



EPE'22 ECCE Europe – Tutorial announcement

Testing, Design, and Monitoring of Power Electronic Components for Reliability

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Scope and Benefits:

In this tutorial, after a review of the basic theory of reliability engineering, several approaches for reliability testing of power electronics components will be presented in the first part. Typical pros and cons of power cycling test setups of Silicon and Silicon Carbide devices will be discussed.

In the second part of the tutorial, loss calculation in a power electronic component as well as the well-established methods for the extraction of an equivalent thermal network of a real power stack will be presented.

Condition monitoring is an emerging topic in reliability engineering, therefore, the third part is devoted to illustrating the state of the art techniques both for junction temperature- and damage estimation.

The tutorial is concluded with an overview of the novel and promising methods for mission-profile-based prediction of Remaining Useful Life (RUL) and a summary and prospects for research on the reliability of power electronics.

Contents:

Reliability testing of power electronic components

- Reliability engineering
- Power cycling testing of Si and SiC devices

Thermal engineering in power electronics

- Loss calculation in power electronic circuits
- Extraction of equivalent thermal networks

Condition monitoring in power electronics

- Basics idea and control freedoms
- Junction temperature estimation
- Damage measurement and health monitoring



Case studies and future research opportunities in reliability of power electronics

- Mission-profile-based reliability prediction - case studies
- Interdisciplinary efforts and opportunities ahead

Schedule:

Friday, 9 September 2022 - 2nd Tutorial Day - Full Day

09:30 - 11:00	Reliability testing of power electronic components
11:00 - 11:30	Coffee break
11.30 - 13:00	Thermal engineering in power electronics
13:00 - 14:00	Lunch break
14:00 - 15:30	Condition monitoring in power electronics
15:30 - 16:00	Coffee break
16:00 - 17:30	Case studies and future research opportunities

Who should attend:

The tutorial is intended for students and design engineers with an interest in reliability estimation and enhancement of power electronic circuits.

Technical Level:

Beginners, as well as experienced engineers, are encouraged to attend the tutorial. Basic knowledge of power semiconductor devices and power electronic systems is recommended, although not mandatory.

About the Lecturers:



Francesco IANNUZZO is currently a professor of reliable power electronics at the Aalborg University, Denmark, where he is also part of the Center of Reliable Power Electronics (CORPE). His research interests are in the field of reliability of power devices, including mission-profile-based life estimation, condition monitoring, failure modeling, and testing up to MW-scale modules under extreme conditions. He is the author or co-author of more than 260 publications on journals and international conferences, three book chapters, and four patents. Besides the publication activity, over the past years, he has been contributing more than 20 technical seminars about reliability at first conferences as ISPSD, IRPS, EPE, ECCE, PCIM, and APEC.

Prof. Iannuzzo is a senior member of the IEEE Industry Application Society, Reliability Society, Power Electronics Society, and Industrial Electronics Society. He currently serves as an Associate Editor for the IEEE Open Journal on Power Electronics, the IEEE Journal of Emerging and Selected Topics in Power Electronics, the IEEE Transactions on Industry Applications, the EPE Journal, and Elsevier Microelectronics Reliability. He is the chair of the IEEE IAS Power Electronic Devices and Components Committee. He is the founder and co-Editor-in-Chief of the Power Electronic Devices and Components journal. Prof. Iannuzzo has been appointed general chair for the EPE-ECCE Europe 2023 conference, in Aalborg.



Amir Sajjad BAHMAN is currently an Associate Professor at the Center of Reliable Power Electronics (CORPE), Aalborg University, Denmark. His research interests include electro-thermo-mechanical modeling, packaging, and reliability of power electronic systems and components. Dr. Bahman received the B.Sc. from Iran University of Science and Technology, in 2008, the M.Sc. from the Chalmers University of Technology, Sweden in 2011, and the Ph.D. from Aalborg University, Denmark, in 2015 all in electrical engineering. He was a Visiting Scholar in the Department of Electrical Engineering, University of Arkansas, USA, in 2014. Moreover, he was with Danfoss Silicon Power, Germany in 2014 as the Thermal Design Engineer. Dr. Bahman is a senior member of the IEEE and currently serves as an Associate Editor for the IEEE Transactions on Transportation Electrification, and Elsevier Microelectronics Reliability.