

POWER ELECTRONICS

HELMUT SCHMIDT UNIVERSITY

UNIVERSITY OF THE FEDERAL ARMED FORCES HAMBURG

Introduction:

The Helmut Schmidt University is a campus university with four faculties where 2500 bachelor and master students are taught. Within the faculty of electrical and information engineering the chairs of electrical machines and drives, electrical power systems and power electronics are responsible for the education in electrical engineering. These institutes are characterized by their effective cooperation and an excellent technological infrastructure. Since 2007 Prof. Hoffmann has been the chair of power electronics. His team currently consists of seven PhD students, one principal engineer and three engineers in the laboratory.



Gate driver circuit with internal protection

Research Scope and Competence Fields:

Power Topologies and Converter Technology:

- Analysis and experimental verification of high frequency switching converter topologies
- Design of load resonant high power inverters with switching frequency above 200kHz
- Efficiency improvement of Uninterruptible Power Supplies (UPS)
- Modular and interleaved controlled DC-DC-converters
- Multilevel converter topologies

Semiconductors and Gate Driver Circuits:

- Parallel operation of uni- and bipolar power devices
- Measurement and characterization of power semiconductors
- Modular high-voltage switches featuring reduced gate driver power consumption
- Gate driver circuits for IGBTs, MOSFETs and JFETs for switching frequencies up to 500kHz
- Analysis and experimental verification of wide bandgap semiconductors (active and passive silicon carbide and gallium nitride devices)

Modeling and Simulation:

- Real-time simulation (hardware-in-the-loop) of power converters
- Simulation of power converter topologies (e.g. resonant converters for lighting applications)

Miscellaneous:

- FPGA based active harmonic compensation
- Calorimetric tests of passive components



High frequency multilevel inverter



Liquid-cooled DC-DC-converter with very high power density

Laboratory Equipment:

Hardware:

- AC power supplies up to 500V with a maximum power of 200kVA in a frequency range from 15Hz up to 400Hz
- DC power supplies with a voltage range of $\pm 440V$ and a maximum power of 100kW
- Programmable DC power supplies up to 1000V and 150kW
- Precision multi-channel digital oscilloscopes with bandwidths up to 1.5GHz and sampling rates of 20GS/s
- Miniature Rogowsky-current-transducers with a bandwidth of 200MHz
- Digital frequency analyzers and precision power function meters
- Precision high power curve tracer (up to 3kV and 400A) for power semiconductors
- Optical and fibre optical temperature measurement systems
- Precision Climate chamber
- High voltage sources up to 60kV

Software tools:

- MATLAB/Simulink, SIMPLORER, PLECS, Mathcad, LTSpice, LabView, RT-Lab