Features
- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax
- Lead-Free

Description
This HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These features combine to make this design an extremely efficient and reliable device for use in a wide variety of other applications.

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>270</td>
<td>A</td>
</tr>
<tr>
<td>ID @ TC = 100°C</td>
<td>190</td>
<td>A</td>
</tr>
<tr>
<td>ID @ TC = 25°C</td>
<td>75</td>
<td>A</td>
</tr>
<tr>
<td>IDM</td>
<td>1080</td>
<td>A</td>
</tr>
<tr>
<td>PD @ TC = 25°C</td>
<td>300</td>
<td>W</td>
</tr>
<tr>
<td>VGS</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>EAS</td>
<td>540</td>
<td>mJ</td>
</tr>
<tr>
<td>EAS (tested)</td>
<td>1160</td>
<td>mJ</td>
</tr>
<tr>
<td>IAAR</td>
<td>See Fig. 12a, 12b, 15, 16</td>
<td>A</td>
</tr>
<tr>
<td>EAAR</td>
<td>See Fig. 12a, 12b, 15, 16</td>
<td>mJ</td>
</tr>
<tr>
<td>TJ</td>
<td>-55 to +175</td>
<td>°C</td>
</tr>
<tr>
<td>TS</td>
<td>300 (1.6mm from case)</td>
<td>°C</td>
</tr>
<tr>
<td>Mounting torque, 6-32 or M3 screw</td>
<td>10 lbf-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>RJC</td>
<td>0.50@</td>
<td>C/W</td>
<td></td>
</tr>
<tr>
<td>RCS</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RJA</td>
<td>62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RJJA</td>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Static @ $T_J = 25^\circ C$ (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>$V_{BR(ON)}$</td>
<td>40</td>
<td>----</td>
<td>----</td>
<td>V</td>
<td>$V_{DS} = 0V, I_D = 250\mu A$</td>
</tr>
<tr>
<td>$\Delta V_{BR(ON)}$</td>
<td></td>
<td>----</td>
<td>0.031</td>
<td>V/$^\circ C$</td>
<td>Reference to $25^\circ C$, $I_D = 1mA$</td>
</tr>
</tbody>
</table>
| $R_{DS(ON)}$ SMD                 | 1.5  | 2.0  |      | m$\Omega$ | $V_{DS} = 10V, I_D = 75A$  
| $R_{DS(ON)}$ TO-220              | 1.8  | 2.3  |      | m$\Omega$ | $V_{DS} = 10V, I_D = 75A$  
| $V_{G(S[F])}$                   | 2.0  | 4.0  |      | V     | $V_{DS} = V_{GS}, I_D = 250\mu A$ |
| $g_{fs}$                         | 130  | ---- | ---- | S     | $V_{DS} = 10V, I_D = 75A$  
| $I_{DSS}$                        |      | 20   |      | $\mu A$ | $V_{DS} = 40V, V_{GS} = 0V$ |
| $I_{GSS}$                        |      | 200  |      | nA    | $V_{DS} = 20V$  
| $Q_g$                            | 160  | 240  |      | nC    | $I_D = 75A$  
| $Q_{gs}$                         | 41   | 62   |      | nC    | $V_{DS} = 32V$  
| $Q_{gd}$                         | 66   | 99   |      | nC    | $V_{GS} = 10V$  
| $t_{on}$                         | 13   |      |      | ns    | $V_{DD} = 20V$  
| $t_r$                            | 120  |      |      | ns    | $I_D = 75A$  
| $t_{off}$                        | 130  |      |      | ns    | $R_G = 2.5\Omega$  
| $t_f$                            | 130  |      |      | ns    | $V_{OS} = 10V$  
| $L_D$                            | 4.5  |      |      | nH    | Between lead, 
|                                 |      |      |      | from package,  
|                                 |      |      |      | and center of die contact |
| $L_S$                            | 7.5  |      |      | nH    | $V_{DS} = 0V$  
| $C_{iss}$                        | 6450 |      |      | pF    | $V_{DD} = 25V$  
| $C_{oss}$                        | 1690 |      |      | pF    | $f = 1.0MHz$, See Fig. 5 |
| $C_{rss}$                        | 840  |      |      | pF    | $V_{DS} = 0V, V_{DD} = 1.0V, f = 1.0MHz$  
| $C_{oss}$                        | 5350 |      |      | pF    | $V_{DS} = 0V, V_{DD} = 32V, f = 1.0MHz$  
| $C_{oss}^{eff.}$                 | 1520 |      |      | pF    | $V_{DS} = 0V$  
| $C_{oss}^{eff.}$                 | 2210 |      |      | pF    | $V_{DS} = 0V$  

**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>$I_S$</td>
<td></td>
<td>270</td>
<td></td>
<td>A</td>
<td>MOSFET symbol</td>
</tr>
<tr>
<td>$I_{SM}$</td>
<td></td>
<td>1080</td>
<td></td>
<td>A</td>
<td>showing the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>integral reverse</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p-n junction diode.</td>
</tr>
</tbody>
</table>
| $V_{SD}$                         | 1.3  |      |      | V     | $T_J = 25^\circ C, I_S = 75A, V_{GS} = 0V$  
| $t_f$                            | 56   | 84   |      | ns    | $T_J = 25^\circ C, I_F = 75A, V_{DD} = 20V$  
| $Q_{tr}$                         | 67   | 100  |      | nC    | $di/dt = 100A/\mu s$  
| $t_{on}$                         |      |      |      | ns    | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD) |

**Notes:**

1. Repetitive rating; pulse width limited by max. junction temperature. (See fig. 7).
2. Limited by $T_{j\max}$, starting $T_J = 25^\circ C$, $L=0.24$mH, $R_C = 25\Omega$, $I_O = 75A$, $V_{DS} = 10V$.
3. Part not recommended for use above this value.
4. $t_{on} \leq 75A$, $di/dt \leq 220A/\mu s$, $V_{DD} \leq V_{BR(ON)}$, $T_J \leq 175^\circ C$.
5. Pulse width $\leq 1.0ms$: duty cycle $\leq 2\%$.
6. $C_{oss}^{eff.}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{oss}$.
7. Limited by $T_{j\max}$, $I_D = 1ma$ for repetitive avalanche performance.
8. This value determined from sample failure population. 100% tested to this value in production.
9. This is applied to D2Pak, when mounted on 1" square PCB (FR-4 or G-10 Material ). For recommended footprint and soldering techniques refer to application note #AN-994.
10. Max $R_{DS(on)}$ for D2Pak and TO-262 (SMD) devices.
11. TO-220 device will have an Rth value of 0.45°C/W.
**Fig 1.** Typical Output Characteristics

**Fig 2.** Typical Output Characteristics

**Fig 3.** Typical Transfer Characteristics

**Fig 4.** Typical Forward Transconductance vs. Drain Current
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 10.** Normalized On-Resistance vs. Temperature

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

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Notes:
1. Duty Factor $D = t_1/t_2$
2. Peak $T_J = P_{dm} \times Z_{thJC} + T_c$
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

Fig 14. Threshold Voltage vs. Temperature
Notes on Repetitive Avalanche Curves, Figures 15, 16:
(For further info, see AN-1005 at www.irf.com)

1. Avalanche failures assumption:
   - Purely a thermal phenomenon and failure occurs at a temperature far in excess of $T_{j_{max}}$. This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as $T_{j_{max}}$ is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 12a, 12b.
4. $P_D(ave) = \frac{1}{2}(1.3 \cdotBV \cdot I_{av})$ = Power dissipation per single avalanche pulse.
5. $BV$ = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6. $I_{av}$ = Allowable avalanche current.
7. $\Delta T$ = Allowable rise in junction temperature, not to exceed $T_{j_{max}}$ (assumed as 25°C in Figure 15, 16).
8. $t_{av}$ = Average time in avalanche.
9. $D = \text{Duty cycle in avalanche} = \frac{t_{av}}{f}$
10. $Z_{thJC}(D, t_{av}) = \text{Transient thermal resistance, see figure 11)$

$P_D(ave) = \frac{1}{2}(1.3 \cdot BV \cdot I_{av}) = \frac{\Delta T}{Z_{thJC}}$

$I_{av} = 2 \Delta T \cdot [1.3 \cdot BV \cdot Z_{th}]$

$E_{AS}(AR) = P_D(ave) \cdot t_{av}$

Fig 15. Typical Avalanche Current Vs. Pulsewidth

Fig 16. Maximum Avalanche Energy Vs. Temperature
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Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

Fig 18a. Switching Time Test Circuit

Fig 18b. Switching Time Waveforms
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TO-220AB Package Outline
Dimensions are shown in millimeters (inches)

Notes:
1. For an Automotive Qualified version of this part please see http://www.irf.com/product-info/datasheets/data/auirf2804.pdf
2. For the most current drawing please refer to IR website at http://www.irf.com/package/

TO-220AB Part Marking Information

Example: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 2000
IN THE ASSEMBLY LINE 'C'

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

IRF1010
INTERNATIONAL
RECTIFIER
LOGO
PART NUMBER
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/datasheets/data/auirf2804.pdf
2. For the most current drawing please refer to IR website at http://www.irf.com/package/

www.irf.com
IRF2804/S/LPbF
D²Pak Package Outline
Dimensions are shown in millimeters (inches)

Notes:
2. For the most current drawing please refer to IR website at [http://www.irf.com/package/](http://www.irf.com/package/)
TO-262 Package Outline
Dimensions are shown in millimeters (inches)

TO-262 Part Marking Information

Notes:
1. For an Automotive Qualified version of this part please see http://www.irf.com/product-info/datasheets/data/auirf2804.pdf
2. For the most current drawing please refer to IR website at http://www.irf.com/package/
IRF2804/S/LPbF

D²Pak Tape & Reel Information
Dimensions are shown in millimeters (inches)

NOTES:
1. CONFORMS TO EIA-418.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION MEASURED @ HUB.
4. INCLUDES FLANGE DISTORTION @ OUTER EDGE.

TO-220AB package is not recommended for Surface Mount Application.

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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