DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

PhD Public Defence

Title: Grid Connected Power Supplies for Particle Accelerator Magnets

Location: Pontoppidanstræde 101, Room 23

Time: Thursday 28 May 2015 at 13.00

PhD defendant: Rasmus Ørndrup Nielsen

Supervisor: Professor Stig Munk-Nielsen

Moderator: Associate Professor Christian Uhrenfeldt

Opponents: Professor Zhe Chen, Dept. of Energy Technology, Aalborg University (Chairman)
Klaus Olesen, Danfoss Silicon Power GmbH, Flensburg, Germany
Associate Professor Morten Nymand, University of Southern Denmark, Odense

All are welcome. The defence will be in English.

After the public defence there will be an informal reception in Pontoppidanstræde 101 room 25/27.

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Abstract:

Power supplies play a large role in particle accelerators, for creating, accelerating, steering and shaping the beam. This thesis covers the power supplies for steering and shaping the beam, namely the magnet power supplies. These power supplies have a special set of requirements regarding output current stability and accuracy, typically allowed drift over 8 hours is down to 10 parts per million of the maximum output current.

Several topologies are discussed and compared for different power ranges. Hereafter a topology is proposed. A converter based on this topology is constructed using a single power module on the grid side of the transformer, consisting of a boost rectifier and a dual half-bridge isolated DC/DC converter. It is shown that it is possible to create a power supply using a single module and that this approach can lead to improved layout and smaller converter size.

A high efficiency converter based on Silicon Carbide switching devices is also presented exhibiting above 96 % efficiency for the entire power range.
Finally reliability issues are considered as the reliability of a particle accelerator supply is of utmost importance. Particle accelerators requires large up time and many power supplies, magnets etc. must function in parallel for the particle accelerator to operate. A method for increasing the reliability of the proposed converter is shown. This is done by creating a lifetime model for the power module converter together with a mission profile.