1. Overview

This MCU is built using the high-performance silicon gate CMOS process using a R8C/Tiny Series CPU core and is packaged in a 32-pin plastic molded LQFP. This MCU operates using sophisticated instructions featuring a high level of instruction efficiency. With 1M bytes of address space, it is capable of executing instructions at high speed.

1.1 Applications

Electric household appliance, office equipment, housing equipment (sensor, security), general industrial equipment, audio, etc.

1.2 Performance Outline

Table 1.1. lists the performance outline of this MCU.

Table 1.1 Performance outline

Item		Performance
CPU	Number of basic instructions	89 instructions
	Shortest instruction execution time	50 ns (f(XIN) = 20 MHz, VCC = 3.0 to 5.5 V) 100 ns (f(XIN) = 10 MHz, VCC = 2.7 to 5.5 V)
	Operating mode	Single-chip
	Address space	1M bytes
	Memory capacity	See Table 1.2.
Peripheral function	Interrupt	Internal: 11 factors, External: 5 factors, Software: 4 factors, Priority level: 7 levels
	Watchdog timer	15 bits x 1 (with prescaler)
	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
	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	Stop detection of main clock oscillation
	Voltage detection circuit	Included
	Power on reset circuit	Included
	Port	Input/Output: 22 (including LED drive port), Input: 2 (LED drive I/O port: 8)
Electrical characteristics	Power supply voltage	VCC = 3.0 to 5.5 V (f(XIN) = 20 MHz) VCC = 2.7 to 5.5 V (f(XIN) = 10 MHz)
	Power consumption	Typ. 9 mA (VCC = 5.0 V, (f(XIN) = 20 MHz, High-speed mode) Typ. 5 mA (VCC = 3.0 V, (f(XIN) = 10 MHz, High-speed mode) Typ. 35 µA (VCC = 3.0 V, Wait mode, Peripheral clock stops) Typ. 0.7 µA (VCC = 3.0 V, Stop mode)
Flash memory	Program/erase voltage	VCC = 2.7 to 5.5 V
	Number of program/erase	100 times
Operating ambient temperature		-20 to 85 °C -40 to 85 °C (D-version)
Package		32-pin plastic mold LQFP

1.3 Block Diagram

Figure 1.1 shows this MCU block diagram.

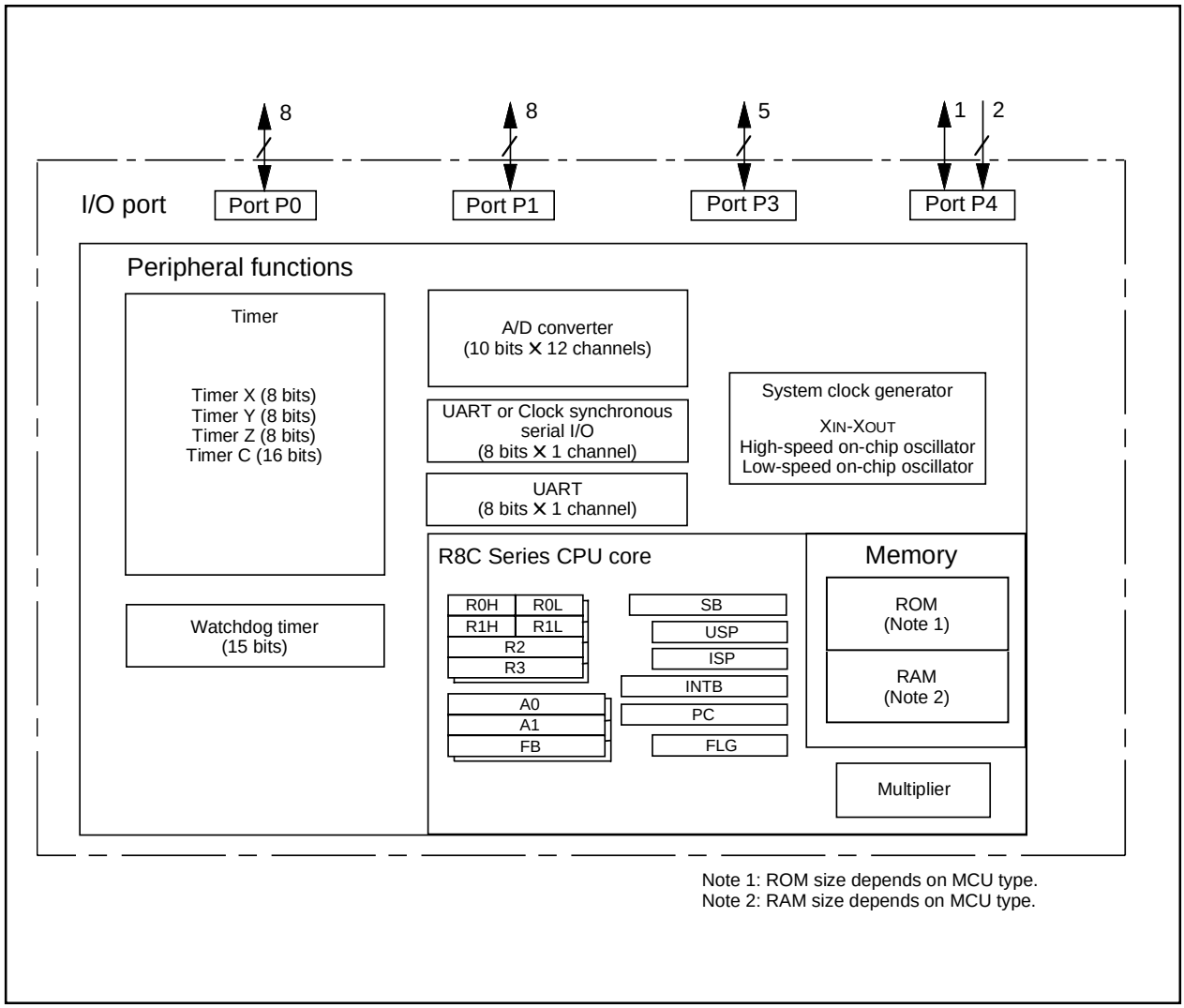


Figure 1.1 Block Diagram

1.4 Product List

Table 1.2 lists the products.

Table 1.2 Product List

As of Sep. 2004

Type No.	ROM capacity	RAM capacity	Package type	Remarks
R5F21112FP	8K bytes	512 bytes	32P6U-A	Flash memory version
R5F21113FP	12K bytes	768 bytes	32P6U-A	
R5F21114FP	16K bytes	1K bytes	32P6U-A	
R5F21112DFP	8K bytes	512 bytes	32P6U-A	D version
R5F21113DFP	12K bytes	768 bytes	32P6U-A	
R5F21114DFP	16K bytes	1K bytes	32P6U-A	

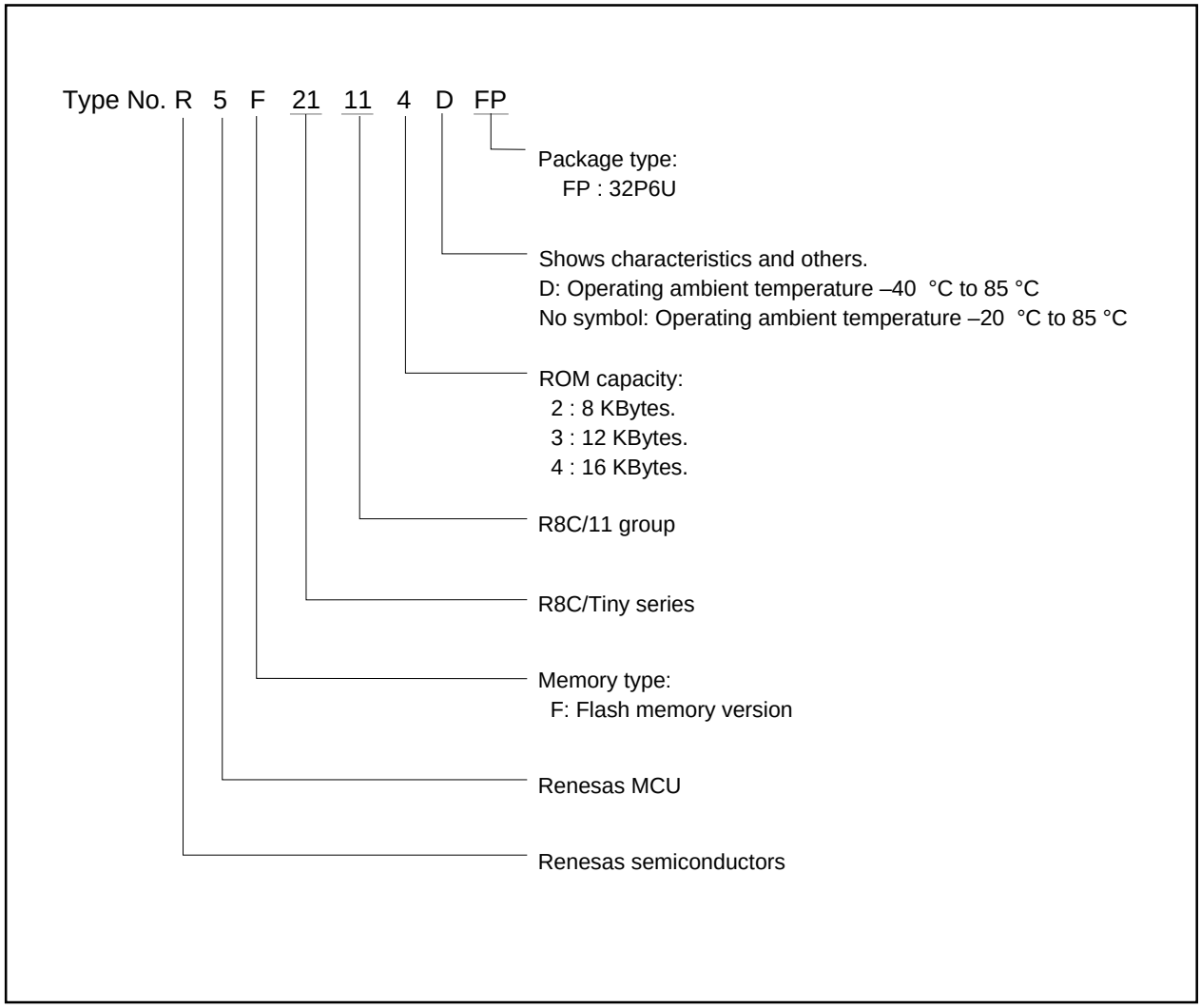


Figure 1.2 Type No., Memory Size, and Package

1.5 Pin Configuration

Figure 1.3 shows the pin configuration (top view).

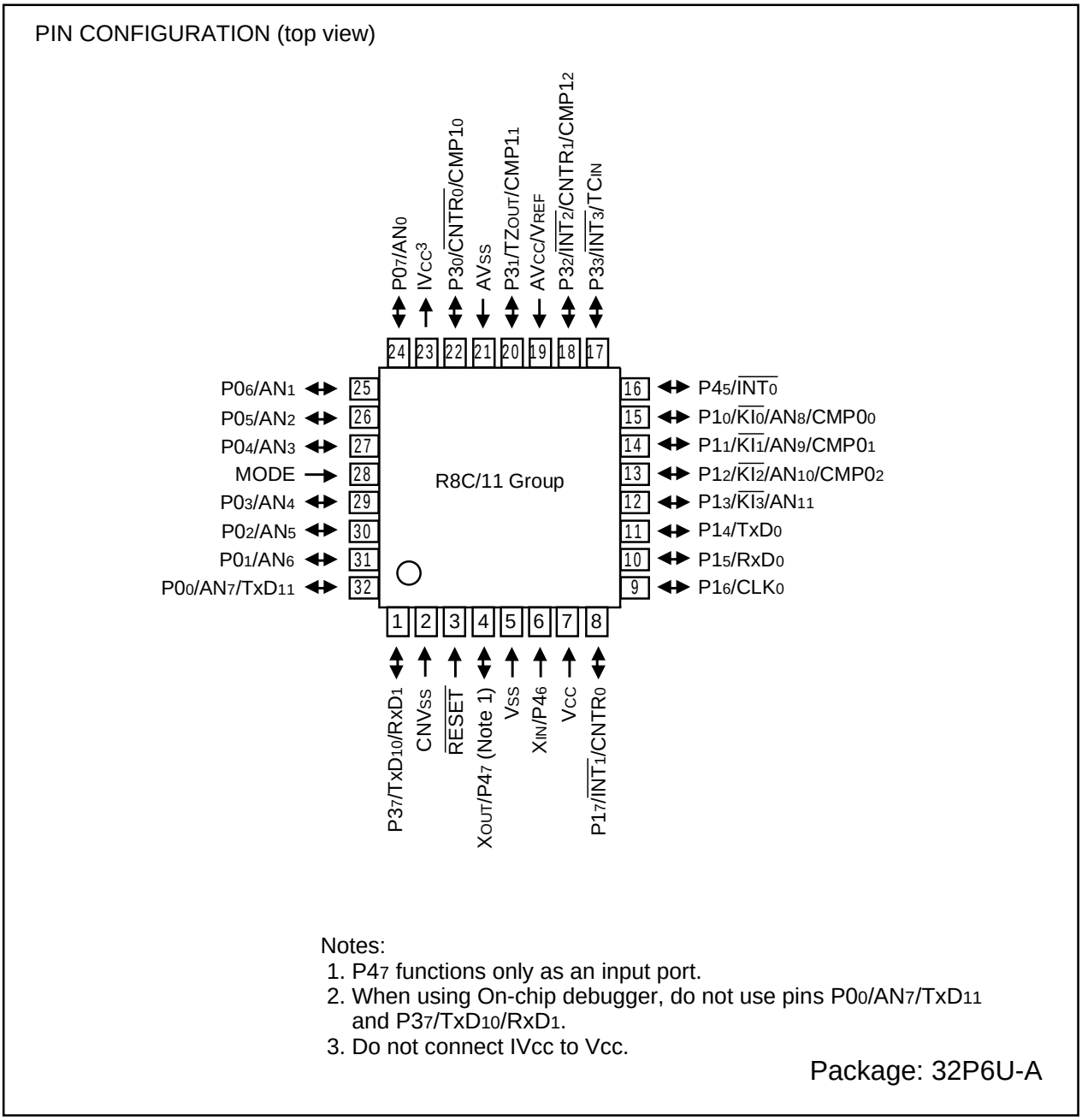


Figure 1.3 Pin Configuration (Top View)

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 µF). Do not connect to Vcc.
Analog power supply input	AVcc, AVss	I	These are power supply input pins for A/D converter. Connect the AVss pin to Vss. Connect a capacitor between pins AVcc and AVss.
Reset input	$\overline{\text{RESET}}$	I	"L" on this input 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	
$\overline{\text{INT}}$ interrupt input	$\overline{\text{INT0}}$ to $\overline{\text{INT3}}$	I	These are $\overline{\text{INT}}$ interrupt input pins.
Key input interrupt	$\overline{\text{KI0}}$ to $\overline{\text{KI3}}$	I	These are key input interrupt pins.
Timer X	CNTR0	I/O	This is the timer X I/O pin.
	$\overline{\text{CNTR0}}$	O	This is the timer X output pin.
Timer Y	CNTR1	I/O	This is the timer Y I/O pin.
Timer Z	TZOUT	O	This is the timer Z output pin.
Timer C	TCIN	I	This is the timer C input pin.
	CMP00 to CMP03, CMP10 to CMP13	O	These are the timer C output pins.
Serial interface	CLK0	I/O	This is a transfer clock I/O pin.
	RxD0, RxD1	I	These are serial data input pins.
	TxD0, TxD10, TxD11	O	These are serial data output pins.
Reference voltage input	VREF	I	This is a reference voltage input pin for A/D converter.
A/D converter	AN0 to AN11	I	These are 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 input/output 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	These are input only pins.

2. Central Processing Unit (CPU)

Figure 2.1 shows the CPU registers. The CPU has 13 registers. Of these, R0, R1, R2, R3, A0, A1 and FB comprise a register bank. There are two register banks.

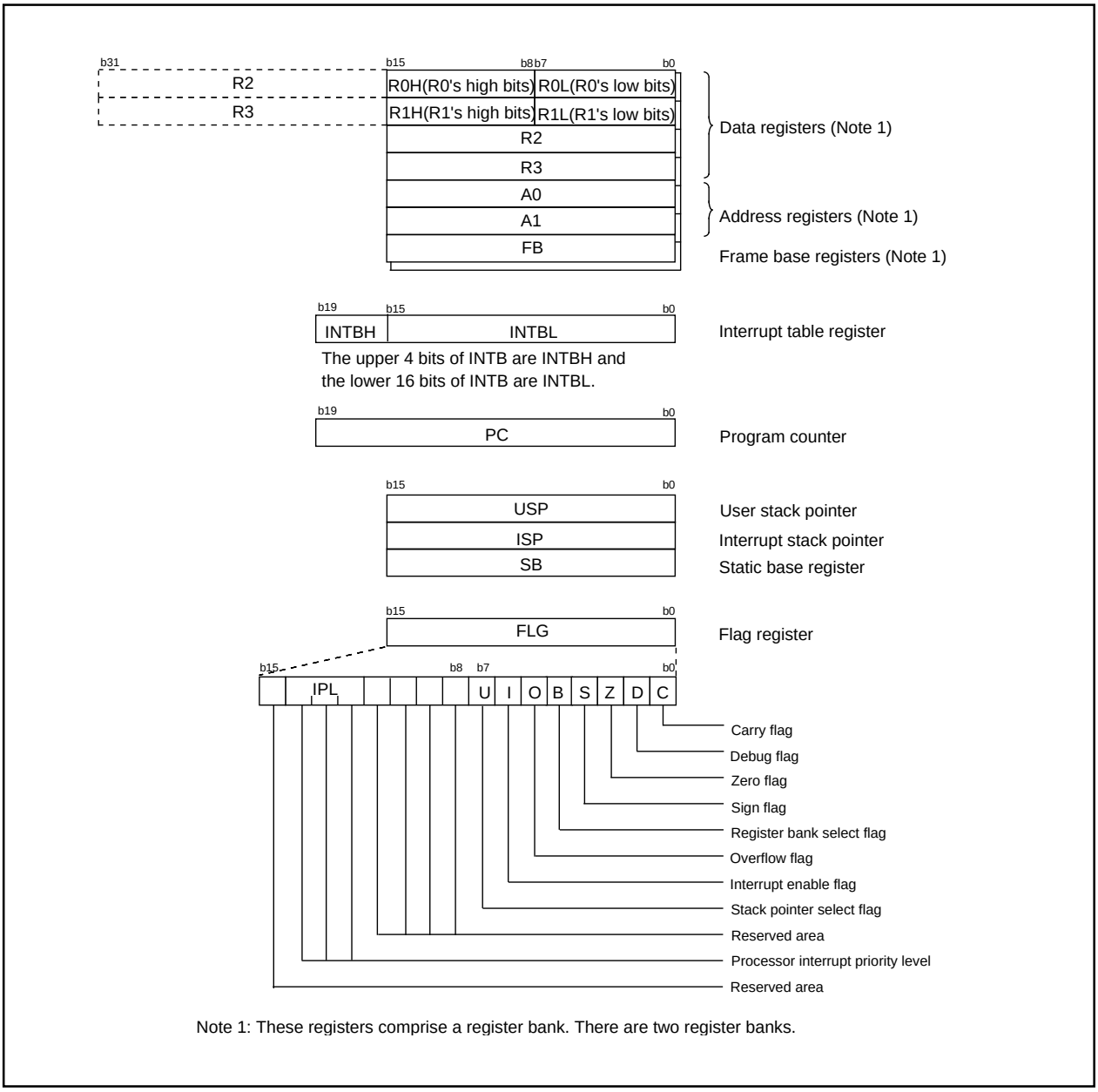


Figure 2.1. Central Processing Unit Register

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

The R0 register consists of 16 bits, and is used mainly for transfers and arithmetic/logic operations. R1 to R3 are the same as R0.

The R0 register can be separated between high (R0H) and low (R0L) for use as two 8-bit data registers. R1H and R1L are the same as R0H and R0L. Conversely, R2 and R0 can be combined for use as a 32-bit data register (R2R0). R3R1 is the same as R2R0.

2.2 Address Registers (A0 and A1)

The register A0 consists of 16 bits, and is used for address register indirect addressing and address register relative addressing. They also are used for transfers and logic/logic operations. A1 is the same as A0.

In some instructions, registers A1 and A0 can be combined for use as a 32-bit address register (A1A0).

2.3 Frame Base Register (FB)

FB is configured with 16 bits, and is used for FB relative addressing.

2.4 Interrupt Table Register (INTB)

INTB is configured with 20 bits, indicating the start address of an interrupt vector table.

2.5 Program Counter (PC)

PC is configured with 20 bits, indicating the address of an instruction to be executed.

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

Stack pointer (SP) comes in two types: USP and ISP, each configured with 16 bits.

Your desired type of stack pointer (USP or ISP) can be selected by the U flag of FLG.

2.7 Static Base Register (SB)

SB is configured with 16 bits, and is used for SB relative addressing.

2.8 Flag Register (FLG)

FLG consists of 11 bits, indicating the CPU status.

2.8.1 Carry Flag (C Flag)

This flag retains a carry, borrow, or shift-out bit that has occurred in the arithmetic/logic unit.

2.8.2 Debug Flag (D Flag)

The D flag is used exclusively for debugging purpose. During normal use, it must be set to “0”.

2.8.3 Zero Flag (Z Flag)

This flag is set to “1” when an arithmetic operation resulted in 0; otherwise, it is “0”.

2.8.4 Sign Flag (S Flag)

This flag is set to “1” when an arithmetic operation resulted in a negative value; otherwise, it is “0”.

2.8.5 Register Bank Select Flag (B Flag)

Register bank 0 is selected when this flag is “0” ; register bank 1 is selected when this flag is “1”.

2.8.6 Overflow Flag (O Flag)

This flag is set to “1” when the operation resulted in an overflow; otherwise, it is “0”.

2.8.7 Interrupt Enable Flag (I Flag)

This flag enables a maskable interrupt.

Maskable interrupts are disabled when the I flag is “0”, and are enabled when the I flag is “1”. The I flag is cleared to “0” when the interrupt request is accepted.

2.8.8 Stack Pointer Select Flag (U Flag)

ISP is selected when the U flag is “0”; USP is selected when the U flag is “1”.

The U flag is cleared to “0” when a hardware interrupt request is accepted or an INT instruction for software interrupt Nos. 0 to 31 is executed.

2.8.9 Processor Interrupt Priority Level (IPL)

IPL is configured with three bits, for specification of up to eight processor interrupt priority levels from level 0 to level 7.

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

2.8.10 Reserved Area

When write to this bit, write "0". When read, its content is indeterminate.

3. Memory

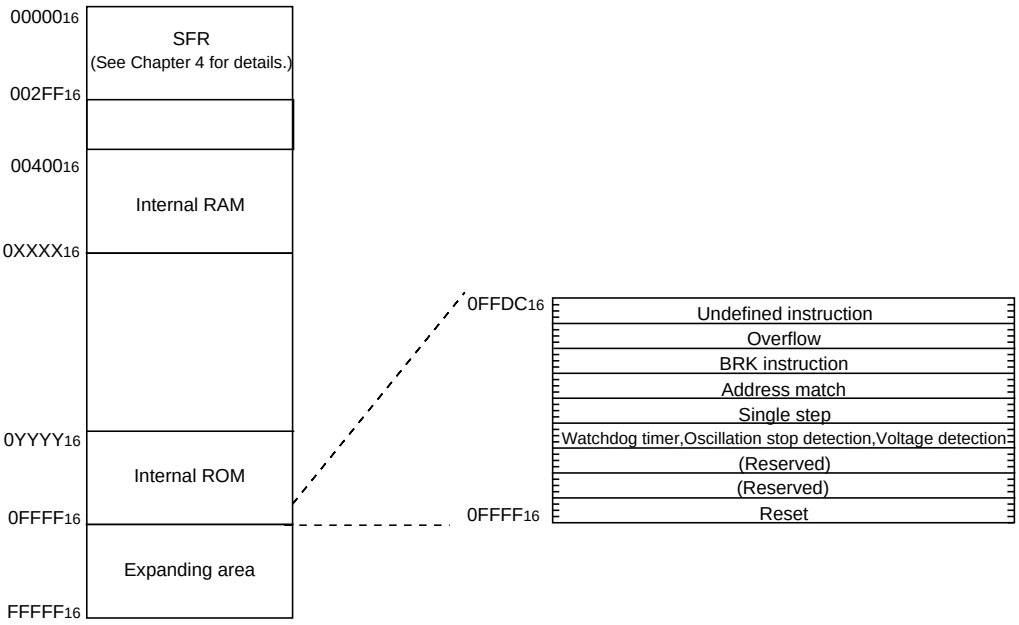
Figure 3.1 is a memory map of this MCU. The address space extends the 1M bytes from address 00000$_{16}$ to FFFFF$_{16}$.

The internal ROM is allocated in a lower address direction beginning with address 0FFFF$_{16}$. For example, a 16-Kbyte internal ROM is allocated to the addresses from 0C000$_{16}$ to 0FFFF$_{16}$.

The fixed interrupt vector table is allocated to the addresses from 0FFDC$_{16}$ to 0FFFF$_{16}$. Therefore, store the start address of each interrupt routine here.

The internal RAM is allocated in an upper address direction beginning with address 00400$_{16}$. For example, a 1-Kbyte internal RAM is allocated to the addresses from 00400$_{16}$ to 007FF$_{16}$. In addition to storing data, the internal RAM also stores the stack used when calling subroutines and when interrupts are generated.

Special function registers (SFR) are allocated to the addresses from 00000$_{16}$ to 002FF$_{16}$. Peripheral function control registers are located here. Of the SFR, any space which has no functions allocated is reserved for future use and cannot be used by users.



NOTES :

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

Type name	Internal ROM		Internal RAM	
	Size	Address 0YYYY$_{16}$	Size	Address 0XXXX$_{16}$
R5F21114FP, R5F21114DFP	16K bytes	0C000$_{16}$	1K bytes	007FF$_{16}$
R5F21113FP, R5F21113DFP	12K bytes	0D000$_{16}$	768 bytes	006FF$_{16}$
R5F21112FP, R5F21112DFP	8K bytes	0E000$_{16}$	512 bytes	005FF$_{16}$

Figure 3.1 Memory Map

4. Special Function Register (SFR)

SFR(Special Function Register) is the control register of peripheral functions. Tables 4.1 to 4.4 list the SFR information

Table 4.1 SFR Information(1)(1)

Address	Register	Symbol	After reset
0000₁₆			
0001₁₆			
0002₁₆			
0003₁₆			
0004₁₆	Processor mode register 0 [1]	PM0	00₁₆
0005₁₆	Processor mode register 1	PM1	00₁₆
0006₁₆	System clock control register 0	CM0	01101000₂
0007₁₆	System clock control register 1	CM1	00100000₂
0008₁₆	High-speed on-chip control register 0	HR0	00₁₆
0009₁₆	Address match interrupt enable register	AIER	XXXXXX00₂
000A₁₆	Protect register	PRCR	00XXX000₂
000B₁₆	High-speed on-chip control register 1	HR1	40₁₆
000C₁₆	Oscillation stop detection register	OCD	00000100₂
000D₁₆	Watchdog timer reset register	WDTR	XX₁₆
000E₁₆	Watchdog timer start register	WDTS	XX₁₆
000F₁₆	Watchdog timer control register	WDC	000XXXXX₂
0010₁₆	Address match interrupt register 0	RMAD0	00₁₆
0011₁₆			00₁₆
0012₁₆			X0₁₆
0013₁₆			
0014₁₆	Address match interrupt register 1	RMAD1	00₁₆
0015₁₆			00₁₆
0016₁₆			X0₁₆
0017₁₆			
0018₁₆			
0019₁₆	Voltage detection register 1 [2]	VCR1	00₁₆
001A₁₆	Voltage detection register 2 [2]	VCR2	XXX00000₁₆
001B₁₆			
001C₁₆			
001D₁₆			
001E₁₆	$\overline{\text{INT0}}$ input filter select register	INT0F	XXXXX000₂
001F₁₆	Voltage detection interrupt register [2]	D4INT	00₁₆ [3] 01000001₂ [4]
0020₁₆			
0021₁₆			
0022₁₆			
0023₁₆			
0024₁₆			
0025₁₆			
0026₁₆			
0027₁₆			
0028₁₆			
0029₁₆			
002A₁₆			
002B₁₆			
002C₁₆			
002D₁₆			
002E₁₆			
002F₁₆			
0030₁₆			
0031₁₆			
0032₁₆			
0033₁₆			
0034₁₆			
0035₁₆			
0036₁₆			
0037₁₆			
0038₁₆			
0039₁₆			
003A₁₆			
003B₁₆			
003C₁₆			
003D₁₆			
003E₁₆			
003F₁₆			

X : Undefined

NOTES:
1. Blank columns are all reserved space. No access is allowed.
2. Software reset or the watchdog timer reset does not affect this register.
3. Owing to Reset input.
4. In the case of $\overline{\text{RESET}}$ pin = H retaining.

Table 4.2 SFR Information(2)(1)

Address	Register	Symbol	After reset
0040₁₆			
0041₁₆			
0042₁₆			
0043₁₆			
0044₁₆			
0045₁₆			
0046₁₆			
0047₁₆			
0048₁₆			
0049₁₆			
004A₁₆			
004B₁₆			
004C₁₆			
004D₁₆	Key input interrupt control register	KUPIC	XXXXX000₂
004E₁₆	A/D conversion interrupt control register	ADIC	XXXXX000₂
004F₁₆			
0050₁₆	Compare 1 interrupt control register	CMP1IC	XXXXX000₂
0051₁₆	UART0 transmit interrupt control register	S0TIC	XXXXX000₂
0052₁₆	UART0 receive interrupt control register	S0RIC	XXXXX000₂
0053₁₆	UART1 transmit interrupt control register	S1TIC	XXXXX000₂
0054₁₆	UART1 receive interrupt control register	S1RIC	XXXXX000₂
0055₁₆	INT2 interrupt control register	INT2IC	XXXXX000₂
0056₁₆	Timer X interrupt control register	TXIC	XXXXX000₂
0057₁₆	Timer Y interrupt control register	TYIC	XXXXX000₂
0058₁₆	Timer Z interrupt control register	TZIC	XXXXX000₂
0059₁₆	INT1 interrupt control register	INT1IC	XXXXX000₂
005A₁₆	INT3 interrupt control register	INT3IC	XXXXX000₂
005B₁₆	Timer C interrupt control register	TCIC	XXXXX000₂
005C₁₆	Compare 0 interrupt control register	CMP0IC	XXXXX000₂
005D₁₆	INT0 interrupt control register	INT0IC	XX00X000₂
005E₁₆			
005F₁₆			
0060₁₆			
0061₁₆			
0062₁₆			
0063₁₆			
0064₁₆			
0065₁₆			
0066₁₆			
0067₁₆			
0068₁₆			
0069₁₆			
006A₁₆			
006B₁₆			
006C₁₆			
006D₁₆			
006E₁₆			
006F₁₆			
0070₁₆			
0071₁₆			
0072₁₆			
0073₁₆			
0074₁₆			
0075₁₆			
0076₁₆			
0077₁₆			
0078₁₆			
0079₁₆			
007A₁₆			
007B₁₆			
007C₁₆			
007D₁₆			
007E₁₆			
007F₁₆			

X : Undefined

NOTES :

1. Blank columns are all reserved space. No access is allowed.

Table 4.3 SFR Information(3)(1)

Address	Register	Symbol	After reset
008016	Timer Y, Z mode register	TYZMR	0016
008116	Prescaler Y	PREY	FF16
008216	Timer Y secondary	TYSC	FF16
008316	Timer Y primary	TYPR	FF16
008416	Timer Y, Z waveform output control register	PUM	0016
008516	Prescaler Z	PREZ	FF16
008616	Timer Z secondary	TZSC	FF16
008716	Timer Z primary	TZPR	FF16
008816			
008916			
008A16	Timer Y, Z output control register	TYZOC	0016
008B16	Timer X mode register	TXMR	0016
008C16	Prescaler X	PREX	FF16
008D16	Timer X register	TX	FF16
008E16	Timer count source setting register	TCSS	0016
008F16			
009016 009116	Timer C register	TC	0016 0016
009216			
009316			
009416			
009516			
009616	External input enable register	INTEN	0016
009716			
009816	Key input enable register	KIEN	0016
009916			
009A16	Timer C control register 0	TCC0	0016
009B16	Timer C control register 1	TCC1	0016
009C16 009D16	Capture, compare 0 register	TM0	FF16 FF16
009E16 009F16	Compare 1 register	TM1	FF16 FF16
00A016	UART0 transmit/receive mode register	U0MR	0016
00A116	UART0 bit rate register	U0BRG	XX16
00A216 00A316	UART0 transmit buffer register	U0TB	XX16 XX16
00A416	UART0 transmit/receive control register 0	U0C0	000010002
00A516	UART0 transmit/receive control register 1	U0C1	000000102
00A616 00A716	UART0 receive buffer register	U0RB	XX16 XX16
00A816	UART1 transmit/receive mode register	U1MR	0016
00A916	UART1 bit rate register	U1BRG	XX16
00AA16 00AB16	UART1 transmit buffer register	U1TB	XX16 XX16
00AC16	UART1 transmit/receive control register 0	U1C0	000010002
00AD16	UART1 transmit/receive control register 1	U1C1	000000102
00AE16 00AF16	UART1 receive buffer register	U1RB	XX16 XX16
00B016	UART transmit/receive control register 2	UCON	0016
00B116			
00B216			
00B316			
00B416			
00B516			
00B616			
00B716			
00B816			
00B916			
00BA16			
00BB16			
00BC16			
00BD16			
00BE16			
00BF16			

X : Undefined
NOTES :
1. Blank columns are all reserved space. No access is allowed.

Table 4.4 SFR Information(4)(1)

Address	Register	Symbol	After reset
00C016	A/D register	AD	XX16
00C116			XX16
00C216			
00C316			
00C416			
00C516			
00C616			
00C716			
00C816			
00C916			
00CA16			
00CB16			
00CC16			
00CD16			
00CE16			
00CF16			
00D016			
00D116			
00D216			
00D316			
00D416	A/D control register 2	ADCON2	0016
00D516			
00D616	A/D control register 0	ADCON0	00000XXX2
00D716	A/D control register 1	ADCON1	0016
00D816			
00D916			
00DA16			
00DB16			
00DC16			
00DD16			
00DE16			
00DF16			
00E016	Port P0 register	P0	XX16
00E116	Port P1 register	P1	XX16
00E216	Port P0 direction register	PD0	0016
00E316	Port P1 direction register	PD1	0016
00E416			
00E516	Port P3 register	P3	XX16
00E616			
00E716	Port P3 direction register	PD3	0016
00E816	Port P4 register	P4	XX16
00E916			
00EA16	Port P4 direction register	PD4	0016
00EB16			
00EC16			
00ED16			
00EE16			
00EF16			
00F016			
00F116			
00F216			
00F316			
00F416			
00F516			
00F616			
00F716			
00F816			
00F916			
03FA16			
00FB16			
00FC16	Pull-up control register 0	PUR0	00XX00002
00FD16	Pull-up control register 1	PUR1	XXXXXX0X2
00FE16	Port P1 drive capacity control register	DRR	0016
00FF16	Timer C output control register	TCOUT	0016
≈			
01B316	Flash memory control register 4	FMR4	010000002
01B416			
01B516	Flash memory control register 1	FMR1	0100XX0X2
01B616			
01B716	Flash memory control register 0	FMR0	000000012

X : Undefined

NOTES :

1. The blank areas, 010016 to 01B216 and 01B816 to 02FF16 are reserved and cannot be used by users.

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	Topr=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
AVcc	Analog supply voltage			—	V_{CC}[3]	—	V
Vss	Supply voltage			—	0	—	V
AVss	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' IOH (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' IOL (peak)		—	—	60	mA
$I_{OL (peak)}$	"L" peak output current	Except P1$_0$ to P1$_7$		—	—	10	mA
		P1$_0$ to P1$_7$	Drive capacity HIGH	—	—	30	mA
			Drive capacity LOW	—	—	10	mA
$I_{OL (avg)}$	"L" average output current	Except P1$_0$ to P1$_7$		—	—	5	mA
		P1$_0$ to P1$_7$	Drive capacity HIGH	—	—	15	mA
			Drive capacity LOW	—	—	5	mA
f (X_{IN})	Main clock input oscillation frequency		3.0V ≤ Vcc ≤ 5.5V	0	—	20	MHz
			2.7V ≤ Vcc < 3.0V	0	—	10	MHz

Note
1: Referenced to V_{CC} = AV$_{CC}$ = 2.7 to 5.5V at Topr = -20 to 85 °C / -40 to 85 °C unless otherwise specified.
2: The mean output current is the mean value within 100ms.
3: Hold Vcc=AVcc.

Table 5.3 A/D Conversion Characteristics

Symbol	Parameter		Measuring condition	Standard			Unit
				Min.	Typ.	Max.	
–	Resolution		V_{ref} =V_{CC}			10	Bit
–	Absolute accuracy	10 bit mode	f(XIN)=øAD=10 MHz, Vref=Vcc=5.0V			±3	LSB
		8 bit mode	f(XIN)=øAD=10 MHz, Vref=Vcc=5.0V			±2	LSB
		10 bit mode	f(XIN)=øAD=10 MHz, Vref=Vcc=3.3V			±5	LSB
		8 bit mode	f(XIN)=øAD=10 MHz, Vref=Vcc=3.3V			±2	LSB
R_{LADDER}	Ladder resistance		V_{REF}=V_{CC}	10		40	kΩ
t_{CONV}	Conversion time	10 bit mode	f(XIN)=øAD=10 MHz, Vref=Vcc=5.0V	3.3			µs
		8 bit mode	f(XIN)=øAD=10 MHz, Vref=Vcc=5.0V	2.8			µs
V_{REF}	Reference voltage				V_{CC}[4]		V
V_{IA}	Analog input voltage			0		V_{ref}	V
–	A/D operation clock frequency[2]	Without sample & hold		0.25		10	MHz
		With sample & hold		1.0		10	MHz

Note
1: Referenced to V_{CC}=AV$_{CC}$=2.7 to 5.5V at Topr = -20 to 85 °C / -40 to 85 °C unless otherwise specified.
2: When f_{AD} is 10 MHz more, divide the f_{AD} and make A/D operation clock frequency (Ø$_{AD}$) lower than 10 MHz.
3: When the Vcc is less than 4.2V, divide the f_{AD} and make A/D operation clock frequency (Ø$_{AD}$) lower than f_{AD}/2.
4: Hold Vcc=Vref.

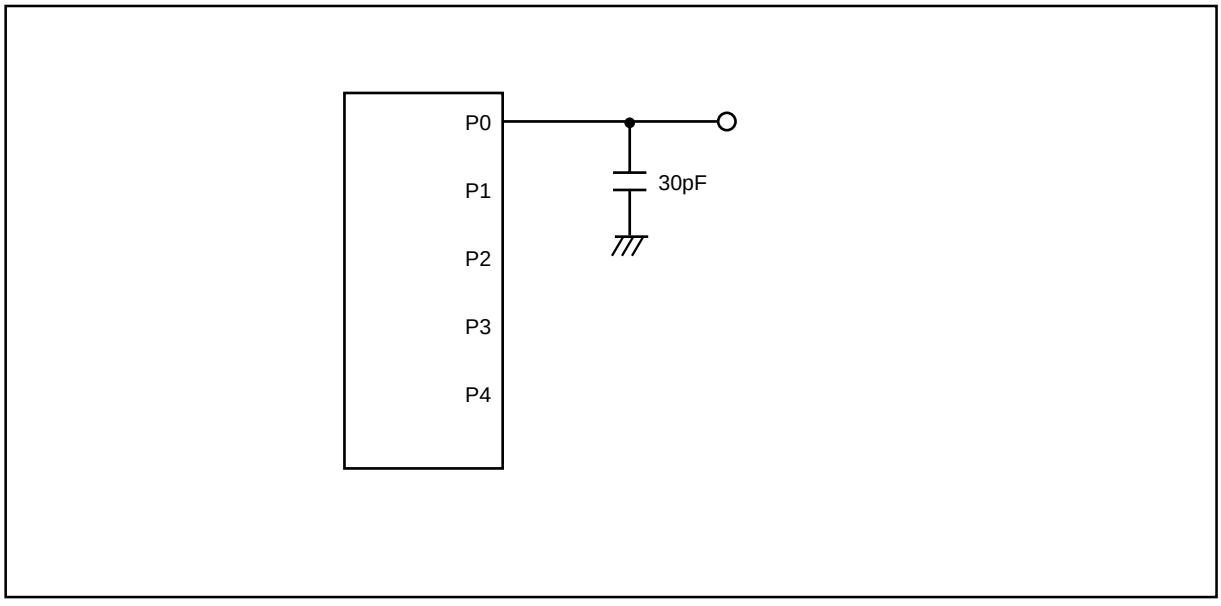


Figure 5.1 Port P0 to P4 measurement circuit

Table 5.4 Flash Memory Version Electrical Characteristics

Symbol	Parameter	Measuring condition	Standard			Unit
			Min.	Typ.	Max	
–	Program/erase cycle		100	—	—	cycle
–	Byte program time	Vcc=5.0V, Topr=25 °C	—	50	400	µs
–	Block erase time	Vcc=5.0V, Topr=25 °C	—	0.4	9	s
td(SR-ES)	Time delay from suspend request until erase suspend		—	—	8	ms
–	Program, Erase voltage		2.7	—	5.5	V
–	Read voltage		2.7	—	5.5	V
–	Program, Erase temperature		0	—	60	°C
–	Data-retention duration	Topr=55 °C	20	—	—	year

Note
1: Referenced to V_{CC1}=AVcc=2.7 to 5.5V at Topr = 0 to 60 °C unless otherwise specified.

Table 5.5 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 till voltage detection circuit operation starts[3]				20	µs
Vccmin	Minimum value of microcomputer operation voltage		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".

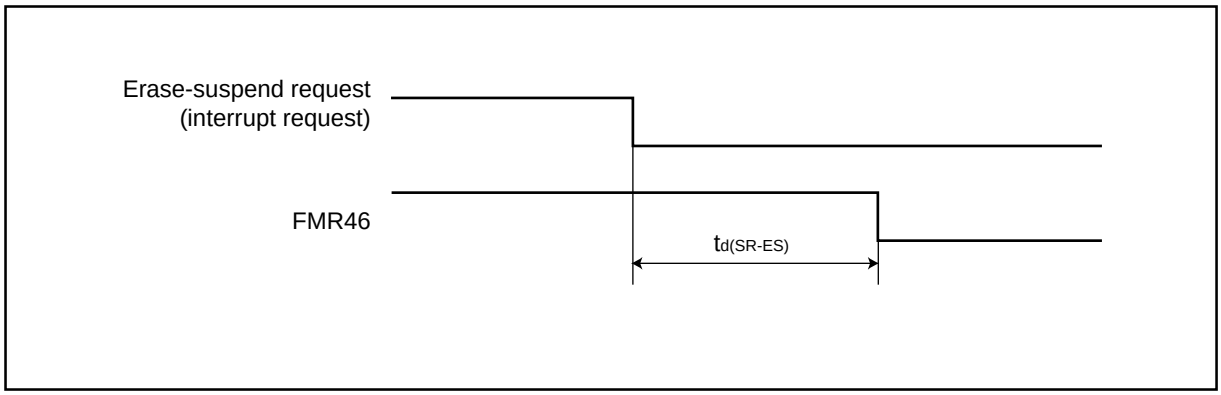


Figure 5.2 Time delay from Suspend Request until Erase Suspend

Table 5.6 Reset Circuit Electrical Characteristics (When Using Hardware Reset 2)

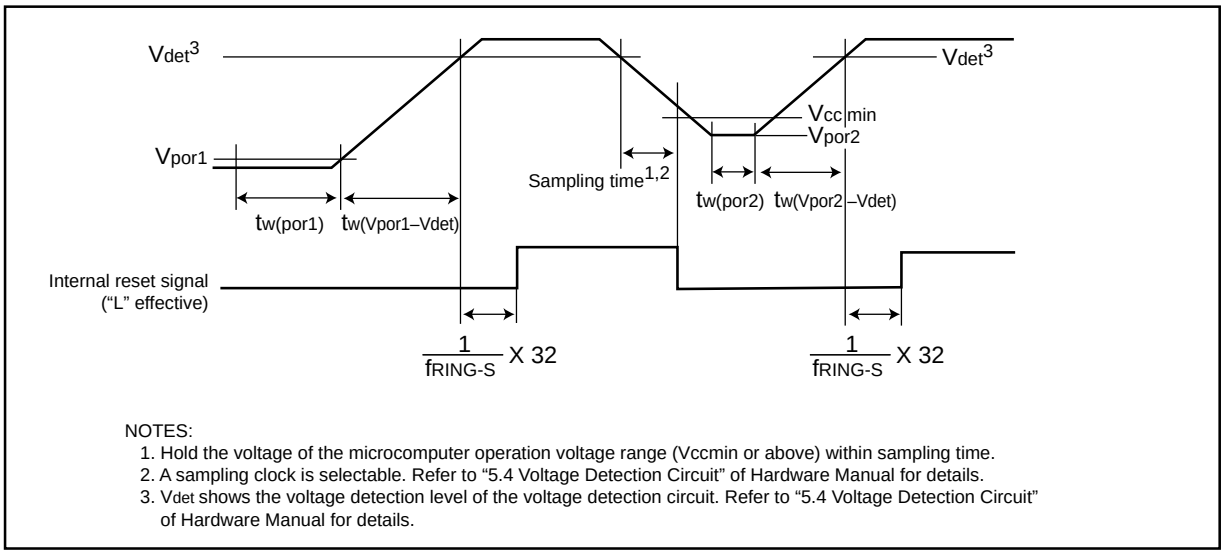
Symbol	Parameter	Measuring condition	Standard			Unit
			Min.	Typ.	Max.	
Vpor2	Power-on reset valid voltage				Vdet	V
tw(Vpor2-Vdet)	Supply voltage rising time when power-on reset is canceled[2]				100	ms
tw(por2)	Time to hold external power below valid voltage		0			s

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.
2. This condition is not applicable when using with Vcc ≥ 1.0V.
3. When turning power on after the time to hold the external power below effective voltage exceeds 10s, refer to Table 16.8 Reset Circuit Electrical Characteristics (When Not Using Voltage Moitor 1 Reset).

Table 5.7 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				0.1	V
tw(Vpor1-Vdet)	Supply voltage rising time when power-on reset is canceled	0°C ≤ Topr ≤ 85°C			100	ms
tw(por1)	Time to hold external power on below valid voltage	0°C ≤ Topr ≤ 85°C	10			s
tw(Vpor1-Vdet)	Supply voltage rising time when power-on reset is canceled	-20°C ≤ Topr ≤ 0°C			100	ms
tw(por1)	Time to hold external power on below valid voltage	-20°C ≤ Topr ≤ 0°C	30			s
tw(Vpor1-Vdet)	Supply voltage rising time when power-on reset is canceled	-20°C ≤ Topr ≤ 0°C			1	ms
tw(por1)	Time to hold external power on below valid voltage	-20°C ≤ Topr ≤ 0°C	10			s
tw(Vpor1-Vdet)	Supply voltage rising time when power-on reset is canceled	0°C ≤ Topr ≤ 85°C			0.5	ms
tw(por1)	Time to hold external power on below valid voltage	0°C ≤ Topr ≤ 85°C	1			s

NOTES:
1. When not the sing hardware reset 2, use with Vcc ≥ 2.7V.



NOTES:
1. Hold the voltage of the microcomputer operation voltage range (Vccmin or above) within sampling time.
2. A sampling clock is selectable. Refer to "5.4 Voltage Detection Circuit" of Hardware Manual for details.
3. Vdet shows the voltage detection level of the voltage detection circuit. Refer to "5.4 Voltage Detection Circuit" of Hardware Manual for details.

Figure 5.3 Reset Circuit Electrical Characteristics

Table 5.8 High-speed On-Chip Oscillator Circuit Electrical Characteristics

Symbol	Parameter	Measuring condition	Standard Min.	Standard Typ.	Standard Max.	Unit
	High-speed on-chip oscillator frequency 1 / {td(HRoffset)+td(HR)} when the reset is released	VCC=5.0V, Topr=25 °C Set "40$_{16}$" in the HR1 register	6	8	10	MHz
td(HRoffset)	Settable high-speed on-chip oscillator minimum period	VCC=5.0V, Topr=25 °C Set "00$_{16}$" in the HR1 register		61		ns
td(HR)	High-speed on-chip oscillator period adjusted unit	Differences when setting "01$_{16}$" and "00$_{16}$" in the HR register		1		ns
	High-speed on-chip oscillator temperature dependence(1)	Frequency fluctuation in temperature range of -10 °C to 50 °C		±5		%
	High-speed on-chip oscillator temperature dependence(2)	Frequency fluctuation in temperature range of -40 °C to 85 °C		±10		%

NOTES:
1. The measuring condition is Vcc=AVcc=5.0 V and Topr=25 °C.

Table 5.9 Power Circuit Timing Characteristics

Symbol	Parameter	Measuring condition	Standard Min.	Standard Typ.	Standard Max.	Unit
td(P-R)	Time for internal power supply stabilization during powering-on[2]				2	ms
td(R-S)	STOP release time[3]				150	µs

Note
1: The measuring condition is Vcc=AVcc=2.7 to 5.5 V and Topr=25 °C.
2: This shows the wait time until the internal power supply generating circuit is stabilized during power-on.
3: This shows the time until BCLK starts from the interrupt acknowledgement to cancel stop mode.

Table 5.10 Electrical Characteristics (1) [Vcc=5V]

Symbol	Parameter		Measuring condition		Standard Min.	Standard Typ.	Standard Max.	Unit
V_{OH}	"H" output voltage	Except X_{OUT}	I_{OH}=-5mA		V_{CC}-2.0		V_{CC}	V
			I_{OH}=-200µA		V_{CC}-0.3		V_{CC}	V
		X_{OUT}	Drive ability HIGH	I_{OH}=-1 mA	V_{CC}-2.0		V_{CC}	V
			Drive ability LOW	I_{OH}=-500µA	V_{CC}-2.0		V_{CC}	V
V_{OL}	"L" output voltage	P10 to P17 Except X_{OUT}	I_{OH}= 5 mA				2.0	V
			I_{OH}= 200 µA				0.45	V
		P10 to P17	Drive capacity HIGH	I_{OL}= 15 mA			2.0	V
			Drive capacity LOW	I_{OL}= 5 mA			2.0	V
			Drive capacity LOW	I_{OL}= 200 µA			0.45	V
		X_{OUT}	Drive capacity HIGH	I_{OL}= 1 mA			2.0	V
			Drive capacity LOW	I_{OL}=500 µA			2.0	V
V_{T+}-V_{T-}	Hysteresis	INT_0, INT_1, INT_2, INT_3, KI_0, KI_1, KI_2, KI_3, $CNTR_0$, $CNTR_1$, TC_{IN}, RxD_0, RxD_1			0.2		1.0	V
		RESET			0.2		2.2	V
I_{IH}	"H" input current		V_I=5V				5.0	µA
I_{IL}	"L" input current		V_I=0V				-5.0	µA
R_{PULLUP}	Pull-up resistance		V_I=0V		30	50	167	kΩ
R_{fXIN}	Feedback resistance	X_{IN}				1.0		MΩ
f_{RING-S}	Low-speed on-chip oscillator frequency				40	125	250	kHz
V_{RAM}	RAM retention voltage		At stop mode		2.0			V

Note
1 : Referenced to V_{CC}=AV_{CC}=4.2 to 5.5V at Topr = -20 to 85 °C / -40 to 85 °C, f(BCLK)=20MHz unless otherwise specified.

Table 5.11 Electrical Characteristics (2) [Vcc=5V]

Symbol	Parameter	Measuring condition		Standard Min.	Standard Typ.	Standard Max.	Unit
Icc	Power supply current (V_{CC}=3.3 to 5.5V) 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		9	15	mA
			X_{IN}=16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz No division		8	14	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		4		mA
			X_{IN}=16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz Division by 8		3		mA
			X_{IN}=10 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on=125 kHz Division by 8		2		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		4	8	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		470	900	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[2] Peripheral clock operation VC27="0"		40	80	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[2] Peripheral clock off VC27="0"		38	76	µA
		Stop mode	Main clock off High-speed on-chip oscillator off Low-speed on-chip oscillator off CM10="1" Peripheral clock off VC27="0"		0.8	3.0	µA

NOTES
1: The power supply current measuring is executed using the measuring program on frash memory.
2: Timer Y is operated with timer mode.

Timing requirements (Unless otherwise noted: VCC = 5V, VSS = 0V at Ta = 25 °C) [VCC=5V]

Table 5.12 XIN input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
tc(XIN)	XIN input cycle time	50		ns
twH(XIN)	XIN input HIGH pulse width	25		ns
twL(XIN)	XIN input LOW pulse width	25		ns

Table 5.13 CNTR0 input, CNTR1 input, $\overline{\text{INT2}}$ input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
tc(CNTR0)	CNTR0 input cycle time	100		ns
twH(CNTR0)	CNTR0 input HIGH pulse width	40		ns
twL(CNTR0)	CNTR0 input LOW pulse width	40		ns

Table 5.14 TCIN input, $\overline{\text{INT3}}$ input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
tc(TCIN)	TCIN input cycle time	400 (1)		ns
twH(TCIN)	TCIN input HIGH pulse width	200 (2)		ns
twL(TCIN)	TCIN input LOW pulse width	200 (2)		ns

NOTES
1 :When using the Timer C input capture mode, adjust the cycle time above (1/ Timer C count source frequency x 3).
2 : When using the Timer C input capture mode, adjust the pulse width above (1/ Timer C count source frequency x 1.5).

Table 5.15 Serial Interface

Symbol	Parameter	Standard		Unit
		Min.	Max.	
tc(CK)	CLKi input cycle time	200		ns
tw(CKH)	CLKi input HIGH pulse width	100		ns
tw(CKL)	CLKi input LOW pulse width	100		ns
td(C-Q)	TxDi output delay time		80	ns
th(C-Q)	TxDi hold time	0		ns
tsu(D-C)	RxDi input setup time	35		ns
th(C-D)	RxDi input hold time	90		ns

Table 5.16 External interrupt $\overline{\text{INT0}}$ input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
tw(INH)	$\overline{\text{INT0}}$ input HIGH pulse width	250 (1)		ns
tw(INL)	$\overline{\text{INT0}}$ input LOW pulse width	250 (2)		ns

NOTES
1 : When selecting the digital filter by the $\overline{\text{INT0}}$ input filter select bit, use the $\overline{\text{INT0}}$ input HIGH pulse width to the greater value,either (1/ digital filter clock frequency x 3) or the minimum value of standard.
2 : When selecting the digital filter by the $\overline{\text{INT0}}$ input filter select bit, use the $\overline{\text{INT0}}$ input LOW pusle width to the greater value,either (1/ digital filter clock frequency x 3) or the minimum value of standard.

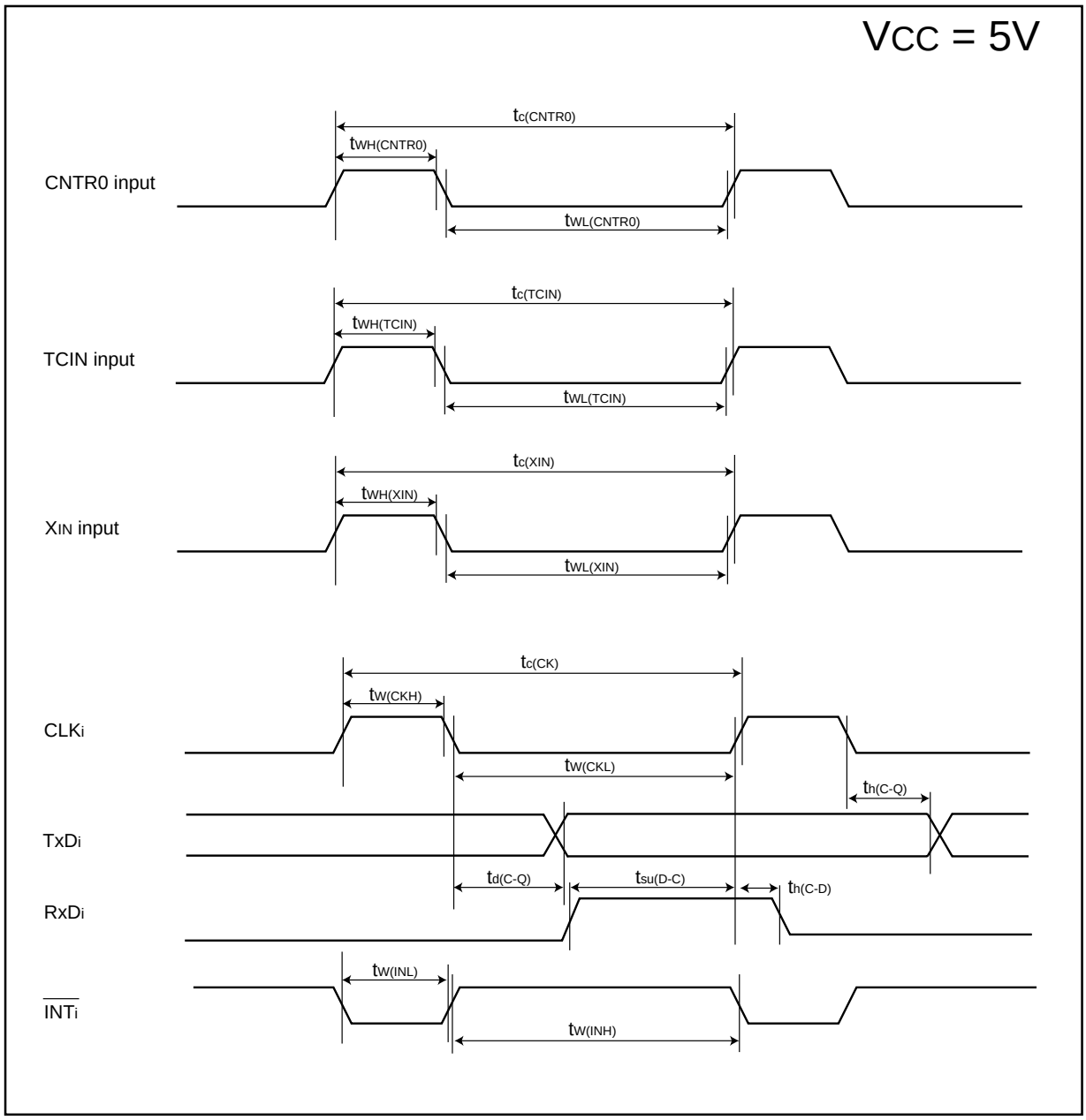


Figure 5.4 Vcc=5V timing diagram

Table 5.17 Electrical Characteristics (3) [Vcc=3V]

Symbol	Parameter		Measuring condition	Standard			Unit
				Min.	Typ.	Max.	
V_{OH}	"H" output voltage	Except X_{OUT}	I_{OH}=-1mA	V_{CC}-0.5		V_{CC}	V
		X_{OUT}	Drive capacity HIGH I_{OH}=-0.1 mA	V_{CC}-0.5		V_{CC}	V
			Drive capacity LOW I_{OH}=-50 µA	V_{CC}-0.5		V_{CC}	V
V_{OL}	"L" output voltage	$P1_0$ to P17 Except X_{OUT}	I_{OH}= 1 mA			0.5	V
		P10 to P17	Drive capacity HIGH I_{OL}= 2 mA			0.5	V
			Drive capacity LOW I_{OL}= 1 mA			0.5	V
		X_{OUT}	Drive capacity HIGH I_{OL}= 0.1 mA			0.5	V
			Drive capacity LOW I_{OL}=50 µA			0.5	V
V_{T+}-V_{T-}	Hysteresis	INT_0, INT_1, INT_2, INT_3, KI_0, KI_1, KI_2, KI_3, $CNTR_0$, $CNTR_1$, TC_{IN}, RxD_0, RxD_1		0.2		0.8	V
		RESET		0.2		1.8	V
I_{IH}	"H" input current		V_I=3V			4.0	µA
I_{IL}	"L" input current		V_I=0V			-4.0	µA
R_{PULLUP}	Pull-up resistance		V_I=0V	66	160	500	kΩ
R_{fXIN}	Feedback resistance	X_{IN}			3.0		MΩ
f_{RING-S}	Low-speed on-chip oscillator frequency			40	125	250	kHz
V_{RAM}	RAM retention voltage		At stop mode	2.0			V

Note
1 : Referenced to V_{CC}=AV_{CC}=2.7 to 3.3V at Topr = -20 to 85 °C / -40 to 85 °C, f(BCLK)=10MHz unless otherwise specified.

Table 5.18 Electrical Characteristics (4) [Vcc=3V]

Symbol	Parameter	Measuring condition		Standard Min.	Standard Typ.	Standard Max.	Unit
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[2] 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[2] Peripheral clock off VC27="0"		35	70	µA
		Stop mode	Main clock off High-speed on-chip oscillator off Low-speed on-chip oscillator off CM10="1" Peripheral clock off VC27="0"		0.7	3.0	µA

Note
1: The power supply current measuring is executed using the measuring program on frash memory.
2: Timer Y is operated with timer mode.

Timing requirements (Unless otherwise noted: VCC = 3V, VSS = 0V at Ta = 25 °C) [VCC=3V]

Table 5.19 XIN input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
tC(XIN)	XIN input cycle time	100		ns
tWH(XIN)	XIN input HIGH pulse width	40		ns
tWL(XIN)	XIN input LOW pulse width	40		ns

Table 5.20 CNTR0 input, CNTR1 input, $\overline{\text{INT2}}$ input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
tC(CNTR0)	CNTR0 input cycle time	300		ns
tWH(CNTR0)	CNTR0 input HIGH pulse width	120		ns
tWL(CNTR0)	CNTR0 input LOW pulse width	120		ns

Table 5.21 TCIN input, $\overline{\text{INT3}}$ input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
tC(TCIN)	TCIN input cycle time	1200 (1)		ns
tWH(TCIN)	TCIN input HIGH pulse width	600 (2)		ns
tWL(TCIN)	TCIN input LOW pulse width	600 (2)		ns

NOTES
1 :When using the Timer C input capture mode, adjust the cycle time above (1/ Timer C count source frequency x 3).
2 : When using the Timer C input capture mode, adjust the pulse width above (1/ Timer C count source frequency x 1.5).

Table 5.22 Serial Interface

Symbol	Parameter	Standard		Unit
		Min.	Max.	
tC(CK)	CLKi input cycle time	300		ns
tW(CKH)	CLKi input HIGH pulse width	150		ns
tW(CKL)	CLKi input LOW pulse width	150		ns
td(C-Q)	TxDi output delay time		160	ns
th(C-Q)	TxDi hold time	0		ns
tsu(D-C)	RxDi input setup time	55		ns
th(C-D)	RxDi input hold time	90		ns

Table 5.23 External interrupt $\overline{\text{INT0}}$ input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
tW(INH)	$\overline{\text{INT0}}$ input HIGH pulse width	380 (1)		ns
tW(INL)	$\overline{\text{INT0}}$ input LOW pulse width	380 (2)		ns

NOTES
1 : When selecting the digital filter by the $\overline{\text{INT0}}$ input filter select bit, use the $\overline{\text{INT0}}$ input HIGH pulse width to the greater value,either (1/ digital filter clock frequency x 3) or the minimum value of standard.
2 : When selecting the digital filter by the $\overline{\text{INT0}}$ input filter select bit, use the $\overline{\text{INT0}}$ input LOW pusle width to the greater value,either (1/ digital filter clock frequency x 3) or the minimum value of standard.

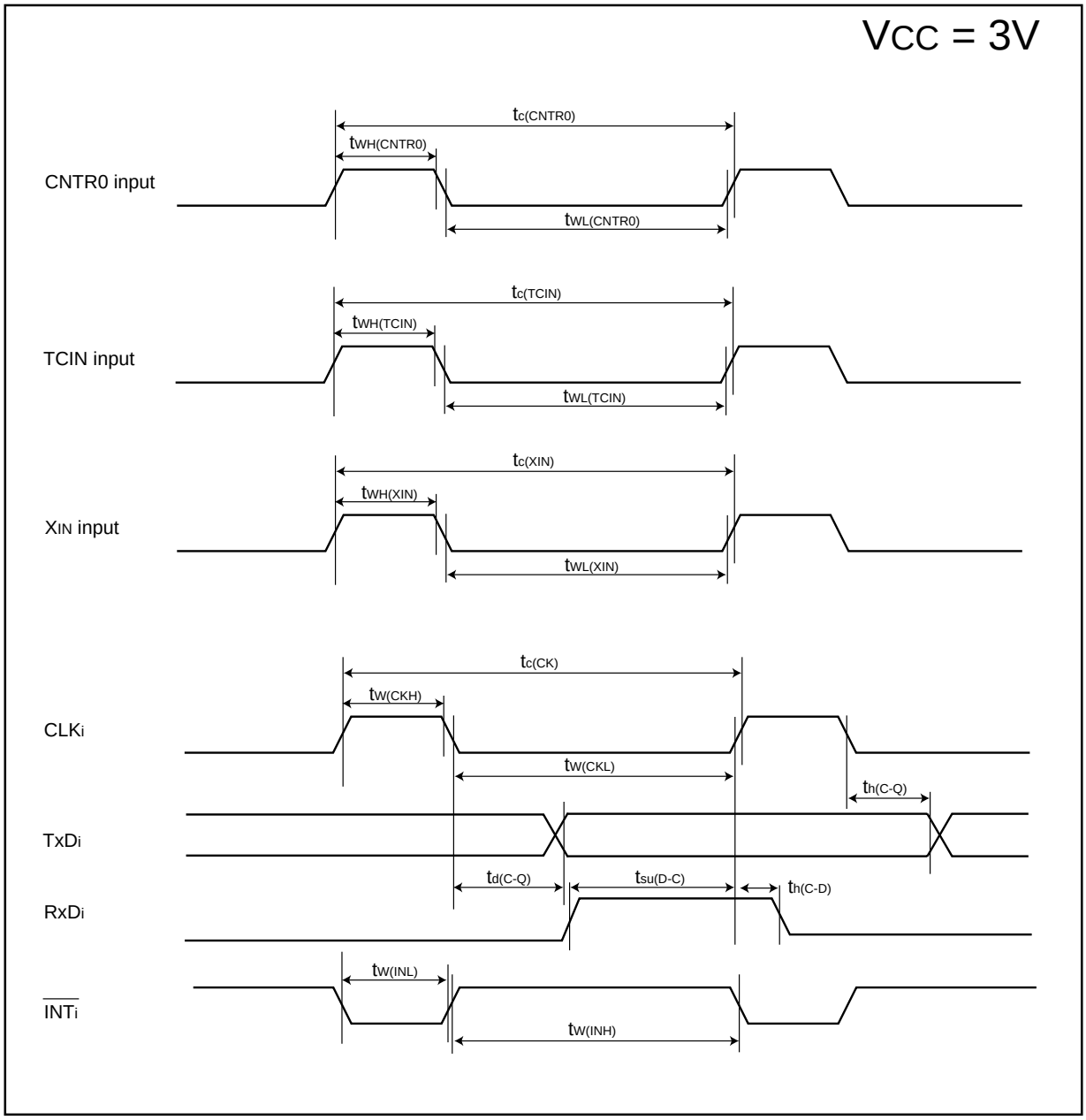


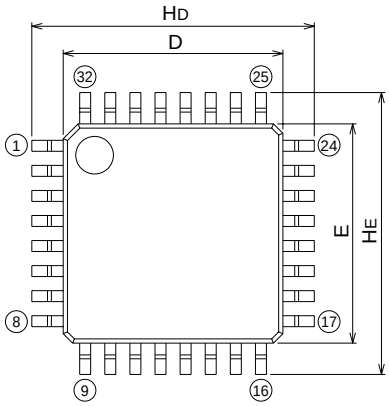
Figure 5.5 Vcc=3V timing diagram

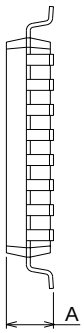
Package Dimensions

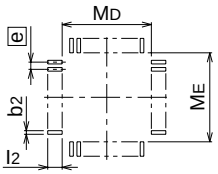
32P6U-A

Plastic 32pin 7×7mm body LQFP

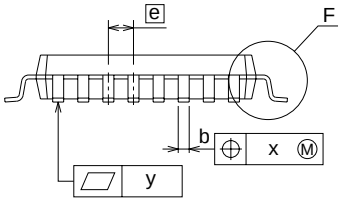
EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
LQFP32-P-0707-0.80	—		Cu Alloy

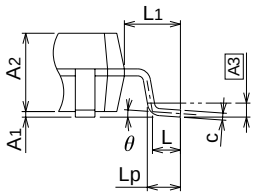






Recommended Mount Pad





Detail F

Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	—	—	1.7
A_1	0	0.1	0.2
A_2	—	1.4	—
b	0.32	0.37	0.45
c	0.105	0.125	0.175
D	6.9	7.0	7.1
E	6.9	7.0	7.1
e	—	0.8	—
H_D	8.8	9.0	9.2
H_E	8.8	9.0	9.2
L	0.3	0.5	0.7
L_1	—	1.0	—
Lp	0.45	0.6	0.75
A3	—	0.25	—
x	—	—	0.2
y	—	—	0.1
θ	0_i	—	10_i
b_2	—	0.5	—
l_2	1.0	—	—
M_D	—	7.4	—
M_E	—	7.4	—

REVISION HISTORY	R8C/11 Group Datasheet

Rev.	Date	Description	
		Page	Summary
1.00	Jun. 19, 2003		First edition issued
1.10	Sep. 08, 2003	2 5 6 10 12 14	Table 1.1: Shortest instruction execution time and f(X_{IN}) changed Figure 1.3: Pin name changed from TX_{OUT} to $\overline{CNTR_0}$ Table 1.3: Pin name changed from TX_{OUT} to $\overline{CNTR_0}$ The value of HR1 register after reset changed The value of TC register after reset changed Chapter “5. Electrical Characteristics” added
1.20	Oct. 31, 2003	2 6 11 14 15 17 19 20 21 22 23 24 25	Table 1.1: Power consumption values added Table 1.3: Resistor value for CNVss and MODE deleted Register name of address 0050_{16} modified from CMP2IC to CMP1IC, register name of address $005C_{16}$ modified from CMP1IC to CMP0IC Table 5.2: Note 3 and Note 4 deleted t_{samp} in Table 5.3 deleted Figure 5.1 added Table 5.10: Vcc changed from “4.2 to 5.5V” to “3.3V to 5.5V”, low-power ring oscillator changed from “on 100kHz” to “125kHz”, X_{IN}=5MHz deleted and X_{IN}=10MHz added in high-speed mode and medium-speed mode, VC27=”0” added in stop mode measuring condition, data added and modified Table 11 to Table 15 added Figure 5.2 added Table 5.16: Note 1, $f_{(BCLK)}$=5 MHz changed to 10 MHz Table 5.17: low-power ring oscillator changed from “on 100kHz” to “125kHz”, X_{IN}=5MHz deleted and X_{IN}=10MHz added in high-speed mode and medium-speed mode, VC27=”0” added in stop mode measuring condition, data added and modified Table 5.18 to Table 5.22 added Figure 5.3 added
1.30	Dec 05, 2003	4 15	Table 1.2 : ** deleted Table 5.4 revised
1.40	Sep 30, 2004	all pages 2 5 6 9 10-13 12 14 15 16 17 18	Words standardized (on-chip oscillator, serial interface, A/D) Table 1.1 revised Figure 1.3, NOTES 3 added Table 1.3 revised Figure 3.1, NOTES added One body sentence in chapter 4 added ; Title of Table 4.1 to 4.4 added Table 4.3 revised ; Table 4.4 revised Table 5.2 revised Table 5.3 revised Table 5.4 revised ; Table 16.5 revised Table 5.6, 5.7 adn 5.8 revised ; Figure 5.3 revised Table 5.9 revised ; Table 5.10 revised

Rev.	Date	Description	
		Page	Summary
1.40	Sep 30, 2004	20	Table 5.12 revised ; Table 5.16 revised
		22	Table 16.17 revised
		24	Table 16.19 revised

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