FULL SiC DOUBLE SIDED BUSBAR POWER MODULE
LOW INDUCTIVE AND HIGH TEMPERATURE POWER MODULE CONCEPT

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

Module properties
• Nominal 80 A/1200 V
• SiC-FETs with low $R_{D\text{son}}$
• Integrated Si-pulse capacitors
• Low inductance of < 1 nH
• $R_{th}$ of 0.4 KW

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
Busbar concept

- H-Bridge with 2x3 SiC-FETs in parallel
- Two Si-pulse capacitors with 10 nF capacitance
- No mold compound necessary
- 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