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April 1st, 2010
Renesas Electronics Corporation

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M16C/80 Group

Operation of Timer A (pulse width modulation mode, 16-bit PWM mode)

1.0 Abstract

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

Table 1. Chosed functions

Item	Set-up	
Count source	<input type="radio"/>	Internal count source ($f_1 / f_8 / f_{32} / f_{c32}$)
PWM mode	<input type="radio"/>	16-bit PWM
	<input type="radio"/>	8-bit PWM
Count start condition	<input type="radio"/>	External trigger input (falling edge of input signal to the TAIiN pin)
	<input type="radio"/>	External trigger input (rising edge of input signal to the TAIiN pin)
	<input type="radio"/>	Timer overflow (TB2/TAj/TAK overflow)

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

2.0 Introduction

- Operation (1) If the TAI_{iN} pin input level changes from "L" to "H" with the count start flag set to "1", the counter performs a down count on the count source. Also, the TAI_{iOUT} pin outputs an "H" level.
- (2) The TAI_{iOUT} 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 hold its value and to stop. Also, the TAI_{iOUT} outputs an "L" level.

- Note
- The period of PWM pulses becomes $(2^{16} - 1)/f_i$, and the "H" level pulse width becomes n/f_i . If the timer Ai register is set to "0000₁₆", the pulse width modulator does not work, and the the TAI_{iOUT} pin output level remains at "L". (f_i : frequency of the count source $f_1, f_8, f_{32}, f_{c32}$; n : value of the timer)
 - Set TAI_{iN} pin's function select register A to I/O port and port direction register to "0".
 - Select TAI_{iOUT} output function with the function select register A and B.
 - When setting the function select registers A, B, and C, sets the function select registers B and/or C first, and then sets the function select register A.

Figure 1 shows the operation timing

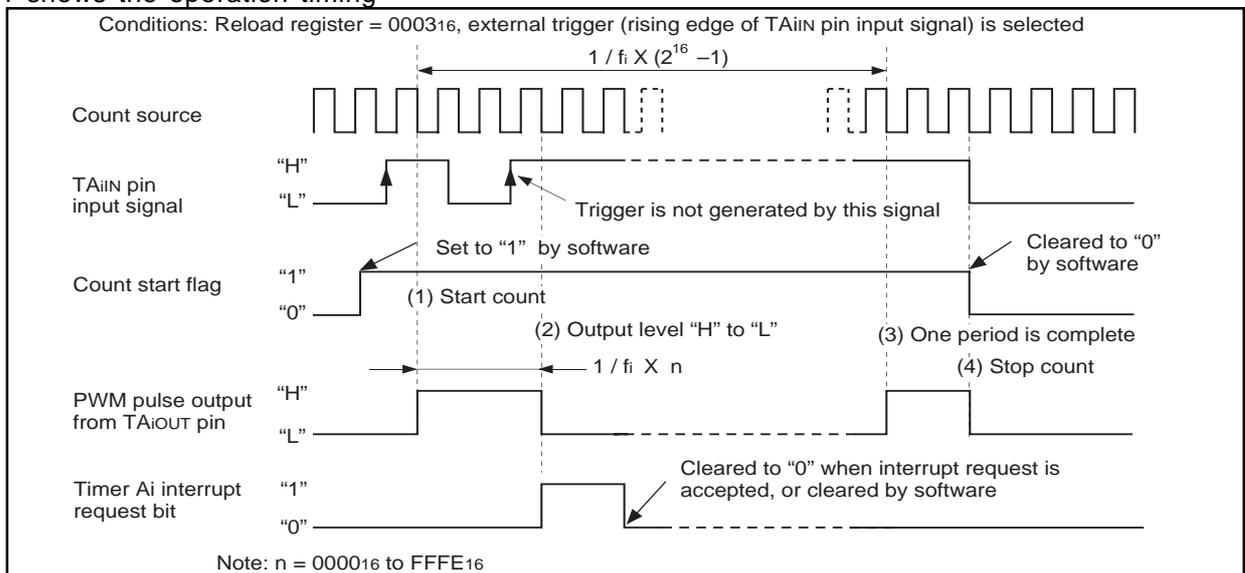


Figure 1. Operation timing of pulse width modulation mode, 16-bit PWM mode

3.0 Set-up procedure

Selecting PWM mode and functions

Timer Ai mode register (i=0 to 4) [Address 0356i16 to 035A16]
TAiMR (i=0 to 4)

Selection of PWM mode
External trigger select bit
1 : Rising edge of TAiIN pin's input signal (Note)
Trigger select bit
1 : Selected by event/trigger select register
16/8-bit PWM mode select bit
0 : Functions as a 16-bit pulse width modulator
Count source select bit

b7	b6	Count source	Count source period
0	0	f1	50ns
0	1	f8	400ns
1	0	f32	1.6μs
1	1	fc32	976.56μs

Note: Set the corresponding function select register A to I/O port and port direction register to "0".

Setting function select register A and B

Function select register A1 [Address 03B116]
PS1

- Port 7₀ output function select bit
0 : I/O port
1 : Peripheral function output (PSL1_0 enabled)
- Port P7₂ output function select bit
0 : I/O port
1 : Peripheral function output (PSL1_2, PSC_0 enabled)
- Port P7₄ function select bit
0 : I/O port
1 : Peripheral function output (PSL1_4 enabled)
- Port P7₆ output function select bit
0 : I/O port
1 : TA3_{OUT} output

Function select register A2 [Address 03B416]
PS2

- Port 8₀ output function select bit
0 : I/O port
1 : Peripheral function output (PSL2_0 enabled)

Function select register B1 [Address 03B316]
PSL1

- Port P7₀ output peripheral function select bit
0 : TxD2(SDA2) port
1 : TA0_{OUT} output
- Port P7₂ output peripheral function select bit
0 : Port P7₂ output peripheral subfunction select bit
1 : TA1_{OUT} output
- Port P7₄ output peripheral function select bit
0 : TA2_{OUT} port
1 : W phase output

Function select register B2 [Address 03B616]
PSL2

- Port P8₀ output peripheral function select bit
0 : TA4_{OUT} output
1 : U phase output

Function select register C [Address 03AF16]
PSC

- Port P7₂ output peripheral subfunction select bit
0 : Must set "0" in selecting TA1_{OUT} output

Clearing timer Ai interrupt request bit

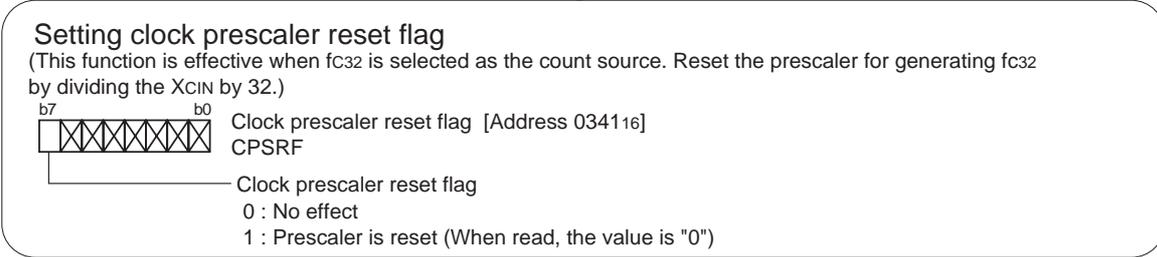
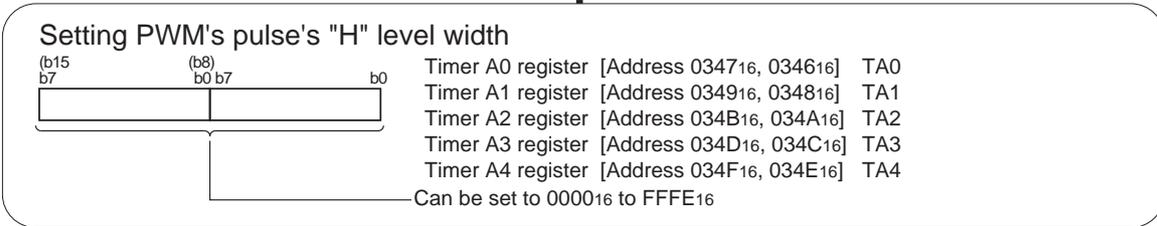
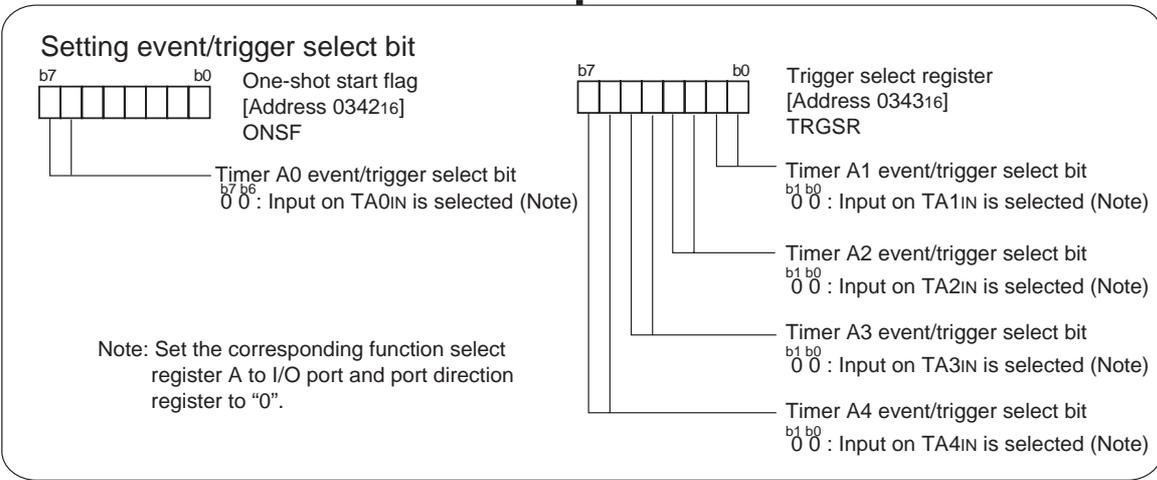
(Please refer to the notes on the pulse width modulation mode of Timer A in the User's manual.)

Timer Ai interrupt control register [Addresses 006C16, 008C16, 006E16, 008E16, 007016]
TAiIC (i=0 to 4)

Interrupt request bit

Continued to the next page

Continued from the previous page



Start count

4.0 Programming Code

```

;*****
;
; M16C/80 Program Collection
;
; FILE NAME : rjj05b0132_src.a30
; CPU      : M16C/80 Group
; FUNCTION : Operation of Timer A
;           (pulse width modulation mode, 16-bit PWM mode)
; HISTORY  : 2003.06.16 Ver 1.00
;
; Copyright(C)2003, Renesas Technology Corp.
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;
;*****
;*****
; Include
;*****
        .LIST      OFF           ;Stops outputting lines to the assembler list file
        .INCLUDE   sfr80100.inc ;Reads the file that defined SFR
        .LIST      ON           ;Starts outputting lines to the assembler list file
;
;*****
; Symbol definition
;*****
ROM_TOP      .EQU    0FFC000H ;Start address of ROM
FIXED_VECT_TOP .EQU  0FFFFDCH ;Start address of fixed vector
;
;*****
; Program area
;*****
;=====
; Start up
;=====
        .SECTION   PROGRAM, CODE ;Declares section name and section type
        .ORG      ROM_TOP       ;Declares start address
RESET:
; Sets Processor mode, System clock and Main clock division
MOV.B #03H, prcr ;Removes protect
MOV.B #10000000B, pm0 ; Single-chip mode
MOV.B #11000000B, pm1 ; Flash memory version
MOV.B #00001000B, cm0 ; Xcin-Xcout High
MOV.B #00100000B, cm1 ; Xin-Xout High
MOV.B #00010010B, mcd ; No division mode
MOV.B #00H, prcr ;Protects all registers
;

```

```

;=====
;   TimerA (pulse width modulation mode,16-bit PWM mode selected)
;=====
;   ; Selecting PWM mode and functions
MOV.B   #01011011B, talmr
;       |||||++-----;Selection of PWM mode
;       |||||+-----;This bit is invalid in M16C/80 series
;       |||||+-----;External trigger select bit
;       |||||          (1:Rising edge of TAlIN pin's input signal) (Note)
;       |||||+-----;Trigger select bit
;       |||||          (1:Selected by event/trigger select register)
;       |||+-----;16/8-bit PWM mode select bit
;       |||          (0:Functions as a 16-bit pulse width modulator)
;       ++-----;Count source (01:f8)
;   ; Clearing timer A1 interrupt request bit
MOV.B   #00000000B, talic
;       +-----;Interrupt request bit
;   ; Setting function select register A and B (Setting pulse output function)
BSET    ps11_2          ;Port P72 peripheral function select bit (TA1OUT output)
BCLR    psc_0           ;Must set "0" in selecting TA1OUT output
BSET    ps1_2           ;Port P72 function select bit (peripheral function output)
;   ; Setting event/trigger select bit
MOV.B   #00000000B, trgsr
;       ++-----;Input on TAlIN is selected (Note)
;   ; (Note) Set the corresponding function select register A to I/O port
;   ; and port direction register to "0"
BCLR    pd7_3          ;Port P73 direction register
BCLR    ps1_3          ;Port P73 is I/O port
;   ; Setting PWM pulse's "H" level width (1msec @20MHz, f8)
MOV.W   #2500, tal
;   ; Setting clock prescaler reset flag
;   ; (This function is effective when fC32 is selected as the count source)
MOV.B   #00000000B, cpsrf
;       +-----;Clock prescaler reset flag (0:No effect)
;   ; Setting count starts flag
MOV.B   #00000010B, tabsr
;       +-----;Timer A1 count start flag
;
MAIN:
    JMP    MAIN
;
;=====
;   Dummy interrupt processing program
;=====
dummy:
    REIT
;
;*****
;   Setting of fixed vector
;*****
.SECTION    F_VECT, ROMDATA
.ORG        FIXED_VECT_TOP
;
.LWORD     dummy    ;Undefined instruction
.LWORD     dummy    ;Overflow
.LWORD     dummy    ;BRK instruction execution
.LWORD     dummy    ;Address match
.LWORD     dummy    ;
.LWORD     dummy    ;Watchdog timer
.LWORD     dummy    ;
.LWORD     dummy    ;NMI
.LWORD     RESET    ;Reset
;
.END

```

5.0 Reference**Renesas Technology Corporation Semiconductor Home page**<http://www.renesas.com/>**Technical Support**E-mail: support_apl@renesas.com**Data Sheet**

M16C/80 group Rev. E3

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