

M16C/62

Using the M16C/62 Timers in One-Shot Mode

1.0 Abstract

One-shots are commonly found in designs because they are useful for debouncing switches, “cleaning” up sensor inputs, and so on. The A timers on the M16C/62 can be configured as one-shots, reducing the need for external components. These one-shots have advantages over their hardware counterparts because they are not susceptible to RC drift, and the pulse widths can be varied under program control allowing for new applications such as fuel injection control and ignition control. The following article describes how to configure the M16C/62 A timers as one-shots, referred to as One-Shot Mode.

2.0 Introduction

The M16C/62 is a 16-bit MCU, based on the M16C CPU core, with features including 10-bit A/D, D/A, UARTS, timers, DMA, etc., and up to 256KB of user flash. The MCU has 5 Timer A’s. All 5 timers can operate in One-Shot Mode.

Timer A has the following additional modes of operation:

- Event Counter Mode
- PWM Mode
- Timer Mode

Figure 1 illustrates the operation of timer A. The remainder of this document will focus on setting up timer A0 in One-Shot Mode using an external trigger.

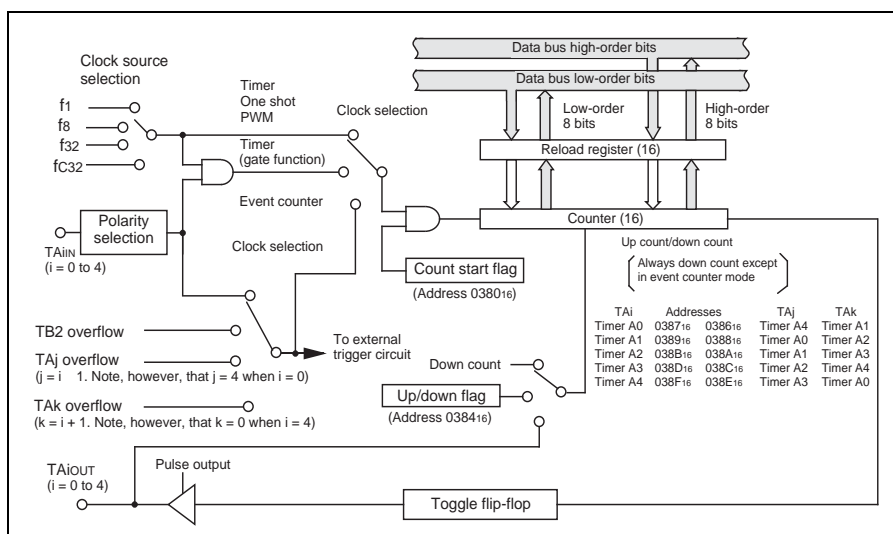


Figure 1 Block Diagram of Timer A

3.0 One-Shot Mode Description

In One-Shot Mode, an event (internal or external trigger) causes the TAIout output pin to go high. The TAI register counts down using the selected clock source until the counter underflows (0000 to FFFFh). At this point, the TAIout pin goes low and the contents of the reload register are loaded back into the TAI register and the interrupt request bit is set. An interrupt will be accepted when all of the following conditions are met:

- interrupt enable flag (I flag) = "1"
- interrupt request bit = "1"
- interrupt priority level > IPL (Processor Interrupt Priority Level)

If at any time during countdown the count start flag is cleared, counting is stopped and the contents of the reload register are loaded back into the count register. The one-shot can be triggered (externally) by a signal on the TAIin pin or (internally) by the one-shot start flag or another timer output. If a trigger occurs while a count is in progress, the counter reloads the value in the reload counter and continues counting. Figure 2 and Figure 3 illustrate this.

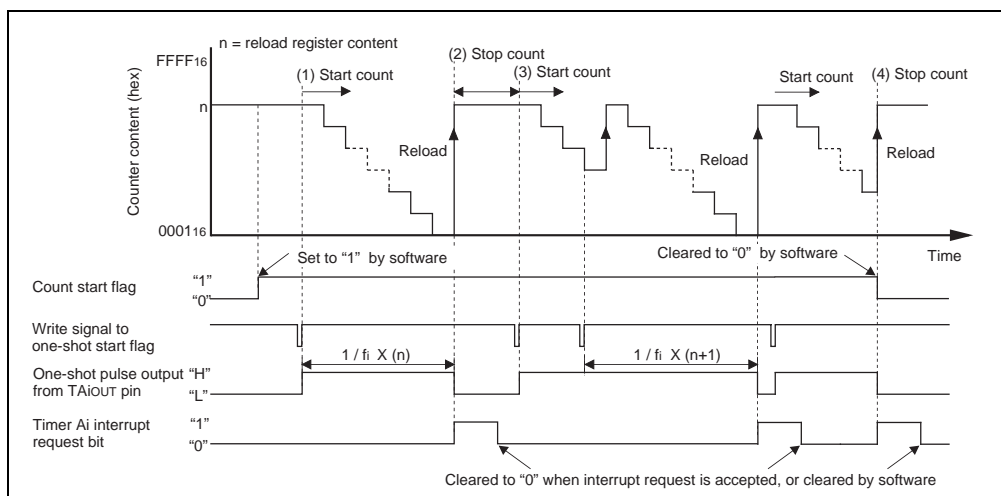


Figure 2 Operation Timing of One-Shot Mode

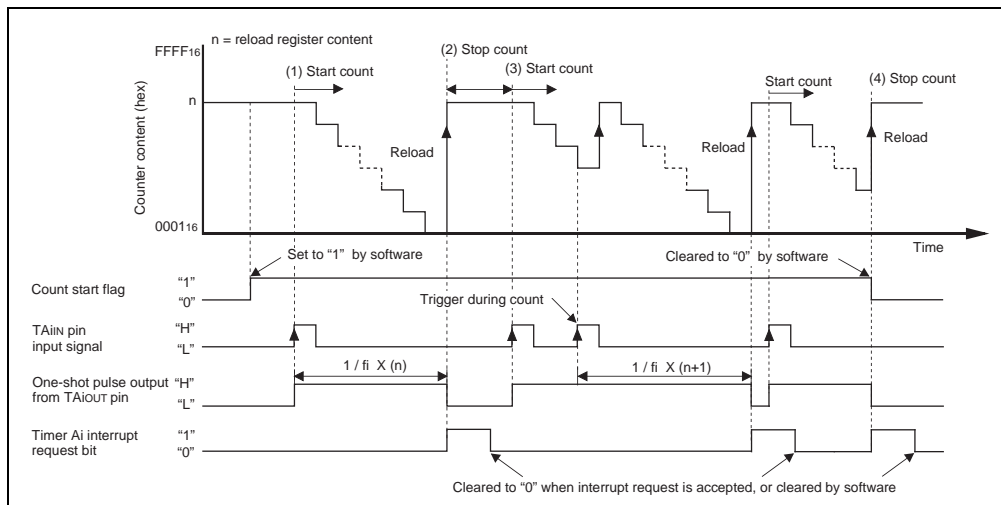


Figure 3 Operation Timing of One-Shot Mode, External Trigger Selected

4.0 Configuring One-Shot Mode

To configure a timer for One-Shot Mode:

1. Load the Timer Ai register, TAI (which also loads the reload register) with the count source.
2. Load the Timer Mode register, TAIMR:
 - Select One-Shot Mode: bits TMOD0 = 0, TMOD1 = 1.
 - Set the MR0 bit = 1 for output on the TAIOUT pin, clear for no output.
 - Clear the MR1 bit for a falling edge external trigger on the TAIIN pin, or set it for rising edge.
 - Clear the MR2 bit to use the 'count start flag' as a trigger, or set it for external trigger.
 - Clear the MR3 bit One-Shot Mode.
 - Select the clock source (f1, f/8, f/32, or fc/32): bits TCK0, TCK1 register.
3. Load the Timer Interrupt Control register (TAIIC) with an interrupt priority level, (ILVL) (load with zero if interrupts are not required).
4. Enable interrupts if required (set the I flag).
5. Set the 'start count' flag bit, TAI_S in the 'Count Start Flag' register, TABSR.
6. Set the one-shot start flag bit, TAI_{OS} in the 'one-shot start flag register', ONSF. Note that if the one-shot start flag is selected as the trigger, the TAIOUT pin will immediately go high.

It is not necessary to perform these steps in the order listed, but an initial value should be loaded into the TAI register before the 'start count' flag is set. Also, the priority level should not be modified when there is a possibility of an interrupt occurring.

The required registers are shown in Figure 4 through Figure 8.

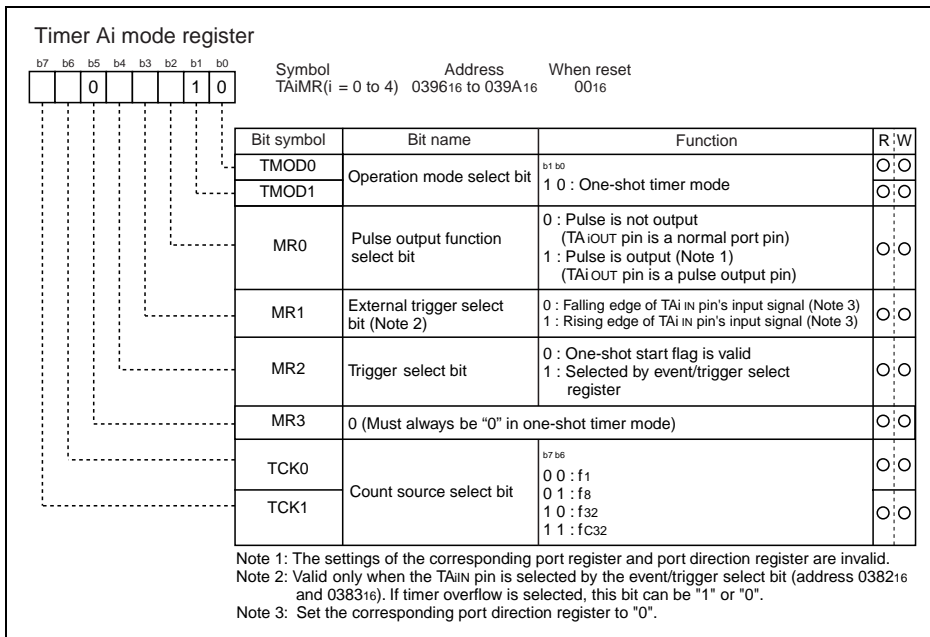


Figure 4 Timer Ai Mode Register in One-Shot Timer Mode

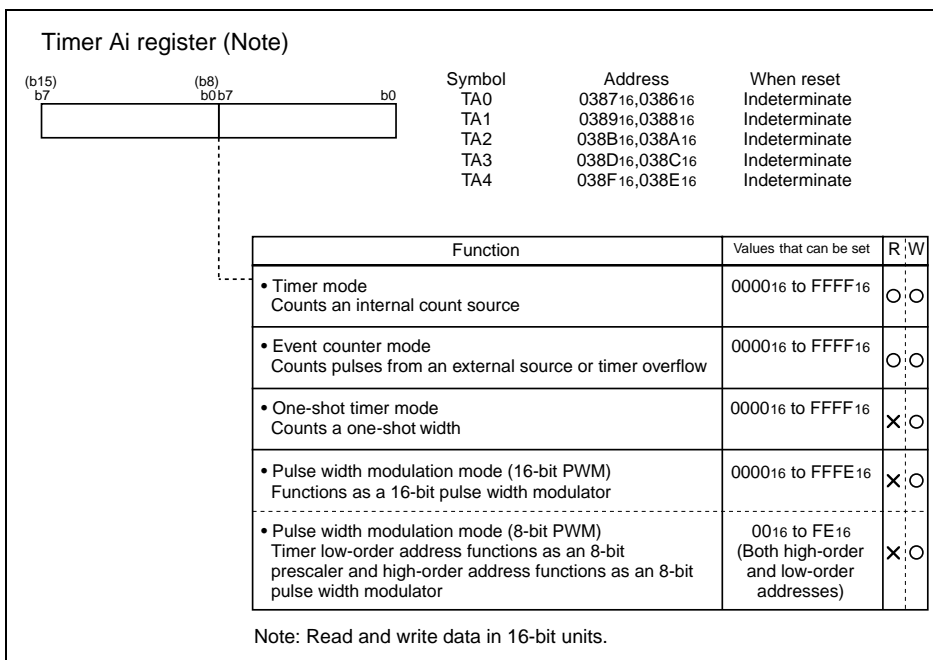


Figure 5 Timer Ai Register

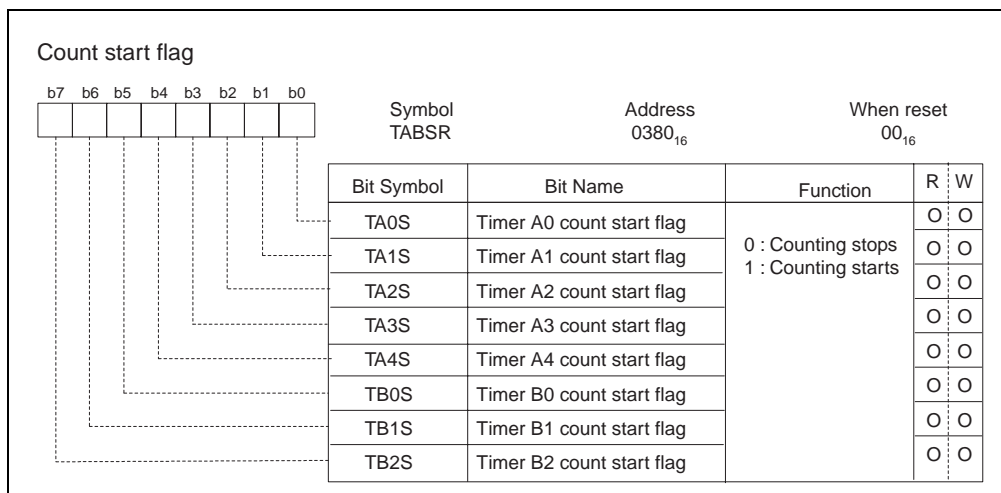


Figure 6 Count Start Flag Register

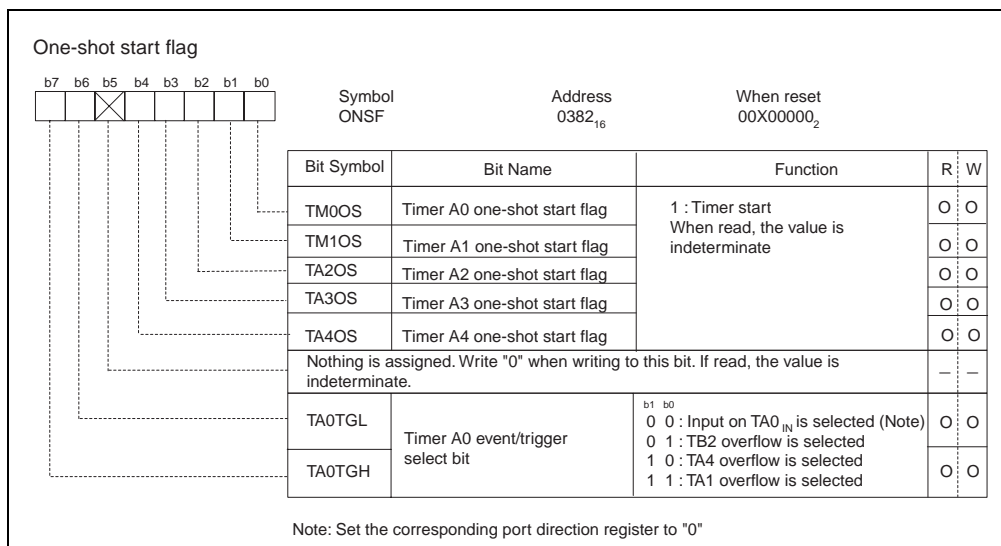


Figure 7 One Shot Start Flag Register

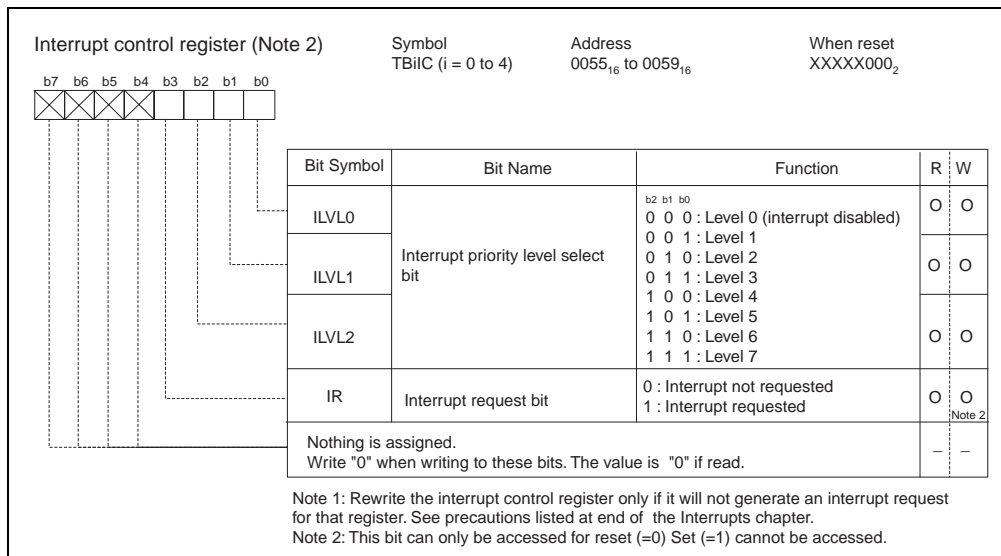


Figure 8 Interrupt Control Register

5.0 References

Renesas Technology Corporation Semiconductor Home Page

<http://www.renesas.com>

E-mail Support

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Data Sheets

- M16C/62 datasheets, 62aeds.pdf

User's Manual

- M16C/62 User's Manual, 62eum.pdf
- M16C/60 and M16C/20 C Language Programming Manual, 6020EC.pdf
- Application Note: Writing Interrupt Handlers in C for the M16C
- NC30 Ver. 4.0 User's Manual, NC30UE.PDF

6.0 Software Code

Following is a program written for Renesas' NC30 compiler to illustrate how to set up One-Shot Mode on timer A0. It generates a 1ms pulse on TAIOUT, triggered by a rising edge on TA0in. The program was tested with 0.5ms pulses, at 250 Hz on TA0in. This program runs on the MSV1632/62 Starter Kit Board.

To get familiar with One-Shot Mode, try changing the pulse width, the clock source, or even switch to a different timer (e.g., TA1, etc.).

```

/*****
*      File Name: oneshot_mode.c
*
*      Content: Example program using Timer A0 in "One Shot Mode", external
*               trigger. This program is written for the One Shot Mode application
*               note. Produces a 1ms. pulse on TA0out (P7.0) triggered from a
*               rising edge on TA0in (P7.1). This program works with the
*               MSV1632/62 starter kit board.
*
*      Compiled with NC30 ver. 3.20.00.
*
*      All timing based on 16 Mhz Xtal
*
*      Copyright, 2003 Renesas Technology Corporation, Inc.
*=====
*      $Log:$
*=====*/
#include "sfr62.h"

#define TIME_CONFIG 0x1e /* 00011110 value to load into timer mode register
|_|_|_|_|_|_|_ TMOD0,TMOD1: ONE-SHOT MODE SELECTED
|_|_|_|_|_|_ MR0:          PULSE OUTPUT
|_|_|_|_|_|_ MR1:          RISING EDGE OF TRIGGER
|_|_|_|_|_|_ MR2:          EXTERNAL TRIGGER
|_|_|_|_|_|_ MR3:          SET TO 0 IN TIMER MODE
|_|_|_|_|_|_ TCK0,TCK1:    F DIVIDED BY 1 SELECTED */

#define CNTR_IPL 0x00 // TA0 interrupt priority level

//prototypes
void init(void);

```

```

/*****
Name:    main()
Parameters: none
Returns: nothing
Description: initializes variables, then does nothing.
*****/

void main (void)
{
    init();
    while (1);    //one shot is now free running
}
/*****
Name:    initial()
Parameters: none
Returns: nothing
Description: Timer TA0 setup for One-Shot Mode
*****/

void init()
{
    ta0 = 16000;    // 16000 divided by 16meg xtal, -> 1msec pulse width.

/* the following procedure for writing an Interrupt Priority Level follows
   that as described in the M16C data sheets under 'Interrupts' */

    _asm ("    fclr i" ) ;    //turn off interrupts before modifying IPL
    ta0ic &= CNTR_IPL;    // use read-modify-write instruction to write IPL
    ta0mr = TIME_CONFIG;
    _asm ("    fset i" );

    ta0s = 1;    // start count bit
    ta0os = 1;    // start one-shot bit
}

```


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