**Description**

United Silicon Carbide, Inc offers the high-performance G3 SiC normally-on JFET transistors. This series exhibits ultra-low on resistance ($R_{\text{DS(on)}}$) and gate charge ($Q_G$) allowing for low conduction and switching loss. The device normally-on characteristics with low $R_{\text{DS(on)}}$ at $V_{GS} = 0$ V is also ideal for current protection circuits without the need for active control, as well as for cascode operation.

**Features**
- Typical on-resistance $R_{\text{DS(on),typ}}$ of 25mΩ
- Voltage controlled
- Maximum operating temperature of 175°C
- Extremely fast switching not dependent on temperature
- Low gate charge
- Low intrinsic capacitance
- RoHS compliant

**Typical Applications**
- Over current protection circuits
- DC-AC inverters
- Switch mode power supplies
- Power factor correction modules
- Motor drives
- Induction heating

**Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-source voltage</td>
<td>$V_{DS}$</td>
<td>DC</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Gate-source voltage</td>
<td>$V_{GS}$</td>
<td>AC (1)</td>
<td>-20 to +20</td>
<td>V</td>
</tr>
<tr>
<td>Continuous drain current</td>
<td>$I_D$</td>
<td>$T_C = 25°C$</td>
<td>85</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_C = 100°C$</td>
<td>62</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed drain current</td>
<td>$I_{DM}$</td>
<td>$T_C = 25°C$</td>
<td>250</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_{\text{tot}}$</td>
<td>$T_C=25°C$</td>
<td>441</td>
<td>W</td>
</tr>
<tr>
<td>Maximum junction temperature</td>
<td>$T_{J,max}$</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td>Operating and storage temperature</td>
<td>$T_J$, $T_{STG}$</td>
<td>-55 to 175</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Max. lead temperature for soldering, 1/8” from case for 5 seconds</td>
<td>$T_L$</td>
<td></td>
<td>250</td>
<td>°C</td>
</tr>
</tbody>
</table>

(1) +20V AC rating applies for turn-on pulses <200ns applied with external $R_G > 1Ω$.
(2) Limited by $T_{J,max}$
(3) Pulse width $t_p$ limited by $T_{J,max}$

For more information go to www.unitedsic.com.
## Electrical Characteristics (T<sub>j</sub> = +25°C unless otherwise specified)

### Typical Performance - Static

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-source breakdown voltage</td>
<td>BV&lt;sub&gt;DS&lt;/sub&gt;</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt;= - 20V, I&lt;sub&gt;D&lt;/sub&gt;=1mA</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Total drain leakage current</td>
<td>I&lt;sub&gt;D&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = 650V, V&lt;sub&gt;GS&lt;/sub&gt; = -20V, T&lt;sub&gt;j&lt;/sub&gt; = 25°C</td>
<td>10</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = 650V, V&lt;sub&gt;GS&lt;/sub&gt; = -20V, T&lt;sub&gt;j&lt;/sub&gt; = 175°C</td>
<td>60</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -20V, T&lt;sub&gt;j&lt;/sub&gt; = 25°C</td>
<td>40</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -20V, T&lt;sub&gt;j&lt;/sub&gt; = 175°C</td>
<td>10</td>
<td>μA</td>
</tr>
<tr>
<td>Total gate leakage current</td>
<td>I&lt;sub&gt;G&lt;/sub&gt;</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -20V, T&lt;sub&gt;j&lt;/sub&gt; = 25°C</td>
<td>100</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -20V, T&lt;sub&gt;j&lt;/sub&gt; = 175°C</td>
<td>38</td>
<td>μA</td>
</tr>
<tr>
<td>Drain-source on-resistance</td>
<td>R&lt;sub&gt;DS(on)&lt;/sub&gt;</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 2V, I&lt;sub&gt;D&lt;/sub&gt; = 20A, T&lt;sub&gt;j&lt;/sub&gt; = 25°C</td>
<td>22</td>
<td>mΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 0V, I&lt;sub&gt;D&lt;/sub&gt; = 20A, T&lt;sub&gt;j&lt;/sub&gt; = 25°C</td>
<td>25</td>
<td>mΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 2V, I&lt;sub&gt;D&lt;/sub&gt; = 20A, T&lt;sub&gt;j&lt;/sub&gt; = 175°C</td>
<td>33</td>
<td>mΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 0V, I&lt;sub&gt;D&lt;/sub&gt; = 20A, T&lt;sub&gt;j&lt;/sub&gt; = 175°C</td>
<td>38</td>
<td>mΩ</td>
</tr>
<tr>
<td>Gate threshold voltage</td>
<td>V&lt;sub&gt;G(th)&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = 5V, I&lt;sub&gt;D&lt;/sub&gt; = 70mA</td>
<td>-14</td>
<td>V</td>
</tr>
<tr>
<td>Gate resistance</td>
<td>R&lt;sub&gt;G&lt;/sub&gt;</td>
<td>f = 1MHz, open drain</td>
<td>2.5</td>
<td>Ω</td>
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## Typical Performance - Dynamic

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<tr>
<th>Parameter</th>
<th>symbol</th>
<th>Test Conditions</th>
<th>Value (Min</th>
<th>Typ</th>
<th>Max)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input capacitance</td>
<td>$C_{iss}$</td>
<td>$V_{DS} = 100V$, $V_{GS} = -20V$</td>
<td>2360</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{oss}$</td>
<td>$V_{DS} = 0V$ to $400V$, $V_{GS} = -20V$</td>
<td>290</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{oss(er)}$</td>
<td>$V_{DS} = 0V$, $f = 100kHz$</td>
<td>282</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>Effective output capacitance, energy related</td>
<td>$C_{oss(er)}$</td>
<td>$V_{DS} = 400V$, $I_D = 60A$, $V_{GS} = -18V$ to $0V$</td>
<td>210</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>Total gate charge</td>
<td>$Q_g$</td>
<td></td>
<td>240</td>
<td></td>
<td></td>
<td>nC</td>
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<tr>
<td>Gate-drain charge</td>
<td>$Q_{GD}$</td>
<td></td>
<td>134</td>
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<td></td>
<td>nC</td>
</tr>
<tr>
<td>Gate-source charge</td>
<td>$Q_{GS}$</td>
<td></td>
<td>24</td>
<td></td>
<td></td>
<td>nC</td>
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<tr>
<td>Turn-on delay time</td>
<td>$t_{d(on)}$</td>
<td></td>
<td>11</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Rise time</td>
<td>$t_r$</td>
<td>$V_{DS} = 400V$, $I_D = 60A$, $V_{GS} = -18V$ to $0V$</td>
<td>64</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>$t_{d(off)}$</td>
<td>$R_{G,EXT} = 1\Omega$, Inductive Load, FWD: UJ3D06530TS $T_J = 25°C$</td>
<td>43</td>
<td></td>
<td></td>
<td>ns</td>
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<tr>
<td>Fall time</td>
<td>$t_f$</td>
<td></td>
<td>44</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Turn-on energy</td>
<td>$E_{ON}$</td>
<td>$V_{DS} = 400V$, $I_D = 60A$, $V_{GS} = -18V$ to $0V$, $R_{G,EXT} = 1\Omega$, Inductive Load, FWD: UJ3D06530TS $T_J = 25°C$</td>
<td>740</td>
<td></td>
<td></td>
<td>μJ</td>
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<tr>
<td>Turn-off energy</td>
<td>$E_{OFF}$</td>
<td></td>
<td>818</td>
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<td></td>
<td>μJ</td>
</tr>
<tr>
<td>Total switching energy</td>
<td>$E_{TOTAL}$</td>
<td></td>
<td>1558</td>
<td></td>
<td></td>
<td>μJ</td>
</tr>
</tbody>
</table>

## Thermal Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>symbol</th>
<th>Test Conditions</th>
<th>Value (Min</th>
<th>Typ</th>
<th>Max)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal resistance, junction-to-case</td>
<td>$R_{JIC}$</td>
<td>$V_{DS} = 400V$, $I_D = 60A$, $V_{GS} = -18V$ to $0V$, $R_{G,EXT} = 1\Omega$, Inductive Load, FWD: UJ3D06530TS $T_J = 25°C$</td>
<td>0.26</td>
<td>0.34</td>
<td></td>
<td>°C/W</td>
</tr>
</tbody>
</table>

Rev. B, December 2018
Typical Performance Diagrams

**Figure 1 Typical output characteristics**
* at $T_J = -55^\circ C$

**Figure 2 Typical output characteristics**
* at $T_J = 25^\circ C$

**Figure 3 Typical output characteristics**
* at $T_J = 175^\circ C$

**Figure 4 Typical drain-source leakage**
* at $V_{GS} = -20V$
Figure 5 Typical capacitances at 100kHz and $V_{gs} = -20V$

Figure 6 Typical transfer characteristics at $V_{ds} = 5V$

Figure 7 Normalized on-resistance vs. temperature at $V_{gs} = 0V$ and $I_D = 20A$

Figure 8 Typical drain-source on-resistance at $V_{gs} = 0V$
**Figure 9** Threshold voltage vs. $T_j$
*at $V_{DS} = 5V$ and $I_D = 70mA* 

**Figure 10** Typical stored energy in $C_{oss}$
*at $V_{GS} = -20V* 

**Figure 11** Total power Dissipation 

**Figure 12** Safe operation area
*$T_c = 25°C$, Parameter $t_p$
Figure 13 Typical gate leakage current at $V_{DS} = 0V$

Figure 14 Typical gate forward current at $V_{DS} = 0V$

Figure 15 Maximum transient thermal impedance

Figure 16 Typical gate charge at $V_{DS} = 400V$ and $I_D = 60A$
Figure 17 Clamped inductive switching energy vs. drain current at $T_J = 150^\circ$C

Figure 18 Clamped inductive switching energy vs. gate resistor $R_G$

Figure 19 Clamped inductive switching energy vs. junction temperature at $I_D = 60$A
Disclaimer

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