

## **Investigation of gate switching instability in SiC power modules with condition monitoring in an application near test environment**

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 SiC power modules testing. 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 Paul Salmen from Infineon, dr Michael Glavanovics and dr Markus Sievers (KAI) 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**

Reliability testing of SiC power devices is crucial to predict their lifetime in different applications, including PV inverters, energy storage, EV onboard converters, or charging stations. The main point is the differences between the properties of standard Si-based devices and their SiC counterparts, such as gate oxide issues, higher switching speeds, and higher switching frequencies. Therefore, the methods applied over the years to Si devices may not fully fit SiC components, especially MOSFETs. Special attention has to be paid to threshold voltage instabilities caused by charges trapped near the SiO<sub>2</sub>/SiC interface. Infineon research teams have investigated this phenomenon and proposed suitable testing procedures. Moreover, a test bench for Easy 1B modules was developed, and tests were conducted to validate the reliability of the tested devices. However, the gathered experiences show that the method and the test bench require further development. The research team at Warsaw University of Technology has also gathered experiences in near-application testing of SiC modules during RECET4Rail project and will continue to work on the issues mentioned above related to gate oxide instabilities.

### **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 reliability testing methods, threshold voltage instabilities, measurement techniques, and protection features.
- Development of a concept of the test bench for SiC power modules (rated at 1200 V and up to 200 A to operate with frequencies up to 200 kHz). The bench will be suited for different types of packages (Easy1B framesize as a must, Easy2B optional) from various vendors, and the expected functions will be related to measurements of the temperature and selected device parameters (in coordination with Infineon). At least the measurement of the chip temperature  $T_{vj}$  will be conducted during stress to enable also a safe turn off. Additional relevant measurement parameters are threshold voltage, RDSon, gate source and drain-source leakage currents.
- Design and construction of the test bench.
- Evaluation of various SiC power modules from different vendors delivered by Infineon. The benchmarking regarding the degradation in interconnections, threshold, and on-state resistance drifts, and temperature stability.

- Publication of the results at international conferences and a highly ranked journals.
- Preparation of PhD thesis.

**Applicants should fulfil the following requirements:**

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

**The following experience is beneficial:**

- Experience in power devices characterisation
- 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](mailto:jacek.rabkowski@pw.edu.pl)) before December 10th 2022. After the initial evaluation, the application for the Doctoral School of Warsaw University of Technology ([https://www.sd.pw.edu.pl/sd\\_en](https://www.sd.pw.edu.pl/sd_en)) will be required.