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R8C/35C Group

Entering Wait Mode Using the Wait Control Bit

1. Abstract

This document describes the setting method and an application example for entering wait mode and exiting wait mode using the wait control bit in the R8C/35C Group.

2. Introduction

The application example described in this document applies to the following MCU:

- MCU : R8C/35C Group

This program can be used with other R8C/Tiny Series MCUs which have the same special function registers (SFRs) as the R8C/35C Group. Check the manual for any additions and modifications to functions. Careful evaluation is recommended before using this application note.

3. Application Example

3.1 Program Outline

Follow the steps below to switch operating modes, enter wait mode, and exit wait mode. In this example, the UART2 receive interrupt request is used to exit wait mode.

- (1) After reset is deasserted, first oscillate the high-speed on-chip oscillator clock and then XCIN clock.
- (2) After waiting until the high-speed on-chip oscillator clock and XCIN clock oscillation stabilize, switch the system clock to high-speed on-chip oscillator clock and select high-speed on-chip oscillator mode (no division) as the operating mode.
- (3) When entering wait mode, switch the system clock to the XCIN clock, select low-speed clock mode (no division) as the operating mode, and stop the high-speed on-chip oscillator clock. Set the CM35 bit in the CM3 register to 0 (the CM06 bit in the CM0 register and bits CM16 and CM17 in the CM1 register are enabled) and bits CM37 and CM36 to 10b (high-speed on-chip oscillator clock selected).
- (4) Set the CM30 bit in the CM3 register (select wait mode) to enter wait mode. The interrupt used to exit wait mode is enabled and the interrupt enable flag (I flag) is disabled.
- (5) After the UART2 receive interrupt request is generated by serial reception (UART mode of UART2 used) from the external, exit wait mode. Do not execute the interrupt routine at this point. Since the system clock is automatically switched to the high-speed on-chip oscillator clock after exiting wait mode, the operating mode becomes high-speed clock mode (no division).
- (6) Repeat steps (3) to (5).

Figure 3.1 shows a Connection Example. Figure 3.2 shows a Wait Mode Operation Example Using the Wait Control Bit. Table 3.1 lists the Pin and Its Function.

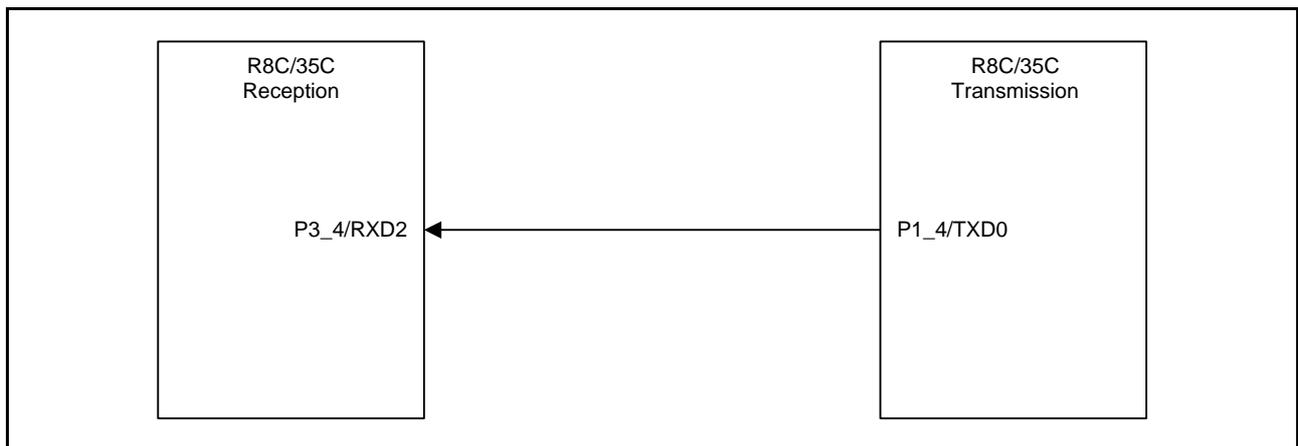


Figure 3.1 Connection Example

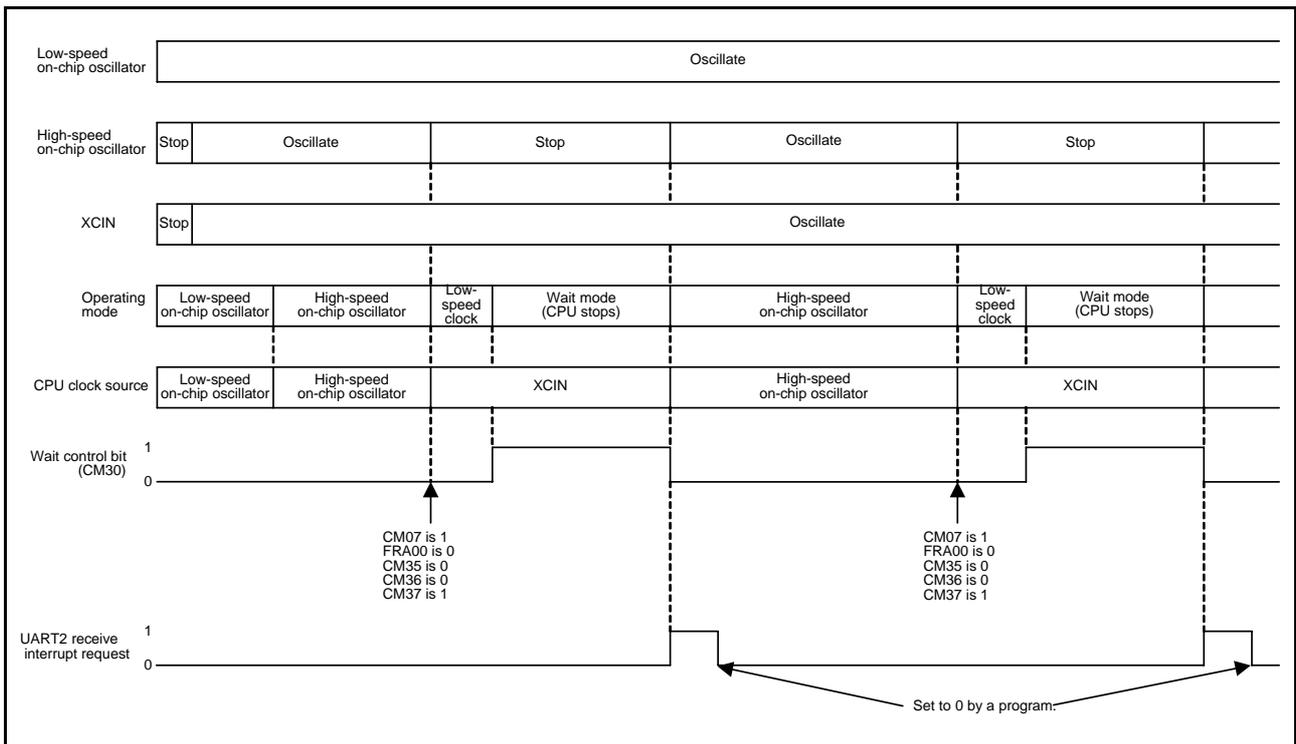


Figure 3.2 Wait Mode Operation Example Using the Wait Control Bit

Table 3.1 Pin and Its Function

Pin Name	I/O	Function
P3_4/RXD2	Input	Serial data input

3.2 Memory

Table 3.2 Memory

Memory	Size	Remarks
ROM	266 bytes	In the rej05b1251_src.c module
RAM	2 bytes	In the rej05b1251_src.c module
Maximum user stack	10 bytes	
Maximum interrupt stack	0 bytes	

Memory size varies depending on the C compiler version and compile options. The above applies to the following conditions:

C compiler: M16C/60, 30, 20, 10, and Tiny and R8C/Tiny Series Compiler V.5.45 Release 00
Compile option: -c -finfo -dir "\$(CONFIGDIR)" -R8C

4. Software

This section shows the initial setting procedures and values to set the example described in section 3. Application Example. Refer to the latest R8C/35C Group Hardware Manual for details on individual registers.

The × in the register's Setting Value represents bits not used in this application, blank spaces represent bits that do not change, and the dash represents reserved bits or bits that have nothing assigned.

4.1 Function Tables

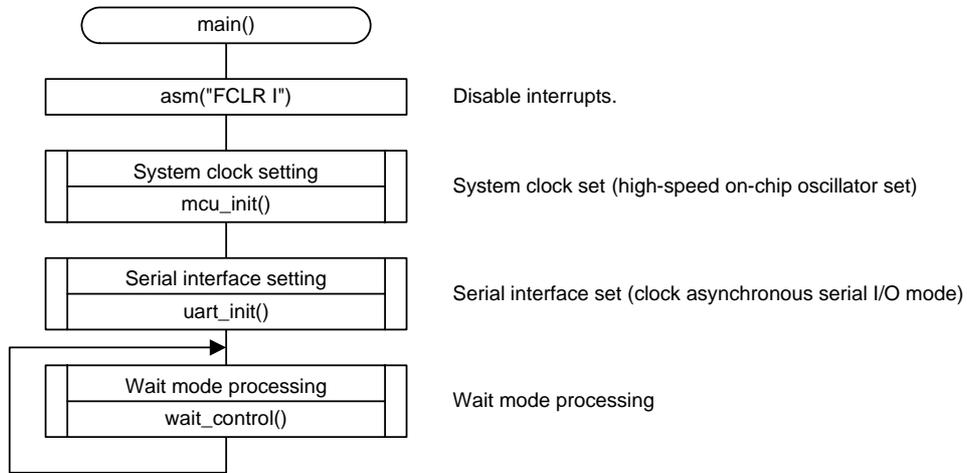
Declaration	void mcu_init(void)		
Outline	System clock setting		
Argument	Argument name		Meaning
	None		—
Variable (global)	Variable name		Contents
	None		—
Returned value	Type	Value	Meaning
	None	—	—
Function	Set the system clock (high-speed on-chip oscillator).		

Declaration	void uart_init(void)		
Outline	Serial interface setting		
Argument	Argument name		Meaning
	None		—
Variable (global)	Variable name		Contents
	None		—
Returned value	Type	Value	Meaning
	None	—	—
Function	Set the serial interface (clock asynchronous serial I/O mode).		

Declaration	void wait_control(void)		
Outline	Wait mode processing		
Argument	Argument name		Meaning
	None		—
Variable (global)	Variable name		Contents
	unsigned short rcv_buf		Receive data buffer
Returned value	Type	Value	Meaning
	None	—	—
Function	Process to enter and exit wait mode.		

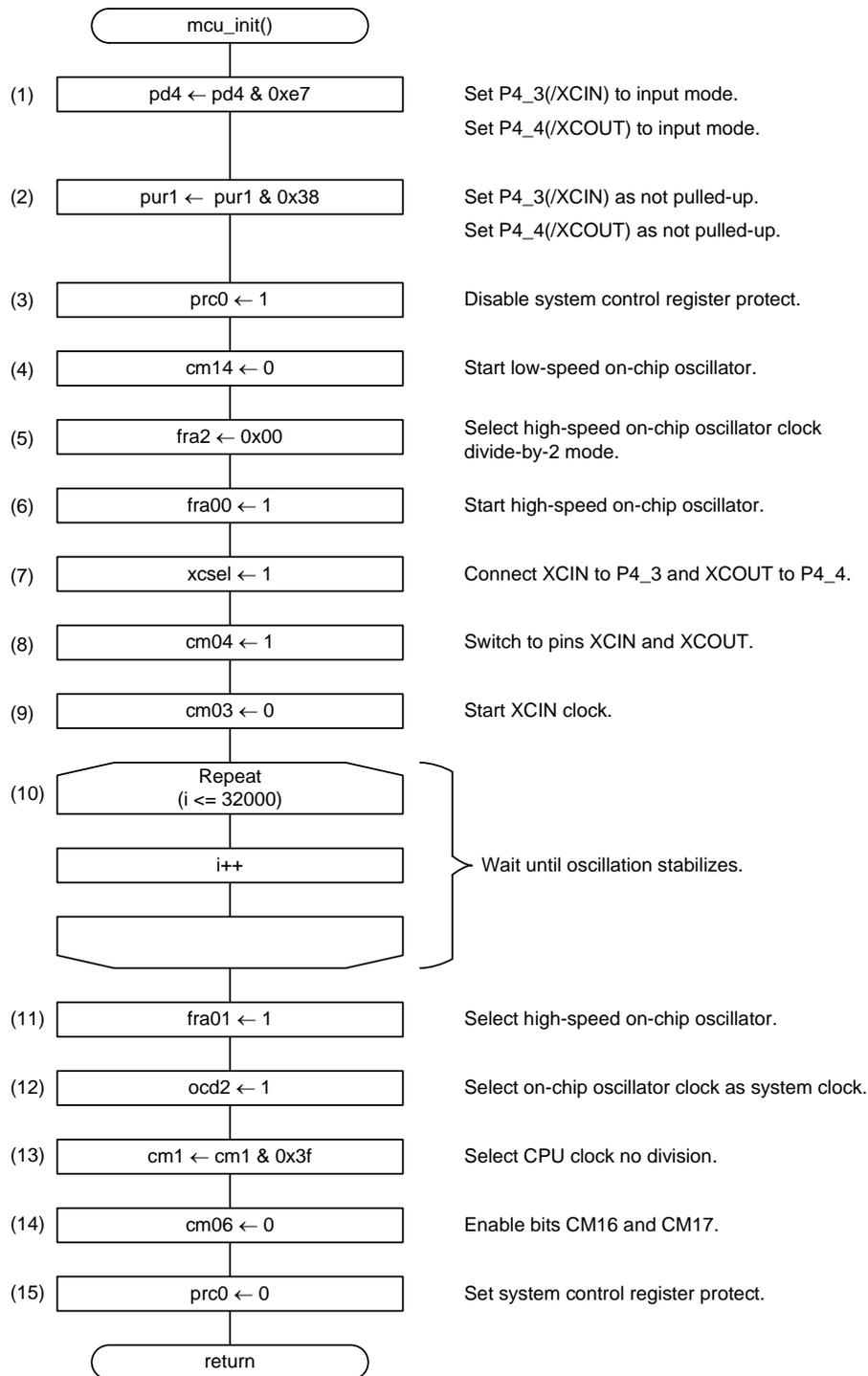
4.2 Main Function

- Flowchart



4.3 System Clock Setting

• Flowchart



• Register settings

(1) Set P4_3(/XCIN) and P4_4(/XCOUT) to input mode.

Port P4 Direction Register (PD4)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	x	x	x	0	0	—	—	—

Bit	Symbol	Bit Name	Function	R/W
b3	PD4_3	Port P4_3 direction bit	0: Input mode (functions as an input port)	R/W
b4	PD4_4	Port P4_4 direction bit	0: Input mode (functions as an input port)	R/W

(2) Set P4_3(/XCIN) and P4_4(/XCOUT) as not pulled-up.

Pull-Up Control Register 1 (PUR1)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	x	x	x	—	0	0

Bit	Symbol	Bit Name	Function	R/W
b0	PU10	P4_3 pull-up	0: Not pulled up	R/W
b1	PU11	P4_4 to P4_7 pull-up	0: Not pulled up	R/W

(3) Enable writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3.

Protect Register (PRCR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	x	x	x	1

Bit	Symbol	Bit Name	Function	R/W
b0	PRC0	Protect bit 0	Enables writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3. 1: Write enabled	R/W

(4) Start the low-speed on-chip oscillator.

System Clock Control Register 1 (CM1)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value			—	0	x	x	x	x

Bit	Symbol	Bit Name	Function	R/W
b4	CM14	Low-speed on-chip oscillator stop bit	0: Low-speed on-chip oscillator on	R/W

(5) Set the division ratio for the high-speed on-chip oscillator.

High-Speed On-Chip Oscillator Control Register 2 (FRA2)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	—	0	0	0

Bit	Symbol	Bit Name	Function	R/W
b0	FRA20	High-speed on-chip oscillator frequency switching bit	Division selection	R/W
b1	FRA21		These bits select the division ratio for the high-speed on-chip oscillator clock. b2 b1 b0 0 0 0: Divide-by-2 mode	R/W
b2	FRA22			R/W

(6) Start the high-speed on-chip oscillator.

High-Speed On-Chip Oscillator Control Register 0 (FRA0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	x	—	—	1

Bit	Symbol	Bit Name	Function	R/W
b0	FRA00	High-speed on-chip oscillator enable bit	1: High-speed on-chip oscillator on	R/W

(7) Connect XCIN to P4_3 and XCOOUT to P4_4.

I/O Function Pin Select Register (PINSR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	x	x	x	x	x	—	—	1

Bit	Symbol	Bit Name	Function	R/W
b0	XCSEL	XCIN/XCOOUT pin connect bit	1: XCIN connected to P4_3, XCOOUT connected to P4_4	R/W

(8) Switch to the XCIN and XCOOUT pin.

System Clock Control Register 0 (CM0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	x	1	—	—	—	—

Bit	Symbol	Bit Name	Function	R/W
b4	CM04	Port/XCIN-XCOOUT switch bit	1: XCIN-XCOOUT pin	R/W

(9) Start the XCIN clock.

System Clock Control Register 0 (CM0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value			x		0		—	—

Bit	Symbol	Bit Name	Function	R/W
b3	CM03	XCIN clock stop bit	0: XCIN clock oscillates	R/W

(10) Wait until oscillation stabilizes.

(11) Select the high-speed on-chip oscillator.

High-Speed On-Chip Oscillator Control Register 0 (FRA0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	x	—	1	

Bit	Symbol	Bit Name	Function	R/W
b1	FRA01	High-speed on-chip oscillator select bit	1: High-speed on-chip oscillator selected	R/W

(12) Select the on-chip oscillator clock as the system clock.

Oscillation Stop Detection Register (OCD)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	x	1	x	x

Bit	Symbol	Bit Name	Function	R/W
b2	OCD2	System clock select bit	1: On-chip oscillator clock selected	R/W

(13) Set CPU clock division select bit 1.

System Clock Control Register 1 (CM1)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	0	0	—		x	x	x	x

Bit	Symbol	Bit Name	Function	R/W
b6	CM16	CPU clock division select bit 1	^{b7 b6} 0 0: No division mode	R/W
b7	CM17			R/W

(14) Set CPU clock division select bit 0.

System Clock Control Register 0 (CM0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value		0	x				—	—

Bit	Symbol	Bit Name	Function	R/W
b6	CM06	CPU clock division select bit 0	0: Bits CM16 and CM17 in CM1 register enabled	R/W

(15) Disable writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3.

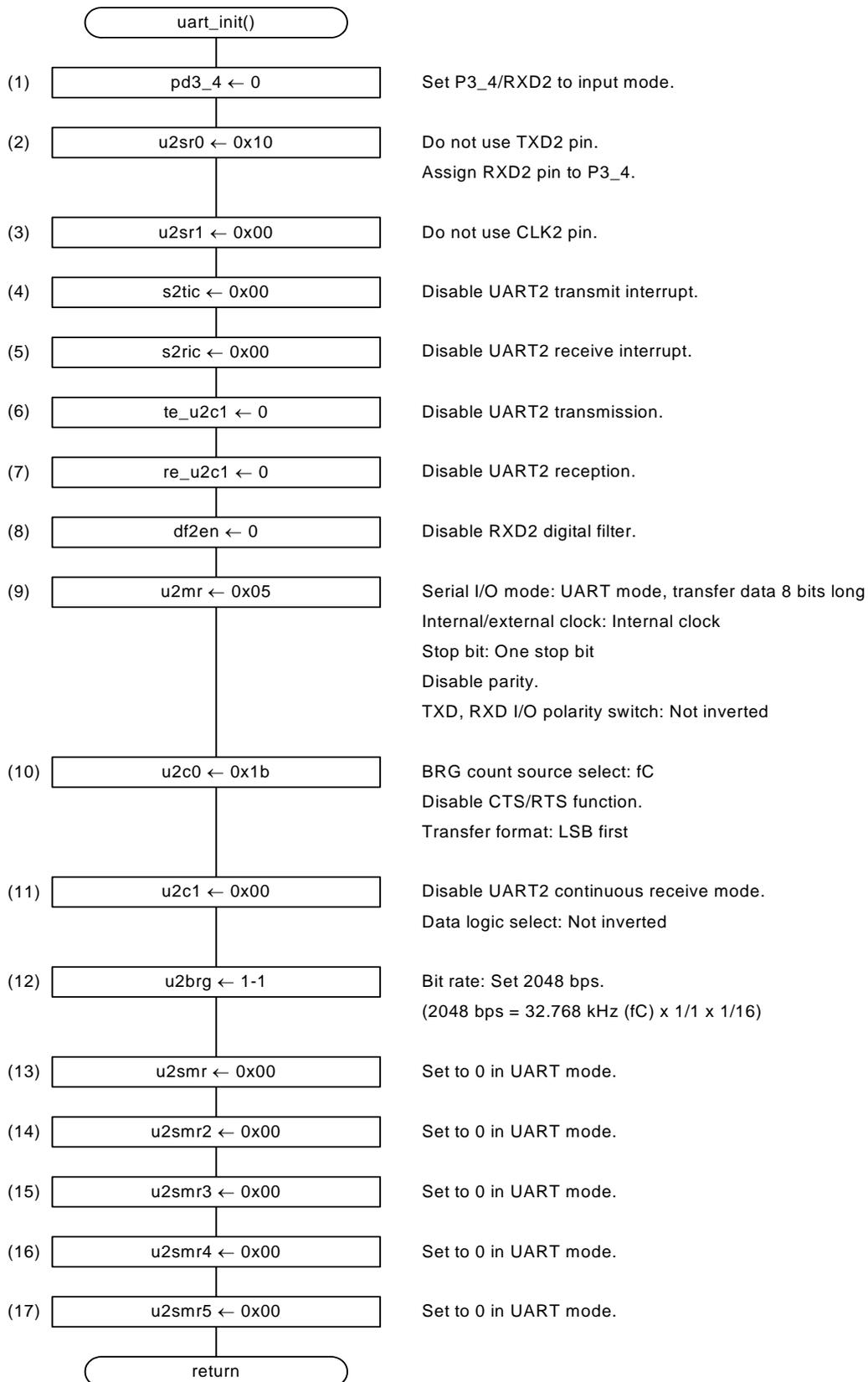
Protect Register (PRCR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	x	x	x	0

Bit	Symbol	Bit Name	Function	R/W
b0	PRC0	Protect bit 0	Enables writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3. 0: Write disabled	R/W

4.4 Serial Interface Setting

• Flowchart



• Register settings

(1) Set P3_4/RXD2 to input mode.

Port P3 Direction Register (PD3)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	x	x	x	0	x	x	x	x

Bit	Symbol	Bit Name	Function	R/W
b4	PD3_4	Port P3_4 direction bit	0: Input mode (functions as an input port)	R/W

(2) Set the TXD2/SDA2 pin select bit and RXD2/SCL2 pin select bit.

UART2 Pin Select Register 0 (U2SR0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	0	1	—	0	0	0

Bit	Symbol	Bit Name	Function	R/W
b0	TXD2SEL0	TXD2/SDA2 pin select bit	b2 b1 b0 0 0 0: TXD2/SDA2 pin not used	R/W
b1	TXD2SEL1			R/W
b2	TXD2SEL2			R/W
b4	RXD2SEL0	RXD2/SCL2 pin select bit	b5 b4 0 1: P3_4 assigned	R/W
b5	RXD2SEL1			R/W

(3) Set the CLK2 pin select bit.

UART2 Pin Select Register 1 (U2SR1)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	x	—	—	0	0

Bit	Symbol	Bit Name	Function	R/W
b0	CLK2SEL0	CLK2 pin select bit	b2 b1 b0 0 0 0: CLK2 pin not used	R/W
b1	CLK2SEL1			R/W

(4) Disable the UART2 transmit interrupt.

Interrupt Control Register (S2TIC)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	0	0	0	0

Bit	Symbol	Bit Name	Function	R/W
b0	ILVL0	Interrupt priority level select bit	b2 b1 b0 0 0 0: Level 0 (interrupt disabled)	R/W
b1	ILVL1			R/W
b2	ILVL2			R/W
b3	IR	Interrupt request bit	0: No interrupt requested	R/W

(5) Disable the UART2 receive interrupt.

Interrupt Control Register (S2RIC)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	0	0	0	0

Bit	Symbol	Bit Name	Function	R/W
b0	ILVL0	Interrupt priority level select bit	b2 b1 b0 0 0 0: Level 0 (interrupt disabled)	R/W
b1	ILVL1			R/W
b2	ILVL2			R/W
b3	IR	Interrupt request bit	0: No interrupt requested	R/W

(6) Disable UART2 transmission.

UART2 Transmit/Receive Control Register 1 (U2C1)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	x			x			x	0

Bit	Symbol	Bit Name	Function	R/W
b0	TE	Transmit enable bit	0: Transmission disabled	R/W

(7) Disable UART2 reception.

UART2 Transmit/Receive Control Register 1 (U2C1)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	x			x		0	x	

Bit	Symbol	Bit Name	Function	R/W
b2	RE	Receive enable bit	0: Reception disabled	R/W

(8) Disable the RXD2 digital filter.

UART2 Digital Filter Function Select Register (URXDF)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	—	0	—	—

Bit	Symbol	Bit Name	Function	R/W
b2	DF2EN	RXD2 digital filter enable bit	0: RXD2 digital filter disabled	R/W

(9) Set the UART2 transmit/receive mode register.

UART2 Transmit/Receive Mode Register (U2MR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	0	0	x	0	0	1	0	1

Bit	Symbol	Bit Name	Function	R/W
b0	SMD0	Serial I/O mode select bit	b2 b1 b0 1 0 1: UART mode, transfer data 8 bits long	R/W
b1	SMD1			R/W
b2	SMD2			R/W
b3	CKDIR	Internal/external clock select bit	0: Internal clock	R/W
b4	STPS	Stop bit length select bit	0: One stop bit	R/W
b6	PRYE	Parity enable bit	0: Parity disabled	R/W
b7	IOPOL	TXD, RXD I/O polarity switch bit	0: Not inverted	R/W

(10) Set UART2 transmit/receive control register 0.

UART2 Transmit/Receive Control Register 0 (U2C0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	0	x	x	1	x	x	1	1

Bit	Symbol	Bit Name	Function	R/W
b0	CLK0	U2BRG count source select bit	b2 b1 b0 1 1: fC selected	R/W
b1	CLK1			R/W
b4	CRD	CTS/RTS disable bit	1: CTS/RTS function disabled	R/W
b7	UFORM	Transfer format select bit	0: LSB first	R/W

(11) Disable UART2 continuous receive mode. Set the data logic select bit.

UART2 Transmit/Receive Control Register 1 (U2C1)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	x	0	0	x			x	

Bit	Symbol	Bit Name	Function	R/W
b5	U2PRM	UART2 continuous receive mode enable bit	0: Continuous receive mode disabled	R/W
b6	U2LCH	Data logic select bit	0: Not inverted	R/W

(12) Set the UART2 bit rate register. Set 2048 bps in this application note. Set 1-1 (00h) based on the calculation formula below:

- $2048 \text{ bps} = 32.768 \text{ kHz (fC)} \times 1/1 \times 1/16$

UART2 Bit Rate Register (U2BRG)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	0	0	0	0	0	0	0	0

Bit	Function	Setting Range	R/W
b7 to b0	If the setting value is n, U2BRG divides the count source by n+1.	00h to FFh	W

(13) Set 0 to the UART2 special mode register (U2SMR) in UART mode.

(14) Set 0 to the UART2 special mode register 2 (U2SMR2) in UART mode.

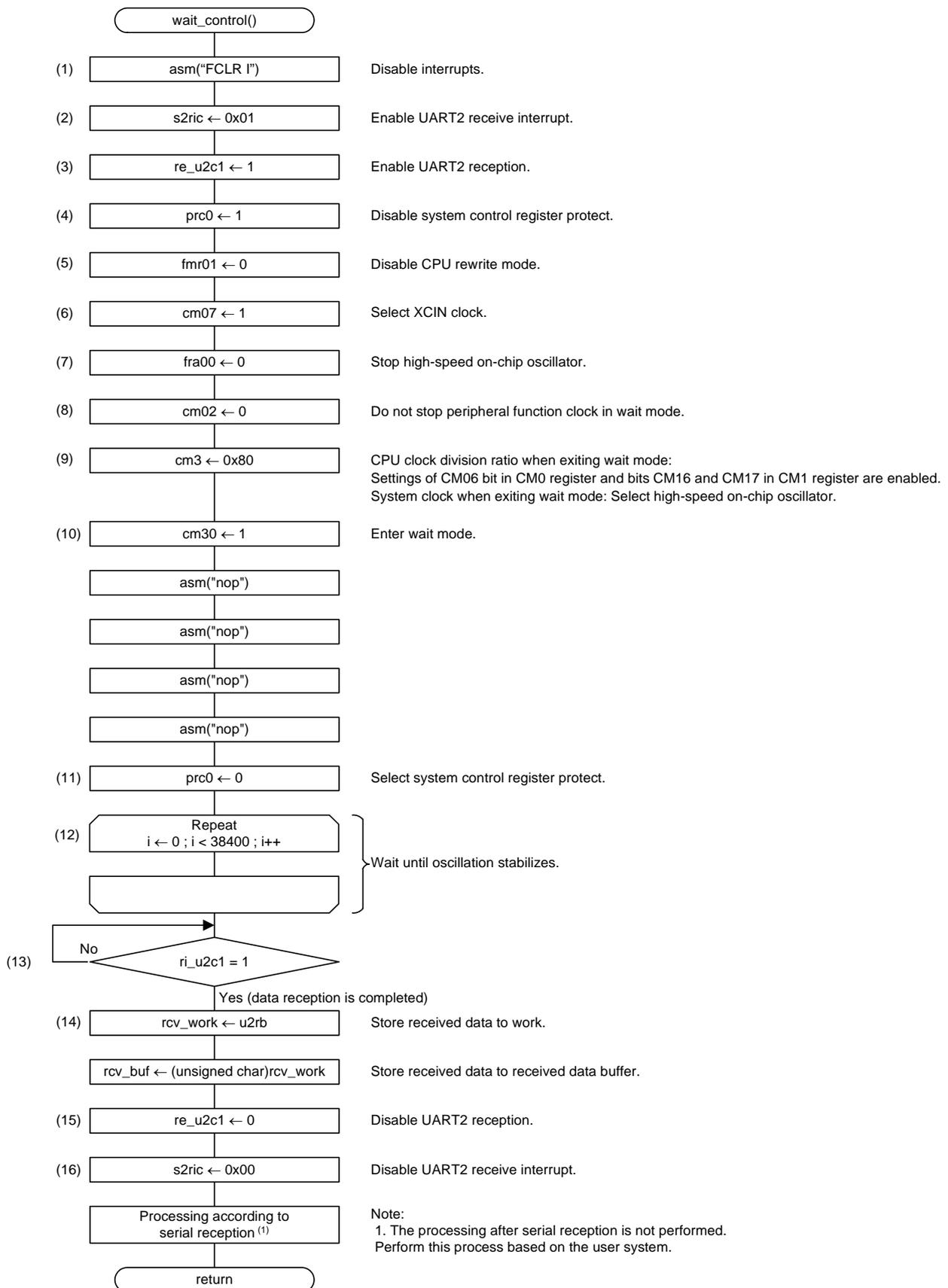
(15) Set 0 to the UART2 special mode register 3 (U2SMR3) in UART mode.

(16) Set 0 to the UART2 special mode register 4 (U2SMR4) in UART mode.

(17) Set 0 to the UART2 special mode register 5 (U2SMR5) in UART mode.

4.5 Wait Mode Processing

• Flowchart



• Register settings

(1) Disable interrupts.

(2) Enable the UART2 receive interrupt.

Interrupt Control Register (S2RIC)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	0	0	0	1

Bit	Symbol	Bit Name	Function	R/W
b0	ILVL0	Interrupt priority level select bit	b2 b1 b0 0 0 1: Level 1	R/W
b1	ILVL1			R/W
b2	ILVL2			R/W
b3	IR	Interrupt request bit	0: No interrupt requested	R/W

(3) Enable UART2 reception.

UART2 Transmit/Receive Control Register 1 (U2C1)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	x			x		1	x	

Bit	Symbol	Bit Name	Function	R/W
b2	RE	Receive enable bit	1: Reception enabled	R/W

(4) Enable writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3.

Protect Register (PRCR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	x	x	x	1

Bit	Symbol	Bit Name	Function	R/W
b0	PRC0	Protect bit 0	Enables writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3. 1: Write enabled	R/W

(5) Disable CPU rewrite mode.

Flash Memory Control Register 0 (FMR0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	x	x	x	x	x	x	0	—

Bit	Symbol	Bit Name	Function	R/W
b1	FMR01	CPU rewrite mode select bit	0: CPU rewrite mode disabled	R/W

(6) Switch the system clock to the XCIN clock.

System Clock Control Register 0 (CM0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	1		x				—	—

Bit	Symbol	Bit Name	Function	R/W
b7	CM07	XIN, XCIN clock select bit	1: XCIN clock	R/W

(7) Stop the high-speed on-chip oscillator.

High-Speed On-Chip Oscillator Control Register 0 (FRA0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	x	—		0

Bit	Symbol	Bit Name	Function	R/W
b0	FRA00	High-speed on-chip oscillator enable bit	0: High-speed on-chip oscillator off	R/W

(8) Select the wait mode peripheral function clock stop bit.

System Clock Control Register 0 (CM0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value			x			0	—	—

Bit	Symbol	Bit Name	Function	R/W
b2	CM02	Wait mode peripheral function clock stop bit	0: Peripheral function clock does not stop in wait mode	R/W

(9) Select the high-speed on-chip oscillator as the system clock when exiting wait mode.

System Clock Control Register 3 (CM3)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	1	0	0	—	—	—	—	

Bit	Symbol	Bit Name	Function	R/W
b5	CM35	CPU clock division when exiting wait mode select bit	0: Following settings are enabled: CM06 bit in CM0 register Bits CM16 and CM17 in CM1 register	R/W
b6	CM36	System clock when exiting wait mode or stop mode select bit	b7 b6 1 0: High-speed on-chip oscillator clock selected	R/W
b7	CM37			R/W

(10) Enter wait mode.

System Clock Control Register 3 (CM3)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value				—	—	—	—	1

Bit	Symbol	Bit Name	Function	R/W
b0	CM30	Wait control bit	1: MCU enters wait mode	R/W

(11) Disable writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3.

Protect Register (PRCR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	x	x	x	0

Bit	Symbol	Bit Name	Function	R/W
b0	PRC0	Protect bit 0	Enables writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3. 0: Write disabled	R/W

(12) Wait until oscillation stabilizes.

(13) Determine reception is completed.

UART2 Transmit/Receive Control Register 1 (U2C1)

Bit	Symbol	Bit Name	Function	R/W
b3	RI	Receive complete flag	0: No data in the U2RB register 1: Data present in the U2RB register	R

(14) Read the value in the UART2 receive buffer register.

UART2 Receive Buffer Register (U2RB)

Bit	Symbol	Bit Name	Function	R/W
b0	—	—	Receive data (D7 to D0)	R
b1	—			
b2	—			
b3	—			
b4	—			
b5	—			
b6	—			
b7	—			
b12	OER	Overrun error flag	0: No overrun error 1: Overrun error	R
b13	FER	Framing error flag	0: No framing error 1: Framing error	R
b14	PER	Parity error flag	0: No parity error 1: Parity error	R
b15	SUM	Error sum flag	0: No error 1: Error	R

(15) Disable UART2 reception.

UART2 Transmit/Receive Control Register 1 (U2C1)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	x		0	x		0	x	x

Bit	Symbol	Bit Name	Function	R/W
b2	RE	Receive enable bit	0: Reception disabled	R/W

(16) Disable the UART2 receive interrupt.

Interrupt Control Register (S2RIC)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	0	0	0	0

Bit	Symbol	Bit Name	Function	R/W
b0	ILVL0	Interrupt priority level select bit	b2 b1 b0 0 0 0: Level 0 (interrupt disabled)	R/W
b1	ILVL1			R/W
b2	ILVL2			R/W
b3	IR	Interrupt request bit	0: No interrupt requested	R/W

5. Sample Programming Code

A sample program can be downloaded from the Renesas Technology website.

To download, click “Application Notes” in the left-hand side menu of the R8C/Tiny Series page.

6. Reference Documents

Hardware Manual

R8C/35C Group Hardware Manual Rev. 0.10

The latest version can be downloaded from the Renesas Technology website.

Technical Update/Technical News

The latest information can be downloaded from the Renesas Technology website.

Website and Support

Renesas Technology website
<http://www.renesas.com/>

Inquiries
<http://www.renesas.com/inquiry>
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REVISION HISTORY	R8C/35C Group Entering Wait Mode Using the Wait Control Bit
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Rev.	Date	Description	
		Page	Summary
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