Fraunhofer ISIT

Super-HEART: a fault-tolerant energy hub

High availability | maintenance friendliness |High efficiency

Interconnected datacenter in urban areas

Electrification of society is reaching mission critical applications. However, Power electronics (PE) devices are prone to failure, and high availability is usually ensured using redundancy - which is expensive and bulky. In the meantime, PE allows hybrid (AC & DC) electric distribution, which is key to integration of solar power and use of hydrogen as energy carrier. Multi-source integration, including renewable generators and energy storage, is furthermore required to ensure continuity of operation, whilst compensating the limited dynamics of power sources like fuel cells and filtering out disturbances carried by the network.

With Super-HEART, Fraunhofer ISIT targets the development of a high availability power converter for multi-source energy integration, for applications that require continuous operations. Together with our academic partners, we have gained extensive experience in the development of multiport isolated DCDC power converters (>20 kW), with an emphasis on high availability and fault-tolerance. For high efficiency and power density, we use SiC, GaN, planar transformers, and custom high performance super-capacitors.

Technologies involved

- Based on multi-winding transformer for maximum efficiency
- High reliability mechanical switches for fault-tolerance
- Magnetic bus enabling few powers conversion stages: more efficient, more reliable
- Custom super-capacitors: higher density, greener
- High frequency transformers, SiC and GaN transistors

Key features by Applications

Features	Comparison to state of art technology	Uninterruptible power supply (UPS) for datacenters	Net zero energy (NZE) for multi-house segments	DC industry network applications
Availability	**Fault tolerance for minimum redundancy**	Maintain operation despite of fault	High availability required for customer acceptation	Avoid supply chain disruption
Multiple source	**Integrated solution**	Easy back-up energy sources integration	Enable integration of battery, PV, small electrolyser and Fuel Cell	Greener plants with reduced energy consumption
Custom super-capacitors	**High energy and power, greener technology**	Compensate for slow dynamics of other sources, filter out disturbances from the network		
Power level / range	**100 kW, scalable**	Connects loads and sources with different voltage and power ratings		
Safety	**All ports isolated**	Medium-frequency transformer incl. galvanic isolation		
Integration level	**Higher density (+20%)**	High power density supported by integrated design and use of a multi-winding transformer, SiC, GaN, and integration technologies, high performance super capacitors		
Efficiency	**-20% losses**	Lower cost of ownership, increase competitiveness of renewable energy systems		

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C A U Christian-Albrechts-Universität zu Kiel

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Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Fraunhofer ISIT

Highly Efficient and Reliable Electronic Energy Systems

Applied research from device- to network-level power electronics made in Northern Germany

What we can do for you @Fraunhofer ISIT

Active reliability

- Sensor integration
- Lifetime analysis
- Reliability-driven control
- Multichip power modules

Hybrid grids

- Medium Voltage DC applications
- New components
- Grid forming converter

Battery integration

- Charging stations
- Grid support
- Bidirectional power transfer

Fraunhofer Institute for Silicon Technology ISIT

Fraunhoferstr. 1
25524 Itzehoe, Germany

ISIT@CAU
Kaiserstr. 4
24143 Kiel, Germany

Head of the Electronic Energy Systems
Prof. Dr.-Ing. Marco Liserre
marco.liserre@isit.fraunhofer.de
www.isit.fraunhofer.de/ees

Headquarter of the Fraunhofer ISIT