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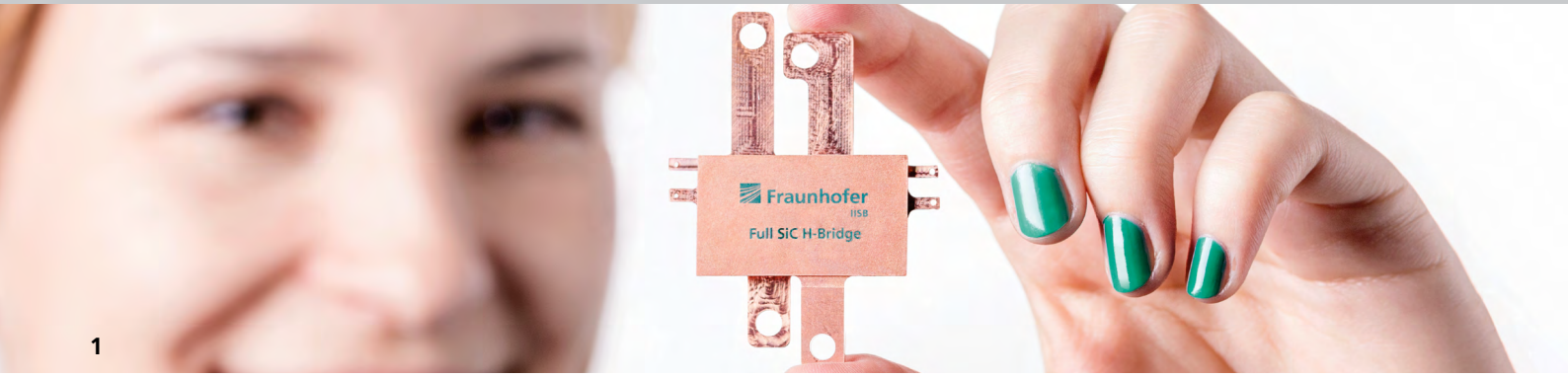

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1 *Employee with full SiC Power Module*

FULL SiC DOUBLE SIDED BUSBAR POWER MODULE

LOW INDUCTIVE AND HIGH TEMPERATURE POWER MODULE CONCEPT

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Idea of concept

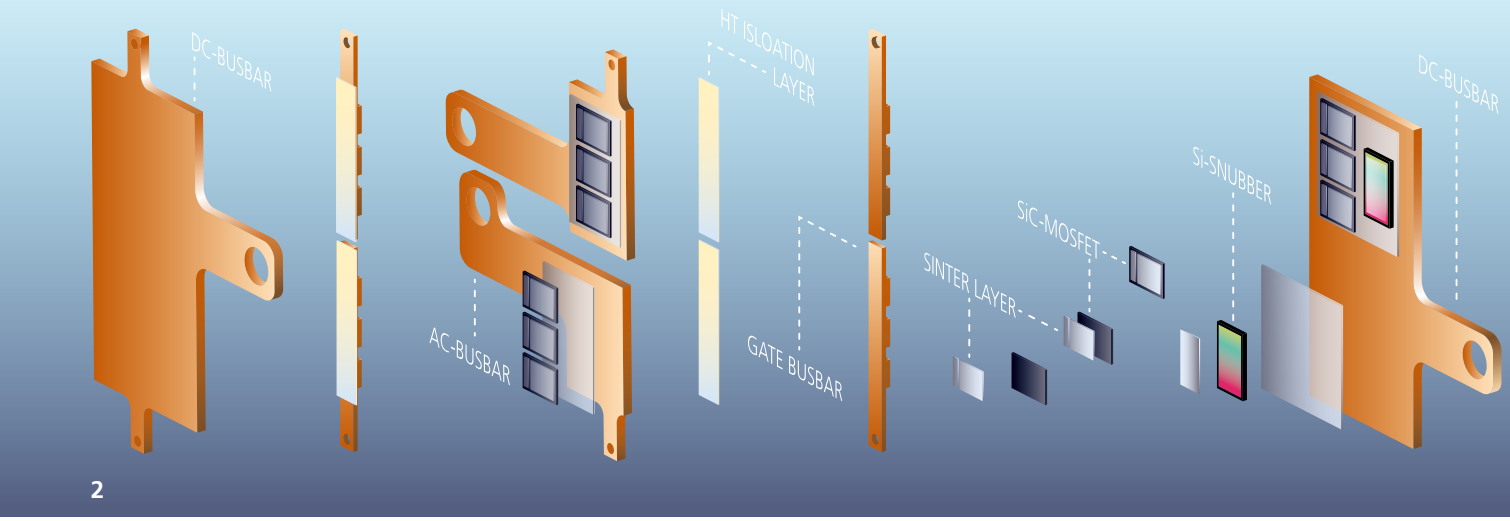
- Low inductance and high temperature power module for e-drives
- Fast switching with SiC
- DC+ & DC- on outer metalliztion for lowest parasitic C to ground
- High reliability and temperature capability by silver sintering
- Low cost due to copper busbars with hybrid polymer isulation layers instead of DBC substrates
- Double sided cooling, high thermal capability

Module properties

- Nominal 80 A/1200 V
- SiC-FETs with low $R_{DS,on}$
- Integrated Si-pulse capacitors
- Low inductance of < 1 nH
- R_{th} of 0.4 K/W

Assembly concept

- Modular design of Full SiC H-Half-Bridge
- High temperature capability (up to 300 °C)
- 70 % less mounting space compared to state-of-the-art modules with same power



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Busbar concept

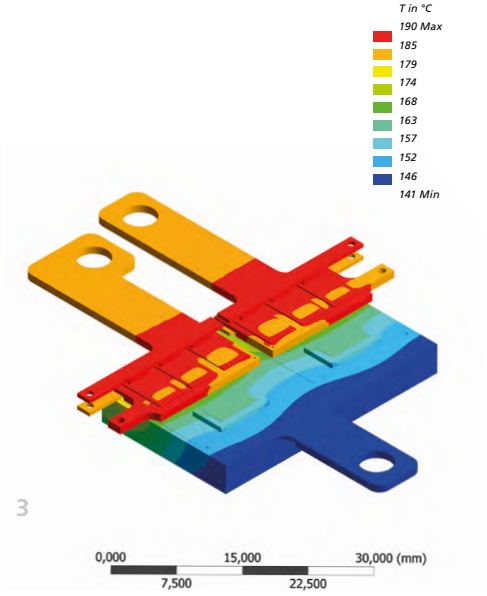
- H-Bridge with 2x3 SiC-FETs in parallel
- Two Si-pulse capacitors with 10 nF capacitance
- No mold compound neccessary
- Electrical isolation of gate-busbars by hybrid polymer
- Electrical isolation of AC- and DC-busbars by hybrid polymer
- Annealed copper to lower thermo-mechanical stresses and to increase electrical and thermal conductivity
- No thermal shielding to electrical motor necessary
- Utilization of electrical motor tooth as a heat sink for high temperature applications

Electrical simulation

- Parasitic extraction by Finite Element Method (FEM) and Fast Multipole Method (FMM)
- State-of-the-art planar assembled power module: 13 nH inductance @ 20 kHz
- Full SiC Busbar concept: 0.7 nH inductance @ 20 kHz
- Low inductance of busbar concept due to integrated Si-pulse-capacitors

Thermal simulation

- Transient thermal simulation until steady state
- Single sided cooling with 65 °C
- Temperature of e-motor: 180 °C
- Temperature of SiC devices: 190 °C
- Temperature of Si capacitors: 149 °C
- Thermal resistance R_{th} from module to e-motor is 0.03 K/W
- Thermal resistance R_{th} from module to coolant is 0.4 K/W



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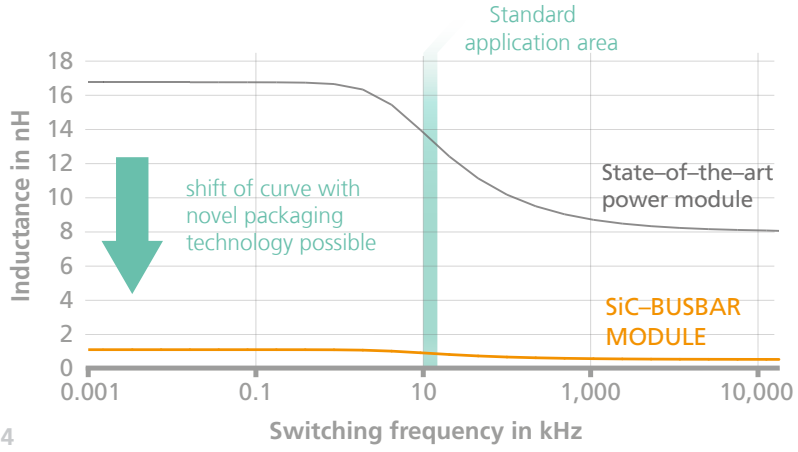

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2 *Full SiC H-Bride busbar concept*

3 *Thermal simulation at steady state*

4 *Comparison of inductance of state-of-the-art commutation cells to new full SiC power module*