Organisational information

Sign up at : www.ecpe.org/events

Registration Deadline:

- **1 December 2021**

Practical Lab Course: restricted to 20 participants
(if necessary 2nd Lab Course for regional participants on 11 December)

Participation fee:

Part I Theory 13. Feb.	Package of Part I + Lab Course	
380,- €*	770,- €*	Industry
300,- €*	655,- €*	University
130,- €*	240,- €*	Students/ PhD students**

*plus 19 % German VAT
students seats are limited

- The regular participation fee includes dinner, lunches, coffee/soft drinks. The reduced (PhD) students fee includes all the above except for dinner (can be booked for an extra fee of € 50*)
- The presentations will be provided by email via a download link short before the event. A printed version of the tutorial handout is available on request (€ 50,-*).
- Upon receipt of registration confirmation via email you are signed-up for the event. The invoice will be sent via email.
- 25 % discount for participants from ECPE member companies.
- 10 % discount for participants from ECPE competence centres.
- Further information (hotel list and maps) will be provided after registration and can be found on the ECPE web page.
- Cancellation policy: Full amount will be refunded in case of cancellation up to 2 weeks prior to the event. After this date and in case of no-show 50 % of the fee is non-refundable (substitutes are accepted anytime).
- The number of participants for the Lab Course is limited to 20 attendees (Course is offered on 2 days).

Organisational information

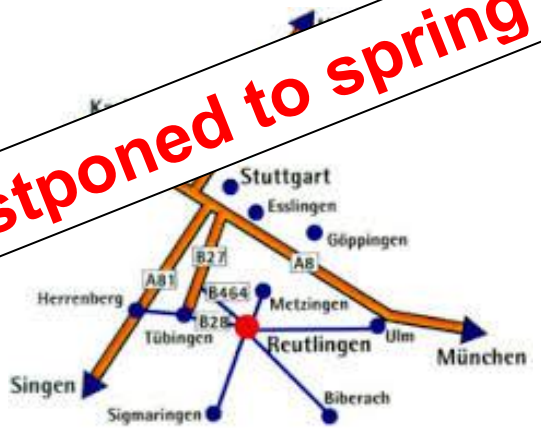
Organiser	ECPE e.V. 90443 Nuremberg, Germany www.ecpe.org
Chairmen	Prof. Ingmar Kallfass, University of Stuttgart
Organisation	Krista Schmidt, ECPE e.V. 0911 / 81 02 88 - 16 krista.schmidt@ecpe.org

Venue

08 Dec. 2021 -
Electronics & Drives
Oferdinger Strasse 50
72768 Reutlingen-Rommelsbach,
Germany

09 or 10 Dec. 2021
Bosch EPC-Labor
Robert Bosch GmbH
Tübinger Strasse 123
72762 Reutlingen, Germany

Postponed to spring 2022



Reutlingen is close to Stuttgart. The distance between both venues is about 6 kilometres.

ECPE
European Center for
Power Electronics e.V.

ECPE Tutorial

Testing and Electrical Characterization of Power Semiconductor Devices

Advanced Course on Dynamic and Application-Related Measurements

8 - 9 / 10 Dec. 2021

Reutlingen

in cooperation with

BOSCH
Electronics & Drives

Cluster Leistungselektronik

Introduction

Testing and Electrical Characterization of Power Semiconductor Devices

Advanced Course on Dynamic and Application-Related Measurements

8 - 9 /10 December 2021, Reutlingen

The dynamic properties of fast-switching power semiconductor devices can only be measured properly if the power semiconductors are integrated in well designed and well known custom circuits and test setups.
Important and relevant measuring techniques including dynamic measurements will be presented that can be used to test and characterize power semiconductor devices in applications.
This tutorial requires basic knowledge in power semiconductor characterization e.g. with static measurements.

The lectures can optionally be supplemented by attending a following practical course in the Bosch EPC-Lab. There the participants can perform own measurements in small groups under supervision.

Objectives:

- Knowledge of relevant physical quantities for testing or characterization of fast-switching power semiconductor devices
- Competence to interpret the corresponding information in standards and data sheets
- Knowledge of possible measuring techniques to be able to check and characterize fast-switching devices in applications
- Knowledge of the advantages and disadvantages or limits of the various measuring techniques
- Competence for the conception and execution of measurements

Target Audience of this Tutorial:

- Developers of power electronic boards and systems who use, specify and select the fast-switching power semiconductor devices
- Engineers from quality assurance and quality management
- Manufacturer of power semiconductor devices
- Engineers from universities and research institutes

All presentations and discussions will be in English language.

Programme - Theory

Wednesday, 8 December 2021

8:30	**Registration**
9:00	**Welcome** G. Feix, ECPE e.V. I. Kallfass, University of Stuttgart
9:30	**Introduction to Double Pulse Measurement** I. Kallfass, University of Stuttgart
10:00	**Measurement of Fast-Switching Operation with Wide Bandgap Transistors** • Required sensors and evaluation • Diode reverse recovery • Si/SiC/GaN transistor suitability for power converters T. Heckel, Fraunhofer IISB
11:00	Coffee Break
11:30	**Calorimetric Measurement of the Switching Loss Power of Resonant Converters** • Calorimetric Measurement Principle • Measurement Setup, Calibration and Loss Power Distribution J. Weimer, University of Stuttgart
12:30	Lunch
13:30	**Current Measurement** • Principles of current measurement • Application in double pulse measurement • Limitations of current sensors S. Hain, ZF Friedrichshafen
14:30	**Challenges of Measuring GaN-Based Half-Bridge Switching Loss** • Dynamic on-resistance, 3rd quadrant conduction, bulk potential I. Kallfass, University of Stuttgart
15:00	Coffee break
15:30	**Measuring On-state Capacitance** • Using the double pulse test • Using the vectorial network analyser I. Kallfass, University of Stuttgart
16:00	**Working Safety and Practical Tips for Measuring** S. Boehm, Robert Bosch
16:45	**Final Discussion and Feedback from Participants**
19:00	Dinner

Speakers:
Prof. Ingmar Kallfass, University of Stuttgart
Dr. Stefan Hain, ZF Friedrichshafen
Dr. Thomas Heckel, Fraunhofer IISB, Erlangen
Stefan Boehm, Robert Bosch GmbH (Power Semiconductors)
Julian Weimer, University of Stuttgart

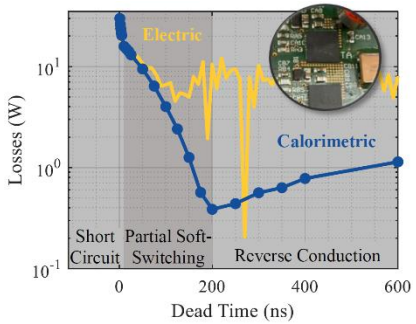
Practical Lab Course (optional)

Thursday, 9 December 2021

8:30	**Registration**
9:00	**Introduction and Outline** I. Kallfass, University of Stuttgart
9:15	**Introduction of Bosch Innolab**
9:30	**Safety Instructions** Bosch Innolab
9:45	Coffee Break
10:00	**Practical Measurements in the Lab, Part 1 and 2**
12:00	Lunch
13:00	**Practical Measurements in the Lab, Part 3 and 4**
15:00	Coffee Break
15:30	**Practical Measurements in the Lab, Part 5**
16:30	**Final Discussion and Feedback from Participants**
17:00	End of Tutorial

The following measuring techniques are demonstrated:

- **Double Pulse Measurement of Si, SiC and GaN Power Transistors (e.g. switching on/off energy, de-skew)**
- **Dynamic Current Measurement (e.g. Pearson converter, Rogowski coil, shunts)**
- **Determining switching losses with calorimetric measurements**
- **Dynamic Voltage Measurement of a Fast-Switching GaN Half Bridge Board (e.g. test probes, bandwidth)**
- **Dynamic Characterization of SiC Diodes (e.g. Q_{rr})**



Speakers and Instructors of Lab Measurements:
Prof. Ingmar Kallfass and team, University of Stuttgart
Stefan Boehm, Robert Bosch GmbH (Power Semiconductors)
Dr. Thomas Heckel, Fraunhofer IISB, Erlangen