Virginia Tech, NREL, Wolfspeed — Academic Member

Project Title: Prototyping and Evaluation of High-Speed 10 kV SiC MOSFET Power Modules with High Scalability and System-Integration Solutions

Objectives: To evaluate the **scalability**, **system integration**, and **reliability** of a wire-bond-less 10 kV silicon carbide MOSFET power module.

Task No. BP5-3.20 (MIP2)
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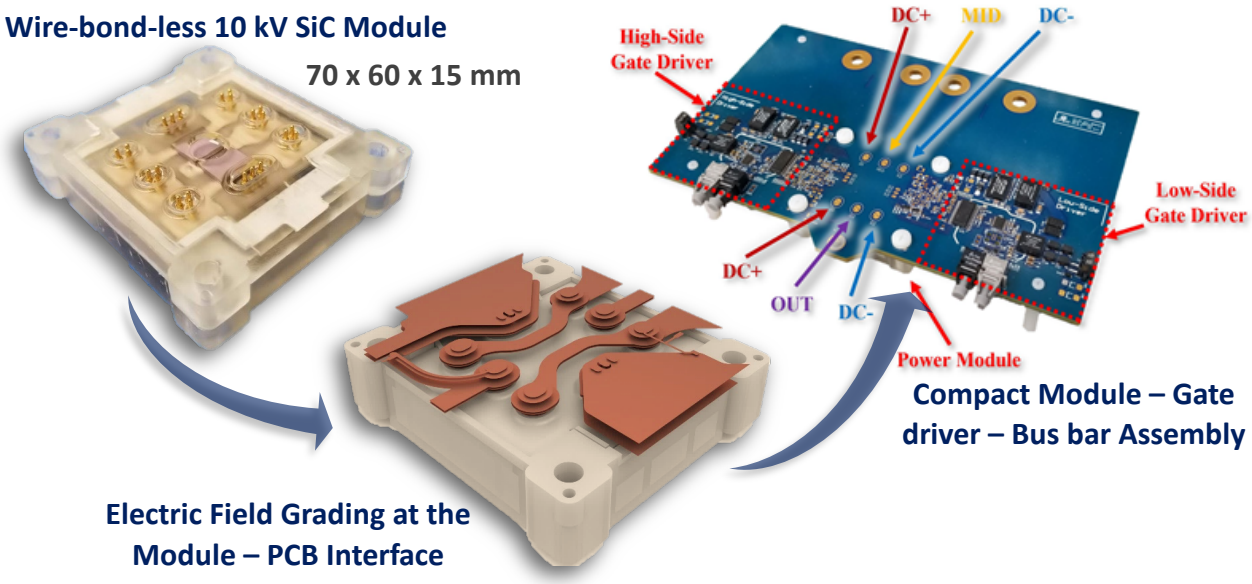

WBG Technology Impact

1. Higher **power density**, faster **switching**, increased **efficiency**, and improved **reliability** compared to 6.5 kV Si IGBT modules.
2. Applications: medium-voltage drives, MVDC naval platforms, large-scale wind and solar, and advanced distribution systems
3. Timeframe for commercialization: 2022 – 2024
4. **10x** higher power density than 6.5 kV Si IGBT modules by eliminating wire bonds, avoiding creepage requirements, and grading the electric fields internal and external to the module; **8x** lower switching loss than 6.5 kV Si IGBT.

Accomplishments/Outcomes

- **Prototyping modules** with 10 kV SiC MOSFETs.
- **Sintering DBA substrates** for reliability evaluation.
- Designed and tested a **gate driver and bus bar PCB** with a partial discharge inception voltage (PDIV) exceeding **11 kV rms**.
- Designed and tested a **PCB–module assembly** with a PDIV exceeding **10 kV rms**.
- Assembled testbed for switching the 10 kV SiC MOSFET modules.
- Verified gate driver up to **2.8 kV** and **85 V/ns** with 4 kV silicon IGBT, and 2 kV with SiC MOSFET module prototype.