### SCT2120AF
N-channel SiC power MOSFET

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drain - Source voltage</strong></td>
<td>( V_{DSS} )</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td><strong>Continuous drain current</strong></td>
<td>( I_D ) *1</td>
<td>29</td>
<td>A</td>
</tr>
<tr>
<td>( T_c = 25^\circ C )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( T_c = 100^\circ C )</td>
<td>( I_D ) *1</td>
<td>20</td>
<td>A</td>
</tr>
<tr>
<td><strong>Pulsed drain current</strong></td>
<td>( I_{D,pulse} ) *2</td>
<td>72</td>
<td>A</td>
</tr>
<tr>
<td><strong>Gate - Source voltage (DC)</strong></td>
<td>( V_{GSS} )</td>
<td>–6 to 22</td>
<td>V</td>
</tr>
<tr>
<td><strong>Gate - Source surge voltage (t&lt;sub&gt;surge&lt;/sub&gt; &lt; 300nsec)</strong></td>
<td>( V_{GSS-surge} ) *3</td>
<td>–10 to 26</td>
<td>V</td>
</tr>
<tr>
<td><strong>Power dissipation (( T_c = 25^\circ C ))</strong></td>
<td>( P_D )</td>
<td>165</td>
<td>W</td>
</tr>
<tr>
<td><strong>Junction temperature</strong></td>
<td>( T_J )</td>
<td>175</td>
<td>( ^\circ C )</td>
</tr>
<tr>
<td><strong>Range of storage temperature</strong></td>
<td>( T_{stg} )</td>
<td>–55 to +175</td>
<td>( ^\circ C )</td>
</tr>
</tbody>
</table>
### Electrical characteristics \((T_a = 25^\circ C)\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain - Source breakdown voltage</td>
<td>(V_{(BR)\text{DSS}})</td>
<td>(V_{GS} = 0V, I_D = 1mA)</td>
<td>650</td>
<td>-</td>
</tr>
<tr>
<td>Zero gate voltage drain current</td>
<td>(I_{\text{DSS}})</td>
<td>(V_{DS} = 650V, V_{GS} = 0V)</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(T_j = 25^\circ C)</td>
<td>10</td>
<td>(\mu A)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(T_j = 150^\circ C)</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Gate - Source leakage current</td>
<td>(I_{\text{GSS+}})</td>
<td>(V_{GS} = +22V, V_{DS} = 0V)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gate - Source leakage current</td>
<td>(I_{\text{GSS-}})</td>
<td>(V_{GS} = -6V, V_{DS} = 0V)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gate threshold voltage</td>
<td>(V_{GS\ (\text{th})})</td>
<td>(V_{DS} = V_{GS}, I_D = 3.3mA)</td>
<td>1.6</td>
<td>2.8</td>
</tr>
</tbody>
</table>

### Thermal resistance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal resistance, junction - case</td>
<td>(R_{\text{thJC}})</td>
<td>-</td>
<td>0.70</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.91</td>
</tr>
<tr>
<td>Soldering temperature, wave soldering for 10s</td>
<td>(T_{\text{sold}})</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>265</td>
</tr>
</tbody>
</table>

### Typical Transient Thermal Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(R_{\text{th1}})</td>
<td>9.61E-02</td>
<td>(\text{K/W})</td>
</tr>
<tr>
<td>(R_{\text{th2}})</td>
<td>4.04E-01</td>
<td>(\text{K/W})</td>
</tr>
<tr>
<td>(R_{\text{th3}})</td>
<td>1.96E-01</td>
<td>(\text{K/W})</td>
</tr>
<tr>
<td>(C_{\text{th1}})</td>
<td>1.55E-03</td>
<td>(\text{Ws/K})</td>
</tr>
<tr>
<td>(C_{\text{th2}})</td>
<td>5.23E-03</td>
<td>(\text{Ws/K})</td>
</tr>
<tr>
<td>(C_{\text{th3}})</td>
<td>8.33E-02</td>
<td>(\text{Ws/K})</td>
</tr>
</tbody>
</table>
### Electrical characteristics (\(T_a = 25^\circ\text{C}\))

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static drain - source on - state resistance</td>
<td>(R_{DS(on)})</td>
<td>(V_{GS} = 18\text{V}, I_D = 10\text{A}) (T_j = 25^\circ\text{C}) (T_j = 125^\circ\text{C})</td>
<td>- 120 156</td>
<td>mΩ</td>
</tr>
<tr>
<td>Gate input resistance</td>
<td>(R_G)</td>
<td>(f = 1\text{MHz}, \text{open drain})</td>
<td>- 13.8</td>
<td>(\Omega)</td>
</tr>
<tr>
<td>Transconductance</td>
<td>(G_{fs})</td>
<td>(V_{DS} = 10\text{V}, I_D = 10\text{A})</td>
<td>- 2.7</td>
<td>S</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>(C_{iss})</td>
<td>(V_{GS} = 0\text{V})</td>
<td>- 1200</td>
<td>pF</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>(C_{oss})</td>
<td>(V_{DS} = 500\text{V})</td>
<td>- 90</td>
<td></td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>(C_{rss})</td>
<td>(f = 1\text{MHz})</td>
<td>- 13</td>
<td></td>
</tr>
<tr>
<td>Effective output capacitance, energy related</td>
<td>(C_{o(er)})</td>
<td>(V_{GS} = 0\text{V}) to 300\text{V})</td>
<td>- 115</td>
<td>pF</td>
</tr>
<tr>
<td>Turn - on delay time</td>
<td>(t_{d(on)})</td>
<td>(V_{DD} = 300\text{V}, I_D = 10\text{A})</td>
<td>- 22</td>
<td></td>
</tr>
<tr>
<td>Rise time</td>
<td>(t_r)</td>
<td>(V_{GS} = 18\text{V}/0\text{V})</td>
<td>- 31</td>
<td>ns</td>
</tr>
<tr>
<td>Turn - off delay time</td>
<td>(t_{d(off)})</td>
<td>(R_L = 30\text{Ω})</td>
<td>- 60</td>
<td></td>
</tr>
<tr>
<td>Fall time</td>
<td>(t_f)</td>
<td>(R_G = 0\text{Ω})</td>
<td>- 19</td>
<td></td>
</tr>
<tr>
<td>Turn - on switching loss</td>
<td>(E_{on})</td>
<td>(V_{DD} = 300\text{V}, I_D=10\text{A}) (V_{GS} = 18\text{V}/0\text{V}) (R_G = 0\text{Ω}) (L=500\mu\text{H})</td>
<td>- 61</td>
<td>(\mu\text{J})</td>
</tr>
<tr>
<td>Turn - off switching loss</td>
<td>(E_{off})</td>
<td>(V_{DD} = 300\text{V}, I_D = 10\text{A})</td>
<td>- 41</td>
<td></td>
</tr>
</tbody>
</table>

### Gate Charge characteristics (\(T_a = 25^\circ\text{C}\))

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total gate charge</td>
<td>(Q_g)</td>
<td>(V_{DD} = 300\text{V})</td>
<td>- 61</td>
<td>nC</td>
</tr>
<tr>
<td>Gate - Source charge</td>
<td>(Q_{gs})</td>
<td>(I_D = 10\text{A})</td>
<td>- 14</td>
<td></td>
</tr>
<tr>
<td>Gate - Drain charge</td>
<td>(Q_{gd})</td>
<td>(V_{GS} = 18\text{V})</td>
<td>- 21</td>
<td></td>
</tr>
<tr>
<td>Gate plateau voltage</td>
<td>(V_{(plateau)})</td>
<td>(V_{DD} = 300\text{V}, I_D = 10\text{A})</td>
<td>- 10.4</td>
<td>V</td>
</tr>
</tbody>
</table>
**Body diode electrical characteristics** (Source-Drain) \( (T_a = 25^\circ C) \)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inverse diode continuous, forward current</td>
<td>( I_s )</td>
<td>( T_c = 25^\circ C )</td>
<td>(-) 29</td>
<td>A</td>
</tr>
<tr>
<td>Inverse diode direct current, pulsed</td>
<td>( I_{SM} )</td>
<td>(-) 72</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td>( V_{SD} )</td>
<td>( V_{GS} = 0V, I_s = 10A )</td>
<td>- 4.3</td>
<td>V</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>( t_r )</td>
<td>( I_F = 10A, V_R = 400V ), ( di/dt = 160A/\mu s )</td>
<td>- 33</td>
<td>ns</td>
</tr>
<tr>
<td>Reverse recovery charge</td>
<td>( Q_{rr} )</td>
<td>(-) 53</td>
<td>nC</td>
<td></td>
</tr>
<tr>
<td>Peak reverse recovery current</td>
<td>( I_{rrm} )</td>
<td>(-) 3.0</td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

*1 Limited only by maximum temperature allowed.

*2 PW \( \leq 10\mu s \), Duty cycle \( \leq 1\%

*3 Example of acceptable Vgs waveform

*4 Pulsed
Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

![Power Dissipation Derating Curve](image)

Case Temperature : $T_C$ [°C]

Power Dissipation : $P_D$ [W]

Fig.2 Maximum Safe Operating Area

![Maximum Safe Operating Area](image)

Drain Current : $I_D$ [A]

Drain-Source Voltage : $V_{DS}$ [V]

Operation in this area is limited by $R_{DS(on)}$.

$P_W = 100\mu$s

$P_W = 1$ ms

$P_W = 10$ ms

$P_W = 100$ ms

$T_a = 25$°C

Single Pulse

Fig.3 Typical Transient Thermal Resistance vs. Pulse Width

![Typical Transient Thermal Resistance vs. Pulse Width](image)

Transient Thermal Resistance : $R_{th}$ [K/W]

Pulse Width : $PW$ [s]

$T_a = 25$°C

Single Pulse
Electrical characteristic curves

Fig. 4 Typical Output Characteristics (I)

Drain Current : $I_D$ [A]

Drain - Source Voltage : $V_{DS}$ [V]

Fig. 5 Typical Output Characteristics (II)

Drain Current : $I_D$ [A]

Drain - Source Voltage : $V_{DS}$ [V]

Fig. 6 $T_J = 150^\circ$C Typical Output Characteristics (I)

Drain Current : $I_D$ [A]

Drain - Source Voltage : $V_{DS}$ [V]

Fig. 7 $T_J = 150^\circ$C Typical Output Characteristics (II)

Drain Current : $I_D$ [A]

Drain - Source Voltage : $V_{DS}$ [V]
Electrical characteristic curves

**Fig. 8 Typical Transfer Characteristics (I)**

- Drain Current: $I_D$ [A]
- Gate Voltage: $V_{GS}$ [V]
- $V_{DS} = 10\text{V}$ Pulsed
- $T_a = 150^\circ\text{C}$
- $T_a = 75^\circ\text{C}$
- $T_a = 25^\circ\text{C}$
- $T_a = -25^\circ\text{C}$

**Fig. 9 Typical Transfer Characteristics (II)**

- Drain Current: $I_D$ [A]
- Gate Voltage: $V_{GS}$ [V]
- $V_{DS} = 10\text{V}$ Pulsed
- $T_a = 150^\circ\text{C}$
- $T_a = 75^\circ\text{C}$
- $T_a = 25^\circ\text{C}$
- $T_a = -25^\circ\text{C}$

**Fig. 10 Gate Threshold Voltage vs. Junction Temperature**

- Gate Threshold Voltage: $V_{GS(th)}$ [V]
- $V_{DS} = V_{GS}$
- $I_D = 3.3\text{mA}$
- Junction Temperature: $T_j$ [°C]

**Fig. 11 Transconductance vs. Drain Current**

- Transconductance: $g_{fs}$ [S]
- $V_{DS} = 10\text{V}$ Pulsed
- $T_a = 150^\circ\text{C}$
- $T_a = 75^\circ\text{C}$
- $T_a = 25^\circ\text{C}$
- $T_a = -25^\circ\text{C}$

- Drain Current: $I_D$ [A]
Electrical characteristic curves

Fig. 12 Static Drain - Source On - State Resistance vs. Gate - Source Voltage

Fig. 13 Static Drain - Source On - State Resistance vs. Junction Temperature

Fig. 14 Static Drain - Source On - State Resistance vs. Drain Current
Electrical characteristic curves

**Fig. 15 Typical Capacitance vs. Drain - Source Voltage**

- Capacitance vs. Drain - Source Voltage: $V_{DS}$ [V]
- Capacitance: $C$ [pF]
- $T_a = 25^\circ C$
- $f = 1 MHz$
- $V_{GS} = 0 V$

**Fig. 16 Coss Stored Energy**

- Coss Stored Energy: $E_{OSS}$ [µJ]
- $T_a = 25^\circ C$

**Fig. 17 Switching Characteristics**

- Switching Time: $t$ [ns]
- Drain Current: $I_D$ [A]
- $T_a = 25^\circ C$
- $V_{DD} = 300 V$
- $V_{GS} = 18 V$
- $R_G = 0 \Omega$
- $t_{d(on)}$
- $t_{r}$
- $t_{d(off)}$

**Fig. 18 Dynamic Input Characteristics**

- Gate - Source Voltage: $V_{GS}$ [V]
- Total Gate Charge: $Q_g$ [nC]
- $V_{DD} = 300 V$
- $V_{GS} = 18 V$
- $I_D = 10 A$
- Pulsed
**Electrical characteristic curves**

**Fig. 19 Typical Switching Loss vs. Drain - Source Voltage**

- $T_a = 25^\circ C$
- $I_D = 10\,A$
- $V_{GS} = 18\,V/0\,V$
- $R_G = 0\,\Omega$
- $L = 500\,\mu H$

**Fig. 20 Typical Switching Loss vs. Drain Current**

- $T_a = 25^\circ C$
- $V_{DD} = 300\,V$
- $V_{GS} = 18\,V/0\,V$
- $R_G = 0\,\Omega$
- $L = 500\,\mu H$

**Fig. 21 Typical Switching Loss vs. External Gate Resistance**

- $T_a = 25^\circ C$
- $V_{DD} = 300\,V$
- $I_D = 10\,A$
- $V_{GS} = 18\,V/0\,V$
- $L = 500\,\mu H$
Electrical characteristic curves

Fig.22 Inverse Diode Forward Current vs. Source - Drain Voltage

Fig.23 Reverse Recovery Time vs. Inverse Diode Forward Current
● Measurement circuits

**Fig. 1-1** Switching Time Measurement Circuit

**Fig. 1-2** Switching Waveforms

**Fig. 2-1** Gate Charge Measurement Circuit

**Fig. 2-2** Gate Charge Waveform

**Fig. 3-1** Switching Energy Measurement Circuit

**Fig. 3-2** Switching Waveforms

**Fig. 4-1** Reverse Recovery Time Measurement Circuit

**Fig. 4-2** Reverse Recovery Waveform
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