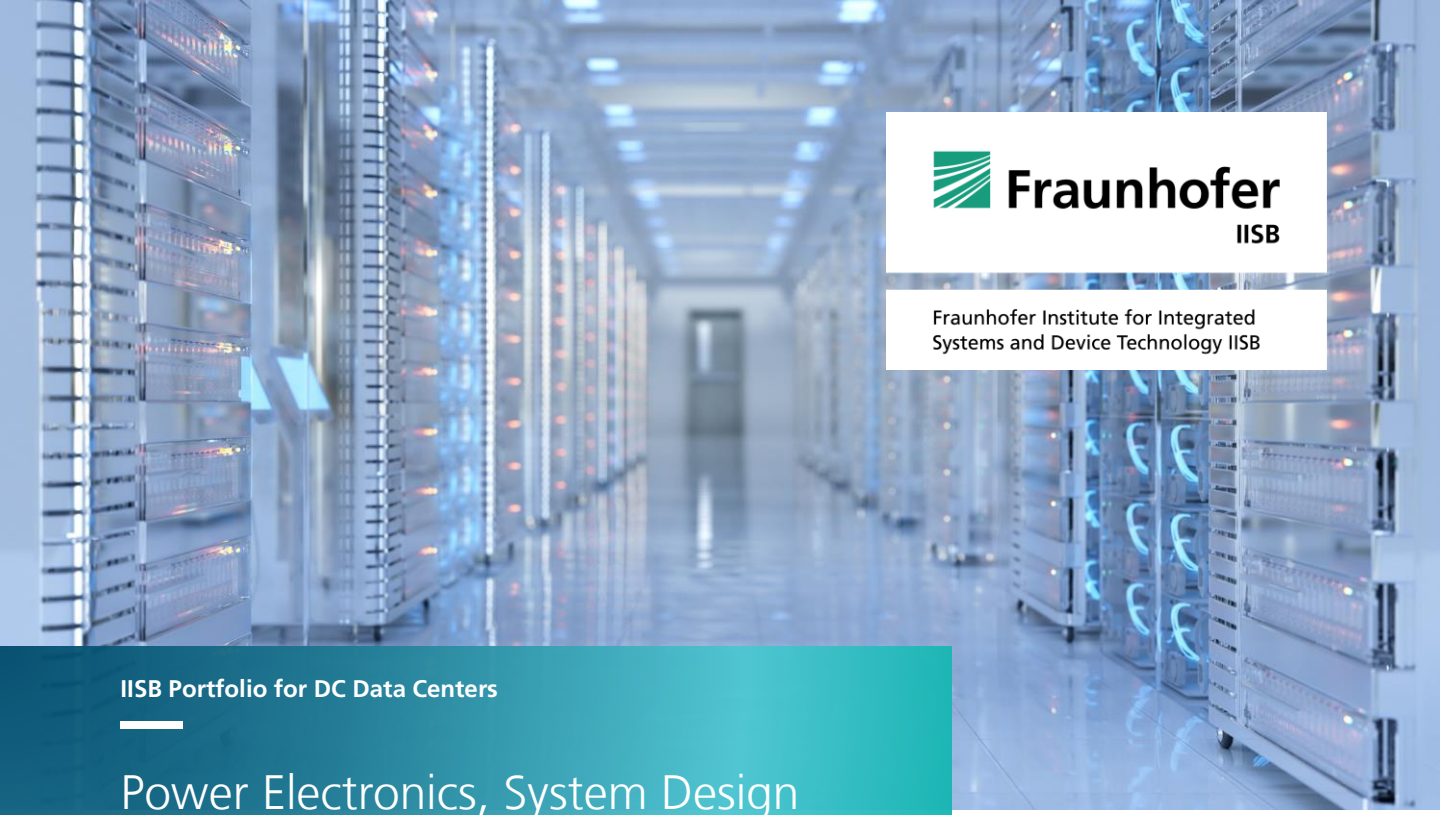

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IISB Portfolio for DC Data Centers

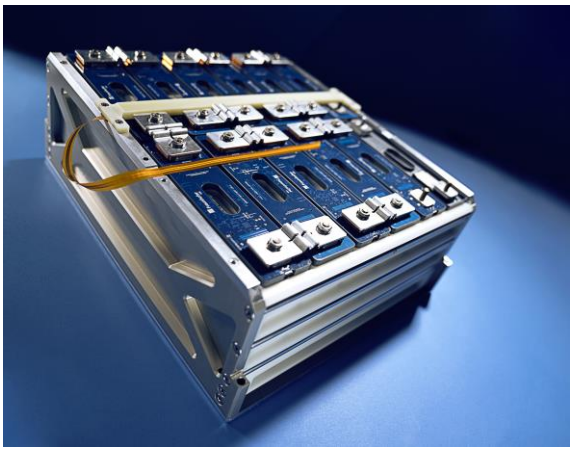
Power Electronics, System Design and Protection for DC Data Centers

Motivation

- Energy consumption by data centres in the EU has risen from 53.9 TWh/year (2010) to 76.8 TWh/year (2018) and already accounted for around 2.7% of the EU's total electricity demand. A further increase to around 92.6 TWh/year is expected by 2025.
- At the same time, power density in data centres is rising sharply: from two- to three-digit kilowatt figures per server cabinet to peak values of up to 1 megawatt per rack for AI applications.
- The 'power infrastructure' – i.e. power electronics, power distribution and cooling – now takes up as much space as the actual IT hardware and is increasingly becoming an equally significant factor in terms of floor space.

Solution

- Servers and GPUs generally operate on direct current (DC) internally. It therefore makes sense to convert the entire power distribution system in the data centre to DC.
- Power electronics, already a central element in traditional power distribution structures, becomes the dominant component of the power supply in DC data centers.
- Very high requirements are placed on power electronics:
  - Maximum efficiency and power density
  - Safe isolation between medium voltage and 800 V DC (e.g. in 'solid-state transformers')
  - Conversion from 800 V DC to low voltages (e.g. 12 V) directly at the servers
  - Dynamic coupling of local energy storage systems to absorb load peaks caused by AI and GPU workloads



Battery Module © Anja Grabinger / Fraunhofer IISB

Power Electronics

- Development, design and characterization of converters
- Modular SST design for MV/LV and LV/SELV
- MMC development for AC/DC interlink
- LVDC-POL DC/DC converters
- Hardware and Control design
- Unlocking the full potential of GaN and SiC in innovative converter design

MMC in 200m² medium voltage lab © Daniel Karmann / Fraunhofer IISB

Standardization

- Founding member of Open DC Alliance (ODCA)
- Participation in OCP Power Distribution DCF group
- Lead and participation of multiple national (DKE) and international (IEC) standardization committees for various DC topics

System Design

- Modelling and simulation of DC grids for:
  - Short circuit and ground current estimation
  - Selectivity Analysis
  - Grid stability
  - Optimization of operation and load scenarios
  - System resiliency
- Grid topology and dimensioning of components
- Design of battery systems for high power and high energy solutions

Modular SST © Moritz Wild / Fraunhofer IISB

Protection

- Development of semiconductor-based circuit breakers
- Fault current detection and limitation within the single-digit µs-area
- Test and characterization of mechanical, hybrid and semiconductor DC switchgear up to 10 kA
- Arc fault detection and mitigation

Fraunhofer IISB
Your One-Stop-Shop for DC Data Centers!

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