

## HP03 programming guide

### 1. Brief description

The HP03 is a low power device, include a piezo-resistive pressure sensor and an ADC interface. It provide 16 bit data for pressure and temperature relate voltage 11 unique coefficients were stored on the chip, thus accurate pressure and temperature reading can be realized. IIC interface is used for communication with a microprocessor.

### 2. Read compensation coefficients and ADC value

#### 1 Read compensation coefficients

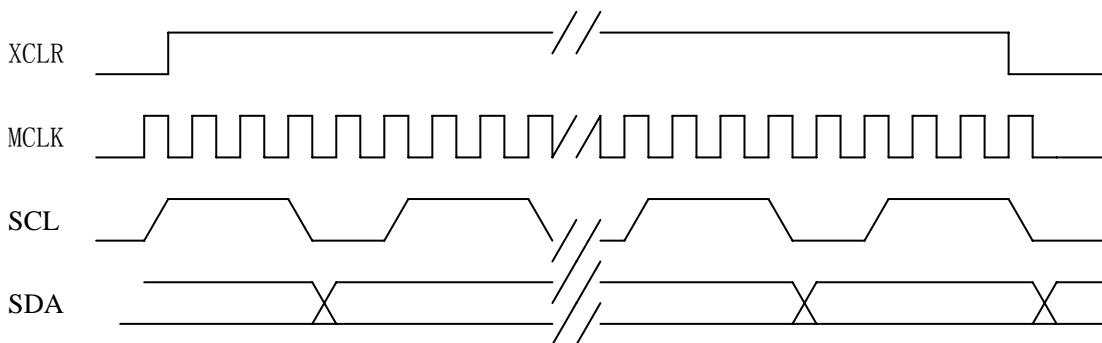
There are 11 compensation datum on the chip, the address of those coefficients are:

C1 (MSB : LSB)	(0x10 : 0x11)
C2 (MSB : LSB)	(0x12 : 0x13)
C3 (MSB : LSB)	(0x14 : 0x15)
C4 (MSB : LSB)	(0x16 : 0x17)
C5 (MSB : LSB)	(0x18 : 0x19)
C6 (MSB : LSB)	(0x1a : 0x1b)
C7 (MSB : LSB)	(0x1c : 0x1d)
A (MSB : LSB)	(0x1e)
B (MSB : LSB)	(0x1f)
C (MSB : LSB)	(0x20)
D (MSB : LSB)	(0x21)

User can read them as same as read AT24c02 chip,

#### 2 Read AD value of the pressure and temperature

##### Timing diagram



In order to get the AD value, must be follow the following timing

Read pressure

S	0xEE	A	0xFF	A	0xF0	A	P	D	S	0xEE	A	0xFD	A	S	0xEF	A	MSB	A	LSB	N	P
---	------	---	------	---	------	---	---	---	---	------	---	------	---	---	------	---	-----	---	-----	---	---

Read temperature

S	0xEE	A	0xFF	A	0xD0	A	P	D	S	0xEE	A	0xFD	A	S	0xEF	A	MSB	A	LSB	N	P
---	------	---	------	---	------	---	---	---	---	------	---	------	---	---	------	---	-----	---	-----	---	---

S: start bit

P: stop bit

A: acknowledge from slave

A: acknowledge from master

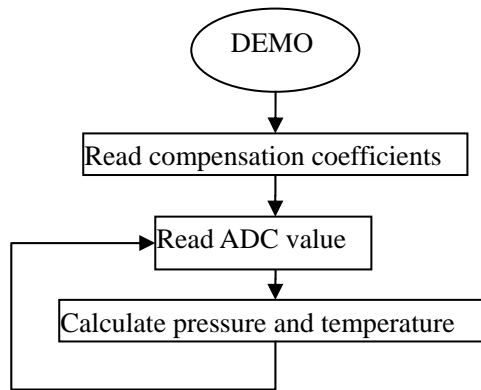
N: no acknowledge from master

D: delay for 40ms

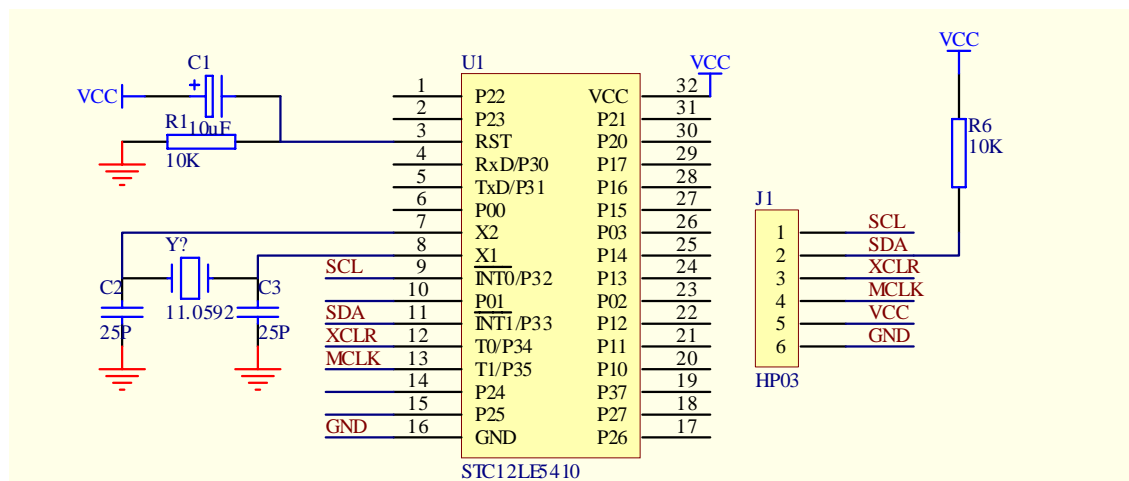
MSB: conversion result MSB

LSB: conversion result LSB.

### 3. Demo flow diagram



### 4. Example for standard 8051 core microcontroller



/\*\*\*\*\*\*

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Title: HP03 simple example based on 8051 C  
Current version: v1.0  
Function: Calculate pressure ,altitude and temperature  
Processor STC12LE5410AD(8051 core)  
Clock: 11.0592MHz Crystal  
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Date: 2007-10-24

## Connections

STC12LE5410AD SIDE	HP03 SIDE
P3.2----->	SCL
P3.3<----->	SDA
P3.4----->	XCLR
P3.5----->	MCLK

\*\*\*\*\*/

```
#include "reg52.h"
```

```
#include <math.h>
```

```
#define MaxPress 1100 //1100Hpa
```

```
#define DELAY10US 10
```

```
/******
```

```
//function declaration
```

```
/******
```

```
void IIC_ReadCalData(void);
```

```
void ReadTemperaturePreesureAD(void);
```

```
unsigned int IIC_ReadTempretureAD(void);
```

```
unsigned int IIC_ReadPressureAD(void);
```

```
void CalculatePressTemp(void);
```

```
void CalculateAltitude(void);
```

```
void IIC_ReadCalData(void);
unsigned char IIC_ReadByte(void);
void IIC_WriteByte( unsigned char);
void IIC_Start(void);
void IIC_Stop(void);
void IIC_ACK(void);
void IIC_NoAck(void);
void IIC_SDA_HIGH(void);
void IIC_SDA_LOW(void);
void IIC_SCL_HIGH(void);
void IIC_SCL_LOW(void);
void IIC_XCLR_LOW(void);
void IIC_XCLR_HIGH(void);
void SysDelay2ms(unsigned int);
void SysDelay(unsigned int);
```

```
//*****
//symbol defined
//*****
```

```
sbit SCL = P3^2;
sbit SDA = P3^3;
sbit XCLR = P3^4;
sbit MCLK = P3^5;
```

```
unsigned int C1 ;
unsigned int C2 ;
unsigned int C3 ;
unsigned int C4 ;
unsigned int C5 ;
unsigned int C6 ;
unsigned int C7 ;
unsigned char AA ;
unsigned char BB ;
unsigned char CC ;
unsigned char DD ;
```

```
unsigned int D1 ;
unsigned int D2 ;
```

long float DUT;  
long float OFF;  
long float SENS;  
long float X;  
long float Press;  
long float Temp;  
long Altitude;

```
//*****  
//comparison table for pressure and altitude  
//*****
```

```
long code Tab_BasicAltitude[80]={-6983,-6201,-5413,-4620,-3820,-3015,-2203,-1385,-560, 270, //0.1m  
    // 1100 1090 1080 1070 1060 1050 1040 1030 1020 1010 //hpa  
    1108, 1953, 2805, 3664, 4224, 5403, 6284, 7172, 8068, 8972,  
    // 1000 990 980 970 960 950 940 930 920 910 //hpa  
    9885, 10805,11734,12671,13617,14572,15537,16510,17494,18486,  
    // 900 890 880 870 860 850 840 830 820 810 //hpa  
    19489,20502,21526,22560,23605,24662,25730,26809,27901,29005,  
    // 800 790 780 770 760 750 740 730 720 710 //hpa  
    30121,31251,32394,33551,34721,35906,37106,38322,39553,40800,  
    // 700 690 680 670 660 650 640 630 620 610 //hpa  
    42060,43345,44644,45961,47296,48652,50027,51423,52841,54281,  
    // 600 590 580 570 560 550 540 530 520 510 //hpa  
    55744,57231,58742,60280,61844,63436,65056,66707,68390,70105,  
    // 500 490 480 470 460 450 440 430 420 410 //hpa  
    71854,73639,75461,77323,79226,81172,83164,85204,87294,89438};  
    // 400 390 380 370 360 350 340 330 320 310 //hpa
```

```
void main(void)
{
    SysDelay2ms(50);

    IIC_ReadCalData( );

    while(1)
    {
        ReadTemperaturePreesureAD( );
        CalculatePressTemp( );
        CalculateAltitude( );
        SysDelay2ms(300);
    }
}

//*****
//function: calculate power for 2
//*****
long int Get2_x(unsigned char i)
{
    long int uiData;
    uiData=2;
    i=i-1;
    while(i)
    {
        uiData <<= 1;
        i--;
    }
    return uiData;
}

//*****
//function:calculate press and temperature
//input   :D1,D2,C1---C7,AA,BB,CC,DD;
//output  :Press, unit: 0.01hpa
//        temp, unit: 0.1 °C
//*****
void CalculatePressTemp(void)
{
    long float MiddleData1;
    long float MiddleData2;
    long float MiddleData3;
    long float MiddleData4;
```

```
//calculate the DUT value
if(D2<C5)
{
//DUT = D2-C5-((D2-C5)/Get2_x(7))*((D2-C5)/Get2_x(7))*BB/Get2_x(CC);
MiddleData1 = (long)D2-C5;
MiddleData2 = MiddleData1*MiddleData1/16384;
MiddleData3 = MiddleData2*BB;
MiddleData4 = Get2_x(CC);
MiddleData4 = MiddleData3/MiddleData4;
DUT = MiddleData1 - MiddleData4;
}
else
{
//DUT = D2-C5-((D2-C5)/Get2_x(7))*((D2-C5)/Get2_x(7))*AA/Get2_x(C);
MiddleData1 = D2-C5;
MiddleData2 = MiddleData1*MiddleData1/16384;
MiddleData3 = MiddleData2*AA;
MiddleData4 = Get2_x(CC);
MiddleData4 = MiddleData3/MiddleData4;
DUT = MiddleData1 - MiddleData4;
}

//calculate the OFF value
//OFF = (C2+(C4-1024)*DUT/Get2_x(14))*4;
MiddleData1 = (long)C4-1024;
MiddleData2 = Get2_x(14);
MiddleData3 = DUT*MiddleData1;
MiddleData4 = MiddleData3/MiddleData2;
MiddleData4 = (long)C2+MiddleData4;
OFF = MiddleData4*4;

//calculate the SENS value
//SENS = C1+C3*DUT/Get2_x(10);
MiddleData1 = (long)C3*DUT;
MiddleData2 = Get2_x(10);
MiddleData3 = MiddleData1/MiddleData2;
SENS = C1+MiddleData3;

//calculate the X value
//X = SENS*(D1-7168)/Get2_x(14)-OFF;
MiddleData1 = Get2_x(14);
MiddleData2 = (long)D1-7168;
MiddleData3 = MiddleData2*SENS;
```

```
MiddleData4 = MiddleData3/MiddleData1;
X = MiddleData4-OFF;

//calculate the Press value,have two decimal fraction
//Press = X*100/Get2_x(5)+C7*10;
MiddleData1 = X*100;
MiddleData2 = Get2_x(5);
MiddleData3 = MiddleData1/MiddleData2;
MiddleData4 = C7*10;
Press = MiddleData3+MiddleData4;

//calculate the Temperature value
Temp = 250+DUT*C6/Get2_x(16)-DUT/Get2_x(DD);

}

//*****
//function:calculate altitude
//input   :Press value
//output  :Altitude, unit: 0.1m
//*****

void CalculateAltitude(void)
{
    char ucCount;
    unsigned int  uiBasicPress;
    unsigned int  uiBiasTotal;
    unsigned int  uiBiasPress;
    unsigned int  uiBiasAltitude;

    for( ucCount=0;   ; ucCount++ )
    {
        uiBasicPress = MaxPress-(ucCount*10);
        if(uiBasicPress < (int)(Press/100))    break;
    }

    uiBiasTotal = Tab_BasicAltitude[ucCount] - Tab_BasicAltitude[ucCount-1];
    uiBiasPress = Press - (long)(uiBasicPress*100);
    uiBiasAltitude = (long)uiBiasTotal * uiBiasPress/1000;

    Altitude = Tab_BasicAltitude[ucCount] - uiBiasAltitude;

    ucCount = abs(Altitude % 10);    // four lose and five up
    if(Altitude < 0)
```



```
{
    if(ucCount > 4)
        Altitude -= 10-ucCount;
    else
        Altitude += ucCount;
}

else
{
    if(ucCount > 4)
        Altitude += 10-ucCount;
    else
        Altitude -= ucCount;
}
}

//=====

void IIC_ReadCalData(void)
{
    unsigned char ucValue;

    IIC_Start();
    IIC_WriteByte(0xa0);
    IIC_WriteByte(16);
    IIC_Start();
    IIC_WriteByte(0xa1);
    ucValue = IIC_ReadByte();
    IIC_ACK();
    C1=ucValue;
    ucValue = IIC_ReadByte();
    IIC_ACK();
    C1 <<= 8;
    C1 |= ucValue;

    ucValue = IIC_ReadByte();
    IIC_ACK();
    C2=ucValue;
    ucValue = IIC_ReadByte();
    IIC_ACK();
    C2 <<= 8;
    C2 |= ucValue;

    ucValue = IIC_ReadByte();
```

```
IIC_ACK();
C3=ucValue;
ucValue = IIC_ReadByte();
IIC_ACK();
C3 <<= 8;
C3 |= ucValue;
```

```
ucValue = IIC_ReadByte();
IIC_ACK();
C4=ucValue;
ucValue = IIC_ReadByte();
IIC_ACK();
C4 <<= 8;
C4 |= ucValue;
```

```
ucValue = IIC_ReadByte();
IIC_ACK();
C5=ucValue;
ucValue = IIC_ReadByte();
IIC_ACK();
C5 <<= 8;
C5 |= ucValue;
```

```
ucValue = IIC_ReadByte();
IIC_ACK();
C6=ucValue;
ucValue = IIC_ReadByte();
IIC_ACK();
C6 <<= 8;
C6 |= ucValue;
```

```
ucValue = IIC_ReadByte();
IIC_ACK();
C7=ucValue;
ucValue = IIC_ReadByte();
IIC_ACK();
C7 <<= 8;
C7 |= ucValue;
```

```
ucValue = IIC_ReadByte();
IIC_ACK();
AA=ucValue;
ucValue = IIC_ReadByte();
IIC_ACK();
```

```
    BB= ucValue;

    ucValue = IIC_ReadByte();
    IIC_ACK();
    CC=ucValue;
    ucValue = IIC_ReadByte();
    IIC_NoAck();
    IIC_Stop();
    DD= ucValue;
}
//=====
void MCLKOn(void)
{
    TMOD = 0x12;
    TH0 = 0xf8;
    TL0 = 0xf8;
    ET0 = 1;
    EA = 1;
    PT0 = 1;
    TR0 = 1;

}
//=====
void MCLKOff(void)
{
    TR0 = 0;
    ET0 = 0;
}

//=====

void ReadTemperaturePressureAD(void)
{
    long uiSumADValue;
    uiSumADValue = 0;
    IIC_XCLR_HIGH();
    MCLKOn();
    SysDelay2ms(1);

    D1 = IIC_ReadPressureAD();
    uiSumADValue += D1;
    D1 = IIC_ReadPressureAD();
```

```
    uiSumADValue += D1;
    D1 = IIC_ReadPressureAD();
    uiSumADValue += D1;
    D1 = IIC_ReadPressureAD();
    uiSumADValue += D1;
    D1 = uiSumADValue >> 2;

    D2 = IIC_ReadTempretureAD();

    SDA=0;
    SCL=0;

    MCLKOff();
    IIC_XCLR_LOW();

}

//=====
void vect_Timer0(void) interrupt 1 using 1 //product 32k Hz signal
{
    MCLK = ~MCLK;
}
//=====

unsigned int IIC_ReadTempretureAD(void)
{
    unsigned char ucData;
    unsigned int wADT;

    IIC_Start();
    IIC_WriteByte(0xEE);
    IIC_WriteByte(0xFF);
    IIC_WriteByte(0xE8);
    IIC_Stop();
    SysDelay2ms(20);

    IIC_Start();
    IIC_WriteByte(0xEE);
    IIC_WriteByte(0xFD);
    IIC_Start();
    IIC_WriteByte(0xEF);

    ucData = IIC_ReadByte();
```

```
IIC_ACK();
// UartSend(CCC);
wADT = ucData;
wADT <<= 8;

ucData = IIC_ReadByte();
IIC_NoAck();
IIC_Stop();
wADT |= ucData;
// UartSend(DD);

return wADT;

}
//=====

unsigned int IIC_ReadPressureAD(void)
{
    unsigned char ucData;
    unsigned int wADp;

    IIC_Start();
    IIC_WriteByte(0xEE);
    IIC_WriteByte(0xFF);
    IIC_WriteByte(0xF0);
    IIC_Stop();
    SysDelay2ms(20);

    IIC_Start();
    IIC_WriteByte(0xEE);
    IIC_WriteByte(0xFD);
    IIC_Start();
    IIC_WriteByte(0xEF);

    ucData = IIC_ReadByte();
    IIC_ACK();
    wADp = ucData ;
    wADp <<=8;
// UartSend(AA);

    ucData = IIC_ReadByte();
    IIC_NoAck();
```

```
IIC_Stop();
wADp |= ucData;
//    UartSend(BB);

    return wADp;
}

//=====

unsigned char IIC_ReadByte(void)
{
    unsigned char ucValue;
    unsigned char ucIndex;

    IIC_SDA_HIGH();
    SysDelay(DELAY10US);
    for ( ucIndex = 0; ucIndex < 8; ucIndex++ )
    {
        ucValue <<= 1;

        IIC_SCL_LOW();
        SysDelay(DELAY10US);

        IIC_SCL_HIGH();
        SysDelay(DELAY10US);

        if(SDA)
            ucValue |= 1;

        SysDelay(DELAY10US);
        IIC_SCL_LOW();
        SysDelay(DELAY10US);

    }

    return ucValue;
}

//=====

void IIC_WriteByte( unsigned char ucData )
{
```

```
    unsigned char i;
    for( i = 0; i < 8; i++ )
    {
        IIC_SCL_LOW();
        SysDelay(DELAY10US);

        if((ucData & 0x80) == 0x80)
        {
            IIC_SDA_HIGH();
            SysDelay(DELAY10US);
        }
        else
        {
            IIC_SDA_LOW();
            SysDelay(DELAY10US);
        }

        IIC_SCL_HIGH();
        SysDelay(DELAY10US);
        ucData <<= 1;
        IIC_SCL_LOW();
    }

    IIC_SDA_HIGH();
    SysDelay(DELAY10US);
    IIC_SCL_LOW();
    SysDelay(DELAY10US);
    IIC_SCL_HIGH();
    SysDelay(DELAY10US);
    IIC_SCL_LOW();
    SysDelay(DELAY10US);

}
//=====================================================

void IIC_Start(void)
{

    IIC_SDA_HIGH();
    SysDelay(DELAY10US);

    IIC_SCL_HIGH();
```

```
    SysDelay(DELAY10US);

    IIC_SDA_LOW();
    SysDelay(DELAY10US);

    IIC_SCL_LOW();
    SysDelay(DELAY10US);

}
//=====

void IIC_Stop(void)
{
    IIC_SCL_LOW();
    SysDelay(DELAY10US);

    IIC_SDA_LOW();
    SysDelay(DELAY10US);

    IIC_SCL_HIGH();
    SysDelay(DELAY10US);

    IIC_SDA_HIGH();
    SysDelay(DELAY10US);
}
//=====

void IIC_ACK(void)
{
    IIC_SDA_LOW();
    SysDelay(DELAY10US);

    IIC_SCL_HIGH();
    SysDelay(DELAY10US);

    IIC_SCL_LOW();
    SysDelay(DELAY10US);
}
//=====

void IIC_NoAck(void)
{
```



```
IIC_SDA_HIGH();
SysDelay(DELAY10US);

IIC_SCL_HIGH();
SysDelay(DELAY10US);

IIC_SCL_LOW();
SysDelay(DELAY10US);

}

//=====

void IIC_SDA_HIGH(void)
{
    SDA=1;
}

//=====

void IIC_SDA_LOW(void)
{
    SDA=0;
}

//=====

void IIC_SCL_HIGH(void)
{
    SCL=1;
}

//=====

void IIC_SCL_LOW(void)
{
    SCL=0;
}

//=====
```

```
void IIC_XCLR_LOW(void)
{
    XCLR=0;
}
```

```
//=====
```

```
void IIC_XCLR_HIGH(void)
{
    XCLR=1;
}
```

```
//=====
```

```
void SysDelay2ms( unsigned int t)
{
    unsigned int i;
    while(t--)
        {for (i = 0; i < 1250; i++);
         for (i = 0; i < 1500; i++);
         }
}
```

```
//=====
```

```
void SysDelay(unsigned int t)
{
    while(t--);
}
```

### Notice:

1. Supply voltage : 2.7V---3.3V
2. MCLK frequency : 30K---35K。 The up edge and down edge should be steep, the edge more steeper the power more lower.
3. Don't be static electricity destroy ,don't operation with power.
4. With constant temperature to solder.
5. After solder, wait for some time ,let temperature tranquilization. For the best wait for 24 hours.

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