3/2-Level Motor Inverter Commissioning

Commissioning, measurement and analysis of a 3-level T-type inverter prototype

Students

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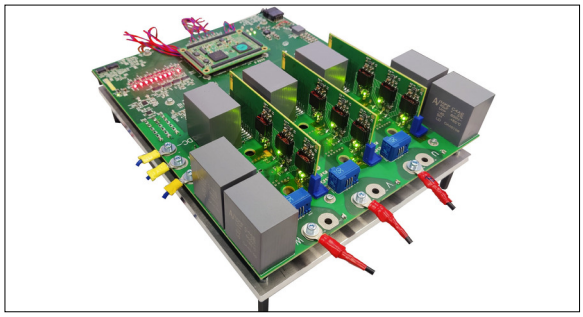
Introduction: Motors are normally driven by three phase sinusoidal currents. Inverters are used to generate these currents by producing modulated AC voltages from a DC source. These AC voltages result in currents in the motor windings which generate the motor torque. A well-known and normally used topology is the two-level inverter. It uses the standard plus and minus potential of a battery, thus two-level, to generate the required AC voltages. To reduce motor losses the currents in the motor should be as close as possible to a sinusoidal form with the wanted frequency. All other harmonics or distortions are not contributing to the active 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. Another way to improve the voltage quality, which is explored in this project, is to add another voltage level to the DC source. In this case the inverter uses an additional third potential which is averaged as the midpoint at 0V. The additional voltage level provides more sinusoidal phase voltages, which affects directly the phase current, in a more sinusoidal shape with less harmonics. Such a three-level inverter prototype in a T-type topology was built in a previous project. This prototype was partially tested including some basic hardware functions and the control interface. In this project a detailed investigation of the prototype is performed and the results are measured and evaluated.

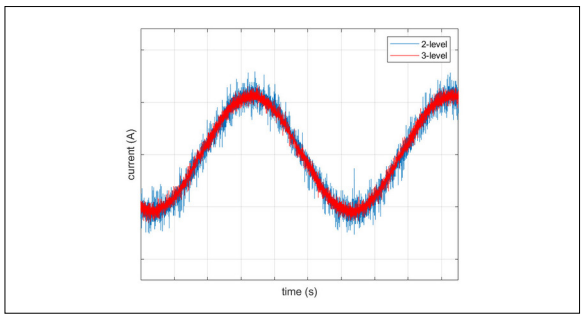
Objective: The objective of this project is to further commission the previously built three-level inverter and conduct measurements to compare its performance to standard inverters. This includes the analysis of inverter current quality, losses of the inverter and the impact of the phase currents at the motor. Since this project is based on the last semester developed prototype, this project is again in cooperation with BRUSA Elektronik AG.

Result: The three-level type T-inverter project was realized successfully. Despite of small issues the prototype was fully commissioned. All the wanted functions work as intended and the system was operated and tested on a motor test bench. The inverter was operated up to a speed of 9000 RPM and a torque of 25 Nm. This results in a total achieved DC power of 23.5 kW. The inverter was operated in two- and three-level mode to compare the performances of inverter and motor. As expected, the three-level operation leads to smoother sinusoidal currents. In addition, the losses in the inverter are also lower in the three-level operation, because of the semiconductor's arrangement, which affects the switched voltage level.

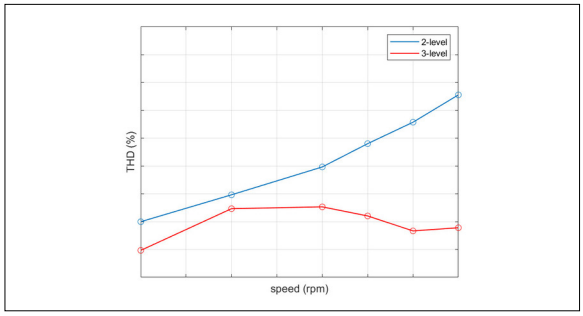
Prototype
Own presentment



Phase current
Own presentment



THD comparison
Own presentment



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Subject Area
Energy and Environment

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