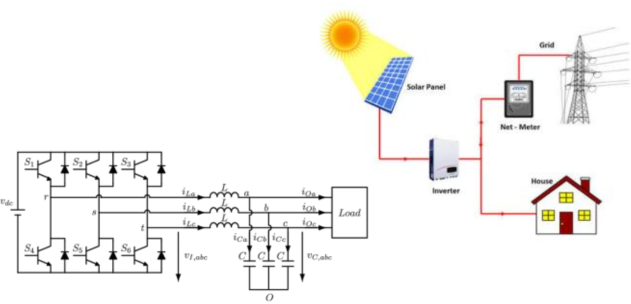
导师经历简介 – 吴德亮

2010	华中科技大学	学士	电气工程
2015	华中科技大学	博士	电力电子与电力传动

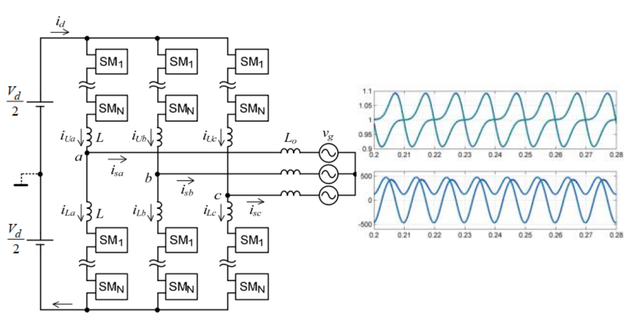
2015 - 2018	华为技术有限公司	Senior Research Engineer

2018 - 2020	Arizona State University	Postdoctoral Scholar

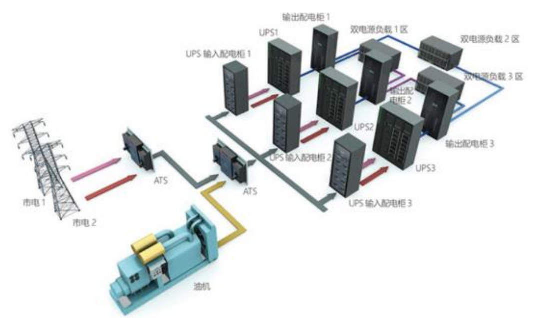
设计实现功率变换器（电路，控制）1~100 kW
工业电源，有源电力滤波器，光伏发电控制器



研究：电力电子变换器建模与控制
博士论文：模块化多电平变换器谐波分析与抑制

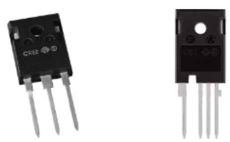


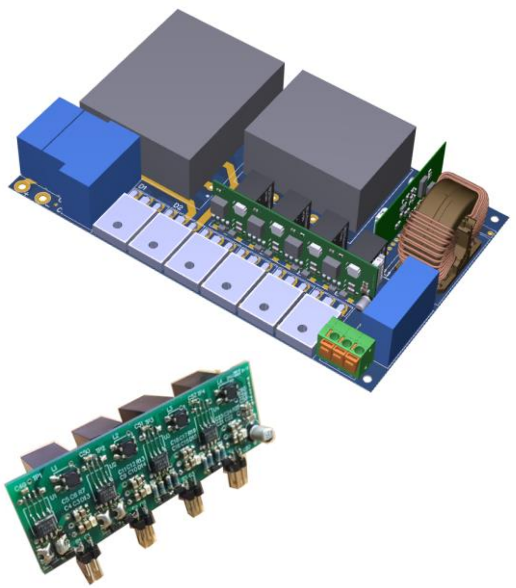
2012实验室 – 中央研究院
ICT设备（服务器，数据中心，基站）电源系统
接近电源极限时的特性



智能光伏逆变器，光伏电站
严格硬件成本控制下软件算法开发
动态特性分析与控制

宽禁带功率器件 SiC MOSFET 1200V
功率硬件设计 效率 功率密度





Achievements

- 5 SCI Papers (IEEE/IET)
  4 first-auth. 1 co-auth.
  3 一区, 1二区, 1三区
- 1 Patent
- 7 Conference (EI) Papers
- 200+ Citations

2020年 上海市国际人才XSC计划 青年优秀人才

2017年 华为技术有限公司 – 瓦特实验室 – 明日之星

2017年 华为技术有限公司 – 中央研究院总裁嘉奖令 – 最佳技术成果转化奖

2018年 华为技术有限公司 – 网络能源产品线逆变器业务部 – 部长奖

2013年 University of Texas at San Antonio, Valero Award

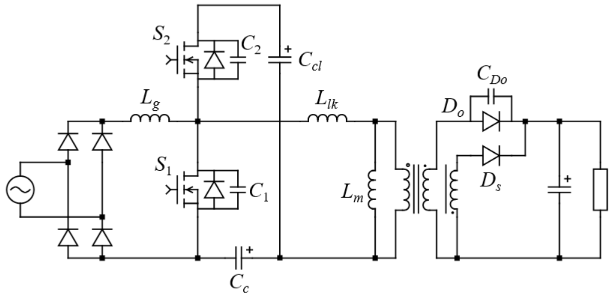
- 国家自然科学基金项目，面向电网的高阶变换器多元网结构控制研究，51577078，2014-2016.
- 博士学位论文创新基金，直流电网用高压变换器研究，2014-2015.
- The United States National Science Foundation, Megawatt Electric Vehicle Superfast Charging Stations with Enhanced Grid Support Functionality as Energy Hubs, Award Number 1151126, Awarded Amount $320,000, 2012–2015.
- 华为技术有限公司中央研究院，能源互联网关键技术，2016-2018.
- Co-PI, PowerAmerica, Isolated, Soft Switching SEPIC with Active Clamp for 480 V AC to 400 V DC Rectifier for Data Centers, $100,000, 2018-2019.
- Co-PI, EV-STS, High Frequency Power Converters for Electric Vehicles, $100,000, 2017-2019.
- Co-PI, Department of Energy Solar Energy Technology Office, Enhancing Grid Reliability and Resilience through Novel Distributed Energy Resource Control, Total Situational Awareness, and Integrated Distribution-Transmission Representation, $3,000,000, 2019-2021.

- IEEE Member，IEEE PELS Member
- Session Chair, IEEE 7th Workshop on Wide Bandgap Power Devices and Applications (WiPDA), Raleigh, NC, 2019
- Reviewer, IEEE Transactions on Power Electronics, IEEE Transactions on Energy Conversion, IEEE Applied Power Electronics Conference and Exposition (APEC), IEEE Energy Conversion Congress and Exposition (ECCE)

主要研究方向

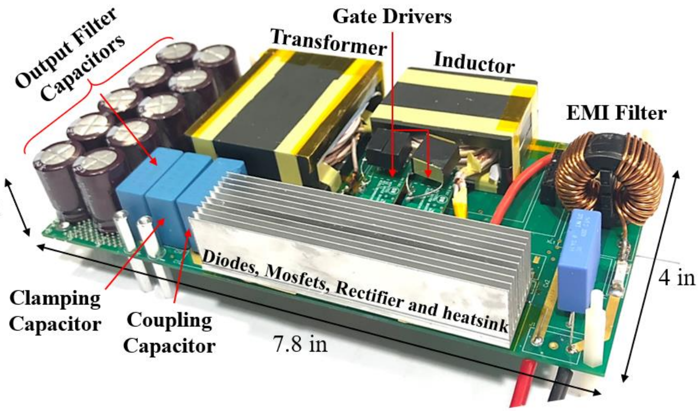
1. 宽禁带功率器件（碳化硅、氮化镓）应用
2. 高效率高功率密度电源（数据中心、5G通信、消费电子等）
3. 电动汽车驱动系统，快充，直流充电桩，车上电源
4. 光伏发电与并网控制

1. Isolated Active-Clamped SEPIC PFC Converter

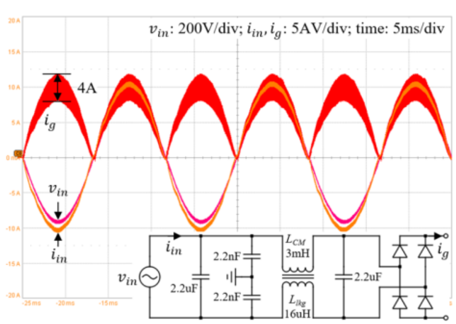


58 W/in^3 (w/ Al. caps)
3.54 kW/L

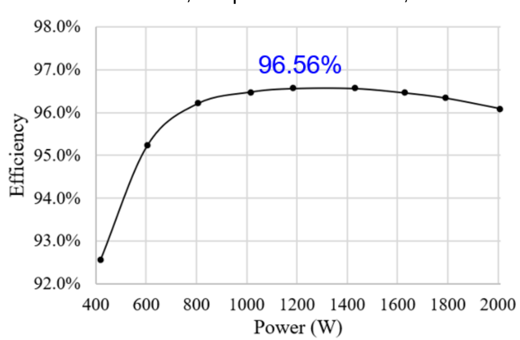
70 W/in^3 (w/o Al. caps)
4.27 kW/L



2kW, PF = 0.9991 and THD_i = 1.91%



Input: 277 Vrms 60Hz, Output: 400 Vdc 2kW, Fsw = 200kHz



Features

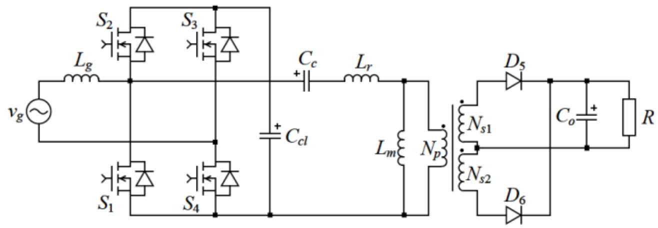
- SEPIC – Isolated, step up/down
- Active clamping, limiting voltage stress
- ZVS for both transistors
- Suitable for half-bridge gate drive
- Lossless snubber for output rectifier
- ZVS → high switching frequency → size and weight reduction in magnetics
- High control bandwidth, fast response, low distortion
- Modular design, single-phase module → three-phase PFC converter

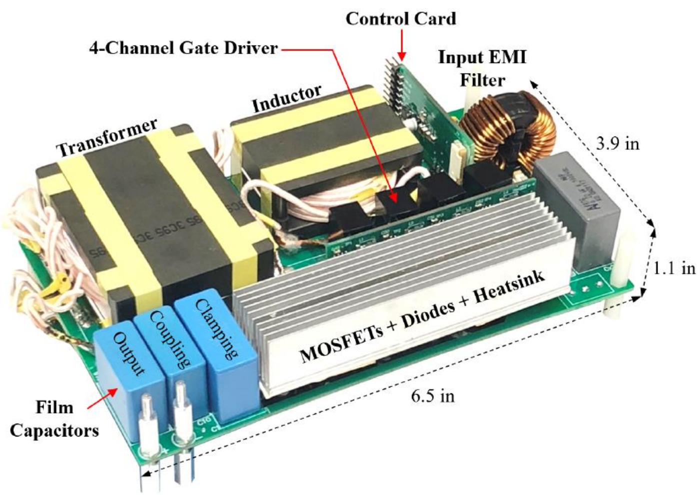
Applications

- Data center power supply
- EV charging station
- On-board charger
- Aircraft power supply
- LED driver

D. Wu, R. Ayyanar, M. Sondharangalla and T. Meyers, "High Performance Active-Clamped Isolated SEPIC PFC Converter with SiC Devices and Lossless Diode Clamp," in IEEE Journal of Emerging and Selected Topics in Power Electronics, 2019.

2. Totem-Pole Active-Clamped SEPIC PFC Converter

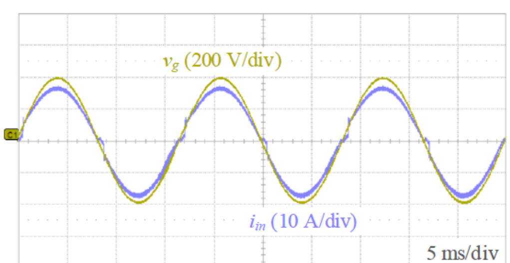


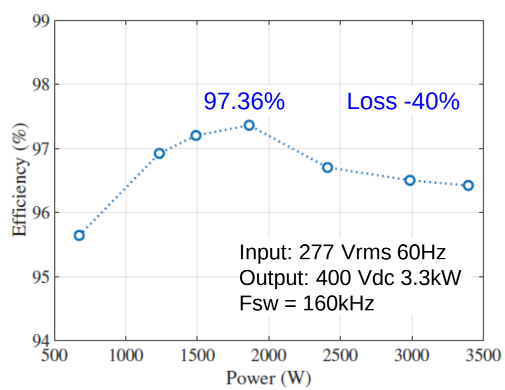


101 W/in^3 (w/ Al. caps)
6.2 kW/L

120 W/in^3 (w/o Al. caps)
7.3 kW/L

THDi = 4.4%, PF = 0.998 at 3.3kW





Features

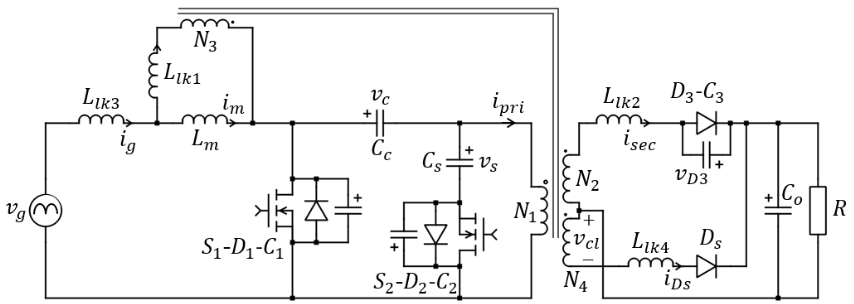
- Bridgeless PFC converter
- SEPIC – Isolated, step up/down
- Active clamping, limiting voltage stress
- ZVS for both transistors
- Suitable for half-bridge gate drive
- Lossless snubber for output rectifier
- ZVS → high switching frequency → size and weight reduction in magnetics
- High control bandwidth, fast response, low distortion
- Modular design, single-phase module → three-phase PFC converter

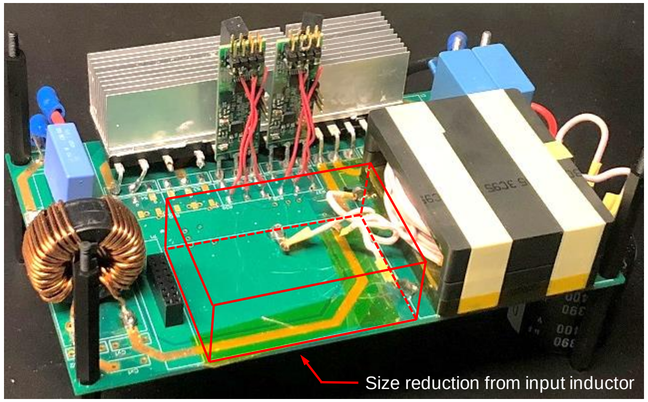
Applications

- Data center power supply
- EV charging station
- On-board charger
- Aircraft power supply
- LED driver

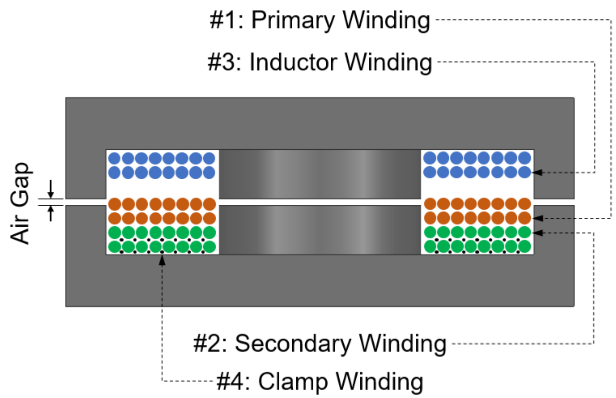
D. Wu, R. Ayyanar, M. Sondharangalla, "Isolated Bridgeless Totem-Pole PFC Converter Based on Active-Clamped SEPIC," submitted to IEEE Transactions on Power Electronics.

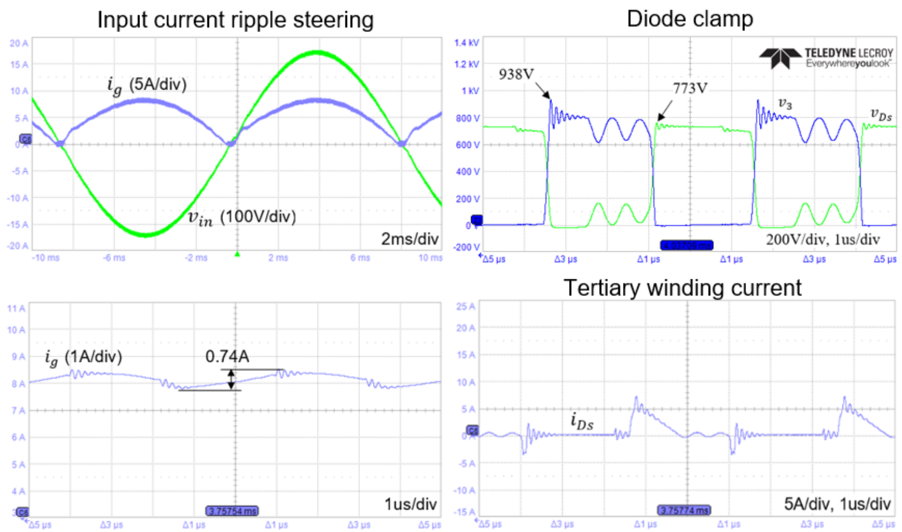
3. Integrated Magnetics and Ripple Cancellation





Power Density
+21%

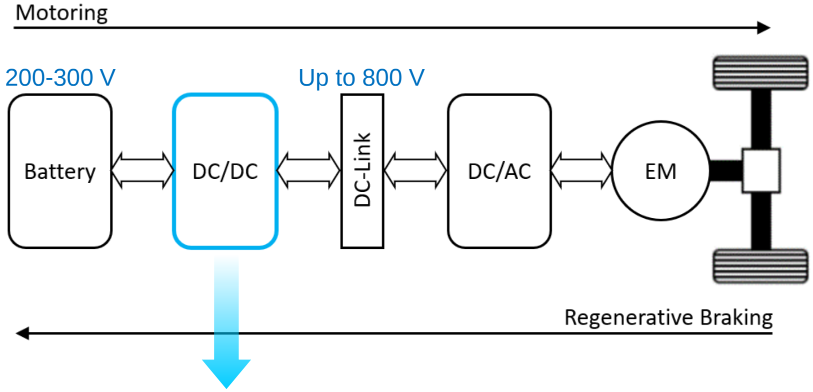




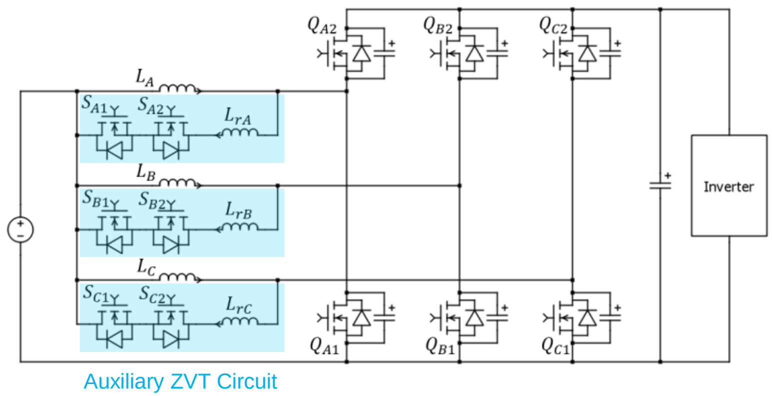
- Integrate input inductor with isolation transformer
- Cancel input inductor current ripple
- Utilize leakage inductance for soft switching
- Low current clamp winding

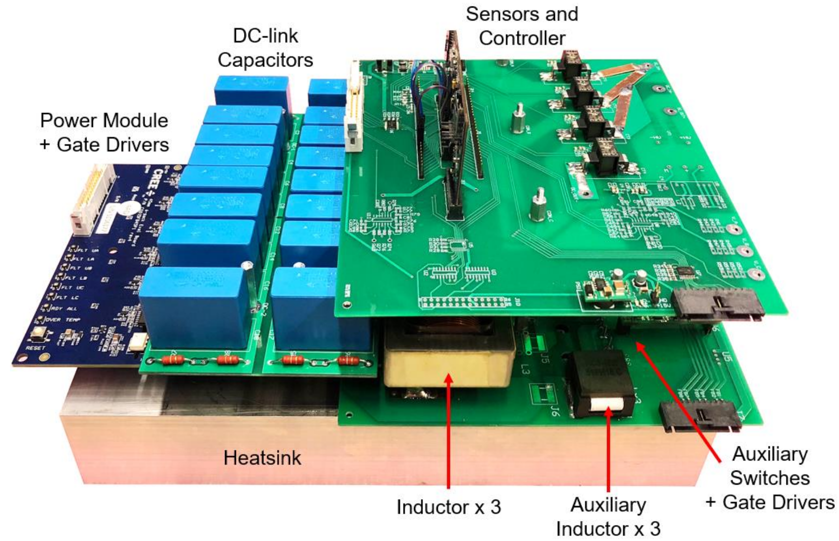
D. Wu, R. Ayyanar, ``Isolated Active-Clamped SEPIC PFC Converter Based on SiC Devices and Integrated Magnetics," 2019 IEEE 7th Workshop on Wide Bandgap Power Devices and Applications (WiPDA), Raleigh, NC, 2019.

4. Soft-switching Bi-directional Boost/Buck Converter



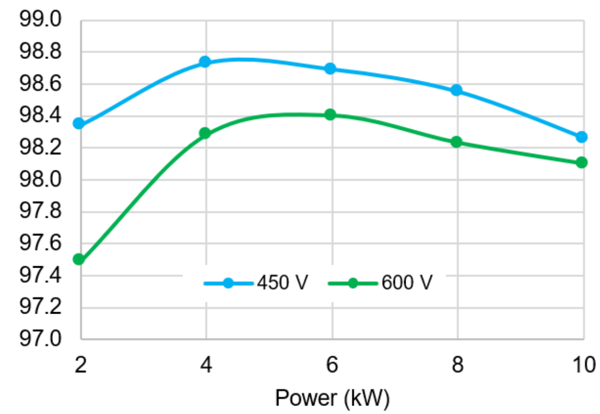
Interleaved ZVT Buck/Boost Converter





>98% efficiency with Fsw = 250 kHz

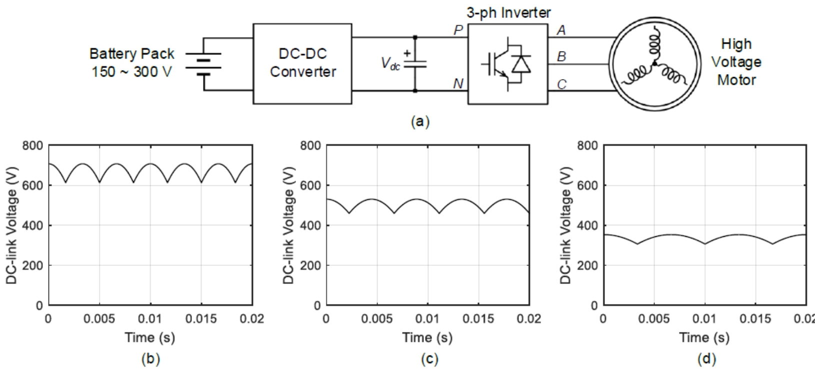
Efficiency of one phase leg

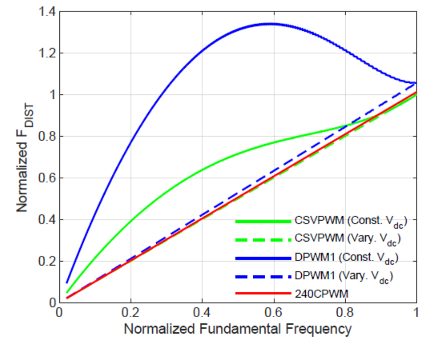


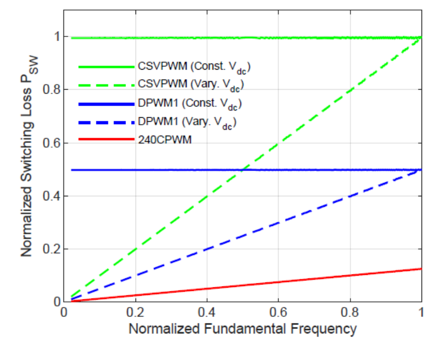
- **Soft switching, low switching loss**
- **High switching frequency**
- **Reduced passive component size**
- **Interleaving, low current ripple**
- **Improved and flexible power capability**

D. Wu, R. Ayyanar, ``High Frequency ZVT Converter for Variable DC-link in Electric Vehicle Traction Drive," 2019 IEEE 7th Workshop on Wide Bandgap Power Devices and Applications (WiPDA), Raleigh, NC, 2019.

5. Advanced Pulse Width Modulation Technique



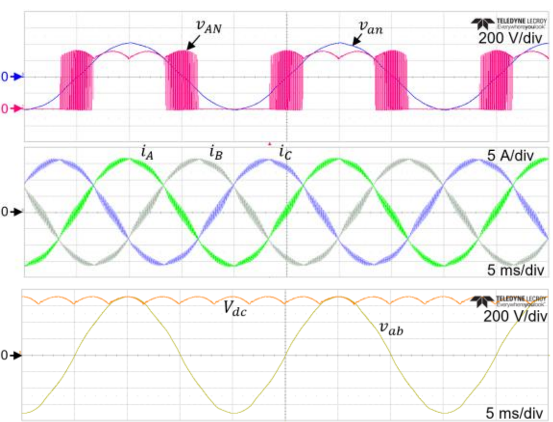




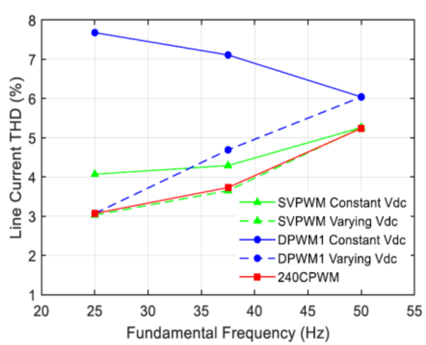
- **240° clamping operation**
- **Eliminating the use of zero states**
- **8x reduction in switching losses compared to CSVPWM (PF = 1.0)**
- **Comparable or better THD performance**
- **Lower dc link ripple current → capacitance reduction**
- **Significant reduction in common-mode voltage**

- **EV traction inverter**
- **Three-phase solar inverter**
- **Motor drives**

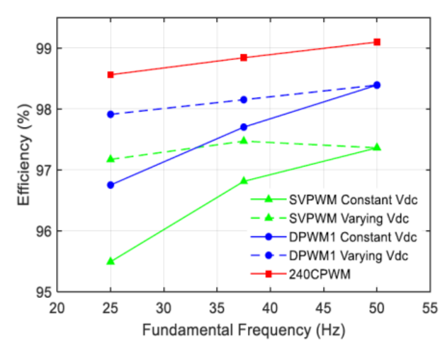
Measured waveforms



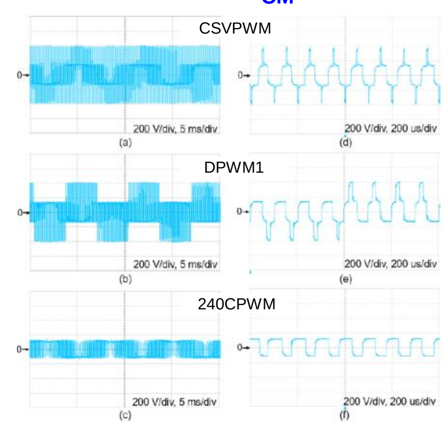
Low THD



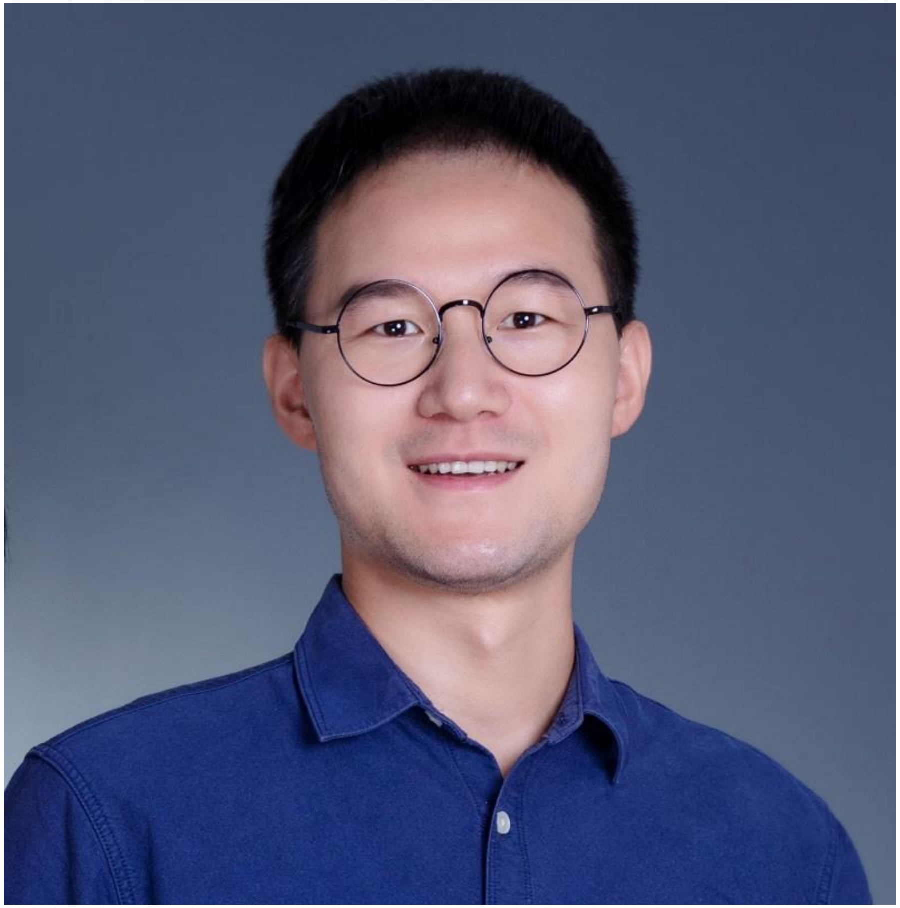
Low Loss



Low V_{CM}



D. Wu, Hafsa Qamar, Haleema Qamar and Raja Ayyanar, ``Comprehensive Analysis and Experimental Validation of 240°-Clamped Space Vector PWM Technique Eliminating Zero States for EV Traction Inverters with Dynamic DC Link," accepted for publication in IEEE Transactions on Power Electronics.



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