Features

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

Description

Specifically designed for Automotive applications, 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 Automotive applications and 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 @ T C = 25°C</td>
<td>51</td>
<td>A</td>
</tr>
<tr>
<td>ID @ T C = 100°C</td>
<td>36</td>
<td>A</td>
</tr>
<tr>
<td>IDM</td>
<td>204</td>
<td>—</td>
</tr>
<tr>
<td>PD @ T C = 25°C</td>
<td>80</td>
<td>W</td>
</tr>
<tr>
<td>VGS</td>
<td>0.53</td>
<td>W/°C</td>
</tr>
<tr>
<td>EAS (Thermally limited)</td>
<td>78</td>
<td>mJ</td>
</tr>
<tr>
<td>EAS (Tested)</td>
<td>110</td>
<td>mJ</td>
</tr>
<tr>
<td>IAR</td>
<td>See Fig.12a, 12b, 15, 16</td>
<td>A</td>
</tr>
<tr>
<td>EAR</td>
<td>Repetitive Avalanche Energy</td>
<td>mJ</td>
</tr>
<tr>
<td>TJ</td>
<td>-55 to +175</td>
<td>°C</td>
</tr>
<tr>
<td>TSTG</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>—</td>
<td>1.67</td>
<td>°C/W</td>
</tr>
<tr>
<td>RCBS</td>
<td>0.50</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>RJA</td>
<td>62</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>RJA</td>
<td>40</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

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3/2/04
### 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>$V_{BRDSS}$ (Drain-to-Source Breakdown Voltage)</td>
<td>55</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>0.05</td>
<td></td>
<td>V/$^\circ C$</td>
<td>Reference to 25°C, $I_D = 1mA$</td>
</tr>
<tr>
<td>$R_{DS(on)}$ (Static Drain-to-Source On-Resistance)</td>
<td>11</td>
<td>13.5</td>
<td></td>
<td>m$\Omega$</td>
<td>$V_{GS} = 10V, I_D = 31A$ @ $T_J = 25°C$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td></td>
<td>m$\Omega$</td>
<td>$V_{GS} = 5.0V, I_D = 30A$ @ $T_J = 125°C$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.5</td>
<td></td>
<td>m$\Omega$</td>
<td>$V_{GS} = 4.5V, I_D = 15A$ @ $T_J = 25°C$</td>
</tr>
<tr>
<td>$V_{GSS}$ (Gate Threshold Voltage)</td>
<td>1.0</td>
<td></td>
<td>3.0</td>
<td>V</td>
<td>$V_{GS} = 25V, I_D = 31A$</td>
</tr>
<tr>
<td>$g_{fs}$ (Forward Transconductance)</td>
<td>27</td>
<td></td>
<td></td>
<td>V</td>
<td>$V_{GS} = 25V, I_D = 31A$</td>
</tr>
<tr>
<td>$I_{DSS}$ (Drain-to-Source Leakage Current)</td>
<td></td>
<td>20</td>
<td></td>
<td>nA</td>
<td>$V_{GS} = 55V, V_{DS} = 0V$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>250</td>
<td>nA</td>
<td>$V_{DS} = 55V, V_{GS} = 0V, T_J = 125°C</td>
</tr>
<tr>
<td>$I_{GS}$ (Gate-to-Source Forward Leakage)</td>
<td></td>
<td></td>
<td></td>
<td>nA</td>
<td>$V_{DS} = 16V$</td>
</tr>
<tr>
<td>$Q_g$ (Total Gate Charge)</td>
<td></td>
<td>24</td>
<td>36</td>
<td>nC</td>
<td>$I_D = 31A$</td>
</tr>
<tr>
<td>$Q_{gs}$ (Gate-to-Source Charge)</td>
<td></td>
<td>7.5</td>
<td></td>
<td>nC</td>
<td>$V_{DS} = 44V$</td>
</tr>
<tr>
<td>$Q_{gd}$ (Gate-to-Drain (&quot;Miller&quot;) Charge)</td>
<td></td>
<td>12</td>
<td></td>
<td>nC</td>
<td>$V_{GS} = 5.0V$</td>
</tr>
<tr>
<td>$t_{on}$ (Turn-On Delay Time)</td>
<td></td>
<td>14</td>
<td></td>
<td>ns</td>
<td>$V_{DD} = 50V$</td>
</tr>
<tr>
<td>$I_{DSS}$ (Continuous Source Current)</td>
<td></td>
<td>160</td>
<td></td>
<td>ns</td>
<td>$I_D = 31A$</td>
</tr>
<tr>
<td>$L_{D}$ (Internal Drain Inductance)</td>
<td></td>
<td>4.5</td>
<td></td>
<td>nH</td>
<td>$R_g = 7.5 \Omega$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$V_{GS} = 5.0V$</td>
</tr>
<tr>
<td>$L_S$ (Internal Source Inductance)</td>
<td></td>
<td>7.5</td>
<td></td>
<td>nH</td>
<td>Between leads, 6mm (0.25in.) from package and center of die contact</td>
</tr>
<tr>
<td>$C_{iss}$ (Input Capacitance)</td>
<td></td>
<td>1620</td>
<td></td>
<td>pF</td>
<td>$V_{GS} = 0V$</td>
</tr>
<tr>
<td>$C_{oss}$ (Output Capacitance)</td>
<td></td>
<td>230</td>
<td></td>
<td>pF</td>
<td>$V_{DS} = 25V$</td>
</tr>
<tr>
<td>$C_{rss}$ (Reverse Transfer Capacitance)</td>
<td></td>
<td>130</td>
<td></td>
<td>pF</td>
<td>$f = 1.0MHz$</td>
</tr>
<tr>
<td>$C_{oss}$ eff. (Effective Output Capacitance)</td>
<td></td>
<td>860</td>
<td></td>
<td>pF</td>
<td>$V_{DS} = 0V, V_{DD} = 1.0V, f = 1.0MHz$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>180</td>
<td></td>
<td>pF</td>
<td>$V_{DS} = 0V, V_{GS} = 44V, f = 1.0MHz$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>280</td>
<td>pF</td>
<td>$V_{DS} = 0V, V_{DD} = 0V to 44V$</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)</td>
<td></td>
<td>51</td>
<td></td>
<td>A</td>
<td>MOSFET symbol showing the integral reverse p-n junction diode.</td>
</tr>
<tr>
<td>$I_{SM}$ (Pulsed Source Current)</td>
<td></td>
<td>204</td>
<td></td>
<td></td>
<td>$V_{DD} = 50V, I_D = 31A$</td>
</tr>
<tr>
<td>$V_{DS}$ (Diode Forward Voltage)</td>
<td></td>
<td>1.3</td>
<td></td>
<td>V</td>
<td>$T_J = 25°C, I_S = 31A, V_{DS} = 0V @ $T_J = 25°C$</td>
</tr>
<tr>
<td>$t_{off}$ (Reverse Recovery Time)</td>
<td></td>
<td>21</td>
<td>32</td>
<td>ns</td>
<td>$I_{F} = 31A, V_{DD} = 28V$</td>
</tr>
<tr>
<td>$Q_{rr}$ (Reverse Recovery Charge)</td>
<td></td>
<td>16</td>
<td>24</td>
<td>nC</td>
<td>$dI/dt = 100A/\mu s$</td>
</tr>
<tr>
<td>$I_{on}$ (Forward Turn-On Time)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)</td>
</tr>
</tbody>
</table>
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
Fig 12a. Unclamped Inductive Test Circuit

Fig 12b. Unclamped Inductive Waveforms

Fig 13a. Basic Gate Charge Waveform

Fig 13b. Gate Charge Test Circuit

Fig 12c. Maximum Avalanche Energy Vs. Drain Current

Fig 14. Threshold Voltage Vs. Temperature

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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 \( T_{j\text{max}} \). This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as \( T_{j\text{max}} \) is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 12a, 12b.
4. \( P_{D\text{ (ave)}} = \) Average power dissipation per single avalanche pulse.
5. \( BV = \) Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6. \( I_{\text{av}} = \) Allowable avalanche current.
7. \( \Delta T = \) Allowable rise in junction temperature, not to exceed \( T_{j\text{max}} \) (assumed as 25°C in Figure 15, 16).
\( t_{\text{av}} = \) Average time in avalanche.
\( D = \) Duty cycle in avalanche = \( \frac{t_{\text{av}}}{f} \)
\( Z_{thJC}(D, t_{\text{av}}) = \) Transient thermal resistance, see figure 11)

\[
P_{D\text{ (ave)}} = \frac{1}{2} \left( 1.3 \cdot BV \cdot I_{\text{av}} \right) = \Delta T / Z_{thJC}
\]

\[
l_{\text{av}} = 2 \Delta T / [1.3 \cdot BV \cdot Z_{th}]
\]

\[
E_{AS\ (AR)} = P_{D\text{ (ave)}} \cdot t_{\text{av}}
\]
**Fig 17.** Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs

**Fig 18a.** Switching Time Test Circuit

**Fig 18b.** Switching Time Waveforms
TO-220AB Package Outline

Dimensions are shown in millimeters (inches)

Dimensions:
- 2.87 (.113)
- 2.62 (.103)
- 15.24 (.600)
- 14.84 (.584)
- 14.09 (.555)
- 13.47 (.530)
- 3X 1.40 (.055)
- 1.15 (.045)
- 2.54 (.100)
- 10.54 (.415)
- 10.29 (.405)
- 3.78 (.149)
- 3.54 (.139)
- 6.47 (.255)
- 6.10 (.240)
- 1.15 (.045)
- 4.69 (.185)
- 4.20 (.165)
- 1.32 (.052)
- 1.22 (.048)
- 3X 0.93 (.037)
- 0.69 (.027)
- 2.92 (.115)
- 2.64 (.104)
- 0.46 (.018)
- 3.55 (.140)
- 0.36 (.014)

NOTES:
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"

INTERNATIONAL RECTIFIER
LOGO

ASSEMBLY LOT CODE

PART NUMBER

DATE CODE
YEAR 7 = 1997
WEEK 19
LINE C

For GB Production

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

INTERNATIONAL RECTIFIER
LOGO

LOT CODE

PART NUMBER

DATE CODE

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IRLZ44Z/S/L

D²Pak Package Outline

Dimensions are shown in millimeters (inches)

D²Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH LOT CODE 8024 ASSEMBLED ON WW 02, 2000 IN THE ASSEMBLY LINE "L".

For GB Production

EXAMPLE: THIS IS AN IRF530S WITH LOT CODE 8024 ASSEMBLED ON WW 02, 2000 IN THE ASSEMBLY LINE "L".

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TO-262 Package Outline
Dimensions are shown in millimeters (inches)

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MILLIMETERS</td>
</tr>
<tr>
<td>A</td>
<td>4.06</td>
</tr>
<tr>
<td>A1</td>
<td>2.03</td>
</tr>
<tr>
<td>b</td>
<td>0.51</td>
</tr>
<tr>
<td>b1</td>
<td>0.98</td>
</tr>
<tr>
<td>b2</td>
<td>1.14</td>
</tr>
<tr>
<td>c</td>
<td>0.63</td>
</tr>
<tr>
<td>c1</td>
<td>1.16</td>
</tr>
<tr>
<td>c2</td>
<td>0.43</td>
</tr>
<tr>
<td>D</td>
<td>8.51</td>
</tr>
<tr>
<td>D1</td>
<td>5.33</td>
</tr>
<tr>
<td>E</td>
<td>9.65</td>
</tr>
<tr>
<td>E1</td>
<td>5.22</td>
</tr>
<tr>
<td>e</td>
<td>0.35</td>
</tr>
<tr>
<td>l</td>
<td>13.48</td>
</tr>
<tr>
<td>l1</td>
<td>3.56</td>
</tr>
<tr>
<td>l2</td>
<td>1.65</td>
</tr>
</tbody>
</table>

**LEAD ASSIGNMENTS**

- **HEXFET**
  1. GATE
  2. DRAIN
  3. SOURCE
  4. DRAIN

- **IGBT**
  1. GATE
  2. COLLECTOR

**NOTES**

1. DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES)
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 (0.05") PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION W AND L APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH

TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

INTERNATIONAL
RECTIFIER
LOGO

PART NUMBER

INTERNATIONAL
RECTIFIER
LOGO

DATE CODE
YEAR 7 = 1997
WEEK 19
LINE C

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Notes:

1. Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
2. Limited by $T_{j \text{max}}$, starting $T_J = 25°C$, $L = 0.166$ mH.
   $R_G = 25Ω$, $I_{KS} = 31A$, $V_{GS} = 10V$. Part not recommended for use above this value.
3. Pulse width $\leq 1.0$ ms; duty cycle $\leq 2\%$.
4. $C_{oss}$ eff. is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.
5. Limited by $T_{j \text{max}}$ - see Fig. 12a, 12b, 15, 16 for typical repetitive avalanche performance.
   This value determined from sample failure population. 100% tested to this value in production.
6. This is only applied to TO-220AB package.
7. This is applied to $D^2$Pak, when mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.
8. $R_J$ is measured at $T_J$ approximately 90°C.

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 Automotive [Q101]market.
Qualification Standards can be found on IR’s Web site.
Note: For the most current drawings please refer to the IR website at:
http://www.irf.com/package/