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April 1<sup>st</sup>, 2010  
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## M16C/62P Group

### Operation of Timer B (pulse width measurement mode)

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#### 1. Abstract

In pulse period/pulse width measurement mode, choose functions from those listed in Table 1. Operations of the circled items are described below. Figure 1 shows the operation timing, and Figure 2 shows the set-up procedure. A reference program is an example when using the Timer B0 interrupt based on the setting procedure of Figure 2.

#### 2. Introduction

This application note is applied to the M16C/62P group Microcomputers.

This program can be operated under the condition of M16C family products with the same SFR(Special Function Register) as M16C/62P Group products. Because some functions may be modified of the M16C family products, see the user's manual. When using the functions shown in this application note, evaluate them carefully for an operation

3. Chosed functions

**Table 1. Chosed functions**

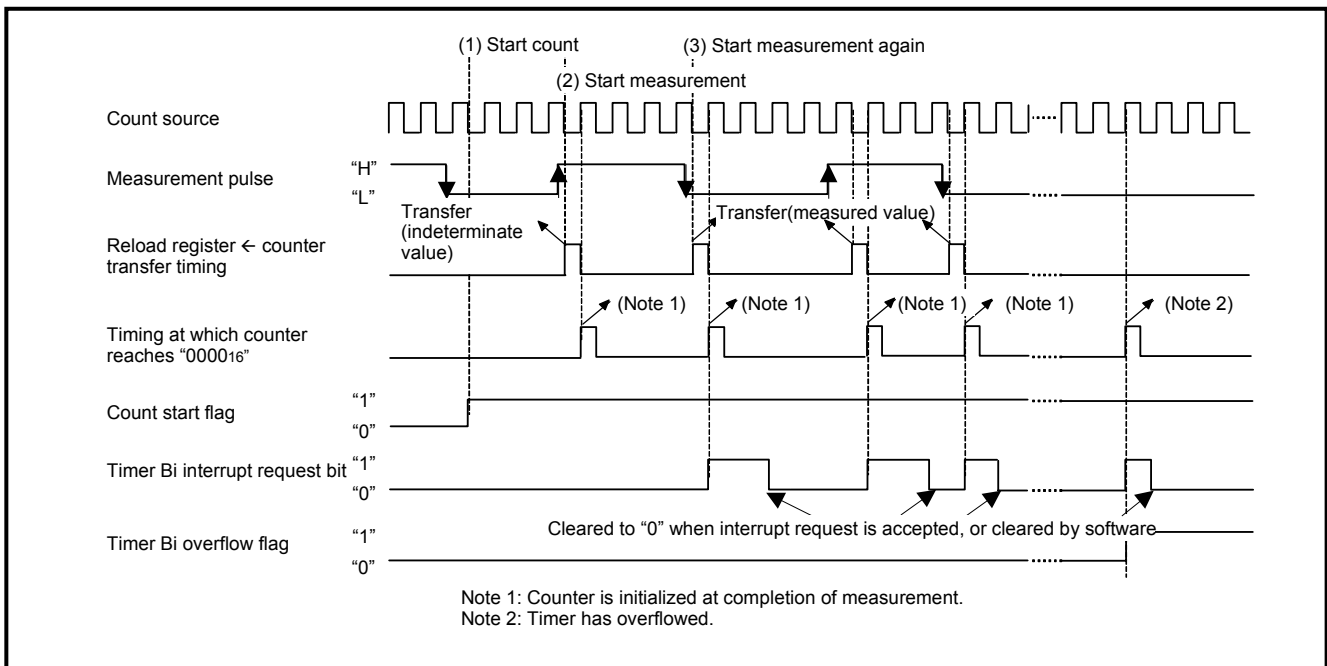
Item	Set-up	
Count source	<input type="radio"/>	Internal count source (f1 / f8 / f32 / fc32)
Measurement mode	<input type="radio"/>	Pulse period measurement (interval between measurement pulse falling edge to falling edge)
	<input type="radio"/>	Pulse period measurement (interval between measurement pulse rising edge to rising edge)
	<input type="radio"/>	Pulse width measurement (interval between measurement pulse falling edge to rising edge, and between rising edge to falling edge)

4. Operation

- (1) Setting the count start flag to “1” causes the counter to start counting the count source.
- (2) If an effective edge of a pulse to be measured is input, the value of the counter goes to “000016”, and measurement is started. In this instance, an indeterminate value is transferred to the reload register. The timer Bi interrupt request does not generate.
- (3) If an effective edge of a pulse to be measured is input again, the value of the counter is transferred to the reload register, and the timer Bi interrupt request bit goes to “1”. Then the value of the counter becomes “000016”, and measurement is started again.

**Note**

- The timer Bi interrupt request bit goes to “1” when an effective edge of a pulse to be measured is input or timer Bi is overflows. The factor of interrupt request can be determined by use of the timer Bi overflow flag within the interrupt routine.
- The value of the counter at the beginning of a count is indeterminate. Therefore, the timer Bi overflow flag may go to “1” and timer Bi interrupt request may be generated during the interval between a count start and an effective edge input.
- The timer Bi overflow flag is indeterminate after reset. The timer Bi overflow flag goes to “0” if timer Bi mode register is written to when the count start flag is “1”. This flag cannot be set to “1” by software.



**Figure 1. Operation timing of pulse width measurement mode**

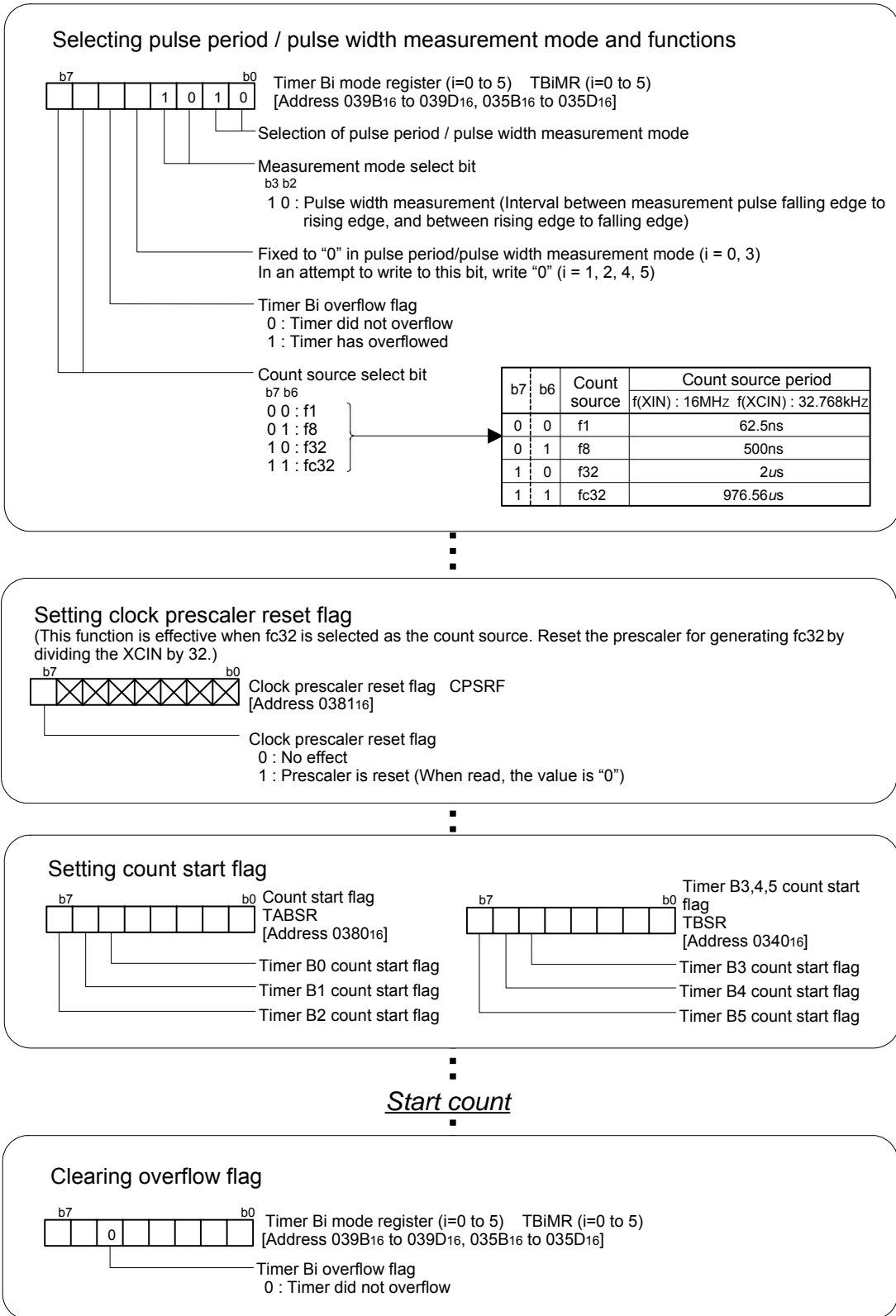


Figure 2. Set-up procedure of pulse width measurement mode

## 5. The example of reference program

```

*****
;
;
; M16C/62P Program Collection
;
; FILE NAME : rjj05b0705_src.a30
; CPU       : M16C/62P Group
; FUNCTION  : Operation of Timer B (pulse width measurement)
; HISTORY   : 2004.12.24 Ver 1.00
;           : 2006.1.25 Ver 1.10
;
; Copyright(C)2006, Renesas Technology Corp.
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;
*****
;
*****
;
; Include
;
*****
;
; .LIST      off           ;Stops outputting lines to the assembler list file
; .INCLUDE   sfr62p.inc    ;Reads the file that defined SFR
; .LIST      on           ;Starts outputting lines to the assembler list file
;
;
*****
;
; Symbol definition
;
*****
;
RAM_TOP      .equ    00400h    ;Start address of RAM
RAM_END      .equ    013ffh    ;End address of RAM
ROM_TOP      .equ    0f4000h   ;Start address of ROM
VECT_TOP     .equ    0ffe00h   ;Start address of vect_top
FIXED_VECT_TOP .equ    0ffdch   ;Start address of fixed_vect_top
SB_BASE      .equ    00380h    ;Base address of sb
;
;
*****
;
; Program area
;
*****
;
=====
;
; Start up
;
=====
;
;
; .section program,code      ;Declares section name and section type
; .org          ROM_TOP     ;Declares start address
; .sb          SB_BASE      ;
;
;

```

START:

```

ldc          #RAM_END+1,isp ;Sets interrupt stack pointer
ldc          #SB_BASE,sb   ;Sets sb register
;
mov.b        #03h,prcr     ;Removes protect
;                               ;Set processor mode registers 0 and 1
mov.w        #0800h,pm0    ;Single-chip mode
;                               ;No expansion, No wait
mov.w        #2008h,cm0    ;Xcin-Xcout High
;                               ;Xin-Xout High, Main clock is No divison
mov.b        #0,prcr      ;Protects all registers
;
ldintb       #VECT_TOP    ;Sets interrupt table register
;
mov.w        #0,r0         ;Clears WORKRAM area
mov.w        #((RAM_END+1)-RAM_TOP)/2,r3
mov.w        #RAM_TOP,a1
sstr.w
;
;=====
; Main program
;=====
mov.b        #01001010b,tb0mr ;Timer B0 mode register
;                               ||||| ++-----;Pulse period/pulsewidth measurement mode
;                               ||| ++-----;Pulse width measurement(measurement between
;                               |||          ;a falling edge and the next rising edge of measured
;                               |||          ;pulse and between a rising edge and the next
;                               |||          ;falling edge)
;                               || +-----;Set to"0" in pulse period and pulse widge
;                               ||         ;measurement mode
;                               || +-----;Timer has not overflowed
;                               ++-----;Count source(f8)
mov.b        #00000011b,tb0ic ;Interrupt control register
;                               |+++-----;Interrupt priority level select bit
;                               |          ;(011:Level 3, interrupt disabled)
;                               +-----;Interrupt request bit (0:interrupt not requested)
mov.b        #00100000b,tabsr ;Count start flag
;                               +-----;Starts counting
nop          ;To set the MR3 bit to "0" (no overflow), set TBiMR
nop          ;register with setting the TBiS bit to "1" and counting the
nop          ;next count source after setting the MR3 bit to "1"
nop          ;(overflow). Newly added in the Ver 1.10
nop          ;
nop          ;
nop          ;

```

```

        nop                ;
        fset               i                ;Set interrupt enable flag
        mov.b              #01001010b,tb0mr ;Timer B0 mode register
;                               +-----;Timer did not overflowed
MAIN:

        jmp                MAIN

;=====
;      Interrupt program
;=====
TB0_INT:
;
;      ;/ TB0 interrupt routine /
;
        reit

;=====
;      Dummy interrupt processing program
;=====
DUMMY:
        reit
;=====
;      Setting of variable vector table
;=====
        .section vect,romdata
        .org                VECT_TOP + (4 * 4)
;
        .lword              DUMMY          ;INT3 interrupt vector
        .lword              DUMMY          ;TB5 interrupt vector
        .lword              DUMMY          ;TB4 interrupt vector
;                               ;UART1 bus collision detection interrupt vector
        .lword              DUMMY          ;TB3 interrupt vector
;                               ;UART0 bus collision detection interrupt vector
        .lword              DUMMY          ;SI/04/INT5 interrupt vector
        .lword              DUMMY          ;SI/03/INT4 interrupt vector
        .lword              DUMMY          ;UART2 bus collision detection interrupt vector
        .lword              DUMMY          ;DMA0 interrupt vector
        .lword              DUMMY          ;DMA1 interrupt vector
        .lword              DUMMY          ;KEY interrupt vector
        .lword              DUMMY          ;A-D interrupt vector
        .lword              DUMMY          ;UART2 transmit/NACK interrupt vector
        .lword              DUMMY          ;UART2 receive/ACK interrupt vector
        .lword              DUMMY          ;UART0 transmit/NACK interrupt vector
        .lword              DUMMY          ;UART0 receive/ACK interrupt vector
        .lword              DUMMY          ;UART1 transmit/NACK interrupt vector
        .lword              DUMMY          ;UART1 receive/ACK interrupt vector
        .lword              DUMMY          ;TA0 interrupt vector

```



```

.word          DUMMY          ;TA1 interrupt vector
.word          DUMMY          ;TA2 interrupt vector
.word          DUMMY          ;TA3 interrupt vector
.word          DUMMY          ;TA4 interrupt vector
.word          TB0_INT        ;TB0 interrupt vector
.word          DUMMY          ;TB1 interrupt vector
.word          DUMMY          ;TB2 interrupt vector
.word          DUMMY          ;INT0 interrupt vector
.word          DUMMY          ;INT1 interrupt vector
.word          DUMMY          ;INT2 interrupt vector
;
;*****
;
;   Setting of fixed vector
;*****
;
;
;   .section f_vect,romdata
;   .org          FIXED_VECT_TOP
;
;   .word          DUMMY          ;Undefined instruction interrupt vector
;   .word          DUMMY          ;Overflow (INTO instruction) interrupt vector
;   .word          DUMMY          ;BRK instruction interrupt vector
;   .word          DUMMY          ;Address match interrupt vector
;   .word          DUMMY          ;Single-step interrupt vector
;   .word          DUMMY          ;Watchdog timer interrupt vector
;   .word          DUMMY          ;Oscillation stop and Re-oscillation detection interrupt
;   .word          DUMMY          ;vector
;   .word          DUMMY          ;Voltage down detection interrupt vector
;   .word          DUMMY          ;DBC interrupt vector
;   .word          DUMMY          ;NMI interrupt vector
;   .word          START         ;Sets start vector
;
;   .end

```

## 6. Referense

Hardware manual

M16C/62P Group Hardware Manual

(Use the most recent version of the document on the Renesas Technology Web site.)

Technical news/Technical update

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<http://www.renesas.com/inquiry>  
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## Revision

Rev.	Issue data	Revised	
		Page	Point
1.00	2004.12	-	First edition issued
1.10	2006.01	5	Reference program modified

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