

Passive Cooling of Power Electronics: Heat in the Box

Michael Berger, Winfried Schernus
West Coast University of Applied Sciences, Heide (Germany)



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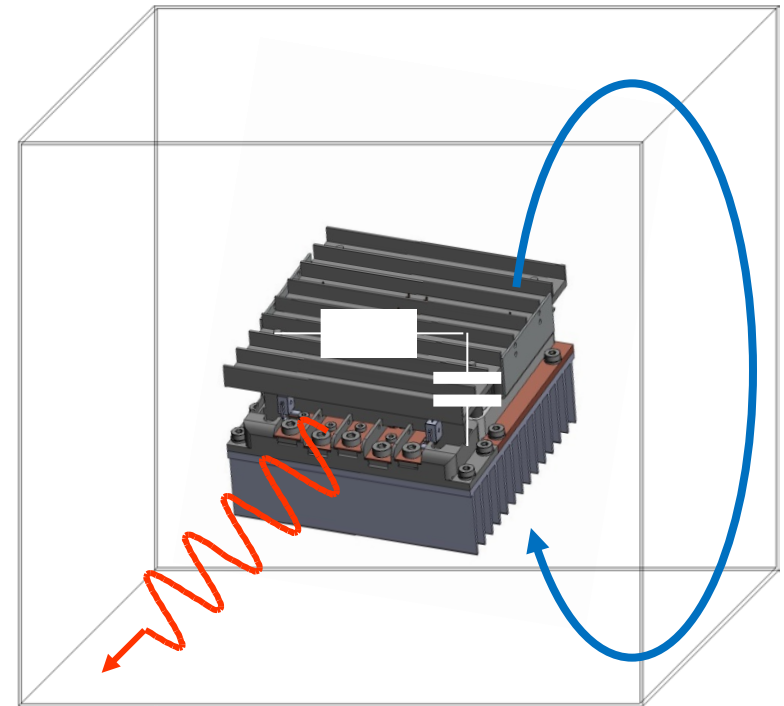
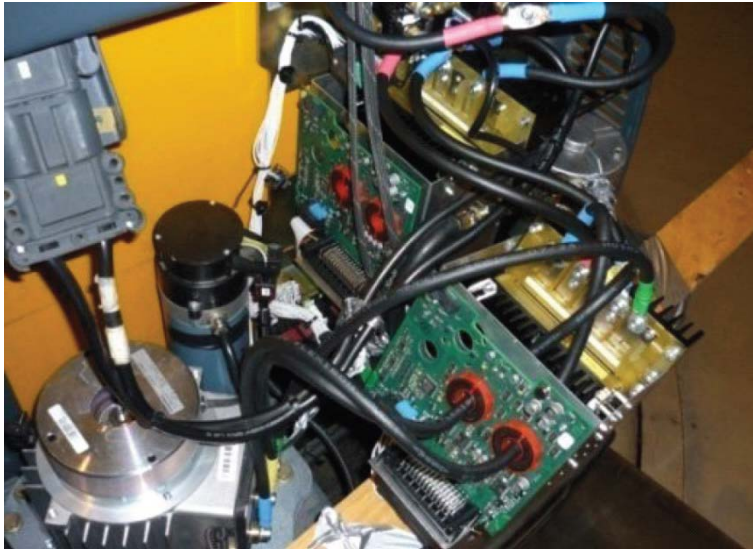
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This project has been supported by the European Union and the State of Schleswig-Holstein, Germany, in the context of the „Center of Competence for Power Electronics Schleswig-Holstein“

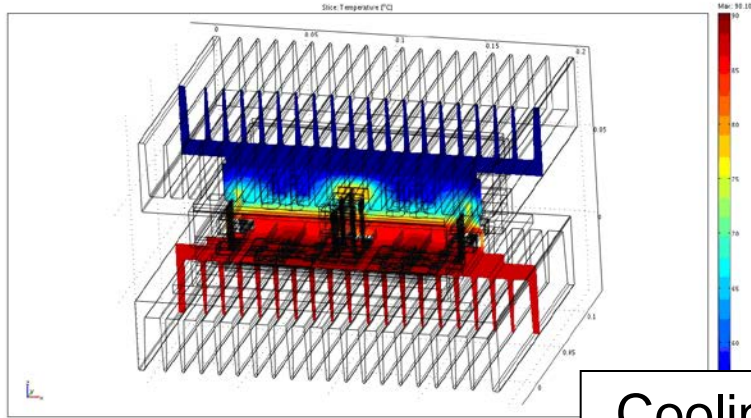


The Problem

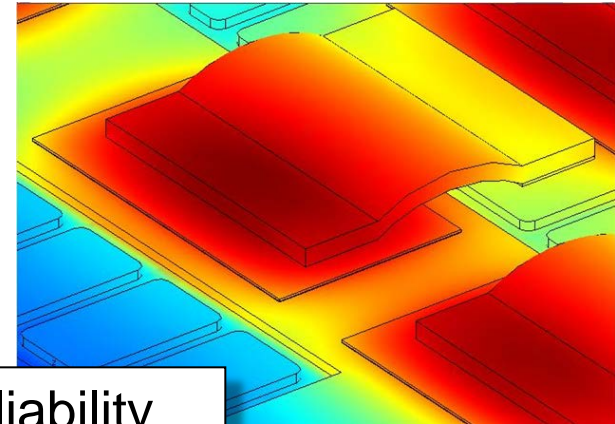


- All transport mechanisms relevant
- Practically closed environments
- Wide spread of physical dimensions and time constants
- Absolute temperature values mandatory

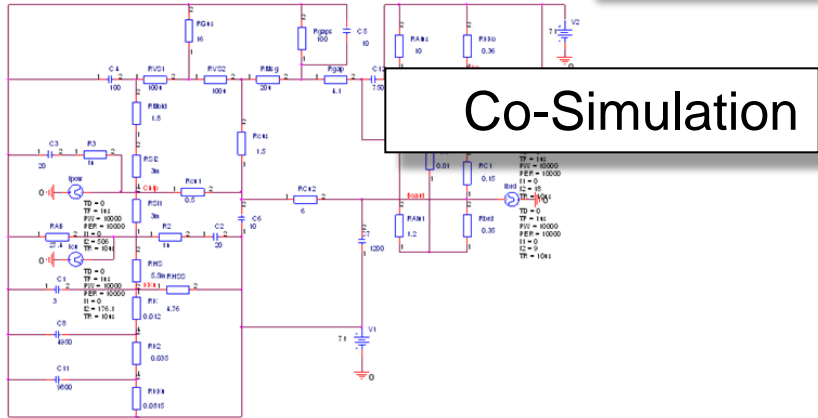
Concurrent Engineering of the 5kW-DC-AC-Converter



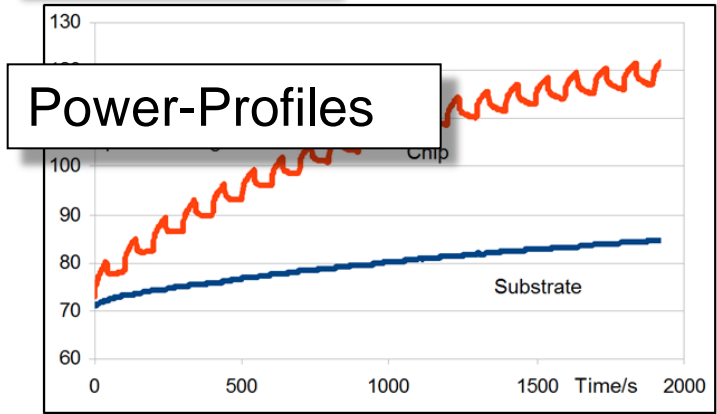
Cooling



Reliability

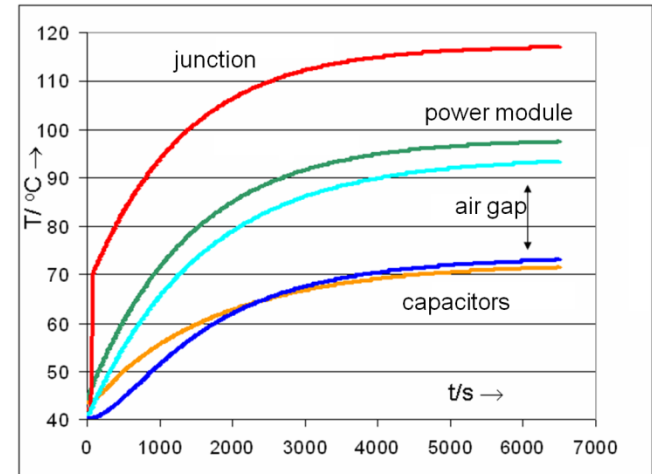
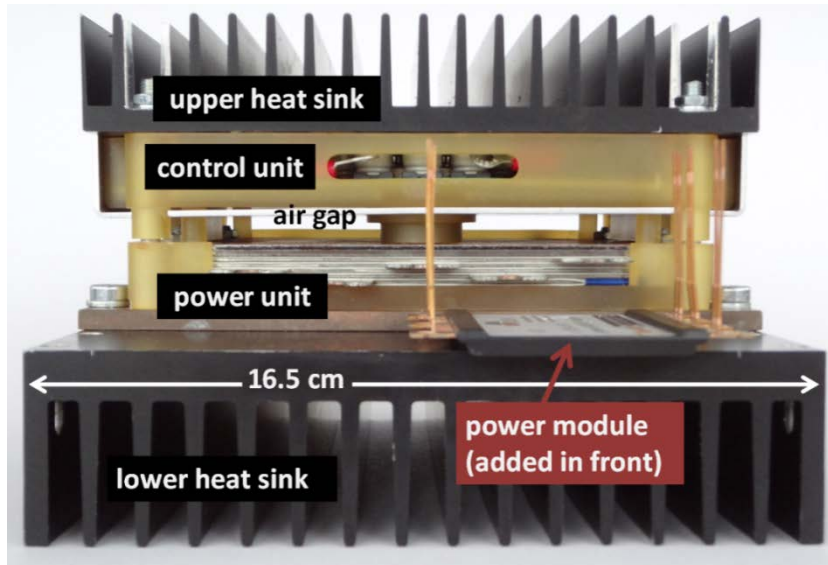


Co-Simulation

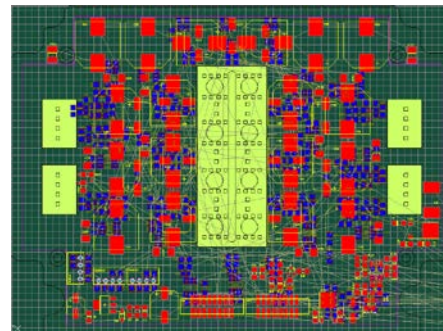
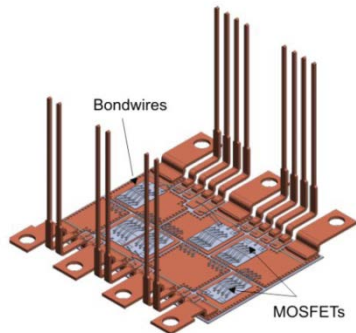


Power-Profiles

Results for the Prototype

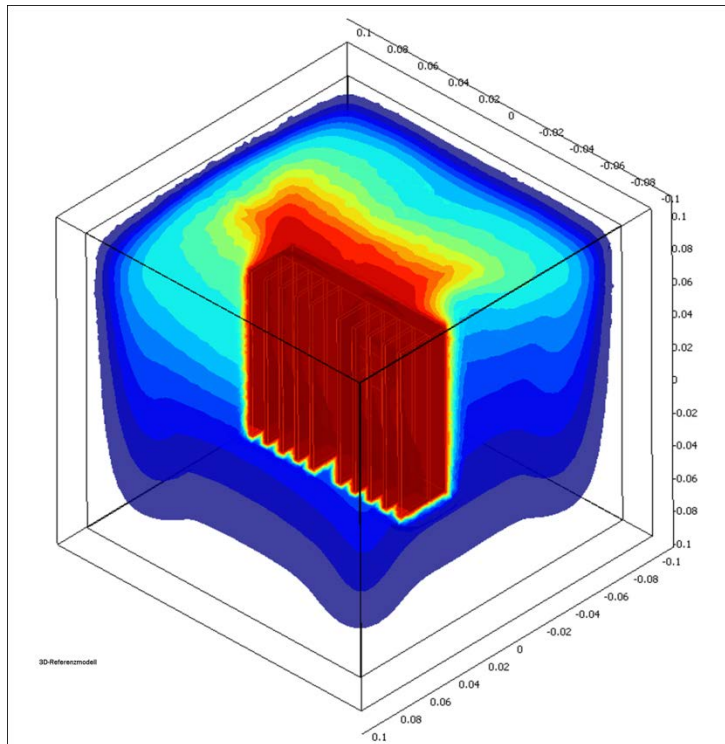


Temperatures measured at 23 °C and extrapolated to 40 °C



Designs of power unit and control unit

Heat Sources in a Closed Environment

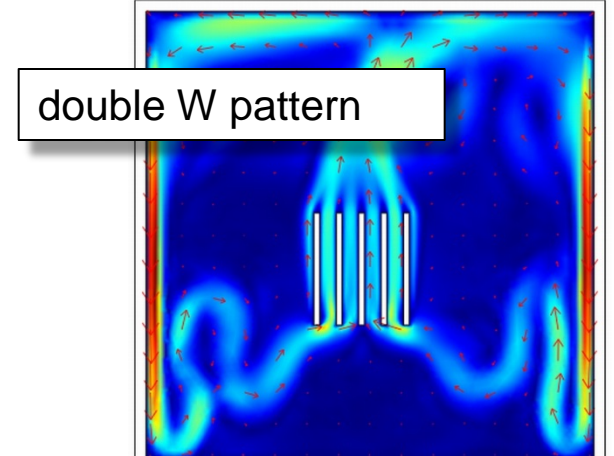
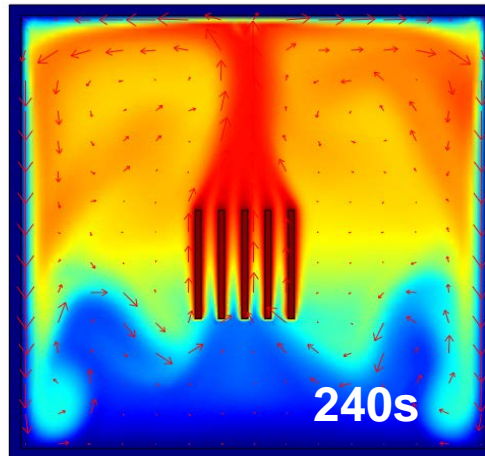
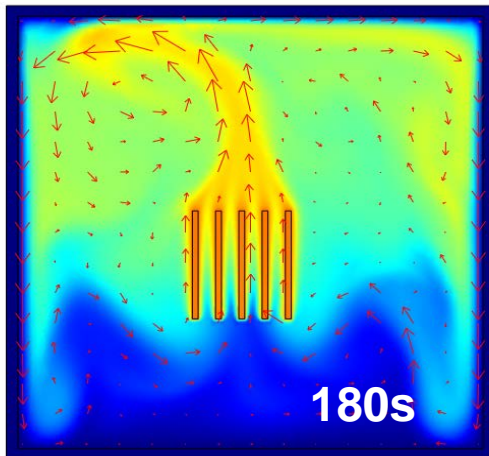
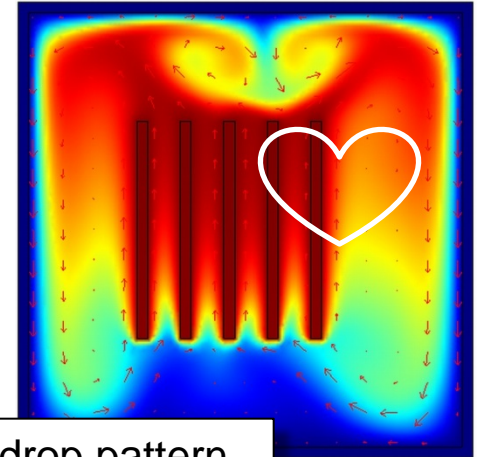
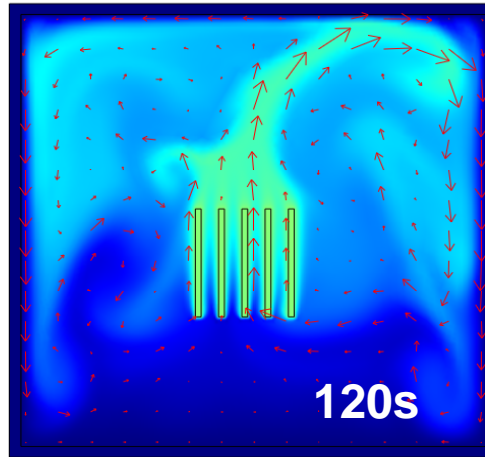
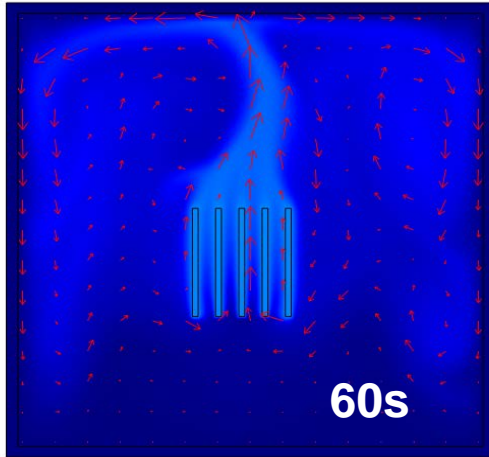


- Modeled by thermal resistance
- Data sheets: open space, free flow
- Project: protecting box
= no inlets or active cooling!

Coupled Heat-Transfer and Navier-Stokes with minor simplifications

- Solutions not proven, but
- + reproducible on different meshes
- + continuous with respect to minor variations of parameters or geometry
- + symmetric
- + in line with general physical considerations
- + recurrence of similar solution patterns

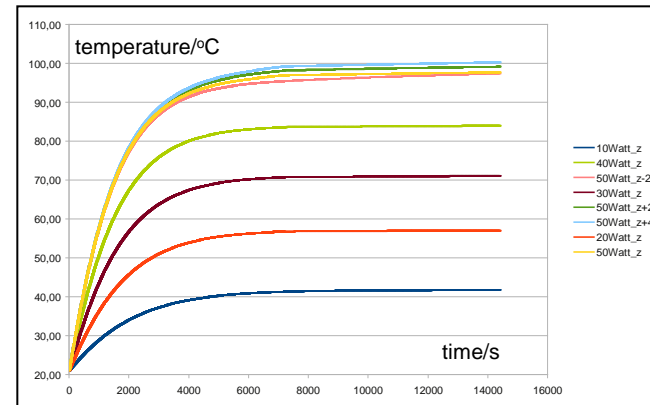
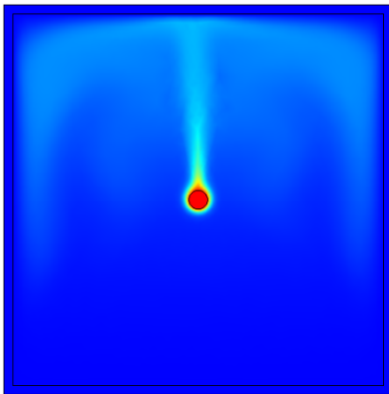
Some Turbulences & No Stationary Solutions





Proposal: Heat in the Box

- Define a basic problem: circular source, square sink.
- Keep strength of source and dimensions variable.



- Find a model for the internal flow patterns.
- Find a model for heat exchange.

