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M16C/64 Group

Operation of Timer A (one-shot timer mode, external trigger)

1. Abstract

In one-shot timer mode, choose functions from those listed in Table 1. Operations of the circled items are described below.

2. Introduction

This application note is applied to the M16C/64, group Microcomputers.

This program can be operated under the condition of M16C family products with the same SFR (Special Function Register) as M16C/64, 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. Chosen functions

Table 1. Chosen functions

Item	Set-up	
Count source	O	Internal count source (f1TIMAB/f2TIMAB/f8TIMAB/f32TIMAB/f64TIMAB/foco-s/fc32)
Pulse output function		No pulse output
	O	Pulses output
Count start condition		External trigger input (falling edge of input signal to the TAiIN pin)
	O	External trigger input (rising edge of input signal to the TAiIN pin)
		Timer overflow (TB2/TAj/TAk overflow)
		Writing “1” to the one-shot start flag
Output polar control	O	Output waveform “H” active
		Output waveform “L” active (output reversed)

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

4. Operation

(1) If the TAiIN 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. At this time, the TAiOUT pin output level goes to “H” level.

(2) If the value of the counter becomes “0000h”, the TAiOUT pin outputs an “L” level, and the counter reloads the content of the reload register and stops counting. At this time, the timer Ai interrupt request bit goes to “1”.

(3) If a trigger occurs while a count is in progress, the counter reloads the value of the reload register again and continues counting. The reload timing is in step with the next count source input after the trigger.

(4) Setting the count start flag to “0” causes the counter to stop and to reload the content of the reload register. Also, the TAiOUT pin outputs an “L” level. At this time, the timer Ai interrupt request bit goes to “1”.

Note: When the timer Ai register is set to “0000h”, the counter does not operate and the timer Ai interrupt request is not generated. When the pulse is set to output, the pulse does not output from the TAiOUT pin.

Figure 1 shows the operation timing.

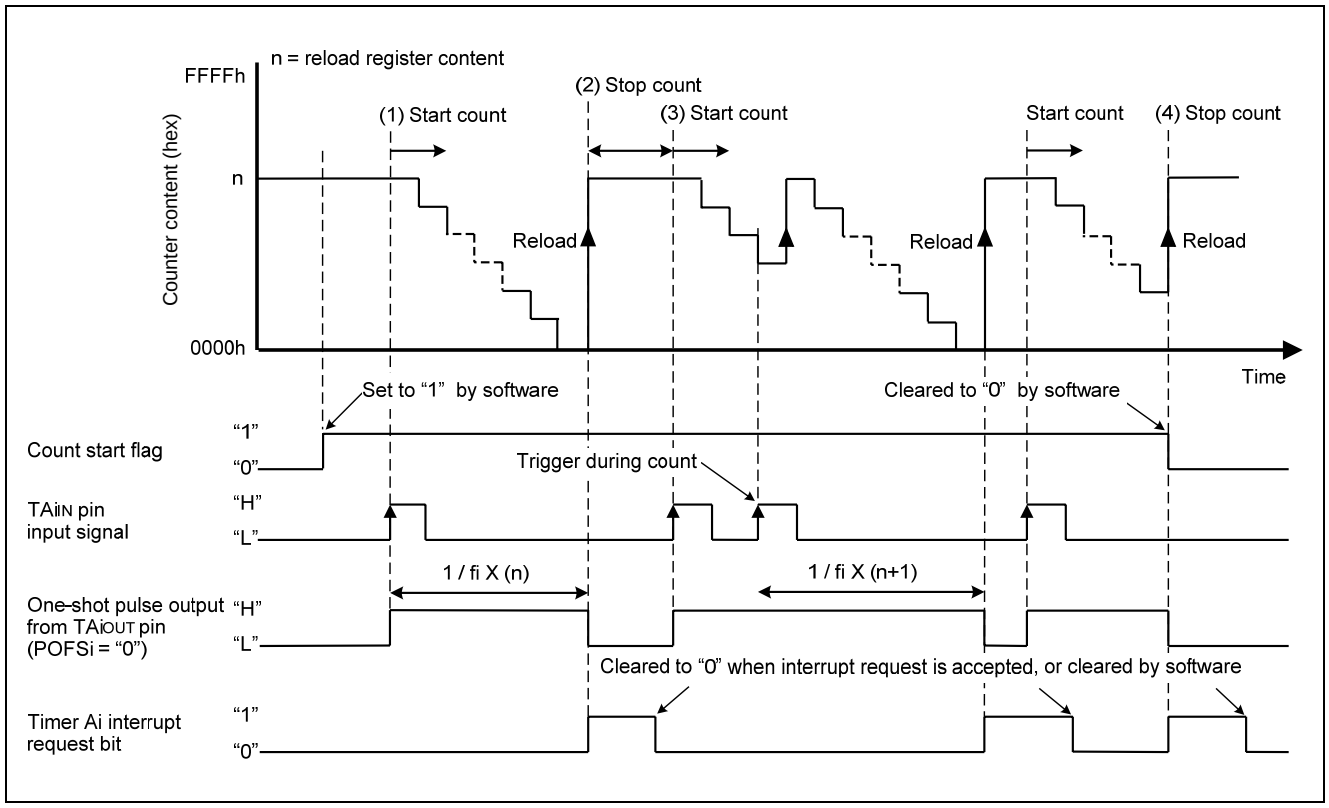


Figure 1. Operation timing of one-shot

5. Set-up procedure

Table 2 shows Timer A count source, Figure 2 shows block diagram of Timer A count source in timer mode.

Table 2. Count Source Selection of Timer A

TACSj register (Note 1)				TAiMR register		Count source	Count source period
TCS3/ TCS7	TCS2/ TCS6	TCS1/ TCS5	TCS0/ TCS4	TCK1	TCK0		f(PLL):24MHz f(XCIN):32.768kHz
0	-	-	-	0	0	f1TIMAB/f2TIMAB (Note 2)	41.7ns or 83.3ns
0	-	-	-	0	1	f8TIMAB	333.3ns
0	-	-	-	1	0	f32TIMAB	1333.3ns
0	-	-	-	1	1	fc32	976.56µs
1	0	0	0	-	-	f1TIMAB/f2TIMAB (Note 2)	41.7ns or 83.3ns
1	0	0	1	-	-	f8TIMAB	333.3ns
1	0	1	0	-	-	f32TIMAB	1333.3ns
1	0	1	1	-	-	f64TIMAB	2666.7ns
1	1	0	1	-	-	foco-s	About 8µs
1	1	1	0	-	-	fc32	976.56µs

Note 1: TCS3~TCS0 bits of TACS0 register correspond to Timer A0 count source selection, TCS7~TCS4 bits of TACS0 register correspond to Timer A1 count source selection, TCS3~TCS0 bits of TACS1 register correspond to Timer A2 count source selection, TCS7~TCS4 bits of TACS1 register correspond to Timer A3 count source selection, and TCS3~TCS0 bits of TACS2 register correspond to Timer A4 count source selection.
Note 2: When the PCLK0 bit in the PCLKR register is "1", the selected clock source is f1TIMAB. When the PCLK0 bit is "0", the selected clock source is f2TIMAB.

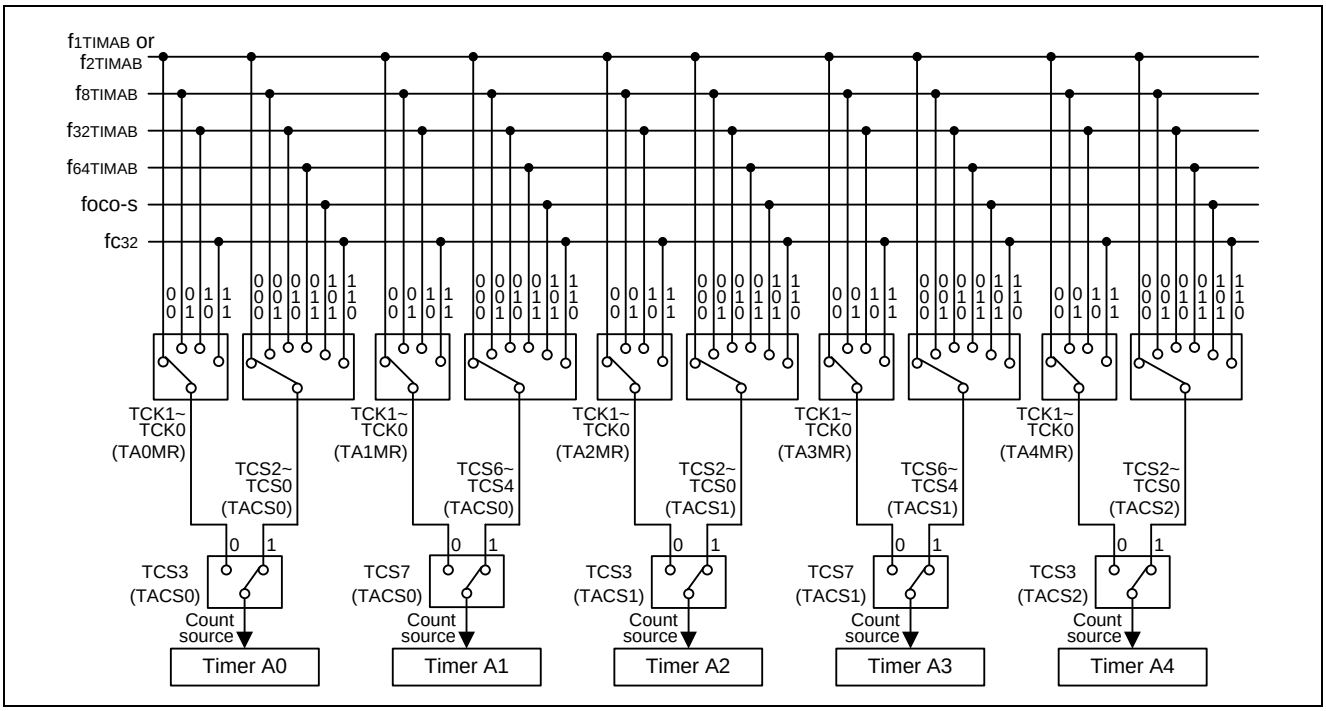
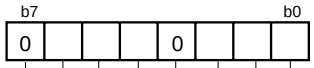


Figure 2. Count source of Timer A

Selecting timer count source

TACS0 register can select Timer A0 and Timer A1 count source, TACS1 can select Timer A2 and Timer A3 count source, and TACS2 can select Timer A4 count suorce.



Timer A count source select register 0 [Address 01D0h] TACS0
Timer A count source select register 1 [Address 01D1h] TACS1

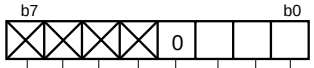
TAi count source select bit (Note1)
b2 b1 b0
0 0 0 : f_{1TIMAB} or f_{2TIMAB} (Note2)
0 0 1 : f_{8TIMAB}
0 1 0 : $f_{32TIMAB}$
0 1 1 : $f_{64TIMSB}$
1 0 0 : Do not set
1 0 1 : foco-s
1 1 0 : fc_{32}
1 1 1 : Do not set

TAi count source option specified bit (Note1)
0 : TCK0, TCK1 enabled, TCS0 to TCS2 disabled

TAj count source select bit (Note1)
b2 b1 b0
0 0 0 : f_{1TIMAB} or f_{2TIMAB} (Note2)
0 0 1 : f_{8TIMAB}
0 1 0 : $f_{32TIMAB}$
0 1 1 : $f_{64TIMSB}$
1 0 0 : Do not set
1 0 1 : foco-s
1 1 0 : fc_{32}
1 1 1 : Do not set

TAj count source option specified bit (Note1)
0 : TCK0, TCK1 enabled, TCS4 to TCS6 disabled

TACS0 register: i = 0, j = 1, TACS1 register: i = 2, j = 3
Note 1: About the count source period, please refer to Table 2.
Note 2: When the PCLK0 bit in the PCLKR register is “1”, the selected clock source is f_{1TIMAB}. When the PCLK0 bit is “0”, the selected clock source is f_{2TIMAB}.



Timer A count source select register 2 [Address 01D2h] TACS2

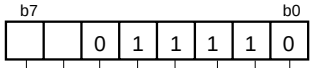
TA4 count source select bit (Note1)
b2 b1 b0
0 0 0 : f_{1TIMAB} or f_{2TIMAB} (Note2)
0 0 1 : f_{8TIMAB}
0 1 0 : $f_{32TIMAB}$
0 1 1 : $f_{64TIMSB}$
1 0 0 : Do not set
1 0 1 : foco-s
1 1 0 : fc_{32}
1 1 1 : Do not set

TA4 count source option specified bit (Note1)
0 : TCK0, TCK1 enabled, TCS0 to TCS2 disabled

No register bits. If necessary, set to 0. Read as undefined value.

Note 1: About the count source period, please refer to Table 2.
Note 2: When the PCLK0 bit in the PCLKR register is “1”, the selected clock source is f_{1TIMAB}. When the PCLK0 bit is “0”, the selected clock source is f_{2TIMAB}.

Selecting one-shot timer mode and functions



Timer Ai mode register (i=0 to 4) [Address 0336h to 033Ah]
TAiMR (i=0 to 4)

Selection of one-shot timer mode

Pulse output function select bit
1 : Pulse is output

External trigger select bit
1 : Rising edge of TAiIN pin's input signal

Trigger select bit
1 : Selected by event/trigger select register

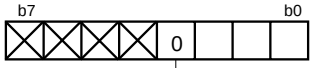
0 (Must always be "0" in one-shot timer mode)

Count source select bit (Note1)
b7 b6
0 0 : f_{1TIMAB} or f_{2TIMAB} (Note2)
0 1 : f_{8TIMAB}
1 0 : $f_{32TIMAB}$
1 1 : fc_{32}

Note 1: Valid when the TCS3 bit or TCS7 bit in registers TACS0 to TACS2 is set to 0 (TCK0, TCK1 enabled). About the count source period, please refer to Table 2.
Note 2: When the PCLK0 bit in the PCLKR register is "1", the selected clock source is f_{1TIMAB}. When the PCLK0 bit is "0", the selected clock source is f_{2TIMAB}.

Clearing timer Ai interrupt request bit

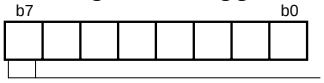
Refer to 'Precaution for Timer A (one shot timer mode)'



Timer Ai interrupt control register [Address 0055h to 0059h]
TAiIC (i=0 to 4)

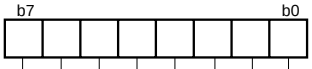
Interrupt request bit

Setting event/trigger select bit



One-shot start flag [Address 0322h]
ONSF

Timer A0 event/trigger select bit
b7 b6
0 0 : Input on TA0IN is selected(Note)



Trigger select register [Address 0323h]
TRGSR

Timer A1 event/trigger select bit
b1 b0
0 0 : Input on TA1IN is selected (Note)

Timer A2 event/trigger select bit
b3 b2
0 0 : Input on TA2IN is selected (Note)

Timer A3 event/trigger select bit
b5 b4
0 0 : Input on TA3IN is selected (Note)

Timer A4 event/trigger select bit
b7 b6
0 0 : Input on TA4IN is selected (Note)

Note: Set the corresponding port direction register to "0"

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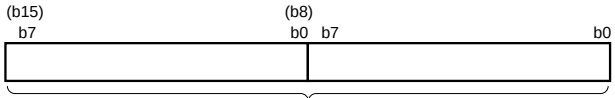
Setting one-shot timer's time



Timer A0 register [Address 0327h, 0326h] TA0
Timer A1 register [Address 0329h, 0328h] TA1
Timer A2 register [Address 032Bh, 032Ah] TA2
Timer A3 register [Address 032Dh, 032Ch] TA3
Timer A4 register [Address 032Fh, 032Eh] TA4

Can be set to 0001h to FFFFh

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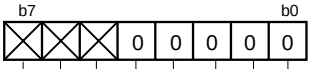
Selecting waveform output function



Timer A waveform output function select register [Address 01D5h]
TAPOFS

TA0OUT output polar control bit
0 : Output waveform “H” active

TA1OUT output polar control bit
0 : Output waveform “H” active

TA2OUT output polar control bit
0 : Output waveform “H” active

TA3OUT output polar control bit
0 : Output waveform “H” active

TA4OUT output polar control bit
0 : Output waveform “H” active

No register bits. If necessary, set to 0. Read as undefined value.

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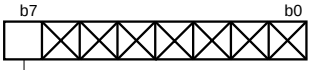
Setting clock prescaler reset flag

(This function is effective when fc_{32} is selected as the count source. Reset the prescaler for generating fc_{32} by dividing the X_{CIN} by 32.)



Count prescaler reset flag [Address 0015h]
CPSRF

Clock prescaler reset flag
0 : No effect
1 : Prescale is reset (When read, the value is “0”)

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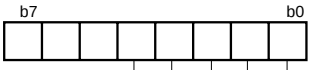
Setting count start flag



Count start flag [Address 0320h]
TABSR

Timer A0 count start flag
Timer A1 count start flag
Timer A2 count start flag
Timer A3 count start flag
Timer A4 count start flag

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Start count

6. Reference

Hardware manual

M16C/64 Group Hardware Manual

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