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

**Description**
Fifth Generation HEXFETs 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><em>I_D @ T_C = 25°C</em> Continuous Drain Current, V_GS @ 10V</td>
<td>9.7</td>
<td>A</td>
</tr>
<tr>
<td><em>I_D @ T_C = 100°C</em> Continuous Drain Current, V_GS @ 10V</td>
<td>6.8</td>
<td>A</td>
</tr>
<tr>
<td><em>I_{DM}</em> Pulsed Drain Current</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td><em>P_D @ T_C = 25°C</em> Power Dissipation</td>
<td>48</td>
<td>W</td>
</tr>
<tr>
<td>Linear Derating Factor</td>
<td>0.32</td>
<td>W/C</td>
</tr>
<tr>
<td><em>V_GS</em> Gate-to-Source Voltage</td>
<td>± 20</td>
<td>V</td>
</tr>
<tr>
<td><em>E_{AS}</em> Single Pulse Avalanche Energy</td>
<td>91</td>
<td>mJ</td>
</tr>
<tr>
<td><em>I_{AR}</em> Avalanche Current</td>
<td>5.7</td>
<td>A</td>
</tr>
<tr>
<td><em>E_{AR}</em> Repetitive Avalanche Energy</td>
<td>4.8</td>
<td>mJ</td>
</tr>
<tr>
<td><em>dv/dt</em> Peak Diode Recovery dv/dt</td>
<td>5.0</td>
<td>V/ns</td>
</tr>
<tr>
<td><em>T_J</em> Operating Junction and Storage Temperature Range</td>
<td>-55 to +175</td>
<td>°C</td>
</tr>
<tr>
<td>Soldering Temperature, for 10 seconds</td>
<td>300 (1.6mm from case)</td>
<td></td>
</tr>
<tr>
<td>Mounting torque, 6-32 or M3 screw</td>
<td>10 lb•in (1.1N•m)</td>
<td></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><em>R_{JUC}</em> Junction-to-Case</td>
<td>—</td>
<td>3.1</td>
<td>°C/W</td>
</tr>
<tr>
<td><em>R_{ICS}</em> Case-to-Sink, Flat, Greased Surface</td>
<td>0.50</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td><em>R_{JUA}</em> Junction-to-Ambient</td>
<td>—</td>
<td>62</td>
<td></td>
</tr>
</tbody>
</table>

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### Electrical Characteristics @ \( T_J = 25\degree C \) (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} ) Drain-to-Source Breakdown Voltage</td>
<td>100</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>( V_{GS} = 0V, I_D = 250\mu A )</td>
</tr>
<tr>
<td>( \Delta V_{BRDSS}/\Delta T_J ) Breakdown Voltage Temp. Coefficient</td>
<td>—</td>
<td>0.11</td>
<td>—</td>
<td>( V/\degree C )</td>
<td>Reference to 25\degree C, ( I_D = 1\mu A )</td>
</tr>
<tr>
<td>( R_{DS(on)} ) Static Drain-to-Source On-Resistance</td>
<td>—</td>
<td>—</td>
<td>0.20</td>
<td>( \Omega )</td>
<td>( V_{GS} = 10V, I_D = 5.7A ) @</td>
</tr>
<tr>
<td>( V_{GS(th)} ) Gate Threshold Voltage</td>
<td>2.0</td>
<td>—</td>
<td>4.0</td>
<td>V</td>
<td>( V_{DS} = V_{GS}, I_D = 250\mu A )</td>
</tr>
<tr>
<td>( g_f ) Forward Transconductance</td>
<td>2.7</td>
<td>—</td>
<td>—</td>
<td>S</td>
<td>( V_{DS} = 50V, I_D = 5.7A ) @</td>
</tr>
<tr>
<td>( I_{DS} ) Drain-to-Source Leakage Current</td>
<td>—</td>
<td>—</td>
<td>25</td>
<td>( \mu A )</td>
<td>( V_{DS} = 100V, V_{GS} = 0V )</td>
</tr>
<tr>
<td>( I_{GSS} ) Gate-to-Source Forward Leakage</td>
<td>—</td>
<td>—</td>
<td>100</td>
<td>nA</td>
<td>( V_{GS} = 20V )</td>
</tr>
<tr>
<td>( Q_g ) Total Gate Charge</td>
<td>—</td>
<td>—</td>
<td>25</td>
<td>nC</td>
<td>( I_D = 5.7A ) @</td>
</tr>
<tr>
<td>( Q_{gs} ) Gate-to-Source Charge</td>
<td>—</td>
<td>—</td>
<td>4.8</td>
<td>nC</td>
<td>( V_{DS} = 80V )</td>
</tr>
<tr>
<td>( Q_{gd} ) Gate-to-Drain (&quot;Miller&quot;) Charge</td>
<td>—</td>
<td>—</td>
<td>11</td>
<td>nC</td>
<td>( V_{GS} = 10V, ) See Fig. 6 and 13 @</td>
</tr>
<tr>
<td>( t_{on(m)} ) Turn-On Delay Time</td>
<td>—</td>
<td>—</td>
<td>4.5</td>
<td>ns</td>
<td>( V_{DD} = 50V )</td>
</tr>
<tr>
<td>( t_r ) Rise Time</td>
<td>—</td>
<td>—</td>
<td>23</td>
<td>—</td>
<td>( I_D = 5.7A )</td>
</tr>
<tr>
<td>( t_{off} ) Turn-Off Delay Time</td>
<td>—</td>
<td>—</td>
<td>32</td>
<td>—</td>
<td>( R_G = 22\Omega )</td>
</tr>
<tr>
<td>( t_f ) Fall Time</td>
<td>—</td>
<td>—</td>
<td>23</td>
<td>—</td>
<td>( R_D = 8.6\Omega, ) See Fig. 10 @</td>
</tr>
<tr>
<td>( L_D ) Internal Drain Inductance</td>
<td>—</td>
<td>—</td>
<td>4.5</td>
<td>nH</td>
<td>Between lead, 6mm (0.25in.) from package</td>
</tr>
<tr>
<td>( L_S ) Internal Source Inductance</td>
<td>—</td>
<td>—</td>
<td>7.5</td>
<td>—</td>
<td>and center of die contact</td>
</tr>
<tr>
<td>( C_{iss} ) Input Capacitance</td>
<td>—</td>
<td>—</td>
<td>330</td>
<td>pF</td>
<td>( V_{GS} = 0V )</td>
</tr>
<tr>
<td>( C_{oss} ) Output Capacitance</td>
<td>—</td>
<td>—</td>
<td>92</td>
<td>pF</td>
<td>( V_{DS} = 25V )</td>
</tr>
<tr>
<td>( C_{rss} ) Reverse Transfer Capacitance</td>
<td>—</td>
<td>—</td>
<td>54</td>
<td>pF</td>
<td>( f = 1.0MHz, ) See Fig. 5</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 ) Continuous Source Current (Body Diode)</td>
<td>—</td>
<td>—</td>
<td>9.7</td>
<td>A</td>
<td>MOSFET symbol showing the integral reverse p-n junction diode.</td>
</tr>
<tr>
<td>( I_{SM} ) Pulsed Source Current (Body Diode) @</td>
<td>—</td>
<td>—</td>
<td>38</td>
<td>A</td>
<td>( V_{DD} = 25V ), ( I_S = 5.7A ), ( V_{GS} = 0V ) @</td>
</tr>
<tr>
<td>( V_{SD} ) Diode Forward Voltage</td>
<td>—</td>
<td>—</td>
<td>1.3</td>
<td>V</td>
<td>( T_J = 25\degree C, I_S = 5.7A )</td>
</tr>
<tr>
<td>( t_{rr} ) Reverse Recovery Time</td>
<td>—</td>
<td>—</td>
<td>99</td>
<td>ns</td>
<td>( T_J = 25\degree C ), ( I_F = 5.7A )</td>
</tr>
<tr>
<td>( Q_{rr} ) Reverse Recovery Charge</td>
<td>—</td>
<td>—</td>
<td>390</td>
<td>nC</td>
<td>( \text{di/dt} = 100A/\mu s ) @</td>
</tr>
</tbody>
</table>

### Notes:

1. Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
2. \( V_{DD} = 25V \), starting \( T_J = 25\degree C \), \( L = 4.7mH \), \( R_G = 25\Omega \), \( I_{AS} = 5.7A \). (See Figure 12)
3. \( I_{SD} \leq 5.7A \), \( \text{di/dt} \leq 240A/\mu s \), \( V_{DD} \leq V_{BRDSS} \), \( T_J \leq 175\degree C \)
4. Pulse width \leq 300\mu s; duty cycle \leq 2\%.
Fig 1. Typical Output Characteristics

Fig 2. Typical Output Characteristics

Fig 3. Typical Transfer Characteristics

Fig 4. Normalized On-Resistance Vs. Temperature
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**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
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**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
**Peak Diode Recovery dv/dt Test Circuit**

- **Driver Gate Drive**
- **D.U.T. ISD Waveform**
- **D.U.T. VDS Waveform**
- **Inductor Current**
- **Reverse Recovery Current**
- **Re-Applied Voltage**

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

**D.U.T. - Device Under Test**
- $dV/dt$ controlled by $R_G$
- Driver same type as D.U.T.
- $I_{SD}$ controlled by Duty Factor "D"

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**Fig 14.** For N-Channel HEXFETS

* $V_{GS} = 5V$ for Logic Level Devices
IRF520NPbF

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

LEAD ASSIGNMENTS
1 - GATE
2 - DRAIN
3 - SOURCE
4 - DRAIN

- B -

1.32 (.052)
1.22 (.048)

3X 0.55 (.022)
0.46 (.018)
2.92 (.115)
2.64 (.104)

4.69 (.185)
4.20 (.165)

1.15 (.045)
0.69 (.027)

MIN

6.47 (.255)
6.10 (.240)

15.24 (.600)
14.84 (.584)

14.09 (.556)
13.47 (.530)

1.40 (.055)
1.15 (.045)

2.54 (.100)

2X

NOTES:
1  DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
2  CONTROLLING DIMENSION: INCH
3  OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
4  HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

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

Data and specifications subject to change without notice.

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