# M16C/Tiny Series

## Operation of Timer A (Timer Mode, Gate Function)

## 1. Abstract

In timer mode, choose functions from those listed in Table 1. Operations of the checked items are described below.

**Table 1. Choosed Functions**

| Item | Set-up | |
|---|---|---|
| Count source | | f1 or f2 |
| | Yes | f8 |
| | | f32 |
| | | fC32 |
| Pulse output function | Yes | No pulses output |
| | | Pulses output |
| Gate function | | No gate function |
| | | Performs count only for the period in which the $TAi_{IN}$ pin is at “L” level |
| | Yes | Performs count only for the period in which the $TAi_{IN}$ pin is at “H” level |

## 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. Operation of Timer A

(1) When the count start flag is set to “1” and the $TAi_{IN}$ pin inputs at “H” level, the counter performs a down count on the count source.
(2) When the $TAi_{IN}$ pin inputs at “L” level, the counter holds its value and stops.
(3) If an underflow occurs, the content of the reload register is reloaded, and the count continues. At this time, the timer Ai interrupt request bit goes to “1”.
(4) Setting the count start flag to “0” causes the counter to hold its value and to stop.

Complement: Make the pulse width of the signal input to the $TAi_{IN}$ pin not less than two cycles of the count source.

Figure 1 shows the operation timing of timer mode, gate function selected.

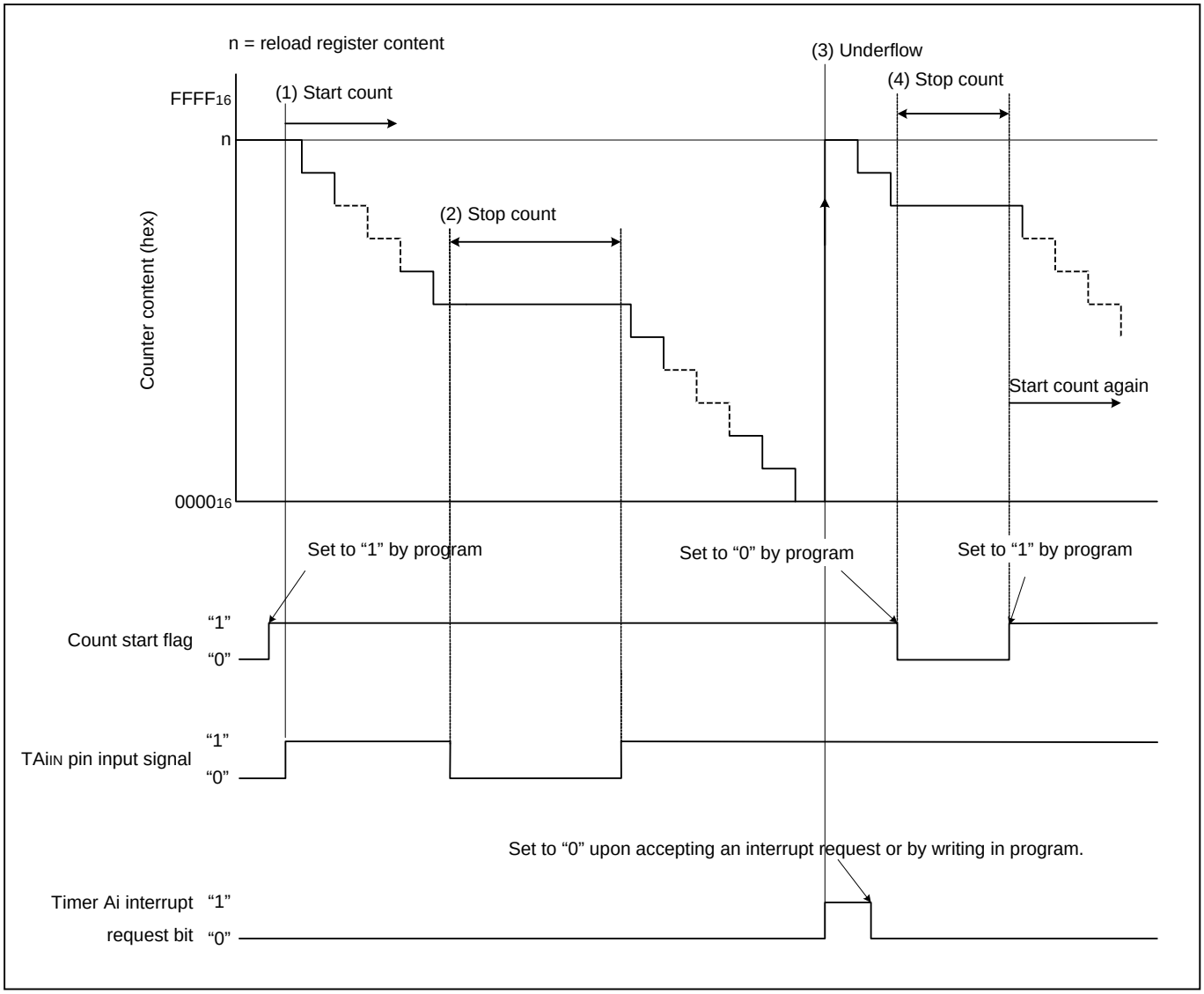
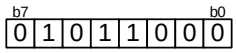



**Figure 1. Operation Timing of Timer Mode, Gate Function Selected**

## 3.1 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 Ai mode register (i=0 to 4)




TMOD1,TMOD0 Operation Mode Select Bit
00: Selection of timer mode

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

MR2,MR1 Gate Function Select Bit
11: Timer counts only when TAiIN pin is held “H”

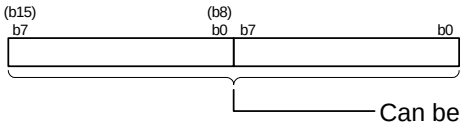
MR3 Set to “0” in timer mode

TCK1,TCK0 Count Source Select Bit
00 : f1 or f2
01 : f8
10 : f32
11 : fC32

| b7 | b6 | Count source | Count source period f(XIN): 20MHz f(XCIN): 32.768kHz |
|---|---|---|---|
| 0 | 0 | f1 (Note 1) | 50ns |
| 0 | 0 | f2 (Note 1) | 100ns |
| 0 | 1 | f8 | 400ns |
| 1 | 0 | f32 | 1600ns |
| 1 | 1 | fC32 | 976.56ms |

Note 1: Count source is f2 if PCLK0 bit in the PCLKR register is “0”, f1 if PCLK0 bit in the PCLKR register is “1”.

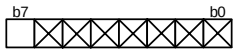
(2) Setting timer Ai register (i=0 to 4)




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

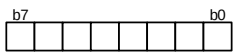
(3) Setting clock prescaler reset flag

(This function is effective when fC32 is selected as the count source. Reset the prescaler for generating fC32 by dividing the XCIN by 32.)




CPSR Clock Prescaler Reset Flag
0: No effect
1: Prescaler is reset (When read, the value is “0”)

(4) Setting count start flag




TA0S Timer A0 Count Start Flag
TA1S Timer A1 Count Start Flag
TA2S Timer A2 Count Start Flag
TA3S Timer A3 Count Start Flag
TA4S Timer A4 Count Start Flag

## 4. Sample Program

```
/************************************************************
 *                                                          *
 *   FILE NAME :                                            *
 *   CPU       : M16C/Tiny series                           *
 *   Function  : Operation of Timer A                       *
 *               (Timer Mode, Gate function)                *
 *   Version   : 1.00                                       *
 *                                                          *
 *   Copyright (C)2004, Renesas Technology Corp.            *
 *   Copyright (C)2004, Renesas Solutions Corp.             *
 *                                                          *
 ************************************************************/
/***************************
 *   include file          *
 ***************************/
#include "sfr28.h"

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

    pd7_3 = 0;   /* Set the corresponding port direction register to "0" */

    ta1mr = 0x58;    /*  Selection of timer mode
                         Pulse output function select bit (0:Pulse is not output)
                         Gate function select bit (11:Timer counts only when TAiIN pin is heold "H" )
                         Count source (01:f8) */

    ta1 = 2500-1;    /*  Setting counter value (1msec @20MHz, f8) */

    cpsrf = 0;       /*  Setting clock prescaler reset flag (0:No effect) */

    ta1s = 1;        /*  TimerA1 count start */

    while (1) {
    }
}
```

## 5. Reference

### Renesas Technology Corporation Home Page

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E-mail: csc@renesas.com

### 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)

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