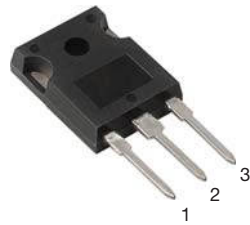
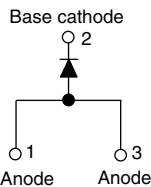
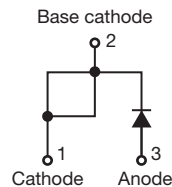


## Hyperfast Rectifier, 30 A FRED Pt®


**TO-247AC**

**TO-247AC modified**

**VS-APH3006HN3**

**VS-EPH3006HN3**

### FEATURES

- Low forward voltage drop
- Hyperfast soft recovery time
- 175 °C operating junction temperature
- AEC-Q101 qualified, meets JESD 201 class 1 whisker test
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


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

### DESCRIPTION / APPLICATIONS

Hyperfast recovery rectifiers designed with optimized performance of forward voltage drop, hyperfast recovery time, and soft recovery.

The planar structure and the platinum doped life time control guarantee the best overall performance, ruggedness and reliability characteristics.

These devices are intended for use in PFC Boost stage in the AC/DC section of SMPS, inverters or as freewheeling diodes.

The extremely optimized stored charge and low recovery current minimize the switching losses and reduce over dissipation in the switching element and snubbers.

### PRODUCT SUMMARY

| Package         | TO-247AC,<br>TO-247AC modified (2 pins) |
|-----------------|---|
| $I_{F(AV)}$     | 30 A                                    |
| $V_R$           | 600 V                                   |
| $V_F$ at $I_F$  | 1.4 V                                   |
| $t_{rr}$ typ.   | 27 ns                                   |
| $T_J$ max.      | 175 °C                                  |
| Diode variation | Single die                              |

### ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                   | SYMBOL         | TEST CONDITIONS       | MAX.        | UNITS |
|---|----------------|-----------------------|-------------|-------|
| Repetitive peak reverse voltage             | $V_{RRM}$      |                       | 600         | V     |
| Average rectified forward current           | $I_{F(AV)}$    | $T_C = 112\text{ °C}$ | 30          | A     |
| Non-repetitive peak surge current           | $I_{FSM}$      | $T_C = 25\text{ °C}$  | 220         |       |
| Operating junction and storage temperatures | $T_J, T_{Stg}$ |                       | -65 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 | $V_{BR}, V_R$ | $I_R = 100\text{ }\mu\text{A}$               | 600  | -    | -    | V             |
|                                     |               |  |      |      |      |               |
| Forward voltage                     | $V_F$         | $I_F = 30\text{ A}$                          | -    | 2.0  | 2.65 | V             |
|                                     |               | $I_F = 30\text{ A}, T_J = 150\text{ °C}$     | -    | 1.4  | 1.8  |               |
| Reverse leakage current             | $I_R$         | $V_R = V_R$ rated                            | -    | -    | 30   | $\mu\text{A}$ |
|                                     |               | $T_J = 150\text{ °C}, V_R = V_R$ rated       | -    | -    | 300  |               |
| Junction capacitance                | $C_T$         | $V_R = 600\text{ V}$                         | -    | 20   | -    | pF            |
| Series inductance                   | $L_S$         | Measured lead to lead 5 mm from package body | -    | 8.0  | -    | nH            |



| <b>DYNAMIC RECOVERY CHARACTERISTICS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified) |           |  |      |      |      |       |
|--|-----------|--|------|------|------|-------|
| PARAMETER  | SYMBOL    | TEST CONDITIONS  | MIN. | TYP. | MAX. | UNITS |
| Reverse recovery time  | $t_{rr}$  | $I_F = 1\text{ A}$ , $di_F/dt = 50\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$ | -    | 26   | 35   | ns    |
|  |           | $T_J = 25\text{ }^\circ\text{C}$   | -    | 26   | -    |       |
|  |           | $T_J = 125\text{ }^\circ\text{C}$  | -    | 70   | -    |       |
| Peak recovery current  | $I_{RRM}$ | $T_J = 25\text{ }^\circ\text{C}$   | -    | 3.5  | -    | A     |
|  |           | $T_J = 125\text{ }^\circ\text{C}$  | -    | 7.6  | -    |       |
| Reverse recovery charge  | $Q_{rr}$  | $T_J = 25\text{ }^\circ\text{C}$   | -    | 50   | -    | nC    |
|  |           | $T_J = 125\text{ }^\circ\text{C}$  | -    | 280  | -    |       |

| <b>THERMAL - MECHANICAL SPECIFICATIONS</b>      |                |  |             |      |             |                           |
|---|----------------|--|-------------|------|-------------|---------------------------|
| PARAMETER                                       | SYMBOL         | TEST CONDITIONS                            | MIN.        | TYP. | MAX.        | UNITS                     |
| Maximum junction and storage temperature range  | $T_J, T_{Stg}$ |  | -65         | -    | 175         | $^\circ\text{C}$          |
| Thermal resistance, junction to case            | $R_{thJC}$     |  | -           | 0.7  | 1.1         | $^\circ\text{C}/\text{W}$ |
| Thermal resistance, junction to ambient per leg | $R_{thJA}$     | Typical socket mount                       | -           | -    | 70          |                           |
| Thermal resistance, case to heatsink            | $R_{thCS}$     | Mounting surface, flat, smooth and greased | -           | 0.5  | -           |                           |
| Weight  |                |  | -           | 5.5  | -           | g                         |
|   |                |  | -           | 0.2  | -           | oz.                       |
| Mounting torque                                 |                |  | 1.2<br>(10) | -    | 2.4<br>(20) | kgf · cm<br>(lbf · in)    |
| Marking device                                  |                | Case style TO-247AC                        | APH3006H    |      |             |                           |
|   |                | Case style TO-247AC modified               | EPH3006H    |      |             |                           |

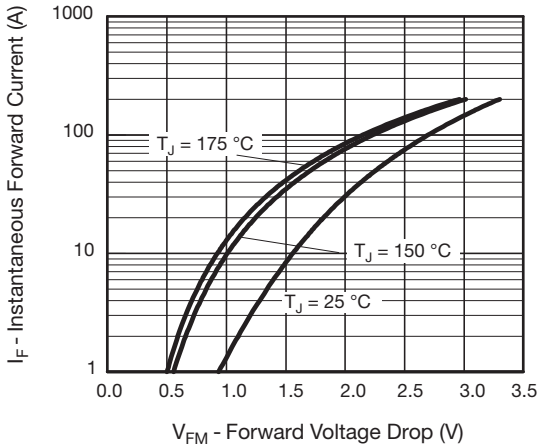


Fig. 1 - Typical Forward Voltage Drop Characteristics

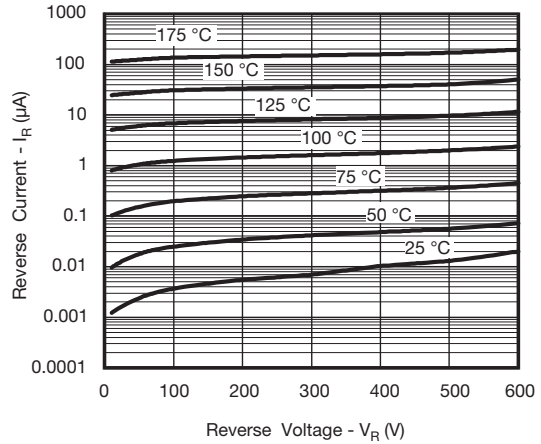


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

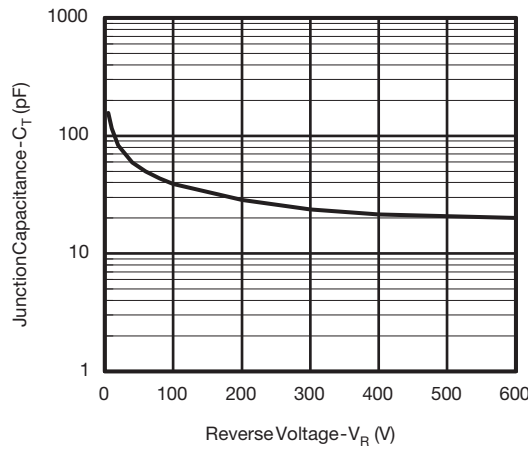


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

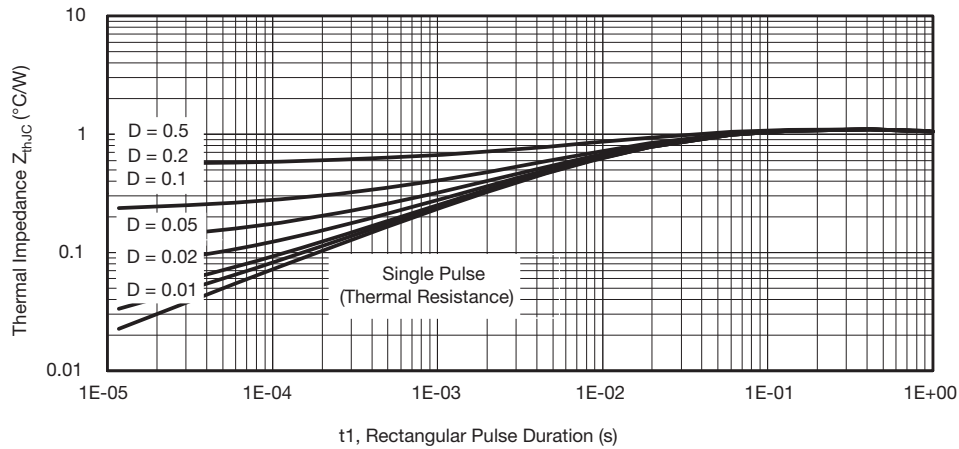


Fig. 4 - Max. Thermal Impedance  $Z_{thJC}$  Characteristics

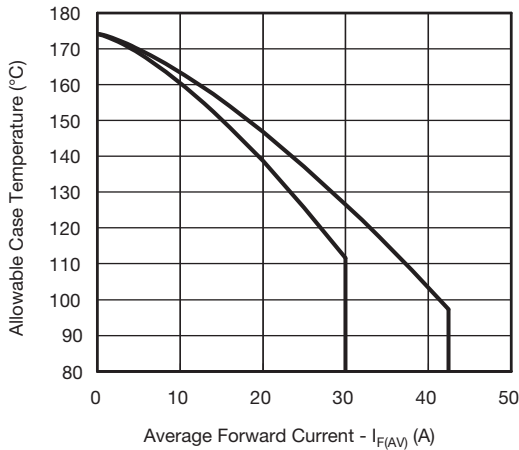


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

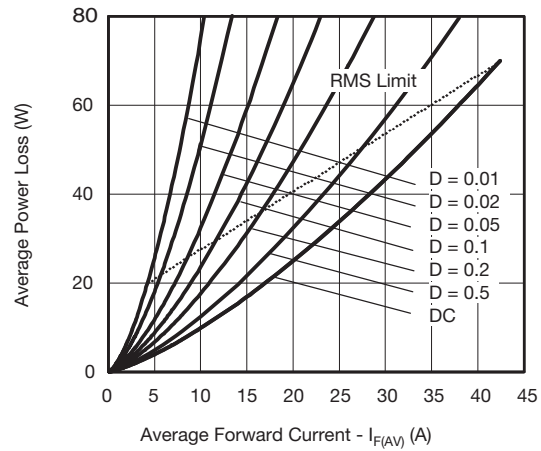


Fig. 6 - Forward Power Loss Characteristics

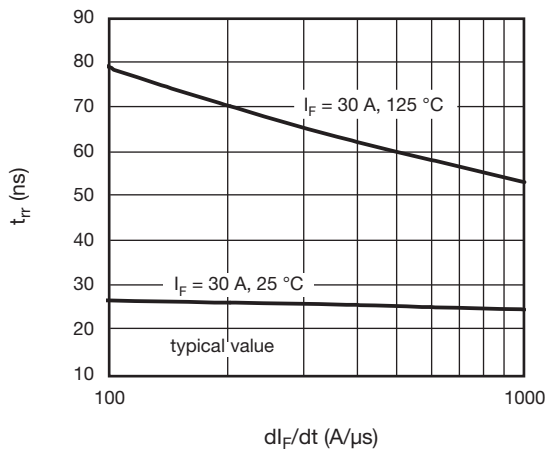


Fig. 7 - Typical Reverse Recovery vs.  $dI_F/dt$

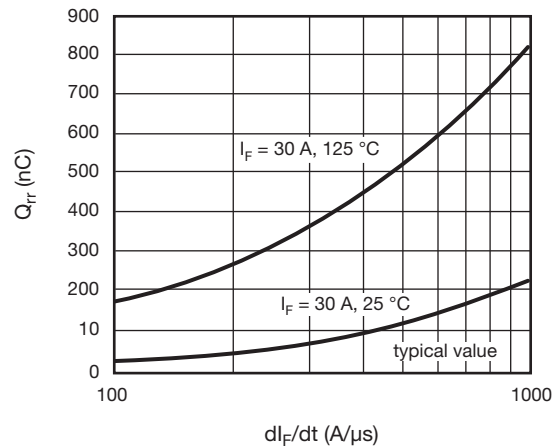
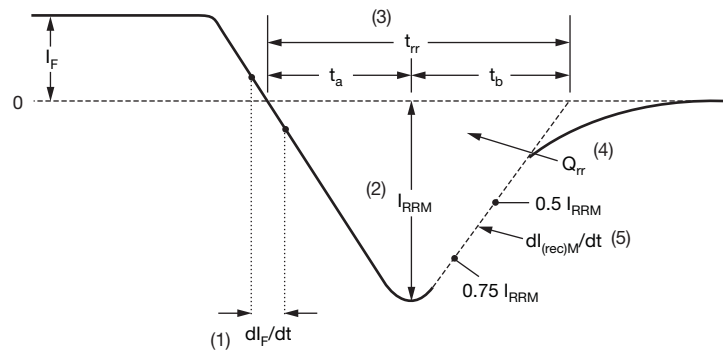


Fig. 8 - Typical Stored Charge vs.  $dI_F/dt$



- (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 zero crossing point of negative going  $I_F$  to point where a line passing through  $0.75 I_{RRM}$  and  $0.50 I_{RRM}$  extrapolated to zero current.

- (4)  $Q_{rr}$  - area under curve defined by  $t_{rr}$  and  $I_{RRM}$

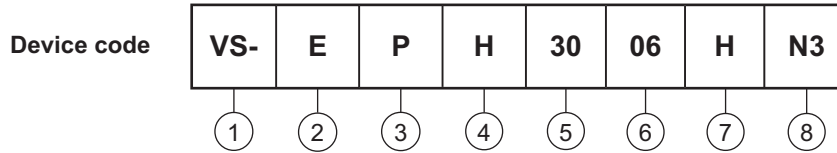
$$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$

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

Fig. 9 - Reverse Recovery Waveform and Definitions



## ORDERING INFORMATION TABLE



- 1** - Vishay Semiconductors product
- 2** - Ultrafast MUR series
  - A = single diode
  - E = single diode (modified)
- 3** - P = TO-247AC
- 4** - H = hyperfast recovery time
- 5** - Current code (30 = 30 A)
- 6** - Voltage code (06 = 600 V)
- 7** - H = AEC-Q101 qualified
- 8** - Environmental digit:  
N3 = halogen-free, RoHS-compliant, and totally lead (Pb)-free

| <b>ORDERING INFORMATION (Example)</b> |                   |                        |                         |
|---------------------------------------|-------------------|------------------------|-------------------------|
| PREFERRED P/N                         | QUANTITY PER TUBE | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
| VS-APH3006HN3                         | 25                | 500                    | Antistatic plastic tube |
| VS-EPH3006HN3                         | 25                | 500                    | Antistatic plastic tube |

| <b>LINKS TO RELATED DOCUMENTS</b> |                   |  |
|-----------------------------------|-------------------|--|
| Dimensions                        | TO-247AC          | <a href="http://www.vishay.com/doc?95542">www.vishay.com/doc?95542</a> |
|                                   | TO-247AC modified | <a href="http://www.vishay.com/doc?95541">www.vishay.com/doc?95541</a> |
| Part marking information          | TO-247AC          | <a href="http://www.vishay.com/doc?95007">www.vishay.com/doc?95007</a> |
|                                   | TO-247AC modified | <a href="http://www.vishay.com/doc?95442">www.vishay.com/doc?95442</a> |



TO-247AC modified - 50 mils L/F

**DIMENSIONS** in millimeters and inches



| SYMBOL | MILLIMETERS |       | INCHES |       | NOTES | SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|--------|-------|-------|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| A      | 4.65        | 5.31  | 0.183  | 0.209 |       | D2     | 0.51        | 1.35  | 0.020     | 0.053 |       |
| A1     | 2.21        | 2.59  | 0.087  | 0.102 |       | E      | 15.29       | 15.87 | 0.602     | 0.625 | 3     |
| A2     | 1.17        | 1.37  | 0.046  | 0.054 |       | E1     | 13.46       | -     | 0.53      | -     |       |
| b      | 0.99        | 1.40  | 0.039  | 0.055 |       | e      | 5.46 BSC    |       | 0.215 BSC |       |       |
| b1     | 0.99        | 1.35  | 0.039  | 0.053 |       | Ø K    | 0.254       |       | 0.010     |       |       |
| b2     | 1.65        | 2.39  | 0.065  | 0.094 |       | L      | 14.20       | 16.10 | 0.559     | 0.634 |       |
| b3     | 1.65        | 2.34  | 0.065  | 0.092 |       | L1     | 3.71        | 4.29  | 0.146     | 0.169 |       |
| b4     | 2.59        | 3.43  | 0.102  | 0.135 |       | Ø P    | 3.56        | 3.66  | 0.14      | 0.144 |       |
| b5     | 2.59        | 3.38  | 0.102  | 0.133 |       | Ø P1   | -           | 7.39  | -         | 0.291 |       |
| c      | 0.38        | 0.89  | 0.015  | 0.035 |       | Q      | 5.31        | 5.69  | 0.209     | 0.224 |       |
| c1     | 0.38        | 0.84  | 0.015  | 0.033 |       | R      | 4.52        | 5.49  | 0.178     | 0.216 |       |
| D      | 19.71       | 20.70 | 0.776  | 0.815 | 3     | S      | 5.51 BSC    |       | 0.217 BSC |       |       |
| D1     | 13.08       | -     | 0.515  | -     | 4     |        |             |       |           |       |       |

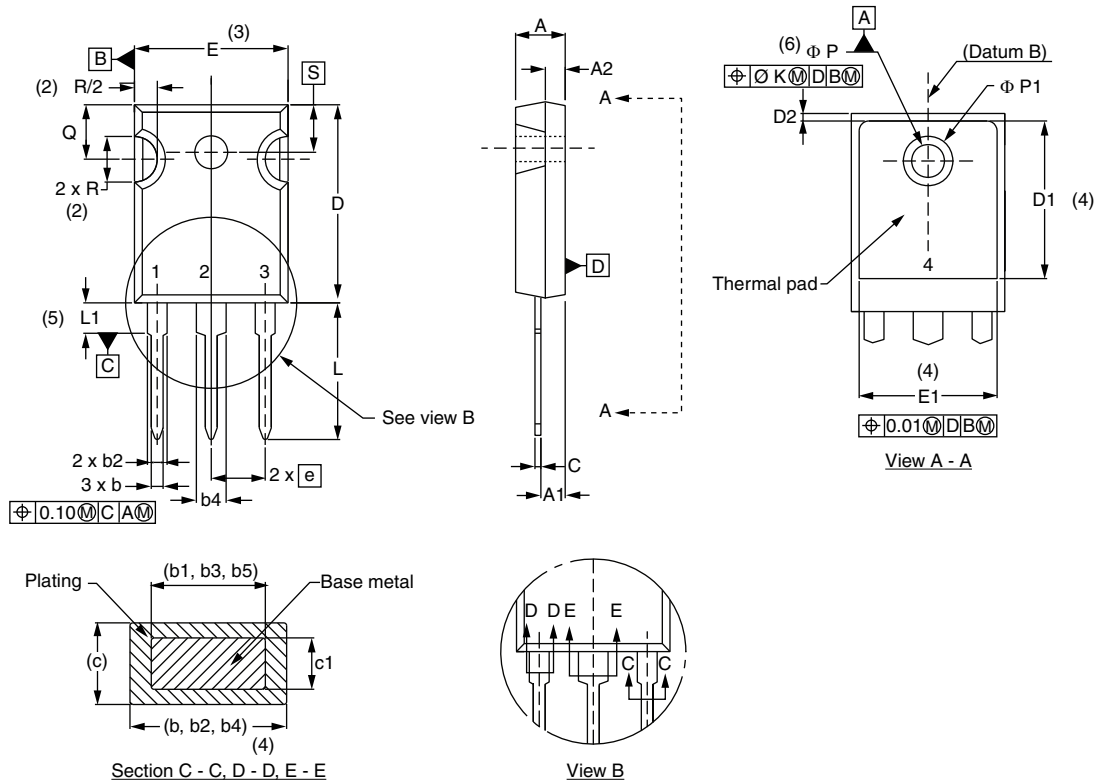
**Notes**

- Dimensioning and tolerance per ASME Y14.5M-1994
- Contour of slot optional
- 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 outermost extremes of the plastic body
- Thermal pad contour optional with dimensions D1 and E1
- Lead finish uncontrolled in L1
- Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")
- Outline conforms to JEDEC® outline TO-247 with exception of dimension c and Q



## TO-247AC - 50 mils L/F

**DIMENSIONS** in millimeters and inches



| SYMBOL | MILLIMETERS |       | INCHES |       | NOTES | SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|--------|-------|-------|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| A      | 4.65        | 5.31  | 0.183  | 0.209 |       | D2     | 0.51        | 1.35  | 0.020     | 0.053 |       |
| A1     | 2.21        | 2.59  | 0.087  | 0.102 |       | E      | 15.29       | 15.87 | 0.602     | 0.625 | 3     |
| A2     | 1.17        | 1.37  | 0.046  | 0.054 |       | E1     | 13.46       | -     | 0.53      | -     |       |
| b      | 0.99        | 1.40  | 0.039  | 0.055 |       | e      | 5.46 BSC    |       | 0.215 BSC |       |       |
| b1     | 0.99        | 1.35  | 0.039  | 0.053 |       | Ø K    | 0.254       |       | 0.010     |       |       |
| b2     | 1.65        | 2.39  | 0.065  | 0.094 |       | L      | 14.20       | 16.10 | 0.559     | 0.634 |       |
| b3     | 1.65        | 2.34  | 0.065  | 0.092 |       | L1     | 3.71        | 4.29  | 0.146     | 0.169 |       |
| b4     | 2.59        | 3.43  | 0.102  | 0.135 |       | Ø P    | 3.56        | 3.66  | 0.14      | 0.144 |       |
| b5     | 2.59        | 3.38  | 0.102  | 0.133 |       | Ø P1   | -           | 7.39  | -         | 0.291 |       |
| c      | 0.38        | 0.89  | 0.015  | 0.035 |       | Q      | 5.31        | 5.69  | 0.209     | 0.224 |       |
| c1     | 0.38        | 0.84  | 0.015  | 0.033 |       | R      | 4.52        | 5.49  | 0.178     | 0.216 |       |
| D      | 19.71       | 20.70 | 0.776  | 0.815 | 3     | S      | 5.51 BSC    |       | 0.217 BSC |       |       |
| D1     | 13.08       | -     | 0.515  | -     | 4     |        |             |       |           |       |       |

**Notes**

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) 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 outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")
- (7) Outline conforms to JEDEC® outline TO-247 with exception of dimension c and Q



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