NEW PRODUCT OVERVIEW
UF3SC
Industry’s lowest $R_{DS(on)}$ SiC FETs

December 9, 2019

UnitedSiC
Introducing the First SiC FETs with RDS(on) < 10mΩ
Delivers Increased Efficiency, Lower Losses
Growth markets demanding more efficiency, performance

- Efficiency characteristics of SiC-based power devices deliver clear cost and performance benefits vs. Si
  - 70-90% lower energy losses based on superior resistance characteristics
  - Improved heat dissipation
  - Withstand higher temperatures
  - Enables higher integration

Source: Goldman Sachs SiC Report, 11/18
Expanding our SiC product portfolio

- Co-packaged high-performance Gen3 SiC JFETs with cascode-optimized Si MOSFET
- Only standard gate drive SiC device in the market today

- 650V and 1200V
- Ultra low RDS(on) – 7mohm to 150mohm
- Excellent reverse recovery
- Excellent body diode performance (Vf<2V)
- Drive with any Si and/or SiC gate drive voltage
- Superior thermal performance
- ESD protection
- T (max op) = 175°C
New UF3SC SiC FETs: Industry’s lowest $R_{DS(on)}$ devices

<table>
<thead>
<tr>
<th>Device</th>
<th>Package</th>
<th>$V_{DS(MAX)}$ (V)</th>
<th>$I_D(100C)$ (A)</th>
<th>$R_{THJC}(max)$ (mΩ)</th>
<th>$R_{DS(ON)}(25C)$ (mΩ)</th>
<th>$R_{DS(ON)}(125C)$ (mΩ)</th>
<th>$R_{DS(ON)}(175C)$ (mΩ)</th>
<th>$C_{OSS(ER)}$ (pF)</th>
<th>$E_{ON}$ (mJ)</th>
<th>$E_{OFF}$ (mJ)</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>UF3SC120009K4S</td>
<td>TO247-4L</td>
<td>1200</td>
<td>120</td>
<td>0.19</td>
<td>13.3</td>
<td>18.2</td>
<td>24.8</td>
<td>395</td>
<td>3.5</td>
<td>0.7</td>
<td>100A, 800V HB 150C</td>
</tr>
<tr>
<td>UF3SC120016K4S</td>
<td>TO247-4L</td>
<td>1200</td>
<td>77</td>
<td>0.29</td>
<td>24.8</td>
<td>33</td>
<td>243</td>
<td>2.82</td>
<td>0.15</td>
<td>80A, 800V HB 150C</td>
<td></td>
</tr>
<tr>
<td>UF3SC120016K3S</td>
<td>TO247-3L</td>
<td>1200</td>
<td>77</td>
<td>0.29</td>
<td>16</td>
<td>24.8</td>
<td>33</td>
<td>243</td>
<td>3.35</td>
<td>0.67</td>
<td>80A, 800V** HB 150C</td>
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<tr>
<td>UF3SC065007K4S</td>
<td>TO247-4L</td>
<td>650</td>
<td>120</td>
<td>0.19</td>
<td>8.7</td>
<td>11</td>
<td>856</td>
<td>1.08</td>
<td>0.1</td>
<td>80A, 400V HB 150C</td>
<td></td>
</tr>
</tbody>
</table>

*Includes a 5ohm, 680pF snubber loss

Well suited for inverters, high powered DC-DC converters, and circuit protection applications
UF3SC SiC FETs: Key features

- 650V & 1200V
- Lowest on-resistance devices
  - 7mohm, 9mohm for 650V, 1200V respectively
- Industry standard TO247 packages
- Low thermal resistance (Ag sintered)
- Drop in compatible with Si IGBTs, Si MOSFETs and SiC MOSFET gate drive voltages
- Excellent paralleling behavior
- Uses advanced stack cascode technology

UnitedSiC
Industry’s lowest $R_{DS(on)}$

Source: website published SiC datasheets 11/19
Easy, direct drop-in functionality

- Simple upgrade from Si IGBTs, Si FETs, SiC MOSFETs or Si superjunction devices
- No change in gate drive voltage
UF3SC benefits in high-powered EV inverters

- Next gen power modules possible
- Can be built at significantly reduced cost with paralleled TO247-4L devices
- Switching frequencies to >20kHz
- Versus 4-8kHz for high powered IGBTs

- Less losses
- Loss estimates for inverters designs
- For 8kHz, 200KW operation, losses are reduced nearly 3X using 6x paralleled SiC FETs per switch
- Inverter efficiencies >99%
- Even while switching at 2X the frequency of IGBTs

<table>
<thead>
<tr>
<th>Voltage Class</th>
<th>Device Type</th>
<th>Chips/Switch</th>
<th>Bus Voltage</th>
<th>Frequency</th>
<th>Loss Type</th>
<th>Power Output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IGBT+Diode</td>
<td>100A X4 each</td>
<td>800V</td>
<td>8kHz</td>
<td>P_conduction (W)</td>
<td>100KW</td>
</tr>
<tr>
<td>1200</td>
<td>SiC FET</td>
<td>UF3SC120009K4S X 4</td>
<td>800V</td>
<td>8kHz</td>
<td>P_conduction (W)</td>
<td>100KW</td>
</tr>
<tr>
<td>1800</td>
<td>SiC FET</td>
<td>UF3SC120009K4S X 6</td>
<td>800V</td>
<td>8kHz</td>
<td>P_conduction (W)</td>
<td>100KW</td>
</tr>
<tr>
<td>2400</td>
<td>SiC FET</td>
<td>UF3SC120009K4S X 4</td>
<td>800V</td>
<td>8kHz</td>
<td>P_conduction (W)</td>
<td>100KW</td>
</tr>
</tbody>
</table>
UF3SC benefits in high-current battery chargers

- For lower battery voltage systems
  - UF3SC65007K4S delivers higher efficiencies vs. IGBT based systems
- For 100A operating current with 50% duty cycle, conduction loss when using:
  - JBS diode may be nearly 100W (2V drop @125C) at operating temperatures
  - UF3SC065007K4S using synchronous rectification, dissipates only 45W (0.9V drop @125C)
- As a synchronous rectifier to replace the secondary side diodes
  - Dramatically cut total losses and heat burden
- Excellent choice for bi-directional designs
UF3SC benefits in solid-state circuit breaker

- Ultra-low conduction loss simplifies design and cooling
  - Solid state circuit breakers
  - Battery disconnect switches in EVs.
- Excellent paralleling behavior
  - Allows scaling to much higher current applications where modules are traditionally required
  - Cost effective

![Diagram showing current and voltage over time](image)

**Ability to safely turn-off very high currents**

UnitedSiC-New_1685-21716-0003-E-0120
High performance through parallelism

2mohm, 1200V in SOT227

6 die in parallel
Loss evaluation for a 60KVA Solar inverter with 800V DC link at 3 operating frequencies for a 2-level, NPC and TNPC topology

- 2-Level: 1X UF3SC120009K4S per switch, i.e. 2/phase. (6 devices total)
- TNPC: 2X UF3Sc120009K4S and 2X UF3SC075007K4S per phase. (12 devices total)
- NPC: 4X UF3SC065007K4S per phase (12 devices total)

This power level is usually accomplished with power modules, but can now be done with UnitedSiC discrete devices.
Sales information

• Part numbers
  • UF3SC120009K4S
  • UF3SC120016K4S
  • UF3SC120016K3S
  • UF3SC065007K4S

• Leadtime
  • Samples: now
  • Production: 2Q’20

• Sales Tools
  • Product selector guide
  • Technical blogs & articles
UF3SC – Industry’s lowest $R_{DS(on)}$ SiC FETs

- Directly addresses fast growing markets
- Delivers better performance, efficiency, reliability, cost effectiveness
- Based on UnitedSiC advance SiC technology

UnitedSiC
Delivering industry-transforming levels of power efficiency
We are here for you. Addresses and Contacts.

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