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April 1st, 2010
Renesas Electronics Corporation

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7548/7549 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):

- Application MCUs: M37548 Group
  M37549 Group
- Oscillation frequency: 8MHz

3. Contents

3.1 Description of the PWM Output Waveform

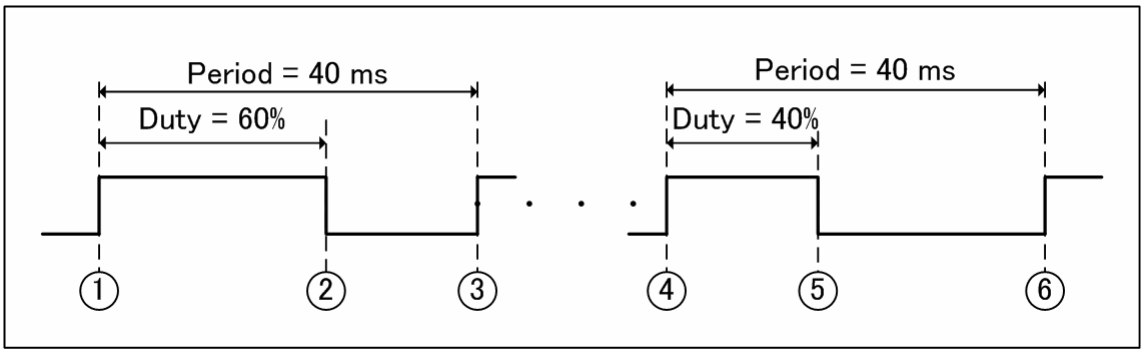


Figure 1 Example of PWM Waveform Output

- 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 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

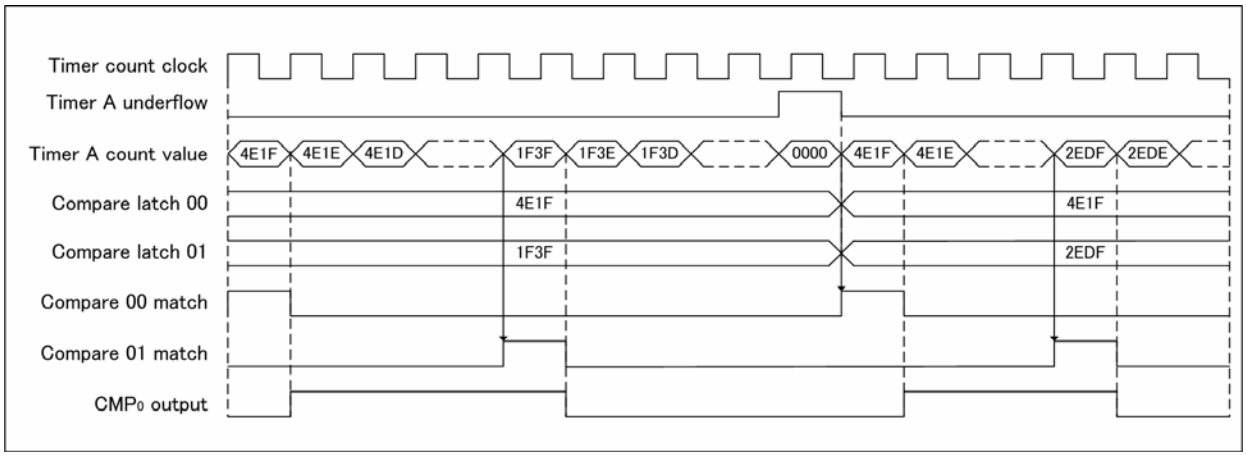


Figure 2 Operation Timing of Output Compare Function to Generate PWM Waveform

3.3 Formulas for PWM

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

PWM period = (TA + 1) / f(timer count clock);

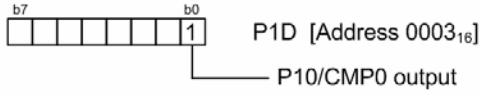
Output pulse "H" Duty = [(CRAi0 – CRAi1) / (TA + 1)] × 100%; (i = 0, 1, 2)

Note: Timer A consists of the low-order register (TAL) and the high-order register (TAH);
CRAi0 and CRAi1 are the compare latch of compare channel i;
Compare channel i output level latch selects positive.

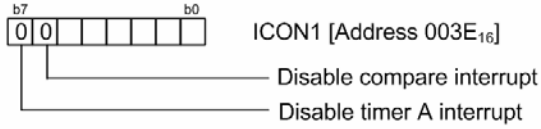
3.4 Registers Setup

7548/49 Group has three output compare channels. Each channel (0 to 2) has the same function and can be used to output waveform by using count value of timer A. In this application example, only use channel 0 of Output Compare Function to output PWM waveform. The setup procedures of output compare 0 are shown below. The setting procedure is the same when using compare channel 1 or 2 to generate PWM output.

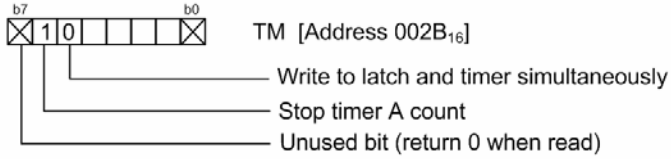
(1) Set Port P1 direction register



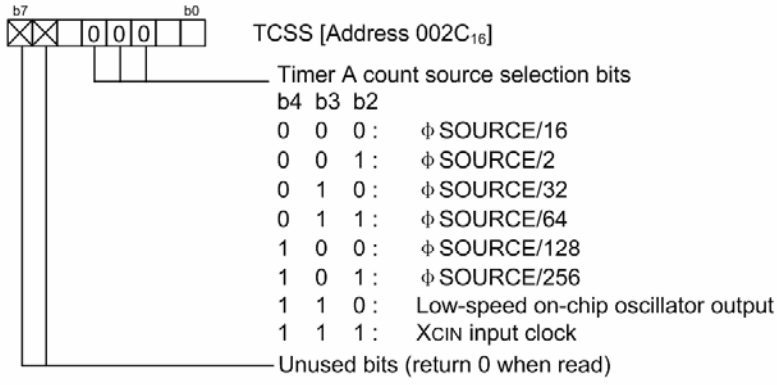
(2) Set interrupt control register



(3) Set timer A mode register



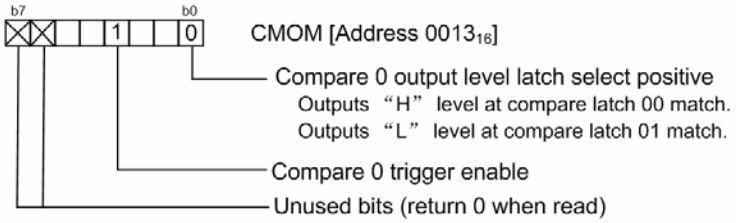
(4) Set timer count source set register



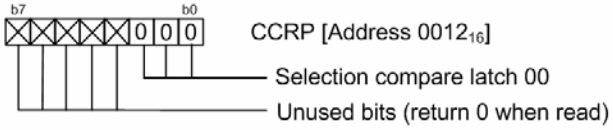
(5) Set timer A register

Note: Write to the low-order of Timer A first, and the high-order of Timer A next and be sure to write both low-order and high-order.

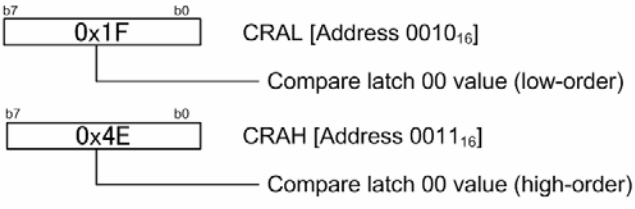
(6) Set compare output mode register



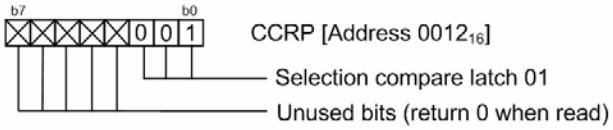
(7) Set capture/compare register R/W pointer



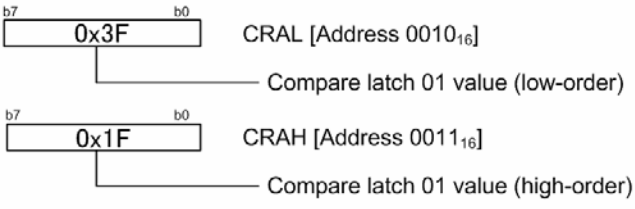
(8) Set capture/compare register



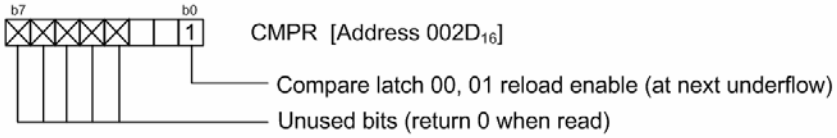
(9) Set capture/compare register R/W pointer



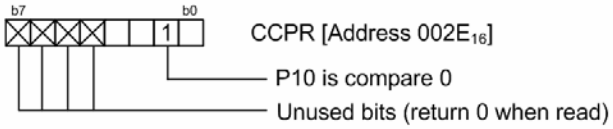
(10) Set capture/compare register



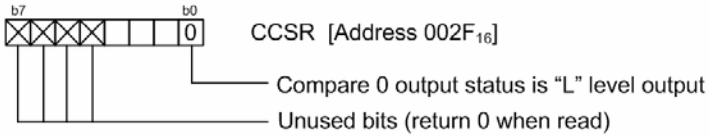
(11) Set compare register re-load register



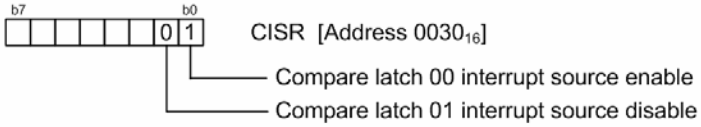
(12) Set capture/compare port register



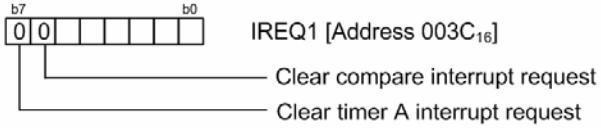
(13) Set capture/compare status register



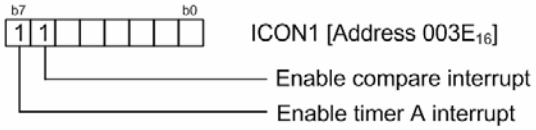
(14) Set compare interrupt source register



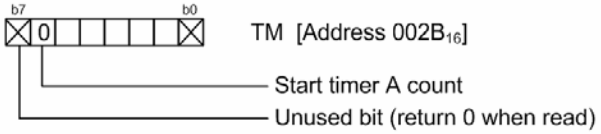
(15) Set interrupt request register



(16) Set interrupt control register



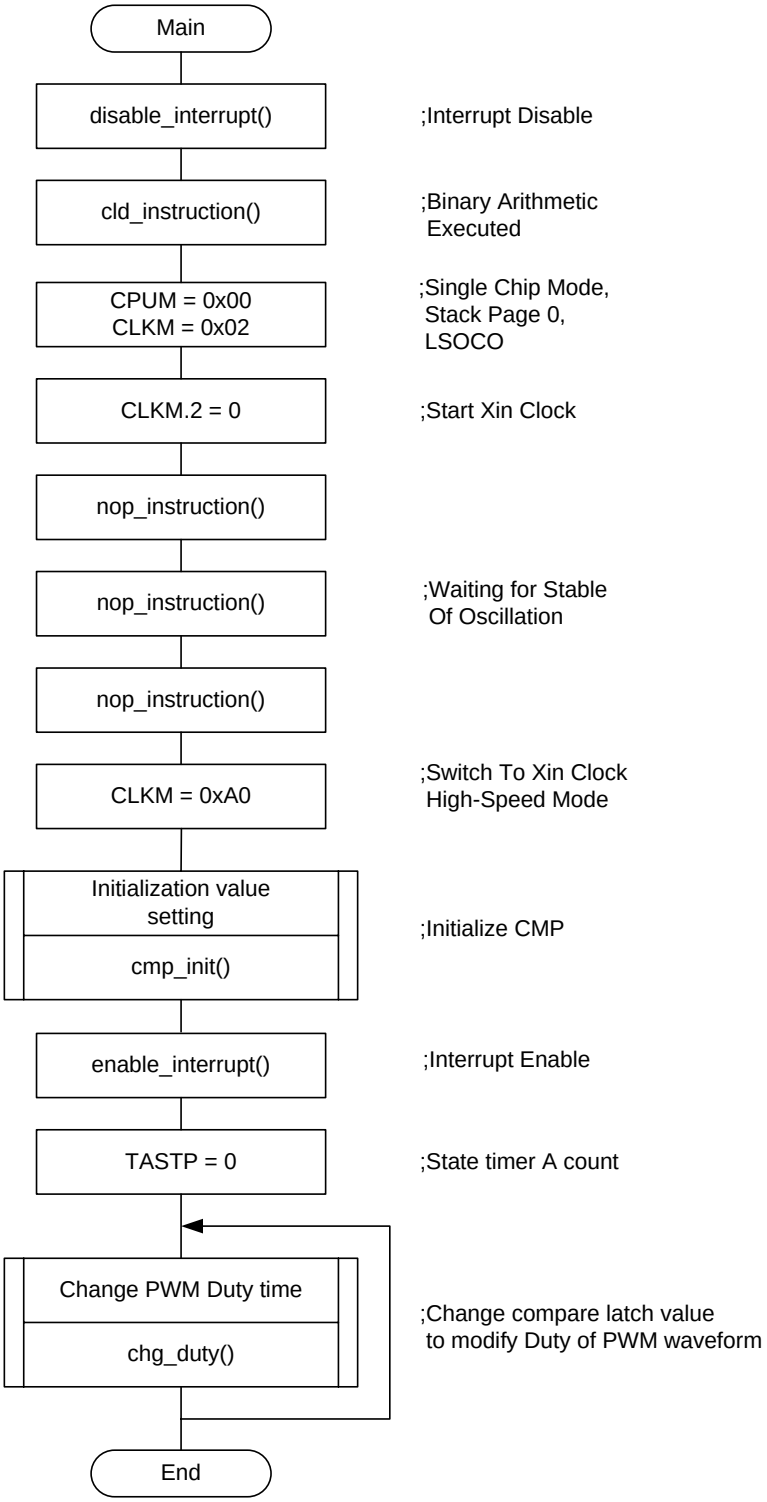
(17) Set timer A mode register



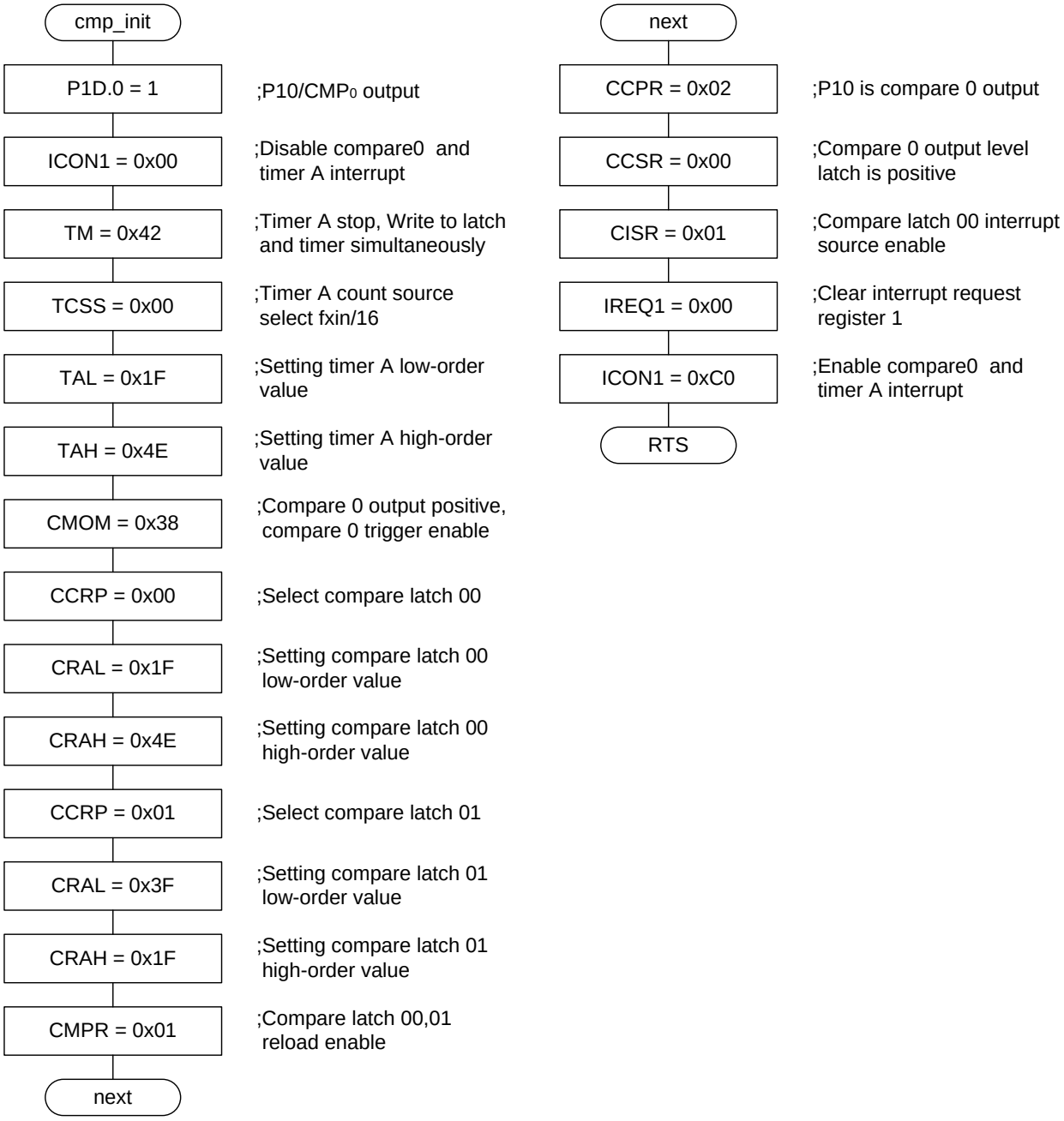
Note: To change compare channel 0 output waveform while timer A is running, repeat procedures from step (8) to step (11). The compare latch 00, 01 reload bit must be set to "1" (reload at next underflow). The compare latch value will be written from compare buffer at next timer underflow.

4. Flow Chart

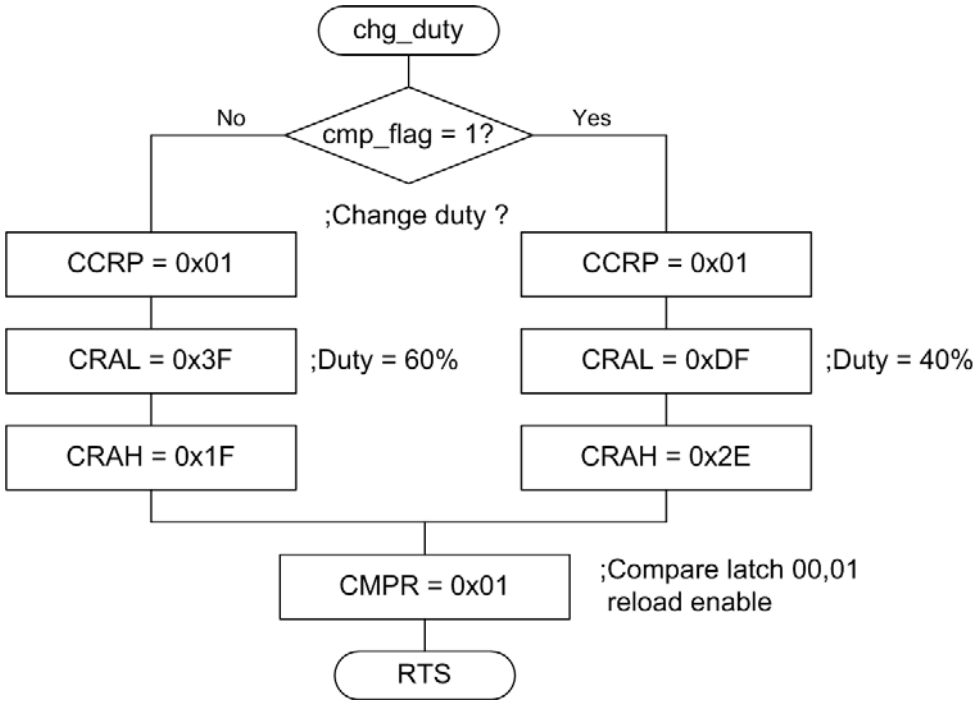
4.1 Flow Chart of Main Function



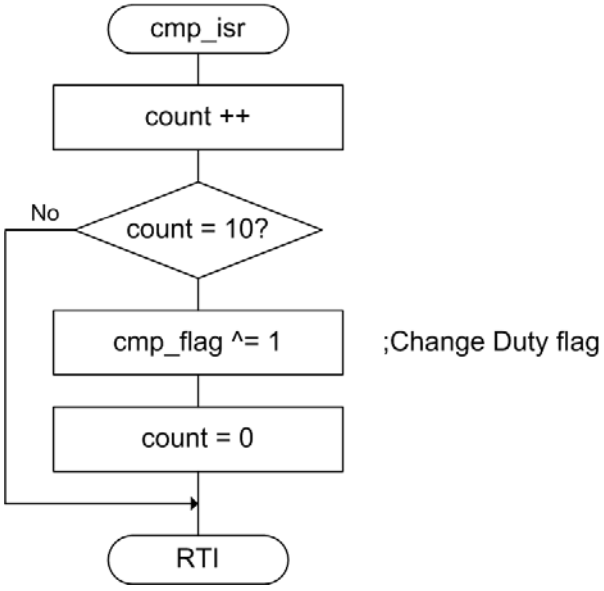
4.2 Flow Chart of Output Compare Initialization Subroutine (cmp_init)



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)



5. Sample Programming Code

Please visit the Renesas Technology Web site for the reference program.
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6. Reference Document

Datasheets
7548 Group Datasheet
7549 Group Datasheet
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Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Oct.07.06	—	First edition issued
2.00	Mar.05.08	2	Section 3.1, the content of "Description (3)" revised
			Section 3.3, the content of formulas and note revised
		3,5	Section 3.4, the content of "Registers Setup (1), (4), (13)" and note revised
		6	Section 4.1, On-Chip LOSC -> LSOCO
		9	Section 5, Sample programming code revised

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