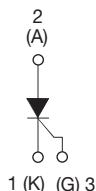




## Thyristor High Voltage, Phase Control SCR, 16 A



TO-220AB



## FEATURES

- Designed and qualified according to JEDEC-JESD47
- 125 °C max. operating junction temperature
- Material categorization:  
For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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

## APPLICATIONS

- Typical usage is in input rectification crowbar (soft start) and AC switch in motor control, UPS, welding, and battery charge

## DESCRIPTION

The VS-16TTS... high voltage series of silicon controlled rectifiers are specifically designed for medium power switching and phase control applications. The glass passivation technology used has reliable operating up to 125 °C junction temperature.

## PRODUCT SUMMARY

|                   |                   |
|-------------------|-------------------|
| Package           | TO-220AB          |
| Diode variation   | Single SCR        |
| $I_{T(AV)}$       | 10 A              |
| $V_{DRM}/V_{RRM}$ | 800 V, 1200 V     |
| $V_{TM}$          | 1.4 V             |
| $I_{GT}$          | 60 mA             |
| $T_J$             | - 40 °C to 125 °C |

## OUTPUT CURRENT IN TYPICAL APPLICATIONS

| APPLICATIONS                                                                     | SINGLE-PHASE BRIDGE | THREE-PHASE BRIDGE | UNITS |
|----------------------------------------------------------------------------------|---------------------|--------------------|-------|
| Capacitive input filter $T_A = 55$ °C, $T_J = 125$ °C, common heatsink of 1 °C/W | 13.5                | 17                 | A     |

## MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER         | TEST CONDITIONS      | VALUES      | UNITS |
|-------------------|----------------------|-------------|-------|
| $I_{T(AV)}$       | Sinusoidal waveform  | 10          | A     |
| $I_{RMS}$         |                      | 16          |       |
| $V_{DRM}/V_{RRM}$ | Range <sup>(1)</sup> | 800/1200    | V     |
| $I_{TSM}$         |                      | 200         | A     |
| $V_T$             | 10 A, $T_J = 25$ °C  | 1.4         | V     |
| dV/dt             |                      | 500         | V/μs  |
| dI/dt             |                      | 150         | A/μs  |
| $T_J$             | Range                | - 40 to 125 | °C    |

## Note

<sup>(1)</sup> For higher voltage up to 1600 V contact factory

## VOLTAGE RATINGS

| PART NUMBER                  | $V_{RRM}$ , MAXIMUM PEAK REVERSE VOLTAGE<br>V | $V_{DRM}$ , MAXIMUM PEAK DIRECT VOLTAGE<br>V | $I_{RRM}/I_{DRM}$ AT 125 °C<br>mA |
|------------------------------|-----------------------------------------------|----------------------------------------------|-----------------------------------|
| VS-16TTS08PbF, VS-16TTS08-M3 | 800                                           | 800                                          | 10                                |
| VS-16TTS12PbF, VS-16TTS12-M3 | 1200                                          | 1200                                         |                                   |

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                                             | SYMBOL          | TEST CONDITIONS                                                                                                       | VALUES                                |      | UNITS         |
|-------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------|------|---------------|
|                                                       |                 |                                                                                                                       | TYP.                                  | MAX. |               |
| Maximum average on-state current                      | $I_{T(AV)}$     | $T_C = 98\text{ }^{\circ}\text{C}$ , 180° conduction, half sine wave                                                  | 10                                    |      | A             |
| Maximum RMS on-state current                          | $I_{RMS}$       |                                                                                                                       | 16                                    |      |               |
| Maximum peak, one-cycle, non-repetitive surge current | $I_{TSM}$       | 10 ms sine pulse, rated $V_{RRM}$ applied                                                                             | 170                                   |      |               |
|                                                       |                 | 10 ms sine pulse, no voltage reapplied                                                                                | 200                                   |      |               |
| Maximum $I^2t$ for fusing                             | $I^2t$          | 10 ms sine pulse, rated $V_{RRM}$ applied                                                                             | 144                                   |      | $A^2s$        |
|                                                       |                 | 10 ms sine pulse, no voltage reapplied                                                                                | 200                                   |      |               |
| Maximum $I^2\sqrt{t}$ for fusing                      | $I^2\sqrt{t}$   | $t = 0.1$ to 10 ms, no voltage reapplied                                                                              | 2000                                  |      | $A^2\sqrt{s}$ |
| Maximum on-state voltage drop                         | $V_{TM}$        | 10 A, $T_J = 25\text{ }^{\circ}\text{C}$                                                                              | 1.4                                   |      | V             |
| On-state slope resistance                             | $r_t$           | $T_J = 125\text{ }^{\circ}\text{C}$                                                                                   | 24.0                                  |      | $m\Omega$     |
| Threshold voltage                                     | $V_{T(TO)}$     |                                                                                                                       | 1.1                                   |      | V             |
| Maximum reverse and direct leakage current            | $I_{RM}/I_{DM}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                                                                    | $V_R = \text{Rated } V_{RRM}/V_{DRM}$ |      | mA            |
|                                                       |                 | $T_J = 125\text{ }^{\circ}\text{C}$                                                                                   |                                       |      |               |
| Holding current                                       | $I_H$           | Anode supply = 6 V, resistive load, initial $I_T = 1$ A<br>16TTS08PbF, 16TTS12PbF, $T_J = 25\text{ }^{\circ}\text{C}$ | -                                     | 150  |               |
| Maximum latching current                              | $I_L$           | Anode supply = 6 V, resistive load, $T_J = 25\text{ }^{\circ}\text{C}$                                                | 200                                   |      |               |
| Maximum rate of rise of off-state voltage             | $dV/dt$         | $T_J = T_J \text{ max.}$ , linear to $80\text{ }^{\circ}\text{C}$ , $V_{DRM} = R_g - k = \text{Open}$                 | 500                                   |      | V/ $\mu s$    |
| Maximum rate of rise of turned-on current             | $dI/dt$         |                                                                                                                       | 150                                   |      | A/ $\mu s$    |

**TRIGGERING**

| PARAMETER                                   | SYMBOL      | TEST CONDITIONS                                                         | VALUES | UNITS |
|---------------------------------------------|-------------|-------------------------------------------------------------------------|--------|-------|
| Maximum peak gate power                     | $P_{GM}$    |                                                                         | 8.0    | W     |
| Maximum average gate power                  | $P_{G(AV)}$ |                                                                         | 2.0    |       |
| Maximum peak positive gate current          | $+I_{GM}$   |                                                                         | 1.5    | A     |
| Maximum peak negative gate voltage          | $-V_{GM}$   |                                                                         | 10     | V     |
| Maximum required DC gate current to trigger | $I_{GT}$    | Anode supply = 6 V, resistive load, $T_J = -65\text{ }^{\circ}\text{C}$ | 90     | mA    |
|                                             |             | Anode supply = 6 V, resistive load, $T_J = 25\text{ }^{\circ}\text{C}$  | 60     |       |
|                                             |             | Anode supply = 6 V, resistive load, $T_J = 125\text{ }^{\circ}\text{C}$ | 35     |       |
| Maximum required DC gate voltage to trigger | $V_{GT}$    | Anode supply = 6 V, resistive load, $T_J = -65\text{ }^{\circ}\text{C}$ | 3.0    | V     |
|                                             |             | Anode supply = 6 V, resistive load, $T_J = 25\text{ }^{\circ}\text{C}$  | 2.0    |       |
|                                             |             | Anode supply = 6 V, resistive load, $T_J = 125\text{ }^{\circ}\text{C}$ | 1.0    |       |
| Maximum DC gate voltage not to trigger      | $V_{GD}$    | $T_J = 125\text{ }^{\circ}\text{C}$ , $V_{DRM} = \text{Rated value}$    | 0.25   | mA    |
| Maximum DC gate current not to trigger      | $I_{GD}$    |                                                                         | 2.0    |       |

**SWITCHING**

| PARAMETER                     | SYMBOL   | TEST CONDITIONS                     | VALUES | UNITS   |
|-------------------------------|----------|-------------------------------------|--------|---------|
| Typical turn-on time          | $t_{gt}$ | $T_J = 25\text{ }^{\circ}\text{C}$  | 0.9    | $\mu s$ |
| Typical reverse recovery time | $t_{rr}$ | $T_J = 125\text{ }^{\circ}\text{C}$ | 4      |         |
| Typical turn-off time         | $t_q$    |                                     | 110    |         |



| THERMAL AND MECHANICAL SPECIFICATIONS           |                                   |                                      |             |                        |
|-------------------------------------------------|-----------------------------------|--------------------------------------|-------------|------------------------|
| PARAMETER                                       | SYMBOL                            | TEST CONDITIONS                      | VALUES      | UNITS                  |
| Maximum junction and storage temperature range  | T <sub>J</sub> , T <sub>Stg</sub> |                                      | - 40 to 125 | °C                     |
| Maximum thermal resistance, junction to case    | R <sub>thJC</sub>                 | DC operation                         | 1.3         | °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<br>maximum                |                                      | 6 (5)       | kgf · cm<br>(lbf · in) |
|                                                 |                                   |                                      | 12 (10)     |                        |
| Marking device                                  |                                   | Case style TO-220AB                  | 16TTS08     |                        |
|                                                 |                                   |                                      | 16TTS12     |                        |

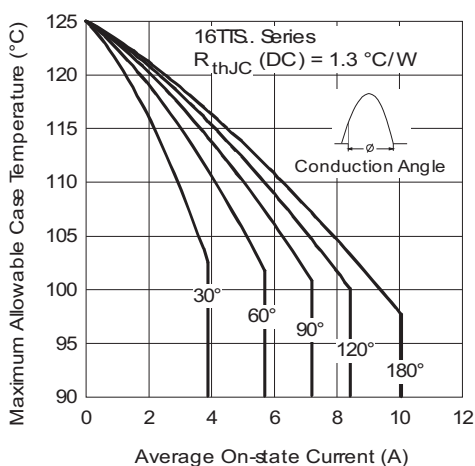


Fig. 1 - Current Rating Characteristics

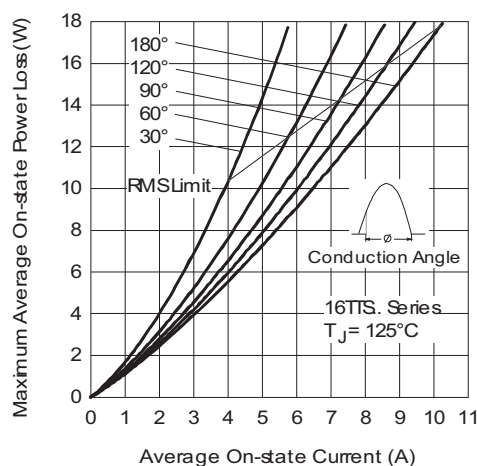


Fig. 3 - On-State Power Loss Characteristics

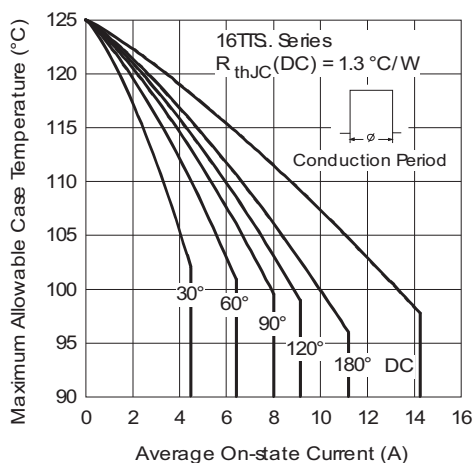


Fig. 2 - Current Rating Characteristics

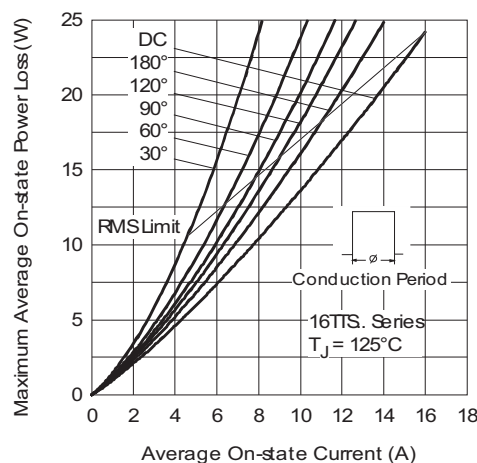


Fig. 4 - On-State Power Loss Characteristics

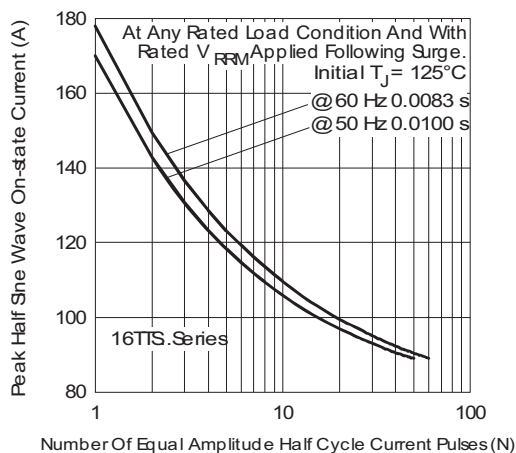


Fig. 5 - Maximum Non-Repetitive Surge Current

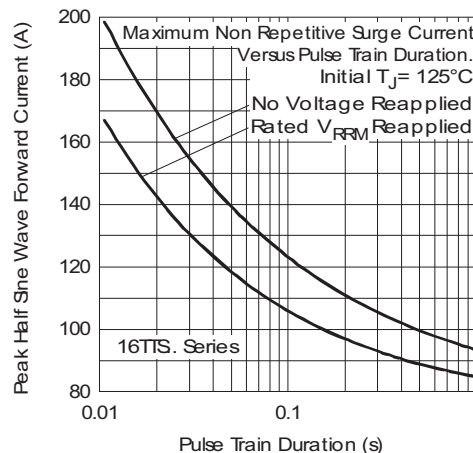


Fig. 6 - Maximum Non-Repetitive Surge Current

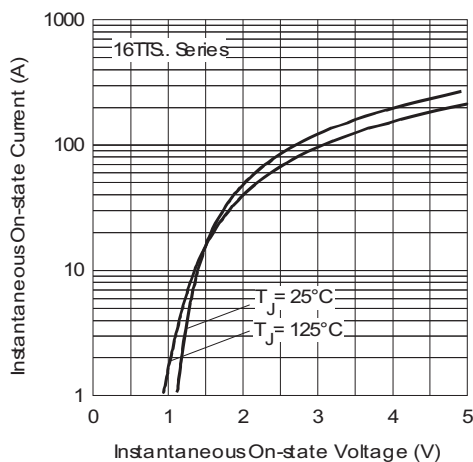
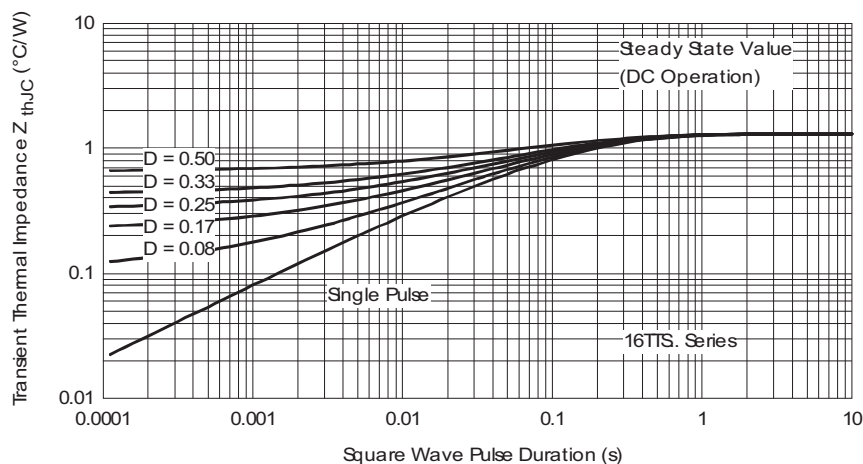


Fig. 7 - On-State Voltage Drop Characteristics


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

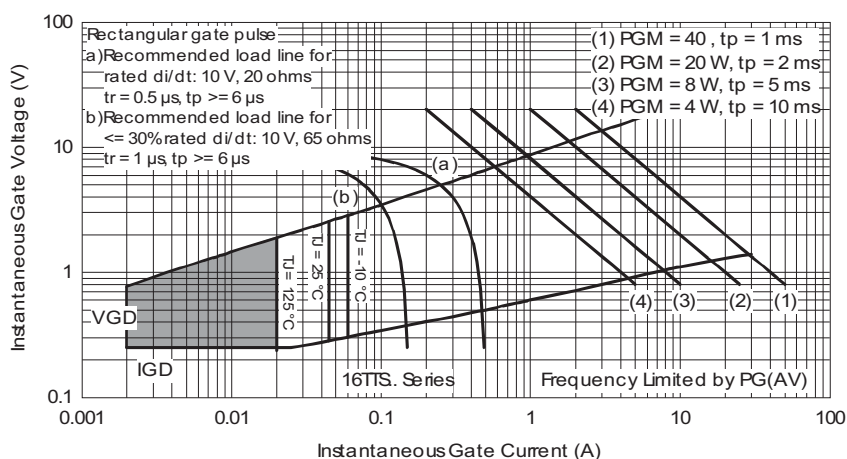


Fig. 9 - Gate Characteristics

## ORDERING INFORMATION TABLE

Device code

| VS- | 16 | T | T | S | 12 | PbF |
|-----|----|---|---|---|----|-----|
| 1   | 2  | 3 | 4 | 5 | 6  | 7   |

- 1 - Vishay Semiconductors product
- 2 - Current rating
- 3 - Circuit configuration:  
T = Single thyristor
- 4 - Package:  
T = TO-220AB
- 5 - Type of silicon:  
S = Converter grade
- 6 - Voltage code  $\times 100 = V_{RRM}$   
08 = 800 V  
12 = 1200 V
- 7 - Environmental digit:  
PbF = Lead (Pb)-free and RoHS compliant  
-M3 = Halogen-free, RoHS compliant, and terminations lead (Pb)-free

## ORDERING INFORMATION (Example)

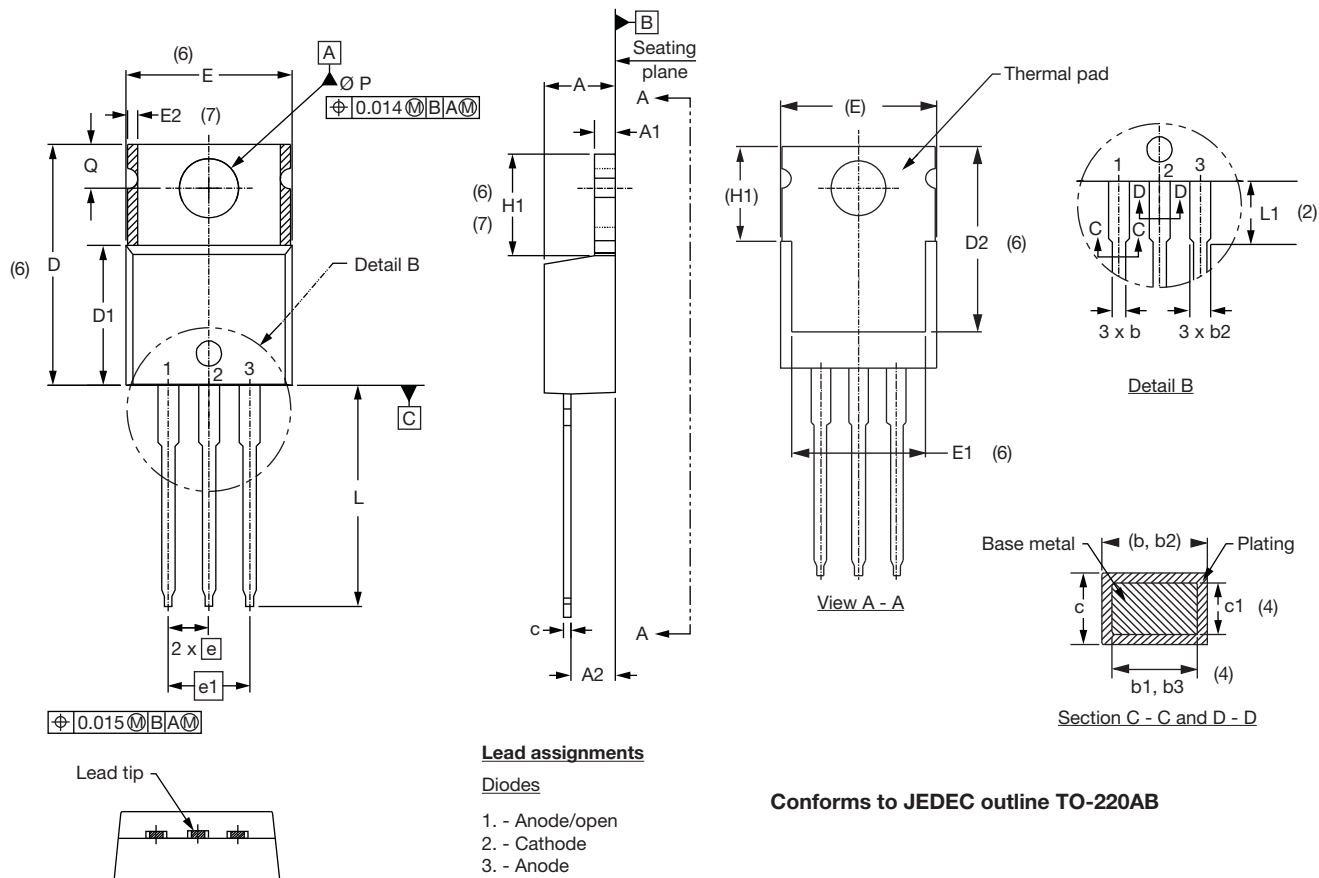
| PREFERRED P/N | QUANTITY PER T/R | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION    |
|---------------|------------------|------------------------|--------------------------|
| VS-16TTS08PbF | 50               | 1000                   | Antistatic plastic tubes |
| VS-16TTS08-M3 | 50               | 1000                   | Antistatic plastic tubes |
| VS-16TTS12PbF | 50               | 1000                   | Antistatic plastic tubes |
| VS-16TTS12-M3 | 50               | 1000                   | Antistatic plastic tubes |

## LINKS TO RELATED DOCUMENTS

|                          |              |                                                                        |
|--------------------------|--------------|------------------------------------------------------------------------|
| Dimensions               |              | <a href="http://www.vishay.com/doc?95222">www.vishay.com/doc?95222</a> |
| Part marking information | TO-220AB PbF | <a href="http://www.vishay.com/doc?95225">www.vishay.com/doc?95225</a> |
|                          | TO-220AB -M3 | <a href="http://www.vishay.com/doc?95028">www.vishay.com/doc?95028</a> |

## TO-220AB

**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     |

| SYMBOL | MILLIMETERS |       | INCHES     |       | NOTES |
|--------|-------------|-------|------------|-------|-------|
|        | MIN.        | MAX.  | MIN.       | MAX.  |       |
| E      | 10.11       | 10.51 | 0.398      | 0.414 | 3, 6  |
| 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     |
| 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 dimensions: inches
- (6) Thermal pad contour optional within dimensions E, H1, D2 and E1
- (7) Dimensions E2 x H1 define a zone where stamping and singulation irregularities are allowed
- (8) Outline conforms to JEDEC TO-220, except A2 (maximum) and D2 (minimum) where dimensions are derived from the actual package outline



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