

# 200 kPa On-Chip Temperature Compensated & Calibrated Pressure Sensors

The MPVZ2202 device series is a silicon piezoresistive pressure sensor providing a highly accurate and linear voltage output - directly proportional to the applied pressure. The sensor is a single monolithic silicon diaphragm with the strain gauge and a thin-film resistor network integrated on-chip. The chip is laser trimmed for precise span and offset calibration and temperature compensation. They are designed for use in applications such as pump/motor controllers, robotics, level indicators, medical diagnostics, pressure switching and respiratory equipment.

### Features

- Temperature Compensated Over 0°C to +85°C
- Easy-to-Use Chip Carrier Package Options
- Increased media compatibility fluorocarbon gel

### Typical Applications

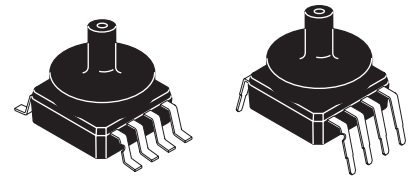
- Pump/Motor Controllers
- Robotics
- Level Indicators
- Medical Diagnostics
- Pressure Switching
- Respiratory Equipment

ORDERING INFORMATION					
Device Type	Options	Case No.	MPX Series Order No.	Packing Options	Device Marking
SMALL OUTLINE PACKAGE (MPVZ2202 SERIES)					
Ported Elements	Gauge, Vertical Port, Surface Mount	482A	MPVZ2202GC6T1	Tape and Reel	MPVZ2202G
	Gauge, Vertical Port, Through Hole	482C	MPVZ2202GC7U	Tube	MPVZ2202G

## MPVZ2202 SERIES

0 TO 200 kPa (0 TO 29 psi)  
 40 mV FULL SCALE SPAN  
 (TYPICAL)

### SMALL OUTLINE PACKAGE SURFACE MOUNT



MPVZ2202GC6T1  
 CASE 482A-01

MPVZ2202GC7U  
 CASE 482C-03

### SMALL OUTLINE PACKAGE PIN NUMBERS

1	GND <sup>(1)</sup>	5	N/C
2	+V <sub>OUT</sub>	6	N/C
3	V <sub>S</sub>	7	N/C
4	V <sub>S</sub>	8	N/C

1. Pin 1 is noted by the notch in the lead.

Figure 1 illustrates a block diagram of the internal circuitry on the stand-alone pressure sensor chip.

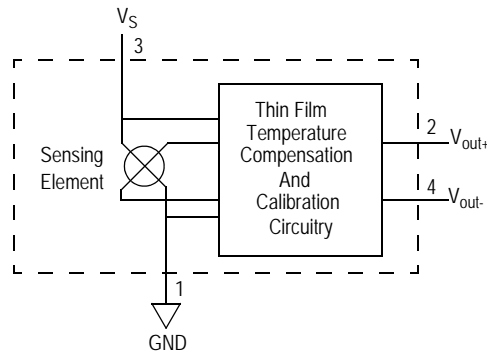


Figure 1. Temperature Compensated Pressure Sensor Schematic

### VOLTAGE OUTPUT VERSUS 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

(P1) side relative to the vacuum (P2) side. Similarly, output voltage increases as increasing vacuum is applied to the vacuum (P2) side relative to the pressure (P1) side.

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

Rating	Symbol	Value	Unit
Maximum Pressure ( $P_1 > P_2$ )	$P_{max}$	800	kPa
Storage Temperature	$T_{stg}$	-40 to +125	°C
Operating Temperature	$T_A$	-40 to +125	°C

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

**Table 2. Operating Characteristics** $(V_S = 10 \text{ Vdc}, T_A = 25^\circ\text{C}$  unless otherwise noted,  $P_1 > P_2$ )

Characteristics	Symbol	Min	Typ	Max	Unit
Pressure Range <sup>(1)</sup>	$P_{OP}$	0	—	200	kPa
Supply Voltage <sup>(2)</sup>	$V_S$	—	10	16	Vdc
Supply Current	$I_o$	—	6.0	—	mAdc
Full Scale Span <sup>(3)</sup>	$V_{FSS}$	38.5	40	41.5	mV
Offset <sup>(4)</sup>	$V_{off}$	-1.0	—	1.0	mV
Sensitivity	$\Delta V/\Delta P$	—	0.2	—	mV/kPa
Linearity <sup>(5)</sup> MPVZ2202D Serie	—	-0.6	—	0.4	% $V_{FSS}$
Pressure Hysteresis <sup>(5)</sup> (0 to 200 kPa)	—	—	$\pm 0.1$	—	% $V_{FSS}$
Temperature Hysteresis <sup>(5)</sup> (-40°C to +125°C)	—	—	$\pm 0.5$	—	% $V_{FSS}$
Temperature Effect on Full Scale Span <sup>(5)</sup>	$TCV_{FSS}$	-2.0	—	2.0	% $V_{FSS}$
Temperature Effect on Offset <sup>(5)</sup>	$TCV_{off}$	-1.0	—	1.0	mV
Input Impedance	$Z_{in}$	1000	—	2500	W
Output Impedance	$Z_{out}$	1400	—	3000	W
Response Time <sup>(6)</sup> (10% to 90%)	$t_R$	—	1.0	—	ms
Warm-Up	—	—	20	—	ms
Offset Stability <sup>(7)</sup>	—	—	$\pm 0.5$	—	% $V_{FSS}$

1. 1.0 kPa (kiloPascal) equals 0.145 psi.

2. 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.

3. 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.

4. Offset ( $V_{off}$ ) is defined as the output voltage at the minimum rated pressure.

5. Accuracy (error budget) consists of the following:

- Linearity: Output deviation from a straight line relationship with pressure, using end point method, 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 at full rated pressure 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.

6. 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.

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

## 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 2) 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. Freescale's specified pressure sensor linearities are based on the end point straight line method measured at the midrange pressure.

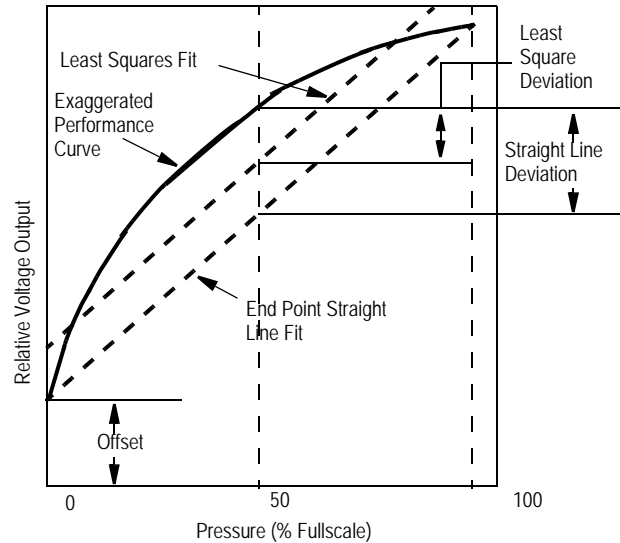


Figure 2. Linearity Specification Comparison

## ON-CHIP TEMPERATURE COMPENSATION AND CALIBRATION

Figure 3 shows the output characteristics of the MPVZ2202 series at 25°C. The output is directly proportional to the differential pressure and is essentially a straight line.

The effects of temperature on Full Scale Span and Offset are very small and are shown under Operating Characteristics.

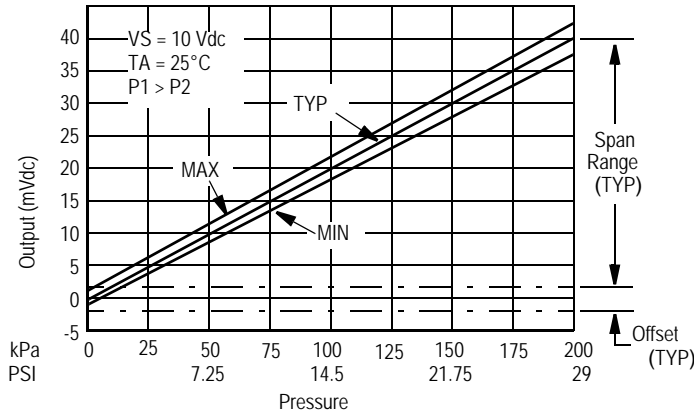
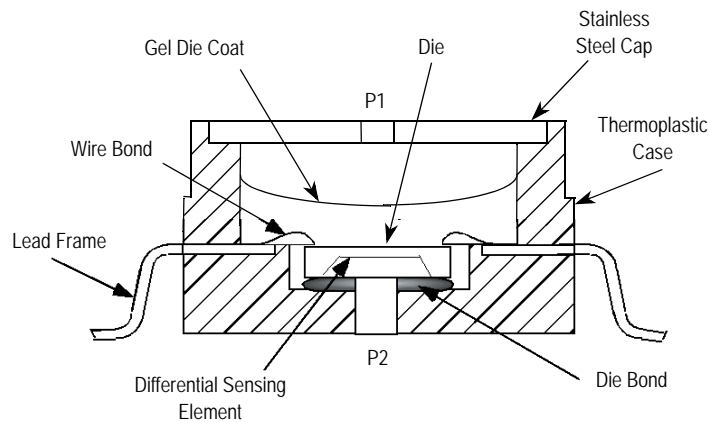


Figure 3. Output versus Pressure Differential



**Figure 4. Cross-Sectional Diagram (Not to Scale)**

Figure 4 illustrates an absolute sensing die (right) and the differential or gauge die in the basic chip carrier (Case 344). A gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm.

Operating characteristics, internal reliability and qualification tests are based on use of dry clean air as the pressure media. Media other than dry clean air may have adverse effects on sensor performance and long term reliability. Contact the factory for information regarding media compatibility in your application.

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

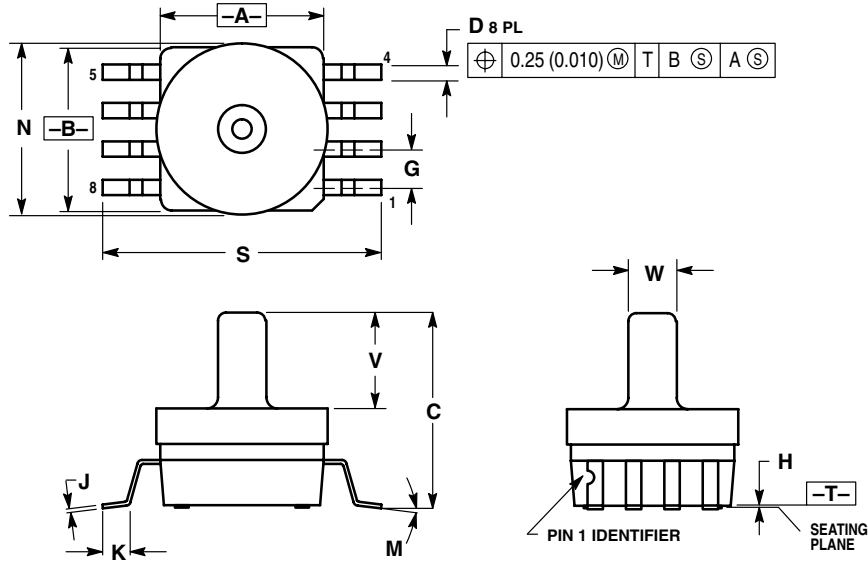
Freescale designates the two sides of the pressure sensor as the Pressure (P1) side and the Vacuum (P2) side. The Pressure (P1) side is the side containing the gel which isolates the die from the environment. The differential or gauge sensor is designed to operate with positive differential pressure applied,  $P1 > P2$ . The absolute sensor is designed for vacuum applied to P1 side.

The Pressure (P1) side may be identified by using the table below:

**Table 3. Pressure (P1)/Vacuum (P2) Side Identification Table**

Part Number	Case Type	Pressure (P1) Side Identifier
MPVZ2202GC6T1	482A	Top with Port Attached
MPVZ2202GC7U	482C	Top with Port Attached

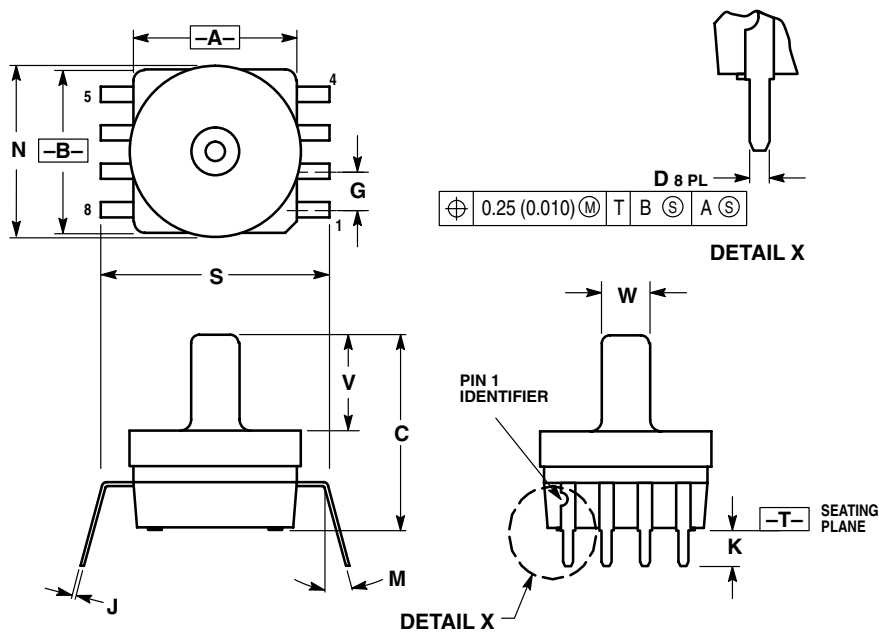
## PACKAGE DIMENSIONS



- 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. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.415	0.425	10.54	10.79
B	0.415	0.425	10.54	10.79
C	0.500	0.520	12.70	13.21
D	0.038	0.042	0.96	1.07
G	0.100 BSC		2.54 BSC	
H	0.002	0.010	0.05	0.25
J	0.009	0.011	0.23	0.28
K	0.061	0.071	1.55	1.80
M	0°	7°	0°	7°
N	0.444	0.448	11.28	11.38
S	0.709	0.725	18.01	18.41
V	0.245	0.255	6.22	6.48
W	0.115	0.125	2.92	3.17

**CASE 482A-01  
ISSUE A  
SMALL OUTLINE PACKAGE**



- 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. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.
  6. DIMENSION S TO CENTER OF LEAD WHEN FORMED PARALLEL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.415	0.425	10.54	10.79
B	0.415	0.425	10.54	10.79
C	0.500	0.520	12.70	13.21
D	0.026	0.034	0.66	0.864
G	0.100 BSC		2.54 BSC	
J	0.009	0.011	0.23	0.28
K	0.100	0.120	2.54	3.05
M	0°	15°	0°	15°
N	0.444	0.448	11.28	11.38
S	0.540	0.560	13.72	14.22
V	0.245	0.255	6.22	6.48
W	0.115	0.125	2.92	3.17

**CASE 482C-03  
ISSUE B  
SMALL OUTLINE PACKAGE**

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