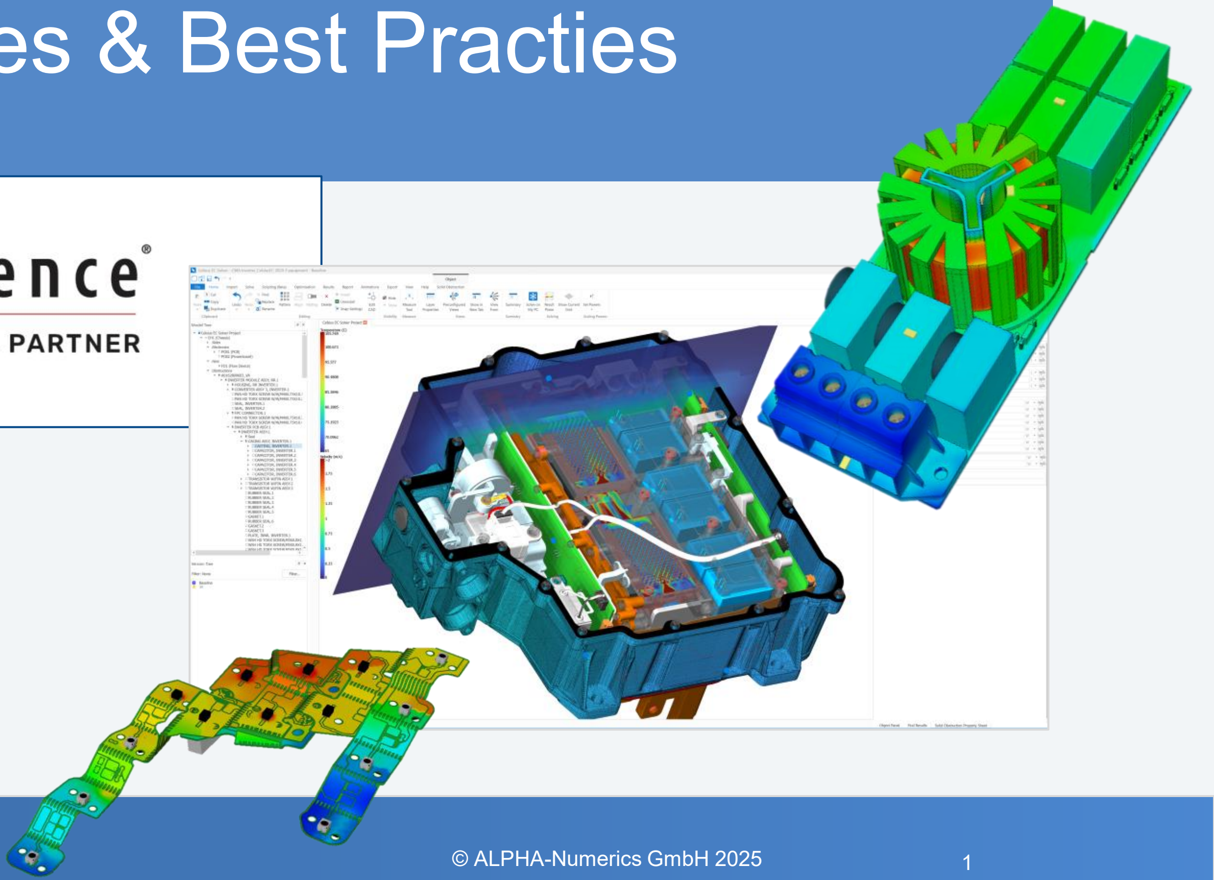
Welcome

Electronics Cooling – Strategies & Best Practies

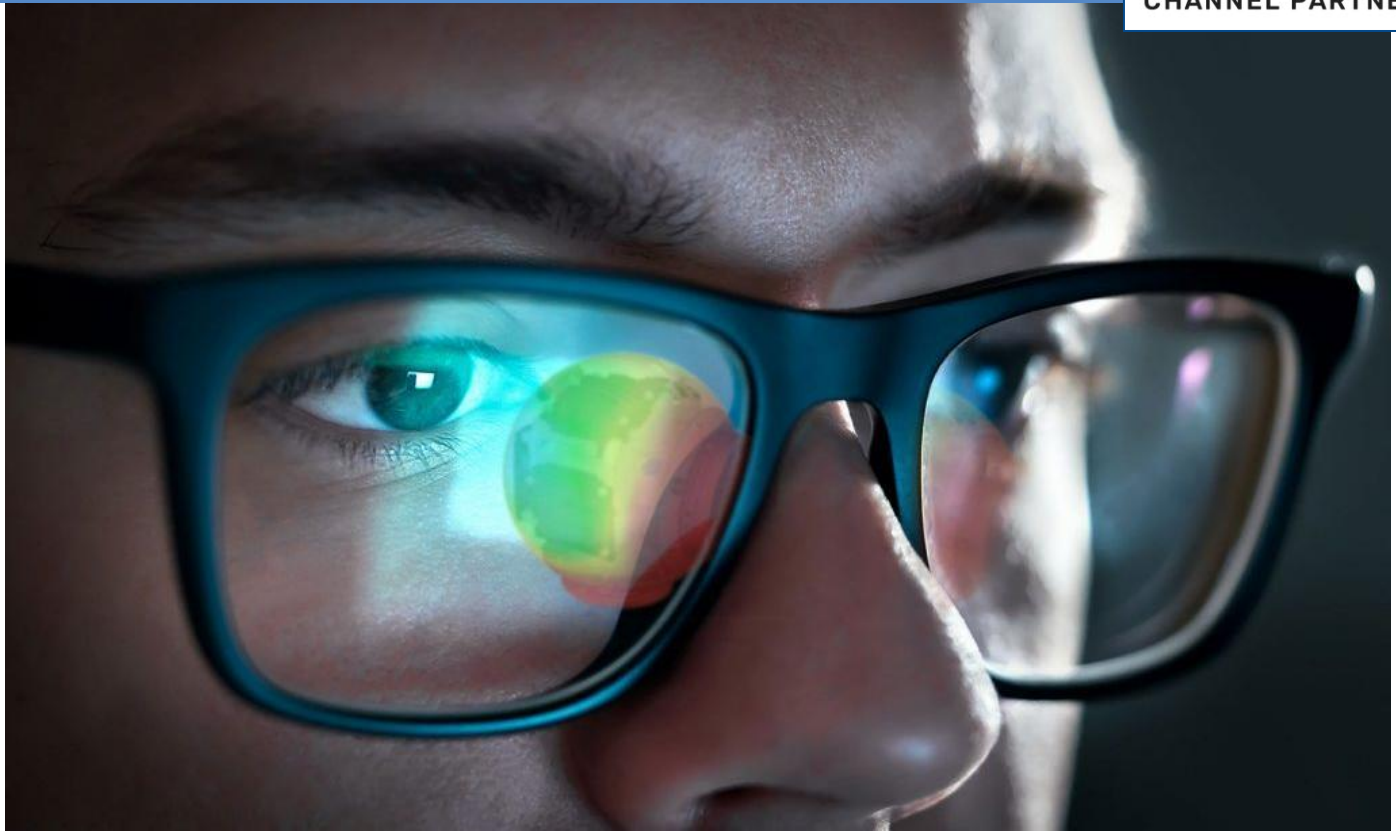
CHANNEL PARTNER



ALPHA-Numerics – Quick Introduction

More than just a Software Reseller

cadence
CHANNEL PARTNER



Specialist for Electronics Cooling

- Simulation Service & Consulting
- EC Trainer / SW Trainer
- Cadence Channel Partner
- Hotline & Technical Support
- EC Partner for other Channel Partners worldwide

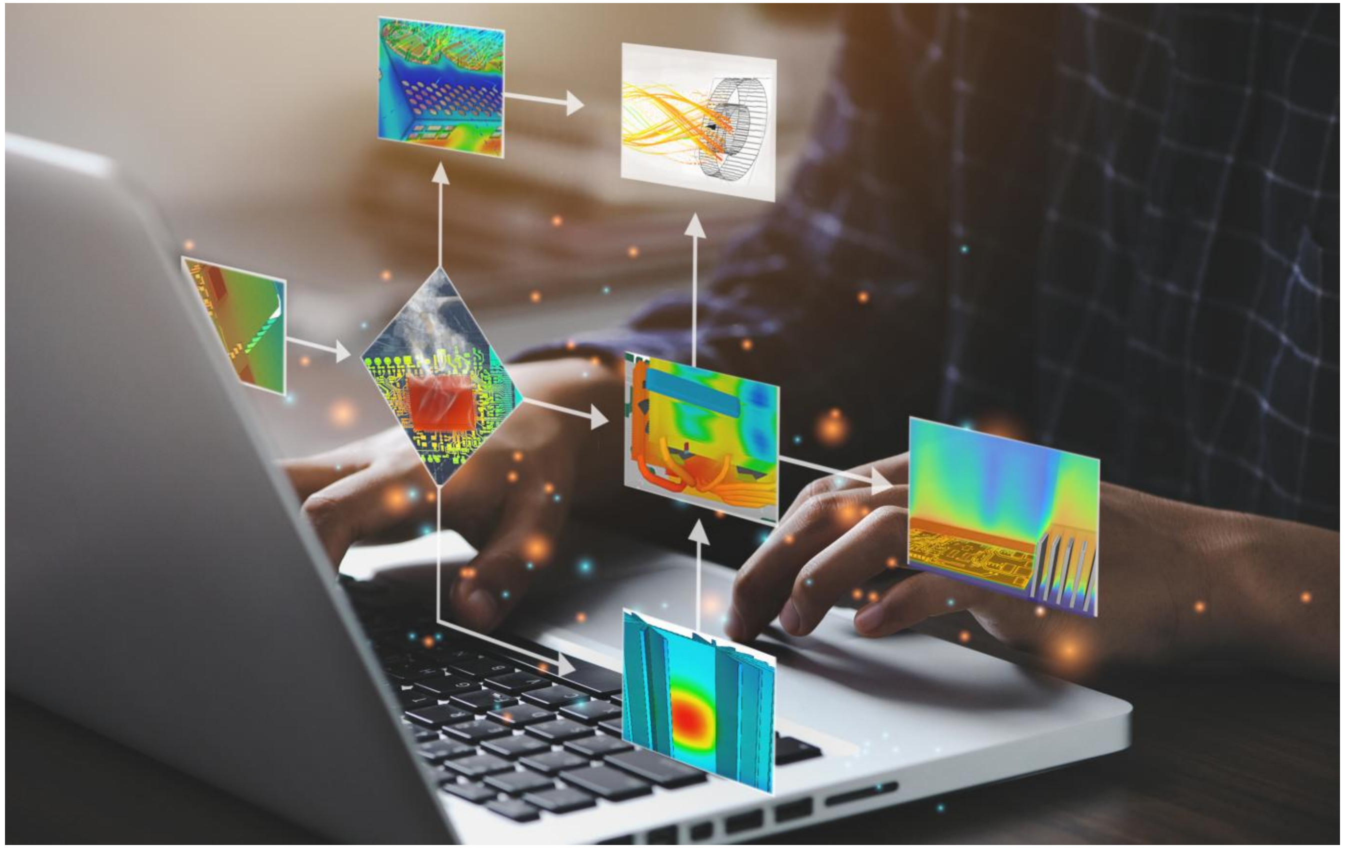
ALPHA-Numerics, a Specialist for Electronics Cooling

ALPHA-NUMERICS

We have been working with the electronics industry in the field of electronics cooling for 30 years. We support our customers in developing innovative cooling solutions for their electronic equipment.

Mercedes	Brose	Dräxlmaier
TE	Rexroth	Kostal
OSRAM	HILTI	Vishay
SE	PREH	Joynext
Rohde & Schwarz	Diehl Aerospace	Phoenix Contact
FESTO	Compleo	Magna
Borg Warner	Porsche	Sick
	Schölly	Siedle

And much more…



What Will We Learn?

- An overview of the field of electronics cooling
- Physical background for heat transfer
- The importance of assessing a cooling concept as a whole
- Key components and their fine-tuning for effective cooling, including PCB boards, air heat sinks, fluid coolers, connecting elements, air paths, installation & operation conditions, and contact points/interface materials

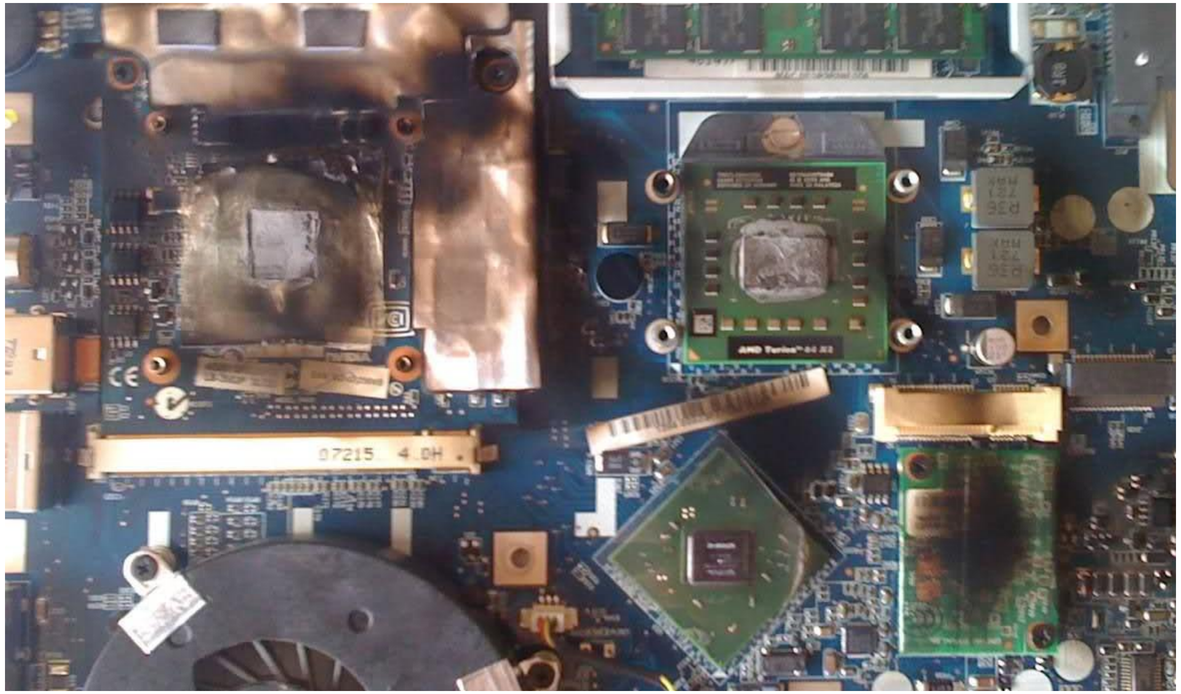
- How simulation can be used early in the design to evaluate and optimize cooling strategies upfront

Takeaways

- The physics behind electronic cooling
- How to optimize various components for better cooling performance
- Practical tips and strategies for implementing a robust cooling design

From „nice to have“ to „mandatory for functionality“

Thermal analysis is becoming increasingly important in System Design for Electronic Equipment



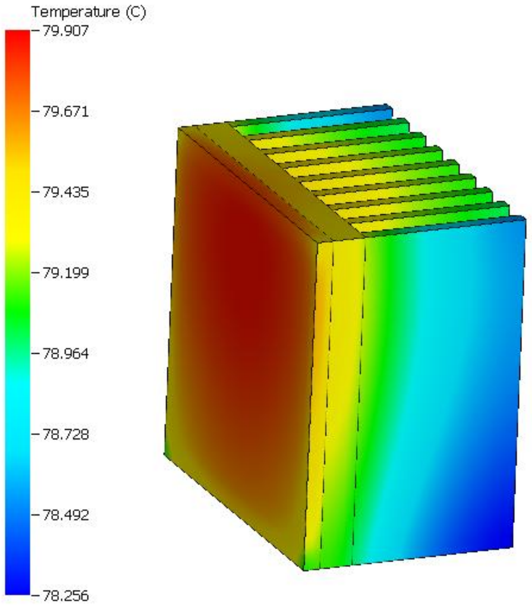
Why Thermal Behaviour is ~~*getting*~~ more important

- Growing heat losses (example AI technology - 30KW -> 130KW per Rack)
- Higher packaging densities
- Ongoing miniaturization
- Demands of high performance / high current applications
- More mobile applications demanding light and robust design
- EMC vs. Cooling Efficiency

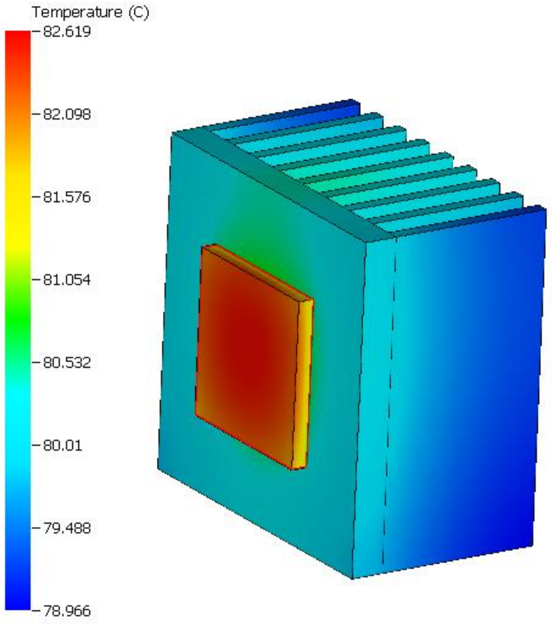
Challenges

Demand for smaller and more compact devices often means the same power loss (heat dissipation) inside a smaller volume

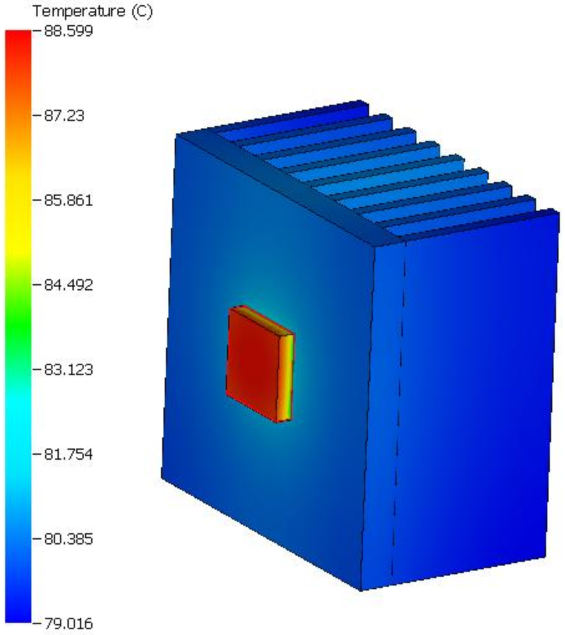
Environment = 20° C
Power = 2W
Component Size: 30mm x 30mm x 1.5mm



Environment = 20° C
Power = 2W
Component Size: 15mm x 15mm x 1.5mm



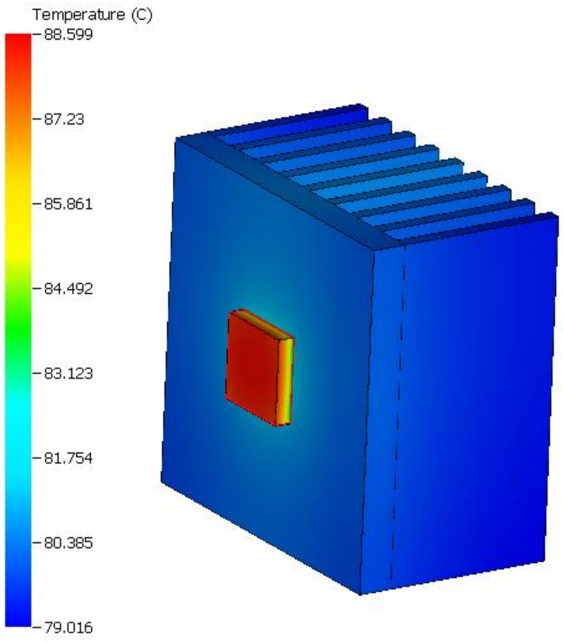
Environment = 20° C
Power = 2W
Component Size: 7.5mm x 7.5mm x 1.5mm



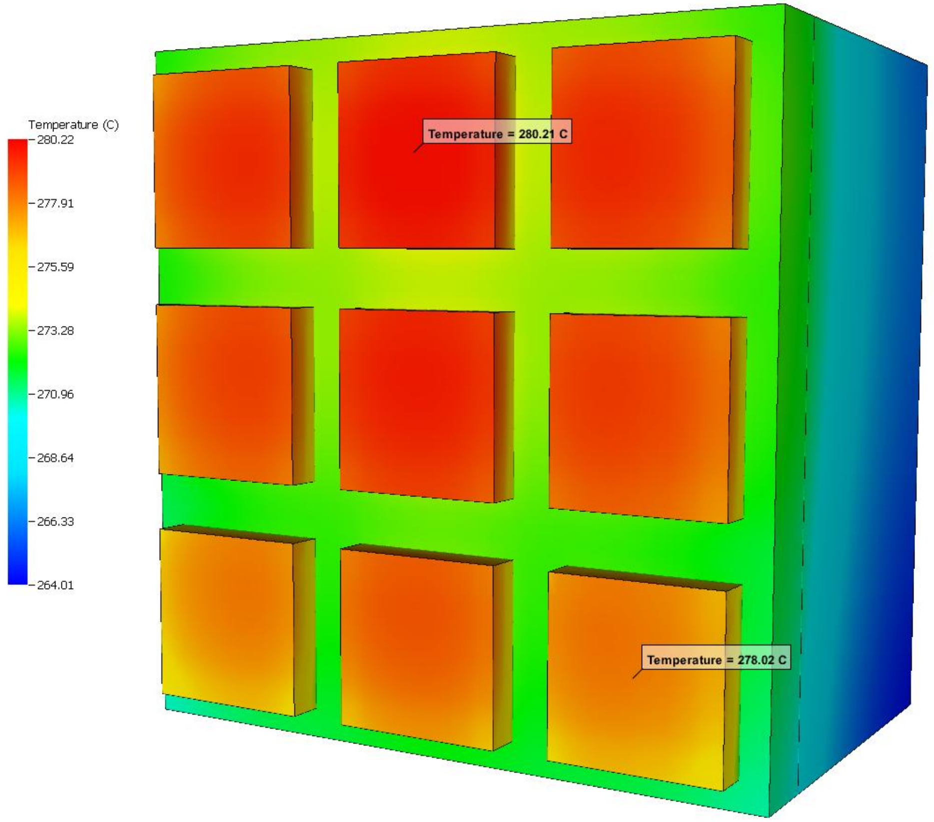
Challenges

High Power Components being pushed closer together

Environment = 20° C
Power = 2W
1x Component Size: 7.5mm x 7.5mm x 1.5mm



Environment = 20° C
Power = 2W
9x Component Size: 7.5mm x 7.5mm x 1.5mm



Challenges

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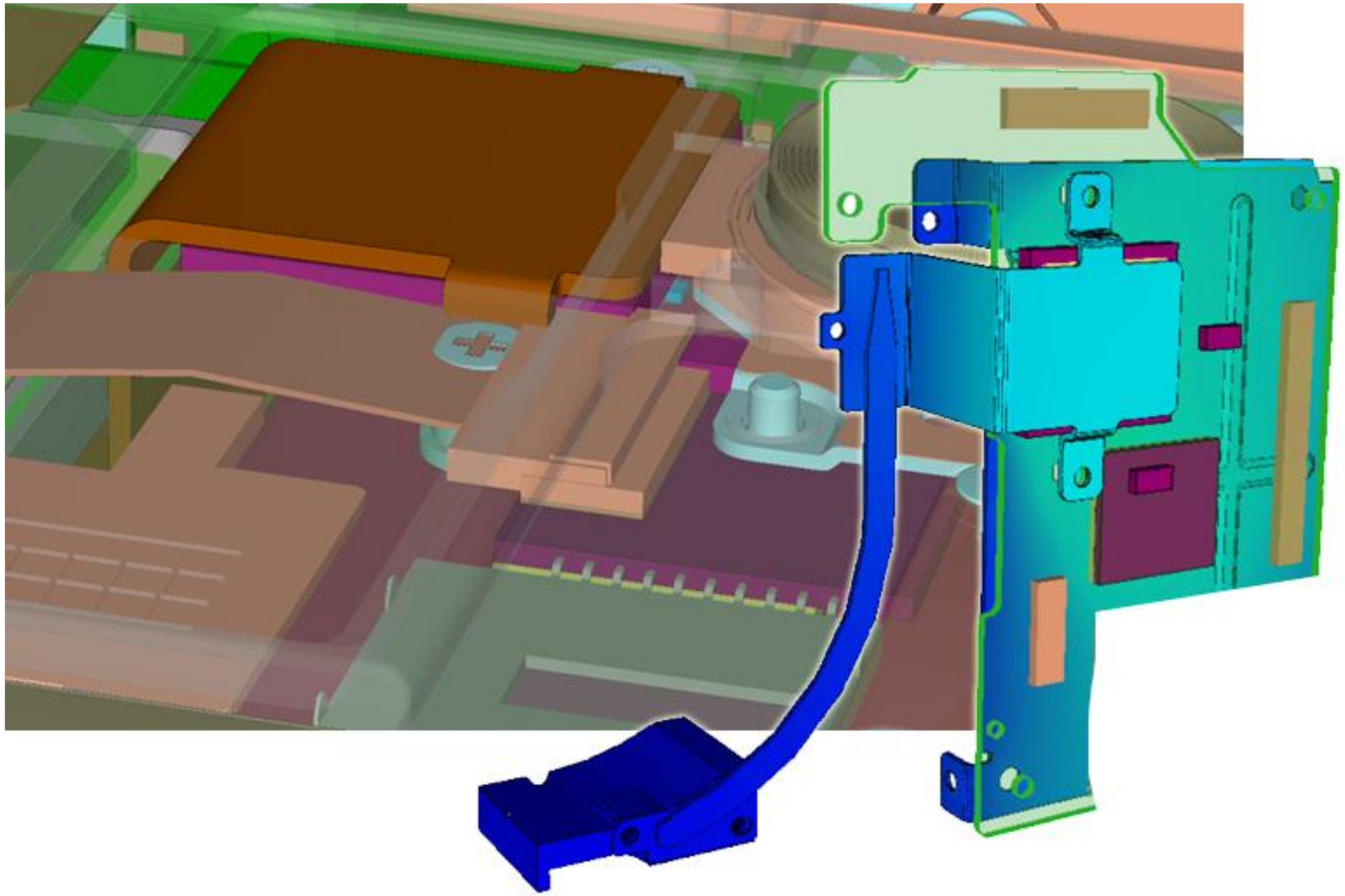
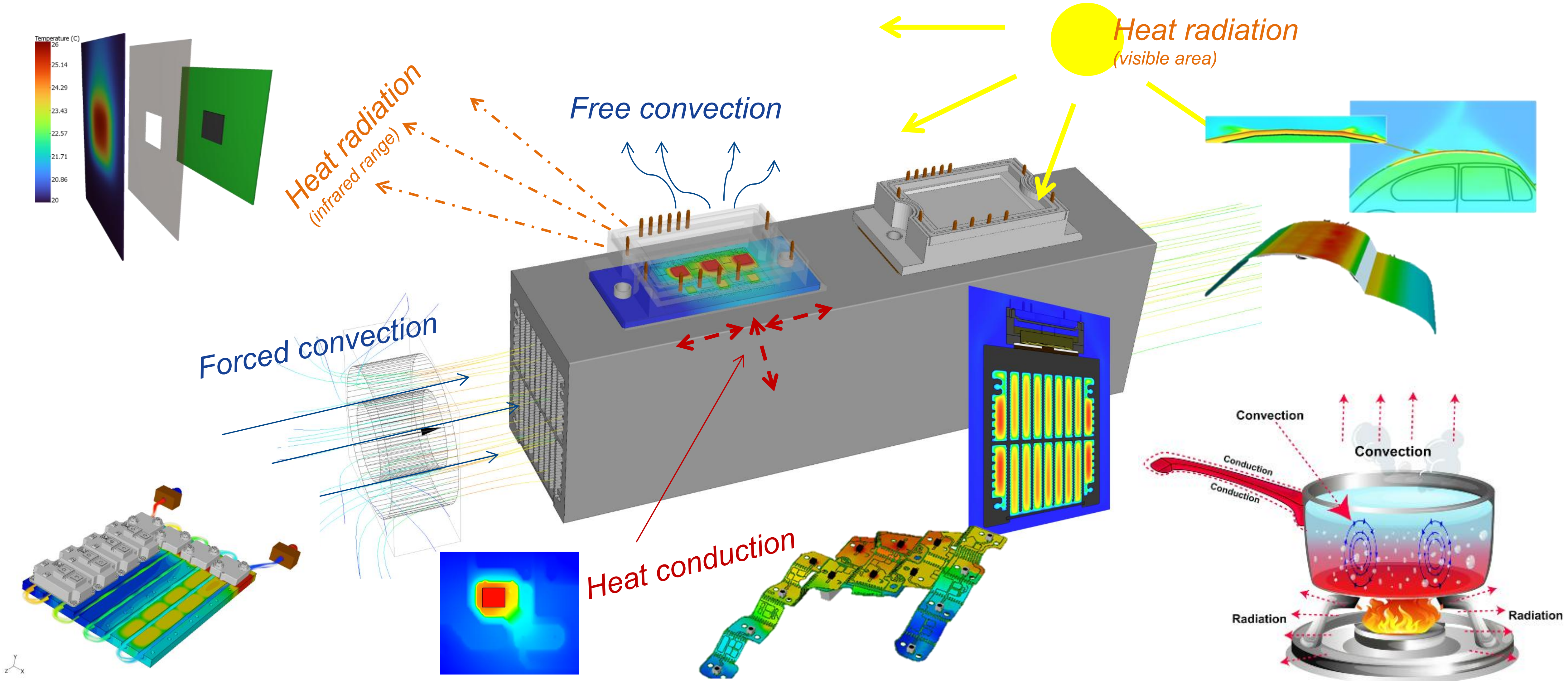
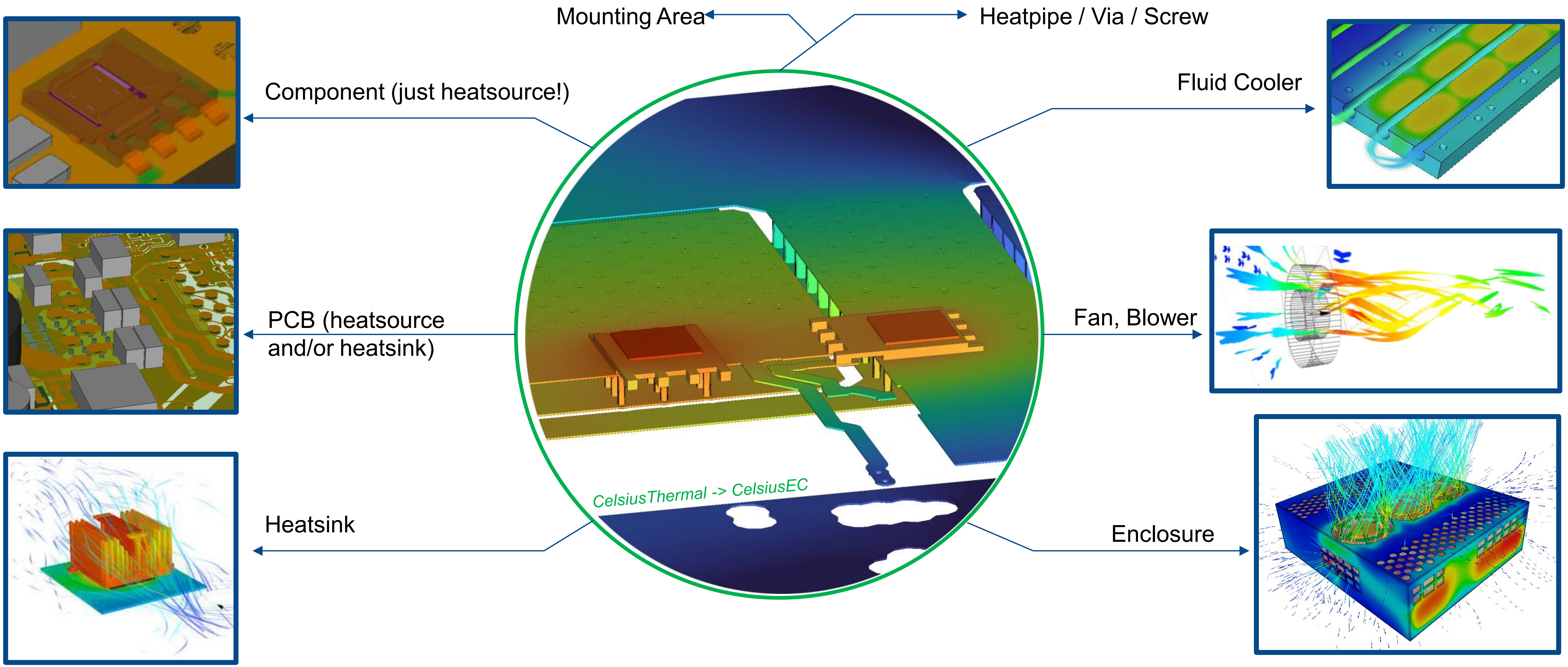
Less space for thermal management solutions



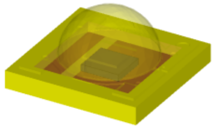
There are only three thermal pathes keep heat dissipation under control



Thermal paths being considered in electronic cooling

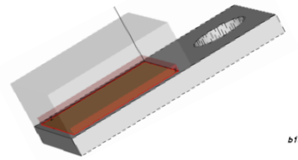


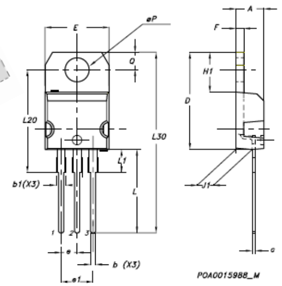
Component

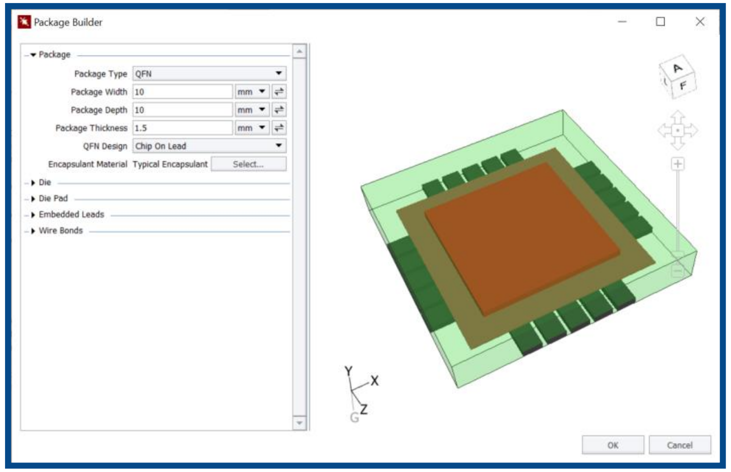


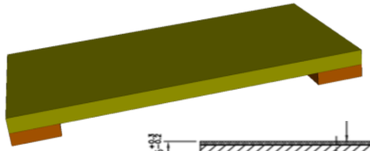
Thermal key points of an electronic component

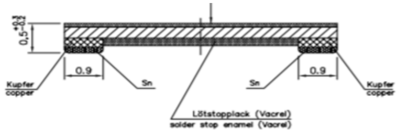
- Generated power loss (worst-case scenario)
- Component size
- Internal thermal resistance (internal structure)
  - guided heat path?
- Connection to PCB
- Connection to a heatsink (heat path in total!)

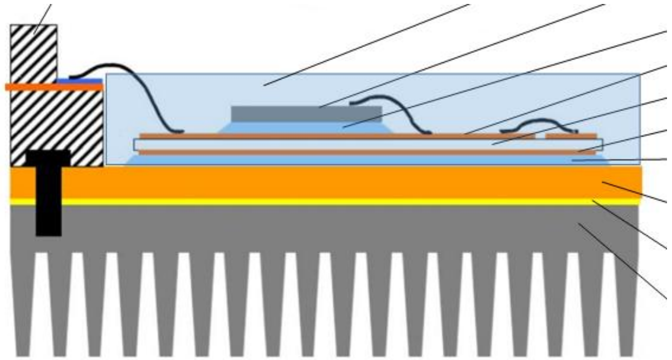


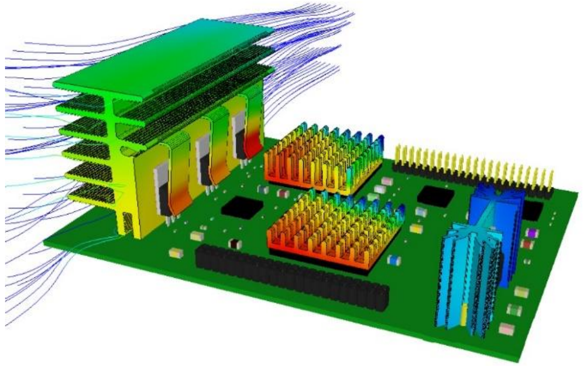


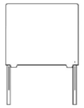


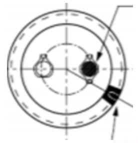


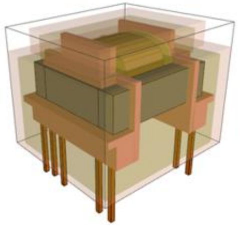


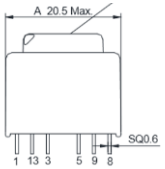


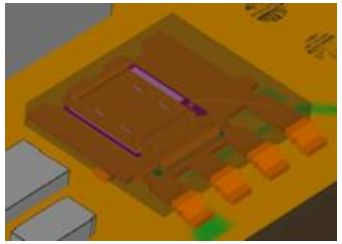


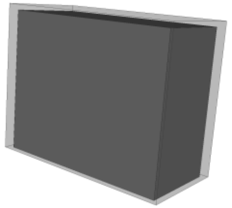


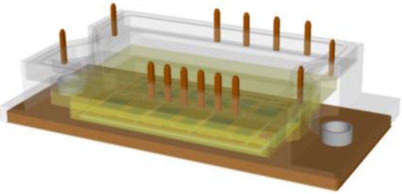


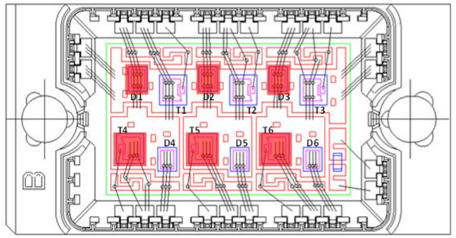


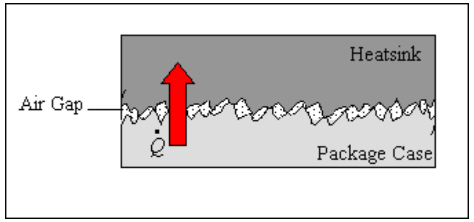












PCB

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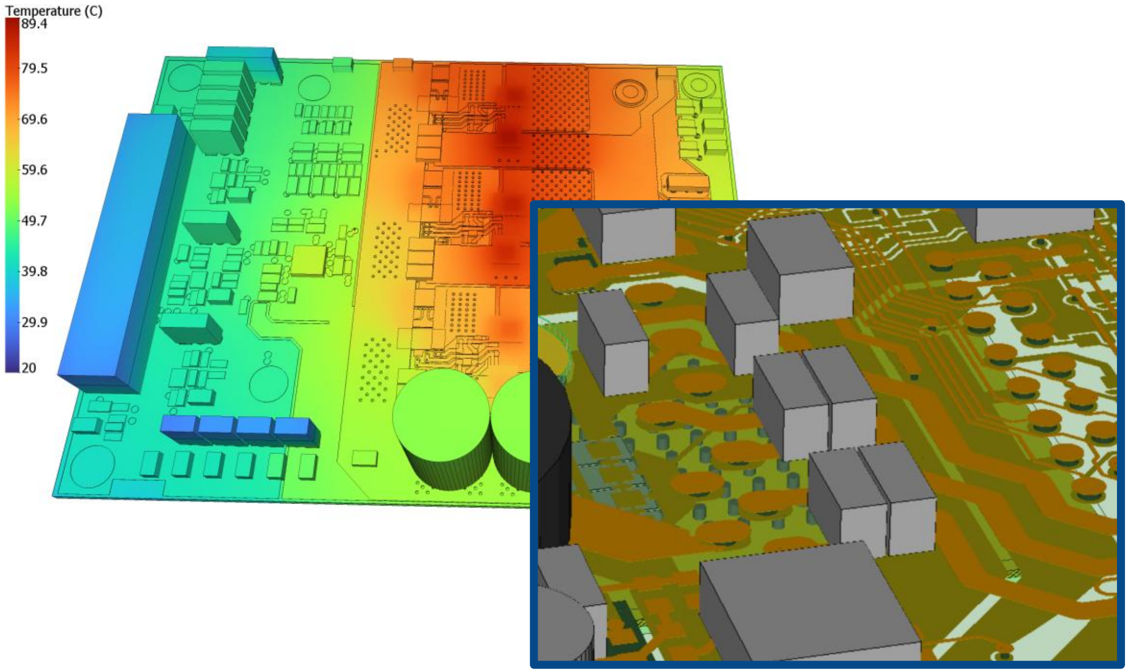
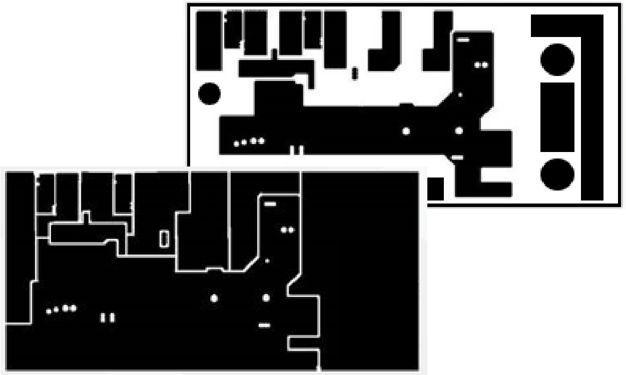
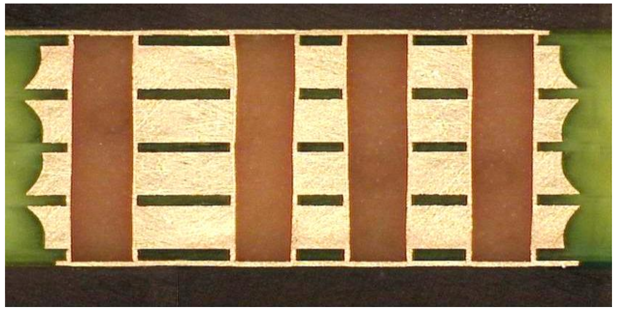
Thermal POI of a printed circuit board

- Thermal conductivity of substrate material (FR4, IMS,..)
- Number and thickness of the signal layers
- Layout (copper distribution, insulation sections)
- Thermal vias, bonded vias, micro vias, CU inlays
- Surface coating
- Additional thermal contacts (screws, clamping, potting, etc.)
- Mounting direction (gravity)

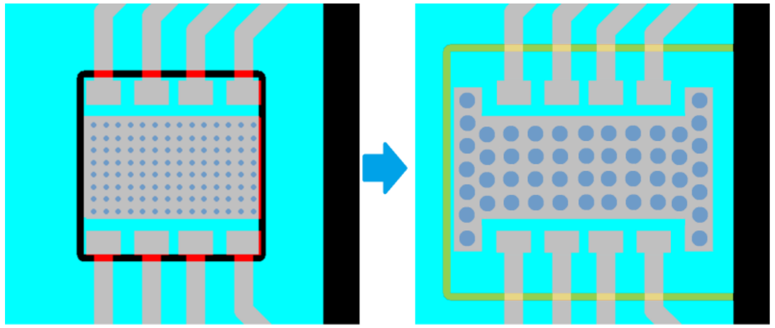




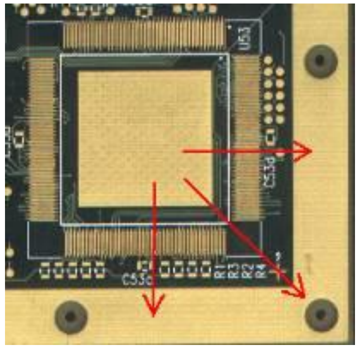
efficient layout



copper inlays and thick copper technology



efficient via arrays



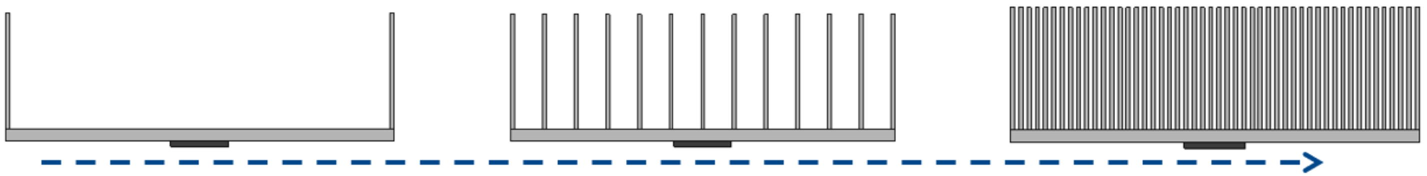
clamp connection

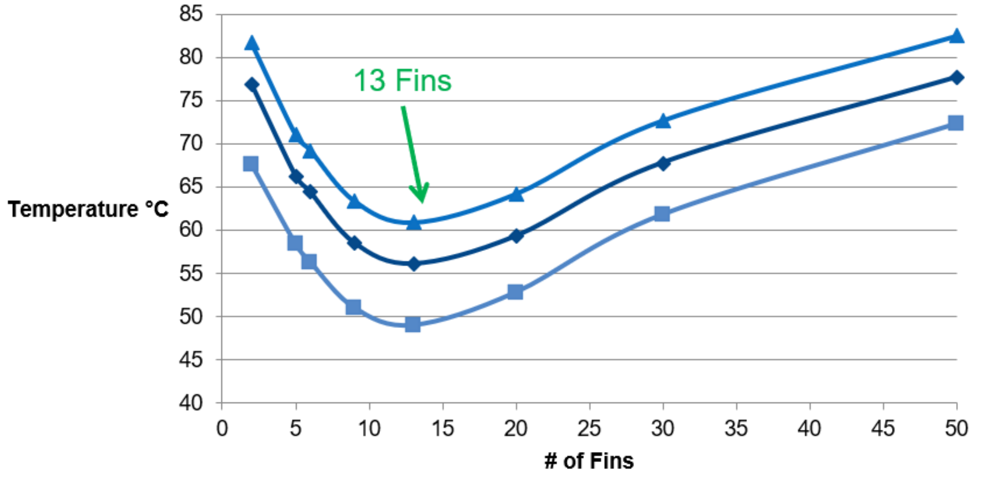
Heatsink

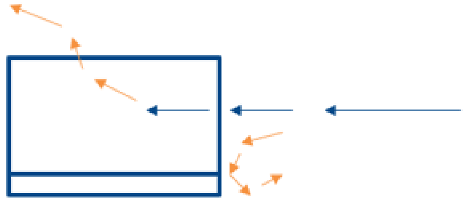
Thermal corner points of a heat sink

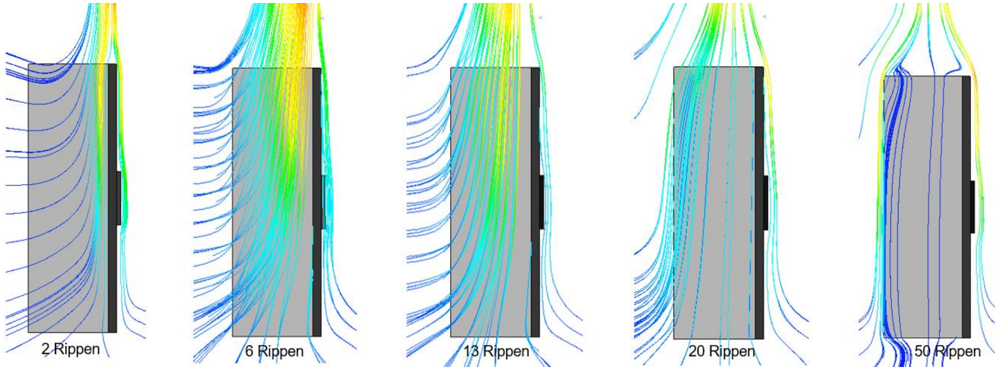
- Volume (capacity) (*)
- "ventilated" area (*)
- Surface roughness at contact point
- Connection type
- Surface finishing / coating
- Material (thermal conductivity (*))
- Geometry for alignment
- Manufacturing method
  - Die casting
  - Milled
  - Extruded
  - Bonded, glued

(*) More does not always lead into an advantage





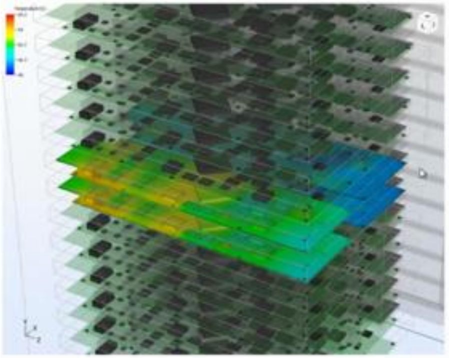


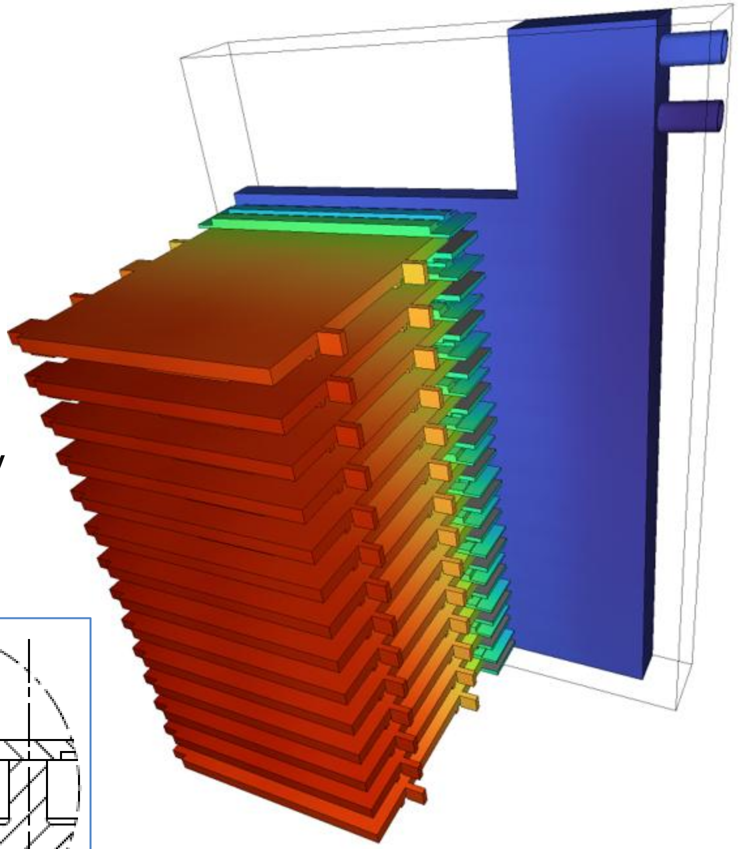


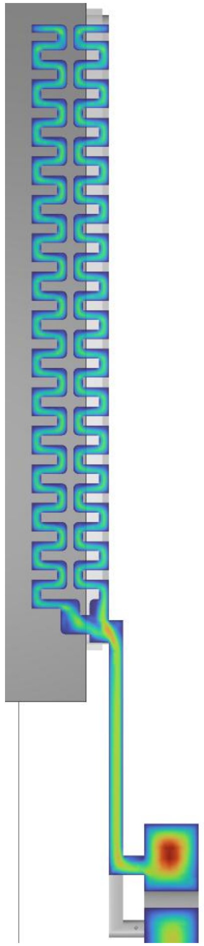
Fluid Cooler

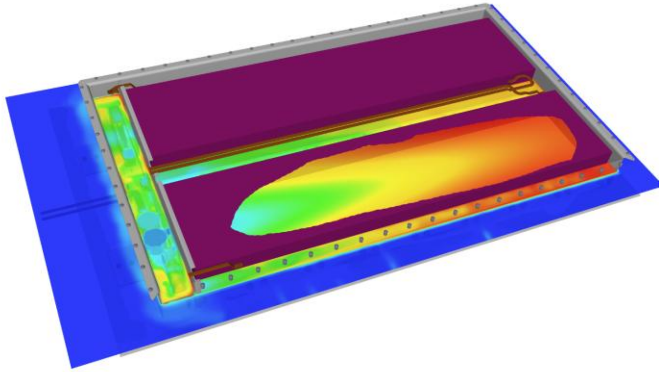
Thermal POI of a cold plate

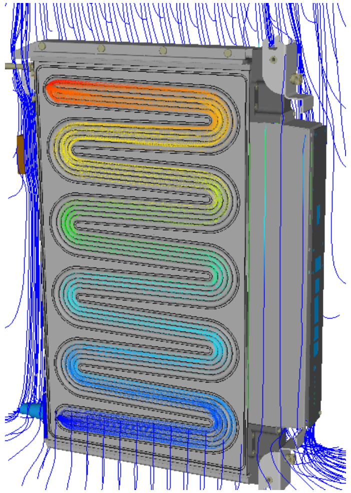
- Gravity direction = hardly relevant
- Ambient temperature = hardly relevant
- Pressure loss
- Fluid guidance
- Turbulators for high HTC….but influences the pressure drop heavily
- Material or material mix (pressed-in loops)
- Connection type

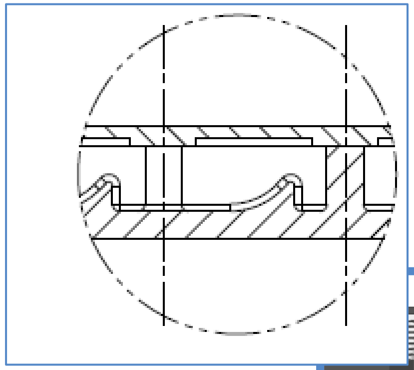


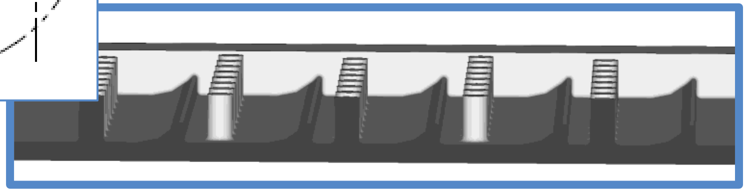








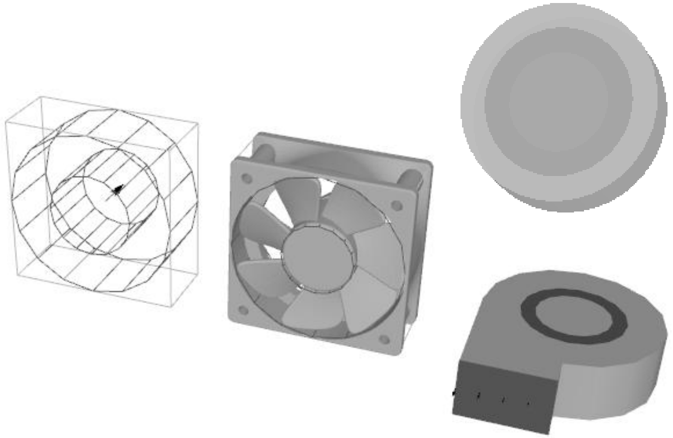


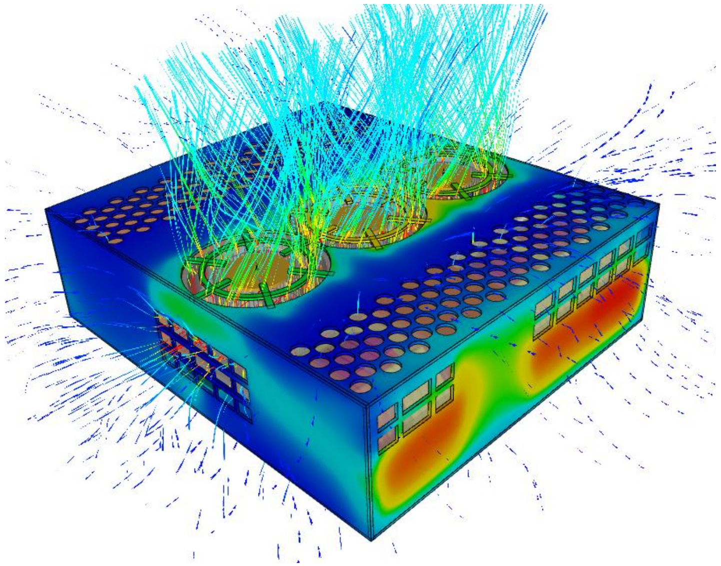


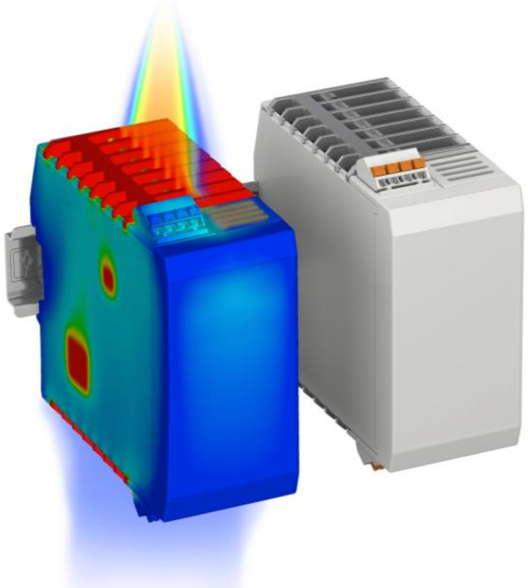
Optimize airflow

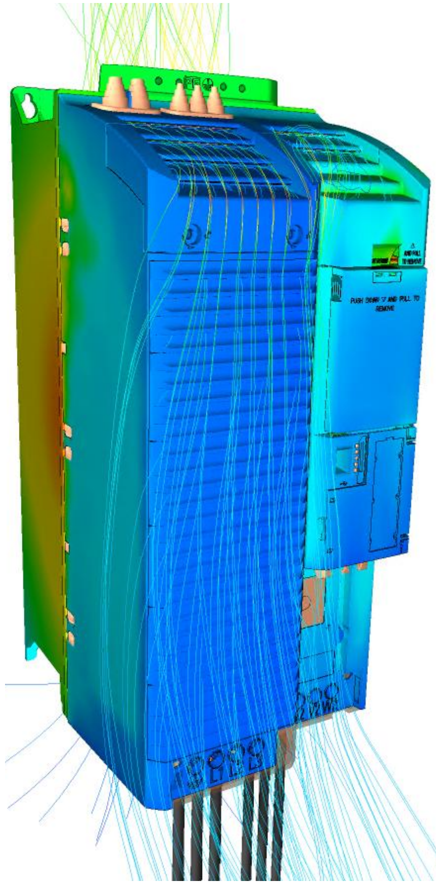
Influence on the flow direction

- 3D Pressure loss due to geometric guidance / obstruction
  - Vent geometry and position, Opening Ratio
  - Air baffles
  - Tight construction can direct the air
  - Cable routing
  - Mounting bracket, etc.
- Inlet pressure (fan, wind)





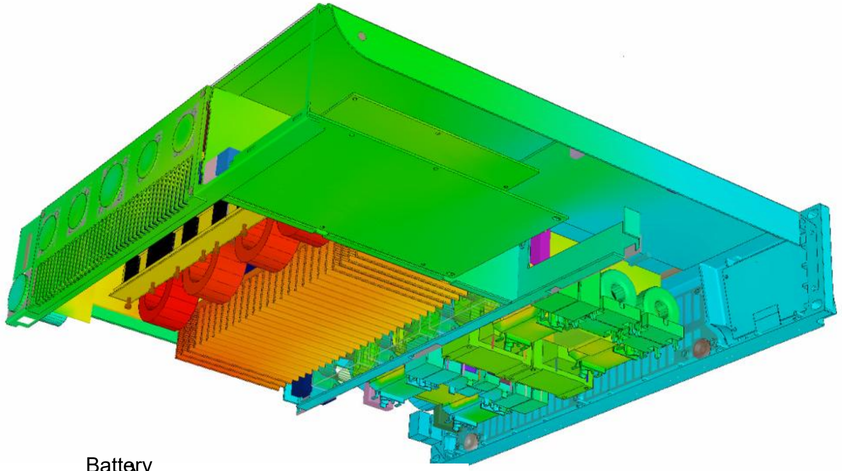


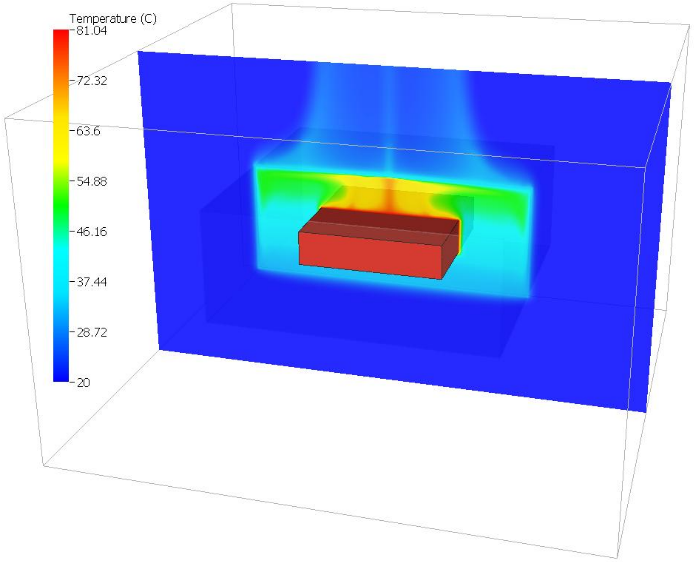


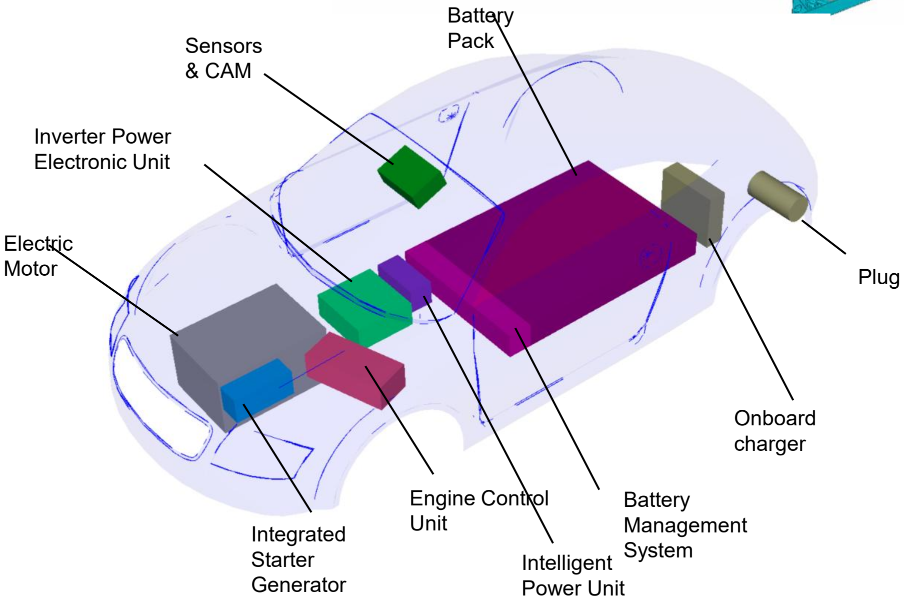
Understand Installation conditions

Cooling sink or external heat influence?

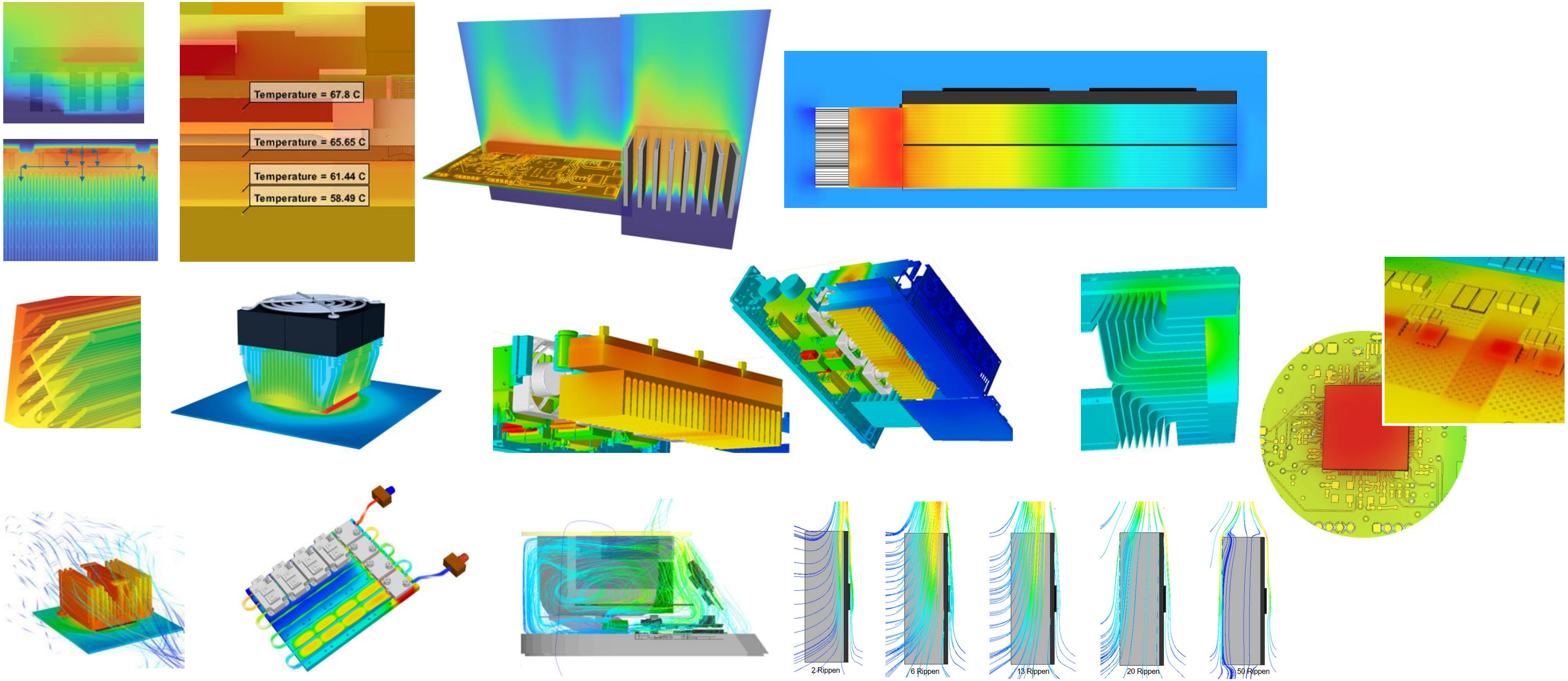
- Installation space / volume
- Gravitational direction
- Assembly contact
- Mounting material
- Mounting temperature
- Supply air obstructed or guided?



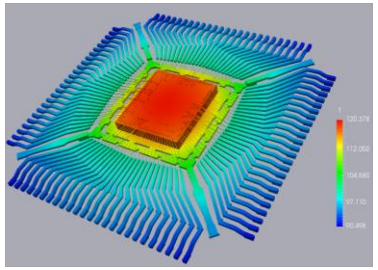


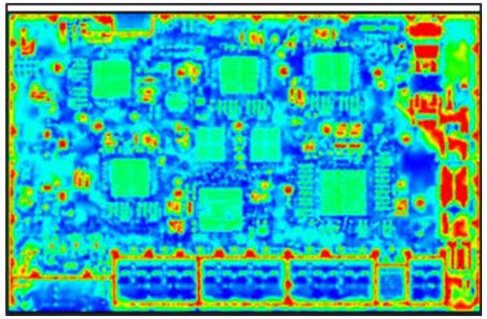


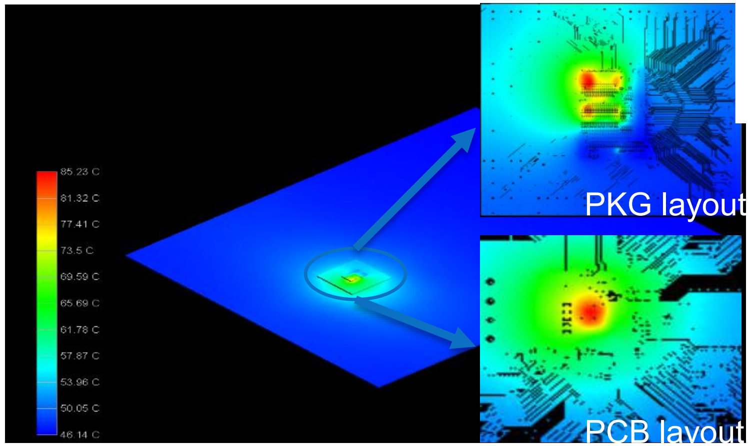
CelsiusEC can help to visualize these thermal pathes „3D“

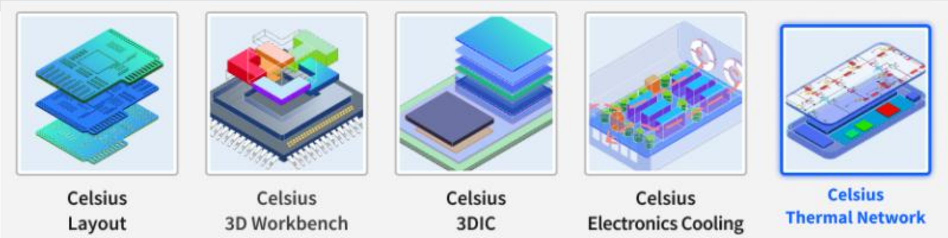


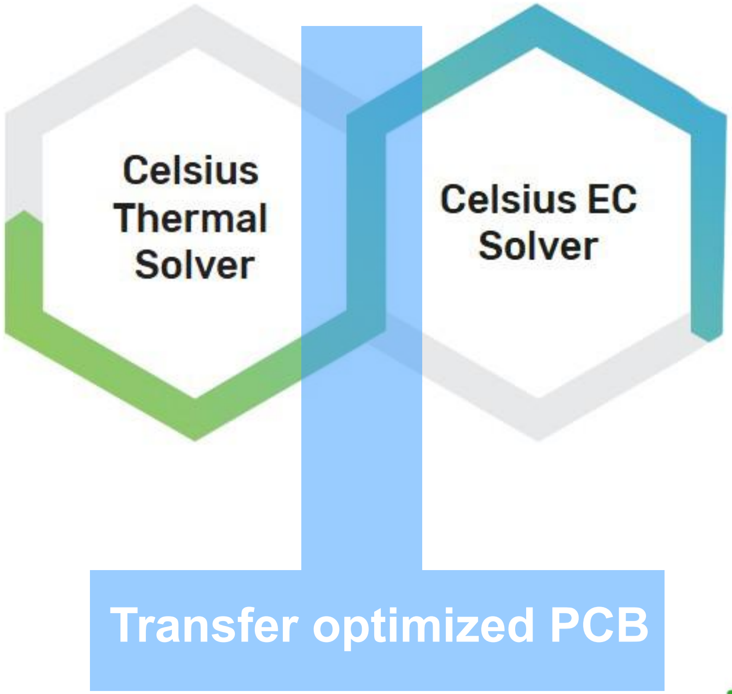
Breakout Question - But why does Cadence promote “two” thermal tools?

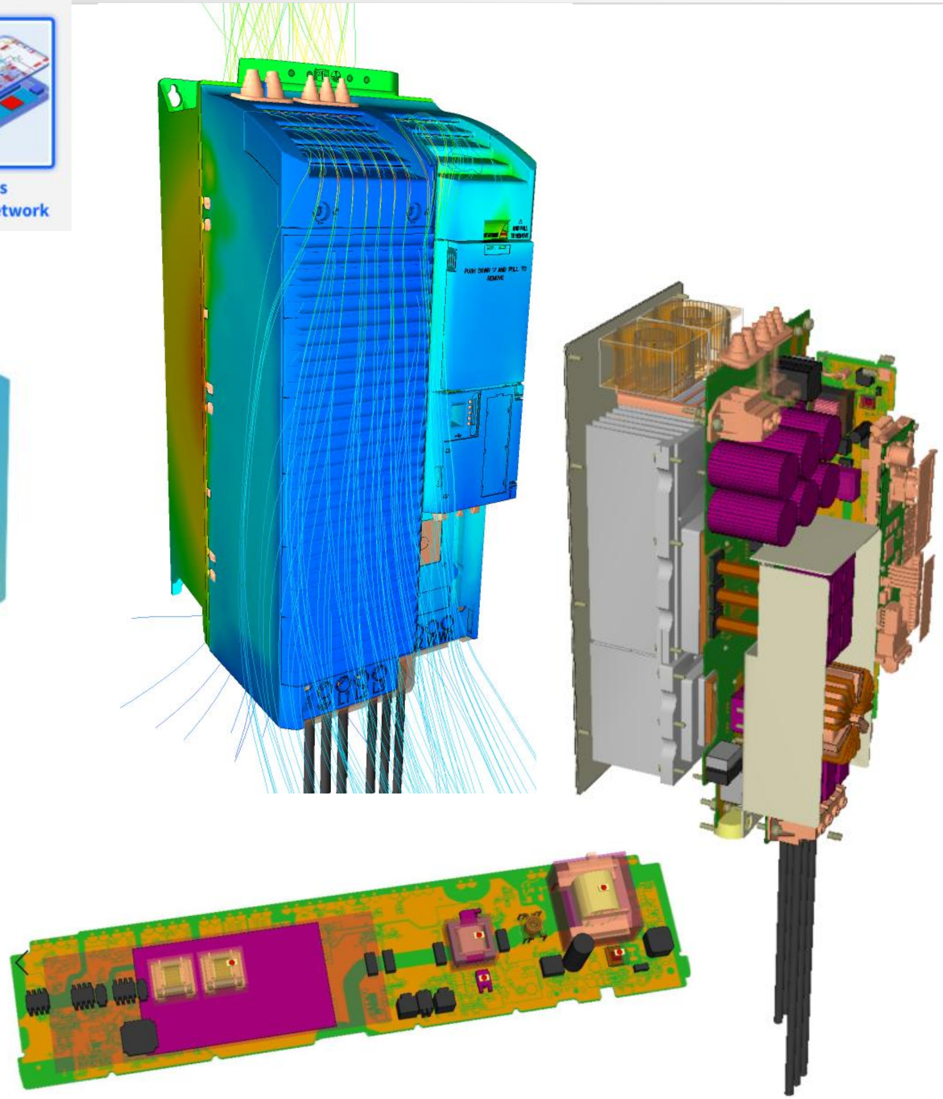












So much, I want to tell you about CelsiusEC…maybe in Webinar #2?

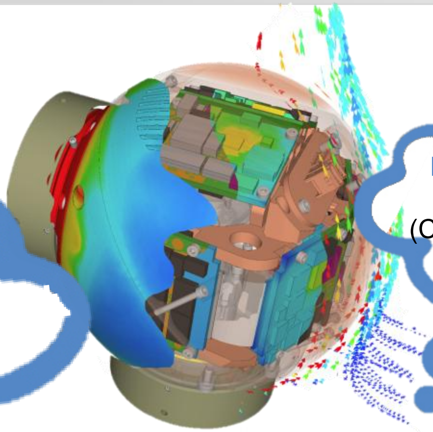
ALPHA-NUMERICS

EC specific

Solver approximation
Libraries
Multifluid
Wall Function
EC specific Support Partner
Object Panel
GUI
Menu & Structure
Interfacing

Interfacing

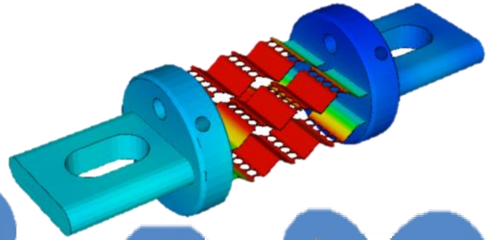
Parasolid
Mechanical CAD
Hardware E-CAD
Step native
ODB++ IPC-2581
Import updated Objects
Full Layout or just copper distribution
Edit CAD

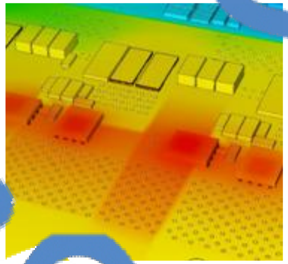


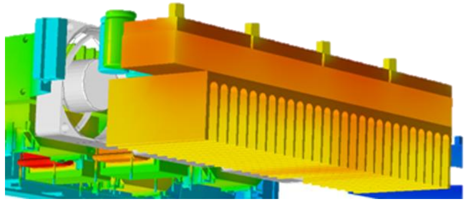
Optimizer

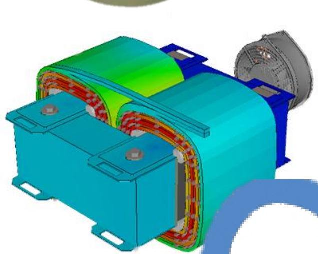
Parametric Study

Scripting (Commander / Python)
Script-driven Solver







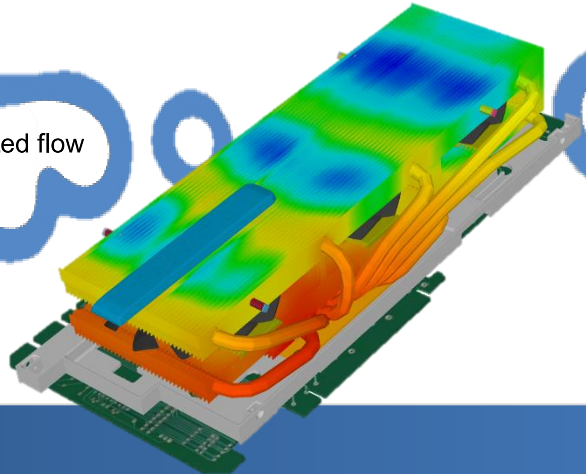


Temp.-related Settings

Temperature controlled fan
Material Properties
Power Loss
Fluid Properties
Electrical Resistance
Thermal Resistance

Physics

Flow & Temperature
Flow only
Conduction
Temperature only
Convection free/forced/mixed
Temperature @ freezed flow
Heat Radiation (infrared / full spectrum)
defined HTC attachments



Solver

Transient
Solar
Steady State
Start from…
750 mio. Cells
Multicore Solver
Stop @ Temperature Target
Multi-Pre/Post
Windows
JouleHeating
Cluster Solver
Melt Solver Licenses to sum multicore capability
Solver Queue
Cloud-Service
Linux

Easy Meshing

fast
local
global
3D
Surface aligned

Thank you for your time

ALPHA-NUMERICS

Software-Distribution
QUESTIONS?
Services
CFD
Training
Hotline
CelsiusEC
THANK YOU!
QUESTIONS
ALPHA-NUMERICS
Heat conduction
Convection
Radiation

Dipl.-Ing.Tobias Best
Managing Director
Phone: 06772 969 3430
Tobias.Best@alpha-numerics.de