**Freescale Semiconductor**
Data Sheet: Technical Data

Document Number: MPXA6115A
Rev 7.2, 10/2012

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

**MPXA6115A**
**MPXAZ6115A**
**MPXH6115A**
**MPXHZ6115A**
**Series**
**15 to 115 kPa (2.2 to 16.7 psi)**
**0.2 to 4.7 V Output**

The MPXxx6115A series 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 pressure sensor a logical and economical choice for the system designer.

The MPXxx6115A 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.

## Application Examples

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

## Features

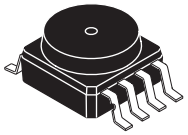
- Resistant to High Humidity and Common Automotive Media
- Improved Accuracy at High Temperature
- Available in Small and Super Small Outline Packages
- 1.5% Maximum Error over 0° to 85°C
- Ideally suited for Microprocessor or Microcontroller-Based Systems
- Temperature Compensated from -40° to +125°C
- Durable Thermoplastic (PPS) Surface Mount Package

**ORDERING INFORMATION**

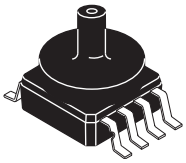
| Device Name | Package Option | Case No. | # of Ports | | | Pressure Type | | | Device Marking |
|---|---|---|---|---|---|---|---|---|---|
| | | | None | Single | Dual | Gauge | Differential | Absolute | |
| **Small Outline Package (MPXA6115A Series)** | | | | | | | | | |
| MPXA6115A6U | Rails | 482 | • | | | | | • | MPXA6115A |
| MPXA6115A6T1 | Tape and Reel | 482 | • | | | | | • | MPXA6115A |
| MPXA6115AC6U | Rails | 482A | | • | | | | • | MPXA6115A |
| MPXA6115AC6T1 | Tape and Reel | 482A | | • | | | | • | MPXA6115A |
| MPXA6115AC7U | Rails | 482C | | • | | | | • | MPXA6115A |
| **Small Outline Package (Media Resistant Gel) (MPXAZ6115A Series)** | | | | | | | | | |
| MPXAZ6115A6U | Rails | 482 | • | | | | | • | MPXAZ6115A |
| MPXAZ6115AC6U | Rails | 482A | | • | | | | • | MPXAZ6115A |
| MPXAZ6115AC6T1 | Tape and Reel | 482A | | • | | | | • | MPXAZ6115A |
| MPXAZ6115AP | Trays | 1369 | | • | | | | • | MPXAZ6115A |
| MPXAZ6115APT1 | Tape and Reel | 1369 | | • | | | | • | MPXAZ6115A |
| **Super Small Outline Package (MPXH6115A Series)** | | | | | | | | | |
| MPXH6115A6U | Rails | 1317 | • | | | | | • | MPXH6115A |
| MPXH6115A6T1 | Tape and Reel | 1317 | • | | | | | • | MPXH6115A |
| MPXH6115AC6U | Rails | 1317A | | • | | | | • | MPXH6115A |
| MPXH6115AC6T1 | Tape and Reel | 1317A | | • | | | | • | MPXH6115A |

| ORDERING INFORMATION | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Small Outline Package (Media Resistant Gel) (MPXHZ6115A Series)** | | | | | | | | | |
| MPXHZ6115A6U | Rails | 1317 | • | | | | | • | MPXHZ6115A |
| MPXHZ6115A6T1 | Tape and Reel | 1317 | • | | | | | • | MPXHZ6115A |
| MPXHZ6115AC6U | Rails | 1317A | | • | | | | • | MPXHZ6115A |
| MPXHZ6115AC6T1 | Tape and Reel | 1317A | | • | | | | • | MPXHZ6115A |

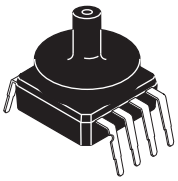
## SMALL OUTLINE PACKAGES



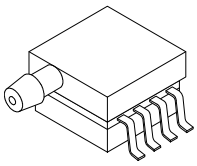
**MPXA6115A6U/T1**
**MPXAZ6115A6U**
**CASE 482**



**MPXA6115AC6U/T1**
**MPXAZ6115AC6U/T1**
**CASE 482A**

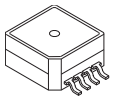


**MPXA6115AC7U**
**CASE 482C**

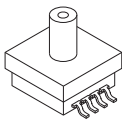


**MPXAZ6115AP/T1**
**CASE 1369**

## SUPER SMALL OUTLINE PACKAGES



**MPXH6115A6U/T1**
**MPXHZ6115A6U/T1**
**CASE 1317**



**MPXH6115AC6U/T1**
**MPXHZ6115AC6U/T1**
**CASE 1317A**

## Operating Characteristics

**Table 1. Operating Characteristics** ($V_S$ = 5.0 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) | $V_S$ | 4.75 | 5.0 | 5.25 | Vdc |
| Supply Current | $I_o$ | — | 6.0 | 10 | mAdc |
| Minimum Pressure Offset(2)(0 to 85°C) @ $V_S$ = 5.0 Volts | $V_{off}$ | 0.133 | 0.200 | 0.268 | Vdc |
| Full Scale Output(3)(0 to 85°C) @ $V_S$ = 5.0 Volts | $V_{FSO}$ | 4.633 | 4.700 | 4.768 | Vdc |
| Full Scale Span(4)(0 to 85°C) @ $V_S$ = 5.0 Volts | $V_{FSS}$ | 4.433 | 4.500 | 4.568 | Vdc |
| Accuracy(5)(0 to 85°C) | — | — | — | ±1.5 | $\%V_{FSS}$ |
| Sensitivity | V/P | — | 45.0 | — | mV/kPa |
| Response Time(6) | $t_R$ | — | 1.0 | — | ms |
| Warm-Up Time(7) | — | — | 20 | — | ms |
| Offset Stability(8) | — | — | ±0.25 | — | $\%V_{FSS}$ |

1. Device is ratiometric within this specified excitation range.
2. Offset ($V_{off}$) is defined as the output voltage at the minimum rated pressure.
3. Full Scale Output ($V_{FSO}$) is defined as the output voltage at the maximum or full rated pressure.
4. 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.
5. 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.
6. 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.
7. Warm-up Time is defined as the time required for the product to meet the specified output voltage after the pressure has been stabilized.
8. Offset Stability is the product's output deviation when subjected to 1000 cycles of Pulsed Pressure, Temperature Cycling with Bias Test.

## Maximum Ratings

**Table 2. Maximum Ratings(1)**

| Rating | Symbol | Value | Units |
|---|---|---|---|
| Maximum Pressure (P1 > P2) | $P_{max}$ | 400 | kPa |
| Storage Temperature | $T_{stg}$ | -40° to +125° | °C |
| Operating Temperature | $T_A$ | -40° to +125° | °C |
| Output Source Current @ Full Scale Output(2) | $I_o$+ | 0.5 | mAdc |
| Output Sink Current @ Minimum Pressure Offset(2) | $I_o$- | -0.5 | mAdc |

1. Exposure beyond the specified limits may cause permanent damage or degradation to the device.
2. Maximum Output Current is controlled by effective impedance from $V_{out}$ to Gnd or $V_{out}$ to $V_S$ in the application circuit.

Figure 1 shows a block diagram of the internal circuitry integrated on a pressure sensor chip.

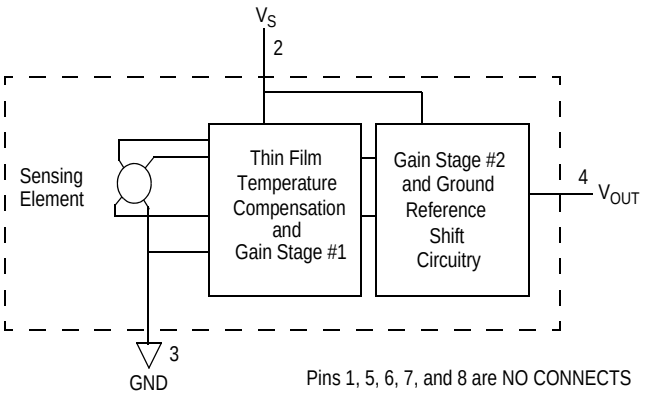



**Figure 1. Fully Integrated Pressure Sensor Schematic**

## On-chip Temperature Compensation and Calibration

Figure 2 illustrates the absolute sensing chip in the basic Super Small Outline chip carrier (Case 1317).

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

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 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 MPXxx6115A 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.

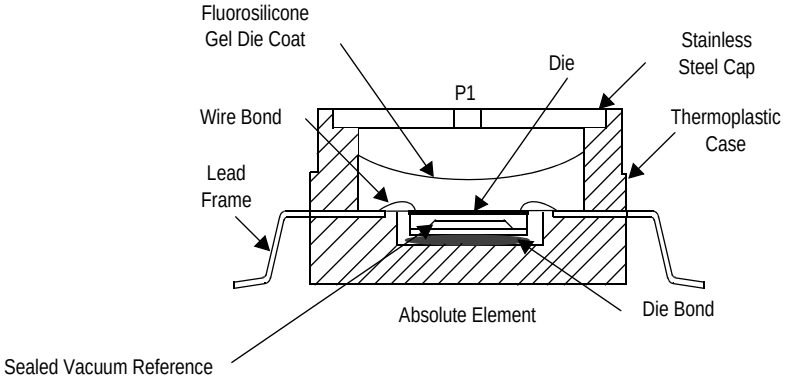



**Figure 2. Cross Sectional Diagram SSOP/SOP (not to scale)**

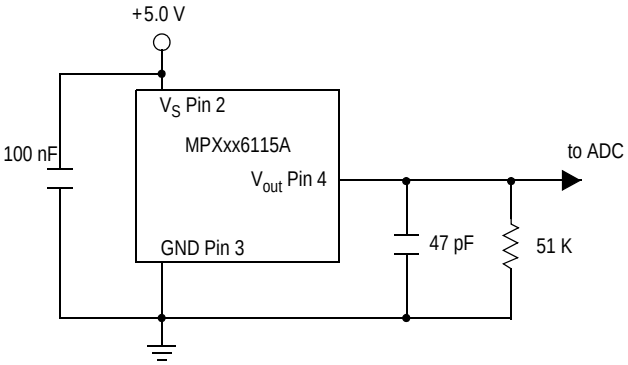



**Figure 3. Typical Application Circuit (Output Source Current Operation)**

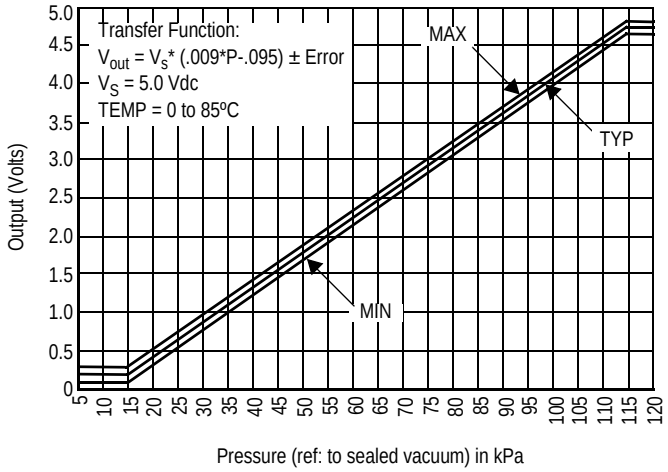
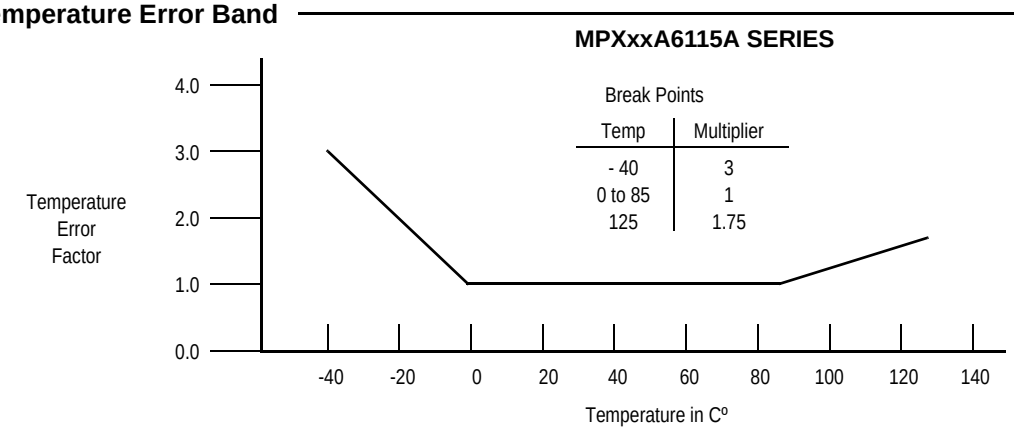



**Figure 4. Output vs. Absolute Pressure**

## Transfer Function (MPXxx6115A)

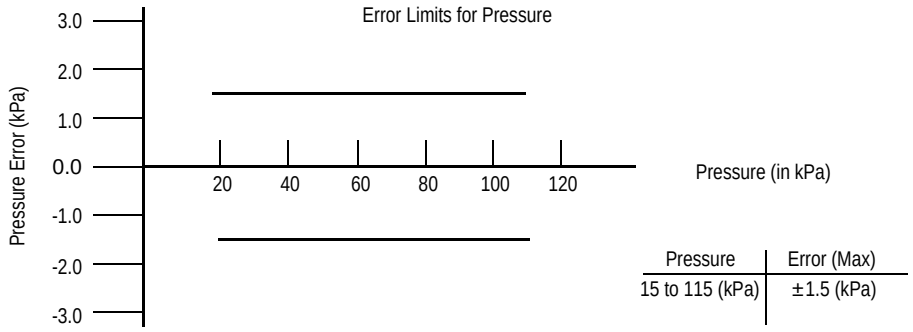
**Nominal Transfer Value:** $V_{out} = V_S$ x (0.009 x P - 0.095)
± (Pressure Error x Temp. Factor x 0.009 x $V_S$)
$V_S = 5.0 \pm 0.25$ Vdc

## Temperature Error Band




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

## Pressure Error Band



## MINIMUM RECOMMENDED FOOTPRINT FOR SMALL AND SUPER SMALL PACKAGES

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.

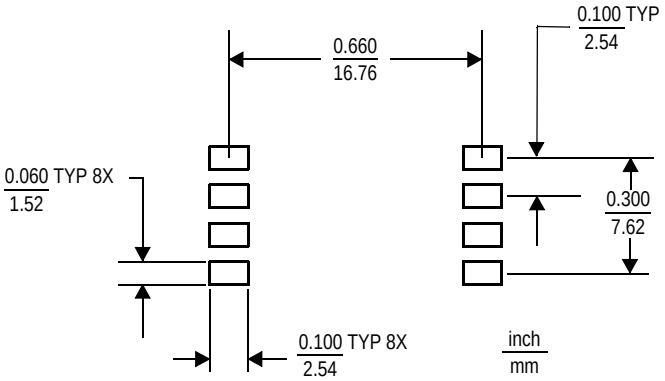



**Figure 5. SOP Footprint (Case 482)**

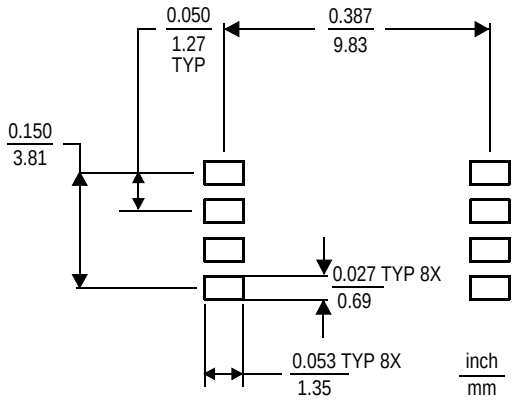
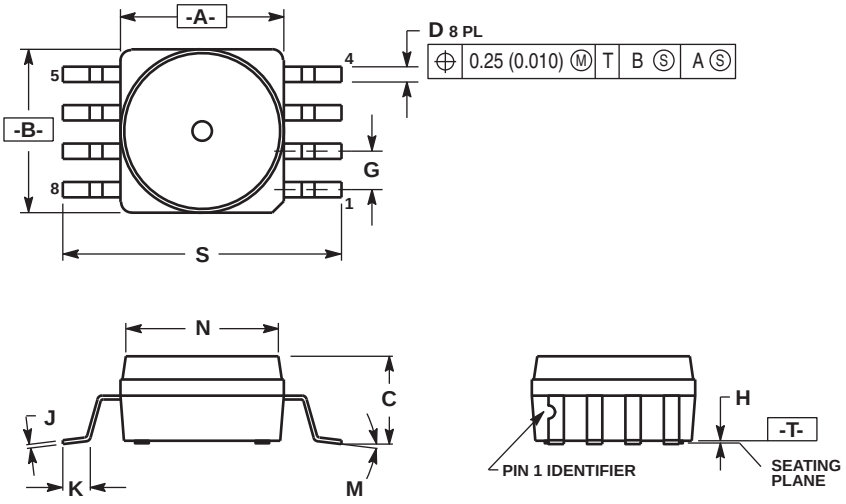



**Figure 6. SSOP Footprint (Case 1317 and 1317A)**

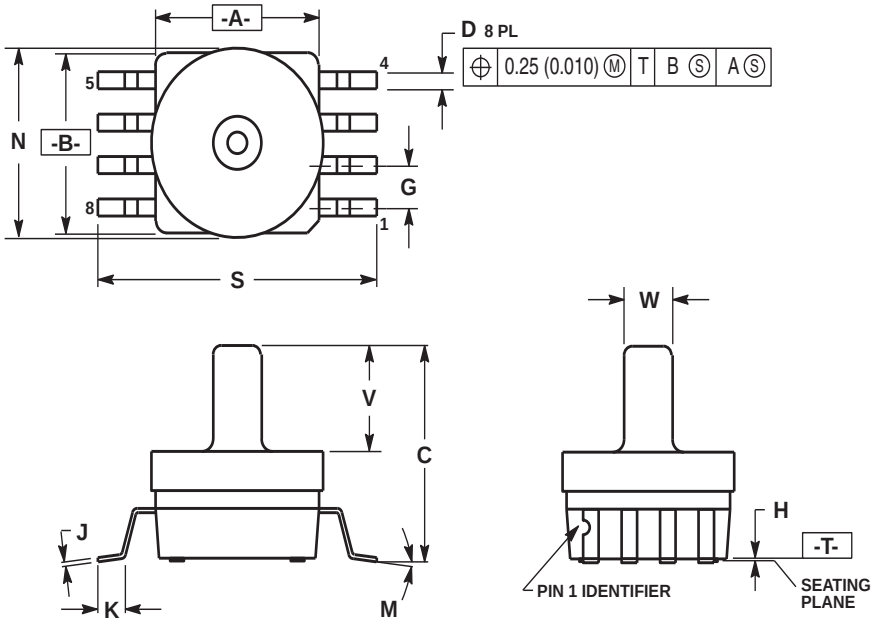
# PACKAGE DIMENSIONS




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.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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**
**SMALL OUTLINE PACKAGE**

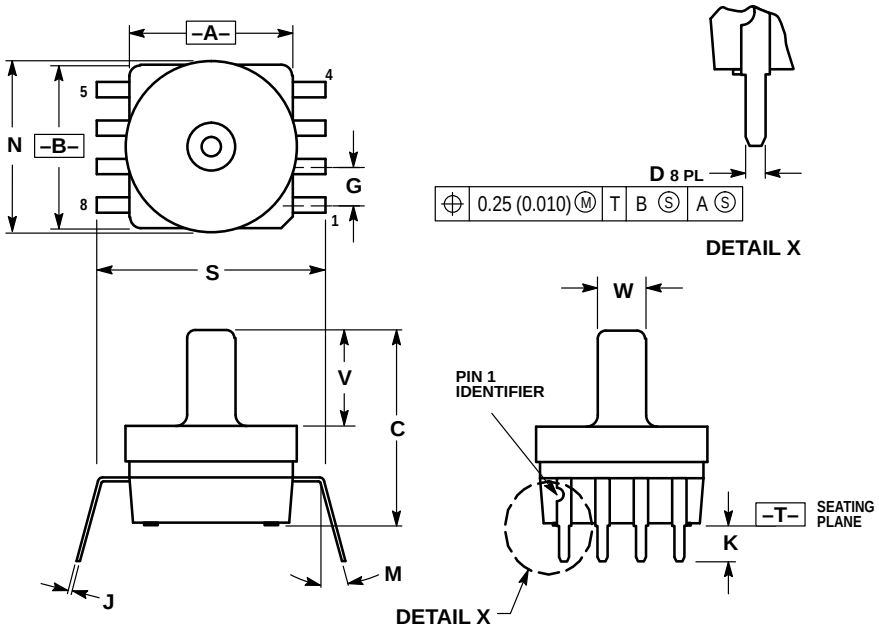



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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**
**SMALL OUTLINE PACKAGE**

# PACKAGE DIMENSIONS

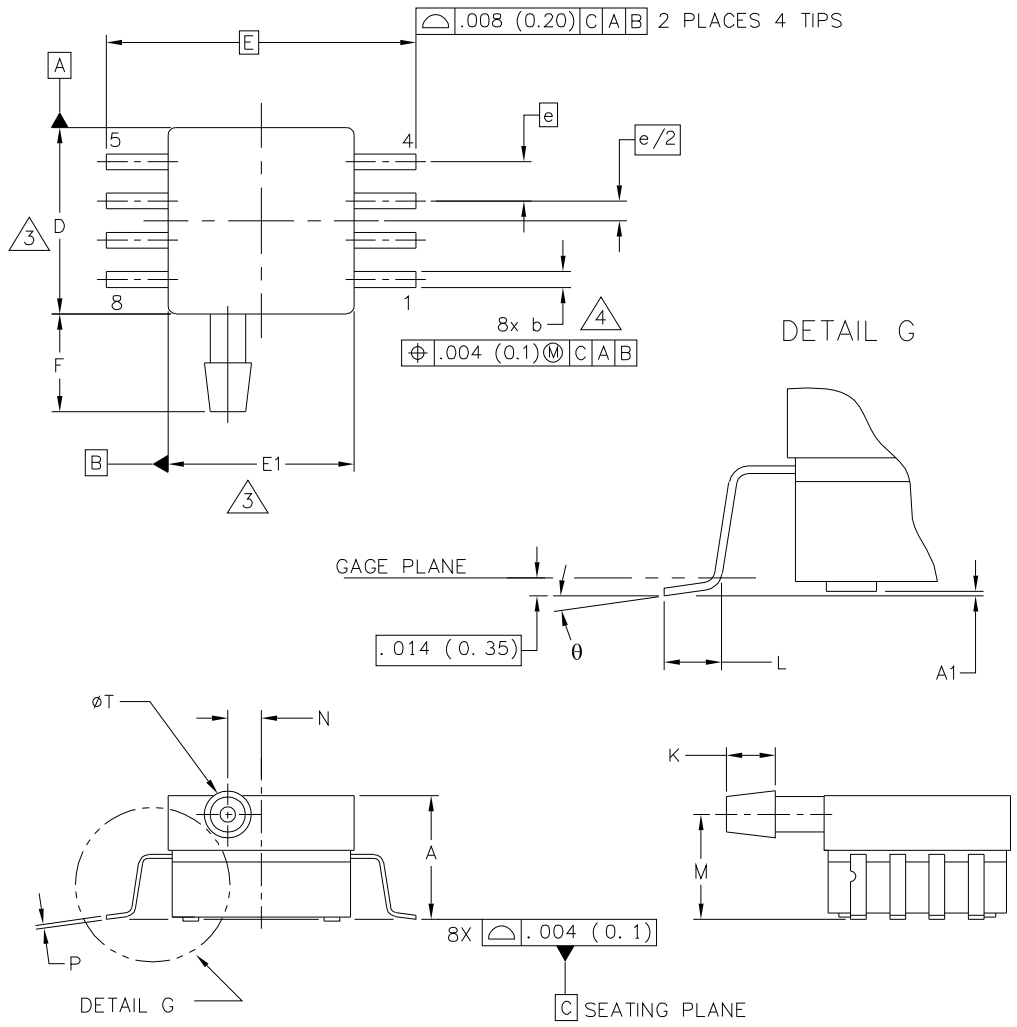



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.
6. DIMENSION S TO CENTER OF LEAD WHEN FORMED PARALLEL.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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 | 0.026 | 0.034 | 0.66 | 0.864 |
| G | 0.100 BSC | | 2.54 BSC | |
| J | 0.009 | 0.011 | 0.23 | 0.28 |
| K | 0.100 | 0.120 | 2.54 | 3.05 |
| M | 0 ° | 15 ° | 0 ° | 15 ° |
| N | 0.444 | 0.448 | 11.28 | 11.38 |
| S | 0.540 | 0.560 | 13.72 | 14.22 |
| V | 0.245 | 0.255 | 6.22 | 6.48 |
| W | 0.115 | 0.125 | 2.92 | 3.17 |

**CASE 482C-03**
**ISSUE B**
**SMALL OUTLINE PACKAGE**

## PACKAGE DIMENSIONS




| | | |
|---|---|---|
| © FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED. | MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE |
| TITLE: 8 LD SOP, SIDE PORT | DOCUMENT NO: 98ASA99303D | REV: D |
| | CASE NUMBER: 1369-01 | 13 DEC 2010 |
| | STANDARD: NON-JEDEC | |



**CASE 1369-01**
**ISSUE B**
**SMALL OUTLINE PACKAGE**

NOTES:
1. CONTROLLING DIMENSION: INCH

2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.

3. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PPROTRUSIONS.
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 (0.152) PER SIDE.

4. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR
PROTRUSION SHALL BE .008 (0.203) MAXIMUM.

| DIM | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX | DIM | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX |
|---|---|---|---|---|---|---|---|---|---|
| A | .300 | .330 | 7.62 | 8.38 | θ | 0° | 7° | 0° | 7° |
| A1 | .002 | .010 | 0.05 | 0.25 | – | --- | --- | --- | --- |
| b | .038 | .042 | 0.96 | 1.07 | – | --- | --- | --- | --- |
| D | .465 | .485 | 11.81 | 12.32 | – | --- | --- | --- | --- |
| E | .717 BSC | | 18.21 BSC | | – | --- | --- | --- | --- |
| E1 | .465 | .485 | 11.81 | 12.32 | – | --- | --- | --- | --- |
| e | .100 BSC | | 2.54 BSC | | – | --- | --- | --- | --- |
| F | .245 | .255 | 6.22 | 6.47 | – | --- | --- | --- | --- |
| K | .120 | .130 | 3.05 | 3.30 | – | --- | --- | --- | --- |
| L | .061 | .071 | 1.55 | 1.80 | – | --- | --- | --- | --- |
| M | .270 | .290 | 6.86 | 7.36 | – | --- | --- | --- | --- |
| N | .080 | .090 | 2.03 | 2.28 | – | --- | --- | --- | --- |
| P | .009 | .011 | 0.23 | 0.28 | – | --- | --- | --- | --- |
| T | .115 | .125 | 2.92 | 3.17 | – | --- | --- | --- | --- |



MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

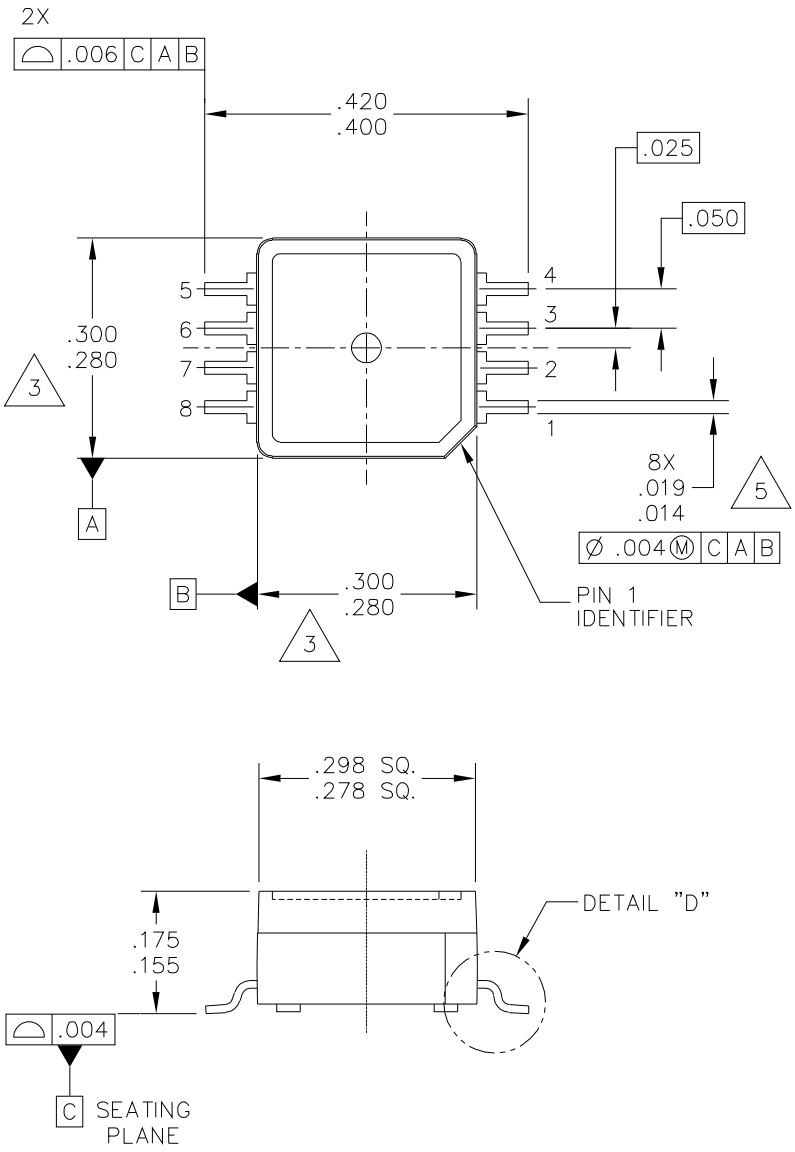
TITLE:
8 LD SOP, SIDE PORT

DOCUMENT NO: 98ASA99303D | REV: D
CASE NUMBER: 1369-01 | 13 DEC 2010
STANDARD: NON-JEDEC



**CASE 1369-01**
**ISSUE B**
**SMALL OUTLINE PACKAGE**

## PACKAGE DIMENSIONS

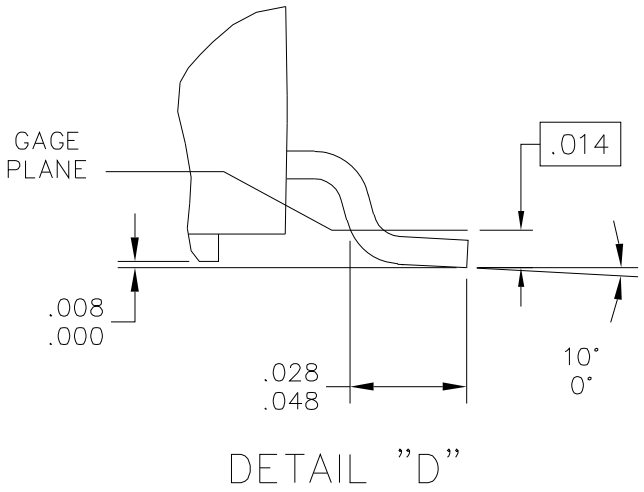



| | | |
|---|---|---|
| © FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED. | **MECHANICAL OUTLINE** | PRINT VERSION NOT TO SCALE |
| TITLE: 8 LEAD SSOP | DOCUMENT NO: 98ARH99066A | REV: H |
| | CASE NUMBER: 1317-04 | 13 APR 2012 |
| | STANDARD: NON-JEDEC | |



**CASE 1317-04**
**ISSUE H**
**SUPER SMALL OUTLINE PACKAGE**

## PACKAGE DIMENSIONS




| © FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED. | MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE |
|---|---|---|
| TITLE: 8 LEAD SSOP | DOCUMENT NO: 98ARH99066A | REV: H |
| | CASE NUMBER: 1317-04 | 13 APR 2012 |
| | STANDARD: NON-JEDEC | |



**CASE 1317-04**
**ISSUE H**
**SUPER SMALL OUTLINE PACKAGE**

NOTES:

1. ALL DIMENSIONS IN INCHES.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994.
3. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
   MOLD FLASH OR PROTRUSION SHALL NOT EXCEED .006 INCHES PER SIDE.
4. ALL VERTICAL SURFACES TO BE 5° MAXIMUM.
5. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION.
   ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 INCHES MAXIMUM.

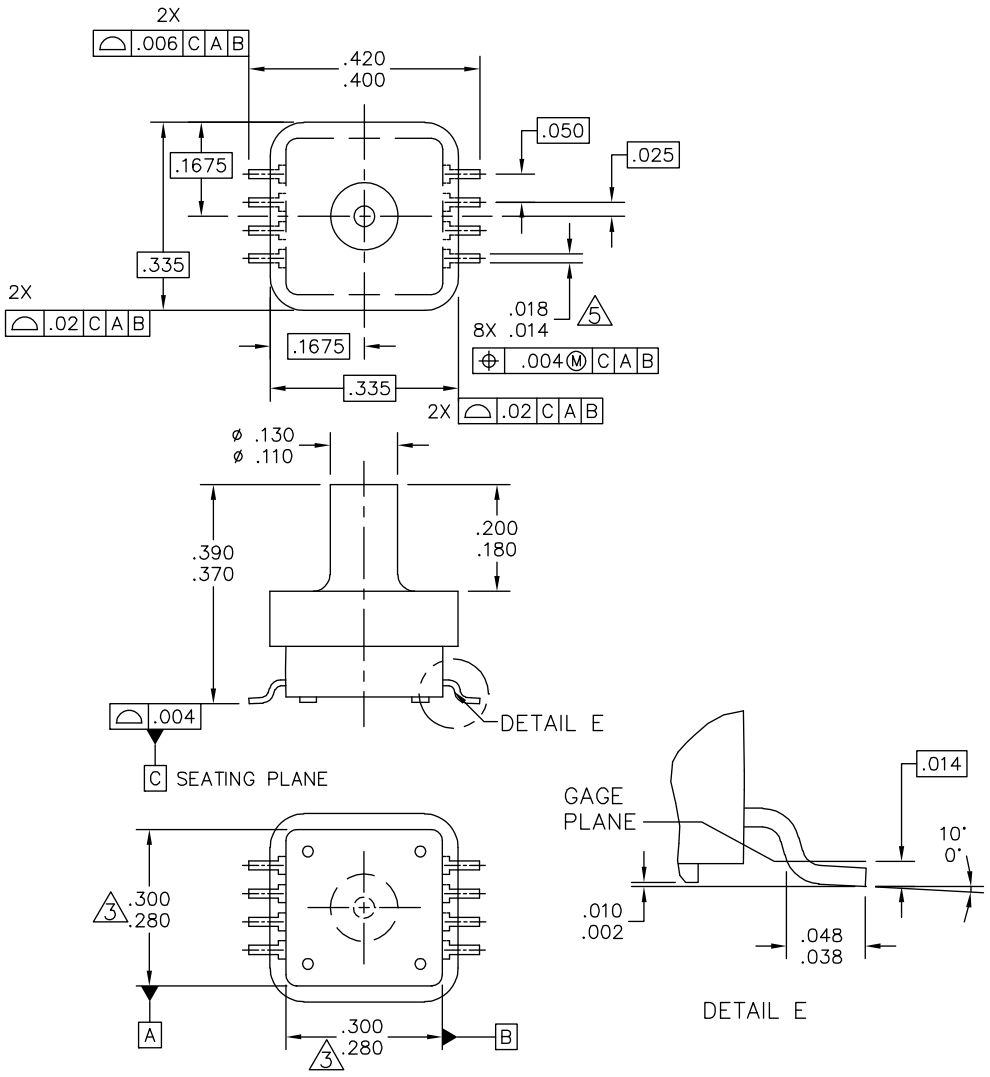


| MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE | |
|---|---|---|
| TITLE: 8 LEAD SSOP | DOCUMENT NO: 98ARH99066A | REV: H |
| | CASE NUMBER: 1317–04 | 13 APR 2012 |
| | STANDARD: NON–JEDEC | |



**CASE 1317-04**
**ISSUE H**
**SUPER SMALL OUTLINE PACKAGE**

# PACKAGE DIMENSIONS




| © FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED. | MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE |
|---|---|---|
| TITLE: 8 LD, PORTED SSOP | DOCUMENT NO: 98ARH99089A | REV: D |
| | CASE NUMBER: 1317A-04 | 26 OCT 2006 |
| | STANDARD: NON-JEDEC | |



**CASE 1317A-04**
**ISSUE D**
**SUPER SMALL OUTLINE PACKAGE**

# PACKAGE DIMENSIONS

NOTES:

1. ALL DIMENSIONS IN INCHES.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994.
3. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
   MOLD FLASH OR PROTRUSION SHALL NOT EXCEED .006 INCHES PER SIDE.
4. ALL VERTICAL SURFACES TO BE 5° MAXIMUM.
5. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION.
   ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 INCHES MAXIMUM.



| MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE | |
|---|---|---|
| TITLE: 8 LD, PORTED SSOP | DOCUMENT NO: 98ARH99089A | REV: D |
| | CASE NUMBER: 1317A–04 | 26 OCT 2006 |
| | STANDARD: NON–JEDEC | |



**CASE 1317A-04**
**ISSUE D**
**SUPER SMALL OUTLINE PACKAGE**

**Table 3. Revision History**

| Revision number | Revision date | Description of changes |
|---|---|---|
| 7.1 | 05/2012 | • Updated Package Drawing 98ARH99066A was Rev. F, updated to Rev. H, |
| 7.2 | 10/2012 | • On page 1, changed typical output voltage from 4.8V to 4.7V to match typical output voltage listed on page 3 of document |

***How to Reach Us:***

**Home Page:**
freescale.com

**Web Support:**
freescale.com/support



MPXA6115A
Rev. 7.2
10/2012