

# Integrated Silicon Pressure Sensor Altimeter/Barometer Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated

The MPX4115 series is designed to sense absolute air pressure in an altimeter or barometer (BAP) applications. Freescale's BAP 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 high reliability of on-chip integration makes the Freescale BAP sensor a logical and economical choice for application designers.

## Features

- 1.5% Maximum Error over 0° to 85°
- Ideally suited for Microprocessor or Microcontroller-Based Systems
- Available in Absolute, Differential and Gauge Configurations
- Durable Epoxy Unibody Element
- Easy-to-Use Chip Carrier Option

## Typical Applications

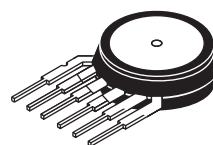
- Altimeter
- Baromete

ORDERING INFORMATION <sup>(1)</sup>				
Device	Options	Case No.	MPX Series Order No.	Marking
Basic Element	Absolute, Element Only	Case 867-08	MPX4115A	MPX4115A
Ported Elements	Absolute, Ported	Case 867B-04	MPX4115AP	MPX4115AP
	Absolute, Stove Pipe Port	Case 867E-03	MPX4115AS	MPX4115A
	Absolute, Axial Port	Case 867F-03	MPX4115ASX	MPX4115A

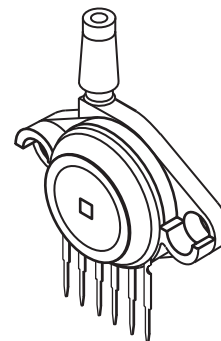
1. The MPX4115A BAP Sensor is available in the Basic Element package or with pressure port fittings that provide mounting ease and barbed hose connections.

## MPX4115 SERIES

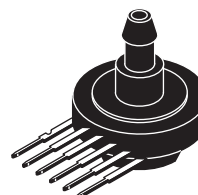
**OPERATING OVERVIEW  
 INTEGRATED  
 PRESSURE SENSOR  
 15 to 115kPa  
 (2.18 to 16.7 psi)  
 0.2 to 4.8 Volts Output**



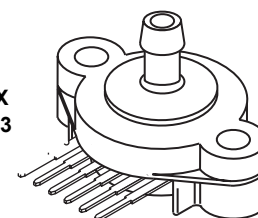
**MPX4115A  
 CASE 867-08**



**MPX4115AP  
 CASE 867B-04**



**MPX4115AS  
 CASE 867E-03**

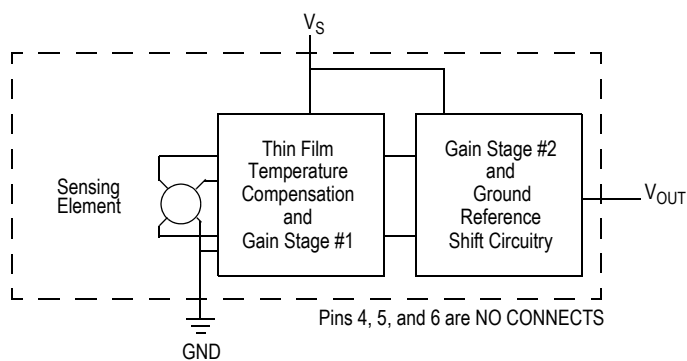


**MPX4115ASX  
 CASE 867F-03**

## PIN NUMBERS

1	V <sub>OUT</sub> <sup>(1)</sup>	4	N/C <sup>(2)</sup>
2	GND	5	N/C <sup>(2)</sup>
3	V <sub>S</sub>	6	N/C <sup>(2)</sup>

1. Pin 1 is noted by the notch in the lead.
2. Pins 4, 5, and 6 are internal device connections. Pin 1 is noted by the notch in the Lead. Do not connect to external circuitry or ground.



**Figure 1. Integrated Pressure Sensor Schematic**

**Table 1. Maximum Ratings<sup>(1)</sup>**

Parametrics	Symbol	Value	Unit
Overpressure <sup>(2)</sup> ( $P_1 > P_2$ )	$P_{max}$	400	kPa
Burst Pressure <sup>(2)</sup> ( $P_1 > P_2$ )	$P_{burst}$	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.

**Table 2. Operating Characteristics**

( $V_S = 5.1$  Vdc,  $T_A = 25^\circ\text{C}$  unless otherwise noted, P1 > P2 Decoupling circuit shown in Figure 3 required to meet electrical specifications.)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure Range <sup>(1)</sup>	$P_{OP}$	15	-	115	kPa
Supply Voltage <sup>(2)</sup>	$V_S$	4.85	5.1	5.35	Vdc
Supply Current	$I_o$	—	7.0	10	mAdc
Minimum Pressure Offset <sup>(3)</sup> @ $V_S = 5.1$ Volts	$V_{off}$	0.135	0.204	0.273	Vdc
Full Scale Output <sup>(4)</sup> @ $V_S = 5.1$ Volts	$V_{FSO}$	4.725	4.794	4.863	Vdc
Full Scale Span <sup>(5)</sup> @ $V_S = 5.1$ Volts	$V_{FSS}$	—	4.59	—	Vdc
Accuracy <sup>(6)</sup>	—	—	—	$\pm 1.5$	% $V_{FSS}$
Sensitivity	V/P	—	46	—	mV/kPa
Response Time <sup>(7)</sup>	$t_R$	—	1.0	—	ms
Output Source Current at Full Scale Output	$I_{o+}$	—	0.1	—	mAdc
Warm-Up Time <sup>(8)</sup>	—	—	20	—	mSec
Offset Stability <sup>(9)</sup>	—	—	$\pm 0.5$	—	% $V_{FSS}$

- 1.0kPa (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, using end point method, 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  $25^\circ\text{C}$ .
  - TcSpan: Output deviation over the temperature range of  $0^\circ$  to  $85^\circ\text{C}$ , relative to  $25^\circ\text{C}$ .
  - TcOffset: Output deviation with minimum pressure applied, over the temperature range of  $0^\circ$  to  $85^\circ\text{C}$ , relative to  $25^\circ\text{C}$ .
  - Variation from Nominal: The variation from nominal values, for Offset or Full Scale Span, as a percent of  $V_{FSS}$  at  $25^\circ\text{C}$ .
- 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.

**Table 3. Mechanical Characteristics**

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 867)	—	—	4.0	—	Grams
Common Mode Line Pressure <sup>(1)</sup>	—	—	—	690	kPa

- Common mode pressures beyond what is specified may result in leakage at the case-to-lead 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 MPX4115A 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 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.)

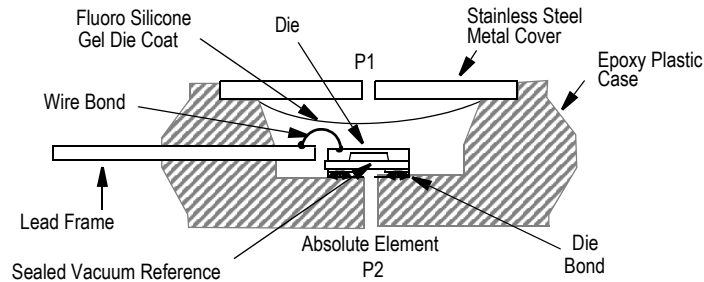


Figure 2. Cross-Sectional Diagram (Not to Scale)

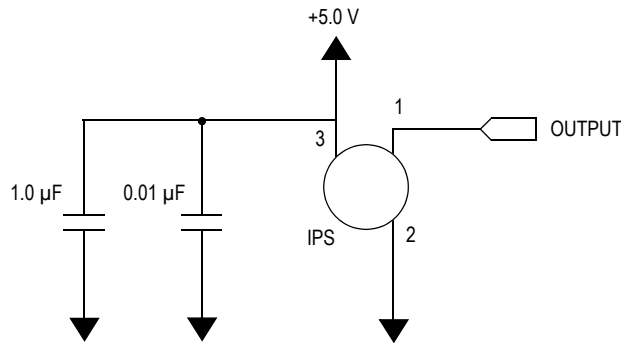


Figure 3. Recommended Power Supply Decoupling.

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

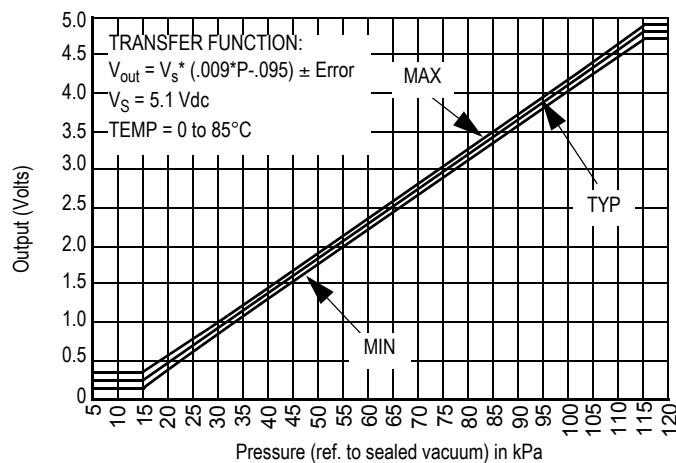


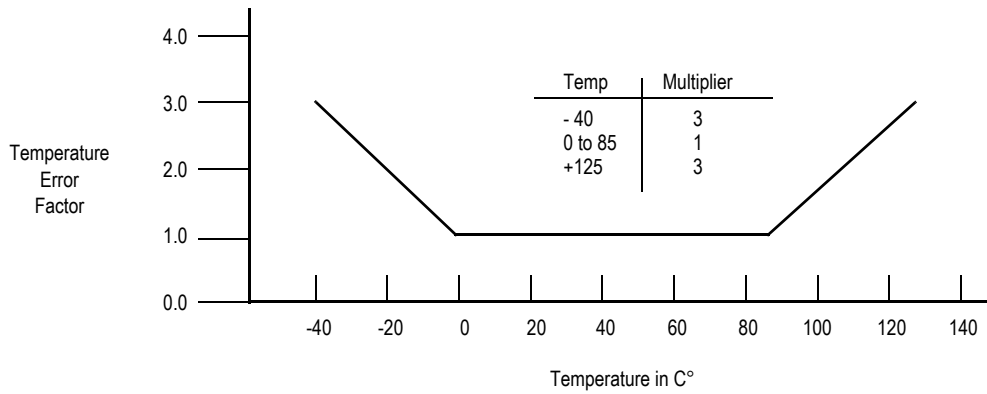
Figure 4. Output versus Absolute Pressure

### Transfer Function (MPX4115)

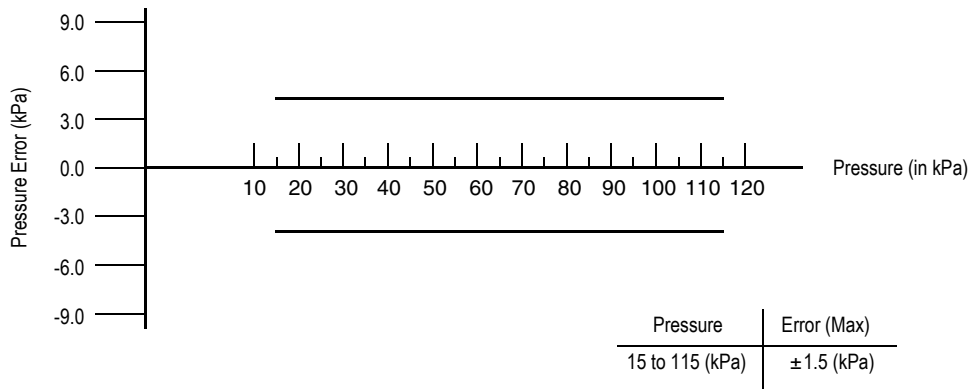
**Nominal Transfer Value:**  $V_{out} = V_S (P \times 0.009 - 0.095)$   
 $\pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.009 \times V_S)$   
 $V_S = 5.1 \text{ V} \pm 0.25 \text{ Vdc}$

### Temperature Error Band

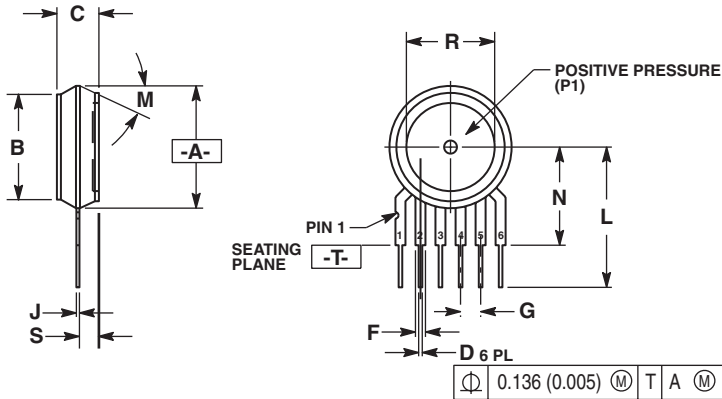
#### MPX4115A Series



### Pressure Error Band



## 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).

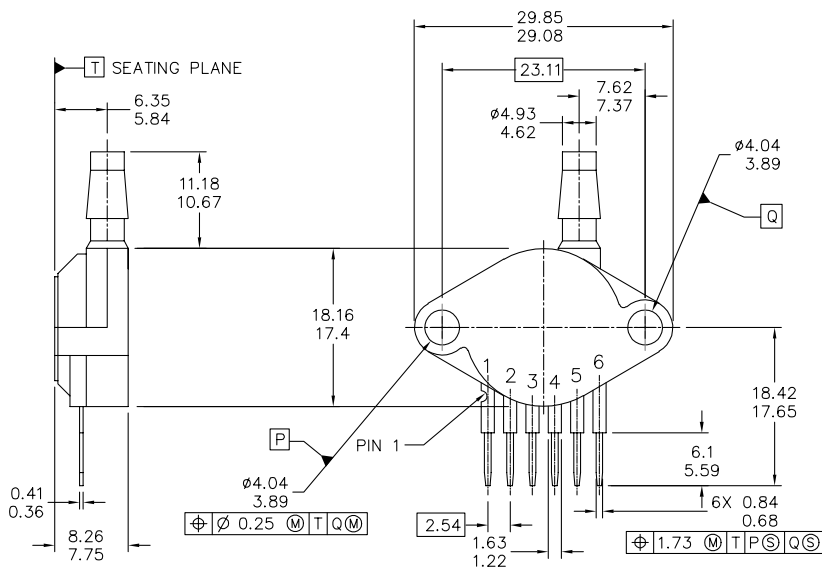
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.595	0.630	15.11	16.00
B	0.514	0.534	13.06	13.56
C	0.200	0.220	5.08	5.59
D	0.027	0.033	0.68	0.84
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.695	0.725	17.65	18.42
M	30° NOM		30° NOM	
N	0.475	0.495	12.07	12.57
R	0.430	0.450	10.92	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 (A, D)



**NOTES:**

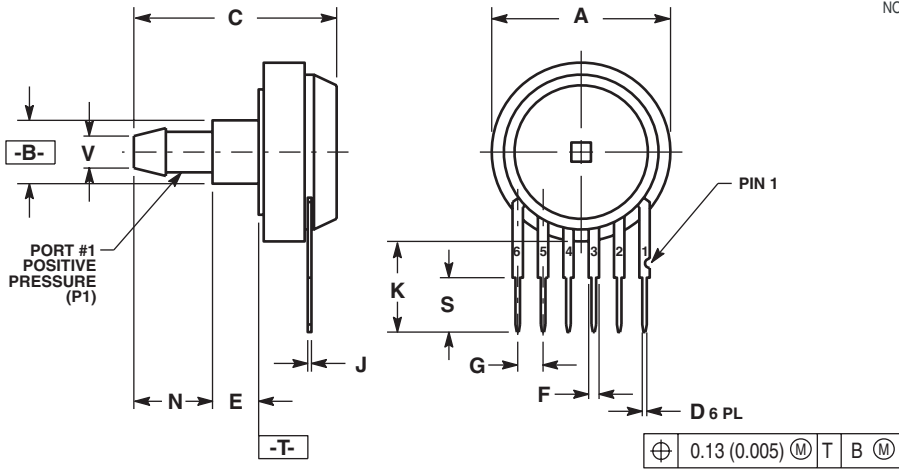
1. DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. 867B-01 THRU -3 OBSOLETE, NEW STANDARD 867B-04.

**STYLE 1:**

PIN 1: V OUT  
 2: GROUND  
 3: VCC  
 4: V1  
 5: V2  
 6: V EX

### CASE 867B-04 ISSUE G PRESSURE SIDE PORTED (AP, GP)

## PACKAGE DIMENSIONS

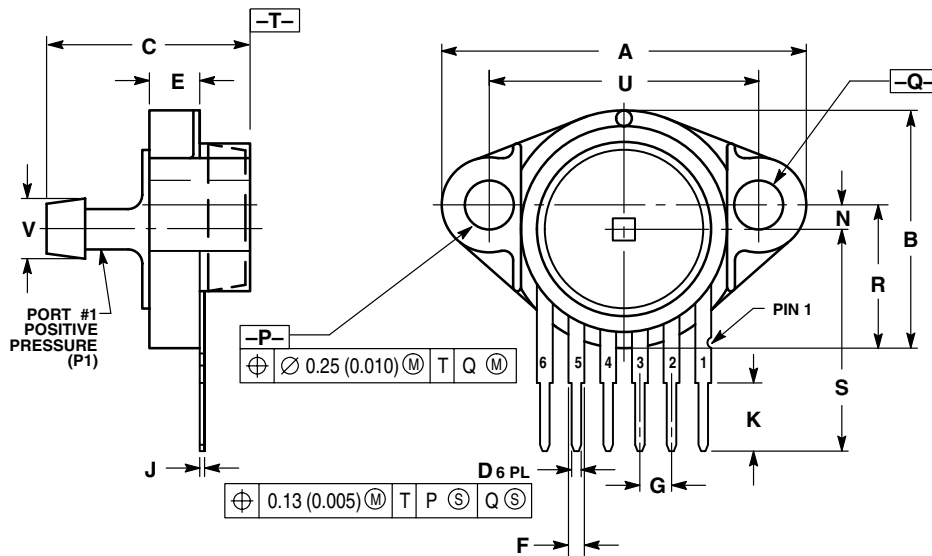


- NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.690	0.720	17.53	18.28
B	0.245	0.255	6.22	6.48
C	0.780	0.820	19.81	20.82
D	0.027	0.033	0.69	0.84
E	0.178	0.186	4.52	4.72
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.41
K	0.345	0.375	8.76	9.53
N	0.300	0.310	7.62	7.87
S	0.220	0.240	5.59	6.10
V	0.182	0.194	4.62	4.93

- STYLE 1:  
 PIN 1.  $V_{OUT}$   
 2. GROUND  
 3.  $V_{CC}$   
 4.  $V_1$   
 5.  $V_2$   
 6.  $V_{EX}$

### CASE 867E-03 ISSUE D PRESSURE SIDE PORTED (AS, GS)



- NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.080	1.120	27.43	28.45
B	0.740	0.760	18.80	19.30
C	0.630	0.650	16.00	16.51
D	0.027	0.033	0.68	0.84
E	0.160	0.180	4.06	4.57
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.41
K	0.220	0.240	5.59	6.10
N	0.070	0.080	1.78	2.03
P	0.150	0.160	3.81	4.06
Q	0.150	0.160	3.81	4.06
R	0.440	0.460	11.18	11.68
S	0.695	0.725	17.65	18.42
U	0.840	0.860	21.34	21.84
V	0.182	0.194	4.62	4.93

- STYLE 1:  
 PIN 1.  $V_{OUT}$   
 2. GROUND  
 3.  $V_{CC}$   
 4.  $V_1$   
 5.  $V_2$   
 6.  $V_{EX}$

### CASE 867F-03 ISSUE D PRESSURE SIDE PORTED (ASX, GSX)

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