



Manifold Absolute Pressure Sensor On-Chip Signal Conditioned, 0.3 V to 4.9 V Output, Temperature Compensated & Calibrated

The Motorola MPX4105A 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.

Motorola's MAP sensor integrates on-chip, bipolar op amp circuitry and thin film resistor networks to provide a high output signal and temperature compensation. The small form factor and high reliability of on-chip integration make the Motorola MAP sensor a logical and economical choice for the automotive system designer.

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 Direct Microprocessor Interfacing
- Patented Silicon Shear Stress Strain Gauge
- Temperature Compensated Over -40 to +125°C
- Durable Epoxy Unibody Element
- Ideal for Non-Automotive Applications, Too
- Call Factory about Top Piston Fit Package Availability.

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

Rating	Symbol	Value	Unit
Overpressure ⁽¹⁾ (P ₁ > P ₂)	P _{max}	400	kPa
Burst Pressure ⁽¹⁾ (P ₁ > P ₂)	P _{burst}	1000	kPa
Storage Temperature	T _{stg}	-40 to +125	°C
Operating Temperature	T _A	-40 to +125	°C

The MPX4105A series piezoresistive transducer is a state-of-the-art, monolithic, signal conditioned, silicon pressure sensor. This sensor, with its patented X-ducer, 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. A vacuum is sealed behind the sensor diaphragm providing a reliable pressure reference.

Figure 1 shows a block diagram of the internal circuitry integrated on the stand-alone pressure sensing chip.

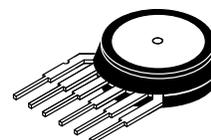
X-ducer is a trademark of Motorola, Inc.

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

MPX4105A SERIES

Motorola Preferred Devices

4105A: 15-105 kPa
X-ducer™
SILICON
PRESSURE SENSOR



CASE 867-07
Style 1

Pin Number					
1	2	3	4	5	6
V _{out}	Ground	V _S	N/C	N/C	N/C

NOTE: Pins 4, 5 and 6 are internal device connections. Do not connect to external circuitry or ground.

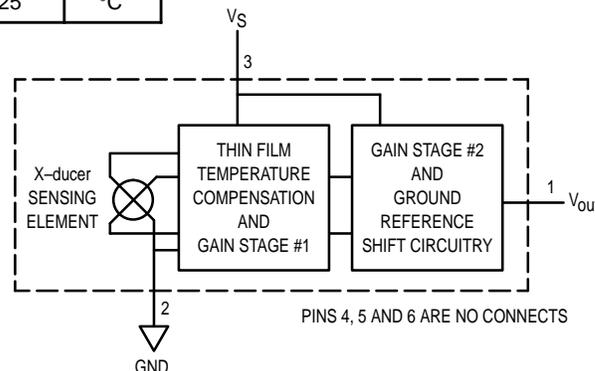


Figure 1. Fully Integrated Pressure Sensor Schematic

MPX4105A SERIES

MPX4105A SERIES OPERATING CHARACTERISTICS ($V_S = 5.1$ Vdc, $T_A = 25^\circ\text{C}$ 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
Minimum Pressure Offset ⁽³⁾	V_{off}	0.184	0.306	0.428	Vdc
Full Scale Output ⁽⁴⁾	V_{FSO}	4.804	4.896	4.988	Vdc
Full Scale Span ⁽⁵⁾	V_{FSS}	—	4.590	—	Vdc
Accuracy ⁽⁶⁾	—	—	—	± 1.8	% V_{FSS}
Sensitivity	$\Delta V/\Delta P$	—	51	—	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⁾	—	—	15	—	ms
Offset Stability ⁽⁹⁾	—	—	± 0.65	—	% V_{FSS}

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 867)	—	—	4.0	—	Grams

NOTES:

- Exposure beyond the specified limits may cause permanent damage or degradation to the device.
- 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_{FSO}) is defined as the output voltage at the maximum or full rated pressure.
- 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.
- 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 $^\circ\text{C}$ over the temperature range of 0° to 85°C , as a percent of span at 25°C .
 - TcOffset: Output deviation per $^\circ\text{C}$ with minimum pressure applied, over the temperature range of 0° to 85°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 Time is defined as the time required for the product to meet the specified output voltage.
- Offset Stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.
- Decoupling circuit shown in Figure 2 required to meet specification.

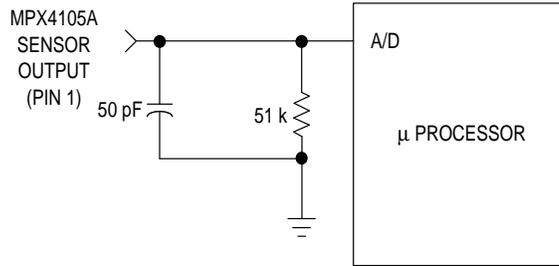


Figure 2. Recommended Decoupling Filter for Sensor to Microprocessor Interface

A fluorosilicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm. The MPXS4105A series pressure sensor operating characteristics, 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 2 shows the recommended decoupling circuit for interfacing the output of the integrated MAP sensor to the A/D input of a microprocessor (see Note 10).

Figure 3 shows the sensor output signal relative to pressure input. Typical minimum and maximum output curves are shown for operation over 0 to 85°C temperature range. (Output will saturate outside of the rated pressure range.)

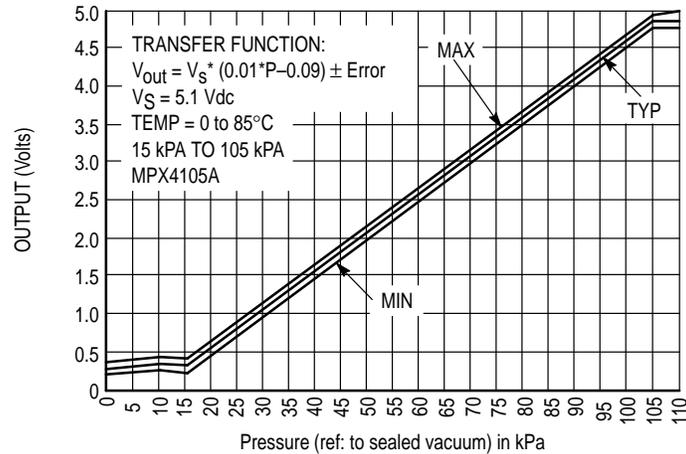


Figure 3. Output versus Absolute Pressure

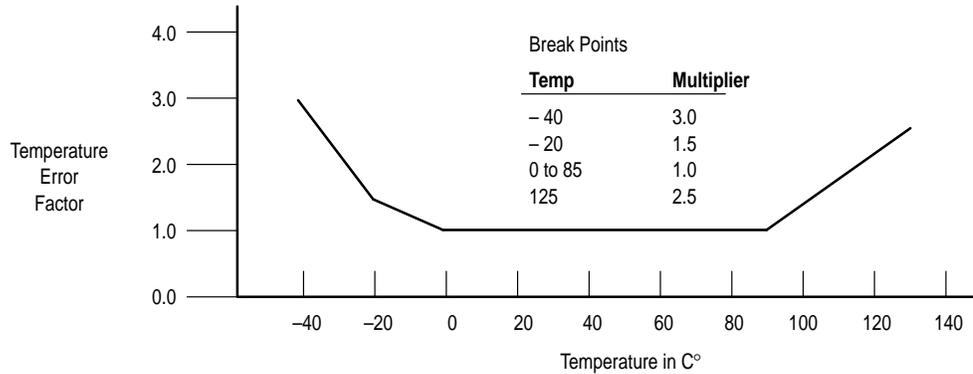
MPX4105A SERIES

Transfer Function (MPX4105A)

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

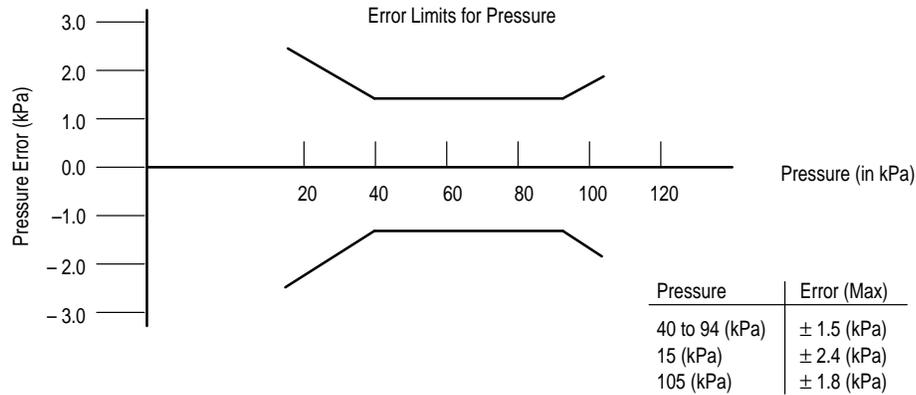
Temperature Error Band

MPX4105A Series



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

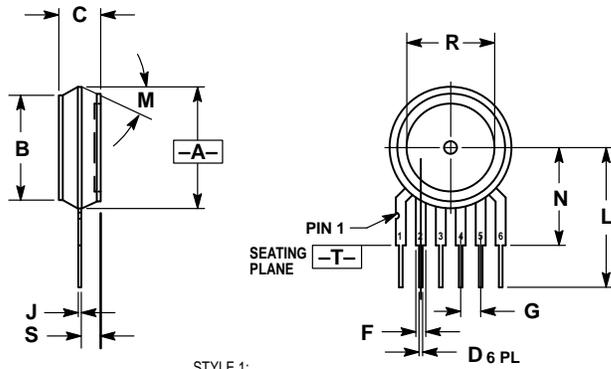


ORDERING INFORMATION

The MPX4105A series MAP silicon pressure sensors are available in the basic element package that provide printed circuit board mounting ease.

Device Type	Options	Case No.	MPX Series Order No.	Marking
Basic Element	Absolute, Element	867-07	MPX4105A	MPX4105A

PACKAGE DIMENSIONS



- STYLE 1:
 PIN 1. V_{OUT}
 2. GROUND
 3. V_{CC}
 4. NC
 5. NC
 6. NC

\oplus	0.136 (0.005)	M	T	A	M
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- NOTES:
 11. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 12. CONTROLLING DIMENSION: INCH.
 13. DIMENSION -A- DOES NOT INCLUDE MOLDED FLASH RING. MOLDED FLASH RING NOT TO EXCEED 16.00 (0.630).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.595	0.620	15.11	15.75
B	0.514	0.534	13.06	13.56
C	0.200	0.220	5.08	5.59
D	0.027	0.033	0.68	0.84
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.695	0.725	17.65	18.42
M	30° NOM		30° NOM	
N	0.475	0.495	12.07	12.57
R	0.430	0.450	10.92	11.43
S	0.090	0.105	2.29	2.66

**CASE 867-07
 ISSUE L**

BASIC ELEMENT (A)

MPX4105A SERIES

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MPX4105A/D

