



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	Not For New Designs
Core Processor	R8C
Core Size	16-Bit
Speed	20MHz
Connectivity	SIO, UART/USART
Peripherals	LED, POR, Voltage Detect, WDT
Number of I/O	22
Program Memory Size	16KB (16K x 8)
Program Memory Type	FLASH
EEPROM Size	4K x 8
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	A/D 12x10b
Oscillator Type	Internal
Operating Temperature	-20°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	32-LQFP
Supplier Device Package	32-LQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f21134fp-u0

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.

1.2 Performance Overview

Table 1.1. lists the performance outline of this MCU.

Table 1.1 Performance outline

Item		Performance
CPU	Number of basic instructions	89 instructions
	Minimum instruction execution time	50 ns (f(X _{IN}) = 20 MHz, V _{CC} = 3.0 to 5.5 V) 100 ns (f(X _{IN}) = 10 MHz, V _{CC} = 2.7 to 5.5 V)
	Operating mode	Single-chip
	Address space	1M bytes
	Memory capacity	See Table 1.2.
Peripheral function	Port	Input/Output: 22 (including LED drive port), Input: 2
	LED drive port	I/O port: 8
	Timer	Timer X: 8 bits x 1 channel, Timer Y: 8 bits x 1 channel, Timer Z: 8 bits x 1 channel (Each timer equipped with 8-bit prescaler) Timer C: 16 bits x 1 channel (Circuits of input capture and output compare)
	Serial interface	•1 channel Clock synchronous, UART •1 channel UART
	A/D converter	10-bit A/D converter: 1 circuit, 12 channels
	Watchdog timer	15 bits x 1 (with prescaler) Reset start function selectable
	Interrupt	Internal: 11 factors, External: 5 factors, Software: 4 factors, Priority level: 7 levels
	Clock generation circuit	2 circuits •Main clock generation circuit (Equipped with a built-in feedback resistor) •On-chip oscillator (high-speed, low-speed) On high-speed on-chip oscillator the frequency adjustment function is usable.
	Oscillation stop detection function	Main clock oscillation stop detection function
	Voltage detection circuit	Included
	Power on reset circuit	Included
Electrical characteristics	Supply voltage	V _{CC} = 3.0 to 5.5V (f(X _{IN}) = 20MHz) V _{CC} = 2.7 to 5.5V (f(X _{IN}) = 10MHz)
	Power consumption	Typ.9 mA (V _{CC} = 5.0V, (f(X _{IN}) = 20MHz) Typ.5 mA (V _{CC} = 3.0V, (f(X _{IN}) = 10MHz) Typ.35 μA (V _{CC} = 3.0V, Wait mode, Peripheral clock stops) Typ.0.7 μA (V _{CC} = 3.0V, Stop mode)
Flash memory	Program/erase supply voltage	V _{CC} = 2.7 to 5.5 V
	Program/erase endurance	10,000 times (Data flash) 1,000 times (Program ROM)
		Operating ambient temperature
		-20 to 85°C -40 to 85°C (D-version)
Package		32-pin plastic mold LOFP

1.3 Block Diagram

Figure 1.1 shows this MCU block diagram.

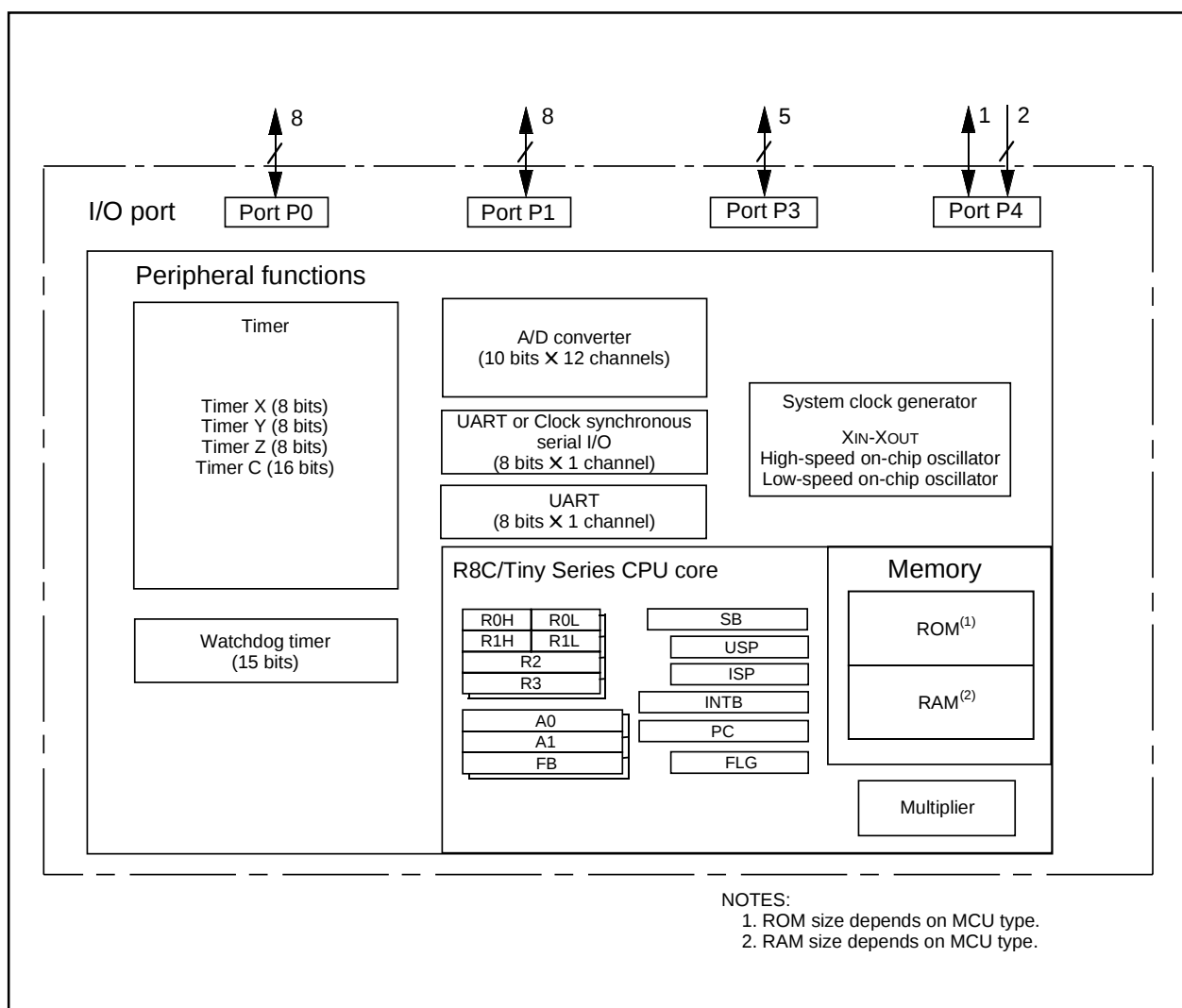


Figure 1.1 Block Diagram

1.4 Product Information

Table 1.2 lists the product information.

Table 1.2 Product Information

As of January 2006

Type No.	ROM capacity		RAM capacity	Package type	Remarks
	Program ROM	Data flash			
R5F21132FP	8K bytes	2K bytes x 2	512 bytes	PLQP0032GB-A	Flash memory version
R5F21133FP	12K bytes	2K bytes x 2	768 bytes	PLQP0032GB-A	
R5F21134FP	16K bytes	2K bytes x 2	1K bytes	PLQP0032GB-A	
R5F21132DFP	8K bytes	2K bytes x 2	512 bytes	PLQP0032GB-A	D version
R5F21133DFP	12K bytes	2K bytes x 2	768 bytes	PLQP0032GB-A	
R5F21134DFP	16K bytes	2K bytes x 2	1K bytes	PLQP0032GB-A	

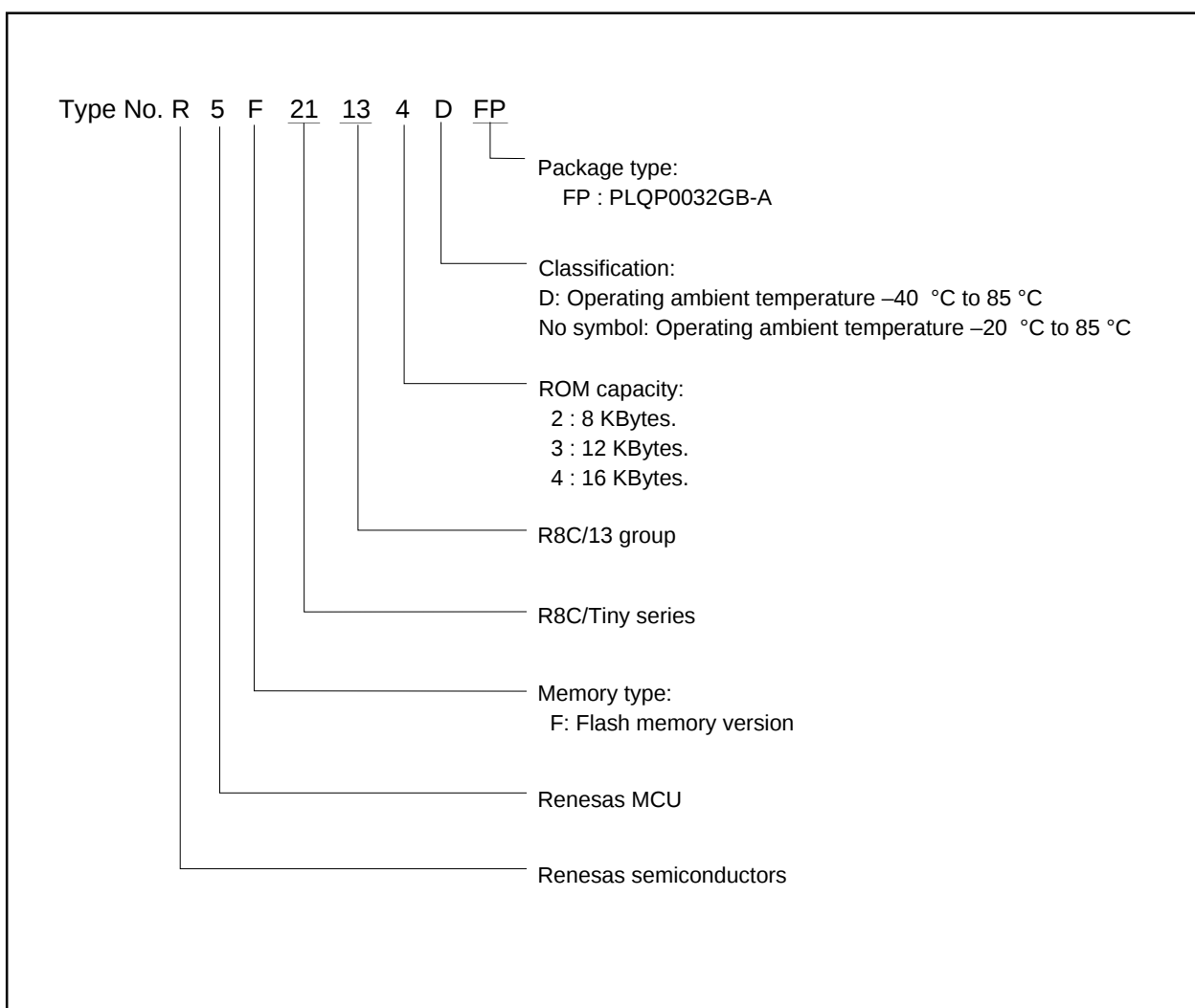


Figure 1.2 Type No., Memory Size, and Package

1.5 Pin Assignments

Figure 1.3 shows the pin configuration (top view).

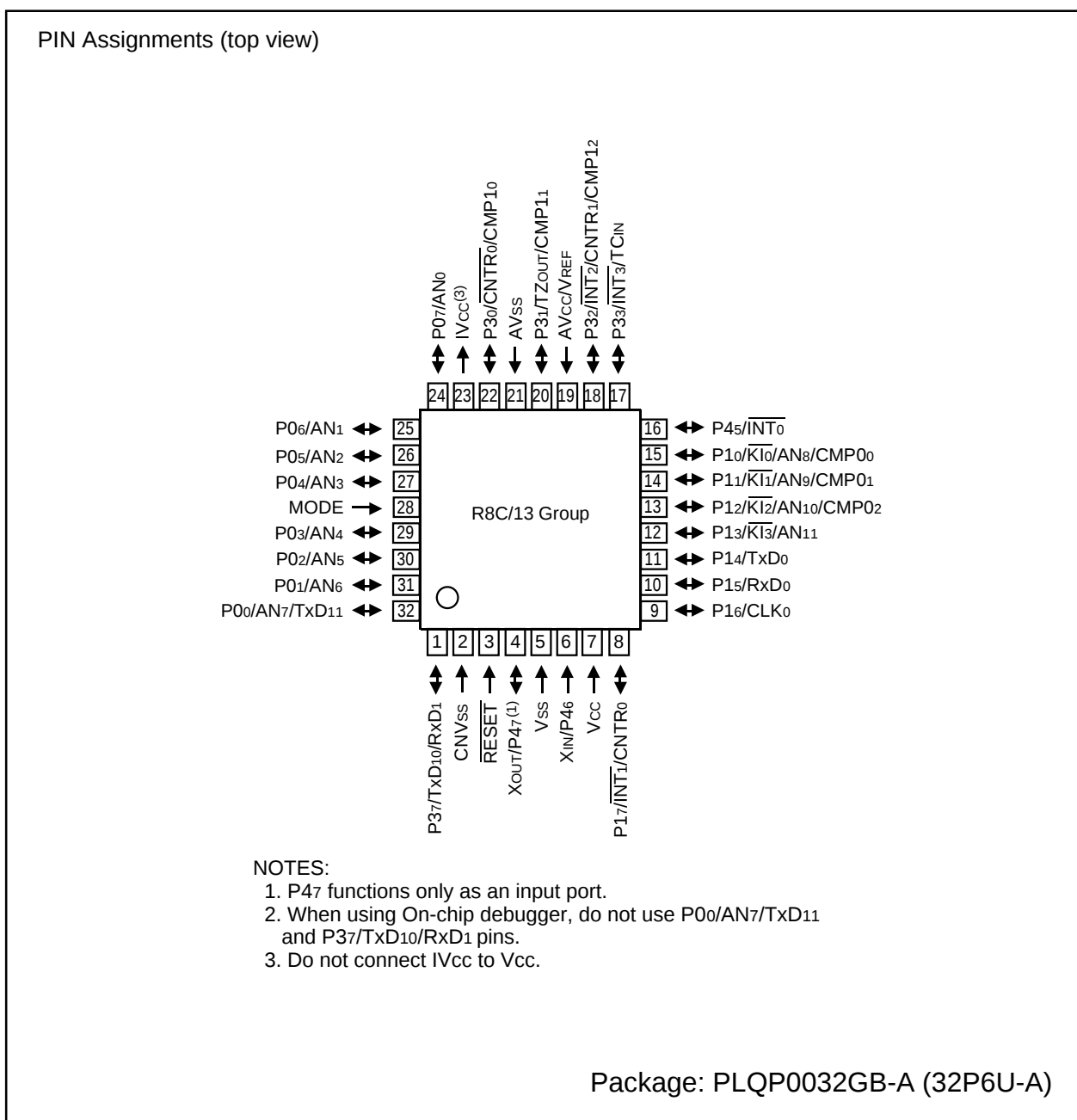


Figure 1.3 Pin Assignments (Top View)

1.6 Pin Description

Table 1.3 shows the pin description

Table 1.3 Pin description

Signal name	Pin name	I/O type	Function
Power supply input	Vcc, Vss	I	Apply 2.7 V to 5.5 V to the Vcc pin. Apply 0 V to the Vss pin.
IVcc	IVcc	O	This pin is to stabilize internal power supply. Connect this pin to Vss via a capacitor (0.1 μ F). Do not connect to Vcc.
Analog power supply input	AVcc, AVss	I	Power supply input pins for A/D converter. Connect the AVcc pin to Vcc. Connect the AVss pin to Vss. Connect a capacitor between pins AVcc and AVss.
Reset input	$\overline{\text{RESET}}$	I	Input "L" on this pin resets the MCU.
CNVss	CNVss	I	Connect this pin to Vss via a resistor.
MODE	MODE	I	Connect this pin to Vcc via a resistor.
Main clock input	XIN	I	These pins are provided for the main clock generating circuit I/O. Connect a ceramic resonator or a crystal oscillator between the XIN and XOUT pins. To use an externally derived clock, input it to the XIN pin and leave the XOUT pin open.
Main clock output	XOUT	O	
INT interrupt input	INT0 to INT3	I	INT interrupt input pins.
Key input interrupt input	KI0 to KI3	I	Key input interrupt pins.
Timer X	CNTR0	I/O	Timer X I/O pin
	CNTR0	O	Timer X output pin
Timer Y	CNTR1	I/O	Timer Y I/O pin
Timer Z	TZOUT	O	Timer Z output pin
Timer C	TCIN	I	Timer C input pin
	CMP00 to CMP02, CMP10 to CMP12	O	The timer C output pins
Serial interface	CLK0	I/O	Transfer clock I/O pin.
	RxD0, RxD1	I	Serial data input pins.
	TxD0, TxD10, TxD11	O	Serial data output pins.
Reference voltage input	VREF	I	Reference voltage input pin for A/D converter. Connect the VREF pin to Vcc.
A/D converter	AN0 to AN11	I	Analog input pins for A/D converter
I/O port	P00 to P07, P10 to P17, P30 to P33, P37, P45	I/O	These are 8-bit CMOS I/O ports. Each port has an I/O select direction register, allowing each pin in that port to be directed for input or output individually. Any port set to input can select whether to use a pull-up resistor or not by program. P10 to P17 also function as LED drive ports.
Input port	P46, P47	I	Port for input-only

2. Central Processing Unit (CPU)

Figure 2.1 shows the CPU Register. The CPU contains 13 registers. Of these, R0, R1, R2, R3, A0, A1 and FB comprise a register bank. Two sets of register banks are provided.

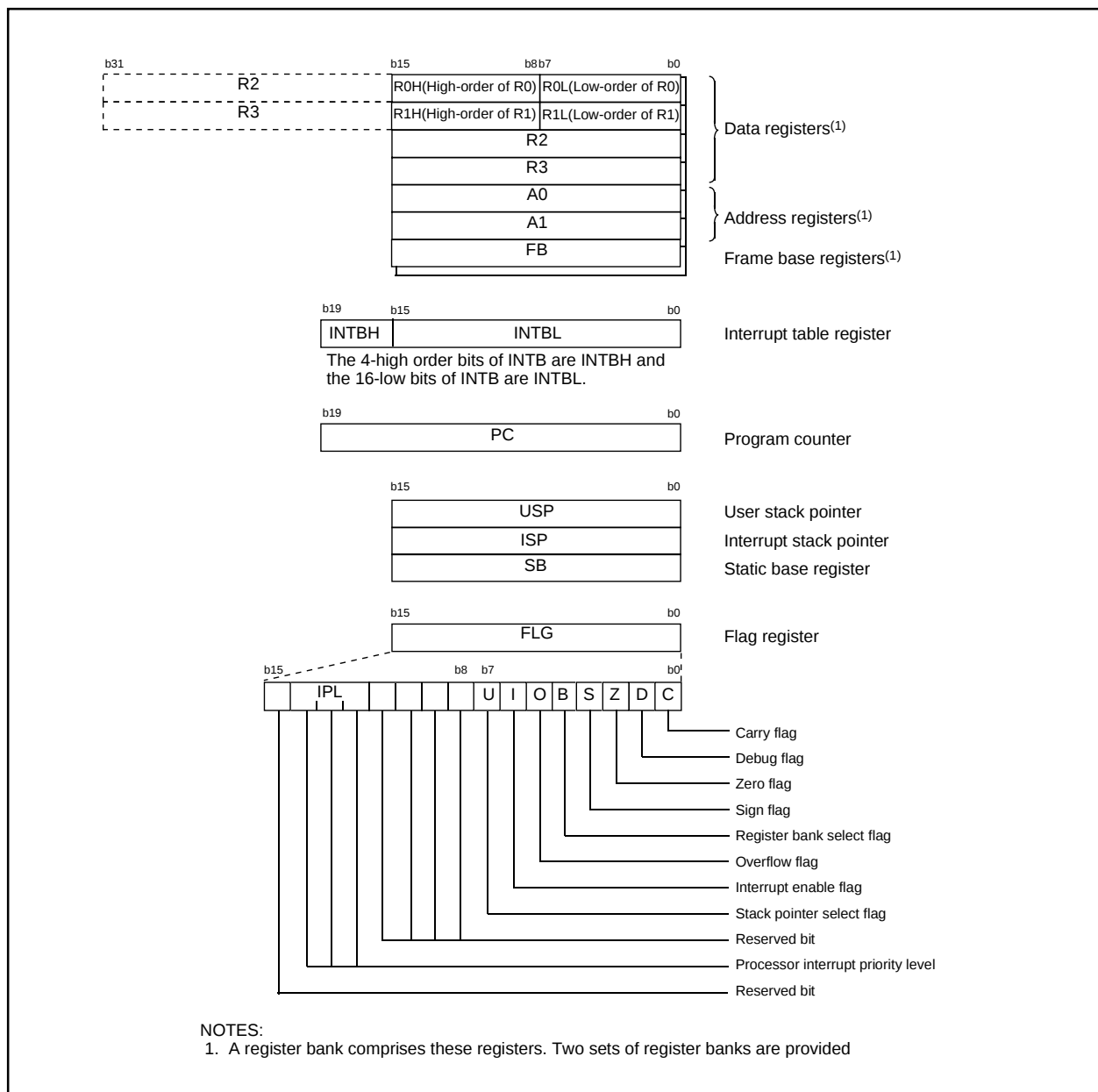


Figure 2.1 CPU Register

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

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

3. Memory

Figure 3.1 is a memory map of this MCU. This MCU provides 1-Mbyte address space from addresses 00000₁₆ to FFFFF₁₆.

The internal ROM (program ROM) is allocated lower addresses beginning with address 0FFFF₁₆. For example, a 16-Kbyte internal ROM is allocated addresses from 0C000₁₆ to 0FFFF₁₆.

The fixed interrupt vector table is allocated addresses 0FFDC₁₆ to 0FFFF₁₆. They store the starting address of each interrupt routine.

The internal ROM (data flash) is allocated addresses from 02000₁₆ to 02FFF₁₆.

The internal RAM is allocated higher addresses beginning with address 00400₁₆. For example, a 1-Kbyte internal RAM is allocated addresses 00400₁₆ to 007FF₁₆. The internal RAM is used not only for storing data, but for calling subroutines and stacks when interrupt request is acknowledged.

Special function registers (SFR) are allocated addresses 00000₁₆ to 002FF₁₆. The peripheral function control registers are located there. All addresses, which have nothing allocated within the SFR, are reserved area and cannot be accessed by users.

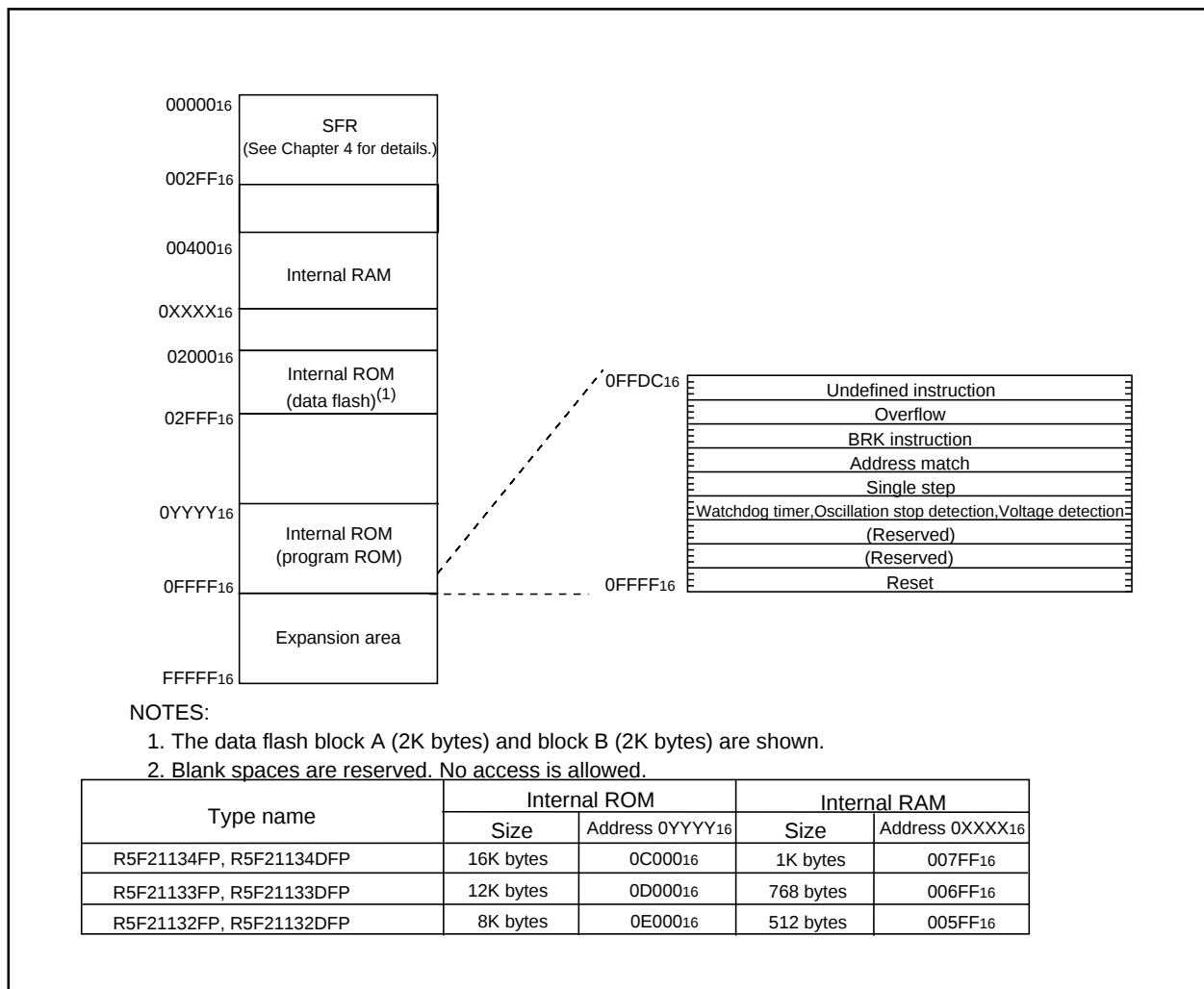


Figure 3.1 Memory Map

Table 4.3 SFR Information(3)(1)

Address	Register	Symbol	After reset
0080 ₁₆	Timer Y, Z mode register	TYZMR	0016
0081 ₁₆	Prescaler Y register	PREY	FF16
0082 ₁₆	Timer Y secondary register	TYSC	FF16
0083 ₁₆	Timer Y primary register	TYPR	FF16
0084 ₁₆	Timer Y, Z waveform output control register	PUM	0016
0085 ₁₆	Prescaler Z register	PREZ	FF16
0086 ₁₆	Timer Z secondary register	TZSC	FF16
0087 ₁₆	Timer Z primary register	TZPR	FF16
0088 ₁₆			
0089 ₁₆			
008A ₁₆	Timer Y, Z output control register	TYZOC	0016
008B ₁₆	Timer X mode register	TXMR	0016
008C ₁₆	Prescaler X register	PREX	FF16
008D ₁₆	Timer X register	TX	FF16
008E ₁₆	Count source set register	TCSS	0016
008F ₁₆			
0090 ₁₆	Timer C register	TC	0016
0091 ₁₆			0016
0092 ₁₆			
0093 ₁₆			
0094 ₁₆			
0095 ₁₆			
0096 ₁₆	External input enable register	INTEN	0016
0097 ₁₆			
0098 ₁₆	Key input enable register	KIEN	0016
0099 ₁₆			
009A ₁₆	Timer C control register 0	TCC0	0016
009B ₁₆	Timer C control register 1	TCC1	0016
009C ₁₆	Capture, compare 0 register	TM0	0016
009D ₁₆			0016 ⁽²⁾
009E ₁₆	Compare 1 register	TM1	FF16
009F ₁₆			FF16
00A0 ₁₆	UART0 transmit/receive mode register	U0MR	0016
00A1 ₁₆	UART0 bit rate register	U0BRG	XX16
00A2 ₁₆	UART0 transmit buffer register	U0TB	XX16
00A3 ₁₆			XX16
00A4 ₁₆	UART0 transmit/receive control register 0	U0C0	000010002
00A5 ₁₆	UART0 transmit/receive control register 1	U0C1	000000102
00A6 ₁₆	UART0 receive buffer register	U0RB	XX16
00A7 ₁₆			XX16
00A8 ₁₆	UART1 transmit/receive mode register	U1MR	0016
00A9 ₁₆	UART1 bit rate register	U1BRG	XX16
00AA ₁₆	UART1 transmit buffer register	U1TB	XX16
00AB ₁₆			XX16
00AC ₁₆	UART1 transmit/receive control register 0	U1C0	000010002
00AD ₁₆	UART1 transmit/receive control register 1	U1C1	000000102
00AE ₁₆	UART1 receive buffer register	U1RB	XX16
00AF ₁₆			XX16
00B0 ₁₆	UART transmit/receive control register 2	UCON	0016
00B1 ₁₆			
00B2 ₁₆			
00B3 ₁₆			
00B4 ₁₆			
00B5 ₁₆			
00B6 ₁₆			
00B7 ₁₆			
00B8 ₁₆			
00B9 ₁₆			
00BA ₁₆			
00BB ₁₆			
00BC ₁₆			
00BD ₁₆			
00BE ₁₆			
00BF ₁₆			

X : Undefined

NOTES:

1. Blank spaces are reserved. No access is allowed.

2. When output compare mode (the TCC13 bit in the TCC1 register = 1) is selected, the value after reset is set to "FFFF16".

Table 4.4 SFR Information(4)(1)

Address	Register	Symbol	After reset
00C0 ₁₆ 00C1 ₁₆	AD register	AD	XX16 XX16
00C2 ₁₆			
00C3 ₁₆			
00C4 ₁₆			
00C5 ₁₆			
00C6 ₁₆			
00C7 ₁₆			
00C8 ₁₆			
00C9 ₁₆			
00CA ₁₆			
00CB ₁₆			
00CC ₁₆			
00CD ₁₆			
00CE ₁₆			
00CF ₁₆			
00D0 ₁₆			
00D1 ₁₆			
00D2 ₁₆			
00D3 ₁₆			
00D4 ₁₆ 00D5 ₁₆	AD control register 2	ADCON2	0016
00D6 ₁₆ 00D7 ₁₆	AD control register 0	ADCON0	00000XXX2
00D8 ₁₆ 00D9 ₁₆	AD control register 1	ADCON1	0016
00DA ₁₆			
00DB ₁₆			
00DC ₁₆			
00DD ₁₆			
00DE ₁₆			
00DF ₁₆			
00E0 ₁₆ 00E1 ₁₆	Port P0 register	P0	XX16
00E2 ₁₆ 00E3 ₁₆	Port P1 register	P1	XX16
00E4 ₁₆ 00E5 ₁₆	Port P0 direction register	PD0	0016
00E6 ₁₆ 00E7 ₁₆	Port P1 direction register	PD1	0016
00E8 ₁₆			
00E9 ₁₆ 00EA ₁₆	Port P3 register	P3	XX16
00EB ₁₆ 00EC ₁₆			
00ED ₁₆ 00EE ₁₆	Port P3 direction register	PD3	0016
00EF ₁₆ 00F0 ₁₆	Port P4 register	P4	XX16
00F1 ₁₆ 00F2 ₁₆			
00F3 ₁₆ 00F4 ₁₆	Port P4 direction register	PD4	0016
00F5 ₁₆			
00F6 ₁₆			
00F7 ₁₆			
00F8 ₁₆			
00F9 ₁₆			
03FA ₁₆			
00FB ₁₆			
00FC ₁₆ 00FD ₁₆	Pull-up control register 0	PUR0	00XX00002
00FE ₁₆ 00FF ₁₆	Pull-up control register 1	PUR1	XXXXXX0X2
	Port P1 drive capacity control register	DRR	0016
	Timer C output control register	TCOUT	0016
01B3 ₁₆ 01B4 ₁₆	Flash memory control register 4	FMR4	010000002
01B5 ₁₆ 01B6 ₁₆	Flash memory control register 1	FMR1	1000000X2
01B7 ₁₆	Flash memory control register 0	FMR0	000000012
0FFF ₁₆	Option function select register(2)	OFS	(Note 2)

X : Undefined

NOTES:

1. Blank columns, 0100₁₆ to 01B2₁₆ and 01B8₁₆ to 02FF₁₆ are all reserved. No access is allowed.

2. The watchdog timer control bit is assigned. Refer to "Figure11.2 OFS, WDC, WDTR and WDTS registers" of Hardware Manual for details

5. Electrical Characteristics

Table 5.1 Absolute Maximum Ratings

Symbol	Parameter	Condition	Rated value	Unit
V _{CC}	Supply voltage	V _{CC} =AV _{CC}	-0.3 to 6.5	V
AV _{CC}	Analog supply voltage	V _{CC} =AV _{CC}	-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	300	mW
T _{opr}	Operating ambient temperature		-20 to 85 / -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		2.7	—	5.5	V
AV _{CC}	Analog supply voltage		—	V _{CC} (3)	—	V
V _{SS}	Supply voltage		—	0	—	V
AV _{SS}	Analog supply voltage		—	0	—	V
V _{IH}	"H" input voltage		0.8V _{CC}	—	V _{CC}	V
V _{IL}	"L" input voltage		0	—	0.2V _{CC}	V
I _{OH} (sum)	"H" peak all output currents	Sum of all pins' I _{OH} (peak)	—	—	-60.0	mA
I _{OH} (peak)	"H" peak output current		—	—	-10.0	mA
I _{OH} (avg)	"H" average output current		—	—	-5.0	mA
I _{OL} (sum)	"L" peak all output currents	Sum of all pins' I _{OL} (peak)	—	—	60	mA
I _{OL} (peak)	"L" peak output current	Except P10 to P17	—	—	10	mA
		P10 to P17	—	—	30	mA
		Drive ability LOW	—	—	10	mA
I _{OL} (avg)	"L" average output current	Except P10 to P17	—	—	5	mA
		P10 to P17	—	—	15	mA
		Drive ability LOW	—	—	5	mA
f (X _{IN})	Main clock input oscillation frequency	3.0V ≤ V _{CC} ≤ 5.5V	0	—	20	MHz
		2.7V ≤ V _{CC} < 3.0V	0	—	10	MHz

NOTES:

1. V_{CC} = AV_{CC} = 2.7 to 5.5V at T_{opr} = -20 to 85 °C / -40 to 85 °C, unless otherwise specified.
2. The typical values when average output current is 100ms.
3. Hold V_{CC}=AV_{CC}.

Table 5.5 Flash Memory (Data flash Block A, Block B) Electrical Characteristics⁽⁴⁾

Symbol	Parameter	Measuring condition	Standard			Unit
			Min.	Typ.	Max	
—	Program/Erase endurance ⁽²⁾		10000 ⁽³⁾	—	—	times
—	Byte program time(program/erase endurance ≤1000 times)		—	50	400	μs
—	Byte program time(program/erase endurance >1000 times)		—	65	—	μs
—	Block erase time(program/erase endurance ≤1000 times)		—	0.2	9	s
—	Block erase time(program/erase endurance >1000 times)		—	0.3	—	s
t _d (SR-ES)	Time delay from Suspend Request until Erase Suspend		—	—	8	ms
—	Erase Suspend Request Interval		10	—	—	ms
—	Program, Erase Voltage		2.7	—	5.5	V
—	Read Voltage		2.7	—	5.5	V
—	Program/Erase Temperature		-20(-40) ⁽⁸⁾	—	85	°C
—	Data hold time ⁽⁹⁾	Ambient temperature = 55 °C	20	—	—	year

NOTES:

1. Referenced to V_{cc}=AV_{cc}=2.7 to 5.5V at Topr = -20°C to 85°C / -40°C to 85°C unless otherwise specified.
2. Definition of Program/Erase
The endurance of Program/Erase shows a time for each block.
If the program/erase number is “n” (n = 1000, 10000), “n” times erase can be performed for each block.
For example, if performing one-byte write to the distinct addresses on Block A of 2K-byte block 2048 times and then erasing that block, the number of Program/Erase cycles is one time.
However, performing multiple writes to the same address before an erase operation is prohibited (overwriting prohibited).
3. Numbers of Program/Erase cycles for which all electrical characteristics is guaranteed.
4. Table 5.5 applies for Block A or B when the Program/Erase cycles are more than 1000. The byte program time up to 1000 cycles are the same as that of the program area (see Table 5.4).
5. To reduce the number of Program/Erase cycles, a block erase should ideally be performed after writing in series as many distinct addresses (only one time each) as possible. If programming a set of 16 bytes, write up to 128 sets and then erase them one time. This will result in ideally reducing the number of Program/Erase cycles. Additionally, averaging the number of Program/Erase cycles for Block A and B will be more effective. It is important to track the total number of block erases and restrict the number.
6. If error occurs during block erase, attempt to execute the clear status register command, then the block erase command at least three times until the erase error disappears.
7. Customers desiring Program/Erase failure rate information should contact their Renesas technical support representative.
8. -40 °C for D version.
9. The data hold time includes time that the power supply is off or the clock is not supplied.

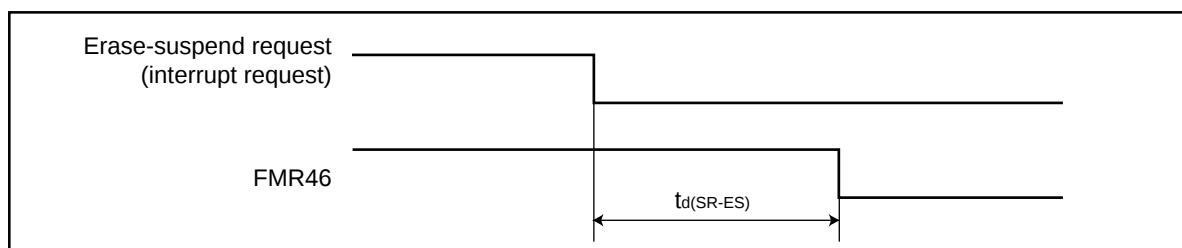
**Figure 5.2 Time delay from Suspend Request until Erase Suspend**

Table 5.6 Voltage Detection Circuit Electrical Characteristics

Symbol	Parameter	Measuring condition	Standard			Unit
			Min.	Typ.	Max.	
Vdet	Voltage detection level		3.3	3.8	4.3	V
	Voltage detection interrupt request generating time ⁽²⁾			40		μs
	Voltage detection circuit self consumption current	VC27=1, VCC=5.0V		600		nA
td(E-A)	Waiting time until voltage detection circuit operation starts ⁽³⁾				20	μs
Vccmin	Microcomputer operation voltage minimum value		2.7			V

NOTES:

1. The measuring condition is Vcc=AVcc=2.7V to 5.5V and Topr=-40°C to 85°C.
2. This shows the time until the voltage detection interrupt request is generated since the voltage passes Vdet.
3. This shows the required time until the voltage detection circuit operates when setting to "1" again after setting the VC27 bit in the VCR2 register to "0".

Table 5.7 Reset Circuit Electrical Characteristics (When Using Hardware Reset 2^(1, 3))

Symbol	Parameter	Measuring condition	Standard			Unit
			Min.	Typ.	Max.	
Vpor2	Power-on reset valid voltage	-20°C ≤ Topr < 85°C	—	—	Vdet	V
tw(Vpor2-Vdet)	Supply voltage rising time when power-on reset is canceled ⁽²⁾	-20°C ≤ Topr < 85°C, tw(por2) ≥ 0s ⁽⁴⁾	—	—	100	ms

NOTES:

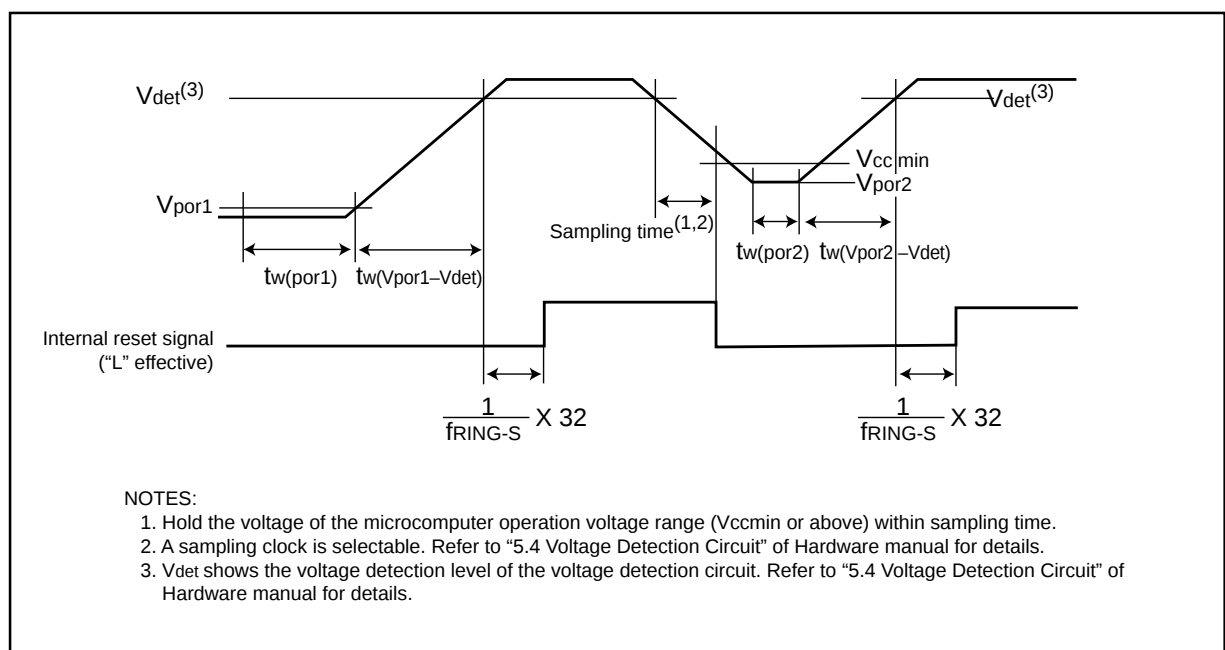
1. The voltage detection circuit which is embedded in a microcomputer is a factor to generate the hardware reset 2. Refer to 5.1.2 Hardware Reset 2 of Hardware Manual for details.
2. This condition is not applicable when using Vcc ≥ 1.0V.
3. When turning power on after the external power has been held below the valid voltage (Vpor1) for greater than 10 seconds, refer to Table 5.8 Reset Circuit Electrical Characteristics (When Not Using Hardware Reset 2).
4. tw(por2) is time to hold the external power below effective voltage (Vpor2).

Table 5.8 Reset Circuit Electrical Characteristics (When Not Using Hardware Reset 2)

Symbol	Parameter	Measuring condition	Standard			Unit
			Min.	Typ.	Max.	
Vpor1	Power-on reset valid voltage	-20°C ≤ Topr < 85°C	—	—	0.1	V
tW(Vpor1-Vdet)	Supply voltage rising time when power-on reset is canceled	0°C ≤ Topr ≤ 85°C, tw(por1) ≥ 10s ⁽²⁾	—	—	100	ms
tW(Vpor1-Vdet)	Supply voltage rising time when power-on reset is canceled	-20°C ≤ Topr < 0°C, tw(por1) ≥ 30s ⁽²⁾	—	—	100	ms
tW(Vpor1-Vdet)	Supply voltage rising time when power-on reset is canceled	-20°C ≤ Topr < 0°C, tw(por1) ≥ 10s ⁽²⁾	—	—	1	ms
tW(Vpor1-Vdet)	Supply voltage rising time when power-on reset is canceled	0°C ≤ Topr ≤ 85°C, tw(por1) ≥ 1s ⁽²⁾	—	—	0.5	ms

NOTES:

1. When not using hardware reset 2, use with Vcc ≥ 2.7V.
2. tw(por1) is time to hold the external power below effective voltage (Vpor1).

**Figure 5.3 Reset Circuit Electrical Characteristics**

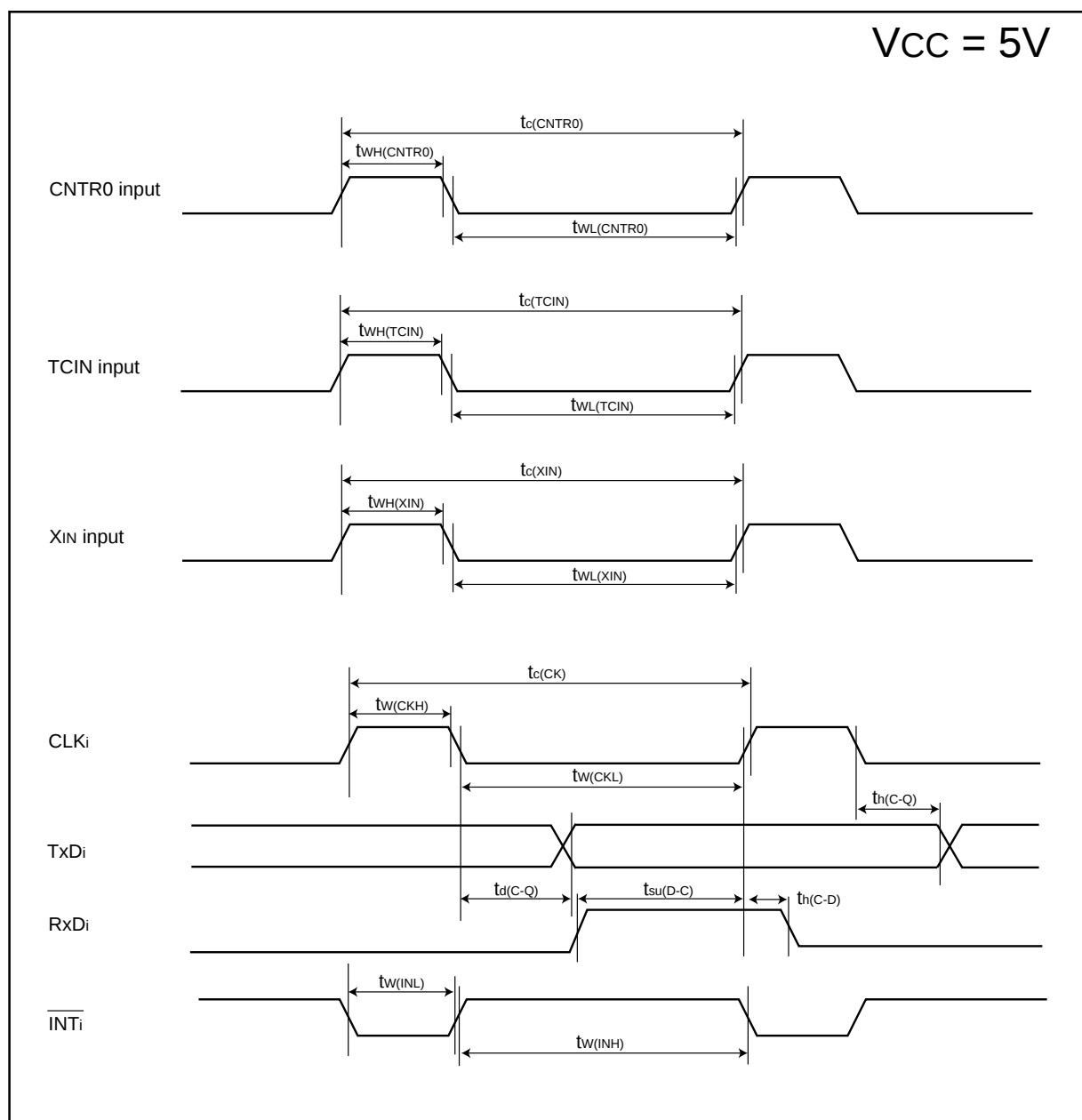
Figure 5.4 $V_{CC}=5V$ timing diagram

Table 5.18 Electrical Characteristics (3) [Vcc=3V]

Symbol	Parameter		Measuring condition		Standard			Unit
					Min.	Typ.	Max.	
VOH	"H" output voltage	Except XOUT	IOH=-1mA		Vcc-0.5	—	Vcc	V
		XOUT	Drive capacity HIGH	IOH=-0.1 mA	Vcc-0.5	—	Vcc	V
			Drive capacity LOW	IOH=-50 μA	Vcc-0.5	—	Vcc	V
VOL	"L" output voltage	Except P10 to P17, XOUT	IOL= 1 mA		—	—	0.5	V
		P10 to P17	Drive capacity HIGH	IOL= 2 mA	—	—	0.5	V
			Drive capacity LOW	IOL= 1 mA	—	—	0.5	V
		XOUT	Drive capacity HIGH	IOL= 0.1 mA	—	—	0.5	V
			Drive capacity LOW	IOL=50 μA	—	—	0.5	V
VT+·VT-	Hysteresis	INT0, INT1, INT2, INT3, KI0, KI1, KI2, KI3, CNTR0, CNTR1, TCIN, RxD0, RxD1, P45			0.2	—	0.8	V
		RESET			0.2	—	1.8	V
IIH	"H" input current		VI=3V		—	—	4.0	μA
IIL	"L" input current		VI=0V		—	—	-4.0	μA
RPULLUP	Pull-up resistance		VI=0V		66	160	500	kΩ
RXIN	Feedback resistance	XIN			—	3.0	—	MΩ
fRING-S	Low-speed on-chip oscillator frequency				40	125	250	kHz
V _{RAM}	RAM retention voltage		At stop mode		2.0	—	—	V

NOTES:

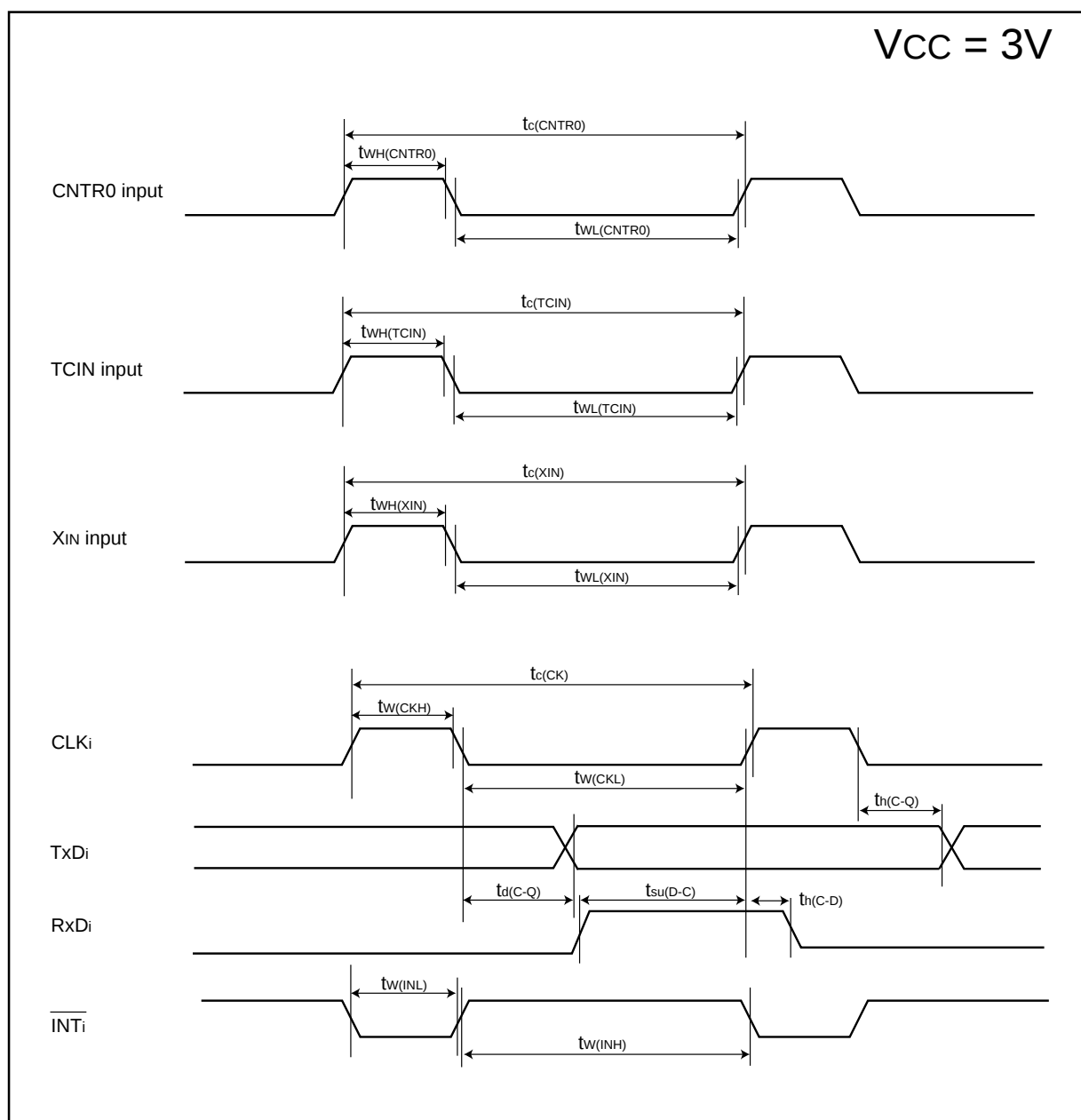
1. Referenced to Vcc = AVcc = 2.7 to 3.3V at Topr = -20 to 85 °C / -40 to 85 °C, f(XIN)=10MHz unless otherwise specified.

Table 5.19 Electrical Characteristics (4) [Vcc=3V]

Symbol	Parameter	Measuring condition	Standard			Unit
			Min.	Typ.	Max.	
I _{CC}	Power supply current (V _{CC} =2.7 to 3.3V) In single-chip mode, the output pins are open and other pins are V _{SS}	High-speed mode X _{IN} =20 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz No division	—	8	13	mA
		X _{IN} =16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz No division	—	7	12	mA
		X _{IN} =10 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz No division	—	5	—	mA
		Medium-speed mode X _{IN} =20 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz Division by 8	—	3	—	mA
		X _{IN} =16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz Division by 8	—	2.5	—	mA
		X _{IN} =10 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz Division by 8	—	1.6	—	mA
		High-speed on-chip oscillator mode Main clock off High-speed on-chip oscillator on=8 MHz Low-speed on-chip oscillator on=125 kHz No division	—	3.5	7.5	mA
		Main clock off High-speed on-chip oscillator on=8 MHz Low-speed on-chip oscillator on=125 kHz Division by 8	—	1.5	—	mA
		Low-speed on-chip oscillator mode Main clock off High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz Division by 8	—	420	800	μA
		Wait mode Main clock off High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz When a WAIT instruction is executed ⁽¹⁾ Peripheral clock operation VC27="0"	—	37	74	μA
		Wait mode Main clock off High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz When a WAIT instruction is executed ⁽¹⁾ Peripheral clock off VC27="0"	—	35	70	μA
		Stop mode Main clock off, Topr=-25 °C High-speed on-chip oscillator off Low-speed on-chip oscillator off CM10="1" Peripheral clock off VC27="0"	—	0.7	3.0	μA

NOTES:

1. Timer Y is operated with timer mode.
2. Referenced to V_{CC} = AV_{CC} = 2.7 to 3.3V at Topr = -20 to 85 °C / -40 to 85 °C, f(X_{IN})=10MHz unless otherwise specified.

Figure 5.5 $V_{CC}=3V$ timing diagram

REVISION HISTORY	R8C/13 Group Datasheet
------------------	------------------------

Rev.	Date	Description	
		Page	Summary
0.10	Oct 28, 2003		First edition issued
0.20	Dec05, 2003	5	Figure 1.3 revised
		10	Chapter 4, NOTES revised
		16	Table 5.4 revised Table 5.5 revised
		17	Table 5.6 revised Figure 5.3 added
		18	Table 5.8 revised Table 5.10 revised
		21	Figure 5.3 revised to Figure 5.4
		22	Table 5.17 revised
		25	Figure 5.4 revised to Figure 5.5
1.00	Sep 30, 2004	All pages	Words standardized (on-chip oscillator, serial interface, A/D)
		2	Table 1.1 revised
		5	Figure 1.3, NOTES 3 added
		6	Table 1.3 revised
		9	Figure 3.1, NOTES added
		10-13	One body sentence in chapter 4 added ; Titles of Table 4.1 to 4.4 added
		12	Table 4.3 revised ; Table 4.4 revised
		14	Table 5.2 revised
		15	Table 5.3 revised
		16	Table 5.4 and Table 5.5 revised
		17	Table 5.6, 5.7 and 5.8 revised ; Figure 5.3 revised
		18	Table 5.9 and 5.11 revised
		19	Table 5.12 revised
		20	Table 5.13 revised
		22	Table 5.18 revised
		23	Table 5.19 revised
		24	Table 5.20 and Table 5.24 revised
1.10	Apr.27.2005	4	Table 1.2, Figure 1.2 package name revised
		5	Figure 1.3 package name revised
		10	Table 4.1 revised
		12	Table 4.3 revised
		15	Table 5.3 partly revised
		16	Table 5.4, Table 5.5 partly added

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

Keep safety first in your circuit designs!

1. Renesas Technology Corp. puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.
Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corp. product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corp. or a third party.
2. Renesas Technology Corp. assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corp. without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor for the latest product information before purchasing a product listed herein.
The information described here may contain technical inaccuracies or typographical errors.
Renesas Technology Corp. assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
Please also pay attention to information published by Renesas Technology Corp. by various means, including the Renesas Technology Corp. Semiconductor home page (<http://www.renesas.com>).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corp. assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corp. semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corp. is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corp. for further details on these materials or the products contained therein.



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 205, AZIA Center, No.133 Yincheng Rd (n), Pudong District, Shanghai 200120, China
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7898

Renesas Technology Hong Kong Ltd.

7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2730-6071

Renesas Technology Taiwan Co., Ltd.

10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

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, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510