DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

PhD Public Defence

Title: Demonstration of High Power Density kW Converters utilizing

Location: Pontoppidanstræde 105, room 4.127

Time: Thursday 24 October at 13.00

PhD defendant: Nicklas Christensen

Supervisor: Professor Stig Munk-Nielsen

Moderator: Associate Professor Szymon Beczkowski

Opponents: Associate Professor Peter Omand Rasmussen, Dept. of Energy Technology, Aalborg University (Chairman)
Prof. Dr.-Ing. Sibylle Dieckerhoff, TU Berlin, Germany
Prof. Mariusz Malinowski, Warsaw University of Technology, Poland

All are welcome. The defence will be in English.

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Abstract:

Power electronic converters are used in a wide range of application, where volume, efficiency and cost are the main parameters of optimization. The new wide bandgap devices introduced, offers a substantial reduction in semiconductor losses. The reduced losses enables a higher power density and efficiency, compared to the established silicon devices.

This thesis presents a design methodology for converters utilizing the new wide bandgap. The methodology covers the initial selection of design parameters, the modelling and layout optimization of a converter system and its experimental validation.

For the design phase, the thesis present a multi objective optimization algorithm. The algorithm developed, objectively selects topology, design parameters and components. Based on the objective design specifications, a three level T-type converter was designed. Electrical models of the T-type converter was developed using layout parasitics of the system. The electrical models were used to optimize the converter layout for fast switching devices. The switching and system performance of the T-type converter was experimentally validated by building a double pulse test and a three phase inverter. A novel bootstrap circuit for a T-type converter was developed, enabling a further increase in converter power density. Furthermore the parasitics of a 10 kV SiC half bridge power module was modelled and experimentally validated using a double pulse test.