1200V SiC COPACK Power Module

Features

- High speed switching SiC MOSFETs
- Freewheeling diode with zero reverse recovery SiC SBDs
- Simple to drive
- Kelvin reference for stable operation

Benefits

- Low switching losses
- Low junction to case thermal resistance
- Very rugged and easy mount
- Direct mounting to heatsink (isolated package)

Applications

- Photovoltaic Inverter
- Battery charger
- Server power supplies
- Energy storage system

Absolute Maximum Ratings

<table>
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<tr>
<th>Characteristics</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Drain-Source Voltage</td>
<td>$V_{\text{rated}}$</td>
<td>$V_{GS}=0V, I_D=20\mu A$</td>
<td>1200</td>
<td>V</td>
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<tr>
<td>Continuous Drain Current</td>
<td>$I_{\text{DS}}$</td>
<td>$T_C=25^\circ C, V_{GS}=20V$</td>
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<td>A</td>
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<tr>
<td></td>
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<td>$T_C=100^\circ C, V_{GS}=20V$</td>
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<tr>
<td>Schottky Diode DC Current</td>
<td>$I_F$</td>
<td>$T_C=25^\circ C, V_{GS}=5V$</td>
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<td>Pulsed Drain Current</td>
<td>$I_{\text{DS,pulse}}$</td>
<td>$T_C=25^\circ C, V_{GS}=20V$</td>
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<td>Gate Source Voltage</td>
<td>$V_{GS\text{max}}$</td>
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<td>V</td>
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<td></td>
<td>$V_{GS\text{op}}$</td>
<td>Recommended operational</td>
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<td>Power Dissipation - MOSFET</td>
<td>$P_{\text{tot}}$</td>
<td>$T_C=25^\circ C$</td>
<td>142</td>
<td>W</td>
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<td>Operating &amp; Storage Temperature</td>
<td>$T_{J, \text{storage}}$</td>
<td>Continuous</td>
<td>-55...175</td>
<td>°C</td>
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*R_{DS} maximum continuous current for parallel SBD and MOSFET body diode assuming maximum R_{TJ} of SBD
# 1200V SiC COPACK Power Module

**GCMS080B120S1-E1**

**Static Electrical Characteristics**, at $T_J=25\degree C$, unless otherwise specified

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<td>$BV_{DSS}$</td>
<td>$V_{GS}=0V$, $I_D=1mA$</td>
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<td>Zero Gate Voltage Drain Current</td>
<td>$I_{DSS}$</td>
<td>$V_{DS}=1200V$, $V_{GS}=0V$</td>
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<td>$V_{DS}=1200V$, $V_{GS}=0V$, $T_J=175\degree C$</td>
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<td>Gate-Source Leakage Current</td>
<td>$I_{GS}$</td>
<td>$V_{GS}=20V$, $V_{DS}=0V$</td>
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<td>nA</td>
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<td></td>
<td>$I_{GSs}$</td>
<td>$V_{GS}=-5V$, $V_{DS}=0V$</td>
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<td></td>
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<td>Gate Threshold Voltage</td>
<td>$V_{GS(h)}$</td>
<td>$V_{GS}=V_{DS}$, $I_D=10mA$</td>
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<td>V</td>
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<td>$V_{GS}=V_{DS}$, $I_D=10mA$, $T_J=175\degree C$</td>
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<tr>
<td>Drain-Source On-Resistance</td>
<td>$R_{DS(on)}$</td>
<td>$V_{GS}=20V$, $I_D=20A$</td>
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<td>mΩ</td>
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<td>$V_{GS}=20V$, $I_D=10A$</td>
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<td>$V_{GS}=20V$, $I_D=20A$, $T_J=125\degree C$</td>
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<td></td>
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<td>$V_{GS}=20V$, $I_D=20A$, $T_J=175\degree C$</td>
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<td>Transconductance</td>
<td>$g_s$</td>
<td>$V_{DS}=20V$, $I_D=20A$</td>
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<td>S</td>
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<tr>
<td>Internal Gate Resistance</td>
<td>$R_{G(int)}$</td>
<td>$f=1MHz$, $V_{AC}=25mV$, D-S Short</td>
<td>3.1</td>
<td>Ω</td>
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**AC Electrical Characteristics**, at $T_J=25\degree C$, unless otherwise specified

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<th>Values</th>
<th>Unit</th>
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<tr>
<td>Input Capacitance</td>
<td>$C_{GS}$</td>
<td>$V_{GS}=0V$</td>
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<td>pF</td>
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<tr>
<td>Output Capacitance</td>
<td>$C_{GS}$</td>
<td>$V_{GS}=1000V$</td>
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<td></td>
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<tr>
<td>Reverse Transfer Capacitance</td>
<td>$C_{RSS}$</td>
<td>$f=200kHz$</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Coss Stored Energy</td>
<td>$E_{OSS}$</td>
<td>$V_{AC}=25mV$</td>
<td>-</td>
<td>µJ</td>
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<tr>
<td>Turn-On Switching Energy</td>
<td>$E_{ON}$</td>
<td>$f=1MHz$, $V_{AC}=25mV$, D-S Short</td>
<td>183</td>
<td></td>
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<tr>
<td>Turn-Off Switching Energy</td>
<td>$E_{OFF}$</td>
<td>$V_{GS}=800V$, $I_{DS}=20A$, $R_{G(ext)}=2.5\Omega$, $f=1MHz$, $V_{AC}=25mV$</td>
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<td>µJ</td>
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<tr>
<td>Turn-On Delay Time</td>
<td>$t_{on}$</td>
<td>$V_{GS}=5/+20V$, $L=975\mu H$, $FWD=GCMS080A120S1-E1$</td>
<td>9</td>
<td>ns</td>
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<tr>
<td>Rise Time</td>
<td>$t_r$</td>
<td>$V_{GS}=-5/+20V$, $I_D=10A$, $T_J=175\degree C$</td>
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<tr>
<td>Turn-Off Delay Time</td>
<td>$t_{off}$</td>
<td>$V_{GS}=-5/+20V$, $I_D=10A$, $T_J=175\degree C$</td>
<td>16</td>
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<td>Fall Time</td>
<td>$t_f$</td>
<td>$V_{GS}=-5/+20V$, $I_D=10A$, $T_J=175\degree C$</td>
<td>14</td>
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<tr>
<td>Total Gate Charge</td>
<td>$Q_G$</td>
<td>$V_{GS}=800V$, $I_{DS}=20A$</td>
<td>-</td>
<td>nC</td>
</tr>
<tr>
<td>Gate to Source Charge</td>
<td>$Q_{GS}$</td>
<td>$V_{GS}=-5/20V$</td>
<td>-</td>
<td></td>
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<tr>
<td>Gate to Drain Charge</td>
<td>$Q_{GD}$</td>
<td>$V_{GS}=-5/20V$</td>
<td>-</td>
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* $C_{OSS}$ is combination of MOSFET $C_{oss}$ and diode junction capacitance

**Freewheeling Diode Characteristics**, at $T_J=25\degree C$, unless otherwise specified

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
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<tr>
<td>Diode Forward Voltage</td>
<td>$V_{SD}$</td>
<td>$V_{GS}=-5V$, $I_S=10A$</td>
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<td>V</td>
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<tr>
<td></td>
<td></td>
<td>$V_{GS}=-5V$, $I_S=10A$, $T_J=175\degree C$</td>
<td>1.50</td>
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<tr>
<td>Reverse Recovery Time</td>
<td>$t_{RR}$</td>
<td>$I_S=20A$, $V_R=800V$, $V_{GS}=-5V$</td>
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<td>ns</td>
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<tr>
<td>Reverse Recovery Charge</td>
<td>$Q_{RR}$</td>
<td>$dI/dt=8.7A/\mu s$</td>
<td>-</td>
<td>nC</td>
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<tr>
<td>Peak Reverse Recovery Current</td>
<td>$I_{RRM}$</td>
<td>$dI/dt=8.7A/\mu s$, $V_{GS}=-5V$</td>
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<td>A</td>
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<tr>
<td>Reverse Recovery Energy</td>
<td>$E_{RR}$</td>
<td>$dI/dt=8.7A/\mu s$, $V_{GS}=-5V$</td>
<td>-</td>
<td>µJ</td>
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Thermal and Package Characteristics, at $T_J=25\,^\circ\text{C}$, unless otherwise specified

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<th>Values</th>
<th>Unit</th>
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<tr>
<td>Thermal resistance, junction-case</td>
<td>$R_{\text{thJC}}$</td>
<td>MOSFET only</td>
<td>- 0.83 1.06</td>
<td>°C/W</td>
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<tr>
<td>Thermal resistance, junction-case</td>
<td>$R_{\text{thJC}}$</td>
<td>Schottky diode only</td>
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<td>Mounting torque</td>
<td>$M_d$</td>
<td>M4-0.7 screws</td>
<td>1.1 - 1.5</td>
<td>N-m</td>
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<tr>
<td>Terminal connection torque</td>
<td>$M_d$</td>
<td>M4-0.7 screws</td>
<td>- 1.1 1.3</td>
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<td>Package weight</td>
<td>$W_i$</td>
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<td>- 32</td>
<td>g</td>
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<td>Isolation voltage</td>
<td>$V_{\text{ISOL}}$</td>
<td>$I_{\text{ISOL}} &lt; 1\text{mA}$, 50/60 Hz, 1 min</td>
<td>2500</td>
<td>V</td>
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Typical Performance

![Figure 1. Output Characteristics $T_J = -55^\circ\text{C}$](image1)

![Figure 2. Output Characteristics $T_J = 25^\circ\text{C}$](image2)
Figure 3. Output Characteristics $T_J = 175^\circ$C

Figure 4. Normalized On-Resistance vs. Temperature

Figure 5. On-Resistance vs. Drain Current For Various Temperature

Figure 6. On-Resistance vs. Temperature For Various Gate Voltages
Figure 7. Transfer Characteristic for Various Junction Temperatures

Figure 8. Freewheeling Diode Characteristics at $T_J = -55^\circ C$

Figure 9. Freewheeling Diode Characteristics at $T_J = 25^\circ C$

Figure 10. Freewheeling Diode Characteristics at $T_J = 175^\circ C$
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Figure 11. $I_{DSS}$ vs. Temperature

Figure 12. $I_{DSS}$ vs. Temperature

Figure 13. Threshold Voltage vs. Temperature

Figure 14. Gate Charge Characteristics
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Figure 15. Output Capacitor Stored Energy

Figure 16. Capacitance vs Drain-Source Voltage

Figure 17. Continuous Drain Current Derating vs. Case Temperature

Figure 18. Maximum Power Dissipation Derating vs Case Temperature
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Figure 19. Transient Thermal impedance (Junction to Case)

Figure 20. Safe Operating Area

Figure 21. Clamped Inductive Switching Energy vs. Drain Current

Figure 22. Clamped Inductive Switching Energy vs. $R_{G(\text{ext})}$
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Figure 23. Clamped Inductive Switching Energy vs. Temperature

Figure 24. Switching Times vs. $R_{\text{G(\text{ext})}}$

Figure 25. Switching Times vs. Drain Current

Figure 26. $dv/dt$ and $di/dt$ vs. Drain Current
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Figure 27. dv/dt and di/dt vs. $R_{G(\text{ext})}$

Figure 28. Turn-off Transient Definitions

Figure 29. Turn-on Transient Definitions

Figure 30. Reverse Recovery Definitions
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Package Dimensions SOT-227

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<th>Sym</th>
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<td>D</td>
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<td>U</td>
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### **Notes**

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The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/EC (RoHS2), as implemented March, 2013. RoHS Declarations for this product can be obtained from the Product Documentation sections of www.SemiQ.com.

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### Revision History

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