

Vertical Stacked 48V-1V Voltage Regulator for Ultra High Current Microprocessors

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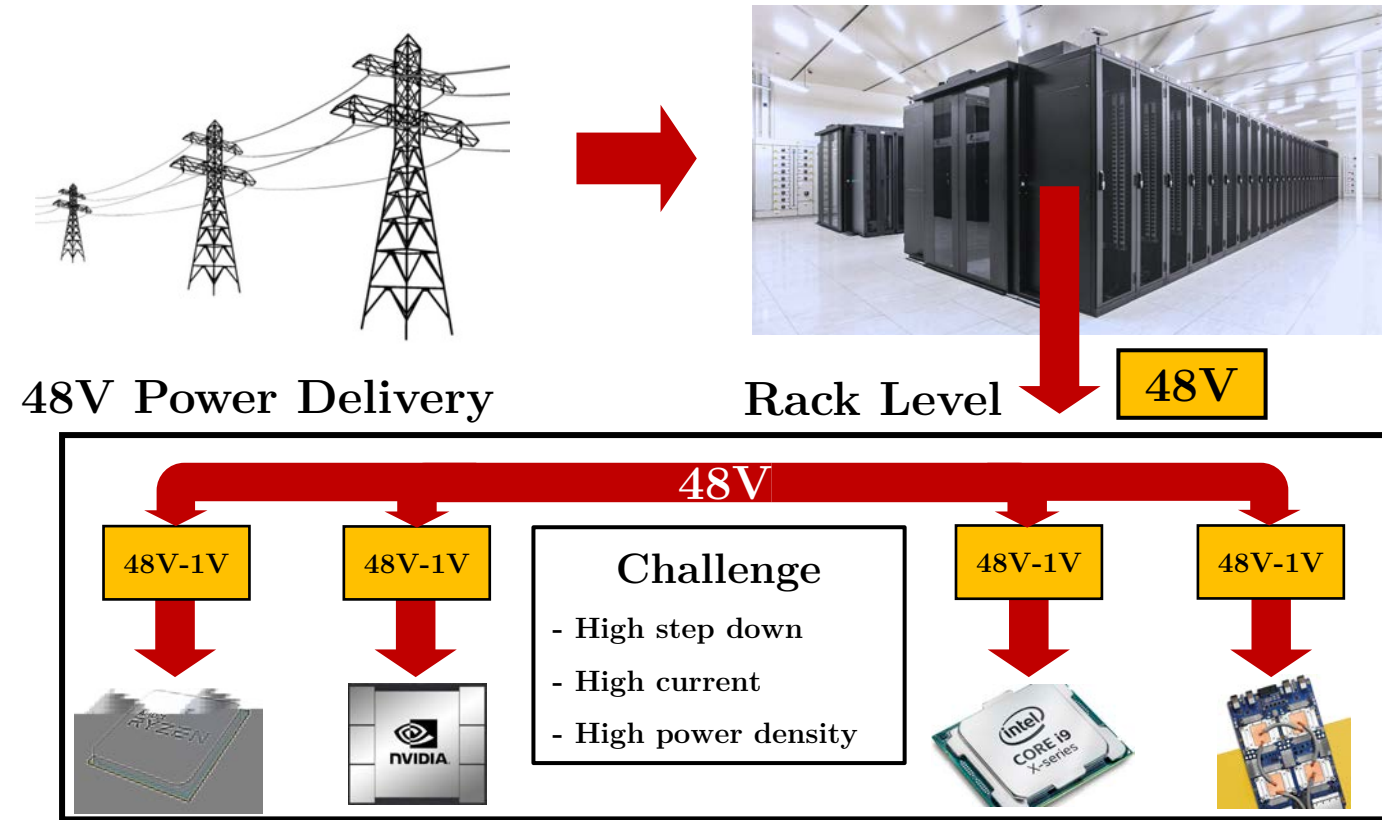
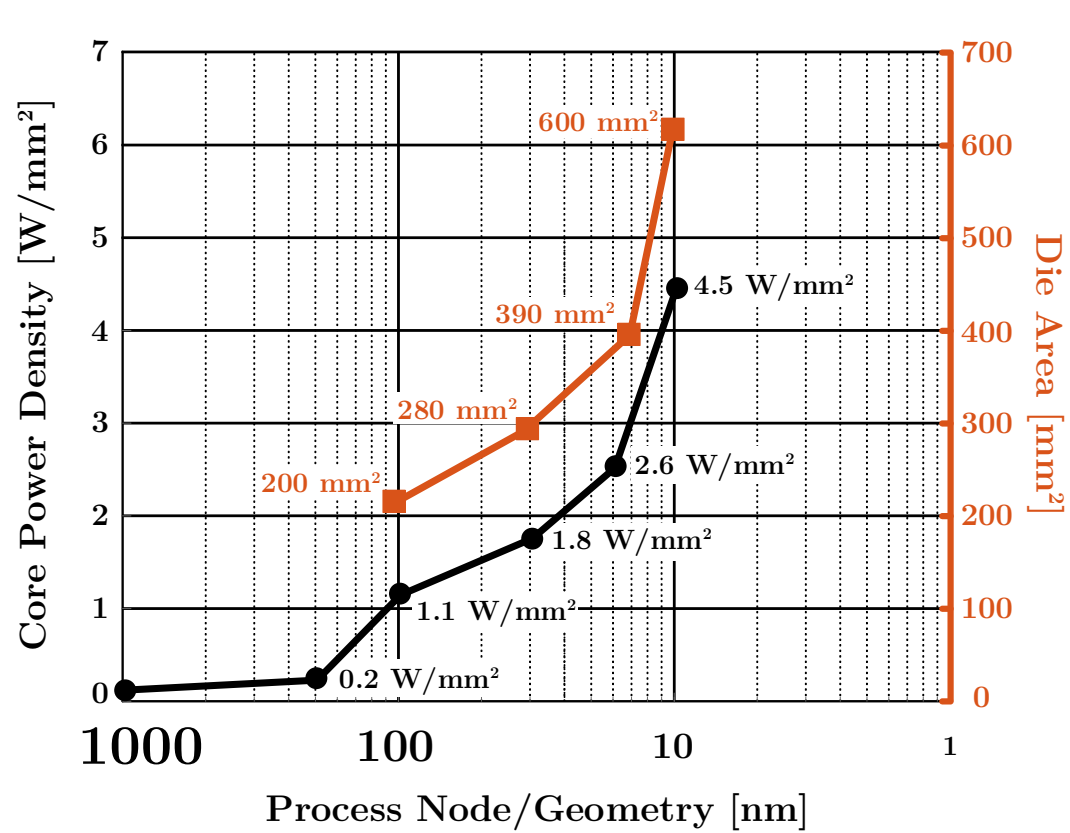
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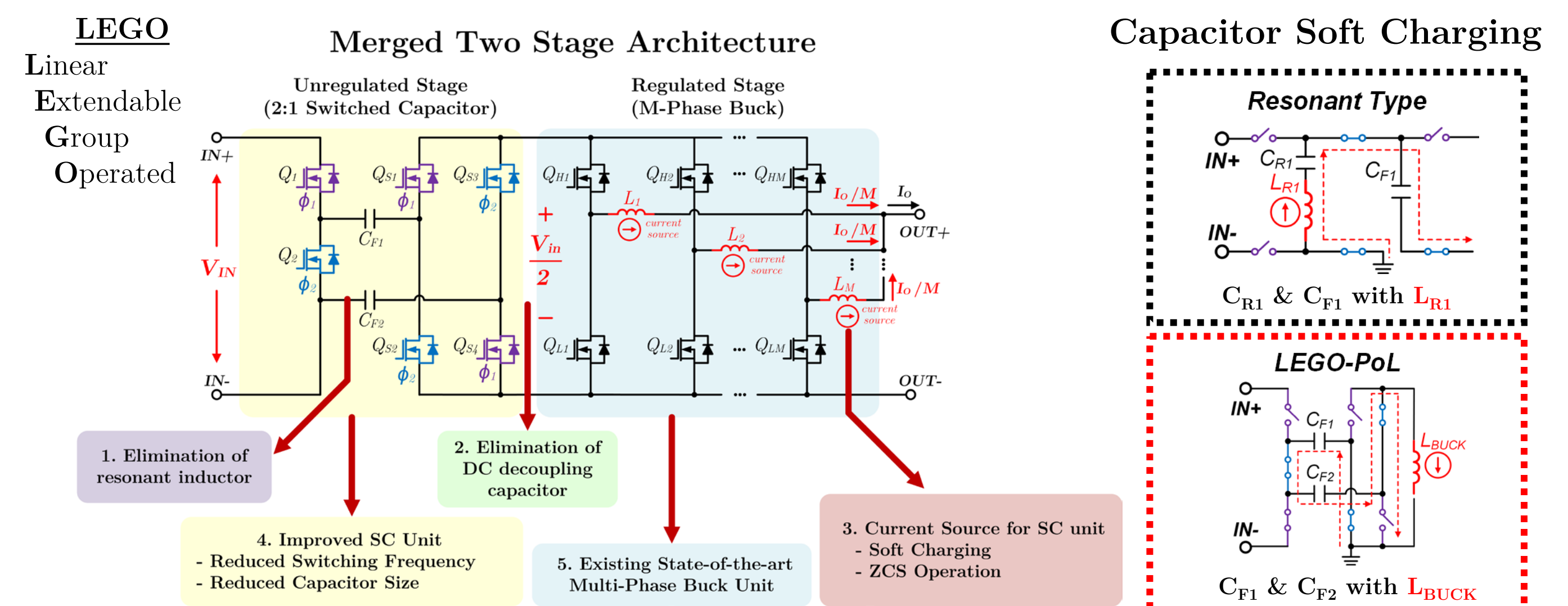


Background & Motivation

- Microprocessors consuming power in the range of kW with low voltage and high current need high performance voltage regulators

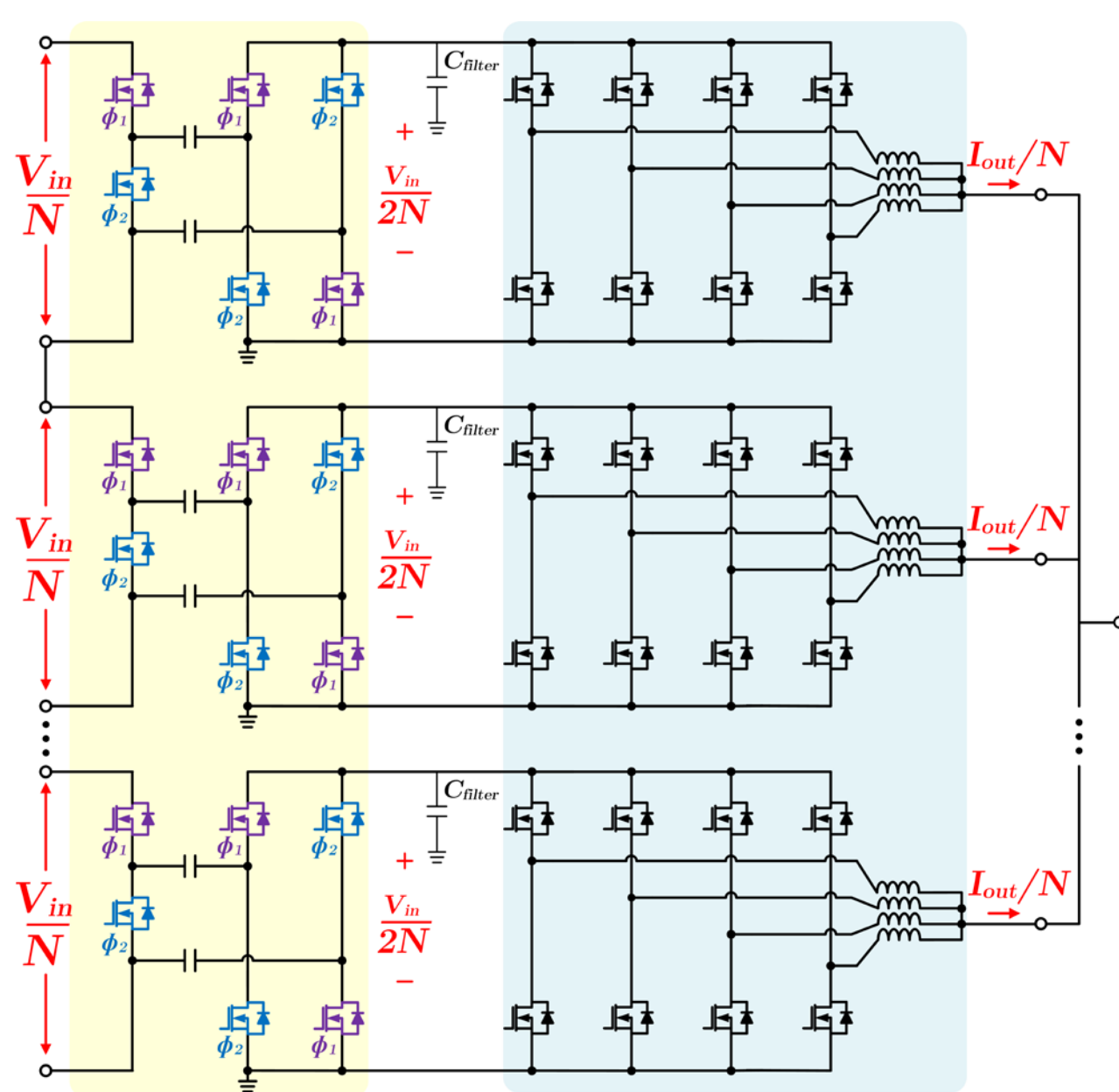


LEGO Point-of-Load Architecture – Basic Module

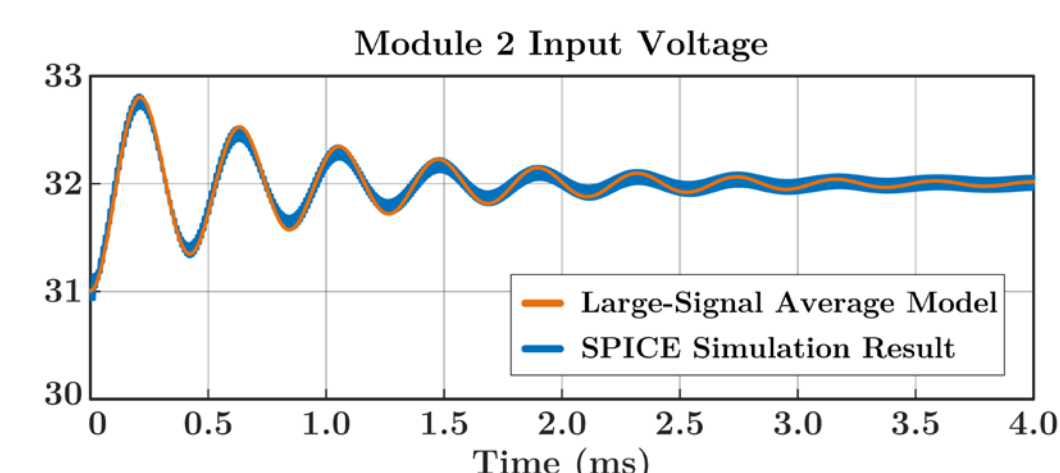


LEGO Point-of-Load Architecture – N Modules

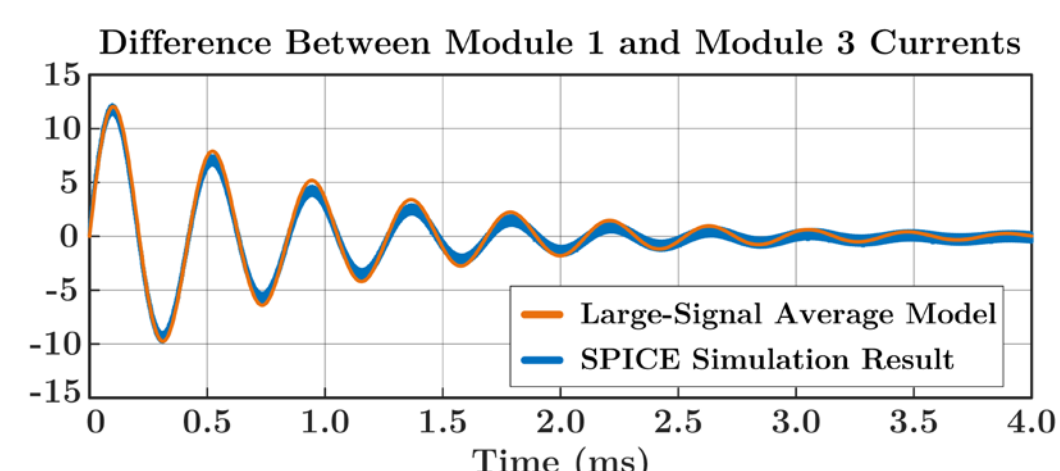
- Scalable and modular LEGO-PoL with automatic voltage and current sharing



Automatic Voltage Balancing



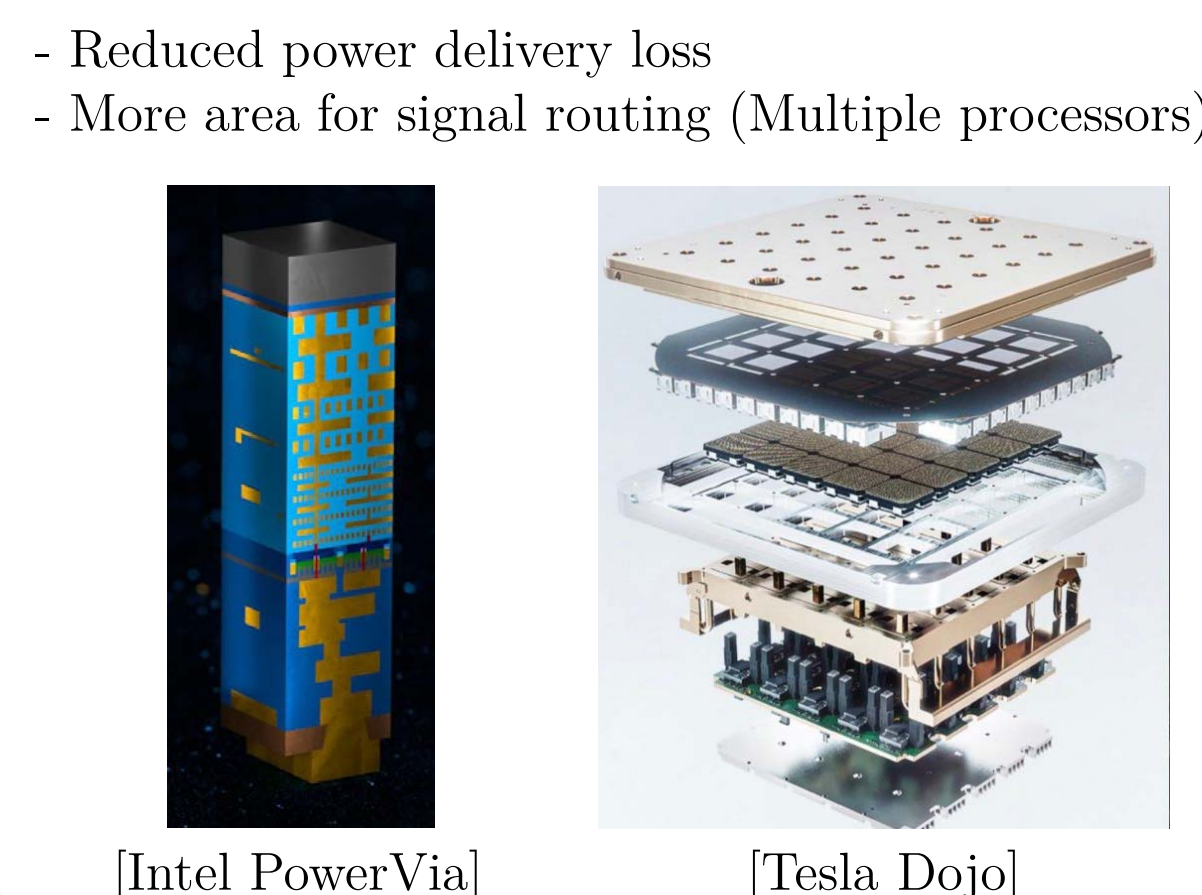
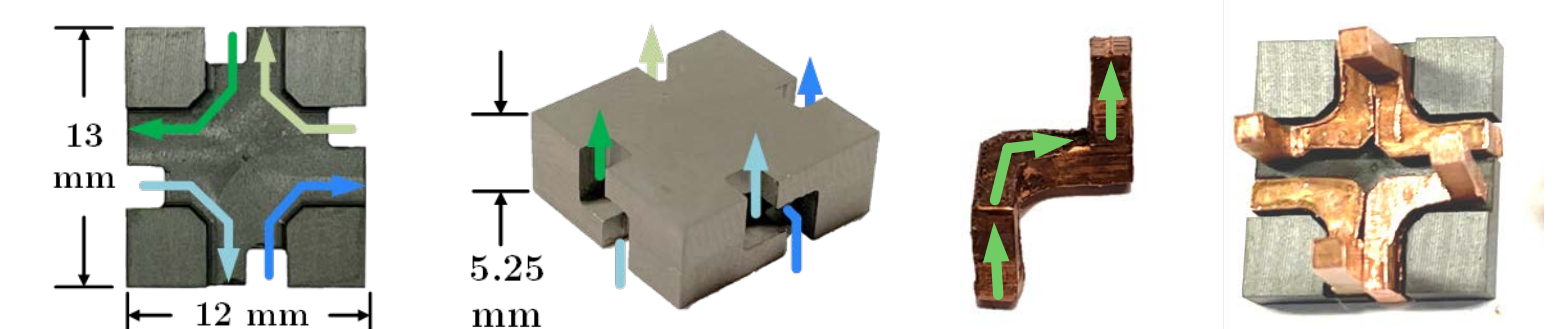
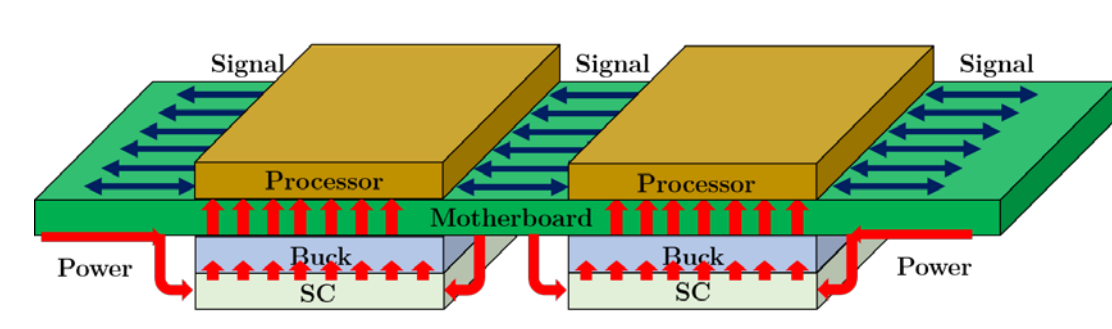
Automatic Current Sharing



Test condition: $N=3$, $V_{in}=48V$, unbalanced initial capacitor voltage

Vertical Power Delivery & Four Phase Coupled Inductor

- Vertical power delivery
- Custom vertical four-phase coupled inductor



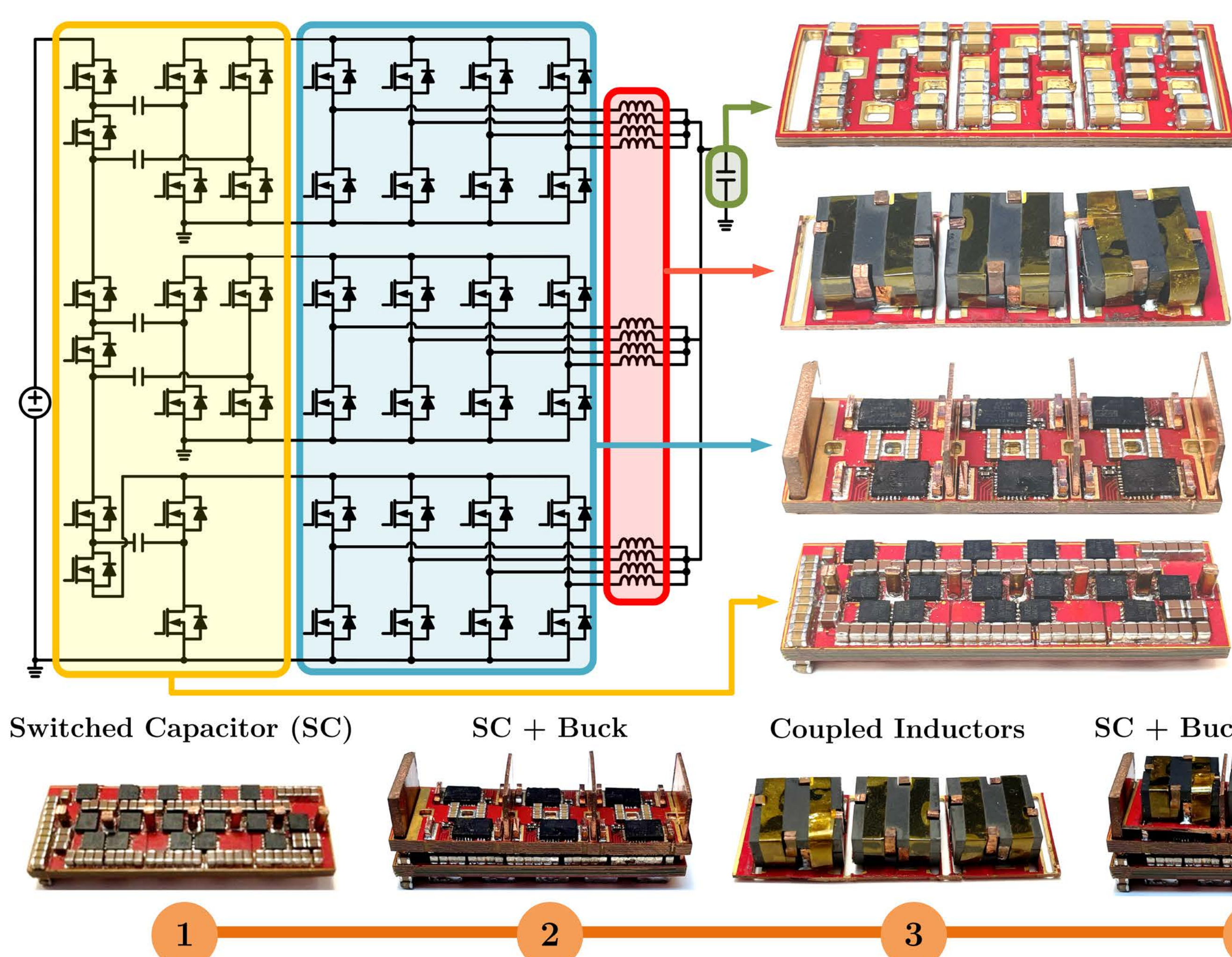
Benefits of Multiphase Coupling

- Reduced Energy Storage Requirements
- Lower Phase Current Ripple
- Fast Transient Speed

Further Reading

Journal Paper SCAN ME

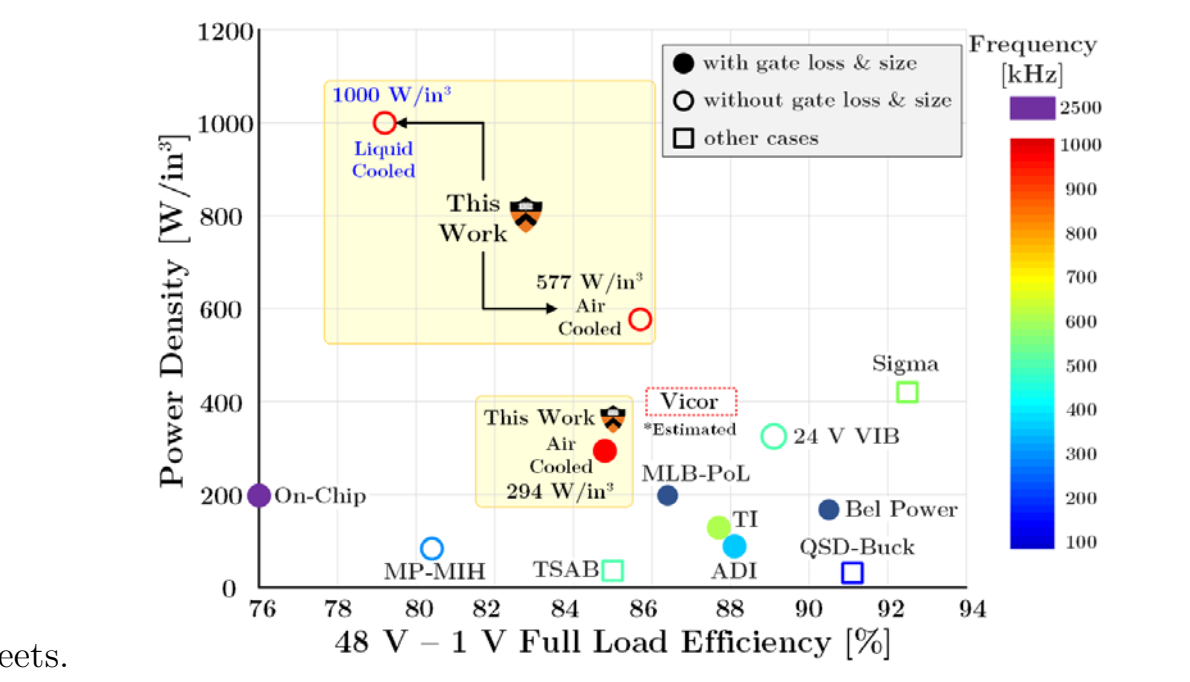
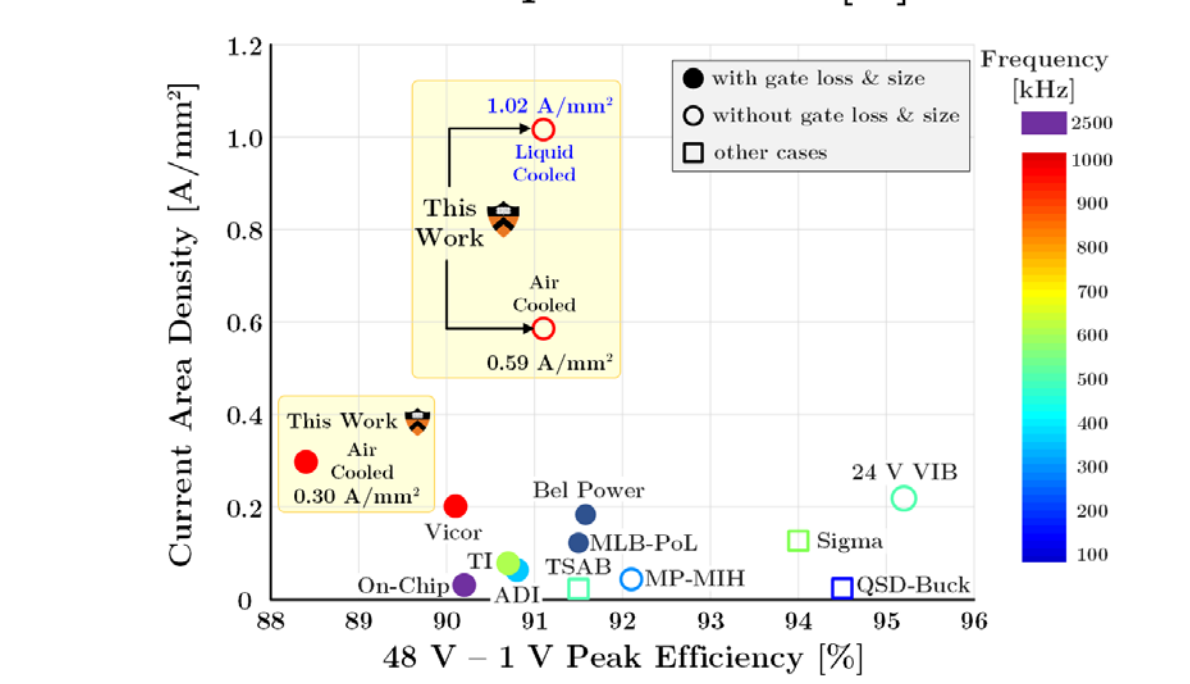
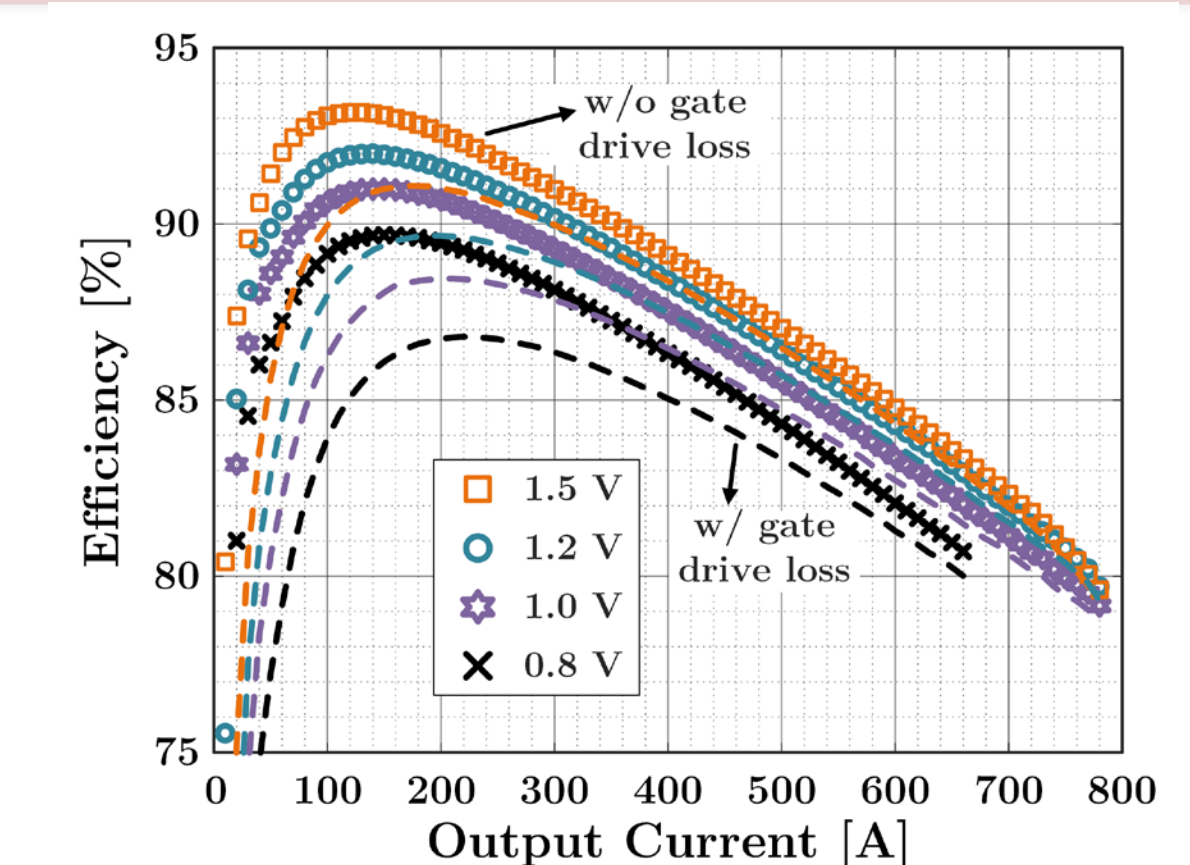
48 V-1 V/780 A Vertical Stacked LEGO-PoL Prototype & Experimental Results



LEGO-PoL: 450 W

- Output Capacitors: 42 × 220 μ F X7R, 1206
- Coupled Inductors: Height: 6.05 mm, Weight: 11 g
- Multiphase Buck: Height: 4.2 mm, Weight: 12 g
- Switched Capacitor: Height: 6.4 mm, Weight: 17 g

Dimensions: 50 mm height, 42.5 mm width, 46.5 mm × 16.5 mm × 16.65 mm depth.



* Disclaimer: The numbers used for the performance comparison are obtained from published papers as well as datasheets. Power densities are calculated box density based on the information provided in these documents. Refer to the original papers and datasheets.