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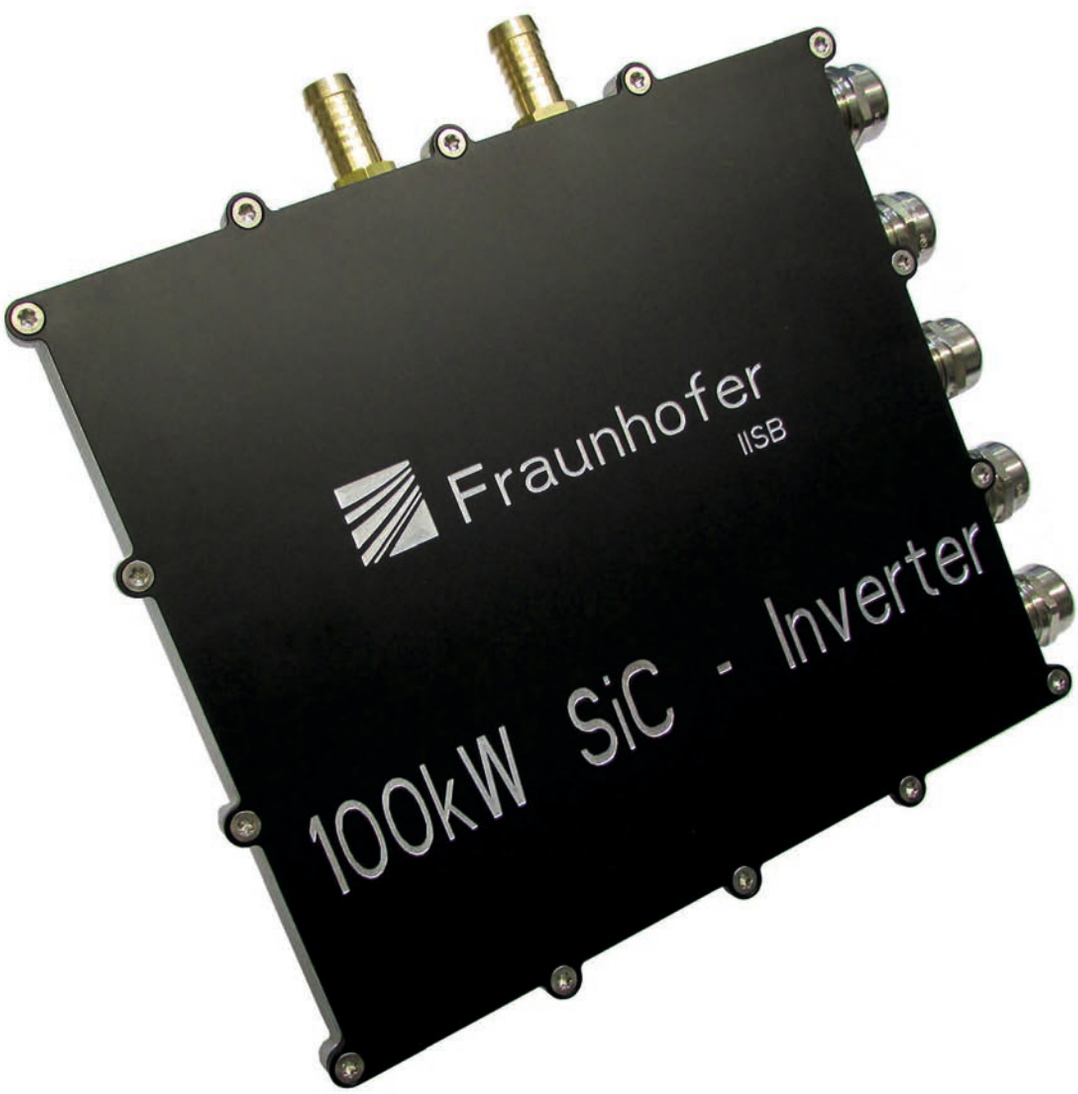
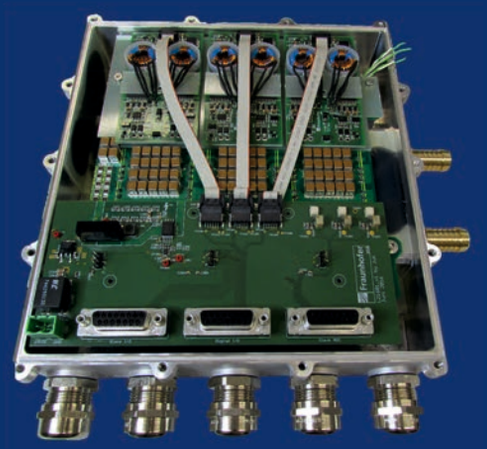
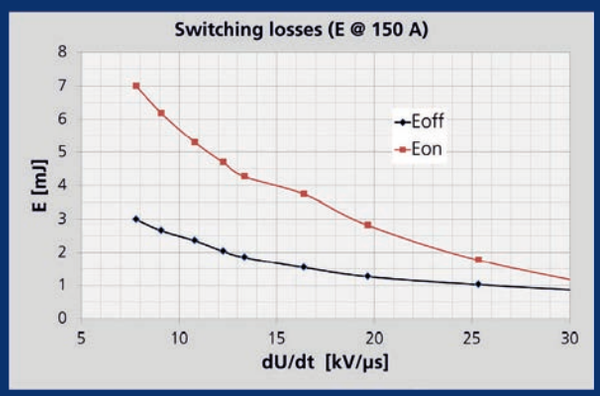
100 kW SiC-Inverter for Automotive Application





SiC inverter with modular design



High switching speed for reduced losses

Automotive SiC-MOSFET Inverter

Siliconcarbide (SiC) MOSFETs offer huge potentials for power electronic systems due to their significantly reduced conduction and switching losses and their capability for highest junction temperatures. Based on this novel semiconductor technology, a modular and compact 3-phase 800 V drive-inverter for automotive application with a maximum output power of 100 kW was designed and realized. Using four parallel MOSFETs per switch, the system provides a maximum phase current of 150 A_{rms}.

The inverter demonstrates the advantages of SiC-semiconductors on system level:

- Highest power density
- Highest (part-load) efficiency
- Highest switching frequency
- Reduced cooling effort

Due to possible switching frequencies of up to 100 kHz, the SiC-inverter is suitable for machines and applications with highest electric frequencies like high-speed traction-motors, compressors and electric turbochargers.

Fraunhofer Institute for Integrated Systems and Device Technology IISB

Schottkystrasse 10
91058 Erlangen, Germany

Contact

Dr. Maximilian Hofmann
Tel.: +49 9131 761-385
maximilian.hofmann@iisb.fraunhofer.de

www.iisb.fraunhofer.de

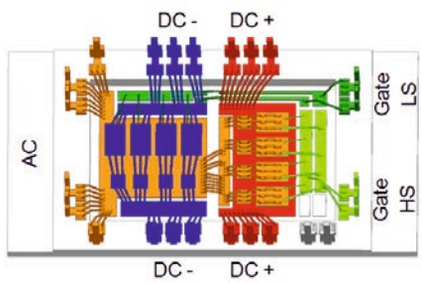
Technical Data

Max. output power	100 kW (@ 800 V)
Max. switching frequency	100 kHz
Input voltage range	200 to 800 V_{DC}
Max. phase current	150 A_{rms}
Weight	3,5 kg
Power density	51 kW/l

Optimized for Highest Efficiency

For the realization of highest switching speeds and reduced switching losses, a low-inductance commutation design of the SiC-inverter is crucial. Despite the use of power-modules with classical aluminum bond-wire technology, a commutation inductance (powermodule ⇔ central DC-link capacitor) of < 12 nH was achieved in the SiC-inverter.

3D-FEM field simulation were carried out to visualize and optimize the transient current paths within the powermodule. Also a low inductive coupling between the power and the signal paths, leading to a robust module behavior, was achieved.



Low impedance power module with 25mOhm SiC-MOSFETs and external SiC-diodes

The central DC-link capacitor of the inverter is connected to the modules using a high current PCB with several 105 µm thick-copper-layers in parallel. Additional ceramic bypass capacitors are optionally placed directly above the DC-connections of the powermodule.
The combination of these measures limits the voltage overshoot during transistor turn-off to max. 200 V even at switching speeds of 40 kV/µs.

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