

DESIGN AND DEVELOPMENT OF A LOW COST, MANUFACTURABLE HIGH VOLTAGE POWER MODULE FOR ENERGY STORAGE SYSTEM

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Arkansas Power Electronics International (APEI), Inc.

Brandon Passmore (PI), Zach Cole, Jennifer Stabach, Greg Falling, John Garrett, Peter Killeen, and Chad O'Neal

DOE Energy Storage Program – Phase II SBIR

BACKGROUND

Objective

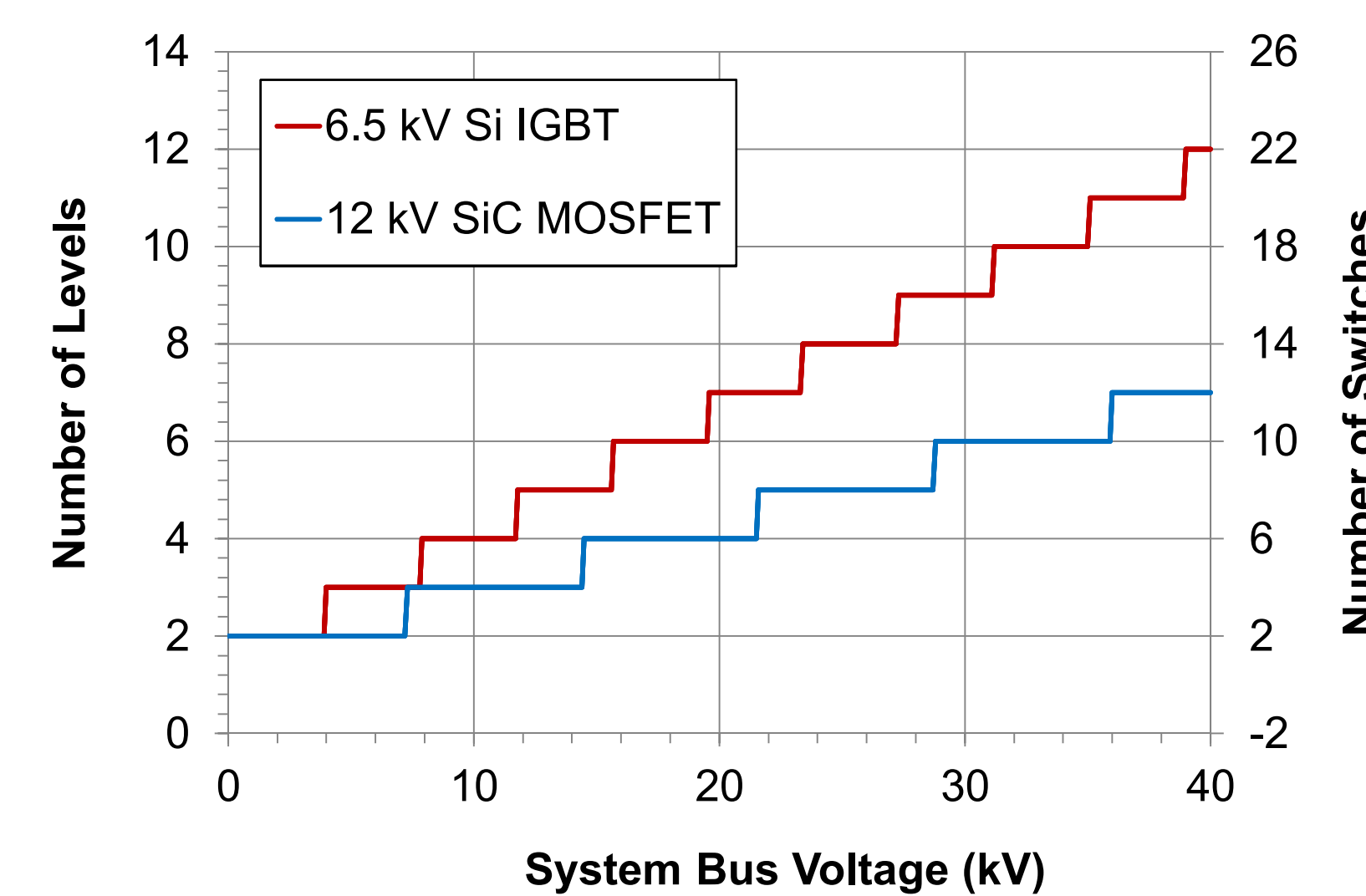
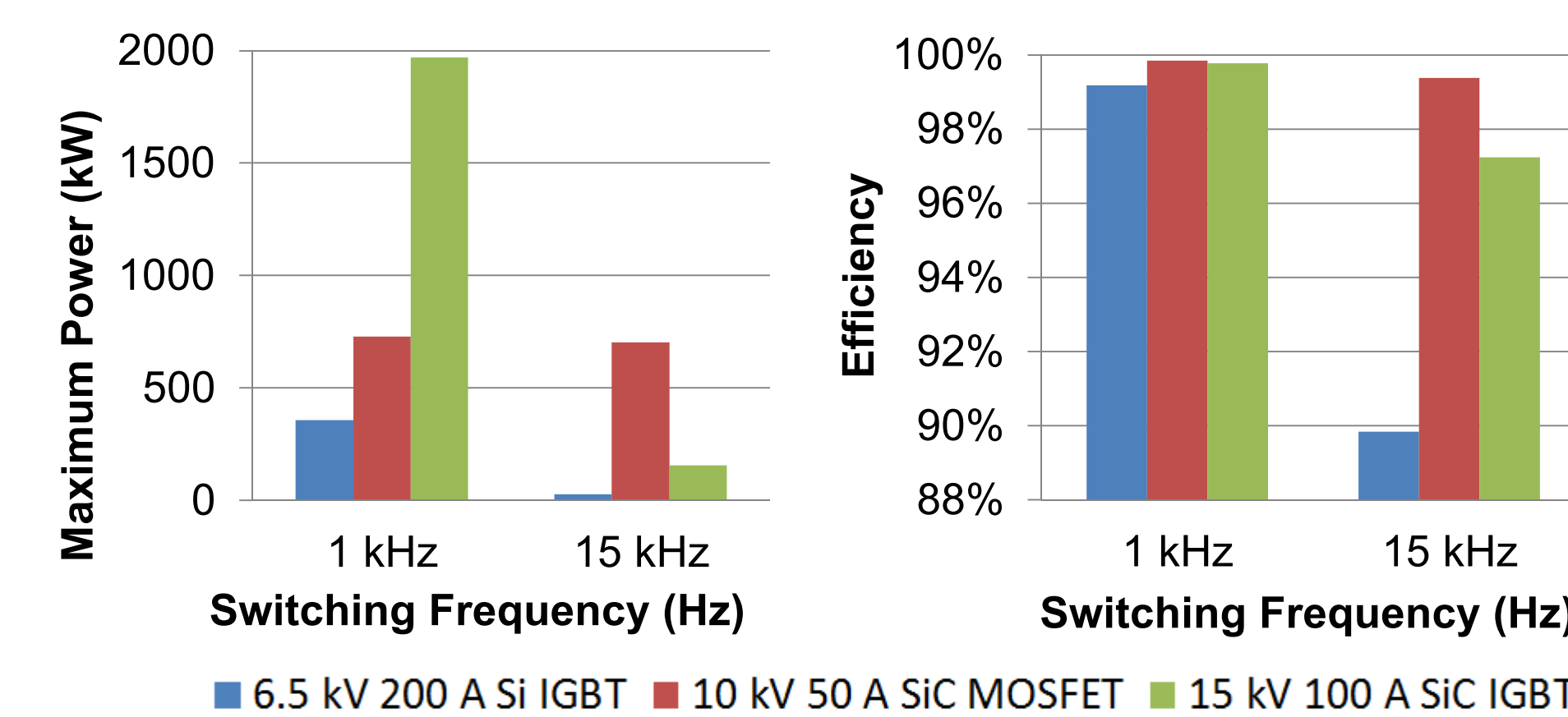
Develop a high voltage (> 15kV) silicon carbide (SiC) power module to aid in the emergence of smarter, seamless powered grids.

Applications

- Energy storage systems
- Solid-state transformers
- Naval power distribution
- Electric locomotives
- Solid-state circuit breakers

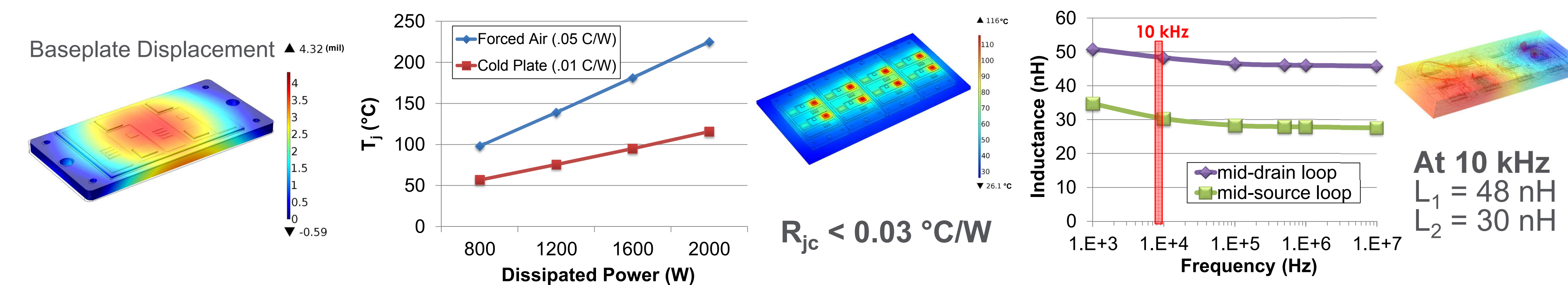
Advantages

- Reduce size/complexity compared to multi-level system
- Eliminate cooling systems
- Increase efficiency and power density

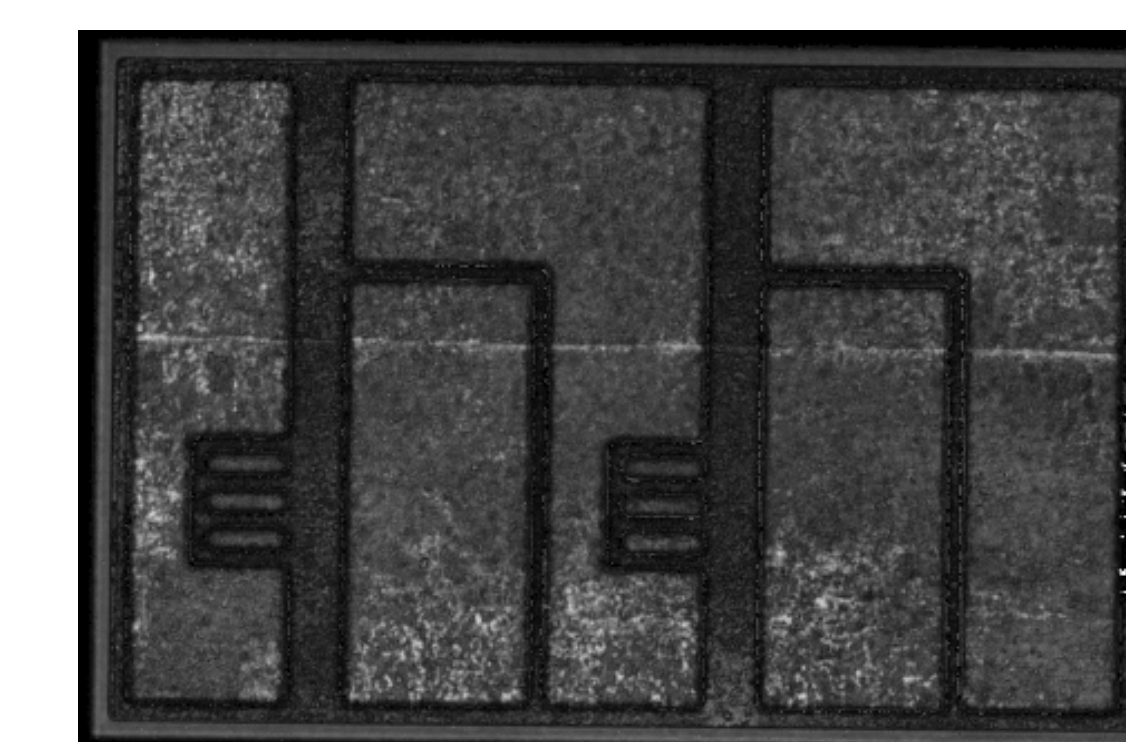


RESULTS

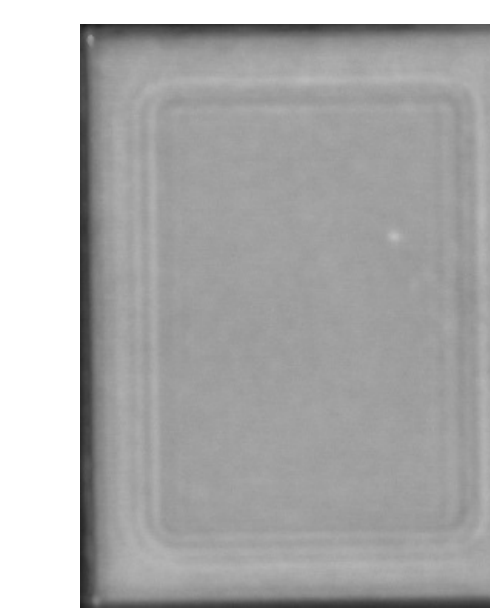
Thermal, Electrical, Mechanical Simulations



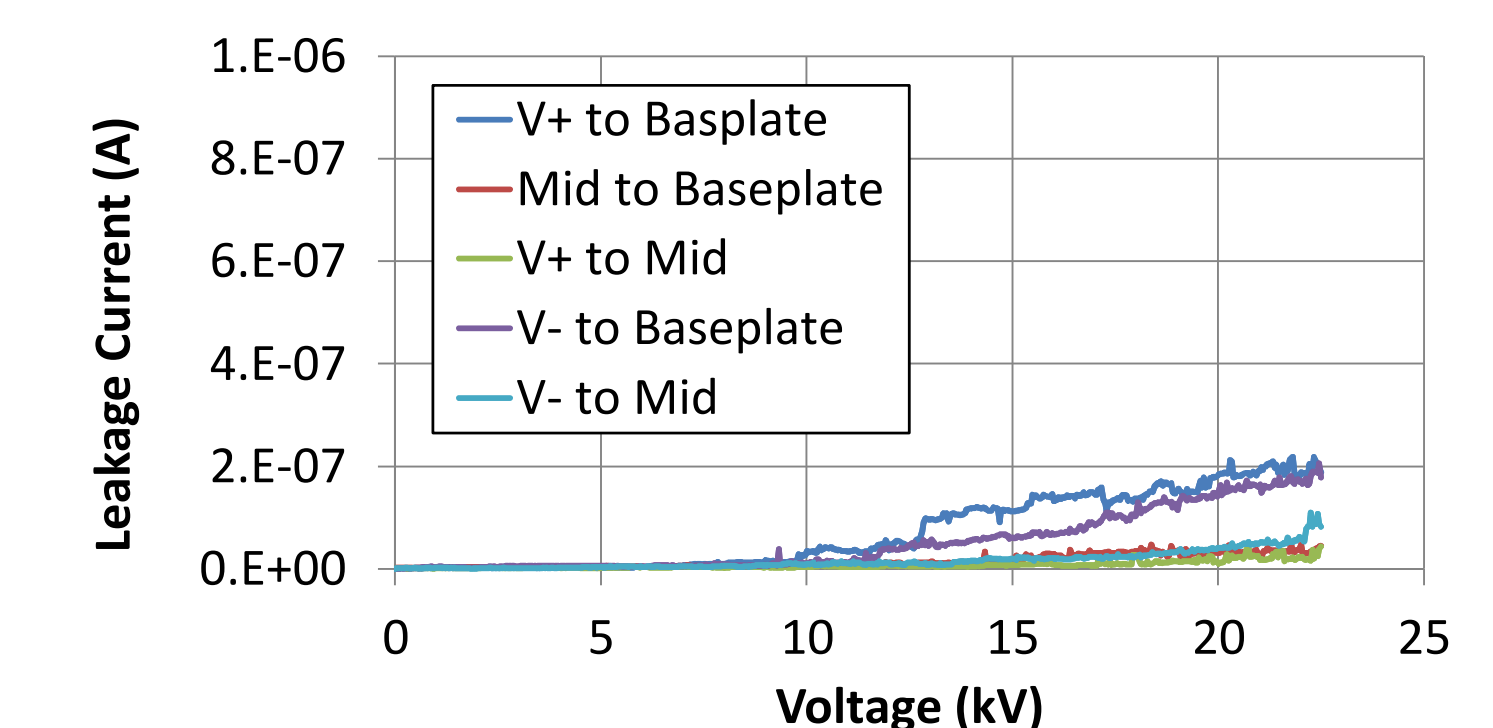
Power Module Assembly Development



Low void power substrate attach (< 5 % voids)



Low void Ag sinter die attach



Low leakage current up to 22.5 kV

APPROACH

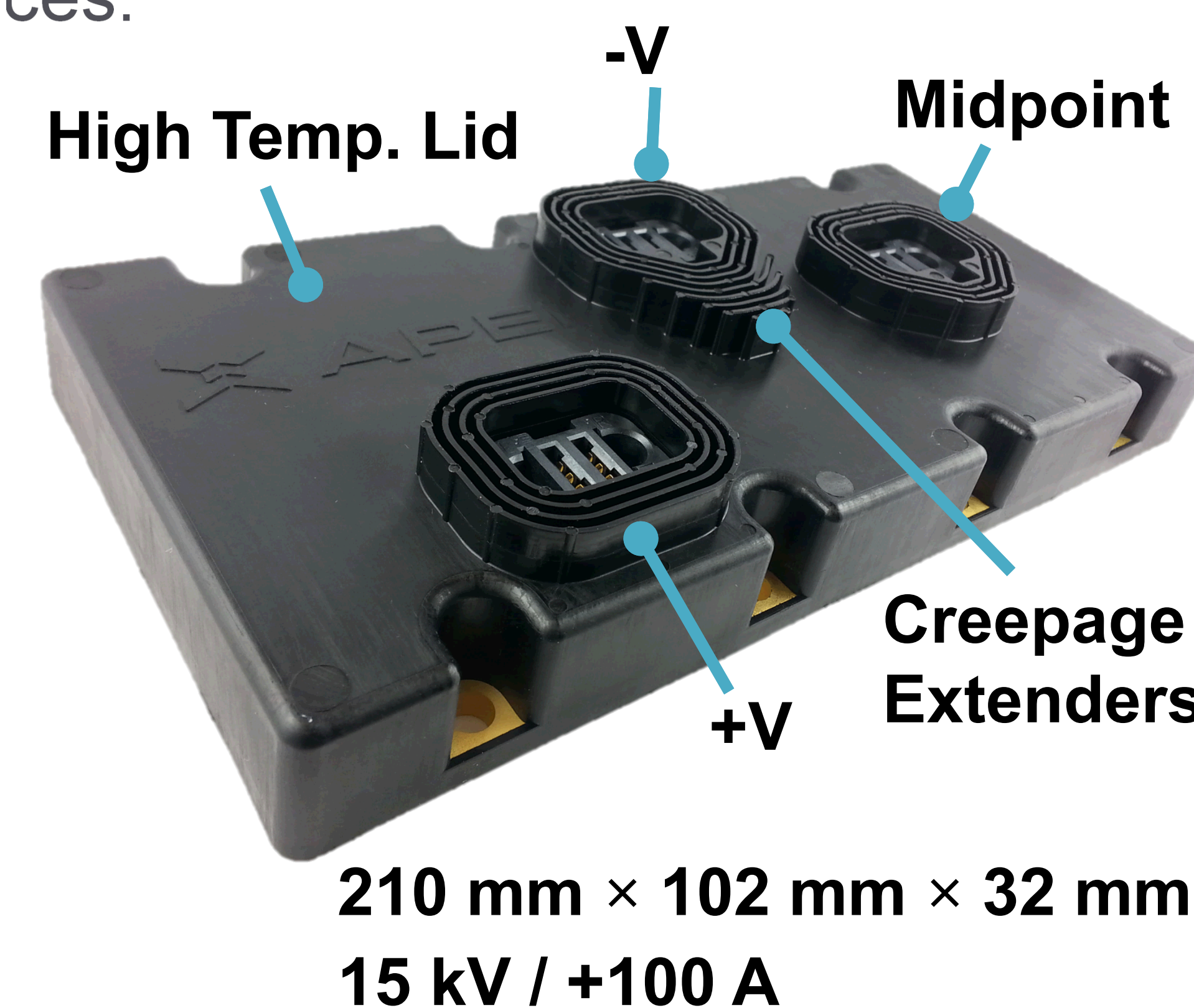
Design a high performance power module that will take full advantage of the superior properties of high voltage SiC devices.

Advantages of SiC Devices

- High breakdown voltage
- High thermal conductivity
- High switching frequency
- High temperature operation

Power Module Features

- Device neutral
- Low profile
- Reduced volume/weight
- High temperature capable (200 °C)



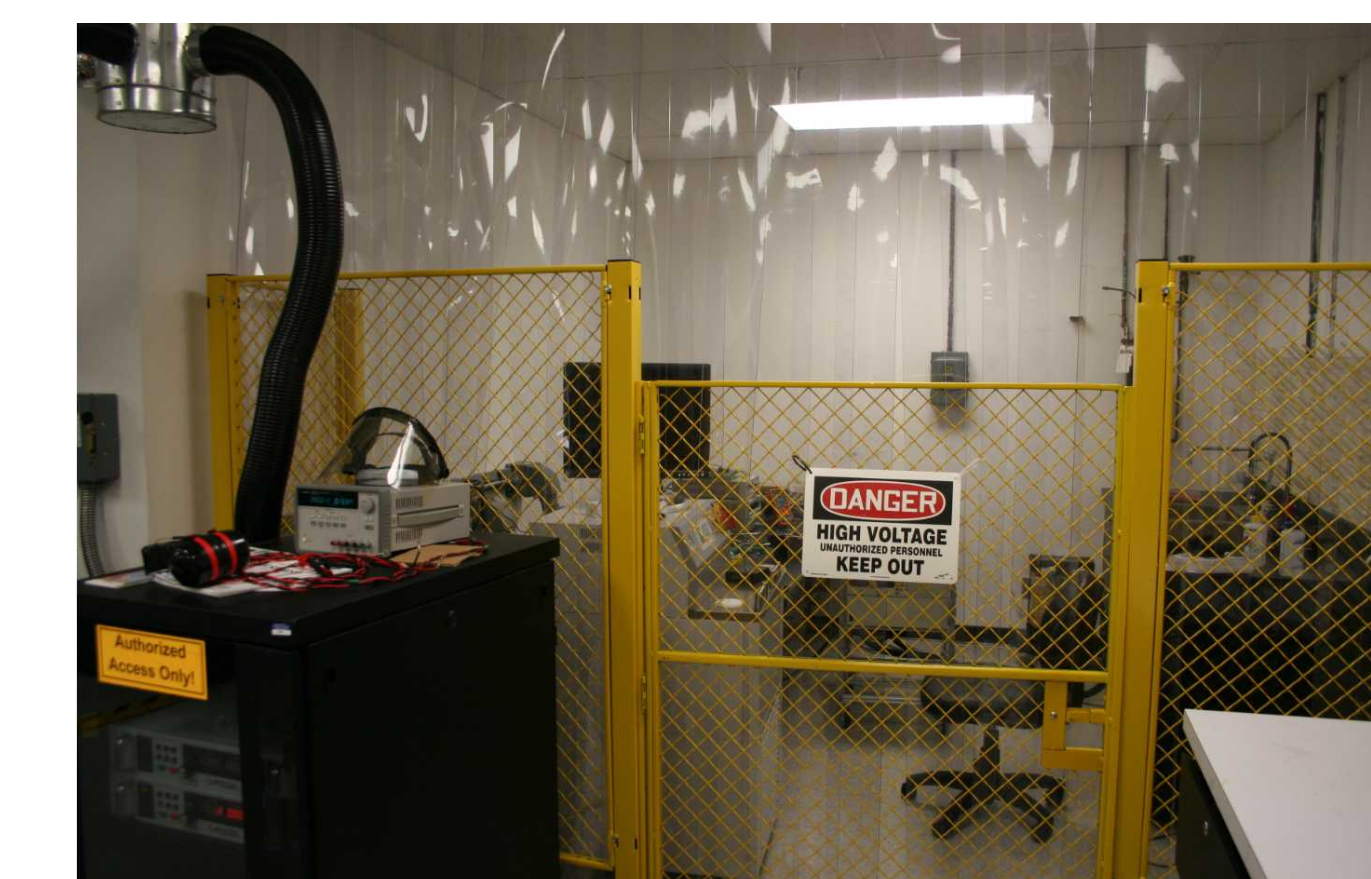
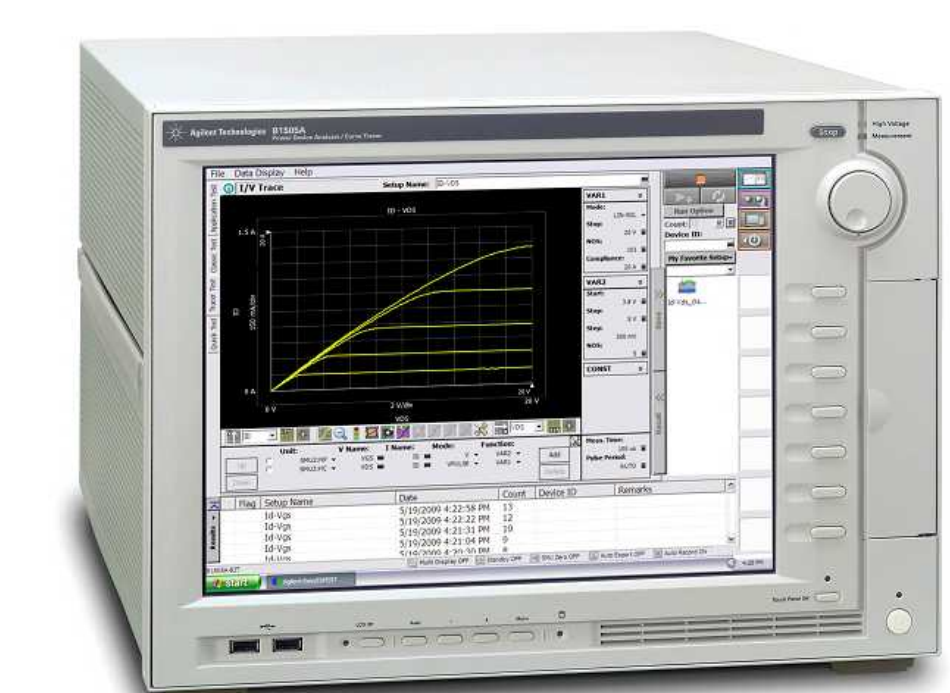
FUTURE WORK

Power Module Static Testing

- Gate leakage
- Reverse leakage
- On-state curves
- On resistance
- Transconductance

Power Module Dynamic Testing

- Turn-on and -off delay time
- Rise and fall time
- Turn-on and -off over voltage
- Switching loss



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