Freescale Semiconductor
Technical Data

Document Number: MPXA6115A
Rev 7, 05/2011

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 4.8 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

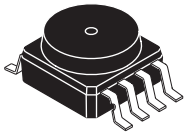
ORDERING INFORMATION

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

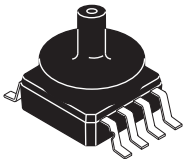
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ORDERING INFORMATION									
Small Outline Package (Media Resistant Gel) (MPXHZ6115A Series)									
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MPXHZ6115A6T1	Tape and Reel	1317	•					•	MPXHZ6115A
MPXHZ6115AC6U	Rails	1317A		•				•	MPXHZ6115A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

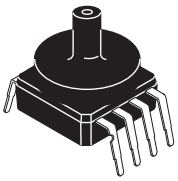
SMALL OUTLINE PACKAGES



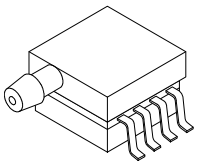
MPXA6115A6U/T1
MPXAZ6115A6U
CASE 482



MPXA6115AC6U/T1
MPXAZ6115AC6U/T1
CASE 482A

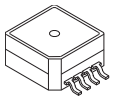


MPXA6115AC7U
CASE 482C

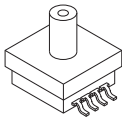


MPXAZ6115AP/T1
CASE 1369

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.

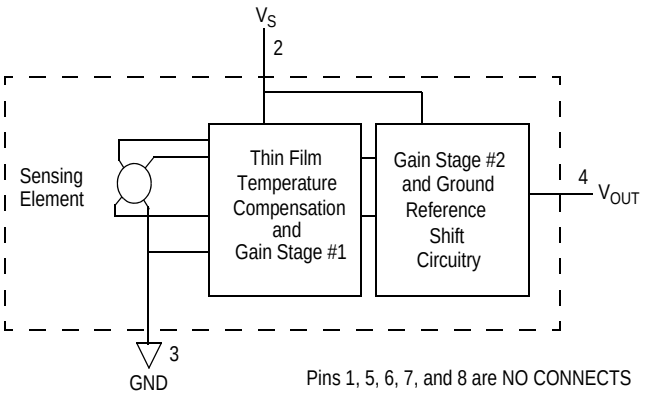


Figure 1. Fully Integrated Pressure Sensor Schematic

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.

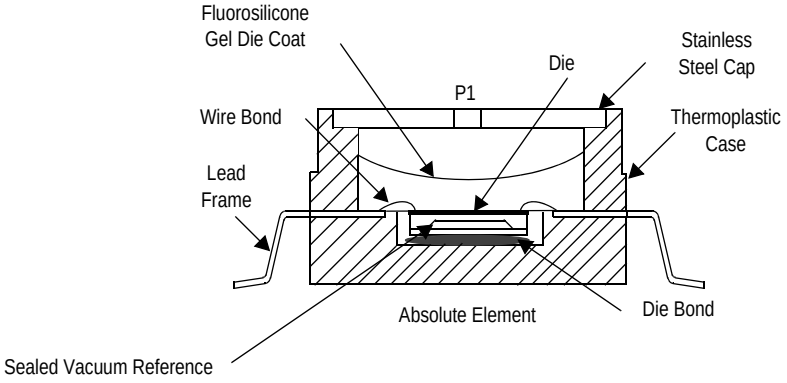


Figure 2. Cross Sectional Diagram SSOP/SOP (not to scale)

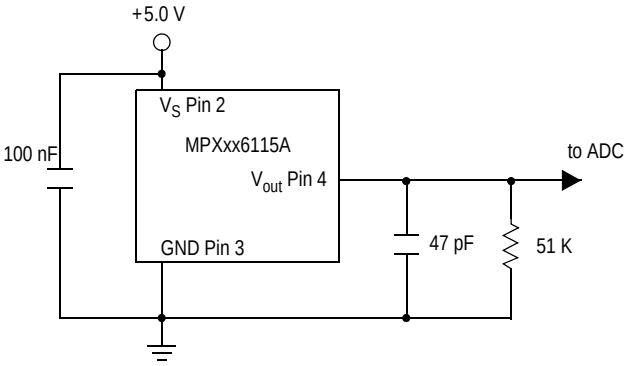


Figure 3. Typical Application Circuit (Output Source Current Operation)

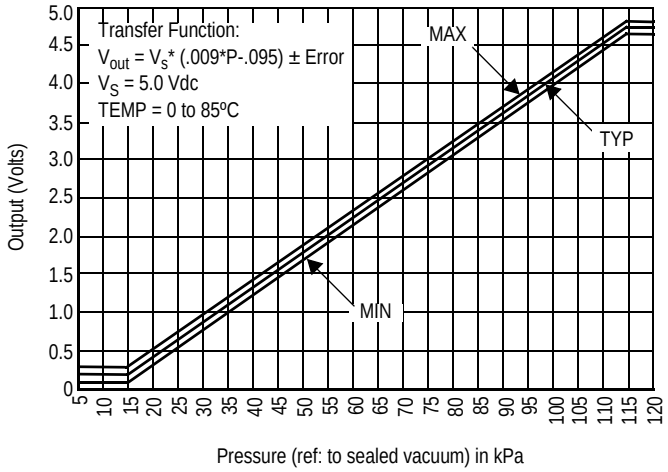
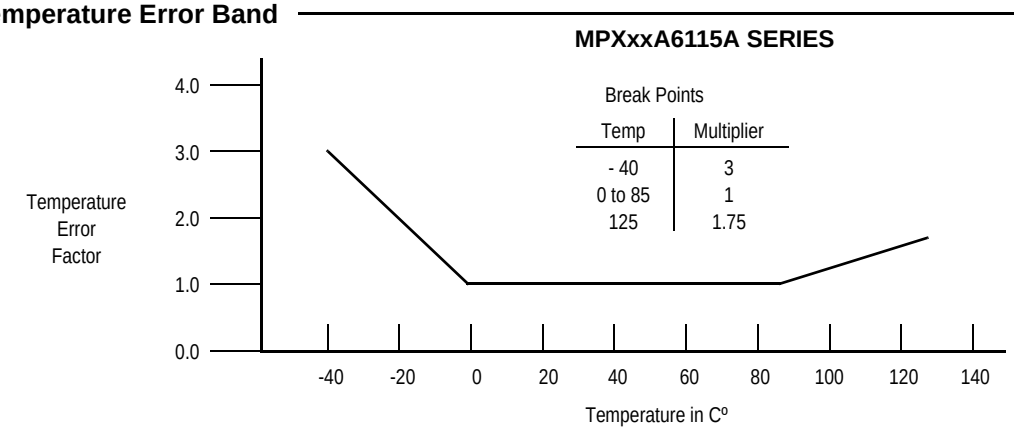


Figure 4. Output vs. Absolute Pressure

Transfer Function (MPXxx6115A)

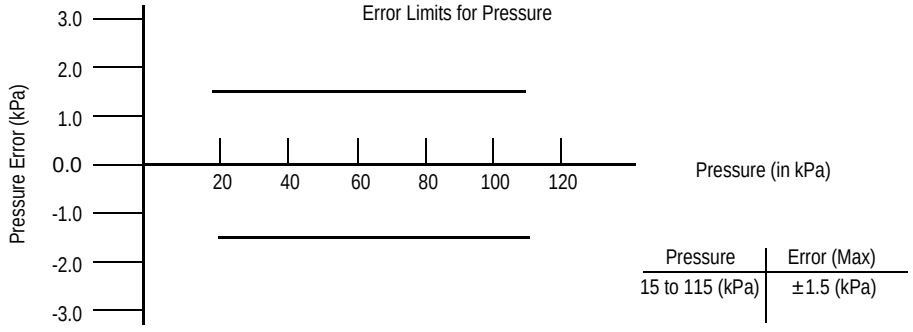
Nominal Transfer Value: $V_{out} = V_S$ x (0.009 x P - 0.095)
± (Pressure Error x Temp. Factor x 0.009 x V_S)
$V_S = 5.0 \pm 0.25$ Vdc

Temperature Error Band



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

Pressure Error Band



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

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.

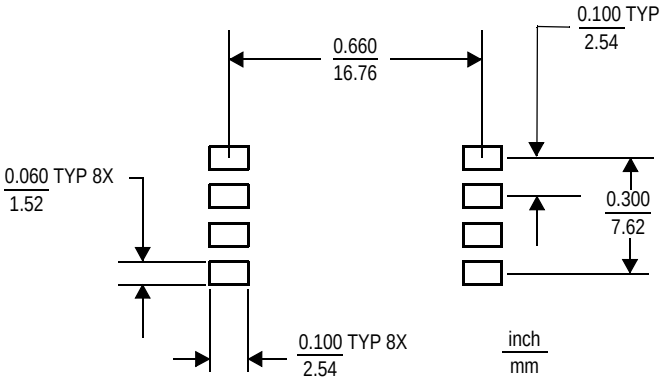


Figure 5. SOP Footprint (Case 482)

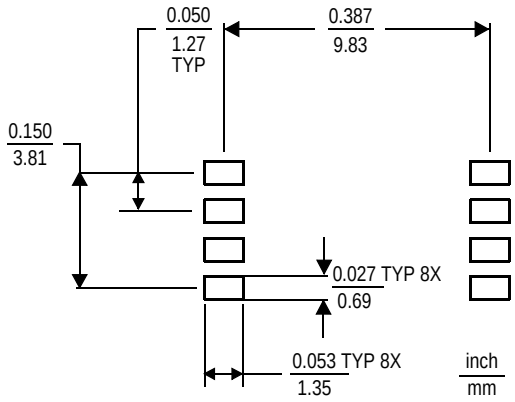
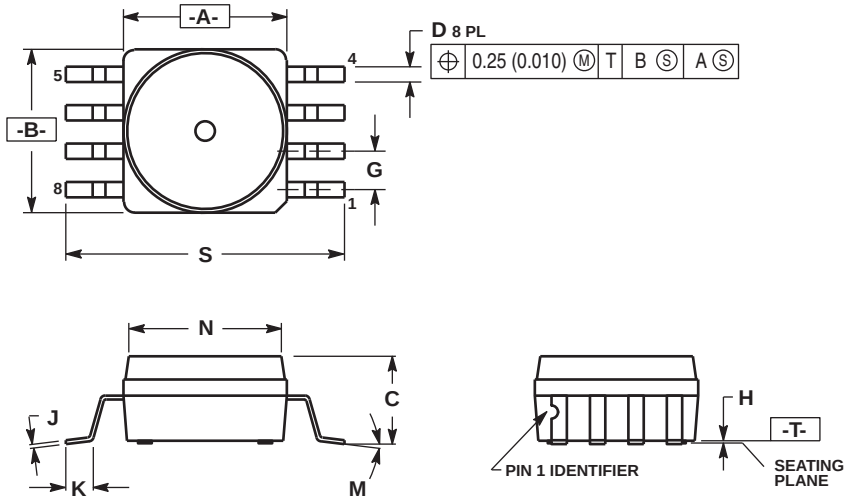


Figure 6. SSOP Footprint (Case 1317 and 1317A)

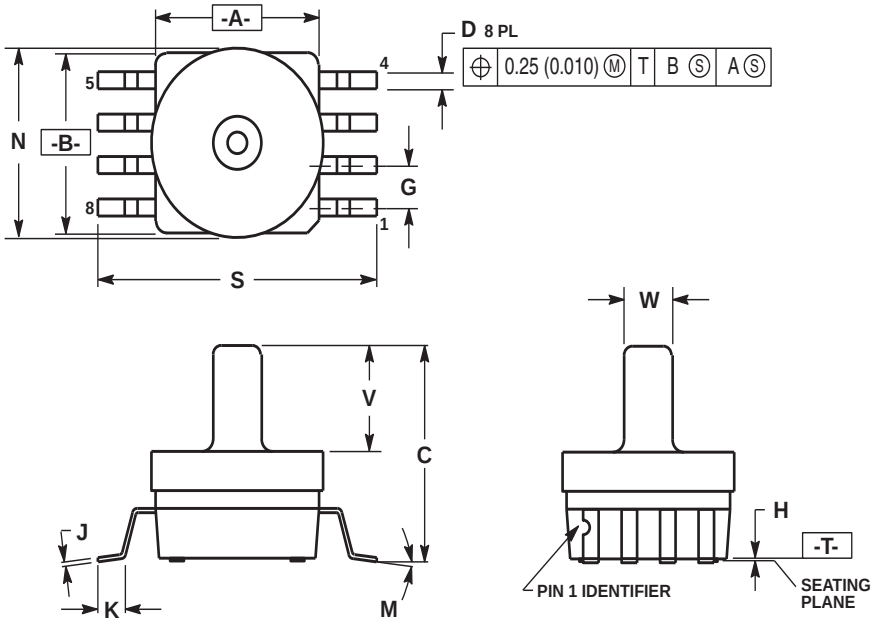
PACKAGE DIMENSIONS



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

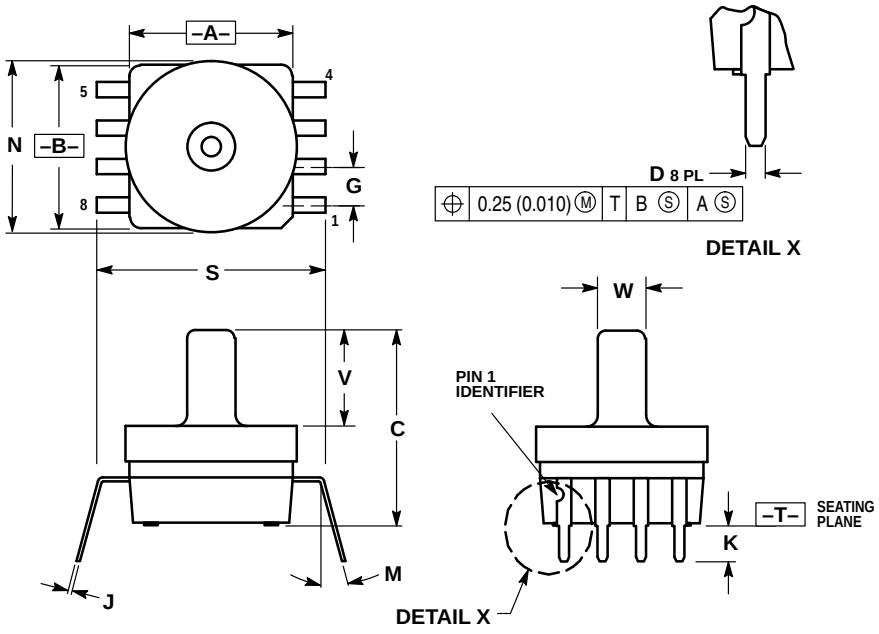


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

	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

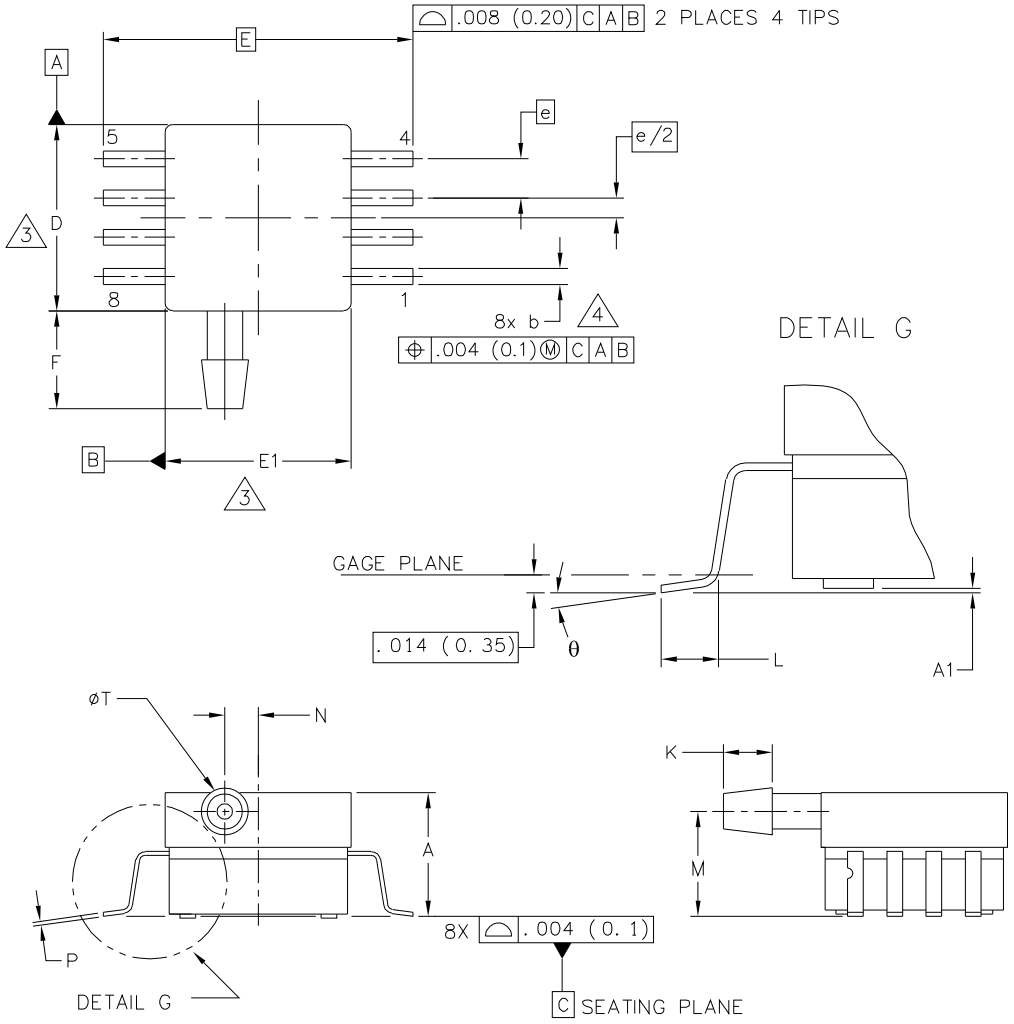


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.
6. DIMENSION S TO CENTER OF LEAD WHEN FORMED PARALLEL.

	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



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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

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	–	---	---	---	---

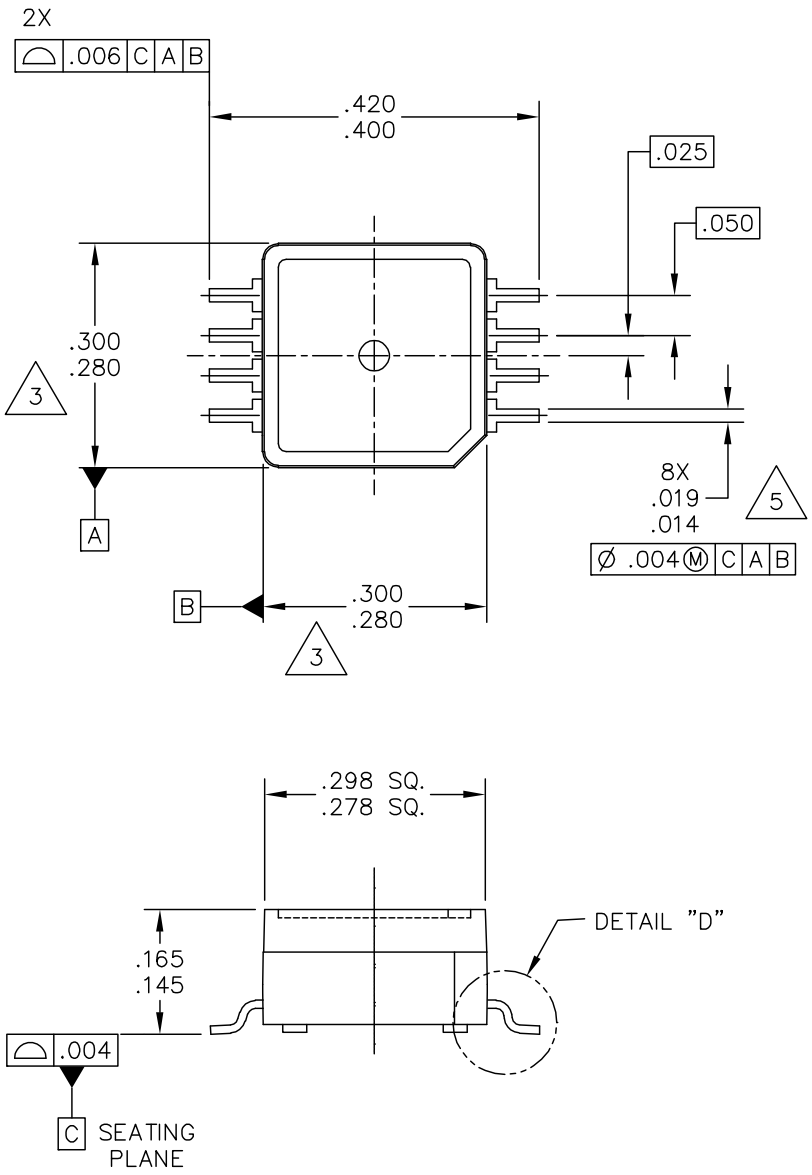
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TITLE:	DOCUMENT NO: 98ASA99303D	REV: D
8 LD SOP, SIDE PORT	CASE NUMBER: 1369-01	13 DEC 2010
	STANDARD: NON-JEDEC	

CASE 1369-01
ISSUE B
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS

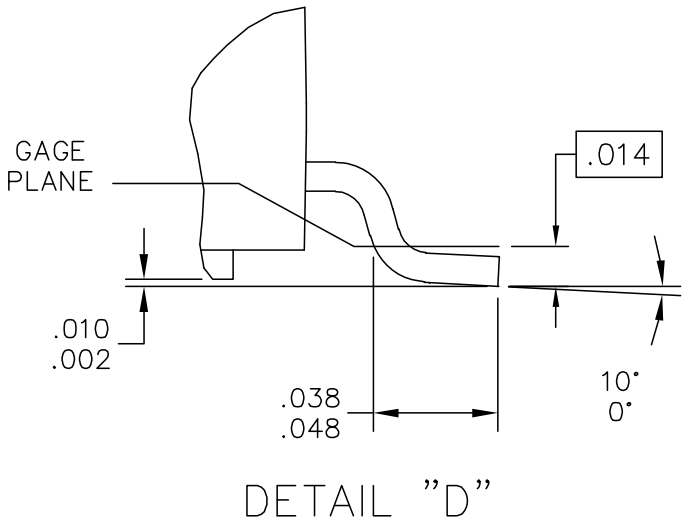


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	CASE NUMBER: 1317–04	24 MAY 2005
	STANDARD: NON–JEDEC	

PAGE 1 OF 3

CASE 1317-04
ISSUE F
SUPER SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



DETAIL "D"

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	CASE NUMBER: 1317–04	24 MAY 2005
	STANDARD: NON–JEDEC	

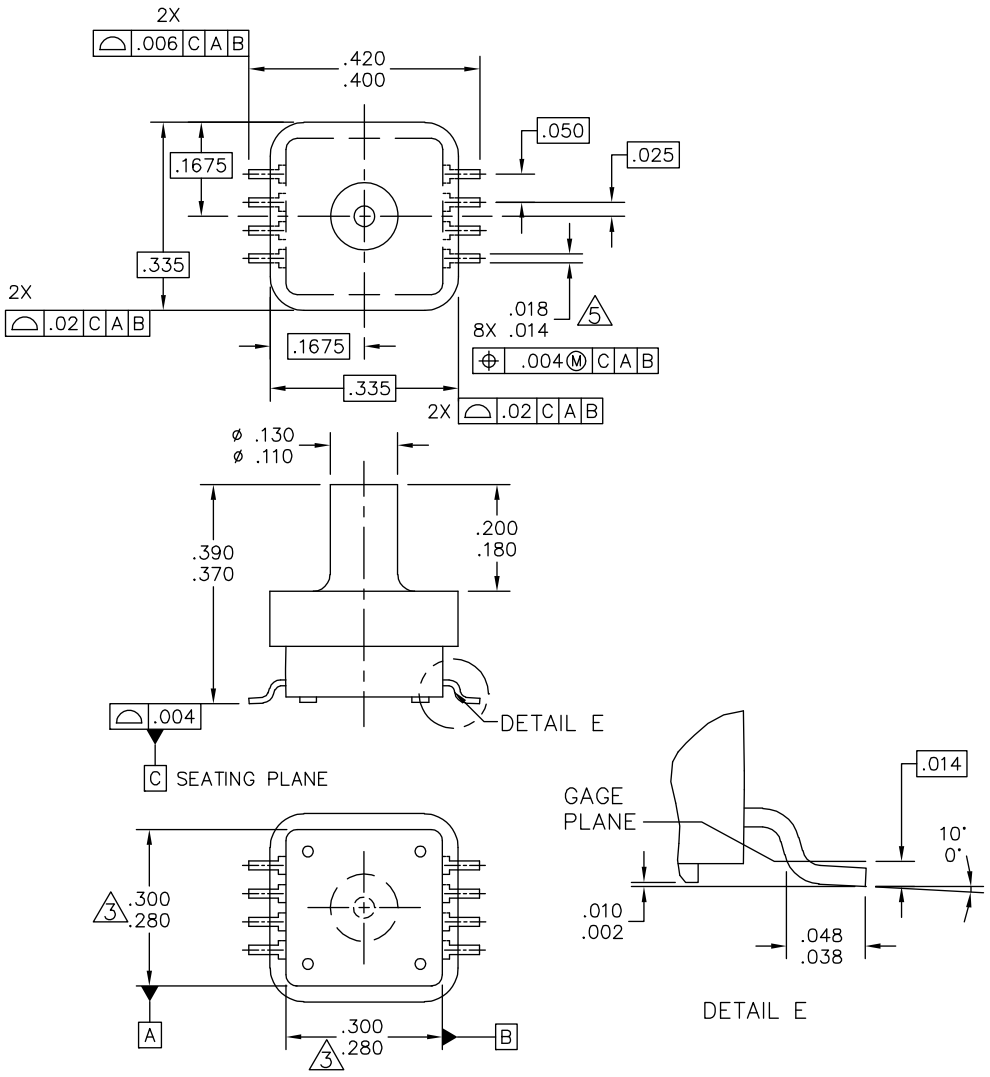
CASE 1317-04
ISSUE F
SUPER SMALL OUTLINE PACKAGE

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.

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TITLE: 8 LEAD SSOP	DOCUMENT NO: 98ARH99066A	REV: F
	CASE NUMBER: 1317–04	24 MAY 2005
	STANDARD: NON–JEDEC	

CASE 1317-04
ISSUE F
SUPER SMALL OUTLINE PACKAGE



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	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.

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MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
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	CASE NUMBER: 1317A–04	26 OCT 2006
	STANDARD: NON–JEDEC	

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