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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.

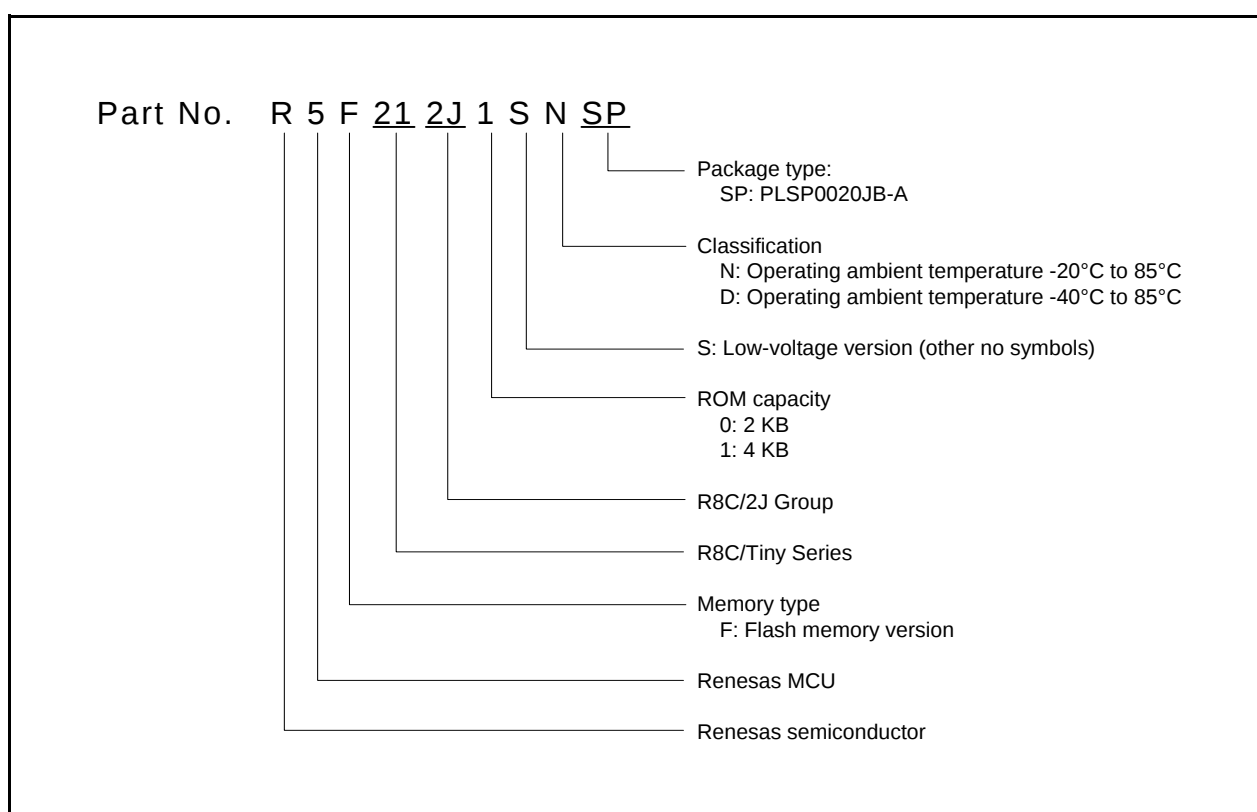
Applications of "[Embedded - Microcontrollers](#)"

Details

Product Status	Obsolete
Core Processor	R8C
Core Size	16-Bit
Speed	8MHz
Connectivity	LINbus, SIO, UART/USART
Peripherals	POR, PWM, Voltage Detect, WDT
Number of I/O	12
Program Memory Size	4KB (4K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	384 x 8
Voltage - Supply (Vcc/Vdd)	2.2V ~ 5.5V
Data Converters	-
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	20-LSSOP (0.173", 4.40mm Width)
Supplier Device Package	20-LSSOP
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f212j1sdsp-u0

Table 1.4 Product List for R8C/2J Group**Current of Mar. 2008**

Part No.	ROM Capacity	RAM Capacity	Package Type	Remarks
R5F212J0SNSP	2 Kbytes	256 bytes	PLSP0020JB-A	N version
R5F212J1SNSP	4 Kbytes	384 bytes	PLSP0020JB-A	
R5F212J0SDSP	2 Kbytes	256 bytes	PLSP0020JB-A	D version
R5F212J1SDSP	4 Kbytes	384 bytes	PLSP0020JB-A	

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

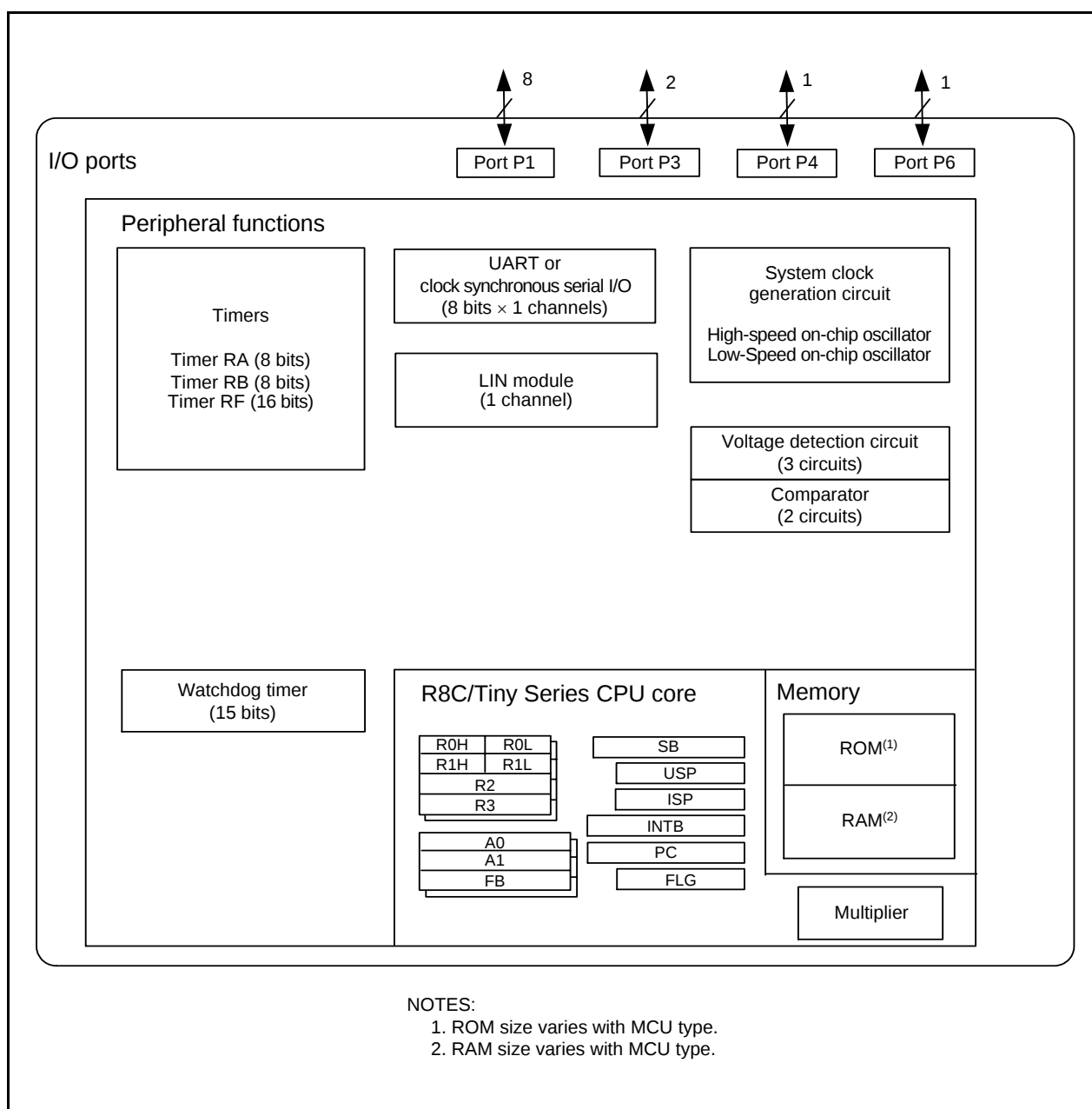


Figure 1.4 Block Diagram of R8C/2J Group

Table 1.5 Pin Name Information by Pin Number of R8C/2H Group

Pin Number	Control Pin	Port	I/O Pin Functions for of Peripheral Modules			
			Interrupt	Timer	Serial Interface	Comparator
1		P6_4			RXD2	
2		P3_7		TRAO/TRFO11		
3	RESET					
4	XCOUT	(P4_4)				
5	VSS					
6	XCIN	(P4_3)				
7	VCC					
8	MODE					
9		P4_5	INT0			
10		P1_7	INT1	TRAIO		
11		P1_6			CLK0	VCOUT2
12		P1_5	(INT1) ⁽¹⁾	(TRAIO) ⁽¹⁾	RXD0	
13		P1_4			TXD0	
14		P1_3	KI3	TRBO		VCOUT1
15		P1_2	KI2	TRFO02		CVREF
16		P6_5		TREO	CLK2	
17		P1_1	KI1	TRFO01		VCMP2
18		P1_0	KI0	TRFO00		VCMP1
19		P3_3		TRFO10/TRFI		
20		P6_3			TXD2	

NOTE:

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

Table 1.6 Pin Name Information by Pin Number of R8C/2J Group

Pin Number	Control Pin	Port	I/O Pin Functions for of Peripheral Modules			
			Interrupt	Timer	Serial Interface	Comparator
1	NC ⁽²⁾					
2		P3_7		TRAO/TRFO11		
3	RESET					
4	NC ⁽²⁾					
5	VSS					
6	NC ⁽²⁾					
7	VCC					
8	MODE					
9		P4_5	INT0			
10		P1_7	INT1	TRAIO		
11		P1_6			CLK0	VCOUT2
12		P1_5	(INT1) ⁽¹⁾	(TRAIO) ⁽¹⁾	RXD0	
13		P1_4			TXD0	
14		P1_3	KI3	TRBO		VCOUT1
15		P1_2	KI2	TRFO02		CVREF
16		P6_5				
17		P1_1	KI1	TRFO01		VCMP2
18		P1_0	KI0	TRFO00		VCMP1
19		P3_3		TRFO10/TRFI		
20	NC ⁽²⁾					

NOTES:

1. Can be assigned to the pin in parentheses by a program.
2. NC(Non-Connection)

Table 1.8 Pin Functions of R8C/2J Group

Type	Symbol	I/O Type	Description
Power supply input	VCC, VSS	—	Apply 2.2 V to 5.5 V to the VCC pin. Apply 0 V to the VSS pin.
Reset input	RESET	I	Input "L" on this pin resets the MCU.
MODE	MODE	I	Connect this pin to VCC via a resistor.
INT interrupt input	INT0, INT1	I	INT interrupt input pins
Key input interrupt	KI0 to KI3	I	Key input interrupt input pins
Timer RA	TRAIO	I/O	Timer RA I/O pin
	TRA0	O	Timer RA output pin
Timer RB	TRBO	O	Timer RB output pin
Timer RF	TRFI	I	Timer RF input pin
	TRFO00 to TRFO02, TRFO10 to TRFO11	O	Timer RF output pins
Serial interface	CLK0	I/O	Clock I/O pin
	RXD0	I	Serial data input pin
	TXD0	O	Serial data output pin
Comparator	VCMP1, VCMP2	I	Analog input pins to comparator
	CVREF	I	Reference voltage input pin to comparator
	VCOUT1, VCOUT2	O	Comparator output pins
I/O port	P1_0 to P1_7, P3_3, P3_7, P4_5, P6_5	I/O	CMOS I/O ports. Each port has an I/O select direction register, allowing each pin in the port to be directed for input or output individually. Any port set to input can be set to use a pull-up resistor or not by a program.

I: Input O: Output I/O: Input and output

Table 4.2 SFR Information (2)⁽¹⁾

Address	Register	Symbol	After reset
0030h			
0031h	Voltage Detection Register 1 ⁽²⁾	VCA1	00001000b
0032h	Voltage Detection Register 2 ⁽²⁾	VCA2	00h ⁽³⁾ 00100000b ⁽⁴⁾
0033h			
0034h			
0035h			
0036h	Voltage Monitor 1 Circuit Control Register ⁽⁵⁾	VW1C	00001010b
0037h	Voltage Monitor 2 Circuit Control Register ⁽⁵⁾	VW2C	00000010b
0038h	Voltage Monitor 0 Circuit Control Register ⁽²⁾	VW0C	1000X010b ⁽³⁾ 1100X011b ⁽⁴⁾
0039h			
003Ah			
003Bh	Voltage Detection Circuit External Input Control Register	VCAB	00h
003Ch	Comparator Mode Register	ALCMR	00h
003Dh	Voltage Monitor Circuit Edge Select Register	VCAC	00h
003Eh	BGR Control Register	BGRCR	00h
003Fh	BGR Trimming Register	BGRTRM	When Shipping
0040h			
0041h	Comparator 1 Interrupt Control Register	VCMP1IC	XXXXX000b
0042h	Comparator 2 Interrupt Control Register	VCMP2IC	XXXXX000b
0043h			
0044h			
0045h			
0046h			
0047h			
0048h			
0049h			
004Ah	Timer RE Interrupt Control Register ⁽⁶⁾	TREIC	XXXXX000b
004Bh	UART2 Transmit Interrupt Control Register ⁽⁶⁾	S2TIC	XXXXX000b
004Ch	UART2 Receive Interrupt Control Register ⁽⁶⁾	S2RIC	XXXXX000b
004Dh	Key Input Interrupt Control Register	KUPIC	XXXXX000b
004Eh			
004Fh			
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			
0054h			
0055h			
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			
005Bh	Timer RF Interrupt Control Register	TRFIC	XXXXX000b
005Ch	Compare 0 Interrupt Control Register	CMP0IC	XXXXX000b
005Dh	INT0 Interrupt Control Register	INT0IC	XX00X000b
005Eh			
005Fh	Capture Interrupt Control Register	CAPIC	XXXXX000b
0060h			
0061h			
0062h			
0063h			
0064h			
0065h			
0066h			
0067h			
0068h			
0069h			
006Ah			
006Bh			
006Ch			
006Dh			
006Eh			
006Fh			

X: Undefined

NOTES:

1. The blank regions are reserved. Do not access locations in these regions.
2. Software reset, watchdog timer reset, voltage monitor 1 reset, or voltage monitor 2 reset do not affect this register.
3. The LVD0ON bit in the OFS register is set to 1 and hardware reset.
4. Power-on reset, voltage monitor 0 reset, or the LVD0ON bit in the OFS register is set to 0 and hardware reset.
5. Software reset, watchdog timer reset, voltage monitor 1 reset, or voltage monitor 2 reset do not affect b2 and b3.
6. This register is not implemented in the R8C/2J Group.

Table 4.4 SFR Information (4)⁽¹⁾

Address	Register	Symbol	After reset
00B0h			
00B1h			
00B2h			
00B3h			
00B4h			
00B5h			
00B6h			
00B7h			
00B8h			
00B9h			
00BAh			
00BBh			
00BCh			
00BDh			
00BEh			
00BFh			
00C0h			
00C1h			
00C2h			
00C3h			
00C4h			
00C5h			
00C6h			
00C7h			
00C8h			
00C9h			
00CAh			
00CBh			
00CCh			
00CDh			
00CEh			
00CFh			
00D0h			
00D1h			
00D2h			
00D3h			
00D4h			
00D5h			
00D6h			
00D7h			
00D8h			
00D9h			
00DAh			
00DBh			
00DCh			
00DDh			
00DEh			
00DFh			
00E0h			
00E1h	Port P1 Register	P1	00h
00E2h			
00E3h	Port P1 Direction Register	PD1	00h
00E4h			
00E5h	Port P3 Register	P3	00h
00E6h			
00E7h	Port P3 Direction Register	PD3	00h
00E8h	Port P4 Register	P4	00h
00E9h			
00EAh	Port P4 Direction Register	PD4	00h
00EBh			
00ECh	Port P6 Register	P6	00h
00EDh			
00EEh	Port P6 Direction Register	PD6	00h
00EFh			

X: Undefined

NOTE:

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

Table 4.5 SFR Information (5)⁽¹⁾

Address	Register	Symbol	After reset
00F0h			
00F1h			
00F2h			
00F3h			
00F4h			
00F5h			
00F6h	Pin Select Register 2	PINSR2	00h
00F7h			
00F8h	Port Mode Register	PMR	00h
00F9h	External Input Enable Register	INTEN	00h
00FAh	INT Input Filter Select Register	INTF	00h
00FBh	Key Input Enable Register	KIEN	00h
00FCh	Pull-Up Control Register 0	PUR0	00h
00FDh	Pull-Up Control Register 1	PUR1	00h
00FEh			
00FFh			
0100h	Timer RA Control Register	TRACR	00h
0101h	Timer RA I/O Control Register	TRAIOC	00h
0102h	Timer RA Mode Register	TRAMR	00h
0103h	Timer RA Prescaler Register	TRAPRE	FFh
0104h	Timer RA Register	TRA	FFh
0105h			
0106h	LIN Control Register	LINCR	00h
0107h	LIN Status Register	LINST	00h
0108h	Timer RB Control Register	TRBCR	00h
0109h	Timer RB One-Shot Control Register	TRBOCR	00h
010Ah	Timer RB I/O Control Register	TRBIOC	00h
010Bh	Timer RB Mode Register	TRBMR	00h
010Ch	Timer RB Prescaler Register	TRBPRE	FFh
010Dh	Timer RB Secondary Register	TRBSC	FFh
010Eh	Timer RB Primary Register	TRBPR	FFh
010Fh			
0110h			
0111h			
0112h			
0113h			
0114h			
0115h			
0116h			
0117h			
0118h	Timer RE Second Data Register / Counter Data Register ⁽²⁾	TRESEC	XXh
0119h	Timer RE Minute Data Register / Compare Data Register ⁽²⁾	TREMIN	XXh
011Ah	Timer RE Hour Data Register ⁽²⁾	TREHR	X0XXXXXXb
011Bh	Timer RE Day of Week Data Register ⁽²⁾	TREWK	X0000XXXb
011Ch	Timer RE Control Register 1 ⁽²⁾	TRECR1	XXX0X0X0b
011Dh	Timer RE Control Register 2 ⁽²⁾	TRECR2	00XXXXXXb
011Eh	Timer RE Count Source Select Register ⁽²⁾	TRECSR	00001000b
011Fh	Timer RE Real-Time Clock Precision Adjust Register ⁽²⁾	TREOPR	00h
0120h			
0121h			
0122h			
0123h			
0124h			
0125h			
0126h			
0127h			
0128h			
0129h			
012Ah			
012Bh			
012Ch			
012Dh			
012Eh			
012Fh			

X: Undefined

NOTES:

1. The blank regions are reserved. Do not access locations in these regions
2. This register is not implemented in the R8C/2J Group.

Table 4.12 SFR Information (12)⁽¹⁾

Address	Register	Symbol	After reset
02B0h			
02B1h			
02B2h			
02B3h			
02B4h			
02B5h			
02B6h			
02B7h			
02B8h			
02B9h			
02BAh			
02BBh			
02BCh			
02BDh			
02BEh			
02BFh			
02C0h			
02C1h			
02C2h			
02C3h			
02C4h			
02C5h			
02C6h			
02C7h			
02C8h			
02C9h			
02CAh			
02CBh			
02CCh			
02CDh			
02CEh			
02CFh			
02D0h			
02D1h			
02D2h			
02D3h			
02D4h			
02D5h			
02D6h			
02D7h			
02D8h			
02D9h			
02DAh			
02DBh			
02DCh			
02DDh			
02DEh			
02DFh			
02E0h			
02EFh			
02F0h			
02F1h			
02F2h			
02F3h			
02F4h			
02F5h			
02F6h			
02F7h			
02F8h			
02F9h			
02FAh			
02FBh	Pin Select Register 4	PINSR4	00h
02FCh			
02FDh			
02FEh			
02FFh	Timer RF Output Control Register	TRFOUT	00h
FFFFh	Option Function Select Register	OFS	(Note 2)

X: Undefined

NOTES:

1. The blank regions are reserved. Do not access locations in these regions.
2. The OFS register cannot be changed by a program. Use a flash programmer to write to it.

5. Electrical Characteristics

5.1 R8C/2H Group

Table 5.1 Absolute Maximum Ratings

Symbol	Parameter	Condition	Rated Value	Unit
V _{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	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

Symbol	Parameter		Conditions	Standard			Unit
				Min.	Typ.	Max.	
V _{CC}	Supply voltage			2.2	–	5.5	V
V _{SS}	Supply voltage			–	0	–	V
V _{IH}	Input “H” voltage			0.8 V _{CC}	–	V _{CC}	V
V _{IL}	Input “L” voltage			0	–	0.2 V _{CC}	V
I _{OH(sum)}	Peak sum output “H” current	Sum of all pins I _{OH(peak)}		–	–	−160	mA
I _{OH(sum)}	Average sum output “H” current	Sum of all pins I _{OH(avg)}		–	–	−80	mA
I _{OH(peak)}	Peak output “H” current	All pins		–	–	−10	mA
I _{OH(avg)}	Average output “H” current	All pins		–	–	−5	mA
I _{OL(sum)}	Peak sum output “L” currents	Sum of all pins I _{OL(peak)}		–	–	160	mA
I _{OL(sum)}	Average sum output “L” currents	Sum of all pins I _{OL(avg)}		–	–	80	mA
I _{OL(peak)}	Peak output “L” currents	All pins		–	–	10	mA
I _{OL(avg)}	Average output “L” current	All pins		–	–	5	mA
f _(XCIN)	XCIN clock input oscillation frequency		2.2 V ≤ V _{CC} ≤ 5.5 V	0	–	70	kHz
–	System clock	OCD2 = 0 XCIN clock selected	2.2 V ≤ V _{CC} ≤ 5.5 V	0	–	70	kHz
		OCD2 = 1 On-chip oscillator clock selected	HRA01 = 0 Low-speed on-chip oscillator selected	–	125	–	kHz
			HRA01 = 1 High-speed on-chip oscillator selected 2.7 V ≤ V _{CC} ≤ 5.5 V	–	–	8	MHz
			HRA01 = 1 High-speed on-chip oscillator selected 2.2 V ≤ V _{CC} ≤ 5.5 V	–	–	4	MHz

NOTES:

- V_{CC} = 2.2 to 5.5 V at 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.

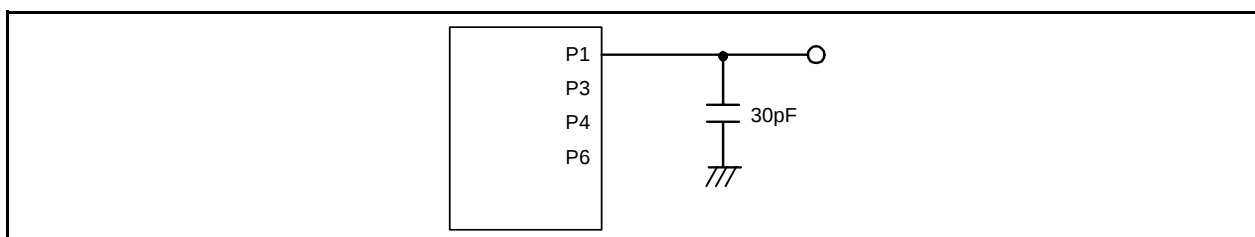


Figure 5.1 Ports P1, P3, P4, and P6 Timing Measurement Circuit

Table 5.4 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
V _{ccmin}	MCU operating voltage minimum value		2.2	—	—	V

NOTES:

1. The measurement condition is V_{CC} = 2.2 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 5.5 Voltage Detection 1 Circuit Electrical Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
V _{det1}	Voltage detection level ⁽⁴⁾		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 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.
4. This parameter shows the voltage detection level when the power supply drops.
The voltage detection level when the power supply rises is higher than the voltage detection level when the power supply drops by approximately 0.1 V.

Table 5.6 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 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 5.12 Electrical Characteristics (1) [V_{CC} = 5 V]

Symbol	Parameter		Condition	Standard			Unit
				Min.	Typ.	Max.	
V _{OH}	Output "H" voltage		I _{OH} = -5 mA	V _{CC} - 2.0	—	V _{CC}	V
			I _{OH} = -200 μ A	V _{CC} - 0.5	—	V _{CC}	V
V _{OL}	Output "L" voltage		I _{OL} = 5 mA	—	—	2.0	V
			I _{OL} = 200 μ A	—	—	0.45	V
V _{T+} -V _{T-}	Hysteresis	$\overline{\text{INT0}}, \overline{\text{INT1}},$ $\overline{\text{KI0}}, \overline{\text{KI1}}, \overline{\text{KI2}}, \overline{\text{KI3}},$ $\overline{\text{RXD0}}, \overline{\text{RXD2}},$ $\overline{\text{CLK0}}, \overline{\text{CLK2}}$		0.1	0.5	—	V
		$\overline{\text{RESET}}$		0.1	1.0	—	V
I _{IH}	Input "H" current		V _I = 5 V, V _{CC} = 5 V	—	—	5.0	μ A
I _{IL}	Input "L" current		V _I = 0 V, V _{CC} = 5 V	—	—	-5.0	μ A
R _{PULLUP}	Pull-up resistance		V _I = 0 V, V _{CC} = 5 V	30	50	167	k Ω
R _{XCIN}	Feedback resistance	XCIN		—	18	—	M Ω
V _{RAM}	RAM hold voltage		During stop mode	2.0	—	—	V

NOTE:

- V_{CC} = 4.2 to 5.5 V at T_{opr} = -20 to 85°C (N version) / -40 to 85°C (D version), unless otherwise specified.

Table 5.13 Electrical Characteristics (2) [V_{CC} = 5 V]
(T_{opr} = -20 to 85°C (N version) / -40 to 85°C (D version), unless otherwise specified.)

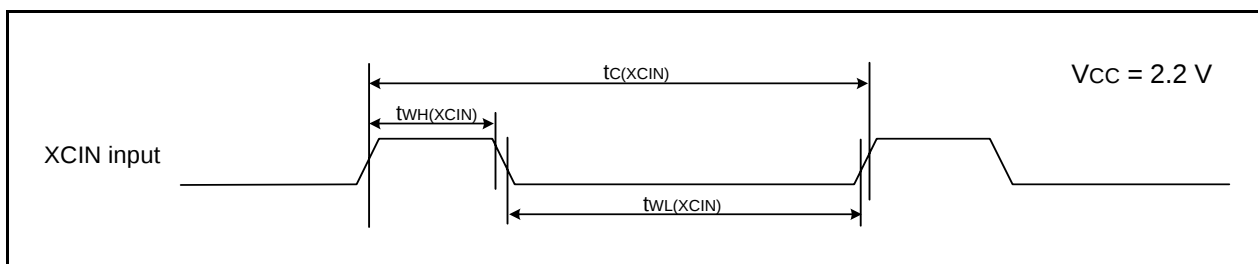
Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
I _{CC}	Power supply current (V _{CC} = 3.3 to 5.5 V) Single-chip mode, output pins are open, other pins are V _{SS}	High-speed on-chip oscillator mode	—	5	8	mA
		High-speed on-chip oscillator on = 8 MHz Low-speed on-chip oscillator on = 125 kHz No division	—	2	—	mA
		High-speed on-chip oscillator on = 8 MHz Low-speed on-chip oscillator on = 125 kHz Divide-by-8	—	130	300	μA
		Low-speed on-chip oscillator mode	—	130	300	μA
		Low-speed clock mode	—	30	—	μA
		Wait mode	—	25	75	μA
		Stop mode	—	0.8	3	μA

Table 5.19 Electrical Characteristics (4) [V_{CC} = 3 V]
(T_{opr} = –20 to 85°C (N version) / –40 to 85°C (D version), unless otherwise specified.)

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
I _{CC}	Power supply current (V _{CC} = 2.7 to 3.3 V) Single-chip mode, output pins are open, other pins are V _{SS}	High-speed on-chip oscillator mode	–	5	–	mA
		High-speed on-chip oscillator on = 8 MHz Low-speed on-chip oscillator on = 125 kHz No division	–	2	–	mA
		High-speed on-chip oscillator on = 8 MHz Low-speed on-chip oscillator on = 125 kHz Divide-by-8	–	130	300	μA
		Low-speed on-chip oscillator mode	–	130	300	μA
		Low-speed clock mode	–	30	–	μA
		Wait mode	–	25	70	μA
		Stop mode	–	0.7	3	μA

Timing requirements**(Unless Otherwise Specified: $V_{CC} = 2.2\text{ V}$, $V_{SS} = 0\text{ V}$ at $T_{opr} = 25^{\circ}\text{C}$) [$V_{CC} = 2.2\text{ V}$]****Table 5.26 XCIN Input**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_c(\text{XCIN})$	XCIN input cycle time	14	–	μs
$t_{WH}(\text{XCIN})$	XCIN input "H" width	7	–	μs
$t_{WL}(\text{XCIN})$	XCIN input "L" width	7	–	μs

**Figure 5.11 XCIN Input Timing Diagram when $V_{CC} = 2.2\text{ V}$** **Table 5.27 TRAIO Input**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_c(\text{TRAIO})$	TRAIO input cycle time	500	–	ns
$t_{WH}(\text{TRAIO})$	TRAIO input "H" width	200	–	ns
$t_{WL}(\text{TRAIO})$	TRAIO input "L" width	200	–	ns

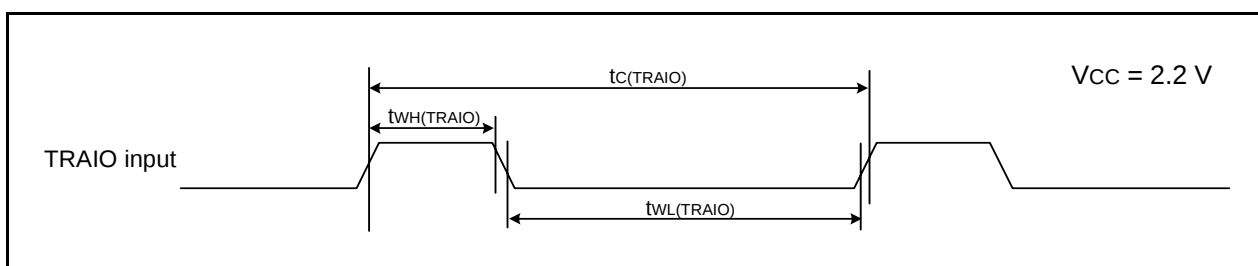
**Figure 5.12 TRAIO Input Timing Diagram when $V_{CC} = 2.2\text{ V}$**

Table 5.33 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
V _{ccmin}	MCU operating voltage minimum value		2.2	—	—	V

NOTES:

1. The measurement condition is V_{CC} = 2.2 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 5.34 Voltage Detection 1 Circuit Electrical Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
V _{det1}	Voltage detection level ⁽⁴⁾		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 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.
4. This parameter shows the voltage detection level when the power supply drops.
The voltage detection level when the power supply rises is higher than the voltage detection level when the power supply drops by approximately 0.1 V.

Table 5.35 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 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 5.41 Electrical Characteristics (1) [V_{CC} = 5 V]

Symbol	Parameter		Condition	Standard			Unit
				Min.	Typ.	Max.	
V _{OH}	Output "H" voltage		I _{OH} = -5 mA	V _{CC} - 2.0	—	V _{CC}	V
			I _{OH} = -200 μ A	V _{CC} - 0.5	—	V _{CC}	V
V _{OL}	Output "L" voltage		I _{OL} = 5 mA	—	—	2.0	V
			I _{OL} = 200 μ A	—	—	0.45	V
V _{T+} -V _{T-}	Hysteresis	$\overline{\text{INT0}}, \overline{\text{INT1}},$ $\overline{\text{KI0}}, \overline{\text{KI1}}, \overline{\text{KI2}}, \overline{\text{KI3}},$ $\overline{\text{RXD0}}, \overline{\text{CLK0}}$		0.1	0.5	—	V
		$\overline{\text{RESET}}$		0.1	1.0	—	V
I _{IH}	Input "H" current		V _I = 5 V, V _{CC} = 5 V	—	—	5.0	μ A
I _{IL}	Input "L" current		V _I = 0 V, V _{CC} = 5 V	—	—	-5.0	μ A
R _{PULLUP}	Pull-up resistance		V _I = 0 V, V _{CC} = 5 V	30	50	167	k Ω
V _{RAM}	RAM hold voltage		During stop mode	2.0	—	—	V

NOTE:

- V_{CC} = 4.2 to 5.5 V at T_{opr} = -20 to 85°C (N version) / -40 to 85°C (D version), unless otherwise specified.

Table 5.46 Electrical Characteristics (3) [V_{CC} = 3 V]

Symbol	Parameter		Condition	Standard			Unit
				Min.	Typ.	Max.	
V _{OH}	Output "H" voltage		I _{OH} = -1 mA	V _{CC} - 0.5	—	V _{CC}	V
V _{OL}	Output "L" voltage		I _{OL} = 1 mA	—	—	0.5	V
V _{T+} -V _{T-}	Hysteresis	$\overline{\text{INT0}}, \overline{\text{INT1}},$ $\overline{\text{KI0}}, \overline{\text{KI1}}, \overline{\text{KI2}}, \overline{\text{KI3}},$ $\overline{\text{RXD0}}, \overline{\text{CLK0}}$		0.1	0.3	—	V
		$\overline{\text{RESET}}$		0.1	0.4	—	V
I _{IH}	Input "H" current		V _I = 3 V, V _{CC} = 3 V	—	—	4.0	μA
I _{IL}	Input "L" current		V _I = 0 V, V _{CC} = 3 V	—	—	-4.0	μA
R _{PULLUP}	Pull-up resistance		V _I = 0 V, V _{CC} = 3 V	66	160	500	kΩ
V _{RAM}	RAM hold voltage		During stop mode	1.8	—	—	V

NOTE:

- V_{CC} = 2.7 to 3.3 V at T_{opr} = -20 to 85°C (N version) / -40 to 85°C (D version), unless otherwise specified.

Timing requirements**(Unless Otherwise Specified: $V_{CC} = 2.2\text{ V}$, $V_{SS} = 0\text{ V}$ at $T_{opr} = 25^{\circ}\text{C}$) [$V_{CC} = 2.2\text{ V}$]****Table 5.53 TRAIO Input**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_c(\text{TRAIO})$	TRAIO input cycle time	500	–	ns
$t_{WH}(\text{TRAIO})$	TRAIO input "H" width	200	–	ns
$t_{WL}(\text{TRAIO})$	TRAIO input "L" width	200	–	ns

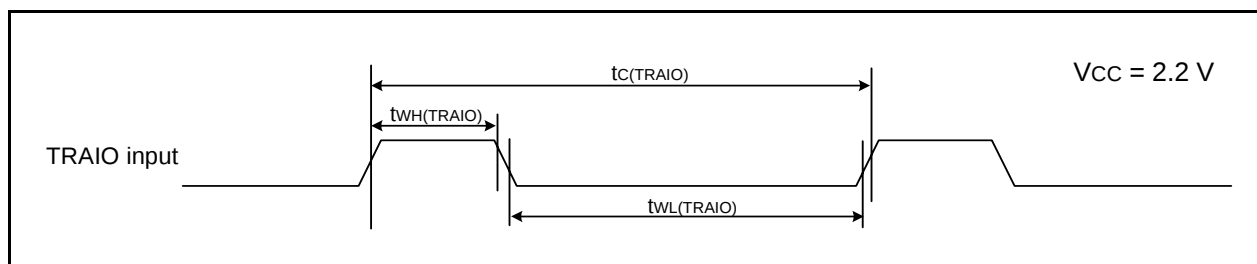
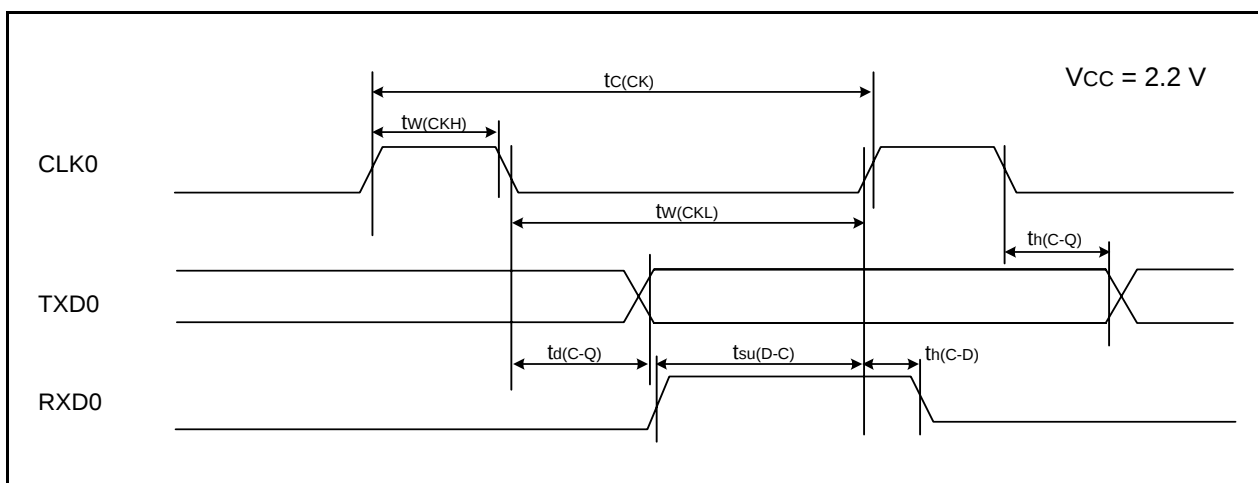
**Figure 5.23 TRAIO Input Timing Diagram when $V_{CC} = 2.2\text{ V}$**

Table 5.54 Serial Interface

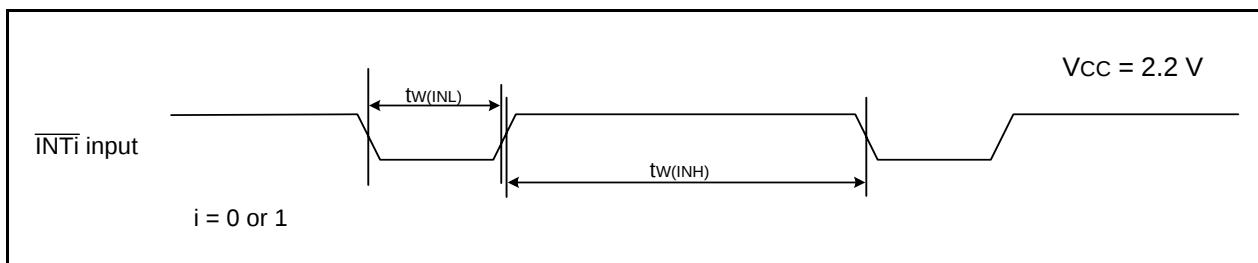
Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(CK)}$	CLK0 input cycle time	800	—	ns
$t_{w(CKH)}$	CLK0 input "H" width	400	—	ns
$t_{w(CKL)}$	CLK0 input "L" width	400	—	ns
$t_{d(C-Q)}$	TXD0 output delay time	—	200	ns
$t_{h(C-Q)}$	TXD0 hold time	0	—	ns
$t_{su(D-C)}$	RXD0 input setup time	150	—	ns
$t_{h(C-D)}$	RXD0 input hold time	90	—	ns

**Figure 5.24 Serial Interface Timing Diagram when Vcc = 2.2 V****Table 5.55 External Interrupt $\overline{INTi}$ ($i = 0$ or 1) Input**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{w(INH)}$	$\overline{INTi}$ input "H" width	1000 ⁽¹⁾	—	ns
$t_{w(INL)}$	$\overline{INTi}$ input "L" width	1000 ⁽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 5.25 External Interrupt $\overline{INTi}$ Input Timing Diagram when Vcc = 2.2 V**