IRF640S/L
HEXFET® Power MOSFET

- Surface Mount (IRF640S)
- Low-profile through-hole (IRF640L)
- Available in Tape & Reel (IRF640S)
- Dynamic dv/dt Rating
- 150°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated

Description

Third Generation HEXFETs from International Rectifier provide the designer with the best combinations of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The D²Pak is a surface mount power package capable of accommodating die sizes up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface mount package. The D²Pak is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0W in a typical surface mount application. The through-hole version (IRF640L) is available for low-profile applications.

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_D @ T_C = 25°C$</td>
<td>18</td>
<td>A</td>
</tr>
<tr>
<td>$I_D @ T_C = 100°C$</td>
<td>11</td>
<td>A</td>
</tr>
<tr>
<td>$I_{DM}$</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>$P_D @ T_A = 25°C$</td>
<td>3.1</td>
<td>W</td>
</tr>
<tr>
<td>$P_D @ T_C = 25°C$</td>
<td>130</td>
<td>W</td>
</tr>
<tr>
<td>Linear Derating Factor</td>
<td>1.0</td>
<td>W/°C</td>
</tr>
<tr>
<td>$V_{GS}$</td>
<td>± 20</td>
<td>V</td>
</tr>
<tr>
<td>$\mathcal{E}_{AS}$</td>
<td>580</td>
<td>mJ</td>
</tr>
<tr>
<td>$I_{AR}$</td>
<td>18</td>
<td>A</td>
</tr>
<tr>
<td>$\mathcal{E}_{AR}$</td>
<td>13</td>
<td>mJ</td>
</tr>
<tr>
<td>$dv/dt$</td>
<td>5.0</td>
<td>V/ns</td>
</tr>
<tr>
<td>$T_J$</td>
<td>-55 to +175</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{STG}$</td>
<td>300 (1.6mm from case)</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>$R_{JUC}$</td>
<td>——</td>
<td>1.0</td>
<td>°C/W</td>
</tr>
<tr>
<td>$R_{JUA}$</td>
<td>——</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

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### 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}</td>
<td>200</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>V_{GS} = 0V, I_D = 250µA</td>
</tr>
<tr>
<td>\Delta V_{BRDSS}/\Delta T_J</td>
<td>0.29</td>
<td>—</td>
<td>—</td>
<td>V/°C</td>
<td>Reference to 25°C, I_D = 1mA</td>
</tr>
<tr>
<td>R_{DS(on)}</td>
<td>—</td>
<td>—</td>
<td>0.18</td>
<td>Ω</td>
<td>V_{GS} = 10V, I_D = 11A</td>
</tr>
<tr>
<td>V_{GS(th)}</td>
<td>2.0</td>
<td>—</td>
<td>4.0</td>
<td>V</td>
<td>V_{DS} = V_{GS}, I_D = 250µA</td>
</tr>
<tr>
<td>g_m</td>
<td>6.7</td>
<td>—</td>
<td>—</td>
<td>S</td>
<td>V_{GS} = 50V, I_D = 11A</td>
</tr>
<tr>
<td>I_DSS</td>
<td>—</td>
<td>—</td>
<td>25</td>
<td>µA</td>
<td>V_{DS} = 200V, V_{GS} = 0V</td>
</tr>
<tr>
<td>I_GSS</td>
<td>—</td>
<td>—</td>
<td>100</td>
<td>nA</td>
<td>V_{GS} = 20V</td>
</tr>
<tr>
<td>Q_g</td>
<td>—</td>
<td>—</td>
<td>70</td>
<td>nC</td>
<td>I_D = 18A</td>
</tr>
<tr>
<td>Q_{gs}</td>
<td>—</td>
<td>13</td>
<td>—</td>
<td>nC</td>
<td>V_{DS} = 160V</td>
</tr>
<tr>
<td>Q_{gd}</td>
<td>—</td>
<td>—</td>
<td>39</td>
<td>—</td>
<td>V_{GS} = 10V, See Fig. 6 and 13</td>
</tr>
<tr>
<td>t_{on}</td>
<td>—</td>
<td>14</td>
<td>—</td>
<td>ns</td>
<td>V_{DD} = 100V</td>
</tr>
<tr>
<td>t_r</td>
<td>—</td>
<td>51</td>
<td>—</td>
<td>—</td>
<td>I_D = 18A</td>
</tr>
<tr>
<td>t_{off}</td>
<td>—</td>
<td>45</td>
<td>—</td>
<td>ns</td>
<td>R_G = 9.1Ω</td>
</tr>
<tr>
<td>t_f</td>
<td>—</td>
<td>36</td>
<td>—</td>
<td>—</td>
<td>R_D = 5.4Ω, See Fig. 10</td>
</tr>
<tr>
<td>L_s</td>
<td>—</td>
<td>7.5</td>
<td>—</td>
<td>nH</td>
<td>Between lead and center of die contact</td>
</tr>
<tr>
<td>C_{iss}</td>
<td>—</td>
<td>1300</td>
<td>—</td>
<td>pF</td>
<td>V_{GS} = 0V</td>
</tr>
<tr>
<td>C_{oss}</td>
<td>—</td>
<td>430</td>
<td>—</td>
<td>pF</td>
<td>V_{DS} = 25V</td>
</tr>
<tr>
<td>C_{rss}</td>
<td>—</td>
<td>130</td>
<td>—</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</td>
<td>—</td>
<td>—</td>
<td>18</td>
<td>A</td>
<td>MOSFET symbol showing the integral reverse p-n junction diode.</td>
</tr>
<tr>
<td>I_{SM}</td>
<td>—</td>
<td>—</td>
<td>72</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>V_{SD}</td>
<td>—</td>
<td>—</td>
<td>2.0</td>
<td>V</td>
<td>T_J = 25°C, I_S = 18A, V_{GS} = 0V</td>
</tr>
<tr>
<td>t_{rr}</td>
<td>—</td>
<td>300</td>
<td>610</td>
<td>ns</td>
<td>T_J = 25°C, I_F = 18A</td>
</tr>
<tr>
<td>Q_{rr}</td>
<td>—</td>
<td>3.4</td>
<td>7.1</td>
<td>µC</td>
<td>d/dt = 100A/µs</td>
</tr>
<tr>
<td>t_{on}</td>
<td>—</td>
<td>3.4</td>
<td>7.1</td>
<td>µC</td>
<td>Intrinsic turn-on time is negligible (turn-on is dominated by L_s+L_D)</td>
</tr>
</tbody>
</table>

**Notes:**

1. Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
2. V_{DD} = 50V, starting T_J = 25°C, L = 2.7mH
3. R_G = 25Ω, I_{AS} = 18A. (See Figure 12)
4. I_{SD} = 18A, d/dt = 150A/µs, V_{DD} = V_{BRDSS}, T_J ≤ 150°C

**When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.**
Fig 1. Typical Output Characteristics, \( T_J = 25^\circ C \)

Fig 2. Typical Output Characteristics, \( T_J = 175^\circ C \)

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. 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
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

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

D.U.T. Circuit Layout Considerations
- Low Stray Inductance
- Ground Plane
- Low Leakage Inductance
- Current Transformer

Fig 14. For N-Channel HEXFETS
IRF640S/L

D2Pak Package Outline

NOTES:
1. DIMENSIONS AFTER SOLDER DIP.
3. CONTROLLING DIMENSION - INCH.
4. HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

Part Marking Information
D2Pak

INTERNATIONAL RECTIFIER LOGO

ASSEMBLY LOT CODE

PART NUMBER
F530S
9246
9B
1M

DATE CODE (YYWW)
YY = YEAR
WW = WEEK

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IRF640S/L

Package Outline
TO-262 Outline

NOTES:
1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982
2. CONTROLLING DIMENSION: INCH
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
4. HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS

Part Marking Information
TO-262

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

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IRF640S/L

Tape & Reel Information

TRR

FEED DIRECTION

1.85 (.073)
1.65 (.065)

TRL

FEED DIRECTION

10.90 (.429)
10.70 (.421)

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

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IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590
IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111
IR FAR EAST: K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo Japan 171 Tel: 81 3 3983 0086
IR SOUTHEAST ASIA: 1 Kim Seng Promenade, Great World City West Tower, 13-11, Singapore 237994 Tel: ++ 65 838 4630
IR TAIWAN: 16 Fl. Suite D. 207, Sec. 2, Tun Haw South Road, Taipei, 10673, Taiwan Tel: 886-2-2377-9936
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