R8C/LA8A Group

Power Control Using Power-Off 2 Mode

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Abstract

This document describes power-off 2 mode in the R8C/LA8A Group .

Product

R8C/LA8A 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

The MCU enters power-off 2 mode from standard operating mode by a program. The MCU exits power-off 2 mode and enters standard operating mode after 1 second, and counts the number of exits from power-off 2 mode.

Table 1.1 lists the Peripheral Function and Its Application. Figure 1.1 shows an Operating Example.

Table 1.1 Peripheral Function and Its Application

Peripheral Function	Application
Timer RH	Exit source from power-off 2 mode

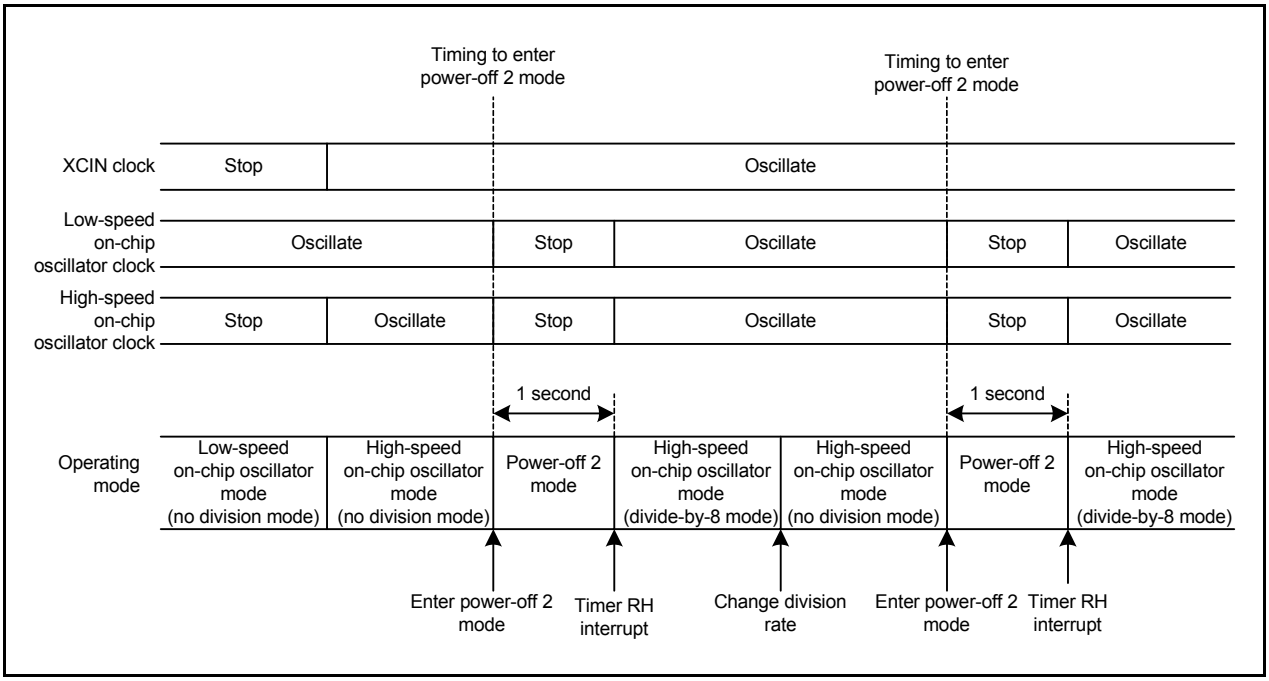


Figure 1.1 Operating Example

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/LA8A Group
Operating frequencies	High-speed on-chip oscillator clock: 20 MHz (typical) XCIN clock: 32.768 kHz System clock: 20 MHz CPU clock: 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

The MCU enters power-off 2 mode from standard operating mode by a program. The timer RH interrupt is used to exit power-off 2 mode. An interrupt request is generated at the periodic interrupt triggered every second. After the MCU exits power-off 2 mode, the number of exits is counted.

Settings:

- Select an exit using the CPU clock immediately before entering power-off 2 mode.
- Use fC-TRH (32.768 kHz) as the count source for timer RH.
- Select 24-hour mode.
- Use the timer RH interrupt (periodic interrupt triggered every second).
- Do not use the alarm function.

(1) After reset, set the high-speed on-chip oscillator (no division mode) for the CPU clock.
(2) After enabling the timer RH interrupt, the MCU enters power-off 2 mode.
(3) The MCU exits from power-off 2 mode using the timer RH interrupt (every second). Divide-by-8 mode of the clock (high-speed on-chip oscillator) used immediately before entering power-off 2 mode is selected for the CPU clock.
(4) Set the high-speed on-chip oscillator (no division mode) for the CPU clock. Then the count data is incremented.
(5) Repeat steps (2) to (4).

Figure 3.1 shows the Mode State Transition.

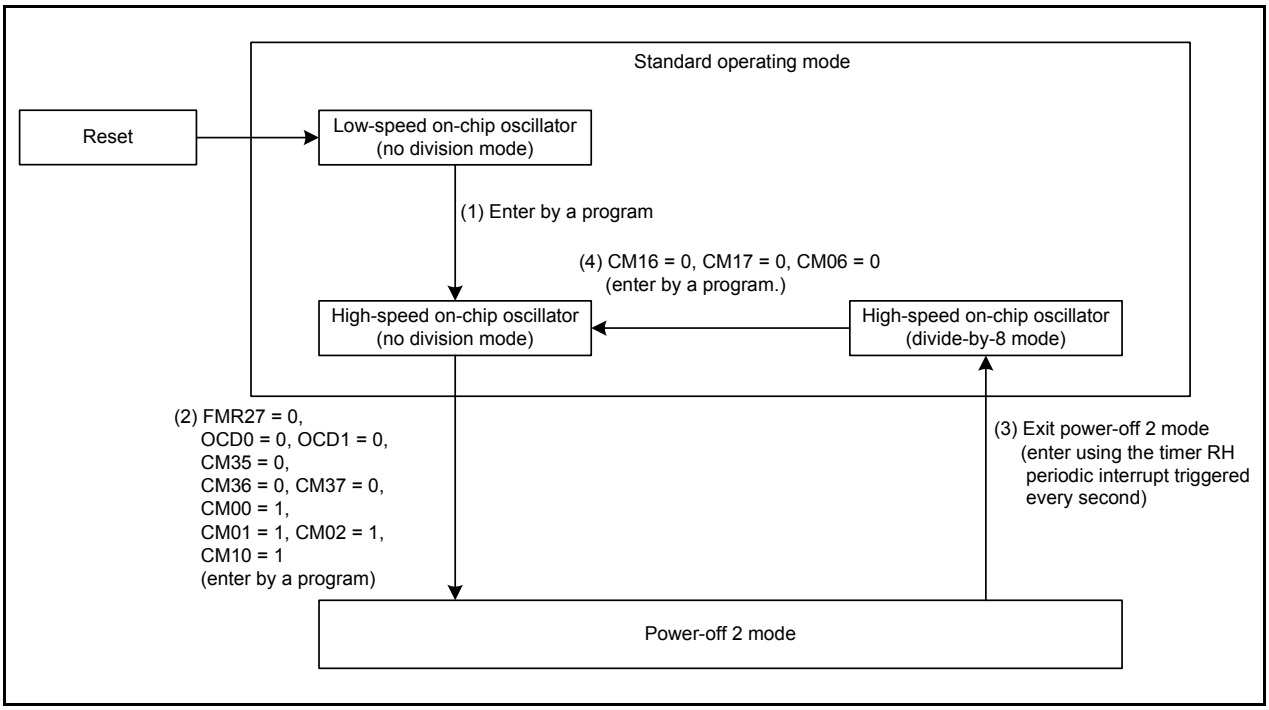


Figure 3.1 Mode State Transition

3.2 Required Memory Size

Table 3.1 lists the Required Memory Size.

Table 3.1 Required Memory Size

Memory Used	Size	Remarks
ROM	299 bytes	In the r01an0368_src.c module
RAM	1 byte	In the r01an0368_src.c module
Maximum user stack usage	10 bytes	
Maximum interrupt stack usage	18 bytes	

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

3.3 Variables

Table 3.2 lists the static Variable.

Table 3.2 static Variable

Type	Variable Name	Contents	Function Used
unsigned char	cnt	Count data	user_program

3.4 Functions

Table 3.3 lists the Functions.

Table 3.3 Functions

Function Name	Outline
mcu_init	System clock setting
user_program	User program processing
power_control	Power control processing
timer_rh_init	Initial setting of timer RH
_timer_rh	Timer RH 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	—

user_program	
Outline	User program processing
Header	None
Declaration	void user_program(void)
Explanation	Perform user program processing. Add processing based on the user system. In this application note, count the number of exits from power-off 2 mode.
Argument	None
Returned value	None
Remark	—

power_control	
Outline	Power control processing
Header	None
Declaration	void power_control(void)
Explanation	Enter power-off 2 mode.
Argument	None
Returned value	None
Remark	—

timer_rh_init	
Outline	Initial setting of timer RH
Header	None
Declaration	void timer_rh_init(void)
Explanation	Perform initial setting to use timer RH in real-time clock mode.
Argument	None
Returned value	None
Remark	—

_timer_rh	
Outline	Timer RH interrupt handling
Header	None
Declaration	void _timer_rh(void)
Explanation	Perform timer RH interrupt handling.
Argument	None
Returned value	None
Remark	—

3.6 Flowcharts

3.6.1 Main Processing

Figure 3.2 shows the Main Processing.

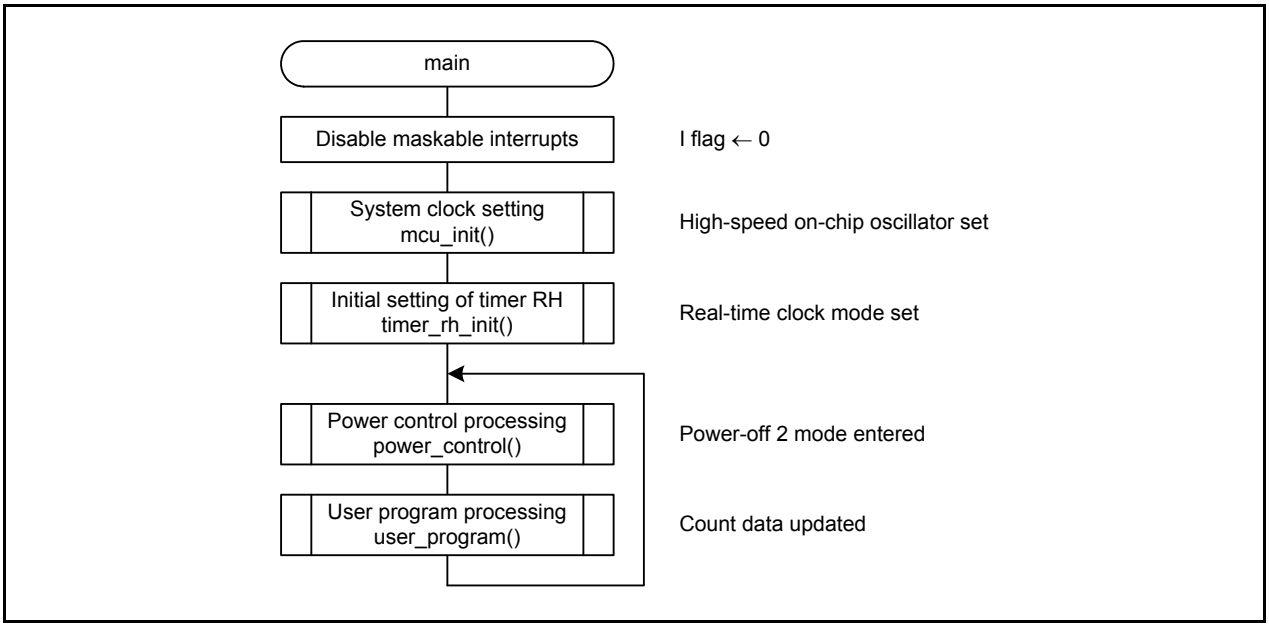


Figure 3.2 Main Processing

3.6.2 System Clock Setting

Figure 3.3 shows the System Clock Setting.

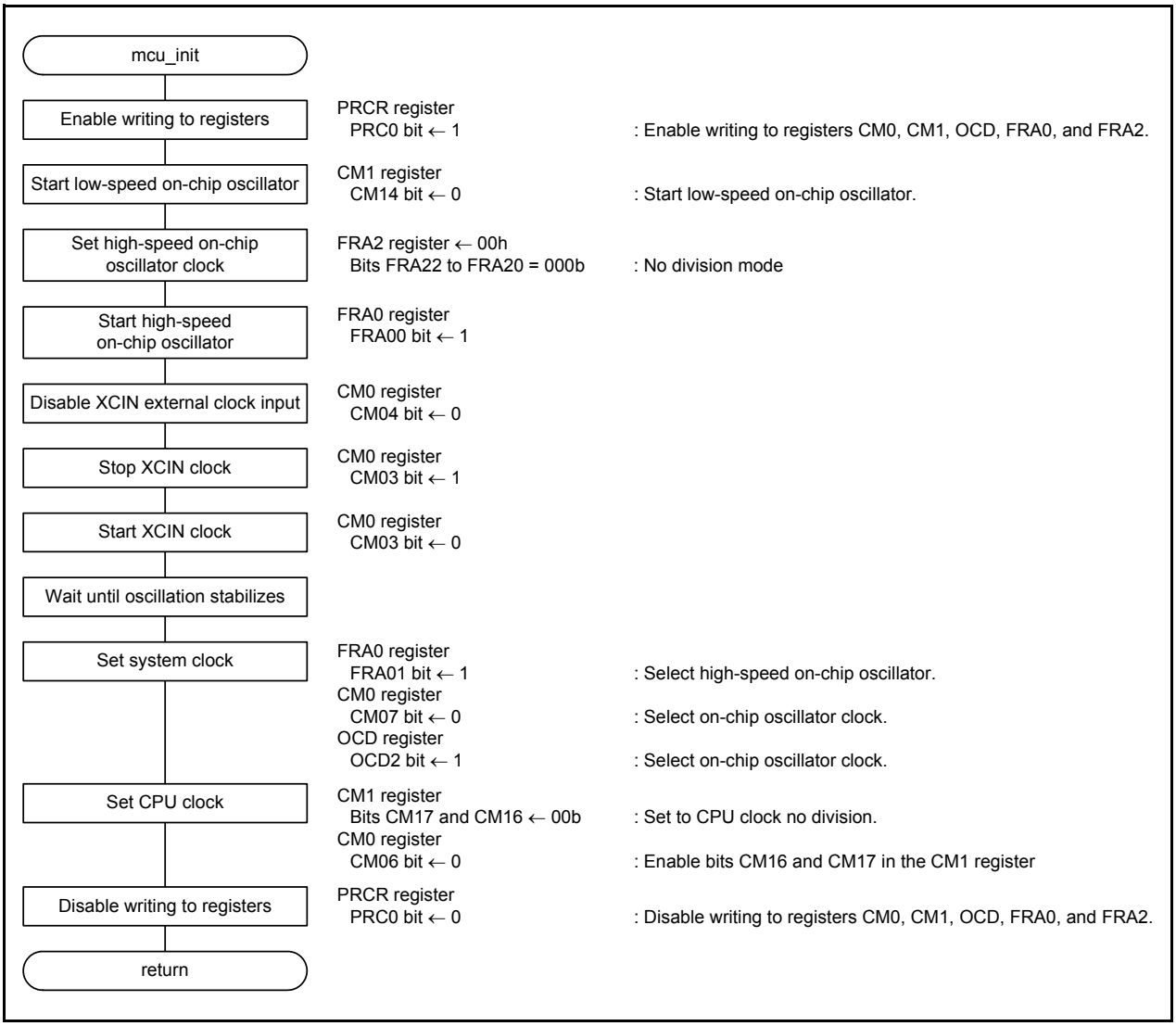


Figure 3.3 System Clock Setting

3.6.3 User Program Processing

Figure 3.4 shows the User Program Processing

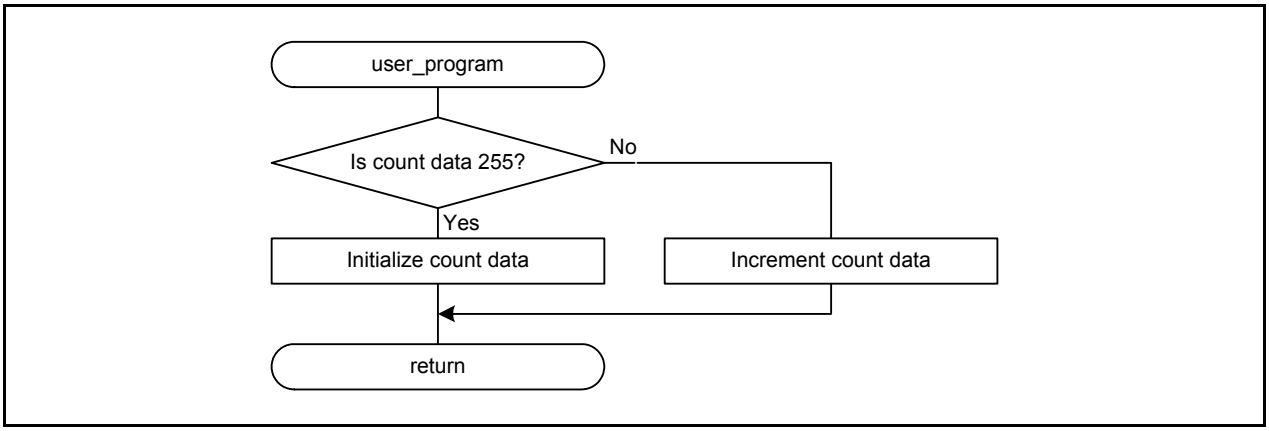
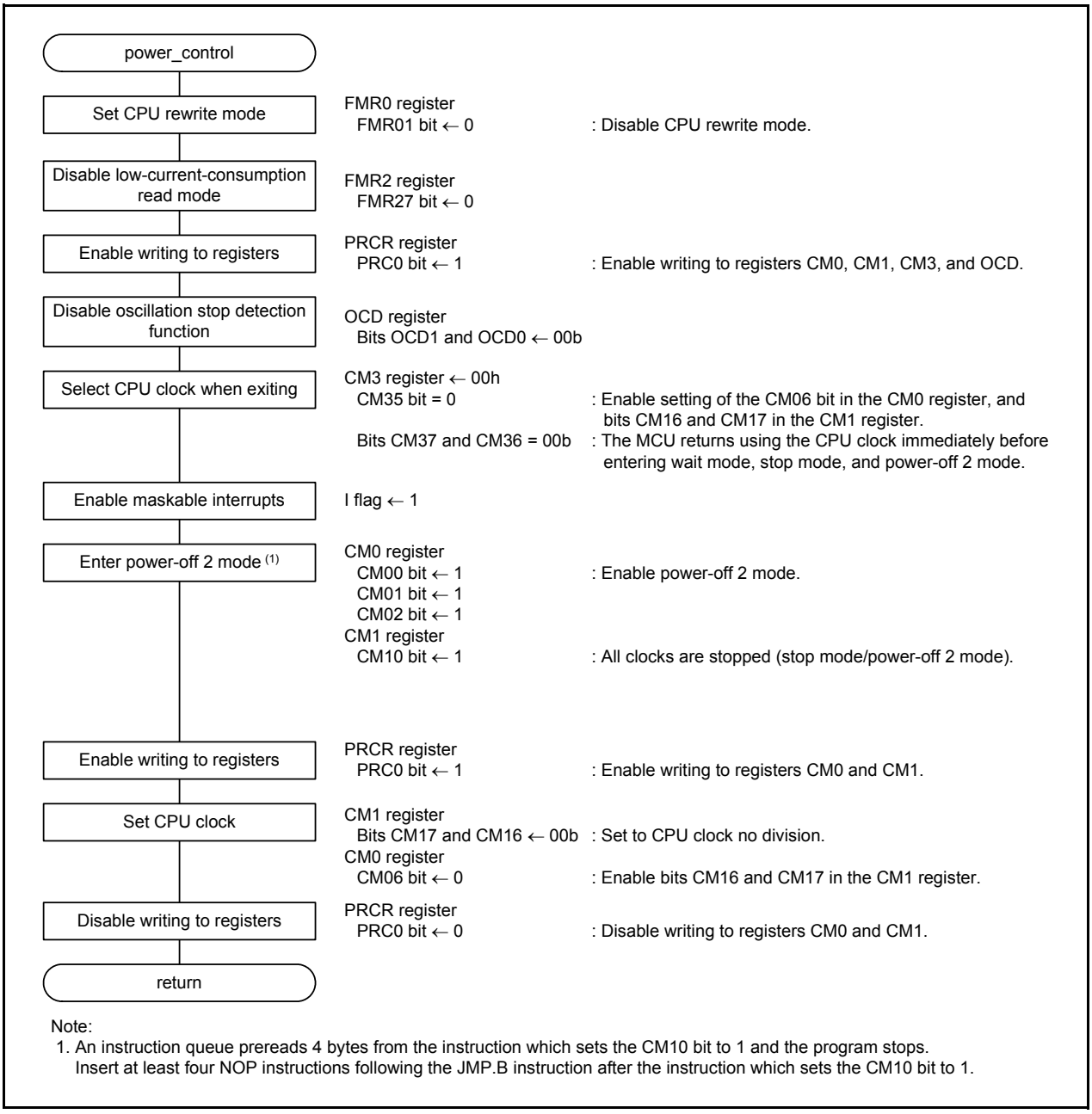


Figure 3.4 User Program Processing

3.6.4 Power Control Processing

Figure 3.5 shows the Power Control Processing.

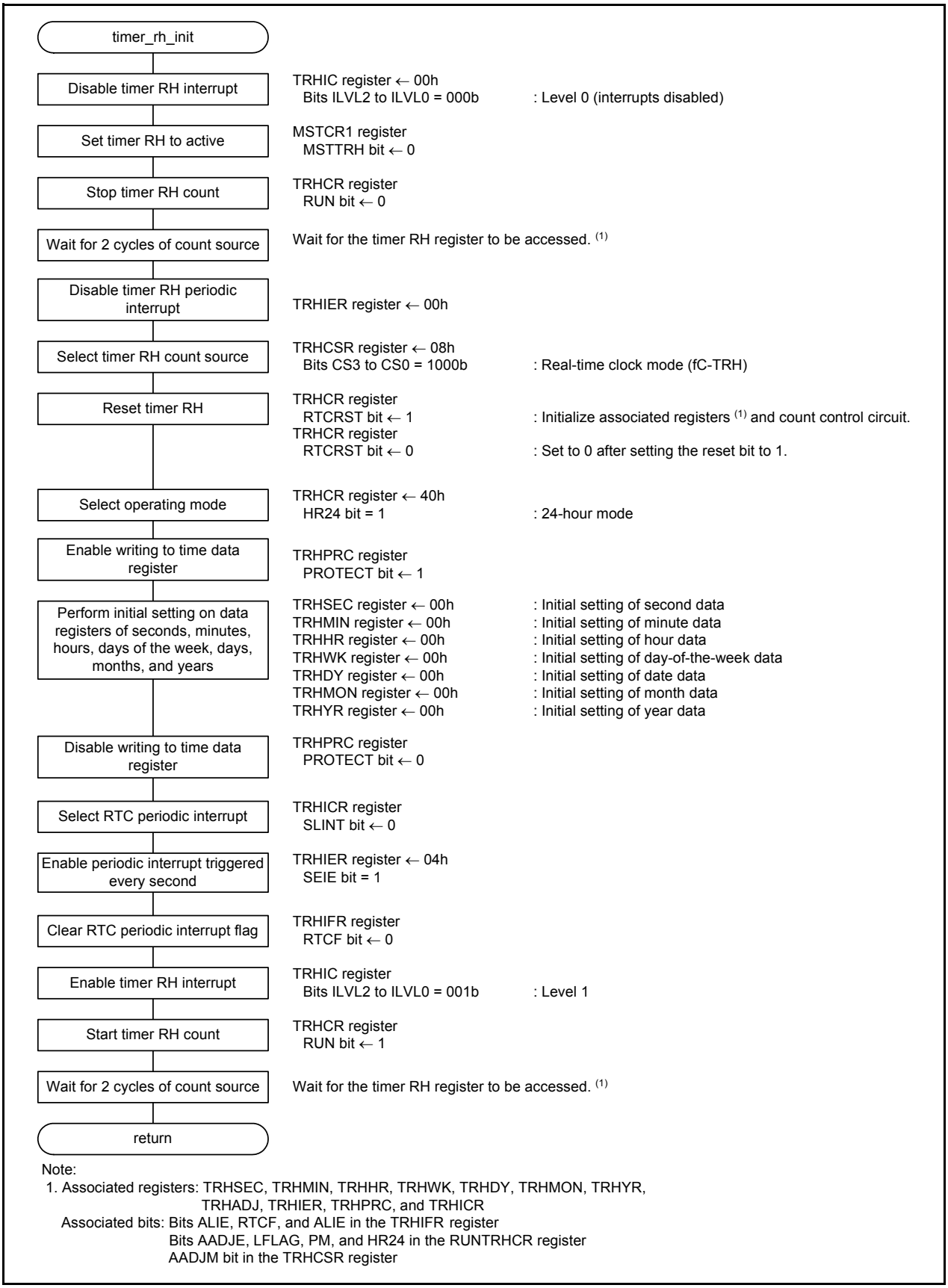


Note:
1. An instruction queue prereads 4 bytes from the instruction which sets the CM10 bit to 1 and the program stops. Insert at least four NOP instructions following the JMP.B instruction after the instruction which sets the CM10 bit to 1.

Figure 3.5 Power Control Processing

3.6.5 Initial Setting of Timer RH

Figure 3.6 shows the Initial Setting of Timer RH.



Note:
1. Associated registers: TRHSEC, TRHMIN, TRHHR, TRHWK, TRHDY, TRHMON, TRHYR, TRHADJ, TRHIER, TRHPRC, and TRHICR
Associated bits: Bits ALIE, RTCF, and ALIE in the TRHIFR register
Bits AADJE, LFLAG, PM, and HR24 in the RUNTRHCR register
AADJM bit in the TRHCSR register

Figure 3.6 Initial Setting of Timer RH

3.6.6 Timer RH Interrupt Handling

Figure 3.7 shows Timer RH Interrupt Handling.

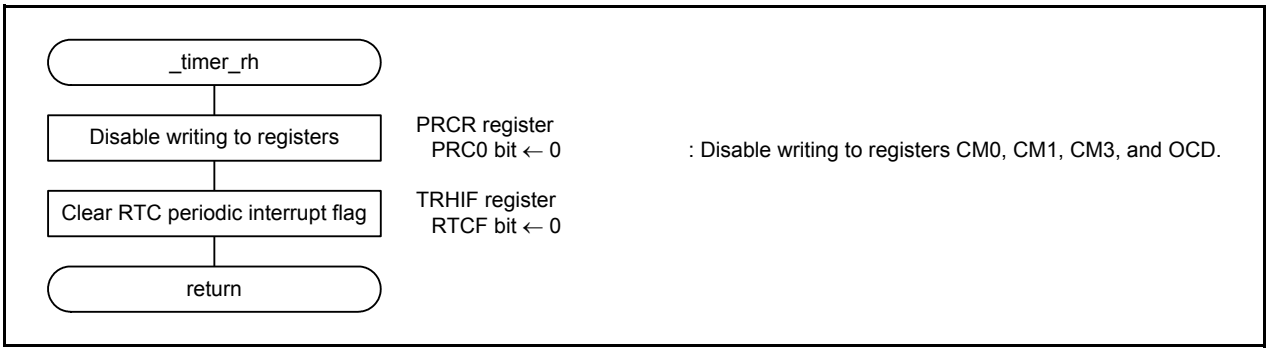


Figure 3.7 Timer RH Interrupt Handling

4. Sample Code

Sample code can be downloaded from the Renesas Electronics website.

5. Reference Documents

R8C/LA8A Group User's Manual: Hardware Rev.1.02
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/LA8A Group Power Control Using Power-Off 2 Mode

Rev.	Date	Description	
		Page	Summary
1.00	Sep. 21, 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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