Pressure Sensor
HSPPAD143C
Application Note

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1 BASIC INFORMATION

1.1 What is atmospheric pressure?

It is the strength of atmospheric pressure. Equal to the weight of all air in the air column extending vertically up to the space where the atmosphere disappears on the unit area (1 m^2) of a certain point. This mass (weight) corresponds to the force of pushing up the height of the mercury column up to 0.760 m under the temperature of 0 °C. This is defined as one atmospheric pressure (symbol atm) which is a standard atmosphere. Relationship with various units is 1 atm = 760 mm Hg = 100, 1325 Pa = 1013.25 hPa. That is, the mass of air per 1 m^2 at sea level altitude 0 m is about 10,000 kg weight (10 t). 10 t are converted to units of force, it is 100,000 N (Newton), when expressed in terms of pressure, it is about 100,000 Pa (Pascal). Since 100 Pa is 1 hPa (hectopascal), it is approximately the same as 1013.25 hPa at 100,000 Pa = 1000 hPa.

The atmospheric pressure also varies with altitude and latitude. The standard atmospheric pressure (1 atm) is set to 1013.25 hPa on the sea surface, but since the atmospheric pressure is the pressure indicating the weight of the upper air, it decreases to the higher place.

Barometric pressure and elevation can be calculated by the formula provided by the “International Civil Aviation Organization” (ICAO) below.

$H\,(m) = 44330.77 \times \{1 - (P / 101325)^{0.190263}\}$

$P\,(Pa) = 101325 \times \{(288.15 - 0.0065 \times H) / 288.15\}^{5.25588}$

Table 1 shows the relationship between atmospheric pressure and altitude.

1.2 What is water pressure?

Water pressure is the pressure that water exerts on objects and water itself. In water with open water surface it is proportional to the depth from the water surface. Water pressure increases by 1 kg/cm^2 every 10 m of water. (Increase by about 1 atm)

Pressure and water depth can be calculated by the following formula.

$D\,(m) = (P - 101325) / 9800$

$P\,(Pa) = 9800 \times D + 101325$

Table 2 shows the relationship between pressure and water depth.

Table.1 Correlation of altitude and the atmospheric pressure

Altitude (m)	Pressure (kPa)
0	101.325
1000	89.875
2000	79.495
2500	74.683
3000	70.109
3500	65.764
4000	61.640
4500	57.728
5000	54.020
5500	50.507
6000	47.181
6500	44.035
7000	41.061
7500	38.251
8000	35.600
8500	33.099
9000	30.742
9500	28.524
10000	26.436

Table.2 Water depth and pressure

Water depth (m)	Pressure (kPa)
1	111.125
10	199.325
20	297.325
30	395.325
40	493.325
50	591.325
60	689.325
70	787.325
80	885.325
90	983.325
100	1081.325
110	1179.325
120	1277.325
130	1375.325
140	1473.325
150	1571.325

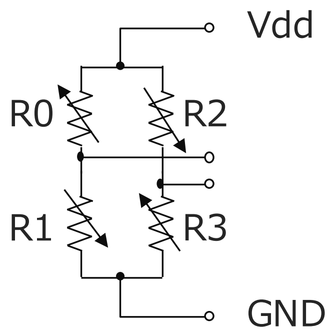
2. Pressure sensor HSPPAD143C

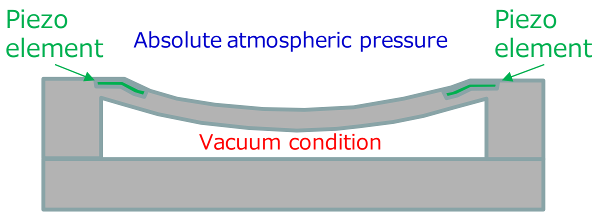
2.1 Overview

Pressure sensor HSPPADA143C is a digital interface pressure sensor. The pressure is detected by the MEMS sensor element using a piezo-resistive bridge circuit formed on the silicon diaphragm. The sensor element is connected to the ASIC for signal conditioning. HSPPAD143C is pressure sensor designed as gas meter system.

2.2 Structure

The HSPPAD series pressure sensor adopts the MEMS structure to convert the change of the atmospheric pressure into the resistance change of the piezo resistance.

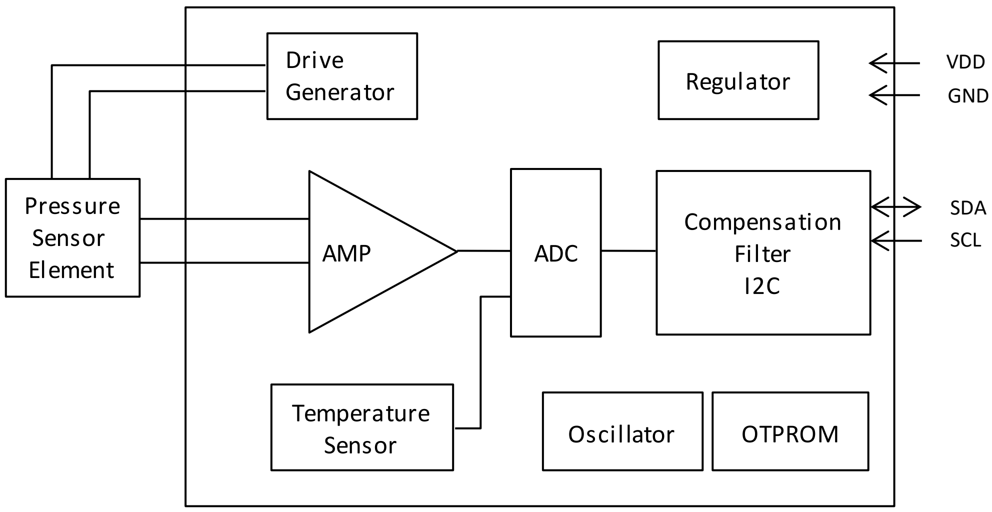




Cross section of pressure sensor

2.3 Block Diagram

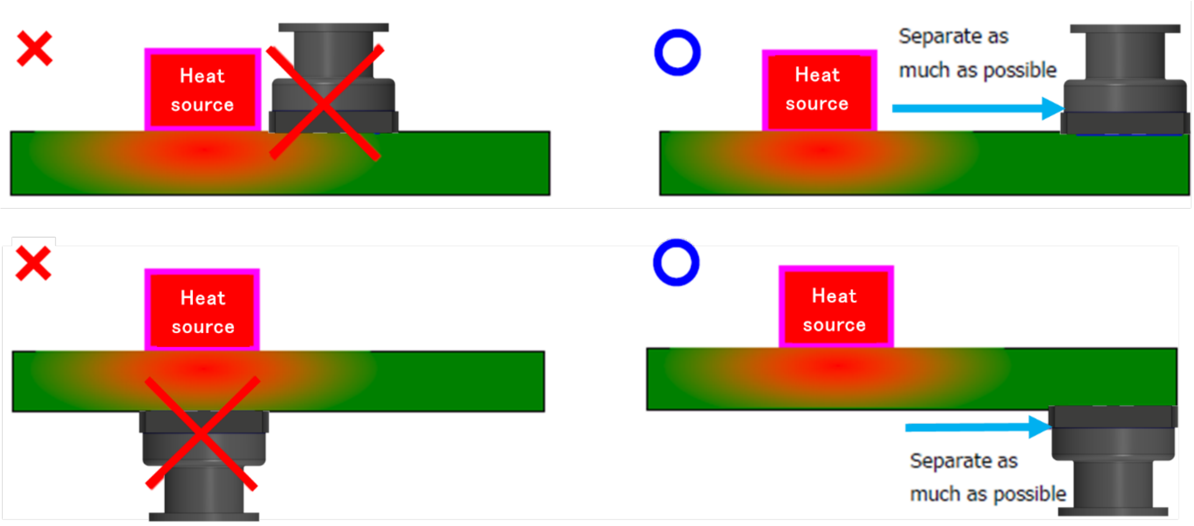
The ASIC has 17-bit ADC and temperature compensation function. The output of the ASIC corrects the pressure value. There are products that correspond to I2C.



3. Design Guide

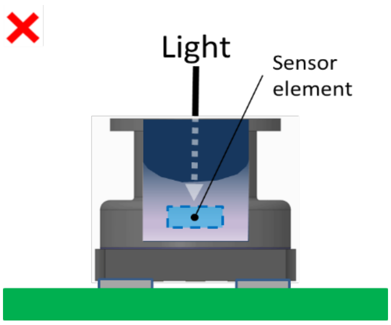
3.1 Mounting position (heat source)

If a sudden temperature change occurs, there is a possibility that the accuracy of the sensor may be affected. As far as possible, install in a place away from the heat source.



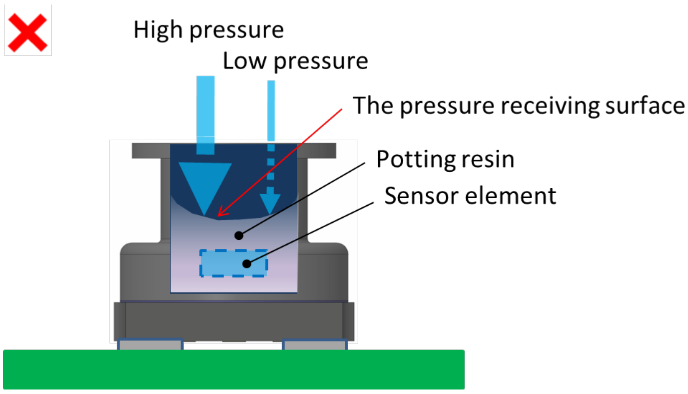
3.2 Mounting position (light source)

When the light illuminates the sensor, an error will occur due to the photoelectric effect. Mount in a position where the light does not illuminate the sensor element.



3.3 Mounting position (pressure source)

Mount in a static pressure environment position. In particular, please note that the potting resin may be deformed or chipped when the flow velocity of the medium is high, or the pressure on the potting surface is uneven.

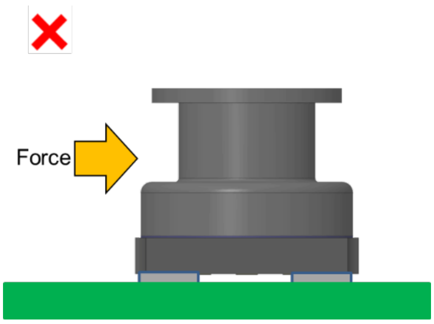


3.4 About mounting board

It is important to use a mounting board with a small coefficient of thermal expansion because the sensor element is deformed by the thermal expansion of the mounting board and affects the output accuracy. In addition, if the board is deformed by the parts mounted around the sensor, the sensor element may also be deformed, and the output accuracy may be affected. When covering the circumference with resin to protect the sensor, the residual stress of the resin affects the output accuracy, so check the output change before and after applying the resin before use.

3.5 About the mounting status

After mounting on the board, do not apply a load on the cylindrical part of the sensor.

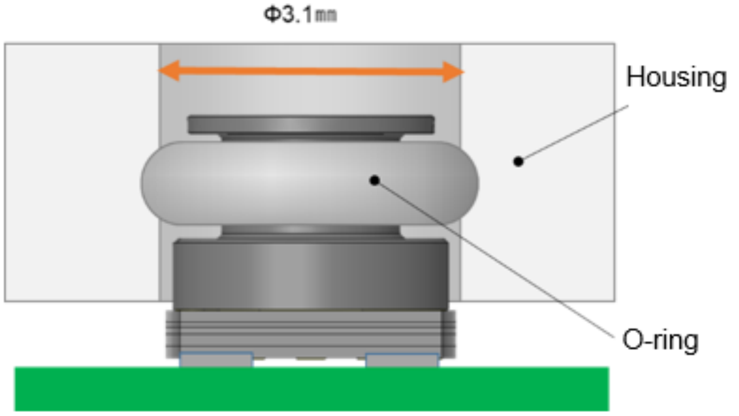


3.6 About terminal short circuit

A short circuit between the terminals of the sensor package can affect other circuits on the same wiring.

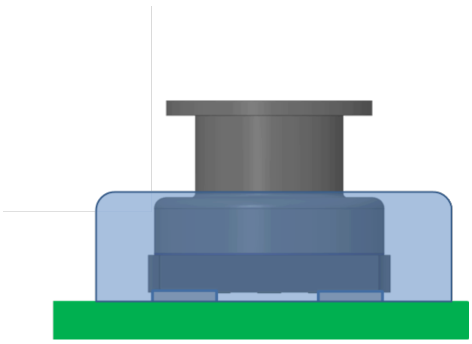
3.7 Assembly Example

When the waterproof case is designed, the recommended dimension of O ring and the case is shown in the figure below.



Housing inner diameter : 3.1mm
O-ring inner diameter : 1.8mm
O-ring cross section diameter : 0.8mm

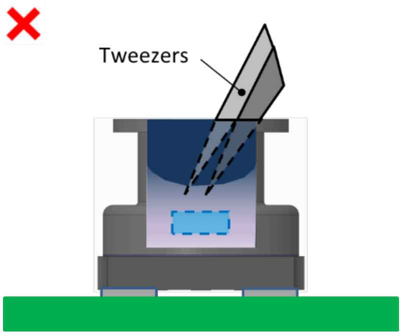
When water does not touch the sensor directly, but the sensor should be protected from humidity, the terminal part is recommended to be protected with the resin. When coating the resin, make sure that the resin does not enter the pressure detection hole. The connection between the ceramic base and the detection port must be protected. Soft elastomer such as silicone potting is recommended as a resin to protect the terminals.



4. Cautions on handling product

4. 1 About product handling

Be careful not to touch the potting resin with tweezers.



4. 2 About ultrasonic cleaning

It may be damaged if ultrasonic waves are applied.

4. 3 About ESD

This product is a precision electronic component and is susceptible to ESD. When using it, take precautions as necessary to prevent damage from ESD.

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