

EPE'2021 – Tutorial Announcement

# Testing and Modelling of Power Electronic Components for Reliability

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

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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 circuit as well as the general heat theory will be introduced first. Afterwards, the extraction of the equivalent thermal network of real power stack will be presented.

The tutorial is concluded with an overview on the novel and promising methods for mission-profile-based prediction of Remaining Useful Life (RUL).

## Contents:

Reliability testing of power electronic components (60 min):

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

Thermal engineering in power electronics (60 min):

- Loss calculation in power electronic circuits
- Heat theory: basics, heat exchange, practical examples
- Extraction of equivalent thermal networks

Overview of methods for mission-profile-based prediction of remaining useful life (60 min):

- Mission-profile analysis
- Prediction of remaining useful life in power electronic components

**Schedule:**

Schedule is as follows:

**Monday, 6 September 2021 - Tutorial day (Virtual)**

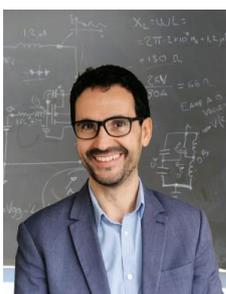
09:30 - 10:30	Reliability testing of power electronic components
10:30 - 11:00	Thermal engineering in power electronics (part 1)
11:00 - 11:30	Coffee break
11.30 - 12:00	Thermal engineering in power electronics (part 2)
12.00 - 13:00	Overview of methods for mission-profile-based prediction of remaining useful life

**Who should attend:**

The tutorial is intended for students and design engineers with interest in thermal modelling of power electronics for improved reliability. Beginners, as well as experienced engineers, are welcome to attend the tutorial. Basic knowledge of power semiconductor devices and power electronic systems is recommended, although not mandatory.

**Technical Level:**

Technical Level: Intermediate

**About the Lecturers:**

**Francesco Iannuzzo** received the M.Sc. degree in Electronic Engineering and the Ph.D. degree in Electronic and Information Engineering from the University of Naples, Italy, in 1997 and 2002, respectively. He is primarily specialized in power device modelling.

He is currently a professor of reliable power electronics at the Aalborg University, Denmark, where he is also part of CORPE, the Center of Reliable Power Electronics. His research interests are in the field of reliability of power devices, including mission-profile-based life estimation, condition monitoring, failure modelling and testing up to MW-scale modules under extreme conditions. He is author or co-author of more than 240 publications on journals and international conferences, three book chapters and four patents. Besides the publication activity, over the past years he has been contributing 19 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 Electronic Society, and Industrial Electronic 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 vice-chair of the IEEE IAS Power Electronic Devices and Components Committee. In 2018 he was the general chair of the 29th ESREF, the first

September 6-10, 2021

Ghent, Belgium

<http://www.epe2021.com>



EPE'21 ECCE Europe

The 23<sup>rd</sup> European Conference on Power Electronics and Applications



European conference on the reliability of electronics, and has recently been appointed general chair for the EPE 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 modelling, 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 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 the IEEE Transactions on Transportation Electrification, and Elsevier Microelectronics Reliability.