MPXT4100 MPXT4101 MPXT4105 SERIES

4100A: 20–105 kPa
4101A: 15–102 kPa
4105A: 15–105 kPa
X–ducer™
SILICON PRESSURE SENSORS

Manifold Absolute Pressure Sensors On-Chip Signal Conditioned, 0.25 V to 4.9 V Output, Temperature Compensated and Calibrated

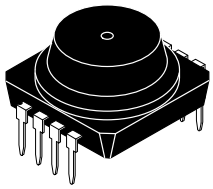
The Motorola MPXT4100A/4101A/4105A series Manifold Absolute Pressure (MAP) sensor for engine control is designed to sense absolute air pressure within the intake manifold. This measurement can be used to compute the amount of fuel required for each cylinder. The small form factor and high reliability of on–chip integration makes the Motorola MAP sensor a logical and economical choice for automotive system designers.

Features

- 1.8% Maximum Error Over 0° to 85°C
- Specifically Designed for Intake Manifold Absolute Pressure Sensing in Engine Control Systems
- Ideally Suited for Microprocessor Interfacing
- Patented Silicon Shear Stress Strain Gauge
- Temperature Compensated Over –40°C to +125°C
- Surface Mount Package
- Ideal for Non–Automotive Applications
- Also Available in Unibody Package

Application Examples

- Manifold Sensing for Automotive Systems



BASIC ELEMENT
CASE 473A–01, STYLE 2

PIN NUMBER			
1	Gnd	5	N/C
2	$+V_{out}$	6	N/C
3	V_S	7	N/C
4	$-V_{out}$	8	N/C

NOTE: Pins 5, 6, 7, and 8 are not device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the Lead.

MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Overpressure(1) (P1 > P2)	P_{max}	400	kPa
Burst Pressure(1) (P1 > P2)	P_{burst}	1000	kPa
Storage Temperature	T_{stg}	–40 to +125	°C
Operating Temperature	T_A	–40 to +125	°C

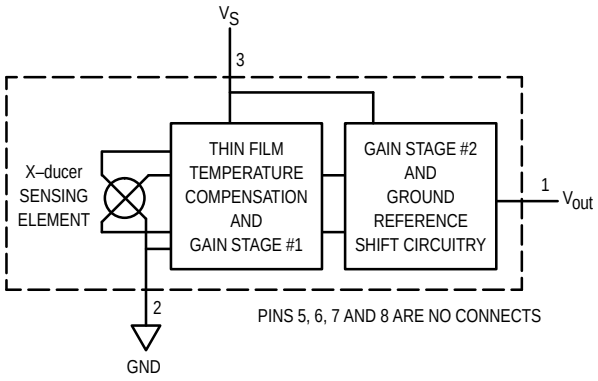


Figure 1. Fully Integrated Pressure Sensor Schematic

The MPXT4100A/4101A/4105A series piezoresistive transducer is a state–of–the–art, monolithic, signal conditioned, silicon pressure sensor. This sensor, with its patented transducer, combines advanced micromachining techniques, thin film metallization, and bipolar semiconductor processing to provide an accurate, high level analog output signal that is proportional to applied pressure.

Figure 1 shows a block diagram of the internal circuitry integrated on a pressure sensor chip.

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MPXT4100A SERIES OPERATING CHARACTERISTICS (V_S = 5.1 Vdc, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range		P_{OP}	20	—	105	kPa
Supply Voltage(2)		V_S	4.85	5.1	5.35	Vdc
Supply Current		I_o	—	7.0	10	mAdc
Offset(3)	(0 to 85°C)	V_{off}	0.225	0.306	0.388	V
Full Scale Output(4)	(0 to 85°C)	V_{FSO}	4.816	4.897	4.978	Vdc
Full Scale Span(5)	(0 to 85°C)	V_{FSS}	4.510	4.591	4.672	V
Accuracy(6)	(0 to 85°C)	—	—	—	±1.8	$\%V_{FSS}$
Sensitivity		$\Delta V/\Delta P$	—	54	—	mV/kPa
Response Time(7)		t_R	—	1.0	—	ms
Output Source Current at Full Scale Output		I_{o+}	—	0.1	—	mA

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 473)	—	—	2.0	—	Grams
Warm–Up Time(8)	—	—	15	—	mSec
Cavity Volume	—	—	—	0.01	IN^3
Volumetric Displacement	—	—	—	0.001	IN^3
Common Mode Line Pressure(11)	—	—	—	690	kPa

MPXT4101A SERIES OPERATING CHARACTERISTICS (V_S = 5.1 Vdc, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range		P_{OP}	15	—	102	kPa
Supply Voltage(2)		V_S	4.85	5.1	5.35	Vdc
Supply Current		I_o	—	7.0	10	mAdc
Offset(3)	(0 to 85°C)	V_{off}	0.171	0.252	0.333	V
Full Scale Output(4)	(0 to 85°C)	V_{FSO}	4.870	4.951	5.032	Vdc
Full Scale Span(5)	(0 to 85°C)	V_{FSS}	4.618	4.700	4.782	V
Accuracy(6)	(0 to 85°C)	—	—	—	±1.8	$\%V_{FSS}$
Sensitivity		$\Delta V/\Delta P$	—	54	—	mV/kPa
Response Time(7)		t_R	—	1.0	—	ms
Output Source Current at Full Scale Output		I_{o+}	—	0.1	—	mA

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 473)	—	—	2.0	—	Grams
Warm–Up Time(8)	—	—	15	—	mSec
Cavity Volume	—	—	—	0.01	IN^3
Volumetric Displacement	—	—	—	0.001	IN^3
Common Mode Line Pressure(11)	—	—	—	690	kPa

MPXT4105A SERIES OPERATING CHARACTERISTICS (V_S = 5.1 Vdc, T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range		P_{OP}	15	—	105	kPa
Supply Voltage(2)		V_S	4.85	5.1	5.35	Vdc
Supply Current		I_o	—	7.0	10	mAdc
Offset(3)	(0 to 85°C)	V_{off}	0.184	0.306	0.428	Vdc
Full Scale Output(4)	(0 to 85°C)	V_{FSO}	4.804	4.896	4.988	Vdc
Full Scale Span(5)	(0 to 85°C)	V_{FSS}	—	4.590	—	Vdc
Accuracy(6)	(0 to 85°C)	—	—	—	±1.8	$\%V_{FSS}$
Sensitivity		ΔV/ΔP	—	51	—	mV/kPa
Response Time(7)		t_R	—	1.0	—	ms
Output Source Current at Full Scale Output		I_{o+}	—	0.1	—	mAdc
Offset Stability(9)		—	—	±0.65	—	$\%V_{FSS}$

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 473)	—	—	2.0	—	Grams
Warm–Up Time(8)	—	—	15	—	mSec
Cavity Volume	—	—	—	0.01	IN^3
Volumetric Displacement	—	—	—	0.001	IN^3
Common Mode Line Pressure(11)	—	—	—	690	kPa

NOTES:

1. Exposure beyond the specified limits may cause permanent damage or degradation to the device.
2. Device is ratiometric within this specified excitation range.
3. Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
4. Full Scale Output (V_{FSO}) is defined as the output voltage at the maximum or full rated pressure.
5. 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.
6. Accuracy is the deviation in actual output from nominal output over the entire pressure range and temperature range as a percent of span at 25°C due to all sources of error including 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 minimum specified pressure applied.
   - Pressure Hysteresis: Output deviation at any pressure within the specified range, when this pressure is cycled to and from minimum or maximum rated pressure at 25°C.
   - TcSpan: Span deviation per °C over the temperature range of 0° to 85°C, as a percent of span at 25°C.
   - TcOffset: Output deviation per °C with minimum pressure applied, over the temperature range of 0° to 85°C.
7. 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.
8. Warm–up Time is defined as the time required for the product to meet the specified output voltage.
9. Offset Stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.
10. Decoupling circuit shown in Figure 3 required to meet specification.
11. Common mode pressures beyond specified may result in leakage at the case–to–lead interface.

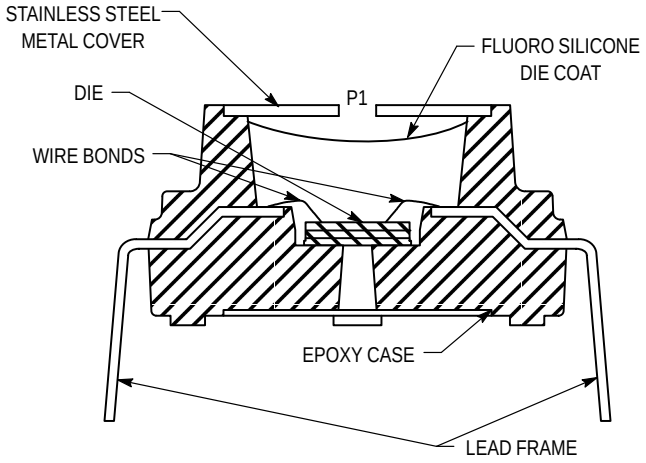


Figure 2. Cross Sectional Diagram (Not to Scale)

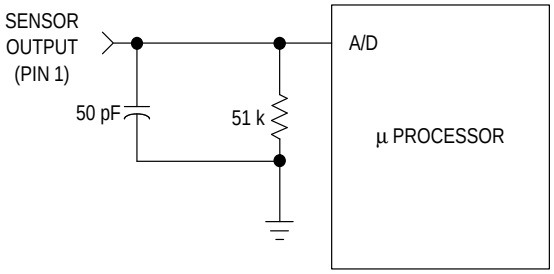


Figure 3. Decoupling Filter for Sensor to Microprocessor Interface

Figure 2 illustrates an absolute sensing chip in the basic chip carrier (Case 473). 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 MPXT4100A/4101A/4105A 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 MAP sensor to the A/D input of a microprocessor. Proper decoupilng of the power supply is recommended.

Figures 4, 5, and 6 show 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. (The output will saturate outside of the specified pressure range.)

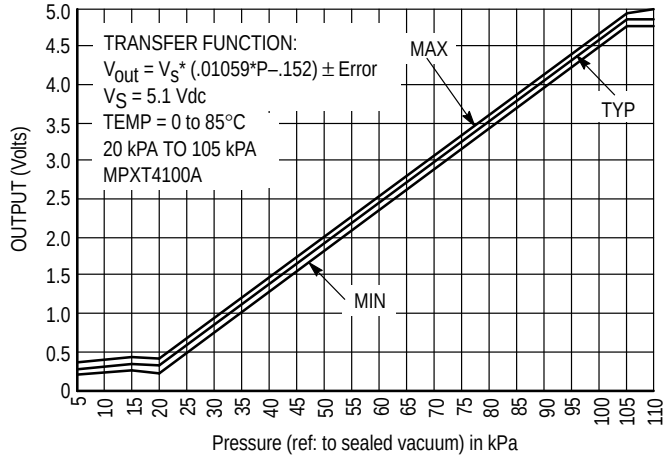


Figure 4. Output versus Absolute Pressure

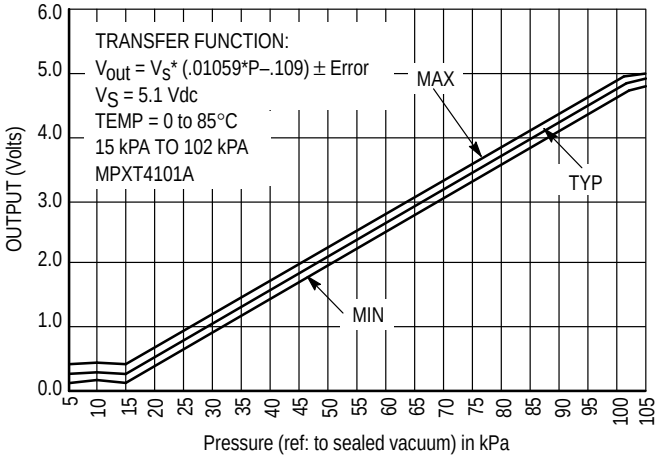


Figure 5. Output versus Absolute Pressure

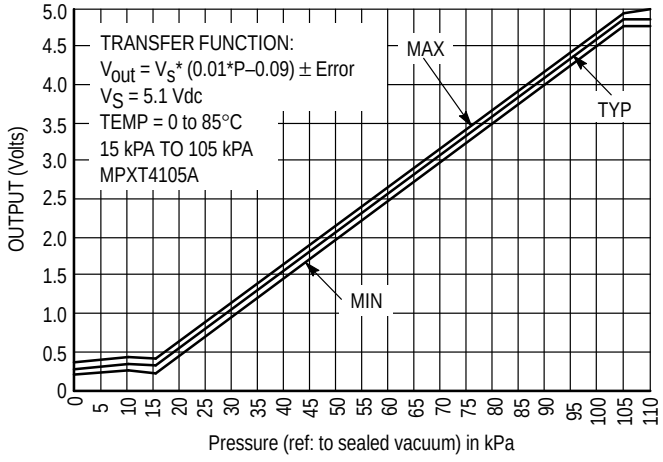


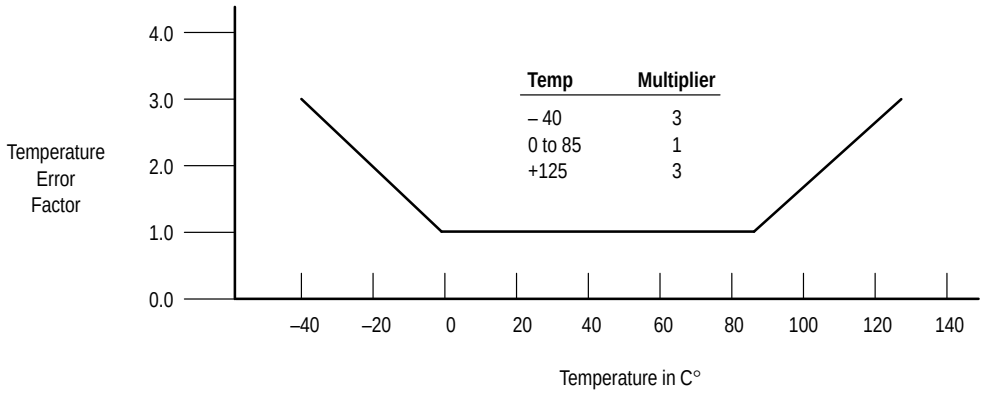
Figure 6. Output versus Absolute Pressure

Transfer Function (MPXT4100A)

Nominal Transfer Value: $V_{out} = V_S$ (P x 0.01059 – 0.1518)
+/– (Pressure Error x Temp. Factor x 0.01059 x V_S)
V_S = 5.1 V ± 0.25 Vdc

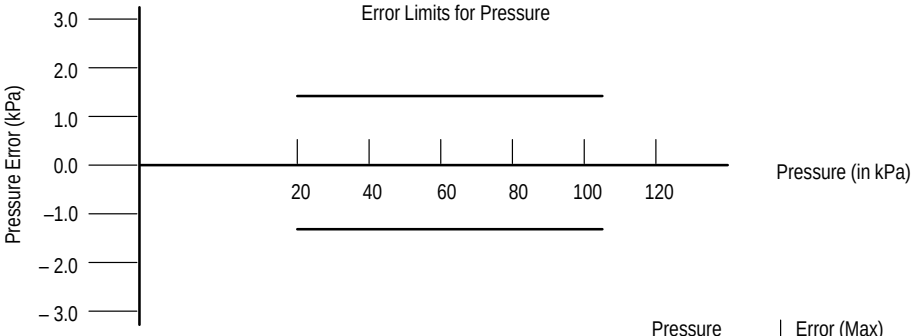
Temperature Error Band

MPXT4100A Series



Temp	Multiplier
– 40	3
0 to 85	1
+125	3

Pressure Error Band



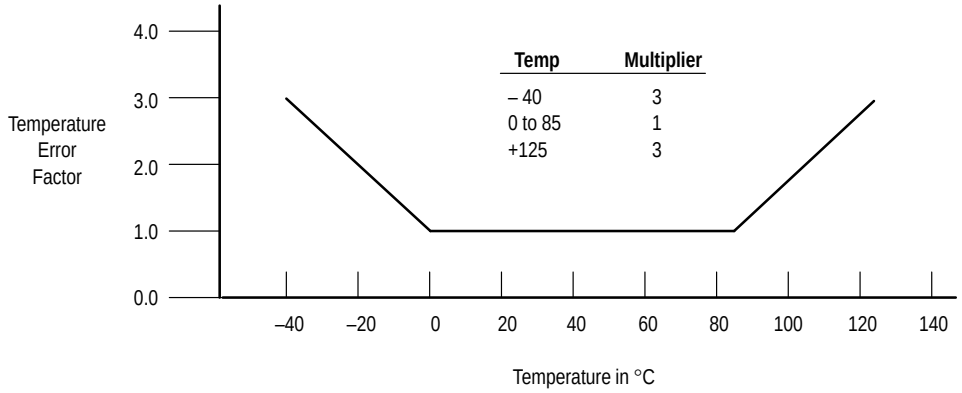
Pressure	Error (Max)
20 to 105 (kPa)	± 1.5 (kPa)

Transfer Function (MPXT4101A)

Nominal Transfer Value: $V_{out} = V_S$ (P x 0.01059 – 0.10941)
+/– (Pressure Error x Temp. Factor x 0.01059 x V_S)
V_S = 5.1 V ± 0.25 Vdc

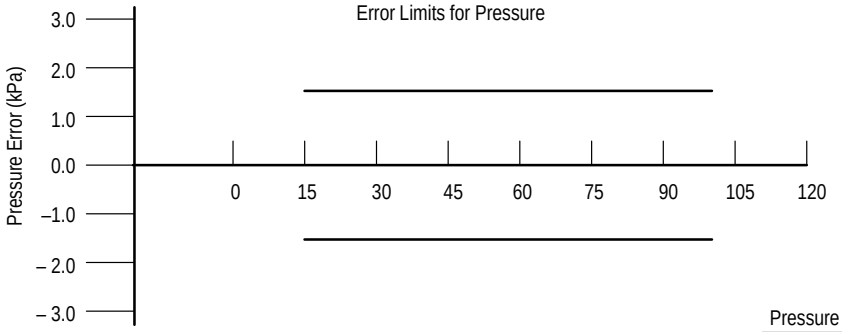
Temperature Error Band

MPXT4101A Series



Temp	Multiplier
– 40	3
0 to 85	1
+125	3

Pressure Error Band



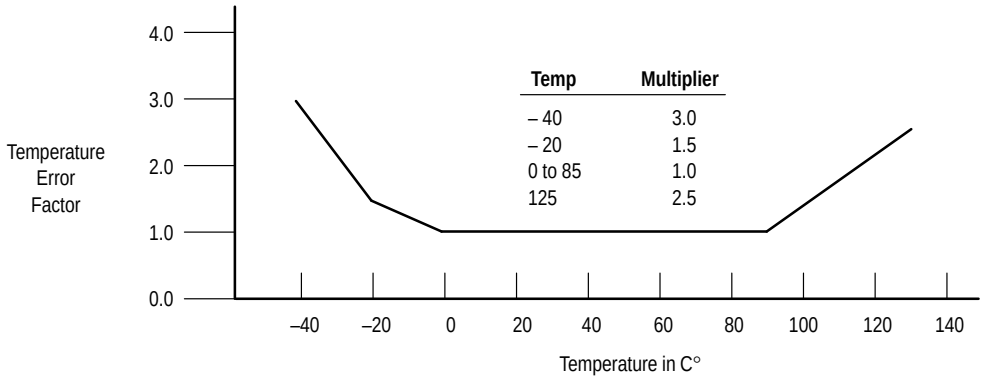
Pressure	Error (Max)
15 to 102 (kPa)	± 1.5 (kPa)

Transfer Function (MPXT4105A)

Nominal Transfer Value: $V_{out} = V_S (P \times 0.01 - 0.09)$
+/– (Pressure Error x Temp. Factor x 0.01 x V_S)
$V_S = 5.1 V \pm 0.25$ Vdc

Temperature Error Band

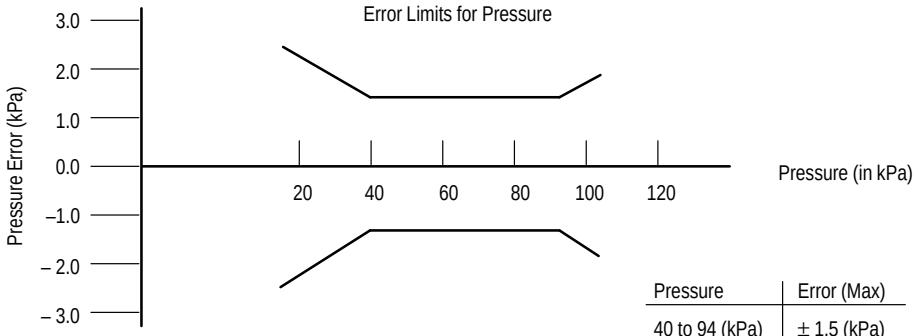
MPXT4105A Series



Temp	Multiplier
– 40	3.0
– 20	1.5
0 to 85	1.0
125	2.5

NOTE: The Temperature Multiplier is a linear response from –40°C to –20°C, –20°C to 0°C, and from 85°C to 125°C

Pressure Error Band



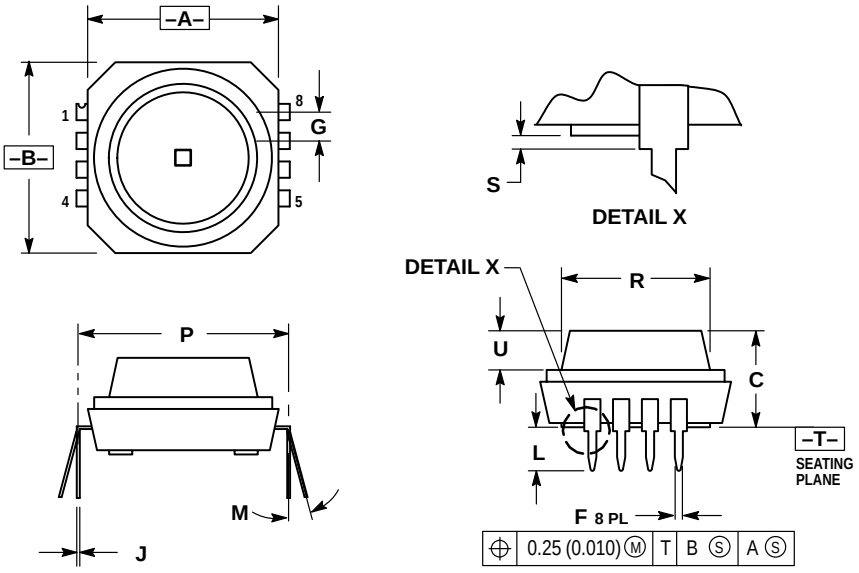
Pressure	Error (Max)
40 to 94 (kPa)	± 1.5 (kPa)
15 (kPa)	± 2.4 (kPa)
105 (kPa)	± 1.8 (kPa)

ORDERING INFORMATION

The MPXT4100A, MPXT4101A, AND MPXT4105A series MAP silicon pressure sensors are available to be shipped in rails.

Packing Options	Port Options	Leadform	Case No.	MPXT Series Order No.	Marking
Rails	Element	84 degree	473A–01	MPXT4100A7U	MPXT4100A
Rails	Element	84 degree	473A–01	MPXT4101A7U	MPXT4101A
Rails	Element	84 degree	473A–01	MPXT4105A7U	MPXT4105A

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.
6. DIMENSION P TO CENTER OF LEAD WHEN FORMED PARALLEL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.658	0.668	16.71	16.97
B	0.658	0.668	16.71	16.97
C	0.329	0.357	8.36	9.07
F	0.026	0.034	0.660	0.864
G	0.100 BSC		2.54 BSC	
J	0.009	0.011	0.23	0.28
L	0.138	0.150	3.81	3.51
M	0 °	15 °	0 °	15 °
P	0.738	0.748	18.75	19.00
R	0.503	0.523	12.78	13.28
S	0.002	0.020	0.05	0.51
U	0.135	0.145	3.43	3.68

STYLE 2:
PIN 1. GROUND
2. +VOUT
3. VSUPPLY
4. –VOUT
5. N/C
6. N/C
7. N/C
8. N/C

CASE 473A–01
ISSUE A

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JAPAN: Nippon Motorola Ltd.: SPD, Strategic Planning Office, 4–32–1, Nishi–Gotanda, Shinagawa–ku, Tokyo 141, Japan. 81–3–5487–8488

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