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R8C/25 Group

Timer RE in Real-Time Clock Mode

1. Abstract

This document describes how to set up and use timer RE in real-time clock mode in the R8C/25 Group.

2. Introduction

The application example described in this document is applied to the following MCU and parameter(s):

- MCU: R8C/25 Group
- XCIN clock: 32.768 kHz

This program can be used with other R8C/Tiny Series which have the same special function registers (SFRs) as the R8C/25 Group. Check the manual for any additions and modifications to functions. Careful evaluation is recommended before using this application note.

3. Descriptions of Applications

3.1 Timer RE

Timer RE has 4-bit and 8-bit counters. Timer RE has the following two modes:

- Real-time clock mode Generate a 1-second signal from fc4 and counts seconds, minutes, hours, and days of the week.
- Output compare mode Count a count source and detect compare matches.

3.2 Real-Time Clock Mode

In real-time clock mode, a 1-second signal is generated from fc4 using a divide-by-2 frequency divider, 4-bit counter, and 8-bit counter and used to count seconds, minutes, hours, and days of the week. Figure 3.1 shows a Block Diagram of Real-Time Clock Mode and Table 3.1 lists the Specifications of Real-Time Clock Mode. Figures 3.2 to 3.6 and 3.8 to 3.9 show the Registers Associated with Real-Time Clock Mode. Table 3.2 lists the Interrupt Sources, Figure 3.7 shows the Definition of Time Representation and Figure 3.10 shows the Operating Example of Real-Time Clock Mode.

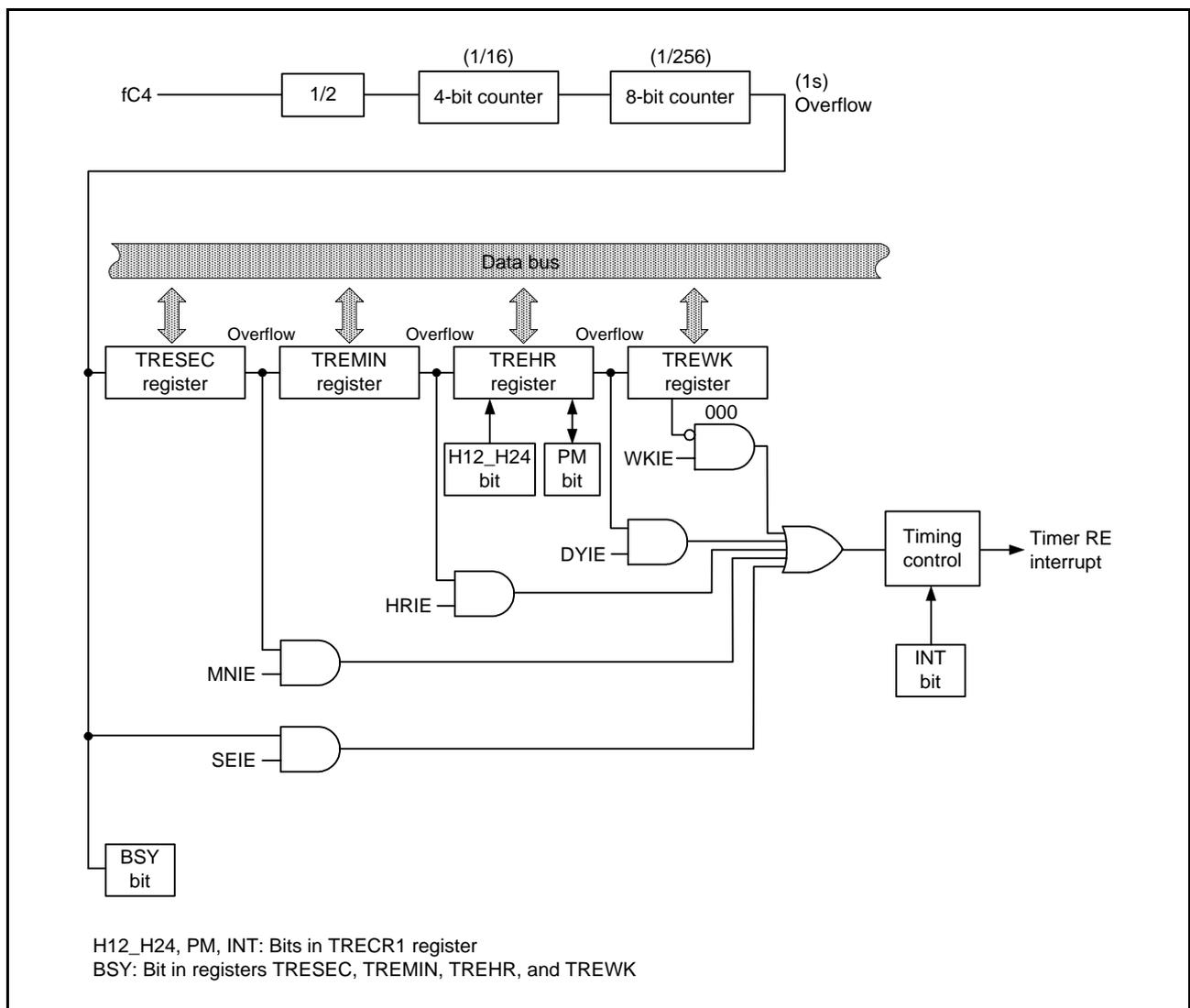


Figure 3.1 Block Diagram of Real-Time Clock Mode

Table 3.1 Specifications of Real-Time Clock Mode

Item	Specification
Count source	fC4
Count operation	Increment
Count start condition	1 (count starts) is written to TSTART bit in TRECR1 register
Count stop condition	0 (count stops) is written to TSTART bit in TRECR1 register
Interrupt request generation timing	Select any one of the following: <ul style="list-style-type: none"> • Update second data • Update minute data • Update hour data • Update day of week data • When day of week data is set to 000b (Sunday)
TREO pin function	Programmable I/O ports or output of f2, f4, or f8
Read from timer	When reading TRESEC, TREMIN, TREHR, or TREWK register, the count value can be read. The values read from registers TRESEC, TREMIN, and TREHR are represented by the BCD code.
Write to timer	When bits TSTART and TCSTF in the TRECR1 register are set to 0 (timer stops), the value can be written to registers TRESEC, TREMIN, TREHR, and TREWK. The values written to registers TRESEC, TREMIN, and TREHR are represented by the BCD codes.
Select functions	<ul style="list-style-type: none"> • 12-hour mode/24-hour mode switch function

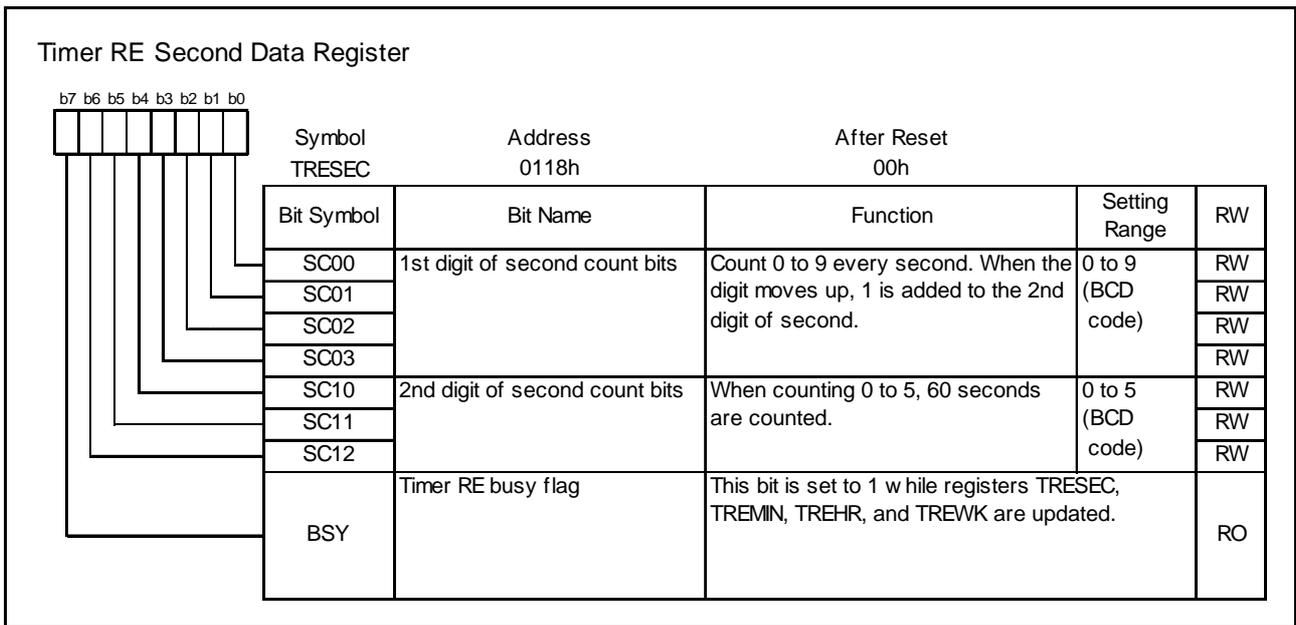


Figure 3.2 TRESEC Register in Real-Time Clock Mode

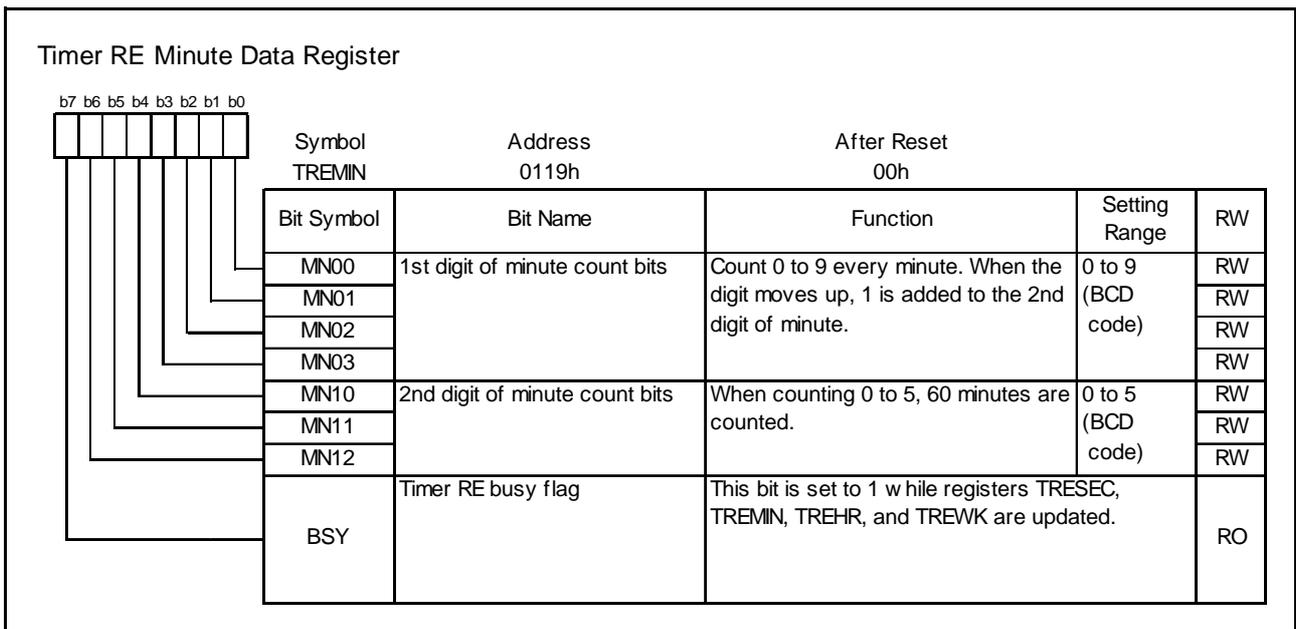


Figure 3.3 TREMIN Register in Real-Time Clock Mode

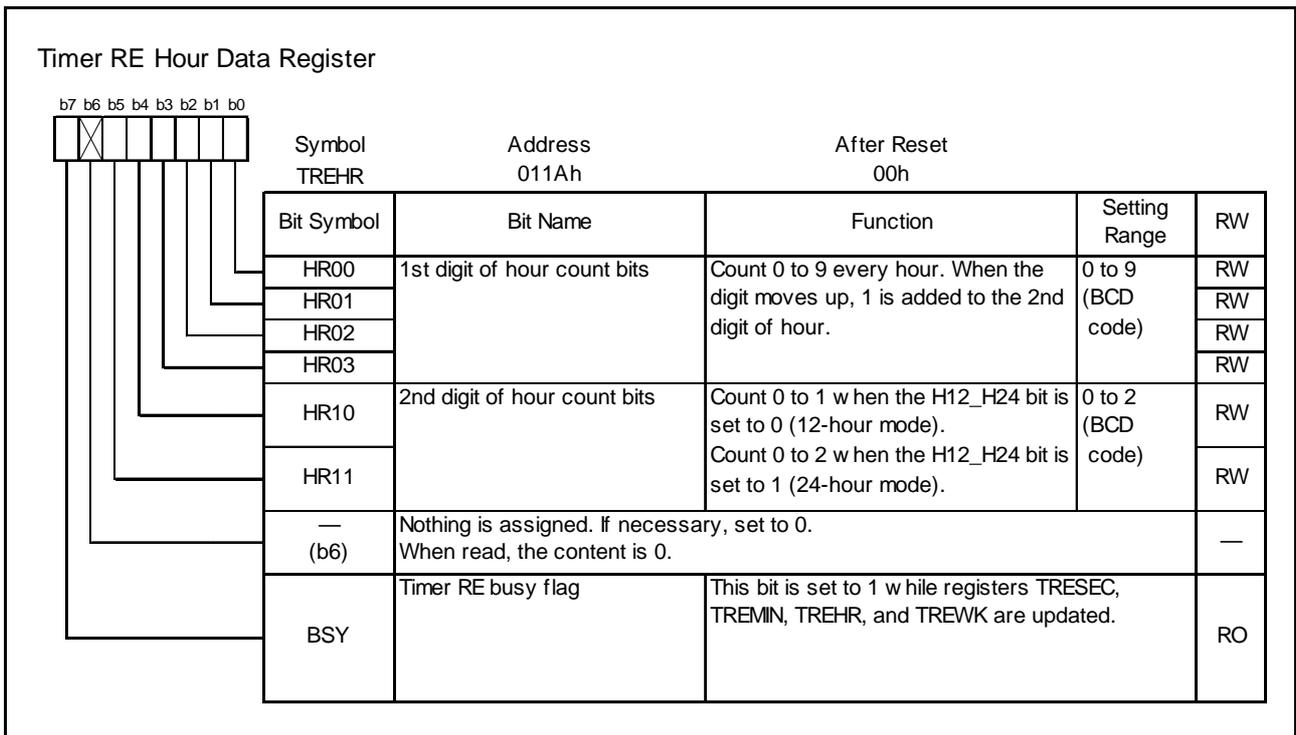


Figure 3.4 TREHR Register in Real-Time Clock Mode

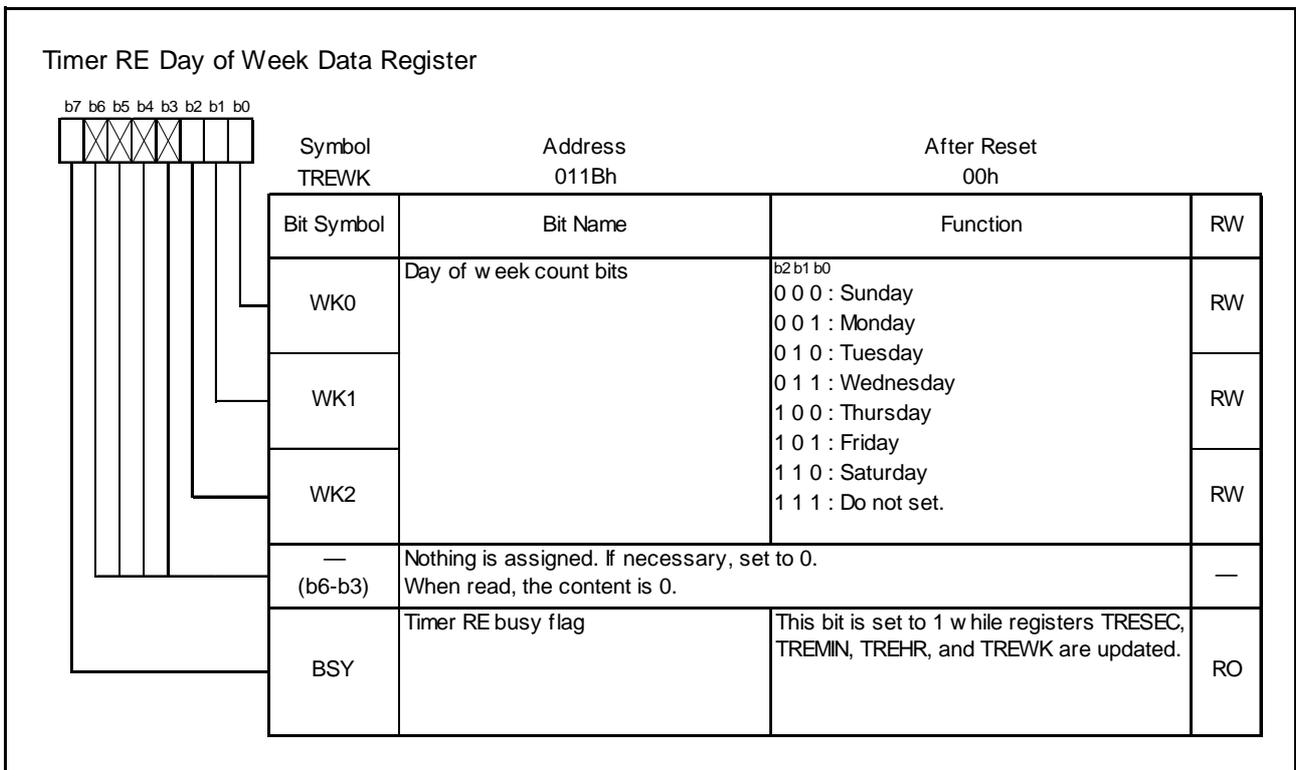


Figure 3.5 TREWK Register in Real-Time Clock Mode

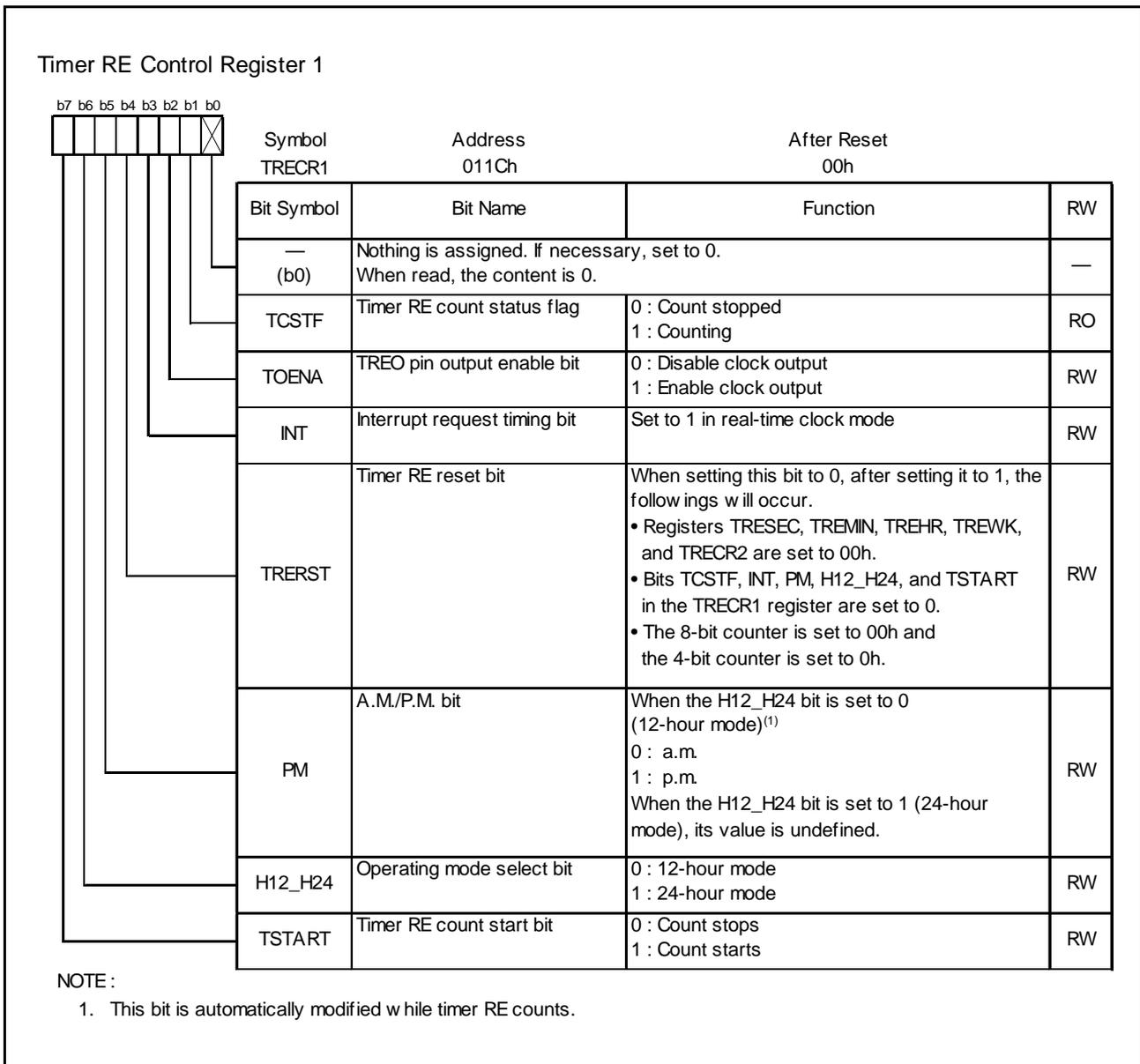


Figure 3.6 TREC1 Register in Real-Time Clock Mode

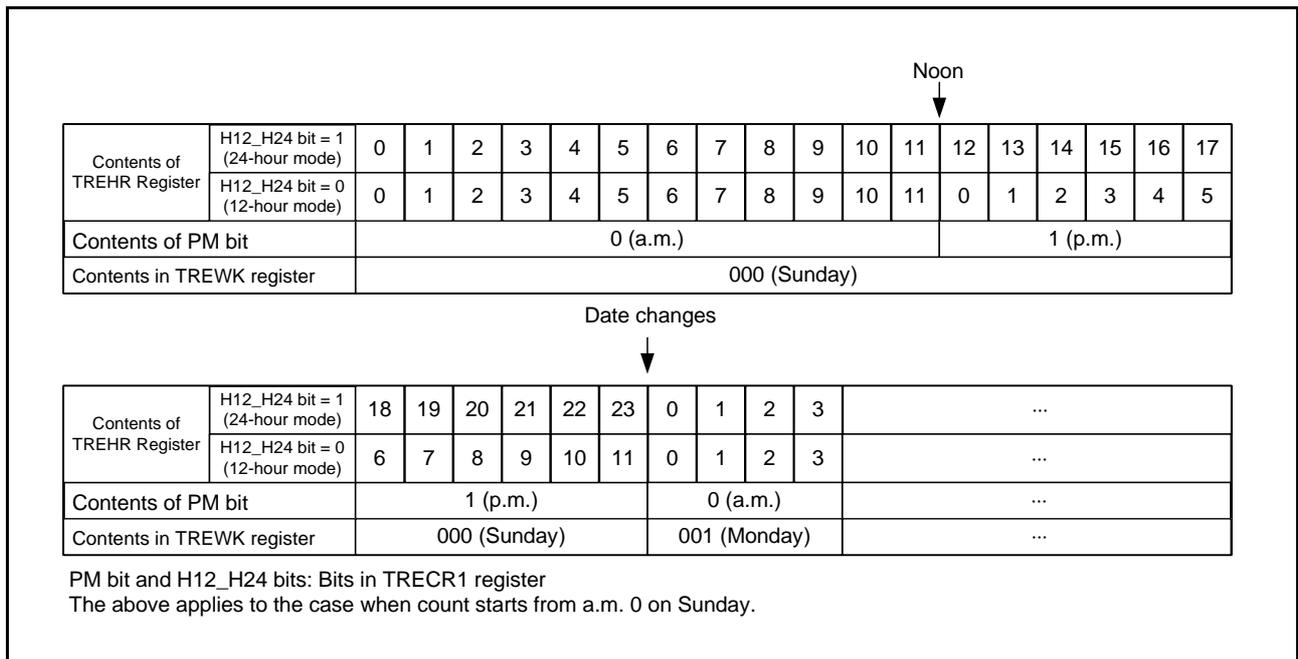


Figure 3.7 Definition of Time Representation

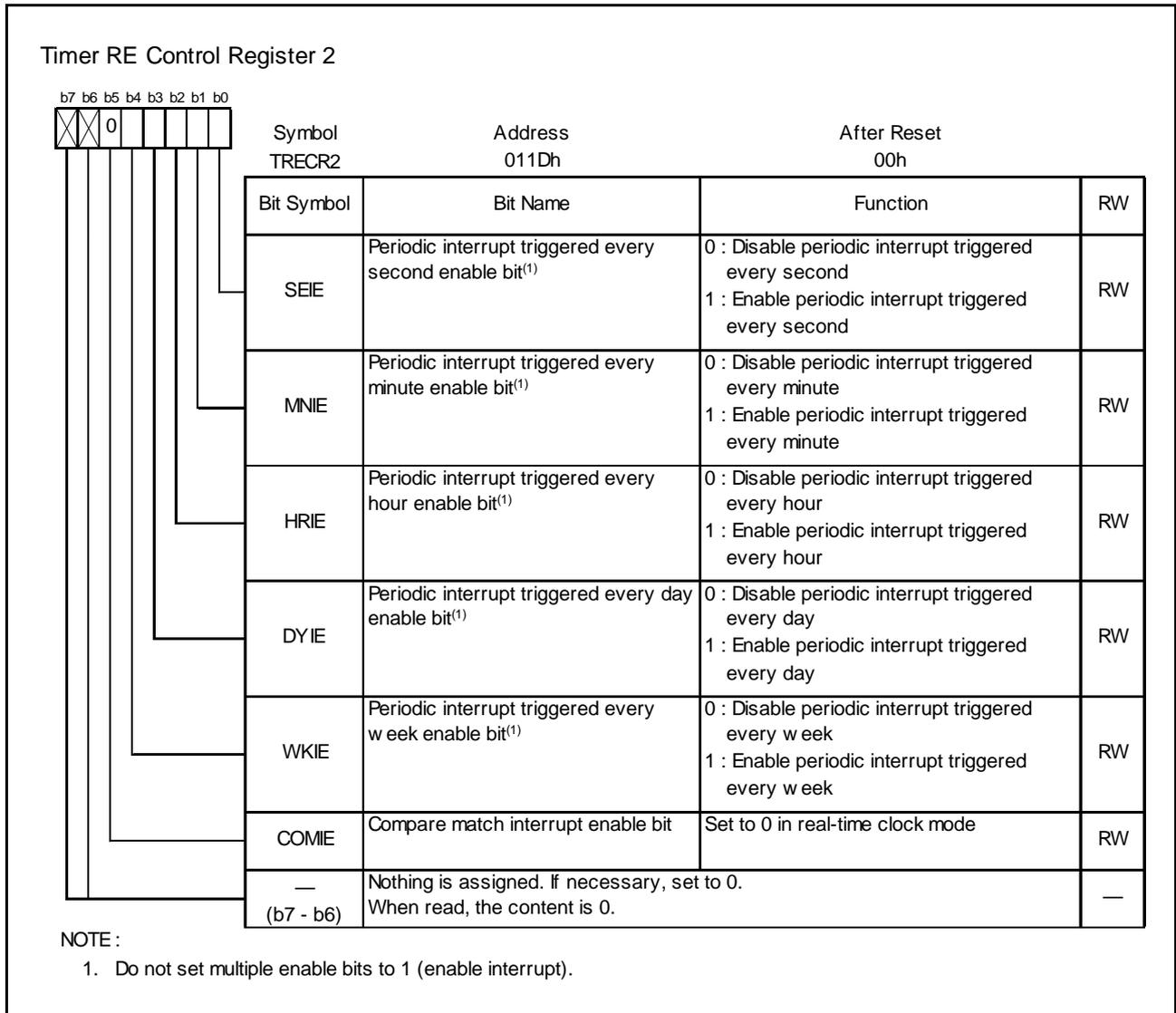


Figure 3.8 TRECR2 Register in Real-Time Clock Mode

Table 3.2 Interrupt Sources

Factor	Interrupt Source	Interrupt Enable Bit
Periodic interrupt triggered every week	Value in TREWK register is set to 000b (Sunday) (1-week period)	WKIE
Periodic interrupt triggered every day	TREWK register is updated (1-day period)	DYIE
Periodic interrupt triggered every hour	TREHR register is updated (1-hour period)	HRIE
Periodic interrupt triggered every minute	TREMIN register is updated (1-minute period)	MNIE
Periodic interrupt triggered every second	TRESEC register is updated (1-second period)	SEIE

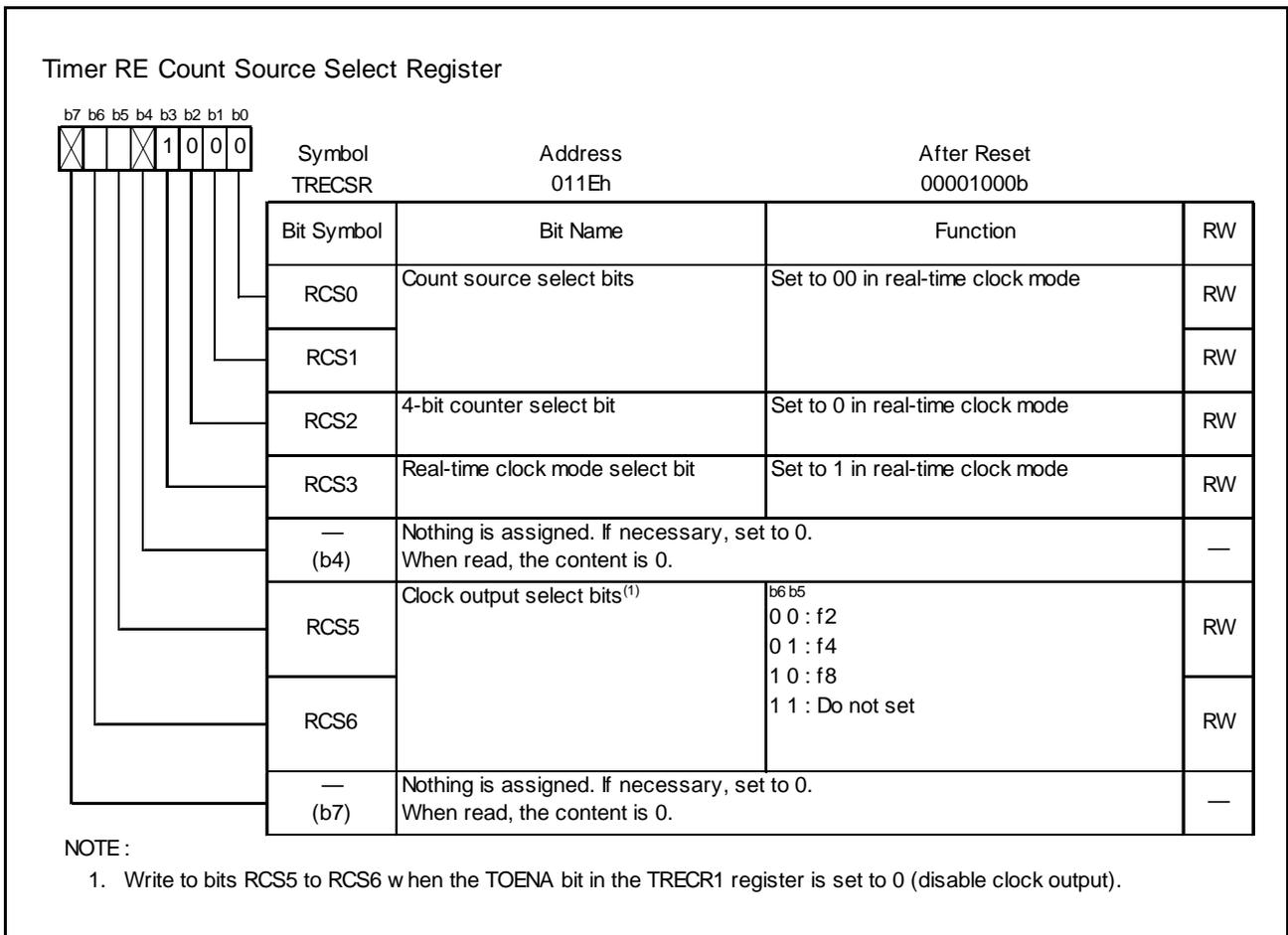


Figure 3.9 TRECSR Register in Real-Time Clock Mode

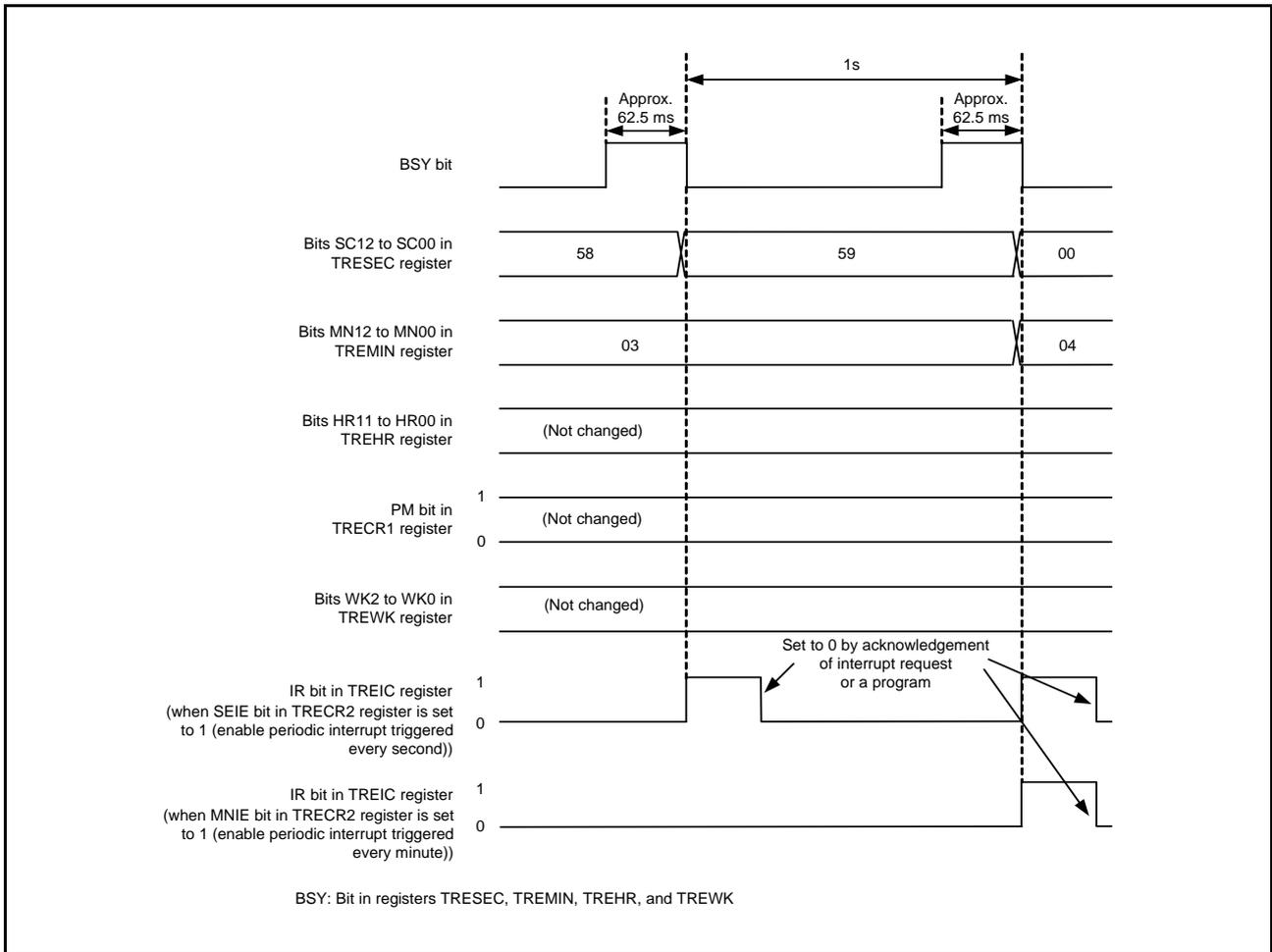


Figure 3.10 Operating Example of Real-Time Clock Mode

3.3 Notes on Timer RE

3.3.1 Starting and Stopping Count

Timer RE has the TSTART bit for instructing the count to start or stop, and the TCSTF bit which indicates count start or stop. Bits TSTART and TCSTF are in the TREC1 register.

Timer RE starts counting and the TCSTF bit is set to 1 (count starts) when the TSTART bit is set to 1 (count starts). It takes up to two cycles of the count source until the TCSTF bit is set to 1 after setting the TSTART bit to 1. During this time, do not access registers associated with timer RE⁽¹⁾ other than the TCSTF bit.

Also, timer RE stops counting when setting the TSTART bit to 0 (count stops) and the TCSTF bit is set to 0 (count stops). It takes the time for up to two cycles of the count source until the TCSTF bit is set to 0 after setting the TSTART bit to 0. During this time, do not access registers associated with timer RE other than the TCSTF bit.

NOTE:

1. Registers associated with timer RE: TRESEC, TREMIN, TREHR, TREWK, TREC1, TREC2, and TRECSR.

3.3.2 Register Setting

Write to the following registers or bits when timer RE is stopped:

- Registers TRESEC, TREMIN, TREHR, TREWK, and TREC2
- Bits H12_H24, PM, and INT in TREC1 register
- Bits RCS0 to RCS3 in TRECSR register

Timer RE is stopped when bits TSTART and TCSTF in the TREC1 register are set to 0 (timer RE stopped).

Also, set all above-mentioned registers and bits (immediately before timer RE count starts) before setting the TREC2 register.

Figure 3.11 shows the Setting Example in Real-Time Clock Mode.

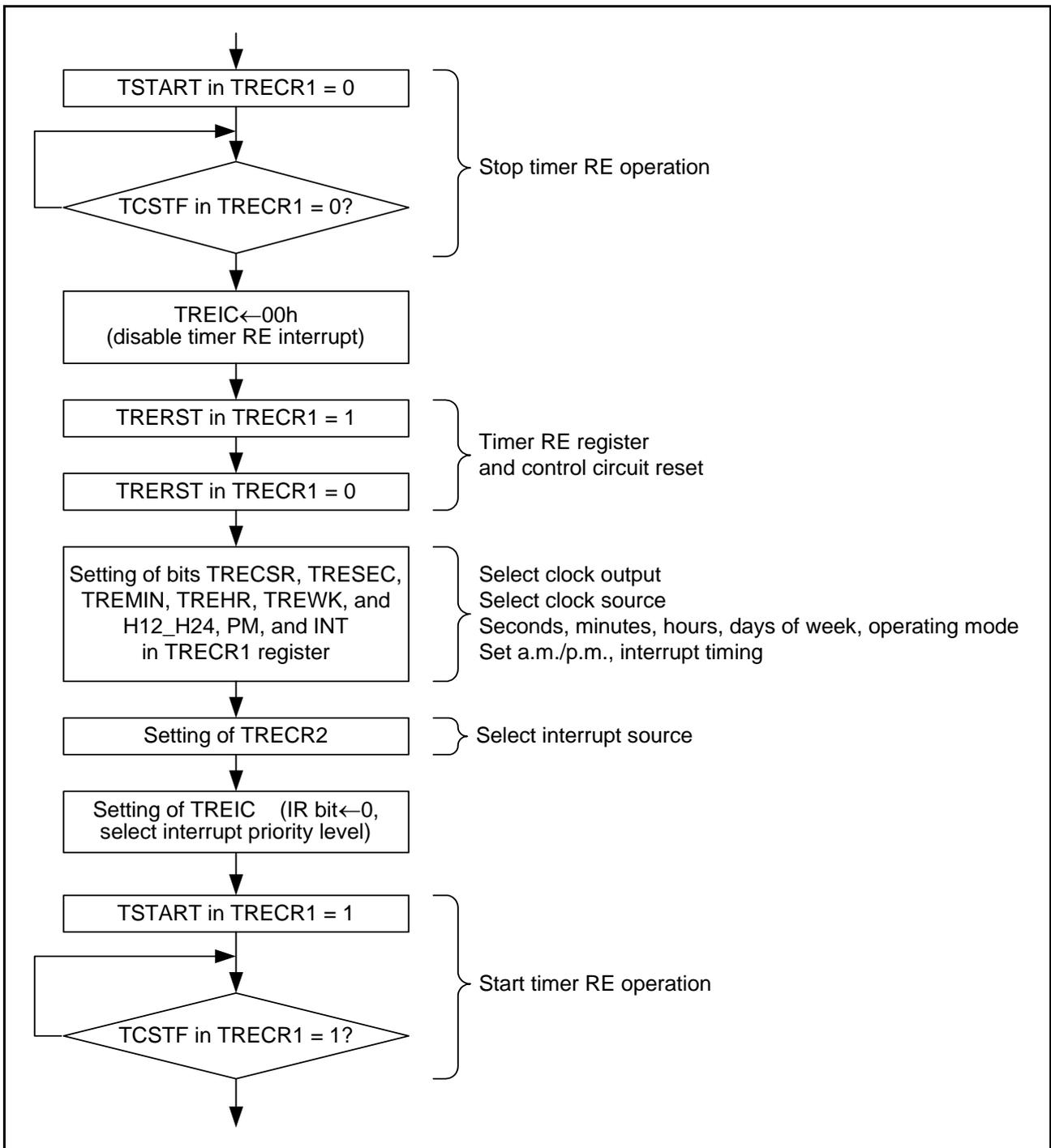


Figure 3.11 Setting Example in Real-Time Clock Mode

3.3.3 Time Reading Procedure of Real-Time Clock Mode

In real-time clock mode, read registers TRESEC, TREMIN, TREHR, and TREWK when time data is updated and read the PM bit in the TRECRI register when the BSY bit is set to 0 (not while data is updated).

Also, when reading several registers, an incorrect time will be read if data is updated before another register is read after reading any register.

In order to prevent this, use the reading procedure shown below:

- Using an interrupt
Read necessary contents of registers TRESEC, TREMIN, TREHR, and TREWK and the PM bit in the TRECRI register in the timer RE interrupt routine.
- Monitoring with a program #1
Monitor the IR bit in the TREIC register with a program and read necessary contents of registers TRESEC, TREMIN, TREHR, and TREWK and the PM bit in the TRECRI register after the IR bit in the TREIC register is set to 1 (timer RE interrupt request generated).
- Monitoring with a program #2
 - (1) Monitor the BSY bit.
 - (2) Monitor until the BSY bit is set to 0 after the BSY bit is set to 1 (approximately 62.5 ms while the BSY bit is set to 1).
 - (3) Read necessary contents of registers TRESEC, TREMIN, TREHR, and TREWK and the PM bit in the TRECRI register after the BSY bit is set to 0.
- Using read results if they are the same value twice
 - (1) Read necessary contents of registers TRESEC, TREMIN, TREHR, and TREWK and the PM bit in the TRECRI register.
 - (2) Read the same register as (1) and compare the contents.
 - (3) Recognize as the correct value if the contents match. If the contents do not match, repeat until the read contents match with the previous contents.
Also, when reading several registers, read them as continuously as possible.

4. Program Outline

When the time data is updated, registers TRESEC, TREMIN, TREHR, and TREWK and the PM bit in the TRECRI register can be read. The timer RD interrupt is generated at the period of the second.

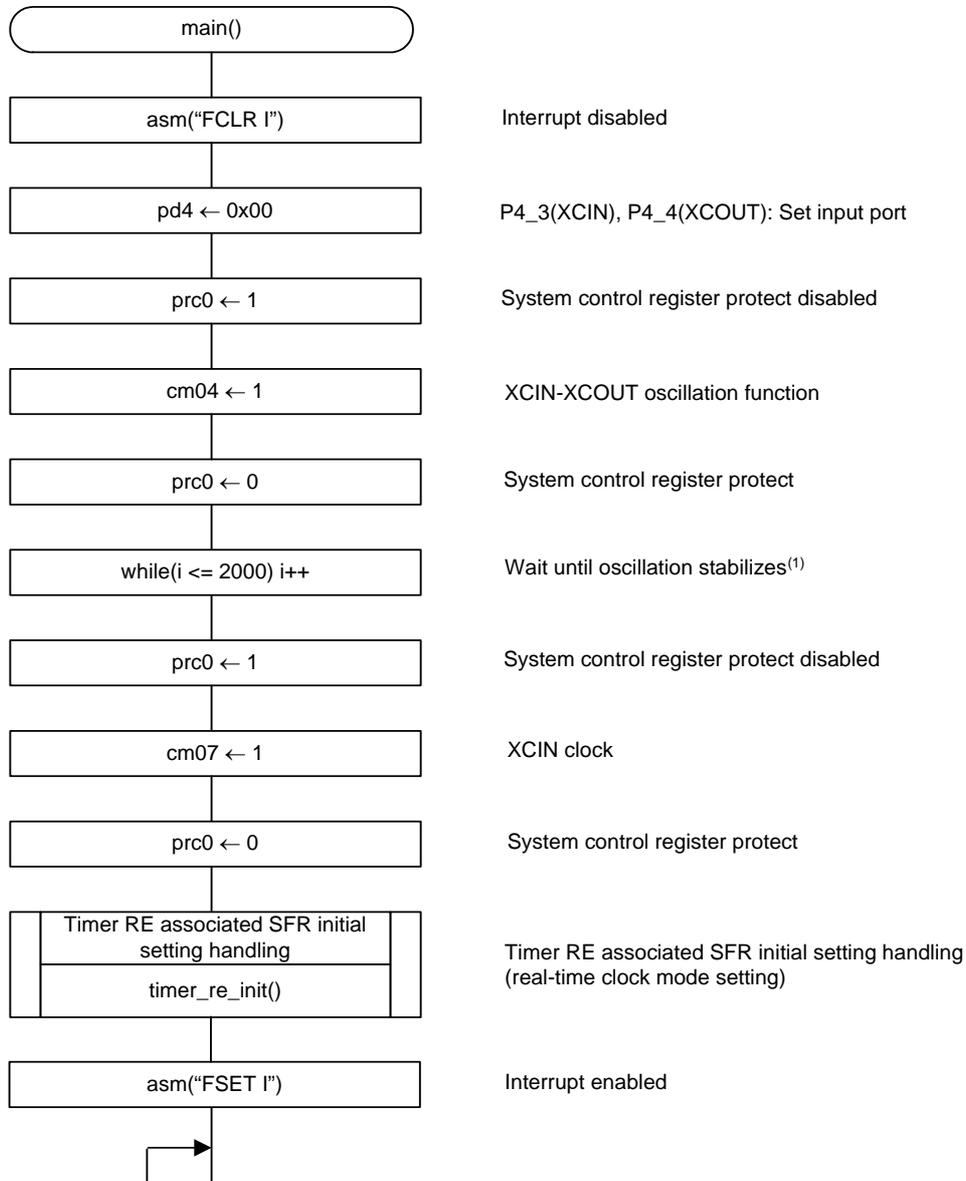
4.1 Function Table

Declaration	void timer_re_init (void)		
Outline	Timer RE associated SFR initial setting		
Argument	Argument name	Meaning	
	None		
Variable used (global)	Variable name	Contents used	
	None		
Returned value	Type	Value	Meaning
	None		
Function	Timer RE associated SFR register settings are initialized.		

Declaration	void timer_re (void)		
Outline	Real-time clock data back-up handling		
Argument	Argument name	Meaning	
	None		
Variable used (global)	Variable name	Contents used	
	7-bit data	time_data.bit.b7_second	Setting
	7-bit data	time_data.bit.b7_minute	Setting
	6-bit data	time_data.bit.b6_hour	Setting
	3-bit data	time_data.bit.b3_week	Setting
	1-bit data	time_data.bit.b1_am_pm	Setting
Return value	Type	Meaning	
	None		
Function	Real-time clock data (second data, minute data, hour data, day of the week data, and a.m./p.m. bit) are updated.		

4.2 Flow Chart

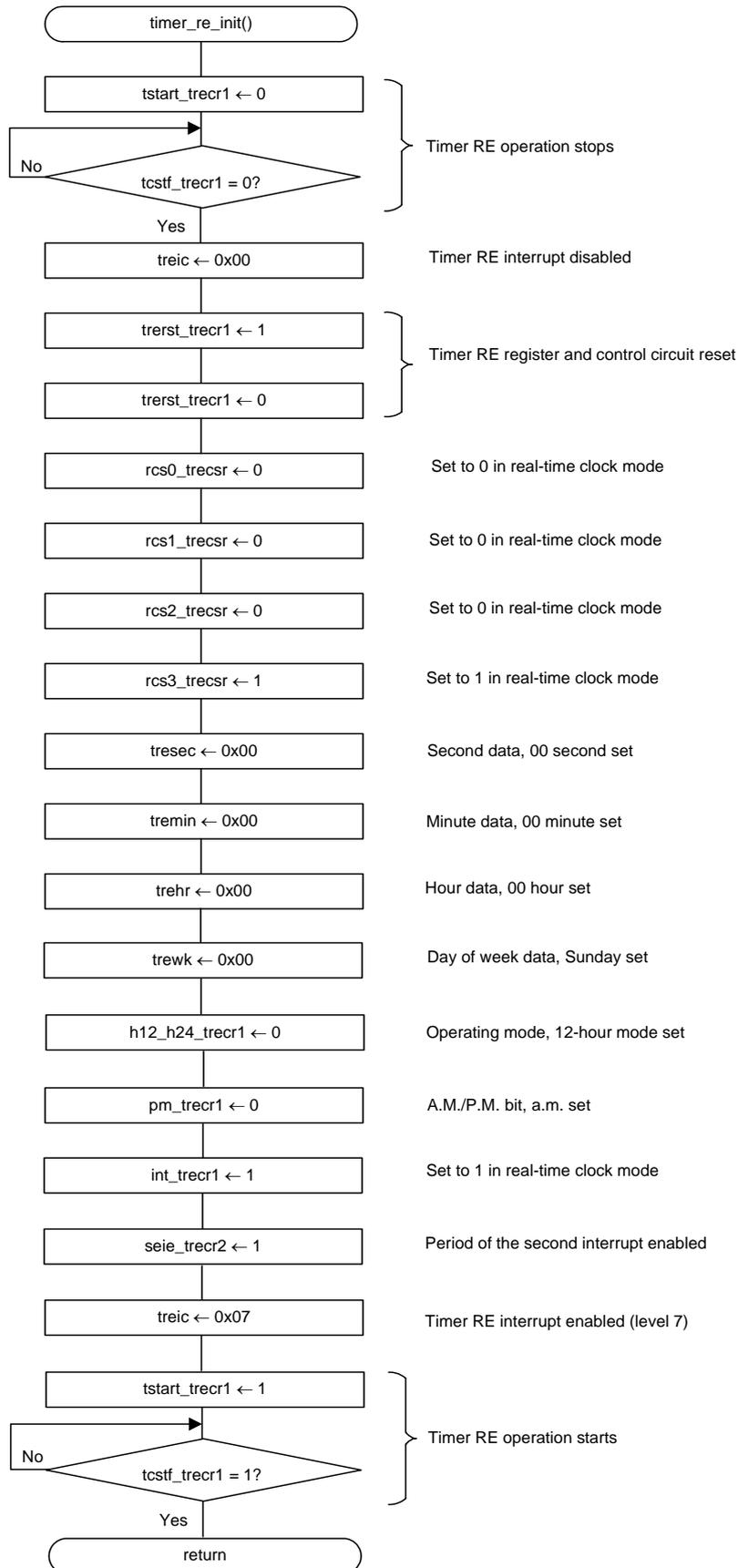
4.2.1 Main Function



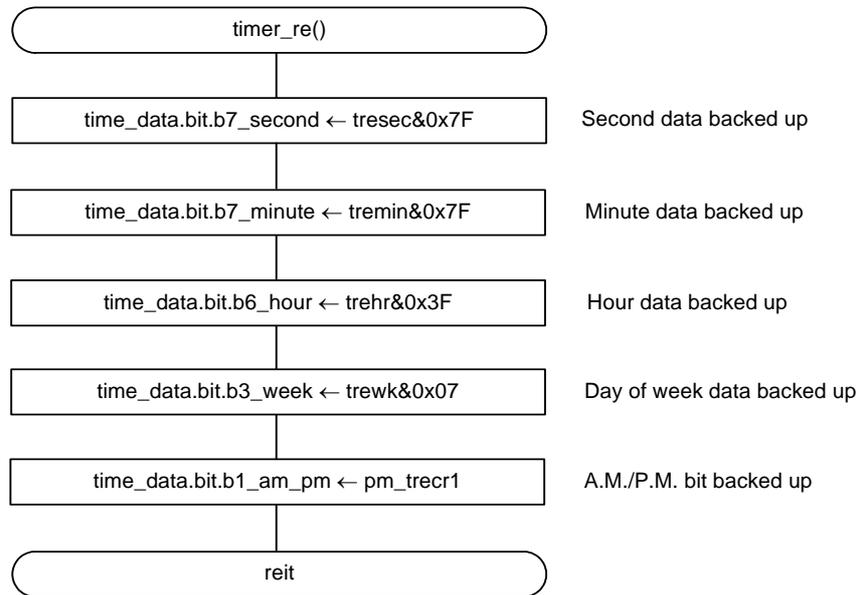
NOTE:

1. Contact the oscillator manufacturer for the oscillation stabilizing time.

4.2.2 Timer RE Associated SFR Initial Setting



4.2.3 Interrupt Handling



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 on the R8C/Tiny Series page.

6. Reference Documents

Hardware Manual

R8C/25 Group Hardware Manual

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

Technical Update/Technical News

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REVISION HISTORY	R8C/25 Group Timer RE in Real-Time Clock Mode
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Rev.	Date	Description	
		Page	Summary
1.00	Dec 01, 2006	–	First Edition issued

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