Freescale Semiconductor

MPXH6400A
Rev 4, 11/2009

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

MPXA6400A
MPXH6400A
MPXHZ6400A
Series
20 to 400 kPa (3.0 to 58 psi)
0.2 to 4.8 V Output

The Freescale MPXxx6400A 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 Freescale pressure sensor a logical and economical choice for the system designer.

The MPXxx6400A 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.

Features

- 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

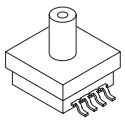
Application Examples

- Industrial Controls
- Engine Control/Manifold Absolute Pressure (MAP)/Liquefied Petroleum Gas (LPG)

ORDERING INFORMATION

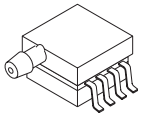
Device Name	Package Options	Case No.	# of Ports			Pressure Type			Device Marking
			None	Single	Dual	Gauge	Differential	Absolute	
Small Outline Package (MPXA6400A Series)									
MPXA6400AP	Tray	1369		•				•	MPXA6400A
Super Small Outline Package (MPXH6400A Series)									
MPXH6400AC6U	Rails	1317A		•				•	MPXH6400A
MPXH6400AC6T1	Tape and Reel	1317A		•				•	MPXH6400A
Super Small Outline Package (Media Resistant Gel) (MPXHZ6400A Series)									
MPXHZ6400AC6T1	Tape and Reel	1317A		•				•	MPXHZ6400A

SUPER SMALL OUTLINE PACKAGE



MPXH6400AC6U/C6T1
MPXHZ6400AC6T1
CASE 1317A-04

SMALL OUTLINE PACKAGE



MPXA6400AP
CASE 1369-01

OPERATING CHARACTERISTICS

(V_S = 10 Vdc, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range		P_{OP}	20	—	400	kPa
Supply Voltage(1)		V_S	4.64	5.0	5.36	Vdc
Supply Current		I_o	—	6.0	10	mAdc
Minimum Pressure Offset @ V_S = 5.0 Volts(2)	(0 to 85°C)	V_{off}	0.133	0.2	0.267	Vdc
Full Scale Output @ V_S = 5.0 Volts(3)	(0 to 85°C)	V_{FSO}	4.733	4.8	4.866	Vdc
Full Scale Span @ V_S = 5.0 Volts(4)	(0 to 85°C)	V_{FSS}	4.467	4.6	4.733	Vdc
Accuracy(5)	(0 to 85°C)	—	—	—	±1.5	$\%V_{FSS}$
Sensitivity		V/P	—	12.1	—	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 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 rated 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_{FSS}, at 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 hours of Pulsed Pressure, Temperature Cycling with Bias Test.

MAXIMUM RATINGS[1]

Rating	Symbol	Value	Unit
Maximum Pressure (P1 > P2)	P_{MAX}	1600	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.

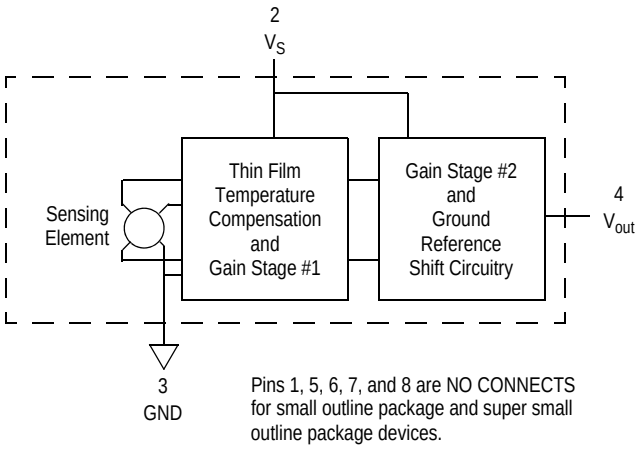


Figure 1. Fully Integrated Pressure Sensor Schematic

Figure 1 illustrates the absolute sensing chip in the basic Super Small Outline chip carrier (Case 1317). Figure 2. illustrates a typical application circuit (output source current operation).

Figure 3. 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 MPXxx6400A 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.

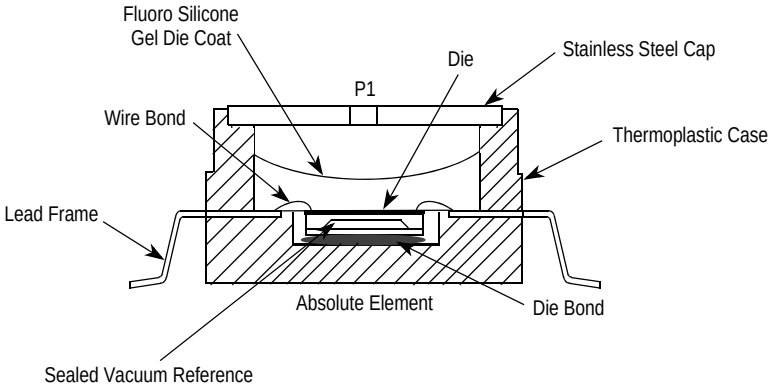


Figure 1. Cross Sectional Diagram SSOP (not to scale)

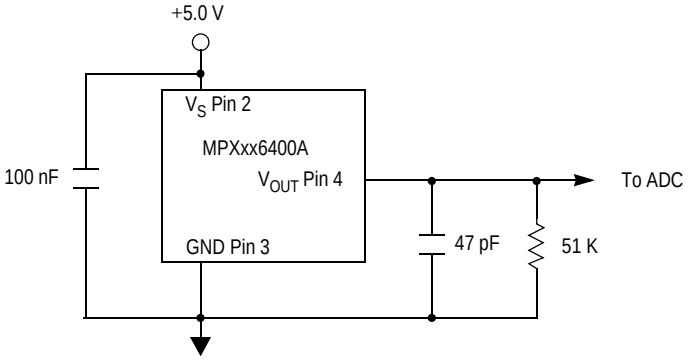


Figure 2. Typical Application Circuit (Output Source Current Operation)

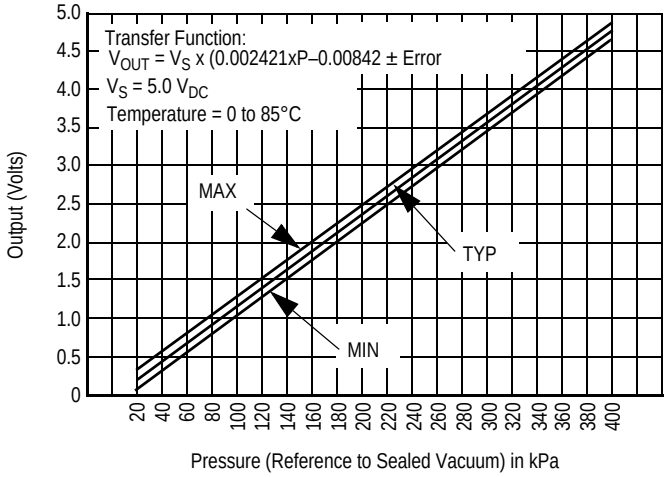
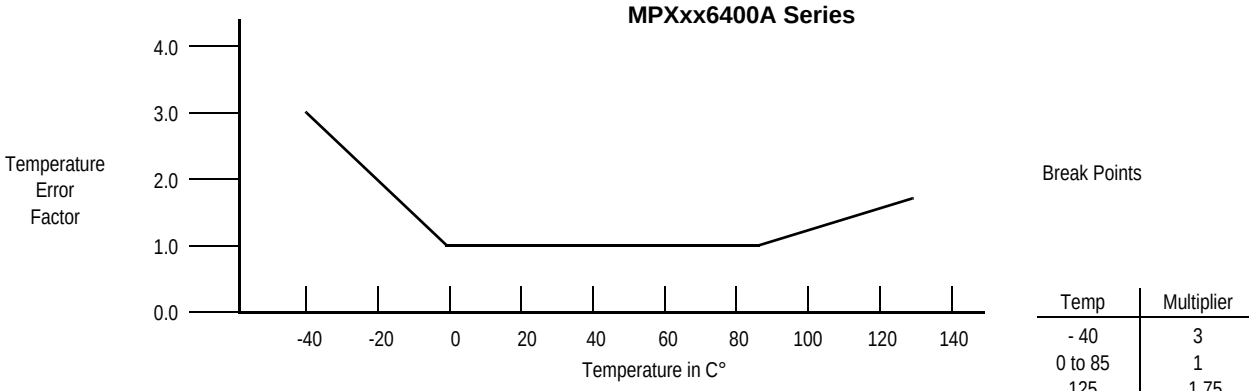


Figure 3. Output vs. Absolute Pressure

Transfer Function (MPXxx6400A)

Normal Transfer Value: $V_{OUT} = V_S \times (0.002421 \times P - 0.00842)$
$\pm$ Pressure Error x Temp. Factor x 0.002421 x V_S
$V_S = 5.0 \pm 0.36\ V_{DC}$

Temperature Error Band

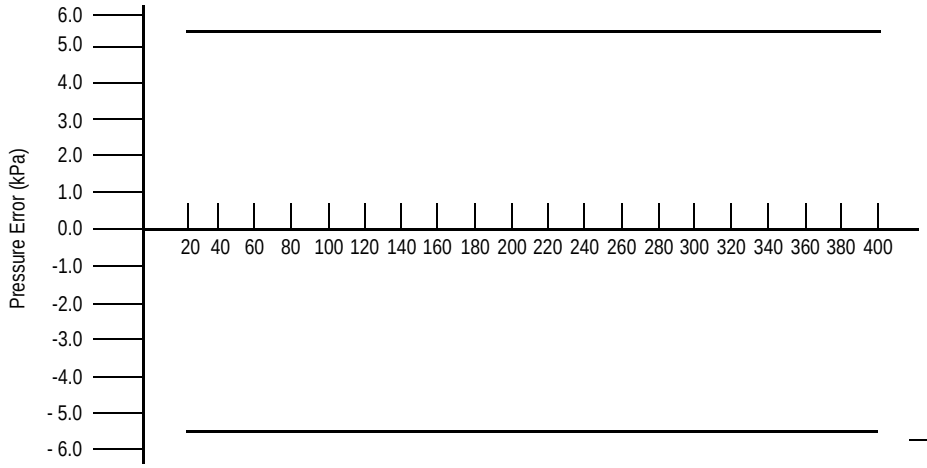


Break Points

Temp	Multiplier
- 40	3
0 to 85	1
125	1.75

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

Pressure Error Band



Error Limits for Pressure
±5.5 (kPa)

Pressure (in kPa)

Pressure	Error (Max)
20 to 400 (kPa)	±5.5 (kPa)

PRESSURE (P1)/VACUUM (P2) SIDE IDENTIFICATION TABLE

The two sides of the pressure sensor are designated as the Pressure (P1) side and the Vacuum (P2) side. The Pressure (P1) side is the side containing fluorosilicone gel, which protects the die from harsh media. The MPX pressure sensor is designed to operate with positive differential pressure applied, P1 > P2.

The Pressure (P1) side may be identified by using the following table:

Part Number	Case Type	Pressure (P1) Side Identifier
MPXH6400AC6U	1317A	Side with Port Attached
MPXH6400AC6T1	1317A	Side with Port Attached
MPXHZ6400AC6T1	1317A	Side with Port Attached
MPXA6400AP	1369	Side with Port Attached

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 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.

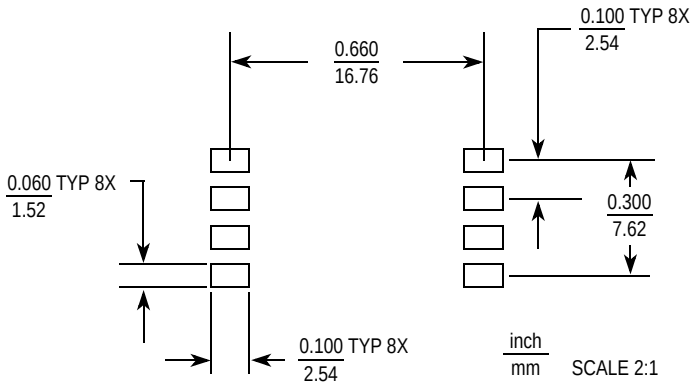


Figure 4. SOP Footprint (Case 1369)

Minimum Recommended Footprint for Super 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.

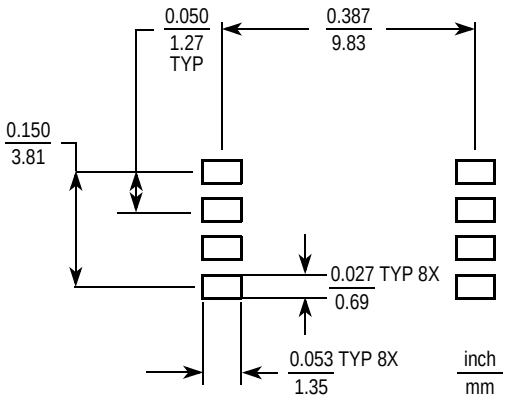
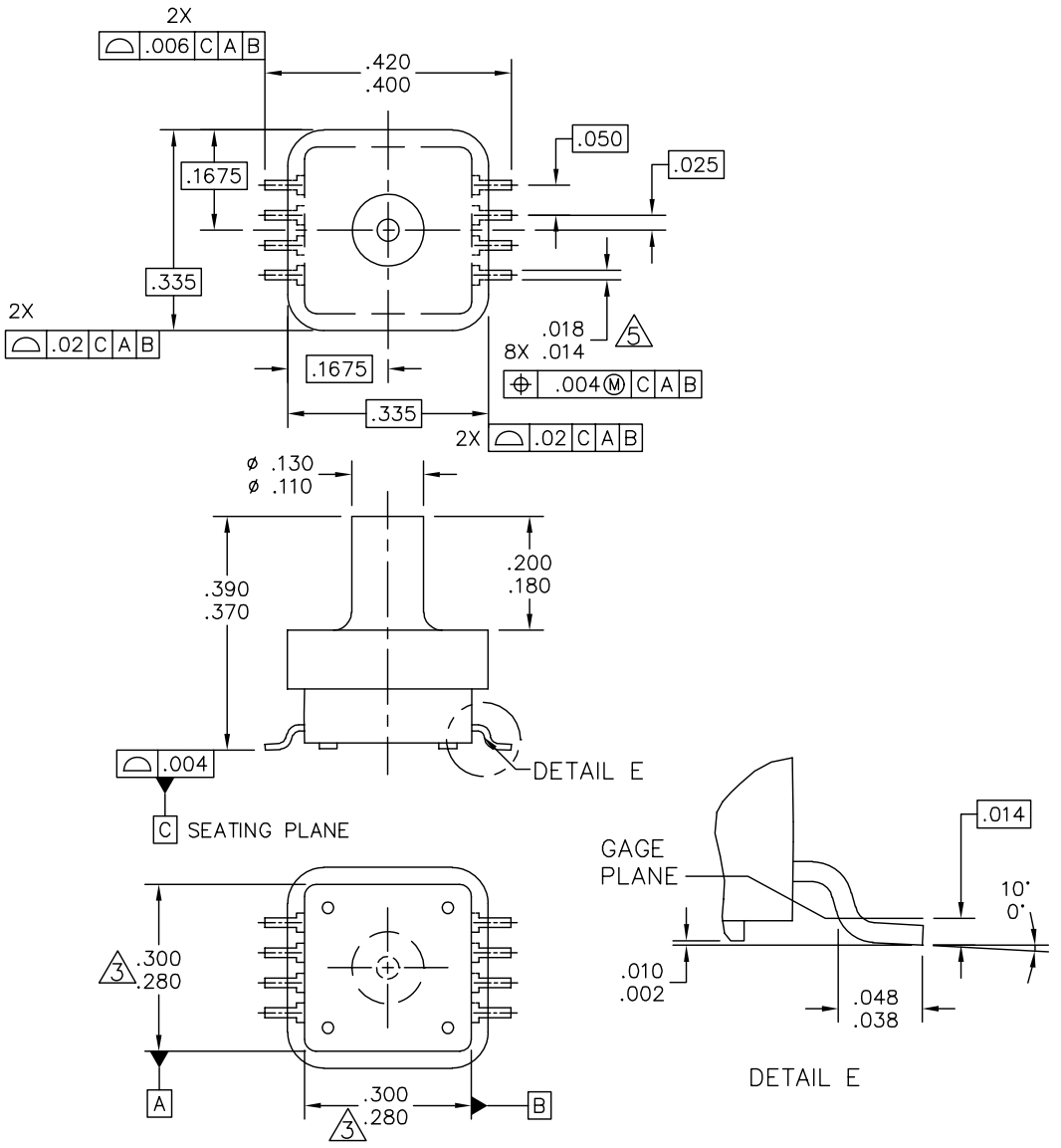


Figure 5. SSOP Footprint (Case 1317A)

PACKAGE DIMENSIONS



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TITLE: 8 LD, PORTED SSOP	DOCUMENT NO: 98ARH99089A	REV: D
	CASE NUMBER: 1317A-04	26 OCT 2006
	STANDARD: NON-JEDEC	

PAGE 1 OF 2

CASE 1317A-04
ISSUE D
SUPER SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS

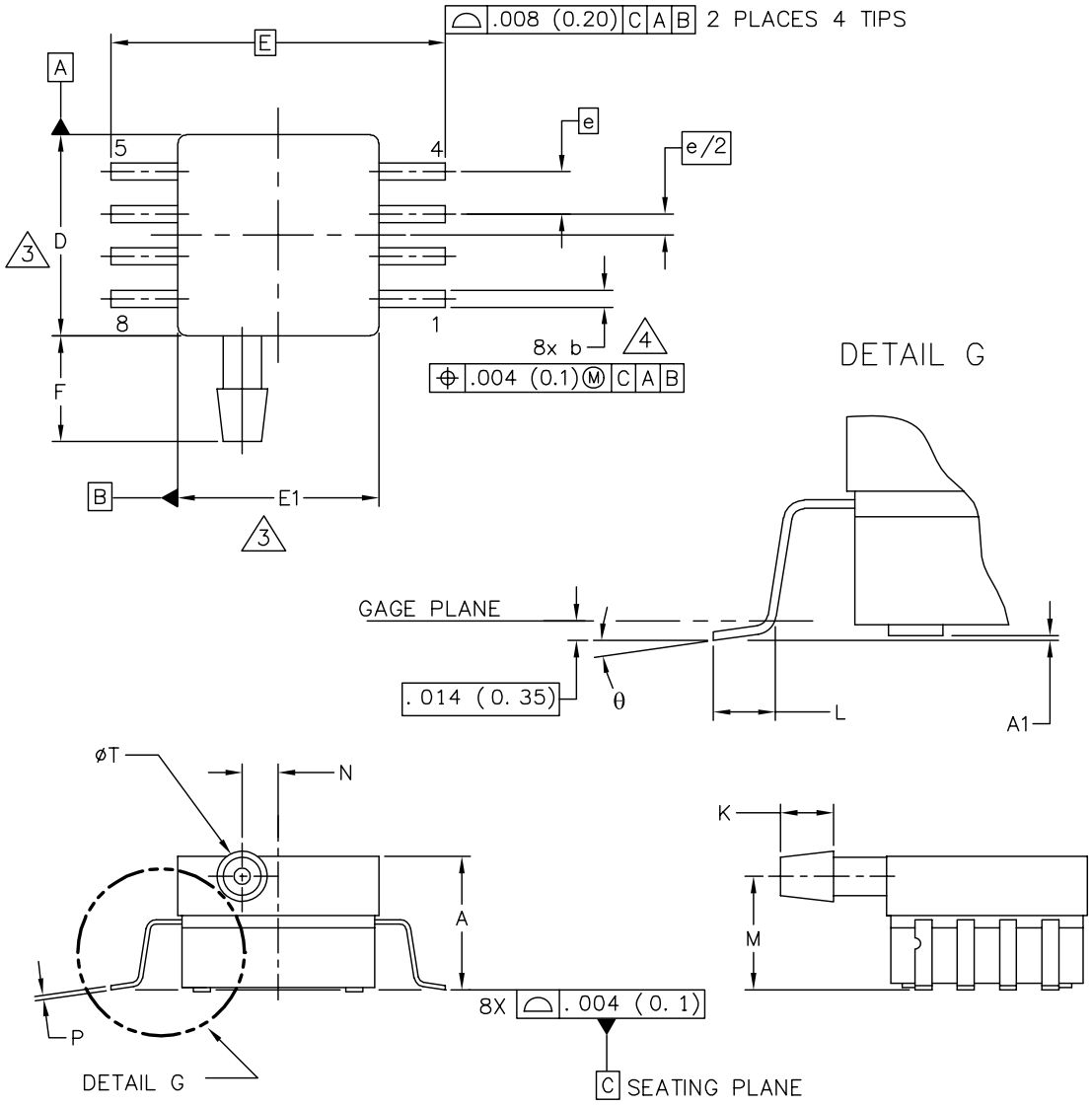
NOTES:

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

PACKAGE DIMENSIONS



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TITLE: 8 LD SOP, SIDE PORT	DOCUMENT NO: 98ASA99303D	REV: B
	CASE NUMBER: 1369-01	24 MAY 2005
	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	7.11	7.62	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:	DOCUMENT NO: 98ASA99303D	REV: B
8 LD SOP, SIDE PORT	CASE NUMBER: 1369-01	24 MAY 2005
	STANDARD: NON-JEDEC	

CASE 1369-01
ISSUE B
SMALL OUTLINE PACKAGE

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