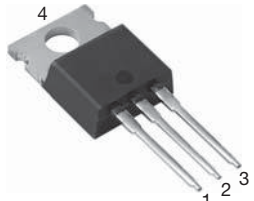
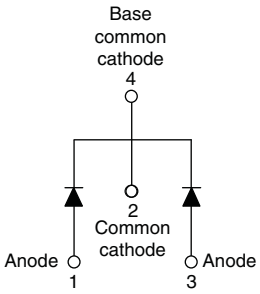
Ultrafast Rectifier, 16 A FRED Pt®



TO-220AB



FEATURES

- Ultrafast recovery time
- Low forward voltage drop
- 175 °C operating junction temperature
- Low leakage current
- AEC-Q101 qualified, meets JESD 201 class 2 whisker test
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e3

RoHS COMPLIANT

HALOGEN FREE

PRIMARY CHARACTERISTICS	
$I_{F(AV)}$	2 x 8 A
V_R	400 V
V_F at I_F	0.94 V
t_{rr} (typ.)	24 ns
T_J max.	175 °C
Package	TO-220AB
Circuit configuration	Common cathode

DESCRIPTION / APPLICATIONS

FRED Pt® series are the state of the art ultrafast recovery rectifiers specifically designed with optimized performance of forward voltage drop and ultrafast 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.

ABSOLUTE MAXIMUM RATINGS					
PARAMETER		SYMBOL	TEST CONDITIONS	VALUES	UNITS
Peak repetitive reverse voltage		V_{RRM}		400	V
Average rectified forward current	per leg	$I_{F(AV)}$		8	A
	total device		T_C = 155 °C, rated V_R	16	
Non-repetitive peak surge current		I_{FSM}	T_C = 25 °C	100	
Peak repetitive forward current		I_{FRM}	T_C = 155 °C, rated V_R, square wave, 20 kHz	16	
Operating junction and storage temperatures		T_J, T_{Stg}		-65 to +175	°C

ELECTRICAL SPECIFICATIONS PER LEG (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	400	-	-	V
Forward voltage	V_F	I_F = 8 A	-	1.19	1.3	
		I_F = 8 A, T_J = 150 °C	-	0.94	1.0	
Reverse leakage current	I_R	V_R = V_R rated	-	0.2	10	µA
		T_J = 150 °C, V_R = V_R rated	-	20	500	
Junction capacitance	C_T	V_R = 400 V	-	14	-	pF
Series inductance	L_S	Measured lead to lead 5 mm from package body	-	8.0	-	nH

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DYNAMIC RECOVERY CHARACTERISTICS PER LEG (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/µA, V_R = 30 V		-	35	-	ns
		I_F = 1.0 A, dI_F/dt = 100 A/µA, V_R = 30 V		-	24	-	
		T_J = 25 °C	I_F = 8 A dI_F/dt = 200 A/µs V_R = 200 V	-	43	-	
		T_J = 125 °C		-	67	-	
Peak recovery current	I_{RRM}	T_J = 25 °C		-	2.8	-	A
		T_J = 125 °C		-	6.3	-	
Reverse recovery charge	Q_{rr}	T_J = 25 °C		-	60	-	nC
		T_J = 125 °C		-	210	-	

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}		-	3.6	4	°C/W
	per device			-	1.8	2	
Thermal resistance, junction to ambient		R_{thJA}	Typical socket mount	-	-	50	
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-220AB	16CTU04H			

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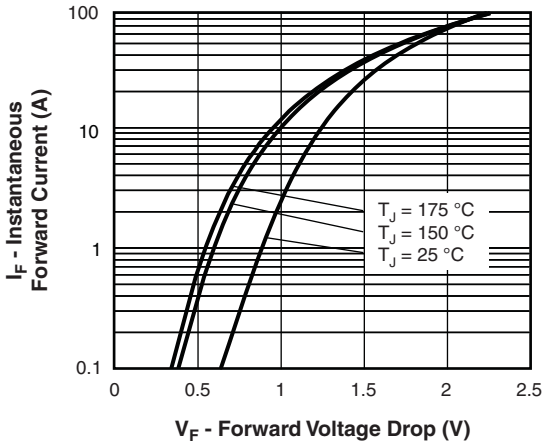

Fig. 1 - Typical Forward Voltage Drop Characteristics

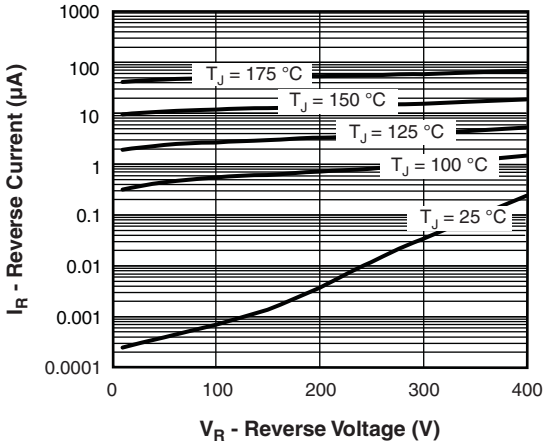

Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

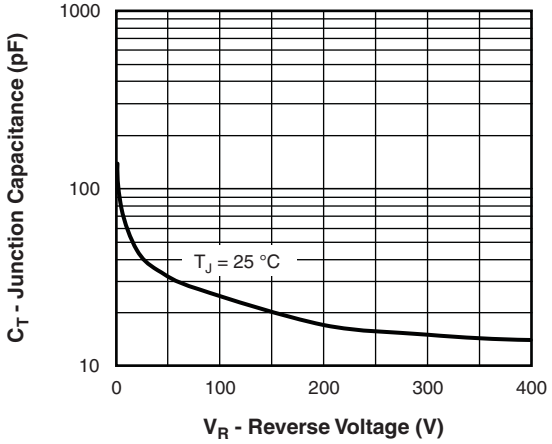

Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

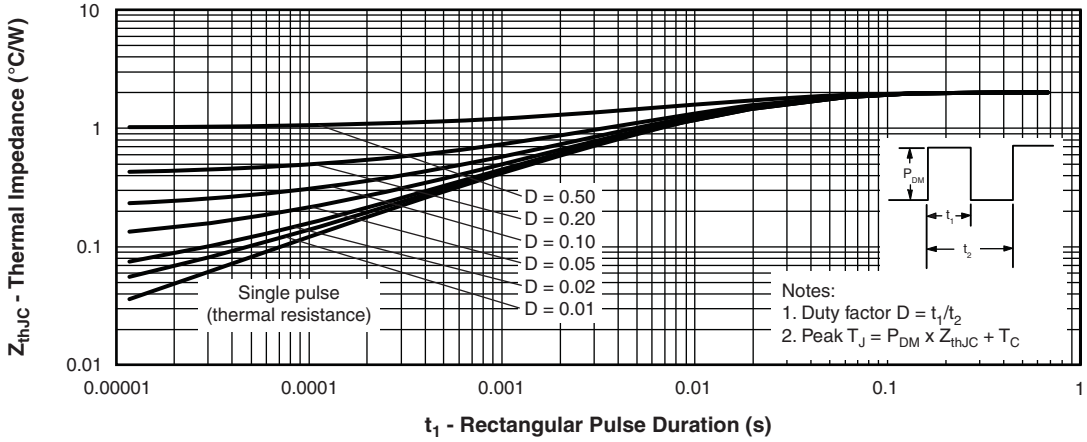

Fig. 4 - Maximum Thermal Impedance Z_{thJC} Characteristics

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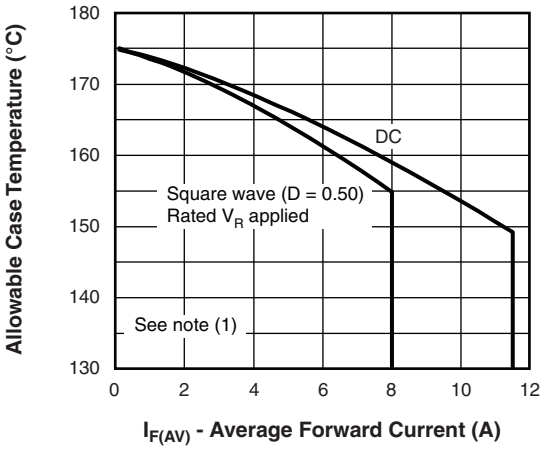

Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

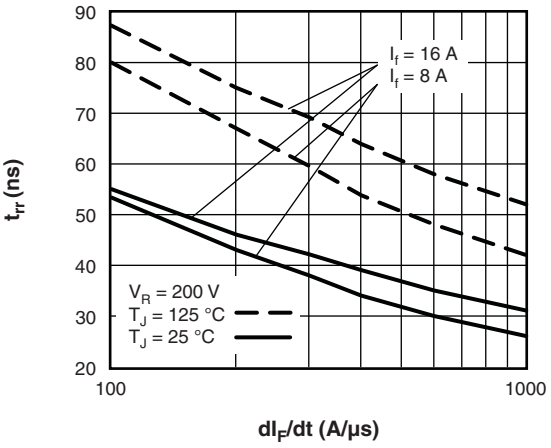

Fig. 7 - Typical Reverse Recovery Time vs. dI_F/dt

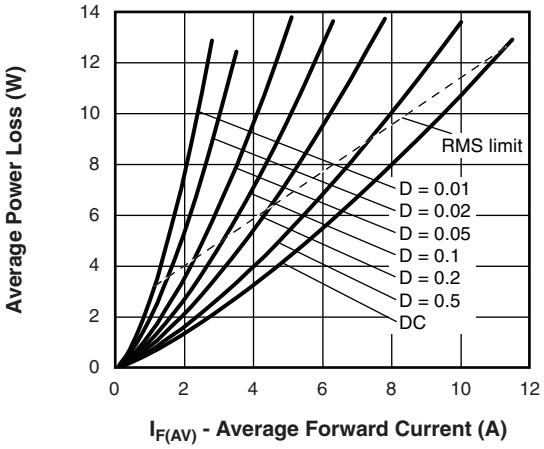

Fig. 6 - Forward Power Loss Characteristics

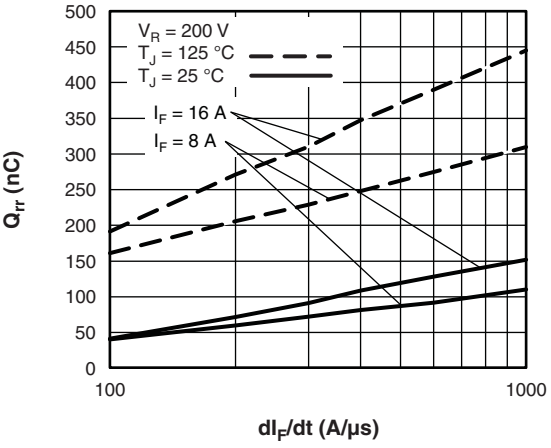

Fig. 8 - Typical Stored Charge vs. dI_F/dt

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

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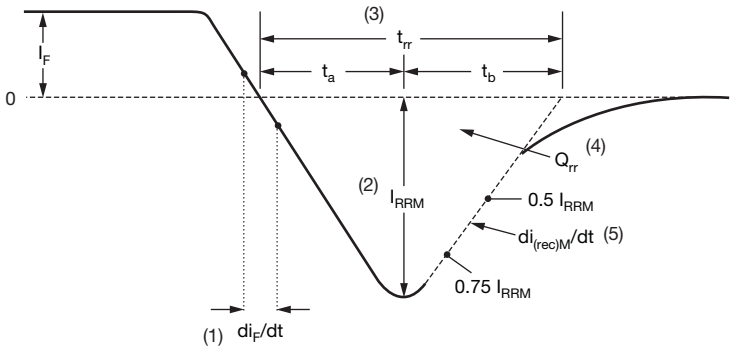

(1) di_F/dt - rate of change of current through zero crossing

(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. 1 - Reverse Recovery Waveform and Definitions

ORDERING INFORMATION TABLE

Device code

VS-	16	C	T	U	04	H	N3
1	2	3	4	5	6	7	8

1 - Vishay Semiconductors product

2 - Current rating (16 = 16 A)

3 - Circuit configuration:
C = Common cathode

4 - Package:
T = TO-220

5 - Ultrafast recovery

6 - Voltage rating (04 = 400 V)

7 - H = AEC-Q101 qualified

8 - Environmental digit:
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-16CTU04HN3	50	1000	Antistatic plastic tube

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95222
Part marking information	www.vishay.com/doc?95028
SPICE model	www.vishay.com/doc?96565

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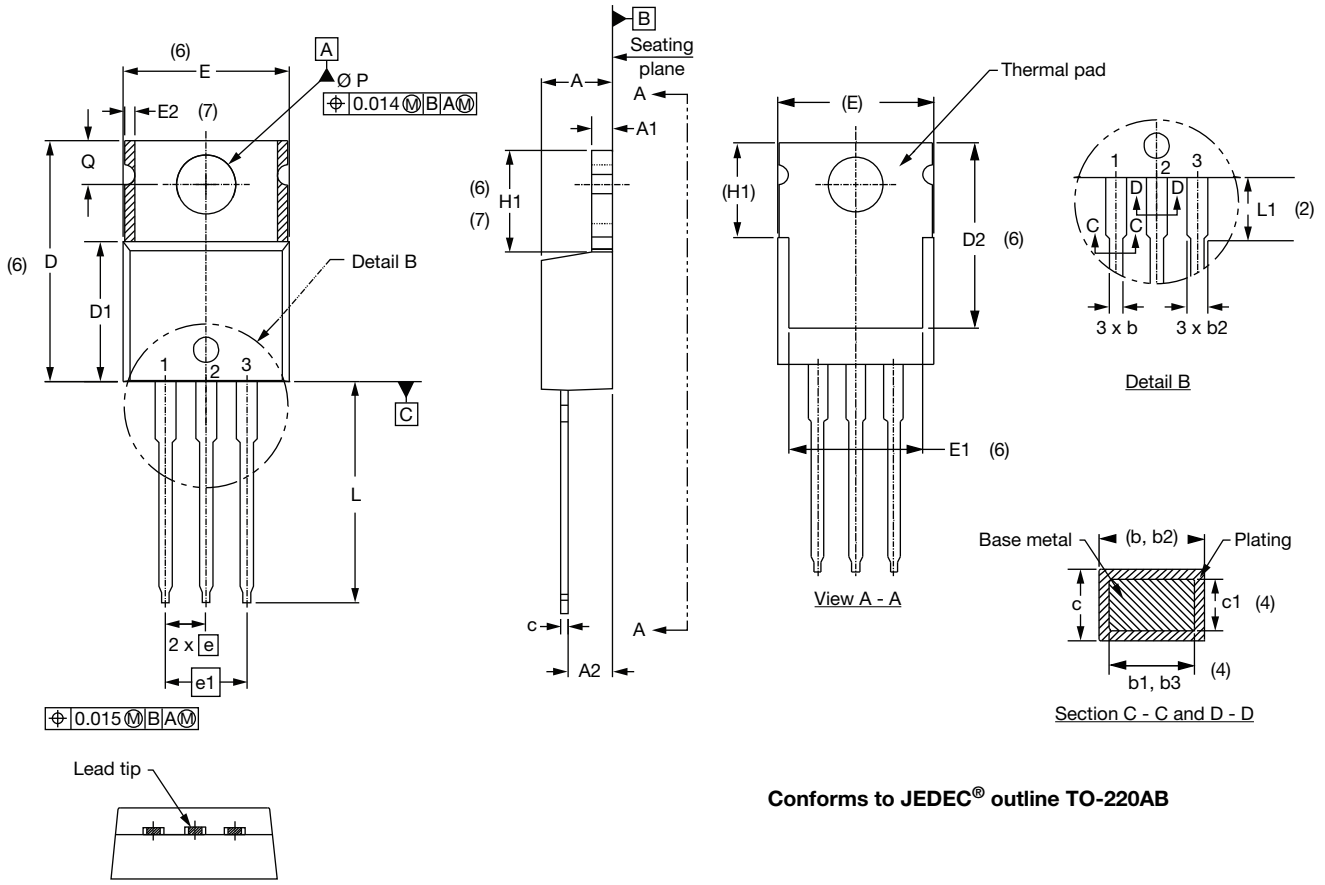
TO-220AB

DIMENSIONS in millimeters and inches



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	

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
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	5.84	6.86	0.230	0.270	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	

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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