BAROMETER MODULE

2006-12-15 PRELIMINARY Version: 1.1

. Integrated pressure sensor
. Pressure Range 300-1100hpa
. 16 Bit Σ–Δ ADC
. 11 coefficients for software compensation stored on chip
. I^2C Serial Interface
. One system clock line (32768Hz)
. One hardware controlled reset line
. Low voltage, low power

Description

The HP03S includes a piezo-resistive pressure sensor and an ADC interface. It provides 16 bit word data for pressure and temperature related voltage. With the help of a highly accurate calibration of the senor, 10 unique coefficients were stored on the chip, thus accurate pressure and temperature reading can be realized. HP03S is a low power, low voltage device with automatic power down switching. I^2C Serial Interface is used for communications with a microprocessor. Sensor packaging options are DIP or SMD (with metal cap)

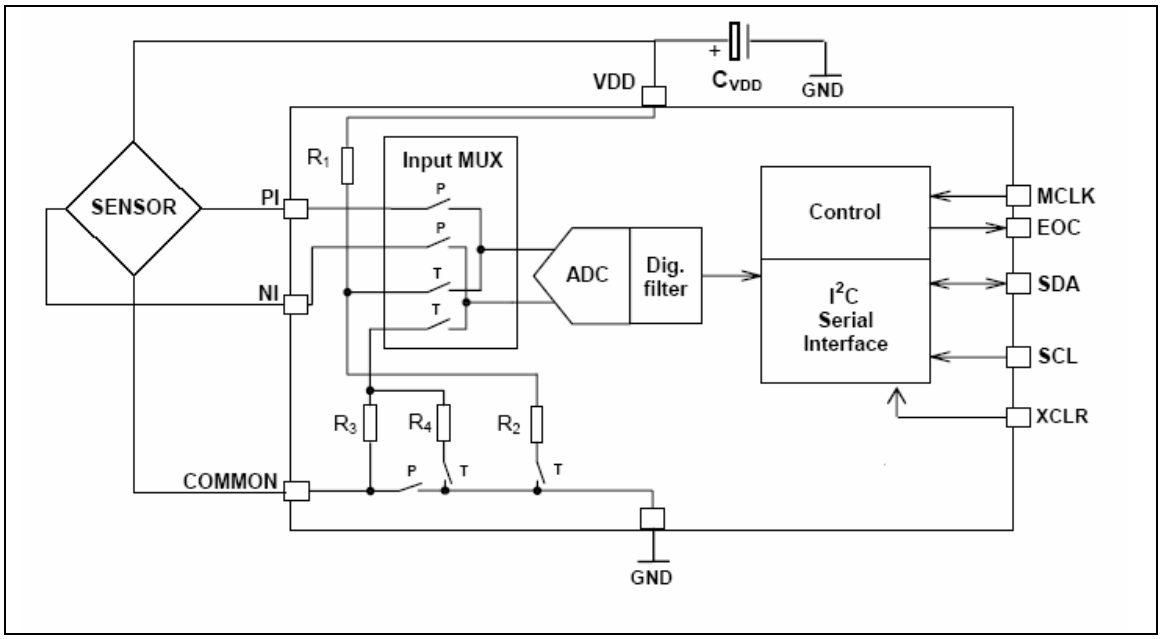
Features

. 15 Bit ADC resolution
. Supply voltage 2.0v-5.0v
. -30°C to + 85°C operating range

Applications

. Pressure measurement and control systems
. Mobile altimeter/barometer systems
. Weather forecast products
. Adventure or multi-mode watches

Block Diagram



Tel: +86-755-82973805 Fax: +86-755-82973550 E-mail: sales@hoperf.com http://www.hoperf.com

BAROMETER MODULE

2006-12-15 PRELIMINARY Version: 1.1

Pin Name	Pin Number	Type	Function
VSS	1	G	power ground
VDD	2	P	power VCC
MCLK	3	I	master clock(32k) input
XCLR	4	I	ADC reset input (keep low when system is in idle state)
SDA	5	I/O	. I²C data input and output
SCL	6	I	I^2C clock input

* XCLR is to reset the AD converter (active low). During the AD conversion phase, XCLR should stay high. After AD conversion end, keep XCLR pin low before another AD conversion starts.

Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply Voltage	VDD	-0.3	5.0	V
Over pressure	P		5	Bar(abs)
Storage Temperature	Tstg	-30	90	℃

Recommended Operating Conditions

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	VDD		2.0	3	5.0	V
Supply Current	I	VDD=3V				V
during conversion				500		μA
stand by				1		μA
Operating Pressure Range	P		300		1100	hpa (abs)
Operating Temperature Range	T		-30	25	85	℃
Conversion Time	T	MCLK=32k			35	ms
Duty Cycle of MCLK			40%	50%	60%	%
Serial Date Rate	SCL				100	KHZ

Pressure and Temperature Output Characteristics

With the calibration data provided by the HP03S system, it should be able to reach the following characteristics:

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Resolution			0.1			hpa
Accuracy		350-1100	-0.5		0.5	hpa
Absolute Pressure Accuracy		350-1100	-1.5		1.5	hpa
Maximum Error Over Temperature		-30~+85	-2.0		2.0	hpa
Long Term Stability		12 month		1		hpa
VDD Dependency		2.0~5.0	-1.5	0	1.5	hpa
Temperature Accuracy			-1.0		1.0	℃

Tel: +86-755-82973805 Fax: +86-755-82973550 E-mail: sales@hoperf.com http://www.hoperf.com

Pressure and Temperature Measurement

The main function of HP03S system is to convert the uncompensated pressure and temperature signal from a pressure sensor. After the conversion, the following two values can be obtained:

. measured temperature "D2"
. measured pressure "D1"

As the sensor is strongly temperature dependent, it is necessary to compensate for these effects. Therefore 7 sensor-specific coefficients are stored on the HP03S at our manufacturing facility, and they allow an accurate software compensation in the application.

The 7 coefficients are:

. Sensitivity coefficient "C1"
. Offset coefficient "C2"
. Temperature Coefficient of Sensitivity "C3"
. Temperature Coefficient of Offset "C4"
. Reference Temperature "C5"
. Temperature Coefficient of Temperature "C6"
. Offset Fine Tuning "C7"

Parameter Range(Hex:Dec)

	Hex		Dec	
C1	0x100	0x7fff	256	32767
C2	0x00	0x1fff	0	8191
C3	0x00	0x400	0	1024
C4	0x00	0x1000	0	4096
C5	0x1000	0x8000	4096	32768
C6	0x00	0x4000	0	16384
C7	0x960	0xA28	2400	2600
D1	0x00	0xffff	0	65535
D2	0x00	0xffff	0	65535

Pressure and Temperature Calculation:

Step 1: (calculate offset, sensitivity and final pressure value)

dUT=D2-C5
T = 250 + dUT * C6 / 2 ^ 16
OFF=(C2+(C4-2048)*dUT/2^14)*4
SENS = C1+ C3*dUT/2^10
X= SENS * (D1-7168)/2^14 - OFF
P=X*10/2^5+C7

Tel: +86-755-82973805 Fax: +86-755-82973550 E-mail: sales@hoperf.com http://www.hoperf.com

For altitude measurement system, recommend to use P=X*100/2^5+C7*10 So that better altitude resolution can be achieved

Step 2: (2nd order temperature and pressure compensation)

T>450	T2=3*C6*(450-T)^2 / 2^26	P2=3*T2*(P-3500)/2^14
T<0	T2=11*C6*(0-T)^2 / 2^26	P2=3*T2*(P-3500)/2^14
0=<T=<450	T2=0	P2=0

P=P-P2
T=T-T2

Example:

C1=29908
C2=3724
C3=312
C4=1465
C5=9191
C6=3990
C7=2500

D1=30036
D2=4107

dUT = 4107-9191 = -5084

T=250-3990*5084/2^16 = -59

OFF = (3724 + (1465-2048) * (-5084) / 2^14) * 4 =15619

SENS= 29908 + 312 * (-5084) / 2^10 = 28359

X= 28359 * (30036-7168) / 2^14 – 15619 = 23963

P= 23963 * 10 /2^5 + 2500 = 9918 = 9988

T2=11*3990*59^2/2^26=2

P2=3*2*(9988-3500)/2^14=2

T=-59-2 = -61= -6.1C

P=9988-2=9986=998.6hpa

Tel: +86-755-82973805 Fax: +86-755-82973550 E-mail: sales@hoperf.com http://www.hoperf.com

Serial Interface

The I2C interface is used for accessing calibration data as well as reading measurement result from AD conversion.
The HP03SA system has a 2k bits (256*8) EEPROM built in, and the space in the range of 16 to 127 were dedicated for calibration coefficients and factory testing use only. **Any accidental corruption to those data will lead to system failure and can lead to wrong calculated pressure and temperature results (write protection solder option is available, default setting: write protected).**

Reading Calibration Factor C1 to C7:

The EEPROM chip address is set to 0, and reading or writing of the EEPROM is fully compatible to AT24C02. Bus drive timing should be referred to the specification of this part.

Coefficient	**EEPROM ADDRESS(decimal)**
C1(MSB:LSB)	(16:17)
C2(MSB:LSB)	(18:19)
C3(MSB:LSB)	(20:21)
C4(MSB:LSB)	(22:23)
C5(MSB:LSB)	(24:25)
C6(MSB:LSB)	(26:27)
C7(MSB:LSB)	(28:29)

Reading Temperature and Pressure value:D1,D2

AD chip I2C address is set to 0xEE (device write address), 0xEF (device read address). In order to get the AD value D1 and D2, you have to follow the following timing sequence:

Pressure Measure:

S	11101110	**A**	11111111	**A**	11110000	**A**	P	D	S	11101110	**A**	11111101	**A**	S	11101111	**A**	**MSB**	A	**LSB**	N	P
Select pressure measurement										Read AD value back											

Temperature Measure:

S	11101110	**A**	11111111	**A**	11101000	**A**	P	D	S	11101110	**A**	11111101	**A**	S	11101111	**A**	**MSB**	A	**LSB**	N	P
Select temperature measurement										Read AD value back											

Tel: +86-755-82973805 Fax: +86-755-82973550 E-mail: sales@hoperf.com http://www.hoperf.com

S: I2C bus START (refer to AT24C02 EEPROM start command)
P: I2C bus STOP (refer to AT24C02 EEPROM stop command)
A (bold**)**: I2C bus acknowledge by slave (SDA pull low: slave send out bit 0)
A: I2C bus acknowledge by master (SDA pull low: master send out bit 0)
N: I2C bus no acknowledge from master (SDA keep high: master send out bit 1 instead)
D : delay for 38ms or above
MSB: conversion result (MSB bit clocked out first)
LSB: conversion result (MSB bit clocked out first).

Remark:

Before start an AD conversion cycle, remember to set XCLR pin high so that the system is no longer in the reset state.

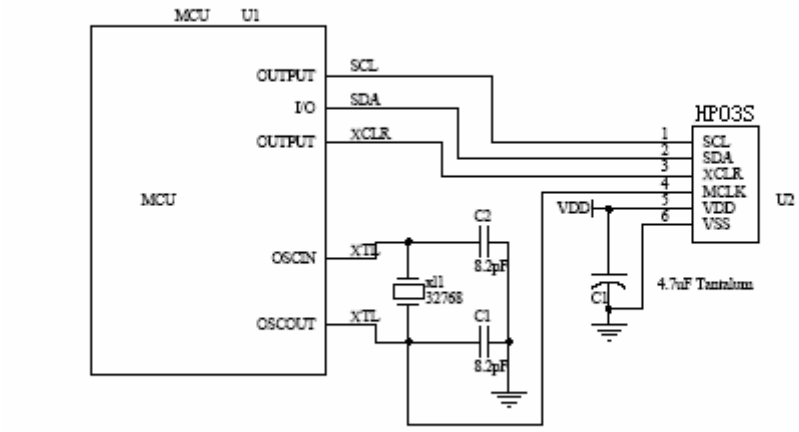
All data read from the module is in hex format.

After first power on, the first read data should be disregarded, and only the second value be used. This can assure that unstable reading after power on reset can be filtered out.

For altitude calculation purpose, use averaging scheme to improve the stability of pressure reading, we recommend making at least 8 times averaging so that it is possible to achieve 0.3m accuracy (about 1 foot).

Like any other semiconductor device, the sensor is sensitive to light. During the application of this sensor, please keep the sensor in dark place to achieve best accuracy.

Typical Application Circuit Diagram:

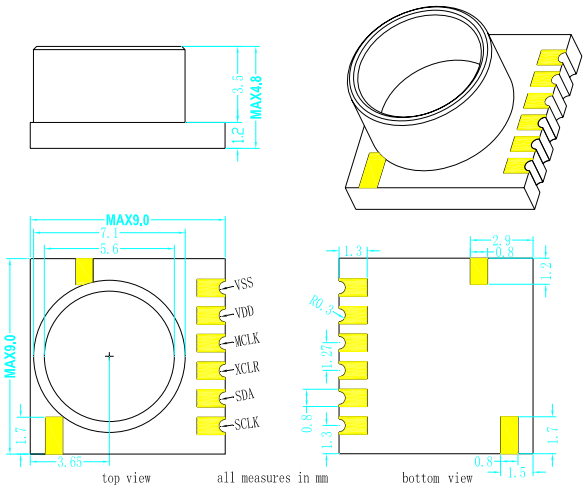


Tel: +86-755-82973805 Fax: +86-755-82973550 E-mail: sales@hoperf.com http://www.hoperf.com

BAROMETER MODULE

2006-12-15 PRELIMINARY Version: 1.1

HP03SA Mechanical Dimension



Important Notices

Do not use this product as safety or emergency stop device or in any application where failure of this product could lead in personal injury. Failure to comply with these instructions could result with death or serious injury.

Should buyer purchase or use HOPE RF products for any such unintended or unauthorized application, buyer should indemnify and hold HOPE RF and its officers, employees, affiliates and distributors harmless against all claims, costs, damages and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury associated with such unintended or unauthorized use, even if such claim alleges that HOPE RF was negligent regarding the design or manufacturing of the part.

Hope RF reserves the right, without further notice, to change the product specification and/or information in this document and to improve reliability, functions and design.

HOPE MICROELECTRONICS CO.,LTD
Rm B.8/F LiJingGe Emperor Regency 6012 ShenNan Rd., Shenzhen,China
Tel: 86-755-82973805
Fax: 86-755-82973550
Email: sales@hoperf.com
trade@hoperf.com
Website: http://www.hoperf.com
http://www.hoperf.cn
http://hoperf.en.alibaba.com