

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

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

SAND2014-17586D

BACKGROUND

Objective

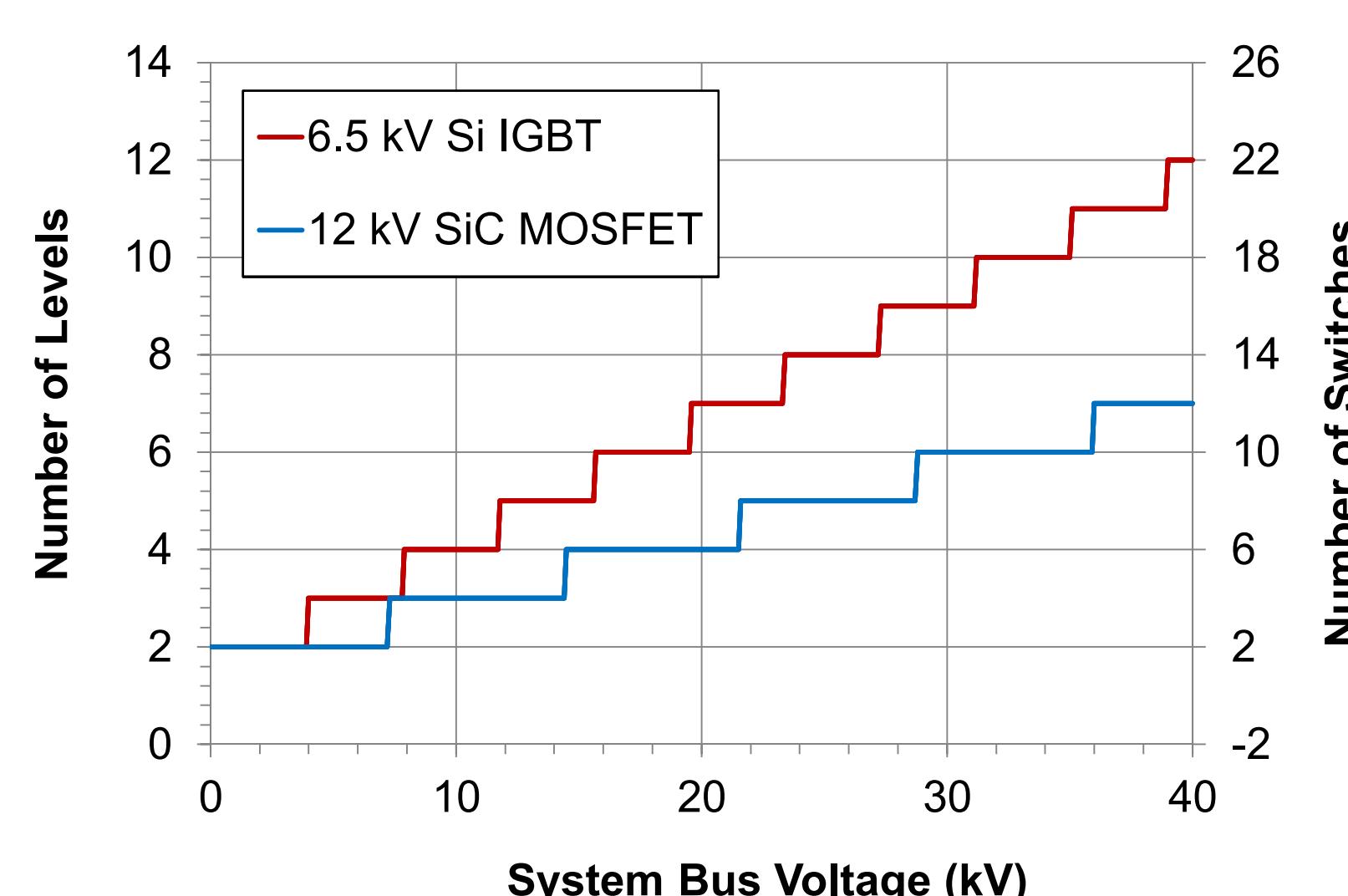
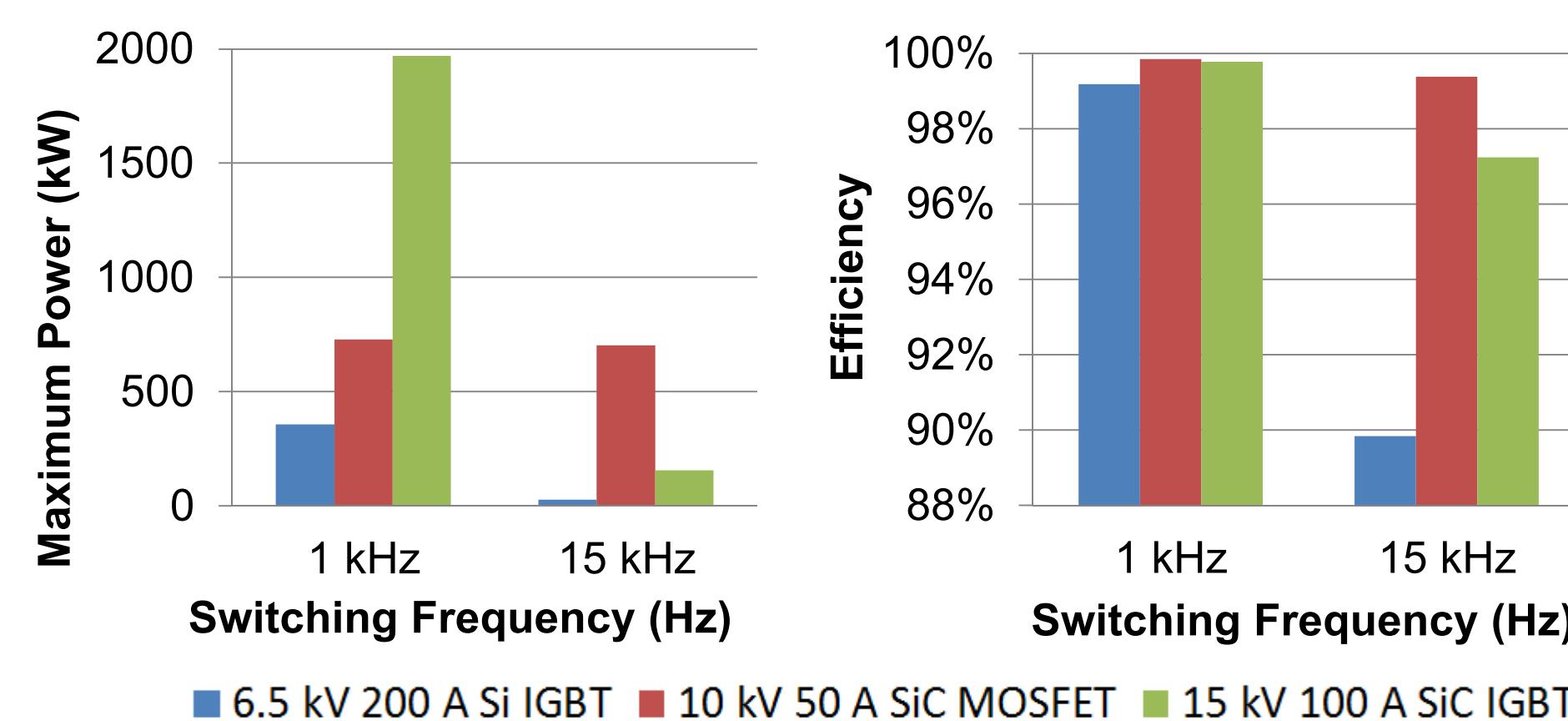
Develop a high voltage (> 15kV) silicon carbide (SiC) power module to aid in the emergence of smarter, seamless powered grids.

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



APPROACH

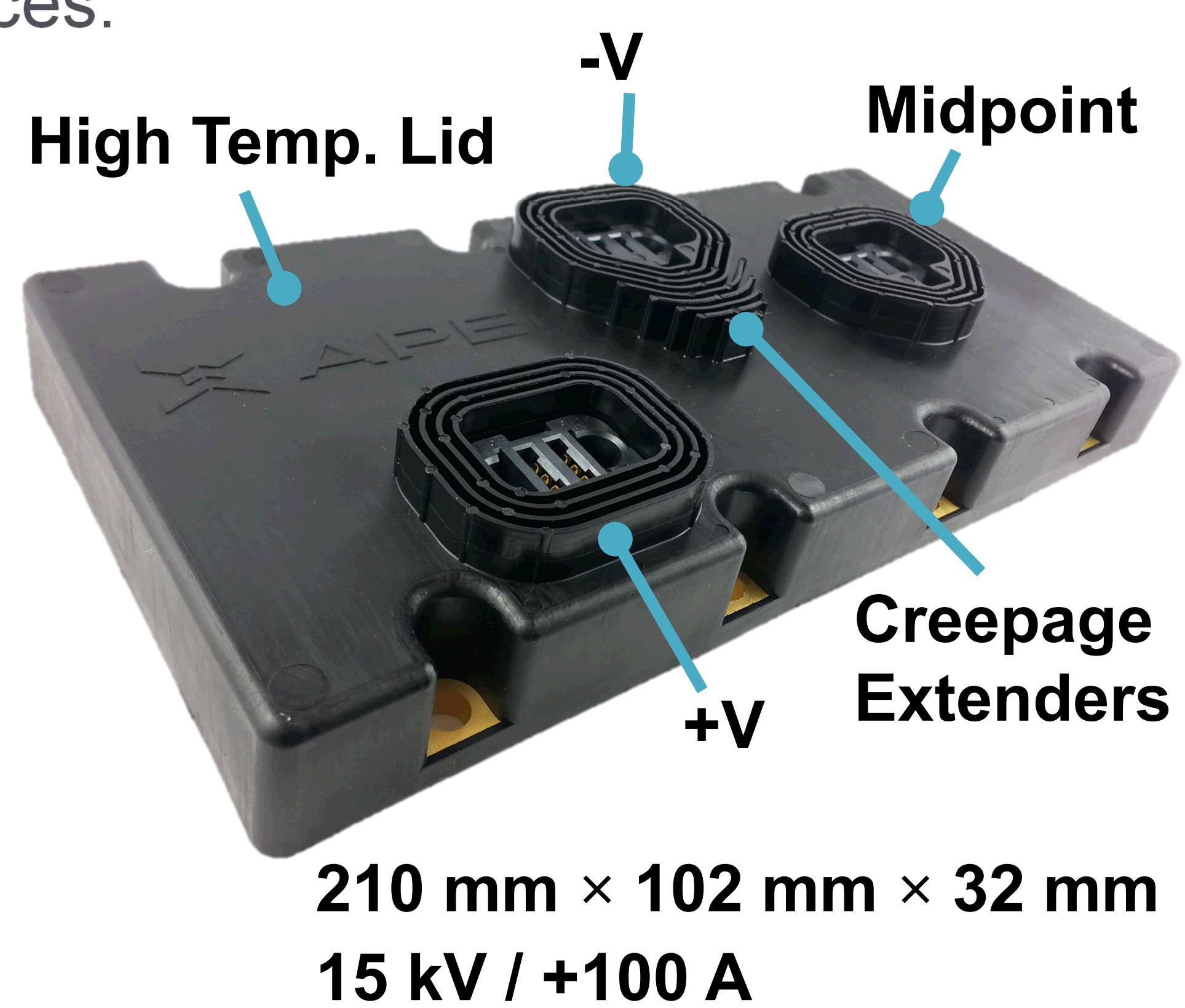
Design a high performance power module that will take full advantage of the superior properties of high voltage SiC devices.

Advantages of SiC Devices

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

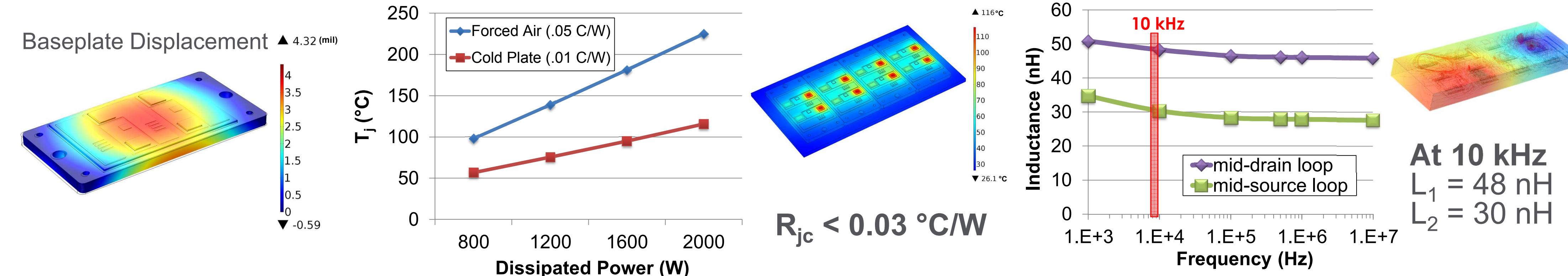
Power Module Features

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



RESULTS

Thermal, Electrical, Mechanical Simulations



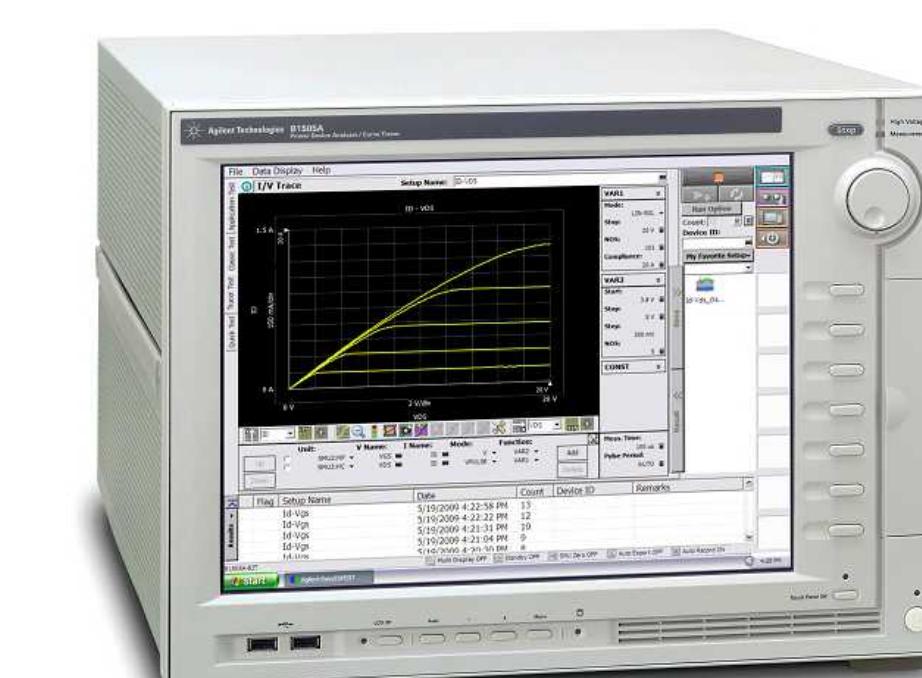
Power Module Assembly Development



FUTURE WORK

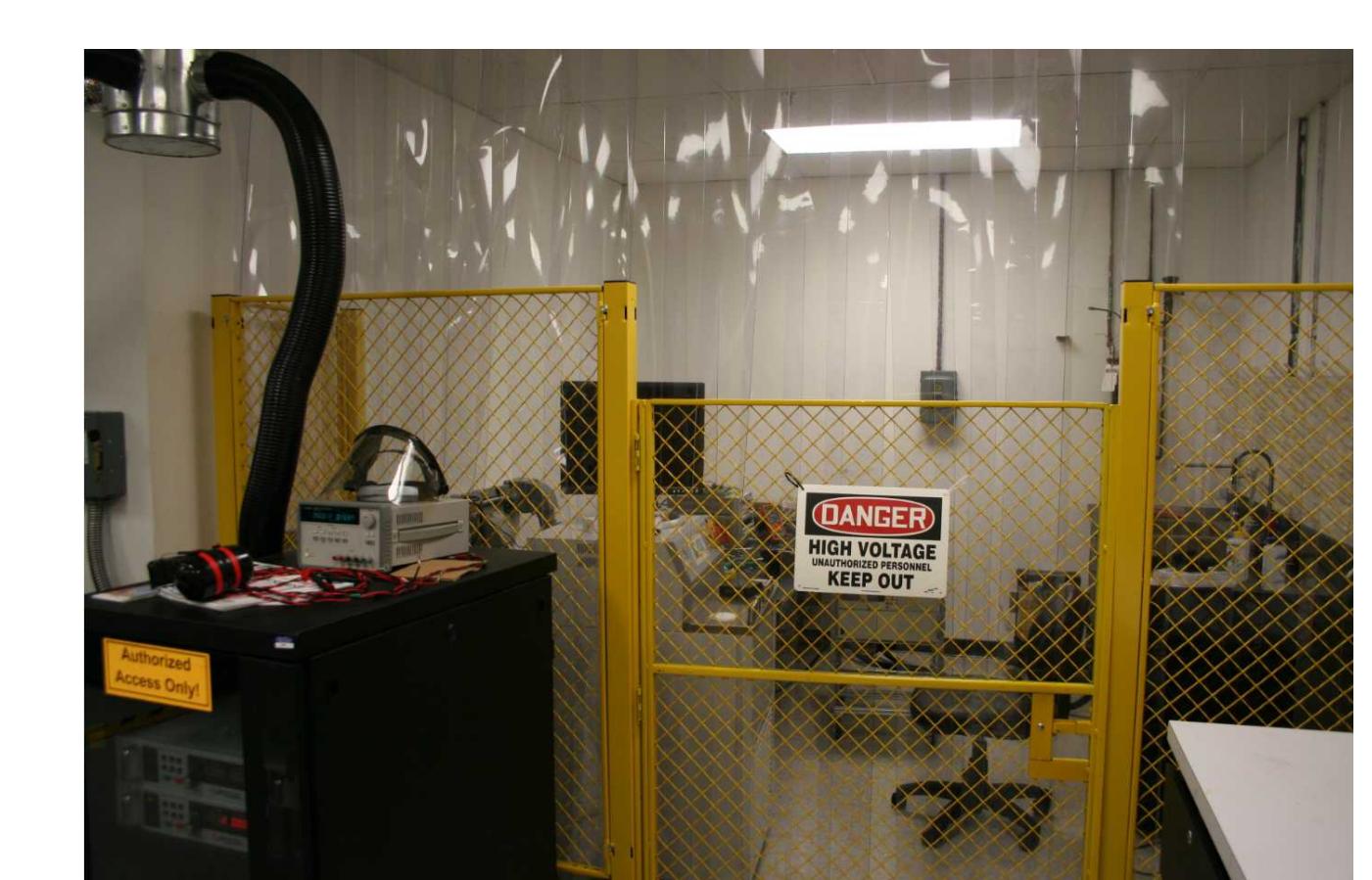
Power Module Static Testing

- 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



APEI, Inc. would like to thank Dr. Imre Gyuk of the DOE Energy Storage Systems Program and Dr. Stan Atcitty for his technical contributions.



Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.