S6E1C3 Series

32-bit ARM® Cortex®-M0+ FM0+ Microcontroller

The S6E1C3 Series is a series of highly integrated 32-bit microcontrollers designed for embedded controllers aiming at low power consumption and low cost. This series has the ARM Cortex-M0+ Processor with on-chip Flash memory and SRAM, and consists of peripheral functions such as various timers, ADC and communication interfaces (UART, CSIO (SPI), I^2C, I^2S, Smart Card, and USB). The products which are described in this data sheet are placed into TYPE3-M0+ product categories in "FM0+ Family Peripheral Manual".

Features

32-bit ARM Cortex-M0+ Core

- Processor version: r0p1
- Maximum operating frequency: 40.8 MHz
- Nested Vectored Interrupt Controller (NVIC): 1 NMI (non-maskable interrupt) and 24 peripheral interrupt with 4 selectable interrupt priority levels
- 24-bit System timer (Sys Tick): System timer for OS task management

Bit Band Operation

Compatible with Cortex-M3 bit band operation.

On-Chip Memory

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

The on-chip SRAM of this series has one independent SRAM .

  - Up to 16 Kbytes
  - 4Kbytes: can retain value in Deep standby Mode

USB Interface

USB interface is composed of Device and Host
With Main PLL, USB clock can be generated by multiplication of Main clock.

- USB Device
  - USB 2.0 Full-Speed supported
  - Max 6 EndPoint supported
    - EndPoint 0 is control transfer
    - EndPoint 1, 2 can be selected Bulk-transfer, Interrupt-transfer or Isochronous-transfer
    - EndPoint 3 to 5 can select Bulk-transfer or Interrupt-transfer
    - EndPoint 1 to 5 comprise Double Buffer
    - The size of each EndPoint is according to the follows
    - EndPoint 0, 2 to 5 : 64 bytes
    - EndPoint 1 : 256 bytes
  - Bulk-transfer, Interrupt-transfer and Isochronous-transfer support
  - USB Device connected/disconnected automatically detect
  - IN/OUT token handshake packet automatically
  - Max 256-byte packet-length supported
  - Wake-up function supported
- USB host
  - USB 2.0 Full/Low-Speed supported

Multi-Function Serial Interface (Max 6channels)

- 3 channels with 64Byte FIFO (Ch.4, 6 and 7), 3 channels without FIFO (Ch.0, 1 and 3)
- The operation mode of each channel can be selected from one of the following.
  - UART
  - CSIO (CSIO is known to many customers as SPI)
  - I^2C
- UART
  - Full duplex double buffer
  - Parity can be enabled or disabled.
  - Built-in dedicated baud rate generator
  - External clock available as a serial clock
  - Hardware Flow control* : Automatically control the transmission by CTS/RTS (only ch.4)
    * : S6E1C32B0A/S6E1C31B0A and S6E1C32C0A/S6E1C31C0A do not support Hardware Flow control.
  - Various error detection functions (parity errors, framing errors, and overrun errors)
- CSIO (also known as SPI)
  - Full duplex double buffer
  - Built-in dedicated baud rate generator
  - Overrun error detection function
  - Serial chip select function (ch1 and ch6 only)
  - Data length: 5 to 16 bits
- I^2C
  - Standard-mode (Max: 100 kbps) supported / Fast-mode (Max 400 kbps) supported.
- I^2S (MFS-I2S)
  - Using CSIO (Max 2 ch: ch.4, ch.6) and I^2S clock generator
  - Supports two transfer protocol
    - I^2S
    - MSB-justified
  - Master mode only

I2C Slave

- I2C Slave supports the slave function of I2C and wake-up function from Standby mode.

Descriptor System Data Transfer Controller (DSTC) (64 Channels)

- The DSTC can transfer data at high-speed without going via the CPU. The DSTC adopts the Descriptor system and, following the specified contents of the Descriptor that has already been constructed on the memory, can access directly the memory / peripheral device and performs the data transfer operation.
- It supports the software activation, the hardware activation, and the chain activation functions

A/D Converter (Max: 8 Channels)

- 12-bit A/D Converter
  - Successive approximation type
  - Conversion time: 2.0 µs @ 2.7 V to 3.6 V
  - Priority conversion available (2 levels of priority)
  - Scan conversion mode
  - Built-in FIFO for conversion data storage (for scan conversion: 16 steps, for priority conversion: 4 steps)

Base Timer (Max: 8 Channels)

The operation mode of each channel can be selected from one of the following.

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

General-Purpose I/O Port

This series can use its pin as a general-purpose I/O port when it is not used for an external bus or a peripheral function. All ports can be set to fast general-purpose I/O ports or slow general-purpose I/O ports. In addition, this series has a port relocate function that can set to which I/O port a peripheral function can be allocated.

- All ports are Fast GPIO which can be accessed by 1cycle
- Capable of controlling the pull-up of each pin
- Capable of reading pin level directly
- Port relocate function
- Up to 54 fast general-purpose I/O ports @64-pin package
- Certain ports are 5 V tolerant.
  See 4.List of Pin Functions and 5.I/O Circuit Typefor the corresponding pins.

Dual Timer (32-/16-bit Down Counter)

The Dual Timer consists of two programmable 32-/16-bit down counters. The operation mode of each timer channel can be selected from one of the following.

- Free-running mode
- Periodic mode (= Reload mode)
- One-shot mode

Real-Time Clock

The Real-time Clock counts year/month/day/hour/minute/second/day of the week from year 00 to year 99.

- The RTC can generate an interrupt at a specific time (year/month/day/hour/minute/second/day of the week) and can also generate an interrupt in a specific year, in a specific month, on a specific day, at a specific hour or at a specific minute.
- It has a timer interrupt function generating an interrupt upon a specific time or at specific intervals.
- It can keep counting while rewriting the time.
- It can count leap years automatically.

Watch Counter

The Watch Counter wakes up the microcontroller from the low power consumption mode. The clock source can be selected from the main clock, the sub clock, the built-in high-speed CR clock or the built-in low-speed CR clock.

Interval timer: up to 64 s (sub clock: 32.768 kHz)

External Interrupt Controller Unit

- Up to 12 external interrupt input pins
- Non-maskable interrupt (NMI) input pin: 1

Watchdog Timer (2 Channels)

The watchdog timer generates an interrupt or a reset when the counter reaches a time-out value.

This series consists of two different watchdogs, hardware watchdog and software watchdog.

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

CRC (Cyclic Redundancy Check) Accelerator

The CRC accelerator calculates the CRC which has a heavy software processing load, and achieves a reduction of the integrity check processing load for reception data and storage.

- CCITT CRC16 and IEEE-802.3 CRC32 are supported.
  - CCITT CRC16 Generator Polynomial: 0x1021
  - IEEE-802.3 CRC32 Generator Polynomial: 0x04C11DB7

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

- HDMI-CEC transmitter
  - Header block automatic transmission by judging Signal free
  - Generating status interrupt by detecting Arbitration lost

- Generating START, EOM, ACK automatically to output CEC transmission by setting 1 byte data
- Generating transmission status interrupt when transmitting 1 block (1 byte data and EOM/ACK)

■ HDMI-CEC receiver
- Automatic ACK reply function available
- Line error detection function available

■ Remote control receiver
- 4 bytes reception buffer
- Repeat code detection function available

Smart Card Interface (Max 1 Channel)

■ Compliant with ISO7816-3 specification

■ Card Reader only/B class card only

■ Available protocols
- Transmitter: 8E2, 8O2, 8N2
- Receiver: 8E1, 8O1, 8N2, 8N1, 9N1
- Inverse mode

■ TX/RX FIFO integrated (RX: 16-bytes, TX:16-bytes)

Clock and Reset

■ Clocks

A clock can be selected from five clock sources (two external oscillators, two built-in CR oscillator, and main PLL).

Main clock:	8 MHz to 48 MHz
Sub clock:	32.768 kHz
Built-in high-speed CR clock:	8 MHz
Built-in low-speed CR clock:	100 kHz
Main PLL clock	8MHz to 16MHz (Input), 75MHz to 150MHz (Output)

■ Resets
- Reset request from the INITX pin
- Power on reset
- Software reset
- Watchdog timer reset
- Low-voltage detection reset
- Clock supervisor reset

Clock Supervisor (CSV)

The Clock Supervisor monitors the failure of external clocks with a clock generated by a built-in CR oscillator.

■ If an external clock failure (clock stop) is detected, a reset is asserted.

■ If an external frequency anomaly is detected, an interrupt or a reset is asserted.

Low-Voltage Detector (LVD)

This series monitors the voltage on the VCC pin with a 2-stage mechanism. When the voltage falls below a designated voltage, the Low-voltage Detector generates an interrupt or a reset.

■ LVD1: monitor V_{CC} and error reporting via an interrupt

■ LVD2: auto-reset operation

Low Power Consumption Mode

This series has six low power consumption modes.

■ Sleep

■ Timer

■ RTC

■ Stop

■ Deep standby RTC (selectable between keeping the value of RAM and not)

■ Deep standby Stop (selectable between keeping the value of RAM and not)

Peripheral Clock Gating

The system can reduce the current consumption of the total system with gating the operation clocks of peripheral functions not used.

Debug

■ Serial Wire Debug Port (SW-DP)

■ Micro Trace Buffer (MTB)

Unique ID

A 41-bit unique value of the device has been set.

Power Supply

■ Wide voltage range:
VCC = 1.65V to 3.6 V
VCC = 3.0V to 3.6V (when USB is used)

Table of Contents

1. Product Lineup

Memory Size

Product name	S6E1C31B0A/ S6E1C31C0A/ S6E1C31D0A	S6E1C32B0A/ S6E1C32C0A/ S6E1C32D0A
On-chip Flash memory	64 Kbytes	128 Kbytes
On-chip SRAM	12 Kbytes	16 Kbytes

Function

Product name		S6E1C32B0A (WLCSP)	S6E1C32B0A/ S6E1C31B0A	S6E1C32C0A/ S6E1C32C0A	S6E1C31D0A/ S6E1C32D0A
Pin count		TBD	32	48	64
CPU		Cortex-M0+			
	Frequency	40.8 MHz			
Power supply voltage range		1.65 V to 3.6 V			
USB2.0 (Device/Host)		1 unit			
DSTC		64 ch.			
Multi-function Serial Interface (UART/CSIO/I^{2}C/I2S)		2 ch. (Max) Ch.0/3 without FIFO	4 ch. (Max) Ch.0/1/3 without FIFO Ch. 6 with FIFO	6 ch. (Max) Ch.0/1/3 without FIFO Ch.4/6/7 with FIFO	6 ch. (Max) Ch.0/1/3 without FIFO Ch.4/6/7 with FIFO
		I2S : No		I2S : 1 ch (Max) Ch. 6 with FIFO	I2S : 2 ch (Max) Ch. 4/6 with FIFO
Base Timer (PWC/Reload timer/PWM/PPG)		8 ch. (Max)			
Dual Timer		1 unit			
HDMI-CEC/ Remote Control Receiver		1 ch.(Max) Ch.1		2 ch (Max) Ch.0/1	
I2C Slave		No	1 ch (Max)		
Smart Card Interface		No			1 ch (Max)
Real-time Clock		1 unit			
Watch Counter		1 unit			
CRC Accelerator		Yes			
Watchdog timer		1 ch. (SW) + 1 ch. (HW)			
External Interrupt		5 pins (Max), NMI × 1	7 pins (Max), NMI x 1	9 pins (Max), NMI x 1	12 pins (Max), NMI x 1
I/O port		20 pins (Max)	24 pins (Max)	38 pins (Max)	54 pins (Max)
12-bit A/D converter		4 ch (1 unit)	6 ch. (1 unit)	8 ch. (1 unit)	8 ch. (1 unit)
CSV (Clock Supervisor)		Yes			
LVD (Low-voltage Detection)		2 ch.			
Built-in CR	High-speed	8 MHz (Typ)			
	Low-speed	100 kHz (Typ)			
Debug Function		SW-DP			
Unique ID		Yes			

Note:

- *All signals of the peripheral function in each product cannot be allocated by limiting the pins of package. It is necessary to use the port relocate function of the I/O port according to your function use.*
  See "11. Electrical Characteristics 11.4 AC Characteristics 11.4.3 Built-in CR Oscillation Characteristics" for accuracy of built-in CR.

2. Packages

Package \ Product name	S6E1C32B0A (WLCSP)	S6E1C32B0A/ S6E1C31B0A	S6E1C32C0A/ S6E1C31C0A	S6E1C32D0A/ S6E1C31D0A
WLCSP (TBD)	❍		-	-
LQFP: LQB032 (0.80 mm pitch)	-	❍	-	-
QFN: WNU032 (0.50 mm pitch)		❍		
LQFP: LQA048-02 (0.50 mm pitch)	-	-	❍	-
QFN: WNY048 (0.50 mm pitch)	-	-	❍	-
LQFP: LQD064-02 (0.50 mm pitch)	-	-	-	❍
QFN: WNS064 (0.50 mm pitch)	-	-	-	❍

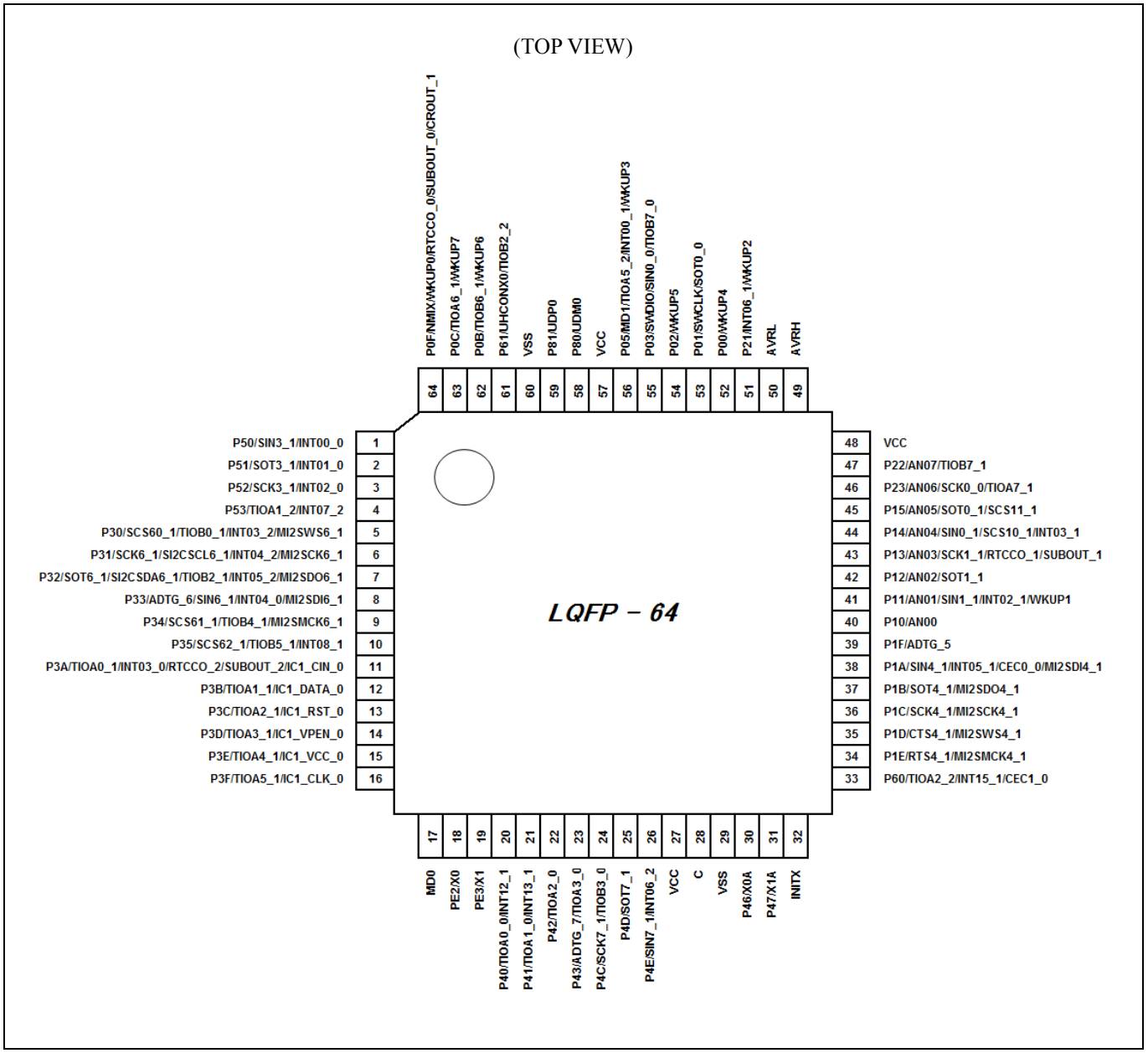
❍: Available

Note:

- *See "13. Package Dimensions" for detailed information on each package.*

3. Pin Assignment

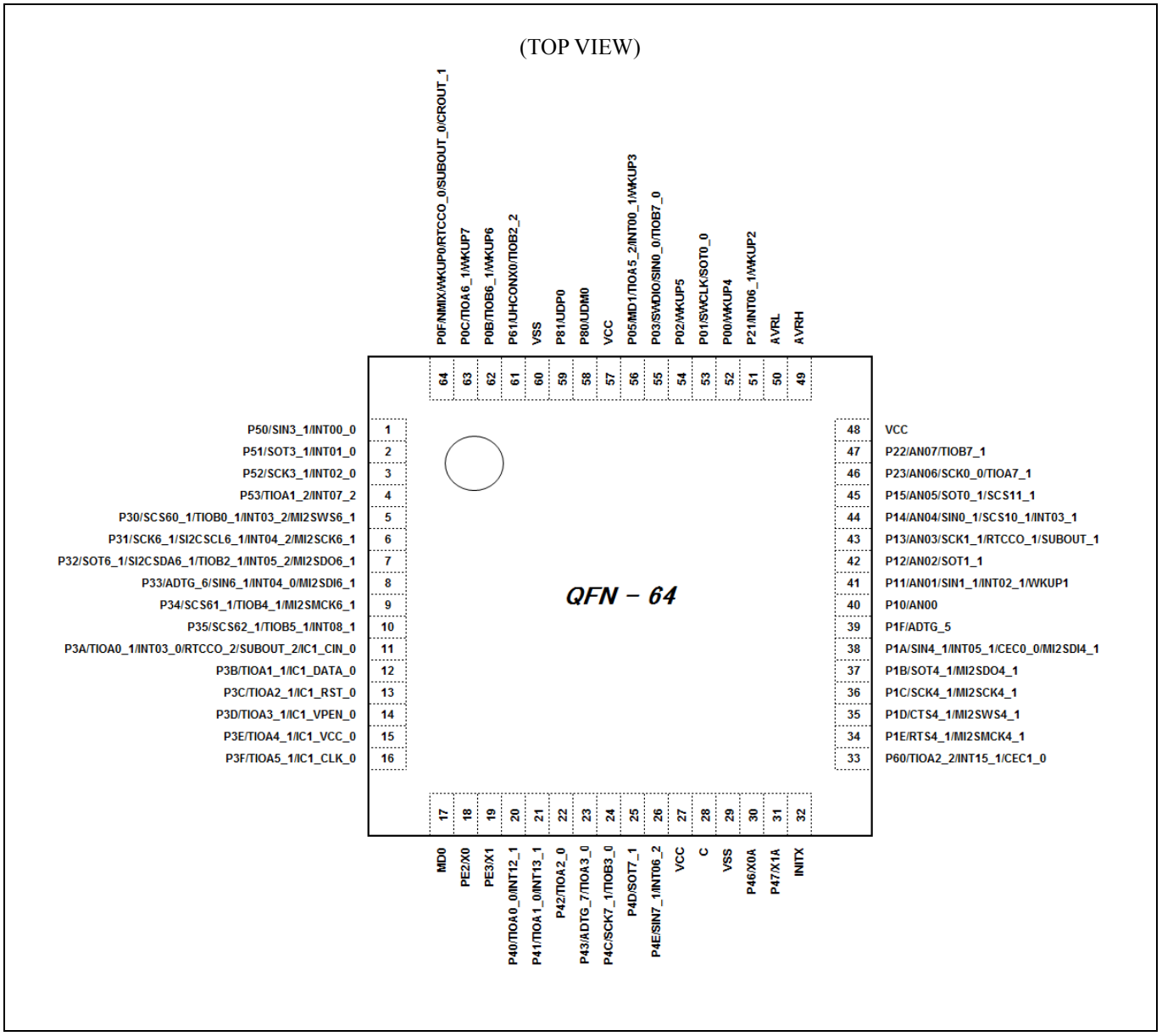
LQD064-02



Note:

- *The number after the underscore ("_") in a pin name such as XXX_1 and XXX_2 indicates the relocated port number. The channel on such pin has multiple functions, each of which has its own pin name. Use the Extended Port Function Register (EPFR) to select the pin to be used.*

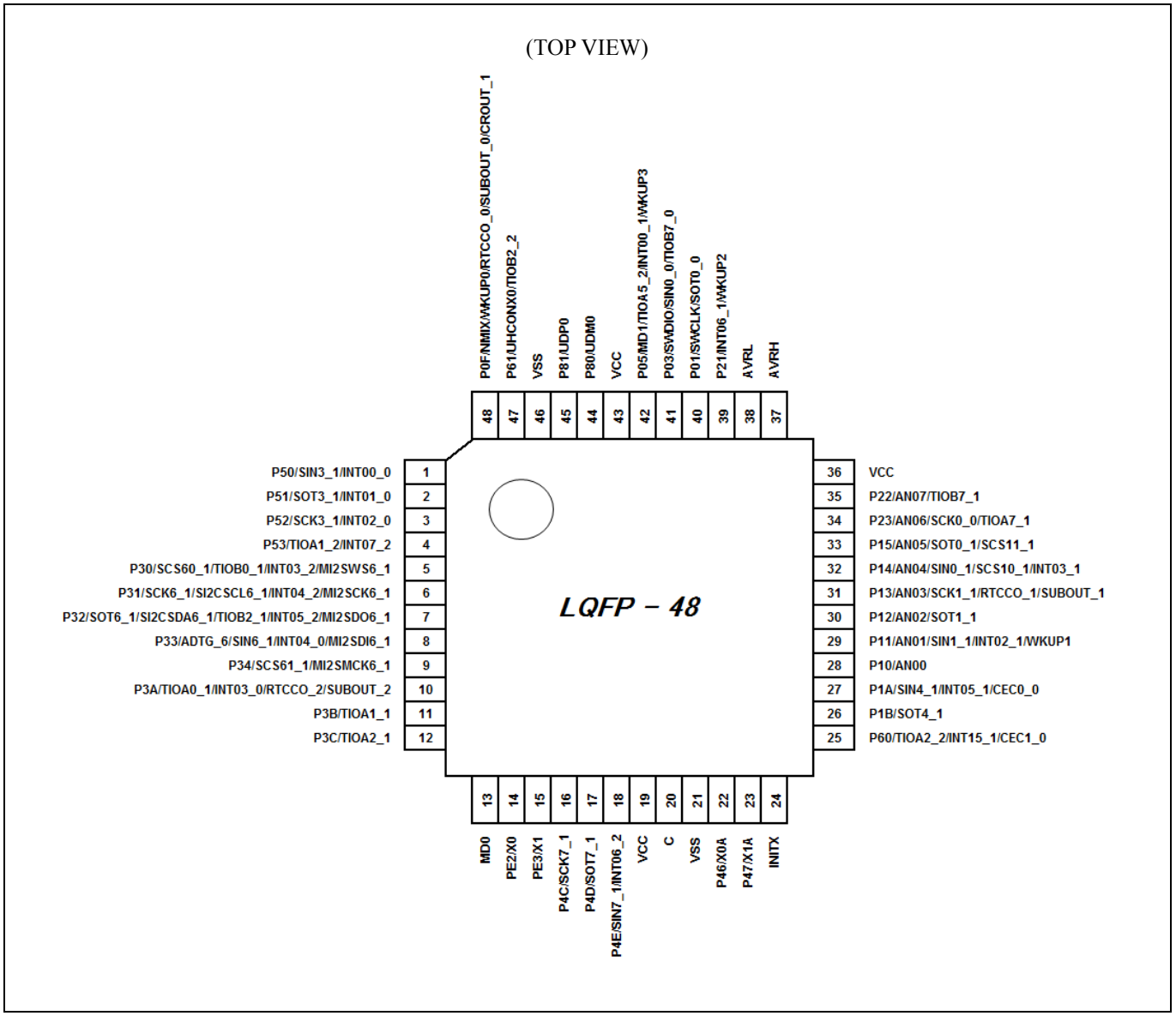
WNS064



Note:

- *The number after the underscore ("_") in a pin name such as XXX_1 and XXX_2 indicates the relocated port number. The channel on such pin has multiple functions, each of which has its own pin name. Use the Extended Port Function Register (EPFR) to select the pin to be used.*

LQA048-02

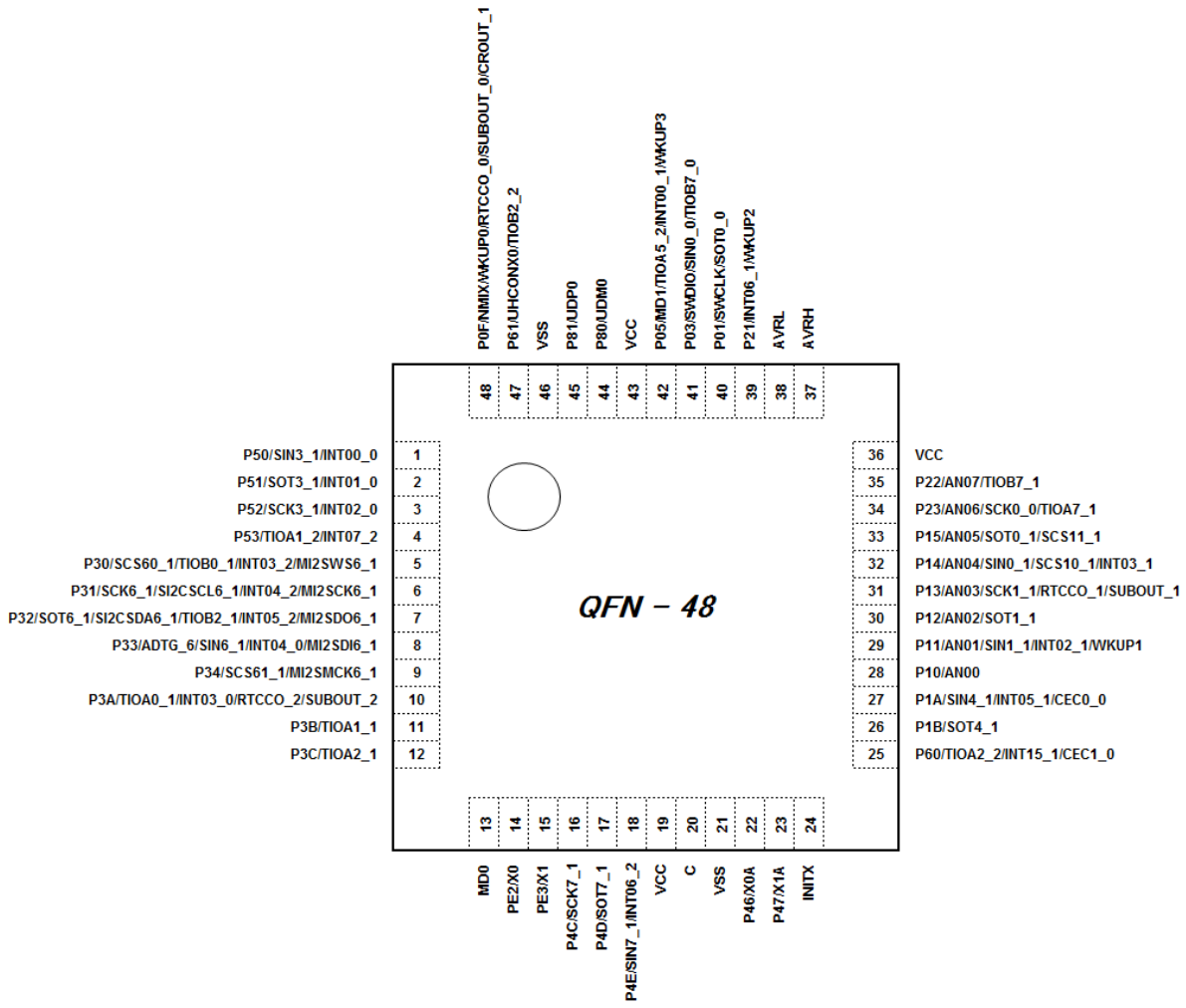


Note:

- *The number after the underscore ("_") in a pin name such as XXX_1 and XXX_2 indicates the relocated port number. The channel on such pin has multiple functions, each of which has its own pin name. Use the Extended Port Function Register (EPFR) to select the pin to be used.*

WNY048

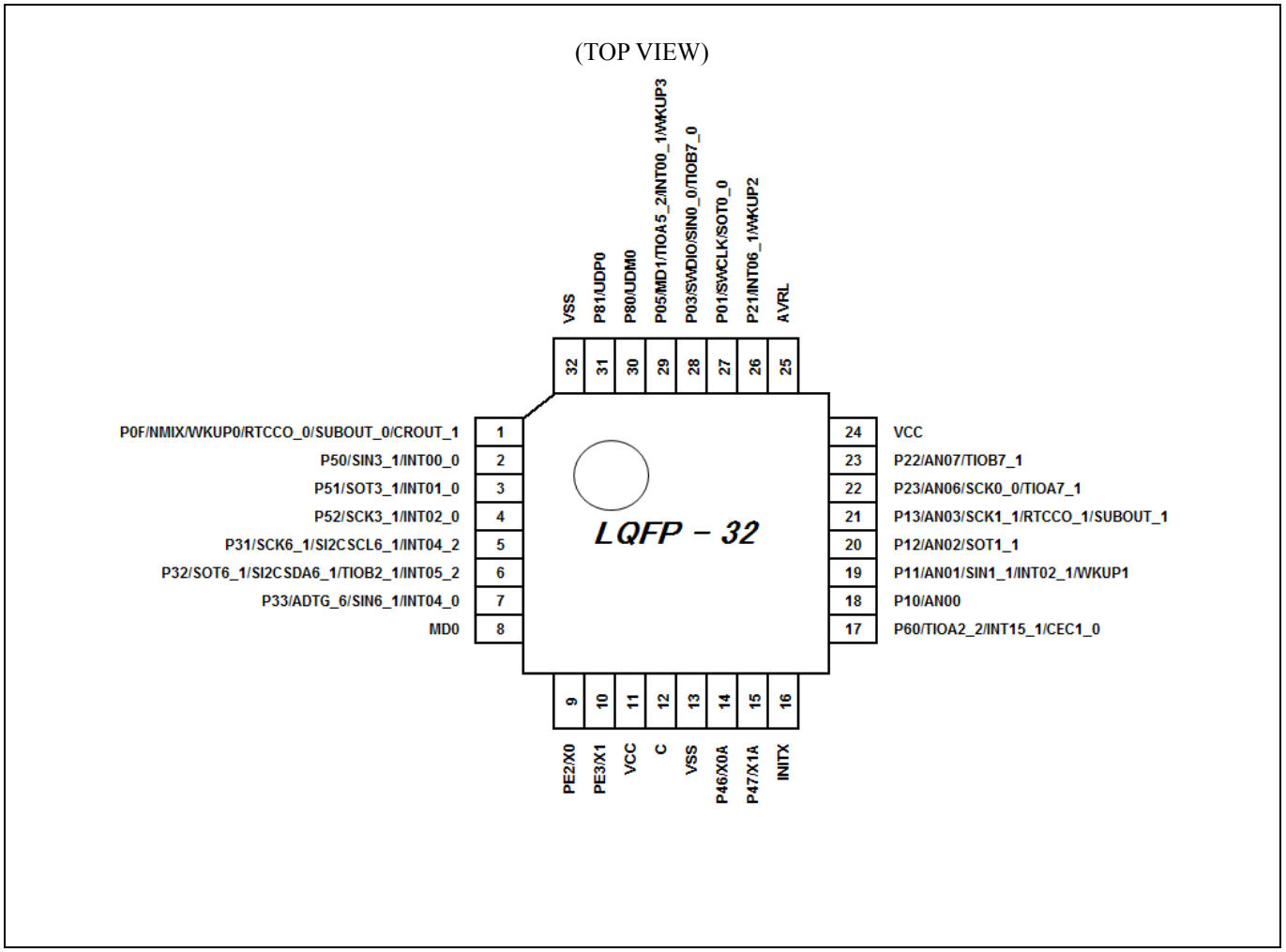
(TOP VIEW)



Note:

- *The number after the underscore ("_") in a pin name such as XXX_1 and XXX_2 indicates the relocated port number. The channel on such pin has multiple functions, each of which has its own pin name. Use the Extended Port Function Register (EPFR) to select the pin to be used.*

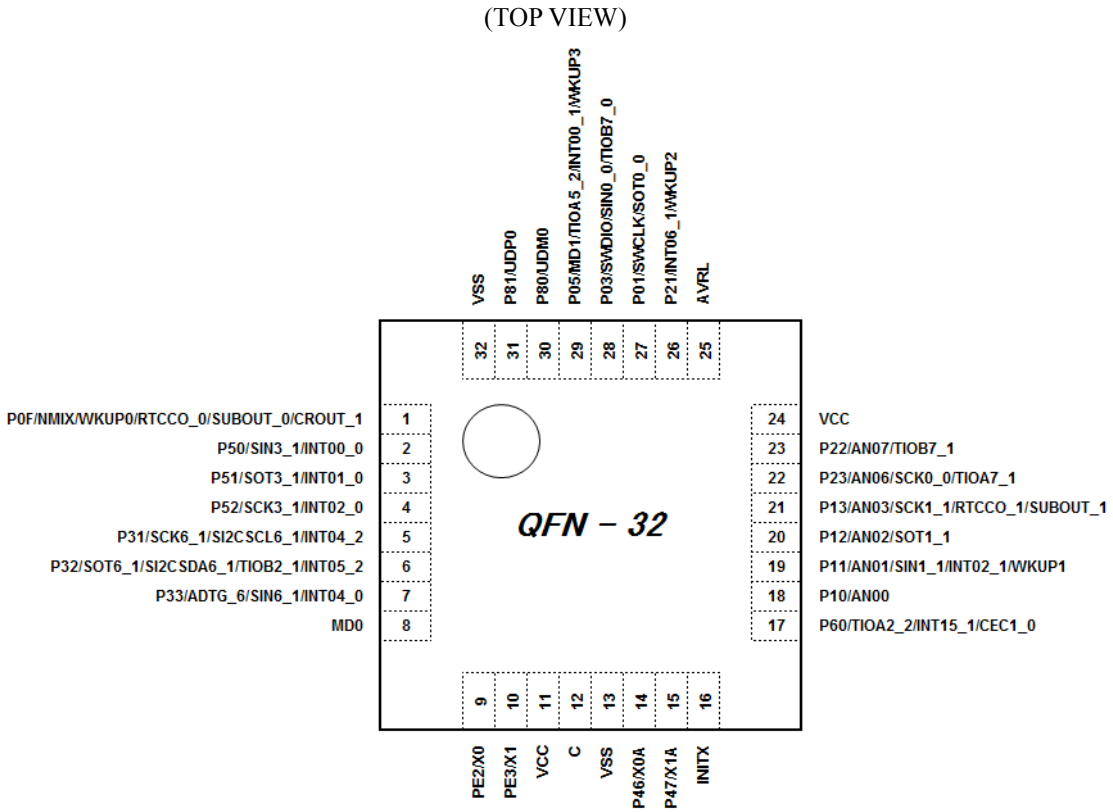
LQB032



Note:

- *The number after the underscore ("_") in a pin name such as XXX_1 and XXX_2 indicates the relocated port number. The channel on such pin has multiple functions, each of which has its own pin name. Use the Extended Port Function Register (EPFR) to select the pin to be used.*

WNU032



Note:

- *The number after the underscore ("_") in a pin name such as XXX_1 and XXX_2 indicates the relocated port number. The channel on such pin has multiple functions, each of which has its own pin name. Use the Extended Port Function Register (EPFR) to select the pin to be used.*

WLCSP

TBD

Note:

- *The number after the underscore ("_") in a pin name such as XXX_1 and XXX_2 indicates the relocated port number. The channel on such pin has multiple functions, each of which has its own pin name. Use the Extended Port Function Register (EPFR) to select the pin to be used.*

4. List of Pin Functions

List of Pin Numbers

The number after the underscore ("_") in a pin name such as XXX_1 and XXX_2 indicates the relocated port number. The channel on such pin has multiple functions, each of which has its own pin name. Use the Extended Port Function Register (EPFR) to select the pin to be used.

Pin no.				Pin Function	I/O circuit type	Pin state type
LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)			
1	1	2	-	P50 SIN3_1 INT00_0	D	K
2	2	3	-	P51 SOT3_1 INT01_0	D	K
3	3	4	-	P52 SCK3_1 INT02_0	D	K
4	4	-	-	P53 TIOA1_2 INT07_2	D	K
5	5	-	-	P30 SCS60_1 TIOB0_1 INT03_2 MI2SWS6_1	D	K
6	6	-	-	P31 SCK6_1 SI2CSCL6_1 INT04_2 MI2SCK6_1	H	K
-	-	5	-	P31 SCK6_1 SI2CSCL6_1 INT04_2	H	K
7	7	-	-	P32 SOT6_1 SI2CSDA6_1 TIOB2_1 INT05_2 MI2SDO6_1	H	K
-	-	6	-	P32 SOT6_1 SI2CSDA6_1 TIOB2_1 INT05_2	H	K

Pin no.				Pin Function	I/O circuit type	Pin state type
LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)			
8	8	-	-	P33 ADTG_6 SIN6_1 INT04_0 MI2SDI6_1	H	K
-	-	7	-	P33 ADTG_6 SIN6_1 INT04_0	H	K
9	-	-	-	P34 SCS61_1 TIOB4_1 MI2SMCK6_1	D	K
-	9	-	-	P34 SCS61_1 MI2SMCK6_1	D	K
10	-	-	-	P35 SCS62_1 TIOB5_1 INT08_1	D	K
11	-	-	-	P3A TIOA0_1 INT03_0 RTCCO_2 SUBOUT_2 IC1_CIN_0	D	K
-	10	-	-	P3A TIOA0_1 INT03_0 RTCCO_2 SUBOUT_2	D	K
12	-	-	-	P3B TIOA1_1 IC1_DATA_0	D	K
-	11	-	-	P3B TIOA1_1	D	K
13	-	-	-	P3C TIOA2_1 IC1_RST_0	D	K
-	12	-	-	P3C TIOA2_1	D	K
14	-	-	-	P3D TIOA3_1 IC1_VPEN_0	D	K

Pin no.				Pin Function	I/O circuit type	Pin state type
LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)			
15	-	-	-	P3E	D	K
				TIOA4_1		
				IC1_VCC_0		
16	-	-	-	P3F	D	K
				TIOA5_1		
				IC1_CLK_0		
17	13	8	-	MD0	I	F
18	14	9	-	PE2	A	A
				X0		
19	15	10	-	PE3	A	B
				X1		
20	-	-	-	P40	D	K
				TIOA0_0		
				INT12_1		
21	-	-	-	P41	D	K
				TIOA1_0		
				INT13_1		
22	-	-	-	P42	D	K
				TIOA2_0		
23	-	-	-	P43	D	K
				ADTG_7		
				TIOA3_0		
24	-	-	-	P4C	D	K
				SCK7_1		
				TIOB3_0		
-	16	-	-	P4C	D	K
				SCK7_1		
25	17	-	-	P4D	D	K
				SOT7_1		
26	18	-	-	P4E	D	K
				SIN7_1		
				INT06_2		
27	19	11	-	VCC	-	-
28	20	12	-	C	-	-
29	21	13	-	VSS	-	-
30	22	14	-	P46	C	C
				X0A		
31	23	15	-	P47	C	D
				X1A		
32	24	16	-	INITX	B	E
33	25	17	-	P60	H	K
				TIOA2_2		
				INT15_1		
				CEC1_0		

Pin no.				Pin Function	I/O circuit type	Pin state type
LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)			
34	-	-	-	P1E RTS4_1 MI2SMCK4_1	D	K
35	-	-	-	P1D CTS4_1 MI2SWS4_1	D	K
36	-	-	-	P1C SCK4_1 MI2SCK4_1	D	K
37	-	-	-	P1B SOT4_1 MI2SDO4_1	D	K
-	26	-	-	P1B SOT4_1	D	K
38	-	-	-	P1A SIN4_1 INT05_1 CEC0_0 MI2SDI4_1	H	K
-	27	-	-	P1A SIN4_1 INT05_1 CEC0_0	H	K
39	-	-	-	P1F ADTG_5	D	K
40	28	18	-	P10 AN00	F	J
41	29	19	-	P11 AN01 SIN1_1 INT02_1 WKUP1	G	J
42	30	20	-	P12 AN02 SOT1_1	F	J
43	31	21	-	P13 AN03 SCK1_1 RTCCO_1 SUBOUT_1	F	J
44	32	-	-	P14 AN04 SIN0_1 SCS10_1 INT03_1	F	J

Pin no.				Pin Function	I/O circuit type	Pin state type
LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)			
45	33	-	-	P15 AN05 SOT0_1 SCS11_1	F	J
46	34	22	-	P23 AN06 SCK0_0 TIOA7_1	F	J
47	35	23	-	P22 AN07 TIOB7_1	F	J
48	36	24	-	VCC	-	-
49	37	-	-	AVRH *	-	-
50	38	25	-	AVRL	-	-
51	39	26	-	P21 INT06_1 WKUP2	E	K
52	-	-	-	P00 WKUP4	E	K
53	40	27	-	P01 SWCLK SOT0_0	D	K
54	-	-	-	P02 WKUP5	E	K
55	41	28	-	P03 SWDIO SIN0_0 TIOB7_0	D	K
56	42	29	-	P05 MD1 TIOA5_2 INT00_1 WKUP3	E	K
57	43	-	-	VCC	-	-
58	44	30	-	P80 UDM0	J	G
59	45	31	-	P81 UDP0	J	G
60	46	32	-	VSS	-	-
61	47	-	-	P61 UHCONX0 TIOB2_2	H	K
62	-	-	-	P0B TIOB6_1 WKUP6	E	K

Pin no.				Pin Function	I/O circuit type	Pin state type
LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)			
63	-	-	-	P0C	E	K
				TIOA6_1		
				WKUP7		
64	48	1	-	P0F	E	I
				NMIX		
				WKUP0		
				RTCCO_0		
				SUBOUT_0		
				CROUT_1		

*: In case of 32-pin package, AVRH pin is internally connected to VCC pin.

List of Pin Functions

The number after the underscore ("_") in a pin name such as XXX_1 and XXX_2 indicates the relocated port number. The channel on such pin has multiple functions, each of which has its own pin name. Use the Extended Port Function Register (EPFR) to select the pin to be used.

Pin function	Pin name	Function description	Pin no.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)
ADC	ADTG_5	A/D converter external trigger input pin	39	-	-	-
	ADTG_6		8	8	7	-
	ADTG_7		23	-	-	-
ADC	AN00	A/D converter analog input pin. ANxx describes ADC ch.xx.	40	28	18	-
	AN01		41	29	19	-
	AN02		42	30	20	-
	AN03		43	31	21	-
	AN04		44	32	-	-
	AN05		45	33	-	-
	AN06		46	34	22	-
	AN07		47	35	23	-
Base Timer 0	TIOA0_0	Base timer ch.0 TIOA pin	20	-	-	-
	TIOA0_1		11	10	-	-
	TIOB0_1	Base timer ch.0 TIOB pin	5	5	-	-
Base Timer 1	TIOA1_0	Base timer ch.1 TIOA pin	21	-	-	-
	TIOA1_1		12	11	-	-
	TIOA1_2		4	4	-	-
Base Timer 2	TIOA2_0	Base timer ch.2 TIOA pin	22	-	-	-
	TIOA2_1		13	12	-	-
	TIOA2_2		33	25	17	-
	TIOB2_1	Base timer ch.2 TIOB pin	7	7	6	-
	TIOB2_2		61	47	-	-
Base Timer 3	TIOA3_0	Base timer ch.3 TIOA pin	23	-	-	-
	TIOA3_1		14	-	-	-
	TIOB3_0	Base timer ch.3 TIOB pin	24	-	-	-
Base Timer 4	TIOA4_1	Base timer ch.4 TIOA pin	15	-	-	-
	TIOB4_1	Base timer ch.4 TIOB pin	9	-	-	-
Base Timer 5	TIOA5_1	Base timer ch.5 TIOA pin	16	-	-	-
	TIOA5_2		56	42	29	-
	TIOB5_1	Base timer ch.5 TIOB pin	10	-	-	-
Base Timer 6	TIOA6_1	Base timer ch.6 TIOA pin	63	-	-	-
	TIOB6_1	Base timer ch.6 TIOB pin	62	-	-	-
Base Timer 7	TIOA7_1	Base timer ch.7 TIOA pin	46	34	22	-
	TIOB7_0	Base timer ch.7 TIOB pin	55	41	28	-
	TIOB7_1		47	35	23	-
Debugger	SWCLK	Serial wire debug interface clock input pin	53	40	27	-
	SWDIO	Serial wire debug interface data input / output pin	55	41	28	-

Pin function	Pin name	Function description	Pin no.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)
External Interrupt	INT00_0	External interrupt request 00 input pin	1	1	2	-
	INT00_1		56	42	29	-
	INT01_0	External interrupt request 01 input pin	2	2	3	-
	INT02_0	External interrupt request 02 input pin	3	3	4	-
	INT02_1		41	29	19	-
	INT03_0	External interrupt request 03 input pin	11	10	-	-
	INT03_1		44	32	-	-
	INT03_2		5	5	-	-
	INT04_0	External interrupt request 04 input pin	8	8	7	-
	INT04_2		6	6	5	-
	INT05_1	External interrupt request 05 input pin	38	27	-	-
	INT05_2		7	7	6	-
	INT06_1	External interrupt request 06 input pin	51	39	26	-
	INT06_2		26	18	-	-
	INT07_2	External interrupt request 07 input pin	4	4	-	-
	INT08_1	External interrupt request 08 input pin	10	-	-	-
	INT12_1	External interrupt request 12 input pin	20	-	-	-
	INT13_1	External interrupt request 13 input pin	21	-	-	-
	INT15_1	External interrupt request 15 input pin	33	25	17	-
	NMIX	Non-Maskable Interrupt input pin	64	48	1	-
GPIO	P00	General-purpose I/O port 0	52	-	-	-
	P01		53	40	27	-
	P02		54	-	-	-
	P03		55	41	28	-
	P05		56	42	29	-
	P0B		62	-	-	-
	P0C		63	-	-	-
	P0F		64	48	1	-
GPIO	P10	General-purpose I/O port 1	40	28	18	-
	P11		41	29	19	-
	P12		42	30	20	-
	P13		43	31	21	-
	P14		44	32	-	-
	P15		45	33	-	-
	P1A		38	27	-	-
	P1B		37	26	-	-
	P1C		36	-	-	-
	P1D		35	-	-	-
	P1E		34	-	-	-
	P1F		39	-	-	-
GPIO	P21	General-purpose I/O port 2	51	39	26	-
	P22		47	35	23	-
	P23		46	34	22	-

Pin function	Pin name	Function description	Pin no.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)
GPIO	P30	General-purpose I/O port 3	5	5	-	-
	P31		6	6	5	-
	P32		7	7	6	-
	P33		8	8	7	-
	P34		9	9	-	-
	P35		10	-	-	-
	P3A		11	10	-	-
	P3B		12	11	-	-
	P3C		13	12	-	-
	P3D		14	-	-	-
	P3E		15	-	-	-
	P3F		16	-	-	-
GPIO	P40	General-purpose I/O port 4	20	-	-	-
	P41		21	-	-	-
	P42		22	-	-	-
	P43		23	-	-	-
	P46		30	22	14	-
	P47		31	23	15	-
	P4C		24	16	-	-
	P4D		25	17	-	-
	P4E		26	18	-	-
GPIO	P50	General-purpose I/O port 5	1	1	2	-
	P51		2	2	3	-
	P52		3	3	4	-
	P53		4	4	-	-
GPIO	P60	General-purpose I/O port 6	33	25	17	-
	P61		61	47	-	-
GPIO	P80	General-purpose I/O port 8	58	44	30	-
	P81		59	45	31	-
GPIO	PE2	General-purpose I/O port E	18	14	9	-
	PE3		19	15	10	-
Multi-function Serial 0	SIN0_0	Multi-function serial interface ch.0 input pin	55	41	28	-
	SIN0_1		44	32	-	-
	SOT0_0 (SDA0_0)	Multi-function serial interface ch.0 output pin. This pin operates as SOT0 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA0 when used as an I2C pin (operation mode 4).	53	40	27	-
	SOT0_1 (SDA0_1)		45	33	-	-
	SCK0_0 (SCL0_0)	Multi-function serial interface ch.0 clock I/O pin. This pin operates as SCK0 when used as a CSIO pin (operation mode 2) and as SCL0 when used as an I2C pin (operation mode 4).	46	34	22	-

Pin function	Pin name	Function description	Pin no.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)
Multi-function Serial 1	SIN1_1	Multi-function serial interface ch.1 input pin	41	29	19	-
	SOT1_1 (SDA1_1)	Multi-function serial interface ch.1 output pin. This pin operates as SOT1 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA1 when used as an I2C pin (operation mode 4).	42	30	20	-
	SCK1_1 (SCL1_1)	Multi-function serial interface ch.1 clock I/O pin. This pin operates as SCK1 when used as a CSIO pin (operation mode 2) and as SCL1 when used as an I2C pin (operation mode 4).	43	31	21	-
	SCS10_1	Multi-function serial interface ch.1 serial chip select 0 input/output pin.	44	32	-	-
	SCS11_1	Multi-function serial interface ch.1 serial chip select 1 output pin.	45	33	-	-
Multi-function Serial 3	SIN3_1	Multi-function serial interface ch.3 input pin	1	1	2	-
	SOT3_1 (SDA3_1)	Multi-function serial interface ch.3 output pin. This pin operates as SOT3 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA3 when used as an I2C pin (operation mode 4).	2	2	3	-
	SCK3_1 (SCL3_1)	Multi-function serial interface ch.3 clock I/O pin. This pin operates as SCK3 when used as a CSIO (operation mode 2) and as SCL3 when used as an I2C pin (operation mode 4).	3	3	4	-
Multi-function Serial 4	SIN4_1	Multi-function serial interface ch.4 input pin	38	27	-	-
	SOT4_1 (SDA4_1)	Multi-function serial interface ch.4 output pin. This pin operates as SOT4 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA4 when used as an I2C pin (operation mode 4).	37	26	-	-
	SCK4_1 (SCL4_1)	Multi-function serial interface ch.4 clock I/O pin. This pin operates as SCK4 when used as a CSIO (operation mode 2) and as SCL4 when used as an I2C pin (operation mode 4).	36	-	-	-
	CTS4_1	Multi-function serial interface ch4 CTS input pin	35	-	-	-
	RTS4_1	Multi-function serial interface ch4 RTS output pin	34	-	-	-

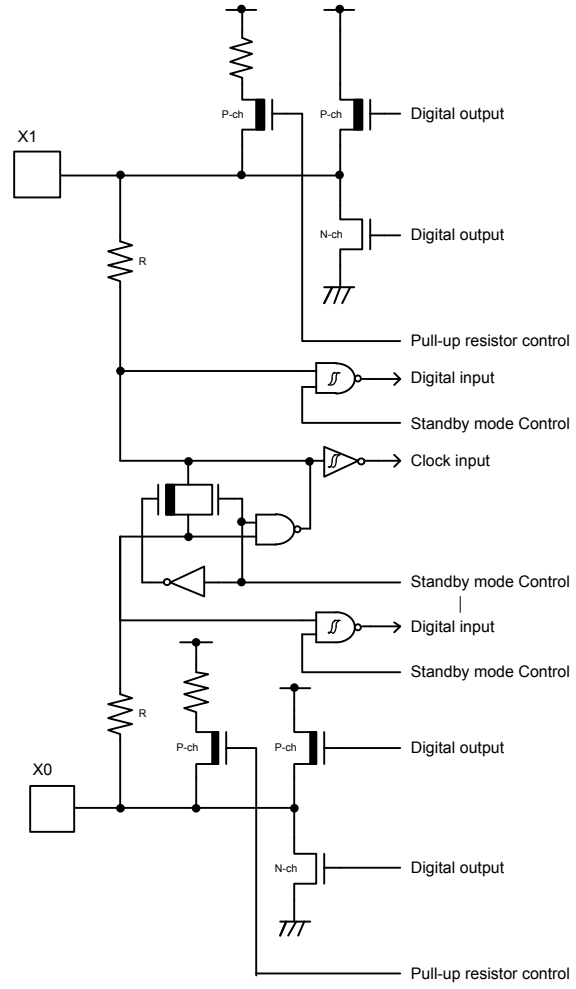
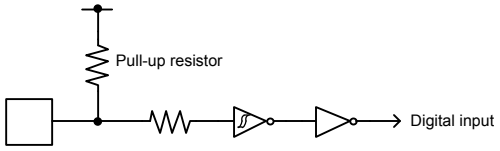
Pin function	Pin name	Function description	Pin no.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)
Multi-function Serial 6	SIN6_1	Multi-function serial interface ch.6 input pin	8	8	7	-
	SOT6_1 (SDA6_1)	Multi-function serial interface ch.6 output pin. This pin operates as SOT6 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA6 when used as an I2C pin (operation mode 4).	7	7	6	-
	SCK6_1 (SCL6_1)	Multi-function serial interface ch.6 clock I/O pin. This pin operates as SCK6 when used as a CSIO (operation mode 2) and as SCL6 when used as an I2C pin (operation mode 4).	6	6	5	-
	SCS60_1	Multi-function serial interface ch.6 serial chip select 0 input/output pin.	5	5	-	-
	SCS61_1	Multi-function serial interface ch.6 serial chip select 1 output pin.	9	9	-	-
	SCS62_1	Multi-function serial interface ch.6 serial chip select 2 output pin.	10	-	-	-
Multi-function Serial 7	SIN7_1	Multi-function serial interface ch.7 input pin	26	18	-	-
	SOT7_1 (SDA7_1)	Multi-function serial interface ch.7 output pin. This pin operates as SOT7 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA7 when used as an I2C pin (operation mode 4).	25	17	-	-
	SCK7_1 (SCL7_1)	Multi-function serial interface ch.7 clock I/O pin. This pin operates as SCK7 when used as a CSIO (operation mode 2) and as SCL7 when used as an I2C pin (operation mode 4).	24	16	-	-

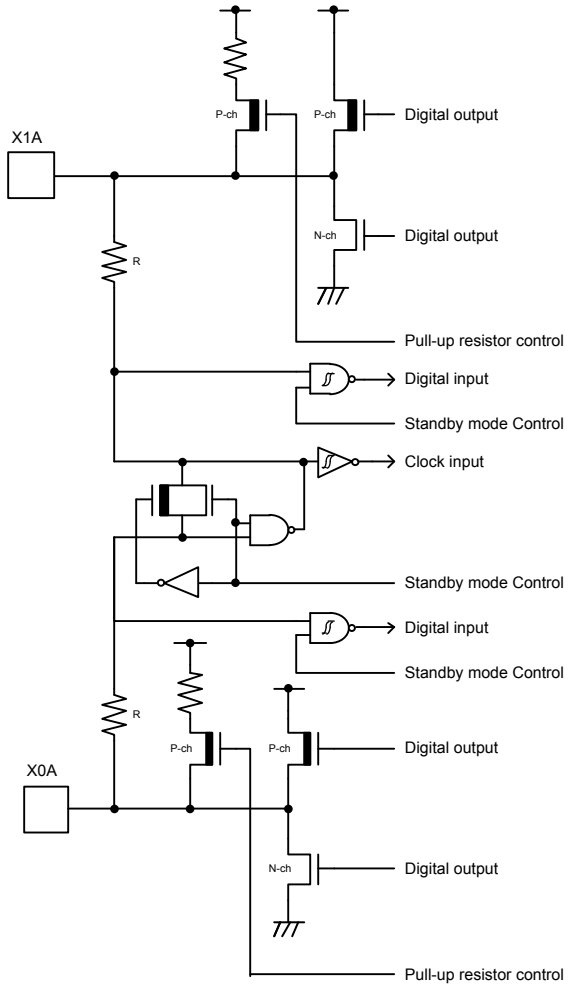
Pin function	Pin name	Function description	Pin no.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)
I2S(MFS)	MI2SDI4_1	I2S Serial Data Input pin (operation mode 2).	38	-	-	-
	MI2SDO4_1	I2S Serial Data Output pin (operation mode 2).	37	-	-	-
	MI2SCK4_1	I2S Serial Clock Output pin (operation mode 2).	36	-	-	-
	MI2SWS4_1	I2S Word Select Output pin (operation mode 2).	35	-	-	-
	MI2SMCK4_1	I2S Master Clock Input/output pin (operation mode 2).	34	-	-	-
	MI2SDI6_1	I2S Serial Data Input pin (operation mode 2).	8	8	-	-
	MI2SDO6_1	I2S Serial Data Output pin (operation mode 2).	7	7	-	-
	MI2SCK6_1	I2S Serial Clock Output pin (operation mode 2).	6	6	-	-
	MI2SWS6_1	I2S Word Select Output pin (operation mode 2).	5	5	-	-
	MI2SMCK6_1	I2S Master Clock Input/output pin (operation mode 2).	9	9	-	-
Smart Card Interface	IC1_CIN_0	Smart Card insert detection output pin	11	-	-	-
	IC1_CLK_0	Smart Card serial interface clock output pin	16	-	-	-
	IC1_DATA_0	Smart Card serial interface data input pin	12	-	-	-
	IC1_RST_0	Smart Card reset output pin	13	-	-	-
	IC1_VCC_0	Smart Card power enable output pin	15	-	-	-
	IC1_VPEN_0	Smart Card programming output pin	14	-	-	-
USB	UDM0	USB function/host D – pin	58	44	30	-
	UDP0	USB function/host D + pin	59	45	31	-
	UHCONX0	USB external pull-up control pin	61	47	-	-
Real-time Clock	RTCCO_0	0.5 seconds pulse output pin of real-time clock	64	48	1	-
	RTCCO_1		43	31	21	-
	RTCCO_2		11	10	-	-
	SUBOUT_0	Sub clock output pin	64	48	1	-
	SUBOUT_1		43	31	21	-
	SUBOUT_2		11	10	-	-
HDMI-CEC/Remote Control Reception	CEC0_0	HDMI-CEC/Remote Control Reception ch.0 input/output pin	38	27	-	-
	CEC1_0	HDMI-CEC/Remote Control Reception ch.1 input/output pin	33	25	17	-

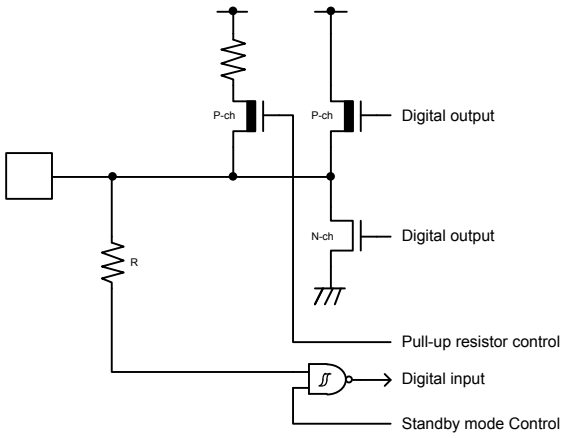
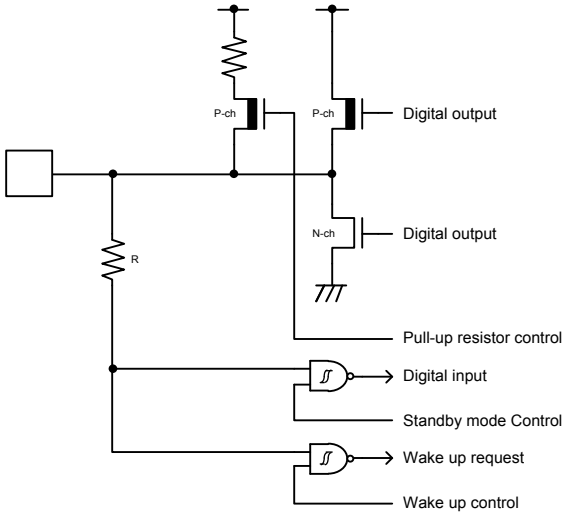
Pin function	Pin name	Function description	Pin no.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP (TBD)
Low Power Consumption Mode	WKUP0	Deep Standby mode return signal input pin 0	64	48	1	-
	WKUP1	Deep Standby mode return signal input pin 1	41	29	19	-
	WKUP2	Deep Standby mode return signal input pin 2	51	39	26	-
	WKUP3	Deep Standby mode return signal input pin 3	56	42	29	-
	WKUP4	Deep Standby mode return signal input pin 4	52	-	-	-
	WKUP5	Deep Standby mode return signal input pin 5	54	-	-	-
	WKUP6	Deep Standby mode return signal input pin 6	62	-	-	-
	WKUP7	Deep Standby mode return signal input pin 7	63	-	-	-
I2C Slave	SI2CSCL6_1	I2C Clock Pin	6	6	5	-
	SI2CSDA6_1	I2C Data Pin	7	7	6	-
RESET	INITX	External Reset Input pin. A reset is valid when INITX="L".	32	24	16	-
MODE	MD0	Mode 0 pin. During normal operation, input MD0="L". During serial programming to Flash memory, input MD0="H".	17	13	8	-
	MD1	Mode 1 pin. During normal operation, input is not needed. During serial programming to Flash memory, MD1 = "L" must be input.	56	42	29	-
CLOCK	X0	Main clock (oscillation) input pin	18	14	9	-
	X0A	Sub clock (oscillation) input pin	30	22	14	-
	X1	Main clock (oscillation) I/O pin	19	15	10	-
	X1A	Sub clock (oscillation) I/O pin	31	23	15	-
	CROUT_1	Built-in high-speed CR oscillation clock output port	64	48	1	-
POWER	VCC	Power supply pin	27	19	11	-
	VCC		48	36	24	-
	VCC		57	43	-	-
GND	VSS	GND pin	29	21	13	-
	VSS		60	46	32	-
Analog Reference	AVRH *	A/D converter analog reference voltage input pin	49	37	-	-
	AVRL	A/D converter analog reference voltage input pin	50	38	25	-
C pin	C	Power supply stabilization capacitance pin	28	20	12	-

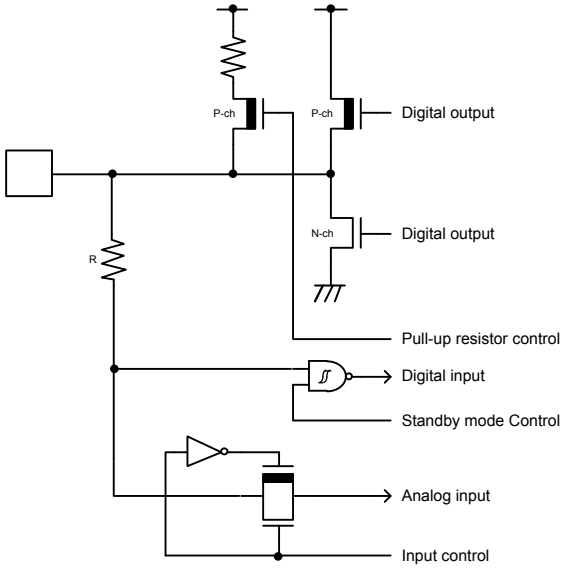
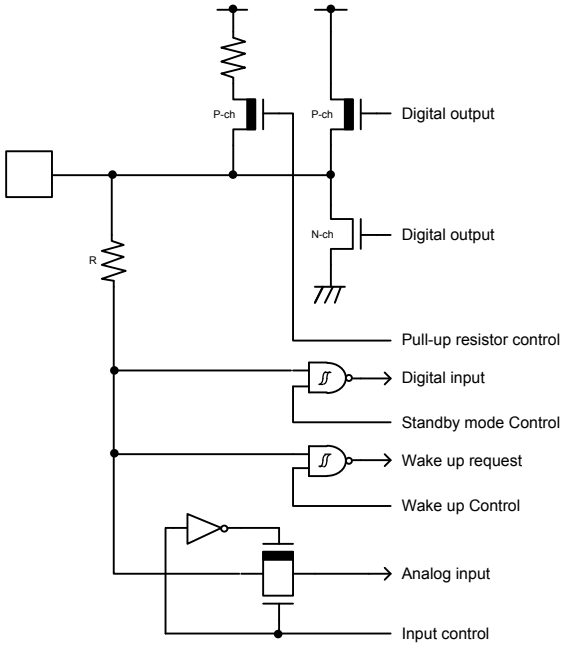
*: In case of 32-pin package, AVRH pin is internally connected to VCC pin.

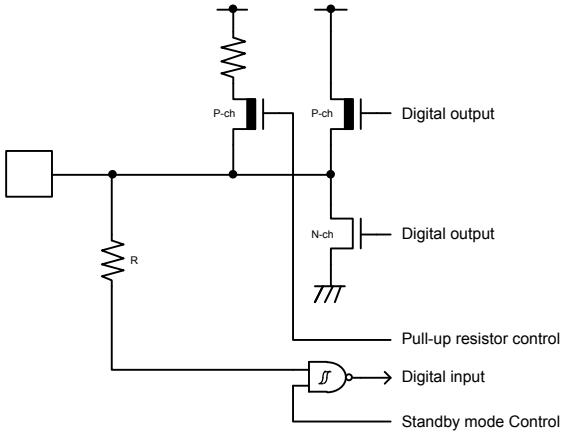
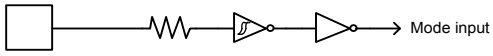
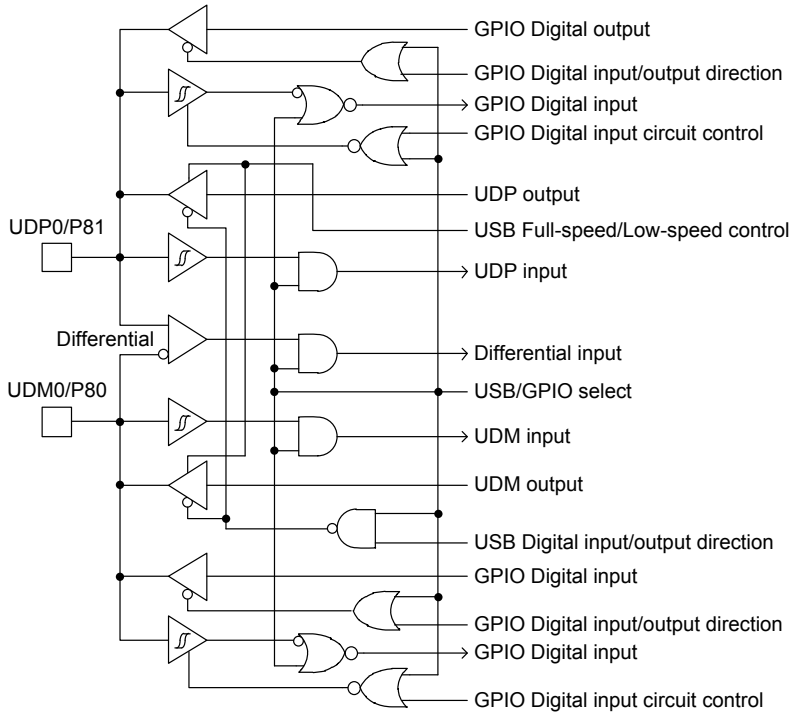
5. I/O Circuit Type

Type	Circuit	Remarks
A		It is possible to select the main oscillation / GPIO function When the main oscillation is selected. ・Oscillation feedback resistor : Approximately 1MΩ ・With standby mode control When the GPIO is selected. ・CMOS level output. ・CMOS level hysteresis input ・With pull-up resistor control ・With standby mode control ・Pull-up resistor : Approximately 33kΩ ・I_{OH}= -4mA, I_{OL}= 4mA
B		CMOS level hysteresis input Pull-up resistor : Approximately 33kΩ

Type	Circuit	Remarks
C		It is possible to select the sub oscillation / GPIO function When the sub oscillation is selected. • Oscillation feedback resistor : Approximately 5MΩ • With Standby mode control When the GPIO is selected. • CMOS level output. • CMOS level hysteresis input • With pull-up resistor control • With standby mode control • Pull-up resistor : Approximately 33kΩ I_{OH}= -4mA, I_{OL}= 4mA

Type	Circuit	Remarks
D		・CMOS level output ・CMOS level hysteresis input ・With pull-up resistor control ・With standby mode control ・Pull-up resistor : Approximately 33kΩ ・IOH= -4mA, IOL= 4mA ・When this pin is used as an I2C pin, the digital output P-ch transistor is always off
E		・CMOS level output ・CMOS level hysteresis input ・With pull-up resistor control ・With standby mode control ・Pull-up resistor : Approximately 33kΩ ・IOH= -4mA, IOL= 4mA ・When this pin is used as an I2C pin, the digital output P-ch transistor is always off

Type	Circuit	Remarks
F		・CMOS level output ・CMOS level hysteresis input ・With input control ・Analog input ・With pull-up resistor control ・With standby mode control ・Pull-up resistor : Approximately 33kΩ ・IOH= -4mA, IOL= 4mA ・When this pin is used as an I2C pin, the digital output P-ch transistor is always off
G		・CMOS level output ・CMOS level hysteresis input ・With input control ・Analog input ・With pull-up resistor control ・With standby mode control ・Pull-up resistor : Approximately 33kΩ ・IOH= -4mA, IOL= 4mA ・When this pin is used as an I2C pin, the digital output P-ch transistor is always off

Type	Circuit	Remarks
H		・CMOS level output ・CMOS level hysteresis input ・5V tolerant ・With pull-up resistor control ・With standby mode control ・Pull-up resistor : Approximately 33kΩ ・IOH= -4mA, IOL= 4mA ・Available to control PZR registers ・When this pin is used as an I2C pin, the digital output P-ch transistor is always off
I		・CMOS level hysteresis input
J		It is possible to select the USB I/O / GPIO function. When the USB I/O is selected. ・Full-speed, Low-speed control When the GPIO is selected. ・CMOS level output ・CMOS level hysteresis input ・With standby mode control

6. Handling Precautions

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

6.1 Precautions for Product Design

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

Absolute Maximum Ratings

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

Recommended Operating Conditions

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

Always use semiconductor devices within the recommended operating conditions. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their sales representative beforehand.

Processing and Protection of Pins

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

(1) Preventing Over-Voltage and Over-Current Conditions

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

(2) Protection of Output Pins

Shorting of output pins to supply pins or other output pins, or connection to large capacitance can cause large current flows. Such conditions if present for extended periods of time can damage the device.

Therefore, avoid this type of connection.

(3) Handling of Unused Input Pins

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

Latch-Up

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

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

(1) Be sure that voltages applied to pins do not exceed the absolute maximum ratings. This should include attention to abnormal noise, surge levels, etc.

(2) Be sure that abnormal current flows do not occur during the power-on sequence.

Observance of Safety Regulations and Standards

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

Fail-Safe Design

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

Precautions Related to Usage of Devices

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

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

6.2 Precautions for Package Mounting

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

Lead Insertion Type

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

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

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

Surface Mount Type

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

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

Lead-Free Packaging

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

Storage of Semiconductor Devices

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

(1) Avoid exposure to rapid temperature changes, which cause moisture to condense inside the product.
Store products in locations where temperature changes are slight.

(2) Use dry boxes for product storage. Products should be stored below 70% relative humidity, and at temperatures between 5 ˚C and 30 ˚C.
When you open Dry Package that recommends humidity 40% to 70% relative humidity.

(3) When necessary, Spansion packages semiconductor devices in highly moisture-resistant aluminum laminate bags, with a silica gel desiccant. Devices should be sealed in their aluminum laminate bags for storage.

(4) Avoid storing packages where they are exposed to corrosive gases or high levels of dust.

Baking

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

Condition: 125°C/24 h

Static Electricity

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

(1) Maintain relative humidity in the working environment between 40% and 70%.
Use of an apparatus for ion generation may be needed to remove electricity.

(2) Electrically ground all conveyors, solder vessels, soldering irons and peripheral equipment.

(3) Eliminate static body electricity by the use of rings or bracelets connected to ground through high resistance (on the level of 1 MΩ).
Wearing of conductive clothing and shoes, use of conductive floor mats and other measures to minimize shock loads is recommended.

(4) Ground all fixtures and instruments, or protect with anti-static measures.

(5) Avoid the use of styrofoam or other highly static-prone materials for storage of completed board assemblies.

6.3 Precautions for Use Environment

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

For reliable performance, do the following:

(1) Humidity

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

(2) Discharge of Static Electricity

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

(3) Corrosive Gases, Dust, or Oil

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

(4) Radiation, Including Cosmic Radiation

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

(5) Smoke, Flame

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

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

7. Handling Devices

Power Supply Pins

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

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

Stabilizing Supply Voltage

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

Crystal Oscillator Circuit

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

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

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

Sub Crystal Oscillator

This series sub oscillator circuit is low gain to keep the low current consumption. The crystal oscillator to fill the following conditions is recommended for sub crystal oscillator to stabilize the oscillation.

■Surface mount type

Size: More than 3.2 mm × 1.5 mm

Load capacitance: Approximately 6 pF to 7 pF

■Lead type

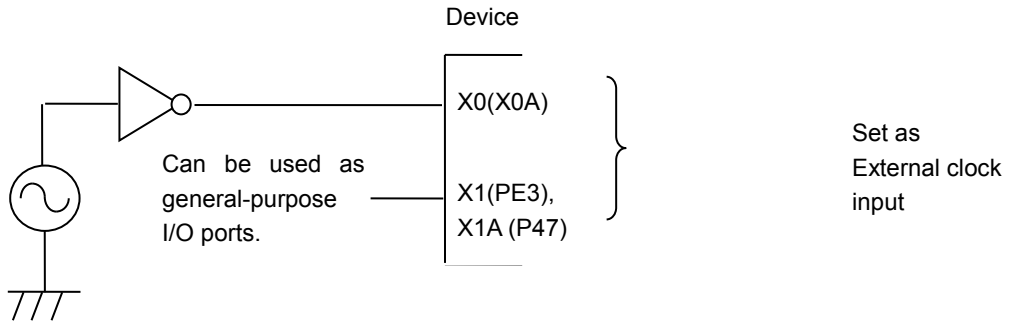
Load capacitance: Approximately 6 pF to 7 pF

Using an External Clock

When using an external clock as an input of the main clock, set X0/X1 to the external clock input, and input the clock to X0. X1(PE3) can be used as a general-purpose I/O port.
Similarly, when using an external clock as an input of the sub clock, set X0A/X1A to the external clock input, and input the clock to X0A. X1A (P47) can be used as a general-purpose I/O port.

However in the Deep Standby mode, an external clock as an input of the sub clock cannot be used.

Example of Using an External Clock



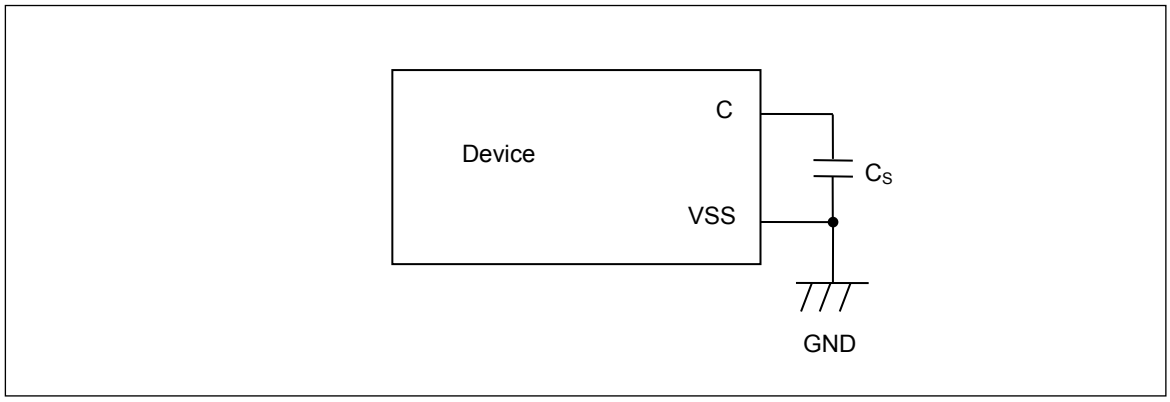
Handling when Using Multi-Function Serial Pin as I²C Pin

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

C Pin

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

Incidentally, the C pin becomes floating in Deep standby mode.



Mode Pins (MD0)

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

Notes on Power-on

Turn power on/off in the following order or at the same time.

Turning on : VCC →AVRH
Turning off : AVRH →VCC

Serial Communication

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

Differences in Features Among the Products with Different Memory Sizes and Between Flash Memory Products and MASK Products

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

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

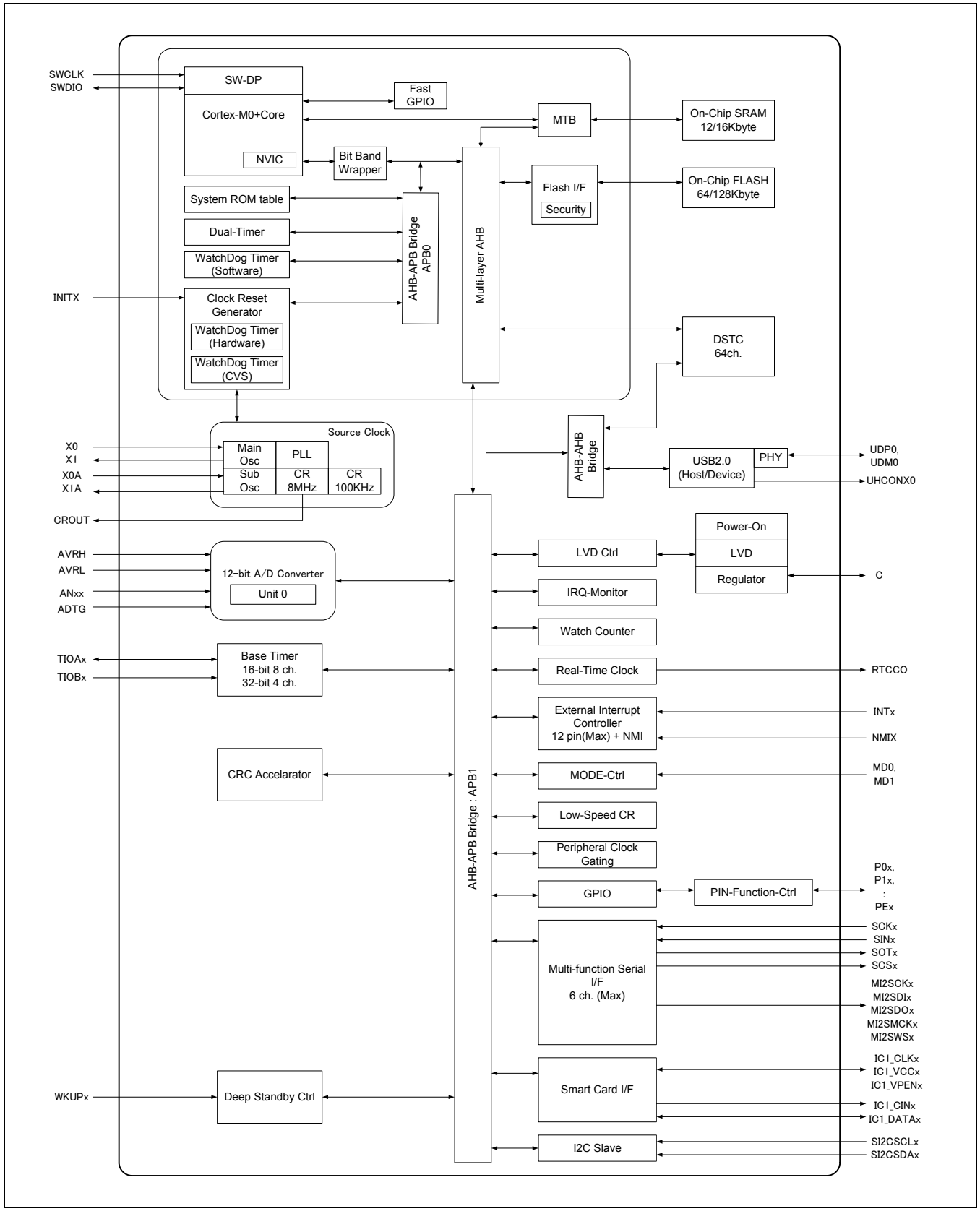
Pull-Up Function of 5 V Tolerant I/O

Please do not input the signal more than VCC voltage at the time of Pull-Up function use of 5 V tolerant I/O.

Handling when Using Debug Pins

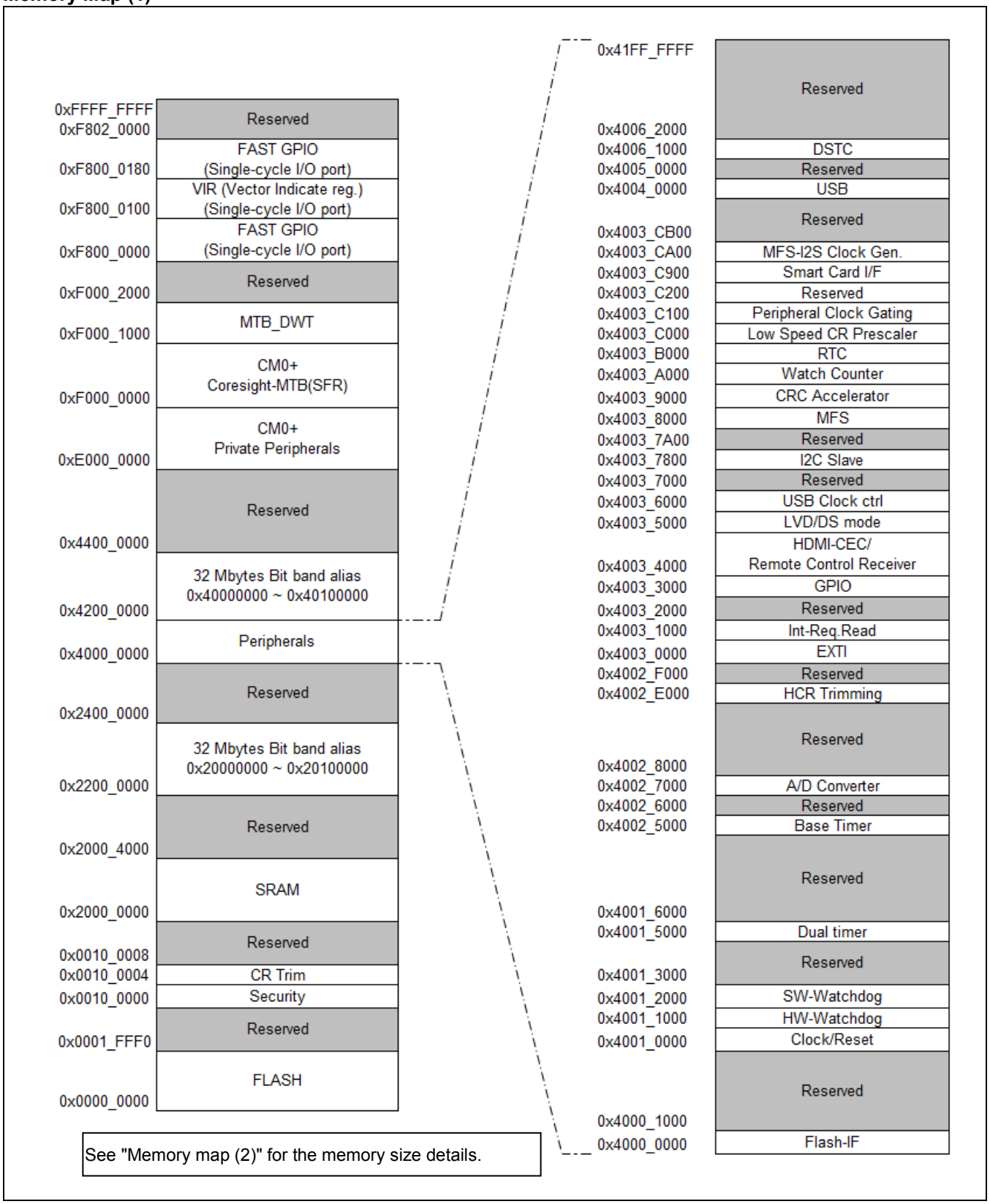
When debug pins (SWDIO/SWCLK) are set to GPIO or other peripheral functions, set them as output only; do not set them as input.

8. Block Diagram

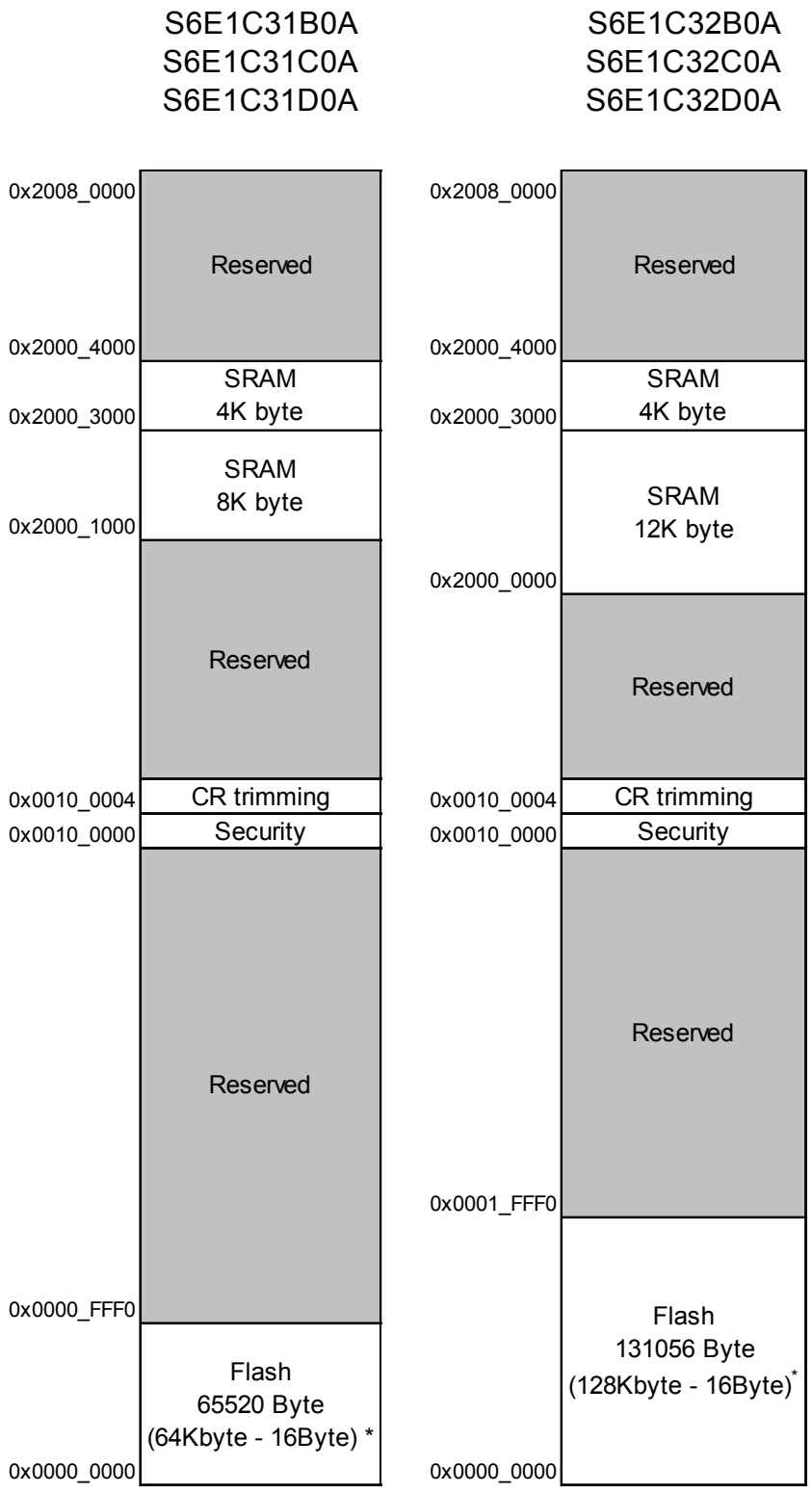


9. Memory Map

Memory Map (1)



Memory Map (2)



*: See "S6E1C1/C3 Series Flash Programming Manual" to check details of the Flash memory.

Peripheral Address Map

Start address	End address	Bus	Peripheral
0x4000_0000	0x4000_0FFF	AHB	Flash memory I/F register
0x4000_1000	0x4000_FFFF		Reserved
0x4001_0000	0x4001_0FFF	APB0	Clock/Reset Control
0x4001_1000	0x4001_1FFF		Hardware Watchdog Timer
0x4001_2000	0x4001_2FFF		Software Watchdog Timer
0x4001_3000	0x4001_4FFF		Reserved
0x4001_5000	0x4001_5FFF		Dual-Timer
0x4001_6000	0x4001_FFFF		Reserved
0x4002_0000	0x4002_0FFF	APB1	Reserved
0x4002_1000	0x4002_3FFF		Reserved
0x4002_4000	0x4002_4FFF		Reserved
0x4002_5000	0x4002_5FFF		Base Timer
0x4002_6000	0x4002_6FFF		Reserved
0x4002_7000	0x4002_7FFF		A/D Converter
0x4002_8000	0x4002_DFFF		Reserved
0x4002_E000	0x4002_EFFF		Built-in CR trimming
0x4002_F000	0x4002_FFFF		Reserved
0x4003_0000	0x4003_0FFF		External Interrupt Controller
0x4003_1000	0x4003_1FFF		Interrupt Request Batch-Read Function
0x4003_2000	0x4003_2FFF		Reserved
0x4003_3000	0x4003_3FFF		GPIO
0x4003_4000	0x4003_4FFF		HDMI-CEC/Remote Control Receiver
0x4003_5000	0x4003_5FFF		Low-Voltage Detection / DS mode / Vref Calibration
0x4003_6000	0x4003_6FFF		USB Clock Generator
0x4003_7000	0x4003_77FF		Reserved
0x4003_7800	0x4003_79FF		I2C Slave
0x4003_7A00	0x4003_7FFF		Reserved
0x4003_8000	0x4003_8FFF		Multi-function Serial Interface
0x4003_9000	0x4003_9FFF		CRC
0x4003_A000	0x4003_AFFF		Watch Counter
0x4003_B000	0x4003_BFFF		Real-time clock
0x4003_C000	0x4003_C0FF		Low-speed CR Prescaler
0x4003_C100	0x4003_C7FF		Peripheral Clock Gating
0x4003_C800	0x4003_C8FF		Reserved
0x4003_C900	0x4003_C9FF		Smart Card Interface
0x4003_CA00	0x4003_CAFF		MFS-I2S Clock Generator
0x4003_CB00	0x4003_FFFF		Reserved
0x4004_0000	0x4004_FFFF	AHB	USB ch.0
0x4005_0000	0x4006_0FFF		Reserved
0x4006_1000	0x4006_1FFF		DSTC
0x4006_2000	0x41FF_FFFF		Reserved

10. Pin Status in Each CPU State

The following table shows pin status in each CPU state.

Type	Selected Pin function		CPU state							
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A	Main osillation circuit selected *1	Main osillation circuit selected	OS	OS	OE	OE	OE	OS	OS	OS
	Digital I/O slected *2	Main clock external input selected	-	-	IE/IS	IE/IS	IE/IS	IS	IS	IS
		GPIO selected	-	-	PC	HC	IS	HS	IS	HS
B	Main osillation circuit selected *1	Main osillation circuit selected	OS	OS	OE	OE	OE	OS	OS	OS
	Digital I/O slected *2	GPIO selected	-	-	PC	HC	IS	GS	IS	GS
C	Sub osillation circuit selected *1	Sub osillation circuit selected	OS	OE	OE	OE	OE	OE	OE	OE
	Digital I/O slected *2	Sub clock external input selected	-	-	IE/IS	IE/IS	IE/IS	IS	IS	IS
		GPIO selected	-	-	PC	HC	IS	HS	IS	HS
D	Sub osillation circuit selected *1	Sub osillation circuit selected	OS	OE	OE	OE	OE	OE	OE	OE
	Digital I/O slected *2	GPIO selected	-	-	PC	HC	IS	HS	IS	HS
E	Digital I/O slected	INITX input	This pin is digital input pin, pull up register is on, and digital input is not shut off in all CPU state..							
F	Digital I/O slected	MD0 input	This pin is digital input pin, pull up register is none, digital input is not shut off in all CPU state..							
G	USB I/O selected *7	USB port selected	-	-	UE	US	US	US	US	US
	Digital I/O slected *6	GPIO selected	IS	IE	CP	HC	IS	HS	IS	HS
H	Digital I/O slected	SW selected	IS	IP *5	PC	IP	IP	IP	IP	IP
		GPIO selected	-	-	PC	HC	IS	HS	IS	HS
I	Digital I/O slected	NMI selected	-	-	IP	IP	IP	-	-	-
		WKUP0 enable and input selected	-	-	IP	IP	IP	IP	IP	IP
		GPIO selected	IS	IE	PC	HC	IS	-	-	-
J	Analog input selected *3	Analog input selected	Analog input is enalbe in all CPU state							
	Digital I/O slected *4	WKUP enable and input selected	-	-	IP	IP	IP	IP	IP	IP
		Exterrnal interrupt enable and input selected	-	-	IP	IP	IP	GS	IS	GS
		GPIO selected	-	-	PC	HC	IS	HS	IS	HS
		Resource other than above selected	-	-	PC	HC	IS	GS	IS	GS
K	Digital I/O slected	CEC pin selected	-	-	CP	CP	CP	CP	CP	CP
		WKUP enable and input selected	-	-	IP	IP	IP	IP	IP	IP
		I2CSLAVE enable selected	-	-	PC	HC	IP	GS	IS	GS
		Exterrnal interrupt enable and input selected	-	-	PC	HC	IP	GS	IS	GS
		GPIO selected	IS	IE	PC	HC	IS	HS	IS	HS
		Resource other than above selected	-	-	PC	HC	IS	GS	IS	GS

Each term in above table have the following meanings.

Type
This indicates a pin status type that is shown in “pin list table” in “4. List of Pin Functions”

Selected Pin function
This indicates a pin function that is selected by user program.

CPU state
This indicates a state of the CPU that is shown below.

(1) Reset state. CPU is initialized by Power-on reset or a reset due to low Power voltage supply.

(2) Reset state. CPU is initialized by INITX input signal or system initialization after power on reset.

(3) Run mode or SLEEP mode state.

(4) Timer mode, RTC mode or STOP mode state.
The standby pin level setting bit (SPL) in the Standby Mode Control Register (STB_CTL) is set to "0".

(5) Timer mode, RTC mode or STOP mode state.
The standby pin level setting bit (SPL) in the Standby Mode Control Register (STB_CTL) is set to "1".

(6) Deep standby STOP mode or Deep standby RTC mode state,
The standby pin level setting bit (SPL) in the Standby Mode Control Register (STB_CTL) is set to "0"

(7) Deep standby STOP mode or Deep standby RTC mode state,
The standby pin level setting bit (SPL) in the Standby Mode Control Register (STB_CTL) is set to "1"

(8) Run mode state after returning from Deep Standby mode.
(I/O state hold function(CONTX) is fixed at 1)

Each pin status

The meaning of the symbols in the pin status table is as follows.

IS	Digital output is disabled. (Hi-Z) Pull up register is off. Digital input is shut off by fixed 0.
IE	Digital output is disabled. (Hi-Z) Pull up register is off. Digital input is not shut off.
IP	Digital output is disabled. (Hi-Z) Pull up register is defined by the value of the PCR register. Digital input is not shut off.
IE/IS	Digital output is disabled. (Hi-Z) Pull up register is off. Digital input is shut off in case of the OSC stop. Digital input is not shut off in case of the OSC operation.
OE	The OSC is in operation state. However, it may be stopped in some operation mode of the CPU. For detail, see chapter “Low Power Consumption Mode” in peripheral manual.
OS	The OSC is in stop state. (Hi-Z)
UE	USB I/O function is controlled by USB controller.
US	USB I/O function is disabled(Hi-Z)
PC	Digital output and pull up register is controlled by the register in the GPIO or peripheral function. Digital input is not shut off
CP	Digital output is controlled by the register in the GPIO or peripheral function. Pull up register is off. Digital input is not shut off.
HC	Digital output and pull up register is maintained the status that is immediately prior to entering the current CPU state. Digital input is not shut off
HS	Digital output and pull up register is maintained the status that is immediately prior to entering the current CPU state. Digital input is shut off
GS	Digital output and pull up register is copied the GPIO status that is immediately prior to entering the current CPU state and the status is maintained. Digital input is shut off

Additional note

Additional note is described below.

*1	In this type, when internal oscillation function is selected, digital output is disabled. (Hi-Z) pull up register is off, digital input is shut off by fixed 0.
*2	In this type, when Digital I/O function is selected, internal oscillation function is disabled.
*3	In this type, when analog input function is selected, digital output is disabled, (Hi-Z). pull up register is off, digital input is shut off by fixed 0.
*4	In this type, when Digital I/O function is selected, analog input function is not available.
*5	In this case, PCR register is initialized to “1”. Pull up register is on.
*6	In this type, when Digital I/O function is selected, USB I/O function is disabled. This pin does not have pull up register.
*7	In this type, when USB I/O function is selected, digital output is disabled. (Hi-Z), digital input is shut off by fixed 0.

11. Electrical Characteristics

11.1 Absolute Maximum Ratings

Parameter	Symbol	Rating		Unit	Remarks
		Min	Max		
Power supply voltage*1, *2	V_{CC}	V_{SS} - 0.5	V_{SS} + 4.6	V	
Analog reference voltage*1, *3	AVRH	V_{SS} - 0.5	V_{SS} + 4.6	V	
Input voltage*1	V_I	V_{SS} - 0.5	V_{CC} + 0.5 (≤ 4.6 V)	V	
		V_{SS} - 0.5	V_{SS} + 6.5	V	5 V tolerant
Analog pin input voltage*1	V_{IA}	V_{SS} - 0.5	V_{CC} + 0.5 (≤ 4.6 V)	V	
Output voltage*1	V_O	V_{SS} - 0.5	Vcc + 0.5 (≤ 4.6 V)	V	
L level maximum output current*4	I_{OL}	-	10	mA	4 mA type
L level average output current*5	I_{OLAV}	-	4	mA	4 mA type
L level total maximum output current	$\sum I_{OL}$	-	100	mA	
L level total average output current*6	$\sum I_{OLAV}$	-	50	mA	
H level maximum output current*4	I_{OH}	-	- 10	mA	4 mA type
H level average output current*5	I_{OHAV}	-	- 4	mA	4 mA type
H level total maximum output current	$\sum I_{OH}$	-	- 100	mA	
H level total average output current*6	$\sum I_{OHAV}$	-	- 50	mA	
Power consumption	P_D	-	200	mW	
Storage temperature	T_{STG}	- 55	+ 150	°C	

*1: These parameters are based on the condition that V_{SS}= 0 V.

*2: V_{CC} must not drop below V_{SS} - 0.5 V.

*3: Ensure that the voltage does not to exceed V_{CC} + 0.5 V at power-on.

*4: The maximum output current is the peak value for a single pin.

*5: The average output is the average current for a single pin over a period of 100 ms.

*6: The total average output current is the average current for all pins over a period of 100 ms.

<WARNING>

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

11.2 Recommended Operating Conditions

(V_{SS}= 0.0 V)

Parameter	Symbol	Conditions	Value		Unit	Remarks
			Min	Max		
Power supply voltage	V_{CC}	-	1.65 *3	3.6	V	
			3.0	3.6	V	*1
Analog reference voltage	AVRH	-	2.7	V_{CC}	V	V_{CC} ≥ 2.7 V
			V_{CC}	V_{CC}	V	V_{CC} < 2.7 V
	AVRL	-	VSS	VSS	V	
Smoothing capacitor	C_S	-	1	10	µF	For regulator*2
Operating temperature	Ta	-	- 40	+ 105	°C	

*1: When P81/UDP0 and P80/UDM0 pins are used as USB (UDP0, UDM0).

*2: See "C Pin" in "7. Handling Devices" for the connection of the smoothing capacitor.

*3: In between less than the minimum power supply voltage reset / interrupt detection voltage or more, instruction execution and low voltage detection function by built-in High-speed CR (including Main PLL is used) or built-in Low-speed CR is possible to operate only.

<WARNING>

1. *The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated within these ranges.*
2. *Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.*
3. *No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet.*
4. *Users considering application outside the listed conditions are advised to contact their representatives beforehand.*

11.3 DC Characteristics

11.3.1 Current Rating

Symbol (Pin Name)	Conditions		HCLK Frequency*4	Value Typ*1	Value Max*2	Unit	Remarks
Icc (VCC)	Run mode, code executed from Flash	8 MHz external clock input, PLL ON*8 NOP code executed Built-in high speed CR stopped All peripheral clock stopped by CKENx	8 MHZ	1.4	2.7	mA	*3
			20 MHZ	2.6	4.1		
			40 MHZ	3.9	5.6		
		8 MHz external clock input, PLL ON*8 Benchmark code executed Built-in high speed CR stopped PCLK1 stopped	8 MHZ	1.3	2.6	mA	*3
			20 MHZ	2.3	3.8		
			40 MHZ	3.4	5.1		
		8 MHz crystal oscillation, PLL ON*8 NOP code executed Built-in high speed CR stopped All peripheral clock stopped by CKENx	8 MHZ	1.6	3.0	mA	*3, *9
			20 MHZ	2.8	4.4		
			40 MHZ	4.1	5.9		
	Run mode, code executed from RAM	8 MHz external clock input, PLL ON*8 NOP code executed Built-in high speed CR stopped All peripheral clock stopped by CKENx	8 MHZ	1.0	2.1	mA	*3
			20 MHZ	1.7	2.9		
			40 MHZ	2.7	4.0		
	Run mode, code executed from Flash	8 MHz external clock input, PLL ON NOP code executed Built-in high speed CR stopped PCLK1 stopped	40 MHZ	1.6	3.1	mA	*3,*6,*7
	Run mode, code executed from Flash	Built-in high speed CR*5 NOP code executed All peripheral clock stopped by CKENx	8 MHZ	1.1	2.4	mA	*3
		32 kHz crystal oscillation NOP code executed All peripheral clock stopped by CKENx	32 kHZ	240	1264	µA	*3
		Built-in low speed CR NOP code executed All peripheral clock stopped by CKENx	100 kHZ	246	1271	µA	*3
Iccs (VCC)	Sleep operation	8 MHz external clock input, PLL ON*8 All peripheral clock stopped by CKENx	8 MHZ	0.8	1.9	mA	*3
			20 MHZ	1.3	2.4		
			40 MHZ	1.8	3.0		
		Built-in high speed CR*5 All peripheral clock stopped by CKENx	8 MHZ	0.6	1.7	mA	*3
		32 kHz crystal oscillation All peripheral clock stopped by CKENx	32 kHZ	237	1261	µA	*3
		Built-in low speed CR All peripheral clock stopped by CKENx	100 kHZ	238	1262	µA	*3

*1 : T_A=+25°C,V_{CC}=3.3 V
*2 : T_A=+105°C,V_{CC}=3.6 V
*3 : All ports are fixed
*4 : PCLK0 is set to divided rate 8
*5 : The frequency is set to 8 MHz by trimming
*6 : Flash sync down is set to FRWTR.RWT=111 and FSYNDN.SD=1111
*7 : VCC=1.65 V
*8 : When HCLK=8 MHz, PLL OFF
*9 : When IMAINSEL bit(MOSC_CTL:IMAINSEL) is “10” (default).

Parameter	Symbol (Pin Name)	Conditions		Value		Unit	Remarks
				Typ	Max		
Power supply current	I_{CCH} (VCC)	Stop mode	Ta=25°C Vcc=3.3 V	12.4	52.4	µA	*1, *2
			Ta=25°C Vcc=1.65 V	12.0	52.0	µA	*1, *2
			Ta=105°C Vcc=3.6 V	-	597	µA	*1, *2
	I_{CCT} (VCC)	Sub timer mode	Ta=25°C Vcc=3.3 V 32 kHz Crystal oscillation	15.6	55.6	µA	*1, *2
			Ta=25°C Vcc=1.65 V 32 kHz Crystal oscillation	15.0	55.0	µA	*1, *2
			Ta=105°C Vcc=3.6 V 32 kHz Crystal oscillation	-	601	µA	*1, *2
	I_{CCR} (VCC)	RTC mode	Ta=25°C Vcc=3.3 V 32 kHz Crystal oscillation	13.2	53.2	µA	*1, *2
			Ta=25°C Vcc=1.65 V 32 kHz Crystal oscillation	12.7	52.7	µA	*1, *2
			Ta=105°C Vcc=3.6 V 32 kHz Crystal oscillation	-	598	µA	*1, *2

*1: All ports are fixed. LVD off. Flash off.
*2: When CALDONE bit(CAL_CTL:CALDONE) is “1”. In case of “0”, Bipolar Vref current is added.

Parameter	Symbol (Pin Name)	Conditions			Value		Unit	Remarks
					Typ	Max		
Power supply current	I_{CCHD} (VCC)	Deep standby Stop mode	RAM off	Ta=25°C Vcc=3.3 V	0.58	1.85	µA	*1, *2
				Ta=25°C Vcc=1.65 V	0.56	1.83	µA	*1, *2
				Ta=105°C Vcc=3.6 V	-	46	µA	*1, *2
			RAM on	Ta=25°C Vcc=3.3 V	0.78	6.6	µA	*1, *2
				Ta=25°C Vcc=1.65 V	0.76	6.6	µA	*1, *2
				Ta=105°C Vcc=3.6 V	-	88	µA	*1, *2
	I_{CCRD} (VCC)	Deep standby RTC mode	RAM off	Ta=25°C Vcc=3.3 V	1.16	2.4	µA	*1, *2
				Ta=25°C Vcc=1.65 V	1.15	2.4	µA	*1, *2
				Ta=105°C Vcc=3.6 V	-	46	µA	*1, *2
			RAM on	Ta=25°C Vcc=3.3 V	1.37	7.2	µA	*1, *2
				Ta=25°C Vcc=1.65 V	1.35	7.2	µA	*1, *2
				Ta=105°C Vcc=3.6 V	-	88	µA	*1, *2

*1: All ports are fixed. LVD off.
*2: When CALDONE bit(CAL_CTL:CALDONE) is “1”. In case of “0”, Bipolar Vref current is added.

LVD Current

(V_{CC}=1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Typ	Max		
Low-Voltage detection circuit (LVD) power supply current	I_{CCLVD}	VCC	At operation	0.15	0.3	µA	For occurrence of reset
				0.10	0.3	µA	For occurrence of interrupt

Bipolar Vref Current

(V_{CC}=1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Typ	Max		
Bipolar Vref Current	I_{CCBGR}	VCC	At operation	100	200	µA	

Flash Memory Current

(V_{CC}=1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Typ	Max		
Flash memory write/erase current	$I_{CCFLASH}$	VCC	At Write/Erase	4.4	5.6	mA	

A/D converter Current

(V_{CC}=1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Typ	Max		
Power supply current	I_{CCAD}	VCC	At operation	0.5	0.75	mA	
Reference power supply current (AVRH)	I_{CCAVRH}	AVRH	At operation	0.69	1.3	mA	AVRH=3.6 V
			At stop	0.1	1.3	µA	

Peripheral Current Dissipation

(V_{CC}=1.65 V to 3.6 V, V_{SS}=0 V, T_A=- 40°C to +105°C)

Clock System	Peripheral	Conditions	Frequency (MHz)			Unit	Remarks
			8	20	40		
HCLK	GPIO	At all ports operation	0.05	0.12	0.23	mA	
	DSTC	At 2ch operation	0.02	0.06	0.10		
	USB	At 1ch operation	0.13	0.13	0.13	mA	*1
PCLK1	Base timer	At 4ch operation	0.02	0.05	0.10	mA	
	ADC	At 1 unit operation	0.04	0.10	0.21		
	Multi-function serial	At 1ch operation	0.01	0.03	0.06		
	MFS-I2S	At 1ch operation	0.02	0.05	0.08		
	Smart Card I/F	At 1ch operation	0.04	0.08	0.18		

*1 USB itself uses 48MHz clock

11.3.2 Pin Characteristics

(V_{CC} = 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
H level input voltage (hysteresis input)	V_{IHS}	CMOS hysteresis input pin, MD0	$V_{CC} \geq 2.7$ V	$V_{CC} \times 0.8$	-	V_{CC} +0.3	V	
			$V_{CC} < 2.7$ V	$V_{CC} \times 0.7$				
		5 V tolerant input pin	$V_{CC} \geq 2.7$ V	$V_{CC} \times 0.8$	-	V_{SS} +5.5	V	
			$V_{CC} < 2.7$ V	$V_{CC} \times 0.7$				
L level input voltage (hysteresis input)	V_{ILS}	CMOS hysteresis input pin, MD0	$V_{CC} \geq 2.7$ V	V_{SS} - 0.3	-	$V_{CC} \times 0.2$	V	
			$V_{CC} < 2.7$ V			$V_{CC} \times 0.3$		
		5 V tolerant input pin	$V_{CC} \geq 2.7$ V	V_{SS} - 0.3	-	$V_{CC} \times 0.2$	V	
			$V_{CC} < 2.7$ V		-	$V_{CC} \times 0.3$		
H level output voltage	V_{OH}	4 mA type	$V_{CC} \geq 2.7$ V, I_{OH} = - 4 mA	V_{CC} - 0.5	-	V_{CC}	V	
			$V_{CC} < 2.7$ V, I_{OH} = - 2 mA	V_{CC} - 0.45				
L level output voltage	V_{OL}	4 mA type	$V_{CC} \geq 2.7$ V, I_{OL} 4 mA	V_{SS}	-	0.4	V	
			$V_{CC} < 2.7$ V, I_{OL}=2 mA					
Input leak current	I_{IL}	-	-	- 5	-	+ 5	µA	
Pull-up resistance value	R_{PU}	Pull-up pin	$V_{CC} \geq 2.7$ V	21	33	48	kΩ	
			$V_{CC} < 2.7$ V	-	-	88		
Input capacitance	C_{IN}	Other than VCC, VSS, AVRH	-	-	5	15	pF	

11.4 AC Characteristics

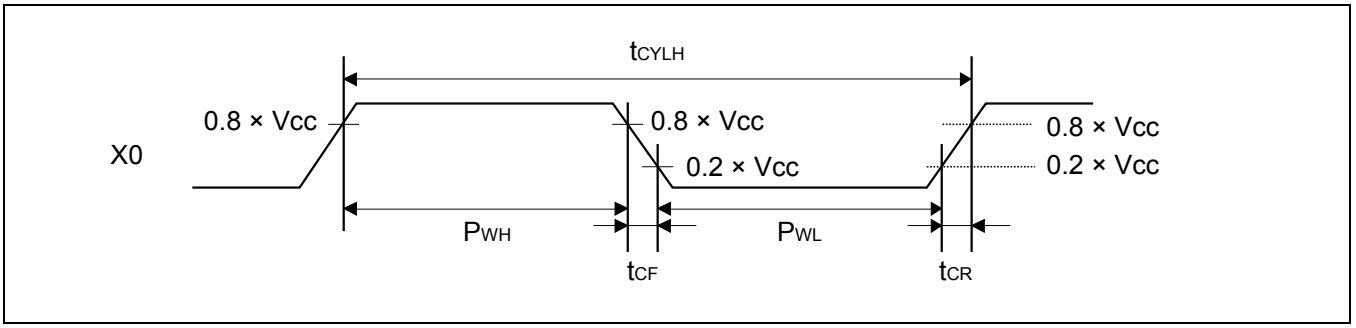
11.4.1 Main Clock Input Characteristics

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin name	Conditions	Value		Unit	Remarks
				Min	Max		
Input frequency	F_{CH}	X0, X1	$V_{CC} \geq 2.7V$	8	48	MHz	When the crystal oscillator is connected
			$V_{CC} < 2.7V$	8	20		
			-	8	48	MHz	When the external clock is used
Input clock cycle	t_{CYLH}		-	20.83	125	ns	When the external clock is used
Input clock pulse width	-		P_{WH}/t_{CYLH}, P_{WL}/t_{CYLH}	45	55	%	When the external clock is used
Input clock rising time and falling time	t_{CF}, t_{CR}		-	-	5	ns	When the external clock is used
Internal operating clock*1 frequency	F_{CM}	-	-	-	40.8	MHz	Master clock
	F_{CC}	-	-	-	40.8	MHz	Base clock (HCLK/FCLK)
	F_{CP0}	-	-	-	40.8	MHz	APB0 bus clock*2
	F_{CP1}	-	-	-	40.8	MHz	APB1 bus clock*2
Internal operating clock*1 cycle time	t_{CYCCM}	-	-	24.5	-	ns	Master clock
	t_{CYCC}	-	-	24.5	-	ns	Base clock (HCLK/FCLK)
	t_{CYCP0}	-	-	24.5	-	ns	APB0 bus clock*2
	t_{CYCP1}	-	-	24.5	-	ns	APB1 bus clock*2

*1: For details of each internal operating clock, refer to "Chapter: Clock" in "FM0+ Family Peripheral Manual".

*2: For details of the APB bus to which a peripheral is connected, see "8. Block Diagram".

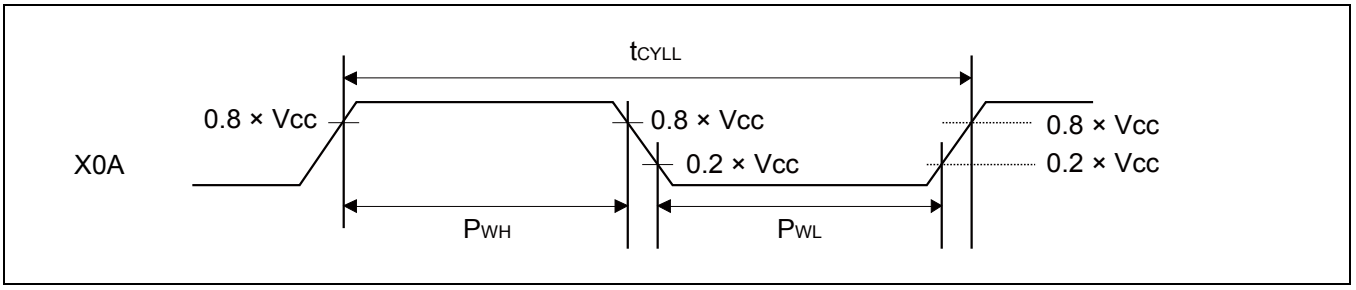


11.4.2 Sub Clock Input Characteristics

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

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

*: See "Sub crystal oscillator" in "7. Handling Devices" for the crystal oscillator used.



11.4.3 Built-in CR Oscillation Characteristics

Built-in High-Speed CR

(V_{CC}= 1.65 V to 3.6 V, V_{SS} = 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	Value			Unit	Remarks
			Min	Typ	Max		
Clock frequency	F_{CRH}	Ta = - 10°C to + 105°C,	7.92	8	8.08	MHz	After trimming *1
		Ta = - 40°C to + 105°C,	7.84	8	8.16	MHz	
Frequency stabilization time	t_{CRWT}	-	-	-	300	µs	*2

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

*2: This is time from the trim value setting to stable of the frequency of the High-speed CR clock. After setting the trim value, the period when the frequency stability time passes can use the High-speed CR clock as a source clock.

Built-in Low-Speed CR

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

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

11.4.4 Operating Conditions of Main PLL (In the Case of Using the Main Clock as the Input Clock of the PLL)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

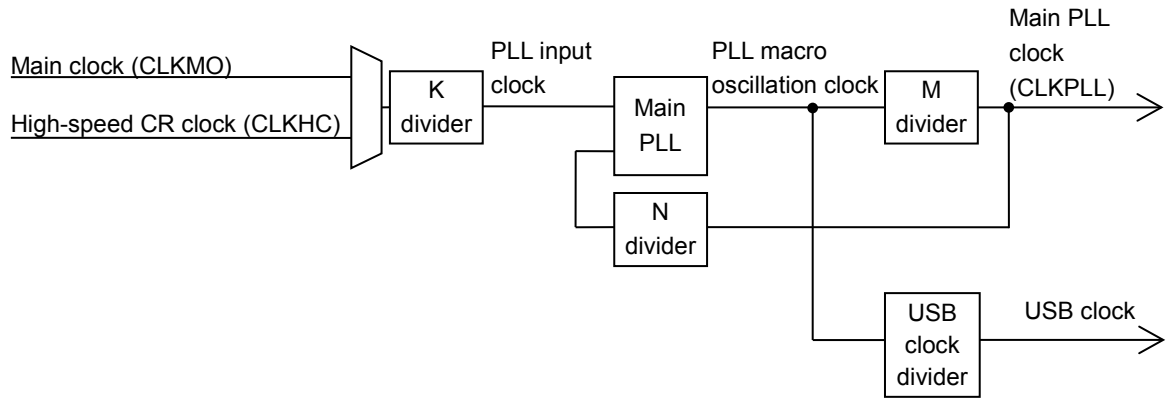
Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
PLL oscillation stabilization wait time*1 (LOCK UP time)	t_{LOCK}	50	-	-	µs	
PLL input clock frequency	F_{PLLI}	8	-	16	MHz	
PLL multiple rate	-	5	-	18	multiple	
PLL macro oscillation clock frequency	F_{PLLO}	75	-	150	MHz	
Main PLL clock frequency*2	F_{CLKPLL}	-	-	40	MHz	
USB clock frequency*3	$F_{CLKSPLL}$	-	-	48	MHz	

*1: The wait time is the time it takes for PLL oscillation to stabilize.

*2: For details of the main PLL clock (CLKPLL), refer to "Chapter: Clock" in "FM0+ Family Peripheral Manual".

*3: For more information about USB clock, see "Chapter: USB Clock Generation" in "FM0+ Family Peripheral Manual Communication Macro Part".

Main PLL connection



11.4.5 Operating Conditions of Main PLL (In the Case of Using the Built-in High-Speed CR Clock as the Input Clock of the Main PLL)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
PLL oscillation stabilization wait time*1 (LOCK UP time)	t_{LOCK}	50	-	-	µs	
PLL input clock frequency	F_{PLLI}	7.84	8	8.16	MHz	
PLL multiple rate	-	9	-	18	multiple	
PLL macro oscillation clock frequency	F_{PLLO}	75	-	150	MHz	
Main PLL clock frequency*2	F_{CLKPLL}	-	-	40.8	MHz	

*1: The wait time is the time it takes for PLL oscillation to stabilize.

*2: For details of the main PLL clock (CLKPLL), refer to "Chapter: Clock" in "FM0+ Family Peripheral Manual".

Note:

- *For the main PLL source clock, input the high-speed CR clock (CLKHC) whose frequency and temperature have been trimmed. When setting PLL multiple rate, please take the accuracy of the built-in High-speed CR clock into account and prevent the master clock from exceeding the maximum frequency.*

11.4.6 Reset Input Characteristics

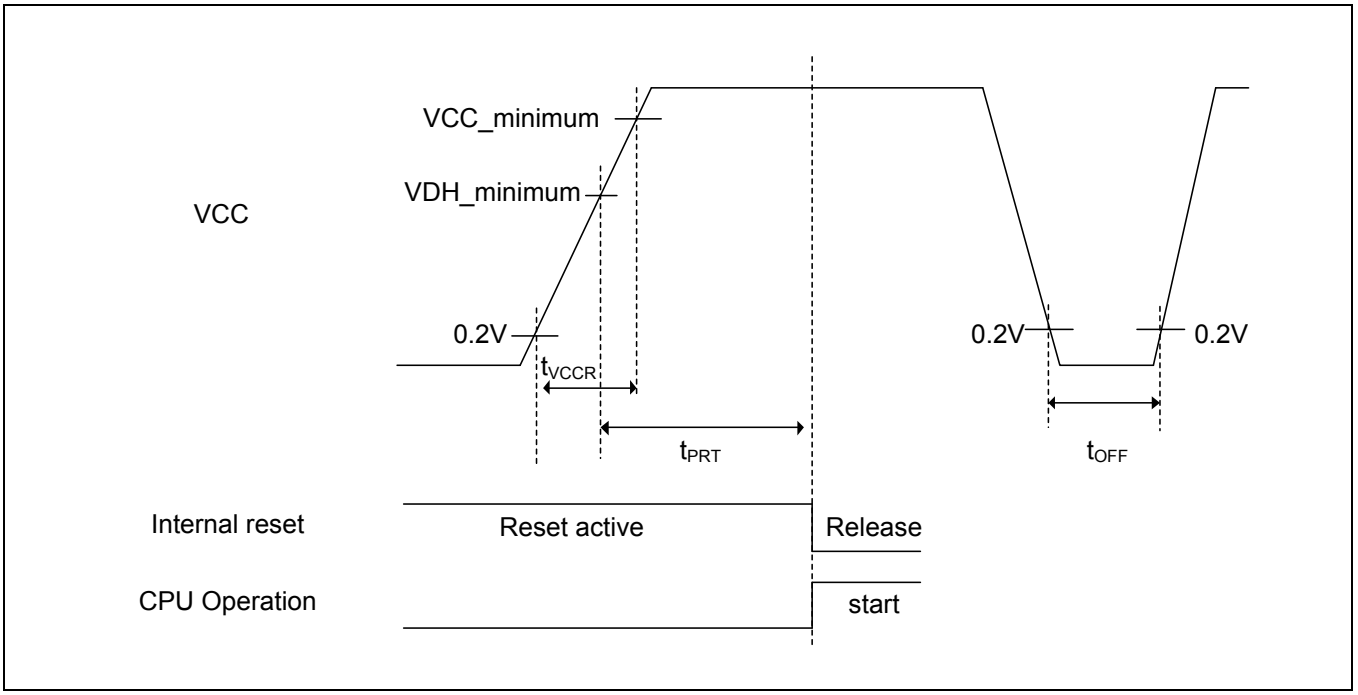
(V_{CC} = 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Reset input time	t_{INITX}	INITX	-	500	-	ns	

11.4.7 Power-on Reset Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Value		Unit	Remarks
			Min	Max		
Power supply rising time	t_{VCCR}	VCC	0	-	ms	
Power supply shut down time	t_{OFF}		1	-	ms	VCC < 0.2V
Time until releasing Power-on reset	t_{PRT}		0.43	3.4	ms	



Glossary

- VCC_minimum : Minimum V_{CC} of recommended operating conditions.
- VDH_minimum : Minimum detection voltage of Low-Voltage detection reset.

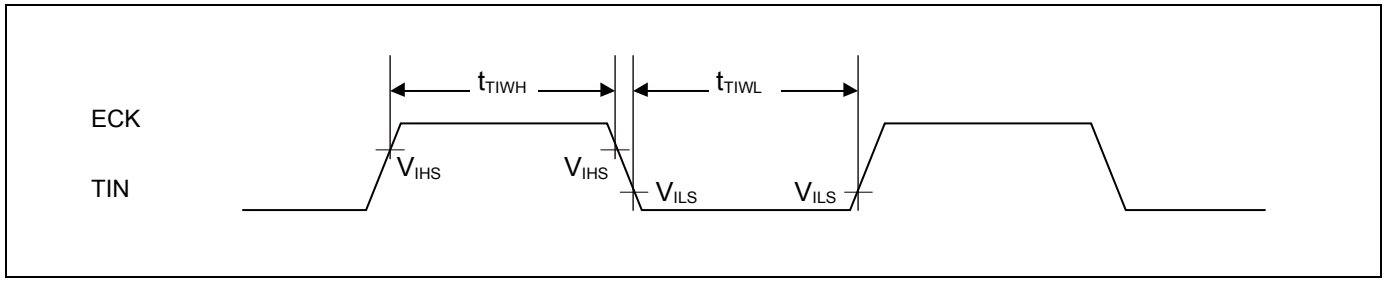
See "11.7 Low-Voltage Detection Characteristics".

11.4.8 Base Timer Input Timing

Timer Input Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

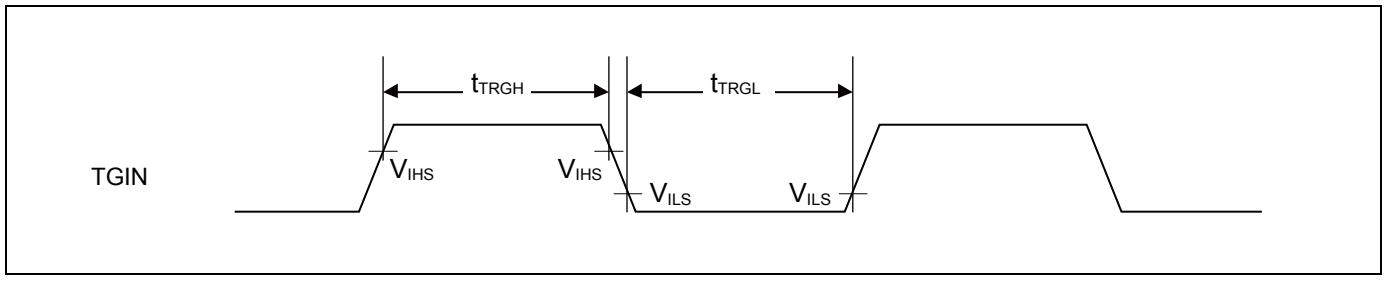
Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Input pulse width	t_{TIWH}, t_{TIWL}	TIOAn/TIOBn (when using as ECK, TIN)	-	2 t_{CYCP}	-	ns	



Trigger Input Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

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



Note:

- *t_{CYCP} indicates the APB bus clock cycle time.*
  For the number of the APB bus to which the Base Timer has been connected, see "8. Block Diagram".

11.4.9 CSIO/SPI/UART Timing

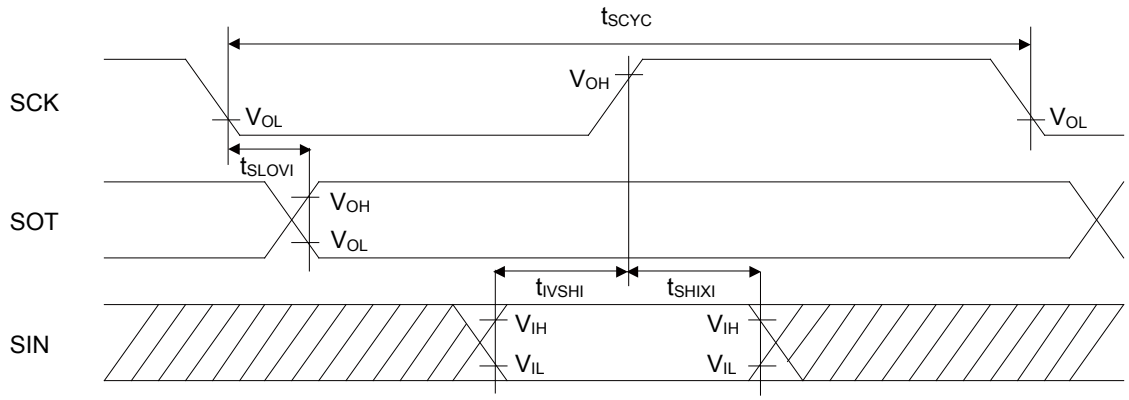
CSIO (SPI=0, SCINV=0)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

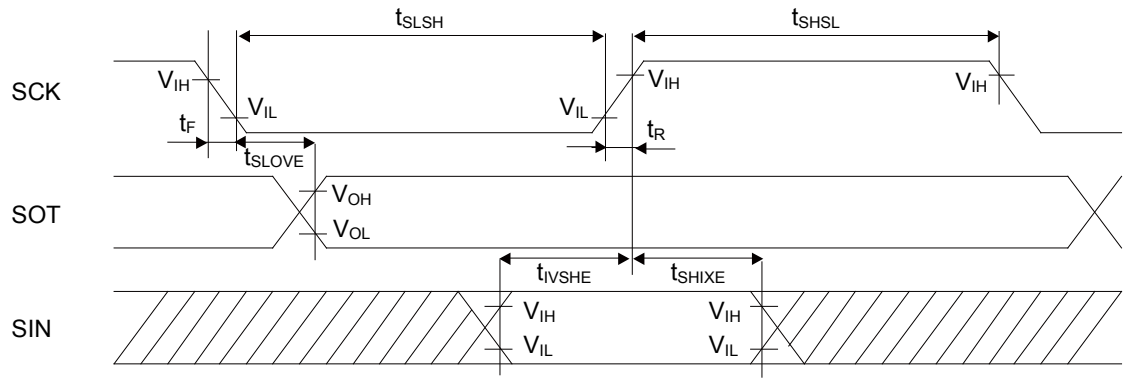
Parameter	Symbol	Pin name	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
				Min	Max	Min	Max	
Serial clock cycle time	t_{SCYC}	SCKx	Master mode	4 t_{CYCP}	-	4 t_{CYCP}	-	ns
SCK ↓ → SOT delay time	t_{SLOVI}	SCKx, SOTx		- 30	+ 30	- 20	+ 20	ns
SIN → SCK ↑ setup time	t_{IVSHI}	SCKx, SINx		50	-	36	-	ns
SCK ↑ → SIN hold time	t_{SHIXI}	SCKx, SINx		0	-	0	-	ns
Serial clock "L" pulse width	t_{SLSH}	SCKx	Slave mode	2 t_{CYCP} - 10	-	2 t_{CYCP} - 10	-	ns
Serial clock "H" pulse width	t_{SHSL}	SCKx		t_{CYCP} + 10	-	t_{CYCP} + 10	-	ns
SCK ↓ → SOT delay time	t_{SLOVE}	SCKx, SOTx		-	50	-	30	ns
SIN → SCK ↑ setup time	t_{IVSHE}	SCKx, SINx		10	-	10	-	ns
SCK ↑ → SIN hold time	t_{SHIXE}	SCKx, SINx		20	-	20	-	ns
SCK falling time	tF	SCKx		-	5	-	5	ns
SCK rising time	tR	SCKx		-	5	-	5	ns

Notes:

- *The above AC characteristics are for clock synchronous mode.*
- *t_{CYCP} represents the APB bus clock cycle time.*
  For the number of the APB bus to which Multi-function Serial has been connected, see "8. Block Diagram".
- *The characteristics are only applicable when the relocate port numbers are the same.*
  For instance, they are not applicable for the combination of SCKx_0 and SOTx_1.
- *External load capacitance C_L=30 pF*



Master mode



Slave mode

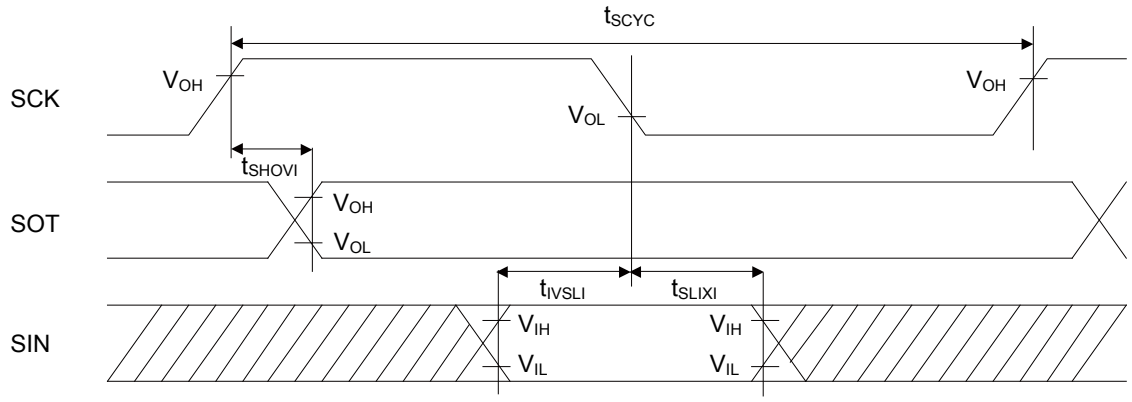
CSIO (SPI=0, SCINV=1)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

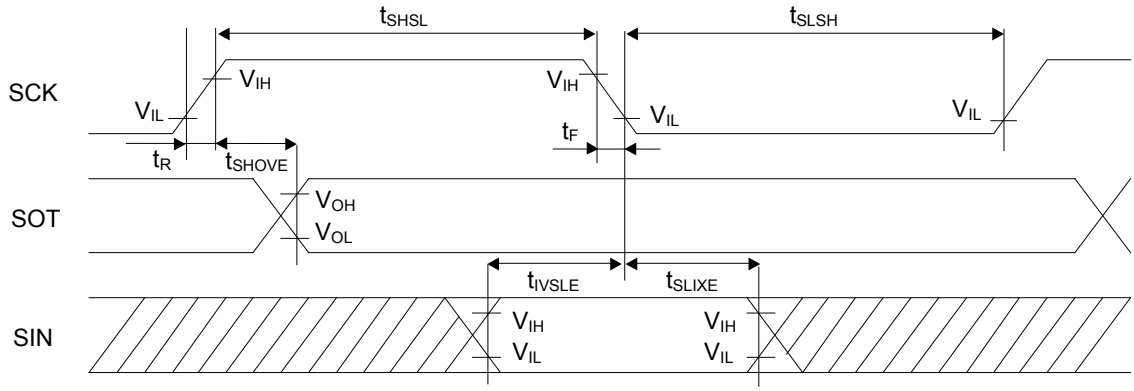
Parameter	Symbol	Pin name	Conditions	V_{CC} < 2.7V		V_{CC} ≥ 2.7V		Unit
				Min	Max	Min	Max	
Serial clock cycle time	t_{SCYC}	SCKx	Master mode	4 t_{CYCP}	-	4 t_{CYCP}	-	ns
SCK ↑ → SOT delay time	t_{SHOVI}	SCKx, SOTx		- 30	+ 30	- 20	+ 20	ns
SIN → SCK ↓ setup time	t_{IVSLI}	SCKx, SINx		50	-	36	-	ns
SCK ↓ → SIN hold time	t_{SLIXI}	SCKx, SINx		0	-	0	-	ns
Serial clock "L" pulse width	t_{SLSH}	SCKx	Slave mode	2 t_{CYCP} - 10	-	2 t_{CYCP} - 10	-	ns
Serial clock "H" pulse width	t_{SHSL}	SCKx		t_{CYCP} + 10	-	t_{CYCP} + 10	-	ns
SCK ↑ → SOT delay time	t_{SHOVE}	SCKx, SOTx		-	50	-	33	ns
SIN → SCK ↓ setup time	t_{IVSLE}	SCKx, SINx		10	-	10	-	ns
SCK ↓ → SIN hold time	t_{SLIXE}	SCKx, SINx		20	-	20	-	ns
SCK falling time	tF	SCKx		-	5	-	5	ns
SCK rising time	tR	SCKx		-	5	-	5	ns

Notes:

- *The above AC characteristics are for clock synchronous mode.*
- *t_{CYCP} represents the APB bus clock cycle time.*
  For the number of the APB bus to which Multi-function Serial has been connected, see "8. Block Diagram".
- *The characteristics are only applicable when the relocate port numbers are the same.*
  For instance, they are not applicable for the combination of SCKx_0 and SOTx_1.
- *External load capacitance C_L=30 pF*



Master mode



Slave mode

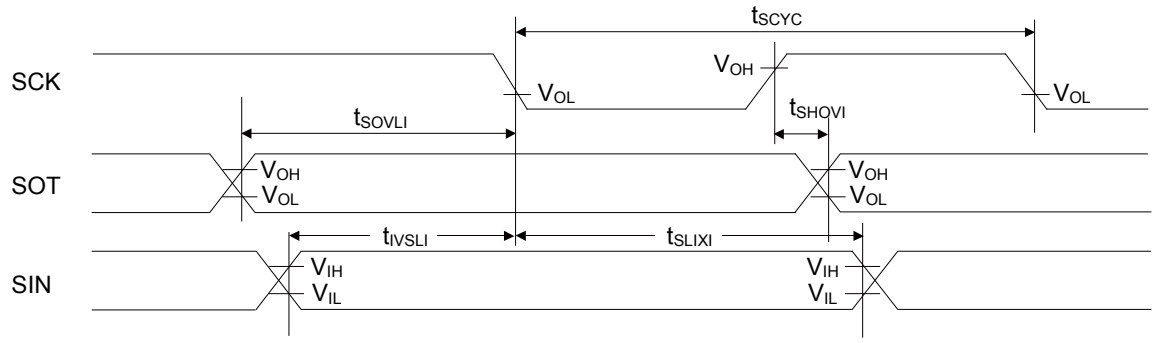
SPI (SPI=1, SCINV=0)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

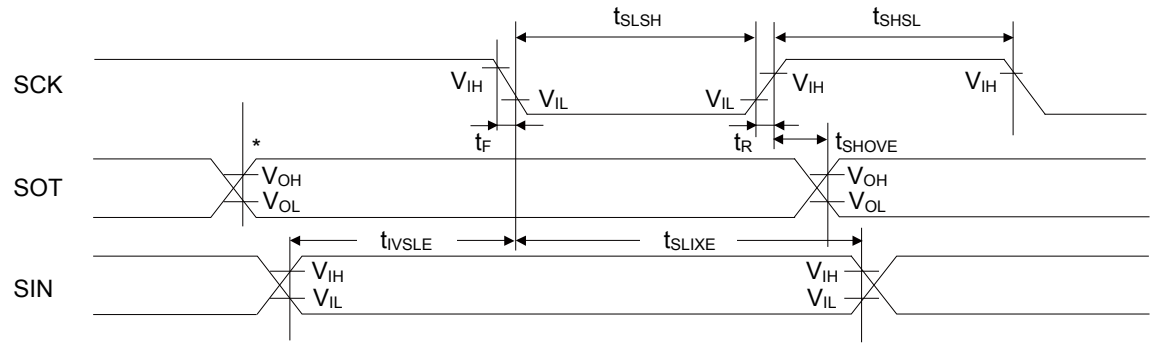
Parameter	Symbol	Pin name	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
				Min	Max	Min	Max	
Serial clock cycle time	t_{SCYC}	SCKx	Master mode	4 t_{CYCP}	-	4 t_{CYCP}	-	ns
SCK ↑ → SOT delay time	t_{SHOVI}	SCKx, SOTx		- 30	+ 30	- 20	+ 20	ns
SIN → SCK ↓ setup time	t_{IVSLI}	SCKx, SINx		50	-	36	-	ns
SCK ↓→ SIN hold time	t_{SLIXI}	SCKx, SINx		0	-	0	-	ns
SOT → SCK ↓ delay time	t_{SOVLI}	SCKx, SOTx		2 t_{CYCP} - 30	-	2 t_{CYCP} - 30	-	ns
Serial clock "L" pulse width	t_{SLSH}	SCKx	Slave mode	2 t_{CYCP} - 10	-	2 t_{CYCP} - 10	-	ns
Serial clock "H" pulse width	t_{SHSL}	SCKx		t_{CYCP} + 10	-	t_{CYCP} + 10	-	ns
SCK ↑ → SOT delay time	t_{SHOVE}	SCKx, SOTx		-	50	-	33	ns
SIN → SCK ↓ setup time	t_{IVSLE}	SCKx, SINx		10	-	10	-	ns
SCK ↓→ SIN hold time	t_{SLIXE}	SCKx, SINx		20	-	20	-	ns
SCK falling time	tF	SCKx		-	5	-	5	ns
SCK rising time	tR	SCKx		-	5	-	5	ns

Notes:

- *The above AC characteristics are for clock synchronous mode.*
- *t_{CYCP} represents the APB bus clock cycle time.*
  For the number of the APB bus to which Multi-function Serial has been connected, see "8. Block Diagram".
- *The characteristics are only applicable when the relocate port numbers are the same.*
  For instance, they are not applicable for the combination of SCKx_0 and SOTx_1.
- *External load capacitance C_L=30 pF*



Master mode



Slave mode

*: Changes when writing to TDR register

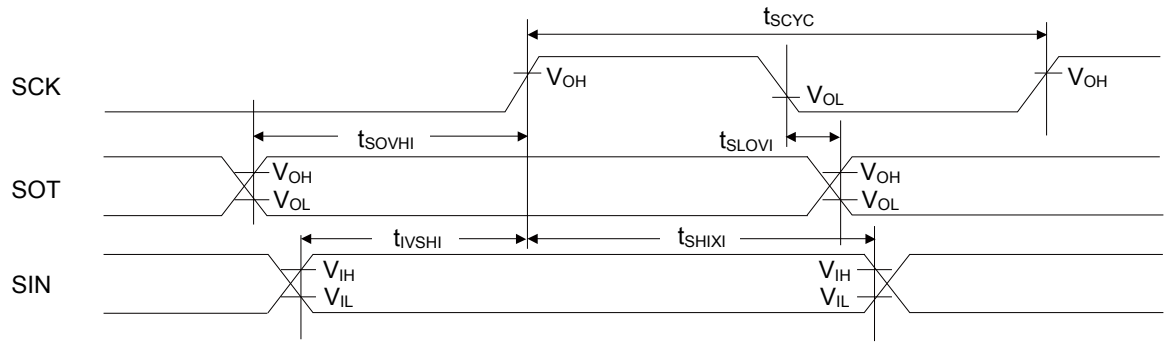
SPI (SPI=1, SCINV=1)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

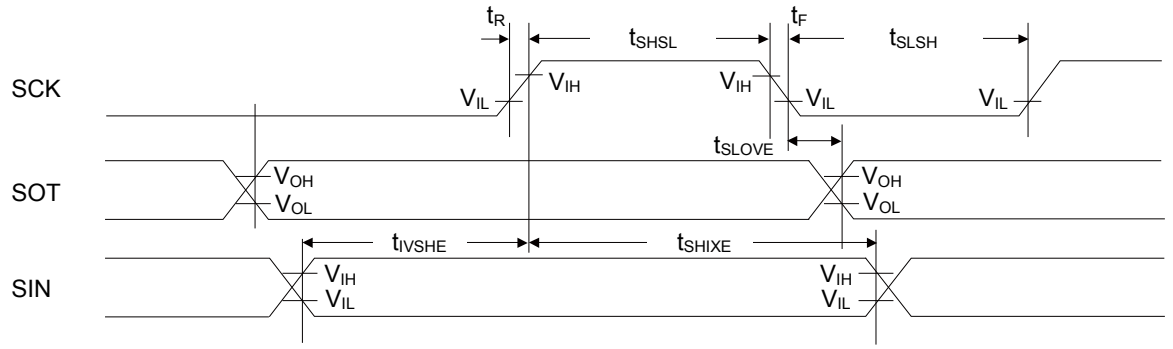
Parameter	Symbol	Pin name	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
				Min	Max	Min	Max	
Serial clock cycle time	t_{SCYC}	SCKx	Master mode	4 t_{CYCP}	-	4 t_{CYCP}	-	ns
SCK ↓ → SOT delay time	t_{SLOVI}	SCKx, SOTx		- 30	+ 30	- 20	+ 20	ns
SIN → SCK ↑ setup time	t_{IVSHI}	SCKx, SINx		50	-	36	-	ns
SCK ↑ → SIN hold time	t_{SHIXI}	SCKx, SINx		0	-	0	-	ns
SOT → SCK ↑ delay time	t_{SOVHI}	SCKx, SOTx		2 t_{CYCP} - 30	-	2 t_{CYCP} - 30	-	ns
Serial clock "L" pulse width	t_{SLSH}	SCKx	Slave mode	2 t_{CYCP} - 10	-	2 t_{CYCP} - 10	-	ns
Serial clock "H" pulse width	t_{SHSL}	SCKx		t_{CYCP} + 10	-	t_{CYCP} + 10	-	ns
SCK ↓ → SOT delay time	t_{SLOVE}	SCKx, SOTx		-	50	-	33	ns
SIN → SCK ↑ setup time	t_{IVSHE}	SCKx, SINx		10	-	10	-	ns
SCK ↑ → SIN hold time	t_{SHIXE}	SCKx, SINx		20	-	20	-	ns
SCK falling time	tF	SCKx		-	5	-	5	ns
SCK rising time	tR	SCKx		-	5	-	5	ns

Notes:

- *The above AC characteristics are for clock synchronous mode.*
- *t_{CYCP} represents the APB bus clock cycle time.*
  For the number of the APB bus to which Multi-function Serial has been connected, see "8. Block Diagram".
- *The characteristics are only applicable when the relocate port numbers are the same.*
  For instance, they are not applicable for the combination of SCKx_0 and SOTx_1.
- *External load capacitance C_L=30 pF*



Master mode



Slave mode

When Using CSIO/SPI Chip Select (SCINV=0, CSLVL=1)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
			Min	Max	Min	Max	
SCS↓→SCK↓ setup time	t_{CSSI}	Master mode	(*1)-50	(*1)+0	(*1)-50	(*1)+0	ns
SCK↑→SCS↑ hold time	t_{CSHI}		(*2)+0	(*2)+50	(*2)+0	(*2)+50	ns
SCS deselect time	t_{CSDI}		(*3)-50	(*3)+50	(*3)-50	(*3)+50	ns
SCS↓→SCK↓ setup time	t_{CSSE}	Slave mode	$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCK↑→SCS↑ hold time	t_{CSHE}		0	-	0	-	ns
SCS deselect time	t_{CSDE}		$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCS↓→SOT delay time	t_{DSE}		-	55	-	40	ns
SCS↑→SOT delay time	t_{DEE}		0	-	0	-	ns

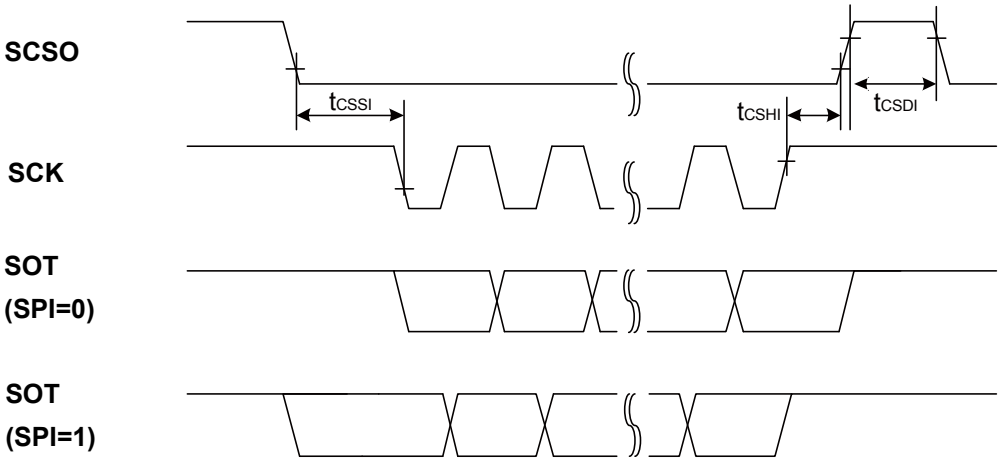
*1: CSSU bit value × serial chip select timing operating clock cycle.

*2: CSHD bit value × serial chip select timing operating clock cycle.

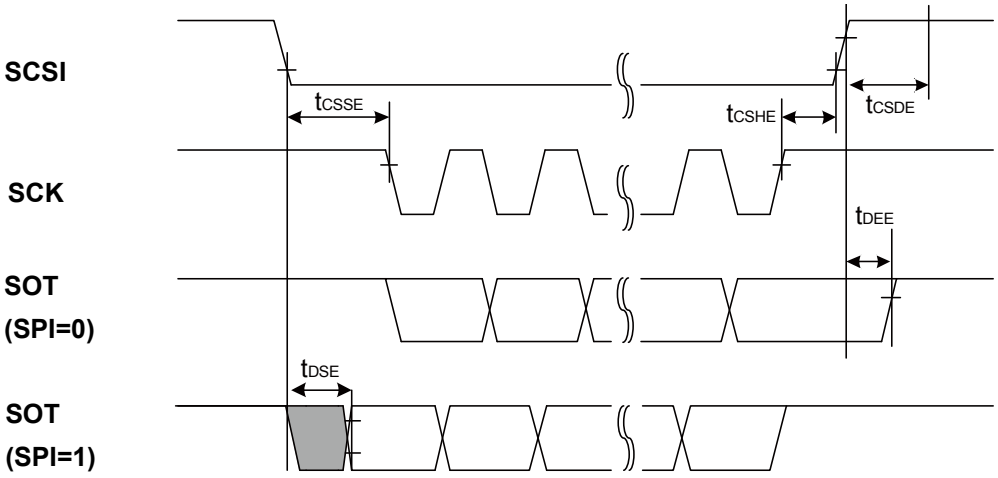
*3: CSDS bit value × serial chip select timing operating clock cycle.
Irrespective of CSDS bit setting, $5t_{CYCP}$ or more are required for the period the time when the serial chip select pin becomes inactive to the time when the serial chip select pin becomes active again.

Notes:

- *t_{CYCP} indicates the APB bus clock cycle time.*
  For information about the APB bus number which Multi-function Serial is connected to, see "8. Block Diagram".
- *For information about CSSU, CSHD, CSDS, serial chip select timing operating clock, see "FM0+ Family Peripheral Manual".*
- *These characteristics only guarantee the same relocate port number.*
  For example, the combination of SCKx_0 and SCSIx_1 is not guaranteed.
- *When the external load capacitance C_L=30 pF.*



Master mode



Slave mode

When Using CSIO/SPI Chip Select (SCINV=1, CSLVL=1)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
			Min	Max	Min	Max	
SCS↓→SCK↑ setup time	t_{CSSI}	Master mode	(*1)-50	(*1)+0	(*1)-50	(*1)+0	ns
SCK↓→SCS↑ hold time	t_{CSHI}		(*2)+0	(*2)+50	(*2)+0	(*2)+50	ns
SCS deselect time	t_{CSDI}		(*3)-50	(*3)+50	(*3)-50	(*3)+50	ns
SCS↓→SCK↑ setup time	t_{CSSE}	Slave mode	$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCK↓→SCS↑ hold time	t_{CSHE}		0	-	0	-	ns
SCS deselect time	t_{CSDE}		$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCS↓→SOT delay time	t_{DSE}		-	55	-	40	ns
SCS↑→SOT delay time	t_{DEE}		0	-	0	-	ns

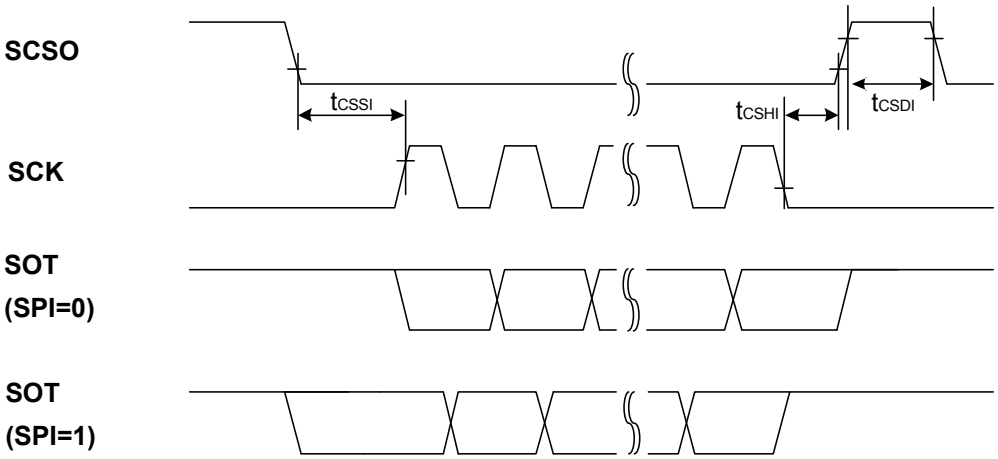
*1: CSSU bit value × serial chip select timing operating clock cycle.

*2: CSHD bit value × serial chip select timing operating clock cycle.

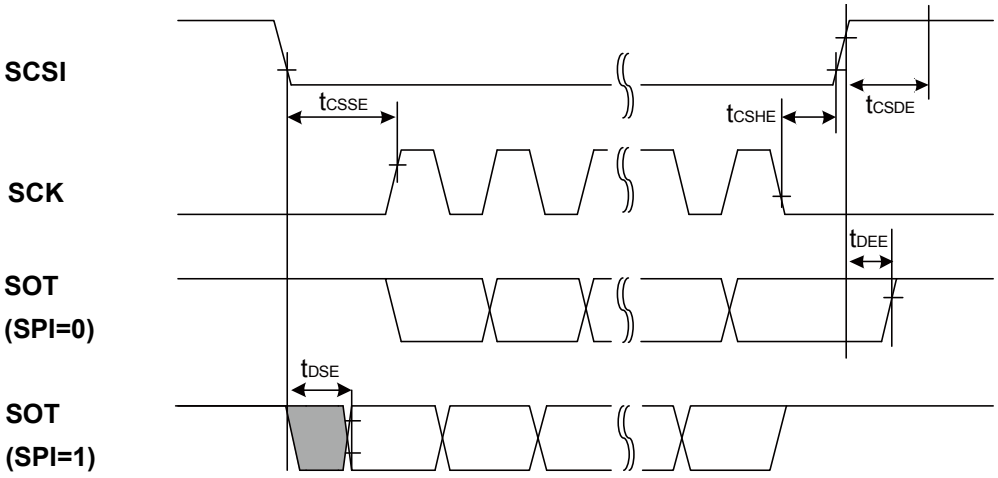
*3: CSDS bit value × serial chip select timing operating clock cycle.
Irrespective of CSDS bit setting, $5t_{CYCP}$ or more are required for the period the time when the serial chip select pin becomes inactive to the time when the serial chip select pin becomes active again.

Notes:

- *t_{CYCP} indicates the APB bus clock cycle time.*
  For information about the APB bus number which Multi-function Serial is connected to, see "8. Block Diagram".
- *For information about CSSU, CSHD, CSDS, serial chip select timing operating clock, see "FM0+ Family Peripheral Manual".*
- *These characteristics only guarantee the same relocate port number.*
  For example, the combination of SCKx_0 and SCSIx_1 is not guaranteed.
- *When the external load capacitance C_L=30 pF.*



Master mode



Slave mode

When Using CSIO/SPI Chip Select (SCINV=0, CSLVL=0)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
			Min	Max	Min	Max	
SCS↑→SCK↓ setup time	t_{CSSI}	Master mode	(*1)-50	(*1)+0	(*1)-50	(*1)+0	ns
SCK↑→SCS↓ hold time	t_{CSHI}		(*2)+0	(*2)+50	(*2)+0	(*2)+50	ns
SCS deselect time	t_{CSDI}		(*3)-50	(*3)+50	(*3)-50	(*3)+50	ns
SCS↑→SCK↓ setup time	t_{CSSE}	Slave mode	$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCK↑→SCS↓ hold time	t_{CSHE}		0	-	0	-	ns
SCS deselect time	t_{CSDE}		$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCS↑→SOT delay time	t_{DSE}		-	55	-	40	ns
SCS↓→SOT delay time	t_{DEE}		0	-	0	-	ns

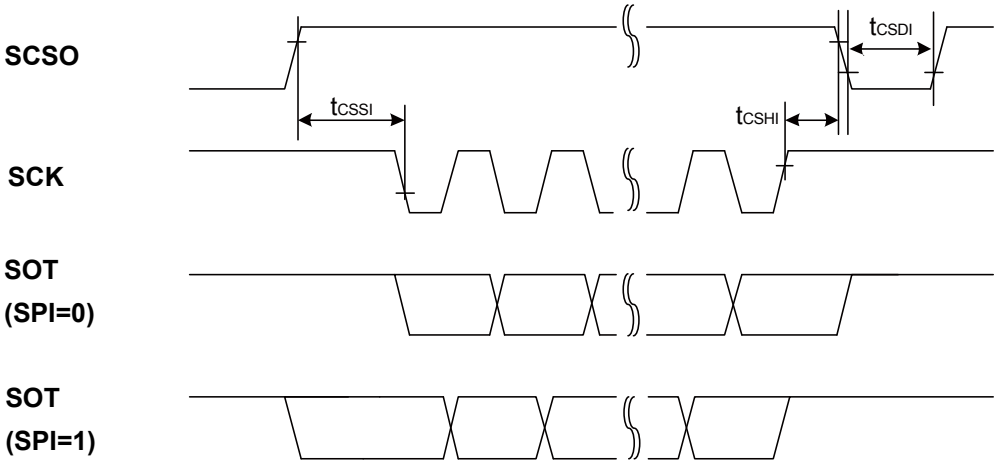
*1: CSSU bit value × serial chip select timing operating clock cycle.

*2: CSHD bit value × serial chip select timing operating clock cycle.

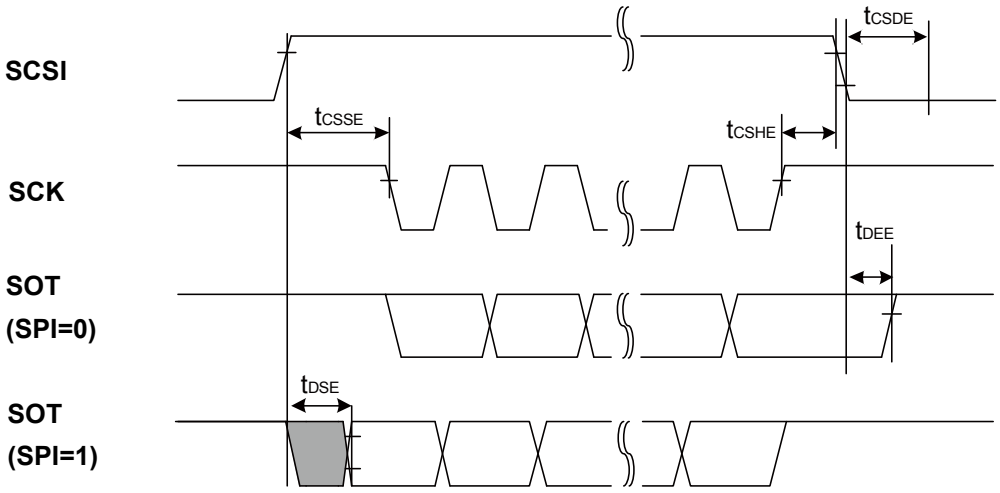
*3: CSDS bit value × serial chip select timing operating clock cycle.
Irrespective of CSDS bit setting, $5t_{CYCP}$ or more are required for the period the time when the serial chip select pin becomes inactive to the time when the serial chip select pin becomes active again.

Notes:

- *t_{CYCP} indicates the APB bus clock cycle time.*
  For information about the APB bus number which Multi-function Serial is connected to, see "8. Block Diagram".
- *For information About CSSU, CSHD, CSDS, serial chip select timing operating clock, see "FM0+ Family Peripheral Manual".*
- *These characteristics only guarantee the same relocate port number.*
  For example, the combination of SCKx_0 and SCSIx_1 is not guaranteed.
- *When the external load capacitance C_L=30 pF.*



Master mode



Slave mode

When Using CSIO/SPI Chip Select (SCINV=1, CSLVL=0)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
			Min	Max	Min	Max	
SCS↑→SCK↑ setup time	t_{CSSI}	Master mode	(*1)-50	(*1)+0	(*1)-50	(*1)+0	ns
SCK↓→SCS↓ hold time	t_{CSHI}		(*2)+0	(*2)+50	(*2)+0	(*2)+50	ns
SCS deselect time	t_{CSDI}		(*3)-50	(*3)+50	(*3)-50	(*3)+50	ns
SCS↑→SCK↑ setup time	t_{CSSE}	Slave mode	$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCK↓→SCS↓ hold time	t_{CSHE}		0	-	0	-	ns
SCS deselect time	t_{CSDE}		$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCS↑→SOT delay time	t_{DSE}		-	55	-	40	ns
SCS↓→SOT delay time	t_{DEE}		0	-	0	-	ns

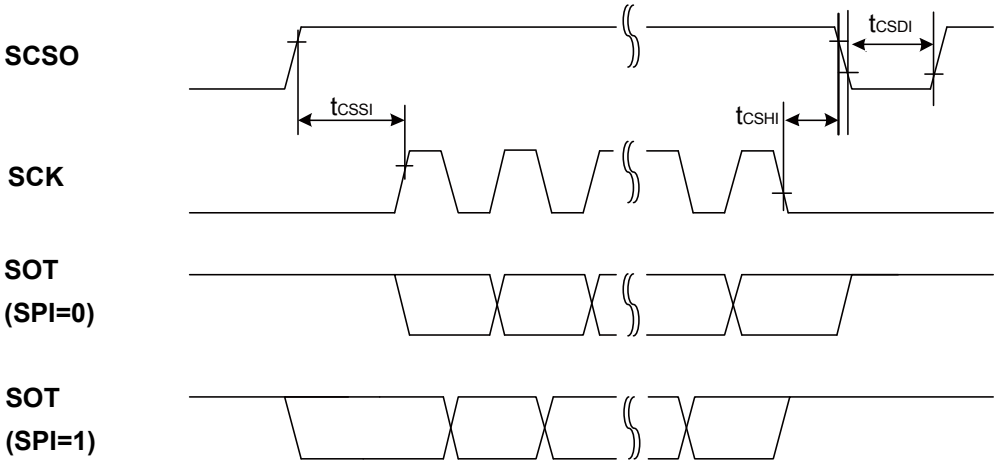
*1: CSSU bit value × serial chip select timing operating clock cycle.

*2: CSHD bit value × serial chip select timing operating clock cycle.

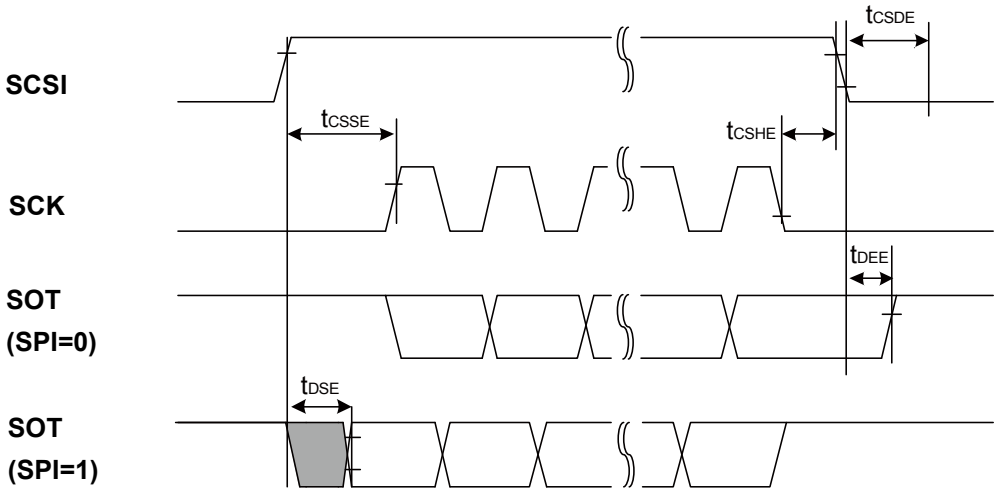
*3: CSDS bit value × serial chip select timing operating clock cycle.
Irrespective of CSDS bit setting, $5t_{CYCP}$ or more are required for the period the time when the serial chip select pin becomes inactive to the time when the serial chip select pin becomes active again.

Notes:

- *t_{CYCP} indicates the APB bus clock cycle time.*
  For information about the APB bus number which Multi-function Serial is connected to, see "8. Block Diagram".
- *For information about CSSU, CSHD, CSDS, serial chip select timing operating clock, see "FM0+ Family Peripheral Manual".*
- *These characteristics only guarantee the same relocate port number.*
  For example, the combination of SCKx_0 and SCSIx_1 is not guaranteed.
- *When the external load capacitance C_L=30 pF.*



Master mode

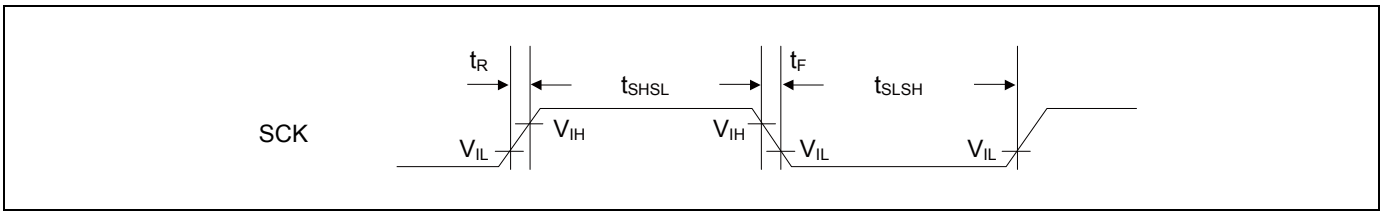


Slave mode

UART external clock input (EXT=1)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	Value		Unit	Remarks
			Min	Max		
Serial clock L pulse width	t_{SLSH}	C_L=30 pF	t_{CYCP} +10	-	ns	
Serial clock H pulse width	t_{SHSL}		t_{CYCP} +10	-	ns	
SCK falling time	t_F		-	5	ns	
SCK rising time	t_R		-	5	ns	



11.4.10 External Input Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

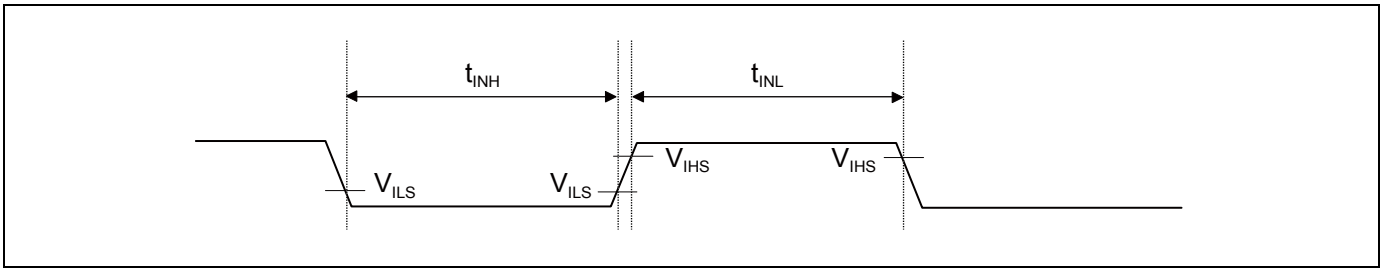
Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Input pulse width	t_{INH}, t_{INL}	ADTGx	-	2 t_{CYCP}*1	-	ns	A/D converter trigger input
		INT00 to INT08, INT12, INT13, INT15, NMIX	*2	2 t_{CYCP} +100*1	-	ns	External interrupt, NMI
			*3	500	-	ns	
		WKUPx	*4	500	-	ns	Deep standby wake up

*1: t_{CYCP} represents the APB bus clock cycle time.
For the number of the APB bus to which the Multi-function Timer is connected and that of the APB bus to which the External Interrupt Controller is connected, see "8. Block Diagram".

*2: In Run mode and Sleep mode

*3: In Timer mode, RTC mode and Stop mode

*4: In Deep Standby RTC mode and Deep Standby Stop mode



11.4.11 I^2C Timing / I2C Slave Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

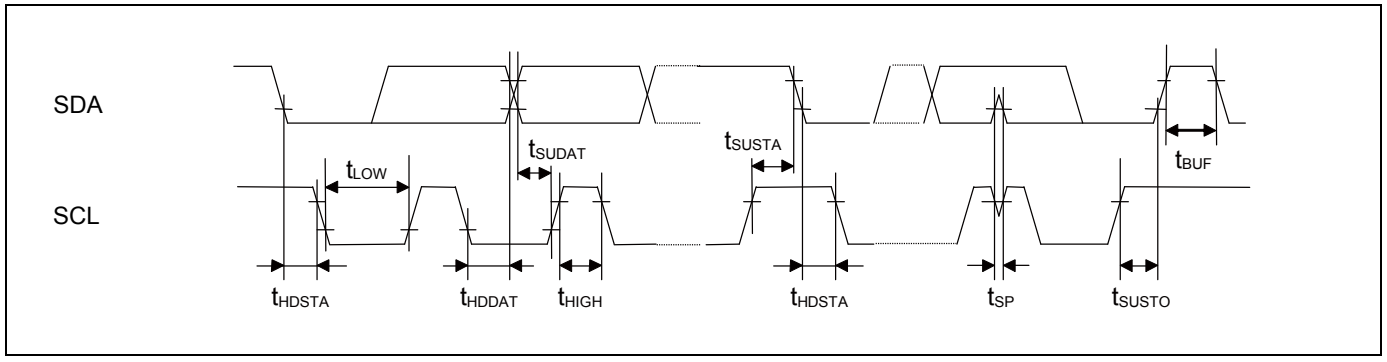
Parameter	Symbol	Conditions	Standard-Mode		Fast-Mode		Unit	Remarks
			Min	Max	Min	Max		
SCL(SI2CSCL) clock frequency	F_{SCL}	C_L=30 pF, R=(Vp/I_{OL})*1	0	100	0	400	kHz	
(Repeated) Start condition hold time SDA(SI2CSDA) ↓ → SCL(SI2CSCL) ↓	t_{HDSTA}		4.0	-	0.6	-	µs	
SCL(SI2CSCL) clock L width	t_{LOW}		4.7	-	1.3	-	µs	
SCL(SI2CSCL) clock H width	t_{HIGH}		4.0	-	0.6	-	µs	
(Repeated) Start setup time SCL(SI2CSCL) ↑ → SDA (SI2CSDA) ↓	t_{SUSTA}		4.7	-	0.6	-	µs	
Data hold time SCL(SI2CSCL) ↓ → SDA(SI2CSDA) ↓↑	t_{HDDAT}		0	3.45*2	0	0.9*3	µs	
Data setup time SDA (SI2CSDA)↓ ↑ → SCL (SI2CSCL)↑	t_{SUDAT}		250	-	100	-	ns	
Stop condition setup time SCL(SI2CSCL) ↑ → SDA(SI2CSDA) ↑	t_{SUSTO}		4.0	-	0.6	-	µs	
Bus free time between Stop condition and Start condition	t_{BUF}		4.7	-	1.3	-	µs	
Noise filter	t_{SP}	-	2 t_{CYCP}*4	-	2 t_{CYCP}*4	-	ns	except I2C Slave

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

*2: The maximum t_{HDDAT} must satisfy at least the condition that the period during which the device is holding the SCL signal at L (t_{LOW}) does not extend.

*3: A Fast-mode I^2C bus device can be used in a Standard-mode I^2C bus system, provided that the condition of t_{SUDAT} ≥ 250 ns is fulfilled.

*4: t_{CYCP} represents the APB bus clock cycle time.
For the number of the APB bus to which the I^2C is connected, see "8. Block Diagram".
To use Standard-mode, set the APB bus clock at 2 MHz or more.
To use Fast-mode, set the APB bus clock at 8 MHz or more.



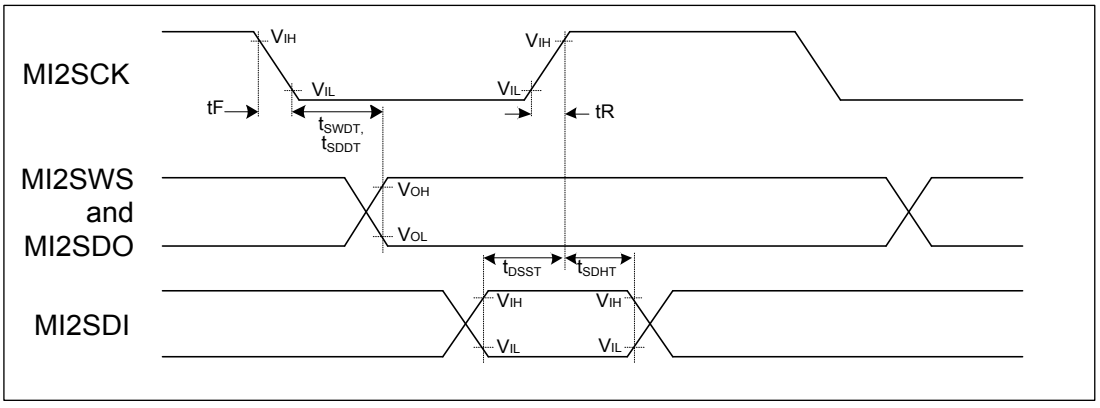
11.4.12 I^2S Timing (MFS-I2S Timing)

Master Mode Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
				Min	Max	Min	Max	
MI2SCK max frequency (*1)	F_{MI2SCK}	MI2SCKx	C_L=30 pF	-	6.144	-	6.144	MHz
I^2S clock cycle time (*1)	t_{ICYC}	MI2SCKx		4 t_{CYCP}	-	4 t_{CYCP}	-	ns
I^2S clock Duty cycle	Δ	MI2SCKx		45%	55%	45%	55%	
MI2SCK ↓ → MI2SWS delay time	t_{SWDT}	MI2SCKx, MI2SWSx		-30	+30	-20	+20	ns
MI2SCK ↓ → MI2SDO delay time	t_{SDDT}	MI2SCKx, MI2SDOx		-30	+30	-20	+20	ns
MI2SDI → MI2SCK ↑ setup time	t_{DSST}	MI2SCKx, MI2SDIx		50	-	36	-	ns
MI2SCK ↑ → MI2SDI hold time	t_{SDHT}	MI2SCKx, MI2SDIx		0	-	0	-	ns
MI2SCK falling time	tF	MI2SCKx		-	5	-	5	ns
MI2SCK rising time	tR	MI2SCKx		-	5	-	5	ns

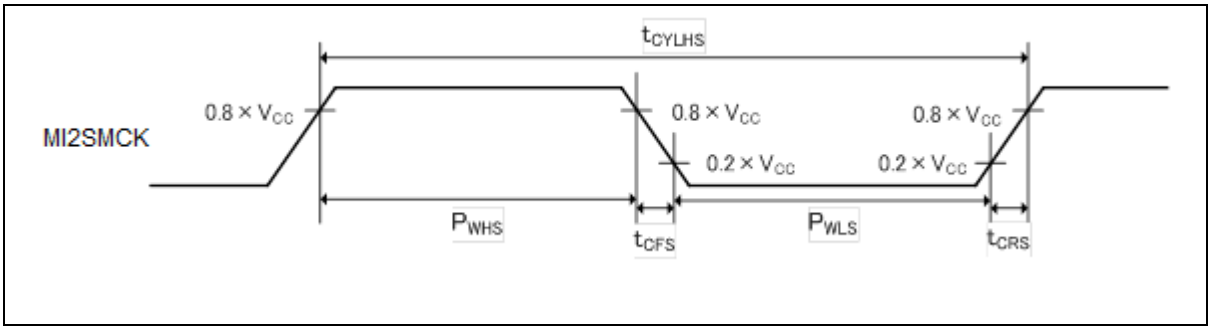
*1: I^2S clock should meet the multiple of PCLK(t_{ICYC}) and the frequency less than F_{MI2SCK} meantime. The detail information please refer to Chapter I^2S of Communication Macro Part of Peripheral Manual.



MI2SMCK Input Characteristics

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Input frequency	f_{CHS}	MI2SMCK	-	-	12.288	MHz	
Input clock cycle	t_{CYLHS}	-	-	81.3	-	ns	
Input clock pulse width	-	-	P_{WHS}/t_{CYLHS} P_{WLS}/t_{CYLHS}	45	55	%	When using external clock
Input clock rise time and fall time	t_{CFS} t_{CRS}	-	-	-	5	ns	When using external clock



MI2SMCK Output Characteristics

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Output frequency	f_{CHS}	MI2SMCK	-	-	25	MHz	$V_{CC} \geq 2.7$ V
				-	20	MHz	$V_{CC} < 2.7$ V

11.4.13 Smart Card Interface Characteristics

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Output rising time	t_R	ICx_VCC, ICx_RST, ICx_CLK, ICx_DATA	C_L=30 pF	4	20	ns	
Output falling time	t_F			4	20	ns	
Output clock frequency	f_{CLK}	ICx_CLK		-	20	MHz	
Duty cycle	Δ			45%	55%		

■External pull-up resistor (20 kΩ to 50 kΩ) must be applied to ICx_CIN pin when it's used as smart card reader function.

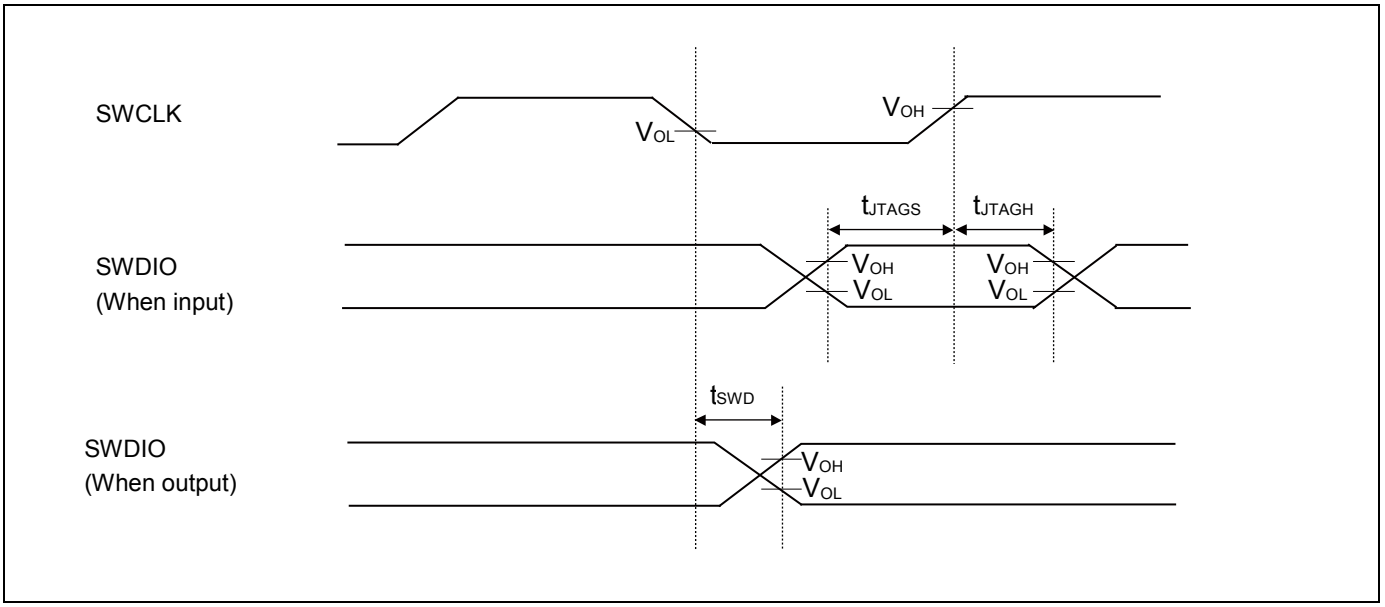
11.4.14 SW-DP Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
SWDIO setup time	t_{SWS}	SWCLK, SWDIO	-	15	-	ns	
SWDIO hold time	t_{SWH}	SWCLK, SWDIO	-	15	-	ns	
SWDIO delay time	t_{SWD}	SWCLK, SWDIO	-	-	45	ns	

Note:

- *External load capacitance C_L=30 pF*



11.5 12-bit A/D Converter

Electrical Characteristics of A/D Converter (Preliminary Values)

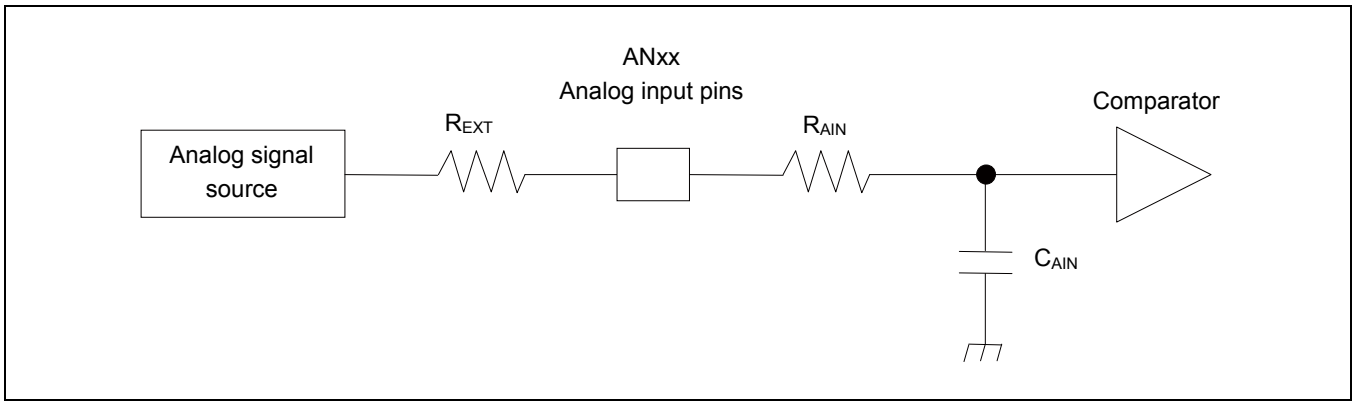
(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Value			Unit	Remarks
			Min	Typ	Max		
Resolution	-	-	-	-	12	bit	
Integral Nonlinearity	-	-	- 4.5	-	4.5	LSB	
Differential Nonlinearity	-	-	- 2.5	-	+ 2.5	LSB	
Zero transition voltage	V_{ZT}	ANxx	- 15	-	+ 15	mV	
Full-scale transition voltage	V_{FST}	ANxx	AVRH - 15	-	AVRH + 15	mV	
Conversion time*1	-	-	1.0	-	-	µs	$V_{CC} \geq 2.7$ V
			4.0	-	-		1.8 ≤ V_{CC} < 2.7 V
			10	-	-		1.65 ≤ V_{CC} < 1.8 V
Sampling time *2	Ts	-	0.3	-	10	µs	$V_{CC} \geq 2.7$ V
			1.2	-			1.8 ≤ V_{CC} < 2.7 V
			3.0	-			1.65 ≤ V_{CC} < 1.8 V
Compare clock cycle *3	Tcck	-	50	-	1000	ns	$V_{CC} \geq 2.7$ V
			200	-			1.8 ≤ V_{CC} < 2.7 V
			500	-			1.65 ≤ V_{CC} < 1.8 V
State transition time to operation permission	Tstt	-	-	-	1.0	µs	
Analog input capacity	C_{AIN}	-	-	-	7.5	pF	
Analog input resistance	R_{AIN}	-	-	-	2.2	kΩ	$V_{CC} \geq 2.7$ V
					5.5		1.8 ≤ V_{CC} < 2.7 V
					10.5		1.65 ≤ V_{CC} < 1.8 V
Interchannel disparity	-	-	-	-	4	LSB	
Analog port input leak current	-	ANxx	-	-	5	µA	
Analog input voltage	-	ANxx	V_{SS}	-	AVRH	V	
Reference voltage	-	AVRH	2.7	-	V_{CC}	V	VCC ≥ 2.7V
			V_{CC}				VCC < 2.7V
	-	AVRL	V_{SS}	-	V_{SS}	V	

*1: The conversion time is the value of sampling time (t_S) + compare time (t_C).
The minimum conversion time is computed according to the following conditions:
$V_{CC} \geq 2.7$ V sampling time=0.3 µs, compare time=0.7 µs
1.8 ≤ V_{CC} < 2.7 V sampling time=1.2 µs, compare time=2.8 µs
1.65 ≤ V_{CC} < 1.8 V sampling time=3.0 µs, compare time=7.0 µs
Ensure that the conversion time satisfies the specifications of the sampling time (t_S) and compare clock cycle (t_{CCK}).
For details of the settings of the sampling time and compare clock cycle, refer to "Chapter: A/D Converter" in "FM0+ Family Peripheral Manual Analog Macro Part".
The register settings of the A/D Converter are reflected in the operation according to the APB bus clock timing.
For the number of the APB bus to which the A/D Converter is connected, see "8. Block Diagram".
The base clock (HCLK) is used to generate the sampling time and the compare clock cycle.

*2: The required sampling time varies according to the external impedance.
Set a sampling time that satisfies (Equation 1).

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



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

t_S: Sampling time

R_{AIN}: Input resistance of A/D Converter = 2.2 kΩ with 2.7 ≤ VCC ≤ 3.6
Input resistance of A/D Converter = 5.5 kΩ with 1.8 ≤ VCC ≤ 2.7
Input resistance of A/D Converter = 10.5 kΩ with 1.65 ≤ VCC ≤ 1.8

C_{AIN}: Input capacitance of A/D Converter = 7.5 pF with 1.65 ≤ VCC ≤ 3.6

R_{EXT}: Output impedance of external circuit

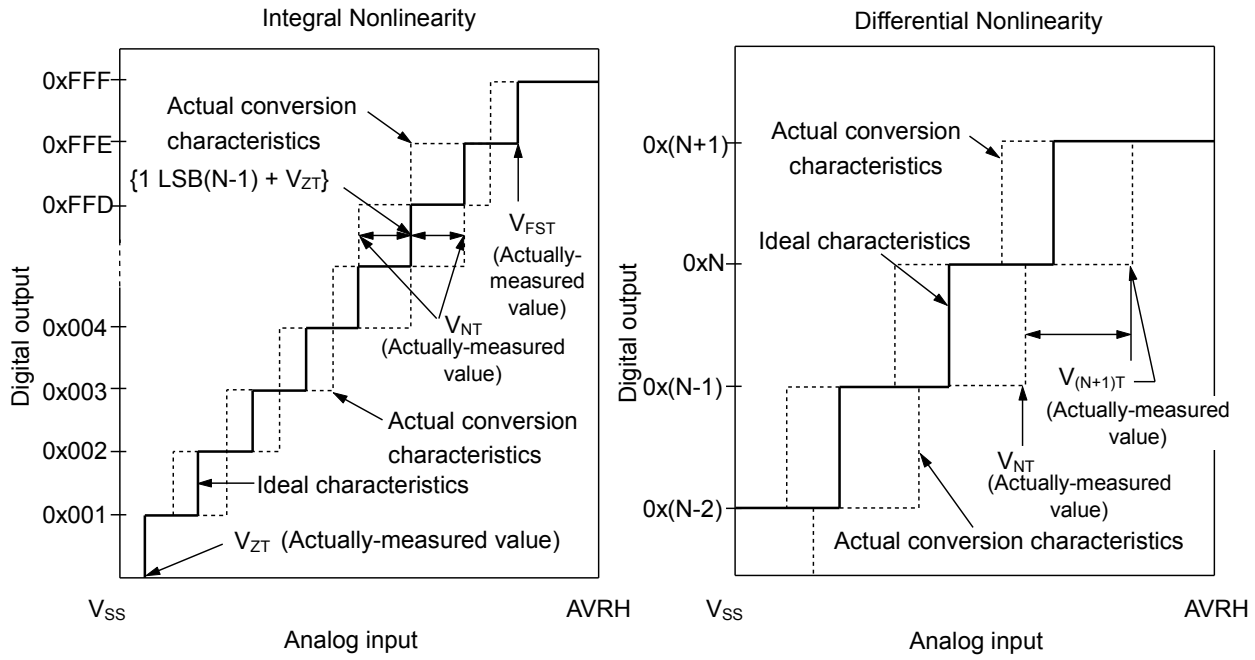
(Equation 2) $t_C = t_{CCK} \times 14$

t_C: Compare time

t_{CCK} : Compare clock cycle

Definitions of 12-bit A/D Converter Terms

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



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

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

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

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

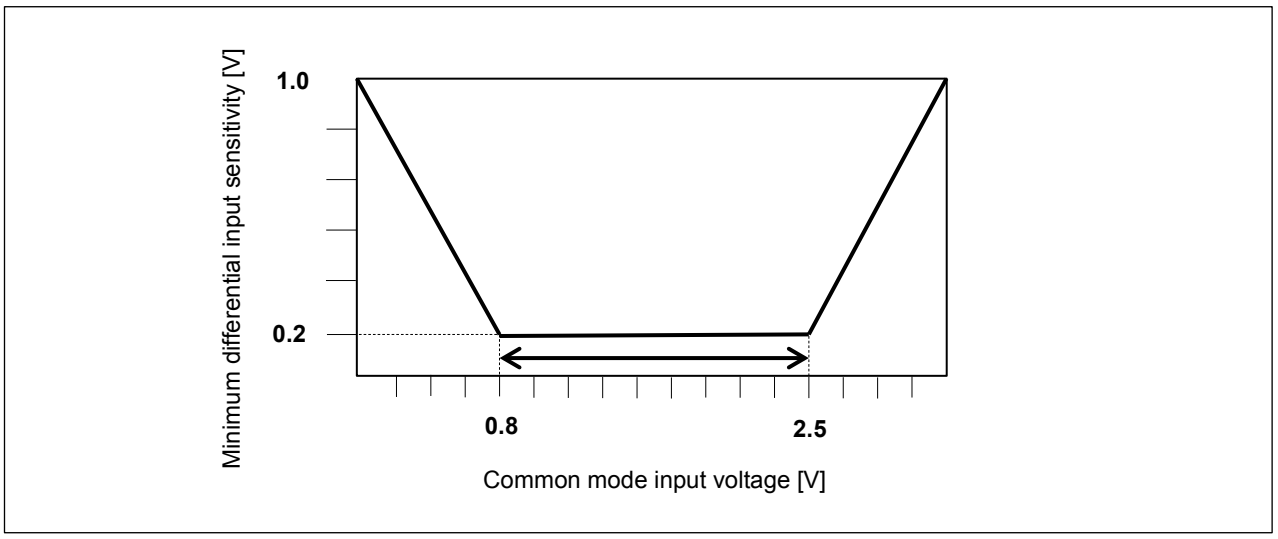
11.6 USB Characteristics

(V_{CC}=3.0 V to 3.6 V, V_{SS}=0 V, T_A=- 40°C to +105°C)

Parameter		Symbol	Pin Name	Conditions	Value		Unit	Remarks
					Min	Max		
Input characteristics	Input H level voltage	V_{IH}	UDP0, UDM0	-	2.0	V_{CC} + 0.3	V	*1
	Input L level voltage	V_{IL}		-	V_{SS} – 0.3	0.8	V	*1
	Differential input sensitivity	V_{DI}		-	0.2	-	V	*2
	Differential common mode range	V_{CM}		-	0.8	2.5	V	*2
Output characteristic	Output H level voltage	V_{OH}		External pull-down resistance = 15 kΩ	2.8	3.6	V	*3
	Output L level voltage	V_{OL}		External pull-up resistance = 1.5 kΩ	0.0	0.3	V	*3
	Crossover voltage	V_{CRS}		-	1.3	2.0	V	*4
	Rising time	t_{FR}		Full-speed	4	20	ns	*5
	Falling time	t_{FF}		Full-speed	4	20	ns	*5
	Rising/Falling time matching	t_{FRFM}		Full-speed	90	111.11	%	*5
	Output impedance	Z_{DRV}		Full-speed	28	44	Ω	*6
	Rising time	t_{LR}		Low-speed	75	300	ns	*7
	Falling time	t_{LF}		Low-speed	75	300	ns	*7
	Rising/Falling time matching	t_{LRFM}		Low-speed	80	125	%	*7

*1 : The switching threshold voltage of single-end-receiver of USB I/O buffer is set as within V_{IL}(Max)=0.8 V, VIH(Min)=2.0 V (TTL input standard).
There are some hysteresis to lower noise sensitivity.

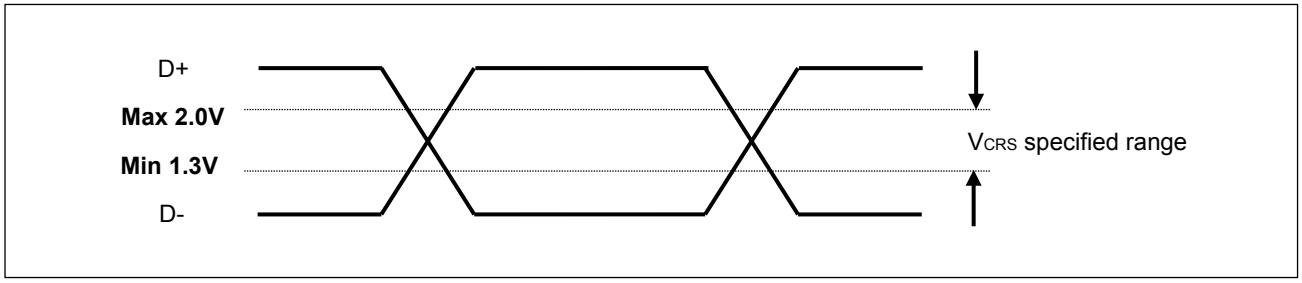
*2 : Use differential-receiver to receive USB differential data signal.
Differential-receiver has 200 mV of differential input sensitivity when the differential data input is within 0.8 V to 2.5 V to the local ground reference level.
Above voltage range is the common mode input voltage range.



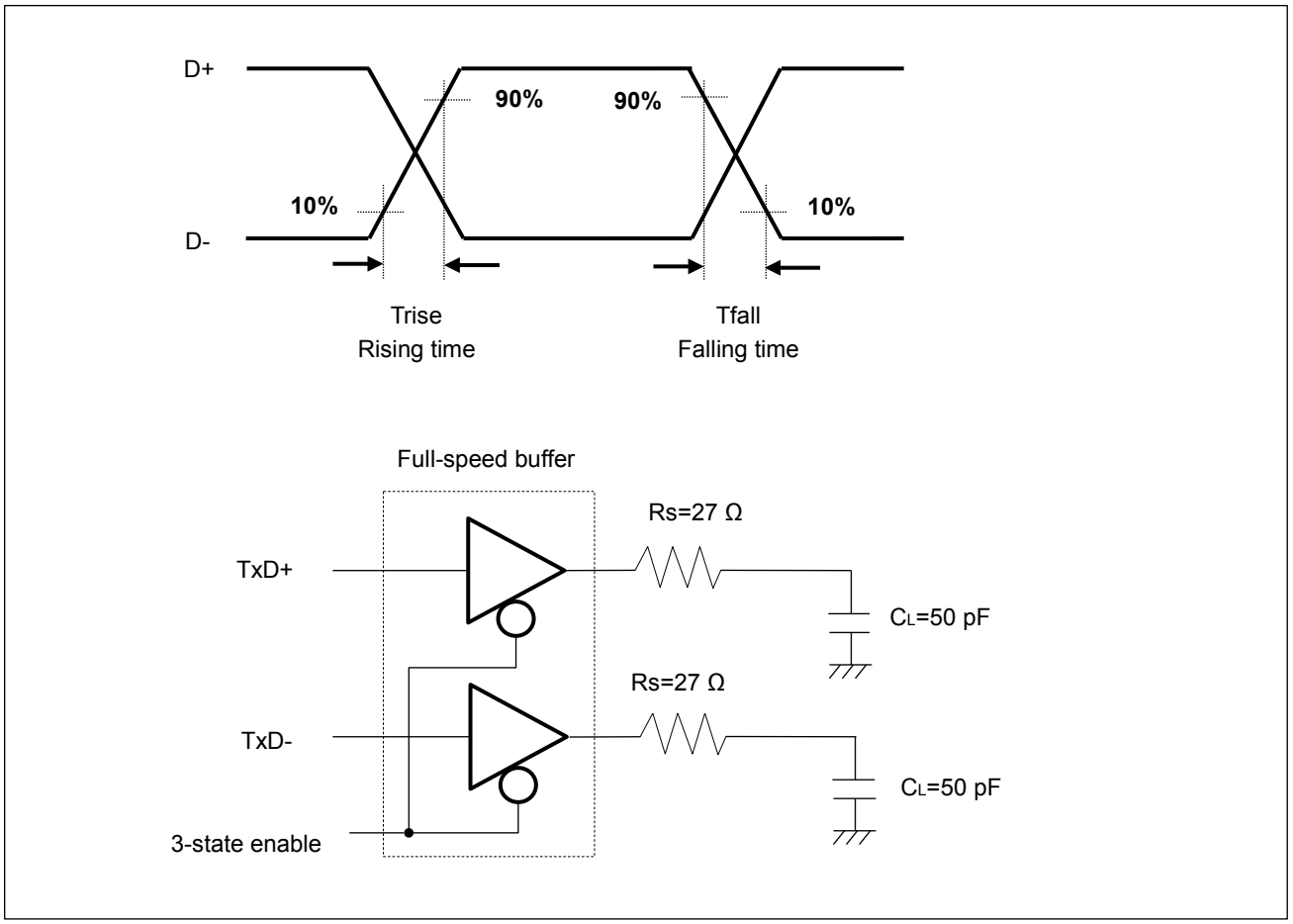
*3 : The output drive capability of the driver is below 0.3 V at Low-state (V_{OL}) (to 3.6 V and 1.5 kΩ load), and 2.8 V or above

(to the VSS and 1.5 kΩ load) at high-state (V_{OH})

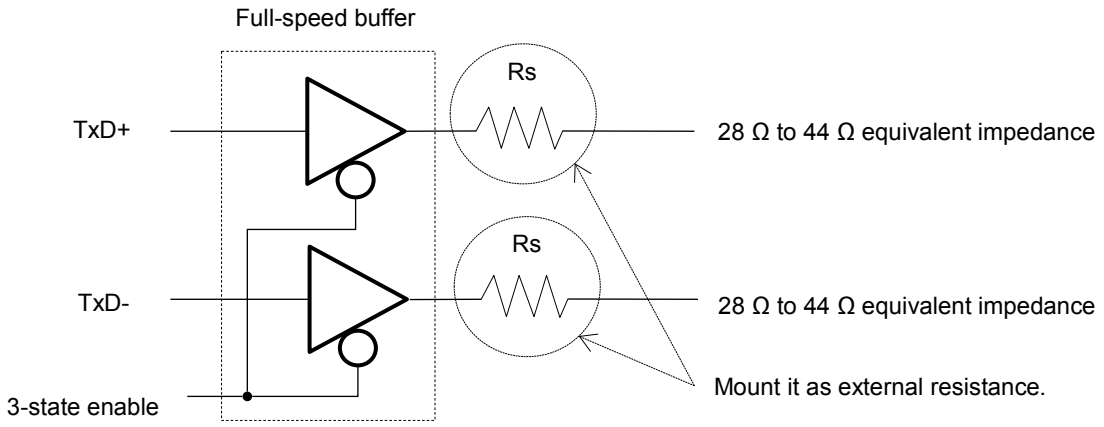
*4 : The cross voltage of the external differential output signal (D+ / D-) of USB I/O buffer is within 1.3 V to 2.0 V.



*5 : The indicate rising time (Trise) and falling time (Tfall) of the full-speed differential data signal.
They are defined by the time between 10% and 90% of the output signal voltage.
For full-speed buffer, Tr/Tf ratio is regulated as within ±10% to minimize RFI emission.

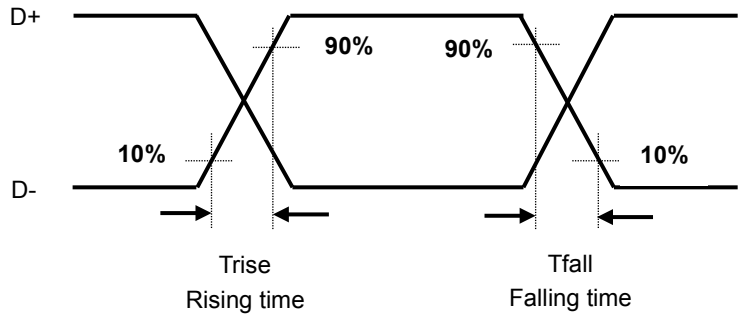


*6 : USB Full-speed connection is performed via twist pair cable shield with 90 Ω ± 15% characteristic impedance (Differential Mode).
USB standard defines that output impedance of USB driver must be in range from 28Ω to 44Ω. So, discrete series resistor (Rs) addition is defined in order to satisfy the above definition and keep balance.
When using this USB I/O, use it with 25 Ω to 33 Ω (recommendation value : 27 Ω) series resistor Rs.



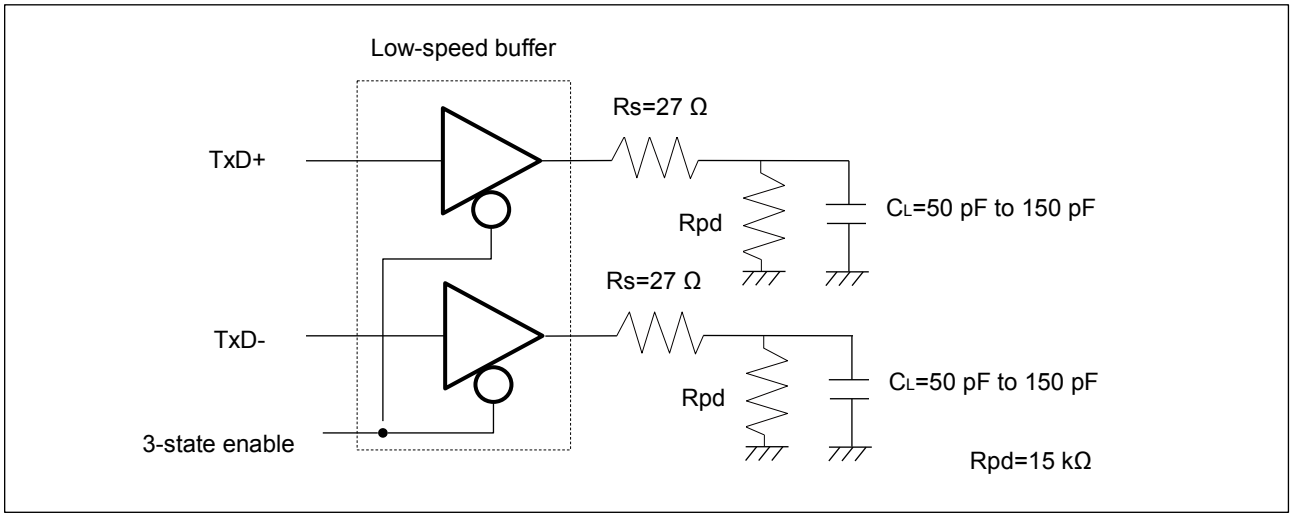
Rs series resistor 25 Ω to 30 Ω
Series resistor of 27 Ω (recommendation value) must be added.
And, use “resistance with an uncertainty of 5% by E24 sequence”.

*7 : They indicate rising time (Trise) and falling time (Tfall) of the low-speed differential data signal.
They are defined by the time between 10% and 90% of the output signal voltage.

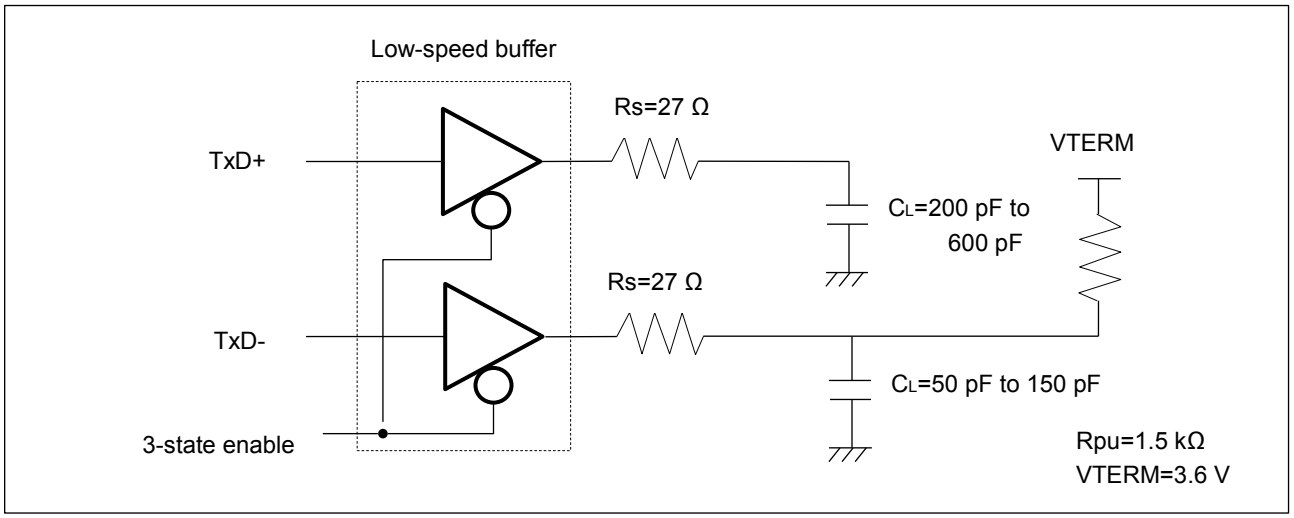


See “Low-speed load (Compliance Load)” for condition of external load.

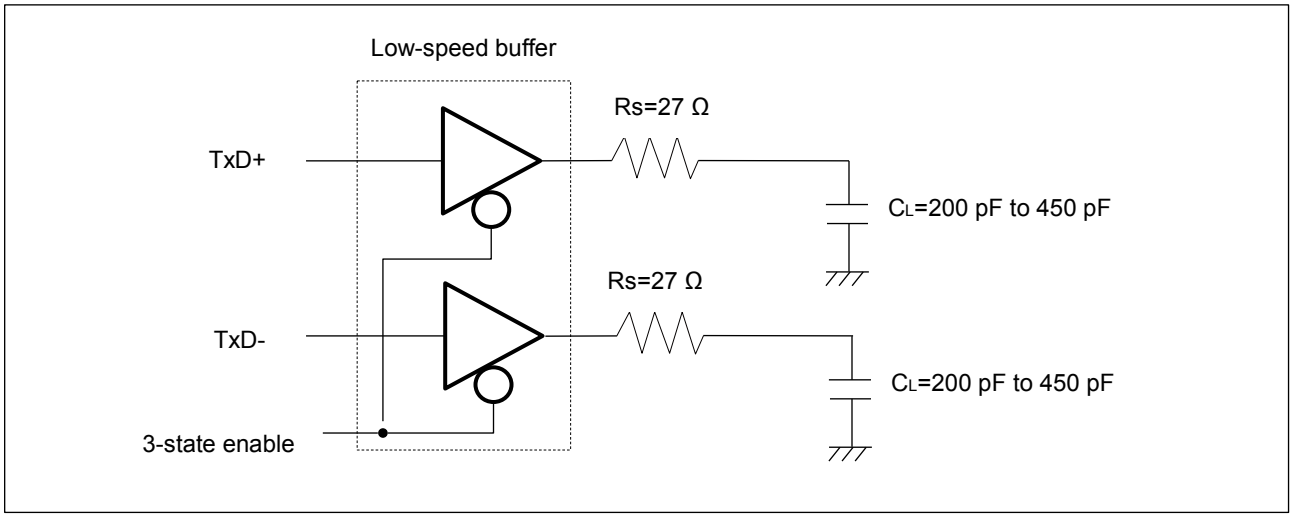
- Low-Speed Load (Upstream Port Load) – Reference 1



- Low-Speed Load (Downstream Port Load) – Reference 2



- Low-Speed Load (Compliance Load)



11.7 Low-Voltage Detection Characteristics

11.7.1 Low-Voltage Detection Reset

(T_A=-40°C to +105°C)

Parameter	Symbol	Conditions	Value			Unit	Remarks
			Min	Typ	Max		
Detected voltage	VDL	Fixed*1	1.38	1.50	1.60	V	When voltage drops
Released voltage	VDH		1.43	1.55	1.65	V	When voltage rises
LVD stabilization wait time	T_{LVDW}	-	-	-	8160× t_{CYCP}*2	µs	
LVD detection delay time	T_{LVDDL}	-	-	-	200	µs	

*1: The value of low voltage detection reset is always fixed.

*2: t_{CYCP} indicates the APB1 bus clock cycle time.

11.7.2 Low-Voltage Detection Interrupt

(T_A=-40°C to +105°C)

Parameter	Symbol	Conditions	Value			Unit	Remarks
			Min	Typ	Max		
Detected voltage	VDL	SVHI=00100	1.56	1.70	1.84	V	When voltage drops
Released voltage	VDH		1.61	1.75	1.89	V	When voltage rises
Detected voltage	VDL	SVHI=00101	1.61	1.75	1.89	V	When voltage drops
Released voltage	VDH		1.66	1.80	1.94	V	When voltage rises
Detected voltage	VDL	SVHI=00110	1.66	1.80	1.94	V	When voltage drops
Released voltage	VDH		1.70	1.85	2.00	V	When voltage rises
Detected voltage	VDL	SVHI=00111	1.70	1.85	2.00	V	When voltage drops
Released voltage	VDH		1.75	1.90	2.05	V	When voltage rises
Detected voltage	VDL	SVHI=01000	1.75	1.90	2.05	V	When voltage drops
Released voltage	VDH		1.79	1.95	2.11	V	When voltage rises
Detected voltage	VDL	SVHI=01001	1.79	1.95	2.11	V	When voltage drops
Released voltage	VDH		1.84	2.00	2.16	V	When voltage rises
Detected voltage	VDL	SVHI=01010	1.84	2.00	2.16	V	When voltage drops
Released voltage	VDH		1.89	2.05	2.21	V	When voltage rises
Detected voltage	VDL	SVHI=01011	1.89	2.05	2.21	V	When voltage drops
Released voltage	VDH		1.93	2.10	2.27	V	When voltage rises
Detected voltage	VDL	SVHI=01100	2.30	2.50	2.70	V	When voltage drops
Released voltage	VDH		2.39	2.60	2.81	V	When voltage rises
Detected voltage	VDL	SVHI=01101	2.39	2.60	2.81	V	When voltage drops
Released voltage	VDH		2.48	2.70	2.92	V	When voltage rises
Detected voltage	VDL	SVHI=01110	2.48	2.70	2.92	V	When voltage drops
Released voltage	VDH		2.58	2.80	3.02	V	When voltage rises
Detected voltage	VDL	SVHI=01111	2.58	2.80	3.02	V	When voltage drops
Released voltage	VDH		2.67	2.90	3.13	V	When voltage rises
Detected voltage	VDL	SVHI=10000	2.67	2.90	3.13	V	When voltage drops
Released voltage	VDH		2.76	3.00	3.24	V	When voltage rises
Detected voltage	VDL	SVHI=10001	2.76	3.00	3.24	V	When voltage drops
Released voltage	VDH		2.85	3.10	3.35	V	When voltage rises
Detected voltage	VDL	SVHI=10010	2.85	3.10	3.35	V	When voltage drops
Released voltage	VDH		2.94	3.20	3.46	V	When voltage rises
Detected voltage	VDL	SVHI=10011	2.94	3.20	3.46	V	When voltage drops
Released voltage	VDH		3.04	3.30	3.56	V	When voltage rises
LVD stabilization wait time	T_{LVDW}	-	-	-	8160 × t_{CYCP}*	µs	
LVD detection delay time	T_{LVDDL}	-	-	-	200	µs	

*: t_{CYCP} represents the APB1 bus clock cycle time.

11.8 Flash Memory Write/Erase Characteristics

(V_{CC}=1.65 V to 3.6 V, T_A=- 40°C to +105°C)

Parameter		Value			Unit	Remarks
		Min	Typ	Max		
Sector erase time	Large sector	-	1.1	2.7	s	The sector erase time includes the time of writing prior to internal erase.
	Small sector	-	0.3	0.9		
Halfword (16-bit) write time		-	30	528	µs	The halfword (16-bit) write time excludes the system-level overhead.
Chip erase time		-	4.5	11.7	s	The chip erase time includes the time of writing prior to internal erase.

*: The typical value is immediately after shipment, the maximum value is guarantee value under 10,000 cycle of erase/write.

Write/Erase Cycle and Data Hold Time

Write/Erase Cycle	Data Hold Time (Year)	Remarks
1,000	20*	
10,000	10*	

*: This value comes from the technology qualification (using Arrhenius equation to translate high temperature acceleration test result into average temperature value at + 85°C).

11.9 Return Time from Low-Power Consumption Mode

11.9.1 Return Factor: Interrupt/WKUP

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

Return Count Time

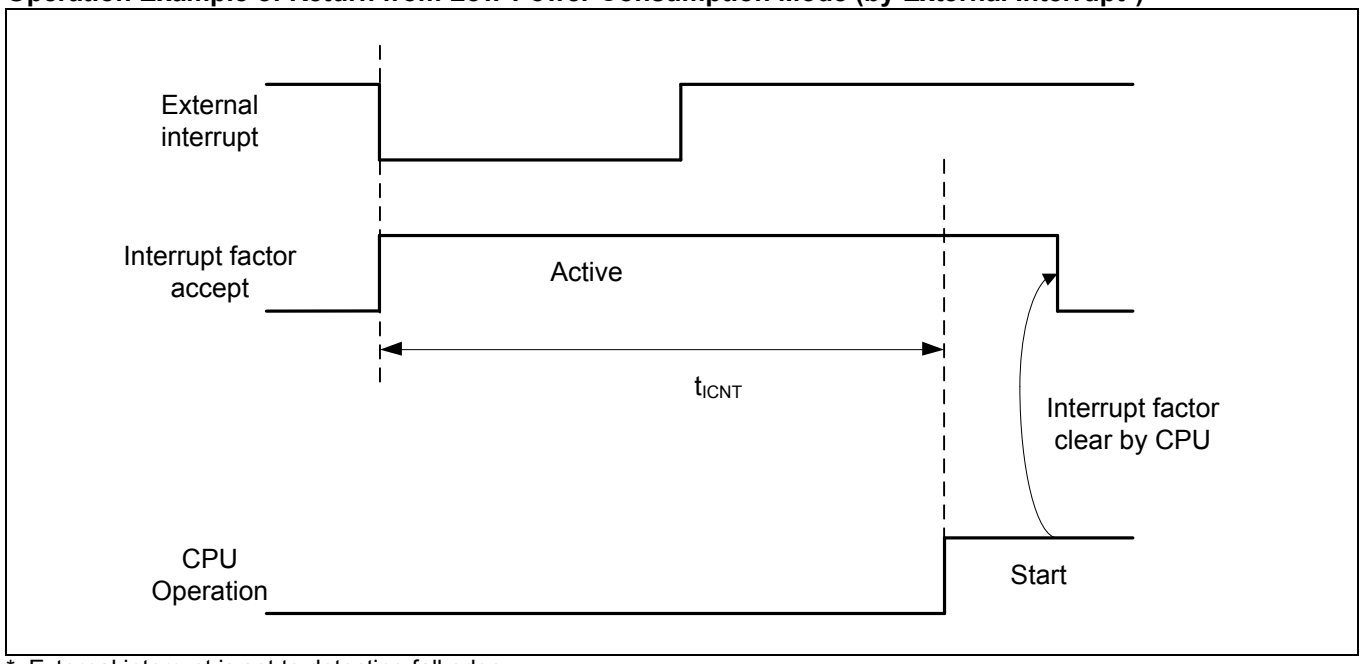
(V_{CC}=1.65 V to 3.6 V, T_A=-40°C to +105°C)

Parameter		Symbol	Value		Unit	Remarks
Current Mode	Mode to return		Typ	Max *1		
Sleep mode	each Run Modes	t_{ICNT}	4*HCLK		µs	When High-speed CR is enabled
Timer mode	High-speed CR Run mode Main Run mode PLL Run mode		12*HCLK	13*HCLK	µs	When High-speed CR is enabled
	Low-speed CR Run mode Sub Run mode		34+12*HCLK	72+13*HCLK	µs	
Stop Mode	High-speed CR Run mode Low-speed CR Run mode		34+12*HCLK	72+13*HCLK	µs	
	Main Run mode Sub Run mode PLL Run mode		34+12*HCLK +t_{OSCWT}	72+13*HCLK +t_{OSCWT}	µs	*2
RTC mode	High-speed CR Run mode Low-speed CR Run mode Sub Run mode		34+12*HCLK	72+13*HCLK	µs	
	Main Run mode PLL Run mode		34+12*HCLK +t_{OSCWT}	72+13*HCLK +t_{OSCWT}	µs	*2
Deep Standby RTC mode Deep Standby Stop mode	High-speed CR Run mode		43	281	µs	

*1: The maximum value depends on the condition of environment.

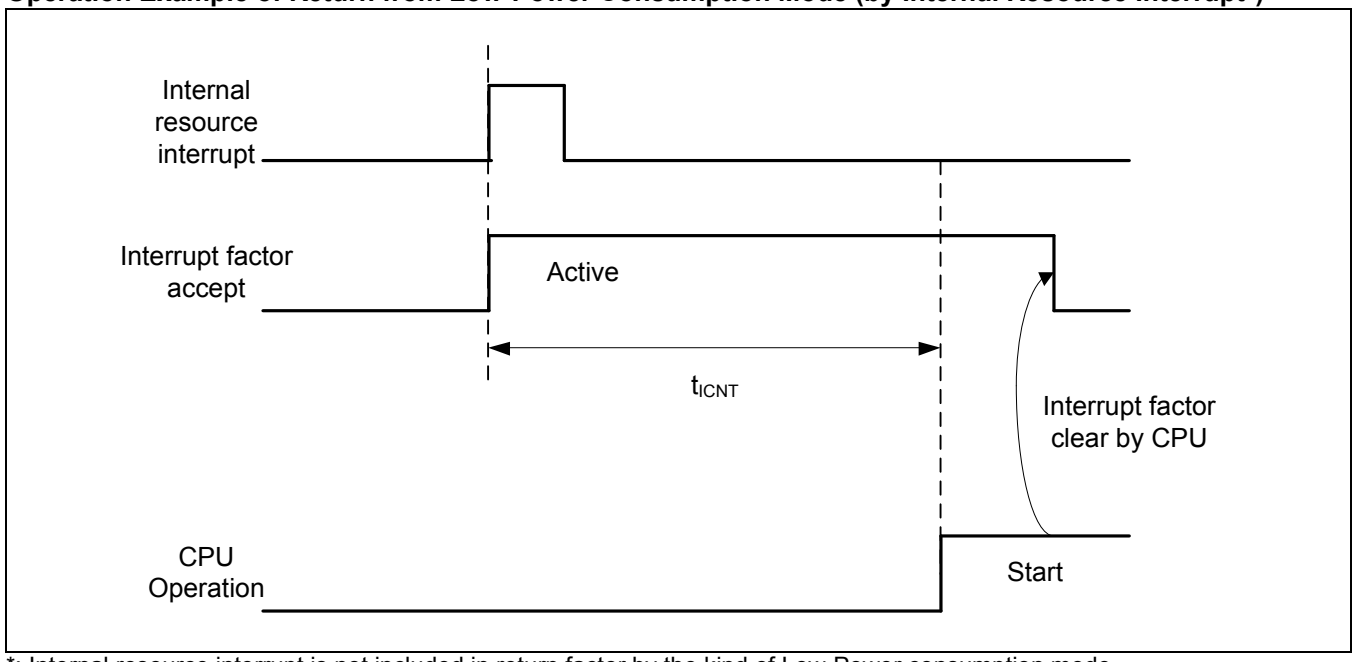
*2: t_{OSCWT} : Oscillator stabilization time.

Operation Example of Return from Low-Power Consumption Mode (by External Interrupt*)



*: External interrupt is set to detecting fall edge.

Operation Example of Return from Low-Power Consumption Mode (by Internal Resource Interrupt*)



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

Notes:

- *The return factor is different in each Low-Power consumption modes.*
  See "Chapter: Low Power Consumption Mode" and "Operations of Standby Modes" in FM0+ Family Peripheral Manual.
- *When interrupt recoveries, the operation mode that CPU recoveries depends on the state before the Low-Power consumption mode transition. See "Chapter: Low Power Consumption Mode" in "FM0+ Family Peripheral Manual".*

11.9.2 Return Factor: Reset

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

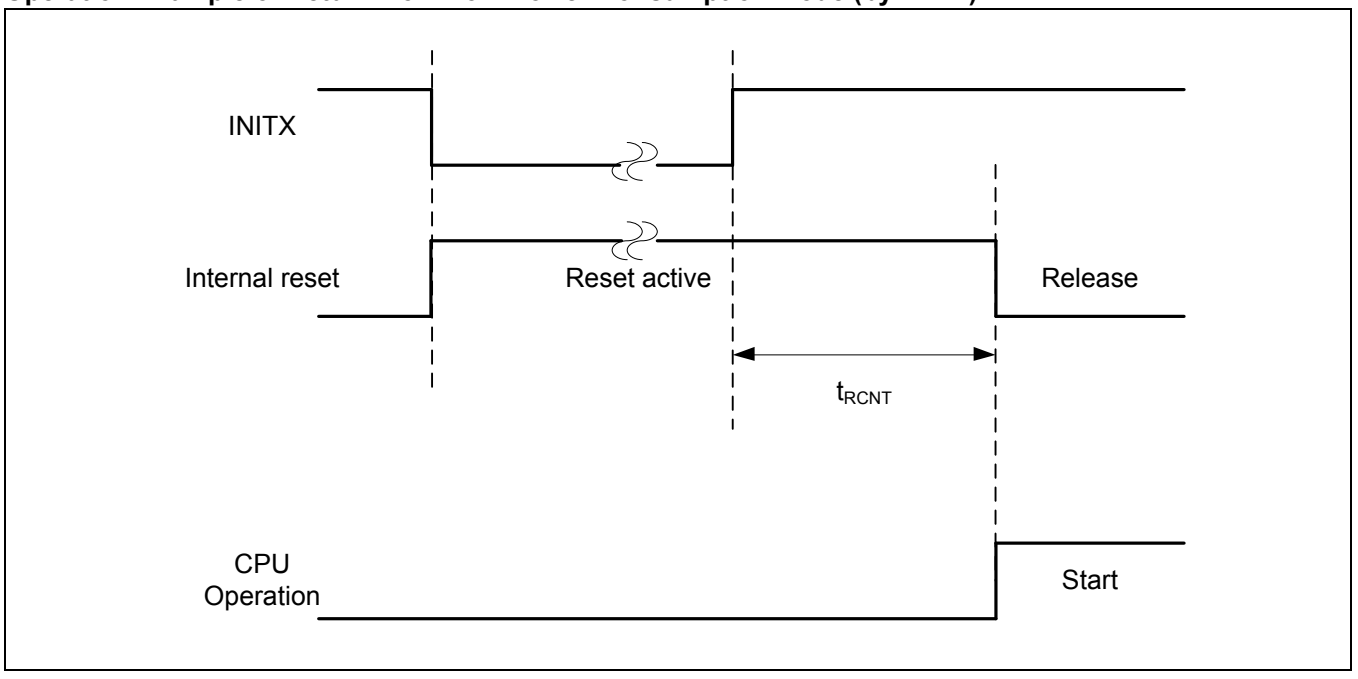
Return Count Time

(V_{CC}=1.65 V to 3.6 V, T_A=-40°C to +105°C)

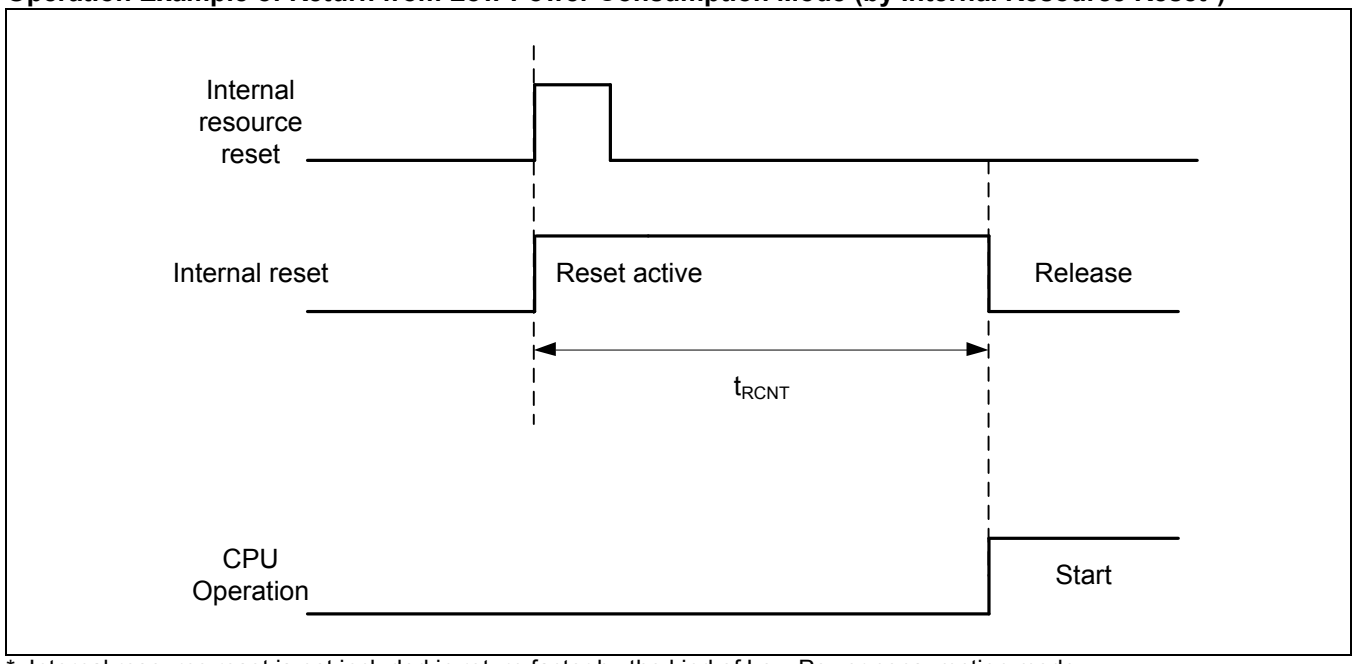
Parameter		Symbol	Value		Unit	Remarks
Current Mode	Mode to return		Typ	Max*		
High-speed CR Sleep mode Main Sleep mode PLL Sleep mode	High-speed CR Run mode	t_{RCNT}	20	22	µs	When High-speed CR is enabled
Low-speed CR Sleep mode			50	106	µs	When High-speed CR is enabled
Sub Sleep mode			112	137	µs	When High-speed CR is enabled
High-speed CR Timer mode Main Timer mode PLL Timer mode			20	22	µs	When High-speed CR is enabled
Low-speed CR Timer mode			87	159	µs	
Sub Timer mode			148	209	µs	
Stop mode RTC mode			45	68	µs	
Deep Standby RTC mode Deep Standby Stop mode			43	281	µs	

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

Operation Example of Return from Low-Power Consumption Mode (by INITX)



Operation Example of Return from Low Power Consumption Mode (by Internal Resource Reset*)



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

Notes:

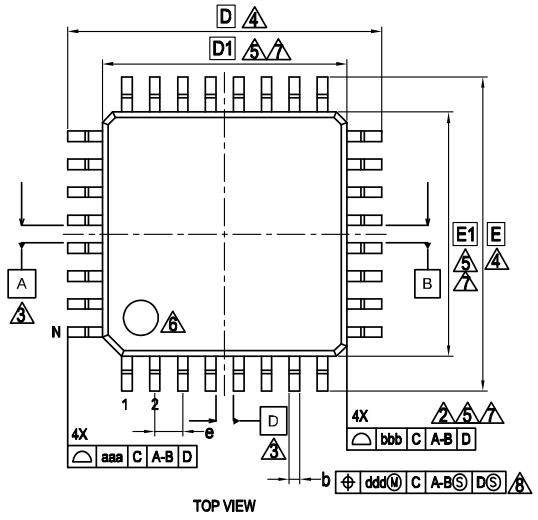
- *The return factor is different in each Low-Power consumption modes.*
  See "Chapter: Low Power Consumption Mode" and "Operations of Standby Modes" in FM0+ Family Peripheral Manual.
- *When interrupt recoveries, the operation mode that CPU recoveries depends on the state before the Low-Power consumption mode transition. See "Chapter: Low Power Consumption Mode" in "FM0+ Family Peripheral Manual".*
- *The time during the power-on reset/low-voltage detection reset is excluded. See "11.4.7 Power-on Reset Timing in 11.4 AC Characteristics in 11. Electrical Characteristics" for the detail on the time during the power-on reset/low -voltage detection reset.*
- *When in recovery from reset, CPU changes to the high-speed CR run mode. When using the main clock or the PLL clock, it is necessary to add the main clock oscillation stabilization wait time or the main PLL clock stabilization wait time.*
- *The internal resource reset means the watchdog reset and the CSV reset.*

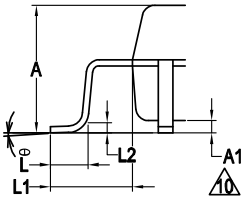
12. Ordering Information

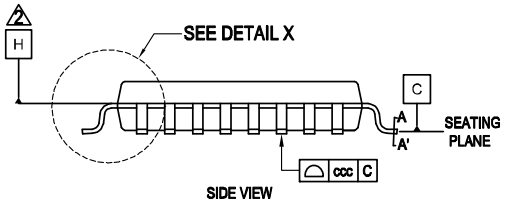
Part number	On-chip Flash memory [Kbyte]	On-Chip SRAM [Kbyte]	Package	Packing
S6E1C32D0AGV20000	128	16	Plastic • LQFP (0.50 mm pitch), 64 pins (LQD064-02)	Tray
S6E1C31D0AGV20000	64	12		
S6E1C32C0AGV20000	128	16	Plastic • LQFP (0.50 mm pitch), 48 pins (LQA048-02)	Tray
S6E1C31C0AGV20000	64	12		
S6E1C32B0AGP20000	128	16	Plastic • LQFP (0.80 mm pitch), 32 pins (LQB032)	Tray
S6E1C31B0AGP20000	64	12		
S6E1C32D0AGN20000	128	16	Plastic • QFN64 (0.50 mm pitch), 64 pins (WNS064)	Tray
S6E1C31D0AGN20000	64	12		
S6E1C32C0AGN20000	128	16	Plastic • QFN48 (0.50 mm pitch), 48 pins (WNY048)	Tray
S6E1C31C0AGN20000	64	12		
S6E1C32B0AGN20000	128	16	Plastic • QFN32 (0.50 mm pitch), 32 pins (WNU032)	Tray
S6E1C31B0AGN20000	64	12		
(TBD)	128	16	WLCSP (TBD)	(TBD)

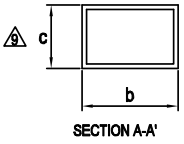
13. Package Dimensions

LQB032 032 LEAD PLASTIC LOW PROFILE QUAD FLAT PACKAGE









PACKAGE	LQB032		
SYMBOL	MIN.	NOM.	MAX.
A	—	—	1.60
A1	0.05	—	0.15
b	0.32	0.35	0.42
c	0.13	—	0.18
D	9.00 BSC		
D1	7.00 BSC		
e	0.80 BSC		
E	9.00 BSC		
E1	7.00 BSC		
θ	0°	—	7°
L	0.45	0.60	0.75
L1	1.00 REF		
L2	0.25 BSC		

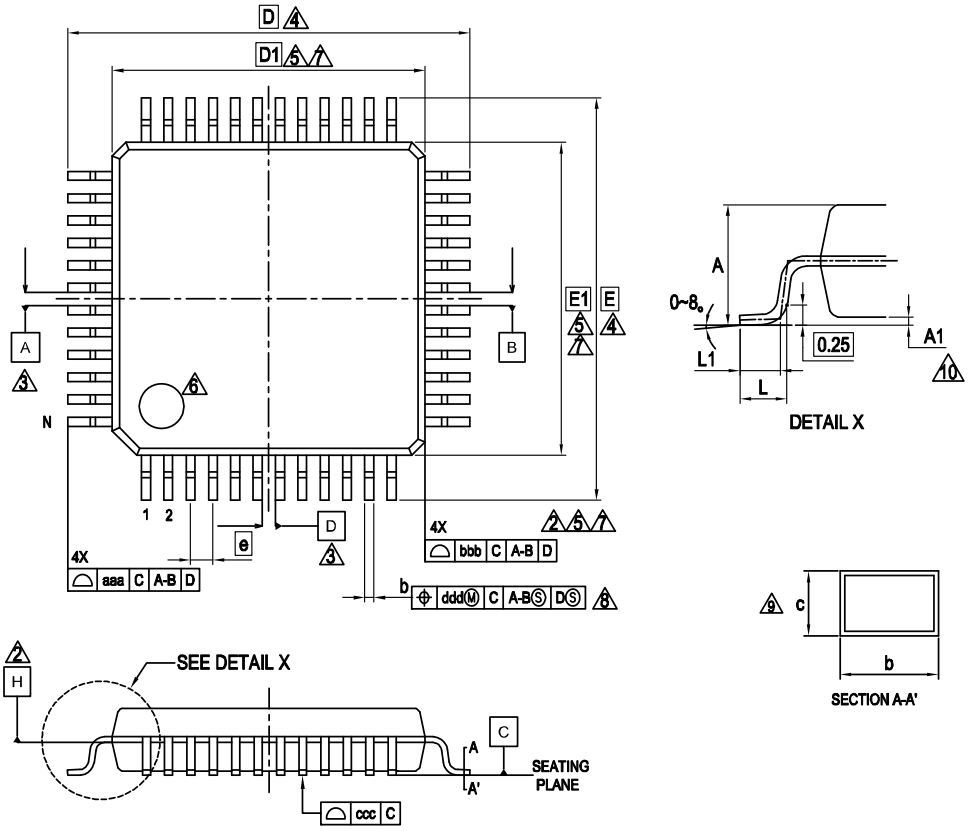
SYMBOL	TOLERANCES OF FORM AND POSITION
N	32
aaa	0.20
bbb	0.10
ccc	0.10
ddd	0.20

NOTES

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

Rev.0B

LQA048-02 , 48 Lead Plastic Low Profile Quad Flat Package



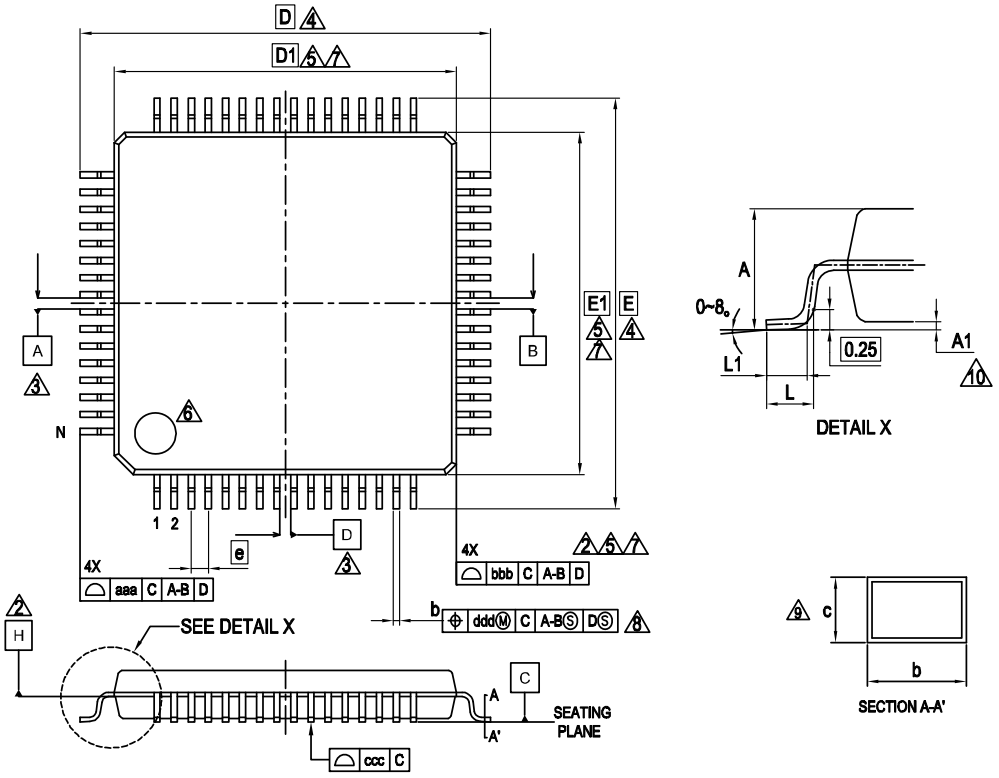
PACKAGE	LQA048-02		
SYMBOL	MIN.	NOM.	MAX.
A	——	——	1.70
A1	0.00	——	0.20
b	0.17	0.22	0.27
c	0.09	——	0.20
D	9.00 BSC.		
D1	7.00 BSC.		
e	0.50 BSC		
E	9.00 BSC.		
E1	7.00 BSC.		
L	0.45	0.60	0.75
L1	0.30	0.50	0.70
aaa	——	——	0.20
bbb	——	——	0.10
ccc	——	——	0.08
ddd	——	——	0.08
N	48		

NOTES

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

Rev. A

LQD064-02 , 64 Lead Plastic Low Profile Quad Flat Package



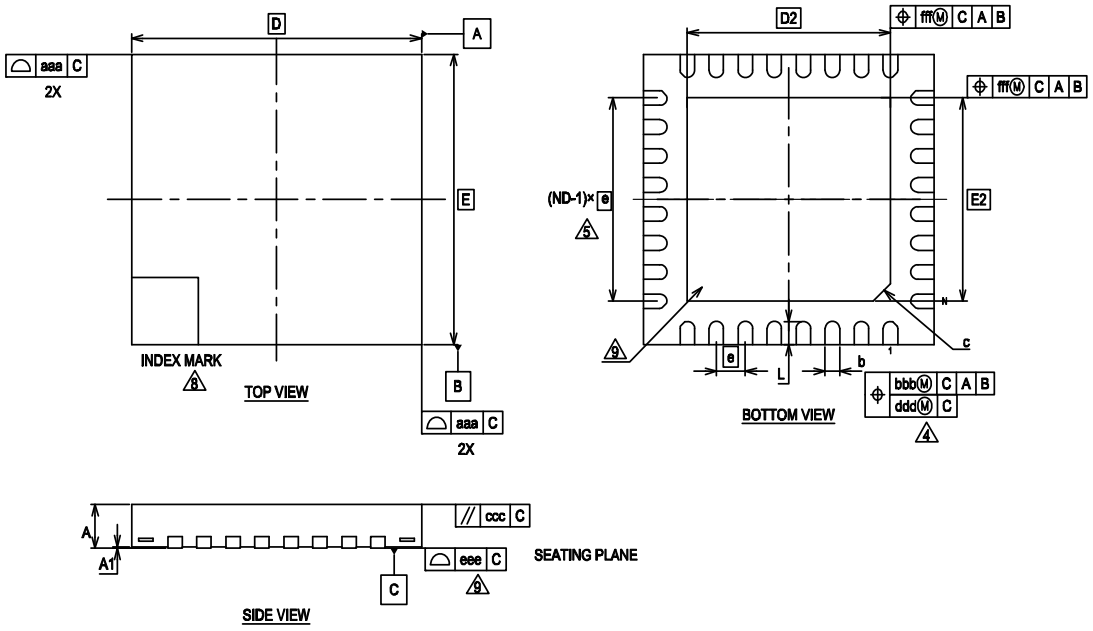
PACKAGE	LQD64-02		
SYMBOL	MIN.	NOM.	MAX.
A	—	—	1.70
A1	0.00	—	0.20
b	0.17	0.22	0.27
c	0.09	—	0.20
D	12.00 BSC.		
D1	10.00 BSC.		
e	0.50 BSC		
E	12.00 BSC.		
E1	10.00 BSC.		
L	0.45	0.60	0.75
L1	0.30	0.50	0.70
aaa	—	—	0.20
bbb	—	—	0.10
ccc	—	—	0.08
ddd	—	—	0.08
N	64		

NOTES

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

Rev. A

WNU032 VERY THIN PLASTIC QUAD FLAT NO LEAD PACKAGES



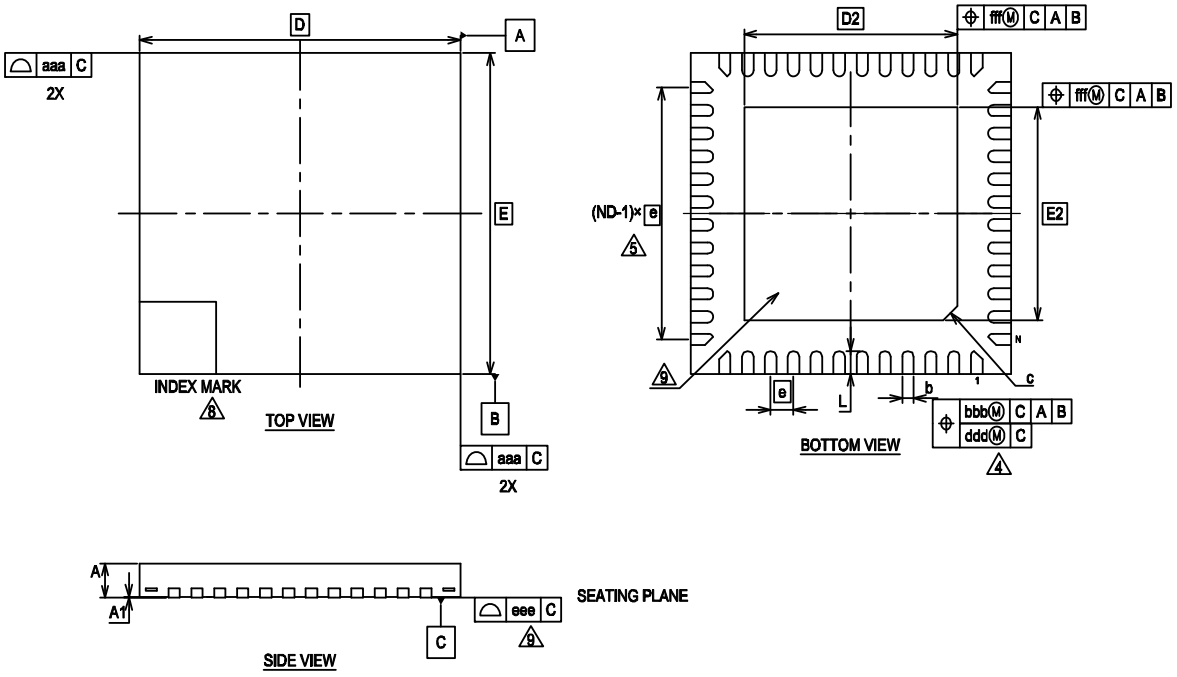
SYMBOL	MILLIMETER			NOTE
	MIN.	NOM.	MAX.	
A	—	—	0.80	PROFILE
A_1	0.00	—	0.05	TERMINAL HEIGHT
D		5.00 BSC		BODY SIZE
E		5.00 BSC		BODY SIZE
b	0.20	0.25	0.30	TERMINAL WIDTH
D_2		3.20 BSC		EXPOSED PAD SIZE
E_2		3.20 BSC		EXPOSED PAD SIZE
e		0.50 BSC		TERMINAL PITCH
c		0.25 REF		EXPOSED PAD CHAMFER
L	0.35	0.40	0.45	TERMINAL LENGTH

N	32	TERMINAL COUNT
aaa	0.10	
bbb	0.10	
ccc	0.10	
ddd	0.05	
eee	0.08	
fff	0.10	

1. DIMENSIONING AND TOLERANCING CONFORMS TO ASME Y14.5-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. DIMENSION "b" APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP.IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL. THE DIMENSION "b"SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
5. ND REFER TO THE NUMBER OF TERMINALS ON D OR E SIDE.
6. MAX. PACKAGE WARPAGE IS 0.05mm.
7. MAXIMUM ALLOWABLE BURRS IS 0.076mm IN ALL DIRECTIONS.
8. PIN #1 ID ON TOP WILL BE LOCATED WITHIN INDICATED ZONE.
9. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

Rev. 0A

WNY048 VERY THIN PLASTIC QUAD FLAT NO LEAD PACKAGES



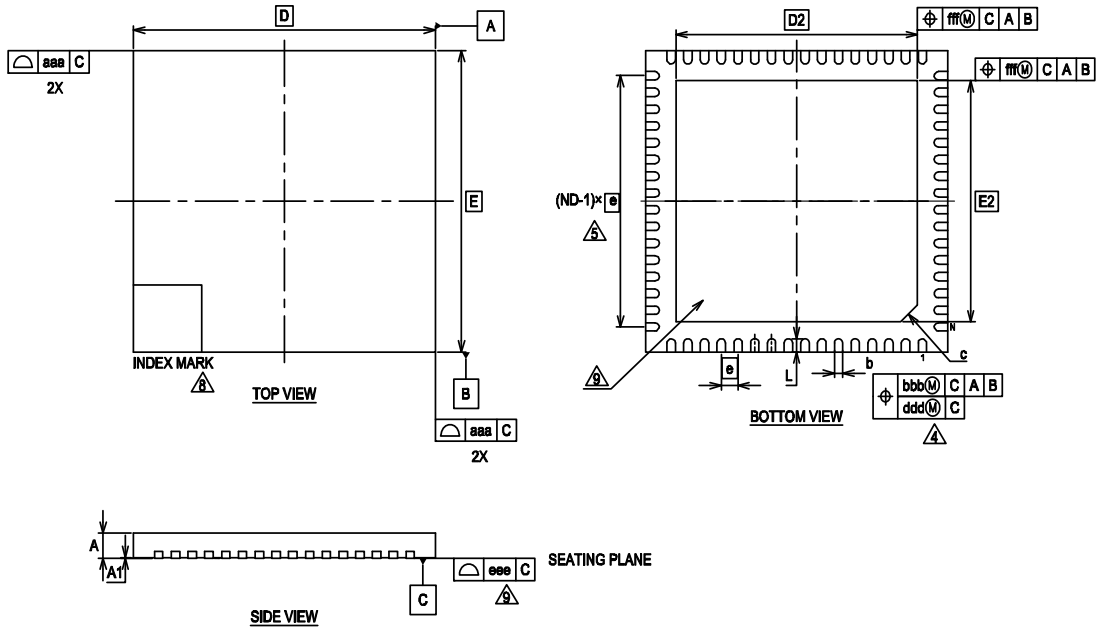
SYMBOL	MILLIMETER			NOTE
	MIN.	NOM.	MAX.	
A	——	——	0.80	PROFILE
A1	0.00	——	0.05	TERMINAL HEIGHT
D		7.00 BSC		BODY SIZE
E		7.00 BSC		BODY SIZE
b	0.18	0.25	0.30	TERMINAL WIDTH
D2		4.65 BSC		EXPOSED PAD SIZE
E2		4.65 BSC		EXPOSED PAD SIZE
e		0.50 BSC		TERMINAL PITCH
c		0.30 REF		EXPOSED PAD CHAMFER
L	0.45	0.50	0.55	TERMINAL LENGTH

N	48	TERMINAL COUNT
aaa	0.10	
bbb	0.10	
ddd	0.05	
eee	0.05	
fff	0.15	

1. DIMENSIONING AND TOLERANCINC CONFORMS TO ASME Y14.5-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. DIMENSION "b" APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP.IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL. THE DIMENSION "b"SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
5. ND REFER TO THE NUMBER OF TERMINALS ON D OR E SIDE.
6. MAX. PACKAGE WARPAGE IS 0.05mm.
7. MAXIMUM ALLOWABLE BURRS IS 0.076mm IN ALL DIRECTIONS.
8. PIN #1 ID ON TOP WILL BE LOCATED WITHIN INDICATED ZONE.
9. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

Rev. 0A

WNS064 VERY THIN PLASTIC QUAD FLAT NO LEAD PACKAGES



SYMBOL	MILLIMETER			NOTE
	MIN.	NOM.	MAX.	
A	—	—	0.80	PROFILE
A_1	0.00	—	0.05	TERMINAL HEIGHT
D		9.00 BSC		BODY SIZE
E		9.00 BSC		BODY SIZE
b	0.20	0.25	0.30	TERMINAL WIDTH
D_2		7.20 BSC		EXPOSED PAD SIZE
E_2		7.20 BSC		EXPOSED PAD SIZE
e		0.50 BSC		TERMINAL PITCH
c		0.50 REF		EXPOSED PAD CHAMFER
L	0.35	0.40	0.45	TERMINAL LENGTH

N	64	TERMINAL COUNT
aaa	0.10	
bbb	0.10	
ddd	0.05	
eee	0.05	
fff	0.15	

1. DIMENSIONING AND TOLERANCINC CONFORMS TO ASME Y14.5-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. DIMENSION "b" APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP.IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL. THE DIMENSION "b"SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
5. ND REFER TO THE NUMBER OF TERMINALS ON D OR E SIDE.
6. MAX. PACKAGE WARPAGE IS 0.05mm.
7. MAXIMUM ALLOWABLE BURRS IS 0.076mm IN ALL DIRECTIONS.
8. PIN #1 ID ON TOP WILL BE LOCATED WITHIN INDICATED ZONE.
9. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

Rev. 0A

Document History

Document Title: S6E1C3 Series 32-bit ARM® Cortex®-M0+ FM0+ Microcontroller
Document Number: 002-00233

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	4896074	TEKA	08/31/2015	New Spec.
*A	4955136	TEKA	10/9/2015	AC/DC characteristics updated. Typo fixed in “List of Pin Functions”.
*B	5158709	YUKT	03/04/2016	Added the frequency value of “Ta = - 10°C to + 105°C” on “11.4.3 Built-in CR Oscillation Characteristics”. Added the remark of “VCC < 0.2V” on “11.4.7 Power-on Reset Timing”. Added the measure condition(*9) of ICC on “11.3.1 Current Rating”. Changed the package outlines to cypress format on “13. Package Dimensions”. Changed the package codes to cypress codes on “3. Pin Assignment” and “12. Ordering Information”.

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