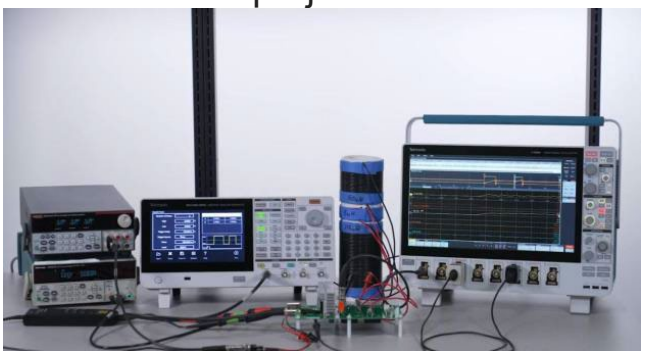
Next-Level Precision: Automated Measurement and Characterization of Wide Bandgap Semiconductor Devices in Power Electronic Systems

Master thesis project

[1]



[2]

Summary:
Investigate, evaluate, and implement methods to characterize Wide Bandgap Semiconductor (WBG) devices in power electronic converters via automated testing and data analysis.

Problem definition:

Promoted by the global electrification of transport, the increasing demand for efficient and compact power electronic systems has driven the adoption of WBG devices, such as Silicon Carbide (SiC) and Gallium Nitride (GaN) [3]. These materials exhibit superior properties, including high breakdown voltage, fast switching speed, and lower on-state losses. As power electronic systems evolve, accurate characterization of WBG devices becomes paramount for designing and optimizing these systems. This Master's thesis aims to investigate the dynamic characterization, measurement, and instrumentation utilizing Standard Commands for Programmable Instruments (SCPI), data post-processing, and analysis of the WBG devices in real power electronic converter. Throughout the journey, you will gain valuable insights into the WBG devices and hands-on experience with the state-of-the-art instruments in the PE laboratory.

Method:

- Review the literature on the characterization of WBG devices;
- Evaluate the instruments on the electrical/calorimetric approach to loss characterization;
- Develop an automated measurement setup for precise and repeatable characterization using SCPI;
- Analyze dynamic characteristics such as switching behavior, transient response, and thermal performance of WBG devices under varying operating conditions.

Research objectives:

- To analyze and obtain insights into the loss mechanism, and dynamic behavior of WBG devices, aiding in the design and optimization of power electronic converters;
- To develop and validate an automated measurement setup for WBG semiconductor devices, contributing to the standardization and advancement of characterization processes.

Courses and supervision:
Recommended courses: POWER ELECTRONIC CONVERTERS (201900254); ADVANCED SEMICONDUCTOR DEVICE PHYSICS (201900135).
Supervision: The supervision will be provided by Prof. dr. ir. T. Batista Soeiro (Thiago) with the assistance of Ph.D. students R. Qiang (Rui) and B.J. Oude Aarninkhof (Bram) under the PowerizeD EU project.

University of Twente.

Power Electronics and Electromagnetic Compatibility **PE Group**

Next-Level Precision: Automated Measurement and Characterization of Wide Bandgap Semiconductor Devices in Power Electronic Systems

Master thesis project

Contact:
Ph.D. Students:

ir. R. Qiang (Rui), r.qiang@utwente.nl; ir. B.J. Oude Aarninkhof (Bram), b.j.oudeaarninkhof@utwente.nl

Supervisor: Prof. dr. ir. T. Batista Soeiro (Thiago), t.batistasoeiro@utwente.nl

[1] Source: https://gansystems.com/newsroom/gan-systems-debuts-suite-of-low-cost-high-performance-gan-power-transistors/

[2] Source: https://www.tek.com/en/blog/double-pulse-testing-to-determine-energy-loss-on-wide-bandgap-mosfets

[3] P. Sun *et al.*, "Focuses and Concerns of Dynamic Test for Wide Bandgap Device: A Questionnaire-Based Survey," *Ieee T Power Electr*, vol. 38, no. 12, pp. 15522–15534, Dec. 2023, doi: 10.1109/TPEL.2023.3312563.