

## Organisational Information

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

### Registration Deadline:

- **16 November 2021**

### Participation Fee:

- **€ 320,-** \* for industry
- **€ 290,-** \* for universities/institutes
- **€ 120,-** \* for students/PhD students (limited spaces; copy of students ID required)

\* plus VAT

- The participation fee includes lectures and digital proceedings (provided 1 day prior to the event by email).
- Participation by web conference tool (Webex). Access data will be provided by email.
- Upon receipt of registration confirmation via email you are signed-up for the event. The invoice will be sent via email.
- ECPE members are able to register 1 participant free of charge, 25 % discount for further participants.
- 10 % discount for participants from ECPE competence centres.
- Cancellation policy: Full amount will be refunded in case of cancellation up to 1 week prior to the event. After this date 50 % of the fee is non-refundable (substitutes are accepted anytime).

## Organisational Information

**Organiser** ECPE e.V.  
90443 Nuremberg, Germany  
[www.ecpe.org](http://www.ecpe.org)

**Contact:** Ingrid Bollens, ECPE e.V.  
+49 911 81 02 88 - 10  
[ingrid.bollens@ecpe.org](mailto:ingrid.bollens@ecpe.org)



Dr. Martin Rittner, Chair of Tutorial  
Robert Bosch



Peter Dietrich  
Richardson RFPD Germany



Steffen Ewald  
Fuji Electric Europe



Dr. Gábor Farkas  
Siemens Digital Industries



(v.l.) Frank Heidemann  
Mathias Gebhardt  
SET



Stefan Schmitt  
Semikron Elektronik



Marc Tüllmann,  
Infineon Technologies



Prof. Dr. Markus Thoben  
Fachhochschule Dortmund



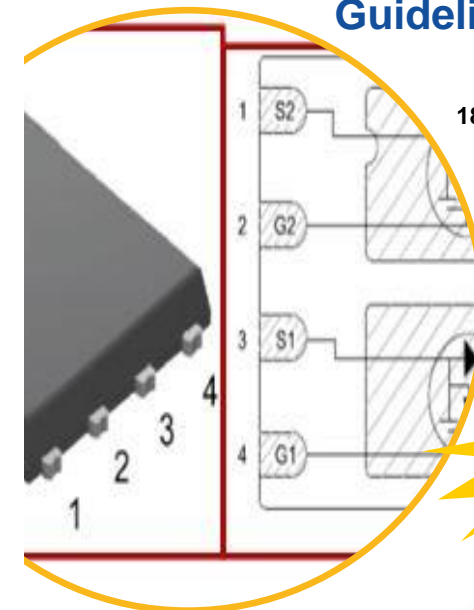
European Center for  
Power Electronics e.V.

## Digital Event

### ECPE Online Tutorial

### Testing Automotive Power Modules according to the ECPE Guideline AQG 324

18 – 19 November 2021



## ECPE Online Tutorial

### Testing Automotive Power Modules according to the ECPE Guideline AQG 324

18 – 19 November 2021

SiC-based Power Modules included!

The ECPE Guideline AQG 324 is prepared and released by the ECPE Working Group 'Automotive Power Module Qualification' comprising ECPE member companies from the automotive supply chain. The original version is based on the supply specification LV 324 which has been developed by German automotive OEMs together with representatives from the power electronics supplier industry.

The described tests concern the module design as well as the qualification of devices on module level (i.e. the assembly) but not the qualification of semiconductor chips or manufacturing processes. The requirements, test conditions and tests presented in the tutorial essentially refer to Release 03.1/2021 of the AQG 324 Guideline dated 31.05.2021 which addresses power modules based on Si power semiconductors in the main document and SiC-based modules in a specific annex.

The Tutorial with speakers from the AQG 324 Core Team will give practical information and advice how to test power modules according to the AQG 324 Guideline under comparable conditions. It aims at direct users from beginners to senior experts coming from power module suppliers, automotive tier 1 suppliers or test service and equipment providers.

#### Course Instructors:

Peter Dietrich, Richardson RFPD Germany  
Steffen Ewald, Fuji Electric Europe  
Dr. Gábor Farkas, Siemens Digital Industries  
Frank Heidemann, Mathias Gebhardt, SET  
Dr. Martin Rittner, Robert Bosch  
Stefan Schmitt, Semikron Elektronik  
Marc Tuellmann, Infineon Technologies  
Prof. Dr. Markus Thoben, Fachhochschule Dortmund

All presentations and discussions will be in English.

## Programme

Thursday, 18 November 2021

08:30 Webex will be started

09:00 **Welcome, Opening**  
Thomas Harder, ECPE e.V.

09:10 **Introduction and Motivation**  
Martin Rittner, Peter Dietrich

- Background of LV 324 and motivation
- Definition of terms
- Scope of AQG 324 and module definition

09:50 **SiC-Based Power Modules in AQG 324**  
Marc Tuellmann

- SiC MOSFET characteristics
- Impact of SiC on qualification of power modules

10:30 Break

10:45 **Mapping of Relevant Standards**  
Frank Heidemann

- Overview on relevant standards
- Different understandings (Europe, Asia, US)

11:15 **Characterizing Module Testing**  
Steffen Ewald (electrical testing),  
Gábor Farkas (thermal testing)

- Overview on chapters 6 and 7 of AQG 324

12:15 Lunch

13:00 **Lifetime Testing: Power Cycling**  
Markus Thoben, Marc Tuellmann

- Chapter 9.2: QL-01 Power cycling ( $PC_{sec}$ )
- Chapter 9.3: QL-02 Power cycling ( $PC_{min}$ )
- Power cycling of SiC-based power modules

14:30 Break

14:45 **Lifetime Testing: Temperature Tests**  
Stefan Schmitt

- Chapter 9.4: QL-03 High-temp. storage (HTS)
- Chapter 9.5: QL-04 Low-temp. storage (LTS)
- Chapter 8.2: QE-01 Thermal shock test (TST)

16:00 **Open Discussion on Lifetime Testing**

16:45 End of 1<sup>st</sup> Day

## Programme

Friday, 19 November 2021

08:30 Webex will be started

09:00 **Lifetime Testing: HTRB and HTGB**  
Mathias Gebhardt

- Chapter 9.6: QL-05 High-Temperature Reverse Bias (HTRB) incl. HTRB for SiC modules
- Chapter 9.7: QL-06 High-Temperature Gate Bias (HTGB) incl. HTGB for SiC modules
- QL-05a Dynamic Reverse Bias (DRB) and QL-06a Dynamic Gate Stress (DGS)

10:30 Break

10:45 **Lifetime Testing: H<sup>3</sup>TRB**  
Stefan Schmitt

- Chapter 9.8: QL-07 High-Humidity, High-Temp. Reverse Bias incl. H<sup>3</sup>TRB for SiC modules
- QL-07a Dynamic High-Humidity, High-Temp. Reverse Bias (dyn. H<sup>3</sup>TRB)

12:00 **Next Steps and Open Discussion**  
High-Temp. Forward Bias (HTFB) and outlook on dynamic testing

12:30 Lunch

13:15 **Mechanical Tests**  
Martin Rittner

- Chapter 8.4: QE-03 Vibration (V)
- Chapter 8.5: QE-04 Mechanical shock (MS)

14:00 **Test Documentation**  
Stefan Schmitt

- Example of a documentation set
- Number of samples/modules for the tests

14:45 Break

15:00 **Outlook**  
Peter Dietrich

- Further WBG challenges in AQG 324
- Adv. module packages e.g. PCB embedding

15:30 **Wrap up, Final Discussion**

16:15 End of Tutorial