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H8/300L SLP Series

Making LEDs on I/O Ports Blink

Introduction

Two LEDs connected to the I/O ports are alternately turned on and off. The interval of turning on and off is set to 0.5 sec. using the clock time-base function of Timer A.

Target Device

H8/38024

Contents

1. Specifications

1. Two LEDs connected to the ports are alternately turned on and off, as shown in figure 1.1.
2. The interval for turning on and off the LEDs is set to 0.5 sec. using the Timer A's clock time-base function.
3. LED1 and LED2 are connected to the P92 and P93 output pins of port 9, respectively.
4. P92 pin is a large-current port.

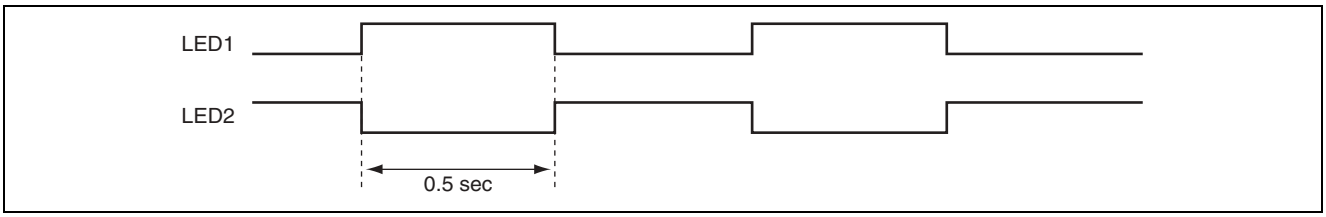


Figure 1.1 Blinking of LEDs

2. Description of Functions

1. In this sample task, LEDs connected to I/O ports are made to blink.
   Figure 2.1 shows the block diagram of the I/O ports which are described below.
   The Port Data Register 9 (PDR9) is an 8-bit register that stores data for pins P95 to P90 of port 9. When a read access to port 9 is made, the values in this register are directly read, regardless of the actual pin states.

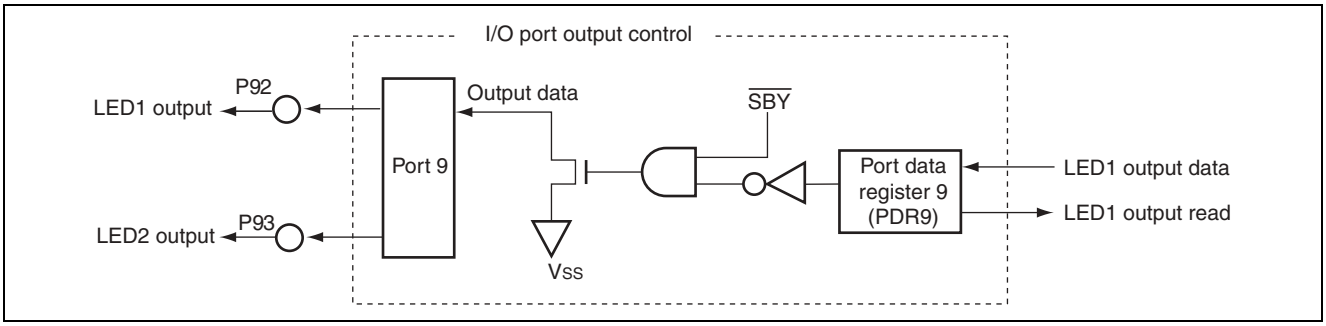


Figure 2.1 Block Diagram of I/O Port Functions

2. Table 2.1 shows the assignment of functions in this sample task. The functions are assigned as shown in table 2.1 to make LEDs on I/O ports blink.

Table 2.1 Function Assignments

Pin/Register	Assigned Function
PSW	5-bit up counter with clock input of subclock (32.768 kHz) / 4
IENTA	Enables Timer A interrupt requests.
IRRTA	Indicates whether or not an Timer A interrupt request has been issued.
TMA	Selects the clock time-base function of timer A and sets the TCA overflow cycle to 0.5 sec.
TCA	8-bit up counter with clock input of subclock (32.768 kHz) / 128
PDR9	Stores data of P92 and P93 output pins.
P92	Output pin for LED1
P93	Output pin for LED2

3. Principle of Operation

1 Figure 3.1 illustrates the principle of operation of this sample task. The LEDs connected to the I/O ports are made to blink through the hardware processing and software processing shown in the figure.

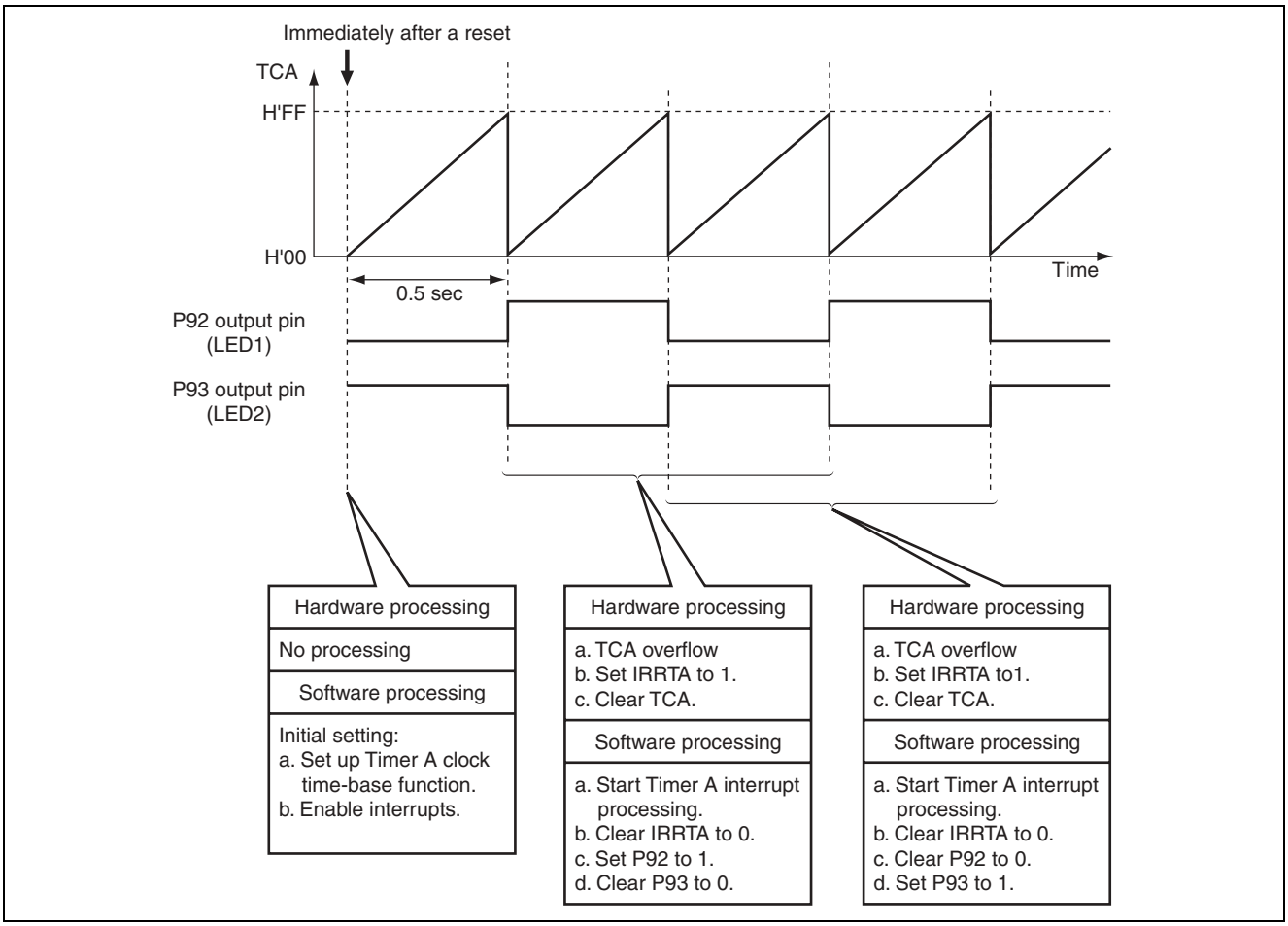


Figure 3.1 Operation Principle of Blinking of LEDs Connected to I/O Ports

4. Description of Software

4.1 Modules

Table 4.1 describes the modules in this sample task.

Table 4.1 Description of Modules

Module	Label	Function
Main Routine	main	Sets the Timer A clock time-base function, sets I/O ports and enables interrupts.
Port Output	taint	A Timer A interrupt handling routine that judges the outputs to LED1 and LED2 and controls the outputs.

4.2 Arguments

Arguments are not used in this sample task.

4.3 Internal registers

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

Table 4.2 Description of Internal Registers

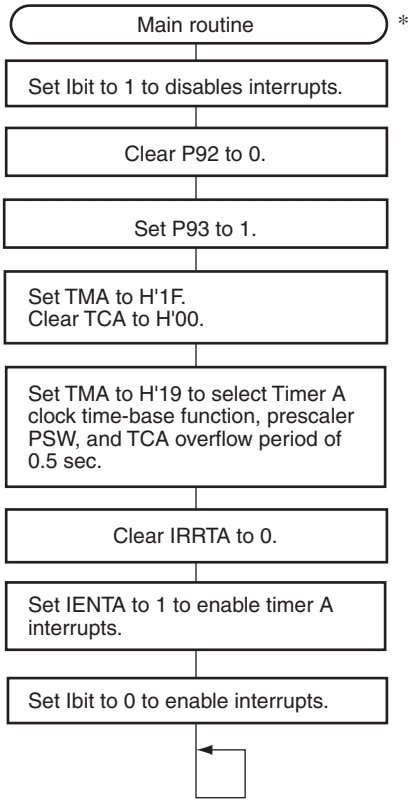
Register		Function	Address	Setting
TMA	TMA3 TMA2 TMA1 TMA0	Timer Mode Register A (Internal Clock Select 3 to 0) If TMA3 = 1, TMA2 = 0, TMA1 = 0 and TMA0 = 1, selects the clock time-base function, prescaler PSW, and the TCA overflow period of 0.5 sec. for Timer A.	H'FFB0 Bit 3 Bit 2 Bit 1 Bit 0	TMA3 = 1 TMA2 = 0 TMA1 = 0 TMA0 = 1
TCA		Timer Counter A An 8-bit up counter that uses the clock output by PSW as input and overflows every 0.5 sec.	H'FFB1	H'00
PDR9	P93	Port Data Register 9 (Port Data Register 93) If P93 = 0, the output level on the P93 pin is Low. If P93 = 1, the output level on the P93 pin is High.	H'FFDC Bit 3	1
	P92	Port Data Register 9 (Port Data Register 92) If P92 = 0, the output level on the P92 pin is Low. If P92 = 1, the output level on the P92 pin is High.	H'FFDC Bit 2	0
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 has been requested.	H'FFF6 Bit 7	0

4.4 Description of RAM

RAM is not used in this sample task.

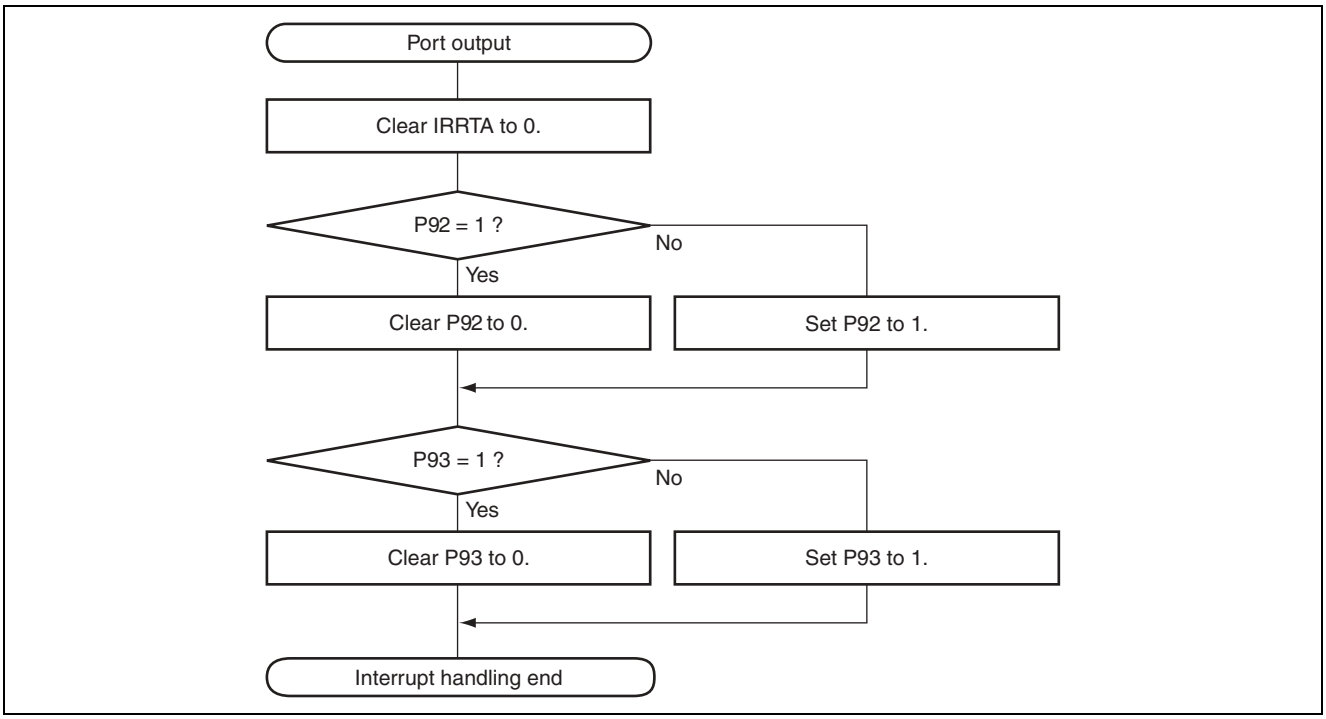
5. Flowchart

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                                                                                                    */
/*                                                                                                                      */
/*  'Flickering of LEDs Connected to I/O Port'                                                                          */
/*                                                                                                                      */
/*  Function                                                                                                            */
/*  : I/O Port                                                                                                          */
/*                                                                                                                      */
/*  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     P93         PDR9_BIT.b3                             /* Port Data Register 93                */
#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 );

/************************************************************************************************************************/
/*  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                                        */

    TMA = 0x1F;                                             /* Initialize Timer Counter A                               */
    TMA = 0x19;                                             /* Initialize TCA Overflow Period                           */

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

    P92 = 0;                                                /* Initialize P92 Terminal Output                           */
    P93 = 1;                                                /* Initialize P93 Terminal Output                           */

    set_imask_ccr(0);                                       /* Interrupt Enable                                         */

    while(1){
        ;
    }
}
```

```
/*****************************************************************************************************************/
/*  Timer A Interrupt                                                                                            */
/*****************************************************************************************************************/
void    taint ( void )
{
    IRRTA = 0;                                          /* Clear IRRTA                          */
    if ( P92 = =  1 ){                                  /* Turn on LED1 ?                       */
        P92 = 0;                                        /* Turn off LED1                        */
    }
    else{
        P92 = 1;                                        /* Turn on LED1                         */
    }

    if ( P93 = =  1 ){                                  /* Turn on LED2 ?                       */
        P93 = 0;                                        /* Turn off LED2                        */
    }
    else{
        P93 = 1;                                        /* Turn on LED2                         */
    }
}
```

Link address specifications

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

Revision Record

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

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