100 kPa On-Chip Temperature Compensated & Calibrated Silicon Pressure Sensors

MPXM2102 SERIES

The MPXM2102 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.

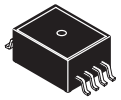
Motorola Preferred Device
0 to 100 kPa (0 to 14.5 psi)
40 mV FULL SCALE SPAN
(TYPICAL)

Features

- Temperature Compensated Over 0°C to +85°C
- Unique Silicon Shear Stress Strain Gauge
- Easy to Use Tape & Reel
- Ratiometric to Supply Voltage
- Gauge Ported & Non Ported Options

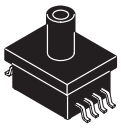
Application Examples

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



SCALE 2:1

CASE 1320A–02
MPAK, STYLE 1



SCALE 2:1

CASE 1320A–02
MPAK, STYLE 2

PIN NUMBER			
1	Gnd	3	V_S
2	$+V_{out}$	4	$-V_{out}$

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

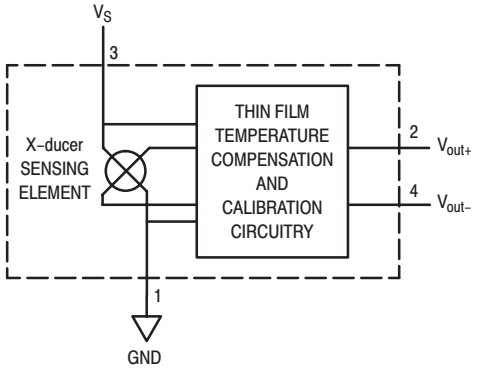


Figure 1. Temperature Compensated Pressure Sensor Schematic

VOLTAGE OUTPUT versus APPLIED DIFFERENTIAL PRESSURE

The differential voltage output of the X–ducer 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.

X–ducer is a trademark of Motorola, Inc.

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MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Overpressure[8] (P1 > P2)	P_{max}	200	kPa
Storage Temperature	T_{stg}	–40 to +125	°C
Operating Temperature	T_A	–40 to +125	°C

OPERATING CHARACTERISTICS (V_S = 10 Vdc, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range[1]		P_{OP}	0	—	100	kPa
Supply Voltage[2]		V_S	—	10	16	Vdc
Supply Current		I_o	—	6.0	—	mAdc
Full Scale Span[3]		V_{FSS}	38.5	40	41.5	mV
Offset[4]	MPXM2102D/G Series MPXM2102A Series	V_{off}	–1.0 –2.0	— —	1.0 2.0	mV
Sensitivity		ΔV/ΔP	—	0.4	—	mV/kPa
Linearity[5]	MPXM2102D/G Series MPXM2102A Series		— —	–0.6 –1.0	— —	0.4 1.0	%V_{FSS}
Pressure Hysteresis[5] (0 to 100 kPa)			—	—	±0.1	—	%V_{FSS}
Temperature Hysteresis[5] (–40°C to +125°C)			—	—	±0.5	—	%V_{FSS}
Temperature Effect on Full Scale Span[5]		TCV_{FSS}	–2.0	—	2.0	%V_{FSS}
Temperature Effect on Offset[5]		TCV_{off}	–1.0	—	1.0	mV
Input Impedance		Z_{in}	1000	—	2500	Ω
Output Impedance		Z_{out}	1400	—	3000	Ω
Response Time[6] (10% to 90%)		t_R	—	1.0	—	ms
Warm–Up			—	—	20	—	ms
Offset Stability[9]			—	—	±0.5	—	%V_{FSS}

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight	—	—	TBD	—	Grams
Common Mode Line Pressure[7]	—	—	—	TBD	kPa

NOTES:

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. Common mode pressures beyond specified may result in leakage at the case–to–lead interface.
8. Exposure beyond these limits may cause permanent damage or degradation to the device.
9. 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: $V_{out} = V_{off}$ + sensitivity x 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.

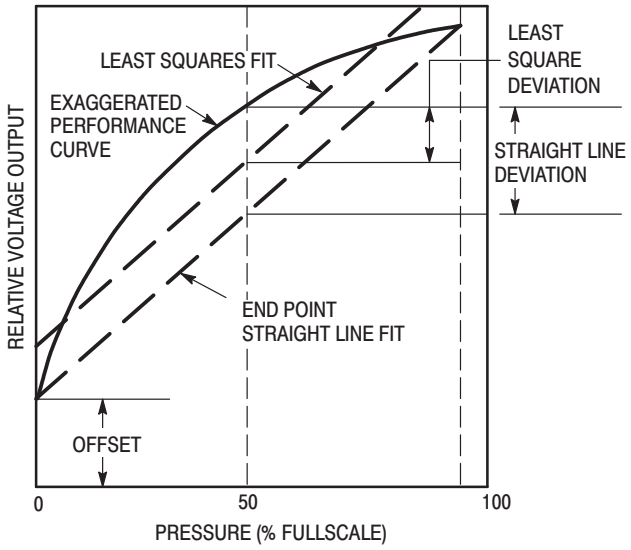


Figure 2. Linearity Specification Comparison

ON–CHIP TEMPERATURE COMPENSATION and CALIBRATION

Figure 3 shows the minimum, maximum and typical output characteristics of the MPXM2102 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.

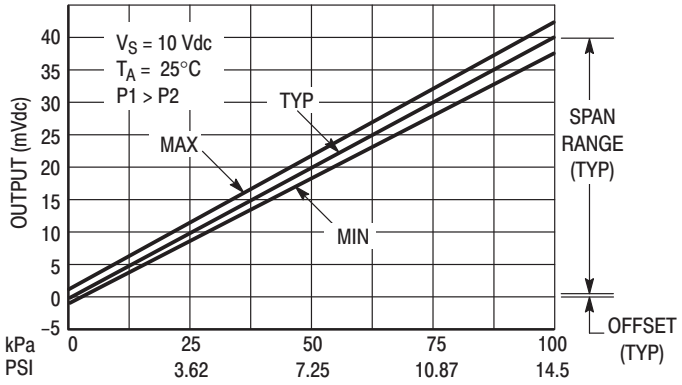
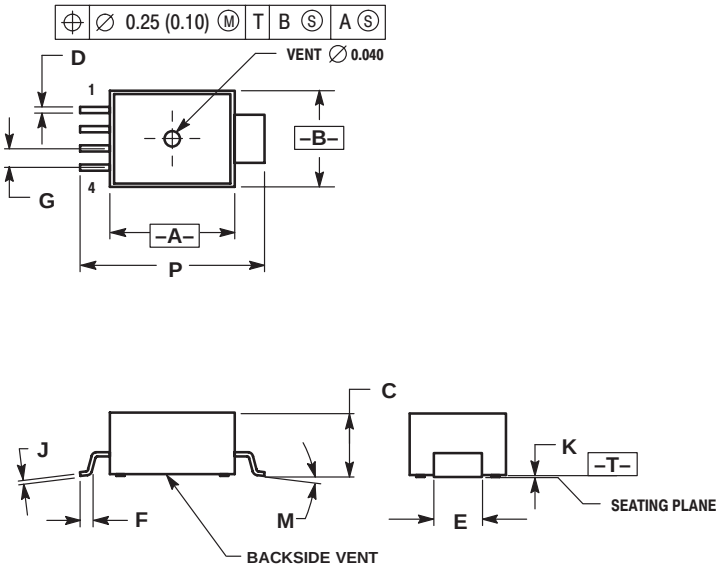


Figure 3. Output versus Pressure Differential

ORDERING INFORMATION	
Device Type	**Options**
MPXM2102D	Non–ported
MPXM2102DT1	Non–ported, Tape and Reel
MPXM2102GS	Ported
MPXM2102GST1	Ported, Tape and Reel
MPXM2102A	Non–ported
MPXM2102AT1	Non–ported, Tape and Reel
MPXM2102AS	Ported
MPXM2102AST1	Ported, Tape and Reel

PACKAGE DIMENSIONS

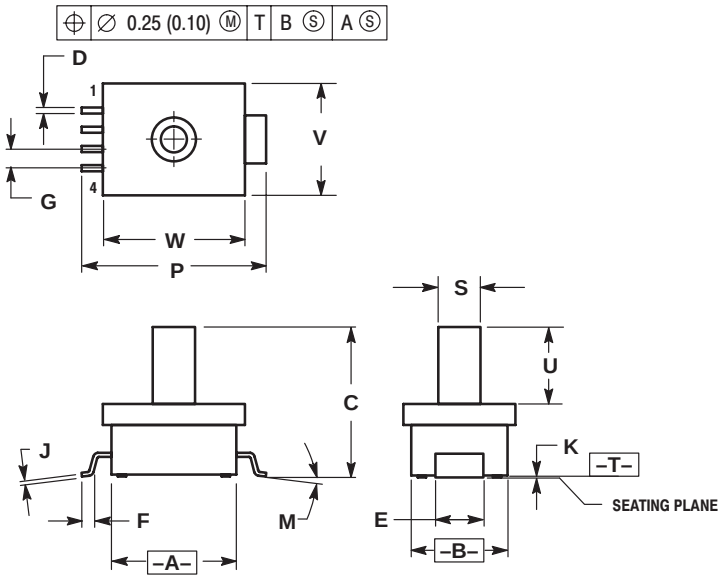


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.325	0.335	8.25	8.51
B	0.245	0.255	6.22	6.48
C	0.155	0.165	3.94	4.19
D	0.014	0.018	0.35	0.46
E	0.120	0.130	3.05	3.30
F	0.020	0.030	0.51	0.76
G	0.050		1.27	
J	0.009	0.011	0.23	0.28
K	0.002	0.010	0.05	0.25
M	0 °	7 °	0 °	7 °
P	0.475	0.485	12.06	12.32

STYLE 1:
PIN 1. GND
2. $+V_{OUT}$
3. V_S
4. $-V_{OUT}$

CASE 1320A–02
MPAK, STYLE 1



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2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.325	0.335	8.25	8.51
B	0.245	0.255	6.22	6.48
C	0.377	0.397	9.57	10.08
D	0.014	0.018	0.35	0.46
E	0.120	0.130	3.05	3.30
F	0.020	0.030	0.51	0.76
G	0.050		1.27	
J	0.009	0.011	0.23	0.28
K	0.002	0.010	0.05	0.25
M	0 °	7 °	0 °	7 °
P	0.475	0.485	12.06	12.32
S	0.107	0.117	2.71	2.97
U	0.192	0.202	4.88	5.13
V	0.283	0.293	7.19	7.44
W	0.363	0.373	9.22	9.47

STYLE 1:
PIN 1. GND
2. $+V_{OUT}$
3. V_S
4. $-V_{OUT}$

CASE 1320A–02
MPAK, STYLE 2

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How to reach us:

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