1. Tutorial Title

Conducted, near-field and radiated EMI Emission Mitigation for Wide Bandgap Converters: fundamentals, modeling and solutions

2. Abstract (No more than 500 words. Accepted abstract will be published through the conference website, program, and proceedings.)

This seminar is part of a series of education activities initiated by IEEE EMC Society Special Committee 5 (SC5) – Power Electronics EMC. The purposes are to raise broader power electronics audiences' awareness of EMC, and connect advanced EMC technologies with WBG power electronics systems to enable low noise, high efficiency, and high power density solutions for future power conversion systems.

This seminar is a comprehensive guide to provide engineers with techniques to develop and construct electromagnetically compatible Wide Bandgap (WBG) power electronic converters. The seminar provides a good opportunity for the fundamental theory, measurement, and suppression of electromagnetic interference (EMI) for WBG power electronics. It will have full coverage on the conducted emission, near field, and radiated EMI.

The first section provides EMC theory and fundamentals for WBG power conversion, comparison of commonly used industrial EMI standards, techniques for common-mode (CM) and differential mode (DM) current separation, and practical CM/DM measurement methods.

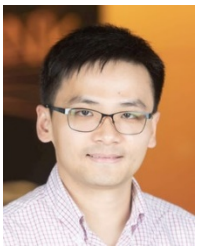
The second section focuses on a comprehensive 5-step EMC design process for WBG power converters' conducted emission EMI challenges: "SOLVE". SOLVE design flow begins with considerations on Selecting proper architectures based upon system ratings and EMC specifications. The next steps develop techniques for Obtaining component parasitics and Layout for the system EMI model. Vetting of different filter design aspects, including magnetic material selection, structure, and practical filter performance. The last step presents techniques and principles for packaging Enhancement.

The third section focuses on the near field EMI generated from components in WBG power converters. The near field EMI can be generated from WBG power modules, transformers, inductors, and PCB traces. It can be coupled to other components in the converter to deteriorate the WBG converter's conductive and radiated EMI. With the high switching speeds and high switching frequencies of WBG power electronics to improve power density, the components are very close to each other, therefore the importance of understanding, measurement, and reduction of near field EMI cannot be overemphasized. The seminar will focus on the advancement of the theory, identification, and reduction of the near field EMI for WBG power electronics.

The fourth section focus on the radiated EMI for WBG power electronics. The WBG device powered power electronics systems can achieve higher power densities than those with the

conventional Si devices. However, higher switching speed and higher switching frequencies lead to more significant radiated EMI. The radiated EMI can be over the limits from several to hundreds of MHz, which poses a big barrier to high power density power electronics design in the areas such as consumer electronics, electric vehicles, and the aviation industry, etc. This is especially important for most power electronics engineers who lack knowledge on the radiated EMI in power electronics systems. The seminar will focus on the advancement of the theory, measurement, and reduction techniques developed in recent years for the radiated EMI in WBG power electronics systems.

3. Instructor Biography



Dr. Cong Li (S'09-M'15-SM'19) received the Ph.D. degree in electrical engineering specializing in power electronics from The Ohio State University, Columbus, OH, USA, in 2014.

He joined GE Global Research Center at Niskayuna, NY, USA as a Research Engineer in 2014 and is currently a Senior Power Electronics Engineer and EMC Lead. His research interests include power electronics topologies, Wide bandgap devices, high-density high-power Silicon Carbide converters for automotive and aviation applications, and EMI mitigation techniques. He has authored more than dozens of technical papers, and patent applications in power electronics and EMC. He is a member of commercial aviation DO-160 EMI standard working group.

He is currently a Senior Member of IEEE, Associate Editor at IEEE Open Journal of Power Electronics and IEEE Transactions on Industry Applications. He is serving as secretary of IEEE-EMCS-SC5 Power Electronics EMC, secretary of IEEE-IAS-IPCSD-Power Electronics Devices & Components Committee (PEDCC), as well as Technical Committee member of IEEE APEC, ECCE, ITEC conferences. He received the 2019 Promising Professional Award from the Society of Asian Scientists and Engineers (SASE).

Shuo Wang (IEEE Fellow) received a Ph.D. degree in Electrical Engineering from Virginia Tech, Blacksburg, VA, in 2005. He is currently a full professor with the Department of Electrical and Computer Engineering, University of Florida, Gainesville, FL. Dr. Shuo Wang has published more than 200 IEEE journal and conference papers and holds around 30 pending/issued US/international patents. He received the NSF CAREER Award in 2012 and several IEEE Journal and conference paper awards. Dr. Wang is the special committee chair for Power Electronics EMI/EMC in IEEE EMC society and serves as a contact person for wide bandgap device EMI/EMC between the IEEE PEL and EMC societies. He is an instructor of IEEE Clayton Paul Global University and was a technical program Co-Chair for the IEEE 2014 International Electric Vehicle Conference. Dr. Wang is an Associate Editor for the IEEE Transactions on Industry Applications and IEEE Transaction on Electromagnetic Compatibility.