
R8C/M12A Group

Timer RC Waveform Output Manipulation Function

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Abstract

This document describes the timer RC waveform output manipulation function for the R8C/M12A Group.

Products

R8C/M12A Group

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

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1. Specifications

This document describes how to use the timer RC waveform output manipulation function. While the waveform output manipulation event is being input, the output level of the TRCIOB pin is fixed at low. After the waveform output manipulation event is cancelled, output automatically resumes or resumes by software.

Table 1.1 lists the Peripheral Functions and Their Applications. Figure 1.1 shows an Operation Example When Output Automatically Resumes.

Table 1.1 Peripheral Functions and Their Applications

Peripheral Function	Application
Timer RC	Waveform output
INT1 interrupt	Waveform output manipulation event input and cancellation
P1_7	Input pin

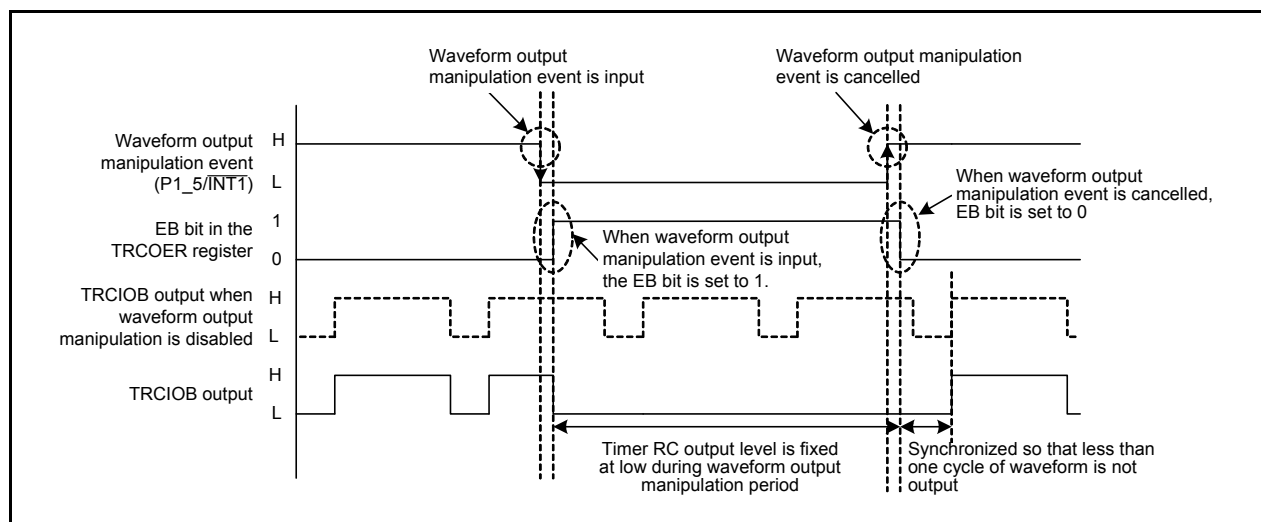


Figure 1.1 Operation Example When Output Automatically Resumes

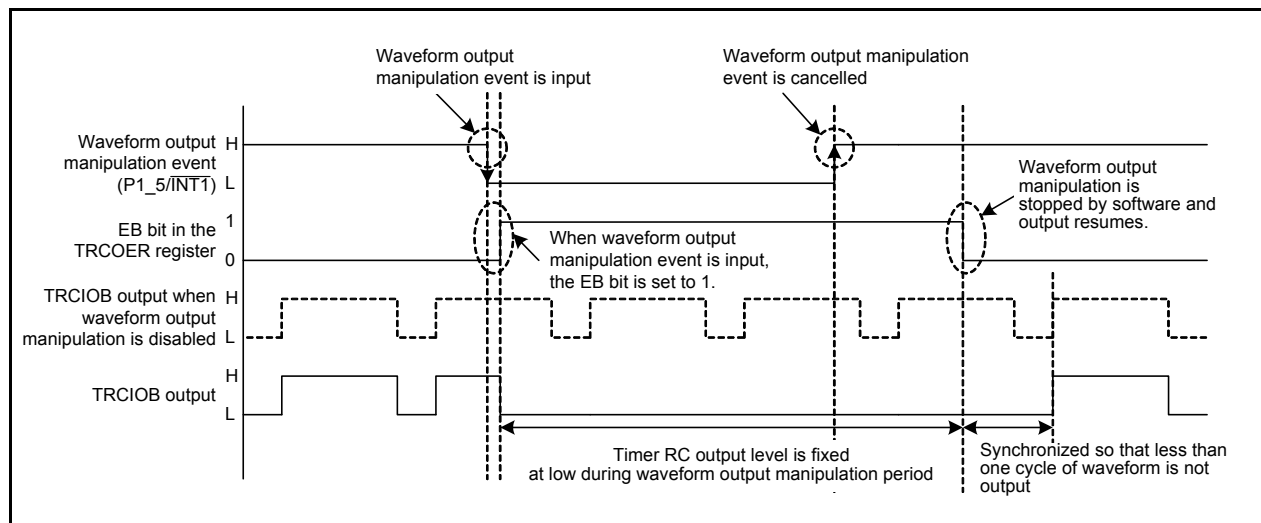


Figure 1.2 Operation Example When Output Resumes by Software

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/M12A Group
Operating frequencies	<ul style="list-style-type: none"> • XIN clock: 20 MHz • CPU clock: 20 MHz • System 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. Hardware

3.1 Pins Used

Table 3.1 lists the Pins Used and Their Functions.

Table 3.1 Pins Used and Their Functions

Pin Name	I/O	Function
P1_2/TRCIOB	Output	Output from timer RC
P1_5/INT1	Input	Input INT1 interrupt
P1_7	Input	Select waveform output resume method

4. Software

4.1 Operation Overview

Perform waveform output from the TRCIOB pin using timer RC. Enable waveform output manipulation and stop waveform output when the waveform output manipulation event occurs. Select low-level input to the INT1 pin for the waveform output manipulation event. Hold the TRBIO pin output level at low while waveform output is stopped. After the waveform output manipulation event is cancelled, output from the TRCIOB pin resumes. Select a resume method according to the port P1_7 state when the waveform output manipulation event occurs. When the port P1_7 input level is high, output automatically resumes. When the port P1_7 input level is low, output resumes by software. Settings and operation are shown below.

Settings

- Use PWM mode for waveform output and output from the TRCIOB pin.
- Enable waveform output manipulation.
- Set waveform output to manipulation during low-level period of the $\overline{\text{INT1}}$ input level for the waveform output manipulation event.
- Select the timer RC output level as low fixed during the waveform output manipulation period for the waveform output manipulation period output level.
- Use the $\overline{\text{INT1}}$ interrupt.
- Use port P1_7 as the input pin.
- Select both edges as the $\overline{\text{INT1}}$ input edge.

Operation

- (1) When the waveform output manipulation event is input, the EB bit in the TRCOER register becomes 1 and the TRCIOB pin output is disabled. And a resuming method is selected in the $\overline{\text{INT1}}$ interrupt handling. The output level of the TRCIOB pin is fixed at low until the waveform output manipulation event is cancelled and the waveform output resumes.
- (2) When output automatically resumes, the EB bit is automatically set to 0 and output resumes after the waveform output manipulation event is cancelled.
- (3) When output resumes by software, TRCIOB output is enabled by a program and output resumes after the waveform output manipulation event is cancelled.

Figure 4.1 shows the Timing Diagram.

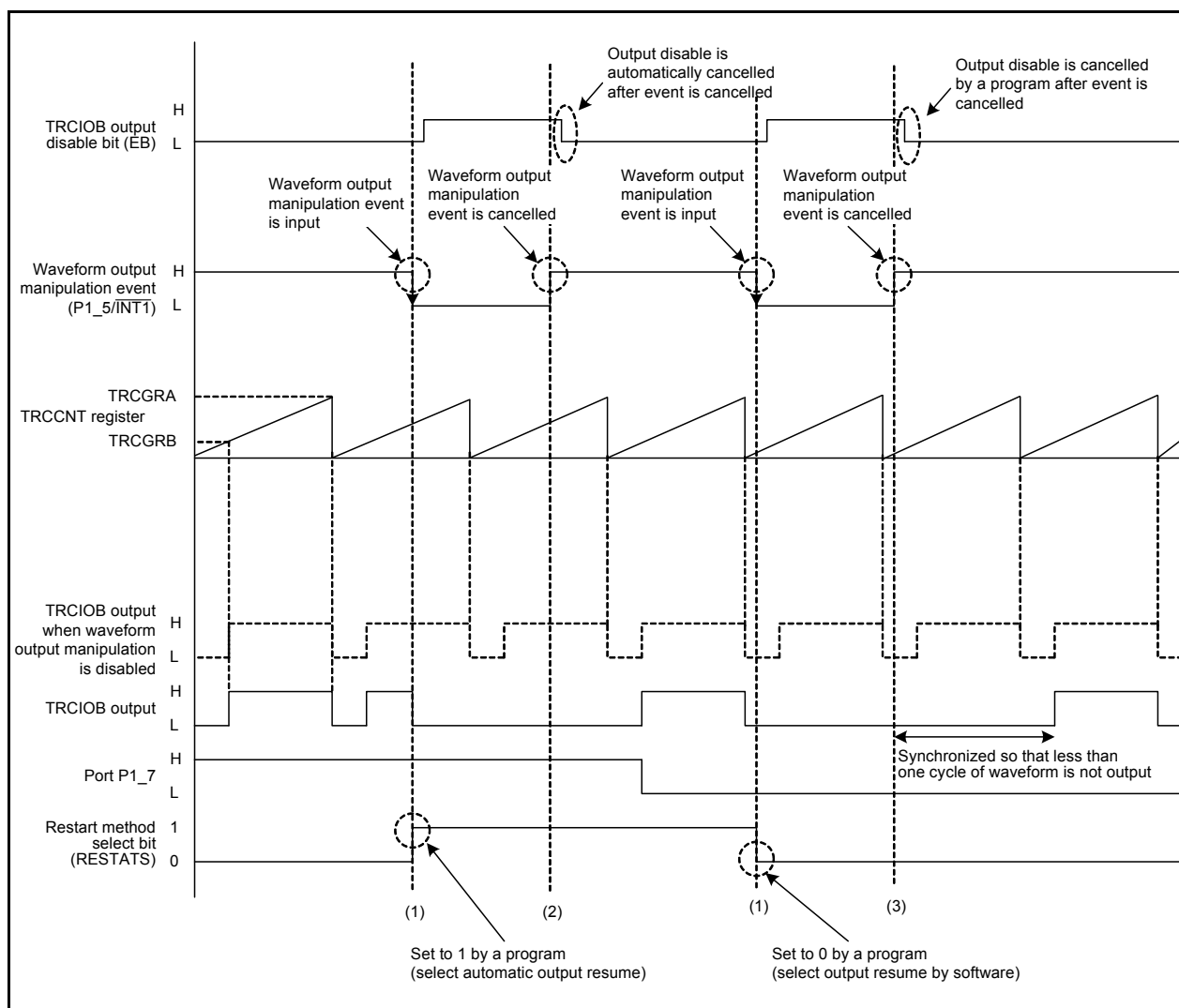


Figure 4.1 Timing Diagram

4.2 Required Memory Size

Table 4.1 lists the Required Memory Size.

Table 4.1 Required Memory Size

Memory Used	Size	Remarks
ROM	254 bytes	In the r01an0356_src.c module
RAM	0 bytes	In the r01an0356_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.

4.3 Constant

Table 4.2 lists the Constant Used in the Sample Code.

Table 4.2 Constant Used in the Sample Code

Constant Name	Setting Value	Contents
AUTO_RESTART	1	Automatic output resume

4.4 Functions

Table 4.3 lists the Functions.

Table 4.3 Functions

Function Name	Outline
mcu_init	System clock setting
int1_init	Initial setting of INT1 pin function
timer_rc_init	Initial setting of timer RC
_int1	INT1 interrupt handling

4.5 Function Specifications

The following tables list the sample code function specifications.

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

int1_init	
Outline	Initial setting of $\overline{\text{INT1}}$ interrupt
Header	None
Declaration	void int1_init(void)
Description	Perform the initial setting to use the $\overline{\text{INT1}}$ interrupt.
Argument	None
Returned value	None

timer_rc_init	
Outline	Initial setting of timer RC
Header	None
Declaration	void timer_rc_init(void)
Description	Perform the initial setting to use timer RC in PWM mode.
Argument	None
Returned value	None

_int1	
Outline	$\overline{\text{INT1}}$ interrupt handling
Header	None
Declaration	void _int1(void)
Description	<ul style="list-style-type: none"> • Select a method to resume according to the port P1_7 input level. • When resume output by software is selected and the event input is cancelled, enable the TRCIOB output.
Argument	None
Returned value	None

4.6 Flowcharts

4.6.1 Main Processing

Figure 4.2 shows the Main Processing.

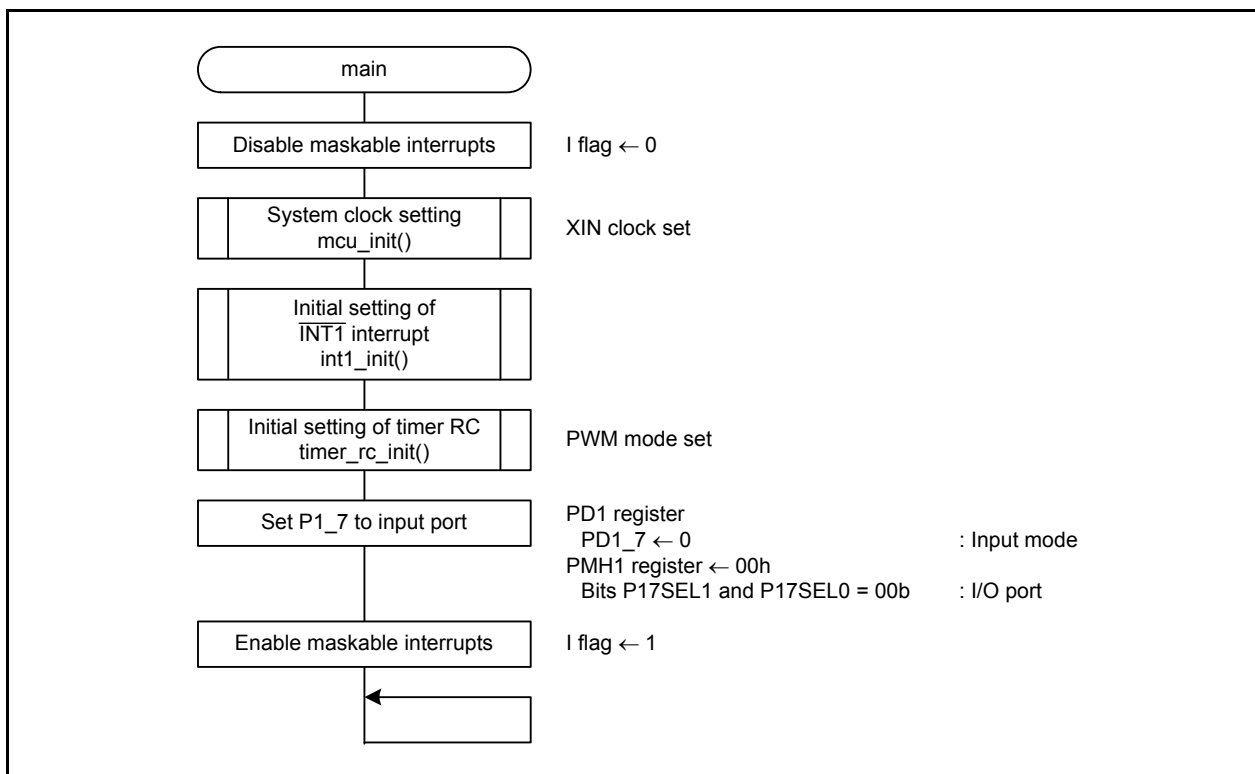


Figure 4.2 Main Processing

4.6.2 System Clock Setting

Figure 4.3 shows the System Clock Setting.

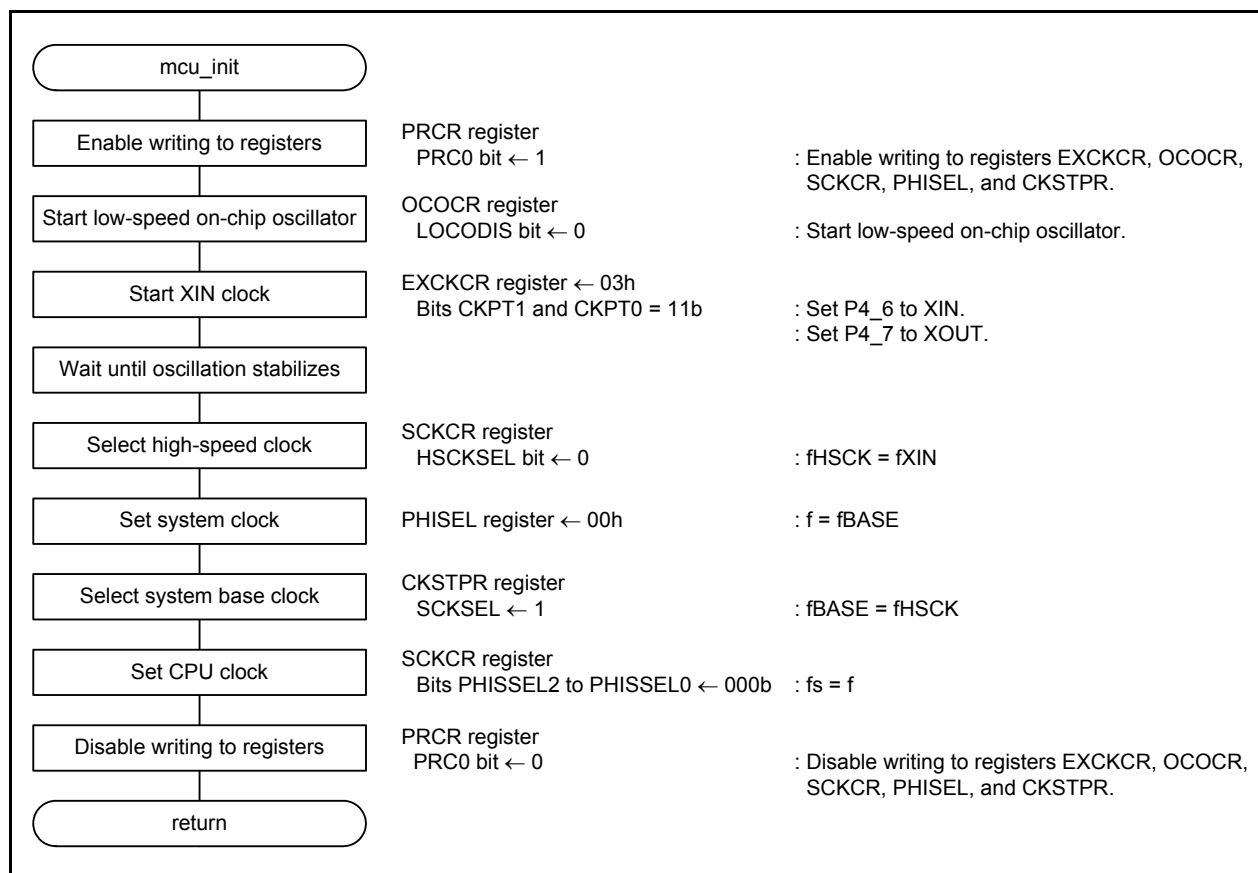


Figure 4.3 System Clock Setting

4.6.3 Initial Setting of $\overline{\text{INT1}}$ Interrupt

Figure 4.4 shows the Initial Setting of the $\overline{\text{INT1}}$ Interrupt.

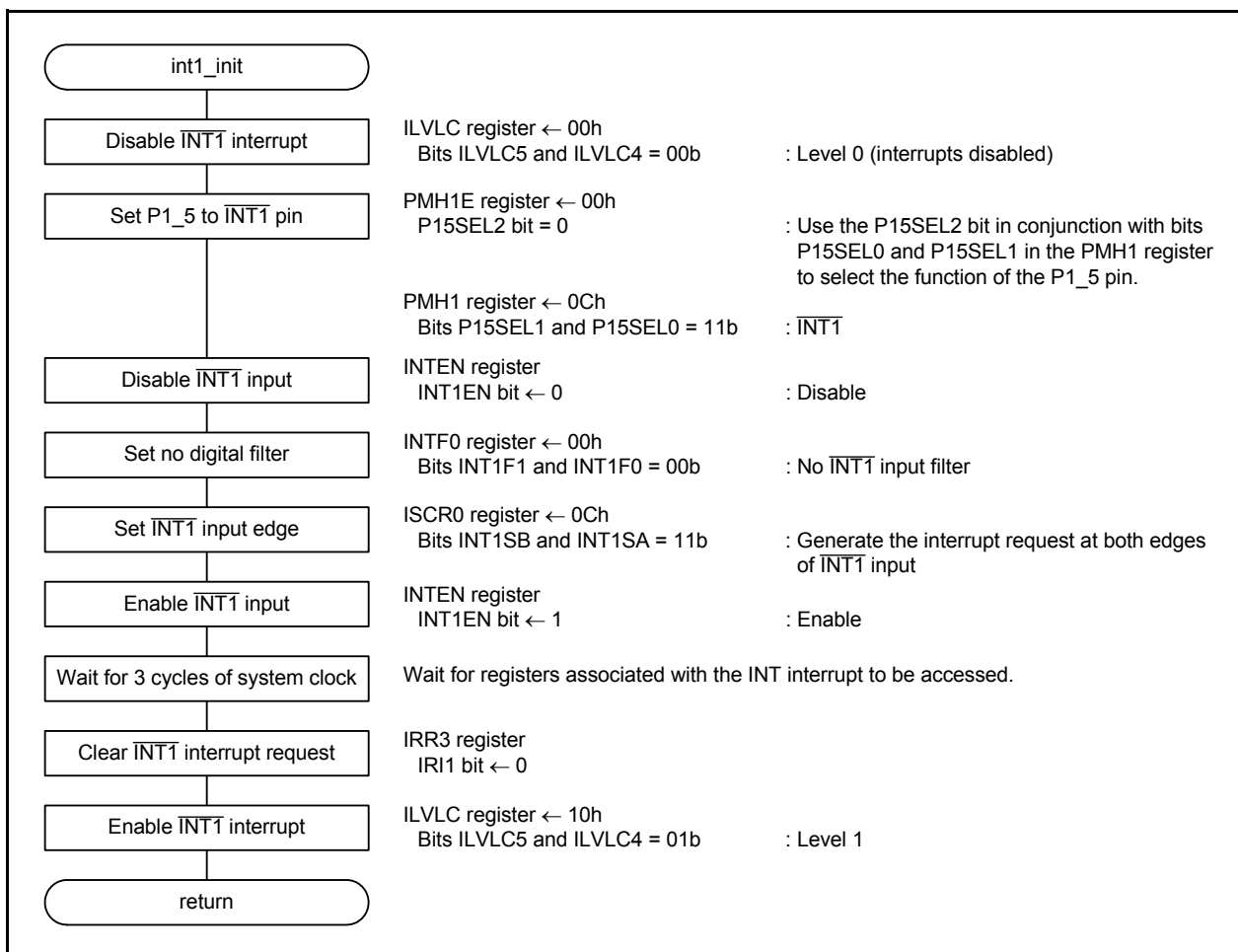


Figure 4.4 Initial Setting of the $\overline{\text{INT1}}$ Interrupt

4.6.4 Initial Setting of Timer RC

Figure 4.5 shows the Initial Setting of Timer RC.

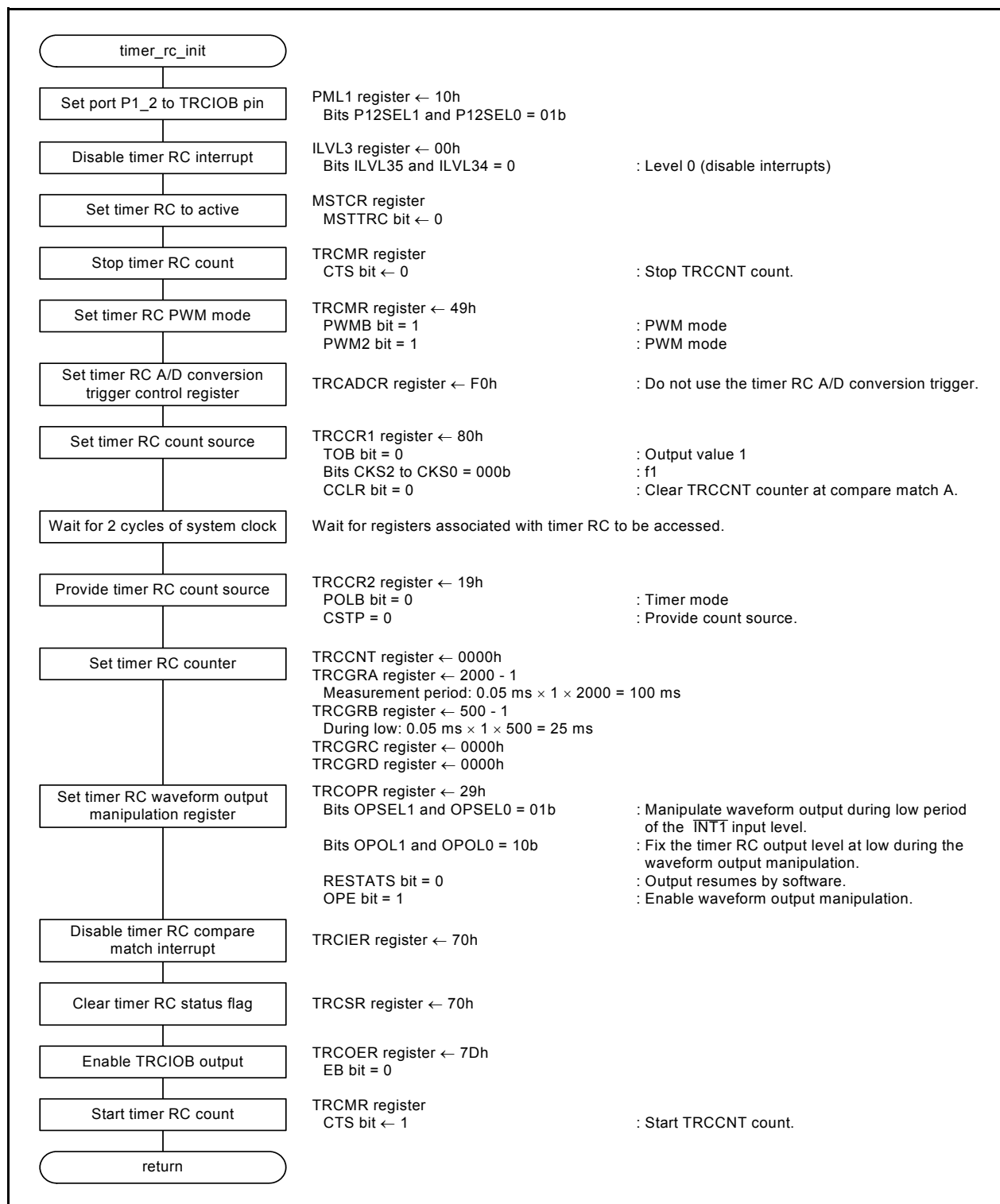


Figure 4.5 Initial Setting of Timer RC

4.6.5 $\overline{\text{INT1}}$ Interrupt Handling

Figure 4.6 shows the $\overline{\text{INT1}}$ Interrupt Handling.

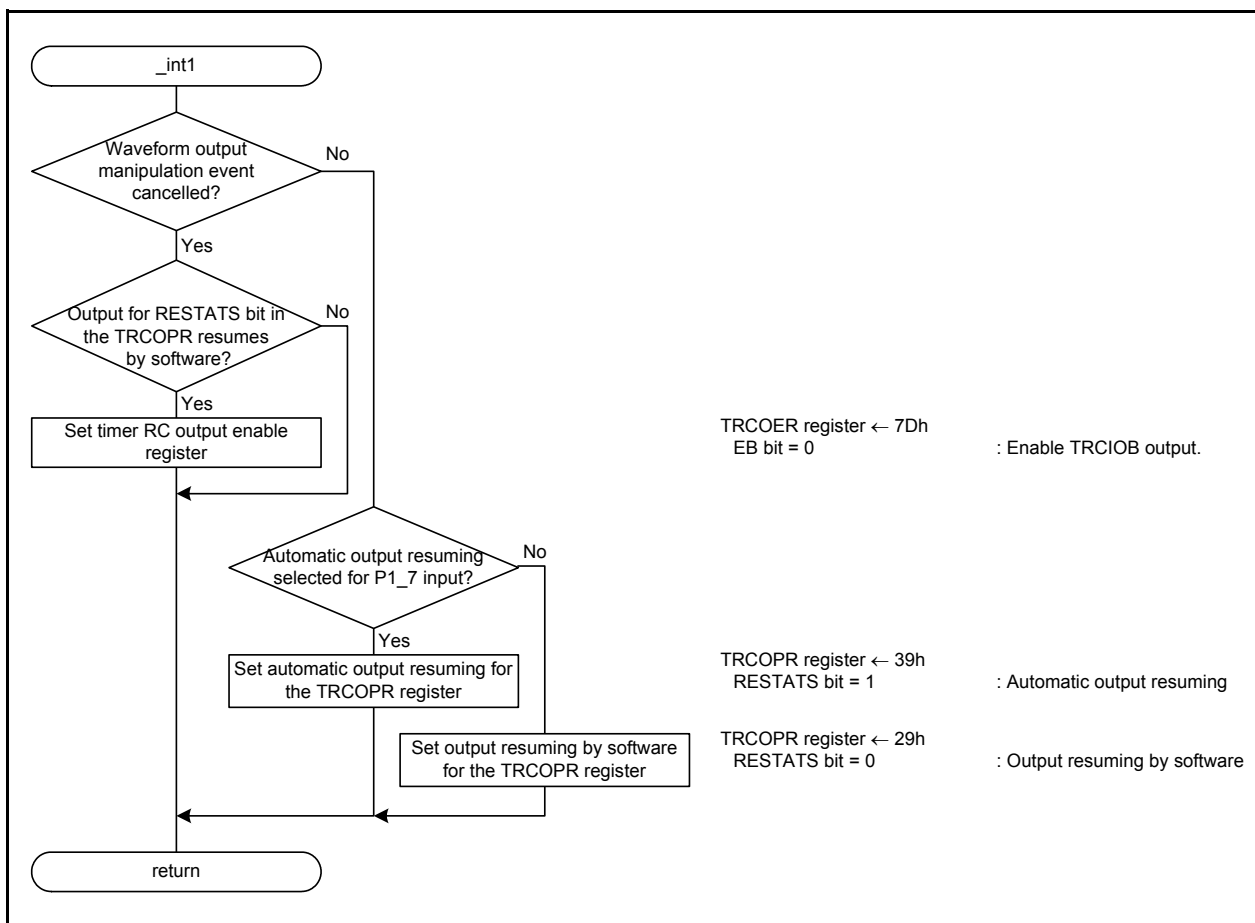


Figure 4.6 $\overline{\text{INT1}}$ Interrupt Handling

5. Sample Code

Sample code can be downloaded from the Renesas Electronics website.

6. Reference Documents

User's Manual

R8C/M12A 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/M12A Group Timer RC Waveform Output Manipulation Function
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Rev.	Date	Description	
		Page	Summary
1.00	Apr. 9, 2012	—	First edition issued

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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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