Dual N-/Dual P-Channel 30-V (D-S) MOSFETs

**PRODUCT SUMMARY**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>N-Channel</th>
<th>P-Channel</th>
<th>Total Quad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-Source Voltage</td>
<td>V_{DS}</td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Gate-Source Voltage</td>
<td>V_{GS}</td>
<td>±20</td>
<td>±20</td>
<td></td>
</tr>
<tr>
<td>Continuous Drain Current (T_{J} = 150°C)</td>
<td>I_D</td>
<td>0.85</td>
<td>-0.6</td>
<td></td>
</tr>
<tr>
<td>Pulsed Drain Current</td>
<td>I_{DM}</td>
<td>3</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>P_D</td>
<td>1.3</td>
<td>1.3</td>
<td>2</td>
</tr>
<tr>
<td>Thermal Resistance, Junction-to-Ambient</td>
<td>R_{thJA}</td>
<td>96.2</td>
<td>96.2</td>
<td>62.5</td>
</tr>
</tbody>
</table>

**FEATURES**

- Low On-Resistance: 0.8/1.6 Ω
- Low Threshold: 1.5/–3.1 V
- Low Input Capacitance: 38/60 pF
- Fast Switching Speed: 9/16 ns
- Low Input and Output Leakage

**BENEFITS**

- Low Offset Voltage
- Low-Voltage Operation
- Easily Driven Without Buffer
- High-Speed Circuits
- Low Error Voltage

**APPLICATIONS**

- Direct Logic-Level Interface: TTL/CMOS
- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories, Transistors, etc.
- Battery Operated Systems
- Solid-State Relays

**ABSOLUTE MAXIMUM RATINGS (T_{A} = 25°C UNLESS OTHERWISE NOTED)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Single</th>
<th>N-Channel</th>
<th>P-Channel</th>
<th>Total Quad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-Source Voltage</td>
<td>V_{DS}</td>
<td></td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Gate-Source Voltage</td>
<td>V_{GS}</td>
<td></td>
<td>(±20)</td>
<td>(±20)</td>
<td></td>
</tr>
<tr>
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<td>I_D</td>
<td></td>
<td>0.85</td>
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</tr>
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<td>I_{DM}</td>
<td></td>
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<td>-2</td>
<td></td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>P_D</td>
<td></td>
<td>1.3</td>
<td>1.3</td>
<td>2</td>
</tr>
<tr>
<td>Thermal Resistance, Junction-to-Ambient</td>
<td>R_{thJA}</td>
<td></td>
<td>96.2</td>
<td>96.2</td>
<td>62.5</td>
</tr>
</tbody>
</table>

**Notes**

a. Pulse width limited by maximum junction temperature.

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**Device Marking**

- Top View: VQ3001J
- Plastic: VQ3001J
- Sidebraze: VQ3001P

“S” = Siliconix Logo
f = Factory Code
l = Lot Traceability
xxyy = Date Code
## SPECIFICATIONS (TA = 25°C UNLESS OTHERWISE NOTED)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Condition</th>
<th>Typa</th>
<th>Limits</th>
<th>Unit</th>
<th>N-Channel</th>
<th>P-Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>Static</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain-Source Breakdown Voltage</td>
<td>V_{BR(DSS)}</td>
<td>V_{GS} = 0 V, I_D = 10 μA, V_{GS} = 0 V, I_D = −10 μA</td>
<td>55</td>
<td>30</td>
<td>−55</td>
<td>−30</td>
<td></td>
</tr>
<tr>
<td>Gate-Source Threshold Voltage</td>
<td>V_{GS(th)}</td>
<td>V_{GS} = 0 V, I_D = 1 mA, V_{GS} = ±20 V, T_J = 125°C</td>
<td>1.5</td>
<td>0.8</td>
<td>2.5</td>
<td>−3.1</td>
<td>−2</td>
</tr>
<tr>
<td>Gate-Body Leakage</td>
<td>I_{GS}</td>
<td>V_{DS} = 0 V, V_{GS} = ±20 V, T_J = 125°C</td>
<td>±100</td>
<td>±100</td>
<td>±500</td>
<td>±500</td>
<td></td>
</tr>
<tr>
<td>Zero-Gate Voltage Drain Current</td>
<td>I_{DSS}</td>
<td>V_{DS} = 24 V, V_{GS} = 0 V, V_{DS} = −24 V, V_{GS} = 0 V, T_J = 125°C</td>
<td>10</td>
<td></td>
<td>−10</td>
<td>500</td>
<td>−500</td>
</tr>
<tr>
<td>On-State Drain Currentb</td>
<td>I_{D(on)}</td>
<td>V_{DS} = 10 V, V_{GS} = 12 V, −10 V, V_{GS} = −12 V</td>
<td>3</td>
<td>2</td>
<td>−2</td>
<td>−1.5</td>
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</tr>
<tr>
<td>Drain-Source On-State Resistanceb</td>
<td>r_{DSS(on)}</td>
<td>V_{GS} = 0.2 A, V_{DS} = 0.2 A, I_{G} = 1 A</td>
<td>1.2</td>
<td>1.75</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>0.81</td>
<td>1.0</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.6</td>
<td>2.0</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.65</td>
<td>2.0</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>2.7</td>
<td>4.0</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Forward Transconductanceb</td>
<td>g_f</td>
<td>V_{DS} = 10 V, I_D = 0.5 A, V_{DS} = −10 V, I_D = −0.5 A</td>
<td>390</td>
<td>250</td>
<td>500</td>
<td>390</td>
<td>250</td>
</tr>
<tr>
<td>Dynamic</td>
<td></td>
<td></td>
<td>38</td>
<td>110</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>C_{iss}</td>
<td>V_{DS} = 15 V, V_{GS} = 0 V, f = 1 MHz</td>
<td>60</td>
<td></td>
<td></td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Output Capacitance</td>
<td>C_{oss}</td>
<td>V_{DS} = −15 V, V_{GS} = 0 V, f = 1 MHz</td>
<td>33</td>
<td></td>
<td></td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Reverse Transfer Capacitance</td>
<td>C_{rss}</td>
<td>V_{DS} = 15 V, V_{GS} = 0 V, f = 1 MHz</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-On Time</td>
<td>t_{ON}</td>
<td>V_{DD} = 15 V, R_L = 23 Ω, I_D = 0.6 A, V_{GEN} = 10 V, R_G = 25 Ω</td>
<td>9</td>
<td>30</td>
<td>19</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Turn-Off Time</td>
<td>t_{OFF}</td>
<td>V_{DD} = −15 V, R_L = 23 Ω, I_D = −0.8 A, V_{GEN} = −10 V, R_G = 25 Ω</td>
<td>14</td>
<td>30</td>
<td>16</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

a. For DESIGN AID ONLY, not subject to production testing.
b. Pulse test: PW = 300 μs duty cycle = 2%.
**TYPICAL CHARACTERISTICS (TA = 25°C UNLESS OTHERWISE NOTED) N-CHANNEL**

**Ohmic Region Characteristics**

- $V_{GS} = 10 \text{ V}$
- $V_{GS} = 7 \text{ V}$
- $V_{GS} = 6 \text{ V}$
- $V_{GS} = 5 \text{ V}$
- $V_{GS} = 4 \text{ V}$
- $V_{GS} = 3 \text{ V}$
- $V_{GS} = 2 \text{ V}$

$V_{DS}$ vs. $I_D$ for different $V_{GS}$ values.

**Output Characteristics for Low Gate Drive**

- $V_{GS} = 10 \text{ V}$
- $V_{GS} = 2.9 \text{ V}$
- $V_{GS} = 2.7 \text{ V}$
- $V_{GS} = 2.5 \text{ V}$
- $V_{GS} = 2.3 \text{ V}$
- $V_{GS} = 2.1 \text{ V}$
- $V_{GS} = 1.7 \text{ V}$

$V_{DS}$ vs. $I_D$ for different $V_{GS}$ values.

**Transfer Characteristics**

- $V_{DS} = 15 \text{ V}$
- $T_J = 125^\circ C$
- $T_J = 25^\circ C$
- $T_J = -55^\circ C$

$V_{GS}$ vs. $I_D$ for different $V_{DS}$ values.

**On-Resistance vs. Gate-Source Voltage**

- $I_D = 0.2 \text{ A}$
- $I_D = 0.5 \text{ A}$
- $I_D = 1.0 \text{ A}$

$r_{DS(on)}$ vs. $V_{GS}$ for different $I_D$ values.

**On-Resistance vs. Drain Current**

- $V_{GS} = 4.5 \text{ V}$
- $V_{GS} = 6 \text{ V}$
- $V_{GS} = 10 \text{ V}$

$r_{DS(on)}$ vs. $I_D$ for different $V_{GS}$ values.

**Normalized On-Resistance vs. Junction Temperature**

- $V_{GS} = 10 \text{ V}$
- $I_D = 0.5 \text{ A}$
- $I_D = 0.1 \text{ A}$

$r_{DS(on)}$ (Normalized) vs. $T_J$ for different $V_{GS}$ and $I_D$ values.
Typical Characteristics (T_A = 25°C unless otherwise noted)

Threshold Region

- V_{DS} = 10 V
- T_J = 150°C
- 25°C
- 0°C
- -55°C

Gate Charge

- I_D = 1 A
- V_{DS} = 15 V
- 24 V

Capacitance

- C_{iss}, C_{oss}, C_{rss}
- V_{GS} = 0 V
- f = 1 MHz

Load Condition Effects on Switching

- V_{DD} = 25 V
- R_L = 24 Ω
- V_{GS} = 0 to 10 V
- I_D = 1 A

Transconductance

- T_J = -55°C
- 25°C
- 150°C
- V_{DD} = 7.5 V
- 300 µs, 1% Duty Cycle Pulse Test

ID – Drain Current (mA)

C – Capacitance (pF)

t_{r}, t_{f}, t_{d(on)}, t_{d(off)}

R_{G} – Gate Resistance (Ω)

G_{FS} – Forward Transconductance (µS)

I_D – Drain Current (mA)

V_{DD} = 25 V
R_L = 24 Ω
V_{GS} = 0 to 10 V
I_D = 1 A

V_{DD} = 10 V
T_J = 150°C

V_{GS} = 0 to 10 V
ID = 1 A
R_{G} = 24 Ω
V_{GS} = 0 to 10 V
V_{DS} = 7.5 V

V_{GS} = 0 V
f = 1 MHz

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TYPICAL CHARACTERISTICS (TA = 25°C UNLESS OTHERWISE NOTED)  P-CHANNEL

Output Characteristics

Transfer Characteristics

Capacitance

Gate Charge

On-Resistance vs. Junction Temperature

Source-Drain Diode Forward Voltage
TYPICAL CHARACTERISTICS (T_A = 25°C UNLESS OTHERWISE NOTED)  P-CHANNEL

On-Resistance vs. Gate-to-Source Voltage

Threshold Region

V_DS = ±10 V

T_J = ±100°C

V_GS = ±55°C
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