SMPS MOSFET

HEXFET® Power MOSFET

Applications
- High Frequency DC-DC Isolated Converters with Synchronous Rectification for Telecom and Industrial Use
- High Frequency Buck Converters for Computer Processor Power
- Lead-Free

Benefits
- Ultra-Low Gate Impedance
- Very Low $R_{DS(on)}$ at 4.5V $V_{GS}$
- Fully Characterized Avalanche Voltage and Current

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DS}$</td>
<td>Drain-Source Voltage</td>
<td>30</td>
<td>V</td>
</tr>
<tr>
<td>$V_{GS}$</td>
<td>Gate-to-Source Voltage</td>
<td>±12</td>
<td>V</td>
</tr>
<tr>
<td>$I_D @ T_C = 25^\circ C$</td>
<td>Continuous Drain Current, $V_{GS} @ 10V$</td>
<td>62</td>
<td>A</td>
</tr>
<tr>
<td>$I_D @ T_C = 70^\circ C$</td>
<td>Continuous Drain Current, $V_{GS} @ 10V$</td>
<td>52</td>
<td>A</td>
</tr>
<tr>
<td>$I_{DM}$</td>
<td>Pulsed Drain Current</td>
<td>248</td>
<td></td>
</tr>
<tr>
<td>$P_D @ T_C = 25^\circ C$</td>
<td>Maximum Power Dissipation</td>
<td>87</td>
<td>W</td>
</tr>
<tr>
<td>$P_D @ T_C = 70^\circ C$</td>
<td>Maximum Power Dissipation</td>
<td>61</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td>Linear Derating Factor</td>
<td>0.58</td>
<td>W/°C</td>
</tr>
<tr>
<td></td>
<td>Junction and Storage Temperature Range</td>
<td>-55 to +175</td>
<td>°C</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>Junction-to-Case</td>
<td>——</td>
<td>1.73</td>
</tr>
<tr>
<td>$R_{ICS}$</td>
<td>Case-to-Sink, Flat, Greased Surface</td>
<td>0.50</td>
<td>——</td>
</tr>
<tr>
<td>$R_{JUA}$</td>
<td>Junction-to-Ambient</td>
<td>——</td>
<td>62</td>
</tr>
<tr>
<td>$R_{JUA}$</td>
<td>Junction-to-Ambient (PCB mount)*</td>
<td>——</td>
<td>40</td>
</tr>
</tbody>
</table>

* When mounted on 1" square PCB (FR-4 or G-10 Material).
  For recommended footprint and soldering techniques refer to application note #AN-994

Notes
- † through ‡ are on page 10

www.irf.com
### Static @ T_J = 25°C (unless otherwise specified)

<table>
<thead>
<tr>
<th>Symbol</th>
<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>Drain-to-Source Breakdown Voltage</td>
<td>30</td>
<td>——</td>
<td>——</td>
<td>V</td>
<td>V_DS = 0V, I_D = 250µA</td>
</tr>
<tr>
<td>\Delta V_{BRDSS}/\Delta T_J</td>
<td>Breakdown Voltage Temp. Coefficient</td>
<td>——</td>
<td>0.028</td>
<td>——</td>
<td>V/°C</td>
<td>Reference to 25°C, I_D = 1mA</td>
</tr>
<tr>
<td>R_{DS(on)}</td>
<td>Static Drain-to-Source On-Resistance</td>
<td>——</td>
<td>8</td>
<td>12.0</td>
<td>mΩ</td>
<td>V_DS = 10V, I_D = 15A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>——</td>
<td>9.5</td>
<td>13.5</td>
<td></td>
<td>V_DS = 4.5V, I_D = 12A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14.5</td>
<td>29</td>
<td></td>
<td>V_DS = 2.8V, I_D = 7.5A</td>
</tr>
<tr>
<td>V_{GSS(min)}</td>
<td>Gate Threshold Voltage</td>
<td>0.6</td>
<td>——</td>
<td>2.0</td>
<td>V</td>
<td>V_DS = V_GS, I_D = 250µA</td>
</tr>
<tr>
<td>I_{DSS}</td>
<td>Drain-to-Source Leakage Current</td>
<td>——</td>
<td>20</td>
<td>——</td>
<td>µA</td>
<td>V_DS = 24V, V_GS = 0V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>——</td>
<td>100</td>
<td>——</td>
<td>nA</td>
<td>V_DS = 24V, V_GS = 0V, T_J = 125°C</td>
</tr>
<tr>
<td>I_{GSS}</td>
<td>Gate-to-Source Leakage Current</td>
<td>——</td>
<td>——</td>
<td>——</td>
<td>nA</td>
<td>V_GS = 12V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>——</td>
<td>——</td>
<td>——</td>
<td>V_GS = —12V</td>
</tr>
</tbody>
</table>

### Dynamic @ T_J = 25°C (unless otherwise specified)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>g_{fs}</td>
<td>Forward Transconductance</td>
<td>49</td>
<td>——</td>
<td>——</td>
<td>S</td>
<td>V_DS = 15V, I_D = 50A</td>
</tr>
<tr>
<td>Q_{g}</td>
<td>Total Gate Charge</td>
<td>——</td>
<td>24</td>
<td>——</td>
<td>nC</td>
<td>I_D = 24.8A</td>
</tr>
<tr>
<td>Q_{gs}</td>
<td>Gate-to-Source Charge</td>
<td>——</td>
<td>6.7</td>
<td>——</td>
<td>nC</td>
<td>V_DS = 15V</td>
</tr>
<tr>
<td>Q_{gd}</td>
<td>Gate-to-Drain (&quot;Miller&quot;) Charge</td>
<td>——</td>
<td>5.8</td>
<td>——</td>
<td>nC</td>
<td>V_GS = 4.5V</td>
</tr>
<tr>
<td>Q_{oss}</td>
<td>Output Gate Charge</td>
<td>——</td>
<td>14</td>
<td>21</td>
<td>——</td>
<td>V_GS = 0V, I_D = 24.8A, V_DS = 15V</td>
</tr>
<tr>
<td>t_{on}</td>
<td>Turn-On Delay Time</td>
<td>——</td>
<td>7.2</td>
<td>——</td>
<td>ns</td>
<td>V_DD = 15V</td>
</tr>
<tr>
<td>t_r</td>
<td>Rise Time</td>
<td>——</td>
<td>50</td>
<td>——</td>
<td>——</td>
<td>I_D = 24.8A</td>
</tr>
<tr>
<td>t_{off}</td>
<td>Turn-Off Delay Time</td>
<td>——</td>
<td>17.6</td>
<td>——</td>
<td>——</td>
<td>R_G = 0.6Ω</td>
</tr>
<tr>
<td>t_f</td>
<td>Fall Time</td>
<td>——</td>
<td>3.7</td>
<td>——</td>
<td>——</td>
<td>V_GS = 4.5V</td>
</tr>
<tr>
<td>C_{iss}</td>
<td>Input Capacitance</td>
<td>——</td>
<td>2147</td>
<td>——</td>
<td>——</td>
<td>V_GS = 0V</td>
</tr>
<tr>
<td>C_{oss}</td>
<td>Output Capacitance</td>
<td>——</td>
<td>707</td>
<td>——</td>
<td>——</td>
<td>V_DS = 15V</td>
</tr>
<tr>
<td>C_{rss}</td>
<td>Reverse Transfer Capacitance</td>
<td>——</td>
<td>52</td>
<td>——</td>
<td>pF</td>
<td>f = 1.0MHz</td>
</tr>
</tbody>
</table>

### Avalanche Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>E_{AS}</td>
<td>Single Pulse Avalanche Energy</td>
<td>——</td>
<td>213</td>
<td>mJ</td>
</tr>
<tr>
<td>I_{AR}</td>
<td>Avalanche Current</td>
<td>——</td>
<td>62</td>
<td>A</td>
</tr>
</tbody>
</table>

### Diode Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_D</td>
<td>Continuous Source Current (Body Diode)</td>
<td>——</td>
<td>——</td>
<td>62</td>
<td>A</td>
<td>MOSFET symbol showing the integral reverse p-n junction diode.</td>
</tr>
<tr>
<td>I_{SM}</td>
<td>Pulsed Source Current (Body Diode)</td>
<td>——</td>
<td>——</td>
<td>248</td>
<td>——</td>
<td></td>
</tr>
<tr>
<td>V_{SD}</td>
<td>Diode Forward Voltage</td>
<td>——</td>
<td>0.88</td>
<td>1.3</td>
<td>V</td>
<td>T_J = 25°C, I_S = 31A, V_GS = 0V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>——</td>
<td>0.80</td>
<td>——</td>
<td>V</td>
</tr>
<tr>
<td>I_{rr}</td>
<td>Reverse Recovery Time</td>
<td>——</td>
<td>41</td>
<td>62</td>
<td>ns</td>
<td>T_J = 25°C, I_F = 31A, V_RS=20V</td>
</tr>
<tr>
<td>Q_{rr}</td>
<td>Reverse Recovery Charge</td>
<td>——</td>
<td>64</td>
<td>96</td>
<td>nC</td>
<td>dl/dt = 100A/µs</td>
</tr>
<tr>
<td>I_{rr}</td>
<td>Reverse Recovery Time</td>
<td>——</td>
<td>43</td>
<td>65</td>
<td>ns</td>
<td>T_J = 125°C, I_F = 31A, V_RS=20V</td>
</tr>
<tr>
<td>Q_{rr}</td>
<td>Reverse Recovery Charge</td>
<td>——</td>
<td>70</td>
<td>105</td>
<td>nC</td>
<td>dl/dt = 100A/µs</td>
</tr>
</tbody>
</table>
**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. Gate-to-Source Voltage

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

**Fig 8.** Maximum Safe Operating Area

\[ C_{iss} = C_{oss}, \quad C_{oss} = C_{ds} + C_{gd} \]

\[ V_{GS} = 0V, \quad f = 1MHz \]

\[ I_D = 24.8A, \quad V_{DS} = 15V \]

\[ V_{SD}, \text{ Source-to-Drain Voltage (V)} \]

\[ V_{DS}, \text{ Drain-to-Source Voltage (V)} \]

\[ I_D, \text{ Drain Current (A)} \]

\[ T_J = 25°C, \quad T_J = 175°C \]

\[ V_{GS} = 0V, \quad V_{DS} = 15V \]
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 12. On-Resistance Vs. Drain Current

Fig 14a&b. Gate Charge Test Circuit and Waveform

Fig 15a&b. Unclamped Inductive Test circuit and Waveforms

Fig 15c. Maximum Avalanche Energy Vs. Drain Current
TO-220AB Package Outline
Dimensions are shown in millimeters (inches)

EXA M PLE:
IN THE ASSM ELY L I N E " C "
THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997

PART NUMBER
INTERNATIONAL RECTIFIER
LOGO
IRF1010
719C
17
89

DATE CODE
YEAR 7 = 1997
WEEK 19
LINE C

PART NUMBER

INTERNATIONAL RECTIFIER
LOGO
IRF1010
719C
17
89

DATE CODE
YEAR 7 = 1997
WEEK 19
LINE C

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 "
Note: "P" in assembly line position indicates "Lead-Free"
D²Pak Package Outline
Dimensions are shown in millimeters (inches)

---

**D²Pak Part Marking Information (Lead-Free)**

**EXAMPLE:**

THIS IS AN IRF530S WITH LOT CODE 0024
ASSEMBLED ON WW 02, 2000 IN THE ASSEMBLY LINE "L"

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

---

**INTERNATIONAL RECTIFIER LOGO**

**PART NUMBER**

**DATE CODE**
YEAR = 2000
WEEK = 02
LINE = L

**F530S**

**PART NUMBER**

**DATE CODE**

**PART NUMBER**

**DATE CODE**

**PART NUMBER**

**DATE CODE**

**PART NUMBER**

**DATE CODE**

---

Dimensions are shown in millimeters (inches)

---

**NOTES:**

1. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1984
2. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES)
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH, MOLD FLASH SHALL NOT EXCEED 0.127 (0.005"
   PER SIDE. OTHER DIMENSIONS ARE MEASURED AT THE REARmost ELEMENTS OF THE PLASTIC BODY
4. DIMENSION A & B APPLY TO BASE METAL ONLY
5. CONTROLLING DIMENSION: INCH
TO-262 Package Outline

**LEAD ASSIGNMENTS**

<table>
<thead>
<tr>
<th>LEAD ASSIGNMENTS</th>
<th>IGBT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>GATE</td>
</tr>
<tr>
<td>2.</td>
<td>COLLECTOR</td>
</tr>
<tr>
<td>3.</td>
<td>EMITTER</td>
</tr>
</tbody>
</table>

**NOTE:**
2. All dimensions are shown in millimeters (inches).
3. Dimensions D1 and D0 do not include mold flash. Mold flash shall not exceed 0.005 in.
4. Pins 1, 2, 3 and 4 are intended to support the TO-262 package. Pins 5, 6, 7, and 8 are intended for use by the user and are not used by the International Rectifier. To prevent damage to the package, pins 5, 6, 7 and 8 should not be used at a voltage exceeding 5V and a current exceeding 10mA. The maximum voltage measured on any pin connected to the collector with ground shall not exceed 65V.
5. The value shown for each lead is the thickness of the lead and not the pin head thickness.

**TO-262 Part Marking Information**

**EXAMPLE:**
This is an IRL3103L
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

**Note:** P in assembly line position indicates "Lead-Free"

**INTERNATIONAL RECTIFIER LOGO**

**ASSEMBLY LOT CODE**

**PART NUMBER**

**DATE CODE**

**YEAR 7 = 1997**

**WEEK 19**

**LINE C**

**OR**

**INTERNATIONAL RECTIFIER LOGO**

**ASSEMBLY LOT CODE**

**PART NUMBER**

**DATE CODE**

**P = DESIGNATES LEAD-FREE PRODUCT (OPTIONAL)**

**YEAR 7 = 1997**

**WEEK 19**

**A = ASSEMBLY SITE CODE**
D²Pak Tape & Reel Information
Dimensions are shown in millimeters (inches)

Notes:
① Repetitive rating; pulse width limited by max. junction temperature.
② Starting T_J = 25°C, L = 0.7 mH
   \( R_G = 25\Omega, I_{AS} = 24.8\ A. \)
③ Pulse width \( \leq 300\mu s; \) duty cycle \( \leq 2\% \).
④ This is only applied to TO-220AB package.

Data and specifications subject to change without notice.
Note: For the most current drawings please refer to the IR website at:
http://www.irf.com/package/