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Renesas Electronics Corporation

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APPLICATION NOTE

Using Clock Output Function for Clock Output

Introduction

The clock output function of timer A is used to produce clock output from the TMOW output pin.

Target Device

H8/300H Tiny Series H8/3664

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1. Specifications

1. The clock output function of timer A is used to produce clock output from the TMOW output pin.
2. The clock to be output can be selected from a total of eight clocks: four clocks obtained by dividing the system clock and another four clocks obtained by dividing 32.768 kHz (subsystem clock).
3. In this sample task, a 2.048-kHz clock (subsystem clock/16) is output from the TMOW output pin.

2. Description of Functions Used

In this sample task, a clock is output from the TMOW output pin by the clock output function of timer A. Figure 2.1 is a block diagram of the clock output function of timer A. The elements of the block diagram are described below.

- The system clock (ϕ) is a 16-MHz OSC clock that is used as a reference clock for operating the CPU and peripheral functions.
- ϕ_w is the clock (32.768 kHz) output by the subclock pulse generator.
- Prescaler S (PSS) is a 13-bit counter with clock input of ϕ. PSS is incremented every cycle.
- Prescaler W (PSW) is a 5-bit counter with clock input of 32.768 kHz divided by four (ϕ_w/4). The divided output is used in clock time-base operation of timer A.
- Timer mode register A (TMA) is an 8-bit readable/writable register that selects the clock to be output from the TMOW output pin. In this sample task, a 2.048-kHz clock (subsystem clock/16) is selected to be output from the TMOW output pin by setting TMA to H'B0.
- The clock output pin (TMOW) is an output pin for the timer output clock. The clock to be output from the TMOW pin can be selected from a total of eight clocks: four clocks obtained by dividing the system clock by 32, 16, 8, and 4, and another four clocks obtained by dividing the subsystem clock by 32, 16, 8, and 4.
- Table 2.1 lists the clock types that can be output from the TMOW pin and the respective TMA values.

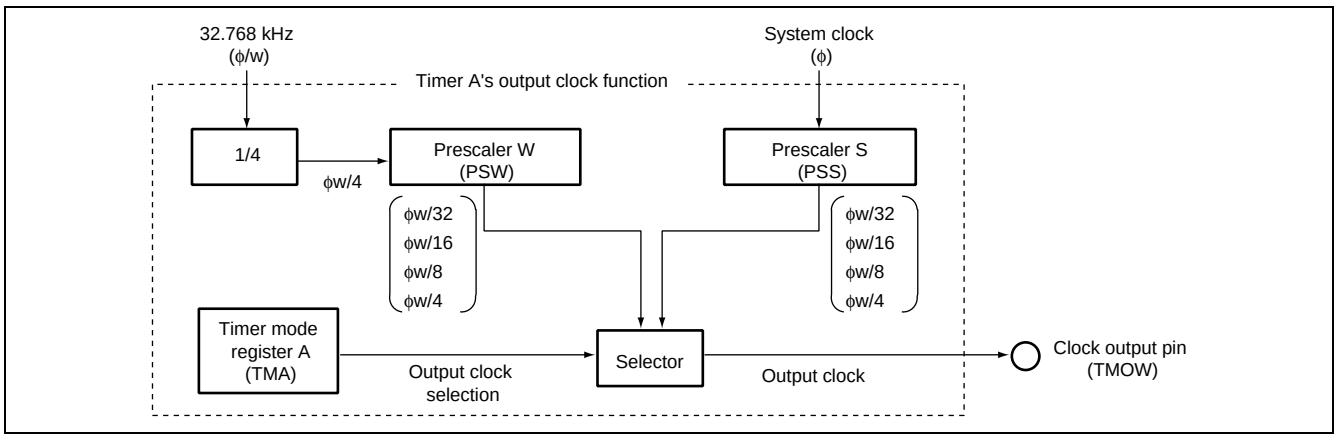

Figure 2.1 Timer A's Clock Output Function

Table 2.1 Clock Output from TMOW Pin and TMA Values

TMA					
TMA7	TMA6	TMA5	Output Clock	Output Clock Frequency	TMA Value
0	0	0	φ/32	16 MHz/32 = 500 kHz	H'10
0	0	1	φ/16	16 MHz/16 = 1000 kHz	H'30
0	1	0	φ/8	16 MHz/8 = 2000 kHz	H'50
0	1	1	φ/4	16 MHz/4 = 4000 kHz	H'70
1	0	0	φ/32	32.768 kHz/32 = 1.024 kHz	H'90
1	0	1	φ/16	32.768 kHz/16 = 2.048 kHz	H'B0
1	1	0	φ/8	32.768 kHz/8 = 4.096 kHz	H'D0
1	1	1	φ/4	32.768 kHz/4 = 8.192 kHz	H'F0

Table 2.2 lists the function allocation for this sample task. The functions listed in table 2.2 are allocated so that a clock is output by the clock output function of timer A.

Table 2.2 Function Allocation

Function	Description
PSS	13-bit counter with system clock input
PSW	5-bit counter with clock input of 32.768 kHz/4
TMA	Selects the output clock
TMOW	Clock output pin
PMR1	Sets the TMOW output pin function

3. Description of Operations

Figure 3.1 shows this sample task's principle of operation. The hardware and software processing shown in figure 3.1 applies the clock output function of timer A for clock output.

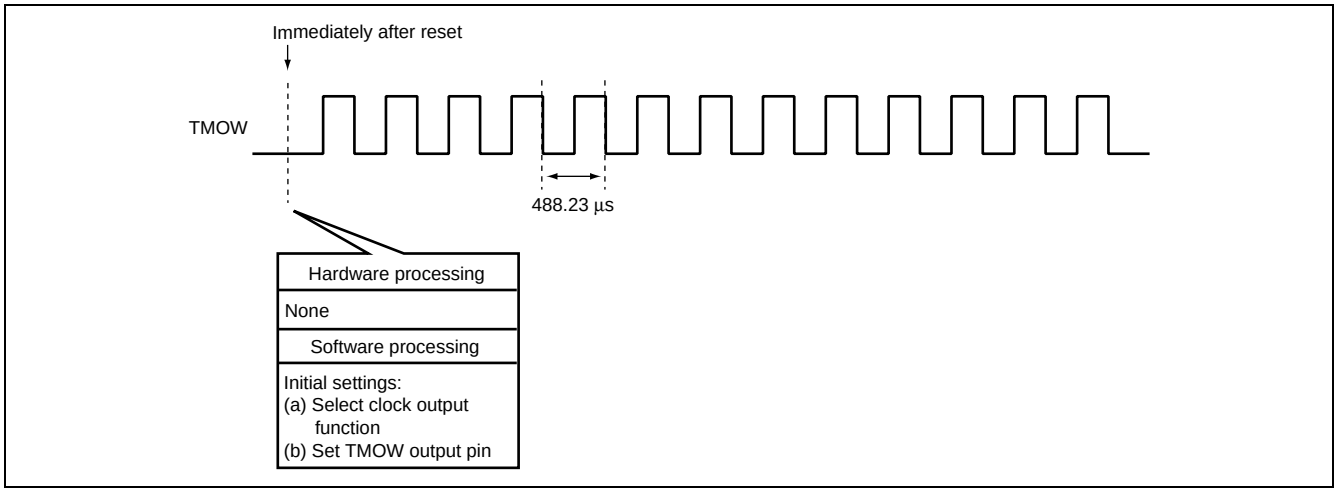

Figure 3.1 Operation Principle: Using Clock Output Function of Timer A for Clock Output

4. Description of Software

4.1 Description of Modules

Table 4.1 describes the software used in this sample task.

Table 4.1 Description of Module

Module Name	Label Name	Function
Main routine	main	Selects the clock output function, sets the TMOW output pin, and enables interrupts.

4.2 Description of Arguments

No arguments are used in this sample task.

4.3 Description of Internal Registers

Table 4.2 describes the internal registers used in this sample task.

Table 4.2 Description of Internal Registers

Register Name		Function	Address	Setting
TMA		Timer mode register A: When TMA is set to H'B0, a 2.048-kHz clock (subsystem clock/16) is output from the TMOW output pin.	H'FFA6	H'B0
PMR1	TMOW	Port mode register 1 ($P1_0$/TMOW pin function switch): When TMOW is set to 1, the $P1_0$/TMOW pin functions as the TMOW output pin.	H'FFE0 Bit 0	 1

4.4 Description of RAM

RAM is not used in this sample task.

5. Flowchart

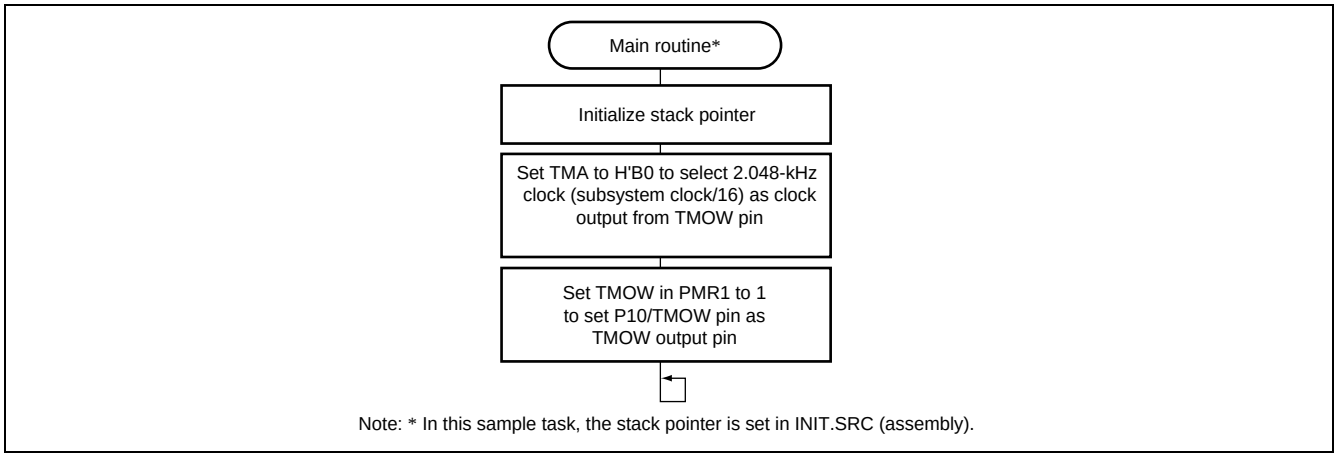

Figure 5.1 Flowchart for Main Routine

6. Program Listing

INIT.SRC (Program listing)

```
      .EXPORT  _INIT
      .IMPORT  _main
 ;
      .SECTION    P,CODE
 _INIT:
      MOV.W    #H'FF80,R7
      LDC.B    #B'10000000,CCR
      JMP      @_main
 ;
      .END
```

```
/************************************************************/
/*                                                          */
/*    H8/300H Tiny Series -H8/3664-                         */
/*    Application Note                                      */
/*                                                          */
/*    'Clock Output by Clock Output Function'               */
/*                                                          */
/*    Function                                              */
/*    : Timer A Clock Output                                */
/*                                                          */
/*    External Clock : 16MHz                                */
/*    Internal Clock : 16MHz                                */
/*    Sub Clock      : 32.768kHz                            */
/*                                                          */
/************************************************************/

#include    <machine.h>
```

```
/************************************************************/
/*    Symbol Defnition                                      */
/************************************************************/

struct BIT {
    unsigned char    b7:1;      /* bit7 */
    unsigned char    b6:1;      /* bit6 */
    unsigned char    b5:1;      /* bit5 */
    unsigned char    b4:1;      /* bit4 */
    unsigned char    b3:1;      /* bit3 */
    unsigned char    b2:1;      /* bit2 */
    unsigned char    b1:1;      /* bit1 */
    unsigned char    b0:1;      /* bit0 */
};

#define        TMA         *(volatile unsigned char *)0xFFA6    /* Timer Mode Register A             */
#define        PMR1_BIT    (*(struct BIT *)0xFFE0)              /* Port Mode Register 1              */
#define        TMOW        PMR1_BIT.b0                          /* P10/TMOW Terminal Function Change */

/************************************************************/
/*     Function Definition                                  */
/************************************************************/
extern    void    INIT ( void );                               /* SP Set                            */
void    main     ( void );

/************************************************************/
/*    Vector Address                                        */
/************************************************************/
#pragma    section        V1                                  /* VECTOR SECTOIN SET                */
void (*const VEC_TBL1[])(void) = {
/* 0x00 - 0x0f */
    INIT                                                     /* 00 Reset                          */
};

#pragma    section                                           /* P                                 */
```

```
/************************************************************/
/*    Main Program                                          */
/************************************************************/

void    main ( void )
{

    TMA = 0xB0;                                     /* Initialize Output Clock Function         */

    TMOW = 1;                                       /* Initialize TMOW Output Terminal Function */

    while(1)    {
        ;
    }
}
```

Link Address Setting:

Section Name	Address
CV1	H'0000
P	H'0100