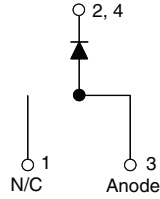


HEXFRED[®], Ultrafast Soft Recovery Diode, 4 A


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


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 | μA |
| | | $T_J = 125\text{ °C}, V_R = 0.8 \times V_R$ 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/ μs |
| | | $T_J = 125\text{ }^\circ\text{C}$ | - | 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 | | | |

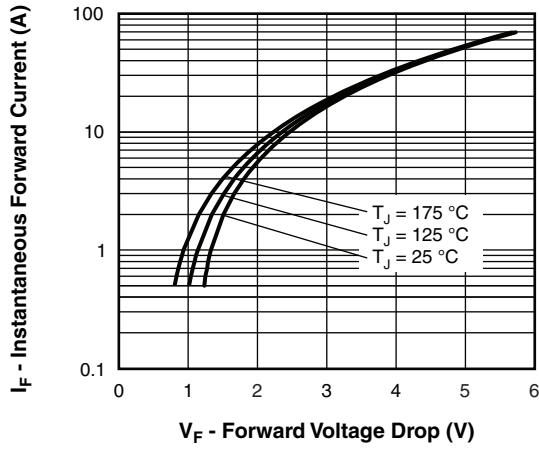


Fig. 1 - Typical Forward Voltage Drop Characteristics

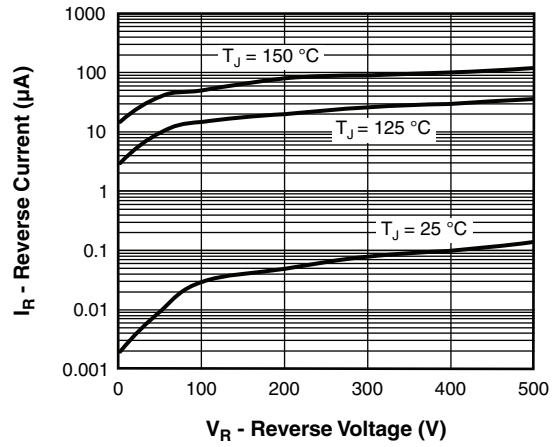


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

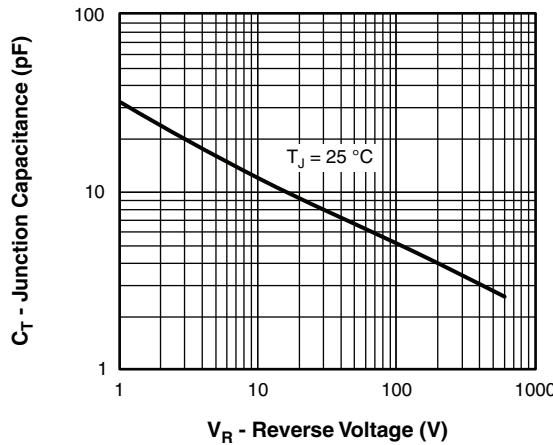


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

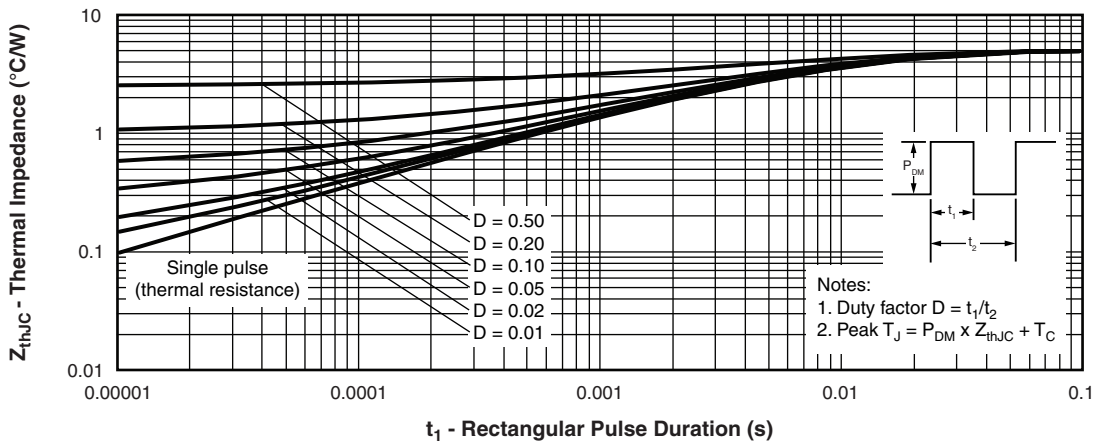


Fig. 4 - Maximum Thermal Impedance Z_{thJC} Characteristics

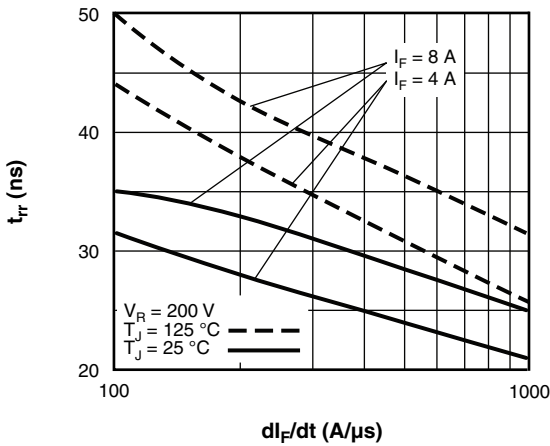


Fig. 5 - Typical Reverse Recovery Time vs. di_F/dt

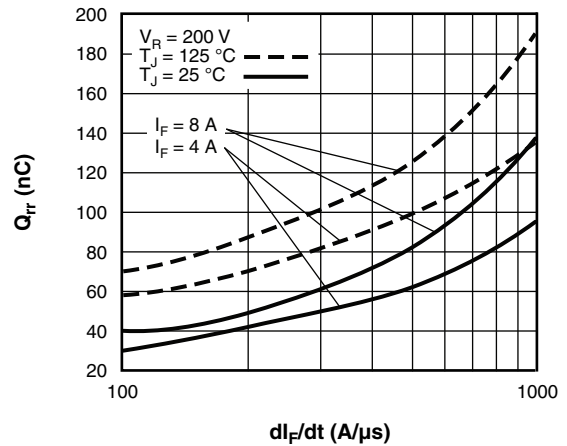


Fig. 7 - Typical Stored Charge vs. di_F/dt

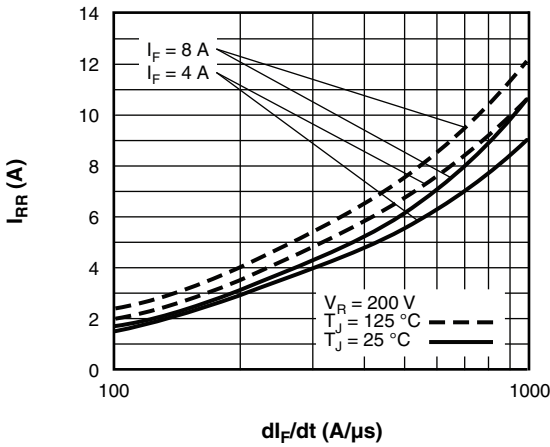


Fig. 6 - Typical Recovery Current vs. di_F/dt

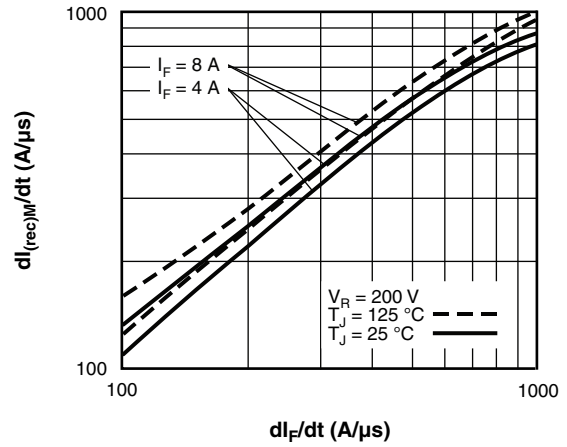


Fig. 8 - Typical $dI_{(rec)M}/dt$ vs. di_F/dt

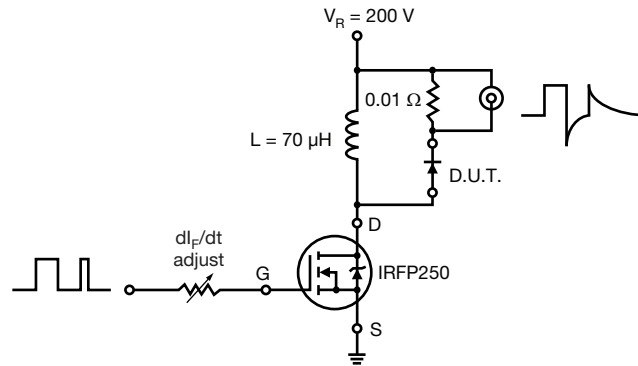
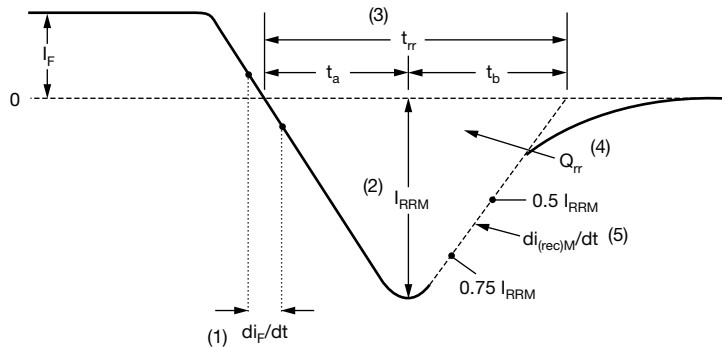


Fig. 9 - Reverse Recovery Parameter Test Circuit



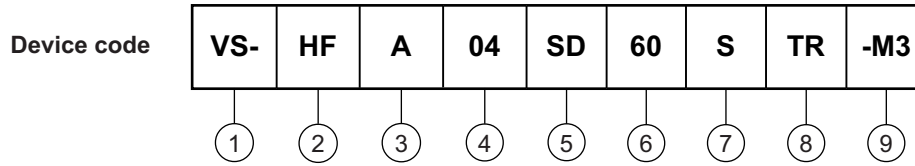
- (1) di_F/dt - rate of change of current through zero crossing
- (2) I_{RRM} - peak reverse recovery current
- (3) t_{rr} - reverse recovery time measured from zero crossing point of negative going I_F to point where a line passing through $0.75 I_{RRM}$ and $0.50 I_{RRM}$ extrapolated to zero current.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

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

Fig. 10 - Reverse Recovery Waveform and Definitions



ORDERING INFORMATION TABLE



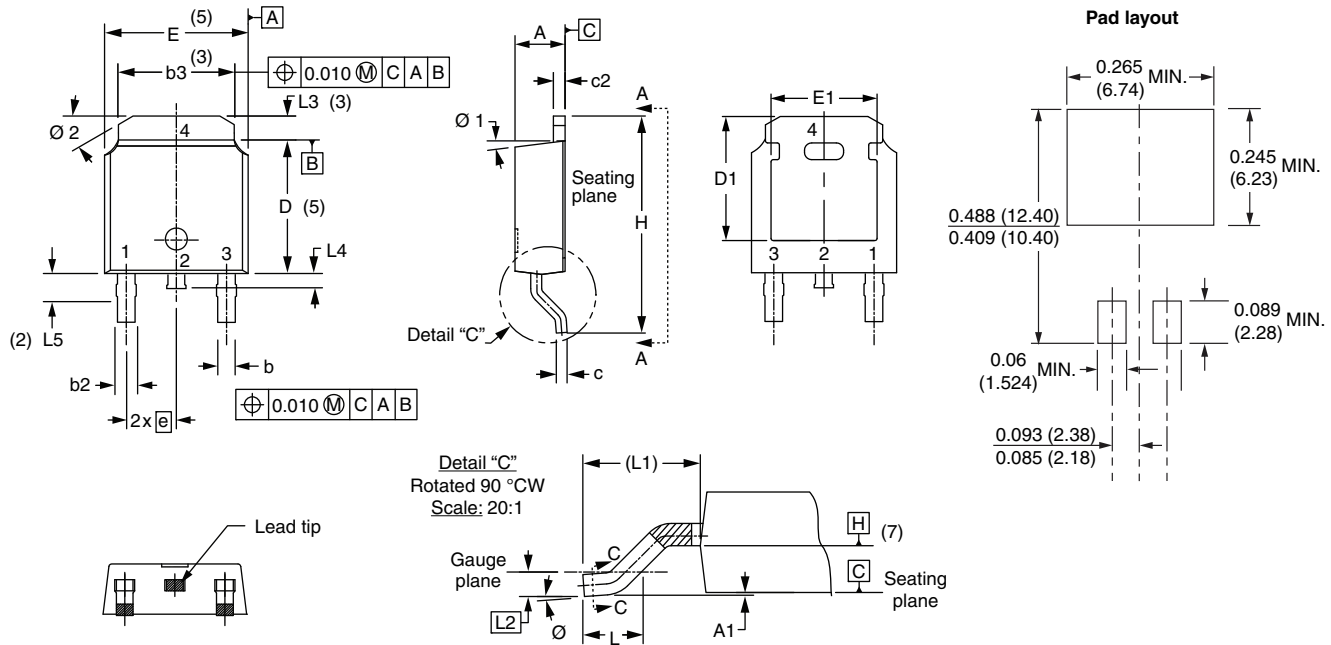
- 1** - Vishay Semiconductors product
- 2** - HEXFRED® family
- 3** - Electron irradiated
- 4** - Current rating (04 = 4 A)
- 5** - D-PAK
- 6** - Voltage rating (60 = 600 V)
- 7** - S = D-PAK
- 8** -
 - TR = tape and reel
 - R = tape and reel (right oriented)
 - L = tape and reel (left oriented)
- 9** - 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-HFA04SD60S-M3 | 75 | 3000 | Antistatic plastic tube |
| VS-HFA04SD60STR-M3 | 2000 | 2000 | 13" diameter reel |
| VS-HFA04SD60SL-M3 | 3000 | 3000 | 13" diameter reel |
| VS-HFA04SD60SR-M3 | 3000 | 3000 | 13" diameter reel |

| LINKS TO RELATED DOCUMENTS | |
|----------------------------|--|
| Dimensions | www.vishay.com/doc?95627 |
| Part marking information | www.vishay.com/doc?95176 |
| Packaging information | www.vishay.com/doc?95033 |

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

DIMENSIONS in millimeters and inches



| SYMBOL | MILLIMETERS | | INCHES | | NOTES | SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|--------|-------------|------|--------|-------|-------|--------|-------------|-------|------------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | | | MIN. | MAX. | MIN. | MAX. | |
| A | 2.18 | 2.39 | 0.086 | 0.094 | | e | 2.29 BSC | | 0.090 BSC | | |
| A1 | - | 0.13 | - | 0.005 | | H | 9.40 | 10.41 | 0.370 | 0.410 | |
| b | 0.64 | 0.89 | 0.025 | 0.035 | | L | 1.40 | 1.78 | 0.055 | 0.070 | |
| b2 | 0.76 | 1.14 | 0.030 | 0.045 | | L1 | 2.74 BSC | | 0.108 REF. | | |
| b3 | 4.95 | 5.46 | 0.195 | 0.215 | 3 | L2 | 0.51 BSC | | 0.020 BSC | | |
| c | 0.46 | 0.61 | 0.018 | 0.024 | | L3 | 0.89 | 1.27 | 0.035 | 0.050 | 3 |
| c2 | 0.46 | 0.89 | 0.018 | 0.035 | | L4 | - | 1.02 | - | 0.040 | |
| D | 5.97 | 6.22 | 0.235 | 0.245 | 5 | L5 | 1.14 | 1.52 | 0.045 | 0.060 | 2 |
| D1 | 5.21 | - | 0.205 | - | 3 | Ø | 0° | 10° | 0° | 10° | |
| E | 6.35 | 6.73 | 0.250 | 0.265 | 5 | Ø1 | 0° | 15° | 0° | 15° | |
| E1 | 4.32 | - | 0.170 | - | 3 | Ø2 | 25° | 35° | 25° | 35° | |

Notes

- (1) Dimensioning and tolerancing as per ASME Y14.5M-1994
- (2) Lead dimension uncontrolled in L5
- (3) Dimension D1, E1, L3 and b3 establish a minimum mounting surface for thermal pad
- (4) Section C - C dimension apply to the flat section of the lead between 0.13 and 0.25 mm (0.005 and 0.10") from the lead tip
- (5) 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
- (6) Dimension b1 and c1 applied to base metal only
- (7) Datum A and B to be determined at datum plane H
- (8) Outline conforms to JEDEC® outline TO-252AA



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