Advanced Process Technology
Ultra Low On-Resistance
Dynamic dv/dt Rating
175°C Operating Temperature
Fast Switching
Fully Avalanche Rated
Lead-Free

Description
Advanced HEXFET® Power MOSFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID @ TC = 25°C</td>
<td>Continuous Drain Current, V GS @ 10V</td>
<td>49</td>
</tr>
<tr>
<td>ID @ TC = 100°C</td>
<td>Continuous Drain Current, V GS @ 10V</td>
<td>35</td>
</tr>
<tr>
<td>IDM</td>
<td>Pulsed Drain Current</td>
<td>160</td>
</tr>
<tr>
<td>PD @ TC = 25°C</td>
<td>Power Dissipation</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>Linear Derating Factor</td>
<td>0.63</td>
</tr>
<tr>
<td>V GS</td>
<td>Gate-to-Source Voltage</td>
<td>± 20</td>
</tr>
<tr>
<td>I AR</td>
<td>Avalanche Current</td>
<td>25</td>
</tr>
<tr>
<td>EAR</td>
<td>Repetitive Avalanche Energy</td>
<td>9.4</td>
</tr>
<tr>
<td>dv/dt</td>
<td>Peak Diode Recovery dv/dt</td>
<td>5.0</td>
</tr>
<tr>
<td>TJ</td>
<td>Operating Junction and Storage Temperature Range</td>
<td>-55 to +175</td>
</tr>
<tr>
<td>T STG</td>
<td>Soldering Temperature, for 10 seconds</td>
<td>300 (1.6mm from case)</td>
</tr>
<tr>
<td></td>
<td>Mounting torque, 6-32 or M3 screw</td>
<td>10 lbf•in (1.1N•m)</td>
</tr>
</tbody>
</table>

Thermal Resistance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>R θ JUC</td>
<td>Junction-to-Case</td>
<td>—</td>
<td>1.5</td>
</tr>
<tr>
<td>R θ JCS</td>
<td>Case-to-Sink, Flat, Greased Surface</td>
<td>0.50</td>
<td>—</td>
</tr>
<tr>
<td>R θ JAA</td>
<td>Junction-to-Ambient</td>
<td>—</td>
<td>62</td>
</tr>
</tbody>
</table>
### Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{BRDSS}</td>
<td></td>
<td></td>
<td>55 V</td>
<td></td>
<td>V_{GS} = 0V, I_{D} = 250µA</td>
</tr>
<tr>
<td>ΔV_{BRDSS}/ΔT_J</td>
<td></td>
<td></td>
<td>0.058V/°C</td>
<td></td>
<td>Reference to 25°C, I_{D} = 1mA</td>
</tr>
<tr>
<td>R_{DS(on)}</td>
<td></td>
<td></td>
<td>17.5 mΩ</td>
<td></td>
<td>V_{DS} = 10V, I_{D} = 25A</td>
</tr>
<tr>
<td>V_{GSS}</td>
<td>2.0 V</td>
<td>4.0 V</td>
<td></td>
<td>V_{GS} = V_{GS}, I_{D} = 250µA</td>
<td></td>
</tr>
<tr>
<td>g_{m}</td>
<td>19 S</td>
<td></td>
<td></td>
<td></td>
<td>V_{DS} = 25V, I_{D} = 25A</td>
</tr>
<tr>
<td>I_{DSS}</td>
<td></td>
<td>25 µA</td>
<td></td>
<td></td>
<td>V_{DS} = 55V, V_{GS} = 0V</td>
</tr>
<tr>
<td>I_{GSS}</td>
<td></td>
<td>100 nA</td>
<td></td>
<td></td>
<td>V_{GS} = 20V</td>
</tr>
<tr>
<td>Q_{g}</td>
<td></td>
<td>63 nC</td>
<td></td>
<td></td>
<td>I_{D} = 25A</td>
</tr>
<tr>
<td>Q_{gs}</td>
<td></td>
<td>14 nC</td>
<td></td>
<td></td>
<td>V_{DS} = 44V</td>
</tr>
<tr>
<td>Q_{gd}</td>
<td></td>
<td>23 nC</td>
<td></td>
<td></td>
<td>V_{DS} = 10V, See Fig. 6 and 13</td>
</tr>
<tr>
<td>I_{D(on)}</td>
<td>12 ns</td>
<td></td>
<td></td>
<td></td>
<td>V_{DD} = 28V</td>
</tr>
<tr>
<td>I_{r}</td>
<td>60 ns</td>
<td></td>
<td></td>
<td></td>
<td>I_{D} = 25A</td>
</tr>
<tr>
<td>I_{D(off)}</td>
<td>44 ns</td>
<td></td>
<td></td>
<td></td>
<td>R_{G} = 12Ω</td>
</tr>
<tr>
<td>I_{f}</td>
<td>45 ns</td>
<td></td>
<td></td>
<td></td>
<td>V_{GS} = 10V, See Fig. 10</td>
</tr>
<tr>
<td>L_{D}</td>
<td>4.5 mH</td>
<td></td>
<td></td>
<td></td>
<td>Between lead, 6mm (0.25in.)</td>
</tr>
<tr>
<td>L_{S}</td>
<td>7.5 mH</td>
<td></td>
<td></td>
<td></td>
<td>from package and center of die contact</td>
</tr>
<tr>
<td>C_{iss}</td>
<td>1470 pF</td>
<td></td>
<td></td>
<td></td>
<td>V_{GS} = 0V</td>
</tr>
<tr>
<td>C_{oss}</td>
<td>360 pF</td>
<td></td>
<td></td>
<td></td>
<td>V_{DS} = 25V</td>
</tr>
<tr>
<td>C_{rss}</td>
<td>88 pF</td>
<td></td>
<td></td>
<td></td>
<td>f = 1.0MHz, See Fig. 5</td>
</tr>
<tr>
<td>E_{AS}</td>
<td>530 mJ</td>
<td>150 mJ</td>
<td></td>
<td></td>
<td>I_{AS} = 25A, L = 0.47mH</td>
</tr>
</tbody>
</table>

### Source-Drain Ratings and Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_{S}</td>
<td></td>
<td></td>
<td>49 A</td>
<td></td>
<td>MOSFET symbol showing the integral reverse p-n junction diode.</td>
</tr>
<tr>
<td>I_{SM}</td>
<td></td>
<td></td>
<td>160 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V_{SD}</td>
<td></td>
<td>1.3 V</td>
<td></td>
<td>V_{DD} = V_{BRDSS}, T_{J} = 175°C</td>
<td></td>
</tr>
<tr>
<td>I_{r}</td>
<td>63 ns</td>
<td>95 ns</td>
<td></td>
<td></td>
<td>I_{J} = 25°C, I_{f} = 25A</td>
</tr>
<tr>
<td>Q_{rr}</td>
<td>170 nC</td>
<td>260 nC</td>
<td></td>
<td></td>
<td>di/dt = 100A/µs</td>
</tr>
</tbody>
</table>

**Notes:**

1. Repetitive rating: pulse width limited by max. junction temperature. (See fig. 11)
2. Starting T_{J} = 25°C, L = 0.48mH, R_{G} = 25Ω, I_{AS} = 25A. (See Figure 12)
3. I_{SD} ≤ 25A, di/dt ≤ 230A/µs, V_{DD} ≤ V_{BRDSS}, T_{J} ≤ 175°C
4. Pulse width ≤ 400µs, duty cycle ≤ 2%.
5. This is a typical value at device destruction and represents operation outside rated limits.
6. This is a calculated value limited to T_{J} = 175°C.
**Fig 1.** Typical Output Characteristics

**Fig 2.** Typical Output Characteristics

**Fig 3.** Typical Transfer Characteristics

**Fig 4.** Normalized On-Resistance Vs. Temperature
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage

**Fig 7.** Typical Source-Drain Diode Forward Voltage

**Fig 8.** Maximum Safe Operating Area
**Fig 9.** Maximum Drain Current Vs. Case Temperature

**Fig 10a.** Switching Time Test Circuit

**Fig 10b.** Switching Time Waveforms

**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case
IRFZ44NPbF

Fig 12a. Unclamped Inductive Test Circuit

Fig 12b. Unclamped Inductive Waveforms

Fig 12c. Maximum Avalanche Energy Vs. Drain Current

Fig 13a. Basic Gate Charge Waveform

Fig 13b. Gate Charge Test Circuit

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**Peak Diode Recovery dv/dt Test Circuit**

- **D.U.T.** - Device Under Test
- **R_G**
- **V_GS**
- **V_DD**

**Circuit Layout Considerations**
- Low Stray Inductance
- Ground Plane
- Low Leakage Inductance
- Current Transformer

- **dv/dt** controlled by **R_G**
- **I_SD** controlled by Duty Factor "D"

**Reverse Polarity of D.U.T. for P-Channel**

**Driver Gate Drive**

**D.U.T. I_SD Waveform**

**D.U.T. V_DS Waveform**

**Inductor Current**

**Reverse Recovery Current**

**Re-Applied Voltage**

**D = P.W.**

**V_GS = 10V**

**V_DG**

**V_DS**

**I_SD**

**Ripple ≤ 5%**

***V_GS = 5.0V for Logic Level and 3V Drive Devices***

**Fig 14. For N-channel HEXFET® power MOSFETs**

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TO-220AB Package Outline (Dimensions are shown in millimeters (inches))

NOTES:
2.- DIMENSIONS ARE SHOWN IN INCHES (IN MILLIMETERS).
3.- LEAD DIMENSIONS AND TOLERANCES UNCONTROLLED N.
4.- DIMENSIONS A, B, K, L DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.001 (0.025) PER SIDE. THESE DIMENSIONS MAY VARY UP TO THE OUTLINES OF THE PLASTIC BODY.
5.- DIMENSIONS H, J, & K APPLY TO BASE METAL ONLY.
6.- CONTROLLING DIMENSION - INCHES.
7.- THERMAL PAST CONTAINER OPTIMUM WITHIN DIMENSIONS C, D, E, & F.
8.- DIMENSION C2 X H2 DIFFERING A ZONE WHERE STAMPING AND SOLDERING INDETERMINES ARE ALLOWED.
9.- OUTLINE COMPARES TO JEDD-TO-220, EXCEPT A2 (0.160) AND D2 (0.190) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 10, 2000
IN THE ASSEMBLY LINE "C"

Note: "P" in assembly line position indicates "Lead-Free"

INTERNATIONAL RECTIFIER LOGO
PART NUMBER
LOT CODE
DATE CODE
YEAR 0 = 2000
WEEK 19
LINE "C"

Notes:
1. For an Automotive Qualified version of this part please see http://www.irf.com/product-info/auto/
2. For the most current drawing please refer to IR website at http://www.irf.com/package/

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

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