

## Organisational information

Sign up at: [www.ecpe.org/events](http://www.ecpe.org/events)

**Registration Deadline:**  
**20 April 2022**

Practical Lab Course: restricted to 20 participants  
(if necessary 2<sup>nd</sup> Lab Course for regional participants on  
29 April 2022)

### Participation fee:

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

(limited spaces; copy of students ID required;  
dinner € 50,-\* extra);  
\* plus VAT

- 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 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](http://www.ecpe.org)

**Chairmen** Prof. Ingmar Kallfass,  
University of Stuttgart

**Technical Organisation** Gudrun Feix, ECPE e.V.  
0911 / 81 02 88 - 15  
[gudrun.feix@ecpe.org](mailto:gudrun.feix@ecpe.org)

**Organisation** Krista Schmidt, ECPE e.V.  
0911 / 81 02 88 - 16  
[krista.schmidt@ecpe.org](mailto:krista.schmidt@ecpe.org)

### Venue



**27 April 2022**  
**Electronics & Drives**  
Oferdinger Strasse 50  
72768 Reutlingen-  
Rommelsbach, Germany



**28 or 29 April 2022**  
**Bosch EPC-Labor**  
Robert Bosch GmbH  
Tübinger Strasse 123  
72762 Reutlingen, Germany



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



## ECPE Tutorial

### Testing and Electrical Characterization of Power Semiconductor Devices

### Advanced Course on Dynamic and Application-Related Measurements

27 – 28 / 29 April 2022

Reutlingen

in cooperation with



# ECPE Tutorial

## Testing and Electrical Characterization of Power Semiconductor Devices

### Advanced Course on Dynamic and Application-Related Measurements

27 - 28 / 29 April 2022, 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, 27 April 2022

- 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 convertersT. 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 DistributionJ. Weimer, University of Stuttgart
- 12:30 Lunch**
- 13:30 Current Measurement**
  - Principles of current measurement
  - Application in double pulse measurement
  - Limitations of current sensorsS. Hain, ZF Friedrichshafen
- 14:30 Challenges of Measuring GaN-Based Half-Bridge Switching Loss**
  - Dynamic on-resistance, 3rd quadrant conduction, bulk potentialI. Kallfass, University of Stuttgart
- 15:00 Coffee break**
- 15:30 Measuring On-state Capacitance**
  - Using the double pulse test
  - Using the vectorial network analyserI. 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 (Power Semiconductors)  
Julian Weimer, University of Stuttgart

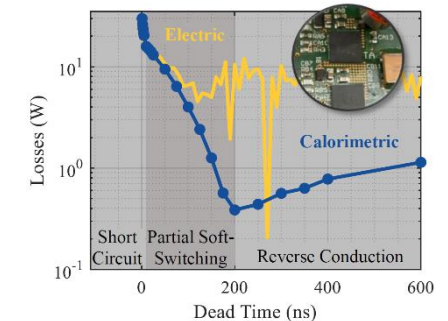
# Practical Lab Course (optional)

Thursday, 28 / 29 April 2022

- 8:30 Registration**
- 9:00 Introduction and Outline**  
I. Kallfass, University of Stuttgart
- 9:15 Introduction of Bosch EPC-Lab**
- 9:30 Safety Instructions**  
Bosch EPC-Lab
- 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