Welcome to E-XFL.COM

What is "Embedded - Microcontrollers"?

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

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	R8C
Core Size	16-Bit
Speed	20MHz
Connectivity	I²C, LINbus, SIO, SSU, UART/USART
Peripherals	POR, PWM, Voltage Detect, WDT
Number of I/O	71
Program Memory Size	96KB (96K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	7K x 8
Voltage - Supply (Vcc/Vdd)	2.2V ~ 5.5V
Data Converters	A/D 20x10b; D/A 2x8b
Oscillator Type	Internal
Operating Temperature	-20°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	80-LQFP
Supplier Device Package	80-LQFP (12x12)
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f212casnfp-v2

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   "Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

Table 1.3 Specifications for R8C/2D Group (1)

Item	Function	Specification
CPU	Central processing unit	R8C/Tiny series core • Number of fundamental instructions: 89 • Minimum instruction execution time: 50 ns (f(XIN) = 20 MHz, VCC = 3.0 to 5.5 V) 100 ns (f(XIN) = 10 MHz, VCC = 2.7 to 5.5 V) 200 ns (f(XIN) = 5 MHz, VCC = 2.2 to 5.5 V) • Multiplier: 16 bits × 16 bits → 32 bits • Multiply-accumulate instruction: 16 bits × 16 bits + 32 bits → 32 bits • Operation mode: Single-chip mode (address space: 1 Mbyte)
Memory	ROM, RAM	Refer to **Table 1.6 Product List for R8C/2D Group**.
Power Supply Voltage Detection	Voltage detection circuit	• Power-on reset • Voltage detection 3
I/O Ports	Programmable I/O ports	• Input-only: 2 pins • CMOS I/O ports: 71, selectable pull-up resistor • High current drive ports: 8
Clock	Clock generation circuits	3 circuits: XIN clock oscillation circuit (with on-chip feedback resistor), On-chip oscillator (high-speed, low-speed) (high-speed on-chip oscillator has a frequency adjustment function), XCIN clock oscillation circuit (32 kHz) • Oscillation stop detection: XIN clock oscillation stop detection function • Frequency divider circuit: Dividing selectable 1, 2, 4, 8, and 16 • Low power consumption modes: Standard operating mode (high-speed clock, low-speed clock, high-speed on-chip oscillator, low-speed on-chip oscillator), wait mode, stop mode
		Real-time clock (timer RE)
Interrupts		• External: 5 sources, Internal: 23 sources, Software: 4 sources • Priority levels: 7 levels
Watchdog Timer		15 bits × 1 (with prescaler), reset start selectable
Timer	Timer RA	8 bits × 1 (with 8-bit prescaler) Timer mode (period timer), pulse output mode (output level inverted every period), event counter mode, pulse width measurement mode, pulse period measurement mode
	Timer RB	8 bits × 1 (with 8-bit prescaler) Timer mode (period timer), programmable waveform generation mode (PWM output), programmable one-shot generation mode, programmable wait one-shot generation mode
	Timer RC	16 bits × 1 (with 4 capture/compare registers) Timer mode (input capture function, output compare function), PWM mode (output 3 pins), PWM2 mode (PWM output pin)
	Timer RD	16 bits × 2 (with 4 capture/compare registers) Timer mode (input capture function, output compare function), PWM mode (output 6 pins), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)
	Timer RE	8 bits × 1 Real-time clock mode (count seconds, minutes, hours, days of week), output compare mode
	Timer RF	16 bits × 1 (with capture/compare register pin and compare register pin) Input capture mode, output compare mode

Table 1.6 Product List for R8C/2D Group **Current of Dec. 2007**

Part No.	ROM Capacity		RAM Capacity	Package Type	Remarks	
	Program ROM	Data flash				
R5F212D7SNFP	48 Kbytes	1 Kbyte × 2	2.5 Kbytes	PLQP0080KB-A	N version	
R5F212D8SNFP	64 Kbytes	1 Kbyte × 2	3 Kbytes	PLQP0080KB-A		
R5F212DASNFP	96 Kbytes	1 Kbyte × 2	7 Kbytes	PLQP0080KB-A		
R5F212DCSNFP	128 Kbytes	1 Kbyte × 2	7.5 Kbytes	PLQP0080KB-A		
R5F212D7SDFP	48 Kbytes	1 Kbyte × 2	2.5 Kbytes	PLQP0080KB-A	D version	
R5F212D8SDFP	64 Kbytes	1 Kbyte × 2	3 Kbytes	PLQP0080KB-A		
R5F212DASDFP	96 Kbytes	1 Kbyte × 2	7 Kbytes	PLQP0080KB-A		
R5F212DCSDFP	128 Kbytes	1 Kbyte × 2	7.5 Kbytes	PLQP0080KB-A		
R5F212D7SNXXXFP	48 Kbytes	1 Kbyte × 2	2.5 Kbytes	PLQP0080KB-A	N version	Factory programming product(1)
R5F212D8SNXXXFP	64 Kbytes	1 Kbyte × 2	3 Kbytes	PLQP0080KB-A		
R5F212DASNXXXFP	96 Kbytes	1 Kbyte × 2	7 Kbytes	PLQP0080KB-A		
R5F212DCSNXXXFP	128 Kbytes	1 Kbyte × 2	7.5 Kbytes	PLQP0080KB-A		
R5F212D7SDXXXFP	48 Kbytes	1 Kbyte × 2	2.5 Kbytes	PLQP0080KB-A	D version	
R5F212D8SDXXXFP	64 Kbytes	1 Kbyte × 2	3 Kbytes	PLQP0080KB-A		
R5F212DASDXXXFP	96 Kbytes	1 Kbyte × 2	7 Kbytes	PLQP0080KB-A		
R5F212DCSDXXXFP	128 Kbytes	1 Kbyte × 2	7.5 Kbytes	PLQP0080KB-A		

NOTE:
1. The user ROM is programmed before shipment.

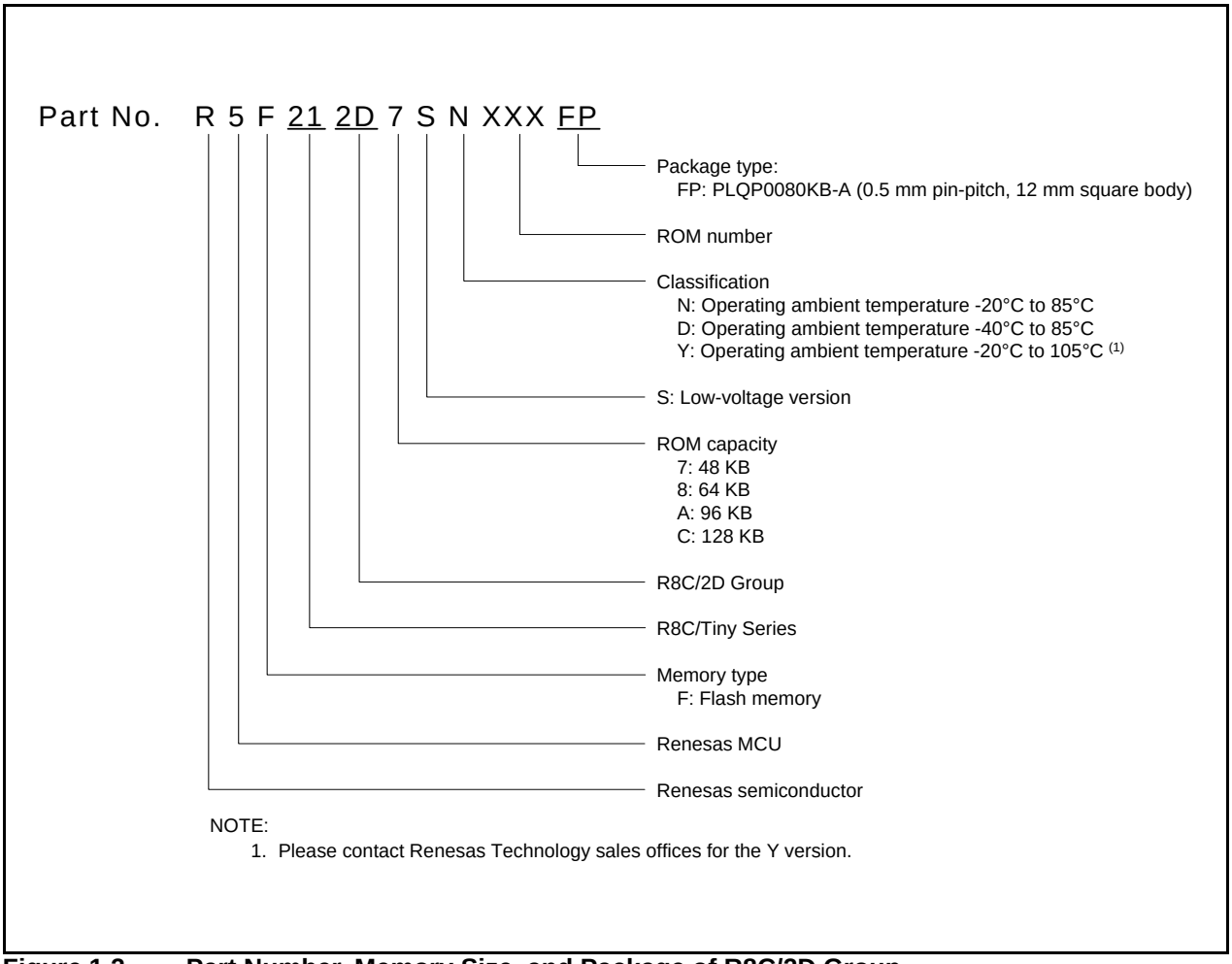


Figure 1.2 Part Number, Memory Size, and Package of R8C/2D Group

Table 1.8 Pin Name Information by Pin Number (2)

Pin Number	Control Pin	Port	I/O Pin Functions for of Peripheral Modules					
			Interrupt	Timer	Serial Interface	SSU	I^2C bus	A/D Converter, D/A Converter
46		P6_7	$\overline{INT3}$		RXD1			
47		P6_5			(CLK1)(1) /CLK2			
48		P6_4			RXD2			
49		P6_3			TXD2			
50		P3_1		TRBO				
51		P3_0		TRAO				
52		P3_6	($\overline{INT1}$)(1)					
53		P3_2	($\overline{INT2}$)(1)					
54		P1_3	$\overline{KI3}$					AN11
55		P1_2	$\overline{KI2}$					AN10
56		P1_1	$\overline{KI1}$					AN9
57		P1_0	$\overline{KI0}$					AN8
58		P7_7						AN19
59		P7_6						AN18
60		P7_5						AN17
61		P7_4						AN16
62		P7_3						AN15
63		P7_2						AN14
64		P7_1						AN13
65		P7_0						AN12
66		P0_0						AN7
67		P0_1						AN6
68		P0_2						AN5
69		P0_3						AN4
70		P0_4						AN3
71		P6_2						
72		P6_1						
73		P0_5			CLK1			AN2
74		P0_6						AN1/DA0
75	VSS/AVSS							
76		P0_7						AN0/DA1
77	VREF							
78	VCC/AVCC							
79		P3_7				SSO		
80		P3_5				SSCK	SCL	

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

2.8.7 Interrupt Enable Flag (I)

The I flag enables maskable interrupts.
Interrupt 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)

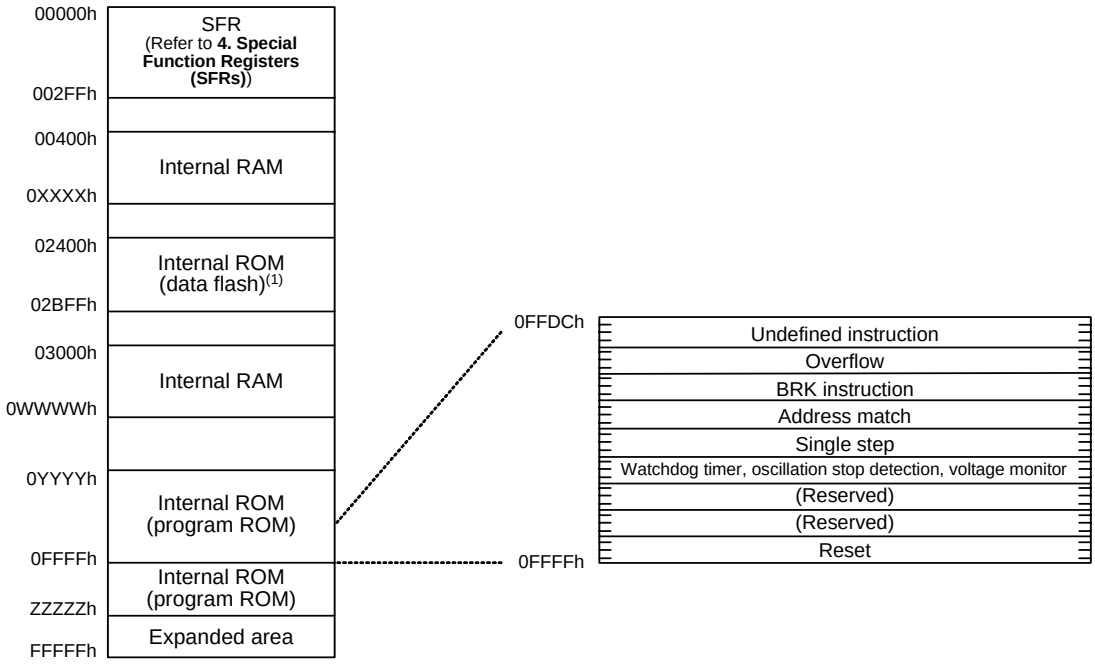
IPL is 3 bits wide and assigns processor interrupt priority levels from level 0 to level 7.
If a requested interrupt has higher priority than IPL, the interrupt is enabled.

2.8.10 Reserved Bit

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

3.2 R8C/2D Group

Figure 3.2 is a Memory Map of R8C/2D Group. The R8C/2D group has 1 Mbyte of address space from addresses 00000h to FFFFFh.
The internal ROM (program ROM) is allocated lower addresses, beginning with address 0FFFFh. For example, a 48-Kbyte internal ROM area is allocated addresses 04000h to 0FFFFh.
The fixed interrupt vector table is allocated addresses 0FFDCh to 0FFFFh. They store the starting address of each interrupt routine.
The internal ROM (data flash) is allocated addresses 02400h to 02BFFh.
The internal RAM area is allocated higher addresses, beginning with address 00400h. For example, a 2.5-Kbyte internal RAM is allocated addresses 00400h to 00DFFh. The internal RAM is used not only for storing data but also for calling subroutines and as stacks when interrupt requests are acknowledged.
Special function registers (SFRs) are allocated addresses 00000h to 002FFh. The peripheral function control registers are allocated here. All addresses within the SFR, which have nothing allocated are reserved for future use and cannot be accessed by users.



NOTES:
1. Data flash block A (1 Kbyte) and B (1 Kbyte) are shown.
2. The blank regions are reserved. Do not access locations in these regions.

Internal ROM			Internal RAM		
Size	Address 0YYYYh	Address ZZZZZh	Size	Address 0XXXXh	Address 0WWWWh
48 Kbytes	04000h	–	2.5 Kbytes	00DFFh	–
64 Kbytes	04000h	13FFFh	3 Kbytes	00FFFh	–
96 Kbytes	04000h	1BFFFh	7 Kbytes	011FFh	03DFFh
128 Kbytes	04000h	23FFFh	7.5 Kbytes	011FFh	03FFFh

Figure 3.2 Memory Map of R8C/2D Group

Table 4.2 SFR Information (2)[1]

Address	Register	Symbol	After reset
0040h			
0041h			
0042h			
0043h			
0044h			
0045h			
0046h			
0047h	Timer RC Interrupt Control Register	TRCIC	XXXXX000b
0048h	Timer RD0 Interrupt Control Register	TRD0IC	XXXXX000b
0049h	Timer RD1 Interrupt Control Register	TRD1IC	XXXXX000b
004Ah	Timer RE Interrupt Control Register	TREIC	XXXXX000b
004Bh	UART2 Transmit Interrupt Control Register	S2TIC	XXXXX000b
004Ch	UART2 Receive Interrupt Control Register	S2RIC	XXXXX000b
004Dh	Key Input Interrupt Control Register	KUPIC	XXXXX000b
004Eh			
004Fh	SSU/IIC Interrupt Control Register[2]	SSUIC / IICIC	XXXXX000b
0050h	Compare 1 Interrupt Control Register	CMP1IC	XXXXX000b
0051h	UART0 Transmit Interrupt Control Register	S0TIC	XXXXX000b
0052h	UART0 Receive Interrupt Control Register	S0RIC	XXXXX000b
0053h	UART1 Transmit Interrupt Control Register	S1TIC	XXXXX000b
0054h	UART1 Receive Interrupt Control Register	S1RIC	XXXXX000b
0055h	INT2 Interrupt Control Register	INT2IC	XX00X000b
0056h	Timer RA Interrupt Control Register	TRAIC	XXXXX000b
0057h			
0058h	Timer RB Interrupt Control Register	TRBIC	XXXXX000b
0059h	INT1 Interrupt Control Register	INT1IC	XX00X000b
005Ah	INT3 Interrupt Control Register	INT3IC	XX00X000b
005Bh	Timer RF Interrupt Control Register	TRFIC	XXXXX000b
005Ch	Compare 0 Interrupt Control Register	CMP0IC	XXXXX000b
005Dh	INT0 Interrupt Control Register	INT0IC	XX00X000b
005Eh	A/D Conversion Interrupt Control Register	ADIC	XXXXX000b
005Fh	Capture Interrupt Control Register	CAPIC	XXXXX000b
0060h			
0061h			
0062h			
0063h			
0064h			
0065h			
0066h			
0067h			
0068h			
0069h			
006Ah			
006Bh			
006Ch			
006Dh			
006Eh			
006Fh			
0070h			
0071h			
0072h			
0073h			
0074h			
0075h			
0076h			
0077h			
0078h			
0079h			
007Ah			
007Bh			
007Ch			
007Dh			
007Eh			
007Fh			

X: Undefined

NOTES:
1. The blank regions are reserved. Do not access locations in these regions.
2. Selected by the IICSEL bit in the PMR register.

Table 4.8 SFR Information (8)(1)

Address	Register	Symbol	After reset
01C0h			
01C1h			
01C2h			
01C3h			
01C4h			
01C5h			
01C6h			
01C7h			
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			
01E1h			
01E2h			
01E3h			
01E4h			
01E5h			
01E6h			
01E7h			
01E8h			
01E9h			
01EAh			
01EBh			
01ECh			
01EDh			
01EEh			
01EFh			
01F0h			
01F1h			
01F2h			
01F3h			
01F4h			
01F5h			
01F6h			
01F7h			
01F8h			
01F9h			
01FAh			
01FBh			
01FCh			
01FDh			
01FEh			
01FFh			

NOTE:
1. The blank regions are reserved. Do not access locations in these regions.

Table 4.11 SFR Information (11)[1]

Address	Register	Symbol	After reset
0280h			
0281h			
0282h			
0283h			
0284h			
0285h			
0286h			
0287h			
0288h			
0289h			
028Ah			
028Bh			
028Ch			
028Dh			
028Eh			
028Fh			
0290h	Timer RF Register	TRF	00h
0291h			00h
0292h			
0293h			
0294h			
0295h			
0296h			
0297h			
0298h			
0299h			
029Ah	Timer RF Control Register 0	TRFCR0	00h
029Bh	Timer RF Control Register 1	TRFCR1	00h
029Ch	Capture / Compare 0 Register	TRFM0	0000h[2]
029Dh			FFFFh[3]
029Eh	Compare 1 Register	TRFM1	FFh
029Fh			FFh
02A0h			
02A1h			
02A2h			
02A3h			
02A4h			
02A5h			
02A6h			
02A7h			
02A8h			
02A9h			
02AAh			
02ABh			
02ACh			
02ADh			
02AEh			
02AFh			
02B0h			
02B1h			
02B2h			
02B3h			
02B4h			
02B5h			
02B6h			
02B7h			
02B8h			
02B9h			
02BAh			
02BBh			
02BCh			
02BDh			
02BEh			
02BFh			

NOTES:
1. The blank regions are reserved. Do not access locations in these regions.
2. After input capture mode.
3. After output compare mode.

5. Electrical Characteristics

The electrical characteristics of N version (Topr = –20°C to 85°C) and D version (Topr = –40°C to 85°C) are listed below.
Please contact Renesas Technology sales offices for the electrical characteristics in the Y version (Topr = –20°C to 105°C).

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	T_{opr} = 25°C	700	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

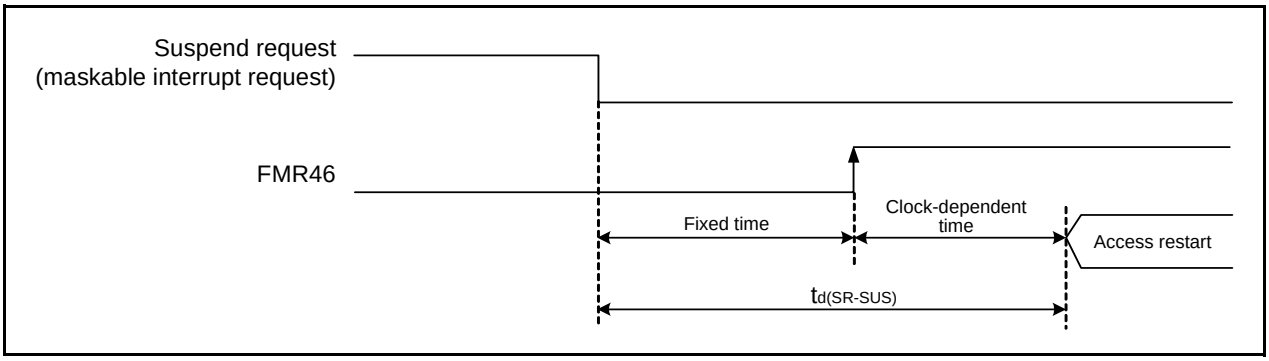


Figure 5.2 Time delay until Suspend

Table 5.7 Voltage Detection 0 Circuit Electrical Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
V_{det0}	Voltage detection level		2.2	2.3	2.4	V
–	Voltage detection circuit self power consumption	VCA25 = 1, V_{CC} = 5.0 V	–	0.9	–	µA
$t_{d(E-A)}$	Waiting time until voltage detection circuit operation starts(2)		–	–	300	µs
Vccmin	MCU operating voltage minimum value		2.2	–	–	V

NOTES:
1. The measurement condition is V_{CC} = 2.2 V to 5.5 V and T_{opr} = –20 to 85°C (N version) / –40 to 85°C (D version).
2. Necessary time until the voltage detection circuit operates when setting to 1 again after setting the VCA25 bit in the VCA2 register to 0.

Table 5.8 Voltage Detection 1 Circuit Electrical Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
V_{det1}	Voltage detection level		2.70	2.85	3.00	V
–	Voltage monitor 1 interrupt request generation time(2)		–	40	–	µs
–	Voltage detection circuit self power consumption	VCA26 = 1, V_{CC} = 5.0 V	–	0.6	–	µA
$t_{d(E-A)}$	Waiting time until voltage detection circuit operation starts(3)		–	–	100	µs

NOTES:
1. The measurement condition is V_{CC} = 2.2 V to 5.5 V and T_{opr} = –20 to 85°C (N version) / –40 to 85°C (D version).
2. Time until the voltage monitor 1 interrupt request is generated after the voltage passes V_{det1}.
3. Necessary time until the voltage detection circuit operates when setting to 1 again after setting the VCA26 bit in the VCA2 register to 0.

Table 5.9 Voltage Detection 2 Circuit Electrical Characteristics

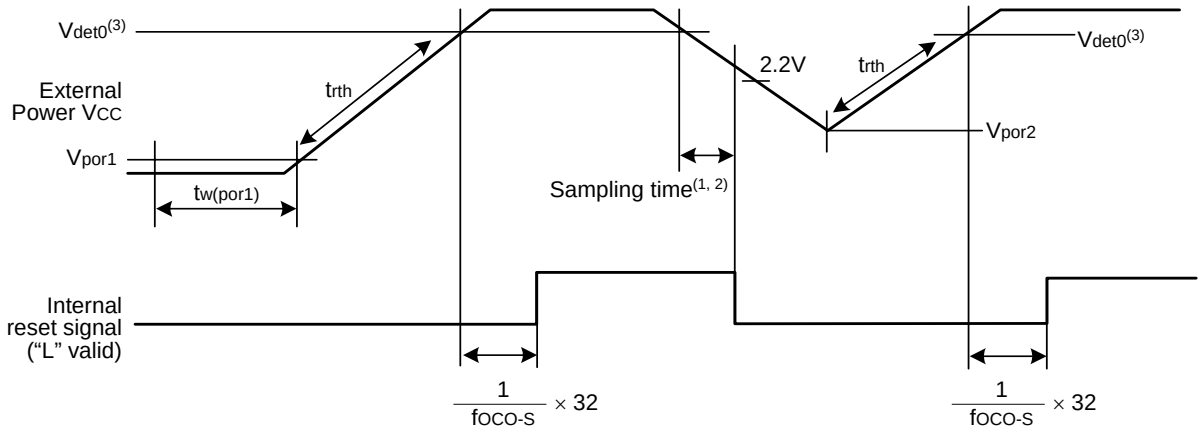
Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
V_{det2}	Voltage detection level		3.3	3.6	3.9	V
–	Voltage monitor 2 interrupt request generation time(2)		–	40	–	µs
–	Voltage detection circuit self power consumption	VCA27 = 1, V_{CC} = 5.0 V	–	0.6	–	µA
$t_{d(E-A)}$	Waiting time until voltage detection circuit operation starts(3)		–	–	100	µs

NOTES:
1. The measurement condition is V_{CC} = 2.2 V to 5.5 V and T_{opr} = –20 to 85°C (N version) / –40 to 85°C (D version).
2. Time until the voltage monitor 2 interrupt request is generated after the voltage passes V_{det2}.
3. Necessary time until the voltage detection circuit operates after setting to 1 again after setting the VCA27 bit in the VCA2 register to 0.

Table 5.10 Power-on Reset Circuit, Voltage Monitor 0 Reset Electrical Characteristics(3)

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
V_{por1}	Power-on reset valid voltage(4)		–	–	0.1	V
V_{por2}	Power-on reset or voltage monitor 0 reset valid voltage		0	–	V_{det0}	V
t_{rth}	External power V_{CC} rise gradient(2)		20	–	–	mV/msec

NOTES:
1. The measurement condition is T_{opr} = –20 to 85°C (N version) / –40 to 85°C (D version), unless otherwise specified.
2. This condition (external power VCC rise gradient) does not apply if $V_{CC} \geq 1.0$ V.
3. To use the power-on reset function, enable voltage monitor 0 reset by setting the LVD0ON bit in the OFS register to 0, the VW0C0 and VW0C6 bits in the VW0C register to 1 respectively, and the VCA25 bit in the VCA2 register to 1.
4. $t_{w(por1)}$ indicates the duration the external power V_{CC} must be held below the effective voltage (V_{por1}) to enable a power on reset. When turning on the power for the first time, maintain $t_{w(por1)}$ for 30 s or more if $-20°C \leq T_{opr} \leq 85°C$, maintain $t_{w(por1)}$ for 3,000 s or more if $-40°C \leq T_{opr} < -20°C$.



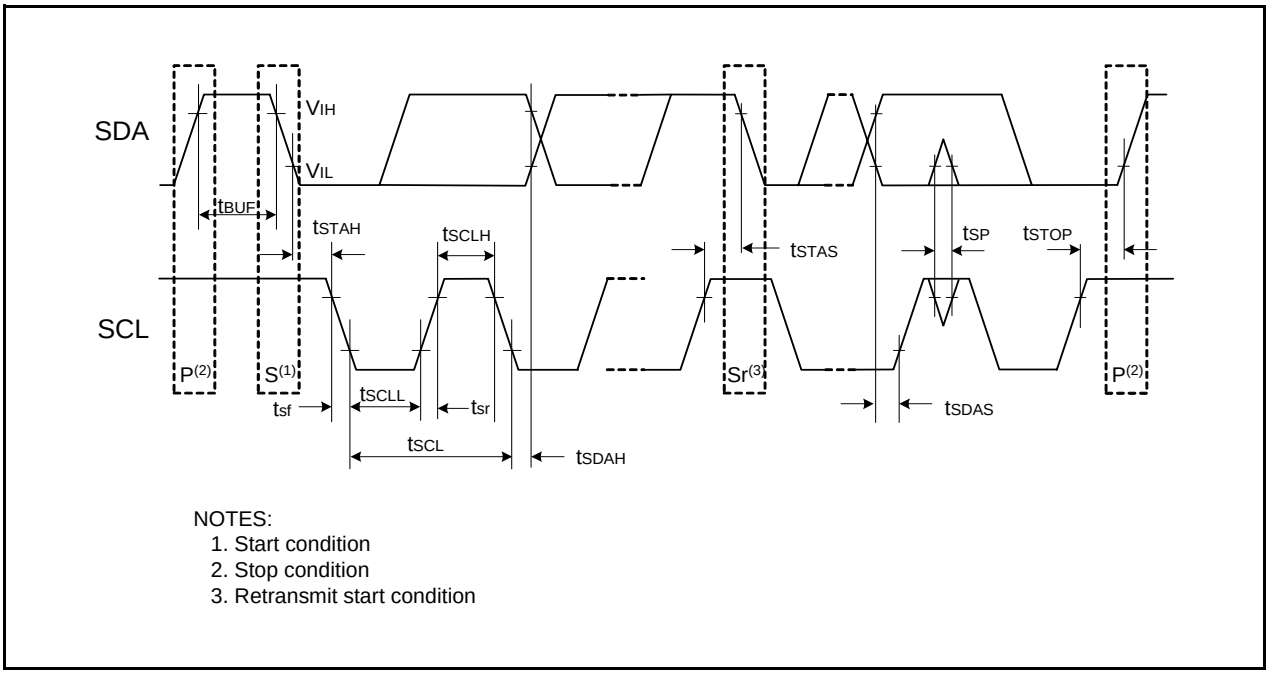
NOTES:
1. When using the voltage monitor 0 digital filter, ensure that the voltage is within the MCU operation voltage range (2.2 V or above) during the sampling time.
2. The sampling clock can be selected. Refer to **6. Voltage Detection Circuit** of Hardware Manual for details.
3. V_{det0} indicates the voltage detection level of the voltage detection 0 circuit. Refer to **6. Voltage Detection Circuit** of Hardware Manual for details.

Figure 5.3 Power-on Reset Circuit Electrical Characteristics

Table 5.15 Timing Requirements of I²C bus Interface (1)

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		$1t_{CYC} + 20$(2)	–	–	ns
t_{SDAH}	Data input hold time		0	–	–	ns

NOTES:
1. V_{CC} = 2.2 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. $1t_{CYC} = 1/f1(s)$



NOTES:
1. Start condition
2. Stop condition
3. Retransmit start condition

Figure 5.7 I/O Timing of I²C bus Interface

Table 5.17 Electrical Characteristics (2) [Vcc = 5 V]
(Topr = –20 to 85°C (N version) / –40 to 85°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	–	12	20	mA
			XIN = 16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz No division	–	10	16	mA
			XIN = 10 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz No division	–	7	–	mA
			XIN = 20 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8	–	5.5	–	mA
			XIN = 16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8	–	4.5	–	mA
			XIN = 10 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8	–	3	–	mA
		High-speed on-chip oscillator mode	XIN clock off High-speed on-chip oscillator on fOCO = 10 MHz Low-speed on-chip oscillator on = 125 kHz No division	–	6	12	mA
			XIN clock off High-speed on-chip oscillator on fOCO = 10 MHz Low-speed on-chip oscillator on = 125 kHz Divide-by-8	–	2.5	–	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, FMR47 = 1	–	150	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 FMR47 = 1	–	150	400	µA
			XIN clock off High-speed on-chip oscillator off Low-speed on-chip oscillator off XCIN clock oscillator on = 32 kHz Program operation on RAM Flash memory off, FMSTP = 1	–	35	–	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	–	30	90	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	–	18	55	µA
			XIN clock off High-speed on-chip oscillator off Low-speed on-chip oscillator off XCIN clock oscillator on = 32 kHz (high drive) While a WAIT instruction is executed VCA27 = VCA26 = VCA25 = 0 VCA20 = 1	–	3.5	–	µA
			XIN clock off High-speed on-chip oscillator off Low-speed on-chip oscillator off XCIN clock oscillator on = 32 kHz (low drive) While a WAIT instruction is executed VCA27 = VCA26 = VCA25 = 0 VCA20 = 1	–	2.3	–	µA
		Stop mode	XIN clock off, Topr = 25°C High-speed on-chip oscillator off Low-speed on-chip oscillator off CM10 = 1 Peripheral clock off VCA27 = VCA26 = VCA25 = 0	–	0.7	3.0	µA
			XIN clock off, Topr = 85°C High-speed on-chip oscillator off Low-speed on-chip oscillator off CM10 = 1 Peripheral clock off VCA27 = VCA26 = VCA25 = 0	–	1.7	–	µA

Timing Requirements
(Unless Otherwise Specified: V_{CC} = 5 V, V_{SS} = 0 V at Topr = 25°C) [V_{CC} = 5 V]

Table 5.18 XIN Input, XCIN Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(XIN)}$	XIN input cycle time	50	–	ns
$t_{WH(XIN)}$	XIN input “H” width	25	–	ns
$t_{WL(XIN)}$	XIN input “L” width	25	–	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

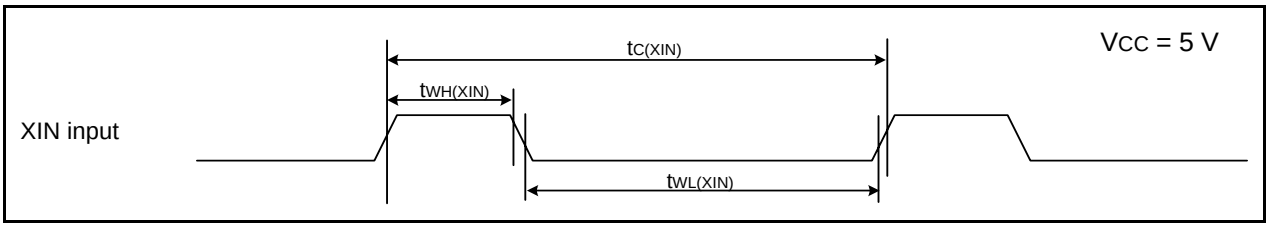


Figure 5.8 XIN Input and XCIN Input Timing Diagram when V_{CC} = 5 V

Table 5.19 TRAIO Input, $\overline{INT1}$ Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TRAIO)}$	TRAIO input cycle time	100	–	ns
$t_{WH(TRAIO)}$	TRAIO input “H” width	40	–	ns
$t_{WL(TRAIO)}$	TRAIO input “L” width	40	–	ns

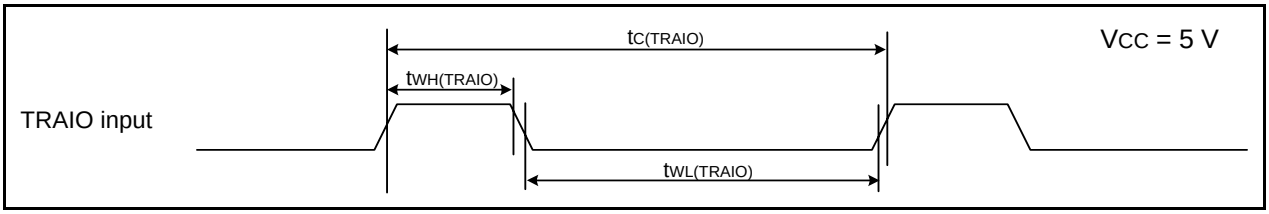


Figure 5.9 TRAIO Input and $\overline{INT1}$ Input Timing Diagram when V_{CC} = 5 V

Table 5.20 TRFI Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TRFI)}$	TRFI input cycle time	400(1)	–	ns
$t_{WH(TRFI)}$	TRFI input “H” width	200(2)	–	ns
$t_{WL(TRFI)}$	TRFI input “L” width	200(2)	–	ns

NOTES:
1. When using timer RF input capture mode, adjust the cycle time to (1/timer RF count source frequency × 3) or above.
2. When using timer RF input capture mode, adjust the pulse width to (1/timer RF count source frequency × 1.5) or above.

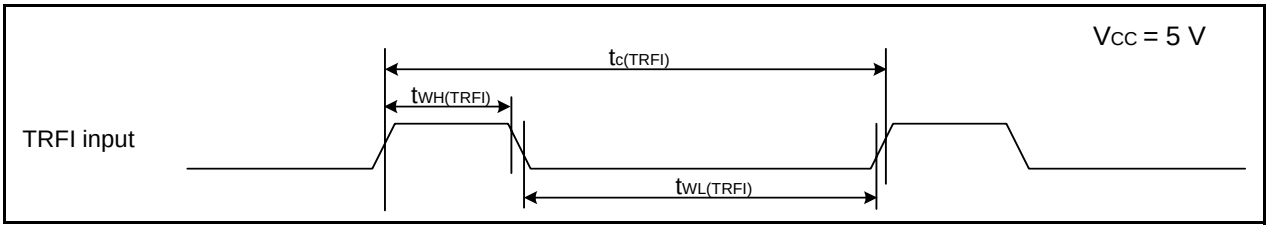


Figure 5.10 TRFI Input Timing Diagram when V_{CC} = 5 V

Table 5.23 Electrical Characteristics (3) [Vcc = 3 V]

Symbol	Parameter		Condition		Standard			Unit
					Min.	Typ.	Max.	
V_{OH}	Output “H” voltage	Except P2_0 to P2_7, XOUT	I_{OH} = –1 mA		Vcc – 0.5	–	Vcc	V
		P2_0 to P2_7	Drive capacity HIGH	I_{OH} = –5 mA	Vcc – 0.5	–	Vcc	V
			Drive capacity LOW	I_{OH} = –1 mA	Vcc – 0.5	–	Vcc	V
		XOUT	Drive capacity HIGH	I_{OH} = –0.1 mA	Vcc – 0.5	–	Vcc	V
			Drive capacity LOW	I_{OH} = –50 µA	Vcc – 0.5	–	Vcc	V
V_{OL}	Output “L” voltage	Except P2_0 to P2_7, XOUT	I_{OL} = 1 mA		–	–	0.5	V
		P2_0 to P2_7	Drive capacity HIGH	I_{OL} = 5 mA	–	–	0.5	V
			Drive capacity LOW	I_{OL} = 1 mA	–	–	0.5	V
		XOUT	Drive capacity HIGH	I_{OL} = 0.1 mA	–	–	0.5	V
			Drive capacity LOW	I_{OL} = 50 µA	–	–	0.5	V
V_{T+}-V_{T-}	Hysteresis	$\overline{INT0}$, $\overline{INT1}$, $\overline{INT2}$, $\overline{INT3}$, $\overline{KI0}$, $\overline{KI1}$, $\overline{KI2}$, $\overline{KI3}$, TRAIO, TRFI, RXD0, RXD1, CLK0, CLK1, CLK2, SSI, SCL, SDA, SSO			0.1	0.3	–	V
		$\overline{RESET}$			0.1	0.4	–	V
I_{IH}	Input “H” current		VI = 3 V		–	–	4.0	µA
I_{IL}	Input “L” current		VI = 0 V		–	–	–4.0	µA
R_{PULLUP}	Pull-up resistance		VI = 0 V		66	160	500	kΩ
R_{fXIN}	Feedback resistance	XIN			–	3.0	–	MΩ
R_{fXCIN}	Feedback resistance	XCIN			–	18	–	MΩ
V_{RAM}	RAM hold voltage		During stop mode		1.8	–	–	V

NOTE:
1. Vcc =2.7 to 3.3 V at T_{opr} = –20 to 85°C (N version) / –40 to 85°C (D version), f(XIN) = 10 MHz, unless otherwise specified.

Timing requirements
(Unless Otherwise Specified: V_{CC} = 3 V, V_{SS} = 0 V at Topr = 25°C) [V_{CC} = 3 V]

Table 5.25 XIN Input, XCIN Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(XIN)}$	XIN input cycle time	100	–	ns
$t_{WH(XIN)}$	XIN input “H” width	40	–	ns
$t_{WL(XIN)}$	XIN input “L” width	40	–	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

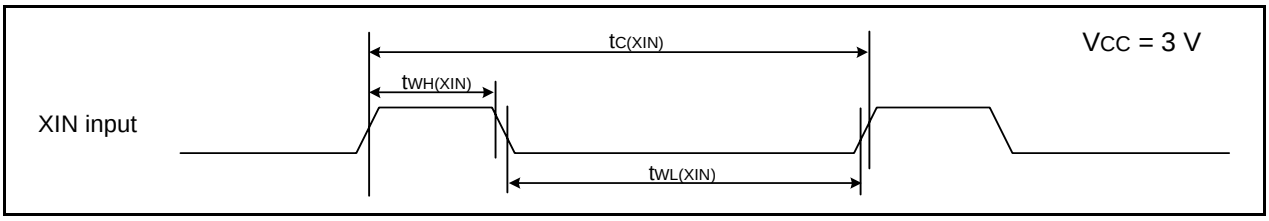


Figure 5.13 XIN Input and XCIN Input Timing Diagram when V_{CC} = 3 V

Table 5.26 TRAIO Input, $\overline{\text{INT1}}$ 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

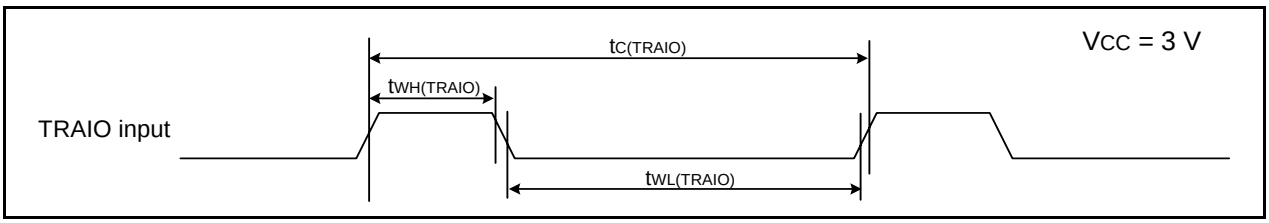


Figure 5.14 TRAIO Input and $\overline{\text{INT1}}$ Input Timing Diagram when V_{CC} = 3 V

Table 5.27 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/timer RF count source frequency × 3) or above.
2. When using timer RF input capture mode, adjust the pulse width to (1/timer RF count source frequency × 1.5) or above.

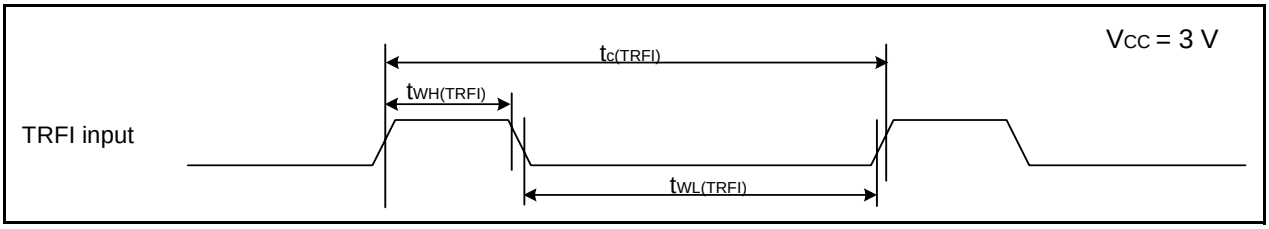


Figure 5.15 TRFI Input Timing Diagram when V_{CC} = 3 V

Table 5.28 Serial Interface

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(CK)}$	CLKi input cycle time	300	–	ns
$t_{W(CKH)}$	CLKi input “H” width	150	–	ns
$t_{W(CKL)}$	CLKi Input “L” width	150	–	ns
$t_{d(C-Q)}$	TXDi output delay time	–	80	ns
$t_{h(C-Q)}$	TXDi hold time	0	–	ns
$t_{su(D-C)}$	RXDi input setup time	70	–	ns
$t_{h(C-D)}$	RXDi input hold time	90	–	ns

i = 0 to 2

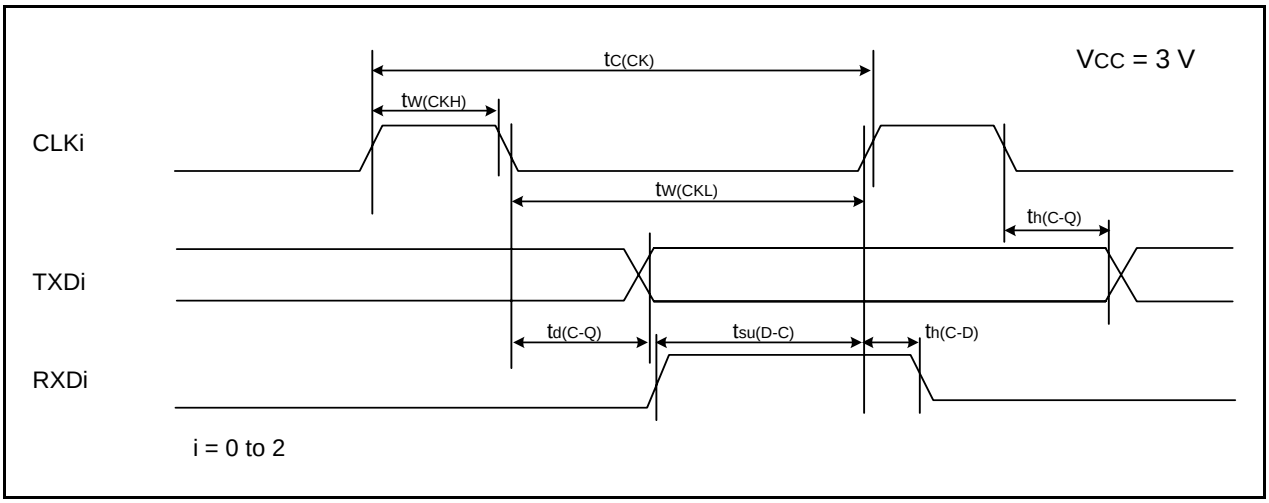


Figure 5.16 Serial Interface Timing Diagram when VCC = 3 V

Table 5.29 External Interrupt $\overline{INTi}$ (i = 0, 2, 3) Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{W(INH)}$	$\overline{INT0}$ input “H” width	380(1)	–	ns
$t_{W(INL)}$	$\overline{INT0}$ input “L” width	380(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 × 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 × 3) or the minimum value of standard, whichever is greater.

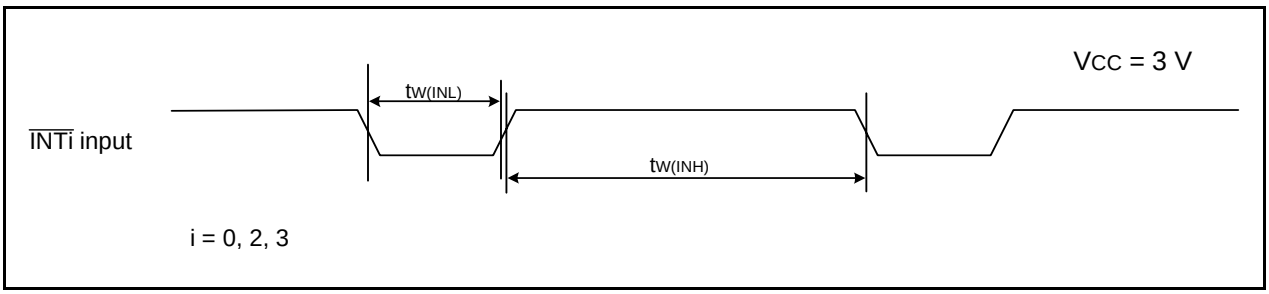


Figure 5.17 External Interrupt $\overline{INTi}$ Input Timing Diagram when VCC = 3 V

REVISION HISTORY	R8C/2C Group, R8C/2D Group Datasheet

Rev.	Date	Description	
		Page	Summary
1.00	Feb 09, 2007	All pages	"Preliminary" deleted
		3	Table 1.2 revised
		5	Table 1.4 revised
		6	Table 1.5 and Figure 1.1 revised
		7	Table 1.6 and Figure 1.2 revised
		17	Figure 3.1 revised
		18	Figure 3.2 revised
		19	Table 4.1; • 0008h: "Module Standby Control Register" → "Module Operation Enable Register" revised • 000Ah: "00XXX000b" → "00h" revised • 000Fh: "00011111b" → "00X11111b" revised • 002Bh: "High-Speed On-Chip Oscillator Control Register 6" added
		23	Table 4.5; 0105h: "LIN Control Register 2" register name revised
		31	Table 5.2 revised
		32	Table 5.3 and Table 5.4; NOTE1 revised
		37	Table 5.11 revised
		44	Table 5.17 revised
		46	Table 5.21 and Figure 5.11; "i = 0 to 2" revised
		48	Table 5.24 revised
		50	Table 5.28 revised, Figure 5.16; "i = 0 to 2" revised
		52	Table 5.31 revised
		53	Table 5.34 revised
		54	Table 5.35 and Figure 5.21; "i = 0 to 2" revised
2.00	Oct 17, 2007	all pages	Y version added
		6, 7	Table 1.5, Table 1.6 (D) mark is deleted
		31	Table 5.1 Rated Value: "TBD" → "700"
2.10	Dec 05, 2007	2, 4	Table 1.1, Table 1.3 Clock: "Real-time clock (timer RE)" added
		6, 7	Table 1.5 and Figure 1.1 revised
		8	Table 1.6 and Figure 1.2 revised
		18, 19	Figure 3.1 and Figure 3.2 revised
		20	Table 4.1 002Ch: High-Speed On-Chip Oscillator Control Register 7 added
		23	Table 4.4 00F5h: After reset "00h" → "000000XXb" revised
		33	Table 5.2 NOTE2 revised
		39	Table 5.11 revised

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

RENESAS SALES OFFICES

http://www.renesas.com

Refer to "**http://www.renesas.com/en/network**" for the latest and detailed information.

Renesas Technology America, Inc.
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology (Shanghai) Co., Ltd.
Unit 204, 205, AZIACenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7858/7898

Renesas Technology Hong Kong Ltd.
7th Floor, North Tower, World Finance Centre, Harbour City, Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2377-3473

Renesas Technology Taiwan Co., Ltd.
10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 3518-3399

Renesas Technology Singapore Pte. Ltd.
1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

Renesas Technology Korea Co., Ltd.
Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510

Colophon .7.2