University of Colorado at Boulder

Project Title:
Dual-Inductor Hybrid Converter for Direct 48V to sub-1V PoL DC-DC Module

Objectives:
Design and implement a TRL6, GaN-based, novel converter architecture with >10X higher current density and up to 3X lower loss, less components, simpler implementation, and lower cost.

Major Milestones:
A TRL6, 48V-1V, 200A, 95%, 1kW/in³ converter design in practical test loads with Lockheed Martin at the end of the 1st project year.

Significant Equipment Acquisition: None

Deliverables: Design methodology with converter optimization script, 4 generations of converter prototypes with test results.

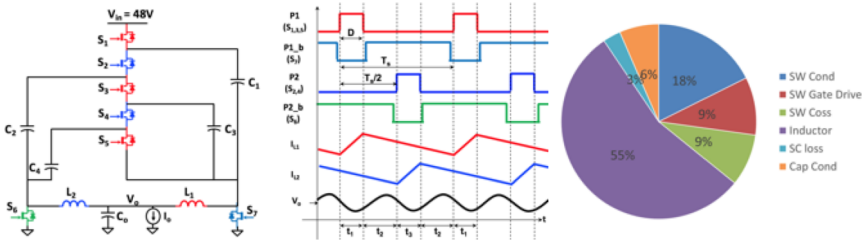

Figure 1: Dual Inductor Hybrid (DIH) converter schematic, operational waveforms, and loss breakdown for a sample 1V-200A output using commercial GaN devices and practical parasitics.

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WBG Technology Impact

1. Allow ultra-high efficiency, high switching frequency for smaller system size.
2. Application Spaces: Power delivery for data centers, cellular base stations, portable applications, as well as future Lockheed Martin's systems.
3. Timeframe for commercialization: 5 years
4. Commercial CMOS 48V-1V converters have efficiency limited to 90%. The GaN-based converter proposed in this project boost the efficiency to 95%. The 2X loss reduction reduce thermal stress, cooling cost. Together with GaN devices, the converter topology allows extreme power density of ~1kW/in³.

Additional impacts

1. The project success will facilitate a faster adoption of WBG devices across various market segments. This mass production will in turn reduce the cost of WBG devices compared with Si devices, especially for power electronics applications.
2. Contribute to reduce the $1.1 bilion loss in the U.S. data center power consumption alone.
3. Train 1 graduate and 2 undergraduate students
4. TRL level

   At project start: TRL 4

   Expected at project completion: TRL 6