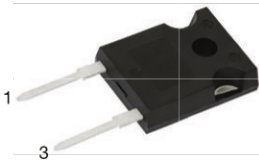
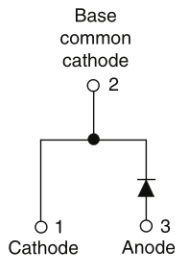
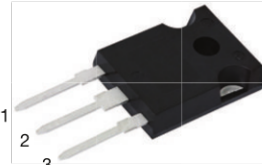
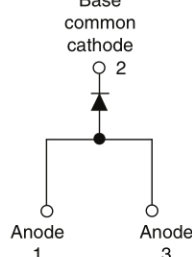


## Ultrafast Soft Recovery Diode, 60 A FRED Pt®


**TO-247AC 2L**

**VS-60EPU04-N3**

**TO-247AC 3L**

**VS-60APU04-N3**

### FEATURES

- Ultrafast recovery time
- Low forward voltage drop
- 175 °C operating junction temperature
- Designed and qualified according to JEDEC®-JESD 47
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://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-247AC 2L, TO-247AC 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.	See Recovery table
$T_J$ max.	175 °C
Package	TO-247AC 2L, TO-247AC 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	$I_{FSM}$	$T_C = 25\text{ °C}, t_p = 10\text{ ms}$	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	$\mu\text{A}$
		$T_J = 150\text{ °C}, V_R = V_R$ 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 <sub>C</sub> = 25 °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> = 1 A, di <sub>F</sub> /dt = 200 A/μs, V <sub>R</sub> = 30 V	-	50	60	ns
		T <sub>J</sub> = 25 °C	-	85	-	
		T <sub>J</sub> = 125 °C	-	145	-	
Peak recovery current	I <sub>RPM</sub>	T <sub>J</sub> = 25 °C	-	8.8	-	A
		T <sub>J</sub> = 125 °C	-	15.4	-	
Reverse recovery charge	Q <sub>rr</sub>	T <sub>J</sub> = 25 °C	-	375	-	nC
		T <sub>J</sub> = 125 °C	-	1120	-	

THERMAL - MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Thermal resistance, junction to case	R <sub>thJC</sub>		-	-	0.70	K/W
Thermal resistance, junction to ambient per leg	R <sub>thJA</sub>	Typical socket mount	-	-	40	°C/W
Thermal resistance, case to heatsink	R <sub>thCS</sub>	Mounting surface, flat, smooth, and greased	-	0.2	-	K/W
Weight			-	5.5	-	g
			-	0.2	-	oz.
Mounting torque			1.2	-	2.4	N · m
			10	-	20	lbf · in
Marking device		Case style TO-247AC 2L	60EPU04			
		Case style TO-247AC 3L	60APU04			

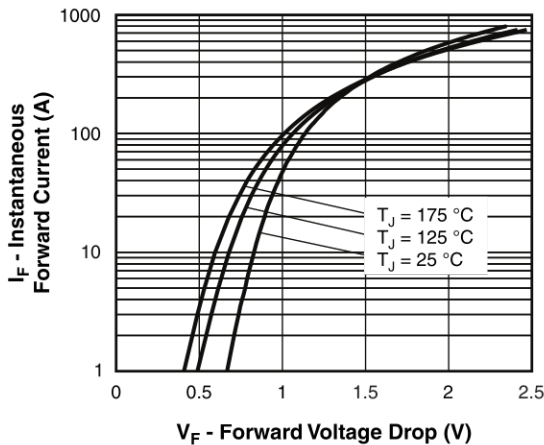


Fig. 1 - Typical Forward Voltage Drop Characteristics

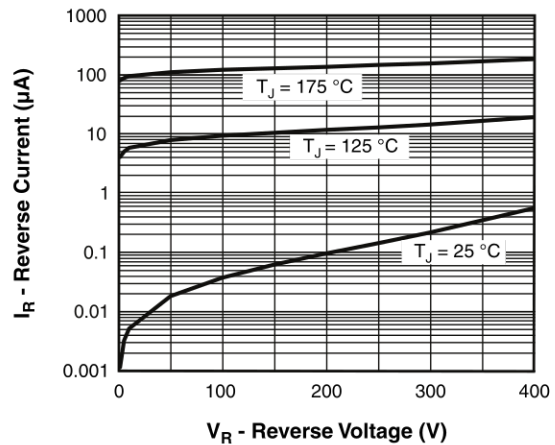


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

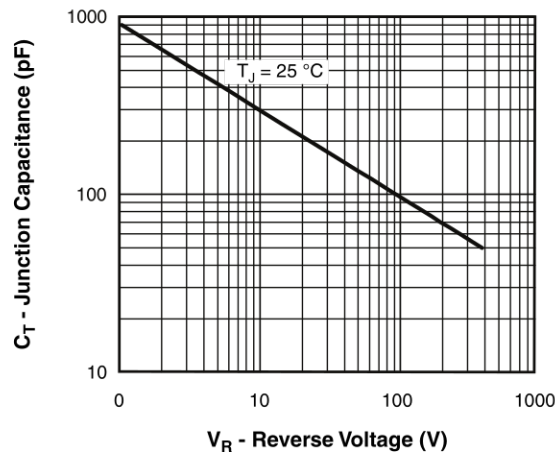


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

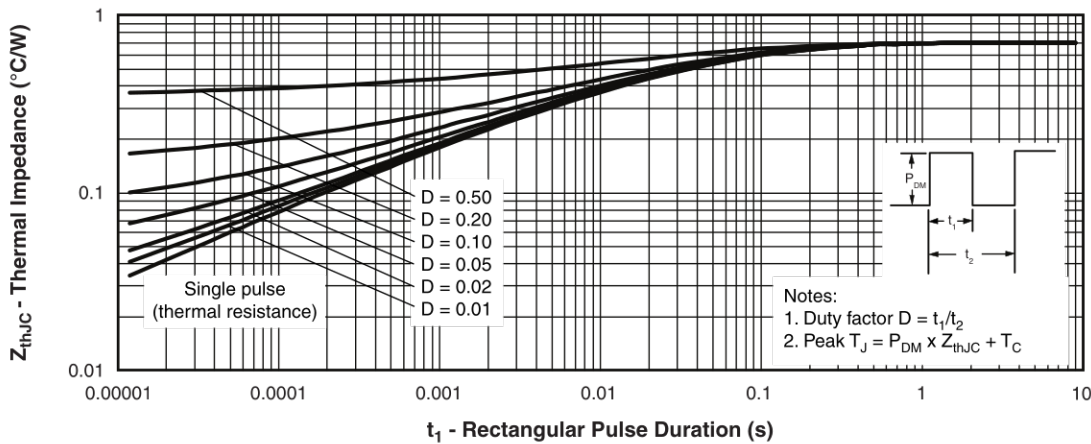


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

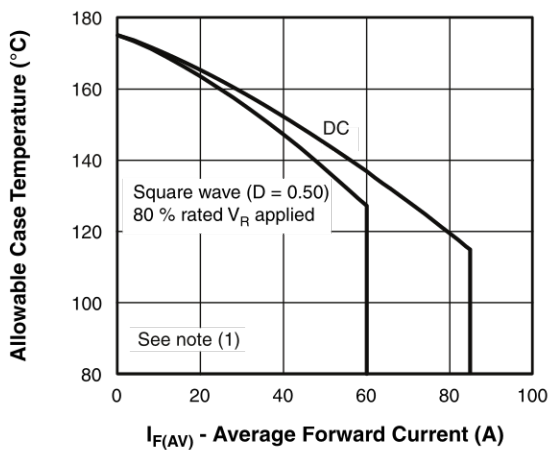


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

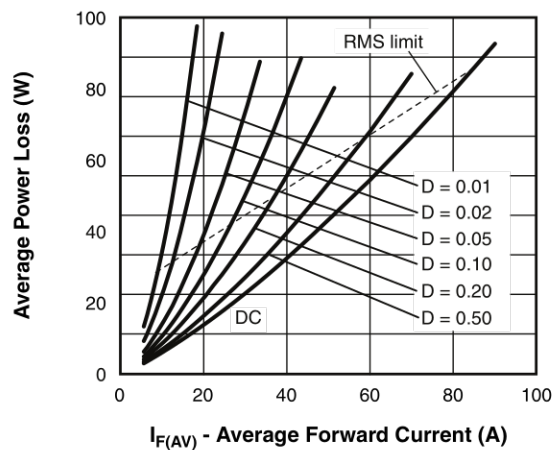


Fig. 6 - Forward Power Loss Characteristics

**Note**

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

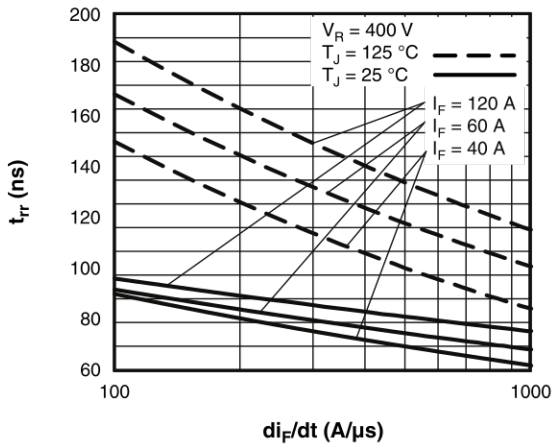


Fig. 7 - Typical Reverse Recovery Time vs.  $di_F/dt$

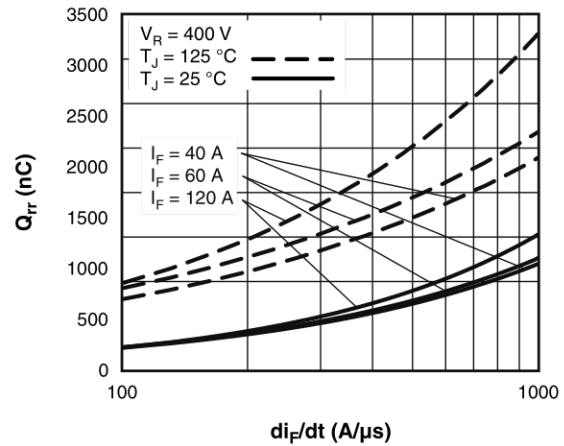
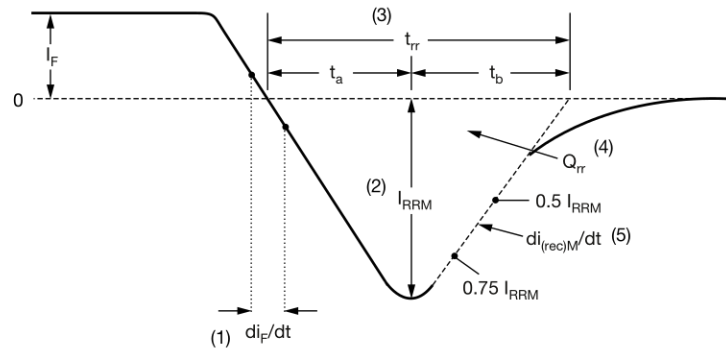


Fig. 8 - Typical Stored Charge vs.  $di_F/dt$



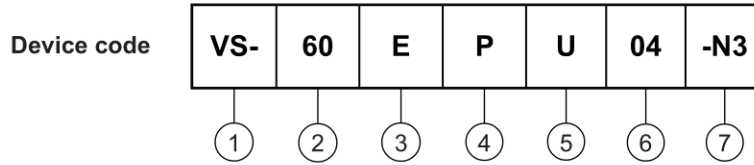
- (1)  $di_F/dt$  - rate of change of current through zero crossing
- (2)  $I_{RRM}$  - peak reverse recovery current
- (3)  $t_{rr}$  - reverse recovery time measured from zero crossing point of negative going  $I_F$  to point where a line passing through  $0.75 I_{RRM}$  and  $0.50 I_{RRM}$  extrapolated to zero current.
- (4)  $Q_{rr}$  - area under curve defined by  $t_{rr}$  and  $I_{RRM}$
- (5)  $di_{(rec)M}/dt$  - peak rate of change of current during  $t_b$  portion of  $t_{rr}$

$$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$

Fig. 9 - Reverse Recovery Waveform and Definitions



## ORDERING INFORMATION TABLE



- 1** - Vishay Semiconductors product
- 2** - Current rating (60 = 60 A)
- 3** - Circuit configuration:
  - E = single diode, 2 pins
  - A = single diode, 3 pins
- 4** - Package:
  - P = TO-247AC
- 5** - Type of silicon:
  - U = ultrafast recovery
- 6** - Voltage rating (04 = 400 V)
- 7** - 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-60EPU04-N3	25	500	Antistatic plastic tube
VS-60APU04-N3	25	500	Antistatic plastic tube

LINKS TO RELATED DOCUMENTS	
Dimensions	TO-247AC 2L <a href="http://www.vishay.com/doc?96144">www.vishay.com/doc?96144</a>
	TO-247AC 3L <a href="http://www.vishay.com/doc?96138">www.vishay.com/doc?96138</a>
Part marking information	TO-247AC 2L <a href="http://www.vishay.com/doc?95648">www.vishay.com/doc?95648</a>
	TO-247AC 3L <a href="http://www.vishay.com/doc?95007">www.vishay.com/doc?95007</a>
SPIICE model	<a href="http://www.vishay.com/doc?96899">www.vishay.com/doc?96899</a>



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