

Editorial for the Inaugural Special Issue on the Developing Trends of Power Electronics: Part 1

WITH this editorial, we sincerely welcome our readers to the brand-new publication — CPSS Transactions on Power Electronics and Applications (CPSS TPEA). It is sponsored and published by China Power Supply Society (CPSS) and technically co-sponsored by IEEE Power Electronics Society (IEEE PELS).

CPSS was founded in 1983 and has been the only top-level national academic society in China that solely focuses on the power supply/power electronics area. In the past 30-plus years CPSS has dedicated to provide to its members, researchers, and industry engineers nationwide with high quality services including conferences, technical training, and various publications, and this in deed has helped the society build up its membership rapidly, which now totals up to more than 4000 individual members plus 500 enterprise members. The fast growth of membership in turn compels CPSS to always work out better services for its members, one of which being the open-up of this periodical — a new journal in English language as a publication platform for international academic exchanging. This of course needs to be done through international cooperation, and that's why IEEE PELS is tightly involved, being the premier international academic organization in power electronics area and one of the fastest growing technical societies of the Institute of Electrical and Electronics Engineers (IEEE).

To fulfill the publishing need of the fast-developing power electronics technology worldwide is a more important purpose of launching this new journal. So far there are only 3 or 4 existing journals which are concentrated on power electronics field and have global reputation. For quite a few years people in the international power electronics community have had the feeling that, the existing journals have not even come close to meeting the huge demand of global academic and technology exchanges. E.g., the two existing IEEE power electronics journals, i.e. IEEE Transactions on Power Electronics (IEEE TPEL) and IEEE Journal of Emerging and Selected Topics in Power Electronics (IEEE JESTPE), now publish about 1000 papers a year, which is under a very low paper acceptance rate of around 25%, but still have a back-log of about one year for the newly accepted papers to finally appear in printed form to the public. The addition of this new dedicated journal would be an ideal improvement to fulfill such a tremendous need.

The booming of publishing need really is an indicator of how fast power electronics has been developing in recent years. Innovations have been continuously coming up from component (both active device and passive device), module, circuit, converter, to system level, covering different tech-

nical aspects as topology or structure conceiving, modeling and analysis, control and design, and measurement and testing. New issues and corresponding solutions have been continuously presenting as the applications of power electronics prevail horizontally in almost every area and corner of human society, from industry, residence and commerce, to transportations, and penetrate vertically through every stage of electric energy flow from generation, transmission and distribution, to utilization, in either a public power grid or a stand-alone power system. I personally believe that we are entering a world with “more electronic” power systems. The prediction around 30 years ago, that power electronics one day will become one of the major poles supporting the human society, is coming into reality. And I also believe, that power electronics is going to last for long time as an important topic since it is one of the keys to answer a basic question for human society, which is how human can harness energy more effectively and in a manner friendlier to both the user and the environment.

Therefore, I assume that there is probably no better fitting as for CPSS TPEA to publish its first few issues under a special topic about the developing trends of power electronics. We have invited a group of leading experts in different areas of power electronics to write survey/review papers or special papers with review/overview nature to some extent. To publish in a timely and regular style, we organize this inaugural Special Issue into different parts. Part 1 is in this issue and the other parts will appear in the following issues.

In Part 1 we are honored to have 8 invited papers. The first 4 address the state-of-the-arts application techniques of new power semiconductor devices and modules based on GaN or SiC and how these devices can be adequately used to improve the performance of converters and systems, while the rest 4 discuss the developing trends of different aspects of some currently hot or future promising application areas.

We begin with a review paper on the application of GaN devices for 1 kW server power supply with integrated magnetics. It is written by Dr. Fred C. Lee and his research group from Virginia Polytechnic Institute and State University. It presents how GaN devices coupled with soft-switching techniques drastically reduce power losses and enable a switching frequency more than ten times higher than silicon devices, with much reduced EMI noises.

The second paper overviews the silicon carbide (SiC) based power conversion technology from device level up to system and application level. It is written by Dr. Fred (Fei) Wang and his research group from the University of Tennessee. The focus of this paper is on the benefits of SiC based power electronics for converters and systems, as well as their ability in enabling new applications.

The third paper is about a specific application of SiC-MOSFET dual modules to bidirectional isolated dual-active-bridge (DAB) DC-DC Converters. It is written by Dr. Hirofumi Akagi and his research group from Tokyo Institute of Technology. It illustrates how SiC-MOSFET is adopted to improve the efficiency and modular expandability of bidirectional isolated DAB DC-DC converter.

The fourth paper is regarding how to suppress turn-on oscillations for hybrid power modules combining Si IGBTs and SiC diodes. It is written by Dr. Dehong Xu and his research group from Zhejiang University in cooperation with Fuji Electric Co., Ltd.. The paper reviews the causing, effect, and recently published damping methods of high frequency oscillation occurring during turning-on transients of Si IGBT and then proposes a novel suppression method.

The fifth paper is written by Dr. Deepak Divan and his research group from Georgia Institute of Technology, discussing the applications of power electronics to the future grid. It looks at the role that distributed power electronics could play where increasing levels of variable and non-dispatchable renewable energy resources are mixed into the grid and bidirectional power flows are adding complexity to grid operations.

The sixth paper is written by Dr. Jan A. Ferreira and his research group from Delft University of Technology, discussing wind turbine generator systems — another important application area of power electronics. It provides a comprehensive review and future trends prediction on how the availability of wind turbine generator system could be increased through appropriate design and control for reliability and fault tolerance.

The seventh paper is written by Dr. S.Y. Ron Hui from the University of Hong Kong and Imperial College London, about a recently emerging application area of power electronics — non-radiative wireless power transfer (WPT). The paper briefly reviews the history of some key concepts and techniques and particularly highlights a few misconceptions of WPT, and supplies the author's view on the present and future trends.

Last but not least, the eighth paper is written by Dr. Frede

Blaabjerg and his research group from Aalborg University, about a very hot application area of power electronics for the past years — grid-connected photovoltaic systems. The paper focuses on design for reliability (DfR) and it summaries in detail the technological challenges in DfR of power electronics with a systematic exemplification.

I'd like to thank the authors of all these 8 invited papers. It's their high-quality contributions that finally leads to the launching of this new journal.

I'd like to thank Dehong Xu, President of CPSS, who in 2015 initiated the idea of publishing the new journal and since then has been persistently supporting my work as the founding Editor-in-Chief. I'd also like to thank Jiaxin Han, Secretary General of CPSS, Jan A. Ferreira, President of IEEE PELS, 2015-2016, Don F.D. Tan, President of IEEE PELS, 2013-2014, and Frede Blaabjerg, IEEE PELS Vice President for Products, 2015-2016, who form the CPSS and IEEE PELS Joint Advisory Committee for our new journal with Dehong Xu and myself. Other IEEE officers and leading staffs like Dushan Borojevich, PELS President, 2011-2012, Alan Mantooth, PELS President, 2017-2018, Mike Kelly, PELS Executive Director, and Frank Zhao, Director of China Operations, IEEE Beijing Office, just to name a few, also provided continuous support and constructive advices. My earnest thanks also go to the CPSS Editorial Office led by Lei Zhang, Deputy Secretary General of CPSS, for their wonderful editing work. It would not have been possible to create a new journal in such a short time without their efforts. I'd like to finally thank all the members of the Standing Council of CPSS and particularly the leaders of Chinese power electronics industry. They always firmly stand behind CPSS TPEA and ready to help whenever needed.

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Jinjun LIU received his B.S. and Ph.D. degrees in Electrical Engineering from Xi'an Jiaotong University (XJTU), China in 1992 and 1997 respectively. He currently holds the position of XJTU Distinguished Professor of Power Electronics, sponsored by Chang Jiang Scholars Program of Chinese Ministry of Education.

Dr. LIU coauthored 3 books (including a textbook), published over 200 technical papers in peer-reviewed journals and conference proceedings, holds more than 30 invention patents (China/USA). He received for 7 times governmental awards at national level or provincial/ministerial level for scientific research achievements or academic/teaching career achievements. He also received the 2006 Delta Scholar Award, the 2014 Chang Jiang Scholar Award, the 2014 Outstanding Sci-Tech Worker of the Nation Award, and the IEEE Transactions on Power Electronics 2016 Prize Paper Award. His research interests are power quality control and utility applications of power electronics, micro-grids for sustainable energy and distributed generation, and more/all electronic power systems.

Dr. Liu has served as the IEEE Power Electronics Society (PELS) Region 10 Liaison and then China Liaison for 9 years, an Associate Editor for the IEEE Transactions on Power Electronics for 9 years, and starting from 2015 the Vice President for membership of IEEE PELS. He is on Board of China Electrotechnical Society (CES) and was elected to a Vice President of the CES Power Electronics Society in 2013. He is the Vice President for International Affairs, China Power Supply Society (CPSS) and the inaugural Editor-in-Chief of CPSS Transactions on Power Electronics and Applications.