**Power MOSFET**

**IRFZ44, SiHFZ44**

**Vishay Siliconix**

### FEATURES
- Dynamic dV/dt Rating
- 175 °C Operating Temperature
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC

### DESCRIPTION
Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness. The TO-220AB package is universally preferred for commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220AB contribute to its wide acceptance throughout the industry.

### ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Package</th>
<th>TO-220AB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead (Pb)-free</td>
<td>IRFZ44PbF</td>
</tr>
<tr>
<td>SnPb</td>
<td>IRFZ44</td>
</tr>
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</table>

### PRODUCT SUMMARY

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
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<tbody>
<tr>
<td>VDS (V)</td>
<td>60</td>
</tr>
<tr>
<td>RDS(on) (Ω)</td>
<td>VGS = 10 V</td>
</tr>
<tr>
<td>Qg (Max.) (nC)</td>
<td>67</td>
</tr>
<tr>
<td>Qgs (nC)</td>
<td>18</td>
</tr>
<tr>
<td>Qgd (nC)</td>
<td>25</td>
</tr>
<tr>
<td>Configuration</td>
<td>Single</td>
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</table>

### ABSOLUTE MAXIMUM RATINGS (TC = 25 °C, unless otherwise noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SYMBOL</th>
<th>LIMIT</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-Source Voltage</td>
<td>VDS</td>
<td>60</td>
<td>V</td>
</tr>
<tr>
<td>Gate-Source Voltage</td>
<td>VGS</td>
<td>± 20</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Drain Currenta</td>
<td>VGS at 10 V</td>
<td>Tc = 25 °C</td>
<td>ID</td>
</tr>
<tr>
<td>Continuous Drain Current</td>
<td>VGS at 100 °C</td>
<td>Tc = 100 °C</td>
<td>ID</td>
</tr>
<tr>
<td>Pulsed Drain Currenta a</td>
<td>VOM</td>
<td>200</td>
<td>A</td>
</tr>
<tr>
<td>Linear Derating Factor</td>
<td></td>
<td>1.0</td>
<td>W/°C</td>
</tr>
<tr>
<td>Single Pulse Avalanche Energy b</td>
<td>EAS</td>
<td>100</td>
<td>mJ</td>
</tr>
<tr>
<td>Maximum Power Dissipation</td>
<td>TP</td>
<td>150</td>
<td>W</td>
</tr>
<tr>
<td>Peak Diode Recovery dv/dtc</td>
<td>dV/dt</td>
<td>4.5</td>
<td>V/ns</td>
</tr>
<tr>
<td>Operating Junction and Storage Temperature Range</td>
<td>Tj , Tstg</td>
<td>55 to + 175 °C</td>
<td>300</td>
</tr>
<tr>
<td>Soldering Recommendations (Peak Temperature) d</td>
<td></td>
<td>10</td>
<td>lbf · in</td>
</tr>
<tr>
<td>Mounting Torque</td>
<td></td>
<td>1.1</td>
<td>N · m</td>
</tr>
</tbody>
</table>

### Notes
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- VDD = 25 V, starting Tj = 25 °C, L = 44 μH, Rg = 25 Ω, IAS = 51 A (see fig. 12).
- ISG ≤ 51 A, dI/dt ≤ 250 A/μs, VDS, Tj ≤ 175 °C.
- 1.6 mm from case.
- Current limited by the package, (die current = 51 A).

* Pb containing terminations are not RoHS compliant, exemptions may apply

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### THERMAL RESISTANCE RATINGS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Junction-to-Ambient</td>
<td>$R_{thJA}$</td>
<td>-</td>
<td>62</td>
<td>°C/W</td>
</tr>
<tr>
<td>Case-to-Sink, Flat, Greased Surface</td>
<td>$R_{thCS}$</td>
<td>0.50</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Maximum Junction-to-Case (Drain)</td>
<td>$R_{thJC}$</td>
<td>-</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

### SPECIFICATIONS ($T_J = 25 \, ^\circ C$, unless otherwise noted)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITIONS</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Static</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain-Source Breakdown Voltage</td>
<td>$V_{DS}$</td>
<td>$V_{GS} = 0 , V$, $I_D = 250 , \mu A$</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>$V_{DS}$ Temperature Coefficient</td>
<td>$\Delta V_{DS}/T_J$</td>
<td>Reference to $25 , ^\circ C$, $I_D = 1 , mA$</td>
<td>-</td>
<td>0.060</td>
<td>-</td>
<td>V/°C</td>
</tr>
<tr>
<td>Gate-Source Threshold Voltage</td>
<td>$V_{GS(th)}$</td>
<td>$V_{DS} = V_{GS}$, $I_D = 250 , \mu A$</td>
<td>2.0</td>
<td>-</td>
<td>4.0</td>
<td>V</td>
</tr>
<tr>
<td>Gate-Source Leakage</td>
<td>$I_{GS}$</td>
<td>$V_{GS} = \pm 20 , V$</td>
<td>-</td>
<td>-</td>
<td>±100</td>
<td>nA</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>$I_{DS}$</td>
<td>$V_{DS} = 60 , V$, $V_{GS} = 0 , V$</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>μA</td>
</tr>
<tr>
<td>Drain-Source On-State Resistance</td>
<td>$R_{DS(on)}$</td>
<td>$V_{GS} = 10 , V$, $I_D = 31 , A^a$</td>
<td>-</td>
<td>-</td>
<td>0.028</td>
<td>Ω</td>
</tr>
<tr>
<td>Forward Transconductance</td>
<td>$g_f$</td>
<td>$V_{DS} = 25 , V$, $I_D = 31 , A$</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>S</td>
</tr>
<tr>
<td><strong>Dynamic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>$C_{iss}$</td>
<td>$V_{GS} = 0 , V$, $V_{DS} = 25 , V$, $f = 1.0 , MHz$, see fig. 5</td>
<td>-</td>
<td>1900</td>
<td>-</td>
<td>pF</td>
</tr>
<tr>
<td>Output Capacitance</td>
<td>$C_{oss}$</td>
<td>-</td>
<td>920</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse Transfer Capacitance</td>
<td>$C_{rss}$</td>
<td>-</td>
<td>170</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Gate Charge</td>
<td>$Q_g$</td>
<td>$V_{GS} = 10 , V$</td>
<td>$I_D = 51 , A$, $V_{DS} = 48 , V$, see fig. 6 and 13$^b$</td>
<td>-</td>
<td>-</td>
<td>67</td>
</tr>
<tr>
<td>Gate-Source Charge</td>
<td>$Q_{gs}$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Gate-Drain Charge</td>
<td>$Q_{gd}$</td>
<td>-</td>
<td>-</td>
<td>67</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Turn-On Delay Time</td>
<td>$t_{d(on)}$</td>
<td>$V_{DD} = 30 , V$, $I_D = 51 , A$, $R_g = 9.1 , \Omega$, $R_0 = 0.55 , \Omega$, see fig. 10$^b$</td>
<td>-</td>
<td>-</td>
<td>14</td>
<td>ns</td>
</tr>
<tr>
<td>Rise Time</td>
<td>$t_i$</td>
<td>$V_{DD} = 30 , V$, $I_D = 51 , A$, $R_g = 9.1 , \Omega$, $R_0 = 0.55 , \Omega$, see fig. 10$^b$</td>
<td>-</td>
<td>-</td>
<td>110</td>
<td>-</td>
</tr>
<tr>
<td>Turn-Off Delay Time</td>
<td>$t_{d(off)}$</td>
<td>-</td>
<td>-</td>
<td>45</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Fall Time</td>
<td>$t_f$</td>
<td>-</td>
<td>92</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Drain Inductance</td>
<td>$L_D$</td>
<td>Between lead, 6 mm (0.25&quot;) from package and center of die contact</td>
<td>-</td>
<td>4.5</td>
<td>-</td>
<td>nH</td>
</tr>
<tr>
<td>Internal Source Inductance</td>
<td>$L_S$</td>
<td>-</td>
<td>7.5</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Drain-Source Body Diode Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Source-Drain Diode Current</td>
<td>$I_S$</td>
<td>MOSFET symbol showing the integral reverse p-n junction diode</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed Diode Forward Current$^a$</td>
<td>$I_{SM}$</td>
<td>-</td>
<td>-</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Diode Voltage</td>
<td>$V_{SD}$</td>
<td>$T_J = 25 , ^\circ C$, $I_S = 51 , A$, $V_{GS} = 0 , V^b$</td>
<td>-</td>
<td>-</td>
<td>2.5</td>
<td>V</td>
</tr>
<tr>
<td>Body Diode Reverse Recovery Time</td>
<td>$t_{rr}$</td>
<td>$T_J = 25 , ^\circ C$, $I_F = 51 , A$, $dI/dt = 100 , A/\mu s$</td>
<td>-</td>
<td>120</td>
<td>180</td>
<td>ns</td>
</tr>
<tr>
<td>Body Diode Reverse Recovery Charge</td>
<td>$Q_{rr}$</td>
<td>-</td>
<td>0.53</td>
<td>0.80</td>
<td>nC</td>
<td></td>
</tr>
<tr>
<td>Forward Turn-On Time</td>
<td>$t_{on}$</td>
<td>Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$)</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).

b. Pulse width ≤ 300 μs; duty cycle ≤ 2 %.
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Fig. 1 Typical Output Characteristics, $T_C = 25$ °C

Fig. 2 - Typical Output Characteristics, $T_C = 175$ °C

Fig. 3 - Typical Transfer Characteristics

Fig. 4 - Normalized On-Resistance vs. Temperature
IRFZ44, SiHFZ44

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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
IRFZ44, SiHFZ44

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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

Pulse width ≥ 1 µs
Duty factor ≤ 0.1 %

R_D
V_GS
R_G
D.U.T.
10 V

V_GS
V_D,
90 %
10 %

V_D,

V_D,

V_D,

V_D,

V_D,

V_D,

V_D,

V_D,

V_D,

V_D,

V_D,

V_D,

V_D,

V_D,

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V_D,
IRFZ44, SiHFZ44

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Peak Diode Recovery dV/dt Test Circuit

Circuit layout considerations
- Low stray inductance
- Ground plane
- Low leakage inductance current transformer

- dV/dt controlled by R_g
- Driver same type as D.U.T.
- I_{SD} controlled by duty factor “D”
- D.U.T. - device under test

① Driver gate drive

② D.U.T. I_{SD} waveform
Reverse recovery current

③ D.U.T. V_{GS} waveform
Body diode forward current

④ Inductor current
Diode recovery dV/dt

Note
a. V_{GS} = 5 V for logic level devices

Fig. 14 - For N-Channel

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TO-220-1

**Note**
- $M^* = 0.052$ inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM

### Package Picture

<table>
<thead>
<tr>
<th>DIM.</th>
<th>MILLIMETERS</th>
<th>INCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.24</td>
<td>0.167</td>
</tr>
<tr>
<td>b</td>
<td>0.69</td>
<td>0.027</td>
</tr>
<tr>
<td>b(1)</td>
<td>1.14</td>
<td>0.045</td>
</tr>
<tr>
<td>c</td>
<td>0.36</td>
<td>0.014</td>
</tr>
<tr>
<td>D</td>
<td>14.33</td>
<td>0.564</td>
</tr>
<tr>
<td>E</td>
<td>9.96</td>
<td>0.392</td>
</tr>
<tr>
<td>e</td>
<td>2.41</td>
<td>0.095</td>
</tr>
<tr>
<td>e(1)</td>
<td>4.88</td>
<td>0.192</td>
</tr>
<tr>
<td>F</td>
<td>1.14</td>
<td>0.045</td>
</tr>
<tr>
<td>H(1)</td>
<td>6.10</td>
<td>0.240</td>
</tr>
<tr>
<td>J(1)</td>
<td>2.41</td>
<td>0.095</td>
</tr>
<tr>
<td>L</td>
<td>13.36</td>
<td>0.526</td>
</tr>
<tr>
<td>L(1)</td>
<td>3.33</td>
<td>0.131</td>
</tr>
<tr>
<td>$\Omega$ P</td>
<td>3.53</td>
<td>0.139</td>
</tr>
<tr>
<td>Q</td>
<td>2.54</td>
<td>0.100</td>
</tr>
</tbody>
</table>

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DWG: 6031

For technical questions, contact: hvm@vishay.com

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