

Magnetically coupled power conversion stages with GaN bidirectional switches

Warsaw University of Technology Faculty of Electrical Engineering, upon agreement with Infineon Austria is looking for a Ph.D. candidate to pursue a thesis in the area of GaN based power converters. The candidate is expected to conduct a 4-year doctoral study in the Doctoral School of Warsaw University of Technology under the supervision of prof. Jacek Rabkowski. Dr Gerald Deboy will also support the Ph.D. student by providing the feedback and experience. The scholarship of € 1300 per month is provided by Infineon Austria in the frame of IPCEI for the Microelectronics programme. In addition, the sum of euro € 4.400 per year will be at the disposal of the Ph.D. student for travel expenses: visits at Infineon, courses or conference trips. Moreover, the student will also have the right to apply for additional scholarships provided for Ph.D. students at WUT (i.e. from the research university programme).

Description

A lack of a proper bidirectional power switch has always been an issue in power electronics. Over the years, different configurations of switches based on discrete components were developed in both Si and, then, SiC and GaN technologies but the disadvantages limited the performance and, in consequence, field applications. In fact, a broad group of power electronic converters based on bidirectional switches, such as current-source or matrix converters, were out of the mainstream due to missing appropriate switch. In consequence, most of today's applications are based on voltage-source topologies even if they also show some drawbacks as square wave AC voltage or boost characteristics. Therefore, the introduction of a monolithically integrated GaN bidirectional switch may be a game changer in many applications. First results of research works performed by ETH Zurich/Infineon groups in high-power charging applications are very promising due to the high power density of 10 kW/dm³ achieved. To continue and extend these works, research on PFC-free single-phase cycloconverter modules with new monolithically integrated GaN bidirectional switches is proposed. The PhD project will be conducted at the Warsaw University of Technology in close cooperation with the Infineon team led by dr Gerald Deboy. The modules will be able to operate in a single- or three-phase configuration (each module connected input to neutral); in the case of a single-phase configuration, a suitable power pulsation buffer will also be included in the system.

Responsibilities and (foreseen) tasks

In addition to a standard duties of the Ph.D. student at WUT, the following research activities are planned:

- The literature overview focused on GaN power switches, power pulsation buffers and high-frequency cycloconverters.
- Development of a test bench for monolithically-integrated GaN bidirectional power devices and investigations of their switching performance
- Simulation-based design of the power converter based on tested switches
- Development of the control algorithm and its implementation in the digital controller
- Evaluation of the developed power converter in a single- and three-phase mode via laboratory experiments.
- Publication of the results at international conferences and highly ranked journals.

- Preparation of Ph.D. thesis.

Applicants should fulfil the following requirements:

- Basic background in GaN power devices technology
- Practical experience in the design of power electronic systems
- Experience with PCB design
- Knowledge of measurement techniques
- Basic skills in programming

The following experience is beneficial:

- Experience in digital control systems
- Working knowledge of electromagnetic compatibility
- Industrial experience

We offer:

- 4-year PhD position in the leading group conducting research on SiC technology in Poland
- Research on one of the key topics in power electronics
- Access to state-of-the-art lab facilities
- Collaboration with the world-leading supplier of power electronics components – Infineon Austria – with the possibility of regular visits and permanent cooperation
- Opportunities for conference visits, research stays and networking with globally leading universities and research centres in the fields of power electronics.

How to apply?

Please submit your CV and motivation letter to prof. Jacek Rabkowski (jacek.rabkowski@pw.edu.pl) before December 10th 2022 with the postscript “GaN”. After the initial evaluation, the application for the Doctoral School of Warsaw University of Technology (https://www.sd.pw.edu.pl/sd_en) will be required.