R8C/M13B Group

Timer RE2 Clock Error Correction Function in Real-Time Clock Mode

R01AN0363EJ0100
Rev. 1.00
June 30, 2011

Abstract

This document describes the setting method and an application example for a program to correct clock errors using the timer RE2 clock error correction function in real-time clock mode in the R8C/M13B Group.

Product

MCU: R8C/M13B Group

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

Contents

1. Specifications

Second, minute, hour, day-of-the-week, date, month, and year (including leap years) data are updated every second. Clock errors generated by frequency deviations of oscillators are corrected every minute.

Table 1.1 lists the Peripheral Function and Its Application. Figure 1.1 shows the Block Diagram. Figure 1.2 shows the Operating Example of Automatic Correction Function and Subtraction Correction.

Table 1.1 Peripheral Function and Its Application

Peripheral Function	Application
Timer RE2	Clock (automatic correction function enabled)

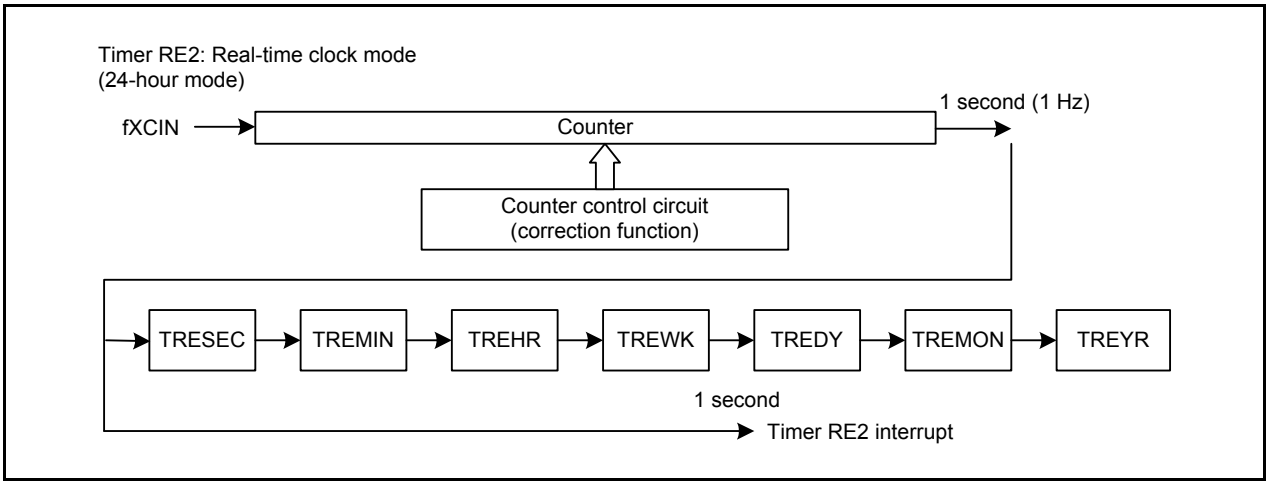


Figure 1.1 Block Diagram

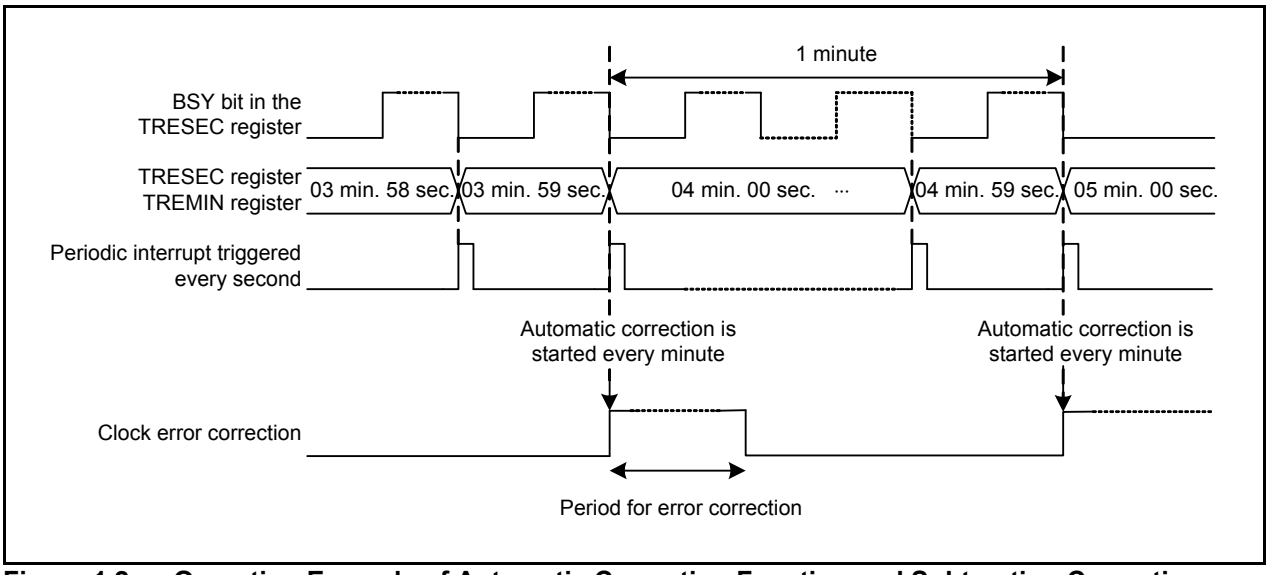


Figure 1.2 Operating Example of Automatic Correction Function and Subtraction Correction

2. Operation Confirmation Conditions

The sample code accompanying this application note has been run and confirmed under the conditions below.

Table 2.1 Operation Confirmation Conditions

Item	Contents
MCU used	R8C/M13B Group
Operating frequencies	XIN clock: 20 MHz XCIN clock: 32.768 kHz CPU clock (fs): 20 MHz System clock (f): 20 MHz
Operating voltage	5.0 V (2.7 to 5.5 V)
Integrated development environment	Renesas Electronics Corporation High-performance Embedded Workshop Version 4.07
C compiler	Renesas Electronics Corporation M16C Series, R8C Family C Compiler V.5.45 Release 01
	Compile options -D__UART0__ -c -finfo -dir "$(CONFIGDIR)" -R8C (Default setting is used in the integrated development environment.)

3. Software

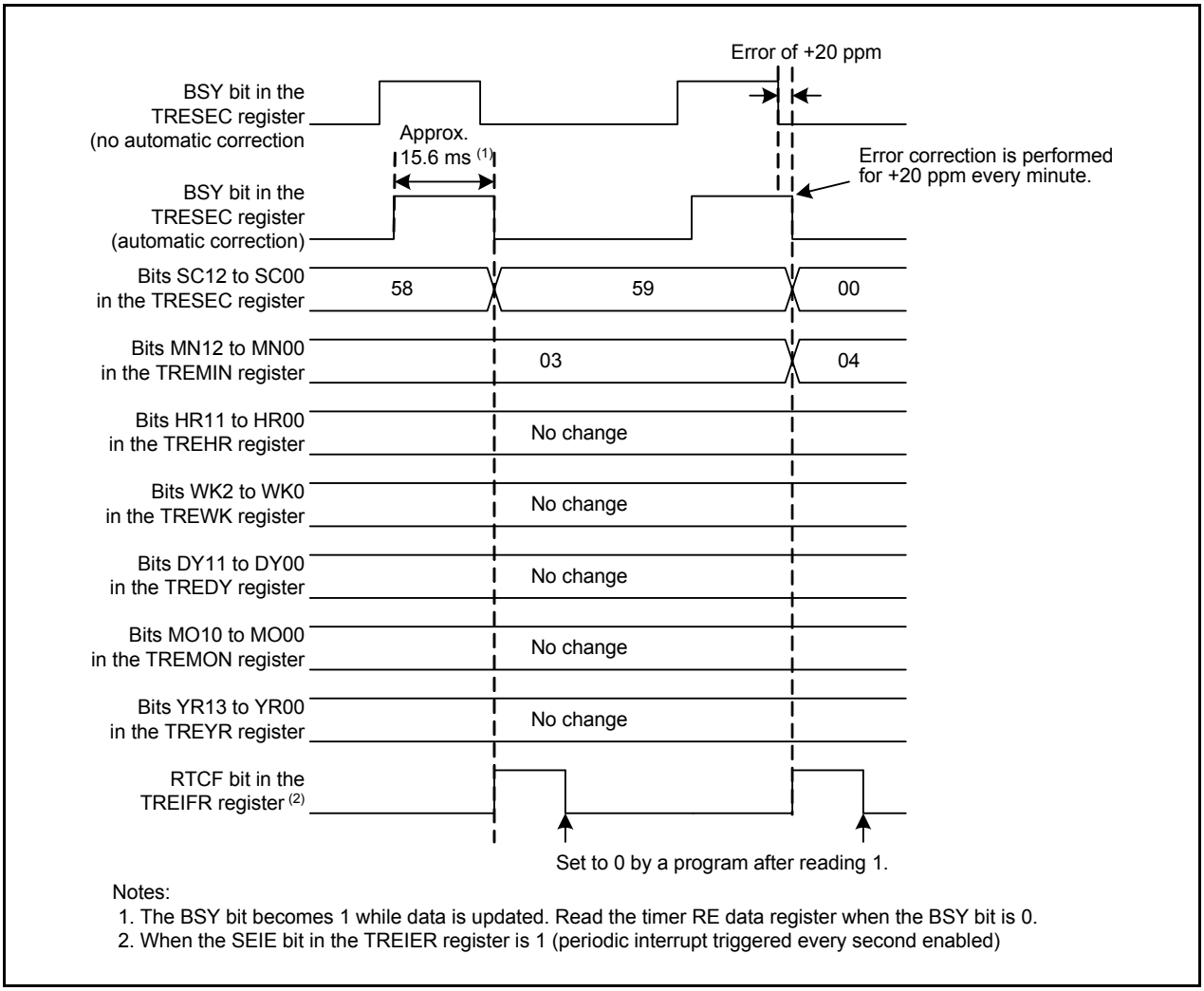
3.1 Operation Overview

Use timer RE2 in real-time clock mode. Use a periodic interrupt triggered every second to obtain the second data (TRESEC), minute data (TREMIN), hour data (TREHR), day-of-the-week data (TREWK), date data (TREDY), month data (TREMON), and year data (TREYR). The count starts from Saturday, January 1, 2011, 00:00:00 (initial value) with timer RE2 operating in 24-hour mode. When the count increments from December 31, 2099, 23:59:59, it becomes January 1, 2000, 00:00:00. fXCIN frequency deviations are corrected using the clock error correction function (automatic correction) while the real-time clock operates. A +20 ppm error is assumed to be generated for oscillators used as fXCIN.

Settings

- Use the XIN clock (20 MHz) for the CPU clock.
- Use fXCIN (32.768 kHz) for the count source of timer RE2.
- Select 24-hour mode.
- Use the timer RE2 interrupt (periodic interrupt triggered every second).
- Assume a +20 ppm error for fXCIN.
- Perform automatic correction (subtraction correction) every minute.
- Do not use the alarm function.

Figure 3.1 shows an Operating Example of the Real-Time Clock Using the Automatic Correction Function.



Notes:
1. The BSY bit becomes 1 while data is updated. Read the timer RE data register when the BSY bit is 0.
2. When the SEIE bit in the TREIER register is 1 (periodic interrupt triggered every second enabled)

Figure 3.1 Operating Example of the Real-Time Clock Using the Automatic Correction Function

3.1.1 Automatic Correction Function

fXCIN frequency deviations are corrected using the automatic correction function. 32.768 kHz and a +20 ppm for fXCIN is assumed in this sample program. fXCIN frequency deviations are corrected to the minus side. Automatic correction is performed every minute.

Settings for corrections are as follows:

- Oscillator frequency = 32.76865536 kHz
- Oscillator frequency error = 20 ppm
- Correction amount = (32.76865536 kHz - 32.768 kHz) × 60 seconds = 39.3216 ≈ 39

Figure 3.2 shows the Automatic Correction Outline.

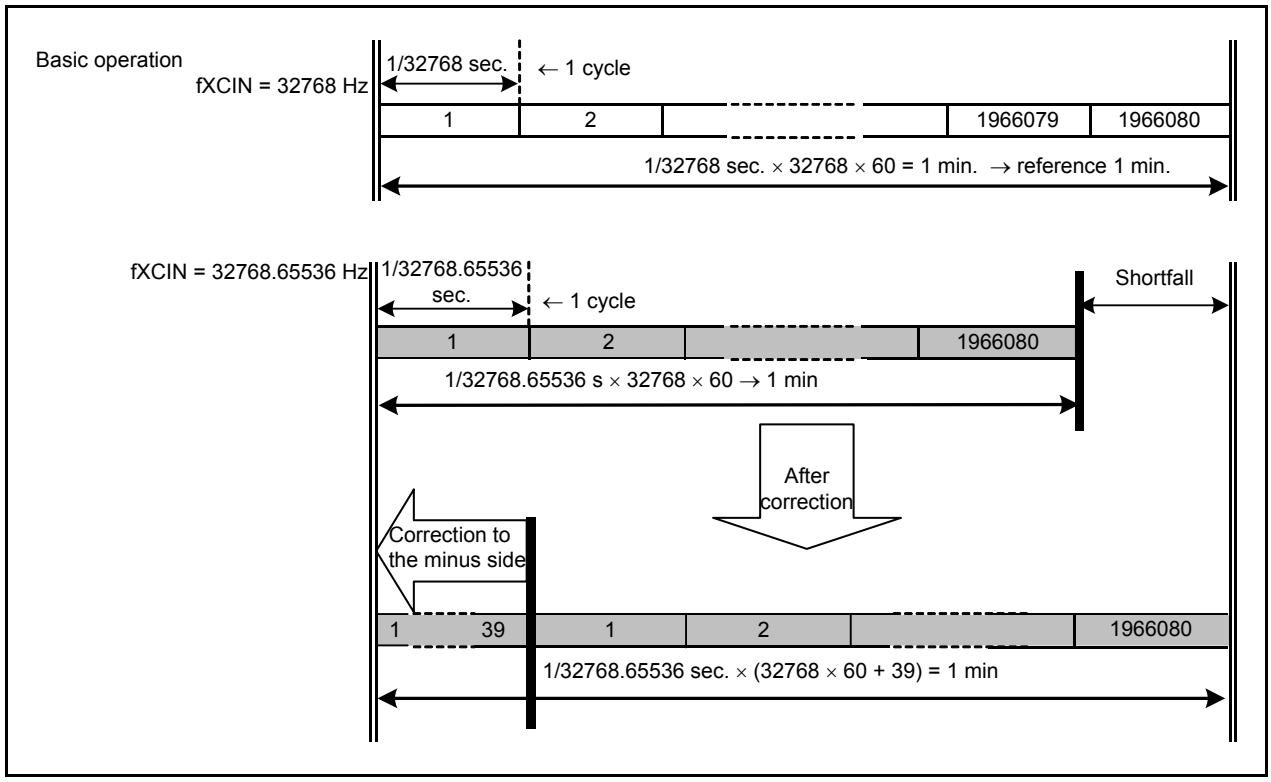


Figure 3.2 Automatic Correction Outline

3.2 Required Memory Size

Table 3.1 lists the Required Memory Size.

Table 3.1 Required Memory Size

Memory Used	Size	Remarks
ROM	336 bytes	In the r01an0363_src.c module
RAM	9 bytes	In the r01an0363_src.c module
Maximum user stack usage	10 bytes	
Maximum interrupt stack usage	4 bytes	

The required memory size varies depending on the C compiler version and compile options.

3.3 Variables

Table 3.2 lists the Global Variables,

Table 3.2 Global Variables

Type	Variable Name	Contents	Function Used
unsigned short	year	Year	timer_re2_init _timer_re2
unsigned char	month	Month	timer_re2_init _timer_re2
unsigned char	day	Date	timer_re2_init _timer_re2
enum	wk	Day of the week {Sun = 0, Mon, Tue, Wed, Thu, Fri, Sat}	timer_re2_init _timer_re2
unsigned char	hr	Hour	timer_re2_init _timer_re2
unsigned char	min	Minute	timer_re2_init _timer_re2
unsigned char	sec	Second	timer_re2_init _timer_re2

3.4 Functions

Table 3.3 lists the Functions.

Table 3.3 Functions

Function Name	Outline
mcu_init	System clock setting
timer_re2_init	Initial setting of timer RE2
_timer_re2	Timer RE2 interrupt handling

3.5 Function Specifications

The following tables list the sample code function specifications.

mcu_init	
Outline	System clock setting
Header	None
Declaration	void mcu_init(void)
Explanation	Set the system clock.
Argument	None
Returned value	None
Remark	—

timer_re2_init	
Outline	Initial setting of timer RE2
Header	None
Declaration	void timer_re2_init(void)
Explanation	Perform initial setting to use timer RE2 in real-time clock mode (automatic correction function enabled).
Argument	None
Returned value	None
Remark	—

_timer_re2	
Outline	Timer RE2 interrupt handling
Header	None
Declaration	void _timer_re2(void)
Explanation	Perform timer RE2 interrupt handling. Obtain the second, minute, hour, day-of-the-week, date, month, and year data.
Argument	None
Returned value	None
Remark	—

3.6 Flowcharts

3.6.1 Main Processing

Figure 3.3 shows the Main Processing.

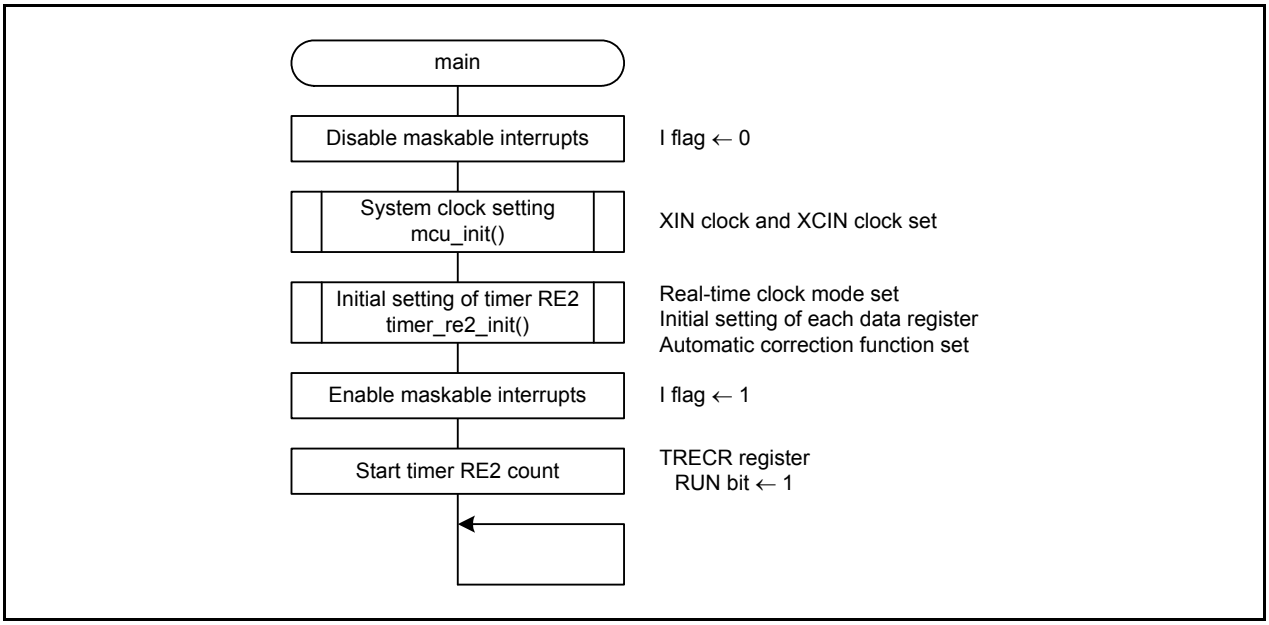


Figure 3.3 Main Processing

3.6.2 System Clock Setting

Figure 3.4 shows the System Clock Setting.

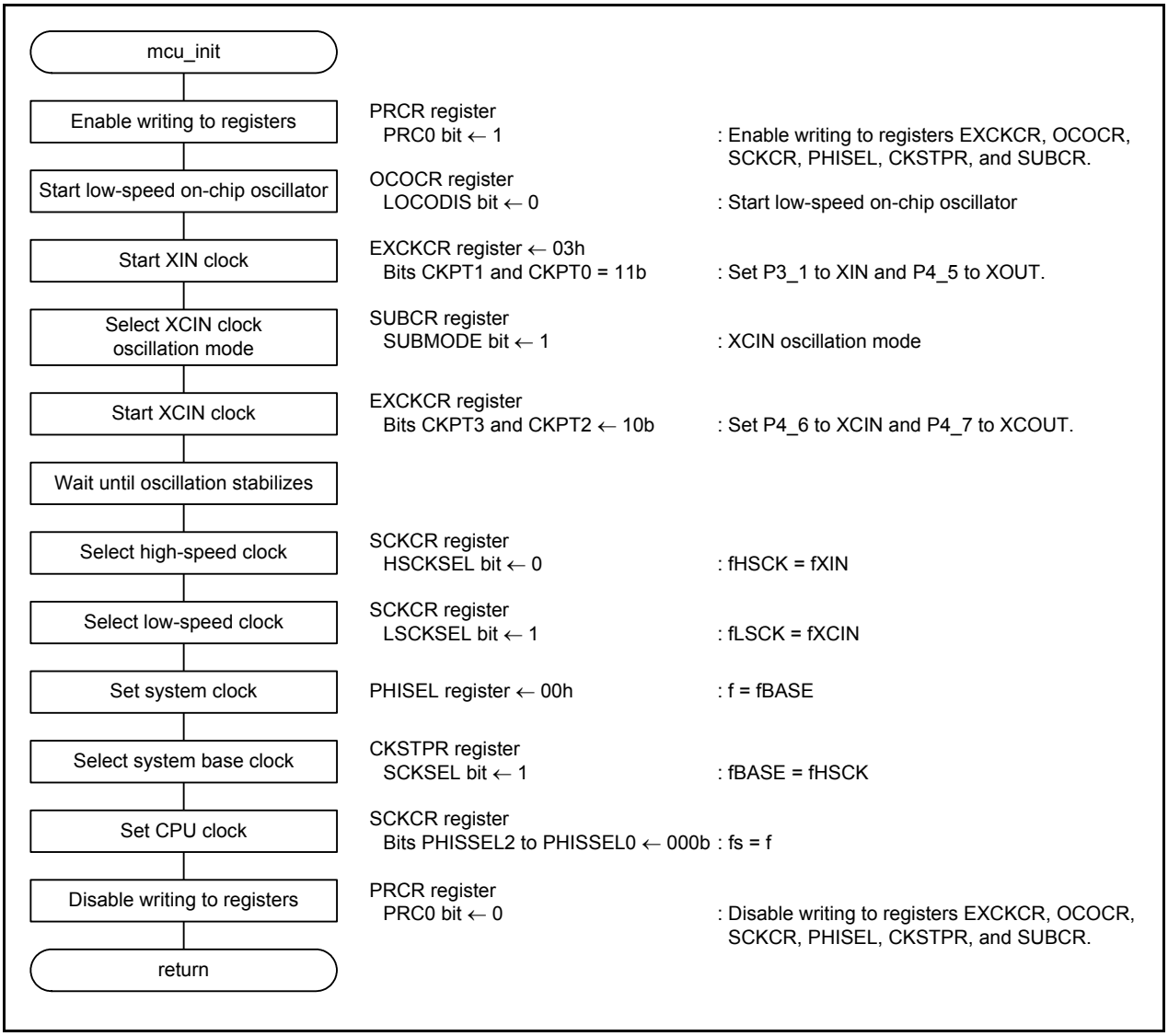
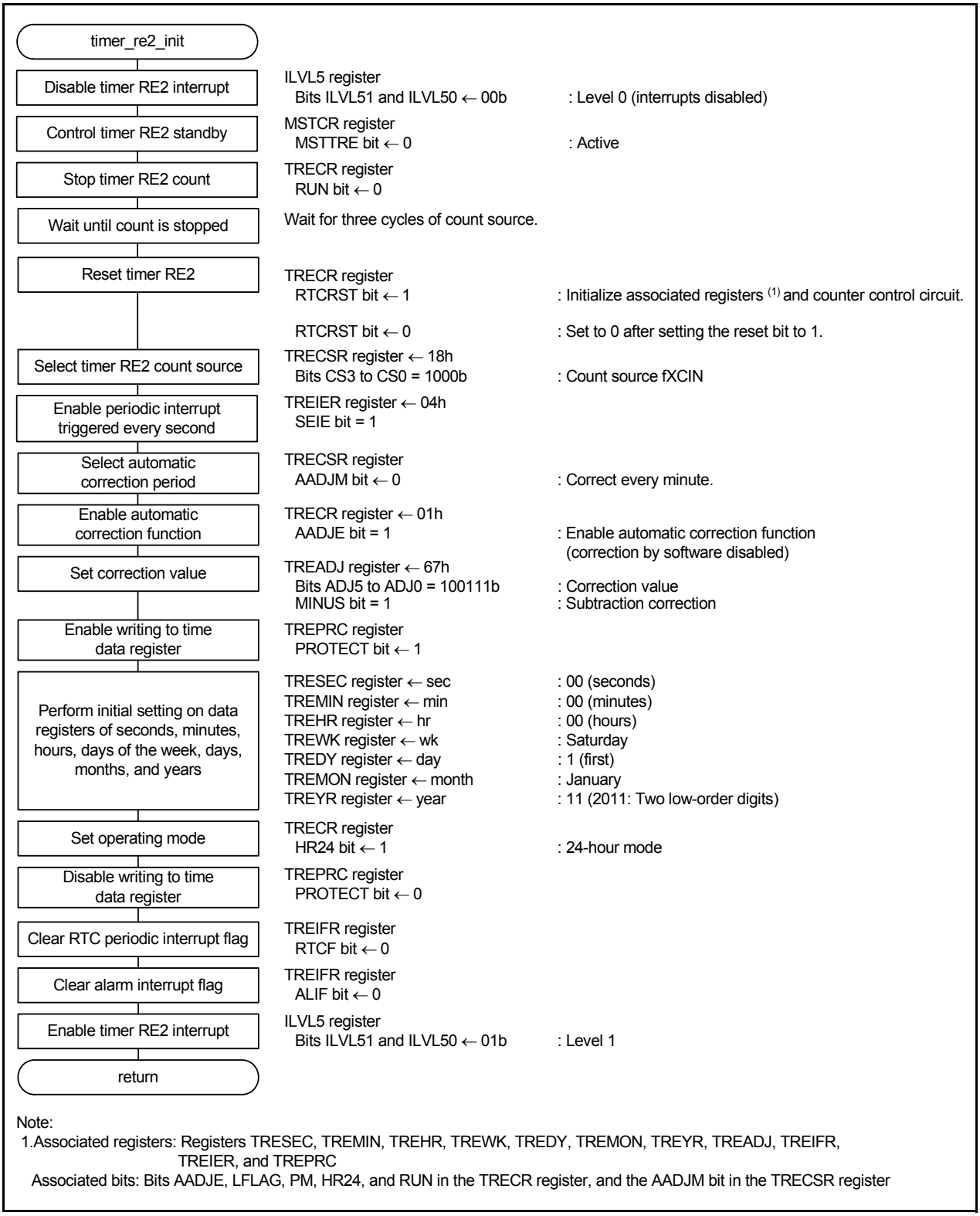


Figure 3.4 System Clock Setting

3.6.3 Initial Setting of Timer RE2

Figure 3.5 shows the Initial Setting of Timer RE2.



Note:
1.Associated registers: Registers TRESEC, TREMIN, TREHR, TREWK, TREDY, TREMON, TREYR, TREADJ, TREIFR, TREIER, and TREPRC
Associated bits: Bits AADJE, LFLAG, PM, HR24, and RUN in the TRECR register, and the AADJM bit in the TRECSR register

Figure 3.5 Initial Setting of Timer RE2

3.6.4 Timer RE2 Interrupt Handling

Figure 3.6 shows the Timer RE2 Interrupt Handling.

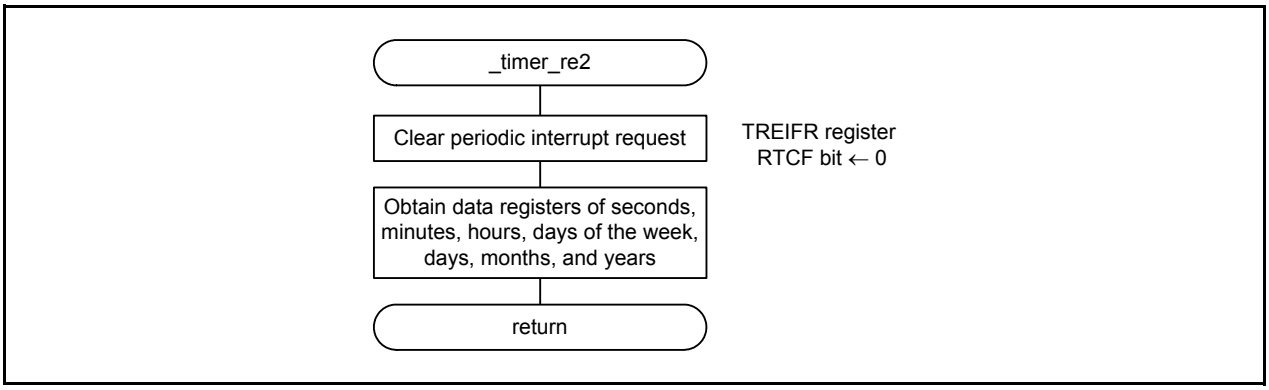


Figure 3.6 Timer RE2 Interrupt Handling

4. Sample Code

Sample code can be downloaded from the Renesas Electronics website.

5. Reference Documents

R8C/M13B Group User's Manual: Hardware Rev.1.00
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.

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Revision History	R8C/M13B Group Timer RE2 Clock Error Correction Function in Real-Time Clock Mode

Rev.	Date	Description	
		Page	Summary
1.00	June 30, 2011	—	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.

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