

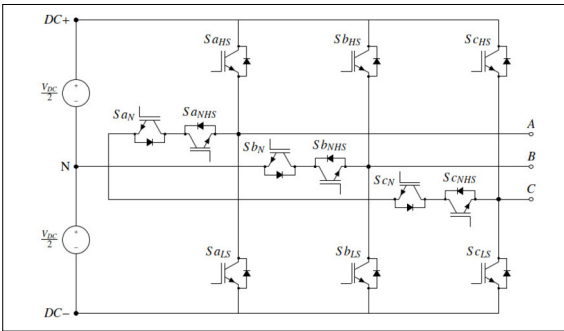


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Subject Area	Energy and Environment
Project Partner	BRUSA Elektronik AG, Sennwald, St. Gallen

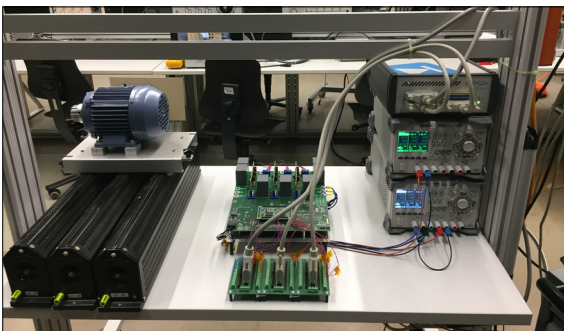
# 3 Level Motor Inverter Prototype

## Design, buildup and commissioning of a 3 level motor inverter



Inverter topology  
Own presentation

**Introduction:** Normally motors are driven by three phase sinusoidal currents. Inverters are used to generate those currents. They feed the motor with the power to drive a load like a car or a machine. To do that an inverter produces modulated AC voltages from a DC source like a battery or a different power supply. These AC voltages then result in a current in the motor windings which generates the motor torque. Due to the working principle of converters the produced current is not sinusoidal but pulsed. A well known and normally used topology is the classical two level inverter. It uses the plus and the minus potentials of a battery, thus two level, to generate the required AC voltages. To reduce losses the currents in the motor should have as close as possible to a sinusoidal form with the wanted frequency. All other harmonics or distortions only produced heat and are not contributing to the delivered power of the motor. One possibility to produce cleaner motor currents is to make a more sinusoidal approximation of a sine wave with the AC voltage. One way to improve the voltage quality, which is explored in this project, is to add another voltage level to the DC source. There is then as before the positive and negative voltage plus an intermediate voltage with a potential in the middle of the other two. In particular a three level inverter in a so called T-type topology is further investigated in this project.



Test setup  
Own presentation

**Objective:** The objective of this project is to build a prototype of a three level inverter in cooperation with BRUSA Elektronik AG. The chosen topology is called a common collector T-Type inverter. The reason behind the name is that the switches of a phase are arranged in a T shape. Two additional power switches are added to every phase which connect the bridge point to the additional midpoint of the DC voltages. The additional switches are connected in a way that they share the same collector potential. This prototype should be able to switch between two level and three level operation and should handle 800V and 50A RMS in both modes of operation. The final target is to measure the benefits of a three level inverter concerning the losses in a motor. Those can then be compared to the losses of the same motor driven by a two level inverter. As a last task the differences in switching losses in comparison to a traditional two level inverter should be investigated.



Results  
Own presentation

**Result:** The three level type T-inverter project was realized successfully in a low voltage operation. The commissioning of the basic functions and the logic was conducted and some small bugs were fixed. The power supplies were tested and all the snubber circuits experimentally determined and corrected from the initial design. The gate drivers work as intended and the power switches fulfil their function. The prototype was then tested successfully with an asynchronous motor as a load. The generated AC currents were able to spin the motor and the generated AC voltages were checked. Also the prototype was able to switch between two- and three level operation. Up to this point the prototype is working as intended. In a next step a motor controller will be implemented and the prototype will be used up to maximum load to prove the operation up to the specified values.