650-V MOSFETs Expand SiC Benefits To Broader Range Of Industrial Applications

Cree has expanded its product portfolio with the release of the Wolfspeed 650-V SiC MOSFETs, delivering SiC benefits to a wider range of industrial applications and enabling the next generation of electric vehicle (EV) onboard charging, data centers, and other renewable systems with industry-leading power efficiency, according to the company.

"Our new 650-V MOSFET family is the next step in delivering a high-powered solution to a broader application base, including industrial applications everywhere," said Cengiz Balkas, senior vice president and general manager of Wolfspeed. "The 650-V MOSFETs deliver power efficiencies that help today's biggest technology leaders create the next generation of onboard EV charging, data centers, and energy storage solutions to reshape our cloud and renewable energy infrastructures."

The new 15-mΩ and 60-mΩ 650-V devices, which use Cree's third-generation C3M MOSFET technology, are said to deliver up to 20% lower switching losses than competing silicon carbide MOSFETs and to provide the lowest on-state resistances for higher efficiency and power dense solutions. End users benefit from lower total cost of ownership in a variety of applications through the more efficient use of power, reduced cooling requirements, and industry-leading reliability.

Compared to silicon, these 650-V silicon carbide MOSFETs deliver 75% lower switching losses and a 50% percent decrease in conduction losses which results in a potential 300% increase in power density. According to Cree, design engineers can now meet and exceed the industry's most ambitious efficiency standards, including 80 Plus Titanium requirements for server power.

The new devices—C3M0015065D, C3M0015065K, C3M0060065D, C3M0060065J, and C3M0060065K—are qualified for operation over a wide temperature range of –40°C to 175°C and are available in through-hole (TO-247-3, TO-247-4) and surface-mount (TO-263-7) packages.

According to the vendor, these MOSFETs offer the industry's lowest on-state resistances in a discrete package over the entire operating temperature range, with the 60-mΩ MOSFETs specified for an $R_{DS(ON)}$ of just 80 mΩ at 175°C.

The ultra-low reverse-recovery charge (Q_{rr}) of the devices, with the 60-mΩ MOSFET offering Q_{rr} of 62 nC, reduces switching losses and enables higher switching frequencies that will reduce the size and weight of the transformers, inductors, capacitors, and other passive components in the system.

To combat the concern of device capacitance as another component that increases switching losses as switching frequency increases, Wolfspeed has achieved much lower device capacitances. For example, the small-signal output capacitance C_{oss} is just 80 pF for the 60-mΩ models and 289 pF for the 15-mΩ models. For a summary of key device specifications see the table.

The 650-V MOSFET family is also well suited for on-board chargers (OBCs) in EVs. The increased efficiencies and faster switching allow customers to design smaller solutions with added performance. Wolfspeed's 650-V SiC MOSFETs also enable bi-directionality in OBCs without compromising the size, weight and complexity of the solution (see the figure). Furthermore, Wolfspeed's experience with automotive AEC-Q101 qualification, proven in the E-series MOSFET family, paves the way for future automotive-qualified 650-V MOSFETs. Other industrial applications, such as general-purpose switched mode power supplies, will also be able to take advantage of the many benefits of the 650-V SiC MOSFETs.

Wolfspeed's 650-V SiC MOSFETs are available now in surface mount and through-hole packages. For more information on these 3rd generation SiC MOSFETs, see "Save on BOM Costs with New C3M 650V MOSFET" or "Announcing the Wolfspeed 650V Series of SiC MOSFETs.

Table. Key specifications for the of the C3M 650-V SiC MOSFETs.

	C3M0015065D	C3M0015065K	C3M0060065D	C3M0060065K	C3M0060065J
Drain-to-source voltage (V_{DS})	650 V				
Current-continuous drain (I_D) at 25°C	120 A		37 A		36 A
Drive voltage V_{GS}	15 V				
$R_{DS(ON)}$	21 mΩ		79 mΩ		
Power dissipation (max)	416 W (Tc)		136 W (Tc)		

Figure. Cree offers a demo board and a reference design for a 6.6-kW bidirectional converter using its 650-V, 60-mΩ (C3M) SiC MOSFETs. This design targets high efficiency and high power density on-board charging applications. The demo board consist of a bidirectional totem-pole PFC (ac-dc) stage and an isolated bidirectional dc-dc stage based on a CLLC topology with quasi-constant dc link voltage.