100 kW DC-DC converter design files

Package " Converter control"

CONTEXT

The use of Silicon Carbide (SiC) components allows increasing the switching frequency of power converters while keeping an acceptable level of losses. Coupled with Medium Frequency Transformer (MFT), it allows a significant increase of the power density.

In order to assess these technologies, SuperGrid Institute has built a DC-DC converter prototype. This prototype operates with voltage of 1.2 kV, a power of 100 kW and a switching frequency of 20 kHz. It his based on one-phase and three phase Dual Active Bridge (DAB) and Single Active Bridge (SAB) topologies.

SuperGrid Institute proposes a set of results which include theoretical studies and technical choice justifications, design files, and testing report. These results will allow a quick mastering of these technologies for DC-DC converter designs. The different results have been divided in 5 packages and a patent.
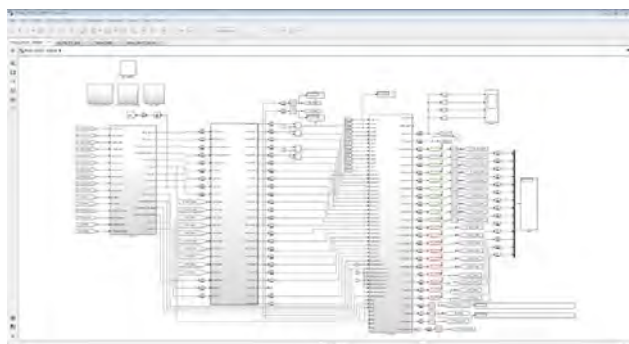
TECHNOLOGY DESCRIPTION

This package focusses on the control of the prototype. For testing the prototype with realistic testing conditions, a back to back method has been used. The control considers also this operating mode.

The control has been implemented on a rapid control prototype (RCP) solution using the Matlab/Simulink environment and includes also the models of the converters. Consequently, the software can be used in simulation without the real target (CPU + FPGA). It includes the following main functions:

- Control strategies for one-phase and three-phase DAB & SAB
- Voltage and current regulation loops
- Magnetizing current control in the transformer
- Fast modulation & protection of the switches (FPGA)

The deliverables include the specification of the software, the implementation (Simulink models) and the testing reports.

APPLICATION DOMAIN

- LV and MV power converters

ADVANTAGES

Ready to use models

Allows it quick mastering of the topologies

Allows a quick implementation of a prototype

TRL SCALE

1 2 3 4 **5** 6 7 8 9

Complete tests realized in laboratory with realistic operating conditions

DELIVERABLES

Matlab/Simulink project

Software specification

SCIENTIFIC REFERENCE

T. Lagier et al., "A 100 kW 1.2 kV 20 kHz DC-DC converter prototype based on the Dual Active Bridge topology," 2018 IEEE International Conference on Industrial Technology (ICIT), Lyon, 2018, pp. 559-564, doi: 10.1109/ICIT.2018.8352238.

T. Lagier and P. Ladoux, "Theoretical and experimental analysis of the soft switching process for SiC MOSFETs based Dual Active Bridge converters," 2018 International Symposium on Power Electronics, Electrical Drives, Automation and Motion (SPEEDAM), Amalfi, 2018, pp. 262-267, doi: 10.1109/SPEEDAM.2018.8445413.

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