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Tutorial Title

SiC Unleashed: Are SiC Technology High Performances Reliable Enough for Your Application?

Instructor Team

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Abstract

Silicon Carbide (SiC) devices improves the power density of various converters by shrinking the size of passive components and improving the power conversion efficiency; by the way, only proper SiC devices design can guarantee the level of reliability required by most professional, industrial, or hi-rel. applications. This seminar presents an in-depth summary of SiC devices and their applications, to help converter designers at different levels to get the full benefits and face the challenges found when using SiC devices; proper design guidelines are also needed to extract the maximum benefit from using SiC devices.

The presentation will begin with an introduction to SiC technology status. A summary of internal device structure and principle of operation will be discussed to understand the potential benefits achievable with a reliable design of devices built on SiC technology. Detailed static and dynamic characteristics, thermal performance and device ruggedness will be discussed with related datasheet parameters to also assess the superior performance of SiC devices over Si. Optimal implementation of SiC MOSFETs will be discussed in detail. This section starts with gate driving design, such as, driving voltage selection, driving circuit design and advanced driving concepts. Then, the power stage design and layout are introduced, including loss estimation, parasitic control, etc. Finally, converter level optimization aspects are covered, such as thermal management and EMI noise control. This section will provide converter designers with design guidelines to implement SiC devices appropriately and ensure their maximum benefits. Design examples in real applications such as EV charger and DC Solid State Circuit Breaker applications will be presented with real hardware and test results to verify the benefit of using SiC device in system size/weight/ cost reduction compared with Si devices.



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Instructor Biography

Dr. Xuning Zhang received his bachelor's and master's degrees in electrical engineering from Tsinghua University, Beijing, China, in 2007 and 2009 respectively, and his PhD degree from CPES-Virginia Tech in 2014. Currently Dr. Zhang is a senior manager in Microchip Inc. focusing on application of SiC devices and strategic planning of SiC power products. Prior to Microchip, Dr. Zhang worked at Littelfuse and Monolith semiconductor as application engineering manager and work at CPES, Virginia Tech as a research scientist all focusing on high efficiency high power density converter design and optimization with wide-band-gap devices. His research interests include high efficiency, high power density converter design, system EMI modeling and filter optimization, interleaving and multilevel converters, SiC device characterization and driving scheme optimization, high frequency system integration, and passive component design and optimization. Dr. Zhang has authored and co-authored more than 50 papers on journals and leading international conferences. He has also presented several tutorial seminars during international conferences including APEC 2017, ITEC-AP 2017 and PEAC 2018, APEC 2019.

Ing. Cesare Bocchiola received the Dr.Ing. Degree in Nuclear Engineering at the University Politecnico of Milano, as well as the Italy Government abilitation, in 1985. Currently Ing. Bocchiola is a Principal embedded solution engineer at Microchip Technology EMEA, focusing on Power Electronic applications, including SiC devices, as well as analog and power management. Prior to Microchip Ing. Bocchiola covered different Application Management positions at International Rectifier Corp., senior R&D researcher at Whirlpool Corp and Project Management positions at FIAR Space Division (now Leonardo), dealing with the development of high voltage power supplies for Space Ion Propulsion. His research interests cover almost all aspects of Power Electronic and power semiconductor devices. Ing. Bocchiola has authored or co-authored more than 40 papers on journals and leading international conferences and holds about 20 patents in various fields of power electronic and its applications.

Dr. Zhiyu Shen received his bachelor's and master's degrees in electrical engineering from Tsinghua University, Beijing, China, in 2004 and 2007 respectively, and his PhD degree from CPES-Virginia Tech in 2013. Currently Dr. Shen is a senior technical staff application engineer in Microchip Inc. focusing on application of SiC devices. Prior to Microchip, Dr. Shen worked at Delta Electronics as senior member of R&D staff, at General Electric Research Center as lead electrical engineer, and at CPES, Virginia Tech as research scientist. Throughout his career, Dr. Shen has worked on varies aspects of power converters design from control to power stage in medium to high power applications. Dr. Shen has authored and co-authored more than 80 and technical papers on journals and leading international conferences.