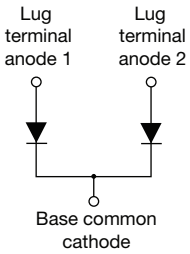
# HEXFRED®
# Ultra Fast Soft Recovery Diode, 320 A

TO-244




## FEATURES

- Very low $Q_{rr}$ and $t_{rr}$
- UL approved file E222165
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

## BENEFITS

- Reduced RFI and EMI
- Reduced snubbing

## DESCRIPTION / APPLICATIONS

HEXFRED® diodes are optimized to reduce losses and EMI/RFI in high frequency power conditioning systems. An extensive characterization of the recovery behavior for different values of current, temperature and $dI_F/dt$ simplifies the calculations of losses in the operating conditions. The softness of the recovery eliminates the need for a snubber in most applications. These devices are ideally suited for power converters, motors drives and other applications where switching losses are significant portion of the total losses.

| PRIMARY CHARACTERISTICS | |
|---|---|
| $I_{F(AV)}$ | 320 A |
| $V_R$ | 400 V |
| $I_{F(DC)}$ at $T_C$ | 255 A at 85 °C |
| Package | TO-244 |
| Circuit configuration | Two diodes common cathode |

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER | SYMBOL | TEST CONDITIONS | MAX. | UNITS |
|---|---|---|---|---|
| Cathode to anode voltage | $V_R$ | | 400 | V |
| Continuous forward current | $I_F$ | $T_C$ = 25 °C | 420 | A |
| | | $T_C$ = 85 °C | 255 | |
| | | $T_C$ = 115 °C | 160 | |
| Single pulse forward current | $I_{FSM}$ | Limited by junction temperature | 1200 | |
| Non-repetitive avalanche energy | $E_{AS}$ | L = 100 µH, duty cycle limited by maximum $T_J$ | 1.4 | mJ |
| Maximum power dissipation | $P_D$ | $T_C$ = 25 °C | 625 | W |
| | | $T_C$ = 100 °C | 250 | |
| Operating junction and storage temperature range | $T_J$, $T_{Stg}$ | | -55 to +150 | °C |

**ELECTRICAL SPECIFICATIONS** ($T_J$ = 25 °C unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNITS |
|---|---|---|---|---|---|---|---|
| Cathode to anode breakdown voltage | $V_{BR}$ | $I_R$ = 100 µA | | 400 | - | - | V |
| Maximum forward voltage | $V_{FM}$ | $I_F$ = 160 A | See fig. 1 | - | 1.10 | 1.35 | |
| | | $I_F$ = 320 A | | - | 1.30 | 1.54 | |
| | | $I_F$ = 160 A, $T_J$ = 125 °C | | - | 1.00 | 1.20 | |
| Maximum reverse leakage current | $I_{RM}$ | $T_J$ = 125 °C, $V_R$ = 400 V | See fig. 2 | - | 0.9 | 3 | mA |
| Junction capacitance | $C_T$ | $V_R$ = 200 V | See fig. 3 | - | 370 | 500 | pF |
| Series inductance | $L_S$ | From top of terminal hole to mounting plane | | - | 5.0 | - | nH |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| DYNAMIC RECOVERY CHARACTERISTICS ($T_J$ = 25 °C unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNITS |
| Reverse recovery time See fig. 5 | $t_{rr}$ | $I_F$ = 1.0 A, $dI_F/dt$ = 200 A/μs, $V_R$ = 30 V | | - | 45 | - | ns |
| | | $T_J$ = 25 °C | $I_F$ = 160 A $dI_F/dt$ = 200 A/μs $V_R$ = 200 V | - | 90 | 140 | |
| | | $T_J$ = 125 °C | | - | 290 | 440 | |
| Peak recovery current See fig. 6 | $I_{RRM}$ | $T_J$ = 25 °C | | - | 8.7 | 20 | A |
| | | $T_J$ = 125 °C | | - | 18 | 30 | |
| Reverse recovery charge See fig. 7 | $Q_{rr}$ | $T_J$ = 25 °C | | - | 420 | 1100 | nC |
| | | $T_J$ = 125 °C | | - | 2600 | 7000 | |
| Peak rate of recovery current See fig. 8 | $dI_{(rec)M}/dt$ | $T_J$ = 25 °C | | - | 300 | - | A/μs |
| | | $T_J$ = 125 °C | | - | 280 | - | |

| THERMAL - MECHANICAL SPECIFICATIONS | | | | | | |
|---|---|---|---|---|---|---|
| PARAMETER | | SYMBOL | MIN. | TYP. | MAX. | UNITS |
| Maximum junction and storage temperature range | | $T_J$, $T_{Stg}$ | - 55 | - | 150 | °C |
| Thermal resistance, junction to case | per leg | $R_{thJC}$ | - | - | 0.19 | °C/W K/W |
| | per module | | - | - | 0.095 | |
| Typical thermal resistance, case to heatsink | | $R_{thCS}$ | - | 0.10 | - | |
| Weight | | | - | 68 | - | g |
| | | | - | 2.4 | - | oz. |
| Mounting torque (1) | | | 30 (3.4) | - | 40 (4.6) | lbf · in (N · m) |
| | center hole | | 12 (1.4) | - | 18 (2.1) | |
| Terminal torque | | | 30 (3.4) | - | 40 (4.6) | |
| Vertical pull | | | - | - | 80 | lbf · in |
| 2" lever pull | | | - | - | 35 | |

**Note**

(1) Mounting surface must be smooth, flat, free of burrs or other protrusions. Apply a thin even film or thermal grease to mounting surface. Gradually tighten each mounting bolt in 5 to 10 lbf · in steps until desired or maximum torque limits are reached.

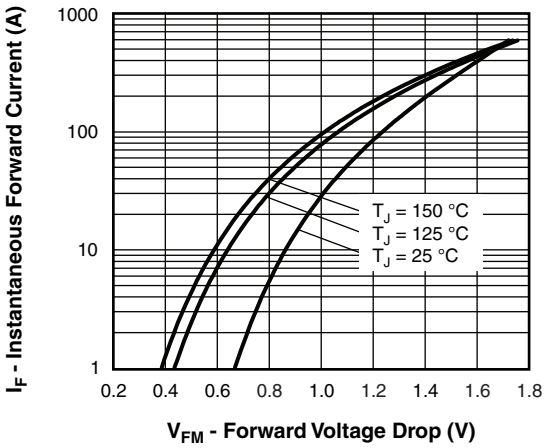


Fig. 1 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current (Per Leg)

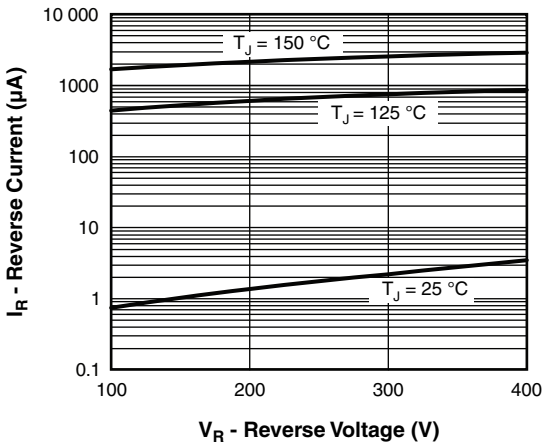


Fig. 2 - Typical Reverse Current vs. Reverse Voltage (Per Leg)


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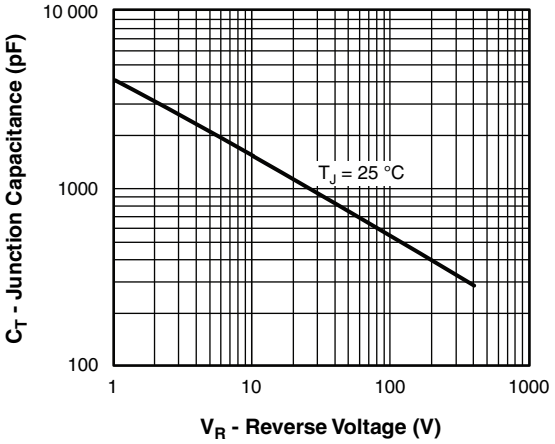


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage (Per Leg)

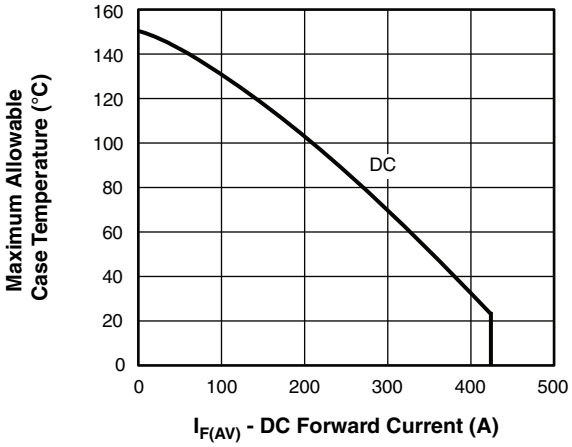


Fig. 4 - Maximum Allowable Case Temperature vs. DC Forward Current (Per Leg)

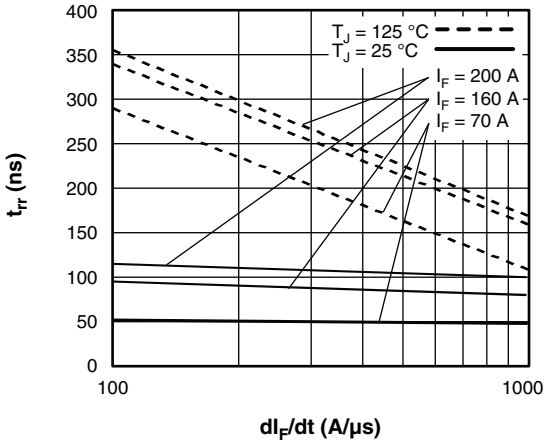


Fig. 5 - Typical Reverse Recovery Time vs. $dI_F/dt$ (Per Leg)

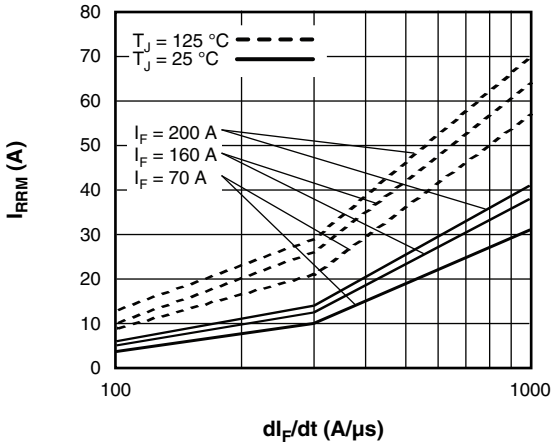


Fig. 6 - Typical Recovery Current vs. $dI_F/dt$ (Per Leg)

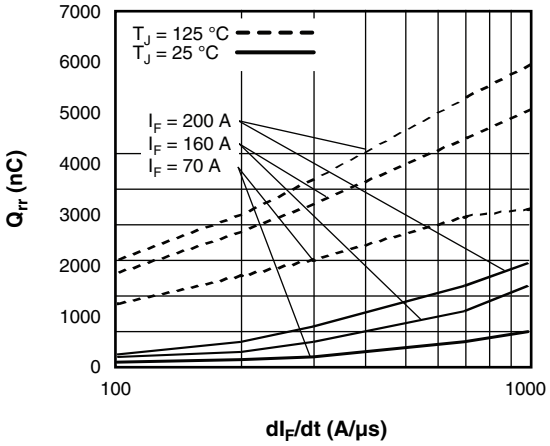


Fig. 7 - Typical Stored Charge vs. $dI_F/dt$ (Per Leg)

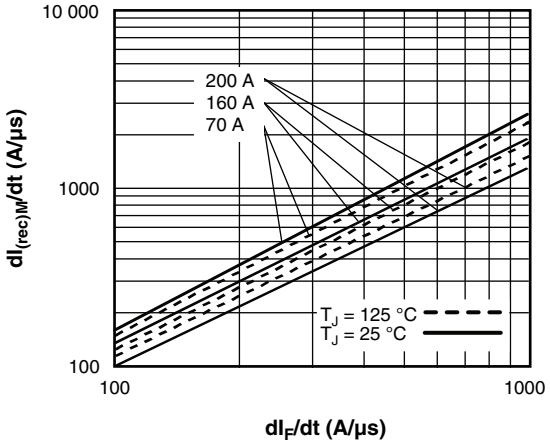


Fig. 8 - Typical $dI_{(rec)M}/dt$ vs. $dI_F/dt$ (Per Leg)


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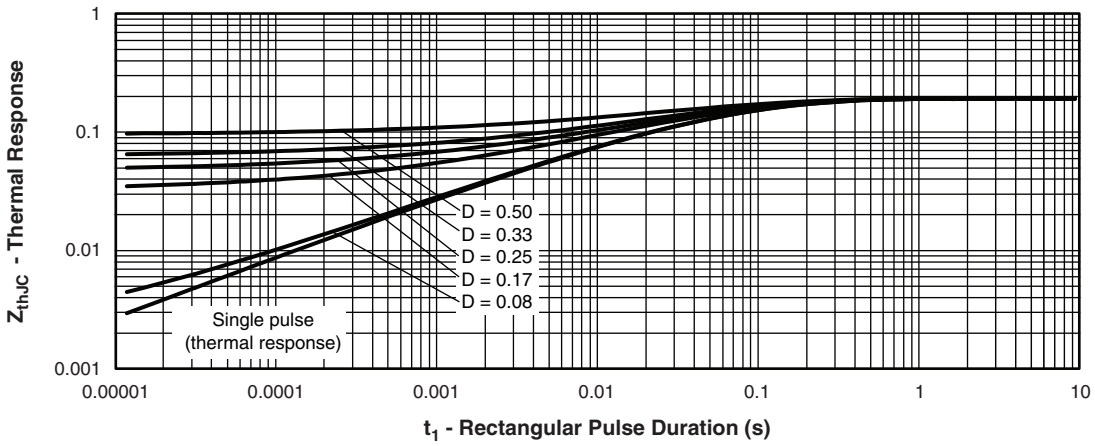



Fig. 9 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (Per Leg)

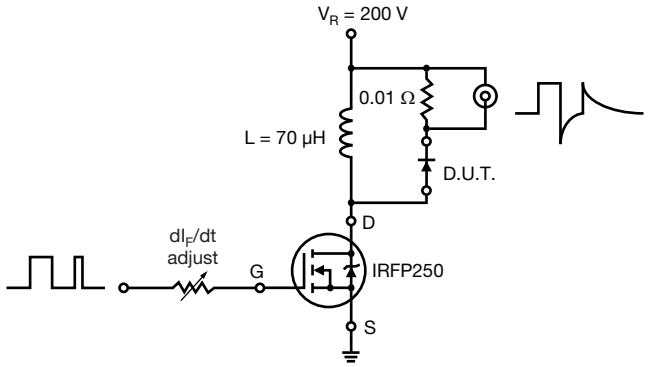
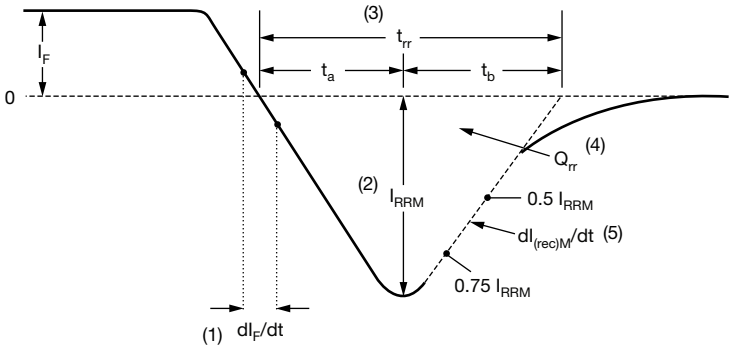



Fig. 10 - Reverse Recovery Parameter Test Circuit




(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 $I_{RRM}$

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

(5) $dI_{(rec)M}/dt$ - peak rate of change of current during $t_b$ portion of $t_{rr}$

Fig. 11 - Reverse Recovery Waveform and Definitions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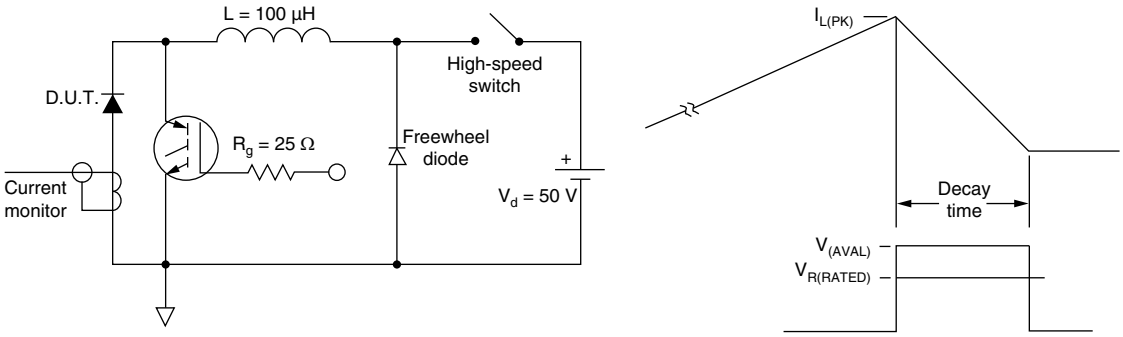


Fig. 12 - Avalanche Test Circuit and Waveforms

## ORDERING INFORMATION TABLE

| Device code | VS- | HFA | 320 | NJ | 40 | C | PbF |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

1 - Vishay Semiconductors product
2 - HEXFRED® family, electron irradiated
3 - Average current rating
4 - NJ = TO-244
5 - Voltage rating (400 V)
6 - C = common cathode
7 - Lead (Pb)-free

| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | www.vishay.com/doc?95021 |


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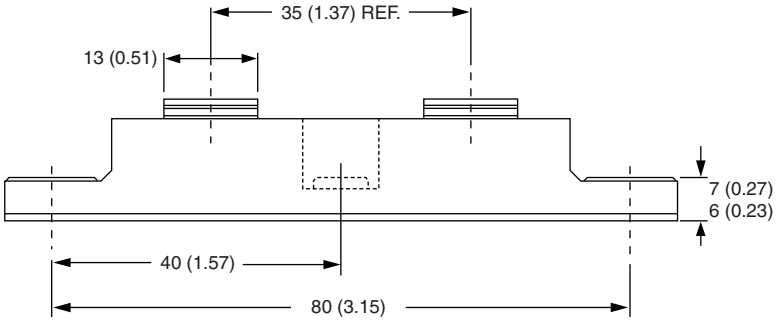
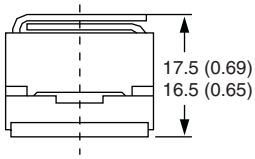
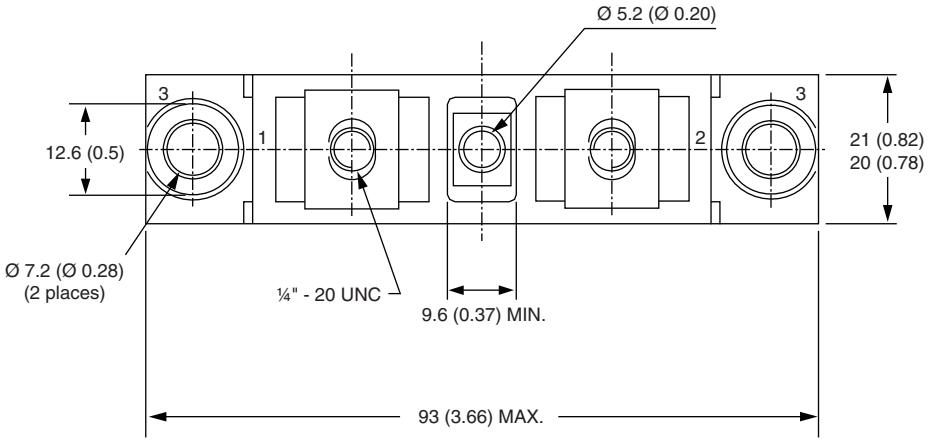
# TO-244

**DIMENSIONS** in millimeters (inches)



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