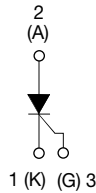
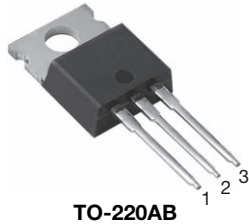




## Thyristor High Voltage, Phase Control SCR, 16 A



### 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            | $I_{RM}/I_{DM}$ | $V_R = \text{Rated } V_{RRM}/V_{DRM}$   | $T_J = 25\text{ }^\circ\text{C}$  | 0.5  |               | mA |
|   |                 |   | $T_J = 125\text{ }^\circ\text{C}$ | 10   |               |    |
| 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   |       |    |
| Maximum DC gate current not to trigger      | $I_{GD}$    |   | 2.0    |       | mA |

| 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  | $T_J, T_{Stg}$ |                                      | - 40 to 125 | °C                     |
| Maximum thermal resistance, junction to case    | $R_{thJC}$     | DC operation                         | 1.3         | °C/W                   |
| Maximum thermal resistance, junction to ambient | $R_{thJA}$     |                                      | 62          |                        |
| Typical thermal resistance, case to heatsink    | $R_{thCS}$     | 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-220AB                  | 16TTS08     |                        |
|   |                |                                      | 16TTS12     |                        |

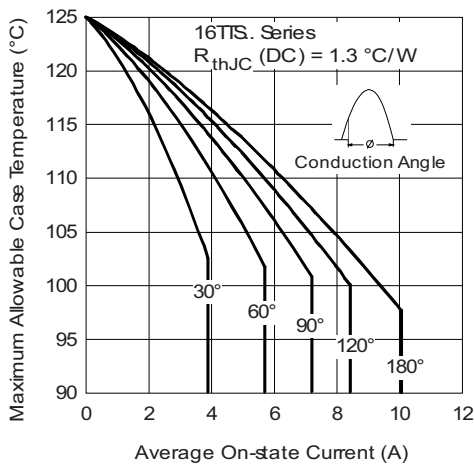


Fig. 1 - Current Rating Characteristics

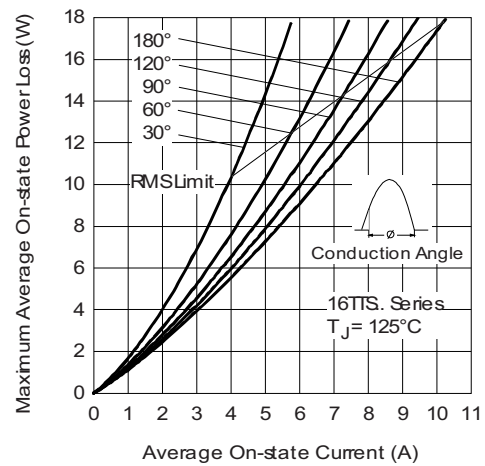


Fig. 3 - On-State Power Loss Characteristics

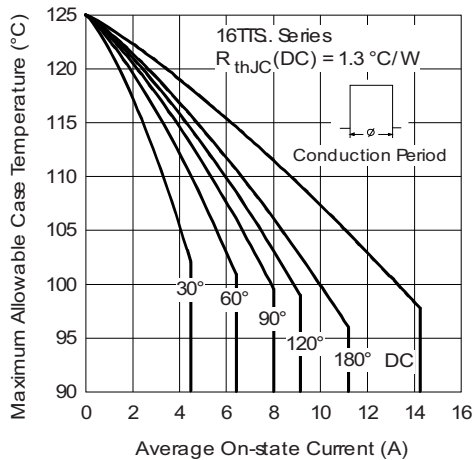


Fig. 2 - Current Rating Characteristics

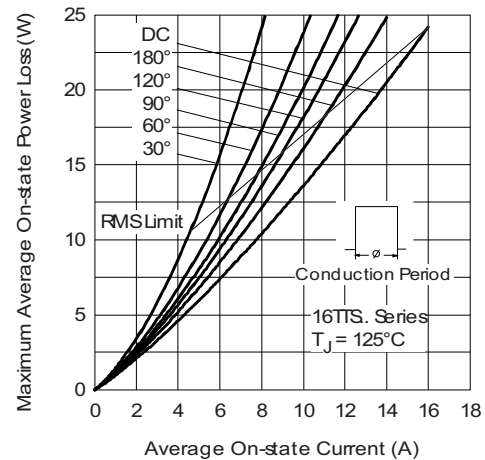


Fig. 4 - On-State Power Loss Characteristics

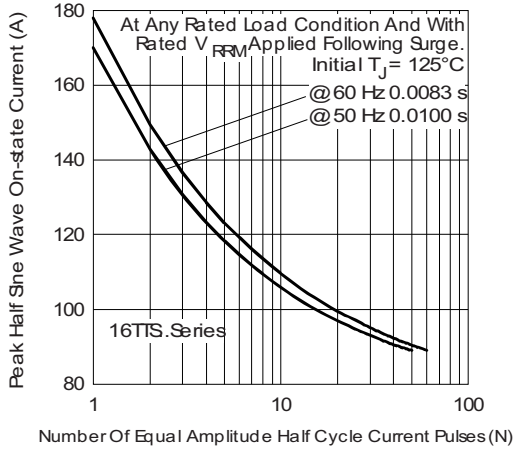


Fig. 5 - Maximum Non-Repetitive Surge Current

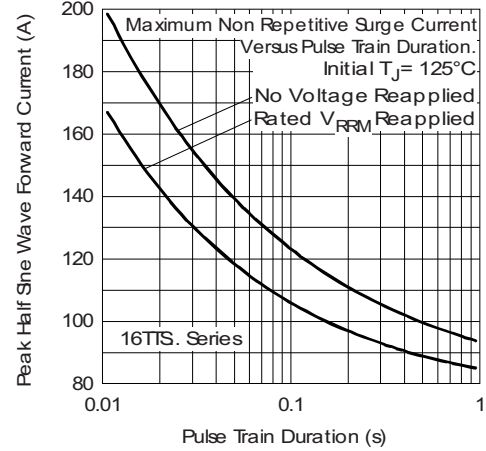


Fig. 6 - Maximum Non-Repetitive Surge Current

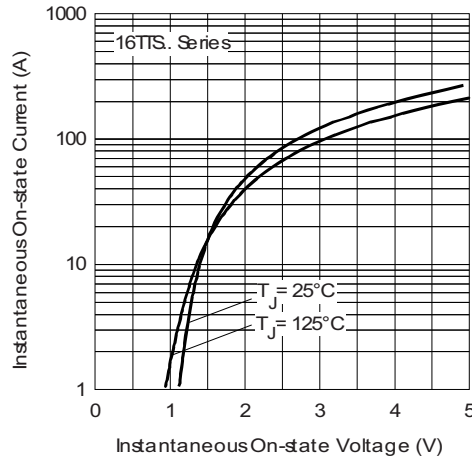


Fig. 7 - On-State Voltage Drop Characteristics

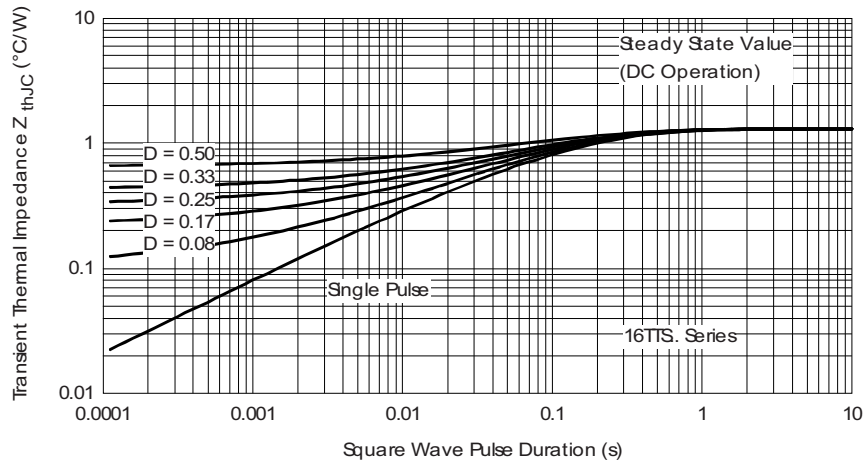


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

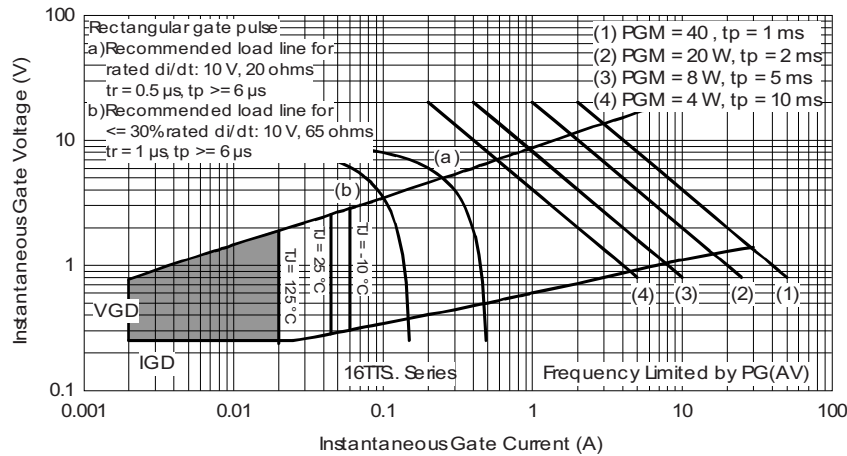


Fig. 9 - Gate Characteristics

**ORDERING INFORMATION TABLE**

|             |            |           |          |          |          |           |            |
|-------------|------------|-----------|----------|----------|----------|-----------|------------|
| Device code | <b>VS-</b> | <b>16</b> | <b>T</b> | <b>T</b> | <b>S</b> | <b>12</b> | <b>PbF</b> |
|             | 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 x 100 =  $V_{RRM}$ 

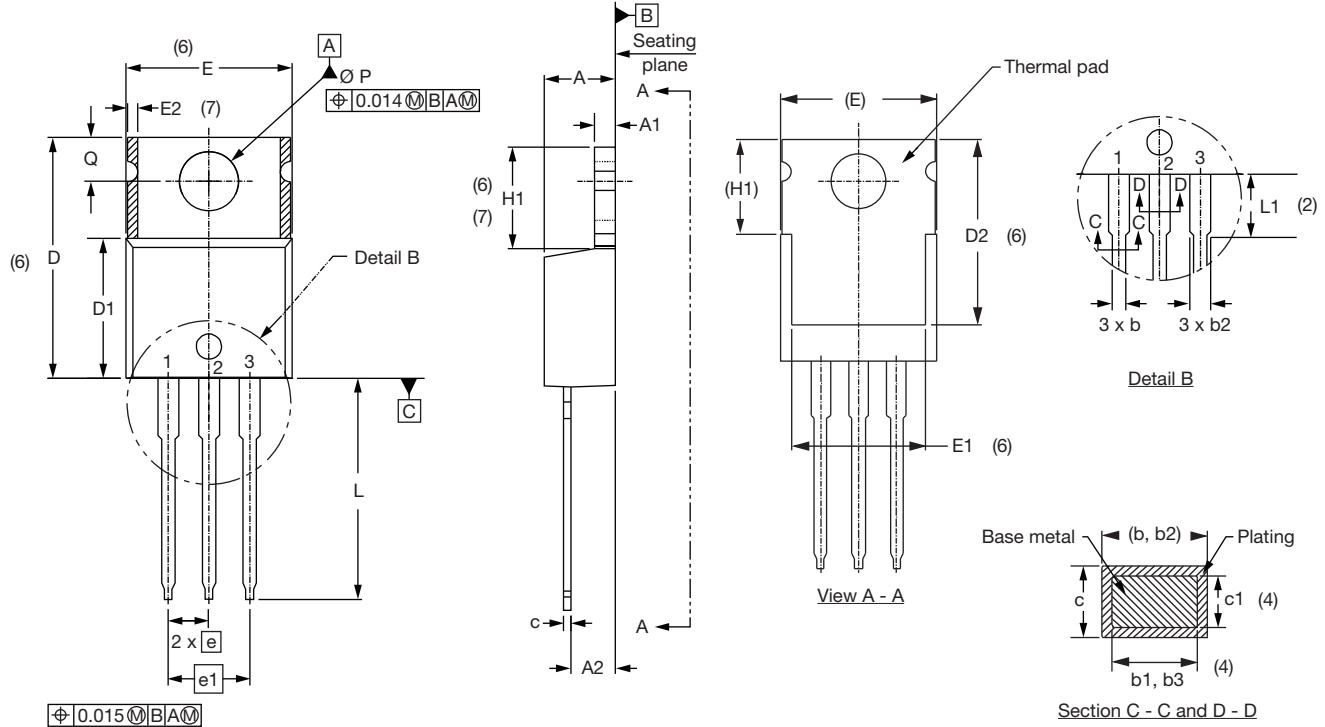
|             |
|-------------|
| 08 = 800 V  |
| 12 = 1200 V |
- ⑦ - Environmental digit:  
PbF = Lead (Pb)-free and RoHS compliant  
-M3 = Halogen-free, RoHS compliant, and terminations lead (Pb)-free

| 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



**Lead assignments**

Diodes

- 1. - Anode/open
- 2. - Cathode
- 3. - Anode

Conforms to JEDEC outline TO-220AB

| 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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