

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

The Motorola MPX4115A/MPXA4115A series Manifold Absolute Pressure (MAP) sensor for engine control is designed to sense absolute air pressure.

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

Features

- 1.5% Maximum Error over 0° to 85°C
- Ideally suited for Microprocessor or Microcontroller-Based Systems
- Temperature Compensated from -40° to +125°C
- Durable Epoxy Unibody Element or Surface Mount Package

Application Examples

- Aviation Altimeters
- Industrial Controls
- Engine Control
- Weather Stations and Weather Reporting Devices

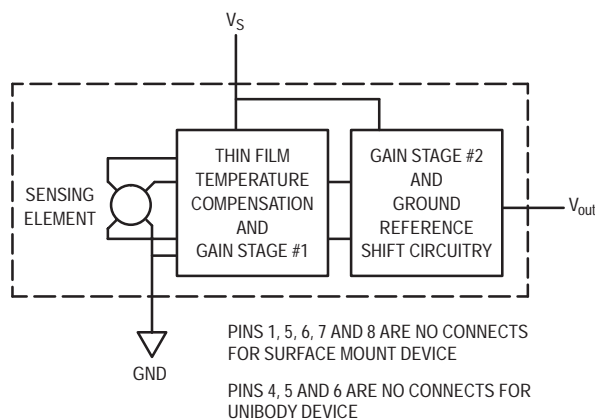
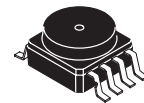


Figure 1. Fully Integrated Pressure Sensor Schematic

MPX4115A MPXA4115A SERIES

OPERATING OVERVIEW
INTEGRATED
PRESSURE SENSOR
15 to 115 kPa (2.2 to 16.7 psi)
0.2 to 4.8 Volts Output

SMALL OUTLINE PACKAGE



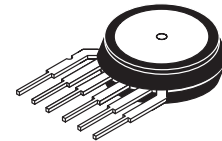
MPXA4115A
CASE 482-01

PIN NUMBER

1	N/C	3	Gnd	5	N/C	7	N/C
2	V _S	4	V _{out}	6	N/C	8	N/C

NOTE: Pins 1, 5, 6, 7, and 8 are internal device connections. Do not connect to external circuitry or ground.

UNIBODY PACKAGE



MPX4115A
BASIC CHIP CARRIER ELEMENT
CASE 867-08, STYLE 1

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.

The MPX4115A/MPXA4115A 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.



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MAXIMUM RATINGS⁽¹⁾

Parametrics	Symbol	Value	Units
Overpressure ⁽⁹⁾ (P1 > P2)	P_{max}	400	kPa
Burst Pressure ⁽⁹⁾ (P1 > P2)	P_{burst}	1000	kPa
Storage Temperature	T_{stg}	-40° to +125°	°C
Operating Temperature	T_A	-40° to +125°	°C

- $T_C = 25^\circ\text{C}$ unless otherwise noted.
- Exposure beyond the specified limits may cause permanent damage or degradation to the device.

OPERATING CHARACTERISTICS ($V_S = 5.1\text{ Vdc}$, $T_A = 25^\circ\text{C}$ 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
Minimum Pressure Offset ⁽²⁾ @ $V_S = 5.1\text{ Volts}$	V_{off}	0.135	0.204	0.273	Vdc
Full Scale Output ⁽³⁾ @ $V_S = 5.1\text{ Volts}$	V_{FSO}	4.725	4.794	4.863	Vdc
Full Scale Span ⁽⁴⁾ @ $V_S = 5.1\text{ Volts}$	V_{FSS}	4.521	4.590	4.659	Vdc
Accuracy ⁽⁵⁾	—	—	—	±1.5	% V_{FSS}
Sensitivity	V/P	—	45.9	—	mV/kPa
Response Time ⁽⁶⁾	t_R	—	1.0	—	mS
Output Source Current at Full Scale Output	I_{o+}	—	0.1	—	mAdc
Warm-Up Time ⁽⁷⁾	—	—	20	—	mSec
Offset Stability ⁽⁸⁾	—	—	±0.5	—	% V_{FSS}

Decoupling circuit shown in Figure 2 required to meet Electrical Specifications.

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 867)	—	—	4.0	—	Grams

NOTES:

- 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 is the deviation in actual output from nominal output over the entire pressure range and temperature range as a percent of span at 25°C due to all sources of error including 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 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 pressure applied, over the temperature range of 0° to 85°C , relative to 25°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 cycles of Pulsed Pressure, Temperature Cycling with Bias Test.
- Exposure beyond these limits may cause permanent damage or degradation to the device.

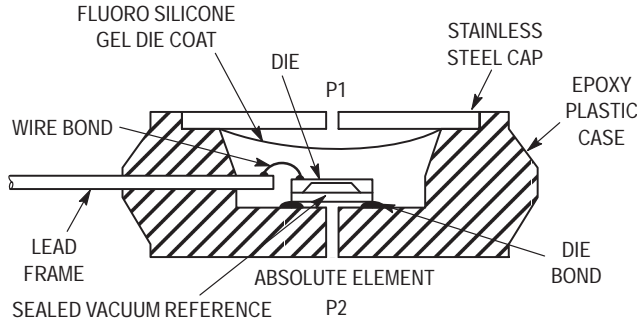


Figure 2. Cross Sectional Diagram (not to scale)

Figure 2 illustrates the absolute sensing chip in the basic chip carrier (Case 867).

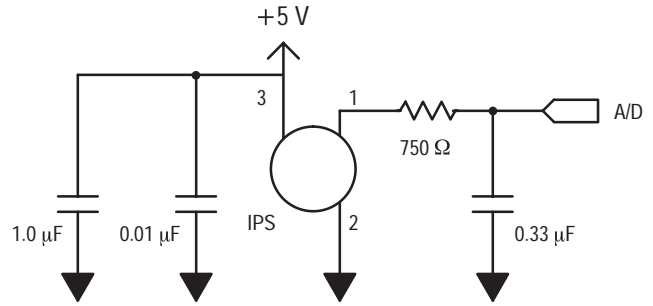


Figure 3. Recommended power supply decoupling and output filtering. Please refer to Application Note AN1646.

Figure 3 shows the recommended decoupling circuit for interfacing the output of the integrated BAP sensor to the A/D input of a microprocessor.

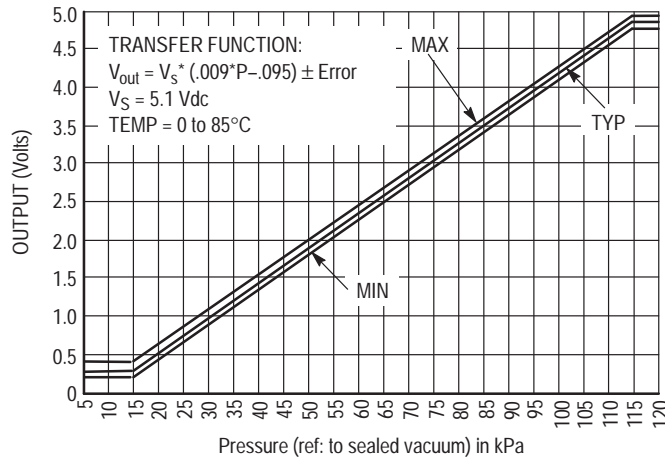


Figure 4. Output versus Absolute Pressure

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 will saturate outside of the rated pressure range.)

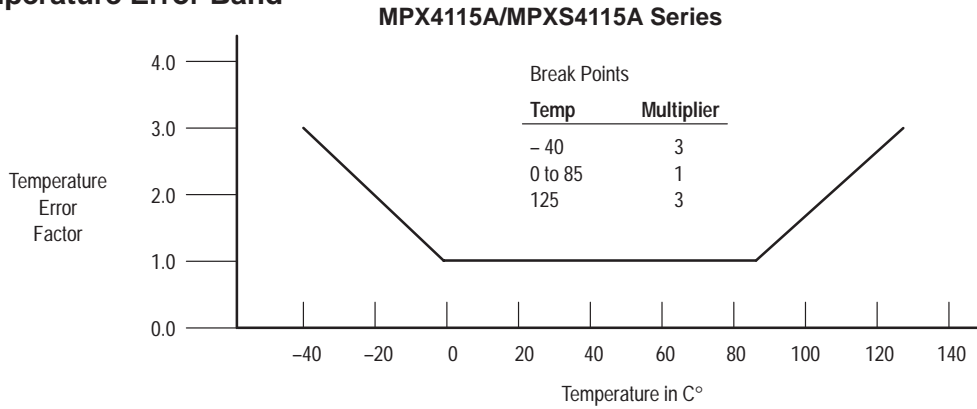
A fluorosilicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm. The

MPX4115A/MPXA4115A 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.

Transfer Function (MPX4115A, MPXA4115A)

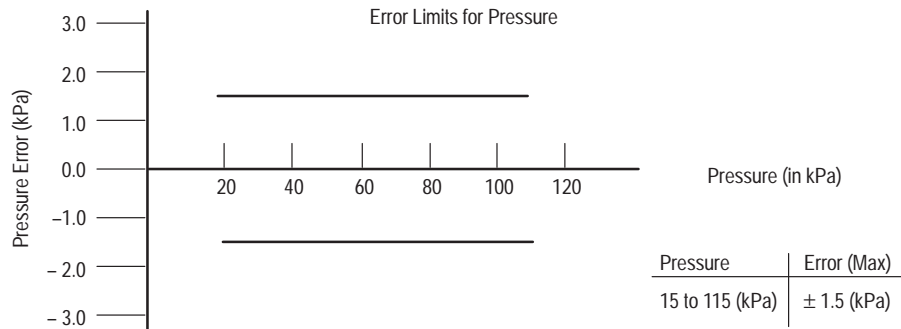
Nominal Transfer Value: $V_{out} = V_S \times (0.009 \times P - 0.095)$
 $\pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.009 \times V_S)$
 $V_S = 5.1 \pm 0.25 \text{ Vdc}$

Temperature Error Band



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

Pressure Error Band



ORDERING INFORMATION — UNIBODY PACKAGE

Device Type	Options	Case No.	MPX Series Order No.	Marking
Basic Element	Absolute, Element Only	867-08	MPX4115A	MPX4115A
Ported Elements	Absolute, Ported	867B-04	MPX4115AP	MPX4115AP
	Absolute, Stove Pipe Port	867E-03	MPX4115AS	MPX4115A
	Absolute, Axial Port	867F-03	MPX4115ASX	MPX4115A

ORDERING INFORMATION — SMALL OUTLINE PACKAGE

Device	Case No.	Packing Options	Marking
MPXA4115A6U	482-01	Rails	MPXA4115A
MPXA4115AC6U	482A-01	Rails	MPXA4115A
MPXA4115A6T1	482-01	Tape and Reel	MPXA4115A

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

footprint, 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.

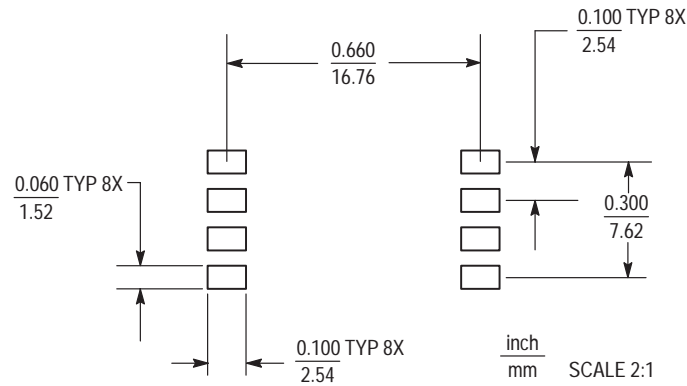


Figure 5. SOP Footprint (Case 482)

SMALL OUTLINE PACKAGE DIMENSIONS

D 8 PL
 $\oplus 0.25 (0.010) \text{ (M) T B (S) A (S)}$

NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
 4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
 5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.415	0.425	10.54	10.79
B	0.415	0.425	10.54	10.79
C	0.212	0.230	5.38	5.84
D	0.038	0.042	0.96	1.07
G	0.100 BSC		2.54 BSC	
H	0.002	0.010	0.05	0.25
J	0.009	0.011	0.23	0.28
K	0.061	0.071	1.55	1.80
M	0°	7°	0°	7°
N	0.405	0.415	10.29	10.54
S	0.709	0.725	18.01	18.41

**CASE 482-01
ISSUE O**

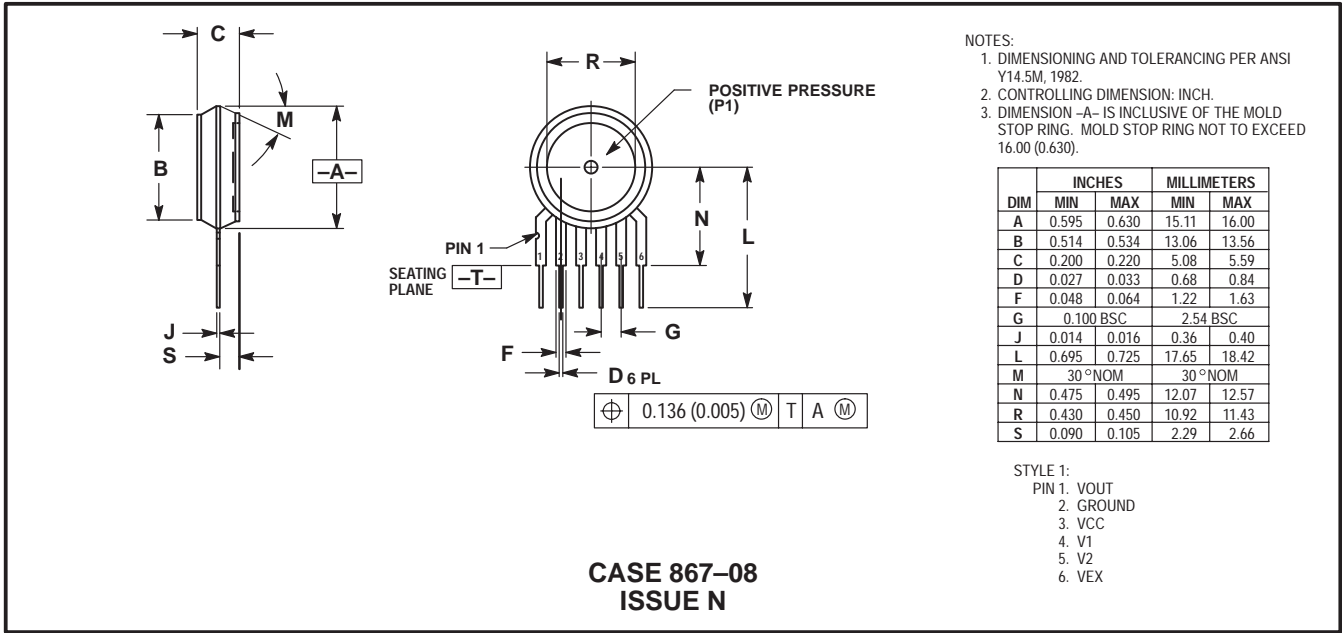
D 8 PL
 $\oplus 0.25 (0.010) \text{ (M) T B (S) A (S)}$

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 4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
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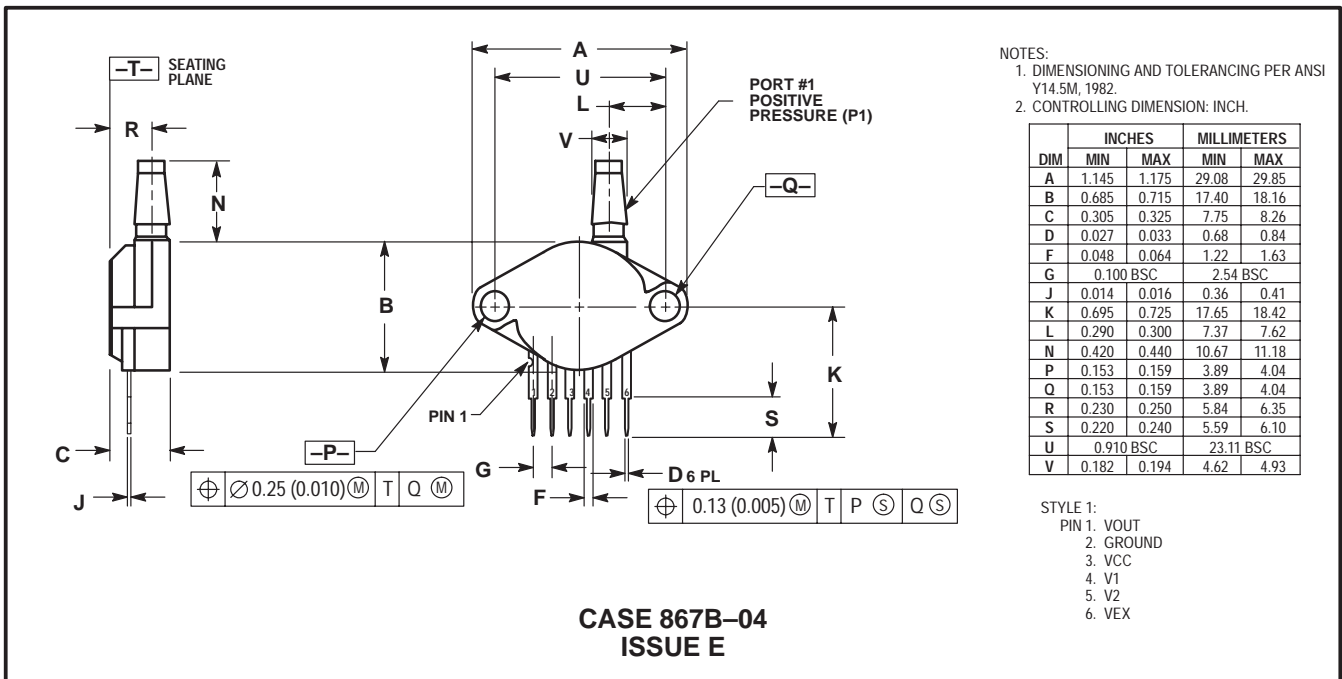
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.415	0.425	10.54	10.79
B	0.415	0.425	10.54	10.79
C	0.500	0.520	12.70	13.21
D	0.038	0.042	0.96	1.07
G	0.100 BSC		2.54 BSC	
H	0.002	0.010	0.05	0.25
J	0.009	0.011	0.23	0.28
K	0.061	0.071	1.55	1.80
M	0°	7°	0°	7°
N	0.444	0.448	11.28	11.38
S	0.709	0.725	18.01	18.41
V	0.245	0.255	6.22	6.48
W	0.115	0.125	2.92	3.17

**CASE 482A-01
ISSUE A**

UNIBODY PACKAGE DIMENSIONS

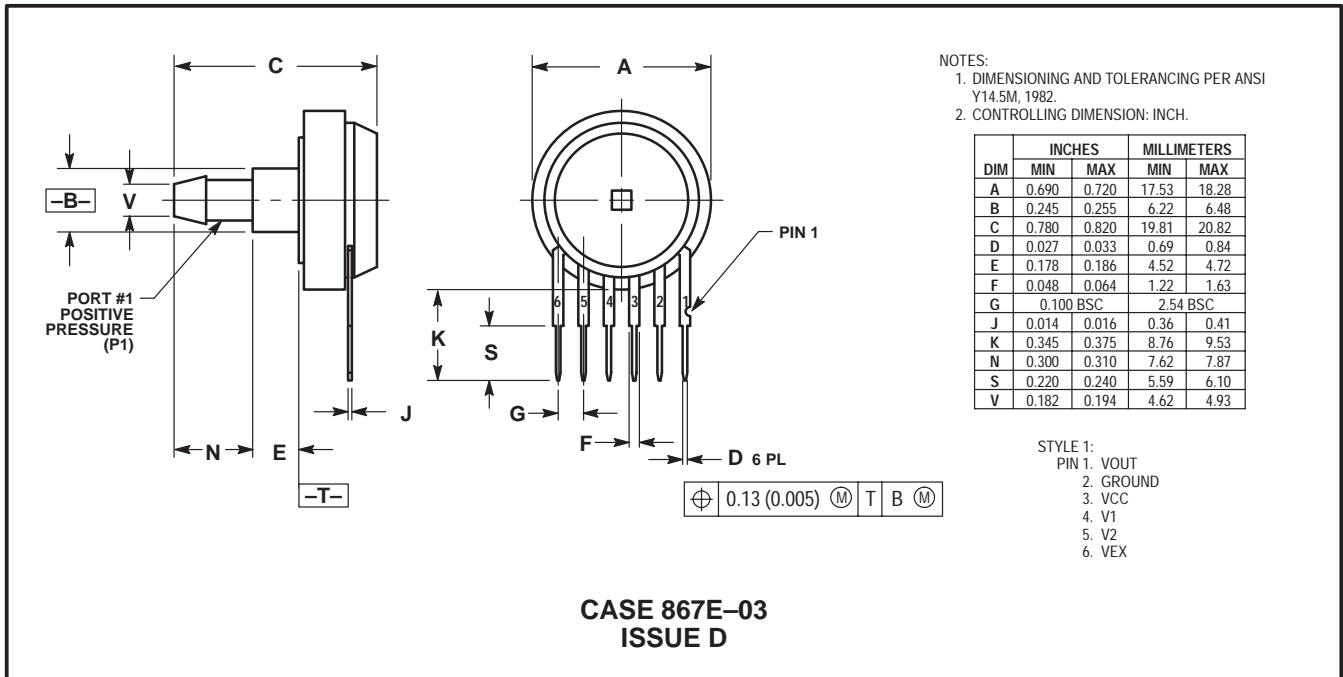


BASIC ELEMENT (A, D)

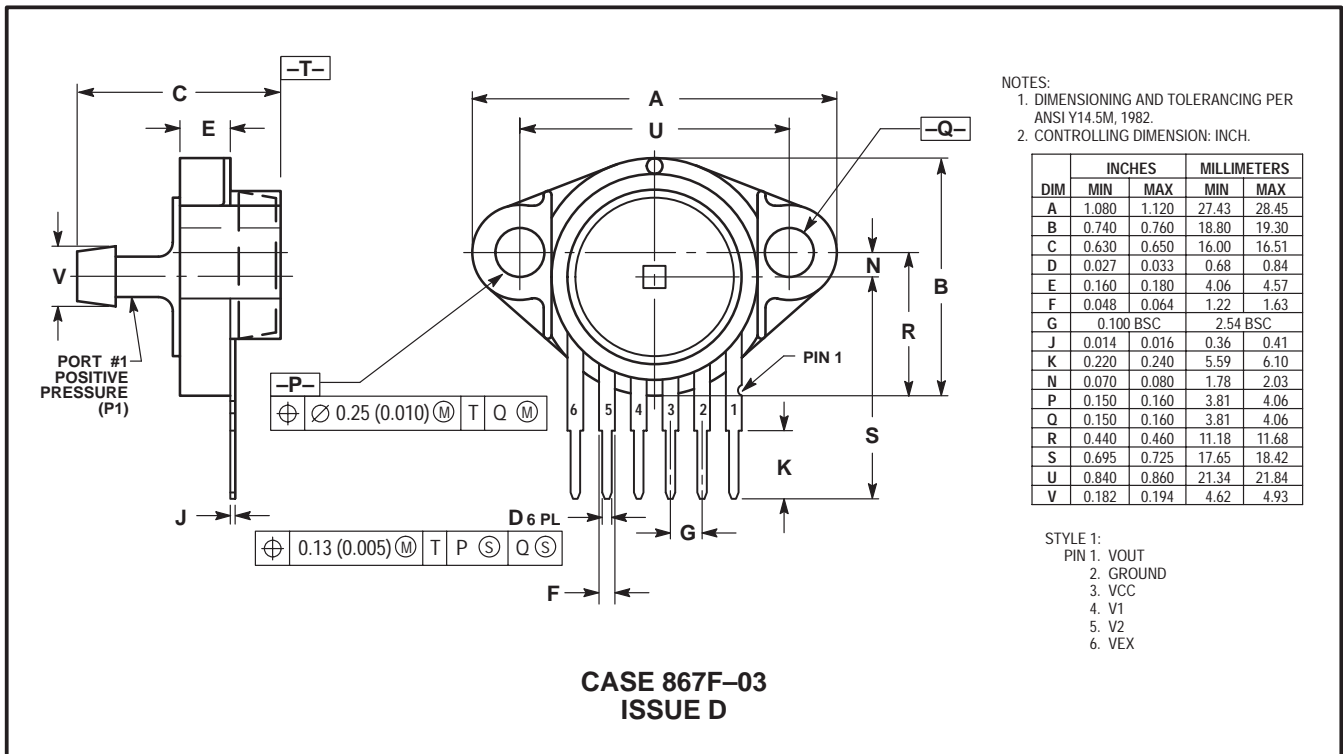


PRESSURE SIDE PORTED (AP, GP)

UNIBODY PACKAGE DIMENSIONS—CONTINUED



PRESSURE SIDE PORTED (AS, GS)




PRESSURE SIDE PORTED (ASX, GSX)

NOTES

NOTES

NOTES

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