BAROMETER MODULE

2006-1-12 Version: 2.0

. Integrated pressure sensor
. Pressure Range 300-1100hpa
. 16 Bit Σ–Δ ADC
. 11 coefficients for software compensation stored on chip
. I²C Serial Interface
. One system clock line (32768Hz)
. One hardware controlled reset line
. Low voltage, low power

Description

The FOSP01 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. FOSP01 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)

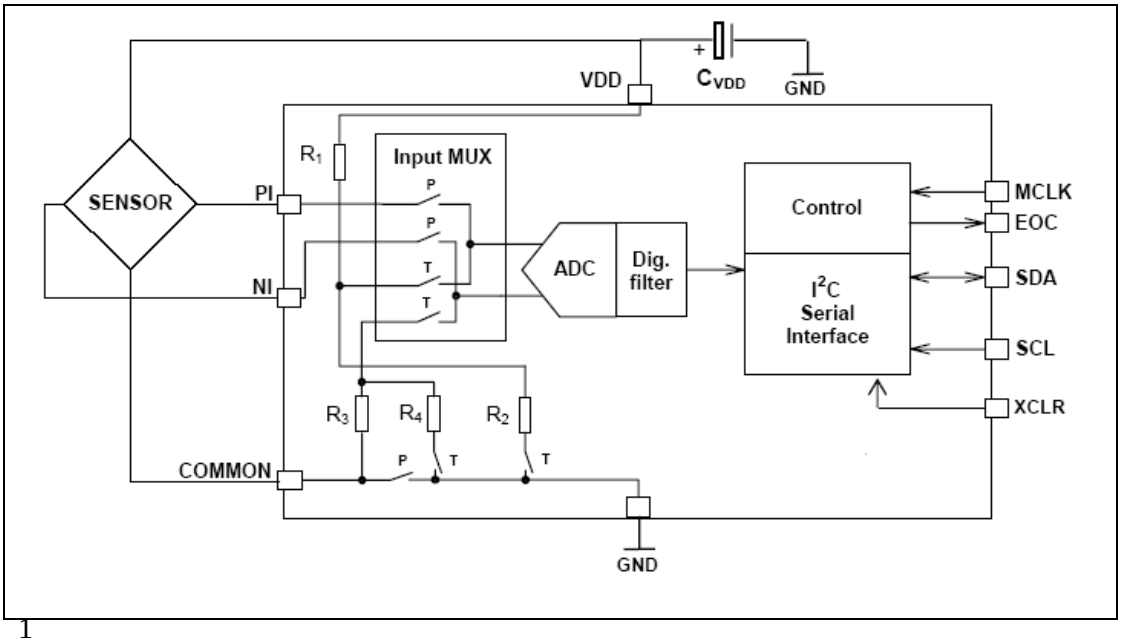
Features

. 15 Bit ADC resolution
. Supply voltage 2.2v-3.6v
. -20°C to + 60°C operating range

Applications

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

Block Diagram



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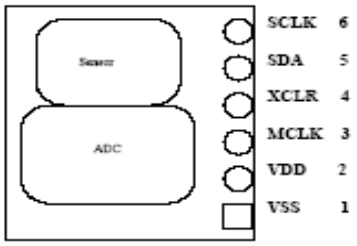

Pin Name	Pin Number	Type	Function
VSS	1	G	power ground
VDD	2	P	power VCC
MCLK	3	I	master clock(32k) input
XCLR	4	I	ADC reset input
SDA	5	I/O	. I²C data input and output
SCL	6	I	I²C clock input

* XCLR is to reset the AD converter (active low), Before start to operate the device, pull low XCLR pin to reset the AD. During the AD conversion phase, XCLR should stay high.

Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply Voltage	VDD	-0.3	4	V
Over pressure	P		15	Bar(abs)
Storage Temperature	Tstg	-30	70	℃

Recommended Operating Conditions

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	VDD		2.2	3	3.6	V
Supply Current	I	VDD=3V				V
during conversion				500		μA
stand by				2		μA
Operating Pressure Range	P		300		1100	hpa (abs)
Operating Temperature Range	T		-20	25	60	℃
Conversion Time	T	MCLK=32k			35	ms
Duty Cycle of MCLK			40%	50%	60%	%
Serial Date Rate	SCL				500	KHZ

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Pressure and Temperature Output Characteristics

With the calibration data provided by the FOSP01A system, it should be able to reach the following characteristics:

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Resolution			0.1			hpa
Accuraccy		750-1100	-0.5		0.5	hpa
Absolute Pressure Accuraccy		750-1100	-1.5		1.5	hpa
Maximum Error Over Temperature		-20~+59	-1.5		1.5	hpa
Long Term Stablity		12 month		2		hpa
VDD Dependency		2.4~3.6	-1.5	0	1.5	hpa
Temperature Accuracy			-0.8		0.8	℃

Pressure and Temperature Measurement

The main function of FOSP01 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 10 sensor-specific coefficients are stored on the FOSP01 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"
. Sensor Specific Parameter "A,B,C,D"

Pressure and Temperature Calculation:

Step 1: (get temperature value)

D2>=C5 dUT= D2-C5 - ((D2-C5)/2^7) * ((D2-C5)/2^7) * A / 2^C
D2 < C5 dUT= D2-C5 - ((D2-C5)/2^7) * ((D2-C5)/2^7) * B / 2^C

Step 2: (calculate offset, sensitivity and final pressure value)

OFF=(C2+(C4-1024)*dUT/2^14)*4
SENS = C1+ C3*dUT/2^10
X= SENS * (D1-7168)/2^14 - OFF
P=X*10/2^5+C7

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

Step 3: (calculate temperature)

T = 250 + dUT * C6 / 2 ^ 16-dUT/2^D

Example:

C1=29908
C2=3724
C3=312
C4=441
C5=9191
C6=3990
C7=2500
A=1
B=4
C=4
D=9

D1=30036
D2=4107

dUT = (4107-9191) - ((4107-9191)*(4107-9191)/128^2) * 4 / 2^4 = -5478

OFF = (3724 + (441-1024) * (-5478) / 2^14) * 4 =15675

SENS= 29908 + 312 * (-5478) / 2^10 = 28238

X= 28238 * (30036-7168) / 2^14 – 15675 = 23738

P= 23738 * 10 /2^5 + 2500 = 9918 = 991.8hpa

T= 250 + (-5478) * 3990 /2^16- (-5478/2^9) =-72 = -7.2°C

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Serial Interface

The I2C interface is used for accessing calibration data as well as reading measurement result from AD conversion.

The FOSP01A 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, while space between 128 to 255 can be used for user definable data storage purpose**. It is the user's responsibility to make sure that data in range of 16 to 127 will not be changed. Any accidental corruption to those data will lead to system failure and can lead to wrong calculated pressure and temperature results.**

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 as well.

Coefficient	**EEPROM ADDRESS**
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)
A	(30)
B	(31)
C	(32)
D	(33)

AD chip 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

Temperature Measure:

S	11101110	**A**	11111111	**A**	11101000	**A**	P	D	S	11101110	**A**	11111101	**A**	S	11101111	**A**	**MSB**	A	**LSB**	N	P

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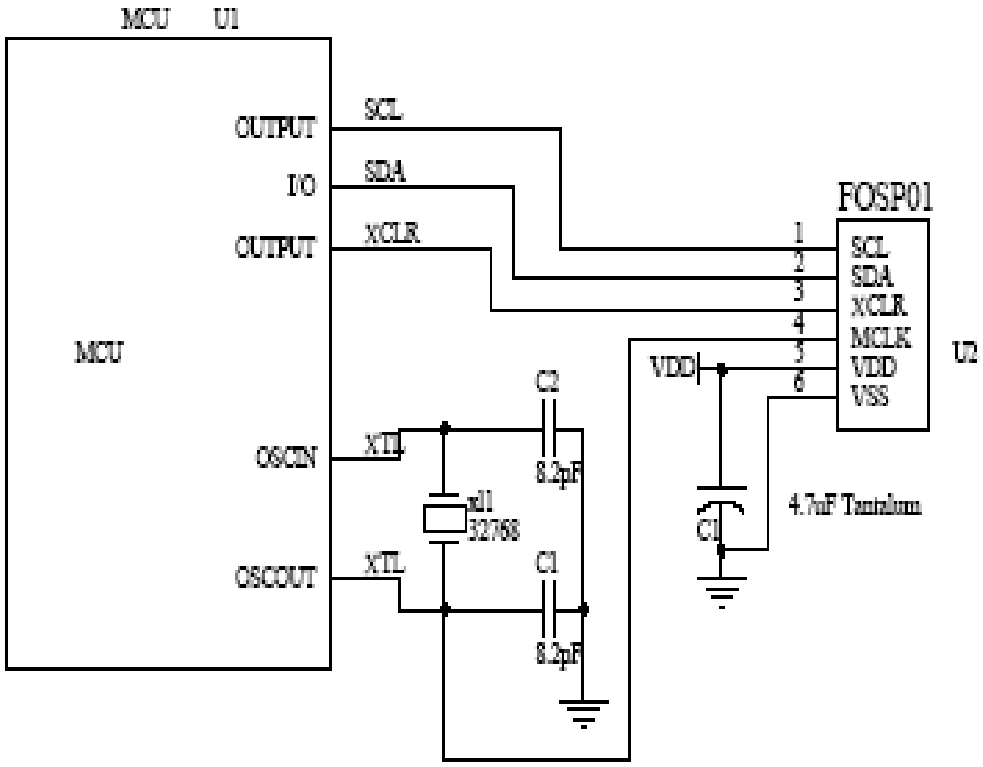
S: start condition
P: stop condition
A (bold**)** : acknowledge from slave
A : acknowledge from master
N: no acknowledge from master (send out bit 1 instead)
D : delay for 40ms minimum
MSB: conversion result MSB
LSB: conversion result LSB.

Remark: before start an AD conversion cycle, remember to use XCLR pin to reset the AD converter.

All data read from the module is in hex format.

Typical Application Circuit Diagram:



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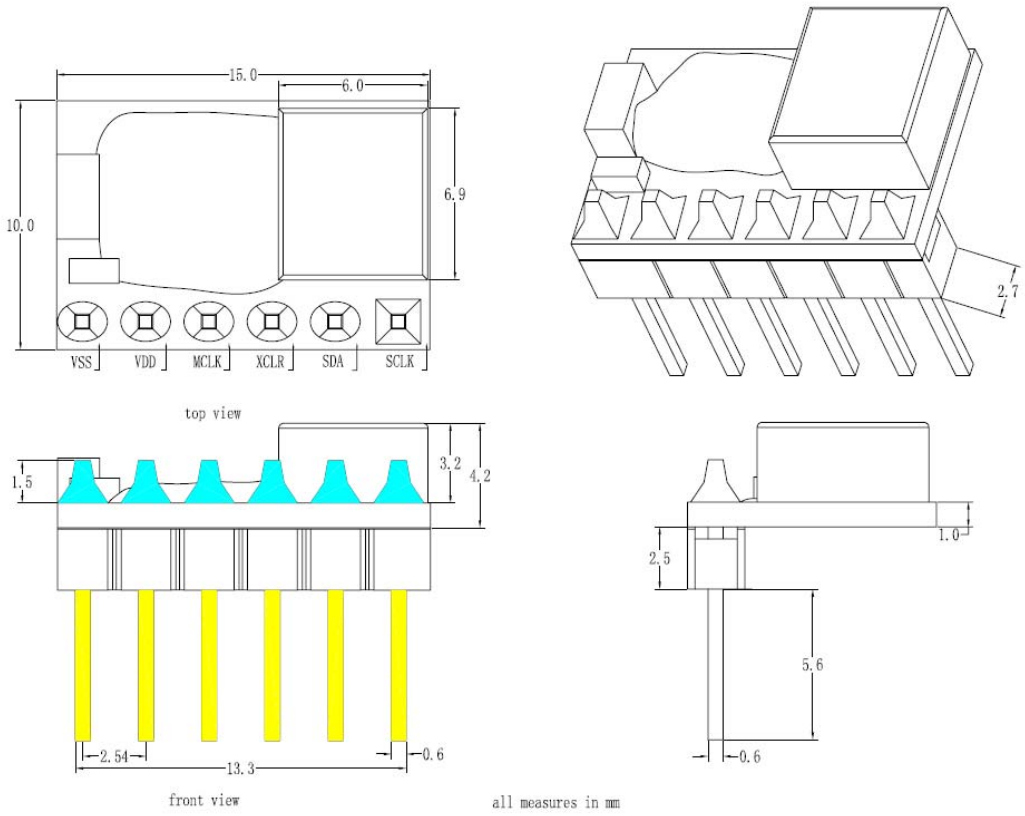
FOSP01A Mechanical Dimension



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.

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