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April 1\(^{st}\), 2010
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M16C/65 Group
Delayed one-shot output

1. Abstract
The following are steps of outputting a pulse only once after a specified elapse since an external trigger is input.

Use the following peripheral function:

- One-shot timer mode of timer A

2. Introduction
This application note is applied to the M16C/65 group microcomputers.

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. Specification

After 1ms from the falling edge which inputs to TA0IN pin, TA1OUT pin will output "H" for 50us.

(1) Set timer A0 in one-shot timer mode, and set timer A1 in one-shot timer mode with pulse output function.

(2) Set TA0 register to make timer A0 underflow period as 1ms. Set TA1 register to make timer A1 generate a pulse with 50us "H" interval.

Set the underflow of timer A0 as the counting start condition of timer A1.

Both timer A0 and timer A1 use fTIMAB as the count source.

(3) Connect a 20MHz oscillator to XIN.

(4) Using POFS1 bit in TAPOFS register, select the output polarity of the TA1OUT pin.

4. Operation

(1) Setting the trigger select bit to “1” and setting the count start flag to “1” enables the counter of timer A0 to count.

(2) If an effective edge, selected by use of the external trigger select bit, is input to the TA0IN pin, the counter begins a down count. The counter of timer A0 performs a down count on count source fTIMAB.

(3) As soon as the counter of timer A0 becomes “0000h”, the counter reloads the content of the reload register and stops counting. At this time, the timer A0 interrupt request bit goes to “1”.

(4) An underflow in timer A0 triggers the counter of timer A1 and causes it to begin counting. When timer A1 begins counting, the output level of the TA1OUT pin goes to “H”.

(5) As soon as the counter of timer A1 becomes “0000h”, the output level of the TA1OUT pin goes to “L”, the counter reloads the content of the reload register, and stops counting. At this time, timer A1 interrupt request bit goes to “1”.
Figure 1 shows the operation timing.

Figure 1. Operation timing of delayed one-shot output

Figure 2 shows the connection diagram.

Figure 2. Connection diagram of delayed one-shot output
5. Set-up procedure

Table 1 shows Timer A count source, Figure 3 shows block diagram of Timer A count source in timer mode.

### Table 1. Count Source Selection of Timer A

<table>
<thead>
<tr>
<th>TCDIV00</th>
<th>TACSj register (Note 2)</th>
<th>TAiMR register</th>
<th>Count source</th>
<th>Count source period</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCS3/ TCS7</td>
<td>TCS2/ TCS6</td>
<td>TCS1/ TCS5</td>
<td>TCS0/ TCS4</td>
<td>TCK1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>

Note 1: TCDIV00 bit is clock select prior to timer AB division bit. Set the TCDIV00 bit before setting other registers associated with timer A. After changing the TCDIV00 bit, set other registers associated with timer A again.

Note 2: 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 3: 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.
Selecting a clock used prior to timer AB frequency dividing
(Set the TCDIV00 bit before setting other registers associated with timer A. After changing the TCDIV00 bit,
set other registers associated with timer A again.)

<table>
<thead>
<tr>
<th>000000</th>
<th>TCKDIV00</th>
</tr>
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<tbody>
<tr>
<td>000000</td>
<td>TCKDIV00</td>
</tr>
<tr>
<td>000000</td>
<td>TCKDIV00</td>
</tr>
</tbody>
</table>

Clock select prior to timer AB division bit
0 : f1
Reserved bits
Set to 0
No register bits. If necessary, set to 0. Read as undefined value.
Reserved bits
Set to 0

Figure 3. Count source of Timer A
### Selecting timer count source

**B7 B0**

- **TA0 count source select bit (Note1)**
  - 000 : f1TIMAB or f2TIMAB (Note2)
  - 001 : f1TIMAB
  - 010 : f2TIMAB
  - 011 : f64TIMSB
  - 100 : fcco-f
  - 101 : fcco-s
  - 110 : fc32
  - 111 : Do not set

- **TA0 count source option specified bit (Note1)**
  - 0 : TCK0, TCK1 enabled, TCS0 to TCS2 disabled

**B7 B6 B0**

- **TA1 count source select bit (Note1)**
  - 000 : f1TIMAB or f2TIMAB (Note2)
  - 001 : f8TIMAB
  - 010 : f32TIMAB
  - 011 : f64TIMSB
  - 100 : fcco-f
  - 101 : fcco-s
  - 110 : fc32
  - 111 : Do not set

- **TA1 count source option specified bit (Note1)**
  - 0 : TCK0, TCK1 enabled, TCS4 to TCS6 disabled

**Note 1:** About the count source period, please refer to Table 1.

**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.

### Setting timer A0

**B7 B0**

- **Timer A0 mode register [Address 0336h]**
  - **TA0MR**

- **Selection of one-shot timer mode**
  - 0 : Pulse is not output (TA0OUT pin is normal port pin)

- **Pulse output function select bit**
  - 0 : Falling edge of TA0IN pin’s input signal

- **External trigger select bit**
  - 1 : Selected by event/trigger select register

- **Trigger select bit**
  - 0 (Must always be “0” in one-shot timer mode)

- **Count source select bit (Note1)**
  - 00 : f1TIMAB or f2TIMAB (Note2)
  - 01 : f1TIMAB
  - 10 : f2TIMAB
  - 11 : fc32

**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 1.

**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.
Setting one-shot timer’s time

4Eh 20h

Timer A0 register [Address 0327h, 0326h]

TA0

Setting timer A1

Selecting one-shot timer mode and functions

0 0 0 1 1 0

Timer A1 mode register [Address 0337h]
TA1MR

Selection of one-shot timer mode

Pulse output function select bit

1 : Pulse is output (TA1OUT pin is pulse output pin)

External trigger select bit

Invalid when choosing timer’s overflow

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 : f1TIMAB or f2TIMAB (Note2)
0 1 : f3TIMAB
1 0 : f32TIMAB
1 1 : fC32

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 1.

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.

Setting event/trigger select bit

(Set timer A0 to trigger timer A1)

b7 0

Trigger select register [Address 0323h]
TRGSR

Timer A1 event/trigger select bit

1 0 : TA0 overflow or underflow is selected
### Setting one-shot timer's time

<table>
<thead>
<tr>
<th>b7</th>
<th>b0</th>
</tr>
</thead>
<tbody>
<tr>
<td>03h</td>
<td>E8h</td>
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</table>

Timer A1 register [Address 0329h, 0328h]

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

### Setting count start flag

<table>
<thead>
<tr>
<th>b7</th>
<th>b0</th>
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<tbody>
<tr>
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</table>

Count start flag [Address 0320h]

- Timer A0 count start flag
  - 1: Starts counting
- Timer A1 count start flag
  - 1: Starts counting

**Start counting**
6. Reference

Hardware manual
M16C/65 Group Hardware Manual
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## Revision

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