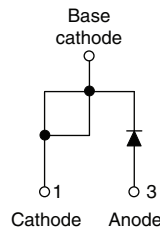


# HEXFRED®

## Ultrafast Soft Recovery Diode, 25 A


**TO-220AC**

**FEATURES**

- Ultrafast and ultrasoft recovery
- Very low  $I_{RRM}$  and  $Q_{rr}$
- Designed and qualified according to JEDEC®-JESD47
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**BENEFITS**

- Reduced RFI and EMI
- Reduced power loss in diode and switching transistor
- Higher frequency operation
- Reduced snubbing
- Reduced parts count

**DESCRIPTION**

VS-HFA25TB60... is a state of the art ultrafast recovery diode. Employing the latest in epitaxial construction and advanced processing techniques it features a superb combination of characteristics which result in performance which is unsurpassed by any rectifier previously available. With basic ratings of 600 V and 25 A continuous current, the VS-HFA25TB60... is especially well suited for use as the companion diode for IGBTs and MOSFETs. In addition to ultrafast recovery time, the HEXFRED® product line features extremely low values of peak recovery current ( $I_{RRM}$ ) and does not exhibit any tendency to “snap-off” during the  $t_b$  portion of recovery. The HEXFRED features combine to offer designers a rectifier with lower noise and significantly lower switching losses in both the diode and the switching transistor. These HEXFRED advantages can help to significantly reduce snubbing, component count and heatsink sizes. The HEXFRED VS-HFA25TB60... is ideally suited for applications in power supplies and power conversion systems (such as inverters), motor drives, and many other similar applications where high speed, high efficiency is needed.

PRODUCT SUMMARY	
Package	TO-220AC
$I_{F(AV)}$	25 A
$V_R$	600 V
$V_F$ at $I_F$	1.3 V
$t_{rr}$ typ.	23 ns
$T_J$ max.	150 °C
Diode variation	Single die

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Cathode to anode voltage	$V_R$		600	V
Maximum continuous forward current	$I_F$	$T_C = 100\text{ °C}$	25	A
Single pulse forward current	$I_{FSM}$		225	
Maximum repetitive forward current	$I_{FRM}$		100	
Maximum power dissipation	$P_D$	$T_C = 25\text{ °C}$	125	W
		$T_C = 100\text{ °C}$	50	
Operating junction and storage temperature range	$T_J, T_{Stg}$		-55 to +150	°C



<b>ELECTRICAL SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Cathode to anode breakdown voltage	$V_{BR}$	$I_R = 100\text{ }\mu\text{A}$	600	-	-	V
Maximum forward voltage	$V_{FM}$	$I_F = 25\text{ A}$	-	1.3	1.7	
		$I_F = 50\text{ A}$	-	1.5	2.0	
		$I_F = 25\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	1.3	1.7	
Maximum reverse leakage current	$I_{RM}$	$V_R = V_R\text{ rated}$	-	1.5	20	$\mu\text{A}$
		$T_J = 125\text{ }^\circ\text{C}, V_R = 0.8 \times V_R\text{ rated}$	-	600	2000	
Junction capacitance	$C_T$	$V_R = 200\text{ V}$	-	55	100	pF
Series inductance	$L_S$	Measured lead to lead 5 mm from package body	-	8.0	-	nH

<b>DYNAMIC RECOVERY CHARACTERISTICS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Reverse recovery time See fig. 5, 6 and 16	$t_{rr}$	$I_F = 1.0\text{ A}, dl_F/dt = 200\text{ A}/\mu\text{s}, V_R = 30\text{ V}$	-	23	-	ns
	$t_{rr1}$	$T_J = 25\text{ }^\circ\text{C}$	-	50	75	
	$t_{rr2}$	$T_J = 125\text{ }^\circ\text{C}$	-	105	160	
Peak recovery current See fig. 7 and 8	$I_{RRM1}$	$T_J = 25\text{ }^\circ\text{C}$	-	4.5	10	A
	$I_{RRM2}$	$T_J = 125\text{ }^\circ\text{C}$	-	8.0	15	
Reverse recovery charge See fig. 9 and 10	$Q_{rr1}$	$T_J = 25\text{ }^\circ\text{C}$	-	112	375	nC
	$Q_{rr2}$	$T_J = 125\text{ }^\circ\text{C}$	-	420	1200	
Peak rate of fall of recovery current during $t_b$ See fig. 11 and 12	$dl_{(rec)M}/dt1$	$T_J = 25\text{ }^\circ\text{C}$	-	250	-	$\text{A}/\mu\text{s}$
	$dl_{(rec)M}/dt2$	$T_J = 125\text{ }^\circ\text{C}$	-	160	-	

<b>THERMAL - MECHANICAL SPECIFICATIONS</b>						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Lead temperature	$T_{lead}$	0.063" from case (1.6 mm) for 10 s	-	-	300	$^\circ\text{C}$
Thermal resistance, junction to case	$R_{thJC}$		-	-	1.0	K/W
Thermal resistance, junction to ambient	$R_{thJA}$	Typical socket mount	-	-	80	
Thermal resistance, case to heatsink	$R_{thCS}$	Mounting surface, flat, smooth and greased	-	0.5	-	
Weight			-	2.0	-	g
			-	0.07	-	oz.
Mounting torque			6.0 (5.0)	-	12 (10)	kgf · cm (lbf · in)
Marking device		Case style TO-220AC	HFA25TB60			

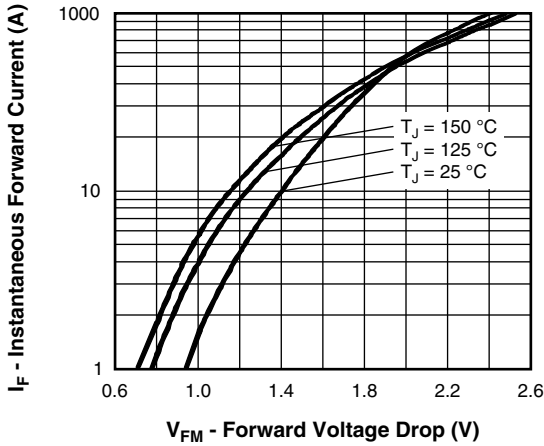


Fig. 1 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

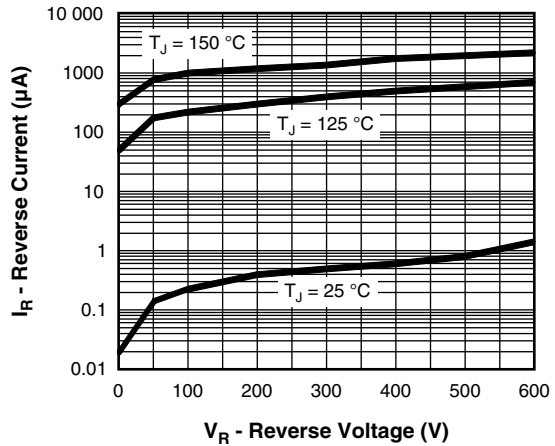


Fig. 2 - Typical Reverse Current vs. Reverse Voltage

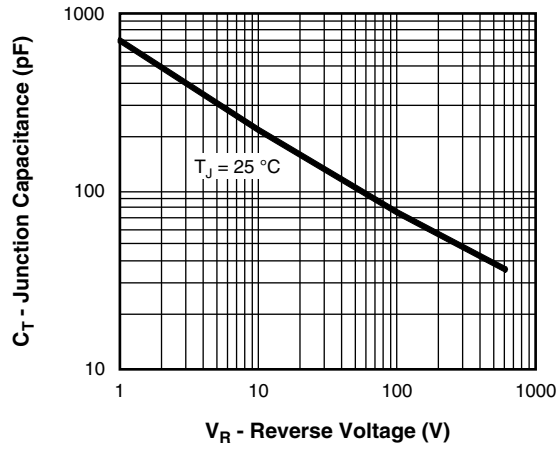


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

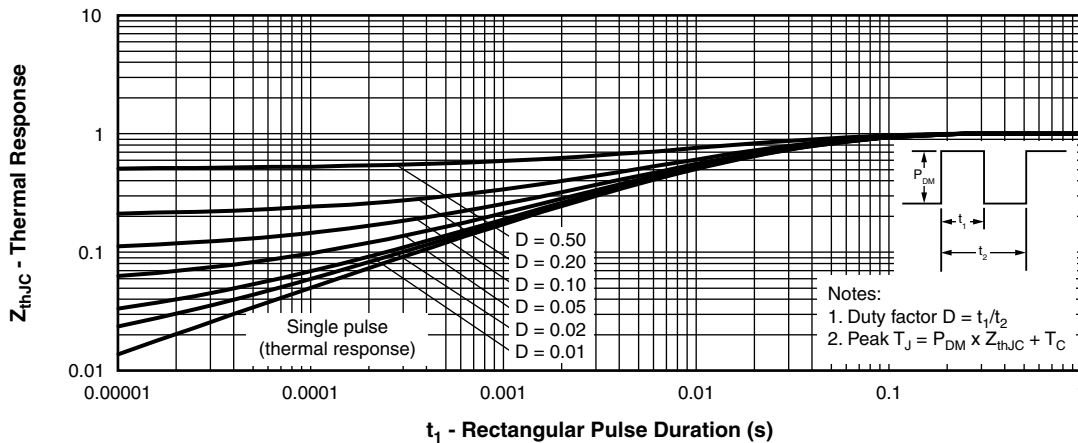


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

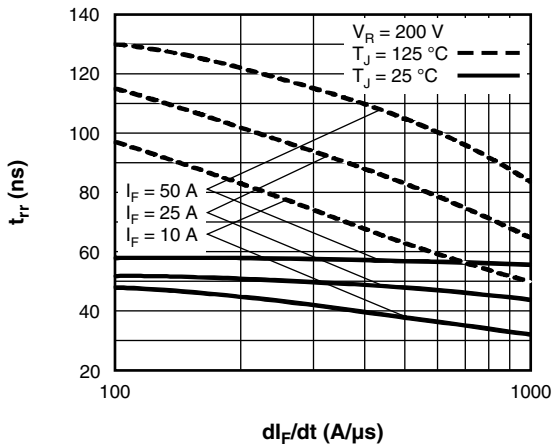


Fig. 5 - Typical Reverse Recovery Time vs.  $di_F/dt$

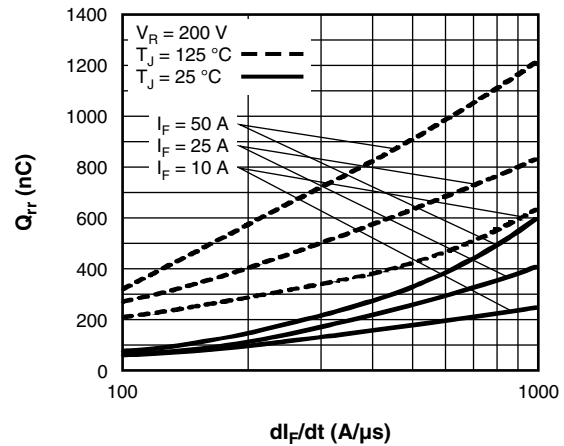


Fig. 7 - Typical Stored Charge vs.  $di_F/dt$

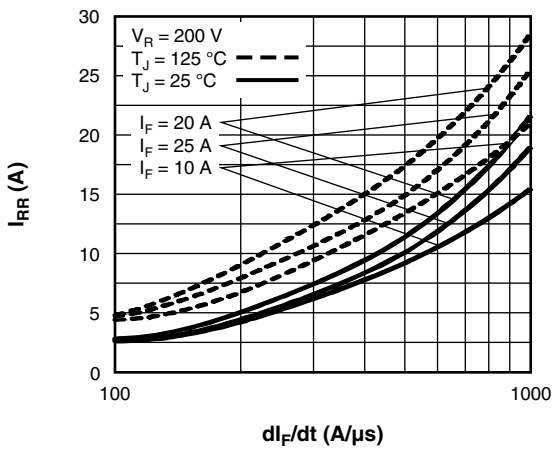


Fig. 6 - Typical Recovery Current vs.  $di_F/dt$

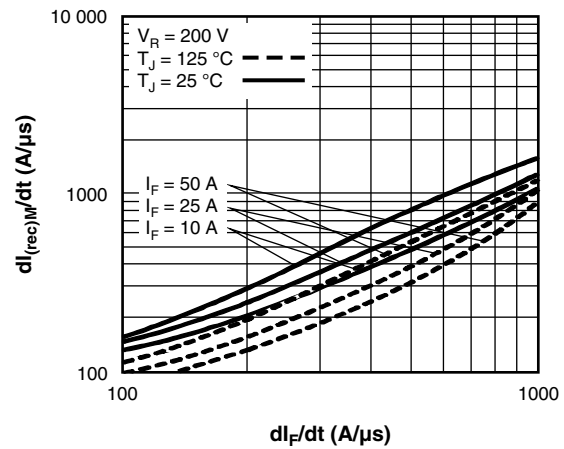


Fig. 8 - Typical  $di_{(rec)M}/dt$  vs.  $di_F/dt$

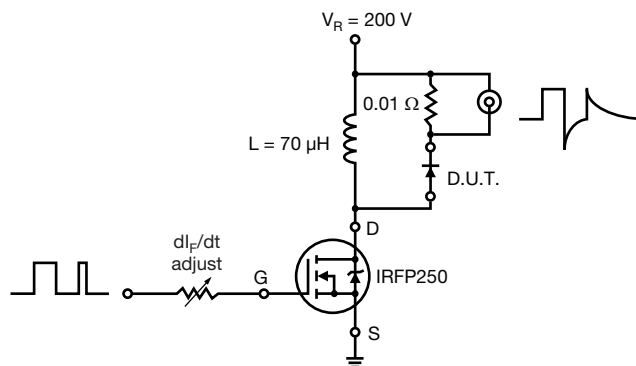


Fig. 9 - Reverse Recovery Parameter Test Circuit



- (1)  $dl_F/dt$  - 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  $I_{RRM}$
- $$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$
- (5)  $dl_{(rec)M}/dt$  - peak rate of change of current during  $t_b$  portion of  $t_{rr}$

Fig. 10 - Reverse Recovery Waveform and Definitions

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>HF</b>	<b>A</b>	<b>25</b>	<b>TB</b>	<b>60</b>	<b>PbF</b>
	①	②	③	④	⑤	⑥	⑦

- 1** - Vishay Semiconductors product
- 2** - HEXFRED® family
- 3** - Electron irradiated
- 4** - Current rating (25 = 25 A)
- 5** - Package:  
TB = TO-220AC
- 6** - Voltage rating (60 = 600 V)
- 7** - Environmental digit:  
PbF = lead (Pb)-free and RoHS-compliant  
-N3 = halogen-free, RoHS-compliant, and totally lead (Pb)-free

<b>ORDERING INFORMATION</b> (Example)			
PREFERRED P/N	QUANTITY PER T/R	MINIMUM ORDER QUANTITY	PACKAGING DESCRIPTION
VS-HFA25TB60PbF	50	1000	Antistatic plastic tube
VS-HFA25TB60-N3	50	1000	Antistatic plastic tube

<b>LINKS TO RELATED DOCUMENTS</b>	
Dimensions	<a href="http://www.vishay.com/doc?95221">www.vishay.com/doc?95221</a>
Part marking information	TO-220ACPbF <a href="http://www.vishay.com/doc?95224">www.vishay.com/doc?95224</a>
	TO-220AC-N3 <a href="http://www.vishay.com/doc?95068">www.vishay.com/doc?95068</a>
SPICE model	<a href="http://www.vishay.com/doc?95468">www.vishay.com/doc?95468</a>

## TO-220AC

**DIMENSIONS** in millimeters and inches



**Lead assignments**  
 Diodes  
 1 + 2 - Cathode  
 3 - Anode

Conforms to JEDEC outline TO-220AC

SYMBOL	MILLIMETERS		INCHES		NOTES	SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.			MIN.	MAX.	MIN.	MAX.	
A	4.25	4.65	0.167	0.183		E1	6.86	8.89	0.270	0.350	6
A1	1.14	1.40	0.045	0.055		E2	-	0.76	-	0.030	7
A2	2.56	2.92	0.101	0.115		e	2.41	2.67	0.095	0.105	
b	0.69	1.01	0.027	0.040		e1	4.88	5.28	0.192	0.208	
b1	0.38	0.97	0.015	0.038	4	H1	6.09	6.48	0.240	0.255	6, 7
b2	1.20	1.73	0.047	0.068		L	13.52	14.02	0.532	0.552	
b3	1.14	1.73	0.045	0.068	4	L1	3.32	3.82	0.131	0.150	2
c	0.36	0.61	0.014	0.024		L3	1.78	2.13	0.070	0.084	
c1	0.36	0.56	0.014	0.022	4	L4	0.76	1.27	0.030	0.050	2
D	14.85	15.25	0.585	0.600	3	$\theta$	90° to 93°		90° to 93°		
D1	8.38	9.02	0.330	0.355							
D2	11.68	12.88	0.460	0.507	6						
E	10.11	10.51	0.398	0.414	3, 6						

**Notes**

- (1) Dimensioning and tolerancing as per ASME Y14.5M-1994
- (2) Lead dimension and finish uncontrolled in L1
- (3) Dimension D, D1 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) Dimension b1, b3 and c1 apply to base metal only
- (5) Controlling dimension: inches
- (6) Thermal pad contour optional within dimensions E, H1, D2 and E1
- (7) Dimension E2 x H1 define a zone where stamping and singulation irregularities are allowed
- (8) Outline conforms to JEDEC TO-220, D2 (minimum) where dimensions are derived from the actual package outline



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