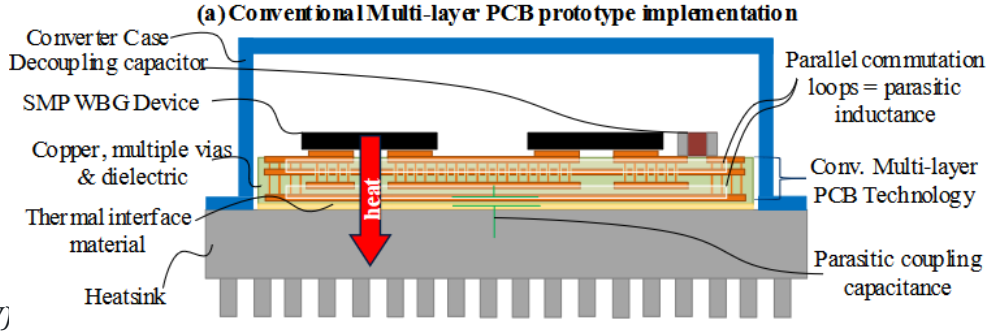
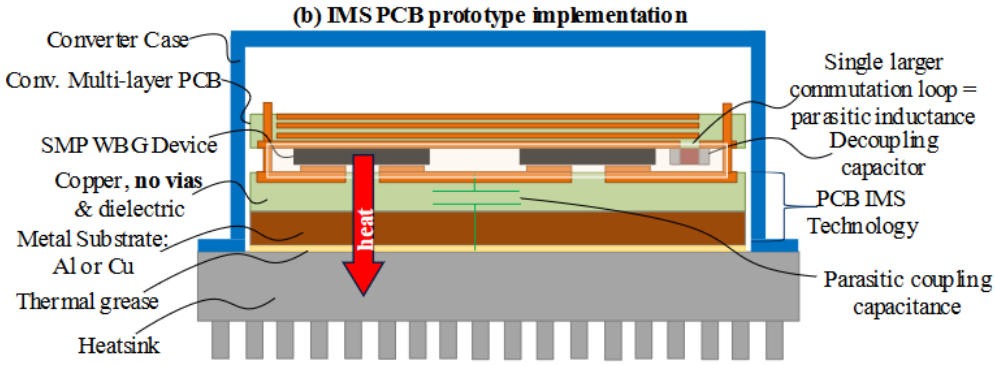
Next-Generation On-board EV Chargers: Exploring Advanced Thermal Management for Compact and Efficient GaN-based Converters

Master thesis project

GaN-CLLC Converter in the PE Lab (3 kW)





Summary:

Investigate, evaluate, and implement advantageous thermal management on an SMD (Surface-Mounted) GaN-based converter with controlled parasitic properties.

Problem definition:

The global electrification of transport has promoted an increasing demand for more efficient and compact power electronic systems featuring WBG semiconductor devices, e.g., Gallium Nitride (GaN). The fast-switching WBG devices pose a great challenge to semiconductor packaging technologies because the parasitic parameters may undermine their performance. To minimize the parasitics, SMD packaging was introduced with compromised thermal management. Among many solutions, PCB featuring a single copper layer and dielectric material bonded to an insulated metal substrate (IMS) can help improve thermal performance.

This project aims to benchmark the thermal and electrical performance of the conventional multi-layer PCB and the IMS PCB in the applications of soft-switched converters such as a CLLC in OBCs.

Method:

- Review the literature on the SMD WBG semiconductor devices and hardware thermal design;
- Model the thermal and electrical behavior of a GaN converter in a half-bridge configuration;
- Design and implement the conventional and innovative, e.g., IMS thermal management concepts;
- Test the prototype and benchmark the proposed concept from the electrical and thermal perspectives.

Research objectives:

This project aims to obtain a deep understanding of the design trade-off from the electrical and thermal perspectives of GaN-based converters. The outcome will be the proposal of suitable technologies and design guidelines to facilitate the usage of SMD GaN devices.

University of Twente.

Power Electronics and Electromagnetic Compatibility **PE Group**

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Courses and supervision:
POWER ELECTRONIC CONVERTERS (201900254);
Supervision: The supervision will be provided by Prof. dr. ir. T. Batista Soeiro (Thiago) with the assistance of Ph.D. student R. Qiang (Rui) under the PowerizeD EU project.

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