International Rectifier

- Generation V Technology
- Ultra Low On-Resistance
- P-Channel Mosfet
- Surface Mount
- Available in Tape & Reel
- Dynamic dv/dt Rating
- Fast Switching
- 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 SO-8 has been modified through a customized leadframe for enhanced thermal characteristics and multiple-die capability making it ideal in a variety of power applications. With these improvements, multiple devices can be used in an application with dramatically reduced board space. The package is designed for vapor phase, infra red, or wave soldering techniques. Power dissipation of greater than 0.8W is possible in a typical PCB mount application.

**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_D @ T_A = 25^\circ\text{C}$</td>
<td>-10</td>
<td>A</td>
</tr>
<tr>
<td>$I_D @ T_A = 70^\circ\text{C}$</td>
<td>-7.1</td>
<td>A</td>
</tr>
<tr>
<td>$I_{DM}$</td>
<td>-45</td>
<td>µA</td>
</tr>
<tr>
<td>$P_D @ T_A = 25^\circ\text{C}$</td>
<td>2.5</td>
<td>W</td>
</tr>
<tr>
<td>Linear Derating Factor</td>
<td>0.02</td>
<td>W/°C</td>
</tr>
<tr>
<td>$V_{GS}$</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>$E_{AS}$</td>
<td>370</td>
<td>mJ</td>
</tr>
<tr>
<td>dv/dt</td>
<td>-5.0</td>
<td>V/µs</td>
</tr>
<tr>
<td>$T_J$ (Operating Junction)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_{STG}$ (Storage Temperature Range)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Thermal Resistance**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{JJA}$ (Junction-to-Ambient)</td>
<td>50</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

PD - 95137A

IRF7416PbF

HEXFET® Power MOSFET

$V_{DSS} = -30\text{V}$

$R_{DS(on)} = 0.02\Omega$

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06/29/11
## Static Electrical Characteristics @ T<sub>J</sub> = 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&lt;sub&gt;BRDSS&lt;/sub&gt;</td>
<td>-30</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 0V, I&lt;sub&gt;D&lt;/sub&gt; = -250μA</td>
</tr>
<tr>
<td>ΔV&lt;sub&gt;BRDSS&lt;/sub&gt;/ΔT&lt;sub&gt;J&lt;/sub&gt;</td>
<td>—</td>
<td>-0.024</td>
<td>—</td>
<td>V/°C</td>
<td>Reference to 25°C, I&lt;sub&gt;D&lt;/sub&gt; = -1mA</td>
</tr>
<tr>
<td>R&lt;sub&gt;DS(on)&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>0.020</td>
<td>Ω</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -10V, I&lt;sub&gt;D&lt;/sub&gt; = -5.6A</td>
</tr>
<tr>
<td>V&lt;sub&gt;GS(th)&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>0.035</td>
<td>Ω</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -4.5V, I&lt;sub&gt;D&lt;/sub&gt; = -2.8A</td>
</tr>
<tr>
<td>g&lt;sub&gt;f&lt;/sub&gt;</td>
<td>5.6</td>
<td>—</td>
<td>—</td>
<td>S</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = -10V, I&lt;sub&gt;D&lt;/sub&gt; = -2.8A</td>
</tr>
<tr>
<td>I&lt;sub&gt;DSS&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>-1.0</td>
<td>μA</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = -24V, V&lt;sub&gt;GS&lt;/sub&gt; = 0V</td>
</tr>
<tr>
<td>I&lt;sub&gt;GSS&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>-100</td>
<td>nA</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -20V</td>
</tr>
<tr>
<td>I&lt;sub&gt;GSS&lt;/sub&gt;</td>
<td>—</td>
<td>100</td>
<td>—</td>
<td>—</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 20V</td>
</tr>
</tbody>
</table>

## Dynamic Electrical Characteristics @ T<sub>J</sub> = 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>Q&lt;sub&gt;g&lt;/sub&gt;</td>
<td>—</td>
<td>61</td>
<td>92</td>
<td>nC</td>
<td>I&lt;sub&gt;D&lt;/sub&gt; = -5.6A</td>
</tr>
<tr>
<td>Q&lt;sub&gt;gs&lt;/sub&gt;</td>
<td>—</td>
<td>8.0</td>
<td>12</td>
<td>nC</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = -24V</td>
</tr>
<tr>
<td>Q&lt;sub&gt;gd&lt;/sub&gt;</td>
<td>—</td>
<td>22</td>
<td>32</td>
<td>nC</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -10V, See Fig. 6 &amp; 9</td>
</tr>
<tr>
<td>t&lt;sub&gt;on&lt;/sub&gt;</td>
<td>—</td>
<td>18</td>
<td>—</td>
<td>ns</td>
<td>V&lt;sub&gt;GG&lt;/sub&gt; = -15V</td>
</tr>
<tr>
<td>t&lt;sub&gt;r&lt;/sub&gt;</td>
<td>—</td>
<td>49</td>
<td>—</td>
<td>ns</td>
<td>I&lt;sub&gt;D&lt;/sub&gt; = -5.6A</td>
</tr>
<tr>
<td>t&lt;sub&gt;off&lt;/sub&gt;</td>
<td>—</td>
<td>59</td>
<td>—</td>
<td>ns</td>
<td>R&lt;sub&gt;G&lt;/sub&gt; = 6.2Ω, See Fig. 10</td>
</tr>
<tr>
<td>t&lt;sub&gt;f&lt;/sub&gt;</td>
<td>—</td>
<td>60</td>
<td>—</td>
<td>ns</td>
<td>R&lt;sub&gt;G&lt;/sub&gt; = 2.7Ω, See Fig. 10</td>
</tr>
<tr>
<td>C&lt;sub&gt;iss&lt;/sub&gt;</td>
<td>—</td>
<td>1700</td>
<td>—</td>
<td>pF</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 0V</td>
</tr>
<tr>
<td>C&lt;sub&gt;oss&lt;/sub&gt;</td>
<td>—</td>
<td>890</td>
<td>—</td>
<td>pF</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = -25V</td>
</tr>
<tr>
<td>C&lt;sub&gt;rss&lt;/sub&gt;</td>
<td>—</td>
<td>410</td>
<td>—</td>
<td>pF</td>
<td>f = 1.0MHz, See Fig. 5</td>
</tr>
</tbody>
</table>

## Diode 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&lt;sub&gt;S&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>-3.1</td>
<td>A</td>
<td>MOSFET symbol showing the integral reverse p-n junction diode.</td>
</tr>
<tr>
<td>I&lt;sub&gt;SM&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>-45</td>
<td>—</td>
<td>(See Figure 12)</td>
</tr>
<tr>
<td>V&lt;sub&gt;DD&lt;/sub&gt;</td>
<td>—</td>
<td>—</td>
<td>-1.0</td>
<td>V</td>
<td>T&lt;sub&gt;J&lt;/sub&gt; = 25°C, I&lt;sub&gt;S&lt;/sub&gt; = -5.6A, V&lt;sub&gt;GS&lt;/sub&gt; = 0V</td>
</tr>
<tr>
<td>t&lt;sub&gt;rr&lt;/sub&gt;</td>
<td>—</td>
<td>56</td>
<td>85</td>
<td>ns</td>
<td>T&lt;sub&gt;J&lt;/sub&gt; = 25°C, t&lt;sub&gt;rr&lt;/sub&gt; = -5.6A</td>
</tr>
<tr>
<td>Q&lt;sub&gt;rr&lt;/sub&gt;</td>
<td>—</td>
<td>99</td>
<td>150</td>
<td>nC</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<sub>J</sub> = 25°C, L = 25mH
   R<sub>G</sub> = 25Ω, I<sub>A</sub> = -5.6A. (See Figure 12)
3. Pulse width ≤ 300μs; duty cycle ≤ 2%.
4. Surface mounted on FR-4 board, t ≤ 10sec.
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. Drain-to-Source Voltage

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

**Fig 8.** Maximum Safe Operating Area
Fig 9a. Basic Gate Charge Waveform

Fig 9b. Gate Charge Test Circuit

Fig 10a. Switching Time Test Circuit

Fig 10b. Switching Time Waveforms

Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient
IRF7416PbF

Fig 12a. Unclamped Inductive Test Circuit

Fig 12b. Unclamped Inductive Waveforms

Fig 12c. Maximum Avalanche Energy Vs. Drain Current
Peak Diode Recovery dv/dt Test Circuit

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"
- D.U.T. - Device Under Test

* Reverse Polarity for P-Channel
** Use P-Channel Driver for P-Channel Measurements

1. Driver Gate Drive
   - P.W. Period
   - D = P.W./Period
   - \( V_{GS} = 10V \) ***

2. D.U.T. \( I_{SD} \) Waveform
   - Reverse Recovery Current
   - Body Diode Forward Current
   - dv/dt

3. D.U.T. \( V_{DS} \) Waveform
   - Body Diode Forward Drop
   - Diode Recovery dv/dt
   - \( V_{DS} \)

4. Inductor Current
   - Re-Applied Voltage
   - Ripple \( \leq 5\% \)
   - \( I_{SO} \)

*** \( V_{GS} = 5.0V \) for Logic Level and 3V Drive Devices

Fig 13. For P-Channel HEXFETS
IRF7416PbF

SO-8 Package Outline
Dimensions are shown in millimeters (inches)

NOTES:
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.
5. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS.
6. MOLD PROTRUSIONS NOT TO EXCEED 0.15 [0.006].
7. DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.

SO-8 Part Marking

EXAMPLE: THIS IS AN IRF7101 (MOSFET)

DATE CODE (YWW)
P = DESIGNATES LEAD-FREE PRODUCT (OPTIONAL)
Y = LAST DIGIT OF THE YEAR
WW = WEEK
A = ASSEMBLY SITE CODE
LOT CODE
PART NUMBER
SO-8 Tape and Reel
Dimensions are shown in millimeters (inches)

NOTES:
1. CONTROLLING DIMENSION: MILLIMETER.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3. OUTLINE CONFORMS TO EIA-481 & EIA-541.

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