

# Multi-Topology-Board for converter characterisation

## Development of an evaluation board for power electronics education

### Graduate



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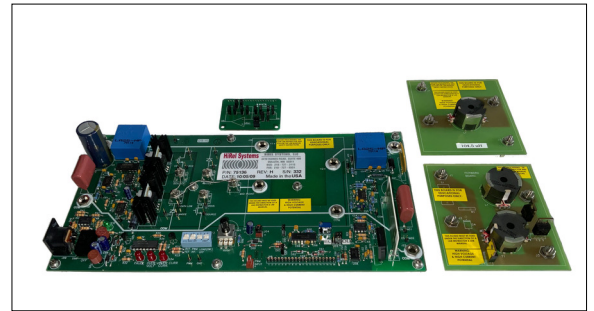
**Definition of Task:** In the bachelor's degree program in Systems Engineering with a specialisation in Electronics and Control Engineering, the basic converter topologies (buck, boost, forward converter) are taught in the subject area of power electronics. Each course content is supplemented by a laboratory exercise. These should help the students to verify the theory they have learned and put their knowledge into practice. Until now, a test board was used for this purpose, with which the corresponding basic topology could be characterised after configuring the board by changing adapter boards and screw connections. The use of this test board revealed considerable potential for improvement. On the one hand, the components used no longer correspond to the current state of the art, which makes it difficult to recognise typical parasitic effects of a converter. On the other hand, time could be saved with an intuitive board, which would benefit the students in understanding the measurements and the basic converter topologies. The aim of this bachelor thesis is to develop a replacement for the old test board. The Multi-Topology-Board should comply with or extend the specifications given by the already existing laboratory exercises. The focus is on simple configuration, intuitive operation and the use of new components.

**Approach:** After determining the hardware requirements, a concept for the new Multi-Topology-Board was developed. Subsequently, a schematic was designed, suitable components were selected, the layout for manufacturing the board was created and the firmware for the microcontroller used on the board was designed. After the board was assembled and commissioned, various measurements were carried out to validate the functionality and verify the required specifications. In particular, it was checked whether the findings conveyed in the existing laboratory exercises can also be reproduced on the new hardware.

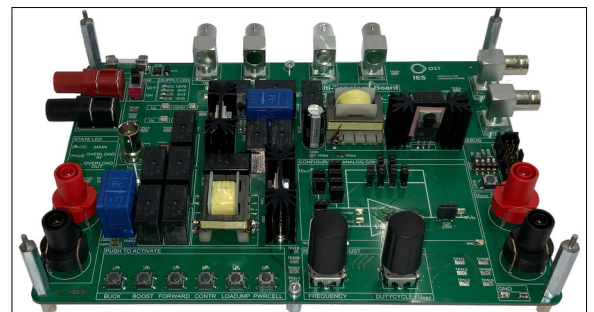
**Result:** The result of this task is a functional prototype of the Multi-Topology-Board. The measurements carried out showed that not all parasitic effects of the converters can be represented satisfactorily with the new board. On the one hand, the switching of the power switch causes disturbances that affect various measured values. On the other hand, the conductor routing, which is not perfect due to the relay circuit, leads to undesired oscillations on the measuring lines. Consequently, minor modifications are still necessary for use in the educational environment. By switching the topologies by means of relays, a simple configurability was realised. The relays connect the power components shared by the three topologies. Push buttons and rotary encoders were provided for operating the board, the actuation of which is detected by the microcontroller. Feedback to the operator is provided via LEDs. Finally, the measured values required for the laboratory exercises

were suitably scaled and connected to BNC sockets.

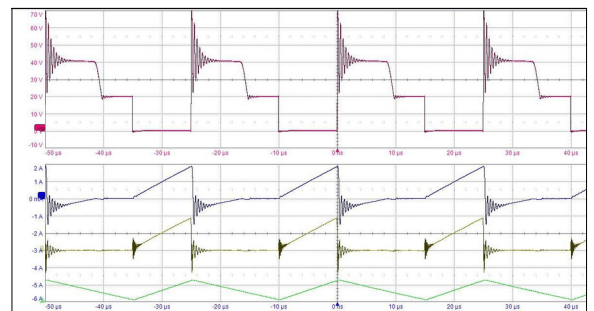
The old test board with its plug-in adapter boards  
Own presentation



3-in-1: The new Multi-Topology-Board with the converter topologies buck, boost and forward  
Own presentation



Representation of a measurement of the current and voltage characteristics in the forward converter  
Own presentation



### Advisor Simon Nigsch

### Co-Examiner Prof. Dr. Daniel Gstöhl

### Subject Area Electronics and Control Engineering