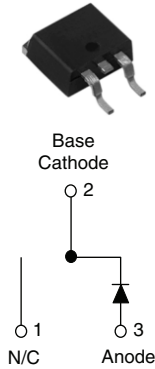


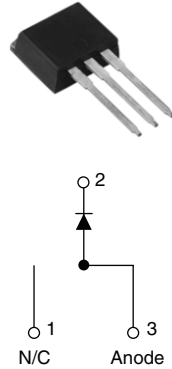
## Hyperfast Rectifier, 15 A FRED Pt<sup>®</sup>

VS-15ETX06SPbF



D<sup>2</sup>PAK

VS-15ETX06-1PbF



TO-262

### FEATURES

- Benchmark ultralow forward voltage drop
- Hyperfast recovery time
- Low leakage current
- 175 °C operating junction temperature
- Meets MSL level 1, per J-STD-020, LF maximum peak of 260 °C
- Halogen-free according to IEC 61249-2-21 definition
- Compliant to RoHS directive 2002/95/EC
- AEC-Q101 qualified



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### DESCRIPTION/APPLICATIONS

State of the art hyperfast recovery rectifiers designed with optimized performance of forward voltage drop, hyperfast recovery time, and soft recovery.

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 PFC boost stage in the ac-to-dc section of SMPS, inverters or as freewheeling diodes.

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

$t_{rr}$	18 ns
$I_{F(AV)}$	15 A
$V_R$	600 V

### ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Peak repetitive reverse voltage	$V_{RRM}$		600	V
Average rectified forward current	$I_{F(AV)}$	$T_C = 133\text{ °C}$	15	A
Non-repetitive peak surge current	$I_{FSM}$	$T_J = 25\text{ °C}$	170	
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	$V_{BR}, V_R$	$I_R = 100\ \mu\text{A}$	600	-	-	V
Forward voltage	$V_F$	$I_F = 15\text{ A}$ $I_F = 15\text{ A}, T_J = 150\text{ °C}$	-	2.3 1.5	3.2 1.8	
Reverse leakage current	$I_R$	$V_R = V_R\text{ rated}$ $T_J = 150\text{ °C}, V_R = V_R\text{ rated}$	-	0.1 40	50 300	$\mu\text{A}$
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

# VS-15ETX06SPbF, VS-15ETX06-1PbF



Vishay High Power Products

Hyperfast Rectifier,  
15 A FRED Pt®

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 = 100 A/μs, V <sub>R</sub> = 30 V	-	18	22	ns	
		I <sub>F</sub> = 15 A, di <sub>F</sub> /dt = 100 A/μs, V <sub>R</sub> = 30 V	-	20	32		
		T <sub>J</sub> = 25 °C	-	22	-		
		T <sub>J</sub> = 125 °C	-	52	-		
Peak recovery current	I <sub>RRM</sub>	T <sub>J</sub> = 25 °C	-	2.4	-	A	
		T <sub>J</sub> = 125 °C	-	5.1	-		
Reverse recovery charge	Q <sub>rr</sub>	T <sub>J</sub> = 25 °C	-	25	-	nC	
		T <sub>J</sub> = 125 °C	-	150	-		
Reverse recovery time	t <sub>rr</sub>	T <sub>J</sub> = 125 °C	I <sub>F</sub> = 15 A di <sub>F</sub> /dt = 800 A/μs V <sub>R</sub> = 390 V	-	37	-	ns
Peak recovery current	I <sub>RRM</sub>			-	16	-	A
Reverse recovery charge	Q <sub>rr</sub>			-	350	-	nC

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, junction to case per leg	R <sub>thJC</sub>		-	1.0	1.3	°C/W
Thermal resistance, junction to ambient per leg	R <sub>thJA</sub>	Typical socket mount	-	-	70	
Thermal resistance, case to heatsink	R <sub>thCS</sub>	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 D <sup>2</sup> PAK	15ETX06S			
		Case style TO-262	15ETX06-1			



# VS-15ETX06SPbF, VS-15ETX06-1PbF

Hyperfast Rectifier,  
15 A FRED Pt®

Vishay High Power Products

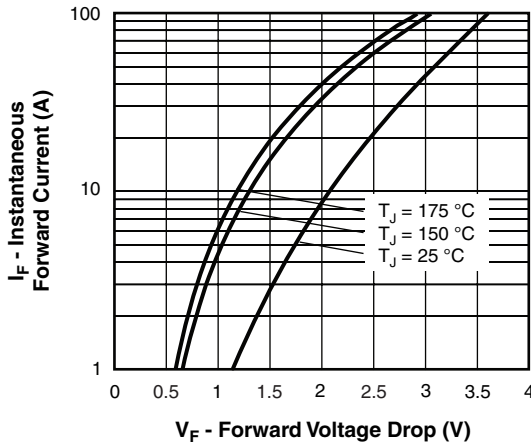


Fig. 1 - Typical Forward Voltage Drop Characteristics

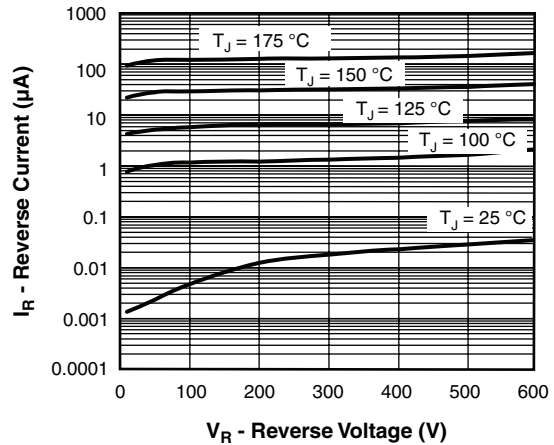


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

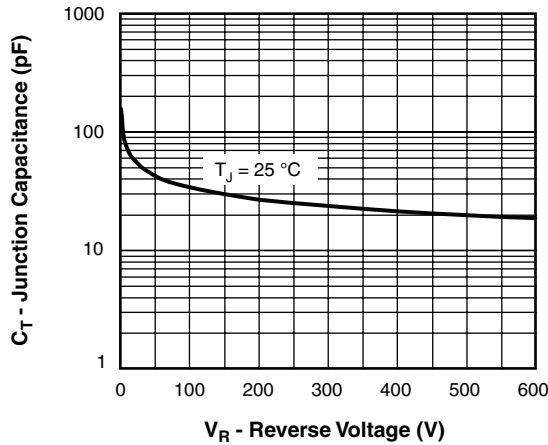


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

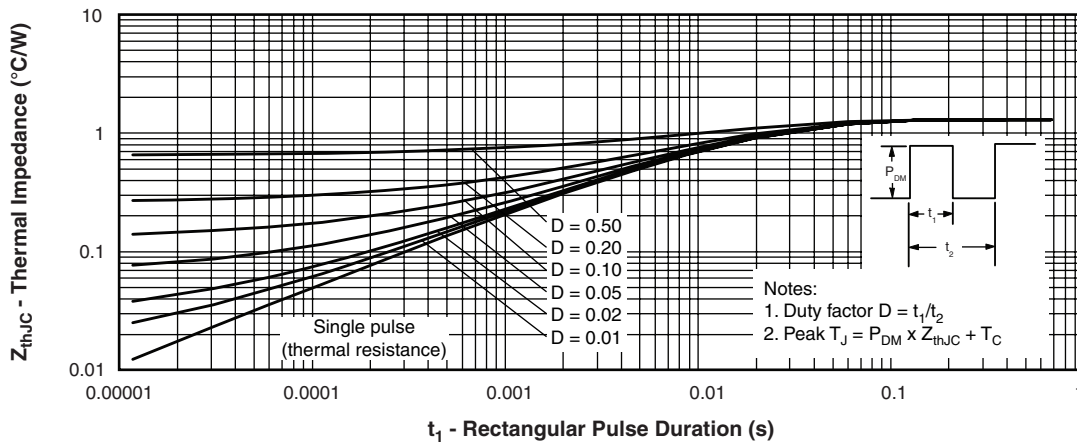


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

# VS-15ETX06SPbF, VS-15ETX06-1PbF



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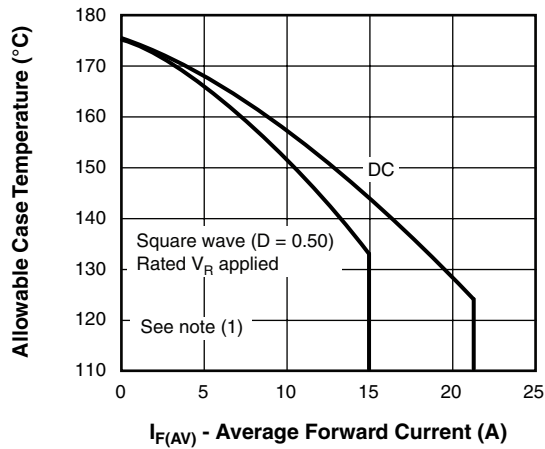


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

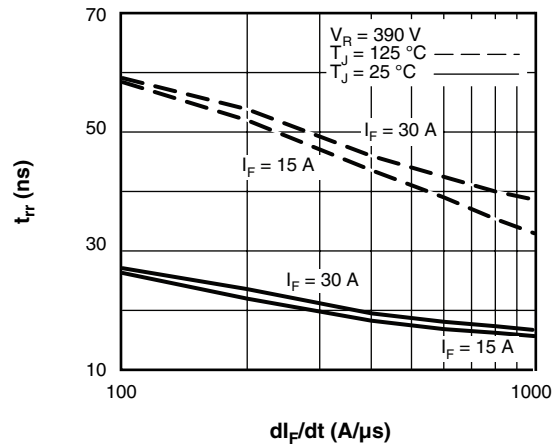


Fig. 7 - Typical Reverse Recovery Time vs.  $di_F/dt$

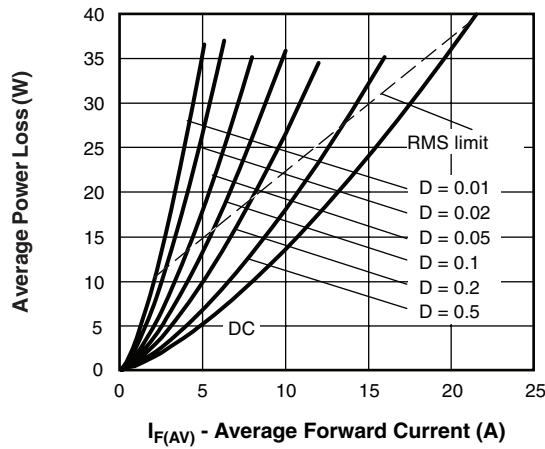


Fig. 6 - Forward Power Loss Characteristics

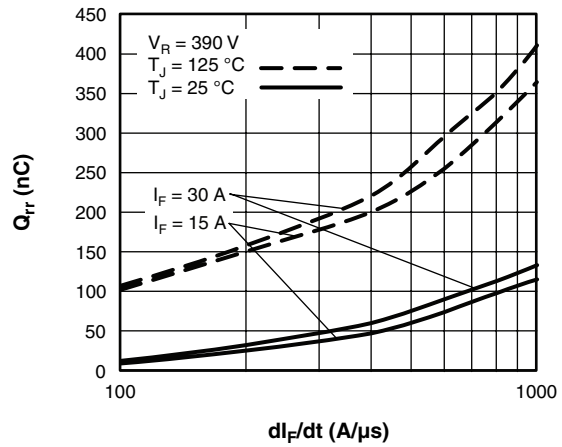


Fig. 8 - Typical Stored Charge vs.  $di_F/dt$

**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  $V_R$

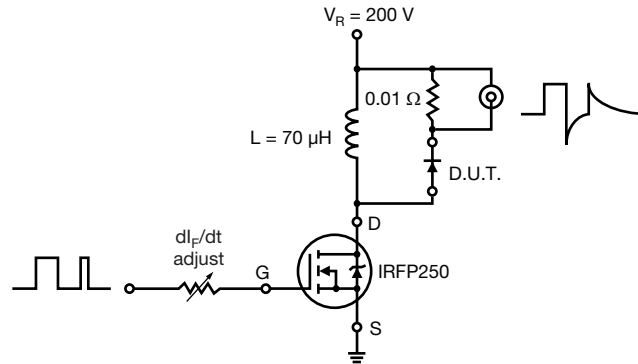
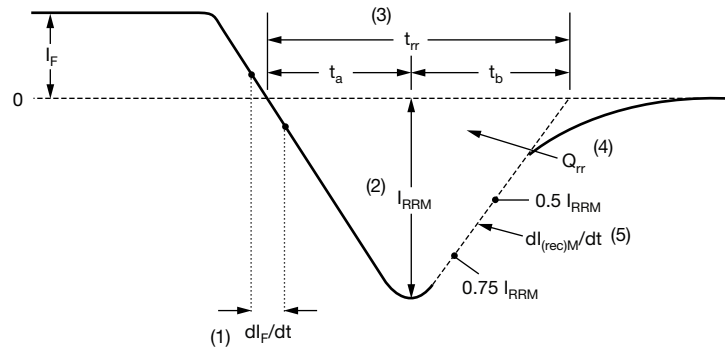


Fig. 9 - Reverse Recovery Parameter Test Circuit



(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

# VS-15ETX06SPbF, VS-15ETX06-1PbF



Vishay High Power Products

Hyperfast Rectifier,  
15 A FRED Pt®

## ORDERING INFORMATION TABLE

Device code	VS-	15	E	T	X	06	S	TRL	PbF
	①	②	③	④	⑤	⑥	⑦	⑧	⑨

- 1** - HPP product suffix
- 2** - Current rating (15 A)
- 3** - E = Single diode
- 4** - T = TO-220, D<sup>2</sup>PAK
- 5** - X = Hyperfast recovery
- 6** - Voltage rating (06 = 600 V)
- 7** -
  - S = D<sup>2</sup>PAK
  - -1 = TO-262
- 8** -
  - None = Tube (50 pieces)
  - TRL = Tape and reel (left oriented, for D<sup>2</sup>PAK package)
  - TRR = Tape and reel (right oriented, for D<sup>2</sup>PAK package)
- 9** - PbF = Lead (Pb)-free

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95014">www.vishay.com/doc?95014</a>
Part marking information	<a href="http://www.vishay.com/doc?95008">www.vishay.com/doc?95008</a>
Packaging information	<a href="http://www.vishay.com/doc?95032">www.vishay.com/doc?95032</a>

## D<sup>2</sup>PAK, TO-262

### DIMENSIONS FOR D<sup>2</sup>PAK in millimeters and inches

Conforms to JEDEC outline D<sup>2</sup>PAK (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

## DIMENSIONS FOR TO-262 in millimeters and inches



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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