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)
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

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

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

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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

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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)