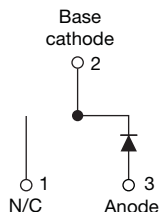
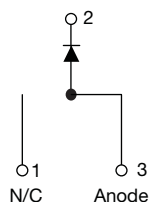


HEXFRED®, Ultrafast Soft Recovery Diode, 15 A

VS-HFA15 TB60SPbF


D²PAK

VS-HFA15 TB60-1PbF


TO-262

FEATURES

- Ultrafast and ultrasoft recovery
- Very low I_{RRM} and Q_{rr}
- Meets MSL level 1, per J-STD-020, LF maximum peak of 260 °C
- Halogen-free according to IEC61249-2-21 definition
- Compliant to RoHS Directive 2002/95/EC
- Designed and qualified for industrial level
- AEC-Q101 qualified



RoHS
COMPLIANT
HALOGEN
FREE

BENEFITS

- Reduced RFI and EMI
- Reduced power loss in diode and switching transistor
- Higher frequency operation
- Reduced snubbing
- Reduced parts count

DESCRIPTION

VS-HFA15TB60SPbF, VS-HFA15TB60-1PbF is a state of the art ultrafast recovery diode. Employing the latest in epitaxial construction and advanced processing techniques it features a superb combination of characteristics which result in performance which is unsurpassed by any rectifier previously available. With basic ratings of 600 V and 15 A continuous current, the VS-HFA15TB60SPbF, VS-HFA15TB60-1PbF is especially well suited for use as the companion diode for IGBTs and MOSFETs. In addition to ultrafast recovery time, the HEXFRED® product line features extremely low values of peak recovery current (I_{RRM}) and does not exhibit any tendency to “snap-off” during the t_b portion of recovery. The HEXFRED features combine to offer designers a rectifier with lower noise and significantly lower switching losses in both the diode and the switching transistor. These HEXFRED advantages can help to significantly reduce snubbing, component count and heatsink sizes. The HEXFRED VS-HFA15TB60SPbF, VS-HFA15TB60-1PbF is ideally suited for applications in power supplies and power conversion systems (such as inverters), motor drives, and many other similar applications where high speed, high efficiency is needed.

PRODUCT SUMMARY

Package	TO-263AB (D ² PAK), TO-262AA
$I_{F(AV)}$	15 A
V_R	600 V
V_F at I_F	1.7 V
t_{rr} (typ.)	23 ns
T_J max.	150 °C
Diode variation	Single die

ABSOLUTE MAXIMUM RATINGS

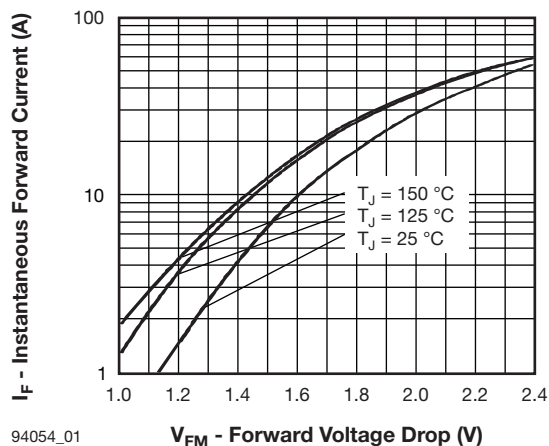
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Cathode to anode voltage	V_R		600	V
Maximum continuous forward current	I_F	$T_C = 100\text{ °C}$	15	A
Single pulse forward current	I_{FSM}		150	
Maximum repetitive forward current	I_{FRM}		60	
Maximum power dissipation	P_D	$T_C = 25\text{ °C}$	74	W
		$T_C = 100\text{ °C}$	29	
Operating junction and storage temperature range	T_J, T_{Stg}		- 55 to + 150	°C



ELECTRICAL SPECIFICATIONS (T _J = 25 °C unless otherwise specified)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS
Cathode to anode breakdown voltage	V _{BR}	I _R = 100 μA		600	-	-	V
Maximum forward voltage	V _{FM}	I _F = 15 A	See fig. 1	-	1.3	1.7	
		I _F = 30 A		-	1.5	2.0	
		I _F = 15 A, T _J = 125 °C		-	1.2	1.6	
Maximum reverse leakage current	I _{RM}	V _R = V _R rated	See fig. 2	-	1.0	10	μA
		T _J = 125 °C, V _R = 0.8 x V _R rated		-	400	1000	
Junction capacitance	C _T	V _R = 200 V	See fig. 3	-	25	50	pF
Series inductance	L _S	Measured lead to lead 5 mm from package body		-	8.0	-	nH

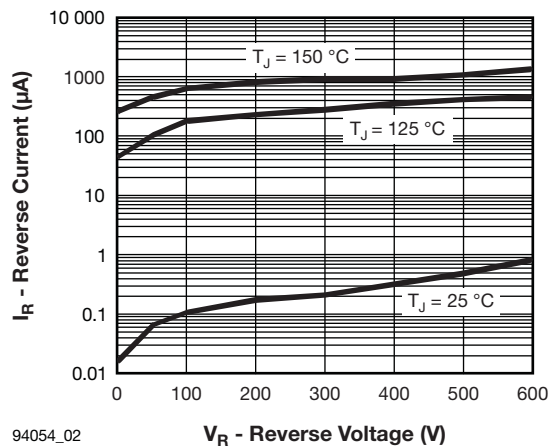
DYNAMIC RECOVERY CHARACTERISTICS (T _J = 25 °C unless otherwise specified)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS
Reverse recovery time See fig. 5	t _{rr}	I _F = 1.0 A, dI _F /dt = 200 A/μs, V _R = 30 V		-	23	-	ns
	t _{rr1}	T _J = 25 °C	I _F = 15 A dI _F /dt = 200 A/μs V _R = 200 V	-	50	60	
	t _{rr2}	T _J = 125 °C		-	105	120	
Peak recovery current See fig. 6	I _{RRM1}	T _J = 25 °C		-	4.5	6.0	A
	I _{RRM2}	T _J = 125 °C		-	6.5	10	
Reverse recovery charge See fig. 7	Q _{rr1}	T _J = 25 °C		-	84	180	nC
	Q _{rr2}	T _J = 125 °C		-	241	600	
Peak rate of fall of recovery current during t _b See fig. 8	dI _{(rec)M} /dt1	T _J = 25 °C		-	188	-	A/μs
	dI _{(rec)M} /dt2	T _J = 125 °C		-	160	-	

THERMAL - MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Lead temperature	T _{lead}	0.063" from case (1.6 mm) for 10 s	-	-	300	°C
Thermal resistance, junction to case	R _{thJC}		-	-	1.7	K/W
Thermal resistance, junction to ambient	R _{thJA}	Typical socket mount	-	-	80	
Thermal resistance, case to heatsink	R _{thCS}	Mounting surface, flat, smooth and greased	-	0.5	-	
Weight			-	2.0	-	g
			-	0.07	-	oz.
Marking device		Case style D ² PAK	HFA15TB60S			
		Case style TO-262	HFA15TB60-1			



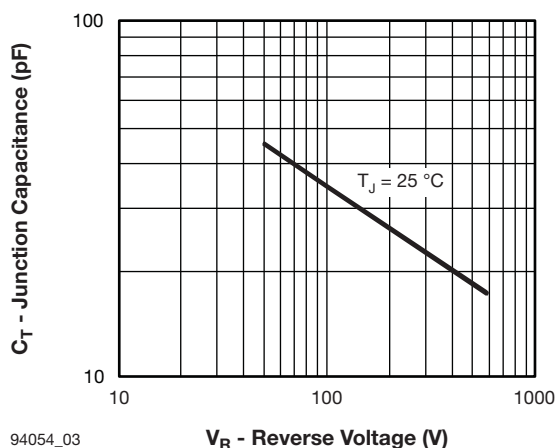
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V_{FM} - Forward Voltage Drop (V)
Fig. 1 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current



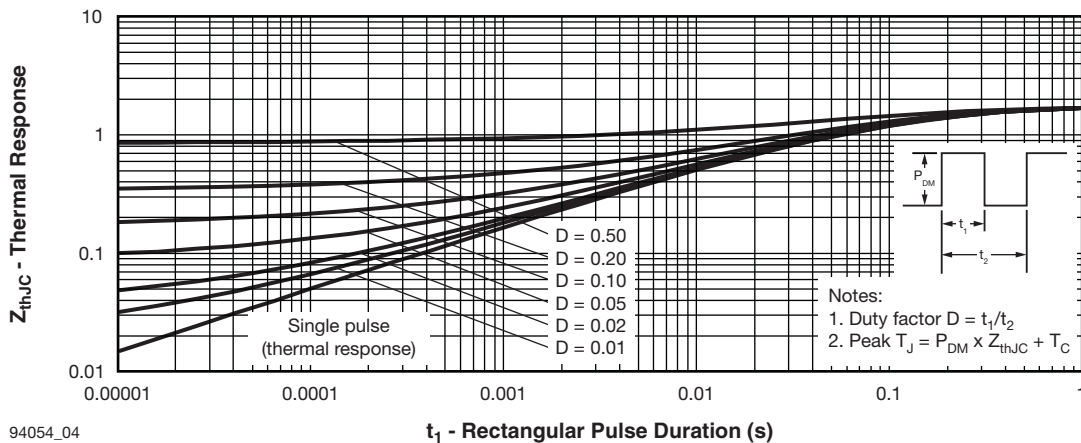
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V_R - Reverse Voltage (V)
Fig. 2 - Typical Reverse Current vs. Reverse Voltage



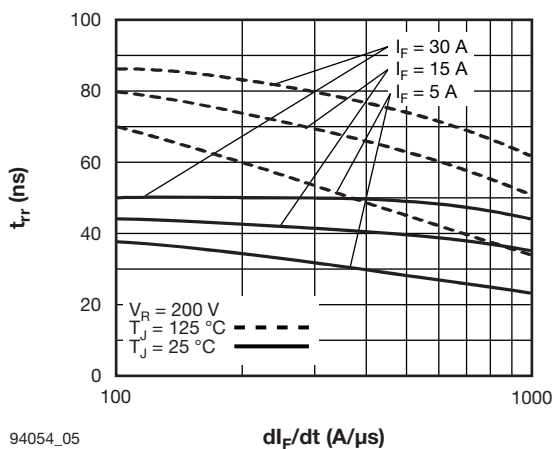
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V_R - Reverse Voltage (V)
Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage



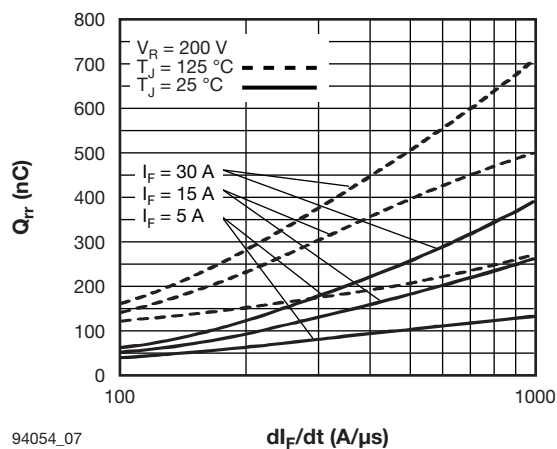
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t₁ - Rectangular Pulse Duration (s)
Fig. 4 - Maximum Thermal Impedance Z_{thJC} Characteristics



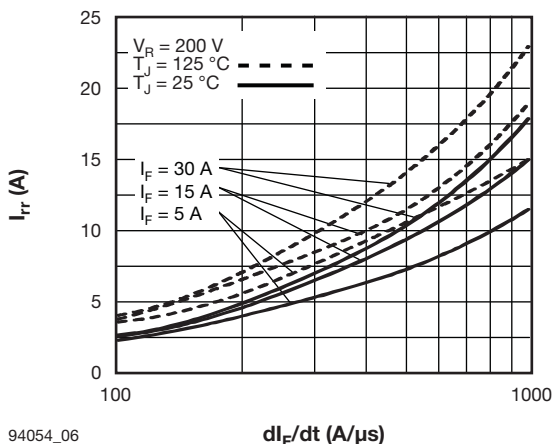
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Fig. 5 - Typical Reverse Recovery Time vs. dI_F/dt



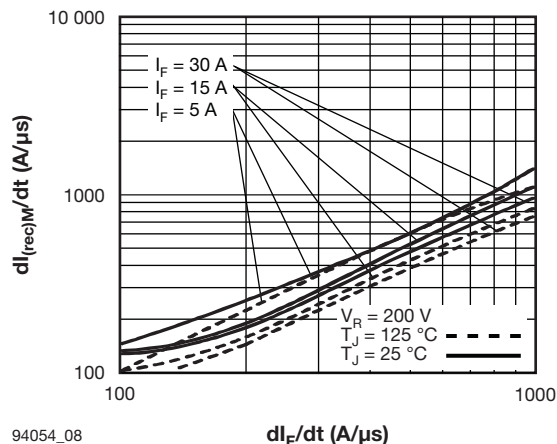
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Fig. 7 - Typical Stored Charge vs. dI_F/dt



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Fig. 6 - Typical Recovery Current vs. dI_F/dt



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Fig. 8 - Typical $dI_{(rec)M}/dt$ vs. dI_F/dt

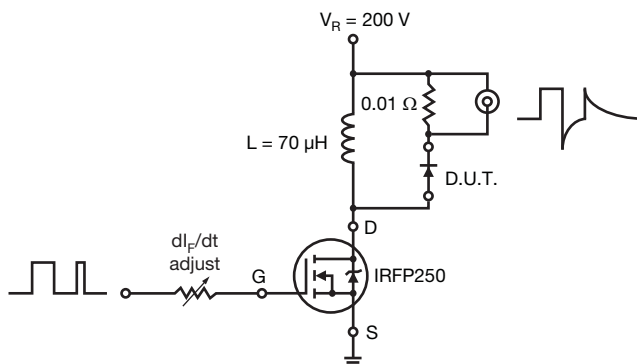
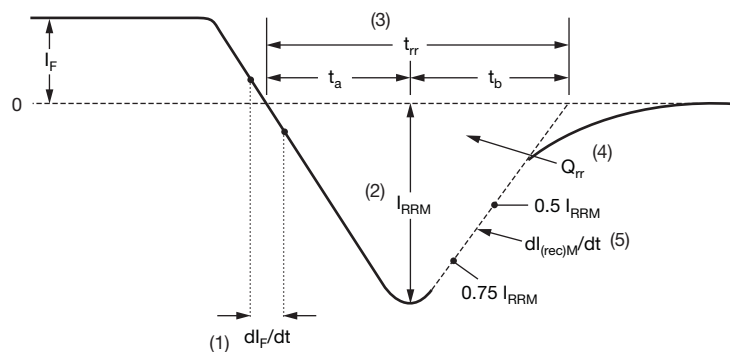


Fig. 9 - Reverse Recovery Parameter Test Circuit



(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-	HF	A	15	TB	60	S	TRL	PbF
	1	2	3	4	5	6	7	8	9

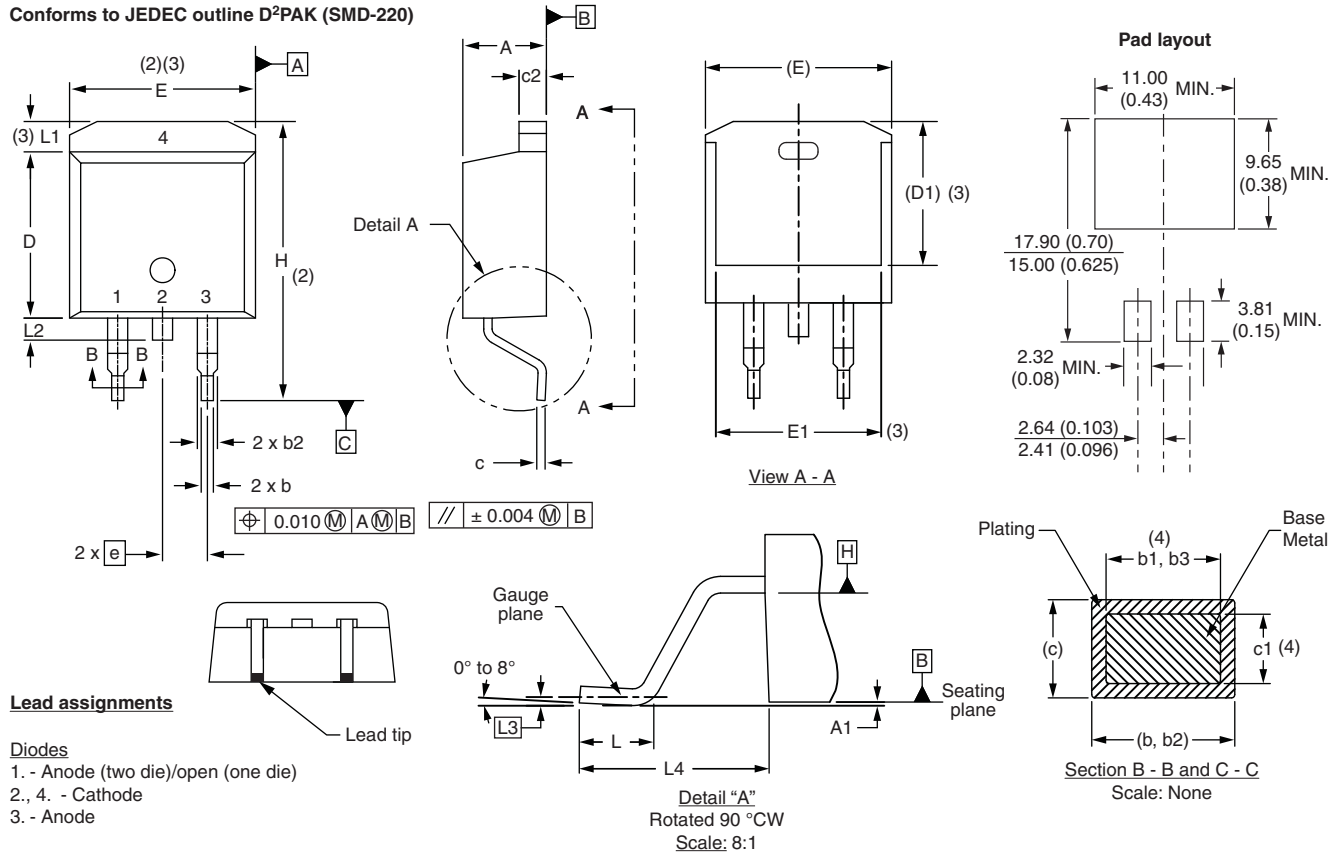
- | | | |
|----------|---|--|
| 1 | - | Vishay Semiconductors product |
| 2 | - | HEXFRED® family |
| 3 | - | Electron irradiated |
| 4 | - | Current rating (15 = 15 A) |
| 5 | - | Package:
TB = TO-220 |
| 6 | - | Voltage rating (60 = 600 V) |
| 7 | - | • S = D ² PAK |
| | - | • -1 = TO-262 |
| 8 | - | • None = Tube (50 pieces) |
| | - | • TRL = Tape and reel (left oriented, for D ² PAK package) |
| | - | • TRR = Tape and reel (right oriented, for D ² PAK package) |
| 9 | - | PbF = Lead (Pb)-free |
| | - | P = Lead (Pb)-free (for D ² PAK TRL and TRR) |

LINKS TO RELATED DOCUMENTS	
Dimensions	TO-263AB (D ² PAK): www.vishay.com/doc?95046
	TO-262AA : www.vishay.com/doc?95419
Part marking information	TO-263AB (D ² PAK): www.vishay.com/doc?95054
	TO-262AA : www.vishay.com/doc?95420
Packaging information	www.vishay.com/doc?95032
SPIICE model	www.vishay.com/doc?95357

D²PAK

DIMENSIONS in millimeters and inches

Conforms to JEDEC outline D²PAK (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	

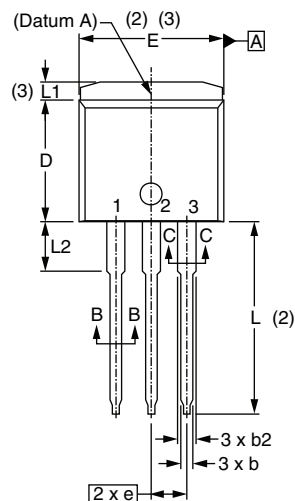
Notes

- (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

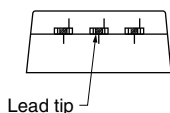
TO-262

DIMENSIONS in millimeters and inches

Modified JEDEC outline TO-262



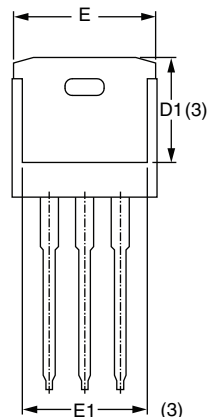
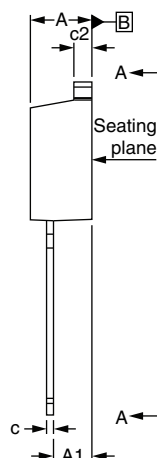
± 0.010 A A B



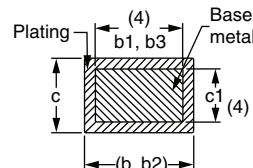
Lead assignments

Diodes

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



Section A - A



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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