SiC MOSFET

The real breakthrough in high-voltage switching

Based on the advanced and innovative properties of wide bandgap materials, ST’s silicon carbide (SiC) MOSFETs feature very low $R_{DS(on)}$ per area, with the new SCT*N65G2 650 V product family and the SCT*N120G2 1200 V product family in development, combined with excellent switching performance, reserve efficient and compact designs. These new families feature the industry’s highest temperature rating of 200 °C for improved thermal design of power electronics systems.

**KEY FEATURES**
- Very low switching losses
- Low power losses at high temperatures
- Higher operating temperature (up to 200 °C)
- Body diode with no recovery losses
- Easy to drive

**KEY BENEFITS**
- Smaller form factor and higher power density
- Reduced size/cost of passive components
- Higher system efficiency
- Reduced cooling requirements and heatsink size

**KEY APPLICATIONS**
- Traction inverter
- EV charge station
- Photovoltaics
- Factory automation
- Motor drive
- Data center power supply
- OBC & DC/DC converter

Silicon Carbide: The Enabling Technology for higher power density in Industrial and Automotive application

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SIC MOSFET VERSUS SILICON TRANSISTOR

Table 1 compares the new ST’s second generation 650 V, 55 mΩ SCTH35N65G2V-7 SiC MOSFET with a trench field-stop (TFS) IGBT of the same voltage rating and equivalent on-state resistance. The SiC MOSFET exhibits significantly reduced switching losses, even at high temperatures. This enables designers to operate at very high switching frequencies, reducing the size of passive components for smaller form factors. In addition, for the SiC MOSFET the variation of \( E_{\text{ON}} \) and \( E_{\text{OFF}} \) with temperature is very small. As an example, the \( E_{\text{OFF}} \) of the SiC MOSFET remains basically unchanged as the temperature rises from 25 °C to 175 °C, while the \( E_{\text{OFF}} \) of the IGBT increases by the 89%. Even the change in resistance as the temperature rises is very low and lower than the competition, as shown in Figure 1.

Table 1: Switching loss comparison

<table>
<thead>
<tr>
<th>Device</th>
<th>( V_{\text{on}} ) typ. (V) @ 25 °C, 20 A</th>
<th>( V_{\text{on}} ) typ. (V) @ 175 °C, 20 A</th>
<th>( E_{\text{on}} ) typ. (µJ) @ 20 A, 400 V</th>
<th>( E_{\text{off}} ) typ. (µJ) @ 20 A, 400 V</th>
<th>( E_{\text{tot}} ) rise with temperature</th>
<th>Die size (Normalized)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCTH35N65G2V-7</td>
<td>1.1</td>
<td>1.48</td>
<td>100 / 100</td>
<td>35 / 35</td>
<td>negligible variation vs. Temperature</td>
<td>0.53</td>
</tr>
<tr>
<td>30 A,650 V TFS IGBT</td>
<td>1.45</td>
<td>1.55</td>
<td>240 / 450</td>
<td>205 / 390</td>
<td>+89% from 25 °C to 175 °C</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note: \( V_{\text{on}} \) measured @ \( V_{\text{GS-SiC}}=18 \) V, \( V_{\text{GE-IGBT}}=15 \) V - \( E_{\text{on}} \) includes the reverse recovery of the diode

Figure 1. normalized on-state resistance vs temperature

Device summary

<table>
<thead>
<tr>
<th>Commercial Product</th>
<th>( V_{\text{DSS}} ) (V)</th>
<th>( I_{\text{D}} ) max (A)</th>
<th>( R_{\text{D(on)}} ) Typ (Ω) @ ( V_{\text{gs}} = 18 ) V</th>
<th>( T_{\text{j max}} ) (°C)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCTH35N65G2V-7</td>
<td>650</td>
<td>45</td>
<td>0.055</td>
<td>175</td>
<td>H2PAK-7</td>
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<tr>
<td>SCTH35N65G2V-7AG</td>
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<td></td>
<td></td>
<td></td>
<td>HIP247</td>
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<td>SCTW35N65G2V</td>
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<tr>
<td>SCTH90N65G2V-7</td>
<td>116</td>
<td>119</td>
<td>0.018</td>
<td>175</td>
<td>H2PAK-7</td>
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<tr>
<td>SCTW90N65G2V</td>
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<td></td>
<td>200</td>
<td>HIP247</td>
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<tr>
<td>SCTH100N65G2-7AG</td>
<td>95</td>
<td>100</td>
<td>0.020</td>
<td>175</td>
<td>H2PAK-7</td>
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<tr>
<td>SCTW100N65G2AG</td>
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<td></td>
<td></td>
<td>200</td>
<td>HIP247</td>
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