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M16C/64 Group

Timer B (Pulse Width Measurement Mode)

1. Abstract

In pulse period measurement mode/pulse width measurement mode, any desired function can be selected from those listed in Table 1. This application note describes the operation of the function selected (marked with a circle) from the items in Table 1.

Table 1. Contents of Settings

Set item	Content of setting	
Count source	○	Internal count source (f1TIMAB or f2TIMAB Note 1 /f8TIMAB /f32TIMAB /f64TIMAB/ fOCO-S/ fC32)
Measurement mode		Pulse period measurement (between a falling edge to the next falling edge of measurement pulse)
		Pulse period measurement (between a rising edge to the next rising edge of measurement pulse)
	○	Pulse width measurement (between a falling edge to the next rising edge of measurement pulse and between a rising edge to the next falling edge)

Note 1: Use the PCLKR register's PCLK0 bit to select.

2. Introduction

The application example presented in this document applies to the microcomputers listed below.

・Microcomputers: M16C/64 group

This application note can be used with other M16C Family MCUs which have the same special function registers (SFRs) as the above group. Check the manual for any modifications to functions. Careful evaluation is recommended before using the program described in this application note.

3. Operation

(1) When the TBiS bit (i = 0–5) of the TABSR or TBSR register is set to 1, the counter starts counting the count source clock cycles. Note 1

(2) When an active edge of the measurement pulse is input, the counter value is reset to 0000h and a measurement starts. At this time, an indeterminate value is transferred to the reload register. (No timer Bi interrupt requests are generated.)

(3) When an active edge of the measurement pulse is input again, the counter value is transferred to the reload register and the TBiIC register's IR bit is set to 1 (interrupt requested). After that, the counter recycles to 0000h and a measurement starts over again.

Note 1: The counter operation in pulse width measurement mode is up-count.

In this sample program, as a countermeasure in case an active pulse edge is input at the same time the counter overflows, the measurement pin state is checked in an interrupt handler and if inverted, the measurement result is read out.

Supplementary explanation

- The IR bit of the TBiIC register (i = 0–5) is set to 1 when an active edge of the measurement pulse is input or the counter of timer Bi overflows. The cause of interrupt can be identified by the MR3 bit of the TBiMR register.
- The counter value after reset is indeterminate. Write the initial value (0000h) to the TBi register before the timer starts counting.

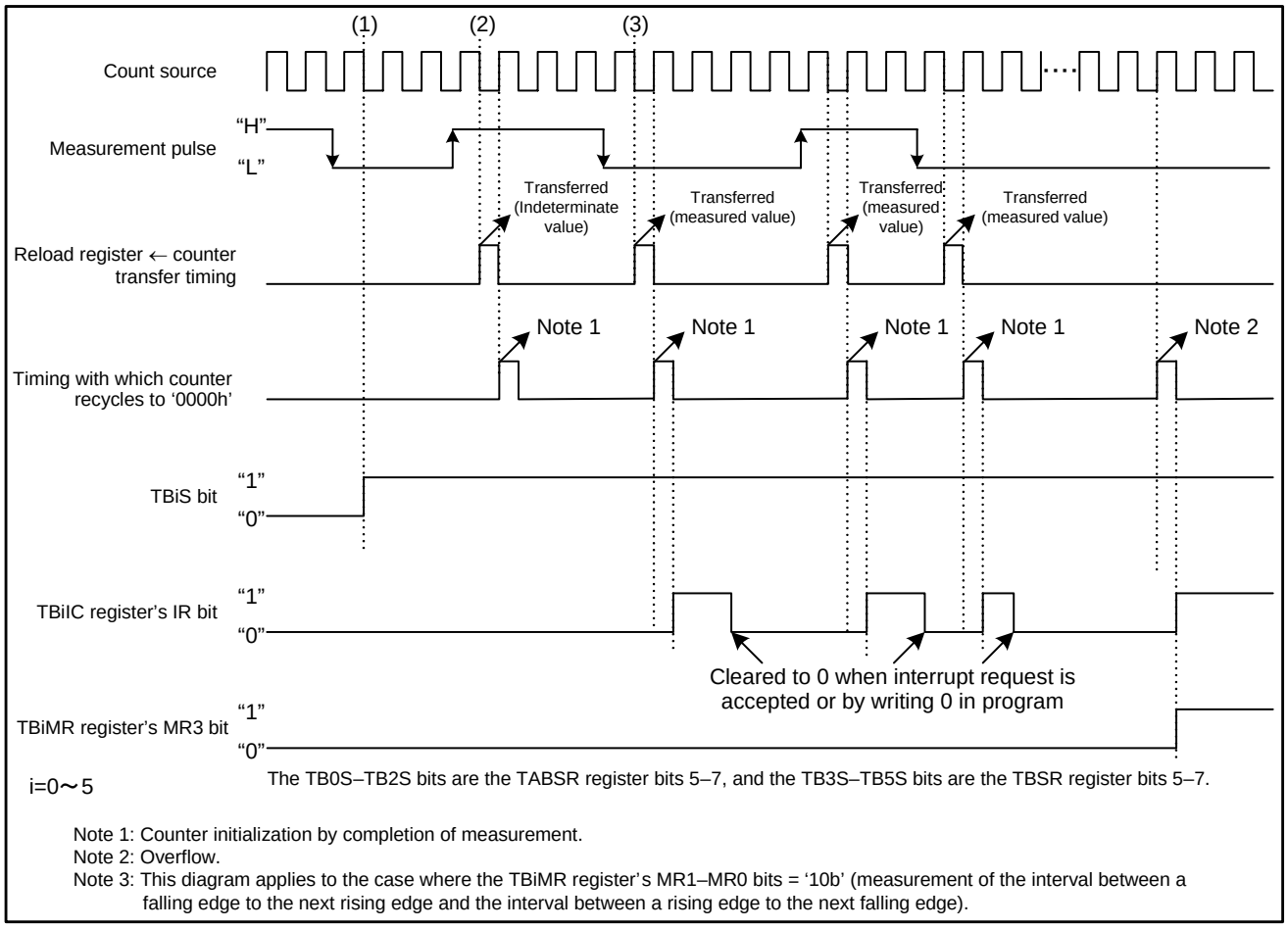

Figure 1. Operation Diagram during Pulse Width Measurement

Table 2 shows how to set the timer B count source.

Table 2. TBi Timer Count Source Settings

TBCSj register				TBiMR register		PCLKR register	TBi count source
TCS3 TCS7	TCS2 TCS6	TCS1 TCS5	TCS0 TCS4	TCK1	TCK0	PCLK0 Note 1	
"0"	—	—	—	"0"	"0"	"1"	f1TIMAB
"0"	—	—	—	"0"	"0"	"0"	f2TIMAB
"0"	—	—	—	"0"	"1"	—	f8TIMAB
"0"	—	—	—	"1"	"0"	—	f32TIMAB
"0"	—	—	—	"1"	"1"	—	fC32
"1"	"0"	"0"	"0"	—	—	"1"	f1TIMAB
"1"	"0"	"0"	"0"	—	—	"0"	f2TIMAB
"1"	"0"	"0"	"1"	—	—	—	f8TIMAB
"1"	"0"	"1"	"0"	—	—	—	f32TIMAB
"1"	"0"	"1"	"1"	—	—	—	f64TIMAB
"1"	"1"	"0"	"1"	—	—	—	fOCO-S
"1"	"1"	"1"	"0"	—	—	—	fC32

When selecting the TB0 count source: i = 0, j = 0, TCS3–TCS0
When selecting the TB1 count source: i = 1, j = 0, TCS7–TCS4
When selecting the TB2 count source: i = 2, j = 1, TCS3–TCS0
When selecting the TB3 count source: i = 3, j = 2, TCS3–TCS0
When selecting the TB4 count source: i = 4, j = 2, TCS7–TCS4
When selecting the TB5 count source: i = 5, j = 3, TCS3–TCS0
—: Don't care (can be 0 or 1).
Note 1: Before rewriting this bit, set the PRCR register's PRC0 bit to 1 (write enabled).

4. How to Set Up

The following shows how to set up the registers to accomplish the operation described in Section 3, "Operation." For details about each register, see the hardware manual of the M16C/64 group.

(1) Set up the peripheral clock select register (PCLKR).

b7 b0: 0 0 0 0 0 0 0 1

- Protect register (PRCR)
- PRC0 CM0, CM1, CM2, PLC0, PCLKR register write enable
  - 1: Enables write
- Reserved bits
  - Set these bits to 0.

b7 b0: 0 0 0 0 0 0 0 0

- Peripheral clock select register (PCLKR)
- PCLK0 Timer A, B clock select bit (clock source for timer A, timer B and shorting prevention timer)
  - 0: f2TIMAB
  - 1: f1TIMAB
- Reserved bits
  - Set these bits to 0.

b7 b0: 0 0 0 0 0 0 0 0

- Protect register (PRCR)
- PRC0 CM0, CM1, CM2, PLC0, PCLKR register write enable
  - 0: Disables write
- Reserved bits
  - Set these bits to 0.

(2) Select pulse period measurement/ pulse width measurement mode and select each function.

b7 b0

- Timer B count source select register 0 (TBCS0) [i = 0, j = 1]
  Timer B count source select register 2 (TBCS2) [i = 3, j = 4]
- TCS2, TCS1, TCS0 TBi count source select bits
- TCS3 TBi count source option specification bit
  - 0: TCK0, TCK1 enabled; TCS0–TCS2 disabled
  - 1: TCK0, TCK1 disabled; TCS0–TCS2 enabled
- TCS6, TCS5, TCS4 TBj count source select bits
- TCS7 TBj count source option specification bit
  - 0: TCK0, TCK1 enabled; TCS4–TCS6 disabled
  - 1: TCK0, TCK1 disabled; TCS4–TCS6 enabled

TCS2 TCS6	TCS1 TCS5	TCS0 TCS4	Function
0	0	0	f1TIMAB or f2TIMAB Note 1
0	0	1	f8TIMAB
0	1	0	f32TIMAB
0	1	1	f64TIMAB
1	0	0	Setting prohibited
1	0	1	fOCO-S
1	1	0	fC32
1	1	1	Setting prohibited

Note 1: Use the PCLKR register's PCLK0 bit to select.

b7 b0

- Timer B count source select register 1 (TBCS1) [i = 2]
  Timer B count source select register 3 (TBCS3) [i = 5]
- TCS2, TCS1, TCS0 TBi count source select bits
- TCS3 TBi count source option specification bit
  - 0: TCK0, TCK1 enabled; TCS0–TCS2 disabled
  - 1: TCK0, TCK1 disabled; TCS0–TCS2 enabled

TCS2	TCS1	TCS0	Function
0	0	0	f1TIMAB or f2TIMAB Note 2
0	0	1	f8TIMAB
0	1	0	f32TIMAB
0	1	1	f64TIMAB
1	0	0	Setting prohibited
1	0	1	fOCO-S
1	1	0	fC32
1	1	1	Setting prohibited

Note 2: Use the PCLKR register's PCLK0 bit to select.

b7 b0: X X X X 1 0 1 0

- Timer Bi mode register (TBiMR [i = 0–5])
- TMOD1, TMOD0 Operation mode select bits
  - 10: Pulse period measurement mode/ pulse width measurement mode
- MR1, MR0 Measurement mode select bits
  - 10: Pulse width measurement
    (Measurement of the interval between a rising edge to the next falling edge of measurement pulse and between a rising edge to the next falling edge)
- MR3 Timer Bi overflow flag
  - 0: No overflow
  - 1: Overflowed
- TCK1, TCK0 Count source select bits
  - 00: f1TIMAB or f2TIMAB
  - 01: f8TIMAB
  - 10: f32TIMAB
  - 11: fC32

Use the PCLKR register's PCLK0 bit to select.

Figure 2. Procedure for Setting Up the Registers to Use a Timer B (Pulse Width Measurement Mode) Application (1)

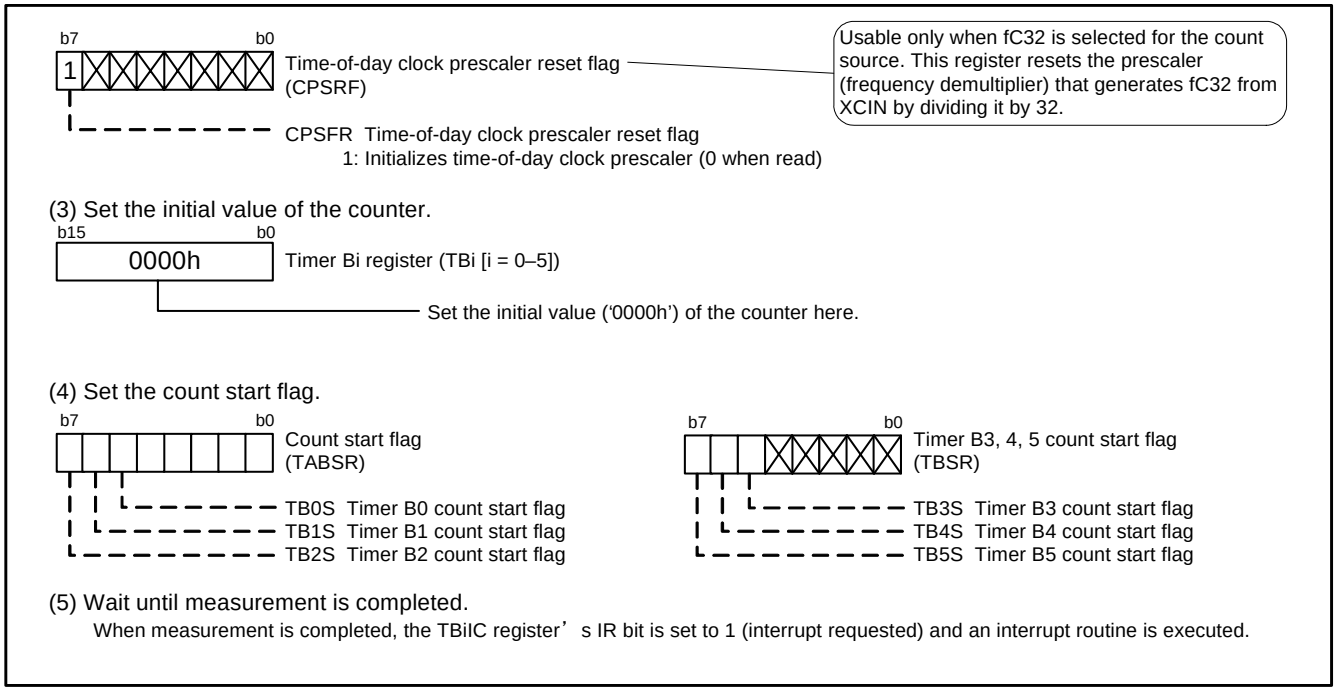

Figure 3. Procedure for Setting Up the Registers to Use a Timer B (Pulse Width Measurement Mode) Application (2)

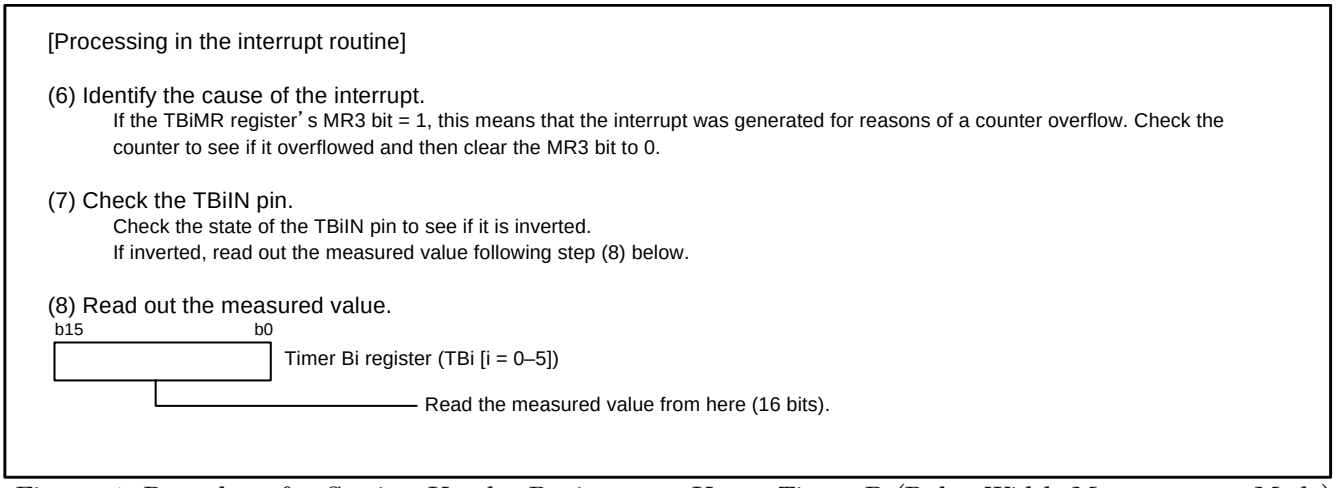

Figure 4. Procedure for Setting Up the Registers to Use a Timer B (Pulse Width Measurement Mode) Application (3)

5. Sample Programs

Download a sample program from the Renesas Technology website. Click the screen menu “Application Note” on the left side of the M16C family’s top web page.

6. Reference Documents

Hardware manual

M16C/64 Group Hardware Manual
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