Bulletin PD-20018 02/01

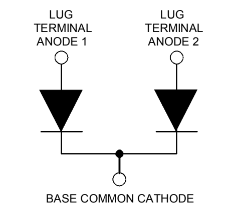
International IOR Rectifier

# S1241

## HEXFRED ™ — Ultrafast, Soft Recovery Diode

### Features

- Reduced RFI and EMI
- Reduced Snubbing
- Extensive Characterization of Recovery Parameters




$V_R$ = 400V
$V_F$(typ.)③ = 1V
$I_{F(AV)}$ = 240A
$Q_{rr}$ (typ.) = 290nC
$I_{RRM}$(typ.) = 7.5A
$t_{rr}$(typ.) = 50ns
$di_{(rec)M}/dt$ (typ.)③ = 270A/μs

### 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/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.

### Absolute Maximum Ratings

| Parameters | | Max | Units |
|---|---|---|---|
| $V_R$ | Cathode-to-Anode Voltage | 400 | V |
| $I_F$ @ $T_C$ = 25°C | Continuous Forward Current | 244 | A |
| $I_F$ @ $T_C$ = 100°C | Continuous Forward Current | 122 | |
| $I_{FSM}$ | Single Pulse Forward Current ① | 900 | |
| $E_{AS}$ | Non-Repetitive Avalanche Energy ② | 1.4 | mJ |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 460 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 185 | |
| $T_J$, $T_{STG}$ | Operating Junction and Storage Temperature Range | - 55 to 150 | °C |

### Case Styles

S1241

TO-244

① Limited by junction temperature
② L = 100μH, duty cycle limited by max $T_J$
③ 125°C

## Electrical Characteristics (per Leg) @ $T_J$ = 25°C (unless otherwise specified)

| | Parameters | Min | Typ | Max | Units | Test Conditions | |
|---|---|---|---|---|---|---|---|
| $V_{BR}$ | Cathode Anode Breakdown Voltage, | 400 | - | - | V | $I_R$ = 100µA | |
| $V_{FM}$ | Max. Forward Voltage | - | 1.1 | 1.3 | V | $I_F$ = 120A | See Fig. 1 |
| | | - | 1.3 | 1.5 | V | $I_F$ = 240A | |
| | | - | 1.0 | 1.2 | V | $I_F$ = 120A, $T_J$ = 125°C | |
| $I_{RM}$ | Max. Reverse Leakage Current | - | 1.5 | 9 | µA | $V_R$ = $V_R$ Rated | See Fig. 2 |
| | | - | 2.3 | 12 | mA | $T_J$ = 125°C, $V_R$ = 320V | |
| $C_T$ | Junction Capacitance | - | 280 | 380 | pF | $V_R$ = 200V | See Fig. 3 |
| $L_S$ | Series Inductance | - | 6.0 | - | nH | From top of terminal hole.to mounting plane | |

## Dynamic Recovery Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameters | Min | Typ | Max | Units | Test Conditions | | |
|---|---|---|---|---|---|---|---|---|
| $t_{rr}$ | Reverse Recovery Time | - | 50 | - | ns | $I_F$ = 1.0A, $di_F/dt$ = 200A/µs, $V_R$ = 30V | | |
| $t_{rr1}$ | | - | 77 | 120 | | $T_J$ = 25°C | See Fig. 5 | $I_F$ = 140A<br>$V_R$ = 200V<br>$di_F/dt$ = 200A/µs |
| $t_{rr2}$ | | - | 290 | 440 | | $T_J$ = 125°C | | |
| $I_{RRM1}$ | Peak Recovery Current | - | 7.5 | 14 | A | $T_J$ = 25°C | See Fig. 6 | |
| $I_{RRM2}$ | | - | 16 | 30 | | $T_J$ = 125°C | | |
| $Q_{rr1}$ | Reverse Recovery Charge | - | 290 | 780 | nC | $T_J$ = 25°C | See Fig. 7 | |
| $Q_{rr2}$ | | - | 2300 | 6300 | | $T_J$ = 125°C | | |
| $di_{(rec)M}/dt1$ | | - | 320 | - | A/µs | $T_J$ = 25°C | See Fig. 8 | |
| $di_{(rec)M}/dt2$ | | - | 270 | - | | $T_J$ = 25°C | | |

## Thermal - Mechanical Characteristics

| | Parameters | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $T_J$ | Max. Junction Temperature Range | | - | - | - 55 to 150 | °C |
| $T_{Stg}$ | Max. Storage Temperature Range | | - | - | - 55 to 150 | |
| $R_{thJC}$ | Thermal Resistance, Junction to Case | Per Leg | - | - | 0.27 | °C/W |
| | Thermal Resistance, Junction to Case | Per Module | - | - | 0.14 | K/W |
| $R_{thCS}$ | Thermal Resistance, Case to Heatsink | | - | 0.10 | - | |
| Wt | Weight | | - | 68 (2.4) | - | g (oz) |
| | Mounting Torque (*) | | 30 (3.4) | - | 40 (4.6) | lbf.in |
| | Mounting Torque Center Hole | | 12 (1.4) | - | 18 (2.1) | (N.m) |
| | Terminal Torque | | 30 (3.4) | - | 40 4.6) | |
| | Vertical Pull | | - | - | 80 | lbf.in |
| | 2 inch Lever Pull | | - | - | 35 | |

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

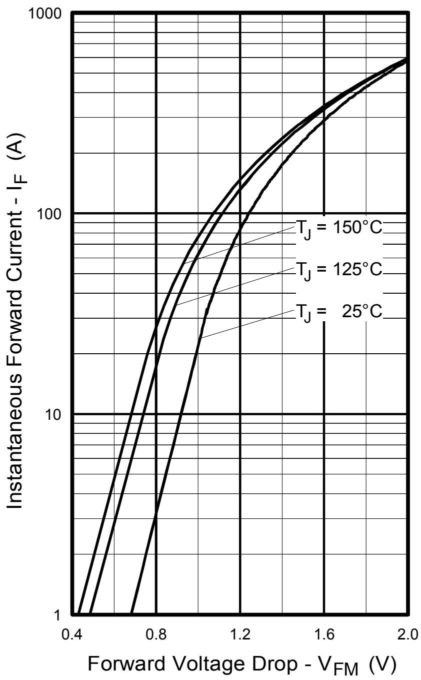



Fig. 1 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current (per Leg)

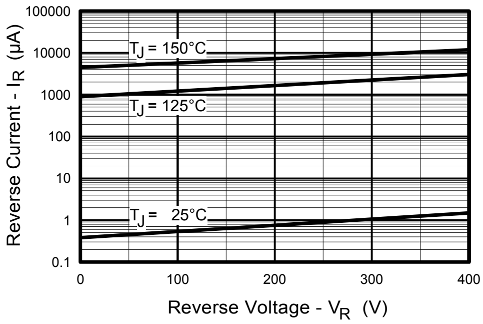



Fig. 2 - Typical Reverse Current vs. Reverse Voltage, (per Leg)

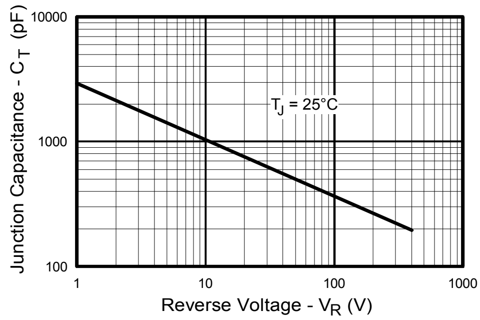



Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage, (per Leg)

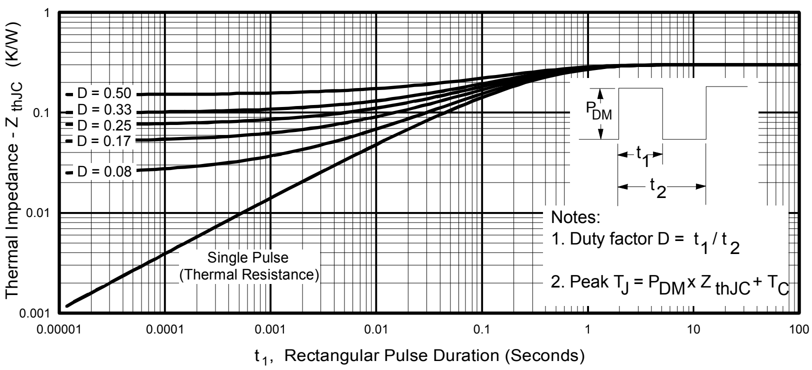



Fig. 4 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics, (per Leg)

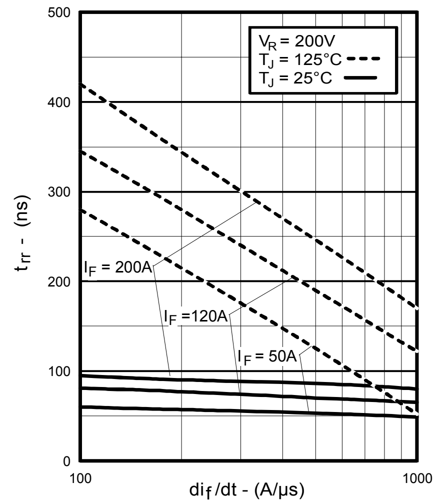



Fig. 5 - Typical Reverse Recovery vs. dif /dt, (per Leg)

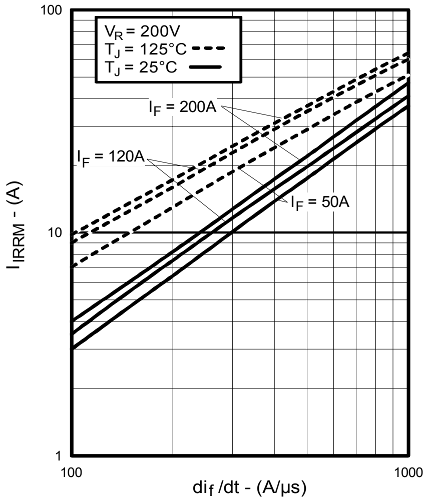



Fig. 6 - Typical Recovery Current vs. dif /dt, (per Leg)

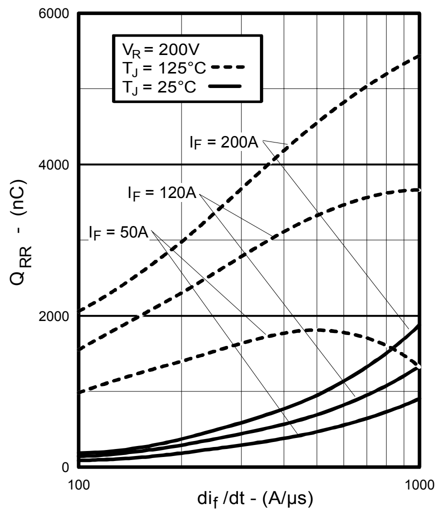



Fig. 7 - Typical Stored Charge vs. dif /dt, (per Leg)

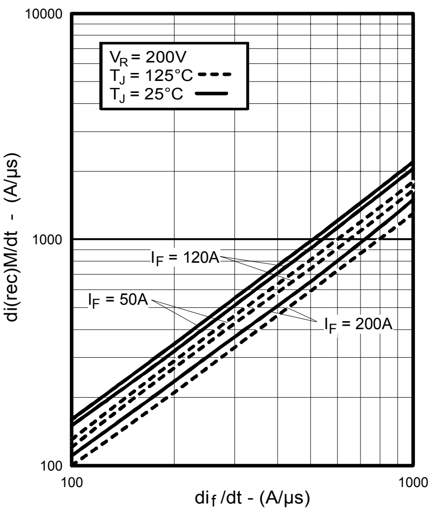



Fig. 8 - Typical $di_{(rec)M}/dt$ vs. dif /dt, (per Leg)

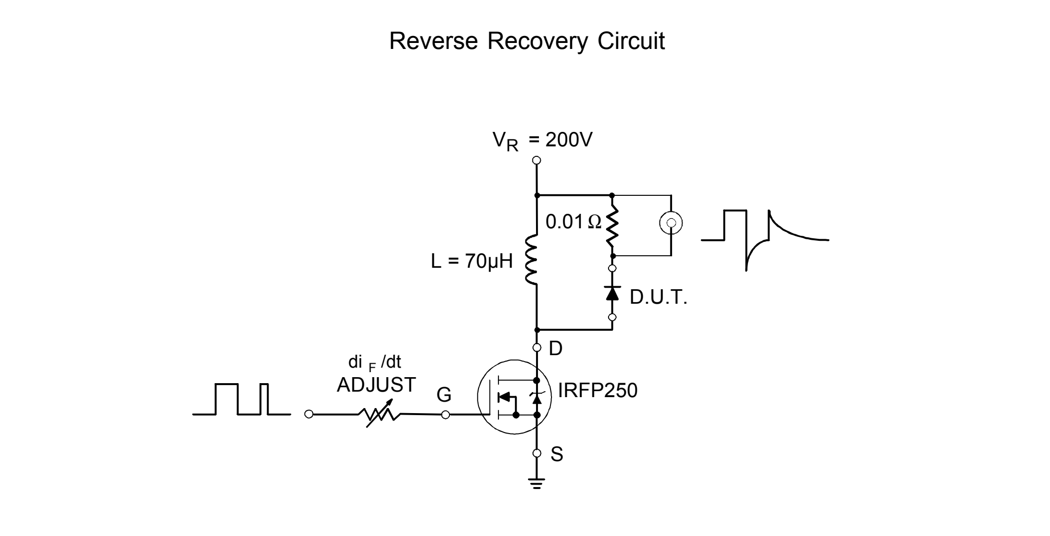
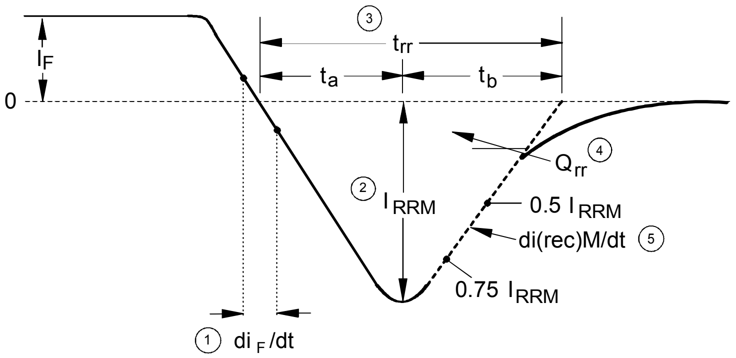



**Fig. 9- Reverse Recovery Parameter Test Circuit**




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 $I_{RRM}$

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

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

**Fig. 10 - Reverse Recovery Waveform and Definitions**

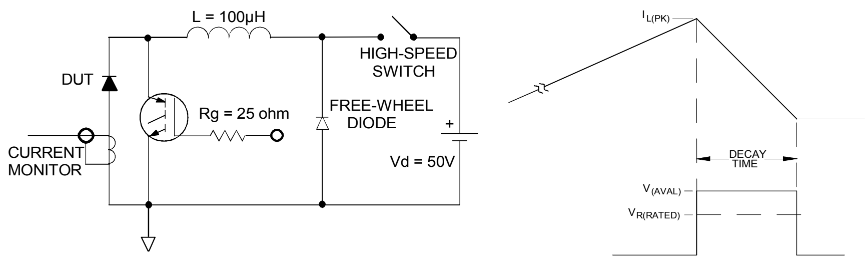
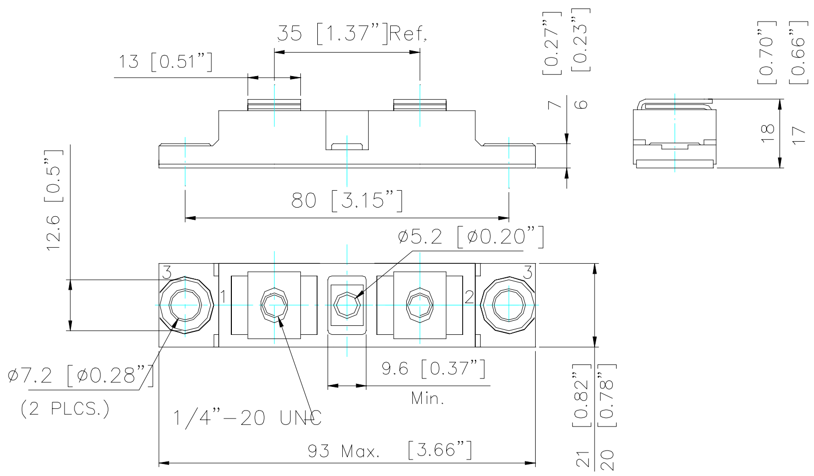



**Fig. 11 - Avalanche Test Circuit and Waveforms**

## Outline Table




**Conforms to JEDEC Outline TO-244**
Dimensions in millimeters and (inches)

Data and specifications subject to change without notice.
This product has been designed and qualified for Industrial Level.
Qualification Standards can be found on IR's Web site.

International IOR Rectifier

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