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April 1st, 2010
Renesas Electronics Corporation

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M16C/Tiny Series

Variable-Period Variable-Duty PWM Output

1. Abstract

In this process, Timer A0 and A1 are used to generate variable-period, variable-duty PWM output. Use the following peripheral functions:

- Timer mode of timer A
- One-shot timer mode of timer A

2. Introduction

The explanation of this issue is applied to the following condition:

Applicable MCU: M16C/26, M16C/26A, M16C/28, M16C/29 Group

This program can also be used when operating other microcomputers within the M16C family, provided they have the same SFR (Special Function Registers) as the M16C/26, M16C/26A, M16C/28, M16C/29 microcomputers. However, some functions may have been modified.

Refer to the User's Manual for details. Use functions covered in this Application Note only after careful evaluation.

3. Contents

3.1 Specifications

- (1) Set timer A0 in timer mode, and set timer A1 in one-shot timer mode with pulse-output function.
- (2) Set 1 ms, the PWM period, to timer A0. Set 500 μ s, the width of PWM "H" pulse, to timer A1. Both timer A0 and timer A1 use f1 for the count source.
- (3) Connect a 20-MHz oscillator to XIN.

3.2 Operation

- (1) Setting the count start flag to "1" causes the counter of timer A0 to begin counting. The counter of timer A0 performs a down count on count source f1.
- (2) If the counter of timer A0 underflows, the counter reloads the content of the reload register and continues counting. At this time, the timer A0 interrupt request bit goes to "1".
- (3) An underflow in timer A0 triggers the counter of timer A1 and causes it to begin counting. When the counter of timer A1 begins counting, the output level of the TA1OUT pin goes to "H" (Note).
- (4) As soon as the count of the counter of timer A1 becomes "0000₁₆", the output level of TA1OUT pin goes to "L", and the counter reloads the content of the reload register and stops counting. At the same time, the timer A1 interrupt request bit goes to "1".

Note: The settings of the TAIOUT pin corresponding port direction register are invalid.

Figure 1 shows the operation timing of variable-period variable-duty PWM output.

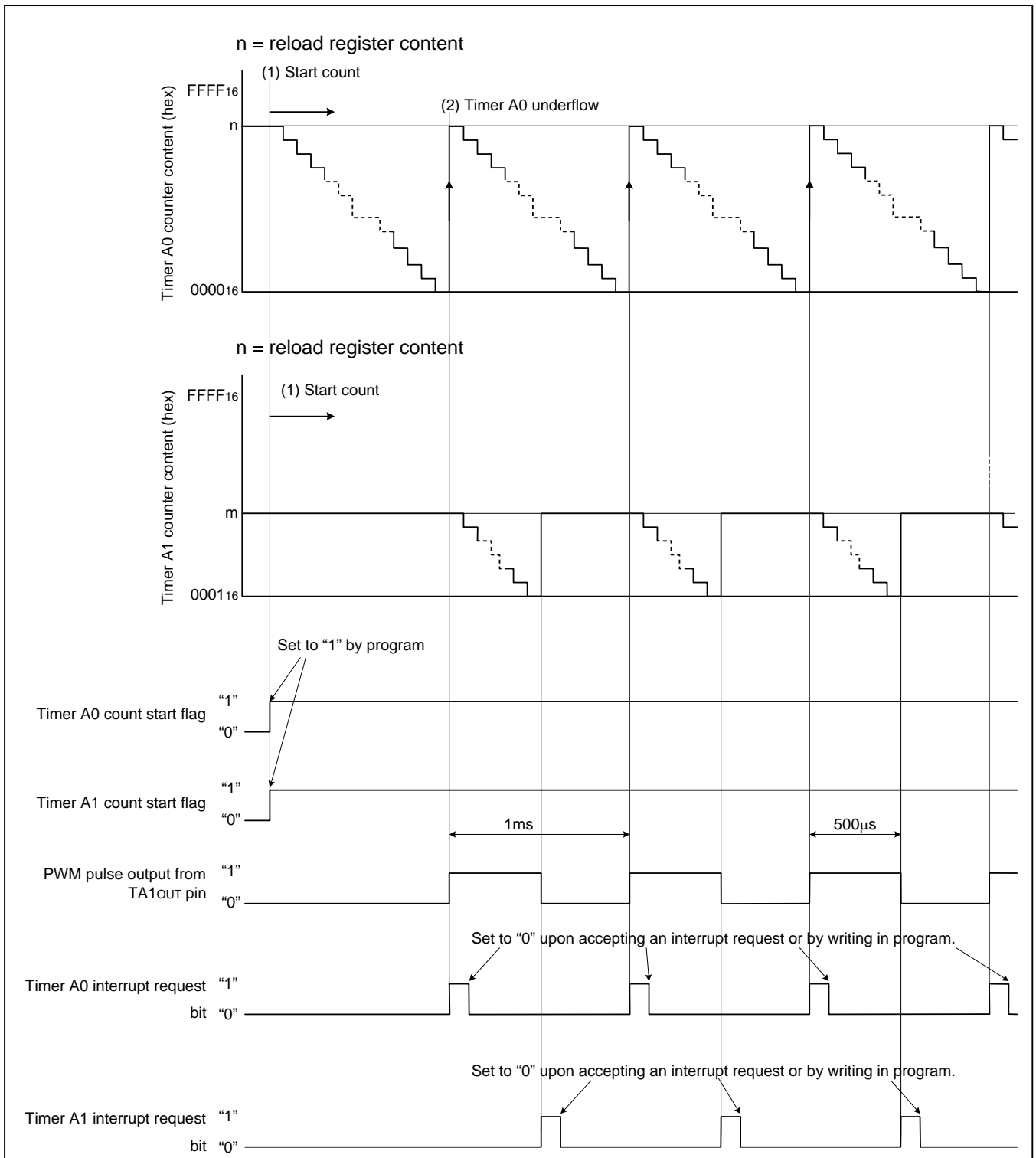


Figure 1. Operation Timing of Variable-Period Variable-Duty PWM Output

Figure 2 shows the Connection diagram of variable-period variable-duty PWM output.

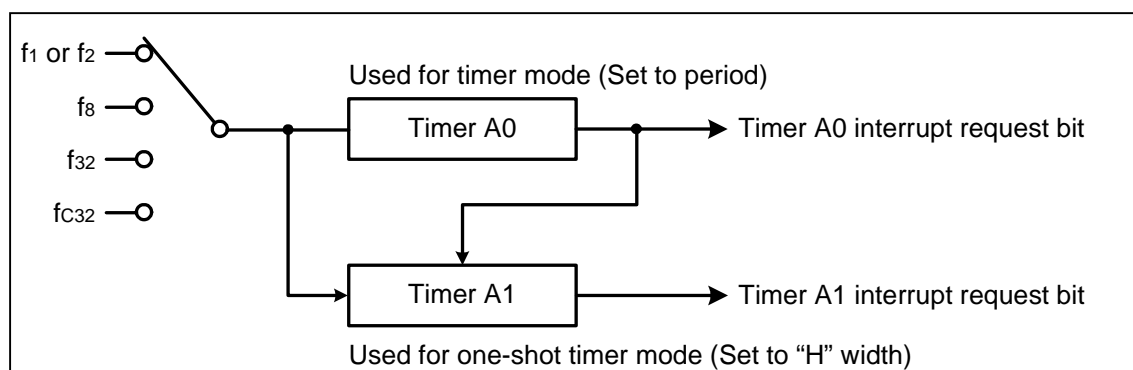
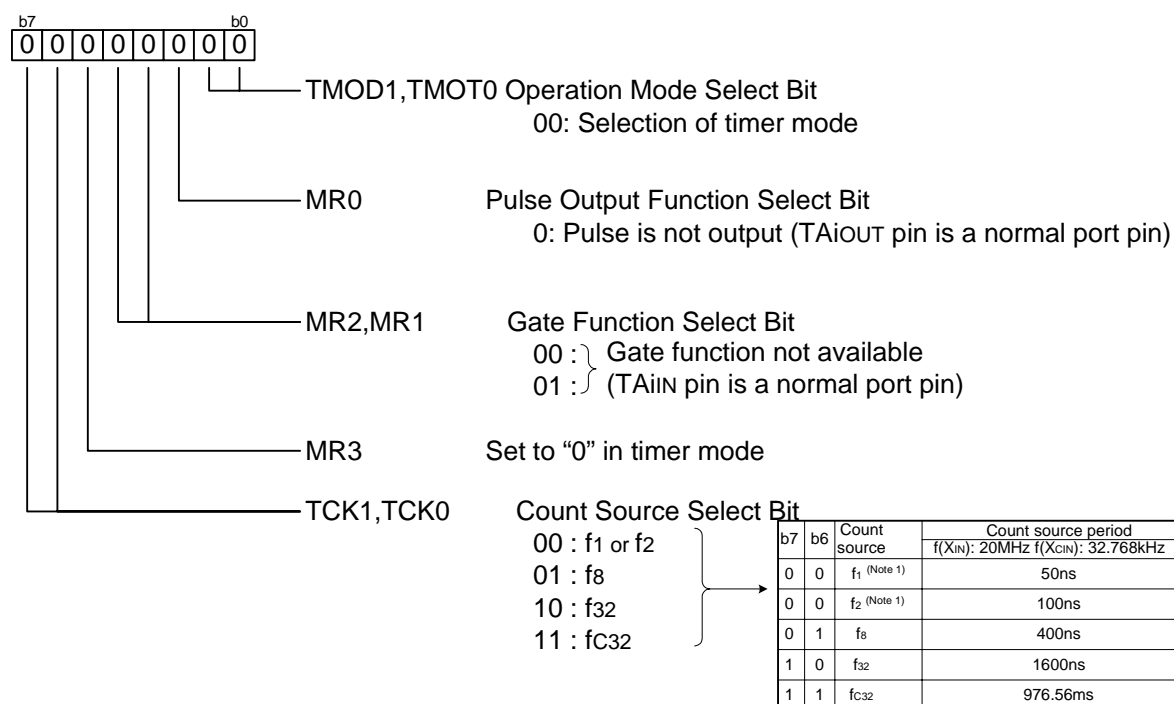


Figure 2. Connection Diagram of Variable-Period Variable-Duty PWM Output

3.3 Register Setting

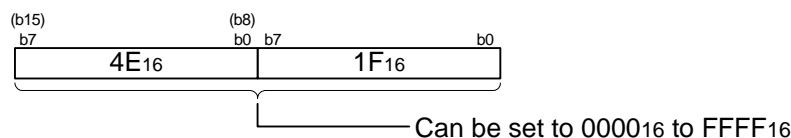
To enable the operation defined in “Section 3. Operation of timer A”, the following register settings must be taken place step by step. For detail configuration of each register, please refer to M16C/26 Group hardware manual, M16C/26A Group hardware manual, M16C/28 Group hardware manual, M16C/29 Group hardware manual.

(1) Setting timer A0 mode register

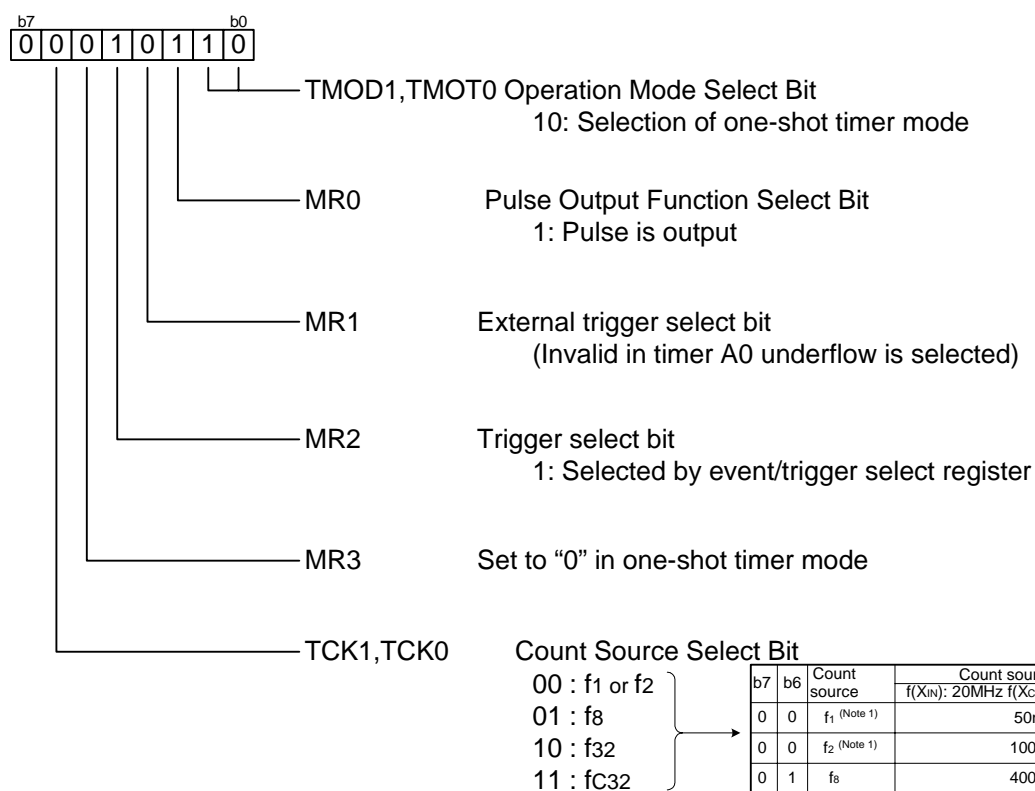


Note 1: Count source is f2 if PCLK0 bit in the PCLKR register is “0”, f1 if PCLK0 bit in the PCLKR register is “1”.

(2) Setting timer A0 register

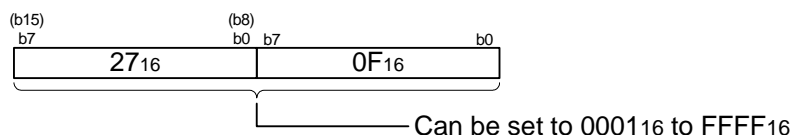


(3) Setting timer A1 mode register



Note 1: Count source is f₂ if PCLK0 bit in the PCLKR register is "0",
f₁ if PCLK0 bit in the PCLKR register is "1".

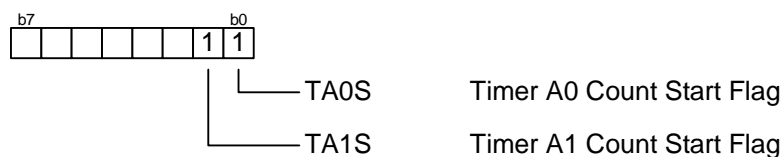
(4) Setting timer A1 register



(5) Setting trigger select register



(6) Setting count start flag



4. Sample Program

```

/*****
 *
 *   FILE NAME :
 *   CPU       : M16C/Tiny series
 *   Function  : Operation of Timer A
 *               (Variable-Period Variable-Duty PWM Output)
 *
 *   Version   : 1.00
 *
 *   Copyright (C)2004, Renesas Technology Corp.
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 *
 *****/
/*****
 *   include file
 *****/
#include "sfr28.h"

/*****
 *   main
 *****/
void main(void) {

    ta0mr = 0x00; /* Selection of timer mode
                  Pulse output function select bit (0:Pulse is not output)
                  Gate function select bit (00:Gate fuction not available)
                  Count source (01:f1 or f2)
                  */

    ta0 = 20000-1; /* Setting counter value (1ms @20MHz, f1) */

    ta1mr = 0x16; /* Selection of onr-shot timer mode
                  Pulse output function select bit (1:Pulse is output)
                  Trigger select bit (1:Selected by event/trigger select register)
                  Count source is selected to f1
                  */

    ta1 = 10000-1; /* Setting counter value (500us @ 20MHz, f1) */

    trgsr = 0x02; /* Setting Trigger select register
                  Trigger of Timer A1 is selected timer A0 Overflow
                  */

    tabsr = 0x03; /* Setting Cout start flag
                  Timer A0 and Timer A1 start
                  */

    while (1) {
    }
}

```

5. Reference

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Hardware Manual

M16C/26, M16C/26A, M16C/28, M16C/29 Group Hardware Manual

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TECHNICAL UPDATE/TECHNICAL NEWS

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REVISION HISTORY

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		Page	Summary
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