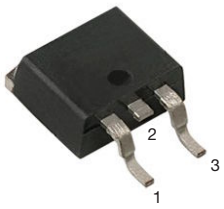
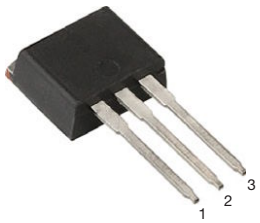
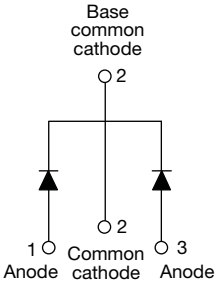
## Hyperfast Rectifier, 2 x 10 A FRED Pt®



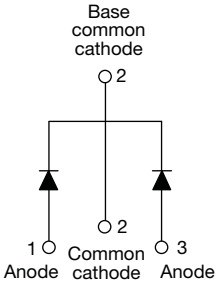

D²PAK (TO-263AB)




TO-262AA




VS-20CTH03SHM3




VS-20CTH03-1HM3

### 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, meets JESD 201, class 1 whisker test
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT
HALOGEN FREE

### 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 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.

| PRIMARY CHARACTERISTICS | |
|---|---|
| $I_{F(AV)}$ | 2 x 10 A |
| $V_R$ | 300 V |
| $V_F$ at $I_F$ | 0.85 V |
| $t_{rr}$ typ. | 23 ns |
| $T_J$ max. | 175 °C |
| Package | TO-263AB ($D^2PAK$), TO-262AA |
| Circuit configuration | Common cathode |

| ABSOLUTE MAXIMUM RATINGS | | | | | |
|---|---|---|---|---|---|
| PARAMETER | | SYMBOL | TEST CONDITIONS | MAX. | UNITS |
| Peak repetitive reverse voltage | | $V_{RRM}$ | | 300 | V |
| Average rectified forward current | per diode | $I_{F(AV)}$ | $T_C$ = 160 °C | 10 | A |
| | per device | | | 20 | |
| Non-repetitive peak surge current | | $I_{FSM}$ | $T_J$ = 25 °C | 120 | |
| Operating junction and storage temperatures | | $T_J$, $T_{Stg}$ | | -55 to +175 | °C |

| ELECTRICAL SPECIFICATIONS ($T_J$ = 25 °C unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Breakdown voltage, blocking voltage | $V_{BR}$, $V_R$ | $I_R$ = 100 µA | 300 | - | - | V |
| Forward voltage | $V_F$ | $I_F$ = 10 A | - | 1.05 | 1.25 | |
| | | $I_F$ = 10 A, $T_J$ = 125 °C | - | 0.85 | 0.95 | |
| Reverse leakage current | $I_R$ | $V_R$ = $V_R$ rated | - | - | 20 | µA |
| | | $T_J$ = 125 °C, $V_R$ = $V_R$ rated | - | 6 | 200 | |
| Junction capacitance | $C_T$ | $V_R$ = 300 V | - | 30 | - | pF |
| Series inductance | $L_S$ | Measured lead to lead 5 mm from package body | - | 8 | - | nH |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| DYNAMIC RECOVERY CHARACTERISTICS ($T_C$ = 25 °C unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNITS |
| Reverse recovery time | $t_{rr}$ | $I_F$ = 1.0 A, $dI_F/dt$ = 100 A/μs, $V_R$ = 30 V | | - | 23 | - | ns |
| | | $T_J$ = 25 °C | $I_F$ = 10 A<br>$dI_F/dt$ = 200 A/μs<br>$V_R$ = 200 V | - | 31 | - | |
| | | $T_J$ = 125 °C | | - | 42 | - | |
| Peak recovery current | $I_{RRM}$ | $T_J$ = 25 °C | | - | 2.4 | - | A |
| | | $T_J$ = 125 °C | | - | 5.6 | - | |
| Reverse recovery charge | $Q_{rr}$ | $T_J$ = 25 °C | | - | 36 | - | nC |
| | | $T_J$ = 125 °C | | - | 120 | - | |

| THERMAL - MECHANICAL SPECIFICATIONS | | | | | | |
|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Maximum junction and storage temperature range | $T_J$, $T_{Stg}$ | | -55 | - | 175 | °C |
| Thermal resistance, junction to case per diode | $R_{thJC}$ | | - | - | 1.5 | °C/W |
| Weight | | | - | 2.0 | - | g |
| | | | - | 0.07 | - | oz. |
| Marking device | | Case style TO-263AB ($D^2PAK$) | 20CTH03SH | | | |
| | | Case style TO-262AA | 20CTH03-1H | | | |

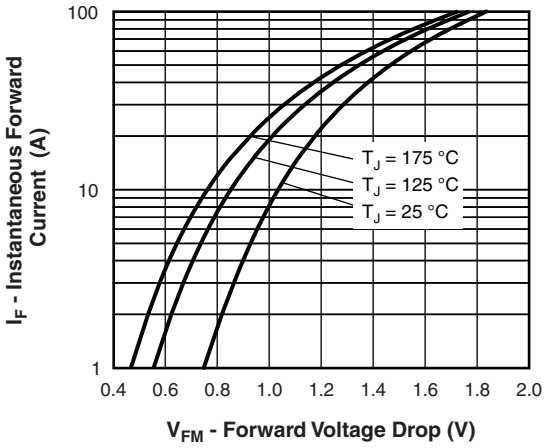


Fig. 1 - Maximum Forward Voltage Drop Characteristics

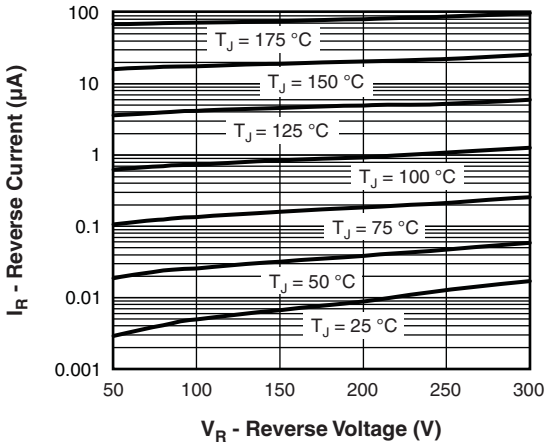


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage


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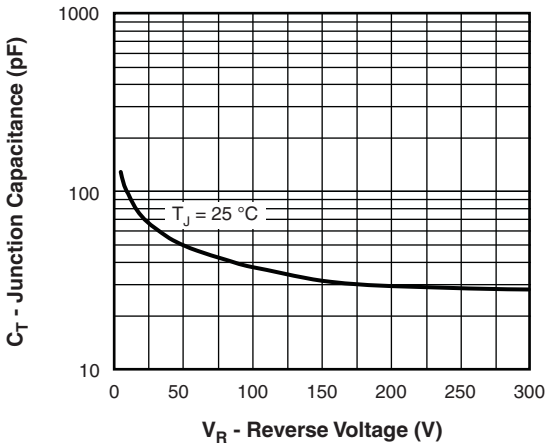


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

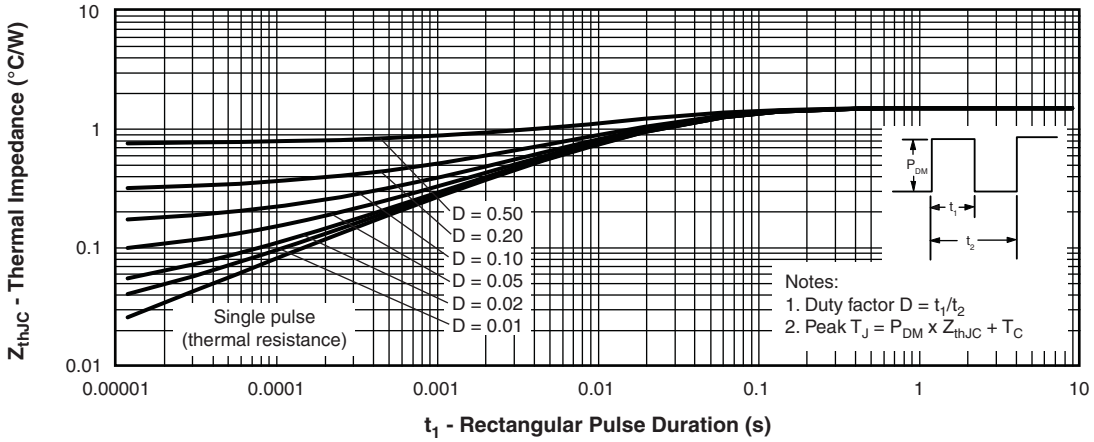


Fig. 4 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics

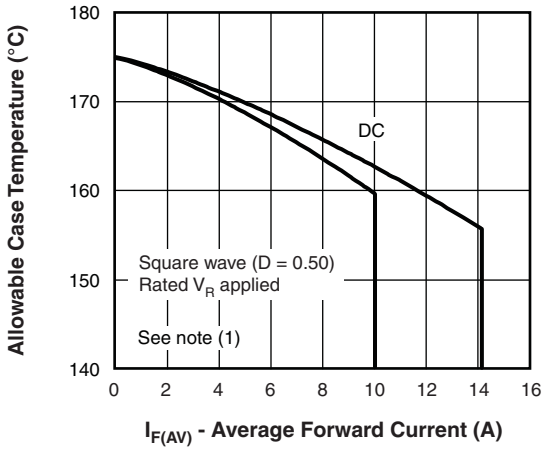


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

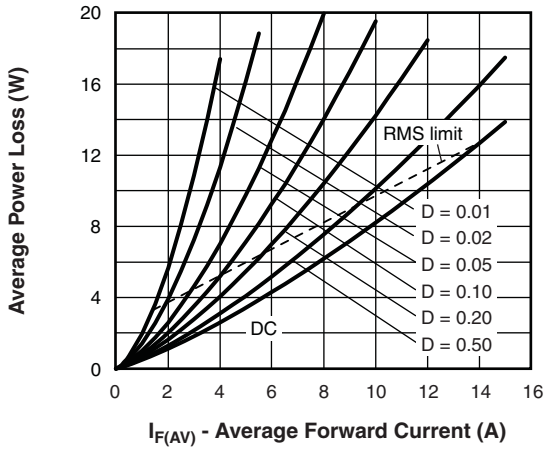


Fig. 6 - Forward Power Loss Characteristics

**Note**

(1) Formula used: $T_C = T_J - (Pd + Pd_{REV}) \times R_{thJC}$;
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 $V_R$


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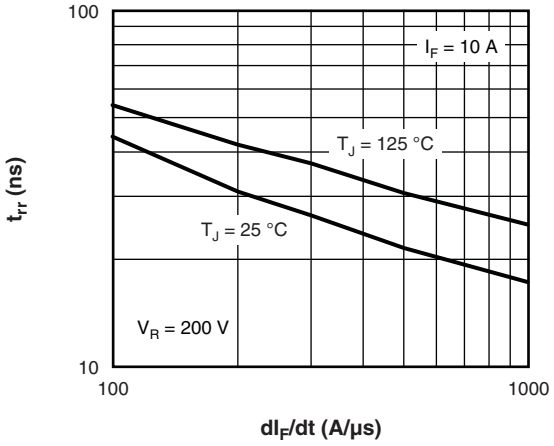



Fig. 7 - Typical Reverse Recovery Time vs. $dI_F/dt$

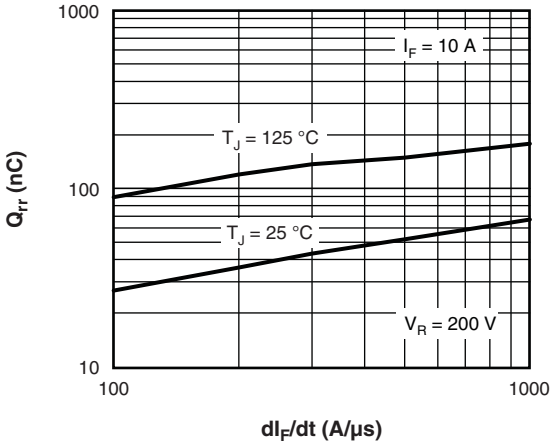
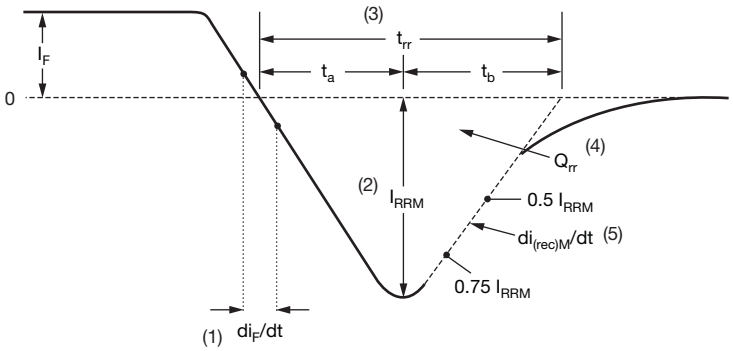



Fig. 8 - Typical Stored Charge vs. $dI_F/dt$




(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. 9 - Reverse Recovery Waveform and Definitions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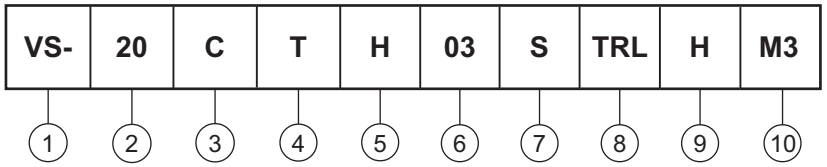
## ORDERING INFORMATION TABLE

**Device code**




| | | |
|---|---|---|
| 1 | - | Vishay Semiconductors product |
| 2 | - | Current rating (20 A) |
| 3 | - | C = common cathode |
| 4 | - | T = TO-220, $D^2PAK$ |
| 5 | - | H = hyperfast rectifier |
| 6 | - | Voltage rating (03 = 300 V) |
| 7 | - | • S = $D^2PAK$<br>• -1 = TO-262 |
| 8 | - | • None = tube (50 pieces)<br>• TRL = tape and reel (left oriented, for $D^2PAK$ package)<br>• TRR = tape and reel (right oriented, for $D^2PAK$ package) |
| 9 | - | H = AEC-Q101 qualified |
| 10 | - | M3 = halogen-free, RoHS-compliant, and termination lead (Pb)-free |

| LINKS TO RELATED DOCUMENTS | | |
|---|---|---|
| Dimensions | TO-263AB ($D^2PAK$) | www.vishay.com/doc?95046 |
| | TO-262AA | www.vishay.com/doc?95419 |
| Part marking information | TO-263AB ($D^2PAK$) | www.vishay.com/doc?95444 |
| | TO-262AA | www.vishay.com/doc?95443 |
| Packaging information | TO-263AB ($D^2PAK$) | www.vishay.com/doc?95032 |
| SPICE model | | www.vishay.com/doc?96583 |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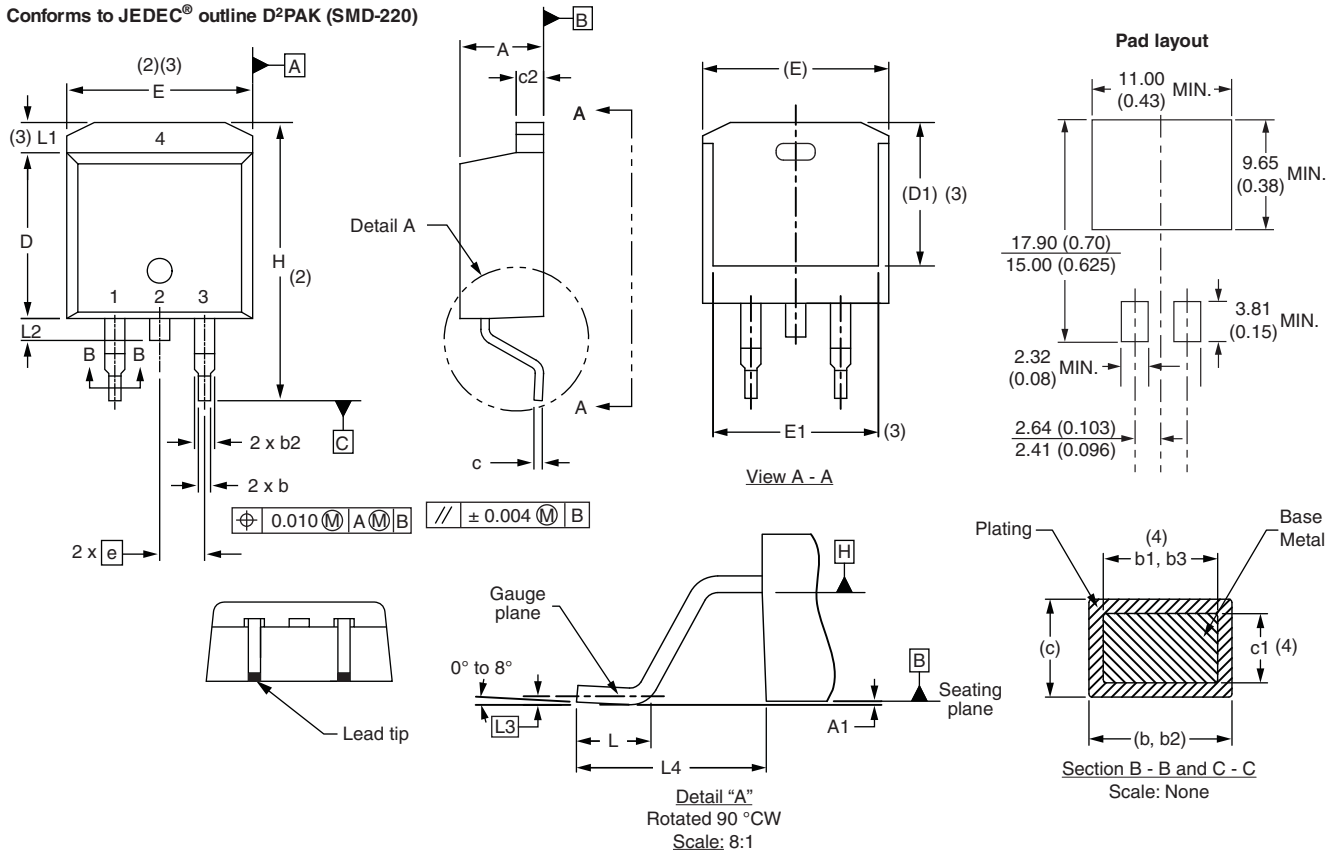
# D²PAK

**DIMENSIONS** in millimeters and inches




| 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: inch

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



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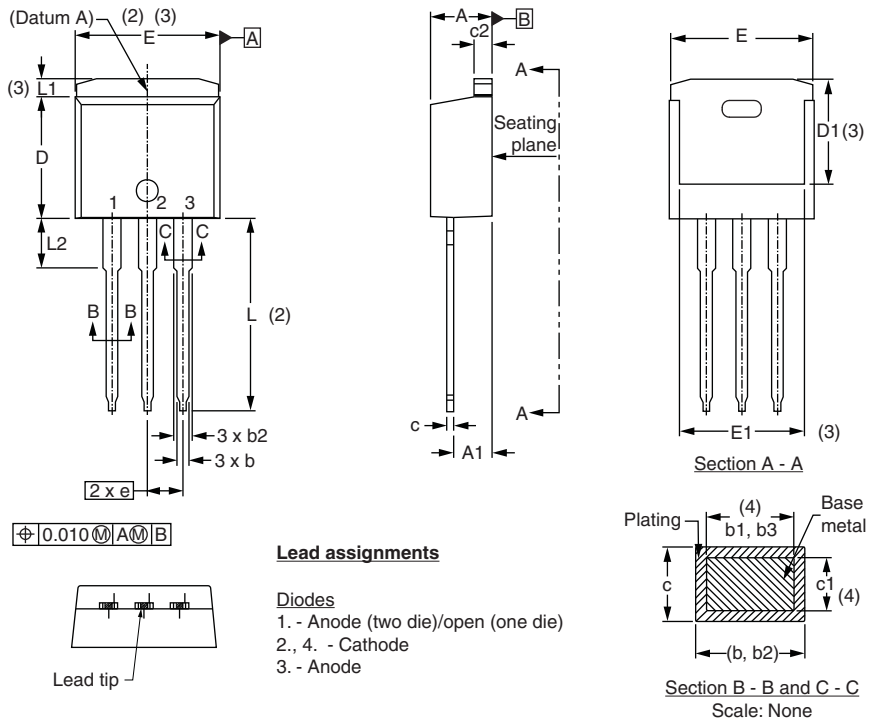
# TO-262

**DIMENSIONS** in millimeters and inches

**Modified JEDEC® outline TO-262**




**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 | 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 | 3.36 | 3.71 | 0.132 | 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) , D1 (minimum) and L2 where dimensions derived the actual package outline



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