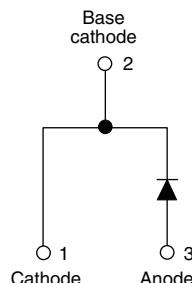


## Ultrafast Soft Recovery Diode, 60 A FRED Pt®



### 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](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.

PRIMARY CHARACTERISTICS	
$I_{F(AV)}$	60 A
$V_R$	600 V
$V_F$ at $I_F$	1.11 V
$t_{rr}$ typ.	See Recovery table
$T_J$ max.	175 °C
Package	TO-247AD 2L
Circuit configuration	Single

ABSOLUTE MAXIMUM RATINGS					
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS	
Cathode to anode voltage	$V_R$			600	V
Continuous forward current	$I_{F(AV)}$	$T_C = 116$ °C	60	A	
Single pulse forward current	$I_{FSM}$	$T_C = 25$ °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 ( $T_J = 25$ °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Breakdown voltage, blocking voltage	$V_{BR}, V_R$	$I_R = 100$ µA	600	-	-	V
Forward voltage	$V_F$	$I_F = 60$ A	-	1.35	1.68	
		$I_F = 60$ A, $T_J = 125$ °C	-	1.20	1.42	
		$I_F = 60$ A, $T_J = 175$ °C	-	1.11	1.30	
Reverse leakage current	$I_R$	$V_R = V_R$ rated	-	-	50	µA
		$T_J = 150$ °C, $V_R = V_R$ rated	-	-	500	
Junction capacitance	$C_T$	$V_R = 600$ V	-	39	-	pF

<b>DYNAMIC RECOVERY CHARACTERISTICS</b> ( $T_J = 25^\circ\text{C}$ 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
		$T_J = 25^\circ\text{C}$		-	81	-	
		$T_J = 125^\circ\text{C}$		-	164	-	
Peak recovery current	$I_{RRM}$	$T_J = 25^\circ\text{C}$	$I_F = 60 \text{ A}$ $dI_F/dt = 200 \text{ A}/\mu\text{s}$ $V_R = 200 \text{ V}$	-	7.4	-	A
		$T_J = 125^\circ\text{C}$		-	17.0	-	
Reverse recovery charge	$Q_{rr}$	$T_J = 25^\circ\text{C}$		-	300	-	nC
		$T_J = 125^\circ\text{C}$		-	1394	-	

<b>THERMAL - MECHANICAL SPECIFICATIONS</b>								
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS	
Thermal resistance, junction to case	$R_{thJC}$	Mounting surface, flat, smooth and greased		-	-	0.63	K/W	
Thermal resistance, case to heatsink	$R_{thCS}$			-	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		60EPU06L				

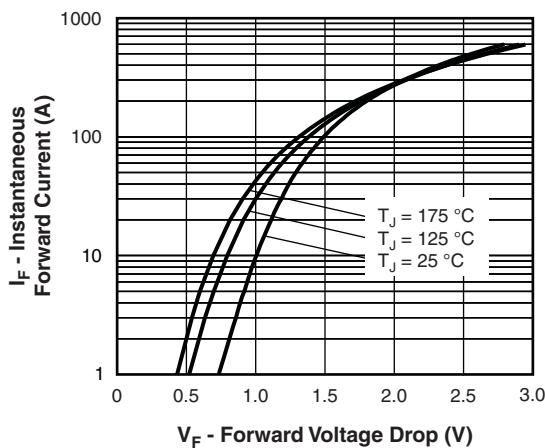


Fig. 1 - Typical Forward Voltage Drop Characteristics

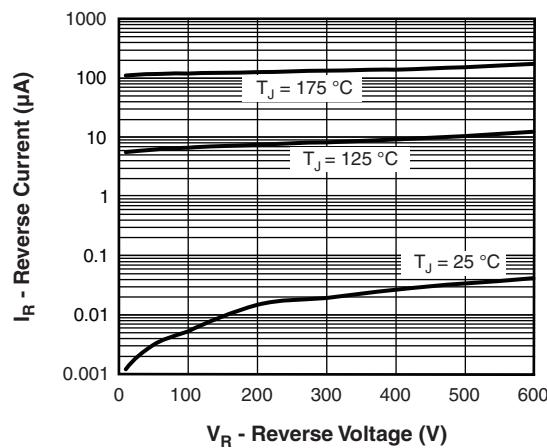


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

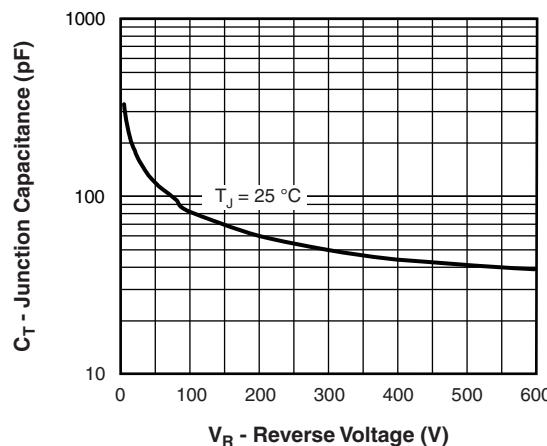


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

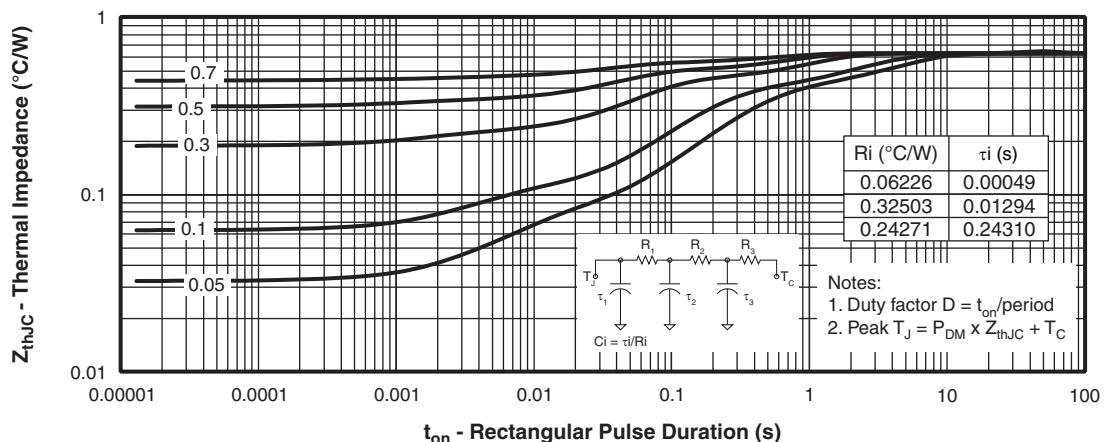


Fig. 4 - Maximum Thermal Impedance Z<sub>thJC</sub> Characteristics

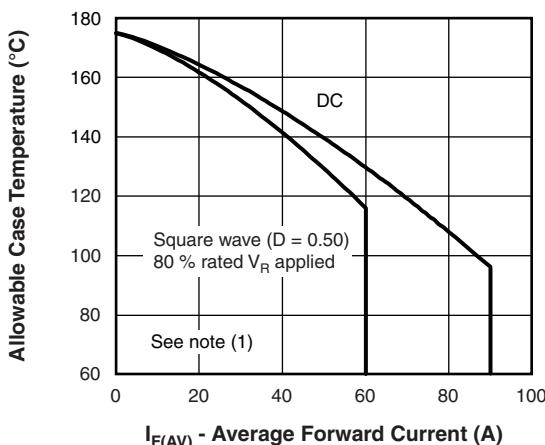


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

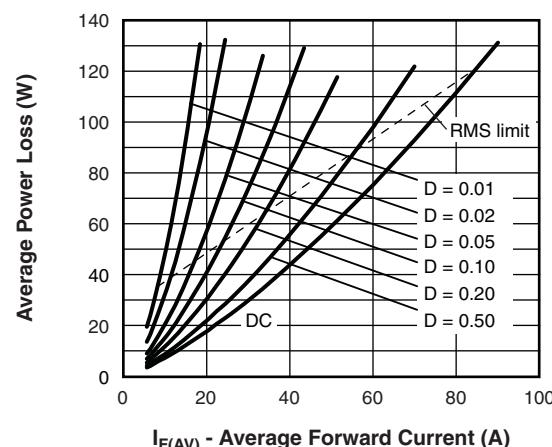


Fig. 6 - Forward Power Loss Characteristics

#### Note

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

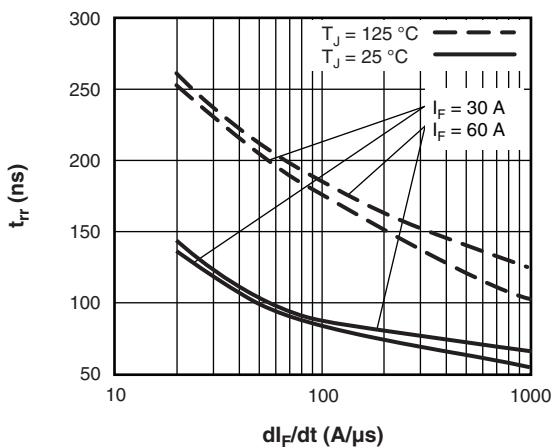


Fig. 7 - Typical Reverse Recovery Time vs.  $dI_F/dt$

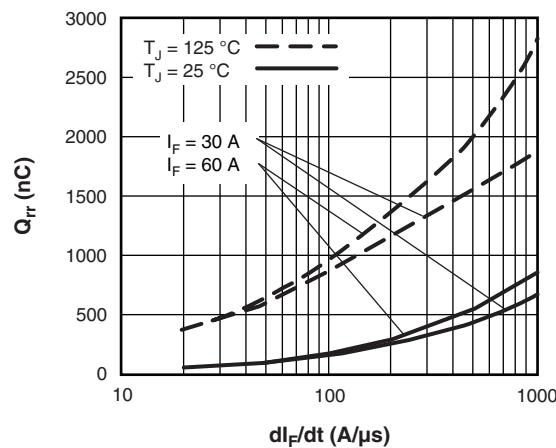
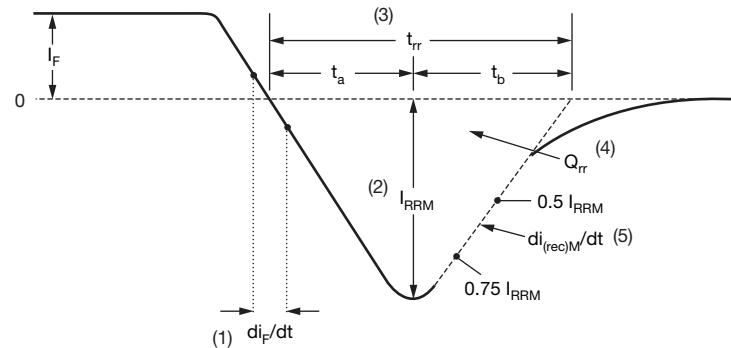


Fig. 8 - Typical Stored Charge vs.  $dI_F/dt$



(1)  $dI_F/dt$  - rate of change of current through zero crossing

(4)  $Q_{rr}$  - area under curve defined by  $t_{rr}$  and  $I_{RRM}$

(2)  $I_{RRM}$  - peak reverse recovery current

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

(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.

(5)  $di_{(rec)M}/dt$  - peak rate of change of current during  $t_b$  portion of  $t_{rr}$

Fig. 9 - Reverse Recovery Waveform and Definitions

**ORDERING INFORMATION TABLE**

Device code	VS-	60	E	P	U	06	L	-N3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>1</b> - Vishay Semiconductors product								
<b>2</b> - Current rating (60 = 60 A)								
<b>3</b> - Circuit configuration: <ul style="list-style-type: none"> <li>• E = single diode</li> <li>• A = single diode, 3 pins</li> </ul>								
<b>4</b> - P = TO-247								
<b>5</b> - U = ultrafast recovery								
<b>6</b> - Voltage rating (06 = 600 V)								
<b>7</b> - L = long lead								
<b>8</b> - Environmental digit: -N3 = halogen-free, RoHS-compliant and totally lead (Pb)-free								

**ORDERING INFORMATION** (Example)

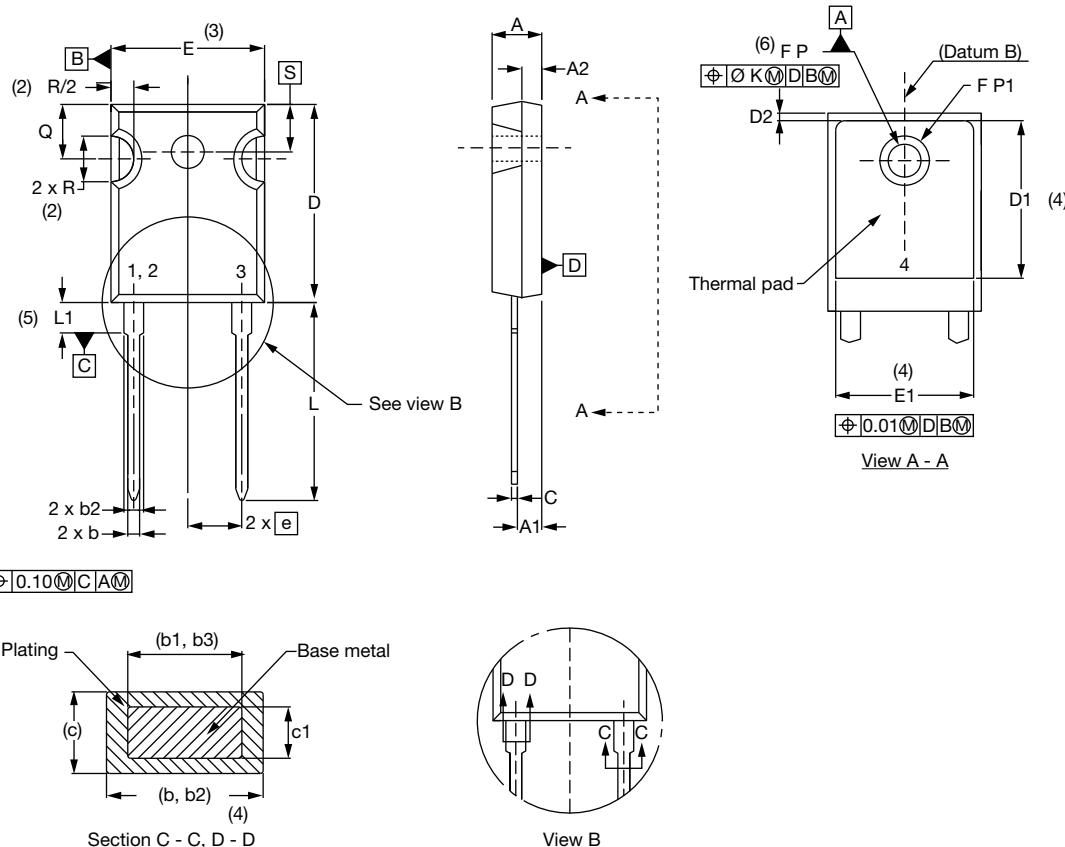
PREFERRED P/N	QUANTITY PER T/R	MINIMUM ORDER QUANTITY	PACKAGING DESCRIPTION
VS-60EPU06L-N3	25	500	Antistatic plastic tube

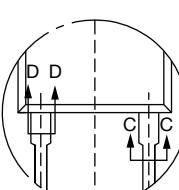
**LINKS TO RELATED DOCUMENTS**

Dimensions	<a href="http://www.vishay.com/doc?95536">www.vishay.com/doc?95536</a>
Part marking information	<a href="http://www.vishay.com/doc?95648">www.vishay.com/doc?95648</a>
SPICE model	<a href="http://www.vishay.com/doc?95545">www.vishay.com/doc?95545</a>

# TO-247AD 2L

**DIMENSIONS** in millimeters and inches



SYMBOL	MILLIMETERS		INCHES		NOTES		SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.				MIN.	MAX.	MIN.	MAX.	
A	4.65	5.31	0.183	0.209			E	15.29	15.87	0.602	0.625	3
A1	2.21	2.59	0.087	0.102			E1	13.46	-	0.53	-	
A2	1.50	2.49	0.059	0.098			e	5.46 BSC		0.215 BSC		
b	0.99	1.40	0.039	0.055			$\varnothing K$	0.254		0.010		
b1	0.99	1.35	0.039	0.053			L	19.81	20.32	0.780	0.800	
b2	1.65	2.39	0.065	0.094			L1	3.71	4.29	0.146	0.169	
b3	1.65	2.34	0.065	0.092			$\varnothing P$	3.56	3.66	0.14	0.144	
c	0.38	0.89	0.015	0.035			$\varnothing P1$	-	6.98	-	0.275	
c1	0.38	0.84	0.015	0.033			Q	5.31	5.69	0.209	0.224	
D	19.71	20.70	0.776	0.815	3		R	4.52	5.49	0.178	0.216	
D1	13.08	-	0.515	-	4		S	5.51 BSC		0.217 BSC		
D2	0.51	1.35	0.020	0.053								

**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)  $\varnothing P$  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

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