15 to 115 kPa Altimeter/Barometer Pressure Sensor, On-Chip Signal Conditioned, 0.2 V to 4.8 V Output, Temperature Compensated & Calibrated

MPX4115 SERIES

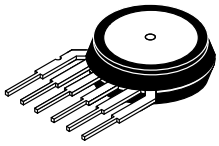
X–ducer™ SILICON PRESSURE SENSOR

The Motorola MPX4115A series sensor is designed to sense absolute air pressure in altimeter or barometer (BAP) applications.

Motorola'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 make the Motorola BAP sensor a logical and economical choice.

Features

- 1.5% Maximum Error Over 0–85°C
- Easy–to–Use Chip Carrier Options
- Ideally suited for direct Microprocessor Interfacing
- Patented Silicon Shear Stress Strain Gauge
- Temperature Compensated Over – 40 to +125°C
- Durable Epoxy Unibody Element
- Ideal for Non–Automotive Applications, Too



CASE 867–04
Style 1

MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Overpressure(7) (P1 > P2)	P_{max}	400	kPa
Burst Pressure(7) (P1 > P2)	P_{burst}	1000	kPa
Storage Temperature	T_{stg}	–50 to +150	°C
Operating Temperature	T_A	–40 to +125	°C

Pin Number					
1	2	3	4	5	6
V_{out}	Ground	V_S	N/C	N/C	N/C

NOTE: Pins 4, 5 and 6 are internal device connections. Do not connect to external circuitry or ground.

The MPX4115A series piezoresistive transducer is a state–of–the–art, silicon pressure sensor. The sensor provides an accurate, high level analog signal that is proportional to applied pressure. A vacuum is sealed behind the sensor diaphragm providing a reliable pressure reference. (See Figure 2.)

Figure 1 shows a block diagram of the internal circuitry integrated calibration and signal conditioning.

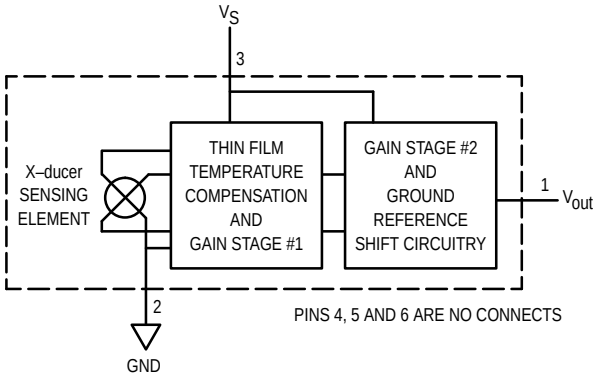


Figure 1. Fully Integrated Pressure Sensor Schematic

X–ducer is a trademark of Motorola, Inc.

MPX 4115A SERIES OPERATING CHARACTERISTICS (V_S = 5.1 Vdc, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range		P_{OP}	15	—	115	kPa
Supply Voltage (1)		V_S	4.85	5.1	5.35	Vdc
Supply Current		I_o	—	7.0	10	mAdc
Full Scale Span (2)	(0 to 85°C)	V_{FSS}	4.521	4.59	4.659	V
Sensitivity		$\Delta V/\Delta P$	—	45.9	—	mV/kPa
Offset (3)	(0 to 85°C)	V_{off}	0.135	0.204	0.275	V
Accuracy (4)	(0 to 85°C)	—	—	—	±1.5	$\%V_{FSS}$
Response Time (5)		t_R	—	1.0	—	ms
Output Source Current at Full Scale Output		I_{ot}	—	0.1	—	mA

MECHANICAL CHARACTERISTICS

Characteristics	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 867)	—	—	4.0	—	Grams
Warm–Up Time	—	—	15	—	ms
Cavity Volume	—	—	—	0.01	IN^3
Volumetric Displacement	—	—	—	0.001	IN^3
Common Mode Line Pressure (6)	—	—	—	690	kPa

NOTES:

1. Device is ratiometric within this specified excitation range.
2. 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.
3. Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
4. 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.
   - Offset Stability: Output deviation, after 1000 temperature cycles, – 40 to 125°C, and 1.5 million pressure cycles, with minimum rated pressure applied.
   - 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.
5. 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.
6. Common mode pressures beyond specified may result in leakage at the case–to–lead interface.
7. Exposure beyond these limits may cause permanent damage or degradation to the device.

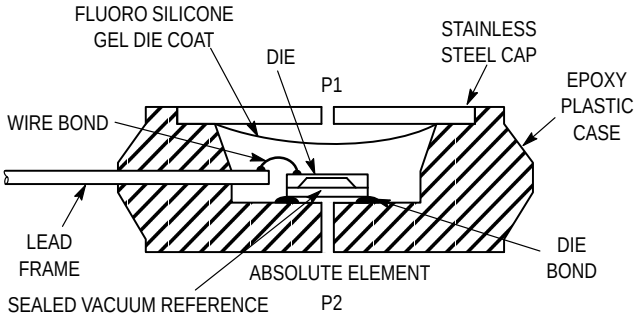


Figure 2. Cross–Sectional Diagram (Not to Scale)

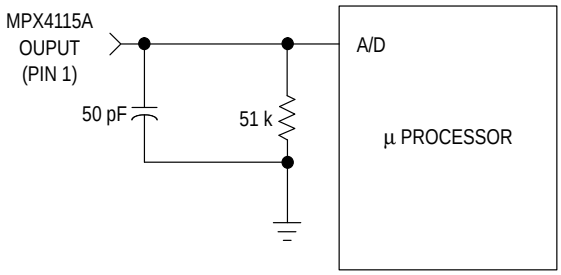


Figure 3. Typical Decoupling Filter for Sensor to Microprocessor Interface

Figure 2 illustrates the absolute sensing chip in the basic chip carrier (Case 867). A fluoro silicone gel isolates the die surface and wire bonds from harsh environments, 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 3 shows a typical decoupling circuit for interfacing the output of the integrated map sensor to the A/D input of a microprocessor.

Figure 4 shows the sensor output signal relative to pressure input. Typical minimum and maximum output curves are shown for operation over 0 to 85°C temperature range. (Output may be nonlinear outside of the rated pressure range.)

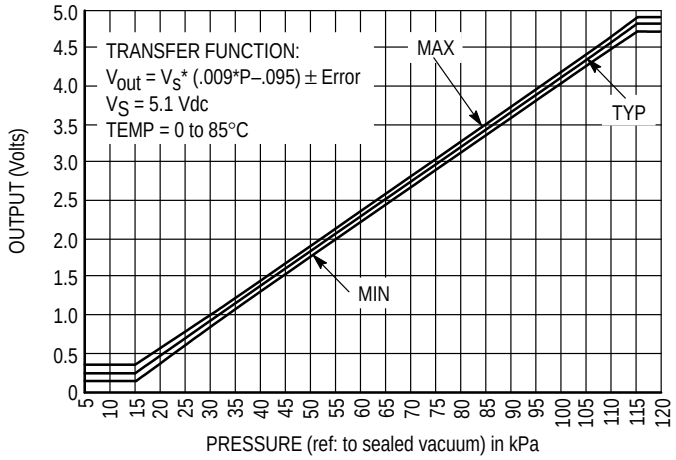


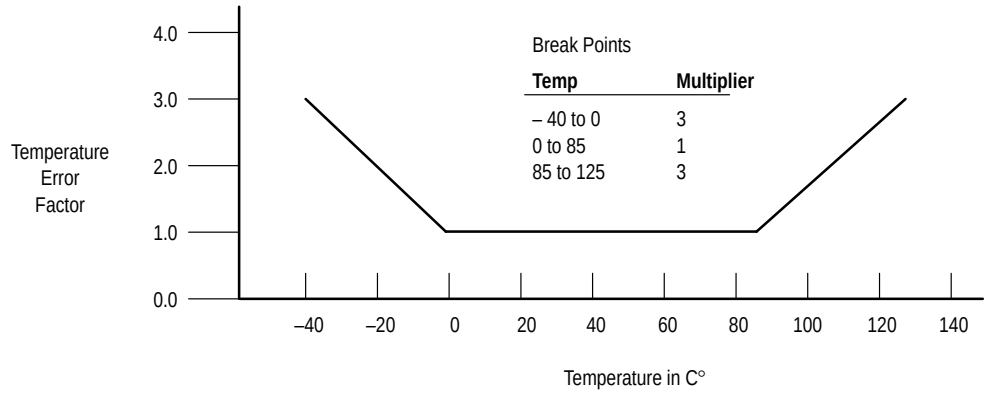
Figure 4. Output versus Absolute Pressure

Transfer Function

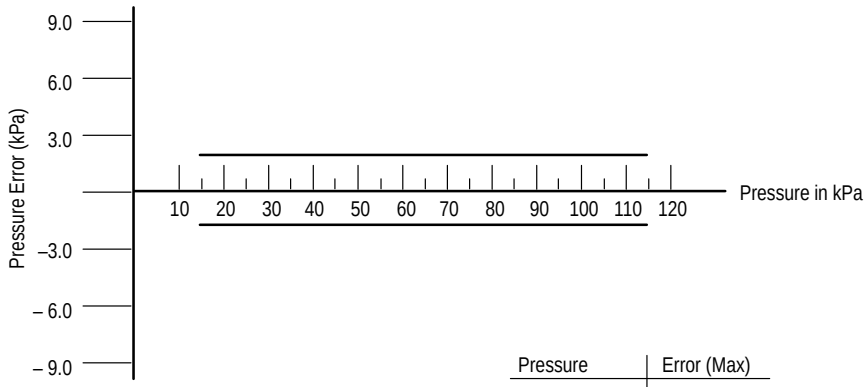
Nominal Transfer Value: $V_{out} = V_S (P \times 0.009 - 0.095)$
$+/- (\text{Pressure Error} \times \text{Temp. Factor} \times 0.009 \times V_S)$
$V_S = 5.1\ V \pm 0.25\ Vdc$

Temperature Error Band

MPX4115A Series



Pressure Error Band



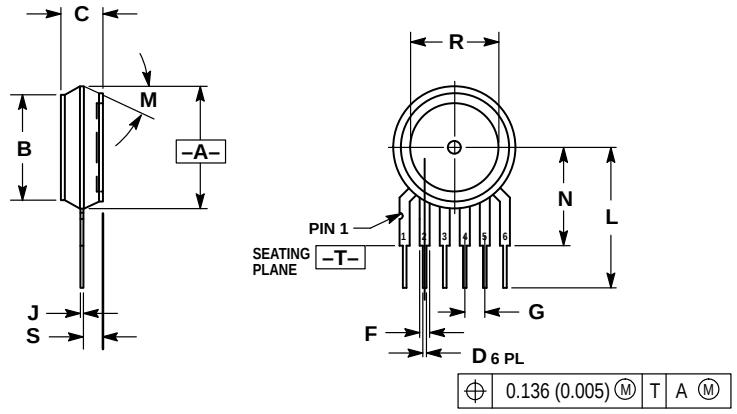
Pressure	Error (Max)
15 to 115 kPa	± 1.5 kPa

Ordering Information

The MPX4115A BAP Sensor is 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 Only	Case 867–04	MPX4115A	MPX4115A
Ported Elements	Absolute, Ported	Case 867B–03	MPX4115AP	MPX4115AP
	Absolute, Stove Pipe Port	Case 867E–02	MPX4115AS	MPX4115A
	Absolute, Axial Port	Case 867F–02	MPX4115ASX	MPX4115A

PACKAGE DIMENSIONS



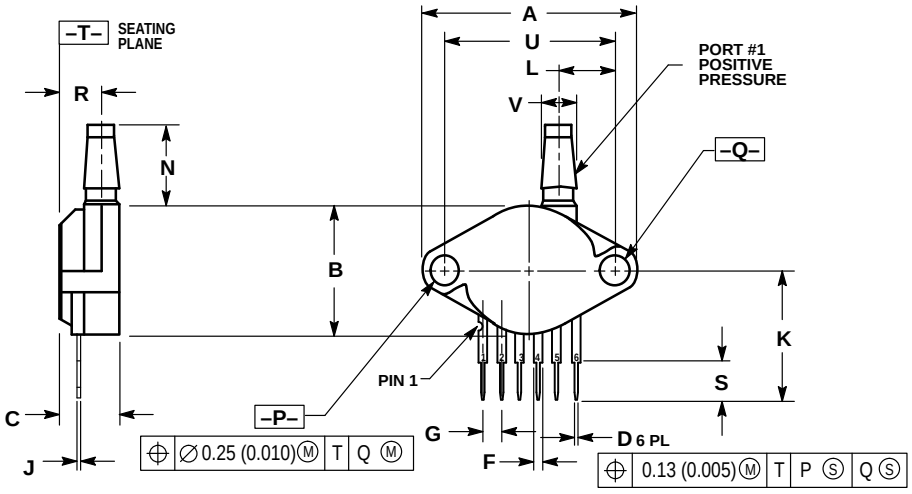
NOTES:
8. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
9. CONTROLLING DIMENSION: INCH.
10. DIMENSION –A– DOES NOT INCLUDE MOLDED FLASH RING. MOLDED FLASH RING NOT TO EXCEED 16.00 (0.630).

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.590	0.615	14.99	15.62
B	0.505	0.525	12.83	13.34
C	0.195	0.225	4.95	5.72
D	0.027	0.033	0.68	0.84
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.685	0.715	17.40	18.16
M	30 ° NOM		30 ° NOM	
N	0.490	0.510	12.45	12.95
R	0.420	0.450	10.67	11.43
S	0.090	0.105	2.29	2.66

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867–04
ISSUE H

BASIC ELEMENT (A, D)



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

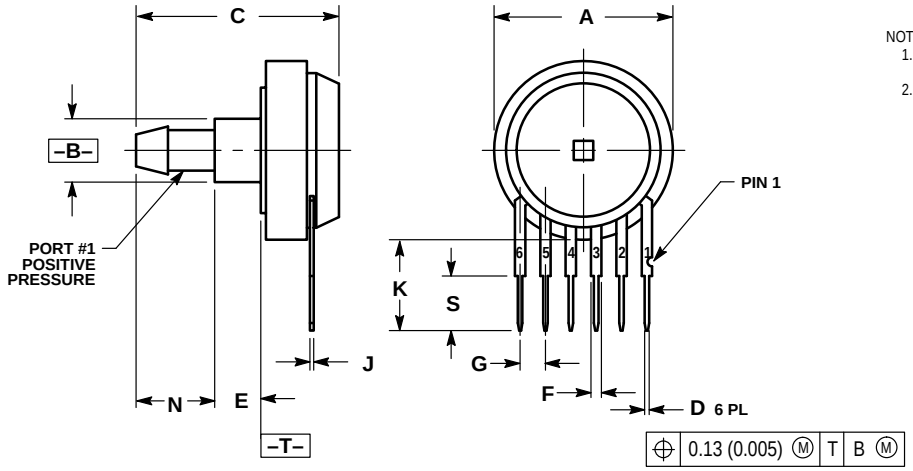
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.140	1.180	28.95	29.97
B	0.685	0.715	17.40	18.16
C	0.310	0.325	7.87	8.26
D	0.027	0.033	0.68	0.84
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.41
K	0.680	0.710	17.27	18.03
L	0.290	0.300	7.34	7.62
N	0.420	0.440	10.67	11.12
P	0.153	0.159	3.89	4.03
Q	0.153	0.159	3.89	4.03
R	0.231	0.250	5.87	6.35
S	0.230 REF		5.84 REF	
U	0.910 BSC		23.11 BSC	
V	0.182	0.194	4.62	4.93

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867B–03
ISSUE C

PRESSURE SIDE PORTED (AP, GP)

PACKAGE DIMENSIONS—CONTINUED



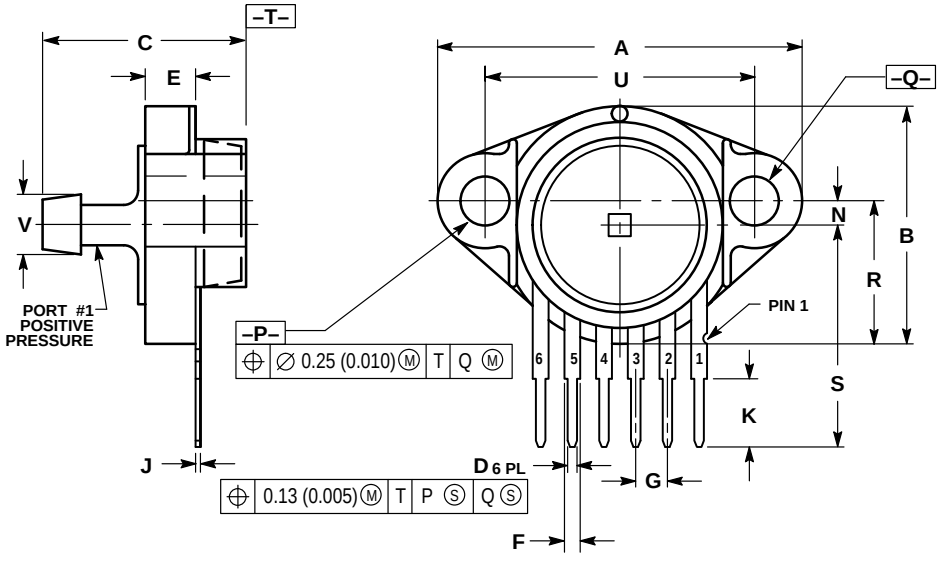
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.690	0.720	17.53	18.28
B	0.247	0.253	6.28	6.42
C	0.780	0.820	19.81	20.82
D	0.027	0.033	0.68	0.84
E	0.178	0.185	4.52	4.69
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.335	0.360	8.51	9.14
N	0.350	0.315	7.75	8.00
S	0.220	0.240	5.59	6.10

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867E–02
ISSUE B

PRESSURE SIDE PORTED (AS, GS)



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

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.075	1.130	27.30	28.70
B	0.740	0.760	18.80	19.30
C	0.635	0.670	16.13	17.02
D	0.027	0.033	0.68	0.84
E	0.160	0.180	4.06	4.57
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.230 REF		5.84 REF	
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	0.445	0.460	11.30	11.68
S	0.685	0.715	17.40	18.16
U	0.840	0.860	21.33	21.84
V	0.185	0.195	4.69	4.95

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867F–02
ISSUE B

PRESSURE SIDE PORTED (ASX, GSX)

Literature Distribution Centers:
USA: Motorola Literature Distribution; P.O. Box 20912; Phoenix, Arizona 85036.
EUROPE: Motorola Ltd.; European Literature Centre; 88 Tanners Drive, Blakelands, Milton Keynes, MK14 5BP, England.
JAPAN: Nippon Motorola Ltd.; 4–32–1, Nishi–Gotanda, Shinagawa–ku, Tokyo 141, Japan.
ASIA PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbour Center, No. 2 Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong.