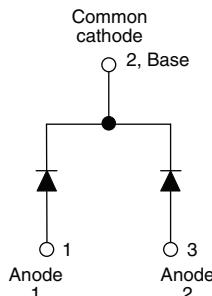
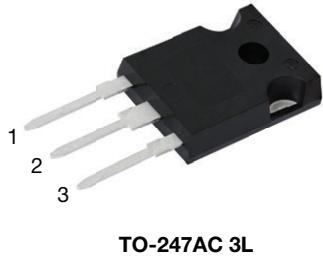


## Ultrafast Rectifier, 2 x 30 A FRED Pt®



### FEATURES

- Low forward voltage drop
- 175 °C operating junction temperature
- Ultrafast recovery time
- Low leakage current
- 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

### DESCRIPTION / APPLICATIONS

VS-60CPU04... series are the state of the art ultrafast recovery rectifiers designed with optimized performance of forward voltage drop and ultrafast recovery time.

The planar structure and the platinum doped life time control guarantee the best overall performance, ruggedness and reliability characteristics.

These devices are intended for use in the output rectification stage of SMPS, welding, UPS, DC/DC converters as well as freewheeling diodes in low voltage inverters, and chopper motor drives.

Their extremely optimized stored charge and low recovery current minimize the switching losses and reduce over dissipation in the switching element and snubbers.

PRIMARY CHARACTERISTICS	
$I_{F(AV)}$	2 x 30 A
$V_R$	400 V
$V_F$ at $I_F$	0.92 V
$t_{rr}$ typ.	37 ns
$T_J$ max.	175 °C
Package	TO-247AC 3L
Circuit configuration	Common cathode

ABSOLUTE MAXIMUM RATINGS					
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS	
Peak repetitive reverse voltage	$V_{RRM}$		400	V	
Average rectified forward current per leg	$I_{F(AV)}$	Rated $V_R$ , $T_C = 134$ °C	30	A	
			60		
			300		
Non-repetitive peak surge current per leg	$I_{FSM}$	$T_J = 25$ °C, $t_p = 10$ ms	300		
Peak repetitive forward current per leg	$I_{FM}$	Rated $V_R$ , square wave, 20 kHz, $T_C = 134$ °C	60		
Operating junction and storage temperatures	$T_J$ , $T_{Stg}$		-65 to +175	°C	

ELECTRICAL SPECIFICATIONS ( $T_J = 25$ °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Forward voltage	$V_F$	$V_R = V_R$ rated, $I_R = 100$ µA	400	-	-	V
		$I_F = 30$ A	-	1.10	1.30	
		$I_F = 30$ A, $T_J = 150$ °C	-	0.92	1.10	
		$I_F = 60$ A	-	1.25	1.6	
Reverse leakage current	$I_R$	$V_R = V_R$ rated	-	-	10	µA
		$T_J = 150$ °C, $V_R = V_R$ rated	-	-	100	
Junction capacitance	$C_T$	$V_R = 400$ V	-	40	-	pF
Series inductance	$L_S$	Measured lead to lead 5 mm from package body	-	12	-	nH

DYNAMIC RECOVERY CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS
Reverse recovery time	$t_{rr}$	$I_F = 1.0 \text{ A}$ , $di_F/dt = 100 \text{ A}/\mu\text{s}$ , $V_R = 30 \text{ V}$		-	37	40	ns
		$I_F = 1.0 \text{ A}$ , $di_F/dt = 50 \text{ A}/\mu\text{s}$ , $V_R = 30 \text{ V}$		-	46	-	
		$T_J = 25^\circ\text{C}$	$I_F = 30 \text{ A}$ $di_F/dt = 200 \text{ A}/\mu\text{s}$ $V_R = 200 \text{ V}$	-	65	-	
		$T_J = 125^\circ\text{C}$		-	119	-	
Peak recovery current	$I_{RRM}$	$T_J = 25^\circ\text{C}$	$I_F = 30 \text{ A}$ $di_F/dt = 200 \text{ A}/\mu\text{s}$ $V_R = 200 \text{ V}$	-	6.4	-	A
		$T_J = 125^\circ\text{C}$		-	14.7	-	
		$T_J = 25^\circ\text{C}$		-	206	-	
Reverse recovery charge	$Q_{rr}$	$T_J = 125^\circ\text{C}$		-	874	-	nC
		$T_J = 25^\circ\text{C}$		-			

THERMAL - MECHANICAL SPECIFICATIONS							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS
Maximum junction and storage temperature range	$T_J, T_{Stg}$			-65	-	+175	°C
Thermal resistance, junction to case per leg	$R_{thJC}$			-	0.6	1.0	°C/W
Thermal resistance, junction to ambient per leg	$R_{thJA}$	Typical socket mount		-	-	40	
Thermal resistance, case to heatsink	$R_{thCS}$	Mounting surface, flat, smooth, and greased		-	0.5	-	
Weight				-	6	-	g
				-	0.21	-	oz.
Mounting torque				6.0 (5.0)	-	12 (10)	kgf · cm (lbf · in)
Marking device		Case style TO-247AC 3L		60CPU04			

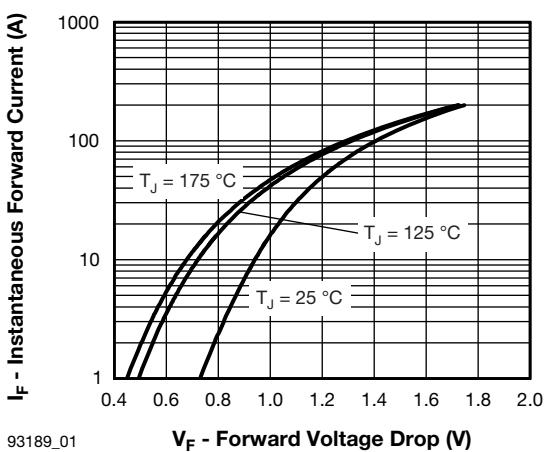


Fig. 1 - Typical Forward Voltage Drop Characteristics

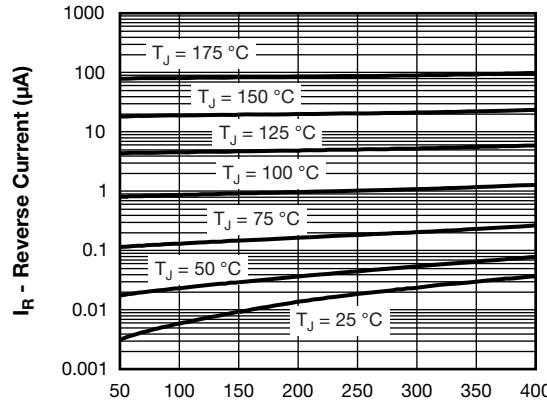


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

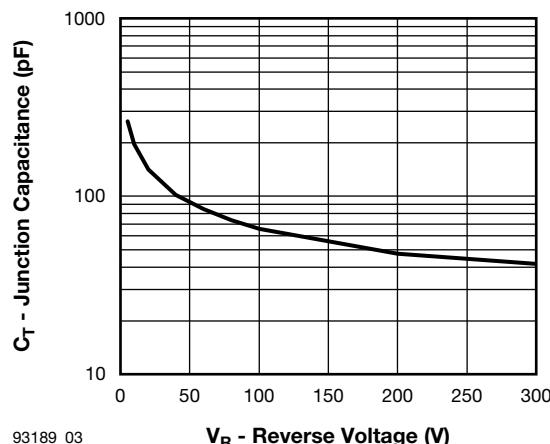


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

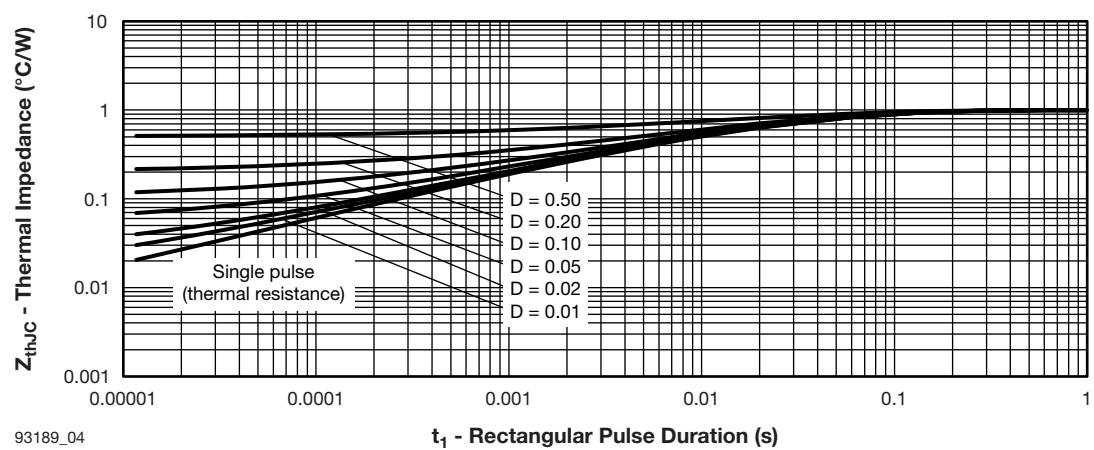


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

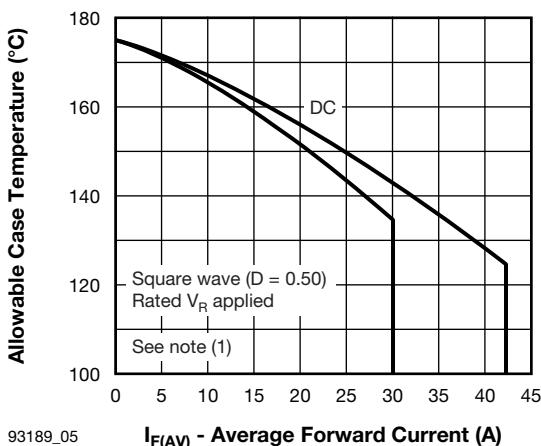


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

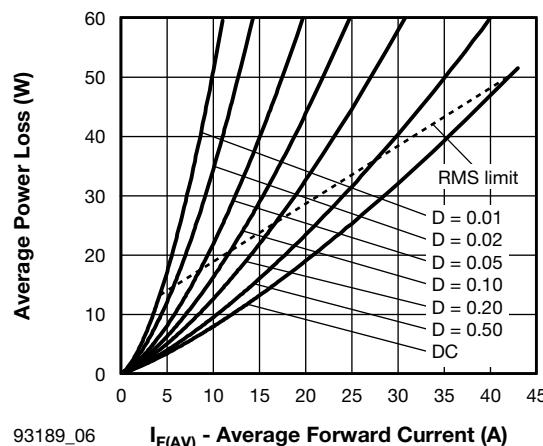
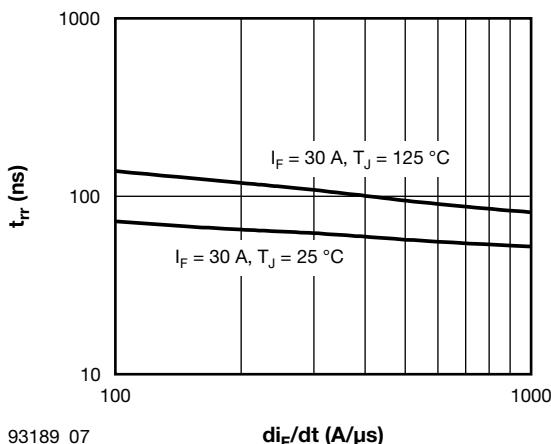
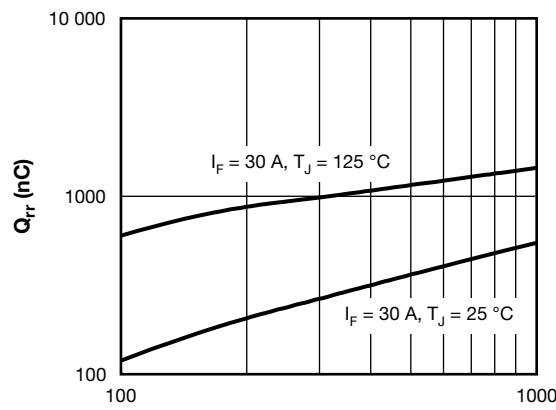


Fig. 6 - Forward Power Loss Characteristics



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**di\_F/dt (A/μs)**

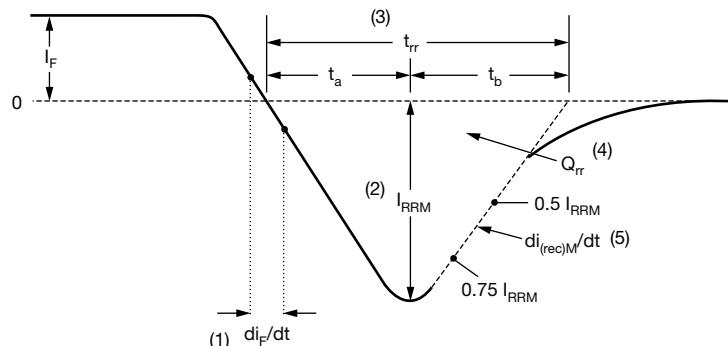
 Fig. 7 - Typical Reverse Recovery Time vs.  $di_F/dt$ 


93189\_08

**di\_F/dt (A/μs)**

 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  $V_{R1}$  = rated  $V_R$


 (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	C	P	U	04	-N3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)

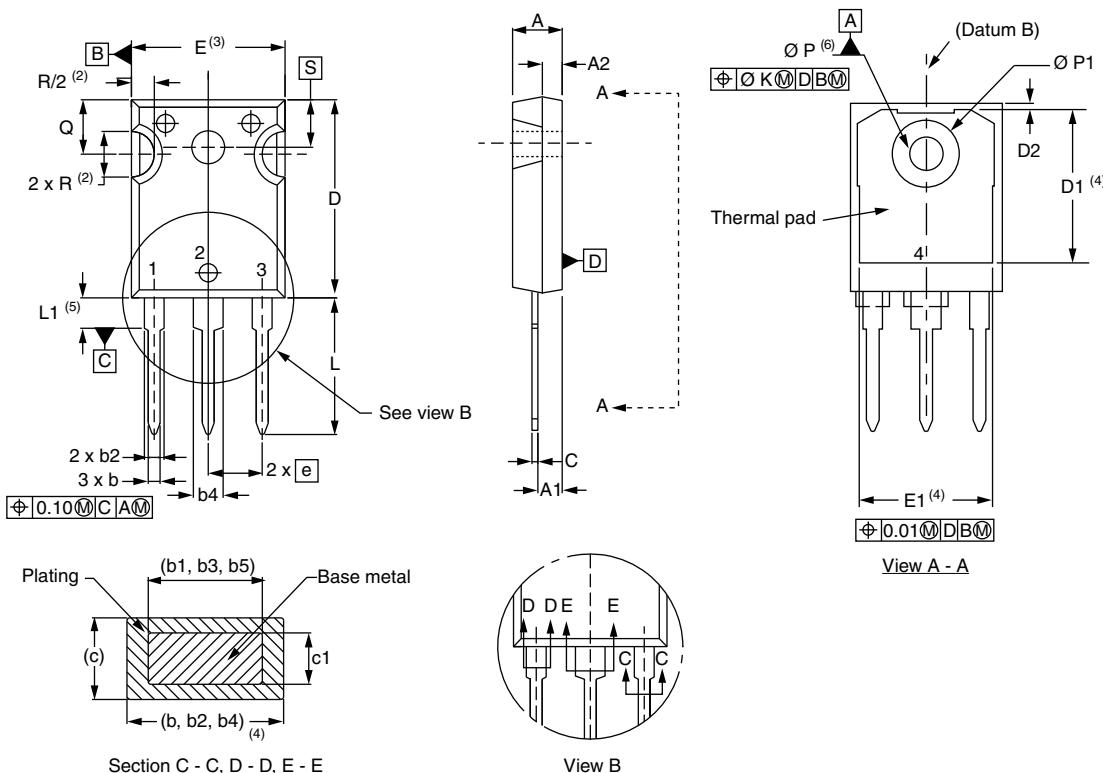
- 1** - Vishay Semiconductors product
- 2** - Current rating (60 = 60 A)
- 3** - Circuit configuration: C = common cathode
- 4** - P = TO-247AC
- 5** - U = ultrafast rectifier
- 6** - Voltage rating (04 = 400 V)
- 7** - Environmental digit:  
-N3 = halogen-free, RoHS-compliant and totally lead (Pb)-free

<b>ORDERING INFORMATION</b> (Example)			
PREFERRED P/N	QUANTITY PER TUBE	MINIMUM ORDER QUANTITY	PACKAGING DESCRIPTION
VS-60CPU04-N3	25	500	Antistatic plastic tube

<b>LINKS TO RELATED DOCUMENTS</b>	
Dimensions	<a href="http://www.vishay.com/doc?96138">www.vishay.com/doc?96138</a>
Part marking information	<a href="http://www.vishay.com/doc?95007">www.vishay.com/doc?95007</a>
SPICE model	<a href="http://www.vishay.com/doc?95398">www.vishay.com/doc?95398</a>

# TO-247AC 3L

**DIMENSIONS** in millimeters and inches



SYMBOL	MILLIMETERS		INCHES		NOTES	View A-A	SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.				MIN.	MAX.	MIN.	MAX.	
A	4.65	5.31	0.183	0.209			D2	0.51	1.35	0.020	0.053	
A1	2.21	2.59	0.087	0.102			E	15.29	15.87	0.602	0.625	3
A2	1.17	1.37	0.046	0.054			E1	13.46	-	0.53	-	
b	0.99	1.40	0.039	0.055			e	5.46 BSC		0.215 BSC		
b1	0.99	1.35	0.039	0.053			Ø K	0.254		0.010		
b2	1.65	2.39	0.065	0.094			L	14.20	16.10	0.559	0.634	
b3	1.65	2.34	0.065	0.092			L1	3.71	4.29	0.146	0.169	
b4	2.59	3.43	0.102	0.135			Ø P	3.56	3.66	0.14	0.144	
b5	2.59	3.38	0.102	0.133			Ø P1	-	7.39	-	0.291	
c	0.38	0.89	0.015	0.035			Q	5.31	5.69	0.209	0.224	
c1	0.38	0.84	0.015	0.033			R	4.52	5.49	0.178	0.216	
D	19.71	20.70	0.776	0.815	3		S	5.51 BSC		0.217 BSC		
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. 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) 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 Q

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