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New 8FX Family
8-BIT MICROCONTROLLER
MB95260H series

Distance Module control

Example of connection to GP2Y0A21YK

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Revision History

Revision	Date	Description
1.0	Feb 17,2011	Initial release

Subject

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1 Introduction

This application note explains the method of controlling the distance measurement module of GP2Y0A21YK. That module is controlled by “New 8FX” family. MB95260H series is used in the explanation of control methods.

2 About Distance measurement module of GP2Y0A21YK

The GP2Y0A21YK is popular distance measurement module of offered commercially. The GP2Y0A21YK has distance measurement controller IC for measurement. These module has LED and PSD(Position Sensitive Detector) which can detect the distance by noncontact. The type of output is analog voltage. Figure 2-1 is outline of GP2Y0A21YK. Figure 2-2 is block diagram of GP2Y0A21YK.

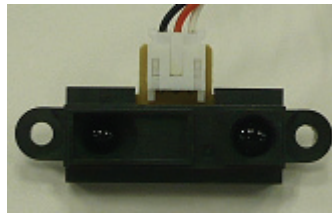


Figure 2-1 GP2Y0A21YK

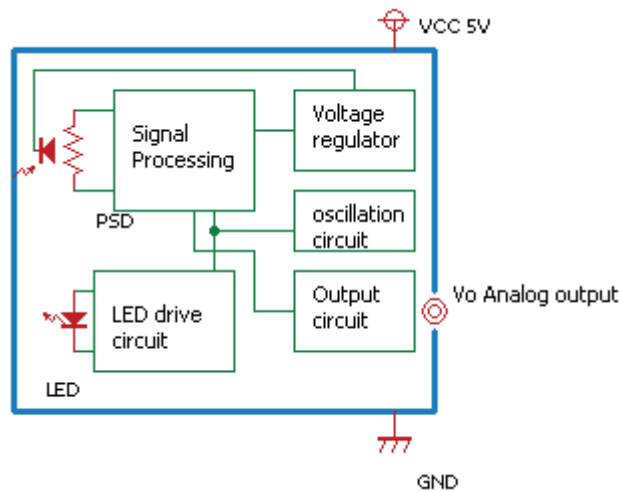


Figure 2-2 GP2Y0A21YK block diagram

2.1 Control signal of GP2Y0A21YK module

Shown below is the GP2Y0A21YK module signal.

pinNo	Symbol	Function
1	Vo Analog output	Result data
2	GND	GND
3	Vcc	4.5 ~ 5.5V

Chart 2-1 GP2Y0A21YK pin

Vo : Measurement data output voltage.

GND : GND

VCC : Supply Voltage 5V

2.2 Distance sensor module GP2Y0A21YK characteristics

The measurement distance of distance sensor module GP2Y0A21YK is from 10cm(min) to 80cm(max).

The output voltage of Vo changed by measurement distance.

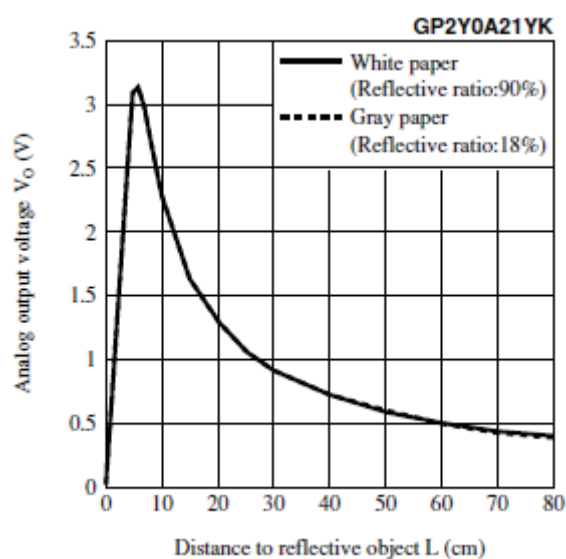


Figure 2-3 GP2Y0A21YK Characteristics

More detailed information get from data sheet.

<http://document.sharpsma.com/files/GP2Y0A21YK-DATA-SHEET.PDF>

(Feb 2011)

2.3 How to get the measurement data from GP2Y0A21YK.

The measurement result of distance voltage output from Vo pin which is analog voltage.

Figure 2-3 is the characteristics of sensor module of GP2Y0A21YK.

This application note explains how to get measurement data of distance data to use A/D convertor of the New 8FX series. The New 8FX series have A/D converter which can be selectable to "8 or 10" bit resolution. This application note used 10bit resolution of A/D conversion.

2.4 How to connect between GP2Y0A21YK to MB95260H series MCU.

Figure 2-5 is the example of MB95260H series and GP2Y0A21YK application. Figure 2-6 is example schematic. The measurement result display on SC1602BS.

Please see more information about control of the SC1602BS.

That will be able to get it from additional application note of "Example of connection to SC1602BS".

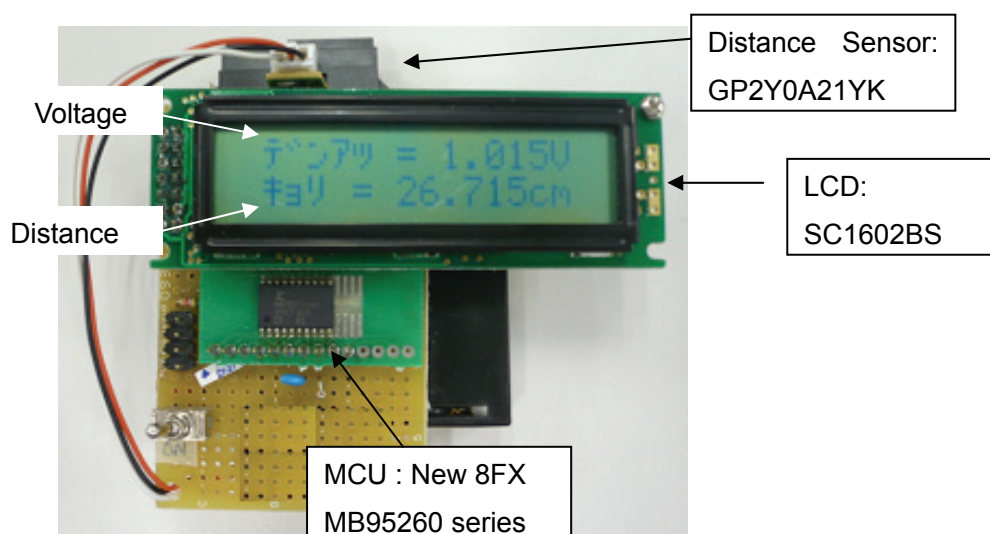


Figure 2-4 GP2Y0A21YK application

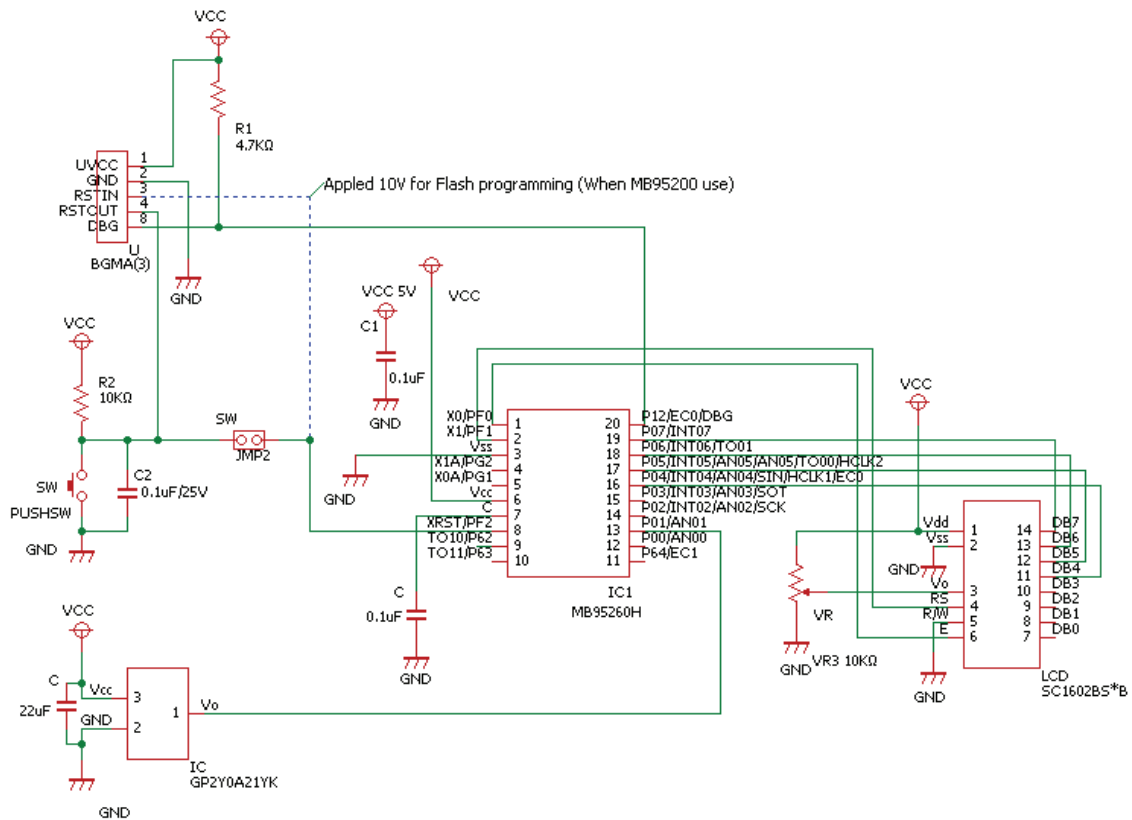


Figure 2-5 MB95260H with GP2Y0A21YK circuit

Note) When you use MB95200H series. The MB95200H series require to 10V high voltage to flash programming. That need connect between RSOUT to RST pin.

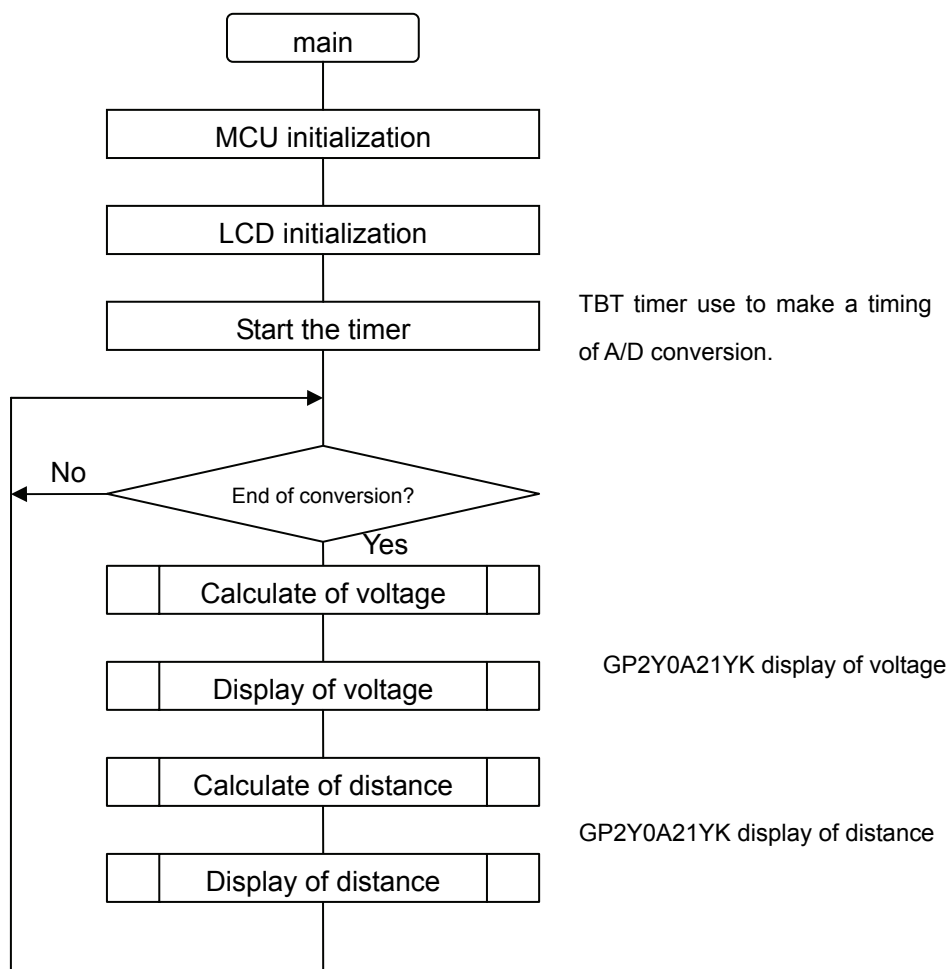
Please get more information from hardware manual of each micro controller.

3 Software control by MB95200H series

3.1 Main flow

The output voltage of distance measurement result is output from Vo.

Showing below are flowchart of initialization sequence and sample program of display of measurement data.



Sample code of main flow chart

```

/* main.c */
/*****
NAME:  main ()
FUNCTION:
*****/
void main()
{
    unsigned char SenseData;
        MCU_initialization();
/*-----*/
//      LCD module initial
/*-----*/
        LCD_Initial();

        IO_TBTC.byte = 0x1c;           /* TBC3-0 1110b 1.049s@8MHz */
        IO_TBTC.bit.TCLR = 1;          /* initial */
        IO_TBTC.bit.TBIE = 1;         /* Interrupt enable */

```

```

/*-----*/
//      Display of AD Data on SC1602SB_LCD
/*-----*/
while(1) {
    if (AD_flag == 1)
    {
        __DI();

        AD_flag = 0;
        LCD_Position(0,0);
        LCD_Printf(" 電圧 =");      // LCD 文字表示 //

        SC1602LCD_Control(LCD_CURSOR_SH_RIGHT);
        lcd_voltage();      // calculate of voltage
        lcd_displayf(answer);      // display to LCD
        LCD_Printf("V");      // LCD "V" 文字表示 //

        LCD_Position(1,0);
        LCD_Printf(" 距離 =");      // LCD 文字表示 //

        SC1602LCD_Control(LCD_CURSOR_SH_RIGHT);
        lcd_distance();      // calculate of distance data

        if (answer <= 63){
            lcd_displayf(answer);      // display to LCD
            LCD_Printf("cm");      // LCD "cm" 文字表示 //
        }
        else{
            LCD_Printf("overflow");      // LCD 文字表示 //
        }

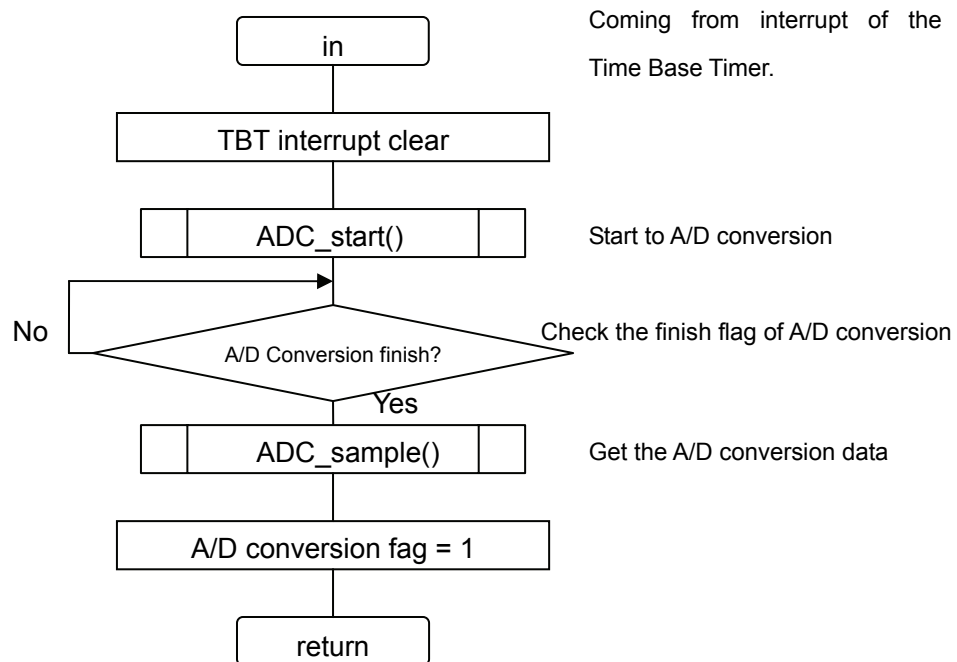
        AD_flag = 0;
        IO_TBTC.bit.TCLR = 1;      /* initial */
        __EI();
    }
}
}

```

3.2 Get a measurement data that used A/D converter of MB95260H series

To use the MB95260H A/D converter to get the output voltage V_o of GP2Y0A21YK.

Showing below are flowchart of A/D converter initialize sequence and sample program to get the measurement data.



Sample code of A/D converter and get a result

```

/* main.c*/
/*****
NAME:  __interrupt void TBT_interrupt ()
FUNCTION: A/D convert and Display function
*****/
__interrupt void TBT_interrupt (void)
{
    __DI();
    IO_TBTC.bit.TBIF = 0;          /* Interrupt clear */
/*-----*/
//      A/D module get GP2Y0A21YK data
/*-----*/
        ADC_start();              // A/D start

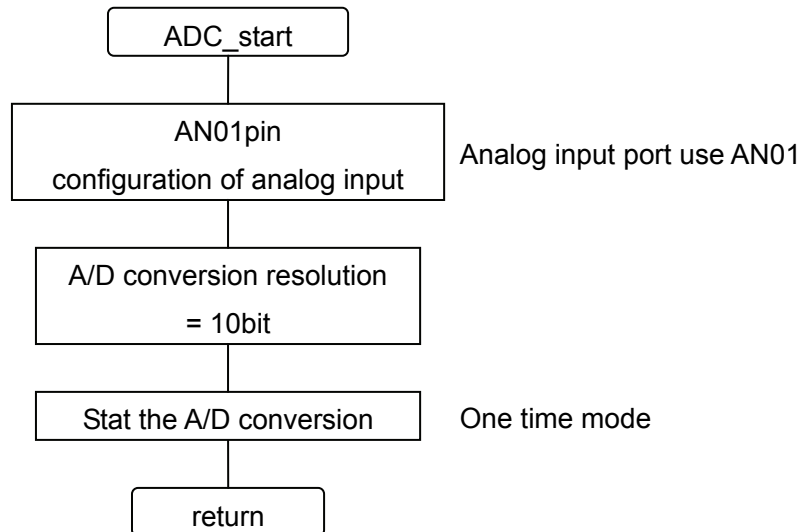
// A/D converter ready?
        while(IO_ADC1.bit.ADMV);  // Check A/D convert finish flag
        AD_Sample();              // Measurement data read
        AD_flag = 1;

    __EI();
}

```


3.3 Initialization of the A/D converter of the MB95260H series

Showing below are sample program flowchart of A/D conversion initialization.



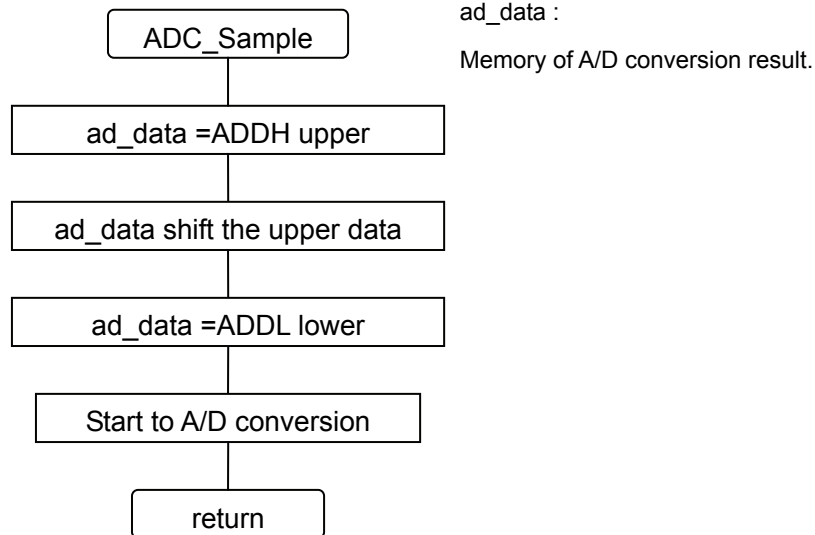
Sample code of initialization of the A/D converter.

```

/*MB95260AD.c*/
/*****
NAME:      ADC_start()
FUNCTION:   Initial AD, IO-PORT
*****/
void ADC_start(void)
{
    IO_ADC1.byte = 0x10;           // AN01 as input
    IO_ADC2.byte = 0x01;           // 10-bit resolution, 2/MCLK
    IO_ADC1.bit.AD = 1;            // start A/D converter
}
  
```

3.4 Read out the 10bit A/D conversion result data from MB95260H series.

Below is sample program flowchart of read out the A/D conversion data from MB95260H series.



Read out the10bit A/D conversion result

```
/*MB95260AD.c*/
unsigned int ad_data;
/*****
NAME:      AD_Sample()
FUNCTION:   Use AN00 as the sample voltage channel
*****/
void AD_Sample(void)
{
    ad_data = IO_ADD.byte.ADDH;          // Read AD Sample value
    ad_data = ad_data << 8;
    ad_data |= IO_ADD.byte.ADDL;

    IO_ADC1.bit.AD=1;                    // Start AD again
}
```

3.5 Voltage conversion result of MB95260H A/D.

Showing below are flowchart of voltage conversion of read out data of A/D conversion data from MB95260H series.

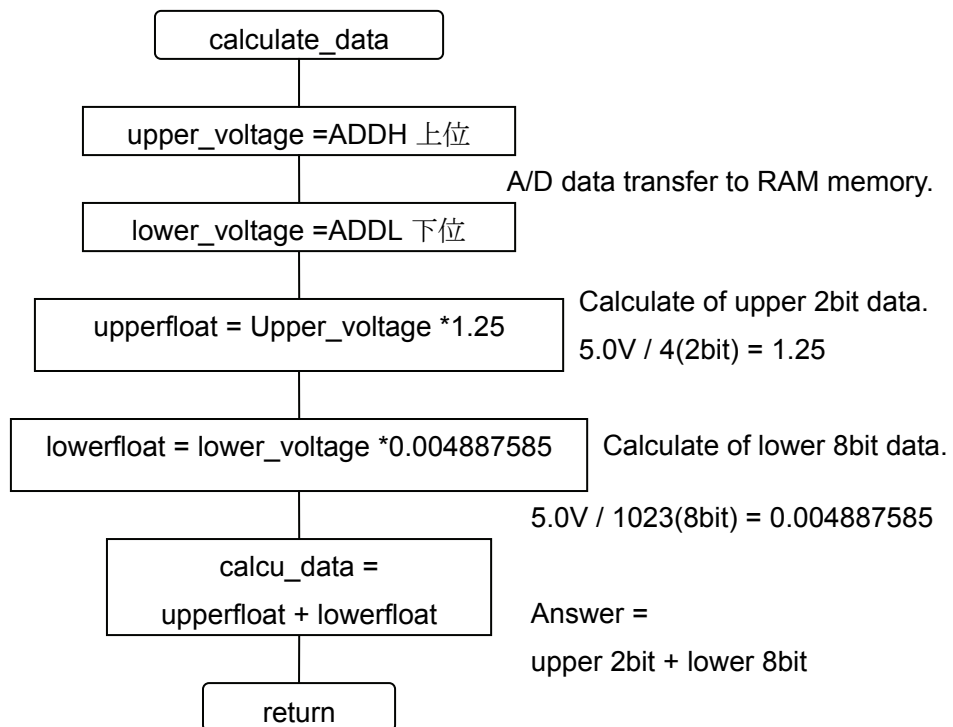
The 10bit A/D conversion result has upper 2bit + lower 8bit data. The A/D conversion result will change to analog voltage.

Condition of calculation:

- MCU Voltage = 5.0Vcc
- A/D conversion resolution =10bit

The voltage of 1bit : $5.0V/1023(10bit) = 0.00487585$.

Calculated the analog voltage by GP2Y0A21YK output voltage.



Sample code of 10bit A/D conversion.

```

/*Main.c*/

/*****
NAME:  caluculate_data()
FUNCTION:      A/D data translate from Hex to Dec
*****/

void calculate_data(void)
{
    /*      calcu_data =(ad_data * 0.0195);      /* 5.0V/10bit Voltage change */
    unsigned int  upper_voltage;
    unsigned int  lower_voltage;
    float  upperfloat;
    float  lowerfloat;
    float  ansfloat;

        upper_voltage = IO_ADD.byte.ADDH;  // Read AD Sampling H_value
        lower_voltage = IO_ADD.byte.ADDL;  // Read AD Sampling L_value
    /*-----*/
    // Upper 2bit(bit9,bit8) = 5.0V/1023 = 100hex(256) (5.0V/4=1.25)
    // Lower 8bit(bit7-0) = 5.0V/1023 = 0.004887585 @1bit*/
    // Output = calucdata = 10bit A/D Voltage
    /*-----*/
        upperfloat = (upper_voltage * 1.25);          /* 上位 2bit */
        lowerfloat = (lower_voltage * 0.004887585);    /* 下位 8bit */

        ansfloat = (upperfloat + lowerfloat);
        calcu_data = ansfloat;          /* 5.0V/10bit Voltage change */
}

```

3.6 Transform voltage into distance.

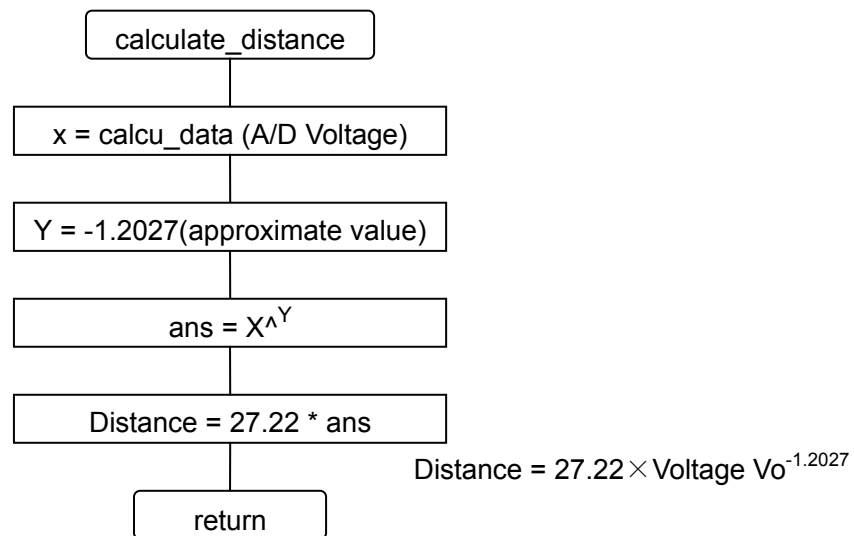
Transform the A/D conversion voltage into distance.

This application use formula to transform voltage into distance.

$$\text{Distance} = 27.22 \times \text{Voltage (Vo)}^{-1.2027}$$

This formula used approximate value from characteristic chart of the sensor.

Showing below are flowchart of transform the A/D voltage into distance.



Sample code of transform voltage into distance

```

/*Main.c*/

/*****
NAME:  caluculate_distance()
FUNCTION:      Calculation of measuring distance
in : calucu_data = ad_converter voltage data
out : Y_distance = 27.22 * x^-1.2027
*****/

void calculate_distance(float calcu_data)
{
    double x;
    double y;
    double ans;

    x = calcu_data;          /* A/D data = Voltage V*/
    y = -1.2027;
    ans = pow(x, y);         /* ans = x^(-1.2027) */

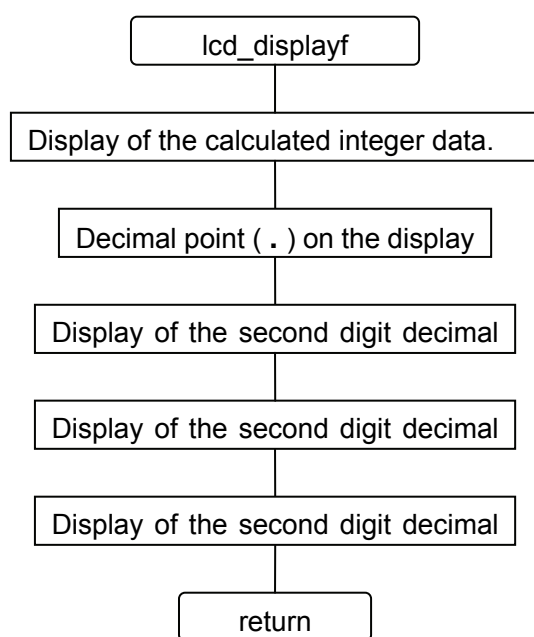
    X_voltage = ans;
//    convert from voltage to distance)
    Y_distance = 27.22 * (X_voltage);
}

```

3.7 Display of LCD (Distance data on LCD)

Calculated measurement distance data display on the LCD. This application use the SC1602BS which is popular LCD module of offered commercially. The SC1602BS has LCD driver controller for LCD display. Controlling of the SC1602BS. Please refer to the document of “LCD Module control Example of connection to SC1602BS”.

Showing below are flowchart of display.



Sample code of calculated data on the display

```

/*Main.c*/
/*****
NAME:          lcd_displayf()
FUNCTION:      Data send to SC1602
*****/
void lcd_displayf(float answer)
{
    unsigned char save_data;
    unsigned char disp_data;

    save_data = answer;          /* 1桁目 float to char 整数変換 */
    /*-----*/
    //      LCD display of distance upper data 0cm~99cm
    /*-----*/

    if (flag == 1){
        make_distance_data(save_data);      /* 整数部 0~99 変換 */
        lcd_display_header(henkan);
    }
}

```



```

/*-----*/
//      LCD display of voltage or distance
/*-----*/

else {
    lcd_display(save_data);
}

LCD_Printf(".");          // LCD 文字表示 //
                          /* 少数 1 桁目 (a.bcd - a = 0.bcd)*10 = b.cd */
answer = (answer-save_data)*10;
disp_data = answer;      /* disp_data = b */
lcd_display(disp_data);

                          /* 少数 2 桁目 (b.cd - b = 0.cd)*10 = c.d */
answer = (answer-disp_data)*10;
disp_data = answer;      /* disp_data = c */
lcd_display(disp_data);

                          /* 少数 3 桁目 (c.d - c = 0.d)*10 = d */
answer = (answer-disp_data)*10;
disp_data = answer;
lcd_display(disp_data);
}

```

note : These code are excerpt from sample program.

Please get more detailed information from sample program.

Additional Information

For more information about how to use MB95260H series and “New 8FX family” MCU, BGM adaptor and SOFTUNE, please visit website

<http://jp.fujitsu.com/fsl/>