

120-MHz 32-bit RX MCU, on-chip FPU, 240 DMIPS, up to 4-MB flash memory, 512-KB SRAM, various communications interfaces including IEEE 1588-compliant Ethernet MAC, full-speed USB 2.0 with battery charging, SD host interface (optional), quad SPI, and CAN, 12-bit A/D converter, RTC, encryption (optional), serial interface for audio, CMOS camera interface

## Features

### ■ 32-bit RXv2 CPU core

- Max. operating frequency: 120 MHz  
Capable of 240 DMIPS in operation at 120 MHz
- Single precision 32-bit IEEE-754 floating point
- Two types of multiply-and-accumulation unit (between memories and between registers)
- 32-bit multiplier (fastest instruction execution takes one CPU clock cycle)
- Divider (fastest instruction execution takes two CPU clock cycles)
- Fast interrupt
- CISC Harvard architecture with 5-stage pipeline
- Variable-length instructions: Ultra-compact code
- Supports the memory protection unit (MPU)
- JTAG and FINE (one-line) debugging interfaces

### ■ Low-power design and architecture

- Single voltage supply: 2.7 to 3.6 V
- Low power consumption: A product that supports all peripheral functions draws only 0.3mA/MHz (Typ.).
- RTC is capable of operation from a dedicated power supply.
- Four low-power modes

### ■ On-chip code flash memory, no wait states

- Up to 4 Mbyte
- 120-MHz operation, 8.3-ns read cycle (no wait states)
- User code is programmable by on-board or off-board programming.
- Background programming/erasing (BGO:Background operation)

### ■ On-chip data flash memory

- 64 Kbytes, reprogrammable up to 100,000 times
- Background programming/erasing (BGO:Background operation)

### ■ On-chip SRAM

- 512 Kbytes of SRAM (no wait states)
- 32 Kbytes of RAM with ECC (one wait state, single-error correction and double error detection)
- 8 Kbytes of standby RAM (backup on deep software standby)

### ■ Data transfer

- DMAC: 8 channels
- DTC
- EXDMAC: 2 channels
- DMAC for the Ethernet controller: 3 channels for 176- and 177-pin products; 2 channels for 100-, 144-, and 145-pin products

### ■ Reset and supply management

- Power-on reset (POR)
- Low voltage detection (LVD) with voltage settings

### ■ Clock functions

- External crystal resonator or internal PLL for operation at 8 to 24 MHz
- Internal 240-kHz LOCO and HOCO selectable from 16, 18, and 20 MHz
- 120-kHz clock for the IWDTa

### ■ Real-time clock

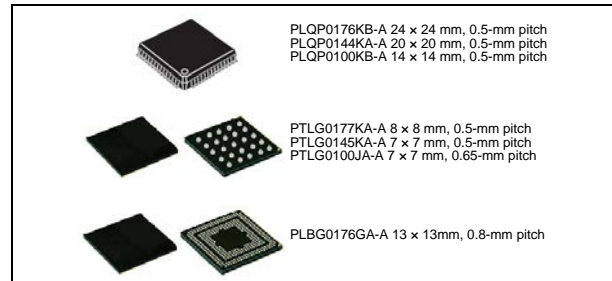
- Adjustment functions (30 seconds, leap year, and error)
- Real-time clock counting and binary counting modes are selectable
- Time capture function  
(for capturing times in response to event-signal input)

### ■ Independent watchdog timer

- 120-kHz (1/2 LOCO frequency) clock operation

### ■ Useful functions for IEC60730 compliance

- Oscillation-stoppage detection, frequency measurement, CRC, IWDTa, self-diagnostic function for the A/D converter, etc.
- Register write protection function can protect values in important registers against overwriting.



### ■ Various communications interfaces

- IEEE 1588-compliant Ethernet MAC  
(for 176- and 177-pin products: 2 modules)
- PHY layer for host/function or OTG controller (1) with full-speed USB 2.0 with battery charging transfer (only for 176- and 177-pin products)
- PHY layer (1) for host/function or OTG controller (1) with full-speed USB 2.0 transfer
- CAN (compliant with ISO11898-1), incorporating 32 mailboxes (up to 3 modules)
- SCIG and SCIH with multiple functionalities (up to 9)  
Choose from among asynchronous mode, clock-synchronous mode, smart-card interface mode, simplified SPI, simplified I<sup>2</sup>C, and extended serial mode.
- SCIFA with 16-byte transmission and reception FIFOs (up to 4 interfaces)
- I<sup>2</sup>C bus interface for transfer at up to 1 Mbps (up to 2 interfaces)
- Four-wire QSPI (1 interface) in addition to RSPIa (1 interface)
- Parallel data capture unit (PDC) for the CMOS camera interface (not in 100-pin products)
- SD host interface (optional: 1 interface) with a 1- or 4-bit SD bus for use with SD memory or SDIO

### ■ External address space

- Buses for full-speed data transfer (max. operating frequency of 60 MHz)
- 8 CS areas
- 8-, 16-, or 32-bit bus space is selectable per area
- Independent SDRAM area (128 Mbytes)

### ■ Up to 29 extended-function timers

- 16-bit TPUa, MTU3a, and GPTA: input capture, output compare, PWM waveform output
- 8-bit TMRa (4 channels), 16-bit CMT (4 channels), 32-bit CMTW (2 channels)

### ■ 12-bit A/D converter

- Two 12-bit units (8 channels for unit 0; 21 channels for unit 1)
- Self diagnosis
- Detection of analog input disconnection

### ■ 12-bit D/A converter: 2 channels

- On-chip operational amplifier output or direct input selectable

### ■ Temperature sensor for measuring temperature within the chip

### ■ Encryption (optional)

- AES (key lengths: 128, 192, and 256 bits)
- DES (key lengths: 56 bits (DES); 3 × 56 bits (T-DES))
- SHA (SHA-1 (128), SHA-2 (224 or 256), HMAC (160, 224, or 256))

### ■ Up to 127 pins for general I/O ports

- 5-V tolerance, open drain, input pull-up, switchable driving ability

### ■ Operating temp. range

- D-version: -40°C to +85°C
- G-version: -40°C to +105°C

## 1. Overview

### 1.1 Outline of Specifications

Table 1.1 lists the specifications in outline, and Table 1.2 gives a comparison of the functions of products in different packages.

Table 1.1 shows the outline of maximum specifications, and the number of peripheral module channels differs depending on the pin number on the package and the code flash memory capacity. For details, see Table 1.2, Comparison of Functions for Different Packages.

**Table 1.1 Outline of Specifications (1/9)**

Classification	Module/Function	Description
CPU	CPU	<ul style="list-style-type: none"> <li>Maximum operating frequency: 120 MHz</li> <li>32-bit RX CPU (RXv2)</li> <li>Minimum instruction execution time: One instruction per state (cycle of the system clock)</li> <li>Address space: 4-Gbyte linear</li> <li>Register set of the CPU               <ul style="list-style-type: none"> <li>General purpose: Sixteen 32-bit registers</li> <li>Control: Ten 32-bit registers</li> <li>Accumulator: Two 72-bit registers</li> </ul> </li> <li>Basic instructions: 75</li> <li>Floating-point instructions: 11</li> <li>DSP instructions: 23</li> <li>Addressing modes: 11</li> <li>Data arrangement               <ul style="list-style-type: none"> <li>Instructions: Little endian</li> <li>Data: Selectable as little endian or big endian</li> </ul> </li> <li>On-chip 32-bit multiplier: 32 × 32 → 64 bits</li> <li>On-chip divider: 32 / 32 → 32 bits</li> <li>Barrel shifter: 32 bits</li> </ul>
	FPU	<ul style="list-style-type: none"> <li>Single precision (32-bit) floating point</li> <li>Data types and floating-point exceptions in conformance with the IEEE754 standard</li> </ul>
Memory	Code flash memory	<ul style="list-style-type: none"> <li>Capacity: 2 Mbytes, 2.5 Mbytes, 3 Mbytes, 4 Mbytes</li> <li>120 MHz, no-wait access</li> <li>On-board programming: Four types</li> <li>Off-board programming (parallel programmer mode)</li> <li>The trusted memory (TM) function protects against the reading of programs from blocks 8 and 9.</li> </ul>
	Data flash memory	<ul style="list-style-type: none"> <li>Capacity: 64 Kbytes</li> <li>Programming/erasing: 100,000 times</li> </ul>
	RAM	<ul style="list-style-type: none"> <li>Capacity: 512 Kbytes</li> <li>120 MHz, no-wait access</li> <li>SED (single error detection)</li> </ul>
	Unique ID	<ul style="list-style-type: none"> <li>12-byte length ID unique to the device</li> </ul>
	RAM with ECC	<ul style="list-style-type: none"> <li>Capacity: 32 Kbytes</li> <li>120 MHz, single wait access</li> <li>SEC-DED (single error correction/double error detection)</li> </ul>
	Standby RAM	<ul style="list-style-type: none"> <li>Capacity: 8 Kbytes</li> <li>Operation synchronized with PCLKB: Up to 60 MHz, two-cycle access</li> </ul>
Operating modes	<ul style="list-style-type: none"> <li>Operating modes by the mode-setting pins at the time of release from the reset state               <ul style="list-style-type: none"> <li>Single-chip mode</li> <li>Boot mode (for the SCI interface)</li> <li>Boot mode (for the USB interface)</li> <li>User boot mode</li> </ul> </li> <li>Selection of operating mode by register setting               <ul style="list-style-type: none"> <li>Single-chip mode, user boot mode</li> <li>On-chip ROM disabled extended mode</li> <li>On-chip ROM enabled extended mode</li> </ul> </li> <li>Endian selectable</li> </ul>	

**Table 1.1 Outline of Specifications (2/9)**

Classification	Module/Function	Description
Clock	Clock generation circuit	<ul style="list-style-type: none"> <li>Main clock oscillator, sub clock oscillator, low-speed/high-speed on-chip oscillator, PLL frequency synthesizer, and IWDT-dedicated on-chip oscillator</li> <li>The peripheral module clocks can be set to frequencies above that of the system clock.</li> <li>Main-clock oscillation stoppage detection</li> <li>Separate frequency-division and multiplication settings for the system clock (ICLK), peripheral module clocks (PCLKA, PCLKB, PCLKC, PCLKD), flash-IF clock (FCLK) and external bus clock (BCLK)</li> </ul> <p>The CPU and other bus masters run in synchronization with the system clock (ICLK): Up to 120 MHz</p> <p>Peripheral modules of MTU3, GPT, RSPI, SCIFA, USBA, ETHERC, ETPC, EDMAC, and AES run in synchronization with PCLKA, which operates at up to 120 MHz.</p> <p>Other peripheral modules run in synchronization with PCLKB: Up to 60 MHz</p> <p>ADCLK in the S12AD (unit 0) runs in synchronization with PCLKC: Up to 60 MHz</p> <p>ADCLK in the S12AD (unit 1) runs in synchronization with PCLKD: Up to 60 MHz</p> <p>Flash IF run in synchronization with the flash-IF clock (FCLK): Up to 60 MHz</p> <p>Devices connected to the external bus run in synchronization with the external bus clock (BCLK): Up to 60 MHz</p> <ul style="list-style-type: none"> <li>Multiplication is possible with using the high-speed on-chip oscillator (HOCO) as a reference clock of the PLL circuit</li> </ul>
Reset		<p>Nine types of reset</p> <ul style="list-style-type: none"> <li>RES# pin reset: Generated when the RES# pin is driven low.</li> <li>Power-on reset: Generated when the RES# pin is driven high and VCC = AVCC0 = AVCC1 rises.</li> <li>Voltage-monitoring 0 reset: Generated when VCC = AVCC0 = AVCC1 falls.</li> <li>Voltage-monitoring 1 reset: Generated when VCC = AVCC0 = AVCC1 falls.</li> <li>Voltage-monitoring 2 reset: Generated when VCC = AVCC0 = AVCC1 falls.</li> <li>Deep software standby reset: Generated in response to an interrupt to trigger release from deep software standby.</li> <li>Independent watchdog timer reset: Generated when the independent watchdog timer underflows, or a refresh error occurs.</li> <li>Watchdog timer reset: Generated when the watchdog timer underflows, or a refresh error occurs.</li> <li>Software reset: Generated by register setting.</li> </ul>
Power-on reset		<p>If the RES# pin is at the high level when power is supplied, an internal reset is generated. After VCC = AVCC0 = AVCC1 has exceeded the voltage detection level and the specified period has elapsed, the reset is cancelled.</p>
Voltage detection circuit (LVDA)		<p>Monitors the voltage being input to the VCC = AVCC0 = AVCC1 pins and generates an internal reset or internal interrupt.</p> <ul style="list-style-type: none"> <li>Voltage detection circuit 0 Capable of generating an internal reset The option-setting memory can be used to select enabling or disabling of the reset. Voltage detection level: Selectable from three different levels (2.94 V, 2.87 V, and 2.80 V)</li> <li>Voltage detection circuits 1 and 2 Voltage detection level: Selectable from three different levels (2.99 V, 2.92 V, and 2.85 V) Digital filtering (1/2, 1/4, 1/8, and 1/16 LOCO frequency) Capable of generating an internal reset</li> <li>Two types of timing are selectable for release from reset An internal interrupt can be requested.</li> <li>Detection of voltage rising above and falling below thresholds is selectable.</li> <li>Maskable or non-maskable interrupt is selectable</li> </ul> <p>Voltage detection monitoring Event linking</p>
Low power consumption	Low power consumption facilities	<ul style="list-style-type: none"> <li>Module stop function</li> <li>Four low power consumption modes Sleep mode, all-module clock stop mode, software standby mode, and deep software standby mode</li> </ul>
	Battery backup function	<ul style="list-style-type: none"> <li>When the voltage on the VCC pin drops, battery power from the VBATT pin is supplied to keep the real-time clock (RTC) operating.</li> </ul>

**Table 1.1 Outline of Specifications (3/9)**

Classification	Module/Function	Description
Interrupt	Interrupt controller (ICUA)	<ul style="list-style-type: none"> <li>Peripheral function interrupts: 293 sources</li> <li>External interrupts: 16 (pins IRQ0 to IRQ15)</li> <li>Software interrupts: 2 sources</li> <li>Non-maskable interrupts: 7 sources</li> <li>Sixteen levels specifiable for the order of priority</li> <li>Method of interrupt source selection: The interrupt vectors consist of 256 vectors (128 sources are fixed. The remaining 128 vectors are selected from among the other 156 sources.)</li> </ul>
External bus extension		<ul style="list-style-type: none"> <li>The external address space can be divided into eight areas (CS0 to CS7), each with independent control of access settings. Capacity of each area: 16 Mbytes (CS0 to CS7) A chip-select signal (CS0# to CS7#) can be output for each area. Each area is specifiable as an 8-, 16-, or 32-bit bus space. The data arrangement in each area is selectable as little or big endian (only for data).</li> <li>SDRAM interface connectable</li> <li>Bus format: Separate bus, multiplex bus</li> <li>Wait control</li> <li>Write buffer facility</li> </ul>
DMA	DMA controller (DMACa)	<ul style="list-style-type: none"> <li>8 channels</li> <li>Three transfer modes: Normal transfer, repeat transfer, and block transfer</li> <li>Request sources: Software trigger, external interrupts, and interrupt requests from peripheral functions</li> </ul>
	EXDMA controller (EXDMACa)	<ul style="list-style-type: none"> <li>2 channels</li> <li>Four transfer modes: Normal transfer, repeat transfer, block transfer, and cluster transfer</li> <li>Single-address transfer enabled with the EDACKn signal</li> <li>Request sources: Software trigger, external DMA requests (EDREQn), and interrupt requests from peripheral functions</li> </ul>
	Data transfer controller (DTCa)	<ul style="list-style-type: none"> <li>Three transfer modes: Normal transfer, repeat transfer, and block transfer</li> <li>Request sources: External interrupts and interrupt requests from peripheral functions</li> </ul>
I/O ports	Programmable I/O ports	<ul style="list-style-type: none"> <li>I/O ports for the 177-pin TFLGA, 176-pin LFBGA, and 176-pin LFQFP I/O pins: 127 Input pin: 1 Pull-up resistors: 127 Open-drain outputs: 127 5-V tolerance: 19</li> <li>I/O ports for the 145-pin TFLGA and 144-pin LFQFP I/O pins: 111 Input pin: 1 Pull-up resistors: 111 Open-drain outputs: 111 5-V tolerance: 18</li> <li>I/O ports for the 100-pin TFLGA and 100-pin LFQFP I/O pins: 78 Input pin: 1 Pull-up resistors: 78 Open-drain outputs: 78 5-V tolerance: 17</li> </ul>
Event link controller (ELC)		<ul style="list-style-type: none"> <li>Event signals such as interrupt request signals can be interlinked with the operation of functions such as timer counting, eliminating the need for intervention by the CPU to control the functions.</li> <li>119 internal event signals can be freely combined for interlinked operation with connected functions.</li> <li>Event signals from peripheral modules can be used to change the states of output pins (of ports B and E).</li> <li>Changes in the states of pins (of ports B and E) being used as inputs can be interlinked with the operation of peripheral modules.</li> </ul>

**Table 1.1 Outline of Specifications (4/9)**

Classification	Module/Function	Description
Timers	16-bit timer pulse unit (TPUa)	<ul style="list-style-type: none"> <li>• (16 bits × 6 channels) × 1 unit</li> <li>• Maximum of 16 pulse-input/output possible</li> <li>• Select from among seven or eight counter-input clock signals for each channel</li> <li>• Input capture/output compare function</li> <li>• Output of PWM waveforms in up to 15 phases in PWM mode</li> <li>• Support for buffered operation, phase-counting mode (two phase encoder input) and cascade-connected operation (32 bits × 2 channels) depending on the channel.</li> <li>• PPG output trigger can be generated</li> <li>• Capable of generating conversion start triggers for the A/D converters</li> <li>• Digital filtering of signals from the input capture pins</li> <li>• Event linking by the ELC</li> </ul>
	Multifunction timer pulse unit (MTU3a)	<ul style="list-style-type: none"> <li>• 9 channels (16 bits × 8 channels, 32 bits × 1 channel)</li> <li>• Maximum of 28 pulse-input/output and 3 pulse-input possible</li> <li>• Select from among 14 counter-input clock signals for each channel (PCLKA/1, PCLKA/2, PCLKA/4, PCLKA/8, PCLKA/16, PCLKA/32, PCLKA/64, PCLKA/256, PCLKA/1024, MTCLKA, MTCLKB, MTCLKC, MTCLKD, MTIOC1A)</li> <li>• 14 of the signals are available for channel 0, 12 are available for channel 2, 11 are available for channels 1, 3, 4, 6 to 8, and 10 are available for channel 5.</li> <li>• Input capture function</li> <li>• 39 output compare/input capture registers</li> <li>• Counter clear operation (synchronous clearing by compare match/input capture)</li> <li>• Simultaneous writing to multiple timer counters (TCNT)</li> <li>• Simultaneous register input/output by synchronous counter operation</li> <li>• Buffered operation</li> <li>• Support for cascade-connected operation</li> <li>• 43 interrupt sources</li> <li>• Automatic transfer of register data</li> <li>• Pulse output mode <ul style="list-style-type: none"> <li>• Toggle/PWM/complementary PWM/reset-synchronized PWM</li> </ul> </li> <li>• Complementary PWM output mode <ul style="list-style-type: none"> <li>• Outputs non-overlapping waveforms for controlling 3-phase inverters</li> <li>• Automatic specification of dead times</li> <li>• PWM duty cycle: Selectable as any value from 0% to 100%</li> <li>• Delay can be applied to requests for A/D conversion.</li> <li>• Non-generation of interrupt requests at peak or trough values of counters can be selected.</li> <li>• Double buffer configuration</li> </ul> </li> <li>• Reset synchronous PWM mode <ul style="list-style-type: none"> <li>• Three phases of positive and negative PWM waveforms can be output with desired duty cycles.</li> </ul> </li> <li>• Phase-counting mode: 16-bit mode (channels 1 and 2); 32-bit mode (channels 1 and 2)</li> <li>• Counter functionality for dead-time compensation</li> <li>• Generation of triggers for A/D converter conversion</li> <li>• A/D converter start triggers can be skipped</li> <li>• Digital filter function for signals on the input capture and external counter clock pins</li> <li>• PPG output trigger can be generated</li> <li>• Event linking by the ELC</li> </ul>
	Port output enable 3 (POE3a)	<ul style="list-style-type: none"> <li>• Control of the high-impedance state of the MTU3/GPT's waveform output pins</li> <li>• 5 pins for input from signal sources: POE0, POE4, POE8, POE10, POE11</li> <li>• Initiation on detection of short-circuited outputs (detection of simultaneous PWM output to the active level)</li> <li>• Initiation by oscillation-stoppage detection or software</li> <li>• The conditions for control can be set for the target pins subject to output control.</li> </ul>

**Table 1.1 Outline of Specifications (5/9)**

Classification	Module/Function	Description
Timers	General PWM timer (GPTA)	<ul style="list-style-type: none"> <li>• 16 bits × 4 channels</li> <li>• Counting up or down (saw-wave), counting up and down (triangle-wave) selectable for all channels</li> <li>• Four clock sources independently selectable for all channels (PCLKA/1, PCLKA/4, PCLKA/8, PCLKA/16)</li> <li>• 2 input/output pins per channel</li> <li>• 2 output compare/input capture registers per channel</li> <li>• For the 2 output compare/input capture registers of each channel, 4 registers are provided as buffer registers and are capable of operating as comparison registers when buffering is not in use.</li> <li>• In output compare operation, buffer switching can be at peaks or troughs, enabling the generation of laterally asymmetrically PWM waveforms.</li> <li>• Registers for setting up frame intervals on each channel (with capability for generating interrupts on overflow or underflow)</li> <li>• Synchronizable operation of the several counters</li> <li>• Modes of synchronized operation (synchronized, or displaced by desired times for phase shifting)</li> <li>• Generation of dead times in PWM operation</li> <li>• Through combination of three counters, generation of automatic three-phase PWM waveforms incorporating dead times</li> <li>• Starting, clearing, and stopping counters in response to external or internal triggers</li> <li>• Internal trigger sources: output of the internal comparator detection, software, and compare-match</li> <li>• Digital filter function for signals on the input capture and external trigger pins</li> <li>• Event linking by the ELC</li> </ul>
	Programmable pulse generator (PPG)	<ul style="list-style-type: none"> <li>• (4 bits × 4 groups) × 2 units</li> <li>• Pulse output with the MTU or TPU output as a trigger</li> <li>• Maximum of 32 pulse-output possible</li> </ul>
	8-bit timers (TMRb)	<ul style="list-style-type: none"> <li>• (8 bits × 2 channels) × 2 units</li> <li>• Select from among seven internal clock signals (PCLKB/1, PCLKB/2, PCLKB/8, PCLKB/32, PCLKB/64, PCLKB/1024, PCLKB/8192) and one external clock signal</li> <li>• Capable of output of pulse trains with desired duty cycles or of PWM signals</li> <li>• The 2 channels of each unit can be cascaded to create a 16-bit timer</li> <li>• Generation of triggers for A/D converter conversion</li> <li>• Capable of generating the internal operating clock signals for SCI5, SCI6, or SCI12</li> <li>• Event linking by the ELC</li> </ul>
	Compare match timer (CMT)	<ul style="list-style-type: none"> <li>• (16 bits × 2 channels) × 2 units</li> <li>• Select from among four internal clock signals (PCLKB/8, PCLKB/32, PCLKB/128, PCLKB/512)</li> <li>• Event linking by the ELC</li> </ul>
	Compare match timer W (CMTW)	<ul style="list-style-type: none"> <li>• (32 bits × 1 channel) × 2 units</li> <li>• Compare-match, input-capture input, and output-comparison output are available.</li> <li>• Select from among four internal clock signals (PCLKB/8, PCLKB/32, PCLKB/128, PCLKB/512)</li> <li>• Interrupt requests can be output in response to compare-match, input-capture, and output-comparison events.</li> <li>• Event linking by the ELC</li> </ul>
	Realtime clock (RTCd)	<ul style="list-style-type: none"> <li>• Clock sources: Main clock, sub clock</li> <li>• Selection of the 32-bit binary count in time count/second unit possible</li> <li>• Clock and calendar functions</li> <li>• Interrupt sources: Alarm interrupt, periodic interrupt, and carry interrupt</li> <li>• Battery backup operation</li> <li>• Time-capture facility for three values</li> <li>• Event linking by the ELC</li> </ul>
	Watchdog timer (WDTA)	<ul style="list-style-type: none"> <li>• 14 bits × 1 channel</li> <li>• Select from among 6 counter-input clock signals (PCLKB/4, PCLKB/64, PCLKB/128, PCLKB/512, PCLKB/2048, PCLKB/8192)</li> </ul>

**Table 1.1 Outline of Specifications (6/9)**

Classification	Module/Function	Description
Timers	Independent watchdog timer (IWDTa)	<ul style="list-style-type: none"> <li>• 14 bits × 1 channel</li> <li>• Counter-input clock: IWDT-dedicated on-chip oscillator</li> <li>• Dedicated clock/1, dedicated clock/16, dedicated clock/32, dedicated clock/64, dedicated clock/128, dedicated clock/256</li> <li>• Window function: The positions where the window starts and ends are specifiable (the window defines the timing with which refreshing is enabled and disabled).</li> <li>• Event linking by the ELC</li> </ul>
Communication function	Ethernet controller (ETHERC)	<ul style="list-style-type: none"> <li>• 2 channels</li> <li>• Input and output of Ethernet/IEEE 802.3 frames</li> <li>• Transfer at 10 or 100 Mbps</li> <li>• Full- and half-duplex modes</li> <li>• MII (Media Independent Interface) or RMII (Reduced Media Independent Interface) as defined in IEEE 802.3u</li> <li>• Detection of Magic Packets<sup>TM*1</sup> or output of a “wake-on-LAN” signal (WOL)</li> <li>• Compliance with flow control as defined in IEEE 802.3x standards</li> <li>• Filtering of multicast frames</li> <li>• Direct transfer of frames between two channels by cut-through</li> </ul>
	PTP controller for Ethernet controller (EPTPC)	<ul style="list-style-type: none"> <li>• A block compatible with the IEEE 1588 standard is connected to the Ethernet controller (ETHERC).</li> <li>• Matching with a time stamp can start counting by MTU3 and the GPT.</li> </ul>
	DMA controller for Ethernet controller (EDMACa)	<ul style="list-style-type: none"> <li>• 3 channels (the round-robin method determines the priority of the channels) 2 channels for ETHERC; 1 channel for EPTPC</li> <li>• Alleviation of CPU load by the descriptor control method</li> <li>• Transmission FIFO: 2 Kbytes; Reception FIFO: 4 Kbytes</li> </ul>
	USB 2.0 FS host/function module (USBb)	<ul style="list-style-type: none"> <li>• Includes a UDC (USB Device Controller) and transceiver for USB 2.0 FS</li> <li>• One port</li> <li>• Compliance with the USB 2.0 specification</li> <li>• Transfer rate: Full speed (12 Mbps), low speed (1.5 Mbps) (host only)</li> <li>• Both self-power mode and bus power are supported</li> <li>• OTG (On the Go) operation is possible (low-speed is not supported)</li> <li>• Incorporates 2 Kbytes of RAM as a transfer buffer</li> <li>• External pull-up and pull-down resistors are not required</li> </ul>
	USB 2.0 FS host/function module with battery charging (USBA)	<ul style="list-style-type: none"> <li>• Includes a UDC (USB Device Controller) and transceiver for USB 2.0 FS</li> <li>• One port (only in 176-pin devices)</li> <li>• Compliance with the USB 2.0 specification</li> <li>• Transfer rate: Full speed (12 Mbps), low speed (1.5 Mbps) (host only)</li> <li>• Both self-power mode and bus power are supported</li> <li>• OTG (On the Go) operation is possible (low-speed is not supported)</li> <li>• Incorporates 8.5 Kbytes of RAM as a transfer buffer</li> <li>• External pull-up and pull-down resistors are not required</li> </ul>
Serial communications interfaces (SCIg, SCIH)	<ul style="list-style-type: none"> <li>• 9 channels (SCIg: 8 channels + SCIH: 1 channel)</li> <li>• SCIg <ul style="list-style-type: none"> <li>Serial communications modes: Asynchronous, clock synchronous, and smart-card interface</li> <li>Multi-processor function</li> <li>On-chip baud rate generator allows selection of the desired bit rate</li> <li>Choice of LSB-first or MSB-first transfer</li> <li>Average transfer rate clock can be input from TMR timers for SCI5, SCI6, and SCI12</li> <li>Start-bit detection: Level or edge detection is selectable.</li> <li>Simple I<sup>2</sup>C</li> <li>Simple SPI</li> <li>9-bit transfer mode</li> <li>Bit rate modulation</li> <li>Double-speed mode</li> <li>Event linking by the ELC (supported by SCI5 only)</li> </ul> </li> <li>• SCIH (The following functions are added to SCIg) <ul style="list-style-type: none"> <li>Supports the serial communications protocol, which contains the start frame and information frame</li> <li>Supports the LIN format</li> </ul> </li> </ul>	

**Table 1.1 Outline of Specifications (7/9)**

Classification	Module/Function	Description
Communication function	Serial communications interface with FIFO (SCIFA)	<ul style="list-style-type: none"> <li>• 4 channels</li> <li>• Methods of transfer: Asynchronous and clock synchronous</li> <li>• Desired bit rates can be selected from the internal baud rate generators.</li> <li>• LSB or MSB first is selectable.</li> <li>• Both the transmission and reception sections are equipped with 16-byte FIFO buffers, allowing continuous transmission and reception.</li> <li>• Bit rate modulation</li> <li>• Double-speed mode</li> </ul>
	I <sup>2</sup> C bus interface (RIICa)	<ul style="list-style-type: none"> <li>• 2 channels (only channel 0 can be used in fast-mode plus)</li> <li>• Communication formats I<sup>2</sup>C bus format/SMBus format</li> <li>• Supports the multi-master</li> <li>• Max. transfer rate: 1 Mbps (channel 0)</li> <li>• Event linking by the ELC</li> </ul>
	CAN module (CAN)	<ul style="list-style-type: none"> <li>• 3 channels</li> <li>• Compliance with the ISO11898-1 specification (standard frame and extended frame)</li> <li>• 32 mailboxes per channel</li> </ul>
	Serial peripheral interface (RSPIa)	<ul style="list-style-type: none"> <li>• 1 channel</li> <li>• RSPI transfer facility Using the MOSI (master out, slave in), MISO (master in, slave out), SSL (slave select), and RSPCK (RSPI clock) signals enables serial transfer through SPI operation (four lines) or clock-synchronous operation (three lines) Capable of handling serial transfer as a master or slave</li> <li>• Data formats Switching between MSB first and LSB first The number of bits in each transfer can be changed to any number of bits from 8 to 16, or to 20, 24, or 32 bits. 128-bit buffers for transmission and reception Up to four frames can be transmitted or received in a single transfer operation (with each frame having up to 32 bits)</li> <li>• Buffered structure Double buffers for both transmission and reception</li> <li>• RSPCK can be stopped with the receive buffer full for master reception.</li> <li>• Event linking by the ELC</li> </ul>
	Quad serial peripheral interface (QSPI)	<ul style="list-style-type: none"> <li>• 1 channel</li> <li>• Connectable with serial flash memory equipped with multiple input and output lines (i.e. for single, dual, or quad operation)</li> <li>• Selectable bit length, polarity, and phase of the clock signal</li> <li>• Sequential execution of transfer</li> <li>• LSB or MSB first is selectable.</li> </ul>
Serial sound interface (SSI)	<ul style="list-style-type: none"> <li>• 2 channels</li> <li>• Full-duplex transfer is possible (only on channel 0).</li> <li>• Support for multiple audio formats</li> <li>• Support for master or slave operation</li> <li>• Bit clock frequency is selectable from four different types (16 fs, 32 fs, 48 fs, and 64 fs).</li> <li>• Support for 8-/16-/18-/20-/22-/24 bit data formats</li> <li>• Internal 8-stage FIFO for transmission and reception</li> <li>• Stopping SSIWS when data transfer is stopped is selectable.</li> </ul>	
Sampling rate converter (SRC)	<ul style="list-style-type: none"> <li>• 1 channel</li> <li>• Data formats: 32-bit stereo (16 bits for the left, 16 bits for the right) and 16-bit monaural.</li> <li>• Input sampling rates: 8, 11.025, 12, 16, 22.05, 24, 32, 44.1, 48 kHz</li> <li>• Output sampling rates: 32, 44.1, 48, 8*2 or 16 kHz*2</li> </ul>	
SD host interface (SDHI)*4	<ul style="list-style-type: none"> <li>• 1 channel</li> <li>• Transfer speed: Supports high-speed mode (15 MB/s) and default speed mode (10 MB/s)</li> <li>• One interface for SD memory and I/O cards (supporting 1- and 4-bit SD buses)</li> <li>• SD specifications Part 1: Physical Layer Specification Ver. 3.01 compliant (DDR not supported) Part E1: SDIO Specification Ver. 3.00</li> <li>• Error checking: CRC7 for commands and CRC16 for data</li> <li>• Interrupt requests: Card access interrupt, SDIO access interrupt, card detection interrupt</li> <li>• DMA transfer requests: SD_BUF write and SD_BUF read</li> <li>• Support for card detection and write protection</li> </ul>	



Table 1.1 Outline of Specifications (8/9)

Classification	Module/Function	Description
	MMC host interface (MMCIF)	<ul style="list-style-type: none"> <li>• 1 channel</li> <li>• Transfer speed: Supports high-speed mode (30 MB/s) and Backward-compatible mode (25 MB/s)</li> <li>• Compliant with JEDEC STANDARD JESD84-A441 (DDR is not supported)</li> <li>• Interface for Multimedia Cards (MMCs)</li> <li>• Device buses: Support for 1-, 4-, and 8-bit MMC buses</li> <li>• Interrupt requests: Card detection interrupt, error/timeout interrupt, normal operation interrupt</li> <li>• DMA transfer requests: CE_DATA write and CE_DATA read</li> <li>• Support for card detection, boot operation, high priority interrupt (HPI)</li> </ul>
	Parallel data capture unit (PDC)	<ul style="list-style-type: none"> <li>• 1 channel</li> <li>• Acquisition of synchronization through external 8-bit horizontal and vertical synchronization signals</li> <li>• Setting of the image size when clipping of the output for a one-frame image is required</li> </ul>
	12-bit A/D converter (S12ADC)	<ul style="list-style-type: none"> <li>• 12 bits × 2 units (unit 0: 8 channels; unit 1: 21 channels)</li> <li>• 12-bit resolution (switchable between 8, 10, and 12 bits)</li> <li>• Conversion time <ul style="list-style-type: none"> <li>0.48 μs per channel (for 12-bit conversion)</li> <li>0.45 μs per channel (for 10-bit conversion)</li> <li>0.42 μs per channel (for 8-bit conversion)</li> </ul> </li> <li>• Operating mode <ul style="list-style-type: none"> <li>Scan mode (single scan mode, continuous scan mode, or group scan mode)</li> <li>Group A priority control (only for group scan mode)</li> </ul> </li> <li>• Sample-and-hold function <ul style="list-style-type: none"> <li>Common sample-and-hold circuit included</li> <li>In addition, channel-dedicated sample-and-hold function (3ch: in unit 0 only) included</li> </ul> </li> <li>• Sampling variable <ul style="list-style-type: none"> <li>Sampling time can be set up for each channel.</li> </ul> </li> <li>• Digital comparison <ul style="list-style-type: none"> <li>Method: Comparison to detect voltages above or below thresholds and window comparison</li> <li>Measurement: Comparison of two results of conversion or comparison of a value in the comparison register and a result of conversion</li> </ul> </li> <li>• Self-diagnostic function <ul style="list-style-type: none"> <li>The self-diagnostic function internally generates three analog input voltages (unit 0: VREFL0, VREFH0 × 1/2, VREFH0; unit 1: AVSS1, AVCC1 × 1/2, AVCC1)</li> </ul> </li> <li>• Double trigger mode (A/D conversion data duplicated)</li> <li>• Detection of analog input disconnection</li> <li>• Three ways to start A/D conversion <ul style="list-style-type: none"> <li>Software trigger, timer (MTU3, GPT, TMR, TPU) trigger, external trigger</li> </ul> </li> <li>• Event linking by the ELC</li> </ul>
	12-bit D/A converter (R12DA)	<ul style="list-style-type: none"> <li>• 2 channels</li> <li>• 12-bit resolution</li> <li>• Output voltage: 0.2 V to AVCC1 – 0.2 V (amplifier output), 0 V to AVCC1 (direct output)</li> <li>• Output via an amplifier or direct output can be selected.</li> <li>• Event linking by the ELC</li> </ul>
	Temperature sensor	<ul style="list-style-type: none"> <li>• 1 channel</li> <li>• Relative precision: ±1°C</li> <li>• The voltage of the temperature is converted into a digital value by the 12-bit A/D converter (unit 1).</li> </ul>
Safety	Memory protection unit (MPU)	<ul style="list-style-type: none"> <li>• Protection area: Eight areas (max.) can be specified in the range from 0000 0000h to FFFF FFFFh.</li> <li>• Minimum protection unit: 16 bytes</li> <li>• Reading from, writing to, and enabling the execution access can be specified for each area.</li> <li>• An address exception occurs when the detected access is not in the permitted area.</li> </ul>
	Trusted Memory (TM) Function	<ul style="list-style-type: none"> <li>• Protects against the reading of programs from blocks 8 and 9 of the code flash memory</li> <li>• Instruction fetching by the CPU is the only form of access to these areas when the TM function is enabled.</li> </ul>
	Register write protection function	<ul style="list-style-type: none"> <li>• Protects important registers from being overwritten for in case a program runs out of control.</li> </ul>

**Table 1.1 Outline of Specifications (9/9)**

Classification	Module/Function	Description
Safety	CRC calculator (CRC)	<ul style="list-style-type: none"> <li>CRC code generation for arbitrary amounts of data in 8-bit units</li> <li>Select any of three generating polynomials:  <math>X^8 + X^2 + X + 1</math>, <math>X^{16} + X^{15} + X^2 + 1</math>, or <math>X^{16} + X^{12} + X^5 + 1</math></li> <li>Generation of CRC codes for use with LSB-first or MSB-first communications is selectable</li> </ul>
	Oscillation stop detection function for the main clock	<ul style="list-style-type: none"> <li>Main clock oscillation stop detection: Available</li> </ul>
	Clock frequency and accuracy measurement circuit (CAC)	<ul style="list-style-type: none"> <li>Monitors the clock output from the main clock oscillator, sub-clock oscillator, low- and high-speed on-chip oscillators, the PLL frequency synthesizer, IWDTC-dedicated on-chip oscillator, and PCLKB, and generates interrupts when the setting range is exceeded.</li> </ul>
	Data operation circuit (DOC)	<ul style="list-style-type: none"> <li>The function to compare, add, or subtract 16-bit data</li> </ul>
Encryption function	AES* <sup>3</sup>	<ul style="list-style-type: none"> <li>Key lengths: 128, 192, and 256 bits</li> <li>Support for CBC, ECB, CFB, OFB, CTR, and CMAC operating modes</li> <li>Speed of calculations: 128-bit key length in 22 cycles  192-bit key length in 26 cycles  256-bit key length in 30 cycles</li> <li>Compliant with FIPS PUB 197</li> </ul>
	DES* <sup>3</sup>	<ul style="list-style-type: none"> <li>Key lengths: 56 bits (DES)/3 × 56 bits (T-DES)</li> <li>Support for DES and triple DES</li> <li>Support for ECB and CBC operating modes</li> <li>Speed of calculations: 6 clock cycles in single DES mode  14 clock cycles in triple DES mode</li> <li>Compliant with FIPS PUB 46-3</li> <li>Compliant with FIPS PUB 81</li> </ul>
	SHA* <sup>3</sup>	<ul style="list-style-type: none"> <li>Support for SHA-1 (128), SHA-2 (224 or 256), and HMAC (160, 224, or 256)</li> <li>Speed of calculations: 50 clock cycles in SHA-1 mode  42 clock cycles in SHA-224 mode  42 clock cycles in SHA-256 mode</li> <li>Compliant with SHA as defined in FIPS PUB 180-1 and -2</li> <li>Compliant with HMAC as defined in FIPS PUB 198</li> </ul>
	True random number generator (RNG)* <sup>3</sup>	<ul style="list-style-type: none"> <li>Length of random numbers: 16 bits</li> <li>Generation of random-number-generated interrupts after a number is generated</li> <li>Random number generation time: 3.6 ms (typ)</li> </ul>
Operating frequency		Up to 120 MHz
Power supply voltage		VCC = AVCC0 = AVCC1 = VCC_USB = 2.7 to 3.6 V, $2.7 \leq VREFH0 \leq AVCC0$ , VCC_USBA = AVCC_USBA = 2.7 to 3.6 V, V <sub>BATT</sub> = 2.0 to 3.6 V
Operating temperature		D-version: -40 to +85°C G-version: -40 to +105°C* <sup>5</sup>
Package		177-pin TFLGA (PTLG0177KA-A) 176-pin LFBGA (PLBG0176GA-A) 176-pin LQFP (PLQP0176KB-A) 145-pin TFLGA (PTLG0145KA-A) 144-pin LQFP (PLQP0144KA-A) 100-pin TFLGA (PTLG0100JA-A) 100-pin LQFP (PLQP0100KB-A)
On-chip debugging system		<ul style="list-style-type: none"> <li>E1 emulator (JTAG and FINE interfaces)</li> <li>E20 emulator (JTAG interface)</li> </ul>

Note 1. Magic Packet™ is a registered trademark of Advanced Micro Devices, Inc.

Note 2. Setting is only possible when the input sampling rate 44.1 kHz is selected.

Note 3. The product part number differs according to whether or not it supports encryption.

Note 4. The product part number differs according to whether or not it includes an SDHI (SD host interface).

Note 5. Please contact us if you are using a G-version product.

**Table 1.2 Comparison of Functions for Different Packages (1/2)**

Functions		RX64M Group		
Package		177 Pins, 176 Pins	145 Pins, 144 Pins	100 Pins
External bus	External bus width	32 bits	16 bits	
	SDRAM area controller	Available		Not supported
DMA	DMA controller	Ch. 0 to 7		
	Data transfer controller	Available		
	EXDMA controller	Ch. 0 and 1		
Timers	16-bit timer pulse unit	Ch. 0 to 5		
	Multi-function timer pulse unit 3	Ch. 0 to 8		
	General-purpose PWM timer	Ch. 0 to 3		
	Port output enable 3	Available		
	Programmable pulse generator	Ch. 0 and 1		
	8-bit timers	Ch. 0 to 3		
	Compare match timer	Ch. 0 to 3		
	Compare match timer W	Ch. 0 and 1		
	Realtime clock	Available		
	Watchdog timer	Available		
	Independent watchdog timer	Available		
Communication function	Ethernet controller	Ch. 0 and 1	Ch. 0	
	PTP controller for ethernet controller	Available		
	DMAC controller for ethernet	Ch. 0 and 1 (ETHERC) Ch. 2 (EPTPC)	Ch. 0 (ETHERC) and 2 (EPTPC)	
	USB 2.0 FS host/function module	Ch. 0		
	USB 2.0 FS host/function module with battery charging	Available	Not supported	
	Serial communications interfaces (SCIg)	Ch. 0 to 7		Ch. 0 to 3, 5 and 6
	Serial communications interfaces (SCIh)	Ch. 12		
	Serial communications interfaces with FIFO	Ch. 8 to 11		Ch. 8 and 9
	I <sup>2</sup> C bus interfaces	Ch. 0 and 2		
	Serial peripheral interface	Ch. 0		
	CAN module	Ch. 0 to 2		Ch. 0 and 1
	Quad serial peripheral interface	Ch. 0		
	Serial sound interfaces	Ch. 0 and 1		
	Sampling rate converter	Available		
	SD host interface	Ch. 0		
	MMC host interface	Ch. 0		
	Parallel data capture unit	Available		Not supported
12-bit A/D converter	AN000 to 007 (unit 0: 8 channels) AN100 to 120 (unit 1: 21 channels)		AN000 to 007 (unit 0: 8 channels) AN100 to 113 (unit 1: 14 channels)	
12-bit D/A converter	Ch. 0 and 1		Ch. 1	
Temperature sensor	Available			
CRC calculator	Available			
Data operation circuit	Available			
Clock frequency accuracy measurement circuit	Available			
AES	Available			

**Table 1.2 Comparison of Functions for Different Packages (2/2)**

Functions Package	RX64M Group		
	177 Pins, 176 Pins	145 Pins, 144 Pins	100 Pins
DES	Available		
SHA	Available		
RNG	Available		
Event link controller	Available		

## 1.2 List of Products

Table 1.3 is a list of products, and Figure 1.1 shows how to read the product part no.

**Table 1.3 List of Products (1/4)**

Group	Part No.	Package	Code Flash Memory Capacity	RAM Capacity	Data Flash Memory Capacity	Operating Frequency (Max.)	Encryption Module	SDHI
RX64M (D-version)	R5F564MLCDFC	PLQP0176KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MLDDFC	PLQP0176KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MLGDFC	PLQP0176KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MLHDFC	PLQP0176KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MJCDFC	PLQP0176KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MJDDFC	PLQP0176KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MJGDFC	PLQP0176KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MJHDFC	PLQP0176KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MGCDFC	PLQP0176KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MGDDFC	PLQP0176KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MGDFC	PLQP0176KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MGHDFC	PLQP0176KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MFCDFC	PLQP0176KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MFDDFC	PLQP0176KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MFGDFC	PLQP0176KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MFHDFC	PLQP0176KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MLCDFB	PLQP0144KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MLDDFB	PLQP0144KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MLGDFB	PLQP0144KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MLHDFB	PLQP0144KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MJCDFB	PLQP0144KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MJDDFB	PLQP0144KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MJGDFB	PLQP0144KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MJHDFB	PLQP0144KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MGCDFB	PLQP0144KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MGDDFB	PLQP0144KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MGDFB	PLQP0144KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MGHDFB	PLQP0144KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MFCDFB	PLQP0144KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MFDDFB	PLQP0144KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MFGDFB	PLQP0144KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MFHDFB	PLQP0144KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
R5F564MLCDFP	PLQP0100KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported	
R5F564MLDDFP	PLQP0100KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available	
R5F564MLGDFP	PLQP0100KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported	
R5F564MLHDFP	PLQP0100KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available	
R5F564MJCDFP	PLQP0100KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported	
R5F564MJDDFP	PLQP0100KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available	
R5F564MJGDFP	PLQP0100KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported	
R5F564MJHDFP	PLQP0100KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available	
R5F564MGCDFP	PLQP0100KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported	
R5F564MGDDFP	PLQP0100KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available	
R5F564MGDFP	PLQP0100KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported	
R5F564MGHDFP	PLQP0100KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available	

Table 1.3 List of Products (2/4)

Group	Part No.	Package	Code Flash Memory Capacity	RAM Capacity	Data Flash Memory Capacity	Operating Frequency (Max.)	Encryption Module	SDHI
RX64M (D-version)	R5F564MFCDFP	PLQP0100KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MFDDFP	PLQP0100KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MFGDFP	PLQP0100KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MFHDFP	PLQP0100KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MLCDBG	PLBG0176GA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MLDDBG	PLBG0176GA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MLGDBG	PLBG0176GA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MLHDBG	PLBG0176GA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MJCDBG	PLBG0176GA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MJDDBG	PLBG0176GA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MJGDBG	PLBG0176GA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MJHDBG	PLBG0176GA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MGCDBG	PLBG0176GA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MGDDBG	PLBG0176GA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MGGDBG	PLBG0176GA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MGHDBG	PLBG0176GA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MFCDBG	PLBG0176GA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MFDDBG	PLBG0176GA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MFGDBG	PLBG0176GA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MFHDBG	PLBG0176GA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MLCDLC	PTLG0177KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MLDDLC	PTLG0177KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MLGDLC	PTLG0177KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MLHDLC	PTLG0177KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MJCDLC	PTLG0177KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MJDDLC	PTLG0177KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MJGDLC	PTLG0177KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MJHDLC	PTLG0177KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MGCDC	PTLG0177KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MGDDLC	PTLG0177KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MGDC	PTLG0177KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MGHDC	PTLG0177KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MFCDC	PTLG0177KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MFDDC	PTLG0177KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MFGDC	PTLG0177KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MFHDC	PTLG0177KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MLCDLK	PTLG0145KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MLDDLK	PTLG0145KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MLGDLK	PTLG0145KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MLHDLK	PTLG0145KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
R5F564MJCDLK	PTLG0145KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported	
R5F564MJDDLK	PTLG0145KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available	
R5F564MJGDLK	PTLG0145KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported	
R5F564MJHDLK	PTLG0145KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available	
R5F564MGCCLK	PTLG0145KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported	
R5F564MGDDLK	PTLG0145KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available	
R5F564MGCK	PTLG0145KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported	
R5F564MGHCLK	PTLG0145KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available	

**Table 1.3 List of Products (3/4)**

Group	Part No.	Package	Code Flash Memory Capacity	RAM Capacity	Data Flash Memory Capacity	Operating Frequency (Max.)	Encryption Module	SDHI
RX64M (D-version)	R5F564MFCDLK	PTLG0145KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MFDDLK	PTLG0145KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MFGDLK	PTLG0145KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MFHDLK	PTLG0145KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MLCDLJ	PTLG0100JA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MLDDLJ	PTLG0100JA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MLGDLJ	PTLG0100JA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MLHDLJ	PTLG0100JA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MJCDLJ	PTLG0100JA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MJDDLJ	PTLG0100JA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MJGDLJ	PTLG0100JA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MJHDLJ	PTLG0100JA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MGCDLJ	PTLG0100JA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MGDDLJ	PTLG0100JA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MGGDLJ	PTLG0100JA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MGHDLJ	PTLG0100JA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MFCDLJ	PTLG0100JA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MFDDLJ	PTLG0100JA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MFGDLJ	PTLG0100JA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MFHDLJ	PTLG0100JA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available

Table 1.3 List of Products (4/4)

Group	Part No.	Package	Code Flash Memory Capacity	RAM Capacity	Data Flash Memory Capacity	Operating Frequency (Max.)	Encryption Module	SDHI
RX64M (G-version)	R5F564MLCGFC	PLQP0176KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MLDGFC	PLQP0176KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MLGGFC	PLQP0176KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MLHGFC	PLQP0176KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MJCGFC	PLQP0176KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MJDGFC	PLQP0176KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MJGGFC	PLQP0176KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MJHGFC	PLQP0176KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MCGFC	PLQP0176KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MGDGFC	PLQP0176KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MGGGFC	PLQP0176KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MGHGFC	PLQP0176KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MFCGFC	PLQP0176KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MFDGFC	PLQP0176KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MFGGFC	PLQP0176KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MFHGFC	PLQP0176KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MLCGFB	PLQP0144KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MLDGFB	PLQP0144KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MLGGFB	PLQP0144KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MLHGFB	PLQP0144KA-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MJCGFB	PLQP0144KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MJDGFB	PLQP0144KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MJGGFB	PLQP0144KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MJHGFB	PLQP0144KA-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MCGFB	PLQP0144KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MGDGFB	PLQP0144KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MGGGFB	PLQP0144KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MGHGFB	PLQP0144KA-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MFCGFB	PLQP0144KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MFDGFB	PLQP0144KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MFGGFB	PLQP0144KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MFHGFB	PLQP0144KA-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MLCGFP	PLQP0100KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MLDGFP	PLQP0100KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MLGGFP	PLQP0100KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MLHGFP	PLQP0100KB-A	4 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
	R5F564MJCGFP	PLQP0100KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported
	R5F564MJDGFP	PLQP0100KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available
	R5F564MJGGFP	PLQP0100KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported
	R5F564MJHGFP	PLQP0100KB-A	3 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available
R5F564MCGFP	PLQP0100KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported	
R5F564MGDGFP	PLQP0100KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available	
R5F564MGGGFP	PLQP0100KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported	
R5F564MGHGFP	PLQP0100KB-A	2.5 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available	
R5F564MFCGFP	PLQP0100KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Not supported	
R5F564MFDGFP	PLQP0100KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Not supported	Available	
R5F564MFGGFP	PLQP0100KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Not supported	
R5F564MFHGFP	PLQP0100KB-A	2 Mbytes	512 Kbytes	64 Kbytes	120 MHz	Available	Available	



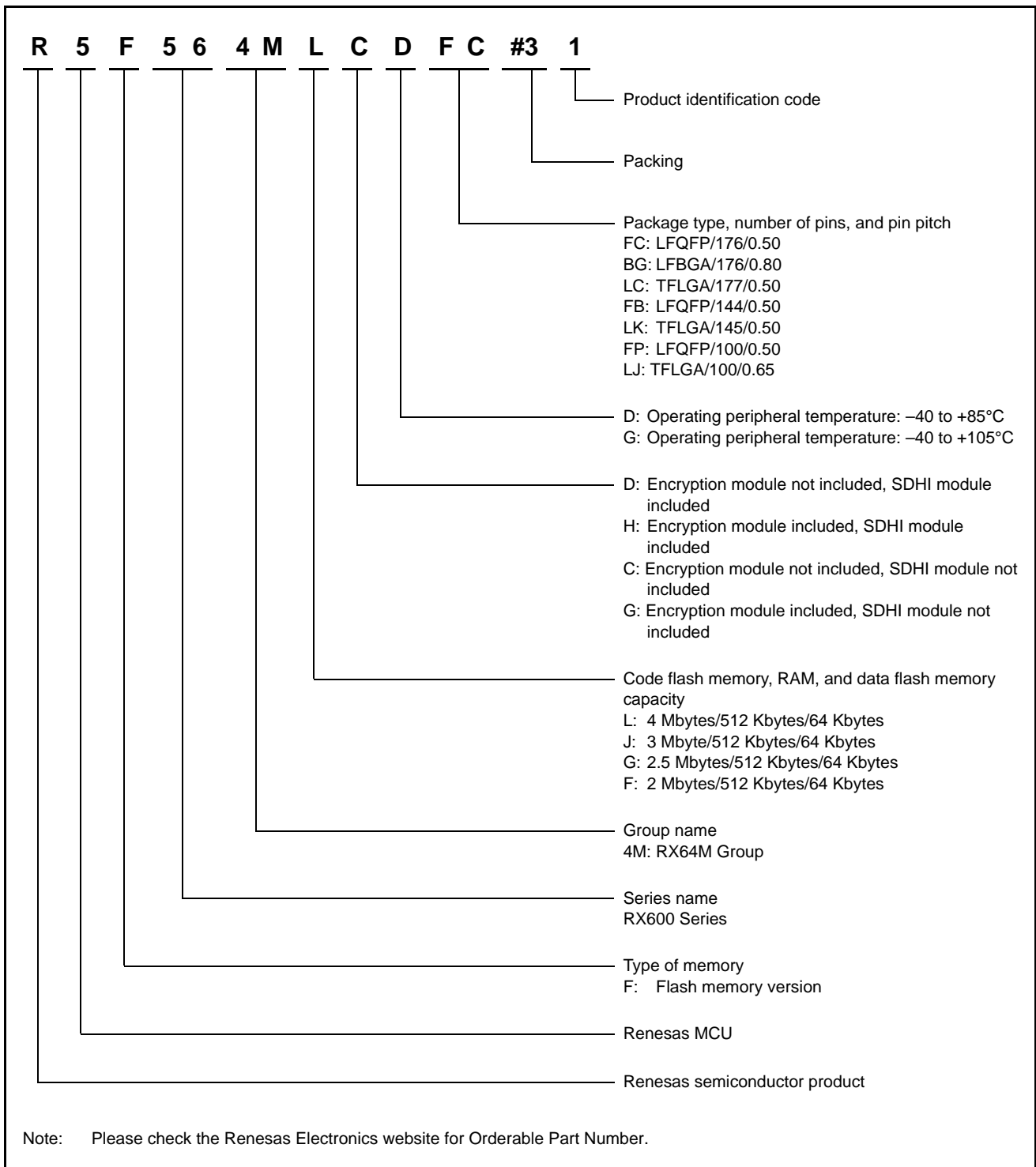


Figure 1.1 How to Read the Product Part Number

### 1.3 Block Diagram

Figure 1.2 shows a block diagram.

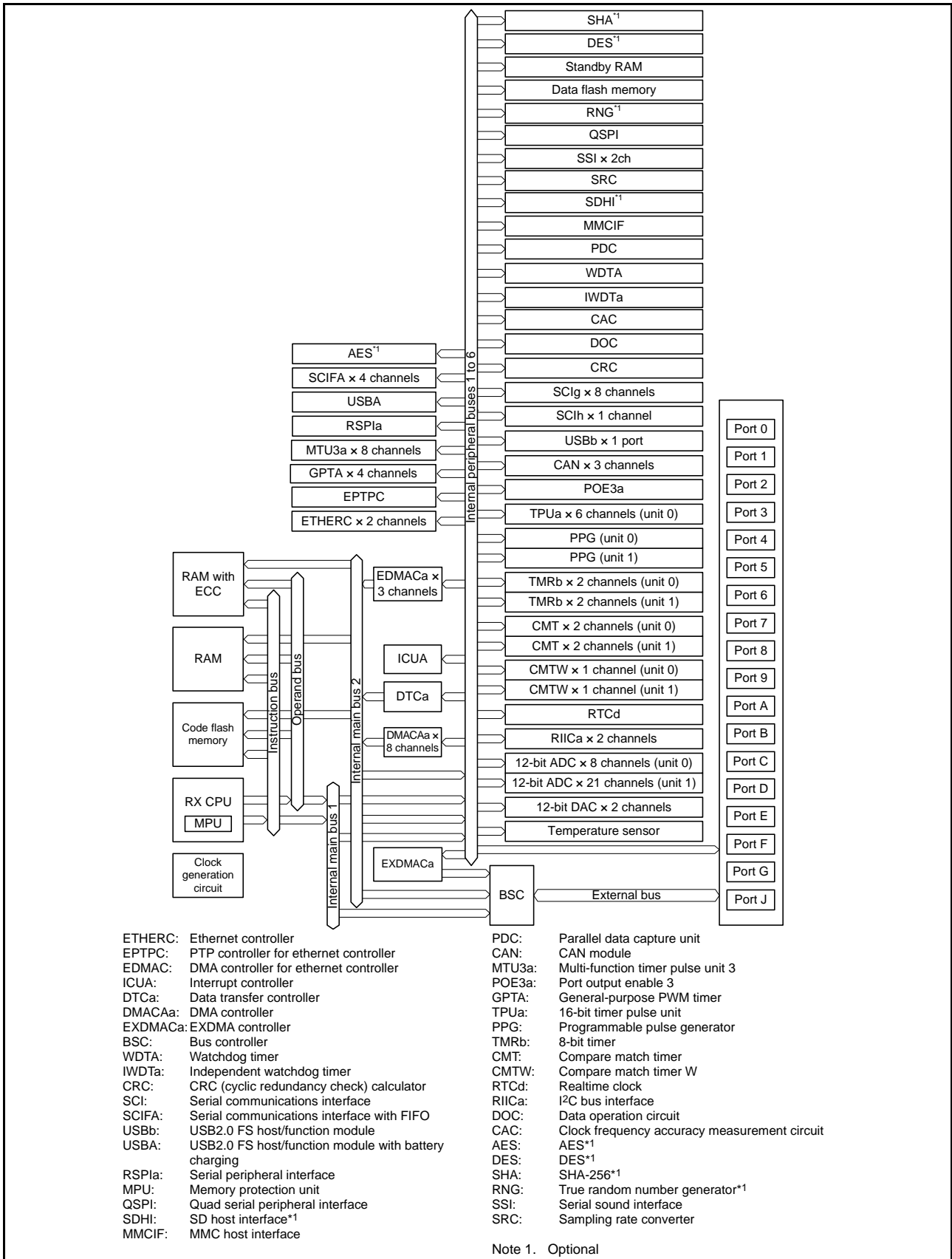


Figure 1.2 Block Diagram

## 1.4 Pin Functions

Table 1.4 lists the pin functions.

**Table 1.4 Pin Functions (1/8)**

Classifications	Pin Name	I/O	Description
Digital power supply	VCC	Input	Power supply pin. Connect this pin to the system power supply. Connect the pin to VSS via a 0.1- $\mu$ F multilayer ceramic capacitor. The capacitor should be placed close to the pin.
	VCL	Input	Connect this pin to VSS via a 0.1- $\mu$ F multilayer ceramic capacitor. The capacitor should be placed close to the pin.
	VSS	Input	Ground pin. Connect it to the system power supply (0 V).
	VBATT	Input	Backup power pin
Clock	XTAL	Output	Pins for a crystal resonator. An external clock signal can be input through the EXTAL pin.
	EXTAL	Input	
	BCLK	Output	Outputs the external bus clock for external devices.
	SDCLK	Output	Outputs the SDRAM-dedicated clock.
	XCOUT	Output	Input/output pins for the sub clock oscillator. Connect a crystal resonator between XCOUT and XCIN.
	XCIN	Input	
Clock frequency accuracy measurement	CACREF	Input	Reference clock input pin for the clock frequency accuracy measurement circuit
Operating mode control	MD	Input	Pins for setting the operating mode. The signal levels on these pins must not be changed during operation.
	UB	Input	USB boot mode or user boot mode enable pin
	UPSEL	Input	Selects the power supply method in USB boot mode. The low level selects self-power mode and the high level selects bus power mode.
System control	RES#	Input	Reset signal input pin. This LSI enters the reset state when this signal goes low.
	EMLE	Input	Input pin for the on-chip emulator enable signal. When the on-chip emulator is used, this pin should be driven high. When not used, it should be driven low.
	BSCANP	Input	Boundary scan enable pin. Boundary scan is enabled when this pin goes high. When not used, it should be driven low.
On-chip emulator	FINED	I/O	Fine interface pin
	TRST#	Input	On-chip emulator or boundary scan pins. When the EMLE pin is driven high, these pins are dedicated for the on-chip emulator.
	TMS	Input	
	TDI	Input	
	TCK	Input	
	TDO	Output	
	TRCLK	Output	This pin outputs the clock for synchronization with the trace data.
	TRSYNC	Output	This pin indicates that output from the TRDATA0 to TRDATA3 pins is valid.
	TRDATA0 to TRDATA3	Output	These pins output the trace information.
Address bus	A0 to A23	Output	Output pins for the address
Data bus	D0 to D31	I/O	Input and output pins for the bidirectional data bus
Multiplexed bus	A0/D0 to A15/D15	I/O	Address/data multiplexed bus

**Table 1.4 Pin Functions (2/8)**

Classifications	Pin Name	I/O	Description
Bus control	RD#	Output	Strobe signal which indicates that reading from the external bus interface space is in progress
	WR#	Output	Strobe signal which indicates that writing to the external bus interface space is in progress, in 1-write strobe mode
	WR0# to WR3#	Output	Strobe signals which indicate that either group of data bus pins (D7 to D0, D15 to D8, D23 to D16 and D31 to D24) is valid in writing to the external bus interface space, in byte strobe mode
	BC0# to BC3#	Output	Strobe signals which indicate that either group of data bus pins (D7 to D0, D15 to D8, D23 to D16 and D31 to D24) is valid in access to the external bus interface space, in 1-write strobe mode
	ALE	Output	Address latch signal when address/data multiplexed bus is selected
	WAIT#	Input	Input pin for wait request signals in access to the external space
	CS0# to CS7#	Output	Select signals for CS areas
	CKE	Output	SDRAM clock enable signal
	SDCS#	Output	SDRAM chip select signal
	RAS#	Output	SDRAM row address strobe signal
	CAS#	Output	SDRAM column address strobe signal
	WE#	Output	SDRAM write enable pin
	DQM0 to DQM3	Output	SDRAM I/O data mask enable signals
	EXDMA controller	EDREQ0, EDREQ1	Input
EDACK0, EDACK1		Output	Single address transfer acknowledge signals
Interrupt	NMI	Input	Non-maskable interrupt request pin
	IRQ0 to IRQ15	Input	Maskable interrupt request pins
Multi-function timer pulse unit 3	MTIOC0A, MTIOC0B, MTIOC0C, MTIOC0D	I/O	The TGRA0 to TGRD0 input capture input/output compare output/PWM output pins
	MTIOC1A, MTIOC1B	I/O	The TGRA1 and TGRB1 input capture input/output compare output/PWM output pins
	MTIOC2A, MTIOC2B	I/O	The TGRA2 and TGRB2 input capture input/output compare output/PWM output pins
	MTIOC3A, MTIOC3B, MTIOC3C, MTIOC3D	I/O	The TGRA3 to TGRD3 input capture input/output compare output/PWM output pins
	MTIOC4A, MTIOC4B, MTIOC4C, MTIOC4D	I/O	The TGRA4 to TGRD4 input capture input/output compare output/PWM output pins
	MTIC5U, MTIC5V, MTIC5W	Input	The TGRU5, TGRV5, and TGRW5 input capture input/dead time compensation input pins
	MTIOC6A, MTIOC6B, MTIOC6C, MTIOC6D	I/O	The TGRA6 to TGRD6 input capture input/output compare output/PWM output pins
	MTIOC7A, MTIOC7B, MTIOC7C, MTIOC7D	I/O	The TGRA7 to TGRD7 input capture input/output compare output/PWM output pins
	MTIOC8A, MTIOC8B, MTIOC8C, MTIOC8D	I/O	The TGRA8 to TGRD8 input capture input/output compare output/PWM output pins
	MTCLKA, MTCLKB, MTCLKC, MTCLKD	Input	Input pins for external clock signals or for phase counting mode clock signals
Port output enable 3	POE0#, POE4#, POE8#, POE10#, POE11#	Input	Input pins for request signals to place the MTU or GPT in the high impedance state

**Table 1.4 Pin Functions (3/8)**

Classifications	Pin Name	I/O	Description
General-purpose PWM timer	GTIOC0A-A/GTIOC0A-B/ GTIOC0A-C/GTIOC0A-D/ GTIOC0A-E, GTIOC0B-A/GTIOC0B-B/ GTIOC0B-C/GTIOC0B-D/ GTIOC0B-E	I/O	GPT0.GTGRA and GPT0.GTGRB input capture input/output compare output/PWM output pins
	GTIOC1A-A/GTIOC1A-B/ GTIOC1A-C/GTIOC1A-D/ GTIOC1A-E, GTIOC1B-A/GTIOC1B-B/ GTIOC1B-C/GTIOC1B-D/ GTIOC1B-E	I/O	GPT1.GTGRA and GPT1.GTGRB input capture input/output compare output/PWM output pins
	GTIOC2A-A/GTIOC2A-B/ GTIOC2A-C/GTIOC2A-D/ GTIOC2A-E, GTIOC2B-A/GTIOC2B-B/ GTIOC2B-C/GTIOC2B-D/ GTIOC2B-E	I/O	GPT2.GTGRA and GPT2.GTGRB input capture input/output compare output/PWM output pins
	GTIOC3A-D/GTIOC3A-E, GTIOC3B-D/GTIOC3B-E	I/O	GPT3.GTGRA and GPT3.GTGRB input capture input/output compare output/PWM output pins
	GTETRГ-B/GTETRГ-C/ GTETRГ-D	Input	External trigger input pin for GPT0 to GPT3
	16-bit timer pulse unit	TIOCA0, TIOCB0, TIOCC0, TIOCD0	I/O
TIOCA1, TIOCB1		I/O	The TGRA1 and TGRB1 input capture input/output compare output/PWM output pins
TIOCA2, TIOCB2		I/O	The TGRA2 and TGRB2 input capture input/output compare output/PWM output pins
TIOCA3, TIOCB3, TIOCC3, TIOCD3		I/O	The TGRA3 to TGRD3 input capture input/output compare output/PWM output pins
TIOCA4, TIOCB4		I/O	The TGRA4 and TGRB4 input capture input/output compare output/PWM output pins
TIOCA5, TIOCB5		I/O	The TGRA5 and TGRB5 input capture input/output compare output/PWM output pins
TCLKA, TCLKB, TCLKC, TCLKD		Input	Input pins for external clock signals or for phase counting mode clock signals
Programmable pulse generator	PO0 to PO31	Output	Output pins for the pulse signals
8-bit timer	TMO0 to TMO3	Output	Compare match output pins
	TMCI0 to TMCI3	Input	Input pins for external clocks to be input to the counter
	TMRI0 to TMRI3	Input	Input pins for the counter reset
Compare match timer W	TIC0 to TIC3	Input	Input pins for CMTW
	TOC0 to TOC3	Output	Output pins for CMTW

**Table 1.4 Pin Functions (4/8)**

Classifications	Pin Name	I/O	Description	
Serial communications interface (SClg)	• Asynchronous mode/clock synchronous mode			
	SCK0 to SCK7	I/O	Input/output pins for the clock	
	RXD0 to RXD7	Input	Input pins for received data	
	TXD0 to TXD7	Output	Output pins for transmitted data	
	CTS0# to CTS7#	Input	Input pins for controlling the start of transmission and reception	
	RTS0# to RTS7#	Output	Output pins for controlling the start of transmission and reception	
	• Simple I <sup>2</sup> C mode			
	SSCL0 to SSCL7	I/O	Input/output pins for the I <sup>2</sup> C clock	
	SSDA0 to SSDA7	I/O	Input/output pins for the I <sup>2</sup> C data	
	• Simple SPI mode			
	SCK0 to SCK7	I/O	Input/output pins for the clock	
	SMISO0 to SMISO7	I/O	Input/output pins for slave transmission of data	
	SMOSI0 to SMOSI7	I/O	Input/output pins for master transmission of data	
	SS0# to SS7#	Input	Chip-select input pins	
	Serial communications interface (SClh)	• Asynchronous mode/clock synchronous mode		
SCK12		I/O	Input/output pin for the clock	
RXD12		Input	Input pin for received data	
TXD12		Output	Output pin for transmitted data	
CTS12#		Input	Input pin for controlling the start of transmission and reception	
RTS12#		Output	Output pin for controlling the start of transmission and reception	
• Simple I <sup>2</sup> C mode				
SSCL12		I/O	Input/output pin for the I <sup>2</sup> C clock	
SSDA12		I/O	Input/output pin for the I <sup>2</sup> C data	
• Simple SPI mode				
SCK12		I/O	Input/output pin for the clock	
SMISO12		I/O	Input/output pin for slave transmission of data	
SMOSI12		I/O	Input/output pin for master transmission of data	
SS12#		Input	Chip-select input pin	
• Extended serial mode				
RDX12		Input	Input pin for received data	
TXDX12		Output	Output pin for transmitted data	
SIOX12		I/O	Input/output pin for received or transmitted data	
Serial communications interface with FIFO (SCIFA)		SCK8 to SCK11	I/O	Input/output pins for the clock
		RXD8 to RXD11	Input	Input pins for received data
		TXD8 to TXD11	Output	Output pins for transmitted data
	CTS8# to CTS11#	Input	Input pins for controlling the start of transmission and reception	
	RTS8# to RTS11#	Output	Output pins for controlling the start of transmission and reception	
I <sup>2</sup> C bus interface	SCL0[FM+], SCL2	I/O	Input/output pins for clocks. Bus can be directly driven by the N-channel open drain	
	SDA0[FM+], SDA2	I/O	Input/output pins for data. Bus can be directly driven by the N-channel open drain	

**Table 1.4 Pin Functions (5/8)**

Classifications	Pin Name	I/O	Description
Ethernet controller	REF50CK0, REF50CK1	Input	50-MHz reference clocks. These pins input reference signals for transmission/reception timings in RMII mode.
	RMII0_CRS_DV, RMII1_CRS_DV	Input	Indicate that there are carrier detection signals and valid receive data on RMII_RXD1 and RMII_RXD0 in RMII mode.
	RMII0_TXD0, RMII0_TXD1, RMII1_TXD0, RMII1_TXD1	Output	2-bit transmit data in RMII mode
	RMII0_RXD0, RMII0_RXD1, RMII1_RXD0, RMII1_RXD1	Input	2-bit receive data in RMII mode
	RMII0_TXD_EN, RMII1_TXD_EN	Output	Output pins for data transmit enable signals in RMII mode
	RMII0_RX_ER, RMII1_RX_ER	Input	Indicate an error has occurred during reception of data in RMII mode.
	ET0_CRS, ET1_CRS	Input	Carrier detection/data reception enable pins
	ET0_RX_DV, ET1_RX_DV	Input	Indicate that there are valid receive data on ET_ERXD3 to ET_ERXD0.
	ET0_EXOUT, ET1_EXOUT	Output	General-purpose external output pins
	ET0_LINKSTA, ET1_LINKSTA	Input	Input link status from the PHY-LSI.
	ET0_ETXD0 to ET0_ETXD3, ET1_ETXD0 to ET1_ETXD3	Output	4 bits of MII transmit data
	ET0_ERXD0 to ET0_ERXD3, ET1_ERXD0 to ET1_ERXD3	Input	4 bits of MII receive data
	ET0_TX_EN, ET1_TX_EN	Output	Transmit enable pins. Function as signals indicating that transmit data is ready on ET_ETXD3 to ET_ETXD0.
	ET0_TX_ER, ET1_TX_ER	Output	Transmit error pins. Function as signals notifying the PHY-LSI of an error during transmission.
	ET0_RX_ER, ET1_RX_ER	Input	Receive error pins. Function as signals to recognize an error during reception.
	ET0_TX_CLK, ET1_TX_CLK	Input	Transmit clock pins. These pins input reference signals for output timings from ET_TX_EN, ET_ETXD3 to ET_ETXD0, and ET_TX_ER.
	ET0_RX_CLK, ET1_RX_CLK	Input	Receive clock pins. These pins input reference signals for input timings to ET_RX_DV, ET_ERXD3 to ET_ERXD0, and ET_RX_ER.
	ET0_COL, ET1_COL	Input	Input collision detection signals.
	ET0_WOL, ET1_WOL	Output	Receive Magic packets.
	ET0_MDC, ET1_MDC	Output	Output reference clock signals for information transfer via ET_MDIO.
ET0_MDIO, ET1_MDIO	I/O	Input or output bidirectional signals for exchange of management information between this MCU and the PHY-LSI.	

**Table 1.4 Pin Functions (6/8)**

Classifications	Pin Name	I/O	Description
USB 2.0 host/function module	VCC_USB, VCC_USBA	Input	Power supply pins
	VSS_USB, VSS1_USBA, VSS2_USBA	Input	Ground pins
	AVCC_USBA	Input	USBA analog power supply pin
	AVSS_USBA	Input	USBA analog ground pin. Short this pin with the PVSS_USBA pin.
	PVSS_USBA	Input	USBA PLL circuit ground pin. Short this pin with the AVSS_USBA pin.
	USBA_RREF	I/O	USBA reference current supply pin. Connect 2.2 kΩ (±1%) to the AVSS_USBA pin.
	USB0_DP, USBA_DP	I/O	Input or output USB transceiver D+ data.
	USB0_DM, USBA_DM	I/O	Input or output USB transceiver D- data.
	USB0_EXICEN, USBA_EXICEN	Output	Connect to the OTG power IC.
	USB0_ID, USBA_ID	Input	Connect to the OTG power IC.
	USB0_VBUSEN, USBA_VBUSEN	Output	USB VBUS power enable pins
CAN module	USB0_OVRCURA/ USB0_OVRCURB, USBA_OVRCURA/ USBA_OVRCURB	Input	USB overcurrent pins
	USB0_VBUS, USBA_VBUS	Input	USB cable connection/disconnection detection input pins
CAN module	CRX0, CRX1-DS, CRX2	Input	Input pins
	CTX0 to CTX2	Output	Output pins
Serial peripheral interface	RSPCKA-A/RSPCKA-B	I/O	Clock input/output pin
	MOSIA-A/MOSIA-B	I/O	Inputs or outputs data output from the master
	MISOA-A/MISOA-B	I/O	Inputs or outputs data output from the slave
	SSLA0-A/SSLA0-B	I/O	Input or output pin for slave selection
	SSLA1-A/SSLA1-B to SSLA3-A/SSLA3-B	Output	Output pin for slave selection
Quad serial peripheral interface	QSPCLK-A/-B	Output	QSPI clock output pin
	QSSL-A/-B	Output	QSPI slave output pin
	QMO-A/-B, QIO0-A/-B	I/O	Master transmit data/data 0
	QMI-A/-B, QIO1-A/-B	I/O	Master input data/data 1
	QIO2-A/-B, QIO3-A/-B	I/O	Data 2, data 3
Serial sound interface	SSISCK0, SSISCK1	I/O	SSI serial bit clock pins
	SSIWS0, SSIWS1	I/O	Word select pins
	SSITXD0	Output	Serial data output pins
	SSIRXD0	Input	Serial data input pins
	SSIDATA1	I/O	Serial data input/output pins
	AUDIO_MCLK	Input	Master clock pin for audio
MMC host interface	MMC_CLK-A/ MMC_CLK-B	Output	MMC clock pin
	MMC_CMD-A/ MMC_CMD-B	I/O	Command/response pin
	MMC_D7-A/MMC_D7-B to MMC_D0-A/MMC_D0-B	I/O	Transmit data/receive data
	MMC_CD-A/MMC_CD-B	Input	Card detection pin
	MMC_RES#-A/MMC_RES#-B	Output	MMC reset output pin



**Table 1.4 Pin Functions (7/8)**

Classifications	Pin Name	I/O	Description
SD host interface	SDHI_CLK-A/SDHI_CLK-B	Output	SD clock output pin
	SDHI_CMD-A/SDHI_CMD-B	I/O	SD command output, response input signal pin
	SDHI_D3-A/SDHI_D3-B to SDHI_D0-A/SDHI_D0-B	I/O	SD data bus pins
	SDHI_CD-A/SDHI_CD-B	Input	SD card detection pin
	SDHI_WP-A/SDHI_WP-B	Input	SD write-protect signal
Parallel data capture unit	PIXCLK	Input	Image transfer clock pin
	VSYNC	Input	Vertical synchronization signal pin
	HSYNC	Input	Horizontal synchronization signal pin
	PIXD0 to PIXD7	Input	8-bit image data pins
	PCKO	Output	Output pin for dot clock
Realtime clock	RTCOUT	Output	Output pin for 1-Hz/64-Hz clock
	RTCIC0 to RTCIC2	Input	Time capture event input pins
12-bit A/D converter	AN000 to AN007, AN100 to AN120	Input	Input pins for the analog signals to be processed by the A/D converter
	ADTRG0#, ADTRG1#	Input	Input pins for the external trigger signals that start the A/D conversion
	ANEX0	Output	Extended analog output pin
	ANEX1	Input	Extended analog input pin
12-bit D/A converter	DA0, DA1	Output	Output pins for the analog signals to be processed by the D/A converter
Analog power supply	AVCC0	Input	Analog voltage supply pin for the 12-bit A/D converter (unit 0). Connect this pin to a branch from the VCC power supply.
	AVSS0	Input	Analog ground pin for the 12-bit A/D converter (unit 0). Connect this pin to a branch from the VSS ground power supply.
	VREFH0	Input	Analog reference voltage supply pin for the 12-bit A/D converter (unit 0). Connect this pin to VCC if the 12-bit A/D converter is not to be used.
	VREFL0	Input	Analog reference ground pin for the 12-bit A/D converter (unit 0). Connect this pin to VSS if the 12-bit A/D converter is not to be used.
	AVCC1	Input	Analog voltage supply and reference voltage supply pin for the 12-bit A/D converter (unit 1) and D/A converter. This pin also supplies the analog voltage to the temperature sensor. Connect this pin to a branch from the VCC power supply.
	AVSS1	Input	Analog voltage supply and reference voltage supply pin for the 12-bit A/D converter (unit 1) and D/A converter. This pin also supplies the analog ground voltage to the temperature sensor. Connect this pin to a branch from the VSS ground power supply.

**Table 1.4 Pin Functions (8/8)**

Classifications	Pin Name	I/O	Description
I/O ports	P00 to P03, P05, P07	I/O	6-bit input/output pins
	P10 to P17	I/O	8-bit input/output pins
	P20 to P27	I/O	8-bit input/output pins
	P30 to P37	I/O	8-bit input/output pins (P35: input pin)
	P40 to P47	I/O	8-bit input/output pins
	P50 to P56	I/O	7-bit input/output pins (176-pin devices have only P50 to P53)
	P60 to P67	I/O	8-bit input/output pins
	P70 to P77	I/O	8-bit input/output pins
	P80 to P83, P86, P87	I/O	6-bit input/output pins
	P90 to P97	I/O	8-bit input/output pins
	PA0 to PA7	I/O	8-bit input/output pins
	PB0 to PB7	I/O	8-bit input/output pins
	PC0 to PC7	I/O	8-bit input/output pins
	PD0 to PD7	I/O	8-bit input/output pins
	PE0 to PE7	I/O	8-bit input/output pins
	PF0 to PF5	I/O	6-bit input/output pins
	PG0 to PG7	I/O	8-bit input/output pins
	PJ3, PJ5	I/O	2-bit input/output pins

Note: Note the following regarding pin names. For details, see section 1.5, Pin Assignments.

- We recommend that pins suffixed with the same letter such as -A and -B, indicating grouping of the pins, should be used as a set. The AC characteristics of the RSPI, QSPI, SDHI, and MMC are measured using the pins from the same group.
- When the pin functions have "-DS" appended to their names, they can also be used as triggers for release from deep software standby.
- RIIC pin functions that have [FM+] appended to their names support fast-mode plus.

1.5 Pin Assignments

1.5.1 177-Pin TFLGA

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R		
15	PE2	PE3	P70	P65	P67	VSS	VCC	PG7	PA6	PB0	P72	PB4	VSS	VCC	PC1	15	
14	PE1	PE0	VSS	PE7	PG3	PA0	PA1	PA2	PA7	VCC	PB1	PB5	P73	P75	P74	14	
13	P63	P64	PE4	VCC	PG2	PG4	PG6	PA3	VSS	P71	PB3	PB7	PC0	PC2	P76	13	
12	P60	VSS	P62	PE5	PE6	P66	PG5	PA4	PA5	PB2	PB6	P77	PC3	PC4	P80	12	
11	PD6	PG1	VCC	P61	<b>RX64M Group PTLG0177KA-A (177-Pin TFLGA) (Upper Perspective View)</b>								P81	P82	PC6	VCC	11
10	P97	PD4	PG0	PD7									PC5	PC7	P83	VSS	10
9	VCC	P96	PD3	PD5									P50	P51	P52	P53	9
8	P94	PD1	PD2	VSS									VCC_	VSS1_	P10	P11	8
7	VSS	P92	PD0	P95									USBA_	VSS2_	USBA_	USBA_	7
6	VCC	P91	P90	P93									AVCC_	VSS_	AVSS_	PVSS_	6
5	P46	P47	P45	P44	NC	VCC_	P12	USB0_	USB0_	5							
4	P42	P41	P43	P00	VSS	BSCANP	PF4	P35	PF3	PF1	P25	P86	P15	P14	P13	4	
3	VREFL0	P40	VREFH0	P03	PF5	PJ3	MD/ FINED	RES#	P34	PF2	PF0	P24	P22	P87	P16	3	
2	AVCC0	P07	AVCC1	P02	EMLE	VCL	XCOUT	VSS	VCC	P32	P30	P26	P23	P17	P20	2	
1	AVSS0	P05	AVSS1	P01	PJ5	VBATT	XCIN	XTAL	EXTAL	P33	P31	P27	VCC	VSS	P21	1	
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R		

Note: This figure indicates the power supply pins and I/O port pins. For the pin configuration, see Table 1.5, List of Pins and Pin Functions (177-Pin TFLGA, 176-Pin LFBGA).

Figure 1.3 Pin Assignment (177-Pin TFLGA)

1.5.2 176-Pin LFBGA

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R		
15	PE2	PE3	P70	P65	P67	VSS	VCC	PG7	PA6	PB0	P72	PB4	VSS	VCC	PC1	15	
14	PE1	PE0	VSS	PE7	PG3	PA0	PA1	PA2	PA7	VCC	PB1	PB5	P73	P75	P74	14	
13	P63	P64	PE4	VCC	PG2	PG4	PG6	PA3	VSS	P71	PB3	PB7	PC0	PC2	P76	13	
12	P60	VSS	P62	PE5	PE6	P66	PG5	PA4	PA5	PB2	PB6	P77	PC3	PC4	P80	12	
11	PD6	PG1	VCC	P61	<b>RX64M Group PLBG0176GA-A (176-Pin LFBGA) (Upper Perspective View)</b>								P81	P82	PC6	VCC	11
10	P97	PD4	PG0	PD7									PC5	PC7	P83	VSS	10
9	VCC	P96	PD3	PD5									P50	P51	P52	P53	9
8	P94	PD1	PD2	VSS									VCC_	VSS1_	P10	P11	8
7	VSS	P92	PD0	P95									USBA_	VSS2_	USBA_	USBA_	7
6	VCC	P91	P90	P93									AVCC_	VSS_	AVSS_	PVSS_	6
5	P46	P47	P45	P44									VCC_	P12	USB0_	USB0_	5
4	P42	P41	P43	P00									VSS	BSCANP	PF4	P35	PF3
3	VREFL0	P40	VREFH0	P03	PF5	PJ3	MD/ FINED	RES#	P34	PF2	PF0	P24	P22	P87	P16	3	
2	AVCC0	P07	AVCC1	P02	EMLE	VCL	XCOUT	VSS	VCC	P32	P30	P26	P23	P17	P20	2	
1	AVSS0	P05	AVSS1	P01	PJ5	VBATT	XCIN	XTAL	EXTAL	P33	P31	P27	VCC	VSS	P21	1	
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R		

Note: This figure indicates the power supply pins and I/O port pins. For the pin configuration, see Table 1.5, List of Pins and Pin Functions (177-Pin TFLGA, 176-Pin LFBGA).

Figure 1.4 Pin Assignment (176-Pin LFBGA)

1.5.3 176-pin LQFP

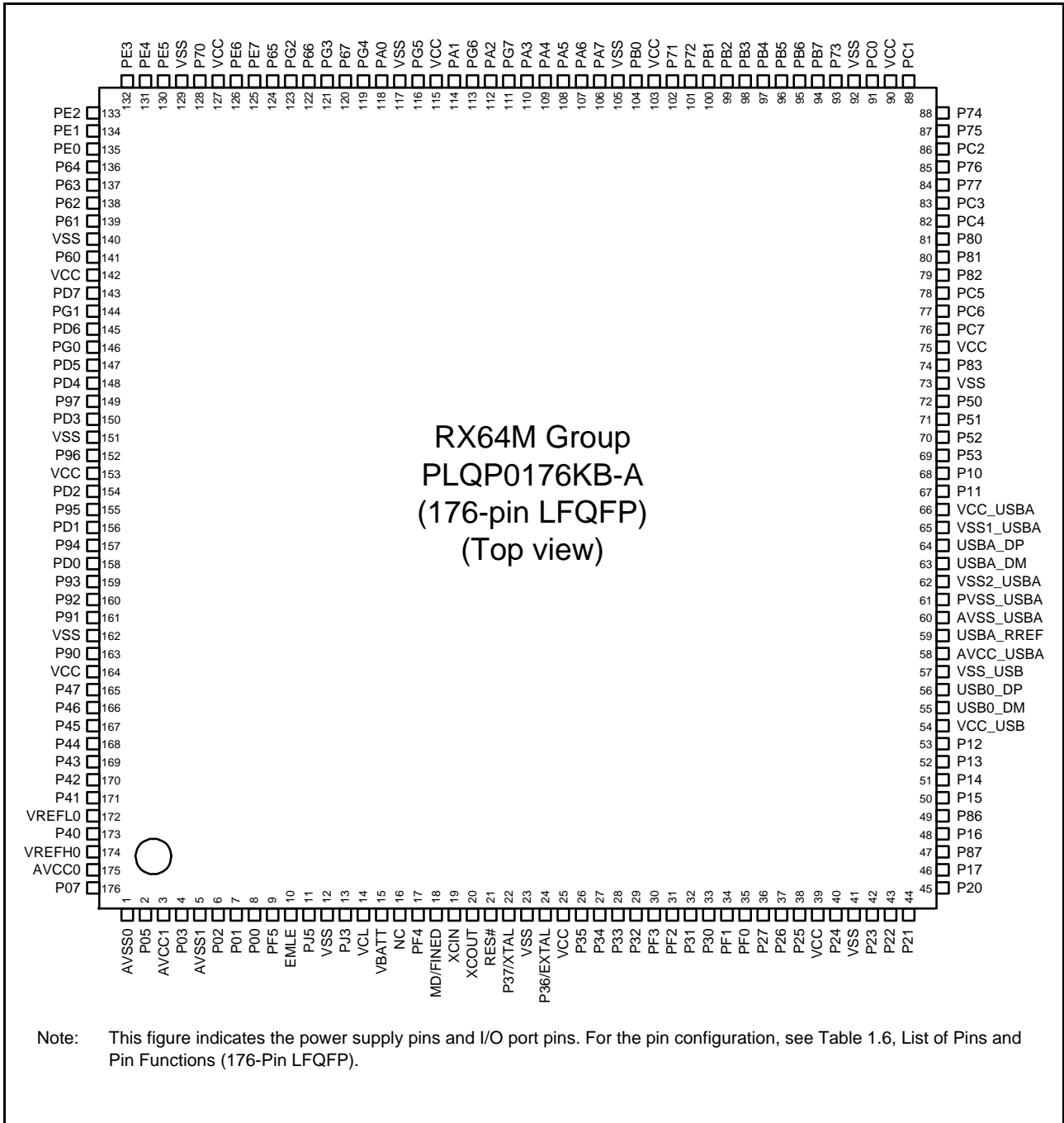


Figure 1.5 Pin Assignment (176-Pin LQFP)

1.5.4 145-Pin TFLGA

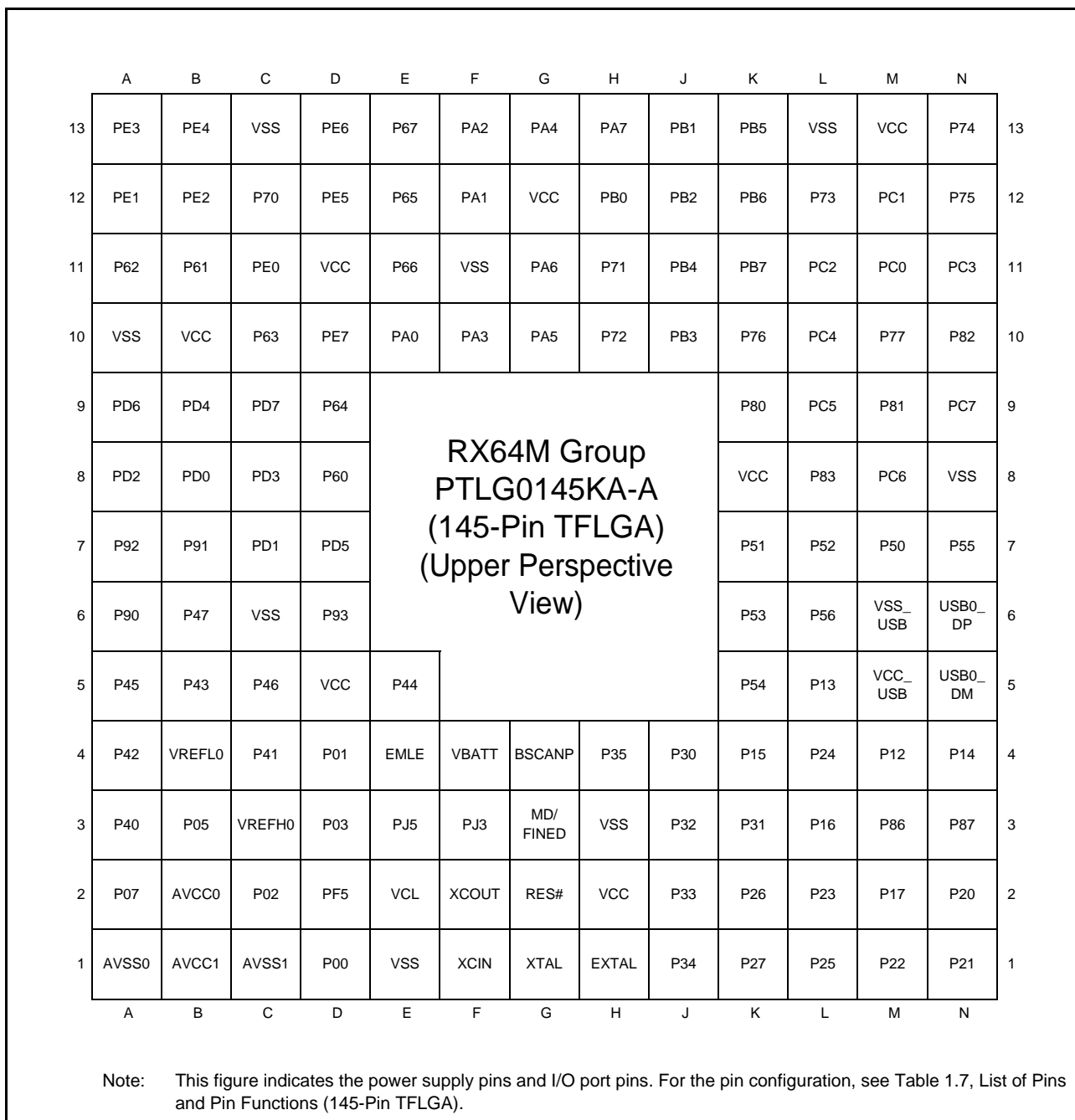


Figure 1.6 Pin Assignment (145-Pin TFLGA)

1.5.5 144-pin LFFQFP

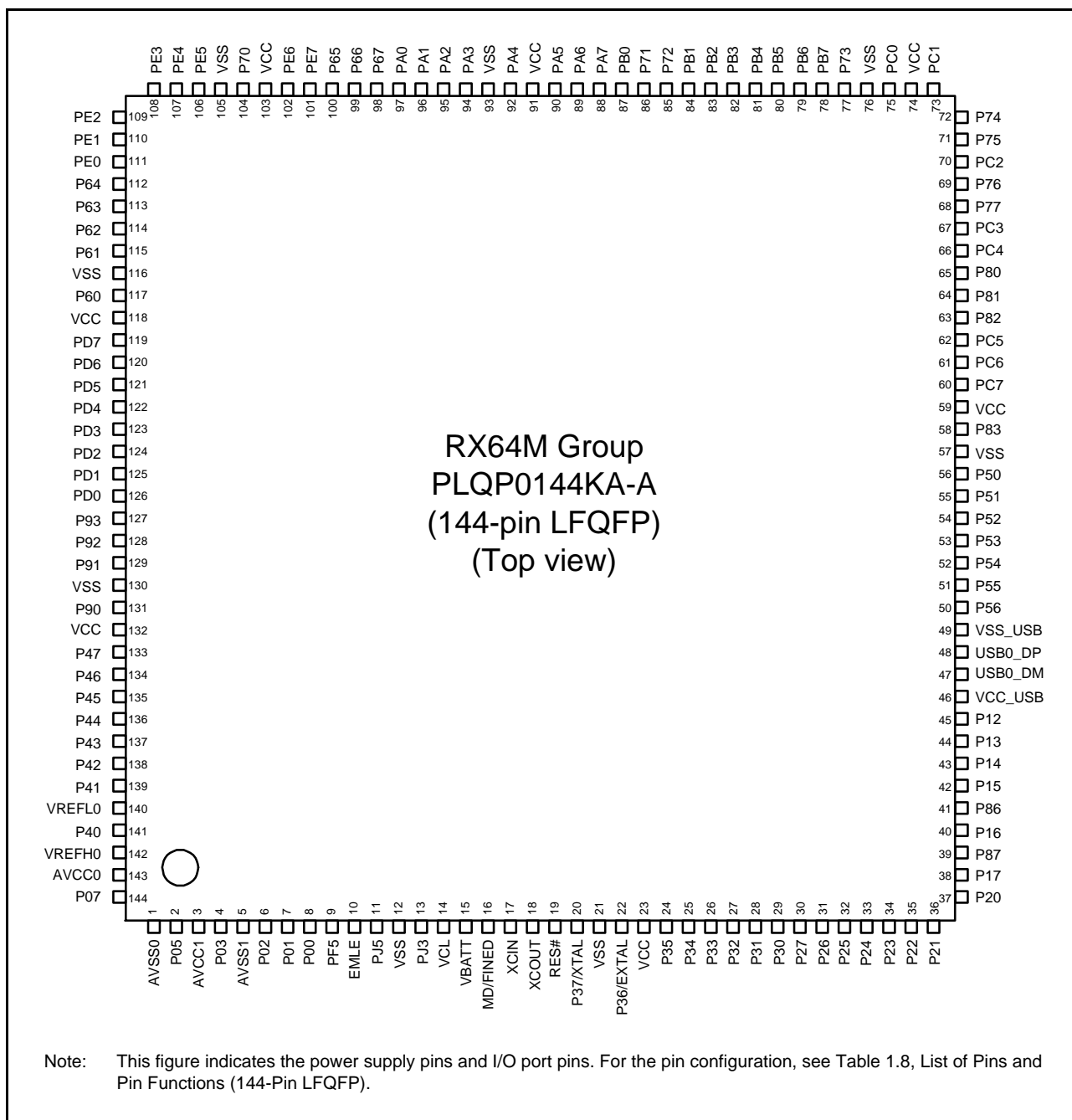


Figure 1.7 Pin Assignment (144-Pin LFFQFP)

1.5.6 100-Pin TFLGA

**RX64M Group  
PTLG0100JA-A (100-Pin TFLGA)  
(Upper Perspective View)**

	A	B	C	D	E	F	G	H	J	K	
10	PE2	PE3	PE4	PA0	PA3	VSS	VCC	PB7	PC1	PC2	10
9	PE1	PD7	PE5	PA1	PA5	PA7	PB1	PB6	PC0	PC3	9
8	PE0	PD6	PD5	PE7	PA4	PB0	PB4	PC6	PC4	PC5	8
7	PD4	PD3	PD2	PE6	PA6	PB2	PB5	PC7	P50	P51	7
6	PD0	PD1	P47	P46	PA2	PB3	P52	P54	VCC_ USB	USB0_ DP	6
5	P43	P44	P42	P45	P41	P12	P53	P55	VSS_ USB	USB0_ DM	5
4	VREFL0	P40	VREFH0	VBATT	P34	P32	P27	P15	P13	P14	4
3	P07	AVCC0	PJ3	MD/ FINED	RES#	P35	P30	P16	P17	P20	3
2	AVCC1	AVSS0	AVSS1	XCOOUT	VSS	VCC	P31	P25	P21	P22	2
1	P05	EMLE	VCL	XCIN	XTAL	EXTAL	P33	P26	P24	P23	1
	A	B	C	D	E	F	G	H	J	K	

Note: This figure indicates the power supply pins and I/O port pins. For the pin configuration, see Table 1.9, List of Pins and Pin Functions (100-Pin TFLGA).

**Figure 1.8 Pin Assignment (100-Pin TFLGA)**



1.5.7 100-pin LFQFP

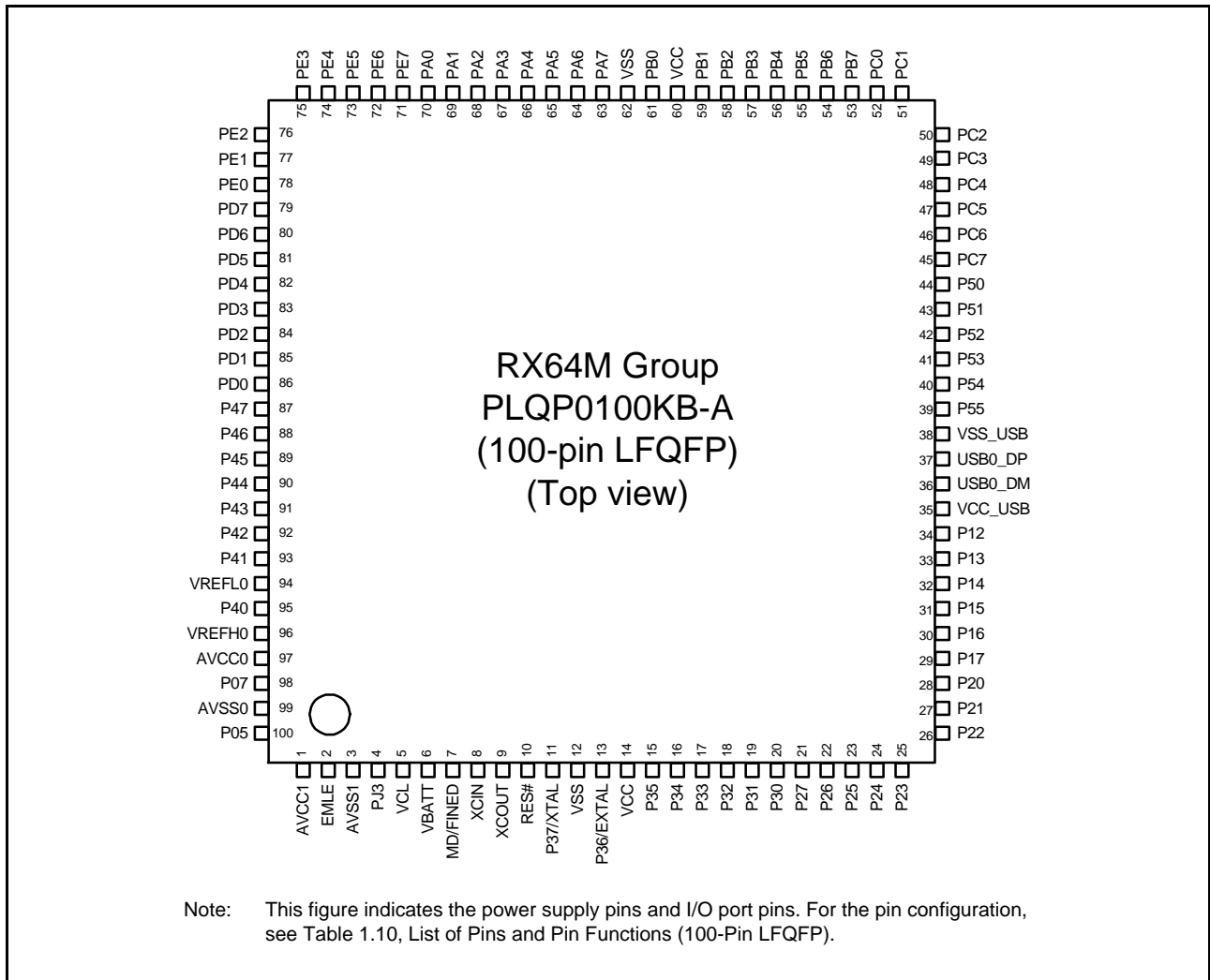


Figure 1.9 Pin Assignment (100-Pin LFQFP)

## 1.6 List of Pins and Pin Functions

## 1.6.1 177-Pin TFLGA and 176-Pin LFBGA

Table 1.5 List of Pins and Pin Functions (177-Pin TFLGA, 176-Pin LFBGA) (1/7)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer  (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication  (ETHERC, SCIG, SCIh, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface  (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
A1	AVSS0							
A2	AVCC0							
A3	VREFL0							
A4		P42					IRQ10-DS	AN002
A5		P46					IRQ14-DS	AN006
A6	VCC							
A7	VSS							
A8		P94	A20/D20		ET1_ERXD0/ RMII1_RXD0			
A9	VCC							
A10		P97	A23/D23		ET1_ERXD3			
A11		PD6	D6[A6/D6]	MTIC5V/MTIOC8A/ POE4#		MMC_D0-B/ SDHI_D0-B/ QIO0-B/ QMO-B	IRQ6	AN106
A12		P60	CS0#		ET1_TX_EN/ RMII1_TXD_EN			
A13		P63	CS3#/CAS#					
A14		PE1	D9[A9/D9]	MTIOC4C/MTIOC3B/ GTIOC1B-A/PO18	TXD12/SMOSI12/ SSDA12/TXD12/ SIOX12	MMC_D5-B		ANEX1
A15		PE2	D10[A10/D10]	MTIOC4A/ GTIOC0B-A/PO23/ TIC3	RXD12/SMISO12/ SSCL12/RXD12	MMC_D6-B	IRQ7-DS	AN100
B1		P05					IRQ13	DA1
B2		P07					IRQ15	ADTRG0#
B3		P40					IRQ8-DS	AN000
B4		P41					IRQ9-DS	AN001
B5		P47					IRQ15-DS	AN007
B6		P91	A17/D17		ET1_COL/SCK7			AN115
B7		P92	A18/D18	POE4#	ET1_CRIS/ RMII1_CRIS_DV/ RXD7/SMISO7/SSCL7			AN116
B8		PD1	D1[A1/D1]	MTIOC4B/ GTIOC1A-E/POE0#	CTX0		IRQ1	AN109
B9		P96	A22/D22		ET1_ERXD2			
B10		PD4	D4[A4/D4]	MTIOC8B/POE11#		MMC_CMD-B/ SDHI_CMD-B/ QSSL-B	IRQ4	AN112
B11		PG1	D25		ET1_RX_ER/ RMII1_RX_ER			
B12	VSS							
B13		P64	CS4#/WE#					
B14		PE0	D8[A8/D8]	MTIOC3D/ GTIOC2B-A	SCK12	MMC_D4-B		ANEX0

Table 1.5 List of Pins and Pin Functions (177-Pin TFLGA, 176-Pin LFBGA) (2/7)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer	Communication	Memory Interface Camera Interface	Interrupt	S12ADC, R12DA
177-Pin TFLGA 176-Pin LFBGA				(MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	(ETHERC, SCIG, SCIh, RSPI, RIIC, CAN, USB, SSI)	(QSPI, SDHI, MMCIF, PDC)		
B15		PE3	D11[A11/D11]	MTIOC4B/ GTIOC2A-A/PO26/ POE8#/TOC3	CTS12#/RTS12#/ SS12#/ ET0_ERXD3	MMC_D7-B		AN101
C1	AVSS1							
C2	AVCC1							
C3	VREFH0							
C4		P43					IRQ11-DS	AN003
C5		P45					IRQ13-DS	AN005
C6		P90	A16/D16		ET1_RX_DV/ TXD7/SMOSI7/SSDA7			AN114
C7		PD0	D0[A0/D0]	GTIOC1B-E/POE4#			IRQ0	AN108
C8		PD2	D2[A2/D2]	MTIOC4D/ GTIOC0B-E/TIC2	CRX0	MMC_D2-B/ SDHI_D2-B/ QIO2-B	IRQ2	AN110
C9		PD3	D3[A3/D3]	MTIOC8D/ GTIOC0A-E/POE8#/ TOC2		MMC_D3-B/ SDHI_D3-B/ QIO3-B	IRQ3	AN111
C10		PG0	D24		ET1_RX_CLK/ REF50CK1			
C11	VCC							
C12		P62	CS2#/RAS#					
C13		PE4	D12[A12/D12]	MTIOC4D/MTIOC1A/ GTIOC1A-A/PO28	ET0_ERXD2			AN102
C14	VSS							
C15		P70	SDCLK					
D1		P01		TMCI0	RXD6/SMISO6/ SSCL6		IRQ9	AN119
D2		P02		TMCI1	SCK6		IRQ10	AN120
D3		P03					IRQ11	DA0
D4		P00		TMRI0	TXD6/SMOSI6/ SSDA6		IRQ8	AN118
D5		P44					IRQ12-DS	AN004
D6		P93	A19/D19	POE0#	ET1_LINKSTA/CTS7#/ RTS7#/SS7#			AN117
D7		P95	A21/D21		ET1_ERXD1/ RMII1_RXD1			
D8	VSS							
D9		PD5	D5[A5/D5]	MTIC5W/MTIOC8C/ POE10#		MMC_CLK-B/ SDHI_CLK-B/ QSPCLK-B	IRQ5	AN113
D10		PD7	D7[A7/D7]	MTIC5U/POE0#		MMC_D1-B/ SDHI_D1-B/ QIO1-B/QMI-B	IRQ7	AN107
D11		P61	CS1#/SDCS#					
D12		PE5	D13[A13/D13]	MTIOC4C/MTIOC2B/ GTIOC0A-A	ET0_RX_CLK/ REF50CK0		IRQ5	AN103
D13	VCC							
D14		PE7	D15[A15/D15]	MTIOC6A/ GTIOC3A-E/TOC1		MMC_RES#-B/ SDHI_WP-B	IRQ7	AN105
D15		P65	CS5#/CKE					
E1		PJ5		POE8#	CTS2#/RTS2#/SS2#			
E2	EMLE							

Table 1.5 List of Pins and Pin Functions (177-Pin TFLGA, 176-Pin LFBGA) (3/7)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SCIG, SCIH, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
E3		PF5					IRQ4	
E4	VSS							
E5*1								
E12		PE6	D14[A14/D14]	MTIOC6C/ GTIOC3B-E/TIC1		MMC_CD-B/ SDHI_CD-B	IRQ6	AN104
E13	TRDATA0	PG2	D26		ET1_TX_CLK			
E14	TRDATA1	PG3	D27		ET1_ETXD0/ RMII1_TXD0			
E15		P67	CS7#/DQM1	MTIOC7C/ GTIOC1B-C	CRX2		IRQ15	
F1	VBATT							
F2	VCL							
F3		PJ3	EDACK1	MTIOC3C	ET0_EXOUT/ CTS6#/RTS6#/ CTS0#/RTS0#/ SS6#/SS0#			
F4	BSCANP							
F12		P66	CS6#/DQM0	MTIOC7D/ GTIOC2B-C	CTX2			
F13	TRSYNC	PG4	D28		ET1_ETXD1/ RMII1_TXD1			
F14		PA0	A0/BC0#/ DQM2	MTIOC4A/MTIOC6D/ GTIOC0B-C/TIOCA0/ CACREF/PO16	SSLA1-B/ ET0_TX_EN/ RMII0_TXD_EN			
F15	VSS							
G1	XCIN							
G2	XCOUT							
G3	MD/FINED							
G4	TRST#	PF4						
G12	TRCLK	PG5	D29		ET1_ETXD2			
G13	TRDATA2	PG6	D30		ET1_ETXD3			
G14		PA1	A1/DQM3	MTIOC0B/MTCLKC/ MTIOC7B/ GTIOC2A-C/TIOC0B/ PO17	SCK5/SSLA2-B/ ET0_WOL		IRQ11	
G15	VCC							
H1	XTAL	P37						
H2	VSS							
H3	RES#							
H4	UPSEL	P35					NMI	
H12		PA4	A4	MTIC5U/MTCLKA/ TIOCA1/TMRI0/PO20	TXD5/SMOSI5/ SSDA5/SSLA0-B/ ET0_MDC		IRQ5-DS	
H13		PA3	A3	MTIOC0D/MTCLKD/ TIOC0D/TCLKB/PO19	RXD5/SMISO5/ SSCL5/ ET0_MDIO		IRQ6-DS	
H14		PA2	A2	MTIOC7A/ GTIOC1A-C/PO18	RXD5/SMISO5/ SSCL5/SSLA3-B			
H15	TRDATA3	PG7	D31		ET1_TX_ER			
J1	EXTAL	P36						
J2	VCC							
J3		P34		MTIOC0A/TMC13/ PO12/POE10#	SCK6/SCK0/ ET0_LINKSTA		IRQ4	

**Table 1.5 List of Pins and Pin Functions (177-Pin TFLGA, 176-Pin LFBGA) (4/7)**

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SCIG, SCIH, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
J4	TMS	PF3						
J12		PA5	A5	MTIOC6B/ GTIOC0A-C/TIOC1/ PO21	RSPCKA-B/ ET0_LINKSTA			
J13	VSS							
J14		PA7	A7	TIOC2B/PO23	MISOA-B/ ET0_WOL			
J15		PA6	A6	MTIC5V/MTCLKB/ GTETR-C/TIOCA2/ TMC13/PO22/POE10#	CTS5#/RTS5#/SS5#/ MOSIA-B/ ET0_EXOUT			
K1		P33	EDREQ1	MTIOC0D/TIOC0D/ TMRI3/PO11/POE4#/ POE11#	RXD6/RXD0/ SMISO6/ SMISO0/SSCL6/ SSCL0/CRX0	PCKO	IRQ3-DS	
K2		P32		MTIOC0C/TIOCC0/ TMO3/PO10/ RTCOU/RTCIC2/ POE0#/POE10#	TXD6/TXD0/ SMOSI6/SMOSI0/ SSDA6/SSDA0/ CTX0/ USB0_VBUSEN	VSYNC	IRQ2-DS	
K3	TDI	PF2			RXD1/SMISO1/ SSCL1			
K4	TCK	PF1			SCK1			
K12		PB2	A10	TIOCC3/TCLKC/ PO26	CTS4#/RTS4#/CTS6#/ RTS6#/SS4#/SS6#/ ET0_RX_CLK/ REF50CK0			
K13		P71	A18/CS1#		ET0_MDIO			
K14	VCC							
K15		PB0	A8	MTIC5W/TIOCA3/ PO24	RXD4/RXD6/SMISO4/ SMISO6/SSCL4/ SSCL6/ET0_ERXD1/ RMII0_RXD1		IRQ12	
L1		P31		MTIOC4D/TMC12/ PO9/RTCIC1	CTS1#/RTS1#/ SS1#/ET1_MDC		IRQ1-DS	
L2		P30		MTIOC4B/TMRI3/ PO8/RTCIC0/POE8#	RXD1/SMISO1/ SSCL1/ET1_MDIO		IRQ0-DS	
L3	TDO	PF0			TXD1/SMOSI1/ SSDA1			
L4		P25	CS5#/ EDACK1	MTIOC4C/MTCLKB/ TIOCA4/PO5	RXD3/SMISO3/ SSCL3/ SSIDATA1	HSYNC		ADTRG0#
L12		PB6	A14	MTIOC3D/TIOCA5/ PO30	RXD9/ET0_ETXD1/ RMII0_TXD1			
L13		PB3	A11	MTIOC0A/MTIOC4A/ TIOC3/TCLKD/ TMO0/PO27/POE11#	SCK4/SCK6/ ET0_RX_ER/ RMII0_RX_ER			
L14		PB1	A9	MTIOC0C/MTIOC4C/ TIOC3/TMC10/PO25	TXD4/TXD6/SMOSI4/ SMOSI6/SSDA4/ SSDA6/ET0_ERXD0/ RMII0_RXD0		IRQ4-DS	
L15		P72	A19/CS2#		ET0_MDC			
M1		P27	CS7#	MTIOC2B/TMC13/PO7	SCK1/ET1_WOL			
M2		P26	CS6#	MTIOC2A/TMO1/PO6	TXD1/CTS3#/ RTS3#/SMOSI1/ SS3#/SSDA1/ ET1_EXOUT			
M3		P24	CS4#/ EDREQ1	MTIOC4A/MTCLKA/ TIOC4B/TMRI1/PO4	SCK3/ USB0_VBUSEN/ SSISCK1	PIXCLK		

**Table 1.5 List of Pins and Pin Functions (177-Pin TFLGA, 176-Pin LFBGA) (5/7)**

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SCIh, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
M4		P86		MTIOC4D/ GTIOC2B-B/TIOCA0	RXD10	PIXD1		
M5	VCC_USB							
M6	AVCC_USBA							
M7	USBA_RREF							
M8	VCC_USBA							
M9		P50	WR0#/WR#		TXD2/SMOSI2/SSDA2			
M10		PC5	A21/CS2#/ WAIT#	MTIOC3B/MTCLKD/ GTIOC1A-D/TMRI2/ PO29	SCK8/RSPCKA-A/ RTS8#/ET0_ETXD2	MMC_D5-A		
M11		P81	EDACK0	MTIOC3D/ GTIOC0B-D/PO27	RXD10/ET0_ETXD0/ RMII0_TXD0	MMC_D3-A/ SDHI_CD-A/ QIO3-A		
M12		P77	CS7#	PO23	TXD11/ET0_RX_ER/ RMII0_RX_ER	MMC_CLK-A/ SDHI_CLK-A/ QSPCLK-A		
M13		PB7	A15	MTIOC3B/TIOCB5/ PO31	TXD9/ET0_CRS/ RMII0_CRS_DV			
M14		PB5	A13	MTIOC2A/MTIOC1B/ TIOCB4/TMRI1/PO29/ POE4#	SCK9/RTS9#/ ET0_ETXD0/ RMII0_TXD0			
M15		PB4	A12	TIOCA4/PO28	CTS9#/ET0_TX_EN/ RMII0_TXD_EN			
N1	VCC							
N2		P23	EDACK0	MTIOC3D/MTCLKD/ GTIOC0A-B/TIOCD3/ PO3	TXD3/CTS0#/RTS0#/ SMOSI3/SS0#/ SSDA3/SSISCK0	PIXD7		
N3		P22	EDREQ0	MTIOC3B/MTCLKC/ GTIOC1A-B/TIOCC3/ TMO0/PO2	SCK0/ USB0_OVRCURB/ USBA_OVRCURB/ AUDIO_MCLK	PIXD6		
N4		P15		MTIOC0B/MTCLKB/ GTETRIG-B/TIOCB2/ TCLKB/TMCI2/PO13	RXD1/SCK3/SMISO1/ SSCL1/CRX1-DS/ USBA_VBUSEN/ SSIWS1	PIXD0	IRQ5	
N5		P12	WR3#/BC3#	MTIC5U/TMCI1	RXD2/SMISO2/ SSCL2/ SCL0[FM+]		IRQ2	
N6	VSS_USB							
N7	VSS2_USBA							
N8	VSS1_USBA							
N9		P51	WR1#/BC1#/ WAIT#		SCK2			
N10	UB	PC7	A23/CS0#	MTIOC3A/MTCLKB/ GTIOC3A-D/TMO2/ TOC0/PO31/CACREF	TXD8/MISOA-A/ ET0_COL	MMC_D7-A	IRQ14	
N11		P82	EDREQ1	MTIOC4A/ GTIOC2A-D/PO28	TXD10/ET0_ETXD1/ RMII0_TXD1	MMC_D4-A		
N12		PC3	A19	MTIOC4D/ GTIOC1B-D/TCLKB/ PO24	TXD5/SMOSI5/ SSDA5/ET0_TX_ER	MMC_D0-A/ SDHI_D0-A/ QIO0-A/ QMO-A		
N13		PC0	A16	MTIOC3C/TCLKC/ PO17	CTS5#/RTS5#/SS5#/ SSLA1-A/ET0_ERXD3		IRQ14	
N14		P73	CS3#	PO16	ET0_WOL			
N15	VSS							
P1	VSS							

Table 1.5 List of Pins and Pin Functions (177-Pin TFLGA, 176-Pin LFBGA) (6/7)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer	Communication	Memory Interface Camera Interface	Interrupt	S12ADC, R12DA
177-Pin TFLGA 176-Pin LFBGA				(MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	(ETHERC, SCIG, SCIh, RSPI, RIIC, CAN, USB, SSI)	(QSPI, SDHI, MMCIF, PDC)		
P2		P17		MTIOC3A/MTIOC3B/ MTIOC4B/ GTIOC0B-B/TIOC0B/ TCLKD/TMO1/PO15/ POE8#	SCK1/TXD3/ SMOSI3/SSDA3/ SDA2-DS/ SSITXD0	PIXD3	IRQ7	ADTRG1#
P3		P87		MTIOC4C/ GTIOC1B-B/TIOCA2	TXD10	PIXD2		
P4		P14		MTIOC3A/MTCLKA/ TIOC0B5/TCLKA/ TMRI2/PO15	CTS1#/RTS1#/ SS1#/CTX1/ USB0_OVRCURA		IRQ4	
P5					USB0_DP			
P6	AVSS_USBA							
P7					USBA_DM			
P8		P10	ALE	MTIC5W/TMRI3	USBA_OVRCURA		IRQ0	
P9		P52	RD#		RXD2/SMISO2/SSCL2			
P10		P83	EDACK1	MTIOC4C/ GTIOC0A-D	CTS10#/ET0_CRS/ RMII0_CRS_DV/ SCK10			
P11		PC6	A22/CS1#	MTIOC3C/MTCLKA/ GTIOC3B-D/TMCI2/ TIC0/PO30	RXD8/MOSIA-A/ ET0_ETXD3	MMC_D6-A	IRQ13	
P12		PC4	A20/CS3#	MTIOC3D/MTCLKC/ GTETR-D/TMCI1/ PO25/POE0#	SCK5/CTS8#/ SSLA0-A/ ET0_TX_CLK	MMC_D1-A/ SDHI_D1-A/ QIO1-A/QMI-A		
P13		PC2	A18	MTIOC4B/ GTIOC2B-D/TCLKA/ PO21	RXD5/SMISO5/ SSCL5/SSLA3-A/ ET0_RX_DV	MMC_CD-A/ SDHI_D3-A		
P14		P75	CS5#	PO20	SCK11/RTS11#/ ET0_ERXD0/ RMII0_RXD0	MMC_RES#-A/ SDHI_D2-A		
P15	VCC							
R1		P21		MTIOC1B/MTIOC4A/ GTIOC2A-B/TIOCA3/ TMCI0/PO1	RXD0/SMISO0/ SSCL0/ USB0_EXICEN/ USBA_EXICEN/ SSIWS0	PIXD5	IRQ9	
R2		P20		MTIOC1A/TIOC0B3/ TMRI0/PO0	TXD0/SMOSI0/ SSDA0/USB0_ID/ USBA_ID/ SSIRXD0	PIXD4	IRQ8	
R3		P16		MTIOC3C/MTIOC3D/ TIOC0B1/TCLKC/ TMO2/PO14/ RTCOUT	TXD1/RXD3/ SMOSI1/SMISO3/ SSDA1/SSCL3/SCL2- DS/USB0_VBUS/ USB0_VBUSEN/ USB0_OVRCURB		IRQ6	ADTRG0#
R4		P13	WR2#/BC2#	MTIOC0B/TIOCA5/ TMO3/PO13	TXD2/SMOSI2/ SSDA2/ SDA0[FM+]		IRQ3	ADTRG1#
R5					USB0_DM			
R6	PVSS_USBA							
R7					USBA_DP			
R8		P11		MTIC5V/TMCI3	SCK2/ USBA_VBUS/ USBA_VBUSEN		IRQ1	
R9		P53*2	BCLK					
R10	VSS							
R11	VCC							

**Table 1.5 List of Pins and Pin Functions (177-Pin TFLGA, 176-Pin LFBGA) (7/7)**

Pin Number 177-Pin TFLGA 176-Pin LFBGA	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SCIG, SCIh, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
R12		P80	EDREQ0	MTIOC3B/PO26	SCK10/RTS10#/ ET0_TX_EN/ RMII0_TXD_EN	MMC_D2-A/ SDHI_WP-A/ QIO2-A		
R13		P76	CS6#	PO22	RXD11/ET0_RX_CLK/ REF50CK0	MMC_CMD-A/ SDHI_CMD-A/ QSSL-A		
R14		P74	A20/CS4#	PO19	CTS11#/ET0_ERXD1/ RMII0_RXD1			
R15		PC1	A17	MTIOC3A/TCLKD/ PO18	SCK5/SSLA2-A/ ET0_ERXD2		IRQ12	

Note 1. The 176-pin LFBGA does not include the E5 pin.

Note 2. The BCLK function is multiplexed with the I/O port function for pin P53, so the port function is not available if the external bus is enabled.



## 1.6.2 176-Pin LQFP

Table 1.6 List of Pins and Pin Functions (176-Pin LQFP) (1/7)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SCIG, SCIh, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface  (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
1	AVSS0							
2		P05					IRQ13	DA1
3	AVCC1							
4		P03					IRQ11	DA0
5	AVSS1							
6		P02		TMC11	SCK6		IRQ10	AN120
7		P01		TMC10	RXD6/SMISO6/ SSCL6		IRQ9	AN119
8		P00		TMR10	TXD6/SMOSI6/ SSDA6		IRQ8	AN118
9		PF5					IRQ4	
10	EMLE							
11		PJ5		POE8#	CTS2#/RTS2#/SS2#			
12	VSS							
13		PJ3	EDACK1	MTIOC3C	ET0_EXOUT/ CTS6#/RTS6#/ CTS0#/RTS0#/ SS6#/SS0#			
14	VCL							
15	VBATT							
16	NC							
17	TRST#	PF4						
18	MD/FINED							
19	XCIN							
20	XCOUT							
21	RES#							
22	XTAL	P37						
23	VSS							
24	EXTAL	P36						
25	VCC							
26	UPSEL	P35					NMI	
27		P34		MTIOC0A/TMC13/ PO12/POE10#	SCK6/SCK0/ ET0_LINKSTA		IRQ4	
28		P33	EDREQ1	MTIOC0D/TIOC0D/ TMR13/PO11/POE4#/ POE11#	RXD6/RXD0/ SMISO6/ SMISO0/SSCL6/ SSCL0/CRX0	PCKO	IRQ3-DS	
29		P32		MTIOC0C/TIOC0C/ TMR03/PO10/ RTCOUT/RTCIC2/ POE0#/POE10#	TXD6/TXD0/ SMOSI6/SMOSI0/ SSDA6/SSDA0/ CTX0/ USB0_VBUSEN	VSYNC	IRQ2-DS	
30	TMS	PF3						
31	TDI	PF2			RXD1/SMISO1/ SSCL1			
32		P31		MTIOC4D/TMC12/ PO9/RTCIC1	CTS1#/RTS1#/ SS1#/ET1_MDC		IRQ1-DS	
33		P30		MTIOC4B/TMR13/ PO8/RTCIC0/POE8#	RXD1/SMISO1/ SSCL1/ET1_MDIO		IRQ0-DS	
34	TCK	PF1			SCK1			

Table 1.6 List of Pins and Pin Functions (176-Pin LFQFP) (2/7)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
35	TDO	PF0			TXD1/SMOSI1/SSDA1			
36		P27	CS7#	MTIOC2B/TMCI3/PO7	SCK1/ET1_WOL			
37		P26	CS6#	MTIOC2A/TMO1/PO6	TXD1/CTS3#/ RTS3#/SMOSI1/ SS3#/SSDA1/ ET1_EXOUT			
38		P25	CS5#/ EDACK1	MTIOC4C/MTCLKB/ TIOCA4/PO5	RXD3/SMISO3/ SSCL3/ SSIDATA1	HSYNC		ADTRG0#
39	VCC							
40		P24	CS4#/ EDREQ1	MTIOC4A/MTCLKA/ TIOCB4/TMRI1/PO4	SCK3/ USB0_VBUSEN/ SSISCK1	PIXCLK		
41	VSS							
42		P23	EDACK0	MTIOC3D/MTCLKD/ GTIOC0A-B/TIOCD3/ PO3	TXD3/CTS0#/ RTS0#/SMOSI3/ SS0#/SSDA3/ SSISCK0	PIXD7		
43		P22	EDREQ0	MTIOC3B/MTCLKC/ GTIOC1A-B/TIOCC3/ TMO0/PO2	SCK0/ USB0_OVRCURB/ USBA_OVRCURB/ AUDIO_MCLK	PIXD6		
44		P21		MTIOC1B/MTIOC4A/ GTIOC2A-B/TIOCA3/ TMCI0/PO1	RXD0/SMISO0/ SSCL0/ USB0_EXICEN/ USBA_EXICEN/ SSIWS0	PIXD5	IRQ9	
45		P20		MTIOC1A/TIOCB3/ TMRI0/PO0	TXD0/SMOSI0/ SSDA0/USB0_ID/ USBA_ID/ SSIRXD0	PIXD4	IRQ8	
46		P17		MTIOC3A/MTIOC3B/ MTIOC4B/ GTIOC0B-B/TIOCB0/ TCLKD/TMO1/PO15/ POE8#	SCK1/TXD3/ SMOSI3/SSDA3/ SDA2-DS/ SSITXD0	PIXD3	IRQ7	ADTRG1#
47		P87		MTIOC4C/ GTIOC1B-B/TIOCA2	TXD10	PIXD2		
48		P16		MTIOC3C/MTIOC3D/ TIOCB1/TCLKC/ TMO2/PO14/ RTCOUT	TXD1/RXD3/ SMOSI1/SMISO3/ SSDA1/SSCL3/ SCL2-DS/ USB0_VBUS/ USB0_VBUSEN/ USB0_OVRCURB		IRQ6	ADTRG0#
49		P86		MTIOC4D/ GTIOC2B-B/TIOCA0	RXD10	PIXD1		
50		P15		MTIOC0B/MTCLKB/ GTETRIG-B/TIOCB2/ TCLKB/TMCI2/PO13	RXD1/SCK3/ SMISO1/SSCL1/ CRX1-DS/ USBA_VBUSEN/ SSIWS1	PIXD0	IRQ5	
51		P14		MTIOC3A/MTCLKA/ TIOCB5/TCLKA/ TMRI2/PO15	CTS1#/RTS1#/ SS1#/CTX1/ USB0_OVRCURA		IRQ4	
52		P13	WR2#/BC2#	MTIOC0B/TIOCA5/ TMO3/PO13	TXD2/SMOSI2/ SSDA2/ SDA0[FM+]		IRQ3	ADTRG1#
53		P12	WR3#/BC3#	MTIC5U/TMCI1	RXD2/SMISO2/ SSCL2/ SCL0[FM+]		IRQ2	
54	VCC_USB							
55					USB0_DM			

Table 1.6 List of Pins and Pin Functions (176-Pin LFQFP) (3/7)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
56					USB0_DP			
57	VSS_USB							
58	AVCC_USBA							
59	USBA_RREF							
60	AVSS_USBA							
61	PVSS_USBA							
62	VSS2_USBA							
63					USBA_DM			
64					USBA_DP			
65	VSS1_USBA							
66	VCC_USBA							
67		P11		MTIC5V/TMC13	SCK2/USBA_VBUS/ USBA_VBUSEN		IRQ1	
68		P10	ALE	MTIC5W/TMR13	USBA_OVRCURA		IRQ0	
69		P53*1	BCLK					
70		P52	RD#		RXD2/SMISO2/SSCL2			
71		P51	WR1#/BC1#/ WAIT#		SCK2			
72		P50	WR0#/WR#		TXD2/SMOSI2/SSDA2			
73	VSS							
74		P83	EDACK1	MTIOC4C/ GTIOC0A-D	CTS10#/ET0_CRS/ RMII0_CRS_DV/ SCK10			
75	VCC							
76	UB	PC7	A23/CS0#	MTIOC3A/MTCLKB/ GTIOC3A-D/TMO2/ TOC0/PO31/CACREF	TXD8/MISOA-A/ ET0_COL	MMC_D7-A	IRQ14	
77		PC6	A22/CS1#	MTIOC3C/MTCLKA/ GTIOC3B-D/TMC12/ TIC0/PO30	RXD8/MOSIA-A/ ET0_ETXD3	MMC_D6-A	IRQ13	
78		PC5	A21/CS2#/ WAIT#	MTIOC3B/MTCLKD/ GTIOC1A-D/TMR12/ PO29	SCK8/RSPCKA-A/ RTS8#/ET0_ETXD2	MMC_D5-A		
79		P82	EDREQ1	MTIOC4A/ GTIOC2A-D/PO28	TXD10/ET0_ETXD1/ RMII0_TXD1	MMC_D4-A		
80		P81	EDACK0	MTIOC3D/ GTIOC0B-D/PO27	RXD10/ET0_ETXD0/ RMII0_TXD0	MMC_D3-A/ SDHI_CD-A/ QIO3-A		
81		P80	EDREQ0	MTIOC3B/PO26	SCK10/RTS10#/ ET0_TX_EN/ RMII0_TXD_EN	MMC_D2-A/ SDHI_WP-A/ QIO2-A		
82		PC4	A20/CS3#	MTIOC3D/MTCLKC/ GTETRQ-D/TMC11/ PO25/POE0#	SCK5/CTS8#/SSLA0- A/ET0_TX_CLK	MMC_D1-A/ SDHI_D1-A/ QIO1-A/QMI-A		
83		PC3	A19	MTIOC4D/ GTIOC1B-D/TCLKB/ PO24	TXD5/SMOSI5/ SSDA5/ ET0_TX_ER	MMC_D0-A/ SDHI_D0-A/ QIO0-A/ QMO-A		
84		P77	CS7#	PO23	TXD11/ET0_RX_ER/ RMII0_RX_ER	MMC_CLK-A/ SDHI_CLK-A/ QSPCLK-A		

Table 1.6 List of Pins and Pin Functions (176-Pin LFQFP) (4/7)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
85		P76	CS6#	PO22	RXD11/ET0_RX_CLK/ REF50CK0	MMC_CMD-A/ SDHI_CMD-A/ QSSL-A		
86		PC2	A18	MTIOC4B/ GTIOC2B-D/TCLKA/ PO21	RXD5/SMISO5/ SSCL5/SSLA3-A/ ET0_RX_DV	MMC_CD-A/ SDHI_D3-A		
87		P75	CS5#	PO20	SCK11/RTS11#/ ET0_ERXD0/ RMII0_RXD0	MMC_RES#-A/ SDHI_D2-A		
88		P74	A20/CS4#	PO19	CTS11#/ET0_ERXD1/ RMII0_RXD1			
89		PC1	A17	MTIOC3A/TCLKD/ PO18	SCK5/SSLA2-A/ ET0_ERXD2		IRQ12	
90	VCC							
91		PC0	A16	MTIOC3C/TCLKC/ PO17	CTS5#/RTS5#/SS5#/ SSLA1-A/ET0_ERXD3		IRQ14	
92	VSS							
93		P73	CS3#	PO16	ET0_WOL			
94		PB7	A15	MTIOC3B/TIOCB5/ PO31	TXD9/ET0_CRS/ RMII0_CRS_DV			
95		PB6	A14	MTIOC3D/TIOCA5/ PO30	RXD9/ET0_ETXD1/ RMII0_TXD1			
96		PB5	A13	MTIOC2A/MTIOC1B/ TIOCB4/TMR11/PO29/ POE4#	SCK9/RTS9#/ ET0_ETXD0/ RMII0_TXD0			
97		PB4	A12	TIOCA4/PO28	CTS9#/ET0_TX_EN/ RMII0_TXD_EN			
98		PB3	A11	MTIOC0A/MTIOC4A/ TIOC3/TCLKD/ TMO0/PO27/POE11#	SCK4/SCK6/ ET0_RX_ER/ RMII0_RX_ER			
99		PB2	A10	TIOCC3/TCLKC/ PO26	CTS4#/RTS4#/ CTS6#/ RTS6#/ SS4#/ SS6#/ ET0_RX_CLK/ REF50CK0			
100		PB1	A9	MTIOC0C/MTIOC4C/ TIOCB3/TMCI0/PO25	TXD4/TXD6/SMOSI4/ SMOSI6/SSDA4/ SSDA6/ET0_ERXD0/ RMII0_RXD0		IRQ4-DS	
101		P72	A19/CS2#		ET0_MDC			
102		P71	A18/CS1#		ET0_MDIO			
103	VCC							
104		PB0	A8	MTIC5W/TIOCA3/ PO24	RXD4/RXD6/SMISO4/ SMISO6/SSCL4/ SSCL6/ET0_ERXD1/ RMII0_RXD1		IRQ12	
105	VSS							
106		PA7	A7	TIOCB2/PO23	MISOA-B/ ET0_WOL			
107		PA6	A6	MTIC5V/MTCLKB/ GTETRG-C/TIOCA2/ TMCI3/PO22/POE10#	CTS5#/RTS5#/ SS5#/ MOSIA-B/ ET0_EXOUT			
108		PA5	A5	MTIOC6B/ GTIOC0A-C/TIOCB1/ PO21	RSPCKA-B/ ET0_LINKSTA			
109		PA4	A4	MTIC5U/MTCLKA/ TIOCA1/TMRI0/PO20	TXD5/SMOSI5/ SSDA5/SSLA0-B/ ET0_MDC		IRQ5-DS	
110		PA3	A3	MTIOC0D/MTCLKD/ TIOC0D/TCLKB/PO19	RXD5/SMISO5/ SSCL5/ ET0_MDIO		IRQ6-DS	

Table 1.6 List of Pins and Pin Functions (176-Pin LQFP) (5/7)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
111	TRDATA3	PG7	D31		ET1_TX_ER			
112		PA2	A2	MTIOC7A/ GTIOC1A-C/PO18	RXD5/SMISO5/ SSCL5/SSLA3-B			
113	TRDATA2	PG6	D30		ET1_ETXD3			
114		PA1	A1/DQM3	MTIOC0B/MTCLKC/ MTIOC7B/ GTIOC2A-C/TIOCB0/ PO17	SCK5/SSLA2-B/ ET0_WOL		IRQ11	
115	VCC							
116	TRCLK	PG5	D29		ET1_ETXD2			
117	VSS							
118		PA0	A0/BC0#/ DQM2	MTIOC4A/MTIOC6D/ GTIOC0B-C/TIOCA0/ CACREF/PO16	SSLA1-B/ ET0_TX_EN/ RMII0_TXD_EN			
119	TRSYNC	PG4	D28		ET1_ETXD1/ RMII1_TXD1			
120		P67	CS7#/DQM1	MTIOC7C/ GTIOC1B-C	CRX2		IRQ15	
121	TRDATA1	PG3	D27		ET1_ETXD0/ RMII1_TXD0			
122		P66	CS6#/DQM0	MTIOC7D/ GTIOC2B-C	CTX2			
123	TRDATA0	PG2	D26		ET1_TX_CLK			
124		P65	CS5#/CKE					
125		PE7	D15[A15/D15]	MTIOC6A/ GTIOC3A-E/TOC1		MMC_RES#-B/ SDHI_WP-B	IRQ7	AN105
126		PE6	D14[A14/D14]	MTIOC6C/ GTIOC3B-E/TIC1		MMC_CD-B/ SDHI_CD-B	IRQ6	AN104
127	VCC							
128		P70	SDCLK					
129	VSS							
130		PE5	D13[A13/D13]	MTIOC4C/MTIOC2B/ GTIOC0A-A	ET0_RX_CLK/ REF50CK0		IRQ5	AN103
131		PE4	D12[A12/D12]	MTIOC4D/MTIOC1A/ GTIOC1A-A/PO28	ET0_ERXD2			AN102
132		PE3	D11[A11/D11]	MTIOC4B/ GTIOC2A-A/PO26/ POE8#/TOC3	CTS12#/RTS12#/ SS12#/ ET0_ERXD3	MMC_D7-B		AN101
133		PE2	D10[A10/D10]	MTIOC4A/ GTIOC0B-A/PO23/ TIC3	RXD12/SMISO12/ SSCL12/RXD12	MMC_D6-B	IRQ7-DS	AN100
134		PE1	D9[A9/D9]	MTIOC4C/MTIOC3B/ GTIOC1B-A/PO18	TXD12/SMOSI12/ SSDA12/TXD12/ SIOX12	MMC_D5-B		ANEX1
135		PE0	D8[A8/D8]	MTIOC3D/ GTIOC2B-A	SCK12	MMC_D4-B		ANEX0
136		P64	CS4#/WE#					
137		P63	CS3#/CAS#					
138		P62	CS2#/RAS#					
139		P61	CS1#/SDCS#					
140	VSS							
141		P60	CS0#		ET1_TX_EN/ RMII1_TXD_EN			
142	VCC							

Table 1.6 List of Pins and Pin Functions (176-Pin LQFP) (6/7)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
143		PD7	D7[A7/D7]	MTIC5U/POE0#		MMC_D1-B/ SDHI_D1-B/ QIO1-B/QMI-B	IRQ7	AN107
144		PG1	D25		ET1_RX_ER/ RMII1_RX_ER			
145		PD6	D6[A6/D6]	MTIC5V/MTIOC8A/ POE4#		MMC_D0-B/ SDHI_D0-B/ QIO0-B/ QMO-B	IRQ6	AN106
146		PG0	D24		ET1_RX_CLK/ REF50CK1			
147		PD5	D5[A5/D5]	MTIC5W/MTIOC8C/ POE10#		MMC_CLK-B/ SDHI_CLK-B/ QSPCLK-B	IRQ5	AN113
148		PD4	D4[A4/D4]	MTIOC8B/POE11#		MMC_CMD-B/ SDHI_CMD-B/ QSSL-B	IRQ4	AN112
149		P97	A23/D23		ET1_ERXD3			
150		PD3	D3[A3/D3]	MTIOC8D/ GTIOC0A-E/POE8#/ TOC2		MMC_D3-B/ SDHI_D3-B/ QIO3-B	IRQ3	AN111
151	VSS							
152		P96	A22/D22		ET1_ERXD2			
153	VCC							
154		PD2	D2[A2/D2]	MTIOC4D/ GTIOC0B-E/TIC2	CRX0	MMC_D2-B/ SDHI_D2-B/ QIO2-B	IRQ2	AN110
155		P95	A21/D21		ET1_ERXD1/ RMII1_RXD1			
156		PD1	D1[A1/D1]	MTIOC4B/ GTIOC1A-E/POE0#	CTX0		IRQ1	AN109
157		P94	A20/D20		ET1_ERXD0/ RMII1_RXD0			
158		PD0	D0[A0/D0]	GTIOC1B-E/POE4#			IRQ0	AN108
159		P93	A19/D19	POE0#	ET1_LINKSTA/CTS7#/ RTS7#/SS7#			AN117
160		P92	A18/D18	POE4#	ET1_CRIS/ RMII1_CRIS_DV/ RXD7/SMISO7/SSCL7			AN116
161		P91	A17/D17		ET1_COL/SCK7			AN115
162	VSS							
163		P90	A16/D16		ET1_RX_DV/ TXD7/SMOSI7/SSDA7			AN114
164	VCC							
165		P47					IRQ15- DS	AN007
166		P46					IRQ14- DS	AN006
167		P45					IRQ13- DS	AN005
168		P44					IRQ12- DS	AN004
169		P43					IRQ11-DS	AN003
170		P42					IRQ10- DS	AN002
171		P41					IRQ9-DS	AN001
172	VREFLO							

**Table 1.6 List of Pins and Pin Functions (176-Pin LFQFP) (7/7)**

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
173		P40					IRQ8-DS	AN000
174	VREFH0							
175	AVCC0							
176		P07					IRQ15	ADTRG0#

Note 1. The BCLK function is multiplexed with the I/O port function for pin P53, so the port function is not available if the external bus is enabled.

## 1.6.3 145-Pin TFLGA

Table 1.7 List of Pins and Pin Functions (145-Pin TFLGA) (1/5)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
A1	AVSS0							
A2		P07					IRQ15	ADTRG0#
A3		P40					IRQ8-DS	AN000
A4		P42					IRQ10-DS	AN002
A5		P45					IRQ13-DS	AN005
A6		P90	A16		TXD7/SMOSI7/SSDA7			AN114
A7		P92	A18	POE4#	RXD7/SMISO7/SSCL7			AN116
A8		PD2	D2[A2/D2]	MTIOC4D/GTIOC0B-E/TIC2	CRX0	MMC_D2-B/SDHI_D2-B/QIO2-B	IRQ2	AN110
A9		PD6	D6[A6/D6]	MTIC5V/MTIOC8A/POE4#		MMC_D0-B/SDHI_D0-B/QIO0-B/QMO-B	IRQ6	AN106
A10	VSS							
A11		P62	CS2#/RAS#					
A12		PE1	D9[A9/D9]	MTIOC4C/MTIOC3B/GTIOC1B-A/PO18	TXD12/SMOSI12/SSDA12/TXD12/SIOX12	MMC_D5-B		ANEX1
A13		PE3	D11[A11/D11]	MTIOC4B/GTIOC2A-A/PO26/POE8#/TOC3	CTS12#/RTS12#/SS12#/ET0_ERXD3	MMC_D7-B		AN101
B1	AVCC1							
B2	AVCC0							
B3		P05					IRQ13	DA1
B4	VREFL0							
B5		P43					IRQ11-DS	AN003
B6		P47					IRQ15-DS	AN007
B7		P91	A17		SCK7			AN115
B8		PD0	D0[A0/D0]	GTIOC1B-E/POE4#			IRQ0	AN108
B9		PD4	D4[A4/D4]	MTIOC8B/POE11#		MMC_CMD-B/SDHI_CMD-B/QSSL-B	IRQ4	AN112
B10	VCC							
B11		P61	CS1#/SDCS#					
B12		PE2	D10[A10/D10]	MTIOC4A/GTIOC0B-A/PO23/TIC3	RXD12/SMISO12/SSCL12/RXD12	MMC_D6-B	IRQ7-DS	AN100
B13		PE4	D12[A12/D12]	MTIOC4D/MTIOC1A/GTIOC1A-A/PO28	ET0_ERXD2			AN102
C1	AVSS1							
C2		P02		TMCI1	SCK6		IRQ10	AN120
C3	VREFH0							
C4		P41					IRQ9-DS	AN001
C5		P46					IRQ14-DS	AN006
C6	VSS							



Table 1.7 List of Pins and Pin Functions (145-Pin TFLGA) (2/5)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
C7		PD1	D1[A1/D1]	MTIOC4B/ GTIOC1A-E/POE0#	CTX0		IRQ1	AN109
C8		PD3	D3[A3/D3]	MTIOC8D/ GTIOC0A-E/POE8#/ TOC2		MMC_D3-B/ SDHI_D3-B/ QIO3-B	IRQ3	AN111
C9		PD7	D7[A7/D7]	MTIC5U/POE0#		MMC_D1-B/ SDHI_D1-B/ QIO1-B/QMI-B	IRQ7	AN107
C10		P63	CS3#/CAS#					
C11		PE0	D8[A8/D8]	MTIOC3D/ GTIOC2B-A	SCK12	MMC_D4-B		ANEX0
C12		P70	SDCLK					
C13	VSS							
D1		P00		TMRI0	TXD6/SMOSI6/SSDA6		IRQ8	AN118
D2		PF5					IRQ4	
D3		P03					IRQ11	DA0
D4		P01		TMCI0	RXD6/SMISO6/SSCL6		IRQ9	AN119
D5	VCC							
D6		P93	A19	POE0#	CTS7#/RTS7#/SS7#			AN117
D7		PD5	D5[A5/D5]	MTIC5W/MTIOC8C/ POE10#		MMC_CLK-B/ SDHI_CLK-B/ QSPCLK-B	IRQ5	AN113
D8		P60	CS0#					
D9		P64	CS4#/WE#					
D10		PE7	D15[A15/D15]	MTIOC6A/ GTIOC3A-E/TOC1		MMC_RES#-B/ SDHI_WP-B	IRQ7	AN105
D11	VCC							
D12		PE5	D13[A13/D13]	MTIOC4C/MTIOC2B/ GTIOC0A-A	ET0_RX_CLK/ REF50CK0		IRQ5	AN103
D13		PE6	D14[A14/D14]	MTIOC6C/GTIOC3B- E/TIC1		MMC_CD-B/ SDHI_CD-B	IRQ6	AN104
E1	VSS							
E2	VCL							
E3		PJ5		POE8#	CTS2#/RTS2#/SS2#			
E4	EMLE							
E5		P44					IRQ12- DS	AN004
E10		PA0	A0/BC0#	MTIOC4A/MTIOC6D/ GTIOC0B-C/TIOCA0/ CACREF/PO16	SSLA1-B/ ET0_TX_EN/ RMII0_TXD_EN			
E11		P66	CS6#/DQM0	MTIOC7D/ GTIOC2B-C	CTX2			
E12		P65	CS5#/CKE					
E13		P67	CS7#/DQM1	MTIOC7C/ GTIOC1B-C	CRX2		IRQ15	
F1	XCIN							
F2	XCOU							
F3		PJ3	EDACK1	MTIOC3C	ET0_EXOUT/CTS6#/ RTS6#/CTS0#/RTS0#/ SS6#/SS0#			
F4	VBATT							
F10		PA3	A3	MTIOC0D/MTCLKD/ TIOC0D/TCLKB/PO19	RXD5/SMISO5/ SSCL5/ET0_MDIO		IRQ6-DS	
F11	VSS							

Table 1.7 List of Pins and Pin Functions (145-Pin TFLGA) (3/5)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
F12		PA1	A1	MTIOC0B/MTCLKC/ MTIOC7B/ GTIOC2A-C/TIOCB0/ PO17	SCK5/SSLA2-B/ ET0_WOL		IRQ11	
F13		PA2	A2	MTIOC7A/ GTIOC1A-C/PO18	RXD5/SMISO5/ SSCL5/SSLA3-B			
G1	XTAL	P37						
G2	RES							
G3	MD/FINED							
G4	BSCANP							
G10		PA5	A5	MTIOC6B/TIOCB1/ GTIOC0A-C/PO21	RSPCKA-B/ ET0_LINKSTA			
G11		PA6	A6	MTIC5V/MTCLKB/ GTETRIG-C/TIOCA2/ TMCI3/PO22/POE10#	CTS5#/RTS5#/SS5#/ MOSIA-B/ ET0_EXOUT			
G12	VCC							
G13		PA4	A4	MTIC5U/MTCLKA/ TIOCA1/TMRI0/PO20	TXD5/SMOSI5/ SSDA5/SSLA0-B/ ET0_MDC		IRQ5-DS	
H1	EXTAL	P36						
H2	VCC							
H3	VSS							
H4	UPSEL	P35					NMI	
H10		P72	A19/CS2#		ET0_MDC			
H11		P71	A18/CS1#		ET0_MDIO			
H12		PB0	A8	MTIC5W/TIOCA3/ PO24	RXD4/RXD6/SMISO4/ SMISO6/SSCL4/ SSCL6/ET0_ERXD1/ RMII0_RXD1		IRQ12	
H13		PA7	A7	TIOCB2/PO23	MISOA-B/ET0_WOL			
J1	TRST#	P34		MTIOC0A/TMCI3/ PO12/POE10#	SCK6/SCK0/ ET0_LINKSTA		IRQ4	
J2		P33	EDREQ1	MTIOC0D/TIOC0D/ TMRI3/PO11/POE4#/ POE11#	RXD6/RXD0/SMISO6/ SMISO0/SSCL6/ SSCL0/CRX0	PCKO	IRQ3-DS	
J3		P32		MTIOC0C/TIOCC0/ TMO3/PO10/ RTCOUT/RTCIC2/ POE0#/POE10#	TXD6/TXD0/SMOSI6/ SMOSI0/SSDA6/ SSDA0/CTX0/ USB0_VBUSEN	VSYNC	IRQ2-DS	
J4	TDI	P30		MTIOC4B/TMRI3/ PO8/RTCIC0/POE8#	RXD1/SMISO1/SSCL1		IRQ0-DS	
J10		PB3	A11	MTIOC0A/MTIOC4A/ TIOC03/TCLKD/ TMO0/PO27/POE11#	SCK4/SCK6/ ET0_RX_ER/ RMII0_RX_ER			
J11		PB4	A12	TIOCA4/PO28	CTS9#/ET0_TX_EN/ RMII0_TXD_EN			
J12		PB2	A10	TIOCC3/TCLKC/ PO26	CTS4#/RTS4#/CTS6#/ RTS6#/SS4#/SS6#/ ET0_RX_CLK/ REF50CK0			
J13		PB1	A9	MTIOC0C/MTIOC4C/ TIOCB3/TMCI0/PO25	TXD4/TXD6/SMOSI4/ SMOSI6/SSDA4/ SSDA6/ET0_ERXD0/ RMII0_RXD0		IRQ4-DS	
K1	TCK	P27	CS7#	MTIOC2B/TMCI3/PO7	SCK1			
K2	TDO	P26	CS6#	MTIOC2A/TMO1/PO6	TXD1/CTS3#/RTS3#/ SMOSI1/SS3#/SSDA1			

Table 1.7 List of Pins and Pin Functions (145-Pin TFLGA) (4/5)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
K3	TMS	P31		MTIOC4D/TMCI2/ PO9/RTCIC1	CTS1#/RTS1#/SSI#		IRQ1-DS	
K4		P15		MTIOC0B/MTCLKB/ GTETR-G-B/TIOCB2/ TCLKB/TMCI2/PO13	RXD1/SCK3/SMISO1/ SSCL1/CRX1-DS/ SSIWS1	PIXD0	IRQ5	
K5	TRDATA2	P54	ALE/EDACK0	MTIOC4B/TMCI1	CTS2#/RTS2#/SS2#/ CTX1/ET0_LINKSTA			
K6		P53*1	BCLK					
K7		P51	WR1#/BC1#/ WAIT#		SCK2			
K8	VCC							
K9	TRDATA0	P80	EDREQ0	MTIOC3B/PO26	SCK10/RTS10#/ ET0_TX_EN/ RMII0_TXD_EN	MMC_D2-A/ SDHI_WP-A/ QIO2-A		
K10		P76	CS6#	PO22	RXD11/ET0_RX_CLK/ REF50CK0	MMC_CMD-A/ SDHI_CMD-A/ QSSL-A		
K11		PB7	A15	MTIOC3B/TIOCB5/ PO31	TXD9/ET0_CRS/ RMII0_CRS_DV			
K12		PB6	A14	MTIOC3D/TIOCA5/ PO30	RXD9/ET0_ETXD1/ RMII0_TXD1			
K13		PB5	A13	MTIOC2A/MTIOC1B/ TIOCB4/TMR11/PO29/ POE4#	SCK9/RTS9#/ ET0_ETXD0/ RMII0_TXD0			
L1		P25	CS5#/ EDACK1	MTIOC4C/MTCLKB/ TIOCA4/PO5	RXD3/SMISO3/ SSCL3/SSIDATA1	HSYNC		ADTRG0#
L2		P23	EDACK0	MTIOC3D/MTCLKD/ GTIOC0A-B/TIOC3D/ PO3	TXD3/CTS0#/RTS0#/ SMOSI3/SS0#/ SSDA3/SSISCK0	PIXD7		
L3		P16		MTIOC3C/MTIOC3D/ TIOCB1/TCLKC/ TMO2/PO14/ RTCOUT	TXD1/RXD3/SMOSI1/ SMISO3/SSDA1/ SSCL3/SCL2-DS/ USB0_VBUS/ USB0_VBUSEN/ USB0_OVRCURB		IRQ6	ADTRG0#
L4		P24	CS4#/ EDREQ1	MTIOC4A/MTCLKA/ TIOCB4/TMR11/PO4	SCK3/ USB0_VBUSEN/ SSISCK1	PIXCLK		
L5		P13		MTIOC0B/TIOCA5/ TMO3/PO13	TXD2/SMOSI2/ SSDA2/SDA0[FM+]		IRQ3	ADTRG1#
L6		P56	EDACK1	MTIOC3C/TIOCA1				
L7		P52	RD#		RXD2/SMISO2/SSCL2			
L8	TRCLK	P83	EDACK1	MTIOC4C/ GTIOC0A-D	CTS10#/ET0_CRS/ RMII0_CRS_DV/ SCK10			
L9		PC5	A21/CS2#/ WAIT#	MTIOC3B/MTCLKD/ GTIOC1A-D/TMR12/ PO29	SCK8/RSPCKA-A/ RTS8#/ET0_ETXD2	MMC_D5-A		
L10		PC4	A20/CS3#	MTIOC3D/MTCLKC/ GTETR-G-D/TMCI1/ PO25/POE0#	SCK5/CTS8#/ SSLA0-A/ ET0_TX_CLK	MMC_D1-A/ SDHI_D1-A/ QIO1-A/QMI-A		
L11		PC2	A18	MTIOC4B/ GTIOC2B-D/TCLKA/ PO21	RXD5/SMISO5/ SSCL5/SSLA3-A/ ET0_RX_DV	MMC_CD-A/ SDHI_D3-A		
L12		P73	CS3#	PO16	ET0_WOL			
L13	VSS							
M1		P22	EDREQ0	MTIOC3B/MTCLKC/ GTIOC1A-B/TIOCC3/ TMO0/PO2	SCK0/ USB0_OVRCURB/ AUDIO_MCLK	PIXD6		

Table 1.7 List of Pins and Pin Functions (145-Pin TFLGA) (5/5)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
M2		P17		MTIOC3A/MTIOC3B/ MTIOC4B/ GTIOC0B-B/TIOC0B/ TCLKD/TMO1/PO15/ POE8#	SCK1/TXD3/SMOSI3/ SSDA3/SDA2-DS/ SSITXD0	PIXD3	IRQ7	ADTRG1#
M3		P86		MTIOC4D/ GTIOC2B-B/TIOCA0	RXD10	PIXD1		
M4		P12		TMC11	RXD2/SMISO2/ SSCL2/SCL0[FM+]		IRQ2	
M5	VCC_USB							
M6	VSS_USB							
M7		P50	WR0#/WR#		TXD2/SMOSI2/SSDA2			
M8		PC6	A22/CS1#	MTIOC3C/MTCLKA/ GTIOC3B-D/TMC12/ TIC0/PO30	RXD8/MOSIA-A/ ET0_ETXD3	MMC_D6-A	IRQ13	
M9	TRDATA1	P81	EDACK0	MTIOC3D/ GTIOC0B-D/PO27	RXD10/ET0_ETXD0/ RMII0_TXD0	MMC_D3-A/ SDHI_CD-A/ QIO3-A		
M10		P77	CS7#	PO23	TXD11/ET0_RX_ER/ RMII0_RX_ER	MMC_CLK-A/ SDHI_CLK-A/ QSPCLK-A		
M11		PC0	A16	MTIOC3C/TCLKC/ PO17	CTS5#/RTS5#/SS5#/ SSLA1-A/ET0_ERXD3		IRQ14	
M12		PC1	A17	MTIOC3A/TCLKD/ PO18	SCK5/SSLA2-A/ ET0_ERXD2		IRQ12	
M13	VCC							
N1		P21		MTIOC1B/MTIOC4A/ GTIOC2A-B/TIOCA3/ TMC10/PO1	RXD0/SMISO0/SSCL0/ USB0_EXICEN/ SSIWS0	PIXD5	IRQ9	
N2		P20		MTIOC1A/TIOC3B/ TMR10/PO0	TXD0/SMOSI0/ SSDA0/USB0_ID/ SSIRXD0	PIXD4	IRQ8	
N3		P87		MTIOC4C/ GTIOC1B-B/TIOCA2	TXD10	PIXD2		
N4		P14		MTIOC3A/MTCLKA/ TIOC3B5/TCLKA/ TMR12/PO15	CTS1#/RTS1#/SS1#/ CTX1/ USB0_OVRCURA		IRQ4	
N5					USB0_DM			
N6					USB0_DP			
N7	TRDATA3	P55	WAIT#/ EDREQ0	MTIOC4D/TMO3	CRX1/ET0_EXOUT		IRQ10	
N8	VSS							
N9	UB	PC7	A23/CS0#	MTIOC3A/MTCLKB/ GTIOC3A-D/TMO2/ TOC0/PO31/CACREF	TXD8/MISOA-A/ ET0_COL	MMC_D7-A	IRQ14	
N10	TRSYNC	P82	EDREQ1	MTIOC4A/ GTIOC2A-D/PO28	TXD10/ET0_ETXD1/ RMII0_TXD1	MMC_D4-A		
N11		PC3	A19	MTIOC4D/ GTIOC1B-D/TCLKB/ PO24	TXD5/SMOSI5/ SSDA5/ET0_TX_ER	MMC_D0-A/ SDHI_D0-A/ QIO0-A/ QMO-A		
N12		P75	CS5#	PO20	SCK11/RTS11#/ ET0_ERXD0/ RMII0_RXD0	MMC_RES#-A/ SDHI_D2-A		
N13		P74	A20/CS4#	PO19	CTS11#/ET0_ERXD1/ RMII0_RXD1			

Note 1. The BCLK function is multiplexed with the I/O port function for pin P53, so the port function is not available if the external bus is enabled.

## 1.6.4 144-Pin LQFP

Table 1.8 List of Pins and Pin Functions (144-Pin LQFP) (1/5)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SClg, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
1	AVSS0							
2		P05					IRQ13	DA1
3	AVCC1							
4		P03					IRQ11	DA0
5	AVSS1							
6		P02		TMCI1	SCK6		IRQ10	AN120
7		P01		TMCI0	RXD6/SMISO6/SSCL6		IRQ9	AN119
8		P00		TMRI0	TXD6/SMOSI6/SSDA6		IRQ8	AN118
9		PF5					IRQ4	
10	EMLE							
11		PJ5		POE8#	CTS2#/RTS2#/SS2#			
12	VSS							
13		PJ3	EDACK1	MTIOC3C	ET0_EXOUT/CTS6#/RTS6#/CTS0#/RTS0#/SS6#/SS0#			
14	VCL							
15	VBATT							
16	MD/FINED							
17	XCIN							
18	XCOUT							
19	RES							
20	XTAL	P37						
21	VSS							
22	EXTAL	P36						
23	VCC							
24	UPSEL	P35					NMI	
25	TRST#	P34		MTIOC0A/TMCI3/PO12/POE10#	SCK6/SCK0/ET0_LINKSTA		IRQ4	
26		P33	EDREQ1	MTIOC0D/TIOC0D/TMRI3/PO11/POE4#/POE11#	RXD6/RXD0/SMISO6/SMISO0/SSCL6/SSCL0/CRX0	PCKO	IRQ3-DS	
27		P32		MTIOC0C/TIOCC0/TMO3/PO10/RTCOUT/RTCIC2/POE0#/POE10#	TXD6/TXD0/SMOSI6/SMOSI0/SSDA6/SSDA0/CTX0/USB0_VBUSEN	VSYNC	IRQ2-DS	
28	TMS	P31		MTIOC4D/TMCI2/PO9/RTCIC1	CTS1#/RTS1#/SS1#		IRQ1-DS	
29	TDI	P30		MTIOC4B/TMRI3/PO8/RTCIC0/POE8#	RXD1/SMISO1/SSCL1		IRQ0-DS	
30	TCK	P27	CS7#	MTIOC2B/TMCI3/PO7	SCK1			
31	TDO	P26	CS6#	MTIOC2A/TMO1/PO6	TXD1/CTS3#/RTS3#/SMOSI1/SS3#/SSDA1			
32		P25	CS5#/EDACK1	MTIOC4C/MTCLKB/TIOCA4/PO5	RXD3/SMISO3/SSCL3/SSIDATA1	HSYNC		ADTRG0#
33		P24	CS4#/EDREQ1	MTIOC4A/MTCLKA/TIOCB4/TMRI1/PO4	SCK3/USB0_VBUSEN/SSISCK1	PIXCLK		
34		P23	EDACK0	MTIOC3D/MTCLKD/GTIOC0A-B/TIOC0D3/PO3	TXD3/CTS0#/RTS0#/SMOSI3/SS0#/SSDA3/SSISCK0	PIXD7		

Table 1.8 List of Pins and Pin Functions (144-Pin LQFP) (2/5)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
35		P22	EDREQ0	MTIOC3B/MTCLKC/ GTIOC1A-B/TIOCC3/ TMO0/PO2	SCK0/ USB0_OVRCURB/ AUDIO_MCLK	PIXD6		
36		P21		MTIOC1B/MTIOC4A/ GTIOC2A-B/TIOCA3/ TMC10/PO1	RXD0/SMISO0/ SSCL0/ USB0_EXICEN/ SSIWS0	PIXD5	IRQ9	
37		P20		MTIOC1A/TIOCB3/ TMR10/PO0	TXD0/SMOSI0/ SSDA0/USB0_ID/ SSIRXD0	PIXD4	IRQ8	
38		P17		MTIOC3A/MTIOC3B/ MTIOC4B/ GTIOC0B-B/TIOCB0/ TCLKD/TMO1/PO15/ POE8#	SCK1/TXD3/SMOSI3/ SSDA3/SDA2-DS/ SSITXD0	PIXD3	IRQ7	ADTRG1#
39		P87		MTIOC4C/ GTIOC1B-B/TIOCA2	TXD10	PIXD2		
40		P16		MTIOC3C/MTIOC3D/ TIOCB1/TCLKC/ TMO2/PO14/ RTCOUT	TXD1/RXD3/SMOSI1/ SMISO3/SSDA1/ SSCL3/SCL2-DS/ USB0_VBUS/ USB0_VBUSEN/ USB0_OVRCURB		IRQ6	ADTRG0#
41		P86		MTIOC4D/ GTIOC2B-B/TIOCA0	RXD10	PIXD1		
42		P15		MTIOC0B/MTCLKB/ GTETRQ-B/TIOCB2/ TCLKB/TMC12/PO13	RXD1/SCK3/SMOSI1/ SSCL1/CRX1-DS/ SSIWS1	PIXD0	IRQ5	
43		P14		MTIOC3A/MTCLKA/ TIOCB5/TCLKA/ TMR12/PO15	CTS1#/RTS1#/SS1#/ CTX1/ USB0_OVRCURA		IRQ4	
44		P13		MTIOC0B/TIOCA5/ TMO3/PO13	TXD2/SMOSI2/ SSDA2/SDA0[FM+]		IRQ3	ADTRG1#
45		P12		TMC11	RXD2/SMISO2/ SSCL2/SCL0[FM+]		IRQ2	
46	VCC_USB							
47					USB0_DM			
48					USB0_DP			
49	VSS_USB							
50		P56	EDACK1	MTIOC3C/TIOCA1				
51	TRDATA3	P55	WAIT#/ EDREQ0	MTIOC4D/TMO3	CRX1/ET0_EXOUT		IRQ10	
52	TRDATA2	P54	ALE/EDACK0	MTIOC4B/TMC11	CTS2#/RTS2#/SS2#/ CTX1/ET0_LINKSTA			
53		P53*1	BCLK					
54		P52	RD#		RXD2/SMISO2/SSCL2			
55		P51	WR1#/BC1#/ WAIT#		SCK2			
56		P50	WR0#/WR#		TXD2/SMOSI2/SSDA2			
57	VSS							
58	TRCLK	P83	EDACK1	MTIOC4C/ GTIOC0A-D	CTS10#/ET0_CRS/ RMII0_CRS_DV/ SCK10			
59	VCC							
60	UB	PC7	A23/CS0#	MTIOC3A/MTCLKB/ GTIOC3A-D/TMO2/ TOC0/PO31/CACREF	TXD8/MISOA-A/ ET0_COL	MMC_D7-A	IRQ14	
61		PC6	A22/CS1#	MTIOC3C/MTCLKA/ GTIOC3B-D/TMC12/ TIC0/PO30	RXD8/MOSIA-A/ ET0_ETXD3	MMC_D6-A	IRQ13	

Table 1.8 List of Pins and Pin Functions (144-Pin LFQFP) (3/5)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
62		PC5	A21/CS2#/WAIT#	MTIOC3B/MTCLKD/GTIOC1A-D/TMRI2/PO29	SCK8/RSPCKA-A/RTS8#/ET0_ETXD2	MMC_D5-A		
63	TRSYNC	P82	EDREQ1	MTIOC4A/GTIOC2A-D/PO28	TXD10/ET0_ETXD1/RMII0_TXD1	MMC_D4-A		
64	TRDATA1	P81	EDACK0	MTIOC3D/GTIOC0B-D/PO27	RXD10/ET0_ETXD0/RMII0_TXD0	MMC_D3-A/SDHI_CD-A/QIO3-A		
65	TRDATA0	P80	EDREQ0	MTIOC3B/PO26	SCK10/RTS10#/ET0_TX_EN/RMII0_TXD_EN	MMC_D2-A/SDHI_WP-A/QIO2-A		
66		PC4	A20/CS3#	MTIOC3D/MTCLKC/GTETR-D/TMCI1/PO25/POE0#	SCK5/CTS8#/SSLA0-A/ET0_TX_CLK	MMC_D1-A/SDHI_D1-A/QIO1-A/QMI-A		
67		PC3	A19	MTIOC4D/GTIOC1B-D/TCLKB/PO24	TXD5/SMOSI5/SSDA5/ET0_TX_ER	MMC_D0-A/SDHI_D0-A/QIO0-A/QMO-A		
68		P77	CS7#	PO23	TXD11/ET0_RX_ER/RMII0_RX_ER	MMC_CLK-A/SDHI_CLK-A/QSPCLK-A		
69		P76	CS6#	PO22	RXD11/ET0_RX_CLK/REF50CK0	MMC_CMD-A/SDHI_CMD-A/QSSL-A		
70		PC2	A18	MTIOC4B/GTIOC2B-D/TCLKA/PO21	RXD5/SMISO5/SSCL5/SSLA3-A/ET0_RX_DV	MMC_CD-A/SDHI_D3-A		
71		P75	CS5#	PO20	SCK11/RTS11#/ET0_ERXD0/RMII0_RXD0	MMC_RES#-A/SDHI_D2-A		
72		P74	A20/CS4#	PO19	CTS11#/ET0_ERXD1/RMII0_RXD1			
73		PC1	A17	MTIOC3A/TCLKD/PO18	SCK5/SSLA2-A/ET0_ERXD2		IRQ12	
74	VCC							
75		PC0	A16	MTIOC3C/TCLKC/PO17	CTS5#/RTS5#/SS5#/SSLA1-A/ET0_ERXD3		IRQ14	
76	VSS							
77		P73	CS3#	PO16	ET0_WOL			
78		PB7	A15	MTIOC3B/TIOCB5/PO31	TXD9/ET0_CRS/RMII0_CRS_DV			
79		PB6	A14	MTIOC3D/TIOCA5/PO30	RXD9/ET0_ETXD1/RMII0_TXD1			
80		PB5	A13	MTIOC2A/MTIOC1B/TIOCB4/TMRI1/PO29/POE4#	SCK9/RTS9#/ET0_ETXD0/RMII0_TXD0			
81		PB4	A12	TIOCA4/PO28	CTS9#/ET0_TX_EN/RMII0_TXD_EN			
82		PB3	A11	MTIOC0A/MTIOC4A/TIOCD3/TCLKD/TMO0/PO27/POE11#	SCK4/SCK6/ET0_RX_ER/RMII0_RX_ER			
83		PB2	A10	TIOCC3/TCLKC/PO26	CTS4#/RTS4#/CTS6#/RTS6#/SS4#/SS6#/ET0_RX_CLK/REF50CK0			
84		PB1	A9	MTIOC0C/MTIOC4C/TIOCB3/TMCI0/PO25	TXD4/TXD6/SMOSI4/SMOSI6/SSDA4/SSDA6/ET0_ERXD0/RMII0_RXD0		IRQ4-DS	
85		P72	A19/CS2#		ET0_MDC			
86		P71	A18/CS1#		ET0_MDIO			

Table 1.8 List of Pins and Pin Functions (144-Pin LFQFP) (4/5)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
87		PB0	A8	MTIC5W/TIOCA3/PO24	RXD4/RXD6/SMISO4/SMISO6/SSCL4/SSCL6/ET0_ERXD1/RMII0_RXD1		IRQ12	
88		PA7	A7	TIOCB2/PO23	MISOA-B/ET0_WOL			
89		PA6	A6	MTIC5V/MTCLKB/GTETR-G-C/TIOCA2/TMC13/PO22/POE10#	CTS5#/RTS5#/SS5#/MOSIA-B/ET0_EXOUT			
90		PA5	A5	MTIOC6B/TIOCB1/GTIOC0A-C/PO21	RSPCKA-B/ET0_LINKSTA			
91	VCC							
92		PA4	A4	MTIC5U/MTCLKA/TIOCA1/TMRI0/PO20	TXD5/SMOSI5/SSDA5/SSLA0-B/ET0_MDC		IRQ5-DS	
93	VSS							
94		PA3	A3	MTIOC0D/MTCLKD/TIOC0D/TCLKB/PO19	RXD5/SMISO5/SSCL5/ET0_MDIO		IRQ6-DS	
95		PA2	A2	MTIOC7A/GTIOC1A-C/PO18	RXD5/SMISO5/SSCL5/SSLA3-B			
96		PA1	A1	MTIOC0B/MTCLKC/MTIOC7B/GTIOC2A-C/TIOCB0/PO17	SCK5/SSLA2-B/ET0_WOL		IRQ11	
97		PA0	A0/BC0#	MTIOC4A/MTIOC6D/GTIOC0B-C/TIOCA0/CACREF/PO16	SSLA1-B/ET0_TX_EN/RMII0_TXD_EN			
98		P67	CS7#/DQM1	MTIOC7C/GTIOC1B-C	CRX2		IRQ15	
99		P66	CS6#/DQM0	MTIOC7D/GTIOC2B-C	CTX2			
100		P65	CS5#/CKE					
101		PE7	D15[A15/D15]	MTIOC6A/GTIOC3A-E/TOC1		MMC_RES#-B/SDHI_WP-B	IRQ7	AN105
102		PE6	D14[A14/D14]	MTIOC6C/GTIOC3B-E/TIC1		MMC_CD-B/SDHI_CD-B	IRQ6	AN104
103	VCC							
104		P70	SDCLK					
105	VSS							
106		PE5	D13[A13/D13]	MTIOC4C/MTIOC2B/GTIOC0A-A	ET0_RX_CLK/REF50CK0		IRQ5	AN103
107		PE4	D12[A12/D12]	MTIOC4D/MTIOC1A/GTIOC1A-A/PO28	ET0_ERXD2			AN102
108		PE3	D11[A11/D11]	MTIOC4B/GTIOC2A-A/PO26/POE8#/TOC3	CTS12#/RTS12#/SS12#/ET0_ERXD3	MMC_D7-B		AN101
109		PE2	D10[A10/D10]	MTIOC4A/GTIOC0B-A/PO23/TIC3	RXD12/SMISO12/SSCL12/RXD12	MMC_D6-B	IRQ7-DS	AN100
110		PE1	D9[A9/D9]	MTIOC4C/MTIOC3B/GTIOC1B-A/PO18	TXD12/SMOSI12/SSDA12/TXD12/SIOX12	MMC_D5-B		ANEX1
111		PE0	D8[A8/D8]	MTIOC3D/GTIOC2B-A	SCK12	MMC_D4-B		ANEX0
112		P64	CS4#/WE#					
113		P63	CS3#/CAS#					
114		P62	CS2#/RAS#					
115		P61	CS1#/SDCS#					
116	VSS							



**Table 1.8 List of Pins and Pin Functions (144-Pin LQFP) (5/5)**

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC SDRAMC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SC1g, SC1h, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF, PDC)	Interrupt	S12ADC, R12DA
117		P60	CS0#					
118	VCC							
119		PD7	D7[A7/D7]	MTIC5U/POE0#		MMC_D1-B/ SDHI_D1-B/ QIO1-B/QMI-B	IRQ7	AN107
120		PD6	D6[A6/D6]	MTIC5V/MTIOC8A/ POE4#		MMC_D0-B/ SDHI_D0-B/ QIO0-B/QMO- B	IRQ6	AN106
121		PD5	D5[A5/D5]	MTIC5W/MTIOC8C/ POE10#		MMC_CLK-B/ SDHI_CLK-B/ QSPCLK-B	IRQ5	AN113
122		PD4	D4[A4/D4]	MTIOC8B/POE11#		MMC_CMD-B/ SDHI_CMD-B/ QSSL-B	IRQ4	AN112
123		PD3	D3[A3/D3]	MTIOC8D/ GTIOC0A-E/POE8#/ TOC2		MMC_D3-B/ SDHI_D3-B/ QIO3-B	IRQ3	AN111
124		PD2	D2[A2/D2]	MTIOC4D/ GTIOC0B-E/TIC2	CRX0	MMC_D2-B/ SDHI_D2-B/ QIO2-B	IRQ2	AN110
125		PD1	D1[A1/D1]	MTIOC4B/ GTIOC1A-E/POE0#	CTX0		IRQ1	AN109
126		PD0	D0[A0/D0]	GTIOC1B-E/POE4#			IRQ0	AN108
127		P93	A19	POE0#	CTS7#/RTS7#/SS7#			AN117
128		P92	A18	POE4#	RXD7/SMISO7/SSCL7			AN116
129		P91	A17		SCK7			AN115
130	VSS							
131		P90	A16		TXD7/SMOSI7/SSDA7			AN114
132	VCC							
133		P47					IRQ15- DS	AN007
134		P46					IRQ14- DS	AN006
135		P45					IRQ13- DS	AN005
136		P44					IRQ12- DS	AN004
137		P43					IRQ11-DS	AN003
138		P42					IRQ10- DS	AN002
139		P41					IRQ9-DS	AN001
140	VREFL0							
141		P40					IRQ8-DS	AN000
142	VREFH0							
143	AVCC0							
144		P07					IRQ15	ADTRG0#

Note 1. The BCLK function is multiplexed with the I/O port function for pin P53, so the port function is not available if the external bus is enabled.

## 1.6.5 100-Pin TFLGA

Table 1.9 List of Pins and Pin Functions (100-Pin TFLGA) (1/4)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SCIG, SCIH, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF)	Interrupt	S12ADC, R12DA
A1	P05						IRQ13	DA1
A2	AVCC1							
A3		P07					IRQ15	ADTRG0#
A4	VREFL0							
A5		P43					IRQ11-DS	AN003
A6		PD0	D0[A0/D0]	GTIOC1B-E/POE4#			IRQ0	AN108
A7		PD4	D4[A4/D4]	MTIOC8B/POE11#		MMC_CMD-B/ SDHI_CMD-B/ QSSL-B	IRQ4	AN112
A8		PE0	D8[A8/D8]	MTIOC3D/GTIOC2B-A	SCK12	MMC_D4-B		ANEX0
A9		PE1	D9[A9/D9]	MTIOC4C/MTIOC3B/ GTIOC1B-A/PO18	TXD12/SMOS12/ SSDA12/TXD12/ SIOX12	MMC_D5-B		ANEX1
A10		PE2	D10[A10/ D10]	MTIOC4A/GTIOC0B- A/PO23/TIC3	RXD12/SMISO12/ SSCL12/RXD12	MMC_D6-B	IRQ7-DS	AN100
B1	EMLE							
B2	AVSS0							
B3	AVCC0							
B4		P40					IRQ8-DS	AN000
B5		P44					IRQ12-DS	AN004
B6		PD1	D1[A1/D1]	MTIOC4B/GTIOC1A- E/POE0#	CTX0		IRQ1	AN109
B7		PD3	D3[A3/D3]	MTIOC8D/GTIOC0A- E/POE8#/TOC2		MMC_D3-B/ SDHI_D3-B/ QIO3-B	IRQ3	AN111
B8		PD6	D6[A6/D6]	MTIC5V/MTIOC8A/ POE4#		MMC_D0-B/ SDHI_D0-B/ QIO0-B/QMO-B	IRQ6	AN106
B9		PD7	D7[A7/D7]	MTIC5U/POE0#		MMC_D1-B/ SDHI_D1-B/ QIO1/QMI-B	IRQ7	AN107
B10		PE3	D11[A11/ D11]	MTIOC4B/GTIOC2A- A/PO26/POE8#/TOC3	CTS12#/RTS12#/ SS12#/ET0_ERXD3	MMC_D7-B		AN101
C1	VCL							
C2	AVSS1							
C3		PJ3	EDACK1	MTIOC3C	ET0_EXOUT/CTS6#/ RTS6#/CTS0#/RTS0#/ SS6#/SS0#			
C4	VREFH0							
C5		P42					IRQ10-DS	AN002
C6		P47					IRQ15-DS	AN007
C7		PD2	D2[A2/D2]	MTIOC4D/GTIOC0B- E/TIC2	CRX0	MMC_D2-B/ SDHI_D2-B/ QIO2-B	IRQ2	AN110
C8		PD5	D5[A5/D5]	MTIC5W/MTIOC8C/ POE10#		MMC_CLK-B/ SDHI_CLK-B/ QSPCLK-B	IRQ5	AN113
C9		PE5	D13[A13/ D13]	MTIOC4C/MTIOC2B/ GTIOC0A-A	ET0_RX_CLK/ REF50CK0		IRQ5	AN103

Table 1.9 List of Pins and Pin Functions (100-Pin TFLGA) (2/4)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SCIG, SCIH, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF)	Interrupt	S12ADC, R12DA
C10		PE4	D12[A12/D12]	MTIOC4D/MTIOC1A/GTIOC1A-A/PO28	ET0_ERXD2			AN102
D1	XCIN							
D2	XCOUT							
D3	MD/FINED							
D4	VBATT							
D5		P45					IRQ13-DS	AN005
D6		P46					IRQ14-DS	AN006
D7		PE6	D14[A14/D14]	MTIOC6C/GTIOC3B-E/TIC1		MMC_CD-B/SDHI_CD-B	IRQ6	AN104
D8		PE7	D15[A15/D15]	MTIOC6A/GTIOC3A-E/TOC1		MMC_RES#-B/SDHI_WP-B	IRQ7	AN105
D9		PA1	A1	MTIOC0B/MTCLKC/MTIOC7B/GTIOC2A-C/TIOCB0/PO17	SCK5/SSLA2-B/ET0_WOL		IRQ11	
D10		PA0	A0/BC0#	MTIOC4A/MTIOC6D/GTIOC0B-C/TIOCA0/CACREF/PO16	SSLA1-B/ET0_TX_EN/RMII0_TXD_EN			
E1	XTAL	P37						
E2	VSS							
E3	RES#							
E4	TRST#	P34		MTIOC0A/TMC13/PO12/POE10#	SCK6/SCK0/ET0_LINKSTA		IRQ4	
E5		P41					IRQ9-DS	AN001
E6		PA2	A2	MTIOC7A/GTIOC1A-C/PO18	RXD5/SMISO5/SSCL5/SSLA3-B			
E7		PA6	A6	MTIC5V/MTCLKB/GTETRIG-C/TIOCA2/TMC13/PO22/POE10#	CTS5#/RTS5#/SS5#/MOSIA-B/ET0_EXOUT			
E8		PA4	A4	MTIC5U/MTCLKA/TIOCA1/TMRI0/PO20	TXD5/SMOSI5/SSDA5/SSLA0-B/ET0_MDC		IRQ5-DS	
E9		PA5	A5	MTIOC6B/TIOCB1/GTIOC0A-C/PO21	RSPCKA-B/ET0_LINKSTA			
E10		PA3	A3	MTIOC0D/MTCLKD/TIOC0D/TCLKB/PO19	RXD5/SMISO5/SSCL5/ET0_MDIO		IRQ6-DS	
F1	EXTAL	P36						
F2	VCC							
F3	UPSEL	P35					NMI	
F4		P32		MTIOC0C/TIOCC0/TMO3/PO10/RTCOUT/RTCIC2/POE0#/POE10#	TXD6/TXD0/SMOSI6/SMOSI0/SSDA6/SSDA0/CTX0/USB0_VBUSEN		IRQ2-DS	
F5		P12		TMC11	RXD2/SMISO2/SSCL2/SCL0[FM+]		IRQ2	
F6		PB3	A11	MTIOC0A/MTIOC4A/TIOC3/TCLKD/TMO0/PO27/POE11#	SCK6/ET0_RX_ER/RMII0_RX_ER			
F7		PB2	A10	TIOCC3/TCLKC/PO26	CTS6#/RTS6#/SS6#/ET0_RX_CLK/REF50CK0			
F8		PB0	A8	MTIC5W/TIOCA3/PO24	RXD6/SMISO6/SSCL6/ET0_ERXD1/RMII0_RXD1		IRQ12	
F9		PA7	A7	TIOCB2/PO23	MISOA-B/ET0_WOL			

Table 1.9 List of Pins and Pin Functions (100-Pin TFLGA) (3/4)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SCIG, SCIH, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF)	Interrupt	S12ADC, R12DA
F10	VSS							
G1		P33	EDREQ1	MTIOC0D/TIOC0D/ TMR13/PO11/POE4#/ POE11#	RXD6/RXD0/SMISO6/ SMISO0/SSCL6/ SSCL0/CRX0		IRQ3-DS	
G2	TMS	P31		MTIOC4D/TMCI2/ PO9/RTIC1	CTS1#/RTS1#/SS1#		IRQ1-DS	
G3	TDI	P30		MTIOC4B/TMR13/ PO8/RTIC0/POE8#	RXD1/SMISO1/SSCL1		IRQ0-DS	
G4	TCK	P27	CS7#	MTIOC2B/TMCI3/PO7	SCK1			
G5		P53*1	BCLK					
G6		P52	RD#		RXD2/SMISO2/SSCL2			
G7		PB5	A13	MTIOC2A/MTIOC1B/ TIOC4/TMR11/PO29/ POE4#	SCK9/RTS9#/ ET0_ETXD0/ RMII0_TXD0			
G8		PB4	A12	TIOCA4/PO28	CTS9#/ET0_TX_EN/ RMII0_TXD_EN			
G9		PB1	A9	MTIOC0C/MTIOC4C/ TIOC3/TMCI0/PO25	TXD6/SMOSI6/ SSDA6/ET0_ERXD0/ RMII0_RXD0		IRQ4-DS	
G10	VCC							
H1	TDO	P26	CS6#	MTIOC2A/TMO1/PO6	TXD1/CTS3#/RTS3#/ SMOSI1/SS3#/SSDA1			
H2		P25	CS5#/ EDACK1	MTIOC4C/MTCLKB/ TIOCA4/PO5	RXD3/SMISO3/ SSCL3/SSIDATA1			ADTRG0#
H3		P16		MTIOC3C/MTIOC3D/ TIOC1/TCLKC/ TMO2/PO14/ RTCOUT	TXD1/RXD3/SMOSI1/ SMISO3/SSDA1/ SSCL3/SCL2-DS/ USB0_VBUS/ USB0_VBUSEN/ USB0_OVRCURB		IRQ6	ADTRG0#
H4		P15		MTIOC0B/MTCLKB/ GTETR-B/TIOC2B/ TCLKB/TMCI2/PO13	RXD1/SCK3/SMISO1/ SSCL1/CRX1-DS/ SSIWS1		IRQ5	
H5		P55	WAIT#/ EDREQ0	MTIOC4D/TMO3	CRX1/ET0_EXOUT		IRQ10	
H6		P54	ALE/ EDACK0	MTIOC4B/TMCI1	CTS2#/RTS2#/SS2#/ CTX1/ET0_LINKSTA			
H7	UB	PC7	A23/CS0#	MTIOC3A/MTCLKB/ GTIOC3A-D/TMO2/ TOC0/PO31/CACREF	TXD8/MISOA-A/ ET0_COL		IRQ14	
H8		PC6	A22/CS1#	MTIOC3C/MTCLKA/ GTIOC3B-D/TMCI2/ TIC0/PO30	RXD8/MOSIA-A/ ET0_ETXD3		IRQ13	
H9		PB6	A14	MTIOC3D/TIOCA5/ PO30	RXD9/ET0_ETXD1/ RMII0_TXD1			
H10		PB7	A15	MTIOC3B/TIOC5/ PO31	TXD9/ET0_CRS/ RMII0_CRS_DV			
J1		P24	CS4#/ EDREQ1	MTIOC4A/MTCLKA/ TIOC4/TMR11/PO4	SCK3/ USB0_VBUSEN/ SSISCK1			
J2		P21		MTIOC1B/MTIOC4A/ GTIOC2A-B/TIOCA3/ TMCI0/PO1	RXD0/SMISO0/ SSCL0/ USB0_EXICEN/ SSIWS0		IRQ9	
J3		P17		MTIOC3A/MTIOC3B/ MTIOC4B/GTIOC0B- B/TIOC0/TCLKD/ TMO1/PO15/POE8#	SCK1/TXD3/SMOSI3/ SSDA3/SDA2-DS/ SSITXD0		IRQ7	ADTRG1#
J4		P13		MTIOC0B/TIOCA5/ TMO3/PO13	TXD2/SMOSI2/ SSDA2/SDA0[FM+]		IRQ3	ADTRG1#
J5	VSS_USB							

**Table 1.9 List of Pins and Pin Functions (100-Pin TFLGA) (4/4)**

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SCIG, SCIH, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF)	Interrupt	S12ADC, R12DA
J6	VCC_USB							
J7		P50	WR0#/WR#		TXD2/SMOSI2/SSDA2			
J8		PC4	A20/CS3#	MTIOC3D/MTCLKC/GTETRQ-D/TMC11/PO25/POE0#	SCK5/CTS8#/SSLA0-A/ET0_TX_CLK			
J9		PC0	A16	MTIOC3C/TCLKC/PO17	CTS5#/RTS5#/SS5#/SSLA1-A/ET0_ERXD3		IRQ14	
J10		PC1	A17	MTIOC3A/TCLKD/PO18	SCK5/SSLA2-A/ET0_ERXD2		IRQ12	
K1		P23	EDACK0	MTIOC3D/MTCLKD/GTIOC0A-B/TIOC3/PO3	TXD3/CTS0#/RTS0#/SMOSI3/SS0#/SSDA3/SSISCK0			
K2		P22	EDREQ0	MTIOC3B/MTCLKC/GTIOC1A-B/TIOCC3/TMO0/PO2	SCK0/USB0_OVRCURB/AUDIO_MCLK			
K3		P20		MTIOC1A/TIOCB3/TMRI0/PO0	TXD0/SMOSI0/SSDA0/USB0_ID/SSIRXD0		IRQ8	
K4		P14		MTIOC3A/MTCLKA/TIOCB5/TCLKA/TMRI2/PO15	CTS1#/RTS1#/SS1#/CTX1/USB0_OVRCURA		IRQ4	
K5					USB0_DM			
K6					USB0_DP			
K7		P51	WR1#/BC1#/WAIT#		SCK2			
K8		PC5	A21/CS2#/WAIT#	MTIOC3B/MTCLKD/GTIOC1A-D/TMRI2/PO29	SCK8/RSPCKA-A/RTS8#/ET0_ETXD2			
K9		PC3	A19	MTIOC4D/GTIOC1B-D/TCLKB/PO24	TXD5/SMOSI5/SSDA5/ET0_TX_ER			
K10		PC2	A18	MTIOC4B/GTIOC2B-D/TCLKA/PO21	RXD5/SMISO5/SSCL5/SSLA3-A/ET0_RX_DV			

Note 1. The BCLK function is multiplexed with the I/O port function for pin P53, so the port function is not available if the external bus is enabled.

## 1.6.6 100-Pin LFQFP

Table 1.10 List of Pins and Pin Functions (100-Pin LFQFP) (1/4)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SCIG, SCIH, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF)	Interrupt	S12ADC, R12DA
1	AVCC1							
2	EMLE							
3	AVSS1							
4		PJ3	EDACK1	MTIOC3C	ET0_EXOUT/ CTS6#/RTS6#/CTS0#/ RTS0#/SS6#/SS0#			
5	VCL							
6	VBATT							
7	MD/FINED							
8	XCIN							
9	XCOUT							
10	RES#							
11	XTAL	P37						
12	VSS							
13	EXTAL	P36						
14	VCC							
15	UPSEL	P35					NMI	
16	TRST#	P34		MTIOC0A/TMC13/ PO12/POE10#	SCK6/SCK0/ ET0_LINKSTA		IRQ4	
17		P33	EDREQ1	MTIOC0D/TIOCD0/ TMR13/PO11/POE4#/ POE11#	RXD6/RXD0/SMISO6/ SMISO0/SSCL6/ SSCL0/CRX0		IRQ3-DS	
18		P32		MTIOC0C/TIOCC0/ TMO3/PO10/ RTCOU/RTCIC2/ POE0#/POE10#	TXD6/TXD0/SMOSI6/ SMOSI0/SSDA6/ SSDA0/CTX0/ USB0_VBUSEN		IRQ2-DS	
19	TMS	P31		MTIOC4D/TMC12/ PO9/RTCIC1	CTS1#/RTS1#/SS1#		IRQ1-DS	
20	TDI	P30		MTIOC4B/TMR13/ PO8/RTCIC0/POE8#	RXD1/SMISO1/SSCL1		IRQ0-DS	
21	TCK	P27	CS7#	MTIOC2B/TMC13/PO7	SCK1			
22	TDO	P26	CS6#	MTIOC2A/TMO1/PO6	TXD1/CTS3#/RTS3#/ SMOSI1/SS3#/SSDA1			
23		P25	CS5#/ EDACK1	MTIOC4C/MTCLKB/ TIOCA4/PO5	RXD3/SMISO3/ SSCL3/SSIDATA1			ADTRG0#
24		P24	CS4#/ EDREQ1	MTIOC4A/MTCLKA/ TIOCB4/TMR11/PO4	SCK3/ USB0_VBUSEN/ SSISCK1			
25		P23	EDACK0	MTIOC3D/MTCLKD/ GTIOC0A-B/TIOCD3/ PO3	TXD3/CTS0#/RTS0#/ SMOSI3/SS0#/ SSDA3/SSISCK0			
26		P22	EDREQ0	MTIOC3B/MTCLKC/ GTIOC1A-B/TIOCC3/ TMO0/PO2	SCK0/ USB0_OVRCURB/ AUDIO_MCLK			
27		P21		MTIOC1B/MTIOC4A/ GTIOC2A-B/TIOCA3/ TMC10/PO1	RXD0/SMISO0/ SSCL0/ USB0_EXICEN/ SSIWS0		IRQ9	
28		P20		MTIOC1A/TIOCB3/ TMR10/PO0	TXD0/SMOSI0/ SSDA0/USB0_ID/ SSIRXD0		IRQ8	

Table 1.10 List of Pins and Pin Functions (100-Pin LFQFP) (2/4)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SClg, SCLh, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface  (QSPI, SDHI, MMCIF)	Interrupt	S12ADC, R12DA
29		P17		MTIOC3A/MTIOC3B/ MTIOC4B/ GTIOC0B-B/TIOC0B/ TCLKD/TMO1/PO15/ POE8#	SCK1/TXD3/SMOSI3/ SSDA3/SDA2-DS/ SSITXD0		IRQ7	ADTRG1#
30		P16		MTIOC3C/MTIOC3D/ TIOC0B1/TCLKC/ TMO2/PO14/ RTCOU	TXD1/RXD3/SMOSI1/ SMISO3/SSDA1/ SSCL3/SCL2-DS/ USB0_VBUS/ USB0_VBUSEN/ USB0_OVRCURB		IRQ6	ADTRG0#
31		P15		MTIOC0B/MTCLKB/ GTETR0B-TIOC0B2/ TCLKB/TMCI2/PO13	RXD1/SCK3/SMOSI0/ SSCL1/CRX1-DS/ SSIWS1		IRQ5	
32		P14		MTIOC3A/MTCLKA/ TIOC0B5/TCLKA/ TMR12/PO15	CTS1#/RTS1#/SS1#/ CTX1/ USB0_OVRCURA		IRQ4	
33		P13		MTIOC0B/TIOCA5/ TMO3/PO13	TXD2/SMOSI2/ SSDA2/SDA0[FM+]		IRQ3	ADTRG1#
34		P12		TMCI1	RXD2/SMISO2/ SSCL2/SCL0[FM+]		IRQ2	
35	VCC_USB							
36					USB0_DM			
37					USB0_DP			
38	VSS_USB							
39		P55	WAIT#/ EDREQ0	MTIOC4D/TMO3	CRX1/ET0_EXOUT		IRQ10	
40		P54	ALE/EDACK0	MTIOC4B/TMCI1	CTS2#/RTS2#/SS2#/ CTX1/ET0_LINKSTA			
41		P53*1	BCLK					
42		P52	RD#		RXD2/SMISO2/SSCL2			
43		P51	WR1#/BC1#/ WAIT#		SCK2			
44		P50	WR0#/WR#		TXD2/SMOSI2/SSDA2			
45	UB	PC7	A23/CS0#	MTIOC3A/MTCLKB/ GTIOC3A-D/TMO2/ TOC0/PO31/CACREF	TXD8/MISOA-A/ ET0_COL		IRQ14	
46		PC6	A22/CS1#	MTIOC3C/MTCLKA/ GTIOC3B-D/TMCI2/ TIC0/PO30	RXD8/MOSIA-A/ ET0_ETXD3		IRQ13	
47		PC5	A21/CS2#/ WAIT#	MTIOC3B/MTCLKD/ GTIOC1A-D/TMR12/ PO29	SCK8/RSPCKA-A/ RTS8#/ET0_ETXD2			
48		PC4	A20/CS3#	MTIOC3D/MTCLKC/ GTETR0D-TMCI1/ PO25/POE0#	SCK5/CTS8#/ SSLA0-A/ ET0_TX_CLK			
49		PC3	A19	MTIOC4D/ GTIOC1B-D/TCLKB/ PO24	TXD5/SMOSI5/ SSDA5/ET0_TX_ER			
50		PC2	A18	MTIOC4B/ GTIOC2B-D/TCLKA/ PO21	RXD5/SMISO5/ SSCL5/SSLA3-A/ ET0_RX_DV			
51		PC1	A17	MTIOC3A/TCLKD/ PO18	SCK5/SSLA2-A/ ET0_ERXD2		IRQ12	
52		PC0	A16	MTIOC3C/TCLKC/ PO17	CTS5#/RTS5#/SS5#/ SSLA1-A/ET0_ERXD3		IRQ14	
53		PB7	A15	MTIOC3B/TIOC0B5/ PO31	TXD9/ET0_CRS/ RMII0_CRS_DV			
54		PB6	A14	MTIOC3D/TIOCA5/ PO30	RXD9/ET0_ETXD1/ RMII0_TXD1			

Table 1.10 List of Pins and Pin Functions (100-Pin LQFP) (3/4)

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SClg, SClH, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface  (QSPI, SDHI, MMCIF)	Interrupt	S12ADC, R12DA
55		PB5	A13	MTIOC2A/MTIOC1B/ TIOCB4/TMR11/PO29/ POE4#	SCK9/RTS9#/ ET0_ETXD0/ RMII0_TXD0			
56		PB4	A12	TIOCA4/PO28	CTS9#/ET0_TX_EN/ RMII0_TXD_EN			
57		PB3	A11	MTIOC0A/MTIOC4A/ TIOCD3/TCLKD/ TMO0/PO27/POE11#	SCK6/ET0_RX_ER/ RMII0_RX_ER			
58		PB2	A10	TIOCC3/TCLKC/ PO26	CTS6#/RTS6#/SS6#/ ET0_RX_CLK/ REF50CK0			
59		PB1	A9	MTIOC0C/MTIOC4C/ TIOCB3/TMCI0/PO25	TXD6/SMOSI6/ SSDA6/ET0_ERXD0/ RMII0_RXD0		IRQ4-DS	
60	VCC							
61		PB0	A8	MTIC5W/TIOCA3/ PO24	RXD6/SMISO6/ SSCL6/ET0_ERXD1/ RMII0_RXD1		IRQ12	
62	VSS							
63		PA7	A7	TIOCB2/PO23	MISOA-B/ET0_WOL			
64		PA6	A6	MTIC5V/MTCLKB/ GTETR-C/TIOCA2/ TMCI3/PO22/POE10#	CTS5#/RTS5#/SS5#/ MOSIA-B/ ET0_EXOUT			
65		PA5	A5	MTIOC6B/TIOCB1/ GTIOC0A-C/PO21	RSPCKA-B/ ET0_LINKSTA			
66		PA4	A4	MTIC5U/MTCLKA/ TIOCA1/TMRI0/PO20	TXD5/SMOSI5/ SSDA5/SSLA0-B/ ET0_MDC		IRQ5-DS	
67		PA3	A3	MTIOC0D/MTCLKD/ TIOCD0/TCLKB/PO19	RXD5/SMISO5/ SSCL5/ET0_MDIO		IRQ6-DS	
68		PA2	A2	MTIOC7A/ GTIOC1A-C/PO18	RXD5/SMISO5/ SSCL5/SSLA3-B			
69		PA1	A1	MTIOC0B/MTCLKC/ MTIOC7B/ GTIOC2A-C/TIOCB0/ PO17	SCK5/SSLA2-B/ ET0_WOL		IRQ11	
70		PA0	A0/BC0#	MTIOC4A/MTIOC6D/ GTIOC0B-C/TIOCA0/ CACREF/PO16	SSLA1-B/ ET0_TX_EN/ RMII0_TXD_EN			
71		PE7	D15[A15/D15]	MTIOC6A/ GTIOC3A-E/TOC1		MMC_RES#-B/ SDHI_WP-B	IRQ7	AN105
72		PE6	D14[A14/D14]	MTIOC6C/GTIOC3B- E/TIC1		MMC_CD-B/ SDHI_CD-B	IRQ6	AN104
73		PE5	D13[A13/D13]	MTIOC4C/MTIOC2B/ GTIOC0A-A	ET0_RX_CLK/ REF50CK0		IRQ5	AN103
74		PE4	D12[A12/D12]	MTIOC4D/MTIOC1A/ GTIOC1A-A/PO28	ET0_ERXD2			AN102
75		PE3	D11[A11/D11]	MTIOC4B/ GTIOC2A-A/PO26/ POE8#/TOC3	CTS12#/RTS12#/ SS12#/ET0_ERXD3	MMC_D7-B		AN101
76		PE2	D10[A10/D10]	MTIOC4A/ GTIOC0B-A/PO23/ TIC3	RXD12/SMISO12/ SSCL12/RXDX12	MMC_D6-B	IRQ7-DS	AN100
77		PE1	D9[A9/D9]	MTIOC4C/MTIOC3B/ GTIOC1B-A/PO18	TXD12/SMOSI12/ SSDA12/TXDX12/ SIOX12	MMC_D5-B		ANEX1
78		PE0	D8[A8/D8]	MTIOC3D/ GTIOC2B-A	SCK12	MMC_D4-B		ANEX0



**Table 1.10 List of Pins and Pin Functions (100-Pin LFQFP) (4/4)**

Pin Number	Power Supply Clock System Control	I/O Port	Bus EXDMAC	Timer (MTU, GPT, TPU, TMR, PPG, RTC, CMTW, POE, CAC)	Communication (ETHERC, SCIG, SCIH, RSPI, RIIC, CAN, USB, SSI)	Memory Interface Camera Interface (QSPI, SDHI, MMCIF)	Interrupt	S12ADC, R12DA
79		PD7	D7[A7/D7]	MTIC5U/POE0#		MMC_D1-B/ SDHI_D1-B/ QIO1-B/ QMI-B	IRQ7	AN107
80		PD6	D6[A6/D6]	MTIC5V/MTIOC8A/ POE4#		MMC_D0-B/ SDHI_D0-B/ QIO0-B/QMO-B	IRQ6	AN106
81		PD5	D5[A5/D5]	MTIC5W/MTIOC8C/ POE10#		MMC_CLK-B/ SDHI_CLK-B/ QSPCLK-B	IRQ5	AN113
82		PD4	D4[A4/D4]	MTIOC8B/POE11#		MMC_CMD-B/ SDHI_CMD-B/ QSSL-B	IRQ4	AN112
83		PD3	D3[A3/D3]	MTIOC8D/ GTIOC0A-E/POE8#/ TOC2		MMC_D3-B/ SDHI_D3-B/ QIO3-B	IRQ3	AN111
84		PD2	D2[A2/D2]	MTIOC4D/ GTIOC0B-E/TIC2	CRX0	MMC_D2-B/ SDHI_D2-B/ QIO2-B	IRQ2	AN110
85		PD1	D1[A1/D1]	MTIOC4B/ GTIOC1A-E/POE0#	CTX0		IRQ1	AN109
86		PD0	D0[A0/D0]	GTIOC1B-E/POE4#			IRQ0	AN108
87		P47					IRQ15-DS	AN007
88		P46					IRQ14-DS	AN006
89		P45					IRQ13-DS	AN005
90		P44					IRQ12-DS	AN004
91		P43					IRQ11-DS	AN003
92		P42					IRQ10-DS	AN002
93		P41					IRQ9-DS	AN001
94	VREFL0							
95		P40					IRQ8-DS	AN000
96	VREFH0							
97	AVCC0							
98		P07					IRQ15	ADTRG0#
99	AVSS0							
100	P05						IRQ13	DA1

Note 1. The BCLK function is multiplexed with the I/O port function for pin P53, so the port function is not available if the external bus is enabled.

## 2. Electrical Characteristics

### 2.1 Absolute Maximum Ratings

**Table 2.1 Absolute Maximum Rating**

Conditions: VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0 V

Item	Symbol	Value	Unit
Power supply voltage	VCC, VCC_USB	-0.3 to +4.6	V
V <sub>BATT</sub> power supply voltage	V <sub>BATT</sub>	-0.3 to +4.6	V
Input voltage (except for ports for 5 V tolerant*1)	V <sub>in</sub>	-0.3 to VCC + 0.3	V
Input voltage (ports for 5 V tolerant*1)	V <sub>in</sub>	-0.3 to VCC + 4.6 (≤ 5.8 max.)	V
Reference power supply voltage	VREFH0	-0.3 to AVCC0 + 0.3	V
Analog power supply voltage	AVCC0, AVCC1*2	-0.3 to +4.6	V
USBA power supply voltage	VCC_USBA*2	-0.3 to +4.6	V
USBA analog power supply voltage	AVCC_USBA*2	-0.3 to +4.6	V
Analog input voltage	V <sub>AN</sub>	-0.3 to AVCC + 0.3	V
Junction temperature	D version	T <sub>j</sub>	°C
	G version		
Storage temperature	T <sub>stg</sub>	-55 to +125	°C

Caution: Permanent damage to the LSI may result if absolute maximum ratings are exceeded.

Note 1. P07, P11 to P17, P20, P21, P30 to P33, P67, and PC0 to PC3 are 5 V tolerant.

Note 2. Connect the AVCC0, AVCC1, and VCC\_USB pins to VCC, and the AVSS0, AVSS1, and VSS\_USB pins to VSS.

When the A/D converter unit 0 is not to be used, connect the VREFH0 pin to VCC and the VREFL0 pin to VSS, respectively. Do not leave these pins open.

When the USBA is not to be used, connect the VCC\_USBA and AVCC\_USBA pins to VCC and the VSS1\_USBA, VSS2\_USBA, PVSS\_USBA, and AVSS\_USBA pins to VSS, respectively. Do not leave these pins open.

**Table 2.2 Recommended Operating Conditions**

Item	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	VCC	2.7	—	3.6	V
	VSS	—	0	—	V
Power supply voltage (only the RTC and subclock oscillator)*1	VCC	2.0	—	3.6	V
V <sub>BATT</sub> power supply voltage	V <sub>BATT</sub>	2.0	—	3.6	V
Reference power voltage	VREFH0	2.7	—	AVCC0	V
	VREFL0	—	0	—	V
Analog power supply voltage	AVCC0, AVCC1	—	VCC	—	V
	AVSS0, AVSS1	—	0	—	V
USB power supply voltage	VCC_USB	—	VCC	—	V
	VSS_USB	—	0	—	V
USBA power supply voltage	VCC_USBA	3.0	—	3.6	V
	VSS1_USBA, VSS2_USBA	—	0	—	V
USBA analog power supply voltage	AVCC_USBA	3.0	—	3.6	V
	AVSS_USBA, PVSS_USBA	—	0	—	V
Operating temperature	D version	T <sub>opr</sub>	—	85	°C
	G version				
		-40	—	105	°C

Note 1. The power-supply voltage range of VBATT in which the RTC and subclock oscillator operate

## 2.2 DC Characteristics

**Table 2.3 DC Characteristics (1)**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item		Symbol	Min.	Typ.	Max.	Unit	Test Conditions			
Schmitt trigger input voltage	IRQ input pin*1 MTU input pin*1 GPT input pin*1 POE3 input pin*1 TPU input pin*1 TMR input pin*1 SCI input pin*1 ADTRG# input pin*1 RES#, NMI	$V_{IH}$	$0.8 \times V_{CC}$	—	$V_{CC} + 0.3$	V				
		$V_{IL}$	-0.3	—	$0.2 \times V_{CC}$					
		$\Delta V_T$	$0.06 \times V_{CC}$	—	—					
	RIIC input pin (except for SMBus)	$V_{IH}$	$0.7 \times V_{CC}$	—	$V_{CC} + 3.6$ ( $\leq 5.8$ max.)					
		$V_{IL}$	-0.3	—	$0.3 \times V_{CC}$					
		$\Delta V_T$	$0.05 \times V_{CC}$	—	—					
	Ports for 5 V tolerant*2	$V_{IH}$	$0.8 \times V_{CC}$	—	$V_{CC} + 3.6$ ( $\leq 5.8$ max.)					
		$V_{IL}$	-0.3	—	$0.2 \times V_{CC}$					
	Other input pins excluding ports for 5 V tolerant*3	$V_{IH}$	$0.8 \times V_{CC}$	—	$V_{CC} + 0.3$					
		$V_{IL}$	-0.3	—	$0.2 \times V_{CC}$					
	Input high voltage (except for Schmitt trigger input pin)	MD pin, EMLE	$V_{IH}$	$0.9 \times V_{CC}$	—			$V_{CC} + 0.3$	V	
		EXTAL, RSPI input pin, EXDMAC input pin, WAIT#, TCK, SSI input pin, SDHI input pin, MMC input pin, PDC input pin, QSPI input pin		$0.8 \times V_{CC}$	—			$V_{CC} + 0.3$		
ETHERC input pin		2.3		—	$V_{CC} + 0.3$					
D0 to D31		$0.7 \times V_{CC}$		—	$V_{CC} + 0.3$					
RIIC (SMBus)		2.1		—	5.8					
Input low voltage (except for Schmitt trigger input pin)	MD pin, EMLE	$V_{IL}$	-0.3	—	$0.1 \times V_{CC}$	V				
	EXTAL, RSPI input pin, ETHERC input pin, EXDMAC input pin, WAIT#, TCK, SSI input pin, SDHI input pin, MMC input pin, PDC input pin, QSPI input pin		-0.3	—	$0.2 \times V_{CC}$					
	D0 to D31		-0.3	—	$0.3 \times V_{CC}$					
	RIIC (SMBus)		-0.3	—	0.8					

Note 1. This does not include the pins, which are multiplexed as ports for 5 V tolerant.

Note 2. P07, P11 to P17, P20, P21, P30 to P33, P67, and PC0 to PC3 are 5 V tolerant.

Note 3. For P32, P31, and P30, input as follows when the  $V_{BATT}$  power supply is selected.

$V_{IH}$  Min. =  $V_{BATT} \times 0.8$ ,  $V_{IH}$  Max. =  $V_{BATT} + 0.3$ ,  $V_{IL}$  Min. = -0.3,  $V_{IL}$  Max. =  $V_{BATT} \times 0.2$  ( $V_{BATT} = 2.0$  to  $3.6$  V)

**Table 2.4 DC Characteristics (2)**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	
Output high voltage	All output pins	$V_{OH}$	$V_{CC} - 0.5$	—	—	V	$I_{OH} = -1$ mA
Output low voltage	All output pins (except for RIIC pins and ETHERC output pin)	$V_{OL}$	—	—	0.5	V	$I_{OL} = 1.0$ mA
	RIIC output pin		—	—	0.4		$I_{OL} = 3.0$ mA
			—	—	0.6		$I_{OL} = 6.0$ mA
	RIIC output pin (only P12 and P13 in channel 0)	$V_{OL}$	—	—	0.4	V	$I_{OL} = 15.0$ mA (ICFER.FMPE = 1)
			—	0.4	—		$I_{OL} = 20.0$ mA (ICFER.FMPE = 1)
ETHERC output pin	$V_{OL}$	—	—	0.4	V	$I_{OL} = 1.0$ mA	
Input leakage current	RES#, MD pin, EMLE*1, BSCANP*1, NMI	$ I_{in} $	—	—	1.0	$\mu$ A	$V_{in} = 0$ V $V_{in} = V_{CC}$
Three-state leakage current (off state)	Other than ports for 5 V tolerant	$ I_{TSI} $	—	—	1.0	$\mu$ A	$V_{in} = 0$ V $V_{in} = V_{CC}$
	Ports for 5 V tolerant		—	—	5.0		$V_{in} = 0$ V $V_{in} = 5.5$ V
Pull-up Resistor	Ports 0 to 2, P30 to P34, P36, P37, Ports 4 to G, PJ3, PJ5	$R_{PU}$	10	—	100	k $\Omega$	$V_{CC} = 2.7$ to $3.6$ V $V_{in} = 0$ V
Pull-down Resistor	EMLE, BSCANP	$R_{PD}$	10	—	100	k $\Omega$	$V_{in} = V_{CC}$
Input capacitance	All input pins (except for P03, P05, P12, P13, P16, P17, EMLE, BSCANP, USB0_DP, USB0_DM, USBA_DP, and USBA_DM)	$C_{in}$	—	—	8	pF	$V_{bias} = 0$ V $V_{amp} = 20$ mV $f = 1$ MHz $T_a = 25^\circ$ C
	P03, P05, P12, P13, P16, P17, EMLE, BSCANP, USB0_DP, USB0_DM, USBA_DP, and USBA_DM		—	—	16		
Output voltage of the VCL pin		$V_{CL}$	—	1.25	—	V	

Note 1. The input leakage current value at the EMLE and BSCANP pins are only when  $V_{in} = 0$  V.

**Table 2.5 DC Characteristics (3)**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{REFH0} = V_{CC\_USB} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item	Symbol	D-version		G-version		Unit	Test Conditions			
		Typ.	Max.	Typ.	Max.					
Supply current*1	High-speed operating mode	Max.*2	—	110	—	120	mA	ICLK = 120 MHz PCLKA = 120 MHz PCLKB = 60 MHz PCLKC = 60 MHz PCLKD = 60 MHz FCLK = 60 MHz BCLK = 120 MHz BCLK pin = 60 MHz		
		Normal	Peripheral function clock signal supplied*4	39	—	39			—	
			Peripheral function clock signal stopped*4	16	—	16			—	
		CoreMark	Peripheral function clock signal stopped*4	21	—	21			—	
		Sleep mode: The clock signal to peripheral modules is supplied*4		32	61	32			70	
		All-module-clock-stop mode (reference value)		10	28	10			40	
		Increased by BGO operation*5	Reading from the code flash memory while the data flash memory is being programmed	7	—	7			—	
			Reading from the code flash memory while the code flash memory is being programmed	10	—	10			—	
		Low-speed operating mode 1: Supply of the clock signal to peripheral modules is stopped*4		3.0	—	3.0			—	All clocks 1 MHz
		Low-speed operating mode 2: Supply of the clock signal to peripheral modules is stopped*4		1.2	—	1.2			—	All clocks 32.768 kHz
	Software standby mode		0.7	10	0.7	19				
	Deep software standby mode	Power supplied to standby RAM and USB resume detecting unit (USBb only)		22	63	22	95	μA		
		Power not supplied to standby RAM and USB resume detecting unit (USBb only)	Power-on reset circuit and low-power consumption function disabled*6	12.5	26	12.5	36.4			
			Power-on reset circuit and low-power consumption function enabled*7	3.1	13.5	3.1	20.0			
		Increased by RTC operation	When a crystal resonator for low clock loads is in use	0.6	—	0.6	—			
			When a crystal resonator for standard clock loads is in use	2.0	—	2.0	—			
		RTC operating while VCC is off (with the battery backup function, only the RTC and sub-clock oscillator operate)	RCR3.RTCDV[2:0] set to drive capacity for standard CL	0.9	—	0.9	—		$V_{BATT} = 2.0$ V, $V_{CC} = 0$ V	
				1.6	—	1.6	—		$V_{BATT} = 3.3$ V, $V_{CC} = 0$ V	
	RCR3.RTCDV[2:0] set to drive capacity for low CL		1.7	—	1.7	—	$V_{BATT} = 2.0$ V, $V_{CC} = 0$ V			
		3.3	—	3.3	—	$V_{BATT} = 3.3$ V, $V_{CC} = 0$ V				

- Note 1. Supply current values are with all output pins unloaded and all input pull-up MOSs in the off state.
- Note 2. Supply of the clock signal to peripheral modules is stopped in this state. This does not include operations as BGO (background operations).
- Note 3.  $I_{CC}$  depends on  $f$  (ICLK) as follows. (ICLK/PCLKA:PCLKB/PCLKC/PCLKD:BCLK:BCLK pin = 10:5:10:5 when EXTAL = 12 MHz)
- D-version
    - $I_{CC}$  Max. =  $0.77 \times f + 18$  (max. operation in high-speed operating mode)
    - $I_{CC}$  Typ. =  $0.08 \times f + 6$  (normal operation in high-speed operating mode)
    - $I_{CC}$  Typ. =  $0.50 \times f + 2.6$  (low-speed operating mode 1)
    - $I_{CC}$  Max. =  $0.36 \times f + 18$  (sleep mode)
  - G-version
    - $I_{CC}$  Max. =  $0.77 \times f + 27$  (max. operation in high-speed operating mode)
    - $I_{CC}$  Typ. =  $0.08 \times f + 6$  (normal operation in high-speed operating mode)
    - $I_{CC}$  Typ. =  $0.50 \times f + 2.6$  (low-speed operating mode 1)
    - $I_{CC}$  Max. =  $0.36 \times f + 27$  (sleep mode)
- Note 4. This does not include operations as BGO (background operations). Whether supply of the clock signal to peripheral modules continues or is stopped only depends on the state determined by the settings of the bits in module stop control registers A to D. The setting for the peripheral module clock stopped state is FCLK = BCLK = PCLKA = PCLKB = PCLKC = PCLKD = BCLK pin = 3.75 MHz (division by 64).
- Note 5. This is the increase for programming or erasure of the code flash memory (limitations apply to the combinations of ranges in which writing proceed) or data flash memory during program execution in the code flash memory.
- Note 6. The low power consumption function is disabled and DEEPCUT[1:0] = 01b.
- Note 7. The low power consumption function is enabled and DEEPCUT[1:0] = 11b.

**Table 2.6 DC Characteristics (4)**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{REFH0} = V_{CC\_USB} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item		Symbol	D-version			G-version			Unit	Test Conditions	
			Min.	Typ.	Max.	Min.	Typ.	Max.			
Analog power supply current*1	During 12-bit A/D conversion (unit 0)	$I_{CC}$	—	0.7	1.0	—	0.7	1.0	mA	I <sub>AVCC0_AD</sub>	
	During 12-bit A/D conversion (unit 0) with the channel-dedicated sample-and-hold circuits for 3 channels operating		—	1.7	2.5	—	1.7	2.5	mA	I <sub>AVCC0_AD+SH</sub>	
	During 12-bit A/D conversion (unit 1)		—	0.6	1.0	—	0.6	1.0	mA	I <sub>AVCC1_AD</sub>	
	During 12-bit A/D conversion (unit 1) with the temperature sensor operating		—	0.7	1.1	—	0.7	1.1	mA	I <sub>AVCC1_AD+TEMP</sub>	
	During D/A conversion (per unit)		Without AMP output	—	0.24	0.4	—	0.24	0.4	mA	I <sub>AVCC1_DA</sub>
			With AMP output	—	0.40	0.7	—	0.40	0.7	mA	
	Waiting for A/D, D/A, or temperature sensor conversion (all units)		—	0.9	1.4	—	0.9	1.4	mA	I <sub>AVCC0 + I<sub>AVCC1</sub></sub>	
A/D, D/A converter, temperature sensor in standby mode (all units)		—	1.3	3.0	—	1.3	4.5	μA	I <sub>AVCC0 + I<sub>AVCC1</sub></sub>		
Reference power supply current	During 12-bit A/D conversion (unit 0)	$I_{REFH}$	—	70	120	—	70	120	μA	I <sub>VREFH0</sub>	
	Waiting for 12-bit A/D conversion (unit 0)		—	0.07	0.4	—	0.07	0.5	μA	I <sub>VREFH0</sub>	
	12-bit A/D converter in standby mode (unit 0)		—	0.07	0.2	—	0.07	0.4	μA	I <sub>VREFH0</sub>	
USB operating current	Low speed	USB	$I_{CCUSBLS}$	—	3.5	6.5	—	3.5	6.5	mA	V <sub>CC_USB</sub>
		USBA		—	8.5	12.0	—	8.5	12.0	mA	V <sub>CC_USBA</sub> = AV <sub>CC_USBA</sub> (PHYSET.HSEB = 0)
		USBA		—	2.8	3.6	—	2.8	3.6	mA	V <sub>CC_USBA</sub> = AV <sub>CC_USBA</sub> (PHYSET.HSEB = 1)
	Full speed	USB	$I_{CCUSBFS}$	—	4.0	10.0	—	4.0	10.0	mA	V <sub>CC_USB</sub>
		USBA		—	12.0	20.0	—	12.0	20.0	mA	V <sub>CC_USBA</sub> = AV <sub>CC_USBA</sub> (PHYSET.HSEB = 0)
		USBA		—	6.5	13.0	—	6.5	13.0	mA	V <sub>CC_USBA</sub> = AV <sub>CC_USBA</sub> (PHYSET.HSEB = 1)
	Standby mode (direct power down)	USBA	$I_{CCUSBSBY}$	—	0.1	3.0	—	0.1	3.0	μA	V <sub>CC_USBA</sub> = AV <sub>CC_USBA</sub>
RAM standby voltage		$V_{RAM}$	2.7	—	—	2.7	—	—	V		
VCC rising gradient		$SrVCC$	8.4	—	20000	8.4	—	20000	μs/V		
VCC falling gradient*2		$SfVCC$	8.4	—	—	8.4	—	—	μs/V		

Note 1. The reference power supply current is included in the power supply current value for 12-bit A/D converter (unit 1) and D/A converter.

Note 2. This applies when  $V_{BATT}$  is used.

**Table 2.7 Thermal Resistances (Reference)**

Item	Package	Symbol	Max.	Unit	Test Conditions	
Thermal resistance	PLQP0176KB-A	$\theta_{ja}$	39.4	°C/W	JESD51-2 and JESD51-7 compliant	
	PLQP0144KA-A		40.7			
	PLQP0100KB-A		41.7			
	PLBG0176GA-A		28.5			JESD51-2 and JESD51-9 compliant
	PTLG0177KA-A		29.4			
	PTLG0145KA-A		29.9			
	PTLG0100JA-A		21.4			
	PLQP0176KB-A	$\Psi_{jt}$	0.5	°C/W	JESD51-2 and JESD51-7 compliant	
	PLQP0144KA-A		0.5			
	PLQP0100KB-A		0.5			
	PLBG0176GA-A		0.2			JESD51-2 and JESD51-9 compliant
	PTLG0177KA-A		0.2			
	PTLG0145KA-A		0.2			
	PTLG0100JA-A		0.2			

Note: The values are reference values when the 4-layer printed circuit board is used. Thermal resistance depends on the number of layers and size of the board. For details, refer to the JEDEC standards.

**Table 2.8 Permissible Output Currents**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item		Symbol	Min.	Typ.	Max.	Unit	
Permissible output low current (average value per pin)	All output pins*1	Normal drive	$I_{OL}$	—	—	2.0	mA
	All output pins*2	High drive	$I_{OL}$	—	—	3.8	mA
Permissible output low current (max. value per pin)	All output pins*1	Normal drive	$I_{OL}$	—	—	4.0	mA
	All output pins*2	High drive	$I_{OL}$	—	—	7.6	mA
Permissible output low current (total)	Total of all output pins		$\Sigma I_{OL}$	—	—	80	mA
Permissible output high current (average value per pin)	All output pins*1	Normal drive	$I_{OH}$	—	—	-2.0	mA
	USB_DPUPE pin*2	High drive	$I_{OH}$	—	—	-3.8	mA
Permissible output high current (max. value per pin)	All output pins*1	Normal drive	$I_{OH}$	—	—	-4.0	mA
	All output pins*2	High drive	$I_{OH}$	—	—	-7.6	mA
Permissible output high current (total)	Total of all output pins		$\Sigma I_{OH}$	—	—	-80	mA

Caution: To protect the LSI's reliability, the output current values should not exceed the values in this table.

Note 1. This is the value when normal driving ability is set with a pin for which normal driving ability is selectable.

Note 2. This is the value when high driving ability is set with a pin for which normal driving ability is selectable or the value of the pin to which high driving ability is fixed.



## 2.3 AC Characteristics

**Table 2.9 Operating Frequency (High-Speed Operating Mode)**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item		Symbol	Min.	Typ.	Max.	Unit	
Operating frequency	System clock (ICLK)	f	—	—	120	MHz	
	Peripheral module clock (PCLKA)		—	—	120		
	Peripheral module clock (PCLKB)		—	—	60		
	Peripheral module clock (PCLKC)		—	—	60		
	Peripheral module clock (PCLKD)		—	—	60		
	Flash-IF clock (FCLK)		—*1	—	60		
	External bus clock (BCLK)		Packages with 177 to 144 pins only	—	—		120
			Package with 100 pins only	—	—		60
	BCLK pin output		Packages with 177 to 144 pins only	—	—		60
			Package with 100 pins only	—	—		30
	SDRAM clock (SDCLK)		Packages with 177 to 144 pins only	—	—		60
	SDCLK pin output		Packages with 177 to 144 pins only	—	—		60

Note 1. The FCLK must run at a frequency of at least 4 MHz when changing the flash memory contents.

**Table 2.10 Operating Frequency (Low-Speed Operating Mode 1)**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item		Symbol	Min.	Typ.	Max.	Unit	
Operating frequency	System clock (ICLK)	f	—	—	1	MHz	
	Peripheral module clock (PCLKA)		—	—	1		
	Peripheral module clock (PCLKB)		—	—	1		
	Peripheral module clock (PCLKC)*1		—	—	1		
	Peripheral module clock (PCLKD)*1		—	—	1		
	Flash-IF clock (FCLK)		—	—	1		
	External bus clock (BCLK)		Packages with 177 to 144 pins only	—	—		1
			Package with 100 pins only	—	—		1
	BCLK pin output		Packages with 177 to 144 pins only	—	—		1
			Package with 100 pins only	—	—		1
	SDRAM clock (SDCLK)		Packages with 177 to 144 pins only	—	—		1
	SDCLK pin output		Packages with 177 to 144 pins only	—	—		1

Note 1. When the 12-bit A/D converter is used, the frequency must be set to at least 1 MHz.

**Table 2.11 Operating Frequency (Low-Speed Operating Mode 2)**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $T_a = T_{opr}$

Item		Symbol	Min.	Typ.	Max.	Unit	
Operating frequency	System clock (ICLK)	f	32	—	264	kHz	
	Peripheral module clock (PCLKA)		—	—	264		
	Peripheral module clock (PCLKB)		—	—	264		
	Peripheral module clock (PCLKC)*1		—	—	264		
	Peripheral module clock (PCLKD)*1		—	—	264		
	Flash-IF clock (FCLK)		32	—	264		
	External bus clock (BCLK)		Packages with 177 to 144 pins only	—	—		264
			Package with 100 pins only	—	—		264
	BCLK pin output		Packages with 177 to 144 pins only	—	—		264
			Package with 100 pins only	—	—		264
	SDRAM clock (SDCLK)		Packages with 177 to 144 pins only	—	—		264
	SDCLK pin output		Packages with 177 to 144 pins only	—	—		264

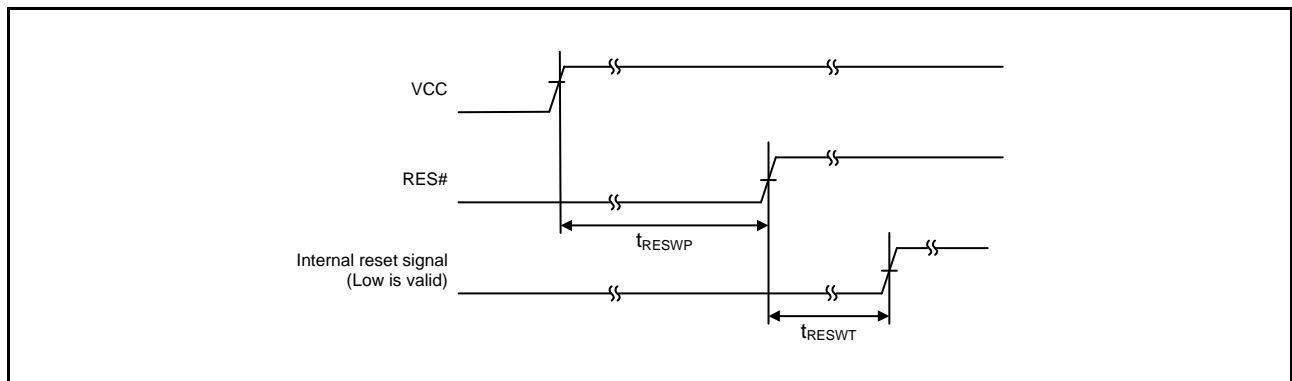
Note 1. The 12-bit A/D converter cannot be used.

### 2.3.1 Reset Timing

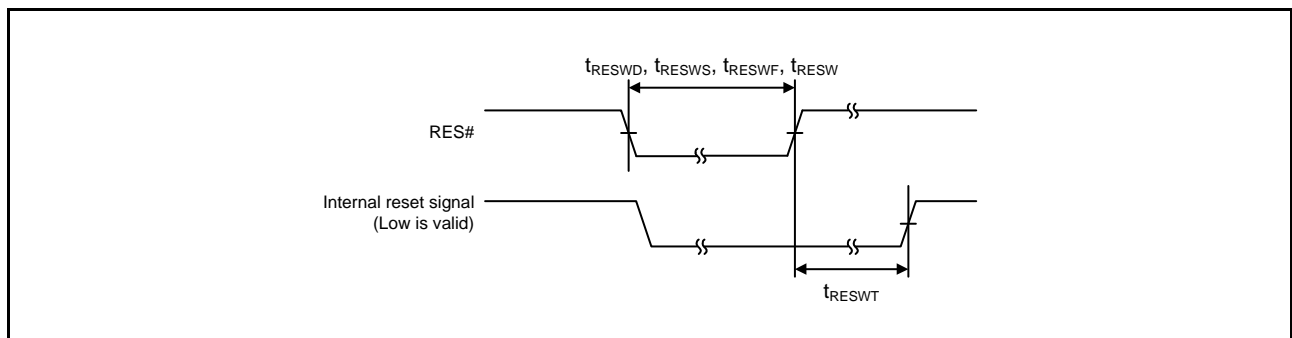
**Table 2.12 Reset Timing**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item		Symbol	Min.	Typ.	Max.	Unit	Test Conditions
RES# pulse width	Power-on	$t_{RESWP}$	1	—	—	ms	Figure 2.1
	Deep software standby mode	$t_{RESWD}$	0.6	—	—	ms	Figure 2.2
	Software standby mode, low-speed operating mode 2	$t_{RESWS}$	0.3	—	—	ms	
	Programming or erasure of the code flash memory, or programming, erasure or blank checking of the data flash memory	$t_{RESWF}$	200	—	—	$\mu$ s	
	Other than above	$t_{RESW}$	200	—	—	$\mu$ s	
Waiting time after release from the RES# pin reset		$t_{RESWT}$	62	—	63	$t_{Lcyc}$	Figure 2.1
Internal reset time (independent watchdog timer reset, watchdog timer reset, software reset)		$t_{RESW2}$	108	—	116	$t_{Lcyc}$	



**Figure 2.1 Reset Input Timing at Power-On**



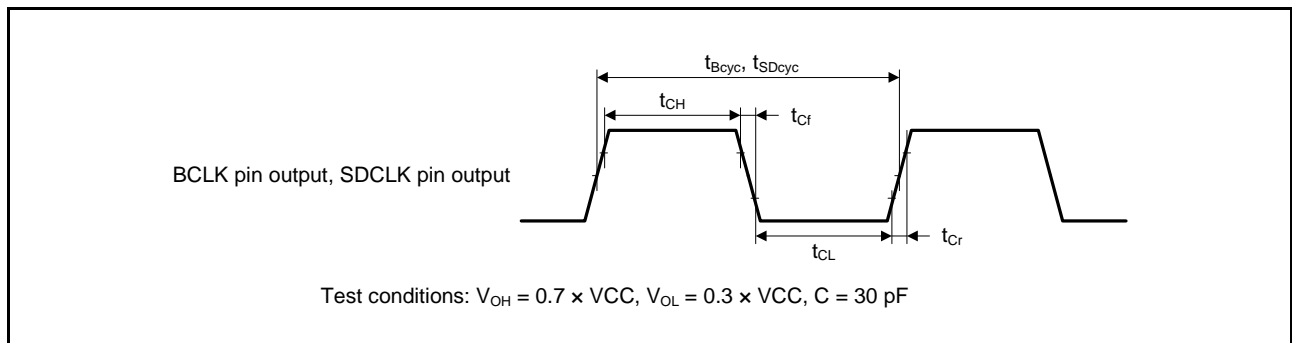
**Figure 2.2 Reset Input Timing**

2.3.2 Clock Timing

**Table 2.13 BCLK Pin Output, SDCLK Pin Output Clock Timing**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item		Symbol	Min.	Typ.	Max.	Unit	Test Conditions
BCLK pin output cycle time	Packages with 177 to 144 pins	$t_{Bcyc}$	16.6	—	—	ns	Figure 2.3
	Packages with 100 pins or less		33.2	—	—	ns	
BCLK pin output high pulse width		$t_{CH}$	3.3	—	—	ns	
BCLK pin output low pulse width		$t_{CL}$	3.3	—	—	ns	
BCLK pin output rising time		$t_{Cr}$	—	—	5	ns	
BCLK pin output falling time		$t_{Cf}$	—	—	5	ns	
SDCLK pin output cycle time	Packages with 177 to 144 pins	$t_{SDcyc}$	16.6	—	—	ns	
SDCLK pin output high pulse width		$t_{CH}$	3.3	—	—	ns	
SDCLK pin output low pulse width		$t_{CL}$	3.3	—	—	ns	
SDCLK pin output rising time		$t_{Cr}$	—	—	5	ns	
SDCLK pin output falling time		$t_{Cf}$	—	—	5	ns	

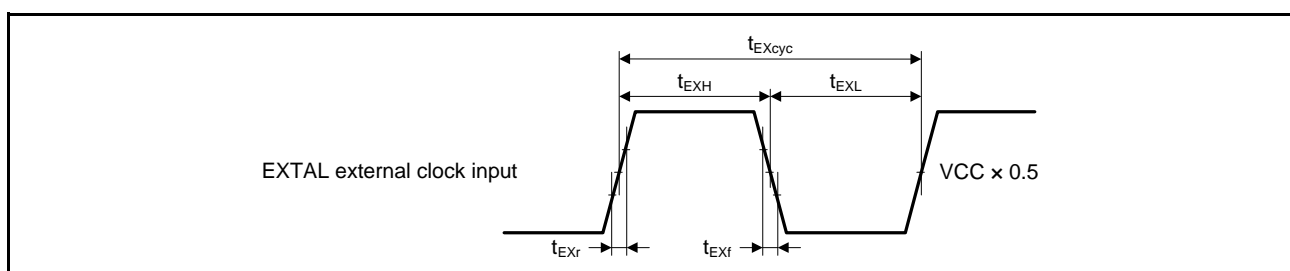


**Figure 2.3 BCLK Pin and SDCLK Pin Output Timing**

**Table 2.14** EXTAL Clock Timing

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $T_a = T_{opr}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
EXTAL external clock input cycle time	$t_{EXcyc}$	41.66	—	—	ns	Figure 2.4
EXTAL external clock input high pulse width	$t_{EXH}$	15.83	—	—	ns	
EXTAL external clock input low pulse width	$t_{EXL}$	15.83	—	—	ns	
EXTAL external clock rising time	$t_{EXr}$	—	—	5	ns	
EXTAL external clock falling time	$t_{EXf}$	—	—	5	ns	

**Figure 2.4** EXTAL External Clock Input Timing**Table 2.15** Main Clock Timing

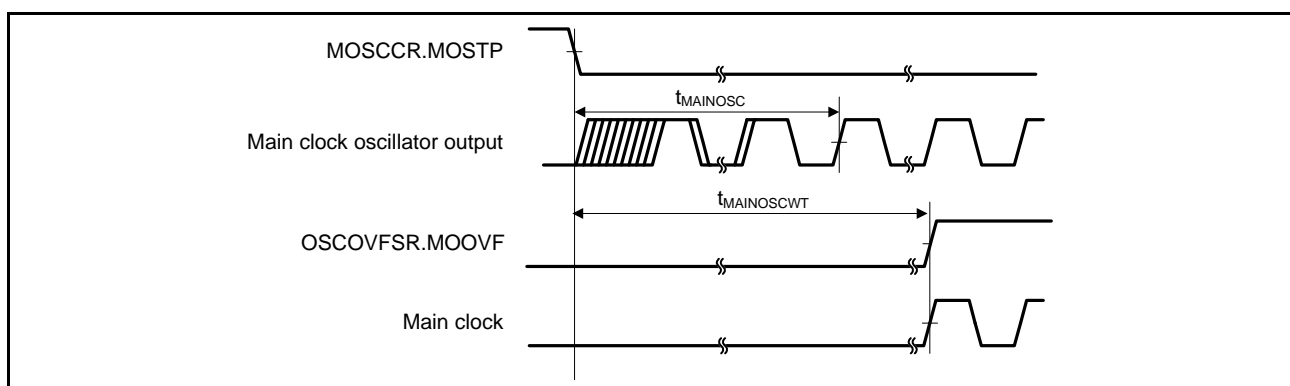
Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $T_a = T_{opr}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Main clock oscillation frequency	$f_{MAIN}$	8	—	24	MHz	
Main clock oscillator stabilization time (crystal)	$t_{MAINOSC}$	—	—	—*1	ms	Figure 2.5
Main clock oscillator stabilization wait time (crystal)	$t_{MAINOSCWT}$	—	—	—*2	ms	

Note 1. When using a main clock, ask the manufacturer of the oscillator to evaluate its oscillation. Refer to the results of evaluation provided by the manufacturer for the oscillation stabilization time.

Note 2. The number of cycles selected by the value of the MOSCWTCR.MSTS[7:0] bits determines the main clock oscillation stabilization wait time in accord with the formula below.

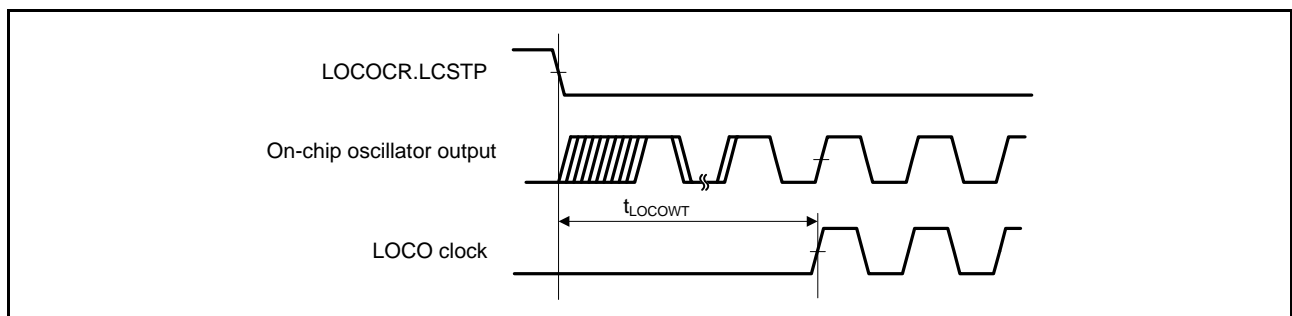
$$t_{MAINOSCWT} = [(MSTS[7:0] \text{ bits} \times 32) + 10] / f_{LOCO}$$

**Figure 2.5** Main Clock Oscillation Start Timing

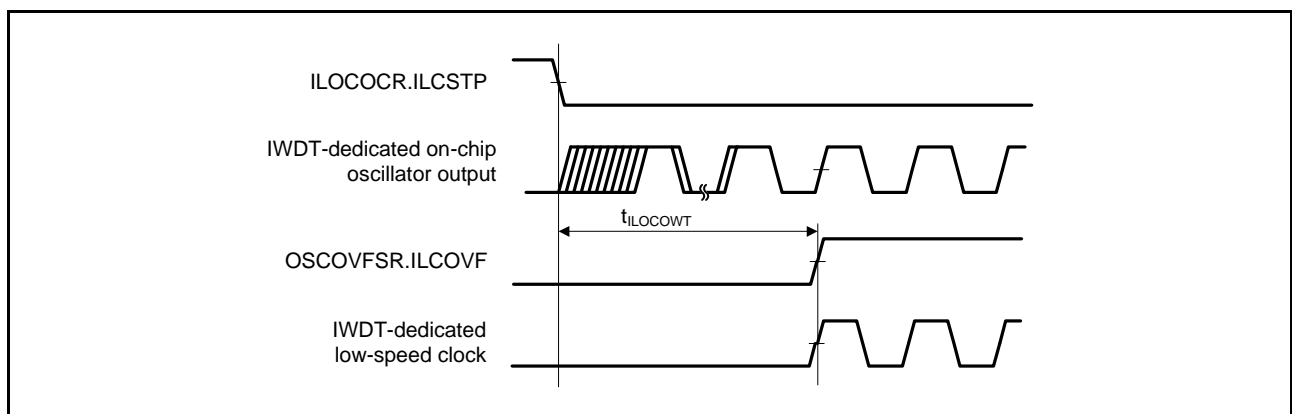
**Table 2.16 LOCO and IWDT-Dedicated Low-Speed Clock Timing**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $T_a = T_{opr}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
LOCO clock cycle time	$t_{Lcyc}$	3.78	4.16	4.63	$\mu s$	
LOCO clock oscillation frequency	$f_{LOCO}$	216	240	264	kHz	
LOCO clock oscillation stabilization wait time	$t_{LOCOWT}$	—	—	44	$\mu s$	Figure 2.6
IWDT-dedicated low-speed clock cycle time	$t_{iLcyc}$	7.57	8.33	9.26	$\mu s$	
IWDT-dedicated low-speed clock oscillation frequency	$f_{iLOCO}$	108	120	132	kHz	
IWDT-dedicated low-speed clock oscillation stabilization wait time	$t_{iLOCOWT}$	—	142	190	$\mu s$	Figure 2.7



**Figure 2.6 LOCO Clock Oscillation Start Timing**

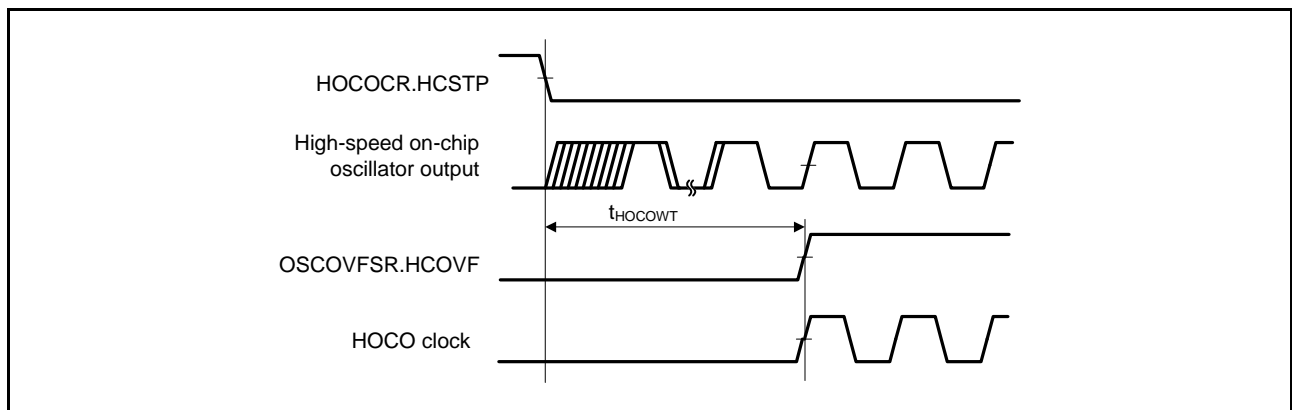


**Figure 2.7 IWDT-dedicated Low-Speed Clock Oscillation Start Timing**

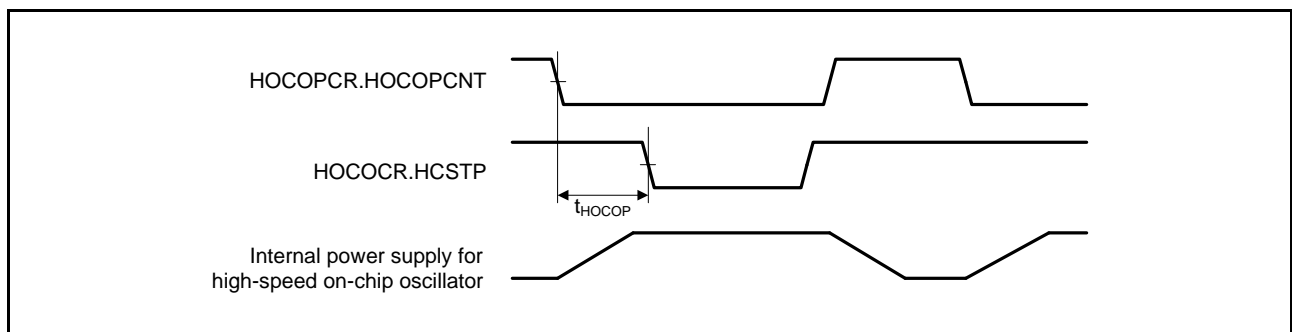
**Table 2.17 HOCO Clock Timing**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $T_a = T_{opr}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
HOCO clock oscillation frequency	$f_{HOCO}$	15.61	16	16.39	MHz	$-20^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$
		17.56	18	18.44	MHz	
		19.52	20	20.48	MHz	
		$-40^{\circ}\text{C} \leq T_a < -20^{\circ}\text{C}$	15.52	16	16.48	MHz
			17.46	18	18.54	MHz
			19.40	20	20.60	MHz
HOCO clock oscillation stabilization wait time	$t_{HOCOWT}$	—	105	149	$\mu\text{s}$	Figure 2.8
HOCO clock power supply stabilization time	$t_{HOCOP}$	—	—	150	$\mu\text{s}$	Figure 2.9



**Figure 2.8 HOCO Clock Oscillation Start Timing (Oscillation is Started by Setting the HOCOCR.HCSTP Bit)**

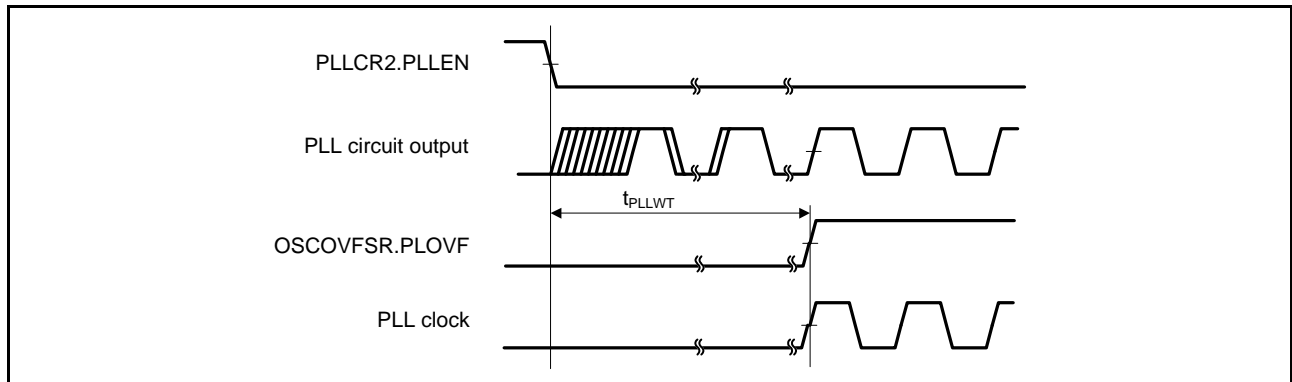


**Figure 2.9 High-Speed On-Chip Oscillator Power Supply Control Timing**

**Table 2.18 PLL Clock Timing**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
PLL clock oscillation frequency	$f_{PLL}$	120	—	240	MHz	
PLL clock oscillation stabilization wait time	$t_{PLLWT}$	—	259	320	$\mu$ s	Figure 2.10



**Figure 2.10 PLL Clock Oscillation Start Timing**

**Table 2.19 Sub-Clock Timing**

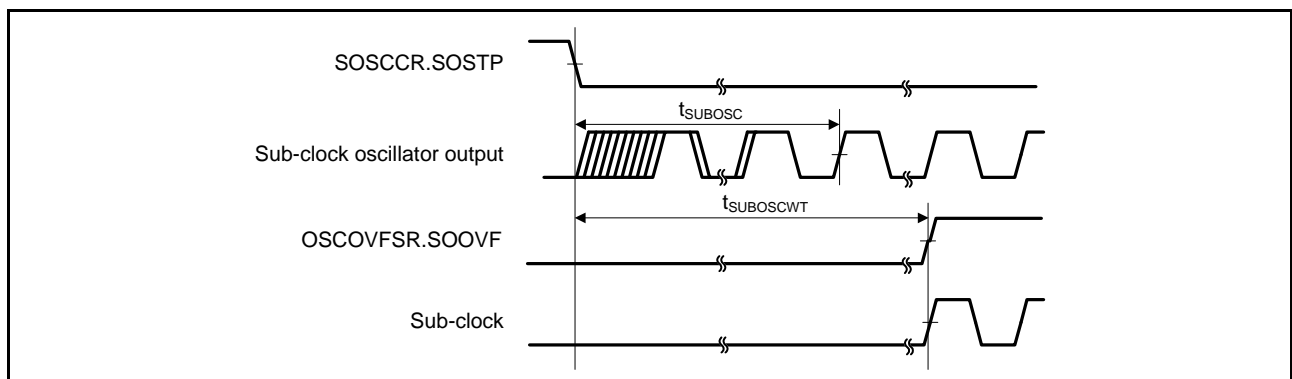
Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $V_{BATT} = 2.0$  to  $3.6$  V,  $T_a = T_{opr}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Sub-clock oscillation frequency	$f_{SUB}$	—	32.768	—	kHz	
Sub-clock oscillation stabilization time	$t_{SUBOSC}$	—	—	*1	s	Figure 2.11
Sub-clock oscillation stabilization wait time	$t_{SUBOSCWT}$	—	—	*2	s	

Note 1. When using a sub-clock, ask the manufacturer of the oscillator to evaluate its oscillation. Refer to the results of evaluation provided by the manufacturer for the oscillation stabilization time.

Note 2. The number of cycles selected by the value of the SOSWTCR.SSTS[7:0] bits determines the sub-clock oscillation stabilization wait time in accord with the formula below.

$$t_{SUBOSCWT} = [(SSTS[7:0] \text{ bits} \times 16384) + 10] / f_{LOCO}$$



**Figure 2.11 Sub-Clock Oscillation Start Timing**



## 2.3.3 Timing of Recovery from Low Power Consumption Modes

**Table 2.20 Timing of Recovery from Low Power Consumption Modes (1)**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $T_a = T_{opr}$

Item			Symbol	Min.	Typ.	Max.		Unit	Test Conditions
						$t_{SBYOSCWT}^{*2}$	$t_{SBYSEQ}^{*3}$		
Recovery time after cancellation of software standby mode*1	Crystal resonator connected to main clock oscillator	Main clock oscillator operating	$t_{SBYMC}$	—	—	$\{(MSTS[7:0] \text{ bit} \times 32) + 76\} / 0.216$	$100 \mu\text{s} + 7/f_{ICLK} + 2n/f_{MAIN}$	$\mu\text{s}$	Figure 2.12
		Main clock oscillator and PLL circuit operating	$t_{SBYPC}$			$\{(MSTS[7:0] \text{ bit} \times 32) + 138\} / 0.216$	$100 \mu\text{s} + 7/f_{ICLK} + 2n/f_{PLL}$		
	External clock input to main clock oscillator	Main clock oscillator operating	$t_{SBYEX}$			352	$100 \mu\text{s} + 7/f_{ICLK} + 2n/f_{EXMAIN}$		
		Main clock oscillator and PLL circuit operating	$t_{SBYPE}$			639	$100 \mu\text{s} + 7/f_{ICLK} + 2n/f_{PLL}$		
	Sub-clock oscillator operating		$t_{SBYSC}$			$\{(SSTS[7:0] \text{ bit} \times 16384) + 13\} / 0.216 + 10/f_{FCLK}$	$100 \mu\text{s} + 4/f_{ICLK} + 2n/f_{SUB}$		
	High-speed on-chip oscillator operating	High-speed on-chip oscillator operating	$t_{SBYHO}$			454	$100 \mu\text{s} + 7/f_{ICLK} + 2n/f_{HOCO}$		
		High-speed on-chip oscillator operating and PLL circuit operating	$t_{SBYPH}$			741	$100 \mu\text{s} + 7/f_{ICLK} + 2n/f_{PLL}$		
	Low-speed on-chip oscillator operating*4		$t_{SBYLO}$			338	$100 \mu\text{s} + 7/f_{ICLK} + 2n/f_{LOCO}$		

Note 1. The time for return after release from software standby is determined by the value obtained by adding the oscillation stabilization waiting time ( $t_{SBYOSCWT}$ ) and the time required for operations by the software standby release sequencer ( $t_{SBYSEQ}$ ).

Note 2. When several oscillators were running before the transition to software standby, the greatest value of the oscillation stabilization waiting time  $t_{SBYOSCWT}$  is selected.

Note 3. For n, the greatest value is selected from among the internal clock division settings.

Note 4. This condition applies when  $f_{ICLK}:f_{FCLK} = 1:1, 2:1, \text{ or } 4:1$ .

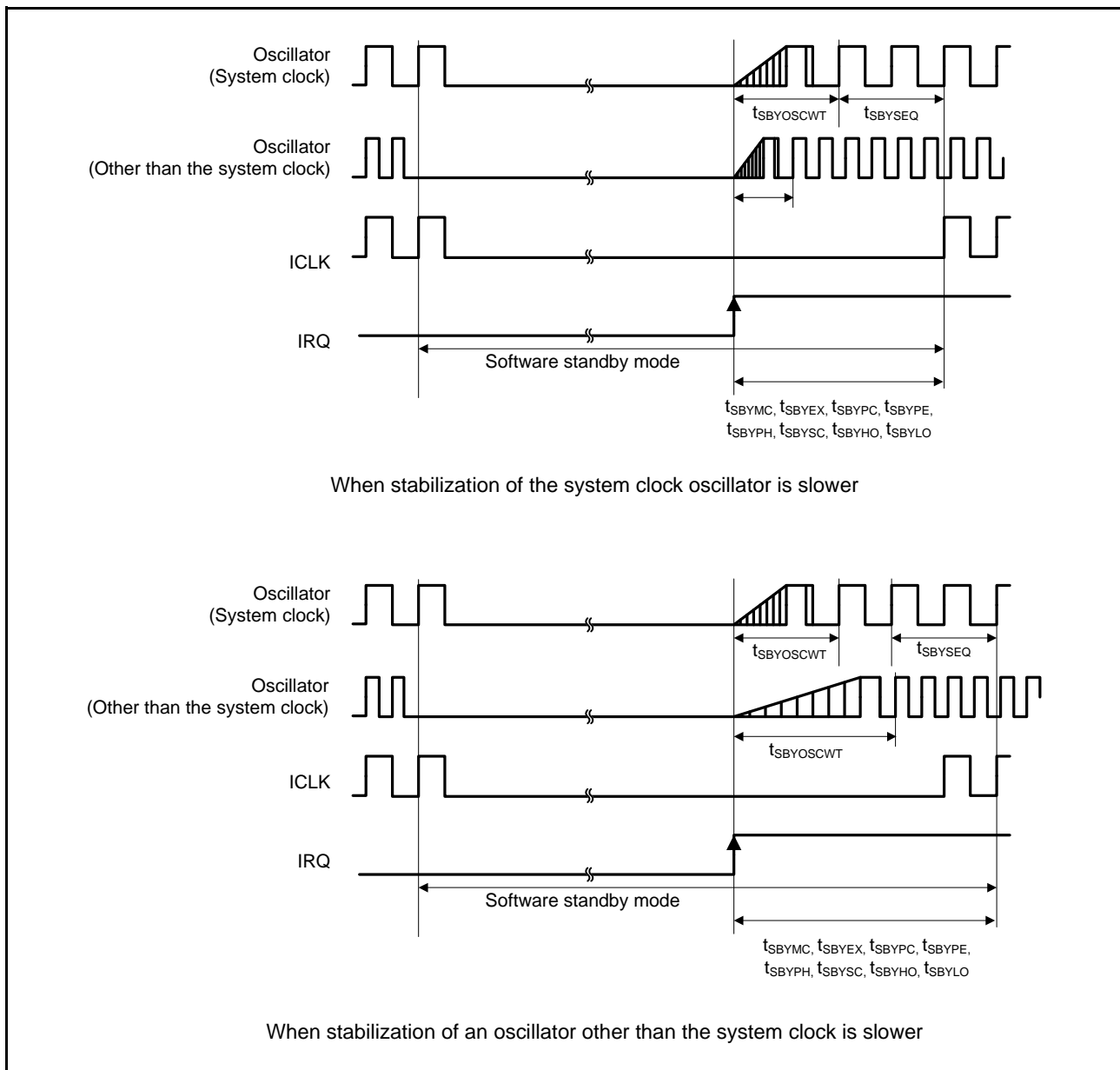
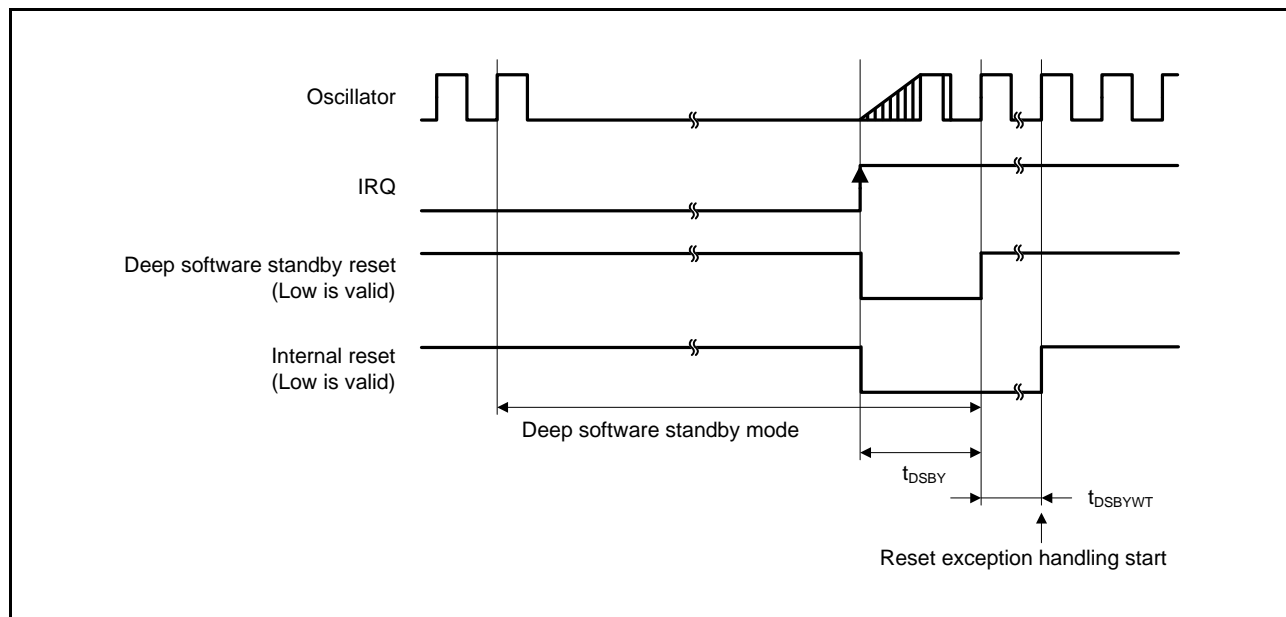


Figure 2.12 Software Standby Mode Cancellation Timing

**Table 2.21 Timing of Recovery from Low Power Consumption Modes (2)**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $T_a = T_{opr}$

Item	Symbol	min	typ	max	Unit	Test Conditions
Recovery time after cancellation of deep software standby mode	$t_{DSBY}$	—	—	0.9	ms	Figure 2.13
Wait time after cancellation of deep software standby mode	$t_{DSBYWT}$	31	—	32	$t_{Lcyc}$	



**Figure 2.13 Deep Software Standby Mode Cancellation Timing**

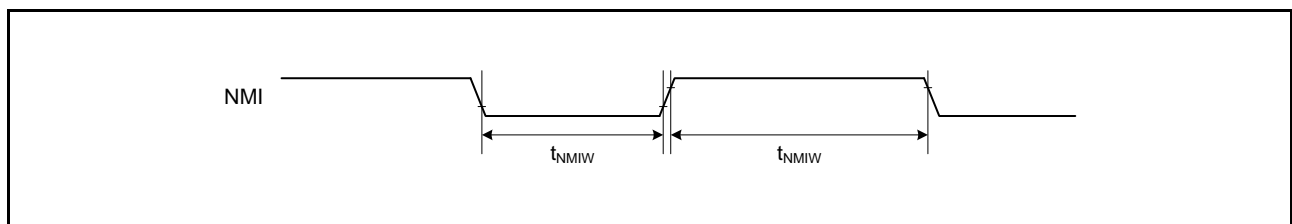
### 2.3.4 Control Signal Timing

**Table 2.22 Control Signal Timing**

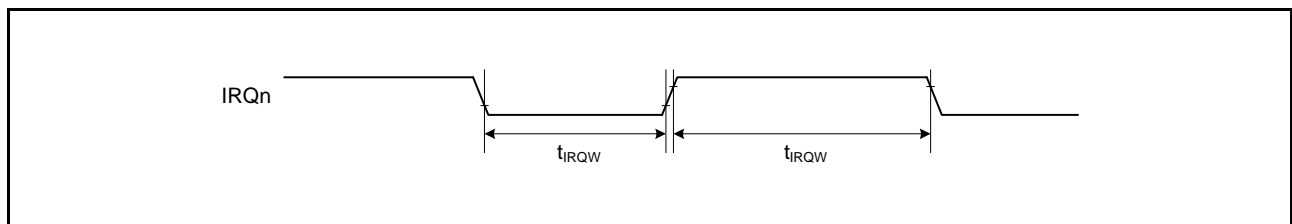
Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $PLCKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$

Item	Symbol	Min.*1	Typ.	Max.	Unit	Test Conditions*1
NMI pulse width	$t_{NMIW}$	200	—	—	ns	$t_{PBcyc} \times 2 \leq 200$ ns, Figure 2.14
		$t_{PBcyc} \times 2$	—	—	ns	$t_{PBcyc} \times 2 > 200$ ns, Figure 2.14
IRQ pulse width	$t_{IRQW}$	200	—	—	ns	$t_{PBcyc} \times 2 \leq 200$ ns, Figure 2.15
		$t_{PBcyc} \times 2$	—	—	ns	$t_{PBcyc} \times 2 > 200$ ns, Figure 2.15

Note 1.  $t_{PBcyc}$ : PCLKB cycle



**Figure 2.14 NMI Interrupt Input Timing**



**Figure 2.15 IRQ Interrupt Input Timing**

## 2.3.5 Bus Timing

**Table 2.23 Bus Timing**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $ICLK = PCLKA = 8$  to  $120$  MHz,  $PCLKB = BCLK = SDCLK = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item	Symbol	Min.	Max.	Unit	Test Conditions
Address delay time	$t_{AD}$	—	12.5	ns	Figure 2.16 to Figure 2.21
Byte control delay time	$t_{BCD}$	—	12.5	ns	
CS# delay time	$t_{CSD}$	—	12.5	ns	
ALE delay time	$t_{ALED}$	—	12.5	ns	
RD# delay time	$t_{RSD}$	—	12.5	ns	
Read data setup time	$t_{RDS}$	12.5	—	ns	
Read data hold time	$t_{RDH}$	0	—	ns	
WR# delay time	$t_{WRD}$	—	12.5	ns	
Write data delay time	$t_{WDD}$	—	12.5	ns	
Write data hold time	$t_{WDH}$	0	—	ns	
WAIT# setup time	$t_{WTS}$	12.5	—	ns	Figure 2.22
WAIT# hold time	$t_{WTH}$	0	—	ns	
Address delay time 2 (SDRAM)	$t_{AD2}$	1	12.5	ns	Figure 2.23
CS# delay time 2 (SDRAM)	$t_{CSD2}$	1	12.5	ns	
DQM delay time (SDRAM)	$t_{DQMD}$	1	12.5	ns	
CKE delay time (SDRAM)	$t_{CKED}$	1	12.5	ns	
Read data setup time 2 (SDRAM)	$t_{RDS2}$	10	—	ns	
Read data hold time 2 (SDRAM)	$t_{RDH2}$	0	—	ns	
Write data delay time 2 (SDRAM)	$t_{WDD2}$	—	12.5	ns	
Write data hold time 2 (SDRAM)	$t_{WDH2}$	1	—	ns	
WE# delay time (SDRAM)	$t_{WED}$	1	12.5	ns	
RAS# delay time (SDRAM)	$t_{RASD}$	1	12.5	ns	
CAS# delay time (SDRAM)	$t_{CASD}$	1	12.5	ns	

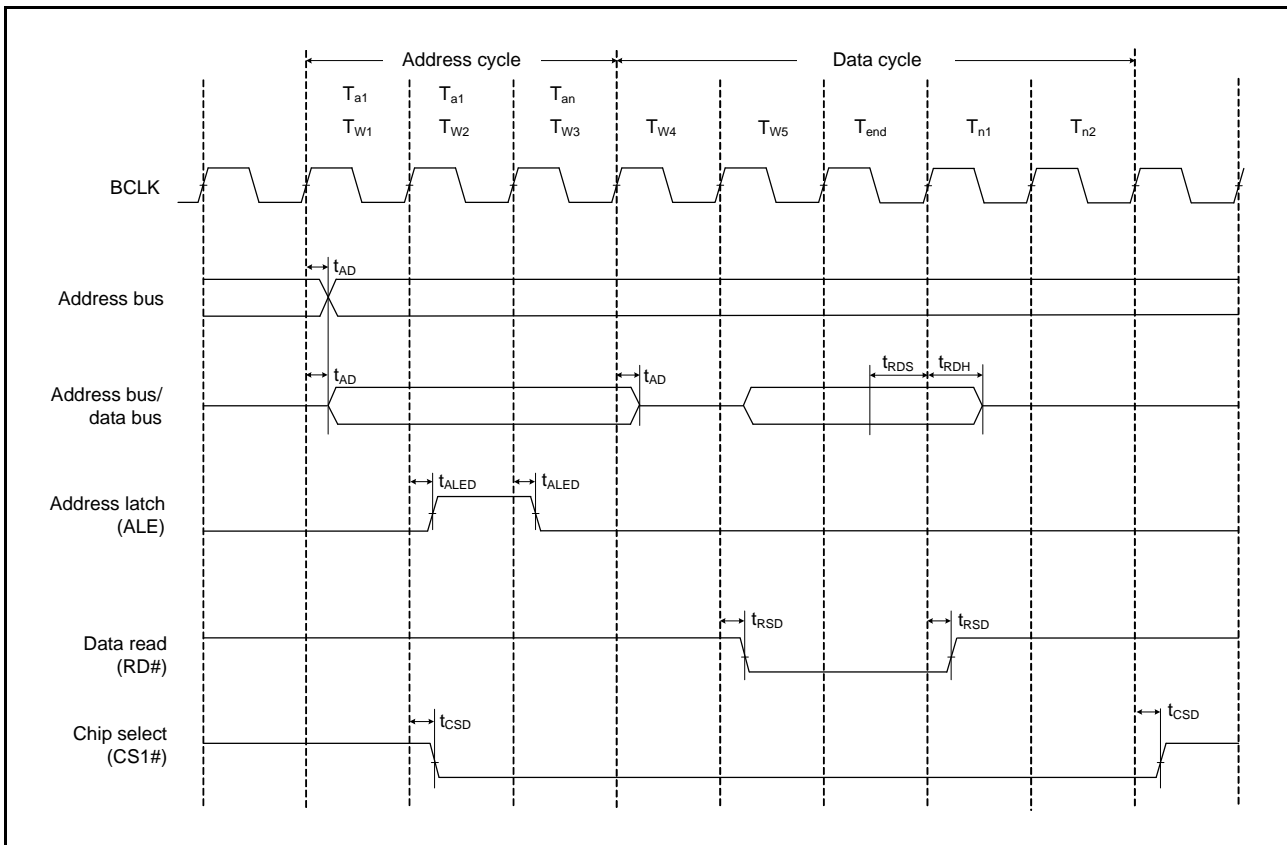


Figure 2.16 Address/Data Multiplexed Bus Read Access Timing

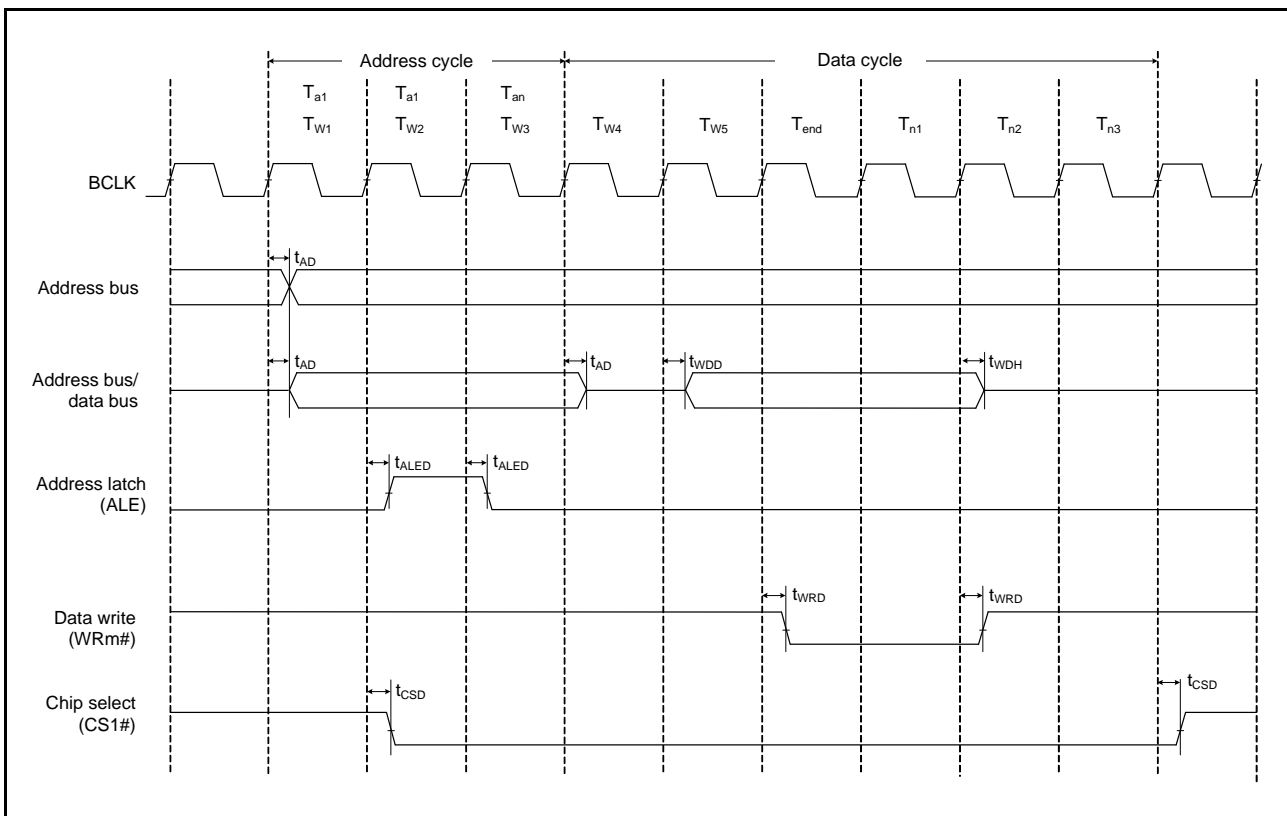


Figure 2.17 Address/Data Multiplexed Bus Write Access Timing

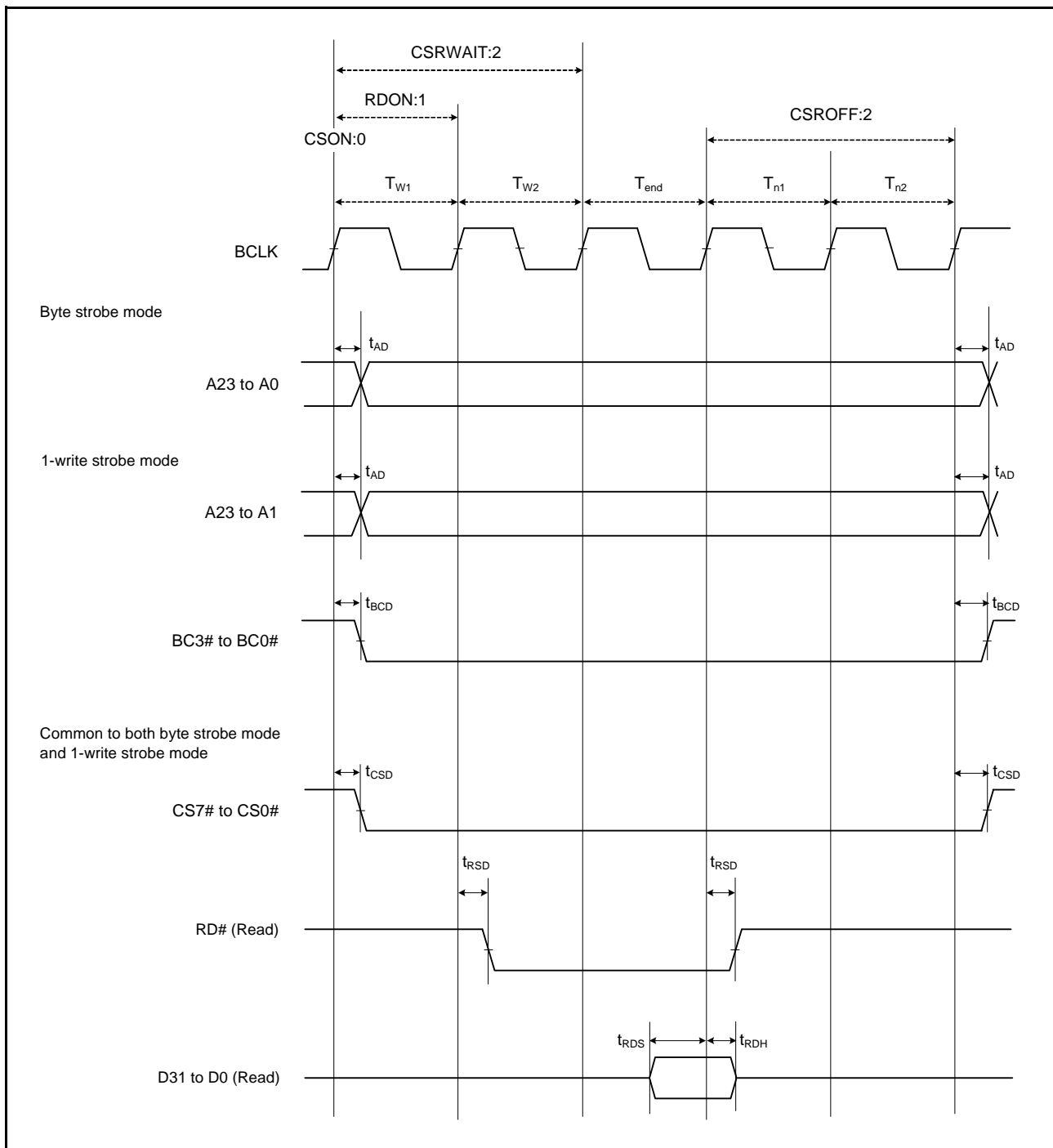


Figure 2.18 External Bus Timing/Normal Read Cycle (Bus Clock Synchronized)

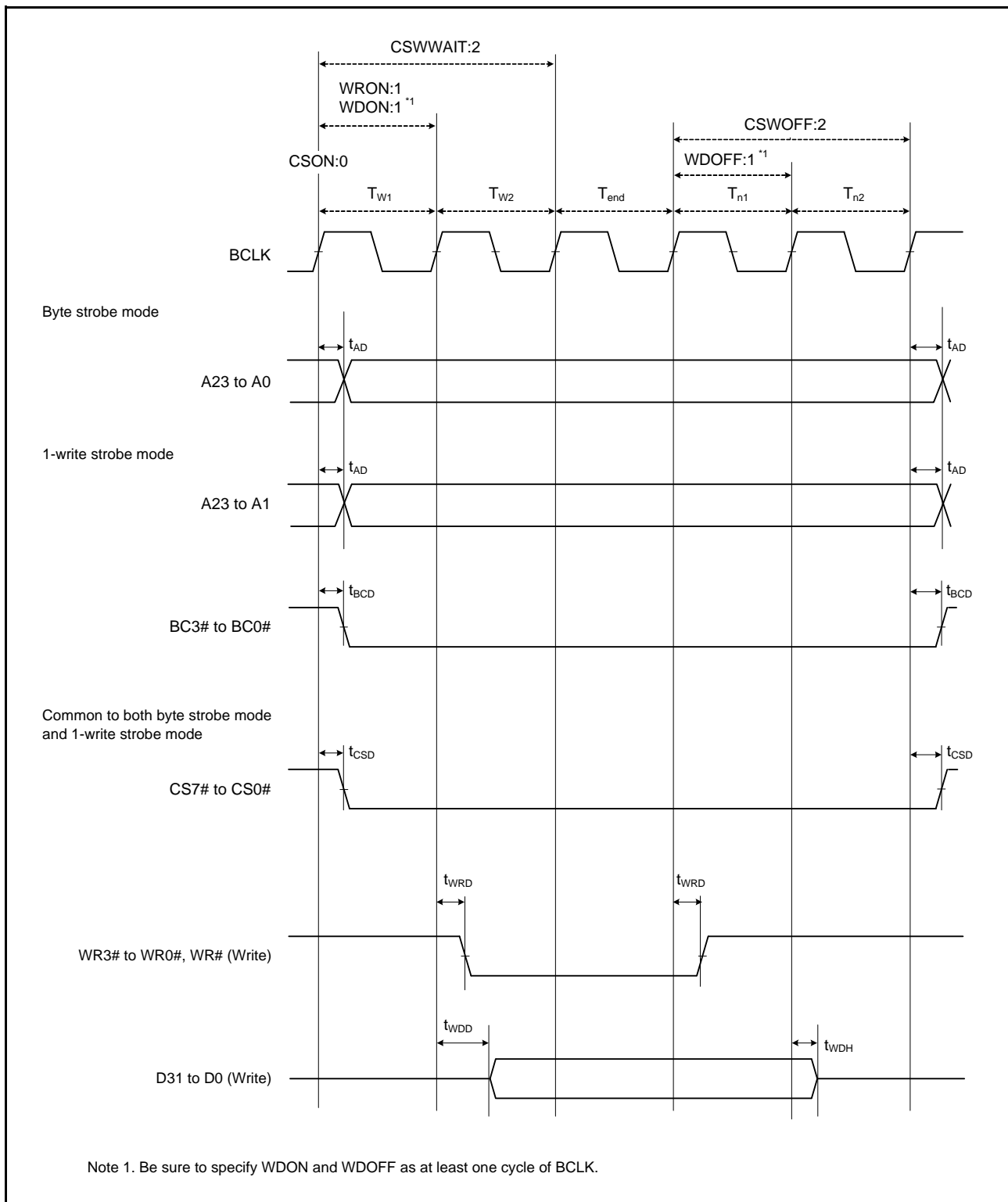


Figure 2.19 External Bus Timing/Normal Write Cycle (Bus Clock Synchronized)



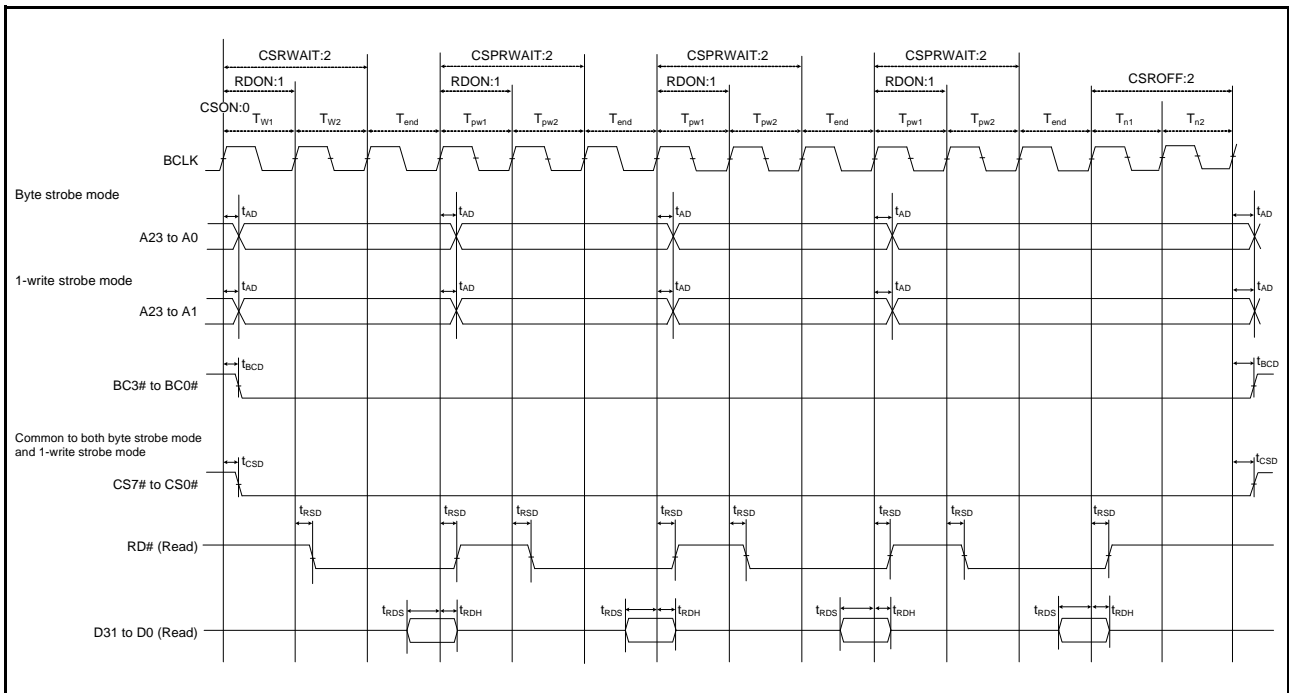


Figure 2.20 External Bus Timing/Page Read Cycle (Bus Clock Synchronized)

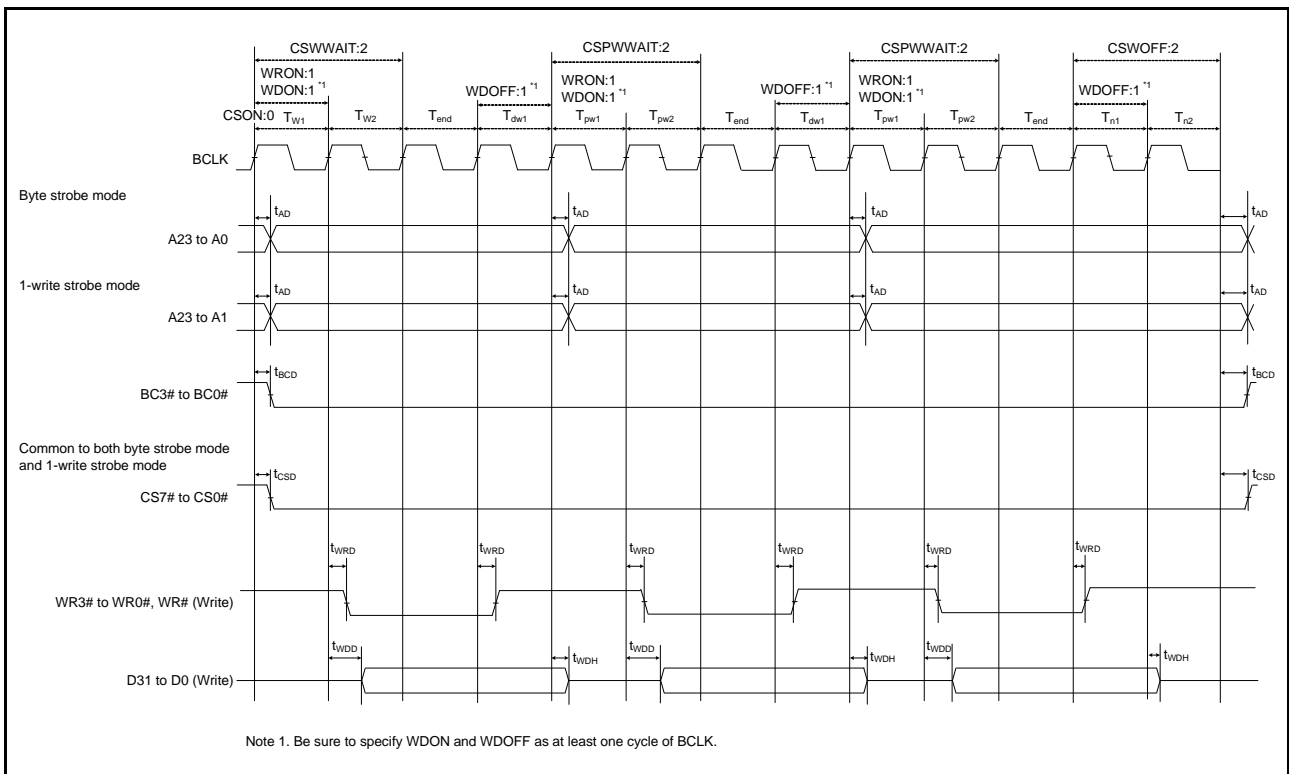


Figure 2.21 External Bus Timing/Page Write Cycle (Bus Clock Synchronized)

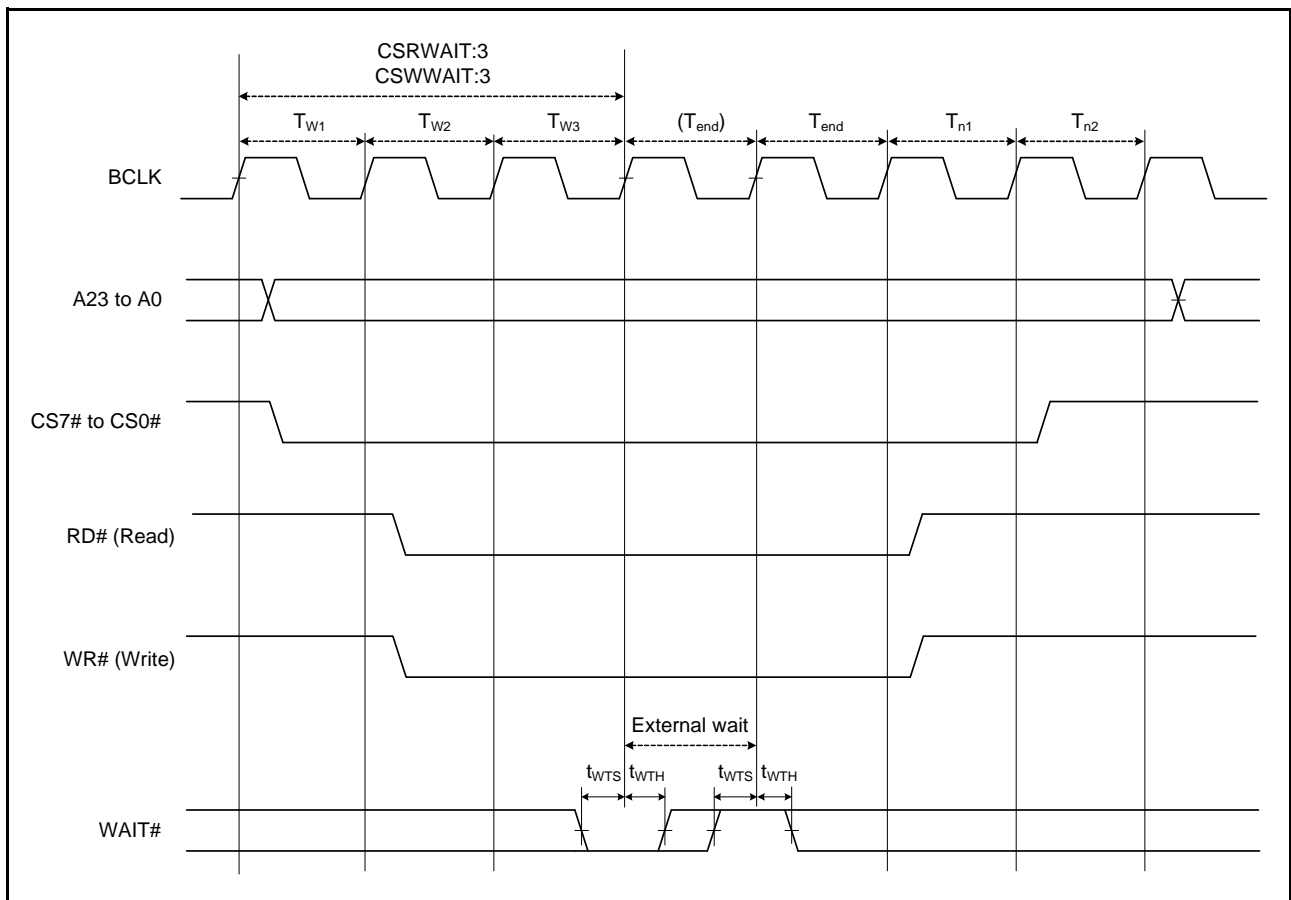


Figure 2.22 External Bus Timing/External Wait Control

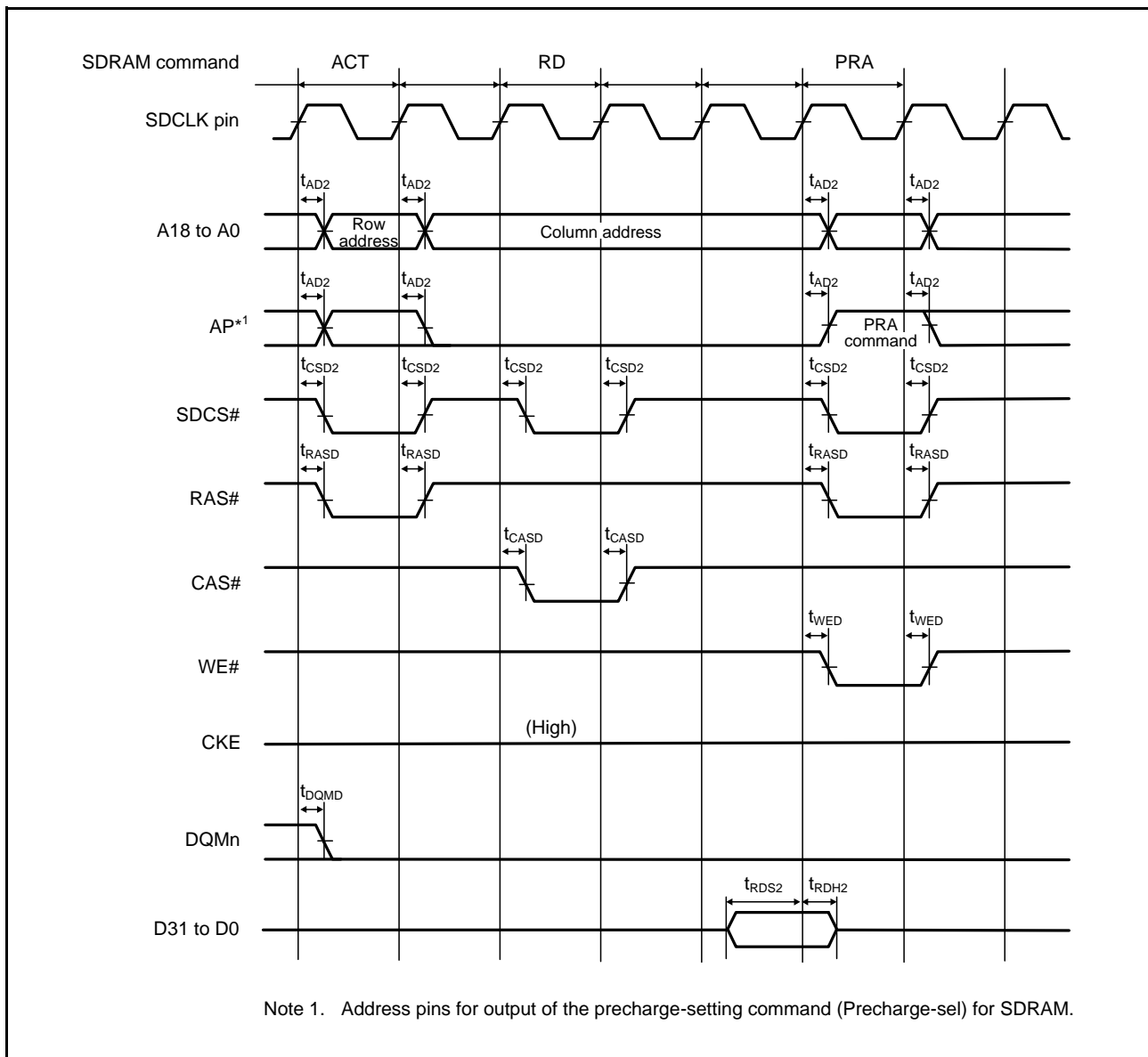


Figure 2.23 SDRAM Space Single Read Bus Timing

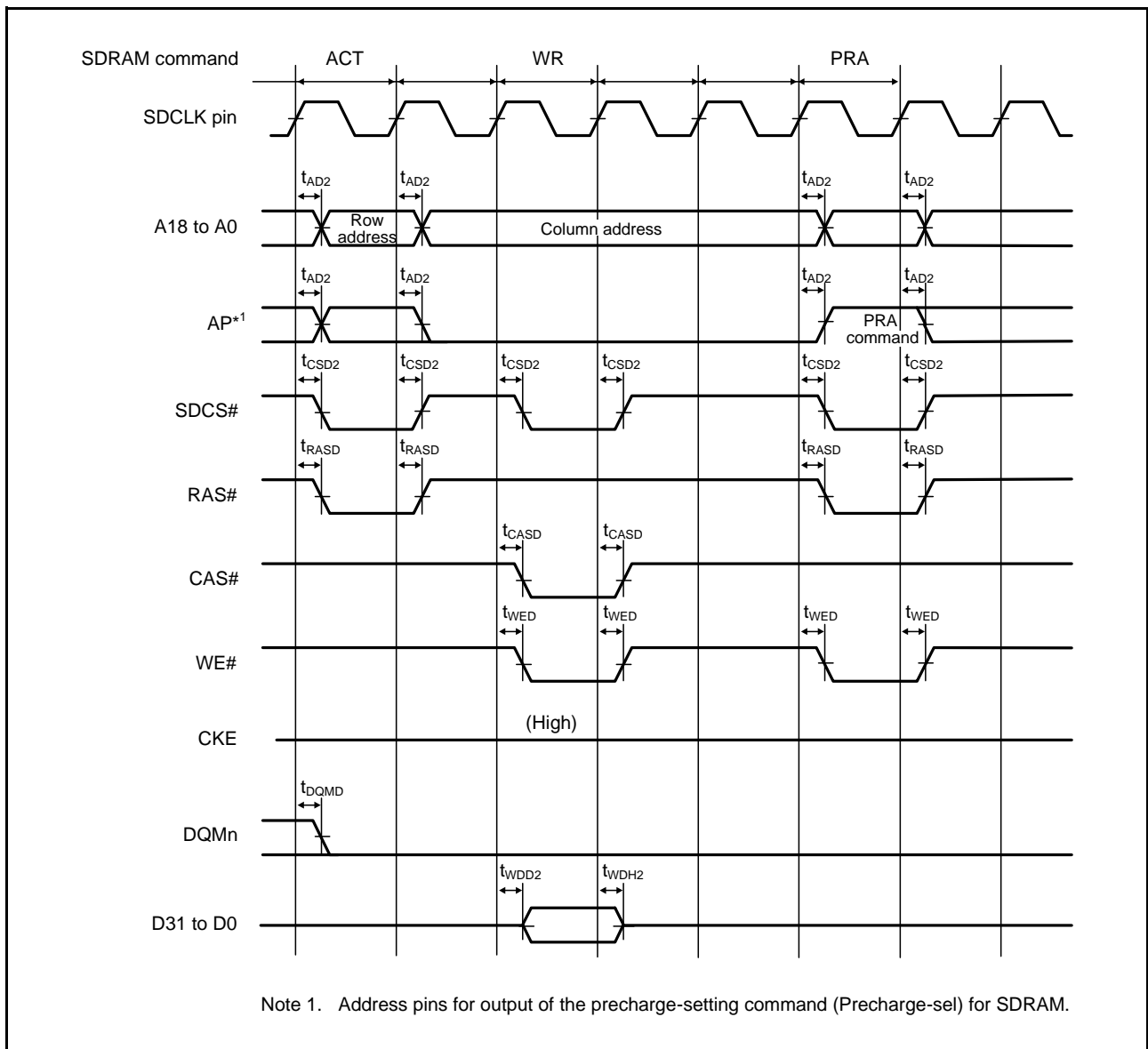


Figure 2.24 SDRAM Space Single Write Bus Timing

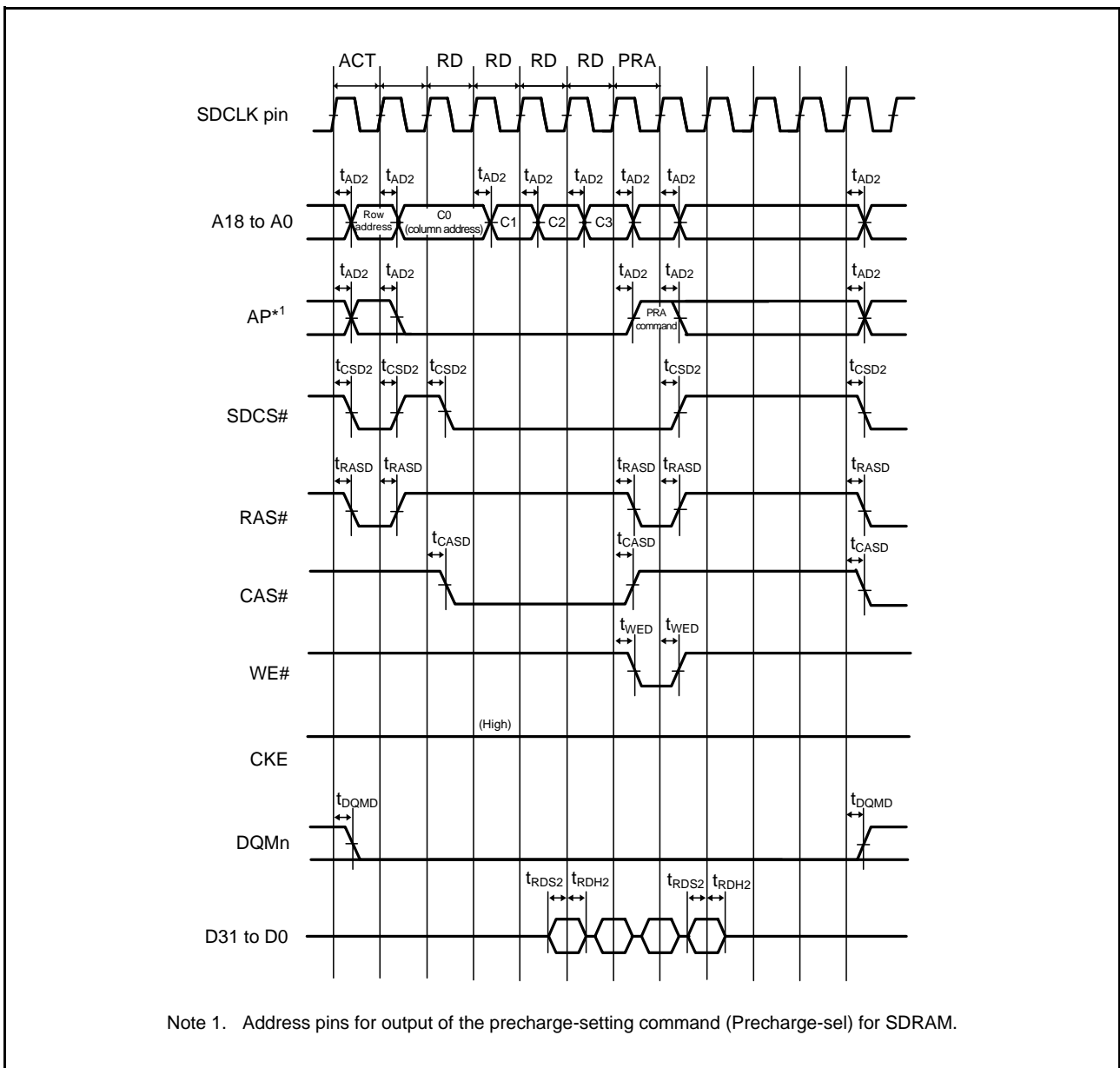


Figure 2.25 SDRAM Space Multiple Read Bus Timing

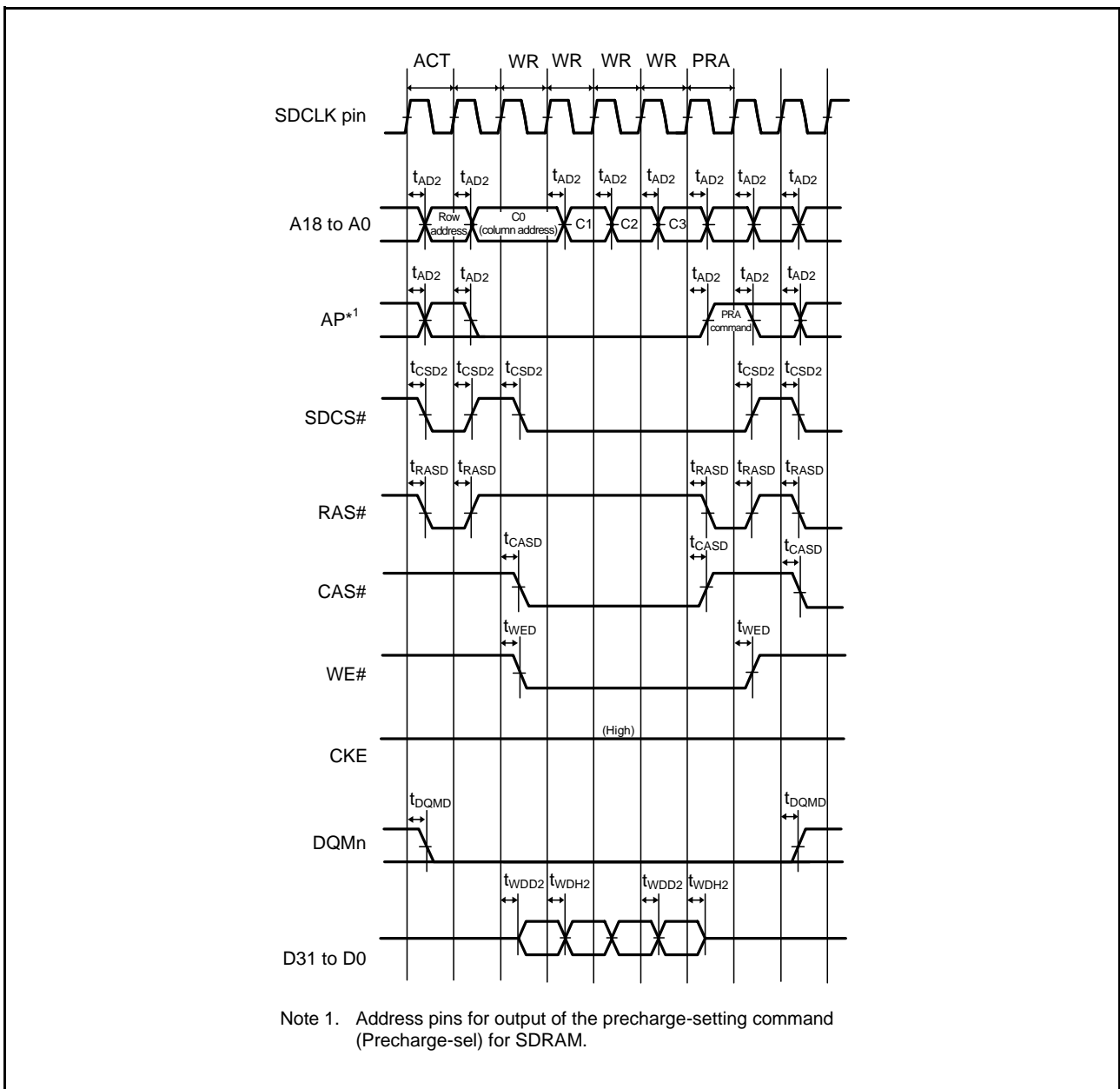


Figure 2.26 SDRAM Space Multiple Write Bus Timing

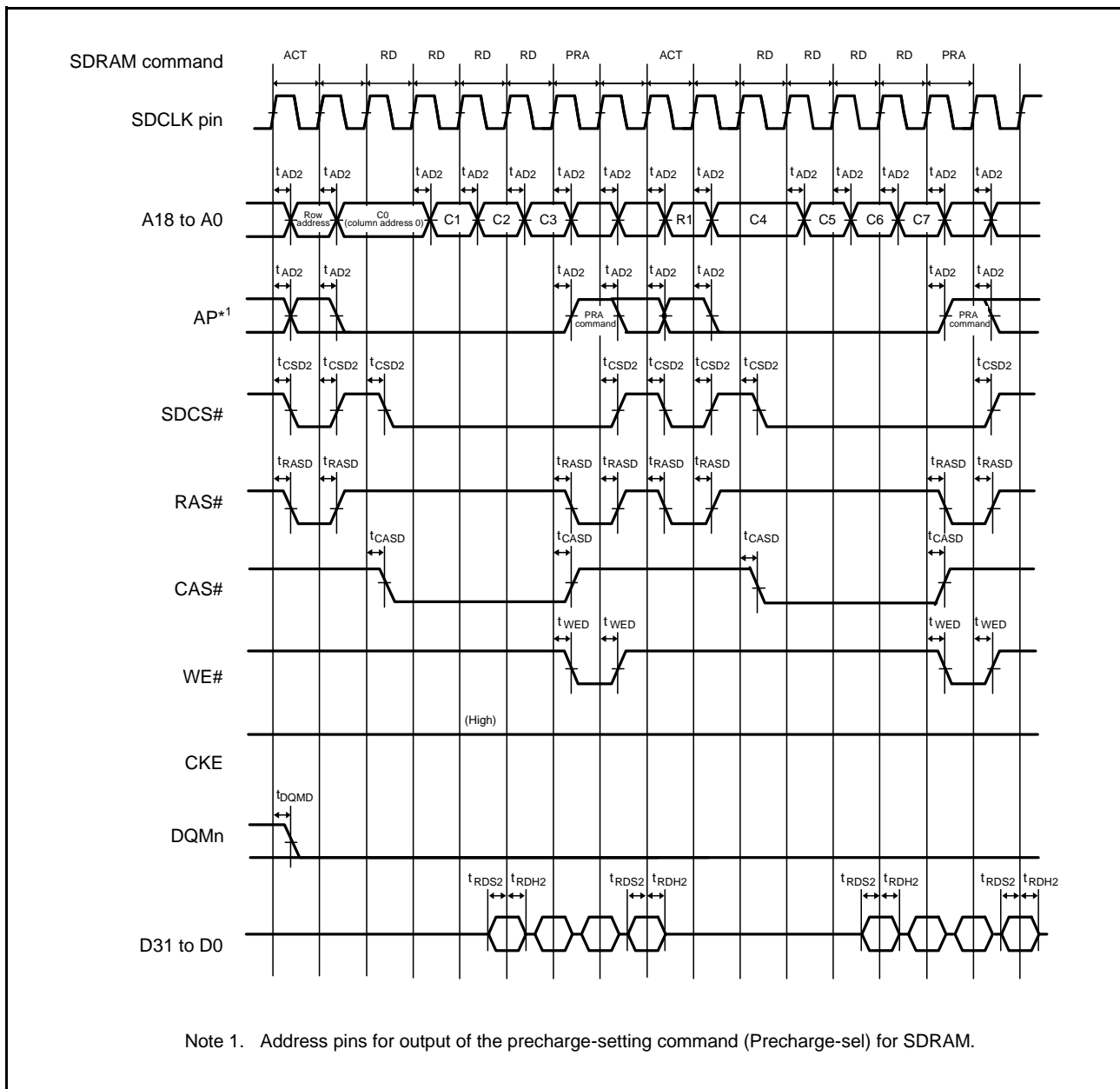


Figure 2.27 SDRAM Space Multiple Read Line Stride Bus Timing

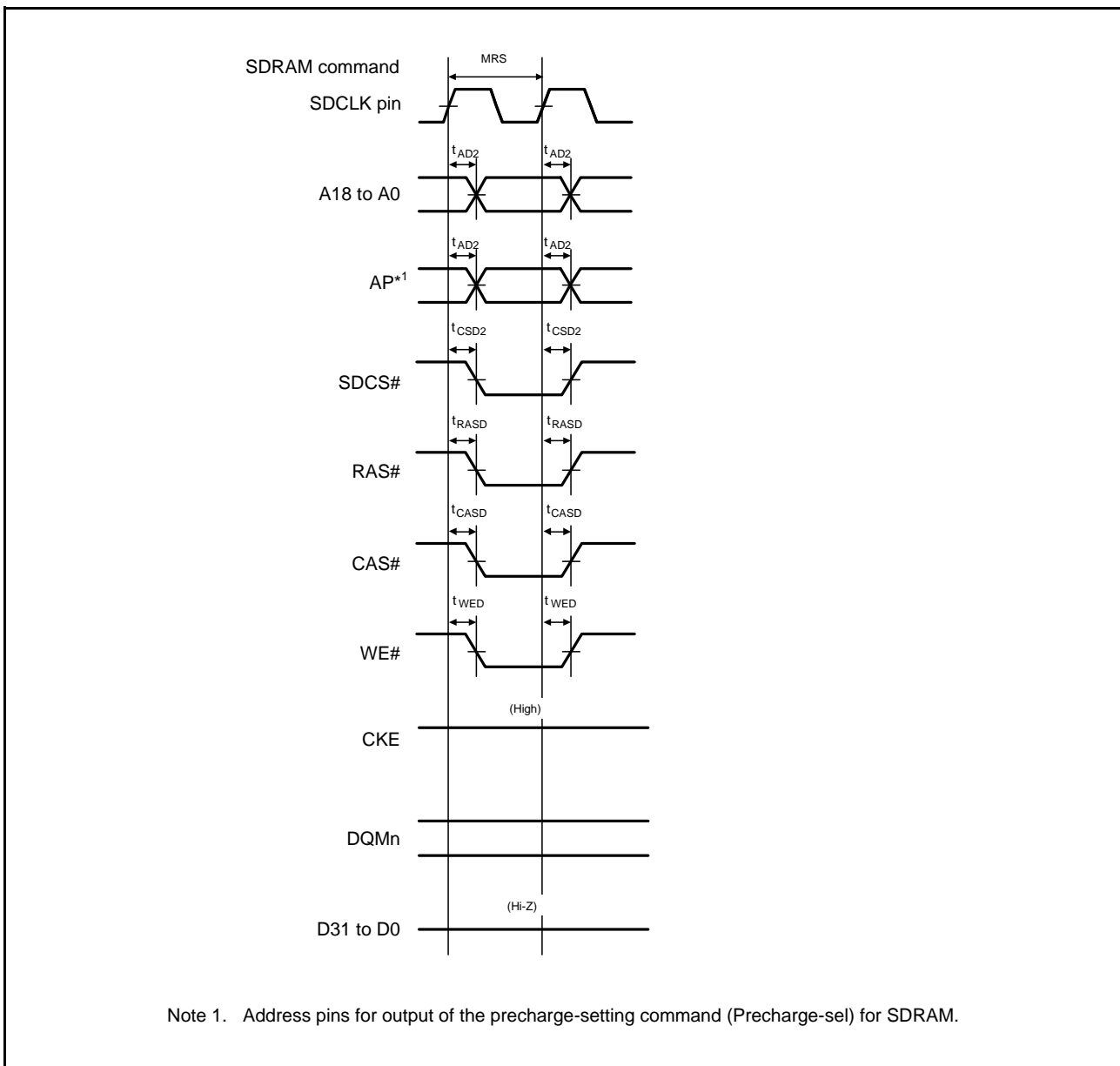


Figure 2.28 SDRAM Space Mode Register Set Bus Timing



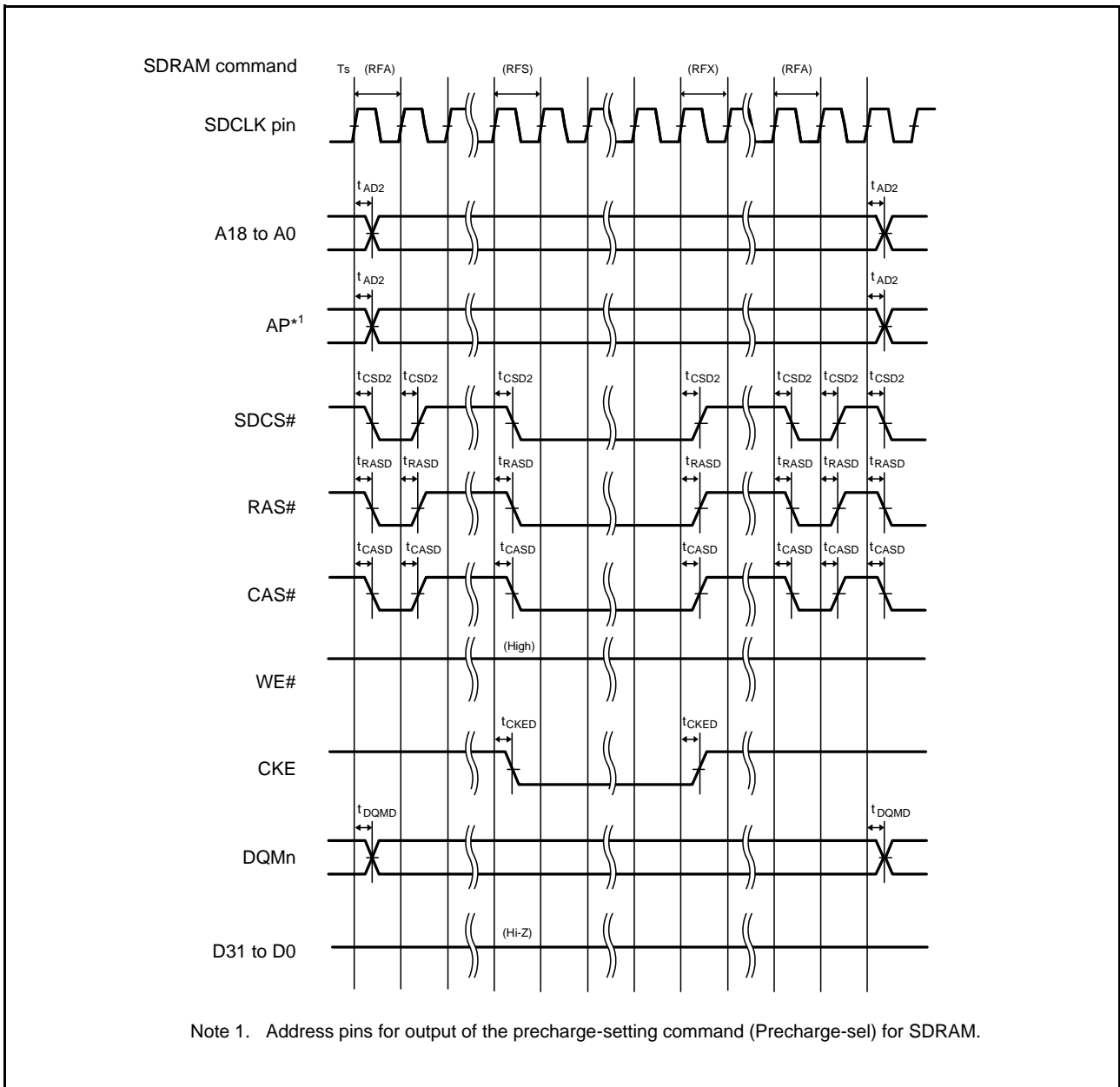


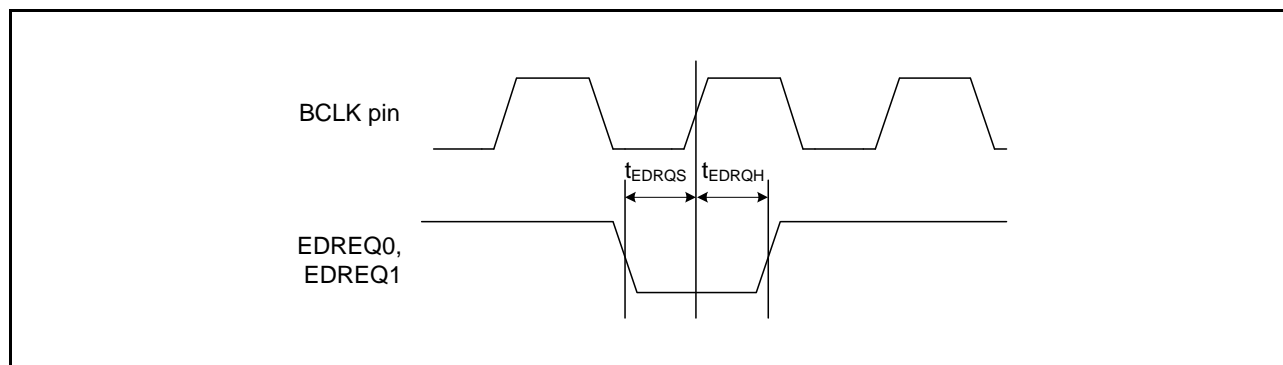
Figure 2.29 SDRAM Space Self-Refresh Bus Timing

### 2.3.6 EXDMAC Timing

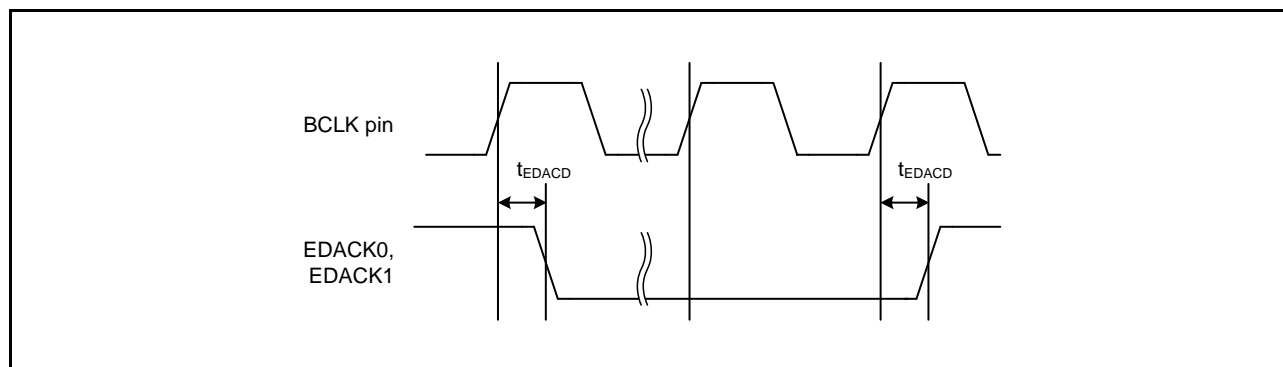
**Table 2.24 EXDMAC Timing**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $ICLK = PCLKA = 8$  to  $120$  MHz,  $PCLKB = BCLK = SDCLK = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

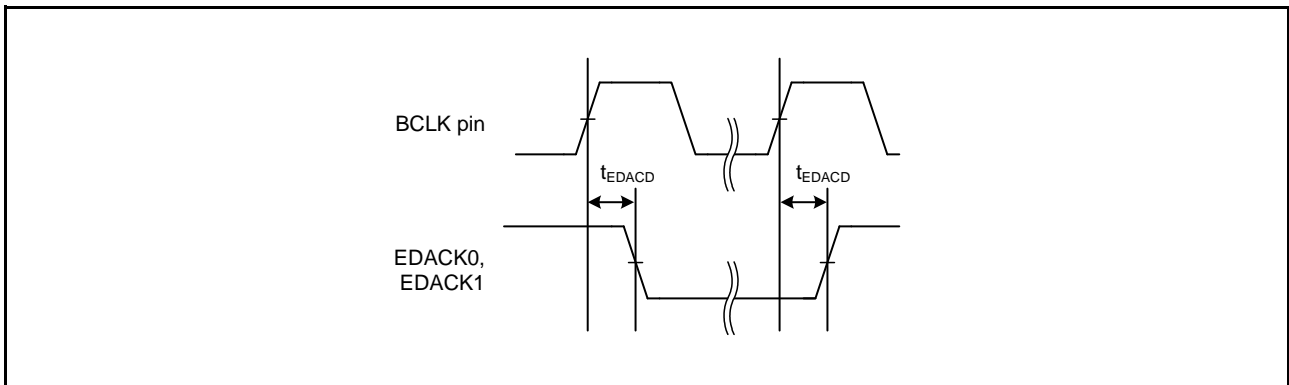
Item	Symbol	Min.	Max.	Unit	Test Conditions	
EXDMAC	EDREQ setup time	$t_{EDRQS}$	13	—	ns	Figure 2.30
	EDREQ hold time	$t_{EDRQH}$	2	—	ns	
	EDACK delay time	$t_{EDACD}$	—	13	ns	Figure 2.31, Figure 2.32



**Figure 2.30 EDREQ0 and EDREQ1 Input Timing**



**Figure 2.31 EDACK0 and EDACK1 Single-Address Transfer Timing (for a CS Area)**



**Figure 2.32 EDACK0 and EDACK1 Single-Address Transfer Timing (for SDRAM)**

### 2.3.7 Timing of On-Chip Peripheral Modules

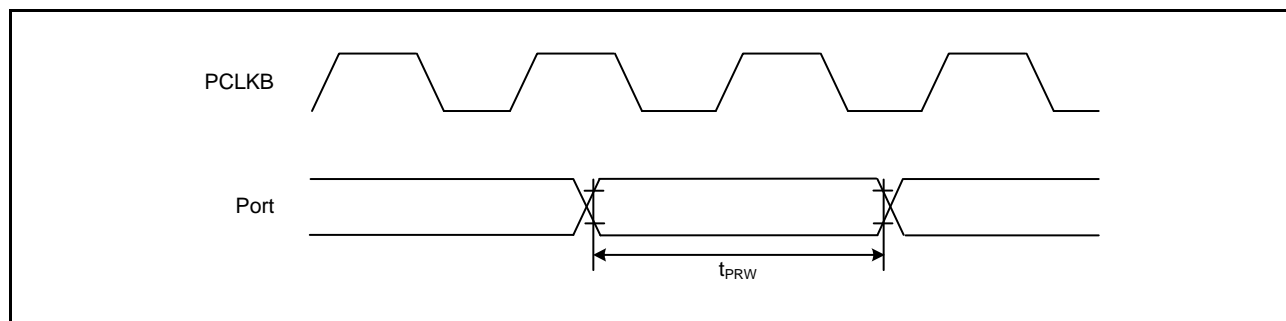
#### 2.3.7.1 I/O Port

**Table 2.25 I/O Port Timing**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item		Symbol	Min.	Max.	Unit*1	Test Conditions
I/O ports	Input data pulse width	$t_{PRW}$	1.5	—	$t_{PBcyc}$	Figure 2.33

Note 1.  $t_{PBcyc}$ : PCLKB cycle



**Figure 2.33 I/O Port Input Timing**

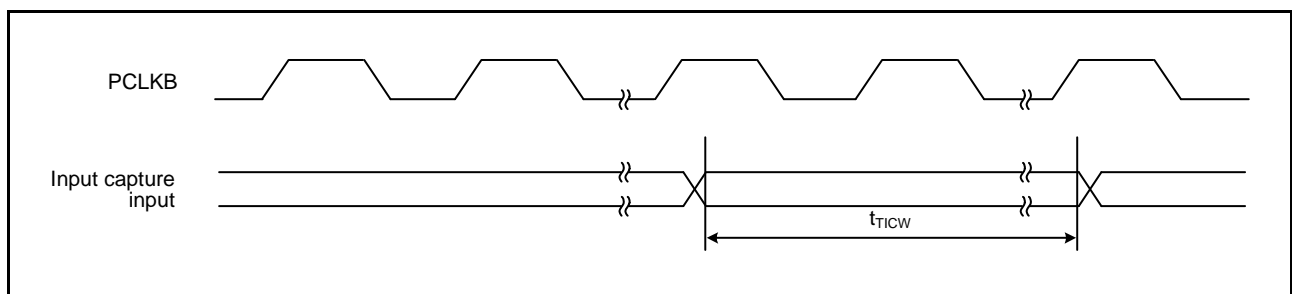
2.3.7.2 TPU

**Table 2.26 TPU Timing**

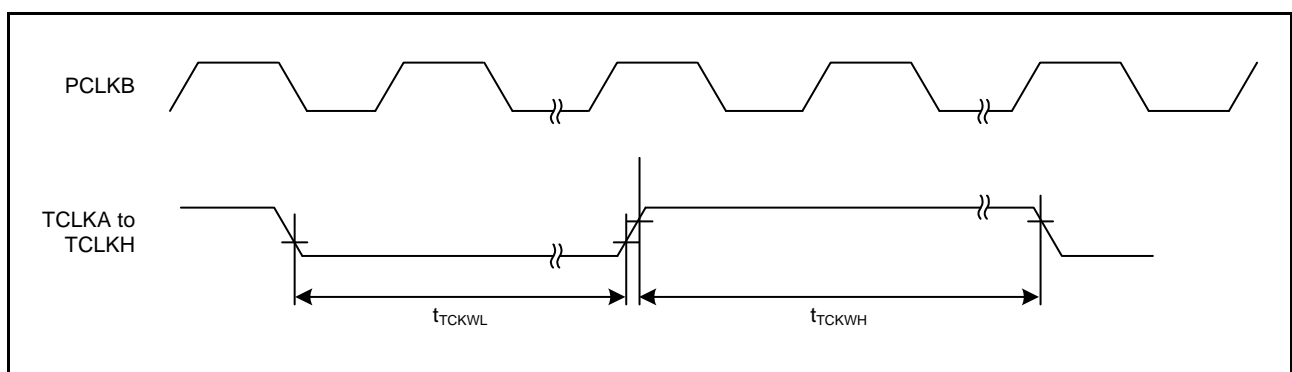
Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item		Symbol	Min.	Max.	Unit*1	Test Conditions
TPU	Input capture input pulse width	Single-edge setting	1.5	—	$t_{PBcyc}$	Figure 2.34
		Both-edge setting	2.5	—		
	Timer clock pulse width	Single-edge setting	$t_{TCKWH}$ , $t_{TCKWL}$	1.5	—	$t_{PBcyc}$
Both-edge setting		2.5		—		
Phase counting mode		2.5		—		

Note 1.  $t_{PBcyc}$ : PCLKB cycle



**Figure 2.34 TPU Input Capture Input Timing**



**Figure 2.35 TPU Clock Input Timing**

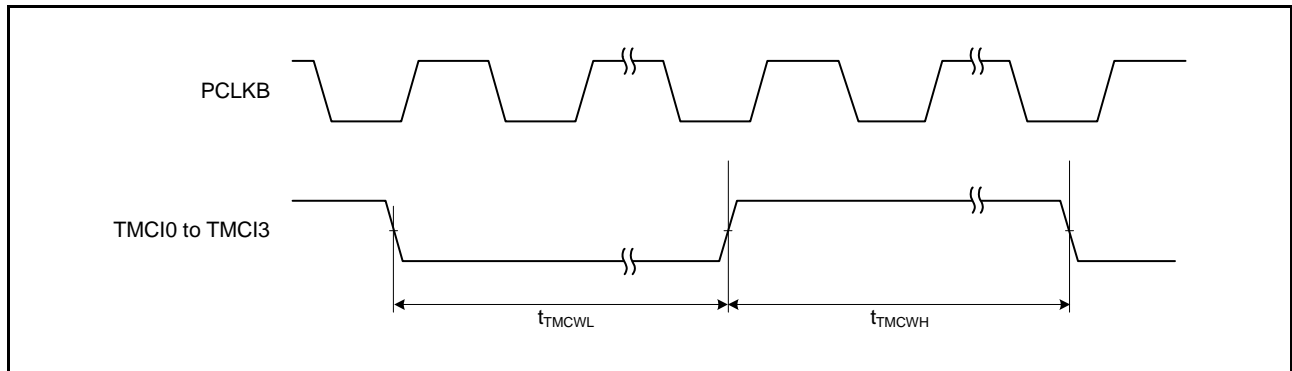
2.3.7.3 TMR

**Table 2.27 TMR Timing**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item		Symbol	Min.	Max.	Unit*1	Test Conditions
TMR	Timer clock pulse width	Single-edge setting	1.5	—	$t_{PBcyc}$	Figure 2.36
		Both-edge setting	2.5	—		

Note 1.  $t_{PBcyc}$ : PCLKB cycle



**Figure 2.36 TMR Clock Input Timing**

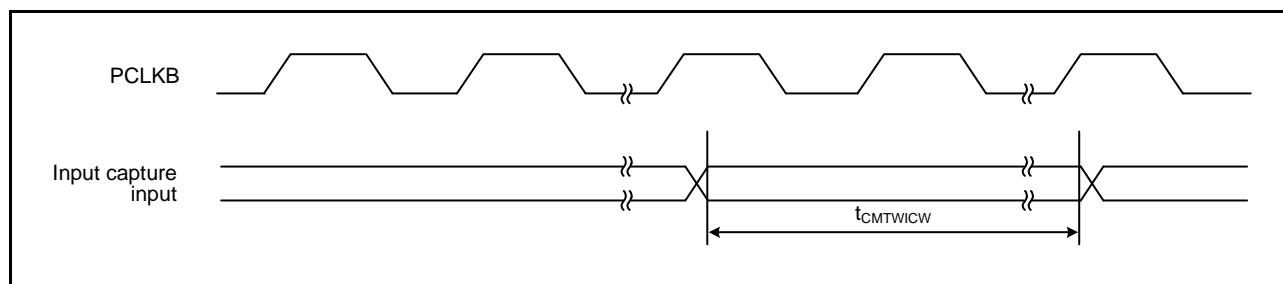
### 2.3.7.4 CMTW

**Table 2.28 CMTW Timing**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item		Symbol	Min.	Max.	Unit*1	Test Conditions
CMTW	Input capture input pulse width	Single-edge setting	1.5	—	$t_{PBcyc}$	Figure 2.37
		Both-edge setting	2.5	—		

Note 1.  $t_{PBcyc}$ : PCLKB cycle



**Figure 2.37 CMTW Input Capture Input Timing**

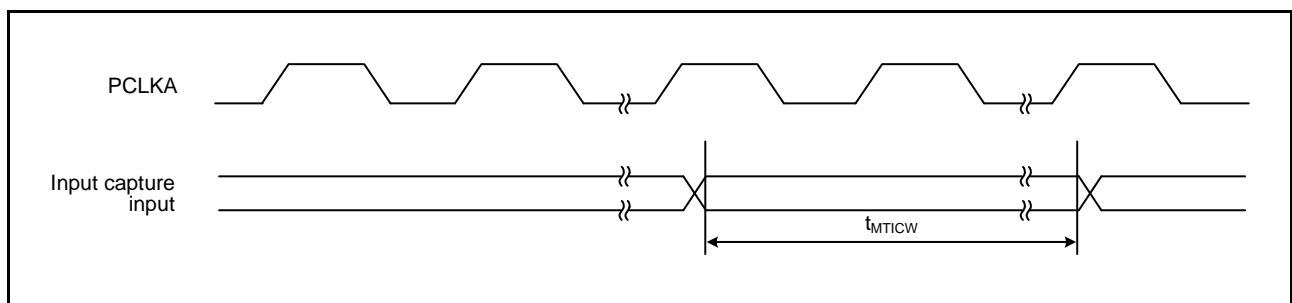
2.3.7.5 MTU3

**Table 2.29 MTU3 Timing**

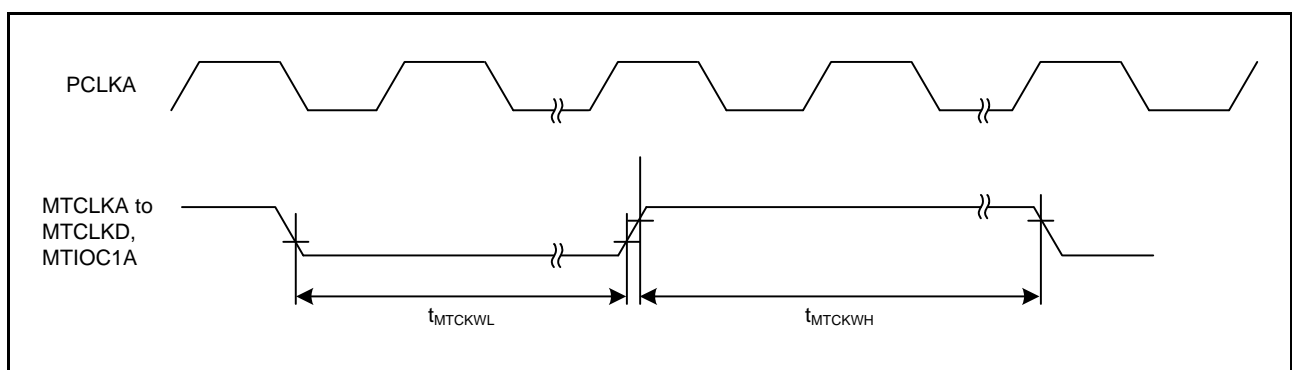
Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item		Symbol	Min.	Max.	Unit*1	Test Conditions
MTU3	Input capture input pulse width	Single-edge setting	1.5	—	$t_{P_{Acyc}}$	Figure 2.38
		Both-edge setting	2.5	—		
	Timer clock pulse width	Single-edge setting	$t_{MTCKWH}$ , $t_{MTCKWL}$	1.5	—	$t_{P_{Acyc}}$
Both-edge setting		2.5		—		
Phase counting mode		2.5		—		

Note 1.  $t_{P_{Acyc}}$ : PCLKA cycle



**Figure 2.38 MTU3 Input Capture Input Timing**



**Figure 2.39 MTU3 Clock Input Timing**



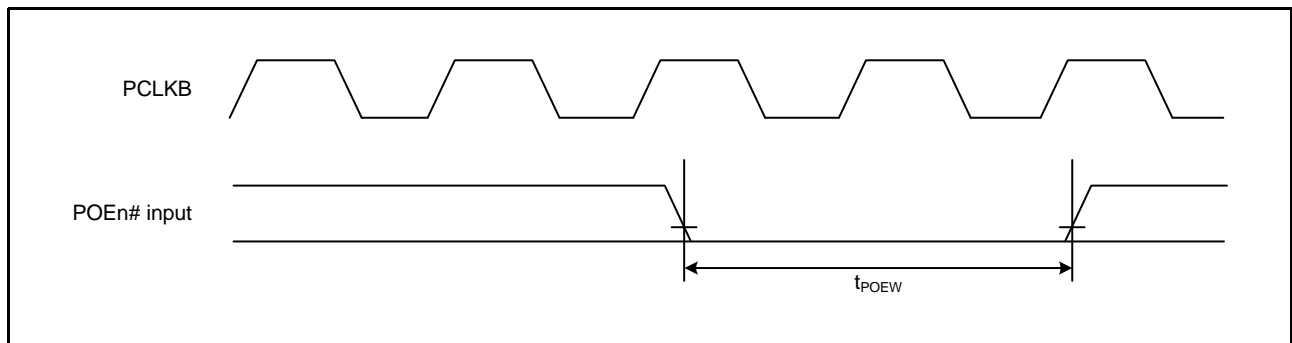
2.3.7.6 POE3

**Table 2.30 POE3 Timing**

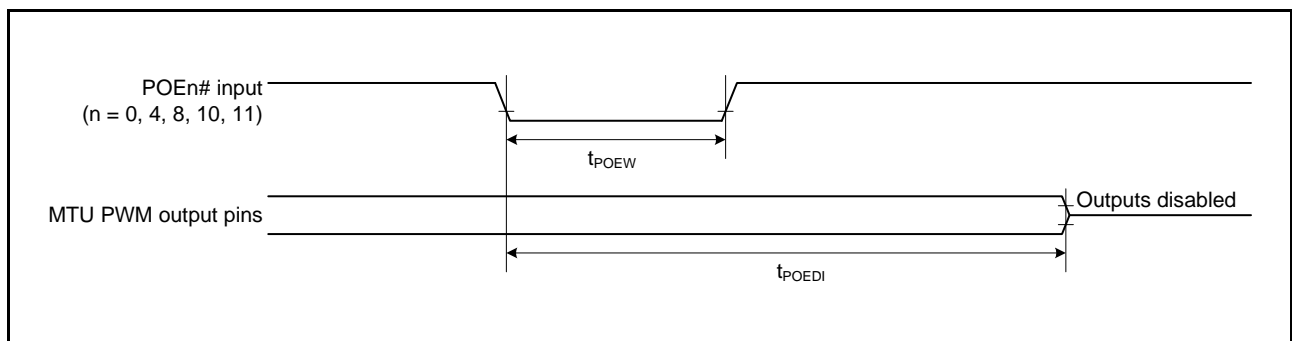
Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item	Symbol	Min.	Typ.	Max.	Unit*1	Test Conditions
POE	POEn# input pulse width	$t_{POEW}$	1.5	—	—	$t_{PBcyc}$ Figure 2.40
	Output disable time	Transition of the POEn# signal level	$t_{POEDI}$	—	—	$5 PCLKB + 0.24$ $\mu$ s Figure 2.41 When detecting falling edges (ICSRm.POEEnM[3:0] = 0000b (m = 1 to 5, n = 0, 4, 8, 10, 11))
		Simultaneous conduction of output pins	$t_{POEDO}$	—	—	$3 PCLKB + 0.2$ $\mu$ s Figure 2.42
		Register setting	$t_{POEDS}$	—	—	$1 PCLKB + 0.2$ $\mu$ s Figure 2.43 Time for access to the register is not included.
		Oscillation stop detection	$t_{POEDOS}$	—	—	21 $\mu$ s Figure 2.44

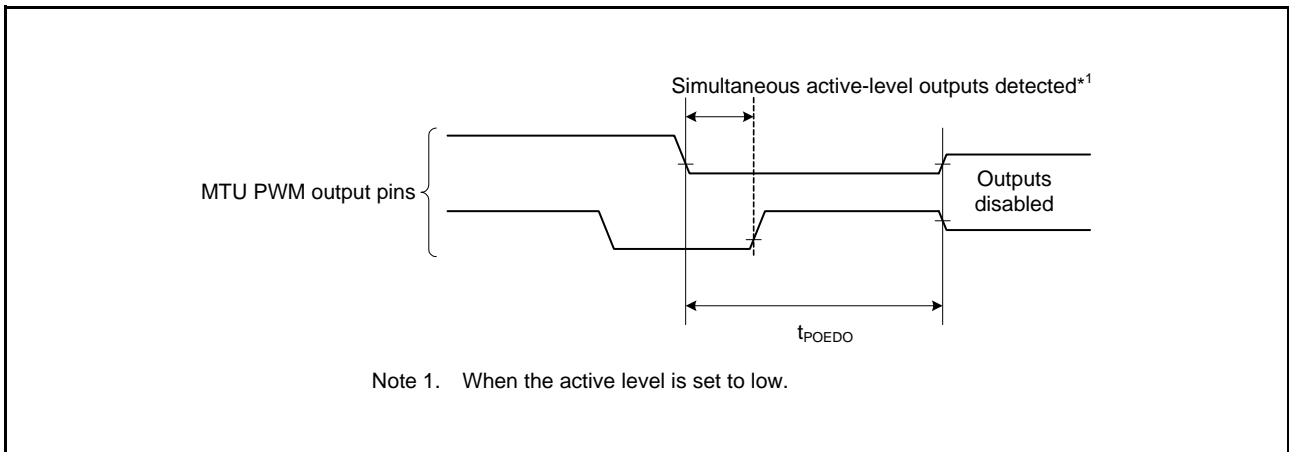
Note 1.  $t_{PBcyc}$ : PCLKB cycle



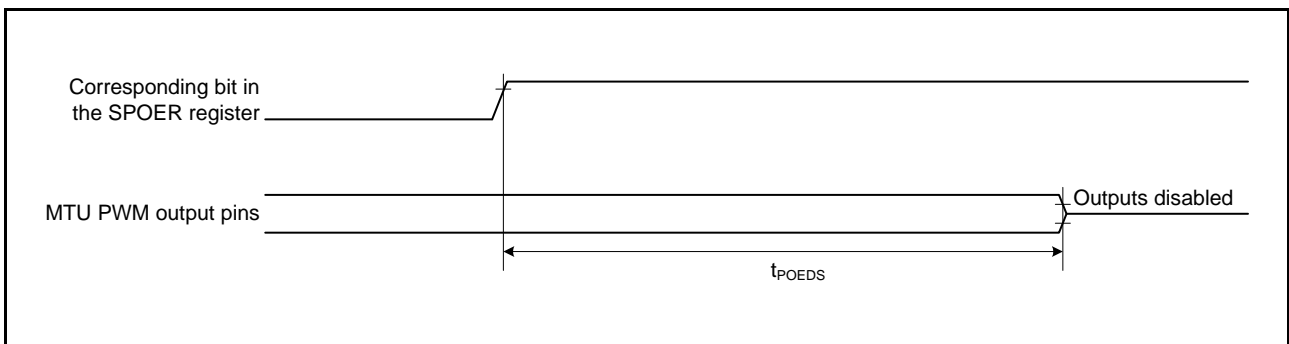
**Figure 2.40 POE# Input Timing**



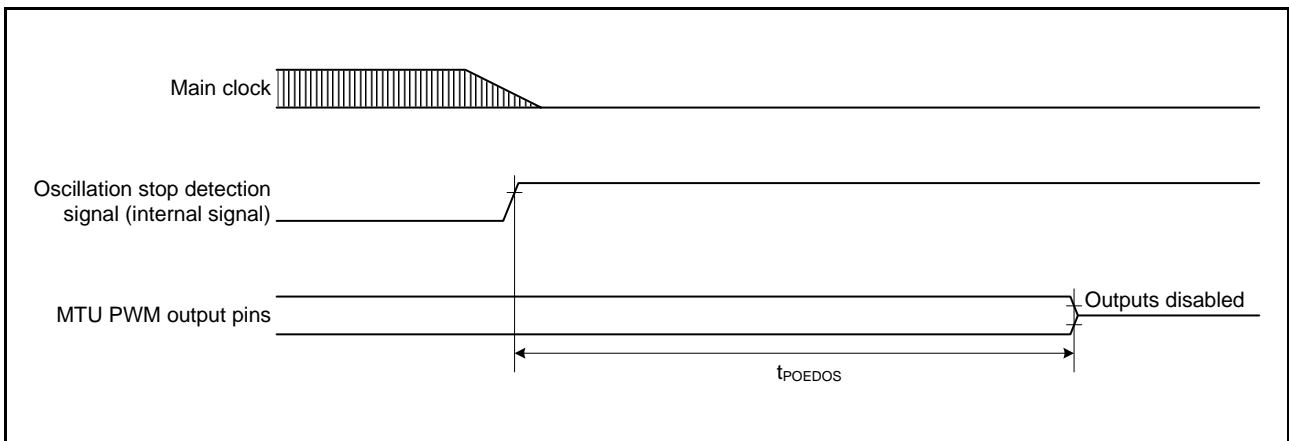
**Figure 2.41 Output Disable Time for POE in Response to Transition of the POEn# Signal Level**



**Figure 2.42 Output Disable Time for POE in Response to the Simultaneous Conduction of Output Pins**



**Figure 2.43 Output Disable Time for POE in Response to the Register Setting**



**Figure 2.44 Output Disable Time for POE in Response to the Oscillation Stop Detection**

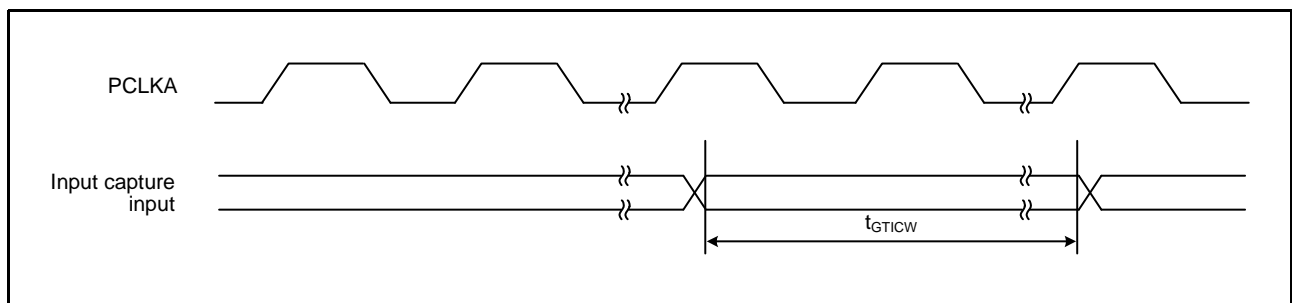
2.3.7.7 GPT

**Table 2.31 GPT Timing**

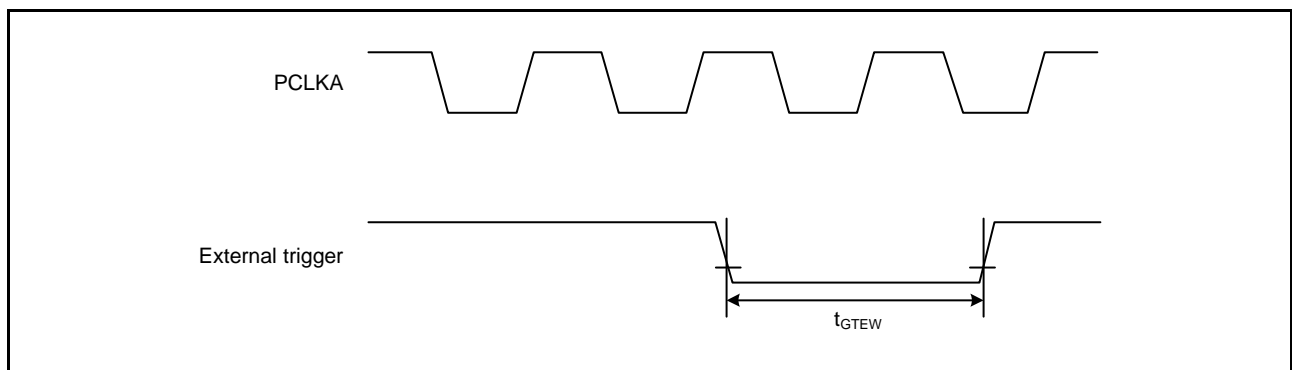
Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item			Symbol	Min.	Max.	Unit*1	Test Conditions
GPT	Input capture input pulse width	Single-edge setting	$t_{GTICW}$	3	—	$t_{PACyc}$	Figure 2.45
		Both-edge setting		5	—		
	External trigger input pulse width	Single-edge setting	$t_{GTEW}$	1.5	—	$t_{PACyc}$	
		Both-edge setting		2.5	—		

Note 1.  $t_{PACyc}$ : PCLKA cycle



**Figure 2.45 GPT Input Capture Input Timing**



**Figure 2.46 GPT External Trigger Input Timing**

## 2.3.7.8 SCI

**Table 2.32 SCI and SCIF Timing**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item		Symbol	Min.*1	Max.*1	Unit*1	Test Conditions		
SCI	Input clock cycle	Asynchronous	$t_{Scyc}$	4	—	$t_{PBcyc}$	Figure 2.47	
		Clock synchronous		6	—			
	Input clock pulse width		$t_{SCKW}$	0.4	0.6	$t_{Scyc}$		
	Input clock rise time		$t_{SCKr}$	—	5	ns		
	Input clock fall time		$t_{SCKf}$	—	5	ns		
	Output clock cycle	Asynchronous*2	$t_{Scyc}$	8	—	$t_{PBcyc}$		
		Clock synchronous		4	—			
	Output clock pulse width		$t_{SCKW}$	0.4	0.6	$t_{Scyc}$		
	Output clock rise time		$t_{SCKr}$	—	5	ns		
	Output clock fall time		$t_{SCKf}$	—	5	ns		
	Transmit data delay time	Clock synchronous	$t_{TXD}$	—	28	ns		Figure 2.48
	Receive data setup time	Clock synchronous	$t_{RXS}$	15	—	ns		
Receive data hold time	Clock synchronous	$t_{RXH}$	5	—	ns			
SCIF	Input clock cycle	Asynchronous	$t_{Scyc}$	4	—	$t_{PAcyc}$	Figure 2.47	
		Clock synchronous		12	—			
	Input clock pulse width		$t_{SCKW}$	0.4	0.6	$t_{Scyc}$		
	Input clock rise time		$t_{SCKr}$	—	5	ns		
	Input clock fall time		$t_{SCKf}$	—	5	ns		
	Output clock cycle	Asynchronous*3	$t_{Scyc}$	8	—	$t_{PAcyc}$		
		Clock synchronous		4	—			
	Output clock pulse width		$t_{SCKW}$	0.4	0.6	$t_{Scyc}$		
	Output clock rise time		$t_{SCKr}$	—	5	ns		
	Output clock fall time		$t_{SCKf}$	—	5	ns		
	Transmit data delay time	Master	$t_{TXD}$	—	10	ns		Figure 2.48
		Slave		—	$4 \times t_{PAcyc} + 20$			
	Receive data setup time	Master	$t_{RXS}$	$3 \times t_{PAcyc} + 20$	—	ns		
		Slave		$t_{PAcyc} + 10$	—			
	Receive data hold time	Master	$t_{RXH}$	$-3 \times t_{PAcyc} + 5$	—	ns		
Slave			$2 \times t_{PAcyc} + 10$	—				

Note 1.  $t_{PBcyc}$ : PCLKB cycle;  $t_{PAcyc}$ : PCLKA cycle

Note 2. When the SEMR.ABCS and SEMR.BGDM bits are set to 1

Note 3. When the SEMR.ABCS0 and SEMR.BGDM bits are set to 1

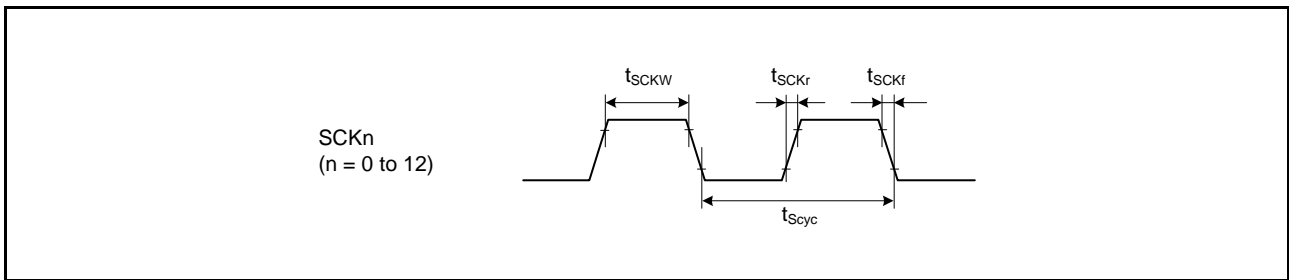


Figure 2.47 SCK Clock Input Timing

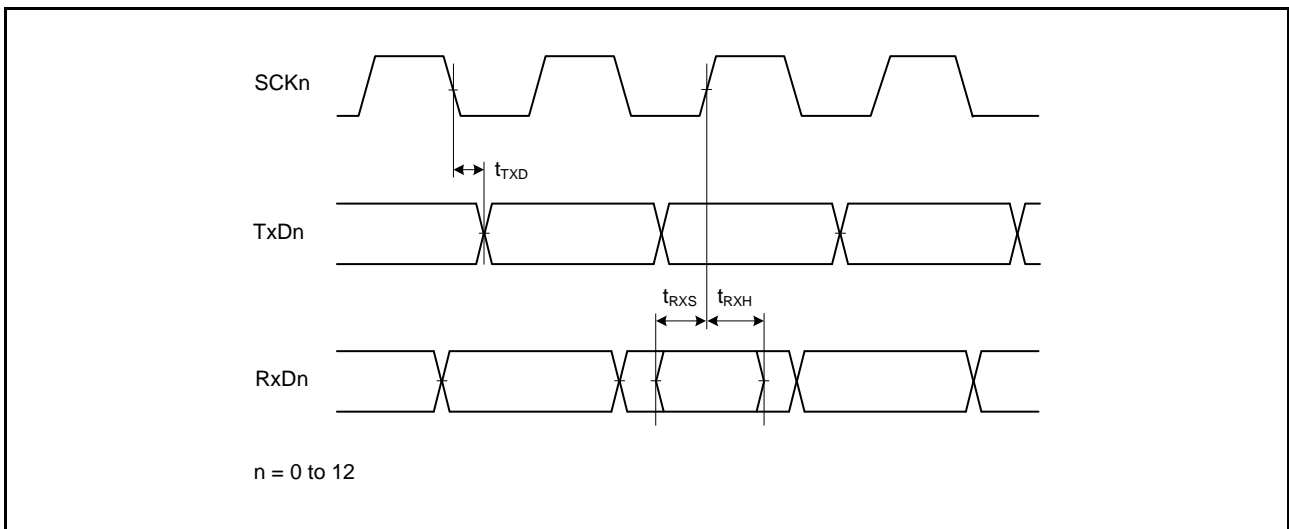


Figure 2.48 SCI Input/Output Timing: Clock Synchronous Mode

Table 2.33 Simple IIC Timing

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 High-drive output is selected by the driving ability control register.

Item		Symbol	Min.*1, *2	Max.	Unit	Test Conditions
Simple IIC (Standard-mode)	SSDA input rise time	$t_{Sr}$	—	1000	ns	Figure 2.49
	SSDA input fall time	$t_{Sf}$	—	300	ns	
	SSDA input spike pulse removal time	$t_{SP}$	0	$4 \times t_{PBcyc}$	ns	
	Data input setup time	$t_{SDAS}$	250	—	ns	
	Data input hold time	$t_{SDAH}$	0	—	ns	
	SSCL, SSDA capacitive load	$C_b$	—	400	pF	
Simple IIC (Fast-mode)	SSCL, SSDA input rise time	$t_{Sr}$	—	300	ns	
	SSCL, SSDA input fall time	$t_{Sf}$	—	300	ns	
	SSCL, SSDA input spike pulse removal time	$t_{SP}$	0	$4 \times t_{PBcyc}$	ns	
	Data input setup time	$t_{SDAS}$	100	—	ns	
	Data input hold time	$t_{SDAH}$	0	—	ns	
	SSCL, SSDA capacitive load	$C_b$	—	400	pF	

Note:  $t_{IICcyc}$ : RIIC internal reference clock (IIC $\phi$ ) cycle

Note 1. The value within parentheses is applicable when the value of the ICMR3.NF[1:0] bits is 11b while the digital filter is enabled by

the setting ICFER.NFE = 1.

Note 2. C<sub>b</sub> is the total capacitance of the bus lines.

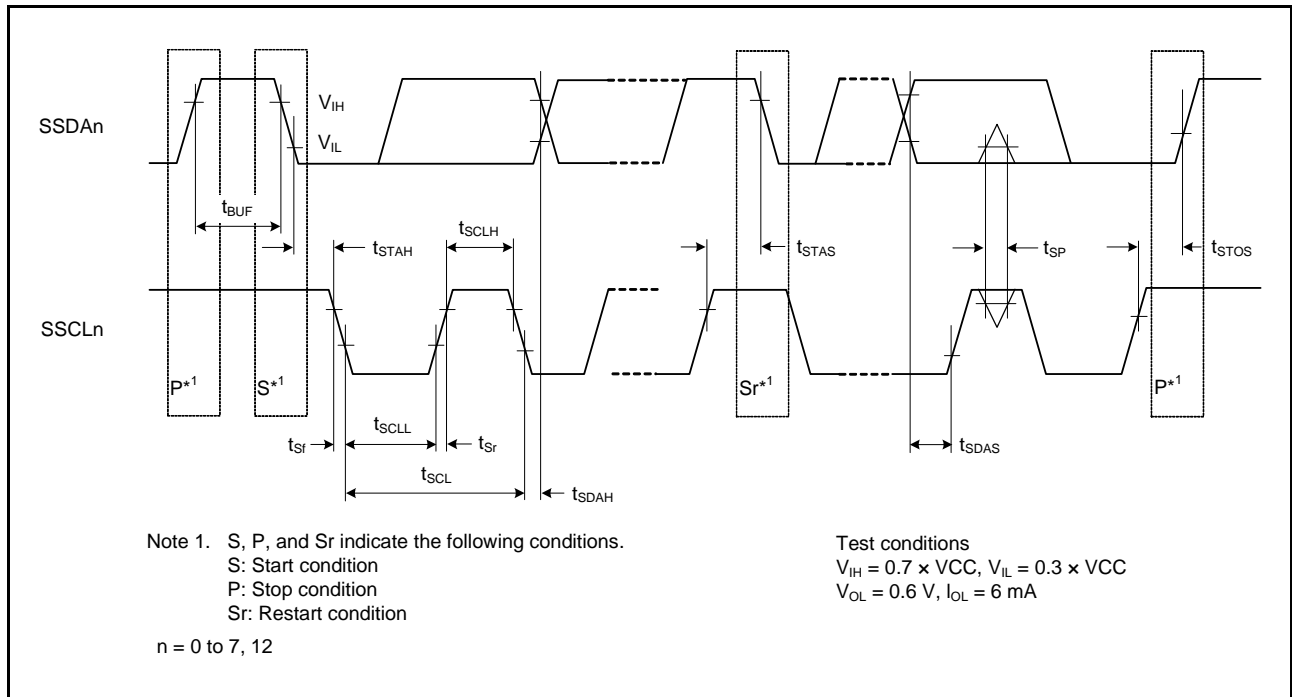


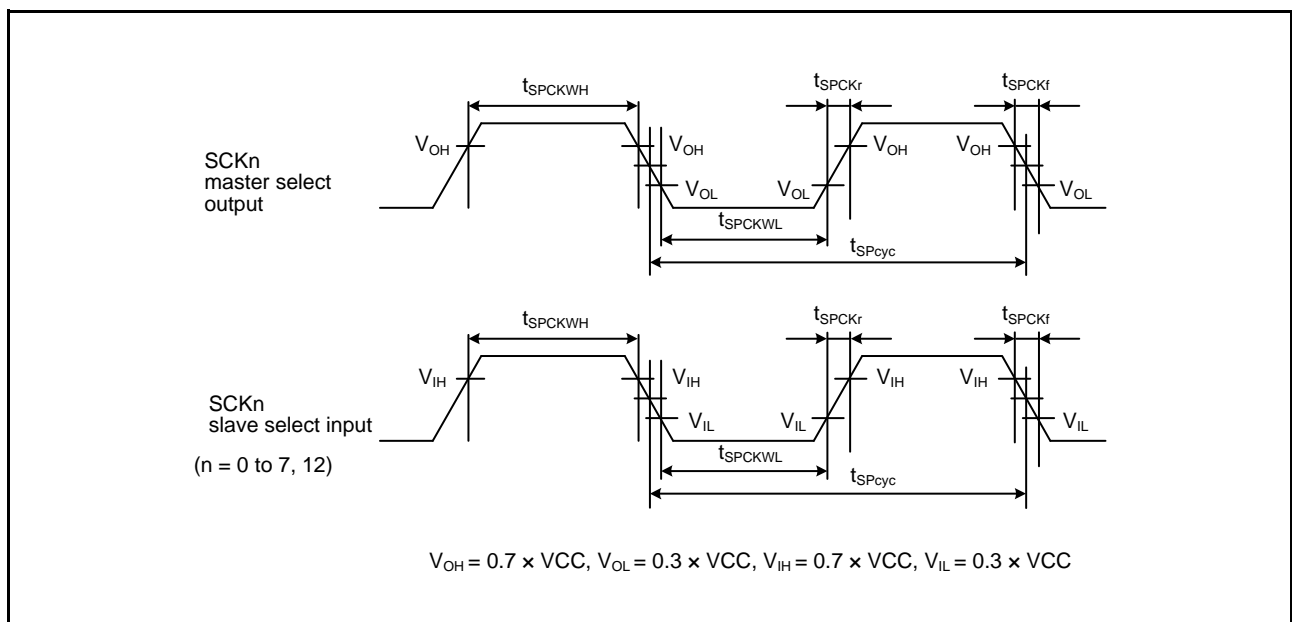
Figure 2.49 Simple IIC Bus Interface Input/Output Timing

**Table 2.34 Simple SPI Timing**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item		Symbol	Min.	Max.	Unit*1	Test Conditions	
Simple SPI	SCK clock cycle output (master)	$t_{SPcyc}$	4	65536	$t_{PBcyc}$	Figure 2.50	
	SCK clock cycle input (slave)		8	65536			
	SCK clock high pulse width	$t_{SPCKWH}$	0.4	0.6	$t_{SPcyc}$		
	SCK clock low pulse width	$t_{SPCKWL}$	0.4	0.6	$t_{SPcyc}$		
	SCK clock rise/fall time	$t_{SPCKr}$ , $t_{SPCKf}$	—	20	ns		
	Data input setup time	$t_{SU}$	33.3	—	ns		Figure 2.51 to Figure 2.54
	Data input hold time	$t_H$	33.3	—	ns		
	SS input setup time	$t_{LEAD}$	1	—	$t_{SPcyc}$		
	SS input hold time	$t_{LAG}$	1	—	$t_{SPcyc}$		
	Data output delay time	$t_{OD}$	—	33.3	ns		
	Data output hold time	$t_{OH}$	-10	—	ns		
	Data rise/fall time	$t_{Dr}$ , $t_{Df}$	—	16.6	ns		
	SS input rise/fall time	$t_{SSLr}$ , $t_{SSLf}$	—	16.6	ns		
	Slave access time	$t_{SA}$	—	5	$t_{PBcyc}$	Figure 2.53, Figure 2.54	
	Slave output release time	$t_{REL}$	—	5	$t_{PBcyc}$		

Note 1.  $t_{PBcyc}$ : PCLKB cycle



**Figure 2.50 Simple SPI Clock Timing**

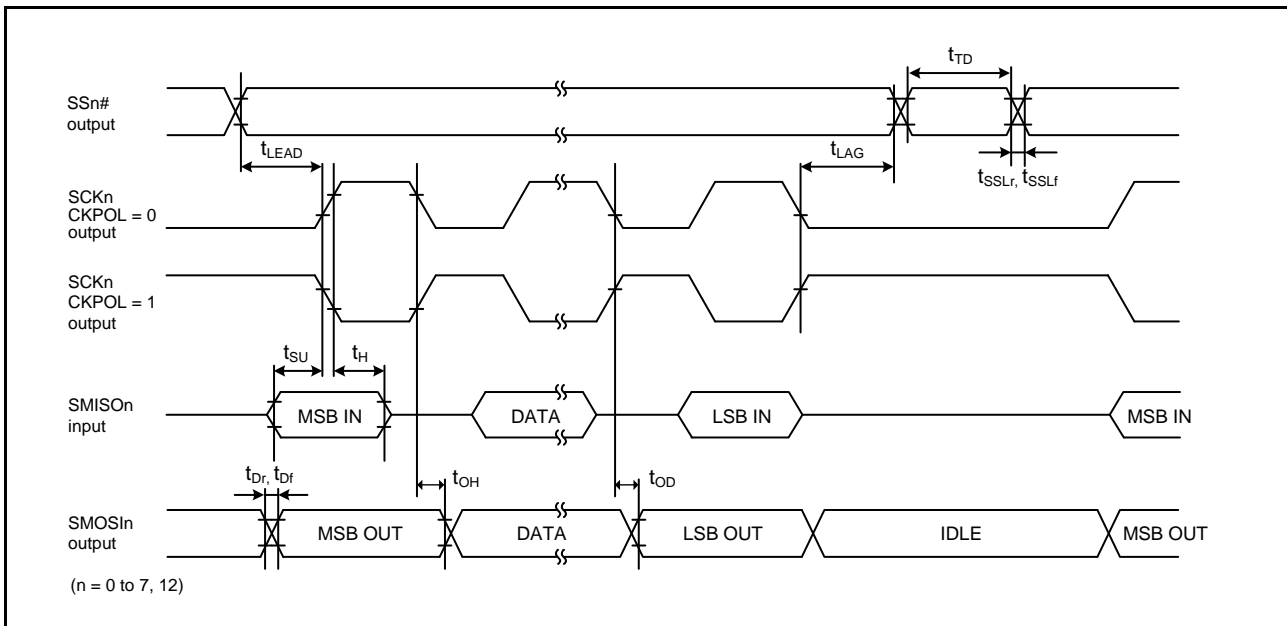


Figure 2.51 Simple SPI Timing (Master, CKPH = 1)

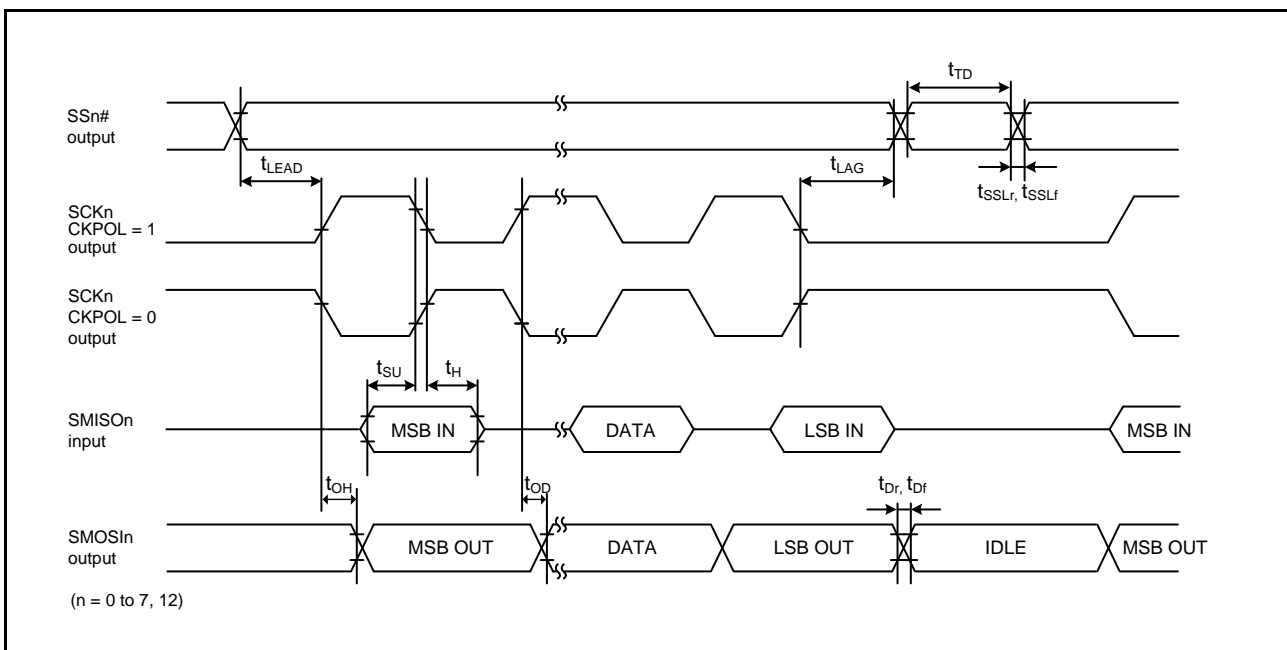


Figure 2.52 Simple SPI Timing (Master, CKPH = 0)



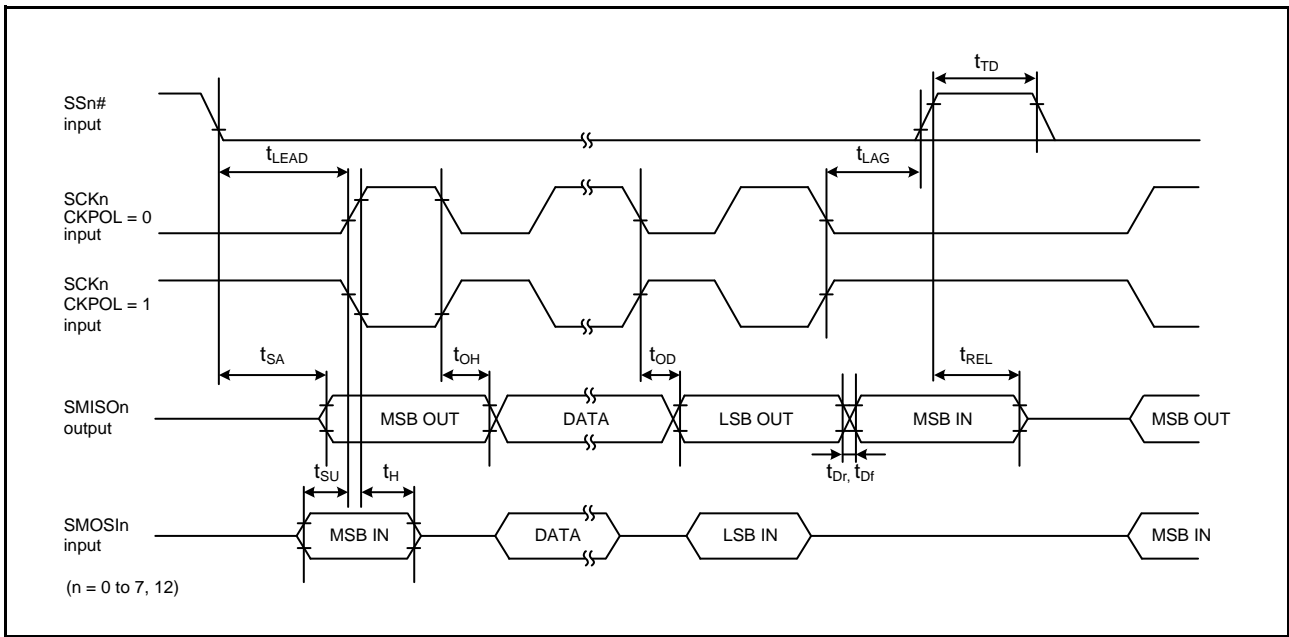


Figure 2.53 Simple SPI Timing (Slave, CKPH = 1)

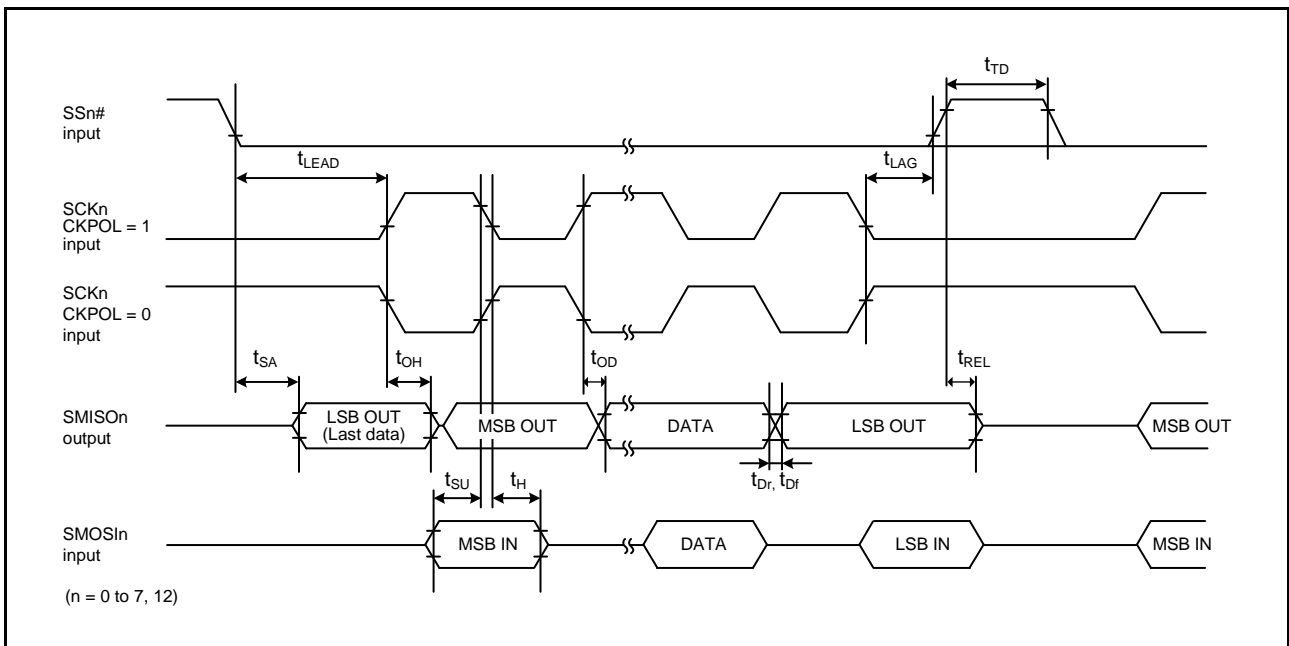


Figure 2.54 Simple SPI Timing (Slave, CKPH = 0)

## 2.3.7.9 RIIC

**Table 2.35 RIIC Timing (1/2)**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 High-drive output is selected by the driving ability control register.

Item		Symbol	Min. *1, *2	Max.	Unit	Test Conditions
RIIC (Standard-mode, SMBus) ICFER.FMPE = 0	SCL input cycle time	$t_{SCL}$	$6(12) \times t_{IICcyc} + 1300$	—	ns	Figure 2.55
	SCL input high pulse width	$t_{SCLH}$	$3(6) \times t_{IICcyc} + 300$	—	ns	
	SCL input low pulse width	$t_{SCLL}$	$3(6) \times t_{IICcyc} + 300$	—	ns	
	SCL, SDA input rise time	$t_{Sr}$	—	1000	ns	
	SCL, SDA input fall time	$t_{Sf}$	—	300	ns	
	SCL, SDA input spike pulse removal time	$t_{SP}$	0	$1(4) \times t_{IICcyc}$	ns	
	SDA input bus free time	$t_{BUF}$	$3(6) \times t_{IICcyc} + 300$	—	ns	
	Start condition input hold time	$t_{STAH}$	$t_{IICcyc} + 300$	—	ns	
	Restart condition input setup time	$t_{STAS}$	1000	—	ns	
	Stop condition input setup time	$t_{STOS}$	1000	—	ns	
	Data input setup time	$t_{SDAS}$	$t_{IICcyc} + 50$	—	ns	
	Data input hold time	$t_{SDAH}$	0	—	ns	
	SCL, SDA capacitive load	$C_b$	—	400	pF	
RIIC (Fast-mode) ICFER.FMPE = 0	SCL input cycle time	$t_{SCL}$	$6(12) \times t_{IICcyc} + 600$	—	ns	
	SCL input high pulse width	$t_{SCLH}$	$3(6) \times t_{IICcyc} + 300$	—	ns	
	SCL input low pulse width	$t_{SCLL}$	$3(6) \times t_{IICcyc} + 300$	—	ns	
	SCL, SDA input rise time	$t_{Sr}$	$20 \times (\text{External pull-up voltage} / 5.5 \text{ V})$	300	ns	
	SCL, SDA input fall time	$t_{Sf}$	$20 \times (\text{External pull-up voltage} / 5.5 \text{ V})$	300	ns	
	SCL, SDA input spike pulse removal time	$t_{SP}$	0	$1(4) \times t_{IICcyc}$	ns	
	SDA input bus free time	$t_{BUF}$	$3(6) \times t_{IICcyc} + 300$	—	ns	
	Start condition input hold time	$t_{STAH}$	$t_{IICcyc} + 300$	—	ns	
	Restart condition input setup time	$t_{STAS}$	300	—	ns	
	Stop condition input setup time	$t_{STOS}$	300	—	ns	
	Data input setup time	$t_{SDAS}$	$t_{IICcyc} + 50$	—	ns	
	Data input hold time	$t_{SDAH}$	0	—	ns	
	SCL, SDA capacitive load	$C_b$	—	400	pF	

**Table 2.35 RIIC Timing (2/2)**

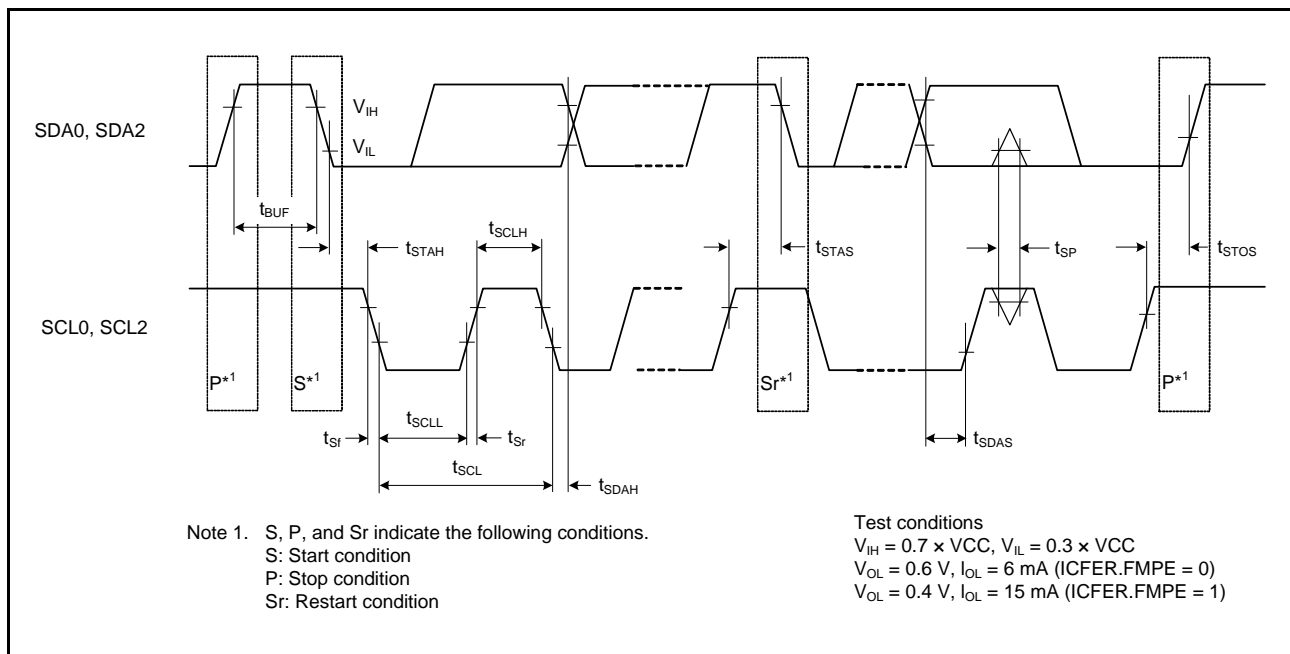
Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 High-drive output is selected by the driving ability control register.

Item	Symbol	Min.*1, *2	Max.	Unit	Test Conditions	
RIIC (Fast-mode+) ICFER.FMPE = 1	SCL input cycle time	$t_{SCL}$	$6(12) \times t_{IICcyc} + 240$	—	ns	Figure 2.55
	SCL input high pulse width	$t_{SCLH}$	$3(6) \times t_{IICcyc} + 120$	—	ns	
	SCL input low pulse width	$t_{SCLL}$	$3(6) \times t_{IICcyc} + 120$	—	ns	
	SCL, SDA input rise time	$t_{Sr}$	—	120	ns	
	SCL, SDA input fall time	$t_{Sf}$	—	120	ns	
	SCL, SDA input spike pulse removal time	$t_{SP}$	0	$1(4) \times t_{IICcyc}$	ns	
	SDA input bus free time	$t_{BUF}$	$3(6) \times t_{IICcyc} + 120$	—	ns	
	Start condition input hold time	$t_{STAH}$	$t_{IICcyc} + 120$	—	ns	
	Restart condition input setup time	$t_{STAS}$	120	—	ns	
	Stop condition input setup time	$t_{STOS}$	120	—	ns	
	Data input setup time	$t_{SDAS}$	$t_{IICcyc} + 20$	—	ns	
	Data input hold time	$t_{SDAH}$	0	—	ns	
	SCL, SDA capacitive load	$C_b$	—	550	pF	

Note:  $t_{IICcyc}$ : RIIC internal reference clock (IIC $\phi$ ) cycle

Note 1. The value within parentheses is applicable when the value of the ICMR3.NF[1:0] bits is 11b while the digital filter is enabled by the setting ICFER.NFE = 1.

Note 2.  $C_b$  is the total capacitance of the bus lines.



**Figure 2.55 RIIC Bus Interface Input/Output Timing**

## 2.3.7.10 RSPI

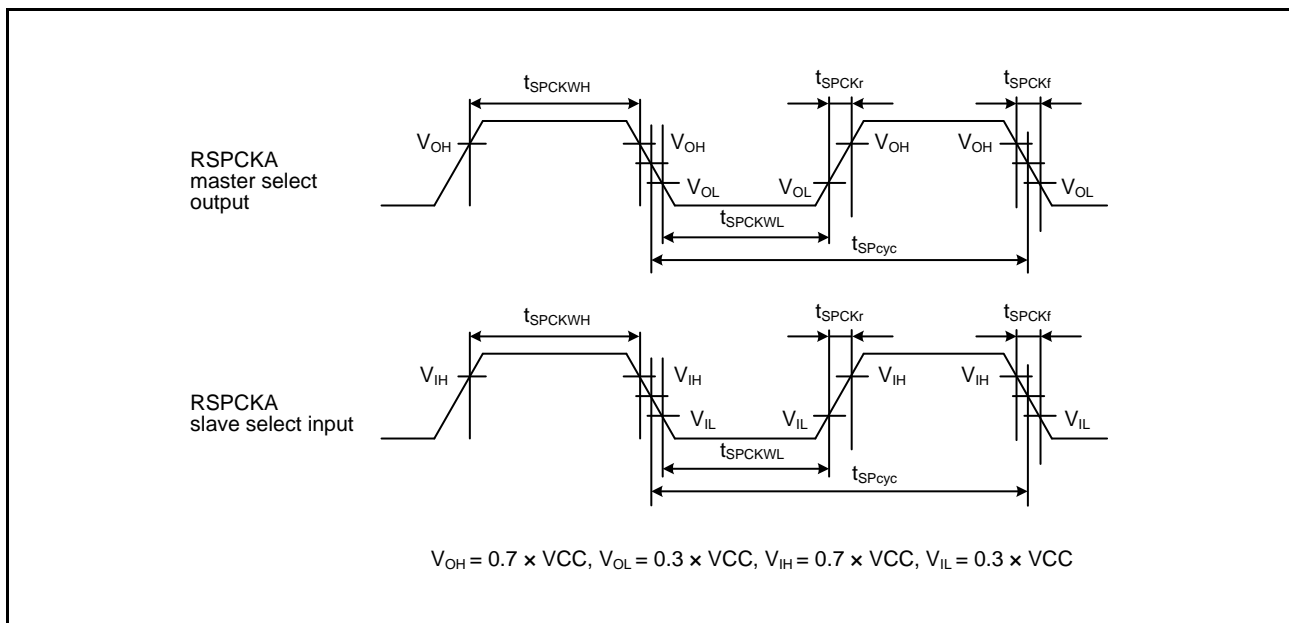
**Table 2.36 RSPI Timing**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
High-drive output is selected by the driving ability control register.

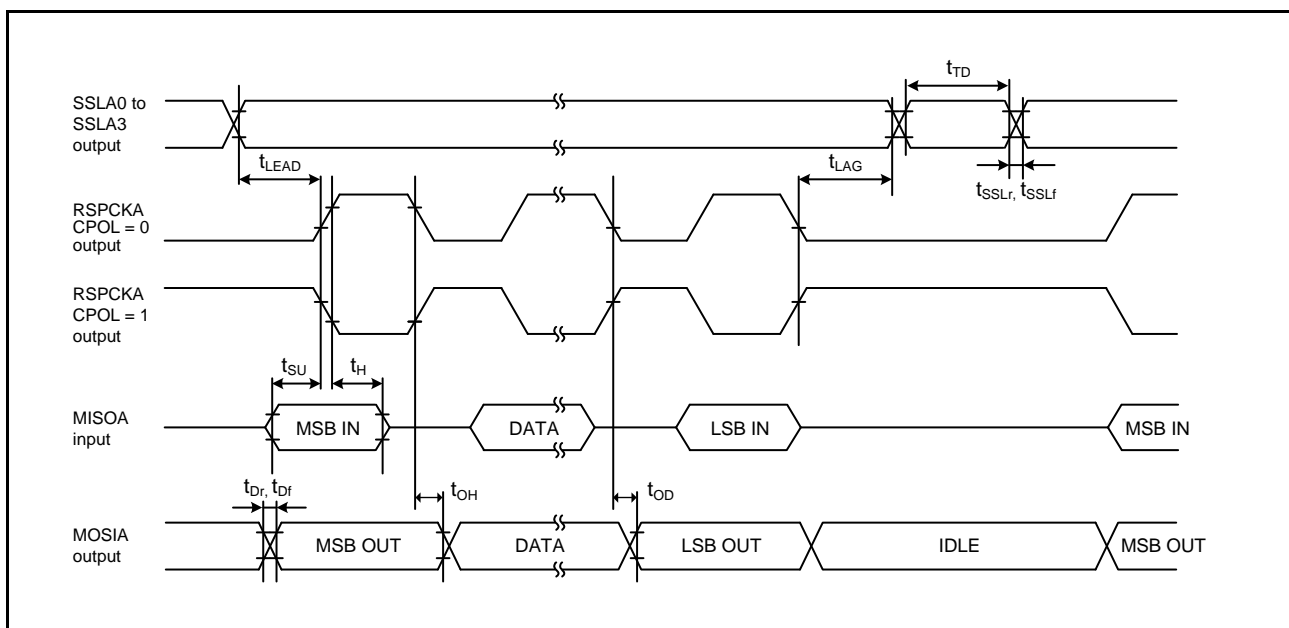
Item		Symbol	Min.*1	Max.*1	Unit*1	Test Conditions*2		
RSPI	RSPCK clock cycle	Master	$t_{SPcyc}$	2	4096	$t_{PAcyc}$	Figure 2.56	
		Slave		8	—			
	RSPCK clock high pulse width	Master	$t_{SPCKWH}$	$(t_{SPcyc} - t_{SPCKR} - t_{SPCKF}) / 2 - 3$		ns		
		Slave		$(t_{SPcyc} - t_{SPCKR} - t_{SPCKF}) / 2$				
	RSPCK clock low pulse width	Master	$t_{SPCKWL}$	$(t_{SPcyc} - t_{SPCKR} - t_{SPCKF}) / 2 - 3$		ns		
		Slave		$(t_{SPcyc} - t_{SPCKR} - t_{SPCKF}) / 2$				
	RSPCK clock rise/fall time	Output	$t_{SPCKr}$ , $t_{SPCKf}$	—	5	ns		
		Input		—	1	$\mu$ s		
	Data input setup time	Master	$t_{SU}$	6	—	ns		Figure 2.57 to Figure 2.62
		Slave		$8.3 - t_{PAcyc}$	—			
	Data input hold time	Master	PCLKA division ratio set to 1/2	$t_{HF}$	0	—		ns
			PCLKA division ratio set to a value other than 1/2	$t_H$	$t_{PAcyc}$			
Slave				$8.3 + 2 \times t_{PAcyc}$	—			
SSL setup time	Master	$t_{LEAD}$	1	8	$t_{SPcyc}$			
	Slave		4	—	$t_{PAcyc}$			
SSL hold time	Master	$t_{LAG}$	1	8	$t_{SPcyc}$			
	Slave		4	—	$t_{PAcyc}$			
Data output delay time	Master	$t_{OD}$	—	6.3	ns			
	Slave		—	$3 \times t_{PAcyc} + 20$				
Data output hold time	Master	$t_{OH}$	0	—	ns			
	Slave		0	—				
Successive transmission delay time	Master	$t_{TD}$	$t_{SPcyc} + 2 \times t_{PAcyc}$	$8 \times t_{SPcyc} + 2 \times t_{PAcyc}$	ns			
	Slave		$4 \times t_{PAcyc}$	—				
MOSI and MISO rise/fall time	Output	$t_{Dr}$ , $t_{Df}$	—	5	ns			
	Input		—	1	$\mu$ s			
SSL rise/fall time	Output	$t_{SSLr}$ , $t_{SSLf}$	—	5	ns			
	Input		—	1	$\mu$ s			
Slave access time		$t_{SA}$	—	4	$t_{PAcyc}$	Figure 2.61, Figure 2.62		
Slave output release time		$t_{REL}$	—	3	$t_{PAcyc}$			

Note 1.  $t_{PAcyc}$ : PCLKA cycle

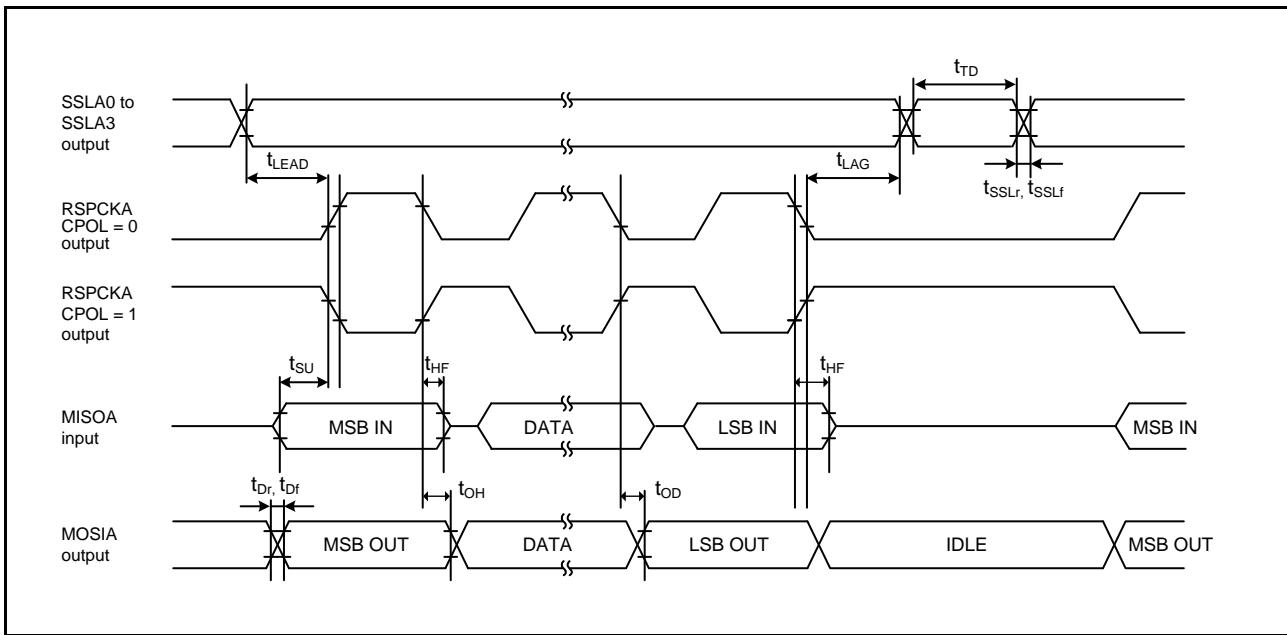
Note 2. We recommend that pins suffixed with the same letter such as -A and -B, indicating grouping of the pins, should be used as a set. The AC characteristics of the RSPI are measured using the pins from the same group.



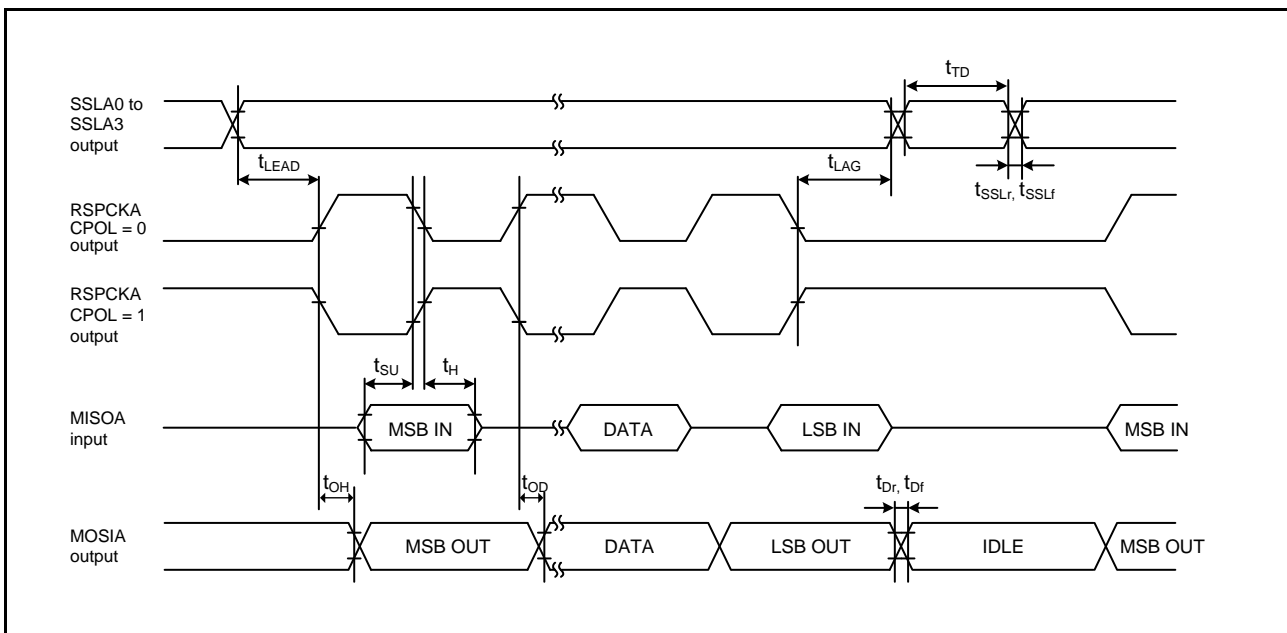
**Figure 2.56 RSPCKA Clock Timing**



**Figure 2.57 RSPCKA Timing (Master, CPHA = 0) (Bit Rate: PCLKB Division Ratio Set to a Value Other Than 1/2)**



**Figure 2.58 RSPI Timing (Master, CPHA = 0) (Bit Rate: PCLKB Division Ratio Set to 1/2)**



**Figure 2.59 RSPI Timing (Master, CPHA = 1) (Bit Rate: PCLKB Division Ratio Set to a Value Other Than 1/2)**

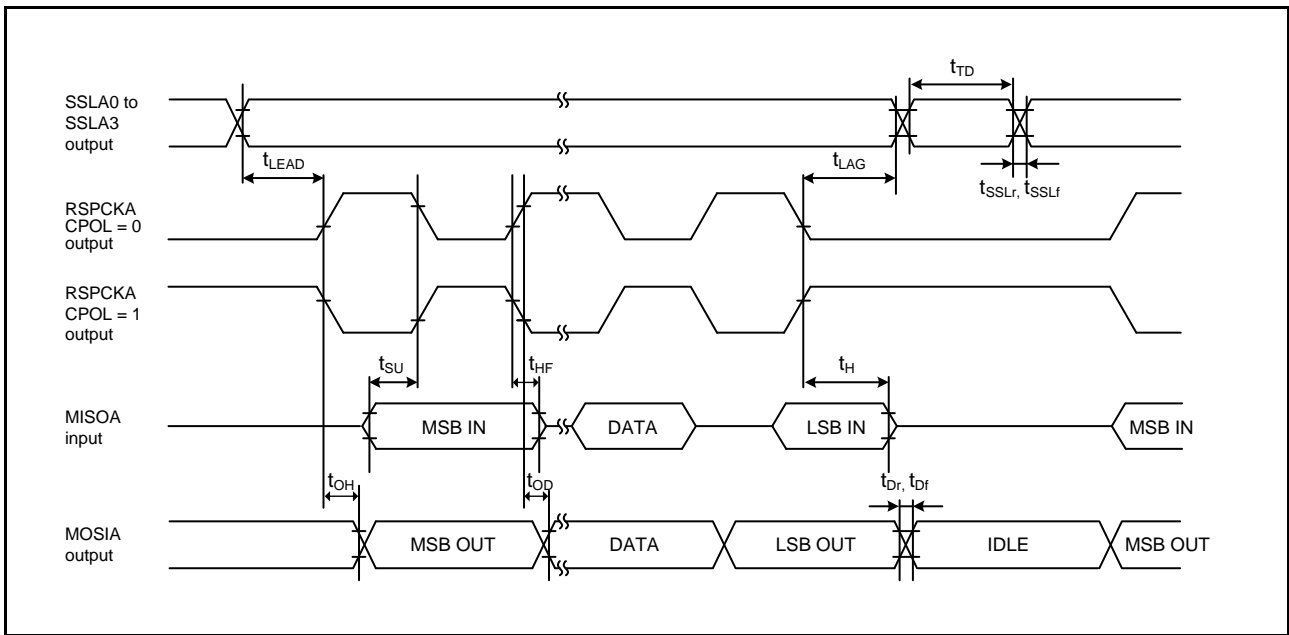


Figure 2.60 RSPI Timing (Master, CPHA = 1) (Bit Rate: PCLKB Division Ratio Set to 1/2)

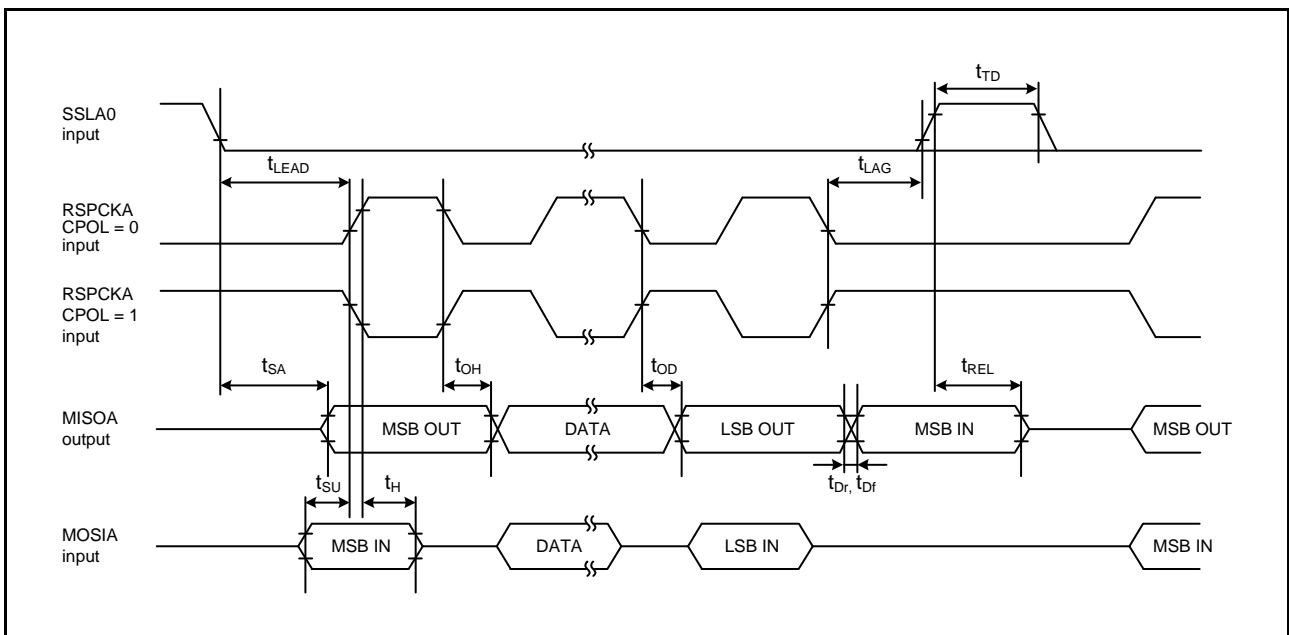


Figure 2.61 RSPI Timing (Slave, CPHA = 0)

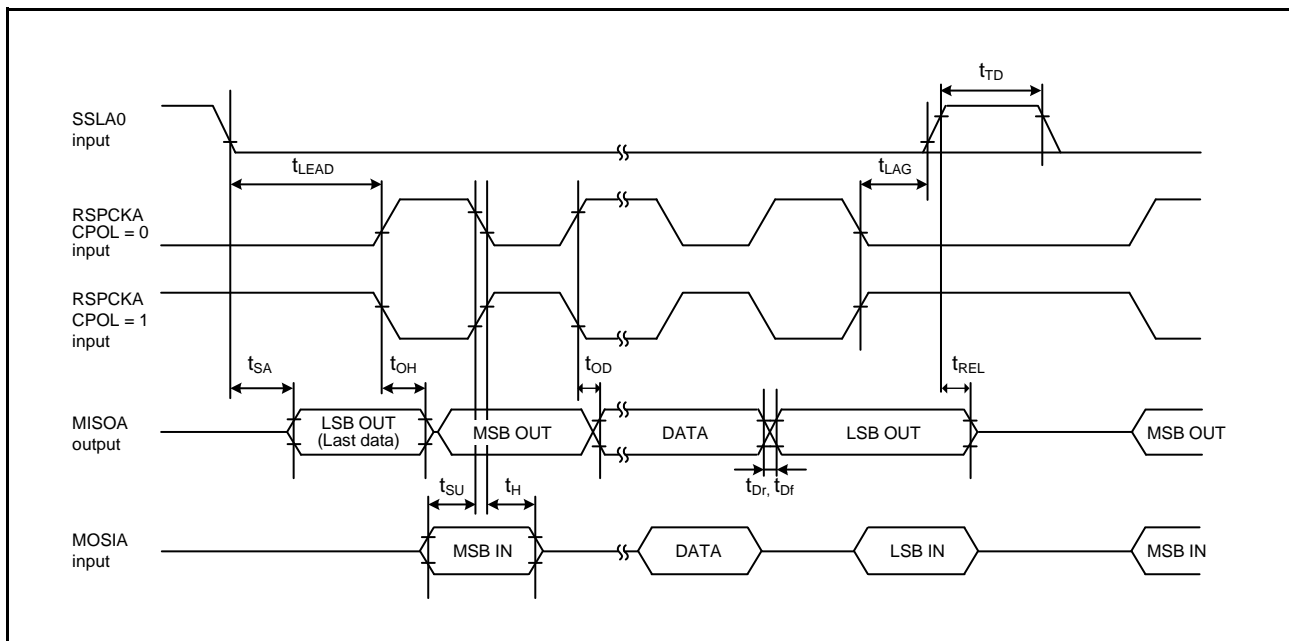


Figure 2.62 RSPI Timing (Slave, CPHA = 1)



2.3.7.11 QSPI

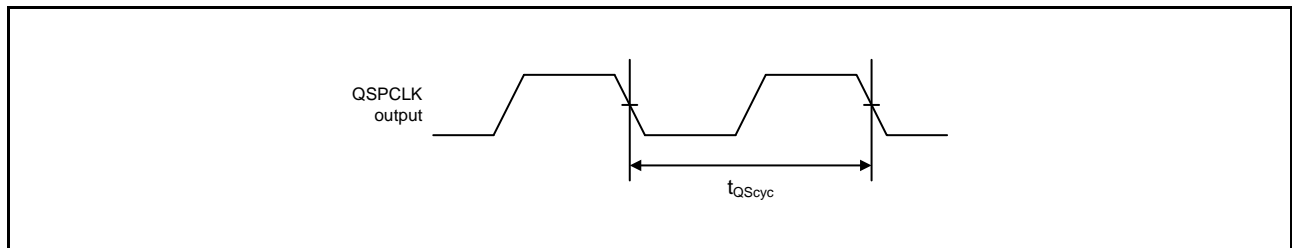
**Table 2.37 QSPI Timing**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = VCC \times 0.5$ ,  $V_{OL} = VCC \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

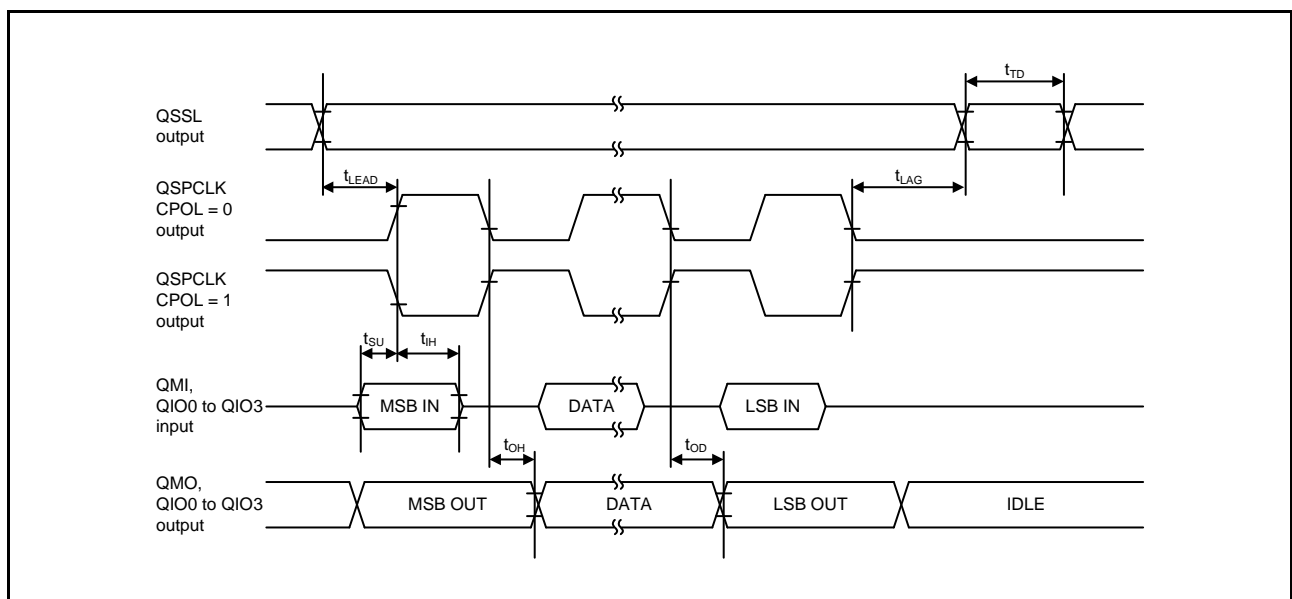
Item	Symbol	Min.	Max.	Unit*1	Test Conditions*2	
QSPI	QSPCLK clock cycle	$t_{QScyc}$	2	4080	$t_{PBcyc}$	Figure 2.63
	Data input setup time	$t_{Su}$	6.5	—	ns	Figure 2.64, Figure 2.65
	Data input hold time	$t_{IH}$	5	—	ns	
	SS setup time	$t_{LEAD}$	1.5	8.5	$t_{QScyc}$	
	SS hold time	$t_{LAG}$	1	8	$t_{QScyc}$	
	Data output delay time	$t_{OD}$	—	10.0	ns	
	Data output hold time	$t_{OH}$	-5	—	ns	
	Successive transmission delay time	$t_{TD}$	1	8	$t_{QScyc}$	

Note 1.  $t_{PBcyc}$ : PCLKB cycle

Note 2. We recommend that pins suffixed with the same letter such as -A and -B, indicating grouping of the pins, should be used as a set. The AC characteristics of the QSPI are measured using the pins from the same group.



**Figure 2.63 QSPI Clock Timing**



**Figure 2.64 Transmit/Receive Timing (CPHA = 0)**

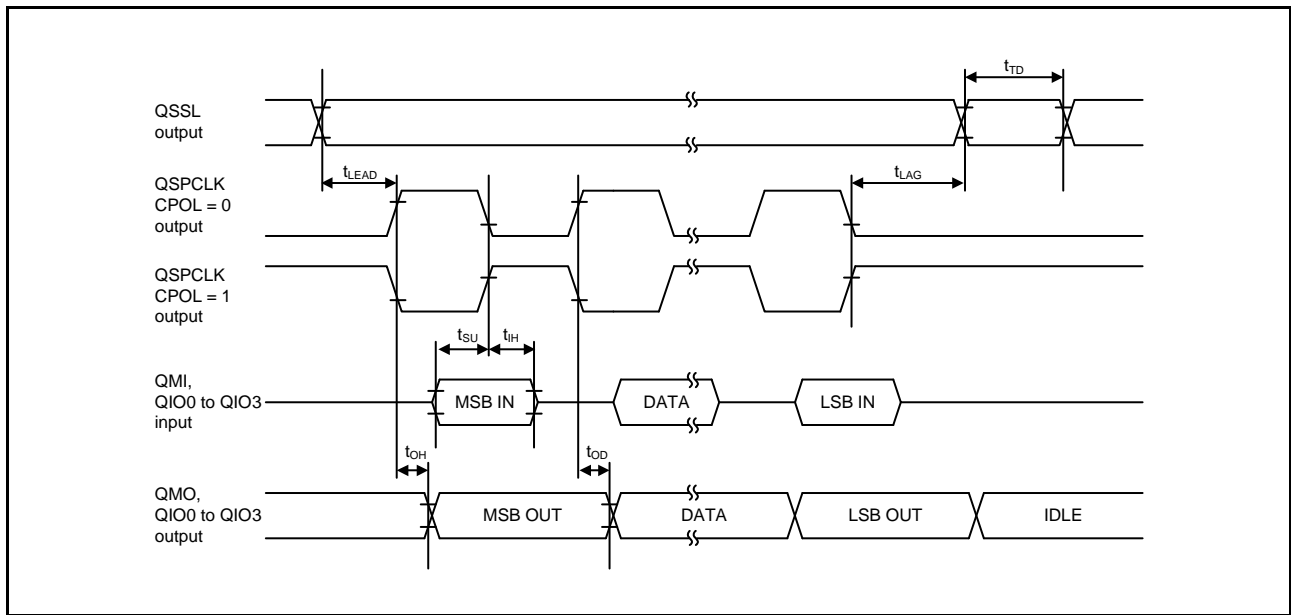


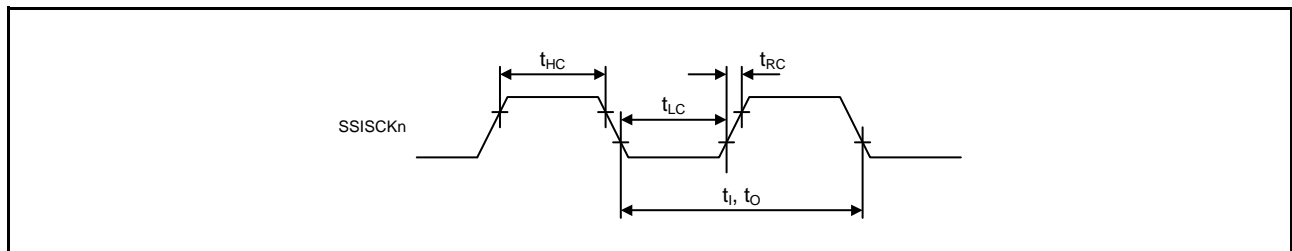
Figure 2.65 Transmit/Receive Timing (CPHA = 1)

2.3.7.12 SSI

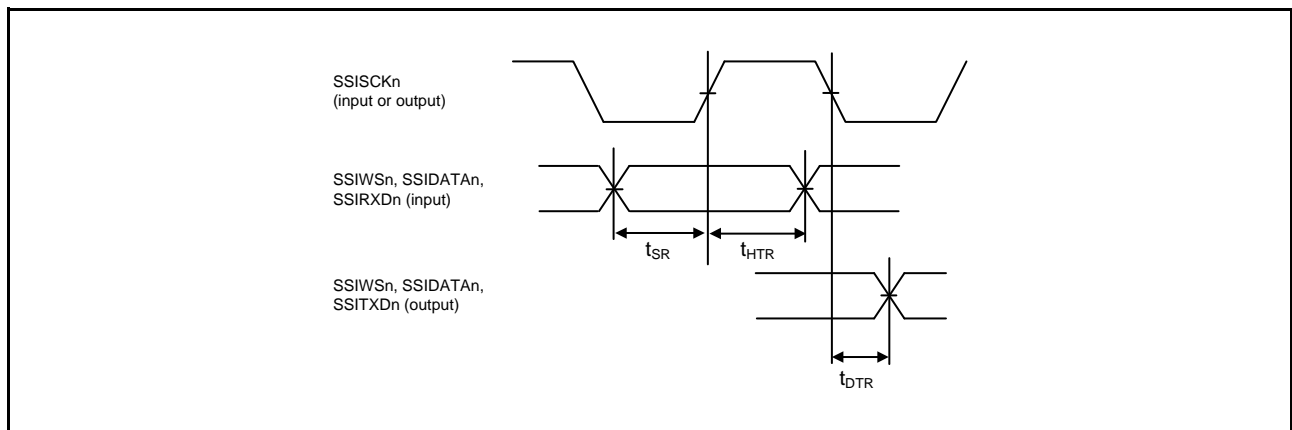
**Table 2.38 Serial Sound Interface Timing**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item	Symbol	Min.	Max.	Unit	Test Conditions
SSI	AUDIO_MCLK input frequency	—	50	MHz	
	Output clock cycle	150	64000	ns	Figure 2.66
	Input clock cycle	150	64000	ns	
	Clock high pulse width	60	—	ns	
	Clock low pulse width	60	—	ns	
	Clock rising time	—	25	ns	
	Clock falling time	—	25	ns	
	Data delay time	-5	25	ns	Figure 2.67, Figure 2.68
	Setup time	25	—	ns	
	Hold time	25	—	ns	
	WS change edge SSIDATA output delay	—	25	ns	Figure 2.69



**Figure 2.66 Clock Input/Output Timing**



**Figure 2.67 Transmit/Receive Timing (SSISCKn Rising Synchronous)**

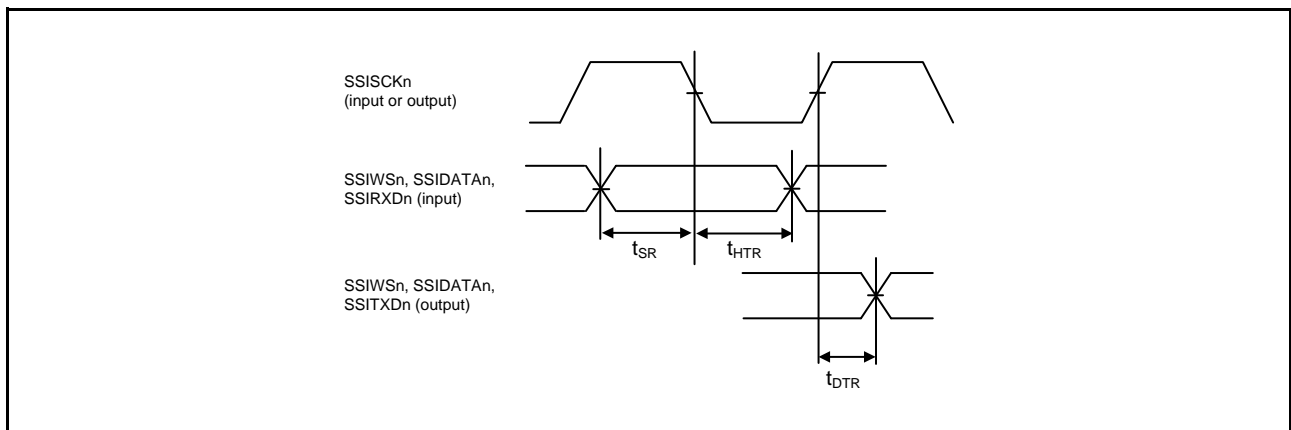


Figure 2.68 Transmit/Receive Timing (SSISCKn Falling Synchronous)

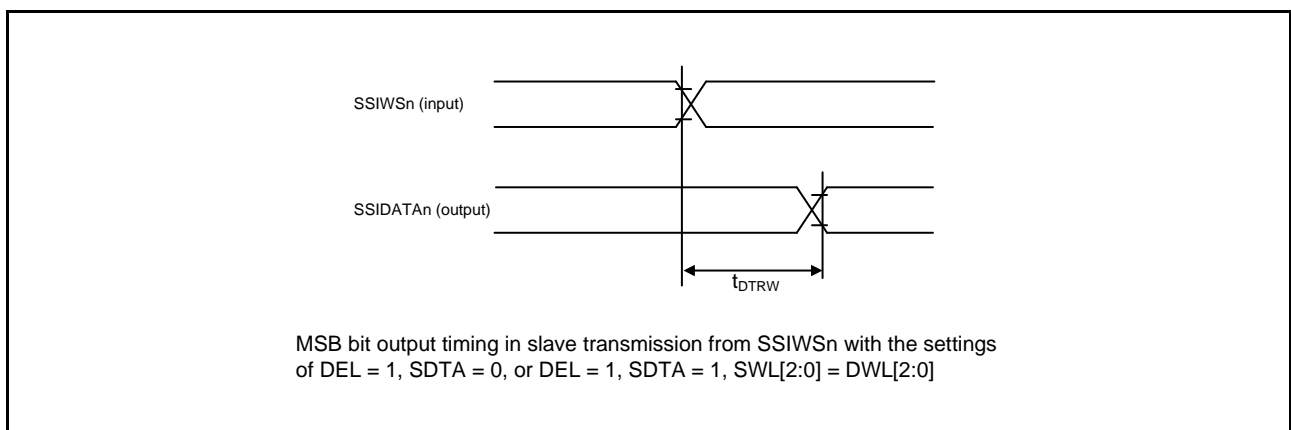


Figure 2.69 SSIDATA Output Delay from SSIWSn Change Edge

2.3.7.13 MMC

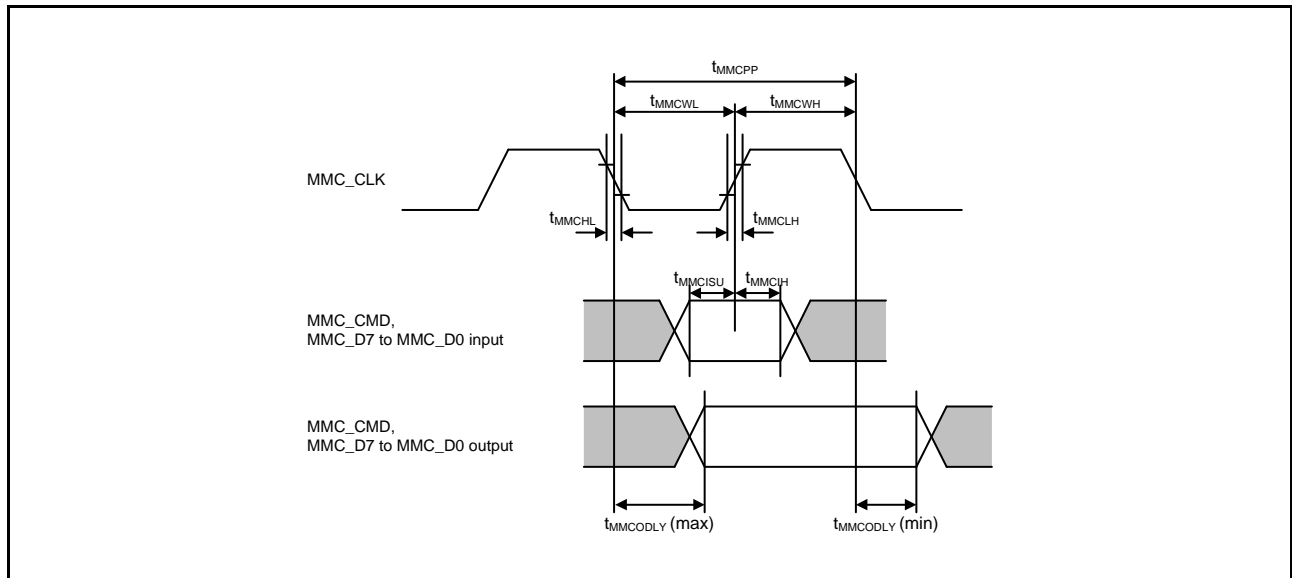
**Table 2.39 MMC Host Interface Timing**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item	Symbol	Min.*1	Max.	Unit	Test Conditions*2	
MMCIF	MMC_CLK clock cycle	$t_{MMCPP}$	$2 \times t_{PBcyc}$	—	ns	Figure 2.70
	MMC_CLK clock high level width	$t_{MMCWH}$	6.5	—	ns	
	MMC_CLK clock low level width	$t_{MMCWL}$	6.5	—	ns	
	MMC_CLK clock rising time	$t_{MMCLH}$	—	5	ns	
	MMC_CLK clock falling time	$t_{MMCHL}$	—	5	ns	
	MMC_CMD, MMC_D7 to MMC_D0 output data delay (data transfer mode)	$t_{MMCODLY}$	-6.5	6.5	ns	
	MMC_CMD, MMC_D7 to MMC_D0 input data setup	$t_{MMCISU}$	8	—	ns	
	MMC_CMD, MMC_D7 to MMC_D0 input data hold	$t_{MMCIH}$	2	—	ns	

Note 1.  $t_{PBcyc}$ : PCLKB cycle

Note 2. We recommend that pins suffixed with the same letter such as -A and -B, indicating grouping of the pins, should be used as a set. The AC characteristics of the MMC are measured using the pins from the same group.



**Figure 2.70 MMC Interface**

2.3.7.14 SDHI

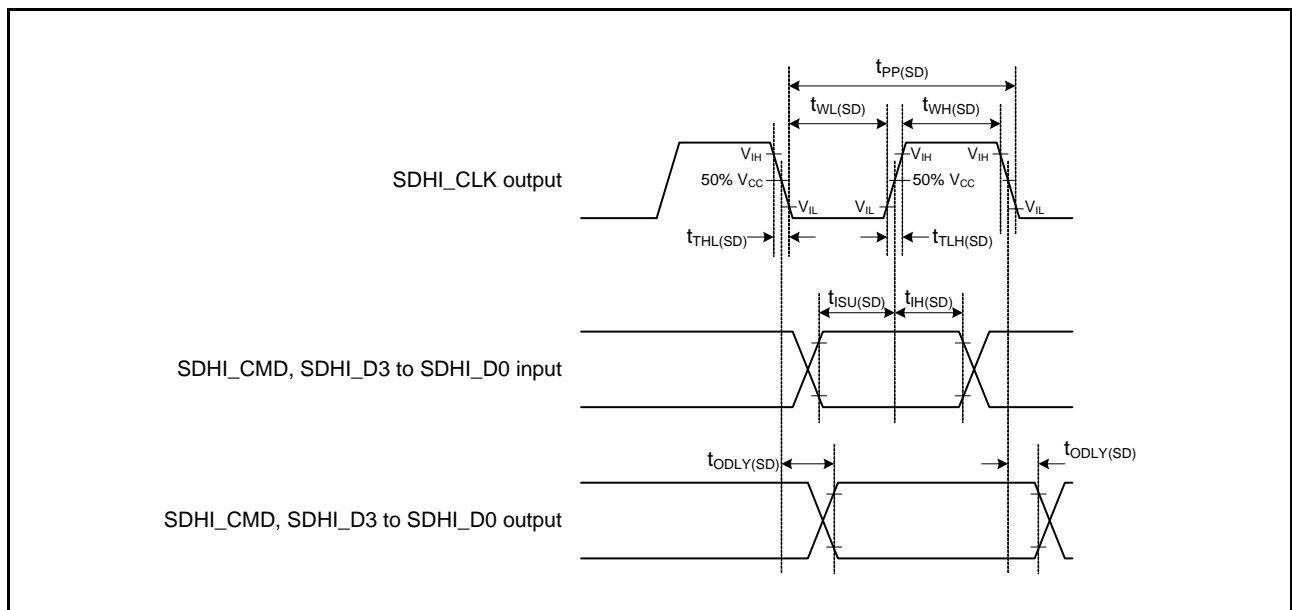
**Table 2.40 SDHI Timing**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7$  V  $\leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$ ,  
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF,  
 High-drive output is selected by the driving ability control register.

Item	Symbol	Min.	Max.	Unit	Test Conditions*1
SDHI	SDHI_CLK pin output cycle time	$2 \times t_{PBcyc}^{*2}$	—	ns	Figure 2.71
	SDHI_CLK pin output high pulse width	$0.4 \times t_{PP(SD)}$	—	ns	
	SDHI_CLK pin output low pulse width	$0.4 \times t_{PP(SD)}$	—	ns	
	SDHI_CLK pin output rise time	—	5	ns	
	SDHI_CLK pin output fall time	—	5	ns	
	Output data delay time (data transfer mode) for SDHI_CMD and SDHI_D0 to SDHI_D3 pins	-6.5	4	ns	
	Input data setup time for SDHI_CMD and SDHI_D0 to SDHI_D3 pins	7	—	ns	
	Input data hold time for SDHI_CMD and SDHI_D0 to SDHI_D3 pins	2	—	ns	

Note 1. When a letter “-A”, “-B”, etc. to indicate group membership is appended to the pin name, each pin is recommended to use in combination with the pins in the same group. All SDHI AC timings are measured in combination with the pins in the same group.

Note 2.  $t_{PBcyc}$ : PCLKB cycle



**Figure 2.71 SD Host Interface Input/Output Signal Timing**

## 2.3.7.15 ETHERC

**Table 2.41 ETHERC Timing**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
Output load conditions:  $V_{OH} = VCC \times 0.5$ ,  $V_{OL} = VCC \times 0.5$ ,  $C = 30$  pF  
High-drive output is selected by the driving ability control register.

	Item	Symbol	Min.	Max.	Unit	Test Conditions
ETHERC (RMII)	REF50CK cycle time	$T_{ck}$	20	—	ns	Figure 2.72 to Figure 2.74
	REF50CK frequency Typ. 50 MHz	—	—	50 + 100 ppm	MHz	
	REF50CK duty	—	35	65	%	
	REF50CK rise/fall time	$T_{ckr/ckf}$	0.5	3.5	ns	
	RMII_xxxx*1 output delay time	$T_{co}$	2.5	15.0	ns	
	RMII_xxxx*2 setup time	$T_{su}$	3	—	ns	
	RMII_xxxx*2 hold time	$T_{hd}$	1	—	ns	
	RMII_xxxx*1, *2 rise/fall time	$T_r/T_f$	0.5	5	ns	
	ET_WOL output delay time	$t_{WOLd}$	1	23.5	ns	Figure 2.76
ETHERC (MII)	ET_TX_CLK cycle time	$t_{Tcyc}$	40	—	ns	—
	ET_TX_EN output delay time	$t_{TENd}$	1	20	ns	Figure 2.77
	ET_ETXD0 to ET_ETXD3 output delay time	$t_{MTDd}$	1	20	ns	
	ET_CRD setup time	$t_{CRDs}$	10	—	ns	
	ET_CRD hold time	$t_{CRSh}$	10	—	ns	
	ET_COL setup time	$t_{COLs}$	10	—	ns	Figure 2.78
	ET_COL hold time	$t_{COLh}$	10	—	ns	
	ET_RX_CLK cycle time	$t_{TRcyc}$	40	—	ns	—
	ET_RX_DV setup time	$t_{RDVs}$	10	—	ns	Figure 2.79
	ET_RX_DV hold time	$t_{RDVh}$	10	—	ns	
	ET_ERXD0 to ET_ERXD3 setup time	$t_{MRDs}$	10	—	ns	
	ET_ERXD0 to ET_ERXD3 hold time	$t_{MRDh}$	10	—	ns	
	ET_RX_ER setup time	$t_{RERs}$	10	—	ns	Figure 2.80
	ET_RX_ER hold time	$t_{RESh}$	10	—	ns	
	ET_WOL output delay time	$t_{WOLd}$	1	23.5	ns	Figure 2.81

Note 1. RMII\_TXD\_EN, RMII\_TXD1, RMII\_TXD0

Note 2. RMII\_CRD\_DV, RMII\_RXD1, RMII\_RXD0, RMII\_RX\_ER

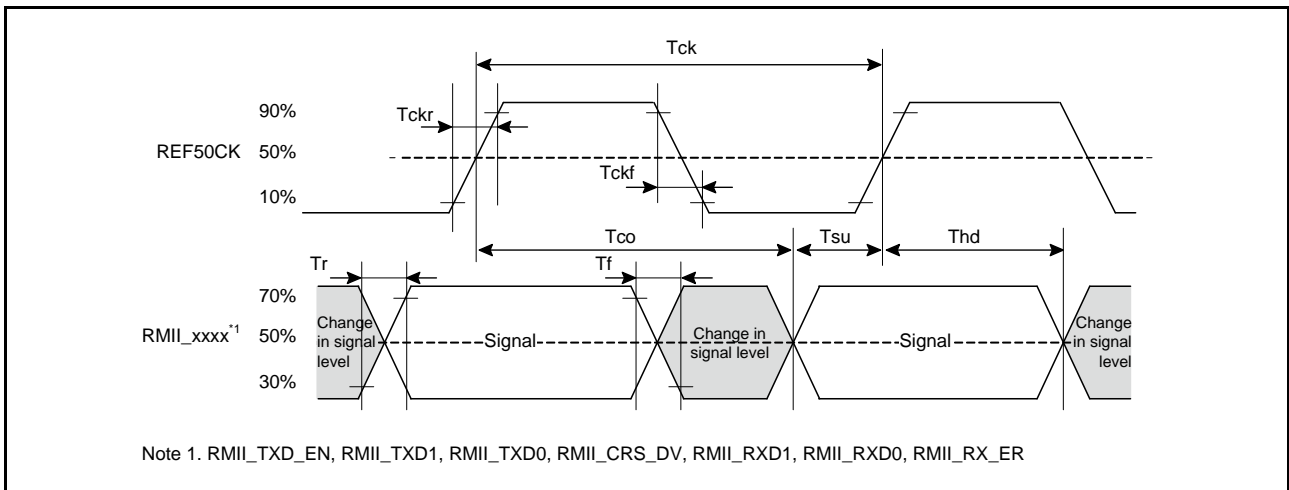


Figure 2.72 Timing with the REF50CK and RMII Signals

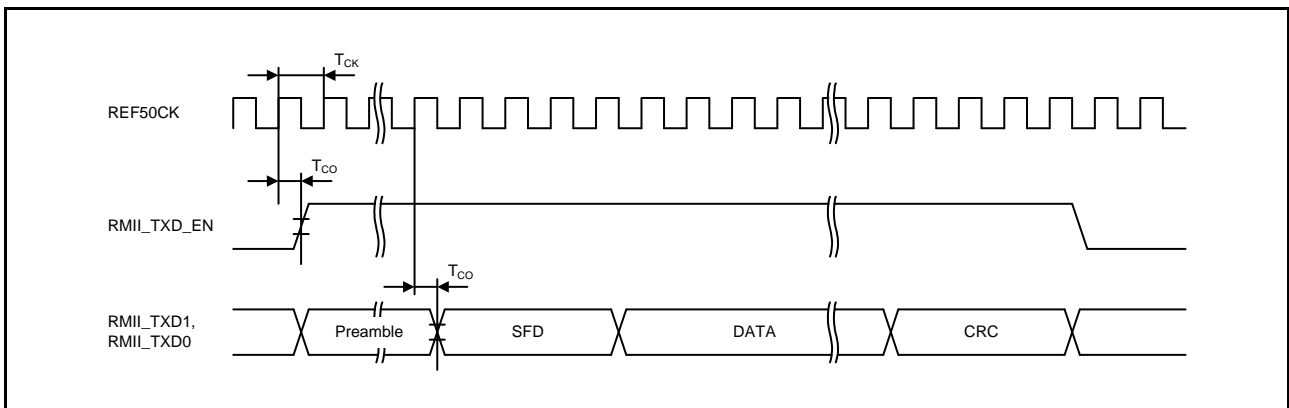


Figure 2.73 RMII Transmission Timing

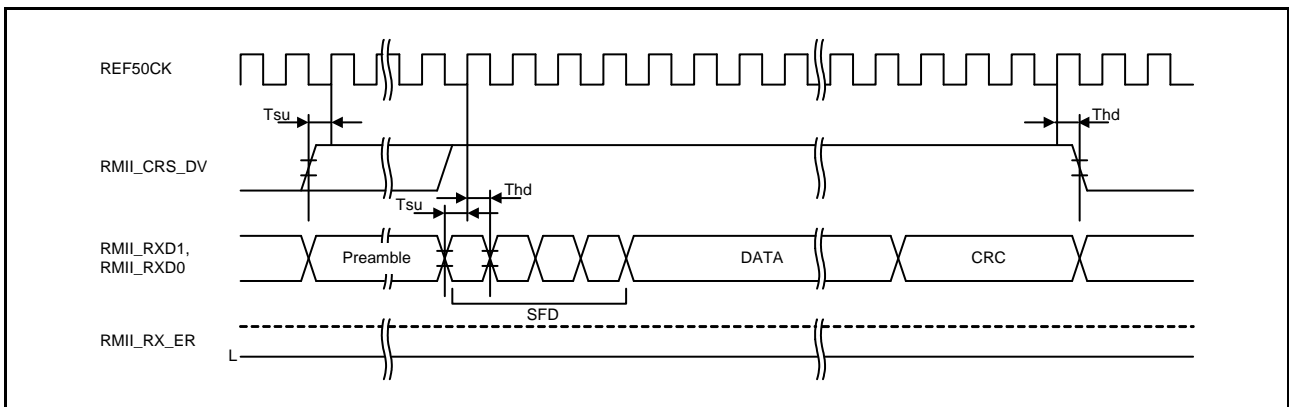


Figure 2.74 RMII Reception Timing (Normal Operation)



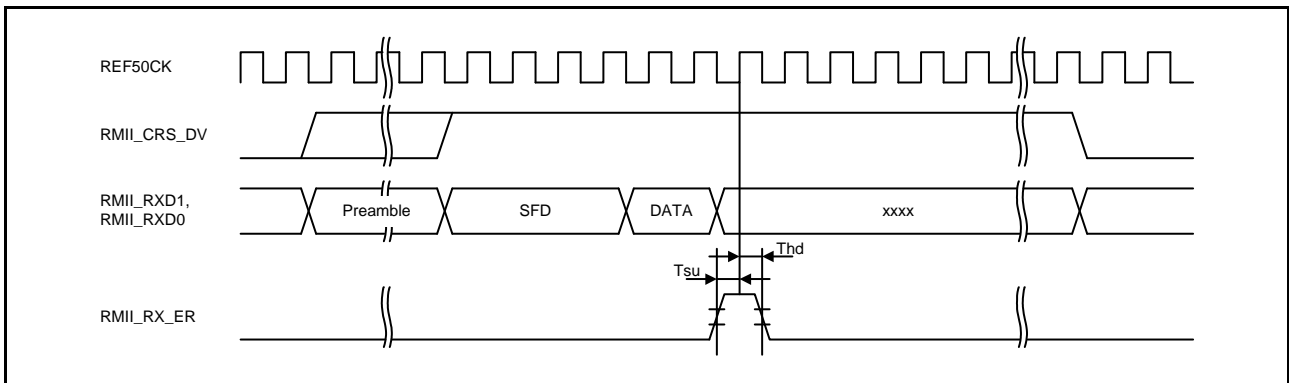


Figure 2.75 RMI Reception Timing (Error Occurrence)

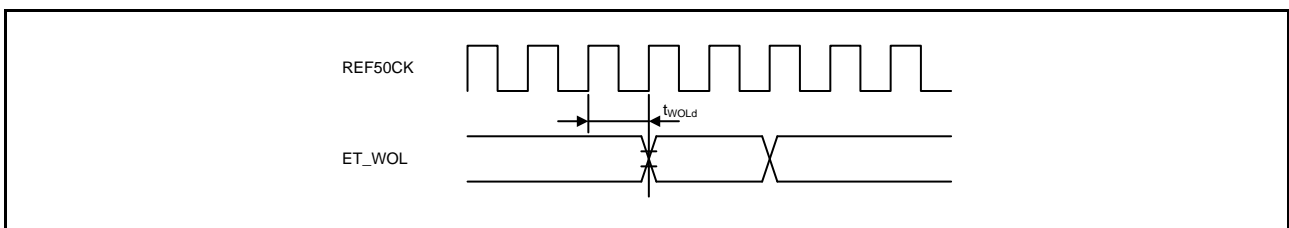


Figure 2.76 WOL Output Timing (RMII)

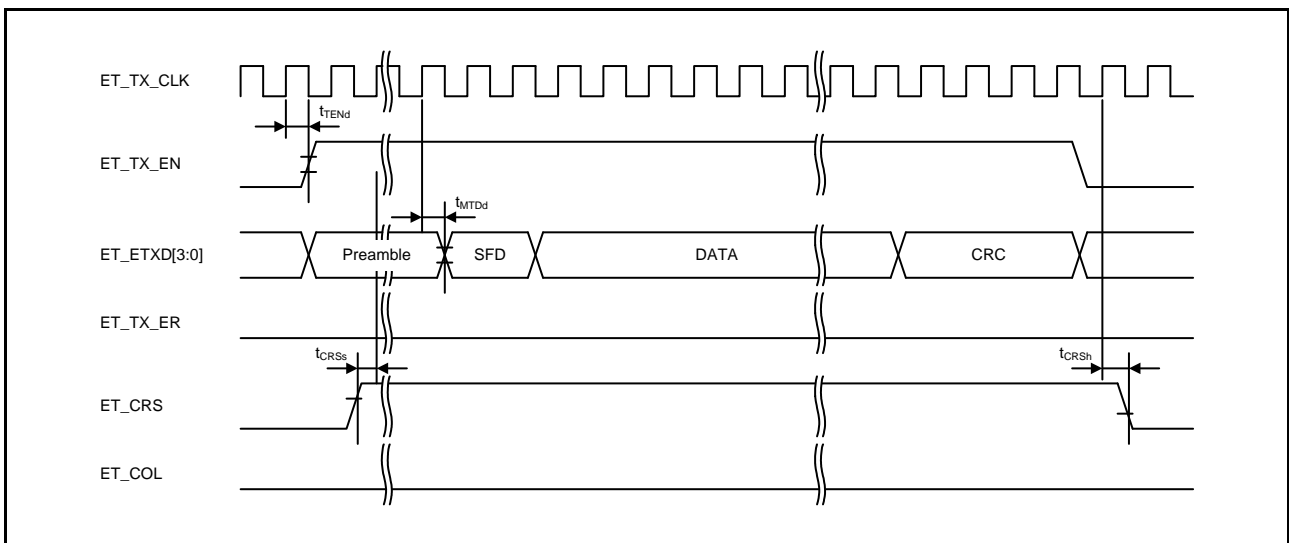


Figure 2.77 MII Transmission Timing (Normal Operation)

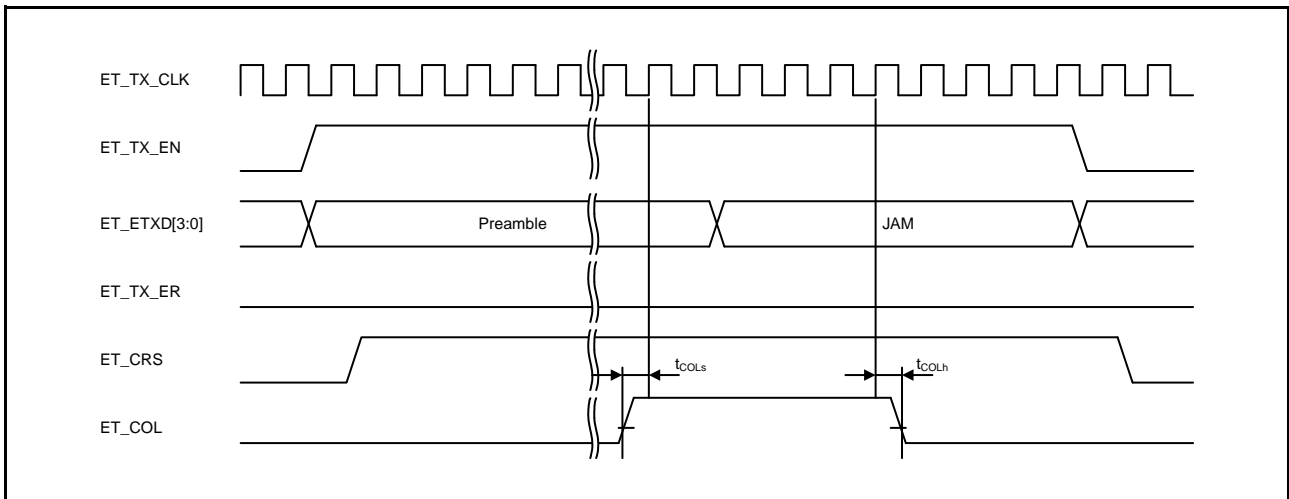


Figure 2.78 MII Transmission Timing (Conflict Occurrence)

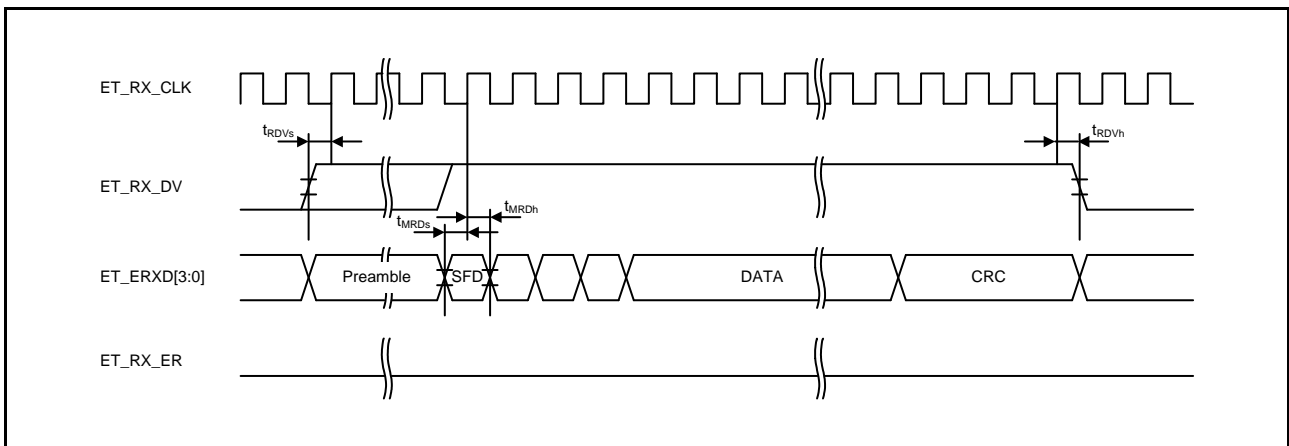


Figure 2.79 MII Reception Timing (Normal Operation)

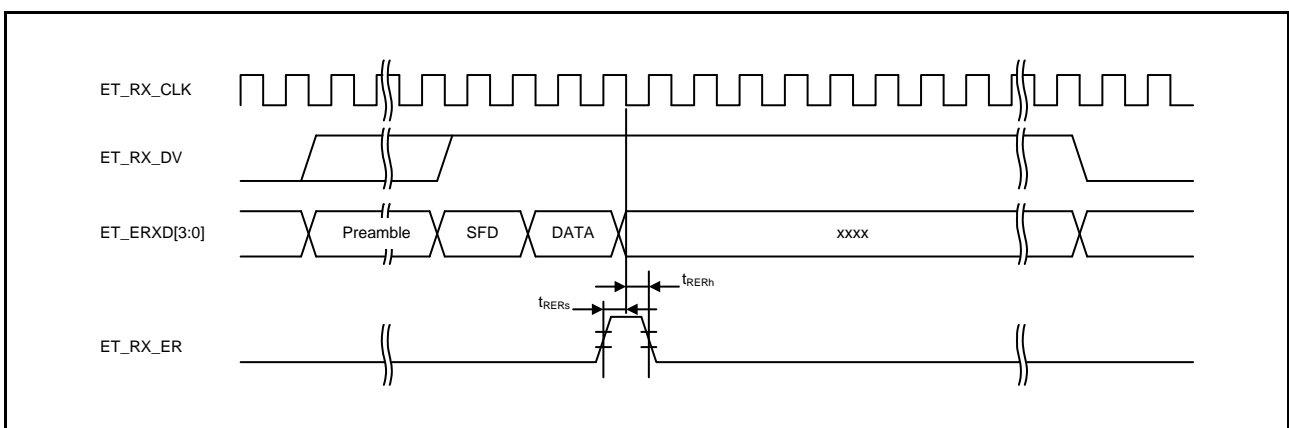


Figure 2.80 MII Reception Timing (Error Occurrence)

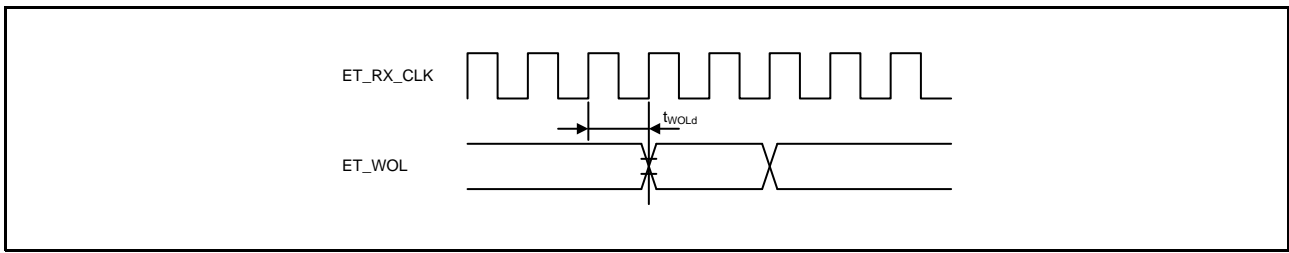


Figure 2.81 WOL Output Timing (MII)

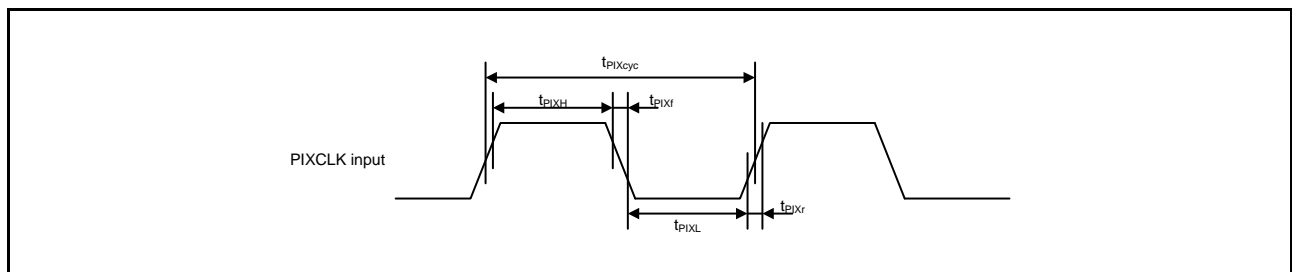
2.3.7.16 PDC

**Table 2.42 PDC Timing**

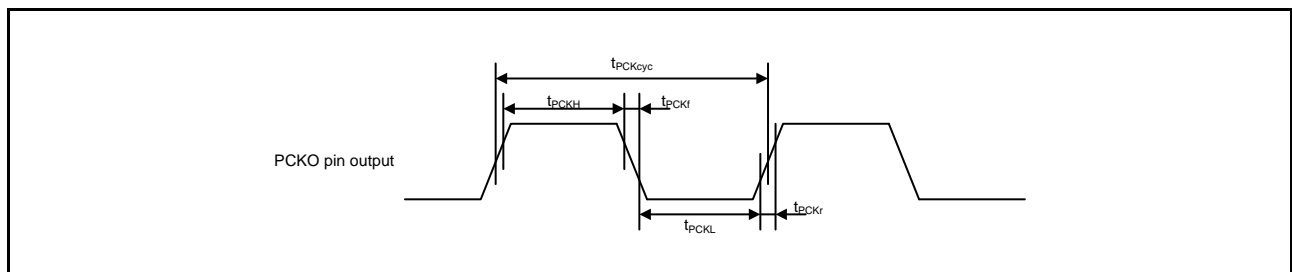
Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item	Symbol	Min.*1	Max.	Unit	Test Conditions	
PDC	PIXCLK input cycle time	$t_{PIXcyc}$	37	—	ns	Figure 2.82
	PIXCLK input high pulse width	$t_{PIXH}$	10	—	ns	
	PIXCLK input low pulse width	$t_{PIXL}$	10	—	ns	
	PIXCLK rising time	$t_{PIXr}$	—	5	ns	
	PIXCLK falling time	$t_{PIXf}$	—	5	ns	
	PCKO output cycle time	$t_{PCKcyc}$	$2 \times t_{PBcyc}$	—	ns	
PCKO output high pulse width	$t_{PCKH}$	$(t_{PCKcyc} - t_{PCKr} - t_{PCKf})/2 - 3$	—	ns		
PCKO output low pulse width	$t_{PCKL}$	$(t_{PCKcyc} - t_{PCKr} - t_{PCKf})/2 - 3$	—	ns		
PCKO rising time	$t_{PCKr}$	—	5	ns		
PCKO falling time	$t_{PCKf}$	—	5	ns		
VSYNV/HSYNC input setup time	VSYNV/HSYNC input setup time	$t_{SYNCS}$	10	—	ns	Figure 2.84
	VSYNV/HSYNC input hold time	$t_{SYNCH}$	5	—	ns	
	PIXD input setup time	$t_{PIXDS}$	10	—	ns	
	PIXD input hold time	$t_{PIXDH}$	5	—	ns	

Note 1.  $t_{PBcyc}$ : PCLKB cycle



**Figure 2.82 PDC Input Clock Timing**



**Figure 2.83 PDC Output Clock Timing**

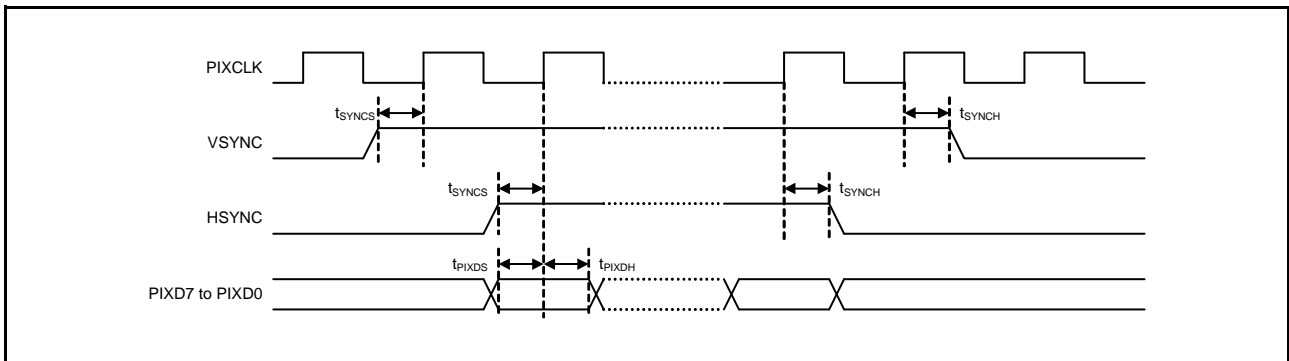


Figure 2.84 PDC AC Timing

### 2.3.7.17 A/D Converter Trigger

Table 2.43 A/D Converter Trigger Timing

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item		Symbol	Min.	Max.	Unit*1	Test Conditions
A/D converter	A/D converter trigger input pulse width	$t_{TRGW}$	1.5	—	$t_{PBcyc}$	Figure 2.85

Note 1.  $t_{PBcyc}$ : PCLKB cycle

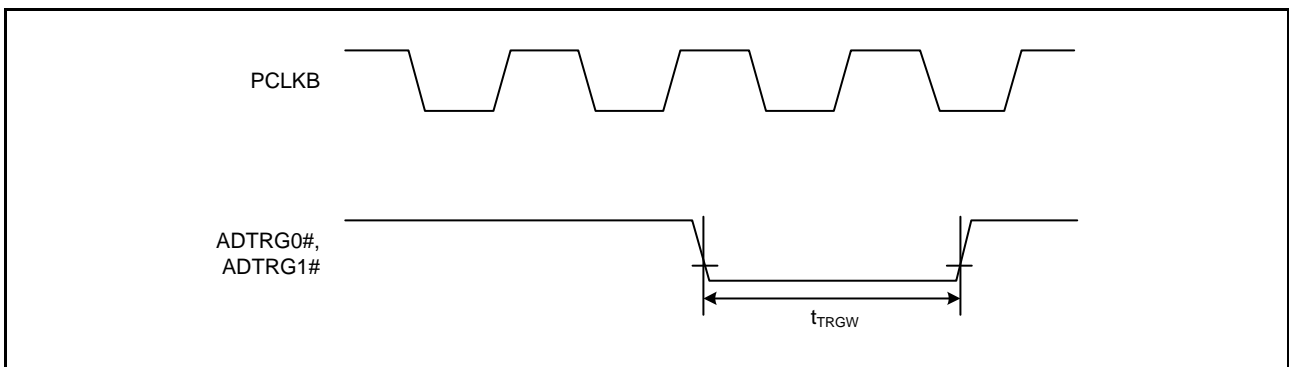


Figure 2.85 A/D Converter Trigger Input Timing

## 2.3.7.18 CAC

**Table 2.44 CAC Timing**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item*1, *2		Symbol	Min.*1	Max.	Unit*1	Test Conditions
CAC	CACREF input pulse width	$t_{PBcyc} \leq t_{cac}$	$t_{CACREF}$	$4.5 t_{cac} + 3 t_{PBcyc}$	—	ns
			$t_{PBcyc} > t_{cac}$	$5 t_{cac} + 6.5 t_{PBcyc}$	—	

Note 1.  $t_{PBcyc}$ : PCLKB cycle

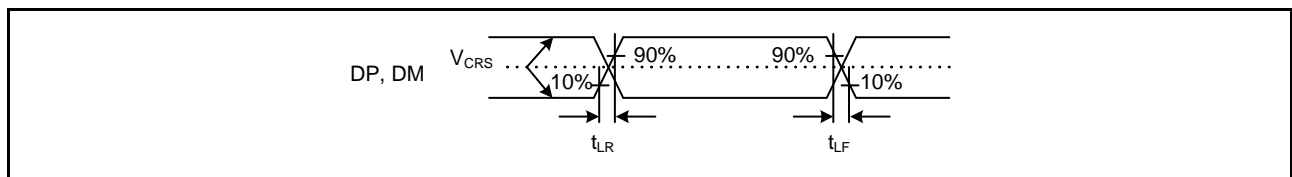
Note 2.  $t_{CAC}$ : CAC count clock source cycle

2.4 USB Characteristics

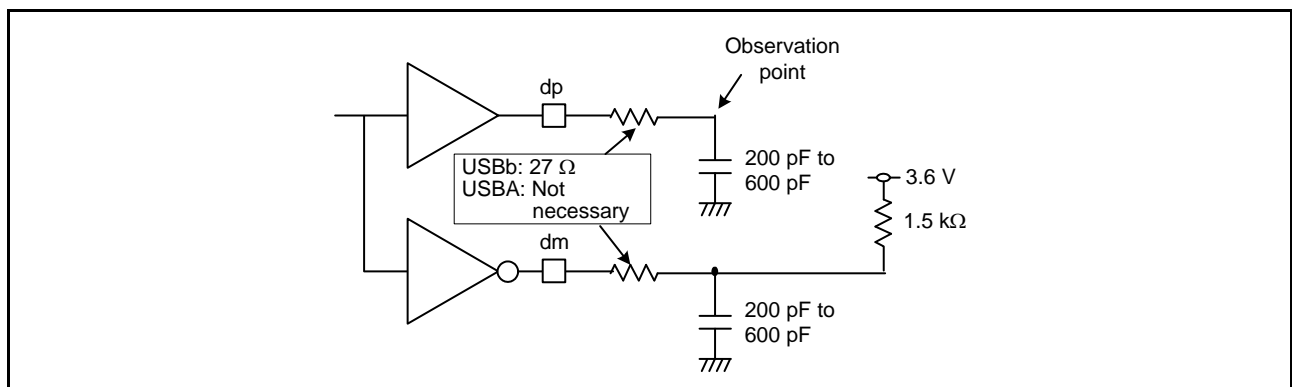
**Table 2.45 On-Chip USB Low Speed (Host Only) Characteristics (DP and DM Pin Characteristics)**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 3.0$  to  $3.6$  V,  $3.0 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $USBA\_RREF = 2.2$  k $\Omega \pm 1\%$ ,  $USBMCLK = 20/24$  MHz,  $UCLK = 48$  MHz,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	
Input characteristics	Input high level voltage	$V_{IH}$	2.0	—	—	V	
	Input low level voltage	$V_{IL}$	—	—	0.8	V	
	Differential input sensitivity	$V_{DI}$	0.2	—	—	V	DP – DM
	Differential common mode range	$V_{CM}$	0.8	—	2.5	V	
Output characteristics	Output high level voltage	$V_{OH}$	2.8	—	3.6	V	$I_{OH} = -200$ $\mu$ A
	Output low level voltage	$V_{OL}$	0.0	—	0.3	V	$I_{OL} = 2$ mA
	Cross-over voltage	$V_{CRS}$	1.3	—	2.0	V	Figure 2.86
	Rise time	$t_{LR}$	75	—	300	ns	
	Fall time	$t_{LF}$	75	—	300	ns	
	Rise/fall time ratio	$t_{LR} / t_{LF}$	80	—	125	%	$t_{LR} / t_{LF}$
Pull-down characteristics	DP/DM pull-down resistance (when the host controller function is selected)	$R_{pd}$	14.25	—	24.80	k $\Omega$	



**Figure 2.86 DP and DM Output Timing (Low Speed)**

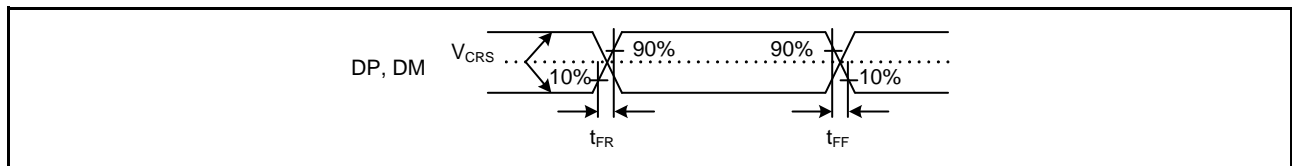


**Figure 2.87 Test Circuit (Low Speed)**

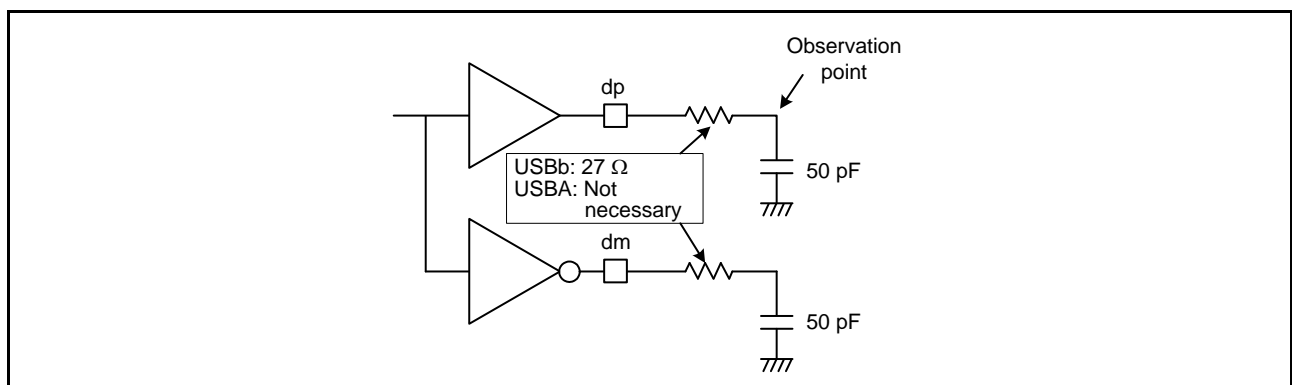
**Table 2.46 On-Chip USB Full-Speed Characteristics (DP and DM Pin Characteristics)**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 3.0$  to  $3.6$  V,  $3.0 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $USBA\_RREF = 2.2$  k $\Omega \pm 1\%$ ,  $USBMCLK = 20/24$  MHz,  $UCLK = 48$  MHz,  
 $PCLKA = 8$  to  $120$  MHz,  $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	
Input characteristics	Input high level voltage	$V_{IH}$	2.0	—	—	V	
	Input low level voltage	$V_{IL}$	—	—	0.8	V	
	Differential input sensitivity	$V_{DI}$	0.2	—	—	V	DP – DM
	Differential common mode range	$V_{CM}$	0.8	—	2.5	V	
Output characteristics	Output high level voltage	$V_{OH}$	2.8	—	3.6	V	$I_{OH} = -200 \mu A$
	Output low level voltage	$V_{OL}$	0.0	—	0.3	V	$I_{OL} = 2$ mA
	Cross-over voltage	$V_{CRS}$	1.3	—	2.0	V	Figure 2.88
	Rise time	$t_{FR}$	4	—	20	ns	
	Fall time	$t_{FF}$	4	—	20	ns	
	Rise/fall time ratio	$t_{FR} / t_{FF}$	90	—	111.11	%	$t_{FR} / t_{FF}$
	Output resistance	$Z_{DRV}$	28	—	44	$\Omega$	USBb: $R_s = 27 \Omega$ included
40.5			—	49.5	$\Omega$	USBA: $R_s$ not necessary (PHYSET.REPSEL[1:0] = 01b and PHYSET.HSEB = 0)	
Pull-up and pull-down characteristics	DP pull-up resistance (when the function controller function is selected)	$R_{pu}$	0.900	—	1.575	k $\Omega$	Idle state
			1.425	—	3.090	k $\Omega$	At transmission and reception
	DP/DM pull-down resistance (when the host controller function is selected)	$R_{pd}$	14.25	—	24.80	k $\Omega$	



**Figure 2.88 DP and DM Output Timing (Full-Speed)**



**Figure 2.89 Test Circuit (Full-Speed)**



**Table 2.47 Battery Charge Characteristics (USBA only)**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA =$   
 $AVSS\_USBA = 0$  V,  $USBA\_RREF = 2.2$  k $\Omega \pm 1\%$ ,  $USBMCLK = 20/24$  MHz,  $PCLKA = 8$  to  $120$  MHz,  
 $PCLKB = 8$  to  $60$  MHz,  $T_a = T_{opr}$

Item	Symbol	Min.	Max.	Unit	Test Conditions
D+ sink current	$I_{DP\_SINK}$	25	175	$\mu$ A	
D- sink current	$I_{DM\_SINK}$	25	175	$\mu$ A	
DCD source current	$I_{DP\_SRC}$	7	13	$\mu$ A	
Data detection voltage	$V_{DAT\_REF}$	0.25	0.4	V	
D+ source voltage	$V_{DP\_SRC}$	0.5	0.7	V	Output current = 250 $\mu$ A
D- source voltage	$V_{DM\_SRC}$	0.5	0.7	V	Output current = 250 $\mu$ A

## 2.5 A/D Conversion Characteristics

**Table 2.48 12-Bit A/D (Unit 0) Conversion Characteristics**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $PCLKB = PCLKC = 1$  MHz to  $60$  MHz,  $T_a = T_{opr}$ , source impedance =  $1.0$  k $\Omega$

Item		Min.	Typ.	Max.	Unit	Test Conditions
Resolution		8	—	12	Bit	
Analog input capacitance		—	—	30	pF	
Channel-dedicated sample-and-hold circuits in use (AN000 to AN002)	Conversion time*1 (Operation at PCLK = 60 MHz)	1.06 (0.40 + 0.25)*2	—	—	$\mu$ s	<ul style="list-style-type: none"> <li>Sampling of channel-dedicated sample-and-hold circuits in 24 states</li> <li>Sampling in 15 states</li> </ul>
	Offset error	—	$\pm 1.5$	$\pm 3.5$	LSB	AN000 to AN002 = 0.25 V
	Full-scale error	—	$\pm 1.5$	$\pm 3.5$	LSB	AN000 to AN002 = $V_{REFH0} - 0.25$ V
	Quantization error	—	$\pm 0.5$	—	LSB	
	Absolute accuracy	—	$\pm 2.5$	$\pm 5.5$	LSB	
	DNL differential nonlinearity error	—	$\pm 1.0$	$\pm 2.0$	LSB	
	INL integral nonlinearity error	—	$\pm 1.5$	$\pm 3.0$	LSB	
	Holding characteristics of sample-and-hold circuits	—	—	20	$\mu$ s	
Dynamic range	0.25	—	$V_{REFH0} - 0.25$	V		
Channel-dedicated sample-and-hold circuits not in use (AN000 to AN007)	Conversion time*1 (Operation at PCLK = 60 MHz)	0.48 (0.267)*2	—	—	$\mu$ s	Sampling in 16 states
	Offset error	—	$\pm 1.0$	$\pm 2.5$	LSB	
	Full-scale error	—	$\pm 1.0$	$\pm 2.5$	LSB	
	Quantization error	—	$\pm 0.5$	—	LSB	
	Absolute accuracy	—	$\pm 2.0$	$\pm 4.5$	LSB	
	DNL differential nonlinearity error	—	$\pm 0.5$	$\pm 1.5$	LSB	
	INL integral nonlinearity error	—	$\pm 1.0$	$\pm 2.5$	LSB	

Note: The above specification values apply when there is no access to the external bus during A/D conversion. If access proceeds during A/D conversion, values may not fall within the above ranges.

Note 1. The conversion time includes the sampling time and the comparison time. As the test conditions, the number of sampling states is indicated.

Note 2. The value in parentheses indicates the sampling time.

**Table 2.49 12-Bit A/D (Unit 1) Conversion Characteristics**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $PCLKB = PCLKD = 1$  MHz to  $60$  MHz,  $T_a = T_{opr}$ , source impedance =  $1.0$  k $\Omega$

Item	Min.	Typ.	Max.	Unit	Test Conditions
Resolution	8	—	12	Bit	
Conversion time*1 (Operation at PCLK = 60 MHz)	0.88 (0.667)*2	—	—	$\mu$ s	Sampling in 40 states
Analog input capacitance	—	—	30	pF	
Offset error	—	$\pm 2.0$	$\pm 3.5$	LSB	
Full-scale error	—	$\pm 2.0$	$\pm 3.5$	LSB	
Quantization error	—	$\pm 0.5$	—	LSB	
Absolute accuracy	—	$\pm 4.0$	$\pm 6.0$	LSB	
DNL differential nonlinearity error	—	$\pm 1.5$	$\pm 2.5$	LSB	
INL integral nonlinearity error	—	$\pm 2.0$	$\pm 3.5$	LSB	

Note: The above specification values apply when there is no access to the external bus during A/D conversion. If access proceeds during A/D conversion, values may not fall within the above ranges.

Note 1. The conversion time includes the sampling time and the comparison time. As the test conditions, the number of sampling states is indicated.

Note 2. The value in parentheses indicates the sampling time.

**Table 2.50 A/D Internal Reference Voltage Characteristics**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $PCLKB = PCLKD = 60$  MHz,  $T_a = T_{opr}$

Item	Min.	Typ.	Max.	Unit	Test Conditions
A/D internal reference voltage	1.20	1.25	1.30	V	

## 2.6 D/A Conversion Characteristics

**Table 2.51 D/A Conversion Characteristics**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  
 $2.7 \leq V_{REFH0} \leq AVCC0$ ,  $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item		Min.	Typ.	Max.	Unit	Test Conditions
Resolution		12	12	12	Bit	
Direct output	Absolute accuracy	—	—	$\pm 6.0$	LSB	2-M $\Omega$ resistive load 10-bit conversion
	DNL differential nonlinearity error	—	$\pm 1.0$	$\pm 2.0$	LSB	2-M $\Omega$ resistive load
	RO output resistance	—	7.5	—	k $\Omega$	
	Conversion time	—	—	3.0	$\mu$ s	20-pF capacitive load
Amplifier output	Resistive load	5	—	—	k $\Omega$	
	Capacitive load	—	—	50	pF	
	Output voltage range	0.2	—	$AVCC1 - 0.2$	V	
	DNL differential nonlinearity error	—	$\pm 1.0$	$\pm 2.0$	LSB	
	INL integral nonlinearity error	—	$\pm 2.0$	$\pm 4.0$	LSB	
	Conversion time	—	—	4.0	$\mu$ s	

## 2.7 Temperature Sensor Characteristics

**Table 2.52 Temperature Sensor Characteristics**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item	Min.	Typ.	Max.	Unit	Test Conditions
Relative accuracy	—	$\pm 1$	—	$^{\circ}$ C	
Temperature slope	—	3.8	—	mV/ $^{\circ}$ C	
Output voltage	—	1.21	—	V	$T_a = 25^{\circ}$ C
Temperature sensor start time	—	—	30	$\mu$ s	
Sampling time*1	4.15	—	—	$\mu$ s	

Note 1. Set the S12AD1.ADSSTRT register such that the sampling time of the 12-bit A/D converter satisfies this specification.

## 2.8 Power-on Reset Circuit and Voltage Detection Circuit Characteristics

**Table 2.53 Power-on Reset Circuit and Voltage Detection Circuit Characteristics**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$

Item		Symbol	Min.	Typ.	Max.	Unit	Test Conditions		
Voltage detection level	Power-on reset (POR)	$V_{POR}$	2.5	2.6	2.7	V	Figure 2.90		
			2.0	2.35	2.7				
	Voltage detection circuit (LVD0)		$V_{det0\_1}$	2.84	2.94		3.04	Figure 2.91	
				$V_{det0\_2}$	2.77		2.87		2.97
				$V_{det0\_3}$	2.70		2.80		2.90
	Voltage detection circuit (LVD1)		$V_{det1\_1}$	2.89	2.99		3.09	Figure 2.92	
				$V_{det1\_2}$	2.82		2.92		3.02
				$V_{det1\_3}$	2.75		2.85		2.95
	Voltage detection circuit (LVD2)		$V_{det2\_1}$	2.89	2.99		3.09	Figure 2.93	
				$V_{det2\_2}$	2.82		2.92		3.02
				$V_{det2\_3}$	2.75		2.85		2.95
	Internal reset time	Power-on reset time	$t_{POR}$	—	4.6		—	ms	Figure 2.90
LVD0 reset time		$t_{LVD0}$	—	0.70	—	Figure 2.91			
LVD1 reset time		$t_{LVD1}$	—	0.57	—	Figure 2.92			
LVD2 reset time		$t_{LVD2}$	—	0.57	—	Figure 2.93			
Minimum VCC down time		$t_{V_{OFF}}$	200	—	—	$\mu$ s	Figure 2.90, Figure 2.91		
Response delay time		$t_{det}$	—	—	200	$\mu$ s	Figure 2.90 to Figure 2.93		
LVD operation stabilization time (after LVD is enabled)*3		$T_{d(E-A)}$	—	—	10	$\mu$ s	Figure 2.92, Figure 2.93		
Hysteresis width (LVD1 and LVD2)		$V_{LVH}$	—	80	—	mV			

Note: The minimum VCC down time indicates the time when VCC is below the minimum value of voltage detection levels  $V_{POR}$ ,  $V_{det1}$ , and  $V_{det2}$  for the POR/ LVD.

Note 1. The low power consumption function is disabled and DEEPCUT[1:0] = 00b or 01b.

Note 2. The low power consumption function is enabled and DEEPCUT[1:0] = 11b.

Note 3. The voltage of  $V_{CC} = AVCC0 = AVCC1$  when LVD1 is enabled must be set to at least 80 mV above the maximum value of the voltage detection 1 level ( $V_{det1\_1, 2, 3}$ ) selected by the LVDLVLR.LVD1LVL[3:0] bits. Similarly, the voltage of  $V_{CC} = AVCC0 = AVCC1$  when LVD2 is enabled must be set to at least 80 mV above the maximum value of the voltage detection 2 level ( $V_{det2\_1, 2, 3}$ ) selected by the LVDLVLR.LVD2LVL[3:0] bits.

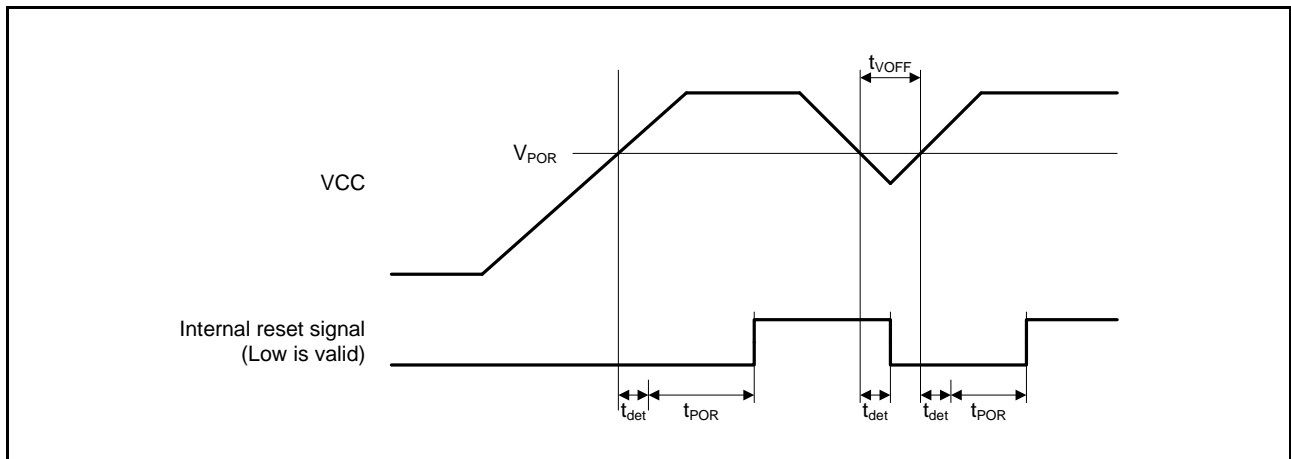


Figure 2.90 Power-on Reset Timing

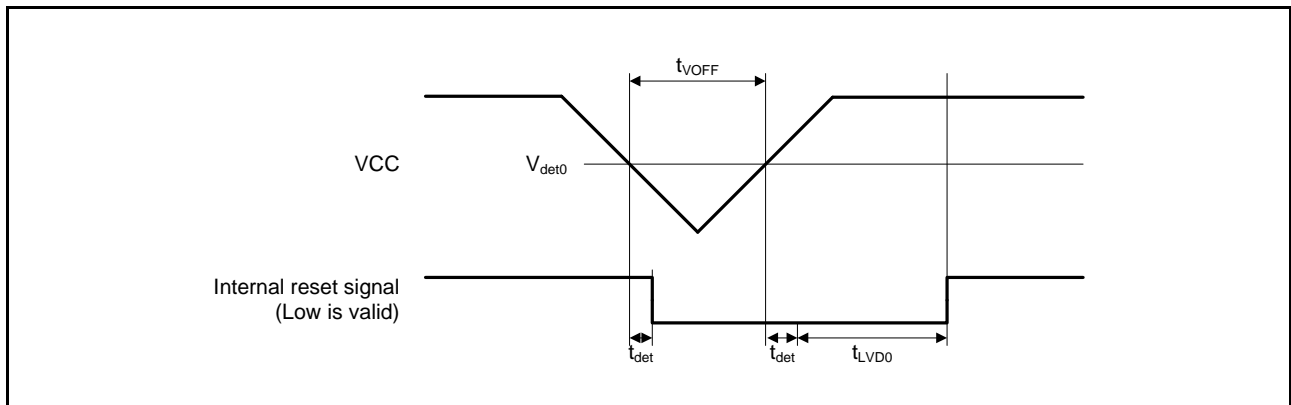


Figure 2.91 Voltage Detection Circuit Timing ( $V_{det0}$ )

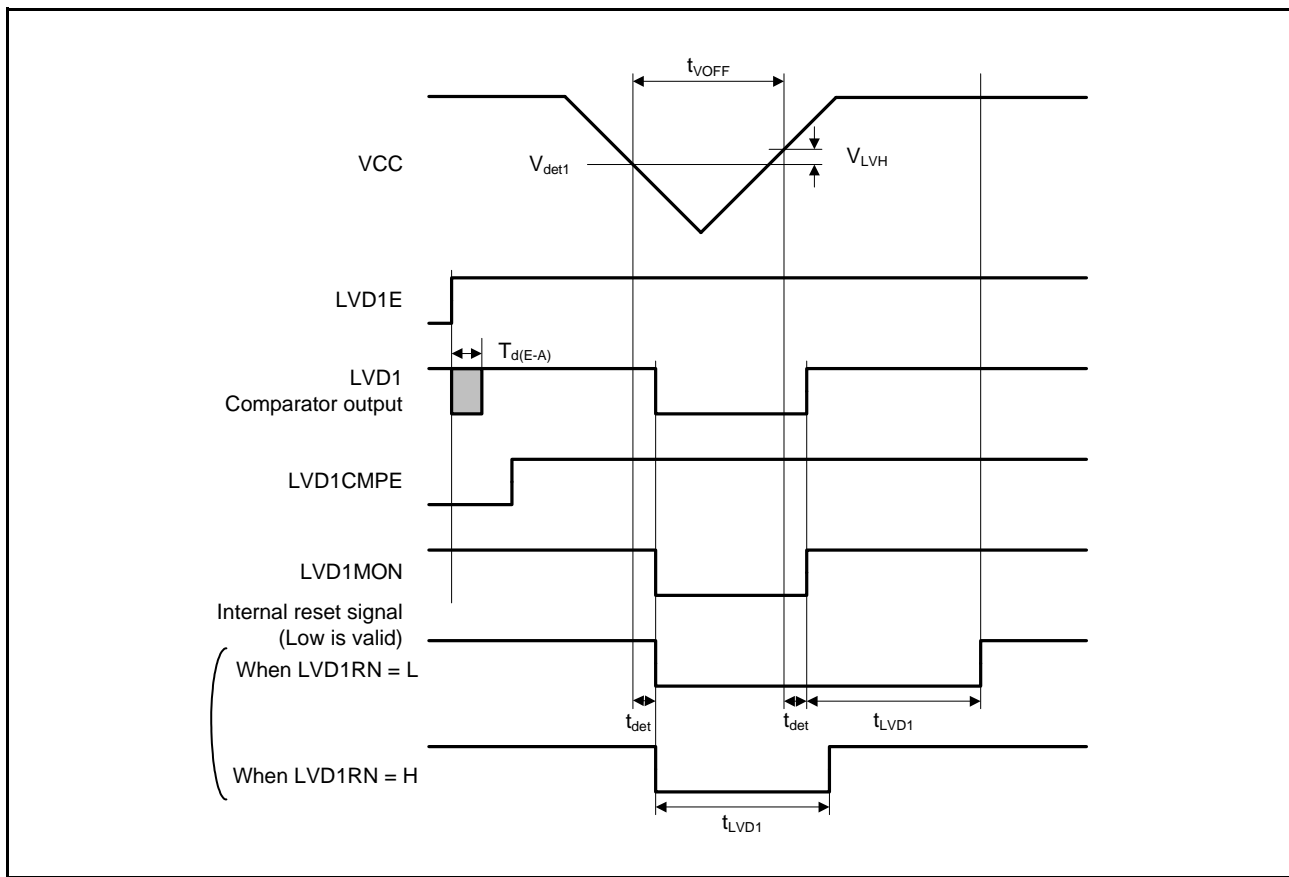


Figure 2.92 Voltage Detection Circuit Timing (V<sub>det1</sub>)

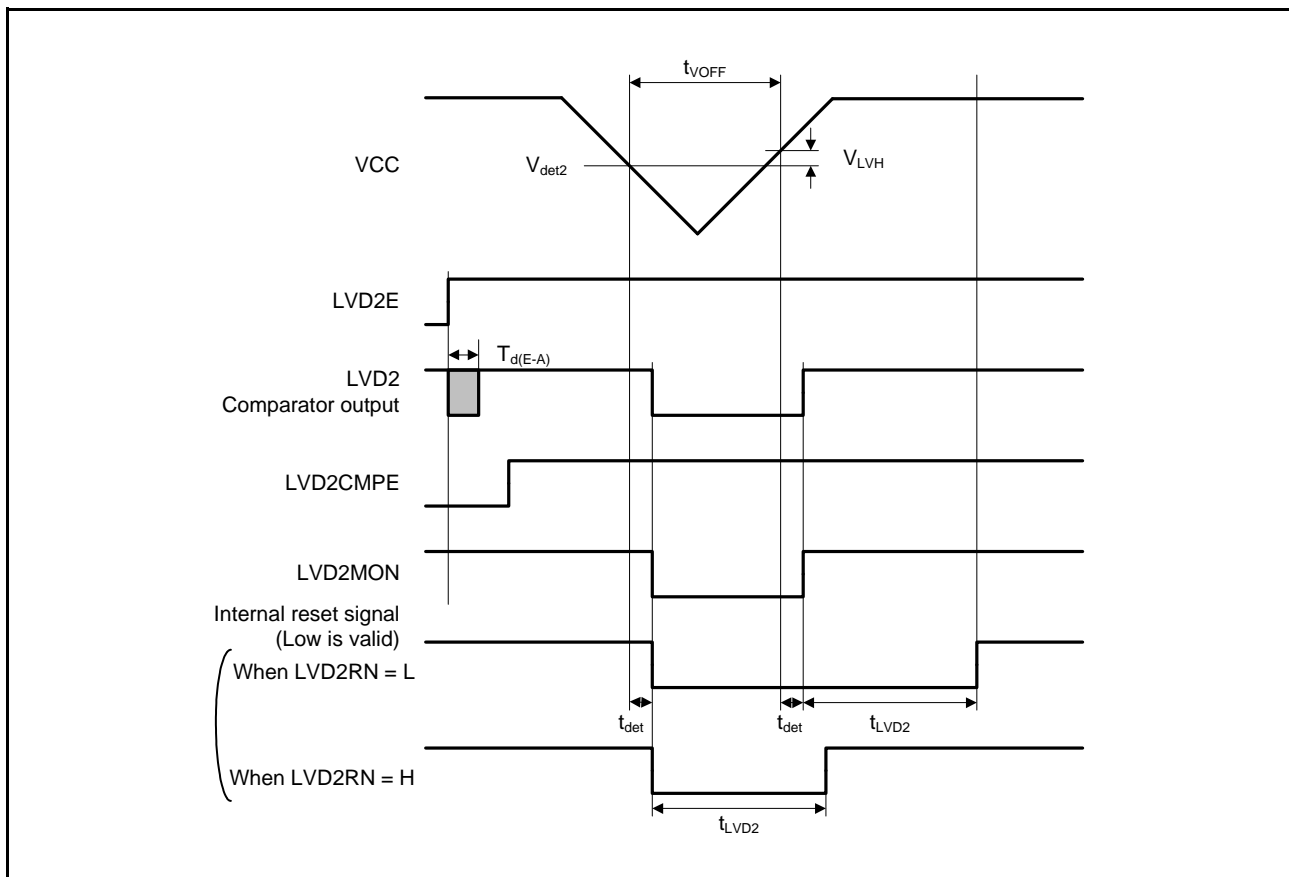


Figure 2.93 Voltage Detection Circuit Timing (V<sub>det2</sub>)

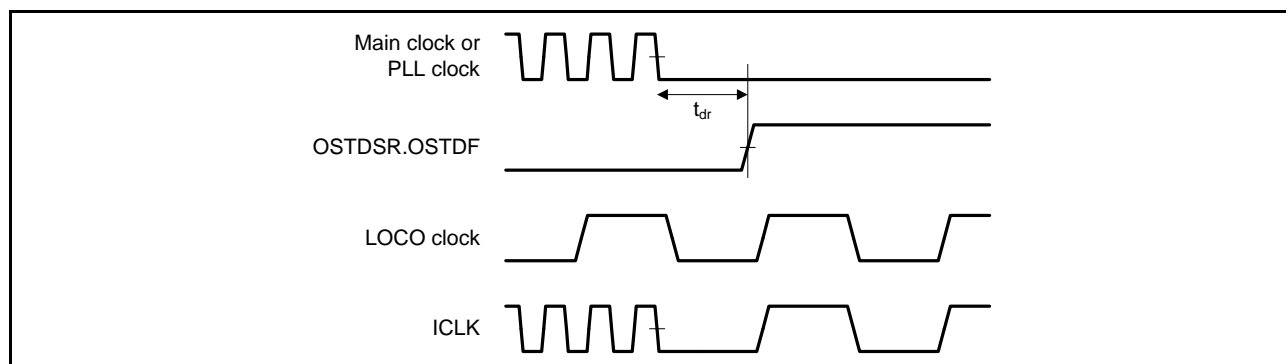


## 2.9 Oscillation Stop Detection Timing

**Table 2.54 Oscillation Stop Detection Circuit Characteristics**

Conditions:  $VCC = AVCC0 = AVCC1 = VCC\_USB = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq VREFH0 \leq AVCC0$ ,  
 $VCC\_USBA = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $VSS = AVSS0 = AVSS1 = VREFL0 = VSS\_USB = VSS1\_USBA = VSS2\_USBA = PVSS\_USBA = AVSS\_USBA = 0$  V,  
 $T_a = T_{opr}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Detection time	$t_{dr}$	—	—	1	ms	Figure 2.94



**Figure 2.94 Oscillation Stop Detection Timing**

### 2.10 Battery Backup Function Characteristics

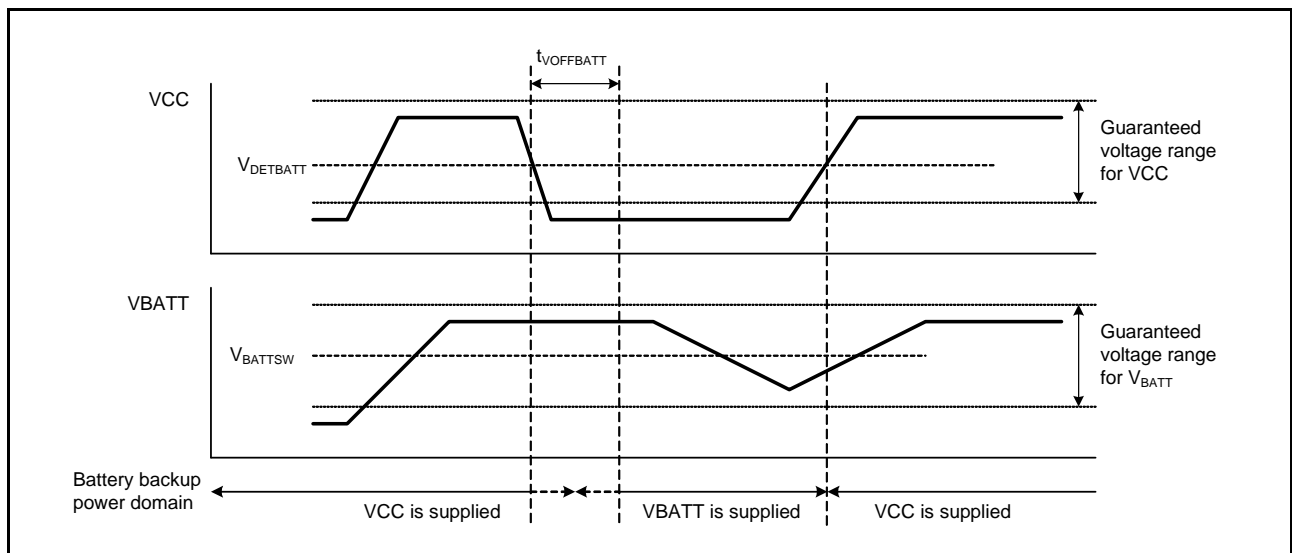
**Table 2.55 Battery Backup Function Characteristics**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $V_{BATT} = 2.0$  to  $3.6$  V,  $T_a = T_{opr}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Voltage level for switching to battery backup	$V_{DET\_BATT}$	2.50	2.60	2.70	V	Figure 2.95
Lower-limit $V_{BATT}$ voltage for power supply switching due to VCC voltage drop*1	$V_{BATT\_SW}$	2.70	—	—		
VCC-off period for starting power supply switching*1	$t_{V\_OFF\_BATT}$	200	—	—	$\mu s$	

Note 1. The  $V_{BATT}$  voltage must not fall below its lower limit  $V_{BATT\_SW}$  when the source of supply is switched to  $V_{BATT}$  from  $V_{CC}$  due to a drop in  $V_{CC}$ .

Note 2. The VCC-off period in switching of the power supply indicates the period from  $V_{CC}$  falling below the minimum value of the battery backup switching threshold voltage ( $V_{DET\_BATT}$ ) until the source of power is switched to  $V_{BATT}$ . If  $V_{CC}$  recovers within this period, the source may not be switched to  $V_{BATT}$  and supply from  $V_{CC}$  is continued instead.



**Figure 2.95 Battery Backup Function Characteristics**

## 2.11 Flash Memory Characteristics

**Table 2.56 Code Flash Memory Characteristics**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V,  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V  
 Temperature range for programming/erasure:  $T_a = T_{opr}$

Item		Symbol	FCLK = 4 MHz			20 MHz ≤ FCLK ≤ 60 MHz			Unit	Test Conditions
			Min.	Typ.	Max.	Min.	Typ.	Max.		
Programming time $N_{PEC} \leq 100$ times	256 bytes	$t_{P256}$	—	0.9	13.2	—	0.4	6	ms	
	8 Kbytes	$t_{P8K}$	—	29	176	—	13	80	ms	
	32 Kbytes	$t_{P32K}$	—	116	704	—	52	320	ms	
Programming time $N_{PEC} > 100$ times	256 bytes	$t_{P256}$	—	1.1	15.8	—	0.5	7.2	ms	
	8 Kbytes	$t_{P8K}$	—	35	212	—	16	96	ms	
	32 Kbytes	$t_{P32K}$	—	140	848	—	64	384	ms	
Erasure time $N_{PEC} \leq 100$ times	8 Kbytes	$t_{E8K}$	—	71	216	—	39	120	ms	
	32 Kbytes	$t_{E32K}$	—	254	864	—	141	480	ms	
Erasure time $N_{PEC} > 100$ times	8 Kbytes	$t_{E8K}$	—	85	260	—	47	144	ms	
	32 Kbytes	$t_{E32K}$	—	304	1040	—	169	576	ms	
Reprogramming/erasure cycle*1	$N_{PEC}$	1000*2	—	—	1000*2	—	—	Times		
Suspend delay time during programming	$t_{SPD}$	—	—	264	—	—	120	$\mu$ s		
First suspend delay time during erasing (in suspend priority mode)	$t_{SESD1}$	—	—	216	—	—	120	$\mu$ s		
Second suspend delay time during erasure (in suspend priority mode)	$t_{SESD2}$	—	—	1.7	—	—	1.7	ms		
Suspend delay time during erasure (in erasure priority mode)	$t_{SEED}$	—	—	1.7	—	—	1.7	ms		
Forced stop command	$t_{FD}$	—	—	32	—	—	20	$\mu$ s		
Data hold time*3, *4	$t_{DRP}$	20	—	—	20	—	—	Year	$T_a \leq 85^\circ\text{C}$	
		10	—	—	10	—	—		$T_a \leq 105^\circ\text{C}$	
FCU reset time	$t_{FCUR}$	35	—	—	35	—	—	$\mu$ s		

Note 1. Definition of reprogram/erase cycle:

The reprogram/erase cycle is the number of erasing for each block. When the reprogram/erase cycle is n times ( $n = 1000$ ), erasing can be performed n times for each block. For instance, when 256-byte programming is performed 32 times for different addresses in 8-Kbyte block and then the entire block is erased, the reprogram/erase cycle is counted as one. However, programming the same address for several times as one erasing is not enabled (overwriting is prohibited).

Note 2. This is the minimum number of times to guarantee all the characteristics after reprogramming (guaranteed range is from 1 to the value of the minimum value).

Note 3. This shows the characteristic when the flash memory writer or self-programming library from Renesas Electronics is in use, and the number of times programming and erasure proceed does not exceed the specified value.

Note 4. These values are based on the results of reliability testing.

**Table 2.57 Data Flash Memory Characteristics**

Conditions:  $V_{CC} = AV_{CC0} = AV_{CC1} = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AV_{CC0}$ ,  
 $V_{CC\_USBA} = AV_{CC\_USBA} = 3.0$  to  $3.6$  V  
 $V_{SS} = AV_{SS0} = AV_{SS1} = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 Temperature range for programming/erasure:  $T_a = T_{opr}$

Item		Symbol	FCLK = 4 MHz			20 MHz ≤ FCLK ≤ 60 MHz			Unit	Test Conditions
			Min.	Typ.	Max.	Min.	Typ.	Max.		
Programming time	4 bytes	$t_{DP4}$	—	0.36	3.8	—	0.16	1.7	ms	
Erasure time	64 bytes	$t_{DE64}$	—	3.1	18	—	1.7	10	ms	
Blank check time	4 bytes	$t_{DBC4}$	—	—	84	—	—	30	μs	
	64 bytes	$t_{DBC64}$	—	—	280	—	—	100	μs	
	2 Kbytes	$t_{DBC2K}$	—	—	6169	—	—	2200	μs	
Reprogramming/erasure cycle*1		$N_{DPEC}$	100000*2	—	—	100000*2	—	—	Times	
Suspend delay time during programming		$t_{DSPD}$	—	—	264	—	—	120	μs	
First suspend delay time during erasure (in suspend priority mode)		$t_{DSESD1}$	—	—	216	—	—	120	μs	
Second suspend delay time during erasure (in suspend priority mode)		$t_{DSESD2}$	—	—	300	—	—	300	μs	
Suspend delay time during erasing (in erasure priority mode)		$t_{DSEED}$	—	—	300	—	—	300	μs	
Forced stop command		$t_{FD}$	—	—	32	—	—	20	μs	
Data hold time*3, *4		$t_{DDRP}$	20	—	—	20	—	—	Year	$T_a \leq 85^\circ\text{C}$
			10	—	—	10	—	—		$T_a \leq 105^\circ\text{C}$

Note 1. Definition of reprogram/erase cycle:

The reprogram/erase cycle is the number of erasing for each block. When the reprogram/erase cycle is n times ( $n = 100000$ ), erasing can be performed n times for each block. For instance, when 4-byte programming is performed 512 times for different addresses in 2-Kbyte block and then the entire block is erased, the reprogram/erase cycle is counted as one. However, programming the same address for several times as one erasing is not enabled (overwriting is prohibited).

Note 2. This is the minimum number of times to guarantee all the characteristics after reprogramming (guaranteed range is from 1 to the value of the minimum value).

Note 3. This shows the characteristic when the flash memory writer or self-programming library from Renesas Electronics is in use, and the number of times programming and erasure proceed does not exceed the specified value.

Note 4. These values are based on the results of reliability testing.

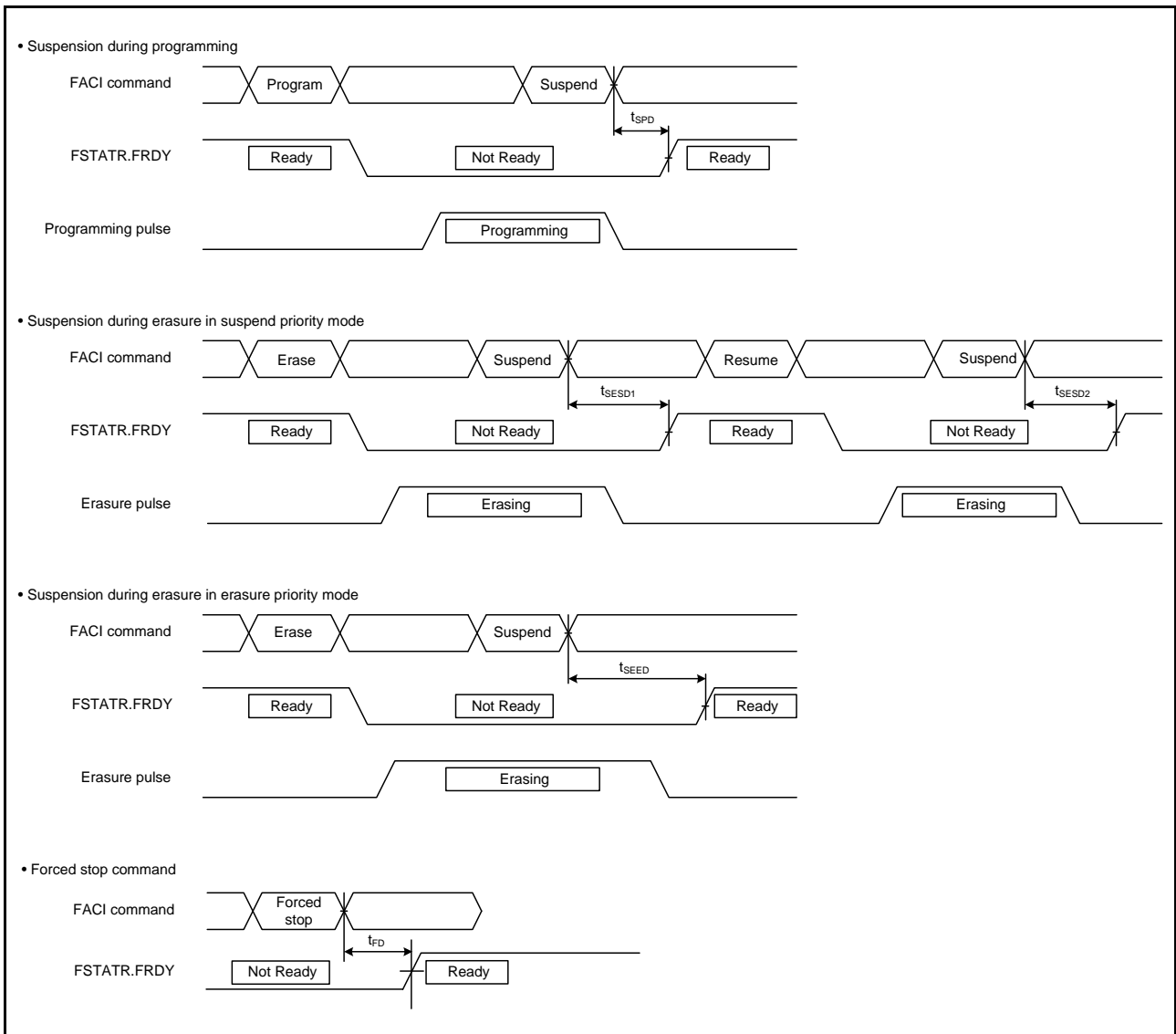


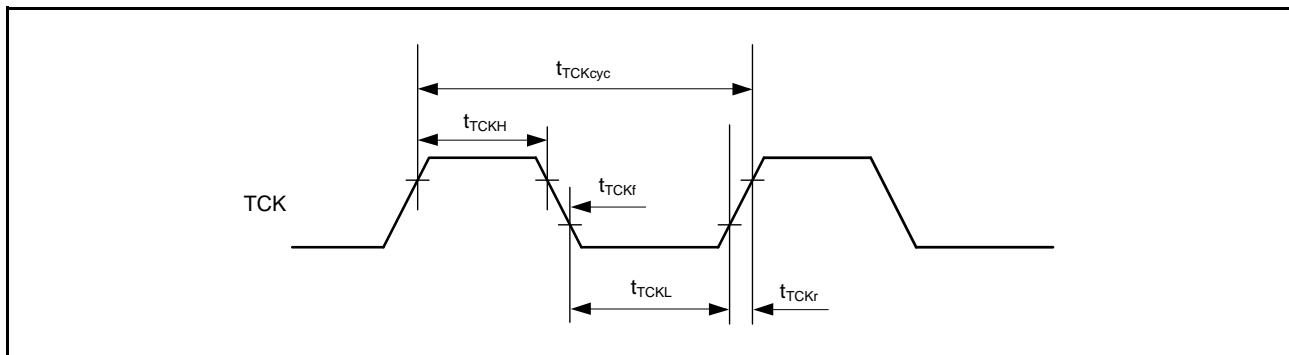
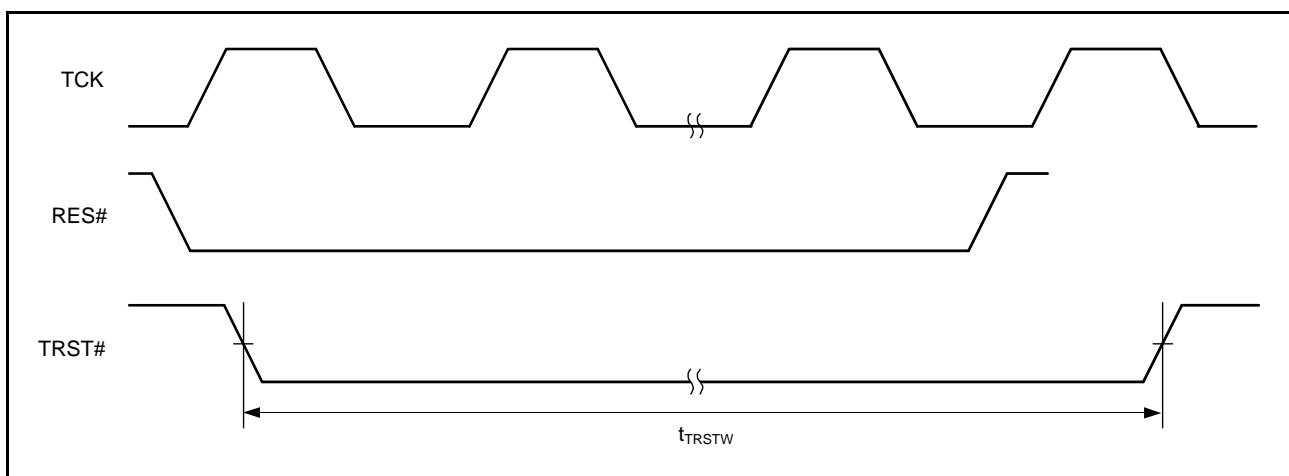
Figure 2.96 Flash Memory Programming/Erasure Suspension Timing

## 2.12 Boundary Scan

**Table 2.58 Boundary Scan Characteristics**

Conditions:  $V_{CC} = AVCC0 = AVCC1 = V_{CC\_USB} = V_{BATT} = 2.7$  to  $3.6$  V,  $2.7 \leq V_{REFH0} \leq AVCC0$ ,  
 $V_{CC\_USBA} = AVCC\_USBA = 3.0$  to  $3.6$  V,  
 $V_{SS} = AVSS0 = AVSS1 = V_{REFL0} = V_{SS\_USB} = V_{SS1\_USBA} = V_{SS2\_USBA} = PV_{SS\_USBA} = AV_{SS\_USBA} = 0$  V,  
 $T_a = T_{opr}$   
 Output load conditions:  $V_{OH} = V_{CC} \times 0.5$ ,  $V_{OL} = V_{CC} \times 0.5$ ,  $C = 30$  pF  
 High-drive output is selected by the driving ability control register.

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
TCK clock cycle time	$t_{TCKcyc}$	100	—	—	ns	Figure 2.97
TCK clock high pulse width	$t_{TCKH}$	45	—	—	ns	
TCK clock low pulse width	$t_{TCKL}$	45	—	—	ns	
TCK clock rise time	$t_{TCKr}$	—	—	5	ns	
TCK clock fall time	$t_{TCKf}$	—	—	5	ns	
TRST# pulse width	$t_{TRSTW}$	20	—	—	$t_{TCKcyc}$	Figure 2.98
TMS setup time	$t_{TMSS}$	20	—	—	ns	Figure 2.99
TMS hold time	$t_{TMSH}$	20	—	—	ns	
TDI setup time	$t_{TDIS}$	20	—	—	ns	
TDI hold time	$t_{TDIH}$	20	—	—	ns	
TDO data delay time	$t_{TDOD}$	—	—	40	ns	

**Figure 2.97 Boundary Scan TCK Timing****Figure 2.98 Boundary Scan TRST# Timing**

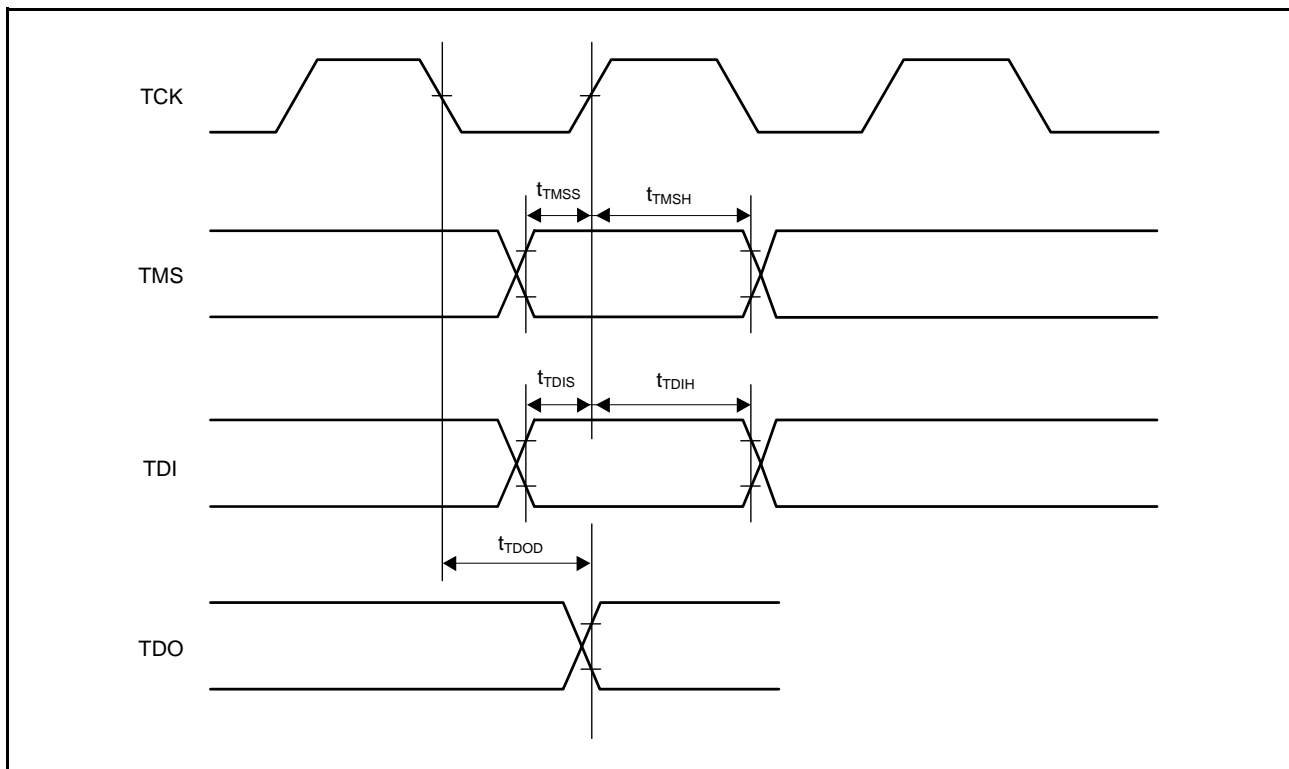


Figure 2.99 Boundary Scan Input/Output Timing

## Appendix 1. Package Dimensions

Information on the latest version of the package dimensions or mountings has been displayed in “Packages” on Renesas Electronics Corporation website.

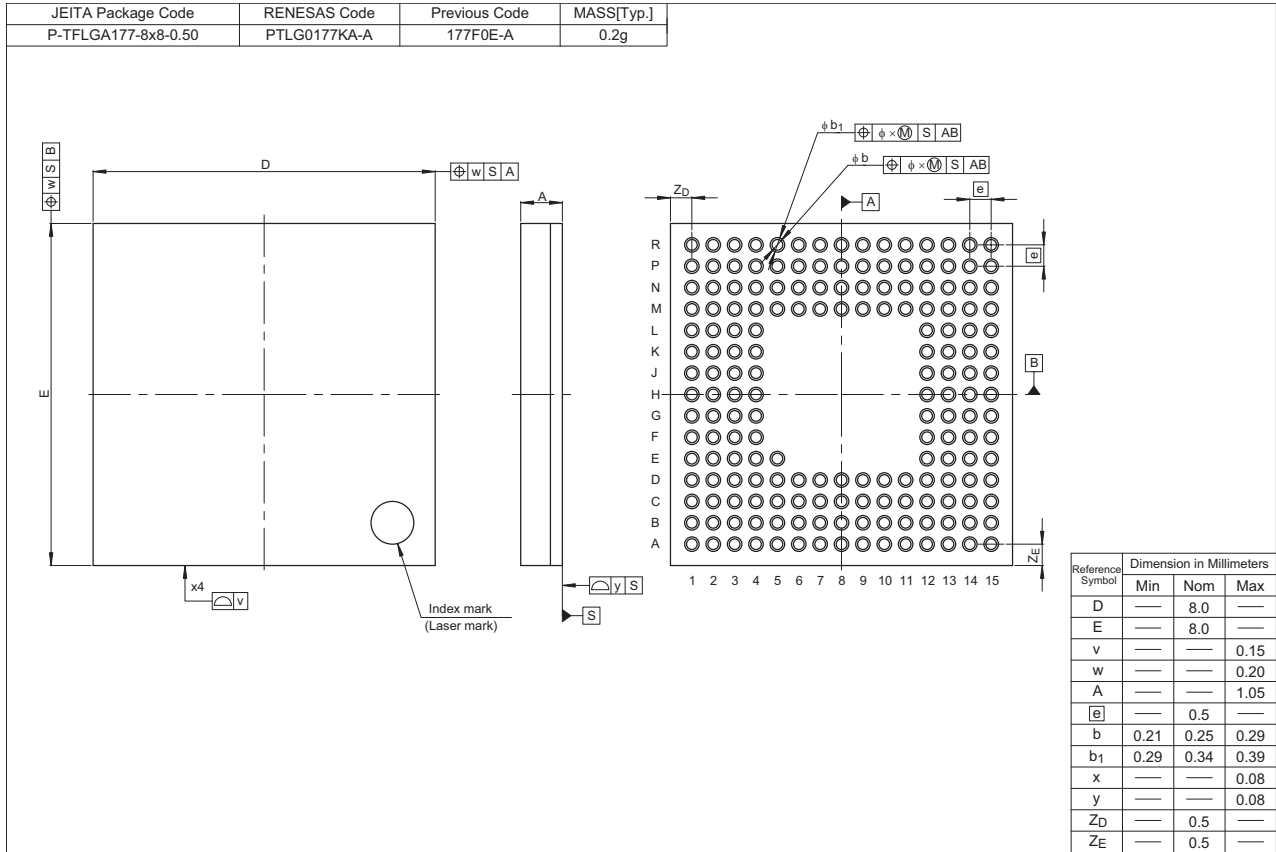


Figure A 177-Pin TFLGA (PTLG0177KA-A)



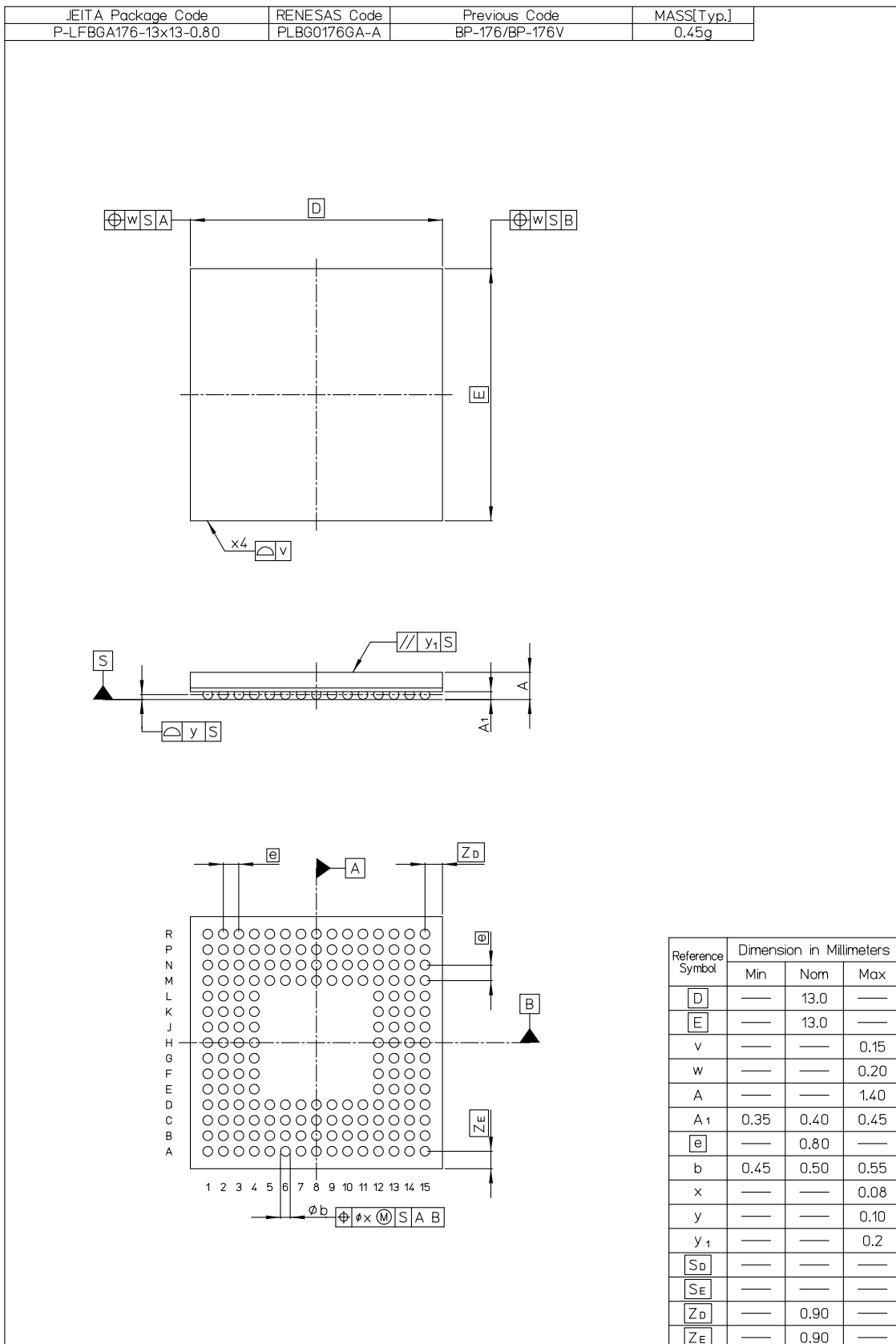


Figure B 176-Pin LFBGA (PLBG0176GA-A)

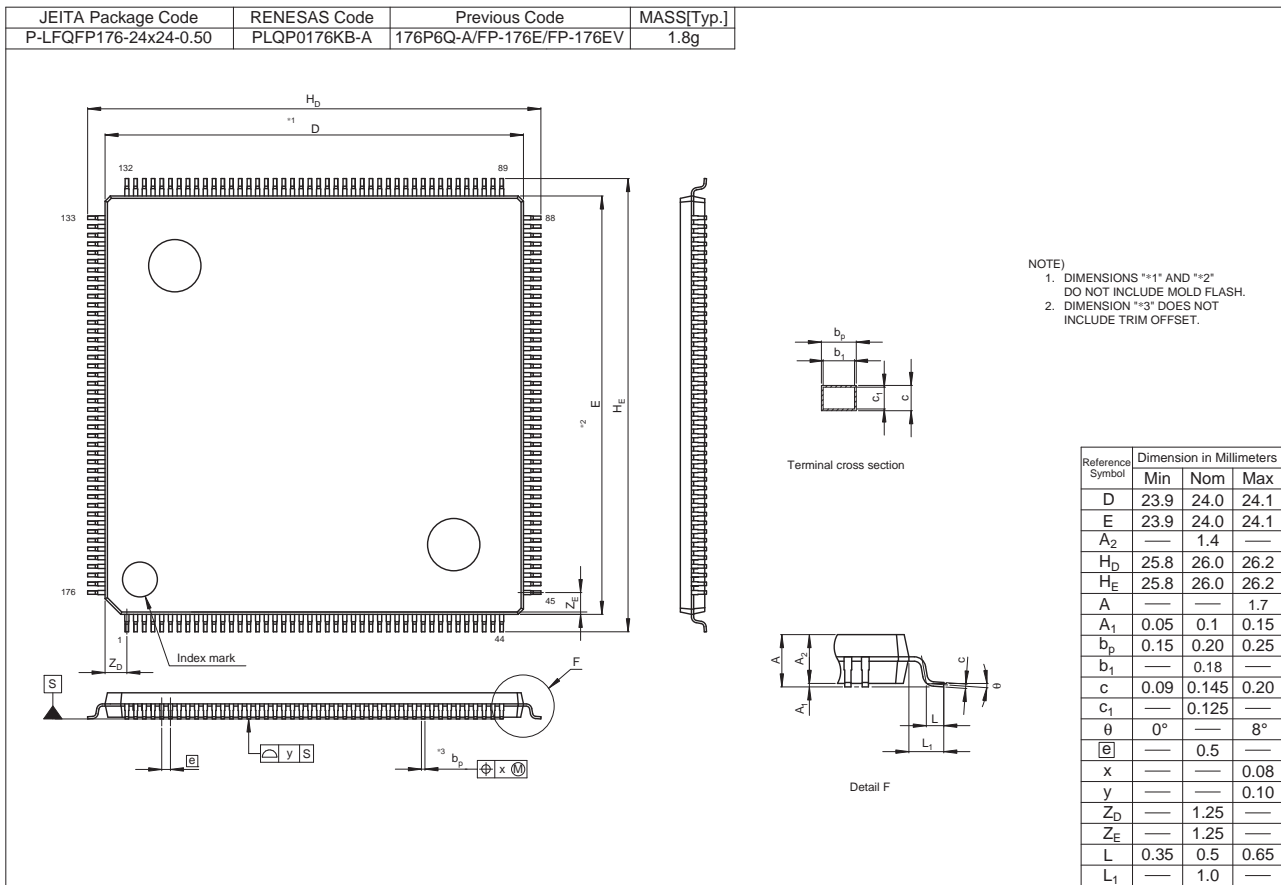


Figure C 176-Pin LFQFP (PLQP0176KB-A)

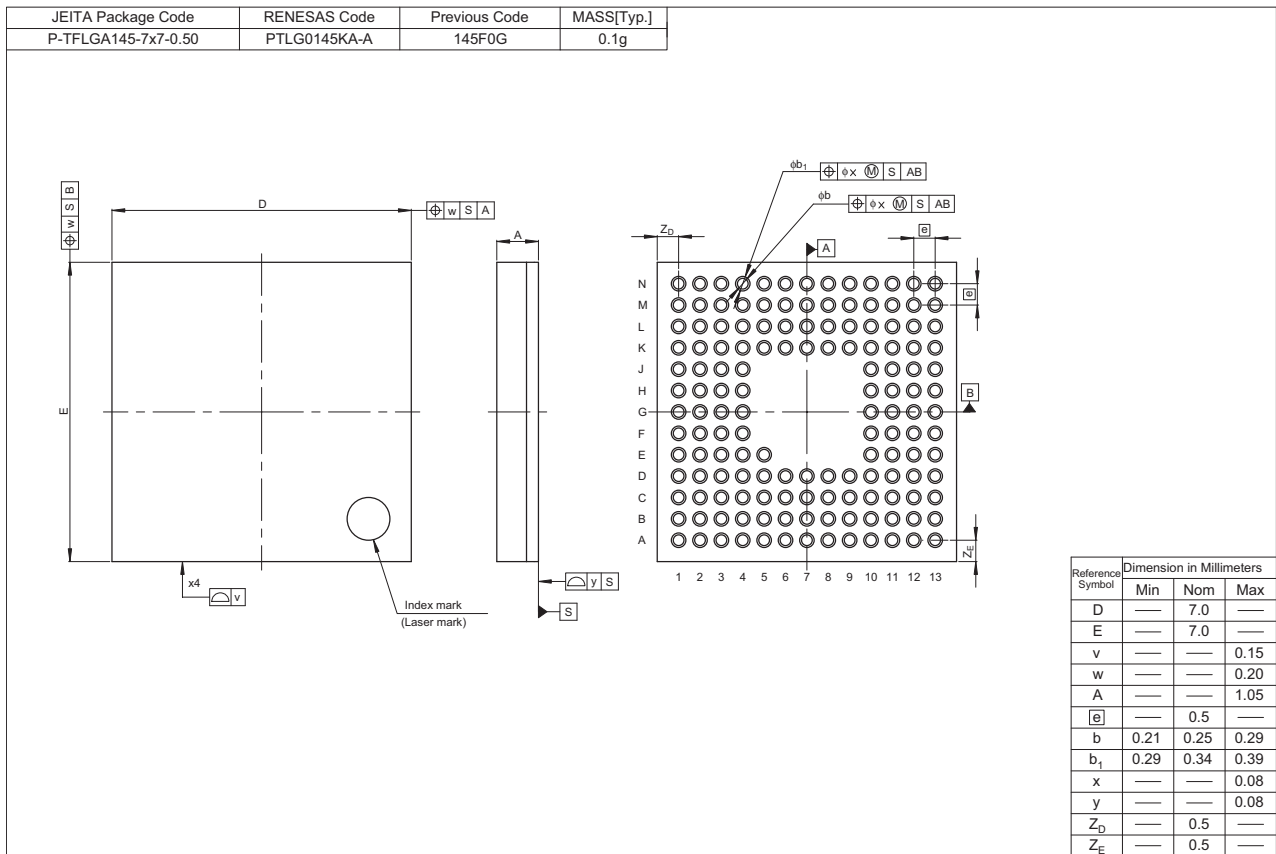


Figure D 145-Pin TFLGA (PTLG0145KA-A)

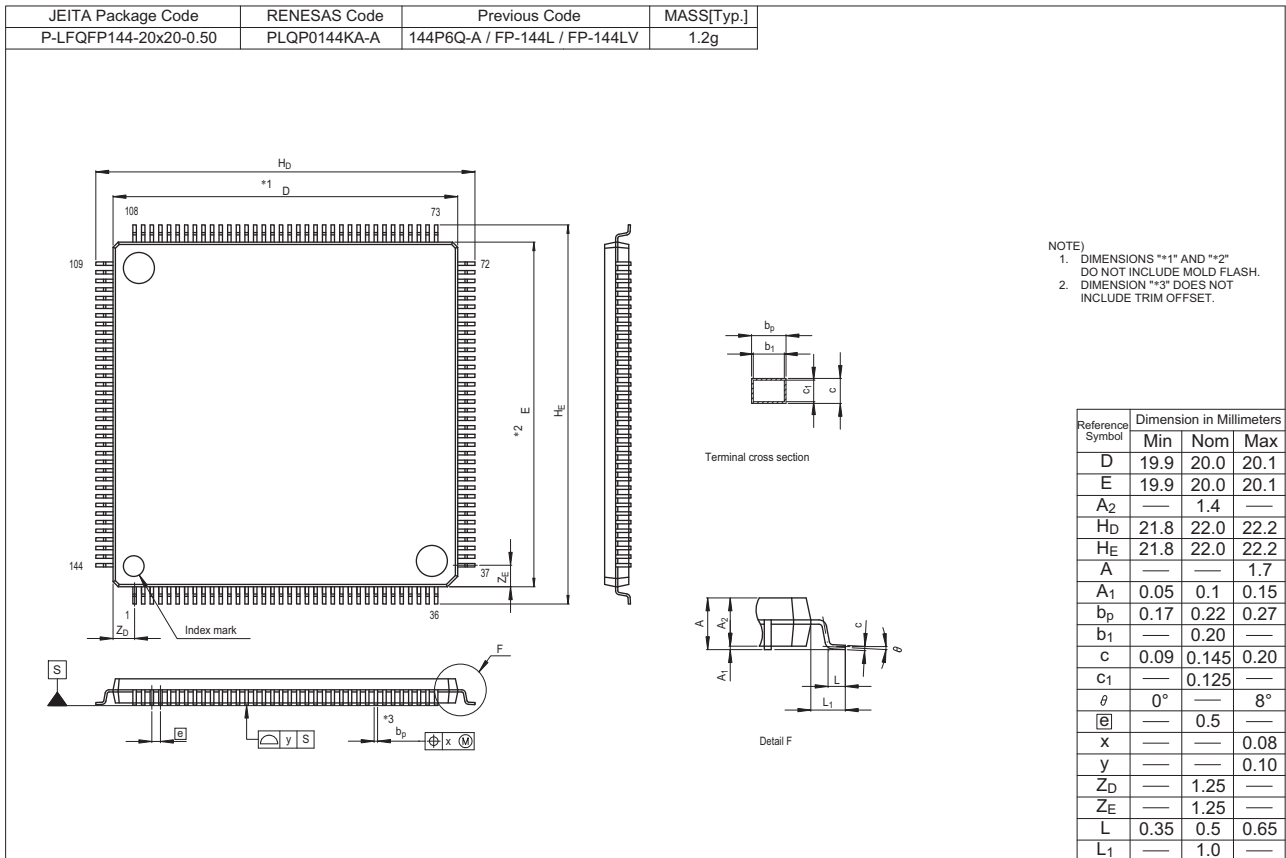


Figure E 144-Pin LFQFP (PLQP0144KA-A)

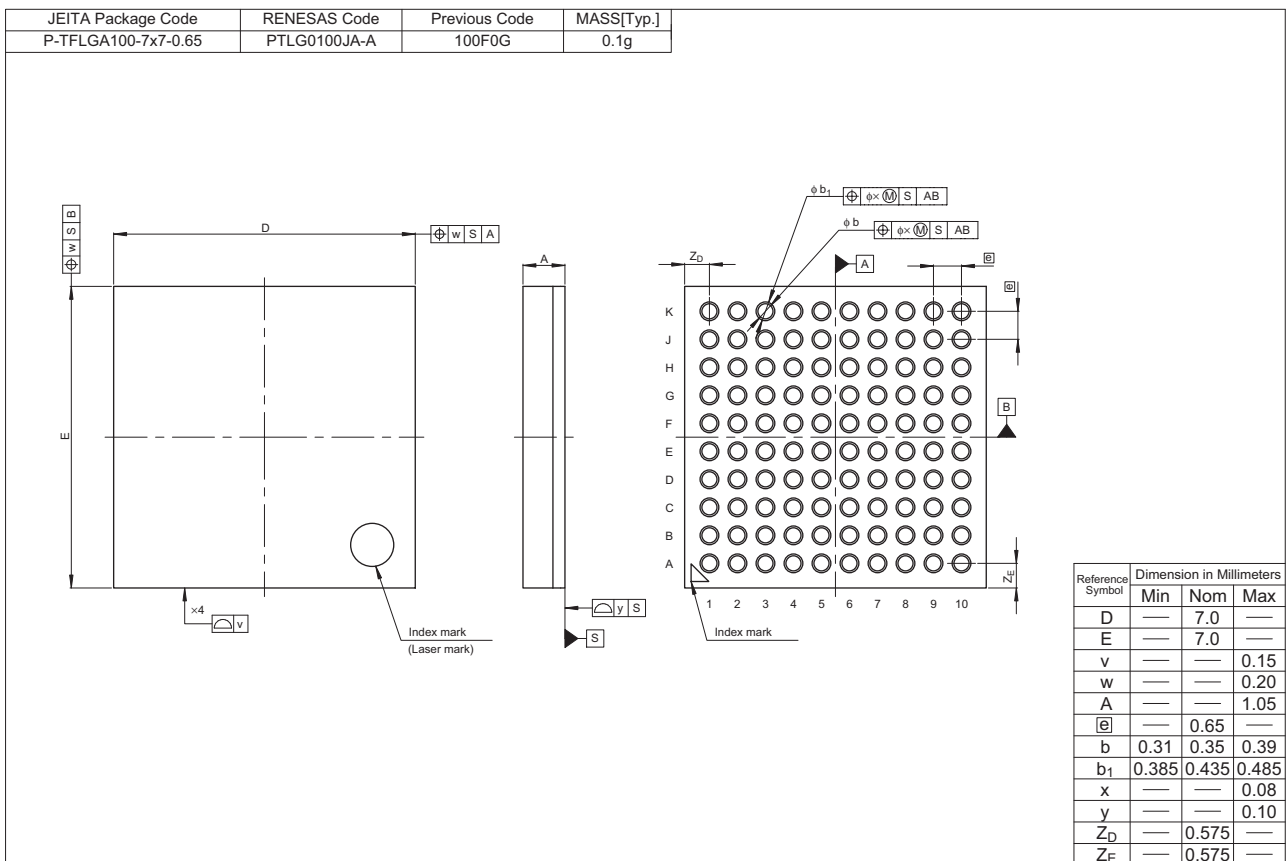


Figure F 100-Pin TFLGA (PTLG0100JA-A)

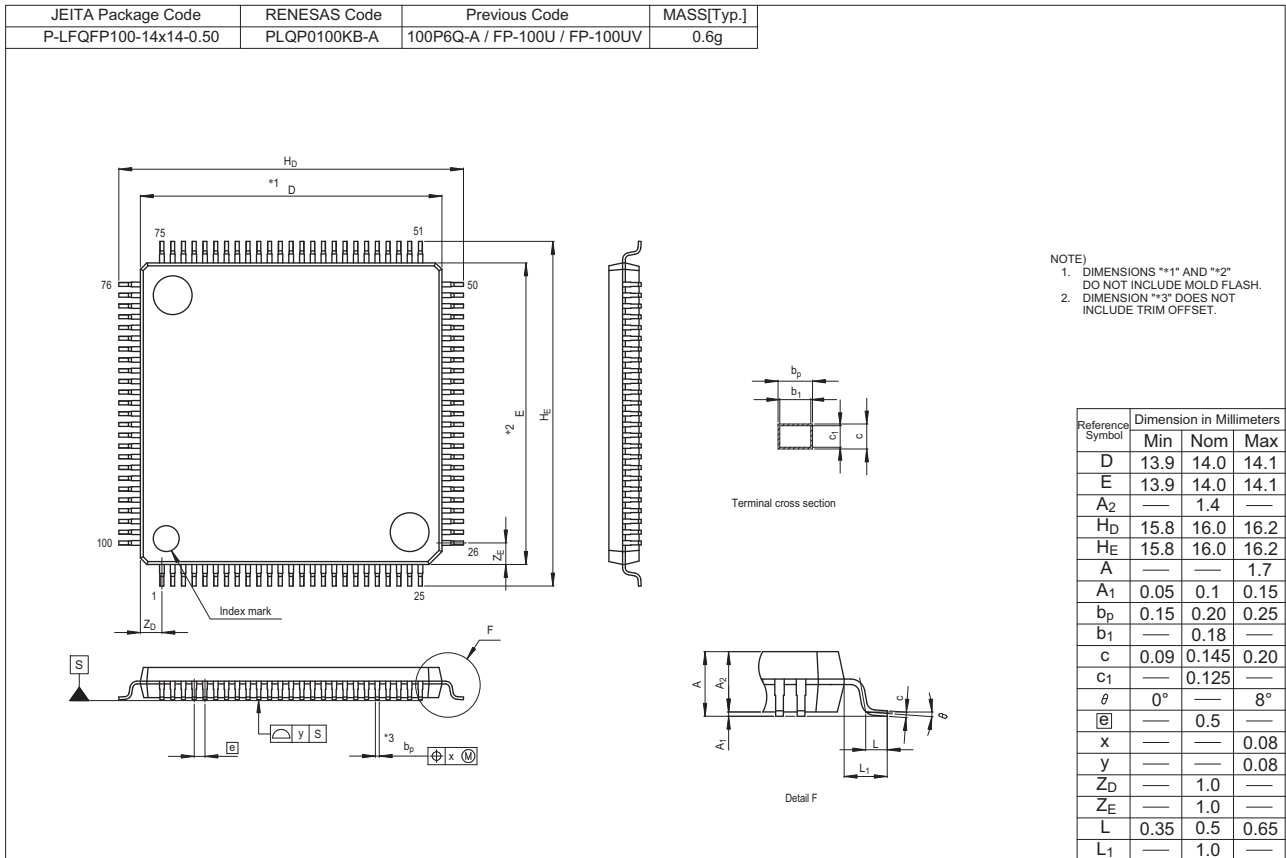


Figure G 100-Pin LFQFP (PLQP0100KB-A)

REVISION HISTORY	RX64M Group Datasheet
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Rev.	Date	Description	
		Page	Summary
0.90	Feb 28, 2014	—	First edition, issued
1.00	Jul 31, 2014	Summary	
		1	■ Data transfer, changed
		1. Overview	
		—	FINEC (Pin), deleted
		2	Table 1.1 Outline of Specifications (1/9), changed
		3	Table 1.1 Outline of Specifications (2/9), changed
		6	Table 1.1 Outline of Specifications (5/9), changed
		7	Table 1.1 Outline of Specifications (6/9), changed
		8	Table 1.1 Outline of Specifications (7/9), changed
		9	Table 1.1 Outline of Specifications (8/9), changed
		10	Table 1.1 Outline of Specifications (9/9), changed
		16	Figure 1.1 How to Read the Product Part Number, changed
		19	Table 1.4 Pin Functions (2/8), changed
		20	Table 1.4 Pin Functions (3/8), changed
		25	Table 1.4 Pin Functions (8/8), note added
		2. CPU, added	
		3. Address Space, added	
		4. I/O Registers, added	
		5. Electrical Characteristics, added	
		Appendix 1. Package Dimensions, added	

#### Classifications

- Items with Technical Update document number: Changes according to the corresponding issued Technical Update
- Items without Technical Update document number: Minor changes that do not require Technical Update to be issued

Rev.	Date	Description		Classification
		Page	Summary	
1.10	Oct 24, 2016	All	Terms unified: GPTa → GPTA LQFP → LFQFP	
		Features		
		1	AES key lengths, changed	TN-RX*-A122A/E
		1. Overview		
		2	Table 1.1 Outline of Specifications (1/9), changed	TN-RX*-A127A/E
		5	Table 1.1 Outline of Specifications (4/9), changed	
		10	Table 1.1 Outline of Specifications (9/9), changed	TN-RX*-A122A/E
		28	Figure 1.5 Pin Assignment (176-Pin LFQFP), changed	
		48	Table 1.7 List of Pin and Pin Functions (145-Pin TFLGA) (2/5), changed	
		49	Table 1.7 List of Pin and Pin Functions (145-Pin TFLGA) (3/5), changed	
		52	Table 1.8 List of Pin and Pin Functions (144-Pin LFQFP) (1/5), changed	
		55	Table 1.8 List of Pin and Pin Functions (144-Pin LFQFP) (4/5), changed	
		58	Table 1.9 List of Pin and Pin Functions (100-Pin TFLGA) (2/4), changed	
		59	Table 1.9 List of Pin and Pin Functions (100-Pin TFLGA) (3/4), changed	
		63	Table 1.10 List of Pin and Pin Functions (100-Pin LFQFP) (3/4), changed	
		4. I/O Registers		
		71	(4) Notes on Sleep Mode and Mode Transitions, added	
		73	Table 4.1 List of I/O Registers (Address Order) (2 / 67) 0008 1200h, 0008 1201h, 0008 1204h, 0008 1208h, added	TN-RX*-A127A/E

Rev.	Date	Description		Classification	
		Page	Summary		
1.10	Oct 24, 2016	108	Table 4.1 List of I/O Registers (Address Order) (37 / 67) 0008 C296h, added		
		110	Table 4.1 List of I/O Registers (Address Order) (39 / 67), changed	TN-RX*-A152A/E	
		111	Table 4.1 List of I/O Registers (Address Order) (40 / 67), changed		
		112	Table 4.1 List of I/O Registers (Address Order) (41 / 67), changed		
		119	Table 4.1 List of I/O Registers (Address Order) (48 / 67) 000C 0438h, 000C 046Ch, deleted		
		132, 133	Table 4.1 List of I/O Registers (Address Order) (61 / 67), (62 / 67), changed		
		138	Table 4.1 List of I/O Registers (Address Order), Note 6 added	TN-RX*-A152A/E	
		5. Electrical Characteristics			
		139	Table 5.1 Absolute Maximum Rating, changed	TN-RX*-A160A/E	
		140	Table 5.2 DC Characteristics (1), changed	TN-RX*-A159A/E TN-RX*-A160A/E	
		141	Table 5.3 DC Characteristics (2), changed	TN-RX*-A159A/E	
		183	Figure 5.48 RSPI Timing (Master, CPHA = 0) (Bit Rate: PCLKB Division Ratio Set to 1/2), changed		
		206	Table 5.49 Temperature Sensor Characteristics, changed	TN-RX*-A159A/E	
		212	Figure 5.84 Battery Backup Function Characteristics, changed		
		213	Table 5.53 Code Flash Memory Characteristics, changed	TN-RX*-A146A/E	
		214	Table 5.54 Data Flash Memory Characteristics, changed		
1.20	Oct 20, 2022	All	G-version products added	TN-RX*-A142A/E	
		Features			
		1	Operating temp. rangeh, changed		
		1. Overview			
		3	Table 1.1 Outline of Specifications (2/9), changed		
		10	Table 1.1 Outline of Specifications (9/9), changed		
		16	Table 1.3 List of Products (4/4), changed		
		17	Figure 1.1 How to Read the Product Part Number, changed		
		24	Table 1.4 Pin Functions (6/8), changed		
		2. Electrical Characteristics			
		66	Table 2.1 Absolute Maximum Rating, changed		
		66	Table 2.2 Recommended Operating Conditions, added		
		68	Table 2.4 DC Characteristics (2), changed		
		69, 70	Table 2.5 DC Characteristics (3), changed		
		71	Table 2.6 DC Characteristics (4), changed		
		72	Table 2.7 Thermal Resistances (Reference), added		
		78	Table 2.16 LOCO and IWDT-Dedicated Low-Speed Clock Timing, changed		
		146	Table 2.55 Battery Backup Function Characteristics, changed		
		147	Table 2.56 Code Flash Memory Characteristics, changed		
		149	Figure 2.96 Flash Memory Programming/Erase Suspension Timing, changed		



## General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

### 1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

### 2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

### 3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

### 4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

### 5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

### 6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.).

### 7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

### 8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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[R5F564MFDDFC#31](#) [R5F564MLCDFP#31](#) [R5F564MJCDFP#31](#) [R5F564MJCDFB#31](#) [R5F564MLCDFC#31](#)  
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