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

MPX4250A
MPXA4250A
SERIES

INTEGRATED PRESSURE SENSOR
20 to 250 kPa (2.9 to 36.3 psi)
0.2 to 4.9 V OUTPUT

The Motorola MPX4250A/MPXA4250A 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 MPX4250A/MPXA4250A series piezoresistive transducer is a state–of–the–art monolithic silicon pressure sensor designed for a wide range of applications, particularly those employing a microcontroller or microprocessor with A/D inputs. This transducer combines advanced micromachining techniques, thin–film metallization and bipolar processing to provide an accurate, high–level analog output signal that is proportional to the applied pressure. The small form factor and high reliability of on–chip integration make the Motorola sensor a logical and economical choice for the automotive system engineer.

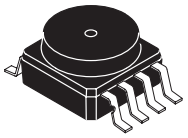
Features

- 1.5% Maximum Error Over 0° to 85°C
- Specifically Designed for Intake Manifold Absolute Pressure Sensing in Engine Control Systems
- Patented Silicon Shear Stress Strain Gauge
- Temperature Compensated Over –40° to +125°C
- Offers Reduction in Weight and Volume Compared to Existing Hybrid Modules
- Durable Epoxy Unibody Element or Thermoplastic Small Outline, Surface Mount Package
- Ideal for Non–Automotive Applications

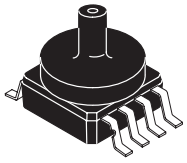
Application Examples

- Turbo Boost Engine Control
- Ideally Suited for Microprocessor or Microcontroller–Based Systems

SMALL OUTLINE PACKAGE

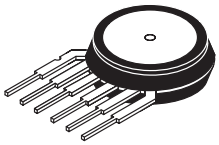


PORT OPTION
CASE 482

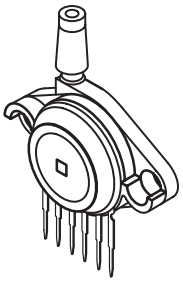


PORT OPTION
CASE 482A

UNIBODY PACKAGE



BASIC CHIP
CARRIER ELEMENT
CASE 867, STYLE 1



PORT OPTION
CASE 867B, STYLE 1

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

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

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.

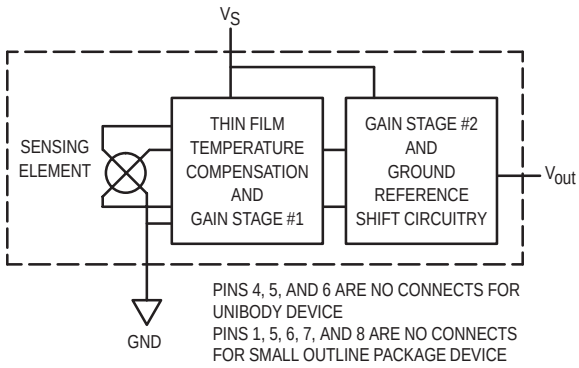


Figure 1. Fully Integrated Pressure Sensor Schematic

REV 4

MAXIMUM RATINGS(1)

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

NOTES:
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, Decoupling circuit shown in Figure 3 required to meet electrical specifications.)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range(1)		P_{OP}	20	—	250	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}	0.133	0.204	0.274	Vdc
Full Scale Output(4) @ V_S = 5.1 Volts	(0 to 85°C)	V_{FSO}	4.826	4.896	4.966	Vdc
Full Scale Span(5) @ V_S = 5.1 Volts	(0 to 85°C)	V_{FSS}	—	4.692	—	Vdc
Accuracy(6)	(0 to 85°C)	—	—	—	±1.5	$\%V_{FSS}$
Sensitivity		$\Delta V/\Delta P$	—	20	—	mV/kPa
Response Time(7)		t_R	—	1.0	—	msec
Output Source Current at Full Scale Output		I_o+	—	0.1	—	mAdc
Warm–Up Time(8)		—	—	20	—	msec
Offset Stability(9)		—	—	±0.5	—	$\%V_{FSS}$

NOTES:
1. 1.0 kPa (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 the 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 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.
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.

MECHANICAL CHARACTERISTICS

Characteristics	Typ	Unit
Weight, Basic Element (Case 867)	4.0	Grams
Weight, Small Outline Package (Case 482)	1.5	Grams

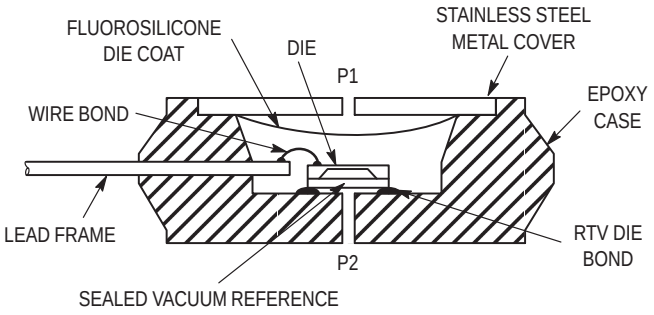


Figure 2. Cross–Sectional Diagram (Not to Scale)

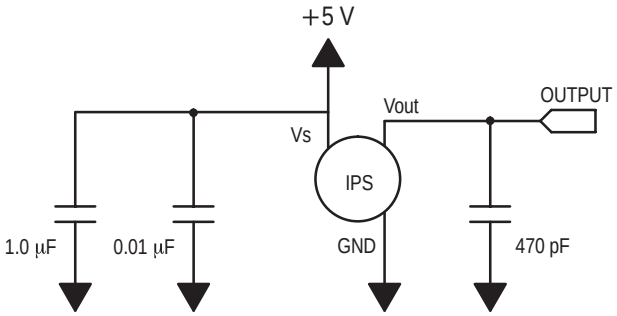


Figure 3. Recommended power supply decoupling and output filtering.
For additional output filtering, please refer to Application Note AN1646.

Figure 2 illustrates the absolute pressure 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 MPX4250A/MPXA4250A 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 the recommended decoupling circuit for interfacing the output of the integrated sensor to the A/D input of a microprocessor or microcontroller.

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 using the decoupling circuit shown in Figure 3. The output will saturate outside of the specified pressure range.

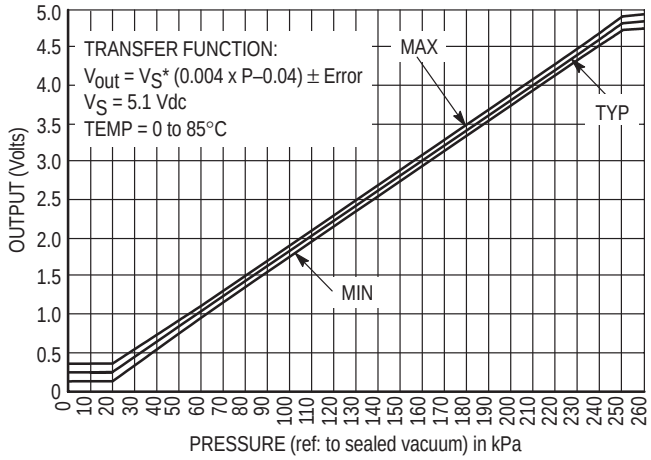
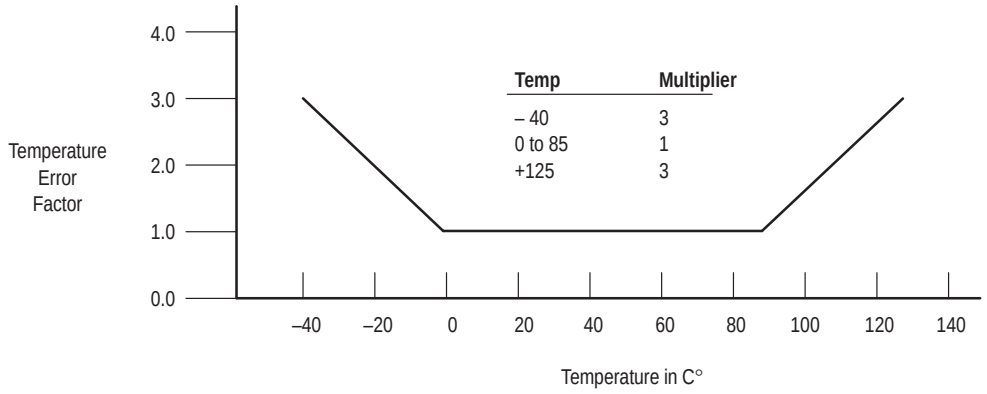


Figure 4. Output versus Absolute Pressure

Transfer Function

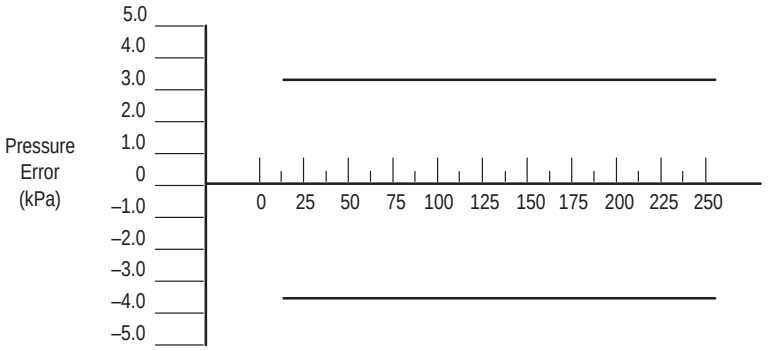
Nominal Transfer Value: $V_{out} = V_S (P \times 0.004 - 0.04)$
+/– (Pressure Error x Temp. Factor x 0.004 x V_S)
$V_S = 5.1\ V \pm 0.25\ Vdc$

Temperature Error Band



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

Pressure Error Band



Pressure	Error (Max)
20 to 250 kPa	± 3.45 (kPa)

ORDERING INFORMATION – UNIBODY PACKAGE (CASE 867)

The MPX4250A series pressure sensors are available in the basic element package or with pressure port fittings that provide mounting ease and barbed hose connections.

Device Type/Order No.	Options	Case No.	Marking
MPX4250A	Basic Element	867	MPX4250A
MPX4250AP	Ported Element	867B	MPX4250AP

ORDERING INFORMATION – SMALL OUTLINE PACKAGE (CASE 482)

The MPXA4250A series pressure sensors are available in the basic element package or with a pressure port fitting. Two packing options are offered for each type.

Device Type/Order No.	Case No.	Packing Options	Device Marking
MPXA4250A6U	482	Rails	MPXA4250A
MPXA4250A6T1	482	Tape and Reel	MPXA4250A
MPXA4250AC6U	482A	Rails	MPXA4250A
MPXA4250AC6T1	482A	Tape and Reel	MPXA4250A

INFORMATION FOR USING THE SMALL OUTLINE PACKAGE (CASE 482)

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the surface mount packages must be the correct size to ensure proper solder connection interface between the board and the package. With the correct fottprint, the packages will self align when subjected to a solder reflow process. It is always recommended to design boards with a solder mask layer to avoid bridging and shorting between solder pads.

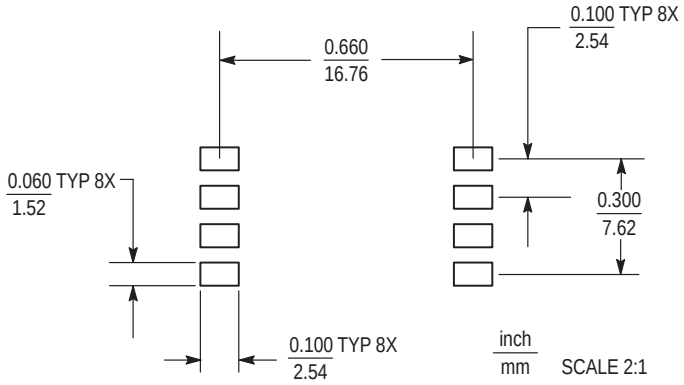


Figure 5. SOP Footprint (Case 482)