R8C/35A Group

Clock Operation Using RTC

R01AN0079EJ0100
Rev.1.00
July 30, 2010

1. Abstract

This document describes a setting method and an application example for a clock operation program using timer RE (real-time clock mode) in the R8C/35A Group.

2. Introduction

The application example described in this document applies to the following microcomputer (MCU) and parameters:

- MCU: R8C/35A Group
- XIN clock frequency: 20 MHz
- XCIN clock frequency: 32.768 kHz

This application note can be used with other R8C Family MCUs which have the same special function registers (SFRs) as the above group. Check the manual for any modifications to functions. Careful evaluation is recommended before using the program described in this application note.

3. Application Example

3.1 Program Outline

Operate timer RE in real-time clock mode. The count start from “Thursday, January 1, 2009, 00:00:00” (initial value) and timer RE operates in 24-hour mode. When the count is incremented from “December 31, 9999, 23:59:59”, it becomes “January 1, 000, 00:00:00”. Use a periodic interrupt triggered every second to obtain the second data (TRESEC), minute data (TREMIN), hour data (TREHR), and day of the week data (TREWK). When the day of the week changes, update the date data. Use the BCD code for the date data.
Leap years are determined by the following:

- A year when the Western calender can be divided by 4 is a leap year.
- A year when the Western calender can be divided by 100 is a common year.
- A year when the Western calender can be divided by 400 is a leap year.

Settings

- Use the 20 MHz XIN clock for the CPU clock.
- Use fC4 (XCIN clock (32.768 kHz) divided by 4) for the timer RE count source.
- Select 24-hour mode.
- Stop the low-speed on-chip oscillator.
- Use the timer RE interrupt (periodic interrupt triggered every second).
  (The BSY bit is not used since interrupt handling is performed immediately.)

Figure 3.1 shows a Block Diagram. Figure 3.2 shows a Operation Flowchart.

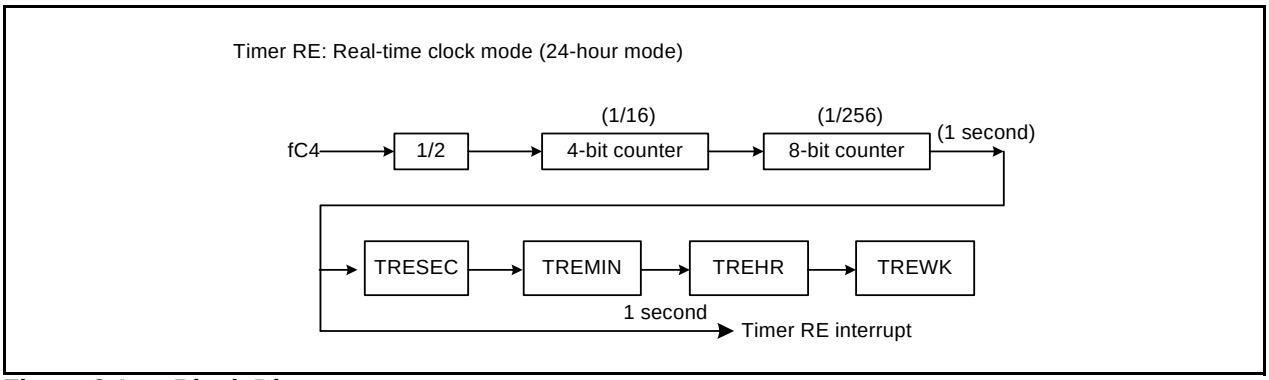


Figure 3.1 Block Diagram

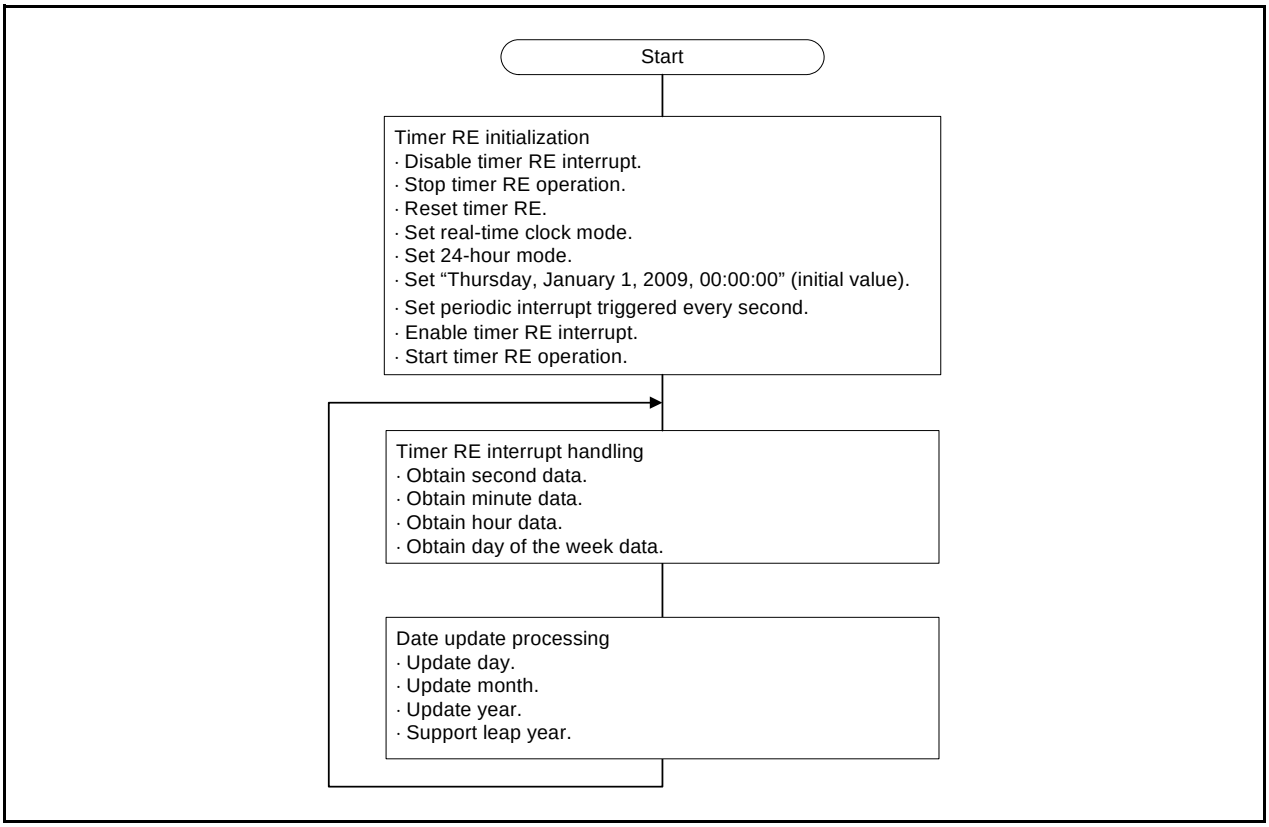


Figure 3.2 Operation Flowchart

3.2 Memory

Table 3.1 Memory

Memory	Size	Remarks
ROM	645 bytes	In the r01an0079_src.c module
RAM	11 bytes	In the r01an0079_src.c module
Maximum user stack	19 bytes	
Maximum interrupt stack	4 bytes	

Memory size varies depending on the C compiler version and compile options.
The above applies to the following conditions:
C compiler: M16C Series, R8C Family C Compiler V.5.45 Release 01
Compile options: -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/35A Group** hardware user's 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 main(void)		
Outline	Main function		
Argument	Argument name		Meaning
	None		—
Variable (global)	Variable name		Contents
	unsigned char leap_flg		Leap year flag
	unsigned char up_flg		Update flag
Returned value	Type	Value	Meaning
	None	—	—
Function	Initialize the system clock and timer RE. Determine whether the year of the initialized date is a leap year and set the leap year flag. Start counting timer RE. When the update flag is 1, update the date.		

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 (XIN clock) and XCIN clock.		

Declaration	void timer_re_init(void)		
Outline	Timer RE associated SFR initial setting		
Argument	Argument name		Meaning
	None		—
Variable (global)	Variable name		Contents
	None		—
Returned value	Type	Value	Meaning
	None	—	—
Function	Initialize SFRs to use timer RE in real-time clock mode.		

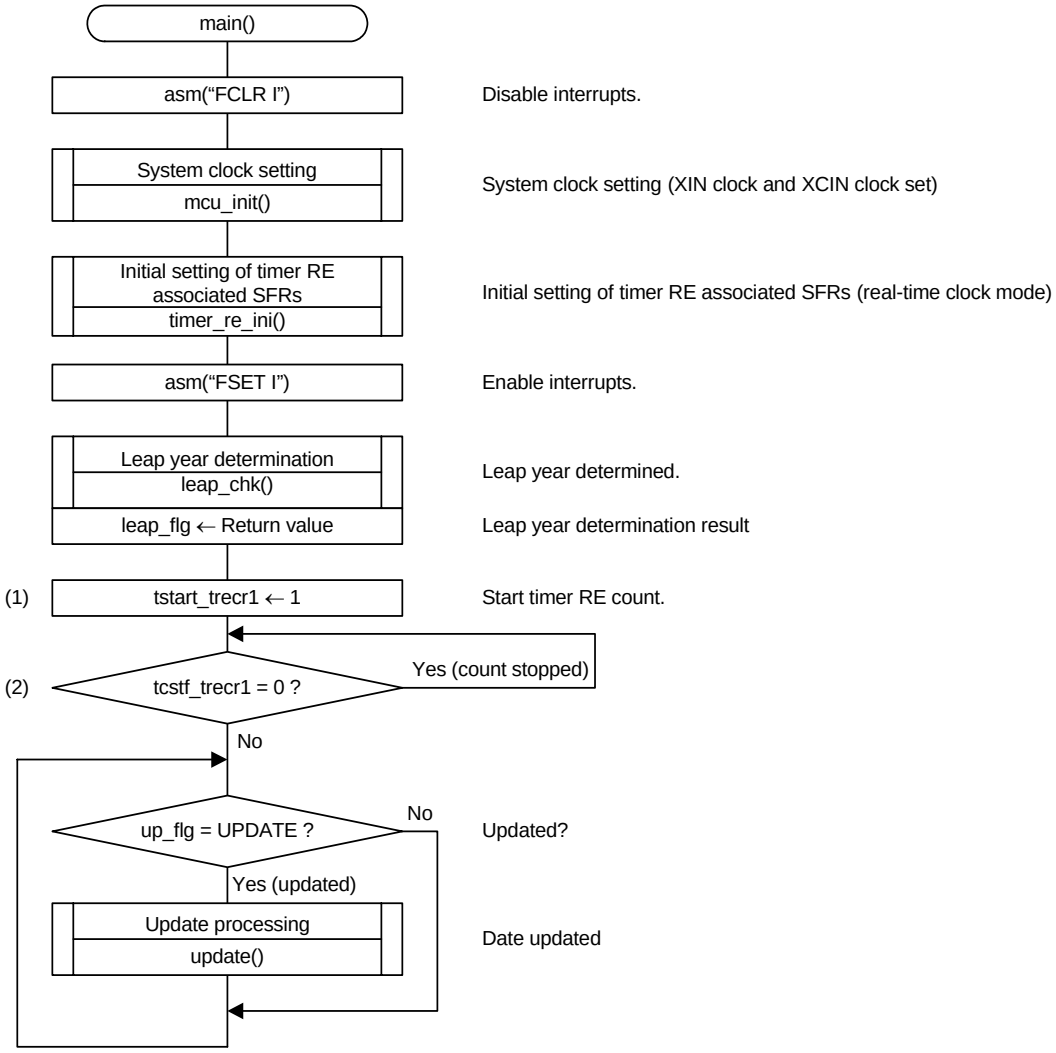
Declaration	void _timer_re(void)		
Outline	Timer RE interrupt handling		
Argument	Argument name		Meaning
	None		—
Variable (global)	Variable name		Contents
	unsigned char wk		Day of week data stored
	unsigned char hr		Hour data stored
	unsigned char min		Minute data stored
	unsigned char sec		Second data stored
	unsigned char wk_old		Previous day of the week data stored
	unsigned char up_flg		Update flag
Returned value	Type	Value	Meaning
	None	—	—
Function	Perform timer RE interrupt handling. Obtain the second data, minute data, hour data, and day of the week data. Set the update date flag to 1.		

Declaration	void update(void)		
Outline	Update processing		
Argument	Argument name		Meaning
	None		—
Variable (global)	Variable name		Contents
	unsigned short year		Year data stored
	unsigned char month		Month data stored
	unsigned char day		Day data stored
	unsigned char wk		Day of the week data stored
	unsigned char wk_old		Previous day of the week data stored
	unsigned char up_flg		Update flag
	unsigned char leap_flg		Leap year flag
Returned value	Type	Value	Meaning
	None	—	—
Function	Update the date data. When updating the year data, determine if the year is a leap year and update the leap year flag.		

Declaration	void char leap_chk(void)		
Outline	Leap year determination		
Argument	Argument name		Meaning
	None		—
Variable (global)	Variable name		Contents
	Unsigned short year		Year data stored
Returned value	Type	Value	Meaning
	unsigned char	COMM	Common year
		LEAP	Leap year
Function	Determine a leap year. A year when the Western calender can be divided by 4 is a leap year. A year when the Western calender can be divided by 100 is a common year. A year when the Western calender can be divided by 400 is a leap year.		

4.2 Main Function

• Flowchart



• Register settings

(1) Start the timer RE count.

Timer RE Control Register 1 (TRECR1)

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

Bit	Symbol	Bit Name	Function	R/W
b7	TSTART	Timer RE count start bit	1: Count starts	R/W

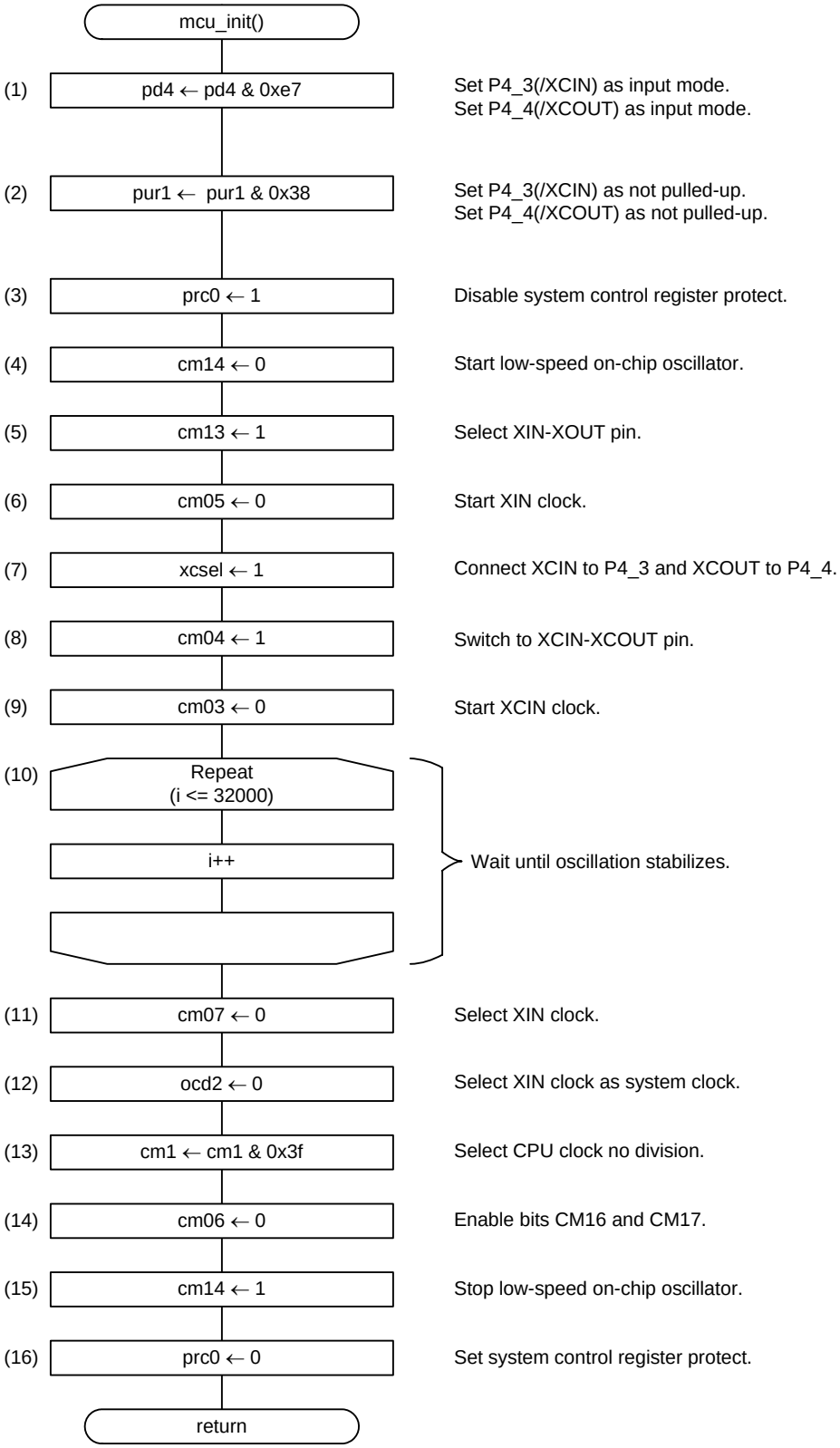
(2) Wait until the timer RE count starts.

Timer RE Control Register 1 (TRECR1)

Bit	Symbol	Bit Name	Function	R/W
b1	TCSTF	Timer RE count status flag	0: Count stopped 1: Counting	R

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		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		R/W

(3) Enable writing to registers CM0, CM1, CM3, and OCD.

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, and OCD. 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

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) Switch P4_6 and P4_7 to the XIN-XOUT pin.

System Clock Control Register 1 (CM1)

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

Bit	Symbol	Bit Name	Function	R/W
b3	CM13	Port/XIN-XOUT switch bit	1: XIN-XOUT pin	R/W

(6) Start the XIN clock.

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
b5	CM05	XIN clock (XIN-XOUT) stop bit	0: XIN clock oscillates	R/W

(7) Connect XCIN to P4_3 and XCOUT 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
b5	XCSEL	XCIN/XCOUT pin connect bit	1: XCIN connected to P4_3, XCOUT connected to P4_4	R/W

(8) Switch to XCIN-XCOUT pin.

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
b4	CM04	Port/XCIN-XCOUT switch bit	1: XCIN-XCOUT 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					0	x	—	—

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 XIN clock.

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
b7	CM07	XIN, XCIN clock select bit	0: XIN clock	R/W

(12) Select the XIN clock as the system clock.

Oscillation Stop Detection Register (OCD)

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

Bit	Symbol	Bit Name	Function	R/W
b2	OCD2	System clock select bit	0: XIN 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

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) Stop the low-speed on-chip oscillator.

System Clock Control Register 1 (CM1)

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

Bit	Symbol	Bit Name	Function	R/W
b4	CM14	Low-speed on-chip oscillator stop bit	1: Low-speed on-chip oscillator off	R/W

(16) Disable writing to registers CM0, CM1, CM3, and OCD.

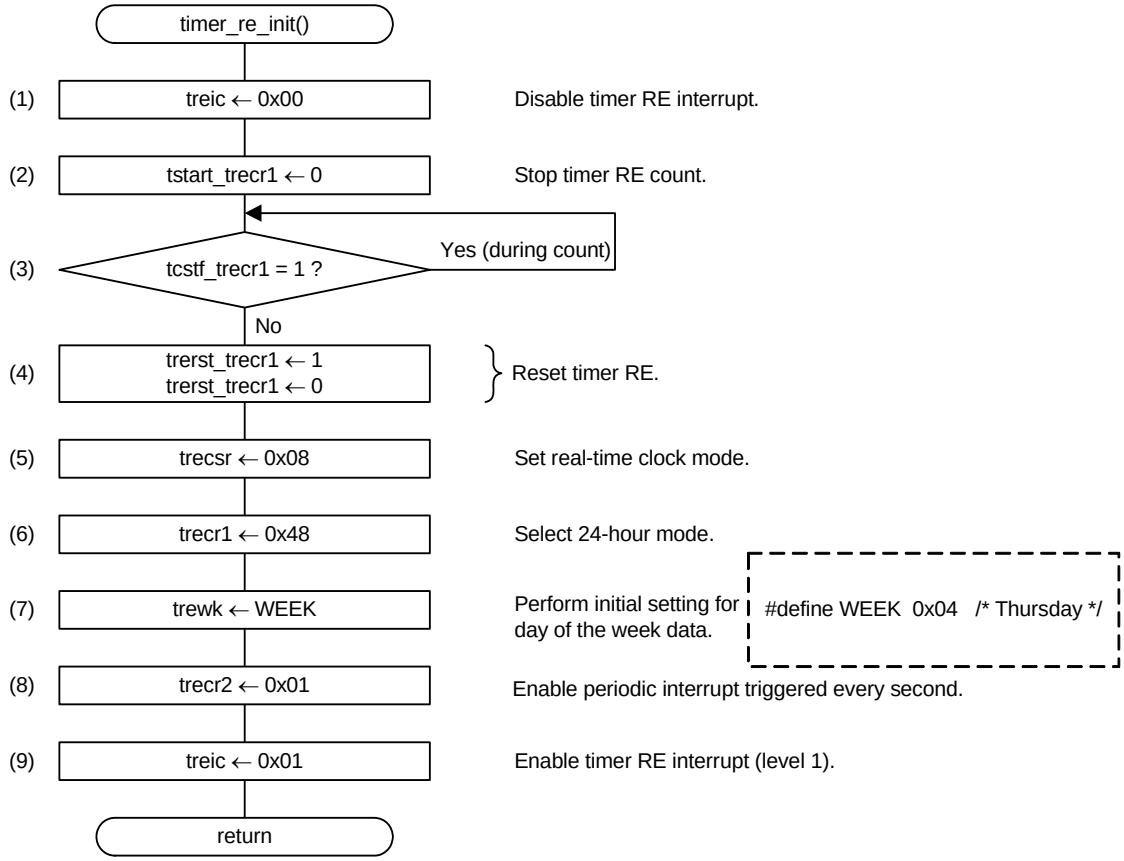
Protect Register (PRCR)

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, and OCD. 0: Write disabled	R/W

4.4 Initial Setting of Timer RE Associated SFRs

• Flowchart



• Register settings

(1) Disable the timer RE interrupt.

Interrupt Control Register (TREIC)

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 1: Interrupt requested	R/W

(2) Stop the timer RE count.

Timer RE Control Register 1 (TRECR1)

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

Bit	Symbol	Bit Name	Function	R/W
b7	TSTART	Timer RE count start bit	0: Count stops	R/W

(3) Wait until the timer RE count stops.

Timer RE Control Register 1 (TRECR1)

Bit	Symbol	Bit Name	Function	R/W
b1	TCSTF	Timer RE count status flag	0: Count stopped 1: Counting	R

(4) Reset timer RE. Set the timer RE reset bit to 0 immediately after setting it to 1.

Timer RE Control Register 1 (TRECR1)

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

Bit	Symbol	Bit Name	Function	R/W
b4	TRERST	Timer RE reset bit	When setting this bit to 0, after setting it to 1, the following will occur. • Registers TRESEC, TREMIN, TREHR, TREWK, and TRECR2 are set to 00h. • Bits TCSTF, INT, PM, H12_H24, and TSTART in the TRECR1 register are set to 0. • The 8-bit counter is set to 00h and the 4-bit counter is set to 0h.	R/W

(5) Set the timer RE count source select register.

Timer RE Count Source Select Register (TRECSR)

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

Bit	Symbol	Bit Name	Function	R/W
b0	RCS0	Count source select bit	Set to 00b in real-time clock mode.	R/W
b1	RCS1			R/W
b2	RCS2	4-bit counter select bit	Set to 0 in real-time clock mode.	R/W
b3	RCS3	Real-time clock mode select bit	Set to 1 in real-time clock mode.	R/W

(6) Set timer RE control register 1.

Timer RE Control Register 1 (TRECR1)

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

Bit	Symbol	Bit Name	Function	R/W
b3	INT	Interrupt request timing bit	Set to 1 in real-time clock mode.	R/W
b6	H12_H24	Operating mode select bit	1: 24-hour mode	R/W

(7) Set the day of the week data.

Timer RE Day of Week Register (TREWK)

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

Bit	Symbol	Bit Name	Function	R/W
b0	WK0	Day of week count bit	b2 b1 b0 1 0 0: Thursday	R/W
b1	WK1			R/W
b2	WK2			R/W

(8) Enable the periodic interrupt triggered every second.

Timer RE Control Register 2 (TRECR2)

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

Bit	Symbol	Bit Name	Function	R/W
b0	SEIE	Periodic interrupt triggered every second enable bit	1: Enable periodic interrupt triggered every second.	R/W
b5	COMIE	Compare match interrupt enable bit	Set to 0 in real-time clock mode.	R/W

(9) Enable the timer RE interrupt.

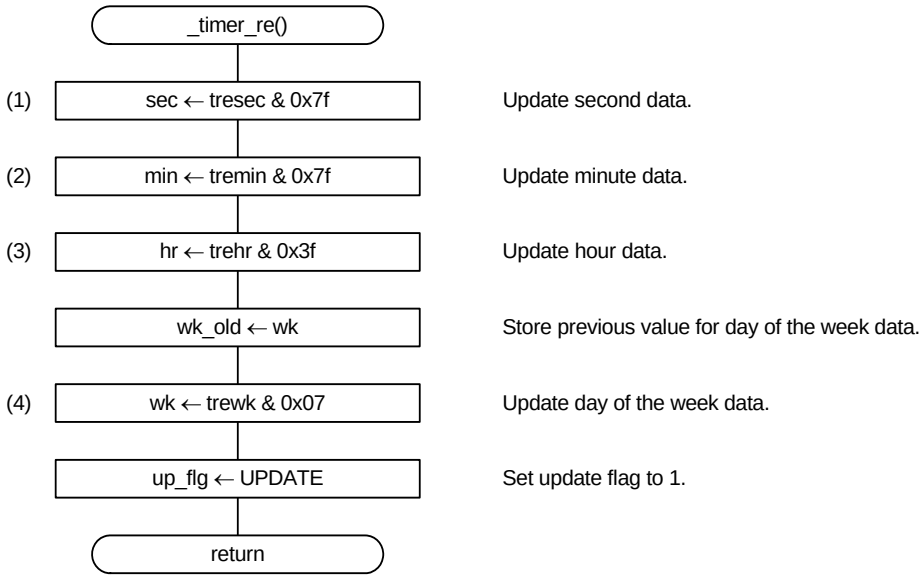
Interrupt Control Register (TREIC)

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

4.5 Timer RE Interrupt Handling

• Flowchart



• Register settings

(1) Read the timer RE second data register to update the second data variable.

Timer RE Second Data Register (TRESEC)

Bit	Symbol	Bit Name	Function	Setting Range	R/W
b0	SC00	1st digit of second count bit	Count 0 to 9 every second. When the digit moves up, 1 is added to the 2nd digit of second.	0 to 9 (BCD code)	R/W
b1	SC01				R/W
b2	SC02				R/W
b3	SC03				R/W
b4	SC10	2nd digit of second count bit	When counting 0 to 5, 60 seconds are counted.	0 to 5 (BCD code)	R/W
b5	SC11				R/W
b6	SC12				R/W

(2) Read the timer RE minute data register to update the minute data variable.

Timer RE Minute Data Register (TREMIN)

Bit	Symbol	Bit Name	Function	Setting Range	R/W
b0	MN00	1st digit of minute count bit	Count 0 to 9 every minute. When the digit moves up, 1 is added to the 2nd digit of minute.	0 to 9 (BCD code)	R/W
b1	MN01				R/W
b2	MN02				R/W
b3	MN03				R/W
b4	MN10	2nd digit of minute count bit	When counting 0 to 5, 60 minutes are counted.	0 to 5 (BCD code)	R/W
b5	MN11				R/W
b6	MN12				R/W

(3) Read the timer RE hour data register to update the hour data variable.

Timer RE Hour Data Register (TREHR)

Bit	Symbol	Bit Name	Function	Setting Range	R/W
b0	HR00	1st digit of hour count bit	Count 0 to 9 every hour. When the digit moves up, 1 is added to the 2nd digit of hour.	0 to 9 (BCD code)	R/W
b1	HR01				R/W
b2	HR02				R/W
b3	HR03				R/W
b4	HR10	2nd digit of hour count bit	Count 0 to 2.	0 to 2 (BCD code)	R/W
b5	HR11				R/W
b6	HR12				R/W

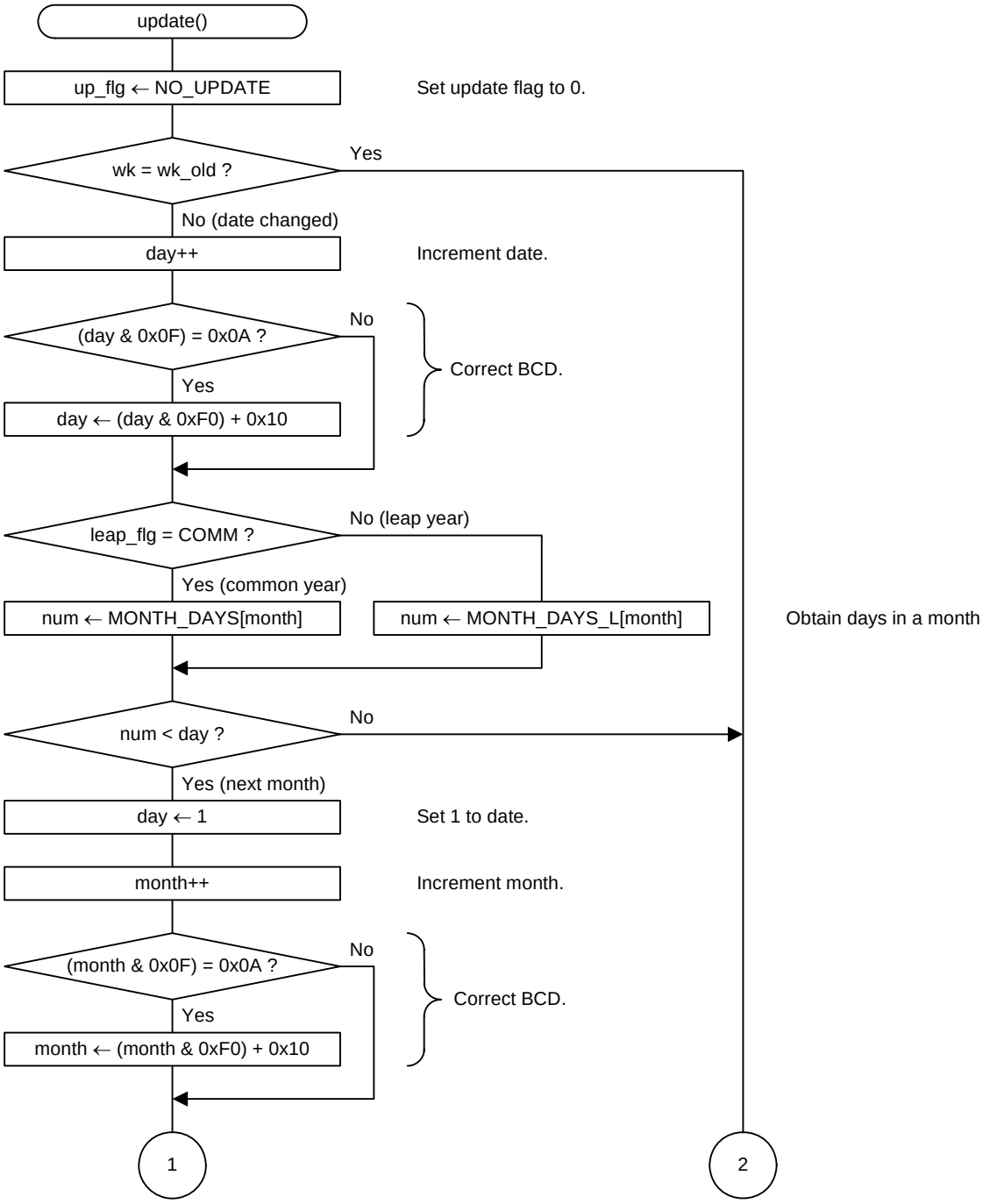
(4) Read the timer RE day of the week data register to update the day of the week data variable.

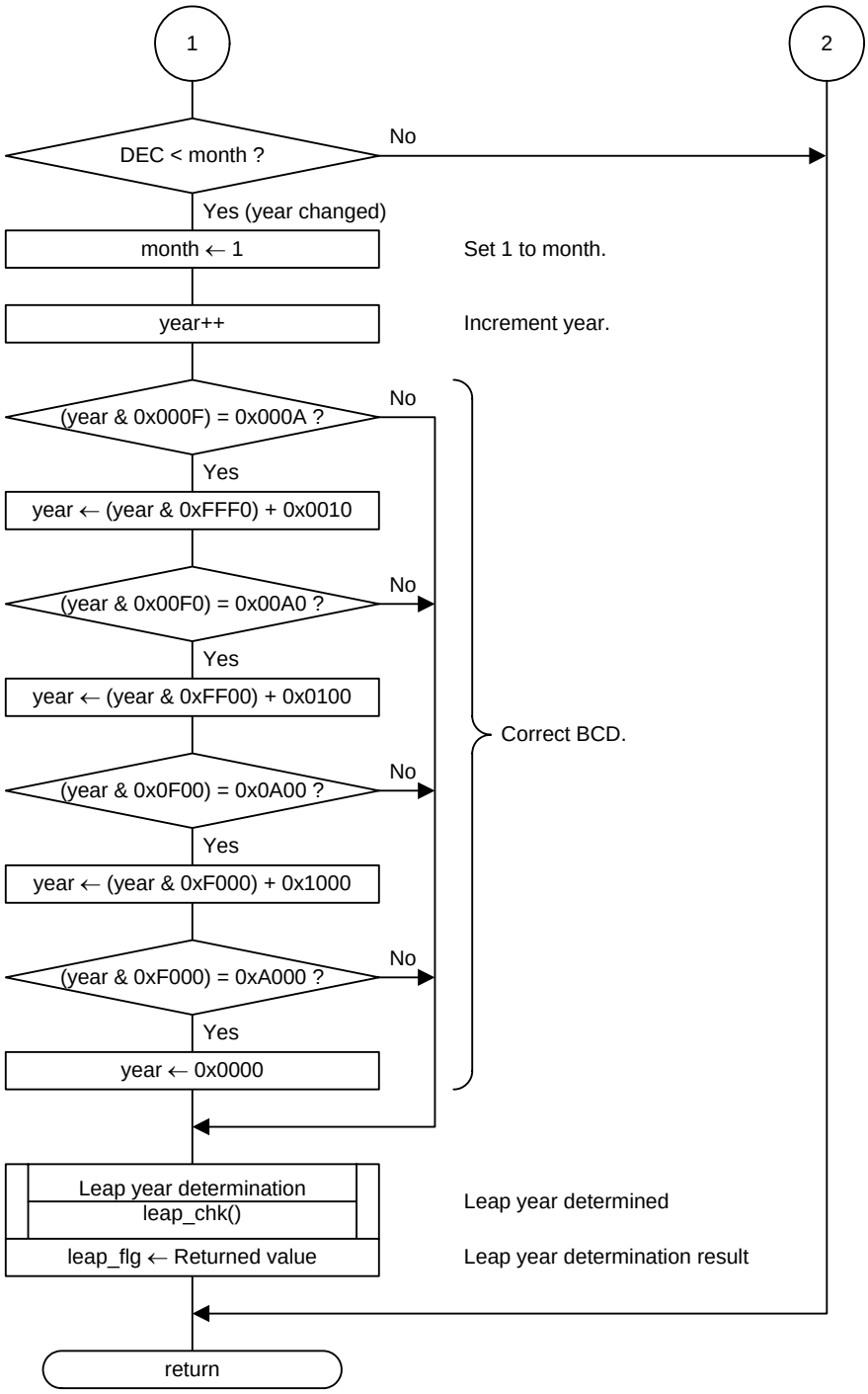
Timer RE Day of Week Data Register (TREWK)

Bit	Symbol	Bit Name	Function	R/W
b0	WK0	Day of week count bit	b2 b1 b0 0 0 0: Sunday 0 0 1: Monday 0 1 0: Tuesday 0 1 1: Wednesday 1 0 0: Thursday 1 0 1: Friday 1 1 0: Saturday 1 1 1: Do not set.	R/W
b1	WK1			R/W
b2	WK2			R/W

4.6 Update Processing

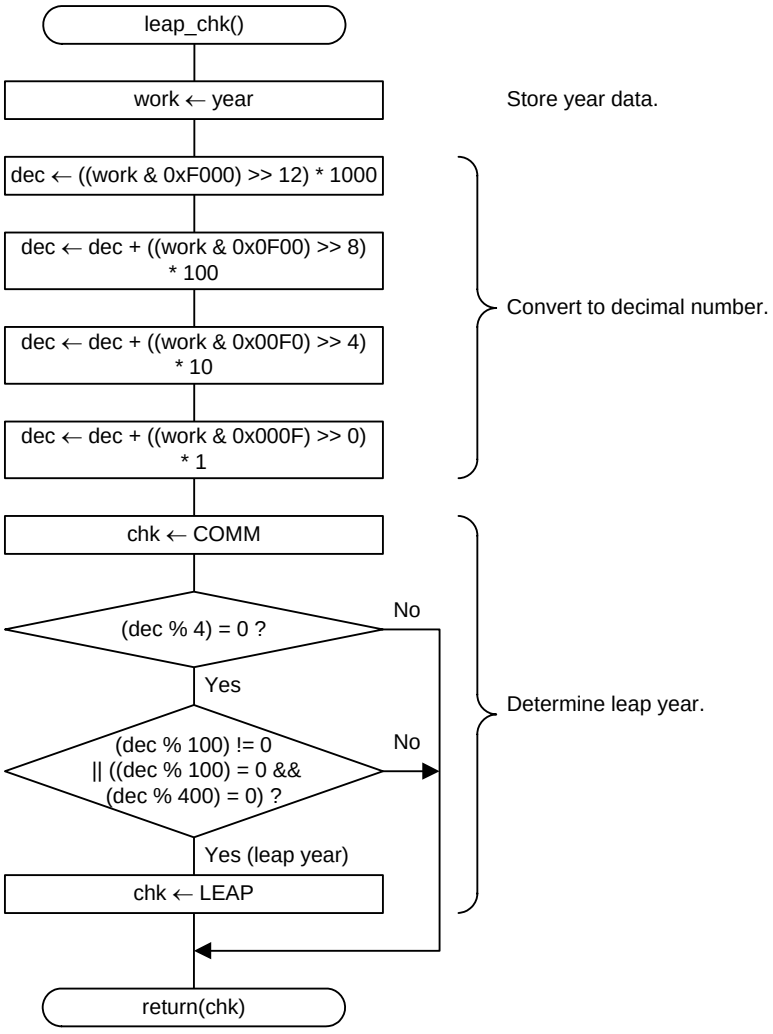
• Flowchart




1
2
DEC < month ?
No
Yes (year changed)
month ← 1
Set 1 to month.
year++
Increment year.
(year & 0x000F) = 0x000A ?
No
Yes
year ← (year & 0xFFF0) + 0x0010
(year & 0x00F0) = 0x00A0 ?
No
Yes
year ← (year & 0xFF00) + 0x0100
(year & 0x0F00) = 0x0A00 ?
No
Yes
year ← (year & 0xF000) + 0x1000
(year & 0xF000) = 0xA000 ?
No
Yes
year ← 0x0000
Correct BCD.
Leap year determination
leap_chk()
Leap year determined
leap_flg ← Returned value
Leap year determination result
return

4.7 Leap Year Determination

• Flowchart



5. Sample Program

A sample program can be downloaded from the Renesas Electronics website.
To download, click “Application Notes” in the left-hand side menu of the R8C Family page.

6. Reference Documents

R8C/35A Group User’s Manual: Hardware Rev.0.40
The latest version can be downloaded from the Renesas Electronics website.

Technical Update/Technical News
The latest information can be downloaded from the Renesas Electronics website.

Website and Support

Renesas Electronics website
http://www.renesas.com/

Inquiries
http://www.renesas.com/inquiry

Revision History	R8C/35A Group Clock Operation Using RTC

Rev.	Date	Description	
		Page	Summary
1.00	July 30, 2010	—	First edition issued

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins

   Handle unused pins in accord with the directions given under Handling of Unused Pins in the manual.

   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment when power is supplied.

   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.

   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.

   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

   Before changing from one product to another, i.e. to one with a different part number, confirm that the change will not lead to problems.

   — The characteristics of MPU/MCU in the same group but having different part numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different part numbers, implement a system-evaluation test for each of the products.

Notice

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