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Renesas Electronics Corporation

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M16C/Tiny Series

Operation of Timer A (Pulse Width Modulation Mode, 8-bit PWM Mode)

1. Abstract

In pulse width modulation mode, choose functions from those listed in Table 1. Operations of the checked items are described below.

Table 1. Choosed Functions

Item	Set-up	
Count source		f1 or f2
	Yes	f8
		f32
		fC32
PWM mode		16-bit PWM mode
	Yes	8-bit PWM mode
Count start condition	Yes	External trigger input (falling edge of input signal to the TAI _{IN} pin)
		External trigger input (rising edge of input signal to the TAI _{IN} pin)
		Timer overflow (TB2 overflow /TAj overflow /TAK overflow)

Note: $j = i - 1$, but $j = 4$ when $i = 0$; $k = i + 1$, but $k = 0$ when $i = 4$.

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. Operation of Timer A

- (1) If the TAI_{IN} pin input level changes from “H” to “L” with the count start flag set to “1”, the counter performs a down count on the count source. At this time, the TAI_{OUT} pin outputs an “H” level.
- (2) The TAI_{OUT} pin output level changes from “H” to “L” when a set time period elapses. At this time, the timer Ai interrupt request bit goes to “1”.
- (3) The counter reloads the content of the reload register every time PWM pulses are output for one cycle, and continues counting.
- (4) Setting the count start flag to “0” causes the counter to stop and to reload the content of the reload register. Also, the TAI_{OUT} pin outputs an “L” level.

Complement:

- The period of PWM pulses becomes $(m + 1) \times (2^8 - 1) / f_i$, and the “H” level pulse width becomes $n \times (m + 1) / f_i$. If “00₁₆” is set in the eight higher-order bits of the timer Ai register, the pulse width modulator does not work, and the TAI_{OUT} pin outputs “L” level, therefore the timer Ai interrupt request is not generated. (f_i : frequency of the count source f1, f2, f8, f32, fC32; n : value of the timer)
- When a trigger is generated, the TAI_{OUT} pin outputs “L” level of same amplitude as “H” level of the set PWM pulse, after which it starts PWM pulse output.

Figure 1 shows the operation timing of pulse width modulation mode, 8-bit PWM mode selected.

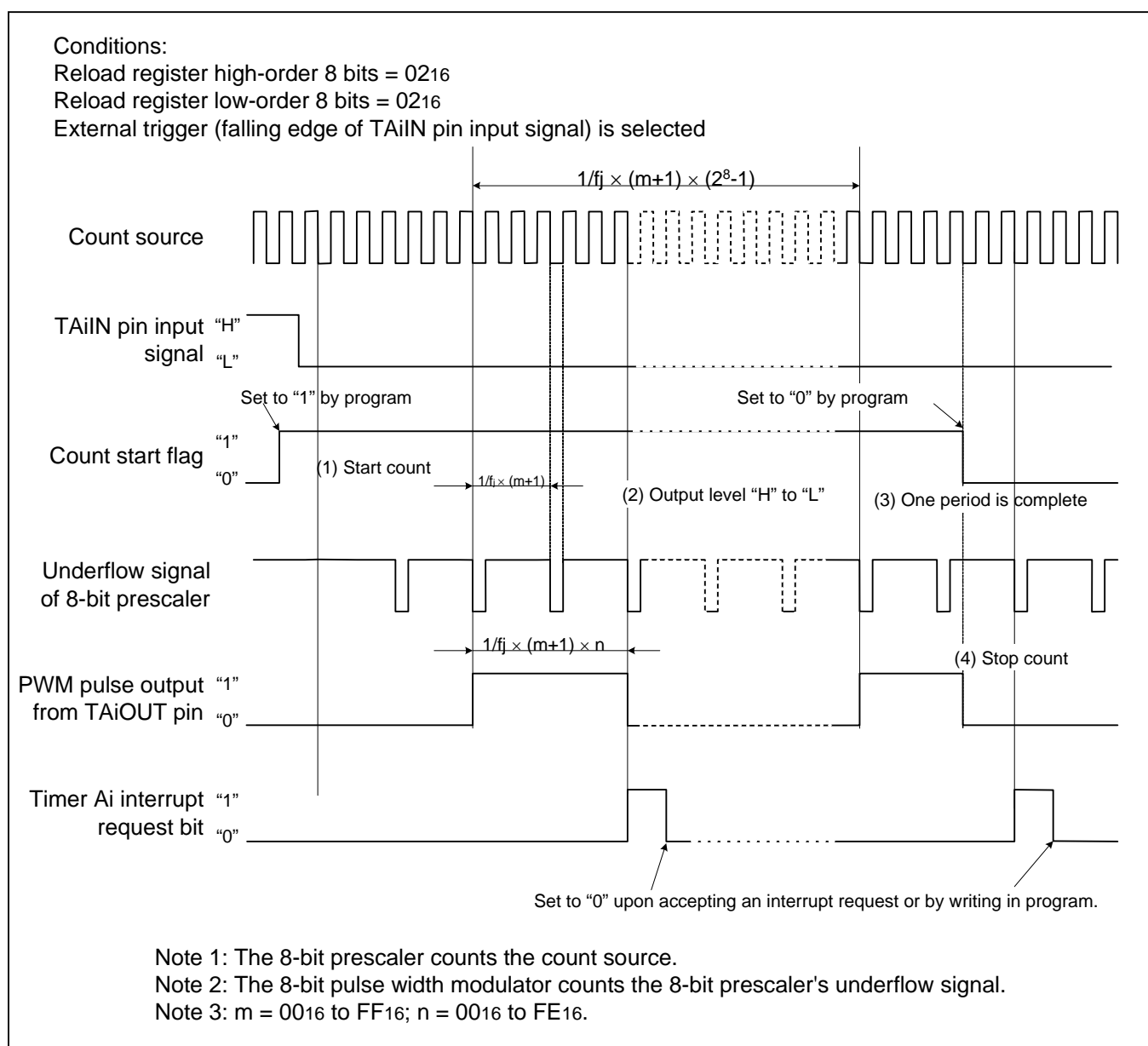
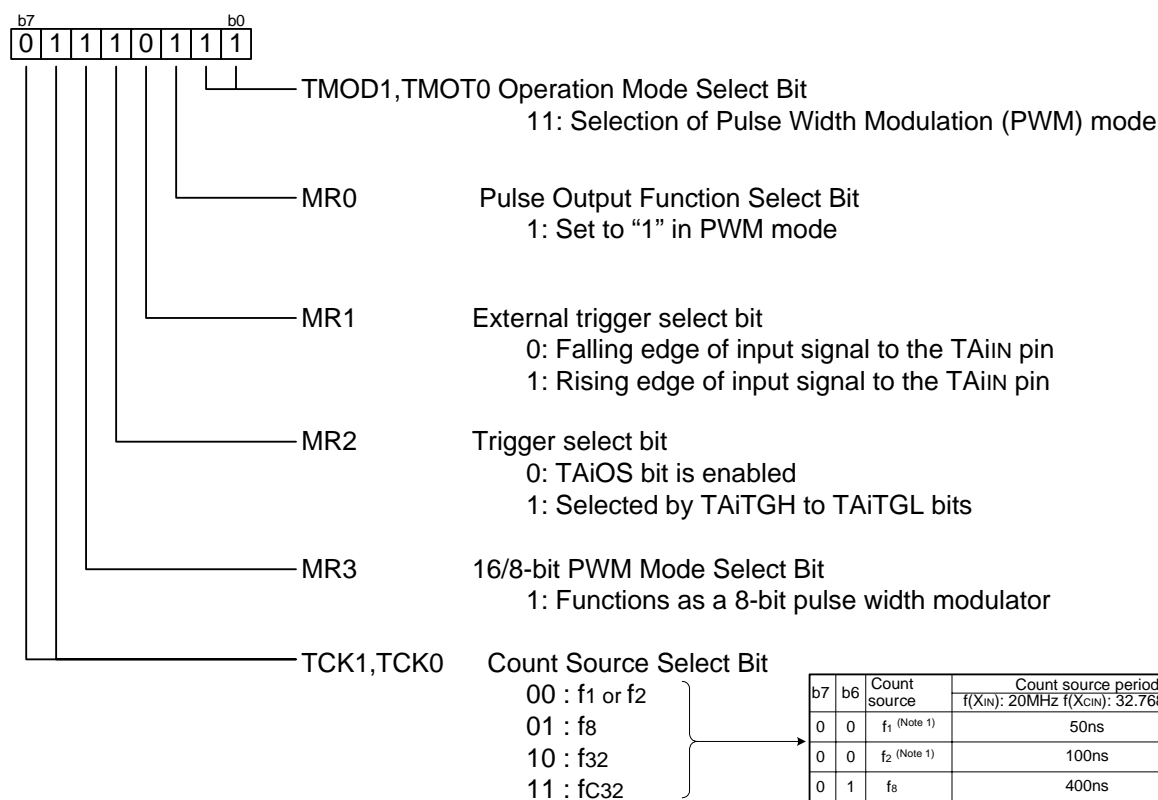


Figure 1. Operation Timing of Pulse Width Modulation Mode, 8-bit PWM Mode Selected

3.1 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.

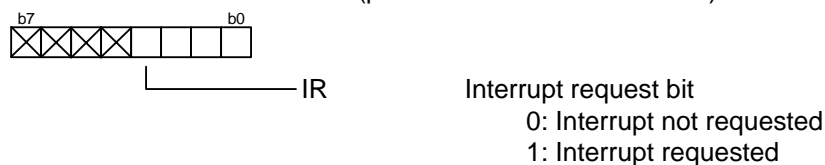
(1) Setting timer Ai mode register (i=0 to 4)



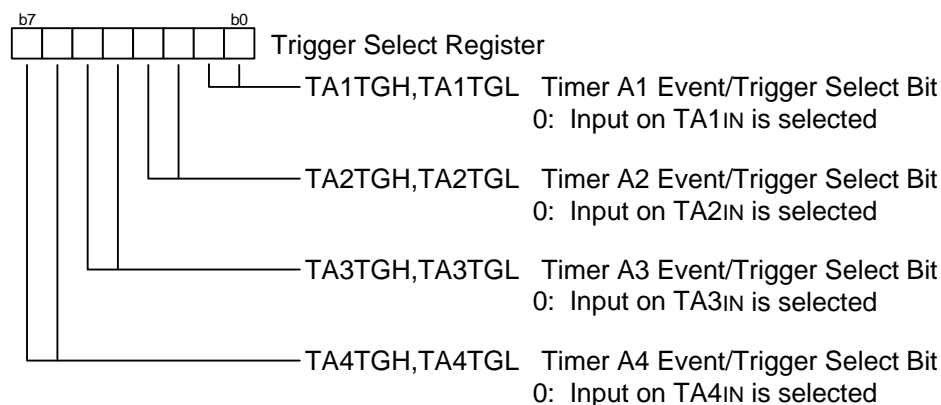
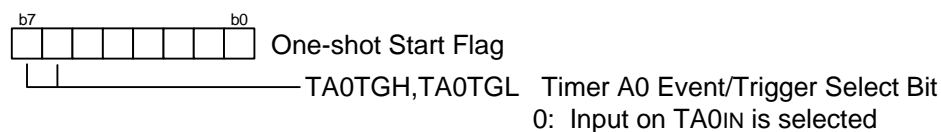
Note 1: Count source is f₂ if PCLK0 bit in the PCLKR register is “0”,
f₁ if PCLK0 bit in the PCLKR register is “1”.

(2) Clearing timer Ai interrupt request bit

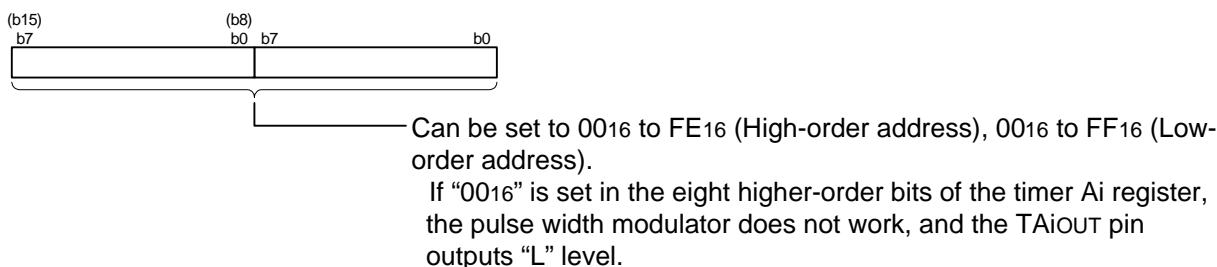
Refer to Precaution for Timer A (pulse width modulation mode)



(3) Setting one-shot start flag and trigger select register

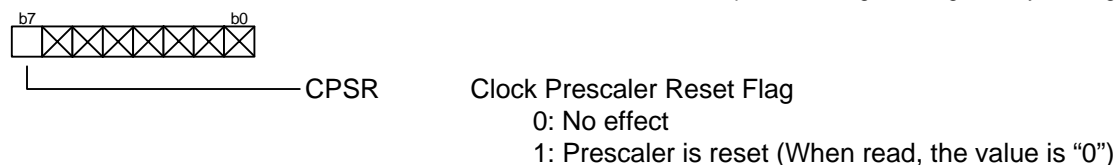


(4) Setting timer Ai register (i=0 to 4)

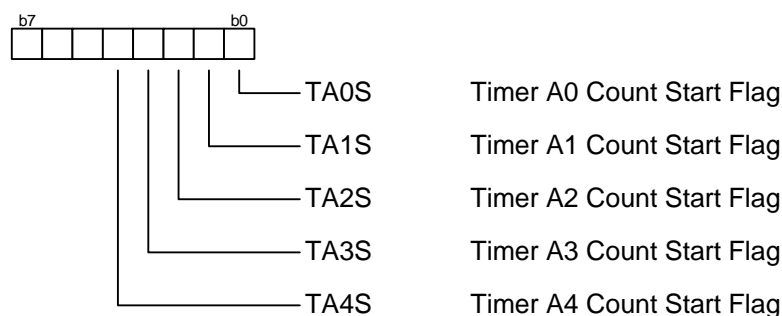


(5) Setting clock prescaler reset flag

(This function is effective when fC32 is selected as the count source. Reset the prescaler for generating fC32 by dividing the XCIN by 32.)



(6) Setting count start flag



4. Sample Program

```

/*****
 *
 *   FILE NAME :
 *   CPU       : M16C/Tiny series
 *   Function  : Operation of Timer A
 *               (Pulse width modulation Mode, 8-bit PWM mode)
 *   Version   : 1.00
 *
 *   Copyright (C)2004, Renesas Technology Corp.
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 *
 *****/
/*****
 *   include file
 *****/
#include "sfr28.h"

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

    talmr = 0x77; /* Selection of PWM mode
                   External trigger (Falling edge of TAIIN pin's input signal)
                   Selected by event/trigger select register
                   Function as 8-bit pulse width modulator
                   Count source (01:f8) */

    talic = 0; /* Clear TimerA1 interrupt request */

    trgsr = 0; /* Setting event/trigger select bit
               00: Input on TAIIN is selected */

    tal = 0x6362; /* Setting counter value (1msec @20MHz, f8) */

    cpsrf = 0; /* Setting clock prescaler reset flag (0:No effect) */

    tals = 1; /* TimerA1 count start */

    while (1) {
    }
}

```


5. Reference

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Hardware Manual

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

(Use the latest version on the home page: <http://www.renesas.com>)

TECHNICAL UPDATE/TECHNICAL NEWS

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REVISION HISTORY

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