

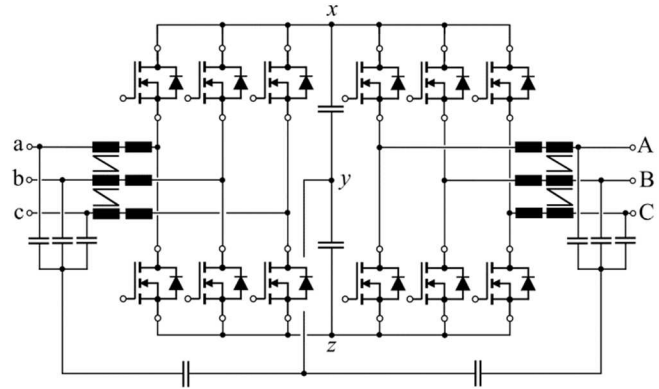
Master Thesis

AC-AC Voltage Source Back-to-Back Converter Aiming for High Efficiency

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Description

Next-generation regenerative Variable Speed Drive (VSD) systems tend to utilize SiC MOSFETs to achieve high efficiency (η) and power density (ρ) by increasing the switching frequency. Passive components can accordingly be downsized. In particular, there is a trend towards Integrated Motor Drives (IMDs), where the complete VSD system is placed in the machine housing. Thus, a more compact design is realized. Since power electronics and machines coexist, thermal aspects are important, and reducing losses eases this task, but this is typically counteracted by higher switching frequency. Most VSD applications today employ the Voltage Source Back-to-Back Converter (V-BBC). This topology is favored by industry due to its simplicity and the low number of semiconductors (12 MOSFETs in a SiC implementation). This master thesis investigates a novel modulation scheme aiming to achieve the highest possible efficiency.



Tasks

- **Literature Review:** Conduct a thorough review of AC-AC topologies that connect the three-phase grid to the machine.
- **Theoretical Analysis:** Perform an analysis of the proposed converter, including the derivation of analytical equations. This includes switching loss calculations, magnetics design, and capacitor selection.
- **Circuit Simulations:** Simulate a closed-loop controller aiming for unity power factor on the grid side while controlling the output currents based on the machine's operating point.
- **Pareto Optimization:** Perform Pareto optimization to find the most optimal design.
- **Hardware Prototype Development:** Develop a hardware prototype or use existing hardware for the project.
- **Commissioning:** Commission the converter and perform efficiency measurements.

Prerequisites

- Strong understanding of the fundamentals of power electronics.
- Experience in circuit design and simulation using MATLAB and PLECS.
- Some experience with designing passive components, such as inductors and capacitors.
- Basic C programming skills; familiarity with VHDL is a plus.

Contact and further information

- Please attach your CV and the latest study transcript to the application

Technical University of Munich

Chair of High-Power Converter Systems
Arcisstr.21, 80333 Munich

christos.leontaris@tum.de

www.epe.ed.tum.de/hlu