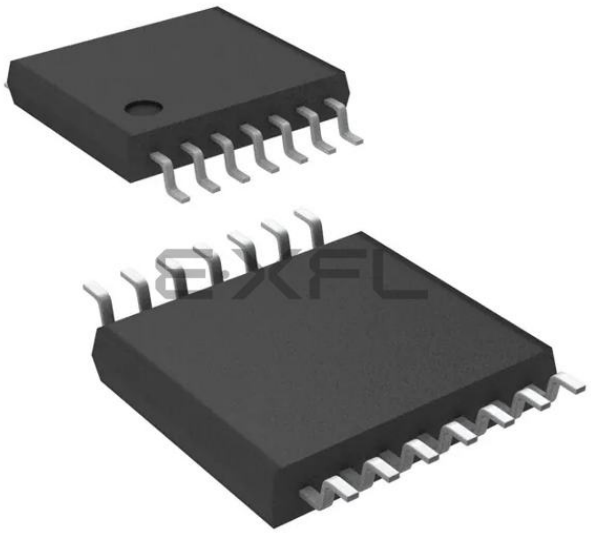

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What is "Embedded - Microcontrollers"?

"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	Not For New Designs
Core Processor	R8C
Core Size	16-Bit
Speed	20MHz
Connectivity	UART/USART
Peripherals	POR, PWM, Voltage Detect, WDT
Number of I/O	11
Program Memory Size	2KB (2K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	256 x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 5.5V
Data Converters	A/D 5x10b
Oscillator Type	Internal
Operating Temperature	-20°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	14-TSSOP (0.173", 4.40mm Width)
Supplier Device Package	14-TSSOP
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f2m110ansp-w4

1.1.2 Differences between Groups

Table 1.1 lists the Specification Comparison between R8C/M11A Group and R8C/M12A Group. The explanations in 1.1.3 and subsequent sections apply to the R8C/M12A Group specifications only, unless otherwise specified.

Table 1.1 Specification Comparison between R8C/M11A Group and R8C/M12A Group

Item	Function	R8C/M11A Group	R8C/M12A Group
Interrupts	External interrupt inputs	6 ($\overline{\text{INT}}$ × 3, key input × 3)	8 ($\overline{\text{INT}}$ × 4, key input × 4)
I/O ports	Number of pins	14 Non-provided pins: P1_0/AN0/TRCIOD/$\overline{\text{KI0}}$ P3_3/IVCMP3/TRCCLK/$\overline{\text{INT3}}$ P3_4/IVREF3/TRCIOC/$\overline{\text{INT2}}$ P3_5/TRCIOD/$\overline{\text{KI2}}$/$\overline{\text{VCOUT}}$3 P4_2/$\overline{\text{TRBO}}$/$\overline{\text{TXD0}}$/$\overline{\text{KI3}}$ P4_5/$\overline{\text{INT0}}$/$\overline{\text{ADTRG}}$	20
	Number of CMOS I/O ports	11 Non-provided ports: P1_0, P3_3, P3_4, P3_5, P4_2, P4_5	17
	Number of high-current drive ports	5 Non-provided ports: P3_3, P3_4, P3_5	8
A/D converter	Number of A/D channels	5 channels Non-provided port: AN0	6 channels
Comparator B	Number of channels	Comparator B1	Comparator B1, comparator B3

Table 1.4 Specifications (2)

Item	Function	Description
Flash memory		• Program/erase voltage for program ROM: VCC = 1.8 V to 5.5 V • Program/erase voltage for data flash: VCC = 1.8 V to 5.5 V • Program/erase endurance: 10,000 times (data flash) 10,000 times (program ROM) • Program security: ID code check, protection enabled by lock bit • Debug functions: On-chip debug, on-board flash rewrite function
Operating frequency/ Power supply voltage		f(XIN) = 20 MHz (VCC = 2.7 V to 5.5 V) f(XIN) = 5 MHz (VCC = 1.8 V to 5.5 V)
Temperature range		-20 °C to 85 °C (N version) -40 °C to 85 °C (D version) (1)
Package		14-pin TSSOP: [Package code] PTSP0014JA-B 14-pin DIP: [Package code] PRDP0014AC-A 20-pin LSSOP: [Package code] PLSP0020JB-A 20-pin DIP: [Package code] PRDP0020AD-A

Note:
1. Specify the D version if it is to be used.

1.3 Block Diagram

Figure 1.2 shows the Block Diagram.

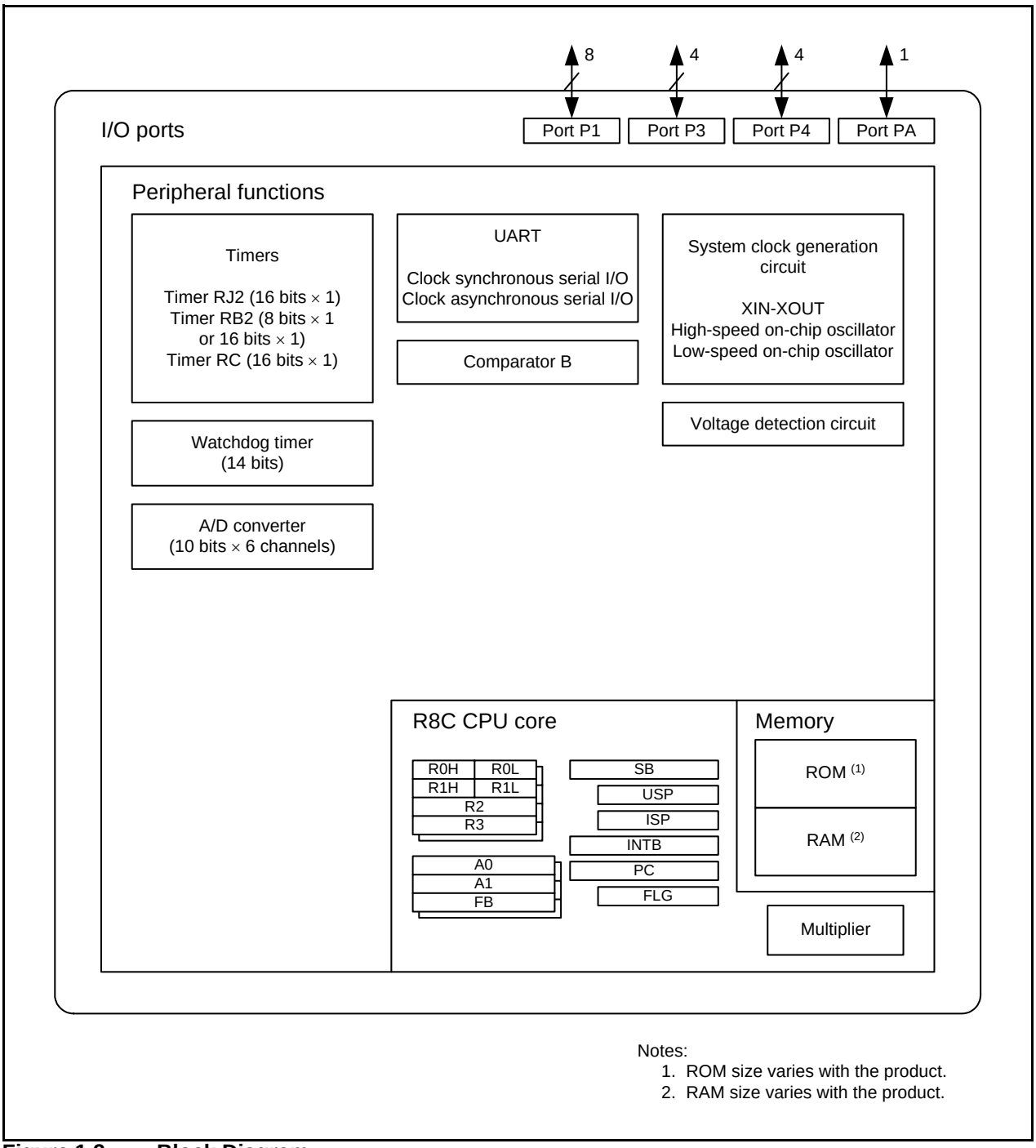
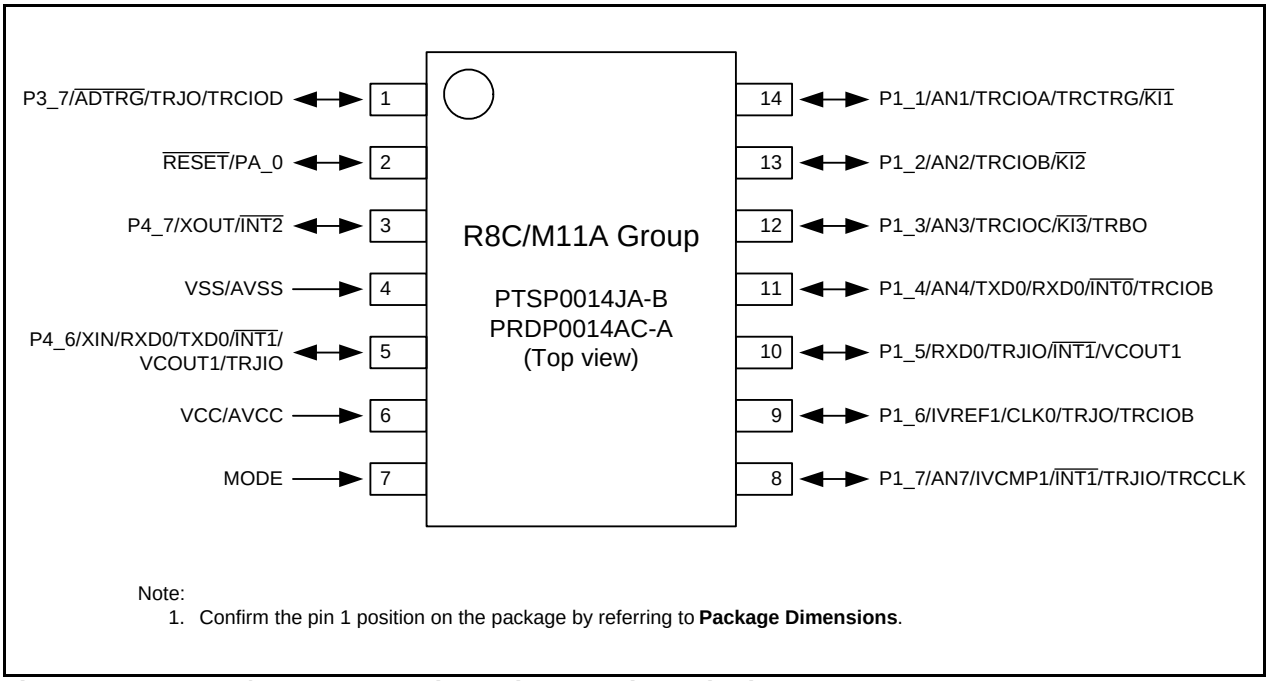


Figure 1.2 Block Diagram

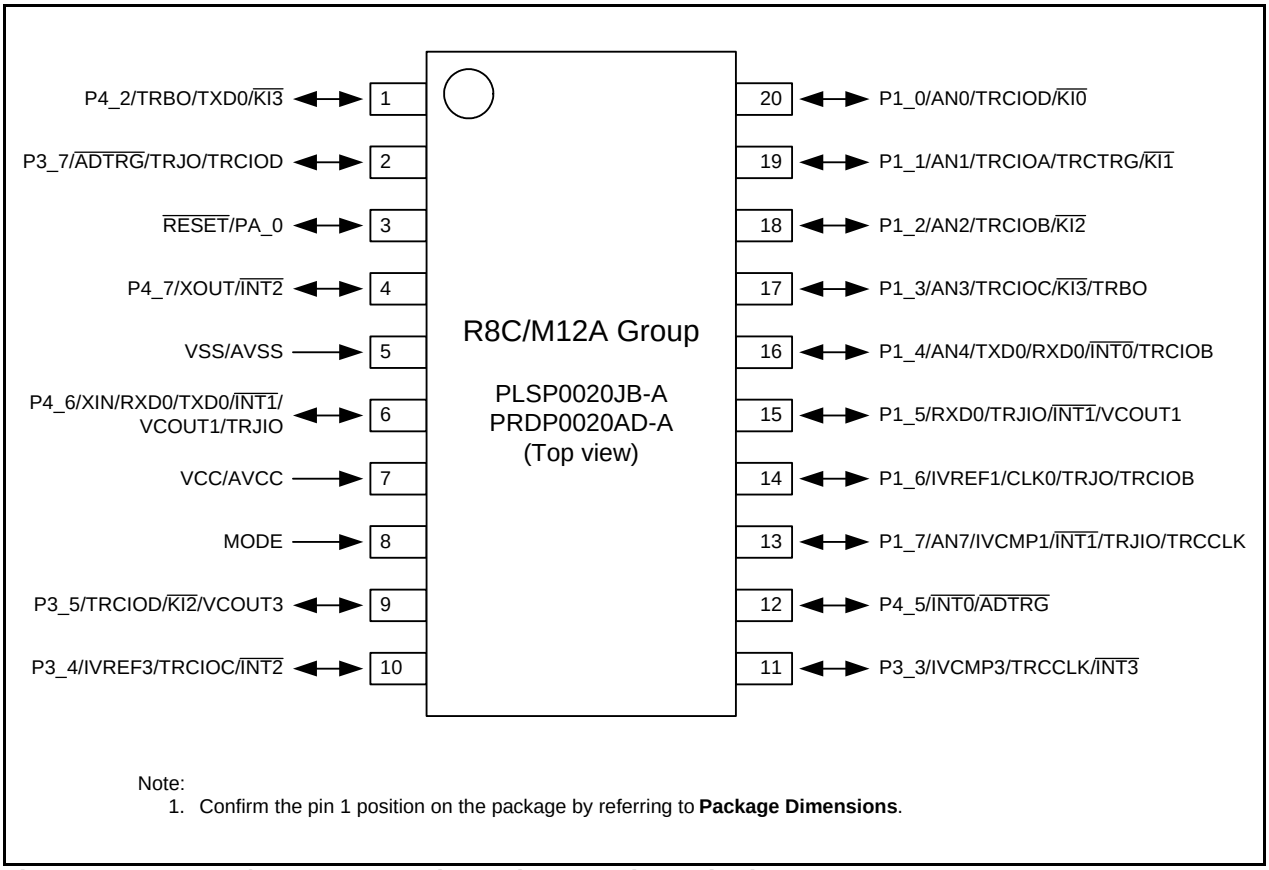
1.4 Pin Assignment

Figures 1.3 and 1.4 show Pin Assignment (Top View). Table 1.6 lists the Pin Name Information by Pin Number.



Note:
1. Confirm the pin 1 position on the package by referring to **Package Dimensions**.

Figure 1.3 R8C/M11A Group Pin Assignment (Top View)

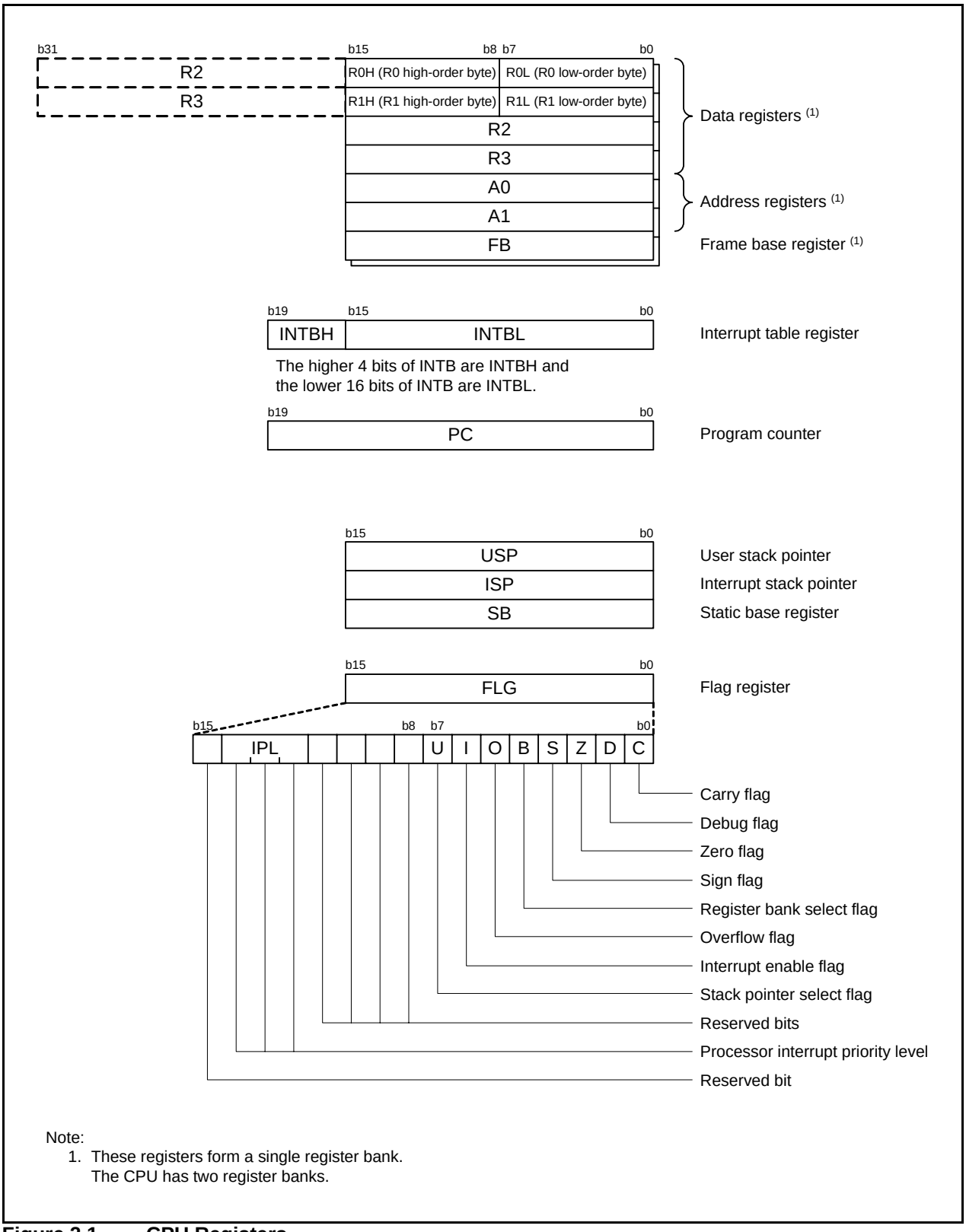


Note:
1. Confirm the pin 1 position on the package by referring to **Package Dimensions**.

Figure 1.4 R8C/M12A Group Pin Assignment (Top View)

2. Central Processing Unit (CPU)

Figure 2.1 shows the 13 CPU Registers. The registers, R0, R1, R2, R3, A0, A1, and FB form a single register bank. The CPU has two register banks.



Note:
1. These registers form a single register bank.
The CPU has two register banks.

Figure 2.1 CPU Registers

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 through R3. R0 can be split into high-order (R0H) and low-order (R0L) registers to be used separately as 8-bit data registers. The same applies to R1H and R1L. R2 can be combined with R0 and used as a 32-bit data register (R2R0). In the same way as with R0 and R2, R3 and R1 can be used as a 32-bit data register (R3R1).

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 functions in the same manner as A0. A1 can be combined with A0 and used as a 32-bit address register (A1A0).

2.3 Frame Base Register (FB)

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

2.4 Interrupt Table Register (INTB)

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

2.5 Program Counter (PC)

PC is a 20-bit register that 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 the FLG register is used to switch between USP and ISP.

2.7 Static Base Register (SB)

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

2.8 Flag Register (FLG)

FLG is an 11-bit register that indicates the CPU state.

2.8.1 Carry Flag (C)

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

2.8.2 Debug Flag (D)

The D flag is for debugging only. It must only be set to 0.

2.8.3 Zero Flag (Z)

The Z flag is set to 1 when an arithmetic operation results in 0. Otherwise it is set 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 it is set 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 1.

2.8.6 Overflow Flag (O)

The O flag is set to 1 when an operation results in an overflow. Otherwise it is set to 0.

Table 3.2 SFR Information (2) (1)

Address	Register Name	Symbol	After Reset
0003Ah	INT Input Filter Select Register 0	INTF0	00h
0003Bh			
0003Ch	INT Input Edge Select Register 0	ISCR0	00h
0003Dh			
0003Eh	Key Input Enable Register	KIEN	00h
0003Fh			
00040h	Interrupt Priority Level Register 0	ILVL0	00h
00041h			
00042h	Interrupt Priority Level Register 2	ILVL2	00h
00043h	Interrupt Priority Level Register 3	ILVL3	00h
00044h	Interrupt Priority Level Register 4	ILVL4	00h
00045h	Interrupt Priority Level Register 5	ILVL5	00h
00046h	Interrupt Priority Level Register 6	ILVL6	00h
00047h	Interrupt Priority Level Register 7	ILVL7	00h
00048h	Interrupt Priority Level Register 8	ILVL8	00h
00049h	Interrupt Priority Level Register 9	ILVL9	00h
0004Ah	Interrupt Priority Level Register A	ILVLA	00h
0004Bh	Interrupt Priority Level Register B	ILVLB	00h
0004Ch	Interrupt Priority Level Register C	ILVLC	00h
0004Dh	Interrupt Priority Level Register D	ILVLD	00h
0004Eh	Interrupt Priority Level Register E	ILVLE	00h
0004Fh			
00050h	Interrupt Monitor Flag Register 0	IRR0	00h
00051h	Interrupt Monitor Flag Register 1	IRR1	00h
00052h	Interrupt Monitor Flag Register 2	IRR2	00h
00053h	External Interrupt Flag Register	IRR3	00h
00054h			
00055h			
00056h			
00057h			
00058h	Voltage Monitor Circuit Edge Select Register	VCAC	00h
00059h			
0005Ah	Voltage Detect Register 2	VCA2	00100100b (2) 00000100b (3)
0005Bh	Voltage Detection 1 Level Select Register	VD1LS	00000111b
0005Ch	Voltage Monitor 0 Circuit Control Register	VW0C	1100X011b (2) 1100X010b (3)
0005Dh	Voltage Monitor 1 Circuit Control Register	VW1C	10001010b
0005Eh			
0005Fh	Reset Source Determination Register	RSTFR	0000XXXXb (4)
00060h			
00061h			
00062h			
00063h			
00064h	High-Speed On-Chip Oscillator 18.432 MHz Control Register 0	FR18S0	Value when shipped
00065h	High-Speed On-Chip Oscillator 18.432 MHz Control Register 1	FR18S1	Value when shipped
00066h			
00067h	High-Speed On-Chip Oscillator Control Register 1	FRV1	Value when shipped
00068h	High-Speed On-Chip Oscillator Control Register 2	FRV2	Value when shipped
00069h			
0006Ah			
0006Bh			
0006Ch			
0006Dh			
0006Eh			
0006Fh			
00070h			
00071h			
00072h			
00073h			
00074h			
00075h			
00076h			
00077h			
00078h			
00079h			

X: Undefined

Notes:

1. The blank areas are reserved. No access is allowed.
2. The LVDAS bit in the OFS register is 0.
3. The LVDAS bit in the OFS register is 1.
4. The value after a reset differs depending on the reset source.

Table 3.3 SFR Information (3) (1)

Address	Register Name	Symbol	After Reset
0007Ah			
0007Bh			
0007Ch			
0007Dh			
0007Eh			
0007Fh			
00080h	UART0 Transmit/Receive Mode Register	U0MR	00h
00081h	UART0 Bit Rate Register	U0BRG	XXh
00082h	UART0 Transmit Buffer Register	U0TBL	XXh
00083h		U0TBH	XXh
00084h	UART0 Transmit/Receive Control Register 0	U0C0	00001000b
00085h	UART0 Transmit/Receive Control Register 1	U0C1	00000010b
00086h	UART0 Receive Buffer Register	U0RBL	XXh
00087h		U0RBH	XXh
00088h	UART0 Interrupt Flag and Enable Register	U0IR	00h
00089h			
0008Ah			
0008Bh			
0008Ch			
0008Dh			
0008Eh			
0008Fh			
00090h			
00091h			
00092h			
00093h			
00094h			
00095h			
00096h			
00097h			
00098h	A/D Register 0	AD0L	XXh
00099h		AD0H	000000XXb
0009Ah	A/D Register 1	AD1L	XXh
0009Bh		AD1H	000000XXb
0009Ch	A/D Mode Register	ADMOD	00h
0009Dh	A/D Input Select Register	ADINSEL	00h
0009Eh	A/D Control Register 0	ADCON0	00h
0009Fh	A/D Interrupt Control Status Register	ADICSR	00h
000A0h			
000A1h			
000A2h			
000A3h			
000A4h			
000A5h			
000A6h			
000A7h			
000A8h			
000A9h	Port P1 Direction Register	PD1	00h
000AAh			
000ABh	Port P3 Direction Register	PD3	00h
000ACh	Port P4 Direction Register	PD4	00h
000ADh	Port PA Direction Register	PDA	00h
000AEh			
000AFh	Port P1 Register	P1	00h
000B0h			
000B1h	Port P3 Register	P3	00h
000B2h	Port P4 Register	P4	00h
000B3h	Port PA Register	PA	00h
000B4h			
000B5h	Pull-Up Control Register 1	PUR1	00h
000B6h			
000B7h	Pull-Up Control Register 3	PUR3	00h
000B8h	Pull-Up Control Register 4	PUR4	00h
000B9h	Port I/O Function Control Register	PINSR	00h
000BAh			
000BBh	Drive Capacity Control Register 1	DRR1	00h
000BCh			
000BDh	Drive Capacity Control Register 3	DRR3	00h
000BEh			
000BFh			

X: Undefined

Note:

1. The blank areas are reserved. No access is allowed.

Table 3.4 SFR Information (4) (1)

Address	Register Name	Symbol	After Reset
000C0h			
000C1h	Open-Drain Control Register 1	POD1	00h
000C2h			
000C3h	Open-Drain Control Register 3	POD3	00h
000C4h	Open-Drain Control Register 4	POD4	00h
000C5h	Port PA Mode Control Register	PAMCR	00010001b
000C6h			
000C7h			
000C8h	Port 1 Function Mapping Register 0	PML1	00h
000C9h	Port 1 Function Mapping Register 1	PMH1	00h
000CAh			
000CBh			
000CCh	Port 3 Function Mapping Register 0	PML3	00h
000CDh	Port 3 Function Mapping Register 1	PMH3	00h
000CEh	Port 4 Function Mapping Register 0	PML4	00h
000CFh	Port 4 Function Mapping Register 1	PMH4	00h
000D0h			
000D1h	Port 1 Function Mapping Expansion Register	PMH1E	00h
000D2h			
000D3h			
000D4h			
000D5h	Port 4 Function Mapping Expansion Register	PMH4E	00h
000D6h			
000D7h			
000D8h	Timer RJ Counter Register	TRJ	FFh
000D9h			FFh
000DAh	Timer RJ Control Register	TRJCR	00h
000DBh	Timer RJ I/O Control Register	TRJIOC	00h
000DCh	Timer RJ Mode Register	TRJMR	00h
000DDh	Timer RJ Event Select Register	TRJISR	00h
000DEh	Timer RJ Interrupt Control Register	TRJIR	00h
000DFh			
000E0h	Timer RB Control Register	TRBCR	00h
000E1h	Timer RB One-Shot Control Register	TRBOCR	00h
000E2h	Timer RB I/O Control Register	TRBIOC	00h
000E3h	Timer RB Mode Register	TRBMR	00h
000E4h	Timer RB Prescaler Register (2) Timer RB Primary/Secondary Register (Lower 8 Bits) (3)	TRBPRE	FFh
000E5h	Timer RB Primary Register (2) Timer RB Primary Register (Higher 8 Bits) (3)	TRBPR	FFh
000E6h	Timer RB Secondary Register (2) Timer RB Secondary Register (Higher 8 Bits) (3)	TRBSC	FFh
000E7h	Timer RB Interrupt Control Register	TRBIR	00h
000E8h	Timer RC Counter	TRCCNT	00h
000E9h			00h
000EAh	Timer RC General Register A	TRCGRA	FFh
000EBh			FFh
000ECh	Timer RC General Register B	TRCGRB	FFh
000EDh			FFh
000EEh	Timer RC General Register C	TRCGRC	FFh
000EFh			FFh
000F0h	Timer RC General Register D	TRCGRD	FFh
000F1h			FFh
000F2h	Timer RC Mode Register	TRCMR	01001000b
000F3h	Timer RC Control Register 1	TRCCR1	00h
000F4h	Timer RC Interrupt Enable Register	TRCIER	01110000b
000F5h	Timer RC Status Register	TRCSR	01110000b
000F6h	Timer RC I/O Control Register 0	TRCIOR0	10001000b
000F7h	Timer RC I/O Control Register 1	TRCIOR1	10001000b
000F8h	Timer RC Control Register 2	TRCCR2	00011000b
000F9h	Timer RC Digital Filter Function Select Register	TRCDF	00h
000FAh	Timer RC Output Enable Register	TRCOER	01111111b
000FBh	Timer RC A/D Conversion Trigger Control Register	TRCADCR	11110000b
000FCh	Timer RC Waveform Output Manipulation Register	TRCOPR	00h
000FDh			
000FEh			
000FFh			

Notes:
1. The blank areas are reserved. No access is allowed.
2. The TCNT16 bit in the TRBMR register is 0.
3. The TCNT16 bit in the TRBMR register is 1.

Table 3.7 SFR Information (7) (1)

Address	Register Name	Symbol	After Reset
00180h	Comparator B Control Register	WCMPR	00h
00181h	Comparator B1 Interrupt Control Register	WCB1INTR	00h
00182h	Comparator B3 Interrupt Control Register	WCB3INTR	00h
00183h			
00184h			
00185h			
00186h			
00187h			
00188h			
00189h			
0018Ah			
0018Bh			
0018Ch			
0018Dh			
0018Eh			
0018Fh			
00190h			
00191h			
00192h			
00193h			
00194h			
00195h			
00196h			
00197h			
00198h			
00199h			
0019Ah			
0019Bh			
0019Ch			
0019Dh			
0019Eh			
0019Fh			
001A0h			
001A1h			
001A2h			
001A3h			
001A4h			
001A5h			
001A6h			
001A7h			
001A8h			
001A9h	Flash Memory Status Register	FST	10000000b
001AAh	Flash Memory Control Register 0	FMR0	00h
001ABh	Flash Memory Control Register 1	FMR1	00h
001ACh	Flash Memory Control Register 2	FMR2	00h
001ADh	Flash Memory Refresh Control Register	FREFR	00h
001AEh			
001AFh			
001B0h			
001B1h			
001B2h			
001B3h			
001B4h			
001B5h			
001B6h			
001B7h			
001B8h			
001B9h			
001BAh			
001BBh			
001BCh			
001BDh			
001BEh			
001BFh			

Note:
1. The blank areas are reserved. No access is allowed.

Table 4.3 A/D Converter Characteristics

Symbol	Parameter	Condition		Standard			Unit
				Min.	Typ.	Max.	
—	Resolution			—	—	10	Bit
—	Absolute accuracy	AVcc = 5.0 V	AN0 to AN4, AN7 input	—	—	±3	LSB
		AVcc = 3.0 V	AN0 to AN4, AN7 input	—	—	±5	LSB
		AVcc = 1.8 V	AN0 to AN4, AN7 input	—	—	±5	LSB
—	A/D conversion clock	4.0 V ≤ AVcc ≤ 5.5 V (2)		2	—	20	MHz
		3.2 V ≤ AVcc ≤ 5.5 V (2)		2	—	16	MHz
		2.7 V ≤ AVcc ≤ 5.5 V (2)		2	—	10	MHz
		1.8 V ≤ AVcc ≤ 5.5 V (2)		2	—	5	MHz
—	Permissible signal source impedance				3		kΩ
t_{CONV}	Conversion time	AVcc = 5.0 V, A/D conversion clock = 20 MHz		2.20	—	—	µs
t_{SAMP}	Sampling time	A/D conversion clock = 20 MHz		0.80	—	—	µs
V_{IA}	Analog input voltage			0	—	AVcc	V

Notes:
1. Vcc/AVcc = 1.8 V to 5.5 V and Vss = 0 V and Topr = -20 °C to 85 °C (N version)/-40 °C to 85 °C (D version), unless otherwise specified.
2. The A/D conversion result will be undefined in stop mode, or when the flash memory is in low-current-consumption read mode or stopped. Do not perform A/D conversion in these states. Do not enter these states during A/D conversion.

Table 4.4 Comparator B Electrical Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
V_{ref}	IVREF1, IVREF3 input reference voltage		0	—	Vcc - 1.4	V
V_I	IVCMP1, IVCMP3 input voltage		-0.3	—	Vcc + 0.3	V
—	Offset		—	5	100	mV
t_d	Comparator output delay time (2)	V_I = Vref ± 100 mV	—	0.1	—	µs
I_{CMP}	Comparator operating current	Vcc = 5.0 V	—	17.5	—	µA

Notes:
1. Vcc = 2.7 V to 5.5 V and Topr = -20 °C to 85 °C (N version)/-40 °C to 85 °C (D version), unless otherwise specified.
2. When the digital filter is disabled.

Table 4.5 Flash Memory (Program ROM) Electrical Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
—	Program/erase endurance (2)		10,000 (3)	—	—	times
—	Byte programming time (program/erase endurance ≤ 1,000 times)		—	80	—	µs
—	Byte programming time (program/erase endurance > 1,000 times)		—	160	—	µs
—	Block erase time		—	0.12	—	s
$t_{d(SR-SUS)}$	Transition time to suspend		—	—	0.25 + CPU clock × 3 cycles	ms
—	Time from suspend until erase restart		—	—	30 + CPU clock × 1 cycle	µs
$t_{d(CMDRST READY)}$	Time from when command is forcibly terminated until reading is enabled		—	—	30 + CPU clock × 1 cycle	µs
—	Program/erase voltage		1.8	—	5.5	V
—	Read voltage		1.8	—	5.5	V
—	Program/erase temperature		0	—	60	°C
—	Data hold time (7)	Ambient temperature = 85 °C	10	—	—	years

Notes:
1. Vcc = 2.7 V to 5.5 V and Topr = 0 °C to 60 °C, unless otherwise specified.
2. Definition of program/erase endurance
   The number of program/erase cycles is defined on a per-block basis.
   If the number of cycles is 10,000, each block can be erased 10,000 times.
   For example, if 1,024 cycles of 1-byte-write are performed to different addresses in 1 Kbyte of block A, and then the block is erased, the number of cycles is counted as one. Note, however, that the same address must not be programmed more than once before completion of an erase (overwriting prohibited).
3. This indicates the number of times up to which all electrical characteristics can be guaranteed after the last programming/erase operation. Operation is guaranteed for any number of operations in the range of 1 to the specified minimum (Min).
4. In a system that executes multiple programming operations, the actual erase count can be reduced by shifting the write addresses in sequence and programming so that as much of the flash memory as possible is used before performing an erase operation. For example, when programming in 16-byte units, the effective number of rewrites can be minimized by programming up to 128 units before erasing them all in one operation. It is also advisable to retain data on the number of erase operations for each block and establish a limit for the number of erase operations performed.
5. If an error occurs during a block erase, execute a clear status register command and then a block erase command at least three times until the erase error does not occur.
6. For information on the program/erase failure rate, contact a Renesas technical support representative.
7. The data hold time includes the time that the power supply is off and the time the clock is not supplied.

Table 4.7 Voltage Detection 0 Circuit Electrical Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
V_{det0}	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 (3)	When Vcc decreases from 5 V to (Vdet0_0 - 0.1) V	—	30	—	µs
—	Self power consumption in voltage detection circuit	VC0E = 1, Vcc = 5.0 V	—	1.5	—	µA
$t_{d(E-A)}$	Wait time until voltage detection circuit operation starts (4)		—	—	100	µs

Notes:
1. The measurement condition is Vcc = 1.8 V to 5.5 V and Topr = -20 °C to 85 °C (N version)/-40 °C to 85 °C (D version).
2. Select the voltage detection level with bits VDSEL0 and VDSEL1 in the OFS register.
3. The response time is from when the voltage passes Vdet0 until the voltage monitor 0 reset is generated.
4. The wait time is necessary for the voltage detection circuit to operate when the VC0E bit in the VCA2 register is set to 0 and then 1.

Table 4.8 Voltage Detection 1 Circuit Electrical Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
V_{det1}	Voltage detection level Vdet1_1 (2)	When Vcc decreases	2.15	2.35	2.55	V
	Voltage detection level Vdet1_3 (2)	When Vcc decreases	2.45	2.65	2.85	V
	Voltage detection level Vdet1_5 (2)	When Vcc decreases	2.75	2.95	3.15	V
	Voltage detection level Vdet1_7 (2)	When Vcc decreases	3.00	3.25	3.55	V
	Voltage detection level Vdet1_9 (2)	When Vcc decreases	3.30	3.55	3.85	V
	Voltage detection level Vdet1_B (2)	When Vcc decreases	3.60	3.85	4.15	V
	Voltage detection level Vdet1_D (2)	When Vcc decreases	3.90	4.15	4.45	V
	Voltage detection level Vdet1_F (2)	When Vcc decreases	4.20	4.45	4.75	V
—	Hysteresis width at the rising of Vcc in voltage detection 1 circuit	Vdet1_1 to Vdet1_5 selected	—	0.07	—	V
		Vdet1_7 to Vdet1_F selected	—	0.10	—	V
—	Voltage detection 1 circuit response time (3)	When Vcc decreases from 5 V to (Vdet1_0 - 0.1) V	—	60	150	µs
—	Self power consumption in voltage detection circuit	VC1E = 1, Vcc = 5.0 V	—	1.7	—	µA
$t_{d(E-A)}$	Wait time until voltage detection circuit operation starts (4)		—	—	100	µs

Notes:
1. The measurement condition is Vcc = 1.8 V to 5.5 V and Topr = -20 °C to 85 °C (N version)/-40 °C to 85 °C (D version).
2. Select the voltage detection level with bits VD1S1 to VD1S3 in the VD1LS register.
3. The response time is from when the voltage passes Vdet1 until the voltage monitor 1 interrupt request is generated.
4. The wait time is necessary for the voltage detection circuit to operate when the VC1E bit in the VCA2 register is set to 0 and then 1.

Table 4.10 High-Speed On-Chip Oscillator Circuit Electrical Characteristics

Symbol	Parameter	Package	Condition	Standard			Unit
				Min.	Typ.	Max.	
—	High-speed on-chip oscillator frequency after reset is cleared	14-pin TSSOP 20-pin LSSOP	Vcc = 1.8 V to 5.5 V, -20 °C ≤ Topr ≤ 85 °C	19.2	20.0	20.8	MHz
		14-pin DIP 20-pin DIP		19.0	20.0	21.0	MHz
		14-pin TSSOP 20-pin LSSOP	Vcc = 1.8 V to 5.5 V, -40 °C ≤ Topr ≤ 85 °C	19.0	20.0	21.0	MHz
	High-speed on-chip oscillator frequency when the FR18S0 register adjustment value is written into the FRV1 register and the FR18S1 register adjustment value into the FRV2 register (2)	14-pin TSSOP 20-pin LSSOP	Vcc = 1.8 V to 5.5 V, -20 °C ≤ Topr ≤ 85 °C	17.694	18.432	19.169	MHz
		14-pin DIP 20-pin DIP		17.510	18.432	19.353	MHz
		14-pin TSSOP 20-pin LSSOP	Vcc = 1.8 V to 5.5 V, -40 °C ≤ Topr ≤ 85 °C	17.510	18.432	19.353	MHz
—	Oscillation stabilization time	—		—	—	30	µs
—	Self power consumption at oscillation	—	Vcc = 5.0 V, Topr = 25 °C	—	530	—	µA

Notes:
1. Vcc = 1.8 V to 5.5 V, Topr = -20 °C to 85 °C (N version)/-40 °C to 85 °C (D version), unless otherwise specified.
2. This enables the setting errors of bit rates such as 9600 bps and 38400 bps to be 0 % when the serial interface is used in UART mode.

Table 4.11 Low-Speed On-Chip Oscillator Circuit Electrical Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
fLOCO	Low-speed on-chip oscillator frequency		60	125	250	kHz
—	Oscillation stabilization time		—	—	35	µs
—	Self power consumption at oscillation	Vcc = 5.0 V, Topr = 25 °C	—	2	—	µA

Note:
1. Vcc = 1.8 V to 5.5 V, Topr = -20 °C to 85 °C (N version)/-40 °C to 85 °C (D version), unless otherwise specified.

Table 4.12 Power Supply Circuit Timing Characteristics

Symbol	Parameter	Condition	Standard			Unit
			Min.	Typ.	Max.	
$t_{d(P-R)}$	Time for internal power supply stabilization during power-on (2)		—	—	2,000	µs

Notes:
1. The measurement condition is Vcc = 1.8 V to 5.5 V and Topr = 25 °C.
2. Wait time until the internal power supply generation circuit stabilizes during power-on.

Table 4.13 DC Characteristics (1) [4.0 V ≤ Vcc ≤ 5.5 V]

Symbol	Parameter		Condition		Standard			Unit
					Min.	Typ.	Max.	
V_{OH}	Output high voltage	P1_2, P1_3, P1_4, P1_5, P3_3, P3_4, P3_5, P3_7 (2)	When drive capacity is high	I_{OH} = -20 mA	Vcc - 2.0	—	Vcc	V
			When drive capacity is low	I_{OH} = -5 mA	Vcc - 2.0	—	Vcc	V
		P1_0, P1_1, P1_6, P1_7, P4_2, P4_5, P4_6, P4_7, PA_0		I_{OH} = -5 mA	Vcc - 2.0	—	Vcc	V
V_{OL}	Output low voltage	P1_2, P1_3, P1_4, P1_5, P3_3, P3_4, P3_5, P3_7 (2)	When drive capacity is high	I_{OL} = 20 mA	—	—	2.0	V
			When drive capacity is low	I_{OL} = 5 mA	—	—	2.0	V
		P1_0, P1_1, P1_6, P1_7, P4_2, P4_5, P4_6, P4_7, PA_0		I_{OL} = 5 mA	—	—	2.0	V
V_{T+}-V_{T-}	Hysteresis	$\overline{INT0}$, $\overline{INT1}$, $\overline{INT2}$, $\overline{INT3}$, $\overline{KI0}$, $\overline{KI1}$, $\overline{KI2}$, $\overline{KI3}$, TRJIO, TRCIOA, TRCIOB, TRCIOC, TRCIOD, RXD0, CLK0	Vcc = 5 V		0.1	1.2	—	V
		$\overline{RESET}$	Vcc = 5 V		0.1	1.2	—	V
I_{IH}	Input high current		V_I = 5 V, Vcc = 5.0 V		—	—	5.0	µA
I_{IL}	Input low current		V_I = 0 V, Vcc = 5.0 V		—	—	-5.0	µA
R_{PULLUP}	Pull-up resistance		V_I = 0 V, Vcc = 5.0 V		25	50	100	kΩ
R_{fXIN}	Feedback resistance	XIN			—	2.2	—	MΩ
V_{RAM}	RAM hold voltage		In stop mode		1.8	—	—	V

Notes:
1. 4.0 V ≤ Vcc ≤ 5.5 V and Topr = -20 °C to 85 °C (N version)/-40 °C to 85 °C (D version), f(XIN) = 20 MHz, unless otherwise specified.
2. High drive capacity can also be used while the peripheral output function is used.

Timing Requirements (Vcc = 5 V, Vss = 0 V at Topr = 25 °C, unless otherwise specified)

Table 4.15 External Clock Input (XIN)

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(XIN)}$	XIN input cycle time	50	—	ns
$t_{WH(XIN)}$	XIN input high width	24	—	ns
$t_{WL(XIN)}$	XIN input low width	24	—	ns

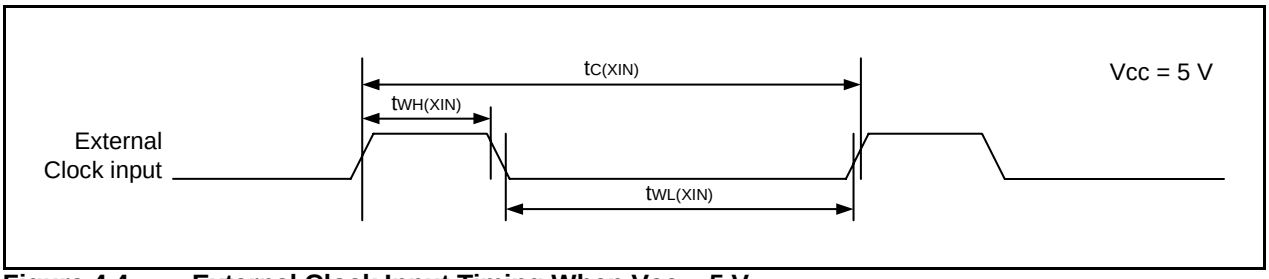


Figure 4.4 External Clock Input Timing When Vcc = 5 V

Table 4.16 TRJIO Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TRJIO)}$	TRJIO input cycle time	100	—	ns
$t_{WH(TRJIO)}$	TRJIO input high width	40	—	ns
$t_{WL(TRJIO)}$	TRJIO input low width	40	—	ns

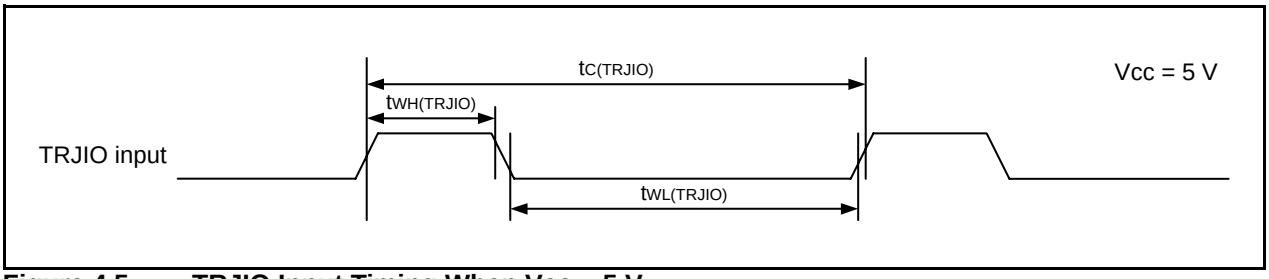


Figure 4.5 TRJIO Input Timing When Vcc = 5 V

Table 4.26 DC Characteristics (6) [1.8 V ≤ Vcc < 2.7 V] (Topr = -20 °C to 85 °C (N version)/-40 °C to 85 °C (D version), unless otherwise specified)

Symbol	Parameter	Condition							Standard			Unit
			Oscillation Circuit	On-Chip Oscillator		CPU Clock	Low-Power-Consumption Setting	Other				
			XIN (2)	High-Speed	Low-Speed				Min.	Typ. (3)	Max.	
Icc	Power supply current (1)	High-speed clock mode	5 MHz	Off	125 kHz	No division	—		—	1.0	—	mA
			5 MHz	Off	125 kHz	Division by 8	—		—	0.6	—	mA
		High-speed on-chip oscillator mode	Off	5 MHz (4)	125 kHz	No division			—	1.6	6.5	mA
			Off	5 MHz (4)	125 kHz	Division by 8			—	1.1	—	mA
			Off	4 MHz (4)	125 kHz	Division by 16	MSTTRC = 1		—	1.0	—	mA
		Low-speed on-chip oscillator mode	Off	Off	125 kHz	Division by 8	FMR27 = 1 LPE = 0		—	60	200	µA
		Wait mode	Off	Off	125 kHz	—	VC1E = 0 VC0E = 0 LPE = 1	Peripheral clock supplied during WAIT instruction execution	—	15	90	µA
			Off	Off	125 kHz	—	VC1E = 0 VC0E = 0 LPE = 1 WCKSTP = 1	Peripheral clock stopped during WAIT instruction execution	—	4.0	80	µA
		Stop mode	Off	Off	Off	—	VC1E = 0 VC0E = 0 STPM = 1	Topr = 25 °C Peripheral clock stopped	—	1.0	4.0	µA
			Off	Off	Off	—	VC1E = 0 VC0E = 0 STPM = 1	Topr = 85 °C Peripheral clock stopped	—	1.5	—	µA

Notes:
1. Vcc = 1.8 V to 2.7 V, single-chip mode, output pins are open, and other pins are connected to Vss.
2. When the XIN input is a square wave.
3. Vcc = 2.2 V
4. Set the system clock to 5 MHz or 4 MHz with the PHISEL register.

Timing Requirements (Vcc = 2.2 V, Vss = 0 V at Topr = 25 °C, unless otherwise specified)

Table 4.27 External Clock Input (XIN)

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(XIN)}$	XIN input cycle time	200	—	ns
$t_{WH(XIN)}$	XIN input high width	90	—	ns
$t_{WL(XIN)}$	XIN input low width	90	—	ns

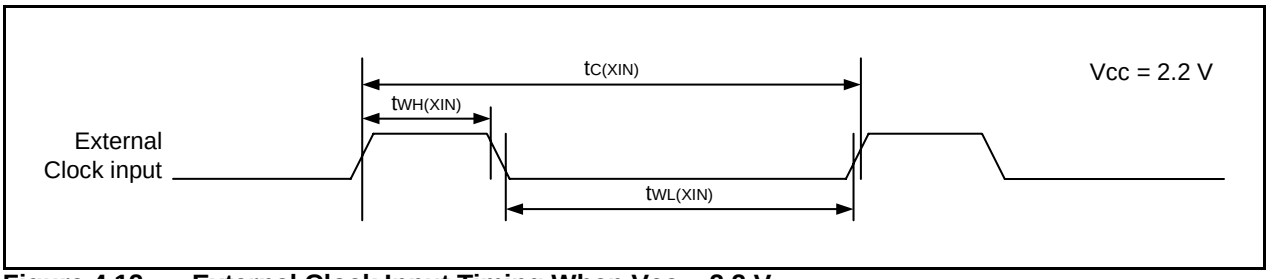


Figure 4.12 External Clock Input Timing When Vcc = 2.2 V

Table 4.28 TRJIO Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TRJIO)}$	TRJIO input cycle time	500	—	ns
$t_{WH(TRJIO)}$	TRJIO input high width	200	—	ns
$t_{WL(TRJIO)}$	TRJIO input low width	200	—	ns

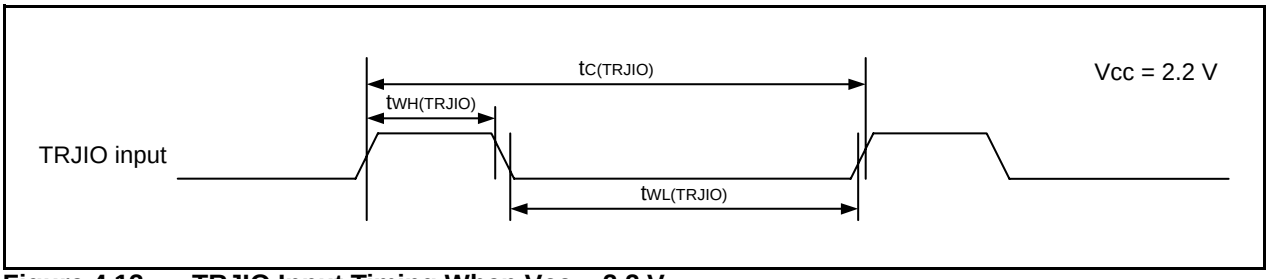
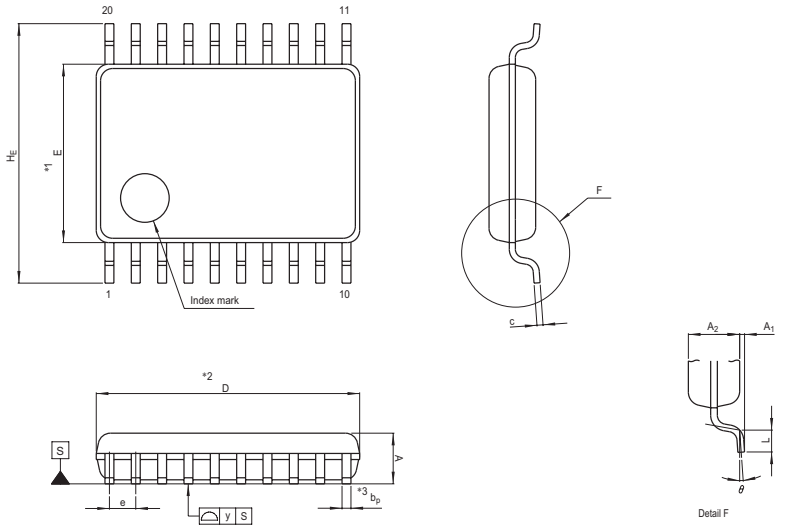


Figure 4.13 TRJIO Input Timing When Vcc = 2.2 V

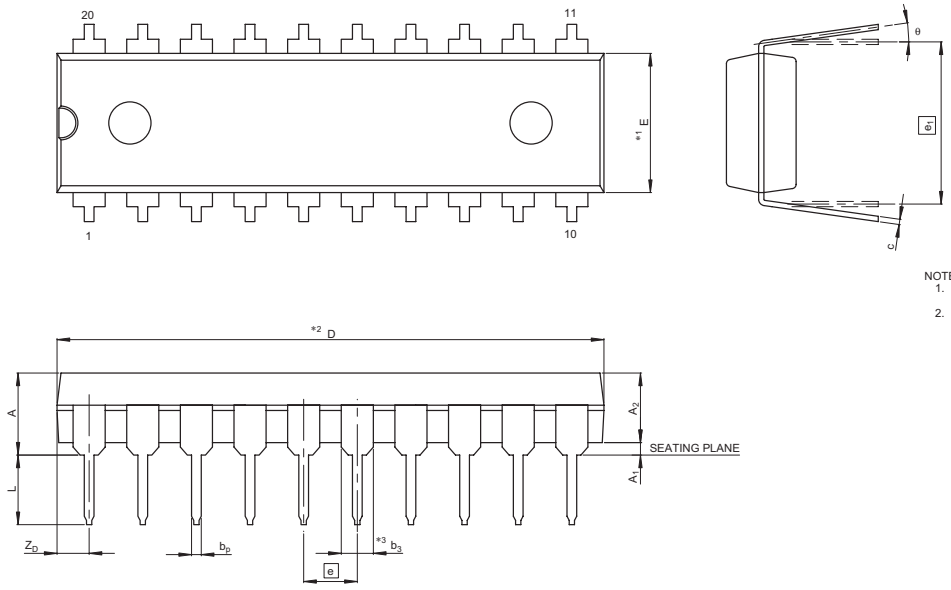
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-LSSOP20-4.4x6.5-0.65	PLSP0020JB-A	20P2F-A	0.1g



NOTE)
1. DIMENSIONS "*1" AND "*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "*3" DOES NOT INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	6.4	6.5	6.6
E	4.3	4.4	4.5
A_2	—	1.15	—
A	—	—	1.45
A_1	0	0.1	0.2
b_p	0.17	0.22	0.32
c	0.13	0.15	0.2
θ	0°	—	10°
H_E	6.2	6.4	6.6
e	0.53	0.65	0.77
y	—	—	0.10
L	0.3	0.5	0.7

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-DIP20-6.6x25.9-2.54	PRDP0020AD-A	20P4X-A	1.39g



NOTE)
1. DIMENSIONS "*1" AND "*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "*3" DOES NOT INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
e1	—	7.69	—
D	24.9	25.9	26.9
E	6.1	6.6	7.1
A	—	—	5.33
A_1	0.38	—	—
A_2	3.1	3.3	3.5
b_p	0.36	0.46	0.56
b_3	1.32	1.52	1.72
c	0.21	—	0.35
θ	0°	—	15°
e	—	2.54	—
Z_D	—	1.52	—
L	2.9	—	—

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