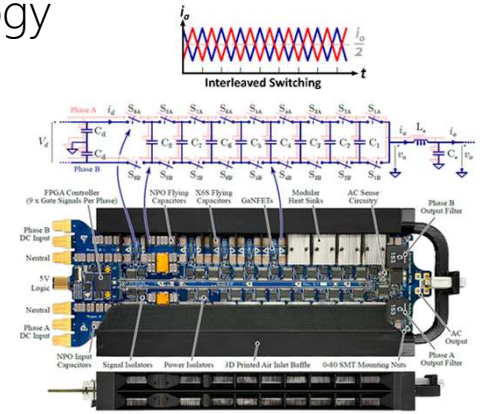
Next-Generation, High-Temperature, High-Frequency, High-Efficiency, High-Power Density Traction System

Berkeley | EECS
Electrical Engineering and Computer Sciences

Approach – Novel Topology

- Energy-dense capacitors are used in power processing
- Multilevel operation, high effective frequency reduces required filter for a given THD
- Wide-bandgap devices facilitate fast switching, low loss, compact design
- High switching frequency reduces the size of the power processing capacitors
- Dual-interleaved design further reduces filter requirements

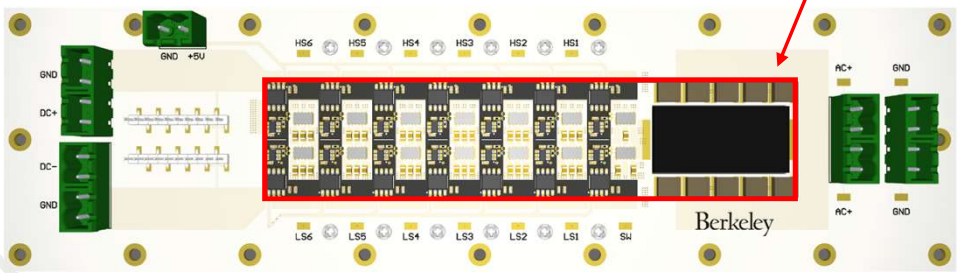


Y1 15 kW-scale Hardware Prototype

Accomplishments - Converter Design

- New design methodology validated using multiple circuit boards for different aspects of the converter
- Effectively 10 layers of copper available for routing
- Optimal use of volume: equal height for all aspects of the converter

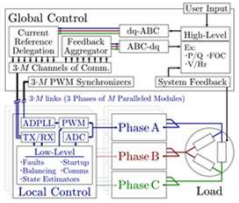
Main Converter Volume

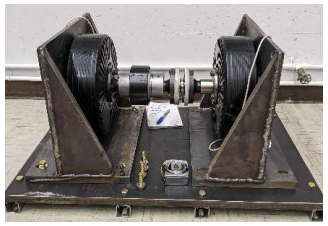


Accomplishments – Control & Testing

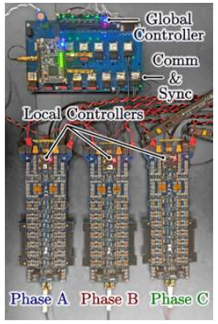
- Switching-frequency synchronization and interleaving achieved through phase-locked-loop design
- Construction of a dual-motor dynamometer has completed. Two low-inductance Emrax 348 motors (peak power 380 kW) have been purchased, allowing the validation of the inverter system driving high power motors
- The motors have been spun, validating the system and FOC control methods developed

Overall Control Diagram





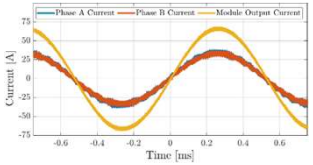
Synchronization Testing

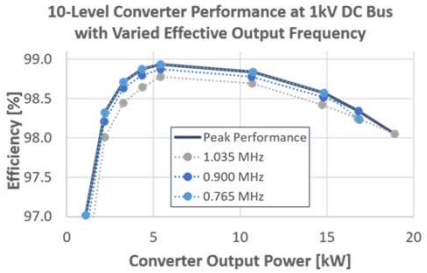


Dual-Motor Dynamometer

Accomplishments – Unparalleled Performance

- High-power test setup designed to assess performance of newest module design
- Phase currents of dual-interleaved module shown to match well
- Efficiency measurements taken at different frequencies and loads





Experimental performance includes gate drive and controller losses

Peak Efficiency	Peak Power	Power Density
98.95%	18.9 kW	38.4 kW/kg

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