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April 1st, 2010
Renesas Electronics Corporation

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M16C/62A Group

Variable-Period Variable-Duty PWM Output

1.0 Abstract

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

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

2.0 Introduction

- 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 f_1 for the count source.
 - (3) Connect a 16-MHz oscillator to X_{IN} .

- 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 f_1 .
 - (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 TA1_{OUT} pin goes to "H".
 - (4) As soon as the count of the counter of timer A1 becomes "0000₁₆", the output level of TA1_{OUT} 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".

Figure 1 shows the operation timing

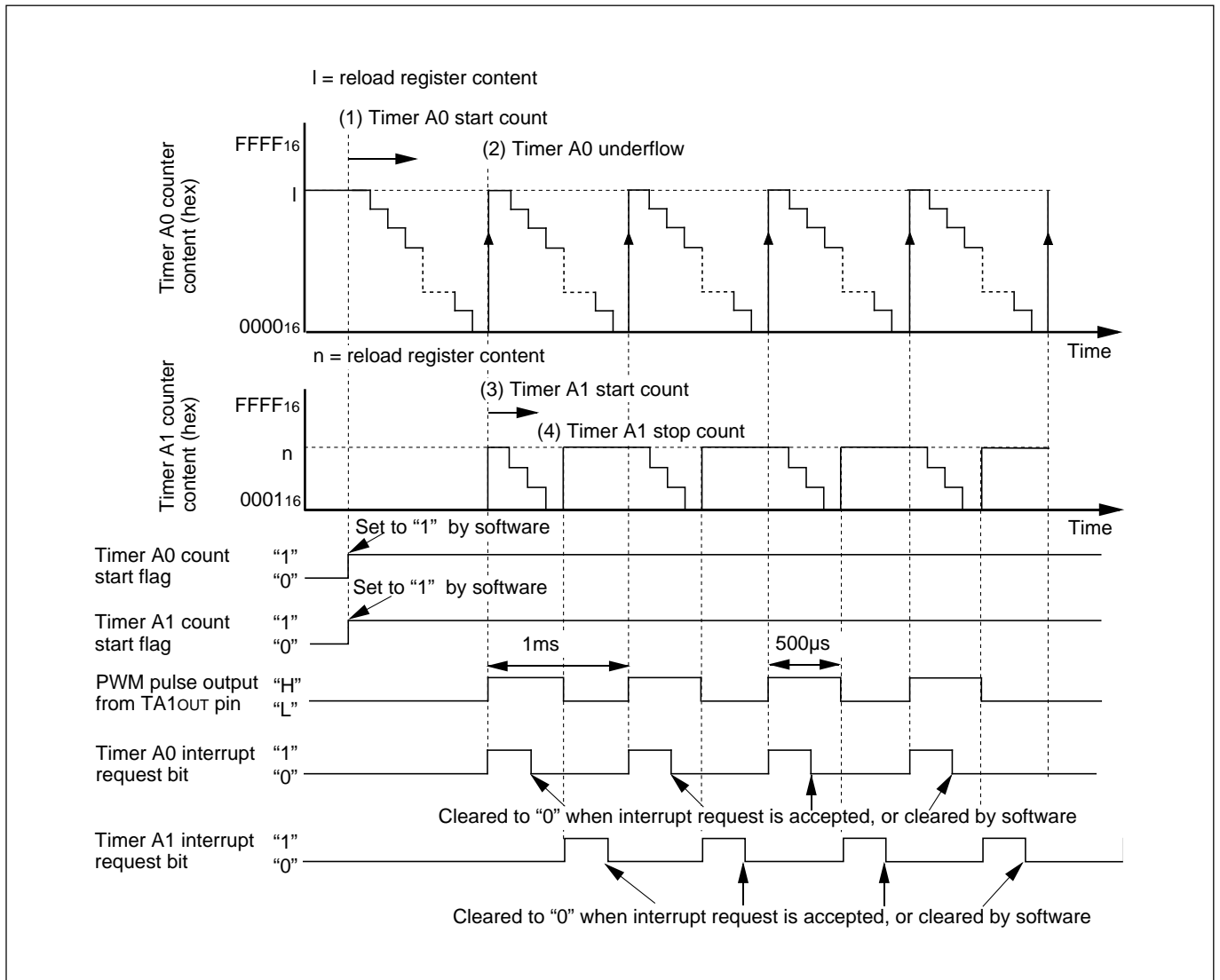


Figure 1. Operation timing of variable-period variable-duty PWM output

Figure 2 shows the connection diagram

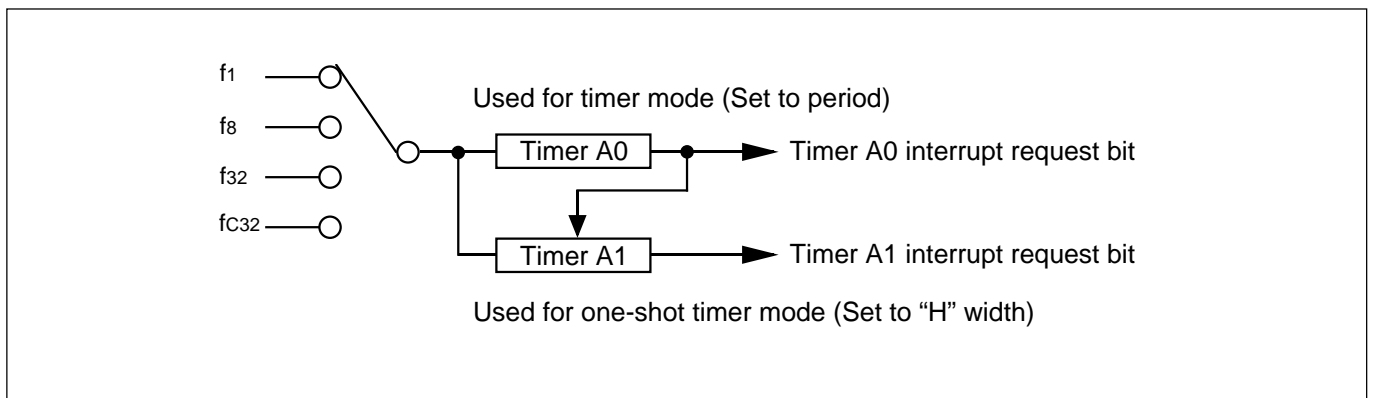


Figure 2. Connection diagram of variable-period variable-duty PWM output

3.0 Set-up procedure

Setting timer A0

Selecting timer mode and functions

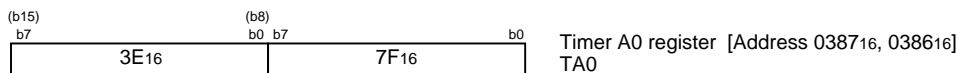
Timer A0 mode register [Address 0396₁₆] TA0MR

b7 b0
0 0 0 0 0 0 0 0

- Selection of timer mode
- Pulse output function select bit
0 : Pulse is not output (TA0OUT pin is a normal port pin)
- Gate function select bit
b4 b3
0 0 : Gate function not available (TA0IN pin is a normal port pin)
- 0 (Must always be "0" in timer mode)
- Count source select bit
b7 b6
0 0 : f₁

b7	b6	Count source	Count source period	
			f(XIN) : 16MHz	f(XCIN) : 32.768kHz
0	0	f ₁	62.5ns	
0	1	f ₈	500ns	
1	0	f ₃₂	2μs	
1	1	f _{C32}	976.56μs	

Setting counter value



Setting timer A1

Selecting one-shot timer mode and functions

Timer A1 mode register [Address 0397₁₆] TA1MR

b7 b0
0 0 0 1 0 1 1 0

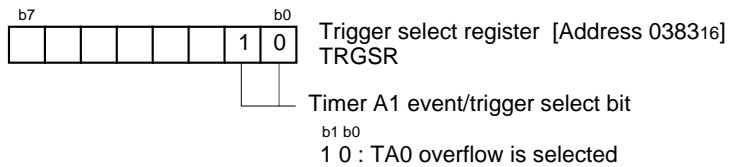
- Selection of one-shot timer mode
- Pulse output function select bit
1 : Pulse is output
- External trigger select bit (Invalid when choosing timer's overflow as trigger)
- Trigger select bit
1 : Selected by event/trigger select register
- 0 (Must always be "0" in one-shot timer mode)
- Count source select bit
b7 b6
0 0 : f₁

b7	b6	Count source	Count source period	
			f(XIN) : 16MHz	f(XCIN) : 32.768kHz
0	0	f ₁	62.5ns	
0	1	f ₈	500ns	
1	0	f ₃₂	2μs	
1	1	f _{C32}	976.56μs	

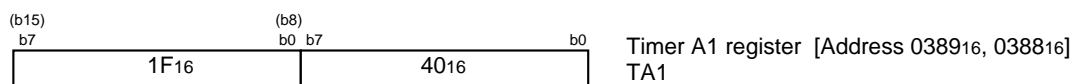
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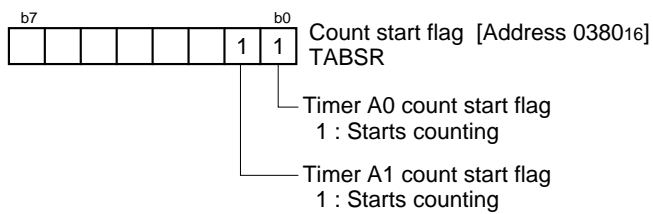
Setting trigger select register



Setting one-shot timer's time



Setting count start flag



Start counting

4.0 Programming Code

```

;*****
;
; M16C/62A Program Collection
;
; FILE NAME : rjj05b0070_src.a30
; CPU      : M16C/62A Group
; FUNCTION  : Timer A Applications
;           (Variable-Period Variable-Duty PWM Output)
; HISTORY   : 2003.05.16 Ver 1.00
;
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; All rights reserved.
;
;*****
;*****
; Include
;*****
        .LIST      OFF          ;Stops outputting lines to the assembler list file
        .INCLUDE   sfr62a.inc   ;Reads the file that defined SFR
        .LIST      ON          ;Starts outputting lines to the assembler list file
;
;*****
; Symbol definition
;*****
ROM_TOP      .EQU    0F8000H    ;Start address of ROM
FIXED_VECT_TOP .EQU  0FFFDC    ;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:
        MOV.B     #03H, prcr     ;Removes protect
                                ;Set processor mode registers 0 and 1
        MOV.B     #00000000B, pm0 ; Single-chip mode
        MOV.B     #00000000B, pm1 ; No expansion, No wait
                                ;Set system clock control registers 0 and 1
        MOV.B     #00001000B, cm0 ; Xcin-Xcout High
        MOV.B     #00100000B, cm1 ; Xin-Xout High, Main clock is No divison
        MOV.B     #00H, prcr     ;Protects all registers
;

```

```

;=====
;   TimerA (variable-period variable-duty PWM output)
;=====
;-----TimerA0-----
MOV.B   #0000000B, ta0mr ;TimerA0 mode register
;       ||||| |++-----;Selection of timer mode
;       ||||| |+-----;Pulse output function select bit
;       ||||| |          (0:Pulse is not output (TA0OUT pin is a normal port pin))
;       ||||| |++-----;Gate function select bit
;       ||||| |          (00:Gate function not available (TA0OUT pin is a normal port pin))
;       |||  |++-----;Must always be "0" in timer mode
;       ||+-----;Count source select bit (00:Count source f1)
MOV.W   #3E7FH, ta0      ;Setting counter value (1msec @16MHz, f1)
;
;-----TimerA1-----
MOV.B   #00010110B, talmr ;TimerA1 mode register
;       ||||| |++-----;Selection of one-shot timer mode
;       ||||| |+-----;Pulse output function select bit
;       ||||| |          (1:Pulse is output)
;       ||||| |++-----;External trigger select bit
;       ||||| |          (Invalid when choosing timer's overflow as trigger)
;       |||  |++-----;Trigger select bit
;       |||  |          (1:Selected by event/trigger select register)
;       ||+-----;Must always be "0" in event counter mode
;       ++-----;Count source select bit (00:Count source f1)
MOV.B   #00000010B, trgsr ;Setting trigger select register
;       ++-----;Timer A1 event/trigger select bit
;       (10:TA0 overflow is selected)
MOV.W   #1F40H, ta1      ;Setting one-shot timer's time (500usec @16MHz, f1)
MOV.B   #00000011B, tabsr ;Setting count start flag
;       |+-----;TimerA0 count start flag(1:Starts counting)
;       +-----;TimerA1 count start flag(1:Starts counting)
;
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 interrupt vector
.LWORD    dummy ;Overflow (INT0 instruction) interrupt vector
.LWORD    dummy ;BRK instruction interrupt vector
.LWORD    dummy ;Address match interrupt vector
.LWORD    dummy ;Single-step interrupt vector
.LWORD    dummy ;Watchdog timer interrupt vector
.LWORD    dummy ;DBC interrupt vector
.LWORD    dummy ;NMI interrupt vector
.LWORD    RESET ;Sets reset vector
;
.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/62A group Rev. C.1
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User's Manual

M16C/62A group Rev. 1.0
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