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SiC Power MOSFET Technology Is Tailored For EV Traction Inverters

STMicroelectronics' fourth-generation STPOWER silicon carbide (SiC) MOSFET technology brings new benchmarks in power efficiency, power density and robustness, according to the vendor. While serving the needs of both the automotive and industrial markets, the technology is particularly optimized for traction inverters in electric vehicle (EV) powertrains. The company plans to introduce further advanced SiC technology innovations through 2027 as a commitment to innovation.

"STMicroelectronics is committed to driving the future of electric mobility and industrial efficiency through our cutting-edge silicon carbide technology. We continue to advance SiC MOSFET technology with innovations in the device, advanced packages, and power modules," said Marco Cassis, president, Analog, Power & Discrete, MEMS and Sensors Group. "Together with our vertically integrated manufacturing strategy, we are delivering industry leading SiC technology performance and a resilient supply chain to meet the growing needs of our customers and contribute to a more sustainable future."

According to the vendor, the Generation 4 SiC MOSFETs feature a significantly lower on-resistance ($R_{DS(ON)}$) measured against prior generations, minimizing conduction losses, and enhancing overall system efficiency. They also are said to offer faster switching speeds, which translate to lower switching losses, crucial for high-frequency applications and enabling more compact and efficient power converters. Additionally, the Generation 4 technology provides extra robustness in dynamic reverse bias (DRB) conditions, exceeding the AQG324 automotive standard, ensuring reliable operation under harsh conditions.

With Generation 4 ST continues to deliver outstanding $R_{DS(ON)}$ x die-area figure of merit to ensure high current-handling capability with minimal losses. The average die size of Generation 4 devices is 12 to 15% smaller than that of Generation 3, considering an $R_{DS(ON)}$ at 25°C, allowing for more compact power converter designs, saving valuable space, and reducing system costs. The improved power density of these devices supports the development of more compact and efficient power converters and inverters, essential for both automotive and industrial applications. In addition, this is particularly beneficial for power supply units in server datacenters for AI, where space and efficiency are critical factors.

This latest generation of SiC devices is conceived to benefit future EV traction inverter platforms, with further advances in size and energy-saving potential. While the EV market continues to grow, challenges remain to achieve widespread adoption and car makers are looking to deliver more affordable electric cars.

800-V EV bus drive systems based on SiC have enabled faster charging and reduced EV weight, allowing car makers to produce vehicles with longer driving ranges for premium models. According to ST, its new SiC MOSFET devices, which will be made available in 750-V and 1200-V classes, will improve energy efficiency and performance of both 400-V and 800-V EV bus traction inverters, bringing the advantages of SiC to mid-size and compact EVs—key segments to help achieve mass market adoption.

The new-generation SiC technology is also suitable for a variety of high-power industrial applications, including motor drives, solar inverters, energy storage solutions and power supplies for server datacenters, significantly improving energy efficiency for these growing applications.

ST has completed qualification of the 750-V class of the fourth-generation SiC technology platform and expects to complete qualification of the 1200-V class in the first quarter of 2025 (see the figure). Commercial availability of devices with nominal voltage ratings of 750-V and 1200-V will follow, allowing designers to address applications operating from standard ac-line voltages up to high-voltage EV batteries and chargers.

To accelerate the development of SiC power devices through its vertically integrated manufacturing strategy, ST is developing multiple SiC technology innovations in parallel to advance power device technologies over the next three years. The fifth generation of ST SiC power devices will feature an innovative high-power density technology based on planar structure. ST is at the same time developing a radical innovation that it says promises outstanding on-resistance $R_{DS(ON)}$ value at high temperatures and further $R_{DS(ON)}$ reduction, compared to existing SiC technologies.

For further information about ST's SiC portfolio, please visit www.st.com/sic-mosfets.

Figure. STMicroelectronics' 4th-gen SiC MOSFETs, described as smaller, more-efficient products, will ramp-up in volumes through 2025 across 750-V and 1200-V classes, bringing the advantages of silicon carbide beyond premium electric vehicle (EV) models to mid-size and compact EVs.