Freescale Semiconductor

MPXV5004G
Rev 12, 09/2009

Integrated Silicon Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated

MPXV5004
MPVZ5004
Series

0 to 3.92 kPa
(0 to 400 mm H_2O)
1.0 to 4.9 V Output

The MPxx5004 series piezoresistive transducer is a state-of-the-art monolithic silicon pressure sensor designed for a wide range of applications, but particularly those employing a microcontroller or microprocessor with A/D inputs. This sensor combines a highly sensitive implanted strain gauge with advanced micromachining techniques, thin-film metallization, and bipolar processing to provide an accurate, high level analog output signal that is proportional to the applied pressure.

Features

- 1.5% Maximum Error for 0 to 100 mm H_2O over +10° to +60°C with Auto Zero
- 2.5% Maximum Error for 100 to 400 mm H_2O over +10° to +60°C with Auto Zero
- 6.25% Maximum Error for 0 to 400 mm H_2O over +10° to +60°C without Auto Zero
- Temperature Compensated over 10° to 60°C
- Available in Gauge Surface Mount (SMT) or Through-Hole (DIP) Configurations
- Durable Thermoplastic (PPS) Package

Application Examples

- Washing Machine Water Level
- Ideally Suited for Microprocessor or Microcontroller-Based Systems
- Appliance Liquid Level and Pressure Measurement
- Respiratory Equipment

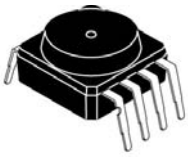
ORDERING INFORMATION

Device Name	Case No.	# of Ports			Pressure Type			Device Marking
		None	Single	Dual	Gauge	Differential	Absolute	
Small Outline Package (MPXV5004 Series)								
MPXV5004DP	1351			•		•		MPXV5004DP
MPXV5004GC6T1	482A		•		•			MPXV5004G
MPXV5004GC6U	482A		•		•			MPXV5004G
MPXV5004GC7U	482C		•		•			MPXV5004G
MPXV5004GP	1369		•		•			MPXV5004GP
MPXV5004GPT1	1369		•		•			MPXV5004GP
MPXV5004GVP	1368		•		•			MPXV5004GVP
Small Outline Package (Media Resistant Gel) (MPVZ5004 Series)								
MPVZ5004G6T1	482	•			•			MPVZ5004G
MPVZ5004G6U	482	•			•			MPVZ5004G
MPVZ5004G7U	482B	•			•			MPVZ5004G
MPVZ5004GC6U	482A		•		•			MPVZ5004G
MPVZ5004GW6U	1735		•		•			MZ5004GW
MPVZ5004GW7U	1560		•		•			MZ5004GW

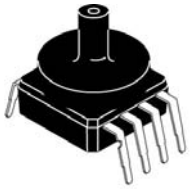
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freescale™ semiconductor

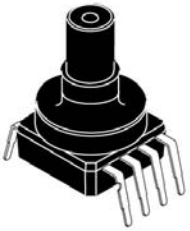
SMALL OUTLINE PACKAGES THROUGH-HOLE



MPVZ5004G7U
CASE 482B-03

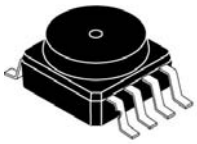


MPXV5004GC7U
CASE 482C-03

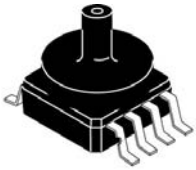


MPVZ5004GW7U
CASE 1560-02

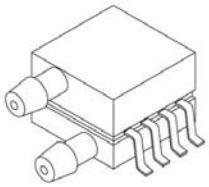
SMALL OUTLINE PACKAGES SURFACE MOUNT



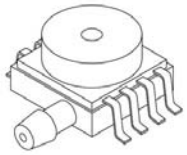
MPVZ5004G6U/6T1
CASE 482-01



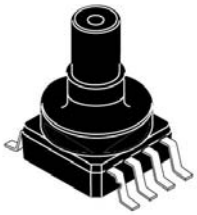
MPXV5004G6U/6T1, MPVZ5004GC6U
CASE 482A-01



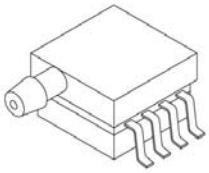
MPXV5004DP
CASE 1351-01



MPXV5004GVP
CASE 1368-01



MPVZ5004GW6U
CASE 1735-01



MPXV5004GP/GPT1
CASE 1369-01

Operating Characteristics

Table 1. Operating Characteristics (V_S = 5.0 V_{DC}, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic		Symbol	Min	Typ	Max	Units
Pressure Range		P_{OP}	0	—	3.92 400	kPa mm H_2O
Supply Voltage(1)		V_S	4.75	5.0	5.25	V_{DC}
Supply Current		I_S	—	—	10	mAdc
Span @ 306 mm H_2O (3 kPa)(2) Full Scale Span @ 400 mm H_2O (3.92 kPa)(2)		V_{FSS}	— —	3.0 4.0	— —	V
Offset(3)		V_{OFF}	0.75	1.0	1.25	V
Sensitivity		V/P	—	1.0	—	V/kPa
Accuracy (4) (5)	0 to 100 mm H_2O (10 to 60°C)	—	—	—	±1.5	$\%V_{FSS}$ with auto zero
	100 to 400 mm H_2O (10 to 60°C)	—	—	—	±2.5	$\%V_{FSS}$ with auto zero
	0 to 400 mm H_2O (10 to 60°C	—	—	—	±6.25	$\%V_{FSS}$ without auto zero

1. Device is ratiometric within this specified excitation range.
2. Span is defined as the algebraic difference between the output voltage at specified pressure and the output voltage at the minimum rated pressure.
3. Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
4. 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.

   Offset Stability:Output deviation, after 1000 temperature cycles, -30 to 100°C, and 1.5 million pressure cycles, with minimum rated pressure applied.

   TcSpan:Output deviation over the temperature range of 10 to 60°C, relative to 25°C.

   TcOffset:Output deviation with minimum rated pressure applied, over the temperature range of 10 to 60°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.
5. Auto Zero at Factory Installation: Due to the sensitivity of the MPVZ5004G, external mechanical stresses and mounting position can affect the zero pressure output reading. Autozeroing is defined as storing the zero pressure output reading and subtracting this from the device's output during normal operations. Reference AN1636 for specific information. The specified accuracy assumes a maximum temperature change of ±5°C between autozero and measurement.

Maximum Ratings

Table 2. Maximum Ratings(1)

Rating	Symbol	Value	Unit
Maximum Pressure (P1 > P2)	P_{MAX}	16	kPa
Storage Temperature	T_{STG}	–30 to +100	°C
Operating Temperature	T_A	0 to +85	°C

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

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

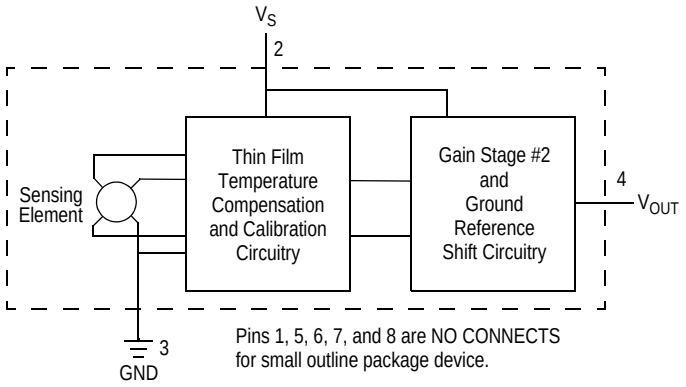


Figure 1. Integrated Pressure Sensor Schematic

On-chip Temperature Compensation and Calibration

The performance over temperature is achieved by integrating the shear-stress strain gauge, temperature compensation, calibration and signal conditioning circuitry onto a single monolithic chip.

Figure 2 illustrates the gauge configuration in the basic chip carrier (Case 482). 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 MPxx5004G series sensor operating characteristics are based on use of dry air as pressure media. Media, other than dry air, may have adverse effects on sensor performance and long-term reliability. Internal reliability and qualification test for dry air, and other media, are available from the factory. Contact the factory for information regarding media tolerance in your application.

Figure 3 shows the recommended decoupling circuit for interfacing the output of the MPxx5004G to the A/D input of the microprocessor or microcontroller. Proper decoupling of the power supply is recommended.

Typical, minimum and maximum output curves are shown for operation over a temperature range of 10°C to 60°C using the decoupling circuit shown in Figure 3. The output will saturate outside of the specified pressure range.

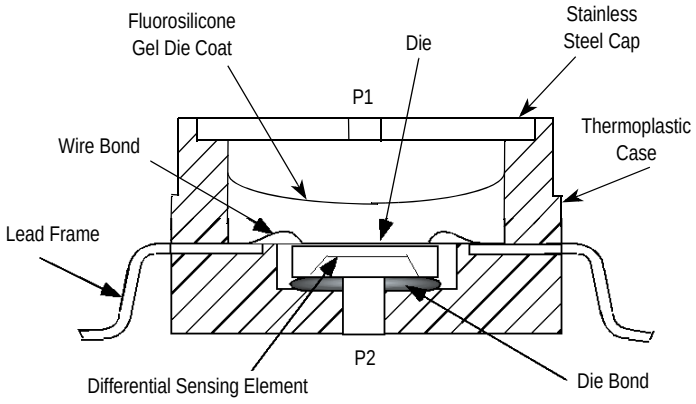


Figure 2. Cross-Sectional Diagram (Not to Scale)

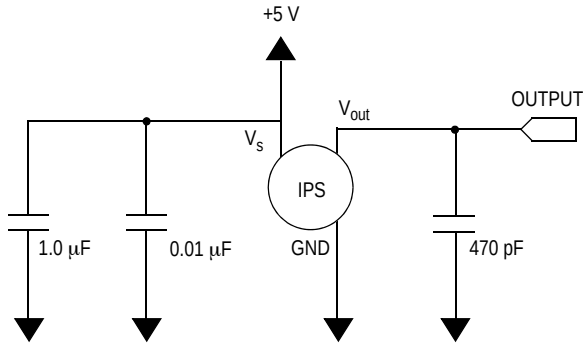


Figure 3. Recommended Power Supply Decoupling and Output Filtering
(For additional output filtering, please refer to AN1646.)

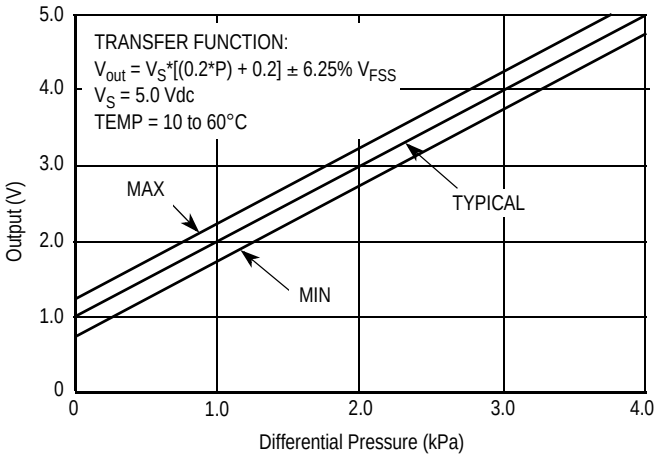


Figure 4. Output vs. Pressure Differential at ±6.25% V_{FSS} (without auto zero, Table 1., note 5)

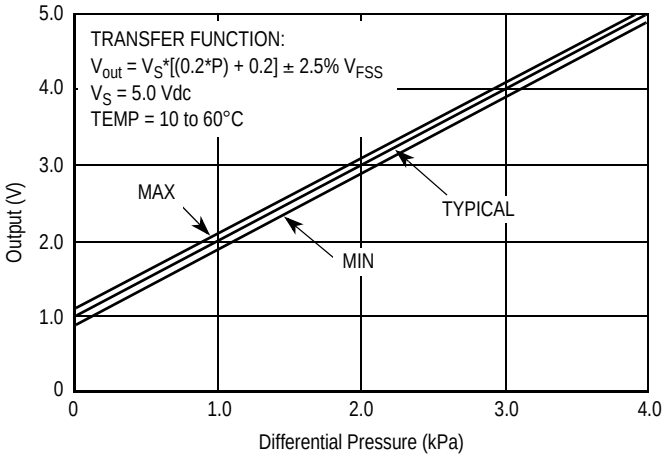


Figure 5. Output vs. Pressure Differential at ±2.5% V_{FSS} (with auto zero, Table 1., note 5))

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

Freescale Semiconductor designates the two sides of the pressure sensor as the Pressure (P1) side and the Vacuum (P2) side. The Pressure (P1) side is the side containing silicone gel which isolates the die from the environment.

The Freescale Semiconductor pressure sensor is designed to operate with positive differential pressure applied, P1 > P2.

The Pressure (P1) side may be identified by using the table below.

Part Number	Case Type	Pressure (P1) Side Identifier
MPXV5004DP	1351	Side with Part Marking
MPXV5004GC6U/6T1, MPVZ5004GC6U	482A	Side with Port Attached
MPXV5004GC7U	482C	Side with Port Attached
MPXV5004GP/GPT1	1369	Side with Port Attached
MPXV5004GVP	1368	Stainless Steel Cap
MPVZ5004G6U/6T1	482	Stainless Steel Cap
MPVZ5004G7U	482B	Stainless Steel Cap
MPVZ5004GW6U	1735	Vertical Port Attached
MPVZ5004GW7U	1560	Vertical Port Attached

INFORMATION FOR USING THE SMALL OUTLINE PACKAGE (CASE 482)

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

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.

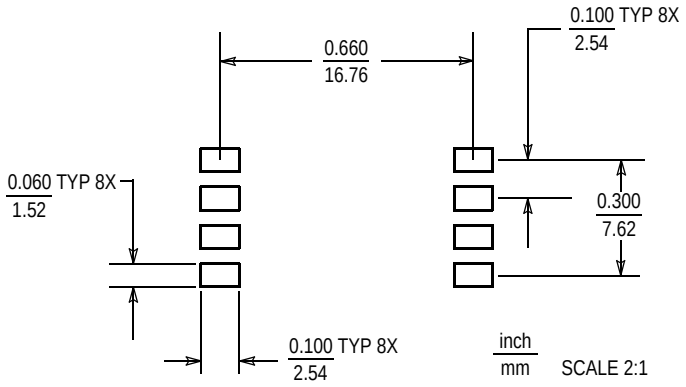
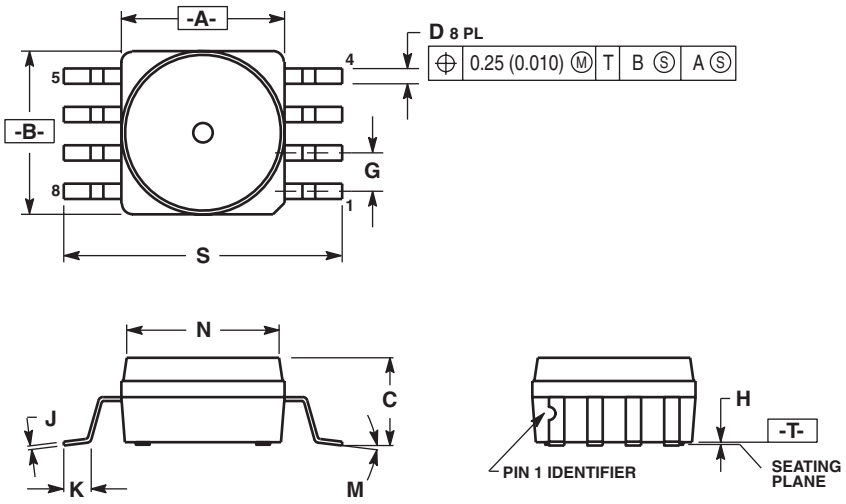


Figure 6. SOP Footprint (Case 482)

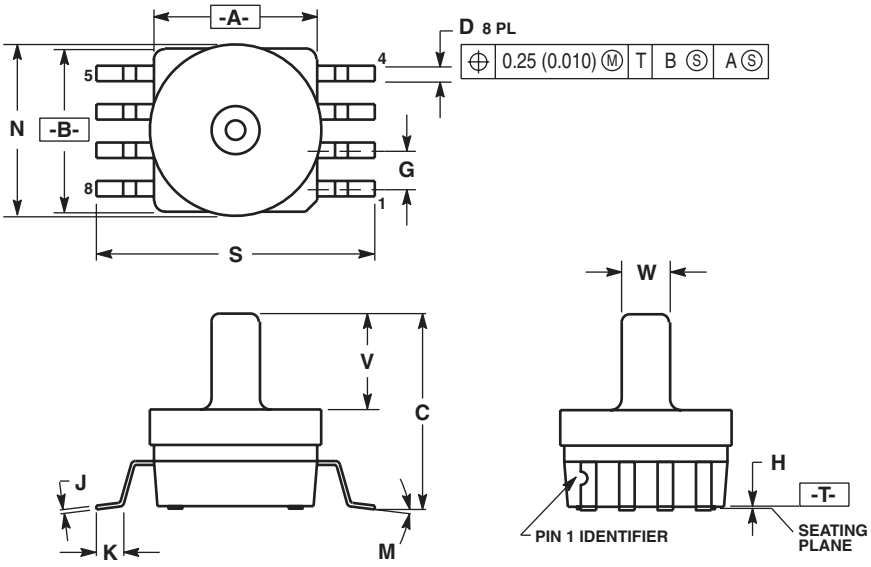
PACKAGE DIMENSIONS



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
SURFACE MOUNT

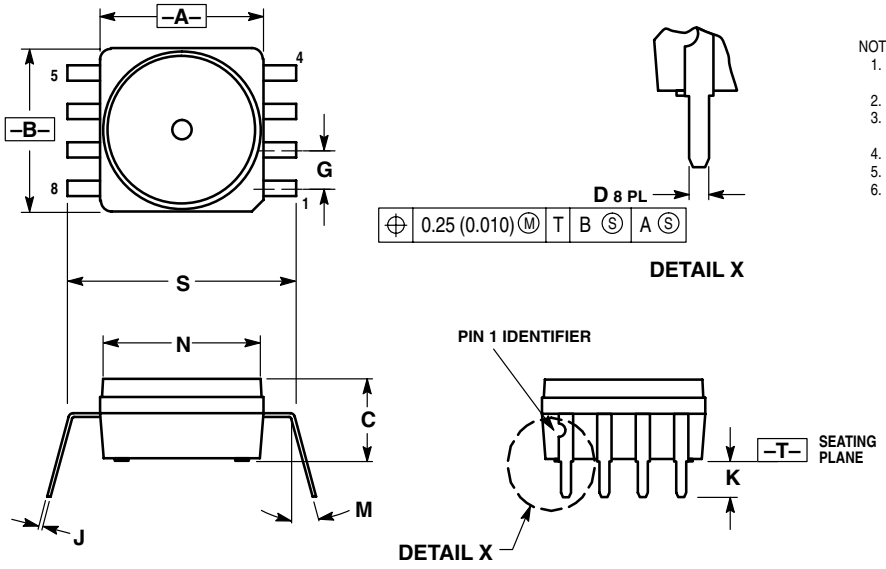


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5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

	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
SURFACE MOUNT

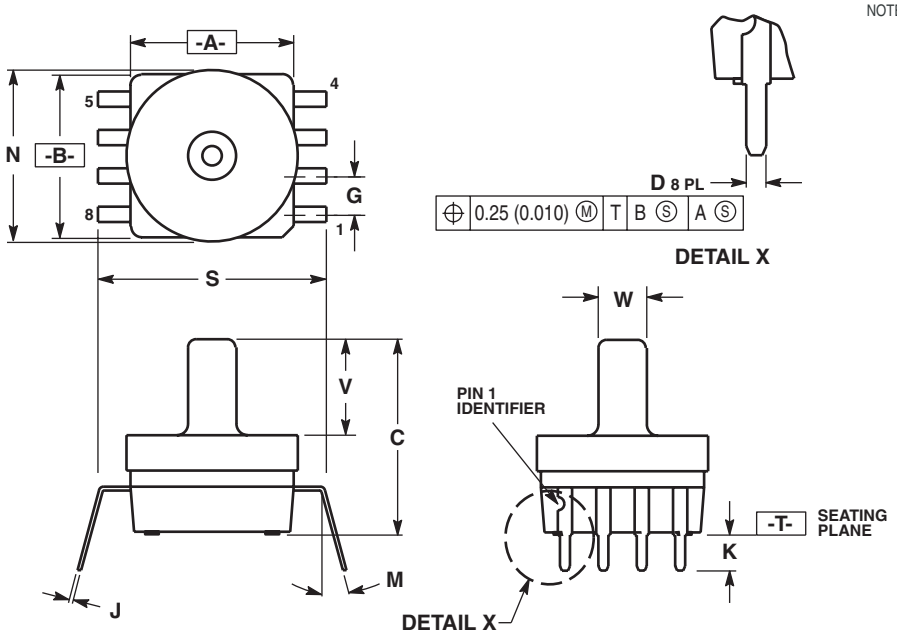
PACKAGE DIMENSIONS



NOTES:
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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	0.210	0.220	5.33	5.59
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	0.405	0.415	10.29	10.54
S	0.540	0.560	13.72	14.22

CASE 482B-03
ISSUE B
SMALL OUTLINE PACKAGE
THROUGH-HOLE

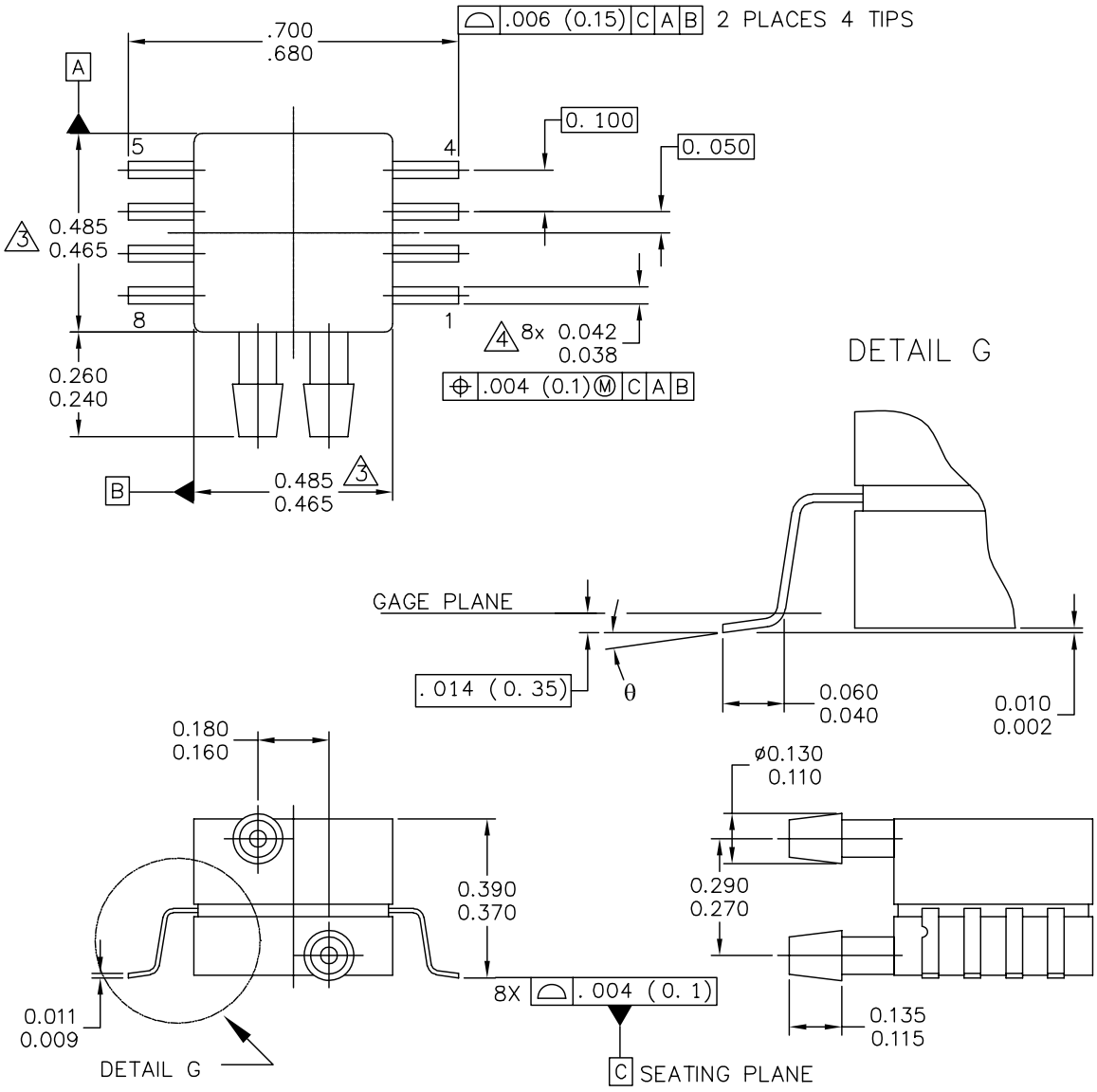


NOTES:
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2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5˚ TYPICAL DRAFT.
6. DIMENSION S TO CENTER OF LEAD WHEN FORMED PARALLEL.

	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
THROUGH-HOLE

PACKAGE DIMENSIONS



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TITLE: 8 LD SNSR, DUAL PORT	DOCUMENT NO: 98ASA99255D	REV: A
	CASE NUMBER: 1351-01	27 JUL 2005
	STANDARD: NON-JEDEC	

CASE 1351-01
ISSUE A
SMALL OUTLINE PACKAGE
SURFACE MOUNT

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 PER SIDE.

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

STYLE 1:	STYLE 2:
PIN 1: GND	PIN 1: N/C
PIN 2: +Vout	PIN 2: Vs
PIN 3: Vs	PIN 3: GND
PIN 4: –Vout	PIN 4: Vout
PIN 5: N/C	PIN 5: N/C
PIN 6: N/C	PIN 6: N/C
PIN 7: N/C	PIN 7: N/C
PIN 8: N/C	PIN 8: N/C

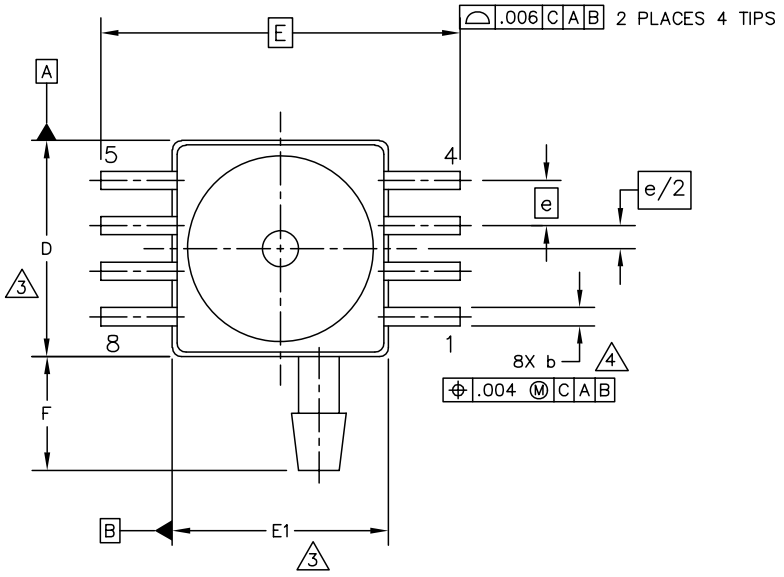
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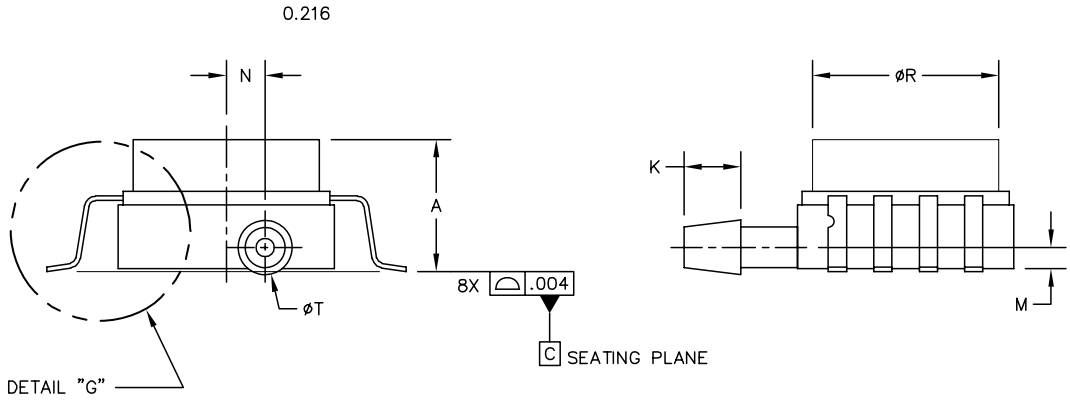
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	STANDARD: NON–JEDEC	

CASE 1351-01
ISSUE A
SMALL OUTLINE PACKAGE
SURFACE MOUNT

PACKAGE DIMENSIONS



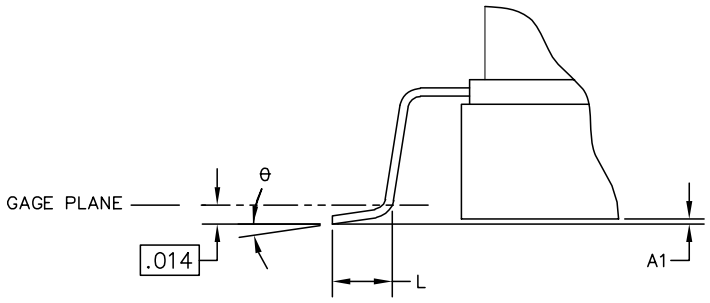


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TITLE: 8 LD SOP, GVP	DOCUMENT NO: 98ASA99302D	REV: B
	CASE NUMBER: 1368–01	23 MAY 2005
	STANDARD: NON–JEDEC	

PAGE 1 OF 3

CASE 1368-01
ISSUE B
SMALL OUTLINE PACKAGE
SURFACE MOUNT

PACKAGE DIMENSIONS



DETAIL "G"

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TITLE: 8 LD SOP, GVP	DOCUMENT NO: 98ASA99302D	REV: B
	CASE NUMBER: 1368–01	23 MAY 2005
	STANDARD: NON–JEDEC	

CASE 1368-01
ISSUE B
SMALL OUTLINE PACKAGE
SURFACE MOUNT

PACKAGE DIMENSIONS

NOTES:

1. CONTROLLING DIMENSION: INCH

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

3. THIS DIMENSIONS DOES NOT INCLUDE MOLD FLASH OR PPROTRUSIONS. MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 PER SIDE.

4. THIS DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.

STYLE 1:
PIN 1: GND
PIN 2: +Vout
PIN 3: Vs
PIN 4: –Vout
PIN 5: N/C
PIN 6: N/C
PIN 7: N/C
PIN 8: N/C

STYLE 2:
PIN 1: N/C
PIN 2: Vs
PIN 3: GND
PIN 4: Vout
PIN 5: N/C
PIN 6: N/C
PIN 7: N/C
PIN 8: N/C

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX	DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	.280	.300	7.11	7.62	R	.405	.415	10.28	10.54
A1	.002	.010	0.05	0.25	θ	0°	7°	0°	7°
b	.038	.042	0.96	1.07	–	---	---	---	---
D	.465	.485	11.81	12.32	–	---	---	---	---
E	.690 BSC		17.52 BSC		–	---	---	---	---
E1	.465	.485	11.85	12.32	–	---	---	---	---
e	.100 BSC		2.54 BSC		–	---	---	---	---
F	.240	.260	6.10	6.60	–	---	---	---	---
K	.115	.135	2.92	3.43	–	---	---	---	---
L	.040	.060	1.02	1.52	–	---	---	---	---
M	.035	.055	1.90	2.41	–	---	---	---	---
N	.075	.095	0.89	1.39	–	---	---	---	---
P	.009	.011	0.23	0.28	–	---	---	---	---
T	.110	.130	2.79	3.30	–	---	---	---	---

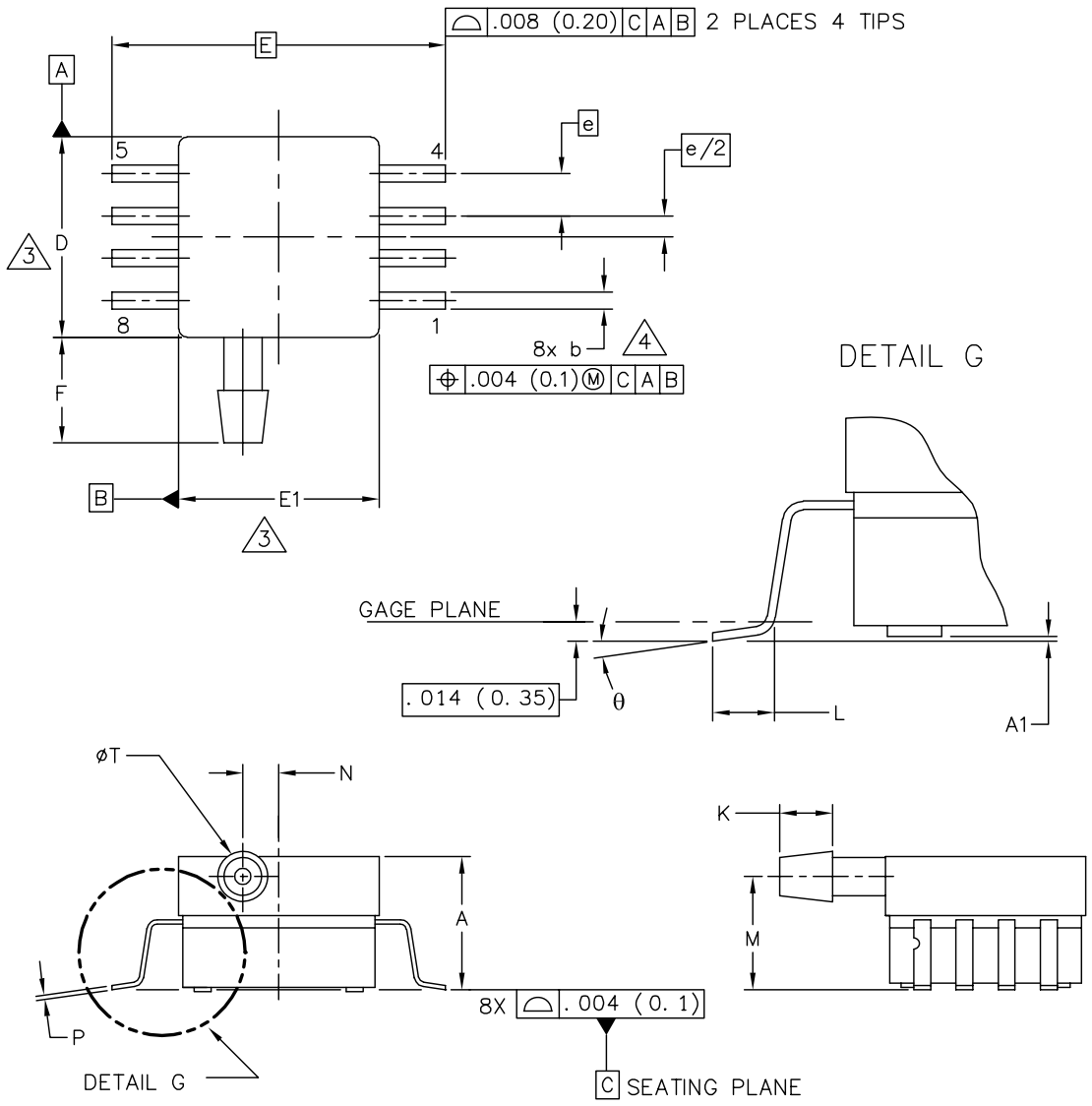
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MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

TITLE:	DOCUMENT NO: 98ASA99302D	REV: B
8 LD SOP, GVP	CASE NUMBER: 1368–01	23 MAY 2005
	STANDARD: NON–JEDEC	

CASE 1368-01
ISSUE B
SMALL OUTLINE PACKAGE
SURFACE MOUNT

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	–	---	---	---	---

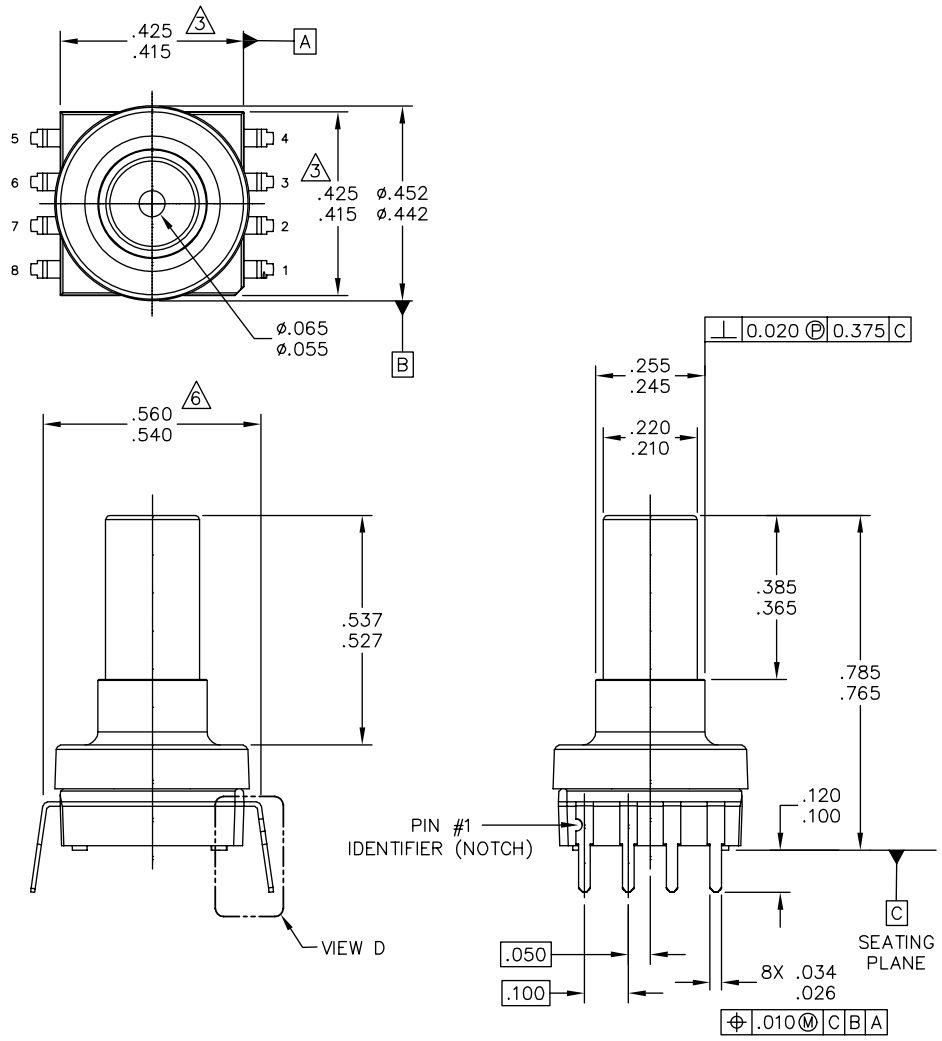
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MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

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

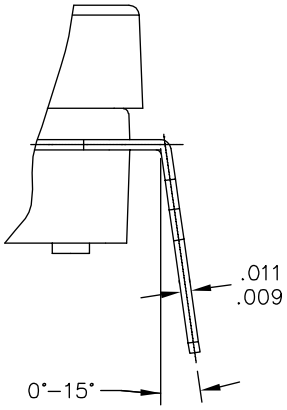
PACKAGE DIMENSIONS



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TITLE: SO, 8 I/O, .420 X .420 PKG, .100 IN PITCH	DOCUMENT NO: 98ASA10611D	REV: D
	CASE NUMBER: 1560-03	25 FEB 2009
	STANDARD: NON-JEDEC	

1560-03
ISSUE C
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



VIEW D

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TITLE: SO, 8 I/O, .420 X .420 PKG, .100 IN PITCH	DOCUMENT NO: 98ASA10611D	REV: D
	CASE NUMBER: 1560–03	25 FEB 2009
	STANDARD: NON–JEDEC	

CASE 1560-03
ISSUE D
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS

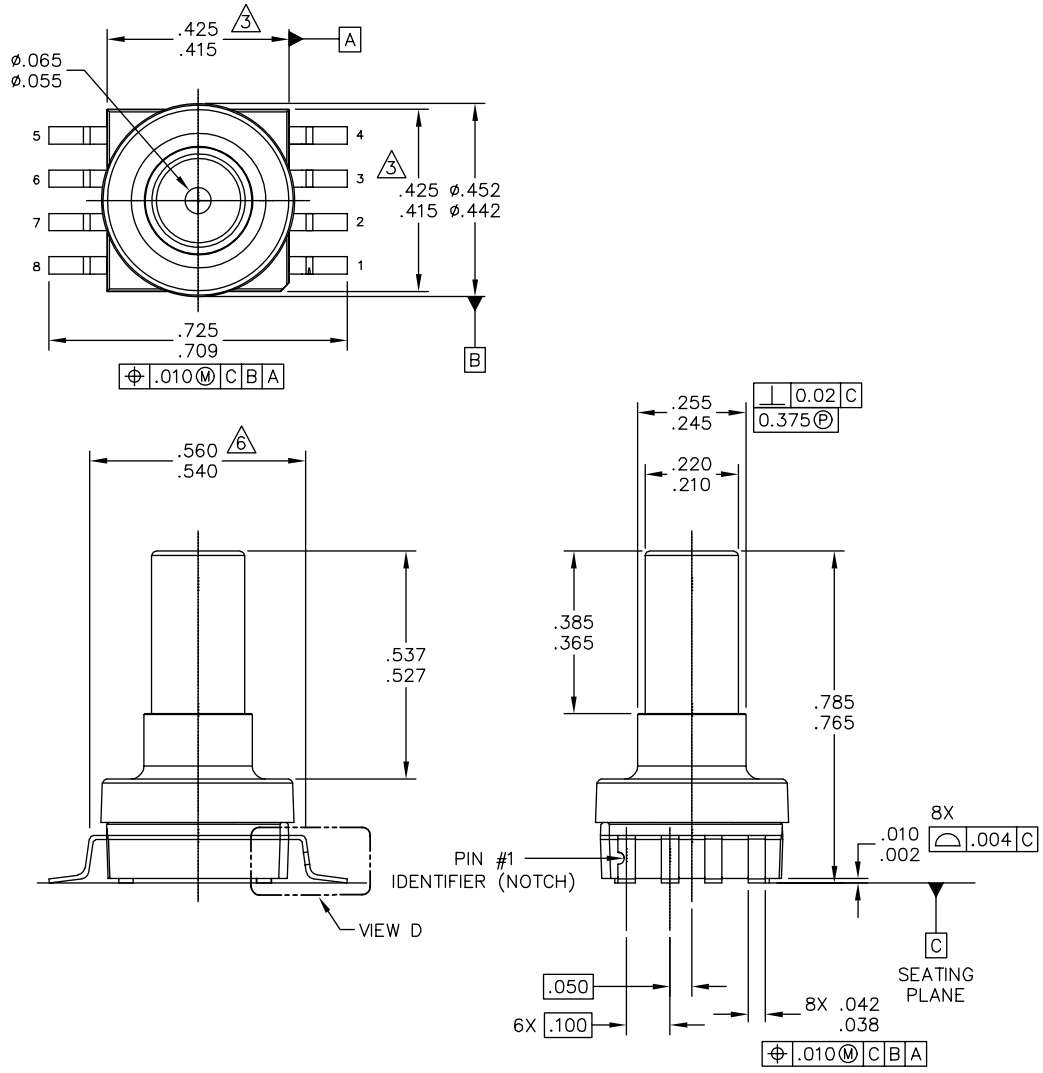
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M – 1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION IS .006.
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.
6. DIMENSION TO CENTER OF LEAD WHEN FORMED PARALLEL.

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TITLE: SO, 8 I/O, .420 X .420 PKG, .100 IN PITCH	DOCUMENT NO: 98ASA10611D	REV: D
	CASE NUMBER: 1560–03	25 FEB 2009
	STANDARD: NON–JEDEC	

CASE 1560-03
ISSUE D
SMALL OUTLINE PACKAGE

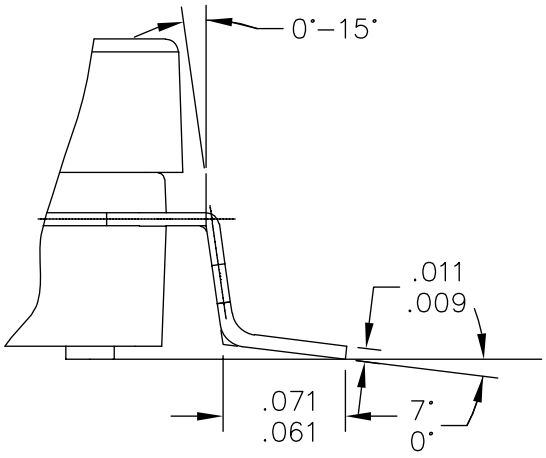
PACKAGE DIMENSIONS



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TITLE: SO, 8 I/O, .420 X .420 PKG, .100 IN PITCH	DOCUMENT NO: 98ASA10686D	REV: B
	CASE NUMBER: 1735–02	19 FEB 2009
	STANDARD: NON–JEDEC	

CASE 1735-02
ISSUE B
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



VIEW D

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TITLE: SO, 8 I/O, .420 X .420 PKG, .100 IN PITCH	DOCUMENT NO: 98ASA10686D	REV: B
	CASE NUMBER: 1735–02	19 FEB 2009
	STANDARD: NON–JEDEC	

CASE 1735-02
ISSUE B
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M – 1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION IS .006.
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.
6. DIMENSION TO CENTER OF LEAD WHEN FORMED PARALLEL.

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TITLE: SO, 8 I/O, .420 X .420 PKG, .100 IN PITCH	DOCUMENT NO: 98ASA10686D	REV: B
	CASE NUMBER: 1735–02	19 FEB 2009
	STANDARD: NON–JEDEC	

CASE 1735-02
ISSUE B
SMALL OUTLINE PACKAGE

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