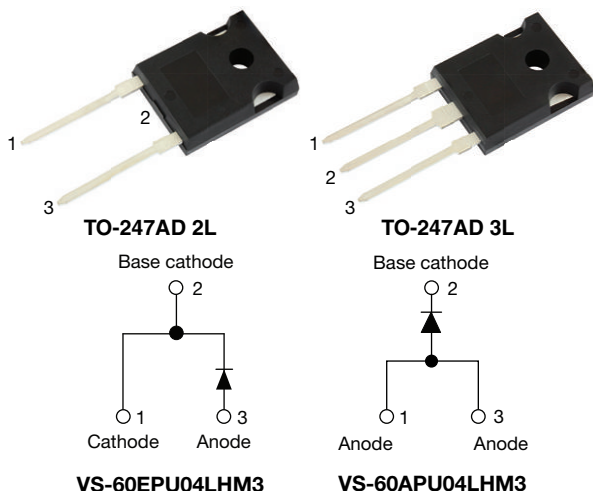


Ultrafast Soft Recovery Diode, 60 A FRED Pt®



FEATURES

- Ultrafast recovery time
- Low forward voltage drop
- 175 °C operating junction temperature
- AEC-Q101 qualified, meets JESD 201 class 1A whisker test
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE

BENEFITS

- Reduced RFI and EMI
- Higher frequency operation
- Reduced snubbing
- Reduced parts count

DESCRIPTION / APPLICATIONS

These diodes are optimized to reduce losses and EMI/RFI in high frequency power conditioning systems.

The softness of the recovery eliminates the need for a snubber in most applications. These devices are ideally suited for HF welding, power converters and other applications where switching losses are not significant portion of the total losses.

MECHANICAL DATA

Case: TO-247AD 2L, TO-247AD 3L

Molding compound meets UL 94 V-0 flammability rating

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

LINKS TO ADDITIONAL RESOURCES



PRIMARY CHARACTERISTICS	
$I_{F(AV)}$	60 A
V_R	400 V
V_F at I_F	0.87 V
t_{rr} typ.	50 ns
T_J max.	175 °C
Package	TO-247AD 2L, TO-247AD 3L
Circuit configuration	Single

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Cathode to anode voltage	V_R		400	V
Continuous forward current	$I_{F(AV)}$	$T_C = 127\text{ °C}$	60	A
Single pulse forward current	I_{FSM}	$T_C = 25\text{ °C}$	600	
Maximum repetitive forward current	I_{FRM}	Square wave, 20 kHz	120	
Operating junction and storage temperatures	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	$I_R = 100\text{ }\mu\text{A}$	400	-	-	V
Forward voltage	V_F	$I_F = 60\text{ A}$	-	1.05	1.25	
		$I_F = 60\text{ A}, T_J = 175\text{ °C}$	-	0.87	1.03	
		$I_F = 60\text{ A}, T_J = 125\text{ °C}$	-	0.93	1.10	
Reverse leakage current	I_R	$V_R = V_R$ rated	-	-	50	μA
		$T_J = 150\text{ °C}, V_R = V_R$ rated	-	-	2	mA
Junction capacitance	C_T	$V_R = 400\text{ V}$	-	50	-	pF
Series inductance	L_S	Measured lead to lead 5 mm from package body	-	3.5	-	nH



DYNAMIC RECOVERY CHARACTERISTICS (T _C = 25 °C unless otherwise specified)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS
Reverse recovery time	t _{rr}	I _F = 1 A, dI _F /dt = 200 A/μs, V _R = 30 V		-	50	-	ns
		T _J = 25 °C	I _F = 60 A dI _F /dt = 200 A/μs V _R = 200 V	-	85	-	
		T _J = 125 °C		-	145	-	
Peak recovery current	I _{RRM}	T _J = 25 °C		-	8.8	-	A
		T _J = 125 °C		-	15.4	-	
Reverse recovery charge	Q _{rr}	T _J = 25 °C		-	375	-	nC
		T _J = 125 °C		-	1120	-	

THERMAL - MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Thermal resistance, junction to case	R_{thJC}		-	-	0.70	K/W
Thermal resistance, case to heatsink	R_{thCS}	Mounting surface, flat, smooth, and greased	-	0.2	-	
Weight			-	5.5	-	g
			-	0.2	-	oz.
Mounting torque			1.2 (10)	-	2.4 (20)	N · m (lbf · in)
Marking device		Case style TO-247AD 2L	60EPU04LH			
		Case style TO-247AD 3L	60APU04LH			

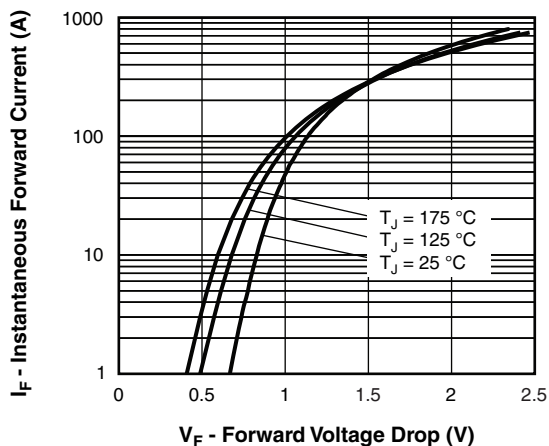


Fig. 1 - Typical Forward Voltage Drop Characteristics

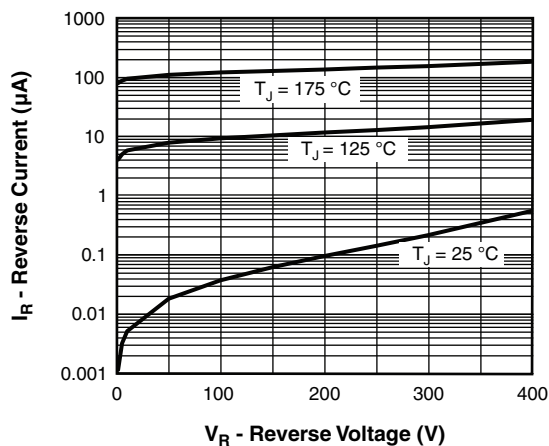


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

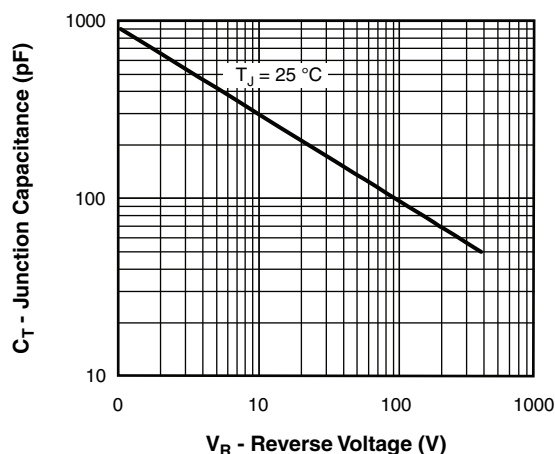


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

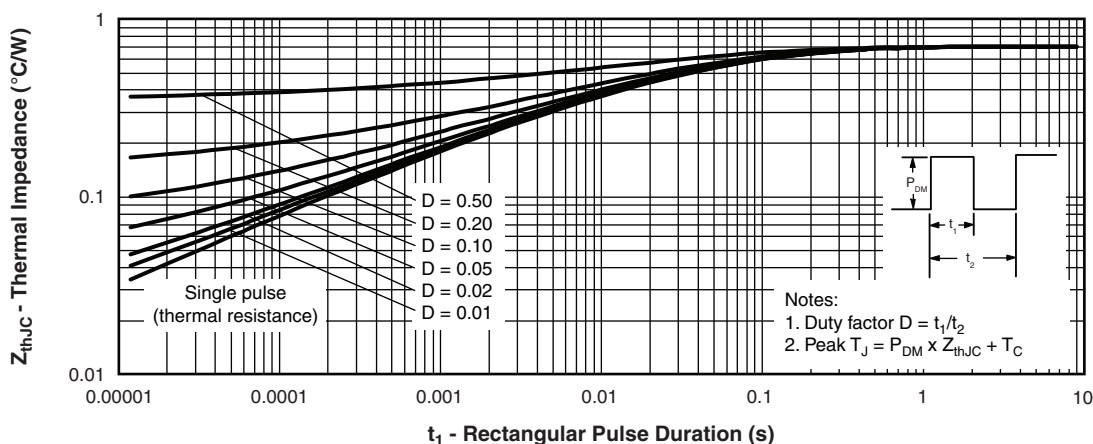
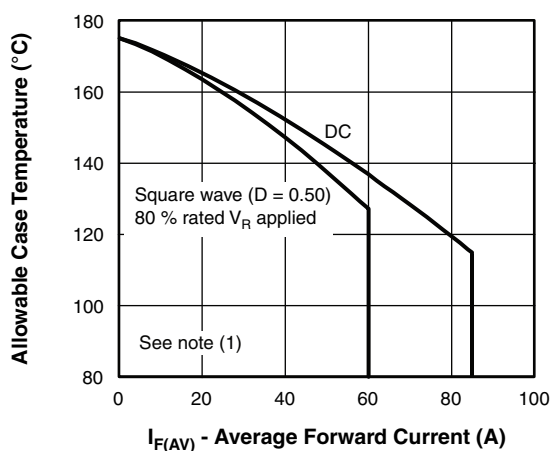

Fig. 4 - Maximum Thermal Impedance Z_{thJC} Characteristics


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

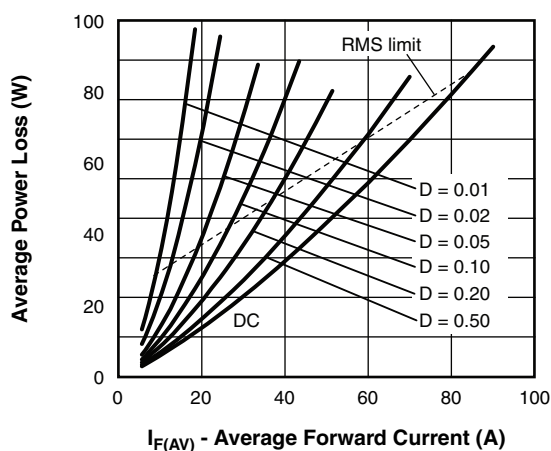


Fig. 6 - Forward Power Loss Characteristics

Note

- (1) Formula used: $T_C = T_J - (P_d + P_{dREV}) \times R_{thJC}$;
 P_d = forward power loss = $I_{F(AV)} \times V_{FM}$ at $(I_{F(AV)}/D)$ (see fig. 6);
 P_{dREV} = inverse power loss = $V_{R1} \times I_R (1 - D)$; I_R at $V_{R1} = 80\%$ rated V_R

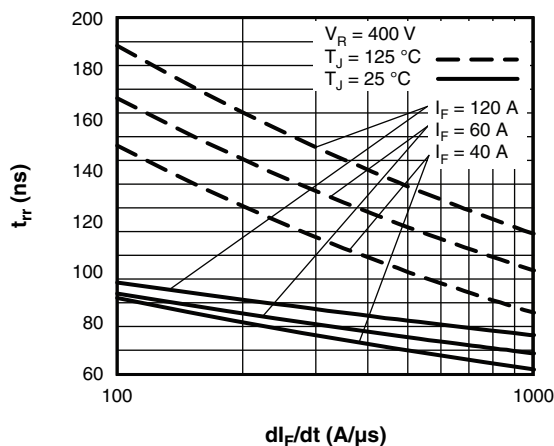
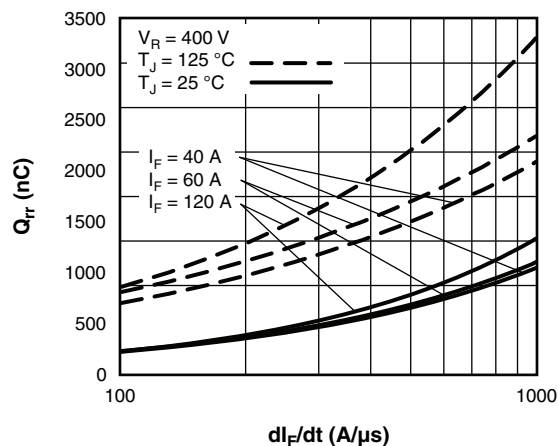
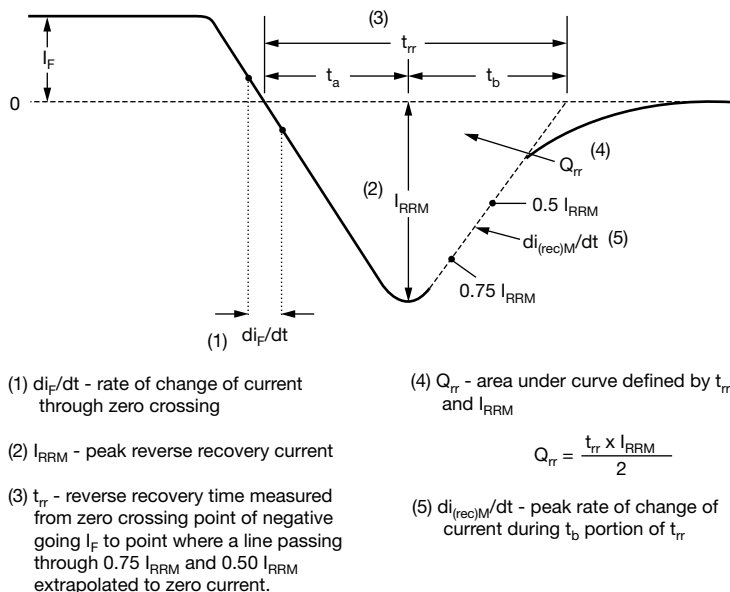

Fig. 7 - Typical Reverse Recovery Time vs. di_F/dt

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


Fig. 9 - Reverse Recovery Waveform and Definitions

**ORDERING INFORMATION TABLE**

Device code	VS-	60	E	P	U	04	L	H	N3
	1	2	3	4	5	6	7	8	9
	1	- Vishay Semiconductors product							
	2	- Current rating (60 = 60 A)							
	3	- Circuit configuration: - E = single diode - A = single diode, 3 pins							
	4	- Package: P = TO-247AC (modified)							
	5	- Type of silicon: U = ultrafast recovery							
	6	- Voltage rating (04 = 400 V)							
	7	- L = long lead (TO-247AD)							
	8	- H = AEC-Q101 qualified							
	9	- Environmental digit: N3 = halogen-free, RoHS-compliant, and totally lead (Pb)-free							

ORDERING INFORMATION (Example)

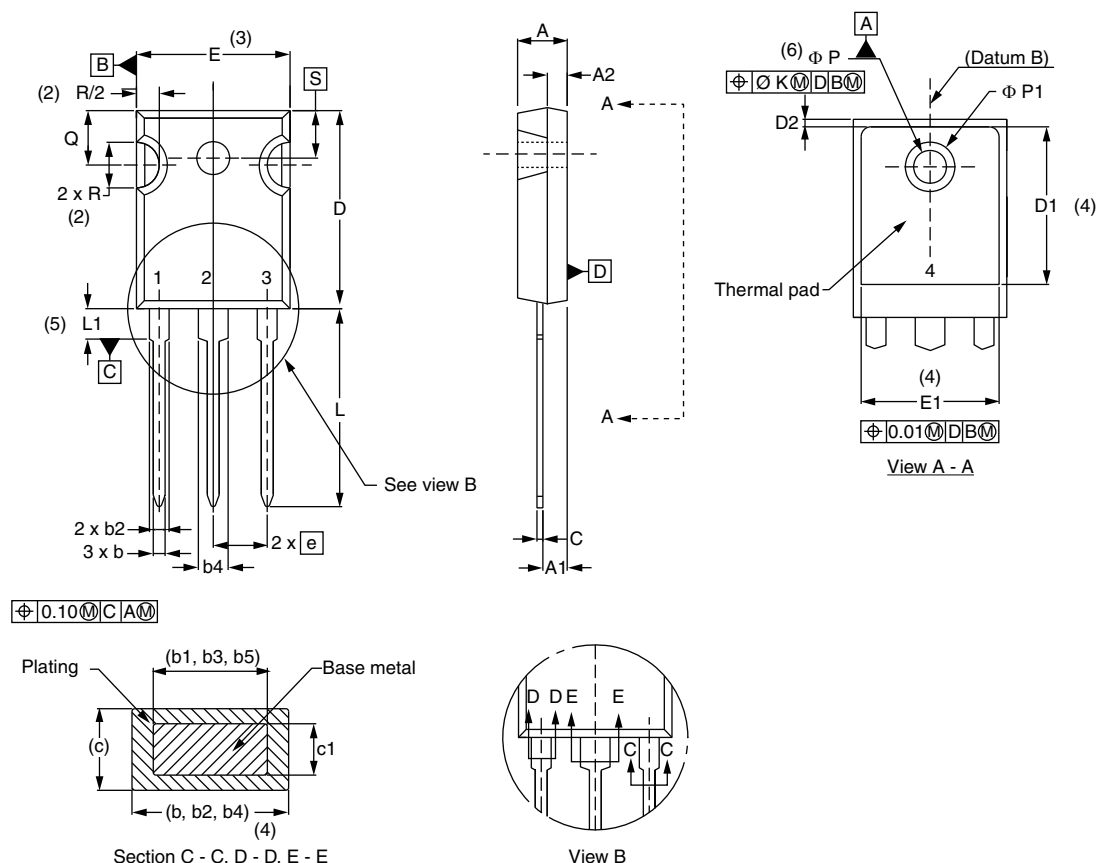
PREFERRED P/N	QUANTITY PER TUBE	MINIMUM ORDER QUANTITY	PACKAGING DESCRIPTION
VS-60EPU04LHN3	25	500	Antistatic plastic tube
VS-60APU04LHN3	25	500	Antistatic plastic tube

LINKS TO RELATED DOCUMENTS

Dimensions	TO-247AD 2L	www.vishay.com/doc?95536
	TO-247AD 3L	www.vishay.com/doc?95626
Part marking information	TO-247AD 2L	www.vishay.com/doc?95648
	TO-247AD 3L	www.vishay.com/doc?95007
SPICE model		www.vishay.com/doc?96899

TO-247AD 3L

DIMENSIONS in millimeters and inches



SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	4.65	5.31	0.183	0.209	
A1	2.21	2.59	0.087	0.102	
A2	1.50	2.49	0.059	0.098	
b	0.99	1.40	0.039	0.055	
b1	0.99	1.35	0.039	0.053	
b2	1.65	2.39	0.065	0.094	
b3	1.65	2.34	0.065	0.092	
b4	2.59	3.43	0.102	0.135	
b5	2.59	3.38	0.102	0.133	
c	0.38	0.89	0.015	0.035	
c1	0.38	0.84	0.015	0.033	
D	19.71	20.70	0.776	0.815	3
D1	13.08	-	0.515	-	4

Notes

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) Dimension D and E do not include mold flash. These dimensions are measured at the outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")
- (7) Outline conforms to JEDEC® outline TO-247 with exception of dimension A min., D, E min., Q min., S, and note 4



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.