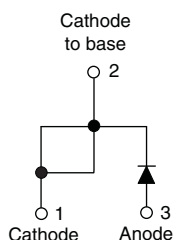


# Ultrafast Soft Recovery Diode, 60 A FRED Pt®



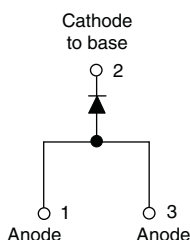
TO-247AC modified



VS-60EPU06HN3



TO-247AC



VS-60APU06HN3

## 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](http://www.vishay.com/doc?99912)



## 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.

## PRODUCT SUMMARY

Package	TO-247AC, TO-247AC modified (2 pins)
$I_{F(AV)}$	60 A
$V_R$	600 V
$V_F$ at $I_F$	1.68 V
$t_{rr}$ typ.	See Recovery table
$T_J$ max.	175 °C
Diode variation	Single die

## ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Cathode to anode voltage	$V_R$		600	V
Continuous forward current	$I_{F(AV)}$	$T_C = 116\text{ °C}$	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	$V_{BR}, V_R$	$I_R = 100\text{ }\mu\text{A}$	600	-	-	V
Forward voltage	$V_F$	$I_F = 60\text{ A}$	-	1.35	1.68	
		$I_F = 60\text{ A}, T_J = 125\text{ °C}$	-	1.20	1.42	
		$I_F = 60\text{ A}, T_J = 175\text{ °C}$	-	1.11	1.30	
Reverse leakage current	$I_R$	$V_R = V_R$ rated	-	-	50	$\mu\text{A}$
		$T_J = 150\text{ °C}, V_R = V_R$ rated	-	-	500	
Junction capacitance	$C_T$	$V_R = 600\text{ V}$	-	39	-	pF



DYNAMIC RECOVERY CHARACTERISTICS ( $T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Reverse recovery time	$t_{rr}$	$I_F = 1\text{ A}$ , $dI_F/dt = 200\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$	-	34	45	ns
		$T_J = 25\text{ }^{\circ}\text{C}$	-	81	-	
		$T_J = 125\text{ }^{\circ}\text{C}$	-	164	-	
Peak recovery current	$I_{RRM}$	$T_J = 25\text{ }^{\circ}\text{C}$	-	7.4	-	A
		$T_J = 125\text{ }^{\circ}\text{C}$	-	17.0	-	
Reverse recovery charge	$Q_{rr}$	$T_J = 25\text{ }^{\circ}\text{C}$	-	300	-	nC
		$T_J = 125\text{ }^{\circ}\text{C}$	-	1394	-	

THERMAL - MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Thermal resistance, junction to case	$R_{thJC}$		-	-	0.63	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-247AC modified	60EPU06H			
		Case style TO-247AC	60APU06H			

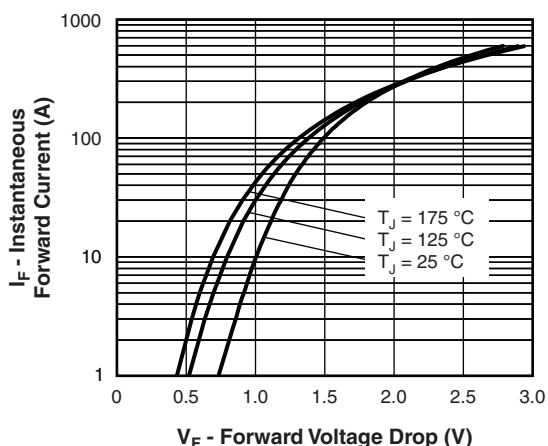


Fig. 1 - Typical Forward Voltage Drop Characteristics

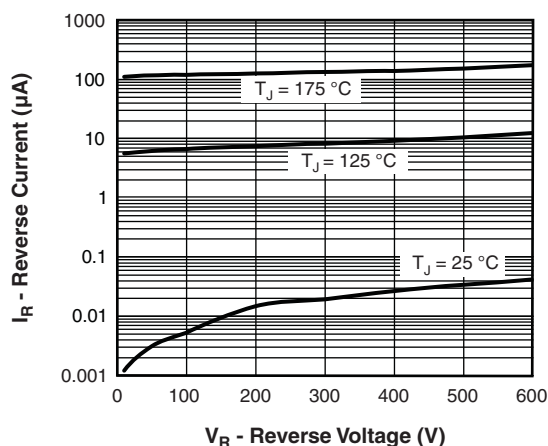


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

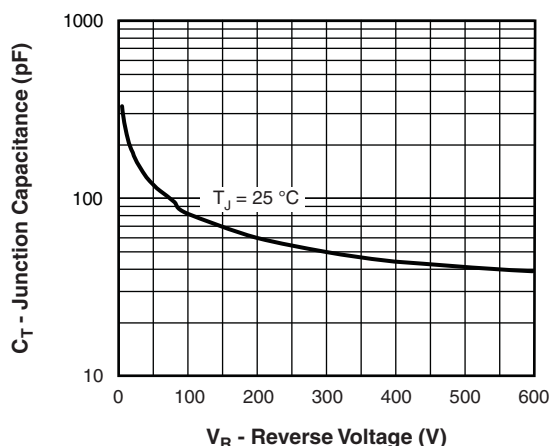


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

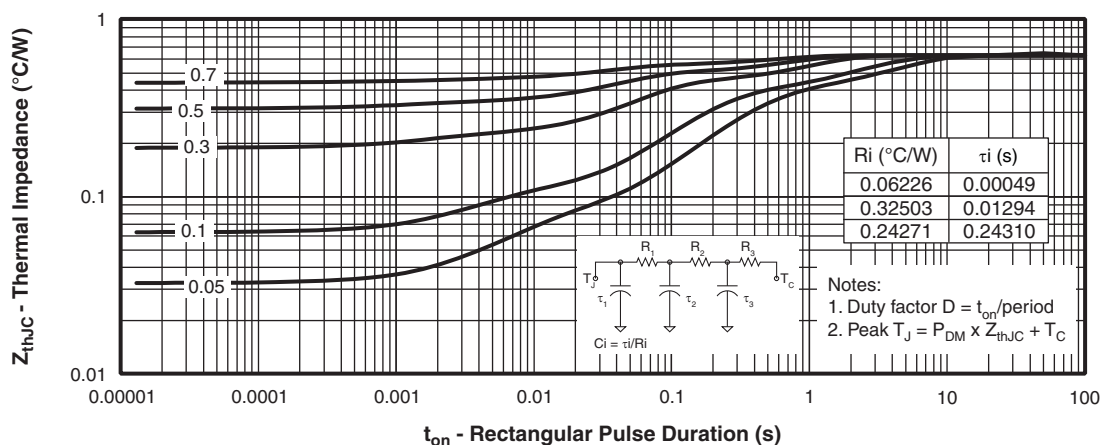
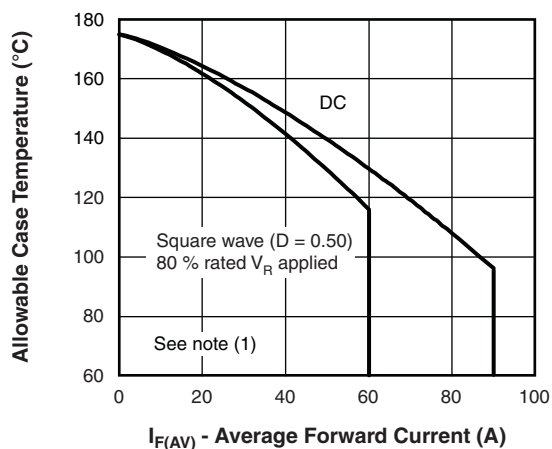

Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics


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

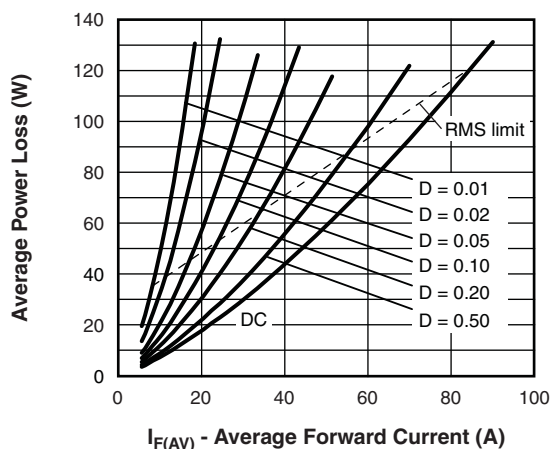
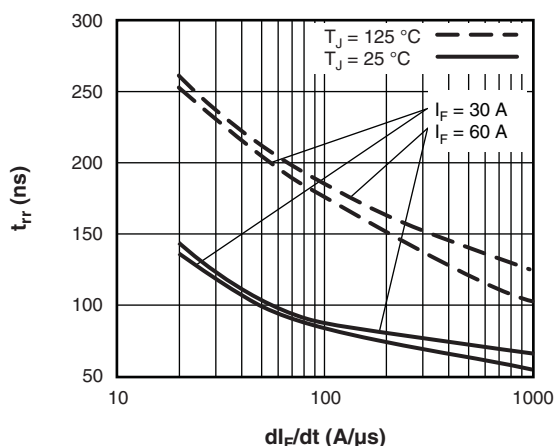
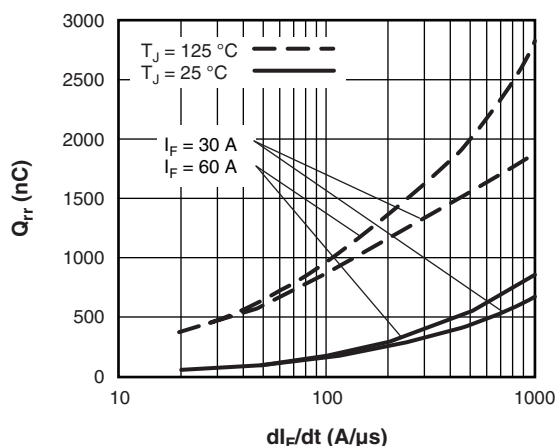


Fig. 6 - Forward Power Loss Characteristics


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

Fig. 8 - Typical Stored Charge vs.  $dI_F/dt$ 
**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  $V_R$

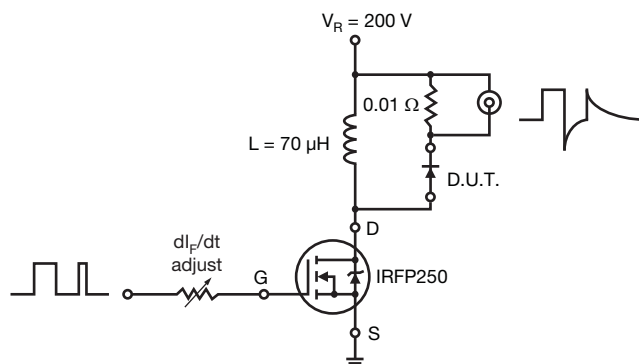


Fig. 9 - Reverse Recovery Parameter Test Circuit

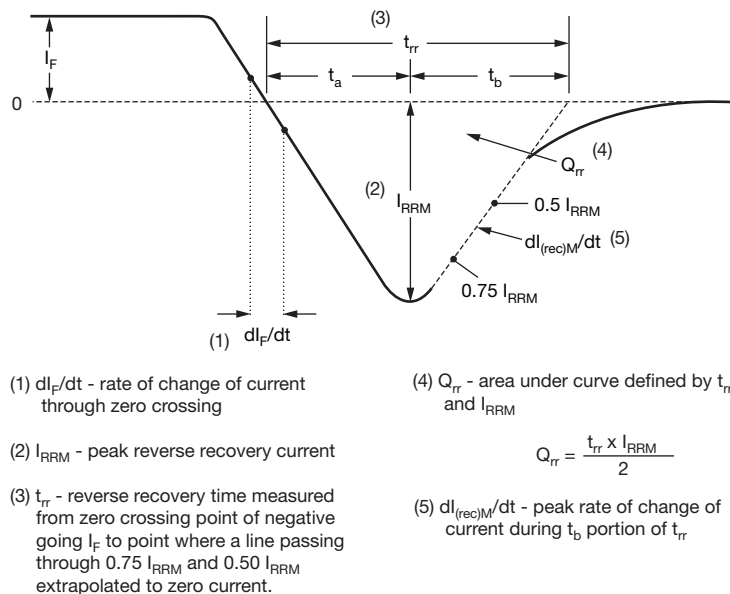


Fig. 10 - Reverse Recovery Waveform and Definitions



## ORDERING INFORMATION TABLE

Device code	VS-	60	E	P	U	06	H	N3
	1	2	3	4	5	6	7	8
1	-	Vishay Semiconductors product						
2	-	Current rating (60 = 60 A)						
3	-	Circuit configuration: <ul style="list-style-type: none"><li>E = Single diode</li><li>A = Single diode, 3 pins</li></ul>						
4	-	P = TO-247AC (modified)						
5	-	U = Ultrafast recovery						
6	-	Voltage rating (06 = 600 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-60EPU06HN3	25	500	Antistatic plastic tube
VS-60APU06HN3	25	500	Antistatic plastic tube

LINKS TO RELATED DOCUMENTS		
Dimensions	TO-247AC modified	<a href="http://www.vishay.com/doc?95253">www.vishay.com/doc?95253</a>
	TO-247AC	<a href="http://www.vishay.com/doc?95223">www.vishay.com/doc?95223</a>
Part marking information	TO-247AC modified	<a href="http://www.vishay.com/doc?95442">www.vishay.com/doc?95442</a>
	TO-247AC	<a href="http://www.vishay.com/doc?95007">www.vishay.com/doc?95007</a>



**DIMENSIONS** in millimeters and inches



### Lead assignments

#### Diodes

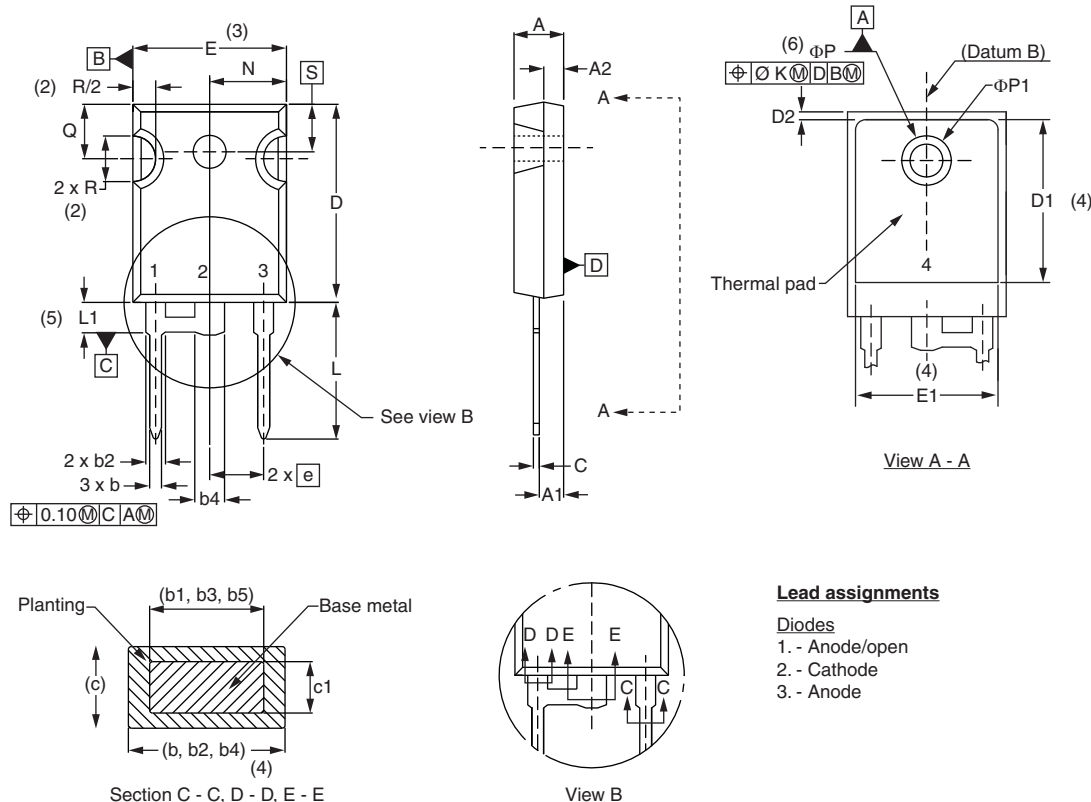
1. - Anode/open
2. - Cathode
3. - Anode

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	2.37	0.065	0.094	
b4	2.59	3.43	0.102	0.135	
b5	2.59	3.38	0.102	0.133	
c	0.38	0.86	0.015	0.034	
c1	0.38	0.76	0.015	0.030	
D	19.71	20.70	0.776	0.815	3
D1	13.08	-	0.515	-	4

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
D2	0.51	1.30	0.020	0.051	
E	15.29	15.87	0.602	0.625	3
E1	13.72	-	0.540	-	
e	5.46 BSC		0.215 BSC		
FK	2.54		0.010		
L	14.20	16.10	0.559	0.634	
L1	3.71	4.29	0.146	0.169	
N	7.62 BSC		0.3		
$\Phi P$	3.56	3.66	0.14	0.144	
$\Phi P1$	-	6.98	-	0.275	
Q	5.31	5.69	0.209	0.224	
R	4.52	5.49	1.78	0.216	
S	5.51 BSC		0.217 BSC		

### 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. 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) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6)  $\Phi P$  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 c

**DIMENSIONS** in millimeters and inches

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
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A1	2.21	2.59	0.087	0.102	
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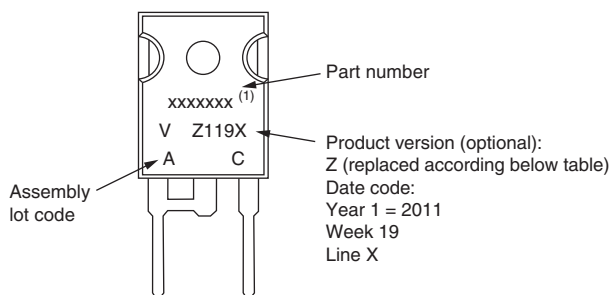
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E1	13.72	-	0.540	-	
e	5.46 BSC		0.215 BSC		
ΦK	2.54		0.010		
L	14.20	16.10	0.559	0.634	
L1	3.71	4.29	0.146	0.169	
N	7.62 BSC		0.3		
ΦP	3.56	3.66	0.14	0.144	
ΦP1	-	6.98	-	0.275	
Q	5.31	5.69	0.209	0.224	
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- Thermal pad contour optional with dimensions D1 and E1
- Lead finish uncontrolled in L1
- ΦP 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")
- Outline conforms to JEDEC outline TO-247 with exception of dimension c



## TO-247AC modified E



Example: This is a xxxxxxxx <sup>(1)</sup> with assembly lot code AC, assembled on WW 19, 2011 in the assembly line "X"

### Note

(1) If part number contain "H" as last digit, product is AEC-Q101 qualified

ENVIRONMENTAL NAMING CODE (Z)	PRODUCT DEFINITION
A	Termination lead (Pb)-free
B	Totally lead (Pb)-free
E	RoHS compliant and termination lead (Pb)-free
F	RoHS compliant and totally lead (Pb)-free
M	Halogen-free, RoHS compliant and termination lead (Pb)-free
N	Halogen-free, RoHS compliant and totally lead (Pb)-free
G	Green





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