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April 1st, 2010
Renesas Electronics Corporation

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7542 Group

A/D Conversion Control

1. Abstract

- The A/D conversion use the following functions:
 - A/D conversion
 - Timer 1(Timer mode)
 - Timer X(Pulse output mode)

2. Introduction

- The explanation of this issue is applied to the following condition:
 - Applicable MCU: 7542 group
 - Oscillation frequency: 8MHz
 - Memory size: ROM 32K ,RAM 1KB
- Operation:
 - LED blink state can be separated two modes:
 - Waiting mode
 - LED blink mode
 - After reset, the Microcomputer goes to Waiting mode (LED begin to blink with 1KHz).
 - When turned potentiometer, LED blink frequency varied with the value of A/D conversion. Higher the value of A/D conversion is , lower the frequency is.
- When push the reset switch, the Microcomputer goes to waiting mode

3. Contents

3.1 Global variable

Table 3.1 show the global variable of program:

Table 3.1 Global variable

Lable Data Type	Initial value	Size(Byte)	Description	Min	Max	Flag
adcurrent	00H	1	Current value of A/D	00	FF	—
adpast	00H	1	Past value of A/D	00	FF	—
adfirst	00H	1	First value of A/D	00	FF	—
sign	00H	1	A/D value changed sign	00	01	—
sign1	FFH	1	P03 output value sign	00	FF	—
resetr	00H	1	Mode sign	00	01	—

3.2 Timer 1(Timer mode)

Figure 1. show the setup of 10ms main loop:

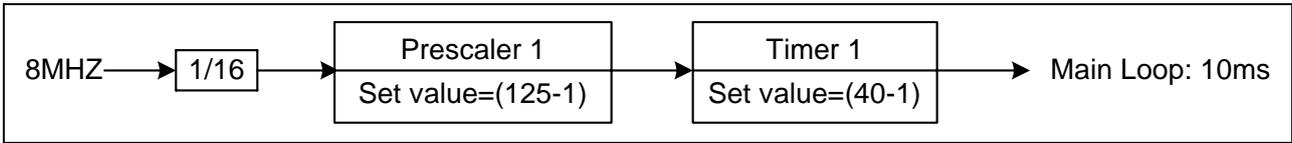
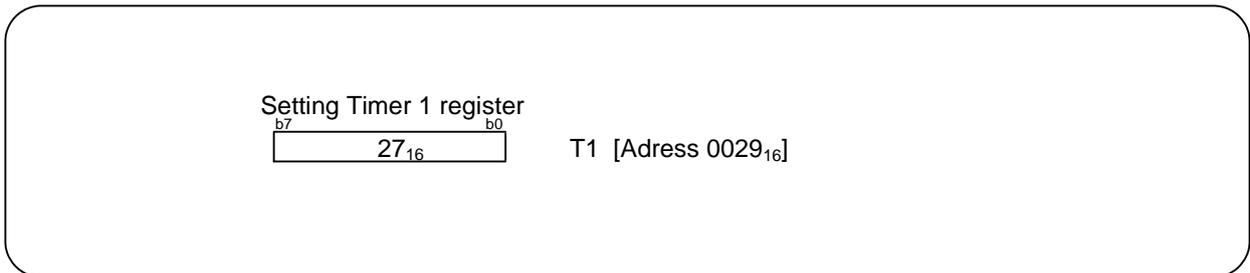
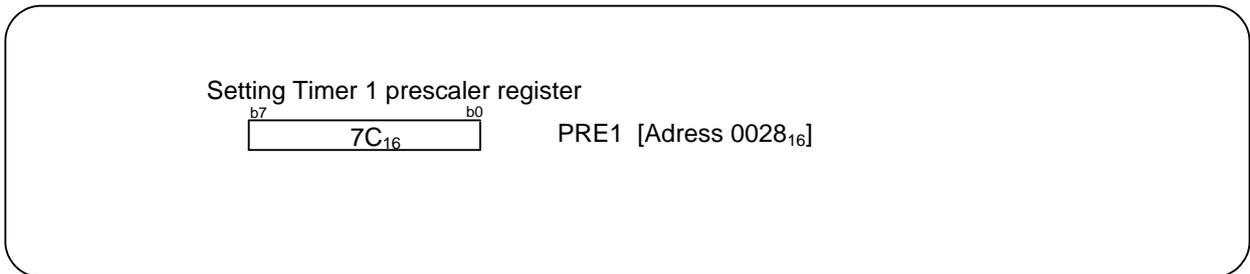


Figure 1. Timer 1 10ms Main Loop Setup

Timer 1 is used in timer mode.
The standard period of 10ms is used for main cycle.
Setup of Timer 1 is shown in the following:



3.3 Timer X (Pulse output mode)

Figure 2. show the setup of 1ms blink time:

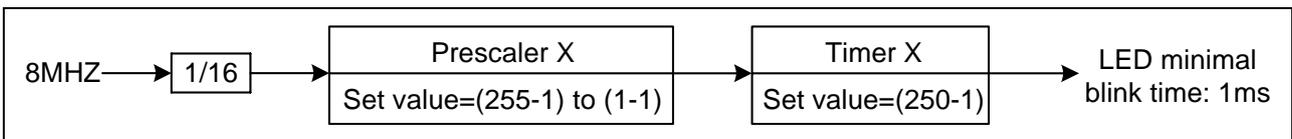
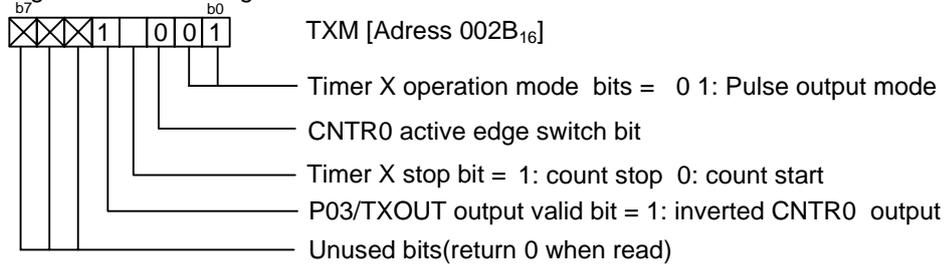


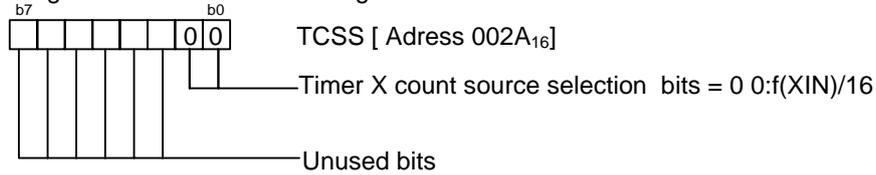
Figure 2. Timer X 1ms Blink Setup

Timer X(Pulse output mode) is used to blink a LED, setup is shown in the following:

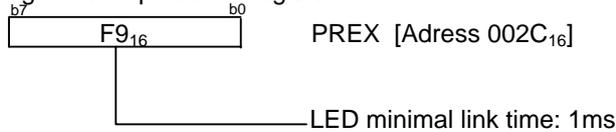
Setting Timer X mode register



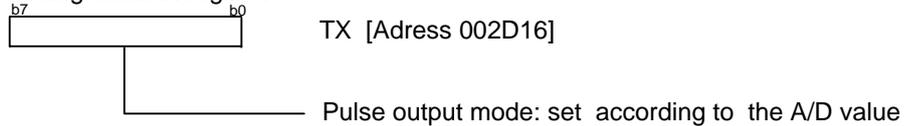
Setting Timer count source set register



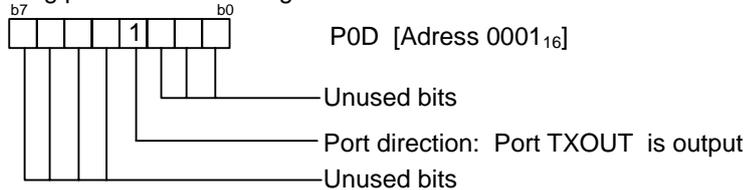
Setting Timer X prescaler register



Setting Timer X register



Setting port P0 direction register

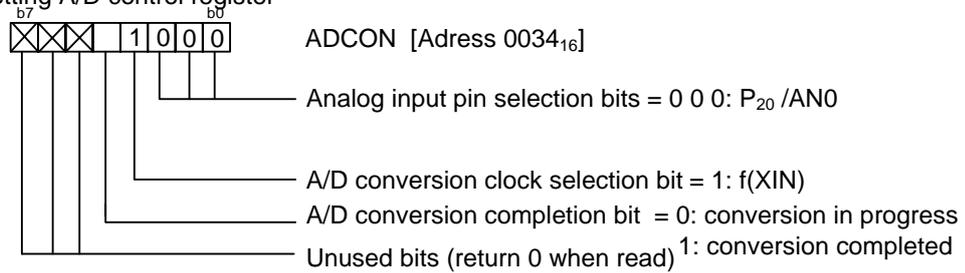


3.4 A/D Input

Input voltage from AN0(P₂₀) is converted by A/D. AN0 shall be setted input pin. A potentiometer is connected to AN0.

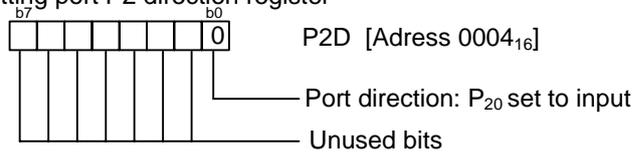
The setups of A/D converter and P2D is shown in the following:

Setting A/D control register



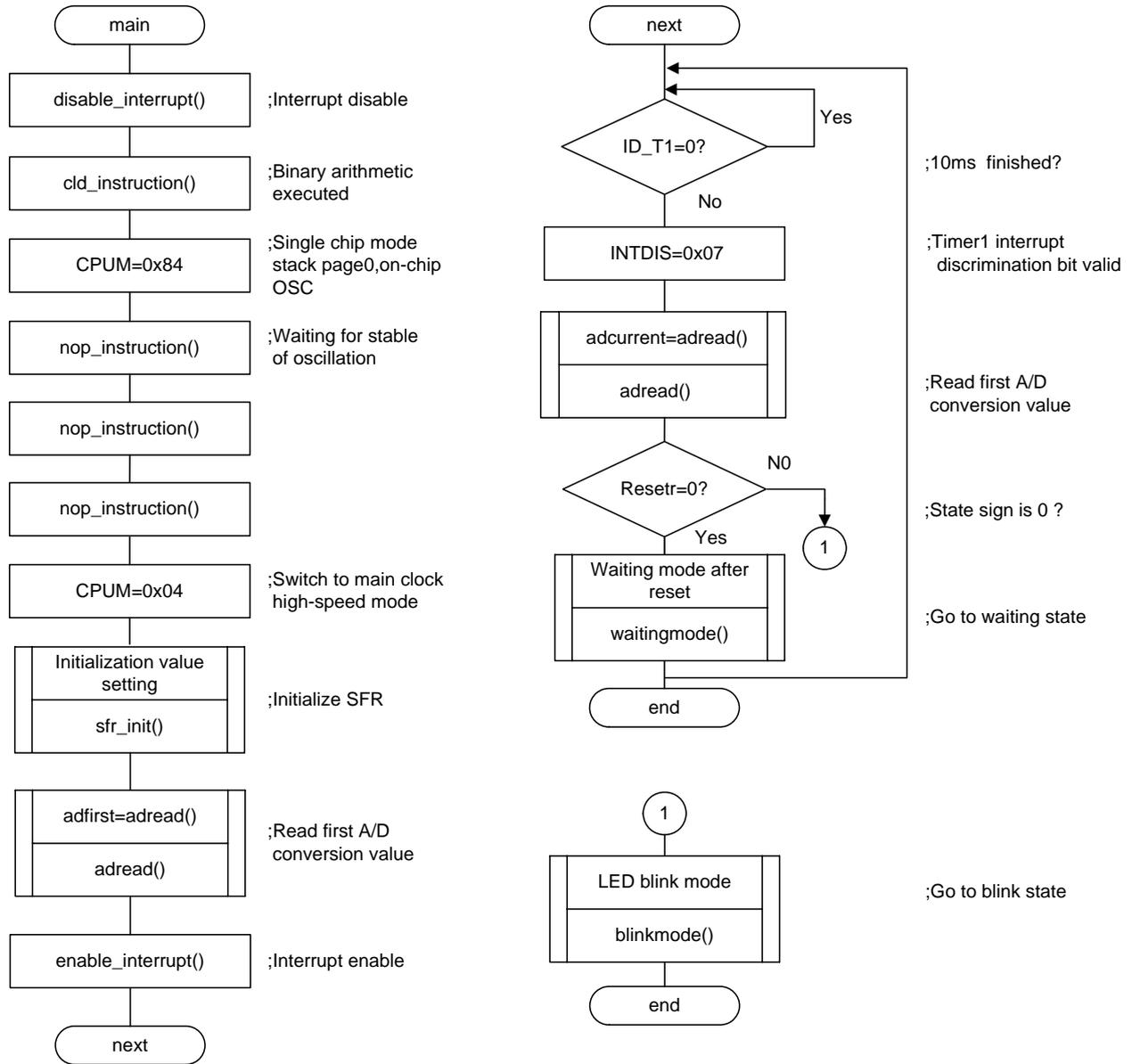
Note: A/D conversion clock = f(XIN) can be used only when ceramic oscillation or on-chip oscillator is used

Setting port P2 direction register

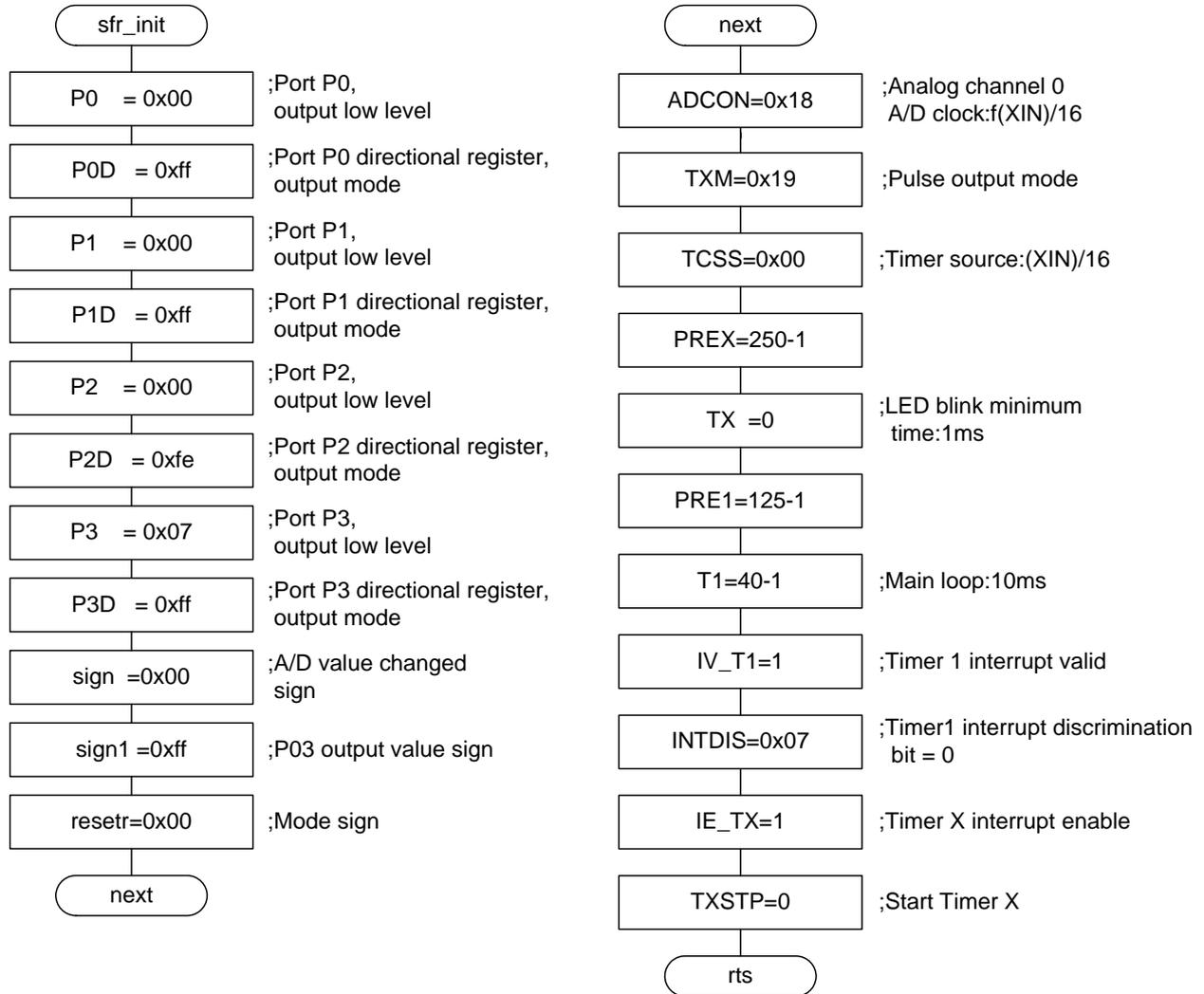


4. Flow chart

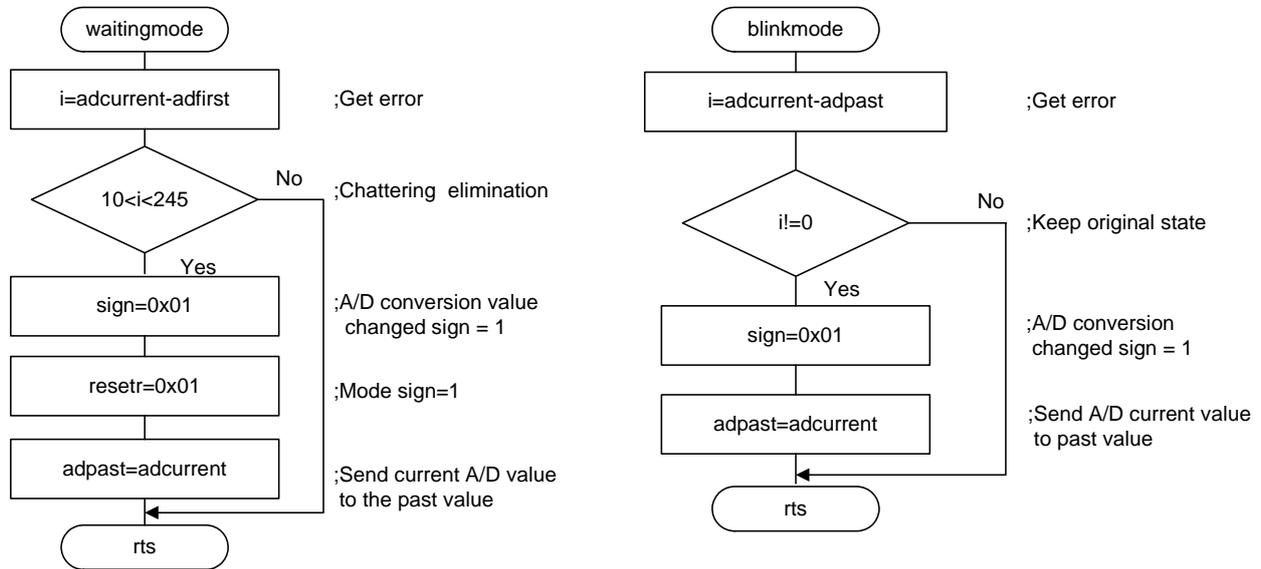
Following is the main loop program chart:



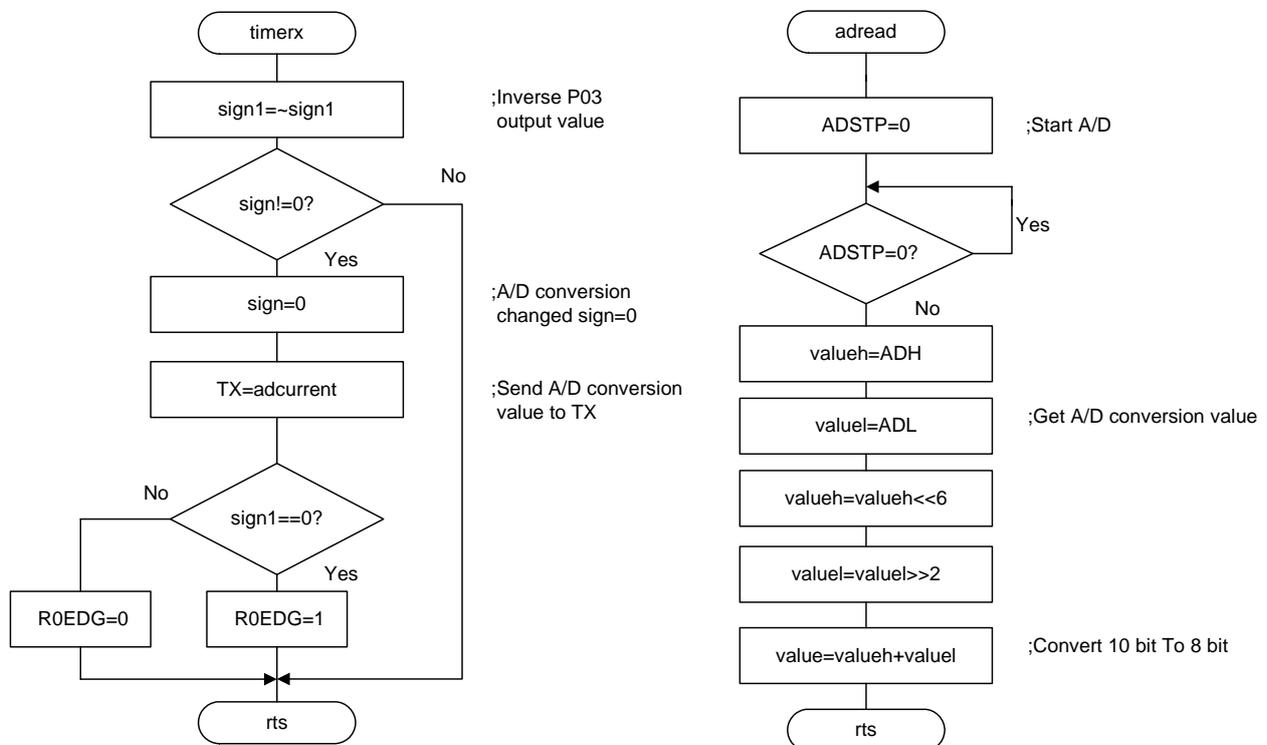
4.1 Following is the charts of initial setting subprogram(sfr_init):



4.2 Following is the charts of waiting mode subprogram(waitingmode),LED blink mode subprogram(blinkmode):



4.3 Following is Timer X interrupt handler subprogram(timerx),A/D read subprogram(adread) :



5. Sample program

```

/*****
* File Name      : main.c
* Contents       : Demo program for AD converter and Timer X
*                 (Pulse Output Mode)
* Copyright      : Renesas Technology Corp.,
* Version        : 1.00( 2005-12-28 ) Initial
*
*****/
#include<intr740.h>
#include "adconvert.h"
#include "SFR_7542.h"
main()
{
    disable_interrupt(); /* Interrupt disable */
    cld_instruction();   /* Binary arithmetic executed */
    CPUM=0x84;           /* Single chip mode,stack page0,on-chip OSC */
    nop_instruction();  /* Waiting for stable of oscillation */
    nop_instruction();
    nop_instruction();
    CPUM=0x04;           /* Switch to main clock,high-speed Mode */
    sfr_init();         /* Initialize SFR */
    adfirst=adread();   /* Read first A/D conversion value */
    enable_interrupt(); /* Interrupt enable */
    while(1)
    {
        while(ID_T1 ==0){} /* 10ms finished? */
        INTDIS=0x07;      /* Timer1 interrupt discrimination bit valid */
        adcurrent = adread();
        if(resetr==0)
            waitingmode(); /* Go to waiting state */
        else
            blinkmode();   /* Go to blink state */
    }
}

/*****
Name      : timerx
Parameters : None
Returns   : None
Description : Change the TX value
*****/
interrupt void timerx(void)
{
    sign1 = ~sign1;      /* Inverse P03 output value */
    if(sign1!=0)
    {
        sign = 0;        /* A/D conversion value changed bit=0 */
        TX = adcurrent;  /* Send A/D conversion value to TX */
        if(sign1==0)
            ROEDG = 1;
        else

```

```

        ROEDG = 0;
    }
}

/*****
Name      : sfr_init
Parameters : None
Returns   : None
Description : Initial the port and signal
*****/
void sfr_init(void)
{
    P0    = 0x00;        /* Port P0,output low level */
    P0D   = 0xff;       /* Port P0 directional register,output mode */
    P1    = 0x00;        /* Port P1,output low level*/
    P1D   = 0xff;       /* Port P1 directional register,output mode */
    P2    = 0x00;        /* Port P2,output low level*/
    P2D   = 0xfe;       /* Port P2 directional register,output mode */
    P3    = 0x07;       /* Port P3,output low level*/
    P3D   = 0xff;       /* Port P3 directional register,output mode */
    sign  = 0x00;       /* A/D value changed sign */
    sign1 = 0xff;       /* P03 port value sign */
    resetr = 0x00;      /* Mode sign */
    ADCON = 0x18;       /* Analog channel0, AD clock:f(XIN)/16 */
    TXM   = 0x19;       /* Pulse output mode */
    TCSS  = 0x00;       /* Timer clock source: f(XIN)/16 */
    PREX  = 250-1;
    TX    = 0;          /* LED3 minimal blink time:1ms */
    PRE1  = 125-1;
    T1    = 40-1;       /* Main loop:10ms */
    IV_T1 = 1;          /* Timer1 interrupt valid */
    INTDIS = 0x07;     /* Timer1 interrupt discrimination bit valid */
    IE_TX = 1;          /* Timer X interrupt enable */
    TXSTP = 0;         /* Start Timer X */
}
/*****
Name      : adread
Parameters : None
Returns   : None
Description : Read A/D value
*****/
unsigned char adread(void)
{
    unsigned char valuel, valueh, value;

    ADSTP = 0;         /* Start A/D */
    while (ADSTP ==0){ /* Wait for A/D conversion ending */
        valueh = ADH;
        valuel = ADL;  /* Get A/D conversion value */
        valueh = valueh<<6;
        valuel = valuel>>2; /* Convert 10 bit to 8 bit */
        value = valuel+valueh; /* Get 8 bit A/D value */
    }
    return(value);
}

```

```

/*****
Name      : waitingmode
Parameters : None
Returns   : None
Description : When reset disposal the pulse output
*****/
void waitingmode(void)
{
    unsigned char i;
    i=adcurrent-adfirst;          /* Get error */
    if(10<i&& i<245)              /* Chattering elimination */
    {
        sign = 0x01;              /* A/D value changed sign=1 */
        resetr = 0x01;           /* Mode sign=1 */
        adpast = adcurrent;      /* Send A/D current value to past memory */
    }
}

/*****
Name      : blinkmode
Parameters : None
Returns   : None
Description : When normal disposal the pulse output
*****/
void blinkmode(void)
{
    unsigned char i;
    i = adcurrent-adpast;        /* Get error */
    if(i!=0)
    {
        sign = 0x01;            /* A/D conversion change sign=1 */
        adpast = adcurrent;     /* Send A/D current value to past memory */
    }
}

*****/
*   File Name      : AD_Convert.H
*   Copyright      : Renesas Technology Corp.,
*   Version        : 1.00 ( 2005-10-15 ) Initial
*****/
#ifndef ADCONVERT
#define ADCONVERT
void sfr_init(void);          /* SFR setting subprogram */
unsigned char adread(void);   /* Read A/D conversion subprogram */
void waitingmode(void);      /* Waiting state subprogram */
void blinkmode(void);        /* Blink state subprogram */
unsigned char adfirst;        /* First A/D conversion value */
unsigned char adcurrent;      /* Current A/D conversion value */
unsigned char adpast;         /* Past A/D conversion value */
unsigned char sign;           /* A/D value changed sign */
unsigned char sign1;          /* P03 port value sign */
unsigned char resetr;         /* Mode sign */
#endif

```

6. Reference

Renesas web-site

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Contact for Renesas technical support

E-mail: csc@renesas.com

Hardware manual

7542 Group Hardware Manual Rev.3.00

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Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Dec.28.05	—	First Edition Issued

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