



**THE DATASHEET OF  
60APU06PBF**





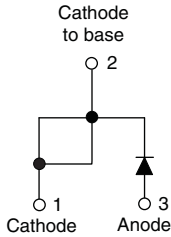
## Ultrafast Soft Recovery Diode, 60 A FRED Pt®



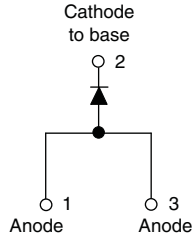
TO-247AC modified



TO-247AC



VS-60EPU06PbF  
VS-60EPU06-N3



VS-60APU06PbF  
VS-60APU06-N3

### FEATURES

- Ultrafast recovery time
- Low forward voltage drop
- 175 °C operating junction temperature
- Designed and qualified according to JEDEC®-JESD47
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### BENEFITS

- Reduced RFI and EMI
- Higher frequency operation
- Reduced snubbing
- Reduced parts count

### DESCRIPTION / APPLICATIONS

These diodes are optimized to reduce losses and EMI/RFI in high frequency power conditioning systems.

The softness of the recovery eliminates the need for a snubber in most applications. These devices are ideally suited for HF welding, power converters and other applications where switching losses are not significant portion of the total losses.

### PRODUCT SUMMARY

|                 |                                      |
|-----------------|--------------------------------------|
| Package         | TO-247AC modified (2 pins), TO-247AC |
| $I_{F(AV)}$     | 60 A                                 |
| $V_R$           | 600 V                                |
| $V_F$ at $I_F$  | 1.11 V                               |
| $t_{rr}$ typ.   | See Recovery table                   |
| $T_J$ max.      | 175 °C                               |
| Diode variation | Single die                           |

### ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                   | SYMBOL         | TEST CONDITIONS       | MAX.        | UNITS |
|---|----------------|-----------------------|-------------|-------|
| Cathode to anode voltage                    | $V_R$          |                       | 600         | V     |
| Continuous forward current                  | $I_{F(AV)}$    | $T_C = 116\text{ °C}$ | 60          | A     |
| Single pulse forward current                | $I_{FSM}$      | $T_C = 25\text{ °C}$  | 600         |       |
| Maximum repetitive forward current          | $I_{FRM}$      | Square wave, 20 kHz   | 120         |       |
| Operating junction and storage temperatures | $T_J, T_{Stg}$ |                       | -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 | $V_{BR}, V_R$ | $I_R = 100\ \mu\text{A}$                 | 600  | -    | -    | V             |
| Forward voltage                     | $V_F$         | $I_F = 60\text{ A}$                      | -    | 1.35 | 1.68 |               |
|                                     |               | $I_F = 60\text{ A}, T_J = 125\text{ °C}$ | -    | 1.20 | 1.42 |               |
|                                     |               | $I_F = 60\text{ A}, T_J = 175\text{ °C}$ | -    | 1.11 | 1.30 |               |
| Reverse leakage current             | $I_R$         | $V_R = V_R$ rated                        | -    | -    | 50   | $\mu\text{A}$ |
|                                     |               | $T_J = 150\text{ °C}, V_R = V_R$ rated   | -    | -    | 500  |               |
| Junction capacitance                | $C_T$         | $V_R = 600\text{ V}$                     | -    | 39   | -    | pF            |



| DYNAMIC RECOVERY CHARACTERISTICS (T <sub>J</sub> = 25 °C unless otherwise specified) |                  |   |      |      |      |       |
|--|------------------|---|------|------|------|-------|
| PARAMETER  | SYMBOL           | TEST CONDITIONS   | MIN. | TYP. | MAX. | UNITS |
| Reverse recovery time  | t <sub>rr</sub>  | I <sub>F</sub> = 1 A, di <sub>F</sub> /dt = 200 A/μs, V <sub>R</sub> = 30 V | -    | 34   | 45   | ns    |
|  |                  | T <sub>J</sub> = 25 °C  | -    | 81   | -    |       |
|  |                  | T <sub>J</sub> = 125 °C   | -    | 164  | -    |       |
| Peak recovery current  | I <sub>RRM</sub> | T <sub>J</sub> = 25 °C  | -    | 7.4  | -    | A     |
|  |                  | T <sub>J</sub> = 125 °C   | -    | 17.0 | -    |       |
| Reverse recovery charge  | Q <sub>rr</sub>  | T <sub>J</sub> = 25 °C  | -    | 300  | -    | nC    |
|  |                  | T <sub>J</sub> = 125 °C   | -    | 1394 | -    |       |

| THERMAL - MECHANICAL SPECIFICATIONS  |                   |  |             |      |             |                     |
|--------------------------------------|-------------------|--|-------------|------|-------------|---------------------|
| PARAMETER                            | SYMBOL            | TEST CONDITIONS                            | MIN.        | TYP. | MAX.        | UNITS               |
| Thermal resistance, junction to case | R <sub>thJC</sub> |  | -           | -    | 0.63        | K/W                 |
| Thermal resistance, case to heatsink | R <sub>thCS</sub> | Mounting surface, flat, smooth and greased | -           | 0.2  | -           |                     |
| Weight                               |                   |  | -           | 5.5  | -           | g                   |
|                                      |                   |  | -           | 0.2  | -           | oz.                 |
| Mounting torque                      |                   |  | 1.2<br>(10) | -    | 2.4<br>(20) | N · m<br>(lbf · in) |
| Marking device                       |                   | Case style TO-247AC modified               | 60EPU06     |      |             |                     |
|                                      |                   | Case style TO-247AC                        | 60APU06     |      |             |                     |

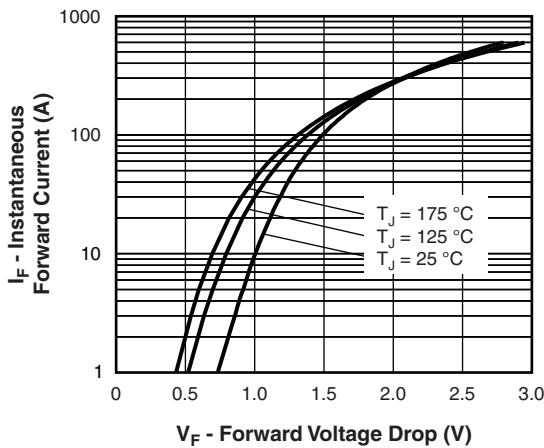


Fig. 1 - Typical Forward Voltage Drop Characteristics

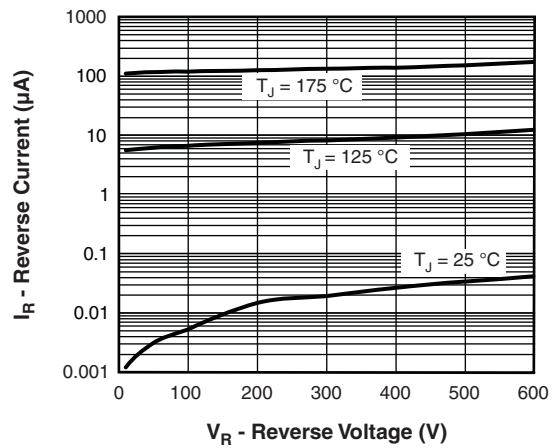


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

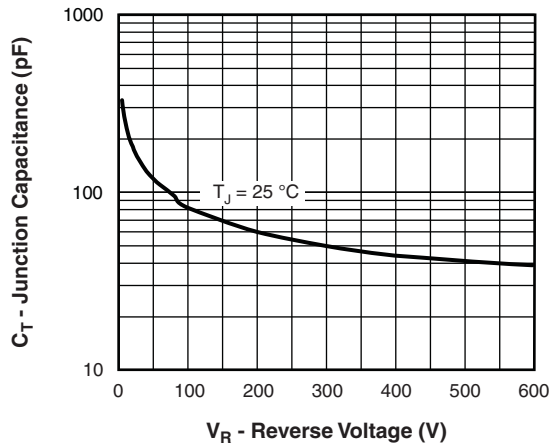


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

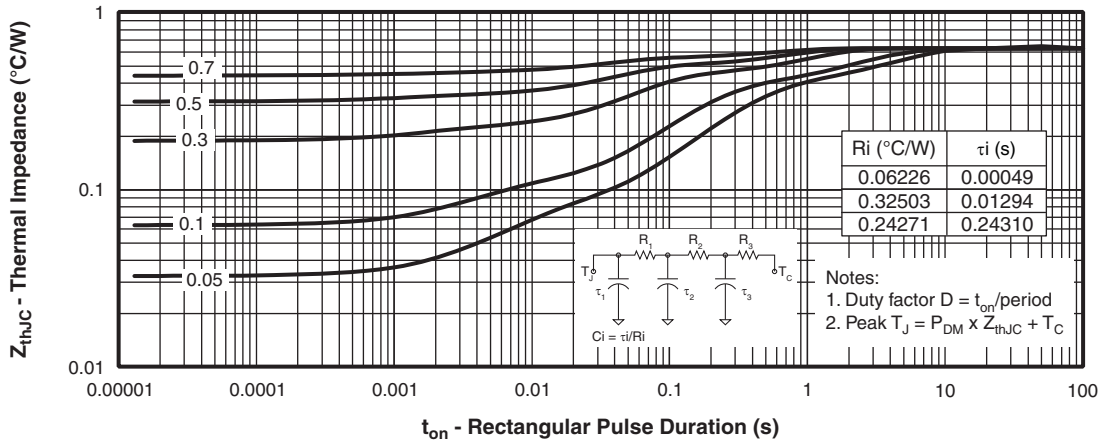


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

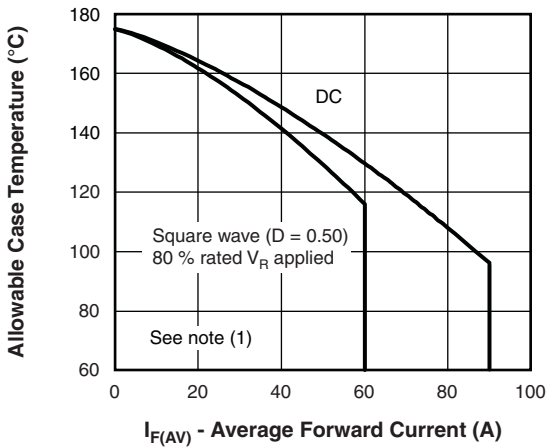


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

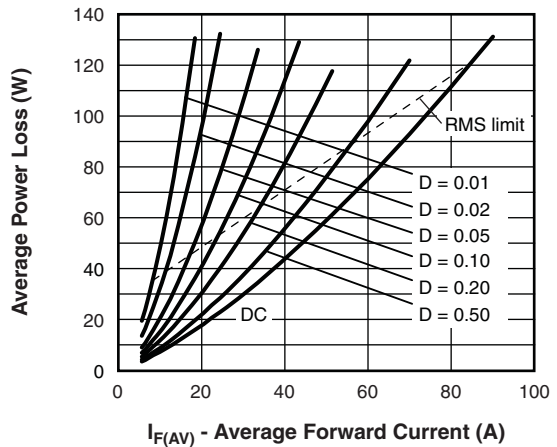


Fig. 6 - Forward Power Loss Characteristics

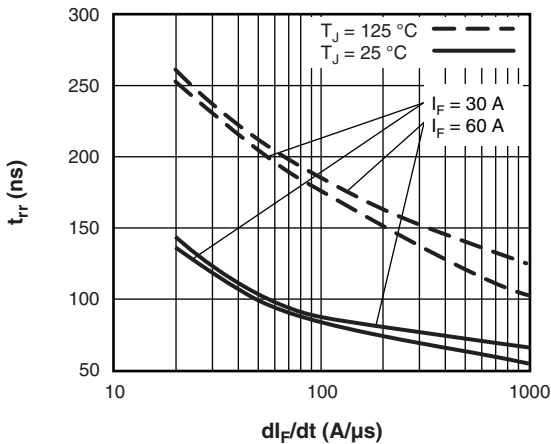


Fig. 7 - Typical Reverse Recovery Time vs.  $di_F/dt$

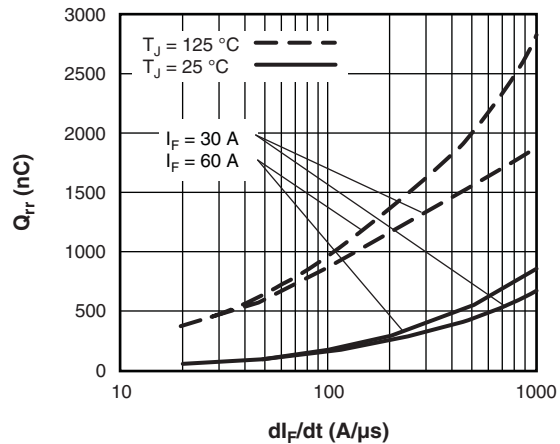


Fig. 8 - Typical Stored Charge vs.  $di_F/dt$

**Note**

- (1) Formula used:  $T_C = T_J - (Pd + Pd_{REV}) \times R_{thJC}$ ;
- $Pd$  = Forward power loss =  $I_{F(AV)} \times V_{FM}$  at  $(I_{F(AV)}/D)$  (see fig. 6);
- $Pd_{REV}$  = Inverse power loss =  $V_{R1} \times I_R (1 - D)$ ;  $I_R$  at  $V_{R1} = 80\%$  rated  $V_R$

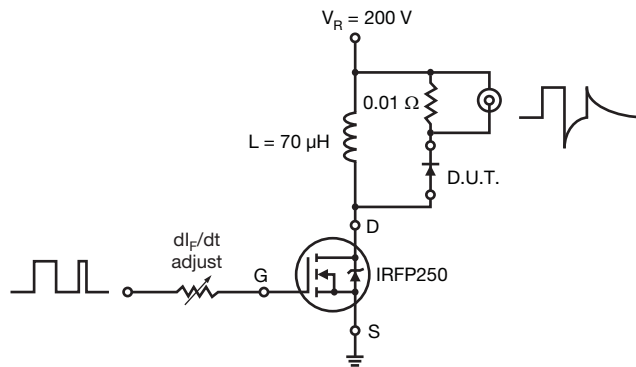
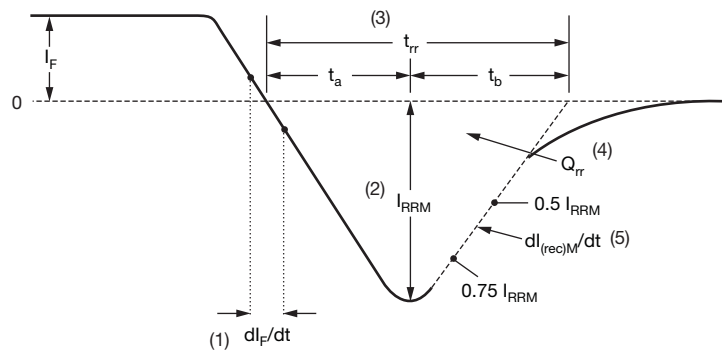


Fig. 9 - Reverse Recovery Parameter Test Circuit



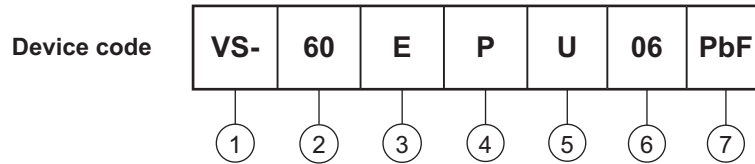
- (1)  $di_F/dt$  - rate of change of current through zero crossing
- (2)  $I_{RRM}$  - peak reverse recovery current
- (3)  $t_{rr}$  - reverse recovery time measured from zero crossing point of negative going  $I_F$  to point where a line passing through  $0.75 I_{RRM}$  and  $0.50 I_{RRM}$  extrapolated to zero current.
- (4)  $Q_{rr}$  - area under curve defined by  $t_{rr}$  and  $I_{RRM}$
- (5)  $dl_{(rec)M}/dt$  - peak rate of change of current during  $t_b$  portion of  $t_{rr}$

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

Fig. 10 - Reverse Recovery Waveform and Definitions



ORDERING INFORMATION TABLE



- 1** - Vishay Semiconductors product
- 2** - Current rating (60 = 60 A)
- 3** - Circuit configuration:
  - E = single diode
  - A = single diode, 3 pins
- 4** - Package:
  - P = TO-247AC (modified)
- 5** - Type of silicon:
  - U = ultrafast recovery
- 6** - Voltage rating (06 = 600 V)
- 7** - Environmental digit:
  - PbF = lead (Pb)-free and RoHS-compliant
  - N3 = halogen-free, RoHS-compliant and totally lead (Pb)-free

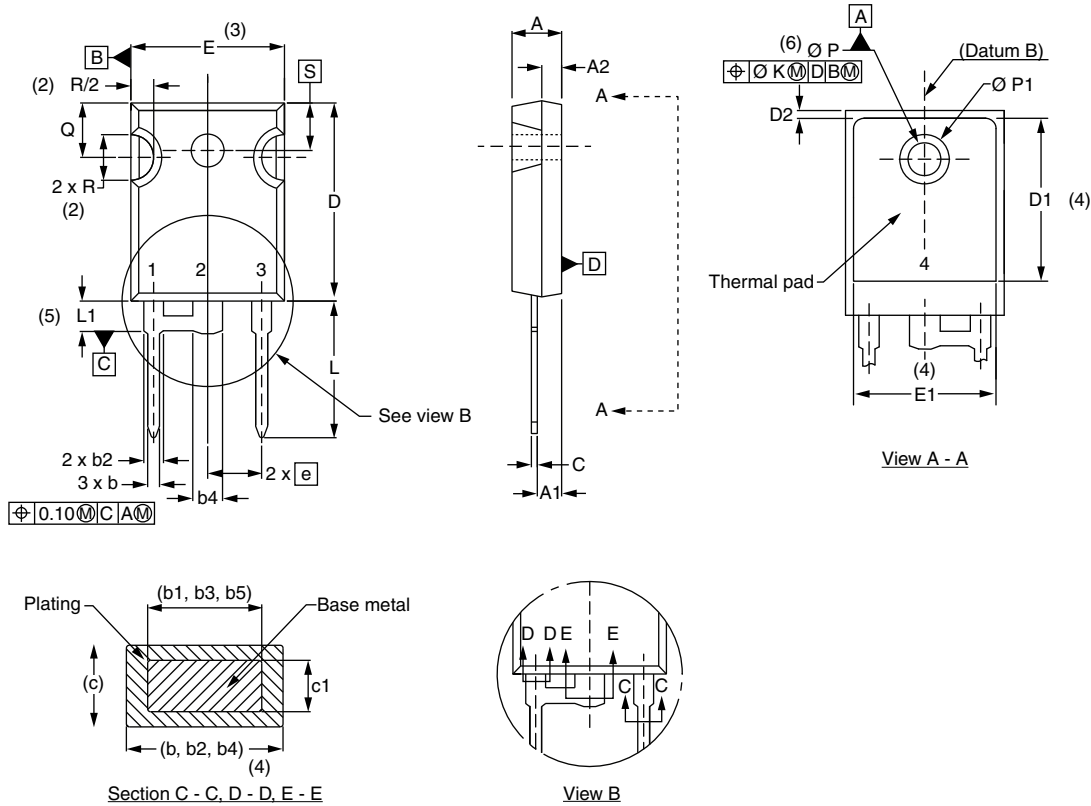
| ORDERING INFORMATION (Example) |                  |                        |                         |
|--------------------------------|------------------|------------------------|-------------------------|
| PREFERRED P/N                  | QUANTITY PER T/R | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
| VS-60EPU06PbF                  | 25               | 500                    | Antistatic plastic tube |
| VS-60EPU06-N3                  | 25               | 500                    | Antistatic plastic tube |
| VS-60APU06PbF                  | 25               | 500                    | Antistatic plastic tube |
| VS-60APU06-N3                  | 25               | 500                    | Antistatic plastic tube |

| LINKS TO RELATED DOCUMENTS |                       |  |
|----------------------------|-----------------------|--|
| Dimensions                 | TO-247AC modified     | <a href="http://www.vishay.com/doc?95541">www.vishay.com/doc?95541</a> |
|                            | TO-247AC              | <a href="http://www.vishay.com/doc?95542">www.vishay.com/doc?95542</a> |
| Part marking information   | TO-247AC modified PbF | <a href="http://www.vishay.com/doc?95255">www.vishay.com/doc?95255</a> |
|                            | TO-247AC modified -N3 | <a href="http://www.vishay.com/doc?95442">www.vishay.com/doc?95442</a> |
|                            | TO-247ACPbF           | <a href="http://www.vishay.com/doc?95226">www.vishay.com/doc?95226</a> |
|                            | TO-247AC-N3           | <a href="http://www.vishay.com/doc?95007">www.vishay.com/doc?95007</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     |        |             |       |           |       |       |

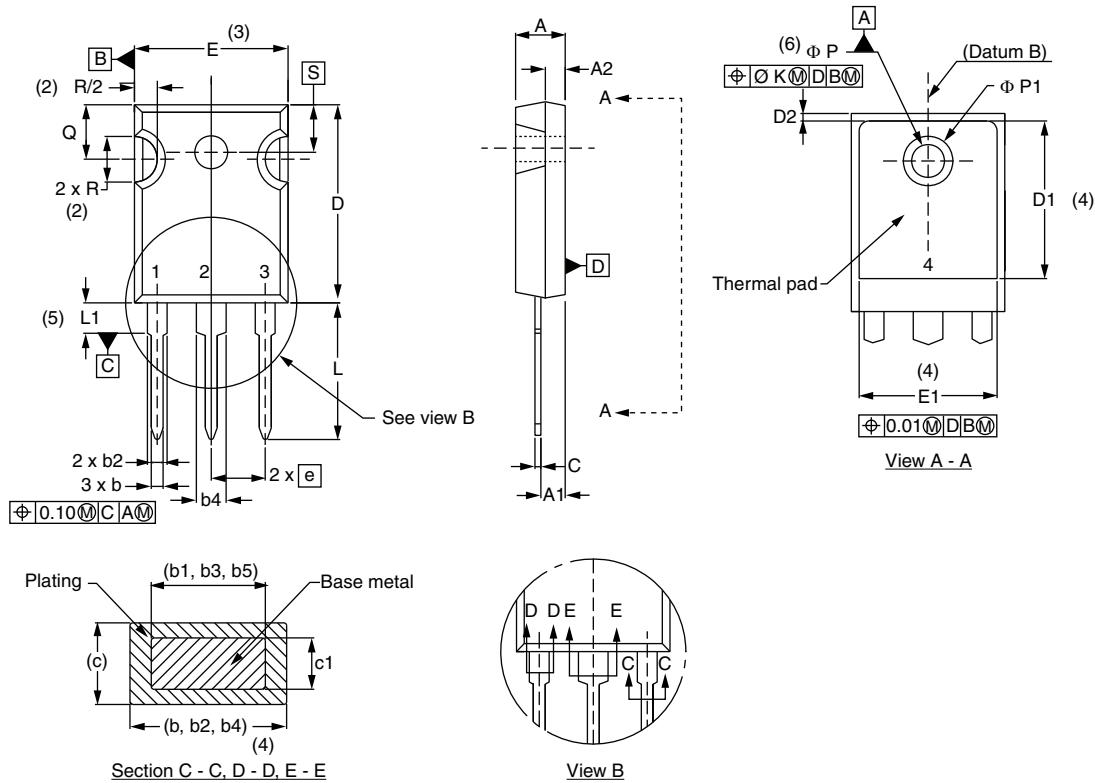
**Notes**

- (1) Dimensioning and tolerance 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



TO-247AC - 50 mils L/F

DIMENSIONS in millimeters and inches



| SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|-----------|-------|-------|
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| Q      | 5.31        | 5.69  | 0.209     | 0.224 |       |
| R      | 4.52        | 5.49  | 0.178     | 0.216 |       |
| S      | 5.51 BSC    |       | 0.217 BSC |       |       |

Notes

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