EPE'23 ECCE Europe – Call for Tutorials

Switching Loss Measurements in Power Semiconductors

Name(s) and Affiliation(s) of the Lecturer(s):

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Tutorial Objectives:

After providing a brief overview over the operation principle of Double Pulse Tests (DPT), this tutorial highlights the influence of the applied sensing equipment on the measurement. We investigate side effects of current and voltage probes on the Device under Test and provide possible solutions to get better results when characterising fast-switching Wide Band Gap (WBG) power semiconductors. The limits for the DPT method and estimates regarding the accuracy and applicability of the measurement principle are derived as well.

Target Audience:

This tutorial both targets participants that are new to the measurement of switching losses of power semiconductors as well as experienced researchers and application engineers who want to get a closer look at the details and pitfalls of such measurements.

Topical Outline:

Introduction and Overview to Switching Loss Measurements: (Estimated time: 45 minutes)

- Possibilities of switching loss measurements – transient and calorimetric
- Double Pulse Test in practice – setup, equipment, norms & standards
- Challenges due to fast switching Wide Band Gap devices
- Summary and Outlook

Topic 1: Correctly Measuring Transient Currents and Voltages: (Estimated time: 30 minutes)

- Overview of available probes
- Requirements of the Sensors for the usage in Double Pulse Test Setups
- Overview and Classification of available Sensors

Topic 2: Measuring Correctly vs. Measuring the Right Thing (Estimated time: 30 minutes)

- Qualitative Influence of Sensors on the Double Pulse Test
- Identification and Calculation of the influences and systematic errors

Topic 3: Available Sensors and their Suitability for Double Pulse Tests (Estimated time: 30 minutes)

- Application of the error analysis for available Sensors
- Development of a selection aid to select suitable Sensors

Topic 4: Possibilities for Error Minimizations (Estimated time: 30 minutes)

- Implications for practical measurements
- Possibilities to reduce the systematic errors
- Application to exemplary Sensors

Conclusions (Estimated time: 15 minutes)

- Conclusion and Discussion

Provisional Schedule of the Tutorial:

Schedule:

9:00 - 10:45: Introduction / Topic 1 / Topic 2

10:45 - 11:15: Coffee break

11:15 - 13:00: Topic 3 / Topic 4 / Conclusions

About the Lecturers:

Sebastian SPRUNCK studied electrical engineering at the University of Kassel, Germany, from 2010 to 2016. He received his B.Sc., M.Sc. and Ph.D. degrees in 2014, 2016 and 2021, respectively. In 2017, he started working as a research assistant at the Centre of Competence for Distributed Electric Power Technology (KDEE) at the University of Kassel where he worked on the miniaturisation of power electronic systems and on the application of wide band gap semiconductors in power electronic devices. Since 2020, he is working at Fraunhofer IEE in Kassel, Germany, in the Converters and Drive Technology Department as Group Manager Devices and Measurement Systems. He is investigating the influences of individual technological advances, such as wide band gap semiconductors, and of broader trends, such as the German "Energiewende", onto power electronic components, circuits and systems. His main interest focuses on the characterisation and optimisation of (WBG) semiconductor switching losses and their implementation in power electronic systems. Mr. Sprunck is a member of the VDE Association for Electrical, Electronic & Information Technologies and of the VDI Association of German Engineers e.V.

Marco JUNG completed an apprenticeship for communication electronics in 2003 and continued to study electrical engineering at the TH Mittelhessen University of Applied Sciences and at the University of Kassel, where he received his Diploma and M.Sc. degrees in 2008 and 2010, respectively. He continued his studies at the Leibniz University Hannover, where he received his Ph.D. degree in 2016. Parallel to his Ph.D. studies, he started working at the Fraunhofer IEE in 2010. Since 2017, he is head of the Converters and Drive Technology Department. In 2019, he additionally became a full Professor at the Bonn-Rhein-Sieg University of Applied Sciences, Sankt Augustin, Germany. At the Institute of Technology, Resource and Energy-Efficient Engineering, he is responsible for power electronics for renewable energies and electric vehicles. Mr. Jung is chairman of the IEEE Joint IES/IAS/PELS German Chapter since Jan. 1st, 2021. He is a member of the International Scientific Committee (ISC) of the European Power Electronics and Drives Association (EPE) and a member of the European Center for Power Electronics (ECPE).

Christian LOTTIS studied electrical engineering at the University of Kassel, Germany, from 2014 to 2021. He received his B.Sc. and M.Sc. degrees in 2019 and 2021, respectively. Since August 2021, he is working as a research assistant at the Bonn-Rhein-Sieg University of Applied Sciences, Sankt Augustin, Germany.