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10.09.2025

Research Thesis
Master Thesis

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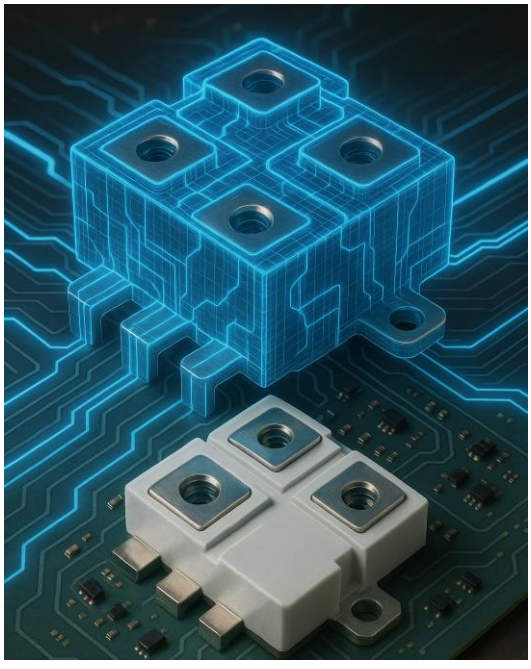
Digital Twin Development and Investigation of a 650 V Embedded GaN Half-Bridge

Abstract

The concept of the Digital Twin enables a seamless link between physical hardware and its virtual representation, providing new opportunities for system design, performance prediction, and reliability analysis. In this thesis, a 650 V embedded GaN half-bridge is modeled and investigated as a digital twin. The work includes the creation of an accurate electrical and thermal model, the validation of the simulation environment with experimental measurements, and the subsequent analysis of switching dynamics, losses, and reliability-relevant parameters. The digital twin will allow a deeper understanding of device behavior under different operating conditions and can serve as a foundation for further system optimization and real-time predictive control strategies.

Objects and Goals

- Literature study and introduction to GaN-based half-bridge topologies and digital twin concepts
- Development of an electrical and thermal simulation environment
- Parameter extraction from experimental measurements of the 650 V embedded GaN half-bridge
- Validation of the digital twin by comparing measurement and simulation results
- Investigation of switching behavior, efficiency, and thermal limits through the digital twin
- Exploration of use-cases for reliability prediction and system-level optimization



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