



6 kPa Water Vapor Compatible Uncompensated Silicon Pressure Sensors

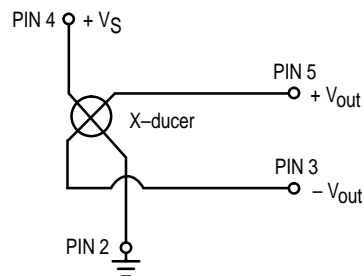
The MPX906D series device is a silicon piezoresistive pressure sensor providing a very accurate and linear voltage output — directly proportional to the applied pressure. This standard, low cost, uncompensated pressure sensor permits manufacturers to design and add their own external temperature compensating and signal conditioning networks. Compensation techniques are simplified because of the predictability of Motorola's single element strain gauge design.

It is designed for applications exposing the pressure (P2) side of the device to water, water vapor and soapy water vapor.

Features

- Low Cost
- Patented Silicon Shear Stress Strain Gauge Design
- Ratiometric to Supply Voltage
- Durable Epoxy Unibody Element
- Water Vapor Compatible — 0 to 600 mmH2O

Figure 1 shows a schematic of the internal circuitry on the stand-alone pressure sensor chip.



**Figure 1. MPX906 Pressure
Sensor Schematic**

VOLTAGE OUTPUT versus APPLIED DIFFERENTIAL PRESSURE

The differential voltage output of the X-ducer is directly proportional to the differential pressure applied.

The output voltage of the sensor increases with increasing pressure applied to the (P2) side relative to the pressure side (P1).

MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

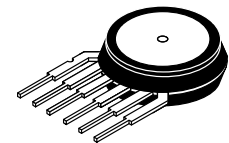
Rating	Symbol	Value	Unit
Overpressure ⁽⁸⁾ (P1 > P2)	P _{max1}	10	kPa
Overpressure ⁽⁸⁾ (P2 > P1)	P _{max2}	100	kPa
Storage Temperature	T _{stg}	-40 to +125	°C
Operating Temperature	T _A	-40 to +125	°C

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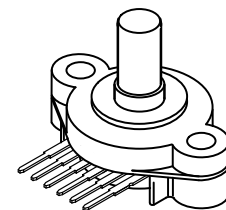
REV 2

MPX906 SERIES

0 to 6 kPa (0 to 24 in. H₂O)
WATER VAPOR
COMPATIBLE
20 mV FULL SCALE SPAN
(TYPICAL)



**BASIC CHIP
CARRIER ELEMENT
CASE 867-08, STYLE 2**



**PORT OPTION
CASE 867H-03, STYLE 2**

NOTE: Pin 1 is the notched pin.

PIN NUMBER			
1	N/C	4	V _S
2	Gnd	5	+V _{out}
3	-V _{out}	6	N/C



MPX906 SERIES

OPERATING CHARACTERISTICS ($V_S = 3.0$ Vdc, $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure Range ⁽¹⁾	P _{OP}	0	—	6.0	kPa
Supply Voltage ⁽²⁾	V _S	—	3.0	6.0	Vdc
Supply Current	I _o	—	6.0	—	mAdc
Full Scale Span ⁽³⁾	V _{FSS}	9.0	20	32	mV
Offset ⁽⁴⁾	V _{off}	-40	-20	0	mV
Sensitivity	V/P	—	3.3	—	mV/kPa
Linearity ⁽⁵⁾	—	-0.5	—	2.0	%V _{FSS}
Pressure Hysteresis (0 to 6 kPa) ⁽⁵⁾	—	—	0.1	—	%V _{FSS}
Temperature Hysteresis (0°C to +85°C) ⁽⁵⁾	—	—	± 0.5	—	%V _{FSS}
Temperature Coefficient of Full Scale Span ⁽⁵⁾	TCV _{FSS}	-0.22	—	-0.16	%V _{FSS} /°C
Temperature Coefficient of Offset ⁽⁵⁾	TCV _{off}	—	-18	—	μV/°C
Temperature Coefficient of Resistance ⁽⁵⁾	TCR	0.25	0.30	0.35	%Z _{in} /°C
Input Impedance	Z _{in}	400	—	550	Ω
Output Impedance	Z _{out}	750	—	1875	Ω
Response Time (10% to 90%) ⁽⁶⁾	t _R	—	1.0	—	ms
Warm-Up	—	—	20	—	ms
Offset Stability ⁽⁹⁾	—	—	±0.5	—	%V _{FSS}

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight (Basic Element, Case 867-08)	—	—	4.0	—	Grams

NOTES:

- 1.0 kPa (kiloPascal) equals 0.145 psi.
- Device is ratiometric within this specified excitation range. Operating the device above the specified excitation range may induce additional error due to device self-heating.
- Full Scale Span (V_{FSS}) is defined as the algebraic difference between the output voltage at full rated pressure and the output voltage at the minimum rated pressure.
- Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
- Accuracy (error budget) consists of the following:
 - Linearity: Output deviation from a straight line relationship with pressure, using end point method, over the specified pressure range.
 - Temperature Hysteresis: Output deviation at any temperature within the operating temperature range, after the temperature is cycled to and from the minimum or maximum operating temperature points, with zero differential pressure applied.
 - Pressure Hysteresis: Output deviation at any pressure within the specified range, when this pressure is cycled to and from the minimum or maximum rated pressure, at 25°C.
 - TcSpan: Output deviation at full rated pressure over the temperature range of 0 to 85°C, relative to 25°C.
 - TcOffset: Output deviation with minimum rated pressure applied, over the temperature range of 0 to 85°C, relative to 25°C.
 - TCR: Z_{in} deviation with minimum rated pressure applied, over the temperature range of -40°C to +125°C, relative to 25°C.
- Response Time is defined as the time for the incremental change in the output to go from 10% to 90% of its final value when subjected to a specified step change in pressure.
- Common mode pressures beyond specified may result in leakage at the case-to-lead interface.
- Exposure beyond these limits may cause permanent damage or degradation to the device.
- Offset stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.

TEMPERATURE COMPENSATION

Figure 2 shows the output characteristics of the MPX906D series at 25°C.

The X–ducer piezoresistive pressure sensor element is a semiconductor device which gives an electrical output signal proportional to the pressure applied to the device. This device uses a unique transverse voltage diffused semiconductor strain gauge which is sensitive to stresses produced in a thin silicon diaphragm by the applied pressure.

Because this strain gauge is an integral part of the silicon diaphragm, there are no temperature effects due to differences in the thermal expansion of the strain gauge and the diaphragm, as are often encountered in bonded strain gauge pressure sensors. However, the properties of the strain gauge itself are temperature dependent, requiring that the device be temperature compensated if it is to be used over an extensive temperature range.

Temperature compensation and offset calibration can be achieved rather simply with additional resistive components.

Several approaches to external temperature compensation over both –40 to +125°C and 0 to +80°C ranges are presented in Motorola Applications Note AN840.

LINEARITY

Linearity refers to how well a transducer’s output follows the equation: $V_{Out} = V_{Off} + \text{sensitivity} \times P$ over the operating pressure range (Figure 3). There are two basic methods for calculating nonlinearity: (1) end point straight line fit or (2) a least squares best line fit. While a least squares fit gives the “best case” linearity error (lower numerical value), the calculations required are burdensome.

Conversely, an end point fit will give the “worst case” error (often more desirable in error budget calculations) and the calculations are more straightforward for the user. Motorola’s specified pressure sensor linearities are based on the end point straight line method measured at the midrange pressure.

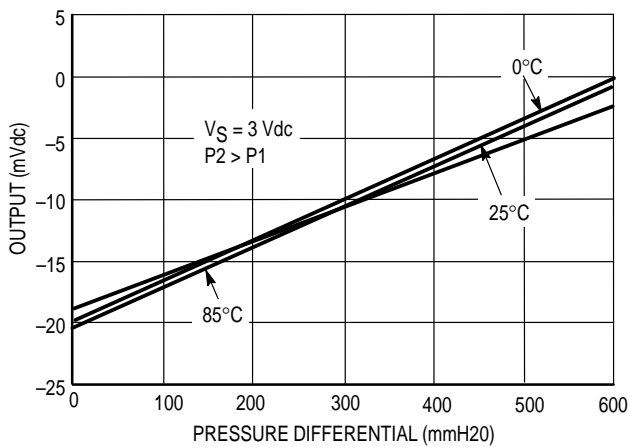


Figure 2. Output versus Pressure Differential

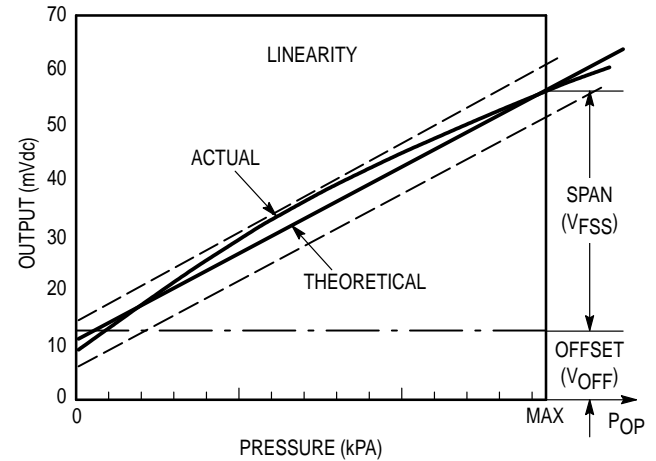


Figure 3. Linearity Specification Comparison

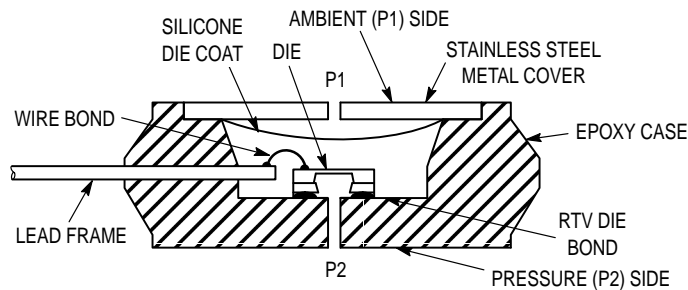


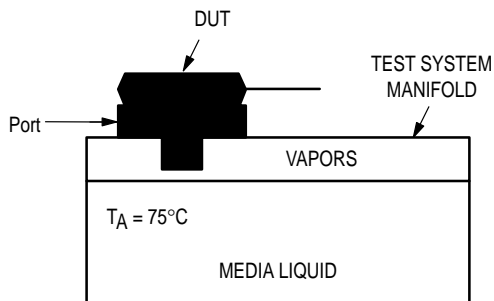
Figure 4. Cross-Sectional Diagram (not to scale)

MPX906 SERIES

SOAPY WATER VAPOR COMPATIBILITY

The compatibility of this product to Soapy Water Vapor has been verified by the reliability sample test method shown in Figure 5. Samples were tested with bias for 504 hours and

evaluated to specification after completion of this vapor exposure. Contact factory for details on liquid exposure compatibility testing.



Test Conditions:

$T_A = 75^\circ\text{C}$

$V_{\text{supply}} = 6 \text{ Volts}$

Solution: 25 grams detergent and 50 milliliters bleach per liter of Phoenix tap water.

Detergent and bleach brand names selected per UL specification #UL2157 Electric Clothes Washing Machines and Extractors

Devices exposed to vapors 5 cm above liquid.

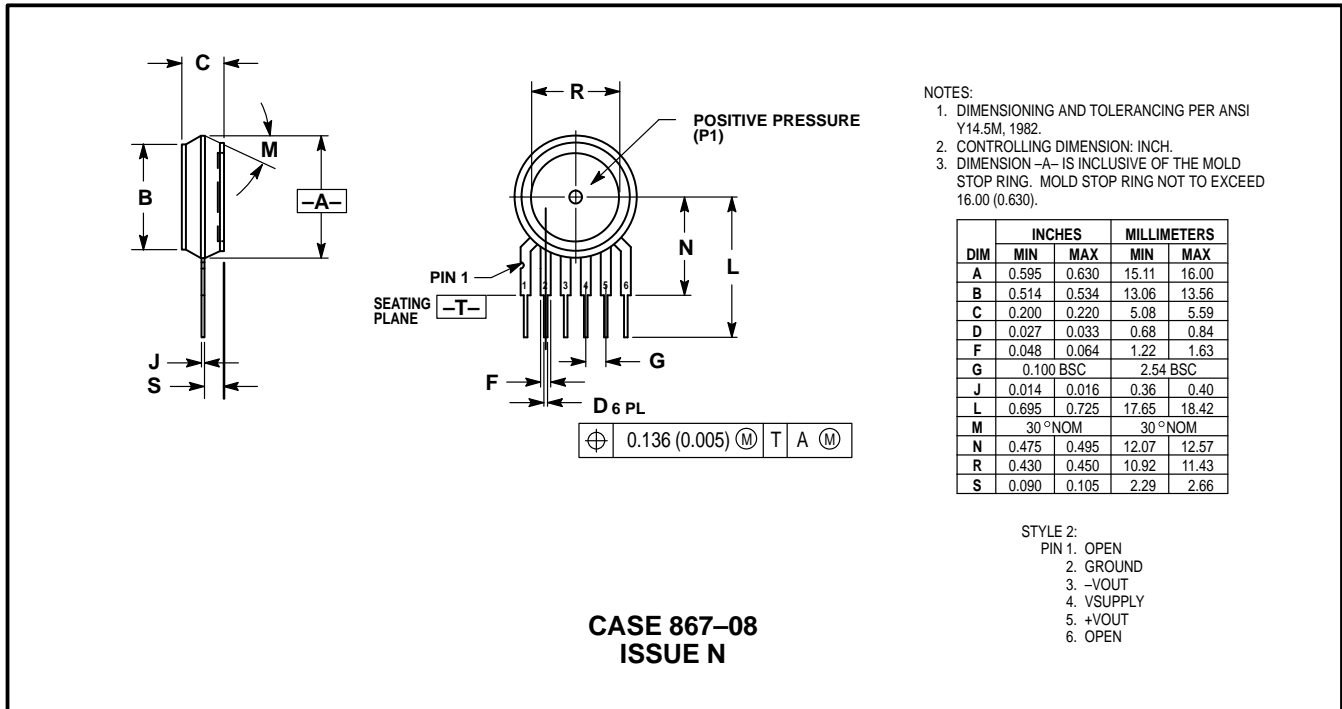
Figure 5. Vapor Test Method

ORDERING INFORMATION

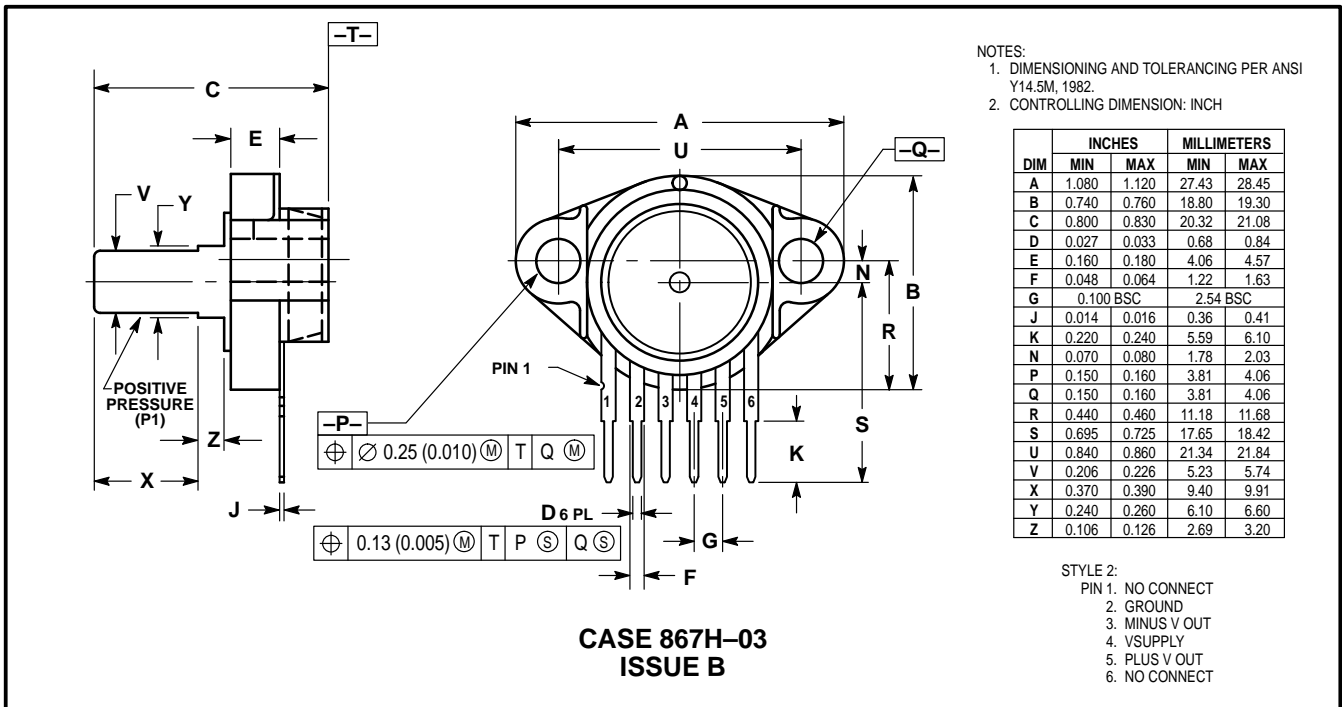
MPX906D series pressure sensors are available in basic element or ported configurations, which provide printed circuit board mounting ease and barbed hose pressure connections.

Device Type	Options	Case Type	MPX Series	
			Order Number	Device Marking
Basic Element	Differential	Case 867-08	MPX906D	MPX906D
Ported Element	Gauge Axial	Case 867H-03	MPX906GVW	MPX906D


PACKAGE DIMENSIONS



BASIC ELEMENT



MPX906 SERIES

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