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The Progression of Silicon Carbide Power Devices Under The Army's High Voltage Power Technology Program

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Recent advances in silicon carbide (SiC) device process, fabrication, design, and packaging have made possible the development of single die, high voltage Insulated-Gate Bipolar Transistors (IGBTs) and Junction Barrier Schottky (JBS) diodes with avalanche breakdown voltages up to 27 kV and 15 kV, respectively [1-2]. SiC power semiconductor devices fabricated on wide epitaxial drift regions [160 μm -230 μm] are desirable for many pulsed-power and continuous low-duty cycle power conversion systems, as they offer an advantage in critical electric field and thermal conductivity over conventional silicon devices.

In collaboration with Wolfspeed (a Cree company) and Texas Tech University, the Army Research Laboratory (ARL) is evaluating the performance of these state-of-the-art devices for their possible use in survivability and lethality systems, power modulators, and micro-grids. The aim of this work is to present the current progress in the development of R&D-grade, >20-kV, 20 A 4H-SiC IGBTs and 10-15 kV, 17 A JBS diodes. This paper expands on previous work reported on similar devices [3-4], with an emphasis on pushing for higher power, voltage operation, and reliability.

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3. M. Hinojosa, H. O'Brien, E. Van Brunt, A. Ogunniyi and C. Scozzie, "Solid-state Marx generator with 24 kV 4H-SIC IGBTs", 2015 IEEE Pulsed Power Conference (PPC), Austin, TX, 2015, pp. 1-5.
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