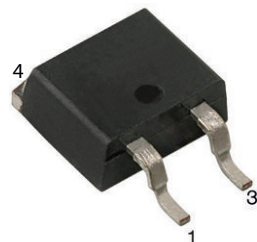
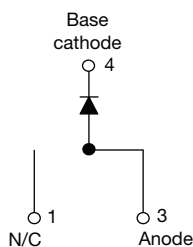


# Hyperfast Rectifier, 20 A FRED Pt® G5


**D<sup>2</sup>PAK 2L (TO-263AB 2L)**


## FEATURES

- Hyperfast and optimized  $Q_{rr}$
- Best in class forward voltage drop and switching losses trade off
- Optimized for high speed operation
- 175 °C maximum operating junction temperature
- Polyimide passivation
- Meets MSL level 1, per J-STD-020, LF maximum peak of 245 °C
- Designed and qualified according to JEDEC®-JESD 47
- Material categorization: for definitions of compliance please see [www.vishay.com/doc299912](http://www.vishay.com/doc299912)


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

## LINKS TO ADDITIONAL RESOURCES



3D Models


Application  
Notes

## PRIMARY CHARACTERISTICS

$I_{F(AV)}$	20 A
$V_R$	1200 V
$V_F$ at $I_F$ at 125 °C	1.88 V
$t_{rr}$	37 ns
$T_J$ max.	175 °C
Package	D <sup>2</sup> PAK 2L (TO-263AB 2L)
Circuit configuration	Single

## DESCRIPTION / APPLICATIONS

Featuring a unique combination of low conduction and switching losses, this rectifier is the right choice for high frequency converters, both soft switched / resonant. Specifically designed to improve efficiency of PFC and output rectification stages of EV / HEV battery charging stations, booster stage of solar inverters and UPS applications, these devices are perfectly matched to operate with MOSFETs or high speed IGBTs.

## MECHANICAL DATA

**Case:** D<sup>2</sup>PAK 2L (TO-263AB 2L)

Molding compound meets UL 94 V-0 flammability rating

**Terminals:** matte tin plated leads, solderable per J-STD-002

## ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Repetitive peak reverse voltage	$V_{RRM}$		1200	V
Average rectified forward current	$I_{F(AV)}$	$T_C = 103\text{ °C}$	20	A
Repetitive peak forward current	$I_{FRM}$	$T_C = 103\text{ °C}$ , $D = 0.50$ , $f = 20\text{ kHz}$	32	
Non-repetitive peak surge current	$I_{FSM}$	$T_C = 45\text{ °C}$ , $t_p = 10\text{ ms}$ , sine wave	125	
Operating junction and storage temperature	$T_J, T_{Stg}$		-55 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	$V_{BR}, V_R$	$I_R = 100\text{ }\mu\text{A}$	1200	-	-	V
Forward voltage	$V_F$	$I_F = 20\text{ A}$	-	2.04	2.66	
		$I_F = 20\text{ A}$ , $T_J = 125\text{ °C}$	-	1.88	-	
Reverse leakage current	$I_R$	$V_R = V_R$ rated	-	-	50	$\mu\text{A}$
		$T_J = 125\text{ °C}$ , $V_R = V_R$ rated	-	-	500	
Junction capacitance	$C_T$	$V_R = 200\text{ V}$	-	10	-	pF
Series inductance	$L_S$	Measured to lead 5 mm from package body	-	8	-	nH

<b>DYNAMIC RECOVERY CHARACTERISTICS</b> ( $T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Reverse recovery time	$t_{rr}$	$I_F = 1.0\text{ A}$ , $dI_F/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$	-	37	-	ns
		$T_J = 25\text{ }^{\circ}\text{C}$	-	125	-	
		$T_J = 125\text{ }^{\circ}\text{C}$	-	188	-	
Peak recovery current	$I_{RRM}$	$T_J = 25\text{ }^{\circ}\text{C}$	-	14	-	A
		$T_J = 125\text{ }^{\circ}\text{C}$	-	19	-	
Reverse recovery charge	$Q_{rr}$	$T_J = 25\text{ }^{\circ}\text{C}$	-	670	-	nC
		$T_J = 125\text{ }^{\circ}\text{C}$	-	1450	-	
Reverse recovery time	$t_{rr}$	$T_J = 25\text{ }^{\circ}\text{C}$	-	90	-	ns
		$T_J = 125\text{ }^{\circ}\text{C}$	-	107	-	
Peak recovery current	$I_{RRM}$	$T_J = 25\text{ }^{\circ}\text{C}$	-	28	-	A
		$T_J = 125\text{ }^{\circ}\text{C}$	-	48	-	
Reverse recovery charge	$Q_{rr}$	$T_J = 25\text{ }^{\circ}\text{C}$	-	1450	-	nC
		$T_J = 125\text{ }^{\circ}\text{C}$	-	2930	-	

<b>THERMAL - MECHANICAL SPECIFICATIONS</b>						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Thermal resistance, junction-to-case	$R_{thJC}$		-	-	1.7	$^{\circ}\text{C}/\text{W}$
Weight			-	2.0	-	g
Maximum junction and storage temperature range	$T_J, T_{Stg}$		-55	-	175	$^{\circ}\text{C}$
Marking device		Case style D <sup>2</sup> PAK 2L (TO-263AB 2L)	E5TH2112S			

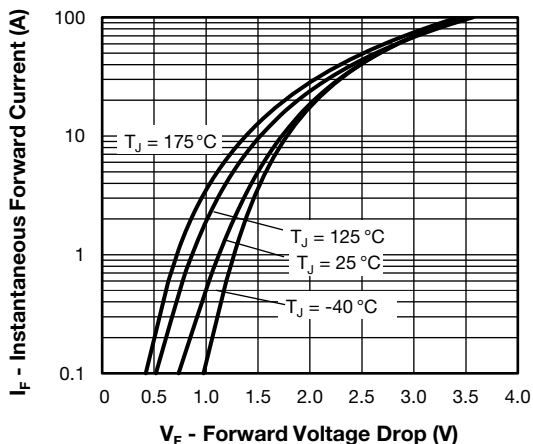


Fig. 1 - Forward Voltage Drop Characteristics

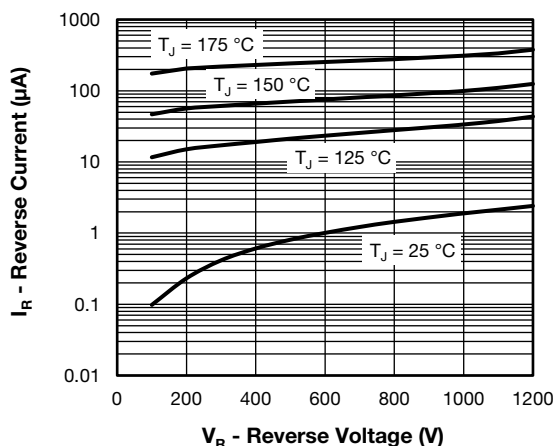


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

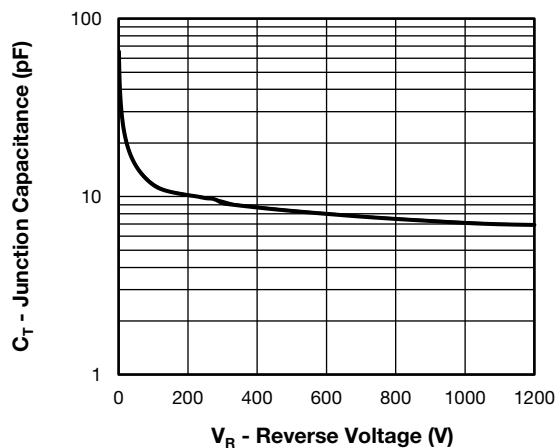


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

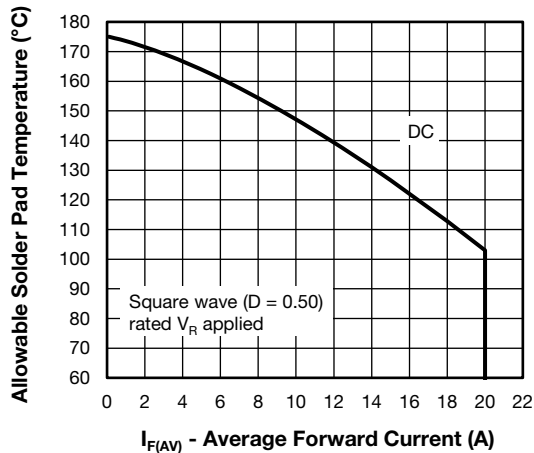


Fig. 4 - Maximum Allowable Case Temperature vs. Average Forward Current

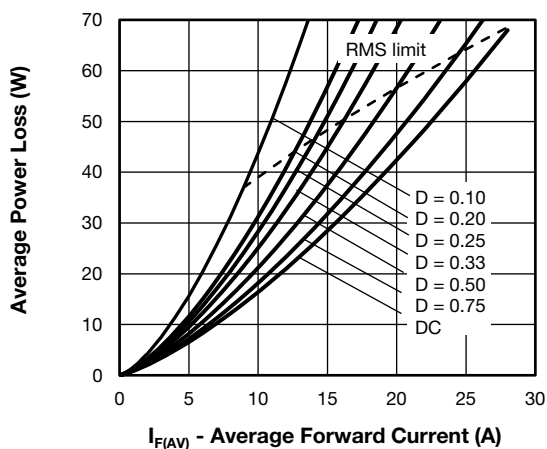


Fig. 5 - Forward Power Loss Characteristics

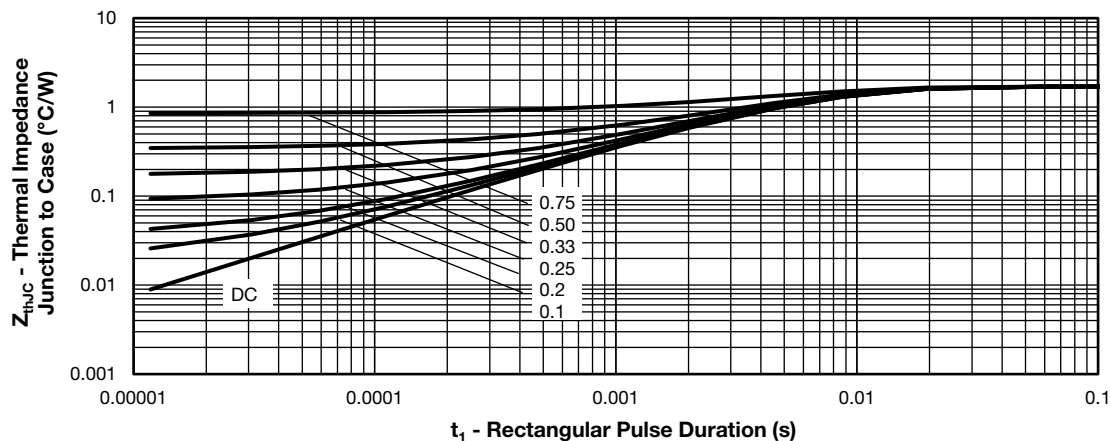
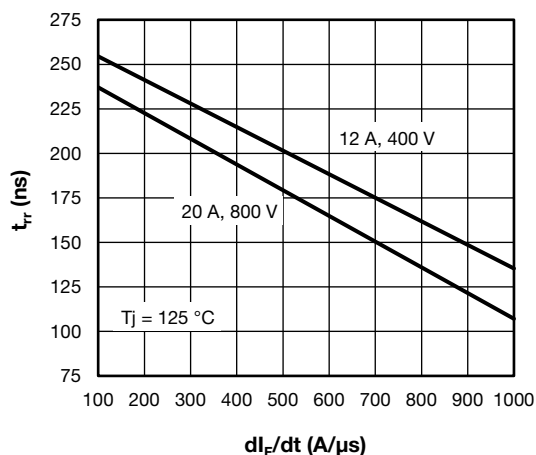
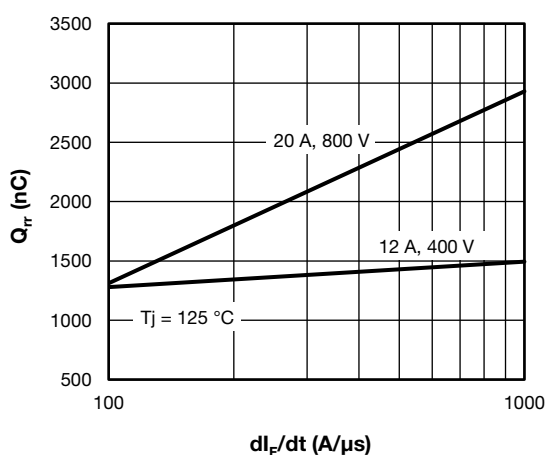
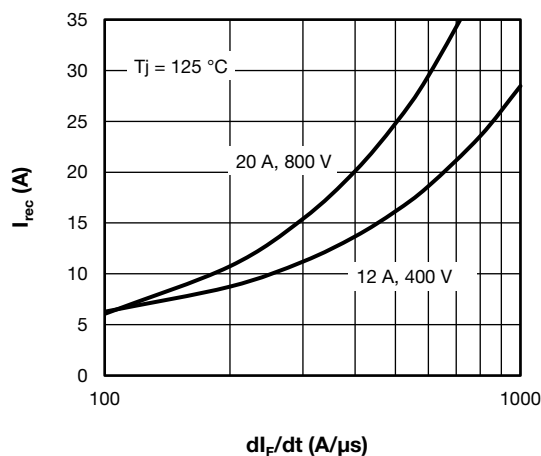


Fig. 6 - Transient Thermal Impedance, Junction to Case


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

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

Fig. 9 - Typical Stored Charge vs.  $di_F/dt$

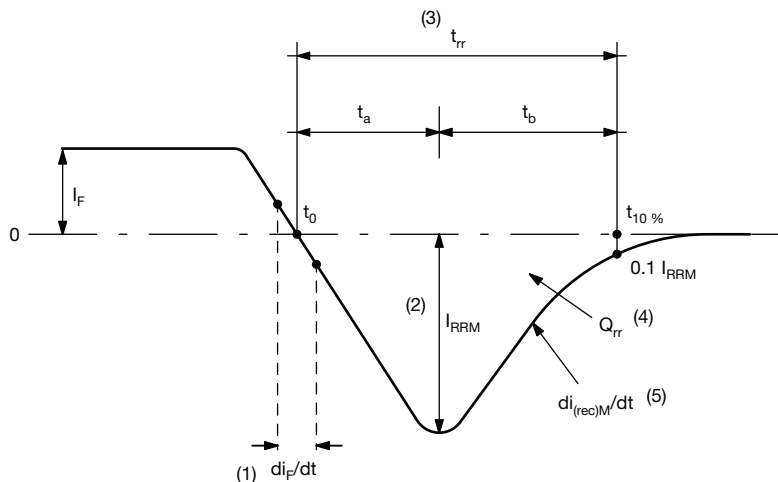


Fig. 10 - Reverse Recovery Waveform and Definitions

#### Notes

- (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  $t_0$ , crossing point of negative going  $I_F$ , to point  $t_{10\%}$ ,  $0.1 I_{RRM}$
- (4)  $Q_{rr}$  - area under curve defined by  $t_0$  and  $t_{10\%}$

$$Q_{rr} = \int_{t_0}^{t_{10\%}} I(t) dt$$

- (5)  $di_{(rec)M}/dt$  - peak rate of change of current during  $t_b$  portion of  $t_{rr}$

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>E</b>	<b>5</b>	<b>T</b>	<b>H</b>	<b>21</b>	<b>12</b>	<b>S2</b>	<b>L</b>	<b>-M3</b>
	1	2	3	4	5	6	7	8	9	10
<b>1</b>	- Vishay Semiconductors product									
<b>2</b>	- E = single diode									
<b>3</b>	- 5 = FRED generation 5									
<b>4</b>	- Package: T = TO-263 / D <sup>2</sup> PAK package									
<b>5</b>	- H = hyperfast recovery									
<b>6</b>	- Current rating (21 = 20 A)									
<b>7</b>	- Voltage rating (12 = 1200 V)									
<b>8</b>	- S2 = true 2 pin D <sup>2</sup> PAK									
<b>9</b>	- None = tube (50 pieces) • L = tape and reel (left oriented, for D <sup>2</sup> PAK package) If needed different orientation/packaging, please contact factory									
<b>10</b>	- Environmental digit: -M3 = halogen-free, RoHS-compliant, and termination lead (Pb)-free									

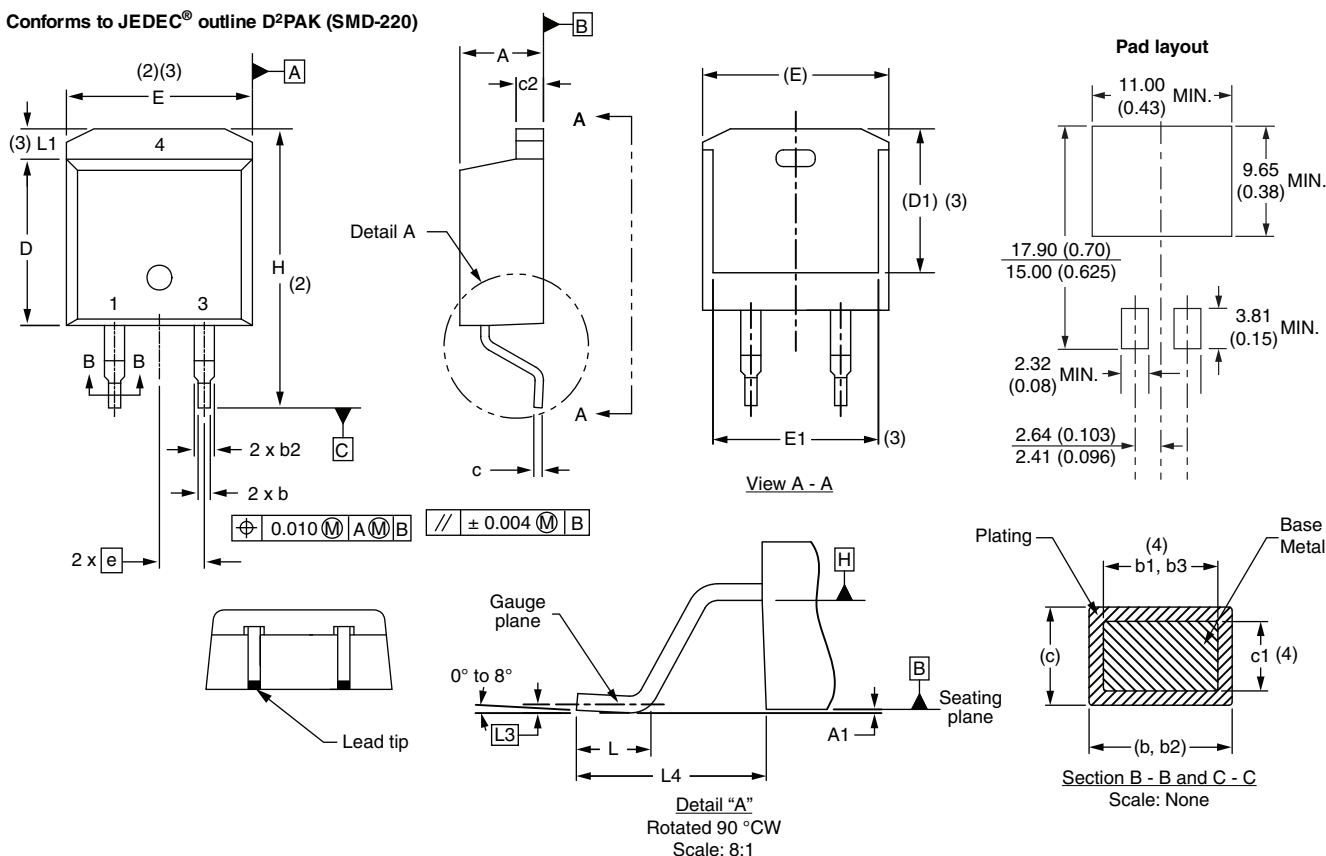
<b>ORDERING INFORMATION</b> (Example)		
PREFERRED P/N	BASE QUANTITY	PACKAGING DESCRIPTION
VS-E5TH2112S2L-M3	800	13" diameter reel

<b>LINKS TO RELATED DOCUMENTS</b>	
Dimensions	<a href="http://www.vishay.com/doc?96683">www.vishay.com/doc?96683</a>
Part marking information	<a href="http://www.vishay.com/doc?96693">www.vishay.com/doc?96693</a>
Packaging information	<a href="http://www.vishay.com/doc?95032">www.vishay.com/doc?95032</a>

### D<sup>2</sup>PAK 2L (TO-263AB 2L)

#### DIMENSIONS 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
L3	0.25 BSC		0.010 BSC		
L4	4.78	5.28	0.188	0.208	

#### Notes

- Dimensioning and tolerancing per ASME Y14.5 M-1994
- 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
- Thermal pad contour optional within dimension E, L1, D1 and E1
- Dimension b1 and c1 apply to base metal only
- Datum A and B to be determined at datum plane H
- Controlling dimension: inch
- Outline conforms to JEDEC® outline TO-263AB



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