



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. 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 makes the Motorola BAP sensor a logical and economical choice for application designers.

Features

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

Application Examples

- Altimeter
- Barometer

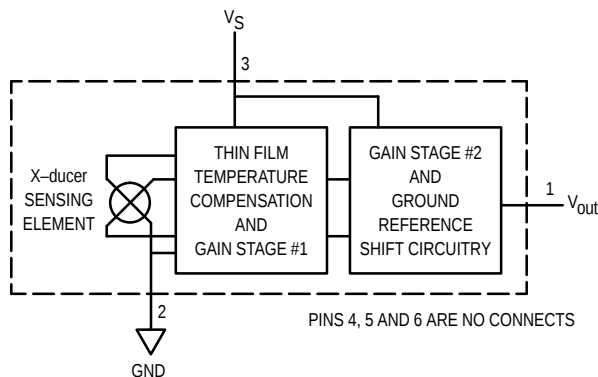
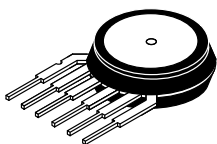


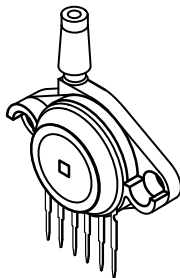
Figure 1. Fully Integrated Pressure Sensor Schematic

MPX4115  
SERIES

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



BASIC CHIP CARRIER  
ELEMENT  
CASE 867-08, STYLE 1



PORT OPTION  
CASE 867B-04, STYLE 1

NOTE: Pin 1 is the notched pin.

| PIN NUMBER |                  |   |     |
|------------|------------------|---|-----|
| 1          | V <sub>out</sub> | 4 | N/C |
| 2          | Grd              | 5 | N/C |
| 3          | V <sub>S</sub>   | 6 | N/C |

NOTE: 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.

Senseon and X-ducer are trademarks of Motorola, Inc.

REV 3

## MPX4115 SERIES

### MAXIMUM RATINGS(1)

| Parametrics                 | Symbol             | Value         | Unit |
|-----------------------------|--------------------|---------------|------|
| Overpressure(2) (P1 > P2)   | P <sub>max</sub>   | 400           | kPa  |
| Burst Pressure(2) (P1 > P2) | P <sub>burst</sub> | 1000          | kPa  |
| Storage Temperature         | T <sub>stg</sub>   | –40° to +125° | °C   |
| Operating Temperature       | T <sub>A</sub>     | –40° to +125° | °C   |

1. T<sub>C</sub> = 25°C unless otherwise noted.

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

### OPERATING CHARACTERISTICS (V<sub>S</sub> = 5.1 Vdc, T<sub>A</sub> = 25°C unless otherwise noted, P1 > P2)

| Characteristic                                             | Symbol           | Min   | Typ   | Max   | Unit              |
|------------------------------------------------------------|------------------|-------|-------|-------|-------------------|
| Pressure Range(1)                                          | P <sub>OP</sub>  | 15    | —     | 115   | kPa               |
| Supply Voltage(2)                                          | V <sub>S</sub>   | 4.85  | 5.1   | 5.35  | Vdc               |
| Supply Current                                             | I <sub>O</sub>   | —     | 7.0   | 10    | mAdc              |
| Minimum Pressure Offset(3)<br>@ V <sub>S</sub> = 5.1 Volts | V <sub>off</sub> | 0.135 | 0.204 | 0.273 | Vdc               |
| Full Scale Output(4)<br>@ V <sub>S</sub> = 5.1 Volts       | V <sub>FSO</sub> | 4.725 | 4.794 | 4.863 | Vdc               |
| Full Scale Span(5)<br>@ V <sub>S</sub> = 5.1 Volts         | V <sub>FSS</sub> | —     | 4.59  | —     | Vdc               |
| Accuracy(6)                                                | —                | —     | —     | ± 1.5 | %V <sub>FSS</sub> |
| Sensitivity                                                | V/P              | —     | 46    | —     | mV/kPa            |
| Response Time(7)                                           | t <sub>R</sub>   | —     | 1.0   | —     | mS                |
| Output Source Current at Full Scale Output                 | I <sub>O+</sub>  | —     | 0.1   | —     | mAdc              |
| Warm-Up Time(8)                                            | —                | —     | 20    | —     | mSec              |
| Offset Stability(9)                                        | —                | —     | ± 0.5 | —     | %V <sub>FSS</sub> |

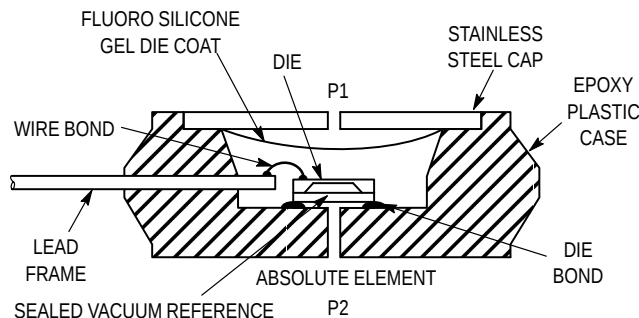
Decoupling circuit shown in Figure 3 required to meet electrical specifications.

### MECHANICAL CHARACTERISTICS

| Characteristic                   | Symbol | Min | Typ | Max | Unit  |
|----------------------------------|--------|-----|-----|-----|-------|
| Weight, Basic Element (Case 867) | —      | —   | 4.0 | —   | Grams |
| Common Mode Line Pressure(10)    | —      | —   | —   | 690 | kPa   |

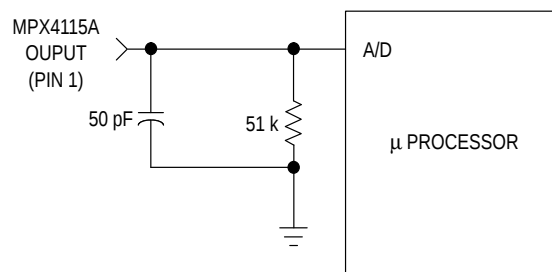
#### NOTES:

1. 1.0kPa (kiloPascal) equals 0.145 psi.
2. Device is ratiometric within this specified excitation range.
3. Offset (V<sub>off</sub>) is defined as the output voltage at the minimum rated pressure.
4. Full Scale Output (V<sub>FSO</sub>) is defined as the output voltage at the maximum or full rated pressure.
5. Full Scale Span (V<sub>FSS</sub>) 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 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<sub>FSS</sub> 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 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.
10. Common mode pressures beyond what is specified may result in leakage at the case-to-lead interface.



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

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 in-

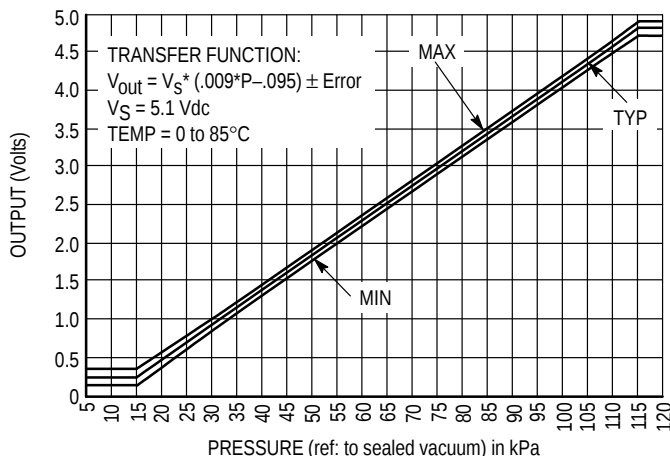


**Figure 3. Decoupling Filter for Sensor to  
Microprocessor Interface**

formation regarding media compatibility in your application.

Figure 3 shows a typical decoupling circuit for interfacing the integrated MAP sensor to the A/D input of a microprocessor. 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.)



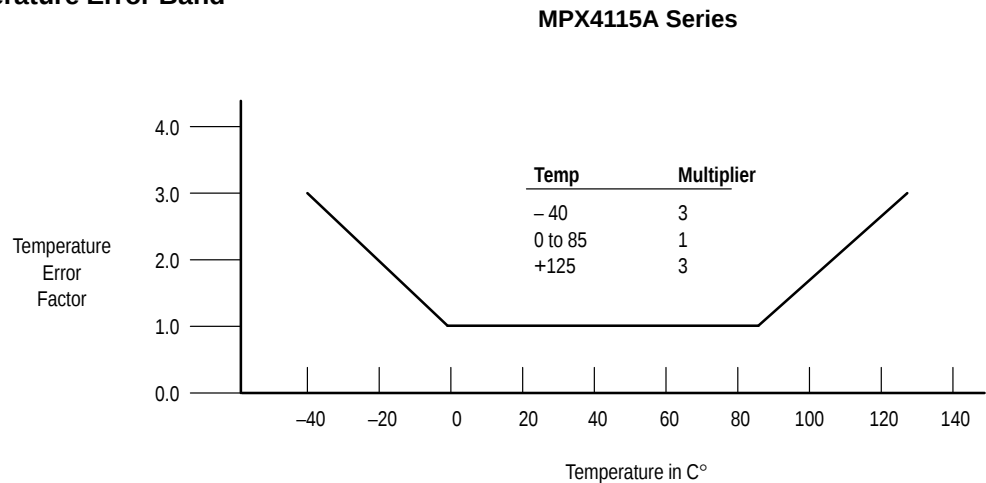
**Figure 4. Output versus Absolute Pressure**

MPX4115 SERIES

Transfer Function

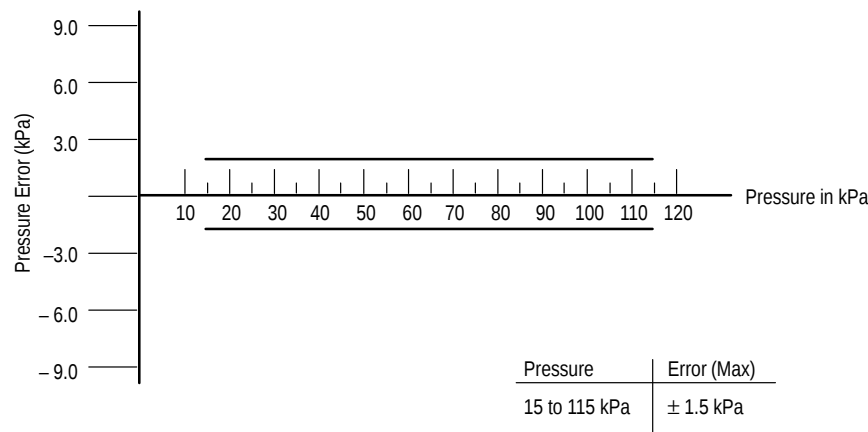
Nominal Transfer Value:  $V_{out} = V_S (P \times 0.009 - 0.095)$   
 $\pm (Pressure\ Error \times Temp.\ Factor \times 0.009 \times V_S)$   
 $V_S = 5.1\ V \pm 0.25\ V_{dc}$

Temperature Error Band



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

Pressure Error Band

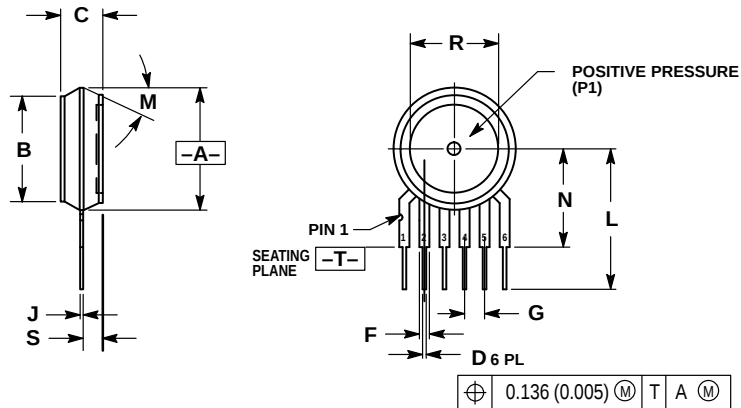


ORDERING INFORMATION

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 867-08  | 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  |

## 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).

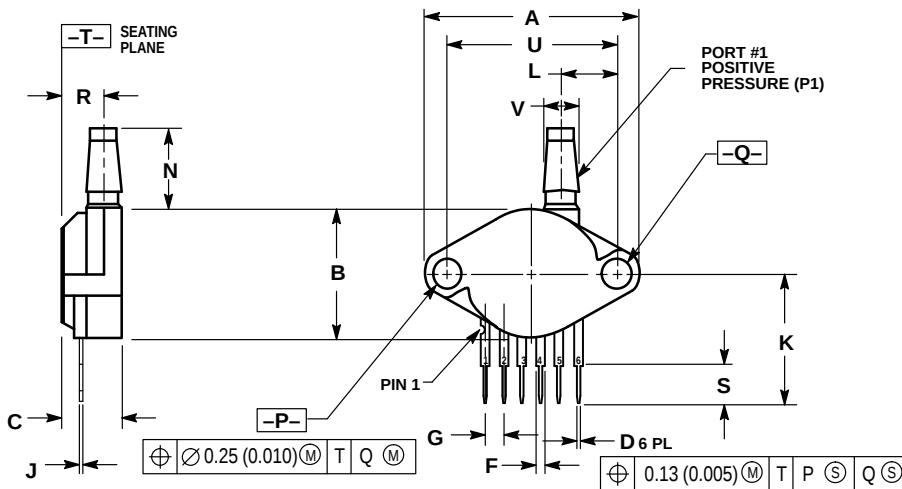
| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.595     | 0.630 | 15.11       | 16.00 |
| B   | 0.514     | 0.534 | 13.06       | 13.56 |
| C   | 0.200     | 0.220 | 5.08        | 5.59  |
| 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
- GROUND
- VCC
- V1
- V2
- VEX

CASE 867-08  
ISSUE N

## BASIC ELEMENT (A, D)



## NOTES:

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

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 1.145     | 1.175 | 29.08       | 29.85 |
| B   | 0.685     | 0.715 | 17.40       | 18.16 |
| C   | 0.305     | 0.325 | 7.75        | 8.26  |
| 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        | 0.41  |
| K   | 0.695     | 0.725 | 17.65       | 18.42 |
| L   | 0.290     | 0.300 | 7.37        | 7.62  |
| N   | 0.420     | 0.440 | 10.67       | 11.18 |
| P   | 0.153     | 0.159 | 3.89        | 4.04  |
| Q   | 0.153     | 0.159 | 3.89        | 4.04  |
| R   | 0.230     | 0.250 | 5.84        | 6.35  |
| S   | 0.220     | 0.240 | 5.59        | 6.10  |
| U   | 0.910 BSC |       | 23.11 BSC   |       |
| V   | 0.182     | 0.194 | 4.62        | 4.93  |

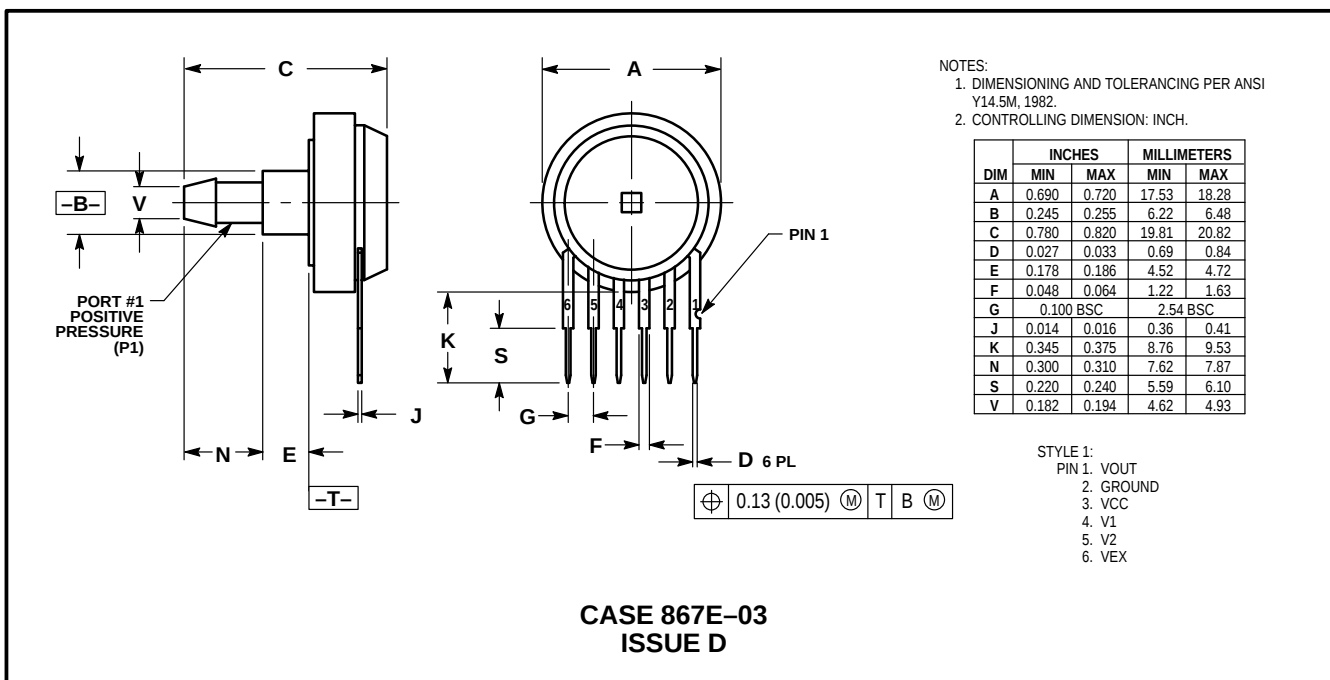
## STYLE 1:

- PIN 1. VOUT
- GROUND
- VCC
- V1
- V2
- VEX

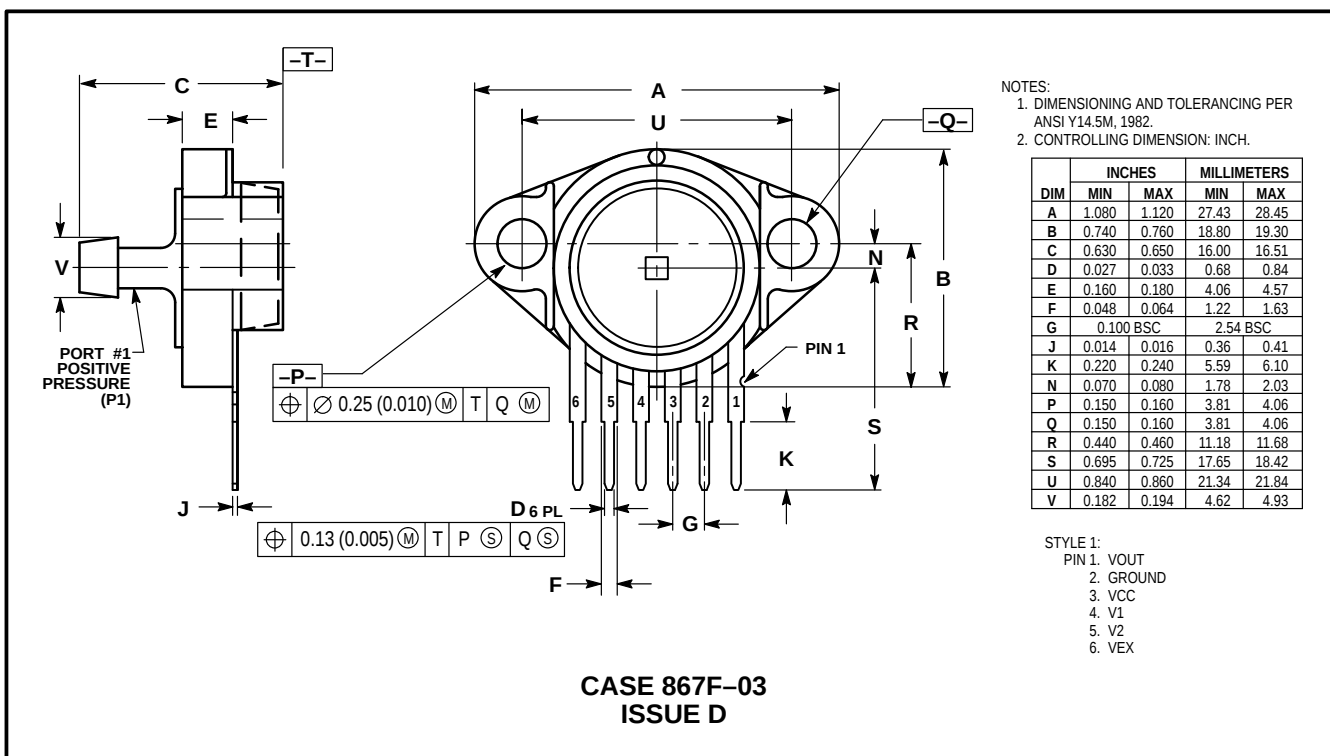
CASE 867B-04  
ISSUE E

## PRESSURE SIDE PORTED (AP, GP)

## PACKAGE DIMENSIONS—CONTINUED



PRESSURE SIDE PORTED (AS, GS)



PRESSURE SIDE PORTED (ASX, GSX)

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters which may be provided in Motorola data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and  are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

## MPX4115 SERIES

Mfax is a trademark of Motorola, Inc.

### How to reach us:

**USA/EUROPE/Locations Not Listed:** Motorola Literature Distribution;  
P.O. Box 5405, Denver, Colorado 80217. 1-303-675-2140 or 1-800-441-2447

**JAPAN:** Nippon Motorola Ltd.: SPD, Strategic Planning Office, 4-32-1,  
Nishi-Gotanda, Shinagawa-ku, Tokyo 141, Japan. 81-3-5487-8488

**Customer Focus Center: 1-800-521-6274**

**Mfax™:** RMFAX0@email.sps.mot.com – TOUCHTONE 1-602-244-6609  
Motorola Fax Back System – US & Canada ONLY 1-800-774-1848  
– <http://sps.motorola.com/mfax/>

**ASIA/PACIFIC:** Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,  
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

**HOME PAGE:** <http://motorola.com/sps/>



**MOTOROLA**



**MPX4115/D**