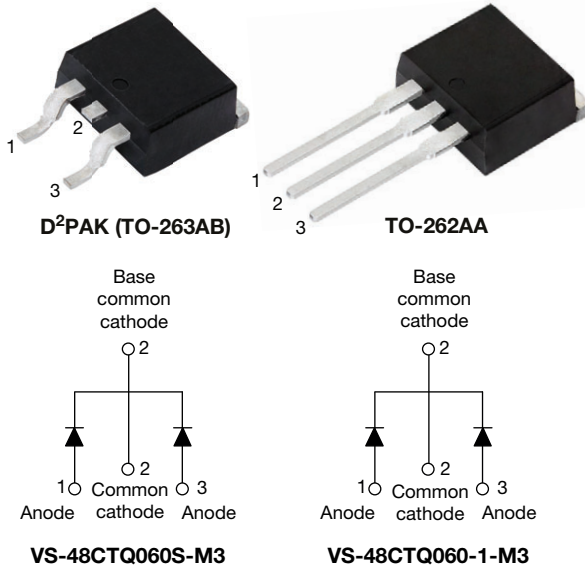


## High Performance Schottky Rectifiers, 2 x 20 A



### FEATURES

- 150 °C T<sub>J</sub> operation
- Center tap configuration
- Low forward voltage drop
- High frequency operation
- High purity, high temperature epoxy encapsulation for enhanced mechanical strength and moisture resistance
- Guard ring for enhanced ruggedness and long term reliability
- Meets MSL level 1, per J-STD-020, LF maximum peak of 245 °C
- Designed and qualified according to JEDEC®-JESD 47
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### DESCRIPTION

This center tap Schottky rectifier series has been optimized for low reverse leakage at high temperature. The proprietary barrier technology allows for reliable operation up to 150 °C junction temperature. Typical applications are in switching power supplies, converters, freewheeling diodes, and reverse battery protection.

### PRIMARY CHARACTERISTICS

|                                  |   |
|----------------------------------|---|
| I <sub>F(AV)</sub>               | 2 x 20 A                                |
| V <sub>R</sub>                   | 60 V                                    |
| V <sub>F</sub> at I <sub>F</sub> | 0.58 V                                  |
| I <sub>RM</sub> max.             | 89 mA at 125 °C                         |
| T <sub>J</sub> max.              | 150 °C                                  |
| E <sub>AS</sub>                  | 13 mJ                                   |
| Package                          | D <sup>2</sup> PAK (TO-263AB), TO-262AA |
| Circuit configuration            | Common cathode                          |

### MAJOR RATINGS AND CHARACTERISTICS

| SYMBOL             | CHARACTERISTICS  | VALUES      | UNITS |
|--------------------|--|-------------|-------|
| I <sub>F(AV)</sub> | Rectangular waveform                                   | 40          | A     |
| V <sub>R</sub>     |  | 60          | V     |
| I <sub>FSM</sub>   | t <sub>p</sub> = 5 μs sine                             | 1000        | A     |
| V <sub>F</sub>     | 20 A <sub>pk</sub> , T <sub>J</sub> = 125 °C (per leg) | 0.58        | V     |
| T <sub>J</sub>     | Range  | -55 to +150 | °C    |

### VOLTAGE RATINGS

| PARAMETER                            | SYMBOL           | VS-48CTQ060S-M3<br>VS-48CTQ060-1-M3 | UNITS |
|--------------------------------------|------------------|-------------------------------------|-------|
| Maximum DC reverse voltage           | V <sub>R</sub>   | 60                                  | V     |
| Maximum working peak reverse voltage | V <sub>RWM</sub> |                                     |       |



| ABSOLUTE MAXIMUM RATINGS  |                       |   |   |        |       |   |
|---|-----------------------|---|---|--------|-------|---|
| PARAMETER   | SYMBOL                | TEST CONDITIONS   |   | VALUES | UNITS |   |
| Maximum average forward current<br>See fig. 5                             | per leg<br>per device | $I_{F(AV)}$   | 50 % duty cycle at $T_C = 111\text{ }^\circ\text{C}$ , rectangular waveform |        | 20    | A |
|   |                       |   |   |        | 40    |   |
| Maximum peak one cycle non-repetitive surge current per leg<br>See fig. 7 | $I_{FSM}$             | 5 $\mu\text{s}$ sine or 3 $\mu\text{s}$ rect. pulse   | Following any rated load condition and with rated $V_{RRM}$ applied         | 1000   | mJ    |   |
|   |                       | 10 ms sine or 6 ms rect. pulse  |   | 260    |       |   |
| Non-repetitive avalanche energy per leg                                   | $E_{AS}$              | $T_J = 25\text{ }^\circ\text{C}$ , $I_{AS} = 1.50\text{ A}$ , $L = 11.5\text{ mH}$  |   | 13     | mJ    |   |
| Repetitive avalanche current per leg                                      | $I_{AR}$              | Current decaying linearly to zero in 1 $\mu\text{s}$<br>Frequency limited by $T_J$ maximum $V_A = 1.5 \times V_R$ typical |   | 1.50   | A     |   |

| ELECTRICAL SPECIFICATIONS                             |                |  |                                   |        |                  |
|---|----------------|--|-----------------------------------|--------|------------------|
| PARAMETER   | SYMBOL         | TEST CONDITIONS  |                                   | VALUES | UNITS            |
| Maximum forward voltage drop per leg<br>See fig. 1    | $V_{FM}^{(1)}$ | 20 A   | $T_J = 25\text{ }^\circ\text{C}$  | 0.61   | V                |
|   |                | 40 A   |                                   | 0.83   |                  |
|   |                | 20 A   | $T_J = 125\text{ }^\circ\text{C}$ | 0.58   |                  |
|   |                | 40 A   |                                   | 0.75   |                  |
| Maximum reverse leakage current per leg<br>See fig. 2 | $I_{RM}^{(1)}$ | $T_J = 25\text{ }^\circ\text{C}$   | $V_R = \text{Rated } V_R$         | 2      | mA               |
|   |                | $T_J = 125\text{ }^\circ\text{C}$  |                                   | 89     |                  |
| Threshold Voltage                                     | $V_{F(TO)}$    | $T_J = T_J$ maximum  |                                   | 0.37   | V                |
| Forward slope resistance                              | $r_t$          |  |                                   | 8.26   | $\text{m}\Omega$ |
| Maximum junction capacitance per leg                  | $C_T$          | $V_R = 5\text{ }V_{DC}$ (test signal range 100 kHz to 1 MHz), $25\text{ }^\circ\text{C}$ |                                   | 1220   | pF               |
| Typical series inductance per leg                     | $L_S$          | Measured lead to lead 5 mm from package body   |                                   | 8.0    | nH               |
| Maximum voltage rate of change                        | $dV/dt$        | Rated $V_R$  |                                   | 10 000 | $V/\mu\text{s}$  |

**Note**

(1) Pulse width < 300  $\mu\text{s}$ , duty cycle < 2 %

| THERMAL - MECHANICAL SPECIFICATIONS                      |                |  |  |             |  |
|--|----------------|--|--|-------------|--|
| PARAMETER  | SYMBOL         | TEST CONDITIONS                          |  | VALUES      | UNITS  |
| Maximum junction and storage temperature range           | $T_J, T_{Stg}$ |  |  | -55 to +150 | $^\circ\text{C}$   |
| Maximum thermal resistance, junction to case per leg     | $R_{thJC}$     | DC operation                             |  | 2.0         | $^\circ\text{C}/\text{W}$  |
| Maximum thermal resistance, junction to case per package |                |  |  | 1.0         |  |
| Typical thermal resistance, case to heatsink             | $R_{thCS}$     | Mounting surface, smooth and greased     |  | 0.50        |  |
| Approximate weight                                       |                |  |  | 2           | g  |
|  |                |  |  | 0.07        | oz.  |
| Mounting torque  | minimum        |  |  | 6 (5)       | $\text{kgf} \cdot \text{cm}$<br>( $\text{lbf} \cdot \text{in}$ ) |
|  | maximum        |  |  | 12 (10)     |  |
| Marking device   |                | Case style D <sup>2</sup> PAK (TO-263AB) |  | 48CTQ060S   |  |
|  |                | Case style TO-262AA                      |  | 48CTQ060-1  |  |

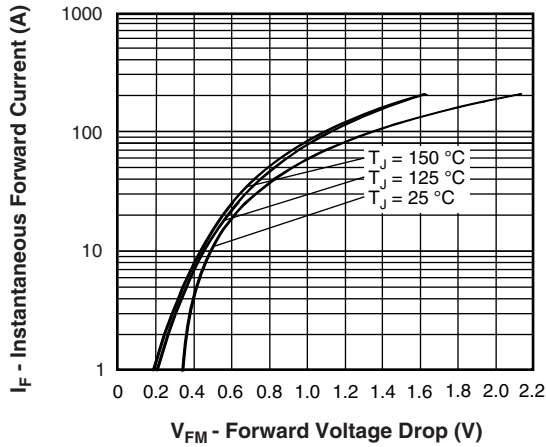


Fig. 1 - Maximum Forward Voltage Drop Characteristics (Per Leg)

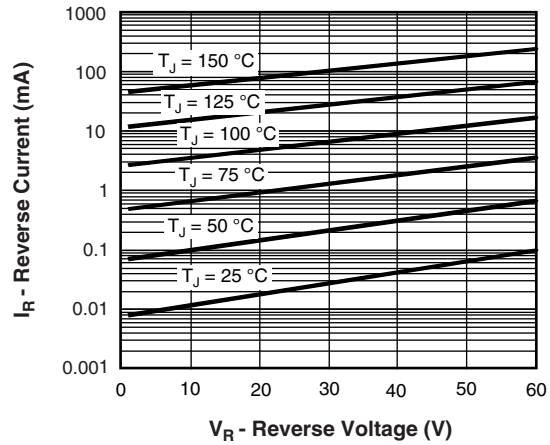


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage (Per Leg)

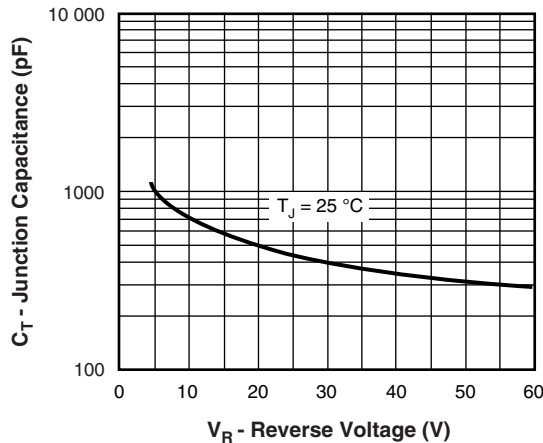


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage (Per Leg)

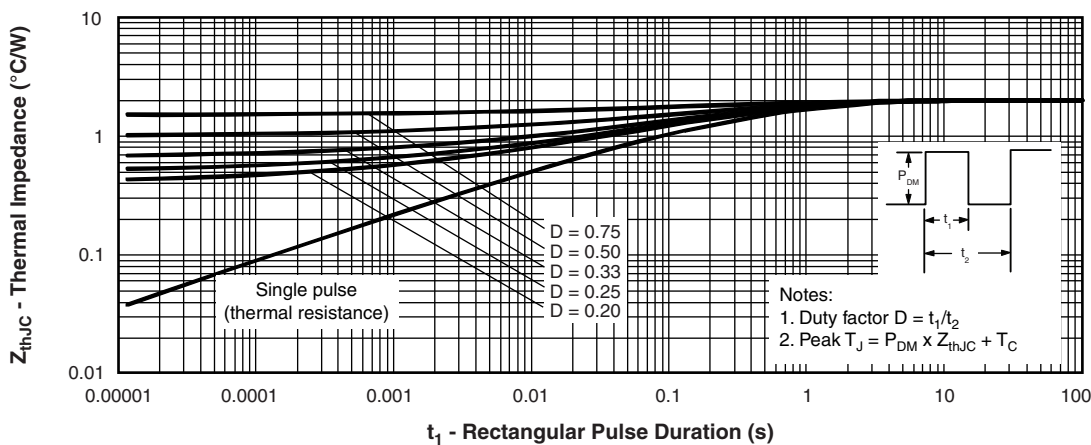


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (Per Leg)

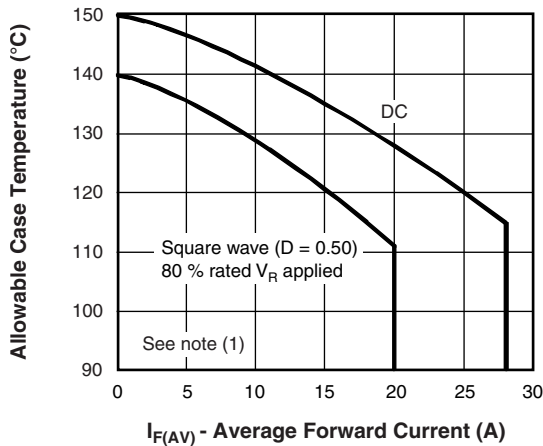


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current (Per Leg)

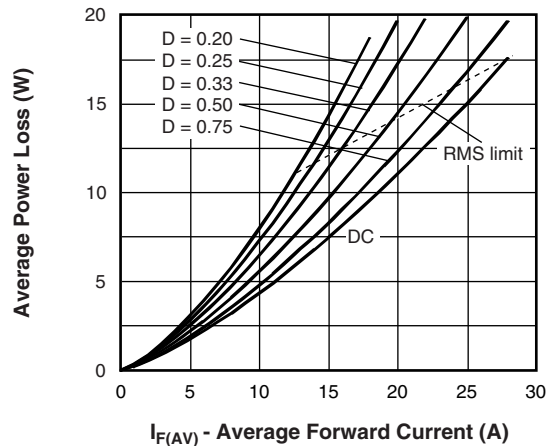


Fig. 6 - Forward Power Loss Characteristics (Per Leg)

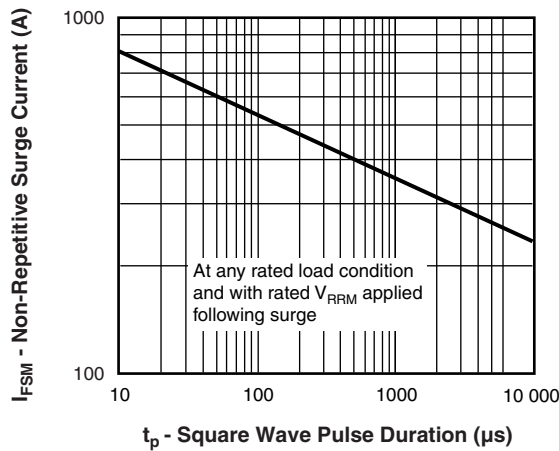


Fig. 7 - Maximum Non-Repetitive Surge Current (Per Leg)

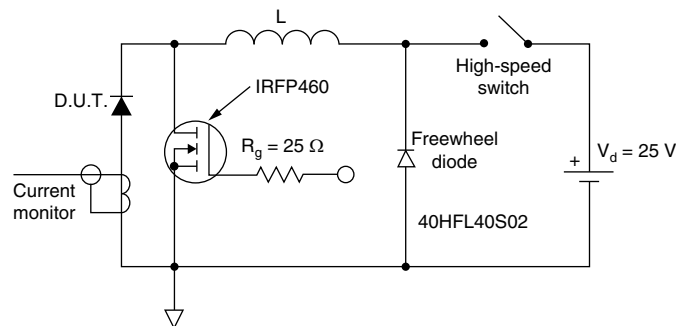


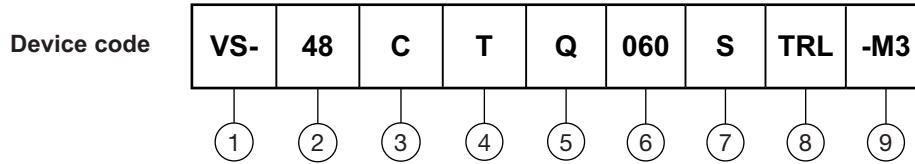
Fig. 8 - Unclamped Inductive Test Circuit

**Note**

- (1) Formula used:  $T_C = T_J - (P_d + P_{dREV}) \times R_{thJC}$ ;
- $P_d$  = forward power loss =  $I_{F(AV)} \times V_{FM}$  at  $(I_{F(AV)}/D)$  (see fig. 6);
- $P_{dREV}$  = inverse power loss =  $V_{R1} \times I_R (1 - D)$ ;  $I_R$  at  $V_{R1} = 10$  V



## ORDERING INFORMATION TABLE



- 1** - Vishay Semiconductors product
- 2** - Current rating (40 A)
- 3** - Circuit configuration: C = common cathode
- 4** - T = TO-220
- 5** - Schottky "Q" series
- 6** - Voltage rating (060 = 60 V)
- 7** -
  - S = D<sup>2</sup>PAK (TO-263AB)
  - -1 = TO-262AA
- 8** -
  - None = tube
  - TRL = tape and reel (left oriented - for D<sup>2</sup>PAK (TO-263AB) only)
  - TRR = tape and reel (right oriented - for D<sup>2</sup>PAK (TO-263AB) only)
- 9** - -M3 = halogen-free, RoHS-compliant, and termination lead (Pb)-free

| ORDERING INFORMATION |                  |                        |                          |
|----------------------|------------------|------------------------|--------------------------|
| PREFERRED P/N        | QUANTITY PER T/R | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION    |
| VS-48CTQ060S-M3      | 50               | 1000                   | Antistatic plastic tubes |
| VS-48CTQ060STRR-M3   | 800              | 800                    | 13" diameter reel        |
| VS-48CTQ060STRL-M3   | 800              | 800                    | 13" diameter reel        |
| VS-48CTQ060-1-M3     | 50               | 1000                   | Antistatic plastic tubes |

| LINKS TO RELATED DOCUMENTS |                               |  |
|----------------------------|-------------------------------|--|
| Dimensions                 | D <sup>2</sup> PAK (TO-263AB) | <a href="http://www.vishay.com/doc?96164">www.vishay.com/doc?96164</a> |
|                            | TO-262AA                      | <a href="http://www.vishay.com/doc?96165">www.vishay.com/doc?96165</a> |
| Part marking information   | D <sup>2</sup> PAK (TO-263AB) | <a href="http://www.vishay.com/doc?95444">www.vishay.com/doc?95444</a> |
|                            | TO-262AA                      | <a href="http://www.vishay.com/doc?95443">www.vishay.com/doc?95443</a> |
| Packaging information      |                               | <a href="http://www.vishay.com/doc?96424">www.vishay.com/doc?96424</a> |

## D<sup>2</sup>PAK

### DIMENSIONS in millimeters and inches

Conforms to JEDEC® outline D<sup>2</sup>PAK (SMD-220)



| SYMBOL | MILLIMETERS |       | INCHES |       | NOTES | SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|--------|-------|-------|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| A      | 4.06        | 4.83  | 0.160  | 0.190 |       | D1     | 6.86        | 8.00  | 0.270     | 0.315 | 3     |
| A1     | 0.00        | 0.254 | 0.000  | 0.010 |       | E      | 9.65        | 10.67 | 0.380     | 0.420 | 2, 3  |
| b      | 0.51        | 0.99  | 0.020  | 0.039 |       | E1     | 7.90        | 8.80  | 0.311     | 0.346 | 3     |
| b1     | 0.51        | 0.89  | 0.020  | 0.035 | 4     | e      | 2.54 BSC    |       | 0.100 BSC |       |       |
| b2     | 1.14        | 1.78  | 0.045  | 0.070 |       | H      | 14.61       | 15.88 | 0.575     | 0.625 |       |
| b3     | 1.14        | 1.73  | 0.045  | 0.068 | 4     | L      | 1.78        | 2.79  | 0.070     | 0.110 |       |
| c      | 0.38        | 0.74  | 0.015  | 0.029 |       | L1     | -           | 1.65  | -         | 0.066 | 3     |
| c1     | 0.38        | 0.58  | 0.015  | 0.023 | 4     | L2     | 1.27        | 1.78  | 0.050     | 0.070 |       |
| c2     | 1.14        | 1.65  | 0.045  | 0.065 |       | L3     | 0.25 BSC    |       | 0.010 BSC |       |       |
| D      | 8.51        | 9.65  | 0.335  | 0.380 | 2     | L4     | 4.78        | 5.28  | 0.188     | 0.208 |       |

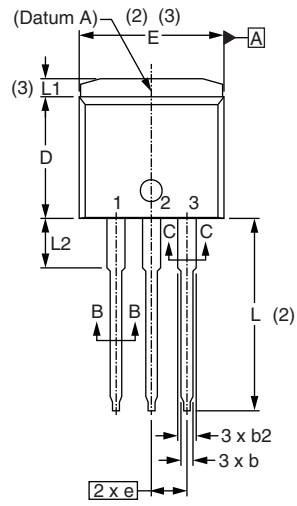
#### Notes

- Dimensioning and tolerancing per ASME Y14.5 M-1994
- Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body
- Thermal pad contour optional within dimension E, L1, D1 and E1
- Dimension b1 and c1 apply to base metal only
- Datum A and B to be determined at datum plane H
- Controlling dimension: inch
- Outline conforms to JEDEC® outline TO-263AB

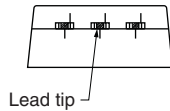
## TO-262

**DIMENSIONS** in millimeters and inches

Modified JEDEC® outline TO-262

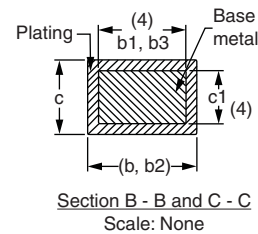
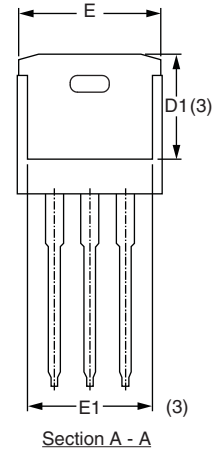
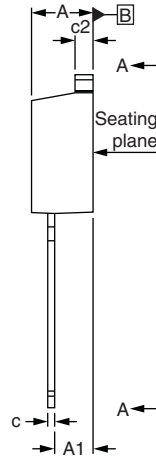


$\oplus 0.010 \text{ M} \text{ A} \text{ M} \text{ B}$



**Lead assignments**

- Diodes**  
 1. - Anode (two die)/open (one die)  
 2., 4. - Cathode  
 3. - Anode



| SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| A      | 4.06        | 4.83  | 0.160     | 0.190 |       |
| A1     | 2.03        | 3.02  | 0.080     | 0.119 |       |
| b      | 0.51        | 0.99  | 0.020     | 0.039 |       |
| b1     | 0.51        | 0.89  | 0.020     | 0.035 | 4     |
| b2     | 1.14        | 1.78  | 0.045     | 0.070 |       |
| b3     | 1.14        | 1.73  | 0.045     | 0.068 | 4     |
| c      | 0.38        | 0.74  | 0.015     | 0.029 |       |
| c1     | 0.38        | 0.58  | 0.015     | 0.023 | 4     |
| c2     | 1.14        | 1.65  | 0.045     | 0.065 |       |
| D      | 8.51        | 9.65  | 0.335     | 0.380 | 2     |
| D1     | 6.86        | 8.00  | 0.270     | 0.315 | 3     |
| E      | 9.65        | 10.67 | 0.380     | 0.420 | 2, 3  |
| E1     | 7.90        | 8.80  | 0.311     | 0.346 | 3     |
| e      | 2.54 BSC    |       | 0.100 BSC |       |       |
| L      | 13.46       | 14.10 | 0.530     | 0.555 |       |
| L1     | -           | 1.65  | -         | 0.065 | 3     |
| L2     | 3.36        | 3.71  | 0.132     | 0.146 |       |

**Notes**

- (1) Dimensioning and tolerancing as per ASME Y14.5M-1994
- (2) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body
- (3) Thermal pad contour optional within dimension E, L1, D1 and E1
- (4) Dimension b1 and c1 apply to base metal only
- (5) Controlling dimension: inches
- (6) Outline conform to JEDEC TO-262 except A1 (maximum), b (minimum), D1 (minimum) and L2 where dimensions derived the actual package outline



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