



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

The Motorola MPX4200 series Manifold Absolute Pressure (MAP) sensor for turbo boost 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 MPX4200 series sensor integrates on-chip, bipolar op amp circuitry and thin film resistor networks to provide a high level analog output signal and temperature compensation. The small form factor and reliability of on-chip integration make the Motorola MAP sensor a logical and economical choice for automotive system designers.

Features

- 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 $+125^{\circ}\text{C}$
- Offers Reduction in Weight and Volume Compared to Existing Hybrid Modules
- Durable Epoxy Unibody Element
- Ideal for Non-Automotive Applications

Application Examples

- Manifold Sensing for Automotive Systems

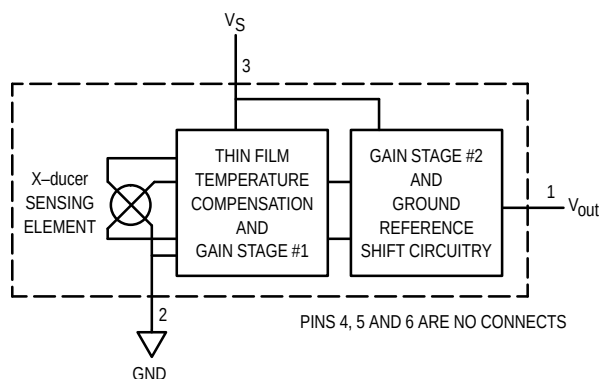
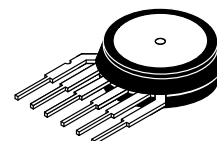


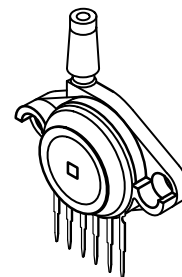
Figure 1. Fully Integrated Pressure Sensor Schematic

MPX4200 SERIES

INTEGRATED
PRESSURE SENSOR
20 to 200 kPa (2.9 to 29 psi)
0.3 to 4.9 V OUTPUT



BASIC CHIP
CARRIER ELEMENT
CASE 867-08, STYLE 1



PORT OPTION
CASE 867B-04, STYLE 1

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. Pin 1 is noted by the notch in the Lead.



MPX4200 SERIES

MAXIMUM RATINGS(1)

Parametrics	Symbol	Value	Unit
Overpressure ⁽²⁾ ($P_1 > P_2$)	$P_{\max}$	400	kPa
Burst Pressure ⁽²⁾ ($P_1 > P_2$)	P_{burst}	1000	kPa
Storage Temperature	T_{stg}	-40 to +125	°C
Operating Temperature	T_A	-40 to +125	°C

1. $T_C = 25^\circ\text{C}$ unless otherwise noted.

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

OPERATING CHARACTERISTICS ($V_S = 5.1\text{ Vdc}$, $T_A = 25^\circ\text{C}$ unless otherwise noted, $P_1 > P_2$)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure Range ⁽¹⁾	P_{OP}	20	—	200	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⁾ @ $V_S = 5.1\text{ Volts}$	V_{off}	0.199	0.306	0.413	Vdc
Full Scale Output ⁽⁴⁾ @ $V_S = 5.1\text{ Volts}$	V_{FSO}	4.725	4.896	4.978	Vdc
Full Scale Span ⁽⁵⁾ @ $V_S = 5.1\text{ Volts}$	V_{FSS}	—	4.590	—	Vdc
Accuracy ⁽⁶⁾	—	—	—	± 1.5	% V_{FSS}
Sensitivity	V/P	—	25.5	—	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	—	ms
Offset Stability ⁽⁹⁾	—	—	± 0.5	—	% V_{FSS}

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

MECHANICAL CHARACTERISTICS

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

NOTES:

- 1.0 kPa (kiloPascal) equals 0.145 psi.
- 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 (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 the minimum or maximum rated pressure, at 25°C .
 - T_{cSpan} : Output deviation over the temperature range of 0° to 85°C , relative to 25°C .
 - T_{cOffset} : Output deviation with minimum rated 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 .
- 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 is defined as the time required for the product to meet the specified output voltage after the Pressure has been stabilized.
- Offset stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.
- Common mode pressures beyond what is specified may result in leakage at the case-to-lead interface.

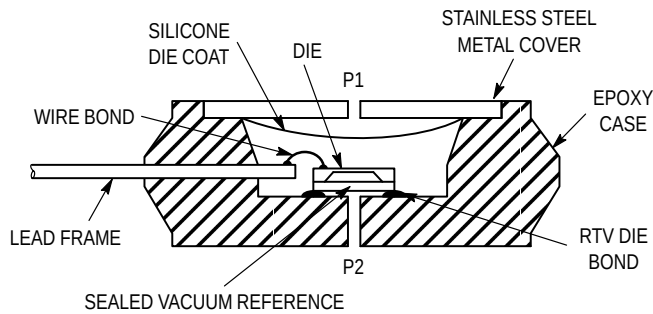


Figure 2. Cross-Sectional Diagram (Not to Scale)

Figure 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 MPX4200A 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 in-

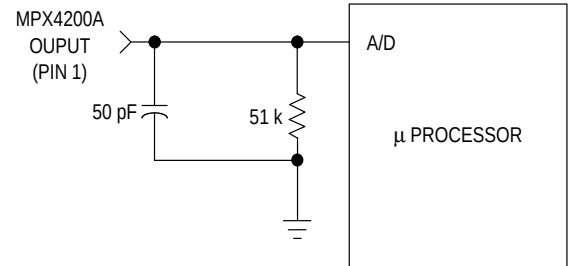


Figure 3. Typical Decoupling Filter for Sensor to Microprocessor Interface

formation 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 temperature range of 0° to 85°C. (The output will saturate outside of the specified pressure range.)

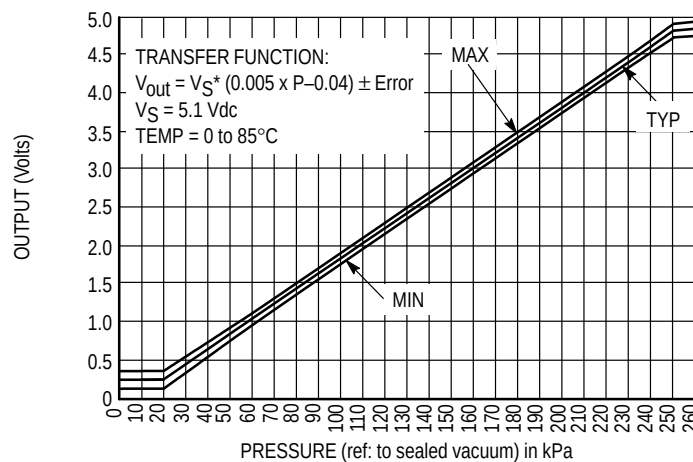


Figure 4. Output versus Absolute Pressure

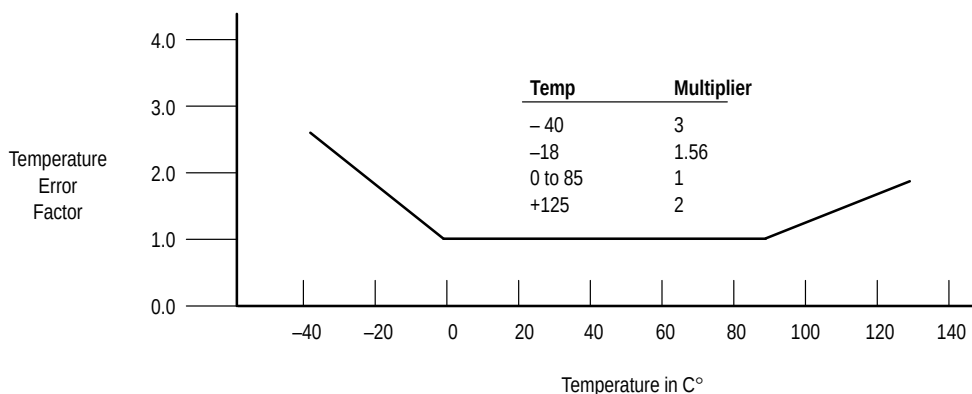
MPX4200 SERIES

Transfer Function (MPX4200A)

Nominal Transfer Value: $V_{out} = V_S \times (0.005 \times P - 0.04)$
 $\pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.005 \times V_S)$
 $V_S = 5.1 \pm 0.25 \text{ Vdc}$

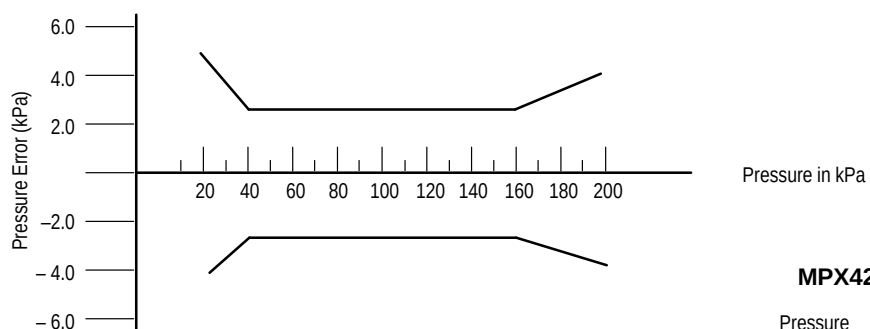
Temperature Error Band

MPX4200A Series



NOTE: The Temperature Multiplier is a linear response.

Pressure Error Band



MPX4200A Series

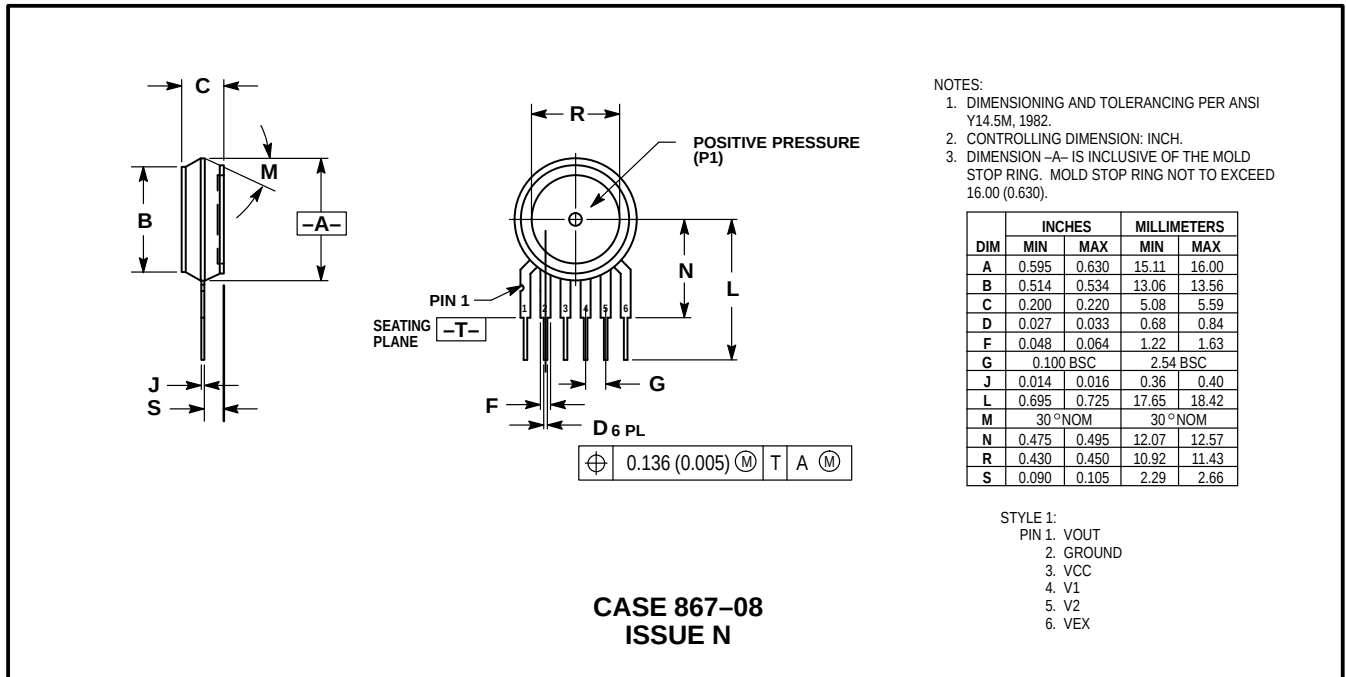
Pressure	Error (Max)
20 kPa	± 4.2 (kPa)
40 kPa	± 2.4 (kPa)
160 kPa	± 2.4 (kPa)
200 kPa	± 3.2 (kPa)

ORDERING INFORMATION

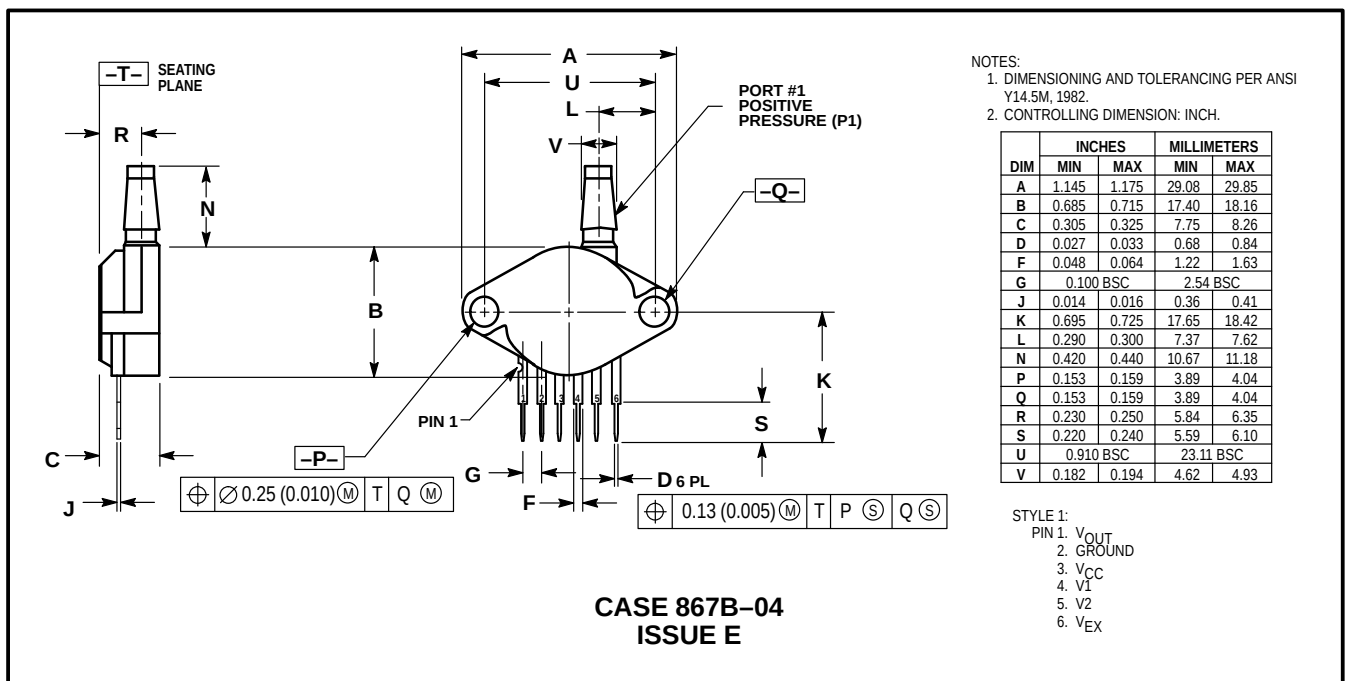
The MPX4200A series Turbo MAP silicon pressure sensors are available in the basic element package or with pressure port fittings that provide mounting ease and barbed hose connections.

Device Type	Options	Case No.	MPX Series Order No.	Marking
Basic Element	Absolute, Element	Case 867-08	MPX4200A	MPX4200A
Ported Elements	Absolute, Ported	Case 867B-04	MPX4200AP	MPX4200AP
	Absolute, Stove Pipe Port	Case 867E-03	MPX4200AS	MPX4200A
	Absolute, Axial Port	Case 867F-03	MPX4200ASX	MPX4200A

PACKAGE DIMENSIONS

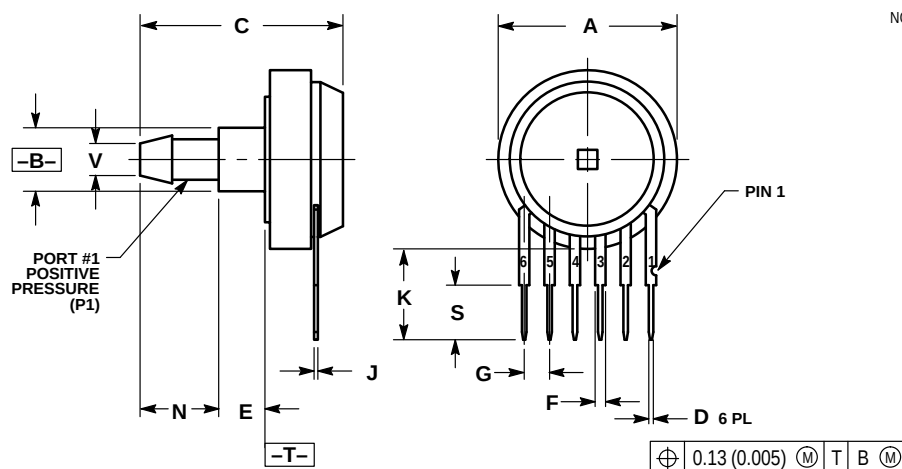


BASIC ELEMENT (A)

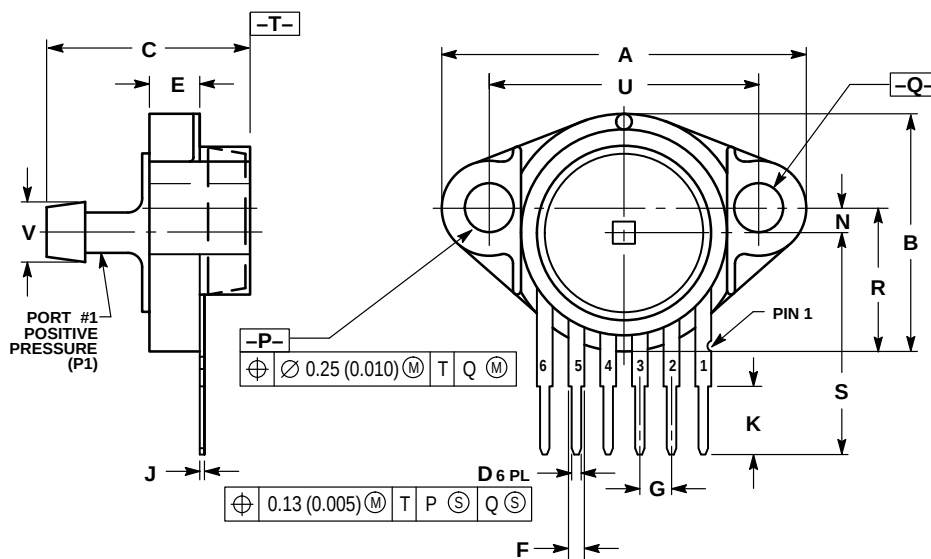


PRESSURE SIDE PORTED (AP)

PACKAGE DIMENSIONS – continued

CASE 867E-03
ISSUE D

PRESSURE SIDE PORTED (AS)

CASE 867F-03
ISSUE D

PRESSURE SIDE PORTED (ASX)

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MPX4200/D