



100 kW DC-DC converter design files

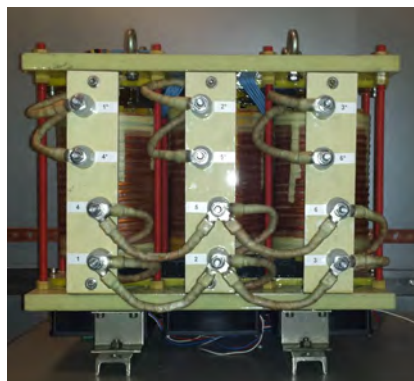
Package "Medium Frequency Transformers"

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 is 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

The package focusses on the different MFTs designed for the DC-DC converter prototype :

- 180 kVA, 20 kHz, 1.2 kV to 0.6 kV one phase MFT
- 250 kVA, 20 kHz three phase transformer with modular coupling (Y_y , $\Delta\Delta$ and Δy) and voltage ratio
- 150 kVA, 20 kHz, 1.2 kV to 1.2 kV three phase transformer with Y_y coupling

Core type structures with ferrite magnetic core have implemented in the three MFTs. The cooling of the MFTs is made by fans. They have been characterized and equivalent circuit models are available. A thermal test in full load conditions and in overload conditions has been made, thus validating the transformer.

The deliverables include the description of the design, the numerical models and the manufacturing details and testing reports

APPLICATION DOMAIN

- Auxiliary transformer for rail
- Solar applications
- Electric vehicles
- Energy storage

ADVANTAGES

High efficiency medium frequency transformer at 20 kHz with air cooling.

TRL SCALE



Complete tests realized in laboratory with realistic operating conditions

DELIVERABLES

- Albert Pereira Ph.D. Thesis on the design of this transformer
- Mechanical assembly of the transformers
- Electric & multi-physic models
- Testing reports

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.

P. Dworakowski, A. Wilk, M. Michna, B. Lefebvre and T. Lagier, "3-phase medium frequency transformer for a 100kW 1.2kV 20kHz Dual Active Bridge converter," IECON 2019 - 45th Annual Conference of the IEEE Industrial Electronics Society, Lisbon, Portugal, 2019, pp. 4071-4076, doi: 10.1109/IECON.2019.8926695.