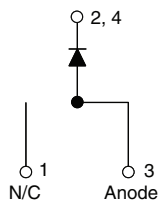


# HEXFRED®, Ultrafast Soft Recovery Diode, 4 A



DPAK (TO-252AA)



## FEATURES

- Ultrafast recovery time
- Ultrasoft recovery
- Very low  $I_{RRM}$
- Very low  $Q_{rr}$
- Guaranteed avalanche
- Specified at operating temperature
- 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**

## PRIMARY CHARACTERISTICS

$I_{F(AV)}$	4 A
$V_R$	600 V
$V_F$ at $I_F$	1.4 V
$t_{rr}$ typ.	17 ns
$T_J$ max.	150 °C
Package	DPAK (TO-252AA)
Circuit configuration	Single

## 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 DPAK (TO-252AA)	HFA04SD60S			

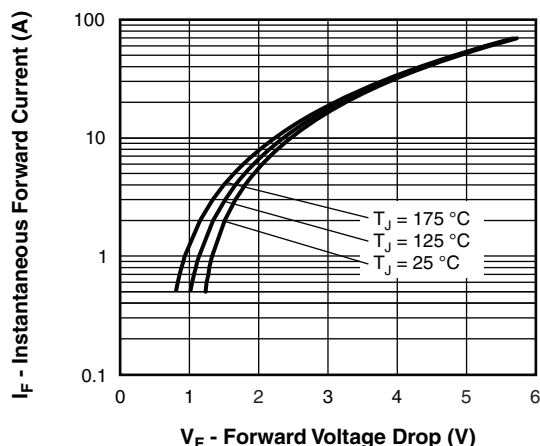


Fig. 1 - Typical Forward Voltage Drop Characteristics

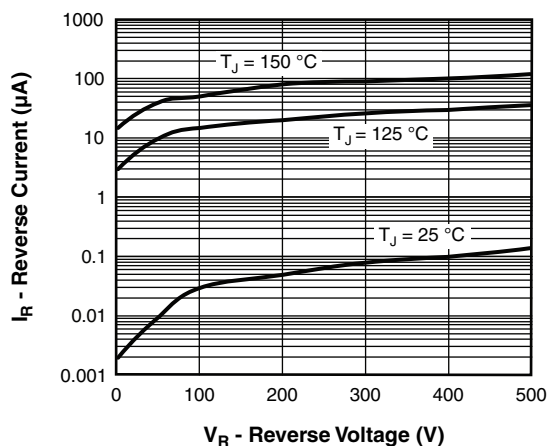


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

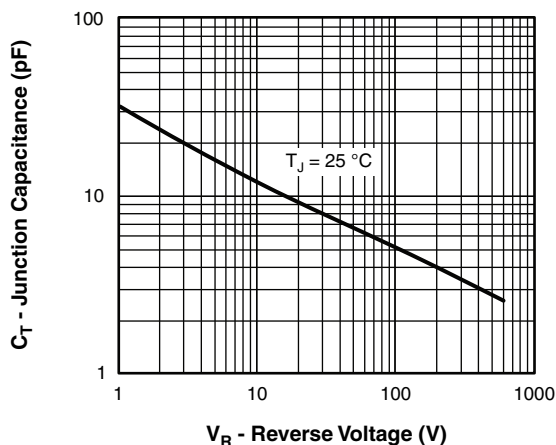
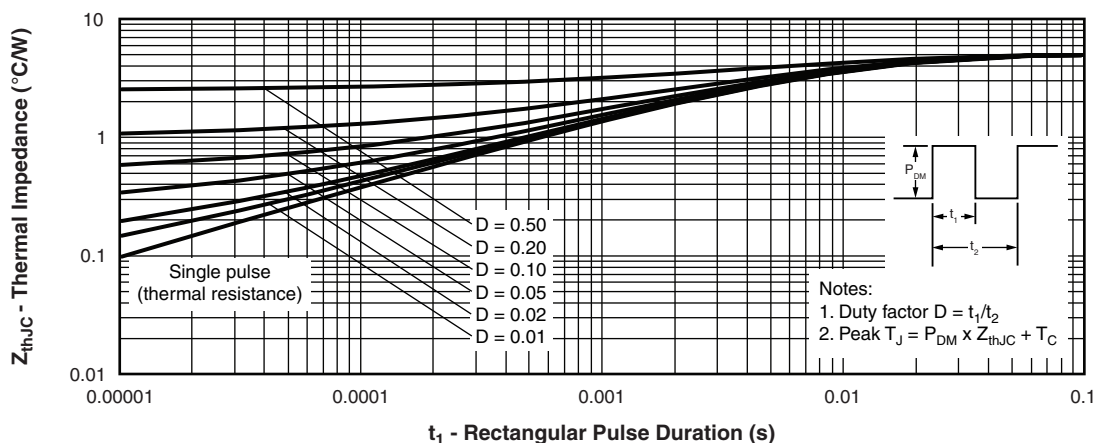
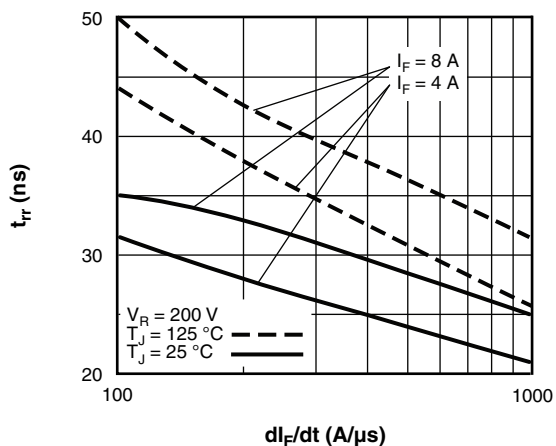
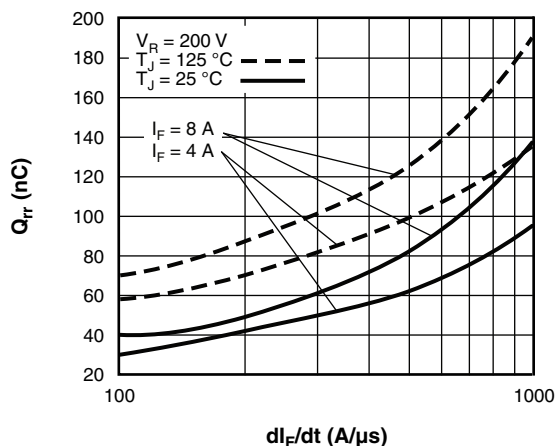
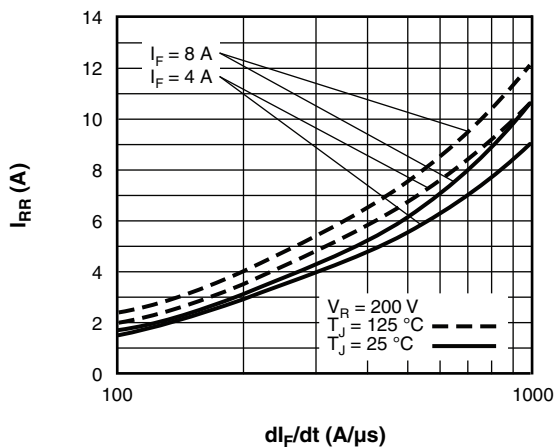
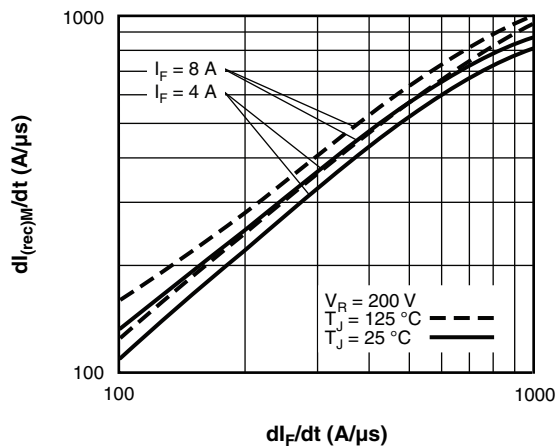


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage


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.  $dI_F/dt$

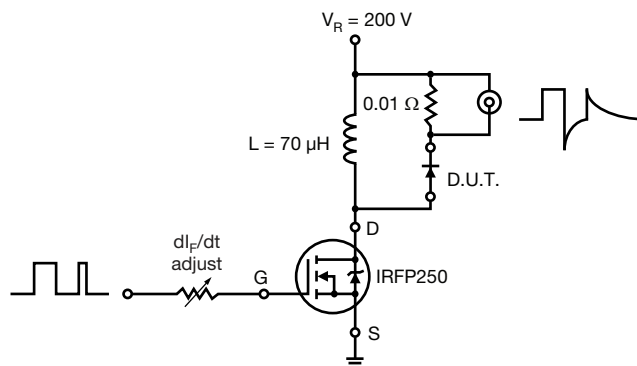


Fig. 9 - Reverse Recovery Parameter Test Circuit

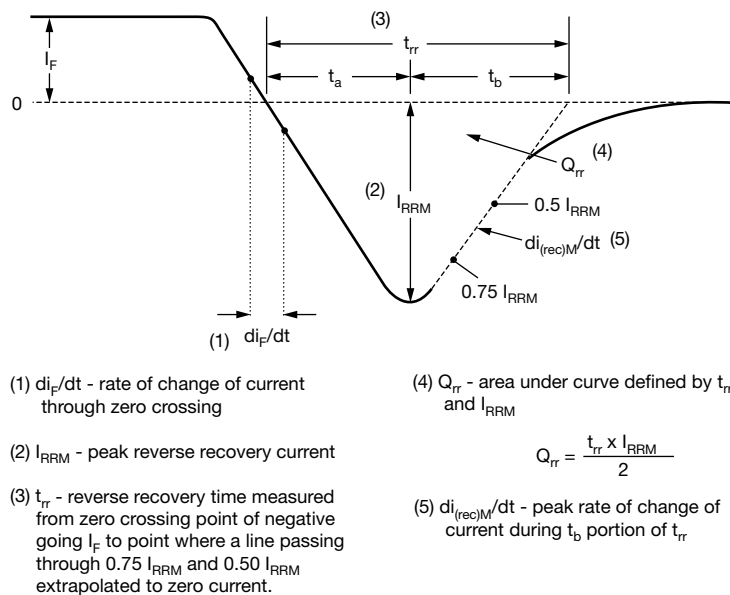


Fig. 10 - Reverse Recovery Waveform and Definitions

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>HF</b>	<b>A</b>	<b>04</b>	<b>SD</b>	<b>60</b>	<b>S</b>	<b>TR</b>	<b>-M3</b>
	1	2	3	4	5	6	7	8	9

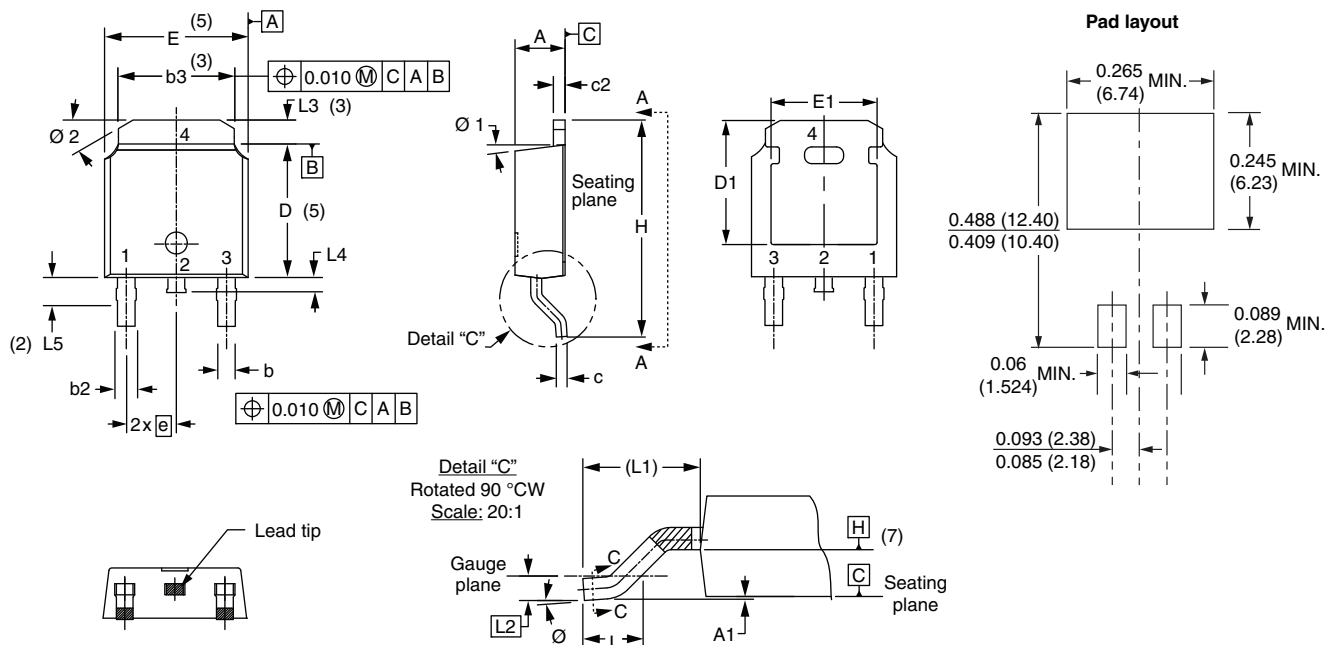
- |          |   |   |
|----------|---|---|
| <b>1</b> | - | Vishay Semiconductors product   |
| <b>2</b> | - | HEXFRED <sup>®</sup> family   |
| <b>3</b> | - | Electron irradiated   |
| <b>4</b> | - | Current rating (04 = 4 A)   |
| <b>5</b> | - | D-PAK   |
| <b>6</b> | - | Voltage rating (60 = 600 V)   |
| <b>7</b> | - | S = D-PAK   |
| <b>8</b> | - | <ul style="list-style-type: none"><li>• TR = tape and reel</li><li>• R = tape and reel (right oriented)</li><li>• L = tape and reel (left oriented)</li></ul> |
| <b>9</b> | - | Environmental digit:<br>-M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free   |

<b>ORDERING INFORMATION (Example)</b>		
<b>PREFERRED P/N</b>	<b>BASE QUANTITY</b>	<b>PACKAGING DESCRIPTION</b>
VS-HFA04SD60S-M3	75	Antistatic plastic tube
VS-HFA04SD60STR-M3	2000	13" diameter reel
VS-HFA04SD60SL-M3	3000	13" diameter reel
VS-HFA04SD60SR-M3	3000	13" diameter reel

<b>LINKS TO RELATED DOCUMENTS</b>	
Dimensions	<a href="http://www.vishay.com/doc?95627">www.vishay.com/doc?95627</a>
Part marking information	<a href="http://www.vishay.com/doc?95176">www.vishay.com/doc?95176</a>
Packaging information	<a href="http://www.vishay.com/doc?95033">www.vishay.com/doc?95033</a>

### D-PAK (TO-252AA) "M"

**DIMENSIONS** in millimeters and inches



SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	2.18	2.39	0.086	0.094	
A1	-	0.13	-	0.005	
b	0.64	0.89	0.025	0.035	
b2	0.76	1.14	0.030	0.045	
b3	4.95	5.46	0.195	0.215	3
c	0.46	0.61	0.018	0.024	
c2	0.46	0.89	0.018	0.035	
D	5.97	6.22	0.235	0.245	5
D1	5.21	-	0.205	-	3
E	6.35	6.73	0.250	0.265	5
E1	4.32	-	0.170	-	3

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
e	2.29 BSC		0.090 BSC		
H	9.40	10.41	0.370	0.410	
L	1.40	1.78	0.055	0.070	
L1	2.74 BSC		0.108 REF.		
L2	0.51 BSC		0.020 BSC		
L3	0.89	1.27	0.035	0.050	3
L4	-	1.02	-	0.040	
L5	1.14	1.52	0.045	0.060	2
Ø	0°	10°	0°	10°	
Ø1	0°	15°	0°	15°	
Ø2	25°	35°	25°	35°	

#### Notes

- Dimensioning and tolerancing as per ASME Y14.5M-1994
- Lead dimension uncontrolled in L5
- Dimension D1, E1, L3 and b3 establish a minimum mounting surface for thermal pad
- Section C - C dimension apply to the flat section of the lead between 0.13 and 0.25 mm (0.005 and 0.010") from the lead tip
- 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
- Dimension b1 and c1 applied to base metal only
- Datum A and B to be determined at datum plane H
- Outline conforms to JEDEC® outline TO-252AA



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