



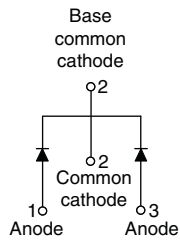
## Hyperfast Rectifier, 2 x 10 A FRED Pt®



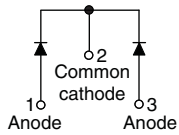
TO-220AB



TO-220 FULL-PAK




VS-20CTH03PbF  
VS-20CTH03-N3



VS-20CTH03FPPbF  
VS-20CTH03FP-N3

### FEATURES

- Hyperfast recovery time
- Low forward voltage drop
- 175 °C operating junction temperature
- Low leakage current
- Fully isolated package ( $V_{INS} = 2500 V_{RMS}$ )
- UL E78996 pending 
- Compliant to RoHS Directive 2002/95/EC
- Designed and qualified according to JEDEC-JESD47
- Halogen-free according to IEC 61249-2-21 definition (-N3 only)



### DESCRIPTION/APPLICATIONS

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.

PRODUCT SUMMARY	
Package	TO-220AB, TO-220FP
$I_{F(AV)}$	2 x 10 A
$V_R$	300 V
$V_F$ at $I_F$	1.25 V
$t_{rr}$ typ.	See Recovery table
$T_J$ max.	175 °C
Diode variation	Common cathode

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Peak repetitive reverse voltage	$V_{RRM}$		300	V
Average rectified forward current	$I_{F(AV)}$	per diode	$T_C = 160\text{ °C}$	A
		(FULL-PAK) per diode	$T_C = 135\text{ °C}$	
		per device		
Non-repetitive peak surge current	$I_{FSM}$	$T_J = 25\text{ °C}$	120	
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	$V_{BR}, V_R$	$I_R = 100\ \mu A$	300	-	-	V
Forward voltage	$V_F$	$I_F = 10\text{ A}$	-	1.05	1.25	
		$I_F = 10\text{ A}, T_J = 125\text{ °C}$	-	0.85	0.95	
Reverse leakage current	$I_R$	$V_R = V_R$ rated	-	-	20	$\mu A$
		$T_J = 125\text{ °C}, V_R = V_R$ rated	-	6	200	
Junction capacitance	$C_T$	$V_R = 300\text{ V}$	-	30	-	pF
Series inductance	$L_S$	Measured lead to lead 5 mm from package body	-	8	-	nH



DYNAMIC RECOVERY CHARACTERISTICS (T <sub>C</sub> = 25 °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> = 1 A, di <sub>F</sub> /dt = 50 A/μs, V <sub>R</sub> = 30 V	-	-	35	ns
		I <sub>F</sub> = 1 A, di <sub>F</sub> /dt = 100 A/μs, V <sub>R</sub> = 30 V	-	-	30	
		T <sub>J</sub> = 25 °C	-	31	-	
		T <sub>J</sub> = 125 °C	-	42	-	
Peak recovery current	I <sub>RRM</sub>	T <sub>J</sub> = 25 °C	-	2.4	-	A
		T <sub>J</sub> = 125 °C	-	5.6	-	
Reverse recovery charge	Q <sub>rr</sub>	T <sub>J</sub> = 25 °C	-	36	-	nC
		T <sub>J</sub> = 125 °C	-	120	-	

THERMAL - MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Maximum junction and storage temperature range	T <sub>J</sub> , T <sub>Stg</sub>		- 65	-	175	°C
Thermal resistance, _____ per diode junction to case (FULL-PAK) per diode	R <sub>thJC</sub>	Mounting surface, flat, smooth and greased	-	-	1.5 3.9	°C/W
Marking device		Case style TO-220AB	20CTH03			
		Case style TO-220 FULL-PAK	20CTH03FP			

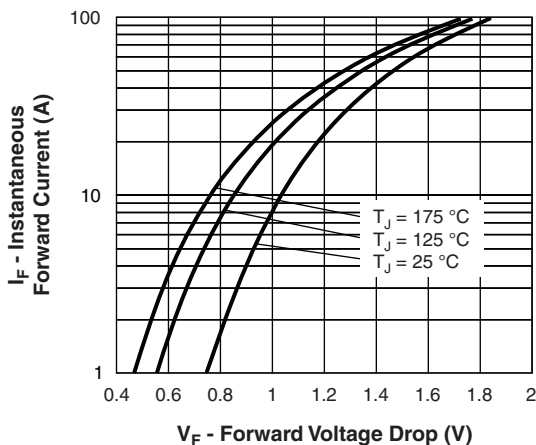


Fig. 1 - Typical Forward Voltage Drop Characteristics

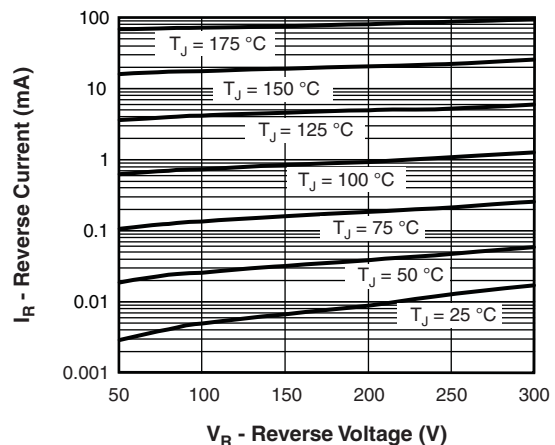


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

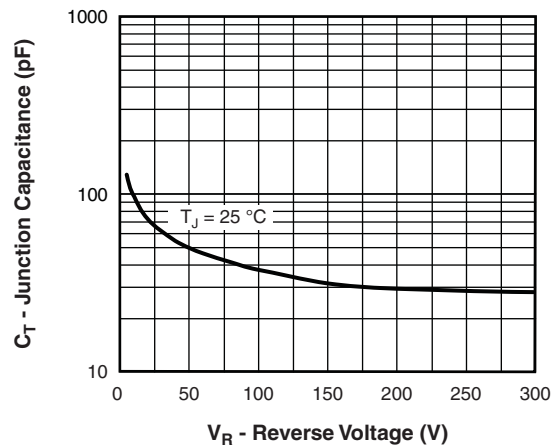


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

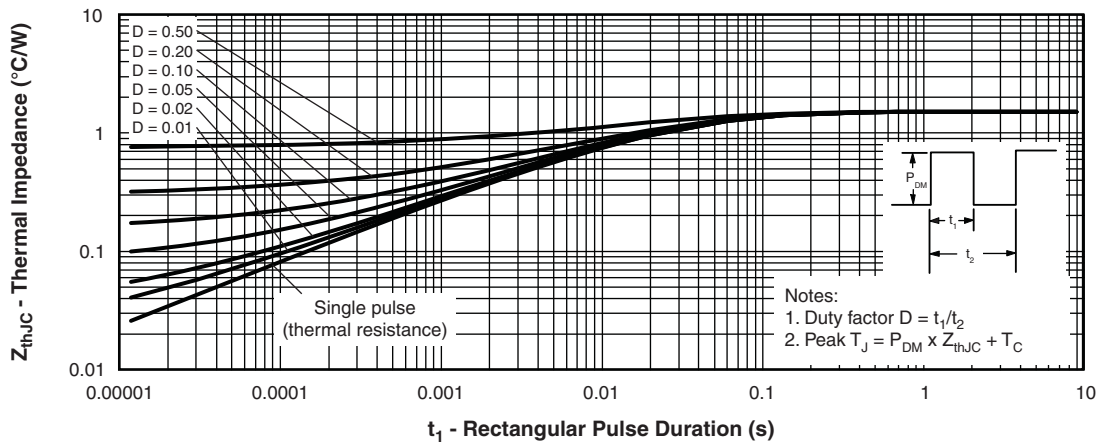


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

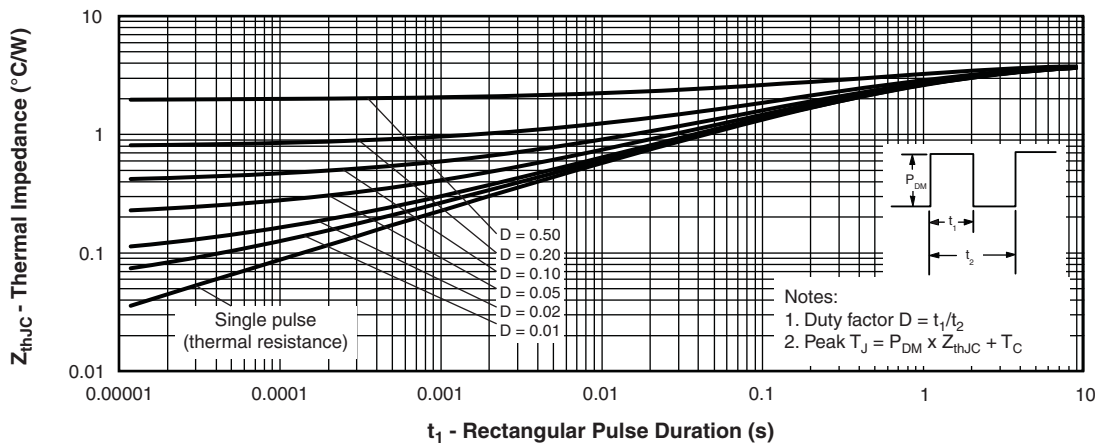


Fig. 5 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (FULL-PAK)

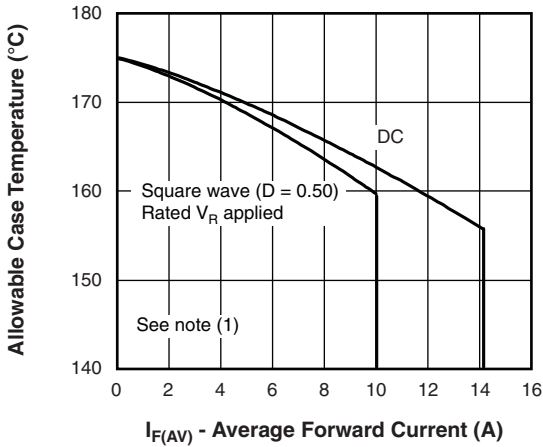


Fig. 6 - Maximum Allowable Case Temperature vs. Average Forward Current

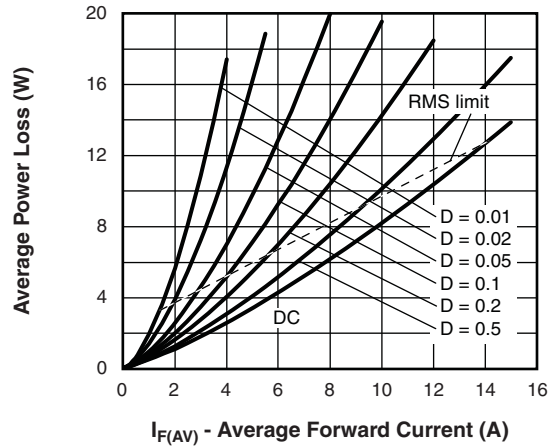


Fig. 8 - Forward Power Loss Characteristics

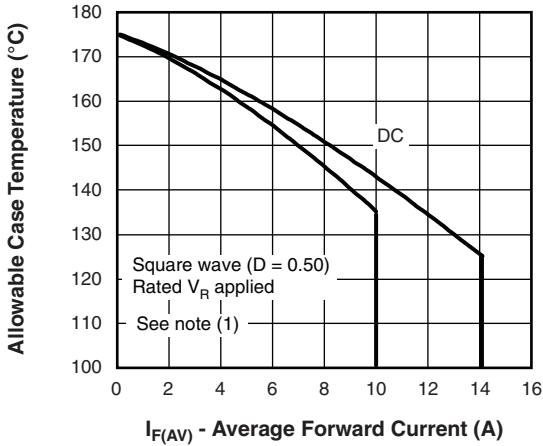


Fig. 7 - Maximum Allowable Case Temperature vs. Average Forward Current (FULL-PAK)

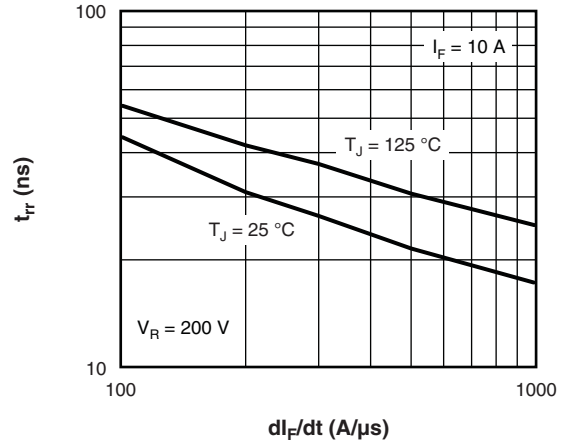


Fig. 9 - Typical Reverse Recovery Time vs.  $di_F/dt$

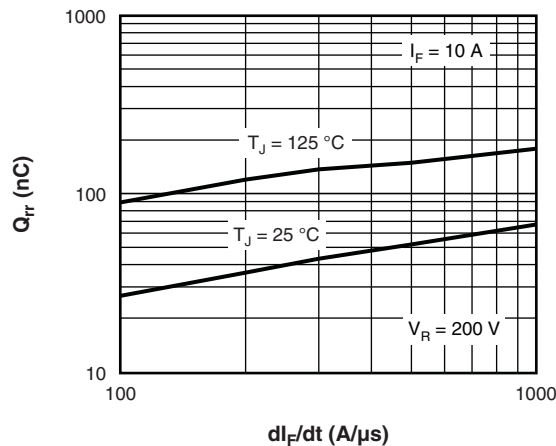


Fig. 10 - Typical Stored Charge vs.  $di_F/dt$

**Note**

- (1) Formula used:  $T_C = T_J - (Pd + Pd_{REV}) \times R_{thJC}$ ;  
 $Pd$  = Forward power loss =  $I_{F(AV)} \times V_{FM}$  at  $(I_{F(AV)}/D)$  (see fig. 8);  
 $Pd_{REV}$  = Inverse power loss =  $V_{R1} \times I_R (1 - D)$ ;  $I_R$  at  $V_{R1}$  = Rated  $V_R$

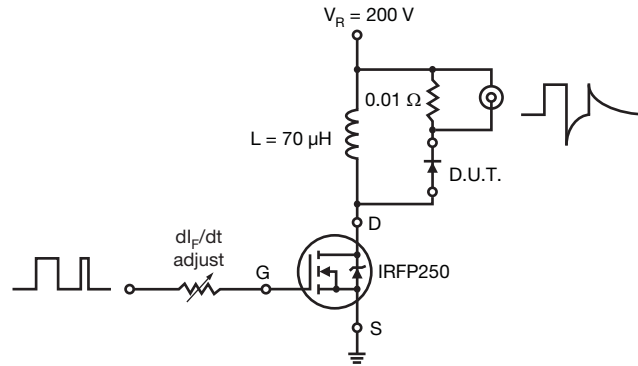
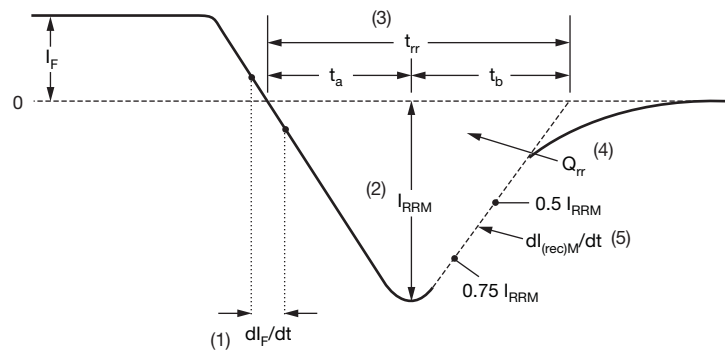


Fig. 11 - Reverse Recovery Parameter Test Circuit



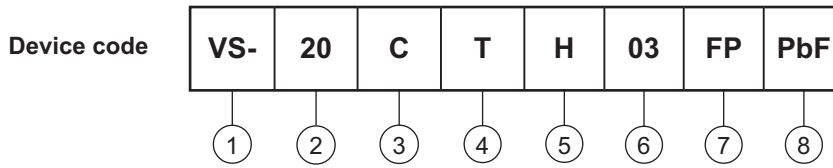
- (1)  $di_F/dt$  - rate of change of current through zero crossing
- (2)  $I_{RRM}$  - peak reverse recovery current
- (3)  $t_{rr}$  - reverse recovery time measured from zero crossing point of negative going  $I_F$  to point where a line passing through  $0.75 I_{RRM}$  and  $0.50 I_{RRM}$  extrapolated to zero current.
- (4)  $Q_{rr}$  - area under curve defined by  $t_{rr}$  and  $I_{RRM}$
- (5)  $di_{(rec)M}/dt$  - peak rate of change of current during  $t_b$  portion of  $t_{rr}$

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

Fig. 12 - Reverse Recovery Waveform and Definitions



ORDERING INFORMATION TABLE



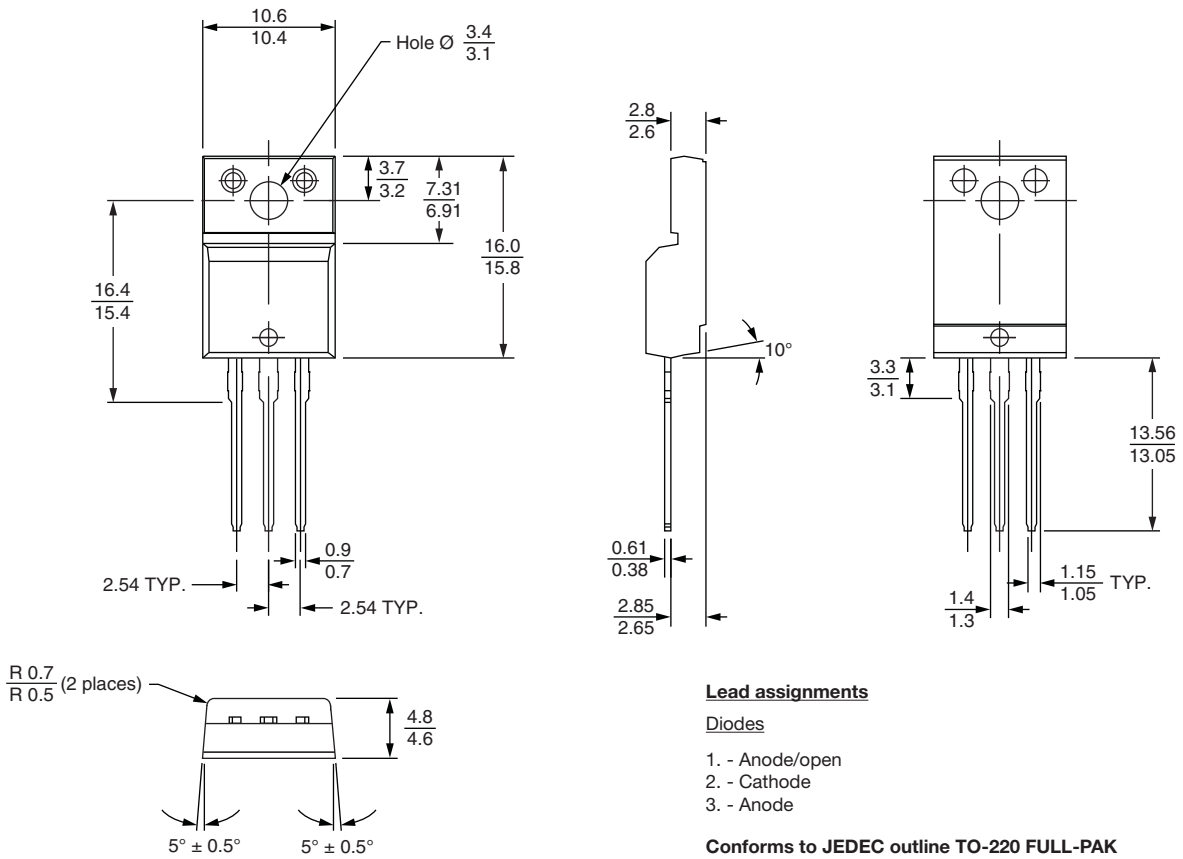
- 1** - Vishay Semiconductors product
- 2** - Current rating (20 = 20 A)
- 3** - C = Common cathode
- 4** - T = TO-220, D<sup>2</sup>PAK
- 5** - H = Hyperfast recovery
- 6** - Voltage rating (03 = 300 V)
- 7** -
  - None = TO-220AB
  - FP = TO-220 FULL-PAK
- 8** - Environmental digit:
  - PbF = Lead (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-20CTH03PbF	50	1000	Antistatic plastic tube
VS-20CTH03-N3	50	1000	Antistatic plastic tube
VS-20CTH03FPPbF	50	1000	Antistatic plastic tube
VS-20CTH03FP-N3	50	1000	Antistatic plastic tube

LINKS TO RELATED DOCUMENTS		
Dimensions	TO-220AB	<a href="http://www.vishay.com/doc?95222">www.vishay.com/doc?95222</a>
	TO-220FP	<a href="http://www.vishay.com/doc?95072">www.vishay.com/doc?95072</a>
Part marking information	TO-220ABPbF	<a href="http://www.vishay.com/doc?95225">www.vishay.com/doc?95225</a>
	TO-220AB-N3	<a href="http://www.vishay.com/doc?95028">www.vishay.com/doc?95028</a>
	TO-220FPPbF	<a href="http://www.vishay.com/doc?95069">www.vishay.com/doc?95069</a>
	TO-220FP-N3	<a href="http://www.vishay.com/doc?95456">www.vishay.com/doc?95456</a>



**DIMENSIONS** in millimeters



### Lead assignments

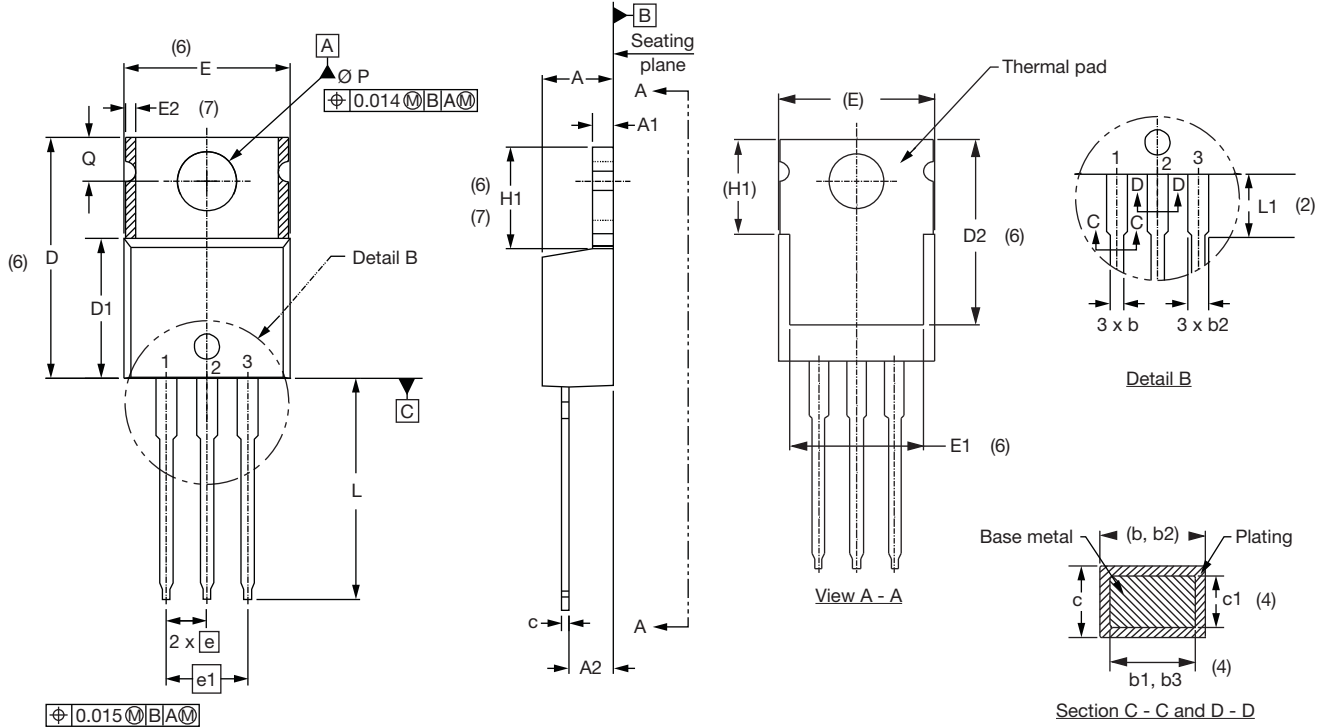
#### Diodes

- 1. - Anode/open
- 2. - Cathode
- 3. - Anode

Conforms to JEDEC outline TO-220 FULL-PAK

## TO-220AB

**DIMENSIONS** in millimeters and inches



**Lead assignments**

Diodes

1. - Anode/open
2. - Cathode
3. - Anode

Conforms to JEDEC outline TO-220AB

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
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
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 dimensions: inches
- (6) Thermal pad contour optional within dimensions E, H1, D2 and E1
- (7) Dimensions E2 x H1 define a zone where stamping and singulation irregularities are allowed
- (8) Outline conforms to JEDEC TO-220, except A2 (maximum) and D2 (minimum) where dimensions are derived from the actual package outline





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