Performance Benchmark of Parallel SiC and Hybrid GaN-SiC Power Switches

By Wassim Faker

Table of Contents

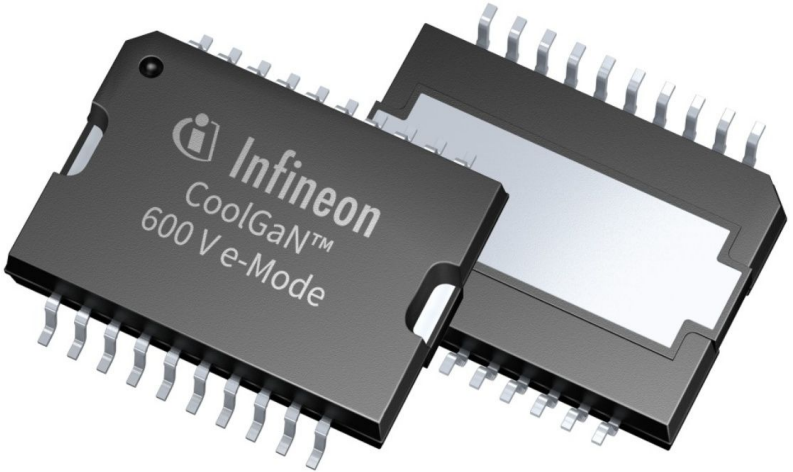
Wide Bandgap Semiconductors

- Due to recent advancements, the Si has approached its limit for power application, which require higher blocking voltages, switching frequencies, efficiency, and reliability.
- **WBGs** has become the focus of study in the search of a replacement for the Si semiconductors.
- Candidates for these devices are Silicon Carbide(SiC), Gallium Nitride(GaN) and Diamond.

Wide Bandgap Semiconductors

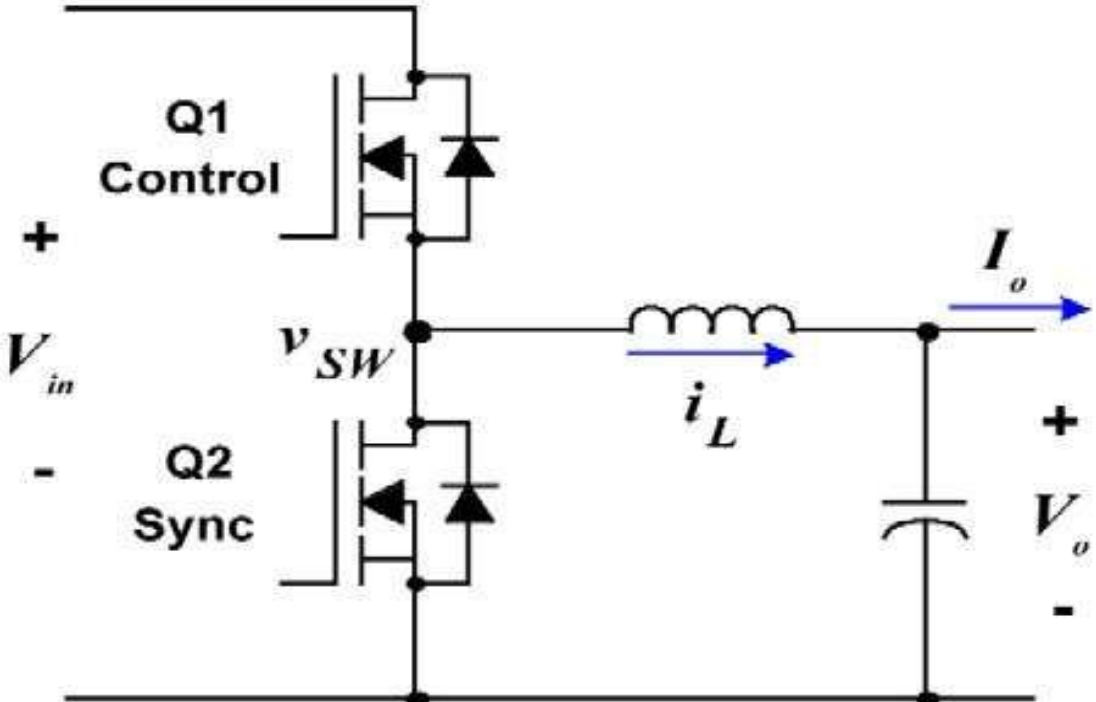
Silicon Carbide

Gallium Nitride



Buck Converters

A buck converter is a DC-DC converter that steps down the voltage.



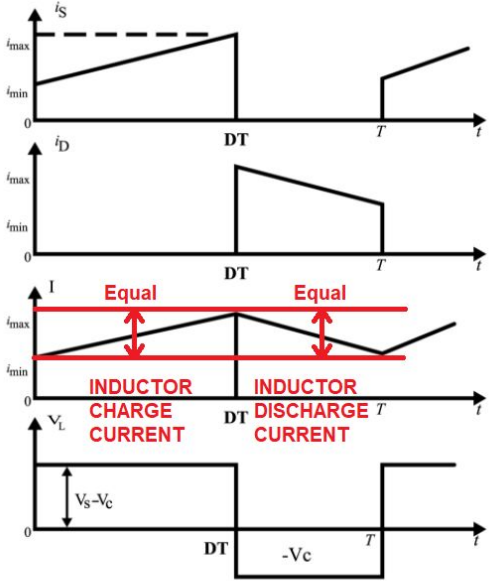


Figure 6. *Supply current I_s, diode current I_D, inductor current I, and inductor voltage V_L waveforms respectively (buck converter)*

Objectives of the Project

- Measure the **GaN SiC Hybrid** configuration efficiency compared to the SiC in parallel configurations

- Develop a **PCB** setup for further testing

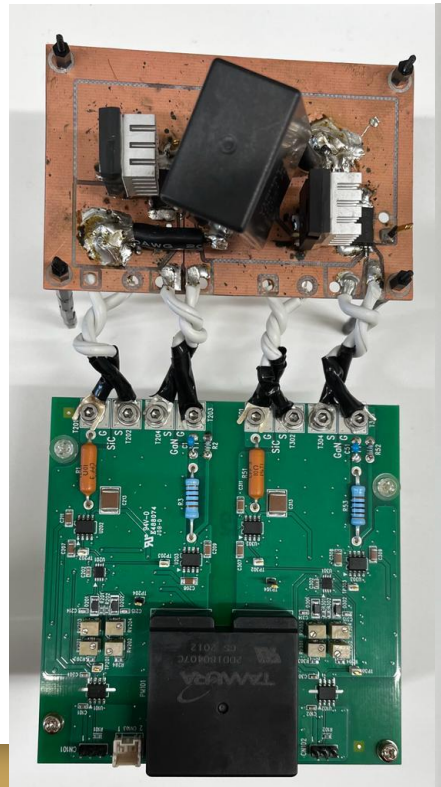
Methods to Achieve Our Objectives

- Method 1: Develop a buck converter setup to compare the power efficiency **SiC in parallel** and the **GaN-SiC Hybrid.**

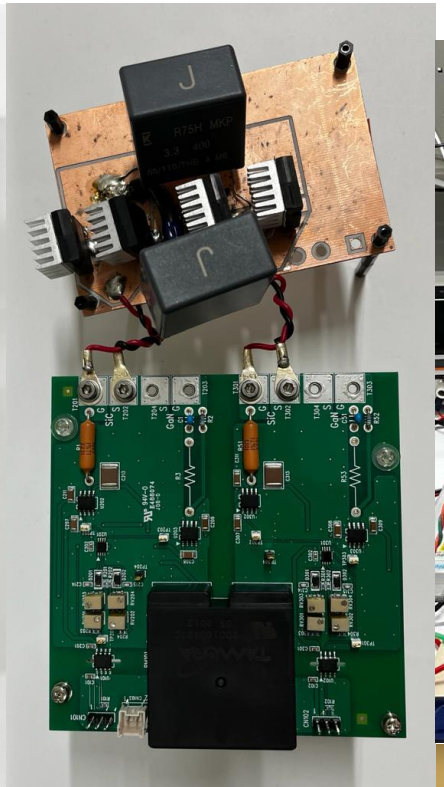
- Method 2: Developing a **PCB** capable of the standalone and parallel configurations analysis

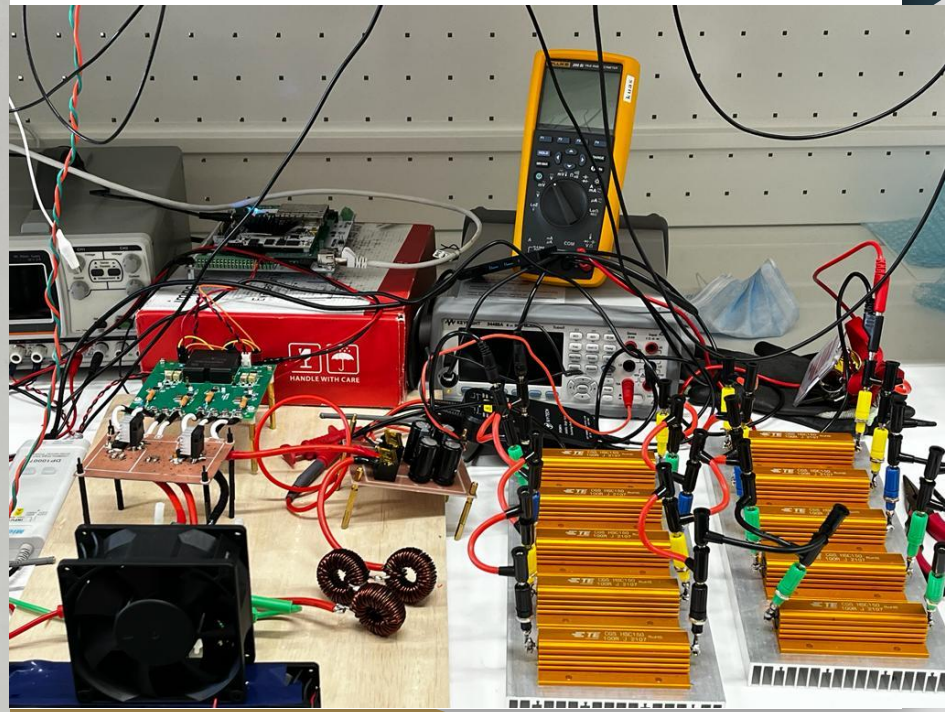
Methods to Achieve Our Objectives

-Hybrid GaN-SiC

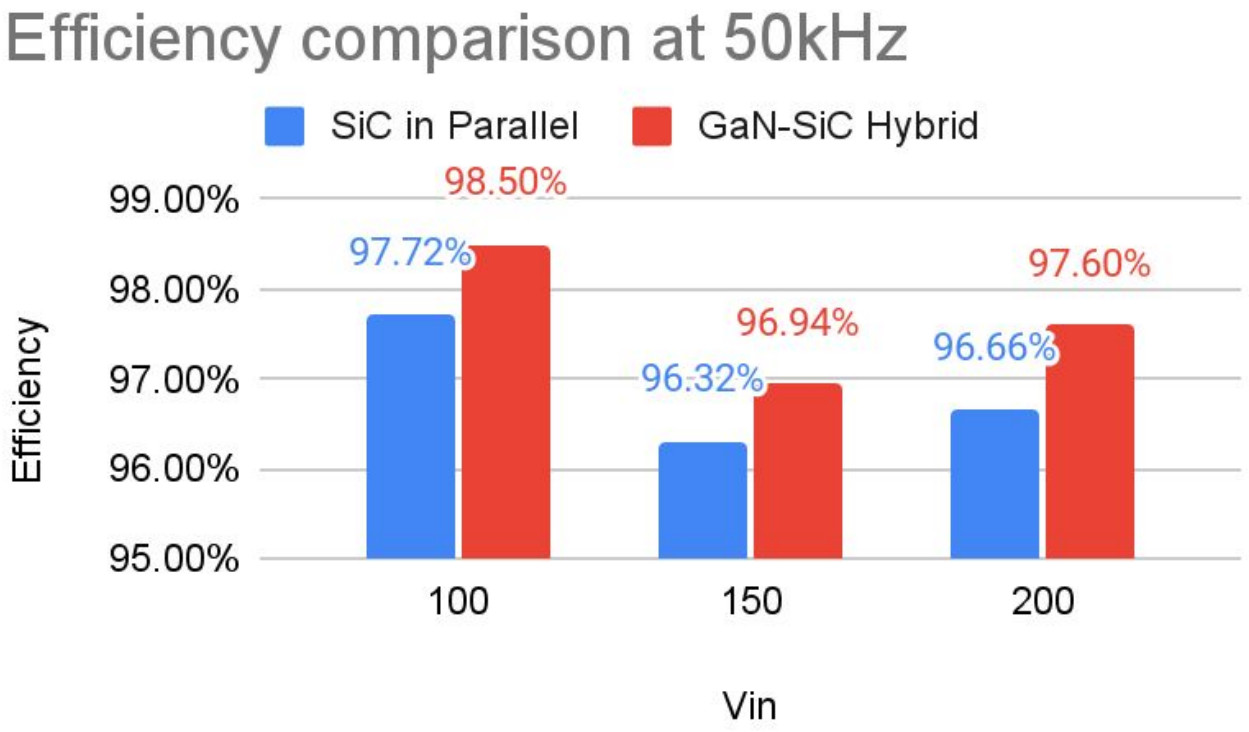


-SiC Parallel

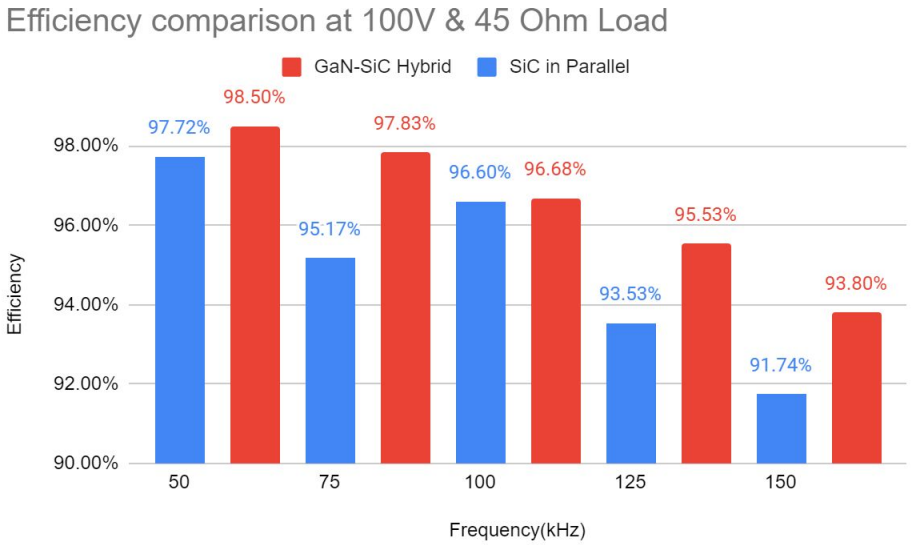


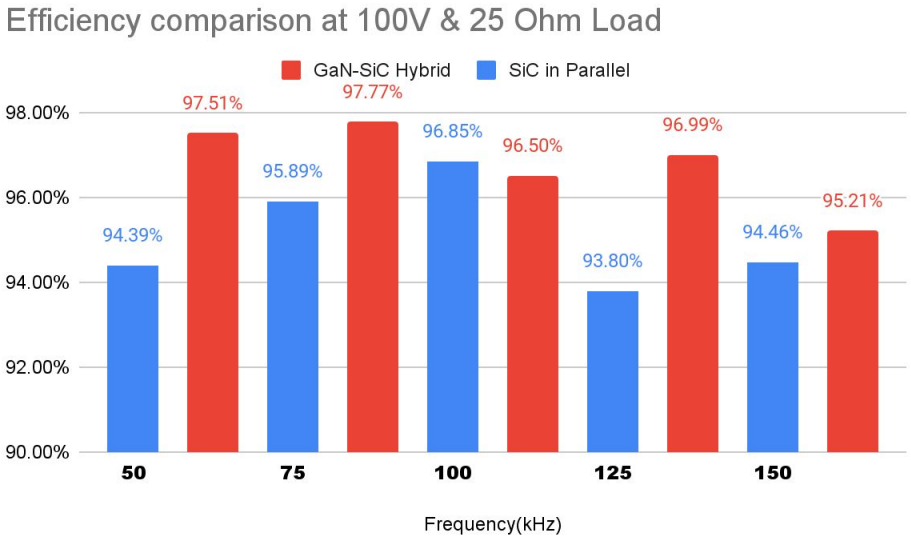


GaN-SiC vs SiC Parallel results



GaN-SiC vs SiC Parallel results





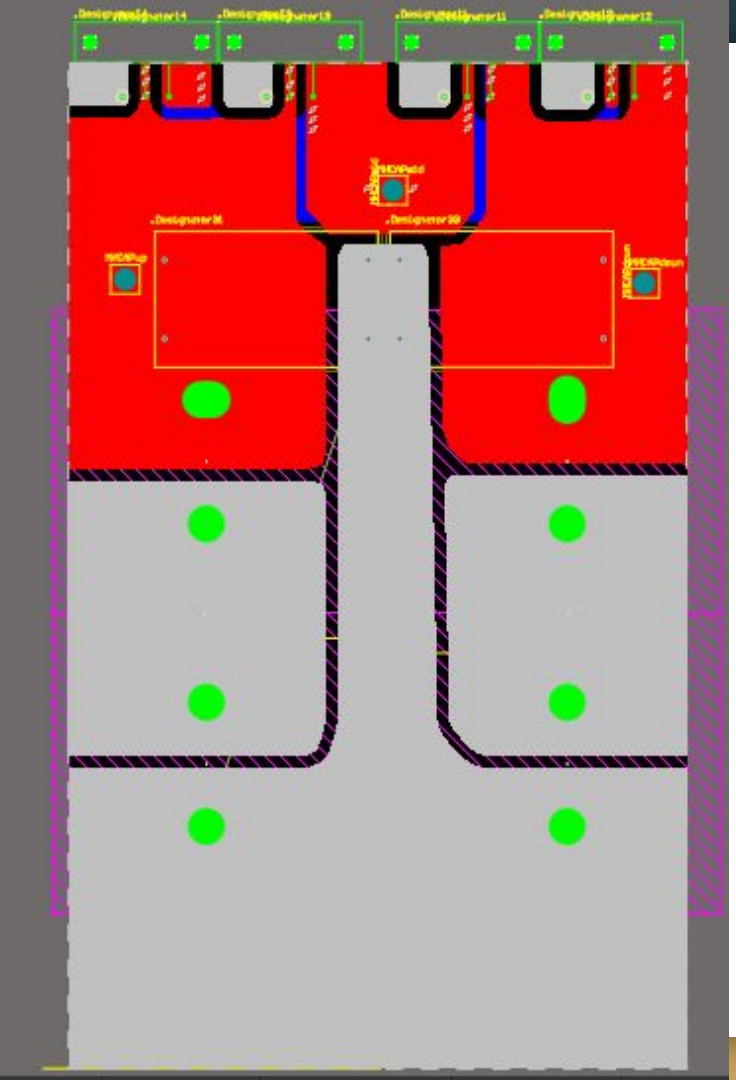
Coclusion: Synthesis and Analysis

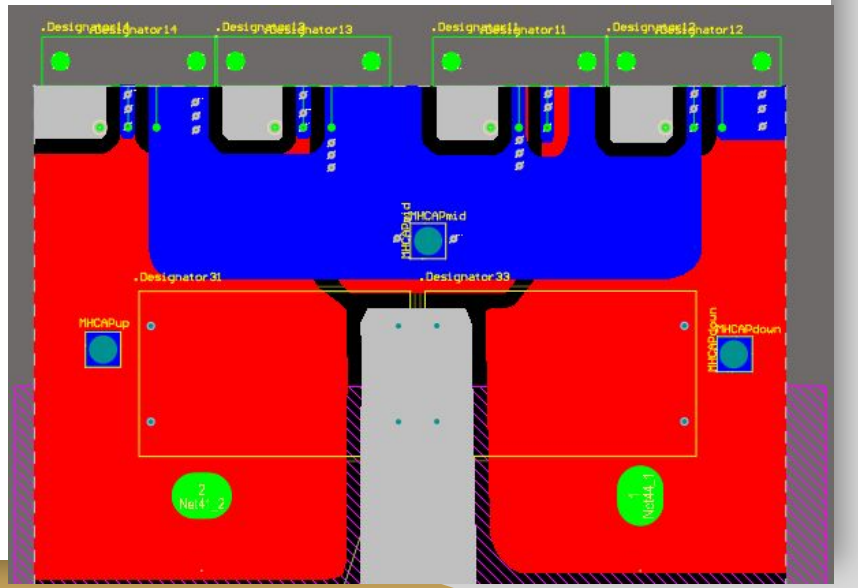
- The **Hybrid GaN-SiC** switch was more effective than the **SiC in parallel** when in came to power loss at different frequencies and loads.

Recommendations

- Conduct research on **GaN** in Parallel.
- Conduct **Double Pulse Test** on the three circuits.
- Conduct **Thermal Analysis**
- Introduce a more efficient **heat sink**
- Conduct a similar research using the **PCB** shown below.

PCB Design





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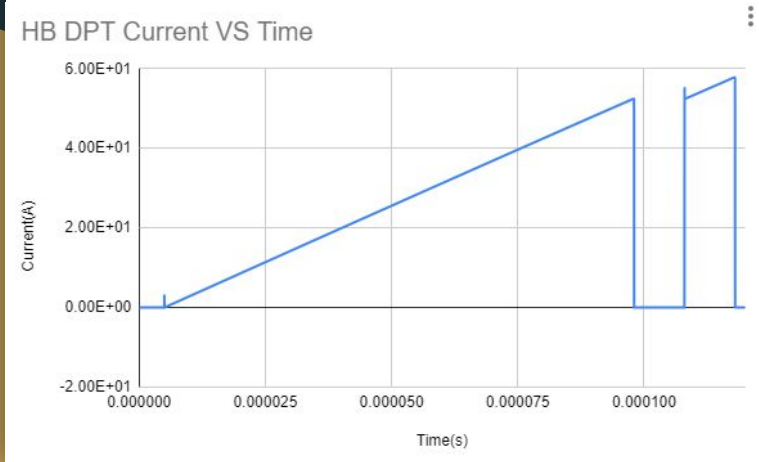
Thank You!

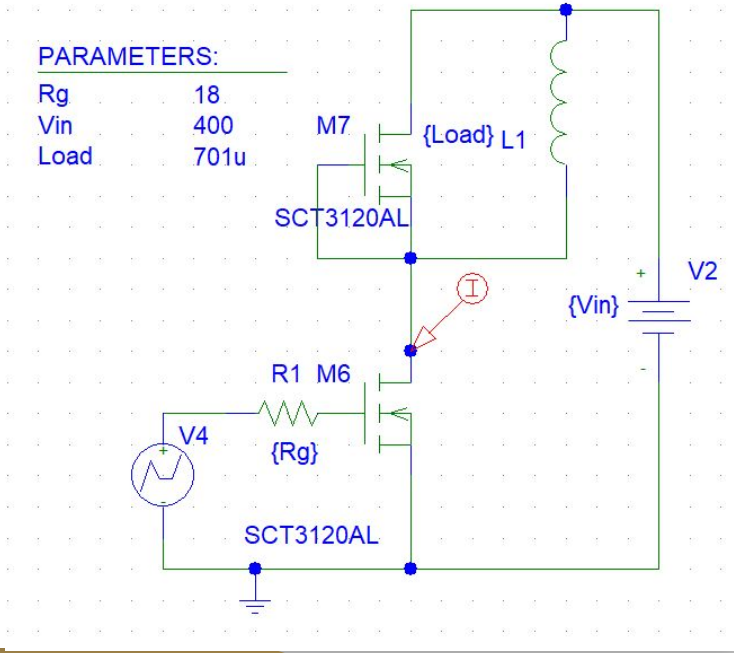
Questions?

Double Pulse Test(DPT)

DPT is a tool that allows a power stack under worst-case operating conditions.

$$I = \int \frac{V}{L} dt$$

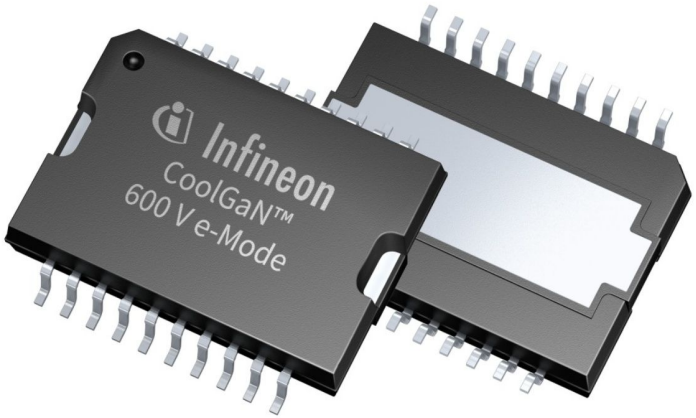




Transistors used:

SCTW35N65G2V

IGO60R070D1



PCB Materials