SCT2080KE
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>1200V</td>
<td>V</td>
</tr>
<tr>
<td>Continuous drain current</td>
<td>$I_D$</td>
<td>40A</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></td>
<td>28A</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed drain current</td>
<td>$I_{D_{pulse}}$</td>
<td>80A</td>
<td>A</td>
</tr>
<tr>
<td>Gate - Source voltage (DC)</td>
<td>$V_{GSS}$</td>
<td>-6 to 22V</td>
<td>V</td>
</tr>
<tr>
<td>Gate - Source surge voltage</td>
<td>$V_{GSS_{surge}}$</td>
<td>-10 to +26V</td>
<td>V</td>
</tr>
<tr>
<td>$t_{surge} &lt; 300\text{nsec}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junction temperature</td>
<td>$T_J$</td>
<td>175°C</td>
<td></td>
</tr>
<tr>
<td>Range of storage temperature</td>
<td>$T_{stg}$</td>
<td>-55 to +175°C</td>
<td></td>
</tr>
</tbody>
</table>

**Features**
1) Low on-resistance
2) Fast switching speed
3) Fast reverse recovery
4) Easy to parallel
5) Simple to drive
6) Pb-free lead plating ; RoHS compliant

**Application**
- Solar inverters
- DC/DC converters
- Induction heating
- Motor drives

**Absolute maximum ratings ($T_a = 25^\circ C$)**

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TSQ50210-SCT2080KE

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### 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)DSS})</td>
<td>(V_{GS} = 0V, I_D = 1mA)</td>
<td>1200</td>
<td>-</td>
</tr>
<tr>
<td>Zero gate voltage drain current</td>
<td>(I_{DSS})</td>
<td>(V_{DS} = 1200V, V_{GS} = 0V)</td>
<td>- 1 10</td>
<td>(\mu)A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T(_J) = 25^\circ C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>T(_J) = 150^\circ C)</td>
<td>- 2 -</td>
<td></td>
</tr>
<tr>
<td>Gate - Source leakage current</td>
<td>(I_{GSS^+})</td>
<td>(V_{GS} = +22V, V_{DS} = 0V)</td>
<td>- - 100</td>
<td>nA</td>
</tr>
<tr>
<td>Gate - Source leakage current</td>
<td>(I_{GSS^-})</td>
<td>(V_{GS} = -6V, V_{DS} = 0V)</td>
<td>- - -100</td>
<td>nA</td>
</tr>
<tr>
<td>Gate threshold voltage</td>
<td>(V_{GS,(th)})</td>
<td>(V_{DS} = V_{GS}, I_D = 4.4mA)</td>
<td>1.6 2.8 4.0</td>
<td>(\Omega)</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_{thJC})</td>
<td>- 0.44 0.57</td>
<td>(^\circ)C/W</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>7.80E-02</td>
<td>kW</td>
</tr>
<tr>
<td>(R_{th2})</td>
<td>1.97E-01</td>
<td>kW</td>
</tr>
<tr>
<td>(R_{th3})</td>
<td>1.62E-01</td>
<td>kW</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>5.00E-03</td>
<td>Ws/K</td>
</tr>
<tr>
<td>(C_{th2})</td>
<td>1.80E-02</td>
<td>Ws/K</td>
</tr>
<tr>
<td>(C_{th3})</td>
<td>2.49E-01</td>
<td>Ws/K</td>
</tr>
</tbody>
</table>
### Electrical characteristics (T<sub>a</sub> = 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></td>
<td></td>
<td></td>
<td>Min.</td>
<td>Typ.</td>
</tr>
<tr>
<td>Static drain - source on - state resistance</td>
<td>R&lt;sub&gt;DS(on)&lt;/sub&gt;</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 18V, I&lt;sub&gt;D&lt;/sub&gt; = 10A</td>
<td>-</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T&lt;sub&gt;j&lt;/sub&gt; = 25°C</td>
<td>-</td>
<td>125</td>
</tr>
<tr>
<td>Gate input resistance</td>
<td>R&lt;sub&gt;G&lt;/sub&gt;</td>
<td>f = 1MHz, open drain</td>
<td>-</td>
<td>6.3</td>
</tr>
<tr>
<td>Transconductance</td>
<td>g&lt;sub&gt;fs&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = 10V, I&lt;sub&gt;D&lt;/sub&gt; = 10A</td>
<td>-</td>
<td>3.7</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>C&lt;sub&gt;iss&lt;/sub&gt;</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 0V</td>
<td>-</td>
<td>2080</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>C&lt;sub&gt;oss&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = 800V</td>
<td>-</td>
<td>77</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>C&lt;sub&gt;rss&lt;/sub&gt;</td>
<td>f = 1MHz</td>
<td>-</td>
<td>16</td>
</tr>
<tr>
<td>Effective output capacitance, energy related</td>
<td>C&lt;sub&gt;o(er)&lt;/sub&gt;</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 0V</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = 0V to 500V</td>
<td>-</td>
</tr>
<tr>
<td>Turn - on delay time</td>
<td>t&lt;sub&gt;d(on)&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt; = 400V, V&lt;sub&gt;GS&lt;/sub&gt; = 18V</td>
<td>-</td>
<td>35</td>
</tr>
<tr>
<td>Rise time</td>
<td>t&lt;sub&gt;r&lt;/sub&gt;</td>
<td>I&lt;sub&gt;D&lt;/sub&gt; = 10A</td>
<td>-</td>
<td>36</td>
</tr>
<tr>
<td>Turn - off delay time</td>
<td>t&lt;sub&gt;d(off)&lt;/sub&gt;</td>
<td>R&lt;sub&gt;L&lt;/sub&gt; = 40Ω</td>
<td>-</td>
<td>76</td>
</tr>
<tr>
<td>Fall time</td>
<td>t&lt;sub&gt;f&lt;/sub&gt;</td>
<td>R&lt;sub&gt;G&lt;/sub&gt; = 0Ω</td>
<td>-</td>
<td>22</td>
</tr>
<tr>
<td>Turn - on switching loss</td>
<td>E&lt;sub&gt;on&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt; = 600V, I&lt;sub&gt;D&lt;/sub&gt; = 10A</td>
<td>-</td>
<td>174</td>
</tr>
<tr>
<td>Turn - off switching loss</td>
<td>E&lt;sub&gt;off&lt;/sub&gt;</td>
<td>*E&lt;sub&gt;on&lt;/sub&gt; includes diode reverse recovery</td>
<td>-</td>
<td>51</td>
</tr>
</tbody>
</table>

### Gate Charge characteristics (T<sub>a</sub> = 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>Total gate charge</td>
<td>Q&lt;sub&gt;g&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt; = 400V</td>
<td>-</td>
<td>106</td>
</tr>
<tr>
<td>Gate - Source charge</td>
<td>Q&lt;sub&gt;gs&lt;/sub&gt;</td>
<td>I&lt;sub&gt;D&lt;/sub&gt; = 10A</td>
<td>-</td>
<td>27</td>
</tr>
<tr>
<td>Gate - Drain charge</td>
<td>Q&lt;sub&gt;gd&lt;/sub&gt;</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 18V</td>
<td>-</td>
<td>31</td>
</tr>
<tr>
<td>Gate plateau voltage</td>
<td>V&lt;sub&gt;(plateau)&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt; = 400V, I&lt;sub&gt;D&lt;/sub&gt; = 10A</td>
<td>-</td>
<td>9.7</td>
</tr>
</tbody>
</table>
### Body diode electrical characteristics (Source-Drain) \((T_a = 25^\circ \text{C})\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body diode continuous, forward current</td>
<td>(I_s) (^*2)</td>
<td>(T_c = 25^\circ \text{C})</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Body diode direct current, pulsed</td>
<td>(I_{SM}) (^*3)</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Forward voltage</td>
<td>(V_{SD}) (^*5)</td>
<td>(V_{GS} = 0V, I_s = 10A)</td>
<td>-</td>
<td>4.6</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>(t_{rr}) (^*5)</td>
<td></td>
<td>-</td>
<td>31</td>
</tr>
<tr>
<td>Reverse recovery charge</td>
<td>(Q_{rr}) (^*5)</td>
<td>(I_f = 10A, V_R = 400V)</td>
<td>-</td>
<td>44</td>
</tr>
<tr>
<td>Peak reverse recovery current</td>
<td>(I_{rrm}) (^*5)</td>
<td>(\text{di/dt} = 150A/\mu\text{s})</td>
<td>-</td>
<td>2.3</td>
</tr>
</tbody>
</table>

*1 Tolerances of dimensions and packing specifications slightly differ between TO-247 and TO-247N, which is unlikely to influence compatibility for mounting. Please refer to corresponding specifications of dimensions for more details.

*2 Limited only by maximum temperature allowed.

*3 \(PW \leq 10\mu\text{s}, \text{Duty cycle} \leq 1\%\)

*4 Example of acceptable \(V_{GS}\) waveform

![Diagram of \(V_{GS}\) waveform](image)

*5 Pulsed
Electrical characteristic curves

![Power Dissipation Derating Curve](image1)

![Maximum Safe Operating Area](image2)

![Typical Transient Thermal Resistance vs. Pulse Width](image3)
●Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

Drain Current : $I_D$ [A]

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

$T_a = 25^\circ C$
Pulsed

$V_{GS} = 20V$
$V_{GS} = 18V$
$V_{GS} = 16V$
$V_{GS} = 14V$
$V_{GS} = 12V$
$V_{GS} = 10V$

Fig.5 Typical Output Characteristics(II)

Drain Current : $I_D$ [A]

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

$T_a = 25^\circ C$
Pulsed

$V_{GS} = 14V$
$V_{GS} = 10V$
$V_{GS} = 20V$

Fig.6 Typical Output Characteristics(I)

Drain Current : $I_D$ [A]

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

$T_a = 150^\circ C$
Pulsed

$V_{GS} = 20V$
$V_{GS} = 18V$
$V_{GS} = 16V$
$V_{GS} = 14V$
$V_{GS} = 12V$
$V_{GS} = 10V$

Fig.7 Typical Output Characteristics(II)

Drain Current : $I_D$ [A]

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

$T_a = 150^\circ C$
Pulsed

$V_{GS} = 20V$
$V_{GS} = 14V$
$V_{GS} = 12V$
**Electrical characteristic curves**

**Fig.8 Typical Transfer Characteristics**

- **Drain Current :** $I_D$ [A]
- **Gate - Source Voltage :** $V_{GS}$ [V]

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

- **Drain Current :** $I_D$ [A]
- **Gate - Source Voltage :** $V_{GS}$ [V]

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

- **Gate Threshold Voltage :** $V_{GS(th)}$ [V]
- **Junction Temperature :** $T_J$ [°C]

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

- **Transconductance :** $g_{fs}$ [S]
- **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: $C \, [\text{pF}]$
- Drain - Source Voltage: $V_{DS} \, [\text{V}]$

**Fig. 16 $C_{oss}$ Stored Energy**

- $C_{oss} \, [\text{pF}]$
- Drain - Source Voltage: $V_{DS} \, [\text{V}]$

**Fig. 17 Switching Characteristics**

- Switching Time: $t \, [\text{ns}]$
- Drain Current: $I_D \, [\text{A}]$

**Fig. 18 Dynamic Input Characteristics**

- Gate - Source Voltage: $V_{GS} \, [\text{V}]$
- Total Gate Charge: $Q_g \, [\text{nC}]$
- Electrical characteristic curves

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

- $T_a = 25^\circ C$
- $I_D = 10A$
- $V_GS = 18V/0V$
- $R_G = 0\Omega$
- $L = 500\mu H$

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

- $T_a = 25^\circ C$
- $V_{DD} = 600V$
- $V_GS = 18V/0V$
- $R_G = 0\Omega$
- $L = 500\mu H$

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

- $T_a = 25^\circ C$
- $V_{DD} = 600V$
- $I_D = 10A$
- $V_GS = 18V/0V$
- $L = 500\mu H$
Electrical characteristic curves

**Fig. 22** Body Diode Forward Current vs. Source - Drain Voltage

- $V_{GS} = 0\,\text{V}$
- Pulsed

- $T_a = 150\,\text{ºC}$
- $T_a = 75\,\text{ºC}$
- $T_a = 25\,\text{ºC}$
- $T_a = -25\,\text{ºC}$

Source - Drain Voltage: $V_{SD} \, [\text{V}]$

**Fig. 23** Reverse Recovery Time vs. Body Diode Forward Current

- $T_a = 25\,\text{ºC}$
- $\frac{di}{dt} = 150\,\text{A/}\mu\text{s}$
- $V_R = 400\,\text{V}$
- $V_{GS} = 0\,\text{V}$
- Pulsed

Reverse Recovery Time: $t_{rr} \, [\text{ns}]$

Body Diode Forward Current: $I_s \, [\text{A}]$
● Measurement circuits

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

![Switching Time Measurement Circuit](image1)

**Fig. 1-2** Switching Waveforms

![Switching Waveforms](image2)

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

![Gate Charge Measurement Circuit](image3)

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

![Gate Charge Waveform](image4)

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

![Switching Energy Measurement Circuit](image5)

**Fig. 3-2** Switching Waveforms

![Switching Waveforms](image6)

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

![Reverse Recovery Time Measurement Circuit](image7)

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

![Reverse Recovery Waveform](image8)
Notes

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