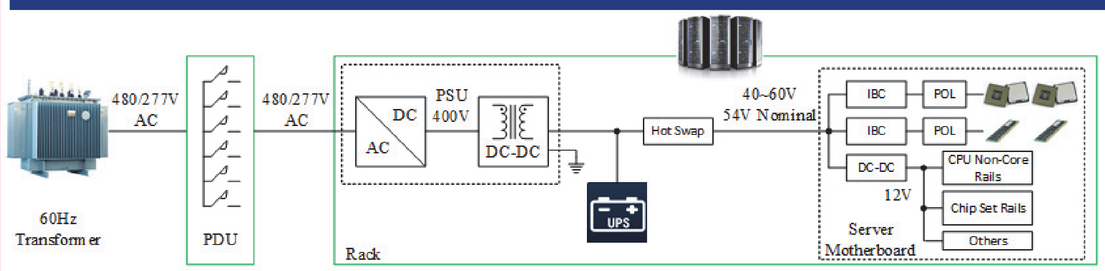
A 99.5% Efficient Bus Converter for Data Center Application

University of Dayton[a] NDSU NORTH DAKOTA STATE UNIVERSITY[b]
Mengxuan Wei[a], Yanchao Li[b], Ze Ni[b], and Dong Cao[a]
dcao02@udayton.edu

Introduction

This work presents a group of high efficiency and power density switched-capacitor based resonant converters with soft switching capability and highly scalable properties. These features allows the topologies be the proper candidate for data center intermediate bus converter application.

Motivation

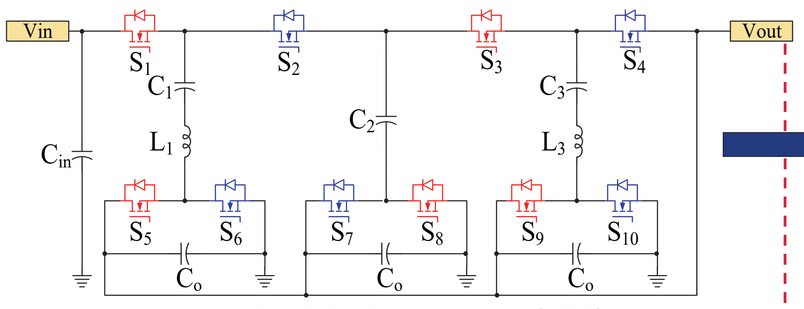


Data Center Power Delivery Architecture

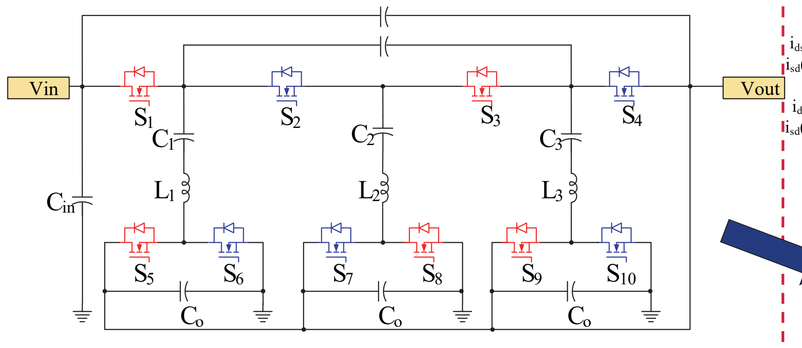
Intermediate Bus Converter (IBC)

- No Isolation needed
- No voltage regulation needed
- Optimize cost and size
- Manufacturability

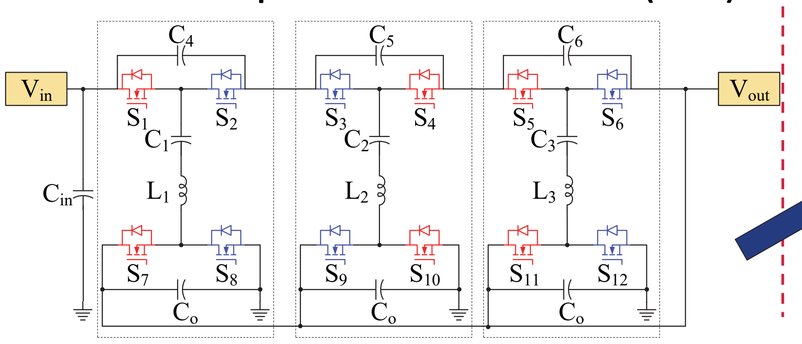
Topologies and Prototypes



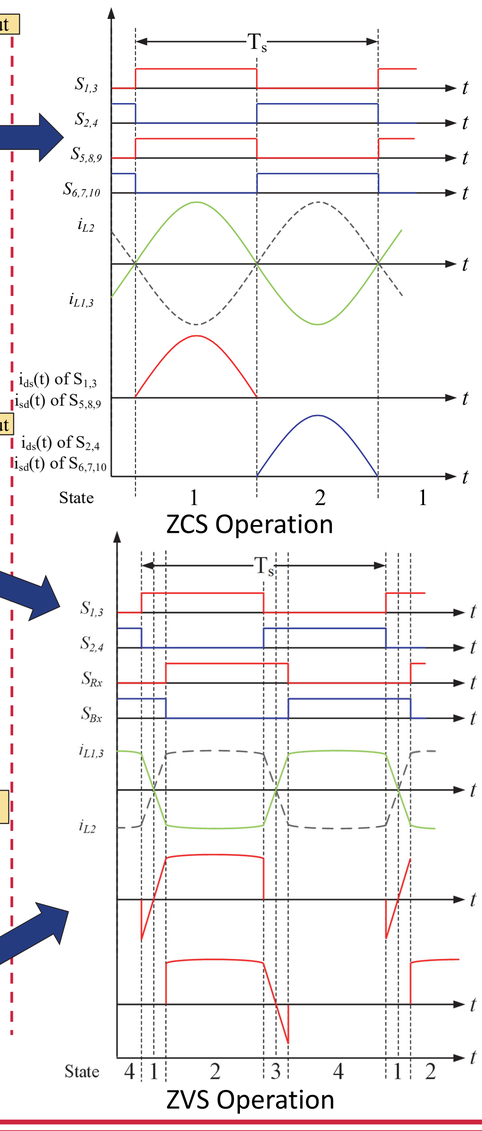
Switched-Tank Converter(STC)

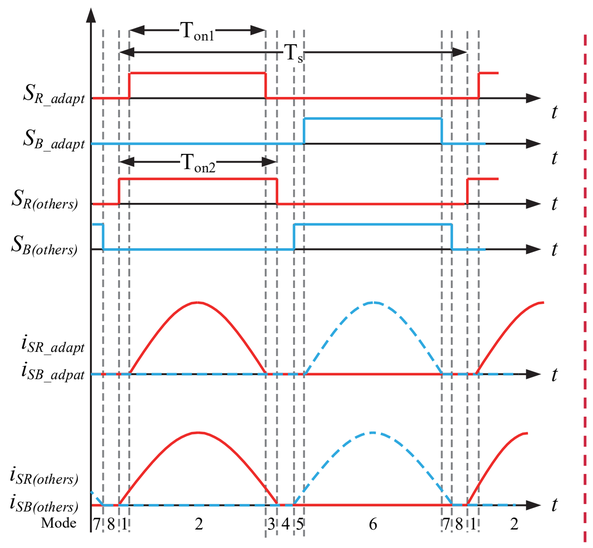


Switched-Capacitor Resonant Converter(SCRC)

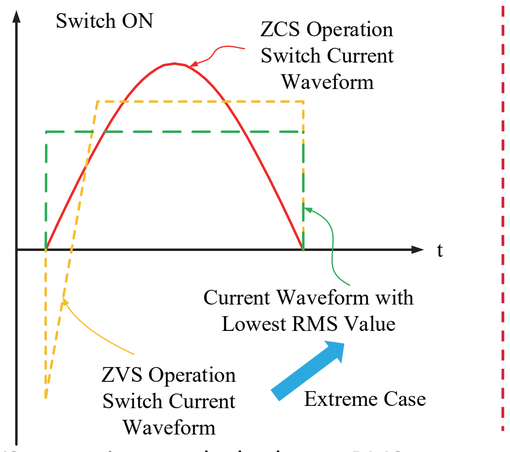


Switched-Tank Modular Converter(STM)

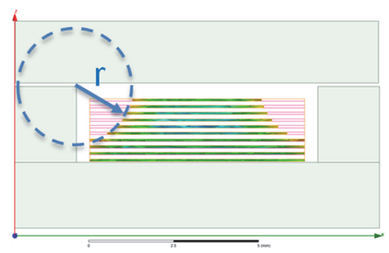




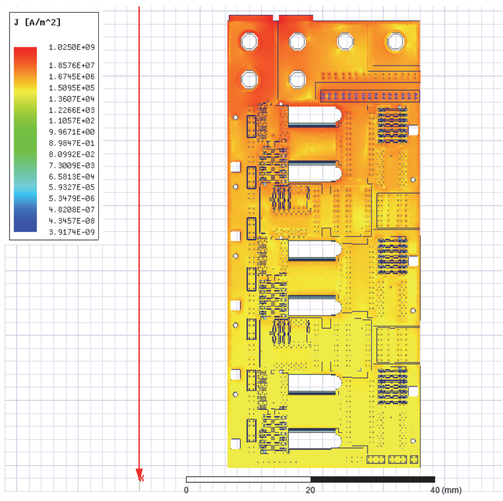
Adaptive On-time control method used to solve the unmatched resonant tank



ZVS operation reach the lower RMS current and restored switch Coss loss

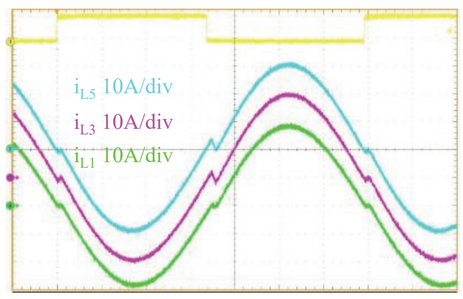


Applying orthogonal winding structure help minimized inductor power loss.

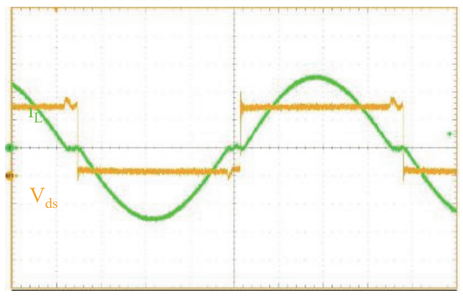


FEA software simulated PCB power loss distribution for GaN-based prototype at 450W

Experimental Results and Efficiency Analysis

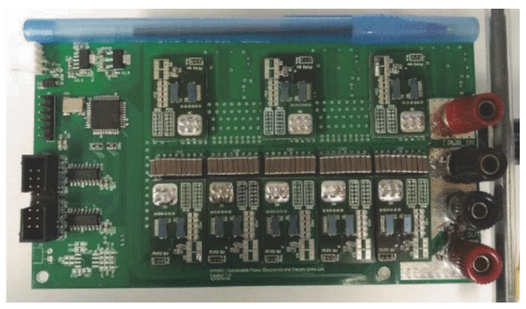


STC ZCS inductor current

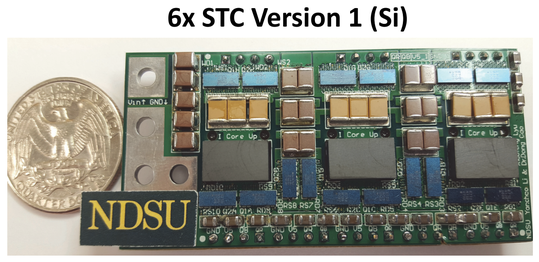


STC ZCS waveform

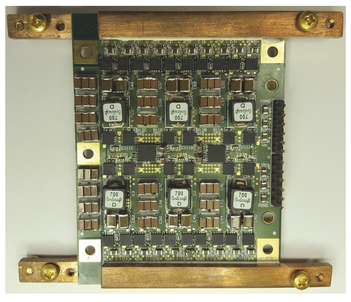
STC full load thermal performance



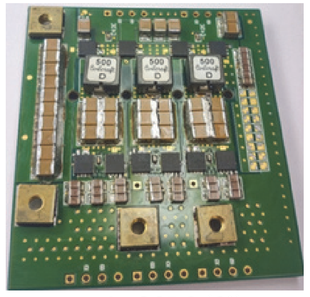
6x STC Version 1 (Si)



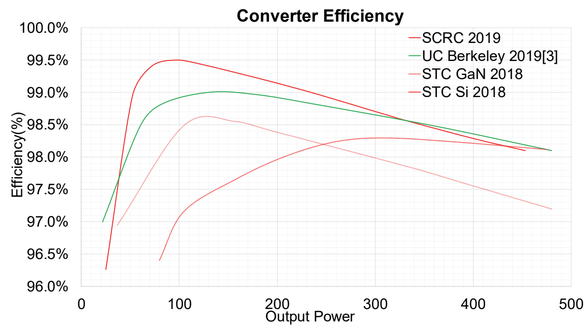
6x STC Version 2 (GaN)

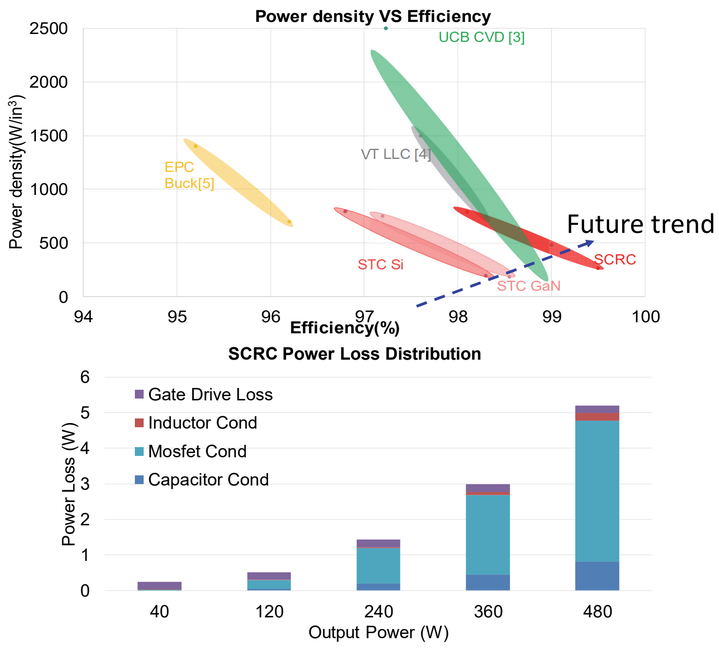


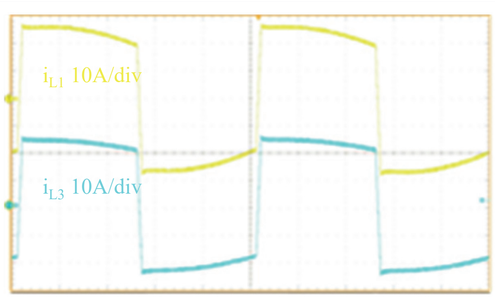
6x STC Version 3 (Si 2 phase)



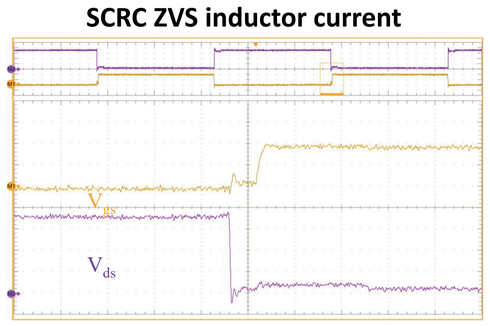
4x SCRC (Si)



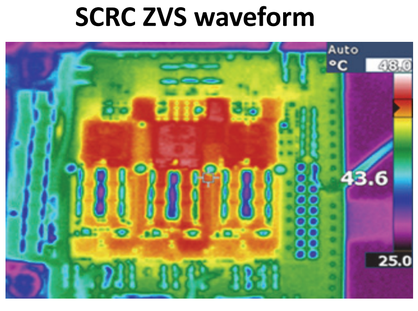




SCRC ZVS inductor current



SCRC ZVS waveform



SCRC full load thermal performance