trimming area of Flash memory at shipment for frequency trimming.

*2: This is the time to stabilize the frequency of High-speed CR clock after setting trimming value.
This period is able to use High-speed CR clock as source clock.

### Built-in Low-speed CR

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Conditions | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Clock frequency | $f_{CRL}$ | - | 50 | 100 | 150 | kHz | |

#### *12.4.4 Operating Conditions of Main PLL (In the case of using main clock for input of PLL)*

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| PLL oscillation stabilization wait time*1 (LOCK UP time) | $t_{LOCK}$ | 200 | - | - | µs | |
| PLL input clock frequency | $f_{PLLI}$ | 4 | - | 20 | MHz | |
| PLL multiplication rate | - | 1 | - | 5 | multiplier | |
| PLL macro oscillation clock frequency | $f_{PLLO}$ | 10 | - | 20 | MHz | |
| Main PLL clock frequency*2 | $f_{CLKPLL}$ | - | - | 20 | MHz | |

*1: Time from when the PLL starts operating until the oscillation stabilizes.

*2: For more information about Main PLL clock (CLKPLL), see Chapter 2-1: Clock in FM3 Family Peripheral Manual.

#### *12.4.5 Operating Conditions of Main PLL (In the case of using the built-in High-speed CR for the input clock of the Main PLL)*

($V_{CC}$ = 2.2V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

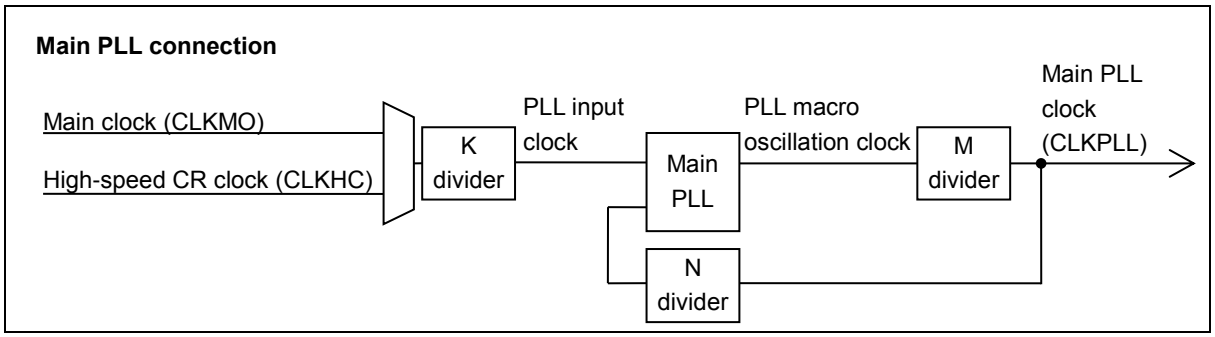
| Parameter | Symbol | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| PLL oscillation stabilization wait time*1 (LOCK UP time) | $t_{LOCK}$ | 200 | - | - | µs | |
| PLL input clock frequency | $f_{PLLI}$ | 3.8 | 4 | 4.2 | MHz | |
| PLL multiplication rate | - | 3 | - | 4 | multiplier | |
| PLL macro oscillation clock frequency | $f_{PLLO}$ | 11.4 | - | 16.8 | MHz | |
| Main PLL clock frequency*2 | $f_{CLKPLL}$ | - | - | 16.8 | MHz | |

*1: Time from when the PLL starts operating until the oscillation stabilizes.

*2: For more information about Main PLL clock (CLKPLL), see Chapter 2-1: Clock in FM3 Family Peripheral Manual.

***Note:***

- *Make sure to input to the Main PLL source clock, the High-speed CR clock (CLKHC) that the frequency has been trimmed. When setting PLL multiple rate, please take the accuracy of the built-in High-speed CR clock into account and prevent the master clock from exceeding the maximum frequency.*




### 12.4.6 Reset Input Characteristics

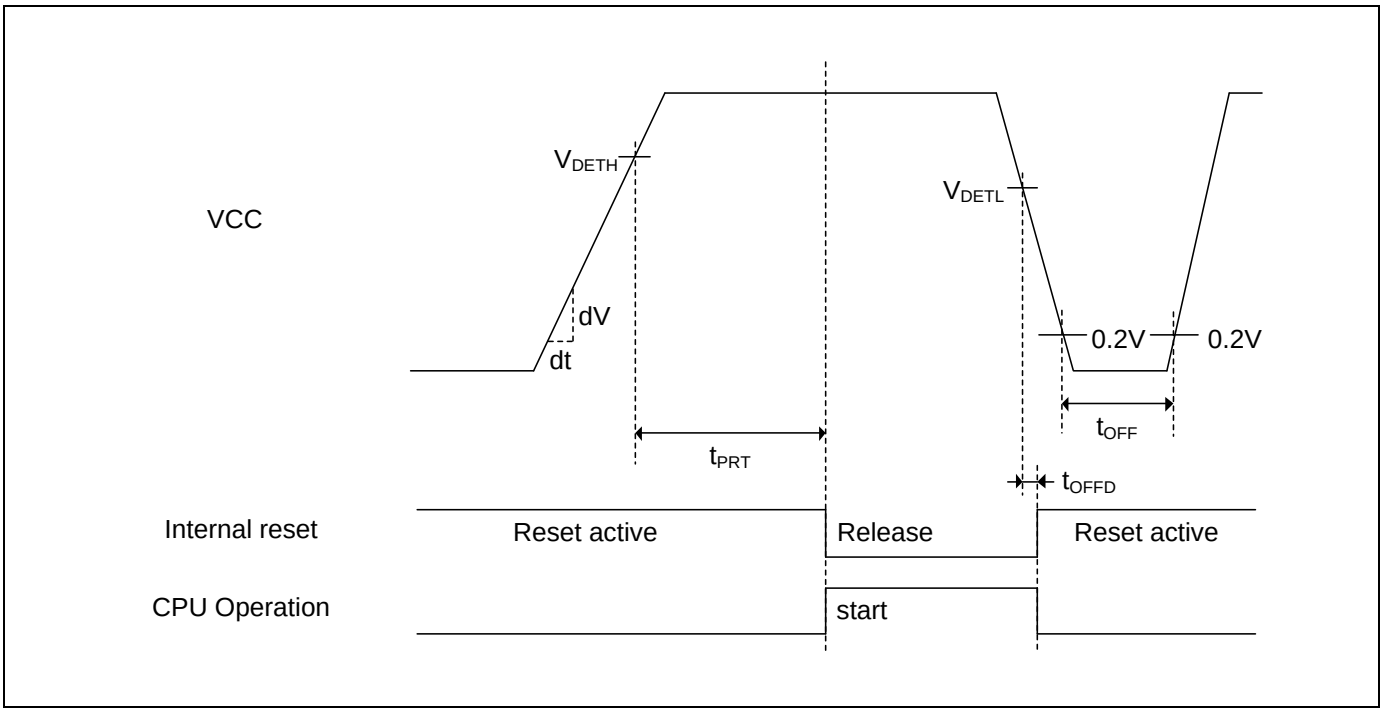
($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| Reset input time | $t_{INITX}$ | INITX | - | 500 | - | ns | |
| | | | | 1.5 | - | ms | When RTC mode or Stop mode |
| | | | | 1.5 | - | ms | When Deep Standby mode |

### 12.4.7 Power-on Reset Timing

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Power supply rising time | dV/dt | VCC | 0.1 | - | - | V/ms | |
| Power supply shut down time | $t_{OFF}$ | | 1 | - | - | ms | |
| Reset release voltage | $V_{DETH}$ | | 1.44 | 1.60 | 1.76 | V | When voltage rises |
| Reset detection voltage | $V_{DETL}$ | | 1.39 | 1.55 | 1.71 | V | When voltage drops |
| Time until releasing Power-on reset | $t_{PRT}$ | | 0.46 | - | 11.4 | ms | dV/dt ≥ 0.1mV/µs |
| Reset detection delay time | $t_{OFFD}$ | | - | - | 0.4 | ms | dV/dt ≥ -0.04mV/µs |

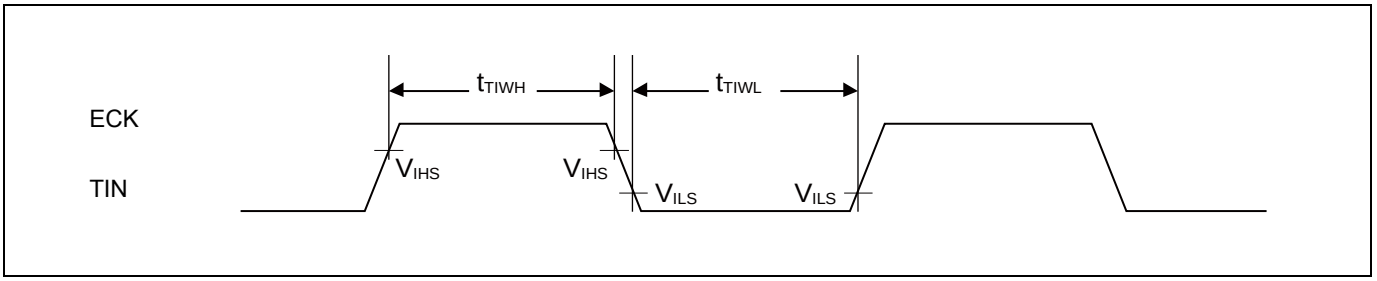



### *12.4.8 Base Timer Input Timing*

**Timer input timing**

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

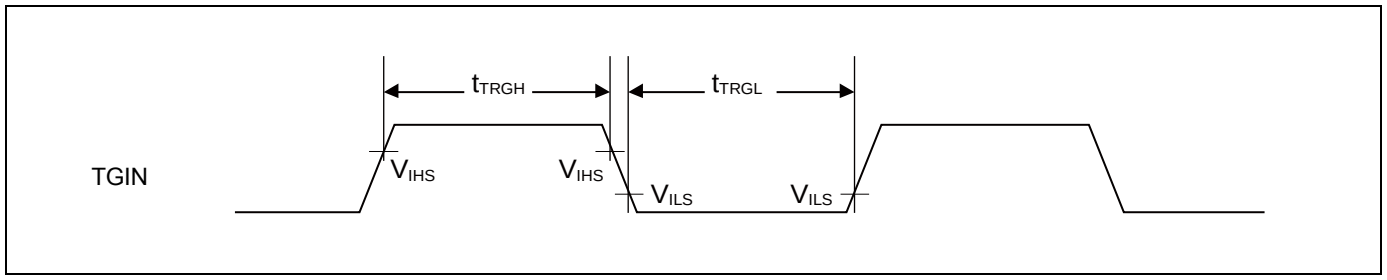
| Parameter | Symbol | Pin name | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| Input pulse width | $t_{TIWH}$, $t_{TIWL}$ | TIOAn/TIOBn (when using as ECK, TIN) | - | $2t_{CYCP}$ | - | ns | |



### Trigger input timing

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| Input pulse width | $t_{TRGH}$, $t_{TRGL}$ | TIOAn/TIOBn (when using as TGIN) | - | $2t_{CYCP}$ | - | ns | |




***Note:***

- *$t_{CYCP}$ indicates the APB bus clock cycle time.*
  *About the APB bus number which the Base Timer is connected to, see Block Diagram in this data sheet.*

### 12.4.9 CSIO/UART Timing

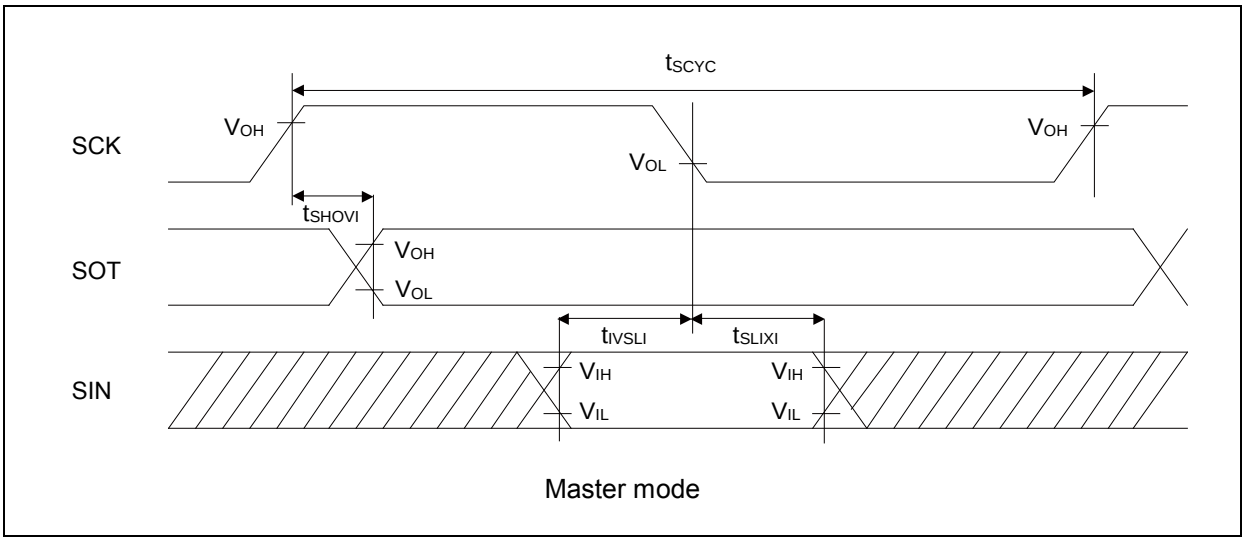
**CSIO (SPI = 0, SCINV = 0)**

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

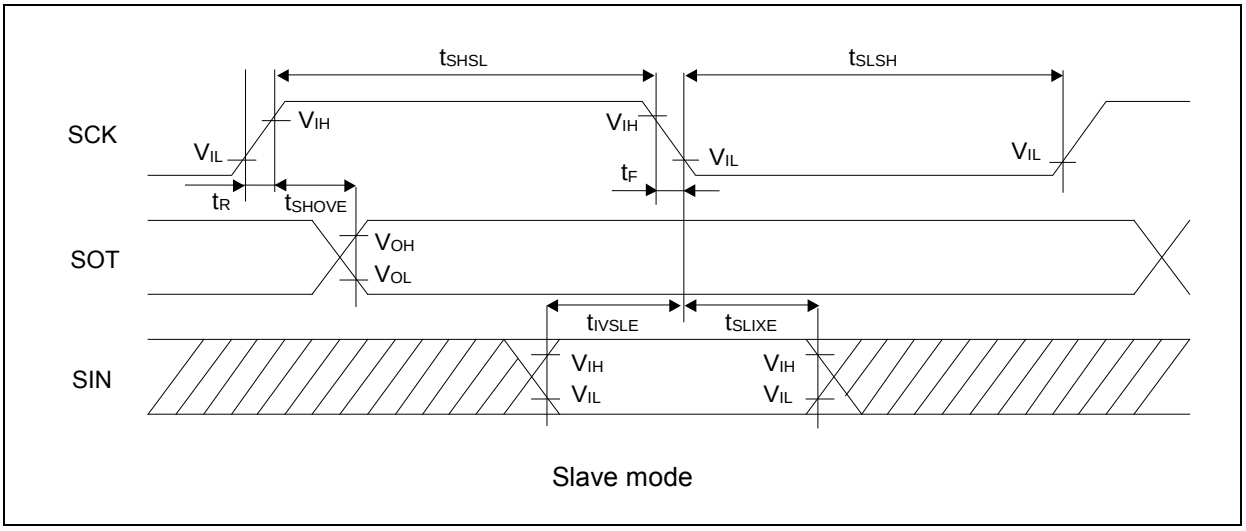
| Parameter | Symbol | Pin name | Conditions | $V_{CC}$ < 2.7 V | | 2.7 V ≤ $V_{CC}$ < 4.5 V | | $V_{CC}$ ≥ 4.5 V | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Max | Min | Max | Min | Max | |
| Baud rate | - | - | - | - | 5 | - | 5 | - | 5 | Mbps |
| Serial clock cycle time | $t_{SCYC}$ | SCKx | Master mode | $4t_{CYCP}$ | - | $4t_{CYCP}$ | - | $4t_{CYCP}$ | - | ns |
| SCK ↓ → SOT delay time | $t_{SLOVI}$ | SCKx, SOTx | | -40 | +40 | -30 | +30 | -20 | +20 | ns |
| SIN → SCK ↑ setup time | $t_{IVSHI}$ | SCKx, SINx | | 75 | - | 50 | - | 30 | - | ns |
| SCK ↑ → SIN hold time | $t_{SHIXI}$ | SCKx, SINx | | 0 | - | 0 | - | 0 | - | ns |
| Serial clock L pulse width | $t_{SLSH}$ | SCKx | Slave mode | $2t_{CYCP}$ - 10 | - | $2t_{CYCP}$ - 10 | - | $2t_{CYCP}$ - 10 | - | ns |
| Serial clock H pulse width | $t_{SHSL}$ | SCKx | | $t_{CYCP}$ + 10 | - | $t_{CYCP}$ + 10 | - | $t_{CYCP}$ + 10 | - | ns |
| SCK ↓ → SOT delay time | $t_{SLOVE}$ | SCKx, SOTx | | - | 75 | - | 50 | - | 30 | ns |
| SIN → SCK ↑ setup time | $t_{IVSHE}$ | SCKx, SINx | | 10 | - | 10 | - | 10 | - | ns |
| SCK ↑ → SIN hold time | $t_{SHIXE}$ | SCKx, SINx | | 20 | - | 20 | - | 20 | - | ns |
| SCK falling time | $t_F$ | SCKx | | - | 5 | - | 5 | - | 5 | ns |
| SCK rising time | $t_R$ | SCKx | | - | 5 | - | 5 | - | 5 | ns |

***Notes:***

- *The above characteristics apply to clock synchronous mode.*
- *$t_{CYCP}$ indicates the APB bus clock cycle time.*
  *About the APB bus number which Multi-function serial is connected to, see Block Diagram in this data sheet.*
- *These characteristics only guarantee the same relocate port number.*
  *For example, the combination of SCKx_0 and SOTx_1 is not guaranteed.*
- *When the external load capacitance $C_L$ = 50 pF.*




Master mode




Slave mode

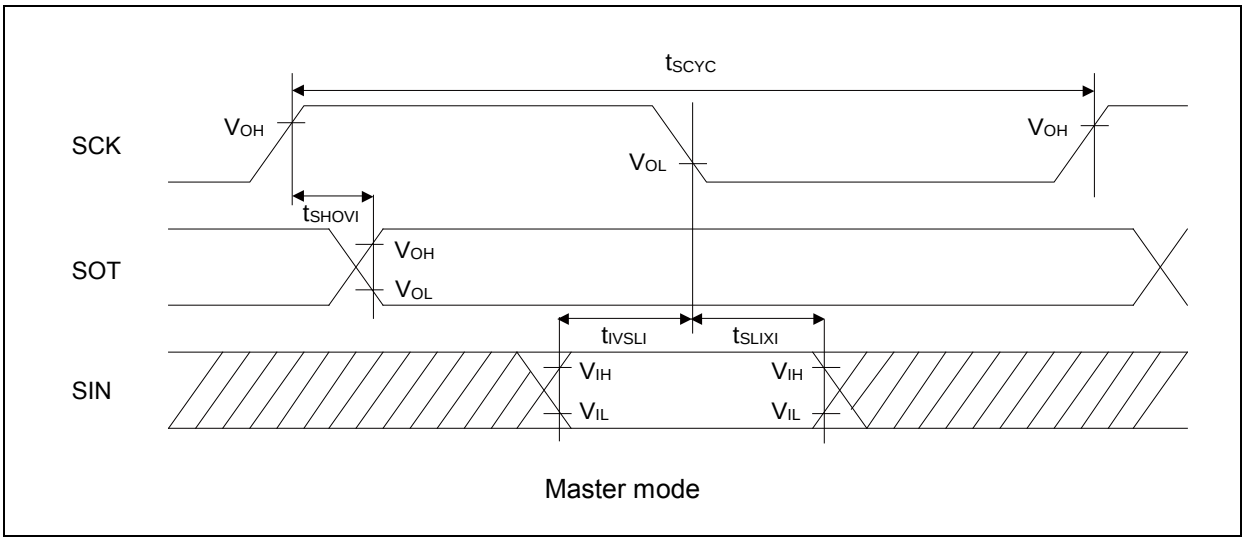
### CSIO (SPI = 0, SCINV = 1)

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

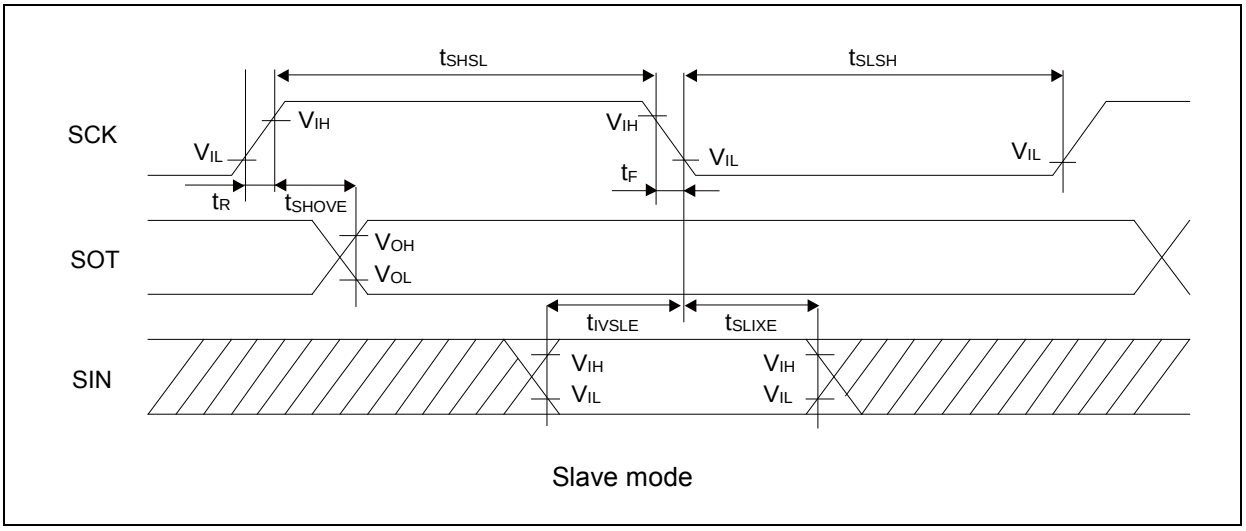
| Parameter | Symbol | Pin name | Conditions | $V_{CC}$ < 2.7 V | | 2.7 V ≤ $V_{CC}$ < 4.5 V | | $V_{CC}$ ≥ 4.5 V | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Max | Min | Max | Min | Max | |
| Baud rate | - | - | - | - | 5 | - | 5 | - | 5 | Mbps |
| Serial clock cycle time | $t_{SCYC}$ | SCKx | Master mode | $4t_{CYCP}$ | - | $4t_{CYCP}$ | - | $4t_{CYCP}$ | - | ns |
| SCK ↑ → SOT delay time | $t_{SHOVI}$ | SCKx, SOTx | | -40 | +40 | -30 | +30 | -20 | +20 | ns |
| SIN → SCK ↓ setup time | $t_{IVSLI}$ | SCKx, SINx | | 75 | - | 50 | - | 30 | - | ns |
| SCK ↓ → SIN hold time | $t_{SLIXI}$ | SCKx, SINx | | 0 | - | 0 | - | 0 | - | ns |
| Serial clock L pulse width | $t_{SLSH}$ | SCKx | Slave mode | $2t_{CYCP}$ - 10 | - | $2t_{CYCP}$ - 10 | - | $2t_{CYCP}$ - 10 | - | ns |
| Serial clock H pulse width | $t_{SHSL}$ | SCKx | | $t_{CYCP}$ + 10 | - | $t_{CYCP}$ + 10 | - | $t_{CYCP}$ + 10 | - | ns |
| SCK ↑ → SOT delay time | $t_{SHOVE}$ | SCKx, SOTx | | - | 75 | - | 50 | - | 30 | ns |
| SIN → SCK ↓ setup time | $t_{IVSLE}$ | SCKx, SINx | | 10 | - | 10 | - | 10 | - | ns |
| SCK ↓ → SIN hold time | $t_{SLIXE}$ | SCKx, SINx | | 20 | - | 20 | - | 20 | - | ns |
| SCK falling time | $t_F$ | SCKx | | - | 5 | - | 5 | - | 5 | ns |
| SCK rising time | $t_R$ | SCKx | | - | 5 | - | 5 | - | 5 | ns |

***Notes:***

- *The above characteristics apply to clock synchronous mode.*
- *$t_{CYCP}$ indicates the APB bus clock cycle time.*
  *About the APB bus number which Multi-function serial is connected to, see Block Diagram in this data sheet.*
- *These characteristics only guarantee the same relocate port number.*
  *For example, the combination of SCKx_0 and SOTx_1 is not guaranteed.*
- *When the external load capacitance $C_L$ = 50 pF.*




Master mode




Slave mode

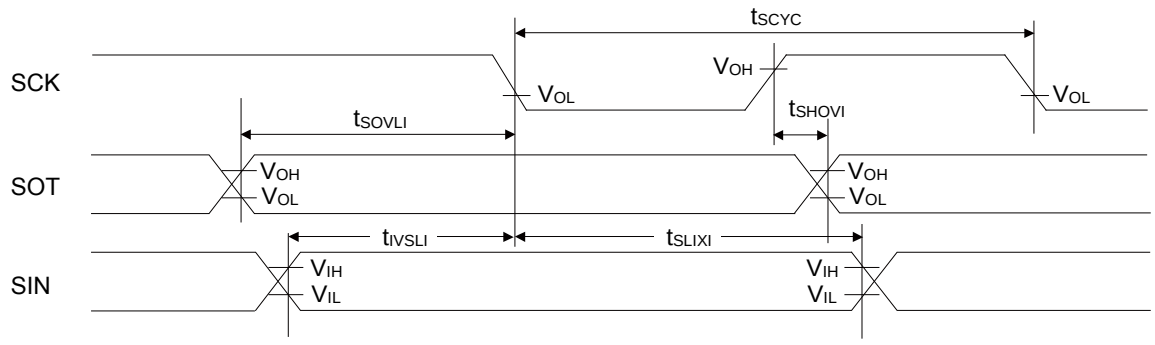
### CSIO (SPI = 1, SCINV = 0)

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

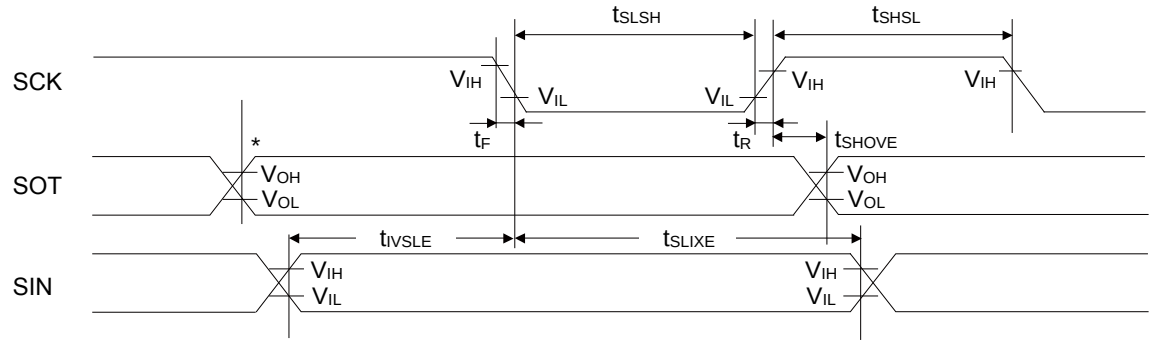
| Parameter | Symbol | Pin name | Conditions | $V_{CC}$ < 2.7 V | | 2.7 V ≤ $V_{CC}$ < 4.5 V | | $V_{CC}$ ≥ 4.5 V | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Max | Min | Max | Min | Max | |
| Baud rate | - | - | - | - | 5 | - | 5 | - | 5 | Mbps |
| Serial clock cycle time | $t_{SCYC}$ | SCKx | Master mode | $4t_{CYCP}$ | - | $4t_{CYCP}$ | - | $4t_{CYCP}$ | - | ns |
| SCK ↑ → SOT delay time | $t_{SHOVI}$ | SCKx, SOTx | | -40 | +40 | -30 | +30 | -20 | +20 | ns |
| SIN → SCK ↓ setup time | $t_{IVSLI}$ | SCKx, SINx | | 75 | - | 50 | - | 30 | - | ns |
| SCK ↓ → SIN hold time | $t_{SLIXI}$ | SCKx, SINx | | 0 | - | 0 | - | 0 | - | ns |
| SOT → SCK ↓ delay time | $t_{SOVLI}$ | SCKx, SOTx | | $2t_{CYCP}$ - 30 | - | $2t_{CYCP}$ - 30 | - | $2t_{CYCP}$ - 30 | - | ns |
| Serial clock L pulse width | $t_{SLSH}$ | SCKx | Slave mode | $2t_{CYCP}$ - 10 | - | $2t_{CYCP}$ - 10 | - | $2t_{CYCP}$ - 10 | - | ns |
| Serial clock H pulse width | $t_{SHSL}$ | SCKx | | $t_{CYCP}$ + 10 | - | $t_{CYCP}$ + 10 | - | $t_{CYCP}$ + 10 | - | ns |
| SCK ↑ → SOT delay time | $t_{SHOVE}$ | SCKx, SOTx | | - | 75 | - | 50 | - | 30 | ns |
| SIN → SCK ↓ setup time | $t_{IVSLE}$ | SCKx, SINx | | 10 | - | 10 | - | 10 | - | ns |
| SCK ↓ → SIN hold time | $t_{SLIXE}$ | SCKx, SINx | | 20 | - | 20 | - | 20 | - | ns |
| SCK falling time | $t_F$ | SCKx | | - | 5 | - | 5 | - | 5 | ns |
| SCK rising time | $t_R$ | SCKx | | - | 5 | - | 5 | - | 5 | ns |

***Notes:***

- *The above characteristics apply to clock synchronous mode.*
- *$t_{CYCP}$ indicates the APB bus clock cycle time.*
  *About the APB bus number which Multi-function serial is connected to, see Block Diagram in this data sheet.*
- *These characteristics only guarantee the same relocate port number.*
  *For example, the combination of SCKx_0 and SOTx_1 is not guaranteed.*
- *When the external load capacitance $C_L$ = 50 pF.*




Master mode




Slave mode

*: Changes when writing to TDR register

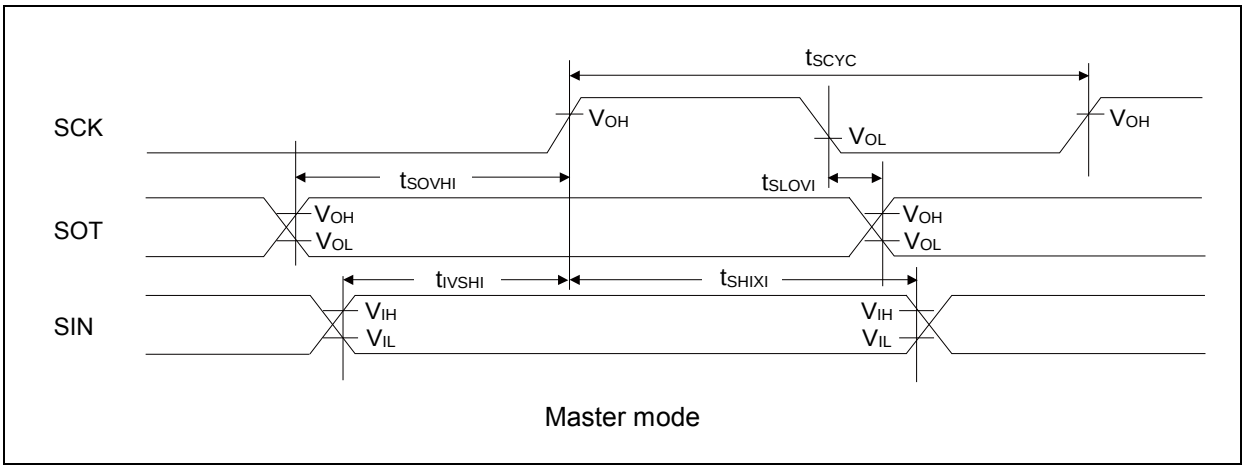
### CSIO (SPI = 1, SCINV = 1)

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

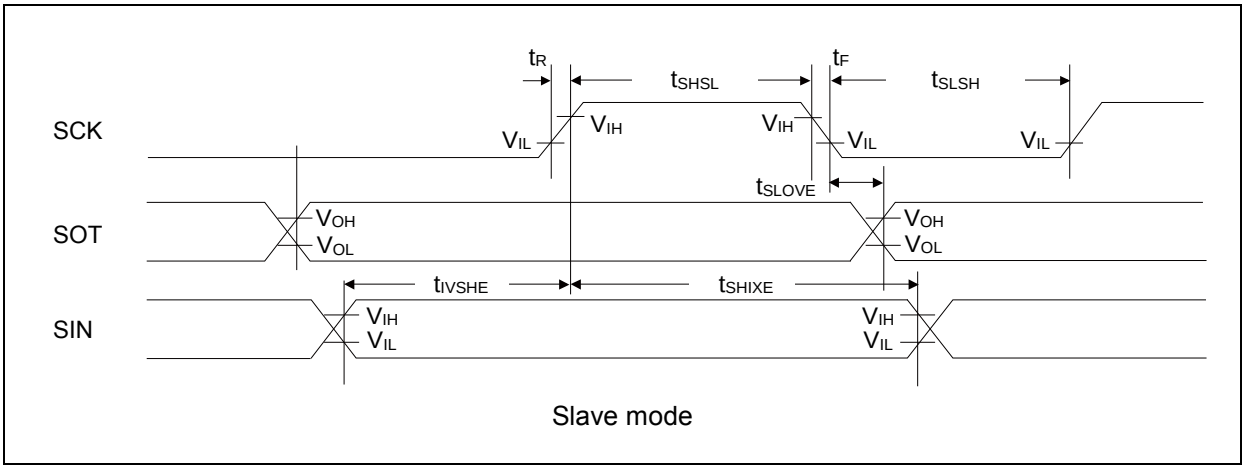
| Parameter | Symbol | Pin name | Conditions | $V_{CC}$ < 2.7 V | | 2.7 V ≤ $V_{CC}$ < 4.5 V | | $V_{CC}$ ≥ 4.5 V | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Max | Min | Max | Min | Max | |
| Baud rate | - | - | - | - | 5 | - | 5 | - | 5 | Mbps |
| Serial clock cycle time | $t_{SCYC}$ | SCKx | Master mode | $4t_{CYCP}$ | - | $4t_{CYCP}$ | - | $4t_{CYCP}$ | - | ns |
| SCK ↓ → SOT delay time | $t_{SLOVI}$ | SCKx, SOTx | | -40 | +40 | -30 | +30 | -20 | +20 | ns |
| SIN → SCK ↑ setup time | $t_{IVSHI}$ | SCKx, SINx | | 75 | - | 50 | - | 30 | - | ns |
| SCK ↑ → SIN hold time | $t_{SHIXI}$ | SCKx, SINx | | 0 | - | 0 | - | 0 | - | ns |
| SOT → SCK ↑ delay time | $t_{SOVHI}$ | SCKx, SOTx | | $2t_{CYCP}$ - 30 | - | $2t_{CYCP}$ - 30 | - | $2t_{CYCP}$ - 30 | - | ns |
| Serial clock L pulse width | $t_{SLSH}$ | SCKx | Slave mode | $2t_{CYCP}$ - 10 | - | $2t_{CYCP}$ - 10 | - | $2t_{CYCP}$ - 10 | - | ns |
| Serial clock H pulse width | $t_{SHSL}$ | SCKx | | $t_{CYCP}$ + 10 | - | $t_{CYCP}$ + 10 | - | $t_{CYCP}$ + 10 | - | ns |
| SCK ↓ → SOT delay time | $t_{SLOVE}$ | SCKx, SOTx | | - | 75 | - | 50 | - | 30 | ns |
| SIN → SCK ↑ setup time | $t_{IVSHE}$ | SCKx, SINx | | 10 | - | 10 | - | 10 | - | ns |
| SCK ↑ → SIN hold time | $t_{SHIXE}$ | SCKx, SINx | | 20 | - | 20 | - | 20 | - | ns |
| SCK falling time | $t_F$ | SCKx | | - | 5 | - | 5 | - | 5 | ns |
| SCK rising time | $t_R$ | SCKx | | - | 5 | - | 5 | - | 5 | ns |

***Notes:***

- *The above characteristics apply to clock synchronous mode.*
- *$t_{CYCP}$ indicates the APB bus clock cycle time.*
  *About the APB bus number which Multi-function serial is connected to, see Block Diagram in this data sheet.*
- *These characteristics only guarantee the same relocate port number.*
  *For example, the combination of SCKx_0 and SOTx_1 is not guaranteed.*
- *When the external load capacitance $C_L$ = 50 pF.*




Master mode

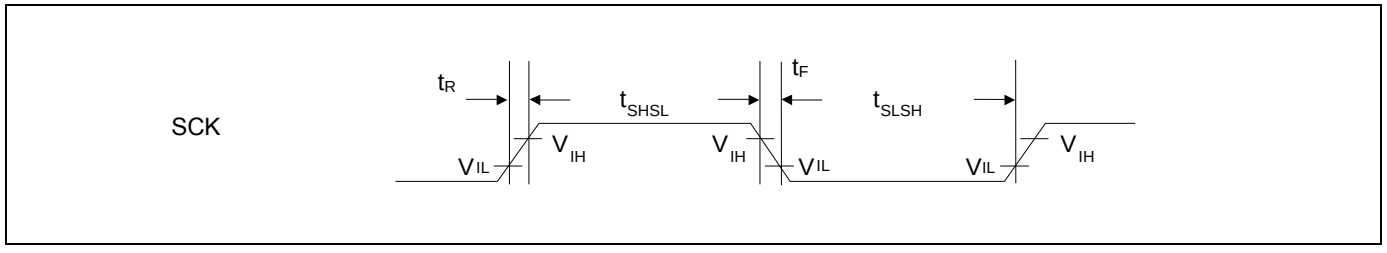



Slave mode

### UART external clock input (EXT = 1)

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|
| | | | Min | Max | | |
| Serial clock L pulse width | $t_{SLSH}$ | $C_L$ = 50 pF | $t_{CYCP}$ + 10 | - | ns | |
| Serial clock H pulse width | $t_{SHSL}$ | | $t_{CYCP}$ + 10 | - | ns | |
| SCK falling time | $t_F$ | | - | 5 | ns | |
| SCK rising time | $t_R$ | | - | 5 | ns | |



### 12.4.10 External Input Timing

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

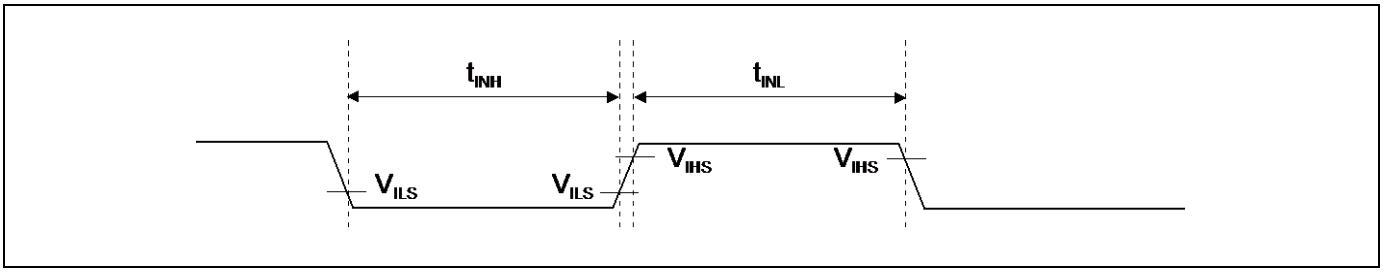
| Parameter | Symbol | Pin name | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| Input pulse width | $t_{INH}$, $t_{INL}$ | ADTG | - | $2t_{CYCP}$*1 | - | ns | A/D converter trigger input |
| | | FRCKx | | | | | Free-run timer input clock |
| | | ICxx | | | | | Input capture |
| | | DTTIxX | - | $2t_{CYCP}$*1 | - | ns | Waveform generator |
| | | IGTRG | - | $2t_{CYCP}$*1 | - | ns | PPG IGBT mode |
| | | INTxx, NMIX | *2 | $2t_{CYCP}$ + 100*1 | - | ns | External interrupt, NMI |
| | | | *3 | 500 | - | ns | |
| | | WKUPx | *4 | 500 | - | ns | Deep standby wake up |

*1: $t_{CYCP}$ indicates the APB bus clock cycle time.
About the APB bus number which the A/D converter, Multi-function Timer, PPG, External interrupt, Deep Standby mode Controller are connected to, see Block Diagram in this data sheet.

*2: When in Run mode, in Sleep mode.

*3: When in Timer mode, in RTC mode, in Stop mode.

*4: When in Deep Standby RTC mode, in Deep Standby Stop mode.



### 12.4.11 I²C Timing

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C )

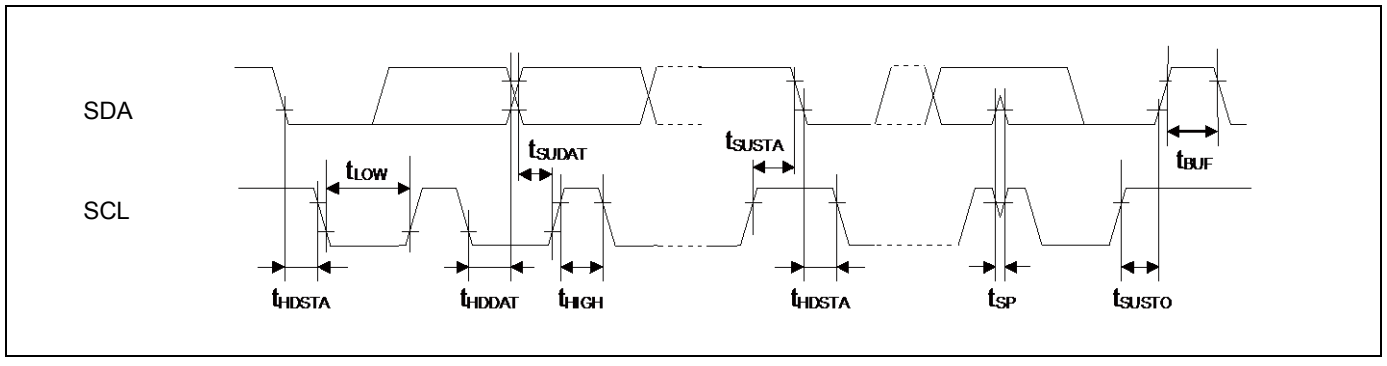
| Parameter | Symbol | Conditions | Standard-mode | | Fast-mode | | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | Min | Max | | |
| SCL clock frequency | $f_{SCL}$ | $C_L$ = 50 pF, R = ($V_P$/$I_{OL}$)*1 | 0 | 100 | 0 | 400 | kHz | |
| (Repeated) START condition hold time SDA ↓ → SCL ↓ | $t_{HDSTA}$ | | 4.0 | - | 0.6 | - | µs | |
| SCL clock L width | $t_{LOW}$ | | 4.7 | - | 1.3 | - | µs | |
| SCL clock H width | $t_{HIGH}$ | | 4.0 | - | 0.6 | - | µs | |
| (Repeated) START condition setup time SCL ↑ → SDA ↓ | $t_{SUSTA}$ | | 4.7 | - | 0.6 | - | µs | |
| Data hold time SCL ↓ → SDA ↓ ↑ | $t_{HDDAT}$ | | 0 | 3.45*2 | 0 | 0.9*3 | µs | |
| Data setup time SDA ↓ ↑ → SCL ↑ | $t_{SUDAT}$ | | 250 | - | 100 | - | ns | |
| STOP condition setup time SCL ↑ → SDA ↑ | $t_{SUSTO}$ | | 4.0 | - | 0.6 | - | µs | |
| Bus free time between STOP condition and START condition | $t_{BUF}$ | | 4.7 | - | 1.3 | - | µs | |
| Noise filter | $t_{SP}$ | - | 2 $t_{CYCP}$*4 | - | 2 $t_{CYCP}$*4 | - | ns | |

*1: R and $C_L$ represent the pull-up resistor and load capacitance of the SCL and SDA lines, respectively.
$V_P$ indicates the power supply voltage of the pull-up resistor and $I_{OL}$ indicates $V_{OL}$ guaranteed current.

*2: The maximum $t_{HDDAT}$ must satisfy that it does not extend at least L period ($t_{LOW}$) of device's SCL signal.

*3: A Fast-mode I²C bus device can be used on a Standard-mode I²C bus system as long as the device satisfies the requirement of $t_{SUDAT}$ ≥ 250 ns.

*4: $t_{CYCP}$ is the APB bus clock cycle time.
About the APB bus number which I²C is connected to, see Block Diagram in this data sheet.
To use Standard-mode, set the APB bus clock at 2 MHz or more.
To use Fast-mode, set the APB bus clock at 8 MHz or more.



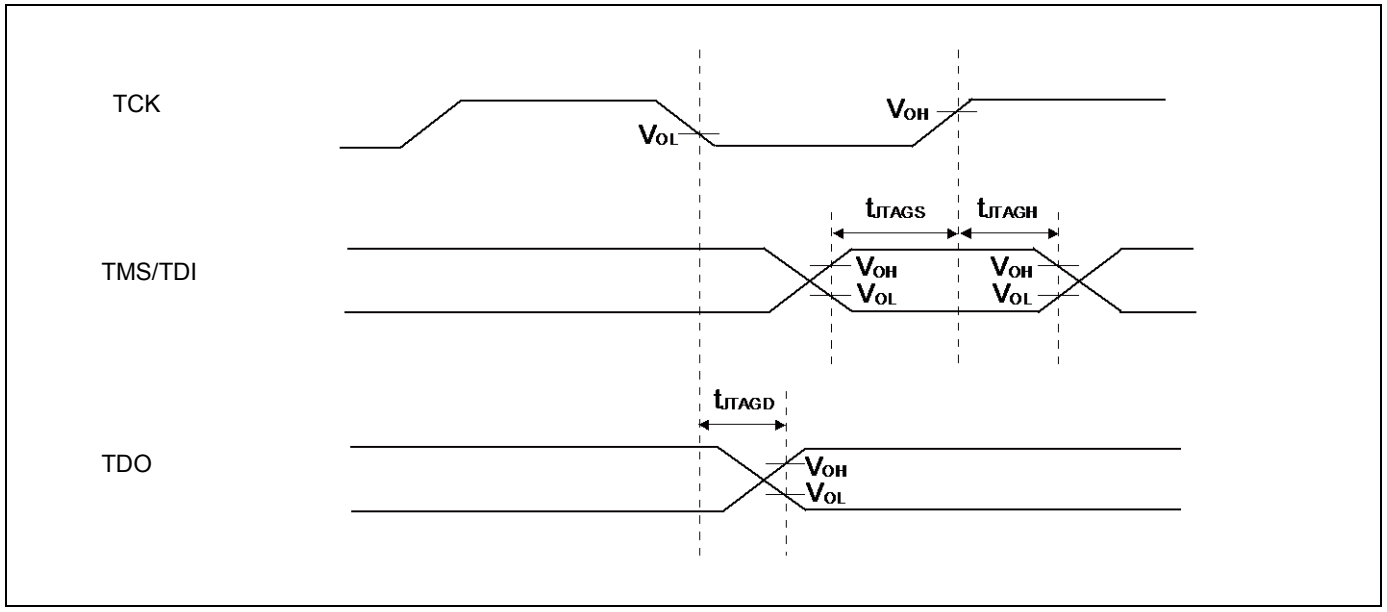
### 12.4.12 JTAG Timing

($V_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Conditions | Value | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| TMS,TDI setup time | $t_{JTAGS}$ | TCK, TMS,TDI | $V_{CC} \geq 4.5$ V | 15 | - | ns | |
| | | | $V_{CC} < 4.5$ V | | | | |
| TMS,TDI hold time | $t_{JTAGH}$ | TCK, TMS,TDI | $V_{CC} \geq 4.5$ V | 15 | - | ns | |
| | | | $V_{CC} < 4.5$ V | | | | |
| TDO delay time | $t_{JTAGD}$ | TCK, TDO | $V_{CC} \geq 4.5$ V | - | 30 | ns | |
| | | | 2.7 V $\leq V_{CC} < 4.5$ V | - | 45 | | |
| | | | $V_{CC} < 2.7$ V | - | 60 | | |

***Note:***

- *When the external load capacitance $C_L$ = 50 pF.*



## 12.5 12-bit A/D Converter

### Electrical Characteristics for the A/D Converter

($V_{CC}$ = $AV_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = $AV_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Resolution | - | - | - | - | 12 | bit | |
| Integral Nonlinearity | INL | - | - | ± 2.5 | ± 3.0 | LSB | $AV_{CC}$ ≥ 2.7 V |
| | | | - | ± 3.5 | ± 4.0 | LSB | $AV_{CC}$ < 2.7 V |
| Differential Nonlinearity | DNL | - | - | ± 1.8 | ± 1.9 | LSB | $AV_{CC}$ ≥ 2.7 V |
| | | | - | ± 2.7 | ± 2.9 | LSB | $AV_{CC}$ < 2.7 V |
| Zero transition voltage | $V_{ZT}$ | ANxx | - | ± 9 | ± 20 | mV | |
| Full-scale transition voltage | $V_{FST}$ | ANxx | - | AVRH ± 9 | AVRH ± 20 | mV | |
| Conversion time*1 | - | - | 1.0 | - | - | µs | $AV_{CC}$ ≥ 2.7 V |
| | | | 4.0 | | | | $AV_{CC}$ < 2.7 V |
| Sampling time*2 | $t_S$ | - | 0.3 | - | 10 | µs | $AV_{CC}$ ≥ 2.7 V |
| | | | 1.2 | | | | $AV_{CC}$ < 2.7 V |
| Compare clock cycle*3 | $t_{CCK}$ | - | 50 | - | 1000 | ns | $AV_{CC}$ ≥ 2.7 V |
| | | | 200 | | | | $AV_{CC}$ < 2.7 V |
| Period of operation enable state transitions | $t_{STT}$ | - | - | - | 1 | µs | |
| Analog input capacity | $C_{AIN}$ | - | - | - | 15 | pF | |
| Analog input resistor | $R_{AIN}$ | - | - | - | 0.9 | kΩ | $AV_{CC}$ ≥ 4.5 V |
| | | | | | 1.6 | | 2.7 V ≤ $AV_{CC}$ < 4.5 V |
| | | | | | 4.0 | | $AV_{CC}$ < 2.7 V |
| Interchannel disparity | - | - | - | - | 4 | LSB | |
| Analog port input leak current | - | ANxx | - | - | 0.3 | µA | |
| Analog input voltage | - | ANxx | $AV_{SS}$ | - | AVRH | V | |
| Reference voltage | - | AVRH | 2.7 | - | $AV_{CC}$ | V | $AV_{CC}$ ≥ 2.7 V |
| | | | $AV_{CC}$ | | | | $AV_{CC}$ < 2.7 V |

*1: The conversion time is the value of sampling time ($t_S$) + compare time ($t_C$).

The condition of the minimum conversion time is the following.

$AV_{CC}$ ≥ 2.7 V, HCLK=20 MHz sampling time: 0.3 µs, compare time: 0.7 µs

$AV_{CC}$ < 2.7 V, HCLK=20 MHz sampling time: 1.2 µs, compare time: 2.8 µs

Ensure that it satisfies the value of the sampling time ($t_S$) and compare clock cycle ($t_{CCK}$).

For setting*4 of the sampling time and compare clock cycle, see Chapter 1-1: A/D Converter in FM3 Family Peripheral Manual Analog Macro Part.

The register settings of the A/D Converter are reflected in the operation according to the APB bus clock timing.

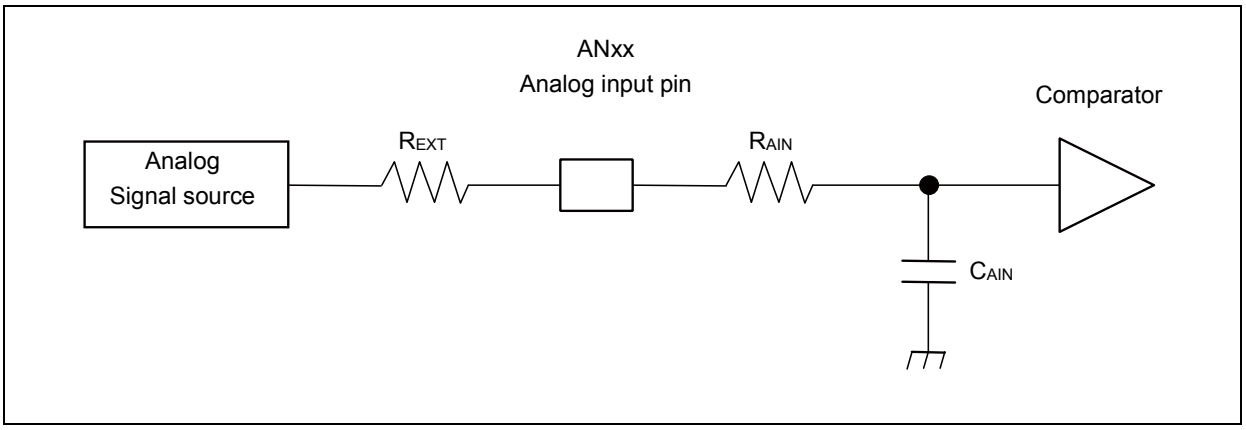
For the number of the APB bus to which the A/D Converter is connected, see Block Diagram.

The Base clock (HCLK) is used to generate the sampling time and the compare clock cycle.

*2: A necessary sampling time changes by external impedance.

Ensure to set the sampling time to satisfy (Equation 1).

*3: The compare time ($t_C$) is the value of (Equation 2).




(Equation 1) $t_S \geq ( R_{AIN} + R_{EXT} ) \times C_{AIN} \times 9$

$t_S$: Sampling time

$R_{AIN}$: input resistor of A/D = 0.9 kΩ at 4.5 V ≤ $AV_{CC}$ ≤ 5.5 V
input resistor of A/D = 1.6 kΩ at 2.7 V ≤ $AV_{CC}$ < 4.5 V
input resistor of A/D = 4.0 kΩ at 1.8 V ≤ $AV_{CC}$ < 2.7 V

$C_{AIN}$: input capacity of A/D = 15 pF at 1.8 V ≤ $AV_{CC}$ ≤ 5.5 V

$R_{EXT}$: Output impedance of external circuit

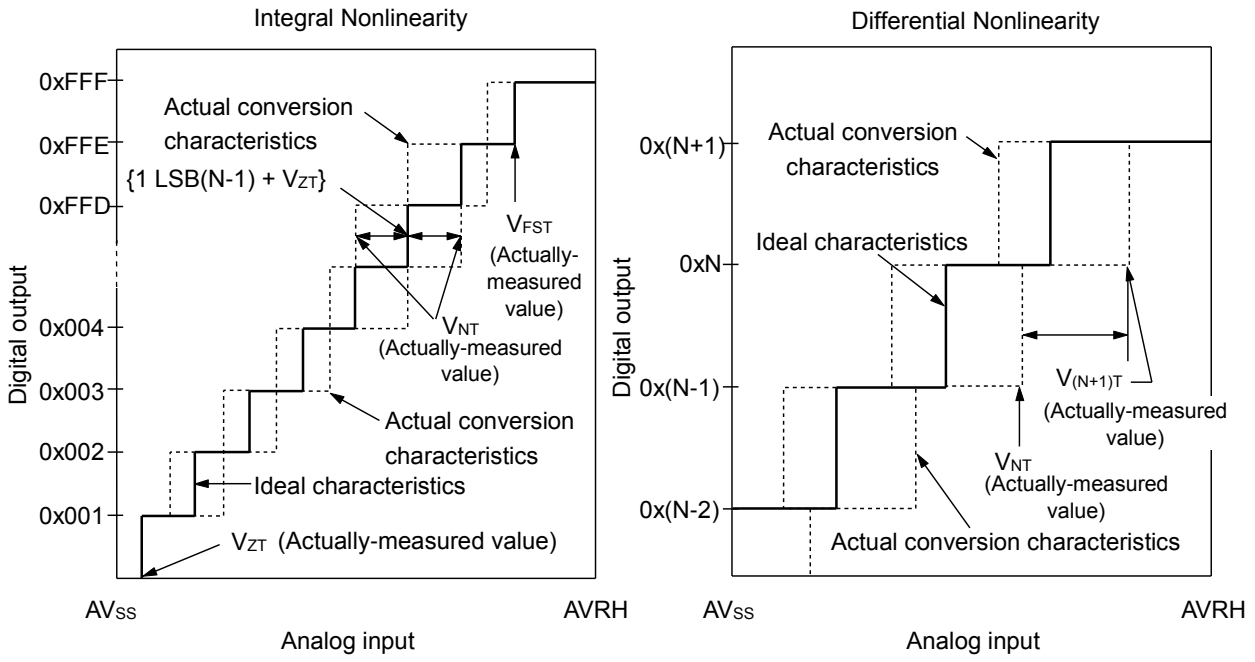
(Equation 2) $t_C = t_{CCK} \times 14$

$t_C$: Compare time

$t_{CCK}$: Compare clock cycle

### Definition of 12-bit A/D Converter Terms

- Resolution: Analog variation that is recognized by an A/D converter.
- Integral Nonlinearity: Deviation of the line between the zero-transition point (0b000000000000←→0b000000000001) and the full-scale transition point (0b111111111110←→0b111111111111) from the actual conversion characteristics.
- Differential Nonlinearity: Deviation from the ideal value of the input voltage that is required to change the output code by 1 LSB.




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

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

$$1LSB = \frac{V_{FST} - V_{ZT}}{4094}$$

N: A/D converter digital output value.
$V_{ZT}$: Voltage at which the digital output changes from 0x000 to 0x001.
$V_{FST}$: Voltage at which the digital output changes from 0xFFE to 0xFFF.
$V_{NT}$: Voltage at which the digital output changes from 0x(N − 1) to 0xN.

## 12.6 10-bit D/A Converter

### Electrical Characteristics for the D/A Converter

($V_{CC}$ = $AV_{CC}$ = 1.8V to 5.5V, $V_{SS}$ = $AV_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Pin name | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Resolution | - | DAx | - | - | 10 | bit | |
| Conversion time | $t_{C20}$ | | 0.37 | 0.53 | 0.69 | µs | Load 20 pF |
| | $t_{C100}$ | | 1.87 | 2.67 | 3.47 | µs | Load 100 pF |
| Integral Nonlinearity | INL | | -4.0 | - | +4.0 | LSB | * |
| Differential Nonlinearity | DNL | | -0.9 | - | +0.9 | LSB | * |
| Output Voltage offset | $V_{OFF}$ | | - | - | 10.0 | mV | Code is 0x000 |
| | | | -50.0 | - | +5.5 | mV | Code is 0x3FF |
| Analog output impedance | $R_O$ | | 2.45 | 3.50 | 5.5 | kΩ | D/A operation |
| | | | 5.0 | 9.0 | - | MΩ | D/A stop |
| Output undefined period | $t_R$ | | - | - | 250 | ns | |

*: No-load

## 12.7 Low-Voltage Detection Characteristics

### *12.7.1 Low-Voltage Detection Reset*

($T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Conditions | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Detected voltage | $V_{DLR}$ | SVHR = 0001 | 1.43 | 1.53 | 1.63 | V | When voltage drops |
| Released voltage | $V_{DHR}$ | | 1.53 | 1.63 | 1.73 | V | When voltage rises |
| Detected voltage | $V_{DLR}$ | SVHR = 0100 | 1.80 | 1.93 | 2.06 | V | When voltage drops |
| Released voltage | $V_{DHR}$ | | 1.90 | 2.03 | 2.16 | V | When voltage rises |
| LVD stabilization wait time | $t_{LVDRW}$ | - | - | - | 633 × $t_{CYCP}$* | µs | |
| Detection delay time | $t_{LVDRD}$ | dV/dt ≥ -4mV/µs | - | - | 60 | µs | |

*: $t_{CYCP}$ indicates the APB2 bus clock cycle time.

### 12.7.2 Interrupt of Low-Voltage Detection

**Normal mode**

($T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Conditions | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Detected voltage | $V_{DLI}$ | SVHI = 0000 | 1.87 | 2.00 | 2.13 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 1.97 | 2.10 | 2.23 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 0001 | 1.96 | 2.10 | 2.24 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 2.06 | 2.20 | 2.34 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 0010 | 2.05 | 2.20 | 2.35 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 2.15 | 2.30 | 2.45 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 0011 | 2.15 | 2.30 | 2.45 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 2.25 | 2.40 | 2.55 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 0100 | 2.24 | 2.40 | 2.56 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 2.34 | 2.50 | 2.66 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 0101 | 2.33 | 2.50 | 2.67 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 2.43 | 2.60 | 2.77 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 0110 | 2.43 | 2.60 | 2.77 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 2.53 | 2.70 | 2.87 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 0111 | 2.61 | 2.80 | 2.99 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 2.71 | 2.90 | 3.09 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 1000 | 2.80 | 3.00 | 3.20 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 2.90 | 3.10 | 3.30 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 1001 | 2.99 | 3.20 | 3.41 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 3.09 | 3.30 | 3.51 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 1010 | 3.36 | 3.60 | 3.84 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 3.46 | 3.70 | 3.94 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 1011 | 3.45 | 3.70 | 3.95 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 3.55 | 3.80 | 4.05 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 1100 | 3.73 | 4.00 | 4.27 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 3.83 | 4.10 | 4.37 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 1101 | 3.83 | 4.10 | 4.37 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 3.93 | 4.20 | 4.47 | V | When voltage rises |
| Detected voltage | $V_{DLI}$ | SVHI = 1110 | 3.92 | 4.20 | 4.48 | V | When voltage drops |
| Released voltage | $V_{DHI}$ | | 4.02 | 4.30 | 4.58 | V | When voltage rises |
| LVD stabilization wait time | $t_{LVDIW}$ | - | - | - | 633 × $t_{CYCP}$* | µs | |
| Detection delay time | $t_{LVDID}$ | dV/dt ≥ - 4mV/µs | - | - | 60 | µs | |

*: $t_{CYCP}$ indicates the APB2 bus clock cycle time.

### Low power mode

($T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Conditions | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Detected voltage | $V_{DLIL}$ | SVHI = 0000 | 1.80 | 2.00 | 2.20 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 1.90 | 2.10 | 2.30 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 0001 | 1.89 | 2.10 | 2.31 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 1.99 | 2.20 | 2.41 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 0010 | 1.98 | 2.20 | 2.42 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 2.08 | 2.30 | 2.52 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 0011 | 2.07 | 2.30 | 2.53 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 2.17 | 2.40 | 2.63 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 0100 | 2.16 | 2.40 | 2.64 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 2.26 | 2.50 | 2.74 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 0101 | 2.25 | 2.50 | 2.75 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 2.35 | 2.60 | 2.85 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 0110 | 2.34 | 2.60 | 2.86 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 2.44 | 2.70 | 2.96 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 0111 | 2.52 | 2.80 | 3.08 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 2.62 | 2.90 | 3.18 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 1000 | 2.70 | 3.00 | 3.30 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 2.80 | 3.10 | 3.40 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 1001 | 2.88 | 3.20 | 3.52 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 2.98 | 3.30 | 3.62 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 1010 | 3.24 | 3.60 | 3.96 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 3.34 | 3.70 | 4.06 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 1011 | 3.33 | 3.70 | 4.07 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 3.43 | 3.80 | 4.17 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 1100 | 3.60 | 4.00 | 4.40 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 3.70 | 4.10 | 4.50 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 1101 | 3.69 | 4.10 | 4.51 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 3.79 | 4.20 | 4.61 | V | When voltage rises |
| Detected voltage | $V_{DLIL}$ | SVHI = 1110 | 3.78 | 4.20 | 4.62 | V | When voltage drops |
| Released voltage | $V_{DHIL}$ | | 3.88 | 4.30 | 4.72 | V | When voltage rises |
| LVD stabilization wait time | $t_{LVDILW}$ | - | - | - | 8039 × $t_{CYCP}$* | µs | |
| Detection delay time | $t_{LVDILD}$ | dV/dt ≥ - 0.4mV/µs | - | - | 800 | µs | |

*: $t_{CYCP}$ indicates the APB2 bus clock cycle time.

## 12.8 Flash Memory Write/Erase Characteristics

### *12.8.1 Write / Erase time*

($V_{CC}$ = 2.0V to 5.5V, $T_A$ = - 40°C to + 85°C)

| Parameter | | Value | | Unit | Remarks |
|---|---|---|---|---|---|
| | | Typ* | Max* | | |
| Sector erase time | Large Sector | 1.6 | 7.5 | s | Includes write time prior to internal erase |
| | Small Sector | 0.4 | 2.1 | | |
| Half word (16-bit) write time | | 25 | 400 | µs | Not including system-level overhead time. |
| Chip erase time | | 4 | 19.2 | s | Includes write time prior to internal erase |

*: The typical value is immediately after shipment, the maximam value is guarantee value under 100,000 cycle of erase/write.

### *12.8.2 Write cycles and data hold time*

| Erase/write cycles (cycle) | Data hold time (year) | Remarks |
|---|---|---|
| 1,000 | 20 * | |
| 10,000 | 10 * | |
| 100,000 | 5* | |

*: At average + 85°C

## 12.9 Return Time from Low-Power Consumption Mode

### *12.9.1 Return Factor: Interrupt/WKUP*

The return time from Low-Power consumption mode is indicated as follows. It is from receiving the return factor to starting the program operation.

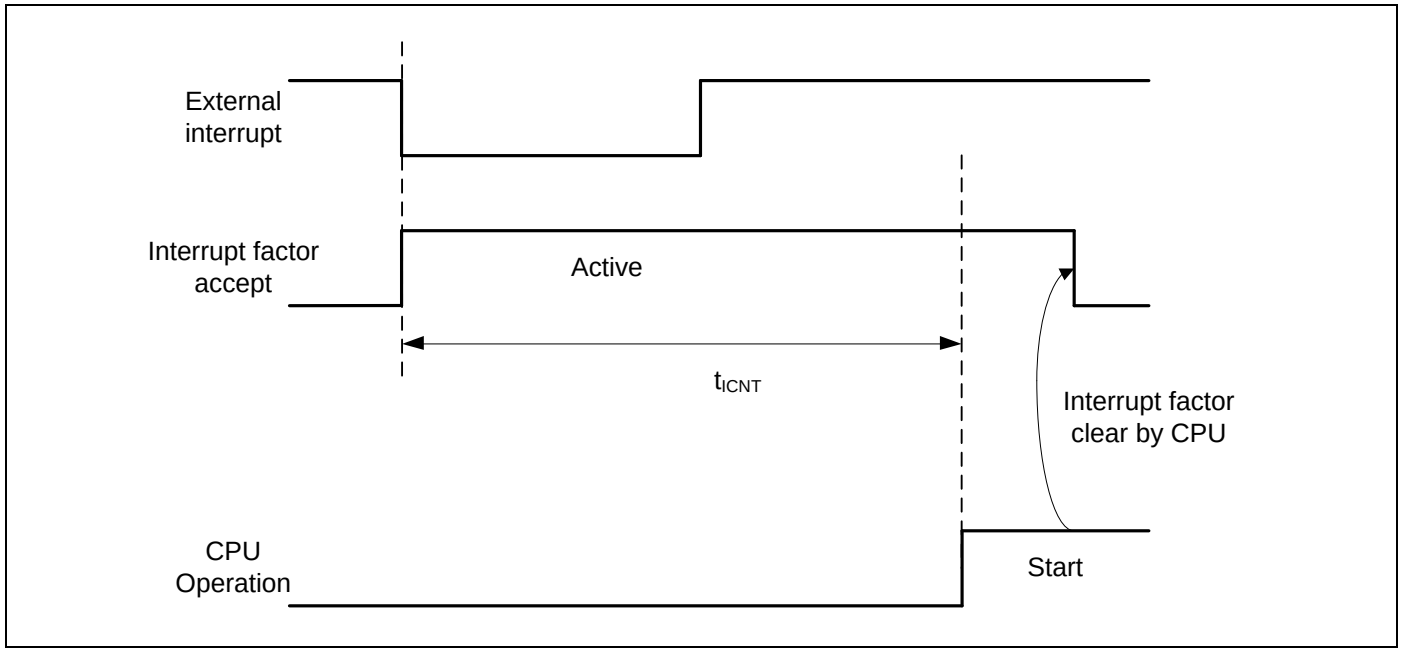
### Return Count Time

($V_{CC}$ = 1.65V to 3.6V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

| Parameter | Symbol | Value | | Unit | Remarks |
|---|---|---|---|---|---|
| | | Typ | Max* | | |
| Sleep mode | $t_{ICNT}$ | $t_{CYCC}$ | | µs | |
| High-speed CR Timer mode,<br>Main Timer mode,<br>PLL Timer mode | | 40 | 80 | µs | |
| Low-speed CR Timer mode | | 630 | 1260 | µs | |
| Sub Timer mode | | 630 | 1260 | µs | |
| RTC mode,<br>Stop mode | | 1083 | 2100 | µs | |
| Deep Standby RTC mode<br>Deep Standby Stop mode | | 1099 | 2127 | µs | |

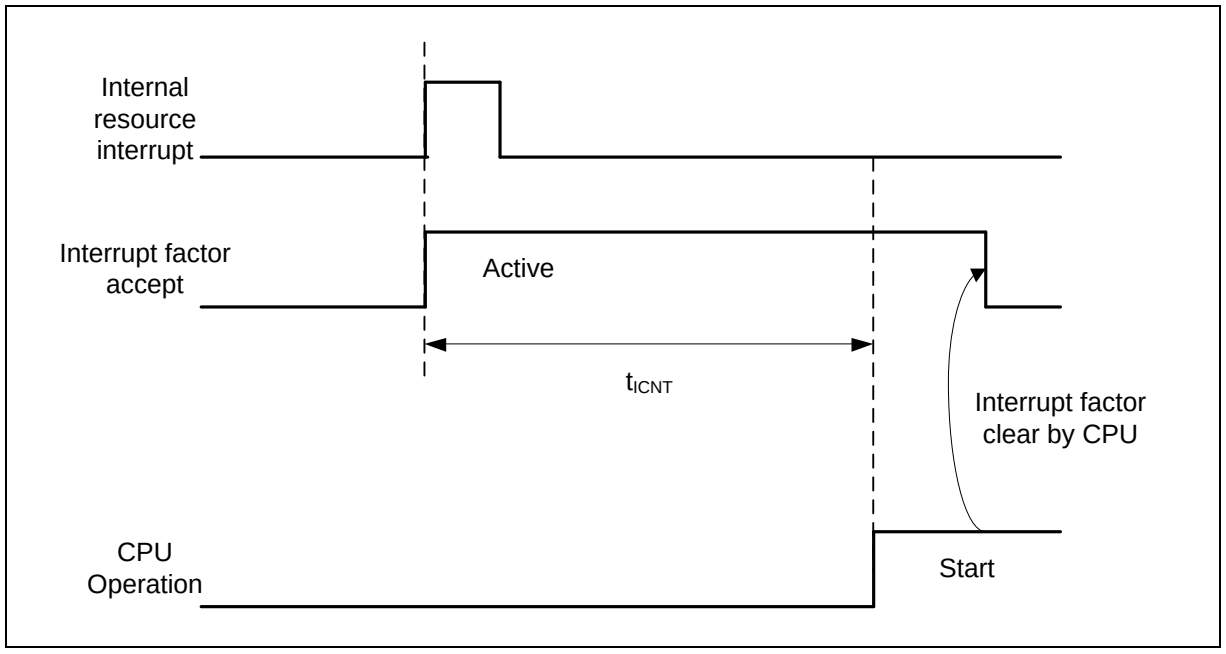
*: The maximum value depends on the accuracy of built-in CR.

### Operation example of return from Low-Power consumption mode (by external interrupt*)




*: External interrupt is set to detecting fall edge.

**Operation example of return from Low-Power consumption mode (by internal resource interrupt*)**




*: Internal resource interrupt is not included in return factor by the kind of Low-Power consumption mode.

***Notes:***

- *The return factor is different in each Low-Power consumption modes. See Chapter 6: Low Power Consumption Mode and Operations of Standby Modes in FM3 Family Peripheral Manual.*
- *When interrupt recoveries, the operation mode that CPU recoveries depend on the state before the Low-Power consumption mode transition. See Chapter 6: Low Power Consumption Mode in FM3 Family Peripheral Manual.*

### 12.9.2 Return Factor: Reset

The return time from Low-Power consumption mode is indicated as follows. It is from releasing reset to starting the program operation.

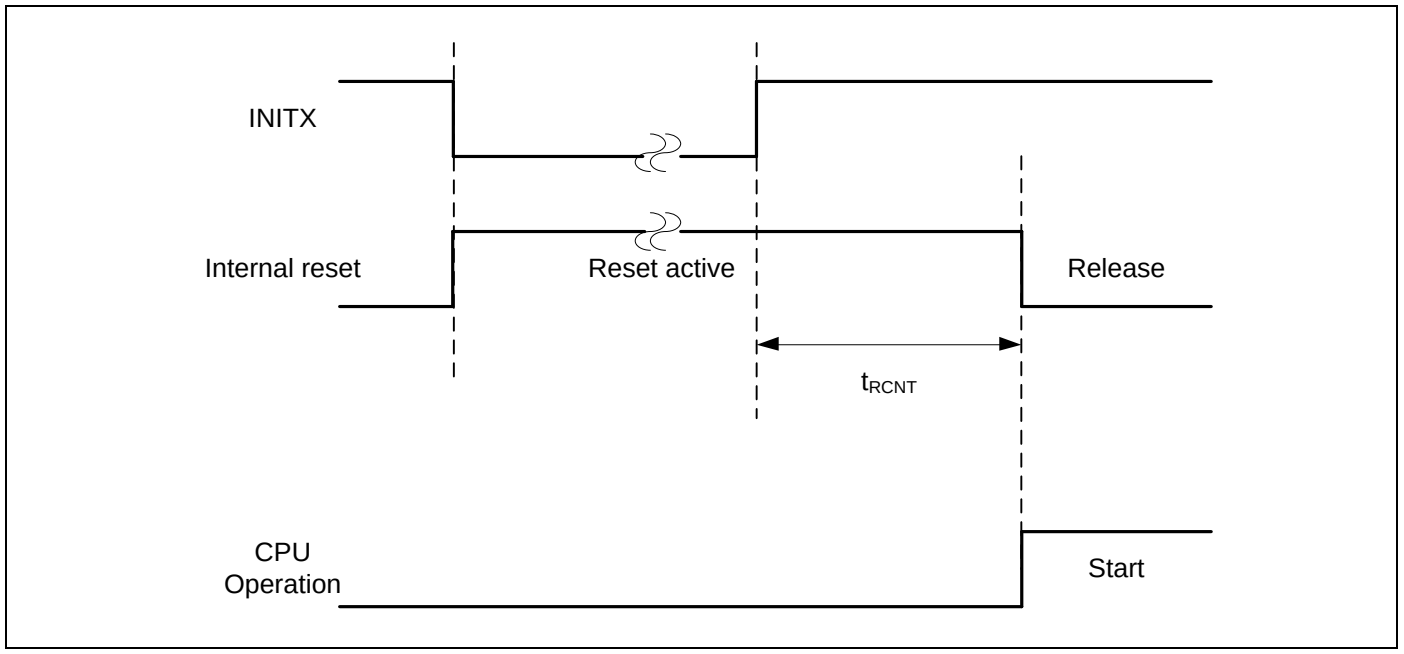
**Return Count Time**

($V_{CC}$ = 1.65V to 3.6V, $V_{SS}$ = 0V, $T_A$ = - 40°C to + 85°C)

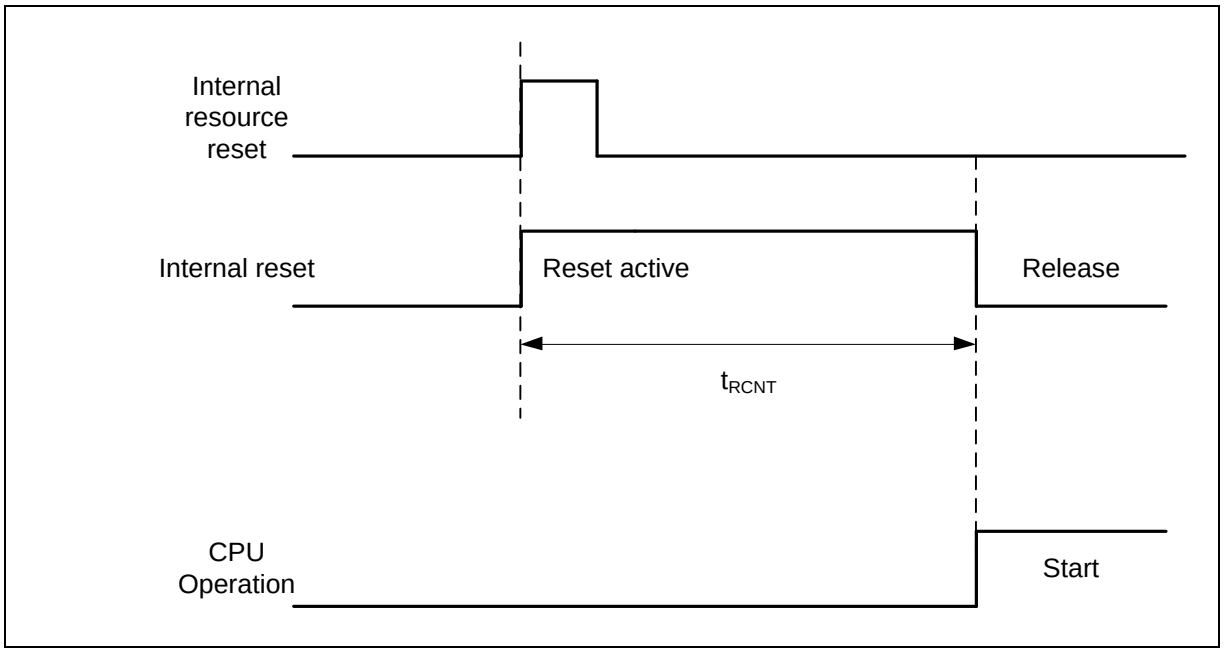
| Parameter | Symbol | Value | | Unit | Remarks |
|---|---|---|---|---|---|
| | | Typ | Max* | | |
| Sleep mode | $t_{RCNT}$ | 359 | 647 | µs | |
| High-speed CR Timer mode,<br>Main Timer mode,<br>PLL Timer mode | | 359 | 647 | µs | |
| Low-speed CR Timer mode | | 929 | 1787 | µs | |
| Sub Timer mode | | 929 | 1787 | µs | |
| RTC/Stop mode | | 1099 | 2127 | µs | |
| Deep Standby RTC mode<br>Deep Standby Stop mode | | 1099 | 2127 | µs | |

*: The maximum value depends on the accuracy of built-in CR.

**Operation example of return from Low-Power consumption mode (by INITX)**



**Operation example of return from low power consumption mode (by internal resource reset*)**




*: Internal resource reset is not included in return factor by the kind of Low-Power consumption mode.

***Notes:***

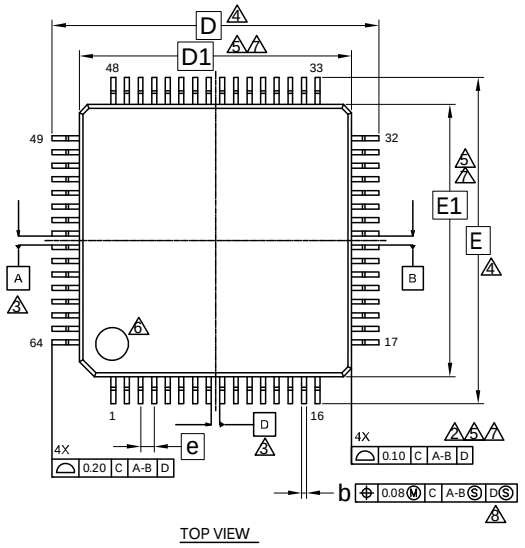
- *The return factor is different in each Low-Power consumption modes. See Chapter 6: Low Power Consumption Mode and Operations of Standby Modes in FM3 Family Peripheral Manual.*
- *When interrupt recoveries, the operation mode that CPU recoveries depend on the state before the Low-Power consumption mode transition. See Chapter 6: Low Power Consumption Mode in FM3 Family Peripheral Manual.*
- *The time during the power-on reset/low-voltage detection reset is excluded. See (12.4.7) Power-on Reset Timing in 12.4 AC Characteristics in Electrical Characteristics for the detail on the time during the power-on reset/low-voltage detection reset.*
- *When in recovery from reset, CPU changes to the High-speed CR Run mode. When using the main clock or the PLL clock, it is necessary to add the main clock oscillation stabilization wait time or the Main PLL clock stabilization wait time.*
- *The internal resource reset means the watchdog reset and the CSV reset.*

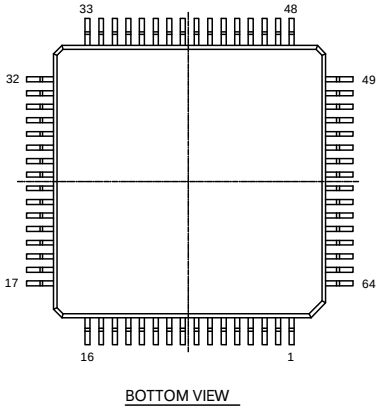
## 13. Ordering Information

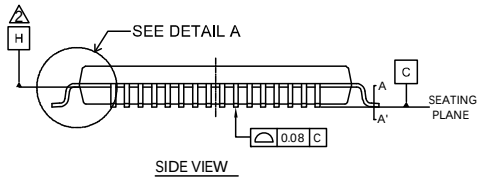
| Part number | On-chip Flash memory | On-chip SRAM | Package | Packing |
|---|---|---|---|---|
| MB9AF1A1LPMC1-G-SNE2 | 64 Kbyte | 12 Kbyte | Plastic・LQFP (0.5mm pitch), 64-pin (LQD064) | Tray |
| MB9AF1A2LPMC1-G-SNE2 | 128 Kbyte | 16 Kbyte | | |
| MB9AF1A1LPMC-G-SNE2 | 64 Kbyte | 12 Kbyte | Plastic・LQFP (0.65mm pitch), 64-pin (LQG064) | |
| MB9AF1A2LPMC-G-UNE2 | 128 Kbyte | 16 Kbyte | | |
| MB9AF1A1MPMC-G-UNE2 | 64 Kbyte | 12 Kbyte | Plastic・LQFP (0.5mm pitch), 80-pin (LQH080) | |
| MB9AF1A2MPMC-G-UNE2 | 128 Kbyte | 16 Kbyte | | |
| MB9AF1A1MPMC1-G-SNE2 | 64 Kbyte | 12 Kbyte | Plastic・LQFP (0.65mm pitch), 80-pin (LQJ080) | |
| MB9AF1A2MPMC1-G-UNE2 | 128 Kbyte | 16 Kbyte | | |
| MB9AF1A1NPMC-G-SNE2 | 64 Kbyte | 12 Kbyte | Plastic・LQFP (0.5mm pitch), 100-pin (LQI100) | |
| MB9AF1A2NPMC-G-UNE2 | 128 Kbyte | 16 Kbyte | | |
| MB9AF1A1NPF-G-SNE1 | 64 Kbyte | 12 Kbyte | Plastic・QFP (0.65mm pitch), 100-pin (PQH100) | |
| MB9AF1A2NPF-G-SNE1 | 128 Kbyte | 16 Kbyte | | |

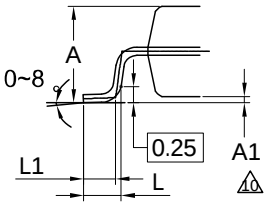
## 14. Package Dimensions

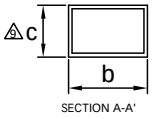
| Package Type | Package Code |
|---|---|
| LQFP 64 | LQD064 |




| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | — | — | 1.70 |
| A1 | 0.00 | — | 0.20 |
| b | 0.15 | — | 0.27 |
| c | 0.09 | — | 0.20 |
| D | 12.00 BSC. | | |
| D1 | 10.00 BSC. | | |
| e | 0.50 BSC | | |
| E | 12.00 BSC. | | |
| E1 | 10.00 BSC. | | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 0.30 | 0.50 | 0.70 |

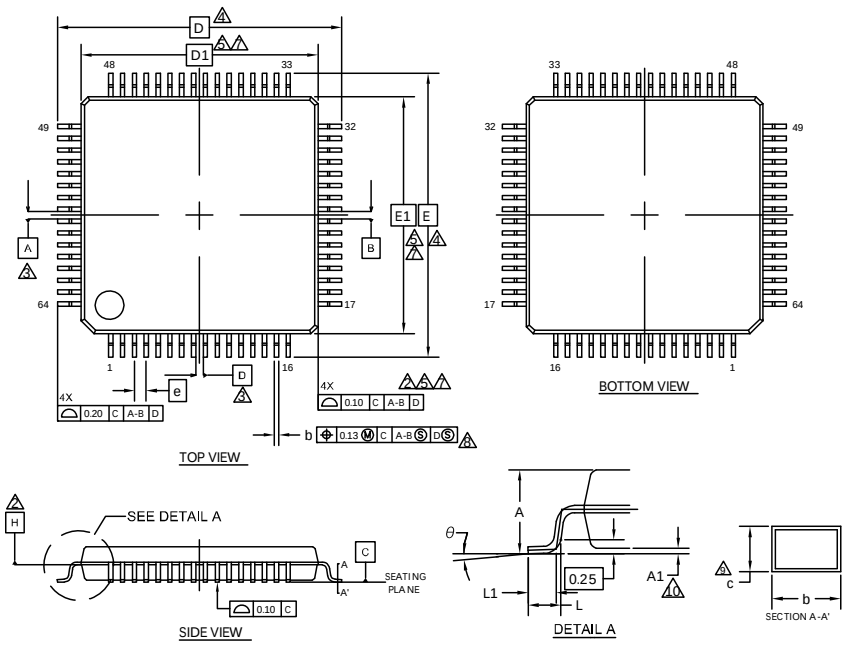
NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
10. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

002-11499 **

PACKAGE OUTLINE, 64 LEAD LQFP
10.0X10.0X1.7 MM LQD064 Rev**

| Package Type | Package Code |
|---|---|
| LQFP 64 | LQG064 |




| SYMBOL | DIMENSION | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | — | — | 1.70 |
| A1 | 0.00 | — | 0.20 |
| b | 0.27 | 0.32 | 0.37 |
| c | 0.09 | — | 0.20 |
| D | 14.00 BSC | | |
| D1 | 12.00 BSC | | |
| e | 0.65 BSC | | |
| E | 14.00 BSC | | |
| E1 | 12.00 BSC | | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 0.30 | 0.50 | 0.70 |
| θ | 0° | — | 8° |

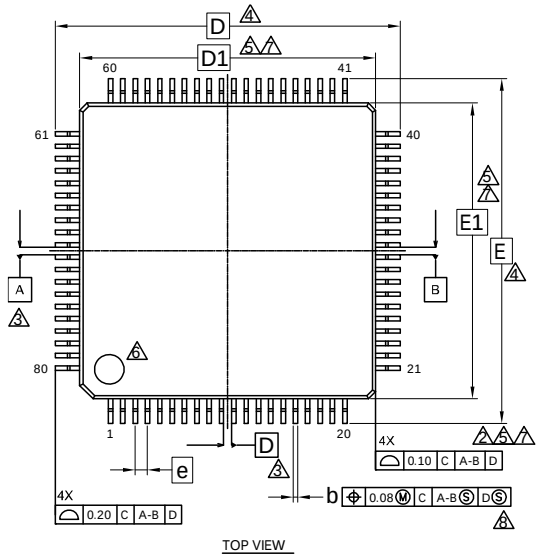
NOTES

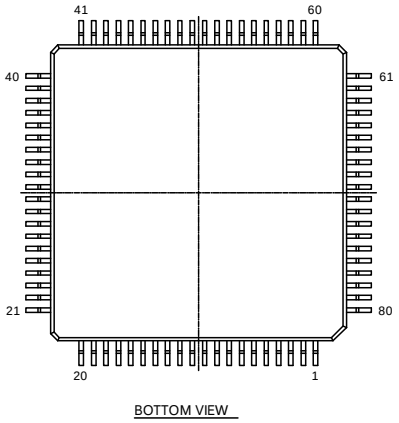
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS, DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
10. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

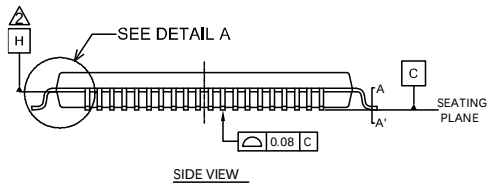
002-13881 **

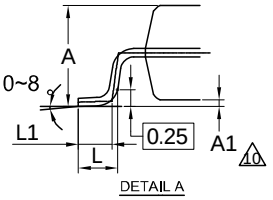
PACKAGE OUTLINE, 64 LEAD LQFP
12.0X12.0X1.7 MM LQG064 REV**

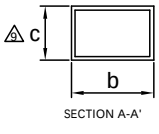
| Package Type | Package Code |
|---|---|
| LQFP 80 | LQH080 |




| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | — | — | 1.70 |
| A1 | 0.05 | — | 0.15 |
| b | 0.15 | — | 0.27 |
| c | 0.09 | — | 0.20 |
| D | 14.00 BSC. | | |
| D1 | 12.00 BSC. | | |
| e | 0.50 BSC | | |
| E | 14.00 BSC. | | |
| E1 | 12.00 BSC. | | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 0.30 | 0.50 | 0.70 |

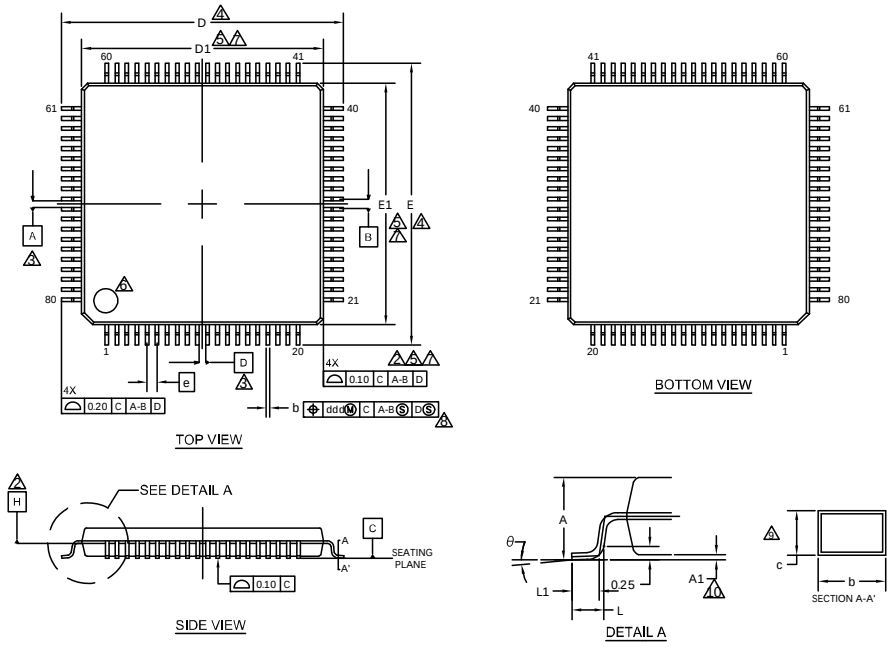
NOTES

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (mm)
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
10. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

002-11501 **

PACKAGE OUTLINE, 80 LEAD LQFP
12.0X12.0X1.7 MM LQH080 Rev **

| Package Type | Package Code |
|---|---|
| LQFP 80 | LQJ080 |




| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | —— | —— | 1.70 |
| A1 | 0.00 | —— | 0.20 |
| b | 0.16 | 0.32 | 0.38 |
| c | 0.09 | —— | 0.20 |
| D | 16.00 BSC | | |
| D1 | 14.00 BSC | | |
| e | 0.65 BSC | | |
| E | 16.00 BSC | | |
| E1 | 14.00 BSC | | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 0.30 | 0.50 | 0.70 |
| θ | 0° | — | 8° |

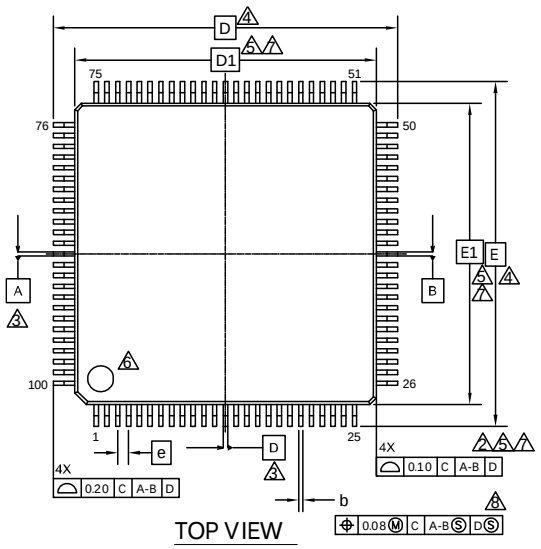
NOTES

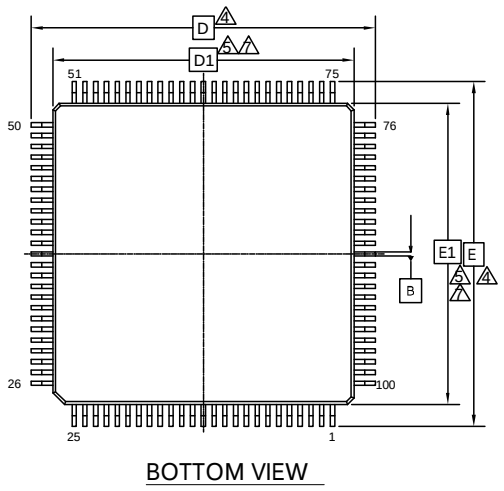
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
10. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

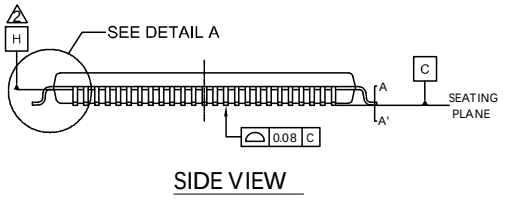
002-14043 **

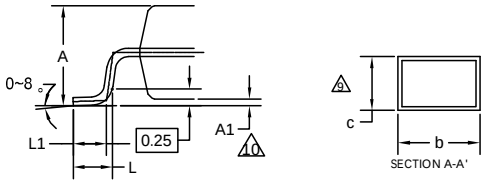
PACKAGE OUTLINE, 80 LEAD LQFP
14.0X14.0X1.7 MM LQJ080 REV**

| Package Type | Package Code |
|---|---|
| LQFP 100 | LQI100 |




| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | —— | —— | 1.70 |
| A1 | 0.05 | —— | 0.15 |
| b | 0.15 | —— | 0.27 |
| c | 0.09 | —— | 0.20 |
| D | 16.00 BSC | | |
| D1 | 14.00 BSC | | |
| e | 0.50 BSC | | |
| E | 16.00 BSC | | |
| E1 | 14.00 BSC | | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 0.30 | 0.50 | 0.70 |

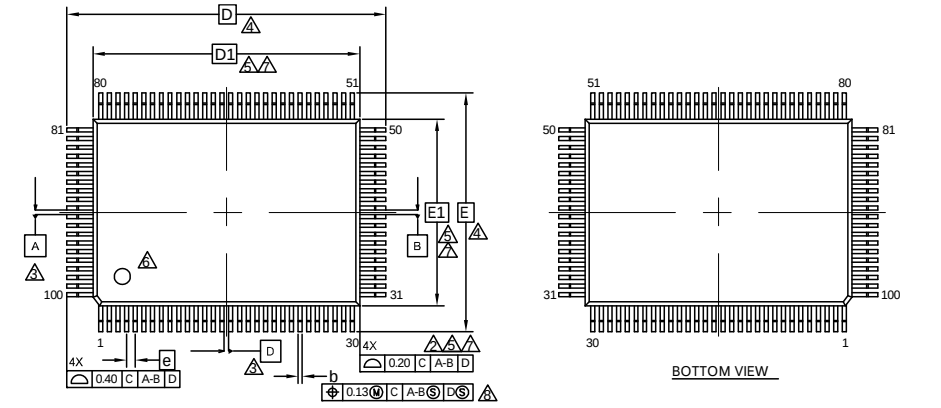
NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
10. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

002-11500 *A

PACKAGE OUTLINE, 100 LEAD LQFP
14.0X14.0X1.7 MM LQI100 REV*A

| Package Type | Package Code |
|---|---|
| QFP 100 | PQH100 |




| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | — | — | 3.35 |
| A1 | 0.05 | — | 0.45 |
| b | 0.27 | 0.32 | 0.37 |
| c | 0.11 | — | 0.23 |
| D | 23.90 BSC | | |
| D1 | 20.00 BSC | | |
| e | 0.65 BSC | | |
| E | 17.90 BSC | | |
| E1 | 14.00 BSC | | |
| θ | 0° | — | 8° |
| L | 0.73 | 0.88 | 1.03 |
| L1 | 1.95 REF | | |
| L2 | 0.25 BSC | | |

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
10. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

002-15156 **

PACKAGE OUTLINE, 100 LEAD QFP
20.00X14.00X3.35 MM PQH100 REV**

# 15. Errata

This chapter describes the errata for MB9A1A0N Series. Details include errata trigger conditions, scope of impact, available workaround, and silicon revision applicability.

Contact your local Cypress Sales Representative if you have questions.

## 15.1 Part Numbers Affected

| Part Number |
|---|
| Initial Revision |
| MB9AF1A1LPMC1-G-SNE2, MB9AF1A2LPMC1-G-SNE2, MB9AF1A1LPMC-G-SNE2, MB9AF1A2LPMC-G-SNE2, MB9AF1A2LPMC-G-UNE2, MB9AF1A1MPMC-G-SNE2, MB9AF1A1MPMC-G-UNE2, MB9AF1A2MPMC-G-SNE2, MB9AF1A2MPMC-G-UNE2, MB9AF1A1MPMC1-G-SNE2, MB9AF1A2MPMC1-G-SNE2, MB9AF1A2MPMC1-G-UNE2, MB9AF1A1NPMC-G-SNE2, MB9AF1A2NPMC-G-SNE2, MB9AF1A2NPMC-G-UNE2, MB9AF1A1NPF-G-SNE1, MB9AF1A2NPF-G-SNE1 |

## 15.2 Qualification Status

Product Status: In Production − Qual.

## 15.3 Errata Summary

This table defines the errata applicability to available devices.

| Items | Part Number | Silicon Revision | Fix Status |
|---|---|---|---|
| [15.4.1] HDMI-CEC polling message issue | Refer to 15.1 | Initial Rev | Next silicon is not planned |
| [15.4.2] RTC delay issue | Refer to 15.1 | Initial Rev | Next silicon is not planned |

## 15.4 Errata Detail

### *15.4.1 HDMI-CEC polling message issue*

■PROBLEM DEFINITION
Error#1) While MCU sends a Polling Message, it always returns a NACK to a message coming to the MCU from another node.

Error#2) MCU always waits for 7-bit signal free on CEC line before it drives the line even when the last line initiator was another node.

■PARAMETERS AFFECTED
N/A

■TRIGGER CONDITION(S)
This error always happens.

■SCOPE OF IMPACT
MCU does not reply properly to another node.

■WORKAROUND
The software workaround is applied to Error #1.

1. Store 0x0 to SFREE register.
2. Monitor CEC line with GPIO and wait until 1 lasts for the signal free time.
3. Store frame data to TXDATA register and store 0x0F to RCADR1 or RCADR2 register.

It sends a message after 3~4 clocks of 32.768 kHz clock when TXDATA is stored 0x0F.

If the device receives a frame from another node within 2~3 clocks after storing TXDATA, the bus error occurs and if the device receives a frame from another node within 3~4 clocks after storing TXDATA, the arbitration lost occurs. In these cases:

4-A-1. Set RCADR1 or RCADR2 to former value from 0x0F to reply ACK

4-A-2. Return back to step 2 above

If the device receives a frame from another node within 1~2 clocks after storing TXDATA, take these steps.

4-B-1. Monitor CEC line with GPIO after 50us from storing TXDATA

4-B-2. Set TXEN to 1 -> 0 -> 1 immediately when GPIO finds state low on the CEC line

4-B-3. Set RCADR1 or RCADR2 to former value from 0x0F to reply ACK

4-B-4. Return back to step 2 above

For Error #2, there is no software workaround, but signal free time of fixed 7-bit does not violate HDMI-CEC specification. The specification says signal free time must be more than and equals to 5-bit.

■FIX STATUS
The user uses the workaround to avoid the issue. The next silicon fixing the issue is not planned.

### *15.4.2 RTC delay issue*

■PROBLEM DEFINITION
RTC delays when software reset or APB2 reset occurs.

■PARAMETERS AFFECTED
N/A

■TRIGGER CONDITION(S)
This error happens when software reset or APB2 reset occurs.

■SCOPE OF IMPACT
RTC delays and does not time correctly.

■WORKAROUND
RTC block is supplied with sub-clock. Both software reset and APB2 reset disable two clocks of sub-clock to RTC block. The workaround is to count occurrence of software and APB2 reset and calculate how many clocks of sub-clock were disabled and add one second to RTC counter when accumulated disabled sub-clock period reaches one second.

■FIX STATUS
The user uses the workaround to avoid the issue. The next silicon fixing the issue is not planned.

## Major Changes

**Spansion Publication Number: DS706-00068**

| Page | Section | Change Results |
|---|---|---|
| Revision 0.1 | | |
| - | - | Initial release |
| Revision 1.0 | | |
| - | - | Changed from Preliminary to Full Producton |
| - | - | Deleted a part of QFN |
| 43 | BLOCK DIAGRAM | Added note for MB9AF1AxL |
| 58,59 | ELECTRICAL CHARACTERISTICS<br>3.DC Characteristics (1) Current Rating | Revised the values of “TBD” |
| Revision 2.0 | | |
| 2 | Features<br>· On-chip Memories | Changed the description of on-chip SRAM |
| 7 - 31 | Packages<br>Pin Assignment<br>List of Pin Functions | Deleted QFN package |
| 40 | Handling Devices<br>Crystal oscillator circuit | Added the following description<br>"Evaluate oscillation of your using crystal oscillator by your mount board." |
| 44 | Memory Map<br>· Memory map(2) | Added the summary of Flash memory sector |
| 57 - 59 | Electrical Characteristics<br>3. DC Characteristics<br>(1) Current rating | · Changed the table format<br>· Added Main Timer mode current<br>· Added Flash Memory Current<br>· Moved A/D Converter Current<br>· Moved D/A Converter Current |
| 60 | Electrical Characteristics<br>3. DC Characteristics<br>(2) Pin Characteristics | Added the input leak current of CEC port at power off |
| 63 | Electrical Characteristics<br>4. AC Characteristics<br>(4-1) Operating Conditions of Main PLL<br>(4-2) Operating Conditions of Main PLL | · Added the figure of Main PLL connection |
| 64 | Electrical Characteristics<br>4. AC Characteristics<br>(6) Power-on Reset Timing | · Changed the figure of timing<br>· Changed from Reset release delay time($t_{OND}$) to Time until releasing Power-on reset($t_{PRT}$) |
| 66 - 73 | Electrical Characteristics<br>4. AC Characteristics<br>(8) CSIO/UART Timing | · Modified from UART Timing to CSIO/UART Timing<br>· Changed from Internal shift clock operation to Master mode<br>· Changed from External shift clock operation to Slave mode |
| 77 | Electrical Characteristics<br>5. 12bit A/D Converter | · Added the typical value of Integral Nonlinearity, Differential Nonlinearity, Zero transition voltage and Full-scale transition voltage<br>· Added Conversion time at $AV_{CC}$ < 2.7 V |
| 81 | Electrical Characteristics<br>7. Low-voltage Detection Characteristics | Deleted the figure |
| 84 | Electrical Characteristics<br>8. Flash Memory Write/Erase Characteristics | Change to the erase time of include write time prior to internal erase |

| Page | Section | Change Results |
|---|---|---|
| 85 - 88 | Electrical Characteristics<br>9. Return Time from Low-Power Consumption Mode | Added Return Time from Low-Power Consumption Mode |
| 89 | Ordering Information | Changed notation of part number |

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

## Document History

**Document Title: MB9A1A0N Series 32-bit Arm® Cortex®-M3 FM3 Microcontroller**
**Document Number: 002-05675**

<table>
<tr><th>Revision</th><th>ECN</th><th>Orig. of Change</th><th>Submission Date</th><th>Description of Change</th></tr>
<tr><td>**</td><td>-</td><td>AKIH</td><td>06/30/2015</td><td>Migrated to Cypress and assigned document number 002-05675.<br>No change to document contents or format.</td></tr>
<tr><td>*A</td><td>5193131</td><td>AKIH</td><td>03/31/2016</td><td>Updated to Cypress format.</td></tr>
<tr><td>*B</td><td>5513616</td><td>HTER</td><td>02/08/2017</td><td>Modified RTC description in “Features, Real-Time Clock(RTC)”. Changed starting count value from 01 to 00. Deleted “second, or day of the week” in the Interrupt function. (Page 2)<br>Changed package code as the following table in following section.<br>2. Package (Page 7)<br>3. Pin Assignment (Page 8 -11)<br>12. Electrical Characteristics (Page 53)<br>13. Ordering Information (Page 87)<br>14. Package Dimensions (Page 88 - 93)
<table>
<tr><th>Before</th><th>After</th></tr>
<tr><td>FPT-64P-M38</td><td>LQD064</td></tr>
<tr><td>FPT-64P-M39</td><td>LQG064</td></tr>
<tr><td>FPT-80P-M37</td><td>LQH080</td></tr>
<tr><td>FPT-80P-M40</td><td>LQJ080</td></tr>
<tr><td>FPT-100P-M23</td><td>LQI100</td></tr>
<tr><td>FPT-100P-M06</td><td>PQH100</td></tr>
</table>
Added the Baud rate spec in “12.4.9 CSIO/UART Timing” (Page 64 - 70)<br>Changed Part numbers in 13. Ordering Information (Page 87)<br>“MB9AF1A2LPMC-G-SNE2” to “MB9AF1A2LPMC-G-UNE2”<br>“MB9AF1A2MPMC-G-SNE2” to “MB9AF1A2MPMC-G-UNE2”<br>“MB9AF1A2NPMC-G-SNE2” to “MB9AF1A2NPMC-G-UNE2”<br>“MB9AF1A1MPMC-G-SNE2” to “MB9AF1A1MPMC-G-UNE2”<br>“MB9AF1A2MPMC1-G-SNE2” to “MB9AF1A2MPMC1-G-UNE2”<br>Added 15. Errata (Page 94 - 95)</td></tr>
<tr><td>*C</td><td>5768635</td><td>YSAT</td><td>06/12/2017</td><td>Adapted new cypress logo</td></tr>
<tr><td>*D</td><td>5929772</td><td>HTER</td><td>10/16/2017</td><td>Corrected the following Analog output impedance MAX value (D/A operation)<br>4.55kΩ → 5.5kΩ<br>in chapter 12.6 10-bit D/A Converter.</td></tr>
</table>

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