

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

The MPXM2202 device is a silicon piezoresistive pressure sensors 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.

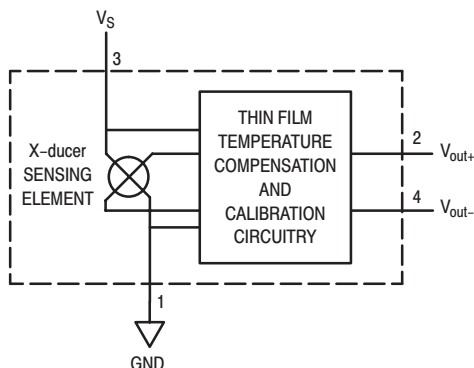
## Features

- Temperature Compensated Over 0°C to +85°C
- Available in Easy-to-Use Tape & Reel
- Ratiometric to Supply Voltage
- Gauge Ported & Non Ported Options

## Application Examples

- Pump/Motor Controllers
- Robotics
- Level Indicators
- Medical Diagnostics
- Pressure Switching
- Barometers
- Altimeters

Figure 1 shows 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.

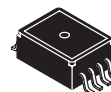
The output voltage of the differential or gauge sensor increases with increasing pressure applied to the pressure side (P1) relative to the vacuum side (P2). Similarly, output voltage increases as increasing vacuum is applied to the vacuum side (P2) relative to the pressure side (P1).

**Preferred** devices are Motorola recommended choices for future use and best overall value.

## MPXM2202 SERIES

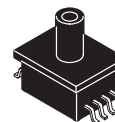
Motorola Preferred Device  
**0 to 200 kPa (0 to 29 psi)**  
**40 mV FULL SCALE SPAN**  
**(TYPICAL)**

## MPAK PACKAGE



SCALE 1:1

CASE 1320



SCALE 1:1

CASE 1320A

## PIN NUMBER

1	Gnd	3	V <sub>S</sub>
2	+V <sub>out</sub>	4	-V <sub>out</sub>



**MPXM2202 SERIES****Freescale Semiconductor, Inc.****MAXIMUM RATINGS(NOTE)**

Rating	Symbol	Value	Unit
Maximum Pressure (P1 > P2)	P <sub>max</sub>	400	kPa
Storage Temperature	T <sub>stg</sub>	–40 to +125	°C
Operating Temperature	T <sub>A</sub>	–40 to +125	°C

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

**OPERATING CHARACTERISTICS** (V<sub>S</sub> = 10 Vdc, T<sub>A</sub> = 25°C unless otherwise noted, P1 > P2)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure Range <sup>(1)</sup>	P <sub>OP</sub>	0	—	200	kPa
Supply Voltage <sup>(2)</sup>	V <sub>S</sub>	—	10	16	Vdc
Supply Current	I <sub>o</sub>	—	6.0	—	mAdc
Full Scale Span <sup>(3)</sup>	V <sub>FSS</sub>	38.5	40	41.5	mV
Offset <sup>(4)</sup>	V <sub>off</sub>	–1.0 –2.0	— —	1.0 2.0	mV
Sensitivity	ΔV/ΔP	—	0.2	—	mV/kPa
Linearity <sup>(5)</sup>	— —	–0.6 –1.0	— —	0.4 1.0	%V <sub>FSS</sub>
Pressure Hysteresis <sup>(5)</sup> (0 to 100 kPa)	—	—	±0.1	—	%V <sub>FSS</sub>
Temperature Hysteresis <sup>(5)</sup> (–40°C to +125°C)	—	—	±0.5	—	%V <sub>FSS</sub>
Temperature Effect on Full Scale Span <sup>(5)</sup>	TCV <sub>FSS</sub>	–2.0	—	2.0	%V <sub>FSS</sub>
Temperature Effect on Offset <sup>(5)</sup>	TCV <sub>off</sub>	–1.0	—	1.0	mV
Input Impedance	Z <sub>in</sub>	1000	—	2500	Ω
Output Impedance	Z <sub>out</sub>	1400	—	3000	Ω
Response Time <sup>(6)</sup> (10% to 90%)	t <sub>R</sub>	—	1.0	—	ms
Warm-Up	—	—	20	—	ms
Offset Stability <sup>(7)</sup>	—	—	±0.5	—	%V <sub>FSS</sub>

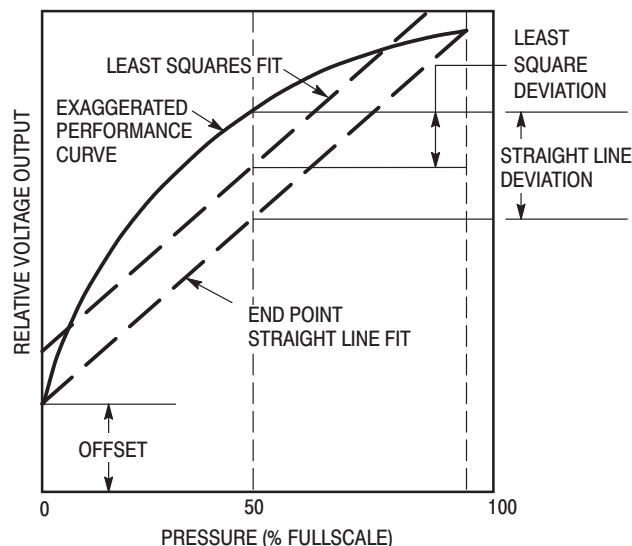
**NOTES:**

- 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<sub>FSS</sub>) 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<sub>off</sub>) is defined as 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, 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.
- 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.

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

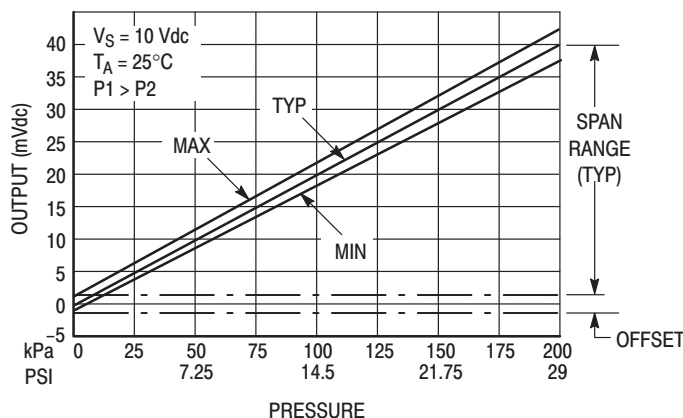


**Figure 2. Linearity Specification Comparison**

## ON-CHIP TEMPERATURE COMPENSATION and CALIBRATION

Figure 3 shows the minimum, maximum and typical output characteristics of the MPXM2202 series at 25°C. The output is directly proportional to the differential pressure and is essentially a straight line.

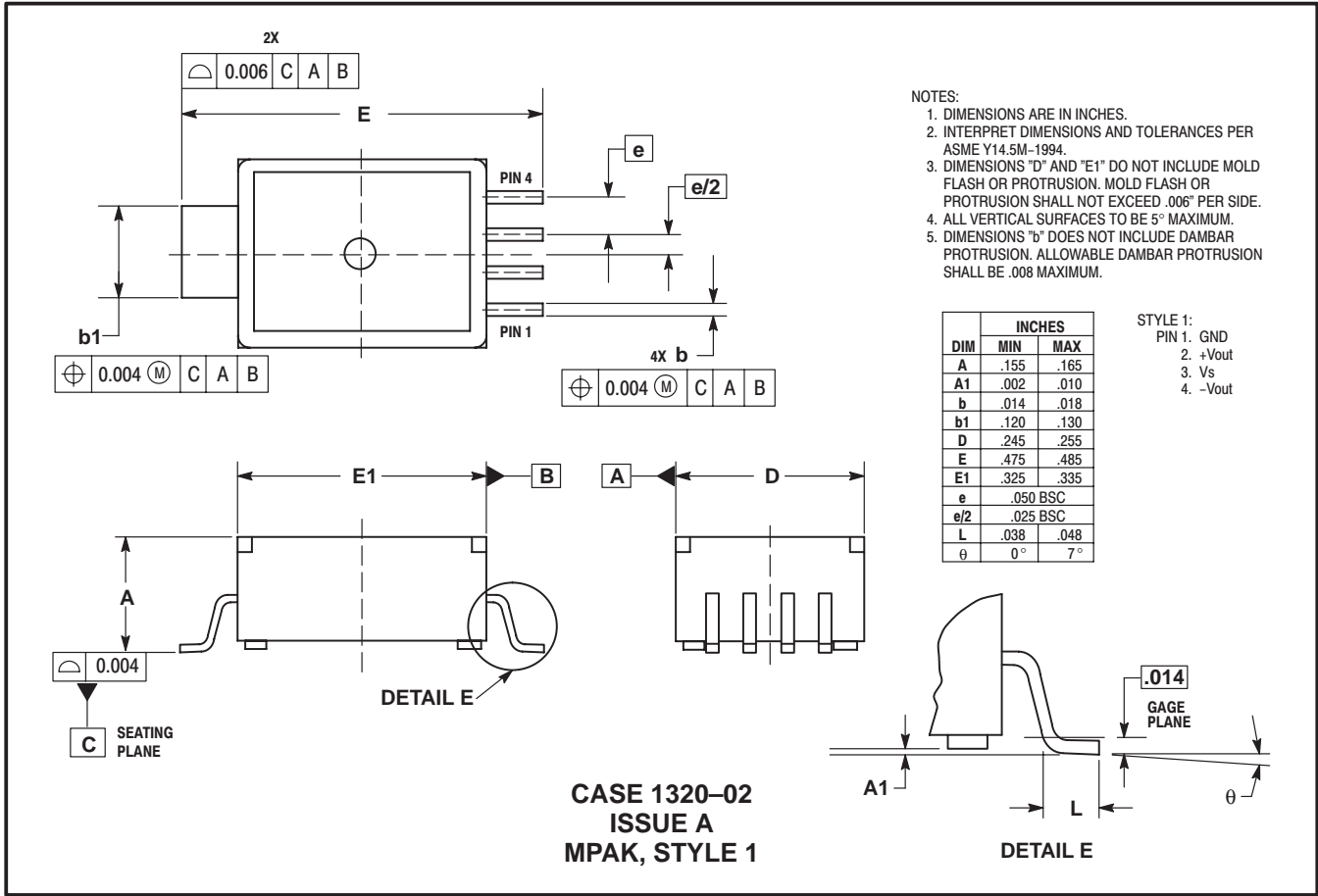
A silicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm.



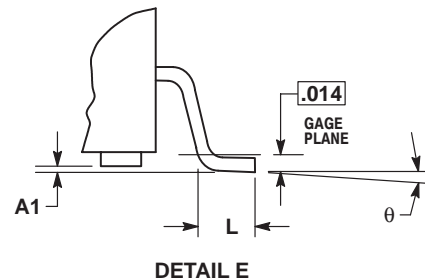
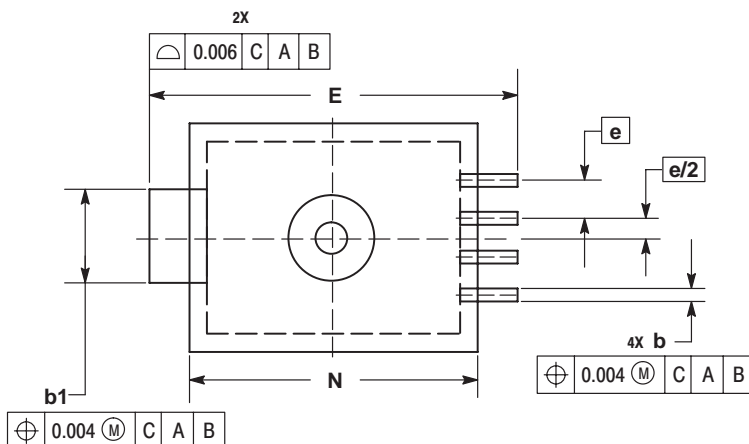
**Figure 3. Output versus Pressure Differential**

ORDERING INFORMATION		
Device Type/Order No.	Options	Case Type
MPXM2202D	Non-ported	1320
MPXM2202DT1	Non-ported, Tape and Reel	1320
MPXM2202GS	Ported	1320A
MPXM2202GST1	Ported, Tape and Reel	1320A
MPXM2202A	Non-ported	1320
MPXM2202AT1	Non-ported, Tape and Reel	1320
MPXM2202AS	Ported	1320A
MPXM2202AST1	Ported, Tape and Reel	1320A

PACKAGE DIMENSIONS

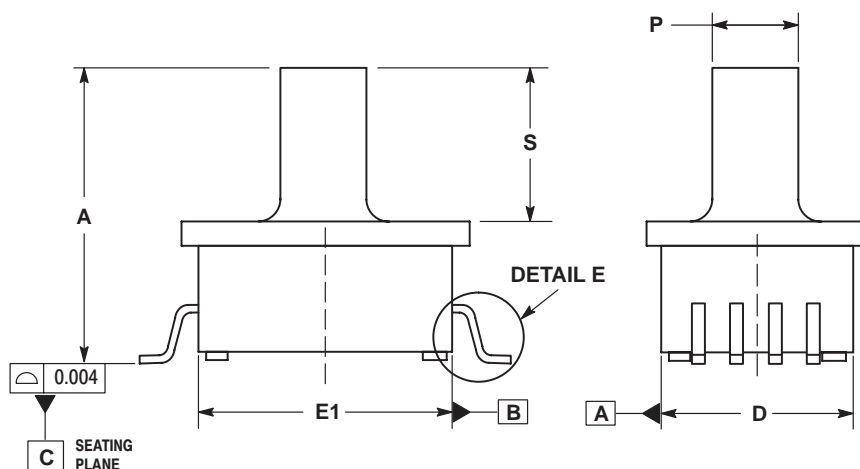


**PACKAGE DIMENSIONS (CONTINUED)**



**NOTES:**

1. DIMENSIONS ARE IN INCHES.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD FLASH OR PROTRUSION. MOLD FLASH OR PROTRUSION SHALL NOT EXCEED .006" PER SIDE.
4. ALL VERTICAL SURFACES TO BE 5° MAXIMUM.
5. DIMENSIONS "b" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.




INCHES		
DIM	MIN	MAX
A	.377	.397
A1	.002	.010
b	.014	.018
b1	.120	.130
D	.245	.255
E	.475	.485
E1	.325	.335
e	.050 BSC	
e/2	.025 BSC	
L	.013	.023
M	.283	.293
N	.363	.373
P	.107	.117
S	.192	.202
θ	0°	7°

**CASE 1320A-02  
ISSUE O  
MPAK, STYLE 1**

## **NOTES**

## **NOTES**

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#### How to reach us:

**USA/EUROPE/Locations Not Listed:** Motorola Literature Distribution; P.O. Box 5405, Denver, Colorado 80217. 1-303-675-2140 or 1-800-441-2447

**JAPAN:** Motorola Japan Ltd.; SPS, Technical Information Center, 3-20-1, Minami-Azabu. Minato-ku, Tokyo 106-8573 Japan. 81-3-3440-3569

**ASIA/PACIFIC:** Motorola Semiconductors H.K. Ltd.; Silicon Harbour Centre, 2 Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong. 852-26668334

**Technical Information Center: 1-800-521-6274**

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MPXM2202/D