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April 1st, 2010
Renesas Electronics Corporation

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M16C/26

Using Timer A in One-Shot Mode

1.0 Abstract

One-shot timers are commonly found in designs, as they are useful for debouncing switches, “cleaning” up sensor inputs, etc. Timer A on the M16C/26 can be configured as one-shots, reducing the need for external components. These one-shots have advantages over their hardware counterparts as 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/26 timer A as one-shots, referred to as One-Shot Mode.

2.0 Introduction

The Renesas M30262 is a 16-bit MCU based on the M16C/60 series CPU core. The MCU features include up to 64K bytes of Flash ROM, 2K bytes of RAM, and 4K bytes of Virtual EEPROM. The peripheral set includes 10-bit A/D, UARTS, Timers, DMA, and GPIO. The MCU has eight timers that consists of five Timer A's and three Timer B's. Only the five timer A's can operate in 'One-Shot Mode'.

Timer A also has the following additional modes of operation:

- Timer Mode
- PWM Mode
- Event Count Mode

Figure 1 shows the timer A block diagram. The remainder of this document will focus on how to setup timer A in One-Shot mode with an external trigger.

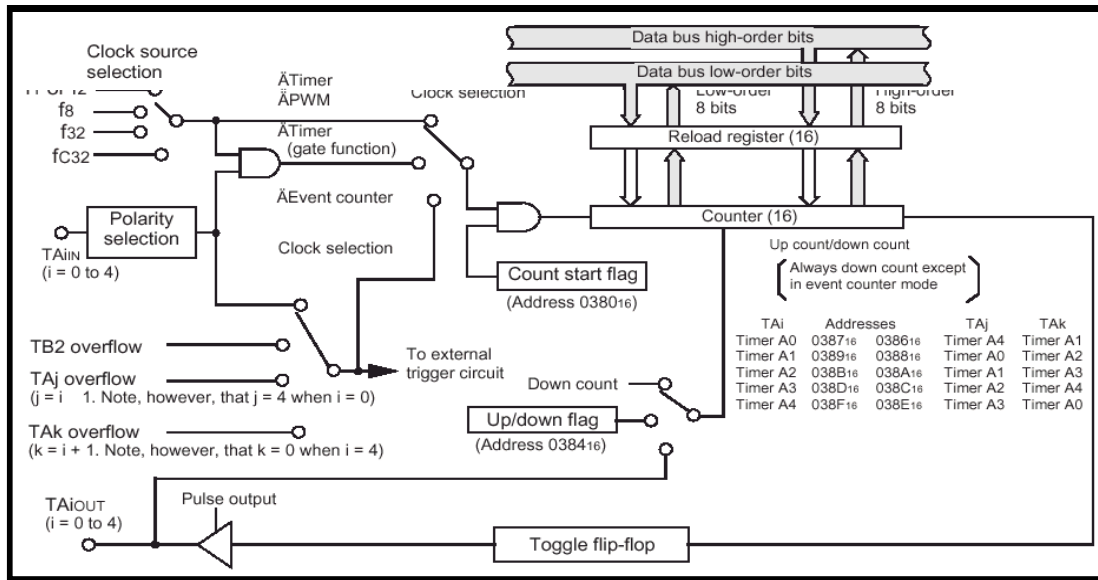


Figure 1 Block Diagram of Timer A

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 FFFF_h). At this point, the $TAiOUT$ pin goes low and the contents of the reload register are copied into the TAi register. At the same time, the timer interrupt request bit is set and an interrupt is generated if the timer interrupt priority level is set above the current CPU priority level (if the I flag in the CPU flag registers is cleared, the interrupt will not be serviced until the flag is set). If at any time during countdown the count start flag is cleared, counting is suspended until set. The one-shot timers can be triggered internally with the one-shot start flag or another timer output; or, externally by a signal on the $TAiIN$ pin. Examples are shown in Figure 2 and Figure 3.

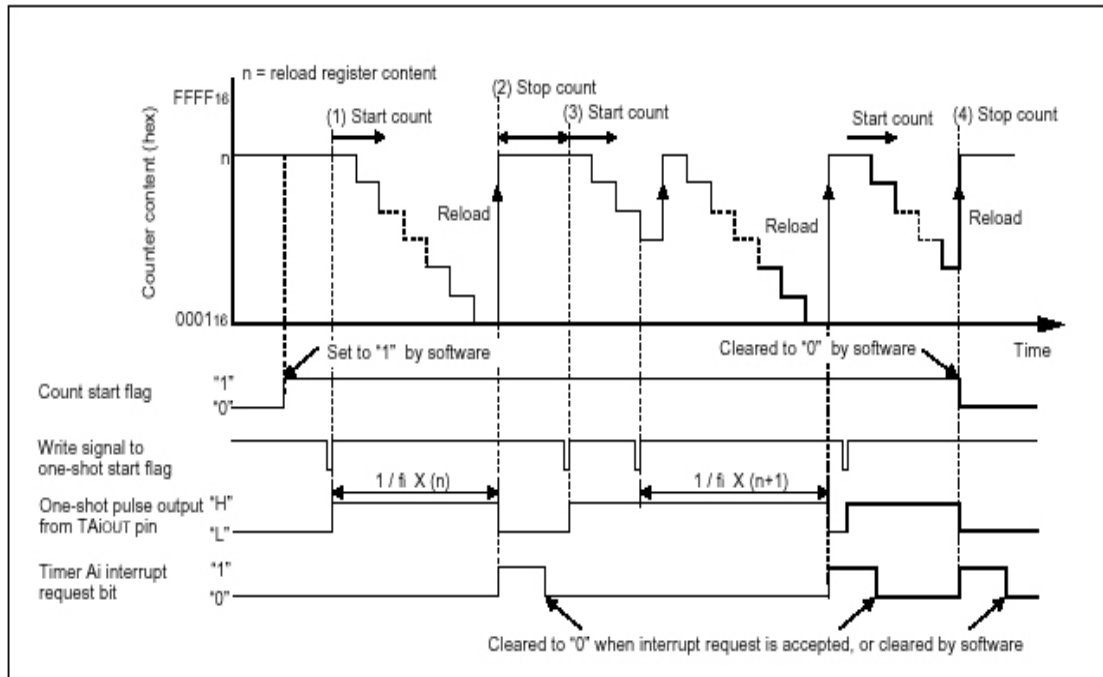


Figure 2 Operation timing of one-shot mode

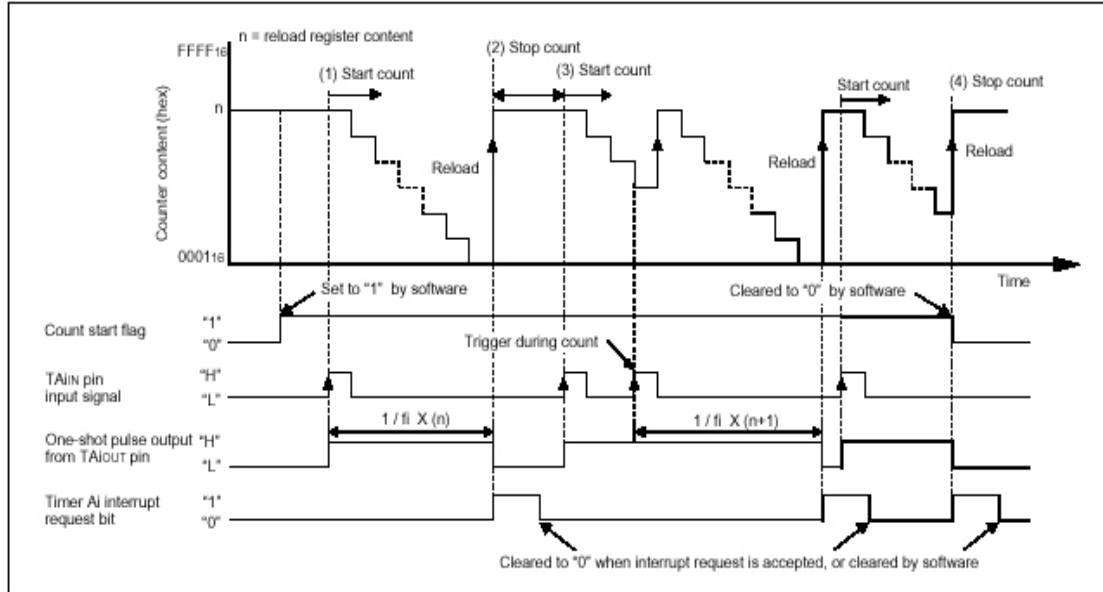


Figure 3 Operation timing of one-shot mode, external trigger selected

4.0 Configuring One-shot Mode

The steps to configure timer A for One-Shot Mode are shown below.

1. Load the TAI register (which also loads the reload register) with the count source
 - 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'.
2. Set the timer 'interrupt priority level', TAIIC (to zero if interrupts are not required).
3. Enabled interrupts if required (CPU I flag set).
4. Set the 'start count' flag bit, TAIIS in the 'count start flag' register, TABSR.
5. Set the one-shot start flag bit, TAIOS in the 'one-shot start flag register', ONSF. Note if the one-shot start flag is selected as the trigger, the TAIOUT pin will immediately go high.

For the most part, the above order is not important, but an initial value should be loaded in the TAI register before the 'start count' flag is set. In addition, the priority level should not be modified when there is a chance of an interrupt occurring. Figure 4 to Figure 8 show the register for configuring the timers in 'One-Shot mode'.

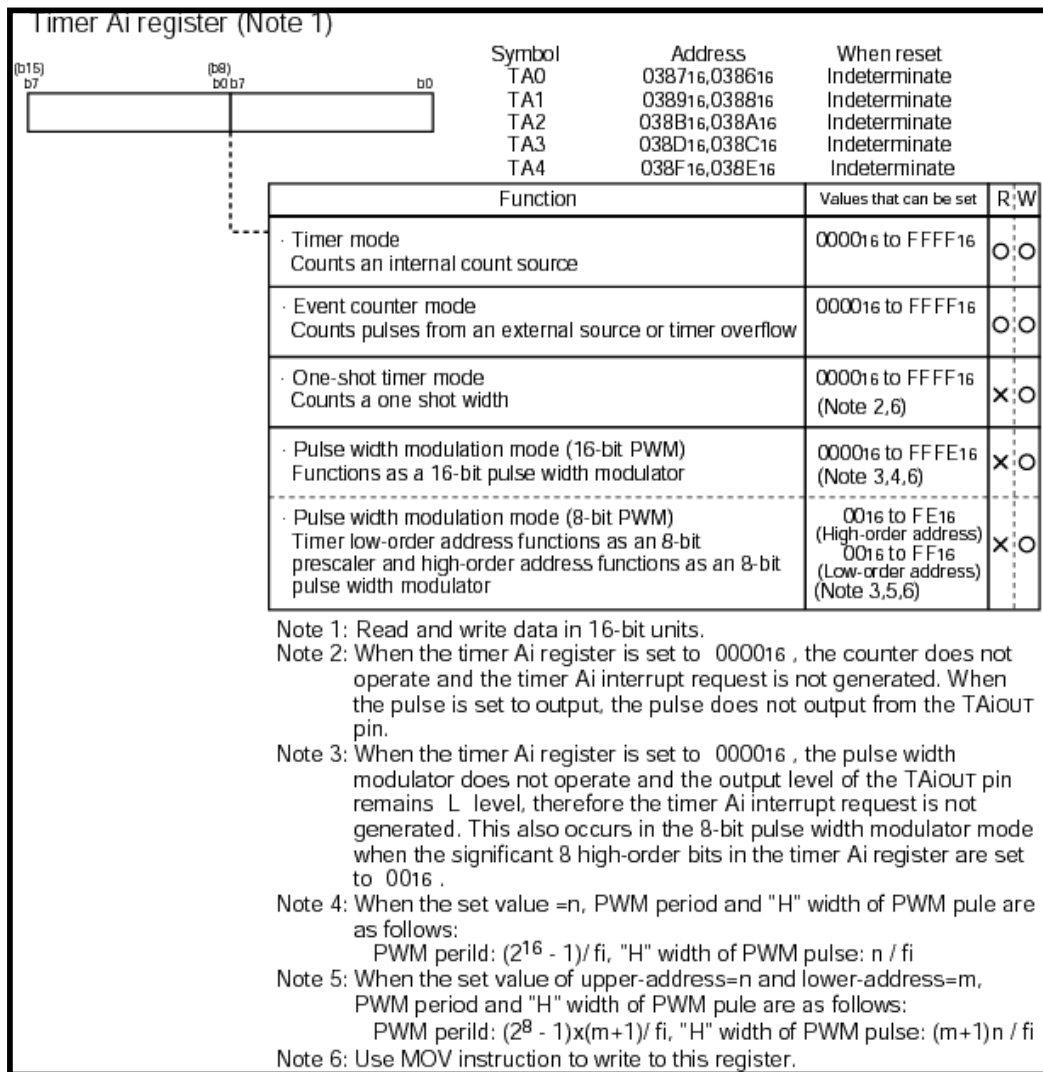


Figure 4 Timer A-related registers

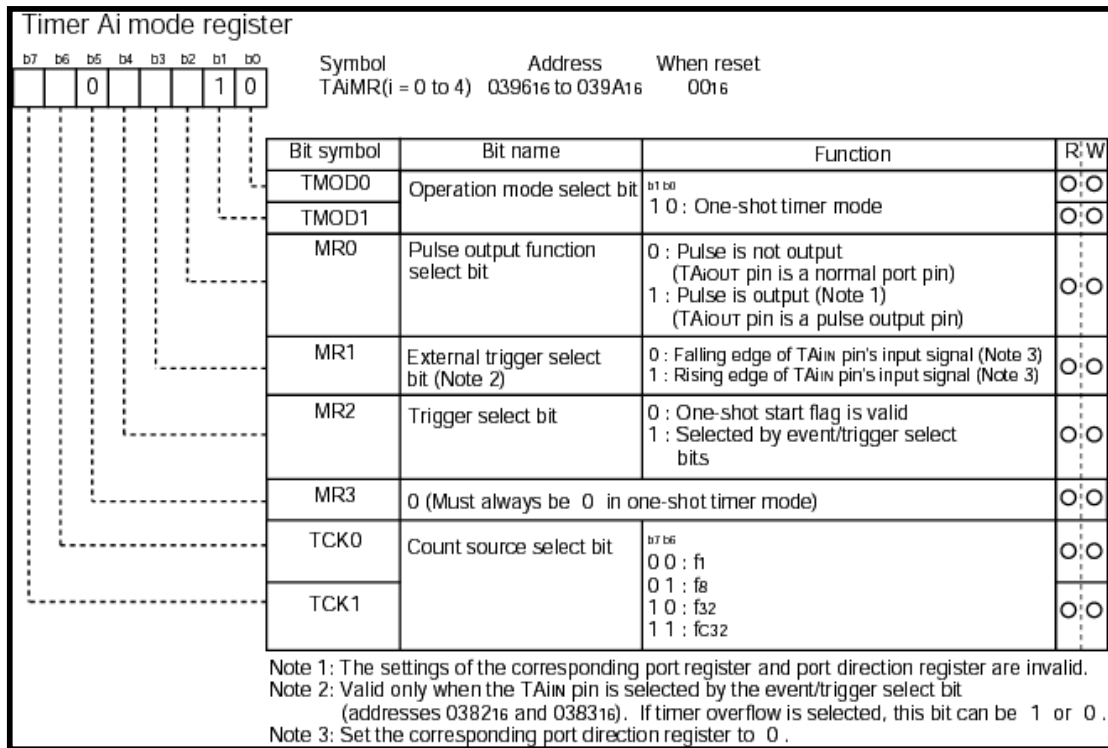


Figure 5 Timer Ai mode register in One-Shot timer mode

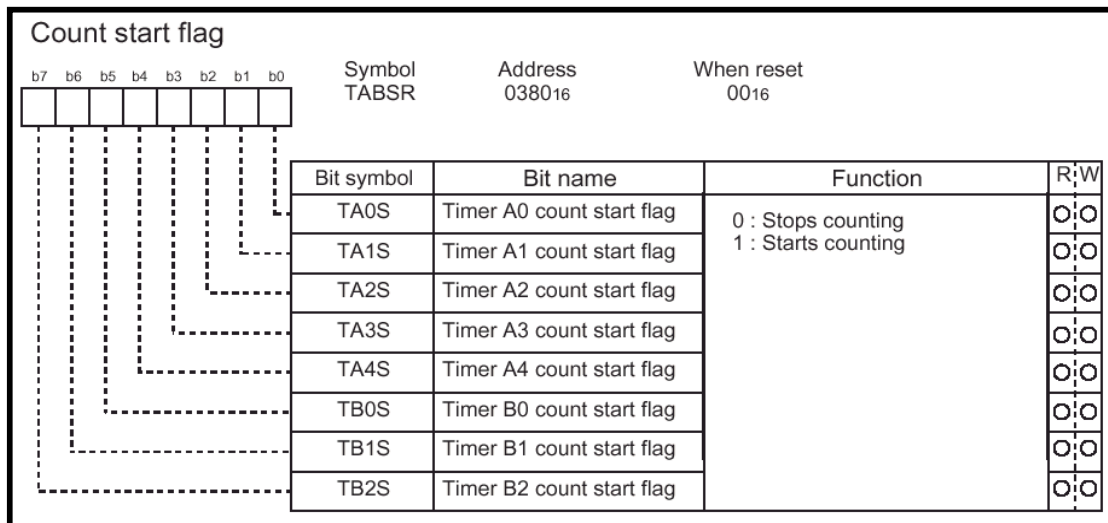


Figure 6 Count start flag register

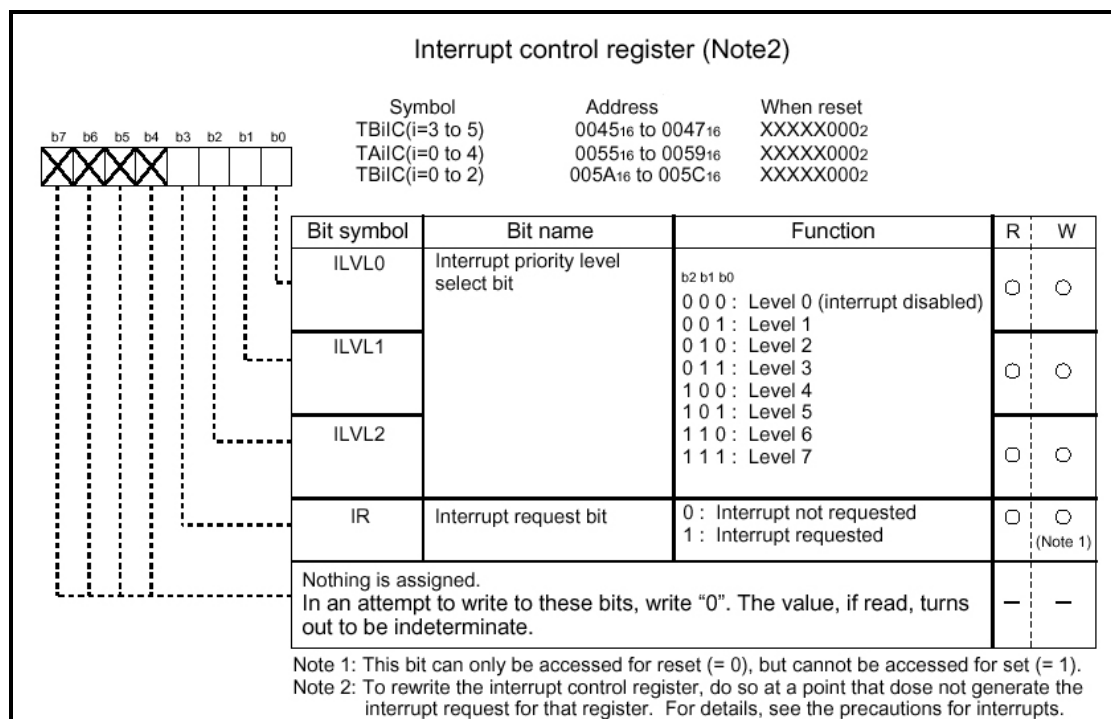


Figure 7 Interrupt control register

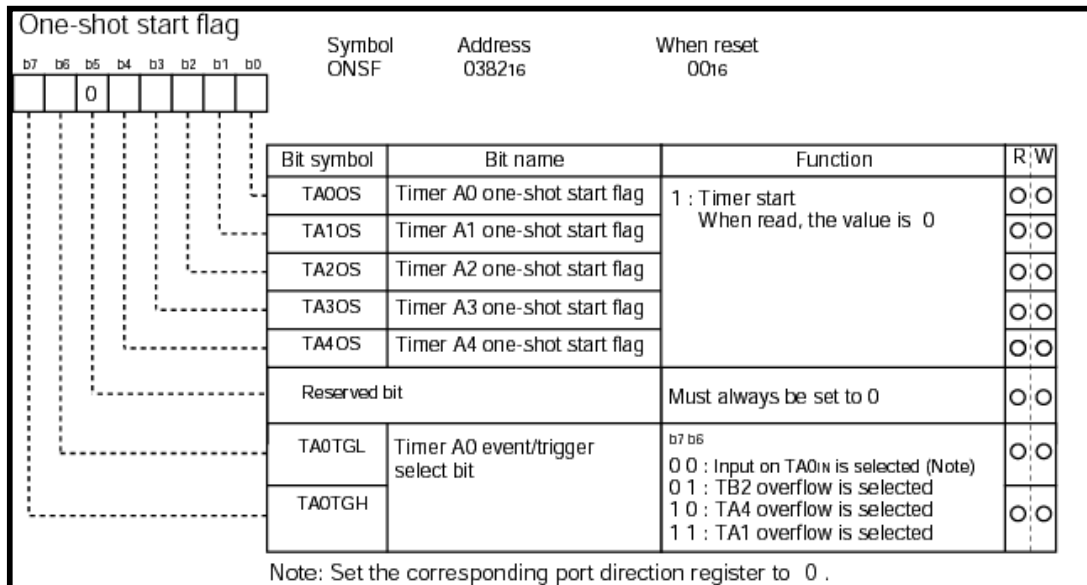


Figure 8 One-Shot control register

5.0 Reference

Renesas Technology Corporation Semiconductor Home Page

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Data Sheets

- M16C/26 datasheet, M30262eds.pdf

User's Manual

- KNC30 Users Manual, KNC30UE.PDF
- M16C/60 and M16C/20 C Language Programming Manual, 6020EC.PDF
- Application Note: Writing interrupt handlers in C for the M16C
- MSV30262-SKP or MSV-Mini26-SKP Quick start guide
- MSV30262-SKP or MSV-Mini26-SKP Users Manual
- MDECE30262 or MSV-Mini26-SKP Schematic

6.0 Software Code

A sample program written in C and compiled using the KNC30 compiler is shown below 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 250Hz on TA0in. This program runs on the MSV30262 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 A in "One Shot Mode", external  
*             trigger.  
*             This program is written for the One Shot Mode application note.  
*             Produces a 1msec. pulse on TA0out (P7.0) triggered from a rising  
*             edge on TA0in(P7.1). This program works with the MSV30262 starter  
*             kit board.  
*  
*   Compiled with KNC30.  
*  
*/
```

```

*      All timing based on 20 Mhz Xtal
*
*      Copyright 2003 Renesas Technology America, Inc.
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*=====
*      $Log:$
*===== */
#include "sfr26.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 = 20000; // 20000 divided by 20meg 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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