SCT3105KR
N-channel SiC power MOSFET

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Drain - Source Voltage</td>
<td>V_{DSS}</td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Drain current</td>
<td>I_{D}^*1</td>
<td>24</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>I_{D}^*1</td>
<td>17</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed Drain current</td>
<td>I_{D,pulse}^*2</td>
<td>60</td>
<td>A</td>
</tr>
<tr>
<td>Gate - Source voltage (DC)</td>
<td>V_{GSS}</td>
<td>-4 to +22</td>
<td>V</td>
</tr>
<tr>
<td>Gate - Source surge voltage (t_{surge} &lt; 300ns)</td>
<td>V_{GSS,surge}^*3</td>
<td>-4 to +26</td>
<td>V</td>
</tr>
<tr>
<td>Recommended drive voltage</td>
<td>V_{GS_op}^*4</td>
<td>0 / +18</td>
<td>V</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>
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- **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
  - Switch mode power supplies
  - Induction heating
  - Motor drives

- **Absolute maximum ratings (T_{a} = 25°C)**

Please note Driver Source and Power Source are not exchangeable. Their exchange might lead to malfunction.

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TSQ50254-SCT3105KR
31.Jul.2019 - Rev.001
### 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) (T_j = 25^\circ C) (T_j = -55^\circ C)</td>
<td>1200 - -</td>
<td>V</td>
</tr>
<tr>
<td>Zero Gate voltage Drain current</td>
<td>(I_{DSS})</td>
<td>(V_{GS} = 0V, V_{DS} = 1200V) (T_j = 25^\circ C) (T_j = 150^\circ C)</td>
<td>- 1 10</td>
<td>(\mu A)</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} = -4V, 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} = 10V, I_D = 3.81mA)</td>
<td>2.7 - 5.6</td>
<td>V</td>
</tr>
<tr>
<td>Static Drain - Source on - state resistance</td>
<td>(R_{DSS(on)})</td>
<td>(V_{GS} = 18V, I_D = 7.6A) (T_j = 25^\circ C) (T_j = 150^\circ C)</td>
<td>- 105 137</td>
<td>m(\Omega)</td>
</tr>
<tr>
<td>Gate input resistance</td>
<td>(R_G)</td>
<td>(f = 1MHz, \text{open drain})</td>
<td>- 13 -</td>
<td>(\Omega)</td>
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### Thermal resistance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Thermal resistance, junction - case</td>
<td>(R_{thJC})</td>
<td>- 0.86 1.12</td>
<td>(^\circ C/W)</td>
</tr>
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### 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>(1.14\times10^{-1})</td>
<td>K/W</td>
</tr>
<tr>
<td>(R_{th2})</td>
<td>(5.07\times10^{-1})</td>
<td>K/W</td>
</tr>
<tr>
<td>(R_{th3})</td>
<td>(2.51\times10^{-1})</td>
<td>K/W</td>
</tr>
<tr>
<td>(C_{th1})</td>
<td>(5.02\times10^{-4})</td>
<td>Ws/K</td>
</tr>
<tr>
<td>(C_{th2})</td>
<td>(4.91\times10^{-3})</td>
<td>Ws/K</td>
</tr>
<tr>
<td>(C_{th3})</td>
<td>(4.99\times10^{-2})</td>
<td>Ws/K</td>
</tr>
</tbody>
</table>
### Electrical characteristics \((T_a = 25^\circ C)\)

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<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transconductance</td>
<td>(g_{fs})^5</td>
<td>(V_{DS} = 10V, I_D = 7.6A)</td>
<td>- 3.4</td>
<td>S</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>(C_{iss})</td>
<td>(V_{GS} = 0V)</td>
<td>- 574</td>
<td>-</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>(C_{oss})</td>
<td>(V_{DS} = 800V)</td>
<td>- 59</td>
<td>pF</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>(C_{rss})</td>
<td>(f = 1MHz)</td>
<td>- 28</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 } 600V)</td>
<td>- 159</td>
<td>pF</td>
</tr>
<tr>
<td>Total Gate charge</td>
<td>(Q_g)^5</td>
<td>(V_{DS} = 600V)</td>
<td>- 51</td>
<td>-</td>
</tr>
<tr>
<td>Gate - Source charge</td>
<td>(Q_{gs})^5</td>
<td>(V_{GS} = 18V)</td>
<td>- 10</td>
<td>nC</td>
</tr>
<tr>
<td>Gate - Drain charge</td>
<td>(Q_{gd})^5</td>
<td>(V_{GS} = 18V)</td>
<td>- 25</td>
<td>-</td>
</tr>
<tr>
<td>Turn - on delay time</td>
<td>(t_{d(on)})^5</td>
<td>(V_{DS} = 600V)</td>
<td>- 4</td>
<td>-</td>
</tr>
<tr>
<td>Rise time</td>
<td>(t_r)^5</td>
<td>(V_{GS} = \text{0V/+18V})</td>
<td>- 12</td>
<td>ns</td>
</tr>
<tr>
<td>Turn - off delay time</td>
<td>(t_{d(off)})^5</td>
<td>(R_G = 0\Omega, L = 750\mu H)</td>
<td>- 16</td>
<td>-</td>
</tr>
<tr>
<td>Fall time</td>
<td>(t_f)^5</td>
<td>(L_\sigma = 50\text{nH}, C_\sigma = 10\text{pF})</td>
<td>- 10</td>
<td>-</td>
</tr>
<tr>
<td>Turn - on switching loss</td>
<td>(E_{on})^5</td>
<td>(E_{on} \text{ includes diode reverse recovery.})</td>
<td>- 125</td>
<td>(\mu\text{J})</td>
</tr>
<tr>
<td>Turn - off switching loss</td>
<td>(E_{off})^5</td>
<td></td>
<td>- 8</td>
<td>-</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>Body diode continuous, forward current</td>
<td>( I_s ) *1</td>
<td>( T_c = 25^\circ C )</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Body diode direct current, pulsed</td>
<td>( I_{SM} ) *2</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Forward voltage</td>
<td>( V_{SD} ) *5</td>
<td>( V_{GS} = 0V ), ( I_D = 7.6A )</td>
<td>-</td>
<td>3.2</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>( t_{rr} ) *5</td>
<td>( I_F = 7.6A ) ( V_R = 600V ) ( \text{di/dt} = 2500A/\mu s )</td>
<td>-</td>
<td>13</td>
</tr>
<tr>
<td>Reverse recovery charge</td>
<td>( Q_{rr} ) *5</td>
<td>( I_D = 50nH ), ( C_{\sigma} = 10pF ) ( \text{See Fig. 3-1, 3-2.} )</td>
<td>-</td>
<td>175</td>
</tr>
<tr>
<td>Peak reverse recovery current</td>
<td>( I_{rrm} ) *5</td>
<td></td>
<td>-</td>
<td>22</td>
</tr>
</tbody>
</table>

*1 Limited by maximum temperature allowed.

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

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

![Peak reverse recovery current](image)

Please note especially when using driver source that \( V_{GSS \_surge} \) must be in the range of absolute maximum rating.

*4 Please be advised not to use SiC-MOSFETs with \( V_{GS} \) below 13V as doing so may cause thermal runaway.

*5 Pulsed
● Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

![Power Dissipation Derating Curve](image1)

Transistor Temperature : $T_C [^\circ C]$

Power Dissipation : $P_D [W]$

Fig.2 Maximum Safe Operating Area

![Maximum Safe Operating Area](image2)

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

$P_W = 1\mu s$

$P_W = 10\mu s$

$P_W = 100\mu s$

$P_W = 1 ms$

$P_W = 10 ms$

$T_a = 25^\circ C$

Single Pulse

*Calculation ($P_W < 10 \mu s$)

Fig.3 Typical Transient Thermal Resistance vs. Pulse Width

![Typical Transient Thermal Resistance vs. Pulse Width](image3)

Transistor Thermal Resistance : $Z_{thJC} [K/W]$

$T_a = 25^\circ C$

Single Pulse

Pulse Width : $P_W [s]$
● Electrical characteristic curves

Fig. 4 Typical Output Characteristics (I)

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

Drain Current : $I_D$ [A]

- $V_{GS} = 8$V
- $T_a = 25^\circ$C
- Pulsed

Fig. 5 Typical Output Characteristics (II)

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

Drain Current : $I_D$ [A]

- $V_{GS} = 8$V
- $T_a = 25^\circ$C
- Pulsed

Fig. 6 $T_j = 25^\circ$C 3rd Quadrant Characteristics

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

Drain Current : $I_D$ [A]

- $T_a = 25^\circ$C
- Pulsed

- $V_{GS} = -4$V
- $V_{GS} = -2$V
- $V_{GS} = 0$V
- $V_{GS} = 18$V
● Electrical characteristic curves

Fig.7 $T_j = 150^\circ$C Typical Output Characteristics(I)

Fig.8 $T_j = 150^\circ$C Typical Output Characteristics(II)

Fig.9 $T_j = 150^\circ$C 3rd Quadrant Characteristics

Fig.10 Body Diode Forward Voltage vs. Gate - Source Voltage
Electrical characteristic curves

Fig. 11 Typical Transfer Characteristics (I)

Fig. 12 Typical Transfer Characteristics (II)

Fig. 13 Gate Threshold Voltage vs. Junction Temperature

Fig. 14 Transconductance vs. Drain Current
Electrical characteristic curves

**Fig. 15** Static Drain - Source On-State Resistance vs. Gate - Source Voltage

**Fig. 16** Static Drain - Source On-State Resistance vs. Junction Temperature

**Fig. 17** Static Drain - Source On-State Resistance vs. Drain Current

**Fig. 18** Normalized Drain - Source Breakdown Voltage vs. Junction Temperature

- **Gate - Source Voltage (V<sub>GS</sub>):** 8 to 22 V
- **Junction Temperature (T<sub>j</sub>):** -25°C to 250°C
- **Drain Current (I<sub>D</sub>):** -16A to 16A
- **Static Drain - Source On-State Resistance (R<sub>DS(on)</sub>):** 0.00 to 0.40 Ω
- **Normalized Drain - Source Breakdown Voltage:** 0.98 to 1.04
Electrical characteristic curves

**Fig. 19 Typical Capacitance vs. Drain - Source Voltage**

- Capacitance: \( C \) [pF]
- \( C_{\text{iss}} \)
- \( C_{\text{oss}} \)
- \( C_{\text{rss}} \)

**Fig. 20 \( C_{\text{oss}} \) Stored Energy**

- Drain - Source Voltage: \( V_{\text{DS}} \) [V]
- \( C_{\text{oss}} \) Stored Energy: \( E_{\text{oss}} \) [\( \mu \)J]

**Fig. 21 Dynamic Input Characteristics**

- Gate - Source Voltage: \( V_{\text{GS}} \) [V]
- Total Gate Charge: \( Q_{\text{g}} \) [nC]

*Gate Charge Waveform*

- \( T_a = 25^\circ \text{C} \)
- \( V_{\text{DD}} = 600 \text{V} \)
- \( I_{\text{p}} = 7.6 \text{A} \)
- Pulsed
Electrical characteristic curves

**Fig. 22 Typical Switching Time vs. External Gate Resistance**

- $T_a = 25°C$
- $V_{DD} = 600V$
- $V_{GS} = +18V/0V$
- $I_D = 7.6A$
- $L = 750μH$

**Fig. 23 Typical Switching Loss vs. Drain - Source Voltage**

- $T_a = 25°C$
- $I_D = 7.6A$
- $V_{GS} = +18V/0V$
- $R_G = 0Ω$
- $L = 750μH$

**Fig. 24 Typical Switching Loss vs. Drain Current**

- $T_a = 25°C$
- $V_{DD} = 600V$
- $V_{GS} = +18V/0V$
- $R_G = 0Ω$
- $L = 750μH$

**Fig. 25 Typical Switching Loss vs. External Gate Resistance**

- $T_a = 25°C$
- $I_D = 7.6A$
- $V_{DD} = 600V$
- $V_{GS} = +18V/0V$
- $L = 750μH$
**Measurement circuits and waveforms**

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

**Fig. 2-1 Switching Characteristics Measurement Circuit**

**Fig. 2-2 Waveforms for Switching Time**

**Fig. 2-3 Waveforms for Switching Energy Loss**

**Fig. 3-1 Reverse Recovery Time Measurement Circuit**

**Fig. 3-2 Reverse Recovery Waveform**

Mathematical equations:

\[ E_{on} = \int I_0 \cdot V_{DS} \, dt \]

\[ E_{off} = \int I_0 \cdot V_{DS} \, dt \]

\[ Q_r = \int I_l \, dt \]
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<td>RoHS</td>
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