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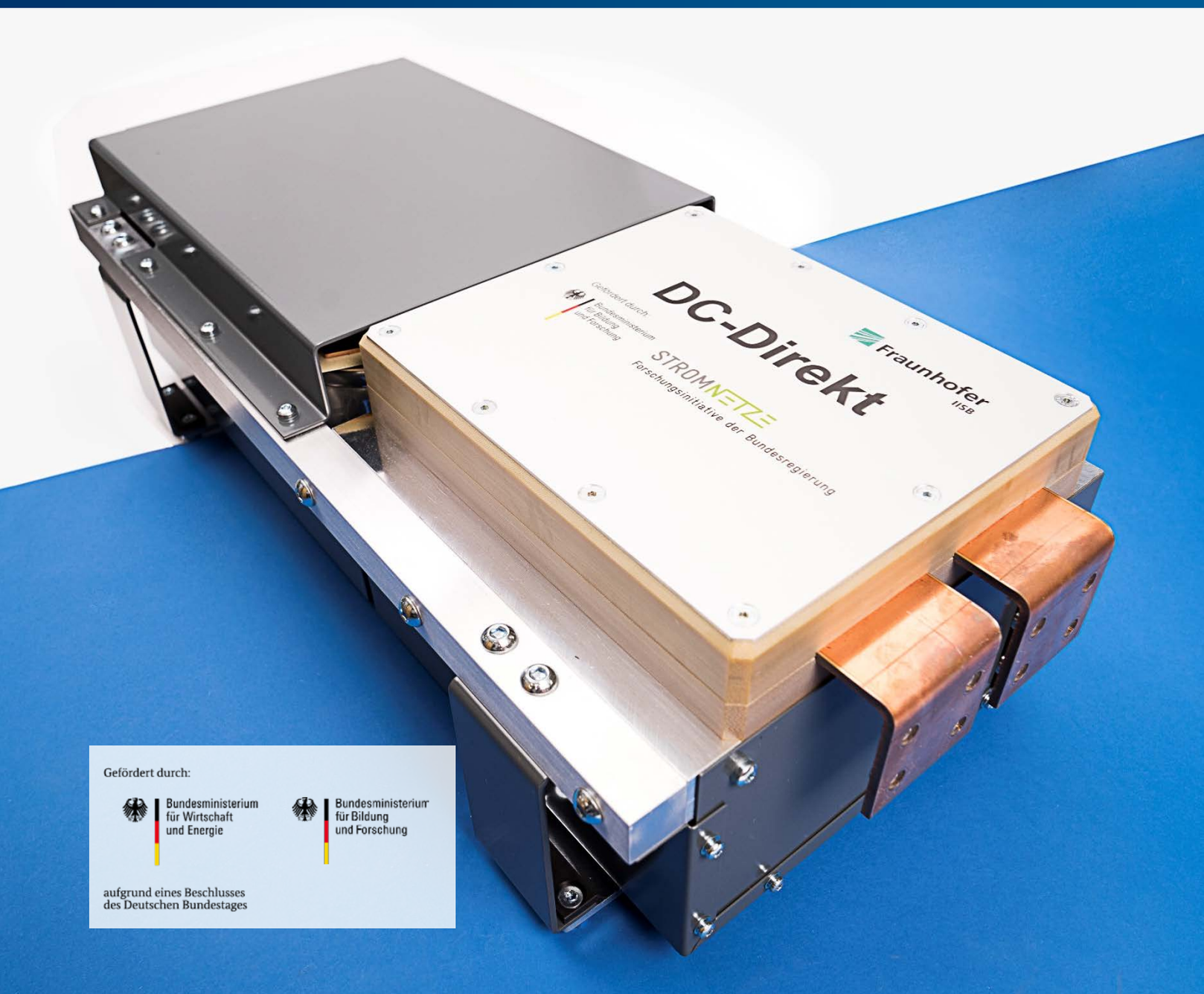
FRAUNHOFER INSTITUTE FOR INTEGRATED SYSTEMS AND DEVICE TECHNOLOGY

600 V Full Bridge Cell For Modular Multilevel Converters

**600 V, 800 A full bridge cell for modular multilevel converters:
cell capacitors and copper busbars (back) and full bridge with gate drive and FPGA control board (front)**



Gefördert durch:

Bundesministerium für Wirtschaft und Energie

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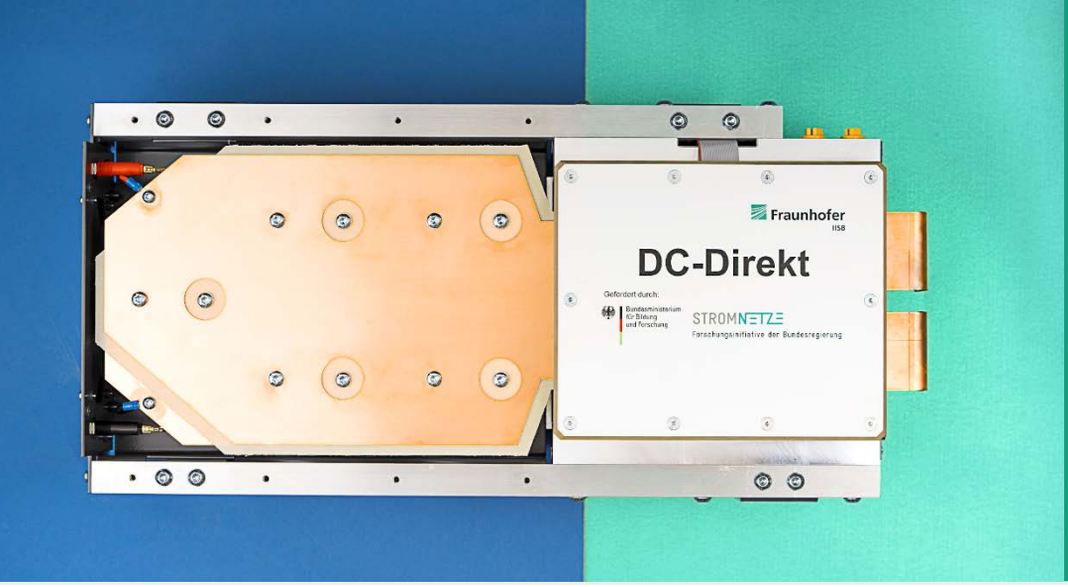
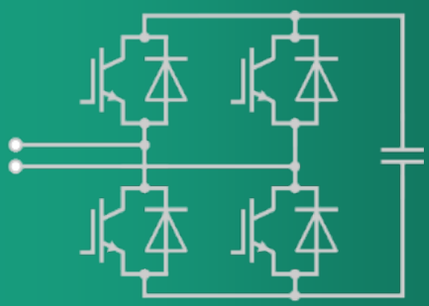
aufgrund eines Beschlusses des Deutschen Bundestages





Power circuit schematic: full bridge with two half bridges and cell capacitor

Our objectives

- Modular Multilevel Converter (M2C) system design
- Application-related component characterization of semiconductor modules
- Customized full or half bridge cell design including cell capacitor, power circuit layout and special gate drive design
- Improvement of system performance considering objectives such as overall system losses, weight and/or cost
- Technical and cost-efficient comparison of multilevel converters such as 2-level, NPC and modular multilevel converters
- Integrated protection mechanisms for e.g. short circuit at feed-in of medium voltage DC grid
- Development of automated SoC control (Cyclon V SoC) with cell voltage and current monitoring

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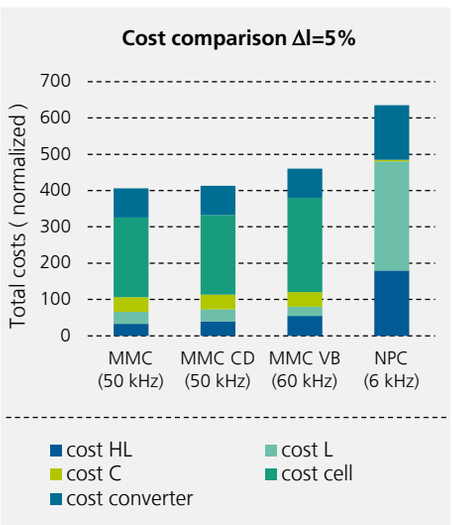
The full bridge cell

- Full bridge realized by two half bridges:
  600 V and 800 A
- 7 mF foil capacitor
- Integrated voltage measurement
- Gate drive with safety features
- Fiber-optic cable interface for communication and sensor data
- FPGA control and hardware watchdog
- External power supply for FPGA and gate drive or internal voltage conversion from cell capacitor

Topology cost comparison

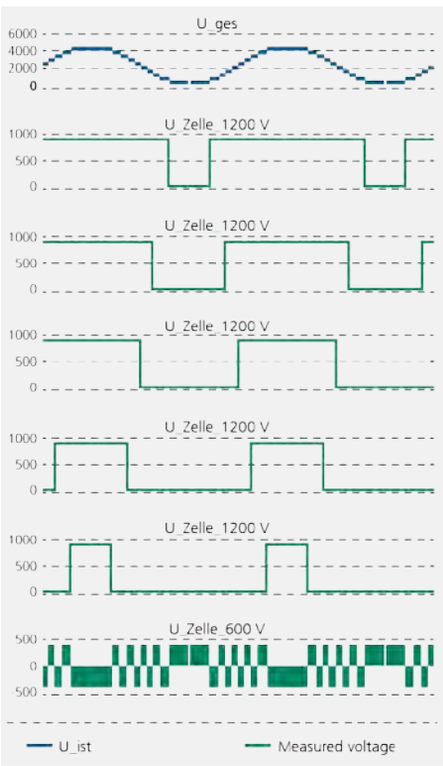
- MATLAB / PLECS © simulation models for 2-level, NPC and multilevel topologies
- Static and dynamic power loss calculation of each component
- Cost comparison for customized hardware setups



Total system cost comparison at an output current ripple of 5 %

Inhomogeneous cell voltages

- Combination of cells with different cell voltages
- Low voltage cells can provide high switching frequencies due to low switching losses
  - Smaller inductors with lower costs
  - Grid support due to higher dynamic
- Higher development effort of inhomogeneous cell voltages is mitigated by advantages for high dynamic operation mode



Total M2C arm voltage (top) combined from high voltage cells with low switching frequency (middle figures) and low voltage cells with high switching frequency (bottom)