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# 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)

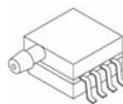
### Application Examples

- 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	
<b>Small Outline Package (MPXV2050 Series)</b>									
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,  $P_1 > P_2$ )

Characteristic	Symbol	Min	Typ	Max	Units
Pressure Range <sup>(1)</sup>	$P_{OP}$	0	—	50	kPa
Supply Voltage <sup>(2)</sup>	$V_S$	—	10	16	$V_{DC}$
Supply Current	$I_O$	—	6.0	—	mAdc
Full Scale Span <sup>(3)</sup>	$V_{FS}$	38.5	40	41.5	mV
Offset <sup>(4)</sup>	—	-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)	—	—	$\pm 0.1$	—	% $V_{FS}$
Temperature Hysteresis (-40° to 125°C)	—	—	$\pm 0.5$	—	% $V_{FS}$
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	$\Omega$
Output Impedance	$Z_{OUT}$	1400	—	3000	$\Omega$
Response Time <sup>(5)</sup> (10% to 90%)	$t_R$	—	1.0	—	ms
Warm-Up Time	—	—	20	—	ms
Offset Stability <sup>(6)</sup>	—	—	$\pm 0.5$	—	% $V_{FS}$

- 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.

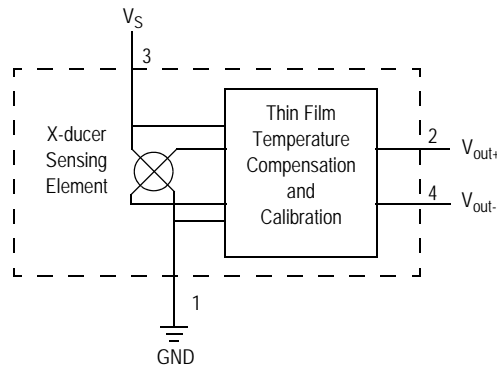
## Maximum Ratings

**Table 2. Maximum Ratings<sup>(1)</sup>**

Rating	Max Value	Unit
Supply Voltage	16	V
Pressure ( $P_1 > P_2$ )	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.

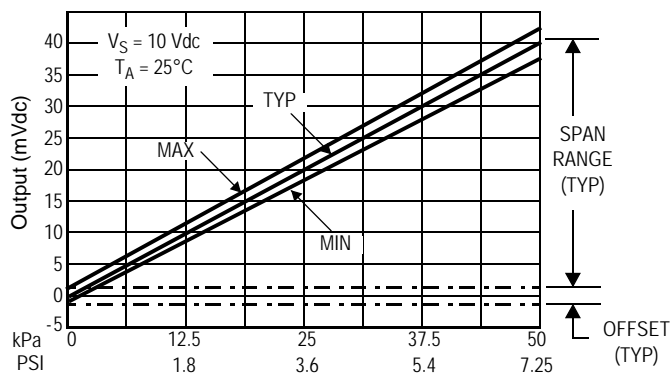
The output voltage of the differential or gauge sensor increases with increasing pressure applied to the pressure

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.

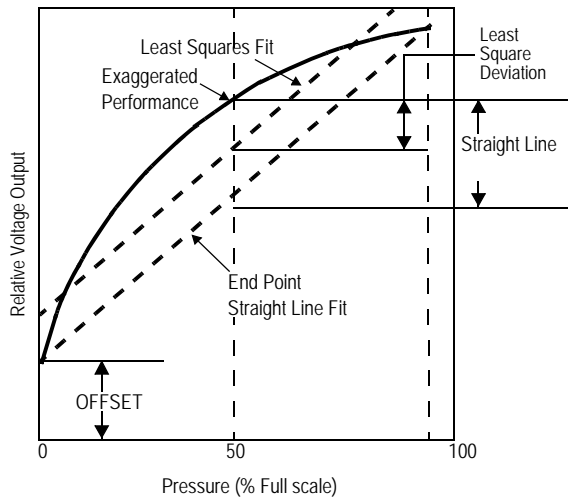


**Figure 2. Output vs. Pressure Differential**

**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.

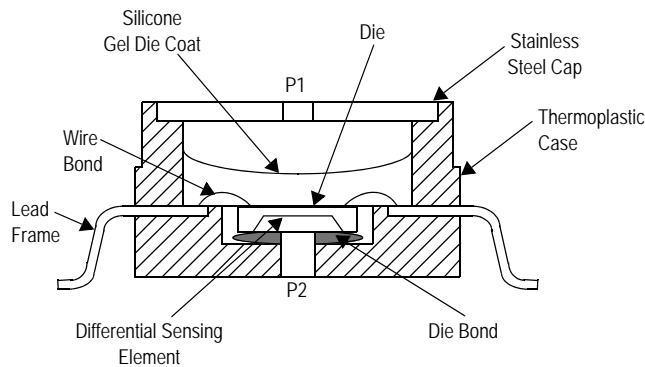


**Figure 3. Linearity Specification Comparison**

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.

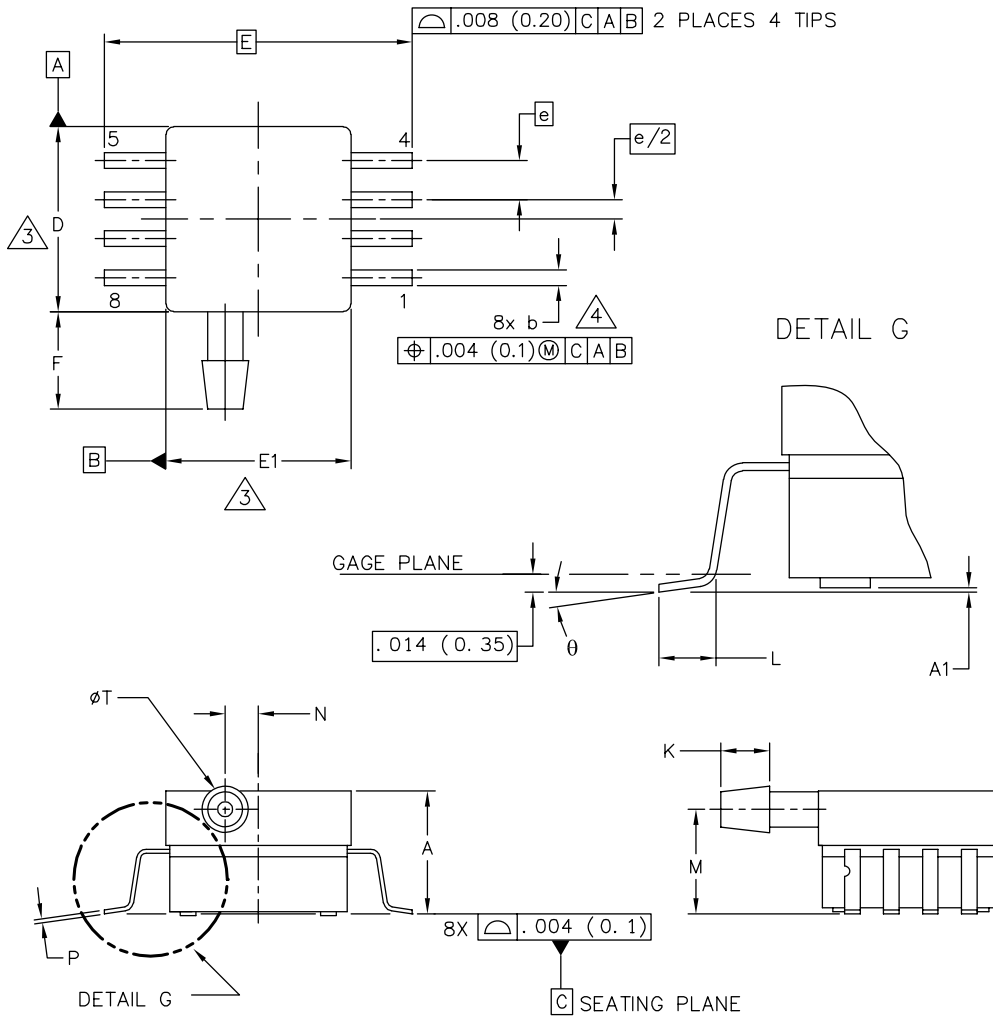
The MPXV2050 series pressure sensor operating characteristics and internal reliability and qualification tests

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



**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	REV: B
		CASE NUMBER: 1369-01	24 MAY 2005	
		STANDARD: NON-JEDEC		

**PACKAGE DIMENSIONS**

NOTES:

1. CONTROLLING DIMENSION: INCH
  2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
- ⚠ DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 (0.152) PER SIDE.
  - ⚠ 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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Freescale Semiconductor, Inc.  
Technical Information Center, EL516  
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Tempe, Arizona 85284  
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Freescale Halbleiter Deutschland GmbH  
Technical Information Center  
Schatzbogen 7  
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+44 1296 380 456 (English)  
+46 8 52200080 (English)  
+49 89 92103 559 (German)  
+33 1 69 35 48 48 (French)  
www.freescale.com/support

**Japan:**

Freescale Semiconductor Japan Ltd.  
Headquarters  
ARCO Tower 15F  
1-8-1, Shimo-Meguro, Meguro-ku,  
Tokyo 153-0064  
Japan  
0120 191014 or +81 3 5437 9125  
support.japan@freescale.com

**Asia/Pacific:**

Freescale Semiconductor China Ltd.  
Exchange Building 23F  
No. 118 Jianguo Road  
Chaoyang District  
Beijing 100022  
China  
+86 010 5879 8000  
support.asia@freescale.com

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Freescale Semiconductor Literature Distribution Center  
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