

# Media Resistant and High Temperature Accuracy Integrated Silicon Pressure Sensor for Measuring Absolute Pressure, On-Chip Signal Conditioned, Temperature Compensated and Calibrated

Motorola's MPXAZ6115A series sensor integrates on-chip, bipolar op amp circuitry and thin film resistor networks to provide a high output signal and temperature compensation. The sensor's packaging has been designed to provide resistance to high humidity conditions as well as common automotive media. The small form factor and high reliability of on-chip integration make the Motorola pressure sensor a logical and economical choice for the system designer.

The MPXAZ6115A 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

- Resistant to High Humidity and Common Automotive Media
- Improved Accuracy at High Temperature
- 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 Thermoplastic (PPS) Surface Mount Package

### Application Examples

- Aviation Altimeters
- Industrial Controls
- Engine Control/Manifold Absolute Pressure (MAP)
- Weather Station and Weather Reporting Devices

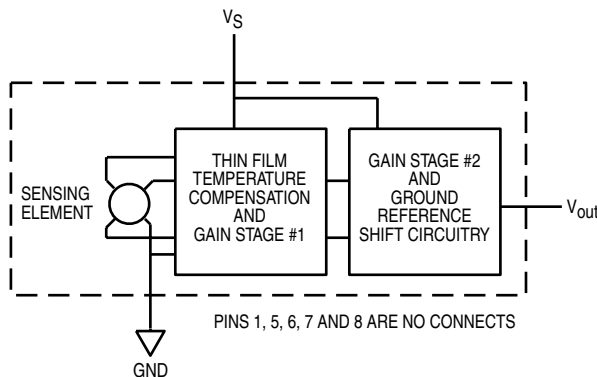
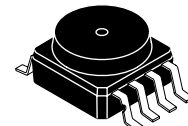


Figure 1. Fully Integrated Pressure Sensor Schematic

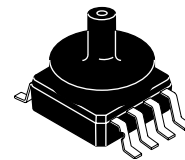
## MPXAZ6115A MPXHZ6115A SERIES

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

### SMALL OUTLINE PACKAGE



MPXAZ6115A6U  
CASE 482-01



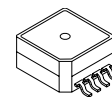
MPXAZ6115AC6U  
CASE 482A-01

### PIN NUMBER

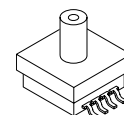
|   |                  |   |     |
|---|------------------|---|-----|
| 1 | N/C              | 5 | N/C |
| 2 | V <sub>S</sub>   | 6 | N/C |
| 3 | Gnd              | 7 | N/C |
| 4 | V <sub>out</sub> | 8 | N/C |

**NOTE:** Pins 1, 5, 6, 7, and 8 are internal device connections. Do not connect to external circuitry or ground. Pin 1 is denoted by the notch in the lead.

### SUPER SMALL OUTLINE PACKAGE



MPXHZ6115A6U  
CASE 1317-04



MPXAZ6115AC6U  
CASE 1317A-03

Freescale Semiconductor, Inc.

**MAXIMUM RATINGS<sup>(1)</sup>**

| Parametrics  | Symbol           | Value         | Units |
|--|------------------|---------------|-------|
| Maximum Pressure (P1 > P2)                                   | P <sub>max</sub> | 400           | kPa   |
| Storage Temperature  | T <sub>stg</sub> | -40° to +125° | °C    |
| Operating Temperature  | T <sub>A</sub>   | -40° to +125° | °C    |
| Output Source Current @ Full Scale Output <sup>(2)</sup>     | I <sub>o+</sub>  | 0.5           | mAdc  |
| Output Sink Current @ Minimum Pressure Offset <sup>(2)</sup> | I <sub>o-</sub>  | -0.5          | mAdc  |

NOTES:

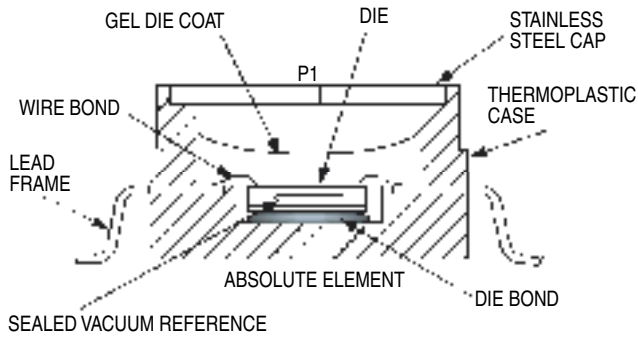
- Exposure beyond the specified limits may cause permanent damage or degradation to the device.
- Maximum Output Current is controlled by effective impedance from V<sub>out</sub> to Gnd or V<sub>out</sub> to V<sub>S</sub> in the application circuit.

**OPERATING CHARACTERISTICS (V<sub>S</sub> = 5.0 Vdc, T<sub>A</sub> = 25°C unless otherwise noted, P1 > P2.)**

| Characteristic   | Symbol            | Min   | Typ   | Max   | Unit              |
|--|-------------------|-------|-------|-------|-------------------|
| Pressure Range   | P <sub>OP</sub>   | 15    | -     | 115   | kPa               |
| Supply Voltage <sup>(1)</sup>  | V <sub>S</sub>    | 4.75  | 5.0   | 5.25  | Vdc               |
| Supply Current   | I <sub>o</sub>    | -     | 6.0   | 10    | mAdc              |
| Minimum Pressure Offset <sup>(2)</sup><br>@ V <sub>S</sub> = 5.0 Volts | V <sub>off</sub>  | 0.133 | 0.200 | 0.268 | Vdc               |
| Full Scale Output <sup>(3)</sup><br>@ V <sub>S</sub> = 5.0 Volts       | V <sub>FSSO</sub> | 4.633 | 4.700 | 4.768 | Vdc               |
| Full Scale Span <sup>(4)</sup><br>@ V <sub>S</sub> = 5.0 Volts         | V <sub>FSS</sub>  | 4.433 | 4.500 | 4.568 | Vdc               |
| Accuracy <sup>(5)</sup>  | -                 | -     | -     | ±1.5  | %V <sub>FSS</sub> |
| Sensitivity  | V/P               | -     | 45.9  | -     | mV/kPa            |
| Response Time <sup>(6)</sup>   | t <sub>R</sub>    | -     | 1.0   | -     | ms                |
| Warm-Up Time <sup>(7)</sup>  | -                 | -     | 20    | -     | ms                |
| Offset Stability <sup>(8)</sup>  | -                 | -     | ±0.25 | -     | %V <sub>FSS</sub> |

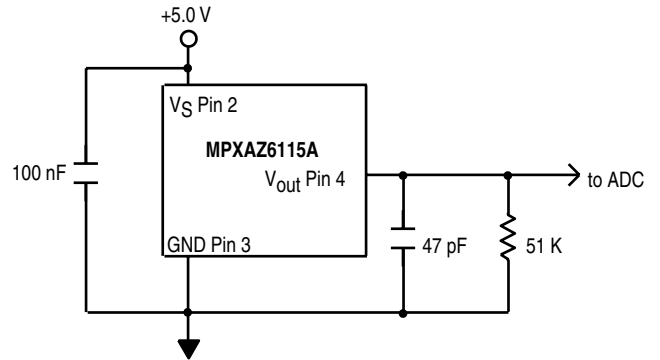
NOTES:

- Device is radiometric within this specified excitation range.
- Offset (V<sub>off</sub>) is defined as the output voltage at the minimum rated pressure.
- Full Scale Output (V<sub>FSSO</sub>) is defined as the output voltage at the maximum or full rated pressure.
- 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.
- 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 Time 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.



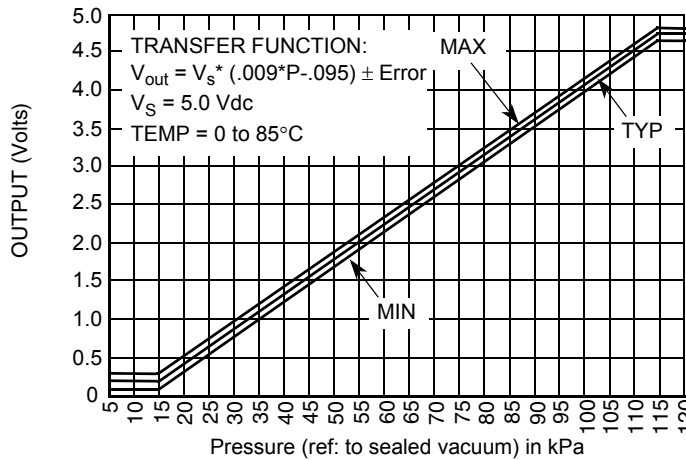
**Figure 2. Cross Sectional Diagram SOP (Not to Scale)**

Figure 2 illustrates the absolute sensing chip in the basic Small Outline chip carrier (Case 482).



**Figure 3. Typical Application Circuit (Output Source Current Operation)**

Figure 3 shows a typical application circuit (output source current operation).



**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. The output will saturate outside of the rated pressure range.

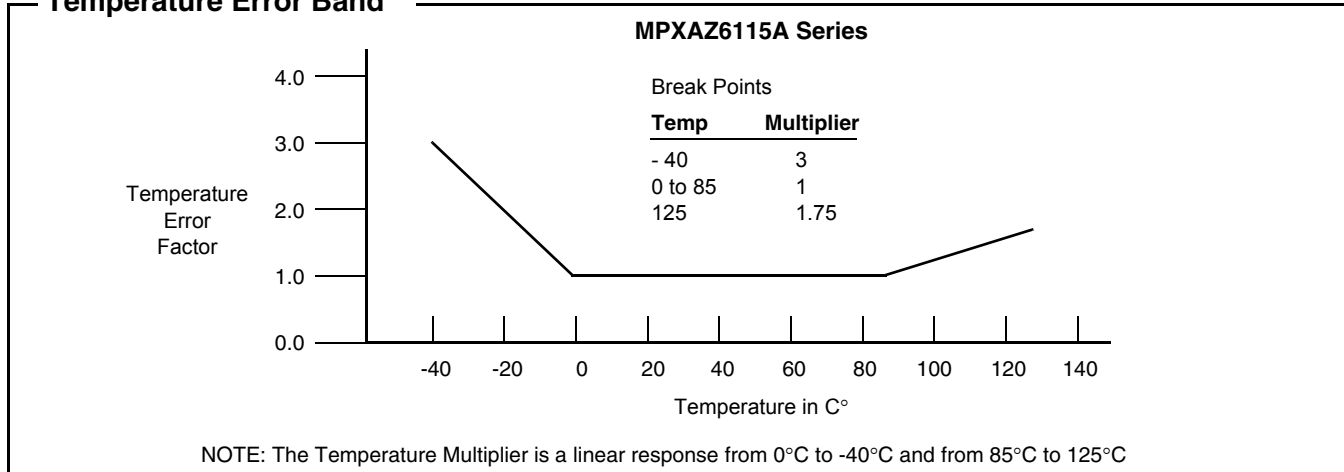
A gel die coat isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the sensor diaphragm.

The gel die coat and durable polymer package provide a media resistant barrier that allows the sensor to operate reliably in high humidity conditions as well as environments containing common automotive media. Contact the factory for more information regarding media compatibility in your specific application.

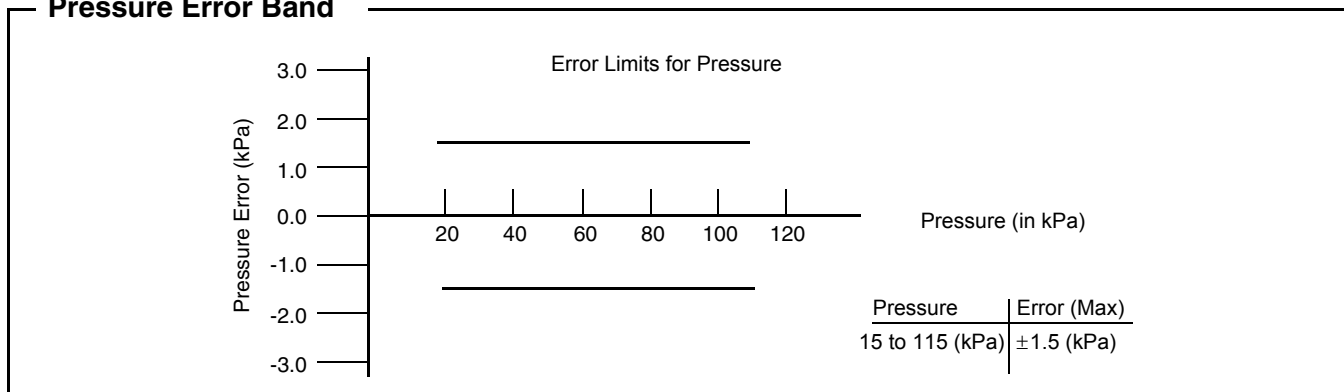
### Transfer Function (MPXAZ6115A)

**Nominal Transfer Value:**  $V_{out} = V_S \times (0.009 \times P - 0.095)$   
 $\pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.009 \times V_S)$   
 $V_S = 5.0 \pm 0.25 \text{ Vdc}$

### Temperature Error Band



### Pressure Error Band



### ORDERING INFORMATION—SMALL OUTLINE PACKAGE

| Device Type    | Options                | Case No. | MPX Series Order No. | Packing Options | Marking    |
|----------------|------------------------|----------|----------------------|-----------------|------------|
| Basic Element  | Absolute, Element Only | 482      | MPXAZ6115A6U         | Rails           | MPXAZ6115A |
|                | Absolute, Element Only | 482      | MPXAZ6115A6T1        | Tape and Reel   | MPXAZ6115A |
| Ported Element | Absolute, Axial Port   | 482A     | MPXAZ6115AC6U        | Rails           | MPXAZ6115A |
|                | Absolute, Axial Port   | 482A     | MPXAZ6115AC6T1       | Tape and Reel   | MPXAZ6115A |

### ORDERING INFORMATION—SUPER SMALL OUTLINE PACKAGE

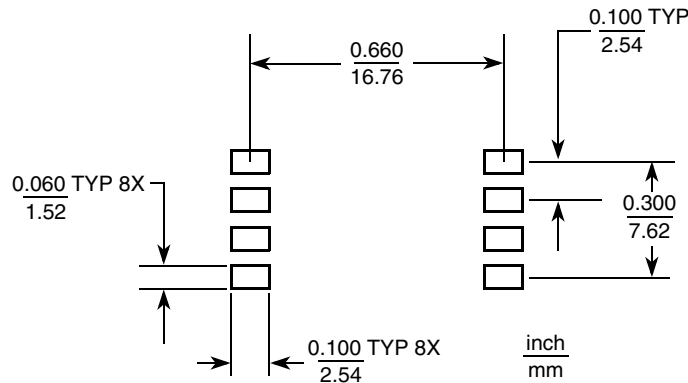
| Device Type    | Options                | Case No. | MPX Series Order No. | Packing Options | Marking    |
|----------------|------------------------|----------|----------------------|-----------------|------------|
| Basic Element  | Absolute, Element Only | 1317     | MPXHZ6115A6U         | Rails           | MPXHZ6115A |
|                | Absolute, Element Only | 1317A    | MPXHZ6115A6T1        | Tape and Reel   | MPXHZ6115A |
| Ported Element | Absolute, Axial Port   | 1317A    | MPXHZ6115AC6U        | Rails           | MPXHZ6115A |
|                | Absolute, Axial Port   | 1317A    | MPXHZ6115AC6T1       | Tape and Reel   | MPXHZ6115A |

**SURFACE MOUNTING INFORMATION**

**MINIMUM RECOMMENDED FOOTPRINT FOR SMALL OUTLINE PACKAGE**

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor package must be the correct size to ensure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self-align when subjected to

a solder reflow process. It is always recommended to fabricate boards with a solder mask layer to avoid bridging and/or shorting between solder pads, especially on tight tolerances and/or tight layouts.

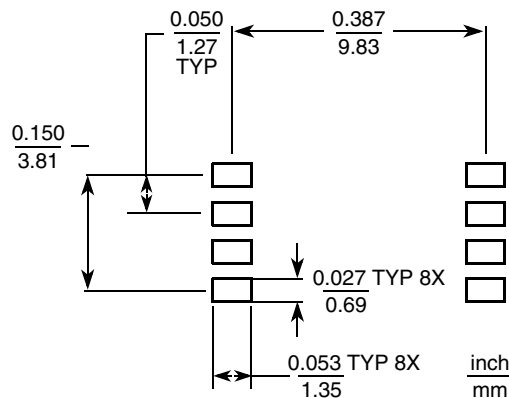


**Figure 5. SOP Footprint (Case 482 and 482A)**

**MINIMUM RECOMMENDED FOOTPRINT FOR SUPER SMALL OUTLINE PACKAGES**

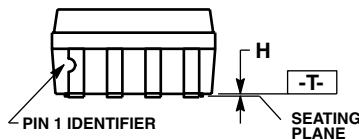
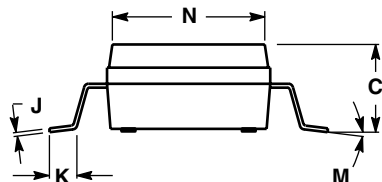
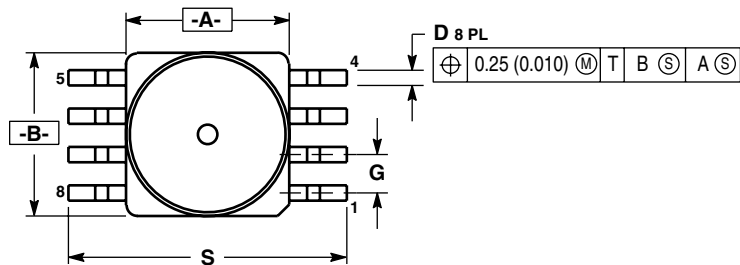
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**Figure 6. SSOP Footprint (Case 1317 and 1317A)**

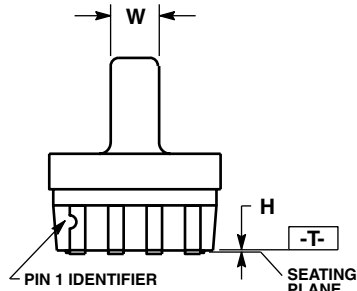
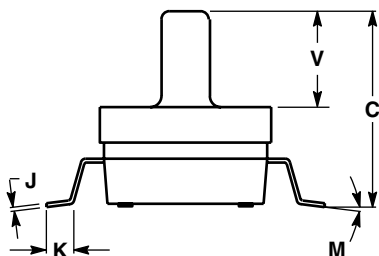
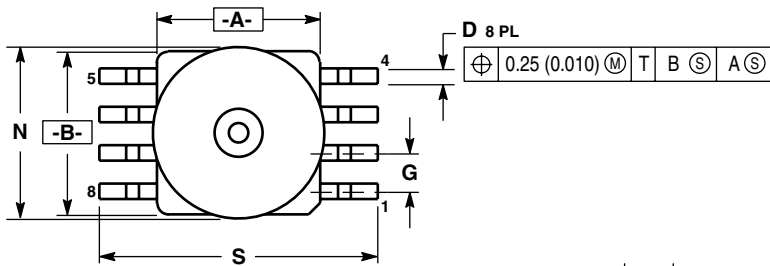
## SMALL OUTLINE PACKAGE DIMENSIONS



- 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**



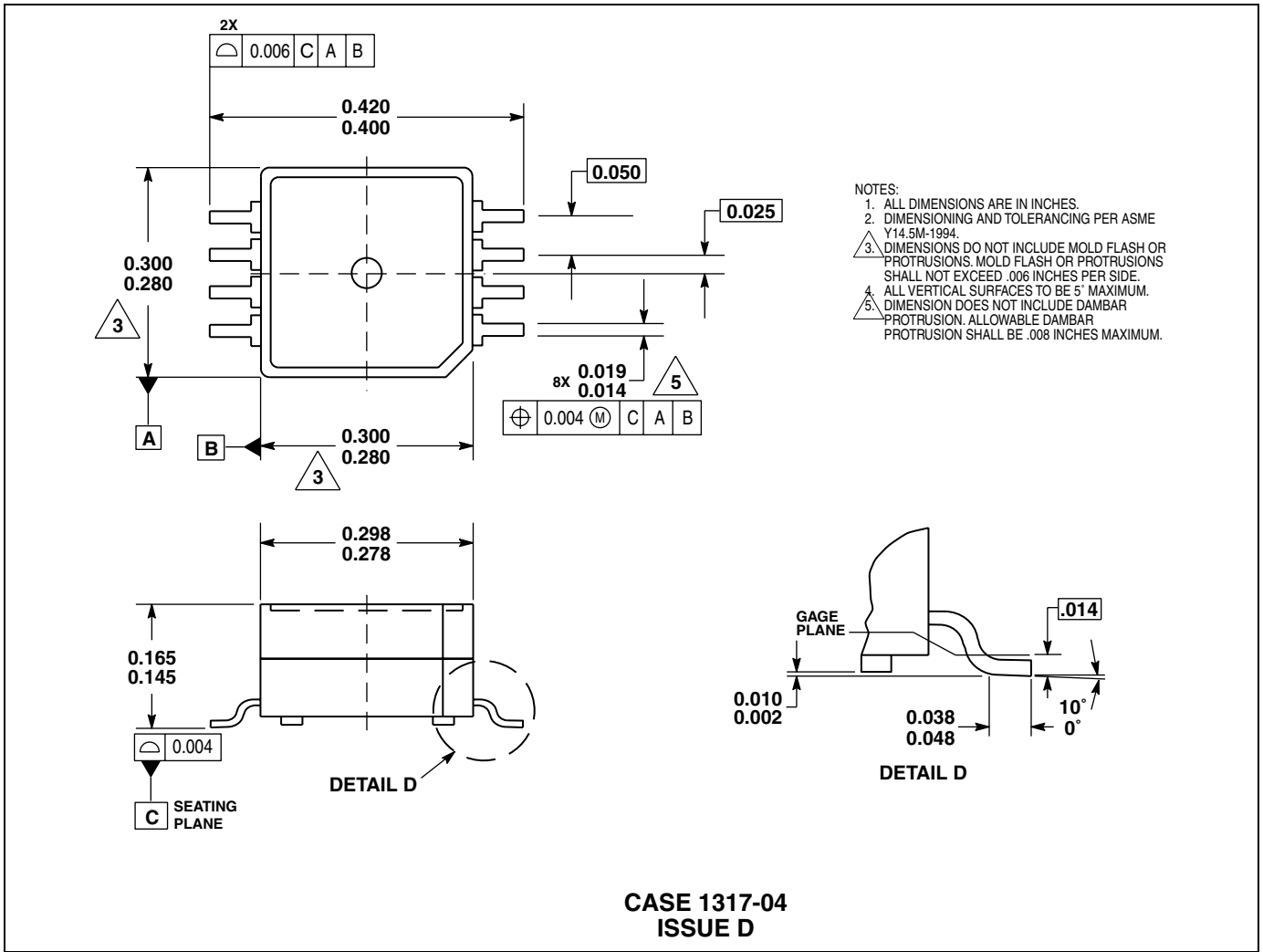
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| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.415     | 0.425 | 10.54       | 10.79 |
| B   | 0.415     | 0.425 | 10.54       | 10.79 |
| 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**

Freescale Semiconductor, Inc.

**SUPER SMALL OUTLINE PACKAGE DIMENSIONS**



**CASE 1317-04  
ISSUE D**

**Freescale Semiconductor, Inc.**





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**MPXAZ6115A**