



**HEXAGON**

## **Front loading thermal design for mission critical electronics**

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# Doing more with engineering simulation



## All physics simulations in one place

Create reliable and accurate digital twins with solutions for structural simulation and analysis, fatigue, computational fluid dynamics, acoustic and NVH simulation and multiphysics co-simulation.



Cradle CFD



Actran



CAEfatigue



Dytran



MSC Nastran



Marc



MSC Apex



Patran



MSC CoSim



## Solutions for system-level insight into movement

Enable CAE-led development of complex products with reduced prototyping and enhanced collaboration.



Adams



Adams Modeler



Easy5



Romax Suite



Elements

Powered by **Nexus**



## Solutions for manufacturing process chains

Simulate metal forming, welding and joining, additive manufacturing (AM) and costing.



Simufact Forming



Simufact Welding



FTI FormingSuite



Simufact Additive



MSC Apex  
Generative Design



## Solutions for integrated computational material engineering and modelling

Add data management and artificial intelligence capabilities.



Digimat



MaterialCenter



## Solutions for design, testing, and virtual validation

Ensure safety and quality for ADAS and autonomous vehicle systems.\_



Virtual Test Drive

## Simulation Governance



SimManager



MaterialCenter

## Artificial Intelligence & Machine Learning



ODYSSEE

nexus



# New challenges in thermal management



## Complexity (Geometry & Physics)

- As devices become more powerful, systems are becoming more complex.
- Extreme operating environment
- Increases the amount of heat generated, Virtual Prototyping is essential for achieving heat dissipation goals with efficient cooling.



## New Design & Manufacturing Techniques

- Traditional methods achieve limited performance
- To go beyond, you need to think out of the box with new approaches and workflows



## Extended Design Space

- To conduct multiple design proposals and optimization simulations, more computational resources and easily accessible components and models are needed



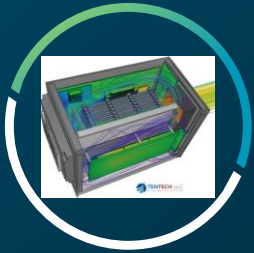
## Sustainability

- Smart Thermal Management enhances energy efficiency and minimizes environmental impact.
- It is necessary to achieve both a comfortable environment and efficient energy consumption.



# Design & regulatory requirements

## Mission critical electronics



### Avionics

- Wide operating temperature range
- High altitude conditions
- Sealed enclosures
- Compliance with standards like RTCA DO-160, MIL-STD-810, VITA



### Automotive

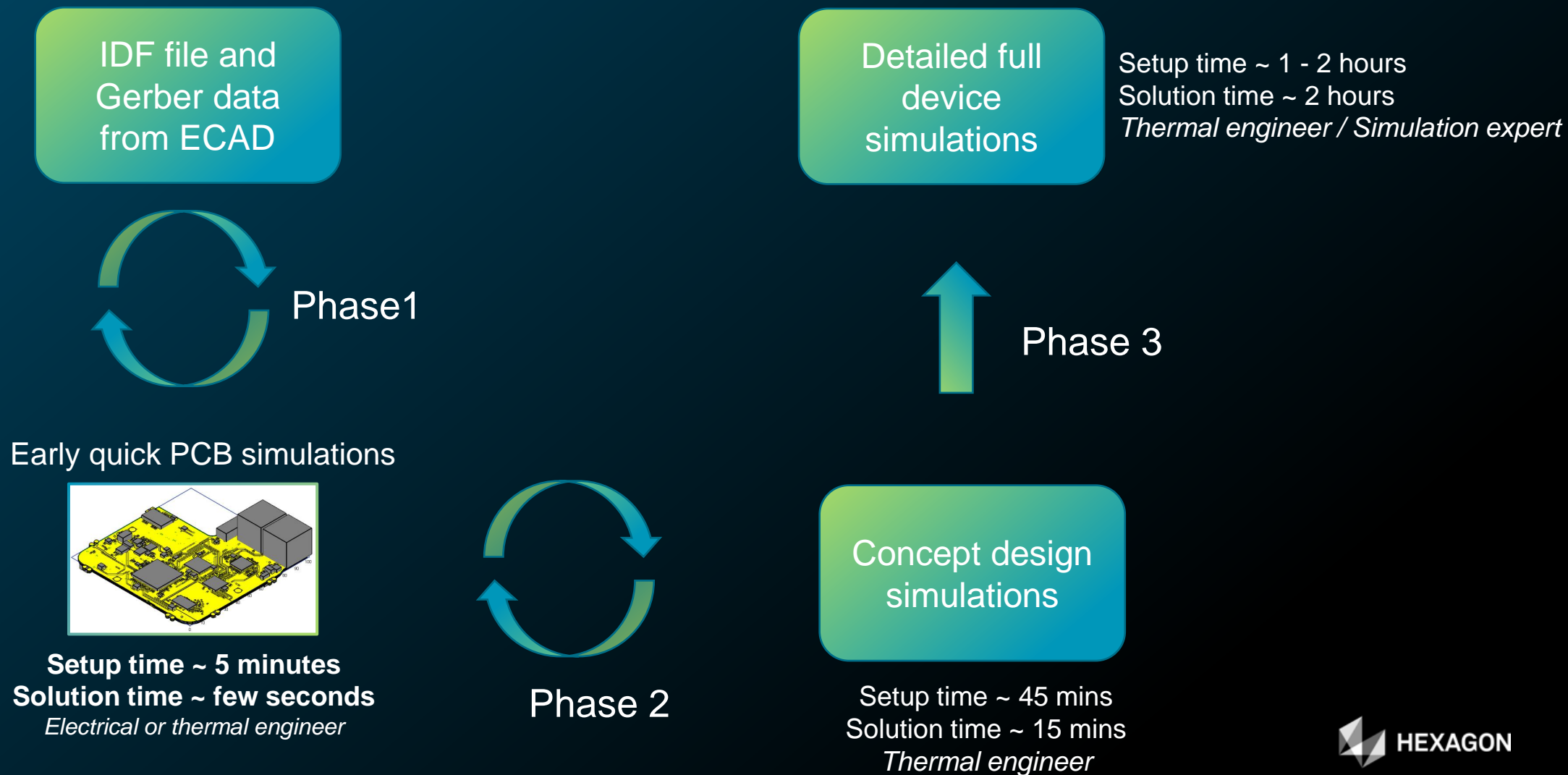
- Wide operating temperature range
- Cyclic thermal stress & resistance to environmental stress
- System level integration
- Reliability standards like AEC-Q100



### Medical Devices

- End user considerations
- Redundant systems for life sustaining devices
- Material biocompatibility
- Touchable surface temperature limit (IEC 60601)
- Ingress protection

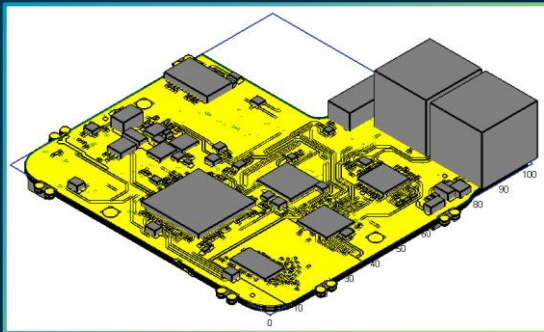
# Front loading electronics thermal design



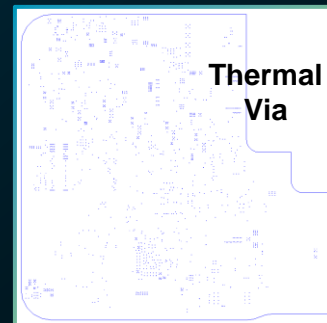
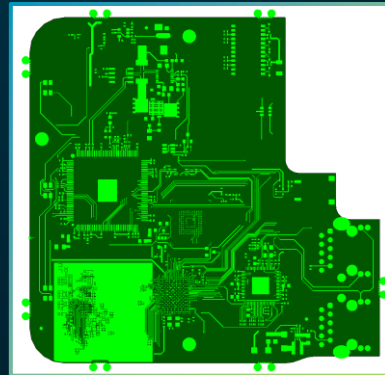
# Phase 1 – PCB thermal analysis

- PCB simulations performed run using PICLS to identify the hot spots
- Quickly explore board layout and temperature distribution
- Import ECAD data of board, components, wiring and thermal via
- Simplified enclosure and heat sink models
- **Model setup & solution takes 5 to 6 minutes**

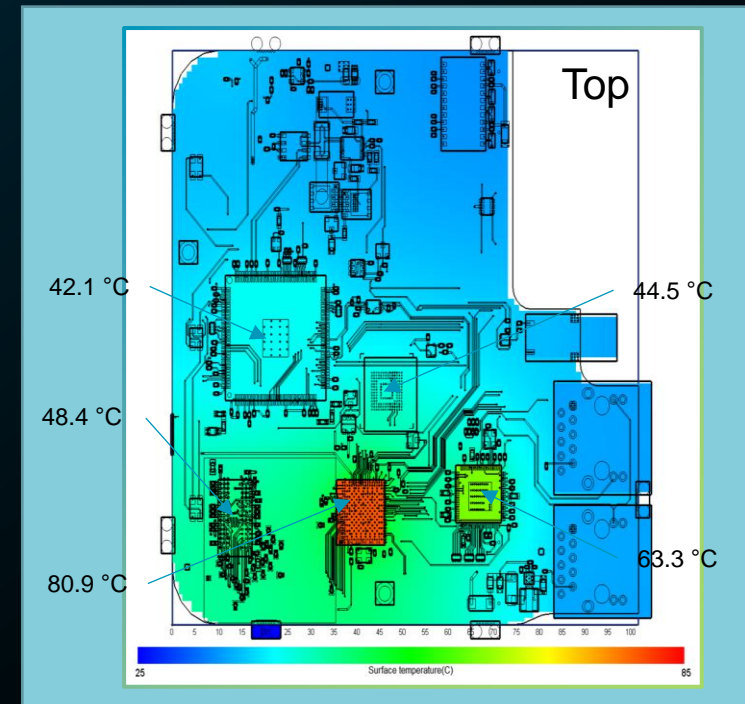
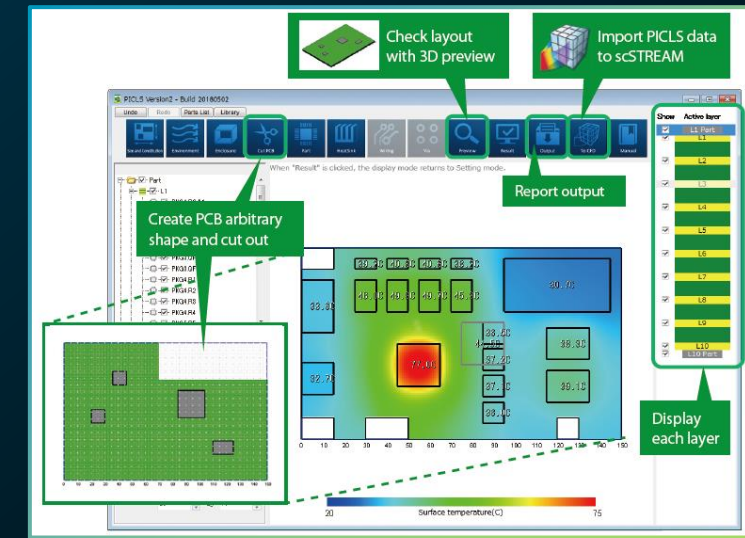
Hexagon Metrology PCB



Board & Component Geometry



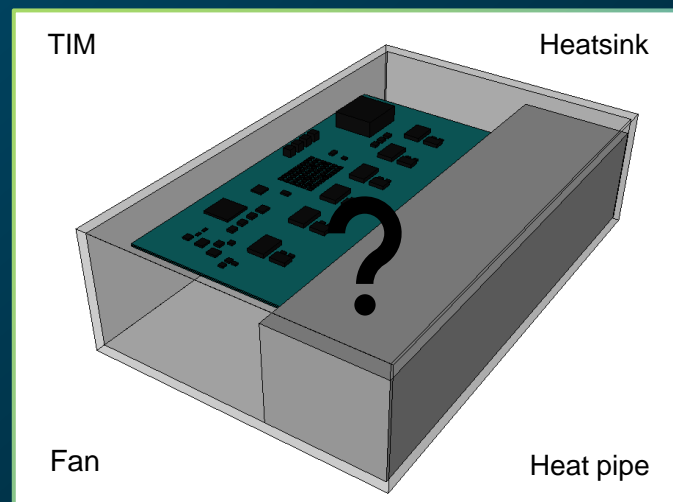
Thermal Via



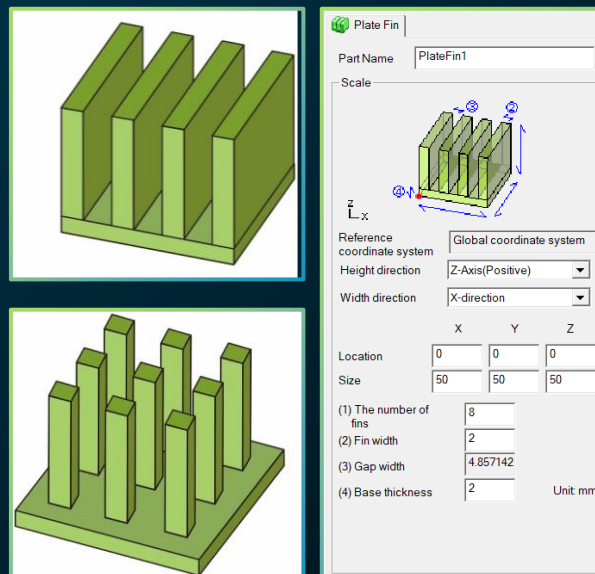


# Phase 2 – Verify device design concepts

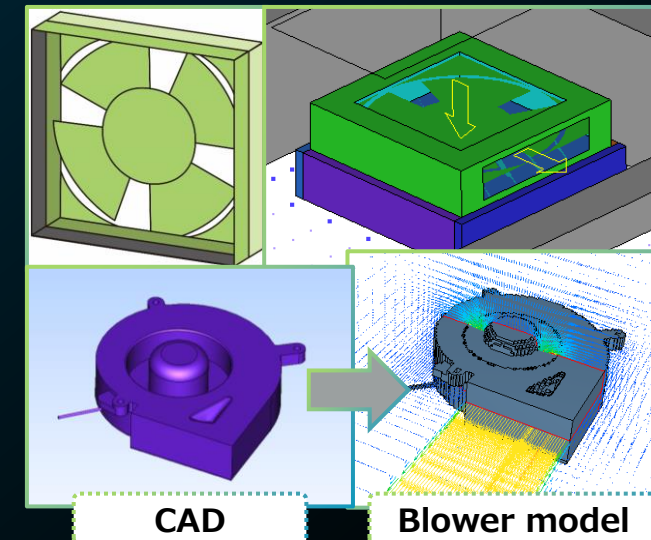
Rapid thermal simulations using built-in model components



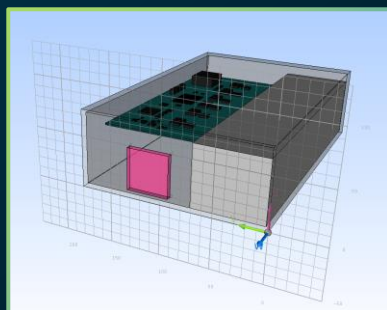
## Heatsink model



## Fan model



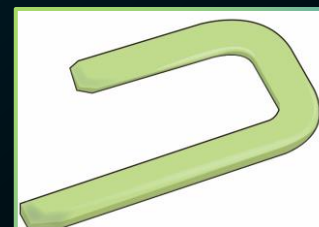
## Housing creation



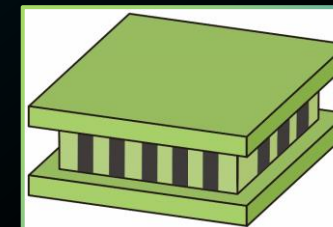
## Primitives



## Heat pipe model



## TEC model

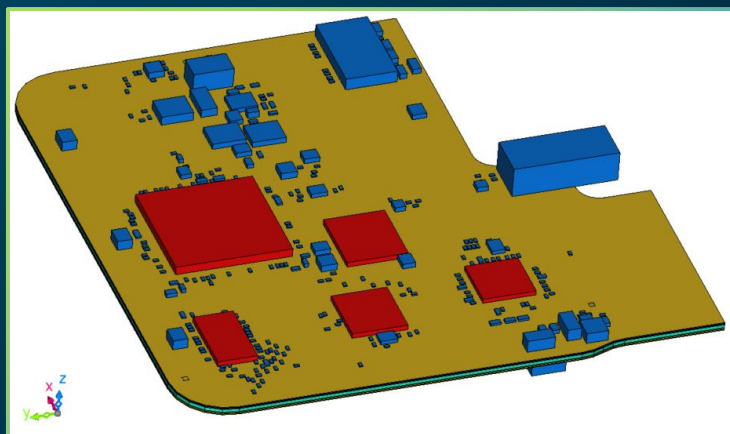




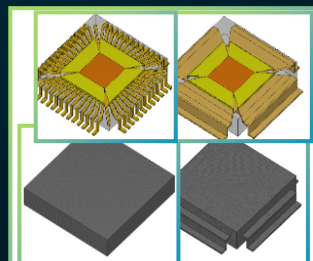


# Phase 3 – Validate detailed device design

Efficient simulations based on ECAD & MCAD data

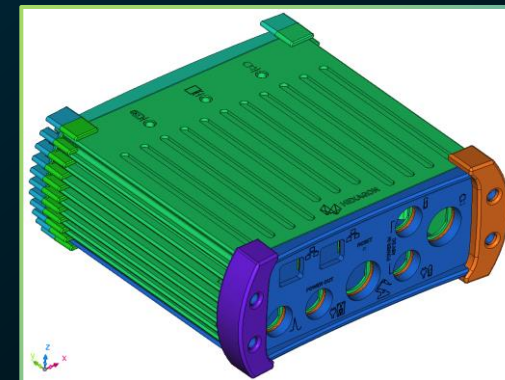
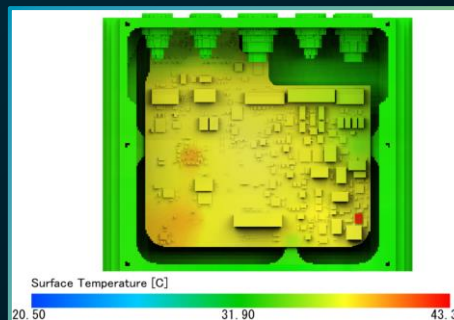


IDF  
Gerber  
PICLS

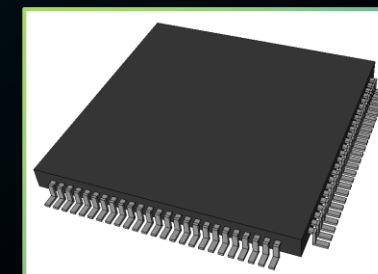


## ElectronicPartsMaker (IC chips)

- Detailed model
- Simplified model
- Thermal circuit models



MCADs native  
Parasolid  
Step  
IGES



EPM  
ECXML





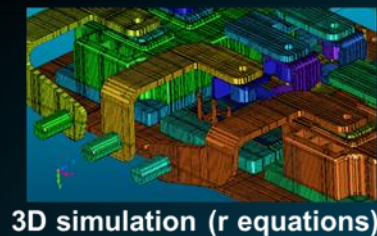


# Making advanced thermal simulation practical

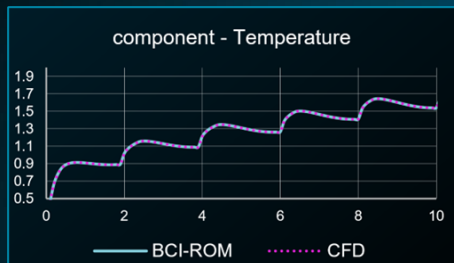
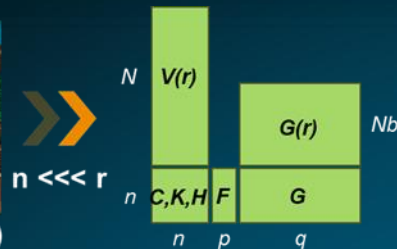
## Compact models and TPMS lattice structures

### BCI - ROM

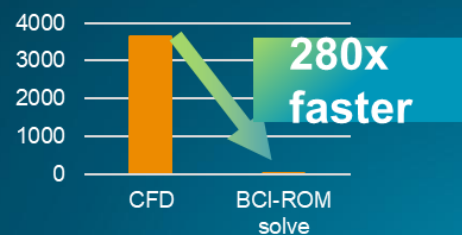
- Boundary Condition Independent ROM
- Low-dimensional model independent of boundary conditions
- Enables long-duration system analysis
- Share models without compromising IP



3D simulation ( $r$  equations)

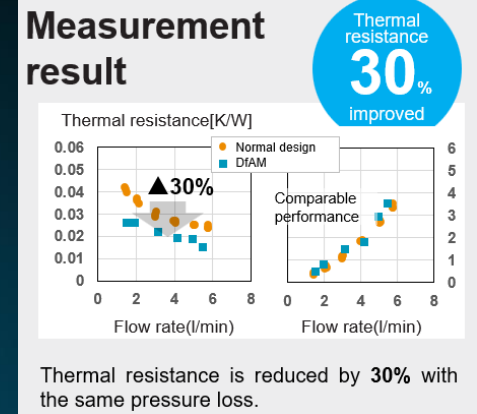
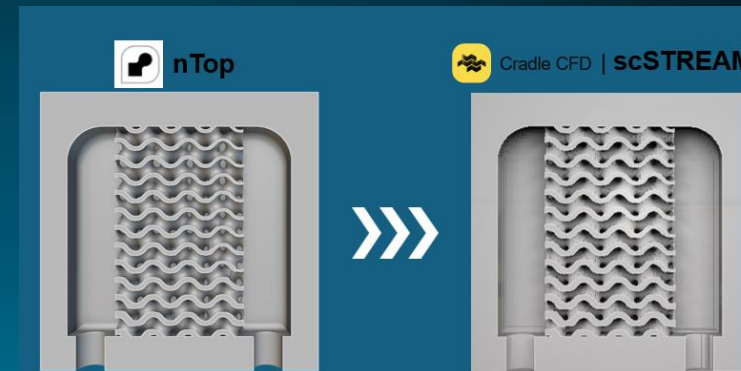


Solver time[s]



### TPMS lattice structure workflow

- TPMS lattice structure heat sinks provide high cooling performance
- New workflow to directly read implicit geometry from nTop. No lengthy & painful STL conversion
- 1000x faster geometry transfer process!



# Thank you



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## Connect

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