Our project consisted of designing and implementing a silicon-carbide based DC/DC converter for high voltage applications. While providing supplementary training videos targeted for undergraduate students, the goal was to both experience the design process and grant future students the opportunity to test and manufacture our design. This project is sponsored by the Department of Energy with an emphasis to create educational modules. Our project can impact the industry by increasing efficiency in applications such as data centers and EVs.

Methodology

Design objective and goal
Our design objective was to create a step-down DC/DC converter using silicon-carbide MOSFETs. We created a Buck converter that steps down from 400V to 200V with an output of 5A at 300kHz. One of its greatest advantages of this design is the isolation that protects our expensive components to set up for the manufacturing phase. Through simulation, we have concluded that the dual power supply topology will provide us with the greatest efficiency of 95%.

Transition to Real Components
For our project, we converted our schematic into real components to set up for the manufacturing phase. Through Digkey and Wurth Electronics, we picked out purchasable components that were properly rated in voltage, current, and power. This also allowed us to import footprints in preparation to PCB layout.

Analysis and Results
We then incorporated current and voltage sensors to provide a feedback signal to the digital controller. An isolation amplifier was used to power the gate driver and sensors while maintaining the isolation of the gate driver. We also included power regulators to provide the sensors and gate drivers with appropriate supplies. Lastly, test points were placed throughout the circuit for easy test measurements and data gathering.

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Summary/Conclusions
In conclusion, goal of our project was to show the process of creating a DC/DC converter using silicon-carbide MOSFETs from research up to manufacturing and testing. We learned the benefits that can be achieved due to using silicon-carbide and the implications it will have on emerging technology around us. Building a DC/DC converter from start to finish has given us invaluable information that will help us in our careers. Furthermore, the opportunity to create learning modules will lead future students learn more about silicon carbide.

Key References

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