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32176 Group

Application of Timer TOP (Continuous Output Mode)

1. Overview

The following article shows sample program of 32176 group using timer TOP.

2. Introduction

The sample task described here uses the following microcomputer, under the respective conditions.

- Microcomputer: 32176 Group (M32176FnVFP, M32176FnTFP)
- Operating frequency: 20 to 40MHz (The sample program is compiled assuming a frequency of 40 MHz.)
- Operating Board: Starter kit for 32176 Group

3. Explanation of an applied technology

3.1 Outline of Multijunction Timers

The multijunction timers (abbreviated MJT) have input event buses and output event buses. Therefore, in addition to be used as a single unit, the timers can be internally connected to each other. This capability allows for highly flexible timer configuration, making it possible to meet various applications needs. It is because the timers are connected to internal event bus at multiple points that they are called the “multijunction” timers.

MJT is detailed in 32176 Group User's Manual.

4. Continuous Output Mode Sample Program

4.1 Outline of the sample program

This sample program uses the TOP10 timer to generate an interrupt. It doesn't output to an external terminal (TO10) but interruption processing does the increment of the P11DATA.

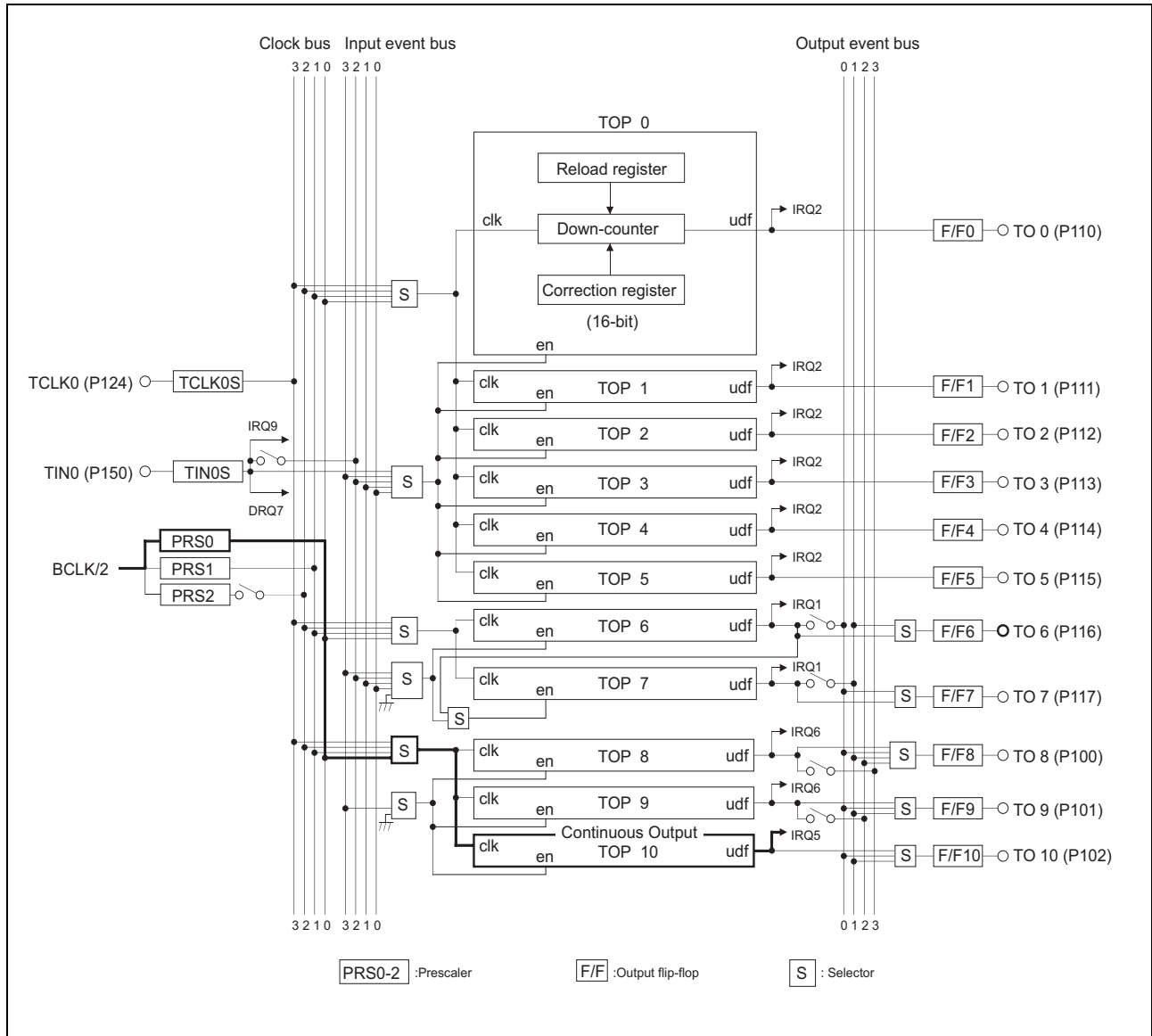


Figure 4.1.1 Configuration of TOP Continuous Output Timer

4.2 Processing procedure

The basic processing flow of a timer setup is shown in Figure 4.2.1.

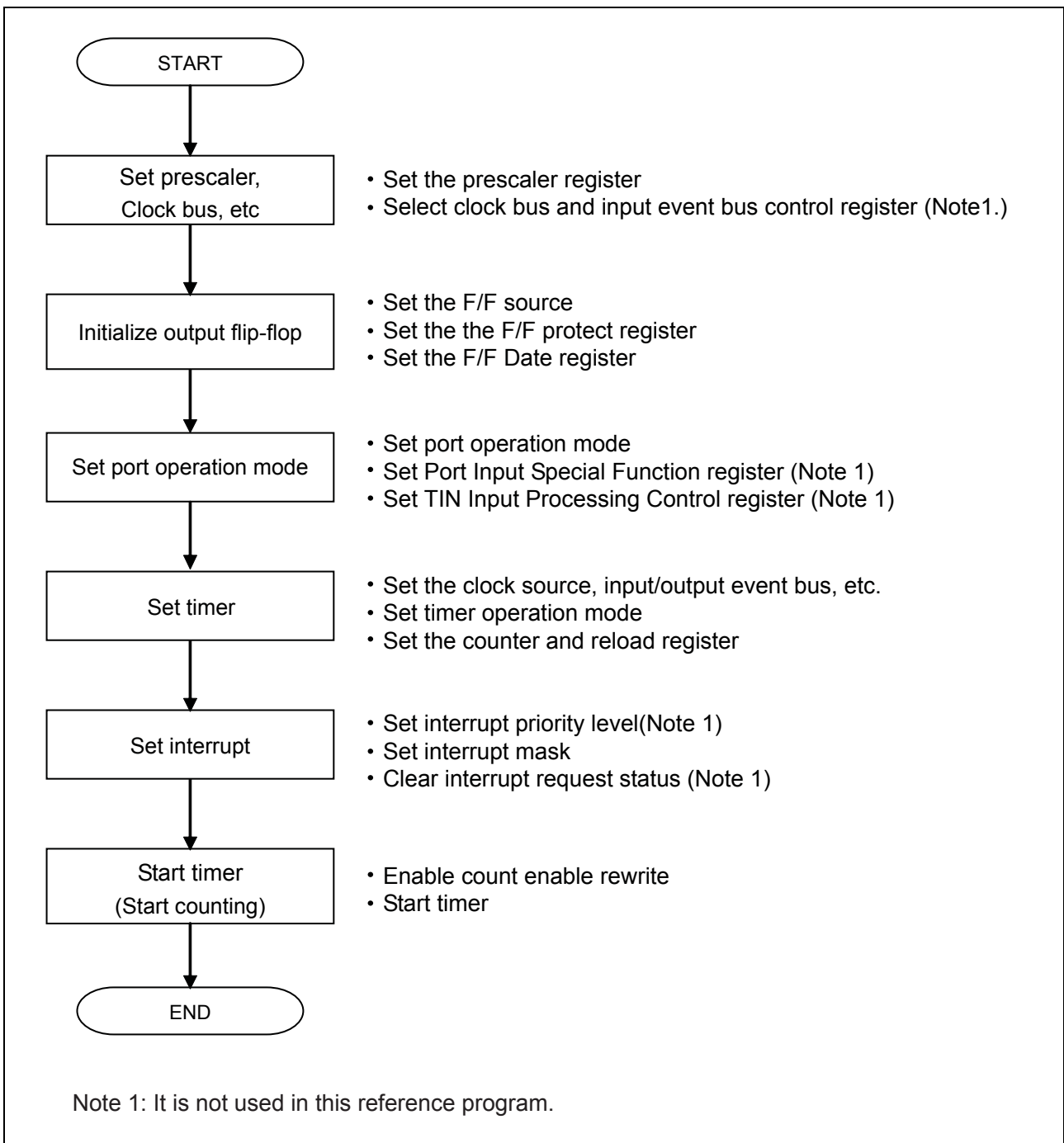


Figure 4.2.1 Basic Timer Setup Flow

4.3 Description of a reference program

Note. The registers used are indicated as (register name: bit name).

4.3.1 Timer initialization function (timer_init())

- (1) Set the prescaler's divide-by value
 - Set prescaler register 0 as “the prescaler's divide-by value-1”. (PRS0)

4.3.2 Port initialization function (port_init())

- (1) Initial setting of output port
 - Initialize P11 Data Register. (P11DATA)
 - Set P11 Direction Register as output mode. (P11DIR)
 - Set P11 Operation Mode Register as input/output port. (P11MOD)

Note. If a Direction Register is set as output before setting up a Data Register, an unfixed value is outputted until writing will be performed to a Data Register.

4.3.3 Various initialization function (init_func())

- (1) Call the port initialization function
- (2) Call the timer initialization function

4.3.4 Main function (main())

- (1) Call the various initialization function
- (2) Call the interrupt disable function
- (3) Call the Initial setting of TOP10 continuous output mode, start counting function
- (4) Call the interrupt enable function
- (5) Infinite loop waiting for Interrupt

4.3.5 TOP10 Interrupt processing function (TOP10_FixCyclnt())

- (1) The increment of P11DATA
 - When TOP10 interrupt occurs, the increment of P11DATA is done.

4.3.6 Initial setting of TOP10 continuous output mode (constant frequency interrupt), start counting function (TOP10_FixCyc_init())

- (1) Initial setting of Timer output terminal (TO10 prohibit outputting)
 - Set the Port P102 operation mode bit as input/output port. (P10MOD: P102MOD)
- (2) Set TOP10 Interrupt
 - Set the priority level of MJT Output Interrupt Control Register 5 (TOP10 Interrupt) as “0” (top priority) (IMJTOCR5: ILEVEL)
- (3) Set TOP10
 - Set Continuous Output Mode. (TOP810CR: TOP10M)
 - Set Clock Source as Clock Bus 0. (TOP810CR: TOP810CKS)
 - Initial setting of Counter. (TOP10CT)
 - Initial setting of reload register. (TOP10RL)
- (4) Start Counting TOP10
 - Set Enable protect bit as enable for rewriting. (TOPPRO: TOP10PRO)
 - Start Counting. (TOPCEN: TOP10CEN)

4.3.7 Startup routine (startup.ms)

- (1) Setting Interrupt
 - Set Interrupt sources of ICU Vector Table, which is MJT output interrupt 5 (H'0000 00B0), as the head address of interrupt processing function (TOP10_FixCycInt()).

4.4 Sample Programming Code

The sample program of TOP10 continuous output mode (fixed cycle interrupt) is shown below. Interrupt cycle is set to 50ms in here.

Note that the sample program below requires the SFR definition file. The latest SFR definition file can be downloaded from Renesas Technology website. When using the SFR definitions file, adjust the path setting to match the operating computer environment.

4.4.1 TOP10_fixcyc_main.c

```

1  /*****"FILE COMMENT"*****/
2  *      M32R C Programming          Rev. 1.01
3  *      < Sample Program for 32176 >
4  *      < TOP10 continuous output (main routine) >
5  *
6  *      Copyright (c) 2004 Renesas Technology Corporation
7  *      All Rights Reserved
8  *****/
9
10 /*****/
11 /*      Include file                */
12 /*****/
13
14 #include      "..\inc\sfr32176_pragma.h"
15
16 /*****/
17 /*      Function prototype declaration      */
18 /*****/
19
20 void          main(void);                /* Main function */
21 void          init_func(void);           /* Initial setup function */
22 void          port_init(void);           /* Initialize port */
23 void          timer_init(void);           /* Timer initialization */
24 void          TOP10_FixCycInt(void);      /* Fixed cycle interrupt processing */
25
26 /*****/
27 /*      Definition of external reference      */
28 /*****/
29
30 extern void    DisInt( void );            /* Interrupt disable function */
31 extern void    EnInt( void );             /* Interrupt enable function */
32
33 extern void    TOP10_FixCyc_init(void);    /* Initialize TOP10 continuous output mode */
34
35 /*****"FUNC COMMENT"*****/
36 * Function name: timer_init()
37 *-----
38 * Description : Timer initialization
39 *-----
40 * Argument    : -
41 *-----
42 * Returns     : -
43 *-----
44 * Notes       : -
45 *****/
46 void timer_init(void)
47 {
48     PRS0 = ( 100 - 1);                    /* Set prescaler(10us@10MHz) */
49 }
50
51 /*****"FUNC COMMENT"*****/
52 * Function name: port_init()
53 *-----
54 * Description : Initialize port
55 *-----
56 * Argument    : -
57 *-----
58 * Returns     : -
59 *-----
60 * Notes       : -
61 *****/
62 void port_init(void)
63 {
64     /*** LED output port ***/
65
66     P11DATA = 0x00;                        /* Output data (must be set prior to mode) */
67     P11DIR  = 0xff;                        /* P110-P117 : Output mode */
68     P11MOD  = 0x00;                        /* P110-P117 : Input/output port */
69 }
70
71 /*****"FUNC COMMENT"*****/

```

```

72  * Function name: init_func()
73  *-----
74  * Description  : Call various initialization functions
75  *-----
76  * Argument    : -
77  *-----
78  * Returns     : -
79  *-----
80  * Notes       : -
81  *"FUNC COMMENT END"*****/
82 void init_func(void)
83 {
84     port_init();                /* Initialize those related to port */
85     timer_init();              /* Initialize those related to timer */
86 }
87
88 /*"FUNC COMMENT"*****
89 * Function name: main()
90 *-----
91 * Description  : While using TOP10 in continuous output mode, this program generates an interrupt at
intervals of 50ms
92 *              : (when the source clock frequency = 10 MHz) to increment the LED (port 11) data.
93 *              : In this case, timer output is not forwarded to external devices.
94 *-----
95 * Argument    : -
96 *-----
97 * Returns     : -
98 *-----
99 * Notes       : -
100 *"FUNC COMMENT END"*****/
101 void main(void)
102 {
103     /*** Initializing microcomputer ***/
104
105     init_func();
106
107     DisInt();                    /* Disable interrupt */
108
109     TOP10_FixCyc_init();         /* Start TOP10 count */
110
111     EnInt();                     /* Enable interrupt */
112
113     while( 1 ){                 /* Wait for interrupt (infinite loop) */
114         ;
115     }
116 }
117
118 /*"FUNC COMMENT"*****
119 * Function name: TOP10_FixCycInt()
120 *-----
121 * Description  : Fixed cycle interrupt processing
122 *-----
123 * Argument    : -
124 *-----
125 * Returns     : -
126 *-----
127 * Notes       : -
128 *"FUNC COMMENT END"*****/
129 void TOP10_FixCycInt( void )
130 {
131     P11DATA++;                 /* Increment port upon occurrence of interrupt */
132 }

```

4.4.2 TOP10_fixcyc.c

```

1  /*****FILE COMMENT*****/
2  *      M32R C Programming          Rev. 1.01
3  *      < Sample Program for 32176 >
4  *      < TOP10 continuous output (fixed cycle) mode >
5  *
6  *      Copyright (c) 2004 Renesas Technology Corporation
7  *      All Rights Reserved
8  *****/
9
10 /*****/
11 /*      Include file                */
12 /*****/
13
14 #include          "..\inc\sfr32176_pragma.h"
15
16 /*****/
17 /*      Function prototype declaration */
18 /*****/
19
20 void              TOP10_FixCyc_init(void);          /* Set TOP10 continuous output mode (fixed
cycle interrupt) */
21 void              TOP10_FixCycInt(void);           /* Process fixed cycle interrupt (user
processing) */
22
23 /*****/
24 /*      Define macro                */
25 /*****/
26
27 /*** Continuous output : Fixed cycle(TOP10) ***/
28
29 /* 0123 4567 89AB CDEF
*/
30 #define TOP10_MASK          0x3013u          /* 0011 0000 0001 0011B
*/
31 #define TOP10_CntOutput     0x2010u          /* 0010 0000 0001 0000B
*/
32 /* ||      |  +- Select clock bus 0
*/
33 /* ||      +----- Select enable source
*/
34 /* +----- TOP10 continuous output mode
*/
35
36 #define TOP10_ILevel        0                /* MJT output interrupt 5 (TOP10) interrupt priority
level */
37
38 #define TOP10_Cycle         5000 - 1        /* TOP10 interrupt cycle */
39
40 /*****FUNC COMMENT*****/
41 * Function name: TOP10_FixCyc_init()
42 *-----
43 * Description : TOP10 interrupt cycleInitial settings necessary to generate an interrupt at fixed
intervals while
44 *              : driving TOP10 in continuous output mode
45 *              : - While driving TOP10 in continuous output mode, this function generates an interrupt at
fixed
46 *              : intervals
47 *              : - No signals are output from TO10
48 *              : - The count source used for this operation is clock bus 0
49 *-----
50 * Argument    : -
51 *-----
52 * Returns     : -
53 *-----
54 * Notes       : The prescaler, clock bus, etc. are set separately from the above
55 *              : Must be executed while interrupts are disabled
56 *****/
57 void TOP10_FixCyc_init( void )
58 {
59     USHORT top810cr;
60     /*** Disabling TOP10 (TO10) output ***/
61
62     P10MOD &= ~0x20u;          /* Disable TOP10 (TO10 output) against output .. Select port P102
output */
63
64     /*** Setting continuous output mode (TOP10) ***/
65
66     IMJTOCR5 = TOP10_ILevel;    /* Set MJT output interrupt 5 (TOP10) interrupt priority
level */
67
68     top810cr = TOP810CR;
69     TOP810CR = ( top810cr & ~TOP10_MASK) | TOP10_CntOutput; /* Set TOP10 continuous output mode */
70
71     TOP10CT = TOP10_Cycle;      /* Set initial value in TOP10 counter */

```

```
72     TOP10RL = TOP10_Cycle;                /* Set initial value in TOP10 reload register */
73
74     TOPPRO &= (~TOP10PRO) & 0xFFFFu;    /* Enable TOP10 enable protect */
75     TOPCEN = 0xffffu;                    /* Enable TOP10 count */
76 }
77
```

4.4.3 startup.ms (A part is extracted.)

(abbreviation)

```

69 ;*****
70 ; ICU Vector Table
71 ;*****
72 ;
73     .SECTION          ICUVECT, DATA, ALIGN=4
74 ;
75     .IMPORT           $TOP10_FixCycInt
76 ;
77 vectbl:
78     .DATA.W           EIT_reset           ; H'0000 0094   MJT Input Interrupt 4:TIN3-TIN6
79     .DATA.W           EIT_reset           ; H'0000 0098   MJT Input Interrupt 3:TIN20-TIN23
80     .DATA.W           EIT_reset           ; H'0000 009C   MJT Input Interrupt 2:TIN12-TIN19
81     .DATA.W           EIT_reset           ; H'0000 00A0   MJT Input Interrupt 1:TIN0-TIN2
82     .DATA.W           EIT_reset           ; H'0000 00A4   MJT Input Interrupt 0:TIN7-TIN11
83     .DATA.W           EIT_reset           ; H'0000 00A8   MJT Output Interrupt 7:TMS0,TMS1
84     .DATA.W           EIT_reset           ; H'0000 00AC   MJT Output Interrupt 6:TOP8,TOP9
85     .DATA.W           $TOP10_FixCycInt    ; H'0000 00B0   MJT Output Interrupt 5:TOP10
86     .DATA.W           EIT_reset           ; H'0000 00B4   MJT Output Interrupt 4:TIO4-TIO7
87     .DATA.W           EIT_reset           ; H'0000 00B8   MJT Output Interrupt 3:TIO8,TIO9
88     .DATA.W           EIT_reset           ; H'0000 00BC   MJT Output Interrupt 2:TOP0-TOP5
89     .DATA.W           EIT_reset           ; H'0000 00C0   MJT Output Interrupt 1:TOP6,TOP7
90     .DATA.W           EIT_reset           ; H'0000 00C4   MJT Output Interrupt 0:TIO0-TIO3
91     .DATA.W           EIT_reset           ; H'0000 00C8   DMAC0-4 Interrupt:DMA0-DMA4
92     .DATA.W           EIT_reset           ; H'0000 00CC   SIO1 Receive Interrupt
93     .DATA.W           EIT_reset           ; H'0000 00D0   SIO1 Transmit Interrupt
94     .DATA.W           EIT_reset           ; H'0000 00D4   SIO0 Receive Interrupt
95     .DATA.W           EIT_reset           ; H'0000 00D8   SIO0 Transmit Interrupt
96     .DATA.W           EIT_reset           ; H'0000 00DC   A-D0 Conversion Interrupt
97     .DATA.W           EIT_reset           ; H'0000 00E0   TID0 Output Interrupt
98     .DATA.W           EIT_reset           ; H'0000 00E4   TOD0 Output Interrupt
99     .DATA.W           EIT_reset           ; H'0000 00E8   DMAC5-9 Interrupt:DMA5-DMA9
100    .DATA.W           EIT_reset           ; H'0000 00EC   SIO2,3 Transmit/Receive Interrupt
101    .DATA.W           EIT_reset           ; H'0000 00F0   RTD Interrupt
102    .DATA.W           EIT_reset           ; H'0000 00F4   TID1 Output Interrupt
103    .DATA.W           EIT_reset           ; H'0000 00F8   TOD1,TOM0 Output Interrupt
104    .DATA.W           EIT_reset           ; H'0000 00FC   SIO4,5 Transmit/Receive Interrupt
105    .DATA.W           EIT_reset           ; H'0000 0100   A-D1 Conversion Interrupt
106    .DATA.W           EIT_reset           ; H'0000 0104   TID2 Output Interrupt
107    .DATA.W           EIT_reset           ; H'0000 0108   TML1 Input Interrupt
108    .DATA.W           EIT_reset           ; H'0000 010C   CAN0 Transmit/Receive & Error Interrupt
109    .DATA.W           EIT_reset           ; H'0000 0110   CAN1 Transmit/Receive & Error Interrupt
110 ;

```

(abbreviation)

4.5 Timing of operation

Timing of operation in this reference program is shown below.
(In the program, it is considering as $n = (5000 - 1)$)

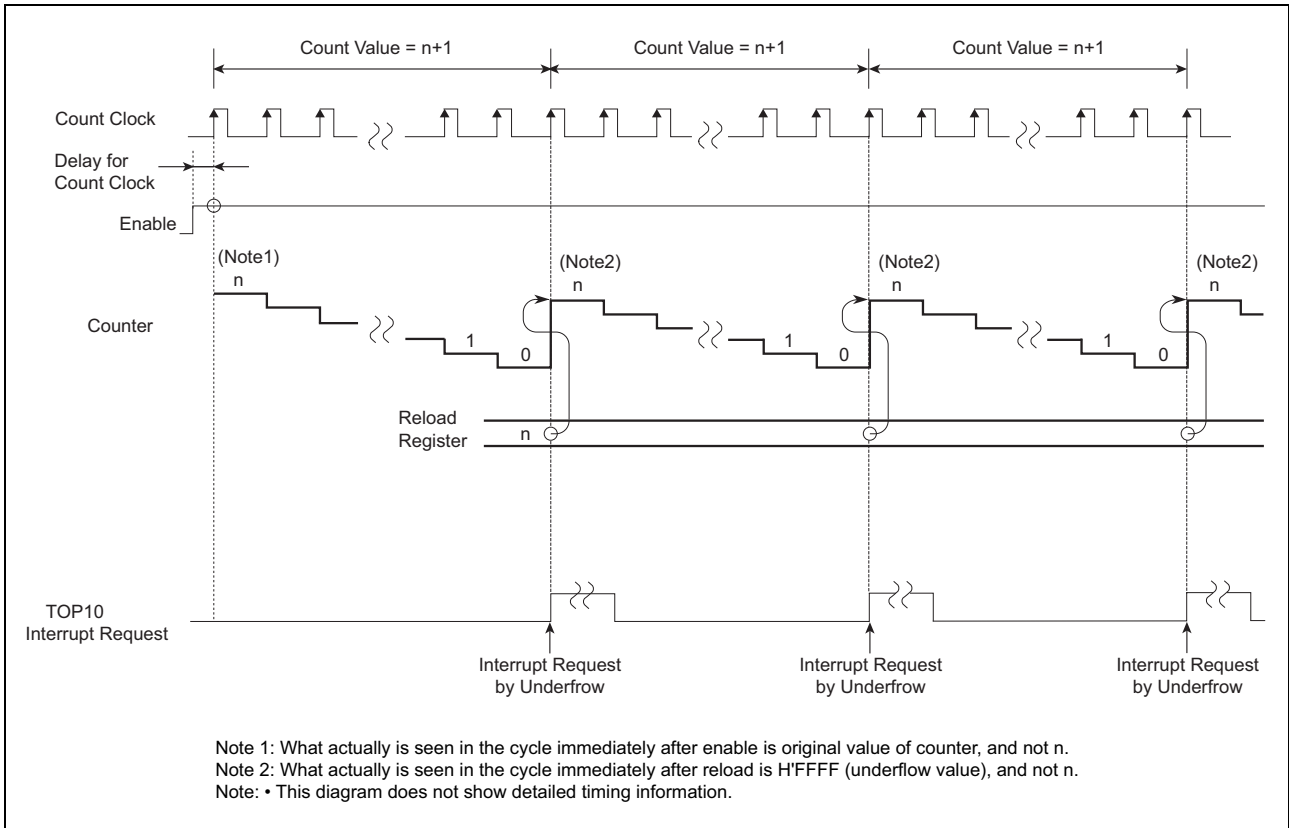


Figure 4.5.1 Timing Diagram for TOP Continuous Pulse Output

5. Reference of Document

- 32176 Group User's Manual Rev.1.01
- M32R Family Software Manual Rev.1.20
- M3T-CC32R V.4.30 User's Manual (Compiler)
- M3T-AS32R V.4.30 User's Manual (Assembler)

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