All Sensors ***Pressure Points*** are application tips to simplify designing with microelectromechanical (MEMS) pressure sensors and avoiding common pitfalls.

Pressure Point #6: Position Sensitivity in Pressure Sensors

Similar to any suspended structure, the thin diaphragm in piezoresistive MEMS pressure sensors is affected by gravitational and other forces. Figure 1 shows gravity applied to the top surface of the sensor. If the sensor's mounting position results in gravitational force applied to the bottom surface, the resulting 2g difference can affect the zero calibration. The thinner the diaphragm, especially in products that sense very low pressure, the greater the sensitivity.

Without appropriate design considerations, the zero calibration shift may be sufficient to cause unacceptable errors in the application with the largest errors occurring when the sensor is mounted opposite to the direction in which it was calibrated. Acceleration forces that exceed 1 g in the application and shock can change the zero output as well without any change in pressure occurring.

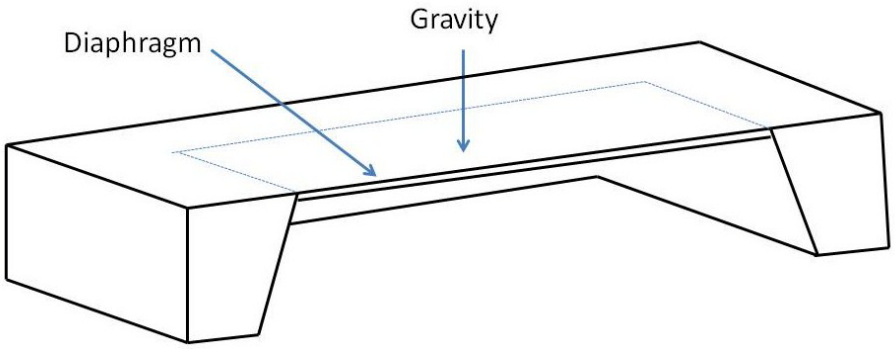

Figure 1. Gravity applied to the top surface of the MEMS pressure sensor results in a force of 1 g applied to the thin diaphragm.

Minimizing Mounting Position Sensitivity

To minimize the affect of gravity and other forces, All Sensors amplified and millivolt output low pressure sensors use a proprietary technology to reduce all output offset or common mode errors. As a result of this design methodology, output offset errors due to change in temperature, stability to warm-up, stability to long time period, and position sensitivity are all significantly reduced when compared to conventional compensation methods.

For example, for All Sensors 1 INCH-Dx-4V-MINI, that has a ratiometric 4-volt output, the Offset Position Sensitivity (within ±1g) is ±5 mV, a value less than half of the Offset Warm-up Shift, and Offset Long Term Drift (one year) and much less than the Offset Temperature Shift (from 5°C to 50°C), that is a maximum of ±60 mV. Offset Position Sensitivity is less than 0.125% of full scan span.

For the 0.5 INCH-D-MV that has a millivolt level output (10 mV nominal span), the Offset Position Sensitivity (1g) is a maximum ±5 µV compared to the Offset Warm-up Shift that is a maximum ±100 µV and Offset Long Term Drift (one year) that is a maximum of ±200 µV. Offset Position Sensitivity is less than 0.05% of the nominal full scan span.

In both cases, the Offset Position Sensitivity is well within the requirements of most applications and substantially lower than other offset parameters.

Conclusion

Position errors due to mounting location, gravity and external acceleration forces are minimal with All Sensors amplified and millivolt output pressure sensors.