



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

The MPXL5010 low profile 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

- Low Profile Package
- 5.0% Maximum Error over 0° to 85°C
- Ideally Suited for Microprocessor or Microcontroller-Based Systems
- Patented Silicon Shear Stress Strain Gauge
- Available in Differential and Gauge Configurations
- Also Available in Unibody Package (see MPX5010 Data Sheet)

Application Examples

- Hospital Beds
- HVAC
- Respiratory Systems
- Process Control

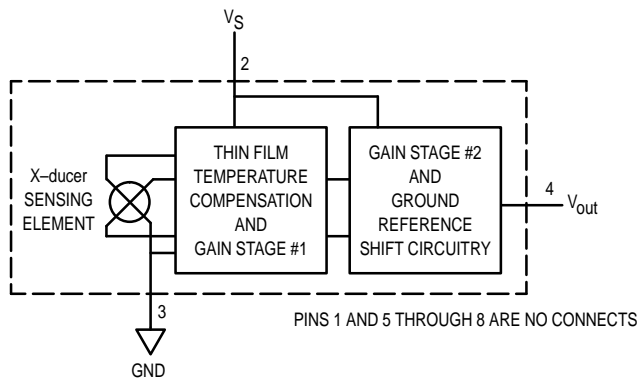


Figure 1. Fully Integrated Pressure Sensor Schematic

MAXIMUM RATINGS(1)

Parametrics	Symbol	Value	Unit
Overpressure ⁽²⁾ (P1 > P2)	P _{max}	75	kPa
Burst Pressure ⁽²⁾ (P1 > P2)	P _{burst}	100	kPa
Storage Temperature	T _{stg}	-40° to +125°	°C
Operating Temperature	T _A	-40° to +125°	°C

1. T_C = 25°C unless otherwise noted.

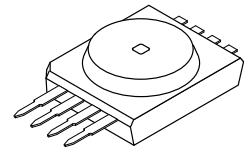
2. Exposure beyond the specified limits may cause permanent damage or degradation to the device.

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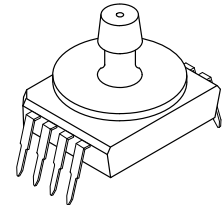
REV 2

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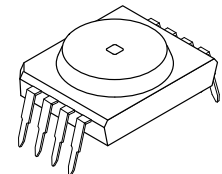
**OPERATING OVERVIEW
INTEGRATED
PRESSURE SENSOR**
0 to 10 kPa (0 to 1.45 psi)
0.2 to 4.7 Volts Output



CASE 469-01, STYLE 1



CASE 472B-01, STYLE 1



CASE 472-01, STYLE 1

PIN NUMBER			
1	N/C	5	N/C
2	V _S	6	N/C
3	Ground	7	N/C
4	V _{out}	8	N/C

NOTE: Pins 1, 5, 6, 7 and 8 are internal device connections. Do not connect to external circuitry or ground.

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OPERATING CHARACTERISTICS ($V_S = 5.0$ Vdc, $T_A = 25^\circ\text{C}$ unless otherwise noted, $P_1 > P_2$)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure Range ⁽¹⁾	P _{OP}	0	—	10	kPa
Supply Voltage ⁽²⁾	V _S	4.75	5.0	5.25	Vdc
Supply Current	I _o	—	7.0	10	mAdc
Minimum Pressure Offset ⁽³⁾ @ V _S = 5.0 Volts	V _{off}	0	0.2	0.425	Vdc
Full Scale Output ⁽⁴⁾ @ V _S = 5.0 Volts	V _{F_{SO}}	4.475	4.7	4.925	Vdc
Full Scale Span ⁽⁵⁾ @ V _S = 5.0 Volts	V _{F_{SS}}	—	4.5	—	Vdc
Accuracy ⁽⁶⁾	—	—	—	±5.0	%V _{F_{SS}}
Sensitivity	V/P	—	450	—	mV/kPa
Response Time ⁽⁷⁾	t _R	—	1.0	—	ms
Output Source Current at Full Scale Output	I _{O+}	—	0.1	—	mAdc
Warm-Up Time ⁽⁸⁾	—	—	20	—	mSec
Offset Stability ⁽⁹⁾	—	—	±0.5	—	%V _{F_{SS}}

Decoupling circuit shown in Figure 3 required to meet Electrical Specifications.

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element	—	—	1.5	—	Grams

NOTES:

- 1.0 kPa (kiloPascal) equals 0.145 psi.
- Device is ratiometric within this specified excitation range.
- Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
- Full Scale Output (V_{F_{SO}}) is defined as the output voltage at the maximum or full rated pressure.
- Full Scale Span (V_{F_{SS}}) is defined as the algebraic difference between the output voltage at full rated pressure and 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 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 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.
 - Variation from Nominal: The variation from nominal values, for Offset or Full Scale Span, as a percent of V_{F_{SS}}, at 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.
- Warm-up is defined as the time required for the product to meet the specified output voltage after the Pressure has been stabilized.
- Offset stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.

ON-CHIP TEMPERATURE COMPENSATION, CALIBRATION AND SIGNAL CONDITIONING

Figure 2 illustrates the Differential/Gauge Sensing Chip in the basic Low Profile Package (Case 469). 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 MPXL5010 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.

Figure 3 shows a typical decoupling circuit for interfacing the integrated sensor to the A/D input of a microprocessor. Proper decoupling of the power supply is recommended.

Figure 4 shows the sensor output signal relative to 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 below. (The output will saturate outside of the specified pressure range.)

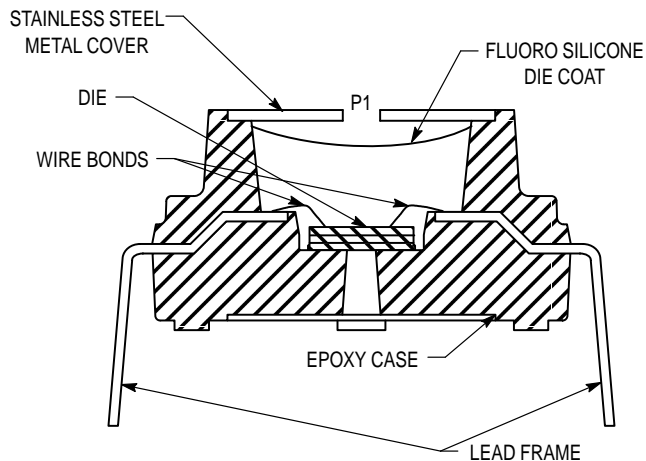


Figure 2. Cross-Sectional Diagram (Not to Scale)

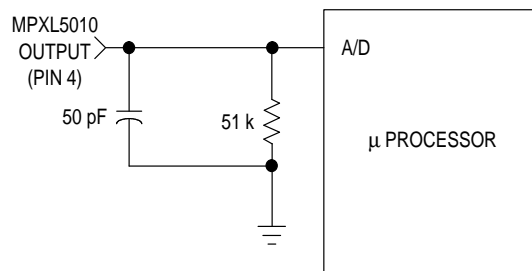


Figure 3. Typical Decoupling Filter for Sensor to Microprocessor Interface

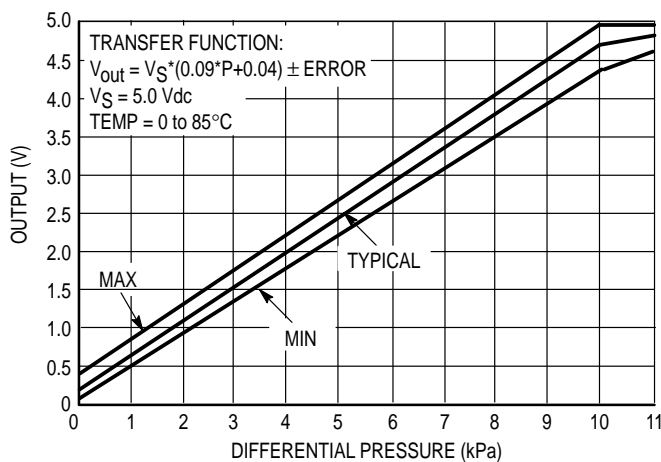


Figure 4. Output versus Pressure Differential

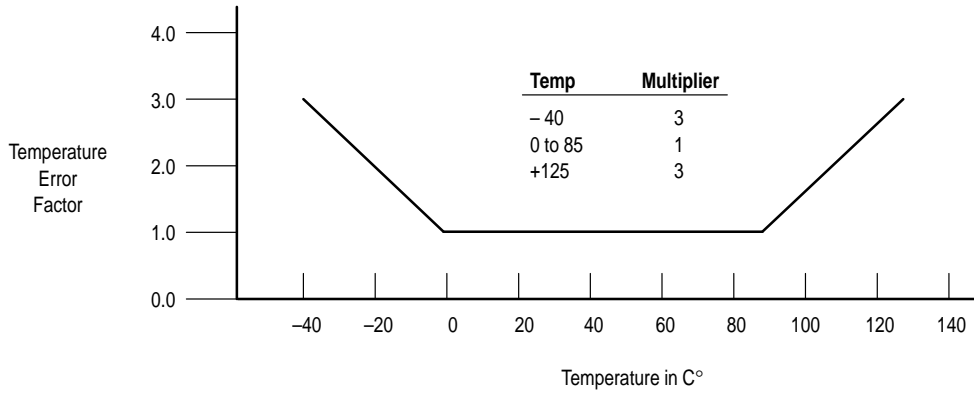
MPXL5010 SERIES

Transfer Function (MPXL5010)

Nominal Transfer Value: $V_{out} = V_S \times (0.09 \times P + 0.04)$
 $\pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.09 \times V_S)$
 $V_S = 5.0 \text{ V} \pm 0.25 \text{ Vdc}$

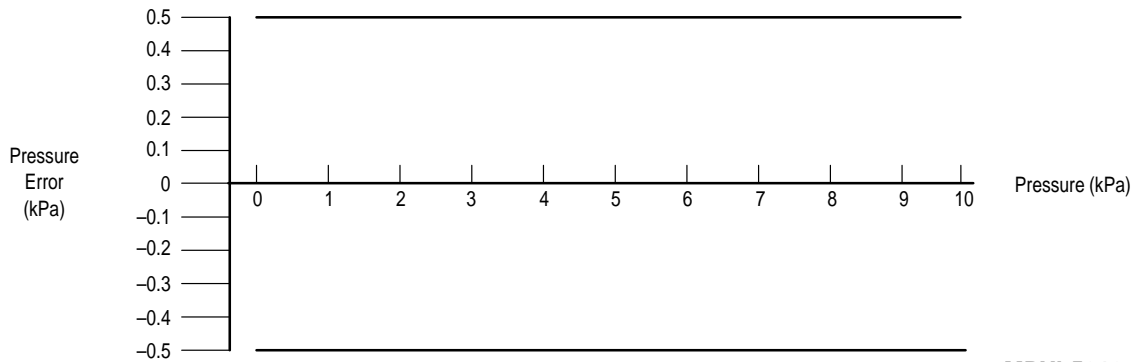
Temperature Error Band

MPXL5010 Series



NOTE: The Temperature Multiplier is a linear response from 0° to -40°C and from 85° to 125°C.

Pressure Error Band



MPXL5010 Series

Pressure	Error (Max)
0 to 10 kPa	± 0.5 kPa

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 fluorosilicone gel which protects the die from the environment. The Motorola

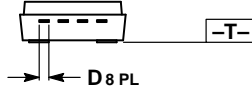
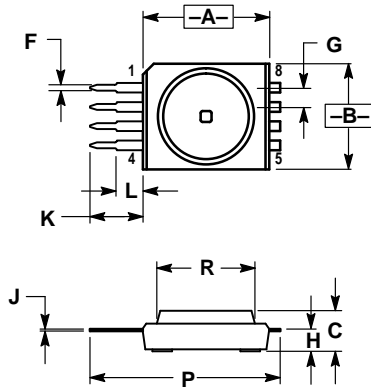
pressure sensor is designed to operate with positive differential pressure applied, $P1 > P2$.

ORDERING INFORMATION

The MPXL5010 pressure sensor is available in differential and gauge configurations. Devices are available in the basic element package or with pressure port fittings.

Device Name	Options	Case Type	MPXL Series	
			Shipping Method	Device Marking
MPXL5010G7U	No Port, 84° Lead Bend	472	Tubes (Sleeve Pack)	MPXL5010G
MPXL5010G8U	No Port, 4–Straight Leads	469	Tubes (Sleeve Pack)	MPXL5010G
MPXL5010GC7U	Axial Port, 84° Lead Bend	472B	Tubes (Sleeve Pack)	MPXL5010G

PACKAGE DIMENSIONS



⊕ 0.25 (0.010) (M) T B (S) A (S)

NOTES:

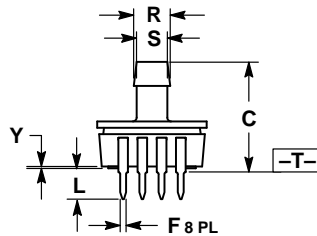
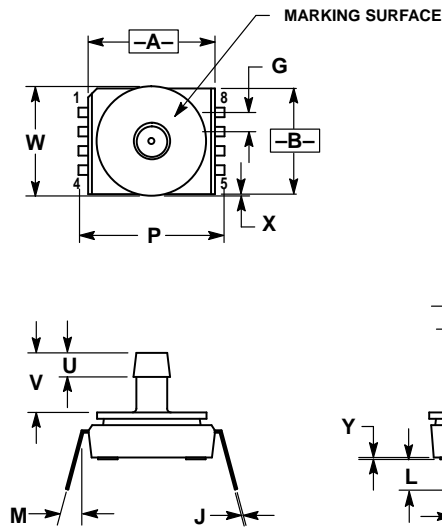
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. VERTICAL SURFACES MAY BE UP TO 5° DRAFT.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.658	0.668	16.71	16.97
B	0.541	0.551	13.74	13.99
C	0.207	0.217	5.26	5.51
D	0.046	0.054	1.17	1.37
F	0.026	0.034	0.66	0.86
G	0.100 BSC		2.54 BSC	
H	0.107	0.117	2.72	2.97
J	0.009	0.011	0.23	0.28
K	0.280	0.292	7.11	7.42
L	0.138	0.150	3.50	3.81
P	0.972	1.006	24.69	25.55
R	0.503	0.523	12.78	13.28

STYLE 1:

- PIN 1. NC
- VSUPPLY
- GROUND
- VOUT
- NC
- NC
- NC
- NC

CASE 469-01
ISSUE O



⊕ 0.25 (0.010) (M) T B (S) A (S)

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. VERTICAL SURFACES MAY BE UP TO 5° DRAFT.
6. DIMENSION P TO CENTER OF LEAD WHEN FORMED PARALLEL.

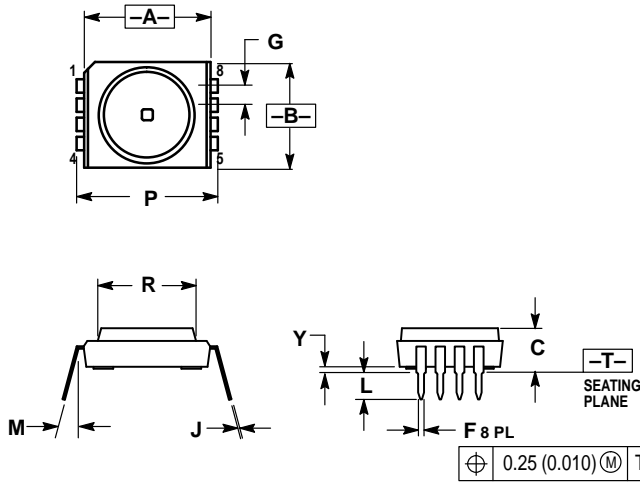
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.658	0.668	16.71	16.97
B	0.541	0.551	13.74	13.99
C	0.555	0.595	14.10	15.11
F	0.026	0.034	0.66	0.86
G	0.100 BSC		2.54 BSC	
J	0.009	0.011	0.23	0.28
L	0.138	0.150	3.50	3.81
M	0° 15°		0° 15°	
P	0.735	0.745	18.67	18.92
R	0.185	0.195	4.69	4.95
S	0.155	0.165	3.94	4.19
U	0.120	0.130	3.05	3.30
V	0.305	0.315	7.75	8.00
W	0.561	0.571	14.25	14.50
X	0.010	0.025	0.25	0.63
Y	0.002	0.020	0.05	0.51

STYLE 1:

- PIN 1. NC
- VSUPPLY
- GROUND
- VOUT
- NC
- NC
- NC
- NC

CASE 472B-01
ISSUE O

PACKAGE DIMENSIONS—CONTINUED



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. VERTICAL SURFACES MAY BE UP TO 5° DRAFT.
6. DIMENSION P TO CENTER OF LEAD WHEN FORMED PARALLEL.


DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.658	0.668	16.71	16.97
B	0.541	0.551	13.74	13.99
C	0.209	0.237	5.31	6.02
F	0.026	0.034	0.66	0.86
G	0.100 BSC		2.54 BSC	
J	0.009	0.011	0.23	0.28
L	0.138	0.150	3.50	3.81
Y	0.002	0.020	0.05	0.51
M	0°	15°	0°	15°
P	0.735	0.745	18.67	18.92
R	0.508	0.518	12.90	13.16

STYLE 1:

- PIN 1: NC
- 2: VSUPPLY
- 3: GROUND
- 4: VOUT
- 5: NC
- 6: NC
- 7: NC
- 8: NC

CASE 472-01
ISSUE O

MPXL5010 SERIES

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