

# Integrated Silicon Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated

The MPX4080D series piezoresistive transducer is a state-of-the-art monolithic silicon pressure sensor designed for a wide range of applications, but particularly those employing a microcontroller or microprocessor with A/D inputs. This patented, single element transducer combines advanced micromachining techniques, thin-film metallization, and bipolar processing to provide an accurate, high level analog output signal that is proportional to the applied pressure.

## Features

- 3.0% Maximum Error over 0° to 85°C
- Ideally suited for Microprocessor or Microcontroller-Based Systems
- Temperature Compensated from -40° to 105°C
- Easy-to-Use, Durable Epoxy Unibody Package

Figure 1 shows a block diagram of the internal circuitry integrated on the pressure sensor chip.

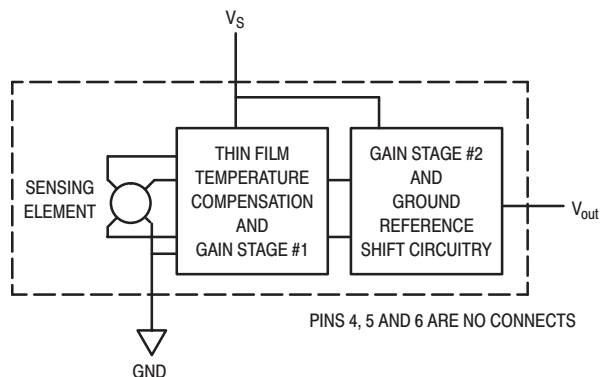
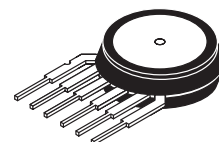


Figure 1. Fully Integrated Pressure Sensor Schematic

# MPX4080D

**INTEGRATED PRESSURE  
SENSOR**  
0 to 80 kPa (0 to 11.6 psi)  
0.58 to 4.9 Volts Output

**UNIBODY PACKAGE**



**MPX4080D  
CASE 867**

NOTE: Pin 1 is the notched pin.

| PIN NUMBER |                  |   |     |
|------------|------------------|---|-----|
| 1          | V <sub>out</sub> | 4 | N/C |
| 2          | Gnd              | 5 | N/C |
| 3          | V <sub>S</sub>   | 6 | N/C |

NOTE: Pins 4, 5, and 6 are internal device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the lead.

## MAXIMUM RATINGS(NOTE)

| Parameters                              | Symbol           | Value         | Unit |
|-----------------------------------------|------------------|---------------|------|
| Maximum Pressure (P1 > P2)<br>(P2 > P1) | P <sub>max</sub> | 400<br>400    | kPa  |
| Storage Temperature                     | T <sub>stg</sub> | –40° to +125° | °C   |

NOTE: Exposure beyond the specified limits may cause permanent damage or degradation to the device.

**OPERATING CHARACTERISTICS** (V<sub>S</sub> = 5.1 Vdc, T<sub>A</sub> = 25°C unless otherwise noted, P1 > P2. Decoupling circuit shown in Figure 4 required to meet electrical specifications.)

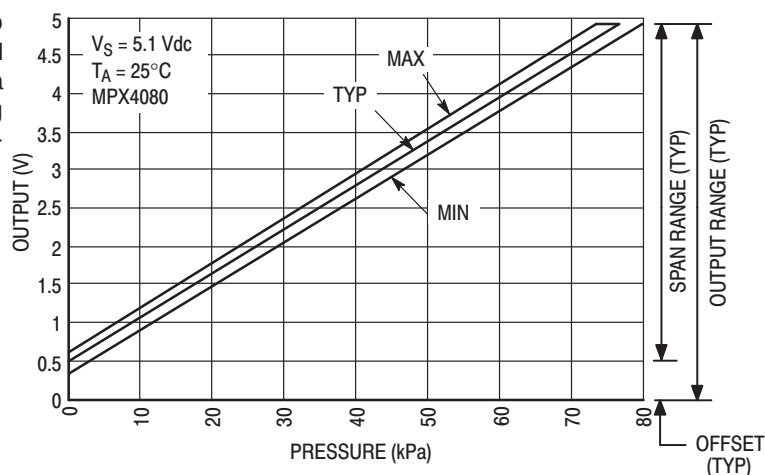
| Characteristic                                                                     | Symbol           | Min   | Typ   | Max   | Unit              |
|------------------------------------------------------------------------------------|------------------|-------|-------|-------|-------------------|
| Pressure Range <sup>(1)</sup>                                                      | P <sub>OP</sub>  | 0     | —     | 80    | kPa               |
| Supply Voltage <sup>(2)</sup>                                                      | V <sub>S</sub>   | 4.85  | 5.1   | 5.35  | Vdc               |
| Supply Current                                                                     | I <sub>o</sub>   | —     | 7.0   | 10    | mAdc              |
| Minimum Pressure Offset <sup>(3)</sup> (0 to 85°C)<br>@ V <sub>S</sub> = 5.1 Volts | V <sub>off</sub> | 0.478 | 0.575 | 0.672 | Vdc               |
| Full Scale Output <sup>(4)</sup> (0 to 85°C)<br>@ V <sub>S</sub> = 5.1 Volts       | V <sub>FSO</sub> | 4.772 | 4.900 | 5.020 | Vdc               |
| Full Scale Span <sup>(5)</sup> (0 to 85°C)<br>@ V <sub>S</sub> = 5.1 Volts         | V <sub>FSS</sub> | —     | 4.325 | —     | Vdc               |
| Accuracy <sup>(6)</sup>                                                            | —                | —     | —     | ± 3.0 | %V <sub>FSS</sub> |
| Sensitivity                                                                        | V/P              | —     | 54    | —     | mV/kPa            |

## NOTES:

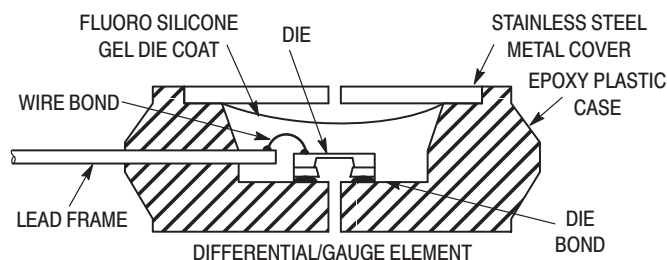
1. 1.0kPa (kiloPascal) equals 0.145 psi.
2. Device is ratiometric within this specified excitation range.
3. Offset (V<sub>off</sub>) is defined as the output voltage at the minimum rated pressure.
4. Full Scale Output (V<sub>FSO</sub>) is defined as the output voltage at the maximum or full rated pressure.
5. Full Scale Span (V<sub>FSS</sub>) is defined as the algebraic difference between the output voltage at full rated pressure and the output voltage at the minimum rated pressure.
6. Accuracy (error budget) consists of the following:
  - Linearity: Output deviation from a straight line relationship with pressure 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 minimum or maximum rated pressure at 25°C.
  - TcSpan: Output deviation over the temperature range of 0° to 85°C, relative to 25°C.
  - TcOffset: Output deviation with minimum pressure applied, over the temperature range of 0° to 85°C, relative to 25°C.
  - Variation from Nominal: The variation from nominal values, for Offset or Full Scale Span, as a percent of V<sub>FSS</sub> at 25°C.

**ON-CHIP TEMPERATURE COMPENSATION, CALIBRATION and SIGNAL CONDITIONING**

Figure 2 shows the sensor output signal relative to differential pressure input. Typical, minimum, and maximum output curves are shown for operation over a temperature range of 0° to 85°C using the decoupling circuit shown in Figure 4. The output will saturate outside of the specified pressure range.



**Figure 2. Output versus Pressure Differential**



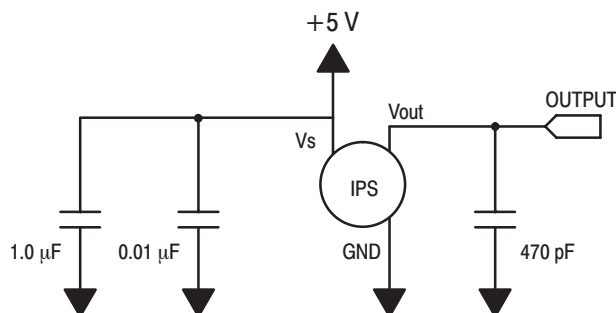
**Figure 3. Cross-Sectional Diagrams (Not to Scale)**

Figure 3 illustrates the differential sensing chip in the basic chip carrier (Case 867). A fluorosilicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the sensor diaphragm.

The MPX4080D pressure sensor operating characteristics, internal reliability, and qualification tests are based on use of dry air as the pressure media. Media, other

than dry air, may have adverse effects on sensor performance and long-term reliability. Contact the factory for information regarding media compatibility in your application.

Figure 4 shows the recommended decoupling circuit for interfacing the output of the integrated sensor to the A/D input of a microprocessor or microcontroller. Proper decoupling of the power supply is recommended.

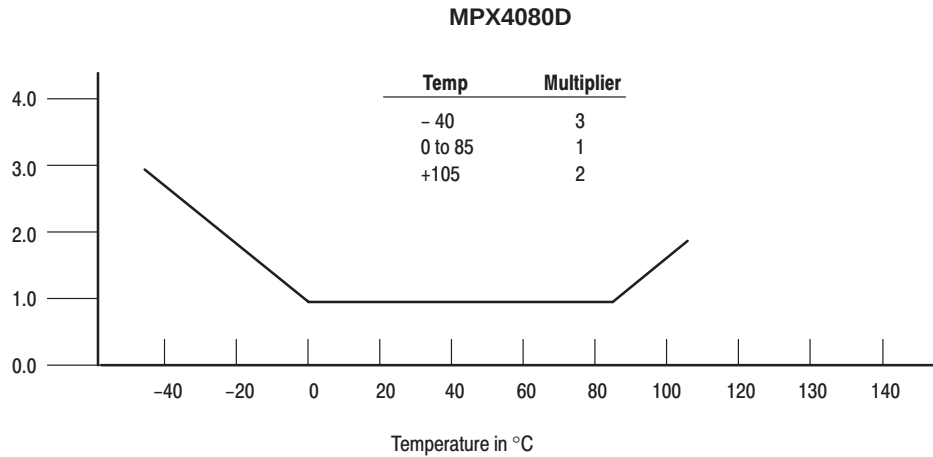


**Figure 4. Recommended power supply decoupling and output filtering.**  
For additional output filtering, please refer to Application Note AN1646.

**Transfer Function (MPX4080D)**

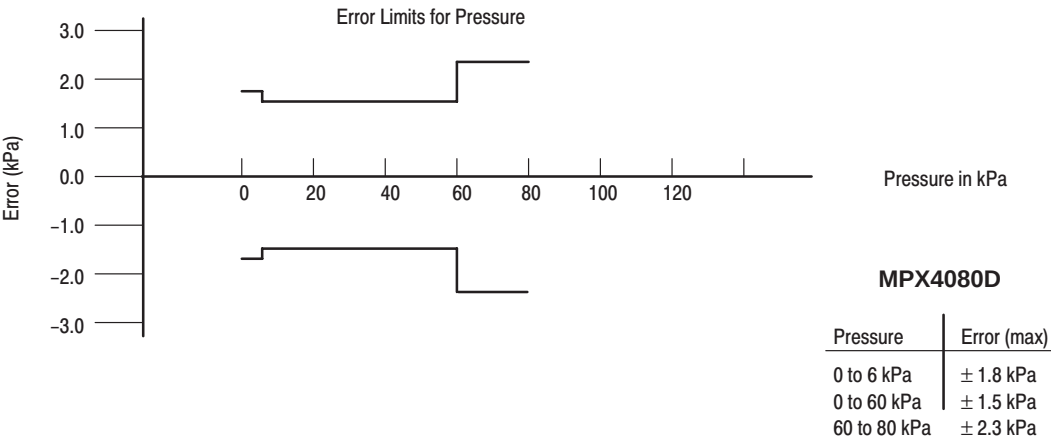
**Nominal Transfer Value:**  $V_{out} = V_S (P \times 0.01059 + 0.11280)$   
 $\pm (Pressure\ Error \times Temp.\ Mult. \times 0.01059 \times V_S)$   
 $V_S = 5.1\ V \pm 0.25V\ P\ kPa$

**Temperature Error Multiplier**



NOTE: The Temperature Multiplier is a linear response from 0° to -40°C and from 85° to 105°C.

**Pressure Error Band**



**PRESSURE (P1)/VACUUM (P2) SIDE IDENTIFICATION TABLE**

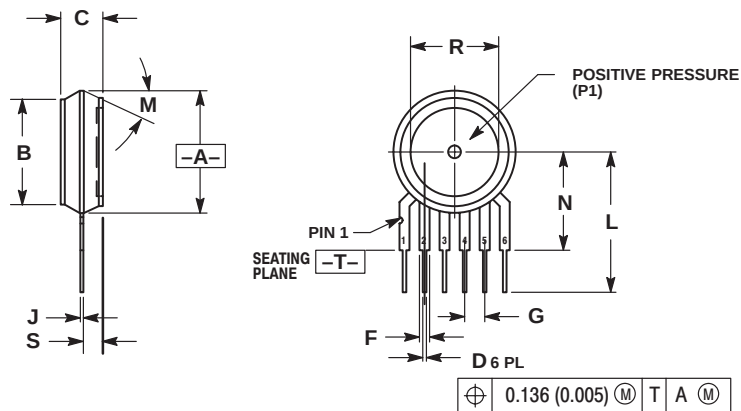
Motorola designates the two sides of the pressure sensor as the Pressure (P1) side and the Vacuum (P2) side. The Pressure (P1) side is the side containing fluoro silicone gel which protects the die from harsh media. The Motorola pres-

sure sensor is designed to operate with positive differential pressure applied,  $P1 > P2$ .  
 The Pressure (P1) side is identified by the stainless steel cap.

**ORDERING INFORMATION:**  
 The MPX4080D is available only in the unibody package.

| Device Order No. | Device Type  | Case No. | Device Marking |
|------------------|--------------|----------|----------------|
| MPX4080D         | Differential | 867      | MPX4080D       |

**PACKAGE DIMENSIONS**



NOTES:  
 7. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 8. CONTROLLING DIMENSION: INCH.  
 9. DIMENSION -A- IS INCLUSIVE OF THE MOLD STOP RING. MOLD STOP RING NOT TO EXCEED 16.00 (0.630).

STYLE 1:  
 PIN 1. VOUT  
 2. GROUND  
 3. VCC  
 4. V1  
 5. V2  
 6. VEX

STYLE 2:  
 PIN 1. OPEN  
 2. GROUND  
 3. -VOUT  
 4. VSUPPLY  
 5. +VOUT  
 6. OPEN

STYLE 3:  
 PIN 1. OPEN  
 2. GROUND  
 3. +VOUT  
 4. +VSUPPLY  
 5. -VOUT  
 6. OPEN

**CASE 867-08  
 ISSUE N**

**BASIC ELEMENT**

## NOTES

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MPX4080D/D