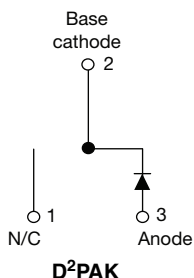
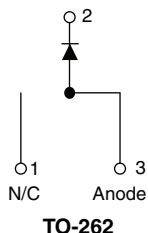


# Ultrafast Rectifier, 15 A FRED Pt®


**VS-ETU1506S-M3**

**VS-ETU1506-1-M3**


## FEATURES

- Low forward voltage drop
- Ultrafast recovery time
- 175 °C operating junction temperature
- Low leakage current
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition
- Designed and qualified according to JEDEC-JESD47



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

## DESCRIPTION/APPLICATIONS

State of the art, ultralow  $V_F$ , soft-switching ultrafast rectifiers optimized for Discontinuous (Critical) Mode (DCM) Power Factor Correction (PFC).

The minimized conduction loss, optimized stored charge and low recovery current minimized the switching losses and reduce over dissipation in the switching element and snubbers.

The device is also intended for use as a freewheeling diode in power supplies and other power switching applications.

## APPLICATIONS

AC/DC SMPS 70 W to 400 W

e.g. laptop and printer AC adaptors, desktop PC, TV and monitor, games units, and DVD AC/DC power supplies.

## PRODUCT SUMMARY

|                 |                            |
|-----------------|----------------------------|
| Package         | TO-263AB (D²PAK), TO-262AA |
| $I_{F(AV)}$     | 15 A                       |
| $V_R$           | 600 V                      |
| $V_F$ at $I_F$  | 1.9 V                      |
| $t_{rr}$ (typ.) | 24 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           | $I_{F(AV)}$    | $T_C = 143\text{ °C}$ | 15          | A     |
| Non-repetitive peak surge current           | $I_{FSM}$      | $T_C = 25\text{ °C}$  | 160         |       |
| 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                     | $V_F$         | $I_F = 15\text{ A}$                          | -    | 1.35 | 1.9  |               |
|                                     |               | $I_F = 15\text{ A}, T_J = 150\text{ °C}$     | -    | 1.1  | 1.3  |               |
| Reverse leakage current             | $I_R$         | $V_R = V_R$ rated                            | -    | 0.01 | 15   | $\mu\text{A}$ |
|                                     |               | $T_J = 150\text{ °C}, V_R = V_R$ rated       | -    | 20   | 200  |               |
| Junction capacitance                | $C_T$         | $V_R = 600\text{ V}$                         | -    | 12   | -    | pF            |
| Series inductance                   | $L_S$         | Measured lead to lead 5 mm from package body | -    | 8.0  | -    | nH            |

**DYNAMIC RECOVERY CHARACTERISTICS** ( $T_J = 25\text{ }^{\circ}\text{C}$  unless otherwise specified)

| PARAMETER               | SYMBOL    | TEST CONDITIONS                                                                                                            | MIN. | TYP. | MAX. | UNITS |
|-------------------------|-----------|----------------------------------------------------------------------------------------------------------------------------|------|------|------|-------|
| Reverse recovery time   | $t_{rr}$  | $I_F = 1\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$                                            | -    | 24   | 28   | ns    |
|                         |           | $I_F = 15\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$                                           | -    | 36   | 47   |       |
|                         |           | $T_J = 25\text{ }^{\circ}\text{C}$                                                                                         | -    | 40   | -    |       |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                                                                        | -    | 87   | -    |       |
| Peak recovery current   | $I_{RRM}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                                                                         | -    | 5    | -    | A     |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                                                                        | -    | 9.0  | -    |       |
| Reverse recovery charge | $Q_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$                                                                                         | -    | 107  | -    | C     |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                                                                        | -    | 430  | -    |       |
| Reverse recovery time   | $t_{rr}$  | $T_J = 125\text{ }^{\circ}\text{C}$<br>$I_F = 15\text{ A}$<br>$di_F/dt = 200\text{ A}/\mu\text{s}$<br>$V_R = 390\text{ V}$ | -    | 53   | -    | ns    |
| Peak recovery current   | $I_{RRM}$ |                                                                                                                            | -    | 25   | -    | A     |
| Reverse recovery charge | $Q_{rr}$  |                                                                                                                            | -    | 730  | -    | nC    |

**THERMAL - MECHANICAL SPECIFICATIONS**

| 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           | $R_{thJC}$        |                                            | -         | 1.3  | 1.51       | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance, junction to ambient        | $R_{thJA}$        | Typical socket mount                       | -         | -    | 70         |                             |
| Thermal resistance, case to heatsink           | $R_{thCS}$        | Mounting surface, flat, smooth and greased | -         | 0.5  | -          |                             |
| Weight                                         |                   |                                            | -         | 2.0  | -          | g                           |
|                                                |                   |                                            | -         | 0.07 | -          | oz.                         |
| Mounting torque                                |                   |                                            | 6<br>(5)  | -    | 12<br>(10) | kgf · cm<br>(lbf · in)      |
| Marking device                                 |                   | Case style D <sup>2</sup> PAK modified     | ETU1506S  |      |            |                             |
|                                                |                   | Case style TO-262                          | ETU1506-1 |      |            |                             |

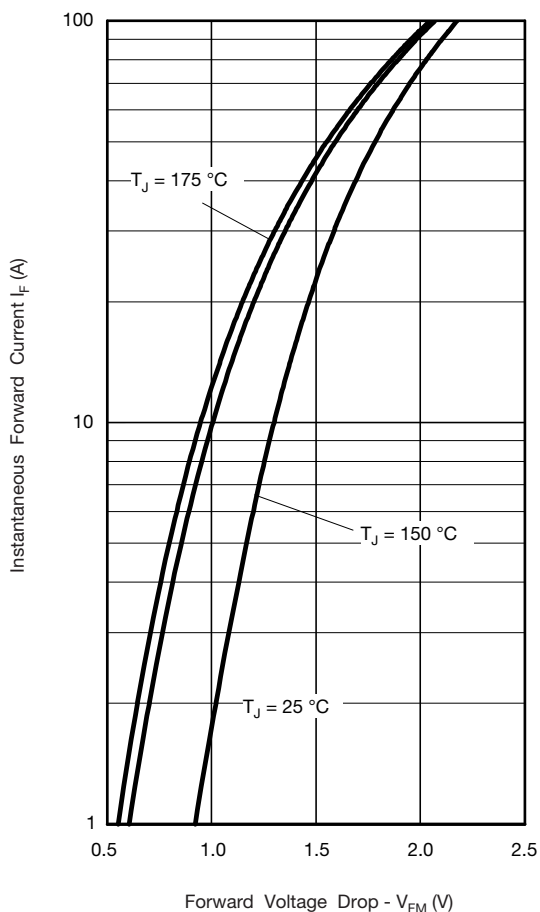


Fig. 1 - Typical Forward Voltage Drop Characteristics

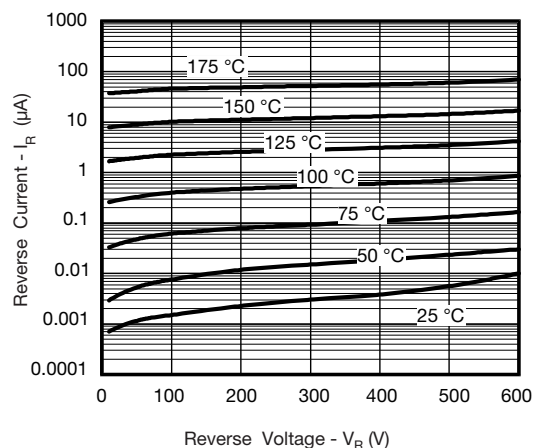


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

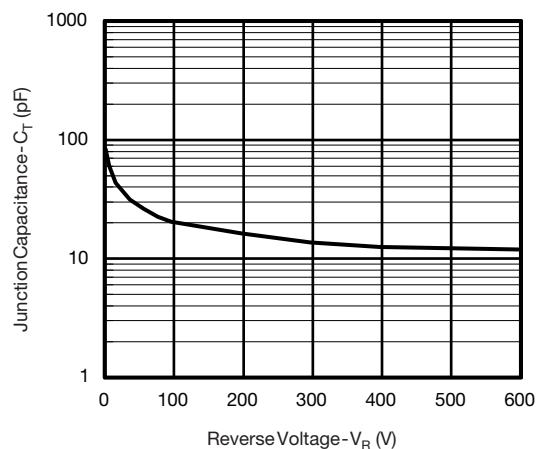


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

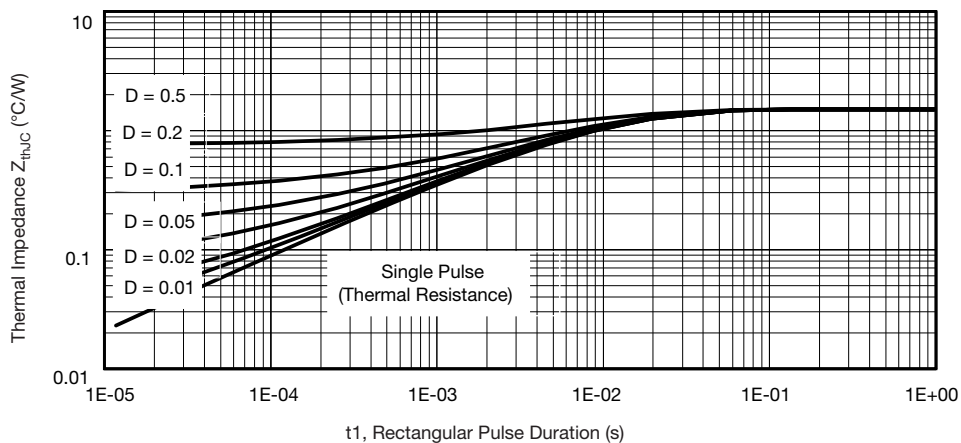


Fig. 4 - Max. Thermal Impedance  $Z_{thJC}$  Characteristics

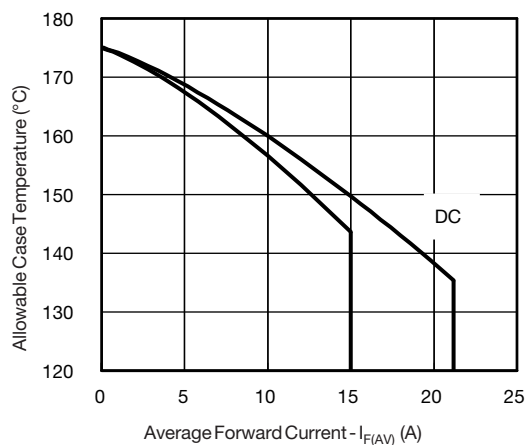


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

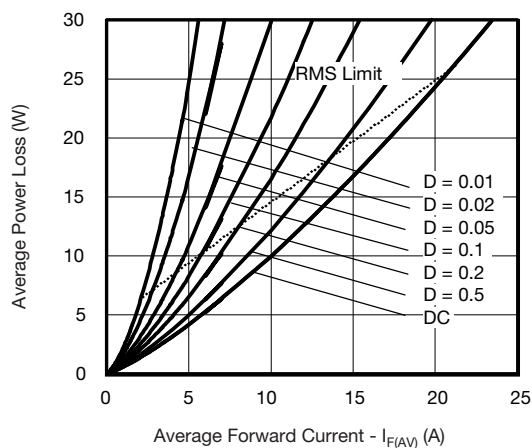


Fig. 6 - Forward Power Loss Characteristics

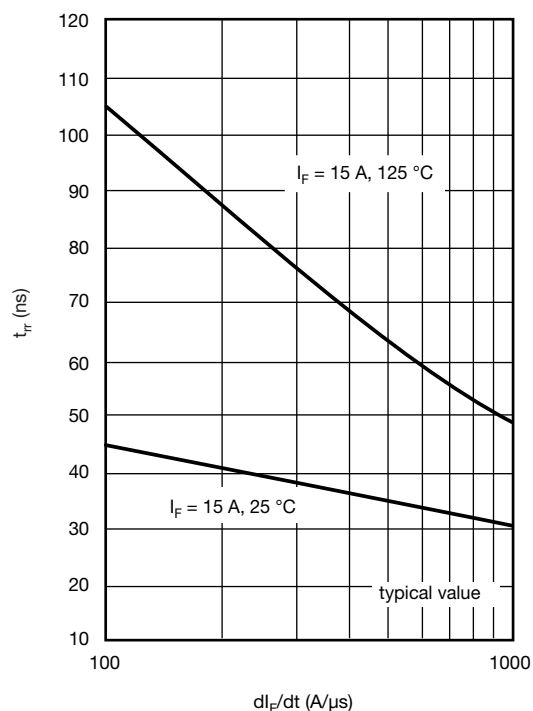


Fig. 7 - Typical Reverse Recovery Time vs.  $dI_F/dt$

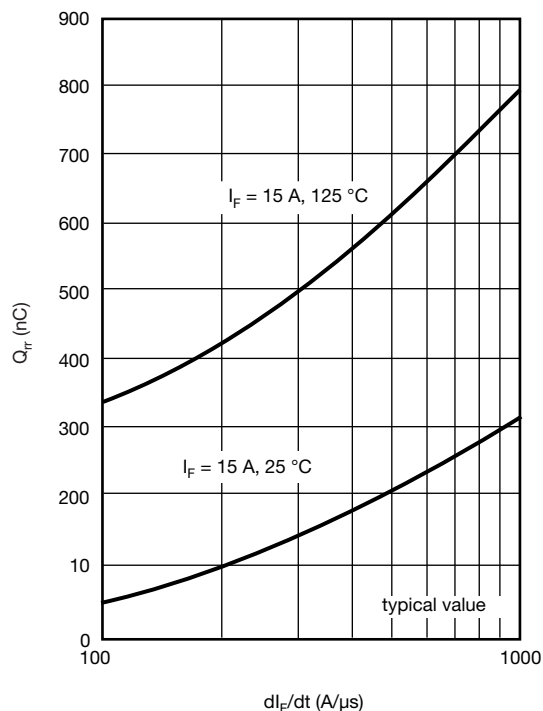


Fig. 8 - Typical Stored Charge vs.  $dI_F/dt$

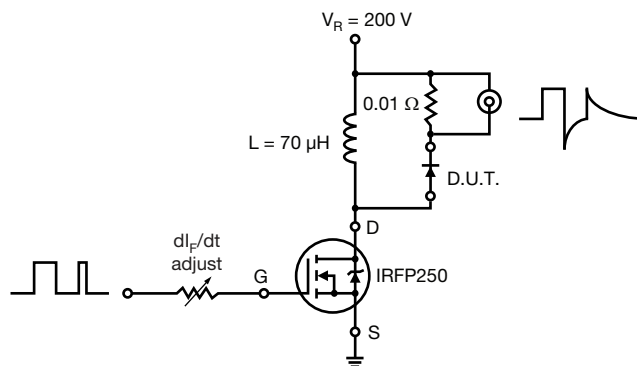


Fig. 9 - Reverse Recovery Parameter Test Circuit

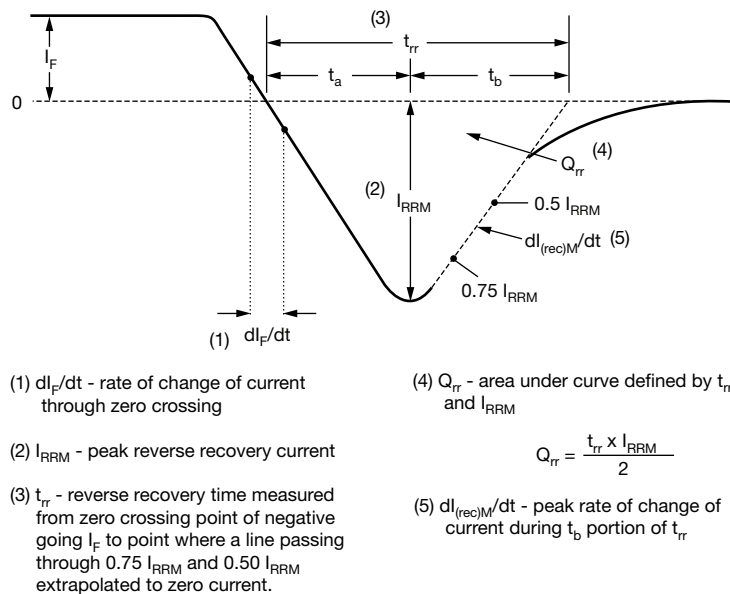


Fig. 10 - Reverse Recovery Waveform and Definitions

**ORDERING INFORMATION TABLE**

|             |            |          |          |          |           |           |          |            |            |
|-------------|------------|----------|----------|----------|-----------|-----------|----------|------------|------------|
| Device code | <b>VS-</b> | <b>E</b> | <b>T</b> | <b>U</b> | <b>15</b> | <b>06</b> | <b>S</b> | <b>TRL</b> | <b>-M3</b> |
|             | 1          | 2        | 3        | 4        | 5         | 6         | 7        | 8          | 9          |

- |          |   |                                                                                                                                                                              |
|----------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | - | Vishay Semiconductors product                                                                                                                                                |
| <b>2</b> | - | Circuit configuration<br>E = Single diode                                                                                                                                    |
| <b>3</b> | - | T = TO-220                                                                                                                                                                   |
| <b>4</b> | - | U = Ultrafast recovery time                                                                                                                                                  |
| <b>5</b> | - | Current code (15 = 15 A)                                                                                                                                                     |
| <b>6</b> | - | Voltage code (06 = 600 V)                                                                                                                                                    |
| <b>7</b> | - | • S = D <sup>2</sup> PAK<br>• -1 = TO-262                                                                                                                                    |
| <b>8</b> | - | • None = Tube (50 pieces)<br>• TRL = Tape and reel (left oriented, for D <sup>2</sup> PAK package)<br>• TRR = Tape and reel (right oriented, for D <sup>2</sup> PAK package) |
| <b>9</b> | - | -M3 = Halogen-free, RoHS compliant, and terminations lead (Pb)-free                                                                                                          |

**ORDERING INFORMATION** (Example)

| PREFERRED P/N     | QUANTITY PER TUBE | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
|-------------------|-------------------|------------------------|-------------------------|
| VS-ETU1506S-M3    | 50                | 1000                   | Antistatic plastic tube |
| VS-ETU1506-1-M3   | 50                | 1000                   | Antistatic plastic tube |
| VS-ETU1506STRR-M3 | 800               | 800                    | 13" diameter reel       |
| VS-ETU1506STRL-M3 | 800               | 800                    | 13" diameter reel       |

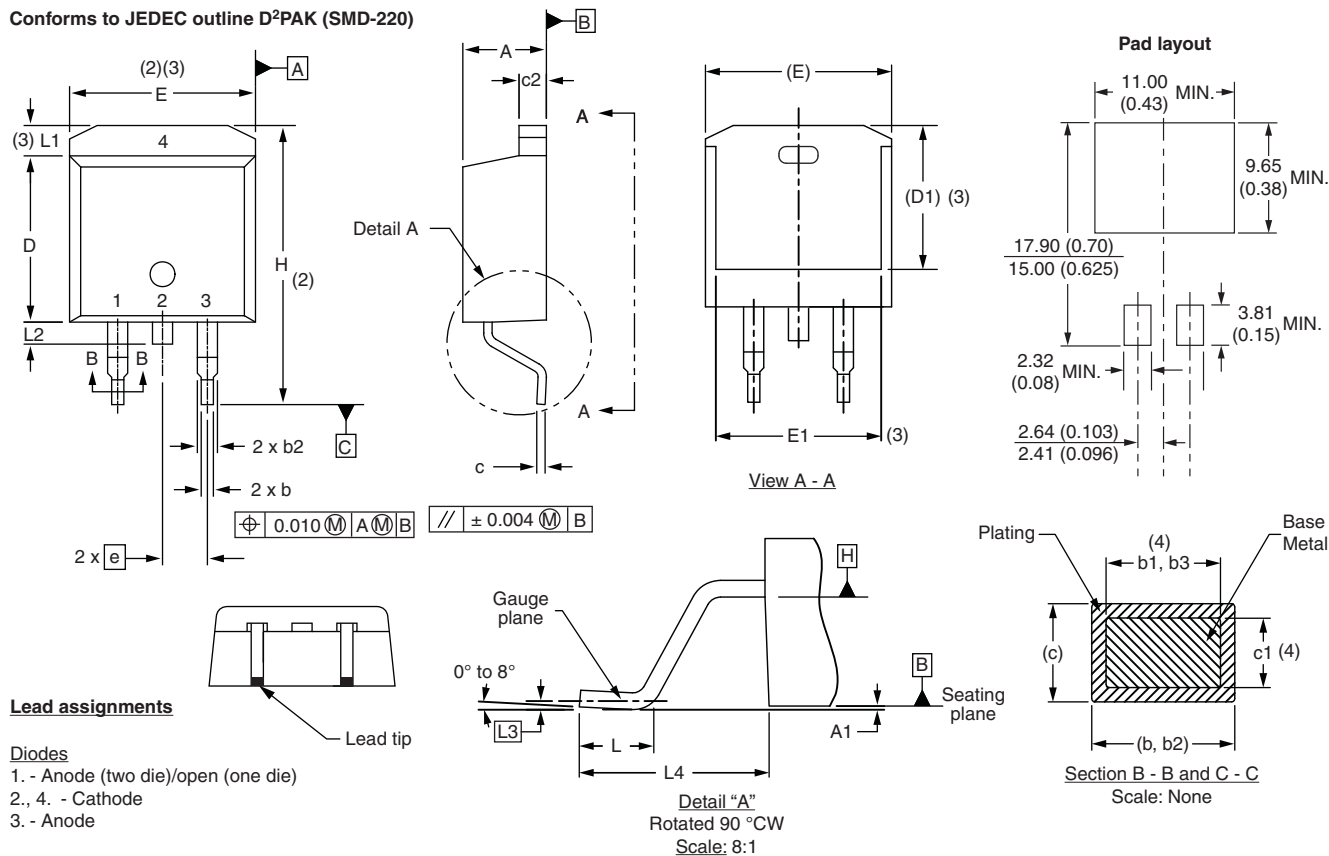
**LINKS TO RELATED DOCUMENTS**

|                          |                               |                                                                        |
|--------------------------|-------------------------------|------------------------------------------------------------------------|
| Dimensions               | TO-263AB (D <sup>2</sup> PAK) | <a href="http://www.vishay.com/doc?95046">www.vishay.com/doc?95046</a> |
|                          | TO-262AA                      | <a href="http://www.vishay.com/doc?95419">www.vishay.com/doc?95419</a> |
| Part marking information | TO-263AB (D <sup>2</sup> PAK) | <a href="http://www.vishay.com/doc?95444">www.vishay.com/doc?95444</a> |
|                          | TO-262AA                      | <a href="http://www.vishay.com/doc?95443">www.vishay.com/doc?95443</a> |
| Packaging information    | TO-263AB (D <sup>2</sup> PAK) | <a href="http://www.vishay.com/doc?95032">www.vishay.com/doc?95032</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 |
|--------|-------------|-------|--------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |
| A      | 4.06        | 4.83  | 0.160  | 0.190 |       |
| A1     | 0.00        | 0.254 | 0.000  | 0.010 |       |
| 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     |

| SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| 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 |       |       |
| H      | 14.61       | 15.88 | 0.575     | 0.625 |       |
| L      | 1.78        | 2.79  | 0.070     | 0.110 |       |
| L1     | -           | 1.65  | -         | 0.066 | 3     |
| L2     | 1.27        | 1.78  | 0.050     | 0.070 |       |
| L3     | 0.25 BSC    |       | 0.010 BSC |       |       |
| L4     | 4.78        | 5.28  | 0.188     | 0.208 |       |

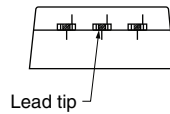
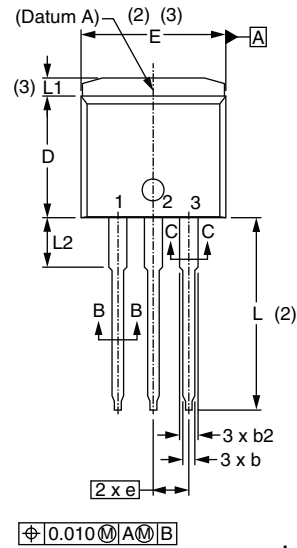
#### Notes

- (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: inch
- (7) Outline conforms to JEDEC outline TO-263AB

## TO-262

### DIMENSIONS in millimeters and inches

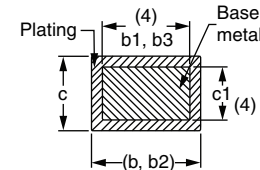
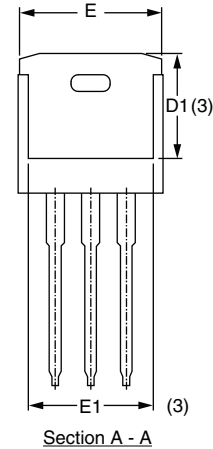
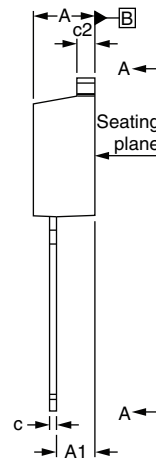
#### Modified JEDEC outline TO-262



#### Lead assignments

##### Diodes

1. - Anode (two die)/open (one die)
2. - Cathode
3. - Anode



Section B - B and C - C  
Scale: None

| 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 (maximum), b (minimum) and D1 (minimum) where dimensions derived the actual package outline



## Disclaimer

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**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**