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April 1st, 2010
Renesas Electronics Corporation

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M32C/84, 85, 86, 87, 88 Group

Variable-Period Variable-Duty PWM Output

1. Abstract

Two timer A's are connected to perform the variable-period variable-duty PWM output.
Use the following peripheral functions as below.

- Timer A0 in timer mode
- Timer A1 in one-shot timer mode

2. Introduction

The application example described in this document is applied to the following MCUs and parameter(s):

MCUs: M32C/84 Group
M32C/85 Group
M32C/86 Group
M32C/87 Group
M32C/88 Group

This program can be used with other M16C Family MCUs which have the same special function registers (SFRs) as the above MCUs. Check the manual for any additions and modifications to functions. Careful evaluation is recommended before using this application note.

3. Example Description

3.1 Specifications

(1) Set timer A0 to timer mode. Set timer A1 to one-shot timer with timer A0 underflow as the trigger.
Also, select the TA1OUT output for the P7_2 function.
(2) Set timer A0 to 1 ms as the PWM period, and set timer A1 to 500 μs as the PWM “H” width.
(3) Connect a 32 MHz oscillator to Xin.

3.2 Operation

(1) Setting bits TA0S and TA1S in the TABSR register to 1 (count started) causes the counter to start counting.
The timer A0 counter counts the count source f1.
(2) If the timer A0 counter underflows, the counter reloads the content of the reload register and continues counting. At this time, the IR bit in the TA0IC register is set to 1 (interrupt requested).
(3) The timer A1 counter starts counting with timer A0 underflow as the trigger.
At the same time, the output level on the TA1OUT pin becomes “H”.
(4) When the timer A1 count value reaches 0000h, the output level on the TA1OUT pin becomes “L” and the counter reloads the content of the reload register and stops counting.
At the same time, the IR bit in the TA1IC register is set to 1 (interrupt requested).

Figure 1 shows the Operation Timing and Figure 2 shows the Timer Connection Diagram.

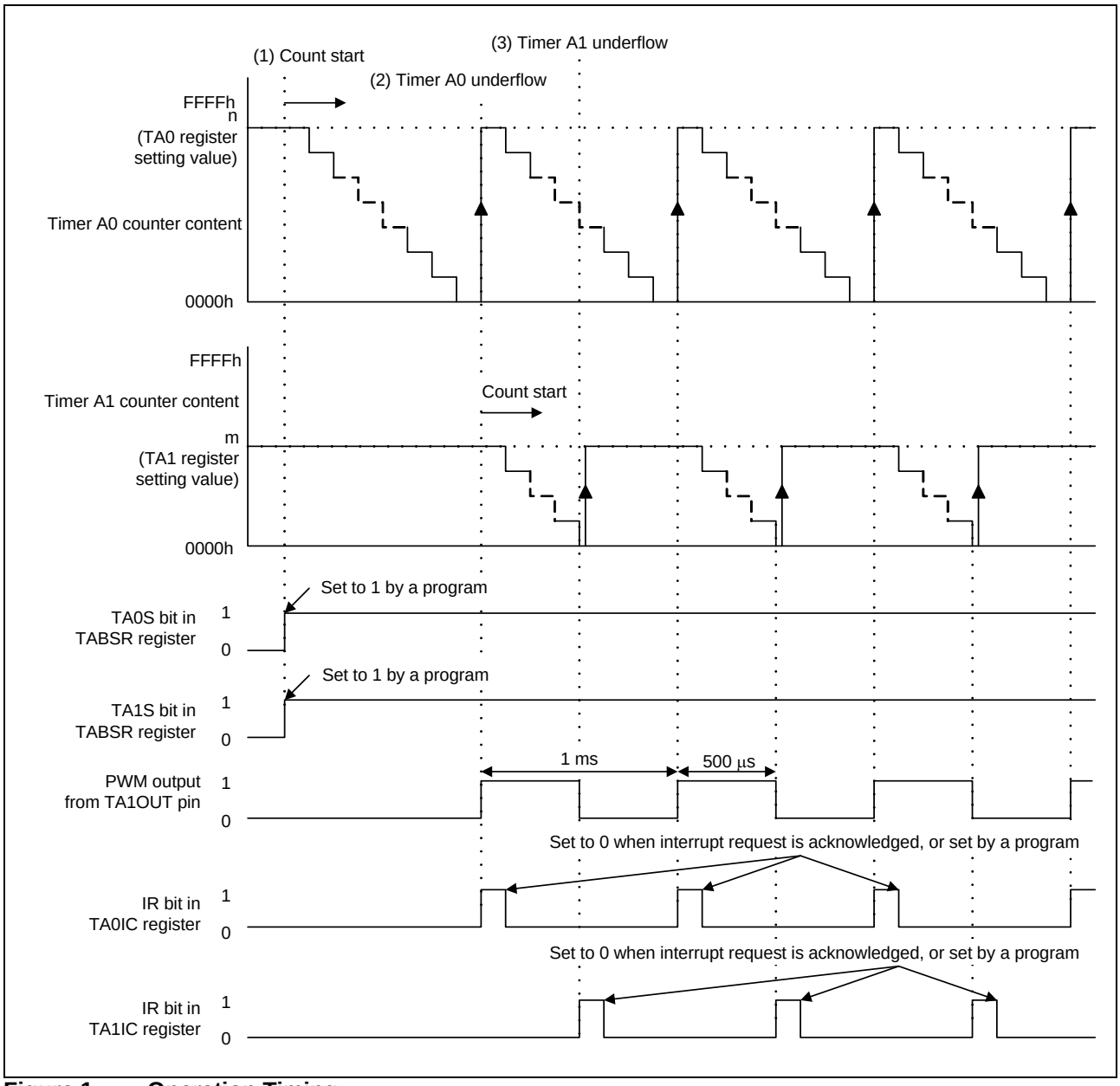


Figure 1 Operation Timing

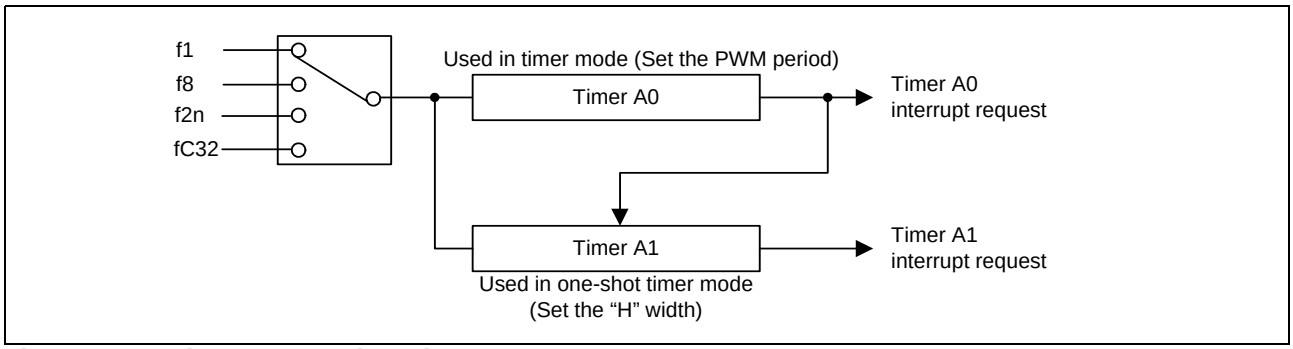
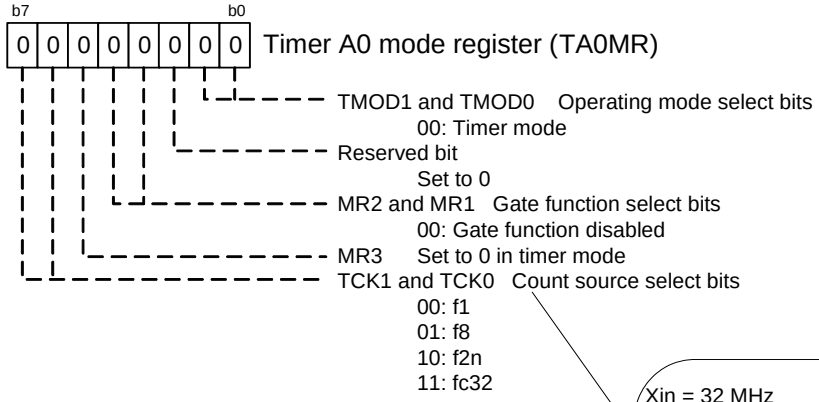


Figure 2 Timer Connection Diagram

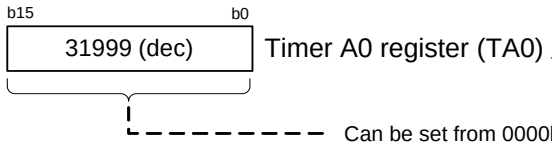
3.3 Setup

This section shows the setting steps and values to perform the application example described in **3. Example Description**.
Refer to the each MCUs Hardware Manual for details of individual registers.

(1) Set the timer A0 mode register

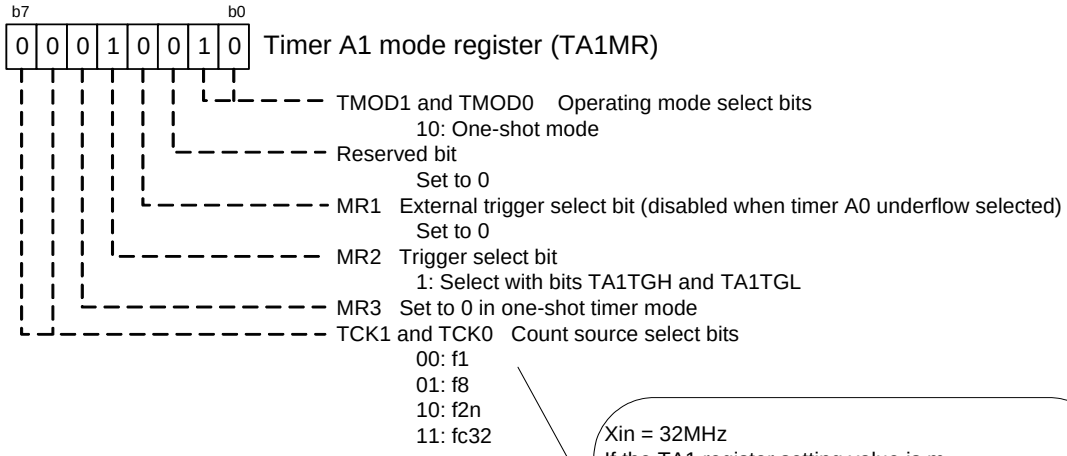


(2) Set the timer A0 register

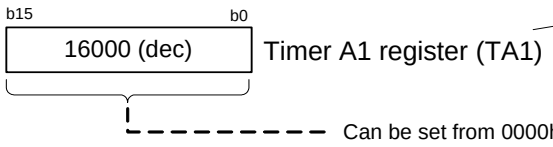


Xin = 32 MHz
If the TA0 register setting value is n,
the timer A0 period is:
$(n + 1)/f1 = (31999 + 1)/(32 \times 10^6) = 10^{-3} = 1$ ms

(3) Set the timer A1 mode register

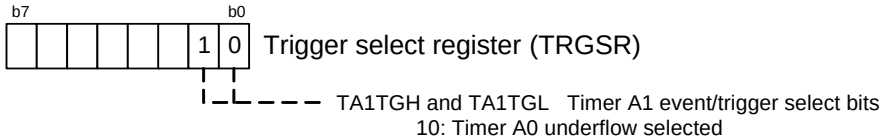


(4) Set the timer A1 register

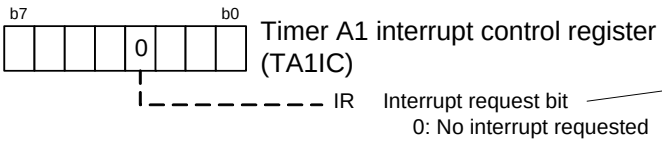


Xin = 32MHz
If the TA1 register setting value is m,
the timer A1 period is;
$m/f1 = 16000/(32 \times 10^6) = 500 \times 10^{-6} = 500$ μs

(5) Set the trigger select register

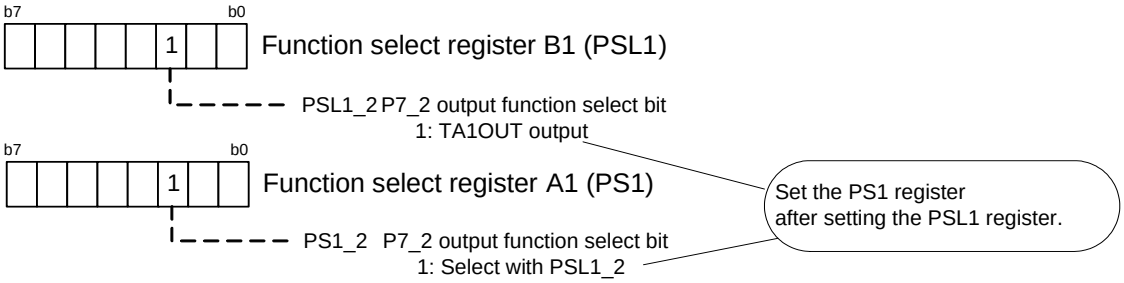


(6) Clear the interrupt request bit



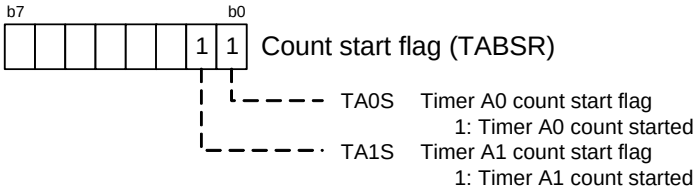
Setting bits TMOD1 to TMOD0 in the TA1MR register to 10b (one-shot timer mode) may set the IR bit to 1(interrupt requested).
Set the IR bit to 0 after setting bits TMOD1 to TMOD0.

(7) Set the function control registers



Set the PS1 register after setting the PSL1 register.

(8) Set the count start flag



4. Sample Programming Code

A sample program can be downloaded from the Renesas Technology website.
For download, click “Application Notes” in the left-hand side menu of the M16C Family page.

5. Reference Documents

Hardware Manuals
M32C/84 Group Hardware Manual
M32C/85 Group Hardware Manual
M32C/86 Group Hardware Manual
M32C/87 Group Hardware Manual
M32C/88 Group Hardware Manual
The latest version can be downloaded from the Renesas Technology website.

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REVISION HISTORY	M32C/84, 85, 86, 87, 88 Group Variable-Period Variable-Duty PWM Output

Rev.	Date	Description	
		Page	Summary
1.00	Sep.10, 2006	–	First Edition issued

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