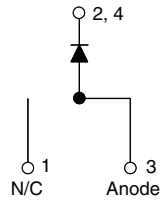


# HEXFRED<sup>®</sup>, Ultrafast Soft Recovery Diode, 4 A



D-PAK (TO-252AA)


**FEATURES**

- Ultrafast recovery time
- Ultrasoft recovery
- Very low  $I_{RRM}$
- Very low  $Q_{rr}$
- Guaranteed avalanche
- Specified at operating temperature
- AEC-Q101 qualified
- Meets JESD 201 class 1A whisker test
- Meets MSL level 1, per J-STD-020, LF maximum peak of 260 °C
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**
**PRODUCT SUMMARY**

Package	TO-252AA (D-PAK)
$I_{F(AV)}$	4 A
$V_R$	600 V
$V_F$ at $I_F$	1.8 V
$t_{rr}$ typ.	17 ns
$T_J$ max.	150 °C
Diode variation	Single die

**BENEFITS**

- Reduced RFI and EMI
- Reduced power loss in diode and switching transistor
- 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 freewheeling, flyback, power converters, motor drives, and other applications where high speed and reduced switching losses are design requirements.

**ABSOLUTE MAXIMUM RATINGS**

PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Cathode to anode voltage	$V_{RRM}$		600	V
Maximum continuous forward current	$I_{F(AV)}$	$T_C = 100\text{ °C}$	4	A
Single pulse forward current	$I_{FSM}$		25	
Repetitive peak forward current	$I_{FRM}$	$T_C = 116\text{ °C}$	16	
Maximum power dissipation	$P_D$	$T_C = 100\text{ °C}$	10	W
Operating junction and storage temperatures	$T_J, T_{Stg}$		- 55 to 150	°C

**ELECTRICAL SPECIFICATIONS ( $T_J = 25\text{ °C}$  unless otherwise specified)**

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Breakdown voltage, blocking voltage	$V_{BR}, V_R$	$I_R = 100\text{ }\mu\text{A}$	600	-	-	V
Forward voltage See fig. 1	$V_F$	$I_F = 4\text{ A}$	-	1.5	1.8	
		$I_F = 8\text{ A}$	-	1.8	2.2	
		$I_F = 4\text{ A}, T_J = 125\text{ °C}$	-	1.4	1.7	
Maximum reverse leakage current	$I_R$	$V_R = V_R$ rated	-	0.17	3.0	$\mu\text{A}$
		$T_J = 125\text{ °C}, V_R = 0.8 \times V_R$ rated	-	44	300	
Junction capacitance	$C_T$	$V_R = 200\text{ V}$	-	4	8	pF
Series inductance	$L_S$	Measured lead to lead 5 mm from package body	-	8.0	-	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	$t_{rr}$	$I_F = 1.0\text{ A}$ , $dI_F/dt = 200\text{ A}/\mu\text{A}$ , $V_R = 30\text{ V}$	-	17	-	ns
		$T_J = 25\text{ }^\circ\text{C}$	-	28	42	
		$T_J = 125\text{ }^\circ\text{C}$	-	38	57	
Peak recovery current	$I_{RRM}$	$T_J = 25\text{ }^\circ\text{C}$	-	2.9	5.2	A
		$T_J = 125\text{ }^\circ\text{C}$	-	3.7	6.7	
Reverse recovery charge	$Q_{rr}$	$T_J = 25\text{ }^\circ\text{C}$	-	40	60	nC
		$T_J = 125\text{ }^\circ\text{C}$	-	70	105	
Rate of fall of recovery current	$dI_{(rec)M}/dt$	$T_J = 25\text{ }^\circ\text{C}$	-	280	-	A/ $\mu\text{s}$
		$T_J = 125\text{ }^\circ\text{C}$	-	235	-	

THERMAL - MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Maximum junction and storage temperature range	$T_J$ , $T_{Stg}$		- 55	-	150	$^\circ\text{C}$
Thermal resistance, junction to case	$R_{thJC}$		-	-	5.0	$^\circ\text{C}/\text{W}$
Thermal resistance, junction to ambient	$R_{thJA}$	Typical socket mount	-	-	80	
Weight			-	2.0	-	g
			-	0.07	-	oz.
Mounting torque			6.0 (5.0)	-	12 (10)	kgf · cm (lbf · in)
Marking device		Case style D-PAK	HFA04SD60SH			

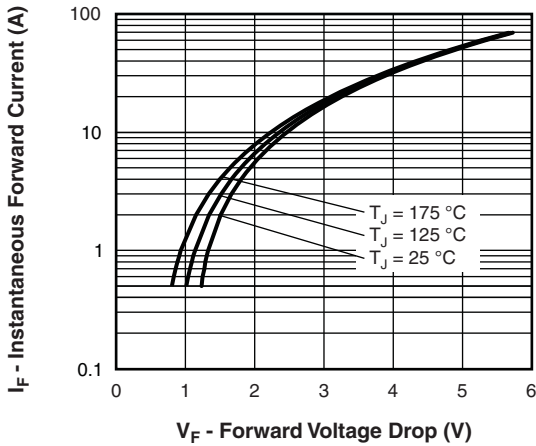


Fig. 1 - Typical Forward Voltage Drop Characteristics

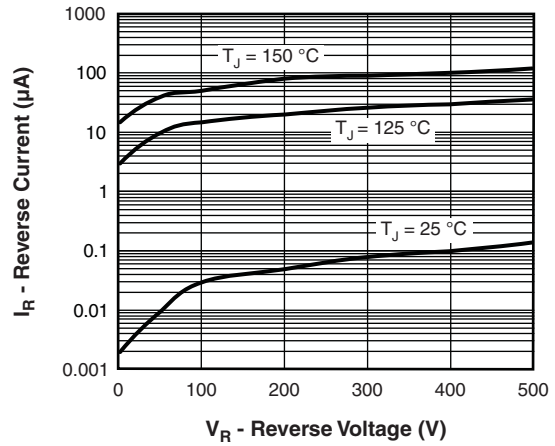


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

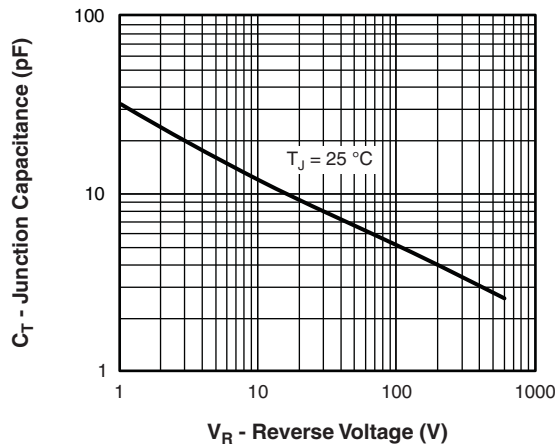


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

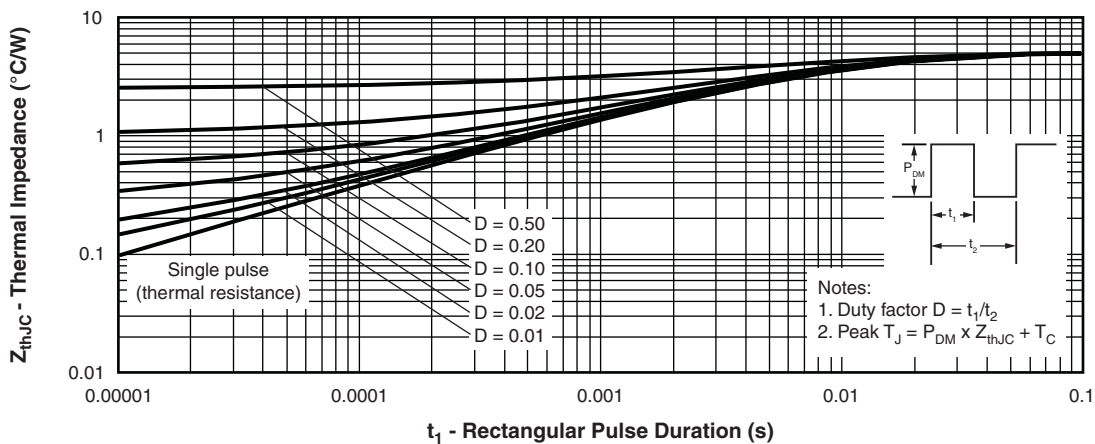


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

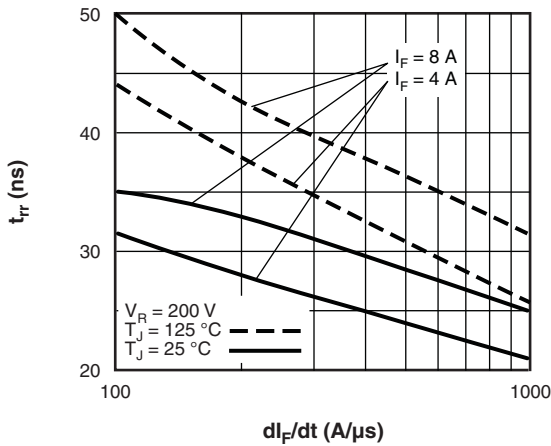


Fig. 5 - Typical Reverse Recovery Time vs.  $di_F/dt$

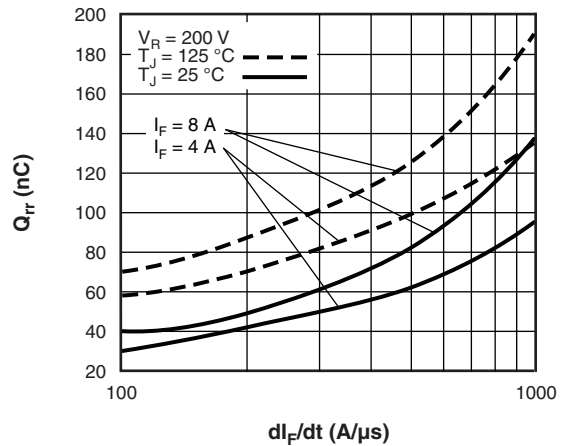


Fig. 7 - Typical Stored Charge vs.  $di_F/dt$

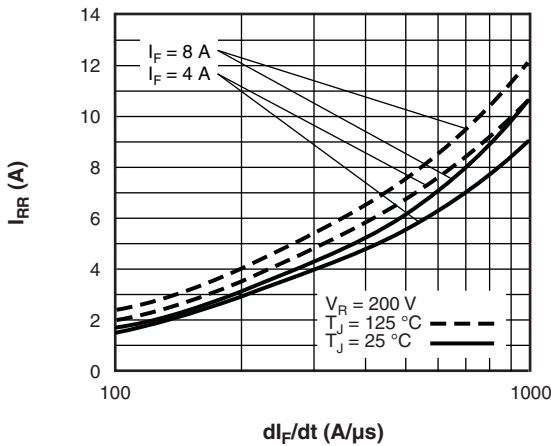


Fig. 6 - Typical Recovery Current vs.  $di_F/dt$

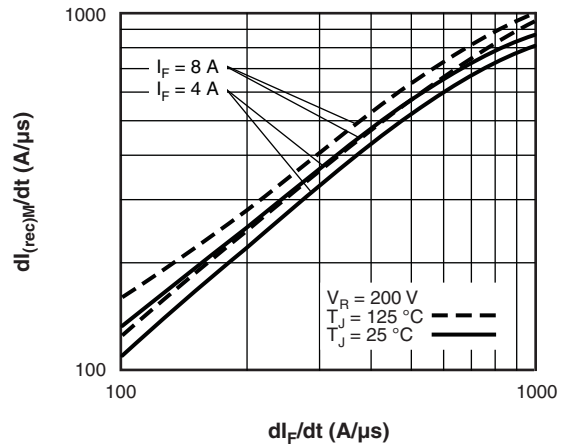


Fig. 8 - Typical  $di_{(rec)M}/dt$  vs.  $di_F/dt$

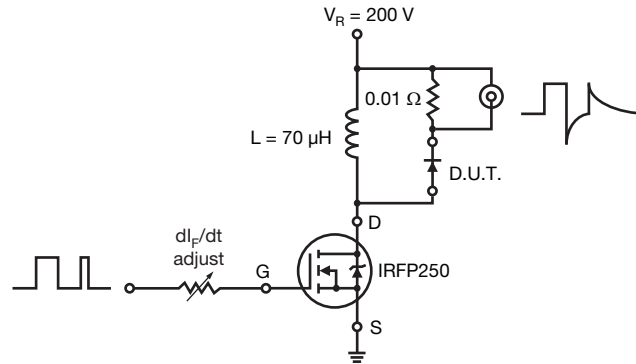
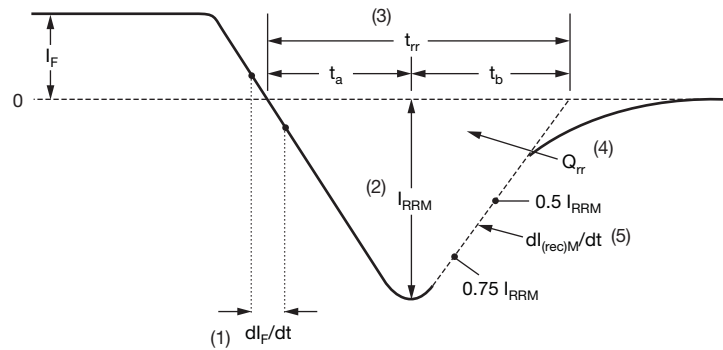


Fig. 9 - Reverse Recovery Parameter Test Circuit

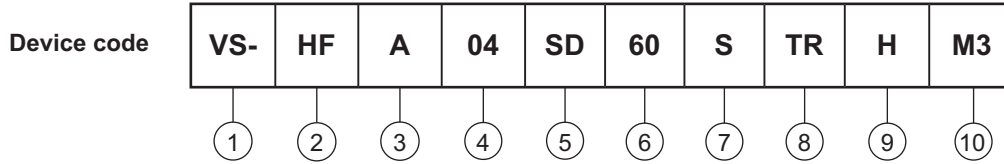


- |   |   |
|---|---|
| <p>(1) <math>di_F/dt</math> - rate of change of current through zero crossing</p> <p>(2) <math>I_{RRM}</math> - peak reverse recovery current</p> <p>(3) <math>t_{rr}</math> - reverse recovery time measured from zero crossing point of negative going <math>I_F</math> to point where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

Fig. 10 - Reverse Recovery Waveform and Definitions



## ORDERING INFORMATION TABLE



- 1** - Vishay Semiconductors product
- 2** - HEXFRED® family
- 3** - Electron irradiated
- 4** - Current rating (04 = 4 A)
- 5** - D-PAK
- 6** - Voltage rating (60 = 600 V)
- 7** - S = D-PAK
- 8** -
  - TR = Tape and reel
  - R = Tape and reel (right oriented)
  - L = Tape and reel (left oriented)
- 9** - H = AEC-Q101 qualified
- 10** - Environmental digit:
  - M3 = Halogen-free, RoHS-compliant, and terminations lead (Pb)-free

ORDERING INFORMATION (Example)			
PREFERRED P/N	QUANTITY PER T/R	MINIMUM ORDER QUANTITY	PACKAGING DESCRIPTION
VS-HFA04SD60SHM3	75	3000	Antistatic plastic tube
VS-HFA04SD60STRHM3	2000	2000	13" diameter reel
VS-HFA04SD60STRRHM3	3000	3000	13" diameter reel
VS-HFA04SD60STRLHM3	3000	3000	13" diameter reel

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95519">www.vishay.com/doc?95519</a>
Part marking information	<a href="http://www.vishay.com/doc?95518">www.vishay.com/doc?95518</a>
Packaging information	<a href="http://www.vishay.com/doc?95033">www.vishay.com/doc?95033</a>



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