

Freescale Semiconductor

MPXV2050
Rev 0, 10/2010

50 kPa On-Chip Temperature Compensated and Calibrated Silicon Pressure Sensors

The MPXV2050 series devices are silicon piezoresistive pressure sensors that provide a highly accurate and linear voltage output directly proportional to the applied pressure. A single, monolithic silicon diaphragm with the strain gauge and an integrated thin-film resistor network. Precise span and offset calibration with temperature compensation are achieved by laser trimming.

Features

- Temperature Compensated Over 0°C to +85°C
- Ratiometric to Supply Voltage

MPXV2050 Series

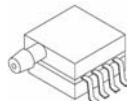
0 to 50 kPa (0 to 7.25 psi)
40 mV Full Scale
(Typical)

Application Examples

- Pump/Motor Control
- Robotics
- Level Detectors
- Medical Diagnostics
- Pressure Switching
- Blood Pressure Measurement

| ORDERING INFORMATION | | | | | | | | | |
|--|-----------------|----------|------------|--------|------|---------------|--------------|----------|----------------|
| Device Name | Package Options | Case No. | # of Ports | | | Pressure Type | | | Device Marking |
| | | | None | Single | Dual | Gauge | Differential | Absolute | |
| Small Outline Package (MPXV2050 Series) | | | | | | | | | |
| MPXV2050GP | Tray | 1369 | | • | | • | | | MPXV2050GP |

SMALL OUTLINE PACKAGE



MPXV2050GP
CASE 1369

Operating Characteristics

Table 1. Operating Characteristics ($V_S = 10 V_{DC}$, $T_A = 25^\circ C$ unless otherwise noted, $P1 > P2$)

| Characteristic | Symbol | Min | Typ | Max | Units |
|---|---------------------|------|-----------|------|------------|
| Pressure Range ⁽¹⁾ | P_{OP} | 0 | — | 50 | kPa |
| Supply Voltage ⁽²⁾ | V_S | — | 10 | 16 | V_{DC} |
| Supply Current | I_O | — | 6.0 | — | mAdc |
| Full Scale Span ⁽³⁾ | V_{FS} | 38.5 | 40 | 41.5 | mV |
| Offset ⁽⁴⁾ | — | -1.0 | — | 1.0 | mV |
| Sensitivity | $\Delta V/\Delta P$ | — | 0.8 | — | mV/kPa |
| Non-Linearity | — | -0.3 | — | 0.3 | % V_{FS} |
| Pressure Hysteresis (0 to 50 kPa) | — | — | ± 0.1 | — | % V_{FS} |
| Temperature Hysteresis (-40° to 125°C) | — | — | ± 0.5 | — | % V_{FS} |
| Temperature Coefficient of Full Scale | TCV_{FS} | -1.0 | — | 1.0 | % V_{FS} |
| Temperature Coefficient of Offset | TCV_{OFF} | -1.0 | — | 1.0 | mV |
| Input Impedance | Z_{IN} | 1000 | — | 2500 | Ω |
| Output Impedance | Z_{OUT} | 1400 | — | 3000 | Ω |
| Response Time ⁽⁵⁾ (10% to 90%) | t_R | — | 1.0 | — | ms |
| Warm-Up Time | — | — | 20 | — | ms |
| Offset Stability ⁽⁶⁾ | — | — | ± 0.5 | — | % V_{FS} |

- 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.
- 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.
- Offset stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.

Maximum Ratings

Table 2. Maximum Ratings⁽¹⁾

| Rating | Max Value | Unit |
|-----------------------------|-------------|------------|
| Supply Voltage | 16 | V |
| Pressure ($P1 > P2$) | 200 | kPa |
| Storage Temperature | -40 to +125 | $^\circ C$ |
| Operating Temperature Range | -40 to +125 | $^\circ C$ |

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

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

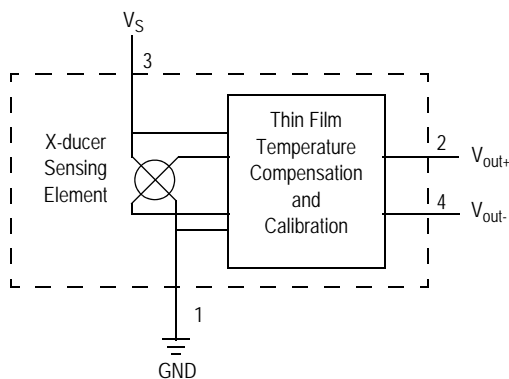


Figure 1. Temperature Compensated Pressure Sensor Schematic

Voltage Output vs. Applied Differential Pressure

The differential voltage output of the sensor is directly proportional to the differential pressure applied.

The output voltage of the differential or gauge sensor increases with increasing pressure applied to the pressure

side relative to the vacuum side. Similarly, output voltage increases as increasing vacuum is applied to the vacuum side relative to the pressure side.

On-Chip Temperature Compensation and Calibration

Figure 2 shows the minimum, maximum and typical output characteristics of the MPXV2050 series at 25°C. The output is directly proportional to the differential pressure and is essentially a straight line.

A silicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm.

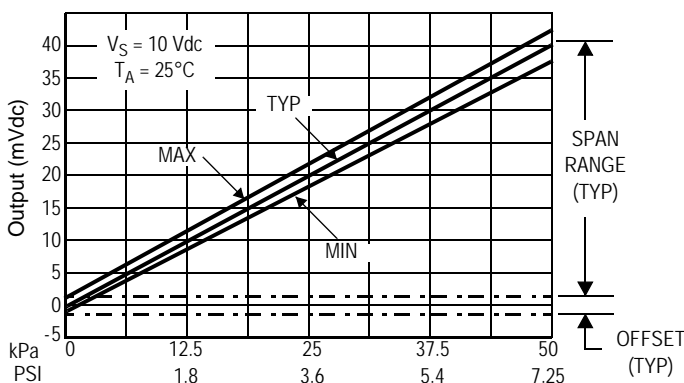


Figure 2. Output vs. Pressure Differential

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. There are two basic methods for calculating nonlinearity: (1) end point straight line fit (see Figure 3) 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. The specified pressure sensor linearities are based on the end point straight line method measured at the midrange pressure.

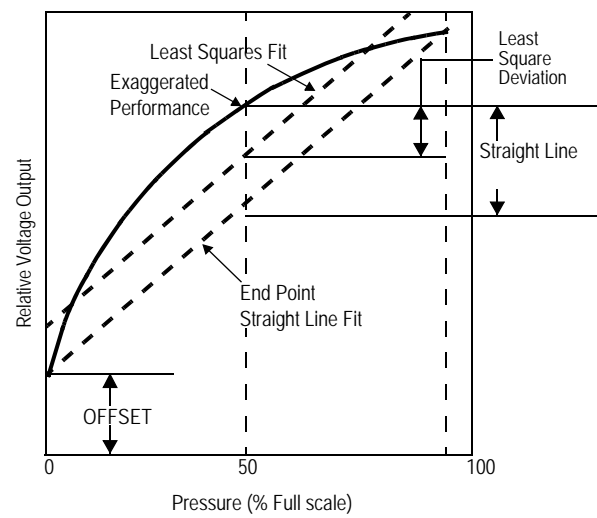


Figure 3. Linearity Specification Comparison

Figure 4 illustrates the differential or gauge configuration in the basic chip carrier. A silicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm.

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. Refer to application note AN3728, for more information regarding media compatibility.

The MPXV2050 series pressure sensor operating characteristics and internal reliability and qualification tests

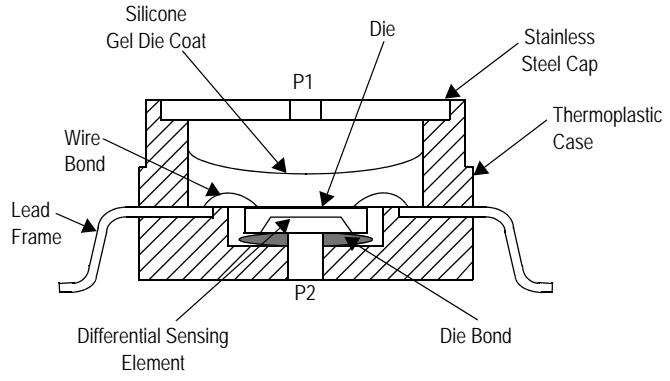
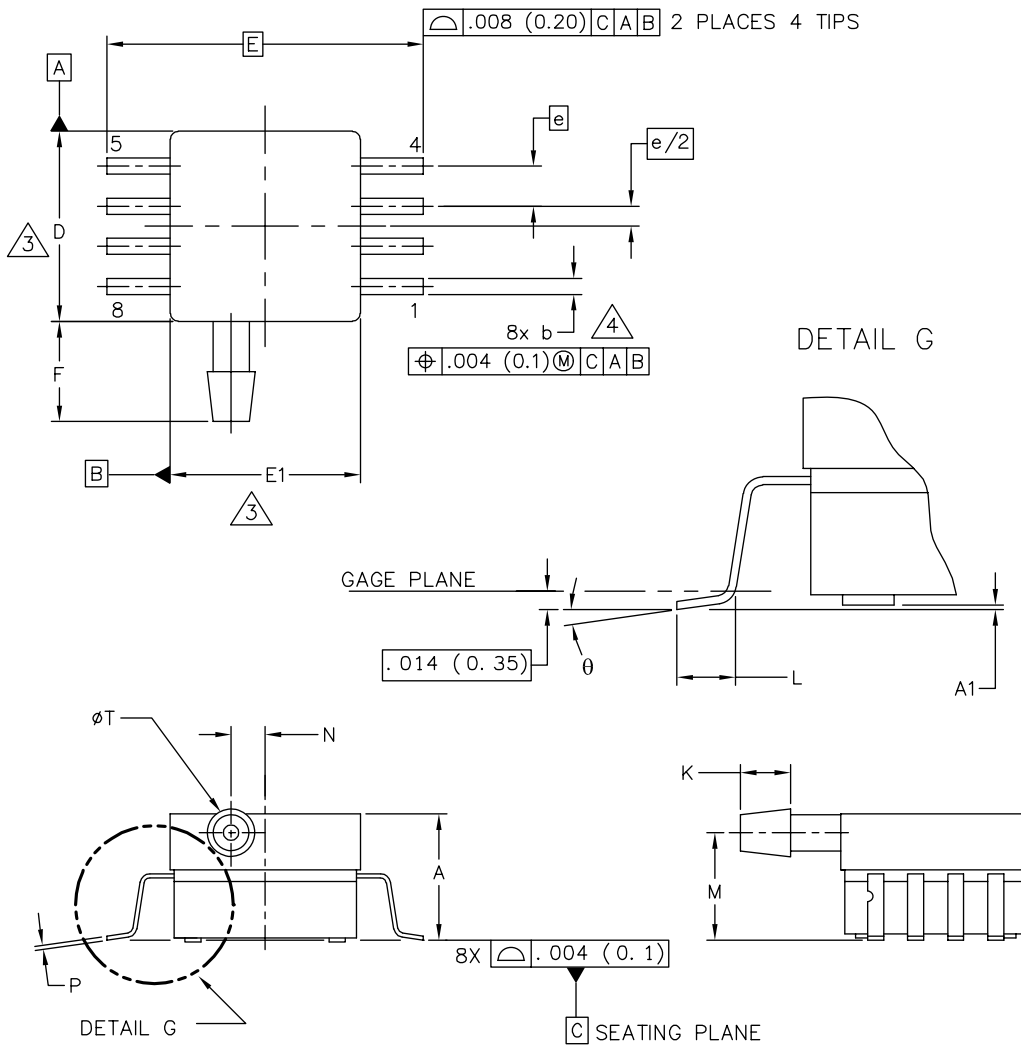


Figure 4. SOP Package — Cross-Sectional Diagram (Not to Scale)

PACKAGE DIMENSIONS



| | | | | |
|---|-------------------------------|--|---|-----------------------|
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| | TITLE: 8 LD SOP, SIDE PORT | | DOCUMENT NO: 98ASA99303D CASE NUMBER: 1369-01 STANDARD: NON-JEDEC | REV: B 24 MAY 2005 |

PACKAGE DIMENSIONS

NOTES:

1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 (0.152) PER SIDE.
4. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 (0.203) MAXIMUM.

| DIM | INCHES | | MILLIMETERS | | DIM | INCHES | | MILLIMETERS | |
|---|----------|------|---------------------------|-------|--------------------------|----------------------------|-----|-------------|-----|
| | MIN | MAX | MIN | MAX | | MIN | MAX | MIN | MAX |
| A | .300 | .330 | 7.11 | 7.62 | θ | 0° | 7° | 0° | 7° |
| A1 | .002 | .010 | 0.05 | 0.25 | - | --- | --- | --- | --- |
| b | .038 | .042 | 0.96 | 1.07 | - | --- | --- | --- | --- |
| D | .465 | .485 | 11.81 | 12.32 | - | --- | --- | --- | --- |
| E | .717 BSC | | 18.21 BSC | | - | --- | --- | --- | --- |
| E1 | .465 | .485 | 11.81 | 12.32 | - | --- | --- | --- | --- |
| e | .100 BSC | | 2.54 BSC | | - | --- | --- | --- | --- |
| F | .245 | .255 | 6.22 | 6.47 | - | --- | --- | --- | --- |
| K | .120 | .130 | 3.05 | 3.30 | - | --- | --- | --- | --- |
| L | .061 | .071 | 1.55 | 1.80 | - | --- | --- | --- | --- |
| M | .270 | .290 | 6.86 | 7.36 | - | --- | --- | --- | --- |
| N | .080 | .090 | 2.03 | 2.28 | - | --- | --- | --- | --- |
| P | .009 | .011 | 0.23 | 0.28 | - | --- | --- | --- | --- |
| T | .115 | .125 | 2.92 | 3.17 | - | --- | --- | --- | --- |
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