PC28D Differential Pressure Sensor

Features

- Pressure ranges from ±125Pa to ±100kPa
- Compensated 14-bit digital pressure output and 11-bit digital temperature output
- I^2C interface
- 3.3V power supply
- Package size is 10mm x 10mm

Application

- Medical breathing
- Industrial controls
- HVAC
- Environmental controls
- Portable equipment

Notes:

1 Do not touch the diaphragm with hard objects, which may cause damage to the diaphragm.

2 Please read the Instruction Manual of the product carefully before installation and check the relevant information of the product.

3 Strictly follow the wiring method for wiring; otherwise, it may cause product damage or other potential faults.

4 Misuse of the product may cause danger or personal injury.

Overview

The PC28D series are high precision MEMS sensor family offers state-of-the-art pressure transducer technology to produce a digital output, fully conditioned, multi-order pressure and temperature compensated outputs. This series provides JEDEC standard SOIC-16 package with the dual vertical ports. It is available in differential, asymmetric differential configurations. With the dual ports, a reference measurement is possible to minimize errors due to changes in ambient pressure.

Combining the pressure sensor with a signal-conditioning ASIC in a single package simplifies the use of advanced silicon micro-machined pressure sensors. The pressure sensor can be mounted directly on a standard printed circuit board, calibrated pressure signal can be acquired from the digital interface. This eliminates the need for additional circuitry, such as a compensation network or microcontroller containing a custom correction algorithm.

This series is intended for use with non-corrosive, non-ionic working fluids such as air and dry gases.

Notes:

1 Do not misuse documentation.

2 The information presented in this product sheet is for reference only. Do not use this document as a product installation guide.

3 Complete installation, operation, and maintenance information is provided in the instructions of the product.

4 Misuse of the product may cause danger or personal injury.

Standard pressure ranges

inH20/cmH2O Pressure Products

Device	Operating range	Proof pressure	Burst pressure
PC28D-001ND/G	±1 inH2O / 0 to 1 inH2O	10kPa	30kPa
PC28D-002ND/G	±2 inH2O / 0 to 2 inH2O	10kPa	30kPa
PC28D-005ND/G	±5 inH2O / 0 to 5 inH2O	10kPa	30kPa
PC28D-010ND/G	±10 inH2O / 0 to10 inH2O	25kPa	75kPa
PC28D-020ND/G	±20 inH2O / 0 to 20 inH2O	25kPa	75kPa
PC28D-030ND/G	±30 inH2O / 0 to 30 inH2O	50kPa	150kPa
PC28D-010CC/D	-0.5~10cmH2O / -10~10cmH2O	10kPa	15kPa
PC28D-020CC/D	-1~20cmH2O / -20~20cmH2O	10kPa	15kPa
PC28D-040CC/D	-5~40cmH2O / -40~40cmH2O	25kPa	50kPa
PC28D-100CC/D	-5~100cmH2O / -100~100cmH2O	50kPa	100kPa

STD. Pressure Products

Device	Operating range	Proof pressure	Burst pressure
PC28D-125PD	±125Pa	10kPa	30kPa
PC28D-250PD/G	±250Pa / 0 to 250Pa	10kPa	30kPa
PC28D-500PD/G	±500Pa / 0 to 500Pa	10kPa	30kPa
PC28D-001KD/G	±1kPa / 0 to 1kPa	10kPa	30kPa
PC28D-002KD/G	±2kPa / 0 to 2kPa	10kPa	30kPa
PC28D-005KD/G	±5kPa / 0 to 5kPa	25kPa	50kPa
PC28D-010KD/G	±10kPa / 0 to 10kPa	50kPa	100kPa
PC28D-015KD/G	±15kPa / 0 to 15kPa	50kPa	100kPa
PC28D-035KD/G	±35kPa / 0 to 35kPa	70kPa	105kPa
PC28D-040KD/G	±40kPa / 0 to 40kPa	80kPa	120kPa
PC28D-100KD/G	±100kPa / 0 to 100kPa	200kPa	300kPa
PC28D-005SD	±5psi	70kPa	105kPa
PC28D-015SD	±15psi	200kPa	300kPa

Performance characteristics

Parameter	Min	Typ	Max	Unit	Note
Compensation Temperature, from -10℃ to 60℃					
Pressure TEB	-1.0		1.0	%FSS	Note(1)
Pressure TEB (125pa and 250pa)	-2.5		2.5	%FSS	Note(1)(5)
Pressure Accuracy		±0.25		%FSS	Note(2)
Temperature Accuracy		3		℃	Note(3)

Note: (1) TEB values are valid only at the calibrated supply voltage.

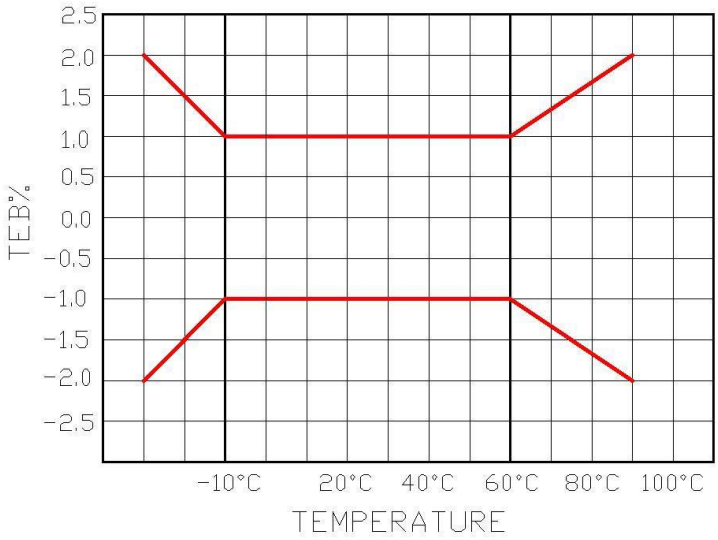
(2) The maximum deviation from a best fit straight line(BFSL) fitted to the output measured over the pressure range at 25C. Includes all errors due to pressure non-linearity, hysteresis, and non-repeatability.

(3) The deviation from a best fit straight line(BFSL) fitted to the output measured over the compensated temperature range.

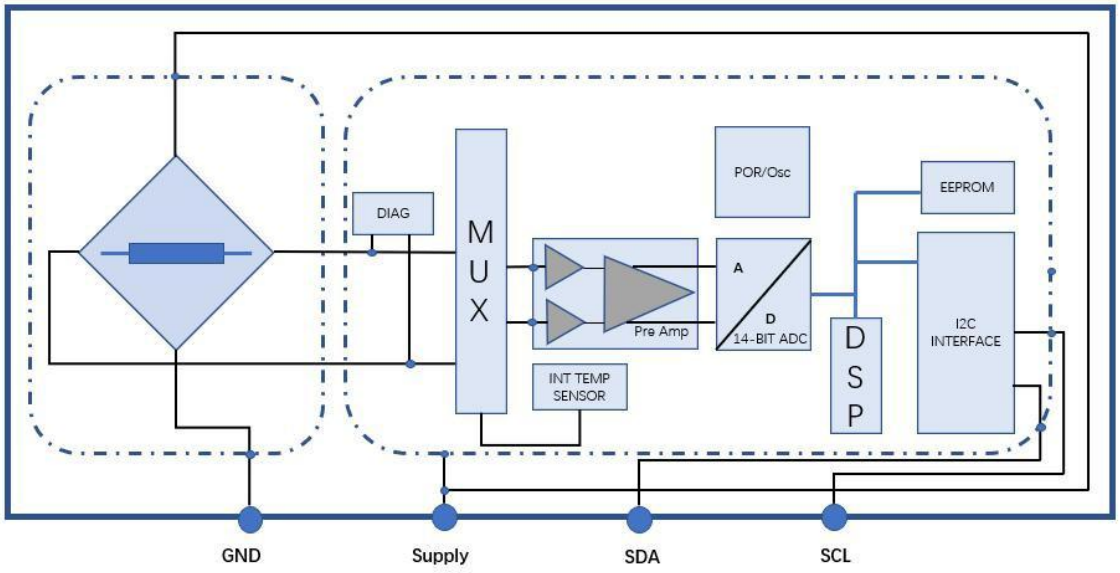
(4) This product can be configured for custom OEM requirements, contact factory for lower power consumption or higher accuracy.

(5) For 125Pa and 250Pa pressure range.

(6) For errors beyond the compensated temperature range, see Extended Temperature Multiplier chart as below.



Functional block diagram



Electrical specifications

Electrical characteristics

DC characteristics @V_{DD}=3.3V, T=25℃ unless otherwise noted

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Operation supply voltage	V_{DD}		2.7	3.3	5.5	V
Operation temperature	T_{OP}		-20		85	℃
Compensated temperature	T_{co}		-10		60	℃
Load resistance	R_L		10			kΩ
Supply current	Idd			3.0		mA
Output pressure resolution					14	Bits
Output temperature resolution			8		11	Bits
Update time				0.5		mS
Startup time					8.4	mS
Serial data clock frequency	f_{SCLK}	I^2C protocol		100	400	kHz
Digital input high voltage	V_{IH}		0.8		1	%V_{DD}
Digital input low voltage	V_{IL}		0		0.2	%V_{DD}
Input capacitance	C_{IN}			4.7		pF
Weight					3	grams

Absolute maximum rating

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply voltage	V_{DD}		-0.3		5.5	V
Interface voltage	V_{IF}		-0.3		V_{DD}+0.3	V
Storage temperature range	T_{STG}		-40		125	℃
ESD rating		Human body model	-2		+2	kV
Solder temperature		250°C, 5 sec max.				

Stresses above those listed as “absolute maximum ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Function descriptions

General description

The PC28D series consists of a piezo-resistive sensor and a sensor interface I²C. The main function of the I²C is to convert the uncompensated analogue output voltage from the piezo-resistive pressure sensor to a 14-bit digital value, as well as providing a 11-bit digital value for the temperature of the sensor, and compensates them by a patented algorithm. The fully-compensated values can be read out by external MCU.

Factory calibration

Every sensor is individually factory calibrated for sensitivity and offset for both of the temperature and pressure measurements; further calibrations are not necessary to be done by the user.

Sensor output conversion

The sensor is programmed for the fastest update rate, conversions will continue to happen after the power-up sequence. Customer just needs to read sensor without other operations.

Serial interface

The PC28D provides I²C interface for serial communication.

I²C Interface

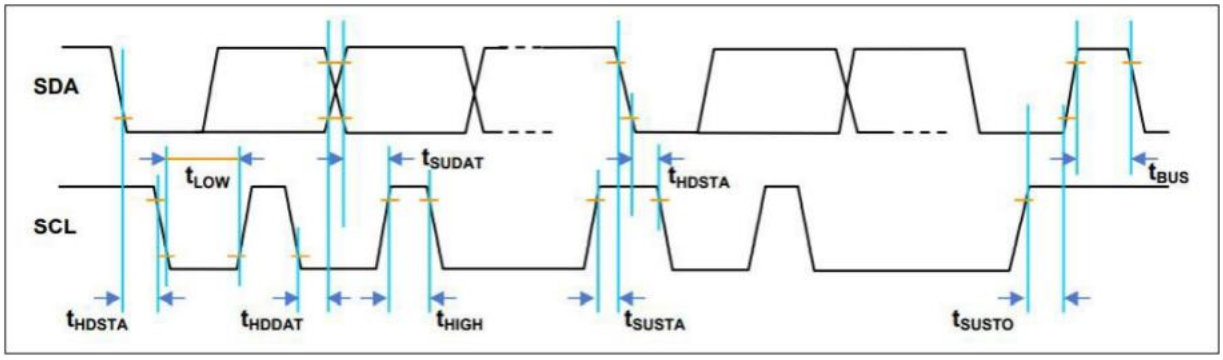
The sensor can communicate via an addressable two-wire (I²C) interface. The address of Device is 0X28H.

I²C timing parameters

Parameter	Symbol	Min	Typ	Max	Units
SCL clock frequency	f_{SCL}	100		400	kHz
Start condition hold time relaltive to SCL edge	t_{HDSTA}	0.1			μs
Minimum SCL clock low width Note	t_{LOW}	0.6			μs
Minimum SCL clock high width Note	t_{HIGH}	0.6			μs
Start condition setup time relative to SCL edge	t_{SUSTA}	0.1			μs
Data hold time on SDA relatve to SCL edge	t_{HDDAT}	0			μs
Data setup time on SDA relatve to SCL edge	t_{SUDAT}	0.1			μs
Stop condtion setup time on SCL	t_{SUSTO}	0.1			μs
Bus free time between stop conditon and start condition	t_{BUS}	2			μs

Note: Combined low and high widths must equal or exceed minimum SCLK period.

I²C timing diagram



Note: There are three differences in the sensor protocol compared with the original I²C protocol:

(1) Sending a start-stop condition without any transitions on the CLK line (no clock pulses in between) creates a communication error for the next communication, even if the next start condition is correct and the clock pulse is applied. An additional start condition must be sent, which results in restoration of proper communication.

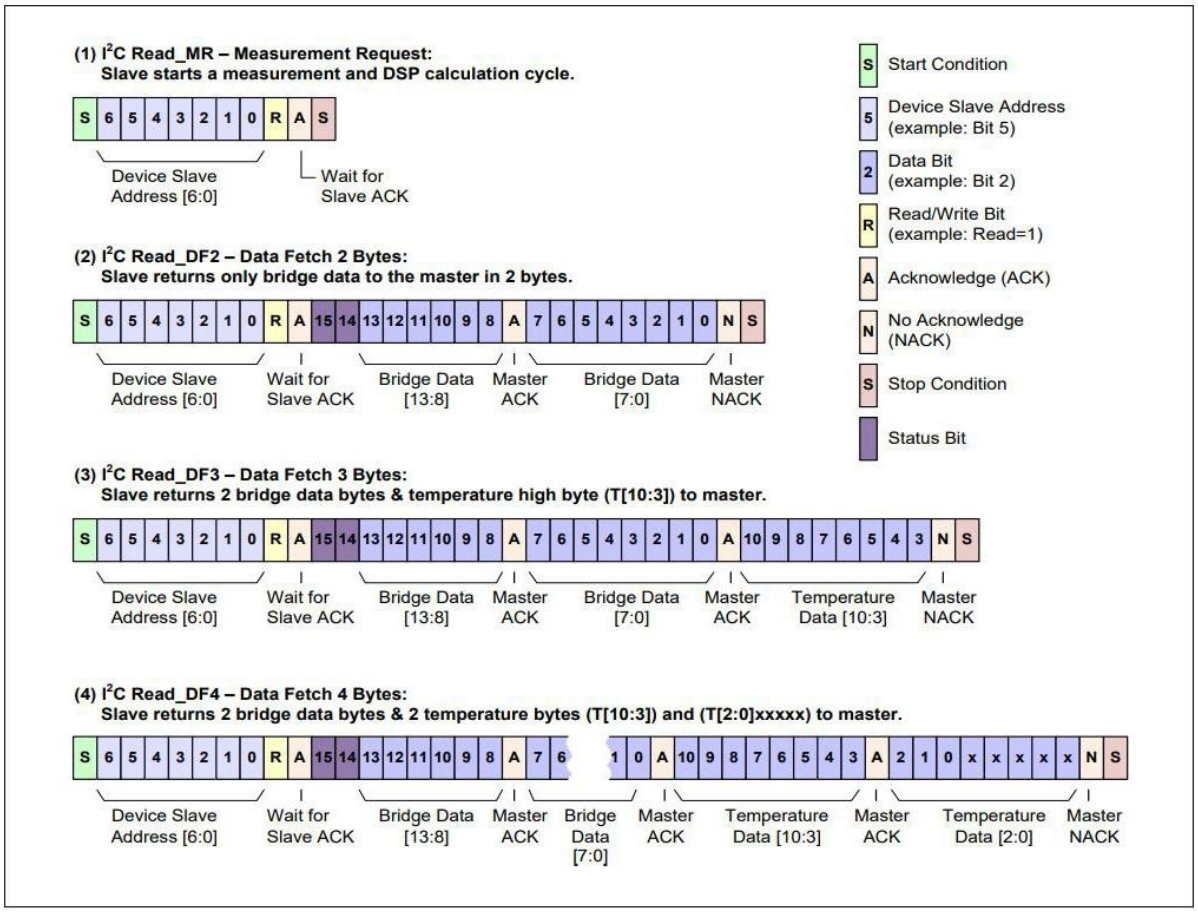
(2) The restart condition ---- a falling SDA edge during data transmission when the CLK clock line is still high-creates the same situation. The next communication fails, and an additional start condition must be sent for correct communication.

(3) A falling SDA edge is not allowed between the start condition and the first rising SCL edge. If using an I²C address with the first bit 0, SDA must be held low from the start condition through the first bit.

I²C read operations

For read operations, the I²C master command starts with the 7bit slave address with the 8th bit =1 (READ).

The sensor as the slave sends an acknowledge (ACK) indicating success. The sensor has four I²C read commands: Read_MR, Read_DF2, Read_DF3, and Read_DF4. Figure as below shows the structure of the measurement packet for three of the four I²C read commands.



The Structure of The Measurement Packet

Note: For sensors that do not offer the optional compensated temperature output, the sensor will still output the third and fourth bytes of data, but the information contained in these bytes is non-corrected data, and should not be used.

Status bits

PC28D digital output pressure sensors offer both standard and optional diagnostics to ensure robust system operation in critical applications. The diagnostic states are indicated by the first two Most Significant Bits of Data Byte 1.

Diagnostic Conditions Indicated by Status Bits

Status Bits		Definition
S1	**S0**	
0	0	Normal Operation, Valid data
0	1	Sensor in command mode Note
1	0	Stale data: data that has already been fetched since the last measurement cycle, or data fetched before the first measurement has been completed.
1	1	Diagnostic condition occurs.

Note: Command mode is used for programming the sensor. The mode should not be seen during normal operation.

Standard diagnostics for PC28D digital output pressure sensors consist of an EEPROM (Electrically Erasable Programmable Read-Only Memory) signature used to validate the EEPROM contents during startup. In the event that any EEPROM contents change after calibration, a diagnostic condition will be flagged.

Optional diagnostics for PC28D digital output pressure sensors consist of:

1 Loss of sensor element connection

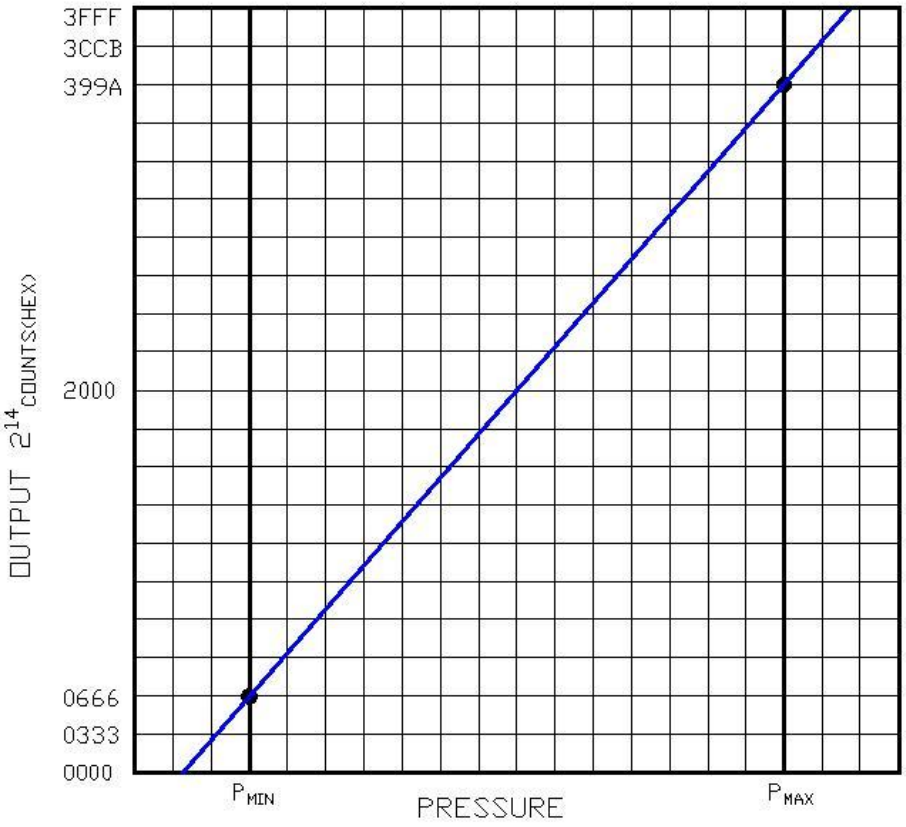
2 Short circuit of sensor element

When the two status bits are “11”, one of the mentioned as above diagnostic faults is indicated.
When the status bits read “10”, “stale” data is indicated, this means that the data that already exists in the sensor’s output buffer has already been fetched by the master, and has not yet been updated with the next data from the current measurement cycle. This can happen when the master polls the data quicker than the sensor can update the output buffer.

Note: Please contact PC28D Customer Service with questions regarding the availability of optional Pressure Sensor diagnostics.

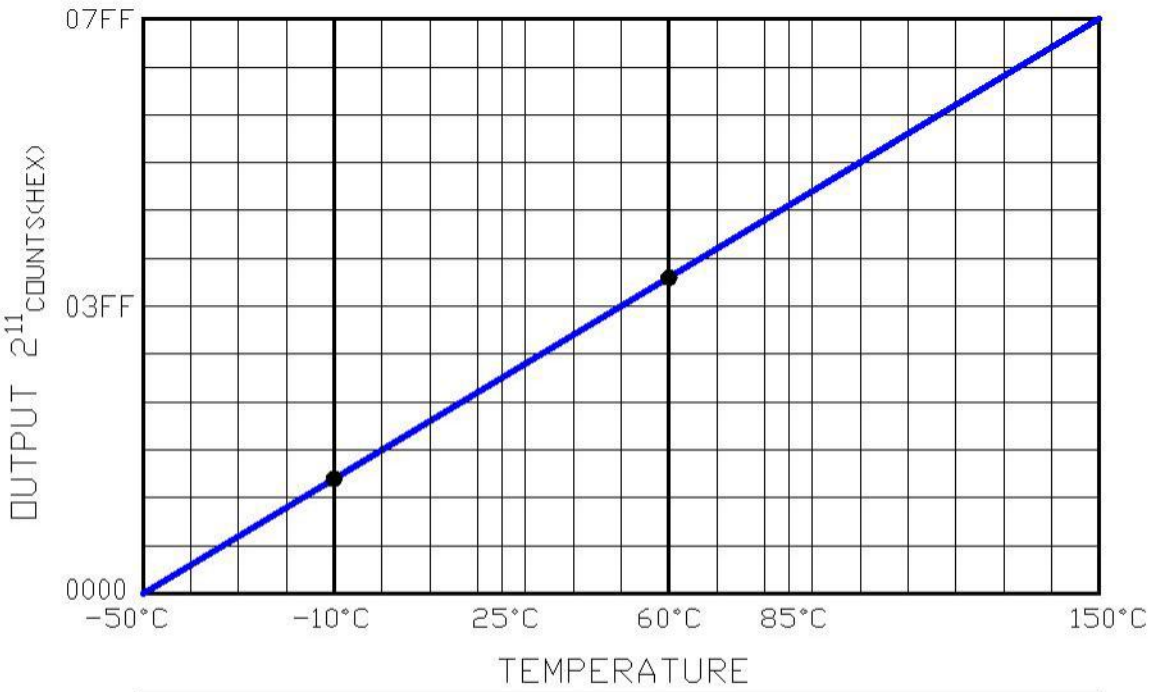
Pressure and temperature transfer function

Pressure



$$PRESSURE_{APPLIED} = \frac{(OUTPUT_{COUNTS(DEC)} - 1638) * (P_{MAX} - P_{MIN})}{80\% * (2^{14} - 1)} + P_{MIN}$$

Sensor Output at Significant Percentages			
% of Count	Output	Digital Counts (decimal)	
0		0	0X0000
5		819	0X0333
10	P_{MIN}	1638	0X0666
50		8192	0X2000
90	P_{MAX}	14746	0X399A
95		15563	0X3CCB
100		16383	0X3FFF



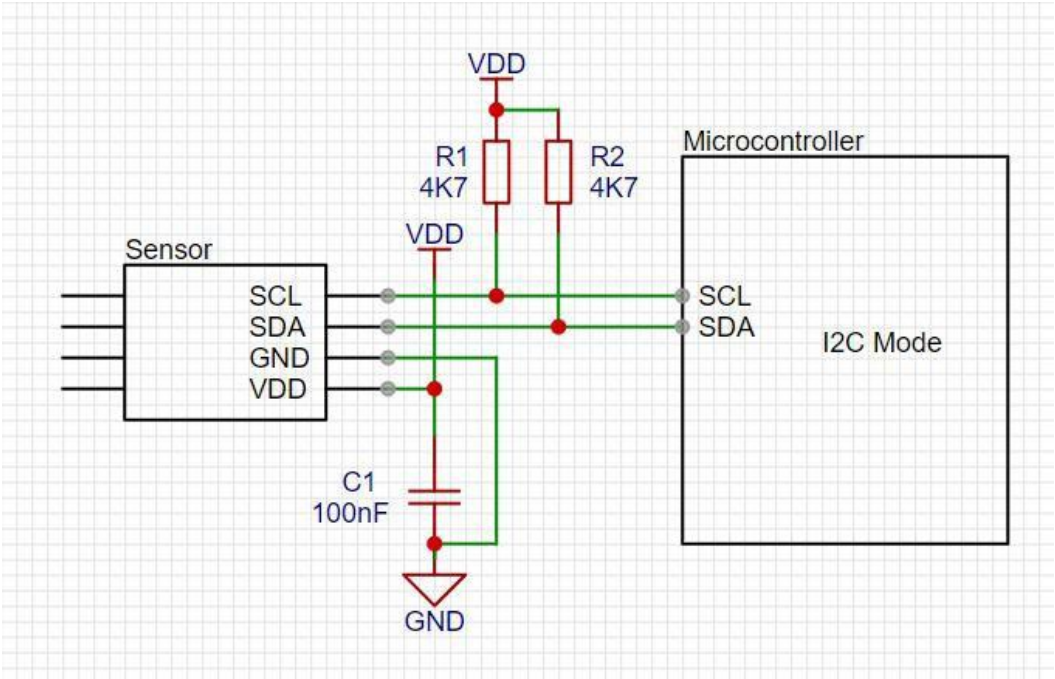
$$OUTPUT°C = \frac{OUTPUT_{COUNTS(DEC)} * 200°C}{2^{11} - 1} - 50°C$$

Temperature Output vs Counts

OUTPUT (°C)	Digital Counts (decimal)	Digital Counts (hex)
-50	0	0X0000
0	511	0X01FF
10	614	0X0266
25	767	0X02FF
60	1125	0X0465
85	1381	0X0565
150	2047	0X07FF

Application information

I²C Interface Circuit

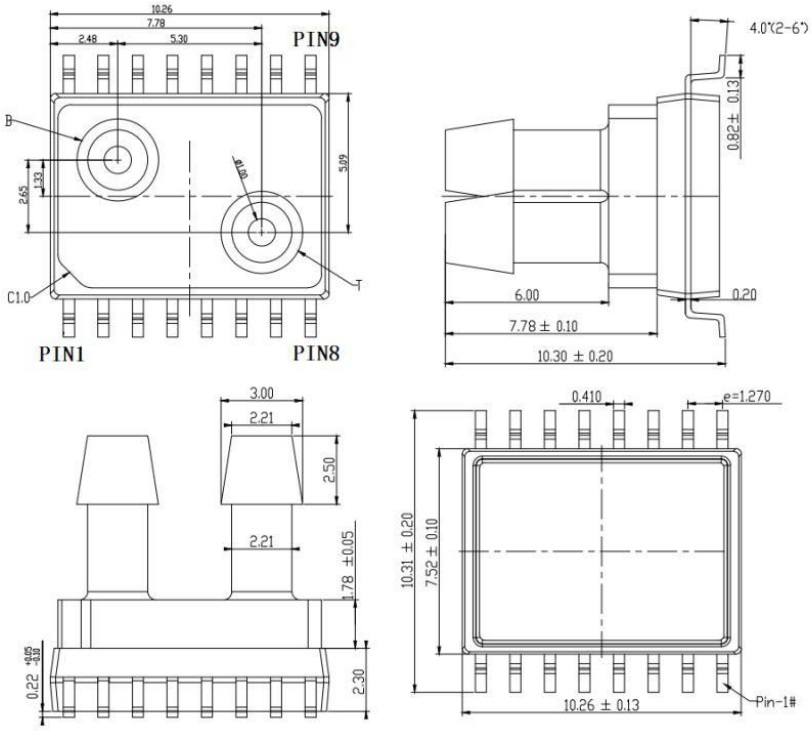


Pin Configuration and Description

Pin definition

Pin	Name	Type	Function
1	NC	NC	No Connection
2	NC	NC	No Connection
3	NC	NC	No Connection
4	NC	NC	No Connection
5	NC	NC	No Connection
6	V_{SS}	G	Ground
7	V_{DD}	P	Positive supply voltage
8	NC	NC	No Connection
9	NC	NC	No Connection
10	SDA	I/O	Serial data input/output, I²C mode(SDA)
11	SCL	I/O	Serial data clock, I²C mode(SCL)
12	NC	NC	No Connection
13	NC	NC	No Connection
14	NC	NC	No Connection
15	NC	NC	No Connection
16	NC	NC	No Connection

Package outline (SOIC16 mm)



Note: (1) All dimensions in units of [mm].

(2) Wetted materials: Silicon, glass, copper, silicone, epoxy, mold compound.

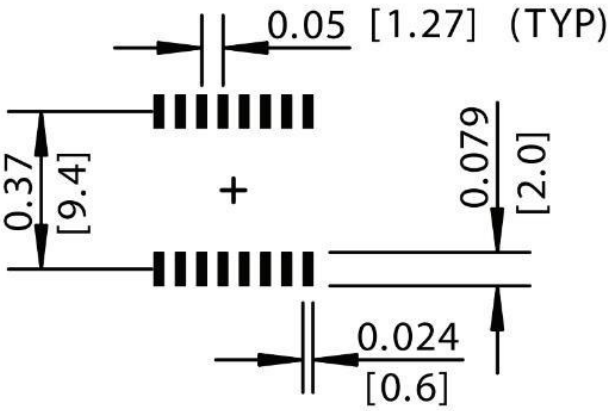
(3) Tolerance on all dimensions ±0.13 mm unless otherwise specified.

(4) [B] is tube connected to bottom side of sensor die, to be connected to the reference pressure.

(5) [T] is tube connected to top side of sensor die, to be connected to the detection pressure.

(6) An increase in top pressure will result in an increase in sensor output.

Recommended pad layout (unit: mm)



Packing options

TUBE

How to order

PC28 D - 002 N D - 10

Product model
PC28

Product model
D: Digital

Pressure range
(refer to “Standard pressure ranges” on page 2)

Pressure reference
F: Differential pressure
G: Gauge pressure
C: Compound
Others

Unit
N: inH2O
K: kPa
P: Pa
C: cmH2O
S: PSI
M: mBar
Others

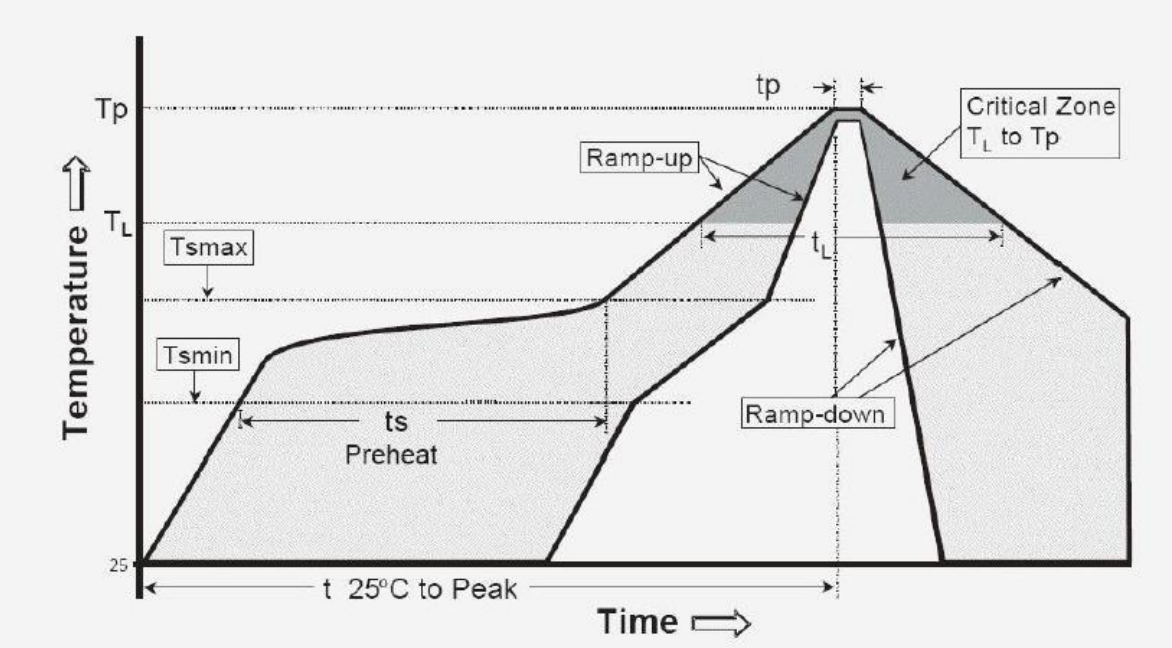
Customer code
10

standard part numbers offered which includes the pressure range and package

Example P/N: PC28D-002ND

Refer to product model PCM28D, ±2inH2O, differential.

Soldering recommendation (IPC/JEDECJ-STD-020D)



IPC/JEDEC J-STD-020D	Pb-Free assembly
Average ramp-up rate (TL-Tp)	3℃/s (Max.)
Preheat Temperature Min. (Tsmin) Temperature Max. (Tsmax) Time(Min. to Max.)(ts)	 150℃ 200℃ 60~180 seconds
Tsmax to TL–Tp	3℃/s (Max.)
Time maintained above: Temperature (TL) Time (tL)	 217℃ above 60~150 seconds
Peak temperature (Tp)	220~245℃
Time of real peak temperature within 5℃ (tp)	40 seconds
Average ramp-down rate (Tp-TL)	6℃/s (Max.)
Time 25℃ to peak temperature	8min. (Max.)

Note: (1) It is recommended that only one time reflow soldering, no more than two times.
(2) After reflow soldering or other high temperature processes, wait for at least 48 hours (or as required by the data sheet) before data reading and processing.
(3) Spot cleaning by hand if necessary, DONOT wash or submerge sensor in cleaning liquid.

Legal disclaimer

1 For the export of products which are controlled items subject to foreign and domestic export laws and regulations, you must obtain approval and/or follow the formalities of such laws and regulations.

2 Products must not be used for military and/or antisocial purposes such as terrorism, and shall not be supplied to any party intending to use the products for such purposes.

3 Unless provided otherwise, the products have been designed and manufactured for application to equipment and devices which are sold to end-users in the market.

4 Before using products, which were not specifically designed for use in automotive applications, please contact an AIOT sales representative.

5 This specification is subject to change without notice.

Wotian reserves the right to make any change in this publication without notice. The information provided is believed to be accurate and reliable as of this product sheet.

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