



EPE'23 ECCE Europe – Call for Tutorials

SiC MOSFET Gate Drivers for High-Power Applications

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

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Tutorial Objectives:

As the next-generation power devices, SiC MOSFETs are gradually increasing their presence in a wide range of applications. Compared with the silicon counterparts, SiC MOSFET has higher voltage blocking capability, high switching frequency and potential high-temperature capability. These superior characteristics will significantly improve the performance of power conversion systems where efficiency and power density are the most critical performances. As the link between the control and power in the power electronics system, gate driving of SiC MOSFETs is critical to fully utilize the potential of the devices. However, simply leveraging solutions for Si devices are not enough. The challenges brought by high-speed switching, reliability-related issues and cost constraints require continuous work. This tutorial covers the basics of the SiC devices, the ultra high-speed switching characteristics, the gate driving principles and device protections, as well as the high power applications of SiC MOSFETs. This will be supported by practical examples and learnings of the authors at Power Electronics Laboratory at EPFL.

Target Audience:

The tutorial attendees should be familiar and with interest into high-performance power converters. We expect a strong interest in the proposed tutorial, driven by the growing need for efficient and high-performance power converter techniques in both academia and industry. SiC MOSFETs related topics are therefore relevant to a broad potential audience, e.g.:

- Master, PhD students and junior research scientists
- Industrial engineers from related sectors
- Senior research scientists from other fields interested in the topic and its challenging aspects



Topical Outline:

1) Introduction: (Estimated time: 30 minutes)

- An overview
- Si devices versus Wide Bandgap devices
- Characteristics and benefits of SiC devices

2) Gate driving of SiC MOSFETs: (Estimated time: 30 minutes)

- High-speed switching of SiC MOSFETs
- Gate driver structure and principles
- Critical parameters selection principles
- Measurement and sensing of switching characteristics

3) High-performance driving of SiC devices: (Estimated time: 30 minutes)

- Crosstalk voltage elimination
- Short-circuit protection of SiC MOSFET
- Active gate driver for SiC devices

Coffee Break: 30 min

4) High-power converters with SiC: (Estimated time: 45 minutes)

- State-of-the-art applications
- SiC converters: features, advantages and benefits

5) SiC MOSFETs integration challenges: (Estimated time: 45 minutes)

- Parallel connection of SiC MOSFETs
- Series connection of SiC MOSFETs
- Si-SiC hybrid solutions

6) Future Trends, Conclusions and Discussion: (Estimated time: 30 minutes)

Provisional Schedule of the Tutorial:

8:00 - 8:30: Introduction

8:30 – 9:00: Gate driving of SiC MOSFETs

9:00 – 9:30: High-performance driving of SiC devices

9:30 – 10:00: Coffee break

10:00 – 10:45: High-power converters with SiC

10:45 – 11:30: SiC MOSFETs integration challenges

11:30 – 12:00: Future Trends, Conclusions and Discussion

About the Lecturers:



Prof. Drazen Dujic is an Associate Professor and Head of the Power Electronics Laboratory at EPFL in Lausanne, Switzerland. He received his PhD degree from Liverpool John Moores University in 2008. From 2009 to 2013 he was with ABB Switzerland and has joined EPFL in 2014. His research interests include the areas of design and control of advanced high-power electronic systems and high-performance drives, predominantly for the medium voltage applications related to electrical energy generation, conversion and storage.



Dr. Chengmin Li is a Postdoctoral researcher at Power Electronics Laboratory at EPFL in Lausanne, Switzerland. He received the Ph.D. degree from Zhejiang University, Hangzhou, China in 2019. From March 2016 to March 2017, he was a Research Intern with the GE Global Research Center, Shanghai, China. His research interests are related to medium voltage high converters and application of SiC power MOSFETs. Dr. Li was the recipient of PCIM Asia Young Engineer Award in 2022.