SCH2080KE
N-channel SiC power MOSFET co-packaged with SiC-SBD

<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>1200</td>
<td>V</td>
</tr>
<tr>
<td>Continuous drain current</td>
<td>I_D</td>
<td>40</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>I_D'</td>
<td>28</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed drain current</td>
<td>I_D,pulse'</td>
<td>80</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 (T_{surge} &lt; 300nsec)</td>
<td>V_{GSS,surge}'</td>
<td>-10 to 26</td>
<td>V</td>
</tr>
<tr>
<td>Power dissipation (T_c = 25°C)</td>
<td>P_D</td>
<td>262</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>

**Outline**

- **V_DSS**: 1200V
- **R_{DS(on)} (Typ.)**: 80mΩ
- **I_D**: 40A
- **P_D**: 262W

**Features**

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

**Application**

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

**Inner circuit**

(1) Gate
(2) Drain
(3) Source

*1 Body Diode
*2 SBD

**Packaging specifications**

<table>
<thead>
<tr>
<th>Type</th>
<th>Packing</th>
<th>Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reel size (mm)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Tape width (mm)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Basic ordering unit (pcs)</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Packing code</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Marking</td>
<td>SCH2080KE</td>
<td></td>
</tr>
</tbody>
</table>

**Absolute maximum ratings (T_a = 25°C)**

- Drain - Source voltage
- Continuous drain current
- Pulsed drain current
- Gate - Source voltage (DC)
- Gate - Source surge voltage (T_{surge} < 300nsec)
- Power dissipation (T_c = 25°C)
- Junction temperature
- Range of storage temperature
### 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>0.44</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>$V_{(B\text{R})DSS}$</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>-</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_j = 25°C$</td>
<td>-</td>
<td>170</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>$V_{GS\ (th)}$</td>
<td>$V_{DS} = V_{GS}$, $I_D = 4.4mA$</td>
<td>1.6</td>
<td>2.8</td>
</tr>
</tbody>
</table>

*1 Limited only by maximum temperature allowed.

*2 PW ≤ 10μs, Duty cycle ≤ 1%

*3 Example of acceptable Vgs waveform

*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)}) (^*4)</td>
<td>(V_{GS} = 18V, I_D = 10A)&lt;br&gt;(T_J = 25^\circ C)&lt;br&gt;(T_J = 125^\circ C)</td>
<td>- 80 117</td>
<td>mΩ</td>
</tr>
<tr>
<td>Gate input resistance</td>
<td>(R_G)</td>
<td>(f = 1MHz, \text{open drain})</td>
<td>- 6.3  -</td>
<td>Ω</td>
</tr>
<tr>
<td>Transconductance</td>
<td>(g_{fs}) (^*4)</td>
<td>(V_{DS} = 10V, I_D = 10A)</td>
<td>- 3.7  -</td>
<td>S</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>(C_{iss})</td>
<td>(V_{GS} = 0V)</td>
<td>- 1850 -</td>
<td></td>
</tr>
<tr>
<td>Output capacitance</td>
<td>(C_{oss})</td>
<td>(V_{DS} = 800V)</td>
<td>- 175  -</td>
<td>pF</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>(C_{rss})</td>
<td>(f = 1MHz)</td>
<td>- 20   -</td>
<td></td>
</tr>
<tr>
<td>Turn - on delay time</td>
<td>(t_{d(on)}) (^*4)</td>
<td>(V_{DD} = 400V, V_{GS} = 18V)</td>
<td>- 37  -</td>
<td>ns</td>
</tr>
<tr>
<td>Rise time</td>
<td>(t_r) (^*4)</td>
<td>(I_D = 10A)</td>
<td>- 33   -</td>
<td></td>
</tr>
<tr>
<td>Turn - off delay time</td>
<td>(t_{d(off)}) (^*4)</td>
<td>(R_L = 40\Omega)</td>
<td>- 70   -</td>
<td></td>
</tr>
<tr>
<td>Fall time</td>
<td>(t_f) (^*4)</td>
<td>(R_G = 0\Omega)</td>
<td>- 28   -</td>
<td></td>
</tr>
<tr>
<td>Turn - on switching loss</td>
<td>(E_{on}) (^*4)</td>
<td>(V_{DD} = 600V, I_D=10A)&lt;br&gt;(V_{GS} = 18V/0V)&lt;br&gt;(R_G = 0\Omega, L=500\mu H)</td>
<td>- 218  -</td>
<td>μJ</td>
</tr>
<tr>
<td>Turn - off switching loss</td>
<td>(E_{off}) (^*4)</td>
<td>*(E_{on}) includes diode reverse recovery</td>
<td>- 64   -</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) (^*4)</td>
<td>(V_{DD} = 400V)</td>
<td>- 106  -</td>
<td>nC</td>
</tr>
<tr>
<td>Gate - Source charge</td>
<td>(Q_{gs}) (^*4)</td>
<td>(I_D = 10A)</td>
<td>- 27   -</td>
<td></td>
</tr>
<tr>
<td>Gate - Drain charge</td>
<td>(Q_{gd}) (^*4)</td>
<td>(V_{GS} = 18V)</td>
<td>- 31   -</td>
<td></td>
</tr>
<tr>
<td>Gate plateau voltage</td>
<td>(V_{(plateau)})</td>
<td>(V_{DD} = 400V, I_D = 10A)</td>
<td>- 9.7  -</td>
<td>V</td>
</tr>
</tbody>
</table>
### Internal 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>-</td>
<td>40 A</td>
</tr>
<tr>
<td>Inverse diode direct current, pulsed</td>
<td>$I_{SM}$</td>
<td></td>
<td>-</td>
<td>80 A</td>
</tr>
<tr>
<td>Forward voltage</td>
<td>$V_{SD}$</td>
<td>$V_{GS} = 0V, I_S = 10A$</td>
<td>1.3</td>
<td>V</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>$t_{rr}$</td>
<td></td>
<td>37</td>
<td>ns</td>
</tr>
<tr>
<td>Reverse recovery charge</td>
<td>$Q_{rr}$</td>
<td>$I_F = 10A, V_R = 400V$</td>
<td>60</td>
<td>nC</td>
</tr>
<tr>
<td>Peak reverse recovery current</td>
<td>$I_{rrm}$</td>
<td>$di/dt = 150A/\mu s$</td>
<td>2.4</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>0.078</td>
<td>K/W</td>
</tr>
<tr>
<td>$R_{th2}$</td>
<td>0.197</td>
<td></td>
</tr>
<tr>
<td>$R_{th3}$</td>
<td>0.162</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>0.005</td>
<td>Ws/K</td>
</tr>
<tr>
<td>$C_{th2}$</td>
<td>0.018</td>
<td></td>
</tr>
<tr>
<td>$C_{th3}$</td>
<td>0.249</td>
<td></td>
</tr>
</tbody>
</table>
Electrical characteristic curves

Fig. 1 Power Dissipation Derating Curve

Fig. 2 Maximum Safe Operating Area

Fig. 3 Typical Transient Thermal Resistance vs. Pulse Width
●Electrical characteristic curves

**Fig.4 Typical Output Characteristics(I)**

Drain Current : \( I_D \) [A]  
Drain - Source Voltage : \( V_{DS} \) [V]  

- \( V_{GS} = 20V \)  
- \( V_{GS} = 18V \)  
- \( V_{GS} = 16V \)  
- \( V_{GS} = 14V \)  
- \( V_{GS} = 12V \)  
- \( V_{GS} = 10V \)  

\( T_a = 25^\circ C \)  
Pulsed

**Fig.5 Typical Output Characteristics(II)**

Drain Current : \( I_D \) [A]  
Drain - Source Voltage : \( V_{DS} \) [V]  

- \( V_{GS} = 20V \)  
- \( V_{GS} = 18V \)  
- \( V_{GS} = 16V \)  
- \( V_{GS} = 14V \)  
- \( V_{GS} = 12V \)  
- \( V_{GS} = 10V \)  

\( T_a = 25^\circ C \)  
Pulsed

**Fig.6 Typical Output Characteristics(I)**

Drain Current : \( I_D \) [A]  
Drain - Source Voltage : \( V_{DS} \) [V]  

- \( V_{GS} = 20V \)  
- \( V_{GS} = 18V \)  
- \( V_{GS} = 16V \)  
- \( V_{GS} = 14V \)  
- \( V_{GS} = 12V \)  
- \( V_{GS} = 10V \)  

\( T_a = 150^\circ C \)  
Pulsed

**Fig.7 Typical Output Characteristics(II)**

Drain Current : \( I_D \) [A]  
Drain - Source Voltage : \( V_{DS} \) [V]  

- \( V_{GS} = 20V \)  
- \( V_{GS} = 18V \)  
- \( V_{GS} = 16V \)  
- \( V_{GS} = 14V \)  
- \( V_{GS} = 12V \)  
- \( V_{GS} = 10V \)  

\( T_a = 150^\circ C \)  
Pulsed
- Electrical characteristic curves

Fig. 8 Typical Transfer Characteristics

Fig. 9 Typical Transfer Characteristics (II)

Fig. 10 Gate Threshold Voltage vs. Junction Temperature

Fig. 11 Transconductance vs. Drain Current

- Transconductance vs. Drain Current
Electrical characteristic curves

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

![Graph showing the static drain-source on-state resistance vs. gate-source voltage.](image)

- **Gate - Source Voltage**: \( V_{GS} \) [V]
- **Static Drain - Source On-State Resistance**: \( R_{DS(on)} \) [Ω]
- **Junction Temperature**: \( T_j \) [ºC]
- **Drain Current**: \( I_D \) [A]
- **VGS = 18V Pulsed**

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

![Graph showing the static drain-source on-state resistance vs. junction temperature.](image)

- **Junction Temperature**: \( T_j \) [ºC]
- **Static Drain - Source On-State Resistance**: \( R_{DS(on)} \) [Ω]
- **I_D = 10A, 20A**

**Fig. 14 Static Drain - Source On - State Resistance vs. Drain Current**

![Graph showing the static drain-source on-state resistance vs. drain current.](image)

- **Drain Current**: \( I_D \) [A]
- **Static Drain - Source On-State Resistance**: \( R_{DS(on)} \) [Ω]
- **VGS = 18V Pulsed**
- **T_a = -25ºC, 25ºC, 75ºC, 150ºC**
**Electrical characteristic curves**

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

Capacitance: $C$ [pF] vs. Drain - Source Voltage: $V_{DS}$ [V]

- $T_a = 25^\circ C$
- $f = 1$ MHz
- $V_{GS} = 0$ V

**Fig.16 Coss Stored Energy**

Coss Stored Energy: $E_{oss}$ [uJ] vs. Drain - Source Voltage: $V_{DS}$ [V]

- $T_a = 25^\circ C$

**Fig.17 Switching Characteristics**

Switching Time: $t$ [ns] vs. Drain Current: $I_D$ [A]

- $T_a = 25^\circ C$
- $V_{DD} = 400$ V
- $V_{GS} = 18$ V
- $R_G = 0$ Ω
- Pulsed

**Fig.18 Dynamic Input Characteristics**

Gate - Source Voltage: $V_{GS}$ [V] vs. Total Gate Charge: $Q_g$ [nC]

- $T_a = 25^\circ C$
- $V_{DD} = 400$ V
- $I_D = 10$ A
- Pulsed
Electrical characteristic curves

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

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

Switching Energy: $E [\mu J]$ vs. Drain - Source Voltage: $V_{DS} [V]$

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

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

Switching Energy: $E [\mu J]$ vs. External Gate Resistance: $R_G [\Omega]$
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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