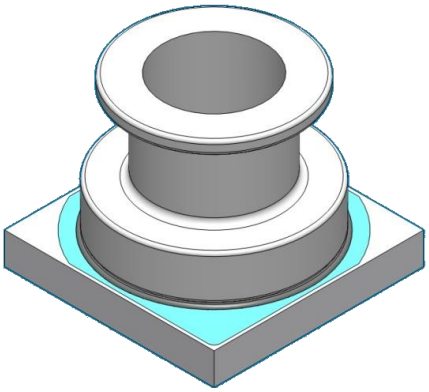
PBM230 series
Digital barometer

Features

- Supply voltage:
  1.7 to 5.5V(V_{DD})
  1.2 to 5.5V(V_{DDIO})
- 300 to 1100 hPa pressure range
- 8cm altitude resolution (RMS)
- 2.2ms fastest conversion time
- Standby current <0.1μA
- I^2C interfaces
- Calibrated and temperature compensated



Application Examples

- Outdoor PND
- Sport watch
- Diving watch
- Weather forecast device
- Smart watch
- Altimeter and barometer for portable device
- Bike computer

Descriptions

The PBM230 is a new generation of high resolution digital barometer. The PBM230 is a digital pressure sensor which consists of a MEMS piezoresistive pressure sensor and a signal conditioning ASIC. The ASIC include a 24bits sigma-delta ADC, OTP memory for calibration data, and serial interface circuits. The PBM230 could provide I^2C interface to communicate with microcontroller.

Pressure calibrated and temperature compensated were key features of the PBM230. The data stored in OTP memory could be used to calibrate the PBM230. The calibration procedure should be implemented by a external microprocessor. The PBM230 is low power and supply voltage designed and suitable for portable devices or battery-supplied ones. The PBM230 is designed for water resistant applications. It could meet the criterion of 100m water resistant according to ISO 2281 standard.

Ordering information

Part No.	Pressure type	Pressure range	Digital interface	Package	Note
PBM230-A11KDT	Absolute	300-1100hPa	I^2C	SMD	JEDEC tray
PBM230-A11KDR	Absolute	300-1100hPa	I^2C	SMD	Tape & Reel
PBM230-A11KDU	Absolute	300-1100hPa	I^2C	SMD	Tube

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1 Functional Block and Pin Descriptions

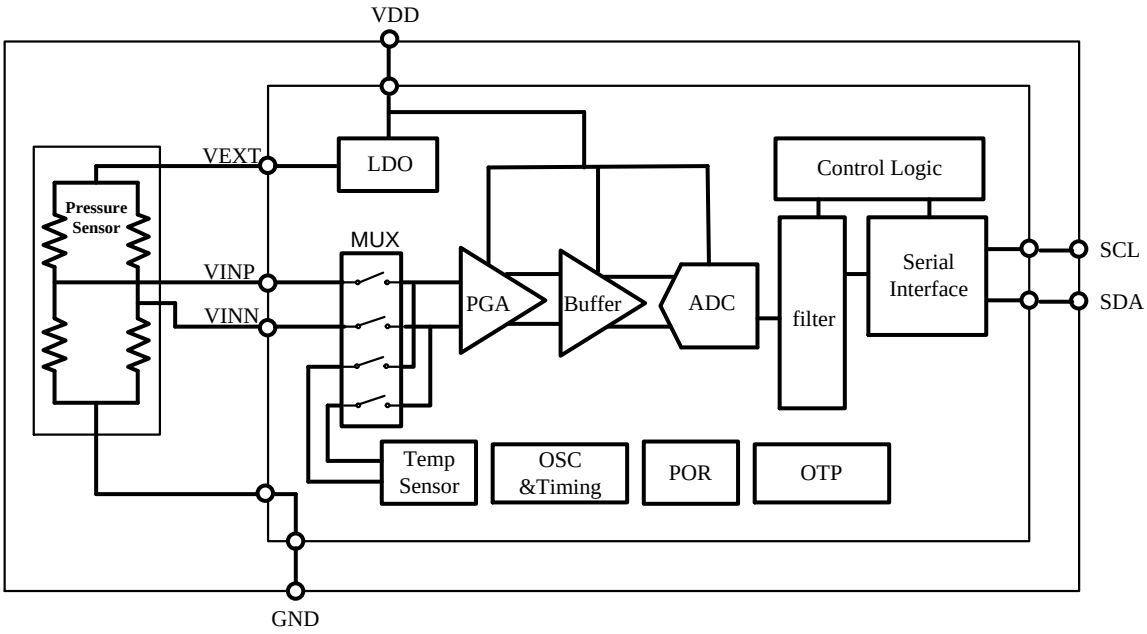
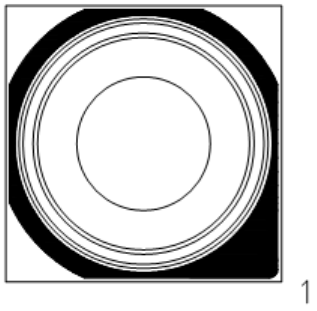
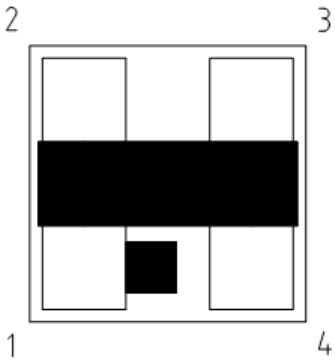


Fig. 1 Functional Block Diagram of PBM230





Pin No.	Pin Name	Description
1	GND	Ground supply
2	VDD	Power supply
3	SCL	Serial clock
4	SDA	Serial data input/output in I^2C mode(SDA)

2 Electrical Characteristic

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
Pressure Range			300		1100	hPa	mbar
Operating Temperature Range			-40		85	°C	
Supply Voltage	V_{DD}		1.7	3	5.5	V	
	V_{DDIO}		1.2		5.5	V	
Supply Current Pressure measurement Ultra low power Standard High resolution Ultra high resolution Temperature measurement	I_{DD}	V_{DD}=3V 1 conversion/sec.		 3.0 4.7 7.7 13.9 1.9	 3.5 6.4 8.9 16.0 2.2	µA	
Peak Current During Conversion Pressure measurement Temperature measurement	I_{peak}	V_{DD}=3V		 1.51 0.95		mA	
Standby Current	I_{sd}			<0.1		µA	
Conversion time Pressure measurement Ultra low power Standard High resolution Ultra high resolution Temperature measurement				 2.2 3.3 5.4 9.8 2.2	 2.5 3.7 6.0 10.7 2.5	ms	
Relative Pressure Accuracy V_{DD}=3V		750～1100 hPa 25℃	-0.5		0.5	hPa	2
		300～1000 hPa 0～50℃	-1		1	hPa	
		300～1100 hPa -40～85℃	-2		5	hPa	
Absolute Pressure Accuracy V_{DD}=3V		750～1100 hPa 25℃	-1.5		1.5	hPa	3
Resolution in ultra high resolution mode		Pressure Temperature		0.01 0.01		hPa ℃	4
Noise in pressure Ultra low power Standard High resolution Ultra high resolution				 1.97 1.46 1.16 0.98		Pa	RMS noise
Absolute temperature accuracy V_{DD}=3V		@25℃ 0～65℃	-1.5 -2	±0.5 ±1	1.5 2	℃	
Maximum error over supply voltage		VDD=1.8～3.6V	-1		1	hPa	
Soldering drift		After solder reflow	-2		2	hPa	
Long term stability		12 months	-1		1	hPa	

1. All the data were measured with 3V supply voltage at a temperature of 25±3℃, unless otherwise noted.
2. Maximum error of pressure reading over the pressure range after offset adjusted at one pressure point.
3. Maximum error of pressure reading over the pressure range.
4. According to 32 bit integer compensation formula.

3 Absolute Maximum Conditions

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
Supply Voltage	AVDD		-0.3		6.5	V	

	VDDIO		-0.3		6.5	V	
Analog pin voltage			-0.3		AVDD+0.3	V	
Digital output voltage			-0.3		VDDIO+0.3	V	
Storage Temperature Range			-40		125	°C	
Maximum Overpressure		100m, ISO 2281			10	bar	Water resistant
ESD Rating HBM				2		kV	

4 Application Information

Owing to state of the art, the PBM230 build a new standard of digital barometer. A 24bits sigma-delta ADC and a MEMS pressure sensor are integrated in a LGA substrate. Pressure calibrated and temperature compensated were key features of the PBM230. The PBM230 is low power and supply voltage designed and suitable for portable devices or battery-supplied ones.

The data stored in OTP memory could be used to calibrate the PBM230. The calibration procedure should be implemented by a external microprocessor. By I^2C interface, you can get the calibration data stored in OTP and the raw data of pressure and temperature. In order to get the correct pressure and temperature reading, the calculating procedure must be implemented in a microprocessor.

Application Circuit example

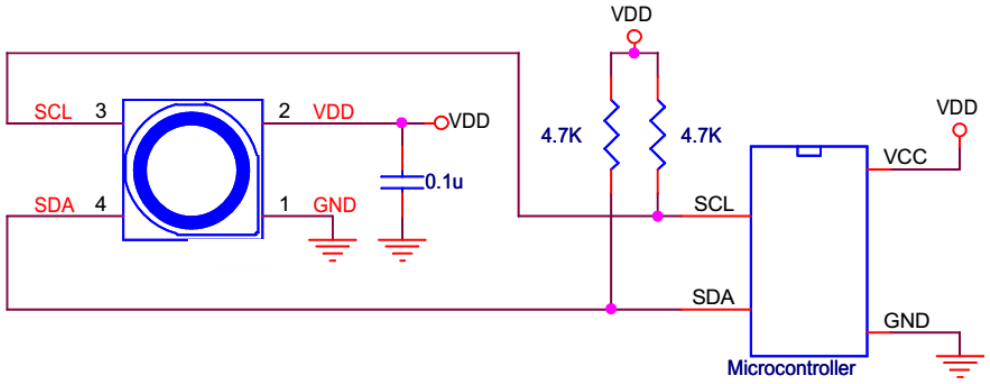


Figure. 4.1 Application circuit for I^2C interface

5 Control registers

Table 5.1 control registers

Addr	Description	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Default
0xF8	DATA_LSB	R	Data out<7:0>								0x00
0xF7	DATA_CSB	R	Data out<15:8>								0x00
0xF6	DATA_MSB	R	Data out<23:16>								0x00
0xF4	CONFIG_1	RW	OSR<1:0>		Measurement_control<5:0>						0x00
0xF1	Cal_coeff	R	Calibration Registers								N/A
0xE0	Soft_reset	W	Softreset<7:0>								0x00
0xD0	Cal_coeff	R	Calibration Registers								N/A
0xBB-0xAA	Cal_coeff	R	Calibration Registers								N/A
0x6B	Part ID	R	PartID<7:0>								0x42

Reg 0xF6–0xF8

Data_out: 24 bits ADC output data

Reg 0xF4

OSR<1:0>: 00:1024X, 01:2048X, 10:4096X, 11:8192X

Measurement_control<5:0>: 101110, indicate a temperature conversion. 110100, indicate a pressure conversion.

Reg 0xE0

Softreset : Write only register. If set to 0xB6, will perform a power on reset sequence. Auto returned to 0 after the soft reset completed.

Reg {0xF1, 0xD0, 0xBB:0xAA}

Calibration Registers : Total 20bytes calibration registers used for sensor calibration.

Reg 0x6B

PartID: 8 bits Part ID, the default value is 0x42.

Table 5.2 Summary of instructions

Instruction	Register address	Value
Pressure measurement, OSR1024	0xF4	0x34
Pressure measurement, OSR2048	0xF4	0x74
Pressure measurement, OSR4096	0xF4	0xB4
Pressure measurement, OSR8192	0xF4	0xF4
Temperature measurement	0xF4	0x2E
Softreset	0xE0	0xB6

6 I²C Interface

I²C bus uses SCL and SDA as signal lines. Both lines are connected to VDDIO externally via pull-up resistors so that they are pulled high when the bus is free. The I²C device address of PBM230 is shown below. The LSB bit of the 7bits device address is configured via SDO/ADDR pin. If the SDO/ADDR pin was left not connected or pulled high, the A1 bit is "1". And the device address is "1101101". For I²C bus application,' CSB' pin have to be left float or pulled high.

Table 7.1 I²C Address.

A7	A6	A5	A4	A3	A2	A1	W/R
1	1	0	1	1	0	SDO/ADDR	0/1

Table 7.2 Electrical specification of the I²C interface pins

Symbol	Parameter	Condition	Min	Max	Unit
f_{scl}	Clock frequency			400	kHz
t_{LOW}	SCL low pulse		1.3		us
t_{HIGH}	SCL high pulse		0.6		us
t_{SUDAT}	SDA setup time		0.1		us
t_{HDDAT}	SDA hold time		0.0		us
t_{SUSTA}	Setup Time for a repeated start condition		0.6		us
t_{HDSTA}	Hold time for a start condition		0.6		us
t_{SUSTO}	Setup Time for a stop condition		0.6		us
t_{BUF}	Time before a new transmission can start		1.3		us

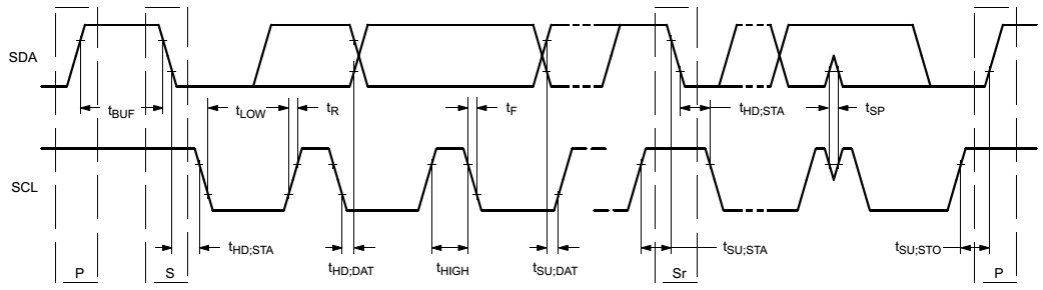


Figure 7.1 I²C Timing Diagram

The I^2C interface protocol has special bus signal conditions. Start (S), stop (P) and binary data conditions are shown below. At start condition, SCL is high and SDA has a falling edge. Then the slave address is sent. After the 7 address bits, the direction control bit R/W selects the read or write operation. When a slave device recognizes that it is being addressed, it should acknowledge by pulling SDA low in the ninth SCL (ACK) cycle.

At stop condition, SCL is also high, but SDA has a rising edge. Data must be held stable at SDA when SCL is high. Data can change value at SDA only when SCL is low.

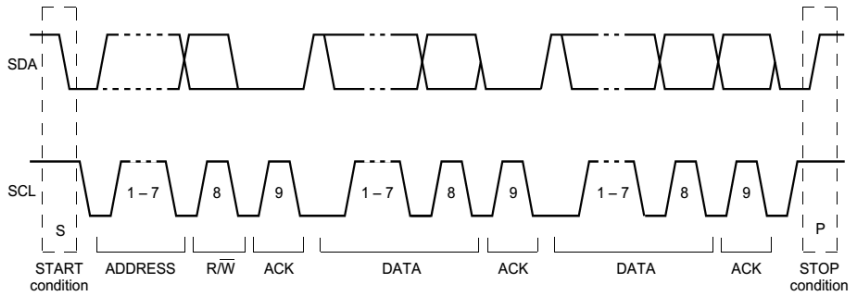
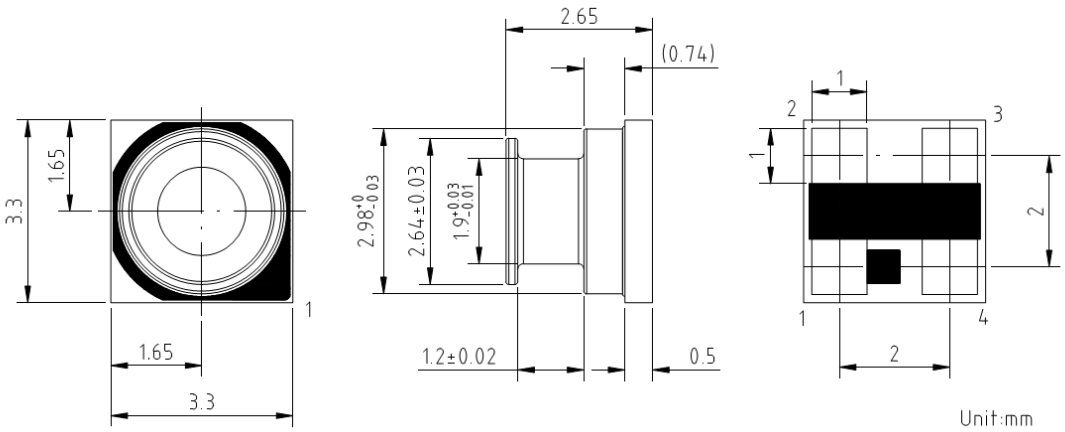


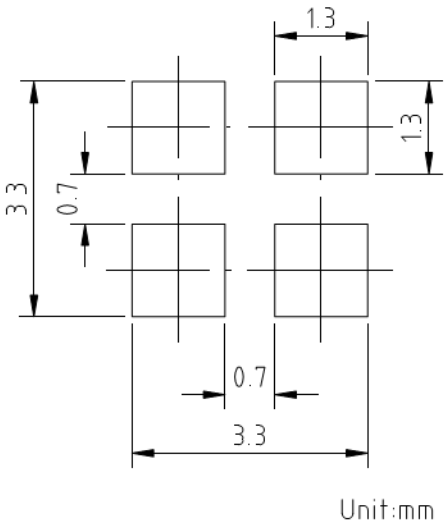
Figure 7.2 I^2C Protocol

7 Package Information

7.1 Outline dimensions



7.2 Recommended footprint



7.3 Tape and Reel specification

8.3.1 Tape dimensions

All dimensions are in mm.

8.3.2 Sensor orientation relative to the tape

8 Document history and modification

Rev.	Description	Date
0.1	First edition (Preliminary)	2016/6/16

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