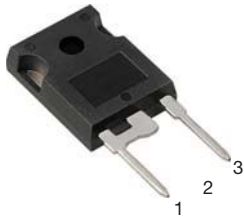
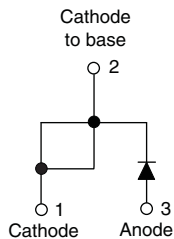
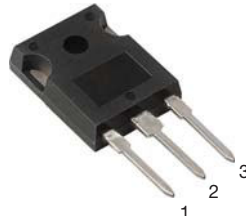


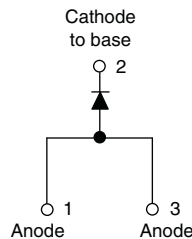
Ultrafast Soft Recovery Diode, 60 A FRED Pt®



TO-247AC modified


VS-60EPU04PbF
VS-60EPU04-N3


TO-247AC


VS-60APU04PbF
VS-60APU04-N3

FEATURES

- Ultrafast recovery time
- Low forward voltage drop
- 175 °C operating junction temperature
- Designed and qualified according to JEDEC-JESD47
- Material categorization:
For definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE
Available

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	400 V
V_F at I_F	1.25 V
t_{rr} typ.	See Recovery table
T_J max.	175 °C
Diode variation	Single die

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 ($T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Reverse recovery time	t_{rr}	$I_F = 1\text{ A}$, $dI_F/dt = 200\text{ A}/\mu\text{s}$, $V_R = 30\text{ V}$	-	50	60	ns
		$T_J = 25\text{ }^{\circ}\text{C}$	-	85	-	
		$T_J = 125\text{ }^{\circ}\text{C}$	-	145	-	
Peak recovery current	I_{RRM}	$T_J = 25\text{ }^{\circ}\text{C}$	-	8.8	-	A
		$T_J = 125\text{ }^{\circ}\text{C}$	-	15.4	-	
Reverse recovery charge	Q_{rr}	$T_J = 25\text{ }^{\circ}\text{C}$	-	375	-	nC
		$T_J = 125\text{ }^{\circ}\text{C}$	-	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-247AC modified	60EPU04			
		Case style TO-247AC	60APU04			

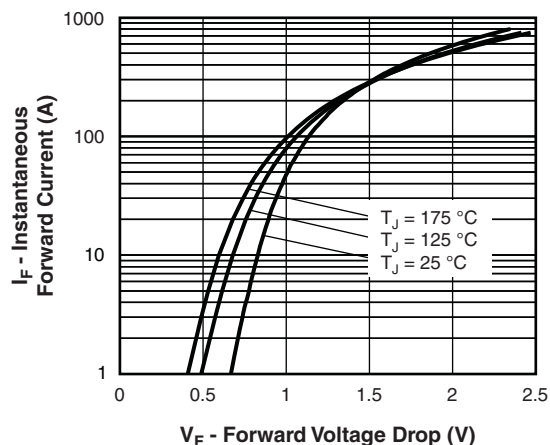


Fig. 1 - Typical Forward Voltage Drop Characteristics

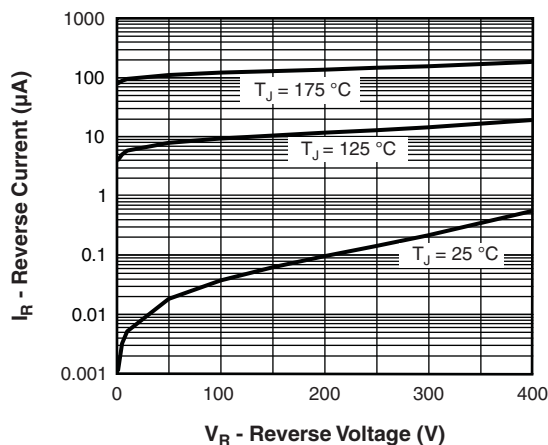


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

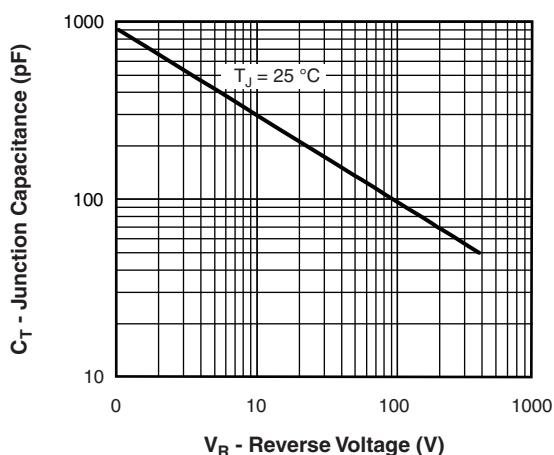


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

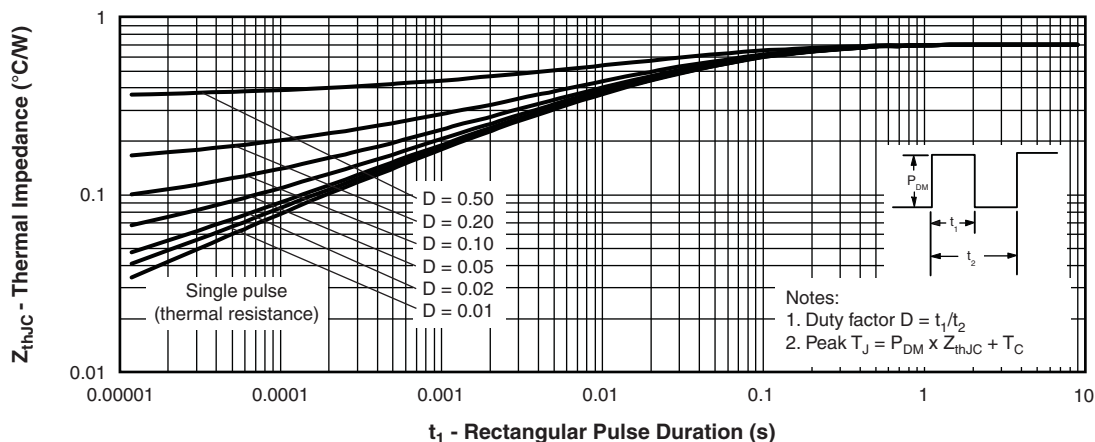


Fig. 4 - Maximum Thermal Impedance Z_{thJC} Characteristics

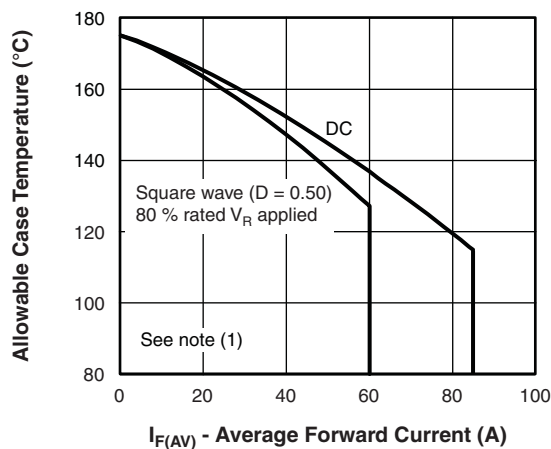


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

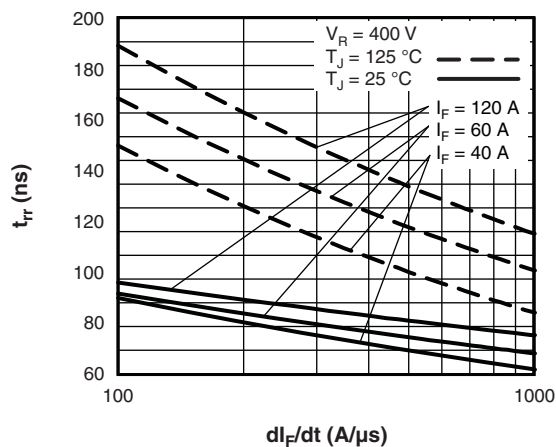


Fig. 7 - Typical Reverse Recovery Time vs. dI_F/dt

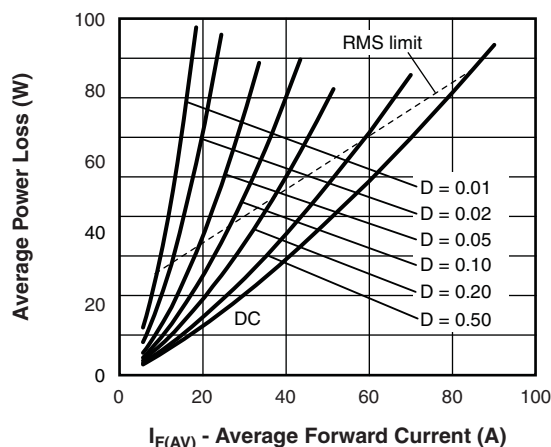


Fig. 6 - Forward Power Loss Characteristics

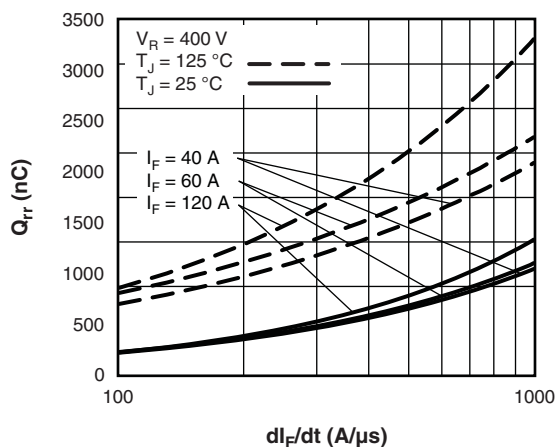


Fig. 8 - Typical Stored Charge vs. dI_F/dt

Note

- (1) Formula used: $T_C = T_J - (P_d + P_{dREV}) \times R_{thJC}$;
 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

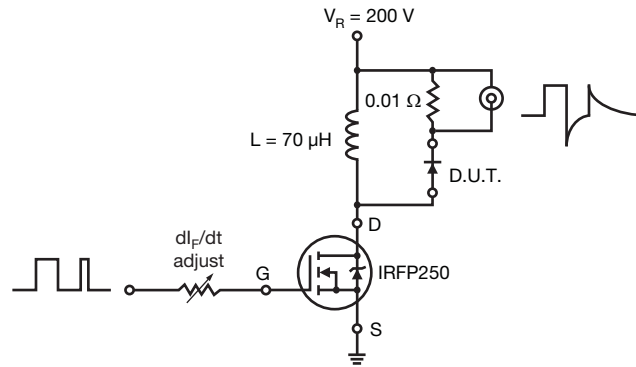


Fig. 9 - Reverse Recovery Parameter Test Circuit

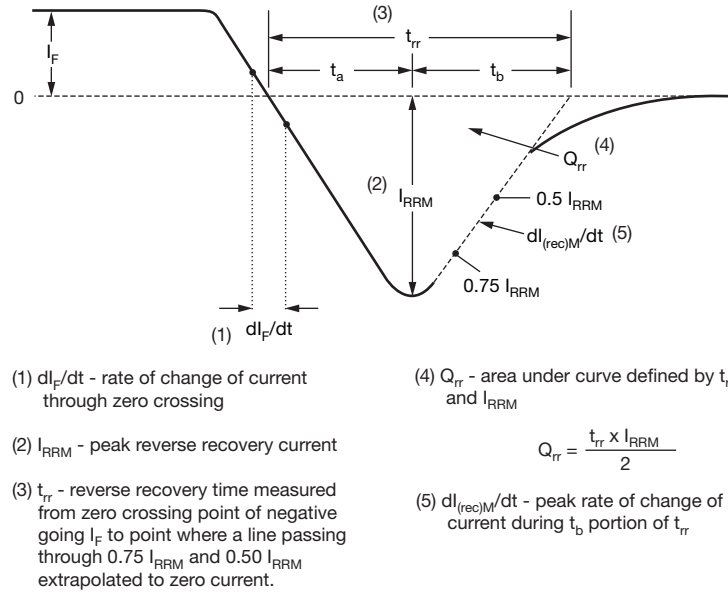


Fig. 10 - Reverse Recovery Waveform and Definitions

**ORDERING INFORMATION TABLE**

Device code	VS-	60	E	P	U	04	PbF
	①	②	③	④	⑤	⑥	⑦

- | | | |
|----------|---|--|
| 1 | - | Vishay Semiconductors product |
| 2 | - | Current rating (60 = 60 A) |
| 3 | - | Circuit configuration: <ul style="list-style-type: none">• 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 | - | Environmental digit:
PbF = Lead (Pb)-free and RoHS compliant
-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-60EPU04PbF	25	500	Antistatic plastic tube
VS-60EPU04-N3	25	500	Antistatic plastic tube
VS-60APU04PbF	25	500	Antistatic plastic tube
VS-60APU04-N3	25	500	Antistatic plastic tube

LINKS TO RELATED DOCUMENTS

Dimensions	TO-247AC modified	www.vishay.com/doc?95541
	TO-247AC	www.vishay.com/doc?95542
Part marking information	TO-247AC modified PbF	www.vishay.com/doc?95255
	TO-247AC modified -N3	www.vishay.com/doc?95442
	TO-247ACPbF	www.vishay.com/doc?95226
	TO-247AC-N3	www.vishay.com/doc?95007



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

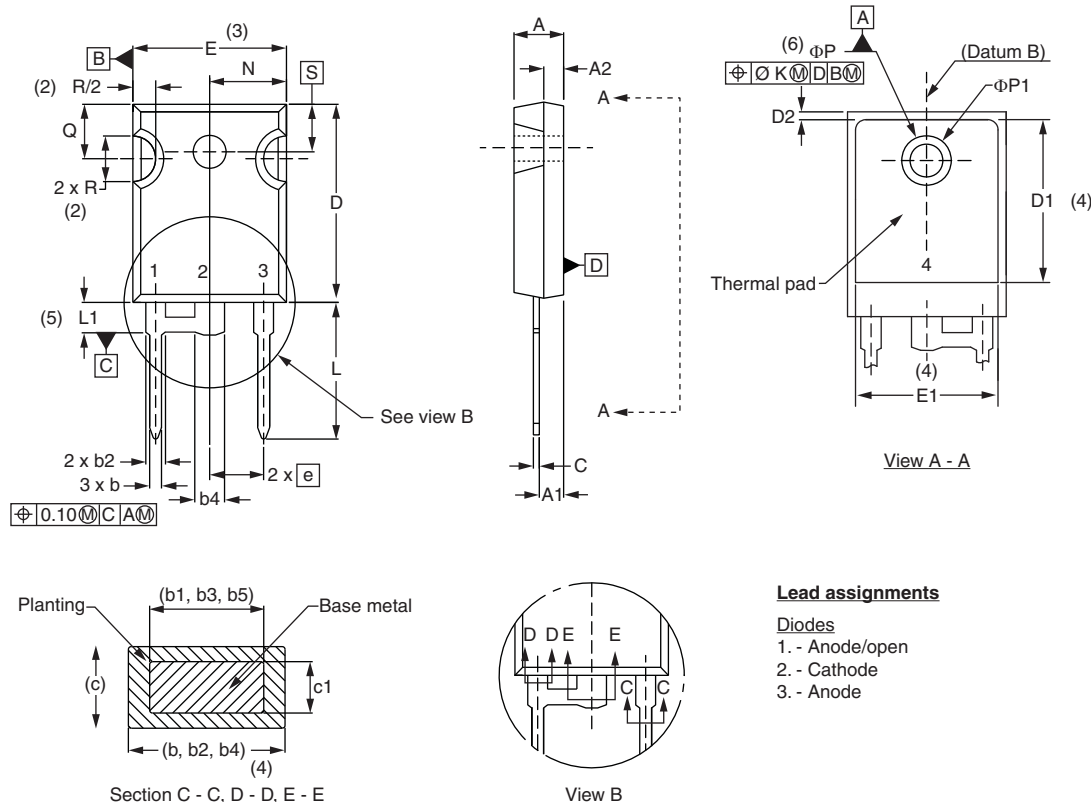
SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
D2	0.51	1.30	0.020	0.051	
E	15.29	15.87	0.602	0.625	3
E1	13.72	-	0.540	-	
e	5.46 BSC		0.215 BSC		
FK	2.54		0.010		
L	14.20	16.10	0.559	0.634	
L1	3.71	4.29	0.146	0.169	
N	7.62 BSC		0.3		
ΦP	3.56	3.66	0.14	0.144	
$\Phi P1$	-	6.98	-	0.275	
Q	5.31	5.69	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) 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")
- (7) Outline conforms to JEDEC outline TO-247 with exception of dimension c



DIMENSIONS in millimeters and inches



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c	0.38	0.86	0.015	0.034	
c1	0.38	0.76	0.015	0.030	
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