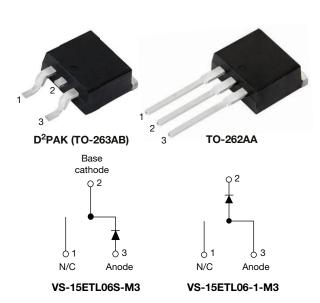


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# Ultralow V<sub>F</sub> Hyperfast Rectifier for Discontinuous Mode PFC, 15 A FRED Pt<sup>®</sup>



PRIMARY CHARACTERISTICS							
I <sub>F(AV)</sub>	15 A						
V <sub>R</sub>	600 V						
V <sub>F</sub> at I <sub>F</sub>	0.85 V						
t <sub>rr</sub> (typ.)	60 ns						
T <sub>J</sub> max.	175 °C						
Package	D <sup>2</sup> PAK (TO-263AB), TO-262AA						
Circuit configuration	Single						

#### **FEATURES**

- Benchmark ultralow forward voltage drop
- Hyperfast recovery time
- Low leakage current
- 175 °C operating junction temperature
- ROHS COMPLIANT HALOGEN FREE
- Meets MSL level 1, per J-STD-020, LF maximum peak of 245 °C
- Material categorization: for definitions of compliance please see <a href="https://www.vishay.com/doc?99912">www.vishay.com/doc?99912</a>

#### **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.

ABSOLUTE MAXIMUM RATINGS								
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS				
Peak repetitive reverse voltage	$V_{RRM}$		600	V				
Average rectified forward current	I <sub>F(AV)</sub>	T <sub>C</sub> = 154 °C	15					
Non-repetitive peak surge current	I <sub>FSM</sub>	T <sub>J</sub> = 25 °C	250	Α				
Peak repetitive forward current	I <sub>FM</sub>		30					
Operating junction and storage temperatures	T <sub>J</sub> , T <sub>Stg</sub>		-65 to +175	°C				

<b>ELECTRICAL SPECIFICATIONS</b> (T <sub>J</sub> = 25 °C unless otherwise specified)								
PARAMETER SYMBOL		TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS		
Breakdown voltage, blocking voltage	V <sub>BR</sub> , V <sub>R</sub>	Ι <sub>R</sub> = 100 μΑ	600	ı	ı			
E	V <sub>F</sub>	I <sub>F</sub> = 15 A	-	0.99	1.05	V		
Forward voltage		I <sub>F</sub> = 15 A, T <sub>J</sub> = 150 °C	-	0.85	0.92			
Dayawaa laakaaa aywaant	,	V <sub>R</sub> = V <sub>R</sub> rated	-	0.1	10			
Reverse leakage current	I <sub>R</sub>	T <sub>J</sub> = 150 °C, V <sub>R</sub> = V <sub>R</sub> rated	-	15	120	μΑ		
Junction capacitance	C <sub>T</sub>	V <sub>R</sub> = 600 V	-	20	-	pF		
Series inductance	L <sub>S</sub>	Measured lead to lead 5 mm from package body	-	8.0	-	nΗ		



# VS-15ETL06S-M3, VS-15ETL06-1-M3

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<b>DYNAMIC RECOVERY CHARACTERISTICS</b> (T <sub>C</sub> = 25 °C unless otherwise specified)								
PARAMETER	SYMBOL	TEST CO	NDITIONS	MIN.	TYP.	MAX.	UNITS	
		I <sub>F</sub> = 1 A, dI <sub>F</sub> /dt = 1	00 A/μs, V <sub>R</sub> = 30 V	-	60	120		
Reverse recovery time		$I_F = 15 \text{ A}, dI_F/dt = 100 \text{ A/}\mu\text{s}, V_R = 30 \text{ V}$		-	190	270		
	t <sub>rr</sub>	T <sub>J</sub> = 25 °C	$I_F = 15 \text{ A}$ $dI_F/dt = 200 \text{ A/}\mu\text{s}$ $V_R = 390 \text{ V}$	-	220	-	ns A μC	
		T <sub>J</sub> = 125 °C		-	320	-		
Deals receivers accurrent	,	T <sub>J</sub> = 25 °C		-	19	-		
Peak recovery current	I <sub>RRM</sub>	T <sub>J</sub> = 125 °C		-	26	-		
Reverse recovery charge	0	T <sub>J</sub> = 25 °C		-	2.2	-		
	Q <sub>rr</sub>	T <sub>J</sub> = 125 °C		-	4.3	-		

THERMAL - MECHANICA	L SPECIFIC	CATIONS				
PARAMETER	SYMBOL	SYMBOL TEST CONDITIONS		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	
Thermal resistance, junction to ambient per leg	R <sub>thJA</sub>	Typical socket mount	-	-	70	°C/W
Thermal resistance, case to heatsink	R <sub>thCS</sub>	Mounting surface, flat, smooth and greased	-	0.5	-	
Woight			-	2.0	-	g
Weight			-	0.07	-	oz.
Mounting torque			6.0 (5.0)	-	12 (10)	kgf · cm (lbf · in)
		Case style D <sup>2</sup> PAK (TO-263AB)	15ETL06S			
Marking device		Case style TO-262AA 15ETL06-			L06-1	



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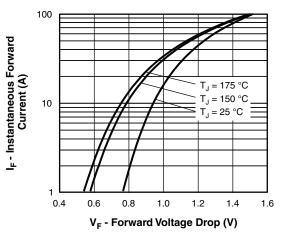


Fig. 1 - Typical Forward Voltage Drop Characteristics

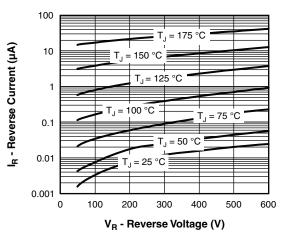


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

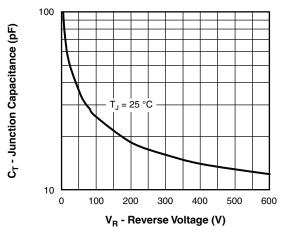


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

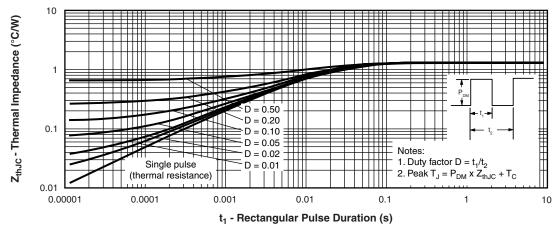


Fig. 4 - Maximum Thermal Impedance Z<sub>thJC</sub> Characteristics



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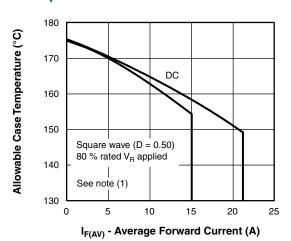


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

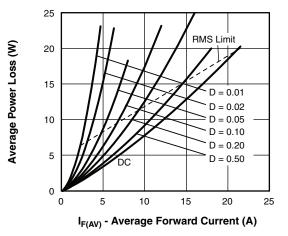


Fig. 6 - Forward Power Loss Characteristics

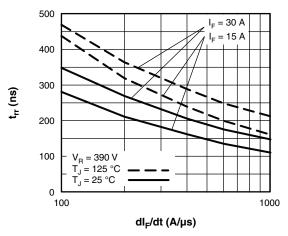


Fig. 7 - Typical Reverse Recovery Time vs. dl<sub>F</sub>/dt

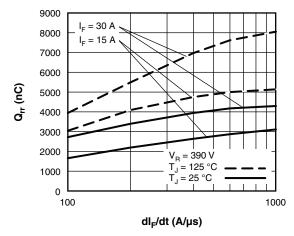
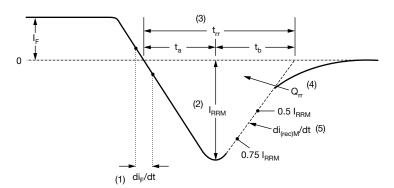


Fig. 8 - Typical Stored Charge vs. dl<sub>F</sub>/dt

### Note

 $^{(1)}$  Formula used: T<sub>C</sub> = T<sub>J</sub> - (Pd + Pd<sub>REV</sub>) x R<sub>thJC</sub>; Pd = forward power loss = I<sub>F(AV)</sub> x V<sub>FM</sub> at (I<sub>F(AV)</sub>/D) (see fig. 6); Pd<sub>REV</sub> = inverse power loss = V<sub>R1</sub> x I<sub>R</sub> (1 - D); I<sub>R</sub> at V<sub>R1</sub> = rated V<sub>R</sub>

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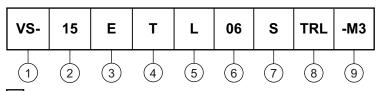


- (1) di<sub>F</sub>/dt rate of change of current through zero crossing
- (4)  $\mathbf{Q}_{rr}$  area under curve defined by  $\mathbf{t}_{rr}$  and  $\mathbf{I}_{RRM}$
- (2) I<sub>RRM</sub> peak reverse recovery current
- $Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$
- (3)  $\rm t_{rr}$  reverse recovery time measured from zero crossing point of negative going  $\rm I_F$  to point where a line passing through 0.75  $\rm I_{RRM}$  and 0.50  $\rm I_{RRM}$  extrapolated to zero current.
- (5) di<sub>(rec)M</sub>/dt peak rate of change of current during t<sub>b</sub> portion of t<sub>rr</sub>

Fig. 9 - Reverse Recovery Waveform and Definitions

#### **ORDERING INFORMATION TABLE**

Device code



- 1 Vishay Semiconductors product
- 2 Current rating (15 A)
- 3 E = single diode
- 4  $T = TO-220, D^2PAK$
- 5 L = ultralow V<sub>E</sub> hyperfast recovery
- 6 Voltage rating (06 = 600 V)
- 7 • S = D<sup>2</sup>PAK
  - -1 = TO-262
- 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 Environmental digit:
  - -M3 = halogen-free, RoHS-compliant, and terminations lead(Pb)-free

LINKS TO RELATED DOCUMENTS							
Dimensions	D <sup>2</sup> PAK (TO-263AB)	www.vishay.com/doc?96164					
Differsions	TO-262AA	www.vishay.com/doc?96165					
Part marking information	D <sup>2</sup> PAK (TO-263AB)	www.vishay.com/doc?95444					
Fart marking information	TO-262AA	www.vishay.com/doc?95443					
Packaging information		www.vishay.com/doc?96424					
SPICE model		www.vishay.com/doc?96051					



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### D<sup>2</sup>PAK

### **DIMENSIONS** in millimeters and inches



SYMBOL	MILLIMETERS		INCHES		NOTES	SYMBOL	MILLIM	ETERS	INC	HES	NOTES
STIVIBUL	MIN.	MAX.	MIN.	MAX.	NOIES	STWBOL	MIN.	MAX.	MIN.	MAX.	NOTES
Α	4.06	4.83	0.160	0.190		D1	6.86	8.00	0.270	0.315	3
A1	0.00	0.254	0.000	0.010		E	9.65	10.67	0.380	0.420	2, 3
b	0.51	0.99	0.020	0.039		E1	7.90	8.80	0.311	0.346	3
b1	0.51	0.89	0.020	0.035	4	е	2.54	BSC	0.100	BSC	
b2	1.14	1.78	0.045	0.070		Н	14.61	15.88	0.575	0.625	
b3	1.14	1.73	0.045	0.068	4	L	1.78	2.79	0.070	0.110	
С	0.38	0.74	0.015	0.029		L1	-	1.65	-	0.066	3
c1	0.38	0.58	0.015	0.023	4	L2	1.27	1.78	0.050	0.070	
c2	1.14	1.65	0.045	0.065		L3	0.25	BSC	0.010	BSC	
D	8.51	9.65	0.335	0.380	2	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: inches
- (7) Outline conforms to JEDEC® outline TO-263AB

Revision: 13-Jul-17 Document Number: 96164

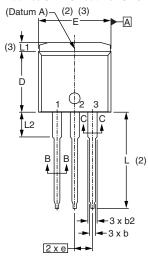


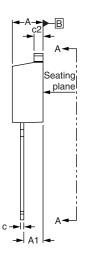
### Vishay Semiconductors

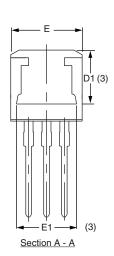
### **TO-262AA**

### **DIMENSIONS** in millimeters and inches

#### Modified JEDEC® outline TO-262







**⊕** 0.010 **M** A**M** B

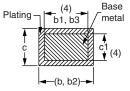
#### Lead assignments



**Diodes** 1. - Anode (two die)/open (one die)

2., 4. - Cathode

3. - Anode



Section B - B and C - C Scale: None

SYMBOL	MILLIM	IETERS	INC	INCHES			
	MIN.	MAX.	MIN.	MAX.	NOTES		
Α	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		
С	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		
Е	9.65	10.67	0.380	0.420	2, 3		
E1	7.90	8.80	0.311	0.346	3		
е	2.54	BSC	0.10	0 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**

(4) Dimension b1 and c1 apply to base metal only

Controlling dimension: inches

<sup>(1)</sup> 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

Thermal pad contour optional within dimension E, L1, D1 and E1

Outline conform to JEDEC® TO-262 except A1 (max.), b (min., max.), b1 (min.), b2 (max.), c (min.), c1(min.), c2 (max.), D (min.), E (max.), L1 (max.), L2 (min., max.)



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