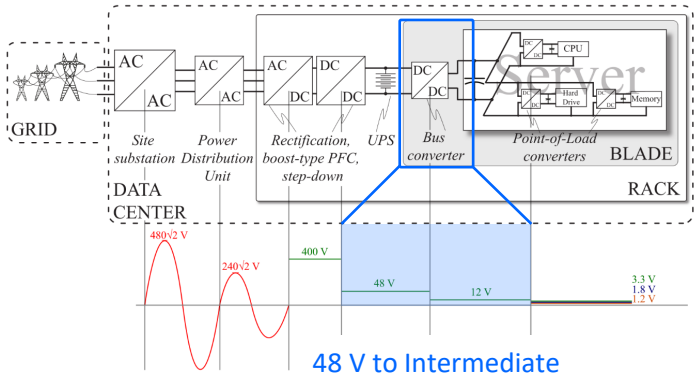
High-Performance 48-to-12 V Cascaded Multi-Resonant Switched-Capacitor Converter for Datacenters

Berkeley Power and Energy Center

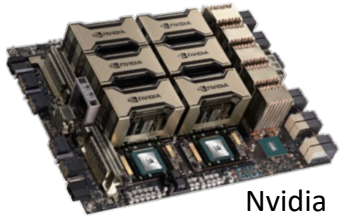
Motivation and Applications

48 V data center power delivery architecture



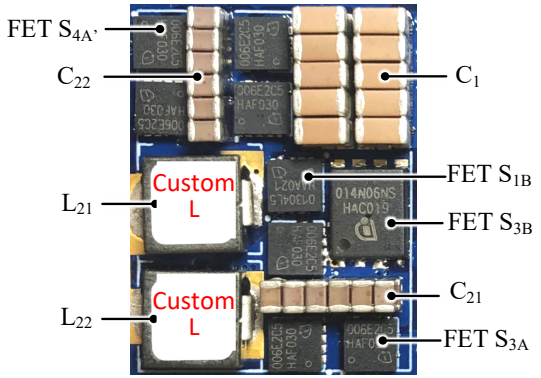
48 V to Intermediate Bus (IB) Converter

- The intermediate bus converter in 48 V data center application requires high efficiency and high power density
- Regulation and isolation are not required

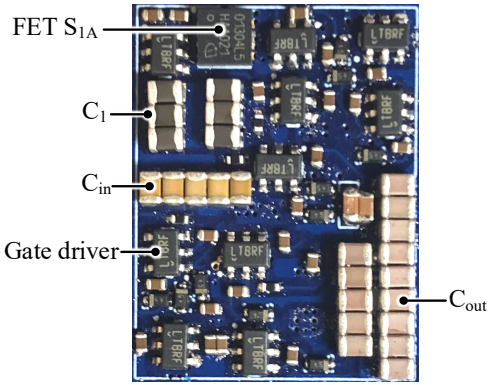


Nvidia

Hardware Demonstration



Top

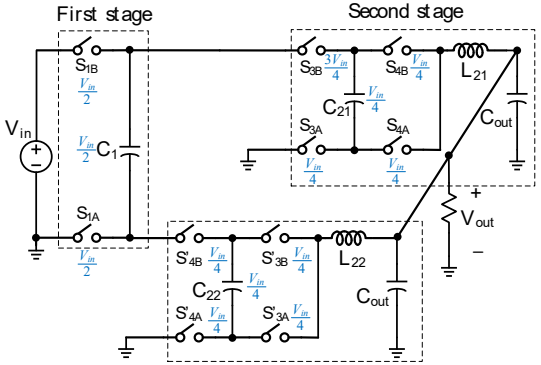


Bottom

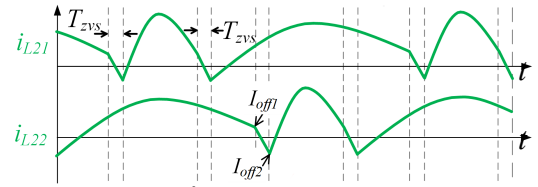
- Dimensions: 17.3 × 23 × 6.6 mm power density: **6000 W/in³** at 12 V output
- **80 A** continuous output and **130 A** - 2 ms transient output

Proposed Topology

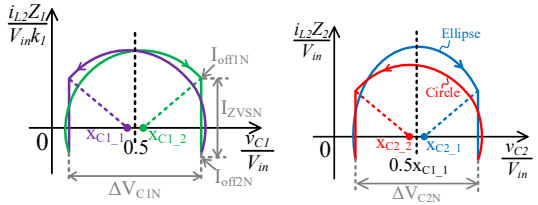
- Cascaded Multi-Resonant converter
- 1st stage uses only two switches to the save space of active components, and gate drive level shifters



- State-plane method is used to calculate multi-resonant inductor current

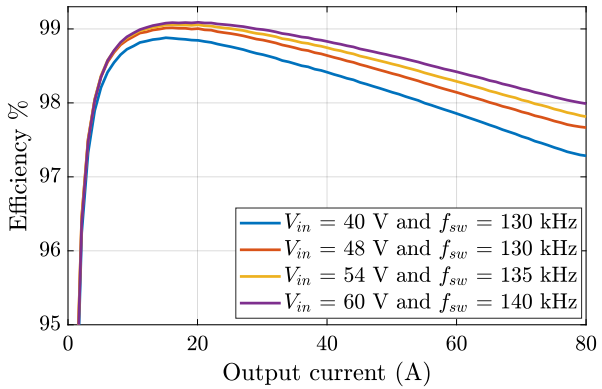


Inductor current

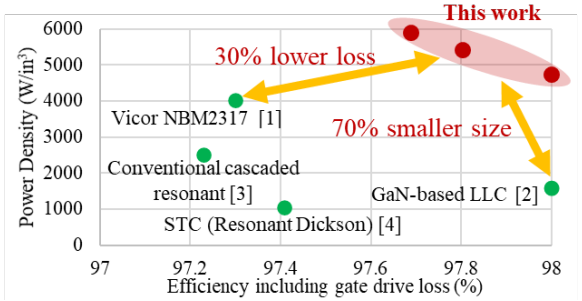


State trajectories of C_1L and C_2L

Experimental Results



Measured efficiencies including gate drive loss



Comparison with State-of-the-Art 48-to-12 V Solutions

Reference: T. Ge, Z. Ye and R. C. N. Pilawa-Podgurski, "A 48-to-12 V Cascaded Multi-Resonant Switched Capacitor Converter with 4700 W/in3 Power Density and 98.9% Efficiency," 2021 IEEE ECCE.

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