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Renesas Electronics Corporation

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H8/300L SLP Series

Using the Clock Time-Base Function to Drive LED Blinking

Introduction

The clock time-base function of Timer A is used to turn on and off the LED every 1 second.

Target Device

H8/38024

Contents

1. Specifications

1. The clock time-base function of Timer A is used to turn on and off the LED every 1 second.
2. A Timer A interrupt is generated by overflow of Timer Counter A (TCA) and the LED is turned on and off during the Timer A interrupt handling.
3. The LED is connected to P92 output pin of Port 9.
4. The P92 pin is a large-current port.
5. Set a Timer A interrupt to be generated every 1 second by clock time-base operation.

2. Description of Functions

1. In this task example, the LED is turned on and off every 1 second using the clock time-base function of Timer A. Figure 2.1 shows a block diagram of the clock time base function of Timer A, which is described below.
   - ϕ_w is the output clock (32.768 kHz) of the subclock oscillator.
   - The prescaler W (PSW) is a 5-bit counter using a clock input ($\phi_w/4$) obtained by dividing 32.768 kHz by 4. The divided output is used in clock time-base operation of Timer A.
   - Timer Mode Register A (TMA) is an 8-bit read/write register and selects the TCA input clock source and TCA overflow period. In this task example, PSW is selected as the TCA input clock source and 1 sec is selected as the TCA overflow period.
   - Timer Counter A (TCA) is an 8-bit read-only up counter and is counted up by an internal clock input. When the TCA overflows, the Timer A overflow interrupt request flag (IRRTA) in Interrupt Request Register 1 (IRR1) is set to 1.
   - IRRTA is set to 1 when the TCA overflows. A Timer A interrupt is accepted and Timer A interrupt handling is started when IRRTA is set to 1, Timer A interrupt enable (IENTA) in Interrupt Enable Register 1 (IENR1) is set to 1 and the I bit in the condition code register (CCR) is cleared to 0.

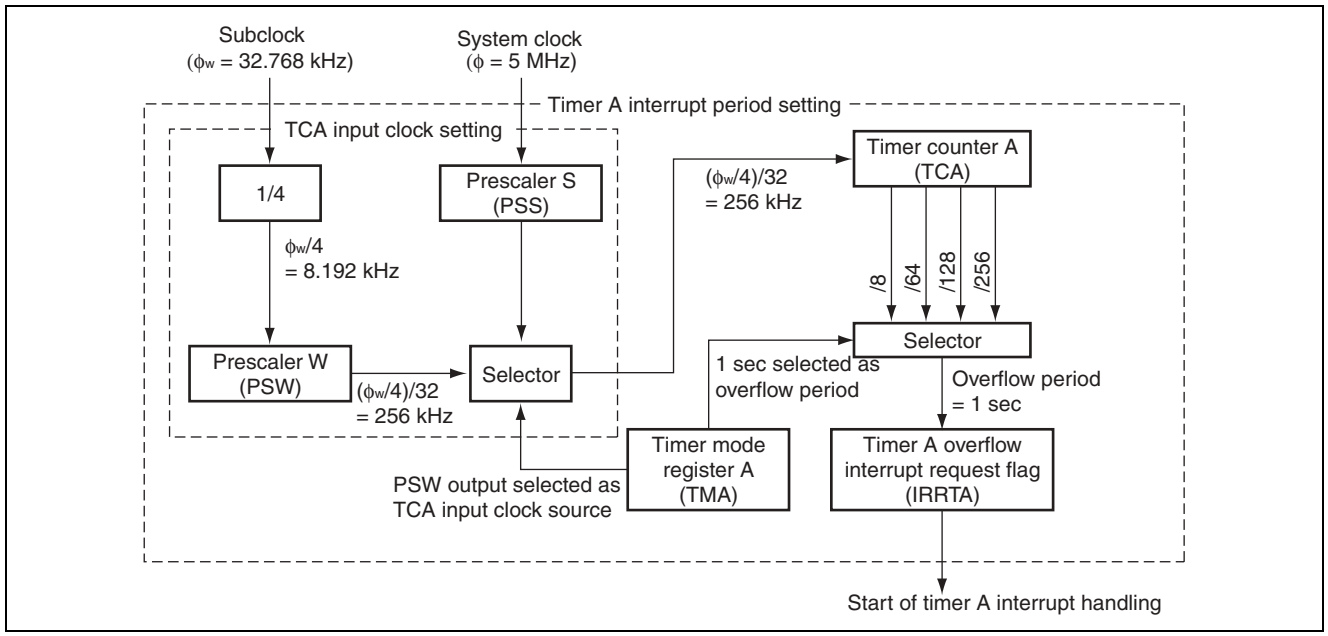


Figure 2.1 Block Diagram of Timer A Clock Time-Base Function

2. Table 2.1 shows function assignment in this task example. The functions are assigned as shown in table 2.1 and the LED is flickered by the clock time-base function of Timer A.

Table 2.1 Assignment of Functions

Function	Assignment
PSW	A 5-bit up counter using a clock input of subclock (32.768 kHz) / 4.
IENTA	Enables Timer A interrupt request.
IRRTA	Indicates whether or not a Timer A interrupt request is issued.
TMA	Selects PSW and sets TCA overflow period.
TCA	An 8-bit up counter using a clock input of subclock (32.768 kHz) / 128.
PDR9	Stores data of the P92 output pin.
P92	LED output

3. Principle of Operation

1. Figure 3.1 illustrates the principle of operation of this sample task. As shown in figure 3.1, the LED is flickered by the clock time base function of Timer A by means of hardware processing and software processing.

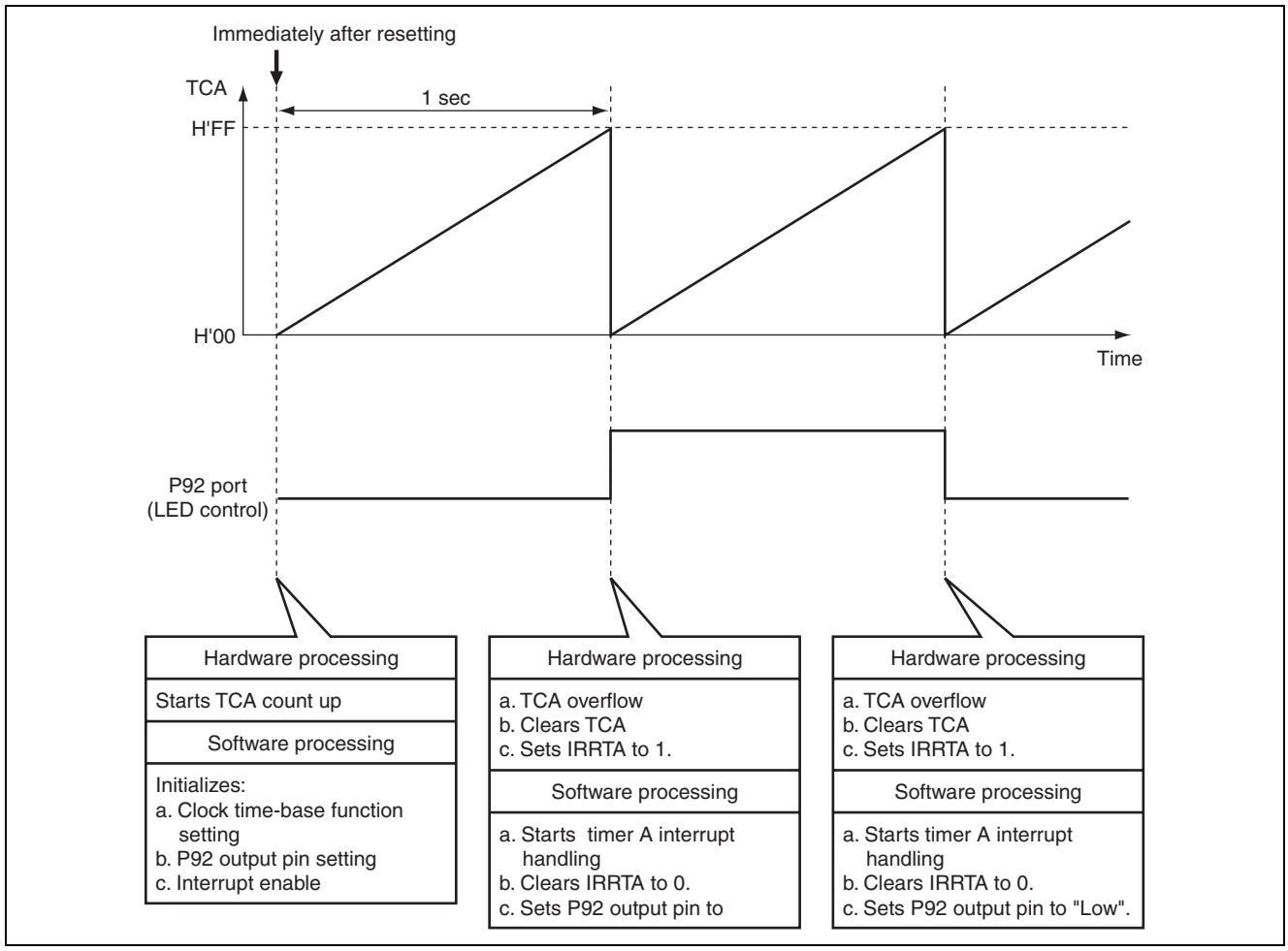


Figure 3.1 Operation Principle of LED Flickering by Timer A Clock Time-Base Function

4. Description of Software

4.1 Modules

Table 4.1 describes the modules in this task example.

Table 4.1 Description of Module

Module	Label	Function
Main Routine	main	Sets the clock time-base function, sets Port 9 and enables interrupts.
LED Control	taint	Turns on and off the LED during the Timer A interrupt handling routine.

4.2 Arguments

Arguments are not used in this task example.

4.3 Internal registers

Table 4.2 describes the internal registers in this task example.

Table 4.2 Description of Internal Registers

Register		Function	Address	Setting
IENR1	IENTA	Interrupt Enable Register 1 (Timer A Interrupt Enable) If IENTA = 0, Timer A interrupt request is disabled. If IENTA = 1, Timer A interrupt request is enabled.	H'FFF3 Bit 7	1
IRR1	IRRTA	Interrupt Request Register 1 (Timer A Interrupt Request Flag) If IRRTA = 0, Timer A interrupt is not requested. If IRRTA = 1, Timer A interrupt is requested.	H'FFF6 Bit 7	0
TMA		Timer Mode Register A If TMA = H'18, the Timer A function is set to the clock time base function, TCA input clock source is set to PSW, and TCA overflow period is set to 1 sec.	H'FFB0	H'18
TCA		Timer Counter A An 8-bit up counter using a clock input of 32.768 kHz/128.	H'FFB1	H'00
PDR9	P92	Port Data Register 9 (Port Data Register 92) If P92 = 0, the output level of the P92 pin is "Low". If P92 = 1, the output level of the P92 pin is "High".	H'FFDC Bit 2	0

4.4 Description of RAM

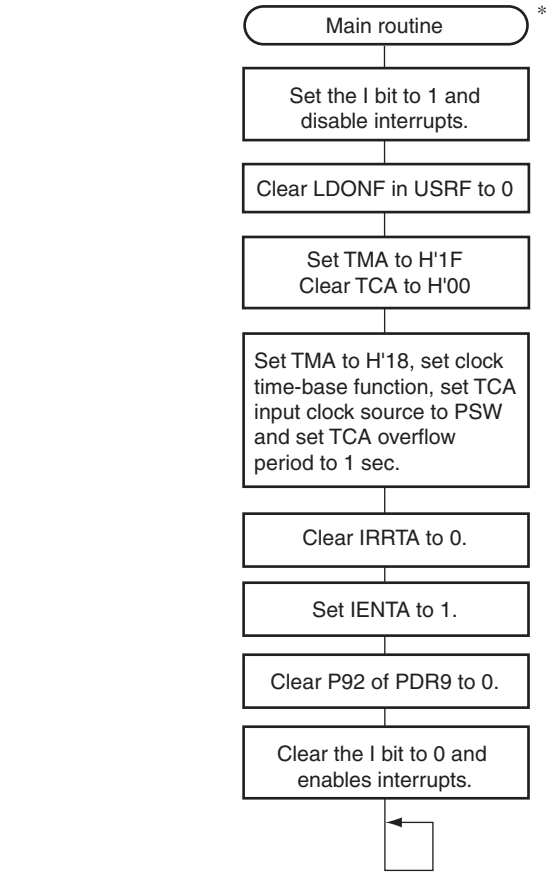
Table 4.3 shows the RAM used in this task example.

Table 4.3 Description of Internal Registers

Label		Function	Address	Used in
USRF	LDONF	Flag to judge LED ON/OFF	H'FB80 Bit 0	Main Routine LED Control

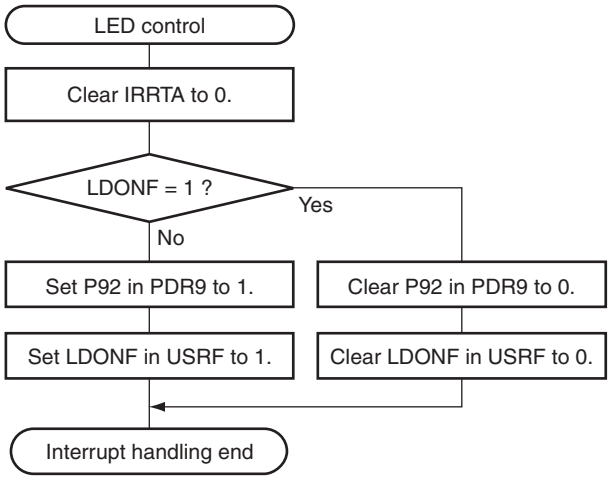
5. Flowchart

1. Main routine



Note: * In this sample task, the stack pointer is set in INIT.SRC (assembly language).

2. Timer A interrupt handling 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
```

```
/************************************************************************************************************************/
/*                                                                                                                      */
/*  H8/300L Super Low Power Series                                                                                      */
/*      -H8/38024 Series-                                                                                               */
/*  Application Note                                                                                                    */
/*                                                                                                                      */
/*  'LED Flickering by Clock Time-Based Function'                                                                       */
/*                                                                                                                      */
/*  Function                                                                                                            */
/*  :Timer A Clock Time Base                                                                                            */
/*                                                                                                                      */
/*  External Clock : 10MHz                                                                                              */
/*  Internal Clock : 5MHz                                                                                               */
/*  Sub Clock      : 32.768kHz                                                                                          */
/*                                                                                                                      */
/************************************************************************************************************************/

#include    <machine.h>

/************************************************************************************************************************/
/*  Symbol Definition                                                                                                   */
/************************************************************************************************************************/
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 *)0xFFB0       /* Timer Mode Register A                */
#define     TCA         *(volatile unsigned char *)0xFFB1       /* Timer Counter A                      */
#define     PDR9_BIT    (*(struct BIT *)0xFFDC)                 /* Port Data Register 9                 */
#define     P92         PDR9_BIT.b2                             /* Port Data Register 92                */
#define     IENR1_BIT   (*(struct BIT *)0xFFF3)                 /* Interrupt Enable Register 1          */
#define     IENTA       IENR1_BIT.b7                            /* Timer A Interrupt Enable             */
#define     IRR1_BIT    (*(struct BIT *)0xFFF6)                 /* Interrupt Request Register 1         */
#define     IRRTA       IRR1_BIT.b7                             /* Timer A Interrupt Request Flag       */
```

```
#pragma interrupt   (taint)
/************************************************************************************************************************/
/*  Function define                                                                                                     */
/************************************************************************************************************************/
extern void INIT ( void );                                  /* SP Set                                                   */
void        main ( void );
void        taint ( void );

/************************************************************************************************************************/
/*  RAM define                                                                                                          */
/************************************************************************************************************************/
unsigned char   USRF;                                       /* User Flag Area                                           */

#define     USRF_BIT    (*(struct BIT *)&USRF)
#define     LDONF       USRF_BIT.b0                         /* Led On Flag                                              */

/************************************************************************************************************************/
/*  Vector Address                                                                                                      */
/************************************************************************************************************************/
#pragma section     V1                                      /* Vector Section Set                                       */
void (*const VEC_TBL1[])(void) = {                          /* 0x0000 - 0x000F                                          */
    INIT                                                    /* 0x0000 Reset Vector                                      */
};
#pragma section     V2                                      /* Vector Section Set                                       */
void (*const VEC_TBL2[])(void) = {
    taint                                                   /* 0x0016 Timer A Interrupt Vector                          */
};

#pragma section                                             /* P                                                        */
/************************************************************************************************************************/
/*  Main Program                                                                                                        */
/************************************************************************************************************************/
void main ( void )
{
    set_imask_ccr(1);                                       /* Interrupt Disable                                        */

    LDONF = 0;                                              /* Clear LDONF                                              */

    TMA = 0x1F;                                             /* Initialize Timer Counter A                               */
    TMA = 0x18;                                             /* Initialize Timer A Function &                            */
                                                            /*                      TCA overflow Period                 */

    IRRTA = 0;                                              /* Clear IRRTA                                              */
    IENTA = 1;                                              /* Timer A Interrupt Enable                                 */

    P92 = 0;                                                /* Clear P92                                                */

    set_imask_ccr(0);                                       /* Interrupt Enable                                         */

    while(1){
        ;
    }
}
```

```
/*****************************************************************************************************************/
/*  Timer A Interrupt                                                                                            */
/*****************************************************************************************************************/
void taint ( void )
{
    IRRTA = 0;                                          /* Clear IRRTA                                          */
    if(LDONF == 1){                                     /* LDONF == 1?                                          */
        P92 = 0;                                        /* Turn Off LED                                         */
        LDONF = 0;                                      /* Clear LDONF                                          */
    }
    else{
        P92 = 1;                                        /* Turn On LED                                          */
        LDONF = 1;                                      /* Set LDONF                                            */
    }
}
```

Link address specifications

Section Name	Address
CV1	H'0000
CV2	H'0016
P	H'0100
B	H'FB80

Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Dec.19.03	—	First edition issued

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