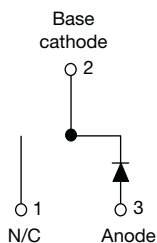
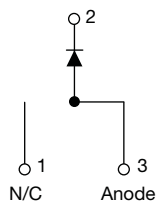


# Ultrafast Rectifier, 8 A FRED Pt®

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


VS-8ETU04SHM3

TO-262AA



VS-8ETU04-1HM3

## FEATURES

- Ultrafast recovery time
- Low forward voltage drop
- Low leakage current
- 175 °C operating junction temperature
- Meets MSL level 1, per J-STD-020, LF maximum peak of 260 °C
- 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

Vishay Semiconductors FRED Pt® series are the state of the art ultrafast recovery rectifiers specifically designed with optimized performance of forward voltage drop and ultrafast recovery time.

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 the output rectification stage of SMPS, UPS, DC/DC converters as well as freewheeling diode in low voltage inverters and chopper motor drives.

Their 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-263AB (D <sup>2</sup> PAK), TO-262AA |
| $I_{F(AV)}$     | 8 A                                     |
| $V_R$           | 400 V                                   |
| $V_F$ at $I_F$  | 0.94 V                                  |
| $t_{rr}$ typ.   | 35 ns                                   |
| $T_J$ max.      | 175 °C                                  |
| Diode variation | Single die                              |

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                   | SYMBOL         | TEST CONDITIONS       | MAX.        | UNITS |
|---------------------------------------------|----------------|-----------------------|-------------|-------|
| Repetitive peak reverse voltage             | $V_{RRM}$      |                       | 400         | V     |
| Average rectified forward current           | $I_{F(AV)}$    | $T_C = 155\text{ °C}$ | 8           | A     |
| Non-repetitive peak surge current           | $I_{FSM}$      | $T_C = 25\text{ °C}$  | 100         |       |
| Repetitive peak forward current             | $I_{FRM}$      |                       | 16          |       |
| 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 | $V_{BR}, V_R$ | $I_R = 100\text{ }\mu\text{A}$               | 400  | -    | -    | V             |
| Forward voltage                     | $V_F$         | $I_F = 8\text{ A}$                           | -    | 1.19 | 1.3  |               |
|                                     |               | $I_F = 8\text{ A}, T_J = 150\text{ °C}$      | -    | 0.94 | 1.0  |               |
| Reverse leakage current             | $I_R$         | $V_R = V_R$ rated                            | -    | 0.2  | 10   | $\mu\text{A}$ |
|                                     |               | $T_J = 150\text{ °C}, V_R = V_R$ rated       | -    | 20   | 500  |               |
| Junction capacitance                | $C_T$         | $V_R = 400\text{ V}$                         | -    | 14   | -    | 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   | $t_{rr}$  | $I_F = 1.0\text{ A}$ , $dI_F/dt = 50\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$ | -    | 35   | 60   | ns    |
|                         |           | $T_J = 25\text{ }^{\circ}\text{C}$                                               | -    | 43   | -    |       |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                              | -    | 67   | -    |       |
| Peak recovery current   | $I_{RRM}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                               | -    | 2.8  | -    | A     |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                              | -    | 6.3  | -    |       |
| Reverse recovery charge | $Q_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$                                               | -    | 60   | -    | nC    |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                              | -    | 210  | -    |       |

**THERMAL - MECHANICAL SPECIFICATIONS**

| PARAMETER                                      | SYMBOL         | TEST CONDITIONS                            | MIN.         | TYP. | MAX.       | UNITS                       |
|------------------------------------------------|----------------|--------------------------------------------|--------------|------|------------|-----------------------------|
| Maximum junction and storage temperature range | $T_J, T_{Stg}$ |                                            | -55          | -    | 175        | $^{\circ}\text{C}$          |
| Thermal resistance, junction to case           | $R_{thJC}$     |                                            | -            | 1.8  | 2.0        | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance, junction to ambient        | $R_{thJA}$     | Typical socket mount                       | -            | -    | 50         |                             |
| Thermal resistance, case to heatsink           | $R_{thCS}$     | Mounting surface, flat, smooth and greased | -            | 0.5  | -          |                             |
| Weight                                         |                |                                            | -            | 2.0  | -          | g                           |
|                                                |                |                                            | -            | 0.07 | -          | oz.                         |
| Mounting torque                                |                |                                            | 6.0<br>(5.0) | -    | 12<br>(10) | kgf · cm<br>(lbf · in)      |
| Marking device                                 |                | Case style TO-263AB (D <sup>2</sup> PAK)   | 8ETU04SH     |      |            |                             |
|                                                |                | Case style TO-262                          | 8ETU04-1H    |      |            |                             |

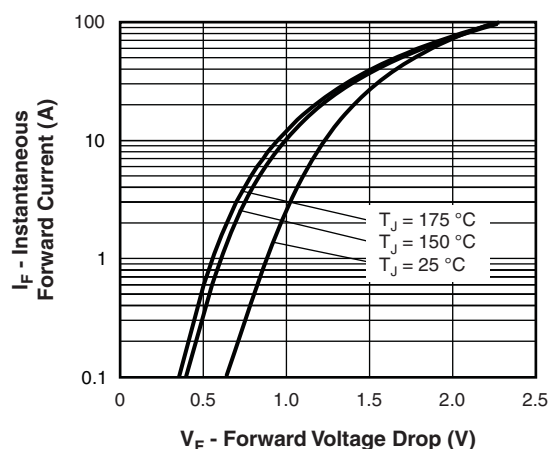


Fig. 1 - Typical Forward Voltage Drop Characteristics

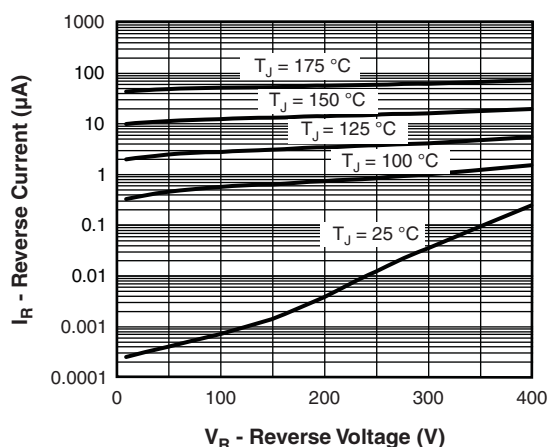


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

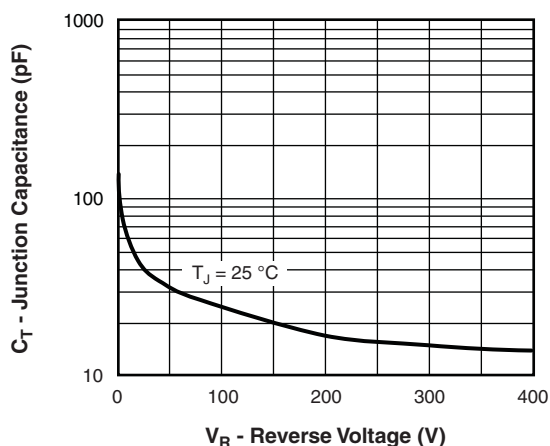


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

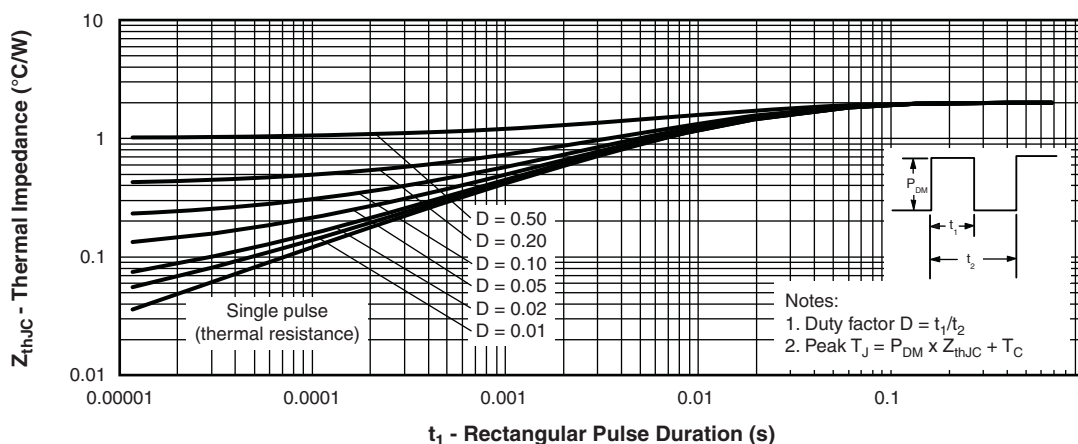
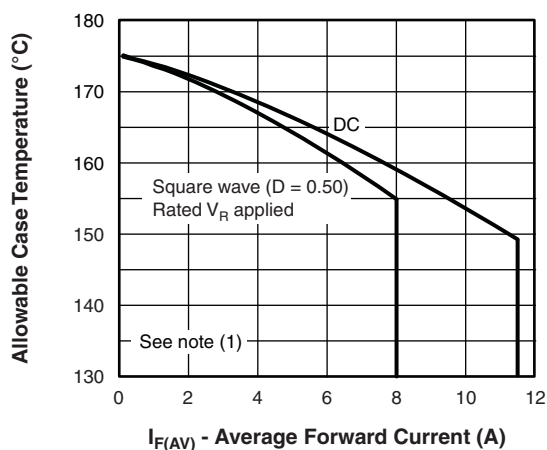

Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics


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

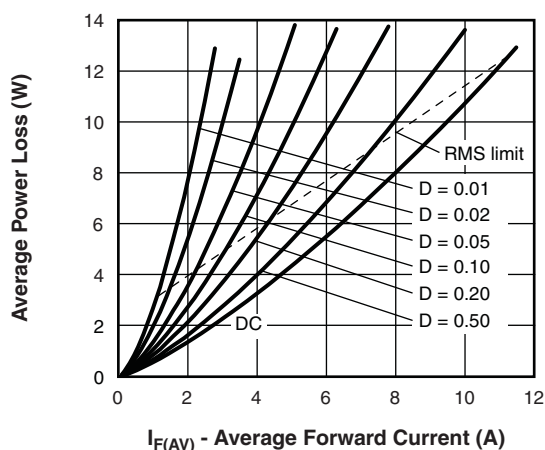
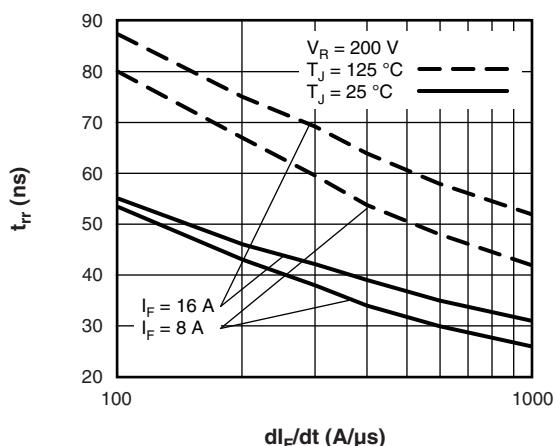
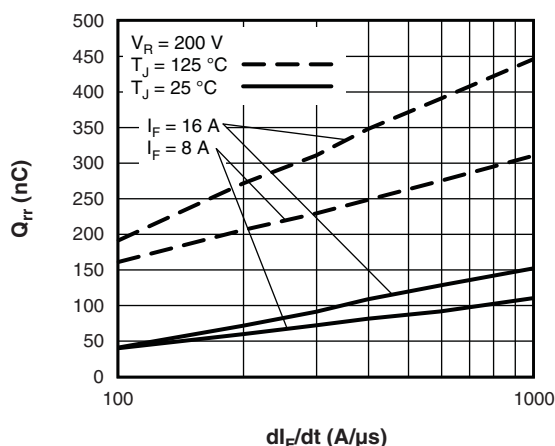


Fig. 6 - Forward Power Loss Characteristics


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

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

- (1) Formula used:  $T_C = T_J - (P_d + P_{dREV}) \times R_{thJC}$ ;  
 $P_d$  = 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  $V_R$

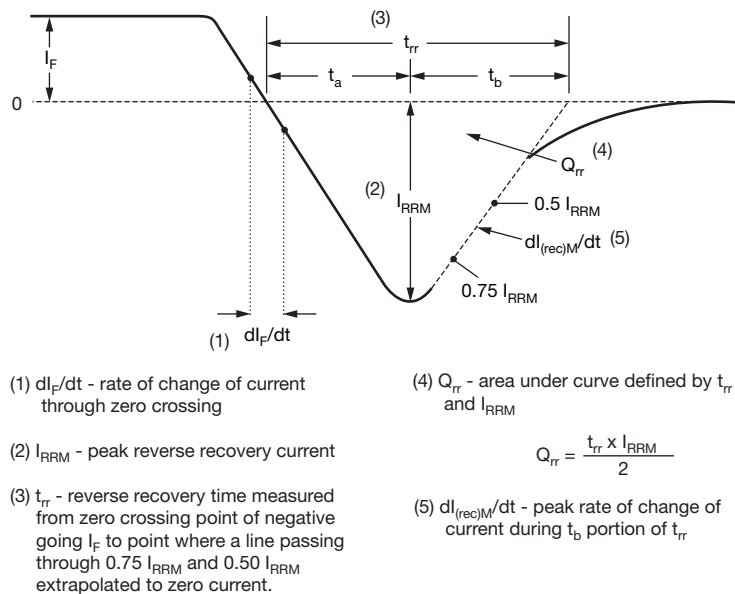


Fig. 9 - Reverse Recovery Waveform and Definitions

**ORDERING INFORMATION TABLE**

|             |            |          |          |          |          |           |          |            |          |           |
|-------------|------------|----------|----------|----------|----------|-----------|----------|------------|----------|-----------|
| Device code | <b>VS-</b> | <b>8</b> | <b>E</b> | <b>T</b> | <b>U</b> | <b>04</b> | <b>S</b> | <b>TRL</b> | <b>H</b> | <b>M3</b> |
|             | 1          | 2        | 3        | 4        | 5        | 6         | 7        | 8          | 9        | 10        |

- |           |   |                                                                                                                                                                              |
|-----------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>  | - | Vishay Semiconductors product                                                                                                                                                |
| <b>2</b>  | - | Current rating (8 A)                                                                                                                                                         |
| <b>3</b>  | - | E = single diode                                                                                                                                                             |
| <b>4</b>  | - | T = TO-220, D <sup>2</sup> PAK                                                                                                                                               |
| <b>5</b>  | - | U = ultrafast recovery                                                                                                                                                       |
| <b>6</b>  | - | Voltage rating (04 = 400 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>  | - | H = AEC-Q101 qualified                                                                                                                                                       |
| <b>10</b> | - | M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free                                                                                                           |

| <b>ORDERING INFORMATION</b> (Example) |                         |                               |                              |
|---------------------------------------|-------------------------|-------------------------------|------------------------------|
| <b>PREFERRED P/N</b>                  | <b>QUANTITY PER T/R</b> | <b>MINIMUM ORDER QUANTITY</b> | <b>PACKAGING DESCRIPTION</b> |
| VS-8ETU04SHM3                         | 50                      | 1000                          | Antistatic plastic tube      |
| VS-8ETU04STRRHM3                      | 800                     | 800                           | 13" diameter reel            |
| VS-8ETU04STRLHM3                      | 800                     | 800                           | 13" diameter plastic reel    |
| VS-8ETU04-1HM3                        | 50                      | 1000                          | Antistatic plastic tube      |

| <b>LINKS TO RELATED DOCUMENTS</b> |                               |                                                                        |
|-----------------------------------|-------------------------------|------------------------------------------------------------------------|
| 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 |       |

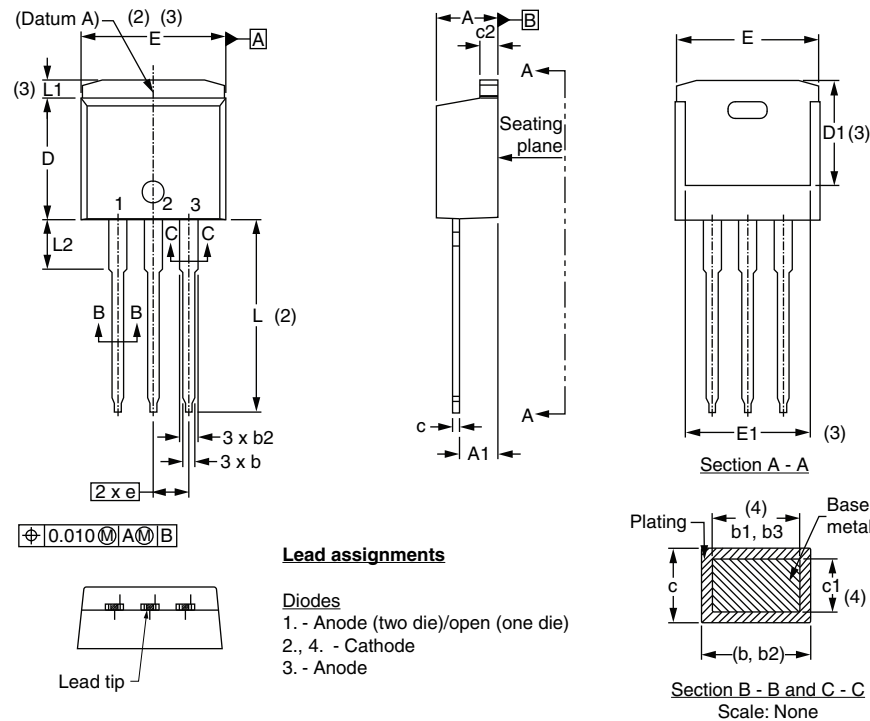
#### Notes

- (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

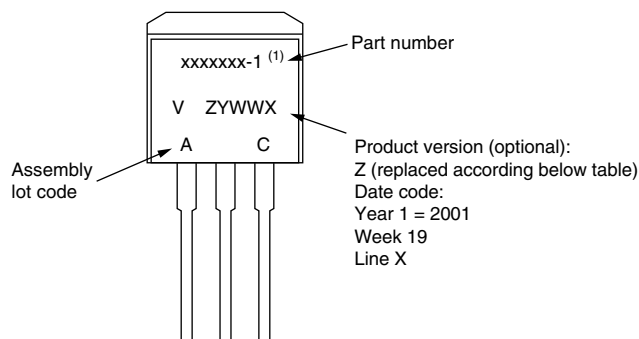


| SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| A      | 4.06        | 4.83  | 0.160     | 0.190 |       |
| A1     | 2.03        | 3.02  | 0.080     | 0.119 |       |
| 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

## TO-262



Example: This is a xxxxxx-1 <sup>(1)</sup> with assembly lot code AC, assembled on WW 19, 2001 in the assembly line "X"

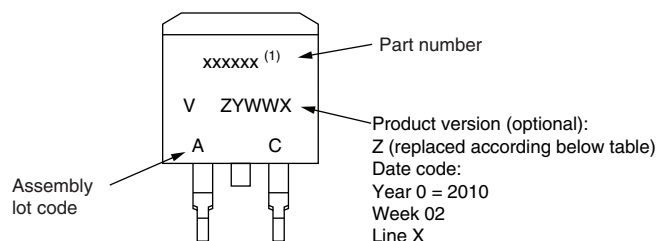
### Note

<sup>(1)</sup> If part number contain "H" as last digit, product is AEC-Q101 qualified

| ENVIRONMENTAL NAMING CODE (Z) | PRODUCT DEFINITION                                          |
|-------------------------------|-------------------------------------------------------------|
| A                             | Termination lead (Pb)-free                                  |
| B                             | Totally lead (Pb)-free                                      |
| E                             | RoHS-compliant and termination lead (Pb)-free               |
| F                             | RoHS-compliant and totally lead (Pb)-free                   |
| M                             | Halogen-free, RoHS-compliant and termination lead (Pb)-free |
| N                             | Halogen-free, RoHS-compliant and totally lead (Pb)-free     |
| G                             | Green                                                       |



## D<sup>2</sup>PAK



Example: This is a xxxxxx <sup>(1)</sup> with assembly lot code AC, assembled on WW 02, 2010

### Note

<sup>(1)</sup> If part number contain "H" as last digit, product is AEC-Q101 qualified

| ENVIRONMENTAL NAMING CODE (Z) | PRODUCT DEFINITION                                           |
|-------------------------------|--------------------------------------------------------------|
| A                             | Termination lead (Pb)-free                                   |
| B                             | Totally lead (Pb)-free                                       |
| E                             | RoHS-compliant and termination lead (Pb)-free                |
| F                             | RoHS-compliant and totally lead (Pb)-free                    |
| M                             | Halogen-free, RoHS-compliant, and termination lead (Pb)-free |
| N                             | Halogen-free, RoHS-compliant, and totally lead (Pb)-free     |
| G                             | Green                                                        |



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