AUTOMOTIVE MOSFET

Features
- 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>94</td>
<td>A</td>
</tr>
<tr>
<td>ID @ T_C = 100°C</td>
<td>66</td>
<td>A</td>
</tr>
<tr>
<td>IDM</td>
<td>75</td>
<td>A</td>
</tr>
<tr>
<td>PD @ T_C = 25°C</td>
<td>140</td>
<td>W</td>
</tr>
<tr>
<td>VGS</td>
<td>± 20</td>
<td>V</td>
</tr>
<tr>
<td>EAS (Thermally limited)</td>
<td>130</td>
<td>mJ</td>
</tr>
<tr>
<td>EAS (Tested)</td>
<td>180</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>Operating Junction and Storage Temperature Range</td>
<td>-55 to +175°C</td>
</tr>
<tr>
<td>TSTG</td>
<td>Soldering Temperature, for 10 seconds</td>
<td>300 (1.6mm from case)</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>RJC</td>
<td>Junction-to-Case</td>
<td>——</td>
<td>1.11°C/W</td>
</tr>
<tr>
<td>RHC</td>
<td>Case-to-Sink, Flat Greased Surface</td>
<td>0.50</td>
<td>——</td>
</tr>
<tr>
<td>RJA</td>
<td>Junction-to-Ambient</td>
<td>——</td>
<td>62</td>
</tr>
<tr>
<td>RJA</td>
<td>Junction-to-Ambient (PCB Mount)</td>
<td>——</td>
<td>40</td>
</tr>
</tbody>
</table>
### Electrical Characteristics @ $T_J = 25^\circ C$ (unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{BRDSS}$</td>
<td>V</td>
<td>55</td>
<td></td>
<td></td>
<td>$V_{GS} = 0V, I_D = 250\mu A$</td>
</tr>
<tr>
<td>$\Delta V_{BRDSS}/\Delta T_J$</td>
<td>V/°C</td>
<td>0.049</td>
<td></td>
<td></td>
<td>Reference to $25^\circ C$, $I_D = 1mA$</td>
</tr>
<tr>
<td>$R_{DS(ON)}$</td>
<td>mΩ</td>
<td>5.8</td>
<td>7.5</td>
<td></td>
<td>$V_{GS} = 10V, I_D = 75A$</td>
</tr>
<tr>
<td>$V_{GS(th)}$</td>
<td>V</td>
<td></td>
<td></td>
<td></td>
<td>$V_{DS} = V_{GS} = 0V$</td>
</tr>
<tr>
<td>$I_{FS}$</td>
<td>μA</td>
<td>20</td>
<td></td>
<td>250</td>
<td>$V_{DS} = 55V, V_{GS} = 0V, T_J = 125^\circ C$</td>
</tr>
<tr>
<td>$I_{DSS}$</td>
<td>nA</td>
<td>200</td>
<td></td>
<td>-200</td>
<td>$V_{GS} = 20V$</td>
</tr>
<tr>
<td>$Q_g$</td>
<td>nC</td>
<td>63</td>
<td>95</td>
<td></td>
<td>$I_D = 75A$</td>
</tr>
<tr>
<td>$Q_{gs}$</td>
<td>nC</td>
<td>19</td>
<td></td>
<td></td>
<td>$V_{DS} = 44V$</td>
</tr>
<tr>
<td>$I_{on}$</td>
<td>ns</td>
<td>18</td>
<td></td>
<td></td>
<td>$V_{DD} = 28V$</td>
</tr>
<tr>
<td>$I_{off}$</td>
<td>ns</td>
<td>92</td>
<td></td>
<td></td>
<td>$V_{GS} = 10V$</td>
</tr>
<tr>
<td>$L_D$</td>
<td>nH</td>
<td>4.5</td>
<td></td>
<td></td>
<td>Between lead, 6mm (0.25in.) from package and center of die contact</td>
</tr>
<tr>
<td>$L_S$</td>
<td>nH</td>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_{iss}$</td>
<td>pF</td>
<td>2840</td>
<td></td>
<td></td>
<td>$V_{GS} = 0V$</td>
</tr>
<tr>
<td>$C_{oss}$</td>
<td>pF</td>
<td>420</td>
<td></td>
<td></td>
<td>$V_{DS} = 25V$</td>
</tr>
<tr>
<td>$C_{oss}$</td>
<td>pF</td>
<td>250</td>
<td></td>
<td></td>
<td>$f = 1.0MHz$</td>
</tr>
<tr>
<td>$C_{oss}$</td>
<td>pF</td>
<td>1630</td>
<td></td>
<td></td>
<td>$V_{DS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$</td>
</tr>
<tr>
<td>$C_{oss}$</td>
<td>pF</td>
<td>360</td>
<td></td>
<td></td>
<td>$V_{GS} = 0V, V_{DS} = 44V, f = 1.0MHz$</td>
</tr>
<tr>
<td>$C_{oss eff.}$</td>
<td>pF</td>
<td>560</td>
<td></td>
<td></td>
<td>$V_{GS} = 0V, V_{DS} = 0V$ to $44V$</td>
</tr>
</tbody>
</table>

### Source-Drain Ratings and Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_S$</td>
<td>A</td>
<td>75</td>
<td></td>
<td></td>
<td>MOSFET symbol showing the integral reverse p-n junction diode.</td>
</tr>
<tr>
<td>$I_{SM}$</td>
<td>A</td>
<td>360</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{DS}$</td>
<td>V</td>
<td>1.3</td>
<td></td>
<td></td>
<td>$T_J = 25^\circ C, I_S = 75A, V_{GS} = 0V$</td>
</tr>
<tr>
<td>$t_{rr}$</td>
<td>ns</td>
<td>22</td>
<td>33</td>
<td></td>
<td>$T_J = 25^\circ C, I_F = 75A, V_{DD} = 25V$</td>
</tr>
<tr>
<td>$Q_{rr}$</td>
<td>nC</td>
<td>15</td>
<td>23</td>
<td></td>
<td>$di/dt = 100A/\mu s$</td>
</tr>
<tr>
<td>$t_{on}$</td>
<td>Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)</td>
<td></td>
<td></td>
<td></td>
<td></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 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 $T_{j_{\text{max}}}$. 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. $P_{D_{\text{ave}}} = \text{Average power dissipation per single}
   \text{avalanche pulse.}$

5. $BV = \text{Rated breakdown voltage (1.3 factor accounts for}
   voltage increase during avalanche).}$

6. $I_{av} = \text{Allowable avalanche current.}$

7. $\Delta T = \text{Allowable rise in junction temperature, not to exceed}
   T_{j_{\text{max}}} \text{ (assumed as 25°C in Figure 15, 16).}$

   $I_{av} = \text{Average time in avalanche.}$

   $D = \text{Duty cycle in avalanche} = t_{av} \cdot f$

   $Z_{thJC}(D, t_{av}) = \text{Transient thermal resistance, see figure 11)}$

   $P_{D_{\text{ave}}} = 1/2 \cdot (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$

   $I_{av} = 2 \cdot \Delta T / (1.3 \cdot BV \cdot Z_{th})$

   $E_{AS\ (AR)} = P_{D_{\text{ave}}} \cdot t_{av}$
Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

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

Fig 18a. Switching Time Test Circuit

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

Dimensions are shown in millimeters (inches)

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.87 (.113)</td>
<td>2.62 (.103)</td>
</tr>
<tr>
<td>15.24 (.600)</td>
<td>14.84 (.584)</td>
</tr>
<tr>
<td>14.09 (.555)</td>
<td>13.47 (.530)</td>
</tr>
<tr>
<td>1.15 (.045)</td>
<td>MIN</td>
</tr>
<tr>
<td>0.93 (.037)</td>
<td>0.69 (.027)</td>
</tr>
<tr>
<td>0.36 (.014)</td>
<td>M B A M</td>
</tr>
<tr>
<td>2.54 (.100)</td>
<td>2X</td>
</tr>
<tr>
<td>10.54 (.415)</td>
<td>10.29 (.403)</td>
</tr>
<tr>
<td>6.47 (.255)</td>
<td>6.10 (.240)</td>
</tr>
<tr>
<td>4.06 (.160)</td>
<td>3.55 (.140)</td>
</tr>
<tr>
<td>3X 1.40 (.055)</td>
<td>1.15 (.045)</td>
</tr>
<tr>
<td>0.55 (.022)</td>
<td>0.46 (.018)</td>
</tr>
<tr>
<td>2.92 (.115)</td>
<td>2.64 (.104)</td>
</tr>
</tbody>
</table>

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"

INTERNATIONAL RECTIFIER LOGO
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
DATE CODE
XXX XXXX
**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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**International Rectifier**

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**Notes:**

1. Dimensions and tolerances per ANSI Y14.5M-1994
2. Dimensions are shown in millimeters (inches)
3. Dimensions D & E do not include mold flash, mold flash may vary shall not exceed 0.005 (0.127) for side, these dimensions are measured at the outermost extremes of the plastic body
4. Dimension A and B apply to bare metal only
5. Control lot dimension with
6. www.irf.com
TO-262 Package Outline
Dimensions are shown in millimeters (inches)

TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L
LOT CODE 1798
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

INTERNATIONAL RECTIFIER OR CAIR
IRL3103L
1798
17
08
PART NUMBER

DATE CODE
YEAR 7 = 1997
WEEK 19
LINE C

LORA 5G1008
IRF1010ZS/L

LEAD ASSIGNMENTS

NOTES:
1. DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994
2. DIMENSIONS ARE ShOWN IN MILLIMETERS (INCHES)
3. DIMENSIONS D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 (0.005"
PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTSIDE EXTREMES OF THE PLASTIC BODY
4. DIMENSIONS L1 AND L2 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: MILLIMETER

INTERNATIONAL RECTIFIER

www.irf.com
IRF1010ZS/L

D²Pak Tape & Reel Information

Notes:
1. Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
2. Limited by T_jmax, starting T_j = 25°C, L = 0.05mH
   R_G = 25Ω, I_A = 75A, V_GS =10V. Part not
   recommended for use above this value.
3. Pulse width ≤ 1.0ms; duty cycle ≤ 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_{jmax} , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
6. This value determined from sample failure population. 100%
   tested to this value in production.
7. This is only applied to TO-220AB package.
8. 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.

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.

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information. 09/03
www.irf.com
Note: For the most current drawings please refer to the IR website at:
http://www.irf.com/package/