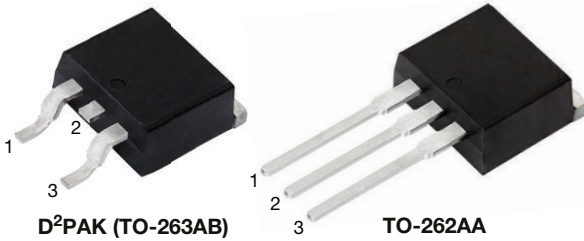
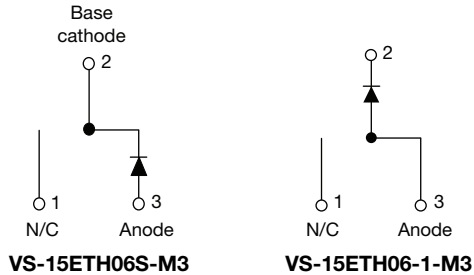


## Hyperfast Rectifier, 15 A FRED Pt<sup>®</sup>


**D<sup>2</sup>PAK (TO-263AB)**
**TO-262AA**

**VS-15ETH06S-M3**
**VS-15ETH06-1-M3**

### FEATURES

- Hyperfast recovery time
- Low forward voltage drop
- Low leakage current
- 175 °C operating junction temperature
- Single die center tap module
- Meets MSL level 1, per J-STD-020, LF maximum peak of 245 °C
- 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

State of the art 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.

### PRIMARY CHARACTERISTICS

|                       |   |
|-----------------------|---|
| $I_{F(AV)}$           | 15 A                                    |
| $V_R$                 | 600 V                                   |
| $V_F$ at $I_F$        | 1.3 V                                   |
| $t_{rr}$ (typ.)       | 22 ns                                   |
| $T_J$ max.            | 175 °C                                  |
| Package               | D <sup>2</sup> PAK (TO-263AB), TO-262AA |
| Circuit configuration | Single                                  |

### ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                   | SYMBOL         | TEST CONDITIONS       | MAX.        | UNITS |
|---|----------------|-----------------------|-------------|-------|
| Peak repetitive reverse voltage             | $V_{RRM}$      |                       | 600         | V     |
| Average rectified forward current           | $I_{F(AV)}$    | $T_C = 140\text{ °C}$ | 15          | A     |
| Non-repetitive peak surge current           | $I_{FSM}$      | $T_J = 25\text{ °C}$  | 120         |       |
| Peak repetitive forward current             | $I_{FM}$       |                       | 30          |       |
| 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                     | $V_F$         | $I_F = 15\text{ A}$                          | -    | 1.8  | 2.2  |               |
|                                     |               | $I_F = 15\text{ A}, T_J = 150\text{ °C}$     | -    | 1.3  | 1.6  |               |
| Reverse leakage current             | $I_R$         | $V_R = V_R$ rated                            | -    | 0.2  | 50   | $\mu\text{A}$ |
|                                     |               | $T_J = 150\text{ °C}, V_R = V_R$ rated       | -    | 30   | 500  |               |
| 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            |



| DYNAMIC RECOVERY CHARACTERISTICS (T <sub>C</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 = 100 A/μs, V <sub>R</sub> = 30 V  | -   | 22   | 30   | ns    |    |
|  |                   | I <sub>F</sub> = 15 A, di <sub>F</sub> /dt = 100 A/μs, V <sub>R</sub> = 30 V | -   | 28   | 35   |       |    |
|  |                   | T <sub>J</sub> = 25 °C   | -   | 29   | -    |       |    |
|  |                   | T <sub>J</sub> = 125 °C  | -   | 75   | -    |       |    |
| Peak recovery current  | I <sub>R</sub> RM | T <sub>J</sub> = 25 °C   | -   | 3.5  | -    | A     |    |
|  |                   | T <sub>J</sub> = 125 °C  | -   | 7    | -    |       |    |
| Reverse recovery charge  | Q <sub>rr</sub>   | T <sub>J</sub> = 25 °C   | -   | 57   | -    | μC    |    |
|  |                   | T <sub>J</sub> = 125 °C  | -   | 300  | -    |       |    |
| Reverse recovery time  | t <sub>rr</sub>   | T <sub>J</sub> = 125 °C  | I <sub>F</sub> = 15 A<br>di <sub>F</sub> /dt = 800 A/μs<br>V <sub>R</sub> = 390 V | -    | 51   | -     | ns |
| Peak recovery current  | I <sub>R</sub> RM |  |   | -    | 20   | -     | A  |
| Reverse recovery charge  | Q <sub>rr</sub>   |  |   | -    | 580  | -     | nC |

| THERMAL - MECHANICAL SPECIFICATIONS             |                                   |   |              |      |            |                        |
|---|-----------------------------------|---|--------------|------|------------|------------------------|
| PARAMETER                                       | SYMBOL                            | TEST CONDITIONS                             | MIN.         | TYP. | MAX.       | UNITS                  |
| Maximum junction and storage temperature range  | T <sub>J</sub> , T <sub>Stg</sub> |   | -65          | -    | 175        | °C                     |
| Thermal resistance, junction to case per leg    | R <sub>thJC</sub>                 |   | -            | 1.0  | 1.3        | °C/W                   |
| Thermal resistance, junction to ambient per leg | R <sub>thJA</sub>                 | Typical socket mount                        | -            | -    | 70         |                        |
| Thermal resistance, case to heatsink            | R <sub>thCS</sub>                 | Mounting surface, flat, smooth, and greased | -            | 0.5  | -          |                        |
| Weight  |                                   |   | -            | 2.0  | -          | g                      |
|   |                                   |   | -            | 0.07 | -          | oz.                    |
| Mounting torque                                 |                                   |   | 6.0<br>(5.0) | -    | 12<br>(10) | kgf · cm<br>(lbf · in) |
| Marking device                                  |                                   | Case style D <sup>2</sup> PAK (TO-263AB)    | 15ETH06S     |      |            |                        |
|   |                                   | Case style TO-262AA                         | 15ETH06-1    |      |            |                        |

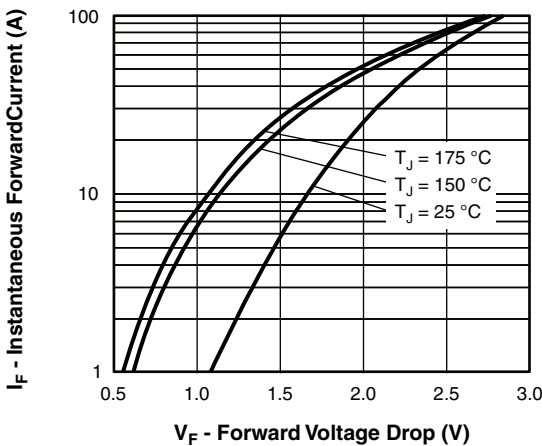


Fig. 1 - Typical Forward Voltage Drop Characteristics

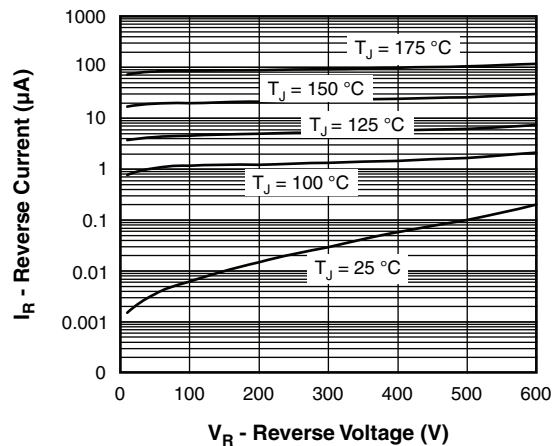


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

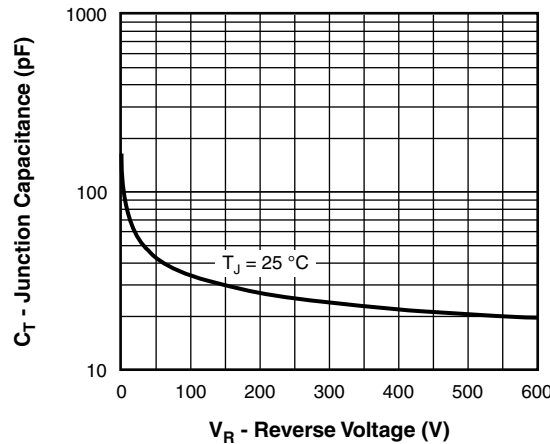


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

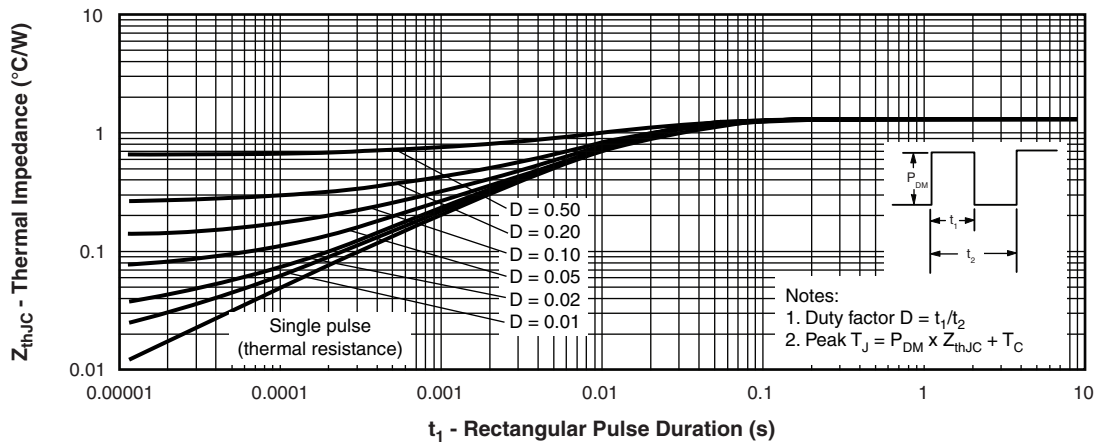


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

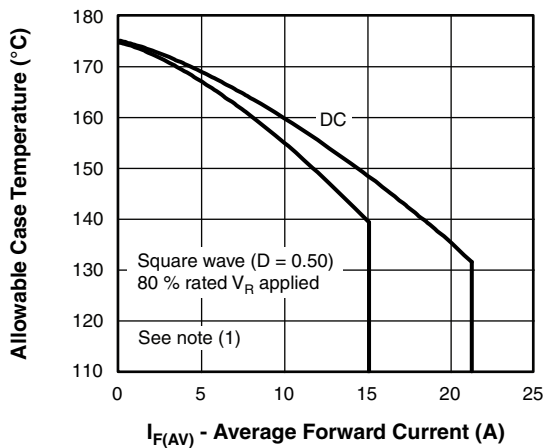


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

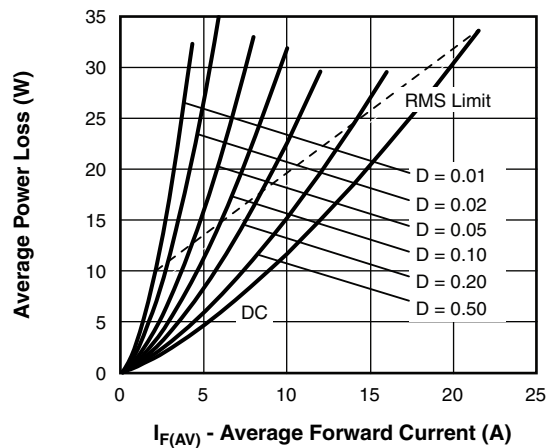


Fig. 6 - Forward Power Loss Characteristics

**Note**

- (1) Formula used:  $T_C = T_J - (P_d + P_{dREV}) \times R_{thJC}$ ;  
 $P_d$  = forward power loss =  $I_{F(AV)} \times V_{FM}$  at  $(I_{F(AV)}/D)$  (see fig. 6);  
 $P_{dREV}$  = inverse power loss =  $V_{R1} \times I_R (1 - D)$ ;  $I_R$  at  $V_{R1}$  = rated  $V_R$

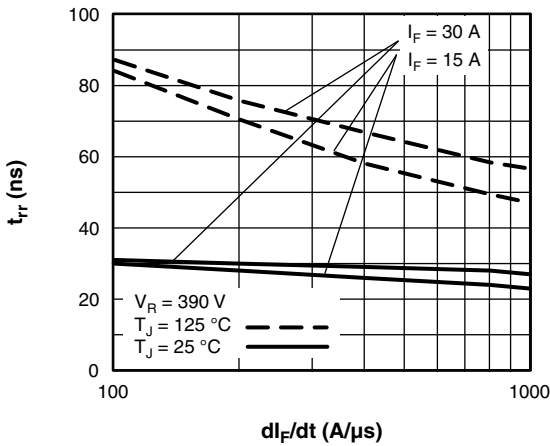


Fig. 7 - Typical Reverse Recovery vs.  $di_F/dt$

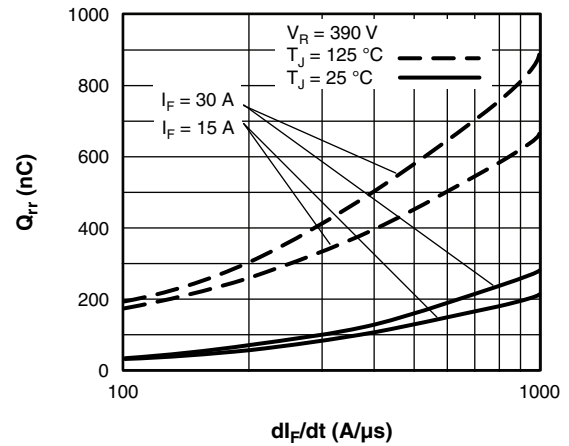


Fig. 8 - Typical Stored Charge vs.  $di_F/dt$

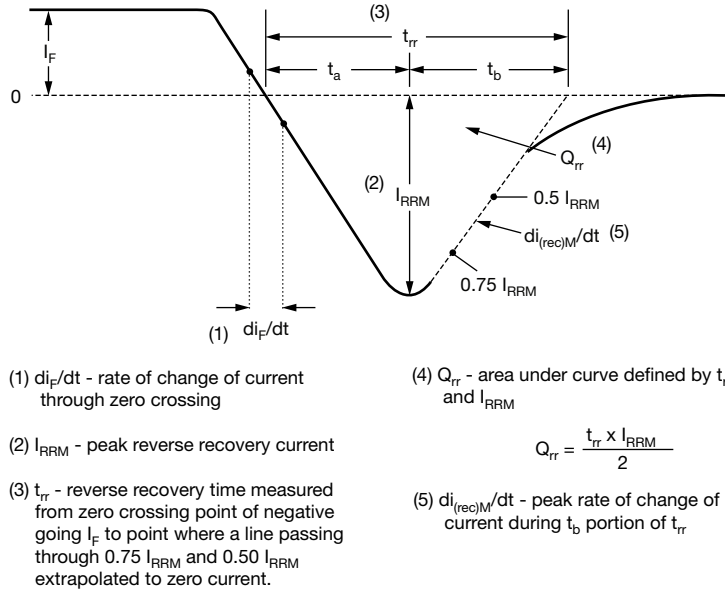
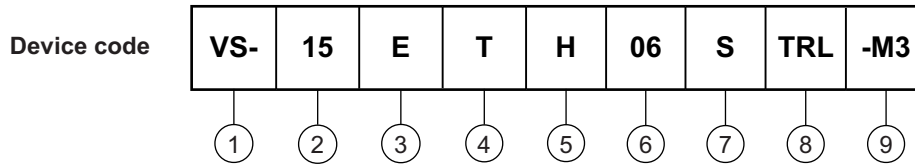


Fig. 9 - Reverse Recovery Waveform and Definitions



## ORDERING INFORMATION TABLE



- 1** - Vishay Semiconductors product
- 2** - Current rating (15 A)
- 3** - E = single diode
- 4** - T = TO-220, D<sup>2</sup>PAK (TO-263AB)
- 5** - H = hyperfast rectifier
- 6** - Voltage rating (06 = 600 V)
- 7** -
  - S = D<sup>2</sup>PAK (TO-263AB)
  - -1 = TO-262AA
- 8** -
  - None = tube (50 pieces)
  - TRL = tape and reel (left oriented, for D<sup>2</sup>PAK (TO-263AB) package)
  - TRR = tape and reel (right oriented, for D<sup>2</sup>PAK (TO-263AB) package)
- 9** - Environmental digit:
  - M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free

| ORDERING INFORMATION (Example) |               |                                    |
|--------------------------------|---------------|------------------------------------|
| PREFERRED P/N                  | BASE QUANTITY | PACKAGING DESCRIPTION              |
| VS-15ETH06S-M3                 | 50            | Antistatic plastic tubes           |
| VS-15ETH06STRR-M3              | 800           | 13" diameter plastic tape and reel |
| VS-15ETH06STRL-M3              | 800           | 13" diameter plastic tape and reel |
| VS-15ETH06-1-M3                | 50            | Antistatic plastic tubes           |

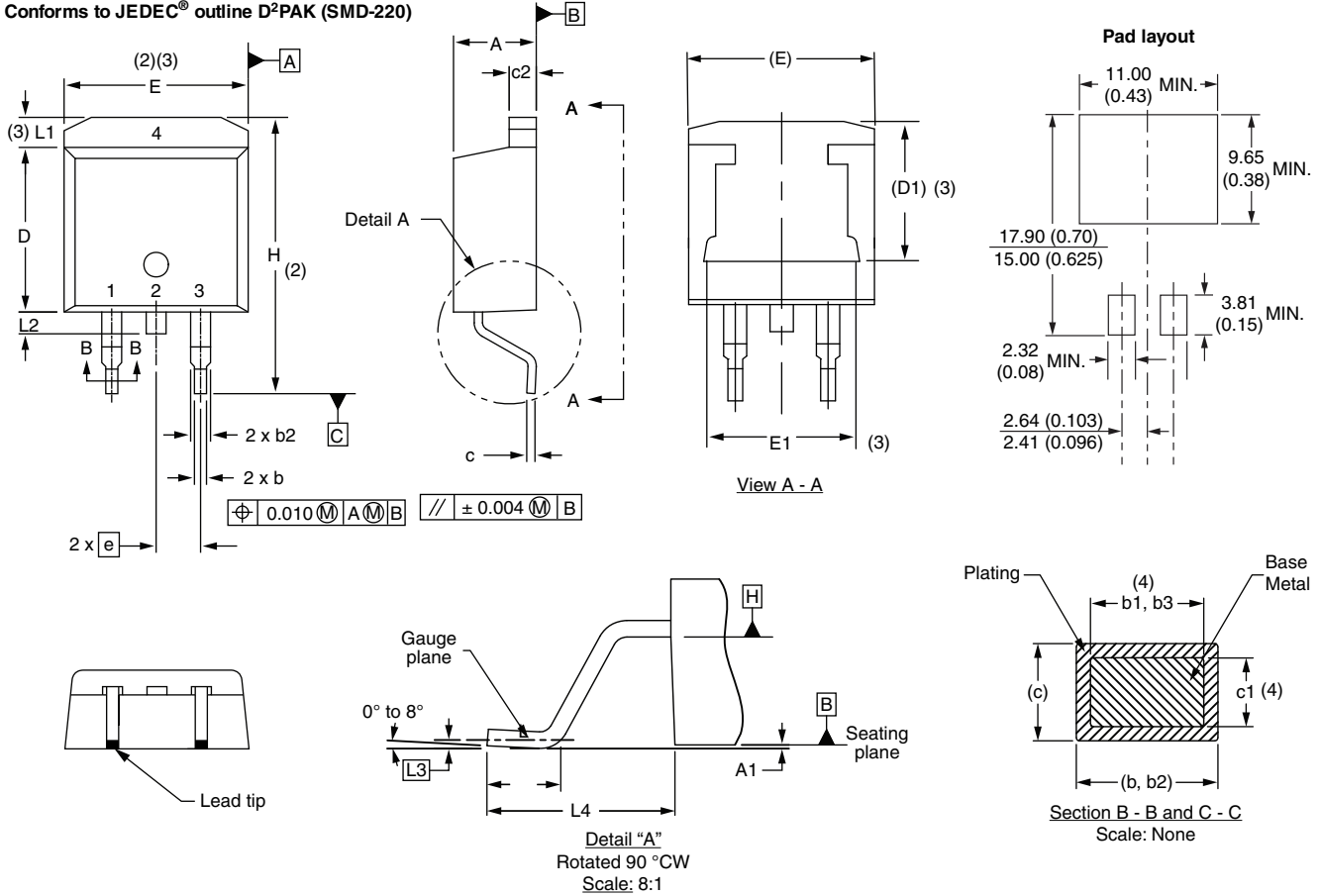
| LINKS TO RELATED DOCUMENTS |                               |  |
|----------------------------|-------------------------------|--|
| Dimensions                 | D <sup>2</sup> PAK (TO-263AB) | <a href="http://www.vishay.com/doc?96164">www.vishay.com/doc?96164</a> |
|                            | TO-262                        | <a href="http://www.vishay.com/doc?96165">www.vishay.com/doc?96165</a> |
| Part marking information   | D <sup>2</sup> PAK (TO-263AB) | <a href="http://www.vishay.com/doc?95444">www.vishay.com/doc?95444</a> |
|                            | TO-262                        | <a href="http://www.vishay.com/doc?95443">www.vishay.com/doc?95443</a> |
| Packaging information      |                               | <a href="http://www.vishay.com/doc?96424">www.vishay.com/doc?96424</a> |
| SPICE model                |                               | <a href="http://www.vishay.com/doc?96617">www.vishay.com/doc?96617</a> |



# D<sup>2</sup>PAK

**DIMENSIONS** in millimeters and inches

Conforms to JEDEC® outline D<sup>2</sup>PAK (SMD-220)



| SYMBOL | MILLIMETERS |       | INCHES |       | NOTES | SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|--------|-------|-------|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| A      | 4.06        | 4.83  | 0.160  | 0.190 |       | D1     | 6.86        | 8.00  | 0.270     | 0.315 | 3     |
| A1     | 0.00        | 0.254 | 0.000  | 0.010 |       | E      | 9.65        | 10.67 | 0.380     | 0.420 | 2, 3  |
| b      | 0.51        | 0.99  | 0.020  | 0.039 |       | E1     | 7.90        | 8.80  | 0.311     | 0.346 | 3     |
| b1     | 0.51        | 0.89  | 0.020  | 0.035 | 4     | e      | 2.54 BSC    |       | 0.100 BSC |       |       |
| b2     | 1.14        | 1.78  | 0.045  | 0.070 |       | H      | 14.61       | 15.88 | 0.575     | 0.625 |       |
| b3     | 1.14        | 1.73  | 0.045  | 0.068 | 4     | L      | 1.78        | 2.79  | 0.070     | 0.110 |       |
| c      | 0.38        | 0.74  | 0.015  | 0.029 |       | L1     | -           | 1.65  | -         | 0.066 | 3     |
| c1     | 0.38        | 0.58  | 0.015  | 0.023 | 4     | L2     | 1.27        | 1.78  | 0.050     | 0.070 |       |
| c2     | 1.14        | 1.65  | 0.045  | 0.065 |       | L3     | 0.25 BSC    |       | 0.010 BSC |       |       |
| D      | 8.51        | 9.65  | 0.335  | 0.380 | 2     | L4     | 4.78        | 5.28  | 0.188     | 0.208 |       |

**Notes**

- (1) Dimensioning and tolerancing per ASME Y14.5 M-1994
- (2) 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 outmost extremes of the plastic body
- (3) Thermal pad contour optional within dimension E, L1, D1 and E1
- (4) Dimension b1 and c1 apply to base metal only
- (5) Datum A and B to be determined at datum plane H
- (6) Controlling dimension: inches
- (7) Outline conforms to JEDEC® outline TO-263AB

### TO-262AA

**DIMENSIONS** in millimeters and inches

Modified JEDEC® outline TO-262



| SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| A      | 4.06        | 4.83  | 0.160     | 0.190 |       |
| A1     | 2.03        | 3.02  | 0.080     | 0.119 |       |
| b      | 0.51        | 0.99  | 0.020     | 0.039 |       |
| b1     | 0.51        | 0.89  | 0.020     | 0.035 | 4     |
| b2     | 1.14        | 1.78  | 0.045     | 0.070 |       |
| b3     | 1.14        | 1.73  | 0.045     | 0.068 | 4     |
| c      | 0.38        | 0.74  | 0.015     | 0.029 |       |
| c1     | 0.38        | 0.58  | 0.015     | 0.023 | 4     |
| c2     | 1.14        | 1.65  | 0.045     | 0.065 |       |
| D      | 8.51        | 9.65  | 0.335     | 0.380 | 2     |
| D1     | 6.86        | 8.00  | 0.270     | 0.315 | 3     |
| E      | 9.65        | 10.67 | 0.380     | 0.420 | 2, 3  |
| E1     | 7.90        | 8.80  | 0.311     | 0.346 | 3     |
| e      | 2.54 BSC    |       | 0.100 BSC |       |       |
| L      | 13.46       | 14.10 | 0.530     | 0.555 |       |
| L1     | -           | 1.65  | -         | 0.065 | 3     |
| L2     | 3.56        | 3.71  | 0.140     | 0.146 |       |

**Notes**

- (1) Dimensioning and tolerancing as per ASME Y14.5M-1994
- (2) 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 outmost extremes of the plastic body
- (3) Thermal pad contour optional within dimension E, L1, D1 and E1
- (4) Dimension b1 and c1 apply to base metal only
- (5) Controlling dimension: inches
- (6) Outline conform to JEDEC® TO-262 except A1 (max.), b (min., max.), b1 (min.), b2 (max.), c (min.), c1(min.), c2 (max.), D (min.), E (max.), L1 (max.), L2 (min., max.)



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