



IEEE ENERGY CONVERSION CONGRESS & EXPO Nashville, TN | OCT.29-Nov.2

## Tutorial Title

**Next-Generation Medium- and High-Voltage High-Power All Silicon Carbide Modules: Design, Characterization, and Applications.**

## Instructor Team

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## Abstract

The medium-voltage (MV) applications, such as railway traction and industrial motor drive systems and renewable energy systems, have traditionally utilized MV silicon IGBTs based power modules. These and many other applications can benefit from the recent advancements in MV and high-voltage (HV) silicon carbide (SiC) technology to increase the converter efficiency and the power density. In this seminar, the presenter from industry and academia will present the latest advancement in MV/HV high power SiC power module technology, from the latest package design to their real-world applications. This presentation starts with a comprehensive review of packaging technology and state-of-the-art for MV/HV SiC power modules, including 3.3 kV, 6.5 kV, 10 kV and beyond. Then the application-specific characterization, power cycling and lifetime prediction methods will be presented, followed by the session of reference designs on gate drivers and converters. In addition, various case studies, e.g., isolated power converters for data center applications and MV DC chargers, will be presented to highlight the system level benefits brought by these SiC MV/HV power modules.

## Instructor Biography

**Dr. Kraig J. Olejniczak** earned his B.S.E.E. degree from Valparaiso University in 1987. His M.S.E.E. and Ph.D. degrees were granted by Purdue University in 1988 and 1991, respectively. He then joined the Department of Electrical Engineering at the University of Arkansas where he led the university's High-Density Electronics Center's effort in the power electronic miniaturization and packaging thrust area. After serving on the faculty for 11 years, in August 2002, he assumed leadership of Valparaiso University's College of Engineering. After serving his alma mater for 11 years, Dr. Olejniczak resigned his tenure to join his colleagues at APEI in Fayetteville, AR. He served as co-founder, chairman of the board, and senior manager for motor drives and electric utility applications until July 2015 when APEI was acquired by Cree Inc. He now serves Wolfspeed Inc. as a Research Scientist for Medium- and High-Voltage Power Products. He is a member of Tau Beta Pi and Eta Kappa Nu. He is a Senior Member of IEEE and a licensed professional engineer in the State of Arkansas.



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**Dr. Ashish Kumar** earned his B.Tech. in Electrical Engineering from Indian Institute of Technology, Kharagpur, India in 2008. He then worked at an offshore Oil & Gas production platform as a system electrical engineer. He completed M.Sc. (Engr.) in Electrical Engineering from Indian Institute of Science, Bangalore, India in 2014. He earned Ph.D. in Electrical Engineering from North Carolina State University, Raleigh in 2021. His doctoral research was focused on design and demonstration for medium voltage power converters enabled by modern high voltage silicon carbide power devices. He now serves Wolfspeed Inc. as an application engineer supporting the medium and high voltage power product group.

**Ahmed H. Ismail** is currently pursuing the PhD degree in Electrical Engineering from the University of Arkansas (UA), Fayetteville, USA. He is a research assistant at the Power Electronic Systems Laboratory (PELSA) working on medium and high voltage power electronics. His research interests include MV/HV power modules characterization, SiC power device applications, gate driver design, high performance and high power density MV/HV converter design and demonstration. He is currently a part-time application engineer intern at Wolfspeed supporting the MV/HV power product group.

**Dr. Yue Zhao** received a Ph.D. degree in electrical engineering from the University of Nebraska-Lincoln, Lincoln, USA, in 2014. Since August 2015, he has been with the University of Arkansas (UA), Fayetteville, USA, where he is currently an Associate Professor in the Department of Electrical Engineering and directing Power Electronic System Laboratory at Arkansas (PELSA). He also serves as the site director for the National Science Foundation (NSF) Center on GRid-connected Advanced Power Electronic Systems (GRAPES). His current research interests include electric machines and drives, power electronics, and renewable energy systems. He has 4 U.S. patents granted and co-authored more than 100 papers in refereed journals and international conference proceedings. He was a recipient of 2018 NSF CAREER Award and the 2020 IEEE IAS Andrew W. Smith Outstanding Young Member Achievement Award.

**Dr. Juan Carlos Balda** received the B.Sc. degree in electrical engineering from the Universidad Nacional del Sur, Bahia Blanca, Argentina, in 1979, and the Ph.D. degree in electrical engineering from the University of Natal, Durban, South Africa, in 1986. He was a Researcher and a part-time Lecturer with the University of Natal until 1987. He was a Visiting Assistant Professor with Clemson University, Clemson, SC, USA, for two years. He has been with the University of Arkansas, Fayetteville, AR, USA, since 1989, where he is currently a University Professor, a Department Head, and an Associate Director of Applications with the National Center for Reliable Electric Power Transmission. His current research interests include power electronics, electric power distribution systems, motor drives, and electric power quality. Dr. Balda is a member of the honor society Eta Kappa Nu. He is also the Vice-Chair of the IEEE Power Electronics Society (PELS) TC5 Committee and a Faculty Advisor of the local chapter of the IEEE PELS.