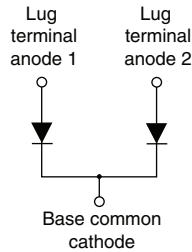


# HEXFRED®

## Ultrafast Soft Recovery Diode, 167 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](http://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 |                           |
|-------------------------|---------------------------|
| $I_F$ (maximum)         | 167 A                     |
| $V_R$                   | 600 V                     |
| $I_{F(DC)}$ at $T_C$    | 84 A at 100 °C            |
| Package                 | TO-244                    |
| Circuit configuration   | Two diodes common cathode |

| ABSOLUTE MAXIMUM RATINGS                         |                |  |             |               |
|--|----------------|--|-------------|---------------|
| PARAMETER  | SYMBOL         | TEST CONDITIONS  | VALUES      | UNITS         |
| Cathode to anode voltage                         | $V_R$          |  | 600         | V             |
| Continuous forward current                       | $I_F$          | $T_C = 25\text{ °C}$   | 167         | A             |
|  |                | $T_C = 100\text{ °C}$  | 84          |               |
| Single pulse forward current                     | $I_{FSM}$      | Limited by junction temperature                                    | 400         |               |
| Non-repetitive avalanche energy                  | $E_{AS}$       | $L = 100\text{ }\mu\text{H}$ , duty cycle limited by maximum $T_J$ | 330         | $\mu\text{J}$ |
| Maximum power dissipation                        | $P_D$          | $T_C = 25\text{ °C}$   | 310         | W             |
|  |                | $T_C = 100\text{ °C}$  | 132         |               |
| Operating junction and storage temperature range | $T_J, T_{Stg}$ |  | -55 to +150 | °C            |

| ELECTRICAL SPECIFICATIONS PER LEG ( $T_J = 25\text{ °C}$ 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  | $V_{FM}$ | $I_F = 70\text{ A}$                         | -          | 1.37 | 1.89 |       |
|  |          | $I_F = 140\text{ A}$                        | -          | 1.58 | 2.1  |       |
|  |          | $I_F = 70\text{ A}, T_J = 125\text{ °C}$    | -          | 1.29 | 1.54 |       |
| Maximum reverse leakage current  | $I_{RM}$ | $T_J = 125\text{ °C}, V_R = 480\text{ V}$   | See fig. 2 | 1.2  | 4    | mA    |
| Junction capacitance   | $C_T$    | $V_R = 200\text{ V}$                        | See fig. 3 | 140  | 250  | pF    |
| Series inductance  | $L_S$    | From top of terminal hole to mounting plane | -          | 7.0  | -    | 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 (fig. 5)   | $t_{rr}$         | $I_F = 1.0\text{ A}$ , $di_F/dt = 200\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$ |  | -    | 33   | -    | ns               |
|  |                  | $T_J = 25\text{ }^\circ\text{C}$  |  | -    | 80   | 120  |                  |
|  |                  | $T_J = 125\text{ }^\circ\text{C}$   |  | -    | 140  | 220  |                  |
| Peak recovery current (fig. 6)   | $I_{RRM}$        | $T_J = 25\text{ }^\circ\text{C}$  |  | -    | 8.5  | 15   | A                |
|  |                  | $T_J = 125\text{ }^\circ\text{C}$   |  | -    | 14   | 25   |                  |
| Reverse recovery charge (fig. 7)   | $Q_{rr}$         | $T_J = 25\text{ }^\circ\text{C}$  |  | -    | 340  | 900  | nC               |
|  |                  | $T_J = 125\text{ }^\circ\text{C}$   |  | -    | 980  | 2300 |                  |
| Peak rate of recovery current (fig. 8)   | $di_{(rec)M}/dt$ | $T_J = 25\text{ }^\circ\text{C}$  |  | -    | 300  | -    | A/ $\mu\text{s}$ |
|  |                  | $T_J = 125\text{ }^\circ\text{C}$   |  | -    | 220  | -    |                  |

| <b>THERMAL - MECHANICAL SPECIFICATIONS</b>     |                |          |      |          |                                  |  |
|--|----------------|----------|------|----------|----------------------------------|--|
| PARAMETER                                      | SYMBOL         | MIN.     | TYP. | MAX.     | UNITS                            |  |
| Maximum junction and storage temperature range | $T_J, T_{Stg}$ | -55      | -    | 150      | $^\circ\text{C}$                 |  |
| Thermal resistance, junction to case           | per leg        | -        | -    | 0.38     | $^\circ\text{C}/\text{W}$<br>K/W |  |
|  | per module     | -        | -    | 0.19     |                                  |  |
| Typical thermal resistance, case to heatsink   | $R_{thCS}$     | -        | 0.10 | -        |                                  |  |
| Weight   |                | -        | 68   | -        | g                                |  |
|  |                | -        | 2.4  | -        | oz.                              |  |
| Mounting torque <sup>(1)</sup>                 |                | 30 (3.4) | -    | 40 (4.6) | lbf · in<br>(N · m)              |  |
| Mounting torque 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 of thermal grease to mounting surface. Gradually tighten each mounting bolt in 5 - 10 lbf · in steps until desired or maximum torque limits are reached

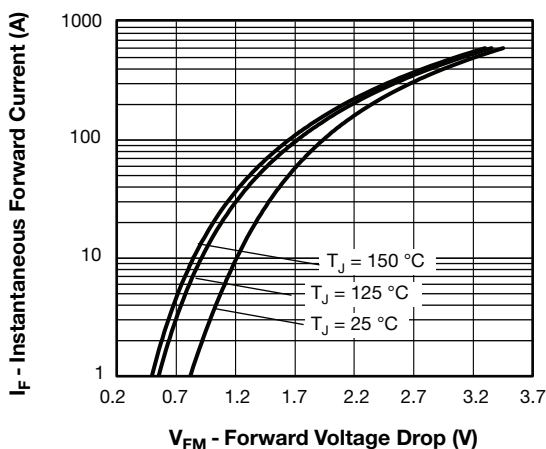


Fig. 1 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current (Per Leg)

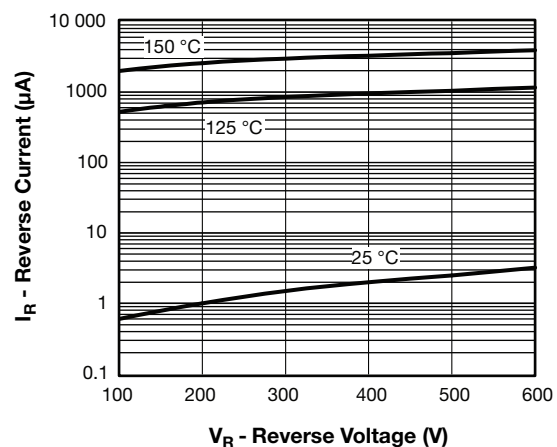


Fig. 2 - Typical Reverse Current vs. Reverse Voltage (Per Leg)

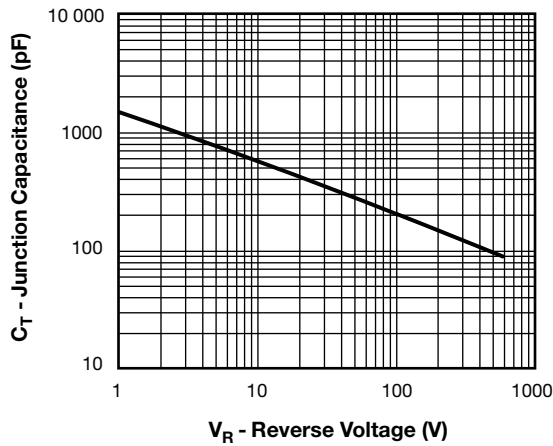


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage (Per Leg)

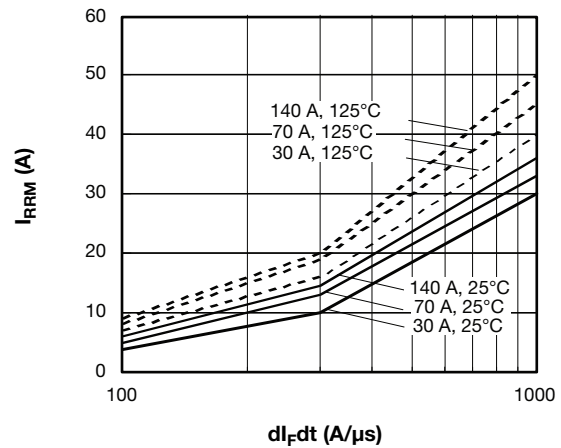


Fig. 6 - Typical Recovery Current vs.  $dI_F/dt$  (Per Leg)

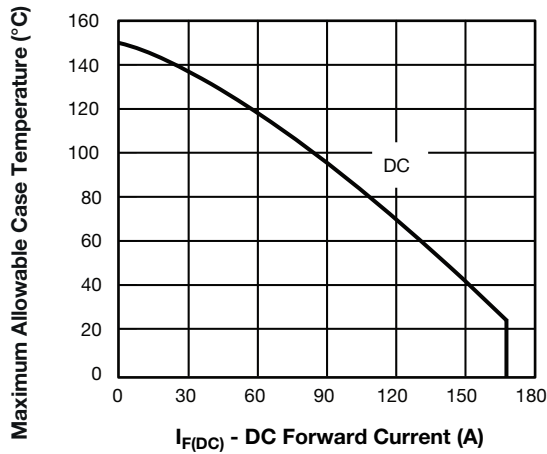


Fig. 4 - Maximum Allowable Case Temperature vs. DC Forward Current (Per Leg)

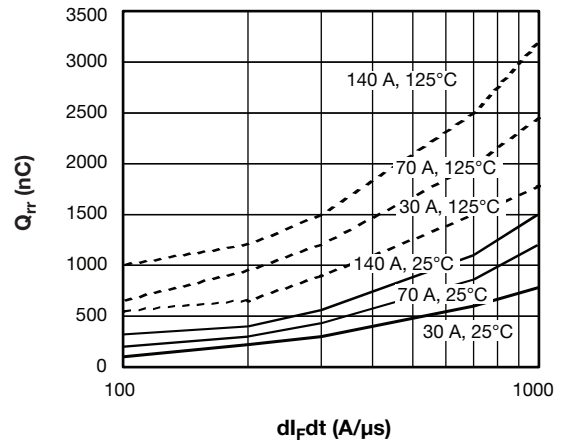


Fig. 7 - Typical Stored Charge vs.  $dI_F/dt$  (Per Leg)

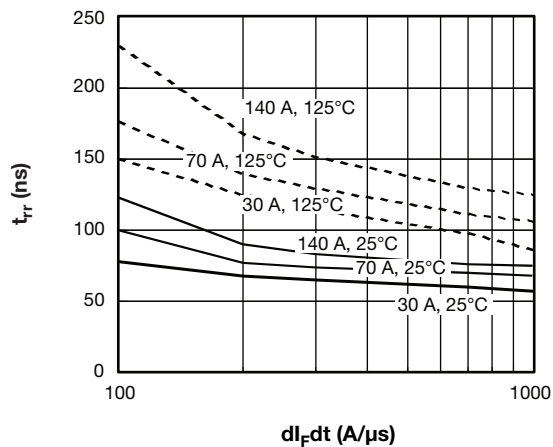


Fig. 5 - Typical Reverse Recovery Time vs.  $dI_F/dt$  (Per Leg)

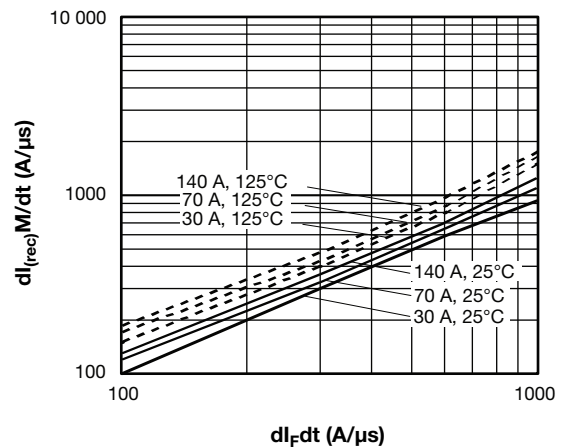


Fig. 8 - Typical  $dI_{(rec)M}/dt$  vs.  $dI_F/dt$  (Per Leg)

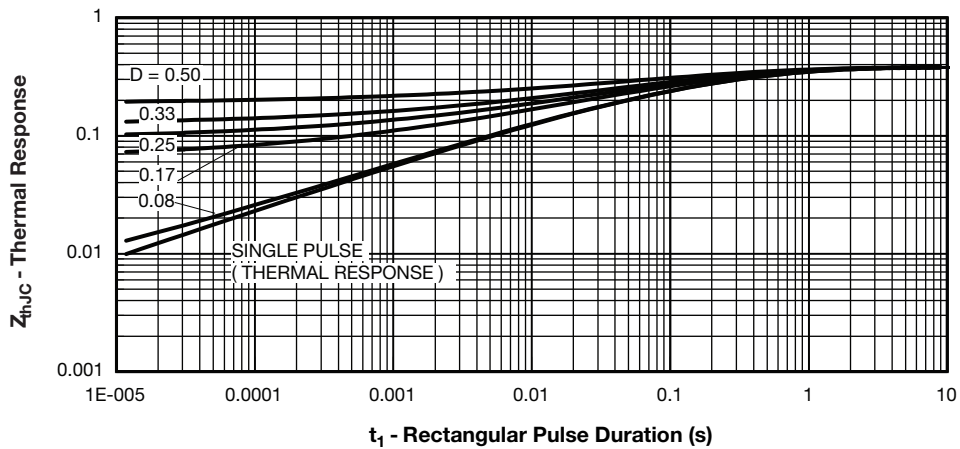


Fig. 9 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

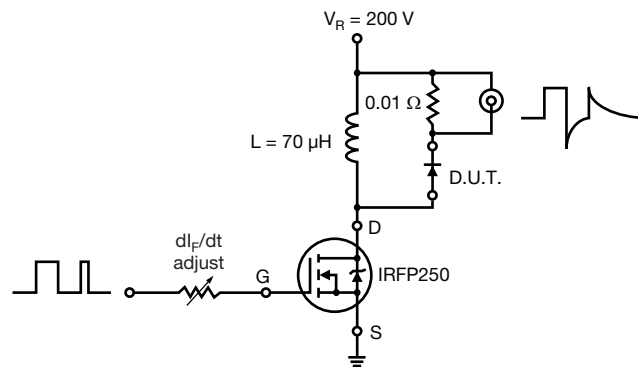
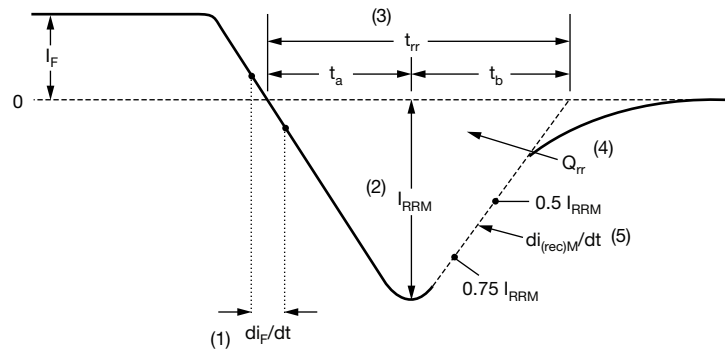


Fig. 10 - Reverse Recovery Parameter Test Circuit



- (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  $I_{RRM}$
- (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. 11 - Reverse Recovery Waveform and Definitions

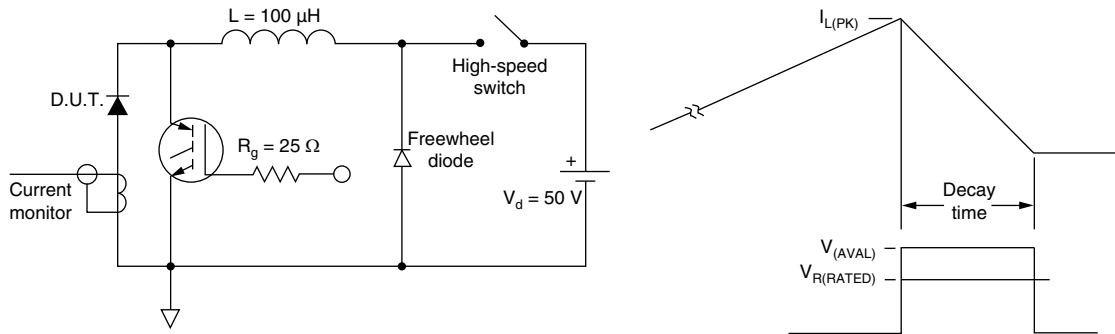


Fig. 12 - Avalanche Test Circuit and Waveforms

## ORDERING INFORMATION TABLE

|             |            |            |            |           |           |          |            |
|-------------|------------|------------|------------|-----------|-----------|----------|------------|
| Device code | <b>VS-</b> | <b>HFA</b> | <b>140</b> | <b>NJ</b> | <b>60</b> | <b>C</b> | <b>PbF</b> |
|             | ①          | ②          | ③          | ④         | ⑤         | ⑥        | ⑦          |

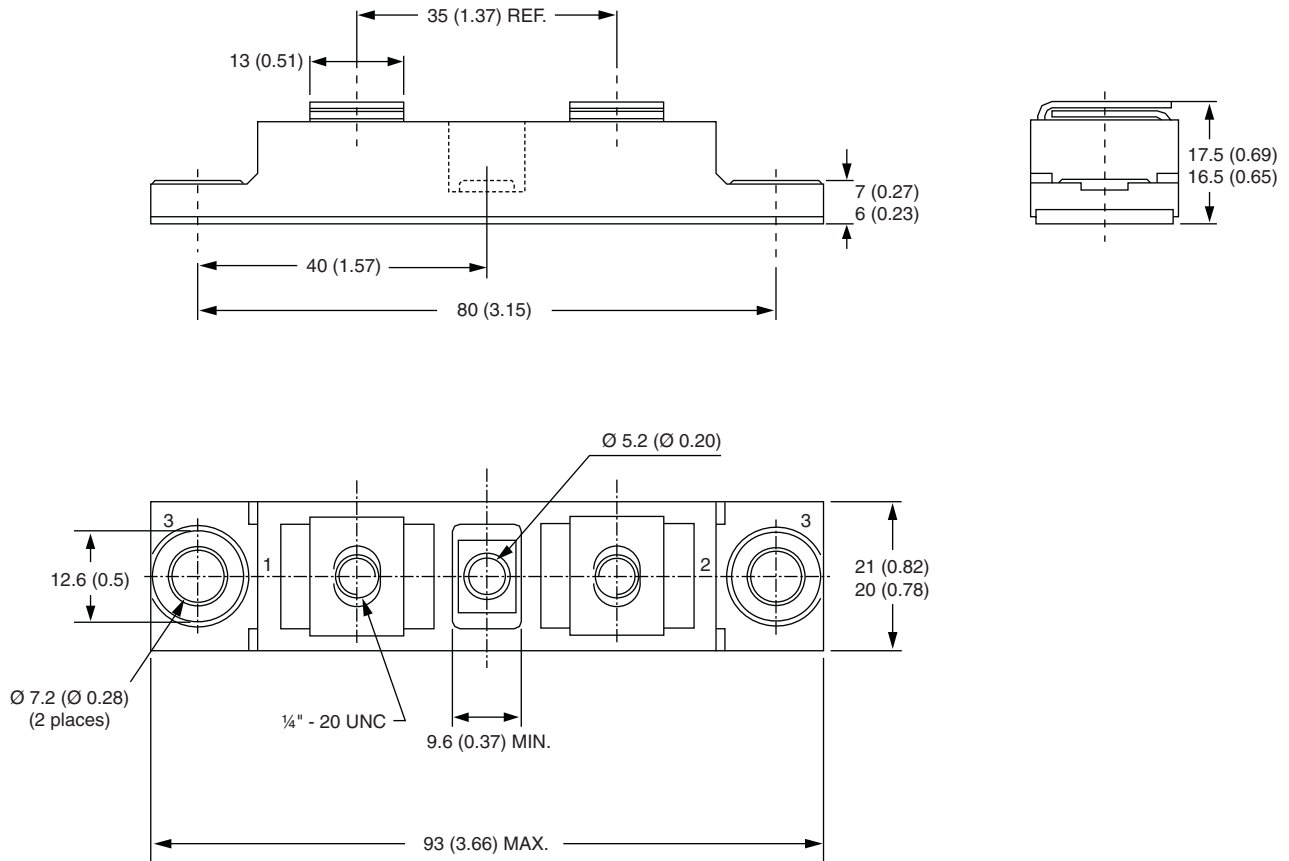
- 1** - Vishay Semiconductors product
- 2** - HEXFRED® family
- 3** - Average current rating
- 4** - NJ = TO-244
- 5** - Voltage rating (600 V)
- 6** - C = two diodes common cathode
- 7** - Lead (Pb)-free

| LINKS TO RELATED DOCUMENTS |  |
|----------------------------|--|
| Dimensions                 | <a href="http://www.vishay.com/doc?95021">www.vishay.com/doc?95021</a> |



## TO-244

**DIMENSIONS** in millimeters (inches)





## Disclaimer

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