

A NOVEL SINGLE-STAGE SINGLE-PHASE DAB-TYPE BIDIRECTIONAL CONVERTER WITH SIMPLE CONTROL

Huanghaohe Zou, Ph.D. Candidate, ECE, UT Austin
Dr. Alex Q. Huang, Professor, ECE, UT Austin

Project Profile

Topic: Power Electronics
Vertical: Materials and Systems Innovation
Strategic Pathway: Advancing new technologies (Grow)
Project Start & Finish: FY25-FY26

Introduction

Battery Energy Storage Systems (BESS) are increasingly important in distributed grid applications requiring resilient power conversion.

This project develops a bidirectional converter with a robust interconnect design to maintain operational integrity during disruption, while emphasizing manufacturability, diagnostics, and reliability.

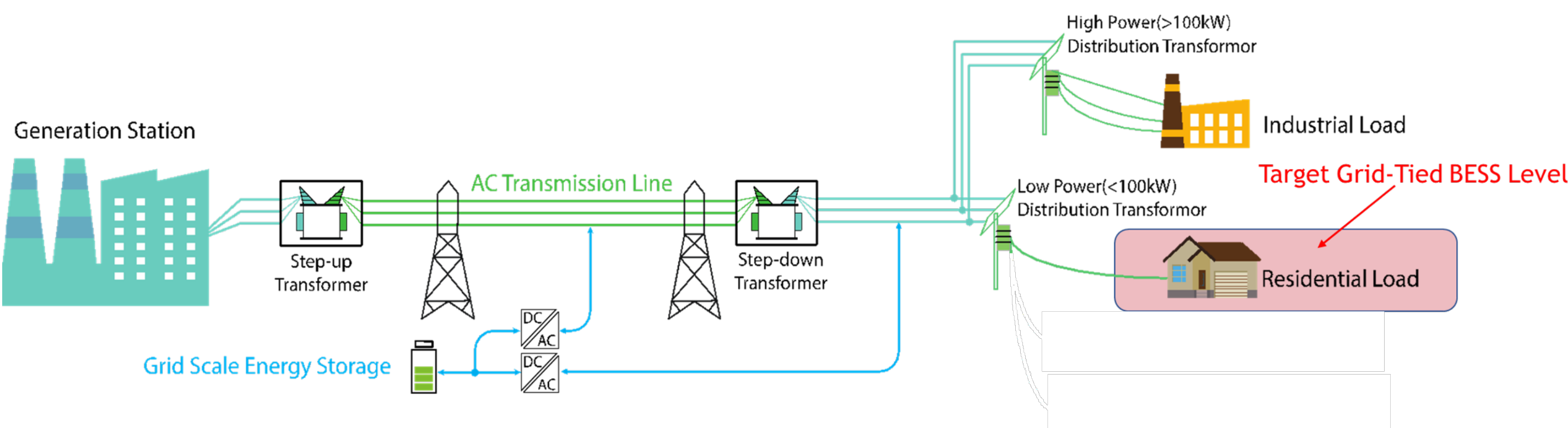


Fig. 1. Grid Tied BESS Structure

Topology

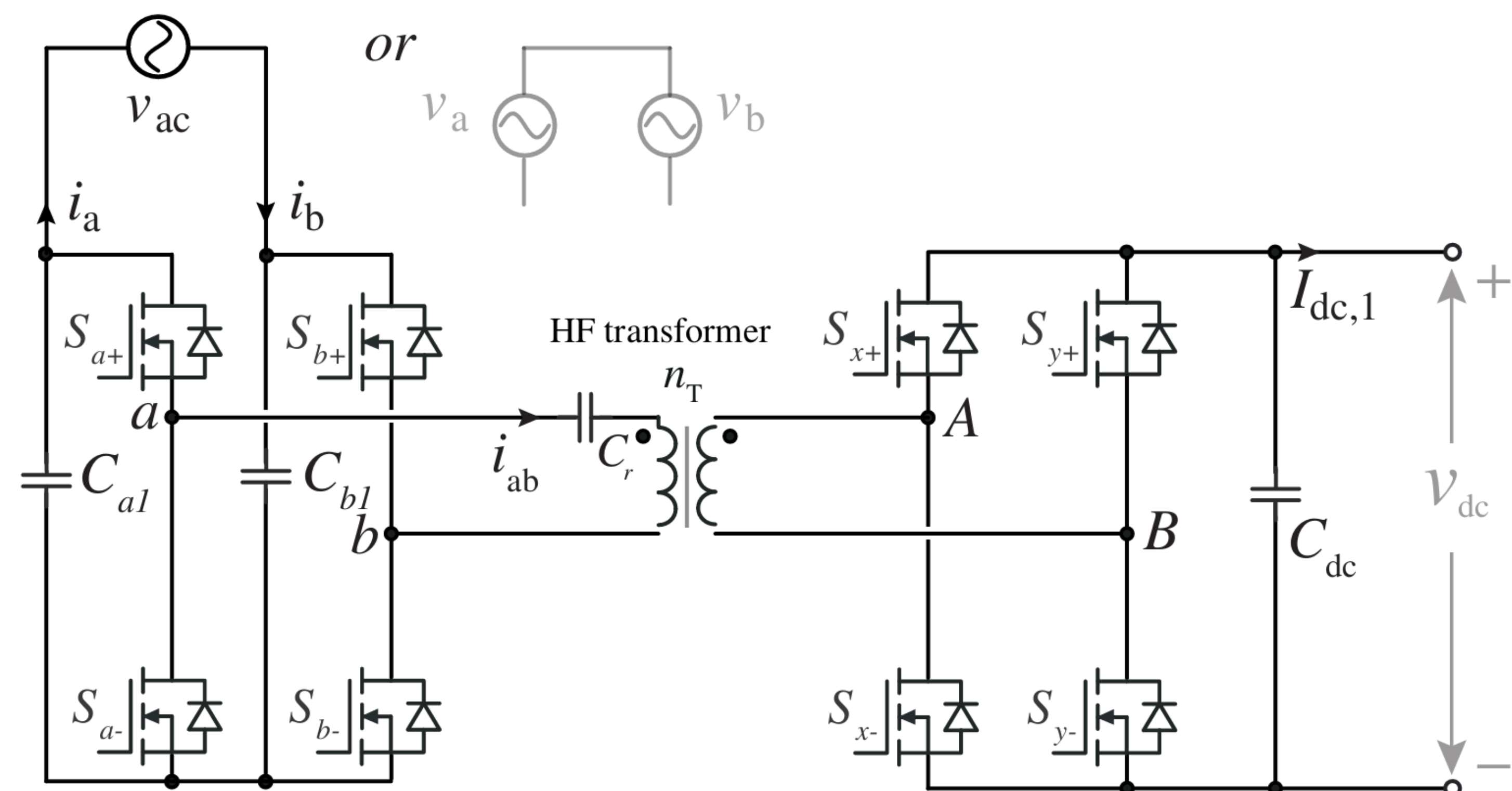


Fig. 2. Proposed Single-stage Topology

- Novel AC side topology eliminates the need for 60Hz frequency unfolding bridge and bidirectional devices.
- Simplified decoupled Dual-Phase-Shift (DPS) Control for simpler power flow control.
- Top-Cooled Device for improved power density.

Designed Hardware Overview

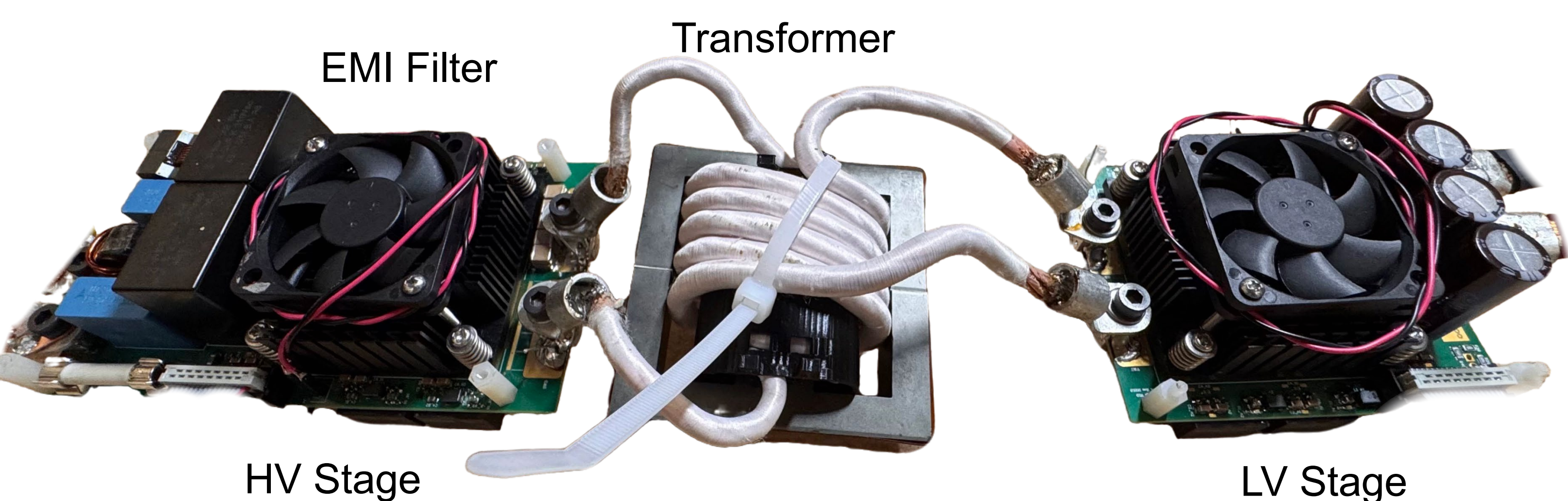
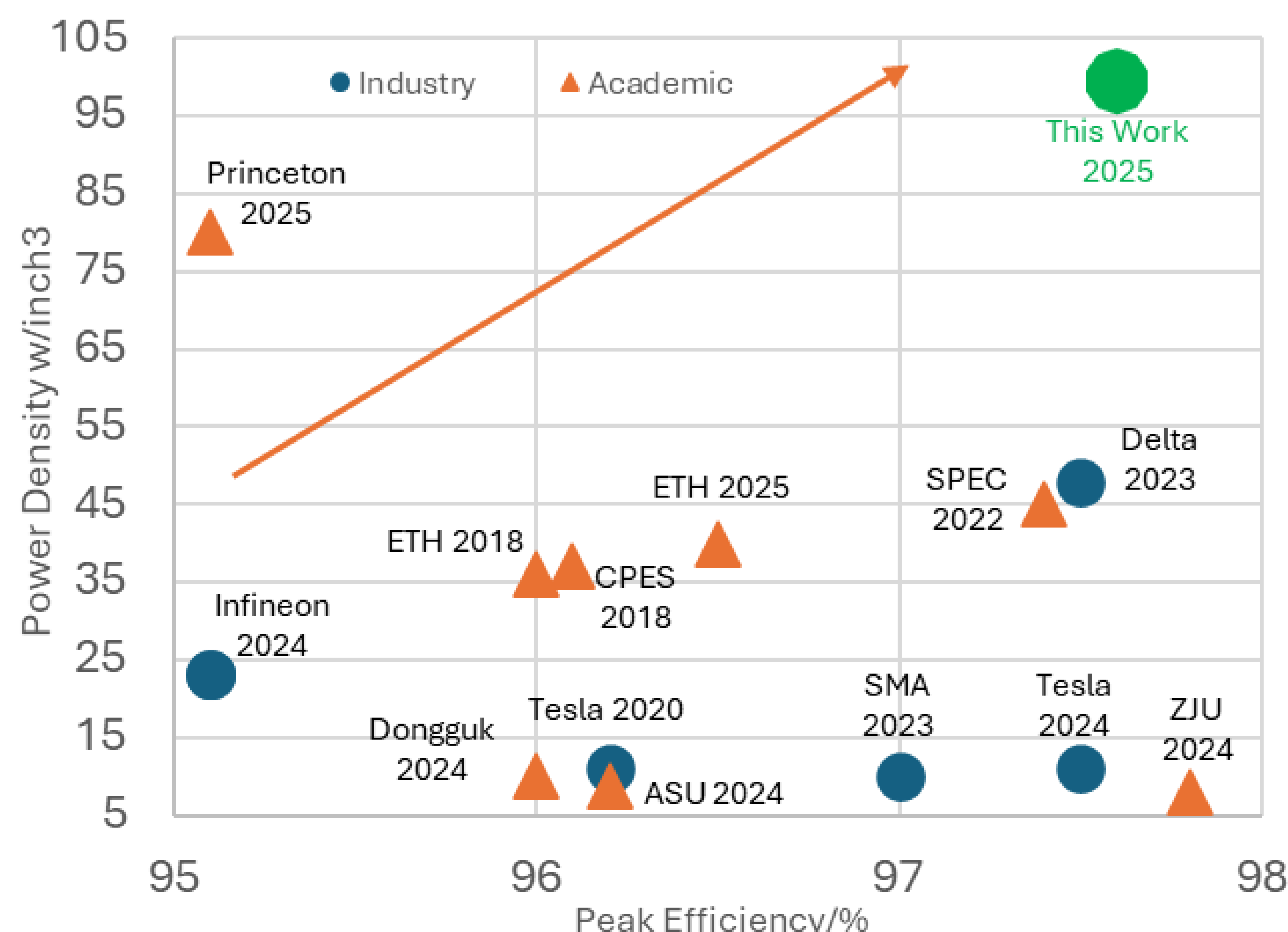


Fig. 3. Proposed 5kW Prototype

Symbol	Description	Value	Symbol	Description	Value
Vac	Grid Voltage	120~240 Vac, 50~60 Hz	fsw	Switching Frequency	100kHz
Vdc	Battery Voltage	12~110 V	Modulation	\	Decoupled DPS
P	Rated Average Power	5 kW per phase	MOSFET Package	TOLT Top-Side-Cooling	650V SiC MOSFET 150V Si MOSFET
Power Density	\	100 W/in ³ 6.1 kW/L	Rja	Total Thermal Dissipation	400W
Dimension	\	11.8*3.1*1.4 inch 30*8*3.5 cm	BOM Cost	Per 1000pcs	\$400 per system \$80/kW

Power Density Comparison



This work outperformed other industry and academic prototypes in terms of **peak efficiency** and **power density**.

Experimental Results, Efficiency & Conclusions

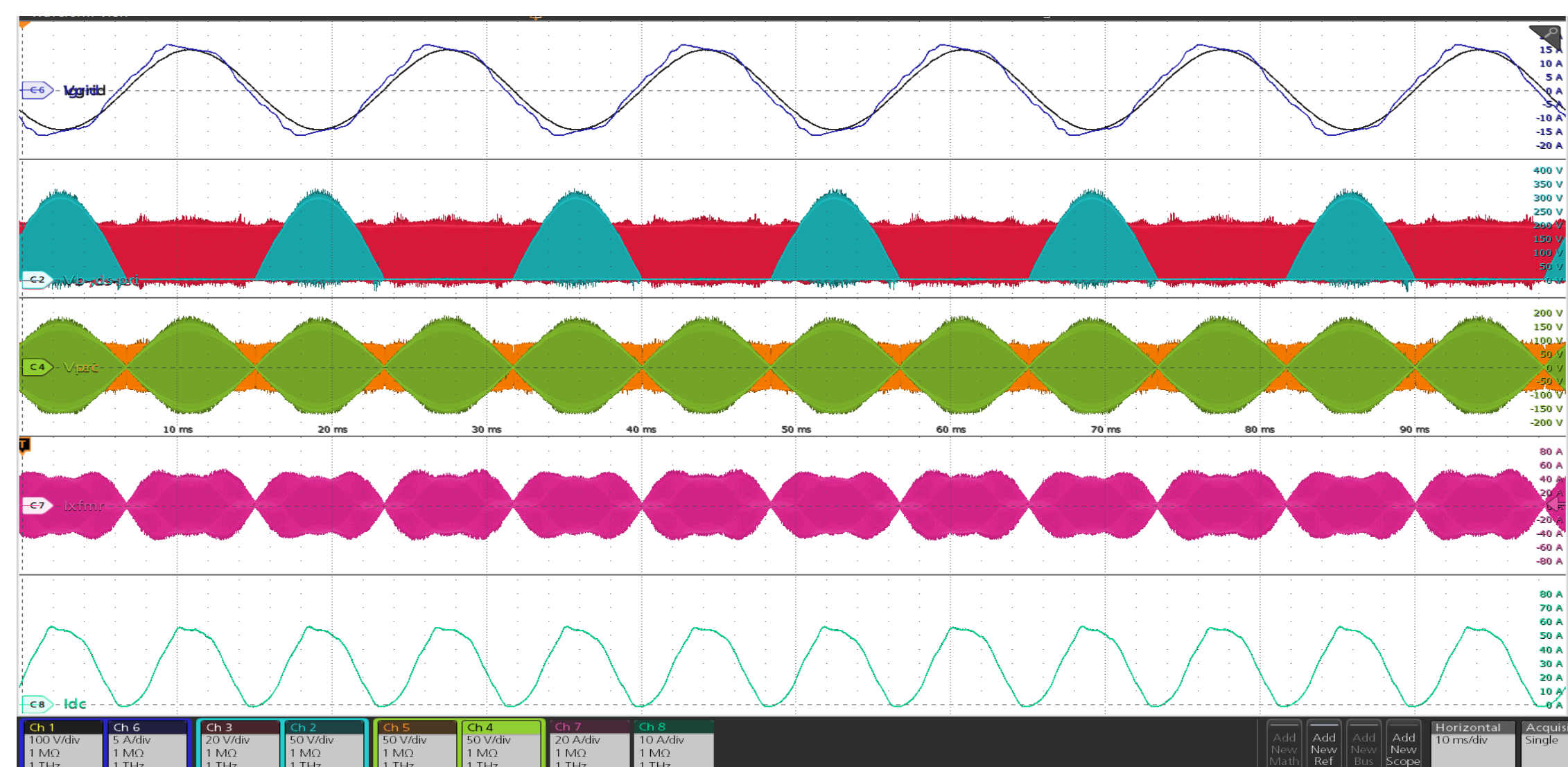


Fig. 5. Zoomed in Waveform @ Vac=240V P=5kW

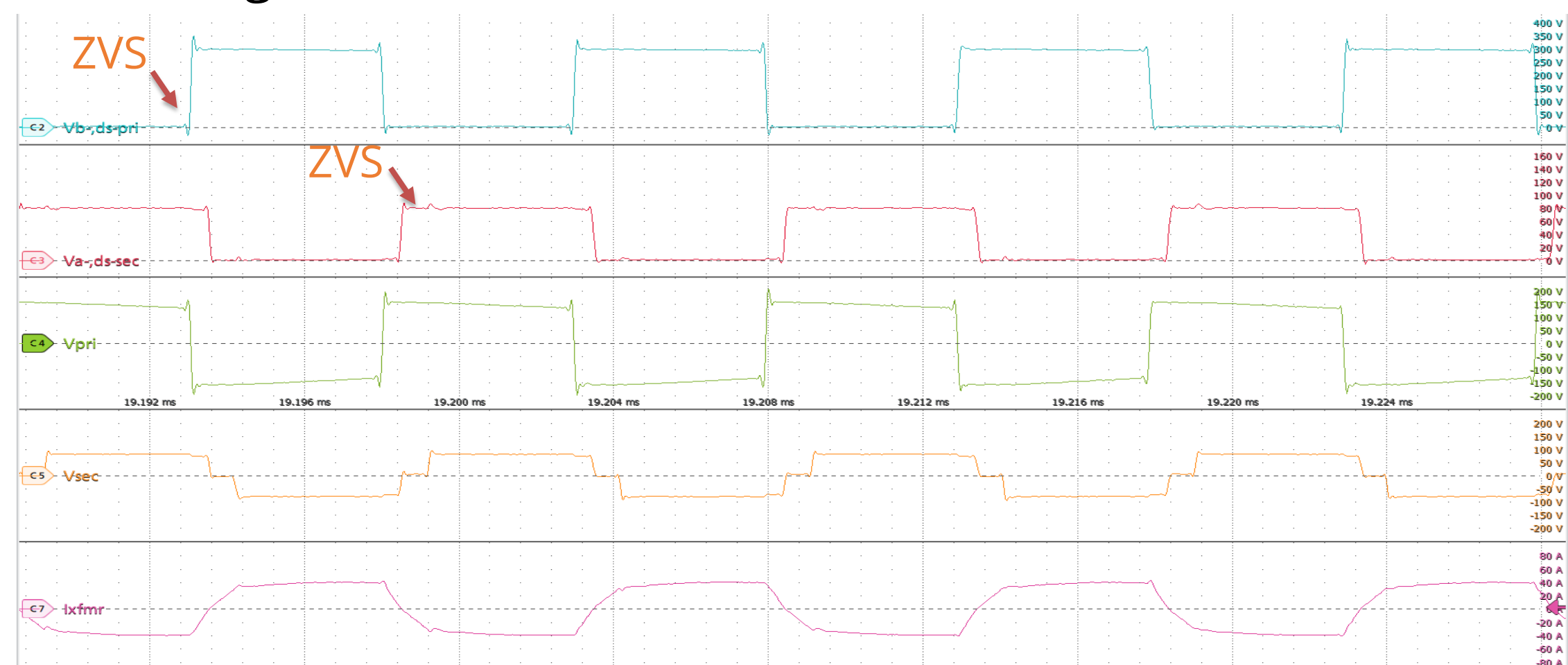


Fig. 4. Overall Waveform @ Vac=240V P=5kW

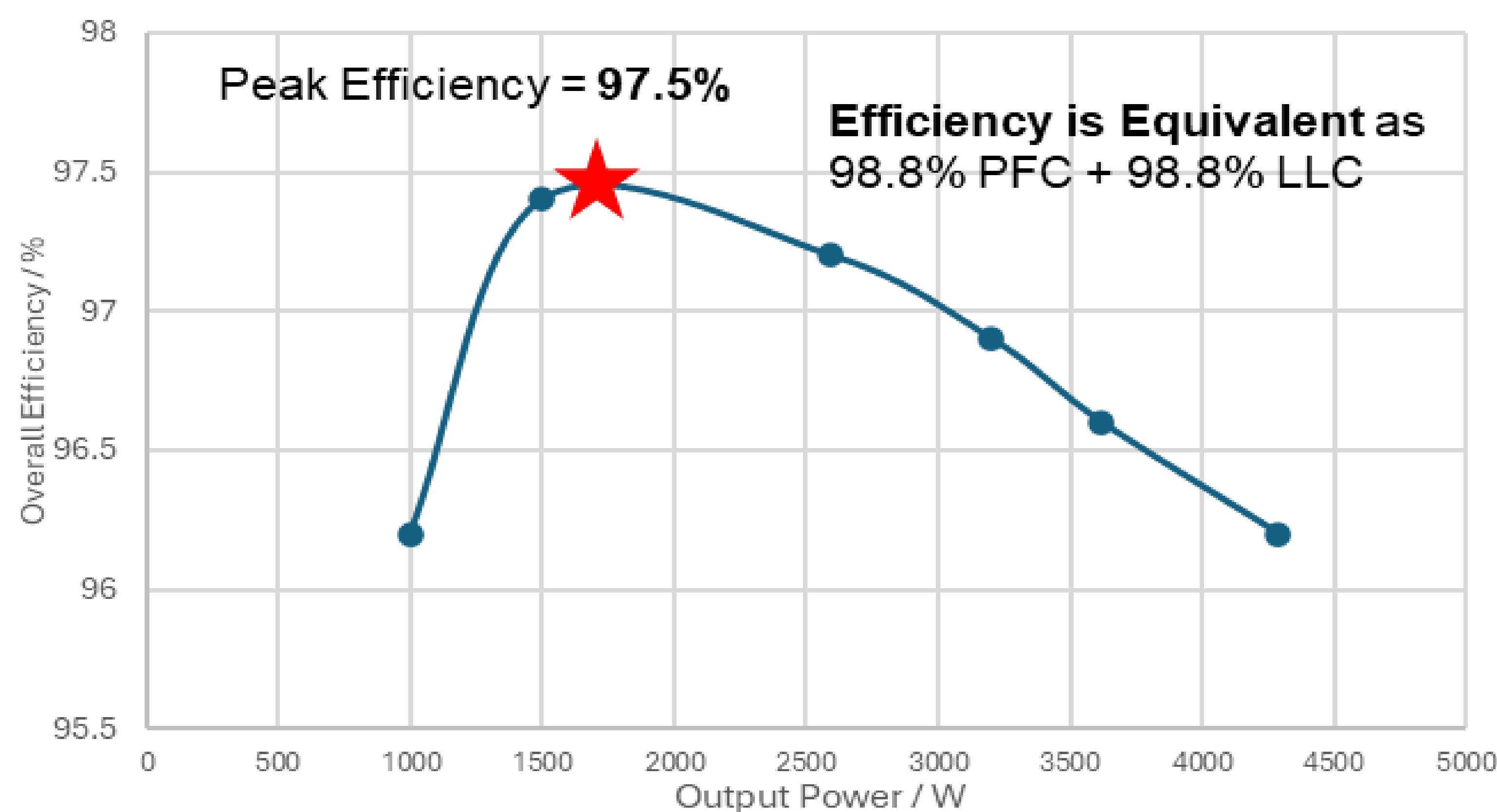


Fig. 6. Efficiency Curve. Compared with Two-Stage Converter (e.g. PFC+LLC), this topology can achieve much higher efficiency.

- Novel 5 kW single-stage DAB-type bidirectional converter experimentally verified.
- Decoupled phase-shift control enables simple and efficient bidirectional operation.
- Natural Grid-Forming Control with compact and reliable solution for grid-tied BESS.

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