High Efficiency DC-AC Inverters for Alternative Energy Systems

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About Me

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Project Introduction

Modern power grids allow wide distribution of Alternating Current (AC) Power, but many sources of of renewable power output Direct Current (DC). Power Inversion allows for integration of sustainable energy sources to the power grid, but modern inverters have inefficiencies and low tolerances due to limitations related to the use of silicon substrates. Our inverter design incorporates GaN wide-bandgap semiconductor materials in order to greatly reduce waste and increase flexibility in connecting sustainable energy sources to the power grid.

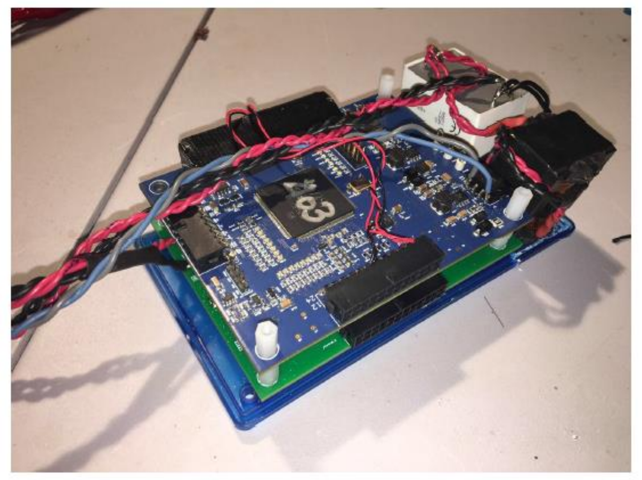

Figure 1
Assembled Inverter package

State of Knowledge

Wide-bandgap semiconductors are less studied than traditional silicon based semiconductors, but exhibit more promising results at higher operating operating temperatures and powers, thereby making them more appealing for power electronics applications.

Relation Sustainable Mg.

Improved inverters provide raw power resources for manufacturing purposes and allow manufacturing-level forward supply chain sustainability improvements. Increased efficiency leads to lower power usage and cost in manufacturing systems.

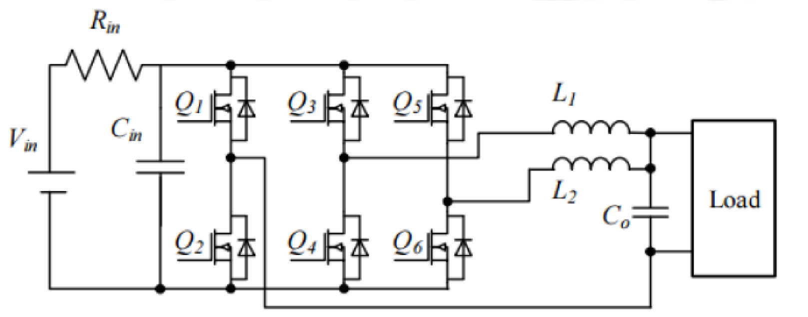

Figure 2
Inverter Topology

Approach

Incorporating Gallium Nitride (GaN) based MOSFET semiconductors into a single phase full bridge inverter with active and passive filter components allows for the creation of an inverter with MHz level switching frequency and smaller passive components while also reducing the overall inefficiencies associated with switching losses in larger MOSFET devices.

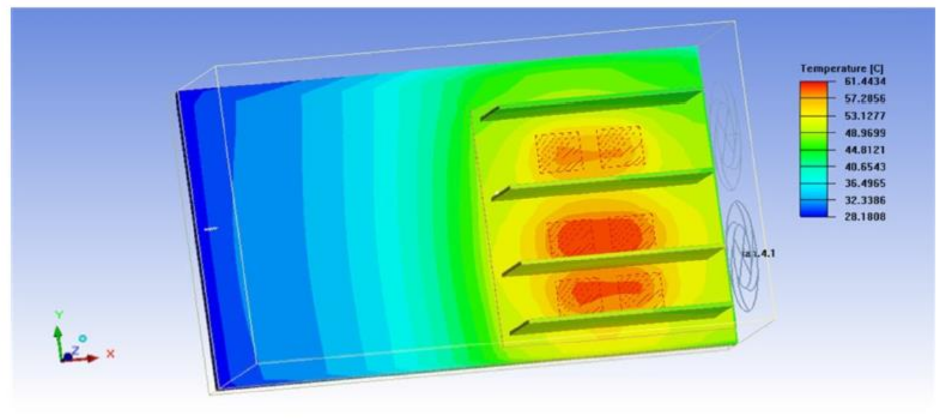

Figure 3
FEA Model

Results

Inverter testing at 0.5kW, 1.5kW, and 2.0kW power levels indicates an overall inverter efficiency of 98%. Thus it is a significant improvement over conventional designs.

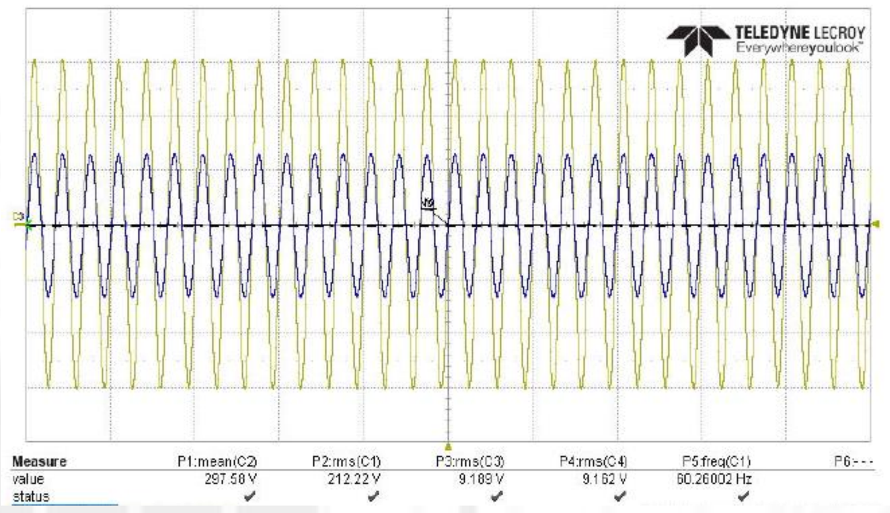

Figure 4
Inverter testing at 2kW (212V,9A Output)

Conclusions

Our inverter design greatly reduces overall system size, complexity, and waste relative to commercial inverters. Integration of GaN based MOSFETs shows great promise for high power applications. Future testing of the design would include testing at 3-8kW power levels.

Acknowledgements

This work is supported by the NSF REU program (Award No. 1461031).
Testing results made possible by the contributions of Duan Chen and Chen Guang Jiang.

References

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