senseon™

Integrated Silicon Pressure Sensor Manifold Absolute Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated

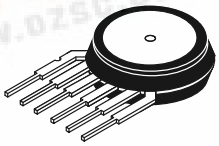
MPX4105 SERIES

OPERATING OVERVIEW INTEGRATED PRESSURE SENSOR
15 to 105 kPa
(2.18 to 15.2 psi)
0.31 to 4.90 Volts Output

The Motorola MPX4105 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.

The MPX4105 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.



BASIC CHIP CARRIER ELEMENT
CASE 867–08, STYLE 1

NOTE: Pin 1 is the notched pin.

PIN NUMBER			
1	V_{out}	4	N/C
2	Gnd	5	N/C
3	V_S	6	N/C

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

Features

- 1.7% 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
- Durable Epoxy Unibody Element
- Ideal for Non–Automotive Applications
- Consult Factory for Top Piston Fit Package Availability

Application Examples

- Manifold Sensing for Automotive Systems

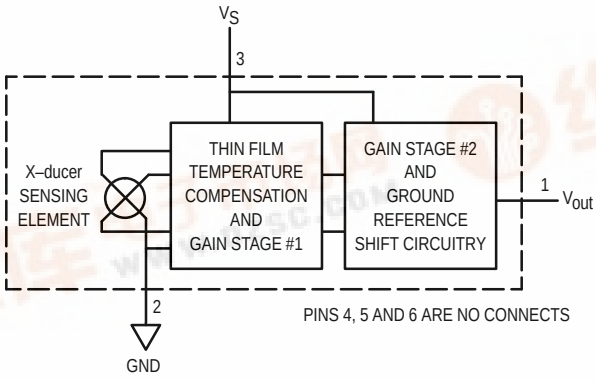


Figure 1. Fully Integrated Pressure Sensor Schematic

MAXIMUM RATINGS(1)

Parametrics	Symbol	Value	Unit
Overpressure(2) (P1 > P2)	P_{max}	400	kPa
Burst Pressure(2) (P1 > P2)	P_{burst}	1000	kPa
Storage Temperature	T_{stg}	−40° to +125°	°C
Operating Temperature	T_A	−40° to +125°	°C

1. T_C = 25°C unless otherwise noted.
2. Exposure beyond the specified limits may cause permanent damage or degradation to the device.

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

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range(1)		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_S = 5.1 Volts	(0 to 85°C)	V_{off}	0.184	0.306	0.428	Vdc
Full Scale Output(4) @ V_S = 5.1 Volts	(0 to 85°C)	V_{FSO}	4.804	4.896	4.988	Vdc
Full Scale Span(5) @ V_S = 5.1 Volts	(0 to 85°C)	V_{FSS}	—	4.590	—	Vdc
Accuracy(6)	(0 to 85°C)	—	—	—	±1.7	$\%V_{FSS}$
Sensitivity		V/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)		—	—	20	—	mSec
Offset Stability(9)		—	—	±0.5	—	$\%V_{FSS}$

Decoupling circuit shown in Figure 3 required to meet electrical specifications.

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 867)	—	—	4.0	—	Grams
Common Mode Line Pressure(10)	—	—	—	690	kPa

NOTES:

1. 1.0kPa (kiloPascal) equals 0.145 psi.
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 (error budget) consists of 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 zero differential 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: Output deviation over the temperature range of 0° to 85°C, relative to 25°C.
   - TcOffset: Output deviation with minimum pressure applied, over the temperature range of 0° to 85°C, relative to 25°C.
   - Variation from Nominal: The variation from nominal values, for Offset or Full Scale Span, as a percent of V_{FSS} at 25°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 is defined as the time required for the product to meet the specified output voltage after the Pressure has been stabilized.
9. Offset stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.
10. Common mode pressures beyond what is specified may result in leakage at the case–to–lead interface.

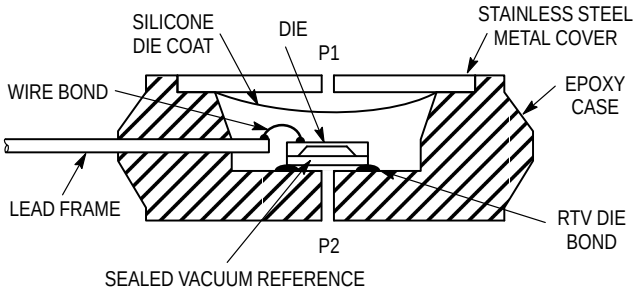


Figure 2. Cross–Sectional Diagram (Not to Scale)

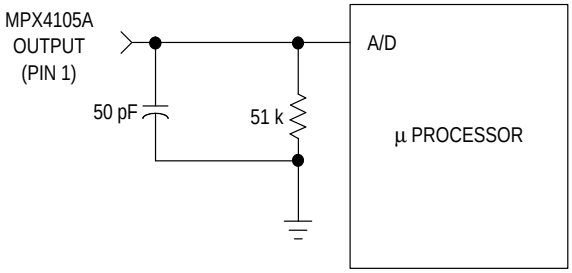


Figure 3. Typical Decoupling Filter for Sensor to Microprocessor Interface

Figure 2 illustrates the absolute sensing chip in the basic chip carrier (Case 867). 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 MPX4105 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 decoupling of the power supply is recommended.

Figure 4 shows 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.)

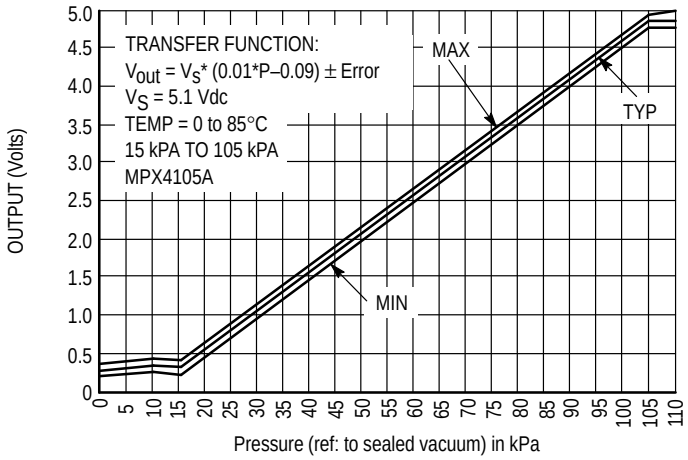


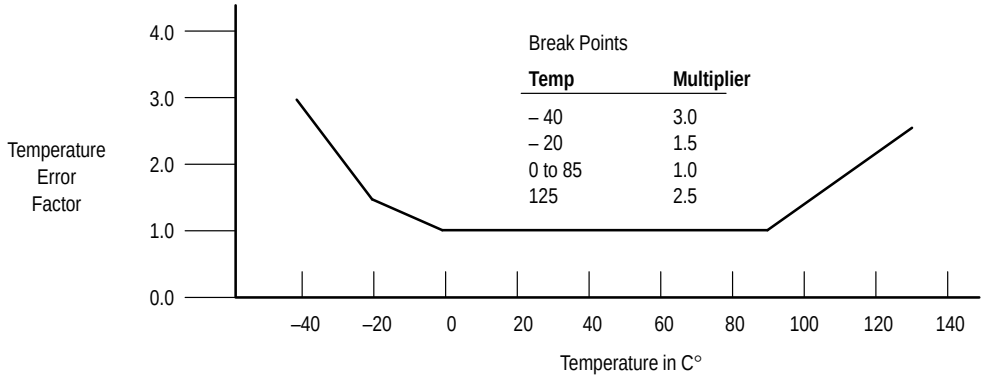
Figure 4. Output versus Absolute Pressure

Transfer Function (MPX4105A)

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

MPX4105A Series

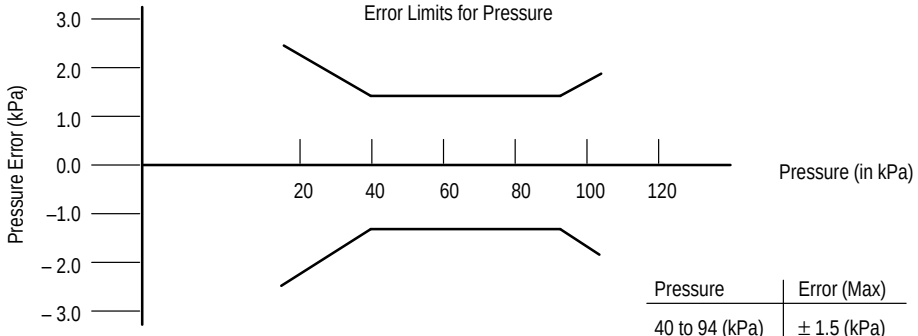


Break Points

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



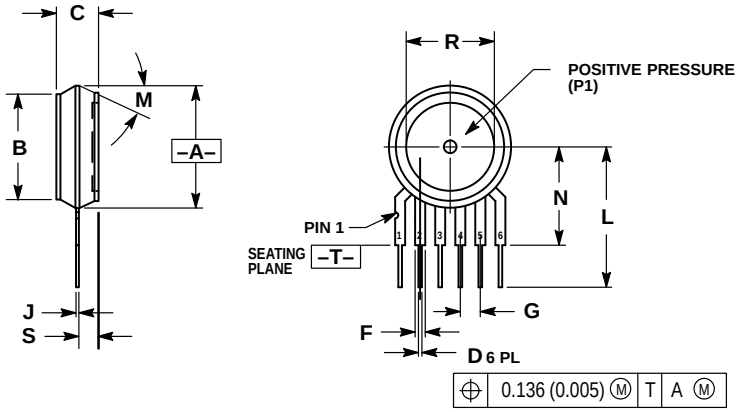
Pressure	Error (Max)
40 to 94 (kPa)	± 1.5 (kPa)
15 (kPa)	± 2.4 (kPa)
105 (kPa)	± 1.8 (kPa)

ORDERING INFORMATION

The 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	867–08	MPX4105A	MPX4105A

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION –A– IS INCLUSIVE OF THE MOLD STOP RING. MOLD STOP RING NOT TO EXCEED 16.00 (0.630).

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.595	0.630	15.11	16.00
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

STYLE 1:
PIN 1. VOUT
2. GROUND
3. VCC
4. V1
5. V2
6. VEX

CASE 867–08
ISSUE N

BASIC ELEMENT (A, D)

How to reach us:

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

Mfax™: RMFAX0@email.sps.mot.com – TOUCHTONE 602–244–6609
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INTERNET: http://motorola.com/sps

JAPAN: Nippon Motorola Ltd.; Tatsumi–SPD–JLDC, 6F Seibu–Butsuryu–Center,
3–14–2 Tatsumi Koto–Ku, Tokyo 135, Japan. 81–3–3521–8315

ASIA / PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852–26629298