Dual P-Channel 20-V (D-S) MOSFET

**PRODUCT SUMMARY**

<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>$V_{DS}$</td>
<td>$-20$</td>
<td>V</td>
</tr>
<tr>
<td>Gate-Source Voltage</td>
<td>$V_{GS}$</td>
<td>$\pm 12$</td>
<td></td>
</tr>
<tr>
<td>Continuous Drain Current ($T_J = 150^\circ C$)$^a$</td>
<td>$I_D$</td>
<td>$\pm 3.4$</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed Drain Current</td>
<td>$I_{DM}$</td>
<td>$\pm 16$</td>
<td></td>
</tr>
<tr>
<td>Continuous Source Current (Diode Conduction)$^a$</td>
<td>$I_S$</td>
<td>$-2.0$</td>
<td></td>
</tr>
<tr>
<td>Maximum Power Dissipation$^a$</td>
<td>$P_D$</td>
<td>$2.0$</td>
<td>W</td>
</tr>
<tr>
<td>Operating Junction and Storage Temperature Range</td>
<td>$T_J$, $T_{stg}$</td>
<td>$-55$ to $150$</td>
<td>°C</td>
</tr>
</tbody>
</table>

**ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ C$ UNLESS OTHERWISE NOTED)**

**THERMAL RESISTANCE RATINGS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Limit</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Junction-to-Ambient$^a$</td>
<td>$R_{thJA}$</td>
<td>$62.5$</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

Notes:

a. Surface Mounted on FR4 Board, $t = 10$ sec.

For SPICE model information via the Worldwide Web: http://www.vishay.com/www/product/spice.htm
## SPECIFICATIONS (T_J = 25°C UNLESS OTHERWISE NOTED)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Condition</th>
<th>Min</th>
<th>Typ&lt;sup&gt;a&lt;/sup&gt;</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>Gate Threshold Voltage</td>
<td>VGS(hi)</td>
<td>V_DS = V_GS, I_D = –250 μA</td>
<td>–0.8</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Gate-Body Leakage</td>
<td>I_GSS</td>
<td>V_DS = 0 V, V_GS = ±12 V</td>
<td>±100</td>
<td></td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>I_DS</td>
<td>V_DS = –16 V, V_GS = 0 V</td>
<td>–1</td>
<td></td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>I_DS</td>
<td>V_DS = –10 V, V_GS = 0 V, T_J = 85°C</td>
<td>–3</td>
<td></td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>On-State Drain Current&lt;sup&gt;b&lt;/sup&gt;</td>
<td>I_D(on)</td>
<td>V_DS = 5 V, V_GS = –4.5 V</td>
<td>–16</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Drain-Source On-State Resistance&lt;sup&gt;b&lt;/sup&gt;</td>
<td>r_DS(on)</td>
<td>V_GS = –4.5 V, I_D = –3.2 A</td>
<td>0.06</td>
<td>0.075</td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>Drain-Source On-State Resistance&lt;sup&gt;b&lt;/sup&gt;</td>
<td>r_DS(on)</td>
<td>V_GS = –3.0 V, I_D = –2.0 A</td>
<td>0.078</td>
<td>0.105</td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>Drain-Source On-State Resistance&lt;sup&gt;b&lt;/sup&gt;</td>
<td>r_DS(on)</td>
<td>V_GS = –2.7 V, I_D = –1 A</td>
<td>0.085</td>
<td>0.115</td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>Forward Transconductance&lt;sup&gt;b&lt;/sup&gt;</td>
<td>gFS</td>
<td>V_DS = –9 V, I_D = –3.4 A</td>
<td>8</td>
<td></td>
<td></td>
<td>S</td>
</tr>
<tr>
<td>Diode Forward Voltage&lt;sup&gt;b&lt;/sup&gt;</td>
<td>V_SD</td>
<td>I_S = –2.0 A, V_GS = 0 V</td>
<td>–0.7</td>
<td>–1.2</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td><strong>Dynamic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Gate Charge</td>
<td>Q_g</td>
<td>V_DS = –6 V, V_GS = –4.5 V, I_D = –3.2 A</td>
<td>10</td>
<td>20</td>
<td></td>
<td>nC</td>
</tr>
<tr>
<td>Gate-Source Charge</td>
<td>Q_gs</td>
<td></td>
<td>2.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate-Drain Charge</td>
<td>Q_gd</td>
<td></td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-On Delay Time</td>
<td>t_{on}</td>
<td></td>
<td>16</td>
<td>40</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Rise Time</td>
<td>t_r</td>
<td></td>
<td>46</td>
<td>80</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Turn-Off Delay Time</td>
<td>t_{off}</td>
<td>I_D = –1 A, V_GSN = –4.5 V, R_G = 6 Ω</td>
<td>40</td>
<td>70</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Fall Time</td>
<td>t_f</td>
<td></td>
<td>25</td>
<td>40</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Source-Drain Reverse Recovery Time</td>
<td>t_{rr}</td>
<td>I_F = –2.0 A, di/dt = 100 A/μs</td>
<td>60</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

- **a.** For design aid only; not subject to production testing.
- **b.** Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2%.
TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

Output Characteristics

- $V_{DS}$ – Drain-to-Source Voltage (V)
- $I_D$ – Drain Current (A)
- $V_{GS}$ – Gate-to-Source Voltage (V)
- $Q_g$ – Total Gate Charge (nC)

Transfer Characteristics

- $V_{GS}$ – Gate-to-Source Voltage (V)
- $I_D$ – Drain Current (A)
- $T_J$ – Junction Temperature (°C)
- $r_{DS(on)}$ – On-Resistance (Ω)

Capacitance

- $C_{rss}$
- $C_{oss}$
- $C_{iss}$

On-Resistance vs. Drain Current

- $I_D$ – Drain Current (A)
- $r_{DS(on)}$ – On-Resistance (Ω)

Gate Charge

- $V_{DS}$ – Drain-to-Source Voltage (V)
- $Q_g$ – Total Gate Charge (nC)

On-Resistance vs. Junction Temperature

- $T_J$ – Junction Temperature (°C)
- $r_{DS(on)} – On-Resistance (Ω)$ (Normalized)

- $V_{GS}$ – Gate-to-Source Voltage (V)
- $I_D$ – Drain Current (A)
- $T_J$ – Junction Temperature (°C)

- $V_{DS}$ = 6 V
  - $I_D$ = 3.2 A

- $V_{GS}$ = 4.5 V
  - $I_D$ = 3.2 A

- $V_{GS}$ = 5 – 3.5 V
  - $I_D$ = 3.2 A

- $V_{GS}$ = 2.7 V

- $V_{GS}$ = 3 V

- $V_{GS}$ = 4.5 V

- $V_{GS}$ = 5 V

- $V_{GS}$ = 3.5 V

- $V_{GS}$ = 2 V

- $V_{GS}$ = 2.5 V

- $V_{GS}$ = 1.5 V

- $V_{GS}$ = 1 V

- $V_{GS}$ = 0.5 V

- $V_{GS}$ = 0 V

- $V_{GS}$ = 2.5 V

- $V_{GS}$ = 2 V

- $V_{GS}$ = 1.5 V

- $V_{GS}$ = 1 V

- $V_{GS}$ = 0.5 V

- $V_{GS}$ = 0 V
**Si9933ADY**

**Vishay Siliconix**

**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**

**Source-Drain Diode Forward Voltage**

![Graph showing Source-Drain Voltage vs. Current](image1)

- **$V_{SD}$** – Source-to-Drain Voltage (V)
- **$I_S$** – Source Current (A)
- **$T_J = 150$°C**
- **$T_J = 25$°C**

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

![Graph showing On-Resistance vs. Gate-to-Source Voltage](image2)

- **$V_{GS}$** – Gate-to-Source Voltage (V)
- **$r_{DS(on)}$** – On-Resistance (Ω)
- **$I_D = 3.2$ A**

**Threshold Voltage**

![Graph showing Threshold Voltage](image3)

- **$V_{GS(th)}$** – Source-to-Drain Voltage (V)
- **$I_D = 250$ µA**

**Single Pulse Power**

![Graph showing Single Pulse Power](image4)

- **$P_{DM}$** – Power (W)
- **$D$** – Duty Cycle
- **$I_T$** – Transient Current

**Normalized Thermal Transient Impedance, Junction-to-Ambient**

![Graph showing Normalized Thermal Transient Impedance](image5)

- **Normalized Effective Transient Thermal Impedance**
- **Square Wave Pulse Duration (sec)**
- **Notes:**
  1. Duty Cycle, $D = \frac{t_1}{T_S}$
  2. Per Unit Base = $R_{thJA} = 62.5$°C/W
  3. $T_{JM} - T_A = P_{DM}Z_{thJA}$
  4. Surface Mounted
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