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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 "<u>Embedded - Microcontrollers</u>"

Details	
Product Status	Obsolete
Core Processor	R8C
Core Size	16-Bit
Speed	20MHz
Connectivity	SIO, UART/USART
Peripherals	LED, POR, Voltage Detect, WDT
Number of I/O	13
Program Memory Size	16KB (16K x 8)
Program Memory Type	FLASH
EEPROM Size	2K x 8
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	-
Oscillator Type	Internal
Operating Temperature	-20°C ~ 85°C (TA)
Mounting Type	Through Hole
Package / Case	20-SDIP (0.300", 7.62mm)
Supplier Device Package	20-SDIP
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f21194dd-v0

# 1.2 Performance Overview

Table 1.1 outlines the Functions and Specifications for R8C/18 Group and Table 1.2 outlines the Functions and Specifications for R8C/19 Group.

Table 1.1 Functions and Specifications for R8C/18 Group

Table 1.1 F	ltem	Specification
CPU	Number of fundamental	89 instructions
	instructions	
	Minimum instruction execution	50 ns (f(XIN) = 20 MHz, VCC = 3.0 to 5.5 V)
	time	100 ns (f(XIN) = 10 MHz, VCC = 2.7 to 5.5 V)
	Operation mode	Single-chip
	Address space	1 Mbyte
	Memory capacity	Refer to Table 1.3 Product Information for R8C/18
		Group
Peripheral	Ports	I/O ports: 13 pins (including LED drive port)
Functions		Input port: 3 pins
	LED drive ports	I/O ports: 4 pins
	Timers	Timer X: 8 bits × 1 channel, timer Z: 8 bits × 1 channel
		(Each timer equipped with 8-bit prescaler)
		Timer C: 16 bits × 1 channel
		(Input capture and output compare circuits)
	Serial interfaces	1 channel
	Cona monacc	Clock synchronous serial I/O, UART
		1 channel
		UART
	Comparator	1-bit comparator: 1 circuit, 4 channels
	Watchdog timer	15 bits × 1 channel (with prescaler)
	Waterlady times	Reset start selectable, count source protection mode
	Interrupts	Internal: 10 sources, External: 4 sources, Software: 4
	Interrupts	sources,
		Priority levels: 7 levels
	Clock generation circuits	2 circuits
	Clock generation on outs	Main clock oscillation circuit (with on-chip feedback
		resistor)
		On-chip oscillator (high speed, low speed)
		High-speed on-chip oscillator has frequency
		adjustment function
	Oscillation stop detection	Main clock oscillation stop detection function
	function	Wall Clock Oscillation stop detection function
	Voltage detection circuit	On-chip
	Power-on reset circuit	On-chip
Electric	Supply voltage	VCC = 3.0 to 5.5 V (f(XIN) = 20 MHz)
Characteristics	Cappi, remage	VCC = 2.7 to 5.5 V (f(XIN) = 10 MHz)
Gridiadionolio	Current consumption	Typ. 9 mA (VCC = 5.0 V, f(XIN) = 20 MHz, comparator stopped)
		Typ. 5 mA (VCC = 3.0V, f(XIN) = 10 MHz, comparator stopped)
		Typ. 35 $\mu$ A (VCC = 3.0 V, wait mode, peripheral clock off)
		Typ. 0.7 $\mu$ A (VCC = 3.0 V, wait mode)
Flash Memory	Programming and erasure voltage	VCC = 2.7 to 5.5 V
I ladii Wollidiy	Programming and erasure	100 times
	endurance	100 111100
Operating Ambi	ent Temperature	-20 to 85°C
	on tomporatoro	-40 to 85°C (D version)
Package		20-pin molded-plastic LSSOP
. aonago		20-pin molded-plastic SDIP
		28-pin molded-plastic HWQFN
		1 - c Forded Pidette F.F. C. 11

Table 1.2 Functions and Specifications for R8C/19 Group

	Item	Specification
CPU	Number of fundamental	89 instructions
	instructions	
	Minimum instruction	50 ns (f(XIN) = 20 MHz, VCC = 3.0 to 5.5 V)
	execution time	100 ns (f(XIN) = 10 MHz, VCC = 2.7 to 5.5 V)
	Operation mode	Single-chip
	Address space	1 Mbyte
	Memory capacity	Refer to Table 1.4 Product Information for R8C/19
		Group
Peripheral	Ports	I/O ports: 13 pins (including LED drive port)
Functions		Input port: 3 pins
	LED drive ports	I/O ports: 4 pins
	Timers	Timer X: 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
		(Input capture and output compare circuits)
	Serial interfaces	1 channel
		Clock synchronous serial I/O, UART
		1 channel
		UART
	Comparator	1-bit comparator: 1 circuit, 4 channels
	Watchdog timer	15 bits x 1 channel (with prescaler)
		Reset start selectable, count source protection mode
	Interrupts	Internal: 10 sources, External: 4 sources, Software: 4
		sources,
		Priority levels: 7 levels
	Clock generation circuits	2 circuits
		Main clock generation circuit (with on-chip feedback
		resistor)
		On-chip oscillator (high speed, low speed)
		High-speed on-chip oscillator has frequency
		adjustment function
	Oscillation stop detection	Main clock oscillation stop detection function
	function	
	Voltage detection circuit	On-chip
	Power-on reset circuit	On-chip
Electric	Supply voltage	VCC = 3.0 to 5.5 V (f(XIN) = 20 MHz)
Characteristics		VCC = 2.7  to  5.5  V  (f(XIN) = 10  MHz)
	Current consumption	Typ. 9 mA (VCC = 5.0 V, f(XIN) = 20 MHz, comparator stopped)
		Typ. 5 mA (VCC = 3.0 V, f(XIN) = 10MHz, comparator stopped)
		Typ. 35 $\mu$ A (VCC = 3.0 V, wait mode, peripheral clock off)
		Typ. 0.7 μA (VCC = 3.0 V, stop mode)
Flash Memory	Programming and erasure voltage	VCC = 2.7 to 5.5 V
	Programming and erasure	10,000 times (data flash)
	endurance	1,000 times (program ROM)
Operating Ambi	ent Temperature	-20 to 85°C
		-40 to 85°C (D version)
Package		20-pin molded-plastic LSSOP
		20-pin molded-plastic SDIP
		28-pin molded-plastic HWQFN

# 1.3 Block Diagram

Figure 1.1 shows a Block Diagram.

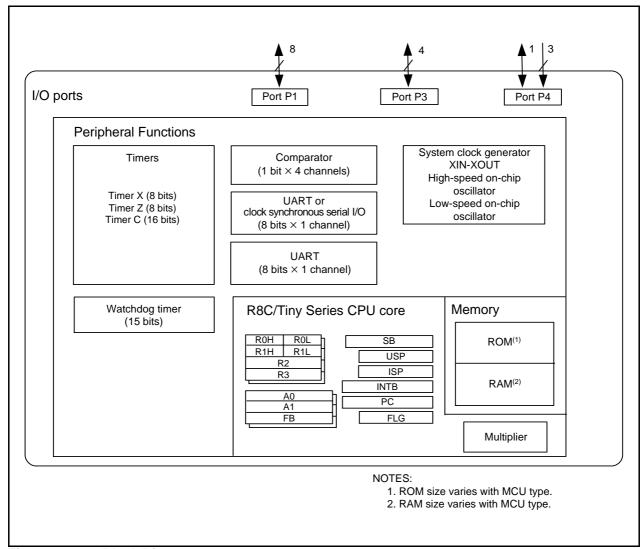


Figure 1.1 Block Diagram

Table 1.4 Product Information for R8C/19 Group

## Current of Apr. 2006

Type No.	ROM C	apacity	RAM	Packago Typo	Remarks
Type No.	Program ROM	Data flash	Capacity	Package Type	Remarks
R5F21191SP	4 Kbytes	1 Kbyte x 2	384 bytes	PLSP0020JB-A	Flash memory version
R5F21192SP	8 Kbytes	1 Kbyte × 2	512 bytes	PLSP0020JB-A	
R5F21193SP	12 Kbytes	1 Kbyte × 2	768 bytes	PLSP0020JB-A	
R5F21194SP	16 Kbytes	1 Kbyte × 2	1 Kbyte	PLSP0020JB-A	
R5F21191DSP (D)	4 Kbytes	1 Kbyte × 2	384 bytes	PLSP0020JB-A	D version
R5F21192DSP (D)	8 Kbytes	1 Kbyte × 2	512 bytes	PLSP0020JB-A	
R5F21193DSP (D)	12 Kbytes	1 Kbyte x 2	768 bytes	PLSP0020JB-A	
R5F21194DSP (D)	16 Kbytes	1 Kbyte × 2	1 Kbyte	PLSP0020JB-A	
R5F21191DD	4 Kbytes	1 Kbyte × 2	384 bytes	PRDP0020BA-A	Flash memory version
R5F21192DD	8 Kbytes	1 Kbyte × 2	512 bytes	PRDP0020BA-A	
R5F21193DD	12 Kbytes	1 Kbyte x 2	768 bytes	PRDP0020BA-A	
R5F21194DD	16 Kbytes	1 Kbyte × 2	1 Kbyte	PRDP0020BA-A	
R5F21192NP	8 Kbytes	1 Kbyte x 2	512 bytes	PWQN0028KA-B	Flash memory version
R5F21193NP	12 Kbytes	1 Kbyte × 2	768 bytes	PWQN0028KA-B	
R5F21194NP	16 Kbytes	1 Kbyte × 2	1 Kbyte	PWQN0028KA-B	

(D): Under Development

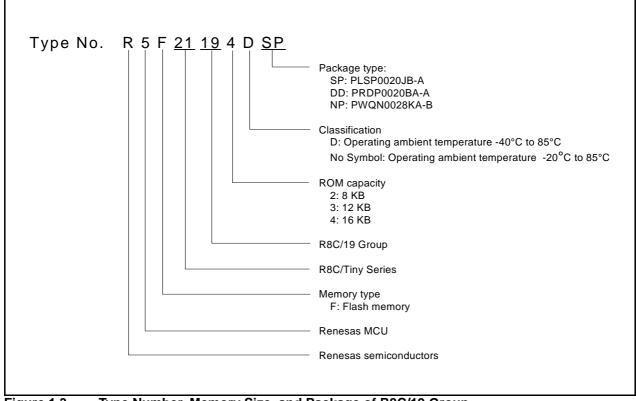


Figure 1.3 Type Number, Memory Size, and Package of R8C/19 Group

# 2. Central Processing Unit (CPU)

Figure 2.1 shows the CPU Registers. The CPU contains 13 registers. R0, R1, R2, R3, A0, A1, and FB configure a register bank. There are two sets of register bank.

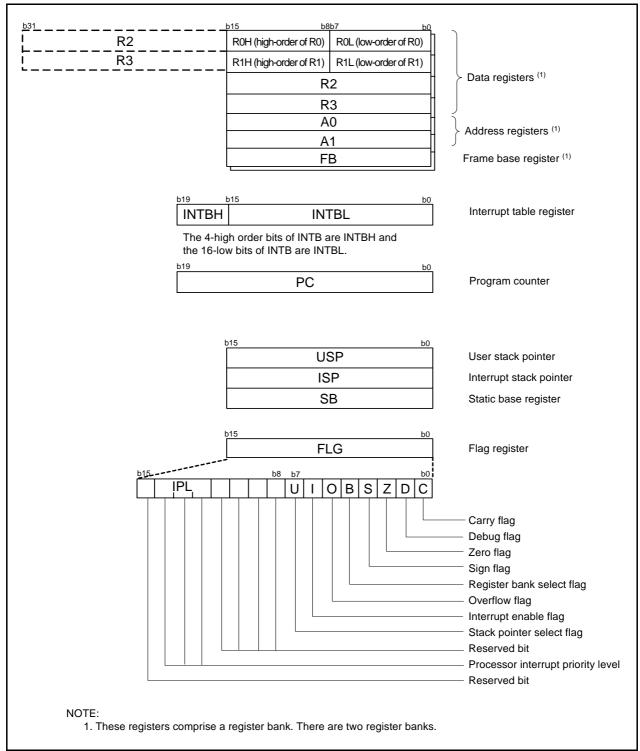


Figure 2.1 CPU Registers

Page 13 of 38

# 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. R0 can be split into high-order bits (R0H) and low-order bits (R0L) to be used separately as 8-bit data registers. R1H and R1L are analogous to R0H and R0L. R2 can be combined with R0 and used as a 32-bit data register (R2R0). R3R1 is analogous to R2R0.

# 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 is analogous to 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 for FB relative addressing.

# 2.4 Interrupt Table Register (INTB)

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

# 2.5 Program Counter (PC)

PC is 20 bits wide, indicates the address of the next instruction to be executed.

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

The stack pointer (SP), USP, and ISP, are each 16 bits wide. The U flag of FLG is used to switch between USP and ISP.

# 2.7 Static Base Register (SB)

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

# 2.8 Flag Register (FLG)

FLG is an 11-bit register indicating the CPU state.

# 2.8.1 **Carry Flag (C)**

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

## 2.8.2 Debug Flag (D)

The D flag is for debugging only. Set it to 0.

## 2.8.3 **Zero Flag (Z)**

The Z flag is set to 1 when an arithmetic operation results in 0; otherwise 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 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 set to 1.

# 2.8.6 Overflow Flag (O)

The O flag is set to 1 when the operation results in an overflow; otherwise to 0.



# 2.8.7 Interrupt Enable Flag (I)

The I flag enables maskable interrupts.

Interrupts are disabled when the I flag is set to 0, and are enabled when the I flag is set to 1. The I flag is set to 0 when an interrupt request is acknowledged.

# 2.8.8 Stack Pointer Select Flag (U)

ISP is selected when the U flag is set to 0; USP is selected when the U flag is set to 1.

The U flag is set to 0 when a hardware interrupt request is acknowledged or the INT instruction of software interrupt numbers 0 to 31 is executed.

# 2.8.9 Processor Interrupt Priority Level (IPL)

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

## 2.8.10 Reserved Bit

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



# 4. Special Function Registers (SFRs)

An SFR (special function register) is a control register for a peripheral function. Tables 4.1 to 4.4 list the special function registers.

Table 4.1 SFR Information (1)<sup>(1)</sup>

Address	Register	Symbol	After reset
0000h	rvegistei	Syllibol	Alter reset
0000h			
0001h			
0002H			
	Draggagy Mada Dagistor O	PM0	006
	Processor Mode Register 0		00h
	Processor Mode Register 1	PM1	00h
0006h	System Clock Control Register 0	CM0	01101000b
	System Clock Control Register 1	CM1	00100000b
0008h			
	Address Match Interrupt Enable Register	AIER	00h
	Protect Register	PRCR	00h
000Bh			
	Oscillation Stop Detection Register	OCD	00000100b
000Dh	Watchdog Timer Reset Register	WDTR	XXh
000Eh	Watchdog Timer Start Register	WDTS	XXh
000Fh	Watchdog Timer Control Register	WDC	00011111b
0010h	Address Match Interrupt Register 0	RMAD0	00h
0011h			00h
0012h			X0h
0012h			7.0
	Address Match Interrupt Register 1	RMAD1	00h
0014II 0015h	Address mater interrupt register 1	KIVIAD I	00h
0016h			X0h
0017h			
0018h			
0019h			
001Ah			
001Bh			
	Count Source Protection Mode Register	CSPR	00h
001Dh			
001Eh	INT0 Input Filter Select Register	INT0F	00h
001Fh	THE INDICE THE COLOUR PROJECT		
	High-Speed On-Chip Oscillator Control Register 0	HRA0	00h
	High-Speed On-Chip Oscillator Control Register 1	HRA1	
002111 0022h	High-Speed On-Chip Oscillator Control Register 2	HRA2	When shipping 00h
	High-Speed On-Chip Oscillator Control Register 2	HRA2	oon
0023h			
002Ah			
002Bh			
002Ch			
002Dh			
002Eh			
002Fh			
0030h			
	Voltage Detection Register 1 <sup>(2)</sup>	VCA1	00001000b
	Voltage Detection Register 2 <sup>(2)</sup>	VCA2	00h <sup>(3)</sup>
	Takaga Datoolion Rogiotol E. /	1 3.12	01000000b <sup>(4)</sup>
00335			01000000000
0033h			
0034h			
0035h			
0036h	Voltage Monitor 1 Circuit Control Register (2)	VW1C	0000X000b <sup>(3)</sup>
			0100X001b <sup>(4)</sup>
0037h	Voltage Monitor 2 Circuit Control Register (5)	VW2C	00h
0038h	5 .0		
0039h			
0033H			
003An			
003Bh			
003Dh			
003Eh 003Fh			
			1

## X: Undefined

- 1. The blank regions are reserved. Do not access locations in these regions.
- 2. Software reset, watchdog timer reset, and voltage monitor 2 reset do not affect this register.
- 3. After hardware reset.
- 4. After power-on reset or voltage monitor 1 reset.
- 5. Software reset, watchdog timer reset, and voltage monitor 2 reset do not affect b2 and b3.



SFR Information (4)<sup>(1)</sup> Table 4.4

DOCCOR	Address	Register	Symbol	After reset
0002h   0003h   0003	00C0h			
9003h				
00C4h         00C8h           00C8h         00C8h           00C7h         00C7h           00C7h         00C7h           00C2h         00C7h           00C2h         00C7h           00C7h         00C7h           00C7h         00C7h           00D9h         00D9h           00D9h <td></td> <td></td> <td></td> <td></td>				
0005h				
000C6h	00C4h			
00C7h         00C8h           00C8h         00C8h           00D0h         00D0h           00D1h         00D0h           00D2h         AD Control Register 0           00D5h         00D0h           00D7h         AD Control Register 0           00D8h         00D0h           00D8h         00D0h           00D8h         00D0h           00D8h         00D0h           00D0h         00D0h           00D0h         00D0h           00E0h         00D0h           00E0h         00C8h           00E3h         00F1 Port P3 Register           00E3h         Port P1 Register           00E3h         Port P3 Register           00E3h         Port P3 Register           00E3h         Port P3 Port P3 Register           00E4h         00E5h           00E5h         Port P3 Registe				
0005h   0005				
0005h   0006h   0006				
00Cbh         00Cbh           00Cbh         00Cbh           00Cbh         00Cbh           00Cbh         00Cbh           00D0bh         00D0bh           00D2h         00D3h           00D3h         AD Control Register 2           00D6h         ADCON0           00D8h         AD Control Register 0           00D8h         ADCON1           00D8h         ADCON1           00D8h         ADCON1           00D8h         ADCON1           00D8h         ADCON1           00D8h         ADCON1           00D8h         ODCh           00Eh         Port P1 Register           00Eh         Port P2 Register           00Eh         Port P3 Direction Register           00Eh         Port P3 Direction Register	00C9h			
00CCh         00CEh           00CCh         00CEh           00CCh         00CH           00D0h         00D0h           00D1h         00D1h           00D3h         00D3h           00D3h         AD Control Register 2           00D4h         AD Control Register 1           00D4h         AD Control Register 1           00D7h         AD Control Register 1           00D4h         AD CON1           00D4h         00D8h           00D4h         00D8h           00D4h         00D8h           00D4h         00D8h           00D4h         00D8h           00D4h         00D8h           00D5h         00D8h           00D6h         00D8h           00E0h         00D8h           00E1h         00E2h           00E2h         00E3h           00E3h         Port P1 Direction Register           00E4h         Port P3 Register         P3           00E4h         Port P4 Register         P4           00E4h         Port P4 Register         P4           00E4h         Port P4 Direction Register         PD3           00E6h         Port P4 Direction Regist				
000Cbh         00CFh           00Cbh         00CPh           00Cbh         00Ch           00Dlah         00Dlah           00Dlah         AD Control Register 2           00Dsh         AD Control Register 0           00Dsh         AD Control Register 1           00Dbh         AD Control Register 1           00Dsh         AD Control Register 1           00Dsh         ADCON1           00Dsh         00Dsh           00Esh         00Esh           00Esh         Port P1 Direction Register           00Esh         Port P3 Direction Register           00Esh         Port P4 Register           00Esh         Port P4 Register           00Esh         Port P5 Direction Register           00Esh         Port P5 Dir				
00CEh         00Ch           00DOh         00DOh           00D1h         00D3h           00D3h         00D3h           00D3h         AD Control Register 2           00D3h         AD Control Register 1           00D4h         AD COND           00D4h         AD COND           00D4h         00DAn           00D4h         00DAn           00D4h         00DAn           00D4h         00DAn           00D5h         00DAn           00D4h         00DAn           00D5h         00DAn           00E3h         00FD           00E3h         Pot P3 Register           00E4h         00E3h           00E5h         Pot P3 Direction Register         P3           00E4h         00E3h           00E4h         00E3h           00E4h         00E3h				
00CPh         00D0h         00D1h           00D1h         00D2h         00D0h           00D3h         AD Control Register 2         00h           00D3h         AD Control Register 0         00000h           00D3h         AD Control Register 1         00h           00D3h         AD Control Register 1         00h           00D3h         00D3h         00h           00D4h         00D4h         00h           00D4h         00D4h         00h           00D5h         00D6h         00h           00D6h         00D6h         00h           00D6h         00D6h         00h           00D6h         00D6h         00h           00E3h         00Fh         00h           00E3h         Port P1 Register         P1         XXh           00E3h         Port P3 Register         P3         XXh           00E3h         Port P3 Register         P3         00h           00E3h         Port P3 Register         P4         XXh           00E3h         Port P4 Direction Register         P3         00h           00E4h         Port P3 Direction Register         P4         00h           00E4h         Port				
00010h				
00D1h         00D2h           00D2h         0D0h           00D3h         AD Control Register 2         ADCON2         00h           00D5h         AD Control Register 0         ADCON0         000000XXb           00D7h         AD Control Register 1         ADCON1         00h           00D8h         00D0h         00h         00h           00D8h         00D0h         00D0h         00D0h           00D0h         00D0h         00D0h         00D0h           00D0h         00D0h         00D0h         00D0h           00D0h         00D0h         00D0h         00D0h           00D0h         00D0h         00D0h         00D0h           00D2h         00D0h         00D0h         00D0h           00D2h         00D0h         00D0h         00D0h           00E3h         Port P1 Register         P1         XXh           00E3h         Port P3 Register         P3         XXh           00E3h         Port P3 Register         P3         XXh           00E3h         Port P4 Direction Register         P3         00h           00E3h         Port P4 Direction Register         P4         00h           00E4h <t< td=""><td></td><td></td><td></td><td></td></t<>				
00D2h         00D4h         AD Control Register 2         ADCON2         00h           00D4h         AD Control Register 0         ADCON0         000000000000000000000000000000000000				
00D4h         AD Control Register 2         ADCON2         00h           00D5h         AD Control Register 0         ADCON0         000000XXXb           00D7h         AD Control Register 1         ADCON1         00h           00D8h         00D8h         00DA         00DA           00D8h         00DA         00DA         00DA           00D5h         00DBh         00DBh         00DBh           00D5h         00DBh         00DBh         00DBh           00D5h         00DBh         00DBh         00DBh           00D6h         00DBh         00DBh         00DBh           00E3h         Port P1 Register         P1         XXh           00E3h         Port P2 Bregister         P3         XXh           00E4h         P0T P3 Register         P3         XXh           00E4h         P0T P4 Register         P4         XXh           00E8h         P0T P4 Register				
00D4h         AD Control Register 2         ADCON2         00h           00D5h         AD Control Register 0         ADCON0         000000XXXb           00D7h         AD Control Register 1         ADCON1         00h           00D8h         00D8h         00DA         00DA           00D8h         00DA         00DA         00DA           00D5h         00DBh         00DBh         00DBh           00D5h         00DBh         00DBh         00DBh           00D5h         00DBh         00DBh         00DBh           00D6h         00DBh         00DBh         00DBh           00E3h         Port P1 Register         P1         XXh           00E3h         Port P2 Bregister         P3         XXh           00E4h         P0T P3 Register         P3         XXh           00E4h         P0T P4 Register         P4         XXh           00E8h         P0T P4 Register	00D3h			
00D6h         A/D Control Register 0         ADCON0         00000XXXb           00D7h         A/D Control Register 1         ADCON1         000h           00D8h         00DAh         00DAh         00DAh           00DBh         00DBh         00DBh         00DBh           00DCh         00DCh         00DCh         00DBh           00DDh         00DBh         00DBh         00DBh           00DFh         00DFh         00DBh         00DBh           00E1h         00E1h         00DBh         00DBh           00E2h         00E3h         00E3h         00DBh           00E3h         Port P1 Direction Register         PD1         00h           00E4h         00E3h         Port P3 Register         P3         XXh           00E6h         00E7h         00H         00E8h         00H           00E8h         Port P4 Register         P4         XXh           00E8h         Port P4 Direction Register         PD4         00h           00E8h         00E0h         00H         00H           00E8h         00E0h         00H         00H           00E0h         00E0h         00H         00H           00E0h <t< td=""><td>00D4h</td><td>A/D Control Register 2</td><td>ADCON2</td><td>00h</td></t<>	00D4h	A/D Control Register 2	ADCON2	00h
00DRh         A/D Control Register 1         00h           00D8h         00D9h           00DAh         00DBh           00DCh         00DCh           00DCh         00DCh           00DEh         00DEh           00Eh         00Eh           00Eh <t< td=""><td></td><td></td><td></td><td></td></t<>				
00D8h         00DAh           00DAh         00DAh           00DBh         00DCh           00DDh         00DDh           00DDh         00DDh           00DFh         00DFh           00DFh         00DFh           00E1h         Port P1 Register           00E2h         00E3h           00E3h         Port P1 Direction Register           00E3h         Port P2 Breston Register           00E6h         Port P3 Direction Register           00E8h         Port P4 Register           00E8h         Port P4 Direction Register           00E8h         Port P4 Direction Register           00E8h         Port P5 Direction Register           00E8h         Port P6 Direction Register           00E8h         Port P7 Direction Register           00E8h         Port P8 Direction Register           00E2h         Oberth           00E2h         Oberth           00E2h         Oberth           00E2h         Oberth           00E2h         Oberth           00F3h         Oberth           00F4h         Oberth           00F5h         Oberth           00F6h         Oberth <t< td=""><td>00D6h</td><td>A/D Control Register 0</td><td>ADCON0</td><td></td></t<>	00D6h	A/D Control Register 0	ADCON0	
00D9h         00DBh           00DBh         00DBh           00DCh         00DCh           00DEh         00DEh           00DFh         00DFh           00E1h         00E1h           00E2h         00E3h           00E3h         Port P1 Direction Register           00E3h         Port P2 Direction Register           00E3h         Port P3 Register           00E6h         Port P4 Register           00E7h         Port P4 Register           00E8h         Port P4 Register           00E8h         Port P4 Register           00E8h         Port P4 Direction Register           00E8h         Port P4 Direction Register           00E8h         Port P4 Direction Register           00E8h         Port P5 P4 Direction Register           00E8h         Port P6 Register           00E9h         Port P6 Register           00E9h         Port P6 Register           00E9h         Port P7 Register           00E9h         Port P8 Register           00F8h         Port P8 Register           00F8h         Port P8 Register           00F8h         Port P8 Register           00F8h         Port P8 Register <t< td=""><td></td><td>A/D Control Register 1</td><td>ADCON1</td><td>uun</td></t<>		A/D Control Register 1	ADCON1	uun
00DAh         00DBh           00DCh         00DCh           00DDh         00DBh           00DFh         00DFh           00E1h         00E1h           00E1h         00E1h           00E1h         00E1h           00E3h         00E3h           00E3h         Port P1 Direction Register           00E3h         Port P2 Register           00E6h         Port P3 Direction Register           00E8h         Port P4 Register           00E8h         Port P4 Register           00E8h         Port P4 Direction Register           00E9h         Ooh           00E1h         Ooh           00E2h         Ooh           00E2h         Ooh           00E2h         Ooh           00E3h         Ooh           00F8h         Ooh           00F8h         Ooh           00F8h         Ooh           00F8h         <				
00DBh         00DCh           00DCh         00DDh           00DFh         00E0h           00E0h         00E1h           00E2h         00E2h           00E2h         00E2h           00E2h         00E2h           00E3h         Port P1 Direction Register           00E3h         Port P3 Register           00E5h         Port P3 Direction Register           00E7h         Port P4 Register           00E8h         Port P4 Register           00E8h         Port P4 Direction Register           00E8h         Port P4 Direction Register           00E8h         Pot P4 Direction Register           00EBh         Do           00ECh         00E0h           00EDh         00E0h           00E7h         00F0h           00E7h         00F3h           00F3h         00F4h           00F3h         00F3h           00F6h         00F6h           00F7h         00F8h           00F8h         00F8h           00F9h         00F9h           00F9h         00F9h           00F9h         00F9h           00F9h         00F9h           00F9	00D9H			
OODCh OODED OODEN O				
OODDh OODEh OODEh OOED OOE1h OOE2h OOE3h OOE3h OOE3h OOE5h OOE5h OOE5h OOE6h OOE7h OOE7h OOE7h OOE7h OOE9h OOF9h OO				
00DFh         00E1h         Port P1 Register         P1         XXh           00E2h         00E3h         Port P1 Direction Register         PD1         00h           00E3h         Port P3 Register         P3         XXh           00E6h         00E7h         Port P3 Direction Register         PD3         00h           00E8h         Port P4 Register         P4         XXh           00E9h         P0         XXh         00E0           00EAh         P0rt P4 Direction Register         PD4         00h           00EBh         P0rt P4 Direction Register         PD4         00h           00EDh         00E0h         00h         00h           00ECh         00EDh         00h         00h           00EFh         00Fh         00Fh         00Fh           00F1h         00Fh         00Fh         00Fh           00F3h         00Fh         00Fh         00Fh           00F3h         00Fh         00Fh         00Fh           00F3h         00Fh         00Fh         00Fh           00F9h         00Fh         00Fh         00Fh         00Fh           00F9h         00Fh         00Fh         00Fh         00Fh	00DDh			
00E1h 00E3h         Port P1 Register         P1         XXh           00E3h 00E3h         Port P1 Direction Register         PD1         00h           00E4h 00E5h         P0T P3 Register         P3         XXh           00E6h 00E7h         Port P3 Direction Register         PD3         00h           00E8h 00E8h 00E8h         P0rt P4 Register         P4         XXh           00E9h 00E9h 00E0h         P0rt P4 Direction Register         PD4         00h           00E8h 00ECh 00E0h         P0rt P4 Direction Register         PD4         00h           00E9h 00E0h 00E0h 00E0h         P0rt P4 Direction Register         PD4         00h           00E1h 00E0h 00E0h 00E0h         P0rt P4 Direction Register         PD4         00h           00E1h 00F2h 00F3h 00F4h         P0rt P4 Direction Register         PD4         00h           00F3h 00F6h 00F6h 00F6h 00F6h         P0rt P4 Direction Register 0         P0rt P4 Direction Register 0         P0rt P4 Direction Register 0           00F8h 00F6h 00F6h         P0rt P4 Direction Register 0         PUR0         00XX0000b 00XX0000b           00F1h 00F6h         P0rt P4 Direction Register 0         PUR0         00XX0000b 00R Direction Register 0           00F1h 00F6h         P0rt P1 Dirive Capacity Control Register 0         PUR0         00XXX000b 00h	00DEh			
00E1h ODE2h         Port PR Register         P1         XXh           00E2h ODE3h         Port P1 Direction Register         PD1         00h           00E4h ODE6h         P0rt P3 Register         P3         XXh           00E6h ODE7h         Port P3 Direction Register         PD3         00h           00E8h P0rt P4 Register         P4         XXh           00E9h ODE8h P0rt P4 Direction Register         PD4         00h           00EAh P0rt P4 Direction Register         PD4         00h           00ED P1         P0F1 P4 Direction Register         PD4         00h           00ED P1         PD4         00h         00h           00ED P2         P0F2         00h				
00E2h         00E3h         Port P1 Direction Register         PD1         00h           00E4h         Port P3 Register         P3         XXh           00E6h         Port P3 Direction Register         PD3         00h           00E8h         Port P4 Register         P4         XXh           00E9h         00E0h         00h         00h           00E8h         Port P4 Direction Register         PD4         00h           00E0h         00E0h         00h         00h           00E0h         00E0h         00h         00h           00E0h         00E0h         00h         00h           00E0h         00E0h         00h         00h           00E1h         00E0h         00H         00H           00E2h         00E0h         00E0h         00E0h           00E1h         00E1h         00E1h         00E1h           00E2h         00E2h         00E2h         00E2h           00E3h         00E3h         00E3h         00E3h           00E4h         00E3h         00E3h         00E3h           00F3h         00F3h         00E3h         00E3h           00F3h         00F3h         00E3h         00E3h				V. 7.
00E3h         Port P1 Direction Register         PD1         00h           00E4h         Port P3 Register         P3         XXh           00E7h         Port P3 Direction Register         PD3         00h           00E8h         Port P4 Register         P4         XXh           00E9h         P0t         P0t         P0t           00EAh         Port P4 Direction Register         PD4         00h           00EBh         00ECh         00ED         00h           00ECh         00EDh         00EDh         00EDh           00EFh         00EFh         00EHh           00Fh         00Fh         00Fh		Port P1 Register	P1	XXh
00E4h         00E6h         Port P3 Register         P3         XXh           00E6h         Port P4 Direction Register         PD3         00h           00E8h         P0T P4 Register         P4         XXh           00E9h         00E0h         00h           00E8h         00h         00h           00EBh         00h         00h           00EDh         00EDh         00h           00EBh         00EDh         00EDh           00EBh         00EDh         00EDh           00EBh         00F0h         00EDh           00EPh         00F0h         00EDh           00F3h         00F3h         00F3h           00F4h         00F3h         00F3h           00F4h         00F3h         00F3h	00E2h	Dort D1 Direction Register	DD4	00h
00E6h         Port P3 Register           00E6h         Port P3 Direction Register           00E7h         Port P4 Register           00E8h         Port P4 Register           00E9h         Port P4 Direction Register           00EAh         Port P4 Direction Register           00EBh         O0           00ECh         O0           00ECh         O0EDh           00ECh         O0EDh           00ECh         O0ERH           00E7h         O0Foh           00F1h         O0Foh           00F2h         O0Foh           00F3h         O0Foh           00F6h         O0Foh           00F6h         O0Foh           00F6h         O0Foh           00F8h         O0Foh           00F8h         O0Foh           00F8h         O0Foh           00F9h         O0Foh           00F0h         Pull-Up Control Register 0           00F0h         Pull-Up Control Register 1           00F0h         Pull P1 Dive Capacity Control Register         Doh           00Feh         O0h           00Feh         O0h         O0h           00FFh         O0h         O0h </td <td></td> <td>  Fort F1 Direction Register</td> <td>וטיו</td> <td>OOT</td>		Fort F1 Direction Register	וטיו	OOT
00E6h         DOETh Port P3 Direction Register         PD3         00h           00E8h         Port P4 Register         P4         XXh           00E8h         00EAh         PD4         00h           00EBh         00         00         00           00EDh         00EBh         00         00           00EDh         00EBh         00         00           00EBh         00Fbh         00         00         00           00Eh         00Eh         00 </td <td></td> <td>L Port P3 Register</td> <td>P3</td> <td>XXh</td>		L Port P3 Register	P3	XXh
00E7h         Port P3 Direction Register         P9         00h           00E8h         Port P4 Register         P4         XXh           00E9h         ODEAh         Port P4 Direction Register         PD4         ODh           00EBh         ODECh         ODH         ODh           00ECh         ODECH         ODECH         ODECH           00EFh         ODECH         ODECH         ODECH           00F1h         ODF3h         ODECH         ODECH           00F3h         ODF3h         ODECH         ODECH           00F6h         ODF6h         ODECH         ODECH           00F8h         ODF8h         ODECH         ODECH           00F8h         ODECH         ODECH         ODECH           00F9h         ODECH         ODECH         ODECH           00F9h         ODECH         ODECH         ODECH           00F0h         DURO         ODXX0000b         DURO           00F0h         DURO         ODXX0000b         DURO           00F0h         DURO         ODXX0000b         DURO           00F0h         DURO         ODXX0000b         DURO           00F0h         DURO         ODXX0000b	00E6h	T or to trog.com	. •	70
00E9h 00E8h 00EBh 00ECh 00ECh 00EDh 00EEh 00EFh 00Fh 00Fh 00Fh 00Fh 00Fh 0			PD3	
00EAh         Port P4 Direction Register         PD4         00h           00EBh         00ECh         00EDh         00EDh <td>00E8h</td> <td>Port P4 Register</td> <td>P4</td> <td>XXh</td>	00E8h	Port P4 Register	P4	XXh
00EBh         00ECh           00EDh         00EFh           00EFh         00Fh           00Fh         00Fh           00Fh         00Fh           00F1h         00Fh           00F3h         00Fh           00F4h         00Fh           00Fh         Pull-Up Control Register 0           00Fh         Pull-Up Control Register 1           00Fh         Port P1 Drive Capacity Control Register           00Fh         Timer C Output Control Register           01B3h         Flash Memory Control Register 4           01B3h         Flash Memory Control Register 1           01B6h         FMR1           01B7h         Flash Memory Control Register 0				
00ECh         00EDh           00EFh         00Fh           00Fh         00Fh           00Fh         00Fh           00Fh         00Fh           00Fh         00Fh           00F3h         00Fh           00F6h         00Fh           00F7h         00Fh           00F9h         00Fh           00Fh         00Fh           00Fh         00Fh           00Fh         00Fh           00Fh         00Fh           00Fh         Pull-Up Control Register 0           00Fh         Pull-Up Control Register 1           00Fh         Port P1 Drive Capacity Control Register           00Fh         Drive Capacity Control Register           00Fh         Timer C Output Control Register           01B3h         Flash Memory Control Register 4         FMR4         01000000b           01B4h         01B5h         Flash Memory Control Register 1         FMR1         1000000xb           01B6h         Flash Memory Control Register 0         FMR0         00000001b		Port P4 Direction Register	PD4	00h
00EDh         00EEh           00EFh	00EBh			
00Eh         00Eh           00F0h	00ECII			
00EFh         00F0h           00F1h         00F1h           00F2h         00F3h           00F4h         00F4h           00F5h         00F6h           00F6h         00F7h           00F8h         00F8h           00F9h         00FAh           00FBh         00FBh           00FDh         Pull-Up Control Register 0           00FDh         Pull-Up Control Register 1           00FFh         Port P1 Drive Capacity Control Register           00FFh         Timer C Output Control Register           01B3h         Flash Memory Control Register 4           01B4h         FMR4           01B5h         Flash Memory Control Register 1           01B6h         FMR1           01B7h         Flash Memory Control Register 0				
00F0h         00F1h           00F2h         00F3h           00F4h         00F4h           00F5h         00F6h           00F7h         00F8h           00F9h         00F9h           00F8h         00F9h           00F0h         Pull-Up Control Register 0           00FDh         PUR0         00XX0000b           00FDh         Pull-Up Control Register 1         PUR1         XXXXXXX0Xb           00FEh         Port P1 Drive Capacity Control Register         DRR         00h           00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         01000000b           01B4h         Flash Memory Control Register 1         FMR1         10000000b           01B6h         Flash Memory Control Register 0         FMR0         00000001b				
00F1h         00F2h           00F3h         00F4h           00F4h         00F5h           00F6h         00F7h           00F8h         00F9h           00F9h         00FAh           00FBh         00FBh           00FDh         Pull-Up Control Register 0           00FDh         Pull-Up Control Register 1           00FEh         Port P1 Drive Capacity Control Register           00FFh         Timer C Output Control Register           01B3h         Flash Memory Control Register 4           01B5h         Flash Memory Control Register 1           01B5h         Flash Memory Control Register 1           01B7h         Flash Memory Control Register 0           01B7h         Flash Memory Control Register 0           01B7h         Flash Memory Control Register 0	00F0h			
00F3h         00F4h           00F5h         00F6h           00F7h         00F8h           00F9h         00F9h           00F8h         00F9h           00F8h         00F9h           00F8h         00F9h           00FCh         Pull-Up Control Register 0         PUR0         00XX0000b           00FDh         Pull-Up Control Register 1         PUR1         XXXXXXXXXb           00FEh         Port P1 Drive Capacity Control Register         DRR         00h           00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         01000000b           01B4h         01B5h         Flash Memory Control Register 1         FMR1         10000000xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         000000001b	00F1h			
00F4h         00F5h           00F6h         00F7h           00F8h         00F9h           00F9h         00F8h           00FBh         00FCh           00FCh         Pull-Up Control Register 0         PUR0         00XX0000b           00FDh         Pull-Up Control Register 1         PUR1         XXXXXXXXb           00FEh         Port P1 Drive Capacity Control Register         DRR         00h           00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         01000000b           01B4h         01B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         000000001b	00F2h			
00F5h         00F6h           00F7h         00F8h           00F9h         00F9h           00FAh         00FBh           00FCh         Pull-Up Control Register 0         PUR0         00XX0000b           00FDh         Pull-Up Control Register 1         PUR1         XXXXXXXXX           00FEh         Port P1 Drive Capacity Control Register         DRR         00h           00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         01000000b           01B4h         01B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B7h         Flash Memory Control Register 0         FMR0         00000001b				
00F6h         00F7h           00F8h         00F9h           00F9h         00FAh           00FBh         00FCh           00FCh         Pull-Up Control Register 0         PUR0         00XX0000b           00FDh         Pull-Up Control Register 1         PUR1         XXXXXXXXX           00FEh         Port P1 Drive Capacity Control Register         DRR         00h           00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         01000000b           01B4h         01B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         00000001b	UUF4h			
00F7h         00F8h           00F9h         00F9h           00FAh         00FBh           00FBh         00FCh           00FCh         Pull-Up Control Register 0         PUR0         00XX0000b           00FDh         Pull-Up Control Register 1         PUR1         XXXXXXXXX           00FEh         Port P1 Drive Capacity Control Register         DRR         00h           00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         01000000b           01B4h         01B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         00000001b				
00F8h         00F9h           00F8h         00F8h           00FBh         00FBh           00FCh         Pull-Up Control Register 0         PUR0         00XX0000b           00FDh         Pull-Up Control Register 1         PUR1         XXXXXX0Xb           00FEh         Port P1 Drive Capacity Control Register         DRR         00h           00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         01000000b           01B4h         01B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         00000001b				
00F9h         00FAh           00FAh         00FBh           00FCh         Pull-Up Control Register 0         PUR0         00XX0000b           00FDh         Pull-Up Control Register 1         PUR1         XXXXXX0Xb           00FEh         Port P1 Drive Capacity Control Register         DRR         00h           00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         010000000b           01B4h         01B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         00000001b				
00FAh         00FAh           00FBh         00FCh           00FCh         Pull-Up Control Register 0           00FDh         Pull-Up Control Register 1           00FEh         Port P1 Drive Capacity Control Register           00FFh         Timer C Output Control Register           01B3h         Flash Memory Control Register 4           01B4h         FMR4           01B5h         Flash Memory Control Register 1           01B6h         FMR1           01B7h         Flash Memory Control Register 0           FMR0         00000001b				
00FBh         00FCh         Pull-Up Control Register 0         PUR0         00XX0000b           00FDh         Pull-Up Control Register 1         PUR1         XXXXXX0Xb           00FEh         Port P1 Drive Capacity Control Register         DRR         00h           00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         01000000b           01B4h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         Flash Memory Control Register 0         FMR0         00000001b	00FAh			
00FCh         Pull-Up Control Register 0         PUR0         00XX0000b           00FDh         Pull-Up Control Register 1         PUR1         XXXXXX0Xb           00FEh         Port P1 Drive Capacity Control Register         DRR         00h           00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         01000000b           01B4h         01B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         00000001b	00FBh			
00FEh         Port P1 Drive Capacity Control Register         DRR         00h           00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         010000000b           01B4h         01B5h         Flash Memory Control Register 1         FMR1         10000000xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         00000001b	00FCh	Pull-Up Control Register 0		
00FFh         Timer C Output Control Register         TCOUT         00h           01B3h         Flash Memory Control Register 4         FMR4         01000000b           01B4h         501B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         701B6h         701B6h         700000001b           01B7h         Flash Memory Control Register 0         FMR0         00000001b	00FDh	Pull-Up Control Register 1		
01B3h         Flash Memory Control Register 4         FMR4         010000000b           01B4h         50         FMR1         1000000Xb           01B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         00000001b	UUFEh	Timer C Output Control Register		
01B4h         01B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         00000001b	UUFFN	Timer C Output Control Register	10001	UUII
01B4h         01B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         00000001b	01B3h	Flash Memory Control Register 4	I FMR4	I 01000000b
01B5h         Flash Memory Control Register 1         FMR1         1000000Xb           01B6h         01B7h         Flash Memory Control Register 0         FMR0         00000001b		aaanory control regional 4		0.000000
01B6h         01B7h         Flash Memory Control Register 0         FMR0         00000001b	01B5h	Flash Memory Control Register 1	FMR1	1000000Xb
01B7h Flash Memory Control Register 0 FMR0 00000001b	01B6h	-		
0FFFFh   Optional Function Select Register   OFS   (Note 2)	01B7h	Flash Memory Control Register 0	FMR0	00000001b
UFFFF   Optional Function Select Register   OFS   (Note 2)				
	0FFFFh	Optional Function Select Register	OFS	(Note 2)

## X: Undefined NOTES:

- The blank regions, 0100h to 01B2h and 01B8h to 02FFh are all reserved. Do not access locations in these regions.
   The OFS register cannot be changed by a program. Use a flash programmer to write to it.

# 5. Electrical Characteristics

Table 5.1 Absolute Maximum Ratings

Symbol	Parameter	Condition	Rated Value	Unit
Vcc	Supply voltage	Vcc = AVcc	-0.3 to 6.5	V
AVcc	Analog supply voltage	Vcc = AVcc	-0.3 to 6.5	٧
Vı	Input voltage		-0.3 to Vcc+0.3	V
Vo	Output voltage		-0.3 to Vcc+0.3	V
Pd	Power dissipation	Topr = 25°C	300	mW
Topr	Operating ambient temperature		-20 to 85 / -40 to 85 (D version)	°C
Tstg	Storage temperature		-65 to 150	°C

**Table 5.2** Recommended Operating Conditions

Comple ed	Parameter		Conditions	Standard			1.1
Symbol	Pa	Falametei		Min.	Тур.	Max.	Unit
Vcc	Supply voltage	Supply voltage		2.7	-	5.5	V
AVcc	Analog supply volt	age		-	Vcc	_	V
Vss	Supply voltage			=	0	=	V
AVss	Analog supply volt	age		-	0	-	V
VIH	Input "H" voltage			0.8Vcc	_	Vcc	V
VIL	Input "L" voltage			0	_	0.2Vcc	V
IOH(sum)	Peak sum output "H" current	Sum of all pins IOH (peak)		=	=	-60	mA
IOH(peak)	Peak output "H" current			_	-	-10	mA
IOH(avg)	Average output "H	" current		_	-	-5	mA
IOL(sum)	Peak sum output "L" currents	Sum of all pins IOL (peak)		=	=	60	mA
IOL(peak)	Peak output "L"	Except P1_0 to P1_3		_	-	10	mA
	currents	P1_0 to P1_3	Drive capacity HIGH	_	-	30	mA
			Drive capacity LOW	-	-	10	mA
IOL(avg)	Average output	Except P1_0 to P1_3		-	_	5	mA
	"L" current	P1_0 to P1_3	Drive capacity HIGH	-	_	15	mA
			Drive capacity LOW	-	-	5	mA
f(XIN)	Main clock input o	scillation frequency	3.0 V ≤ Vcc ≤ 5.5 V	0	-	20	MHz
			2.7 V ≤ Vcc < 3.0 V	0	_	10	MHz

## NOTES:

- 1. Vcc = 2.7 to 5.5 V at Topr = -20 to 85 °C / -40 to 85 °C, unless otherwise specified.
- 2. Typical values when average output current is 100 ms.

Page 22 of 38

Table 5.4 Flash Memory (Program ROM) Electrical Characteristics

Cymahal	Darameter	Conditions		Lloit		
Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit
=	Program/erase endurance <sup>(2)</sup>	R8C/18 Group	100(3)	-	=	times
		R8C/19 Group	1,000(3)	-	-	times
-	Byte program time		ī	50	400	μS
=	Block erase time		_	0.4	9	S
td(SR-SUS)	Time delay from suspend request until suspend		=	=	97+CPU clock × 6 cycles	μS
_	Interval from erase start/restart until following suspend request		650	=	-	μS
_	Interval from program start/restart until following suspend request		0	=	-	ns
=	Time from suspend until program/erase restart		=	=	3+CPU clock × 4 cycles	μS
_	Program, erase voltage		2.7	_	5.5	V
-	Read voltage		2.7	-	5.5	V
=	Program, erase temperature		0	-	60	°C
=	Data hold time <sup>(8)</sup>	Ambient temperature = 55 °C	20	-	=	year

- 1. Vcc = 2.7 to 5.5 V at Topr = 0 to 60 °C, unless otherwise specified.
- 2. Definition of programming/erasure endurance
  - The programming and erasure endurance is defined on a per-block basis.
  - If the programming and erasure endurance is n (n = 100 or 10,000), each block can be erased n times. For example, if 1,024 1-byte writes are performed to block A, a 1 Kbyte block, and then the block is erased, the programming/erasure endurance still stands at one. However, the same address must not be programmed more than once per erase operation (overwriting prohibited).
- 3. Endurance to guarantee all electrical characteristics after program and erase. (1 to Min. value can be guaranteed).
- 4. If emergency processing is required, a suspend request can be generated independent of this characteristic. In that case the normal time delay to Suspend can be applied to the request. However, we recommend that a suspend request with an interval of less than 650 μs is only used once because, if the suspend state continues, erasure cannot operate and the incidence of erasure error rises.
- 5. In a system that executes multiple programming operations, the actual erasure count can be reduced by writing to sequential addresses in turn so that as much of the block as possible is used up before performing an erase operation. For example, when programming groups of 16 bytes, the effective number of rewrites can be minimized by programming up to 128 groups before erasing them all in one operation. In addition, averaging the number of erase operations between block A and block B can further reduce the effective number of rewrites. It is also advisable to retain data on the erase count of each block and limit the number of erase operations to a certain number.
- 6. If an error occurs during block erase, attempt to execute the clear status register command, then execute the block erase command at least three times until the erase error does not occur.
- 7. Customers desiring programming/erasure failure rate information should contact their Renesas technical support representative.
- 8. The data hold time includes time that the power supply is off or the clock is not supplied.

Table 5.13 Electrical Characteristics (2) [Vcc = 5 V] (Topr = -40 to 85  $^{\circ}$ C, unless otherwise specified.)

Symbol	Parameter		Condition		Standard		Unit
Cymbol	1 didiliotoi			Min.	Тур.	Max.	01110
Icc	Power supply current (Vcc = 3.3 to 5.5 V) Single-chip mode, output pins are open,	High-speed mode	XIN = 20 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz No division	I	9	15	mA
	other pins are Vss, comparator is stopped		XIN = 16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz No division	-	8	14	mA
			XIN = 10 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz No division	-	5	ı	mA
		Medium- speed mode	XIN = 20 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8	I	4	ı	mA
			XIN = 16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8	-	3	_	mA
			XIN = 10 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-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 Divide-by-8	ı	1.5	ı	mA
		Low-speed on-chip oscillator mode	Main clock off High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8 FMR47 = 1	1	110	300	μΑ
		Wait mode	Main clock off High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz While a WAIT instruction is executed Peripheral clock operation VCA27 = VCA26 = 0	-	40	80	μА
		Wait mode	Main clock off High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz While a WAIT instruction is executed Peripheral clock off VCA27 = VCA26 = 0	_	38	76	μА
		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 VCA27 = VCA26 = 0	_	0.8	3.0	μА

Table 5.17 Senai intenace	<b>Table</b>	5.17	Serial	Interface
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Symbol	Symbol Parameter		Standard		
Symbol			Max.	Unit	
tc(CK)	CLKi input cycle time	200	=	ns	
tW(CKH)	CLKi input "H" width	100	=	ns	
tW(CKL)	CLKi input "L" width	100	=	ns	
td(C-Q)	TXDi output delay time	-	50	ns	
th(C-Q)	TXDi hold time	0	-	ns	
tsu(D-C)	RXDi input setup time	50	=	ns	
th(C-D)	RXDi input hold time	90	-	ns	

i = 0 or 1

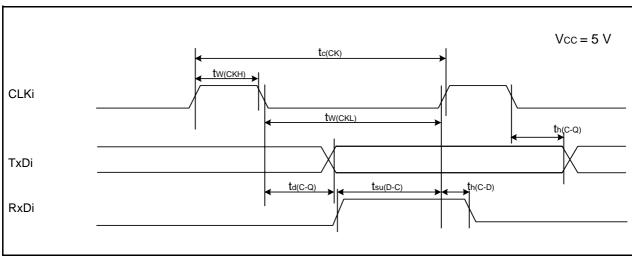


Figure 5.7 Serial Interface Timing Diagram when Vcc = 5 V

Table 5.18 External Interrupt INTO Input

Symbol	Parameter	Stan	dard	Unit
Syllibol	Faidilletei	Min.	Max.	Offic
tW(INH)	INTO input "H" width	250 <sup>(1)</sup>	-	ns
tW(INL)	INTO input "L" width	250(2)	-	ns

#### NOTES:

- 1. When selecting the digital filter by the INT0 input filter select bit, use an INT0 input HIGH width of either (1/digital filter clock frequency x 3) or the minimum value of standard, whichever is greater.
- 2. When selecting the digital filter by the INT0 input filter select bit, use an INT0 input LOW width of either (1/digital filter clock frequency x 3) or the minimum value of standard, whichever is greater.

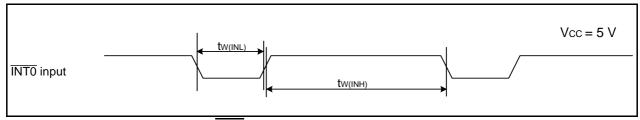


Figure 5.8 External Interrupt INTO Input Timing Diagram when Vcc = 5 V

Page 32 of 38

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

Symbol	Paran	notor	Cond	dition	St	andard		Unit
Symbol	Paran	neter	Conc	Condition		Тур.	Max.	Offic
Vон	Output "H" voltage	Except Xouт	Iон = -1 mA		Vcc - 0.5	_	Vcc	V
		Хоит	Drive capacity HIGH	IOH = -0.1 mA	Vcc - 0.5	-	Vcc	V
			Drive capacity LOW	Іон = -50 μΑ	Vcc - 0.5	_	Vcc	V
Vol	Output "L" voltage	Except P1_0 to P1_3, Xout	IOL = 1mA		-	=	0.5	V
		P1_0 to P1_3	Drive capacity HIGH	IOL = 2 mA	-	_	0.5	V
			Drive capacity LOW	IOL = 1 mA	-	_	0.5	V
		Хоит	Drive capacity HIGH	IOL = 0.1 mA	=	-	0.5	V
			Drive capacity LOW	IOL = 50 μA	-	-	0.5	V
VT+-VT-	Hysteresis	INTO, INT1, INT2, INT3, KIO, KI1, KI2, KI3, CNTRO, CNTR1, TCIN, RXD0			0.2	-	0.8	V
		RESET			0.2	-	1.8	V
Іін	Input "H" current	•	VI = 3 V		-	-	4.0	μΑ
lıL	Input "L" current		VI = 0 V		-	-	-4.0	μΑ
RPULLUP	Pull-up resistance		VI = 0 V		66	160	500	kΩ
RfXIN	Feedback resistance	XIN			=	3.0	=	ΜΩ
fring-s	Low-speed on-chip os	cillator frequency			40	125	250	kHz
VRAM	RAM hold voltage		During stop mode		2.0	-	-	V

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

Electrical Characteristics (4) [Vcc = 3V] (Topr = -40 to 85 °C, unless otherwise specified.) **Table 5.20** 

Symbol	Parameter	Condition			Standard		Unit
Cymbol					Тур.	Max.	01110
Icc	Power supply current (Vcc = 2.7 to 3.3 V) Single-chip mode, output pins are open,	High-speed mode	XIN = 20 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz No division	ı	8	13	mA
	other pins are Vss, comparator is stopped		XIN = 16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz No division	ſ	7	12	mA
			XIN = 10 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz No division	_	5	ı	mA
		Medium- speed mode	XIN = 20 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8	-	3		mA
			XIN = 16 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8	-	2.5	-	mA
			XIN = 10 MHz (square wave) High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz Divide-by-8	I	1.6	İ	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 Divide-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 Divide-by-8 FMR47 = 1	-	100	280	μΑ
		Wait mode	Main clock off High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz While a WAIT instruction is executed Peripheral clock operation VCA27 = VCA26 = 0	<del>-</del>	37	74	μΑ
		Wait mode	Main clock off High-speed on-chip oscillator off Low-speed on-chip oscillator on = 125 kHz While a WAIT instruction is executed Peripheral clock off VCA27 = VCA26 = 0	=	35	70	μΑ
		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 VCA27 = VCA26 = 0	-	0.7	3.0	μА

## **Timing requirements**

(Unless Otherwise Specified: Vcc = 3 V, Vss = 0 V at Ta = 25 °C) [Vcc = 3 V]

Table 5.21 XIN Input

Symbol	Parameter	Stan	dard	Unit
Symbol	Falanielei		Max.	Offic
tc(XIN)	XIN input cycle time	100	=	ns
twh(xin)	XIN input "H" width	40	=	ns
tWL(XIN)	XIN input "L" width	40	=	ns

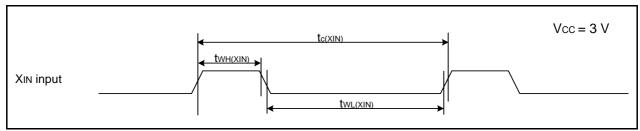


Figure 5.9 XIN Input Timing Diagram when Vcc = 3 V

Table 5.22 CNTR0 Input, CNTR1 Input, INT1 Input

Symbol	Parameter	Standard		Unit	
Symbol	Faranietei	Min.	Max.	Offic	
tc(CNTR0)	CNTR0 input cycle time	300	-	ns	
tWH(CNTR0)	CNTR0 input "H" width	120	=	ns	
tWL(CNTR0)	CNTR0 input "L" width	120	-	ns	

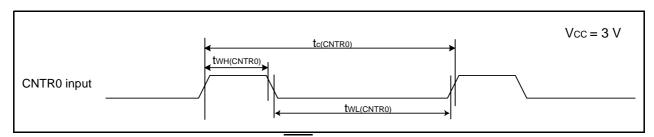


Figure 5.10 CNTR0 Input, CNTR1 Input, INT1 Input Timing Diagram when Vcc = 3 V

Table 5.23 TCIN Input, INT3 Input

Symbol	Parameter	Stan	dard	Unit
Symbol	Falametei	Min.	Max.	
tc(TCIN)	TCIN input cycle time	1,200(1)	-	ns
tWH(TCIN)	TCIN input "H" width	600(2)	-	ns
twl(tcin)	TCIN input "L" width	600(2)	_	ns

- 1. When using the timer C input capture mode, adjust the cycle time to (1/timer C count source frequency × 3) or above.
- 2. When using the timer C input capture mode, adjust the width to (1/timer C count source frequency x 1.5) or above.

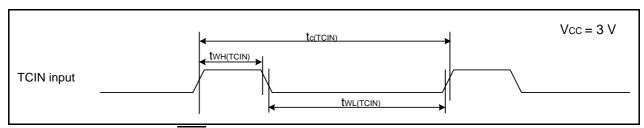


Figure 5.11 TCIN Input, INT3 Input Timing Diagram when Vcc = 3 V

Table 5.24 Serial Interface

Symbol	Parameter		Standard		
	Faidilletei	Min.	Max.	Unit	
tc(CK)	CLKi input cycle time	300	=	ns	
tW(CKH)	CLKi input "H" width	150	=	ns	
tW(CKL)	CLKi input "L" width	150	-	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	70	=	ns	
th(C-D)	RXDi input hold time	90	-	ns	

i = 0 or 1

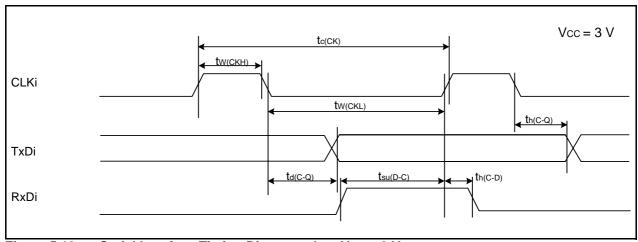


Figure 5.12 Serial Interface Timing Diagram when Vcc = 3 V

Table 5.25 External Interrupt INTO Input

Symbol	Parameter	Stan	dard	Unit
Symbol	Falametei		Max.	Offic
tW(INH)	INTO input "H" width	380 <sup>(1)</sup>	-	ns
tW(INL)	INTO input "L" width	380(2)	-	ns

- 1. When selecting the digital filter by the INT0 input filter select bit, use an INT0 input HIGH width of either (1/digital filter clock frequency x 3) or the minimum value of standard, whichever is greater.
- 2. When selecting the digital filter by the INT0 input filter select bit, use an INT0 input LOW width of either (1/digital filter clock frequency x 3) or the minimum value of standard, whichever is greater.

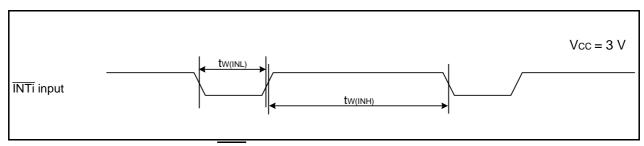
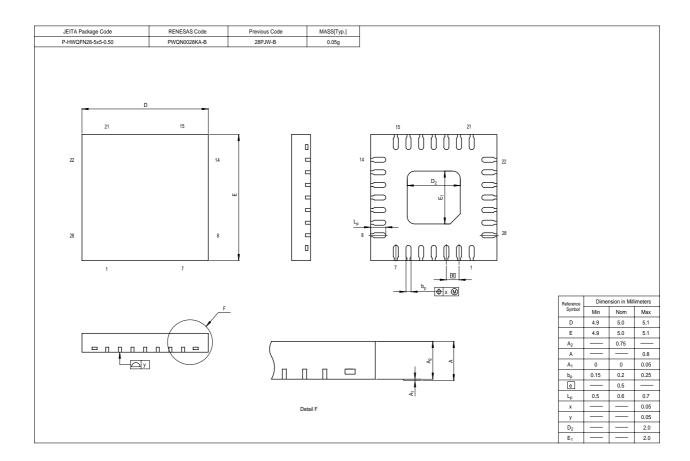


Figure 5.13 External Interrupt INTO Input Timing Diagram when Vcc = 3 V



F	REVISION HISTORY			R8C/18 Group, R8C/19 Group Datasheet			
Rev.	Date			Description			
Nev.	Date	Page		Summary			
1.20	Nov 01, 2005	16	0009h: 000Ah:	SFR Information(1);  "XXXXXX00b" → "00h"  "00XXX000b" → "00h"  "XXXXX000b" → "00h" revised			
		18	0085h: 0086h: 0087h: 008Ch: 008Dh:	SFR Information(3);  "Prescaler Z" → "Prescaler Z Register"  "Timer Z Secondary" → "Timer Z Secondary Register"  "Timer Z Primary" → "Timer Z Primary Register"  "Prescaler X" → "Prescaler X Register"  "Timer X" → "Timer X Register"  0091h: "Timer C" → "Timer C Register" revised			
		22		Flash Memory (Program ROM) Electrical Characteristics; 3 and 5 revised, NOTE8 deleted			
		23		Flash Memory (Data flash Block A, Block B) Electrical ristics; NOTES 1 and 3 revised			
		25		Reset Circuit Electrical Characteristics (When Using Voltage Reset); NOTE 2 revised			
		26	Character "High-S "High-S	O High-speed On-Chip Oscillator Circuit Electrical ristics; peed On-Chip Oscillator" → peed On-Chip Oscillator Frequency" revised 2, 3 added			
		28		3 Electrical Characteristics (2) [Vcc = 5V]; deleted			
		32		D Electrical Characteristics (4) [Vcc = 3V]; I deleted			
1.30	Dec 16, 2005	_	Products	of PWQN0028KA-B package included			
		5, 6	Table 1.3,	Table 1.4 revised			
		24		Flash Memory (Program ROM) Electrical Characteristics; pient temperature			
		25		Flash Memory (Data flash Block A, Block B) Electrical ristics; Ta → Ambient temperature			
		30, 34	Table 5.13	3, Table 5.20; The title revised, Condition of Stop Mode added			
		32, 36	Table 5.17	7, Table 5.24; td(C-Q) and tsu(D-C) revised			
		37, 38	Package	Dimensions revised			
1.40	Apr 14, 2006	2, 3	•	Table 1.2; : Internal 8 → 10 sources,			
		5, 6	Table 1.3,	Table 1.4; Type No. added, deleted			
		16, 17	Figure 3.1	, Figure 3.2; Part Number added, deleted			
		24, 25	Table 5.4, Conditions	Table 5.5; s: VCC = 5.0 V at Topr = 25 °C deleted			

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