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April 1st, 2010
Renesas Electronics Corporation

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M16C/80 Group

Long-Period Timers

1.0 Abstract

In this process, Timer A0 and Timer A1 are connected to make a 16-bit timer with a 16-bit prescaler. Use the following peripheral functions:

- Timer mode of timer A
- Event counter mode of timer A

2.0 Introduction

Specifications

(1) Set timer A0 to timer mode, and set timer A1 to event counter mode.

(2) Perform a count on count source f_1 using timer A0 to count for 1 ms, and perform a count on timer A0 using timer A1 to count for 1 second.

(3) Connect a 20-MHz oscillator to X_{IN}.

(4) The formula for calculating the Long-Period becomes as follows.

(Long-Period) = (Count source period of Timer A0)x(Timer A0 register +1)x(Timer A1 register +1)

Setting example for 1 sec period

(1 sec) = (50ns)x(19999+1)x(999+1)

Operation

(1) Setting the count start flag to “1” causes the counter to begin counting. The counter of timer A0 performs a down count on count source f_1.

(2) If the counter of timer A0 underflows, the counter reloads the content of the reload register and continues counting. At this time, the timer A0 interrupt request bit goes to “1”. The counter of timer A1 performs a down count on underflows in timer A0.

(3) If the counter of timer A1 underflows, the counter reloads the content of the reload register and continues counting. At this time, the timer A1 interrupt request bit goes to “1”.

Figure 1 shows the operation timing.

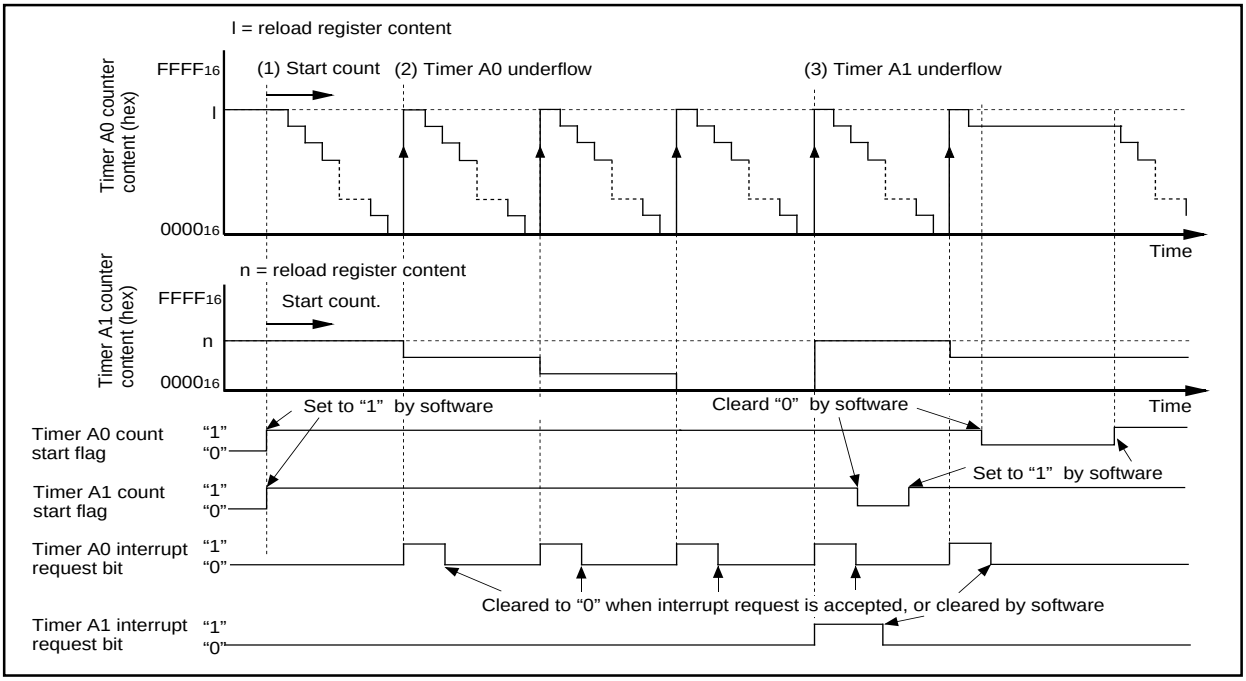


Figure 1. Operation timing of long-period timers

Figure 2 shows the connection diagram of long-period timers.

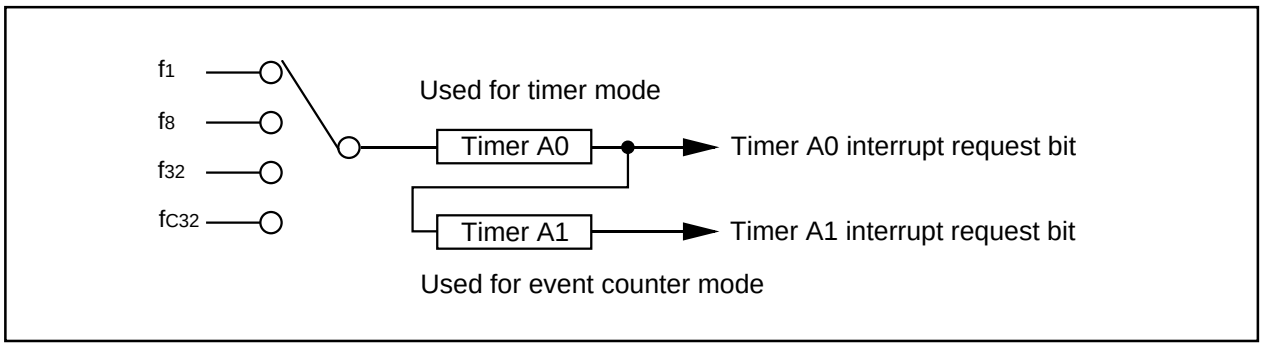
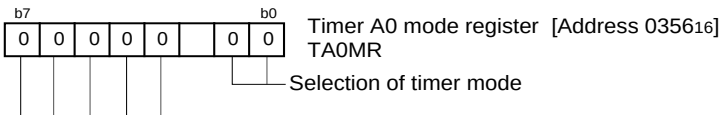


Figure 2. Connection diagram of long-period timers

3.0 Set-up procedure

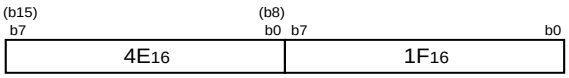
Setting timer A0

Selecting timer mode and functions



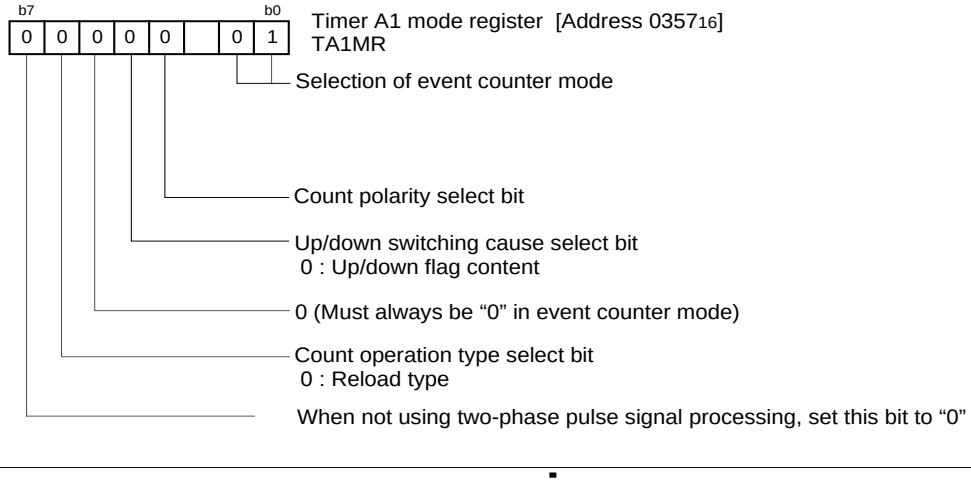
b7	b6	Count source	Count source period f(XIN) : 20MHz f(XCIN) : 32.768kHz
0	0	f1	50ns
0	1	f8	400ns
1	0	f32	1.6µs
1	1	fC32	976.56µs

Setting divide ratio



Setting timer A1

Selecting event counter mode and each function



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Setting up/down flag

b7 b6 b5 b4 b3 b2 b1 b0
0 0 0 0

Up/down flag [Address 0344$_{16}$] (Note1)
UDF

Timer A1 up/down flag
0 : Down count

When not using the 2-phase pulse signal processing function, set the select bit to "0".

Note1: Use MOV instruction to write to this register.

Setting trigger select register

b7 b6 b5 b4 b3 b2 b1 b0
1 0

Trigger select register [Address 0343$_{16}$]
TRGSR

Timer A1 event/trigger select bit
b1 b0
1 0 : TA0 overflow is selected

Setting divide ratio

(b15) (b8)
b7 b0 b7 b0
03$_{16}$ E7$_{16}$

Timer A1 register [Address 0349$_{16}$, 0348$_{16}$]
TA1

Setting count start flag

b7 b6 b5 b4 b3 b2 b1 b0
1 1

Count start flag [Address 0340$_{16}$]
TABSR

Timer A0 count start flag
1 : Starts counting

Timer A1 count start flag
1 : Starts counting

Start counting

4.0 Programming Code

```
;***************************************************************************************
;
;   M16C/80 Program Collection
;
;   FILE NAME : rjj05b0505_src.a30
;   CPU       : M16C/80 Group
;   FUNCTION  : Timer A Applications
;               (Long-Period Timers)
;   HISTORY   : 2004.03.15  Ver 1.00
;
;   Copyright(C)2003, Renesas Technology Corp.
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;
;***************************************************************************************
;***************************************************************************************
;       Include
;***************************************************************************************
        .LIST       OFF             ;Stops outputting lines to the assembler list file
        .INCLUDE    sfr80100.inc    ;Reads the file that defined SFR
        .LIST       ON              ;Starts outputting lines to the assembler list file
;
;***************************************************************************************
;       Symbol definition
;***************************************************************************************
RAM_TOP          .EQU    000400H    ;Start address of RAM
RAM_END          .EQU    002BFFH    ;End address of RAM
ROM_TOP          .EQU    0FFC000H   ;Start address of ROM
FIXED_VECT_TOP   .EQU    0FFFFDCH   ;Start address of fixed vector
;
;***************************************************************************************
;       Program area
;***************************************************************************************
;=======================================================================
;       Start up
;=======================================================================
        .SECTION    PROGRAM, CODE  ;Declares section name and section type
        .ORG        ROM_TOP        ;Declares start address
RESET:
        LDC      #RAM_END+1, ISP   ;Sets initial value in stack pointer
        ; Sets Processor mode, System clock and Main clock division
        MOV.B    #03H, prcr        ;Removes protect
        MOV.B    #10000000B, pm0   ; Single-chip mode
        MOV.B    #11000000B, pm1   ; Flash memory version
        MOV.B    #00001000B, cm0   ; Xcin-Xcout High
        MOV.B    #00100000B, cm1   ; Xin-Xout High
        MOV.B    #00010010B, mcd   ; No division mode
        MOV.B    #00H, prcr        ;Protects all registers
;
```

```
;======================================================================
;       TimerA (Long-Period Timers)
;======================================================================
;----------------------------------------------------------------------
;       Setting Timer A0 (Timer mode, 1ms)
;----------------------------------------------------------------------
        ; Selecting timer mode and functions
        MOV.B    #00000000B, ta0mr
;                 ||||||++---------;Selection of timer mode
;                 |||||+-----------;This bit is invalid in M16C/80 series
;                 |||++------------;Gate function select bit
;                 |||               (00 or 01:Gate function not available)
;                 ||+--------------;Must always be "0" in timer mode
;                 ++---------------;Count source select bit (00:f1)
        ; Setting divide ratio
        MOV.W    #04E1FH, ta0      ;(1msec @20MHz, f1)
;
;----------------------------------------------------------------------
;       Setting Timer A1 (Event counter mode, count underflows of Timer A0)
;----------------------------------------------------------------------
        ; Setting event counter mode and functions
        MOV.B    #00000001B, ta1mr
;                 ||||||++---------;Selection of event counter mode
;                 |||||+-----------;This bit is invalid in M16C/80 series
;                 ||||+------------;Count polarity select bit
;                 |||+-------------;Up/down switching cause select bit (0:Up/down flag's content)
;                 ||+--------------;Must always be "0" in event counter mode
;                 |+---------------;Count operation  type select bit (0:Reload type)
;                 +----------------;When not using the 2-phase pulse signal processing function,
;                                   set the select bit to "0"
        ; Setting up/down flag
        MOV.B    #00000000B, udf
;                 |||   +----------;Timer A1 up/down flag (0:Down count)
;                 +++--------------;When not using the 2-phase pulse signal processing function,
;                                   set the select bit to "0"
        ; Setting trigger select register
        MOV.B    #00000010B, trgsr
;                       ++---------;Timer A1 event/trigger select bit
;                                   (10:TA0 overflow is selected)
        ; Setting divide ratio
        MOV.W    #03E7H, ta1       ;(1msec * 1000 = 1sec)
        ; Setting count start flag
        MOV.B    #00000011B, tabsr
;                       |+---------;TimerA0 count start flag (1:Starts counting)
;                       +----------;TimerA1 count start flag (1:Starts counting)
;
MAIN:
        JMP      MAIN
;
;======================================================================
;       Dummy interrupt processing program
;======================================================================
dummy:
        REIT
;
;************************************************************************************
;       Setting of fixed vector
;************************************************************************************
        .SECTION    F_VECT, ROMDATA
        .ORG        FIXED_VECT_TOP
;
        .LWORD    dummy    ;Undefined instruction
        .LWORD    dummy    ;Overflow
        .LWORD    dummy    ;BRK instruction execution
        .LWORD    dummy    ;Address match
        .LWORD    dummy    ;
        .LWORD    dummy    ;Watchdog timer
        .LWORD    dummy    ;
        .LWORD    dummy    ;NMI
        .LWORD    RESET    ;Reset
;
        .END
```

5.0 Reference

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Data Sheet

M16C/80 group Rev. E3

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