*Product Preview*

# 2.5 Watt Plastic Surface Mount Silicon Zener Diodes Powermite® Package

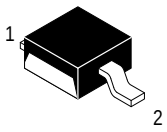
This complete new line of zener/tvs diodes offers a 2.5 watt series in a micro miniature, space saving surface mount package. The Powermite zener/tvs diodes are designed for use as a tvs or a regulation device in automotive and telecommunication applications where efficiency, low leakage, size/height and profile are important.

**Features:**

- Voltage Range – 3.3 to 91 V
- ESD Rating of Class 3 (> 16 kV) per Human Body Model
- Low Profile – maximum height of 1.1mm
- Integral Heat Sink/Locking Tabs
- Full metallic bottom eliminates flux entrapment
- Small Footprint – Footprint area of 8.45mm$^2$
- Supplied in 12mm tape and reel – 12,000 units per reel
- Powermite is JEDEC Registered as DO–216AA

**1PMT5913BT3 through 1PMT5948BT3**

**PLASTIC SURFACE MOUNT ZENER DIODES 2.5 WATTS 3.3–91 VOLTS**




**CASE 457–01 PLASTIC**


1: CATHODE
2: ANODE

**MAXIMUM RATINGS**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| DC Power Dissipation @ $T_L$ = 75°C, Measured at Zero Lead Length<br>Derate above 75°C | $P_D$ | 2.5<br>40 | Watts<br>mW/°C |
| DC Power Dissipation @ $T_A$ = 25°C(1)<br>Derate above 25°C | $P_D$ | 380<br>2.8 | mW<br>mW/°C |
| Thermal Resistance from Junction to Lead | $R_{\theta JL}$ | 26 | °C/W |
| Thermal Resistance from Junction to Ambient | $R_{\theta JA}$ | 324 | °C/W |
| Operating and Storage Junction Temperature Range | $T_J$, $T_{stg}$ | – 65 to +150 | °C |
| Typical $P_{pk}$ Dissipation @ $T_L$ < 25°C, (PW–10/1000 μs per Figure 8)(2) | $P_{pk}$ | 200 | Watts |
| Typical $P_{pk}$ Dissipation @ $T_L$ < 25°C, (PW–8/20 μs per Figure 9)(2) | $P_{pk}$ | 1000 | Watts |

(1)FR4 Board, within 1” to device, using Motorola minimum recommended footprint, as shown in case 403A outline dimensions spec.
(2)Non–repetitive current pulse.

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Thermal Clad is a trademark of the Bergquist Company.

**ELECTRICAL CHARACTERISTICS** ($V_F$ = 1.5 Volts Max @ $I_F$ = 200 mAdc for all types.)

| Device* | Nominal Zener Voltage $V_Z$ @ $I_{ZT}$ Volts (Note 1) | Test Current $I_{ZT}$ mA | Max Zener Impedance (Note 2) | | | Max Reverse Leakage Current | | Maximum DC Zener Current $I_{ZM}$ mAdc | Device Marking |
|---|---|---|---|---|---|---|---|---|---|
| | | | $Z_{ZT}$ @ $I_{ZT}$ Ohms | $Z_{ZK}$ Ohms | @ $I_{ZK}$ mA | $I_R$ μA | @ $V_R$ Volts | | |
| 1PMT5913BT3 | 3.3 | 113.6 | 10 | 500 | 1 | 100 | 1 | 454 | 913B |
| 1PMT5914BT3 | 3.6 | 104.2 | 9 | 500 | 1 | 75 | 1 | 416 | 914B |
| ***1PMT5915BT3*** | ***3.9*** | ***96.1*** | ***7.5*** | ***500*** | ***1*** | ***25*** | ***1*** | ***384*** | ***915B*** |
| ***1PMT5916BT3*** | ***4.3*** | ***87.2*** | ***6*** | ***500*** | ***1*** | ***5*** | ***1*** | ***348*** | ***916B*** |
| ***1PMT5917BT3*** | ***4.7*** | ***79.8*** | ***5*** | ***500*** | ***1*** | ***5*** | ***1.5*** | ***319*** | ***917B*** |
| ***1PMT5918BT3*** | ***5.1*** | ***73.5*** | ***4*** | ***350*** | ***1*** | ***5*** | ***2*** | ***294*** | ***918B*** |
| ***1PMT5919BT3*** | ***5.6*** | ***66.9*** | ***2*** | ***250*** | ***1*** | ***5*** | ***3*** | ***267*** | ***919B*** |
| ***1PMT5920BT3*** | ***6.2*** | ***60.5*** | ***2*** | ***200*** | ***1*** | ***5*** | ***4*** | ***241*** | ***920B*** |
| 1PMT5921BT3 | 6.8 | 55.1 | 2.5 | 200 | 1 | 5 | 5.2 | 220 | 921B |
| 1PMT5922BT3 | 7.5 | 50 | 3 | 400 | 0.5 | 5 | 6.8 | 200 | 922B |
| ***1PMT5923BT3*** | ***8.2*** | ***45.7*** | ***3.5*** | ***400*** | ***0.5*** | ***5*** | ***6.5*** | ***182*** | ***923B*** |
| 1PMT5924BT3 | 9.1 | 41.2 | 4 | 500 | 0.5 | 5 | 7 | 164 | 924B |
| ***1PMT5925BT3*** | ***10*** | ***37.5*** | ***4.5*** | ***500*** | ***0.25*** | ***5*** | ***8*** | ***150*** | ***925B*** |
| ***1PMT5926BT3*** | ***11*** | ***34.1*** | ***5.5*** | ***550*** | ***0.25*** | ***1*** | ***8.4*** | ***136*** | ***926B*** |
| ***1PMT5927BT3*** | ***12*** | ***31.2*** | ***6.5*** | ***550*** | ***0.25*** | ***1*** | ***9.1*** | ***125*** | ***927B*** |
| 1PMT5928BT3 | 13 | 28.8 | 7 | 550 | 0.25 | 1 | 9.9 | 115 | 928B |
| ***1PMT5929BT3*** | ***15*** | ***25*** | ***9*** | ***600*** | ***0.25*** | ***1*** | ***11.4*** | ***100*** | ***929B*** |
| 1PMT5930BT3 | 16 | 23.4 | 10 | 600 | 0.25 | 1 | 12.2 | 93 | 930B |
| ***1PMT5931BT3*** | ***18*** | ***20.8*** | ***12*** | ***650*** | ***0.25*** | ***1*** | ***13.7*** | ***83*** | ***931B*** |
| 1PMT5932BT3 | 20 | 18.7 | 14 | 650 | 0.25 | 1 | 15.2 | 75 | 932B |
| 1PMT5933BT3 | 22 | 17 | 17.5 | 650 | 0.25 | 1 | 16.7 | 68 | 933B |
| ***1PMT5934BT3*** | ***24*** | ***15.6*** | ***19*** | ***700*** | ***0.25*** | ***1*** | ***18.2*** | ***62*** | ***934B*** |
| ***1PMT5935BT3*** | ***27*** | ***13.9*** | ***23*** | ***700*** | ***0.25*** | ***1*** | ***20.6*** | ***55*** | ***935B*** |
| ***1PMT5936BT3*** | ***30*** | ***12.5*** | ***26*** | ***750*** | ***0.25*** | ***1*** | ***22.8*** | ***50*** | ***936B*** |
| 1PMT5937BT3 | 33 | 11.4 | 33 | 800 | 0.25 | 1 | 25.1 | 45 | 937B |
| ***1PMT5938BT3*** | ***36*** | ***10.4*** | ***38*** | ***850*** | ***0.25*** | ***1*** | ***27.4*** | ***41*** | ***938B*** |
| 1PMT5939BT3 | 39 | 9.6 | 45 | 900 | 0.25 | 1 | 29.7 | 38 | 939B |
| 1PMT5940BT3 | 43 | 8.7 | 53 | 950 | 0.25 | 1 | 32.7 | 34 | 940B |
| 1PMT5941BT3 | 47 | 8 | 67 | 1000 | 0.25 | 1 | 35.8 | 31 | 941B |
| 1PMT5942BT3 | 51 | 7.3 | 70 | 1100 | 0.25 | 1 | 38.8 | 29 | 942B |
| 1PMT5943BT3 | 56 | 6.7 | 86 | 1300 | 0.25 | 1 | 42.6 | 26 | 943B |
| 1PMT5944BT3 | 62 | 6 | 100 | 1500 | 0.25 | 1 | 47.1 | 24 | 944B |
| 1PMT5945BT3 | 68 | 5.5 | 120 | 1700 | 0.25 | 1 | 51.7 | 22 | 945B |
| 1PMT5946BT3 | 75 | 5 | 140 | 2000 | 0.25 | 1 | 56 | 20 | 946B |
| 1PMT5947BT3 | 82 | 4.6 | 160 | 2500 | 0.25 | 1 | 62.2 | 18 | 947B |
| 1PMT5948BT3 | 91 | 4.1 | 200 | 3000 | 0.25 | 1 | 69.2 | 16 | 948B |

* TOLERANCE AND VOLTAGE DESIGNATION Tolerance designation — The type numbers listed indicate a tolerance of ±5%.

Devices listed in bold, italic are Motorola preferred devices.

## TYPICAL CHARACTERISTICS

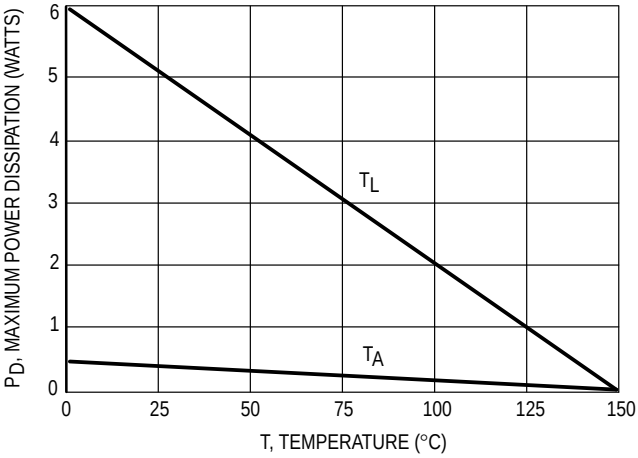



**Figure 1. Steady State Power Derating**

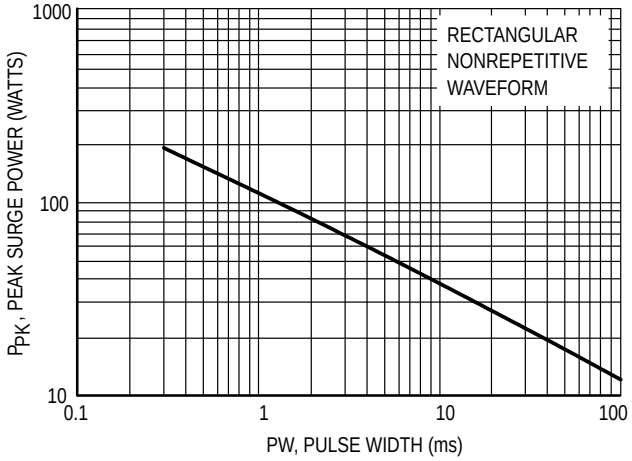



**Figure 2. Maximum Surge Power**

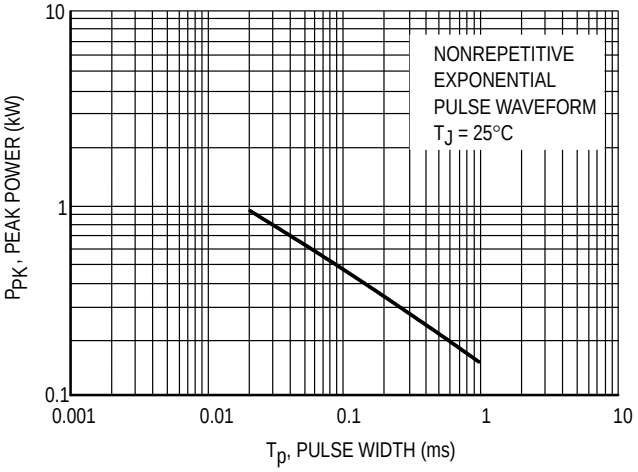



**Figure 3. Maximum Surge Power**

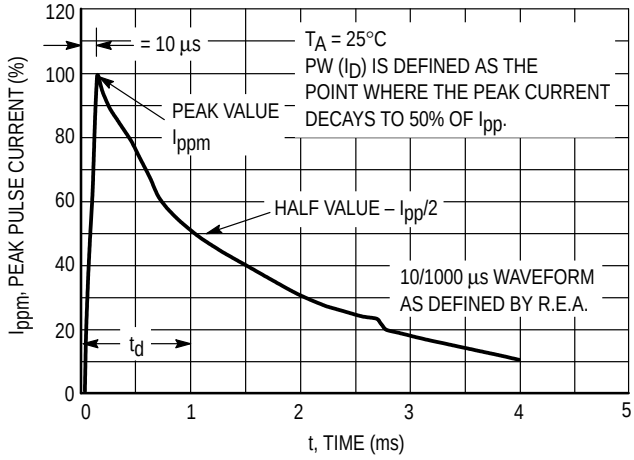



**Figure 4. Pulse Waveform 10/1000**

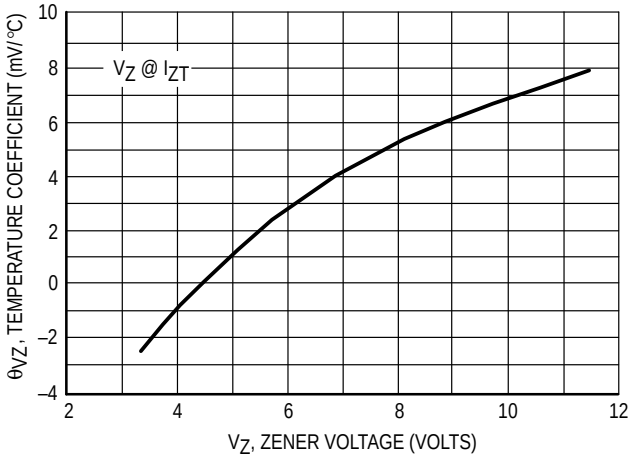



**Figure 5. Zener Voltage – To 12 Volts**

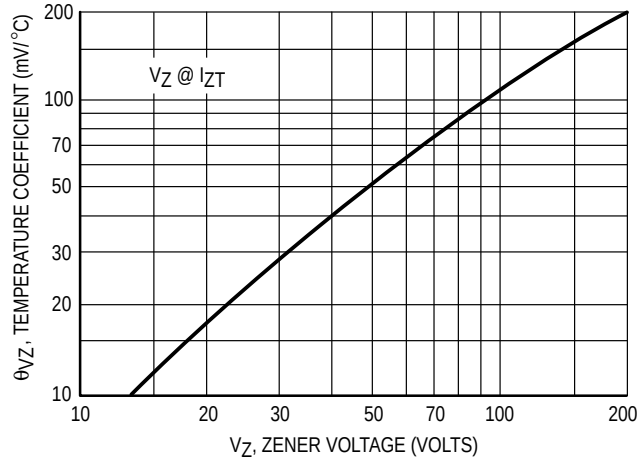



**Figure 6. Zener Voltage – 14 To 200 Volts**

**NOTE 1. ZENER VOLTAGE ($V_Z$) MEASUREMENT**
Nominal zener voltage is measured with the device junction in thermal equilibrium with ambient temperature at 25°C

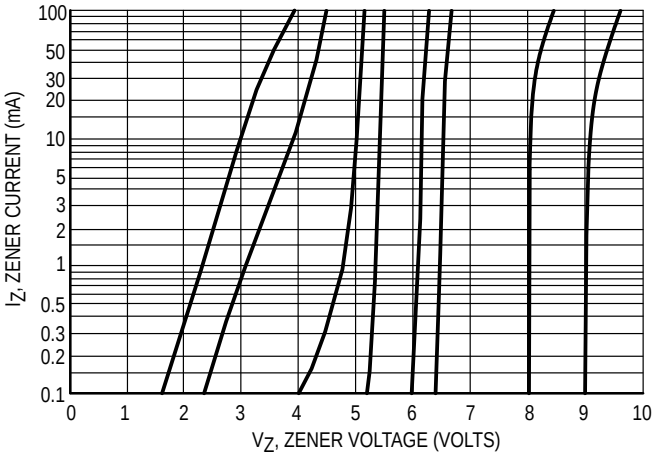



**Figure 7. $V_Z$ = 3.3 thru 10 Volts**

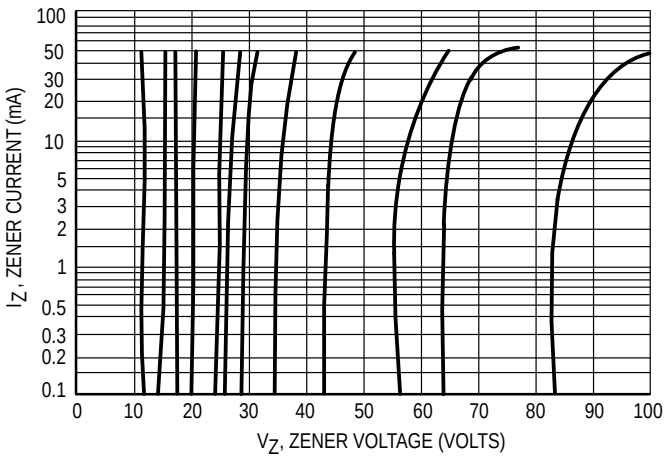



**Figure 8. $V_Z$ = 12 thru 82 Volts**

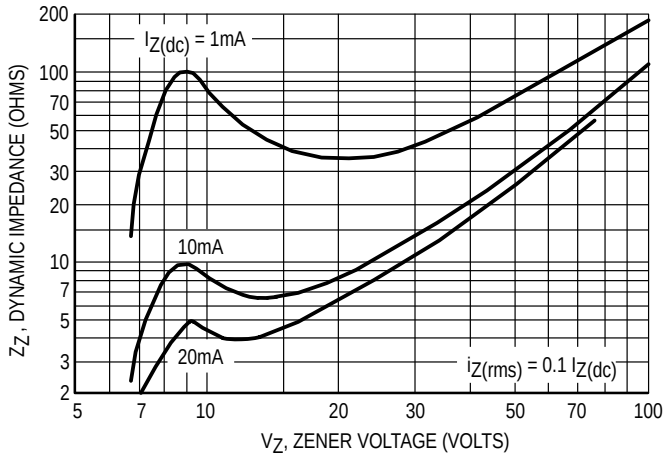



**Figure 9. Effect of Zener Voltage**

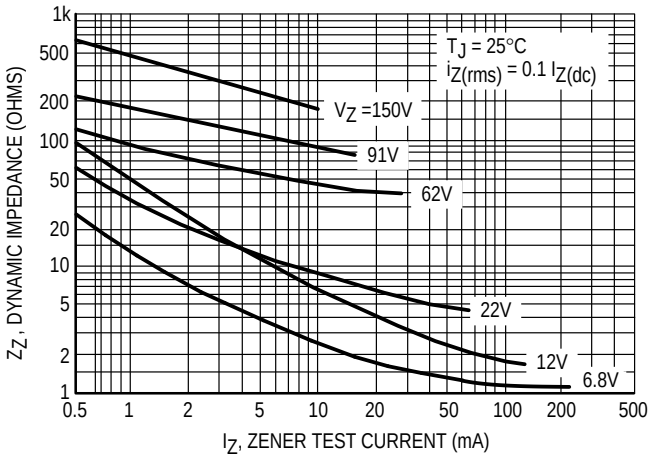


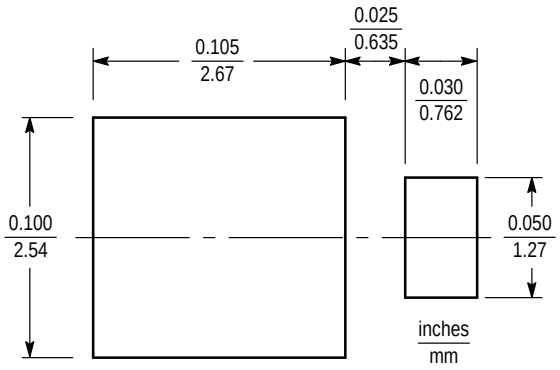

**Figure 10. Effect of Zener Current**

**NOTE 2. ZENER IMPEDANCE ($Z_Z$) DERIVATION**
$Z_{ZT}$ and $Z_{ZK}$ are measured by dividing the ac voltage drop across the device by the ac current applied. The specified limits are for $I_Z$(ac) = 0.1 $I_Z$(dc) with the ac frequency = 60 Hz.

# INFORMATION FOR USING THE POWERMITE SURFACE MOUNT PACKAGE

## MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure 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.




**POWERMITE**

## POWERMITE POWER DISSIPATION

The power dissipation of the Powermite is a function of the drain pad size. This can vary from the minimum pad size for soldering to a pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by $T_{J(max)}$, the maximum rated junction temperature of the die, $R_{\theta JA}$, the thermal resistance from the device junction to ambient, and the operating temperature, $T_A$. Using the values provided on the data sheet for the Powermite package, $P_D$ can be calculated as follows:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature $T_A$ of 25°C, one can calculate the power dissipation of the device which in this case is 386 milliwatts.

$$P_D = \frac{150°C - 25°C}{324°C/W} = 386 \text{ milliwatts}$$

The 324°C/W for the Powermite package assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 386 milliwatts. There are other alternatives to achieving higher power dissipation from the Powermite package. Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad™. Using a board material such as Thermal Clad, an aluminum core board, the power dissipation can be doubled using the same footprint.

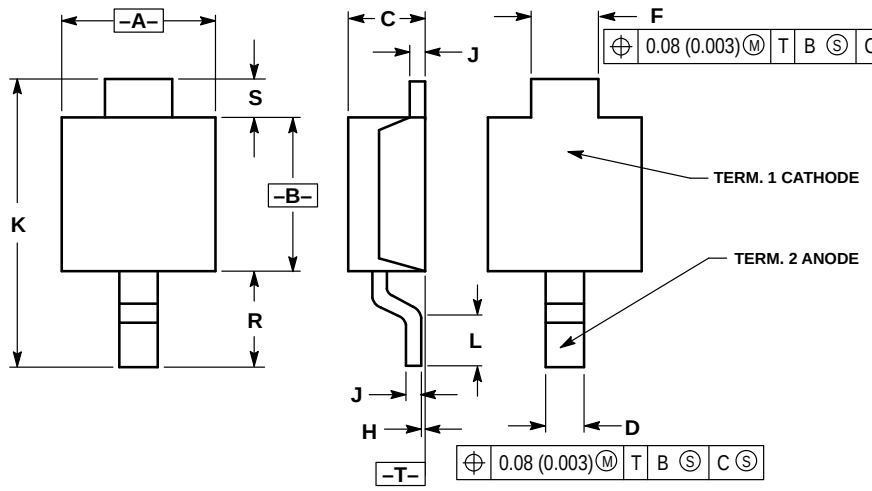
## SOLDERING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference shall be a maximum of 10°C.
- The soldering temperature and time shall not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling.

* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

## OUTLINE DIMENSIONS




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 1.75 | 2.15 | 0.069 | 0.081 |
| B | 1.75 | 2.15 | 0.069 | 0.086 |
| C | 0.85 | 1.15 | 0.033 | 0.045 |
| D | 0.40 | 0.65 | 0.016 | 0.026 |
| F | 0.70 | 1.00 | 0.028 | 0.039 |
| H | –0.05 | +0.10 | –0.002 | +0.004 |
| J | 0.10 | 0.25 | 0.004 | 0.010 |
| K | 3.60 | 4.15 | 0.142 | 0.163 |
| L | 0.50 | 0.80 | 0.020 | 0.031 |
| R | 1.20 | 1.50 | 0.047 | 0.059 |
| S | 0.50 REF | | 0.020 | |

**CASE 457–01**
**ISSUE O**



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