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>Drain - Source voltage</td>
<td>$V_{DSS}$</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Continuous drain current</td>
<td>$I_D^1$</td>
<td>29</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>$I_D^1$</td>
<td>20</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed drain current</td>
<td>$I_D\text{,pulse}^2$</td>
<td>72</td>
<td>A</td>
</tr>
<tr>
<td>Gate - Source voltage (DC)</td>
<td>$V_{GSS}$</td>
<td>–6 to 22</td>
<td>V</td>
</tr>
<tr>
<td>Gate - Source surge voltage</td>
<td>$V_{GSS\text{-surge}}^3$</td>
<td>–10 to 26</td>
<td>V</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_D$</td>
<td>165</td>
<td>W</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>$T_J$</td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td>Range of storage temperature</td>
<td>$T_{stg}$</td>
<td>–55 to 175</td>
<td>°C</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>Soldering temperature, wavesoldering for 10s</td>
<td>$T_{\text{sold}}$</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

## Electrical characteristics ($T_a = 25°C$)

<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>$V_{(BR)DSS}$</td>
<td>$V_{GS} = 0V$, $I_D = 1mA$</td>
<td>650</td>
<td>-</td>
</tr>
<tr>
<td>Zero gate voltage drain current</td>
<td>$I_{DSS}$</td>
<td>$V_{DS} = 650V$, $V_{GS} = 0V$</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_j = 25°C$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_j = 150°C$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate - Source leakage current</td>
<td>$I_{GSS+}$</td>
<td>$V_{GS} = +22V$, $V_{DS} = 0V$</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gate - Source leakage current</td>
<td>$I_{GSS-}$</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>

*1 Limited only by maximum temperature allowed.
*2 $PW \leq 10\mu$s, Duty cycle $\leq 1\%$
*3 Example of acceptable Vgs waveform

```
+26V
+22V
0V
-6V
-10V
```

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

### Gate Charge 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>Total gate charge</td>
<td>(Q_g)</td>
<td>(V_{DD} = 300V)</td>
<td>- 61 -</td>
<td>nC</td>
</tr>
<tr>
<td>Gate - Source charge</td>
<td>(Q_{gs})</td>
<td>(I_D = 10A)</td>
<td>- 14 -</td>
<td></td>
</tr>
<tr>
<td>Gate - Drain charge</td>
<td>(Q_{gd})</td>
<td>(V_{GS} = 18V)</td>
<td>- 21 -</td>
<td></td>
</tr>
<tr>
<td>Gate plateau voltage</td>
<td>(V_{(plateau)})</td>
<td>(V_{DD} = 300V, I_D = 10A)</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 ) (^*1)</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} ) (^*2)</td>
<td></td>
<td>- - 72</td>
<td>A</td>
</tr>
<tr>
<td>Forward voltage</td>
<td>( V_{SD} ) (^*4)</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 ) (^*4)</td>
<td>( I_F = 10A, V_R = 400V ) ( \frac{di}{dt} = 160A/\mu s )</td>
<td>- 33 -</td>
<td>ns</td>
</tr>
<tr>
<td>Reverse recovery charge</td>
<td>( Q_{tr} ) (^*4)</td>
<td></td>
<td>- 53 -</td>
<td>nC</td>
</tr>
<tr>
<td>Peak reverse recovery current</td>
<td>( I_{rm} ) (^*4)</td>
<td></td>
<td>- 3.0 -</td>
<td>A</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_{th1} )</td>
<td>96.1m</td>
<td>K/W</td>
</tr>
<tr>
<td>( R_{th2} )</td>
<td>404m</td>
<td></td>
</tr>
<tr>
<td>( R_{th3} )</td>
<td>196m</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_{th1} )</td>
<td>1.55m</td>
<td>Ws/K</td>
</tr>
<tr>
<td>( C_{th2} )</td>
<td>5.23m</td>
<td></td>
</tr>
<tr>
<td>( C_{th3} )</td>
<td>83.3m</td>
<td></td>
</tr>
</tbody>
</table>
● Electrical characteristic curves

**Fig. 1 Power Dissipation Derating Curve**

<table>
<thead>
<tr>
<th>Junction Temperature (°C)</th>
<th>Power Dissipation (P₀ [W])</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>180</td>
</tr>
<tr>
<td>50</td>
<td>160</td>
</tr>
<tr>
<td>100</td>
<td>140</td>
</tr>
<tr>
<td>150</td>
<td>120</td>
</tr>
<tr>
<td>200</td>
<td>100</td>
</tr>
</tbody>
</table>

**Fig. 2 Maximum Safe Operating Area**

- Operation in this area is limited by R_DS(ON)

<table>
<thead>
<tr>
<th>Drain Current (Ig [A])</th>
<th>Drain - Source Voltage (V_DS [V])</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0001</td>
<td>100</td>
</tr>
<tr>
<td>0.001</td>
<td>10</td>
</tr>
<tr>
<td>0.01</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**Fig. 3 Typical Transient Thermal Resistance vs. Pulse Width**

- Operation in this area is limited by R₉₅₅₈₉₃

<table>
<thead>
<tr>
<th>Pulse Width (PW [s])</th>
<th>Transient Thermal Resistance (Rth [K/W])</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0001</td>
<td>0.001</td>
</tr>
<tr>
<td>0.001</td>
<td>0.01</td>
</tr>
<tr>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1000</td>
<td>1000</td>
</tr>
</tbody>
</table>

Ta = 25°C

Single Pulse
Electrical characteristic curves

Fig. 4 Typical Output Characteristics (I)

Fig. 5 Typical Output Characteristics (II)

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

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

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

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

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

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

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

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

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

- **Transconductance :** $g_{fs}$ [S]
- **Drain Current :** $I_D$ [A]
- $V_{DS} = 10V$ Pulsed
- $T_a = 150^\circ C$
- $T_a = 75^\circ C$
- $T_a = 25^\circ C$
- $T_a = -25^\circ C$
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: C [pF]
- Drain - Source Voltage: V_DS [V]
- Ta = 25°C
- f = 1MHz
- V_GS = 0V

**Fig. 16 Coss Stored Energy**

- Coss Stored Energy: E_oss [µJ]
- Drain - Source Voltage: V_DS [V]
- Ta = 25°C

**Fig. 17 Switching Characteristics**

- Switching Time: t [ns]
- Drain Current: I_D [A]
- Ta = 25°C
- V_DD = 300V
- V_GS = 18V
- R_G = 0Ω

**Fig. 18 Dynamic Input Characteristics**

- Gate - Source Voltage: V_GS [V]
- Total Gate Charge: Q_G [nC]
- Ta = 25°C
- V_DD = 300V
- I_D = 10A
- Pulsed
●Electrical characteristic curves

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

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

---

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

- $T_a = 25^\circ C$
- $V_{DD}=300V$
- $V_{DS} = 18V/0V$
- $R_G = 0 \Omega$
- $L=500 \mu H$
- $I_D=10A$

---

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

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