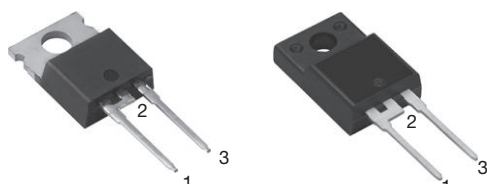


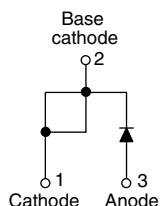
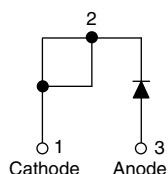


Ultralow V_F Hyperfast Rectifier for Discontinuous Mode PFC, 15 A FRED Pt®



TO-220AC

TO-220 FULL-PAK

VS-15ETL06PbF
VS-15ETL06-N3VS-15ETL06FPPbF
VS-15ETL06FP-N3

FEATURES

- Hyperfast recovery time
- Benchmark ultralow forward voltage drop
- 175 °C operating junction temperature
- Low leakage current
- Fully isolated package ($V_{INS} = 2500 V_{RMS}$)
- UL E78996 approved 
- Designed and qualified according to JEDEC®-JESD 47
- Material categorization: for definitions of compliance please see www.vishay.com/doc299912



RoHS
COMPLIANT
HALOGEN
FREE
Available

DESCRIPTION

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

The minimized conduction loss, optimized stored charge and low recovery current minimize 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-220AC, TO-220FP
$I_{F(AV)}$	15 A
V_R	600 V
V_F at I_F	0.85 V
t_{rr} typ.	60 ns
T_J max.	175 °C
Diode variation	Single die

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Peak repetitive reverse voltage	V_{RRM}		600	V
Average rectified forward current	$I_{F(AV)}$	$T_C = 154\text{ °C}$	15	A
		$T_C = 120\text{ °C (FULL-PAK)}$		
Non-repetitive peak surge current	I_{FSM}	$T_J = 25\text{ °C}$	250	
Peak repetitive forward current	I_{FM}		30	
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	$I_F = 15\text{ A}$	-	0.99	1.05	
		$I_F = 15\text{ A}, T_J = 150\text{ °C}$	-	0.85	0.92	
Reverse leakage current	I_R	$V_R = V_R$ rated	-	0.1	10	μA
		$T_J = 150\text{ °C}, V_R = V_R$ rated	-	15	120	
Junction capacitance	C_T	$V_R = 600\text{ V}$	-	20	-	pF
Series inductance	L_S	Measured lead to lead 5 mm from package body	-	8.0	-	nH

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Reverse recovery time	t_{rr}	$I_F = 1\text{ A}$, $di_F/dt = 100\text{ A}/\mu\text{s}$, $V_R = 30\text{ V}$	-	60	120	ns
		$I_F = 15\text{ A}$, $di_F/dt = 100\text{ A}/\mu\text{s}$, $V_R = 30\text{ V}$	-	190	270	
		$T_J = 25\text{ }^{\circ}\text{C}$	-	220	-	
		$T_J = 125\text{ }^{\circ}\text{C}$	-	320	-	
Peak recovery current	I_{RRM}	$T_J = 25\text{ }^{\circ}\text{C}$	-	19	-	A
		$T_J = 125\text{ }^{\circ}\text{C}$	-	26	-	
Reverse recovery charge	Q_{rr}	$T_J = 25\text{ }^{\circ}\text{C}$	-	2.2	-	μC
		$T_J = 125\text{ }^{\circ}\text{C}$	-	4.3	-	

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 (FULL-PAK)	R_{thJC}		-	1.0	1.3	$^{\circ}\text{C}/\text{W}$
			-	3.0	3.5	
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	-	0.5	-	
Weight			-	2.0	-	g
			-	0.07	-	oz.
Mounting torque			6.0 (5.0)	-	12 (10)	kgf · cm (lbf · in)
Marking device		Case style TO-220AC	15ETL06			
		Case style TO-220AC FULL-PAK	15ETL06FP			

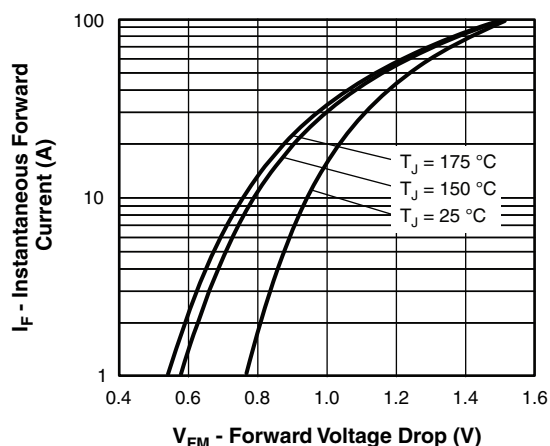


Fig. 1 - Maximum Forward Voltage Drop Characteristics

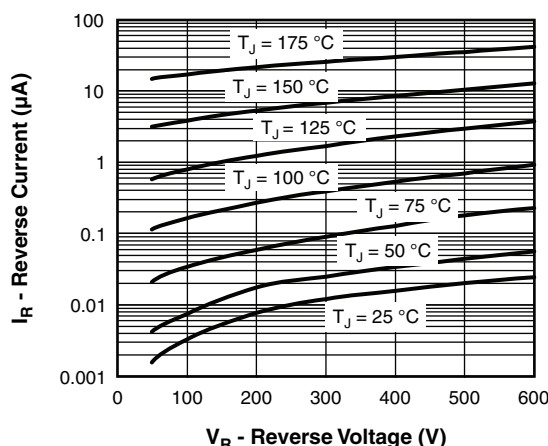


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

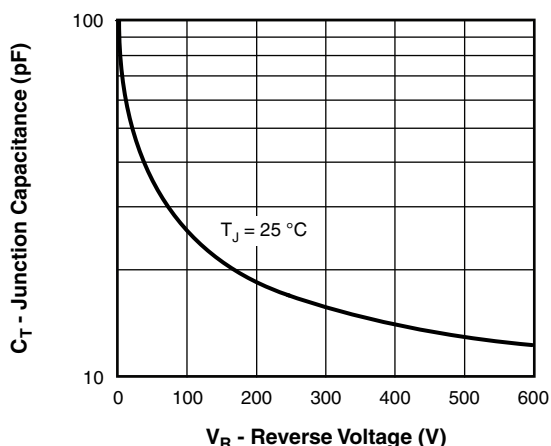


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

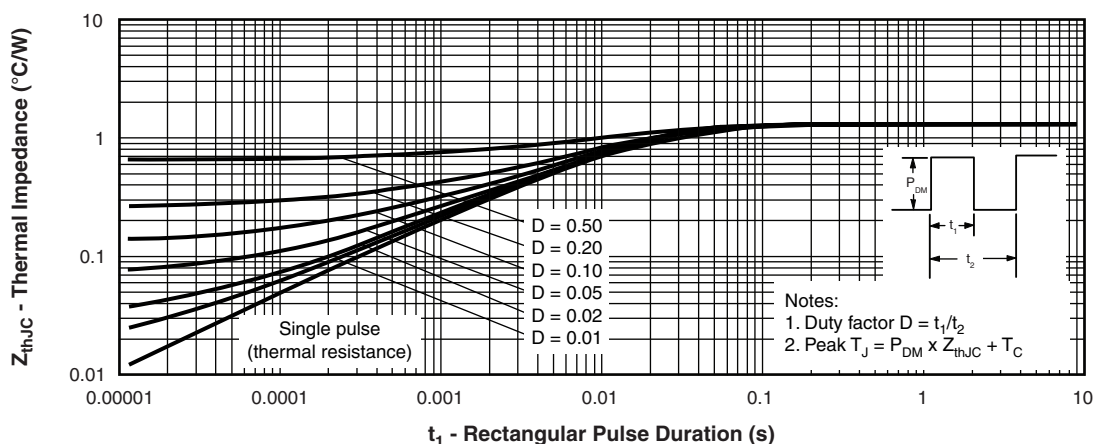


Fig. 4 - Maximum Thermal Impedance Z_{thJC} Characteristics

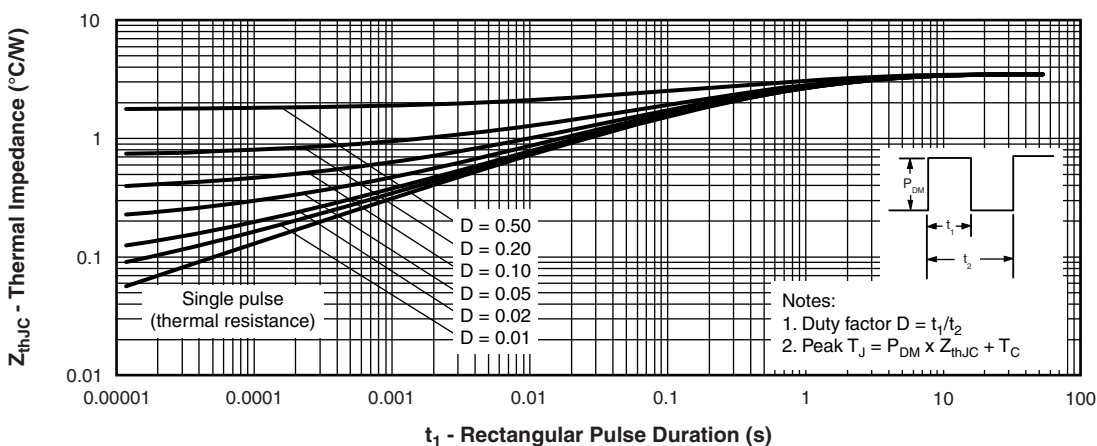


Fig. 5 - Maximum Thermal Impedance Z_{thJC} Characteristics (FULL-PAK)

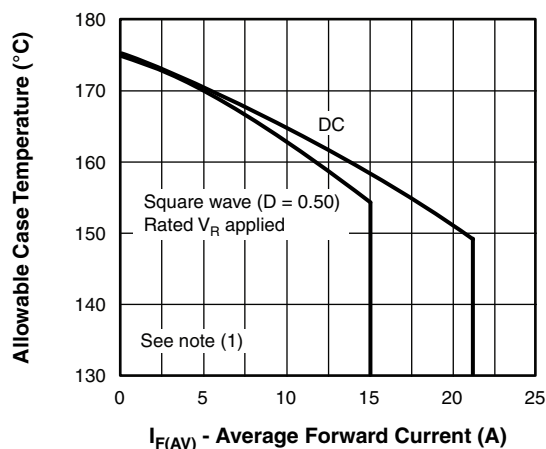


Fig. 6 - Maximum Allowable Case Temperature vs. Average Forward Current

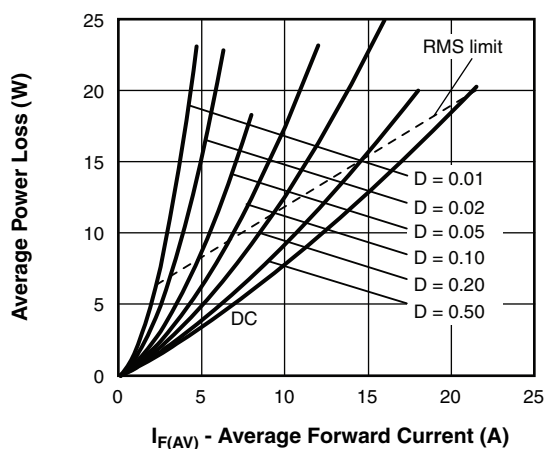


Fig. 8 - Forward Power Loss Characteristics

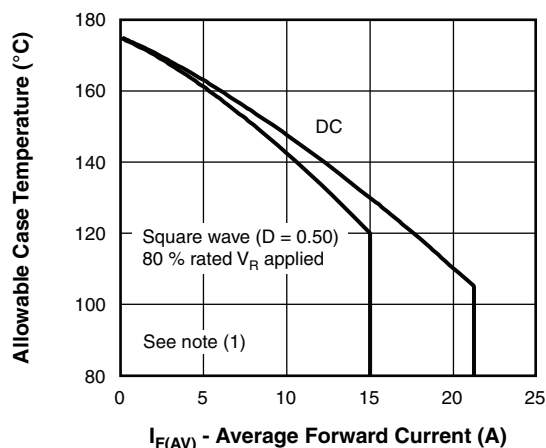


Fig. 7 - Maximum Allowable Case Temperature vs. Average Forward Current (FULL-PAK)

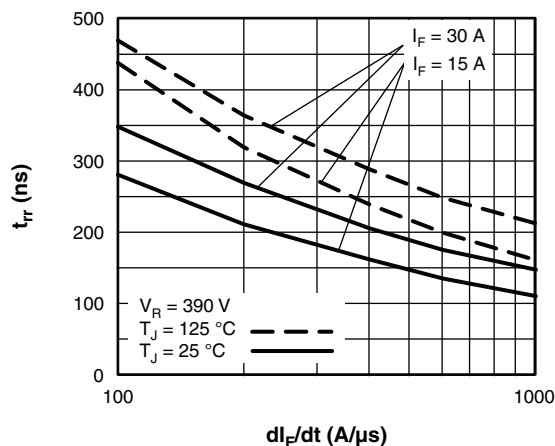


Fig. 9 - Typical Reverse Recovery Time vs. dI_F/dt

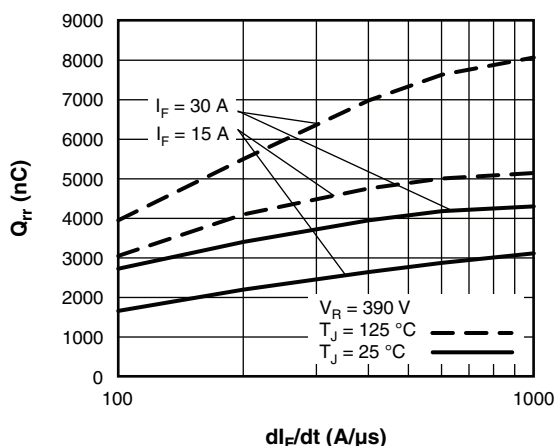


Fig. 10 - Typical Stored Charge vs. dI_F/dt

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. 8);
 P_{dREV} = Inverse power loss = $V_{R1} \times I_R (1 - D)$; I_R at V_{R1} = Rated V_R

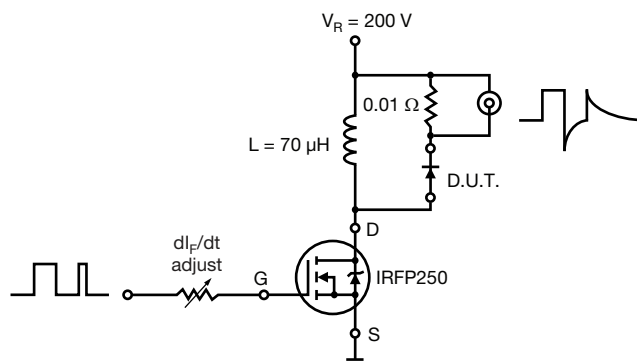
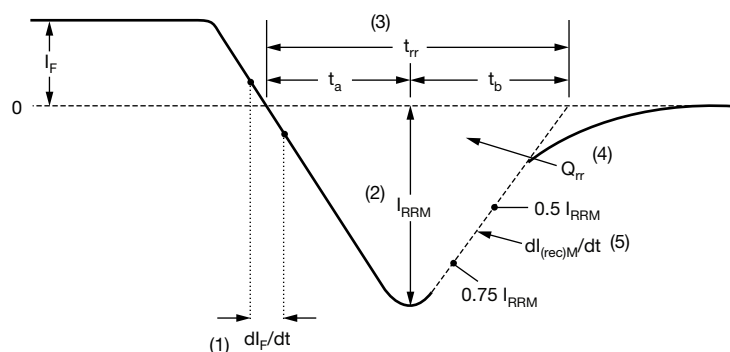


Fig. 11 - Reverse Recovery Parameter Test Circuit



(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. 12 - Reverse Recovery Waveform and Definitions

**ORDERING INFORMATION TABLE**

Device code	VS-	15	E	T	L	06	FP	PbF
	1	2	3	4	5	6	7	8

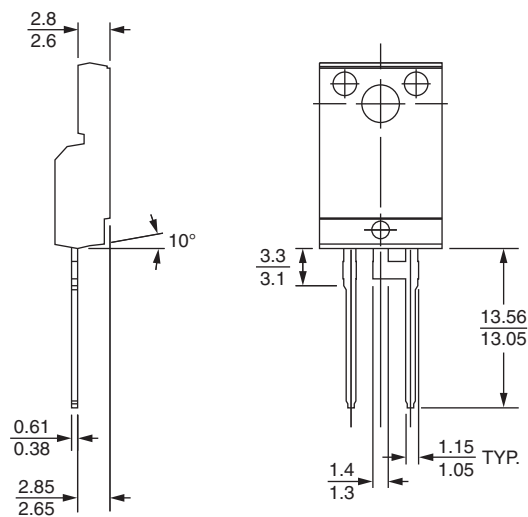
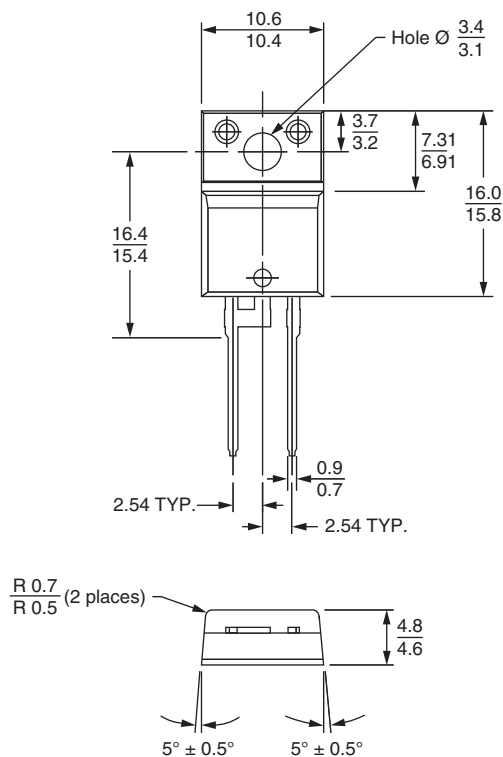
- | | | |
|----------|---|--|
| 1 | - | Vishay Semiconductors product |
| 2 | - | Current rating (15 = 15 A) |
| 3 | - | E = single diode |
| 4 | - | T = TO-220, D ² PAK |
| 5 | - | L = ultralow V _F hyperfast recovery |
| 6 | - | Voltage rating (06 = 600 V) |
| 7 | - | • None = TO-220AC
• FP = TO-220 FULL-PAK |
| 8 | - | Environmental digit:
PbF = lead (Pb)-free and RoHS-compliant
-N3 = halogen-free, RoHS-compliant and totally lead (Pb)-free |

ORDERING INFORMATION (Example)			
PREFERRED P/N	QUANTITY PER T/R	MINIMUM ORDER QUANTITY	PACKAGING DESCRIPTION
VS-15ETL06PbF	50	1000	Antistatic plastic tube
VS-15ETL06-N3	50	1000	Antistatic plastic tube
VS-15ETL06FPPbF	50	1000	Antistatic plastic tube
VS-15ETL06FP-N3	50	1000	Antistatic plastic tube

LINKS TO RELATED DOCUMENTS		
Dimensions	TO-220AC	www.vishay.com/doc?95221
	TO-220FP	www.vishay.com/doc?95005
Part marking information	TO-220ACPbF	www.vishay.com/doc?95224
	TO-220AC-N3	www.vishay.com/doc?95068
	TO-220FPPbF	www.vishay.com/doc?95009
	TO-220FP-N3	www.vishay.com/doc?95440
SPICE model	TO-220AC	www.vishay.com/doc?96051
	TO-220FP	www.vishay.com/doc?96052



DIMENSIONS in millimeters



Lead assignments

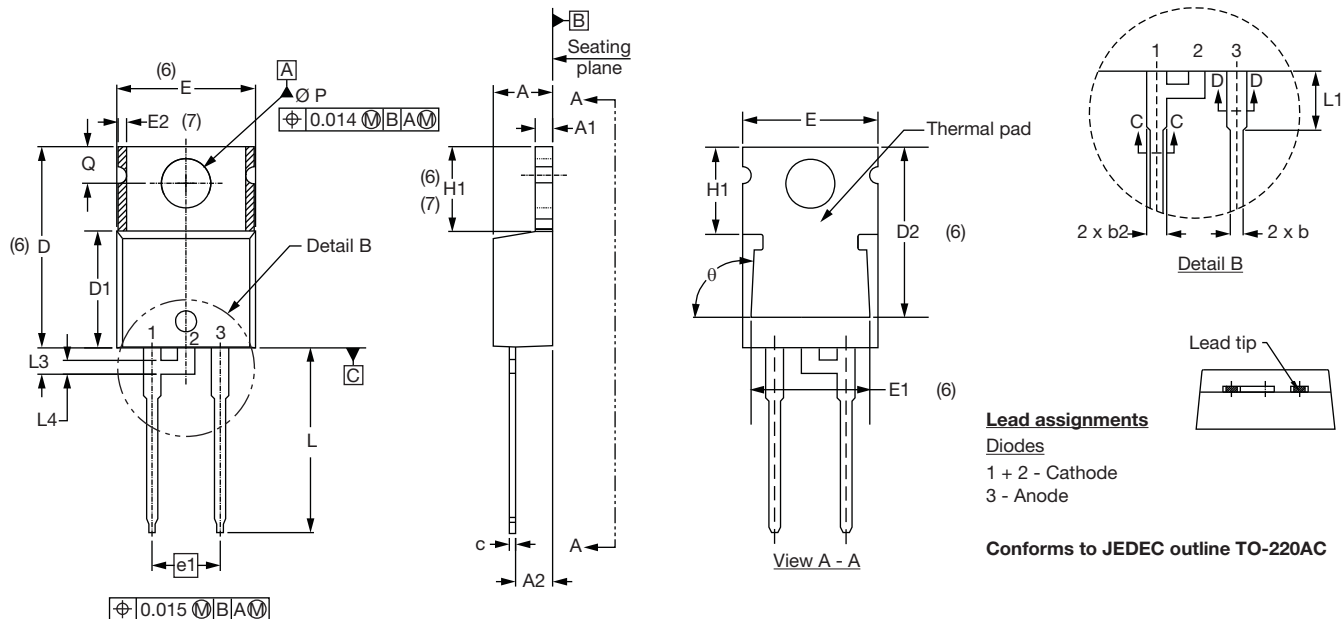
Diodes

1 + 2 - Cathode
3 - Anode

Conforms to JEDEC outline TO-220 FULL-PAK

TO-220AC

DIMENSIONS in millimeters and inches



SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	4.25	4.65	0.167	0.183	
A1	1.14	1.40	0.045	0.055	
A2	2.56	2.92	0.101	0.115	
b	0.69	1.01	0.027	0.040	
b1	0.38	0.97	0.015	0.038	4
b2	1.20	1.73	0.047	0.068	
b3	1.14	1.73	0.045	0.068	4
c	0.36	0.61	0.014	0.024	
c1	0.36	0.56	0.014	0.022	4
D	14.85	15.25	0.585	0.600	3
D1	8.38	9.02	0.330	0.355	
D2	11.68	12.88	0.460	0.507	6
E	10.11	10.51	0.398	0.414	3, 6

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
E1	6.86	8.89	0.270	0.350	6
E2	-	0.76	-	0.030	7
e	2.41	2.67	0.095	0.105	
e1	4.88	5.28	0.192	0.208	
H1	6.09	6.48	0.240	0.255	6, 7
L	13.52	14.02	0.532	0.552	
L1	3.32	3.82	0.131	0.150	2
L3	1.78	2.13	0.070	0.084	
L4	0.76	1.27	0.030	0.050	2
Ø P	3.54	3.73	0.139	0.147	
Q	2.60	3.00	0.102	0.118	
θ	90° to 93°		90° to 93°		

Notes

- (1) Dimensioning and tolerancing as per ASME Y14.5M-1994
- (2) Lead dimension and finish uncontrolled in L1
- (3) Dimension D, D1 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 outermost extremes of the plastic body
- (4) Dimension b1, b3 and c1 apply to base metal only
- (5) Controlling dimension: inches
- (6) Thermal pad contour optional within dimensions E, H1, D2 and E1
- (7) Dimension E2 x H1 define a zone where stamping and singulation irregularities are allowed
- (8) Outline conforms to JEDEC TO-220, D2 (minimum) where dimensions are derived from the actual package outline



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