

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

The MPXV7025 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 patented, single element transducer combines 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

- 5.0% Maximum Error Over \varnothing to 85°C
- Ideally Suited for Microprocessor or Microcontroller-Based Systems
- Temperature Compensated Over -40 to +125°C
- Thermoplastic (PPS) Surface Mount Package
- Patented Silicon Shear Stress Strain Gauge
- Available in Differential and Gauge Configurations

MPXV7025 Series

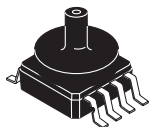
-25 to 25 kPa (-3.6 to 3.6 psi)
0.2 to 4.7 V Output

Application Examples

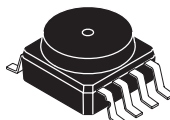
- Respiratory Systems
- Process Control
- Patient Monitoring
- Remote Monitoring Devices

| ORDERING INFORMATION | | | | | | | | | |
|--|-----------------|----------|------------|--------|------|---------------|--------------|----------|----------------|
| Device Name | Package Options | Case No. | # of Ports | | | Pressure Type | | | Device Marking |
| | | | None | Single | Dual | Gauge | Differential | Absolute | |
| Small Outline Package (MPXV7025 Series) | | | | | | | | | |
| MPXV7025GC6U | Rails | 482A | | • | | • | | | MPXV7025G |
| MPXV7025GC6T1 | Tape & Reel | 482A | | • | | • | | | MPXV7025G |
| MPXV7025GP | Trays | 1369 | | • | | • | | | MPXV7025GP |
| MPXV7025DP | Trays | 1351 | | | • | | • | | MPXV7025DP |
| Small Outline Package (Media Resistant Gel) (MPVZ7025 Series) | | | | | | | | | |
| MPVZ7025GC6T1 | Tape & Reel | 482A | | • | | • | | | MPVZ7025G |
| MPVZ7025GC6U | Rails | 482A | | • | | • | | | MPVZ7025G |
| MPVZ7025GP | Trays | 1369 | | • | | • | | | MPVZ7025GP |
| MPVZ7025G6T1 | Tape & Reel | 482 | • | | | | • | | MPVZ7025G |
| MPVZ7025G6U | Rails | 482 | • | | | | • | | MPVZ7025G |
| MPVZ7025DP | Trays | 1351 | | | • | | • | | MPVZ7025DP |

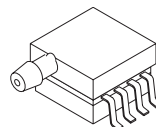
SMALL OUTLINE PACKAGE



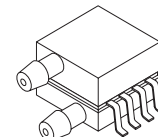
MPXV7025GC6U/T1
MPVZ7025GC6U/T1
CASE 482A-01



MPVZ7025G6U/T1
CASE 482-01



MPXV7025GP
MPVZ7025GP
CASE 1369-01



MPXV7025DP
MPVZ7025DP
CASE 1351-01

Operating Characteristics

Table 1. Operating Characteristics ($V_S = 5.0$ Vdc, $T_A = 25^\circ\text{C}$ unless otherwise noted, $P_1 > P_2$. Decoupling circuit shown in Figure 3 required to meet electrical specifications.)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|-----------|-------|-----------|-----------|-------------|
| Pressure Range ⁽¹⁾ | P_{OP} | -25 | — | 25 | kPa |
| Supply Voltage ⁽²⁾ | V_S | 4.75 | 5.0 | 5.25 | Vdc |
| Supply Current | I_o | — | 7.0 | 10 | mAdc |
| Minimum Pressure Offset ⁽³⁾ @ $V_S = 5.0$ Volts | V_{off} | 0.116 | 0.25 | 0.384 | Vdc |
| Full Scale Output ⁽⁴⁾ @ $V_S = 5.0$ Volts | V_{FSO} | 4.610 | 4.75 | 4.890 | Vdc |
| Full Scale Span ⁽⁵⁾ @ $V_S = 5.0$ Volts | V_{FSS} | — | 4.5 | — | Vdc |
| Accuracy | — | — | — | ± 5.0 | $\%V_{FSS}$ |
| Sensitivity | V/P | — | 90 | — | mV/kPa |
| Response Time ⁽⁶⁾ | t_R | — | 1.0 | — | ms |
| Output Source Current at Full Scale Output | I_{o+} | — | 0.1 | — | mAdc |
| Warm-Up Time ⁽⁷⁾ | — | — | 20 | — | ms |
| Offset Stability ⁽⁸⁾ | — | — | ± 0.5 | — | $\%V_{FSS}$ |

- 1.0 kPa (kiloPascal) equals 0.145 psi.
- Device is ratiometric within this specified excitation range.
- Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
- Full Scale Output (V_{FSO}) is defined as the output voltage at the maximum or full rated pressure.
- 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.
- 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 hours of Pulsed Pressure, Temperature Cycling with Bias Test.

Maximum Ratings

Table 2. Maximum Ratings⁽¹⁾

| Rating | Symbol | Value | Unit |
|----------------------------|-----------|-------------|------|
| Maximum Pressure (P1 > P2) | P_{max} | 200 | kPa |
| Storage Temperature | T_{stg} | -40 to +125 | °C |
| Operating Temperature | T_A | -40 to +125 | °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.

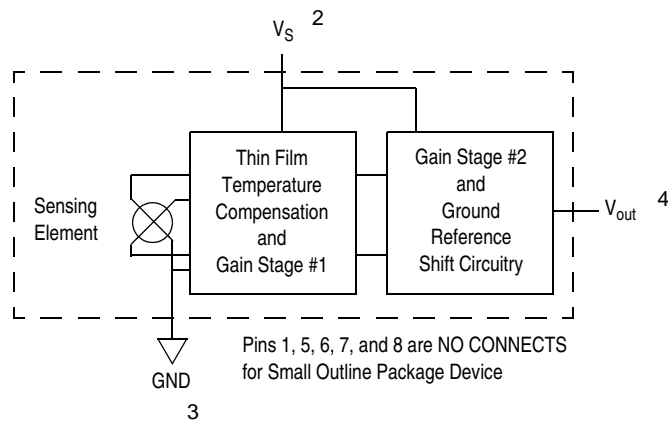


Figure 1. Integrated Pressure Sensor Schematic

On-chip Temperature Compensation and Calibration

The MPXV7025 series pressure sensor operating characteristics, and 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 shows the sensor output signal relative to pressure input. Typical, minimum, and maximum output

curves are shown for operation over a temperature range of 0° to 85°C using the decoupling circuit shown in Figure 3. The output will saturate outside of the specified pressure range.

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

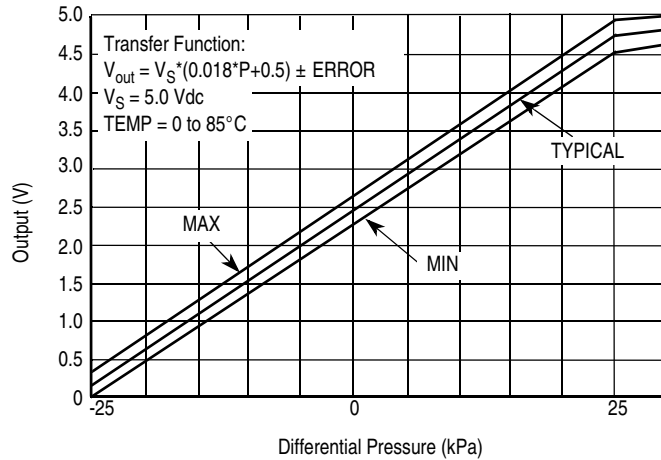


Figure 2. Output versus Pressure Differential

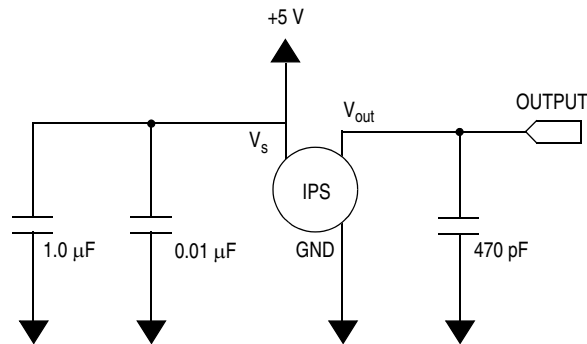


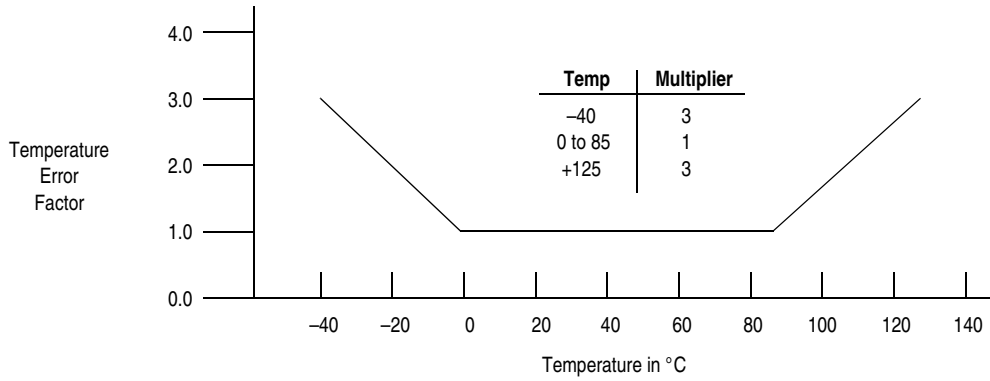
Figure 3. Recommended Power Supply Decoupling and Output Filtering
 (For additional output filtering, please refer to Application Note AN1646.)

Transfer Function

Nominal Transfer Value: $V_{out} = V_S (P \times 0.018 + 0.5)$
 $\pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.018 \times V_S)$
 $V_S = 5.0 \text{ V} \pm 0.25 \text{ Vdc}$

Temperature Error Band

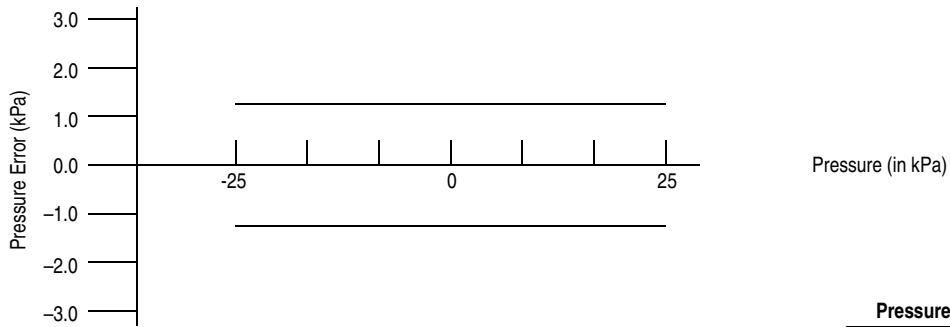
MPXV7025 SERIES



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

Pressure Error Band

Error Limits for Pressure



| Pressure | Error (Max) |
|-----------------|-------------|
| -25 to 25 (kPa) | ±1.25 (kPa) |

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

Freescale 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 fluorosilicone gel which protects the die from harsh media. The 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 |
|------------------------------------|-----------|-------------------------------|
| MPXV7025GC6U/C6T1, MPVZ7025GC6U/T1 | 482A | Side with Port Attached |
| MPXV7025GP, MPVZ7025GP | 1369 | Side with Port Attached |
| MPXV7025DP, MPVZ7025DP | 1351 | Side with Part Marking |
| MPVZ7025G6U/T1 | 482 | Side with Part Marking |

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.

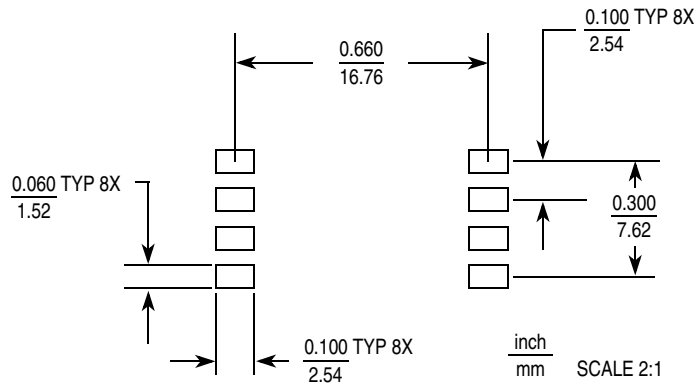
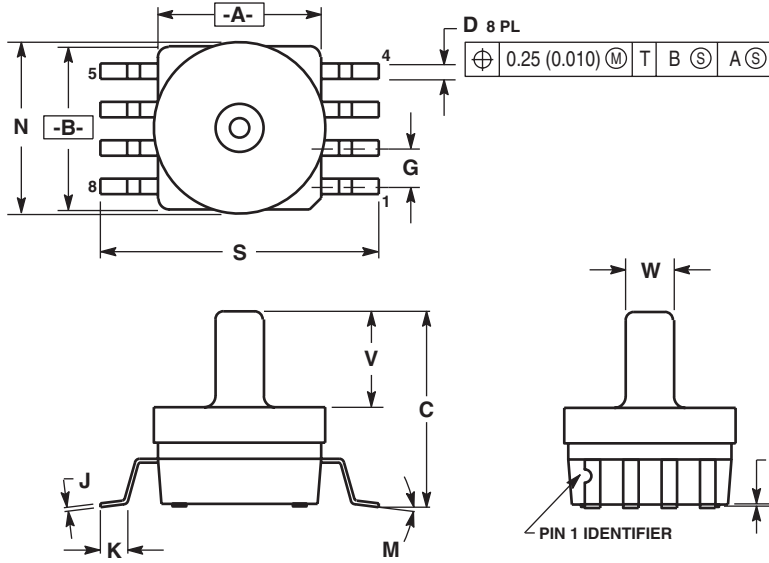


Figure 4. Small Outline Package Footprint

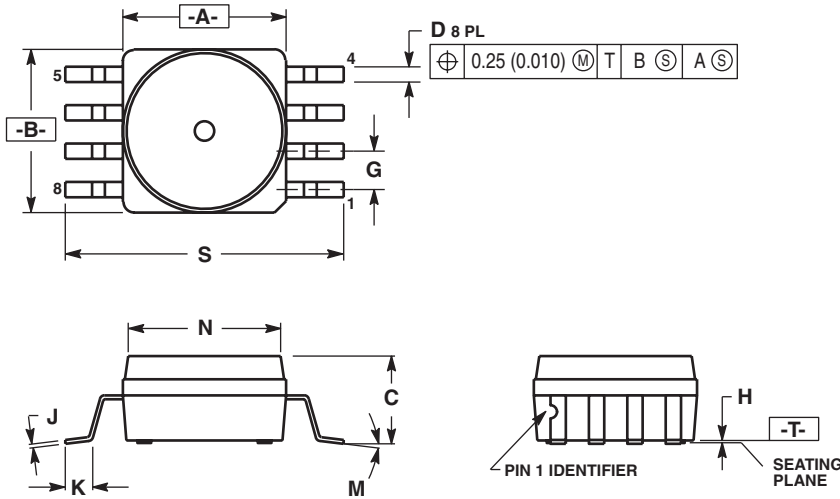
PACKAGE DIMENSIONS



- 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 | 0.500 | 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

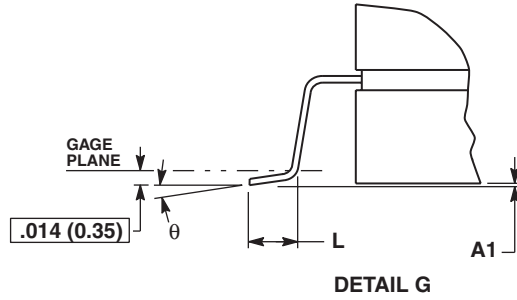
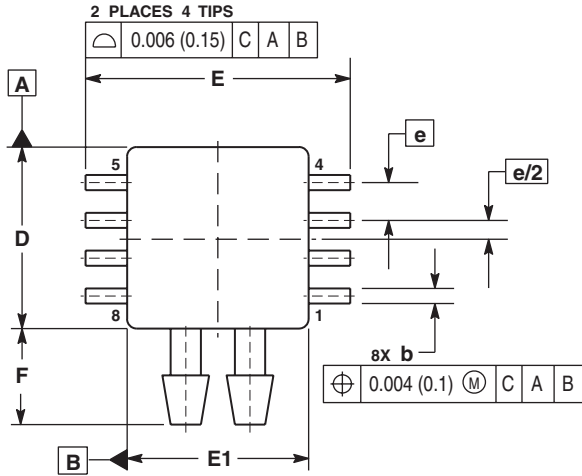


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 5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

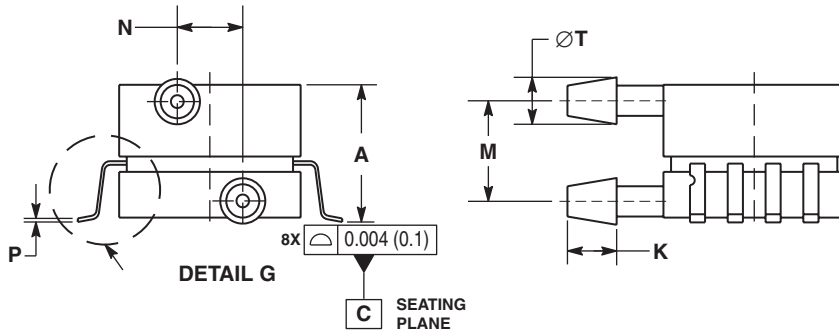
| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.415 | 0.425 | 10.54 | 10.79 |
| B | 0.415 | 0.425 | 10.54 | 10.79 |
| C | 0.212 | 0.230 | 5.38 | 5.84 |
| D | 0.038 | 0.042 | 0.96 | 1.07 |
| G | 0.100 BSC | | 2.54 BSC | |
| H | 0.002 | 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
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



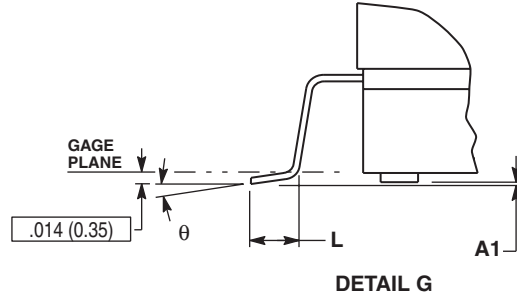
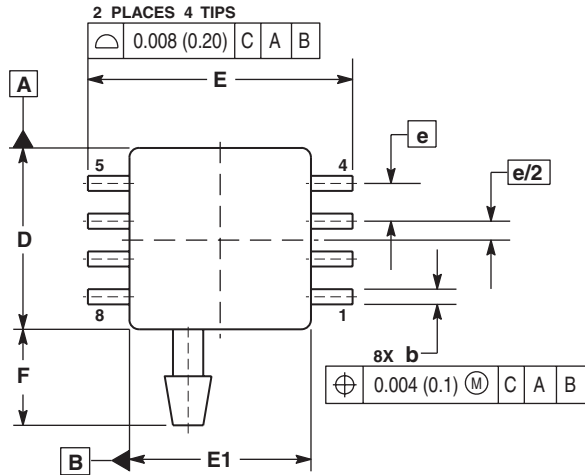
- NOTES:
1. CONTROLLING DIMENSION: INCH.
 2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
 3. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 (0.152) PER SIDE.
 4. DIMENSION "b" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.008 (0.203) MAXIMUM.
- STYLE 1:
 PIN 1. GND
 2. +Vout
 3. Vs
 4. -Vout
 5. N/C
 6. N/C
 7. N/C
 8. N/C
- STYLE 2:
 PIN 1. N/C
 2. Vs
 3. GND
 4. Vout
 5. N/C
 6. N/C
 7. N/C
 8. N/C



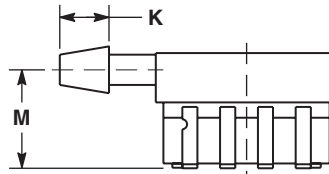
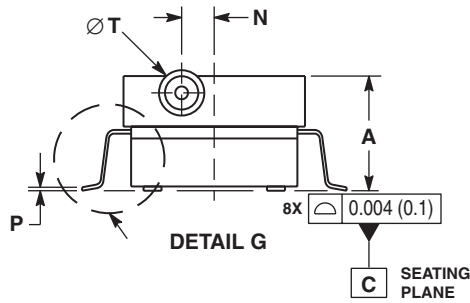
| DIM | INCHES | | MILLIMETERS | |
|----------|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.370 | 0.390 | 9.39 | 9.91 |
| A1 | 0.002 | 0.010 | 0.05 | 0.25 |
| b | 0.038 | 0.042 | 0.96 | 1.07 |
| D | 0.465 | 0.485 | 11.81 | 12.32 |
| E | 0.680 | 0.700 | 17.27 | 17.78 |
| E1 | 0.465 | 0.485 | 11.81 | 12.32 |
| e | 0.100 BSC | | 2.54 BSC | |
| F | 0.240 | 0.260 | 6.10 | 6.60 |
| K | 0.115 | 0.135 | 2.92 | 3.43 |
| L | 0.040 | 0.060 | 1.02 | 1.52 |
| M | 0.270 | 0.290 | 6.86 | 7.37 |
| N | 0.160 | 0.180 | 4.06 | 4.57 |
| P | 0.009 | 0.011 | 0.23 | 0.28 |
| T | 0.110 | 0.130 | 2.79 | 3.30 |
| θ | 0° | 7° | 0° | 7° |

CASE 1351-01
 ISSUE O
 SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



- NOTES:
1. CONTROLLING DIMENSION: INCH.
 2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
 3. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 (0.152) PER SIDE.
 4. DIMENSION "b" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.008 (0.203) MAXIMUM.



| DIM | INCHES | | MILLIMETERS | |
|----------|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.300 | 0.330 | 7.11 | 7.62 |
| A1 | 0.002 | 0.010 | 0.05 | 0.25 |
| b | 0.038 | 0.042 | 0.96 | 1.07 |
| D | 0.465 | 0.485 | 11.81 | 12.32 |
| E | 0.717 BSC | | 18.21 BSC | |
| E1 | 0.465 | 0.485 | 11.81 | 12.32 |
| e | 0.100 BSC | | 2.54 BSC | |
| F | 0.245 | 0.255 | 6.22 | 6.47 |
| K | 0.120 | 0.130 | 3.05 | 3.30 |
| L | 0.061 | 0.071 | 1.55 | 1.80 |
| M | 0.270 | 0.290 | 6.86 | 7.36 |
| N | 0.080 | 0.090 | 2.03 | 2.28 |
| P | 0.009 | 0.011 | 0.23 | 0.28 |
| T | 0.115 | 0.125 | 2.92 | 3.17 |
| θ | 0° | 7° | 0° | 7° |

CASE 1369-01
 ISSUE O
 SMALL OUTLINE PACKAGE

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