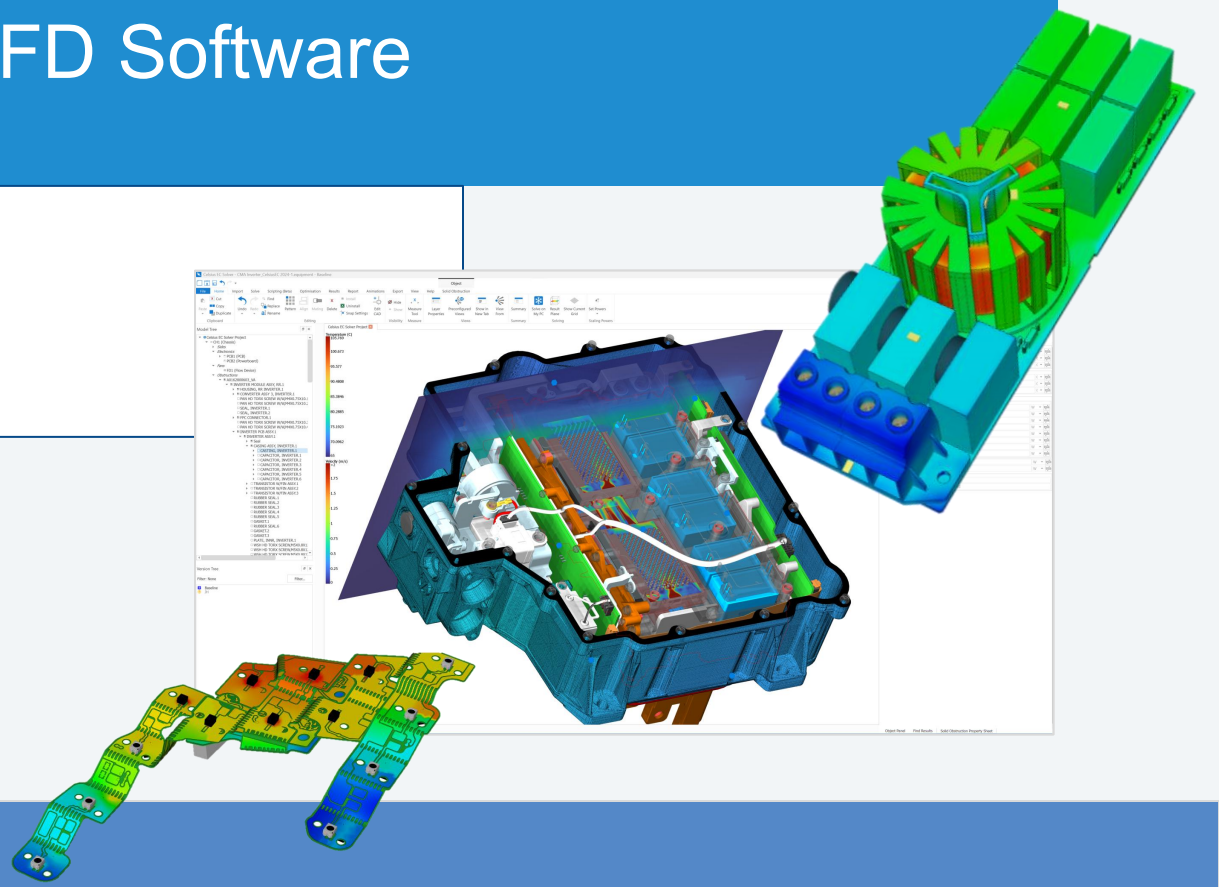
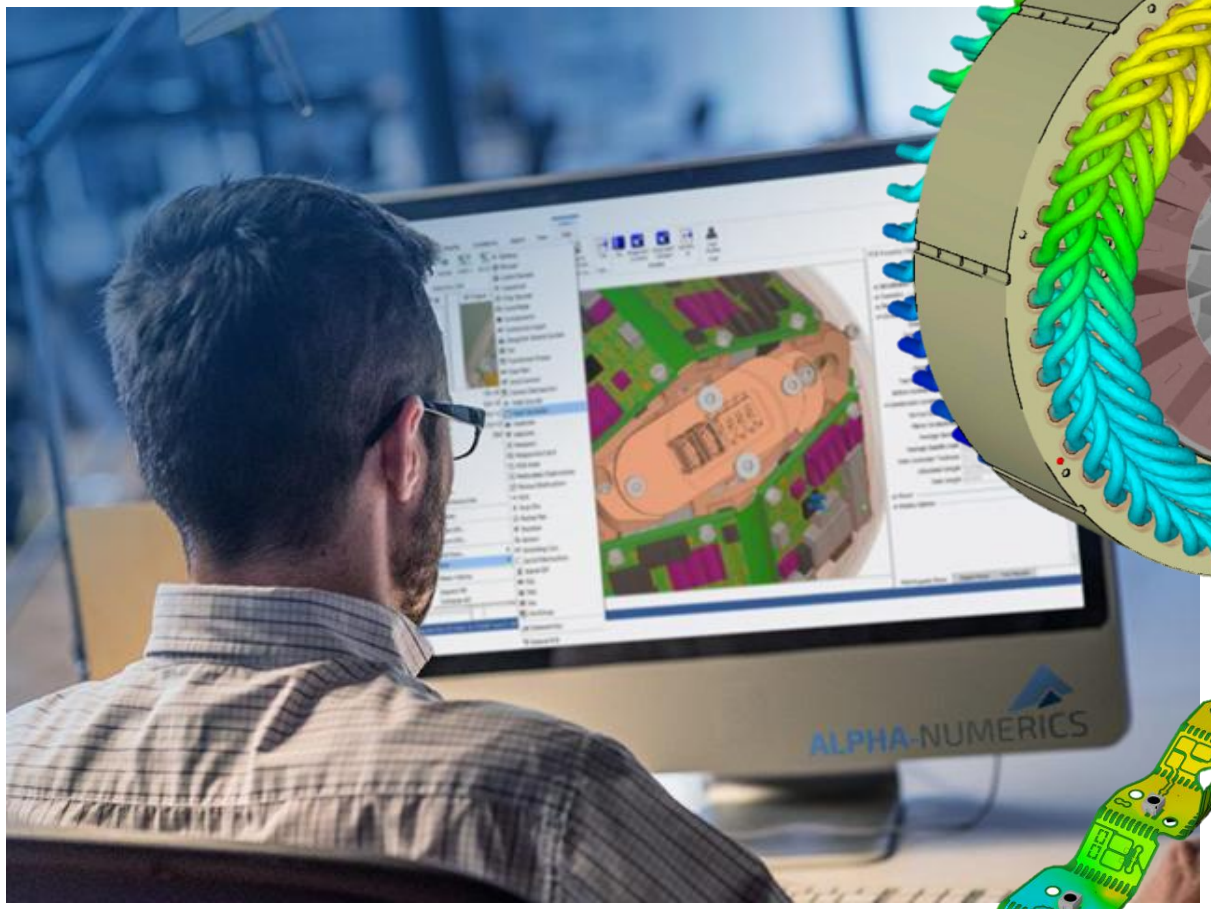
Welcome

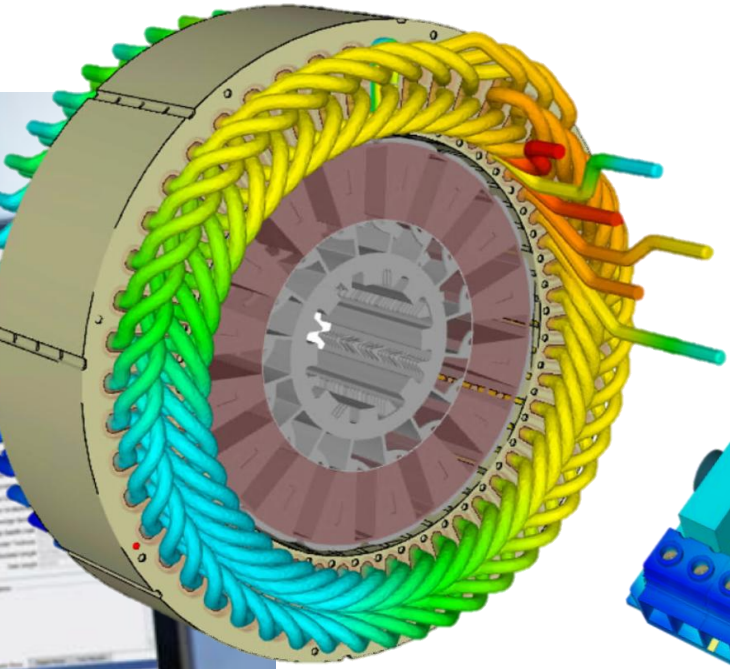
CelsiusEC, an Industry Specific CFD Software

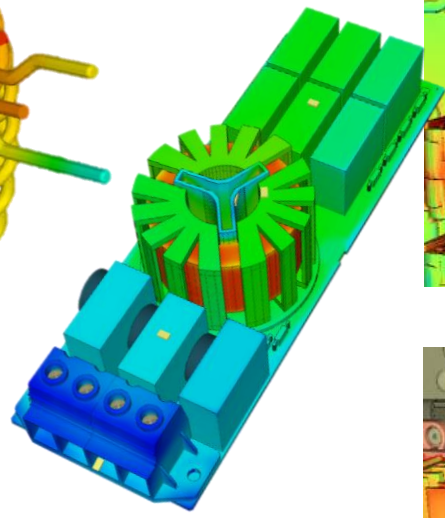
Tobias Best, ALPHA-Numerics GmbH

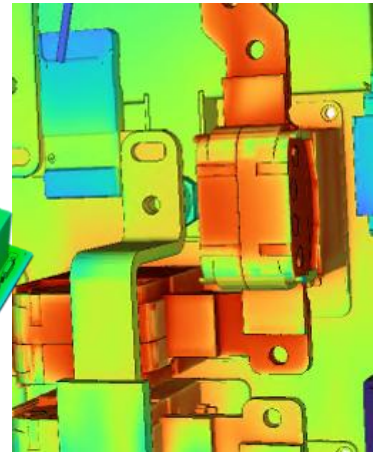


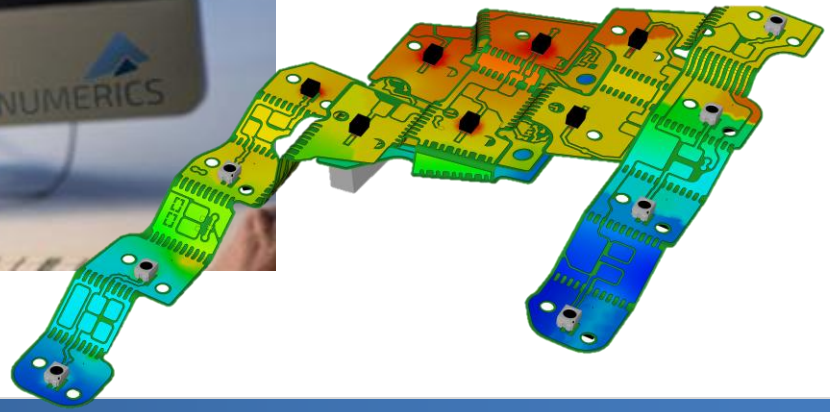
ALPHA-Numerics, a „Software Reseller & Service Provider„

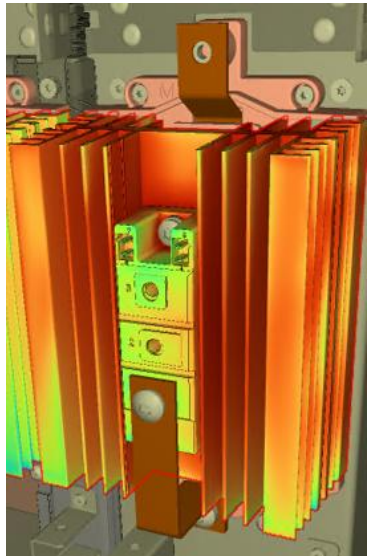












- Engineering Office near Wiesbaden
- Specialist for Electronics Cooling
  - Simulation Service & Consulting
  - EC trainer / SW trainer
  - Cadence Software Reseller
  - Hotline & Technical Support
  - A Mentor for CelsiusEC Starters

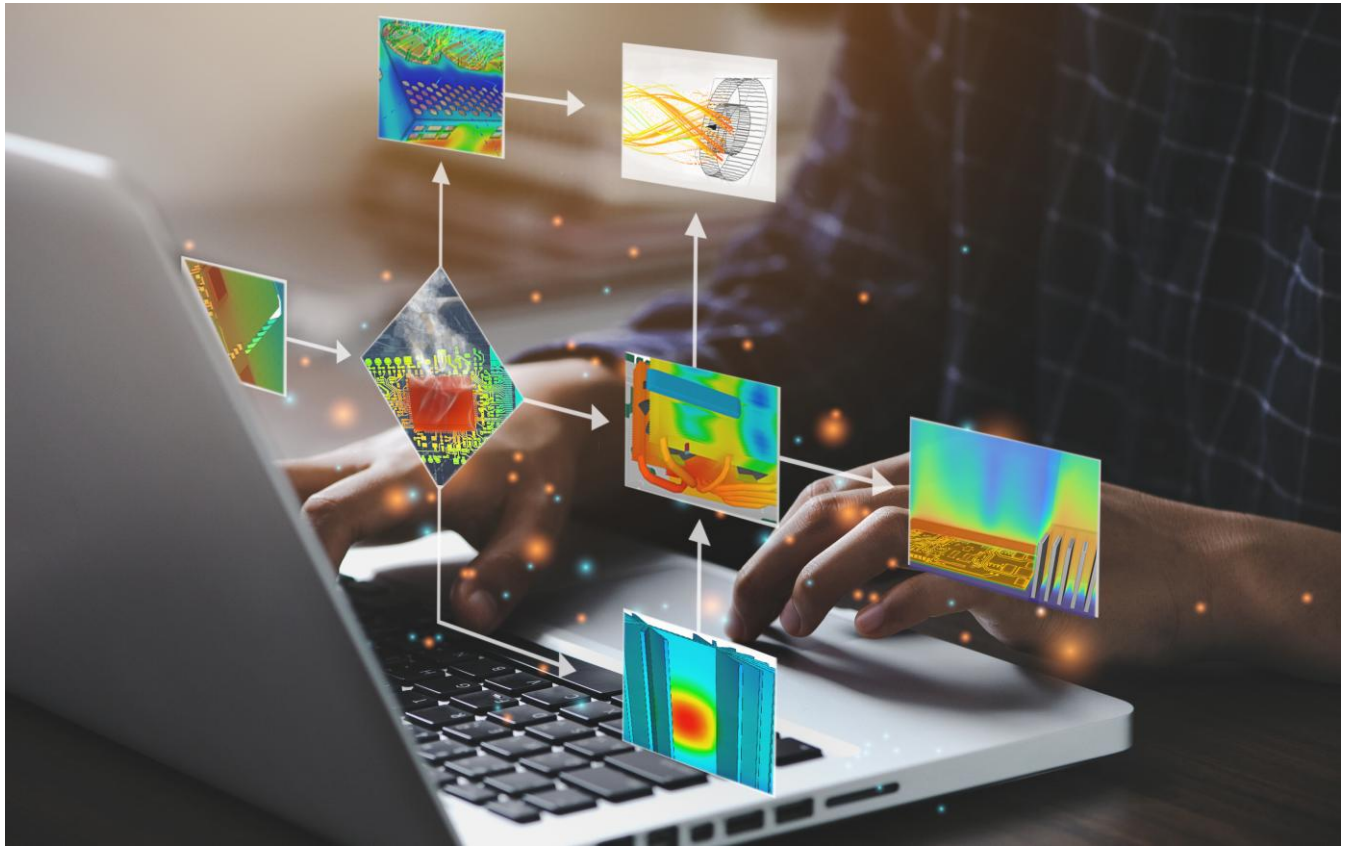
Specialist for Electronics Cooling

We have been working with the electronics industry in the field of electronics cooling for 30 years.

We support our customers to develop innovative cooling solutions for their electronic equipment.

Mercedes	Brose	Elektrobit
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 many more



Topic for today

Practical Guide to Electronics Cooling Design with Cadence Celsius EC

Date: June 23, 2026

Time: 2 PM ET | 11 AM PT or 11AM CEST

Presenter: Tobias Best, General Manager ALPHA-Numerics GmbH

Key Takeaways

By the end of this webinar, you will:

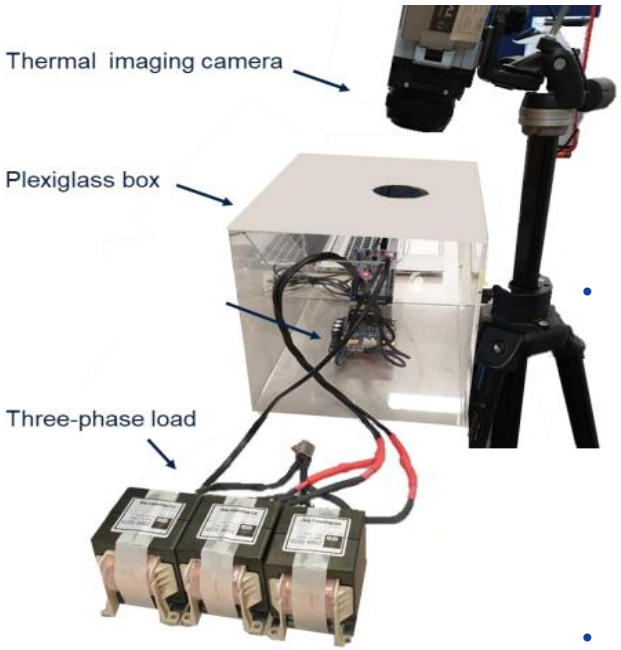
- Understand how to use Celsius EC to model real-world electronics cooling scenarios with confidence
- Be able to set up and execute a complete thermal simulation workflow from setup through results
- Gain practical tips to improve model fidelity while reducing setup time
- Learn how to identify thermal risks earlier and optimize cooling strategies before hardware is built
- Walk away with a repeatable approach for integrating thermal analysis into your design process

When and Why to shift left from physical testings to simulation

ALPHA-NUMERICS

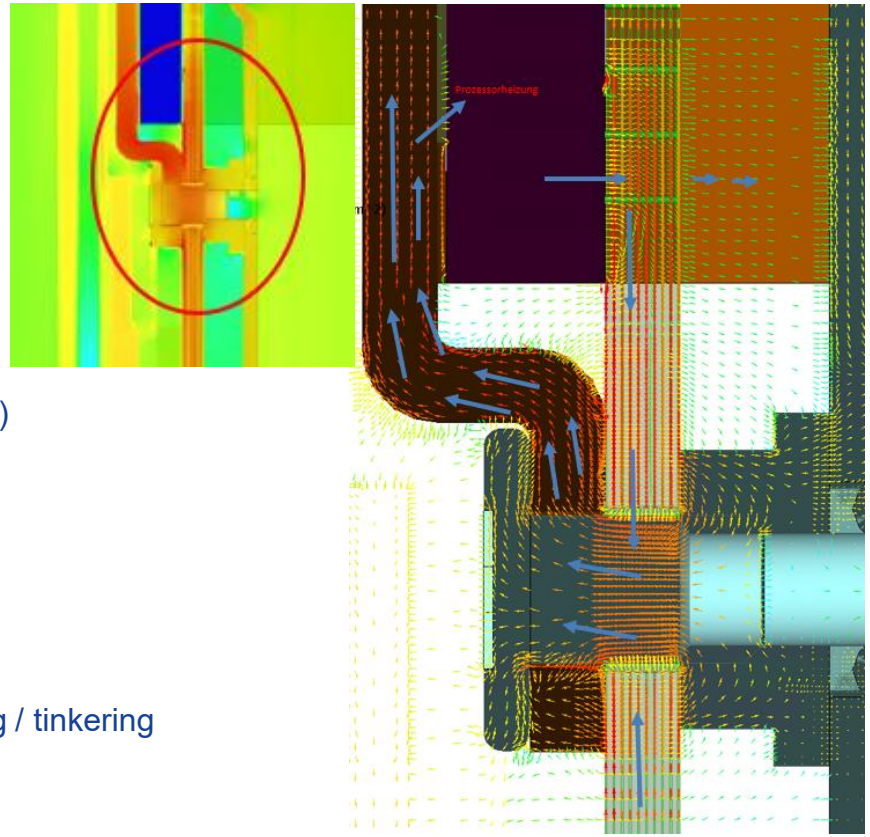
Product development timeline

Concept Development	Product Development	Prototyping / Measurements	Certification	Series / Field



- Later understanding of the thermal behaviour and thus
  - Expensive troubleshooting
  - Delay in market launch (competitive disadvantage)
  - Expensive solutions
    - oversized?
    - heavy
    - puts the brakes on innovation
    - makes it complicated?

- Measurements are selective
  - No information about thermal paths.....blind poking / tinkering
  - No certainty of having caught the hotspot



When and Why to shift left from physical testings to simulation

ALPHA-NUMERICS

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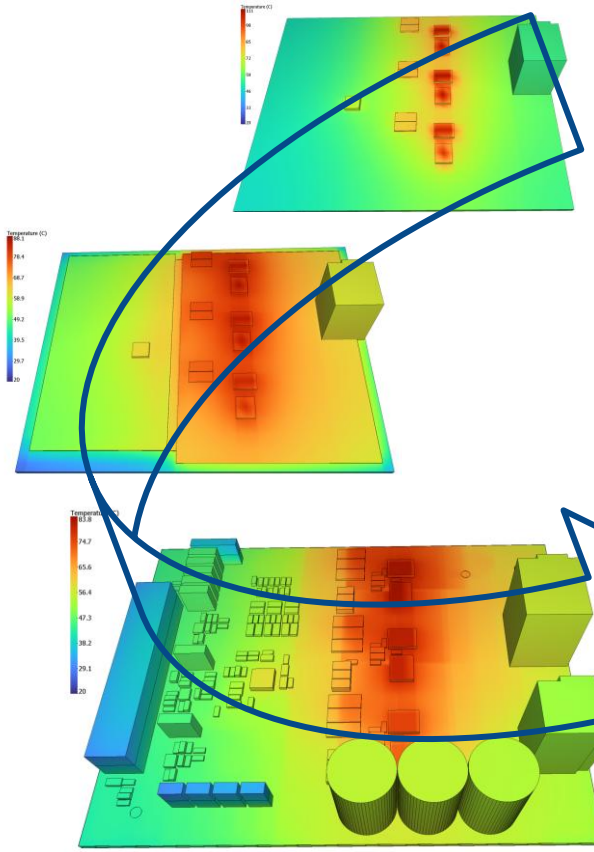
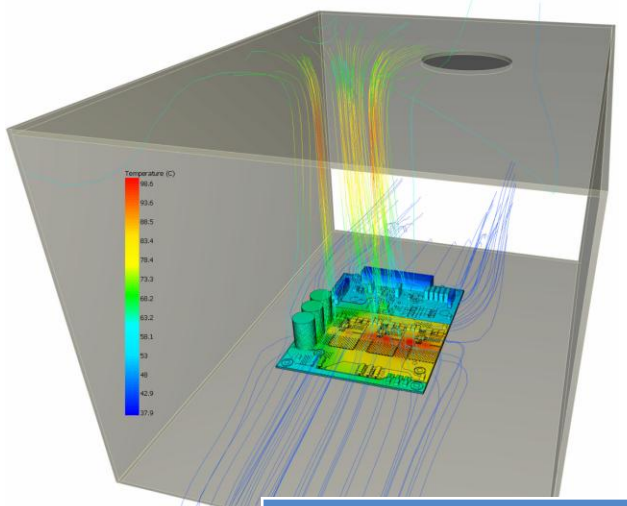
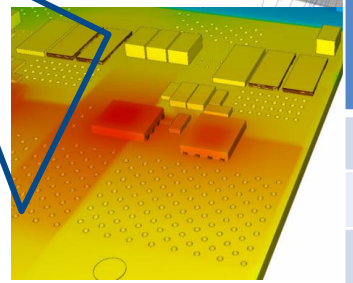
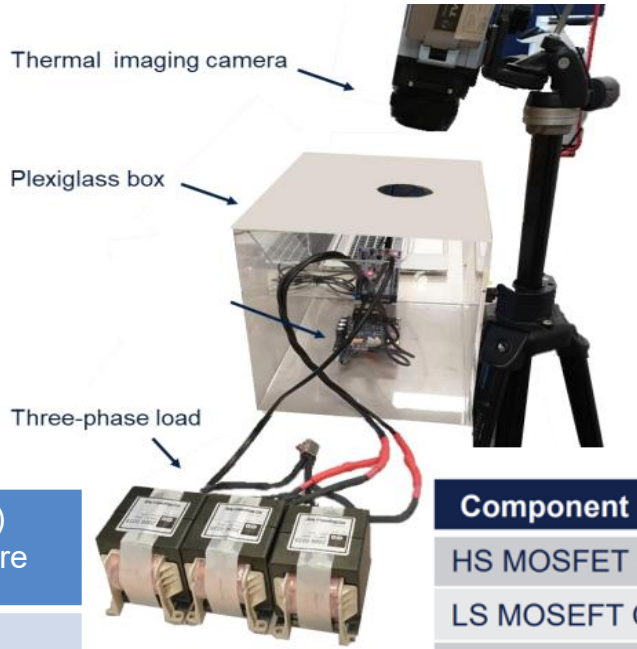






Simulation Results (ºC) at 25.8ºC lab temperature
93.5
91.1
82.4



Component	Measure [°C]
HS MOSFET Q1	93.8
LS MOSEFT Q4	91.7
Shunt resistor R23	82.6

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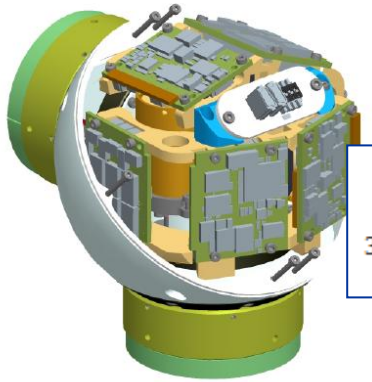
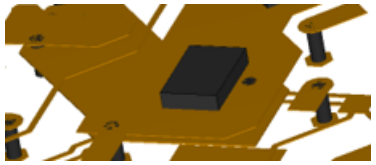
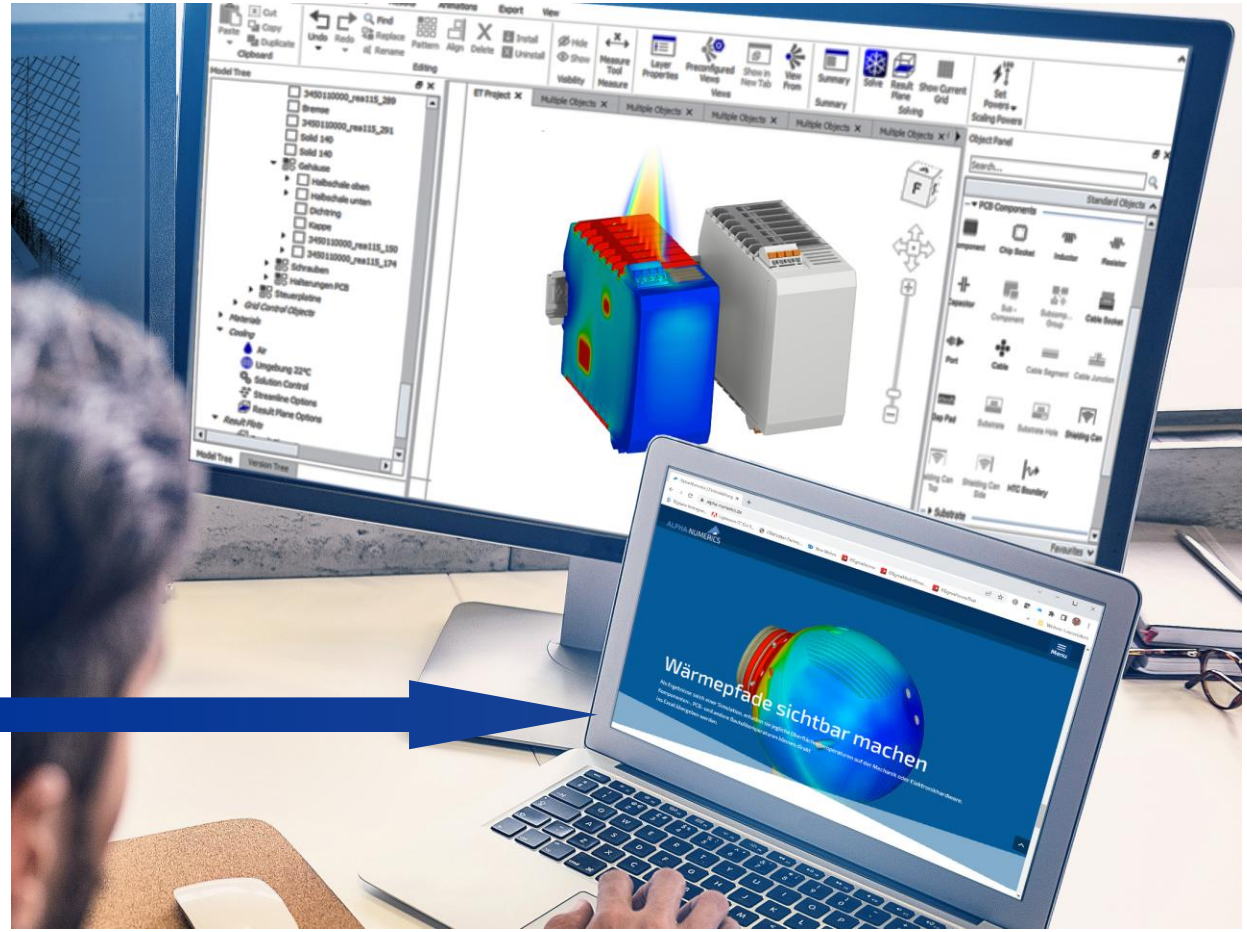
CelsiusEC is an Industry specific CFD Software

- GUI is easy to use for Engineers
  - Mechanical Engineers
  - Hardware Engineers
  - Testing / Measurement Specialists
- Task related Objects
- Import Filters of all relevant Datasets
- Supporting Automatisms
  - Modelling
  - Meshing
  - Physical Settings
- …







Development Path

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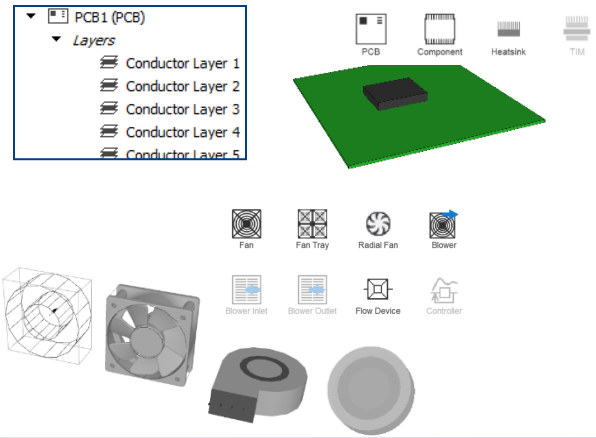
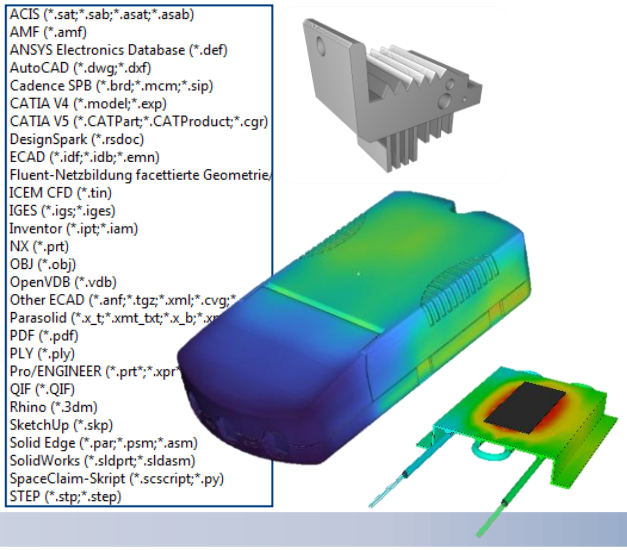
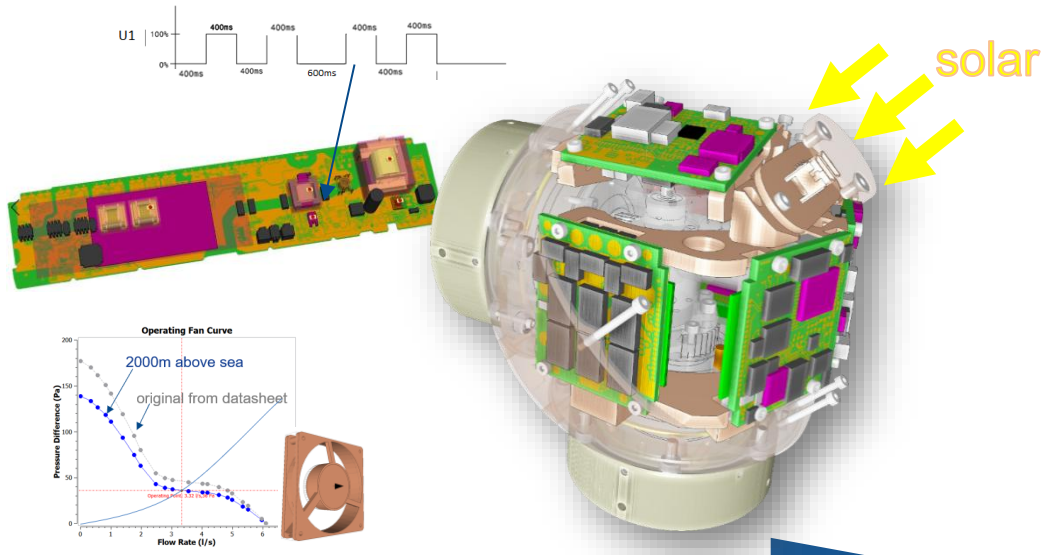
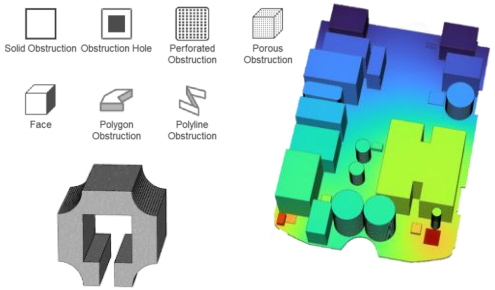




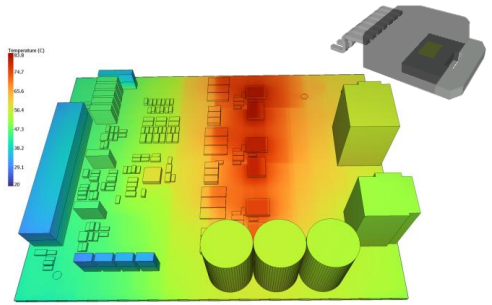


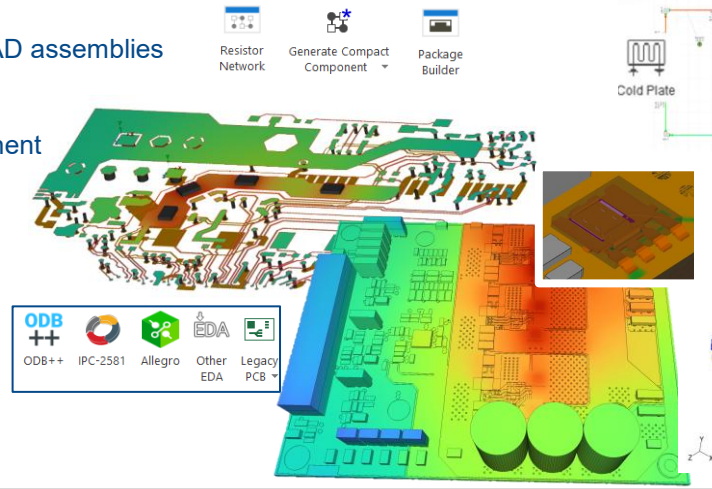
Konzept → **Digitaler Zwilling**

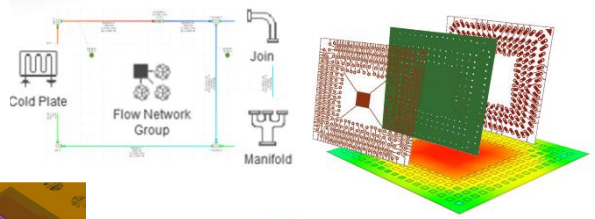
- model at draft level
- library
- drag & drop of intelligent objects
- Simple definition of componet and pcb

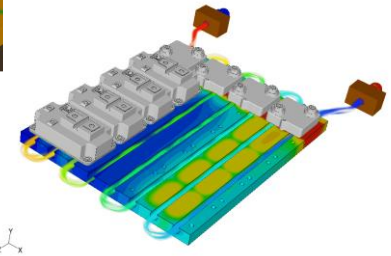


- smart interfacing for mechanical CAD data
  - no pressure to simplify complex CAD assemblies
- Optimisation of heatsinks
- Optimisation of cold plates
- Detailled representation of pcb and component

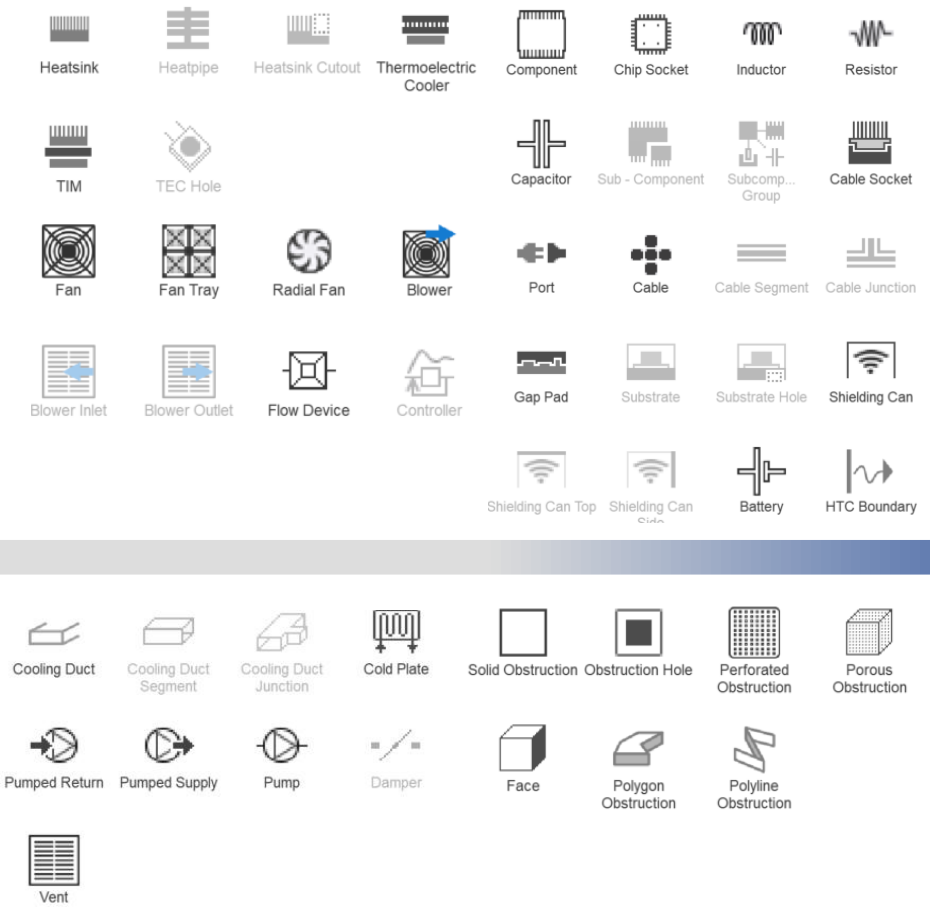


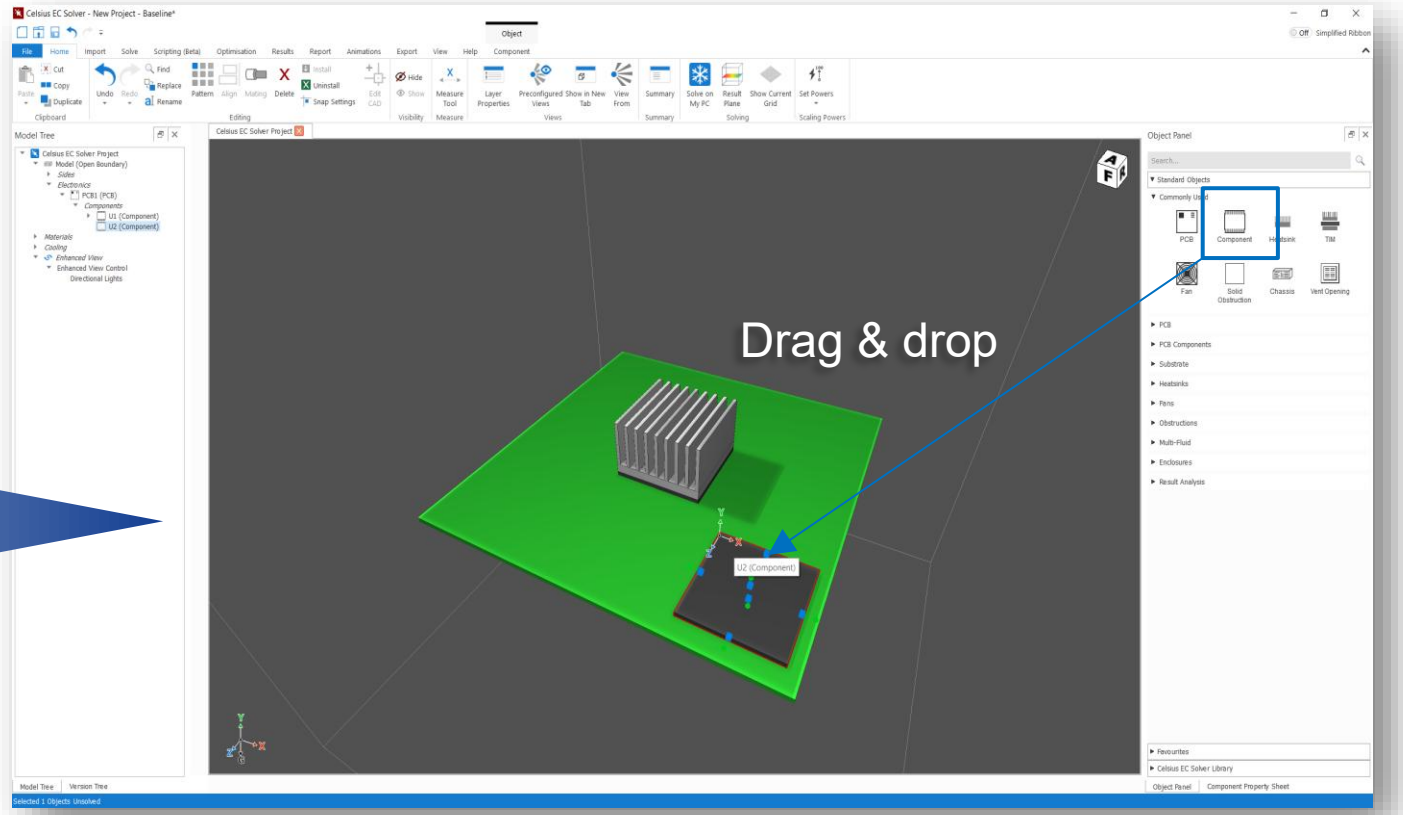




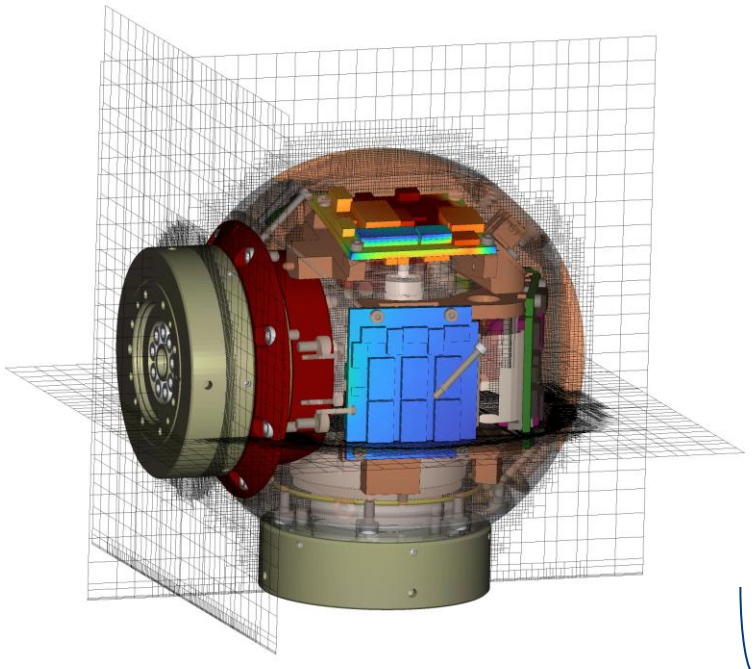


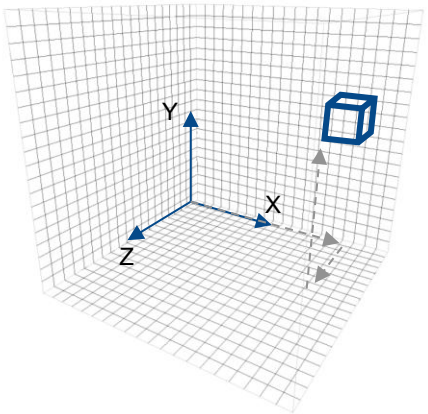
From **Concept Level** to a Digital Twin

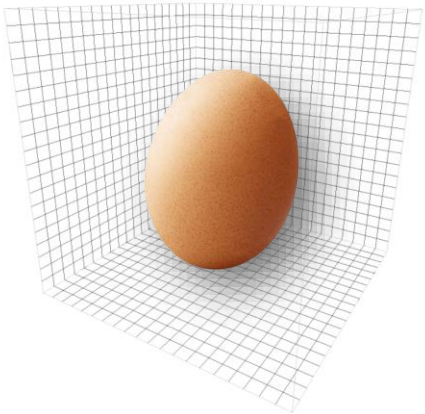


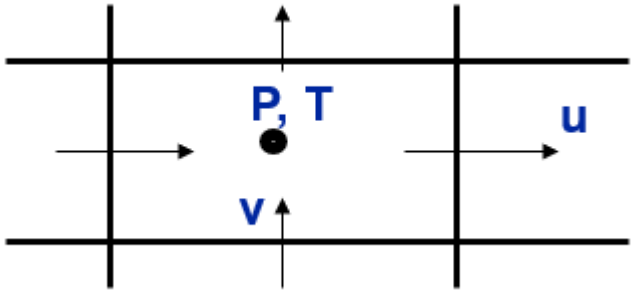


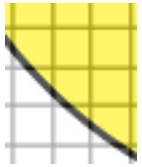
Meshing – it is not very complex



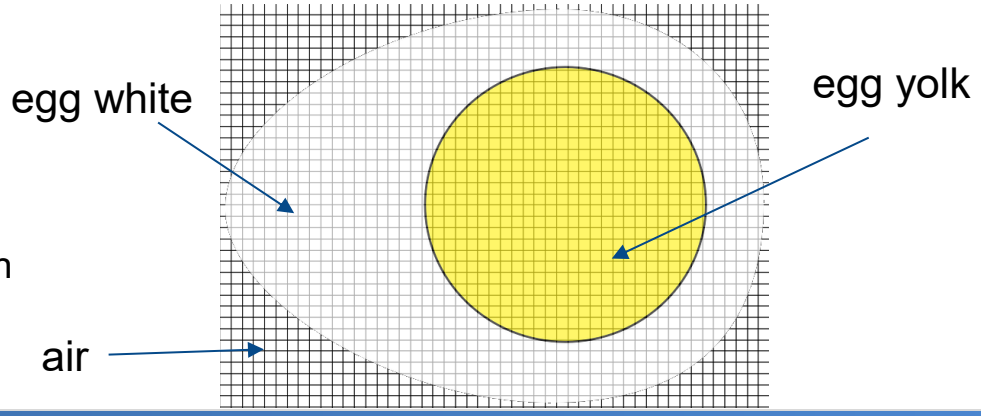




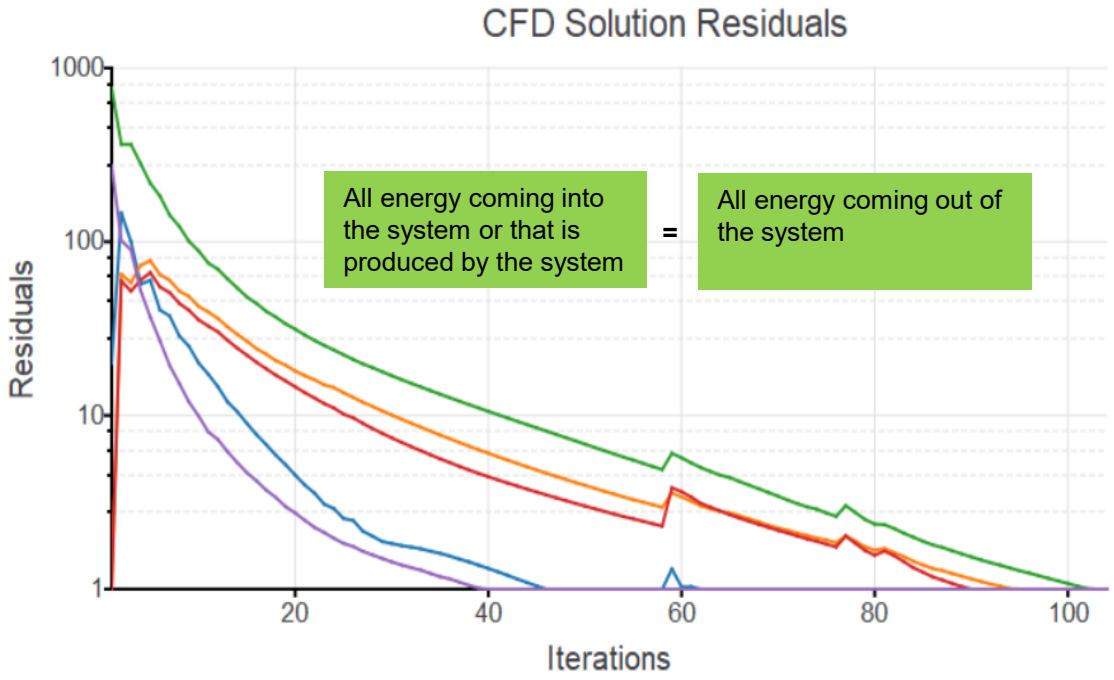


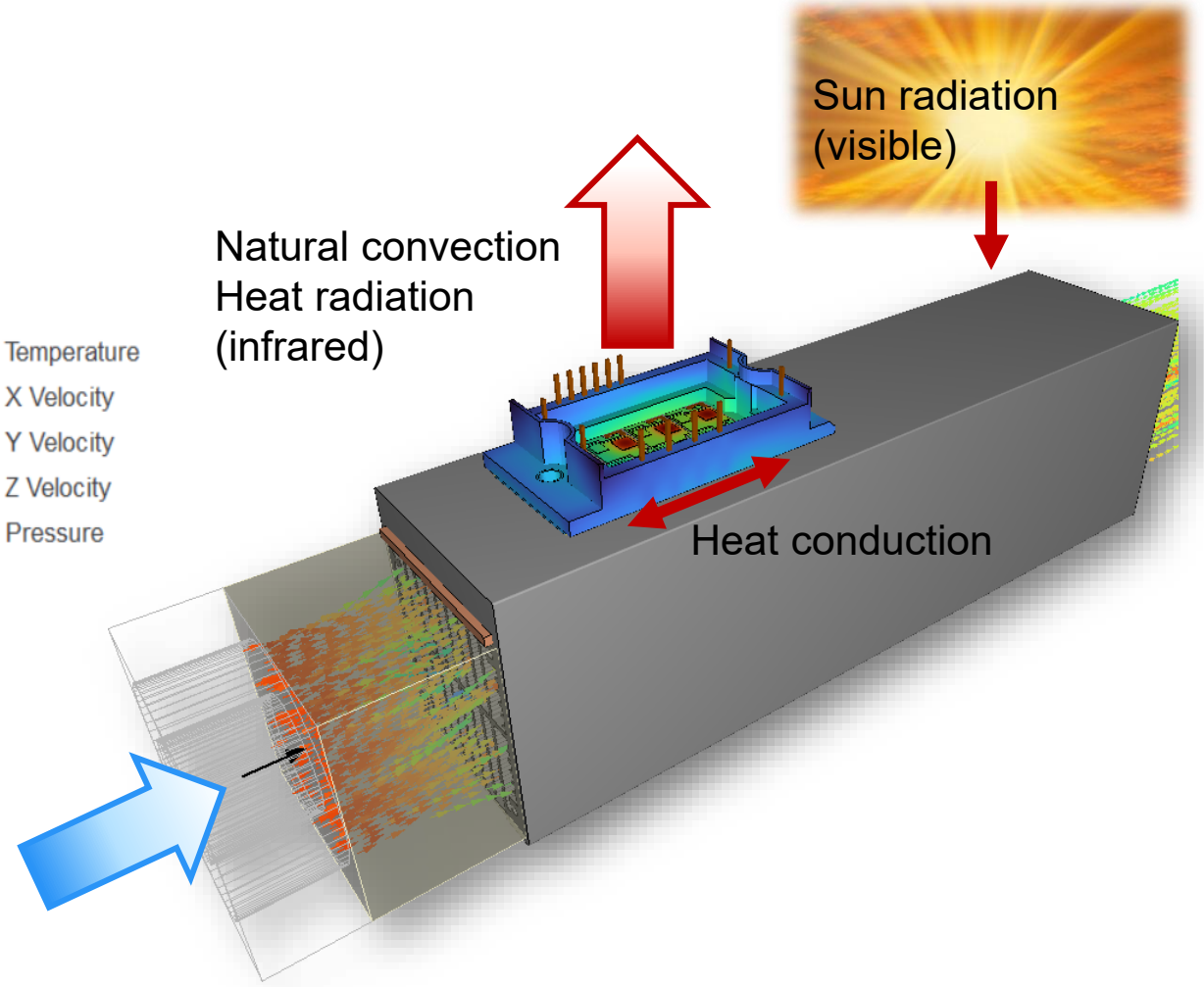


- Position
- Material
- Surface classification

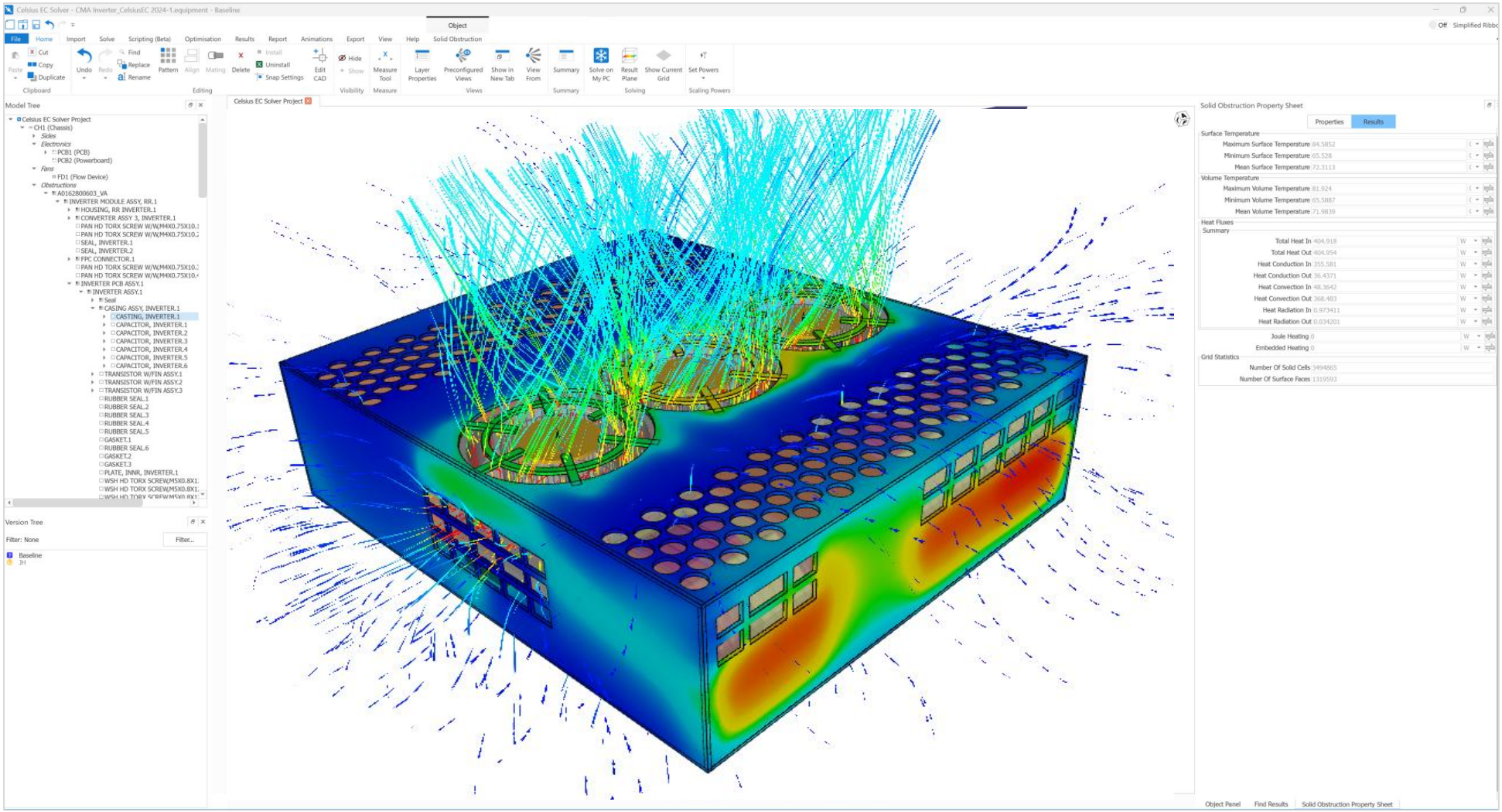


Physics of the CFD Calculation





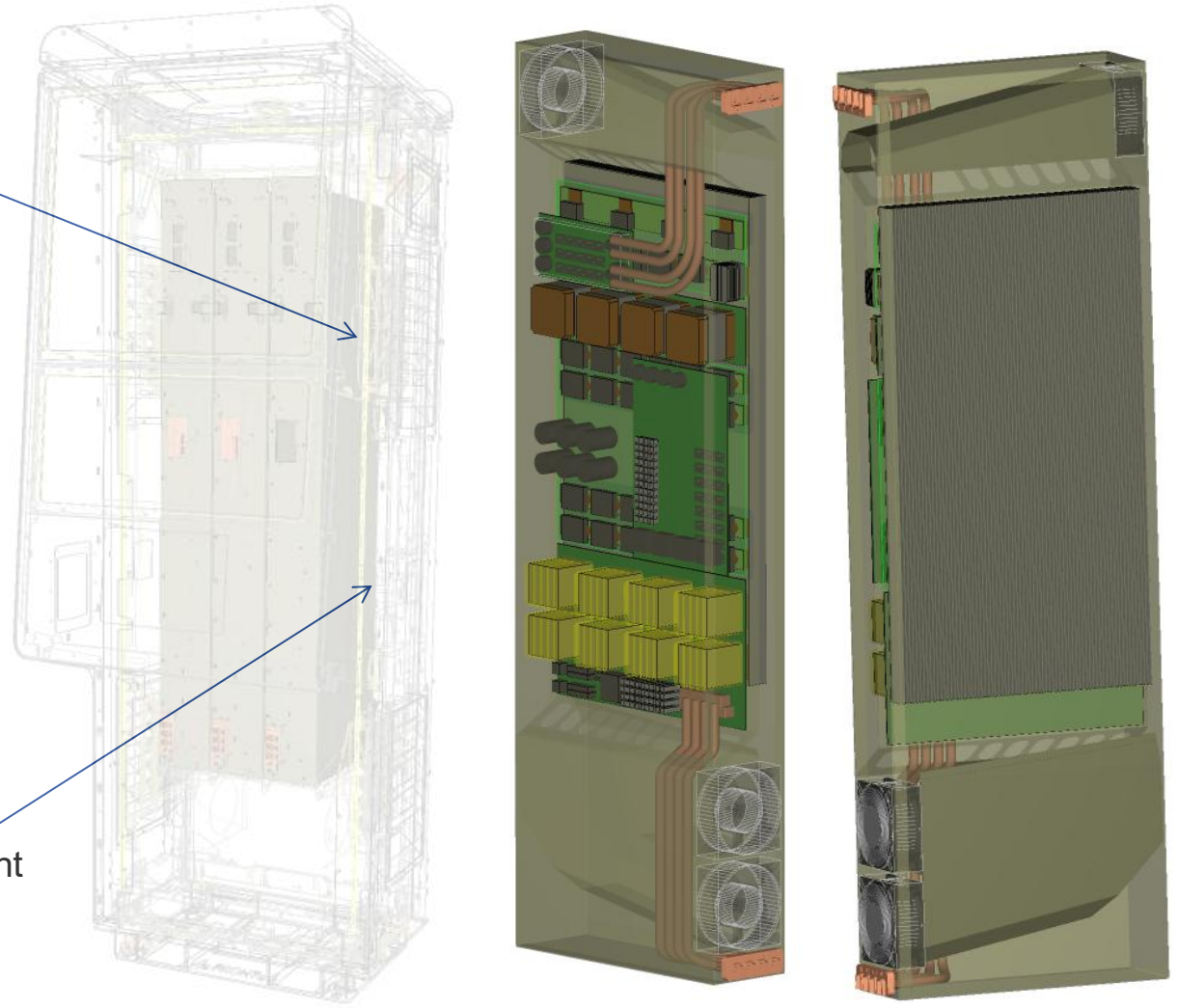
Quick Live Demo – Part 1



From Concept Level to a Digital Twin

Ambient
- Temp Profil
- Location
- Wind
- Sun

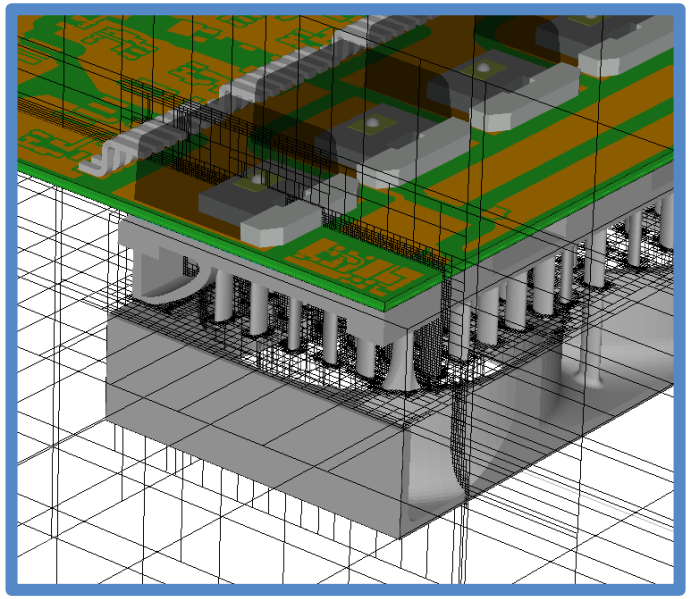
Power loss
- temp dependant
- controlled
- Joule Heating



Material-Library

Auto-Mesh

Meshing – it is not very complex



▼ Hybrid Cells

Allow ☑

Exclude Flow Boundaries ☐

▼ Grid

Unstructured Grid Control

Limit Refinement Ratio ☑

Refinement Ratio Limit 2

Gap Refinement ☐

Grid Plane Display

X Location 0 mm

Y Location 0 mm

Z Location 0 mm

Grid Rules Definition File GridRules.cfg

Limit Maximum Cell Size ☐

Cell Count Target 50000000

Minimum Gap Size 0.5 mm

Enable Heat Conduction Gri... ☑

Use Advanced Grid Controls ☑

Allow Manual Only Gridding ☐

Use Inflation ☑

Apply Smoothing ☐

Mounting Rail Simplification ☐

Grid Summary

Grid Cell Count no value

Auto (Unlimited) Cell Count no value

Largest Cells

Largest X no value

Largest Y no value

Largest Z no value

Smallest Cells

Smallest X no value

Smallest Y no value

Smallest Z no value

Maximum Aspect Ratio no value

Maximum Expansion Ratio no value

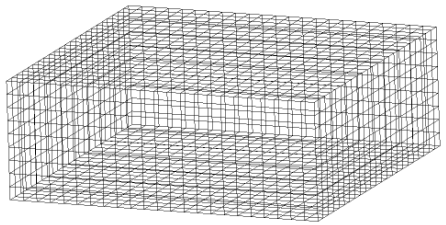
Maximum Refinement Ratio no value

Grid Rule handled as a 3D Object

☐ CAD Object xyz

Grid Control 3D 3x3x3mm

Grid Control GEO based



Installed ☑

▶ Identification

▼ Geometry

Direction X

Size From Parent

▶ Construction

▶ Display Options

X
Y
Z
3D
Geometry Based

X Construction

Extra Grid Type Maximum Size

Maximum Size 3 mm

Exact Grid Lines ☐

Y Construction

Extra Grid Type Maximum Size

Maximum Size 3 mm

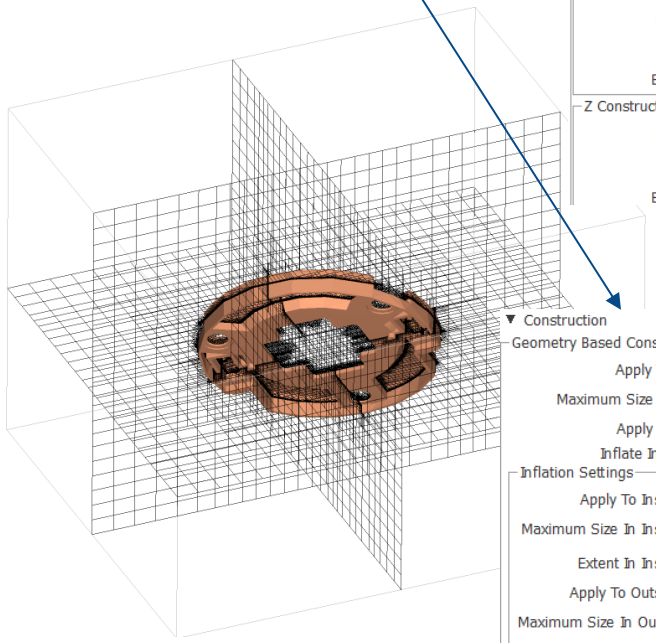
Exact Grid Lines ☐

Z Construction

Extra Grid Type Maximum Size

Maximum Size 3 mm

Exact Grid Lines ☐



▼ Construction

Geometry Based Construction

Apply To Solid ☑

Maximum Size In Solid 1 mm

Apply To Fluid ☐

Inflate Into Fluid ☑

Inflation Settings

Apply To Inside Fluid ☑

Maximum Size In Inside Fluid 0.2 mm

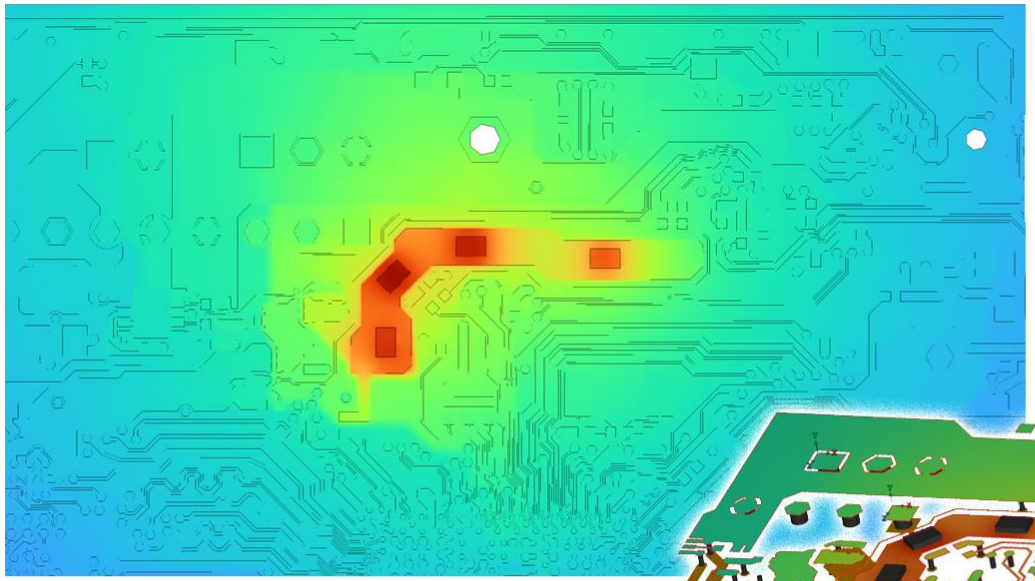
Extent In Inside Fluid 0.4 mm

Apply To Outside Fluid ☑

Maximum Size In Outside Fl... 0.2 mm

Extent In Outside Fluid 0.4 mm

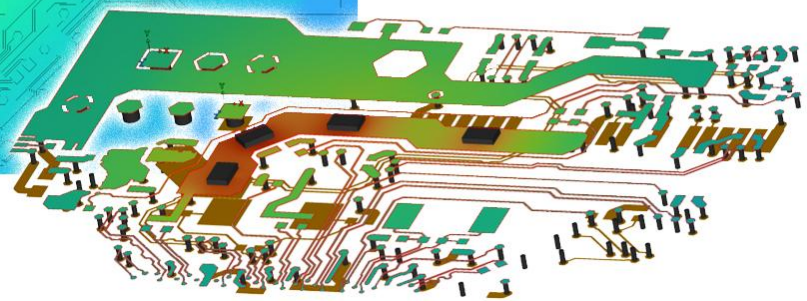
Thermal Path



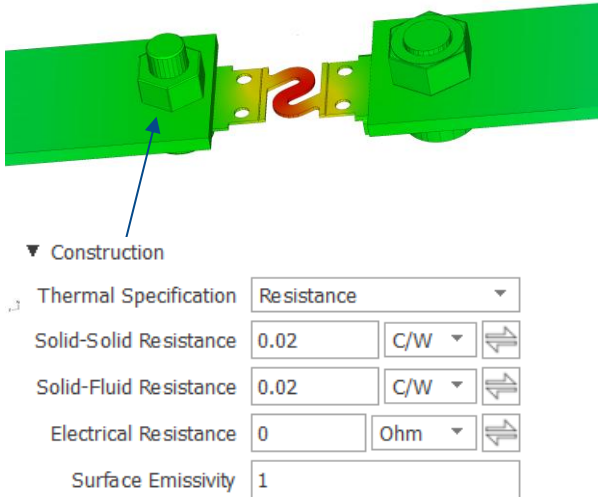
Conduction

$$\Delta T = \frac{d}{\lambda \cdot A} \cdot P$$

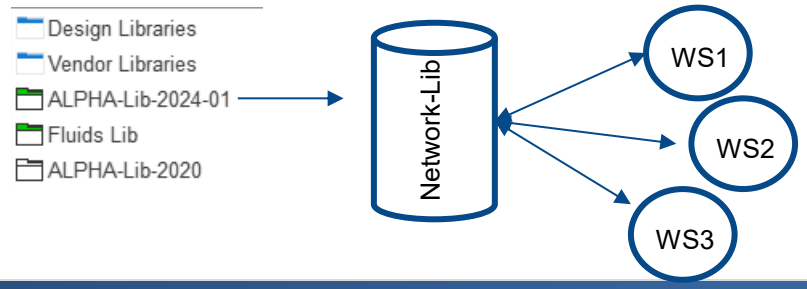
ΔT = *Temperature Difference*
d = *Length / Thickness*
A = *Surface Area*
P = *Power Losses*



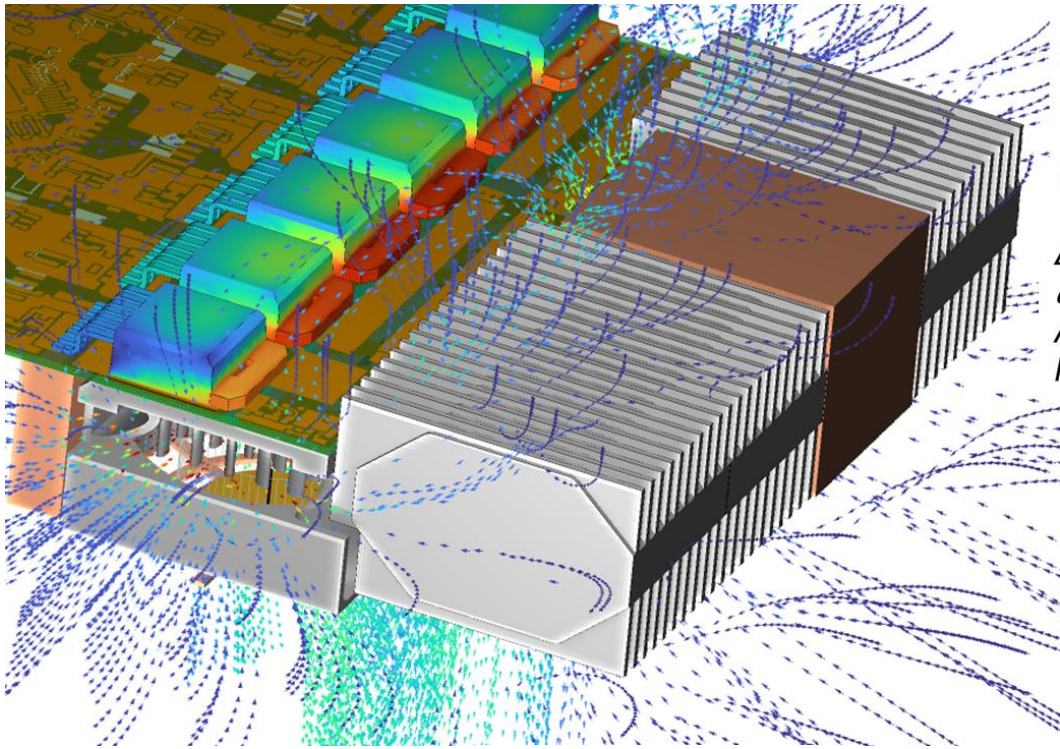
- Conduction-Only Calculation possible (Vaccum)
- Isotropic -> Temperature Dependent
- Plana Isotropic (Flex-PCB)
- Orthotropic
- Radial Conducting (Battery Cells)
- Thermal & Electrical Contact Resistance



Local & Central Library Structure for Materials (…and other Objects)



Thermal Path - Convection

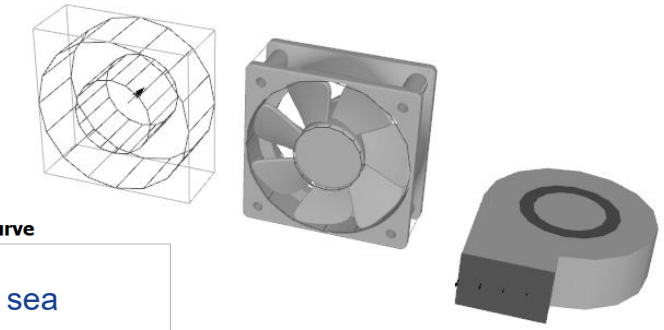


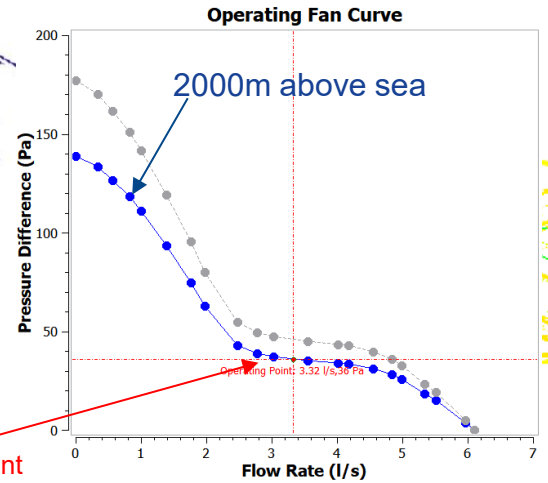
Convektion

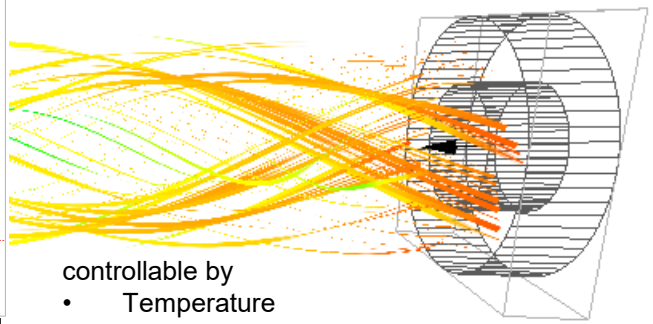
$$\Delta T = \frac{P}{\alpha \cdot A}$$

ΔT = *Temperature Difference*
α = *Heat Transfer Coefficient*
A = *Surface Area*
P = *Power Losses*

- Flow-Only Calculation possible
- Free Convection
- Forced Convection (KE Solver)
  - Flexible Wallfunctions
- Calculated at any local cell at surfaces the right HTC
  - Defined Heat Transfer Coefficient possible
- MultiFluid Calculation (no Phase Change!)

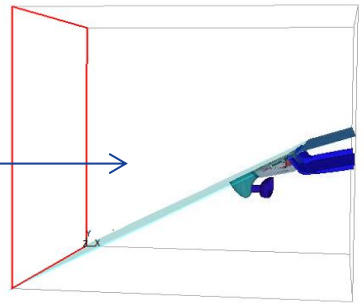




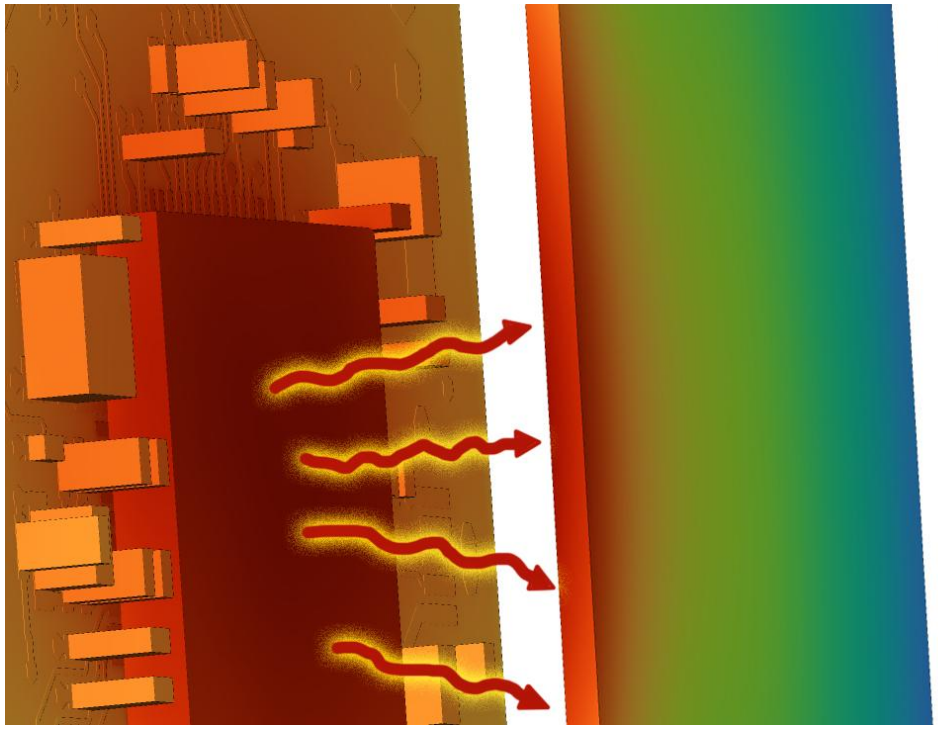


controllable by
- Temperature
- RPM

Windprofile / Airflow



Thermal Path - Radiation



Radiation

$$\dot{Q} = \frac{\partial Q}{\partial t} = \varepsilon \sigma A T^4$$

$\dot{Q}$: *Radiation Heat Fluxes*

ε: *Emissivity*

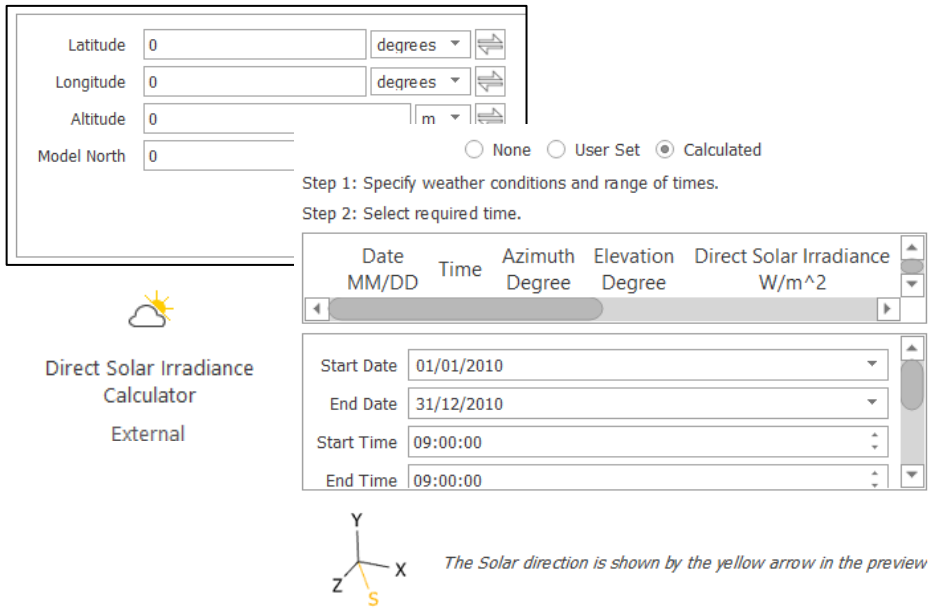
$\sigma = 5{,}67 \cdot 10^{-8} \frac{\mathrm{W}}{\mathrm{m^2\,K^4}}$

A: *Surface Area*

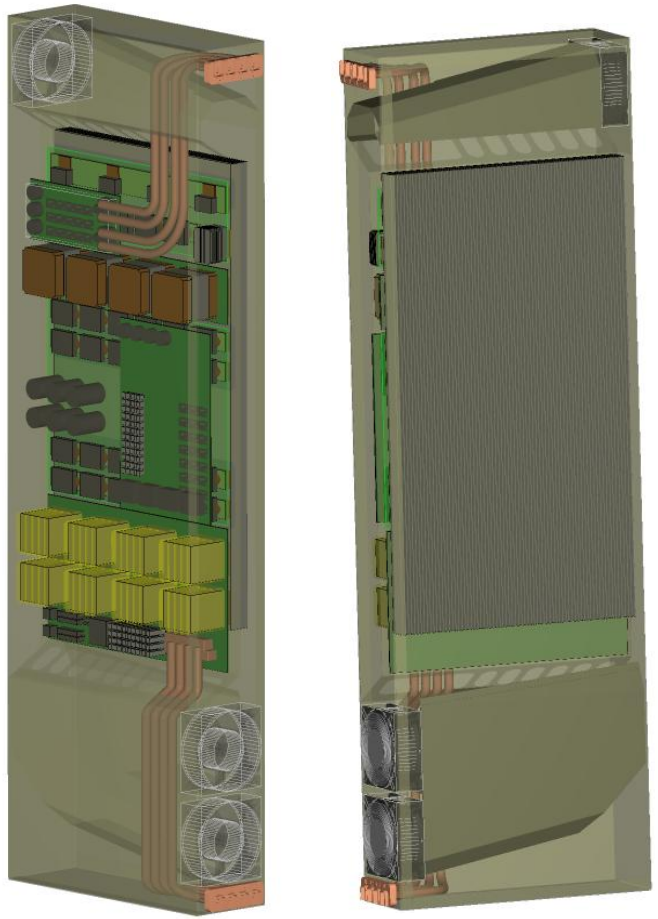
T: *Object Temperatur*

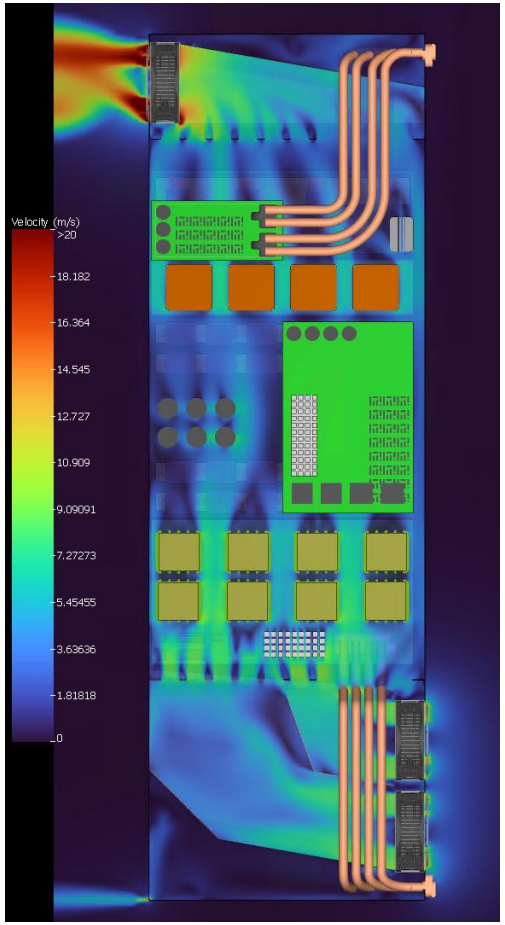
Real Calculation of heat Transfer by

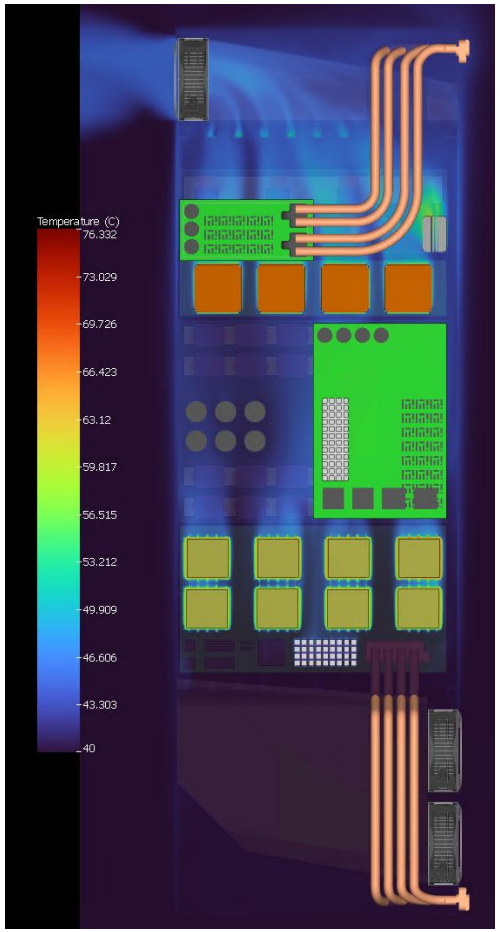
- View Factors
- Distance
- Angle
- Temperature Difference
- Surface Emmisivity (for infrared)
  - Transparence possible
- Reflectance (solar)
  - Transparence-> Absorbtiance (solar)



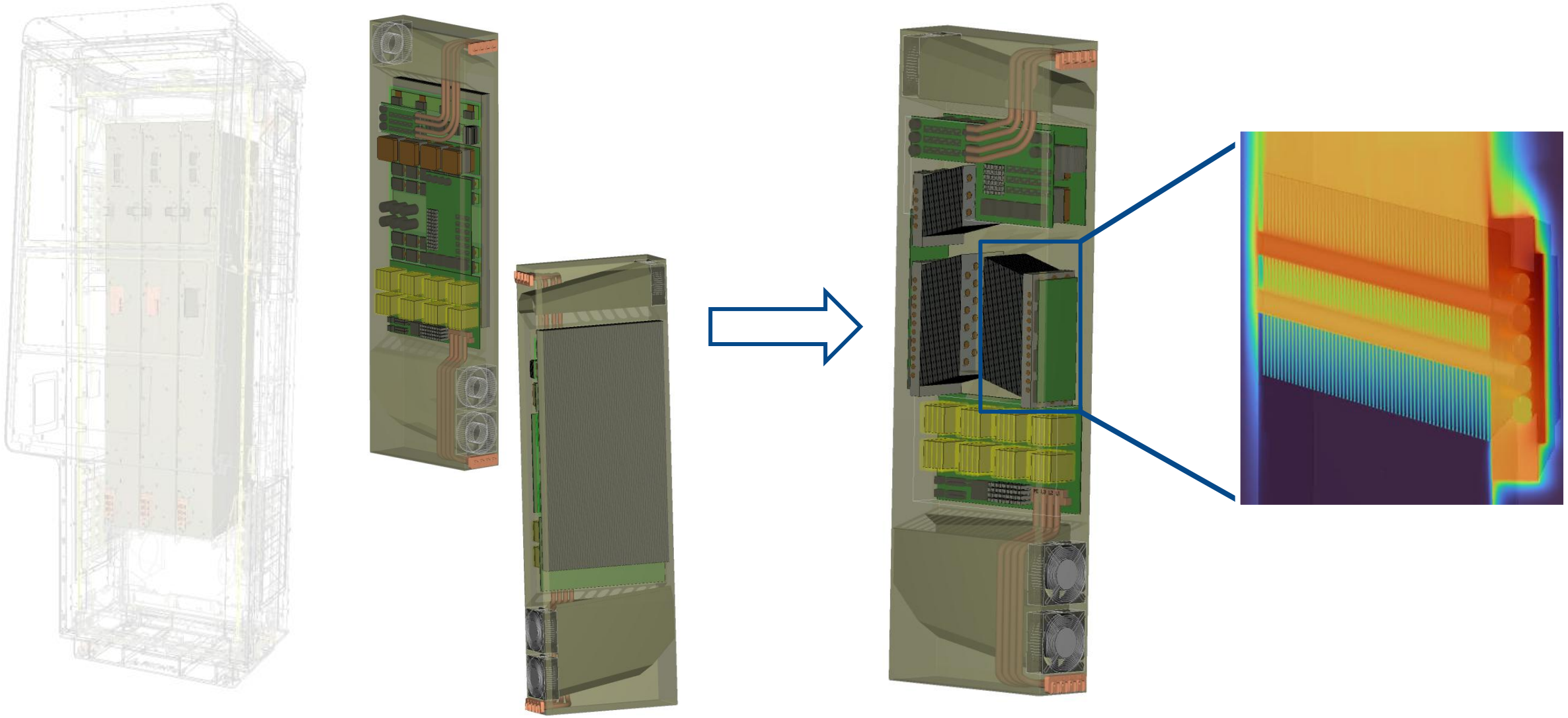
Results at this level will lead into most important design decisions for your cooling strategy



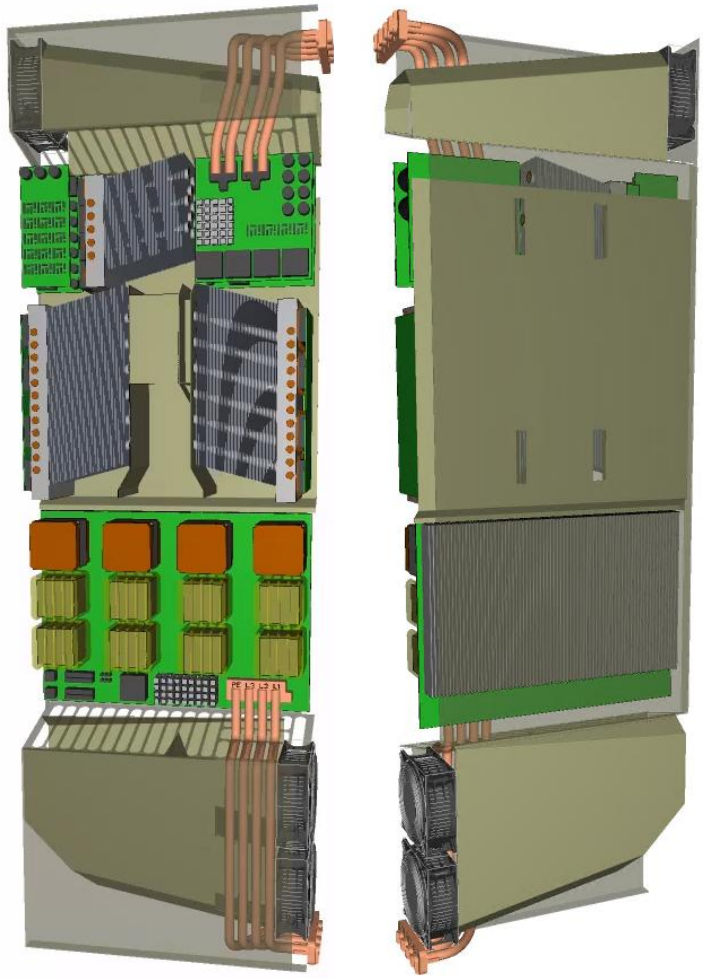


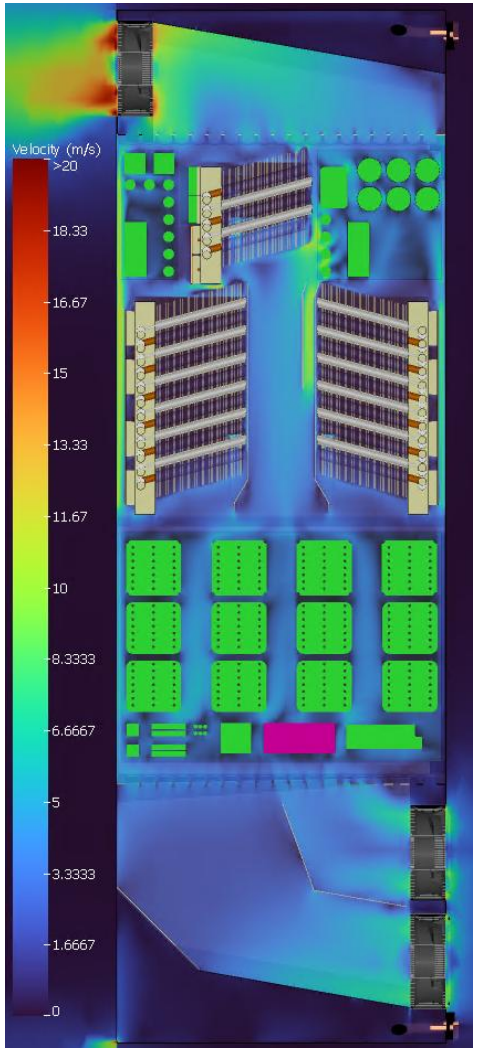


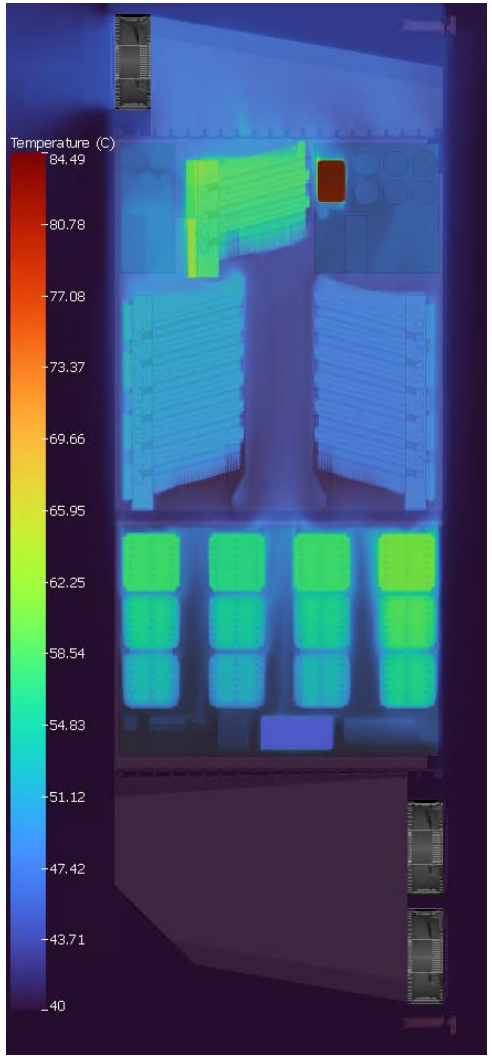
Optimisation at concept level and lift the model to engineering level



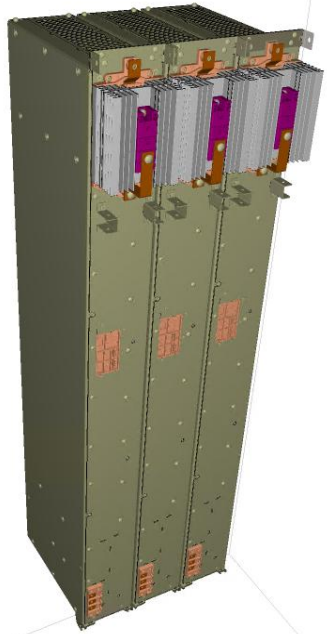
Understand the bottle necks and beat the limits

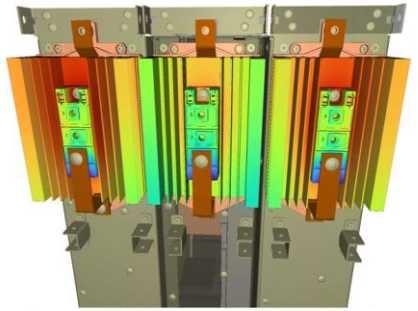


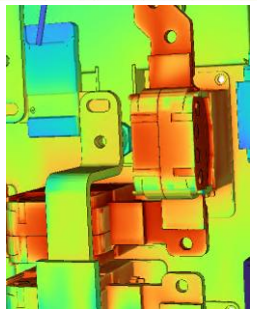


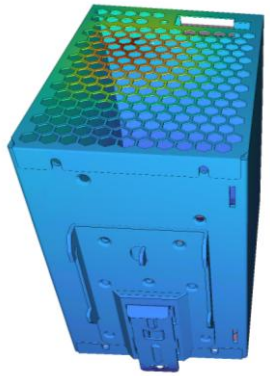


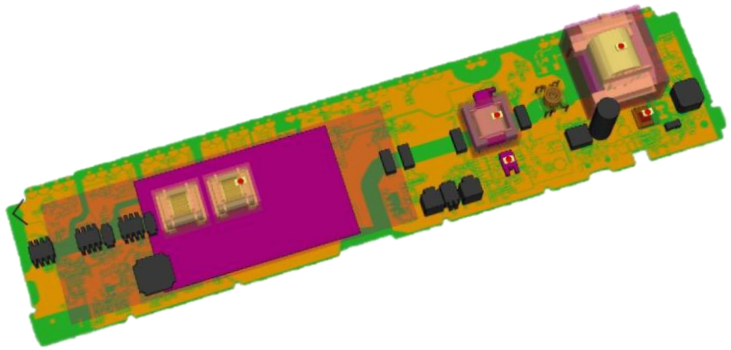
Engineering level will end into a detailed „Digital Twin“

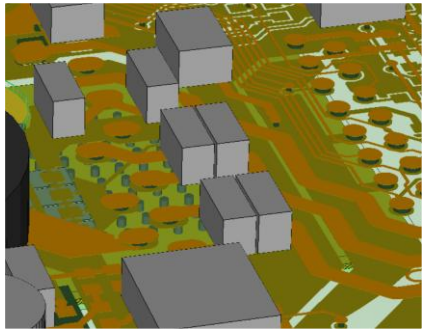






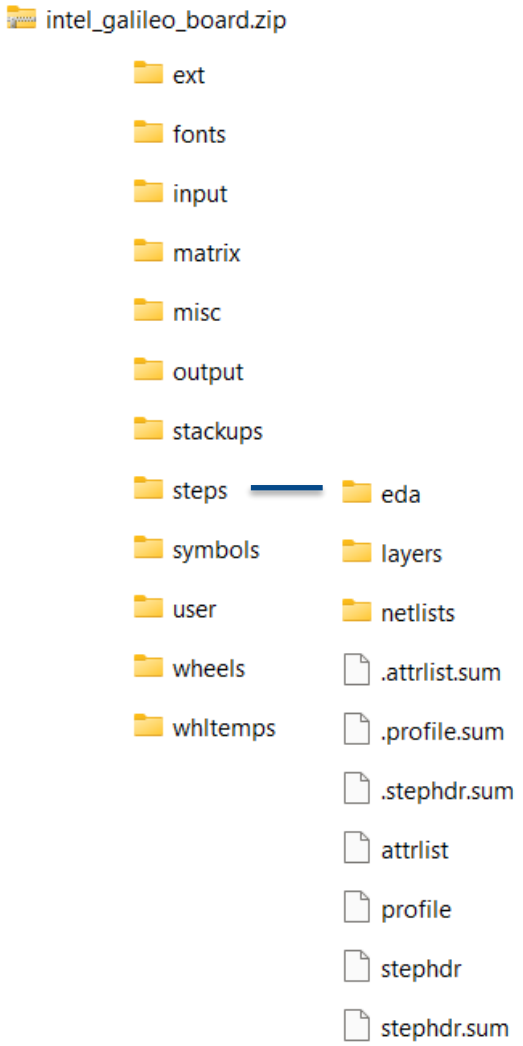


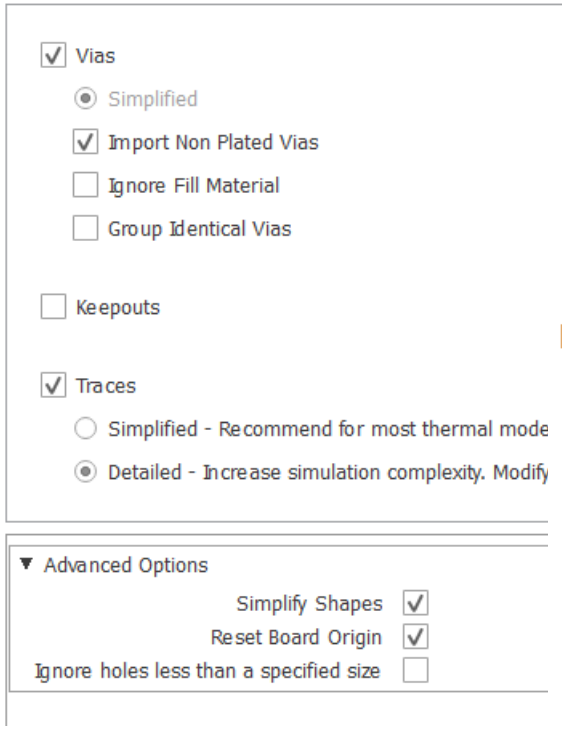




Importing „Hardware Data“ into a CFD tool could be a pain…but not for CelsiusEC

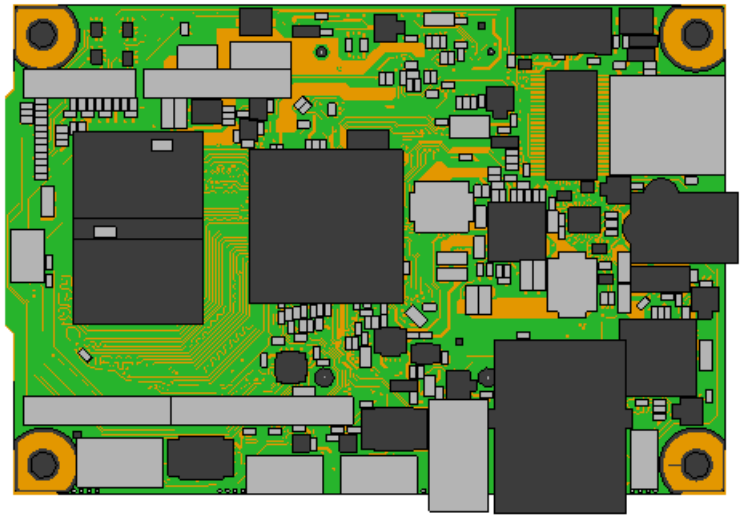
ALPHA-NUMERICS





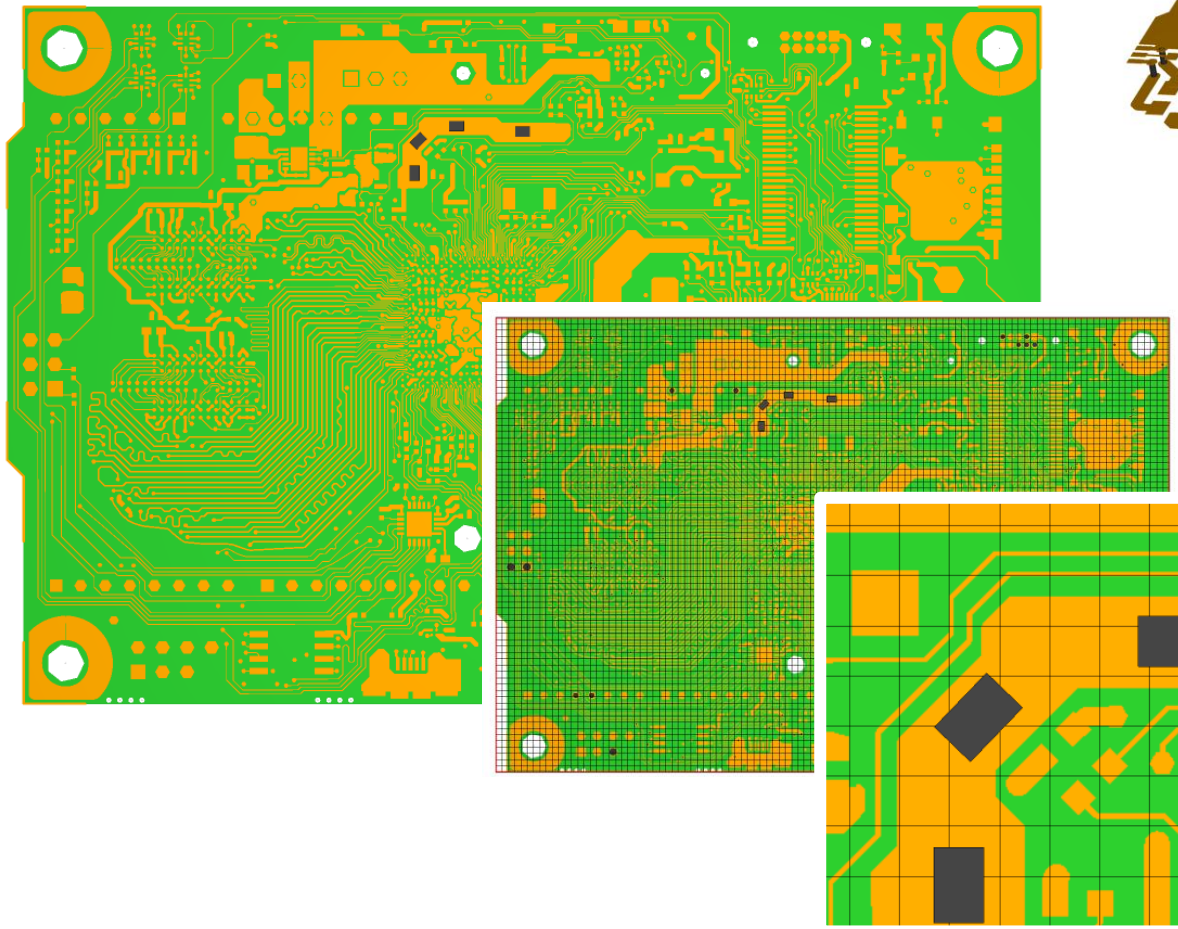
Preview

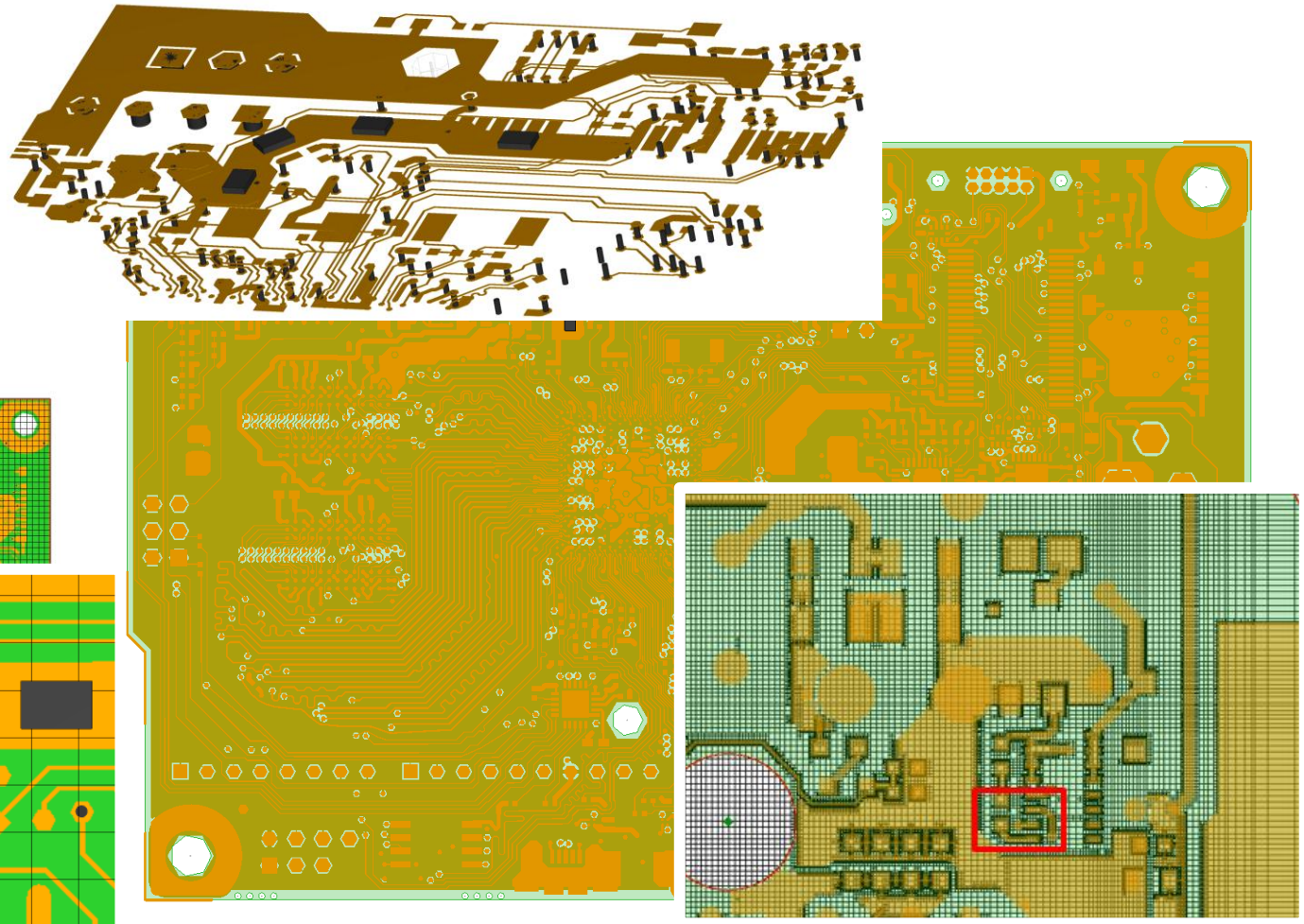
Type	Count	Filtere
Component	75	4
Resistor	240	0
Capacitor	206	0
Daughter Board Socket	14	0
Cable Socket	0	0
Via	2076	0
Traces	2366	0



The task will define the level of details you use for simulation

2 395 383 Cells (0 % to 100 % copper)

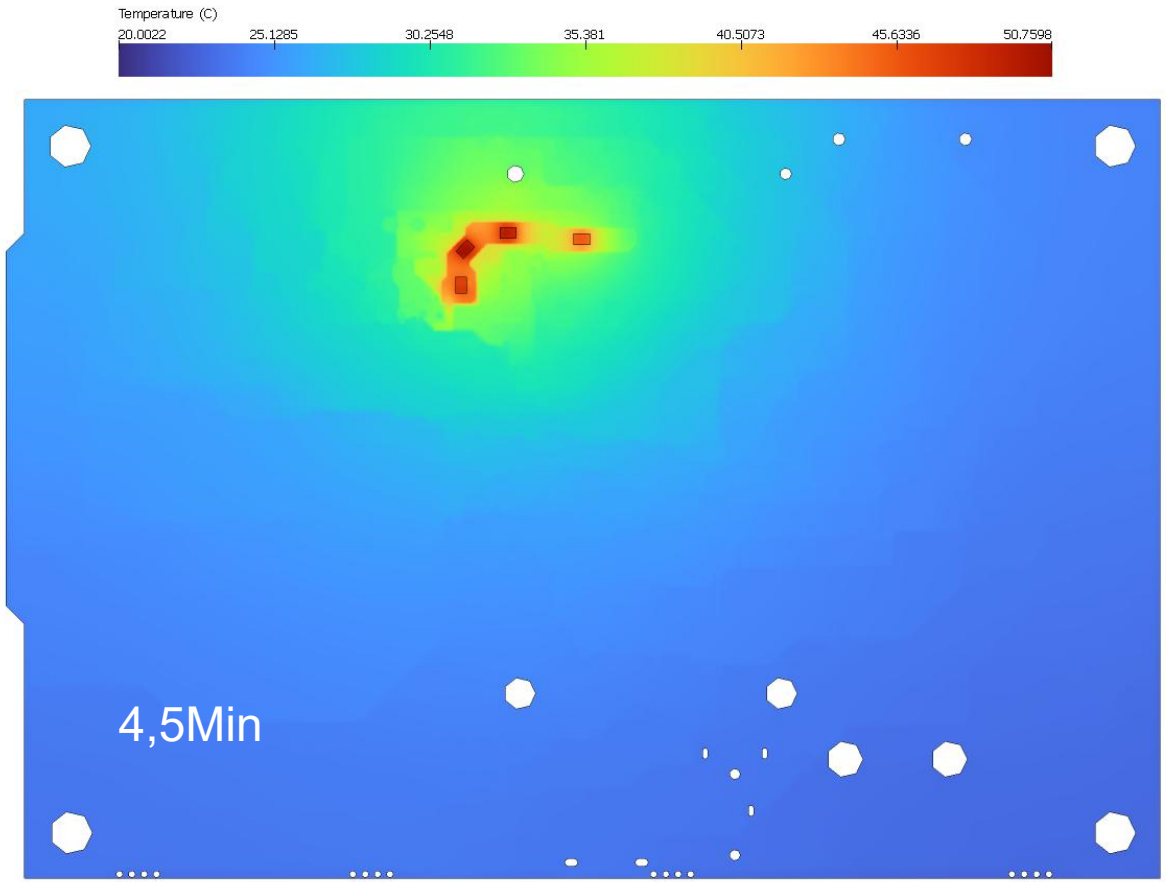


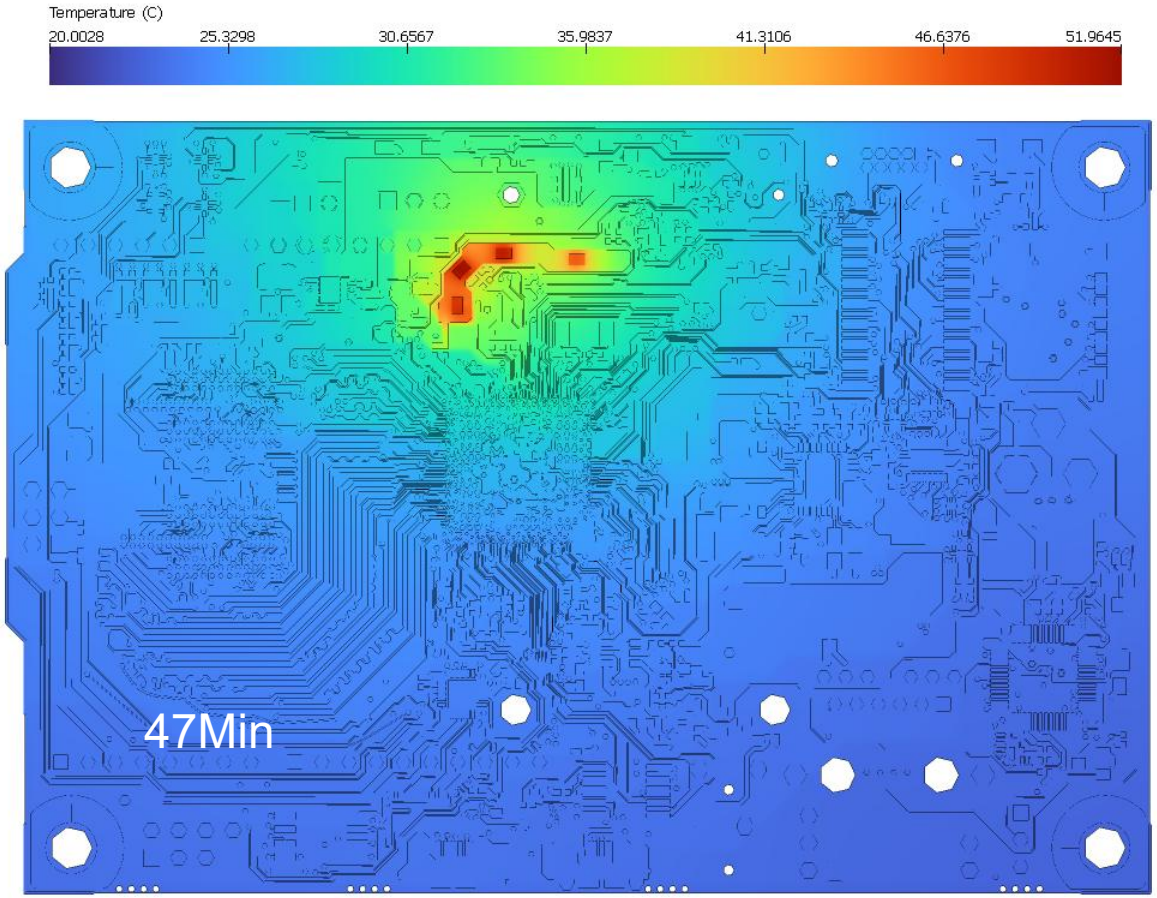


13 406 085 Cells (0 % **or** 100 % Copper)

Layout-Image-Discription can save a lot of time

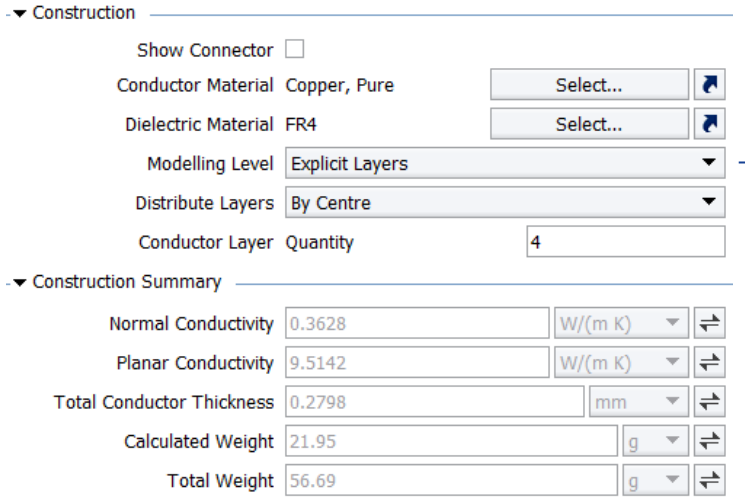
Full CFD Calculation with Heat Radiation solved on GPU

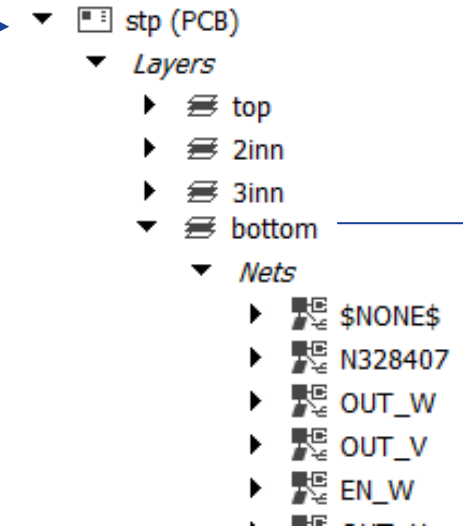


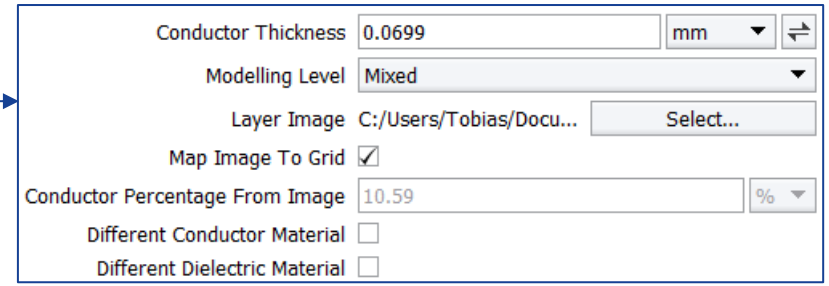


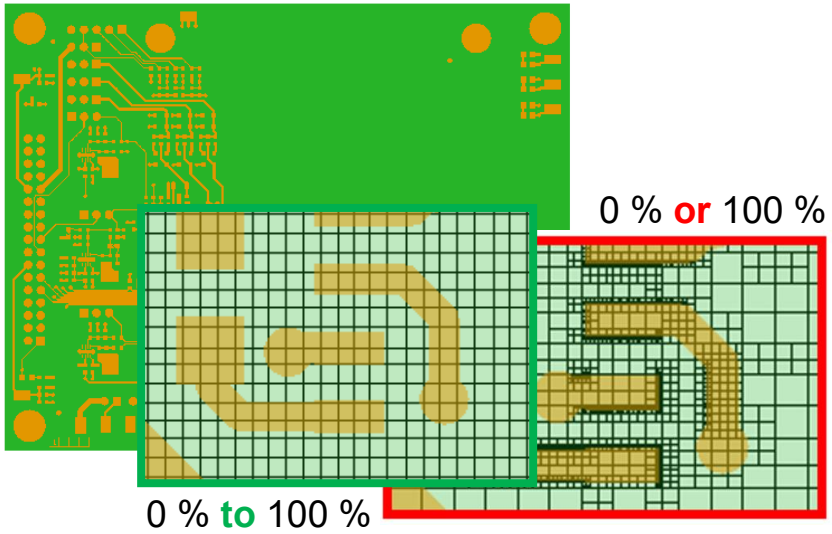
Application: High-Power-PCBs – efficient modelling can save a lot of time

ALPHA-NUMERICS









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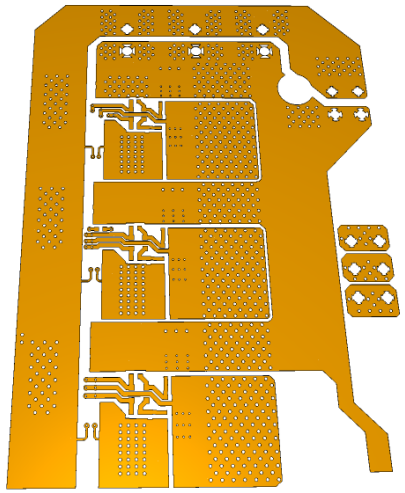

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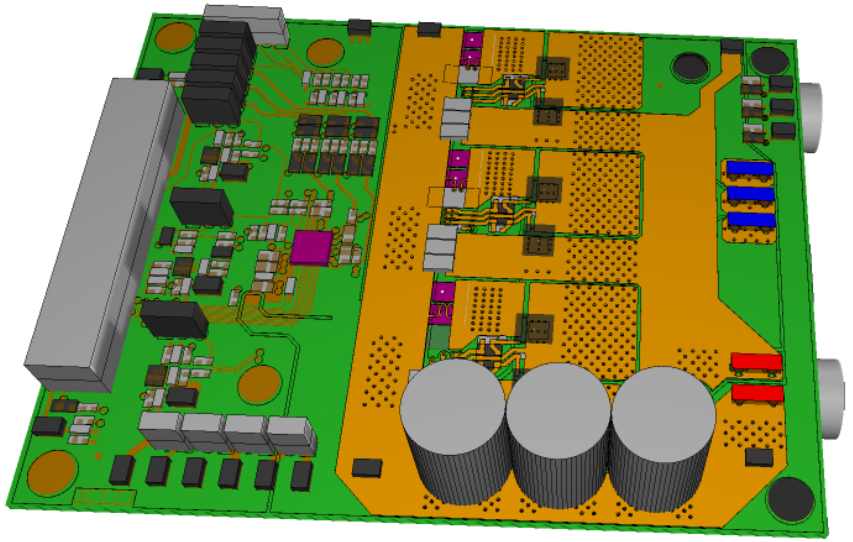
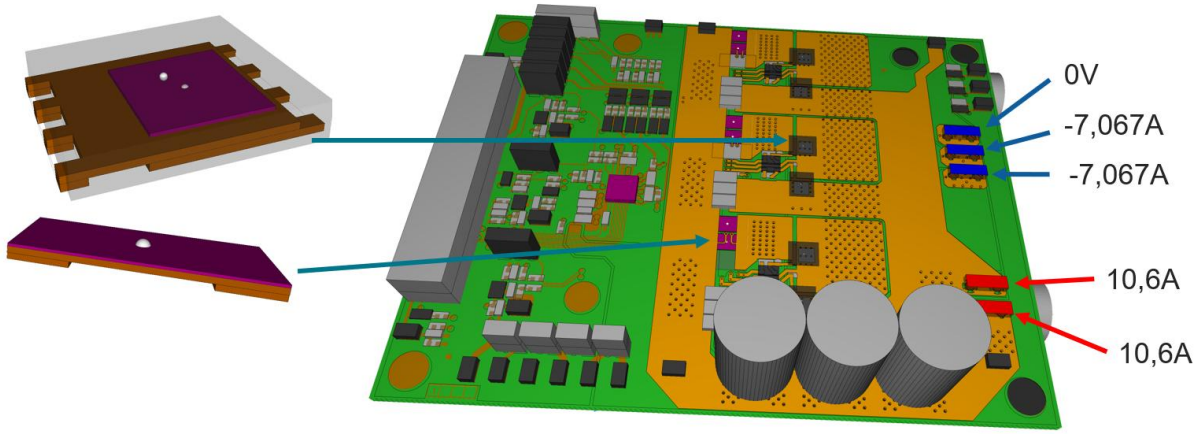
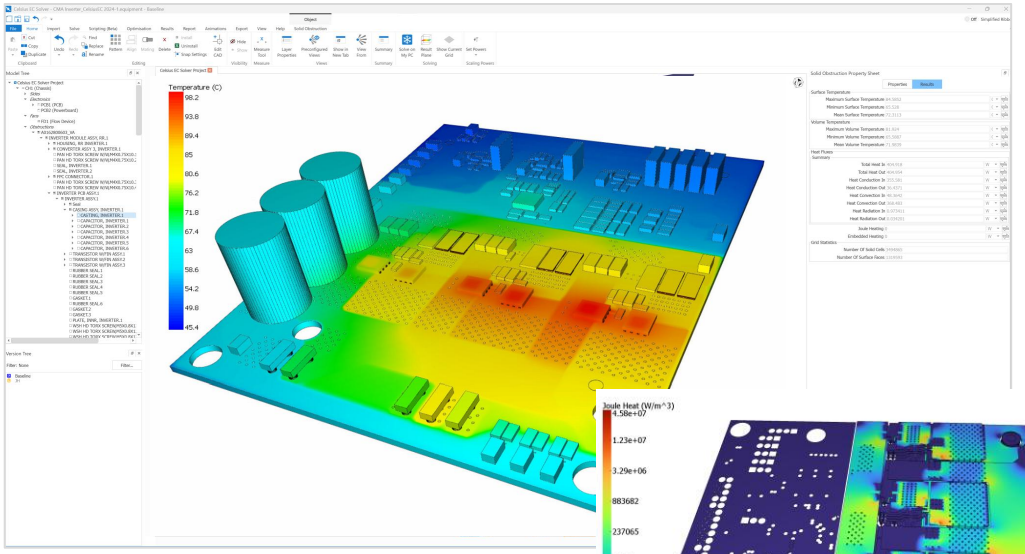
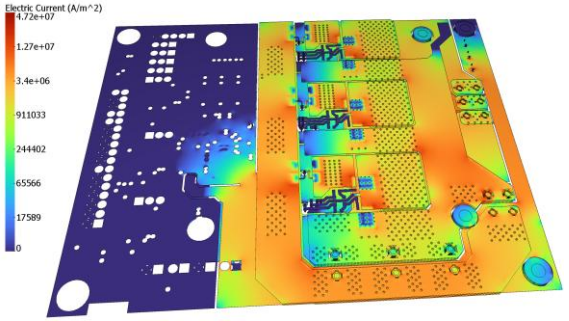
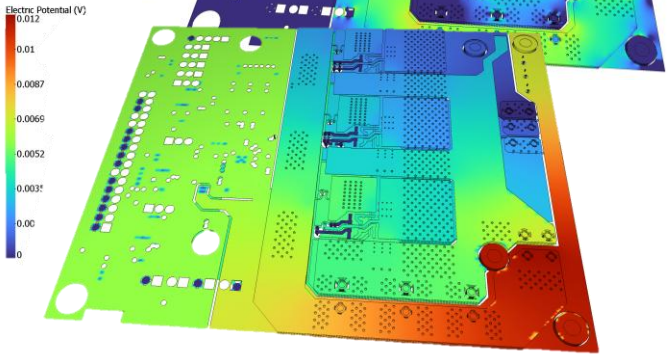


Thermo-Electrical Calculation (Joule Heating in Metall Objects)



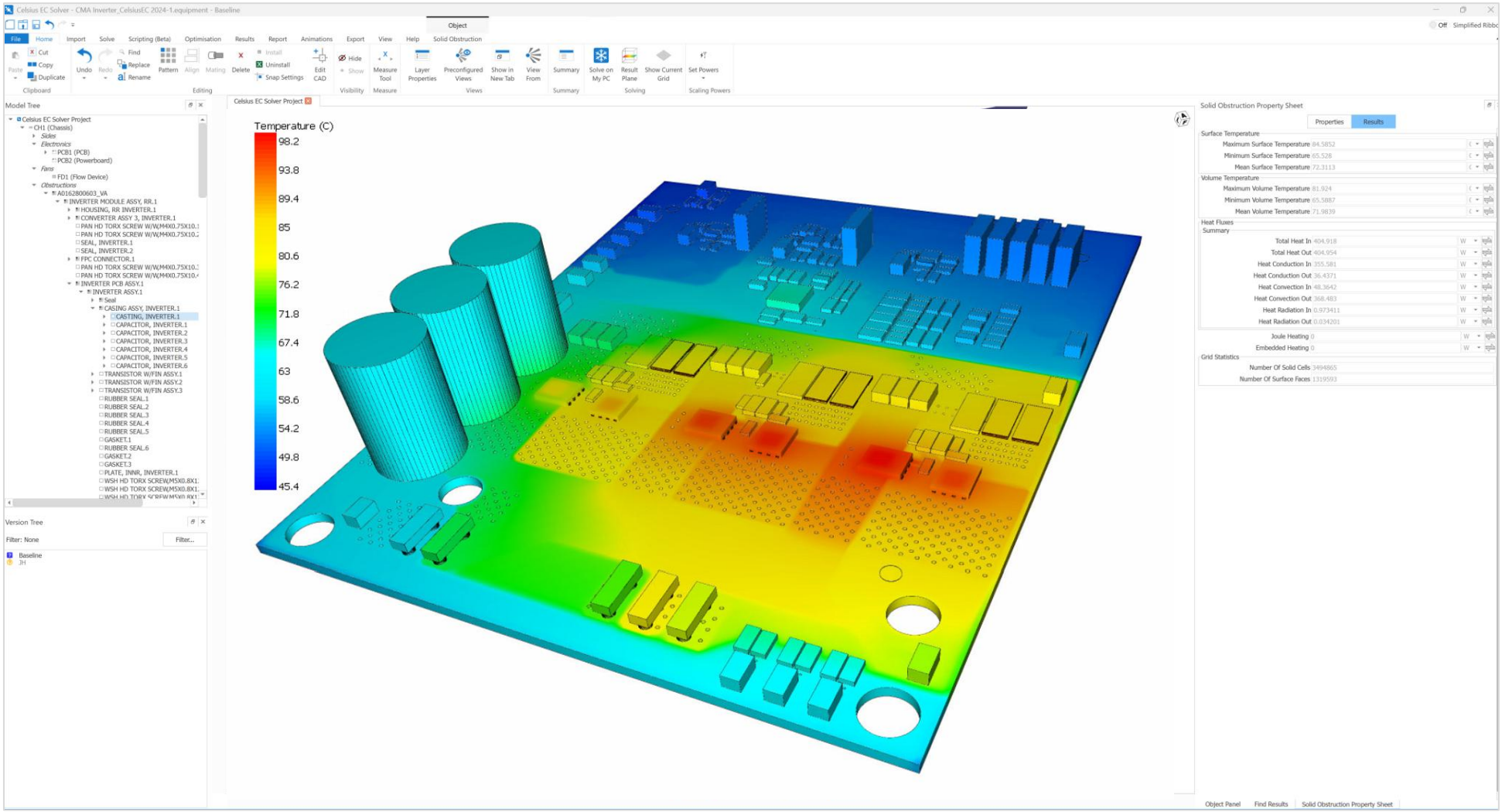




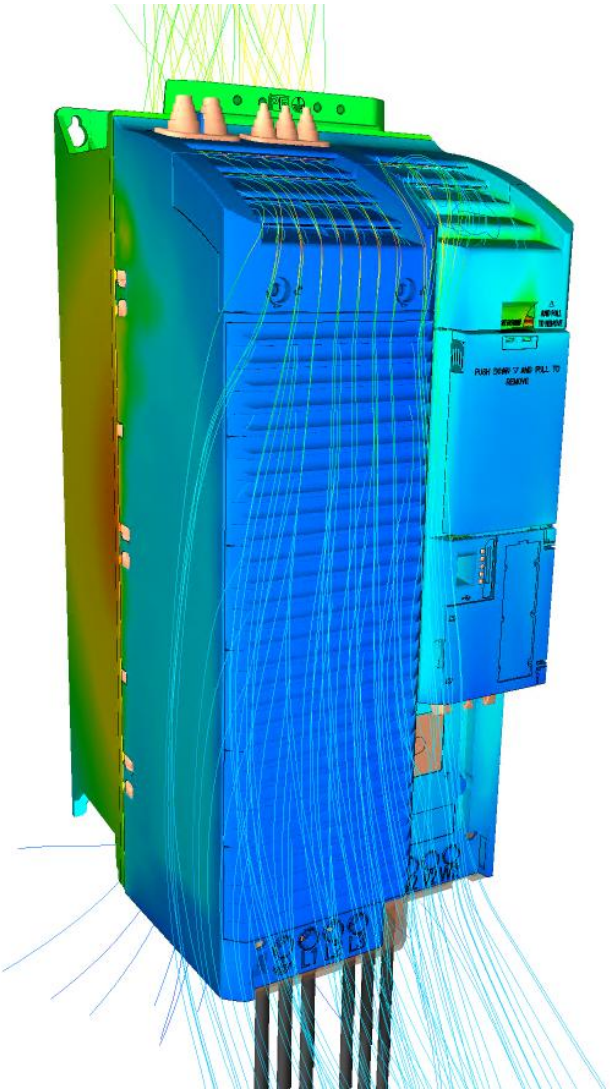


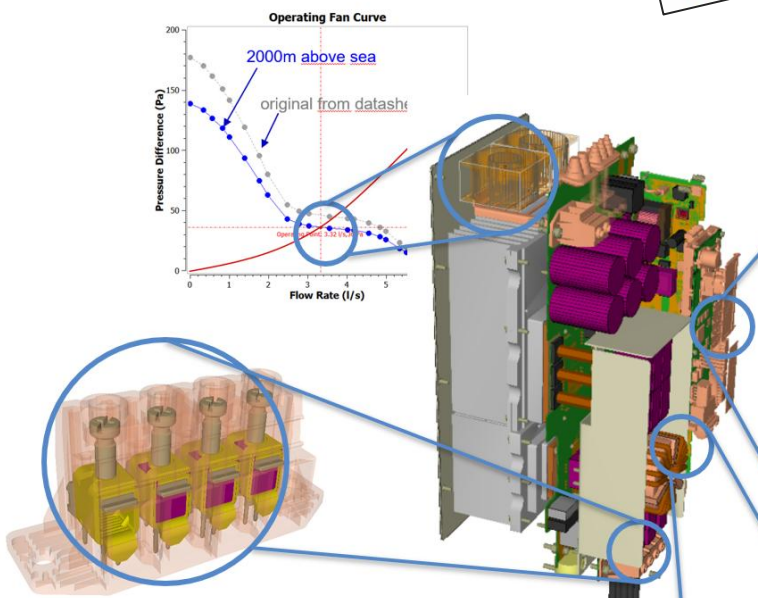
- Temperature and/or time dependant attributes
  - Power (W)
  - Electrical Sources
  - Thermal & Electrical Resistance

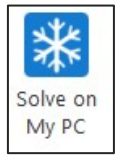
Quick Live Demo – Part 2

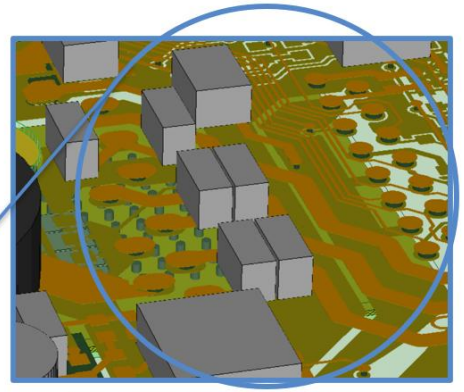


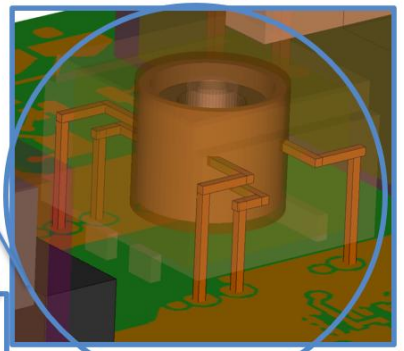
Results to support development decisions

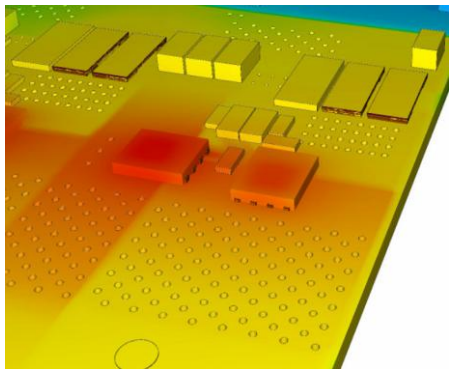




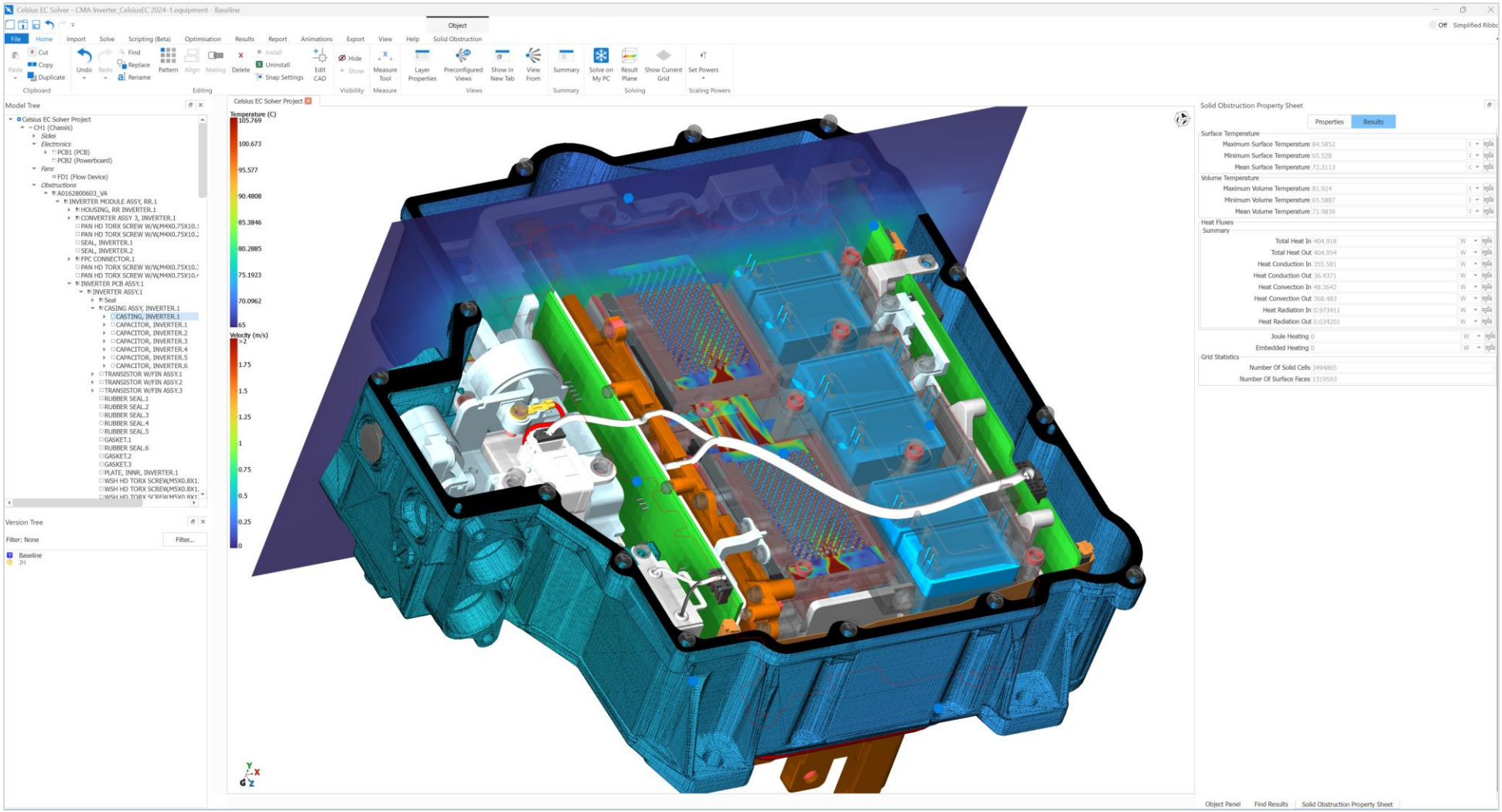








Quick Live Demo – Part 3



Thank you for your time

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