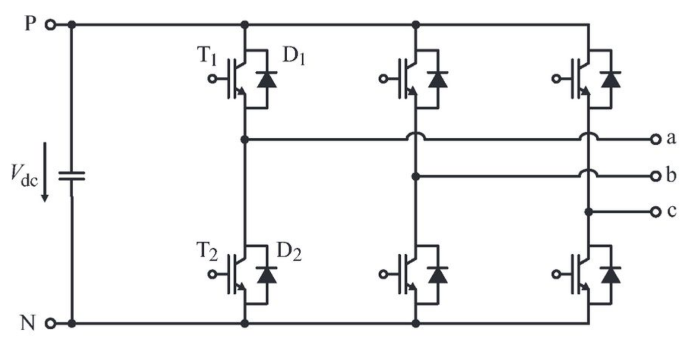
PROGRESS TO SUCCESS

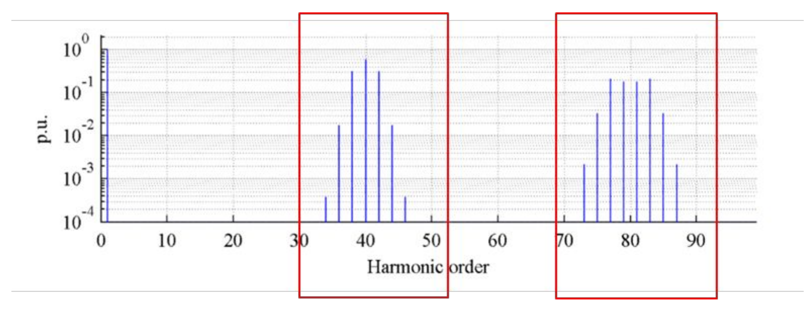
UC 1.4 Battery electric heavy-duty vehicle (BEHDV) drive inverter for high voltage

SCANIA · KTH · EDR MEDESO · RISE Research Institutes of Sweden · SAL SILICON AUSTRIA LABS

Objectives:

- To accurately define the specifications, requirements, and opportunities for the design of BEHDV drivetrains with a 1250 V nominal battery voltage.
- To identify suitable circuit topologies to meet the requirements.
- To design a competitive and highly efficient 1250 V SiC-based BEHDV inverter.
- To design a gate drive unit with condition monitoring of the SiC MOSFETs.
- To verify the designed traction inverter design through realistic laboratory tests
- To drive reliability improvements, prediction of reliability, and investigate methods for condition monitoring in the entire drive system.

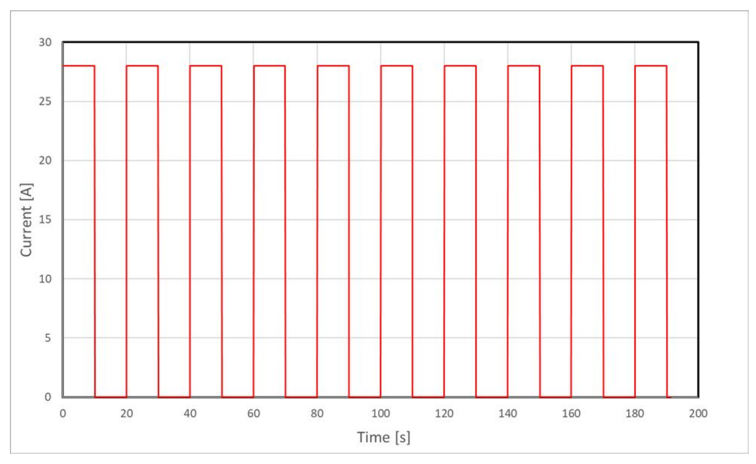


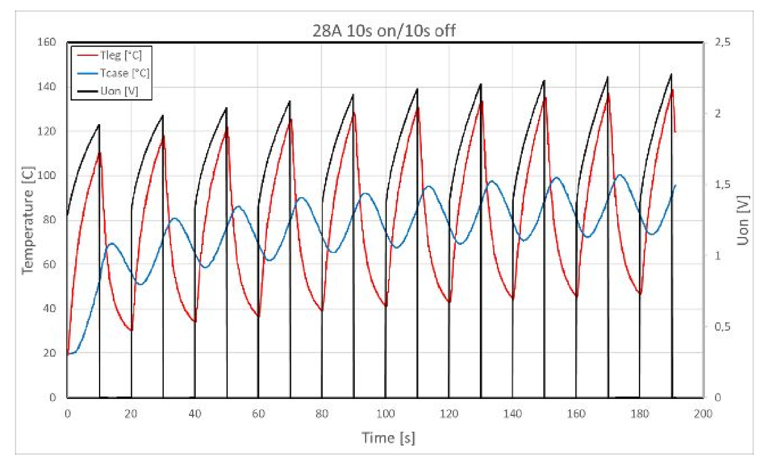


Inverter loss estimation of a 2-level inverter using 2 kV SiC MOSFET's from Infineon.

Methods:

- Multi-physics models in combination with numerical simulations, analytical descriptions, and experiments.
- Multi-physics optimization of the traction inverter will be performed such that the specified target function is minimized.
- Lifetime models of critical components will be developed through a combination of review of existing literature, analytical considerations, numerical simulations, and experiments.
- Suitable implementations will be identified and verified experimentally. The models will be employed both during the design and in the condition-monitoring implemented in the drive inverter.





Accelerated ageing experiments, by means of power cycling of SiC MOSFET's at different/variable loads.

KPIs:

- Nominal power losses of the traction inverter of 0.6%.
- Losses over the VECTO long-haul drive cycle of 0.7%.
- Nominal input voltage of the designed converters of 1250 V.
- Power density of the traction inverter of 50 kW/l.

Motivation:

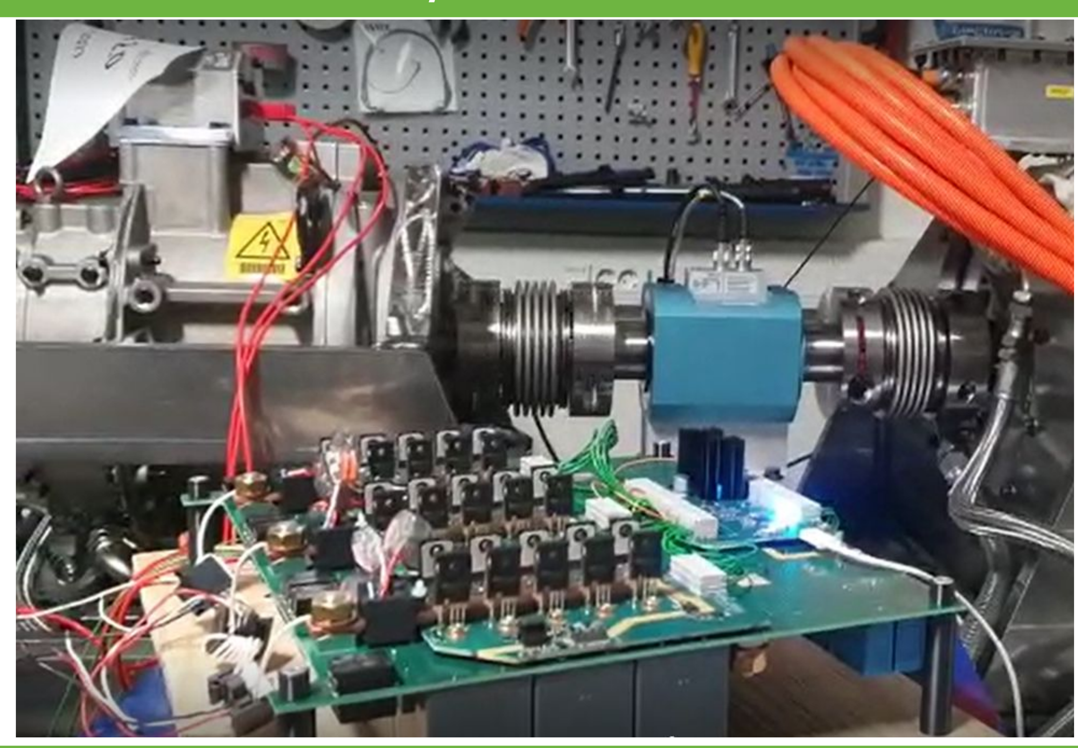
Today's BEHDVs use batteries with voltages of 800 V or lower. An increase in battery voltage to 1250 V would increase the charging power and thus lowering the charging time, allowing for an accelerated shift towards electrification.

Relevance:

The higher voltage level is in line with the new megawatt-charging standard (MCS). Digital twin and prognostics and health management of the system will enable predictive maintenance of power electronics, opening up for new data driven business models.

Markets:

Electric commercial vehicles, i.e. BEV trucks and buses.



First prototype inverter. 300 A, 650 VDC.

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