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

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

Details

Product Status	Active
Core Processor	R8C
Core Size	16-Bit
Speed	20MHz
Connectivity	I ² C, LINbus, SIO, SSU, UART/USART
Peripherals	POR, PWM, Voltage Detect, WDT
Number of I/O	59
Program Memory Size	96KB (96K x 8)
Program Memory Type	FLASH
EEPROM Size	4K x 8
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 5.5V
Data Converters	A/D 12x10b; D/A 2x8b
Oscillator Type	Internal
Operating Temperature	-20°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-LQFP
Supplier Device Package	64-LFQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f2136acnfp-50

Table 1.2 Specifications for R8C/36C Group (2)

Item	Function	Specification
Timer	Timer RE	8 bits × 1 Real-time clock mode (count seconds, minutes, hours, days of week), output compare mode
	Timer RF	16 bits × 1 Input capture mode (input capture circuit), output compare mode (output compare circuit)
	Timer RG	16 bits × 1 (with 2 capture/compare registers) Timer mode (input capture function, output compare function), PWM mode (output 1 pin), phase counting mode (available automatic measurement for the counts of 2-phase encoder)
Serial Interface	UART0, UART1	Clock synchronous serial I/O/UART × 2 channel
	UART2	Clock synchronous serial I/O, UART, I ² C mode (I ² C bus), multiprocessor communication function
Synchronous Serial Communication Unit (SSU)		1 (shared with I ² C bus)
I ² C bus		1 (shared with SSU)
LIN Module		Hardware LIN: 1 (timer RA, UART0)
A/D Converter		10-bit resolution × 12 channels, includes sample and hold function, with sweep mode
D/A Converter		8-bit resolution × 2 circuits
Comparator B		2 circuits
Flash Memory		• Programming and erasure voltage: VCC = 2.7 to 5.5 V • Programming and erasure endurance: 10,000 times (data flash) 1,000 times (program ROM) • Program security: ROM code protect, ID code check • Debug functions: On-chip debug, on-board flash rewrite function • Background operation (BGO) function (data flash)
Operating Frequency/Supply Voltage		f(XIN) = 20 MHz (VCC = 2.7 to 5.5 V) f(XIN) = 5 MHz (VCC = 1.8 to 5.5 V)
Current consumption		Typ. 7.0 mA (VCC = 5.0 V, f(XIN) = 20 MHz) Typ. 3.5 mA (VCC = 3.0 V, f(XIN) = 10 MHz) Typ. 4.0 μA (VCC = 3.0 V, wait mode (f(XCIN) = 32 kHz)) Typ. 2.0 μA (VCC = 3.0 V, stop mode)
Operating Ambient Temperature		−20 to 85°C (N version) −40 to 85°C (D version) ⁽¹⁾
Package		64-pin LQFP • Package code: PLQP0064KB-A (previous code: 64P6Q-A) • Package code: PLQP0064GA-A (previous code: 64P6U-A) 64-pin TQFP • Package code: PTQP0064LB-A

Note:

1. Specify the D version if D version functions are to be used.

Table 1.4 Product List for R8C/36C Group (2)

Current of Nov 2010

Part No.	ROM Capacity		RAM Capacity	Package Type	Remarks	
	Program ROM	Data flash				
R5F21364CDFP	16 Kbytes	1 Kbyte × 4	1.5 Kbytes	PLQP0064KB-A	D version	
R5F21365CDFP	24 Kbytes	1 Kbyte × 4	2 Kbytes	PLQP0064KB-A		
R5F21366CDFP	32 Kbytes	1 Kbyte × 4	2.5 Kbytes	PLQP0064KB-A		
R5F21367CDFP	48 Kbytes	1 Kbyte × 4	4 Kbytes	PLQP0064KB-A		
R5F21368CDFP	64 Kbytes	1 Kbyte × 4	6 Kbytes	PLQP0064KB-A		
R5F2136ACDFP	96 Kbytes	1 Kbyte × 4	8 Kbytes	PLQP0064KB-A		
R5F2136CCDFP	128 Kbytes	1 Kbyte × 4	10 Kbytes	PLQP0064KB-A		
R5F21364CDFA	16 Kbytes	1 Kbyte × 4	1.5 Kbytes	PLQP0064GA-A		
R5F21365CDFA	24 Kbytes	1 Kbyte × 4	2 Kbytes	PLQP0064GA-A		
R5F21366CDFA	32 Kbytes	1 Kbyte × 4	2.5 Kbytes	PLQP0064GA-A		
R5F21367CDFA	48 Kbytes	1 Kbyte × 4	4 Kbytes	PLQP0064GA-A		
R5F21368CDFA	64 Kbytes	1 Kbyte × 4	6 Kbytes	PLQP0064GA-A		
R5F2136ACDFA	96 Kbytes	1 Kbyte × 4	8 Kbytes	PLQP0064GA-A		
R5F2136CCDFA	128 Kbytes	1 Kbyte × 4	10 Kbytes	PLQP0064GA-A		
R5F21364CDFB (D)	16 Kbytes	1 Kbyte × 4	1.5 Kbytes	PTQP0064LB-A		
R5F21365CDFB (D)	24 Kbytes	1 Kbyte × 4	2 Kbytes	PTQP0064LB-A		
R5F21366CDFB (D)	32 Kbytes	1 Kbyte × 4	2.5 Kbytes	PTQP0064LB-A		
R5F21367CDFB (D)	48 Kbytes	1 Kbyte × 4	4 Kbytes	PTQP0064LB-A		
R5F21368CDFB (D)	64 Kbytes	1 Kbyte × 4	6 Kbytes	PTQP0064LB-A		
R5F2136ACDFB (D)	96 Kbytes	1 Kbyte × 4	8 Kbytes	PTQP0064LB-A		
R5F2136CCDFB (D)	128 Kbytes	1 Kbyte × 4	10 Kbytes	PTQP0064LB-A		
R5F21364CDXXXFP	16 Kbytes	1 Kbyte × 4	1.5 Kbytes	PLQP0064KB-A	N version	Factory programming product
R5F21365CDXXXFP	24 Kbytes	1 Kbyte × 4	2 Kbytes	PLQP0064KB-A		
R5F21366CDXXXFP	32 Kbytes	1 Kbyte × 4	2.5 Kbytes	PLQP0064KB-A		
R5F21367CDXXXFP	48 Kbytes	1 Kbyte × 4	4 Kbytes	PLQP0064KB-A		
R5F21368CDXXXFP	64 Kbytes	1 Kbyte × 4	6 Kbytes	PLQP0064KB-A		
R5F2136ACDXXXFP	96 Kbytes	1 Kbyte × 4	8 Kbytes	PLQP0064KB-A		
R5F2136CCDXXXFP	128 Kbytes	1 Kbyte × 4	10 Kbytes	PLQP0064KB-A		
R5F21364CDXXXFA	16 Kbytes	1 Kbyte × 4	1.5 Kbytes	PLQP0064GA-A		
R5F21365CDXXXFA	24 Kbytes	1 Kbyte × 4	2 Kbytes	PLQP0064GA-A		
R5F21366CDXXXFA	32 Kbytes	1 Kbyte × 4	2.5 Kbytes	PLQP0064GA-A		
R5F21367CDXXXFA	48 Kbytes	1 Kbyte × 4	4 Kbytes	PLQP0064GA-A		
R5F21368CDXXXFA	64 Kbytes	1 Kbyte × 4	6 Kbytes	PLQP0064GA-A		
R5F2136ACDXXXFA	96 Kbytes	1 Kbyte × 4	8 Kbytes	PLQP0064GA-A		
R5F2136CCDXXXFA	128 Kbytes	1 Kbyte × 4	10 Kbytes	PLQP0064GA-A		
R5F21364CDXXXFB (D)	16 Kbytes	1 Kbyte × 4	1.5 Kbytes	PTQP0064LB-A		
R5F21365CDXXXFB (D)	24 Kbytes	1 Kbyte × 4	2 Kbytes	PTQP0064LB-A		
R5F21366CDXXXFB (D)	32 Kbytes	1 Kbyte × 4	2.5 Kbytes	PTQP0064LB-A		
R5F21367CDXXXFB (D)	48 Kbytes	1 Kbyte × 4	4 Kbytes	PTQP0064LB-A		
R5F21368CDXXXFB (D)	64 Kbytes	1 Kbyte × 4	6 Kbytes	PTQP0064LB-A		
R5F2136ACDXXXFB (D)	96 Kbytes	1 Kbyte × 4	8 Kbytes	PTQP0064LB-A		
R5F2136CCDXXXFB (D)	128 Kbytes	1 Kbyte × 4	10 Kbytes	PTQP0064LB-A		

(D): Under development

Note:

1. The user ROM is programmed before shipment.

1.3 Block Diagram

Figure 1.2 shows a Block Diagram.

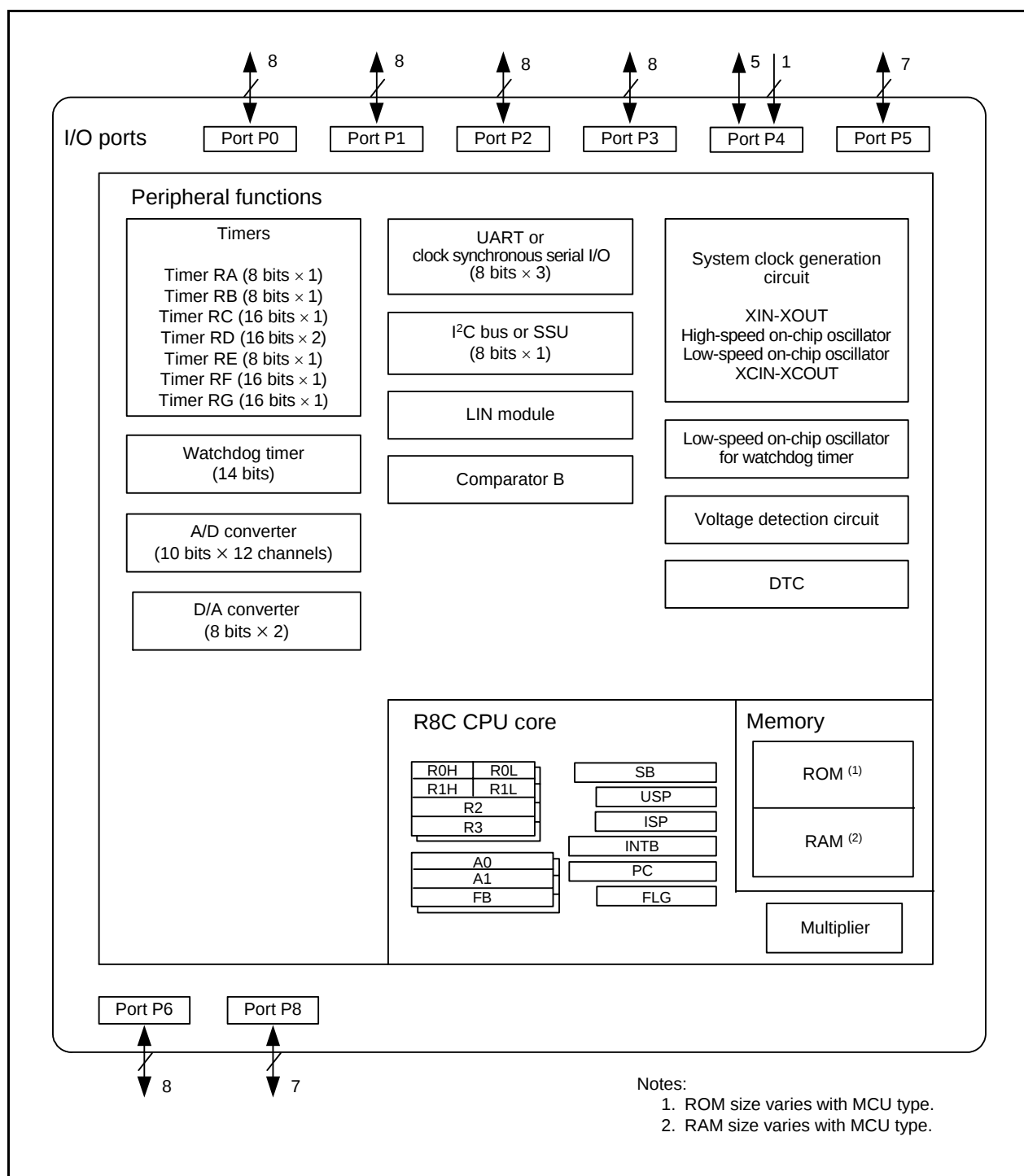


Figure 1.2 Block Diagram

1.4 Pin Assignment

Figure 1.3 shows Pin Assignment (Top View). Tables 1.5 and 1.6 outline the Pin Name Information by Pin Number.

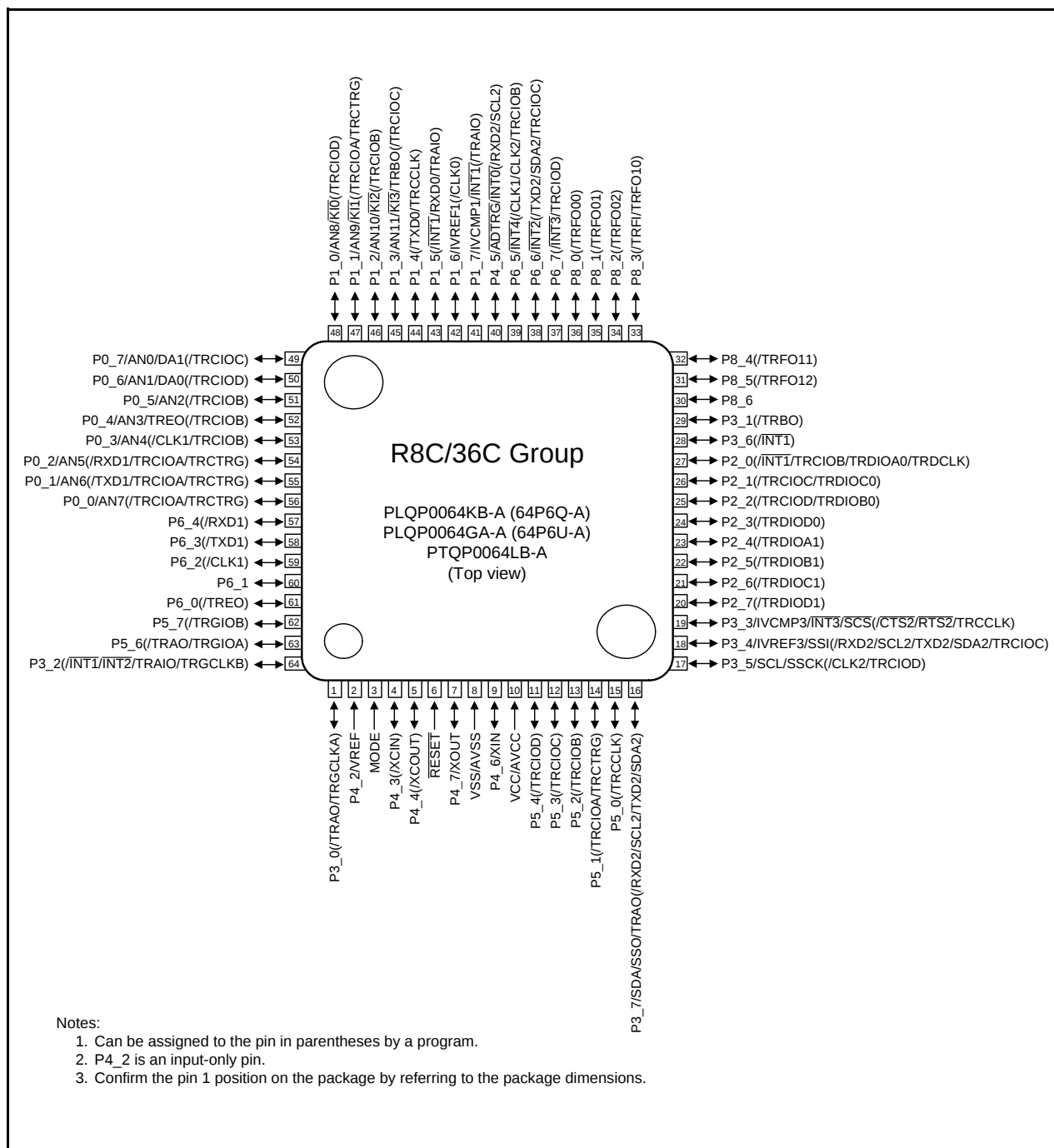


Figure 1.3 Pin Assignment (Top View)

Table 1.5 Pin Name Information by Pin Number (1)

Pin Number	Control Pin	Port	I/O Pin Functions for Peripheral Modules					
			Interrupt	Timer	Serial Interface	SSU	I ² C bus	A/D Converter, D/A Converter, Comparator B
1		P3_0		(TRA0/TRGCLKA)				
2		P4_2						VREF
3	MODE							
4	(XCIN)	P4_3						
5	(XCOUT)	P4_4						
6	RESET							
7	XOUT	P4_7						
8	VSS/AVSS							
9	XIN	P4_6						
10	VCC/AVCC							
11		P5_4		(TRCIOD)				
12		P5_3		(TRCIOC)				
13		P5_2		(TRCIOB)				
14		P5_1		(TRCIOA/TRCTRG)				
15		P5_0		(TRCCLK)				
16		P3_7		TRA0	(TXD2/SDA2/ RXD2/SCL2)	SSO	SDA	
17		P3_5		(TRCIOD)	(CLK2)	SSCK	SCL	
18		P3_4		(TRCIOC)	(TXD2/SDA2/ RXD2/SCL2)	SSI		IVREF3
19		P3_3	INT3	(TRCCLK)	(CTS2/RTS2)	SCS		IVCMP3
20		P2_7		(TRDIOD1)				
21		P2_6		(TRDIOC1)				
22		P2_5		(TRDIOB1)				
23		P2_4		(TRDIOA1)				
24		P2_3		(TRDIOD0)				
25		P2_2		(TRCIOD/TRDIOB0)				
26		P2_1		(TRCIOC/TRDIOC0)				
27		P2_0	(INT1)	(TRCIOB/TRDIOA0/ TRDCLK)				
28		P3_6	(INT1)					
29		P3_1		(TRBO)				
30		P8_6						
31		P8_5		(TRFO12)				
32		P8_4		(TRFO11)				
33		P8_3		(TRFI/TRFO10)				
34		P8_2		(TRFO02)				
35		P8_1		(TRFO01)				
36		P8_0		(TRFO00)				
37		P6_7	(INT3)	(TRCIOD)				
38		P6_6	INT2	(TRCIOC)	(TXD2/SDA2)			
39		P6_5	INT4	(TRCIOB)	(CLK2/CLK1)			

Note:

1. Can be assigned to the pin in parentheses by a program.

2.1 Data Registers (R0, R1, R2, and R3)

R0 is a 16-bit register for transfer, arithmetic, and logic operations. The same applies to R1 to R3. R0 can be split into high-order bits (R0H) and low-order bits (R0L) to be used separately as 8-bit data registers. R1H and R1L are analogous to R0H and R0L. R2 can be combined with R0 and used as a 32-bit data register (R2R0). R3R1 is analogous to R2R0.

2.2 Address Registers (A0 and A1)

A0 is a 16-bit register for address register indirect addressing and address register relative addressing. It is also used for transfer, arithmetic, and logic operations. A1 is analogous to A0. A1 can be combined with A0 and as a 32-bit address register (A1A0).

2.3 Frame Base Register (FB)

FB is a 16-bit register for FB relative addressing.

2.4 Interrupt Table Register (INTB)

INTB is a 20-bit register that indicates the starting address of an interrupt vector table.

2.5 Program Counter (PC)

PC is 20 bits wide and indicates the address of the next instruction to be executed.

2.6 User Stack Pointer (USP) and Interrupt Stack Pointer (ISP)

The stack pointers (SP), USP and ISP, are each 16 bits wide. The U flag of FLG is used to switch between USP and ISP.

2.7 Static Base Register (SB)

SB is a 16-bit register for SB relative addressing.

2.8 Flag Register (FLG)

FLG is an 11-bit register indicating the CPU state.

2.8.1 Carry Flag (C)

The C flag retains carry, borrow, or shift-out bits that have been generated by the arithmetic and logic unit.

2.8.2 Debug Flag (D)

The D flag is for debugging only. Set it to 0.

2.8.3 Zero Flag (Z)

The Z flag is set to 1 when an arithmetic operation results in 0; otherwise to 0.

2.8.4 Sign Flag (S)

The S flag is set to 1 when an arithmetic operation results in a negative value; otherwise to 0.

2.8.5 Register Bank Select Flag (B)

Register bank 0 is selected when the B flag is 0. Register bank 1 is selected when this flag is set to 1.

2.8.6 Overflow Flag (O)

The O flag is set to 1 when an operation results in an overflow; otherwise to 0.

2.8.7 Interrupt Enable Flag (I)

The I flag enables maskable interrupts.

Interrupts are disabled when the I flag is set to 0, and are enabled when the I flag is set to 1. The I flag is set to 0 when an interrupt request is acknowledged.

2.8.8 Stack Pointer Select Flag (U)

ISP is selected when the U flag is set to 0; USP is selected when the U flag is set to 1.

The U flag is set to 0 when a hardware interrupt request is acknowledged or the INT instruction of software interrupt numbers 0 to 31 is executed.

2.8.9 Processor Interrupt Priority Level (IPL)

IPL is 3 bits wide and assigns processor interrupt priority levels from level 0 to level 7.

If a requested interrupt has higher priority than IPL, the interrupt is enabled.

2.8.10 Reserved Bit

If necessary, set to 0. When read, the content is undefined.

Table 4.7 SFR Information (7) ⁽¹⁾

Address	Register	Symbol	After Reset
0180h	Timer RA Pin Select Register	TRASR	00h
0181h	Timer RB/RC Pin Select Register	TRBRCR	00h
0182h	Timer RC Pin Select Register 0	TRCPSR0	00h
0183h	Timer RC Pin Select Register 1	TRCPSR1	00h
0184h	Timer RD Pin Select Register 0	TRDPSR0	00h
0185h	Timer RD Pin Select Register 1	TRDPSR1	00h
0186h	Timer Pin Select Register	TIMSR	00h
0187h	Timer RF Output Control Register	TRFOUT	00h
0188h	UART0 Pin Select Register	U0SR	00h
0189h	UART1 Pin Select Register	U1SR	00h
018Ah	UART2 Pin Select Register 0	U2SR0	00h
018Bh	UART2 Pin Select Register 1	U2SR1	00h
018Ch	SSU/IIC Pin Select Register	SSUIICSR	00h
018Dh			
018Eh	INT Interrupt Input Pin Select Register	INTSR	00h
018Fh	I/O Function Pin Select Register	PINSR	00h
0190h			
0191h			
0192h			
0193h	SS Bit Counter Register	SSBR	11111000b
0194h	SS Transmit Data Register L / IIC bus Transmit Data Register ⁽²⁾	SSTDRL / ICDRT	FFh
0195h	SS Transmit Data Register H ⁽²⁾	SSTDRLH	FFh
0196h	SS Receive Data Register L / IIC bus Receive Data Register ⁽²⁾	SSRDL / ICDRL	FFh
0197h	SS Receive Data Register H ⁽²⁾	SSRDLH	FFh
0198h	SS Control Register H / IIC bus Control Register 1 ⁽²⁾	SSCRH / ICCR1	00h
0199h	SS Control Register L / IIC bus Control Register 2 ⁽²⁾	SSCRL / ICCR2	01111101b
019Ah	SS Mode Register / IIC bus Mode Register ⁽²⁾	SSMR / ICMR	00010000b / 00011000b
019Bh	SS Enable Register / IIC bus Interrupt Enable Register ⁽²⁾	SSER / ICIE	00h
019Ch	SS Status Register / IIC bus Status Register ⁽²⁾	SSSR / ICSR	00h / 0000X000b
019Dh	SS Mode Register 2 / Slave Address Register ⁽²⁾	SSMR2 / SAR	00h
019Eh			
019Fh			
01A0h			
01A1h			
01A2h			
01A3h			
01A4h			
01A5h			
01A6h			
01A7h			
01A8h			
01A9h			
01AAh			
01ABh			
01ACh			
01ADh			
01AEh			
01AFh			
01B0h			
01B1h			
01B2h	Flash Memory Status Register	FST	10000X00b
01B3h			
01B4h	Flash Memory Control Register 0	FMR0	00h
01B5h	Flash Memory Control Register 1	FMR1	00h
01B6h	Flash Memory Control Register 2	FMR2	00h
01B7h			
01B8h			
01B9h			
01BAh			
01BBh			
01BCh			
01BDh			
01BEh			
01BFh			

X: Undefined

Notes:

1. The blank areas are reserved and cannot be accessed by users.
2. Selectable by the IICSEL bit in the SSUIICSR register.

Table 4.8 SFR Information (8) (1)

Address	Register	Symbol	After Reset
01C0h	Address Match Interrupt Register 0	RMAD0	XXh
01C1h			XXh
01C2h			0000XXXXb
01C3h	Address Match Interrupt Enable Register 0	AIER0	00h
01C4h	Address Match Interrupt Register 1	RMAD1	XXh
01C5h			XXh
01C6h			0000XXXXb
01C7h	Address Match Interrupt Enable Register 1	AIER1	00h
01C8h			
01C9h			
01CAh			
01CBh			
01CCh			
01CDh			
01CEh			
01CFh			
01D0h			
01D1h			
01D2h			
01D3h			
01D4h			
01D5h			
01D6h			
01D7h			
01D8h			
01D9h			
01DAh			
01DBh			
01DCh			
01DDh			
01DEh			
01DFh			
01E0h	Pull-Up Control Register 0	PUR0	00h
01E1h	Pull-Up Control Register 1	PUR1	00h
01E2h	Pull-Up Control Register 2	PUR2	00h
01E3h			
01E4h			
01E5h			
01E6h			
01E7h			
01E8h			
01E9h			
01EAh			
01EBh			
01ECh			
01EDh			
01EEh			
01EFh			
01F0h	Port P1 Drive Capacity Control Register	P1DRR	00h
01F1h	Port P2 Drive Capacity Control Register	P2DRR	00h
01F2h	Drive Capacity Control Register 0	DRR0	00h
01F3h	Drive Capacity Control Register 1	DRR1	00h
01F4h	Drive Capacity Control Register 2	DRR2	00h
01F5h	Input Threshold Control Register 0	VLT0	00h
01F6h	Input Threshold Control Register 1	VLT1	00h
01F7h	Input Threshold Control Register 2	VLT2	00h
01F8h	Comparator B Control Register 0	INTCMP	00h
01F9h			
01FAh	External Input Enable Register 0	INTEN	00h
01FBh	External Input Enable Register 1	INTEN1	00h
01FCh	INT Input Filter Select Register 0	INTF	00h
01FDh	INT Input Filter Select Register 1	INTF1	00h
01FEh	Key Input Enable Register 0	KIEN	00h
01FFh			

X: Undefined

Note:

1. The blank areas are reserved and cannot be accessed by users.

Table 4.11 SFR Information (11) ⁽¹⁾

Address	Register	Symbol	After Reset
2CB0h	DTC Control Data 14	DTCD14	XXh
2CB1h			XXh
2CB2h			XXh
2CB3h			XXh
2CB4h			XXh
2CB5h			XXh
2CB6h			XXh
2CB7h			XXh
2CB8h	DTC Control Data 15	DTCD15	XXh
2CB9h			XXh
2CBAh			XXh
2CBBh			XXh
2CBCh			XXh
2CBDh			XXh
2CBEh			XXh
2CBFh			XXh
2CC0h	DTC Control Data 16	DTCD16	XXh
2CC1h			XXh
2CC2h			XXh
2CC3h			XXh
2CC4h			XXh
2CC5h			XXh
2CC6h			XXh
2CC7h			XXh
2CC8h	DTC Control Data 17	DTCD17	XXh
2CC9h			XXh
2CCAh			XXh
2CCBh			XXh
2CCCh			XXh
2CCDh			XXh
2CCEh			XXh
2CCFh			XXh
2CD0h	DTC Control Data 18	DTCD18	XXh
2CD1h			XXh
2CD2h			XXh
2CD3h			XXh
2CD4h			XXh
2CD5h			XXh
2CD6h			XXh
2CD7h			XXh
2CD8h	DTC Control Data 19	DTCD19	XXh
2CD9h			XXh
2CDAh			XXh
2CDBh			XXh
2CDCh			XXh
2CDDh			XXh
2CDEh			XXh
2CDFh			XXh
2CE0h	DTC Control Data 20	DTCD20	XXh
2CE1h			XXh
2CE2h			XXh
2CE3h			XXh
2CE4h			XXh
2CE5h			XXh
2CE6h			XXh
2CE7h			XXh
2CE8h	DTC Control Data 21	DTCD21	XXh
2CE9h			XXh
2CEAh			XXh
2CEBh			XXh
2CECh			XXh
2CEDh			XXh
2CEEh			XXh
2CEFh			XXh

X: Undefined

Note:

1. The blank areas are reserved and cannot be accessed by users.

5. Electrical Characteristics

Table 5.1 Absolute Maximum Ratings

Symbol	Parameter	Condition	Rated Value	Unit
V _{CC} /AV _{CC}	Supply voltage		–0.3 to 6.5	V
V _I	Input voltage		–0.3 to V _{CC} + 0.3	V
V _O	Output voltage		–0.3 to V _{CC} + 0.3	V
P _d	Power dissipation	–40°C ≤ T _{opr} ≤ 85°C	500	mW
T _{opr}	Operating ambient temperature		–20 to 85 (N version)/ –40 to 85 (D version)	°C
T _{stg}	Storage temperature		–65 to 150	°C

Table 5.2 Recommended Operating Conditions (1)

Symbol	Parameter				Conditions	Standard			Unit
						Min.	Typ.	Max.	
Vcc/AVcc	Supply voltage					1.8	—	5.5	V
Vss/AVss	Supply voltage					—	0	—	V
VIH	Input “H” voltage	Other than CMOS input				0.8 Vcc	—	Vcc	V
		CMOS input	Input level switching function (I/O port)	Input level selection: 0.35 Vcc	4.0 V ≤ Vcc ≤ 5.5 V	0.5 Vcc	—	Vcc	V
					2.7 V ≤ Vcc < 4.0 V	0.55 Vcc	—	Vcc	V
					1.8 V ≤ Vcc < 2.7 V	0.65 Vcc	—	Vcc	V
				Input level selection: 0.5 Vcc	4.0 V ≤ Vcc ≤ 5.5 V	0.65 Vcc	—	Vcc	V
					2.7 V ≤ Vcc < 4.0 V	0.7 Vcc	—	Vcc	V
					1.8 V ≤ Vcc < 2.7 V	0.8 Vcc	—	Vcc	V
				Input level selection: 0.7 Vcc	4.0 V ≤ Vcc ≤ 5.5 V	0.85 Vcc	—	Vcc	V
					2.7 V ≤ Vcc < 4.0 V	0.85 Vcc	—	Vcc	V
					1.8 V ≤ Vcc < 2.7 V	0.85 Vcc	—	Vcc	V
	External clock input (XOUT)				1.2	—	Vcc	V	
VIL	Input “L” voltage	Other than CMOS input				0	—	0.2 Vcc	V
		CMOS input	Input level switching function (I/O port)	Input level selection: 0.35 Vcc	4.0 V ≤ Vcc ≤ 5.5 V	0	—	0.2 Vcc	V
					2.7 V ≤ Vcc < 4.0 V	0	—	0.2 Vcc	V
					1.8 V ≤ Vcc < 2.7 V	0	—	0.2 Vcc	V
				Input level selection: 0.5 Vcc	4.0 V ≤ Vcc ≤ 5.5 V	0	—	0.4 Vcc	V
					2.7 V ≤ Vcc < 4.0 V	0	—	0.3 Vcc	V
					1.8 V ≤ Vcc < 2.7 V	0	—	0.2 Vcc	V
				Input level selection: 0.7 Vcc	4.0 V ≤ Vcc ≤ 5.5 V	0	—	0.55 Vcc	V
					2.7 V ≤ Vcc < 4.0 V	0	—	0.45 Vcc	V
					1.8 V ≤ Vcc < 2.7 V	0	—	0.35 Vcc	V
	External clock input (XOUT)				0	—	0.4	V	
IOH(sum)	Peak sum output “H” current	Sum of all pins IOH(peak)		—	—	−160	mA		
IOH(sum)	Average sum output “H” current	Sum of all pins IOH(avg)		—	—	−80	mA		
IOH(peak)	Peak output “H” current	Drive capacity Low		—	—	−10	mA		
		Drive capacity High		—	—	−40	mA		
IOH(avg)	Average output “H” current	Drive capacity Low		—	—	−5	mA		
		Drive capacity High		—	—	−20	mA		
IOL(sum)	Peak sum output “L” current	Sum of all pins IOL(peak)		—	—	160	mA		
IOL(sum)	Average sum output “L” current	Sum of all pins IOL(avg)		—	—	80	mA		
IOL(peak)	Peak output “L” current	Drive capacity Low		—	—	10	mA		
		Drive capacity High		—	—	40	mA		
IOL(avg)	Average output “L” current	Drive capacity Low		—	—	5	mA		
		Drive capacity High		—	—	20	mA		
f(XIN)	XIN clock input oscillation frequency			2.7 V ≤ Vcc ≤ 5.5 V	—	—	20	MHz	
				1.8 V ≤ Vcc < 2.7 V	—	—	5	MHz	
f(XCIN)	XCIN clock input oscillation frequency			1.8 V ≤ Vcc ≤ 5.5 V	—	32.768	50	kHz	
fOCO40M	When used as the count source for timer RC, timer RD or timer RG ⁽³⁾			2.7 V ≤ Vcc ≤ 5.5 V	32	—	40	MHz	
fOCO-F	fOCO-F frequency			2.7 V ≤ Vcc ≤ 5.5 V	—	—	20	MHz	
				1.8 V ≤ Vcc < 2.7 V	—	—	5	MHz	
—	System clock frequency			2.7 V ≤ Vcc ≤ 5.5 V	—	—	20	MHz	
				1.8 V ≤ Vcc < 2.7 V	—	—	5	MHz	
f(BCLK)	CPU clock frequency			2.7 V ≤ Vcc ≤ 5.5 V	—	—	20	MHz	
				1.8 V ≤ Vcc < 2.7 V	—	—	5	MHz	

Notes:

- V_{CC} = 1.8 to 5.5 V and T_{opr} = −20 to 85 °C (N version)/−40 to 85 °C (D version), unless otherwise specified.
- The average output current indicates the average value of current measured during 100 ms.
- f_{OCO40M} can be used as the count source for timer RC, timer RD or timer RG in the range of V_{CC} = 2.7 to 5.5 V.

Table 5.6 Flash Memory (Program ROM) Electrical Characteristics

Symbol	Parameter	Conditions	Standard			Unit
			Min.	Typ.	Max.	
—	Program/erase endurance ⁽²⁾		1,000 ⁽³⁾	—	—	times
—	Byte program time		—	80	500	μs
—	Block erase time		—	0.3	—	s
t _d (SR-SUS)	Time delay from suspend request until suspend		—	—	5 + CPU clock × 3 cycles	ms
—	Interval from erase start/restart until following suspend request		0	—	—	μs
—	Time from suspend until erase restart		—	—	30 + CPU clock × 1 cycle	μs
t _d (CMDRST-READY)	Time from when command is forcibly stopped until reading is enabled		—	—	30 + CPU clock × 1 cycle	μs
—	Program, erase voltage		2.7	—	5.5	V
—	Read voltage		1.8	—	5.5	V
—	Program, erase temperature		0	—	60	°C
—	Data hold time ⁽⁷⁾	Ambient temperature = 55 °C	20	—	—	year

Notes:

1. V_{CC} = 2.7 to 5.5 V and T_{opr} = 0 to 60 °C, unless otherwise specified.
2. Definition of programming/erasure endurance
The programming and erasure endurance is defined on a per-block basis.
If the programming and erasure endurance is n (n = 1,000), each block can be erased n times. For example, if 1,024 1-byte writes are performed to different addresses in block A, a 1 Kbyte block, and then the block is erased, the programming/erasure endurance still stands at one. However, the same address must not be programmed more than once per erase operation (overwriting prohibited).
3. Endurance to guarantee all electrical characteristics after program and erase. (1 to Min. value can be guaranteed.)
4. In a system that executes multiple programming operations, the actual erasure count can be reduced by writing to sequential addresses in turn so that as much of the block as possible is used up before performing an erase operation. For example, when programming groups of 16 bytes, the effective number of rewrites can be minimized by programming up to 128 groups before erasing them all in one operation. It is also advisable to retain data on the erasure endurance of each block and limit the number of erase operations to a certain number.
5. If an error occurs during block erase, attempt to execute the clear status register command, then execute the block erase command at least three times until the erase error does not occur.
6. Customers desiring program/erase failure rate information should contact their Renesas technical support representative.
7. The data hold time includes time that the power supply is off or the clock is not supplied.

Table 5.8 Voltage Detection 0 Circuit Electrical Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
Vdet0	Voltage detection level Vdet0_0 ⁽²⁾		1.80	1.90	2.05	V
	Voltage detection level Vdet0_1 ⁽²⁾		2.15	2.35	2.50	V
	Voltage detection level Vdet0_2 ⁽²⁾		2.70	2.85	3.05	V
	Voltage detection level Vdet0_3 ⁽²⁾		3.55	3.80	4.05	V
—	Voltage detection 0 circuit response time ⁽⁴⁾	At the falling of Vcc from 5.0 V to (Vdet0_0 – 0.1) V	—	6	150	μs
—	Voltage detection circuit self power consumption	VCA25 = 1, Vcc = 5.0 V	—	1.5	—	μA
td(E-A)	Waiting time until voltage detection circuit operation starts ⁽³⁾		—	—	100	μs

Notes:

1. The measurement condition is Vcc = 1.8 to 5.5 V and T_{opr} = –20 to 85 °C (N version)/–40 to 85 °C (D version).
2. Select the voltage detection level with bits VDSEL0 and VDSEL1 in the OFS register.
3. Necessary time until the voltage detection circuit operates when setting to 1 again after setting the VCA25 bit in the VCA2 register to 0.
4. Time until the voltage monitor 0 reset is generated after the voltage passes Vdet0.

Table 5.9 Voltage Detection 1 Circuit Electrical Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
Vdet1	Voltage detection level Vdet1_0 ⁽²⁾	At the falling of Vcc	2.00	2.20	2.40	V
	Voltage detection level Vdet1_1 ⁽²⁾	At the falling of Vcc	2.15	2.35	2.55	V
	Voltage detection level Vdet1_2 ⁽²⁾	At the falling of Vcc	2.30	2.50	2.70	V
	Voltage detection level Vdet1_3 ⁽²⁾	At the falling of Vcc	2.45	2.65	2.85	V
	Voltage detection level Vdet1_4 ⁽²⁾	At the falling of Vcc	2.60	2.80	3.00	V
	Voltage detection level Vdet1_5 ⁽²⁾	At the falling of Vcc	2.75	2.95	3.15	V
	Voltage detection level Vdet1_6 ⁽²⁾	At the falling of Vcc	2.85	3.10	3.40	V
	Voltage detection level Vdet1_7 ⁽²⁾	At the falling of Vcc	3.00	3.25	3.55	V
	Voltage detection level Vdet1_8 ⁽²⁾	At the falling of Vcc	3.15	3.40	3.70	V
	Voltage detection level Vdet1_9 ⁽²⁾	At the falling of Vcc	3.30	3.55	3.85	V
	Voltage detection level Vdet1_A ⁽²⁾	At the falling of Vcc	3.45	3.70	4.00	V
	Voltage detection level Vdet1_B ⁽²⁾	At the falling of Vcc	3.60	3.85	4.15	V
	Voltage detection level Vdet1_C ⁽²⁾	At the falling of Vcc	3.75	4.00	4.30	V
	Voltage detection level Vdet1_D ⁽²⁾	At the falling of Vcc	3.90	4.15	4.45	V
	Voltage detection level Vdet1_E ⁽²⁾	At the falling of Vcc	4.05	4.30	4.60	V
	Voltage detection level Vdet1_F ⁽²⁾	At the falling of Vcc	4.20	4.45	4.75	V
—	Hysteresis width at the rising of Vcc in voltage detection 1 circuit	Vdet1_0 to Vdet1_5 selected	—	0.07	—	V
		Vdet1_6 to Vdet1_F selected	—	0.10	—	V
—	Voltage detection 1 circuit response time ⁽³⁾	At the falling of Vcc from 5.0 V to (Vdet1_0 – 0.1) V	—	60	150	μs
—	Voltage detection circuit self power consumption	VCA26 = 1, Vcc = 5.0 V	—	1.7	—	μA
td(E-A)	Waiting time until voltage detection circuit operation starts ⁽⁴⁾		—	—	100	μs

Notes:

1. The measurement condition is Vcc = 1.8 to 5.5 V and T_{opr} = –20 to 85 °C (N version)/–40 to 85 °C (D version).
2. Select the voltage detection level with bits VD1S0 to VD1S3 in the VD1LS register.
3. Time until the voltage monitor 1 interrupt request is generated after the voltage passes Vdet1.
4. Necessary time until the voltage detection circuit operates when setting to 1 again after setting the VCA26 bit in the VCA2 register to 0.

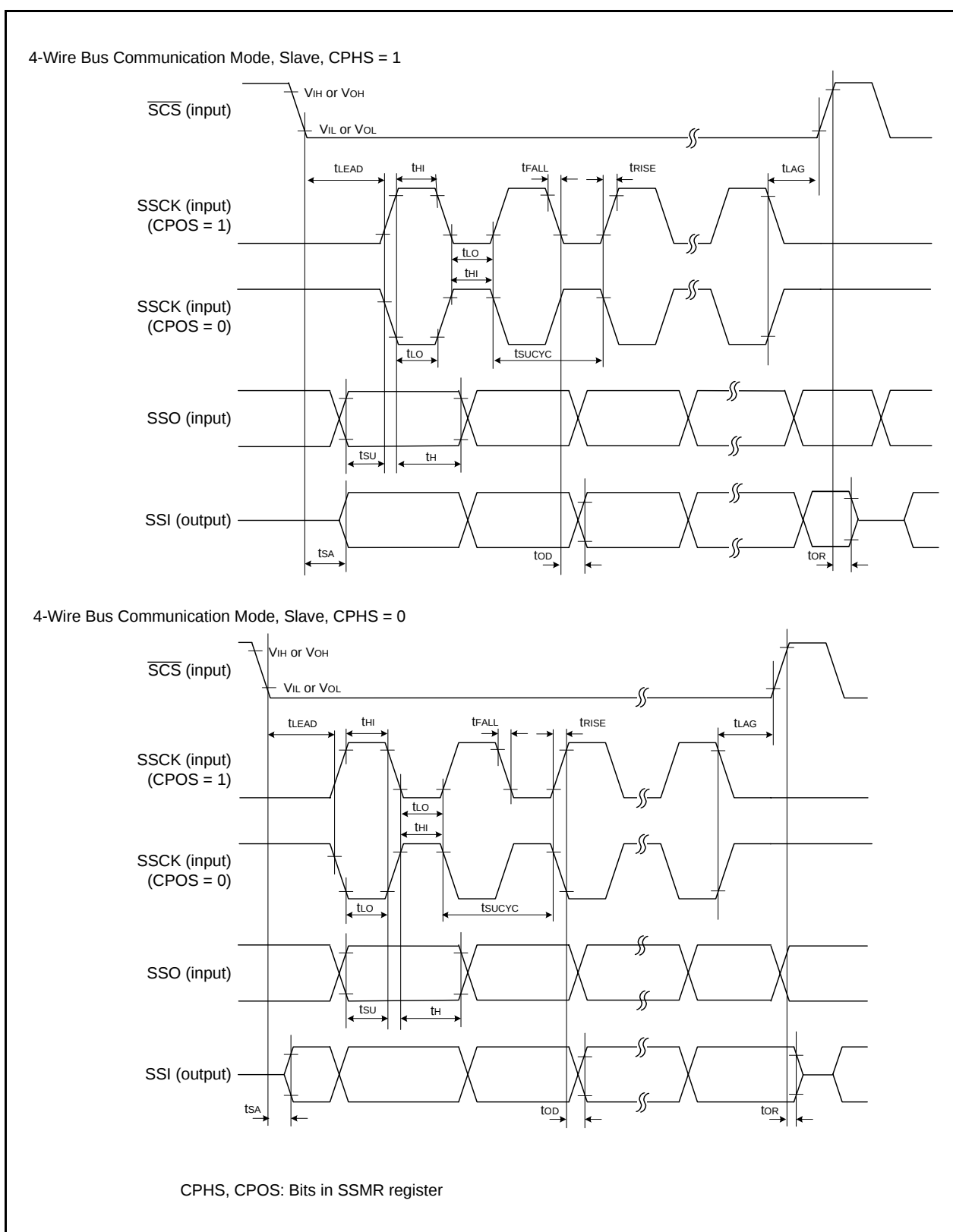


Figure 5.5 I/O Timing of Synchronous Serial Communication Unit (SSU) (Slave)

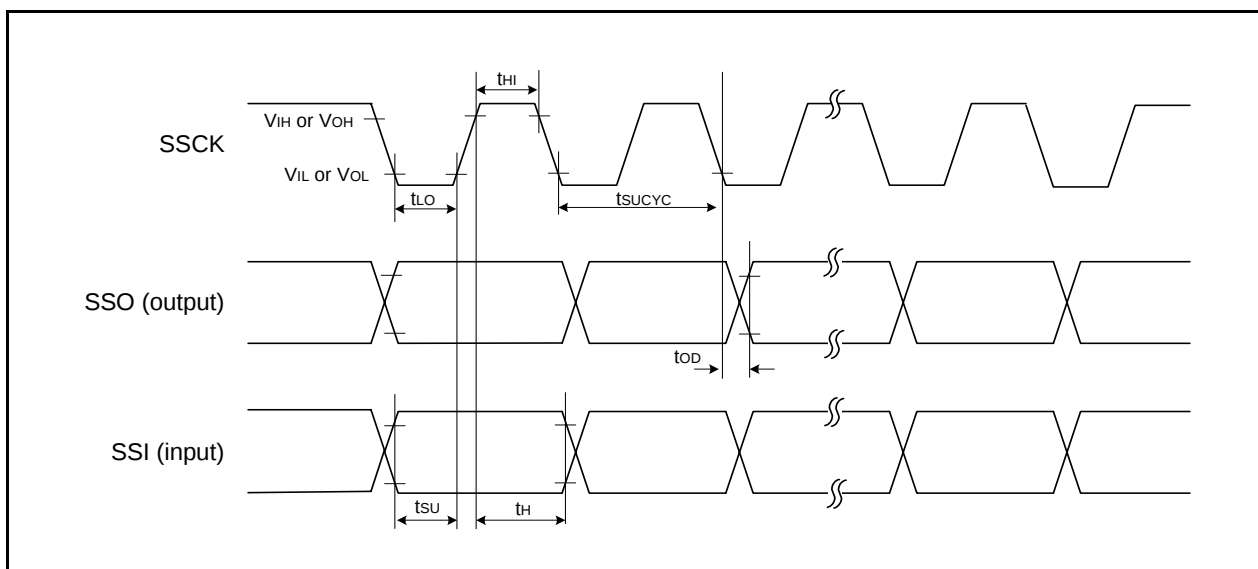


Figure 5.6 I/O Timing of Synchronous Serial Communication Unit (SSU) (Clock Synchronous Communication Mode)

Table 5.16 Timing Requirements of I²C bus Interface

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
t _{SCL}	SCL input cycle time		12t _{cyC} + 600 ⁽²⁾	—	—	ns
t _{SCLH}	SCL input "H" width		3t _{cyC} + 300 ⁽²⁾	—	—	ns
t _{SCLL}	SCL input "L" width		5t _{cyC} + 500 ⁽²⁾	—	—	ns
t _{sf}	SCL, SDA input fall time		—	—	300	ns
t _{SP}	SCL, SDA input spike pulse rejection time		—	—	1t _{cyC} ⁽²⁾	ns
t _{BUF}	SDA input bus-free time		5t _{cyC} ⁽²⁾	—	—	ns
t _{STAH}	Start condition input hold time		3t _{cyC} ⁽²⁾	—	—	ns
t _{STAS}	Retransmit start condition input setup time		3t _{cyC} ⁽²⁾	—	—	ns
t _{STOP}	Stop condition input setup time		3t _{cyC} ⁽²⁾	—	—	ns
t _{SDAS}	Data input setup time		1t _{cyC} + 40 ⁽²⁾	—	—	ns
t _{SDAH}	Data input hold time		10	—	—	ns

Notes:

1. V_{CC} = 1.8 to 5.5 V, V_{SS} = 0 V, and T_{opr} = -20 to 85 °C (N version)/-40 to 85 °C (D version), unless otherwise specified.
2. 1t_{cyC} = 1/f₁(s)

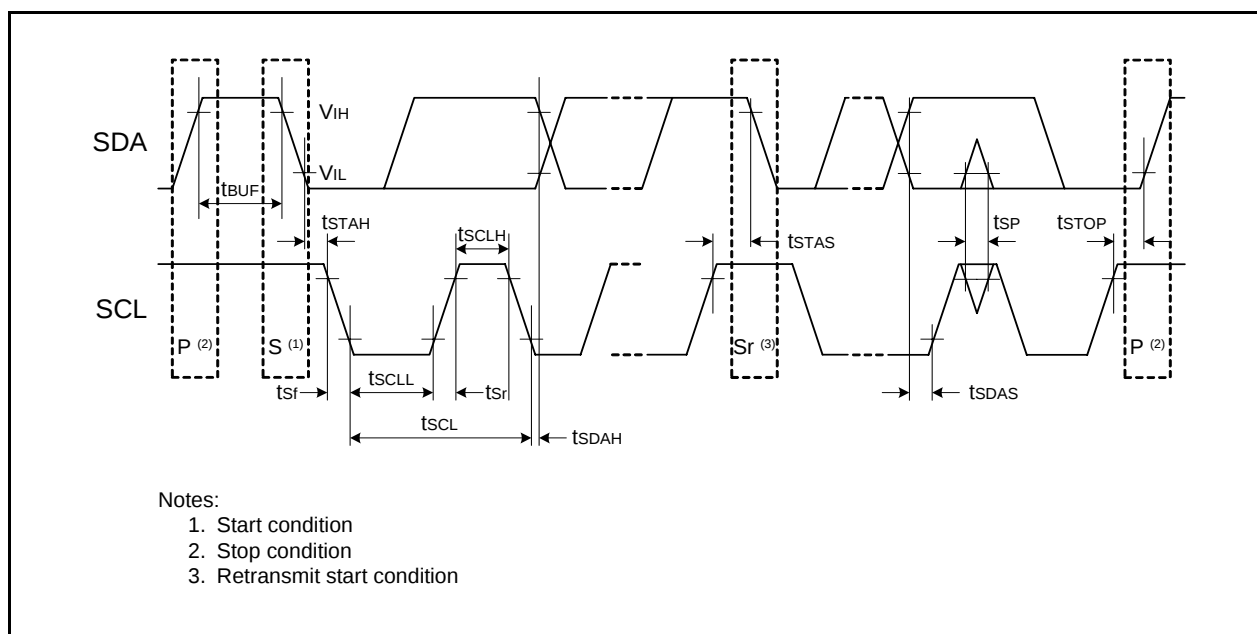
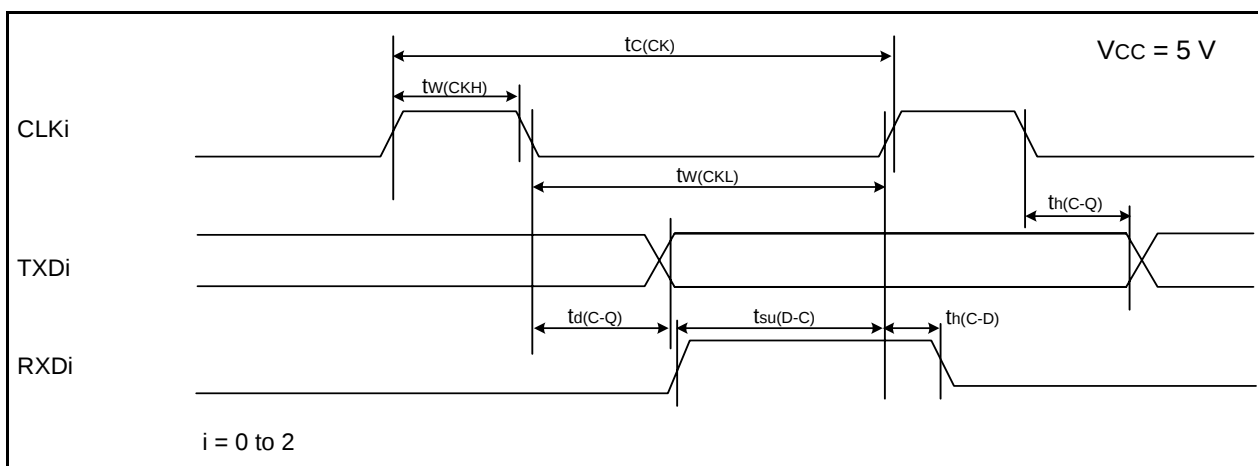
**Figure 5.7 I/O Timing of I²C bus Interface**

Table 5.18 Electrical Characteristics (2) [$3.3\text{ V} \leq V_{CC} \leq 5.5\text{ V}$]
($T_{opr} = -20\text{ to }85\text{ }^{\circ}\text{C}$ (N version)/ $-40\text{ to }85\text{ }^{\circ}\text{C}$ (D version), unless otherwise specified.)

Symbol	Parameter	Condition	Standard			Unit	
			Min.	Typ.	Max.		
Icc	Power supply current (Vcc = 3.3 to 5.5 V) Single-chip mode, output pins are open, other pins are Vss	High-speed clock mode	XIN = 20 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz No division	—	6.5	15	mA
			XIN = 16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz No division	—	5.3	12.5	mA
			XIN = 10 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz No division	—	3.6	—	mA
			XIN = 20 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8	—	3.0	—	mA
			XIN = 16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8	—	2.2	—	mA
			XIN = 10 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8	—	1.5	—	mA
		High-speed on-chip oscillator mode	XIN clock off High-speed on-chip oscillator on fOCO-F = 20 MHz Low-speed on-chip oscillator on = 125 kHz No division	—	7.0	15	mA
			XIN clock off High-speed on-chip oscillator on fOCO-F = 20 MHz Low-speed on-chip oscillator on = 125 kHz Divide-by-8	—	3.0	—	mA
			XIN clock off High-speed on-chip oscillator on fOCO-F = 4 MHz Low-speed on-chip oscillator on = 125 kHz Divide-by-16, MSTIIC = MSTTRD = MSTTRC = 1	—	1	—	mA
		Low-speed on-chip oscillator mode	XIN clock off High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8, FMR27 = 1, VCA20 = 0	—	90	400	μA
		Low-speed clock mode	XIN clock off High-speed on-chip oscillator off Low-speed on-chip oscillator off XCIN clock oscillator on = 32 kHz No division FMR27 = 1, VCA20 = 0	—	85	400	μA
			XIN clock off High-speed on-chip oscillator off Low-speed on-chip oscillator off XCIN clock oscillator on = 32 kHz No division Program operation on RAM Flash memory off, FMSTP = 1, VCA20 = 0	—	47	—	μA
		Wait mode	XIN clock off High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz While a WAIT instruction is executed Peripheral clock operation VCA27 = VCA26 = VCA25 = 0, VCA20 = 1	—	15	100	μA
			XIN clock off High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz While a WAIT instruction is executed Peripheral clock off VCA27 = VCA26 = VCA25 = 0, VCA20 = 1	—	4	90	μA
			XIN clock off High-speed on-chip oscillator off Low-speed on-chip oscillator off XCIN clock oscillator on = 32 kHz (peripheral clock off) While a WAIT instruction is executed VCA27 = VCA26 = VCA25 = 0, VCA20 = 1	—	3.5	—	μA
		Stop mode	XIN clock off, T _{opr} = 25 °C High-speed on-chip oscillator off Low-speed on-chip oscillator off CM10 = 1 Peripheral clock off VCA27 = VCA26 = VCA25 = 0	—	2.0	5.0	μA
			XIN clock off, T _{opr} = 85 °C High-speed on-chip oscillator off Low-speed on-chip oscillator off CM10 = 1 Peripheral clock off VCA27 = VCA26 = VCA25 = 0	—	15	—	μA

Table 5.22 Serial Interface

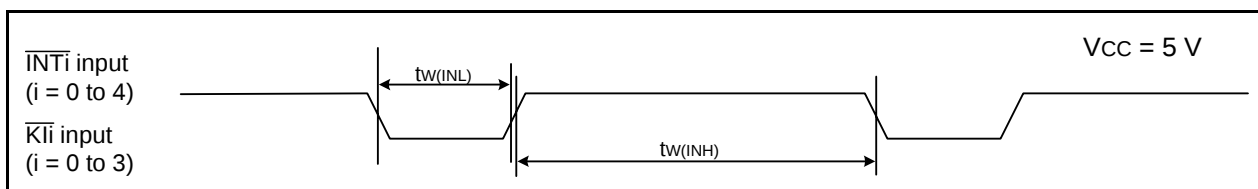
Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(CK)}$	CLKi input cycle time	200	—	ns
$t_{w(CKH)}$	CLKi input "H" width	100	—	ns
$t_{w(CKL)}$	CLKi input "L" width	100	—	ns
$t_{d(C-Q)}$	TXDi output delay time	—	50	ns
$t_{h(C-Q)}$	TXDi hold time	0	—	ns
$t_{su(D-C)}$	RXDi input setup time	50	—	ns
$t_{h(C-D)}$	RXDi input hold time	90	—	ns

 $i = 0 \text{ to } 2$ **Figure 5.11 Serial Interface Timing Diagram when VCC = 5 V****Table 5.23 External Interrupt $\overline{INTi}$ ($i = 0 \text{ to } 4$) Input, Key Input Interrupt $\overline{Kli}$ ($i = 0 \text{ to } 3$)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{w(INH)}$	$\overline{INTi}$ input "H" width, $\overline{Kli}$ input "H" width	250 ⁽¹⁾	—	ns
$t_{w(INL)}$	$\overline{INTi}$ input "L" width, $\overline{Kli}$ input "L" width	250 ⁽²⁾	—	ns

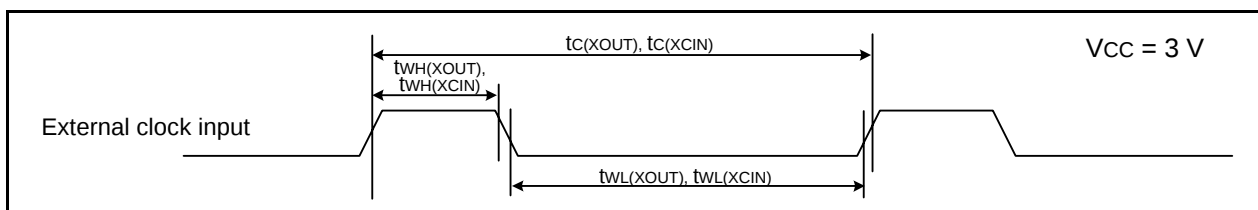
Notes:

1. When selecting the digital filter by the $\overline{INTi}$ input filter select bit, use an $\overline{INTi}$ input HIGH width of either (1/digital filter clock frequency $\times 3$) or the minimum value of standard, whichever is greater.
2. When selecting the digital filter by the $\overline{INTi}$ input filter select bit, use an $\overline{INTi}$ input LOW width of either (1/digital filter clock frequency $\times 3$) or the minimum value of standard, whichever is greater.

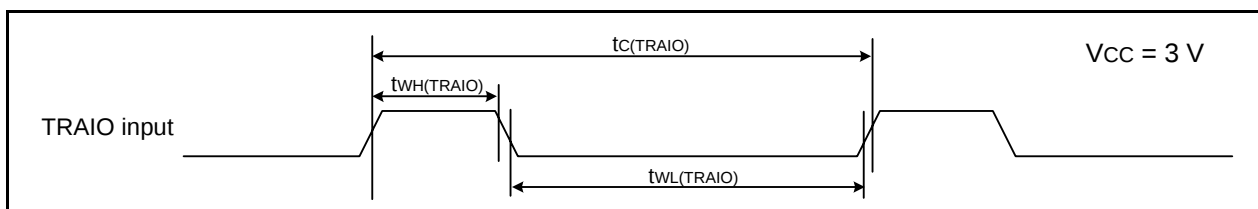
**Figure 5.12 Input Timing Diagram for External Interrupt $\overline{INTi}$ and Key Input Interrupt $\overline{Kli}$ when VCC = 5 V**

Timing requirements (Unless Otherwise Specified: $V_{CC} = 3\text{ V}$, $V_{SS} = 0\text{ V}$, $T_{opr} = 25\text{ }^{\circ}\text{C}$)**Table 5.26 External Clock Input (XOUT, XCIN)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_c(XOUT)$	XOUT input cycle time	50	—	ns
$t_{WH}(XOUT)$	XOUT input "H" width	24	—	ns
$t_{WL}(XOUT)$	XOUT input "L" width	24	—	ns
$t_c(XCIN)$	XCIN input cycle time	14	—	μs
$t_{WH}(XCIN)$	XCIN input "H" width	7	—	μs
$t_{WL}(XCIN)$	XCIN input "L" width	7	—	μs

**Figure 5.13 External Clock Input Timing Diagram when $V_{CC} = 3\text{ V}$** **Table 5.27 TRAIO Input**

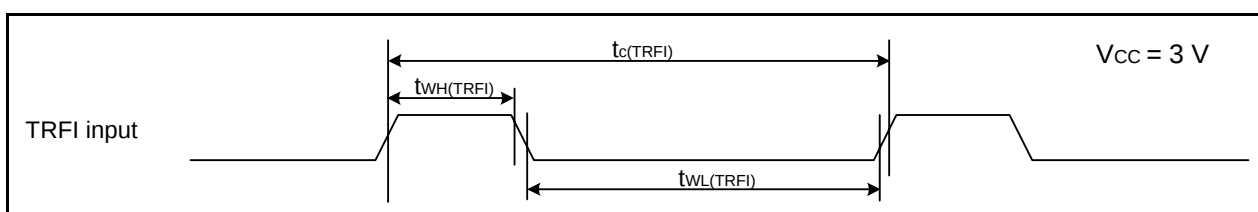
Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_c(TRAIO)$	TRAIO input cycle time	300	—	ns
$t_{WH}(TRAIO)$	TRAIO input "H" width	120	—	ns
$t_{WL}(TRAIO)$	TRAIO input "L" width	120	—	ns

**Figure 5.14 TRAIO Input Timing Diagram when $V_{CC} = 3\text{ V}$** **Table 5.28 TRFI Input**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_c(TRFI)$	TRFI input cycle time	1200 (1)	—	ns
$t_{WH}(TRFI)$	TRFI input "H" width	600 (2)	—	ns
$t_{WL}(TRFI)$	TRFI input "L" width	600 (2)	—	ns

Notes:

1. When using timer RF input capture mode, adjust the cycle time to $(1/\text{timer RF count source frequency} \times 3)$ or above.
2. When using timer RF input capture mode, adjust the pulse width to $(1/\text{timer RF count source frequency} \times 1.5)$ or above.

**Figure 5.15 TRFI Input Timing Diagram when $V_{CC} = 3\text{ V}$**