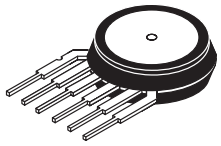
Integrated Silicon Pressure Sensor for Manifold Absolute Pressure Applications On-Chip Signal Conditioned, Temperature Compensated and Calibrated

MPX4200A SERIES

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

The Motorola MPX4200A 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 MPX4200A 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.



MPX4200A CASE 867

Features

- 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

Application Examples

- Manifold Sensing for Automotive Systems
- Ideally suited for Microprocessor or Microcontroller–Based Systems
- Also ideal for Non–Automotive Applications

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.

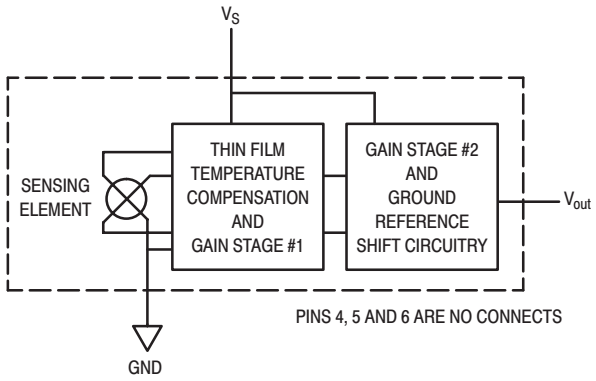


Figure 1. Fully Integrated Pressure Sensor Schematic

MAXIMUM RATINGS(NOTE)

Parametrics	Symbol	Value	Unit
Maximum Pressure (P1 > P2)	P_{max}	800	kPa
Storage Temperature	T_{stg}	–40 to +125	°C
Operating Temperature	T_A	–40 to +125	°C

NOTE: 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	—	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 Volts	(0 to 85°C)	V_{off}	0.199	0.306	0.413	Vdc
Full Scale Output(4) @ V_S = 5.1 Volts	(0 to 85°C)	V_{FSO}	4.725	4.896	4.978	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)	—	—	—	±1.5	$\%V_{FSS}$
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	—	$\%V_{FSS}$

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 Time 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

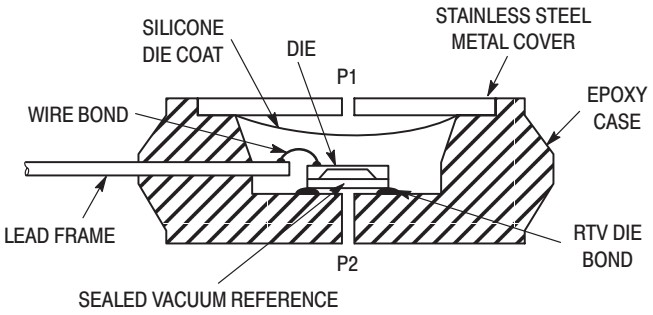


Figure 2. Cross–Sectional Diagram (Not to Scale)

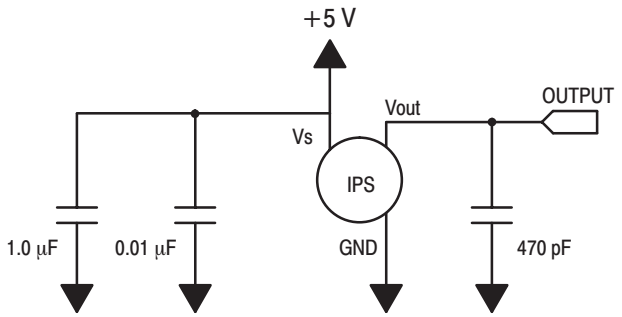


Figure 3. Recommended power supply decoupling and output filtering.
For additional output filtering, please refer to Application Note AN1646.

Figure 2 illustrates the absolute 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 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. 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.

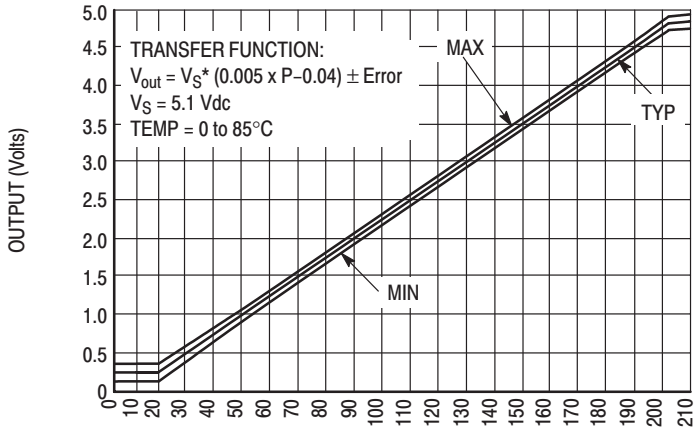


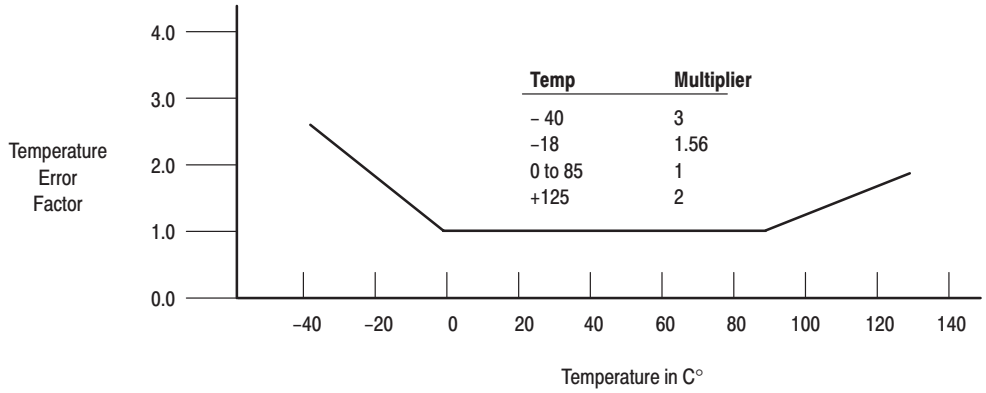
Figure 4. Output versus Absolute Pressure

Transfer Function (MPX4200A)

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

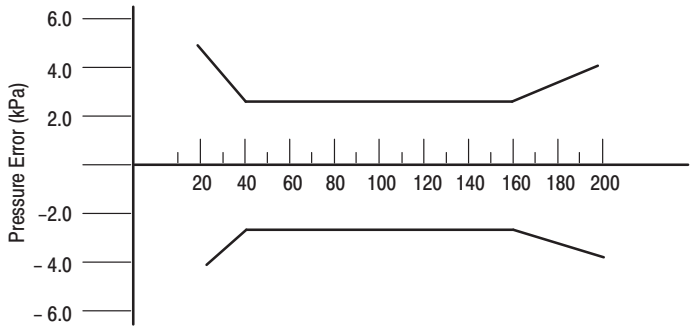
Temperature Error Band

MPX4200A Series



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

Pressure Error Band



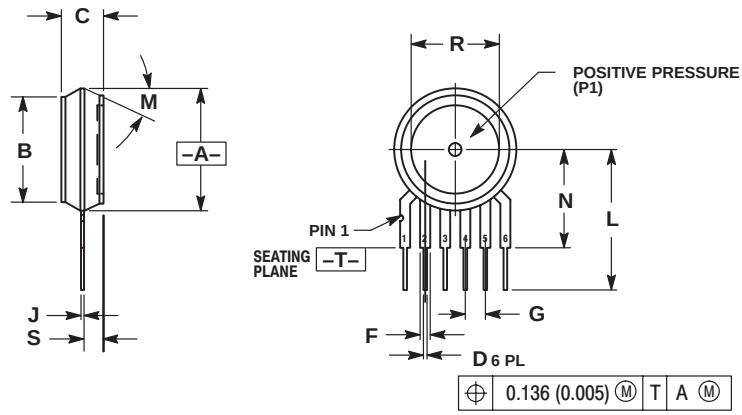
MPX4200A Series

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

Device Type	Options	Case No.	MPX Series Order No.	Marking
Basic Element	Absolute, Element	Case 867	MPX4200A	MPX4200A

PACKAGE DIMENSIONS



NOTES:
10. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
11. CONTROLLING DIMENSION: INCH.
12. 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

STYLE 2:
PIN 1. OPEN
2. GROUND
3. –VOUT
4. VSUPPLY
5. +VOUT
6. OPEN

STYLE 3:
PIN 1. OPEN
2. GROUND
3. +VOUT
4. +VSUPPLY
5. –VOUT
6. OPEN

CASE 867–08
ISSUE N

BASIC ELEMENT

NOTES

NOTES

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