Medium-Frequency Transformers and Inductors for Economic and Resource Efficient dc-dc Converter Systems

Future electric grids with direct-current technology (dc) provide higher flexibility and efficiency for decentralized energy systems compared to conventional ac technology. Within the project “Flexible Electrical Networks” (FEN), a new approach to develop a dc-dc converter for green energy power grids is presented. You design a power electronic (PE) converter system with medium-frequency transformers (MFT) and inductors for high-efficiency, low costs and reduced material demand. Hence, your converter design method achieves superior economical magnetic components for future environmentally sustainable PE systems.

In this work, you focus on the conceptual design and comparison of latest three-phase MFTs and inductors with new C-core, toroidal core and coil-layout technologies for high-power galvanically isolated dc-dc converter systems. In contrast to conventional core structures, the arrangement of round toroidal cores for three-phase MFTs features lower winding, core and stray losses, enables full symmetry and improved cooling. You extend the available optimization framework to design the PE system simultaneously according to optimal efficiency, mass and material costs.

For each core technology, you implement the optimal configuration of MFT and external inductor in series to achieve the converter’s required series inductance and compare this to alternative methods with enhanced leakage inductance of the MFT. You evaluate these results between each other in terms of efficiency, mass, volume, hot-spot temperature, cooling and costs.

The goal of this work is to present dc-dc converters with economic and resource efficient magnetic components. You have the ability to work with Matlab to develop future design methods and new ideas. You can use the available design tool and you can build up required software skills within this thesis. Good luck!

This thesis is adapted for students from the following course studies:

☒ Elektrotechnik, Informationstechnik und Technische Informatik
☒ Wirtschaftsingenieurwesen (Fachrichtung: Elektrische Energietechnik)

The earliest starting time: 15.11.2019

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