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April 1st, 2010
Renesas Electronics Corporation

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7546/7547 Group

Operation of Timer A (Output Compare Mode)

1. Abstract

The following article describes how to generate PWM waveform by Output Compare Function of timer A.

2. Introduction

The application explained in this document applies to the following MCUs and parameter(s):

- Applicable MCUs: M37546 Group
M37547 Group
- Oscillation frequency: 8 MHz

3. Contents

3.1 Description of the PWM Output Waveform

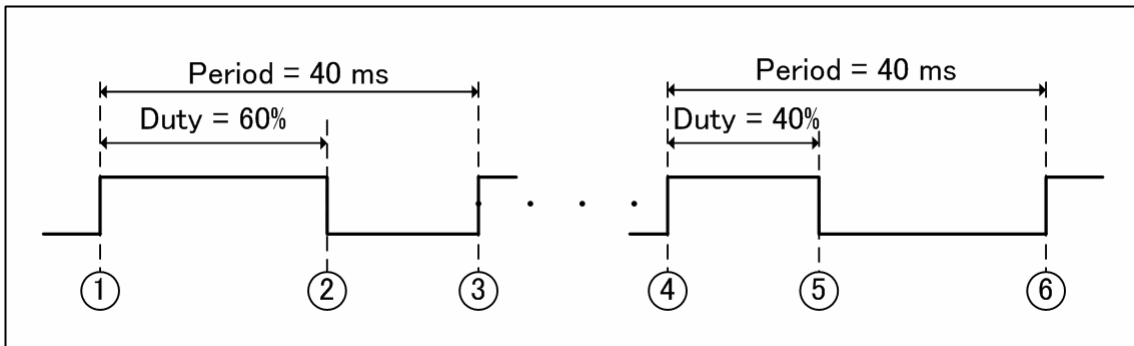


Figure 1 Example of PWM Waveform Output

• Description

- (1) Initialize SFRs of timer A and Output Compare Function, setting the period and duty of PWM output.
- (2) When count value of timer and setting value of compare latch are matched, compare output trigger occurs; compare output waveform is reversed.
- (3) The value of the compare register is loaded to compare latch when the next timer A underflow. After reloading, the compare output waveform is reversed when compare output trigger occurs again.
- (4) Change the duty value after repeating a PWM output period 10 times.
- (5) When new count value of timer and setting value of compare latch are matched, compare output trigger occurs; compare output waveform is reversed.
- (6) Continue PWM output switching the duty value between 60% and 40% after repeating each duty value 10 times.

3.2 Timing of Generating PWM Output Waveform

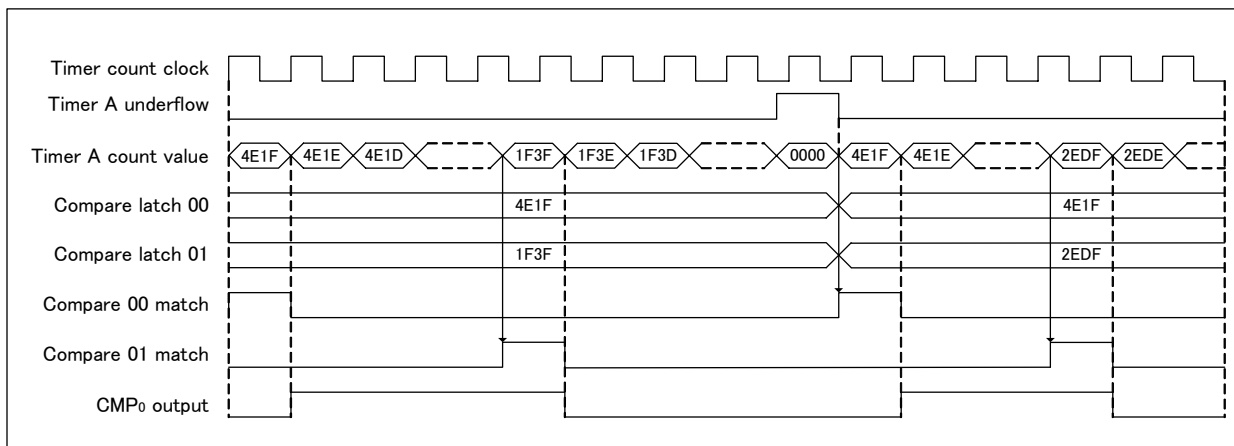


Figure 2 Operation Timing of Output Compare Function to Generate PWM Waveform

3.3 Formulas for PWM

The following formulas are used to calculate the period and “H” level width of the PWM.

$$\text{Period} = (TA + 1) / f(\text{timer count clock});$$

$$\text{Output pulse "H" Duty} = [(CMPi0 - CMPi1) / (TA + 1)] \times 100\%; \quad (i = 0, 1, 2, 3)$$

Note: Timer A consists of the low-order register (TAL) and the high-order register (TAH);

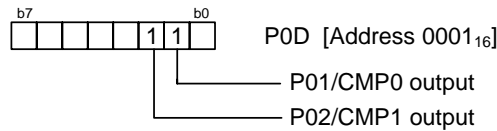
CMPi0 and CMPi1 are the compare latch of compare channel i;

Compare i output level latch selects Positive.

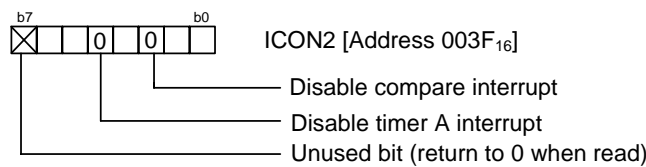
3.4 Registers Setup

7546/47 Group has four output compare channels. In this application example, the output compare channel 0 is used to output PWM waveform. The setup procedure of the output compare channel 0 is shown below. The same procedure is also applicable when using output compare channels 1 to 3.

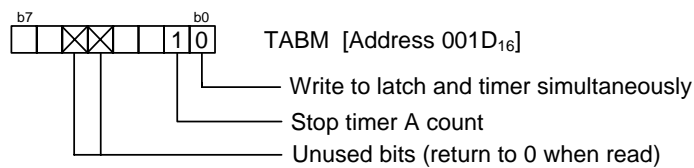
- (1) Set Port P0 direction register



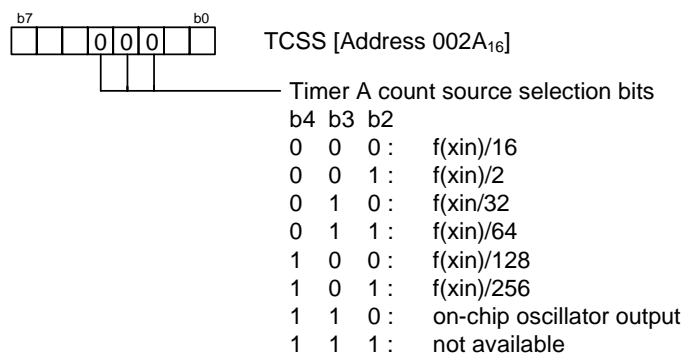
- (2) Set interrupt control register 2



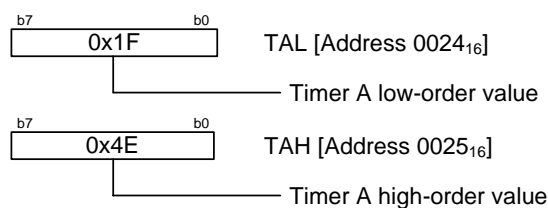
- (3) Set timer A,B mode register



- (4) Set timer count source set register

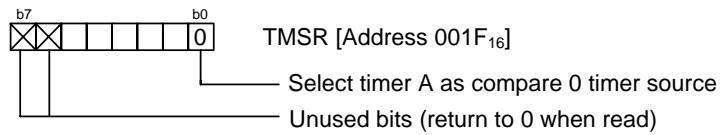


- (5) Set timer A register

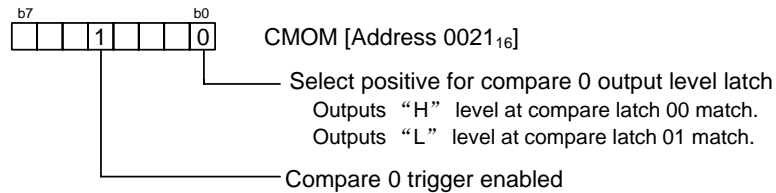


Note: Write values to the timer A low-order register first and the timer A high-order register next. Be sure that values are written to both low-order and high-order register.

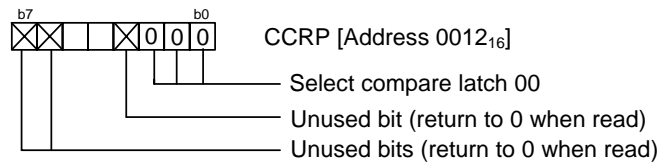
(6) Set timer source selection register



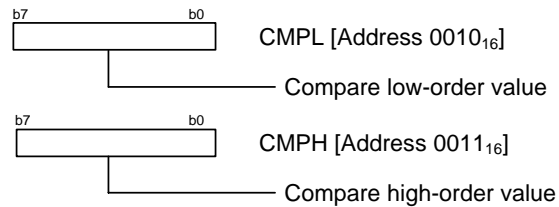
(7) Set compare output mode register



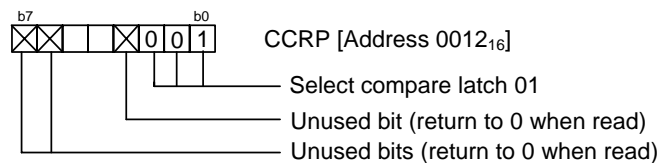
(8) Set capture/compare register R/W pointer



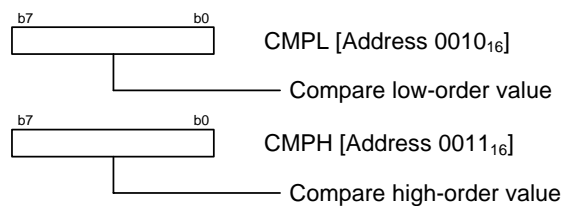
(9) Set compare latch 00



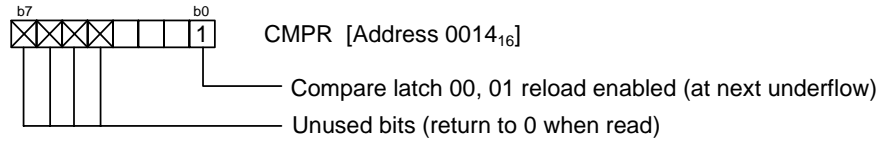
(10) Set capture/compare register R/W pointer



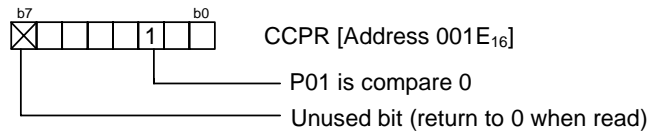
(11) Set compare latch 01



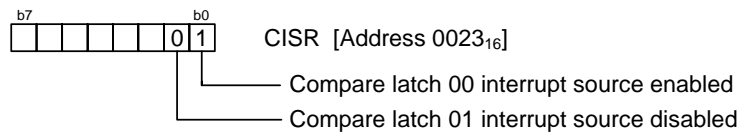
(12) Set compare register re-load register



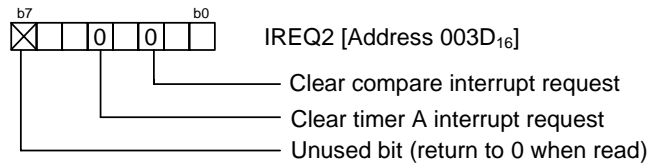
(13) Set capture/compare port register



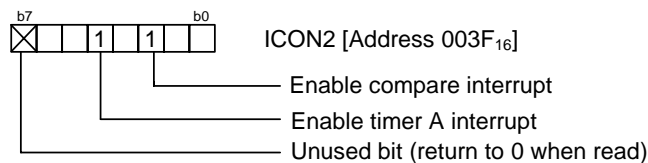
(14) Set compare interrupt source register



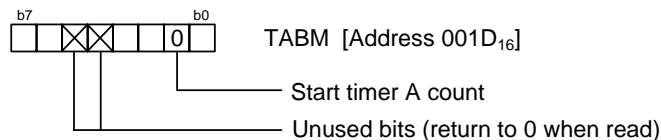
(15) Set interrupt request register 2



(16) Set interrupt control register 2



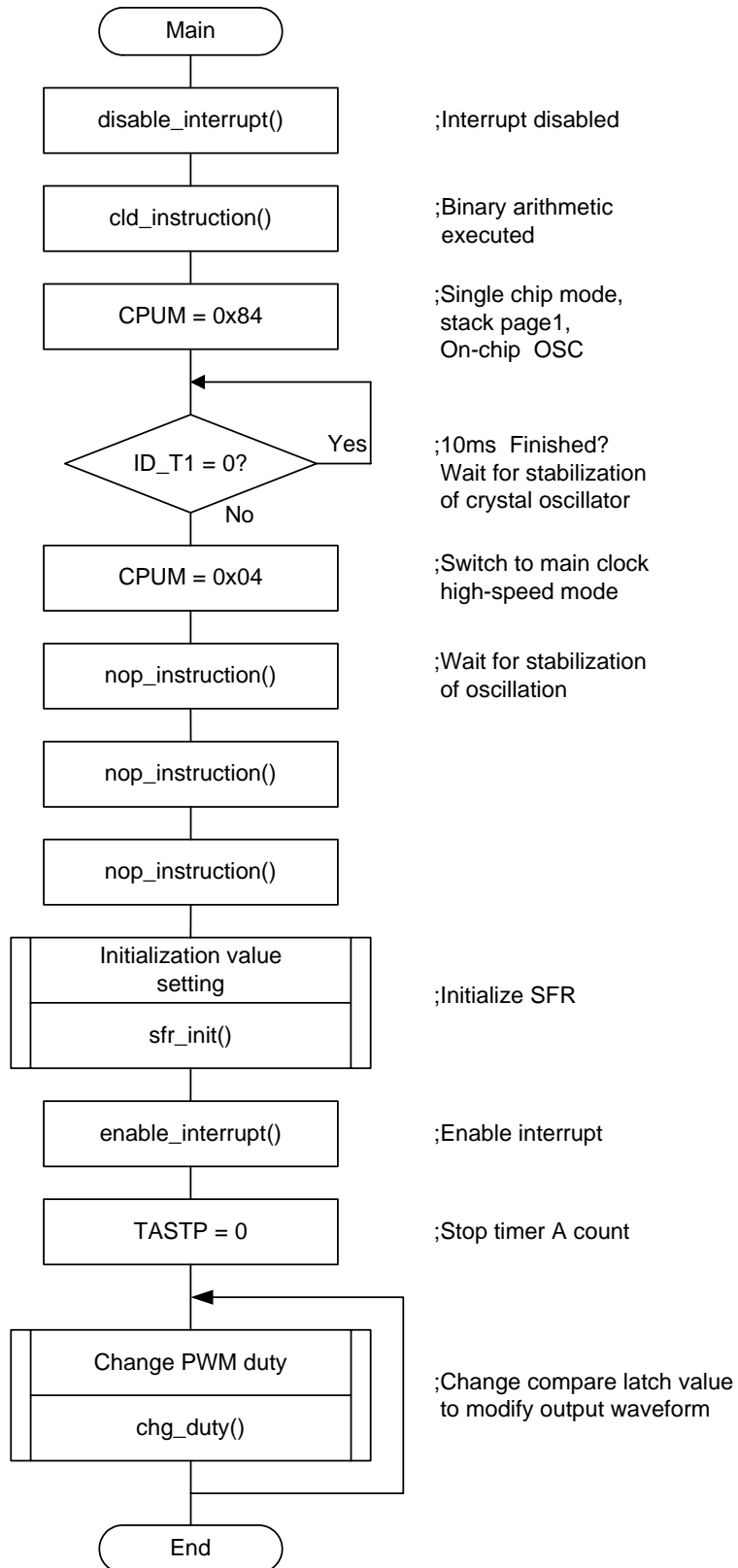
(17) Set timer A,B mode register



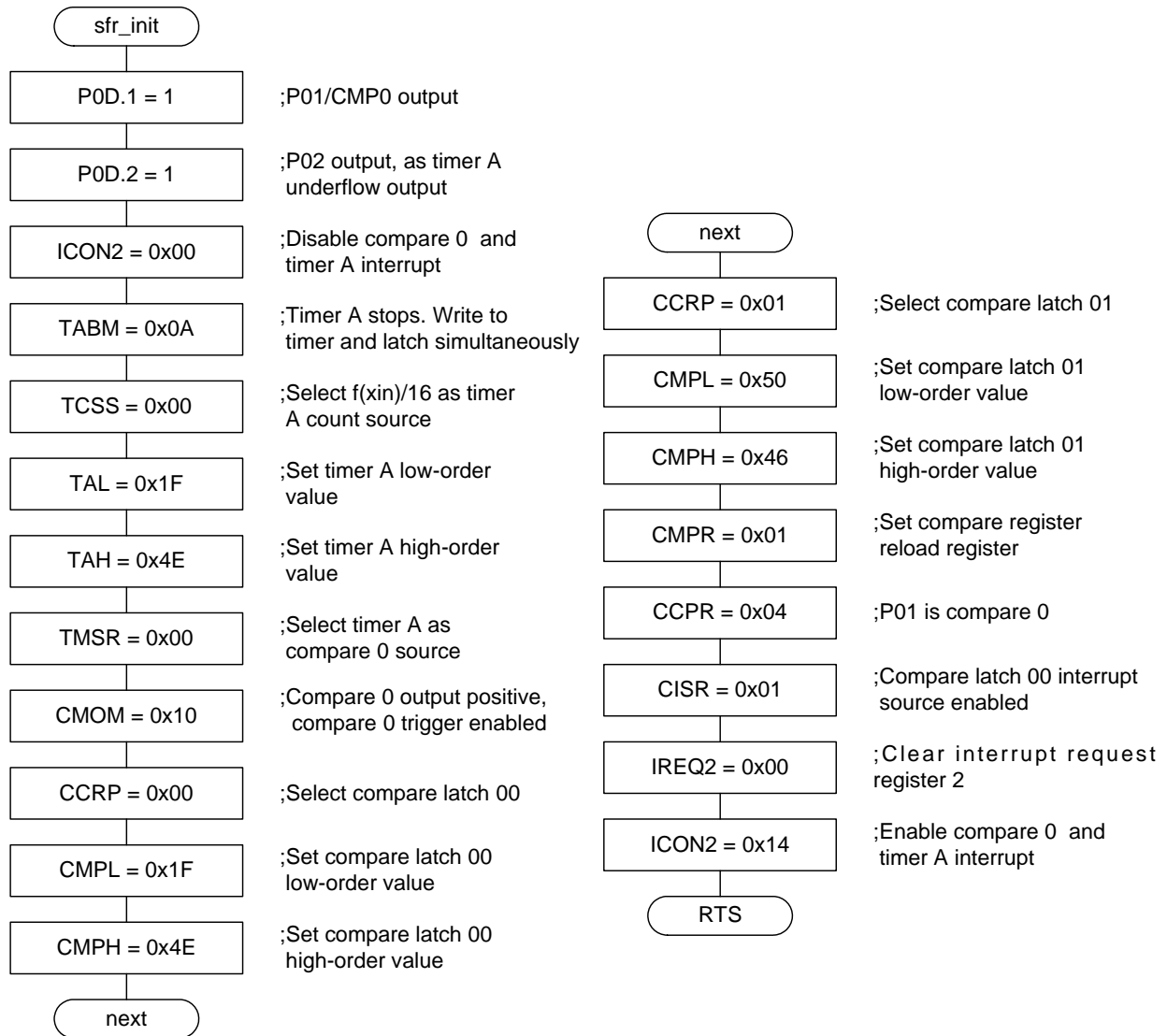
Note: To change compare 0 output waveform while timer A is running, repeat procedure (8) to (12). The compare latch 00, 01 reload bit must be set to “1” (reload at next underflow). The compare latch value is written from compare buffer at next timer underflow and the output waveform is changed.

4. Flow Chart

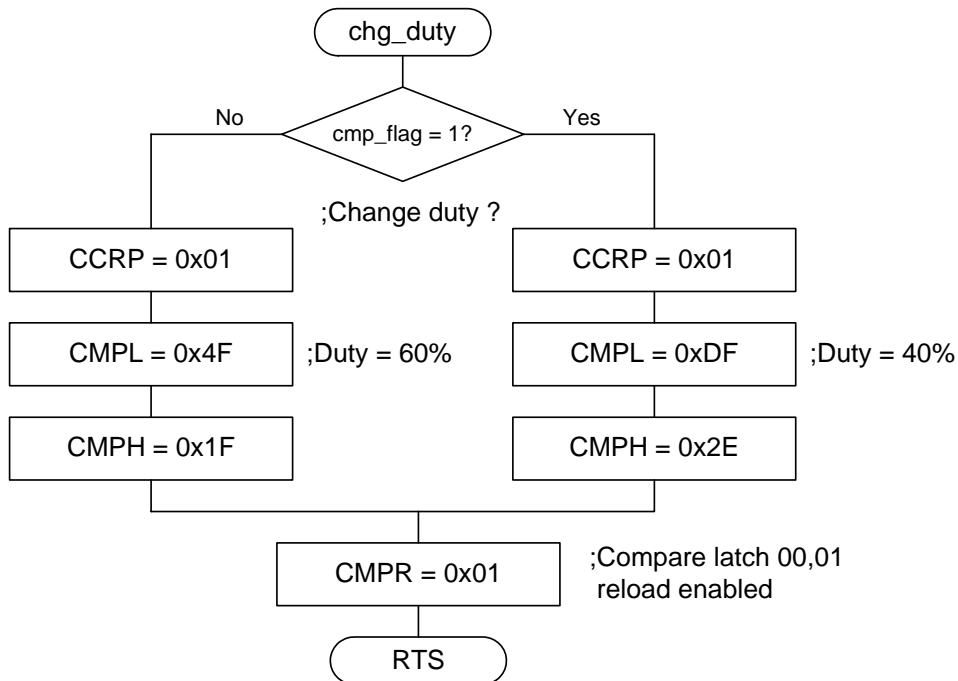
4.1 Flow Chart of Main Function



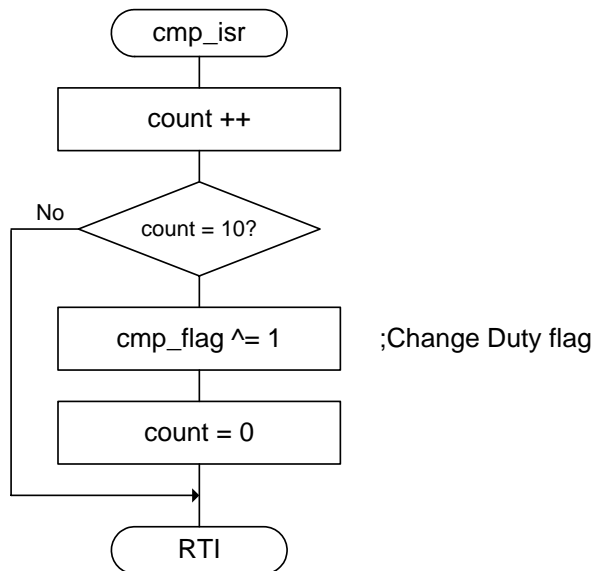
4.2 Flow Chart of Initial Setting Subroutine (sfr_init)



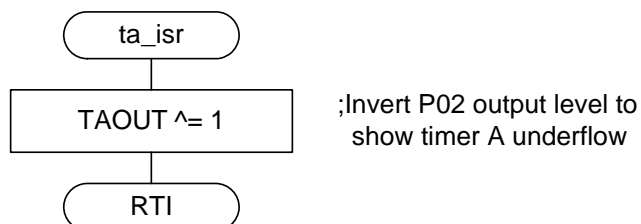
4.3 Flow Chart of Change the Duty of PWM Waveform Subroutine (chg_duty)



4.4 Flow Chart of Compare Interrupt Service Routine (cmp_isr)



4.5 Flow Chart of Timer A Service Handle (ta_isr)



5. Sample Programming Code

Please visit the Renesas Technology Web site for the reference program.

Click “Application Notes” in the left side menu on the page of the 7546/7547 Group.

6. Reference Document

Datasheets

7546 Group Datasheet

7547 Group Datasheet

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Rev.	Date	Description	
		Page	Summary
1.01	Apr.13.07	—	First edition issued
1.02	Mar.21.08	2	Section 3.1, the content of "Description (3)" revised
		9	The content of Section 5 revised

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