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As All-SiC Module Emerges, GaN Powers Server Supplies

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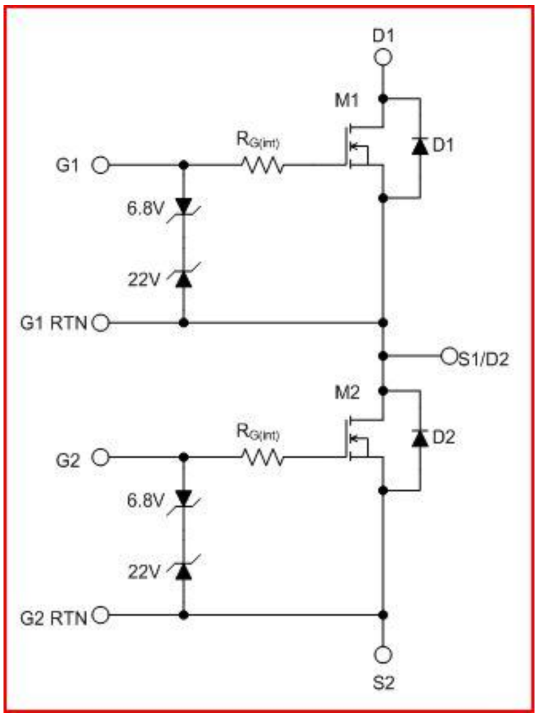
The long talked about all-silicon-carbide (SiC) module is finally here. This month at Electronica in Munich, Germany, Cree unwrapped a 1200-V, 100-A all-SiC module, the CAS100H12AM1, which is qualified and certified for commercial production.

As shown in Fig.1, the module includes SiC MOSFETs and SiC Schottky diodes in a 50-mm half-bridge configuration rated to a 150°C maximum junction temperature. In this module, M1 and M2 each comprise five 1200-V, 80-mΩ Z-FET MOSFETs (CPMF-1200-S080B.) Since each SiC transistor comes with a parallel SiC Schottky diode, five Schottkys rated at 1200 V, 10 A (CPW2-1200-S010B) make D1. Similarly five diodes are used to make D2. The all-SiC components are assembled in a rugged module design, which incorporates an AlSiC baseplate and direct bonded copper (DBC) substrate, as depicted in Fig. 1.



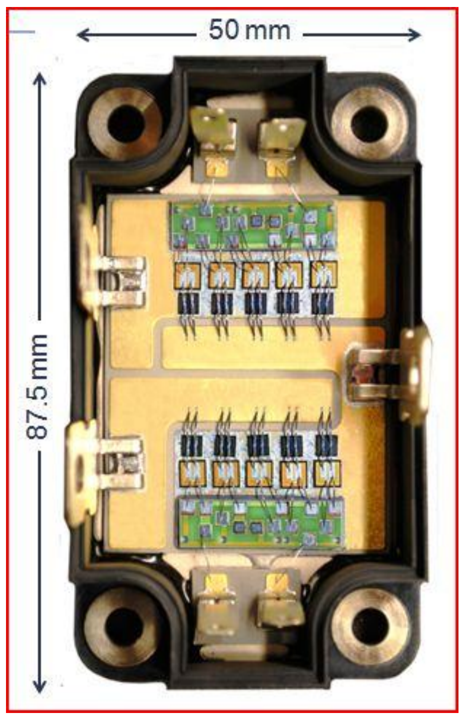


Fig. 1. This half-bridge power configuration uses only SiC MOSFETs and diodes for the power devices. The rugged module incorporates five 1200-V, 80-mΩ Z-FET MOSFETs in parallel for the high-side transistor and five such devices for the low side. Similarly, diodes D1 and D2 each use five 1200-V, 10-A Schottky diodes.

Although, the SiC components enable the module to operate at very high switching frequencies, in order to reduce size, weight and cost of the power conversion system, the all-SiC power module was demonstrated at a 100-kHz switching frequency, according to Cree. Other key features include zero turn-off current from the MOSFET, zero reverse current from the Schottky diode, and an easy-to-drive MOS gate.

In testing the CAS100H12AM1 module with collaborators at North Carolina State University, Cree said that the all-SiC module achieved 97% efficiency at a 20-kHz switching frequency and 35-kVA power output. Target applications include high power converters, industrial motor drives, solar inverters and uninterruptible power supplies (UPS).

Mrinal Das, marketing manager for Cree's Power and RF products, stated, "the 1200-V, 100-A dual module extends our existing discrete MOSFET and diode products into higher power applications." He added, "The efficient switching characteristics of an all-SiC module should allow system designers to meet customer demands for reduced size, weight and cost of the end system, while reducing global energy consumption."

In fact, one early customer is Alstom Belgium Transport. Although no details were given on the power converter using this SiC module, Alstom's innovation and research engineer Fisal Al-Kayal stated, "it enables us to meet our transit customer's demands for reduced size and weight of auxiliary power converters, while meeting efficiency and cost targets."

Also, at Electronica, Fairchild Semiconductor released its first family of SiC-based 1200-V bipolar junction transistors with current ratings of 50-A and 15-A in a plastic TO-247 package for 175°C operation. In addition, the company is also planning to introduce 20-A and 6-A 1200-V BJTs in a hermetic TO-258 package for 250°C operation. To enable development of complete SiC solutions, Fairchild has also developed "plug-n-play" discrete driver boards for 50-A and 15-A BJTs (Fig. 2.) The company roadmap indicates that Fairchild is planning to convert this complete BJT driver board into an IC, which the company expects to release in late 2013. In addition, using its BJTs and drivers, the chip maker has also created reference designs to meet specific application needs of the designers.

Fig. 2. This discrete SiC BJT driver board from Fairchild Semiconductor is a plug-and-play solution.

Similarly, Microsemi introduced a new family of 1200-V SiC-based Schottky diodes for a wide range of industrial applications. The diodes are being offered in TO-247 and D3 packages. Microsemi claims it is the only manufacturer to offer a SiC Schottky diode in a large surface-mount backside-solderable D3 package, allowing designers to achieve increased power density and lower manufacturing costs.

Members of Microsemi's 1200-V SiC Schottky diode portfolio include the following models:

- APT10SCD120BCT (a 10-A, common-cathode dual device in a TO-247),
- APT20SCD120B (a 20-A device in a TO-247),
- APT30SCD120B (a 30-A device in a TO-247),
- APT20SCD120S (a 20-A device in a D3) and
- APT30SCD120S (a 30-A device in a D3).

GaN-Powered Converter

Meanwhile, on the gallium nitride (GaN) front, Fujitsu Semiconductor claims to have readied a power-factor-corrected 2.5-kW server power-supply using its gallium-nitride on silicon (GaN-on-Si) power devices. Fujitsu said that its GaN-on-Si based power devices were demonstrated for the first time at the Embedded Technology 2012 Conference and Exhibition (Nov. 14-16), Pacifico Yokohama Convention Center in Japan. Although, no details on the GaN power devices as well as the power supply unit were provided, Fujitsu said that the supply's efficiency was over 90% from light load to full load (Fig. 3.) According to the manufacturer, volume production of the GaN power devices will start by the second half of 2013.

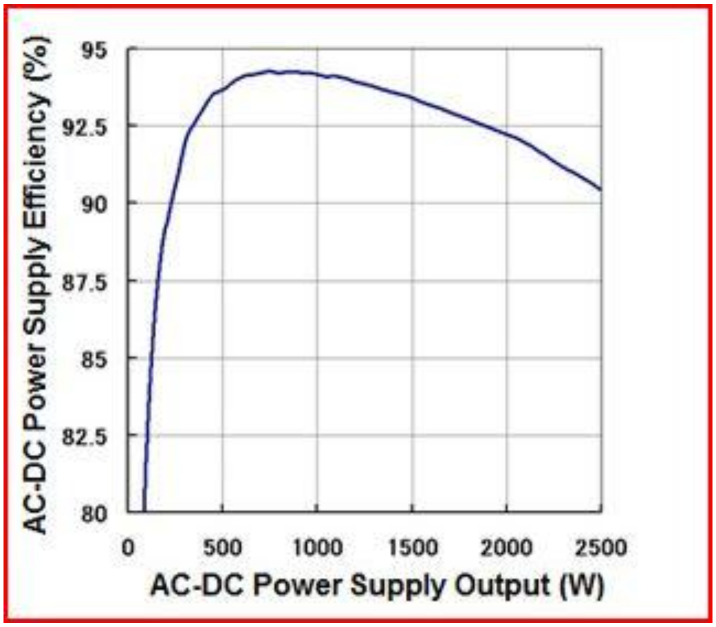


Fig. 3. Measured efficiency versus output power performance for server supply using Fujitsu Semiconducor's GaN-on-Si power devices.

Fujitsu began working on GaN devices in 2009. In collaboration with Fujitsu Laboratories, it has optimized the performance of its GaN-on-Si based power devices. Furthermore, Fujitsu started sampling these devices to key power supply customers in 2011. Since then, the company has been working closely with partners to optimize the use of its GaN-on-Si devices in power supply units.

According to Fujitsu Semiconductor, the company has established a mass-production line for 6-inch wafers at its Aizu-Wakamatsu plant, and will begin full-scale production of GaN power devices in the second half of 2013.

About The Author

Ashok Bindra is a veteran writer and editor with more than 25 years of editorial experience covering RF/wireless technologies, semiconductors and power electronics. He has written, both for print and the web, for leading electronics trade publications in the U.S, including Electronics, EETimes, Electronic Design and RF Design. Presently, he has his own technical writing company called Technika through which he does writing projects for different trade publications and vendors. Prior to becoming an editor, Bindra worked in industry as an electronics engineer. He holds an M.S. degree from the Department of Electrical and Computer Engineering, Clarkson College of Technology (now Clarkson University) in Potsdam, NY, and an M.Sc (Physics) from the University of Bombay, India. He can be reached by email at bindra1[at]verizon.net.