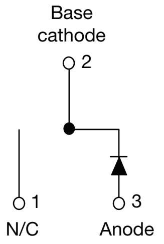
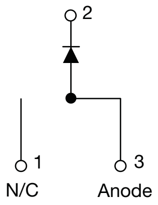
# Hyperfast Rectifier, 15 A FRED Pt®

**TO-263AB (D$^2$PAK)**



**VS-15ETH03SPbF**

**TO-262AA**



**VS-15ETH03-1PbF**

| PRODUCT SUMMARY | |
|---|---|
| Package | TO-263AB (D$^2$PAK), TO-262AA |
| $I_{F(AV)}$ | 15 A |
| $V_R$ | 300 V |
| $V_F$ at $I_F$ | 0.85 V |
| $t_{rr}$ (typ.) | 40 ns |
| $T_J$ max. | 175 °C |
| Diode variation | Single diode |

## FEATURES

- Hyperfast 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
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

## DESCRIPTION / APPLICATIONS

Vishay Semiconductors 300 V series are the state of the art hyperfast recovery rectifiers designed with optimized performance of forward voltage drop and hyperfast 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 diodes 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.

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | TEST CONDITIONS | MAX. | UNITS |
|---|---|---|---|---|
| Repetitive peak reverse voltage | $V_{RRM}$ | | 300 | V |
| Average rectified forward current | $I_{F(AV)}$ | $T_C$ = 142 °C | 15 | A |
| Non-repetitive peak surge current | $I_{FSM}$ | $T_J$ = 25 °C | 140 | |
| Operating junction and storage temperatures | $T_J$, $T_{Stg}$ | | -65 to +175 | °C |

## ELECTRICAL SPECIFICATIONS ($T_J$ = 25 °C unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
|---|---|---|---|---|---|---|
| Breakdown voltage, blocking voltage | $V_{BR}$,<br>$V_R$ | $I_R$ = 100 µA | 300 | - | - | V |
| Forward voltage | $V_F$ | $I_F$ = 15 A | - | 1.05 | 1.25 | |
| | | $I_F$ = 15 A, $T_J$ = 125 °C | - | 0.85 | 1.00 | |
| Reverse leakage current | $I_R$ | $V_R$ = $V_R$ rated | - | 0.05 | 40 | µA |
| | | $T_J$ = 125 °C, $V_R$ = $V_R$ rated | - | 12 | 400 | |
| Junction capacitance | $C_T$ | $V_R$ = 300 V | - | 45 | - | pF |
| Series inductance | $L_S$ | Measured lead to lead 5 mm from package body | - | 8 | - | nH |

| **DYNAMIC RECOVERY CHARACTERISTICS** ($T_J$ = 25 °C unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Reverse recovery time | $t_{rr}$ | $I_F$ = 1.0 A, $dI_F/dt$ = 50 A/μs, $V_R$ = 30 V | | - | - | 40 | ns |
| | | $T_J$ = 25 °C | $I_F$ = 15 A<br>$dI_F/dt$ = -200 A/μs<br>$V_R$ = 200 V | - | 32 | - | |
| | | $T_J$ = 125 °C | | - | 45 | - | |
| Peak recovery current | $I_{RRM}$ | $T_J$ = 25 °C | | - | 2.4 | - | A |
| | | $T_J$ = 125 °C | | - | 6.1 | - | |
| Reverse recovery charge | $Q_{rr}$ | $T_J$ = 25 °C | | - | 38 | - | nC |
| | | $T_J$ = 125 °C | | - | 137 | - | |

| **THERMAL - MECHANICAL SPECIFICATIONS** | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Maximum junction and storage temperature range | $T_J$, $T_{Stg}$ | | -65 | - | 175 | °C |
| Thermal resistance, junction to case per leg | $R_{thJC}$ | | - | 1.02 | 2.0 | °C/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 | - | 0.2 | - | |
| 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 $D^2PAK$ | 15ETH03S | | | |
| | | Case style TO-262 | 15ETH03-1 | | | |

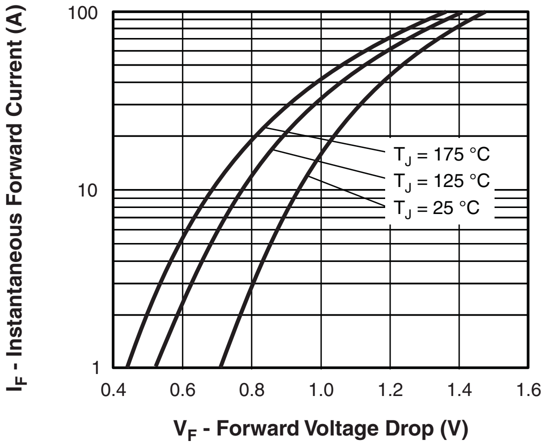


Fig. 1 - Typical Forward Voltage Drop Characteristics

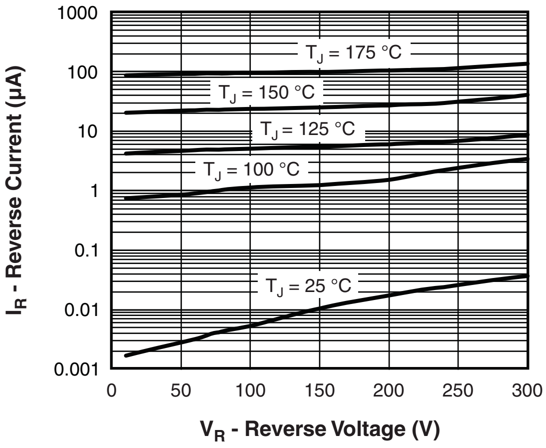


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

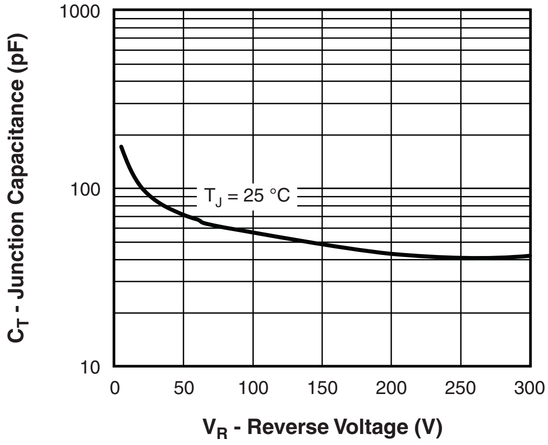


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

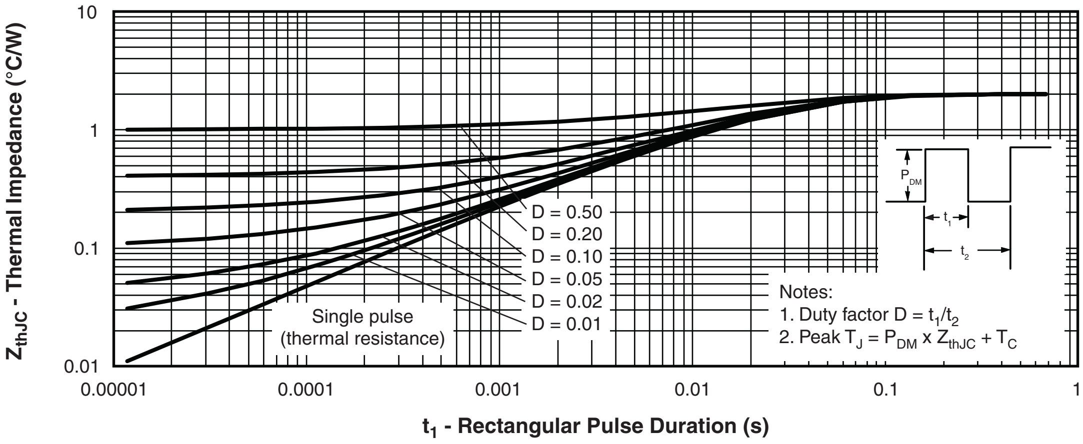


Fig. 4 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics

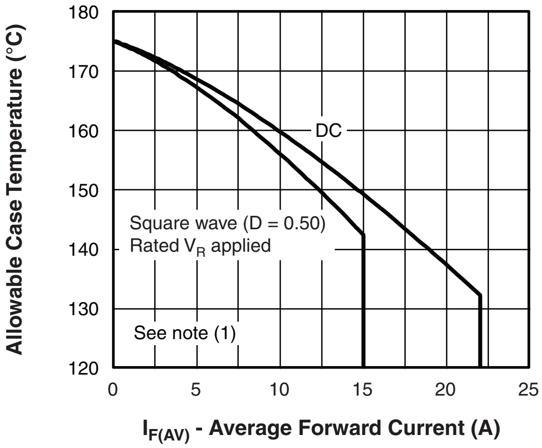


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

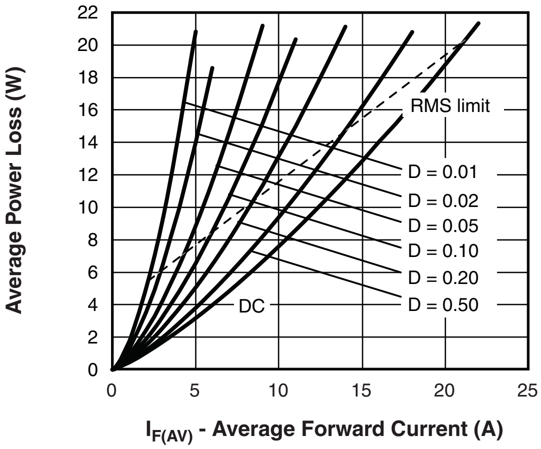


Fig. 6 - Forward Power Loss Characteristics

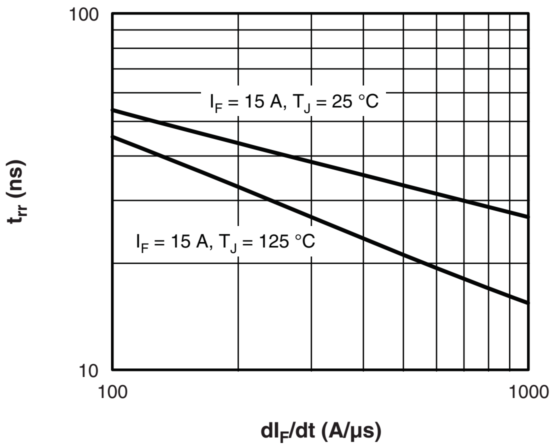


Fig. 7 - Typical Reverse Recovery Time vs. $dI_F/dt$

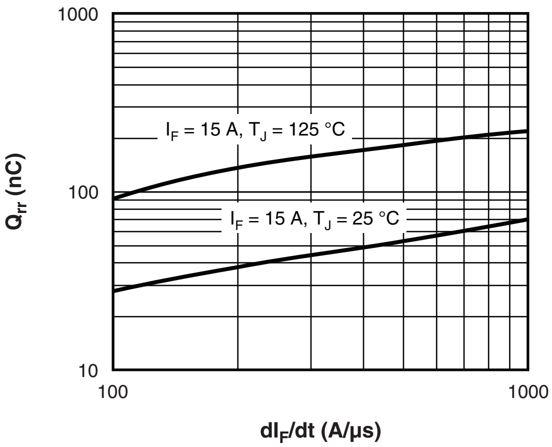


Fig. 8 - Typical Stored Charge vs. $dI_F/dt$

**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 $V_{R1}$ = Rated $V_R$

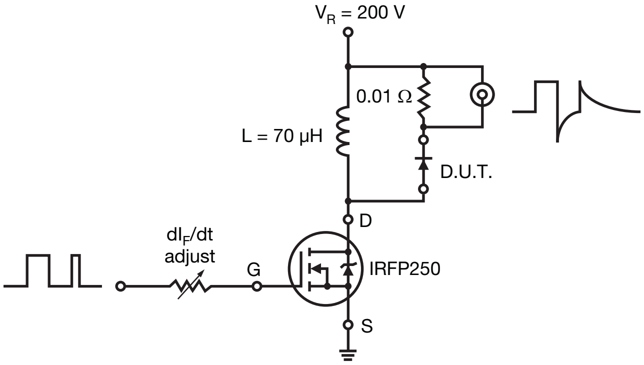
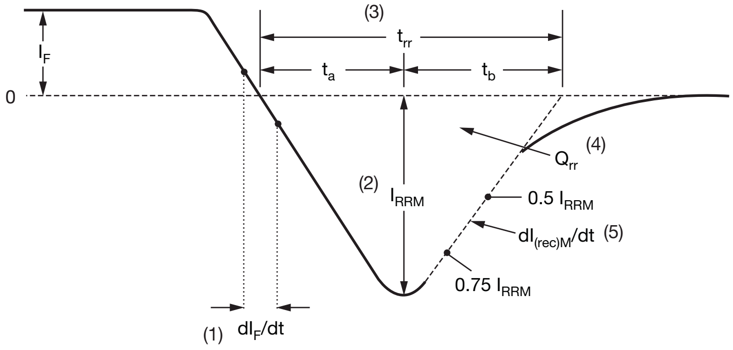


Fig. 9 - Reverse Recovery Parameter Test Circuit



(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 $I_{RRM}$

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

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

Fig. 10 - Reverse Recovery Waveform and Definitions

## ORDERING INFORMATION TABLE

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Device code** | **VS-** | **15** | **E** | **T** | **H** | **03** | **S** | **TRL** | **PbF** |
| | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ |

**1** - Vishay Semiconductors product
**2** - Current rating (15 A)
**3** - E = single diode
**4** - T = TO-220, D²PAK
**5** - H = hyperfast rectifier
**6** - Voltage rating (03 = 300 V)
**7** -
- S = D²PAK
- -1 = TO-262

**8** -
- None = tube (50 pieces)
- TRL = tape and reel (left oriented, for D²PAK package)
- TRR = tape and reel (right oriented, for D²PAK package)

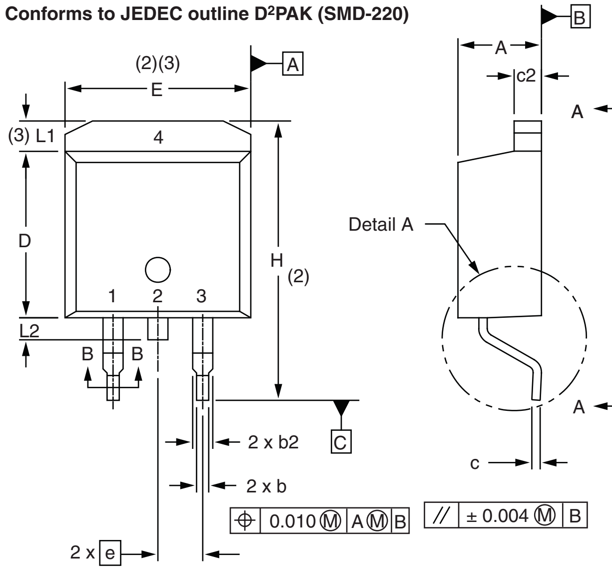
**9** - PbF = lead (Pb)-free

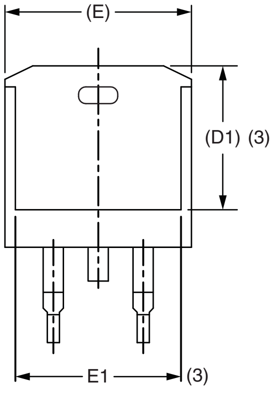
| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | www.vishay.com/doc?95014 |
| Part marking information | www.vishay.com/doc?95008 |
| Packaging information | www.vishay.com/doc?95032 |

# $D^2$PAK, TO-262

## DIMENSIONS - $D^2$PAK in millimeters and inches

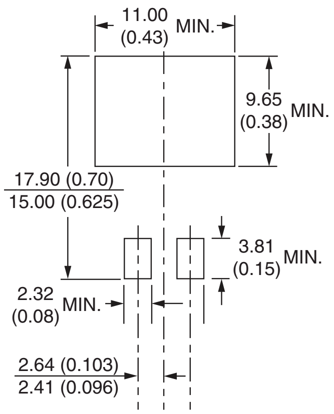
**Conforms to JEDEC outline $D^2$PAK (SMD-220)**

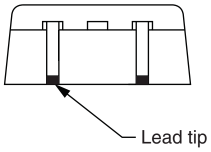


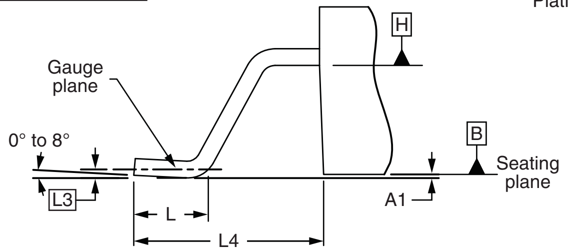


View A - A

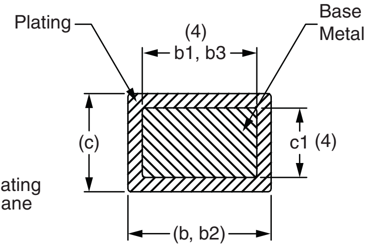
**Pad layout**







Detail "A"
Rotated 90 °CW
Scale: 8:1



Section B - B and C - C
Scale: None

**Lead assignments**

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

| 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 |
| 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

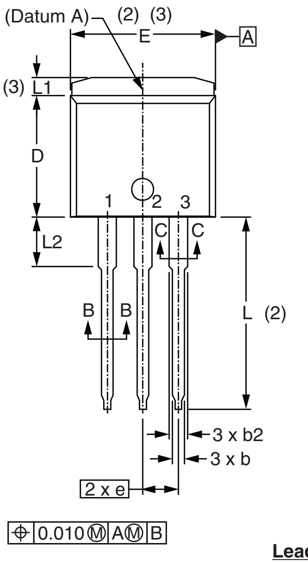
(5) Datum A and B to be determined at datum plane H

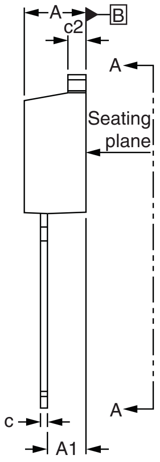
(6) Controlling dimension: inch

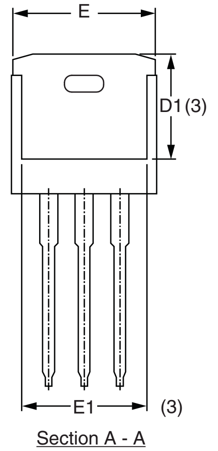
(7) Outline conforms to JEDEC outline TO-263AB

## DIMENSIONS - TO-262 in millimeters and inches

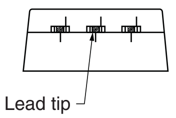
**Modified JEDEC outline TO-262**





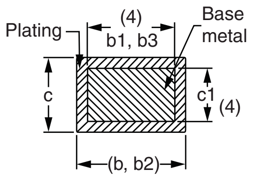


Section A - A



**Lead assignments**

Diodes
1. - Anode (two die)/open (one die)
2., 4. - 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

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