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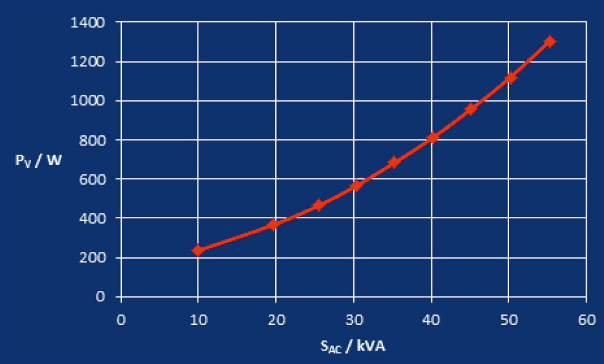
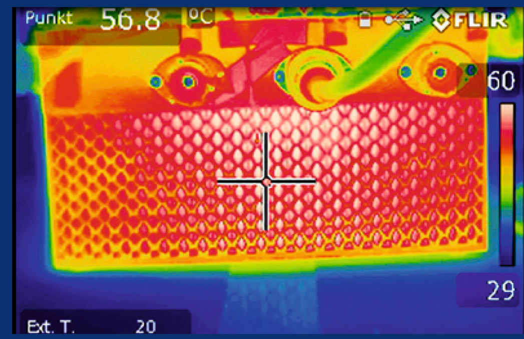
AIR-COOLED
40 KW SiC-INVERTER



Total losses of the SiC-inverter (f_{SW} = 70 kHz)



Thermal characterization of the 3D cooling structure

Air-cooled SiC-Inverter

Wide Band Gap (WBG) semiconductors offer huge potentials for power electronic systems due to their significantly reduced conduction and switching losses.

Based on SiC-MOSFET technology, a modular and compact three-phase 800 V drive-inverter with a constant output power of 40 kW and a continuous phase current of 70 A_{rms} was designed and realized.

Due to the raised efficiency with significantly reduced heat-losses, an air-cooled design with additively manufactured heatsink was realized.

The heatsink structure is directly integrated into the inverter housing and combines an optimized heat dissipation with the used fans, low weight and good manufacturability.

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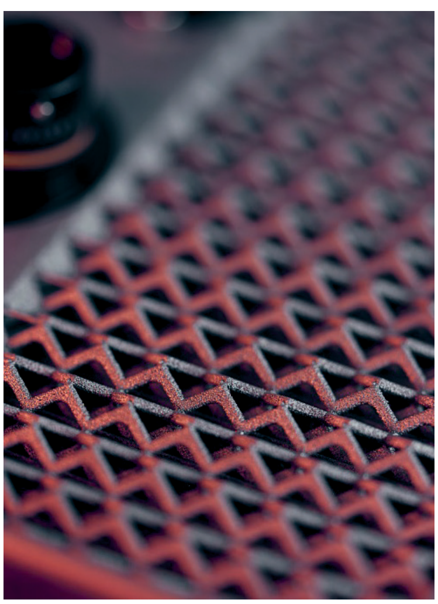
Technical Data

Constant power	40 kW (@800 V)
Max. Switching Frequency	100 kHz
Input voltage range	200 to 800 V_{DC}
Cont. phase current	70 A_{rms}
Total weight	4 kg

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.

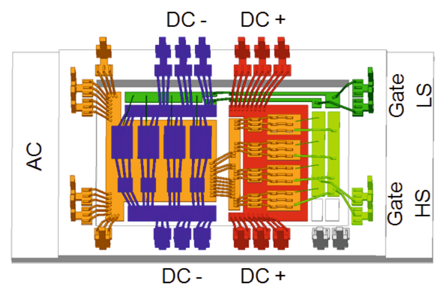
Also high frequency harmonics, modulated on top of the fundamental sinusoidal phase current, are possible to avoid or create acoustic stimulation within the electric machine.



Additively manufactured cooling structure

Optimized for Highest Efficiency

For the realization of highest switching speeds and reduced switching losses, a low-inductance commutation cell of the SiC-inverter is crucial. Despite the use of power modules with classical aluminum bond-wire technology, a commutation inductance of < 12 nH was achieved.



Power module with 25 mΩ SiC-MOSFET and external SiC-diodes

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

Even at switching speeds of 40 kV/µs only a turn-off voltage overshoot smaller than 200 V was measured with this module design.

Internal phase current, temperature and DC-Link voltage sensing as well as a gate-driver hardware detection for MOSFET-overcurrent ensure a safe operation of the system.