R8C/M13B Group

Timer RK in Output Compare Mode

R01AN0367EJ0100
Rev. 1.00
Apr. 6, 2011

Abstract

This document describes using timer RK in output compare mode for the R8C/M13B Group.

Products

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.

1. Specifications

When using timer RK in output compare mode, the TRKO pin outputs two waveforms. The first waveform is a 12.8 µs period with a high width of 3.15 µs, and the second waveform is a 9.6 µs period with a 3.15 µs high width. Each waveform is output twice before switching to the other waveform.
Table 1.1 lists the Peripheral Function and Its Application. Figure 1.1 shows an Output Waveform.

Table 1.1 Peripheral Function and Its Application

Peripheral Function	Application
Timer RK	Pulse output

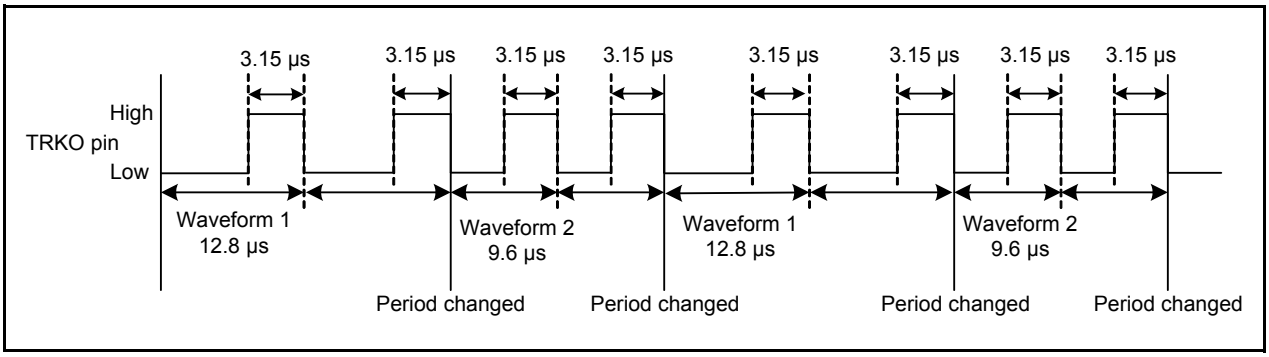


Figure 1.1 Output Waveform

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 • System clock: 20 MHz • CPU clock: 20 MHz
Operating voltage	5.0 V (can be operated between 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. Hardware

3.1 Pin Used

Table 3.1 lists the Pin Used and Its Function.

Table 3.1 Pin Used and Its Function

Pin Name	I/O	Function
P0_7/TRKO	Output	Timer RK output

4. Software

4.1 Operation Overview

Two pulses are output from the TRKO pin using timer RK. Low is selected as the initial level of the TRKO pin. After the count starts, high is output when the value in the TMKCMP register matches the value in the TRKCNT register, and low is output again when timer RK overflows. These operations are repeated. The number of overflows is counted in the interrupt handling generated when timer RK overflows and the period is changed each time the second pulse is completed. The period is changed to switch auto-reload from disabled to enabled. Timer RK uses the settings below.

Settings

- Use output compare mode.
- Select f1 (20 MHz) as the count source.
- Use the auto-reload function.
- Enable TRKO output.
- Select low as the initial output level of the TRKO pin.
- Use the timer RK overflow interrupt.

(1) Set C0h to the TMKCMP register for the initial setting, and set the TKLDM bit in the TMKM register to 1 (auto-reload enabled).
(2) Set the TSTART bit in the TMKCR register to 1 and start counting timer RK.
(3) When timer RK overflows, the timer RK interrupt is generated. Every time the timer RK interrupt is generated, set the TMKOVIF bit in the TMKIR register to 0 (no overflow interrupt request).
(4) When writing 40h to the TMKLD register in the timer RK interrupt handling, continue counting from the reload value 40h written to the TMKLD register.
(5) When timer RK overflows, start counting from the reload value 40h written to the TMKLD register.
(6) When timer RK overflows again, set the TKLDM bit to 0 (auto-reload disabled) in the timer RK interrupt handling.
(7) When timer RK overflows, start counting from 00h.
(8) When timer RK overflows again, set the TKLDM bit to 1 (auto-reload enabled) in the timer RK interrupt handling. Repeat steps (5) to (8).

Figure 4.1 shows the Timing Diagram.

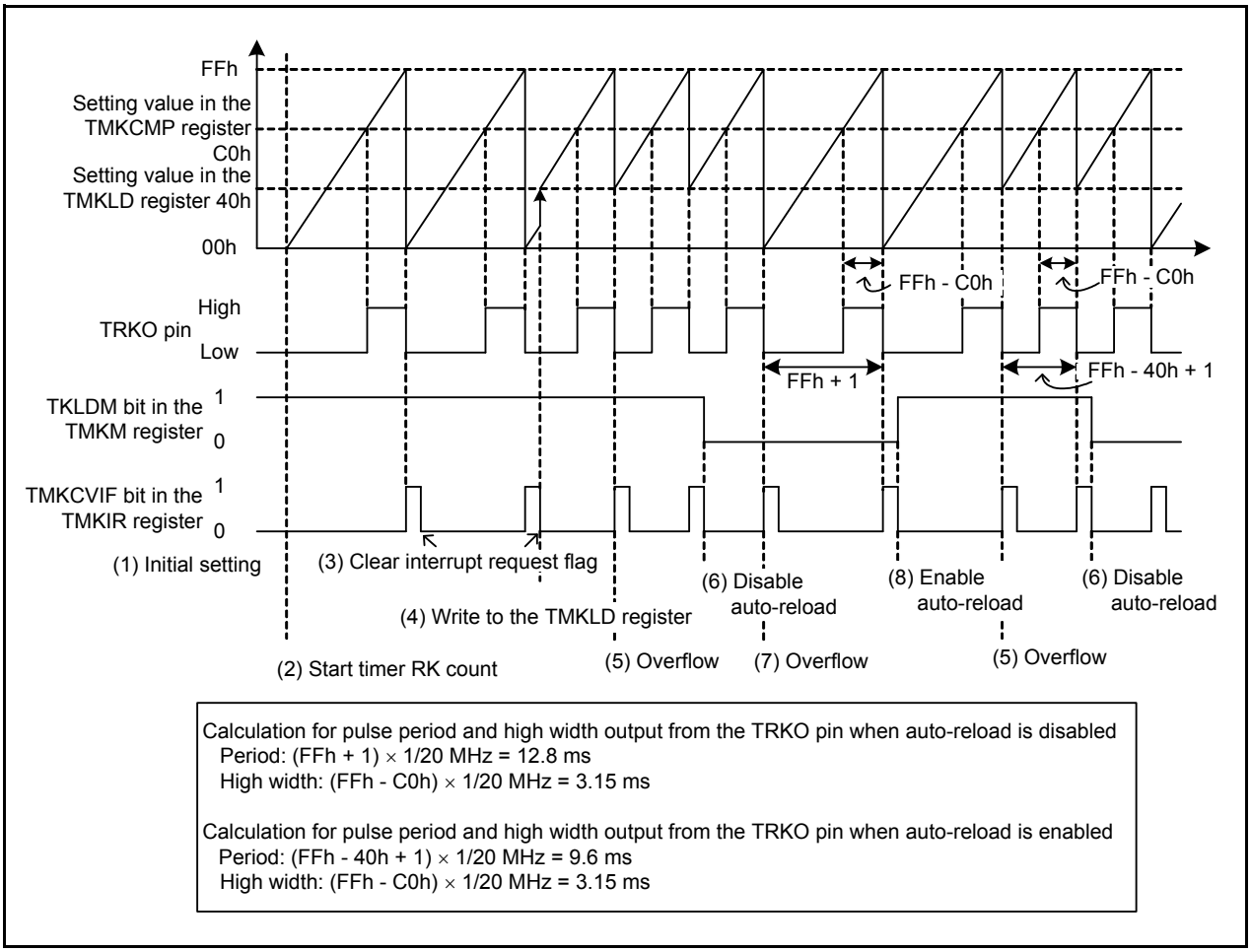


Figure 4.1 Timing Diagram

4.2 Required Memory Size

Table 4.1 lists the Required Memory Size.

Table 4.1 Required Memory Size

Memory Used	Size	Remarks
ROM	225 bytes	In the r01an0367_src.c module
RAM	1 byte	In the r01an0367_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 compiler options.

4.3 Constants

Table 4.2 lists the Constants Used in the Sample Code.

Table 4.2 Constants Used in the Sample Code

Constant Name	Setting Value	Contents
LOW	0	Output level low of TRKO pin
TRKO	P0_7	TRKO pin

4.4 Variable

Table 4.3 lists the static Variable.

Table 4.3 static Variable

Type	Variable Name	Contents	Function Used
unsigned char	cnt	Timer RK overflow counter	_timer_rk

4.5 Functions

Table 4.4 lists the Functions.

Table 4.4 Functions

Function Name	Outline
mcu_init	System clock setting
timer_rk_init	Timer RK initial setting
_timer_rk	Timer RK interrupt handling

4.6 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_rk_init	
Outline	Timer RK initial setting
Header	None
Declaration	void timer_rk_init(void)
Explanation	Perform initial setting to use timer RK in output compare mode.
Argument	None
Returned value	None
Remark	—

_timer_rk	
Outline	Timer RK interrupt handling
Header	None
Declaration	void _timer_rk(void)
Explanation	Write to the TMKLD register, and enable or disable auto-reload depending on the number of timer RK overflows.
Argument	None
Returned value	None
Remark	—

4.7 Flowcharts

4.7.1 Main Processing

Figure 4.2 shows the Main Processing.

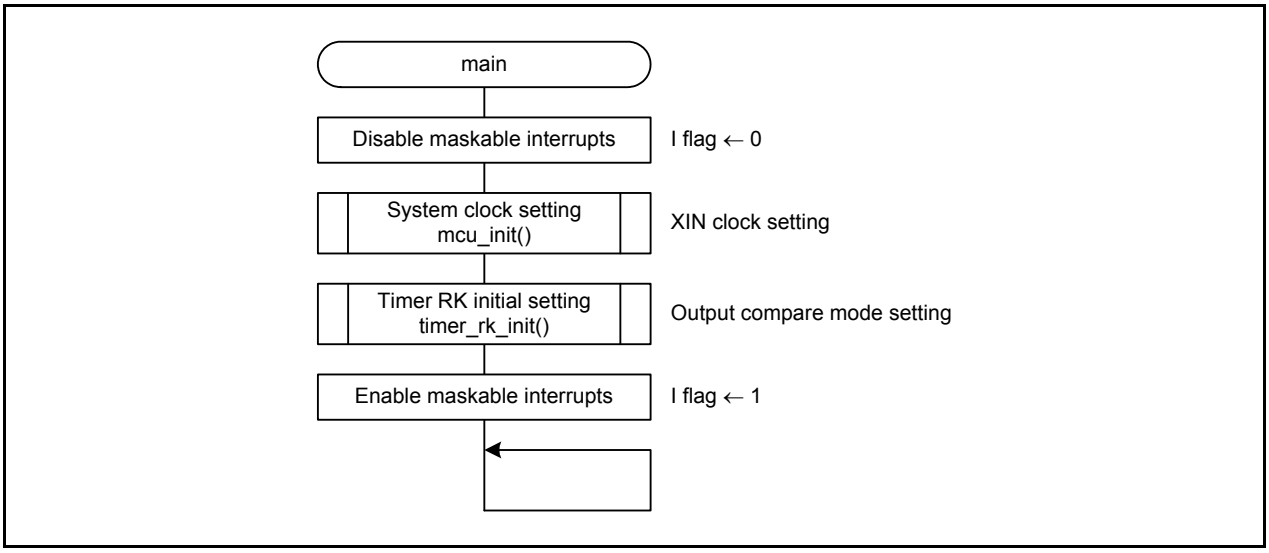


Figure 4.2 Main Processing

4.7.2 System Clock Setting

Figure 4.3 shows the System Clock Setting.

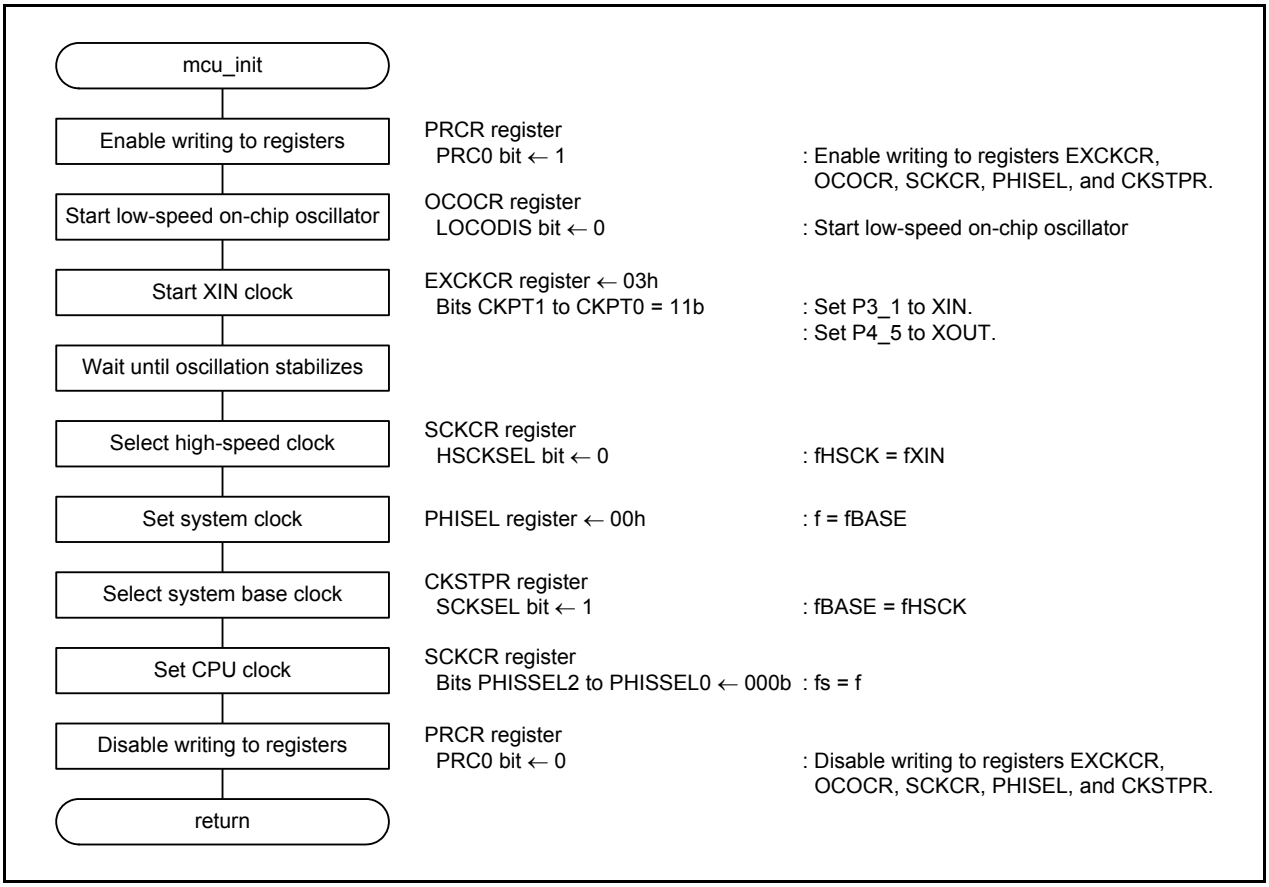
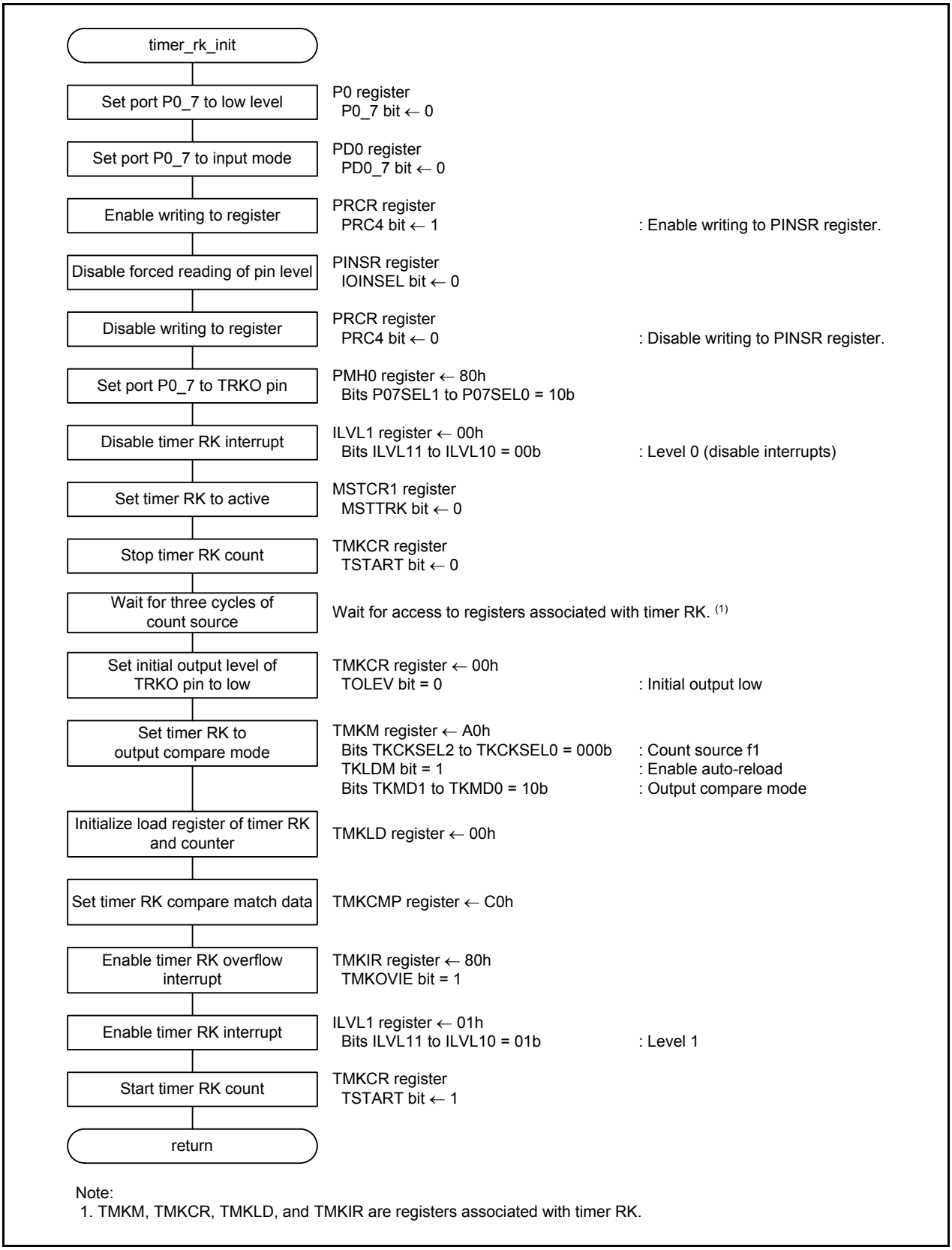


Figure 4.3 System Clock Setting

4.7.3 Timer RK Initial Setting

Figure 4.4 shows the Timer RK Initial Setting.



Note:
1. TMKM, TMKCR, TMKLD, and TMKIR are registers associated with timer RK.

Figure 4.4 Timer RK Initial Setting

4.7.4 Timer RK Interrupt Handling

Figure 4.5 shows the Timer RK Interrupt Handling.

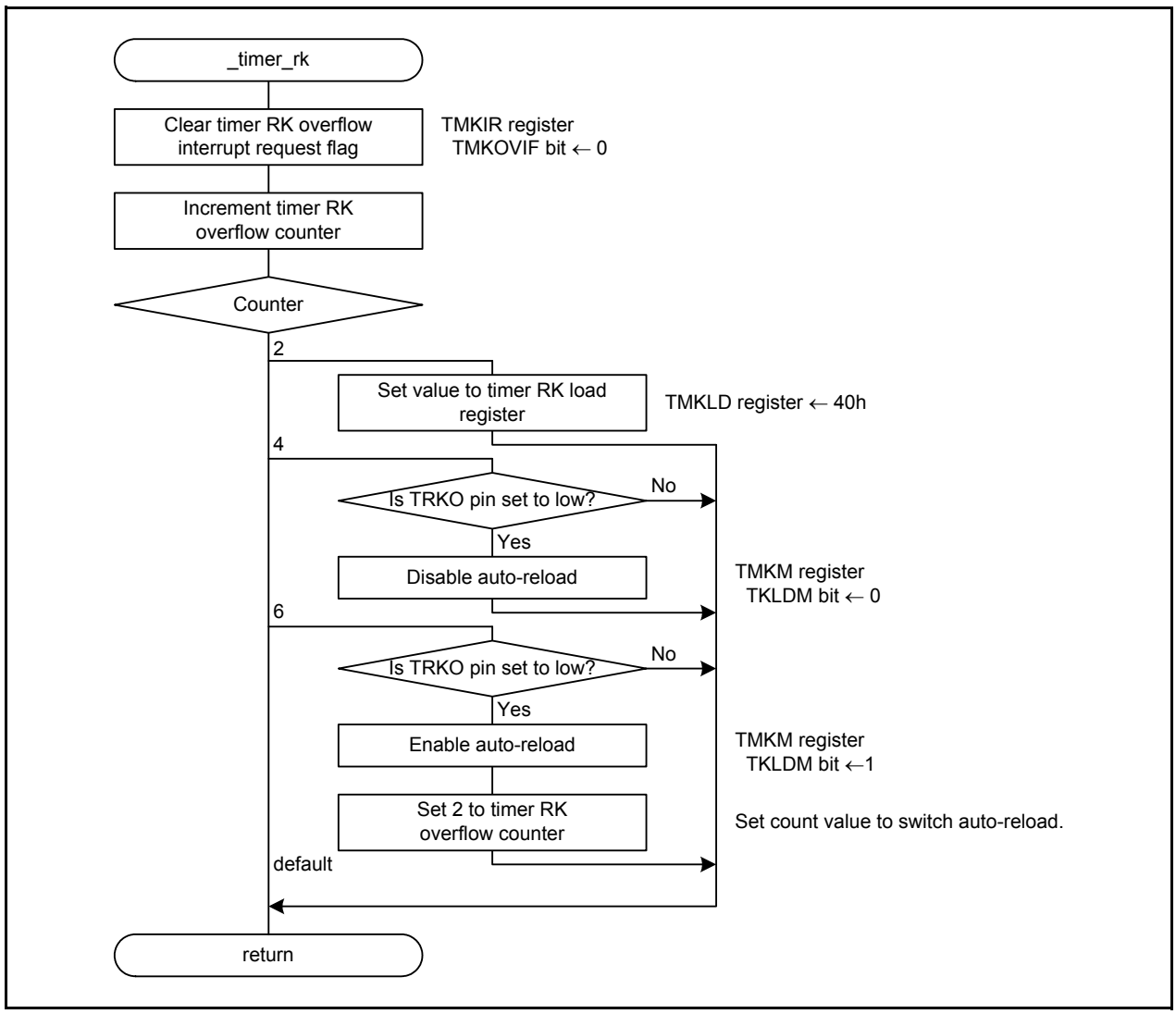


Figure 4.5 Timer RK Interrupt Handling

5. Sample Code

Sample code can be downloaded from the Renesas Electronics website.

6. 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.

7. Website and Support

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

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Revision History	R8C/M13B Group Timer RK in Output Compare Mode

Rev.	Date	Description	
		Page	Summary
1.00	Apr. 6, 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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