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April 1st, 2010
Renesas Electronics Corporation

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M16C/Tiny Series

Solution for External Interrupt Pins Shortage

1. Abstract

The following are solution for external interrupt pins shortage.
Use the following peripheral function:

- Event counter mode of timer A

2. Introduction

The explanation of this issue is applied to the following condition:
Applicable MCU: M16C/26, M16C/26A, M16C/28, M16C/29 Group

This program can also be used when operating other microcomputers within the M16C family, provided they have the same SFR (Special Function Registers) as the M16C/26, M16C/26A, M16C/28, M16C/29 microcomputers. However, some functions may have been modified.
Refer to the User's Manual for details. Use functions covered in this Application Note only after careful evaluation.

3. Contents

3.1 Specification

(1) Inputting a falling edge to the $TA0_{IN}$ pin generates a timer A0 interrupt.

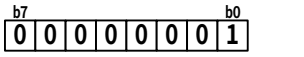
3.2 Operation

(1) Set timer A0 to event counter mode, set timer to "0", and set interrupt priority levels in timer A0.
(2) Inputting a falling edge to the $TA0_{IN}$ pin generates a timer A0 interrupt.

3.3 Register Setting

To enable the operation defined in "Section 3. Operation of timer A", the following register settings must be taken place step by step. For detail configuration of each register, please refer to M16C/26 Group hardware manual, M16C/26A Group hardware manual, M16C/28 Group hardware manual, M16C/29 Group hardware manual.

(1) Setting timer A0 mode register



TMOD1,TMOT0 Operation Mode Select Bit
01: Selection of event counter mode

MR0 Pulse Output Function Select Bit
0: Pulse is not output (TA0OUT pin is a normal port pin)

MR1 Count polarity select bit
0: Counts external signal's falling edge

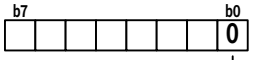
MR2 Up/down switching cause select bit
0: Up/down flag's content

MR3 Set to “0” in event counter mode

TCK0 Count operation type select bit
0: Reload type

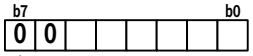
TCK1 Set to “0” in event counter mode

(2) Setting up/down flag



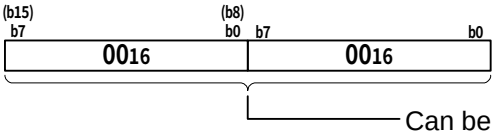
TA0UD Timer A0 up/down flag
0: Down count

(3) Setting one-shot start flag



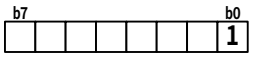
TA0TGH,TA0TGL Timer A0 Event/Trigger Select Bit
0: Input on TA0IN is selected

(4) Setting timer A0 register



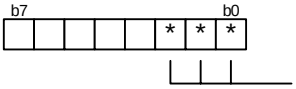
Can be set to 0000_{16} to $FFFF_{16}$

(5) Setting count start flag



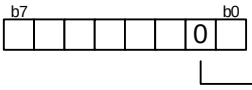
TA0S Timer A0 Count Start Flag

(6) Setting interrupt priority levels in timer A0



ILVL2 to ILVL0 Interrupt Priority Level Select Bit
Set a value 1 to 7

(7) Setting port P7 direction register



PD7_1 Port P7$_1$ direction register
0 : input mode

(8) Setting interrupt enable flag (I flag)

4. Sample Program

```
/************************************************************
 *                                                          *
 *   FILE NAME :                                            *
 *   CPU       : M16C/Tiny series                           *
 *   Function  : Application of Timer A                     *
 *            (Solution for External Interrupt Pins Shortage)  *
 *   Version   : 1.00                                       *
 *                                                          *
 *   Copyright (C)2004, Renesas Technology Corp.            *
 *   Copyright (C)2004, Renesas Solutions Corp.             *
 *                                                          *
 ************************************************************/
/***************************
 *   include file          *
 ***************************/
#include "sfr28.h"

/***************************
 *   Function Definition   *
 ***************************/
voidta0_int(void);
#pragma INTERRUPT ta0_int

/***************************
 *   main                  *
 ***************************/
void main(void) {

    ta0mr = 0x01;    /*  Selection of event counter mode
                         Pulse output function select bit (0:Pulse is not output)
                         Counts external signal's falling edge
                         Up/down flag's content
                         Count operation type select bit (0:Reload type)
                     */

    udf = 0;         /*  Setting up/down flag */

    onsf = 0;

    ta0 = 0x00;      /*  Counter value on event counter mode (down count) */

    ta0s = 1;        /*  TimerA0 count start */

    ta0ic = 0x01;    /*  Setting interrupt priority levels in timer A0 */

    pd7_1 = 0;       /*  Port P7_1 direction register is set to "0"(Input mode)*/

    #pragma ASM
    fsetI            ;Set Interrupt enable flag
    #pragma ENDASM

    while (1) {
    }
}

/*********************************
 *   Timer A0 interrupt routine   *
 *********************************/
voidta0_int() {

/*  Timer A0 interrupt process */

}
```

5. Reference

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Hardware Manual

M16C/26, M16C/26A, M16C/28, M16C/29 Group Hardware Manual
(Use the latest version on the home page: http://www.renesas.com)

TECHNICAL UPDATE/TECHNICAL NEWS

(Use the latest information on the home page: http://www.renesas.com)

REVISION HISTORY

Rev.	Date	Description	
		Page	Summary
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