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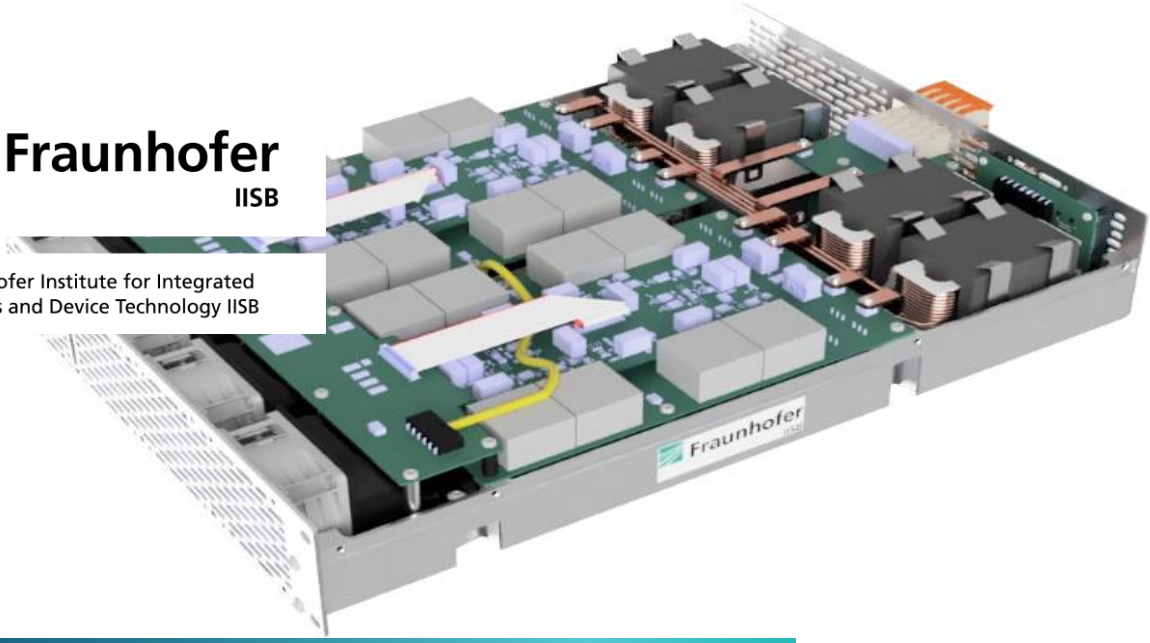
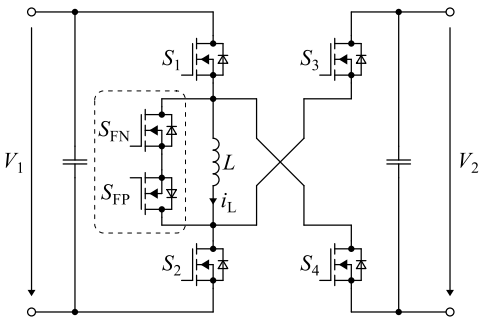


50 kW SCI DC/DC Converter
@ Kilian Drexler / Fraunhofer IISB

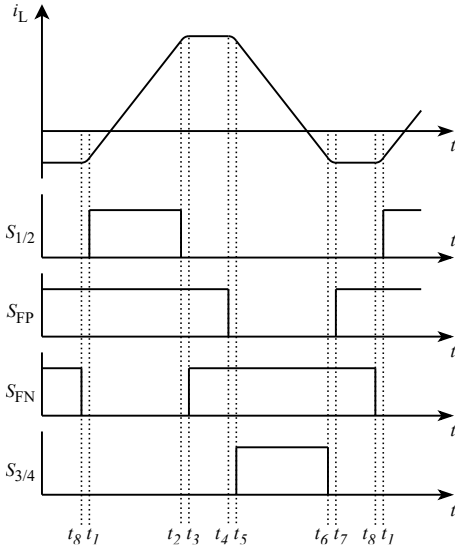
DC/DC Converter with Semicoductor-Based Isolation for EV Charging Stations

Motivation

- In larger electric vehicle (EV) charging parks supplied by a common DC bus, the galvanically isolated DC/DC converters usually used in the charging stations constitute a significant portion of the overall costs, size and losses.
- To reduce this, this DC/DC converter abandons the classic transformer-based isolation and instead implements semiconductor-based isolation (SCI) through its innovative topology.
- This enables significant improvements in power density and efficiency compared to commercial devices.
- Both 400V and 800V vehicle voltages are supported, and bidirectional power flow also enables V2H and V2G.



Basic topology of a single phase of the SCI converter. @ Kilian Drexler / Fraunhofer IISB



Switching pattern of the SCI converter.
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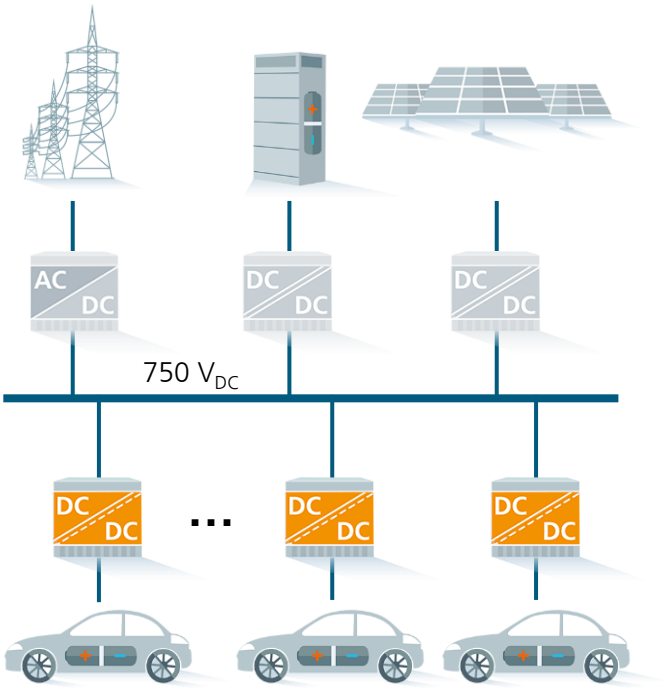
Prof. Dr.-Ing. Martin März



DC grid architecture of a charging park with SCI-Converter © Kilian Drexler / Fraunhofer IISB

Features

- Housing: 19-inch, 2HU, 600mm length
- Power: 50 kW
- Power density: 2,15 kW/L
- Voltage area (both sides): 80 V – 1000 V
- Voltage grid-side, nominal: 700 V (ODCA and Current/OS compatible)
- Maximum Current: 100 A
- Switching frequency: 40 – 80 kHz
- Power-flow: bidirectional
- Efficiency (at 50% Pmax): 98,75%
- Cooling: forced airflow
- Internal fault detection and mitigation
- Patent pending

Semiconductor Based Isolation

According to the product standard for DC charging stations (**IEC 61851-23**), charging points need to be isolated from each other. With this isolation, it is ensured that a fault in one charging path does not have any impact on another charging point. This is especially important considering battery systems with **different voltage levels (400V and 800V)**. Without this isolating stage, a single ground fault in one charging path can cause the vehicle's insulation voltage to be exceeded at another charging point. This results in damage to the vehicle, even though the fault actually occurs in a separate circuit. The **SCI-converter** achieves a level of protection comparable to that of a conventional transformer-based solution, but with **significant savings in weight, volume and cost**. This is achieved by ensuring that at least one semiconductor switch is always in the off state between the two sides of the converter. However, it is therefore essential to ensure that **the converter detects a faulty switch** and shuts down immediately. This is achieved through the circuit design, enabling the SCI converter to maintain the **protective potential** even in the event of internal faults.

Contact

Kilian Drexler
DC-Grids
Phone +49 9131 761-603
kilian.drexler@iisb.fraunhofer.de

Fraunhofer IISB
Schottkystraße 10
91058 Erlangen, Germany

www.iisb.fraunhofer.de

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