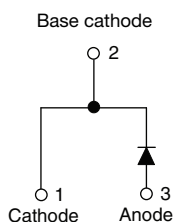


# Hyperfast Rectifier, 15 A FRED Pt® G5


**TO-220AC 2L**


## FEATURES

- Hyperfast and optimized  $Q_{rr}$
- Best in class forward voltage drop and switching losses trade off
- Optimized for high speed operation
- 175 °C maximum operating junction temperature
- Polyimide passivation
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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

## LINKS TO ADDITIONAL RESOURCES



3D Models



Application Notes

**SPICE**

Models

| PRIMARY CHARACTERISTICS  |             |
|--------------------------|-------------|
| $I_{F(AV)}$              | 15 A        |
| $V_R$                    | 1200 V      |
| $V_F$ at $I_F$ at 125 °C | 2.1 V       |
| $t_{rr}$                 | 29 ns       |
| $T_J$ max.               | 175 °C      |
| Package                  | TO-220AC 2L |
| Circuit configuration    | Single      |

## DESCRIPTION / APPLICATIONS

Featuring a unique combination of low conduction and switching losses, this rectifier is the right choice for high frequency converters, both soft switched / resonant. Specifically designed to improve efficiency of PFC and output rectification stages of EV / HEV battery charging stations, booster stage of solar inverters and UPS applications, these devices are perfectly matched to operate with MOSFETs or high speed IGBTs.

## MECHANICAL DATA

**Case:** TO-220AC 2L

Molding compound meets UL 94 V-0 flammability rating

**Terminals:** matte tin plated leads, solderable per J-STD-002

**Polarity:** as per marking device details

| ABSOLUTE MAXIMUM RATINGS                   |                   |                                                         |             |       |
|--------------------------------------------|-------------------|---------------------------------------------------------|-------------|-------|
| PARAMETER                                  | SYMBOL            | TEST CONDITIONS                                         | VALUES      | UNITS |
| Repetitive peak reverse voltage            | $V_{RRM}$         |                                                         | 1200        | V     |
| Average rectified forward current          | $I_{F(AV)}$       | $T_C = 98\text{ °C}$ , $D = 0.50$                       | 15          | A     |
| Repetitive peak forward current            | $I_{FRM}$         | $T_C = 98\text{ °C}$ , $D = 0.50$ , $f = 20\text{ kHz}$ | 30          |       |
| Non-repetitive peak surge current          | $I_{FSM}$         | $T_C = 45\text{ °C}$ , $t_p = 10\text{ ms}$ , sine wave | 110         |       |
| Operating junction and storage temperature | $T_J$ , $T_{Stg}$ |                                                         | -55 to +175 | °C    |

| ELECTRICAL SPECIFICATIONS ( $T_J = 25\text{ °C}$ unless otherwise specified) |                  |                                                                    |      |            |           |               |
|------------------------------------------------------------------------------|------------------|--------------------------------------------------------------------|------|------------|-----------|---------------|
| PARAMETER                                                                    | SYMBOL           | TEST CONDITIONS                                                    | MIN. | TYP.       | MAX.      | UNITS         |
| Breakdown voltage, blocking voltage                                          | $V_{BR}$ , $V_R$ | $I_R = 100\text{ }\mu\text{A}$                                     | 1200 | -          | -         | V             |
| Forward voltage                                                              | $V_F$            | $I_F = 15\text{ A}$<br>$I_F = 15\text{ A}$ , $T_J = 125\text{ °C}$ | -    | 2.5<br>2.1 | 3.3<br>-  |               |
| Reverse leakage current                                                      | $I_R$            | $V_R = V_R$ rated<br>$T_J = 125\text{ °C}$ , $V_R = V_R$ rated     | -    | -          | 50<br>500 | $\mu\text{A}$ |
| Junction capacitance                                                         | $C_T$            | $V_R = 200\text{ V}$                                               | -    | 10         | -         |               |
| Series inductance                                                            | $L_S$            | Measured to lead 5 mm from package body                            | -    | 8          | -         | nH            |

**DYNAMIC RECOVERY CHARACTERISTICS** ( $T_J = 25\text{ }^{\circ}\text{C}$  unless otherwise specified)

| PARAMETER               | SYMBOL    | TEST CONDITIONS                                                                   | MIN. | TYP. | MAX. | UNITS |
|-------------------------|-----------|-----------------------------------------------------------------------------------|------|------|------|-------|
| Reverse recovery time   | $t_{rr}$  | $I_F = 1.0\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$ | -    | 29   | 44   | ns    |
|                         |           | $T_J = 25\text{ }^{\circ}\text{C}$                                                | -    | 96   | -    |       |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                               | -    | 137  | -    |       |
| Peak recovery current   | $I_{RRM}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                                | -    | 11.5 | -    | A     |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                               | -    | 16   | -    |       |
| Reverse recovery charge | $Q_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$                                                | -    | 375  | -    | nC    |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                               | -    | 900  | -    |       |
| Reverse recovery time   | $t_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$                                                | -    | 77.5 | -    | ns    |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                               | -    | 106  | -    |       |
| Peak recovery current   | $I_{RRM}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                                | -    | 21   | -    | A     |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                               | -    | 29   | -    |       |
| Reverse recovery charge | $Q_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$                                                | -    | 680  | -    | nC    |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                               | -    | 1600 | -    |       |

**THERMAL - MECHANICAL SPECIFICATIONS**

| PARAMETER                                      | SYMBOL            | TEST CONDITIONS        | MIN.         | TYP. | MAX.       | UNITS                       |
|------------------------------------------------|-------------------|------------------------|--------------|------|------------|-----------------------------|
| Thermal resistance, junction-to-case           | $R_{thJC}$        |                        | -            | -    | 1.7        | $^{\circ}\text{C}/\text{W}$ |
| Weight                                         |                   |                        | -            | 2.0  | -          | g                           |
| Mounting torque                                |                   |                        | 6.0<br>(5.0) | -    | 12<br>(10) | kgf · cm<br>(lbf · in)      |
| Maximum junction and storage temperature range | $T_J$ , $T_{Stg}$ |                        | -55          | -    | 175        | $^{\circ}\text{C}$          |
| Marking device                                 |                   | Case style TO-220AC 2L | E5TX1512     |      |            |                             |

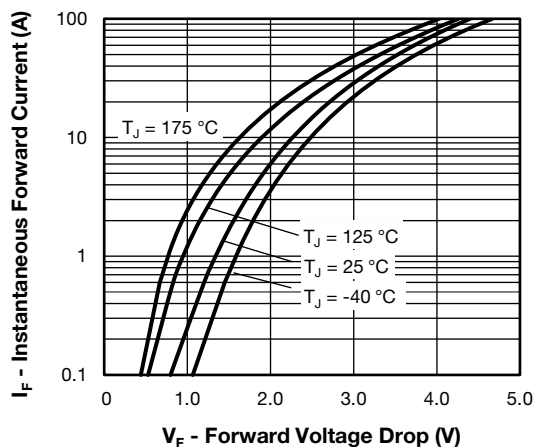


Fig. 1 - Forward Voltage Drop Characteristics

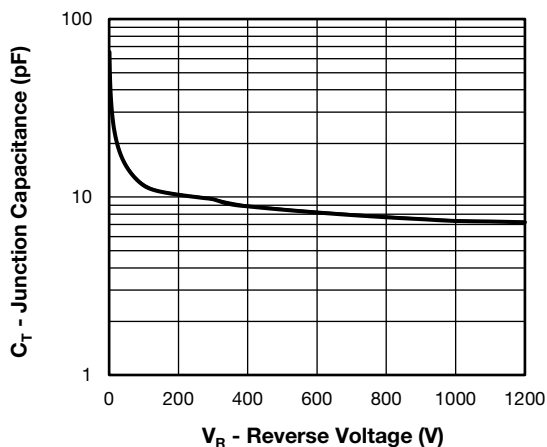


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

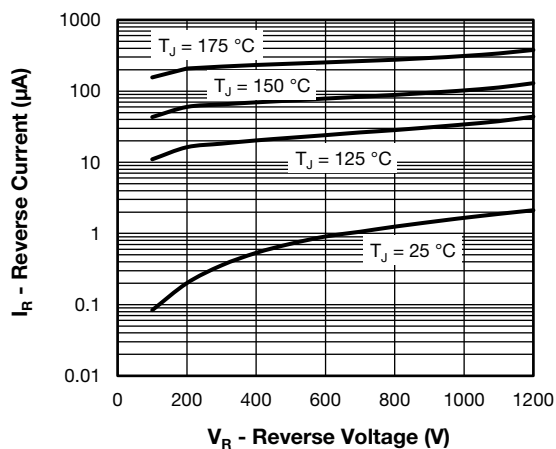


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

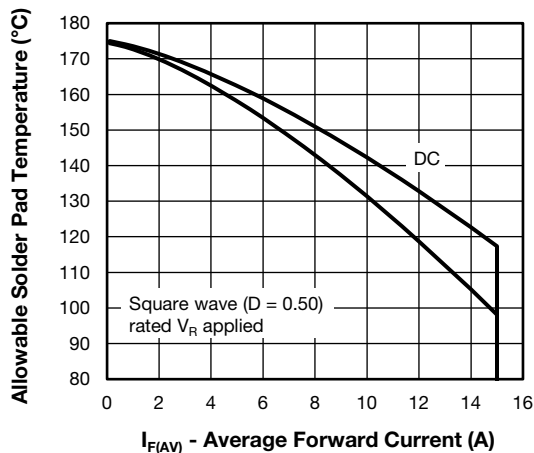


Fig. 4 - Maximum Allowable Case Temperature vs. Average Forward Current

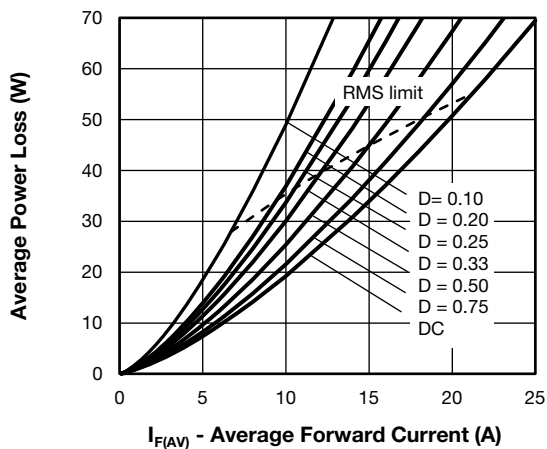


Fig. 5 - Forward Power Loss Characteristics

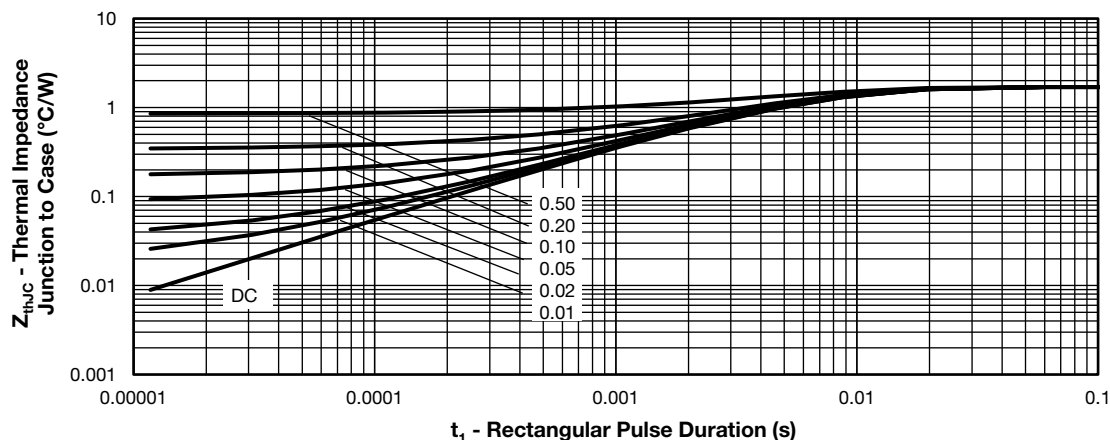


Fig. 6 - Transient Thermal Impedance, Junction to Case

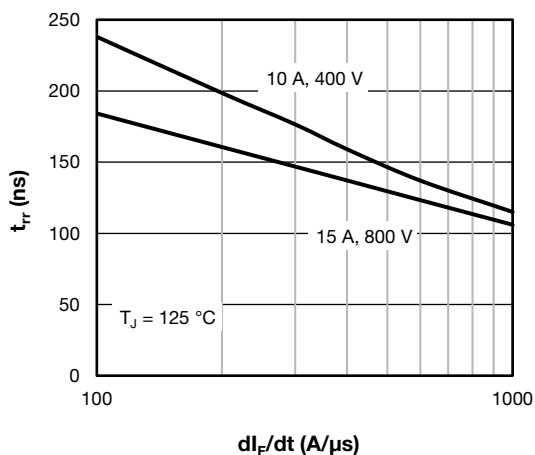


Fig. 7 - Typical Reverse Recovery Time vs.  $dI_F/dt$

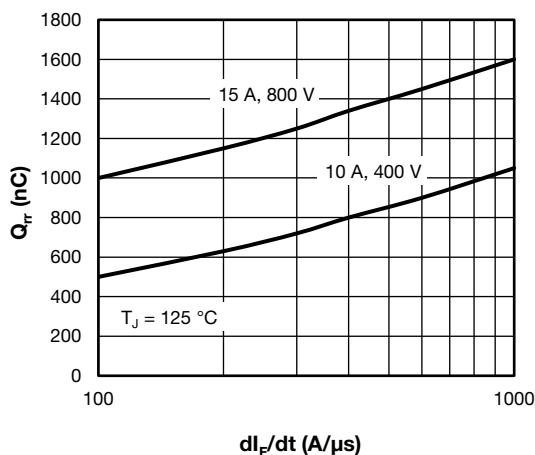


Fig. 8 - Typical Stored Charge vs.  $dI_F/dt$

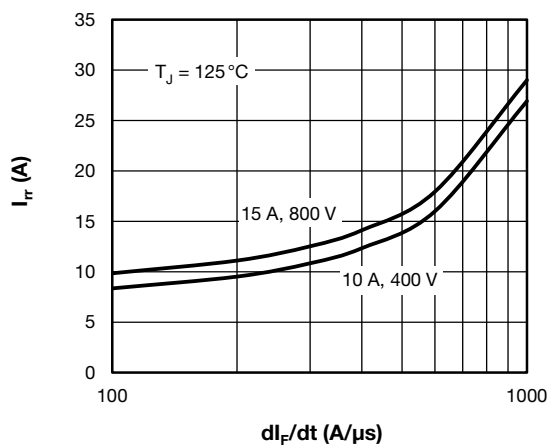


Fig. 9 - Typical Recovery Current vs.  $dI_F/dt$

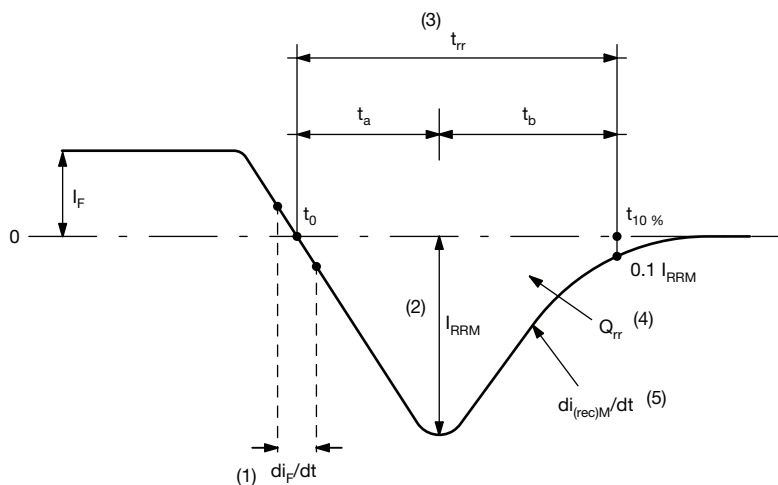


Fig. 10 - Reverse Recovery Waveform and Definitions

#### Notes

- (1)  $di_F/dt$  - rate of change of current through zero crossing
- (2)  $I_{RRM}$  - peak reverse recovery current
- (3)  $t_{rr}$  - reverse recovery time measured from  $t_0$ , crossing point of negative going  $I_F$ , to point  $t_{10\%}$ ,  $0.1 I_{RRM}$
- (4)  $Q_{rr}$  - area under curve defined by  $t_0$  and  $t_{10\%}$

$$Q_{rr} = \int_{t_0}^{t_{10\%}} I(t) dt$$

- (5)  $di_{(rec)M}/dt$  - peak rate of change of current during  $t_b$  portion of  $t_{rr}$

**ORDERING INFORMATION TABLE**

| Device code | VS- | E                                                                                          | 5 | T | X | 15 | 12 | -M3 |
|-------------|-----|--------------------------------------------------------------------------------------------|---|---|---|----|----|-----|
|             | 1   | 2                                                                                          | 3 | 4 | 5 | 6  | 7  | 8   |
| 1           | -   | Vishay Semiconductors product                                                              |   |   |   |    |    |     |
| 2           | -   | E = single diode                                                                           |   |   |   |    |    |     |
| 3           | -   | 5 = FRED generation 5                                                                      |   |   |   |    |    |     |
| 4           | -   | Package:<br>T = TO-220AC 2L                                                                |   |   |   |    |    |     |
| 5           | -   | X = hyperfast recovery                                                                     |   |   |   |    |    |     |
| 6           | -   | Current rating (15 = 15 A)                                                                 |   |   |   |    |    |     |
| 7           | -   | Voltage rating (12 = 1200 V)                                                               |   |   |   |    |    |     |
| 8           | -   | Environmental digit:<br>-M3 = halogen-free, RoHS-compliant, and termination lead (Pb)-free |   |   |   |    |    |     |

**ORDERING INFORMATION** (Example)

| PREFERRED P/N  | BASE QUANTITY | PACKAGING DESCRIPTION    |
|----------------|---------------|--------------------------|
| VS-E5TX1512-M3 | 50            | Antistatic plastic tubes |

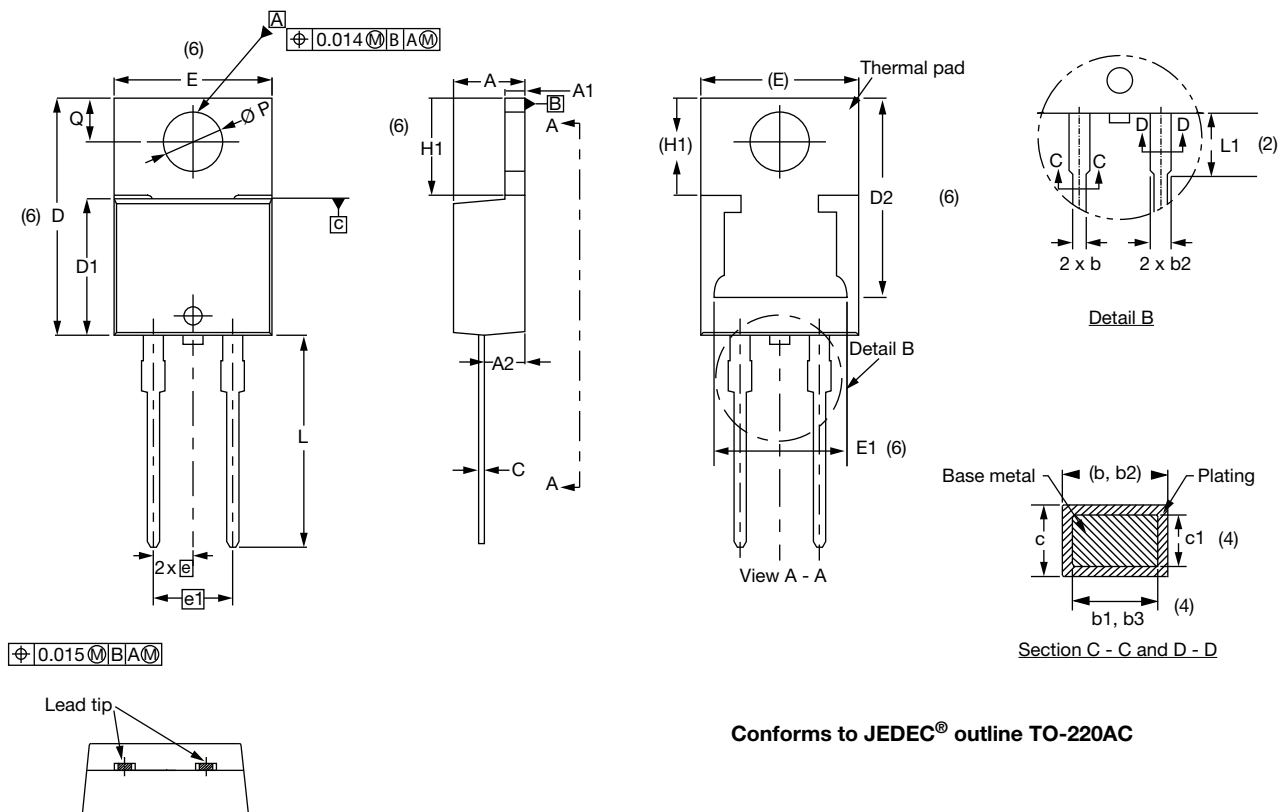
**LINKS TO RELATED DOCUMENTS**

|                          |                                                                        |
|--------------------------|------------------------------------------------------------------------|
| Dimensions               | <a href="http://www.vishay.com/doc?96156">www.vishay.com/doc?96156</a> |
| Part marking information | <a href="http://www.vishay.com/doc?95391">www.vishay.com/doc?95391</a> |
| SPIICE Model             | <a href="http://www.vishay.com/doc?97160">www.vishay.com/doc?97160</a> |



## TO-220AC 2L

**DIMENSIONS** in millimeters and inches



Conforms to JEDEC® outline TO-220AC

| SYMBOL | MILLIMETERS |       | INCHES |       | NOTES |
|--------|-------------|-------|--------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |
| A      | 4.25        | 4.65  | 0.167  | 0.183 |       |
| A1     | 1.14        | 1.40  | 0.045  | 0.055 |       |
| A2     | 2.50        | 2.92  | 0.098  | 0.115 |       |
| b      | 0.69        | 1.01  | 0.027  | 0.040 |       |
| b1     | 0.38        | 0.97  | 0.015  | 0.038 | 4     |
| b2     | 1.20        | 1.73  | 0.047  | 0.068 |       |
| b3     | 1.14        | 1.73  | 0.045  | 0.068 | 4     |
| c      | 0.36        | 0.61  | 0.014  | 0.024 |       |
| c1     | 0.36        | 0.56  | 0.014  | 0.022 | 4     |
| D      | 14.85       | 15.35 | 0.585  | 0.604 | 3     |
| D1     | 8.38        | 9.02  | 0.330  | 0.355 |       |
| D2     | 11.68       | 13.30 | 0.460  | 0.524 | 6, 7  |
| E      | 10.11       | 10.51 | 0.398  | 0.414 | 3, 6  |
| E1     | 6.86        | 8.89  | 0.270  | 0.350 | 6     |
| e      | 2.41        | 2.67  | 0.095  | 0.105 |       |
| e1     | 4.88        | 5.28  | 0.192  | 0.208 |       |
| H1     | 6.09        | 6.48  | 0.240  | 0.255 | 6     |
| L      | 13.52       | 14.02 | 0.532  | 0.552 |       |
| L1     | 3.32        | 3.82  | 0.131  | 0.150 | 2     |
| Ø P    | 3.54        | 3.91  | 0.139  | 0.154 |       |
| Q      | 2.60        | 3.00  | 0.102  | 0.118 |       |

### Notes

- (1) Dimensioning and tolerancing as per ASME Y14.5M-1994
- (2) Lead dimension and finish uncontrolled in L1
- (3) Dimension D, D1, 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 outermost extremes of the plastic body
- (4) Dimension b1, b3, and c1 apply to base metal only
- (5) Controlling dimensions: inches
- (6) Thermal pad contour optional within dimensions E, H1, D2, and E1
- (7) Outline conforms to JEDEC® TO-220, except D2



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