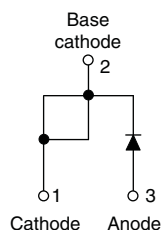




## Fast Soft Recovery Rectifier Diode, 10 A



TO-220AC



## FEATURES

- Glass passivated pellet chip junction
- 150 °C max operating junction temperature
- Low forward voltage drop and short reverse recovery time
- 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**

## PRODUCT SUMMARY

|                 |                |
|-----------------|----------------|
| Package         | TO-220AC       |
| $I_{F(AV)}$     | 10 A           |
| $V_R$           | 1000 V, 1200 V |
| $V_F$ at $I_F$  | 1.33 V         |
| $I_{FSM}$       | 140 A          |
| $t_{rr}$        | 80 ns          |
| $T_J$ max.      | 150 °C         |
| Diode variation | Single die     |
| Snap factor     | 0.6            |

## APPLICATIONS

These devices are intended for use in output rectification and freewheeling in inverters, choppers and converters as well as in input rectification where severe restrictions on conducted EMI should be met.

## DESCRIPTION

The VS-10ETF1... fast soft recovery rectifier series has been optimized for combined short reverse recovery time and low forward voltage drop.

The glass passivation ensures stable reliable operation in the most severe temperature and power cycling conditions.

## MAJOR RATINGS AND CHARACTERISTICS

| SYMBOL      | CHARACTERISTICS     | VALUES       | UNITS |
|-------------|---------------------|--------------|-------|
| $V_{RRM}$   |                     | 1000 to 1200 | V     |
| $I_{F(AV)}$ | Sinusoidal waveform | 10           | A     |
| $I_{FSM}$   |                     | 140          |       |
| $t_{rr}$    | 1 A, 100 A/μs       | 80           | ns    |
| $V_F$       | 10 A, $T_J = 25$ °C | 1.33         | V     |
| $T_J$       |                     | -40 to +150  | °C    |

## VOLTAGE RATINGS

| PART NUMBER                  | $V_{RRM}$ , MAXIMUM PEAK REVERSE VOLTAGE<br>V | $V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE<br>V | $I_{RRM}$<br>AT 150 °C<br>mA |
|------------------------------|-----------------------------------------------|--------------------------------------------------------------|------------------------------|
| VS-10ETF10PbF, VS-10ETF10-M3 | 1000                                          | 1100                                                         | 4                            |
| VS-10ETF12PbF, VS-10ETF12-M3 | 1200                                          | 1200                                                         |                              |

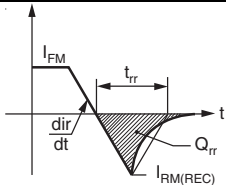
## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                           | SYMBOL        | TEST CONDITIONS                                | VALUES | UNITS             |
|-----------------------------------------------------|---------------|------------------------------------------------|--------|-------------------|
| Maximum average forward current                     | $I_{F(AV)}$   | $T_C = 125$ °C, 180° conduction half sine wave | 10     | A                 |
| Maximum peak one cycle non-repetitive surge current | $I_{FSM}$     | 10 ms sine pulse, rated $V_{RRM}$ applied      | 115    |                   |
|                                                     |               | 10 ms sine pulse, no voltage reapplied         | 140    |                   |
| Maximum $I^2t$ for fusing                           | $I^2t$        | 10 ms sine pulse, rated $V_{RRM}$ applied      | 66     | A <sup>2</sup> s  |
|                                                     |               | 10 ms sine pulse, no voltage reapplied         | 94     |                   |
| Maximum $I^2\sqrt{t}$ for fusing                    | $I^2\sqrt{t}$ | $t = 0.1$ to 10 ms, no voltage reapplied       | 940    | A <sup>2</sup> √s |

**ELECTRICAL SPECIFICATIONS**

| PARAMETER                       | SYMBOL      | TEST CONDITIONS                          |                               | VALUES | UNITS            |
|---------------------------------|-------------|------------------------------------------|-------------------------------|--------|------------------|
| Maximum forward voltage drop    | $V_{FM}$    | 10 A, $T_J = 25\text{ }^{\circ}\text{C}$ |                               | 1.33   | V                |
| Forward slope resistance        | $r_t$       | $T_J = 150\text{ }^{\circ}\text{C}$      |                               | 22.9   | $\text{m}\Omega$ |
| Threshold voltage               | $V_{F(TO)}$ |                                          |                               | 0.96   | V                |
| Maximum reverse leakage current | $I_{RM}$    | $T_J = 25\text{ }^{\circ}\text{C}$       | $V_R = \text{Rated } V_{RRM}$ | 0.1    | mA               |
|                                 |             | $T_J = 150\text{ }^{\circ}\text{C}$      |                               | 4      |                  |

**RECOVERY CHARACTERISTICS**

| PARAMETER                | SYMBOL   | TEST CONDITIONS                                                             | VALUES | UNITS         |  |
|--------------------------|----------|-----------------------------------------------------------------------------|--------|---------------|-------------------------------------------------------------------------------------|
| Reverse recovery time    | $t_{rr}$ | $I_F$ at 10 A <sub>pk</sub><br>25 A/ $\mu\text{s}$<br>25 $^{\circ}\text{C}$ | 310    | ns            |                                                                                     |
| Reverse recovery current | $I_{rr}$ |                                                                             | 4.7    | A             |                                                                                     |
| Reverse recovery charge  | $Q_{rr}$ |                                                                             | 1.05   | $\mu\text{C}$ |                                                                                     |
| Typical snap factor      | S        |                                                                             | 0.6    |               |                                                                                     |

**THERMAL - MECHANICAL SPECIFICATIONS**

| PARAMETER                                      | SYMBOL                            | TEST CONDITIONS                      | VALUES             | UNITS                  |
|------------------------------------------------|-----------------------------------|--------------------------------------|--------------------|------------------------|
| Maximum junction and storage temperature range | T <sub>J</sub> , T <sub>Stg</sub> |                                      | -40 to +150        | °C                     |
| Maximum thermal resistance junction to case    | R <sub>thJC</sub>                 | DC operation                         | 1.5                | °C/W                   |
| Maximum thermal resistance junction to ambient | R <sub>thJA</sub>                 |                                      | 62                 |                        |
| Typical thermal resistance, case to heatsink   | R <sub>thCS</sub>                 | Mounting surface, smooth and greased | 0.5                |                        |
| Approximate weight                             |                                   |                                      | 2                  | g                      |
|                                                |                                   |                                      | 0.07               | oz.                    |
| Mounting torque                                | minimum                           |                                      | 6 (5)              | kgf · cm<br>(lbf · in) |
|                                                | maximum                           |                                      | 12 (10)            |                        |
| Marking device                                 |                                   | Case style TO-220AC (JEDEC)          | 10ETF10<br>10ETF12 |                        |

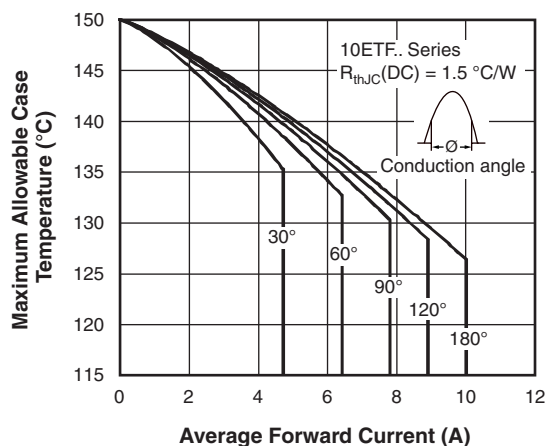


Fig. 1 - Current Rating Characteristics

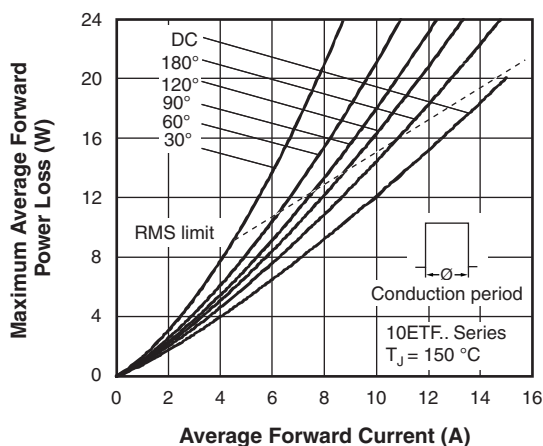


Fig. 4 - Forward Power Loss Characteristics

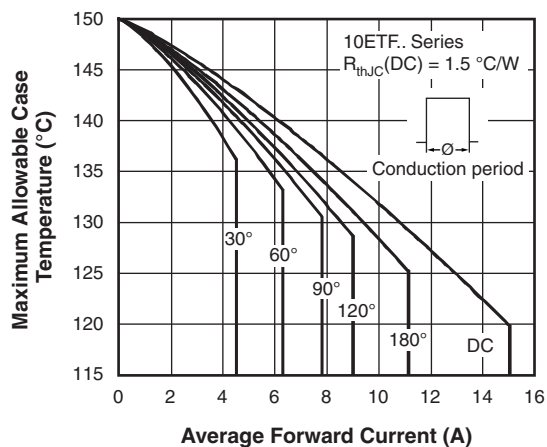


Fig. 2 - Current Rating Characteristics

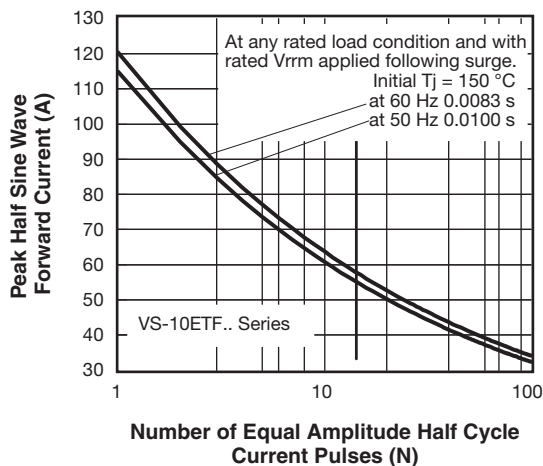


Fig. 5 - Maximum Non-Repetitive Surge Current

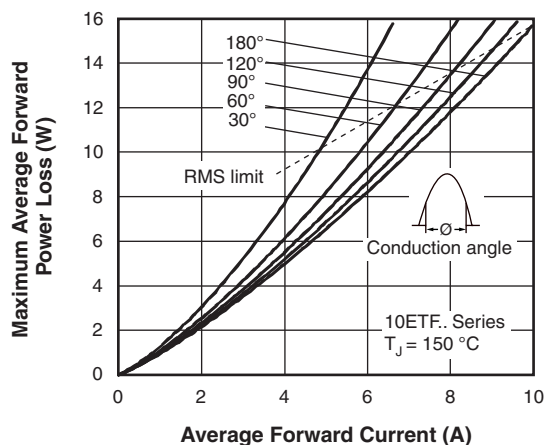


Fig. 3 - Forward Power Loss Characteristics

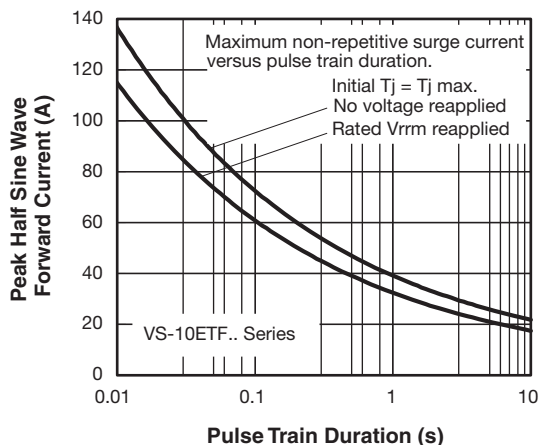


Fig. 6 - Maximum Non-Repetitive Surge Current

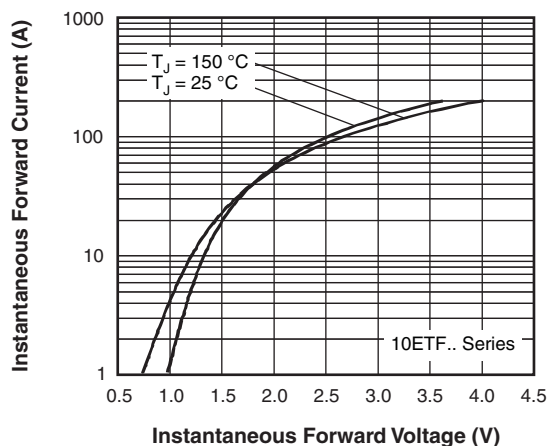


Fig. 7 - Forward Voltage Drop Characteristics

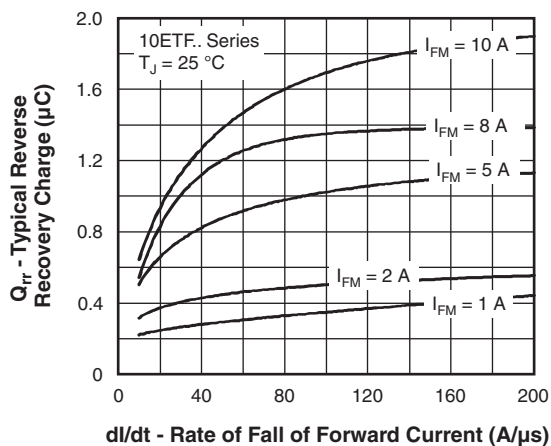


Fig. 10 - Recovery Charge Characteristics,  $T_J = 25\text{ °C}$

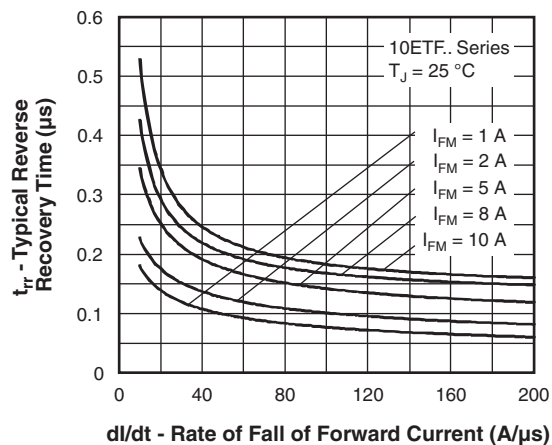


Fig. 8 - Recovery Time Characteristics,  $T_J = 25\text{ °C}$

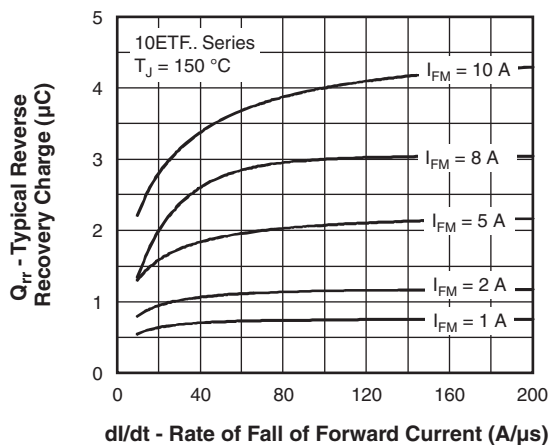


Fig. 11 - Recovery Charge Characteristics,  $T_J = 150\text{ °C}$

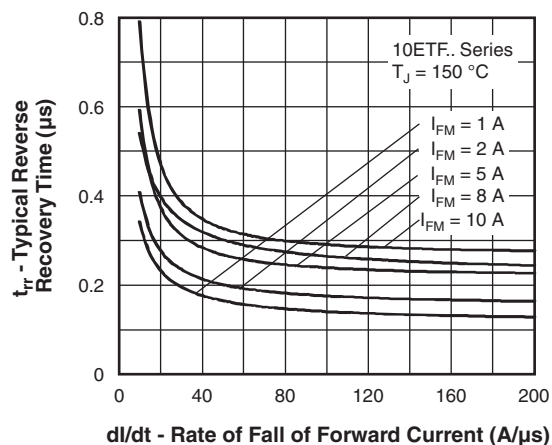


Fig. 9 - Recovery Time Characteristics,  $T_J = 150\text{ °C}$

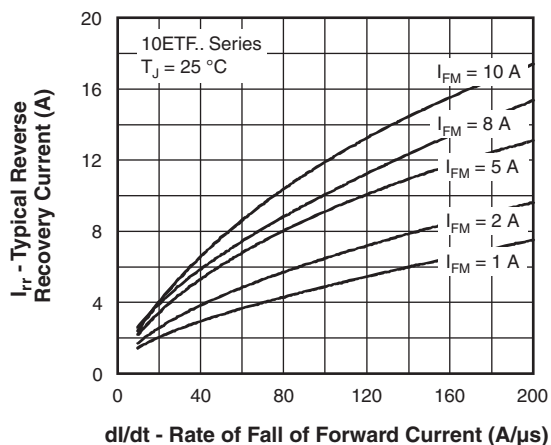
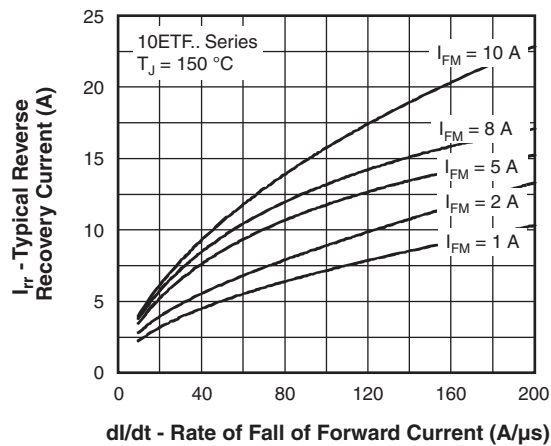
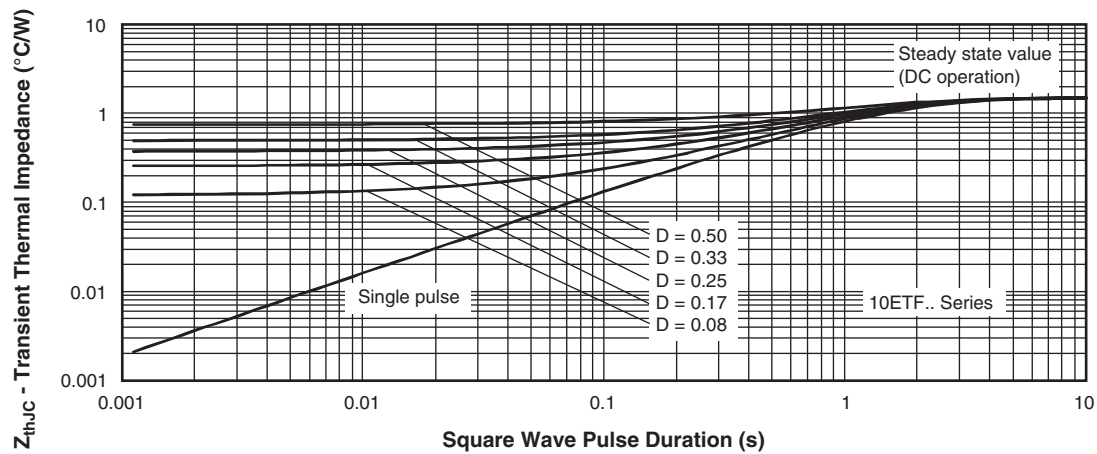


Fig. 12 - Recovery Current Characteristics,  $T_J = 25\text{ °C}$


Fig. 13 - Recovery Current Characteristics,  $T_J = 150\text{ }^{\circ}\text{C}$ 

Fig. 14 - Thermal Impedance  $Z_{thJC}$  Characteristics

**ORDERING INFORMATION TABLE**

|             |            |           |          |          |          |           |            |
|-------------|------------|-----------|----------|----------|----------|-----------|------------|
| Device code | <b>VS-</b> | <b>10</b> | <b>E</b> | <b>T</b> | <b>F</b> | <b>12</b> | <b>PbF</b> |
|             | ①          | ②         | ③        | ④        | ⑤        | ⑥         | ⑦          |

|             |                                                                                                                                                                                               |             |             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|
| <b>1</b>    | - Vishay Semiconductors product                                                                                                                                                               |             |             |
| <b>2</b>    | - Current rating (10 = 10 A)                                                                                                                                                                  |             |             |
| <b>3</b>    | - Circuit configuration:<br>E = single diode                                                                                                                                                  |             |             |
| <b>4</b>    | - Package:<br>T = TO-220AC                                                                                                                                                                    |             |             |
| <b>5</b>    | - Type of silicon:<br>F = fast soft recovery rectifier                                                                                                                                        |             |             |
| <b>6</b>    | - Voltage code x 100 = $V_{RRM}$ <table border="1"><tr><td>10 = 1000 V</td></tr><tr><td>12 = 1200 V</td></tr></table>                                                                         | 10 = 1000 V | 12 = 1200 V |
| 10 = 1000 V |                                                                                                                                                                                               |             |             |
| 12 = 1200 V |                                                                                                                                                                                               |             |             |
| <b>7</b>    | - Environmental digit <ul style="list-style-type: none"><li>• PbF = lead (Pb)-free and RoHS-compliant</li><li>• -M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free</li></ul> |             |             |

| ORDERING INFORMATION (Example) |                  |                        |                         |
|--------------------------------|------------------|------------------------|-------------------------|
| PREFERRED P/N                  | QUANTITY PER T/R | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
| VS-10ETF10PbF                  | 50               | 1000                   | Antistatic plastic tube |
| VS-10ETF10-M3                  | 50               | 1000                   | Antistatic plastic tube |
| VS-10ETF12PbF                  | 50               | 1000                   | Antistatic plastic tube |
| VS-10ETF12-M3                  | 50               | 1000                   | Antistatic plastic tube |

| LINKS TO RELATED DOCUMENTS |              |                                                                        |
|----------------------------|--------------|------------------------------------------------------------------------|
| Dimensions                 |              | <a href="http://www.vishay.com/doc?95221">www.vishay.com/doc?95221</a> |
| Part marking information   | TO-220AC PbF | <a href="http://www.vishay.com/doc?95224">www.vishay.com/doc?95224</a> |
|                            | TO-220AC -M3 | <a href="http://www.vishay.com/doc?95068">www.vishay.com/doc?95068</a> |

### TO-220AC

**DIMENSIONS** in millimeters and inches



| 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     | 2.56        | 2.92  | 0.101  | 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       | 15.25 | 0.585  | 0.600 | 3     |
| D1     | 8.38        | 9.02  | 0.330  | 0.355 |       |
| D2     | 11.68       | 12.88 | 0.460  | 0.507 | 6     |
| E      | 10.11       | 10.51 | 0.398  | 0.414 | 3, 6  |

| SYMBOL | MILLIMETERS |       | INCHES     |       | NOTES |
|--------|-------------|-------|------------|-------|-------|
|        | MIN.        | MAX.  | MIN.       | MAX.  |       |
| E1     | 6.86        | 8.89  | 0.270      | 0.350 | 6     |
| E2     | -           | 0.76  | -          | 0.030 | 7     |
| 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, 7  |
| L      | 13.52       | 14.02 | 0.532      | 0.552 |       |
| L1     | 3.32        | 3.82  | 0.131      | 0.150 | 2     |
| L3     | 1.78        | 2.13  | 0.070      | 0.084 |       |
| L4     | 0.76        | 1.27  | 0.030      | 0.050 | 2     |
| Ø P    | 3.54        | 3.73  | 0.139      | 0.147 |       |
| Q      | 2.60        | 3.00  | 0.102      | 0.118 |       |
| θ      | 90° to 93°  |       | 90° to 93° |       |       |

#### 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 dimension: inches
- (6) Thermal pad contour optional within dimensions E, H1, D2 and E1
- (7) Dimension E2 x H1 define a zone where stamping and singulation irregularities are allowed
- (8) Outline conforms to JEDEC TO-220, D2 (minimum) where dimensions are derived from the actual package outline



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