

3kV Multilevel DC-DC Converter with Coupled Inductor

Graduate



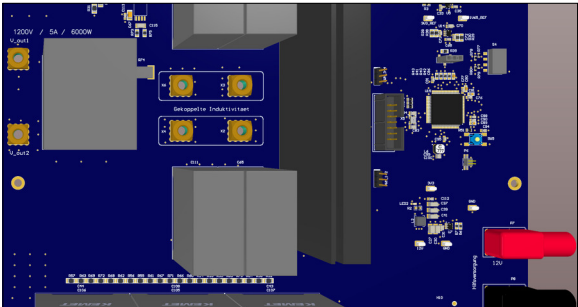
Milion Meseret

Initial Situation: To supply the onboard components of railway vehicles with voltage, input voltages in the kilovolt range must be converted into lower DC voltages. Conventional single-stage DC-DC converters reach their limits in this regard, since available semiconductors cannot provide sufficiently high blocking voltages and at the same time cause high switching and copper losses. This limits both the efficiency and the power density of the systems. Multi-stage topologies, on the other hand, allow the voltage to be distributed across several switches and thus form the basis for more compact and powerful converter concepts.

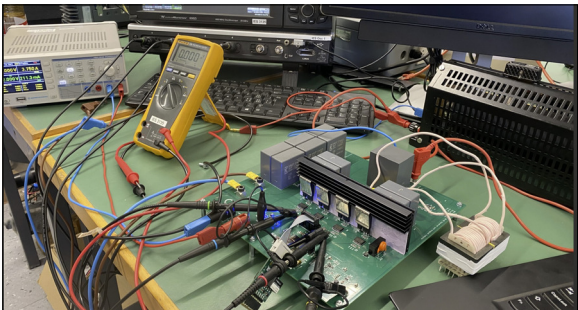
Objective:
The aim of this work is the development and experimental validation of a novel multi-level DC-DC converter. The selected topology combines a multi-level DC-DC converter with coupled inductors, which is operated in Boundary Conduction Mode (BCM). The following objectives are central:
Develop a multi-level DC-DC converter for a 3 kV input voltage.
Employ coupled inductors for current ripple reduction and capacitor balancing.

Result: multi-level converter was successfully developed that can convert high input voltages into lower DC voltages. The high input voltage is halved by means of the coupled inductor between the DC-link capacitors. The average voltage across the capacitors deviates slightly from the simulated voltage. This can be attributed to losses in the inductance as well as to tolerance differences of the capacitors.

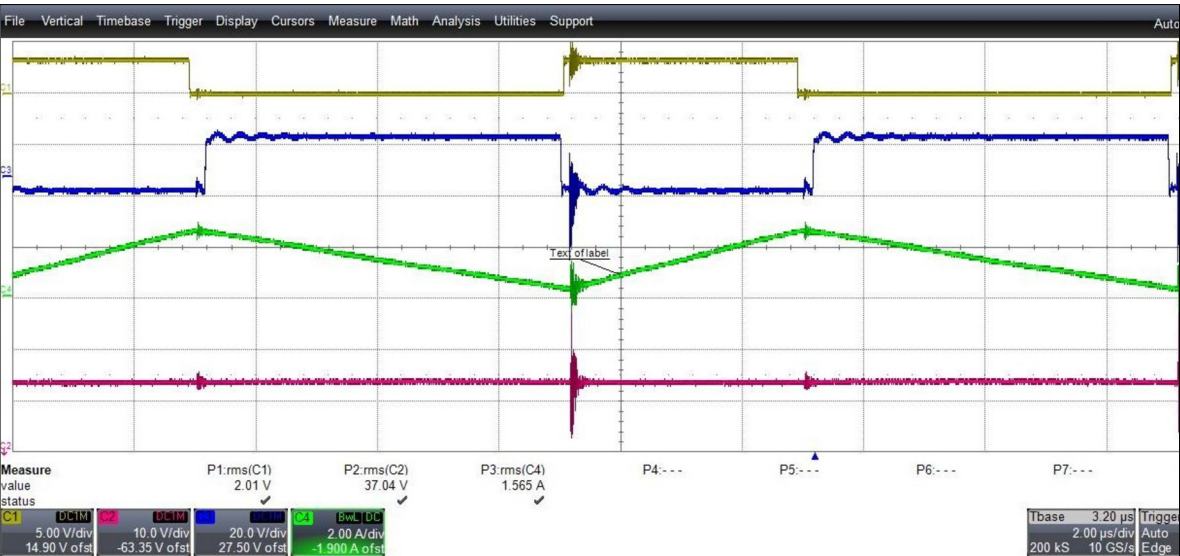
PCB Layout of the 3 kV Multilevel Converter
Own presentation



3 kV Multilevel Converter Test Setup
Own presentation



Oscilloscope Measurement of the Multilevel Converter
Own presentation



Advisor

Simon Nigsch

Co-Examiner

MSc. Markus
Markstaler

Subject Area

Electronics and Control
Engineering