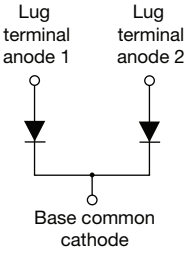
# HEXFRED®
# Ultrafast Soft Recovery Diode, 210 A

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 | |
|---|---|
| $I_{F(AV)}$ | 210 A |
| $V_R$ | 600 V |
| $I_{F(DC)}$ at $T_C$ | 120 A at 100 °C |
| Package | TO-244 |
| Circuit configuration | Two diodes common cathode |

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER | SYMBOL | TEST CONDITIONS | MAX. | UNITS |
|---|---|---|---|---|
| Cathode to anode voltage | $V_R$ | | 600 | V |
| Continuous forward current | $I_F$ | $T_C$ = 25 °C | 235 | A |
| | | $T_C$ = 100 °C | 120 | |
| Single pulse forward current | $I_{FSM}$ | Limited by junction temperature | 600 | |
| Non-repetitive avalanche energy | $E_{AS}$ | L = 100 µH, duty cycle limited by maximum $T_J$ | 2.2 | mJ |
| Maximum power dissipation | $P_D$ | $T_C$ = 25 °C | 463 | W |
| | | $T_C$ = 100 °C | 185 | |
| Operating junction and storage temperature range | $T_J$, $T_{Stg}$ | | -55 to +150 | °C |

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

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNITS |
|---|---|---|---|---|---|---|---|
| Cathode to anode breakdown voltage | $V_{BR}$ | $I_R$ = 100 µA | | 600 | - | - | V |
| Maximum forward voltage | $V_{FM}$ | $I_F$ = 105 A | See fig. 1 | - | 1.38 | 1.9 | |
| | | $I_F$ = 210 A | | - | 1.6 | 2.25 | |
| | | $I_F$ = 105 A, $T_J$ = 125 °C | | - | 1.3 | 1.56 | |
| Maximum reverse leakage current | $I_{RM}$ | $T_J$ = 125 °C, $V_R$ = 480 V | See fig. 2 | - | 1.8 | 6.0 | mA |
| Junction capacitance | $C_T$ | $V_R$ = 200 V | See fig. 3 | - | 200 | 300 | pF |
| Series inductance | $L_S$ | From top of terminal hole to mounting plane | | - | 6.0 | - | nH |

| DYNAMIC RECOVERY CHARACTERISTICS ($T_J$ = 25 °C unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Reverse recovery time (fig. 5) | $t_{rr}$ | $I_F$ = 1.0 A, $dI_F/dt$ = 200 A/μs, $V_R$ = 30 V | | - | 35 | - | ns |
| | | $T_J$ = 25 °C | $I_F$ = 105 A<br>$dI_F/dt$ = 200 A/μs<br>$V_R$ = 200 V | - | 90 | 140 | |
| | | $T_J$ = 125 °C | | - | 160 | 240 | |
| Peak recovery current (fig. 6) | $I_{RRM}$ | $T_J$ = 25 °C | | - | 10 | 18 | A |
| | | $T_J$ = 125 °C | | - | 15 | 30 | |
| Reverse recovery charge (fig. 7) | $Q_{rr}$ | $T_J$ = 25 °C | | - | 450 | 1300 | nC |
| | | $T_J$ = 125 °C | | - | 1200 | 3600 | |
| Peak rate of recovery current (fig. 8) | $dI_{(rec)M}/dt$ | $T_J$ = 25 °C | | - | 310 | - | A/μs |
| | | $T_J$ = 125 °C | | - | 240 | - | |

| 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 | $R_{thJC}$ | - | - | 0.27 | °C/W<br>K/W |
| | per module | | - | - | 0.135 | |
| 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<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 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

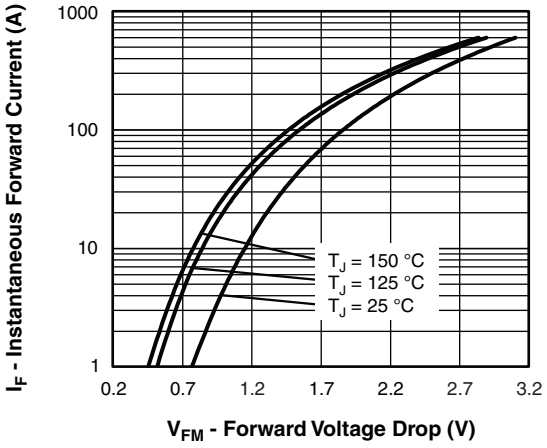



Fig. 1 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current (Per Leg)

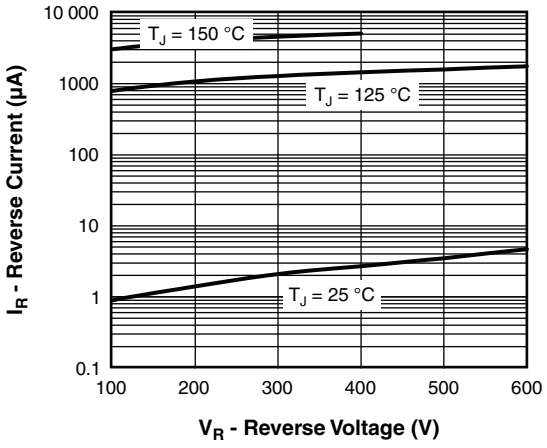



Fig. 2 - Typical Reverse Current vs. Reverse Voltage (Per Leg)

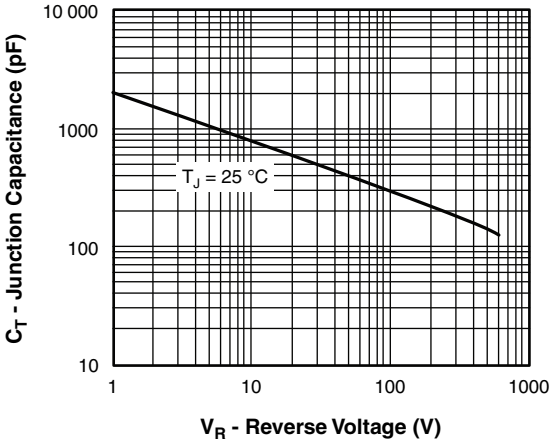



Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage (Per Leg)

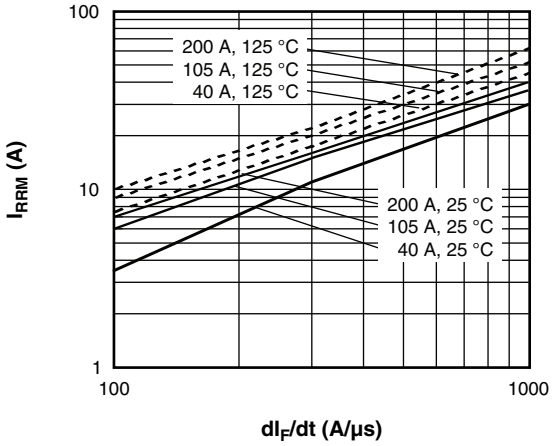



Fig. 6 - - Typical Recovery Current vs. $dI_F/dt$ (Per Leg)

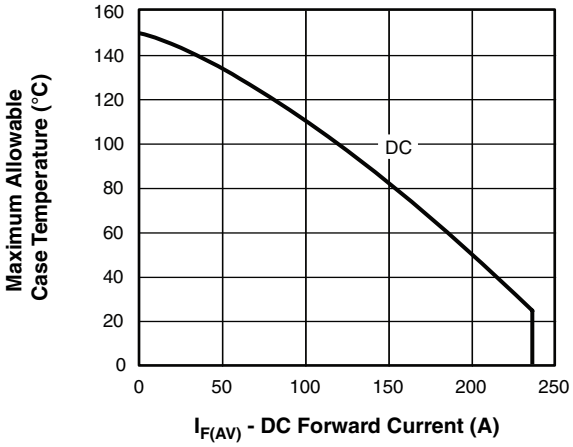



Fig. 4 - Maximum Allowable Case Temperature vs. DC Forward Current (Per Leg)

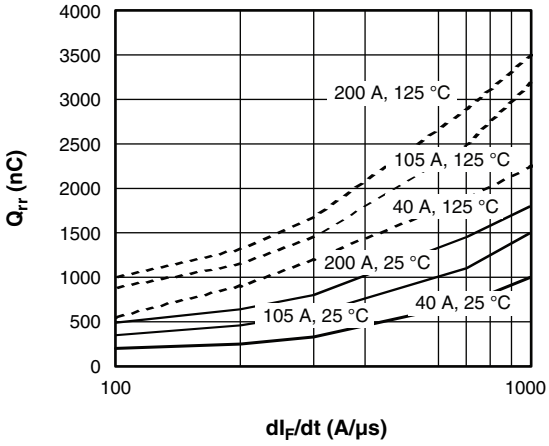



Fig. 7 - - Typical Stored Charge vs. $dI_F/dt$ (Per Leg)

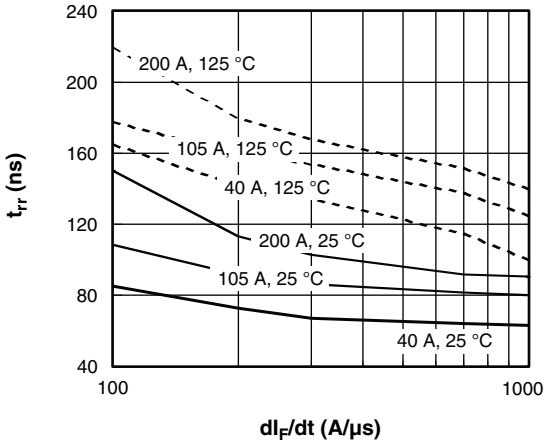



Fig. 5 - Typical Reverse Recovery Time vs. $dI_F/dt$ (Per Leg)

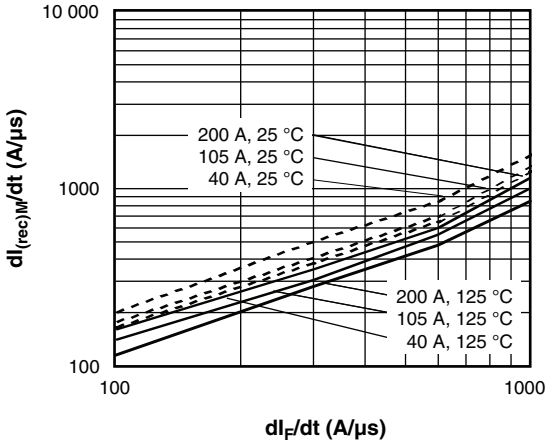



Fig. 8 - - Typical $dI_{(rec)M}/dt$ vs. $dI_F/dt$ (Per Leg)

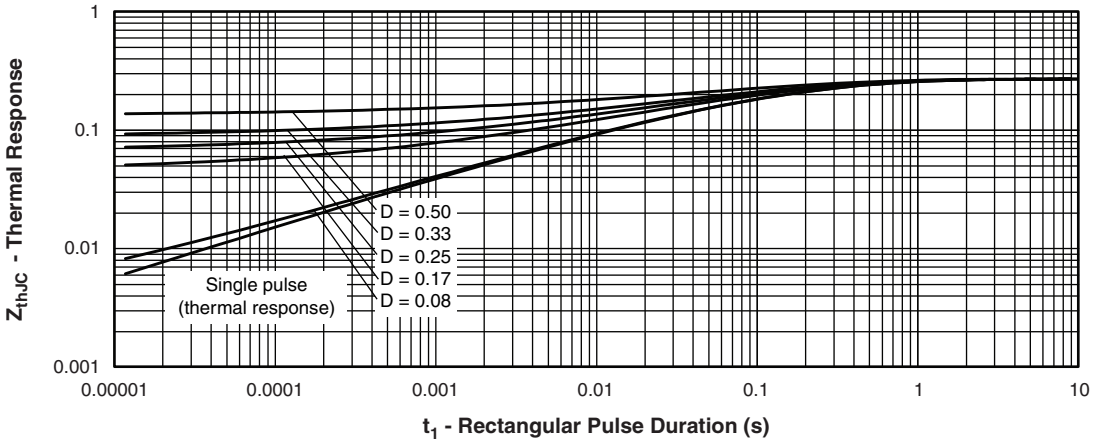



Fig. 9 - - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (Per Leg)

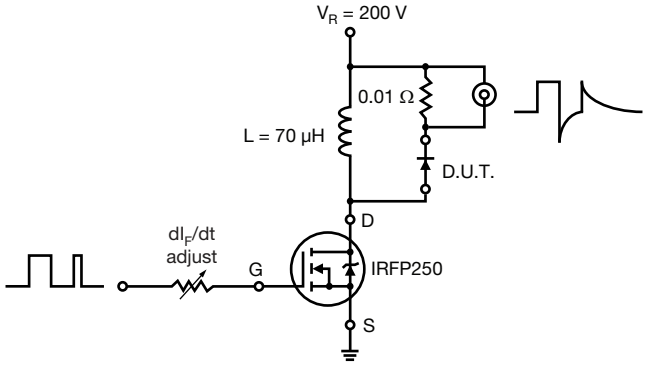
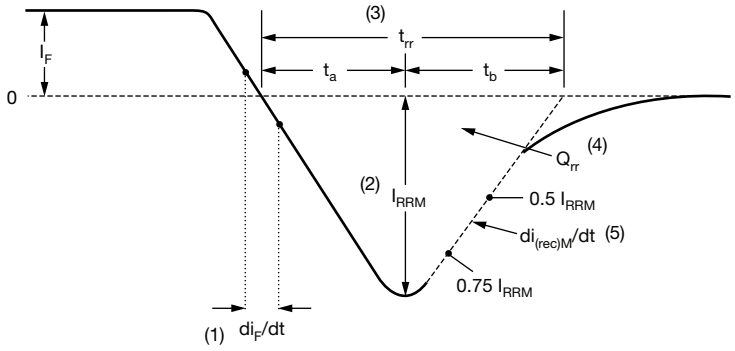



Fig. 10 - - Reverse Recovery Parameter Test Circuit




(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

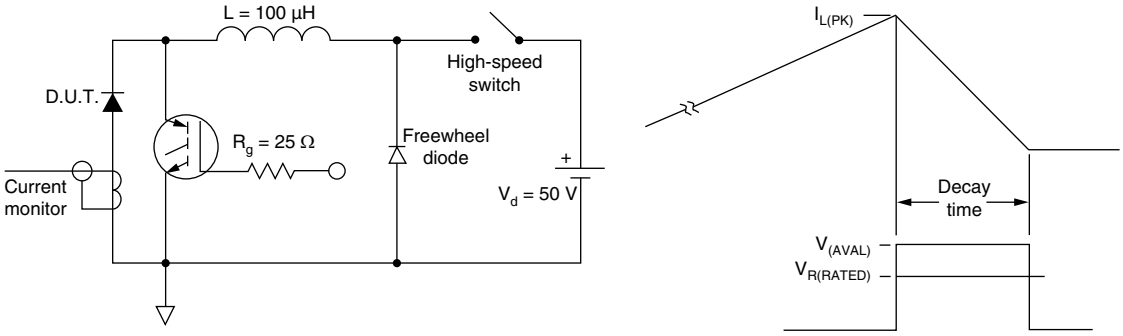



Fig. 12 - Avalanche Test Circuit and Waveforms

## ORDERING INFORMATION TABLE

**Device code**

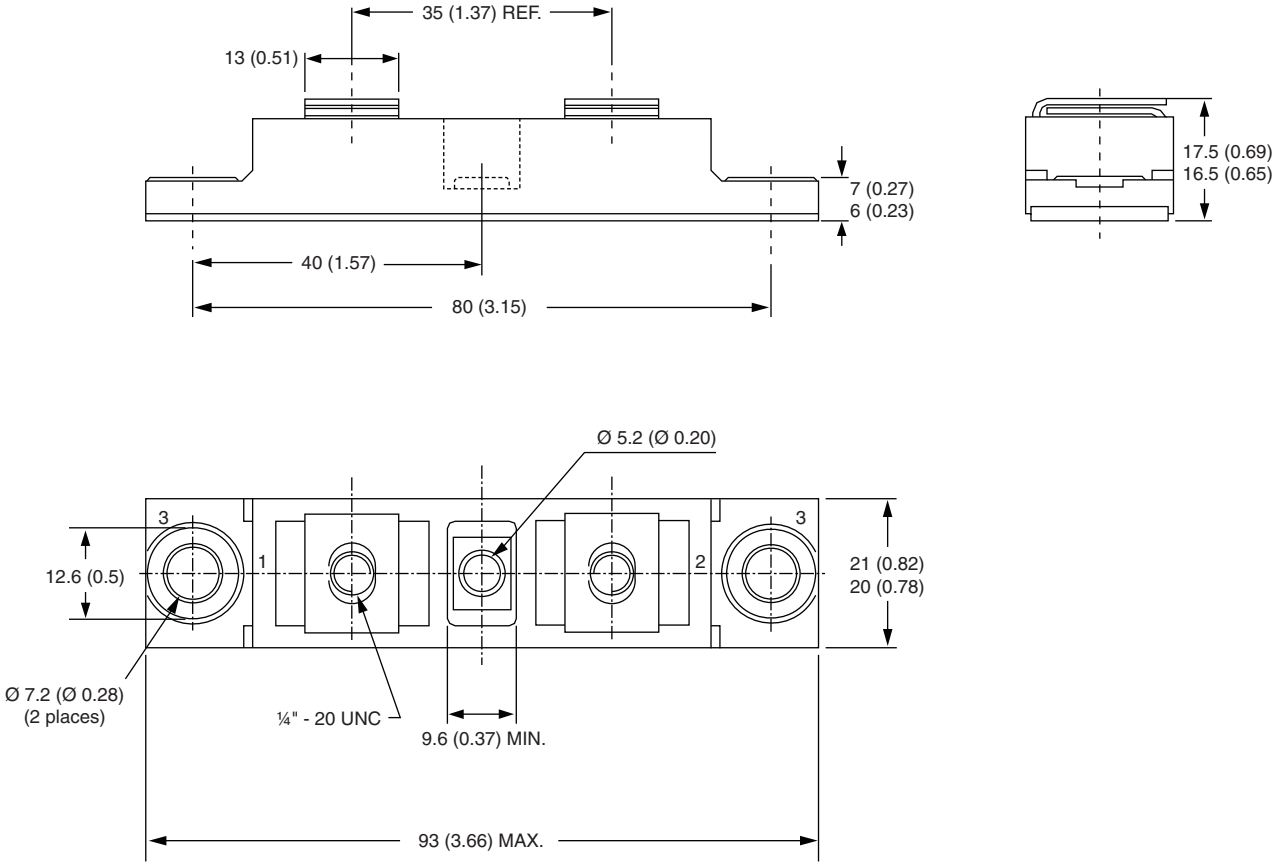
| VS- | HFA | 210 | NJ | 60 | C | PbF |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

| | | |
|---|---|---|
| 1 | - | Vishay Semiconductors product |
| 2 | - | HEXFRED® family, electron irradiated |
| 3 | - | Average current rating |
| 4 | - | NJ = TO-244 |
| 5 | - | Voltage rating (60 = 600 V) |
| 6 | - | C = two diodes common cathode |
| 7 | - | Lead (Pb)-free |

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

# TO-244

**DIMENSIONS** in millimeters (inches)



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