Freescale Semiconductor
Technical Data

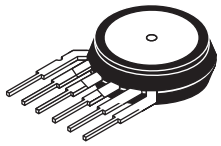
Document Number: MPX4105A
Rev 6, 07/2006

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

MPX4105A SERIES

INTEGRATED PRESSURE SENSOR 15 TO 105 kPA (2.2 TO 15.2 psi) 0.3 TO 4.9 V OUTPUT

UNIBODY PACKAGE



MPX4105A
CASE 867-08

The Freescale 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.

Freescale'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 Freescale MAP sensor a logical and economical choice for the automotive system designer.

The MPX4105A series piezoresistive transducer is a state-of-the-art, monolithic, signal conditioned, silicon pressure sensor. This sensor 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.

Features

- 1.8% Maximum Error Over 0° to 85°C
- Specifically Designed for Intake Manifold Absolute Pressure Sensing in Engine Control Systems
- Temperature Compensated Over –40 to +125°C
- Durable Epoxy Unibody Element

Typical Applications

- Manifold Sensing for Automotive Systems
- Ideally Suited for Microprocessor or Microcontroller-Based Systems
- Also Ideal for Non-Automotive Applications

ORDERING INFORMATION				
Device Type	**Options**	**Case No.**	**MPX Series Order No.**	**Device Marking**
UNIBODY PACKAGE (MPX4105A SERIES)				
Basic Element	Absolute, Element	867	MPX4105A	MPX4105A

PIN NUMBERS[1]			
1	V_{out}	4	N/C
2	GND	5	N/C
3	V_S	6	N/C

1. 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.

freescale semiconductor

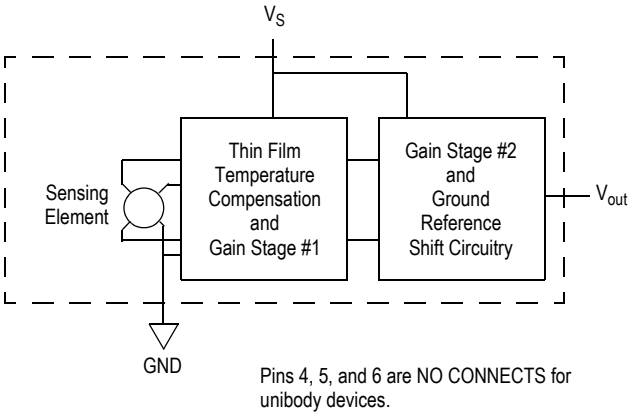


Figure 1. Fully Integrated Pressure Sensor Schematic

Table 1. Maximum Ratings(1)

Rating	Symbol	Value	Unit
Maximum Pressure (P1 > P2)	P_{MAX}	400	kPa
Storage Temperature	T_{STG}	-40 to +125	°C
Operating Temperature	T_A	-40 to +125	°C

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

Table 2. 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}	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]	(0 to 85°C)	V_{off}	0.184	0.306	0.428	Vdc
Full Scale Output[4]	(0 to 85°C)	V_{FSO}	4.804	4.896	4.988	Vdc
Full Scale Span[5]	(0 to 85°C)	V_{FSS}	—	4.590	—	Vdc
Accuracy[6]	(0 to 85°C)	—	—	—	±1.8	$\%V_{FSS}$
Sensitivity		ΔV/ΔP	—	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	—	$\%V_{FSS}$

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.

Table 3. Mechanical Characteristics

Characteristics	Typ	Unit
Weight, Basic Element (Case 867)	4.0	grams

ON-CHIP TEMPERATURE COMPENSATION AND CALIBRATION

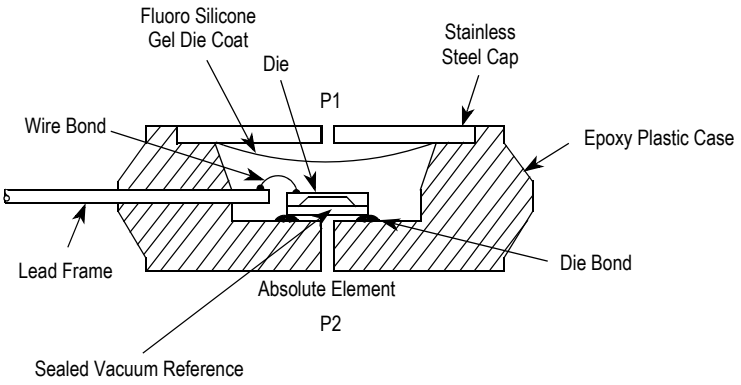


Figure 2. Cross Sectional Diagram (not to scale)

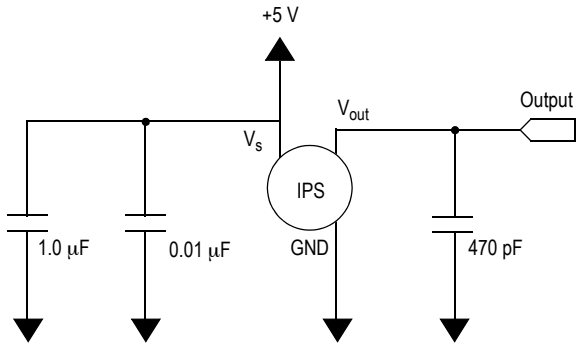


Figure 3. Recommended Power Supply Decoupling and Output Filtering

(For additional output filtering, please refer to Application Note AN1646)

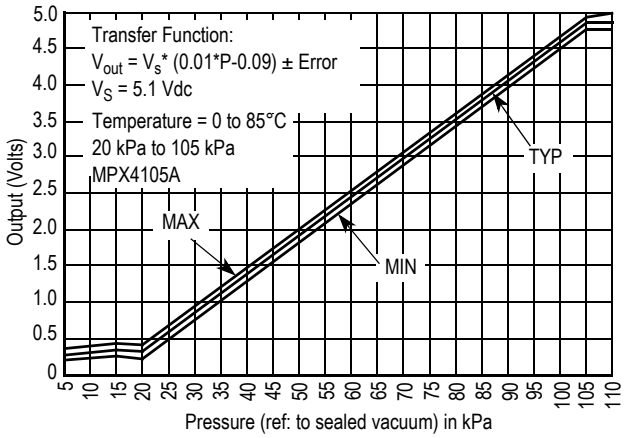


Figure 4. Output versus Absolute Pressure

Figure 2 illustrates an 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 MPX4105A 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 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.

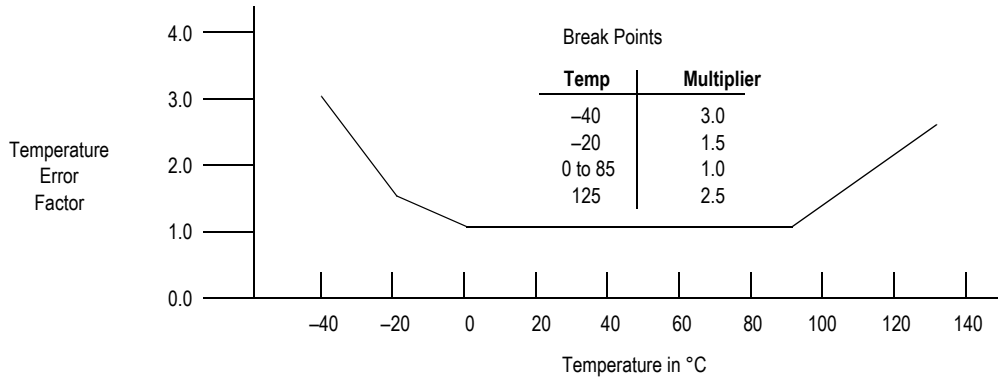
Figure 4 shows the sensor output signal relative to pressure input. Typical minimum and maximum output curves are shown for operation over a temperature range of 0° to 85°C. The output will saturate outside of the specified pressure range.

Transfer Function (MPX4105A)

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

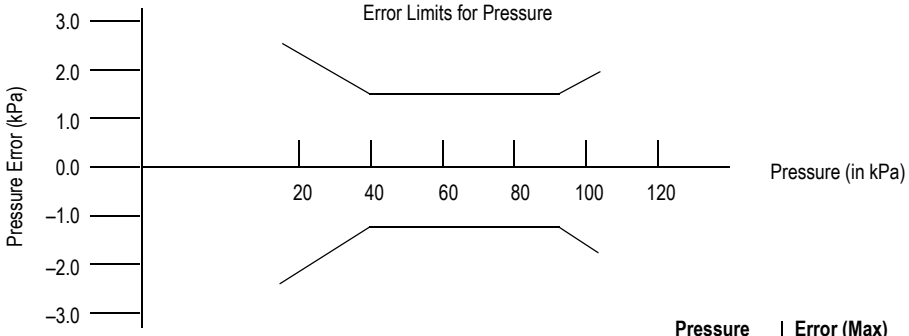
Temperature Error Band

MPX4105A Series



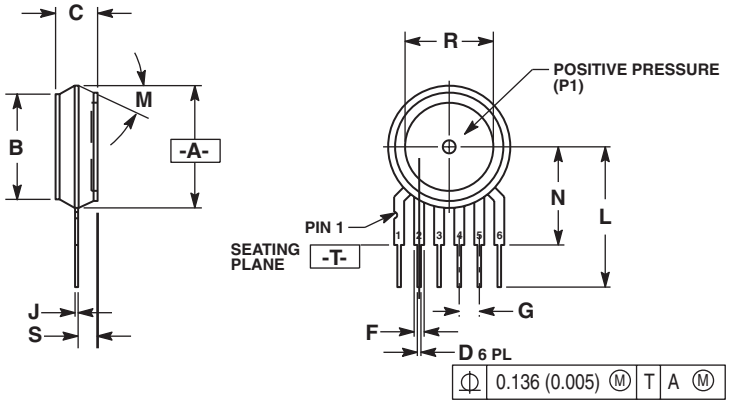
NOTE: The Temperature Multiplier is a linear response from –40°C to –20°C, –20°C to 0°C, and from 85°C to 125°C.

Pressure Error Band



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

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

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
UNIBODY PACKAGE

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