2023
台灣 Simcenter
用戶大會

2023 Taiwan Simcenter
User Conference

2023 NOV 17

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Ingenuity for life

Agenda

時間	議程	主講人
08:30 - 09:00	Registration / Welcome Coffee	
09:00 - 09:15	Welcome Speech	簡志明 執行長 易富迪科技股份有限公司 郭一龍 總經理 大塚資訊科技股份有限公司
09:15 - 09:25	西門子智慧製造創新技術	陳晧璋 總經理 台灣西門子軟體工業股份有限公司
09:25 - 10:10	Simcenter Flotherm Flexx v2304 / v2310 功能介紹	Voon Hon Wong, PhD. Siemens Industry Software Pte. Ltd.
10:10 - 10:30	Simcenter STAR-CCM+ v2306 最新版功能介紹	卞志堅 資深顧問 台灣西門子軟體工業股份有限公司
10:30 - 10:55	Coffee Break	
10:55 - 11:20	System Thermal Design Process Sharing	劉立崗 博士 易富迪科技股份有限公司
11:20- 11:45	Numerical analysis and optimization of multiple blade modules	鄭偉隆 副理 微星科技股份有限公司
11:45 - 12:10	Wireless product thermal design	徐輔鴻 經理 明泰科技股份有限公司
12:10 - 13:10	Lunch	
13:10 - 13:35	淺談 FloEFD 於智能居家產品設計到生產應用	黃仁傑 智聯網開發部副理 沅聖科技股份有限公司
13:35 - 14:05	掛載拋投之CFD模擬 & 穀帽鰭設計分析技術建立	飛彈火箭研究所氣動力學組 國家中山科學研究院
14:05 - 14:30	電動車集成式熱管理	戴嘉慧 科長 鴻華先進科技股份有限公司
14:30 - 15:00	Tea break	
15:00 - 15:25	Simcenter MicReD 解決方案的規劃及發展	許欽淳 博士 台灣西門子軟體工業股份有限公司
15:25 - 15:50	T3Ster量測案例分享	曾嘉玲 主任工程師 易富迪科技股份有限公司
15:50 - 16:00	Lucky draw and closing	
16:00 - 17:00	全新熱特性量測實驗室參訪介紹	蔡杰修 資深顧問 易富迪科技股份有限公司

易富迪科技聯絡方式：

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軟體使用問題：CSD@efd.com.tw

Simcenter Flotherm Flexx v2304 / v2310 功能介紹

Voon Hon Wong, PhD.
Siemens Industry Software Pte. Ltd.

Introduction and reminder

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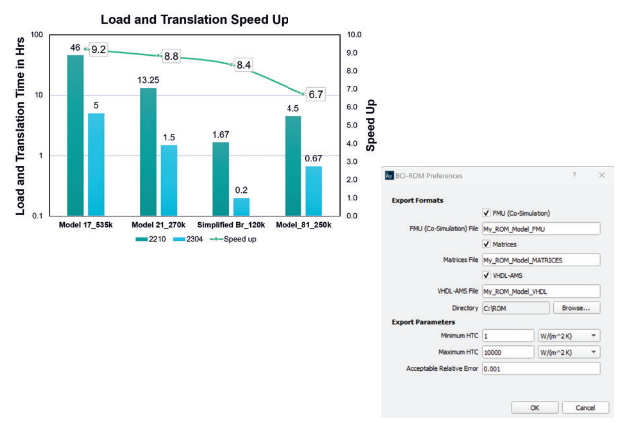
Simcenter Flotherm Flexx Release schedule

Two releases at six month intervals delivering constant stream of new features and enhancements

Simcenter Flotherm 2304 features



10x speed up of pre-processing

- Models with 100,000+ objects takes longer to prepare compared to solution time
- New translator

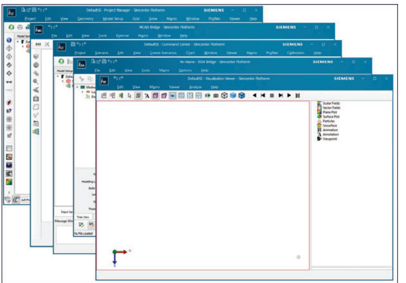
BCI-ROM Export – single calculation for all export formats

Updated MCAD Bridge

- Supports Siemens CAD formats (NX, Solidedge), Parasolid
- Voxelization supported on multiple cores
- New Part number

Updated Siemens UI

Voxelize Speed	3 Rays	1 Ray
MCAD Bridge 2304	2m 28s	46s
MCAD Bridge 2210	N/A	2h 20m 54s



Simcenter Flotherm XT 2304 features

EDA Bridge – **Independent Thermal Territories**

- Need not be linked to a component on the board

EDA Bridge – **Improved Stack Up Editor**

- Multi-select
- Double click to edit
- Local units update

SmartPCB update

- Improved performance: user controlled auto update for node calculations. User controlled net outline display. Min. node size displayed.
- Joule heating – Hyperlynx PI co-simulation: Auto detection of powered nets. Joule heat Global Goal created automatically.

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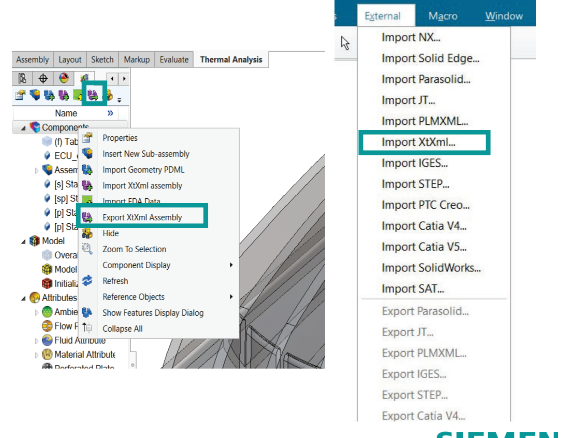
Simcenter Flotherm XT 2304 features

Parametric Study Update – Network Assembly attached thermal attributes can be varied.

Model Interoperability – transfer of Flotherm XT models to Flotherm using XtXml format

- Supports Smartparts
- But project data not yet supported (assembly information only)
- Make use of MCAD Bridge to read in XtXml files



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Simcenter Flotherm 2310

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Agenda

Embeddable BCI-ROM
Library Interaction of Power Maps
Siemens UX updates
Documentation updates

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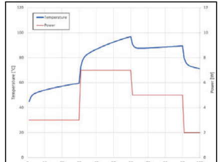
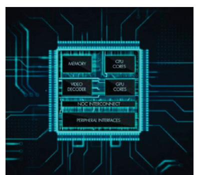
Embeddable BCI-ROM

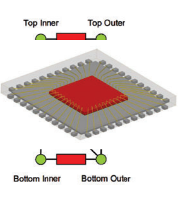
Embeddable BCI-ROMs as IC Package Compact Models

Challenge: Detailed thermal models of IC packages expose sensitive intellectual property, while standardized compact models do not support transient simulations or multiple heat sources.

Thermal Model Supply Chain Options







BCI ROM

Model	BCI?	Transient?	Multiple Heat Sources?	IP Protected?

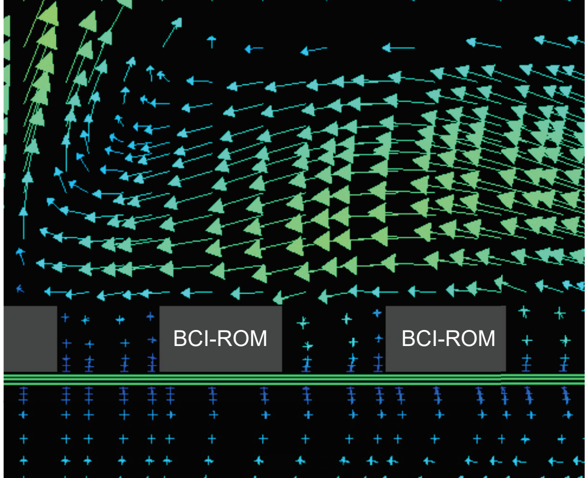
Embeddable BCI-ROMs as IC Package Compact Models

Embeddable BCI-ROMs included as a component in full 3D CFD models is the ideal solution

Boundary Condition Independent
Multiple Heat Sources
Steady State or Transient

Lightweight
Impossible to Reverse Engineer

Accuracy Similar to DELPHI models (+/- 5%)



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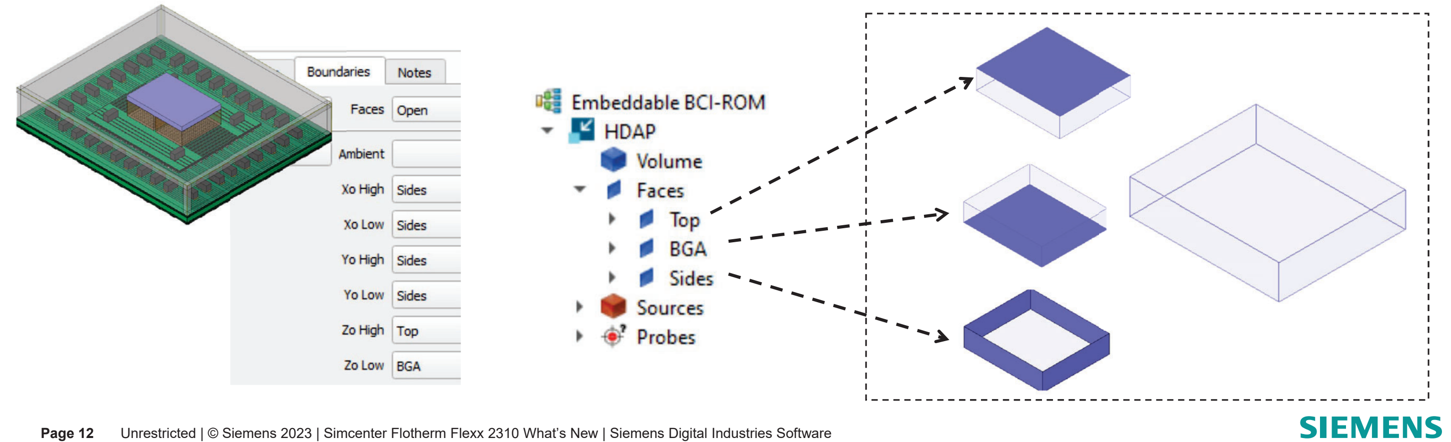
Embeddable BCI-ROMs : Author Workflow

Workflow:

- Create detailed model of device using modeling best practices
- Ensure grid independence
- Attach ambient attributes to domain faces with meaningful names. The consumer of the embeddable BCI-ROM will use these as references to position the device.



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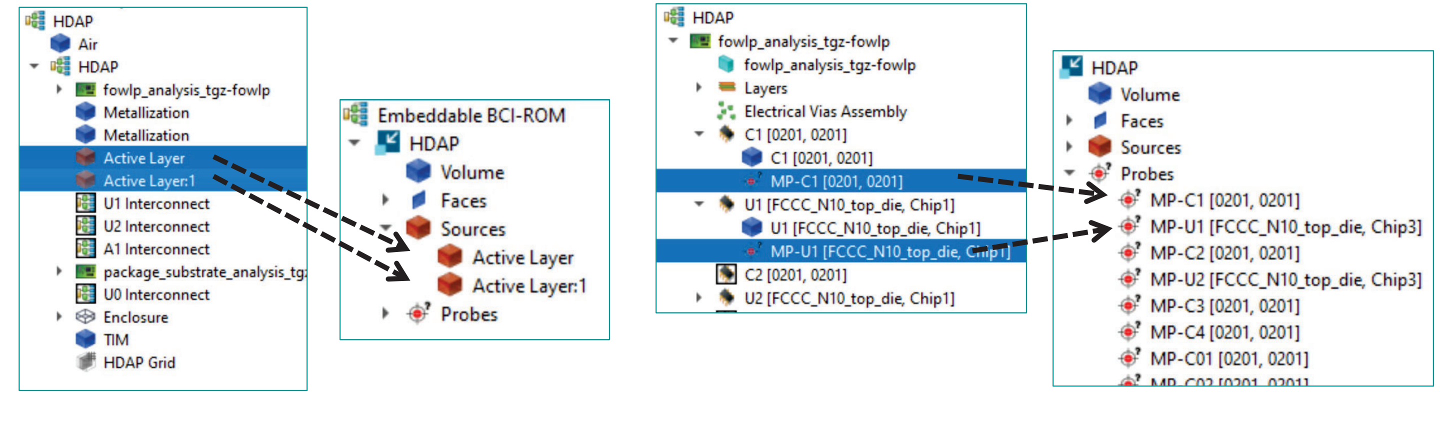
Embeddable BCI-ROMs : Author Workflow

Workflow:

- Assign meaningful names to the heat sources and monitor points.
- The consumer of the embeddable BCI-ROM will use these names to interact with the model.



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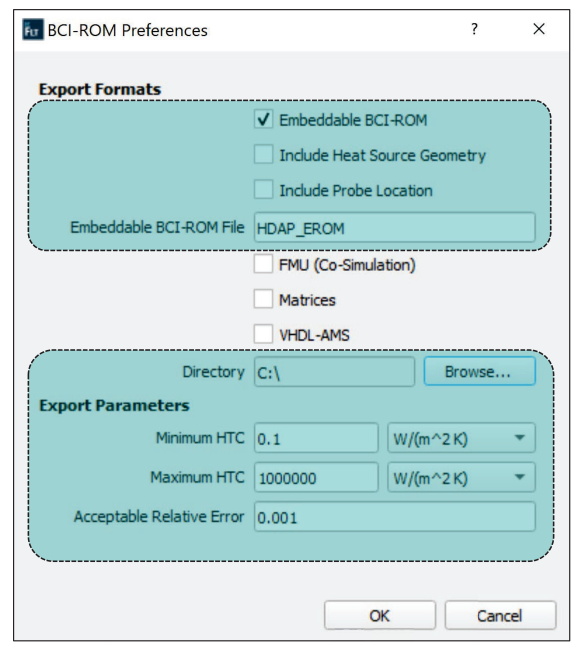
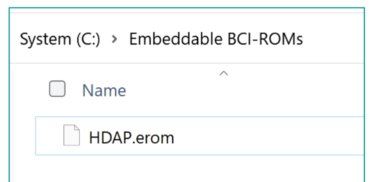
Embeddable BCI-ROMs : Author Workflow

Workflow:

- Extract the embeddable BCI-ROM
  - Include Heat Source Geometry *[optional]*
  - Include Probe Location *[optional]*
  - These optional settings do not impact results! They may be useful as additional positioning aides for the embeddable BCI-ROM consumer.
  - HTC Range: Large enough to cover all deployment scenarios: Recommended:
    - 0.1 to 1,000,000 W/m^{2}K
    - Acceptable Relative Error:
      - Default of 0.001 is usually a good balance between extraction speed and accuracy

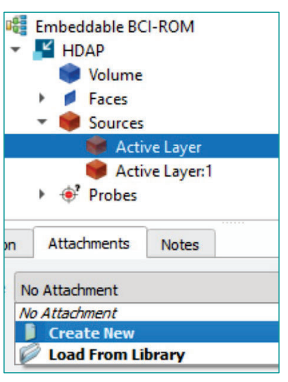


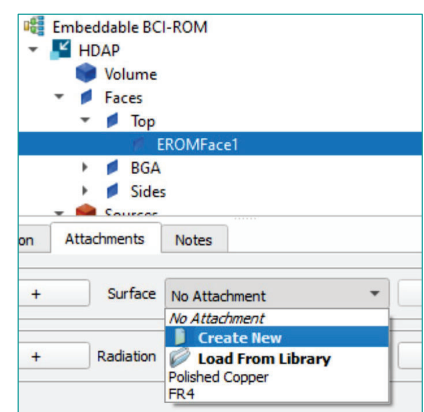
Embeddable BCI-ROMs : Author Workflow



Workflow:

- Extraction process will create a file with an .erom extension.





- Prepare model for distribution:
- Select target assembly
- Use the embeddable BCI-ROM option in the geometry palette:
- Find the desired .erom file

- Add attributes:
  - Heat Source attributes
  - Surface attributes to set emissivity/color
  - Grid constraints

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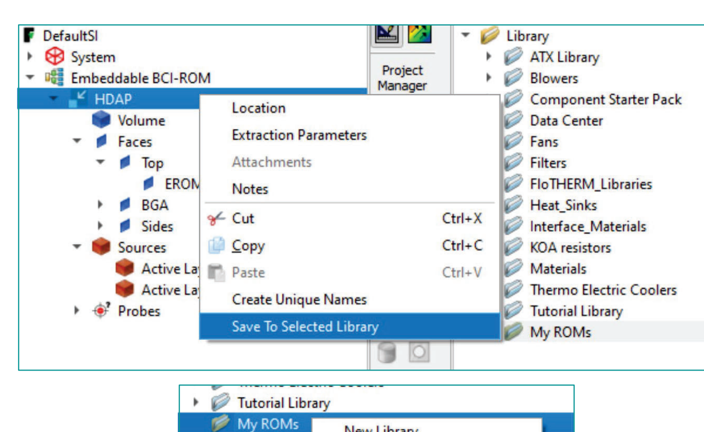
Embeddable BCI-ROMs : Author Workflow

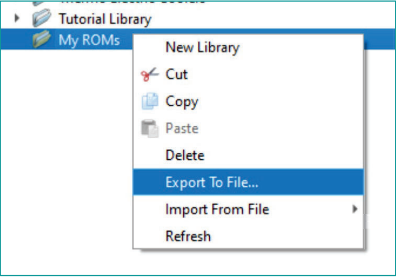
Workflow:

- Prepare for distribution:
- Validate results by comparing to detailed model.

- Save embeddable BCI-ROM to Library

- Export Library and distribute





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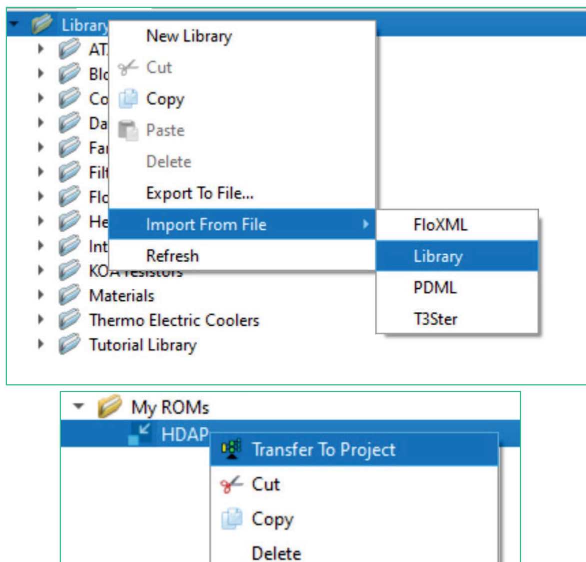
Embeddable BCI-ROMs : Consumer Workflow

Workflow:

- Import provided .library file
- Select target assembly
- Load library item.

- Or…

- Select target assembly
- Use the embeddable BCI-ROM option in the geometry palette:
- Find the desired .erom file



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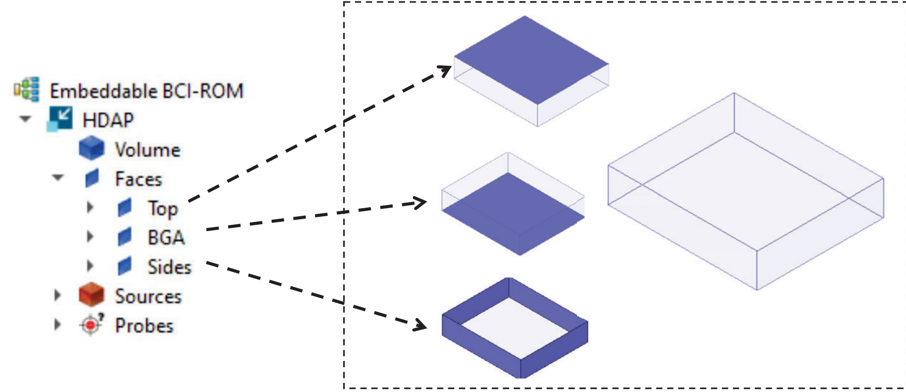
Embeddable BCI-ROMs : Consumer Workflow

Workflow:

- Use reference geometry contained in the 'Faces' node to position the embeddable BCI-ROM
  - Translate, Rotate, Copy, Paste, Align are supported



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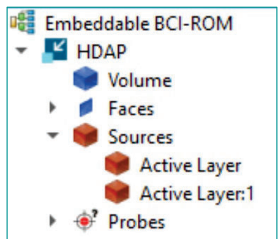
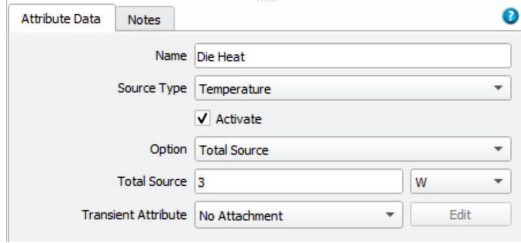
Embeddable BCI-ROMs : Consumer Workflow

Workflow:

- Use geometry contained in the 'Sources' node to assign or modify powers
  - A total power source attribute must be attached to each embeddable BCI-ROM source
  - Transient power profiles are defined with transient attributes





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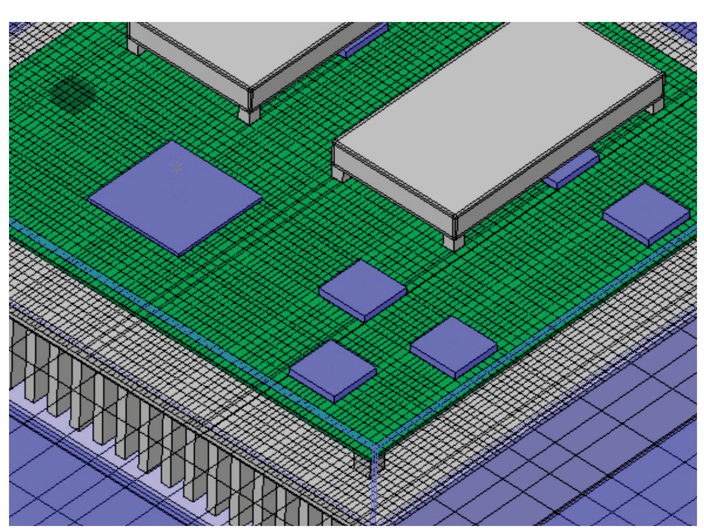
Embeddable BCI-ROMs : Consumer Workflow

Workflow:

- Embeddable BCI-ROMs are automatically key-pointed like all other Simcenter Flotherm SmartParts.
- Grid constraints are used to define grid across and around the embeddable BCI-ROM
- Grid cells inside the embeddable BCI-ROM are ignored



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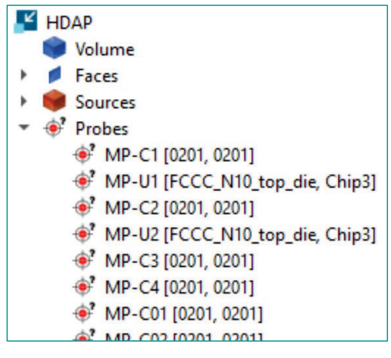
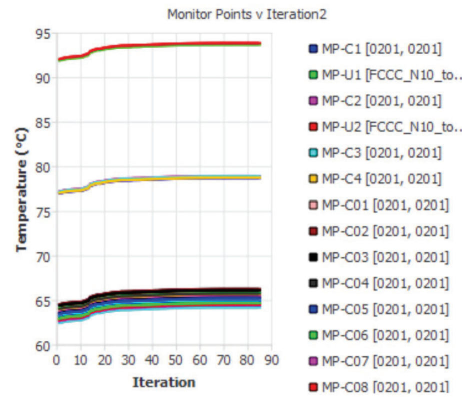
Embeddable BCI-ROMs : Consumer Workflow

Workflow:

- Use geometry contained in the ‘Probes’ node to track solution and post-process results.
  - Each probe will appear in Profiles during solve

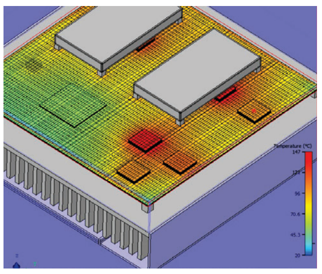


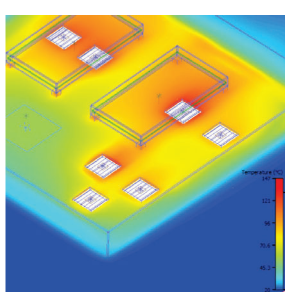


Embeddable BCI-ROMs : Consumer Workflow

Workflow:

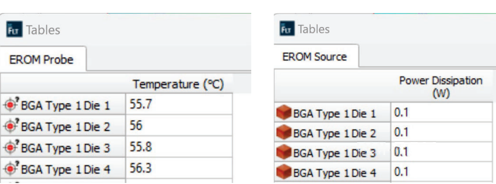
- Post-Processing
  - Visual:
    - Surface temperature plots
    - Plane plots are void inside embeddable BCI-ROM volumes
  - Numerical
    - Tables for embeddable BCI-ROM
      - Faces:
      - Probes:
      - Heat Sources:





EROM Faces

	Min EROM Surfaces Temperature (°C)	Max EROM Surfaces Temperature (°C)	Mean EROM Surfaces Temperature (°C)
Faces	93.455	103.26	100.7893
Faces	63.15	71.312	68.3356
Faces	56.703	60.481	57.94535



Tables

EROM Probe

	Temperature (°C)
BGA Type 1 Die 1	55.7
BGA Type 1 Die 2	56
BGA Type 1 Die 3	55.8
BGA Type 1 Die 4	56.3

Tables

EROM Source

	Power Dissipation (W)
BGA Type 1 Die 1	0.1
BGA Type 1 Die 2	0.1
BGA Type 1 Die 3	0.1
BGA Type 1 Die 4	0.1

Supporting Material

Best Practices:

- Description of the steps for the embeddable BCI-ROM author
- Best practices for model setup, extraction settings, and using embeddable BCI-ROMs in full Simcenter Flotherm models.

Validation Document:

- Comparison of detailed and embeddable BCI-ROM results for various applications and thermal environments.

Simcenter Flotherm™
Embeddable BCI-ROM Best Practices

Software Version 2310
October 2023

Simcenter Flotherm™
Embeddable BCI-ROM Validation

Software Version 2310
October 2023

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EROM Demonstration

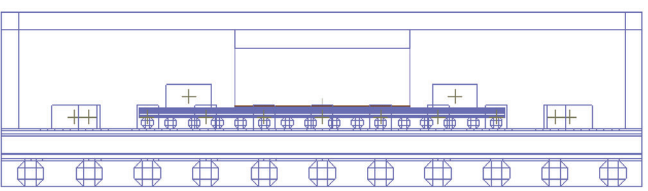
Examples

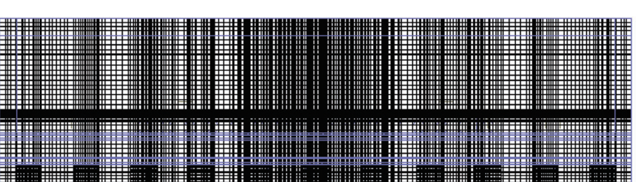
Example – BGA Package

Detailed Model:

- Substrates modeled explicitly
  - FOWLP (2217 objects)
  - BGA substrate (2179 objects)
- 378 solder balls
- 804 bumps
- Two die
- 40 capacitors

- Total:
  - 12682 objects
  - 11 million grid cells





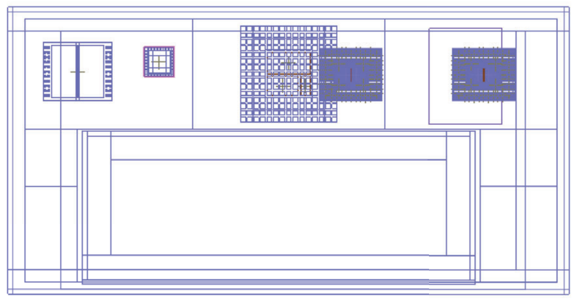
Example – Installed in SmartPhone model

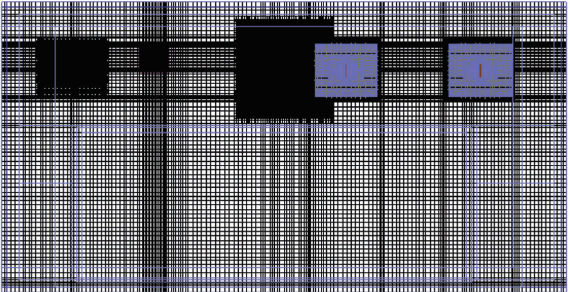
Detailed Model:

- 5 Detailed Packages
  - 2 instances of HDAP from previous slide
  - 2 other BGAs
  - QFN

  - 25,909 objects
  - 26.6 Million grid cells

  - Solve time (steady state): 3.5 hours





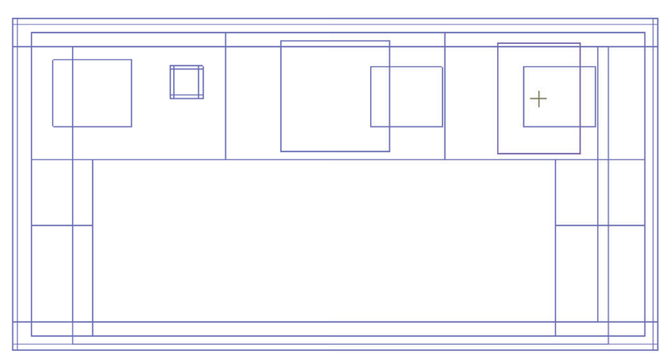
Example – Embeddable BCI-ROM Version

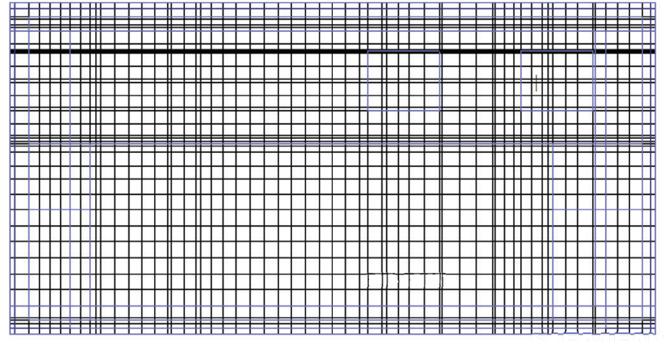
Simplified Model:

- The 5 packages are now represented with embeddable BCI-ROMs

  - All detailed packages deleted
  - 236 objects
  - 0.1 Million grid cells

  - Solve time (steady state): ~30 seconds





Example – Results Comparison

Temperature (°C)
125
110
95
80
65
50

Embeddable BCI-ROM components

Detailed components

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Example – Results Comparison

Package	HDAP 1	HDAP 2	BGA 1	BGA 2	QFN
Embeddable BCI-ROM	136.42	128.12	71.25	84.19	118.9
Detailed	134.16	127.33	71.1	83.94	117.84

95
80
65
50

Embeddable BCI-ROM components

Detailed components

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Example – Chiplet

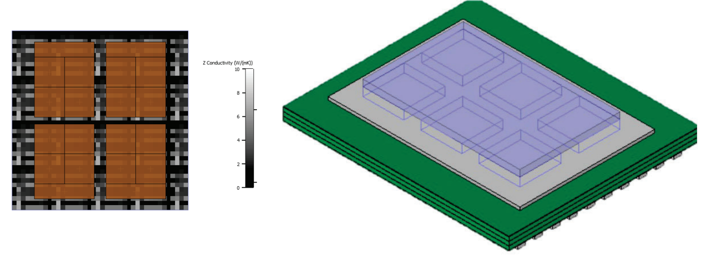
Detailed Model:

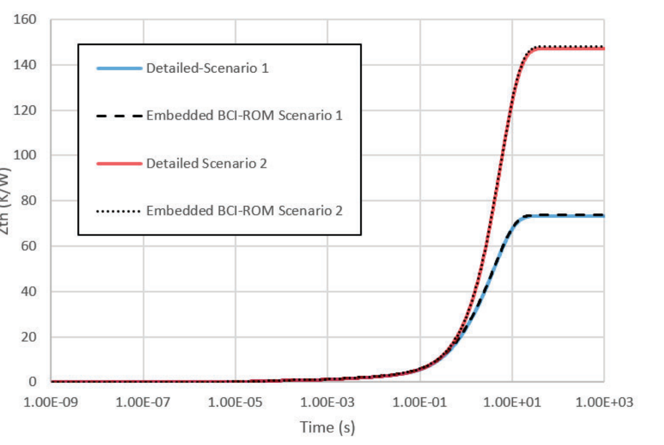
- High fidelity thermal model of a 16 core chiplet
- 778,870 grid cells required for the chiplet

- Transform chiplet model into embeddable BCI-ROM and position 6 copies of it on an interposer/substrate structure

- Package with embeddable BCI-ROMs requires ~100k grid cells.
- Package with high fidelity chiplet models requires ~8M cells

- Results within 1% in this case

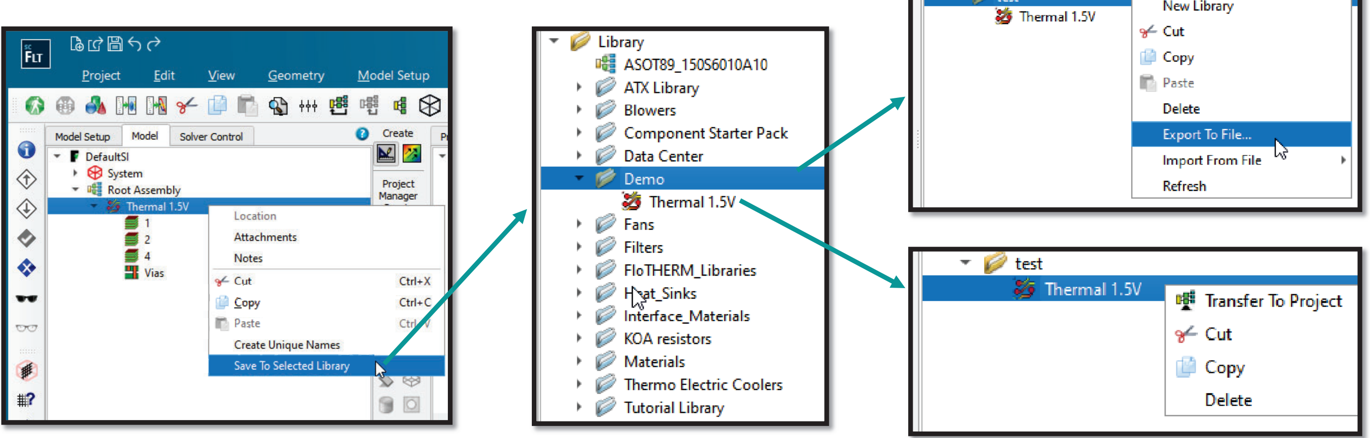




Library Interaction of Power Maps

Library Interaction of Power Maps

Power maps can be part of the Simcenter Flotherm Library



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Simcenter Flotherm XT 2310

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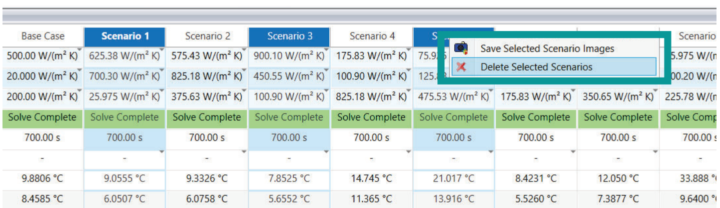
Parametric Study Update

Challenge: Making wide-spread changes to a large parametric study can be time consuming when each scenario must be deleted individually.

Save time by deleting multiple scenarios at once.

Solution:

- Ability to delete multiple selected scenarios in one operation.
  - Via keyboard
  - or right click menu option.



Exporting Projects

Challenge: Cannot easily transfer Flotherm XT projects to other Siemens tools.

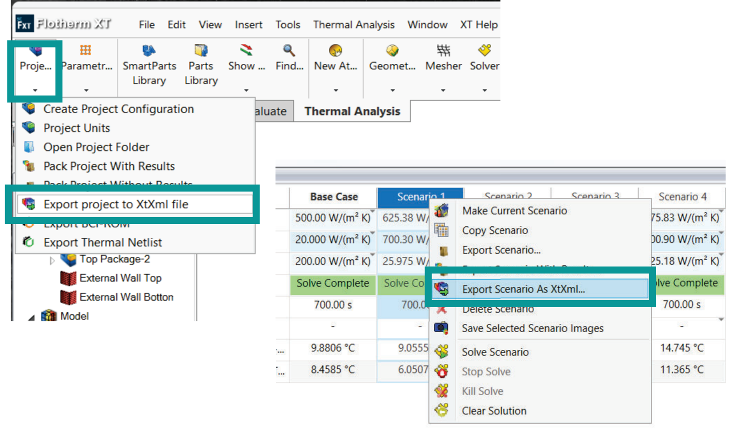
Eliminate errors and save time with seamless transfer between tools.

Solution:

- Export entire project with geometry and model setup data
- Export project from parametric study
  - Single scenario
  - All Scenarios

Note: Xtxmlp format does not include

- Transient time patch data
- Suppressed components



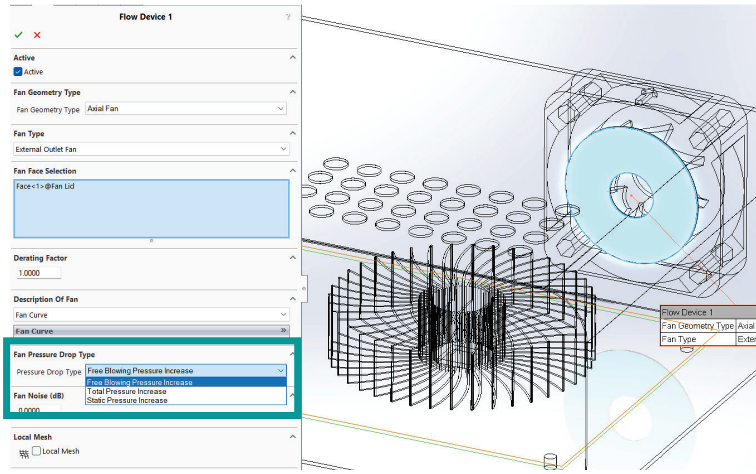
Smart Parts Update

Challenge: Free blowing pressure drop treatment for fans and flow devices is not always applicable in every situation. Not consistent with other Siemens tools

Improved confidence by achieving identical results in different tools.

Solution:

- Increase options for Fan Pressure Drop Type to reflect options available in Simcenter FLOEFD
- Options now include:
  - Total Pressure based calculation
  - Static Pressure based calculation



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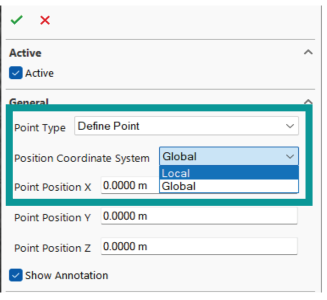
Smart Parts Update – Point Goals

Challenge: When assemblies with point goals based on global coordinates are saved in the library and reused in different projects, the point goal location is incorrect.

Reduce modeling errors and save time by ensuring goals are correctly positioned.

Solution:

- Point goals based on local coordinate system of parent assembly.
- Local coordinate based point goal will move with assembly if:
  - Assembly location is changed in project
  - Assembly is saved in library and reused in new different project.



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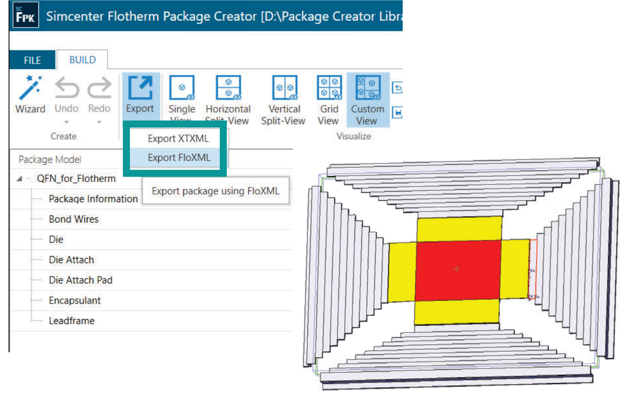
Detailed Package Model Export Update

Save time with a streamlined flow and improve accuracy with better models

Challenge: Detailed packages created in Simcenter Flotherm Package Creator have to be processed through MCAD Bridge before they can be used in Simcenter Flotherm.

Solution:

- Export Simcenter Flotherm ready detailed models from Simcenter Flotherm Package Creator directly.
  - Floxml format
  - Stair-stepped lead frames by default to avoid overlaps
  - Where necessary temperature dependent material properties exported as constant at default temperature



Scripting Capabilities

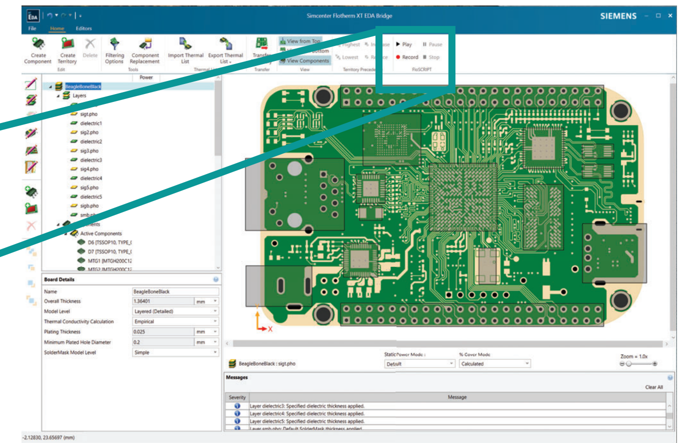
Save time with automatic, repeatable workflows.

Challenge: Need to be able to investigate various board representations in a reproducible manner.

Solution: Record the workflow and playback with alternative designs.

- Controls added to record and playback scripts.
- Scripts can be edited to create workflow alterations.

- Note:
  - Scripting support is available for commands in the main window only at this time
  - Support for dialog windows (including library swapping) is planned.



Contact

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Mobile +65 9129 0302

E-mail hon.wong@siemens.com

Simcenter STAR-CCM+ v2306 最新版功能介紹

卞志堅　資深顧問
台灣西門子軟體工業股份有限公司

Simcenter STAR-CCM+
Simcenter SPH Flow
Simcenter Battery Design Studio

Release Highlights

Version 2306

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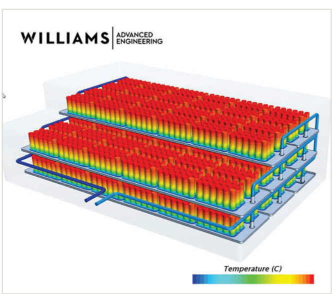
Williams Advanced Engineering (WAE) develops high-performance Li-ion batteries using Simcenter

YouTube link

WAE obtains the highest accuracy in simulating thermal battery performance

deviation compared to experimental data



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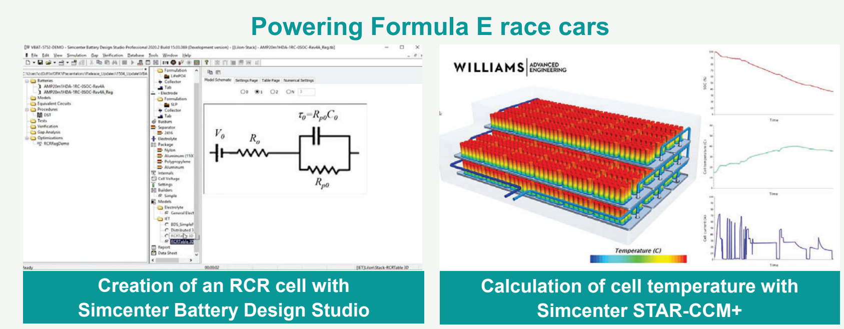
Williams Advanced Engineering (WAE) develops high-performance Li-ion batteries for Formula E and other racing series using Simcenter

- Obtained the highest accuracy in simulating thermal battery performance with less than 1C° deviation compared to experimental data
- Increased battery range, while saving vehicle mass

YouTube link

Powering Formula E race cars



Creation of an RCR cell with Simcenter Battery Design Studio

Calculation of cell temperature with Simcenter STAR-CCM+

- Detailed geometric characterization of cells
- Electro-thermal CFD simulation

“We don’t need to wait until we built and test the battery to know if it meets the targets. CFD and system simulation have helped us to reduce the time needed to complete our programs and develop our products. ”

Jorge Lopez, Senior CFD Engineer at Williams Advanced Engineering

Where engineering meets tomorrow
Investment imperatives for a comprehensive digital twin strategy

Model the complexity
Ensuring decision confidence

Explore the possibilities
Enabling insights

Go faster
Achieving speed and agility

Stay integrated
Connecting all activities

Simcenter
Simulation & Test

fluids · thermal · electromagnetics · acoustics · chemistry · structural

Model the complexity · Explore the possibilities · Stay integrated · Go faster

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3D-CAD in parallel simulation for significant memory reduction

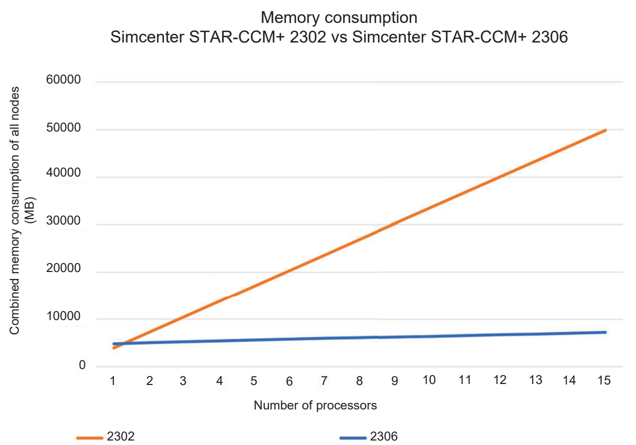
Model the complexity

Challenge
Model the complexity of real-world geometries without oversimplifying assumptions, while handling assemblies of 1,000s of parts with ease.

Solution
CAD geometry only instantiated on a single node during parallel simulations

Benefits
Reduce memory usage when handling geometry in parallel simulations

Efficiently handle complex CAD assemblies



Mesh to CAD: Convert Tessellation to CAD

Model the complexity

Challenge

CAD is the unchallenged way to accurately represent and handle product geometry. But sometimes geometric representations are only available in a tessellated format

Solution

Create CAD bodies from tessellated mesh

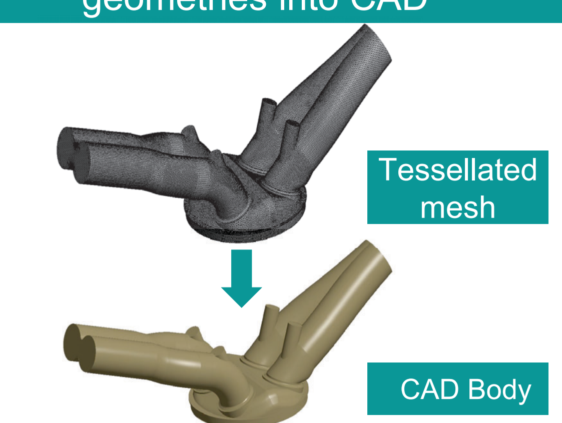
Use 3D-CAD operation to create a solid body

Benefits

Use tessellated geometries for e.g. In-Cylinder combustion simulations* by converting the tessellated surfaces to CAD bodies

Currently Supports: .INP and .STL import,

Quickly convert tessellated geometries into CAD



*Note: This feature is not meant and will not be capable to generate a complex assembly from a huge, tessellated grid

Application Focus – Model the Complexity

Tackle high-fidelity E-powertrain simulations with ease

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E-machine performance workflow update - Create skewed rotor sector

Model the complexity

Challenge

High effort of simulating full e-Motor geometries while symmetry could be leveraged

Solution

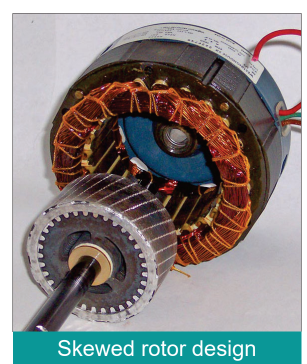
Reduction of the computational domain size to a sector now supported for Skewed Rotor designs

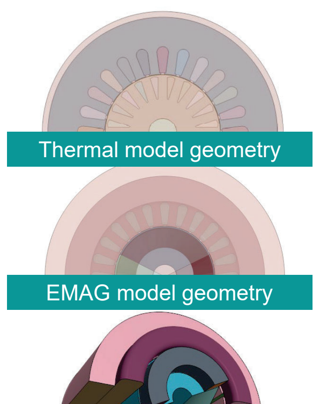
Available through the e-machine performance workflow import (Skewed rotor sector is supported from Simcenter SPEED export)

Benefits

- Faster simulations with reduced domain size leveraging symmetry
- Method consistency across all e-machine architectures

Faster simulations for skewed rotor designs


Skewed rotor design



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Electromagnetic modeling of lamination layers

Model the complexity

Challenge

Permanent magnet radial e-machines stator made of several hundreds of thin laminated steel layers. Model setup complex with high element count

Solution

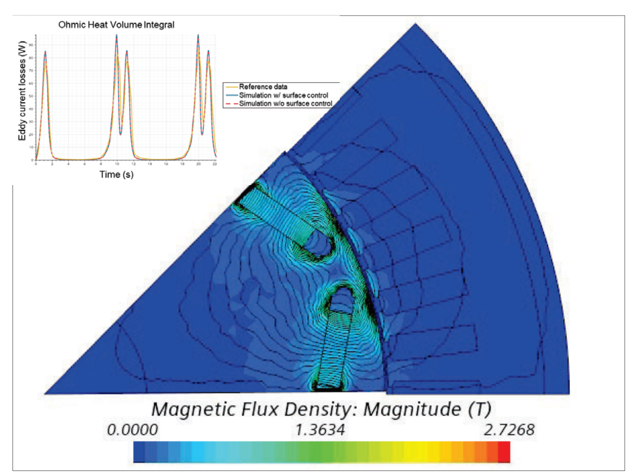
Bulk lamination model models effects of lamination stack (ohmic heat due to eddy currents losses) without explicitly considering laminated geometry.

Benefits

Significantly simplified model preparation

- No need for mesh that resolves the layered geometry nor the insulation between the layers
- A single mesh element that spans several layers is sufficient

High fidelity modeling of e-machine power losses due to eddy currents



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Automated battery data analysis setup

Model the complexity

Challenge

Solution

Battery Module Reports option with multi-valued monitor

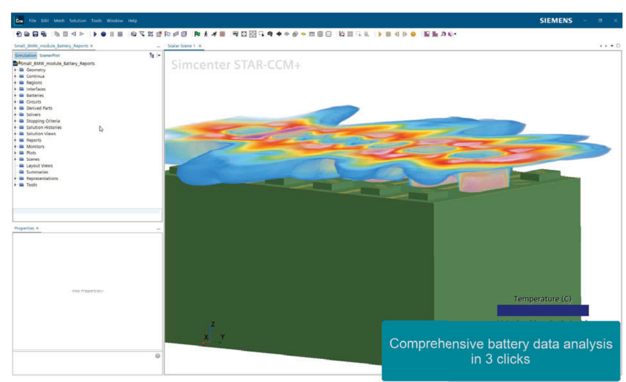
- Automatically generates hundreds of reports, monitors, and plots of entire pack cells' common quantities, grouped
- Supports thermal runaway model and equivalent circuit models related common field functions

Benefits

Productivity increase in battery data analysis

- Concise simulation tree
- Less prone to input errors
- Removes the need to use scripting

Comprehensive battery data analysis in 3 clicks



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Gradient-based (adjoint) optimization

Explore the possibilities

Challenge

Direct parametric optimization may require a large number of design assesments, adjoint based topology optimization may lead to difficult-to-manufacture designs

Solution

Gradient-based optimization

- Leverage adjoint solver in a parametric design study to get parameters' sensitivities
- Drive optimization algorithm to the closest local optimum using those sensitivities

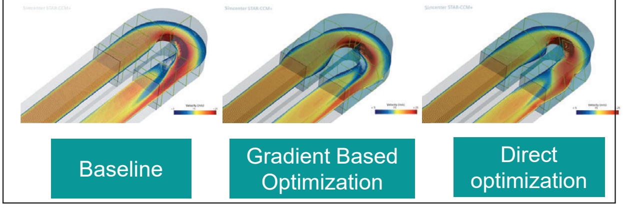
Benefits

- Faster convergence towards local best designs, especially for large number of parameters
- Single or multiple objectives
- Ensure manufacturability of your optimized design: smoother shapes with no design space violations

Find better designs faster

	Gradient-based Optimization SQP (18 parameters)	Direct optimization Sherpa (18 parameters)
Pressure drop (Pa)	137	135
% improvement from baseline	38%	39%
Number of evaluations	22	247
Physical hours*	4	42.4

*Using a single fully populated node (2 x AMD EPYC 7532 32-Core Processor)



Baseline | Gradient Based Optimization | Direct optimization

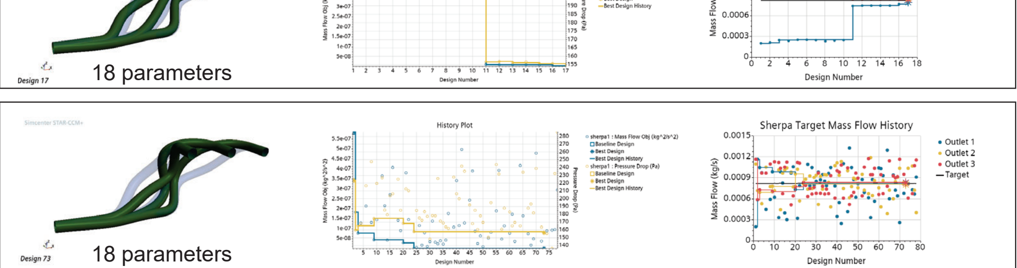
Gradient-based Optimization

Automated process in Design Manager leveraging

- Dedicated framework to define the gradient-based optimization study
- 3D-CAD and CAD Clients parameter sensitivities from adjoint simulations
  - Supporting smooth geometries without sharp edges or corners
  - Gradient-based algorithms (Sequence Quadratic Programing) and optimization focused post-processing

Gradient-based optimization using SQP

Direct optimization using Sherpa



Clipping and Slicing Option for Simcenter STAR-CCM+ Web Viewer

Explore the possibilities

Challenge

Interactively sharing and exploring engineering insights used to require the installation of Simcenter STAR-CCM+ (Viewer)

Solution

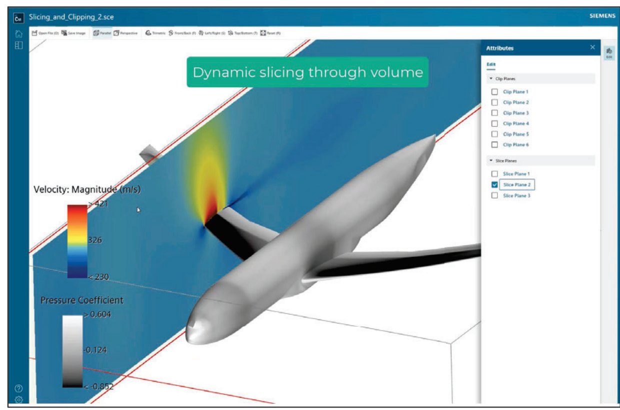
Simcenter STAR-CCM+ Web Viewer Quick interactive data analysis from a browser, now with clipping and slicing options

Benefits

Explore and share your results from any device, anytime, anywhere, now with further added fidelity:

- Dynamically slice through volumetric data to understand flow behaviour
- Quickly understand geometry by clipping

Accelerate engineering decision making in the web



https://cloud.sw.siemens.com/starccmviewer/

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Go faster

Simcenter
Simulation & Test

Continued GPU performance improvements

Go faster

Challenge
Get the maximum out of GPU-enabled acceleration

Solution
Continued Improvements to the performance of the GPU solver. AMG setup was optimized to remove bottlenecks in the AMG set up process

Benefits
Further increased GPU performance (up to 16%)
Major benefit seen for polyhedral meshes

Even faster simulations on GPUs

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Continued expansion of solvers supporting GPU acceleration

Go faster

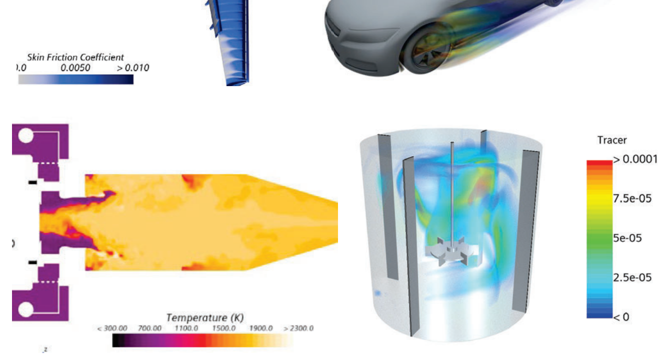
Challenge
GPU-enabled performance enhancements limited to applications by the set of ported solvers

Solution
Continue the expansion of GPU-based acceleration to an increasing set of solvers:

- Coupled Flow and Energy Solver
- PISO Solver
- Wall-modeled Large Eddy Simulation (LES)
- Passive scalar solver
- Flamelet combustion modelling
- Temperature Polynomial Material Properties

Benefits
New application enablement

More applications faster on GPUs



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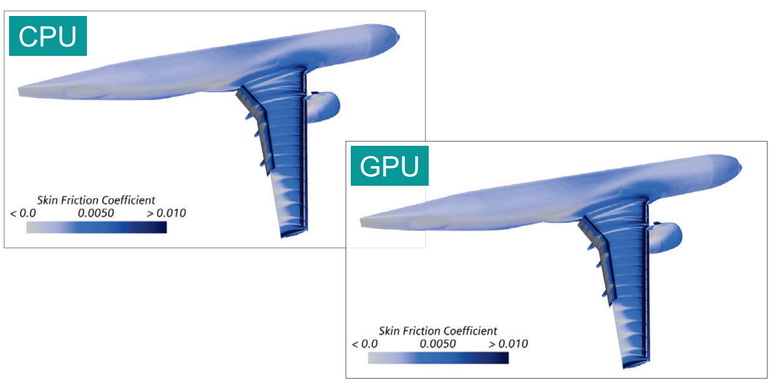
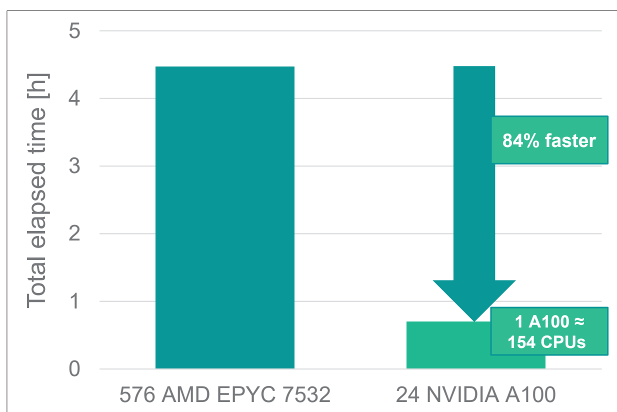
GPU native coupled flow and energy solver

Faster external aerodynamics simulations with native GPU implementation of the coupled flow and energy solver

CPU-equivalent flow solutions ensured by maintaining a unified code base



110M cells aerospace aerodynamics within 40 minutes on GPU



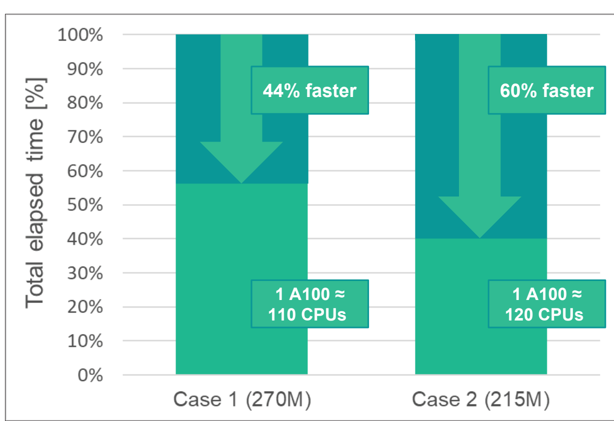
The reduction of 84% in computing time is here evaluated comparing a CPU solution on 576 AMD EPYC 7532 to a GPU solution on 24 NVIDIA A100 cards.

GPU native coupled flow and energy solver

Significant speedup for automotive external aerodynamics simulation with native GPU implementation of the coupled flow solver

Note: Grid Sequencing Initialization (GSI) of the coupled solver is not ported to GPU

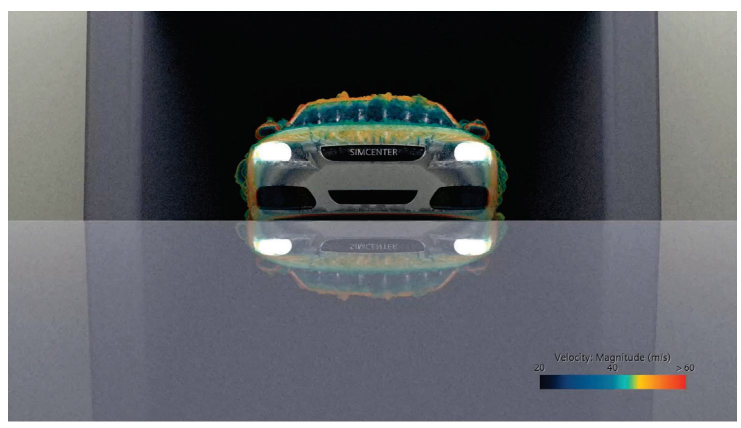
Up to 60% speed-up of automotive vehicle external aerodynamics cases



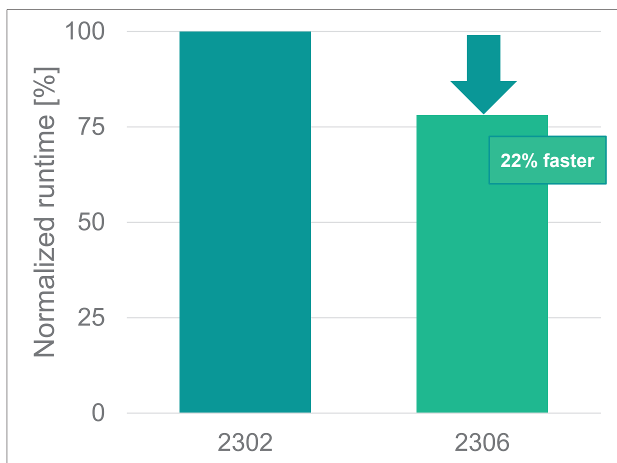
The reduction in computing time is here evaluated comparing a CPU solution on 1024 AMD EPYC 7532 to a GPU solution on 24 NVIDIA A100 cards.

GPU native wall-modeled Large Eddy Simulation

Further GPU acceleration of wall-modeled Large Eddy Simulation (LES) by porting the LES Off-Wall Wall Treatment option to GPU



More than 20% faster WMLES for vehicle external aerodynamics



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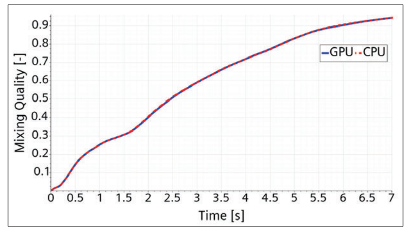
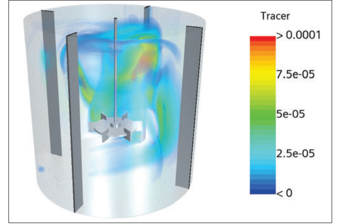
GPU native passive scalar solver

Faster simulations involving the use of passive scalars with a native GPU implementation of the passive scalar solver

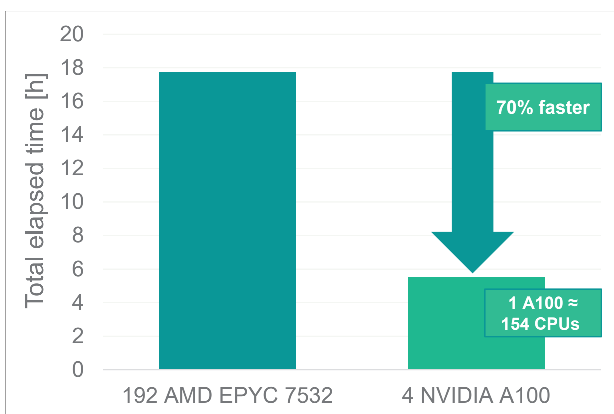
Equivalent solution between CPU and GPU hardware

- Example of Mixing Quality transient development in a mixing vessel





GPU accelerated mixing time analysis for mixing tanks



The reduction of 70% in computing time is here evaluated comparing a CPU solution on 192 AMD EPYC 7532 to a GPU solution on 4 NVIDIA A100 cards.

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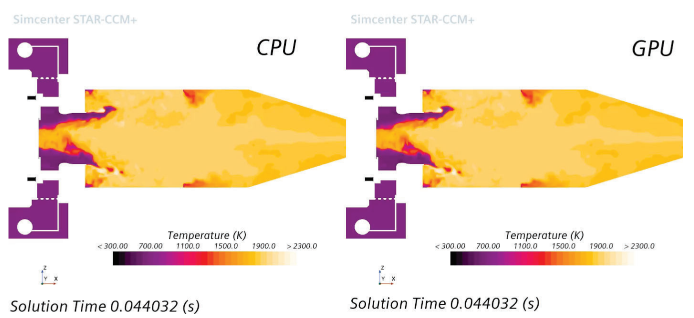
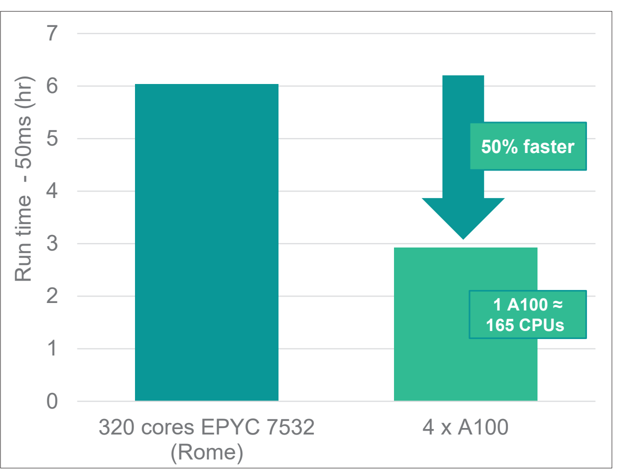
GPU native Flamelet modeling

Faster high-fidelity combustion simulations

- Flamelet Generated Manifold (FGM) with all available flame propagation methods
- Steady Laminar Flamelet and Chemical Equilibrium models
- Prompt, Thermal and Fuel NOx emissions models
- Combine with GPU enabled LES (2210) and PISO (2306) models for rapid, high-fidelity combustion simulations



Speed up of Flamelet combustion modeling



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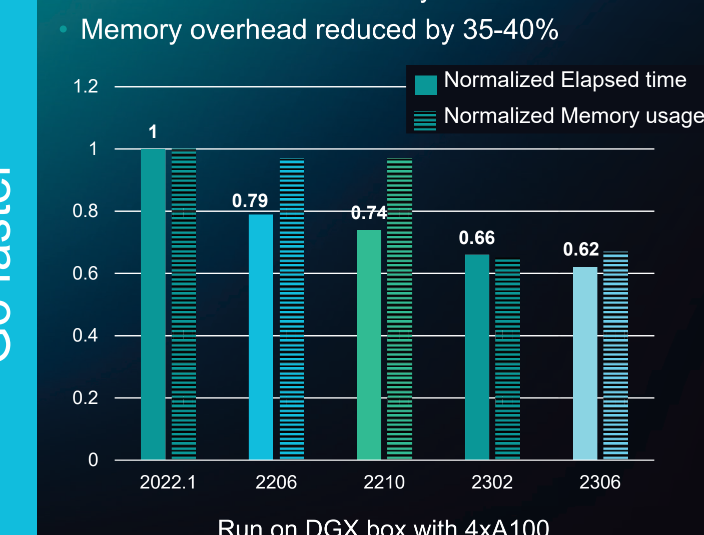
GPU Acceleration – Continuous Performance Improvements

Go faster

- Turnaround time reduced by 38%
- Memory overhead reduced by 35-40%



Corvette C6 ZR1 external aerodynamics
110M cells, SST-DDES, MRF for the wheels

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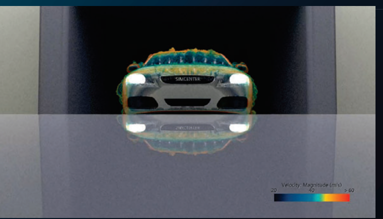
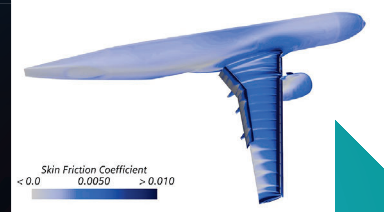
GPU Acceleration – Continuous Solver and Application Expansion

Go faster

Model the complexity





2022.1

Unsteady Vehicle Aerodynamics

- Segregated Flow
- k-ω SST, k-ε, RANS & DES
- Constant Density
- MRF

2210

Aeroacoustics

High Fidelity Aerodynamics

CHT

- LES
- Acoustic Wave models
- Segregated Energy*
- Ideal Gas

2306

Steady Aerodynamics

Industrial Combustion

Gas Turbine Aerodynamics

Mixing Vessels

- Coupled Solver
- Passive Scalar
- Flamelet Combustion
- PISO
- WMLES

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Create Point Probes from Table Data and Multivalued Monitoring

Go faster

Challenge

Quantitative comparison of measured and simulated key quantities at a large number of critical locations ensuring correct match of data extraction locations

Solution

Automatically create point probes from external (measurement locations) table data

Easier and automated monitoring of point probe arrays with a Multi-Valued monitor

Benefits

- Fast and error free setup and monitoring of probe arrays
- Concise presentation in simulation tree

Quick and reliable validation of complex simulations

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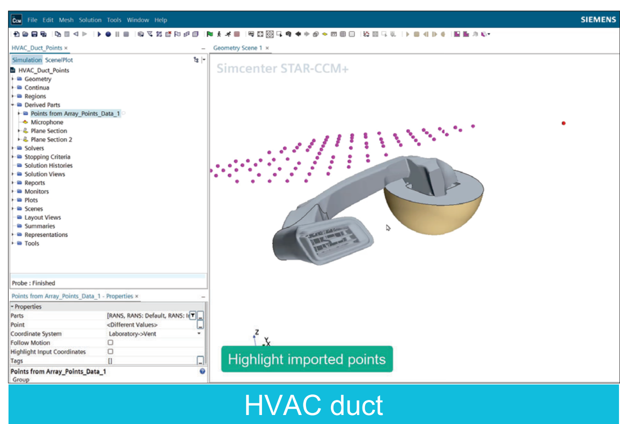
Create point probes from table data
D1442,Community Idea

Increase automation by creating point probes directly from a file table (standard .csv file)

- Easily directly import of external data
- Avoid manually creating hundreds of probe points or writing Java code to set up an acoustic array
- Automated troubleshooting of grouped points with ability to highlight points both inside and outside of the meshed region

Example: Faster acoustics setup with seamless import of a multitude of predefined microphone probe locations

Set up many microphones from a simple .csv import



HVAC duct

Multi-valued monitors

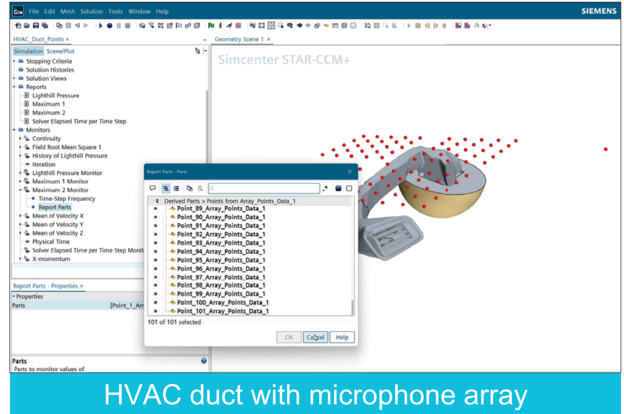
D5617, D5427

Easier and automated plot creation for many parts with Multi-Valued Monitor

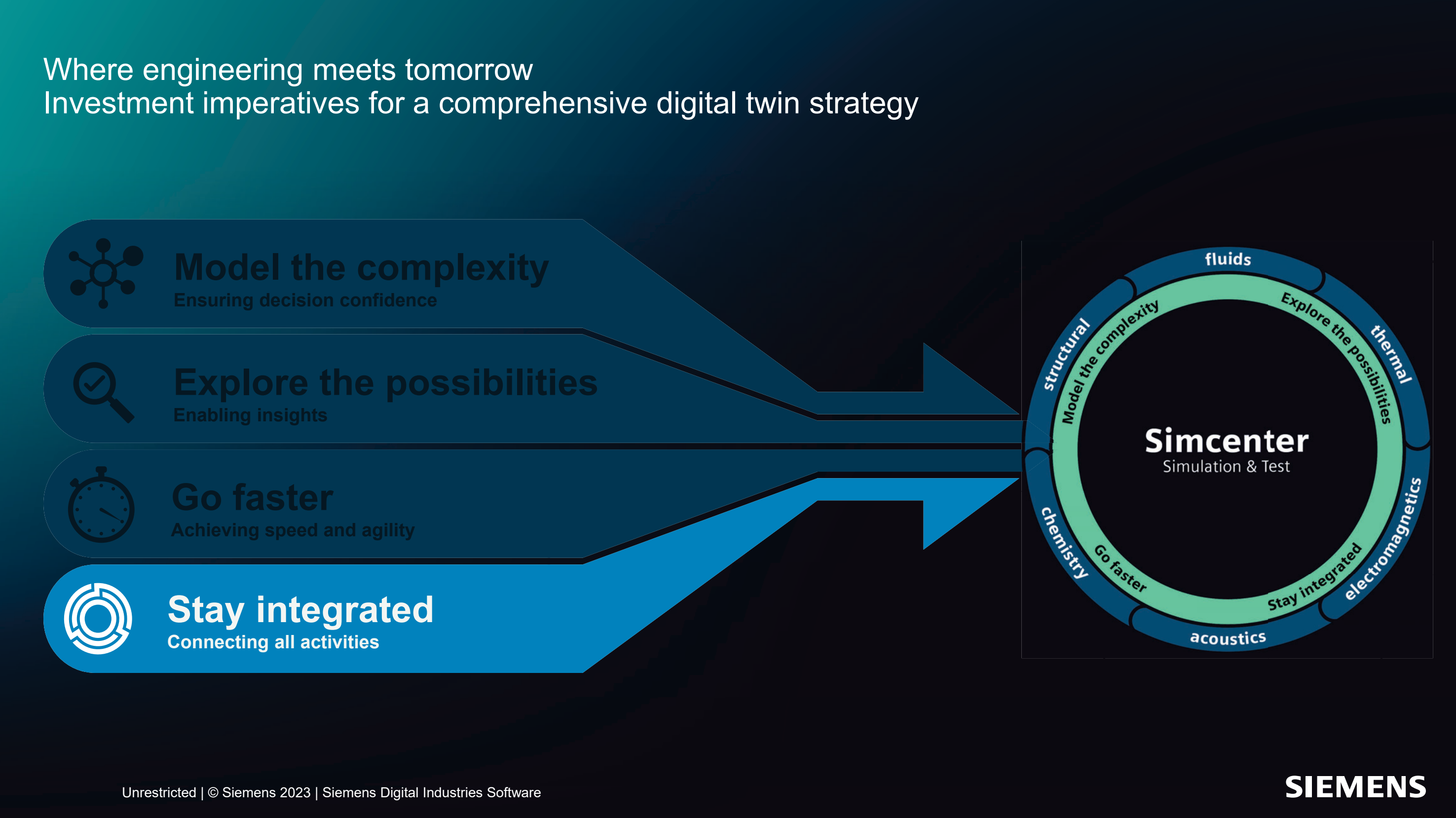
- Greatly improved workflow through usage of singular Monitor for multiple part values
- Assign multiple parts to a single Report and Monitor
- Avoid creating and managing a lot of reports, monitors, and plots to go with a multitude of parts or derived parts
- Concise presentation in simulation tree with only one monitor node for many parts

Application example: Easier and automated monitoring of microphone array

Create a monitor for hundreds of points in a few clicks



HVAC duct with microphone array



Simcenter STAR-CCM+ to Simcenter STAR-CCM+ co-simulation for Solid Mechanics and Fluid-Structure Interaction

Stay integrated

Challenge

Run high-fidelity FSI from existing models quickly

Solution

Co-sim complements the single simulation approach to FSI and allows to couple existing models of different .sim files

Benefits

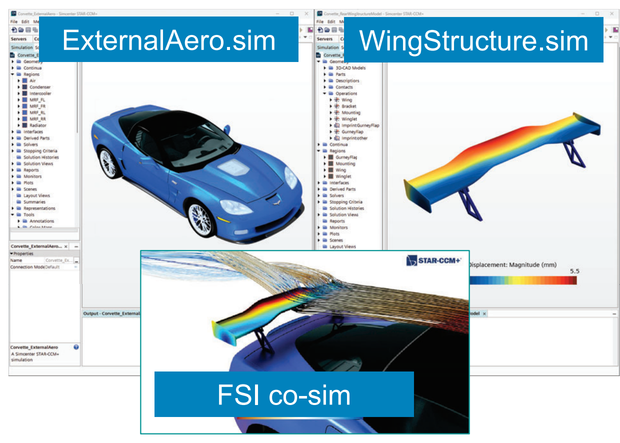
Pragmatic FSI simulation from already existing fluid and thermal .sim files

Supports strong and weak coupled applications

NOTE

Whenever possible FSI should be approached as a single simulation with fluid and structure in the same .sim file

Collaborate to couple physics



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Simcenter Cloud HPC Multiple region support and compatibility

Stay integrated

Challenge

Setting up and accessing the cloud using 3rd party providers requires significant time and expertise in cloud and HPC technologies and interrupts existing workflows.

Solution

Simcenter Cloud HPC allows you to submit jobs to the cloud from within Simcenter STAR-CCM+

Benefits

- Seamless access from your CFD environment
- No install, setup or maintenance required
- Pay only for what you use
- Adapt to changing demands for HPC
- Scalable from SMBs to large enterprises

Instant access to practically unlimited compute, direct from your desktop

Did you know

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Supported version: Simcenter STAR-CCM+ 2306
Available in the Americas, and **from July 15th for preview, 2023 in APAC**

Simcenter Cloud HPC

Licensing

- Simcenter STAR-CCM+ Hybrid SaaS license is pre-requisite and required for local pre and post
- Credits purchased in bundles (1,000 – 100,000)
- Pricing structure provides best value for money when purchasing larger bundles and using larger clusters

Simcenter STAR-CCM+ specific features

- Four clusters available; 105 – 700 cores
- Upload companion Java macros and external files
- Graphical solution monitoring via new Job Monitor

Clusters size

Contact your support engineer or sales representative for more information

Simcenter SPH Flow

The STS leadership team has decided to accelerate the integration of SPH into Simcenter STAR-CCM+

- Halt new feature development for the standalone Simcenter SPH Flow
- Version 2306 will be the last release with new features
- Further releases will be maintenance only

2306 New features

Model the complexity — **Next-generation explicit weakly-compressible solver**
Simulate additional compressible applications through uniform capabilities in both explicit and implicit SPH methods

Go faster — **Dedicated Fluid Structure Interaction User Interface**
Faster setup of FSI applications

Stay Integrated — **Liquid realistic rendering**
Produce industrial-grade scenes

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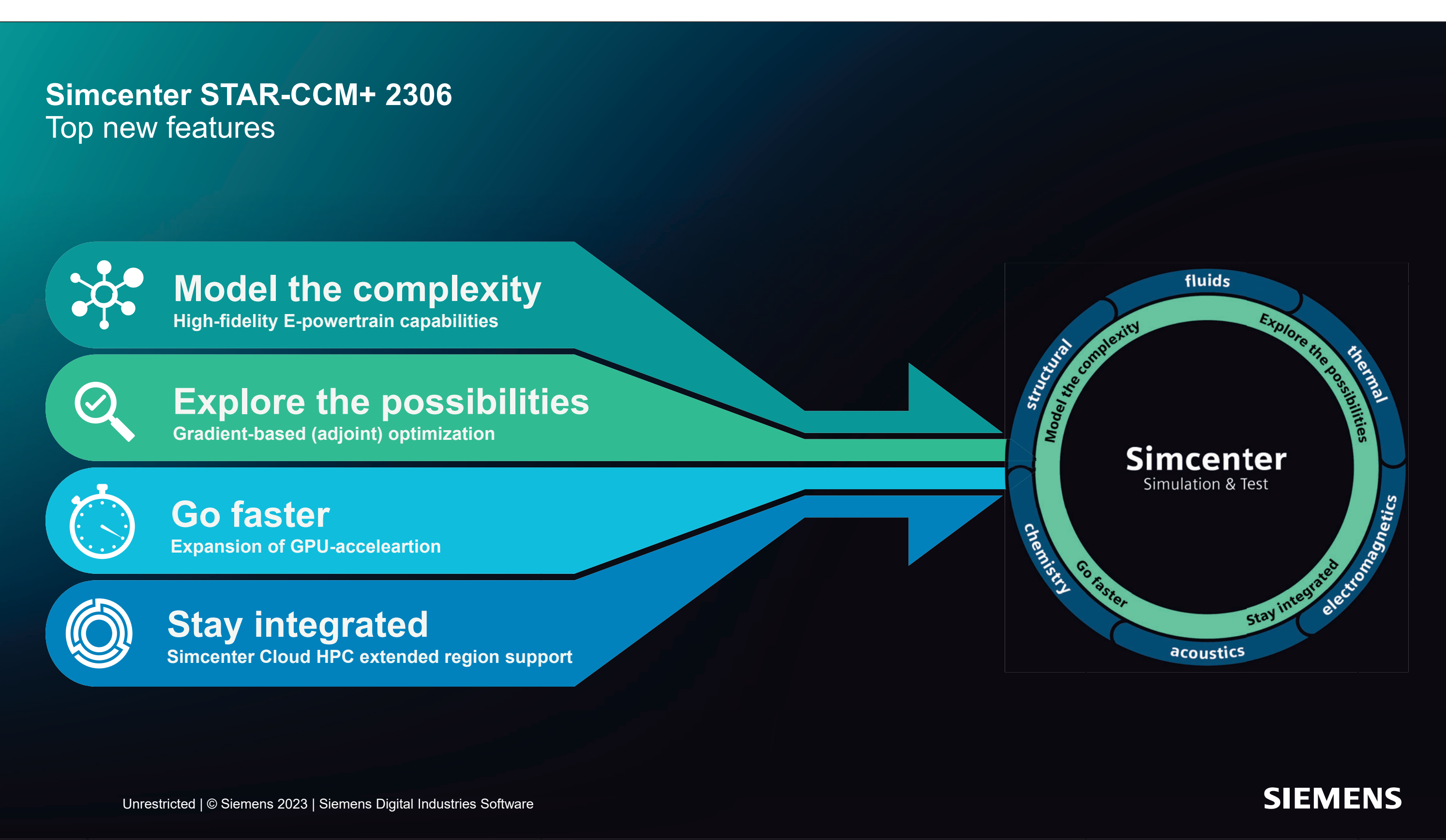

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System Thermal Design Process Sharing

劉立崗　博士
易富迪科技股份有限公司

Numerical analysis and optimization of multiple blade modules

鄭偉隆　副理
微星科技股份有限公司

msi

Numerical analysis and optimization of multiple blade modules system.
多模組系統的數值分析與優化

November 17th 2023
Enterprise Platform Solutions
Weilung Cheng

Tech meets Aesthetic

msi

以下簡報是微星科技內部資料，請各位先進
勿拍照或錄影，感謝大家的配合。

Tech meets Aesthetic

Agenda

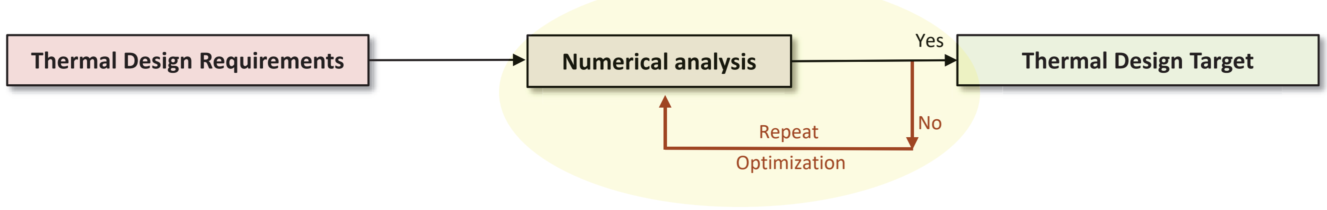
Agenda

- *Introduction*
- *Thermal Model Construction*
- *Simulation Condition Assumptions*
- *Numerical Analysis.*
- *Numerical Optimization*
- *Other Suggestions and Conclusion*

Tech meets Aesthetic

Introduction

- We using CFD Software FloTHERM to build numerical modules, expect reducing development cost, time, convergence development problem and improve design reliability.
- Case sharing: share part of our experience in the numerical analysis process and the thermal analysis done through this lecture.



Simulation Condition Assumptions

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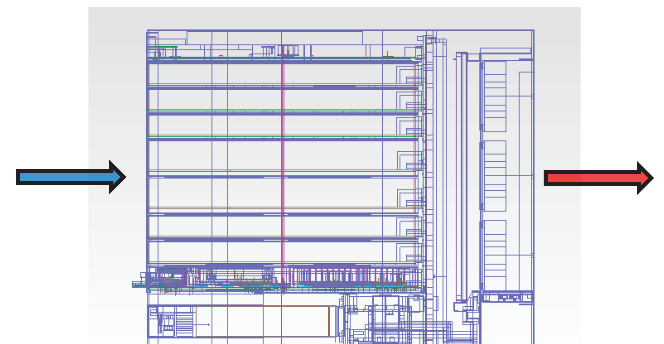
1. Turbulent flow patterns in 3D
2. Steady flow field
3. Ambient temperature is 25~ 55°C
4. Consider the effects of gravity (Y-direction)
5. The thermal power value and thermal conductivity coefficient are fixed values.
6. Total number of grid points used: ~200 million
7. Maximum aspect ratio of grid points: 200
8. System size: 440.5(W)*661(D)*543.6(H) mm



Numerical Analysis - Flow Chart

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Repeat and adjust

Much

Time

Less

Multiple blade modules system

Construct detailed geometric models using numerical software

Numerical analysis

Numerical Result

Mockup System

Airflow Test with Wind Tunnel

Experiment Result

Summary Airflow result with Experiment and Numerical Simulation

Single blade module

Numerical analysis

Numerical Result

Single Heatsink module

Numerical optimization analysis

Numerical optimization Result

- Analytical perspective on the board, not system.
- Saving time, to do numerical wind tunnel on blade.
- Import Improvement policy.

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Thank you very much for Your attention
GOLDEN
RATIO
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CREATOR
AWARDS
ESL
THE OFFICIAL GAMING PARTNER
IEM
Intel® Extreme
Masters Certified PC
MGA
MSI GAMING ARENA

Wireless product thermal design

徐輔鴻　經理
明泰科技股份有限公司

Wireless product thermal design

明泰科技CAE部
Andrew Hsu

Alpha公司簡介

2003年9月
成立時間

DMS
(設計、製造、服務)
提供服務

2004年在台灣證券交易所正式掛牌上市
上市公司

ALPHA

TWD 33,634 M
2022
合併營收

人數超過5,000+人
全球員工

實收資本額
TWD 5,417 M

ALPHA Networks

Qisda NCG成員

NCG (Alpha Networks)

代工 ODM/OEM	通路/品牌 Channel/Brand	系統整合 SI	補強技術 New Technology
ALPHA Networks 明泰科技	hitron 仲琦科技	ijt 互動國際 多元化系統整合 電信/有線電視/媒體/IT與雲端/GIS台灣代理/5G專網和垂直應用	AESPULA 艾普勒 5G軟體關鍵技術
		TRANSNET 辰隆科技 5G專網系統整合	rapidtek 鐳洋科技 低軌衛星相關元件

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明泰Thermal模擬

- 軟體:

  Flotherm: 主要使用

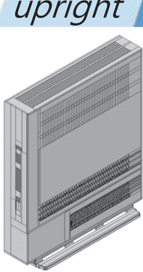
  Flotherm XT: 輔助使用(較複雜外型產品)

- 產品設計種類
  - Switch
  - Wireless router/AP/CPE
  - XGS-PON
  - Small cell
  - Smart doorbell
  - IP-cam

Wireless product thermal design considerations

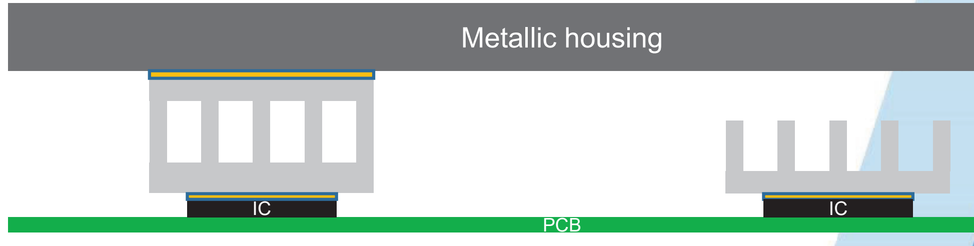
- Design Factors:
  - TDP (thermal dissipation power)
  - Housing size & material: usually PC/ABS
  - Opening (area/ratio): ratio <20%
  - Ambient temperature: usually 40-50°C for consumer product
  - Orientation:

ceiling mount *desktop* *wall /pole mount* *upright*



Heat transfer mechanism and design concept

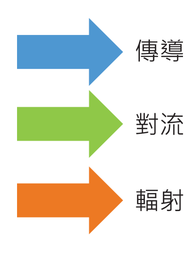
- 同樣面積、設計良好的情況下，熱傳速度：
  - 熱傳導 > 熱對流 > 熱輻射

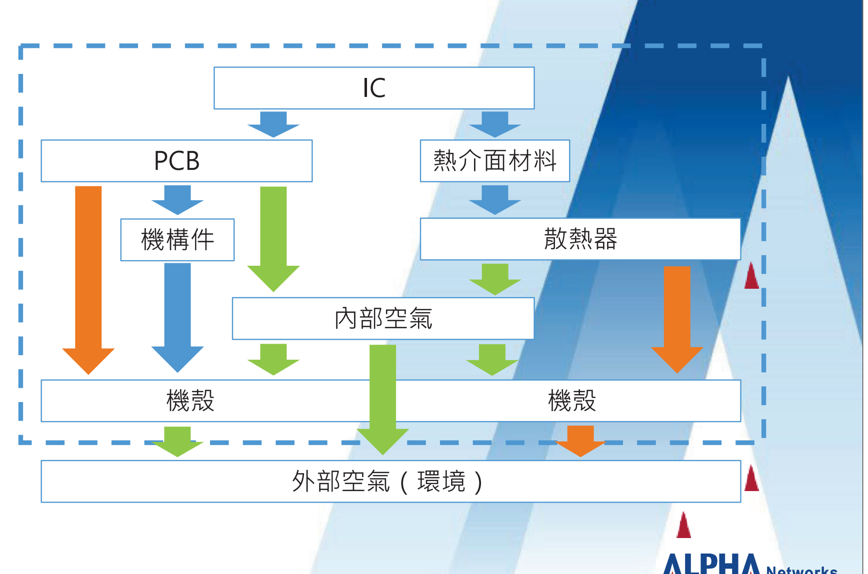


- 但熱傳導基本上只能用在產品內部
  - 要把熱從產品傳到環境，還是要靠熱對流（還有熱輻射）
  - 兩種策略：1. 靠機殼散熱 2. 讓內外空氣流通
  - 機殼、空氣流量會是物理限制

Heat dissipation concept

- 簡易的散熱架構示意圖
- 兩個問題：
  - 主要的熱傳路徑為何？
  - 路徑上哪裡溫差大？





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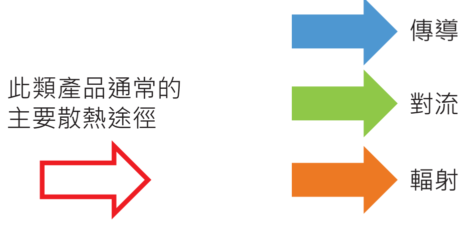
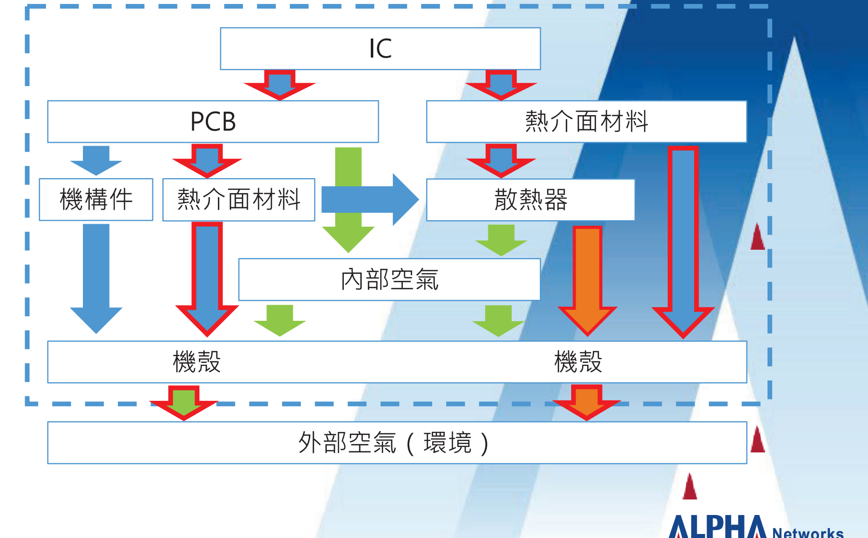
Heat transfer path – fanless w/ metal case

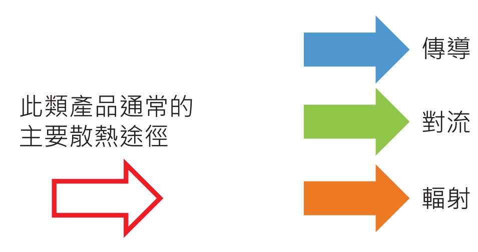
- 例 1：無風扇、透過金屬機殼散熱的產品
  - IC 封裝型式？
  - PCB 銅層、via 是否足夠？
  - 熱介面材料規格？面積？
  - 機殼厚度、材質？
  - 機殼表面處理？

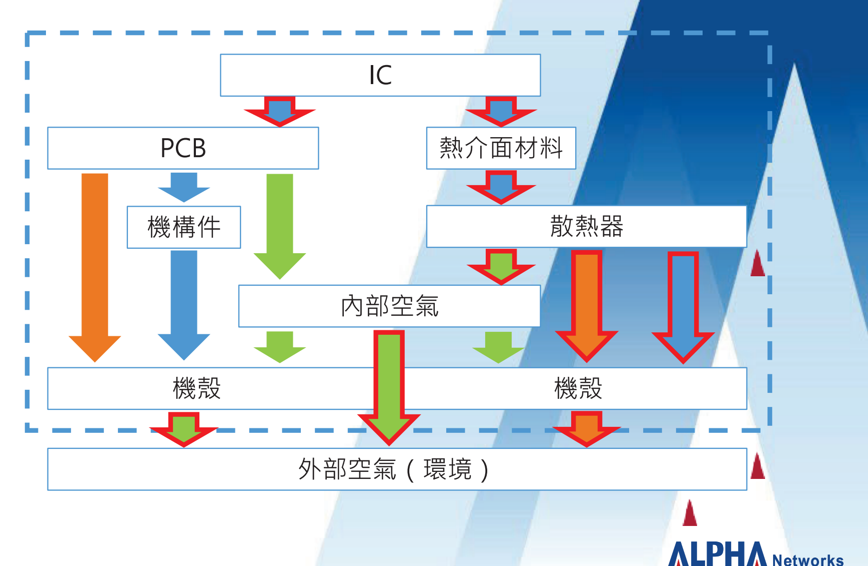




Heat transfer path – fanless w/ plastic case

- 例 2：塑膠機殼、透過自然對流散熱的產品
  - 熱介面材料規格？面積？
  - 散熱器尺寸？有效面積？
  - 是否考慮散熱器貼殼？
  - 開孔型式、面積？

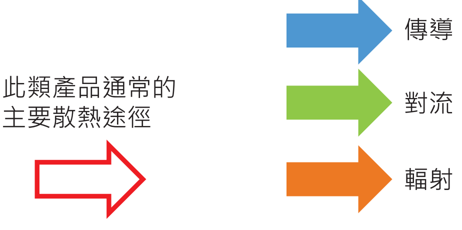


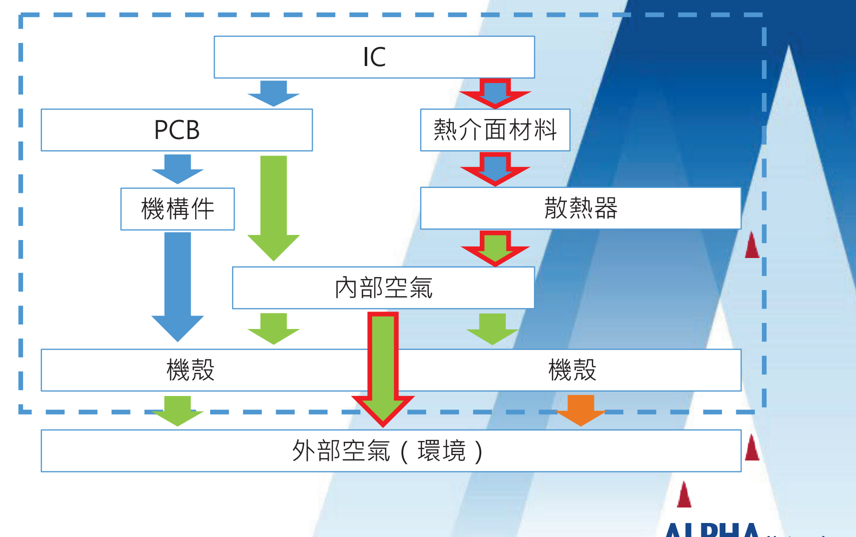


Heat transfer path – with fan

- 例 3：透過風扇散熱的產品
  - 熱介面材料規格？面積？
  - 散熱器尺寸？有效面積？
  - 風扇選用？
  - 開孔型式、面積？

此類產品通常的
主要散熱途徑





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Case study 1: 5G CPE

5G CPE product info.

- Housing material: PC
- Orientation: desktop and wall mount
- Dimension: 190x190x62mm
- TDP = 24.5W
- Ta = 45degC
- Thermal solution:
  Heat sink w/ fan(3010 x1)

Wall mount

Desktop

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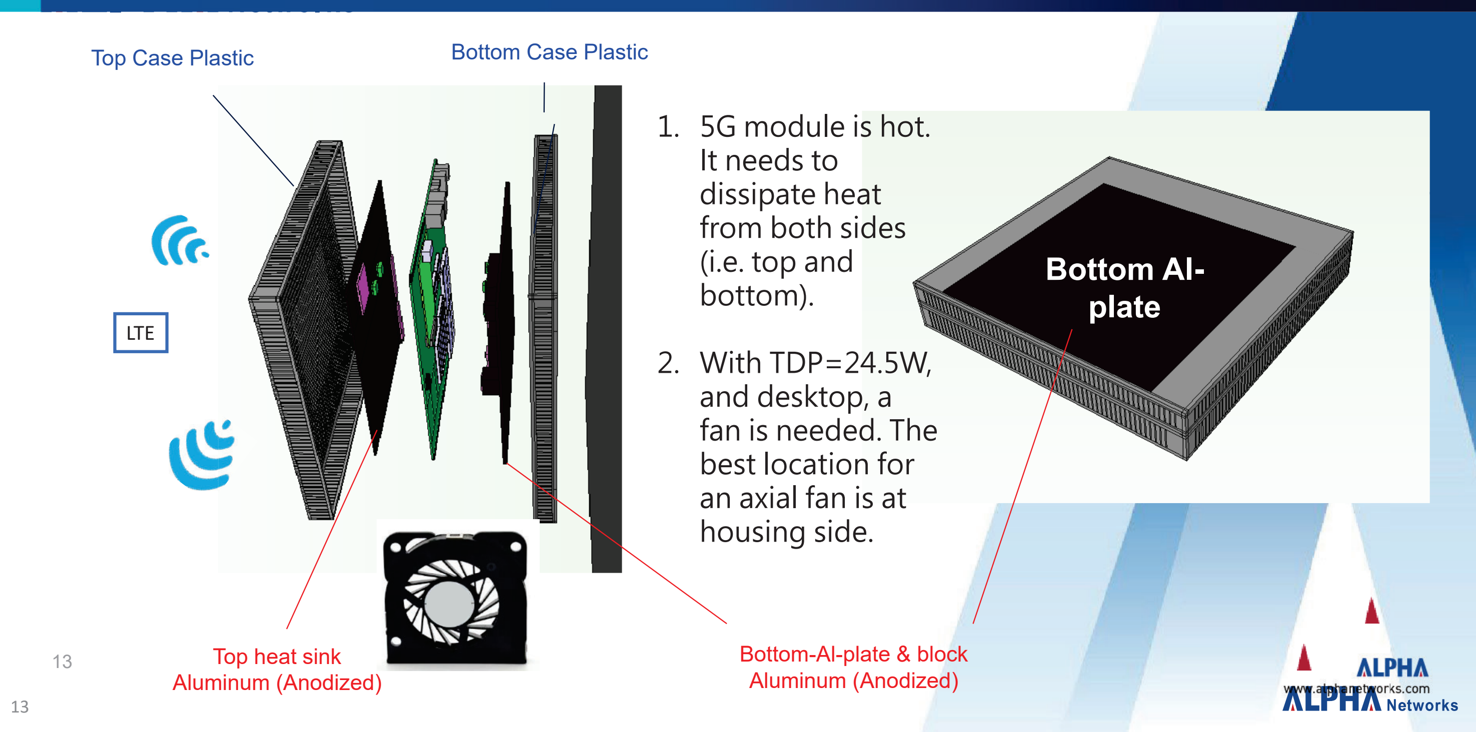
Thermal design concept

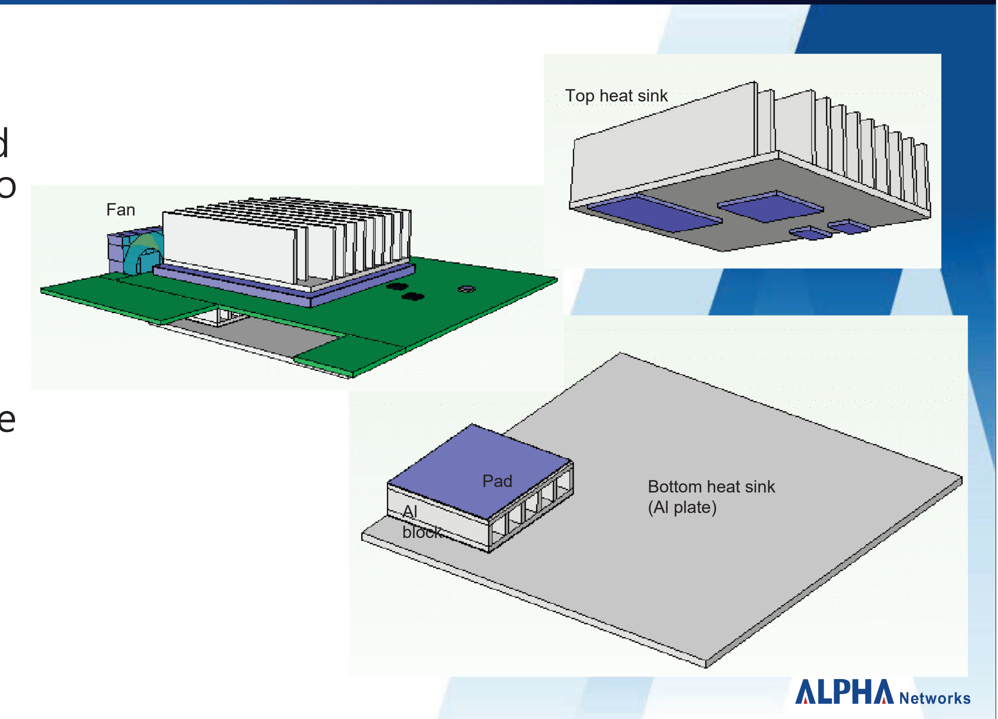


Actual thermal design

Actual design:

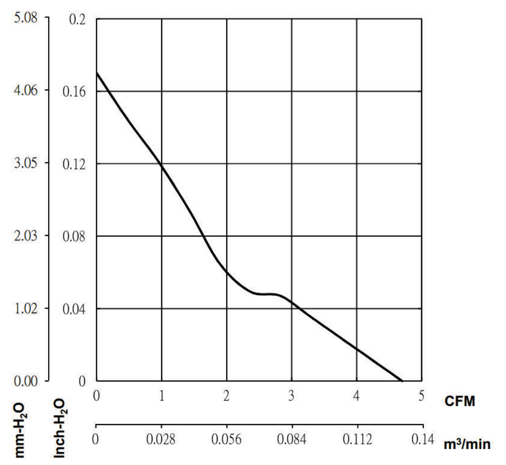
Use two heat sinks and a fan at housing side to provide flow through both heat sinks.

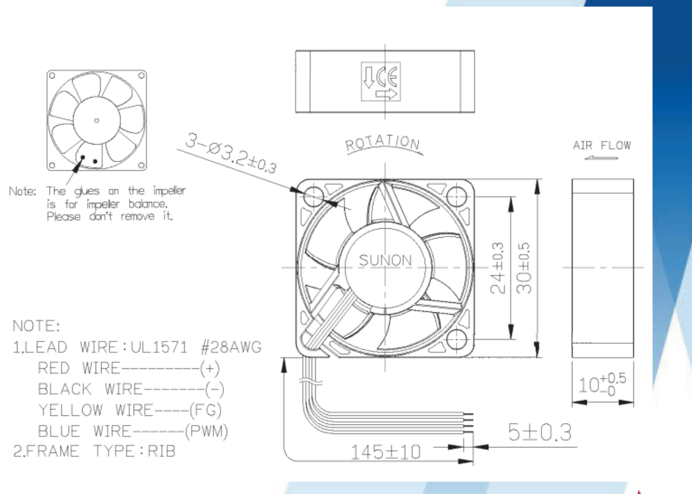
Bottom heat sink (Al plate) is exposed to the air to further reduce thermal resistance.



Fan

Sunon 3010 axial fan





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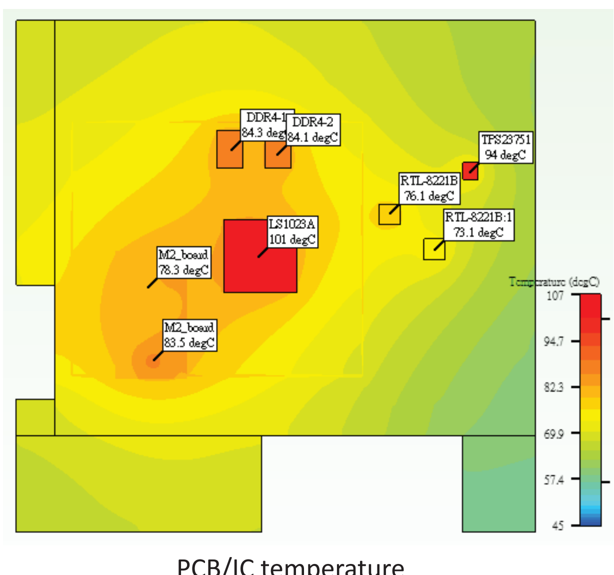
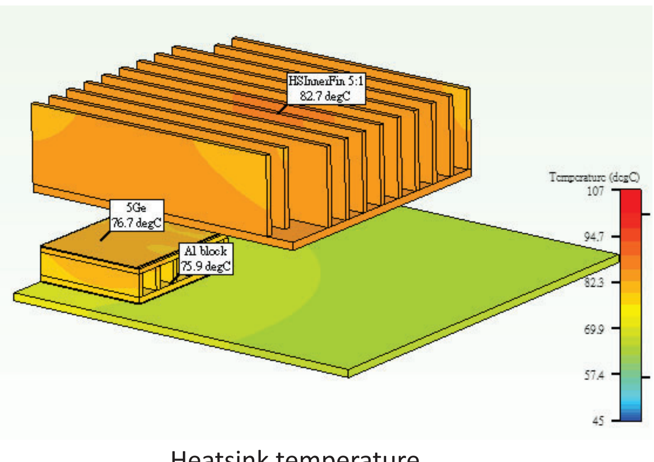
Temperature Results

All IC pass temperature spec.



PCB/IC temperature



Heatsink temperature

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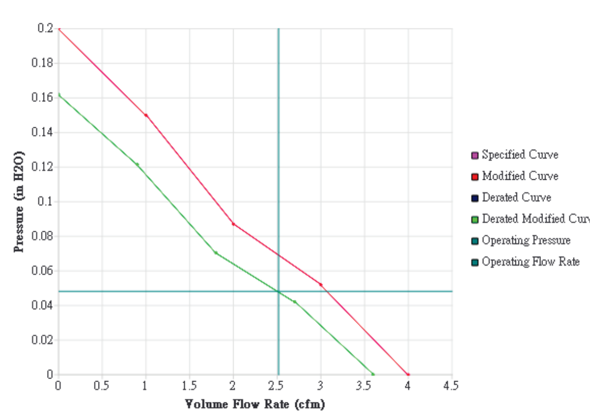
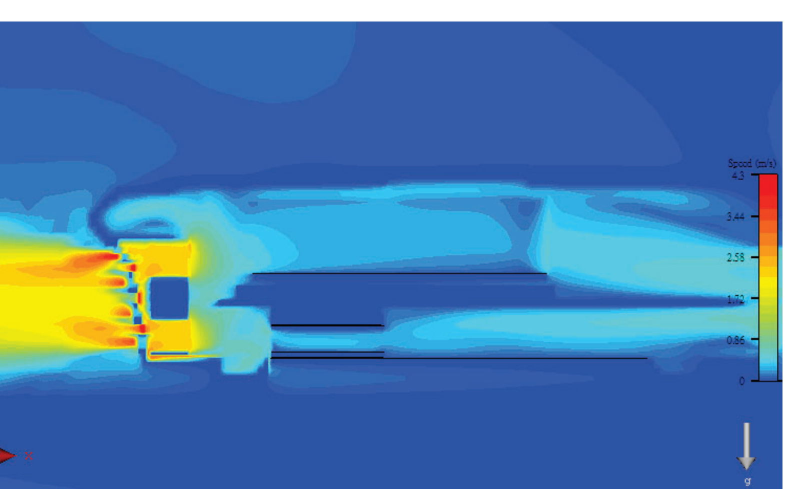
Flow Results

Fan speed w/ 10% derating, operating point volume flow rate = 2.5CFM





Air flow speed (AFO)

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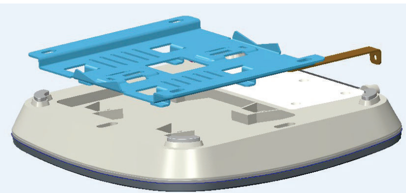
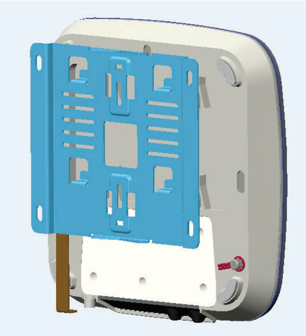
Case study 2: Wifi-6 AP

Wifi-6 AP product info.

- Housing material: PC
- Orientation: ceiling and pole mount
- Dimension: 185x185x35mm
- TDP = 7.79W
- Ta = 50degC
- Thermal solution:
  Heat sink (exposed to air)

Ceiling mount





Pole mount

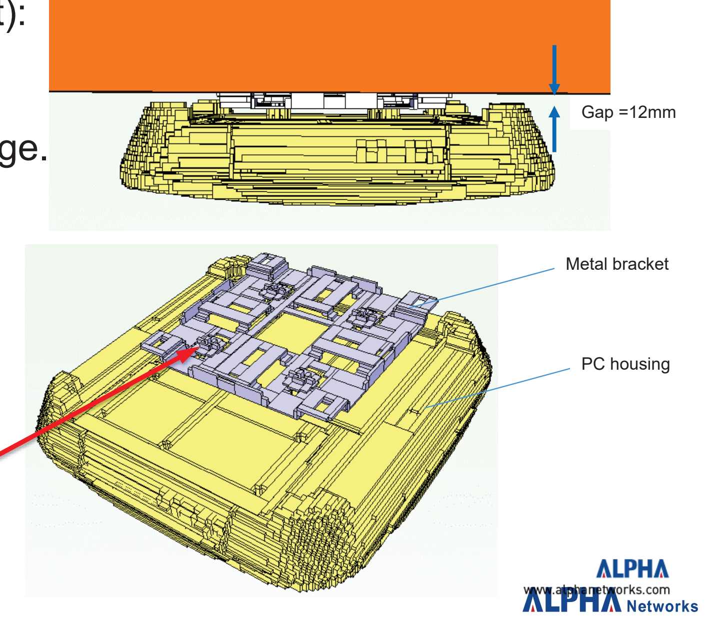
Thermal design concept

Key design considerations (ceiling mount):

1. Gap to ceiling:
   Larger is better, but cannot be too large.

2. Housing bottom/heatsink material:
   Metal is better than PC. Also, it's best if heatsink can be exposed to air.

   Alpha had applied our own patent to further increase heat dissipation.



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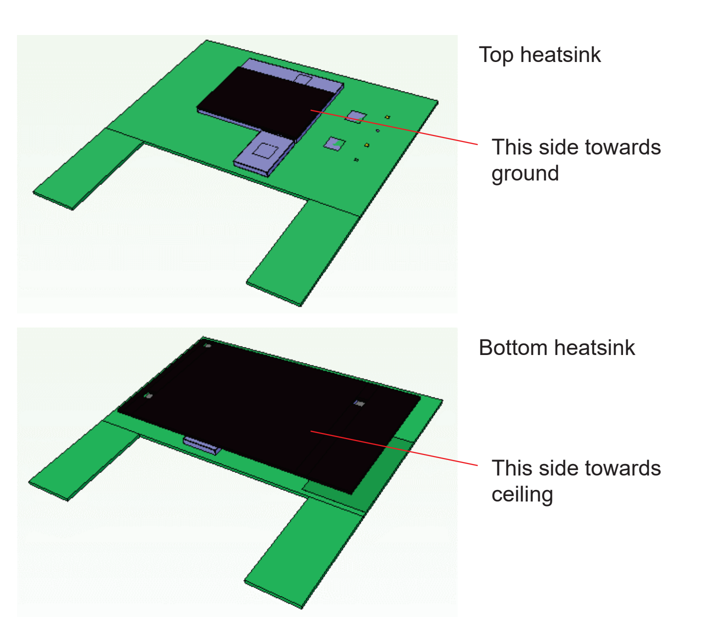
Detail thermal design

<u>Detail design</u>:

Due to the nature of ceiling mount, it is better to dissipate heat from bottom heatsink.

Bottom heat sink (Al plate) is exposed to the air and contact with metal bracket to further reduce thermal resistance.

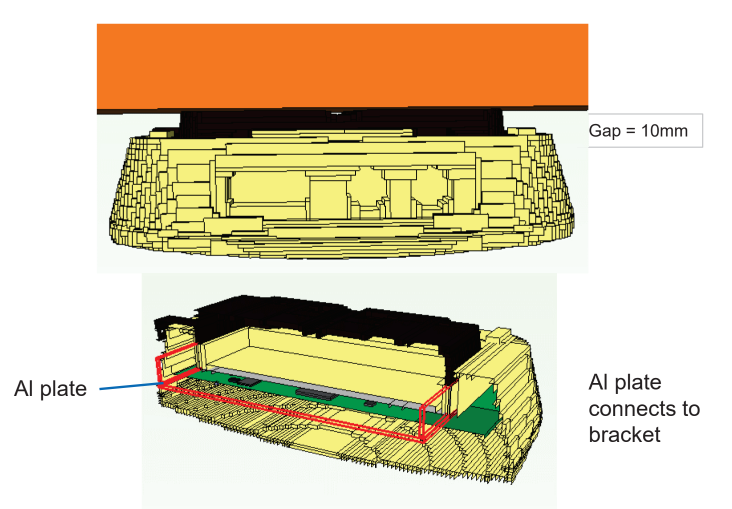
Also, housing material can affect thermal performance.

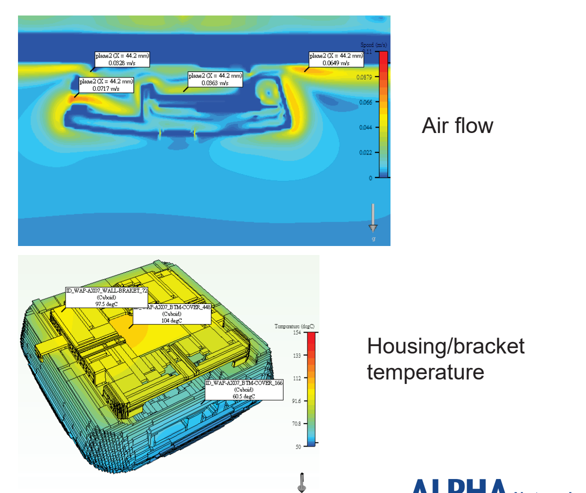


Simulation results

此案經過很多次的設變。以下面這組設計參數為例，其結果CPU的溫度Tj = 112.4度 (fail 2.4度)。

Ceiling gap = 10mm
Metal bracket connect with internal Al plate





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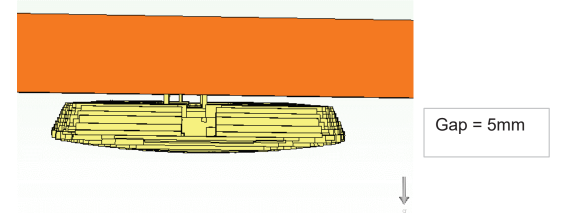
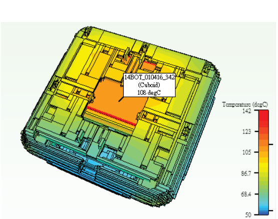
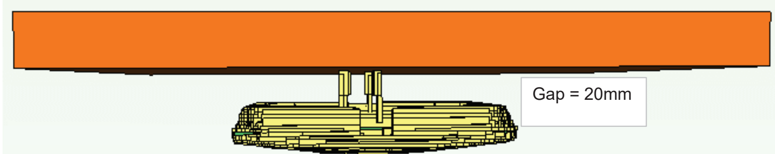
Ceiling gap effect

當ceiling gap變大時，內部IC溫度會下降。但實際的gap仍要看客戶的需求。以這個案例來說，若將gap從5mm加大到20mm時，CPU的溫度會降低10.2度。



CPU temperature:
106.8°C





CPU temperature:
96.6°C

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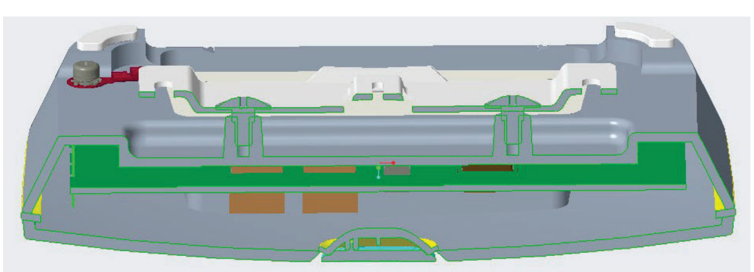
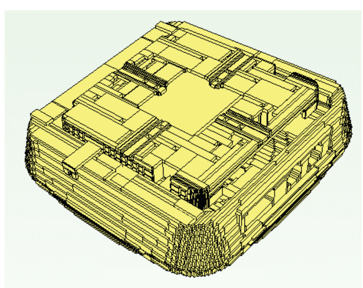
Alpha patent illustrated

為了讓AP在Ceiling mount的時候更有效的導熱到殼外，Alpha使用了一金屬bracket接殼內側的鋁板(如下圖)。

右圖顯示若使用此設計，在同樣的ceiling gap下，CPU的溫度較使用塑膠bracket可降低31度。

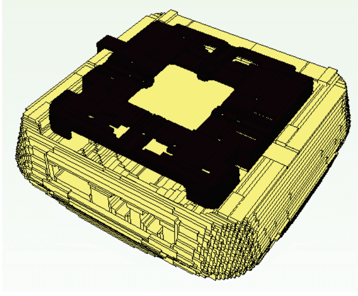


金屬bracket接鋁板設計概念圖



塑膠bracket

CPU=133度



金屬bracket接鋁板

CPU=102度

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Conclusion

- Wireless產品線因發熱瓦數較小，大多使用無風扇自然對流設計。
- 5G CPE為Alpha首次使用風扇的無線產品。其他產品如Router, AP因傳輸速度已從Wifi-6提升到Wifi-7, 發熱瓦數已>40W。故未來會有越來越多須上風扇的設計。部分機種還有噪音需求。
- 針對無風扇設計，ceiling mount為worst case。在Wifi-6 AP的案例中，Alpha透過鋁片外接金屬bracket的設計來強化散熱，同時能滿足客戶在外觀設計上的需求。

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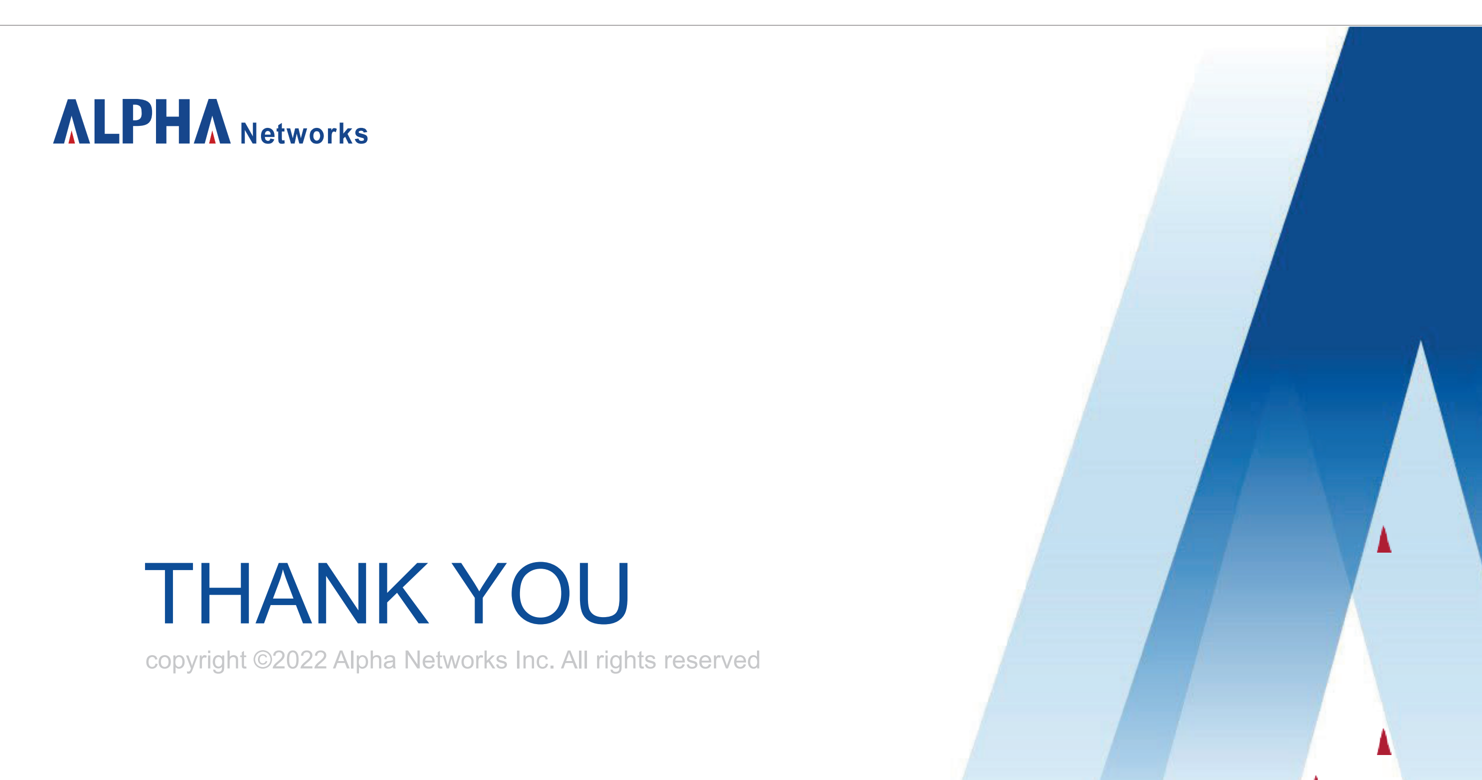
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淺談 FloEFD 於智能居家產品設計到生產應用

黃仁傑　智聯網開發部副理
沅聖科技股份有限公司

沅聖科技_淺談FloEFD
智能居家產品設計到生產

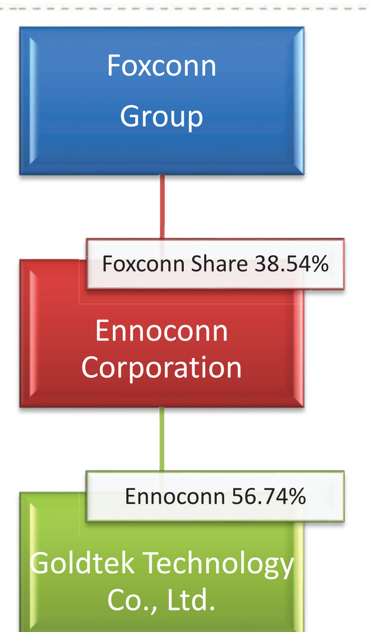
GOLDTeK Technology Co., Ltd.
Roscoe Huang 黃仁傑
2023.11.17

GOLDTek Company Profile

COMPANY NAME	GOLDTeK Technology Co., Ltd.
HQ LOCATION	Taiwan 16F, No.166, Jian 1st Rd., Zhonghe Dist., New Taipei City 23511, Taiwan (R.O.C)
FACTORY LOCATIONS	China Factory: - Shenzhen Foxconn Campus (SMT + Assembly) None-China Factory: - Malaysia (SMT + Assembly)
ESTABLISH	August, 2008
CAPITAL	USD 10 Million
Foxconn Group	Joined the Group in 2014
IPO	June, 2017
HEAD COUNT	HQ: 180 persons, GOLDTeK Shenzhen Factory: 1,200 persons

Confidential information-strictly protected under the non-disclosure agreement.

GOLDTek Ownership Structure & Share



- **Foxconn**
  - Strong EMS Partner for Worldwide Brands
  - Consumer and IT Products Focusing
  - Tier1 Large Scale Manufacturing
- **Ennoconn**
  - Industrial Computer Product Focusing
  - X86 Platform
  - EMS service with design capability (OEM/JDM/ODM)
- **Goldtek**
  - **IoT Product Focusing (wireless, low power consumption, water-proof..)**
  - **ARM-Based Platform**
  - **EMS service with design capability (OEM/JDM/ODM)**

GT Shareholders (Top 5)

56.74%
2.67%
2.53%
2.26%
2.25%
33.55%

Ennoconn International Investment Co., Ltd.
JIA-YI LIN
HUEI-BIN LIANG
HUEI-CHONG LIANG
SHU-CING HUANG
Others

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GOLDTek Production Site - China

GT Shenzhen Factory

- Location: China (Foxconn Longhua campus)
- 130,000 sq.ft.
- SMT 6 LINES
- ASSEMBLY LINE over 10 LINES
- Testing/Measurement Equipment
- Shop Floor Control System Equipped
- 100% Function test
- Burn In (Aging test)
- Certification: ISO 9001/14001
- ISO 13485

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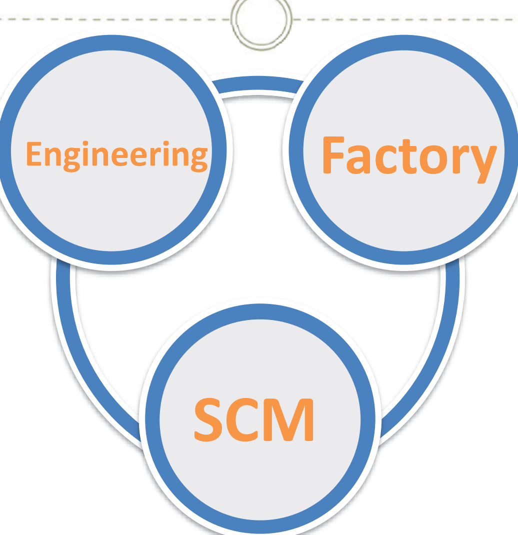
GOLDTek Core Value

Full Functional R&D Team

GOLDTeK Engineering teams has full function, we are capable to provide **one-stop shop service** on hardware & software development which includes ID/ME/Packing design, quality testing, Manufacturing and EMC/Safety certification tests etc. **Our R&D team has abundant design experience of IoT device.**

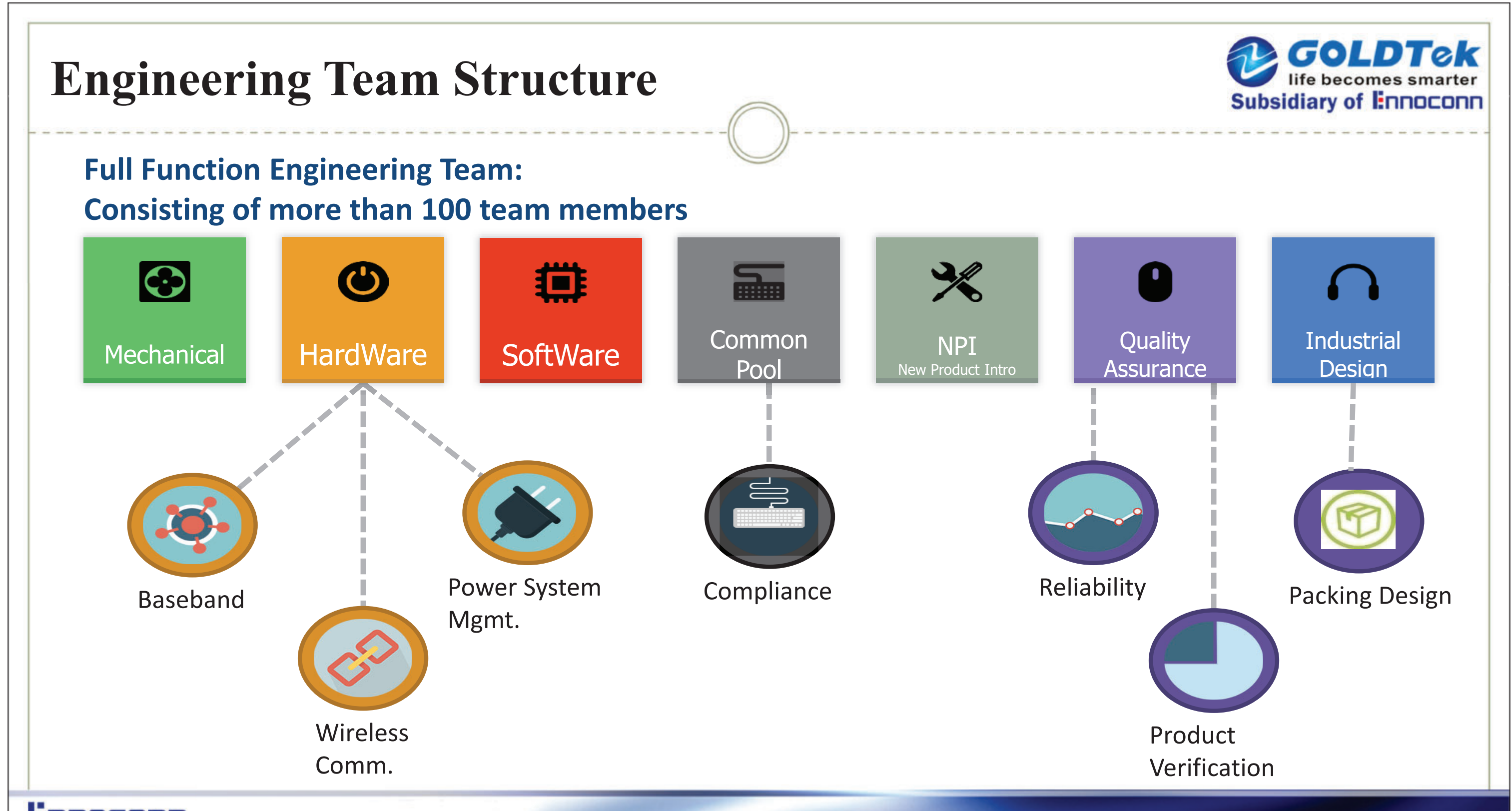


Manufacturing Capacity with High Quality

GOLDTeK factory is located in Foxconn facility in Shenzhen China. GOLDTeK is able to leverage resources of Foxconn such as machines and labors whenever we have demands. We will provide flexible service to make smooth NPI to MP transition to our clients. We're the **expert of manufacturing Smart Home/IoT device.**

Foxconn Common Pool Leverage

As subsidiary of Foxconn group, we are able to leverage **the Foxconn global supply chain's purchasing powe**r. Foxconn develops and designs supply chain solutions tailored to our client's needs. GOLDTeK will work with Foxconn team to satisfy our client's cost and lead-time goals.



Customers Reference

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NATURE

Full Experienced Smart Home ODM Supplier

- ODM of worldwide smart home Top Players. USA, EUROPE, JAPAN etc.
- Abundant camera integrated product experiences (Hand-held Device, Security cam, Doorbell, Intercom)
- Variety of traditional product convert to Smart.

ember

Lansinoh.

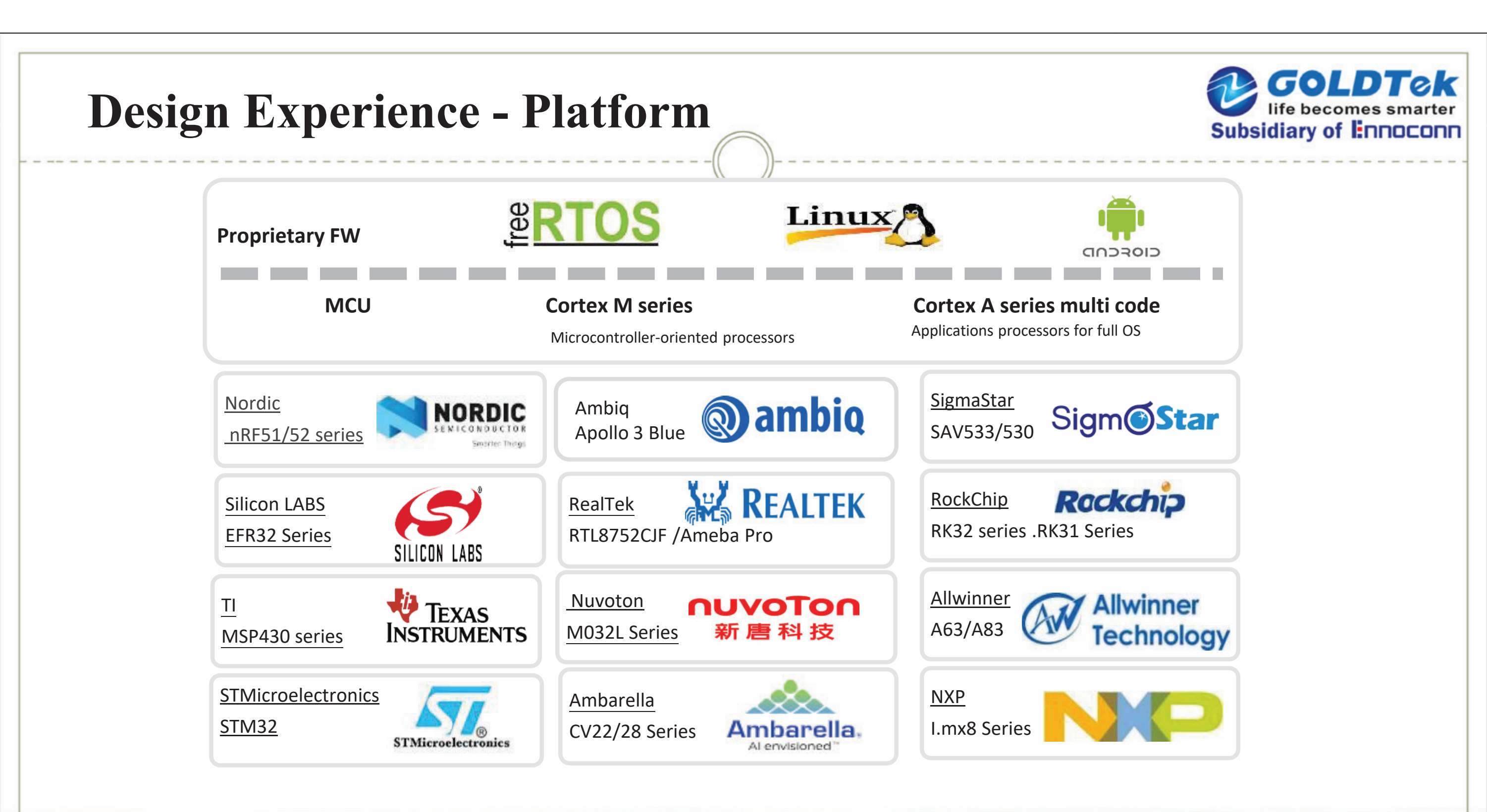
ring

ring

System Integration Service Provider

- PCBA Design/DFM
- Thermal Simulation
- Mechanical Design (IPXX)
- ID/Package Design
- RF System Design
- Image/video and voice/audio integration
- Verification/Certification service

CHAMBERLAIN



RF- Equipment List

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Keysight N9322C New
Spectrum Analyzer (BSA), 9 kHz to 7 GHz

Anritsu MT8852B
Bluetooth Tester:

Rohde & Schwarz CMU200
3.5G Radio Communication Analyzer

Anritsu MT8820C
4G Radio Communication Analyzer

FM RADIO, RDS, Broadcast, GNSS, ANT+, ZigBee Alliance, NFC, RFID, Bluetooth SMART READY, Wi-Fi, LoRa, sigfox, GSM, Sub-1GHz, GPRS, 3G, LTE, 4G LTE, 5G

< 50m
< 300m
> 1.5k

GSG-5
GNSS Simulator:

LitePoint IQnav
GPS Simulator :

FM/AM Signal Generator

Iqxel-80 Test System
Wi-Fi/LoRa/Bluetooth/Zigbee Tester: Lite Point

IQ fact studio
Wi-Fi automatic tester

Anritsu MT8821C
Radio Communication Analyzer
LTE/ M1/NB-IOT

RF- Equipment List

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ZVL6
Network Analyzer w/
Spectrum :Rohde & Schwarz

R&S ZNB8
Vector Network Analyzer, 4 ports,
9kHz - 8.5GHz,

MS2830A
Spectrum Analyzer/Signal Analyzer
13Ghz Anritsu

Z_S Z_C Z_L

Frequency (GHz)

10db/1db
Attenuator

RF Chamber

Shield Room

Shielding Box

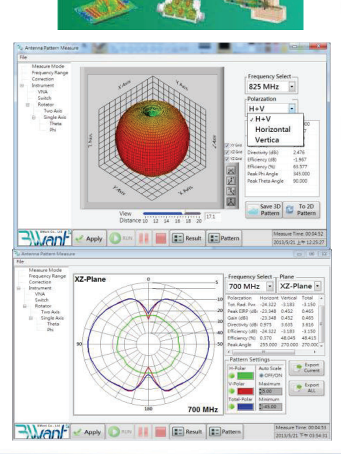
Innoconn An Innovative Foxconn Subsidiary
Confidential information-strictly protected under the non-disclosure agreement.

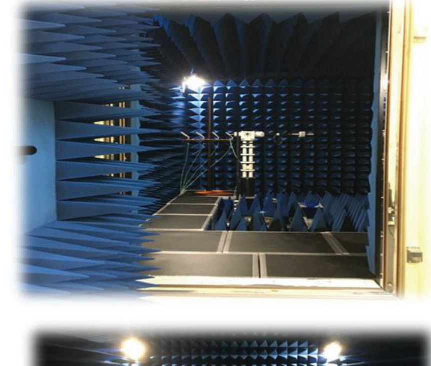
RF- In House Chamber

OTA Test Chamber

OTA chamber is an essential tool for developing wireless and portable IOT devices. GT has an in-house OTA chamber which provides highly efficiency in design phase when validating product RF performance.

- Size: L x W x H=7m x 4m x 3m
- Operating Band : from 700MHz to 6GHz
- Measurement:
  - Antenna Performance (Active /Passive)
  - Antenna Radiation Pattern
  - Through-put





Thermal test equipment

GT has temperature chambers in our laboratory, and we also work with 3rd party venders for thermal simulation report & related solution via temperature simulation tool.

Temperature Chambers in GT's laboratory

- Right: *General temperature & humidity chamber*, temperature range from -40℃ to +150 ℃, humidity from 10% to 98%
- Left: *Thermal shock chamber*, perform high & low temperature cycles within certain short period of time. High temperature ranges from 60 ℃ to 150 ℃, low temperature ranges from -10 ℃ to -65 ℃.

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Outdoor/Indoor Smart Camera Standard Product _Marimo

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Marimo

Multifunctional Security Camera

User Scenario

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Indoor Camera

Smart doorbell
Intercom
Call out button
Indoor camera
Doorbell chime
Outdoor camera

Chime

Doorbell

Functions

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4 IR LED
Objects can be clearly seen in night mode.

Indicator LED
Indicates the status of the device.

SD card
Can store video local and cloud.

Ball pin wall mount
Can adjust the horizontal and vertical angles in a wide range.

ALS
Detect light intensity to switch day and night mode.

MIC
Provides two-way talk.

1/4” Screw nut
Can be used with any camera mount.

Call out/ Answer button

Speaker
Two-way talk, prompt sound in different modes.

Security screw nut
Prevent device from being quickly removed.

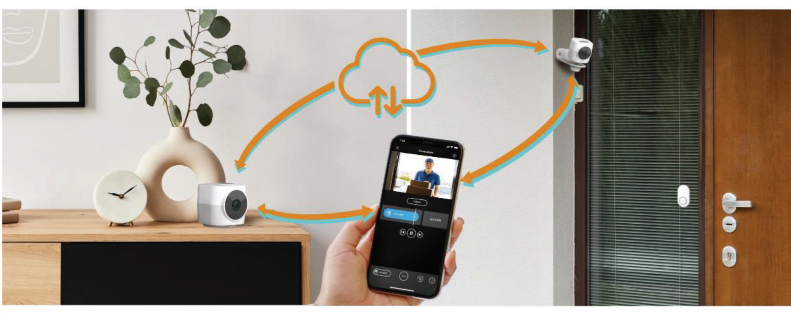
Marimo – Outdoor Smart Camera

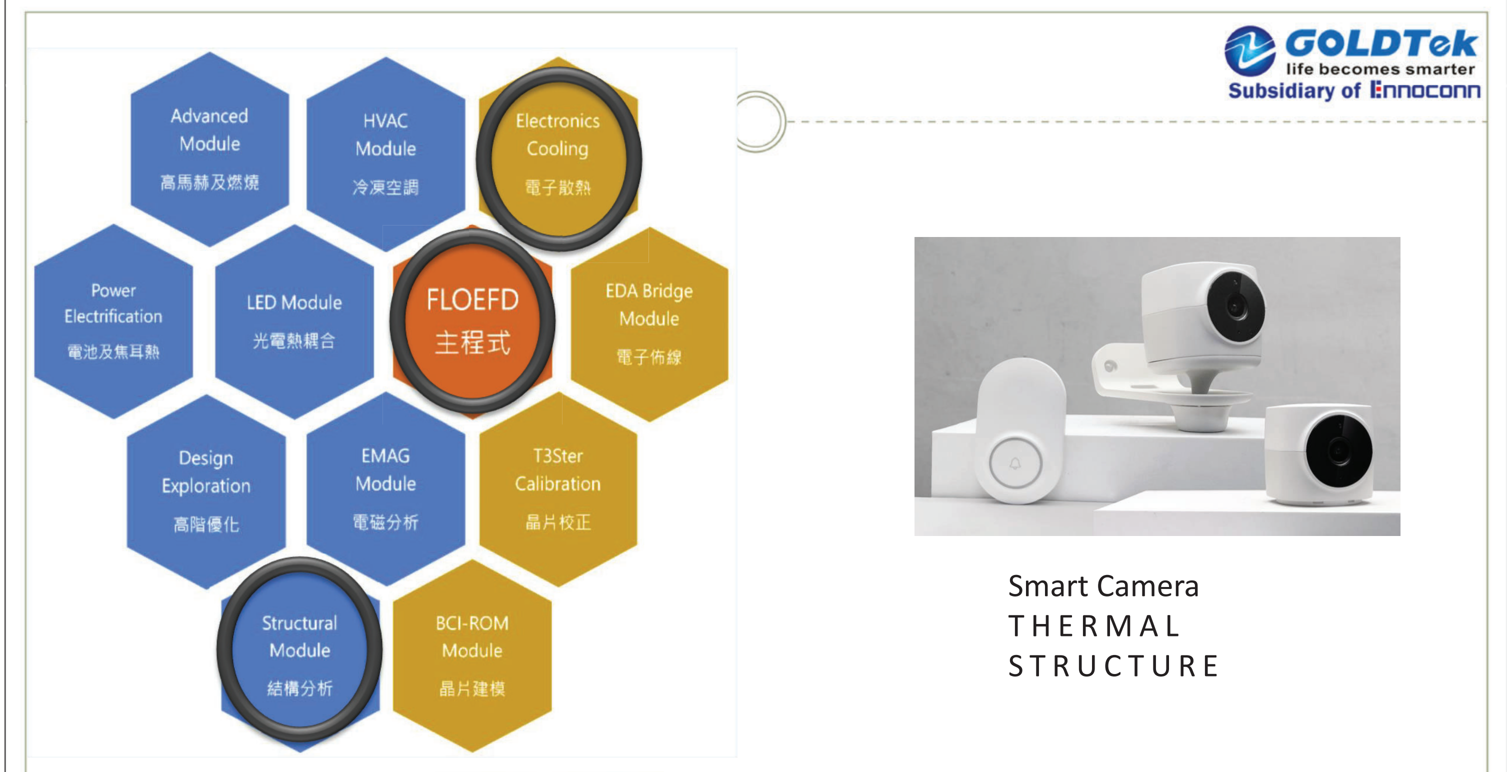
Camera:
- Image sensor: 1080P, 2MP
- FOV: 106°(H), 56° (V), 127° (D)
- Resolution: 1920 x 1080
- Video compression: H.265 / H.264
- Night vision: 850nm IR LED x 4
- Motion detection: Yes

Connectivity:
- Wi-Fi: 802.11 b/g/n @2.4GHz
- Safety: WPA/WPA2, WPA-PSK/WPS2-PSK
- 433MHz communication with remote button

Interface:
- Power: 5V@1A power adapter
- Mic: Omni-directional
- Speaker: 1W, Built-in
- TF card slot: Built-in
- Antenna: Built-in

Environment:
- Operating condition: -20℃ to 45 ℃
- Humidity: <95%, non-condensing





Solar radiation simulation

The color temperature of solar radiation is about 5900K radiation, and the radiation energy reaching the surface of the Earth's atmosphere is about 1366W/m^2. The radiation energy will be weakened by atmospheric absorption, and the related radiation strength will be different through different atmospheric paths.

The International Commission on Illumination (CIE) publication 20 simulated the cumulative intensity and spectral distribution of solar radiation for experimental tests, with an average total intensity of solar to terrestrial radiation of 1120W/m^2

AM0: The average illuminance of sunlight outside the atmosphere; The standard solar constant irradiance is 1366W/m2
AM1.5: The average irradiance of sunlight passing through 1.5 times the atmosphere at an Angle θ=48.2 degrees to reach the surface is 1120 W/m2

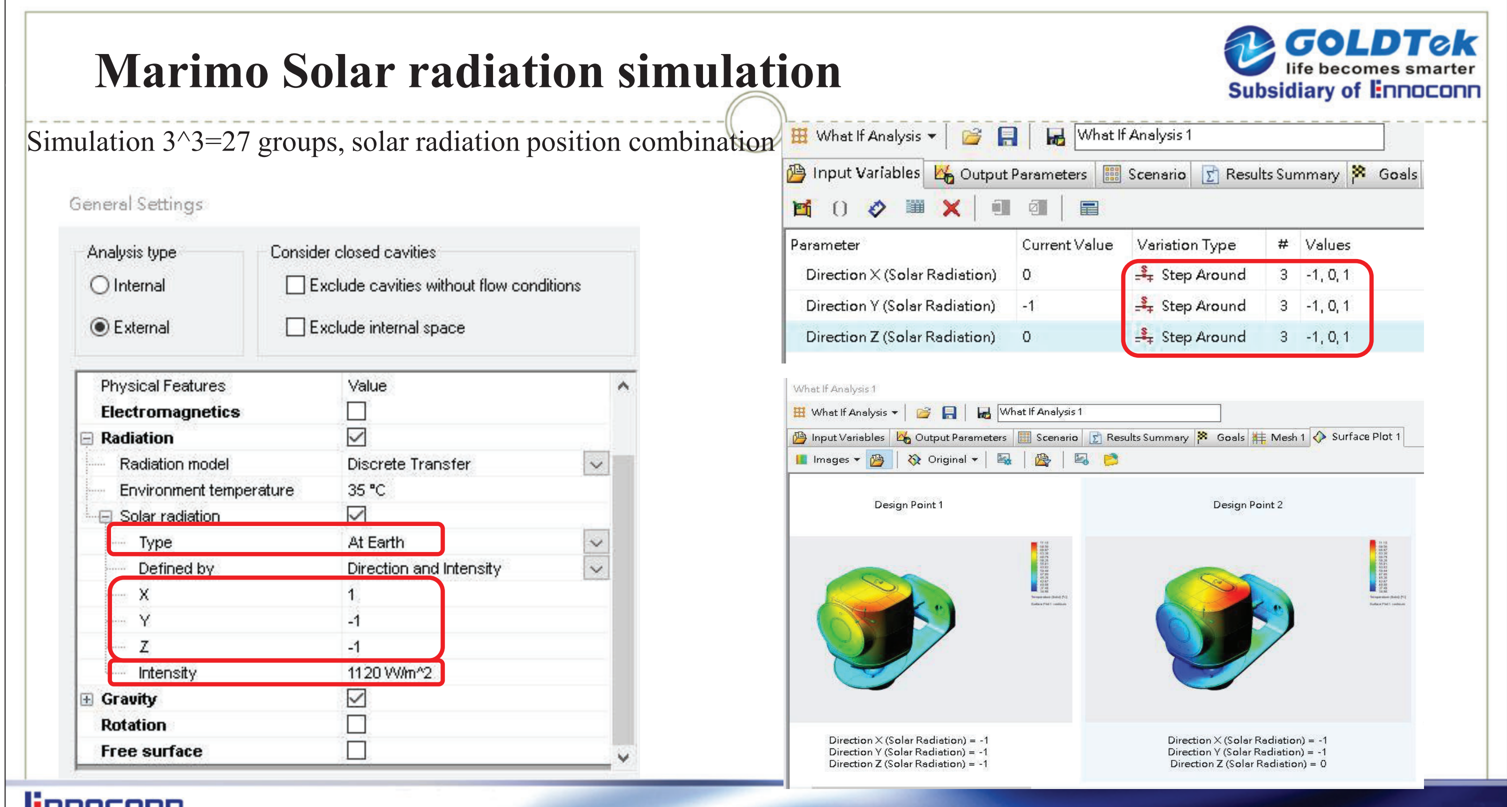
AM = P/P0 = sec θz
θz - ZENITH ANGLE
AM 2.0 60.1°
AM 1.5 48.2°
AM 0
AM 1.0
ATMOSPHERE
EARTH

radiant intensity
$\frac{W}{m^2 \mu m}$
2500
2000
1500
1000
500
ideal black body (temperature 5900 K)
extraterrestrical sunlight (air mass AM0) 1366W/m²
terrestrical sunlight (air mass AM1.5) 1120W/m²
250 500 750 1000 1250 1500 1750 2000 2250 nm
UV
visible light
IR
wavelength

Yearly sum of Global Horizontal Irradiation (GHI)
850 ~ 1.6 Kw / m²

Global solar illuminance distribution, regional illuminance range 850~1600 W/m^2 in the figure

Source: Meteonorm 7.1 (www.meteonorm.com); uncertainty 8%
Period: 1991 - 2010; grid cell size: 0.125°
March 2014



Simulation parameters

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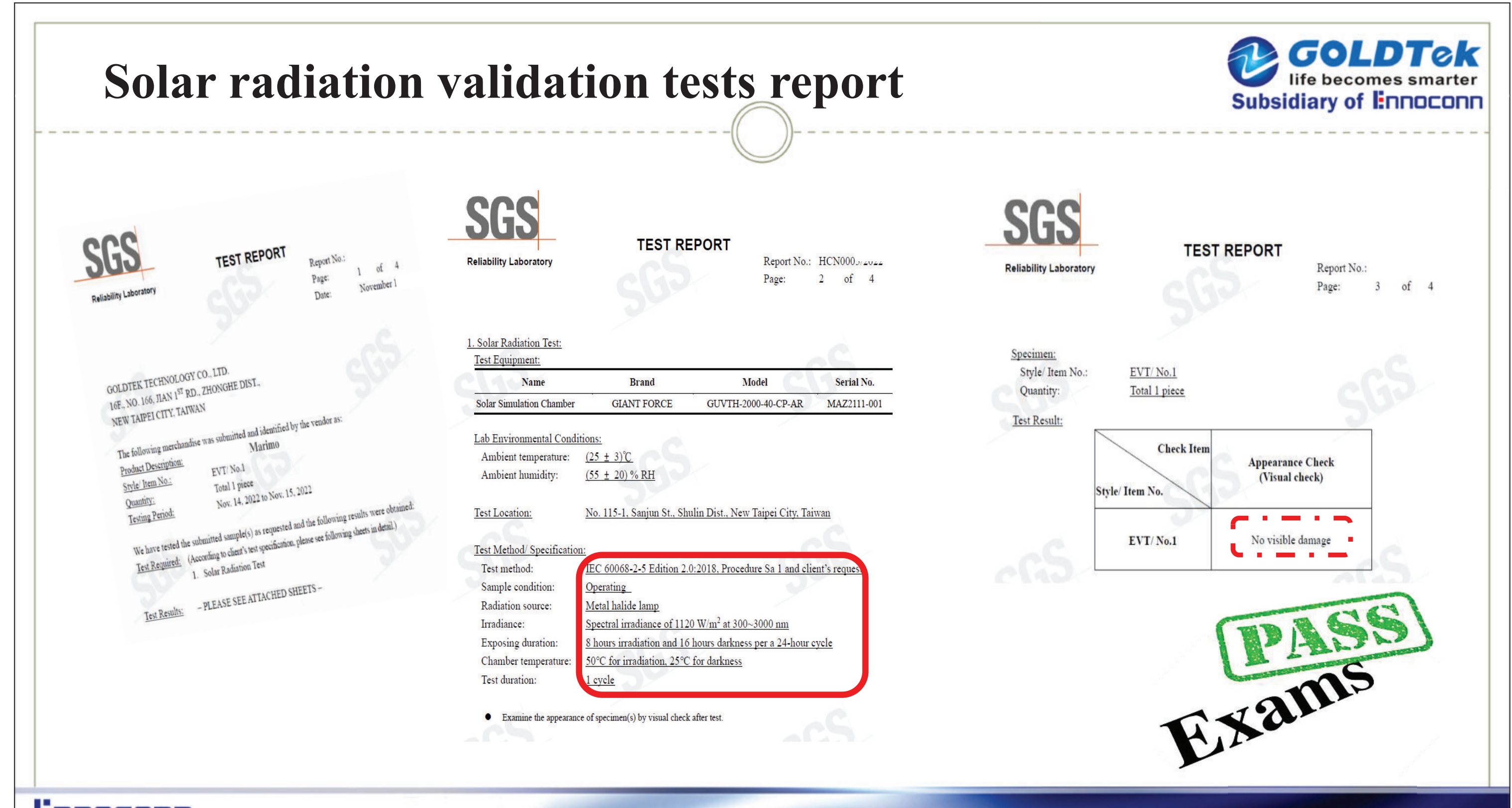
Total 27 cases@35°C,Intensity 1120W/m^2

Parameter	Design Point 1	Design Point 2	Design Point 3	Design Point 4	Design Point 5	Design Point 6	Design Point 7	Design Point 8	Design Point 9	Design Point 10
Direction X (Solar Radiation) [ ]	-1	-1	-1	-1	-1	-1	-1	-1	-1	0
Direction Y (Solar Radiation) [ ]	-1	-1	-1	0	0	0	1	1	1	-1
Direction Z (Solar Radiation) [ ]	-1	0	1	-1	0	1	-1	0	1	-1
Temperature (Solid) [°C]						The Highest				
Maximum	-7.302697805	-4.711401786	-2.202128664	-7.757248484	-3.224353932	75.98379579	-11.73174725	-10.16482622	-6.849680991	-6.466876471

Temperature (Solid) Maximum

Through simulation, it is found that the high temperature heating area of Case6 conforms to the heat resistance specification of plastic materials and is not easy to occur thermal deformation design



Marimo Boundary conduction for structure analysis

Situation	Simulate a user setting up a camera
Task	1. Fix the head on the wall 2. Apply 3.06kg downforce
Action	3. Ball shaft part - stress and strain, whether it meets the safety design
Result	Observe camera 1.2.3 body, whether the structural str ength is properly designed Overlay cycle, speed up design correction

Fixed on the wall, applied force on the top
Observed the product structure analysis

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30N=3.06KG

1. Constrain the fixed surface
2. Apply force to the loading area
3. The ball shaft contacts the sliding area

Marimo Structural analysis summary

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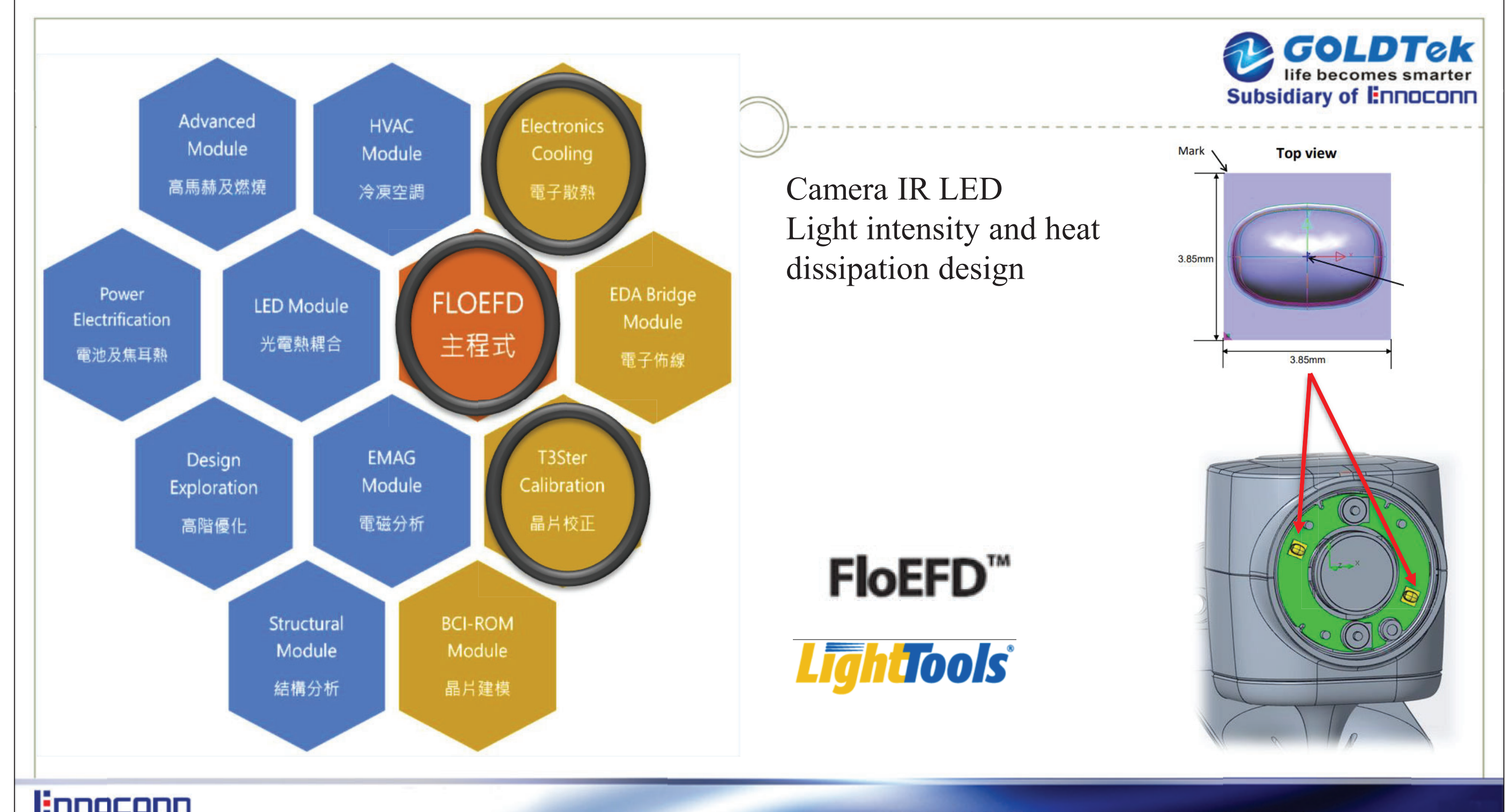
81.274
75.469
69.664
63.858
58.053
52.248
46.443
40.637
34.832
29.027
23.221
17.416
11.611
5.805
0
Von Mises Stress [MPa]
Surface Plot 3: contours

FloEFD Structure
Simulate user installation techniques

The magnitude of the equivalent stres
s in the sphere axis is related to
Where damage may occur

179.561
166.735
153.910
141.084
128.258
115.432
102.606
89.781
76.955
64.129
51.303
38.477
25.652
12.826
0
Von Mises Stress [MPa]
Surface Plot 2: contours

Von Mises Stress 39.210 MPa
Von Mises Stress 39.620 MPa
Von Mises Stress 50.695 MPa
Surface Plot 2 Maximum
Von Mises Stress 179.561 MPa
Von Mises Stress 59.169 MPa



LED light source distribution and thermal countermeasures

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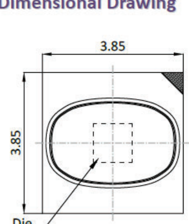
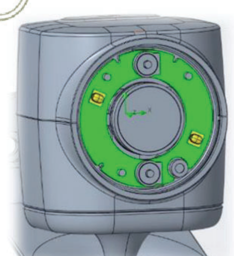
Asymmetrical light type, oval shape

Dimensional Drawing





LED monomers list different amps (A) Light and thermal power ratio actual measurement data table

T_A : 25 °C

Parameter	Symbol		Rating
Forward current	I_F	max.	1 A
Power consumption	P_{tot}	max.	2.2 W
Pulse forward current	I_{PF}	max.	3 A
Reverse voltage	V_R	max.	5 V
Junction temperature	T_j	max.	115 °C
Operating temperature	T_{op}	min.	-40 °C
		max.	105 °C
Storage temperature	T_{stg}	min.	-40 °C
		max.	105 °C
Soldering temperature	T_{sol}	max.	260 °C
Thermal resistance junction	R_{th}	typ.	4.5 K/W
		max.	9 K/W

IR LED型號	安培(A)	電壓(V)	最大功率 (W)	光功率占比	光功率 (W)	熱功率占比	熱功率 (W)	Rth jc=K/W	ΔT=Rth jc* (Power)
SL3838F85CQ00	1	1.694	1.694	48.468%	0.821	51.532%	0.873	9.000	7.855
	0.75	1.621	1.216	51.119%	0.622	48.881%	0.594	9.000	5.349
	0.5	1.542	0.771	54.376%	0.419	45.624%	0.352	9.000	3.165
	0.375	1.498	0.562	54.676%	0.307	45.324%	0.255	9.000	2.291
	0.25	1.449	0.362	56.385%	0.204	43.615%	0.158	9.000	1.422
	0.125	1.390	0.174	57.344%	0.100	42.656%	0.074	9.000	0.667
	0.1	1.375	0.138	57.644%	0.079	42.356%	0.058	9.000	0.524
	0.05	1.338	0.067	58.243%	0.039	41.757%	0.028	9.000	0.251

Rthjc via T3STER_Measurement Process

Structure Function

- Integral Structure Function @25℃
- Use TDI Method (diff. Thermal Pad) JESD 51-14Yellow Pad Thermal Conductivity = 3.5W/mKBlue Pad Thermal Conductivity = 6.2W/mK
- **Rthjc = 4.534 K/W @2A**

LED Photo

Measure Parameter

Set Parameter	SL3838F85CQ00
I measure	20mA
I drive	1A
Ambient Temperature	25℃

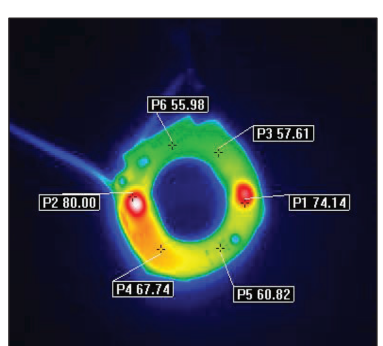
TSP Calibration

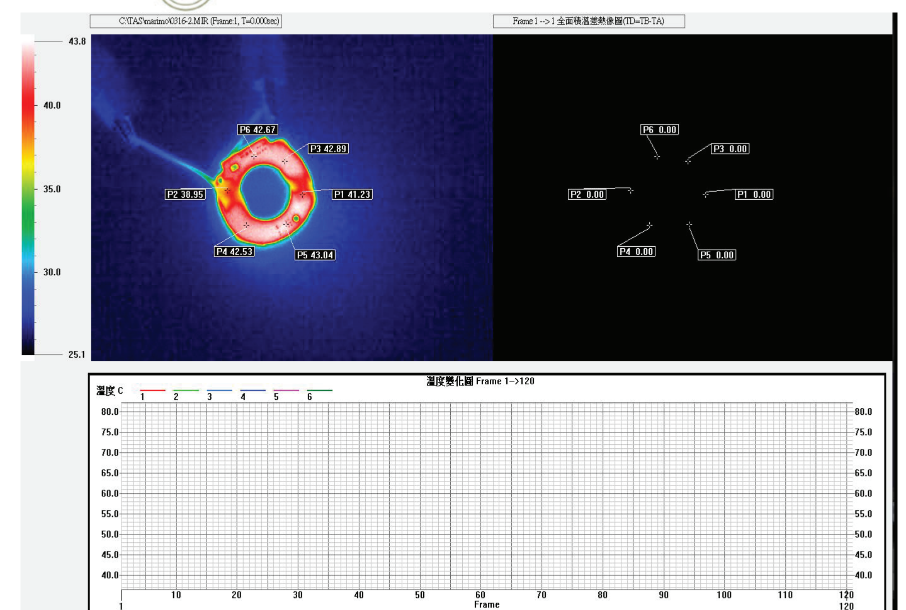
Measured data from TCO
Approximate function R² = 0.999879
Voltage [V]
Temperature [°C]

SL3838F85CQ00		
Item	T (℃)	V_F (V)
T1	24.97	1.16323
T2	34.86	1.15226
T3	44.80	1.14104
T4	54.76	1.12962
T5	64.64	1.11814
T6	74.51	1.10650
Sensitivity (mV/K)	-1.145	

Confidential

T3STER actually measures @2A
LED typical resistance
Ensure that the thermal parameters of the LED monomer are consistent with the product datasheet





@Ambient 25°C,input 0.375A , heat source 0.255W,Rthjc:4.524K/W ,0~180 sec build up

LED Surface:80°C
LED T-junction:78.8°C(Spec 115°C)

Shift the ambient to 45°C
LED T-junction:98.8°C still within Spec 115°C

Night Vision Compression

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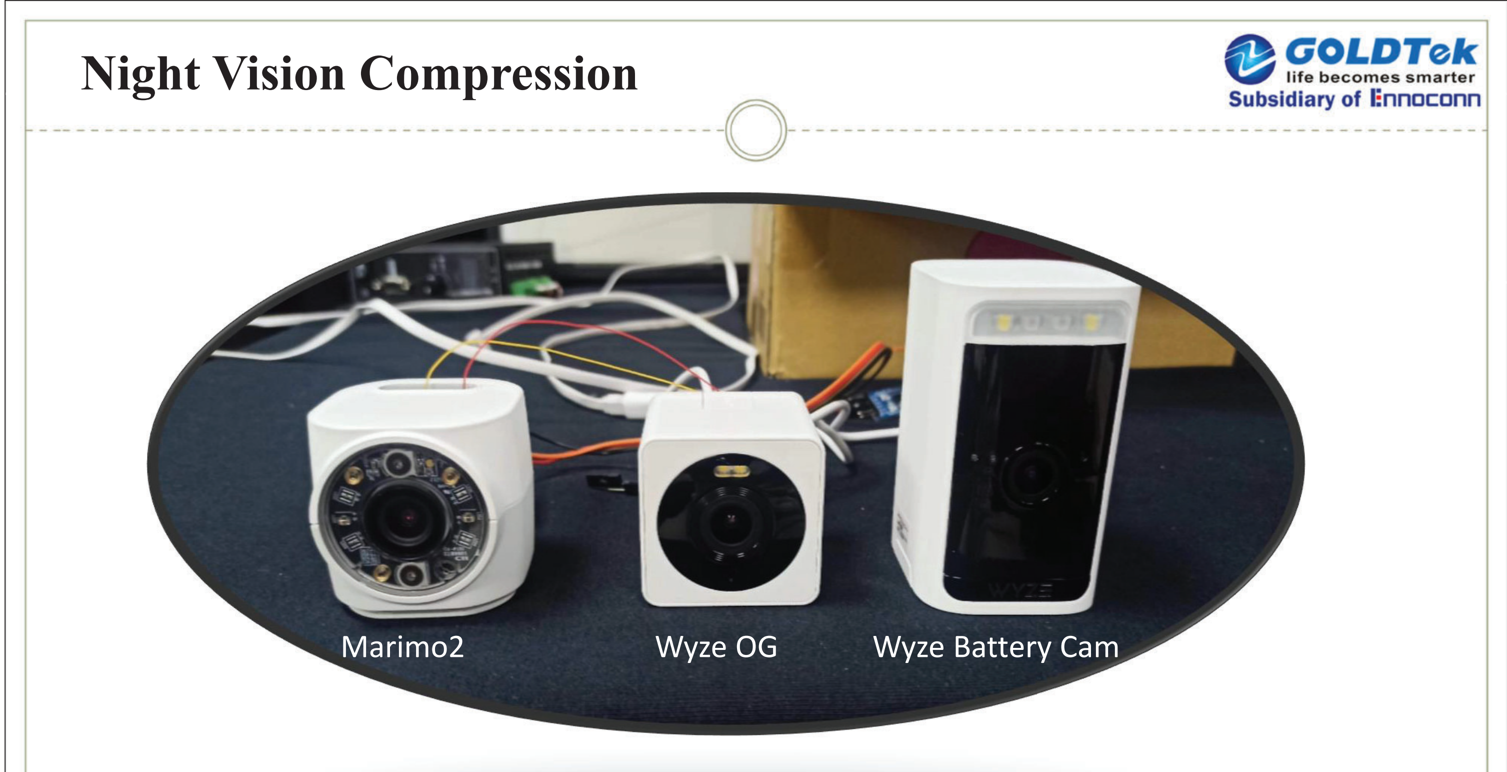


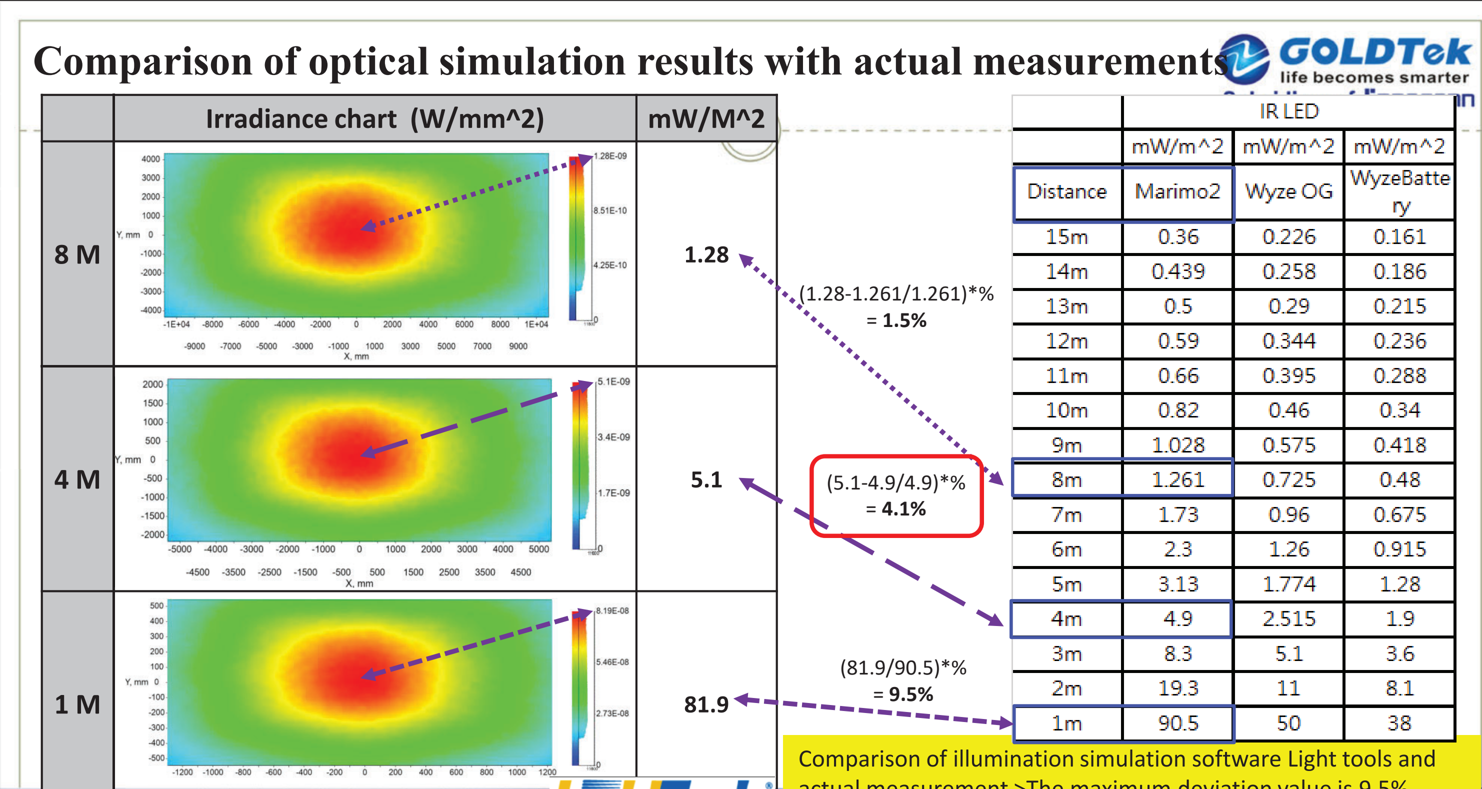
IR LED Uniformity measurement result

Marimo @4M
The uniformity of the surrounding corners is relatively consistent

Wyze OG @4M
The uniformity of the surrounding corners is darker and the middle is brighter

Wyze Battery Cam @4M
The uniformity of the surrounding corners and center is dark

Comparison of optical simulation results with actual measurements



	IR LED		
	mW/m^2	mW/m^2	mW/m^2
Distance	Marimo2	Wyze OG	WyzeBattery
15m	0.36	0.226	0.161
14m	0.439	0.258	0.186
13m	0.5	0.29	0.215
12m	0.59	0.344	0.236
11m	0.66	0.395	0.288
10m	0.82	0.46	0.34
9m	1.028	0.575	0.418
8m	1.261	0.725	0.48
7m	1.73	0.96	0.675
6m	2.3	1.26	0.915
5m	3.13	1.774	1.28
4m	4.9	2.515	1.9
3m	8.3	5.1	3.6
2m	19.3	11	8.1
1m	90.5	50	38

Comparison of illumination simulation software Light tools and actual measurement >The maximum deviation value is 9.5%
The mean deviation value is 5%

IR LED uniformity measurement result

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Marimo @4M
The uniformity of the surrounding corners is relatively consistent

BEST
BETTER
GOOD

2. 配光特性 (Directivity)

圖1

+y
0L
270L
-x
90L
+x
180L
-y

圖2

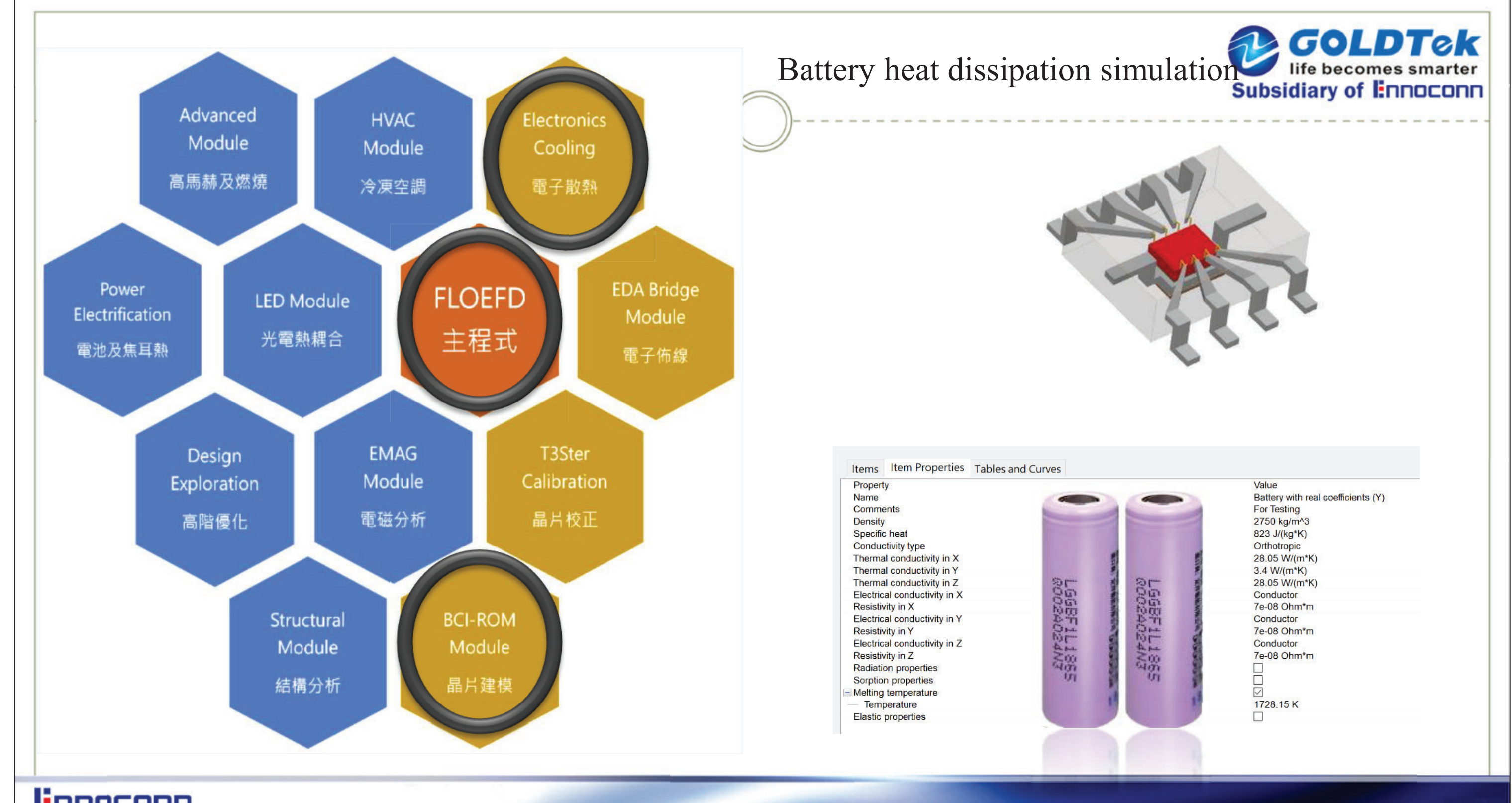
L = 0.0000
L = 90.000

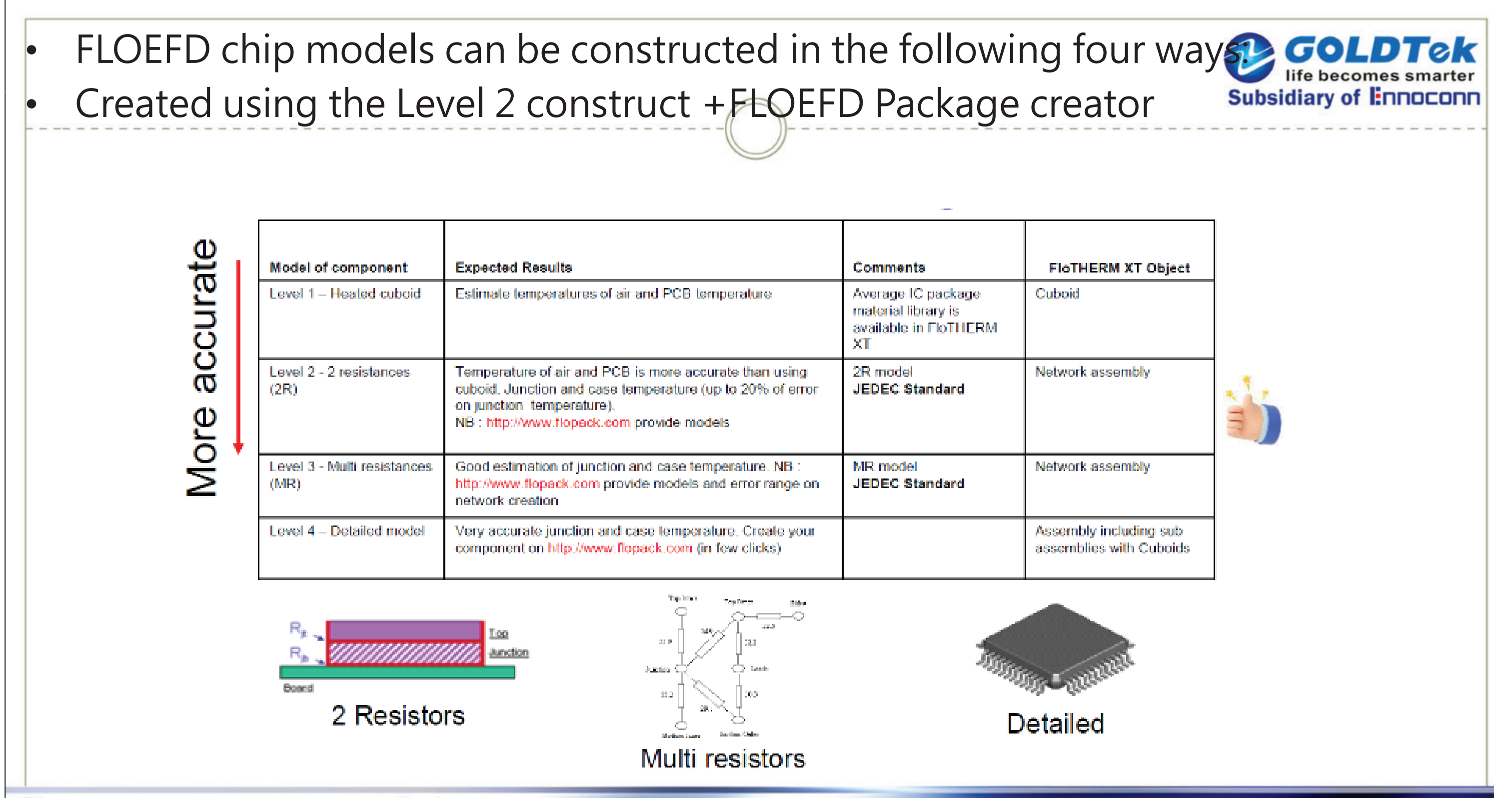
Intensity (%)
degrees

Import asymmetric light type, SL3838F85CQ00H
Surpass competitive products and meet the two factors of product design

1. LED heat dissipation, low thermal resistance Rthjc:4.5
2. LED average luminosity, light intensity 4.9~5.1
   enhance the uniformity around
   (Figure 1.2 red area and curve)

弘凱 Brightek





Model of component	Expected Results	Comments	FloTHERM XT Object
Level 1 – Heated cuboid	Estimate temperatures of air and PCB temperature	Average IC package material library is available in FloTHERM XT	Cuboid
Level 2 - 2 resistances (2R)	Temperature of air and PCB is more accurate than using cuboid. Junction and case temperature (up to 20% of error on junction temperature). NB : http://www.flopack.com provide models	2R model **JEDEC Standard**	Network assembly
Level 3 - Multi resistances (MR)	Good estimation of junction and case temperature. NB : http://www.flopack.com provide models and error range on network creation	MR model **JEDEC Standard**	Network assembly
Level 4 – Detailed model	Very accurate junction and case temperature. Create your component on http://www.flopack.com (in few clicks)		Assembly including sub assemblies with Cuboids

FLOEFD Package Creator

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Simcenter FLOEFD Package Creator

新建封装

选择起始模板

TSSOP SOP QFN ChipArray FOWLP

WirebondPBGA FlipChipPBGA ThinTO263 TO263 TO220

TO252

设计名称	SOP-8
外形类型	标准外形
Jedec 覆盖范围	3.81x4.93mm
Jedec 引线	8
热功率	1.4100 W
晶粒长度	1.4790 mm
晶粒宽度	1.1430 mm
外露焊盘	☑
引线框材料	基于合金 42

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Steady state
Board level
PCBA + Charger IC

Steady state
Package level
Analysis battery Charging

可能性 \ 影响	低	中	高
高	低	中	高
中	低	中	中
低	低	低	低

Significantly reduce thermal risk before sample build

Items | Item Properties | Tables and Curves

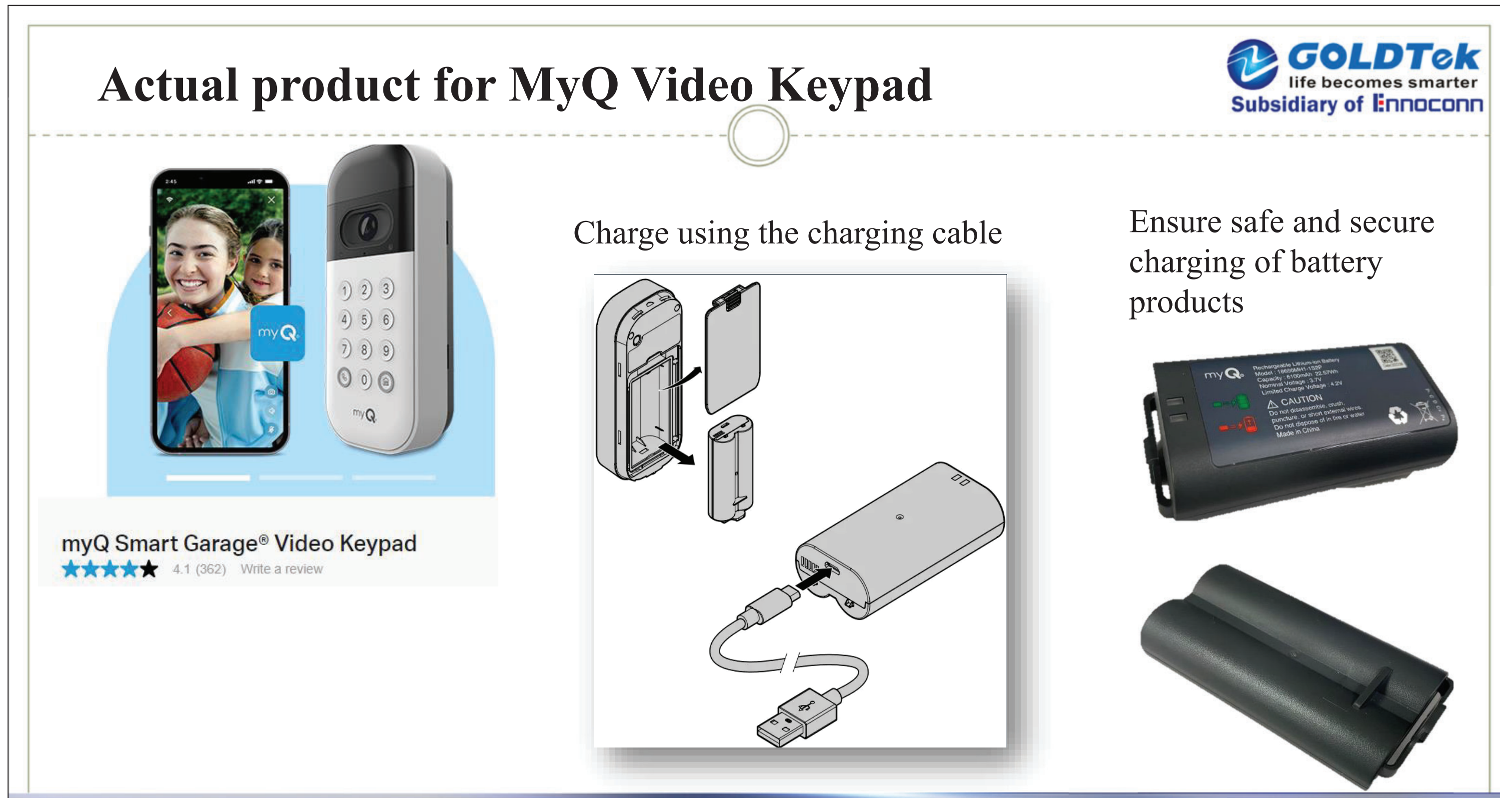
Property	Value
Name	Battery with real coefficients (Y)
Comments	For Testing
Density	2750 kg/m^3
Specific heat	823 J/(kg*K)
Conductivity type	Orthotropic
Thermal conductivity in X	28.05 W/(m*K)
Thermal conductivity in Y	3.4 W/(m*K)
Thermal conductivity in Z	28.05 W/(m*K)
Electrical conductivity in X	Conductor
Resistivity in X	7e-08 Ohm*m
Electrical conductivity in Y	Conductor
Resistivity in Y	7e-08 Ohm*m
Electrical conductivity in Z	Conductor
Resistivity in Z	7e-08 Ohm*m
Radiation properties	☐
Sorption properties	☐
Melting temperature	☑
Temperature	1728.15 K
Elastic properties	☐

Charging Transient Phenomenon

Simulated battery charging transient change 0~35000 seconds

Power consumption trend
IC power (Watt)
Time (SEC)

Simulate charging state, internal components - thermal transient changes



Thank you!

Smart Home &Surveillance Products series

掛載拋投之CFD模擬 &
轂帽鰭設計分析技術建立

飛彈火箭研究所氣動力學組
國家中山科學研究院

掛載拋投之CFD模擬

CFD simulation of Store Separation from a 3D Delta Wing

林潔茵 2023/11/17

國家中山科學研究院
National Chung-Shan Institute of Science and Technology

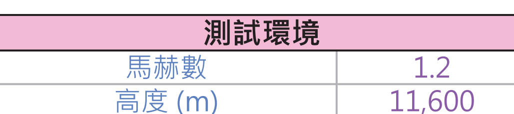
大綱

- 一、介紹
- 二、彈道分析
- 三、暫態模擬 – STRA-CCM+
- 四、結果

介紹 – 拋投條件

推力

實驗用支桿



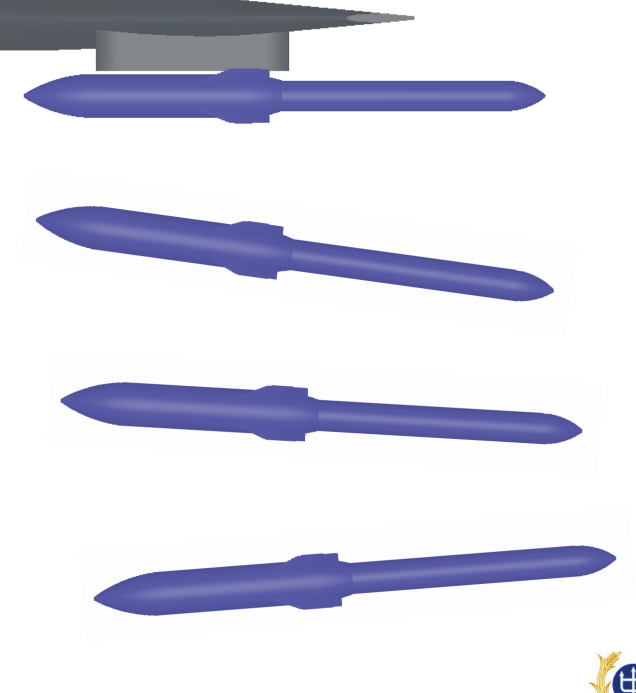
測試環境	
馬赫數	1.2
高度 (m)	11,600

物理性質	
質量 (kg)	907
質心位置 (m)	1.418
轉動慣量x (kg-m^2)	27
轉動慣量y (kg-m^2)	488
轉動慣量z (kg-m^2)	488

施加外力	
前推力位置 (m)	-0.1805
後推力位置 (m)	0.3285
前推力 (Nt)	10,700
後推力 (Nt)	42,700
有效範圍 (m)	0.1

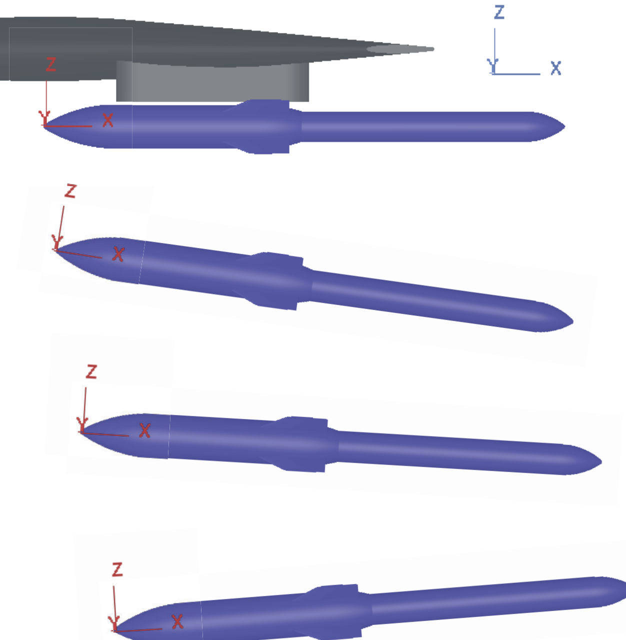
介紹 – 擬穩態vs暫態

- 擬穩態
  - 彈道分析程式
  - 積分各時步的位移和角位移
- 暫態
  - STAR-CCM+模擬
  - 求解紊流方程式



彈道分析 – 理論

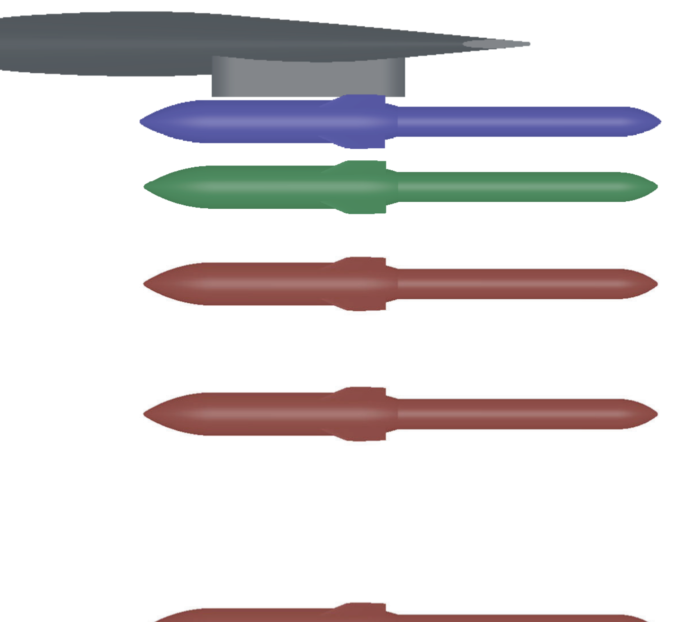
- 時間積分: 4th Runge-Kutta
  - 位移: $\vec{F} = \left[d(\vec{V})/dt\right]_B + \vec{\omega} \times m\vec{V}$
  - 角位移: $\vec{M} = \left[d\vec{H}/dt\right]_B + \vec{\omega} \times \vec{H}$



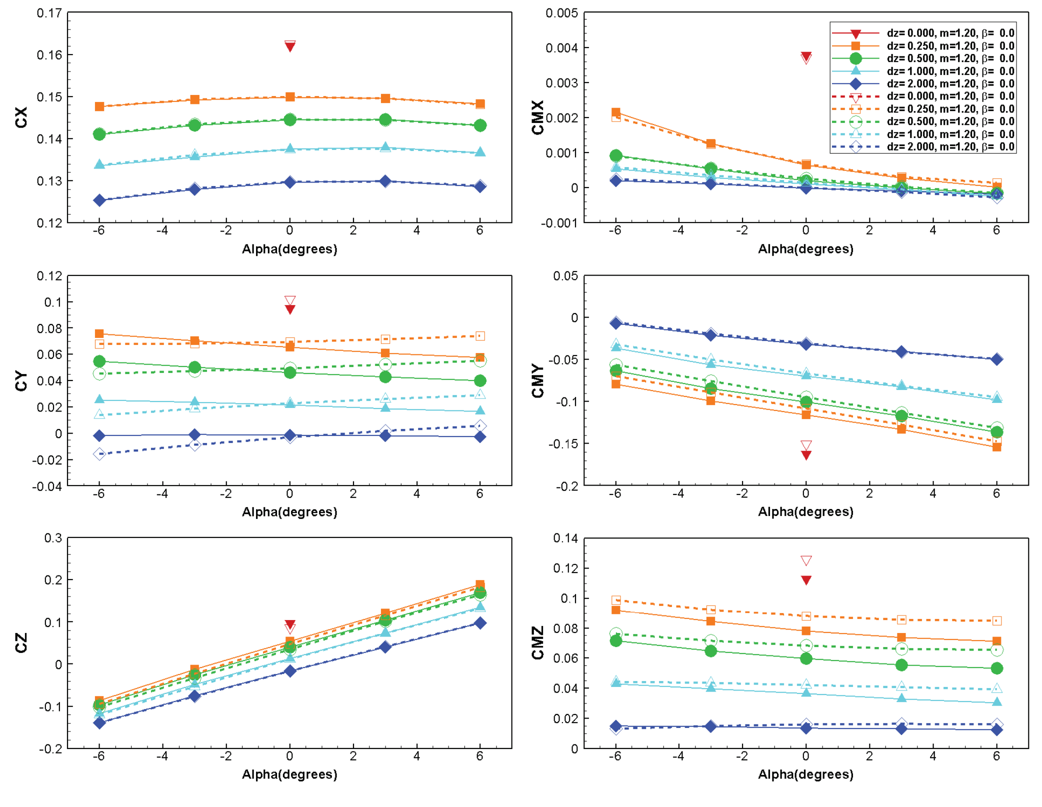
- 慣性座標系
- 彈體座標系 - 321系統
  - 座標軸依z, y, x旋轉ϕ, θ, ψ

彈道分析 – 係數

- 高度: $0m$
  - 攻角: 0°
  - 側滑角: 0°
- 高度: $0.25m$
  - 攻角: $-6° \sim 6°$
  - 側滑角: $-6 \sim 0°$
- 高度: $0.5m, 1m, 2m$
  - 攻角:$-6 \sim 6°$
  - 側滑角:$-12 \sim 0°$



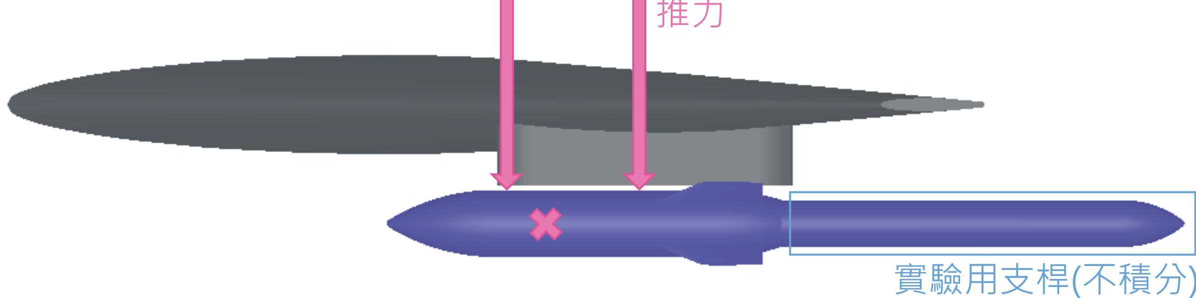
彈道分析 – 係數



暫態模擬 – 設定

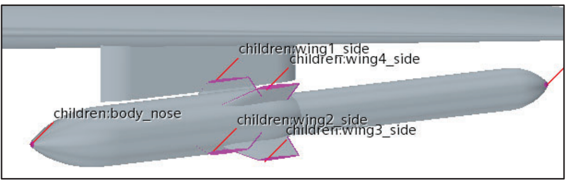
- 紊流模型: SST $k-\omega$
- 可壓縮流
- 考慮重力
- 時步: 1×10^{-4}

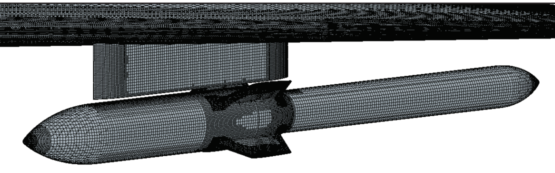
- 監測參數
  - 慣性座標位置
  - 彈體座標速度
  - 321系統之角度和角速度

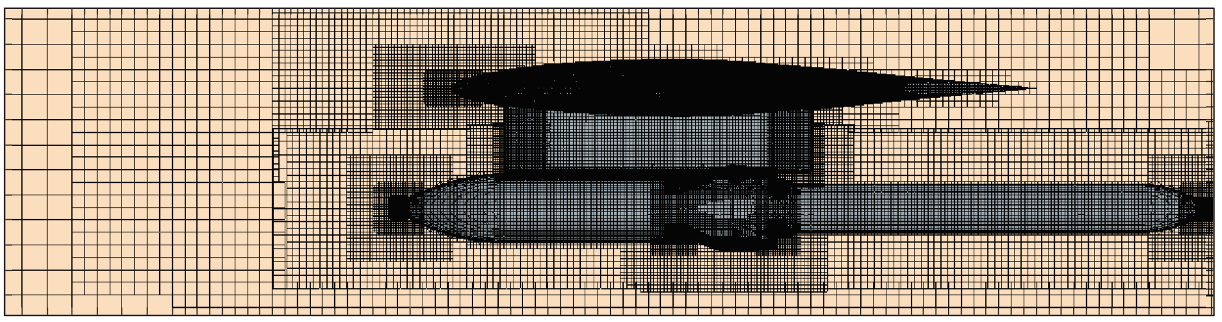


暫態模擬 – 網格

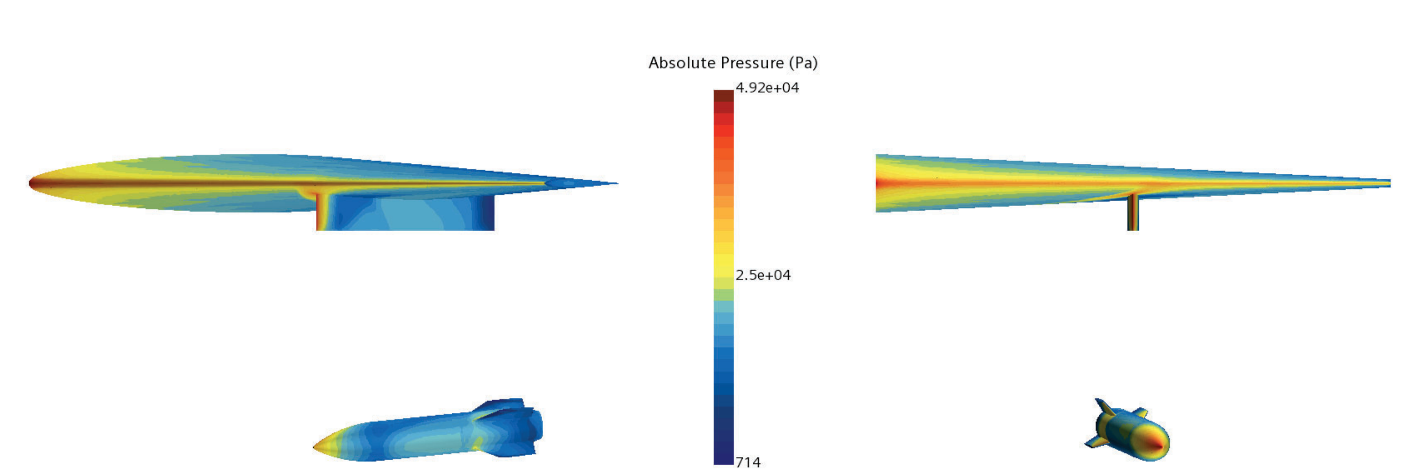
- 類型: trimmed cell
- 數量: 500萬
- 採用overset
- 搭配adaptive mesh



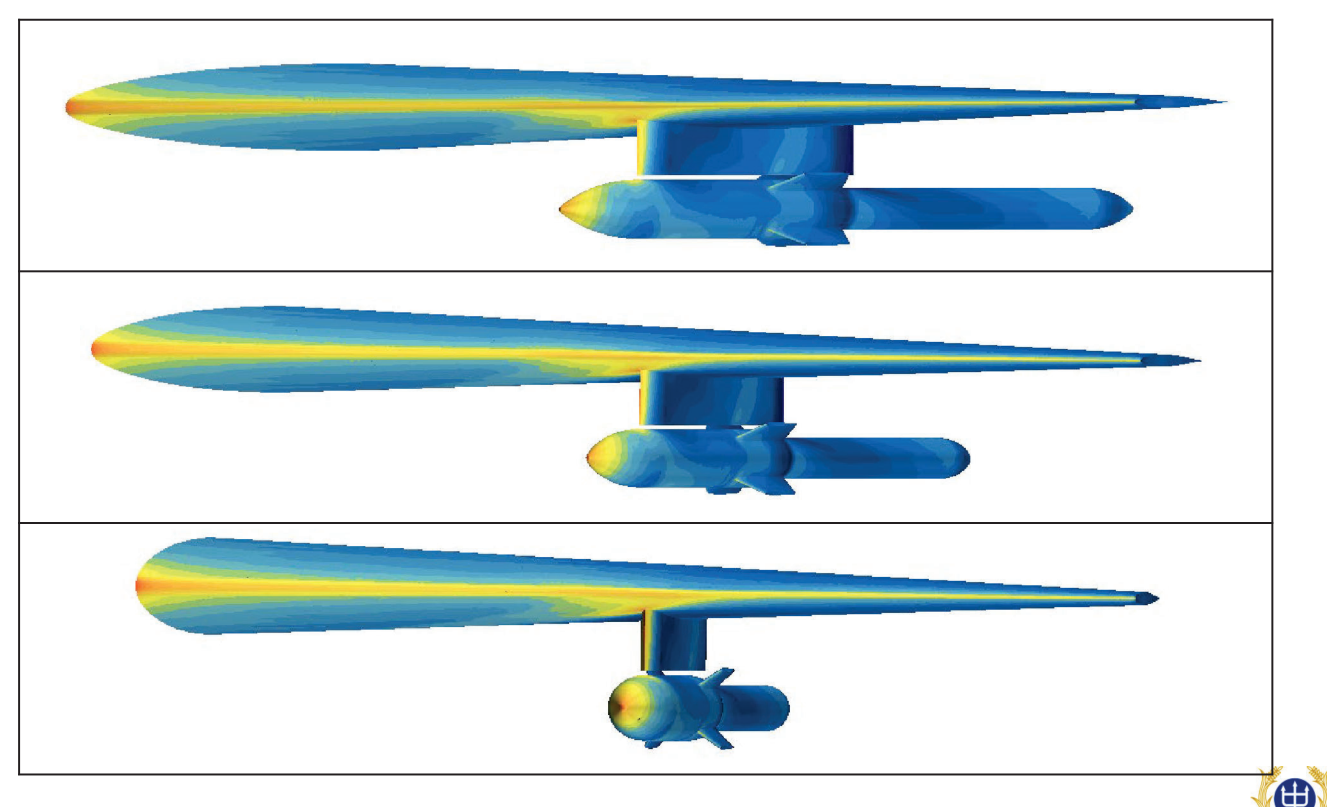




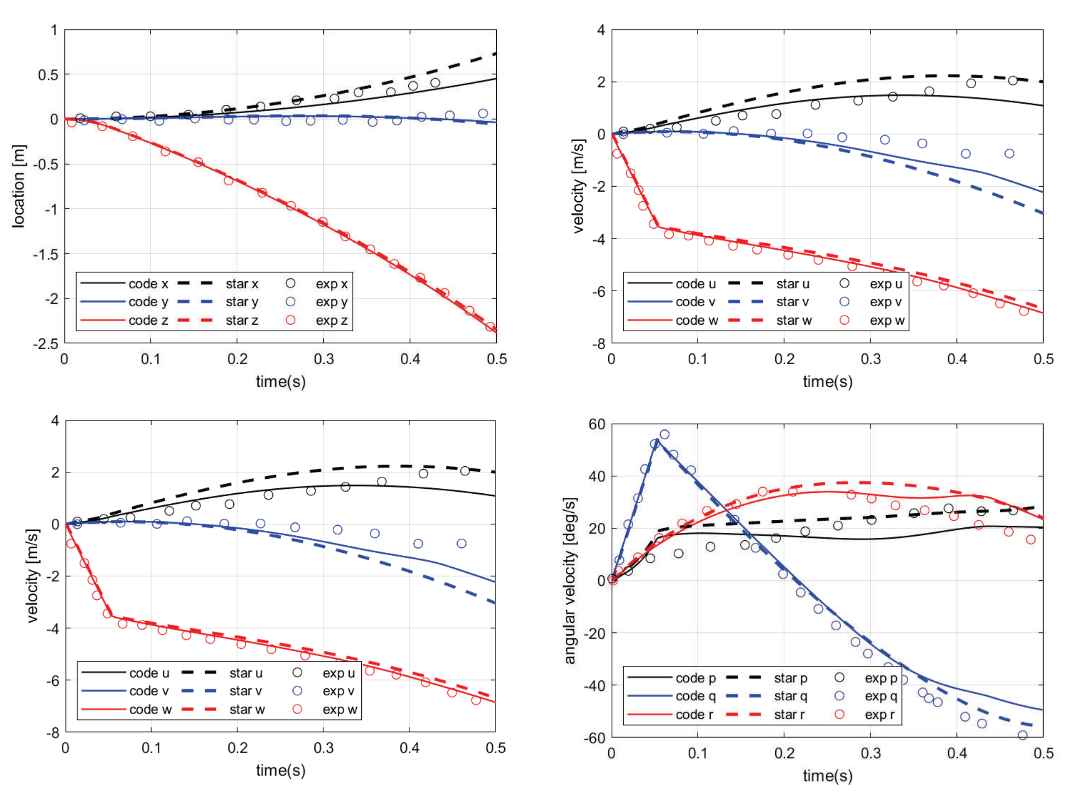
暫態模擬 – 拋投過程



暫態模擬 – 結果繪製



結果



結果

- 彈道分析和暫態模擬的結果都和實驗值很接近，驗證了擬穩態的方式確實可用來評估拋投情況。
- 為得到彈道分析的係數矩陣，共需計算182個穩態案例，其計算量極大，但之後要得到拋投軌跡則相對暫態模擬容易許多。

轂帽鰭設計分析技術建立

提報單位：國家中山科學研究院 飛彈火箭研究所

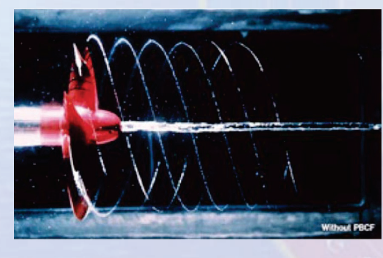
報 告 人：郭鑑輝 助理研究員

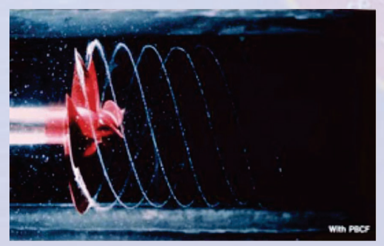
日　　期：112年11月17日

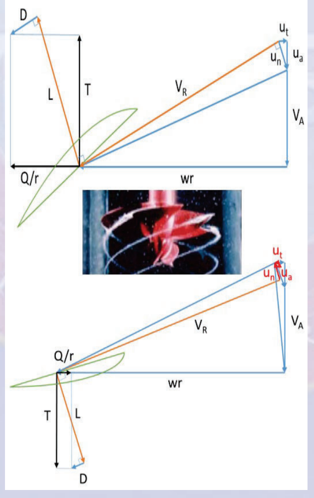
一、設計緣由及原理概述 (1/1)

鑒於X於空蝕水槽進行自推試驗時發現螺槳作動時會產生轂部渦空化(Hub Vortex Cavitation)，使得載具航行時發出明顯噪音，為改善此一現象，本組自行設計轂帽鰭(Propeller Boss Cap Fin, PBCF)以探討流場優化效益。

轂部渦形成原因為軸對稱體近表面邊界層成長而使螺槳攻角增加，使得轂部下游漩渦強度上升，當漩渦中心壓力低於流體飽和蒸汽壓即產生轂部渦空化。







轂帽鰭為一位於螺槳後方且與螺槳同方向、速度轉動之裝置，其主要作用為削弱轂部渦強度。若轂帽鰭螺距角、拱高設計正確，則轂帽鰭將產生一負推力及負轉矩力(相比前螺槳)，後者即為多數轂帽鰭文獻說明其可回收部分旋向動能而有推進效率增益之緣故。

二、設計條件及參數評估(1/1)

- 設計條件

本轂帽鰭係裝置於及螺槳之後，其設計目標為確保X於最嚴苛推進條件下不致產生較擴散型螺槳帽者更強之轂部渦。預定達成目標：
(1) 轂帽鰭下游之流場切向速度降低15%，壓力回升20%。

- 參數評估

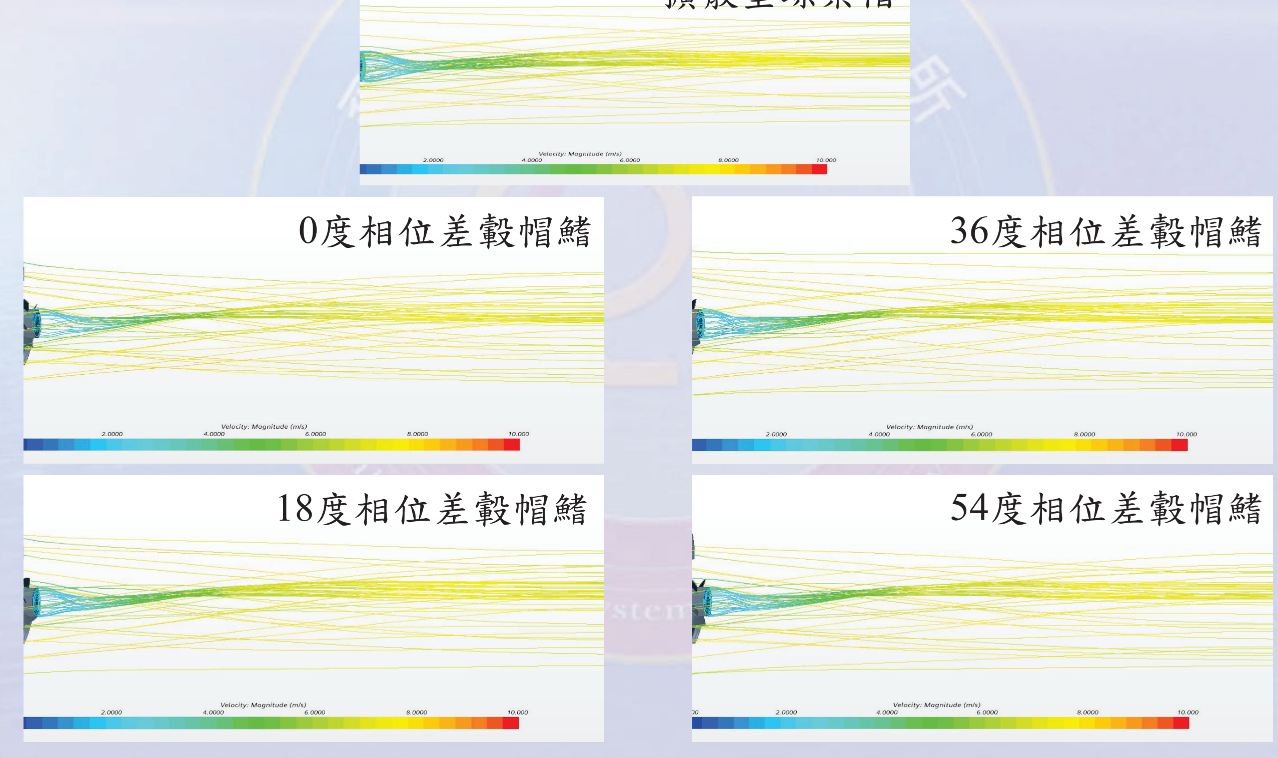
經閱覽國內外多篇轂帽鰭相關研究論文，本組歸納出以下幾點設計原則：
1.轂帽鰭直徑應約為前方螺槳直徑之30%。
2.轂帽鰭葉片數應與前方螺槳葉片數一致。
3.轂帽鰭與前方螺槳之螺距角差異應不大於5度。
並設計一代號為PBCF0之轂帽鰭，其螺距角於各徑向處與螺槳之差異為0度，此外探討螺槳與PBCF0轂帽鰭葉片中心線(軸中心至葉片根部弦長中點連線)之安裝角度差異，考量二者均為5葉，各葉片角度差為360/5=72度，故先行分析0、18、36、54度之相位差組合。

PBCF0轂帽鰭 D=0.45m 5B P/D=1.253 EAR=0.5										
r/R	Tmax(mm)	Chord(mm)	P/D	T/C	F/C	C/D	T/D	Xs/D	TE t/D	Skew(degree)
0.5	15.750	113.85	0.750	0.138340	-0.020	0.253	0.0350	0	0.010	0
0.6	14.085	125.10	1.014	0.112590	-0.018	0.278	0.0313	0	0.010	0
0.7	12.825	135.90	1.253	0.094371	-0.016	0.302	0.0285	0	0.009	0
0.8	11.880	146.70	1.465	0.080982	-0.014	0.326	0.0264	0	0.009	0
0.9	11.250	157.95	1.654	0.071225	-0.012	0.351	0.0250	0	0.009	0
1.0	10.800	169.65	1.817	0.063660	-0.010	0.377	0.0240	0	0.009	0

基本設計 → 參數整順 → 外型產出 → 數值模擬 → 結果分析

三、數值模擬及後處理分析(一)(1/3)

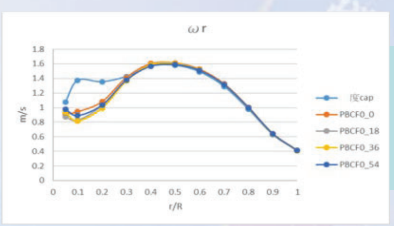
- Star-CCM+速度場數值模擬



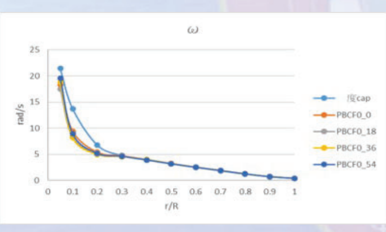
三、數值模擬及後處理分析(一)(2/3)

- 後處理分析

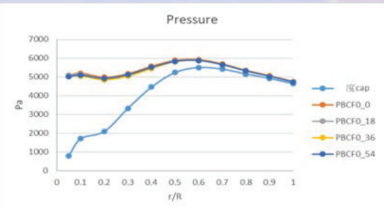
選擇於螺槳帽、轂帽鰭下游0.1D處(D= 螺槳直徑)平面擷取各徑向流場切向速度ωr、角速度ω 、壓力分布。



18度相位差PBCF0轂帽鰭之軸中心線附近切向速度最低，於0.05r/R處僅為擴散型螺槳帽者之81.5%，符合設計目標。



經換算，18度相位差PBCF0轂帽鰭之軸中心線附近角速度最低。



各相位差PBCF0轂帽鰭於0.05r/R處之全壓均較擴散型螺槳帽者高出六倍有餘，不僅皆滿足設計目標，18度相位差PBCF0轂帽鰭仍為於軸中心線附近壓力維持最高者。

三、數值模擬及後處理分析(一)(3/3)

- 後處理分析

於同一軸轉速下，螺槳搭配任一相位PBCF0轂帽鰭之綜合推力皆較擴散型螺槳帽者為高，然綜合轉矩亦較高，未有明顯優勢。

為探討各相位PBCF0轂帽鰭是否能增進載具推進效益，於此以擴散型螺槳帽為基準，作簡易效率及1-t計算比較：

$$\eta = \frac{\text{船後螺槳推力}}{\text{裸船含螺槳吸力效果}} \times \frac{\text{主機馬力(擴散　度螺槳帽)}}{\text{主機馬力}}$$

$$1 - t = \frac{\text{裸船阻力}}{\text{船後螺槳推力}}$$

	PBCF0_0	PBCF0_18	PBCF0_36	PBCF0_54	度Cap
η	1.2294	1.2245	1.2265	1.2217	1.2175
1-t	0.6435	0.6506	0.6506	0.6528	0.6693

→效率差異不及1%

轂帽鰭1-t普遍偏低意謂其減速(retardation)作用較為明顯，初步評估，PBCF0_18之特性較符合設計目標。

四、二階參數評估(1/1)

- ## 參數評估

於PBCF0_18轂帽鰭基礎下，此階段將探討變動轂帽鰭螺距對流場及推進效率之影響，而螺距角變化範圍以不大於5度為原則，故繪製較PBCF0_18轂帽鰭螺距大1、2、3、4、5度之PBCF1_18、PBCF2_18、PBCF3_18、PBCF4_18、PBCF5_18及較PBCF0_18轂帽鰭螺距小1、2、3、4、5度之PBCF-1_18、PBCF-2_18、PBCF-3_18、PBCF-4_18、PBCF-5_18共計十型轂帽鰭作為分析標的，其螺距直徑比整理如下表：

	PBCF1_18	PBCF2_18	PBCF3_18	PBCF4_18	PBCF5_18
r/R	P/D	P/D	P/D	P/D	P/D
0.5	0.784	0.819	0.854	0.890	0.927
0.6	1.057	1.101	1.146	1.191	1.238
0.7	1.305	1.357	1.411	1.466	1.522
0.8	1.525	1.586	1.648	1.711	1.776
0.9	1.721	1.790	1.860	1.931	2.004
1.0	1.891	1.967	2.044	2.123	2.204

	PBCF-1_18	PBCF-2_18	PBCF-3_18	PBCF-4_18	PBCF-5_18
r/R	P/D	P/D	P/D	P/D	P/D
0.5	0.716	0.683	0.651	0.619	0.588
0.6	0.971	0.930	0.890	0.850	0.810
0.7	1.202	1.153	1.104	1.057	1.010
0.8	1.406	1.349	1.293	1.238	1.184
0.9	1.588	1.524	1.461	1.399	1.338
1.0	1.744	1.673	1.603	1.535	1.467

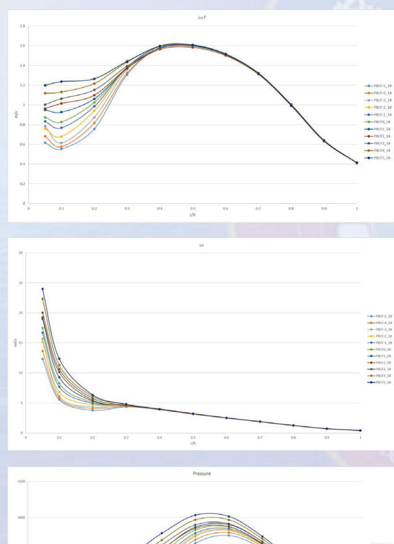
螺距示意

粉色：PBCF_5
灰色：PBCF_-5

五、數值模擬及後處理分析(二)(1/2)

- ## 後處理分析

選擇於螺槳帽、轂帽鰭下游0.1D處(D= 螺槳直徑)平面擷取各徑向流場切向速度ωr、角速度ω 、壓力分布。



PBCF-5_18轂帽鰭之軸中心線附近切向速度最低，於0.05r/R處僅為PBCF0_18轂帽鰭者之70.6%，且為擴散型螺槳帽者之57.6%。

經換算，PBCF-5_18轂帽鰭之軸中心線附近角速度最低，而螺距角高於PBCF0_18之轂帽鰭，均會於軸中心線附近產生較PBCF0_18者高之角速度。

PBCF-5_18轂帽鰭於0.05r/R處之全壓最低，惟仍較擴散型螺槳帽者高出約5.6倍。

五、數值模擬及後處理分析(二)(2/2)

- 後處理分析

相比PBCF0_18，各組合間船後螺槳推力、主機馬力數據差異有限。為探討各相位PBCF0轂帽鰭是否能增進載具推進效益，於此以擴散型螺槳帽為基準，作簡易效率及1-t計算比較：

	度Cap	PBCF-5_18	PBCF-4_18	PBCF-3_18	PBCF-2_18	PBCF-1_18
η	1.2175	1.2082	1.2260	1.2344	1.2150	1.2273
1-t	0.6693	0.6515	0.6480	0.6509	0.6538	0.6500

	PBCF0_18	PBCF1_18	PBCF2_18	PBCF3_18	PBCF4_18	PBCF5_18
η	1.2245	1.2244	1.2093	1.2146	1.2313	1.2378
1-t	0.6506	0.6505	0.6580	0.6522	0.6486	0.6464

→效率差異僅2.4%

	0.05r/R流場切向速度相比擴散型螺槳帽 (需低於85%)	0.05r/R壓力相比擴散型螺槳帽 (需高於120%)
PBCF-5_18	57.6%	559.7%
PBCF-4_18	63.7%	580.2%
PBCF-3_18	73.3%	584.2%
PBCF-2_18	70.8%	609.9%
PBCF-1_18	77.8%	613.9%
PBCF0_18	81.6%	635.6%

左列轂帽鰭皆可滿足需求！

六、檢討及未來建議(1/1)

- 檢討結語

1. 經數值模擬驗證，轂帽鰭確實可有效降低螺槳下游軸中心線附近之切向速度，並能提高局部壓力，尤以後者作用最為顯著。
2. 因X推進系統軸向損失占比高，轂帽鰭不易於旋向損失中回收能量。

- 未來建議

1. 本技術成果可應用於存在轂部渦空化風險之水面、水下載具，為擴散型螺槳帽之另一選項。
2. 轂部渦空化之發生條件難以預測，且亦有尺度效應等問題，值得長期投入研究。
3. 轂帽鰭相關設計分析能量應結合水槽試驗或海測結果做持續精進。

七、附錄(VOF空化模擬)(1/1)

轂部渦空化發生實驗情形：

Fraction of H2O(G)
0.99493 0.99541 0.99589

實驗條件重現

Volume Fraction of H2O(G)
0.99493 0.99541 0.99589

改以PBCF-5再次模擬

簡 報 完 畢

謝 謝 聆 聽

飛彈火箭研究所 M2SRD Missile & Rocket Systems Research Division

電動車集成式熱管理

戴嘉慧　科長
鴻華先進科技股份有限公司

電動車集成式熱管理-CFD

戴嘉慧 Carry Tai

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https://www.efd.com.tw/simcenter-event.html

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FOXTRON
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Abstract

- STAR CCM+應用於電動車熱管理
- EBUS - Aerodynamic、Cabin Comfort、coolant loop design
- C SUV - Aerodynamic 、Under hood Flow 、Cabin Comfort 、Window Defrost
- B CrossOver …………….

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FOXTRON
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電動車集成式熱管理-CFD

01 關於我

02 關於鴻華先進

03 解決甚麼問題

04 解決方案

05 第三方驗證

06 討論

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戴嘉慧 Carry Tai

具備將CFD軟體應用於交通工具與電子產品的正向開發多年經驗，
專長為空氣動力與熱管理；擅長軟體Star ccm+，Floefd ，Flotherm XT，NX

- 現仁鴻華先進科技股份有限公司整車熱流整合組組長
- GOGORO Thermal Team leader
- 和碩聯合科技技術課長
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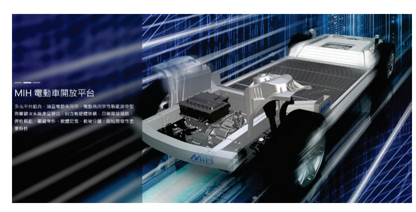
透過電動車共用平台攜手全球客戶共同提升競爭優勢
以軟體定義汽車發展趨勢，迎向全球CASE新發展方向



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關於鴻華先進-整車熱流整合組

- **車電架構-** 熱管理控制邏輯與控制器研發
- **空力-** 風阻
- **熱管理-**電機/電池/空調系統整合

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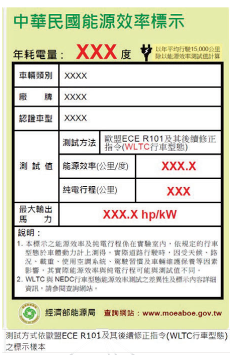
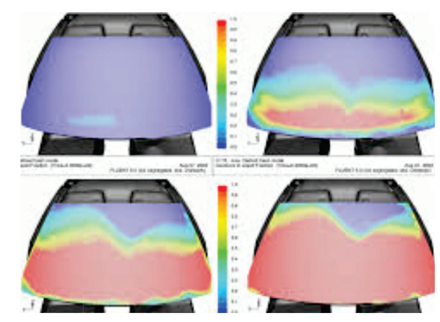
解決甚麼問題

- 能耗與續航里程
- 散熱性能/舒適性與能耗的平衡

測試方式依歐盟ECE R101及其後續修正指令(NEDC行車型態)之標示樣本



測試方式依歐盟ECE R101及其後續修正指令(WLTC行車型態)之標示樣本



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解決方案

EV Bus

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解決方案
EV Bus

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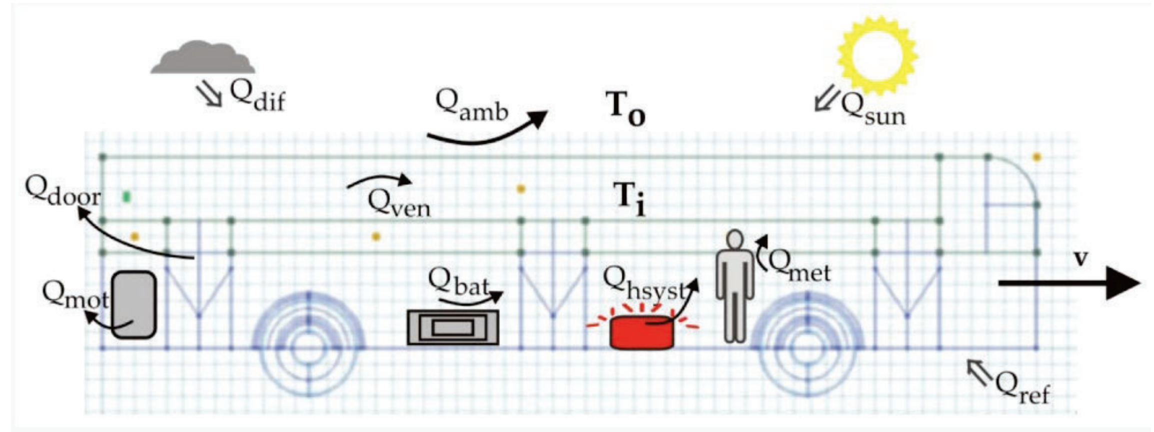
解決方案
EV Bus

Q˙total=Q˙met+Q˙sun+Q˙mot+Q˙bat+Q˙ven+Q˙amb+Q˙doors+Q˙hsyst.



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解決方案
C SUV

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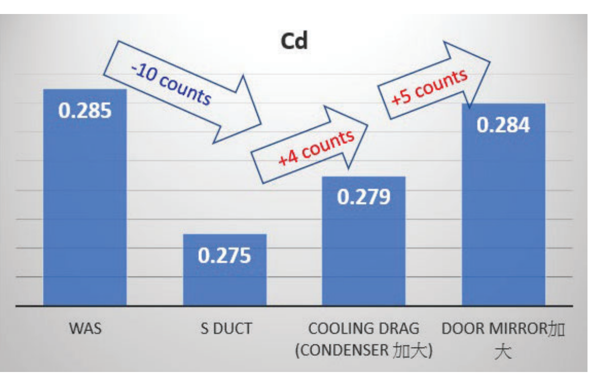
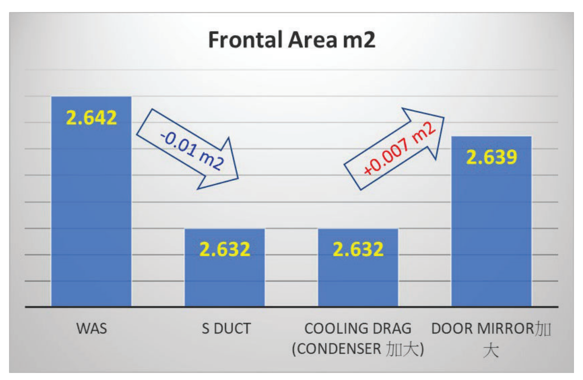
技

解決方案
C SUV

Aerodynamic Cd

Cd & Frontal area





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解決方案
C SUV

Cabin comfort

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解決方案
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Under hood flow

Air guide base

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解決方案

B Cross Over

我們一直在做
透過STAR-CCM+執行CFD
並結合一維分析軟件發展整車熱管理控制

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第三方驗證

擬定與國際風洞執行風洞試驗計畫

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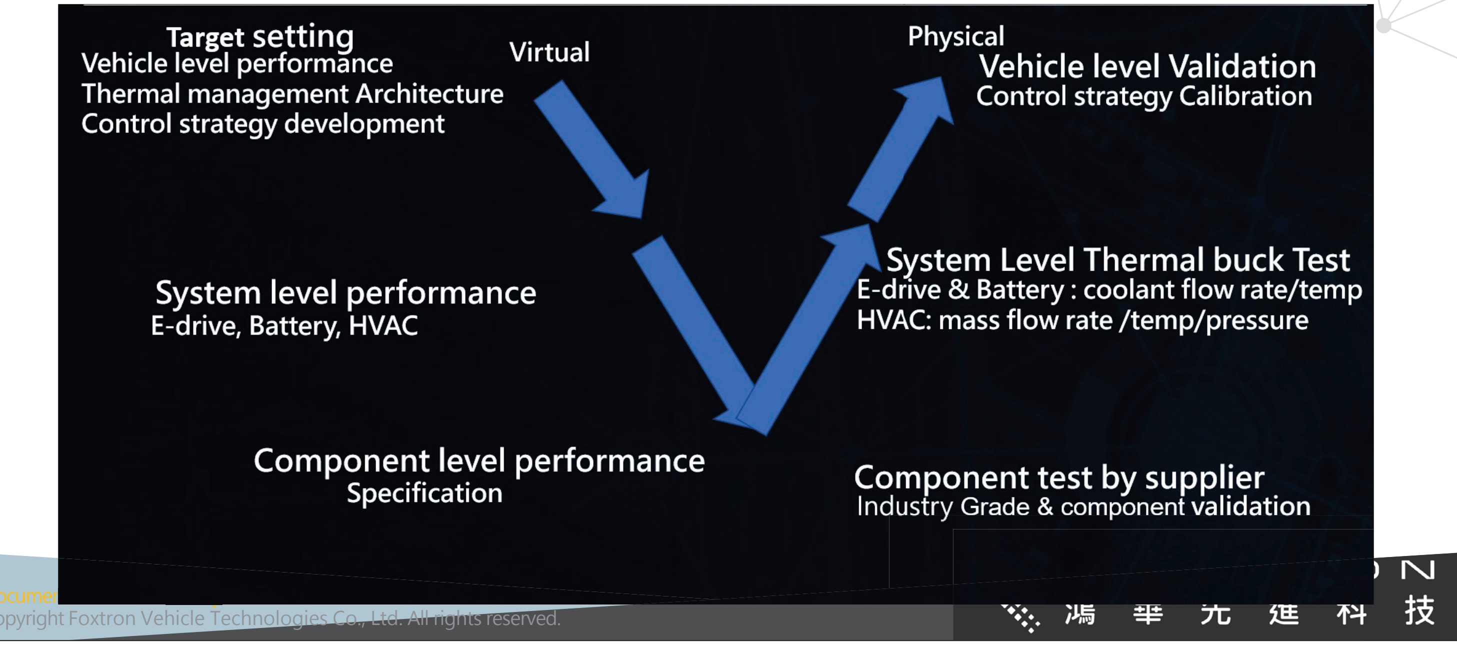
第三方驗證

實現正向開發流程：整車→系統→零件→系統→整車



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Simcenter MicReD 解決方案的規劃及發展

許欽淳　博士
台灣西門子軟體工業股份有限公司

New Release for Simcenter Test (MicReD)

Alvin Hsu, Ph.D
PreSales Consultant
Alvin.hsu@siemens.com

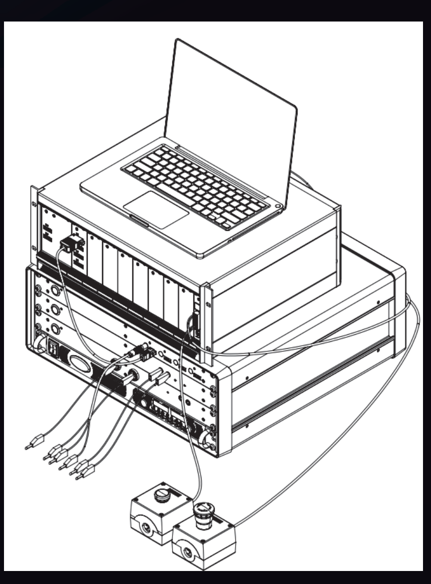
New high voltage booster - High voltage measurement capability

"Classic" High voltage boosters (150V and 280V) are not supported by T3STER SI

- ✓ Safety system is not suitable for industrial environments
- ✓ No high voltage diode (LED) measurement capability in T3Ster SI systems

New high voltage booster enables high voltage DUT testing with T3Ster SI systems, by also ensuring safe operation:

- ✓ Modular structure (PSU, OS, CG, DIV)
- ✓ Two versions
  - Simcenter Micred Power Booster 10A/150V, PN MG288359NO
  - Simcenter Micred Power Booster 5A/300V, PN MG288361NO
- ✓ Proper safety features implemented
- ✓ T3STER SI control SW 2021.2 or higher is required



New high voltage booster - Package

Modular system

- ✓ All modules (PSU, OS, CG, DIV) has 19” 1U form factor
- ✓ System delivered in 4U high mini rack for desktop application, can be assembled to standard 19” rack by customer
- ✓ Heating current source PSU (TDK) is included in the PN, no PSU needs to be ordered by customer from third party supplier
- ✓ System requires 2 mains sockets: 1x PSU and 1x others

New high voltage booster is not compatible with classic T3STER

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New high voltage booster - HXM OS

Output stage module (heating current switching module)

- ✓ Up to 10A/150 or 5A/150V current switching capability
- ✓ Fast turn-off transient
- ✓ Accelerated turn-on transient by voltage precharging
  - Output capacitance of the switching mode power supply providing the heating current is precharged to a voltage level close to the DUT on state voltage
  - Also protects DUT from current peaks at turn-on
  - Works only with TDK Gensys series power supplies (included in PN)

Safe operation

- ✓ Output is galvanically isolated until
  - the source is activated by software
  - and all safety signals are received (HW and SW)

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New high voltage booster - HXM CG

Measurement current generator module

- ✓ 100mA measurement current up to 100V (1uA resolution)
- ✓ 25mA measurement current up to 300V (4uA resolution)
- ✓ Output voltage limit programmable (5mV resolution)

Safe operation

- ✓ Output is galvanically isolated until
  - the source is activated by software
  - and all safety signals are received (HW and SW)

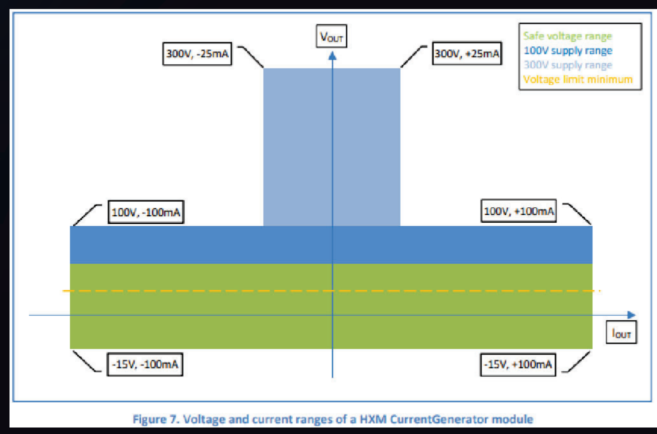

Figure 7. Voltage and current ranges of a HXM CurrentGenerator module

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New high voltage booster - HXM DIV

Signal pre-scaler (divider) module

- ✓ 4 voltage inputs from DUT, 4 outputs towards T3STER SI MS401 measurement channel
- ✓ 3MΩ input impedance
- ✓ Two operation states:
  - 300V input voltage range
    1:32 division state enables voltage measurement for up to 300V, in combination with MS401 provides multiple differential measurement ranges from 32V to 300V (input voltage protection up to 400V)
  - Direct MS401 connection without rewiring
    1:1 division state directly couples input to output with relays.
    Below 80V this state allows direct connection to MS401 measurement channel to maximize resolution and accuracy

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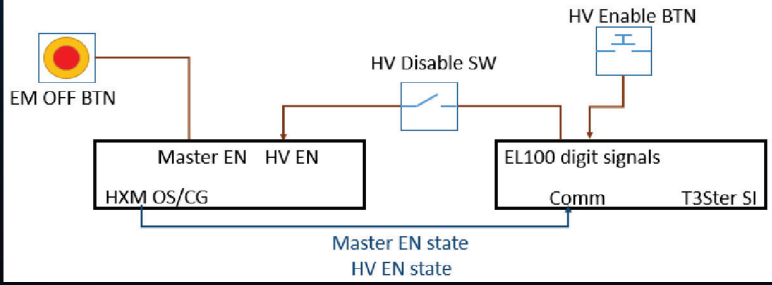
New high voltage booster - Safety system

- ✓ All outputs are galvanically isolated when no measurement is running
- ✓ EM OFF BTN: Emergency off button, immediately disables all high voltage sources and isolates outputs (mandatory)
- ✓ HV Enable BTN: High voltage enable button, after measurement with voltage above 50V is initiated from control software interface, the system prompts for HV enable (momentary) button to be pushed before high voltage state is activated (mandatory). This button prevents remote activation of high voltage state.
- ✓ HV Disable SW: High voltage disable switch, additional switch (or e.g. door open sensor) can be added in series with the high voltage enable signal to ensure no high voltage is activated in unsafe state (optional, not provided with system)



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What's New in Simcenter Micred T3ster SI Control Software

1. **New Option to Delay Switching**
   - ✓ The effect of slow heating turn off can be corrected by changing the timepoint of the heating current switching
   - ✓ Switching voltage peaks can be moderated
2. **HW Support**
   - ✓ Additional chillers supported
3. **Merge Customer Specific Branches**
   - ✓ USB thermostat connection
4. **Documentation Improvements**
   - ✓ Measurement example added to API documentation
5. **Licensing update**
   - ✓ SALT 2.0 license is used from this release on

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What's New in Simcenter Micred T3ster SI Control Software

6. **Repeat and Average Measurement**
   - ✓ A series of repeated measurements can be done automatically
   - ✓ Average of the outcomes is calculated
7. **New Option to Save to USB**
   - ✓ Measurement results can be saved to an external USB drive
8. **User Interface Improvements**
   - ✓ Source switching delays are hidden as default
   - ✓ Trigger panel has been updated
   - ✓ Measurement plots can be saved in svg format
   - ✓ Measurement plots can be extended to fullscreen
9. **Bug Fixes**
   - ✓ The Auto Range function of the HXM Booster has been adjusted
   - ✓ The limit of high voltage measurement mode of the HXM Booster has been set to 40 V

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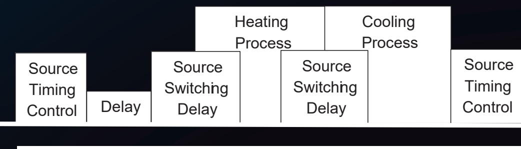
New Switching Delay Option

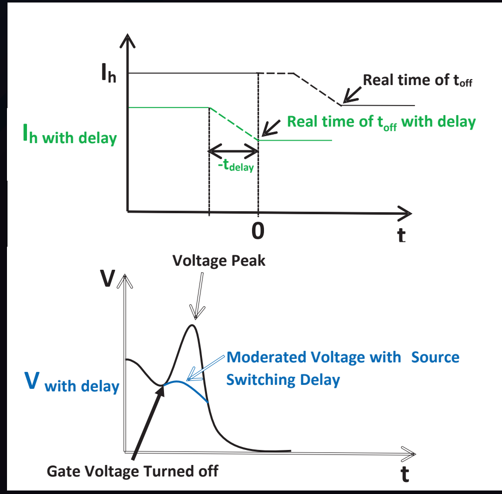
Existing Delay Options in T3ster SI Control Software 2301 – 1st Level:

- Source Timing Control: Allows the user to control the order of activation and deactivation of the resources
- Delay: Allows the user to delay the start point of the measurement

New Delay Options in T3ster SI Control Software 2301 – 2nd Level:

- Source switching delay (falling/rising) for the trigger allows the user to moderate the effect of slow heating turn off (dashed black line)
  - Turn off process of the heating current is started earlier to start transient sampling where the actual power switching happens.
  - This delay is measured from the beginning of the heating/cooling sampling.
- Source switching delay for the gate voltage (of the 240 A Booster) helps to decrease the voltage transient peak in the circuit (continuous black line)
  - Turnoff of the gate drive voltage can be postponed
  - This delay is measured from the end of the heating process





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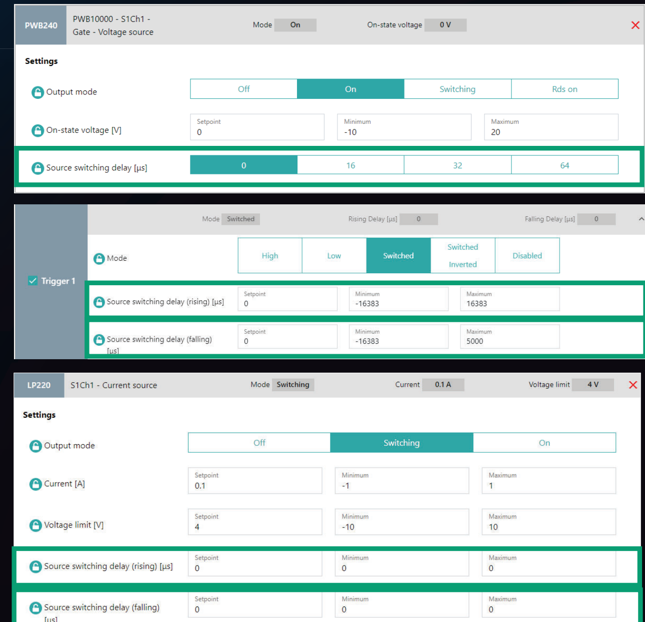
New Option to Delay Switching

A set of new source switching delay features were integrated:

- Delay with discrete values for the gate voltage source of the 240A Booster:
  - 0, 16, 32, 64 us
- Falling/rising trigger delay in case of external device
- Falling/rising delay for LP220 sources
- These delays can be set by the resolution of us, in the range of:
  - Rising up to ±16 ms
  - Falling -16 ms to +5 ms



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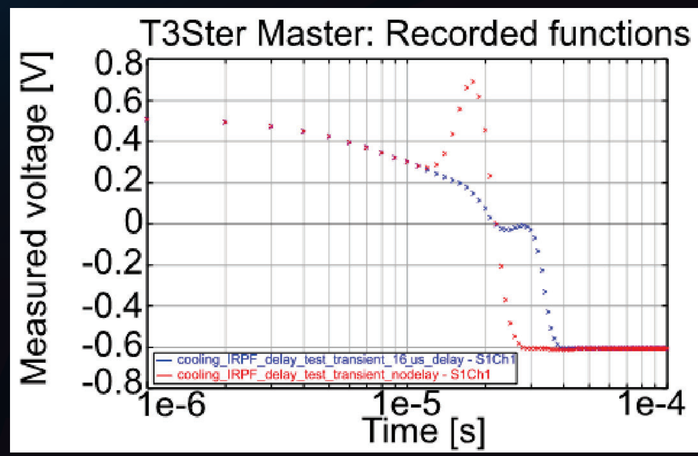
Use Case 1 - Moderating the Transient Effect of Cable Inductance

- Having long cables in the measurement setup increase the inductance of the circuit
- When switching sources simultaneously, it leads to high transient voltage peak (red)
- Source switching delay allows the gate voltage turn off to be delayed, eliminating this transient (blue)



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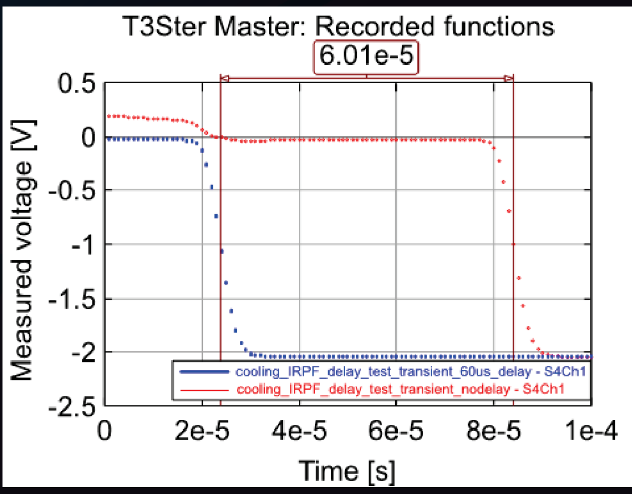
Use Case 2 – Compensating the Effect of Slow Heating Turn off

- By setting a negative delay for the trigger, the effect of instrumental delay can be controlled
- As seen on the graph, with a - 60 us delay, the turn off process of the heating current started -60 us earlier (blue) compared to the no delay version (red)
- This way the transient sampling started where the actual power switching happened



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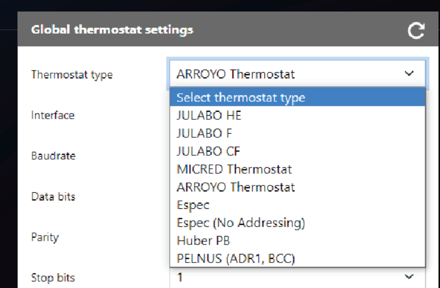
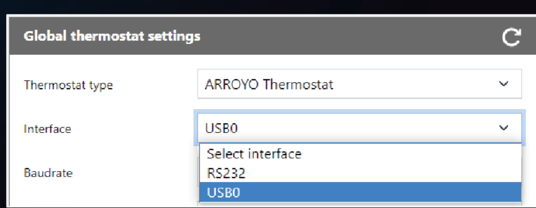
2. T3STER SI 2301 can be applied to all customized T3ster SI systems

Software compatibility with customized T3ster SI systems:

	Available for All Users	T3ster 2301 Applicable
Keenus Pelnus Chiller	Yes	Yes
Arroyo Chiller	Yes	Yes
Power Booster with one Power Supply Unit	No	Yes



3. T3ster SI 2301 supports USB port thermostat connection beside the RS232 option



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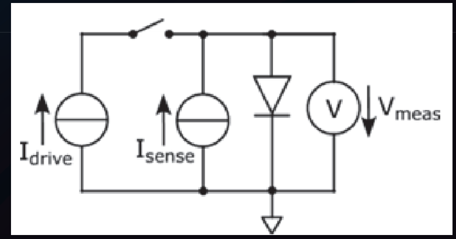
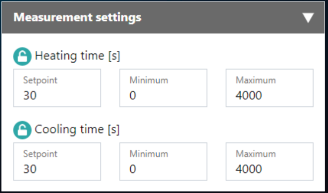
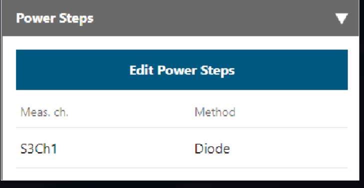
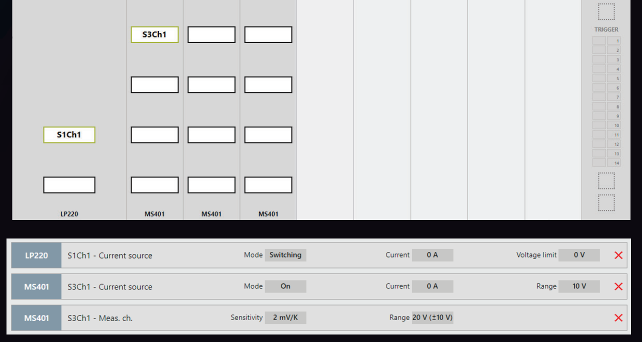
API Documentation Improvement: Customizable Single Diode Transient Measurement Example Coded in Python

- The script helps to get started with API programming
- It describes a single diode thermal transient measurement
- The code can also be customized by the user's specific needs
- Script sample can be downloaded from the T3ster SI 2301 UI
- IP address needs to be filled out
- The thermal transient measurement results will be saved in the same folder









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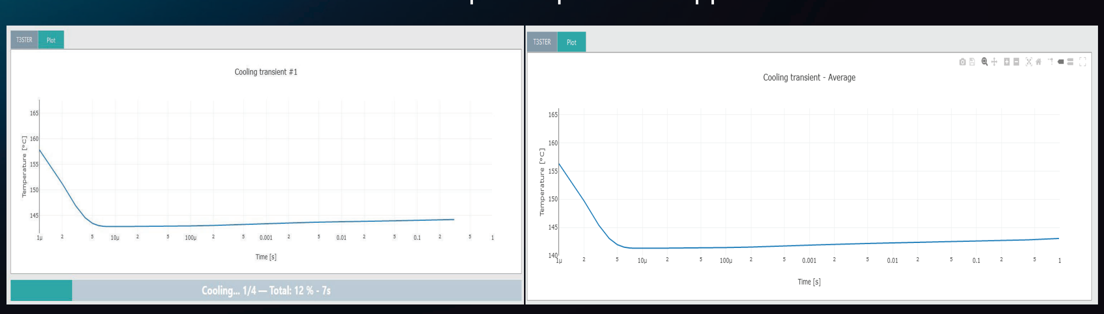
Repeat and Average Measurement

- To reduce the noise of the signal, repeat and average measurement was introduced:
  - The same measurement is repeated several times
  - At the end an average transient function is calculated
- Intermediate measurements are stored
- All repeated measurements and their average result can be downloaded
- The number of repetition is limited by the size of the storage, length of the measurement, and the number of active channels
- Measurements are stored as a separate parx and zipped at the end



Download results

File name prefix

Save all to "DATA_16GB" USB mass storage

Measurement Parameters

diode_repeated_aver - Cooling (PARX)

diode_repeated_aver - Heating (PARX)

RepeatedMeasurement - Compressed (ZIP)

RepeatedMeasurementParx - Compressed (ZIP)

RepeatedMeasurementAver - Compressed (ZIP)

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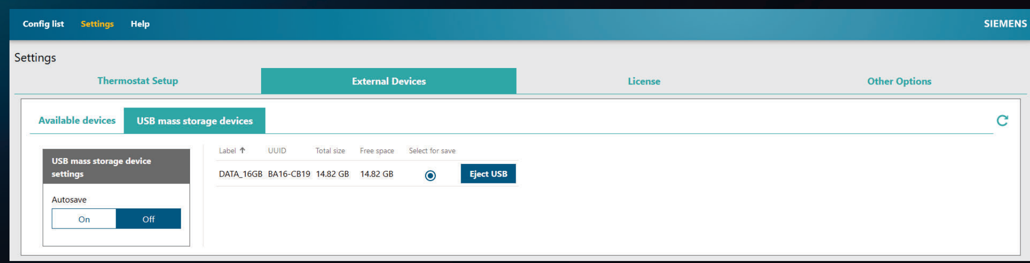
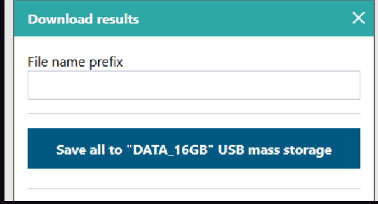
New Option to Save to USB Drive

- This feature supports the repeat and average measurement implementation allowing a greater amount of data to be handled
- New version allows the user to save measurement files to an external USB drive
- This way measurement outcomes can be transported easily to another device
- USB drive needs to be FAT32 formatted, max. capacity is 32 GB
- File writing/reading speed is limited according to USB high speed specification (USB2.0) - even if USB3.X drive is used





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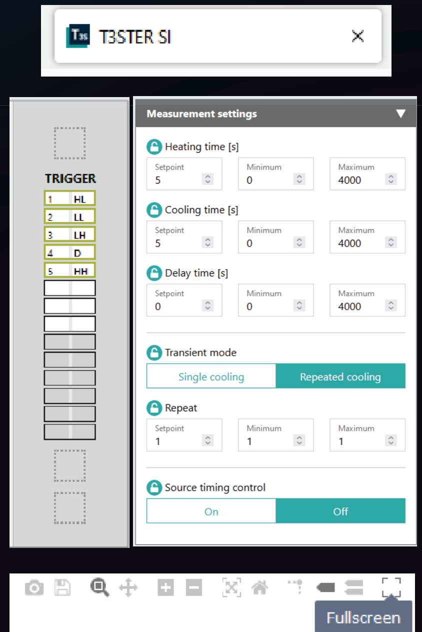
User Interface Improvements

- The new source switching delay feature of the previous release is hidden as default
  - It can be activated by the Source timing control "On" button
  - Reverse power off sequence and Wait for instrumental delay settings can be activated separately, after turning the Source timing control "On" (as before)
- Favicon has been modified according to the new iconset
- Trigger panel has been updated
  - HH: High, LL: Low, HL: Switched, LH: Switched Inverted, D: Disabled
- Measurement plots can be saved to *svg* format (beside *png*)
- Measurement plots can be put to fullscreen



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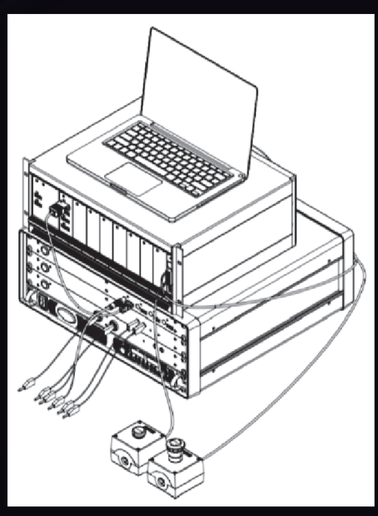
Bug Fixes

- ➢ In the HXM Booster, the Auto Range function has been adjusted
- ➢ High voltage measurement mode limit in the HXM Booster has been set to 40V
  - Previous system limits have been unified
  - Measurements below 40V are considered low voltage, no extra validation is necessary before source activation
  - Measurements above 40 V are considered high voltage, and due to life protection risk, an additional confirmation is needed from the user to to activate the sources (pushing the physical button)



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Questions ?

SIEMENS

T3Ster量測案例分享

曾嘉玲　主任工程師
易富迪科技股份有限公司

T3Ster Advance Measurement Case

01
T3Ster Principle

Principles, Advantages, etc.

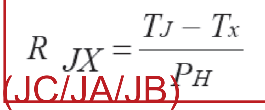
T3Ster SI 熱阻量測原理概要

- T3Ster SI
  - 電性量測法 (Electrical test method, ETM)
  - 由電壓變化求得真正接面溫度Tj
  - 精確(0.01℃)且即時(1μs)的量測
  - 符合JEDEC國際量測規範
  - 穩態量測及暫態量測
  - 可測得封裝分層熱阻
- Specification of Rth

JESD51-1 ETM

$$R_{JX} = \frac{T_J - T_X}{P_H}$$

(JC/JA/JB)



where $R_{\theta JX}$ = thermal resistance from device junction to the specific environment (alternative symbol is θ_{JX}) [°C/W]
T_J = device junction temperature in the steady state test condition [°C]
T_X = reference temperature for the specific environment [°C]
P_H = power dissipated in the device [W]

- 溫度敏感係數 TSP(K factor)

$$K = \frac{|(T_{Hi} - T_{Lo})|}{|(V_{Hi} - V_{Lo})|}$$

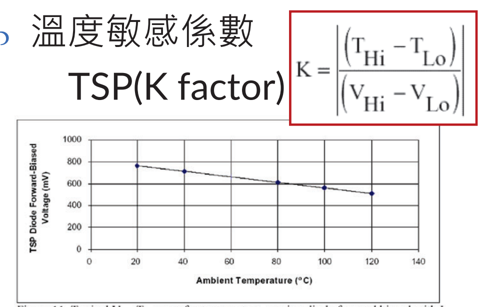
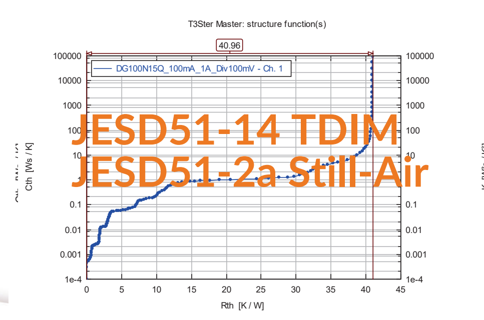
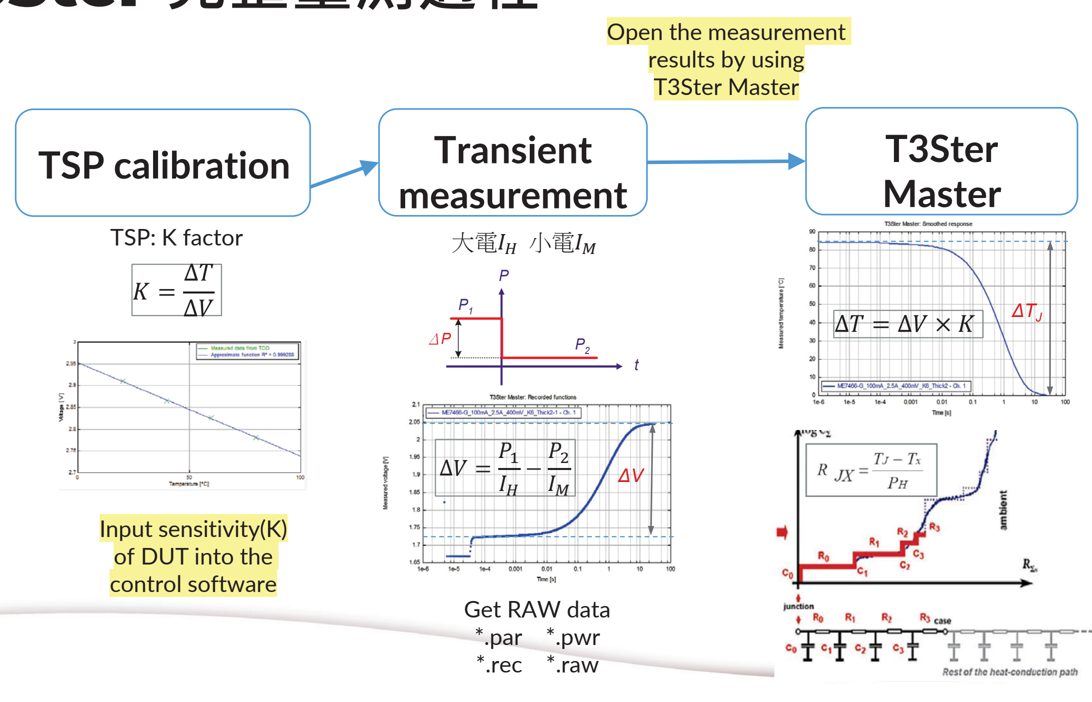


Figure 11. Typical V_F - T_A curve for temperature-sensing diode forward biased with I_M



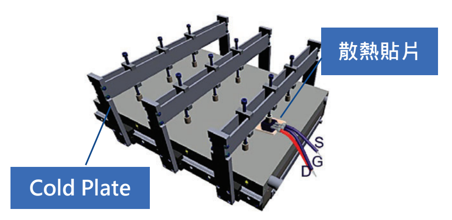
JESD51-14 TDIM
JESD51-2a Still-Air

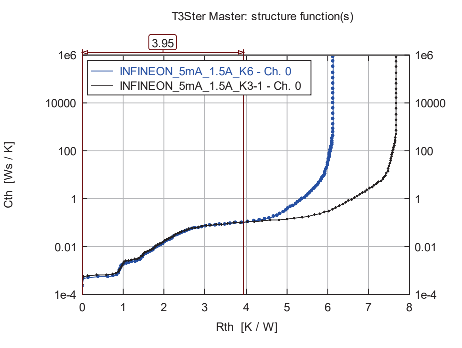
T3Ster 完整量測過程



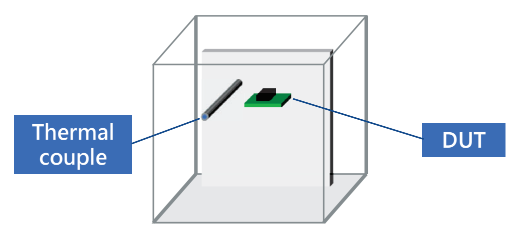
量測過程符合JEDEC規範

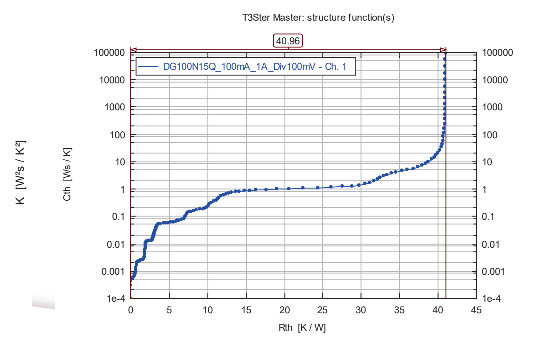
JESD51-14 TDIM 異介質量測法-強制熱傳





JESD51-2a Still-Air 自然對流量測法-靜止空氣





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02
Case Study

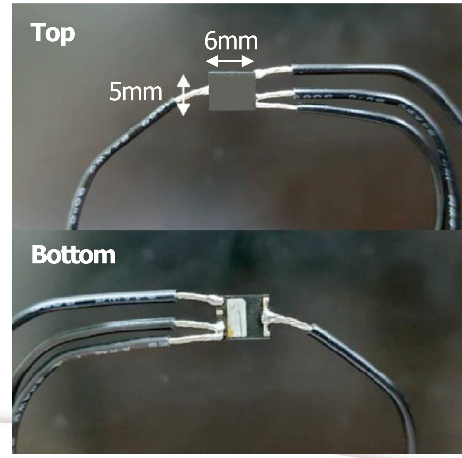
To show the benefits of T3Ster by some cases for you

Case 1

GaN 熱阻量測分析

Device **Description**

- This device is GaN HEMT
- Rthjc measurement



Bare Sample

GATE
SOURCE
DRAIN

Measurement Detail_ I_M

- DUT put on Cold plate(水冷板)and measurement
- Measurement Parameter as bellow:

Set Parameter	GaN
V_{gs}	5V
I_M	TBD
I_H	2 A
Ambient Temp.	25 °C

※Remark: I_M is measurement current and I_H is heating current.

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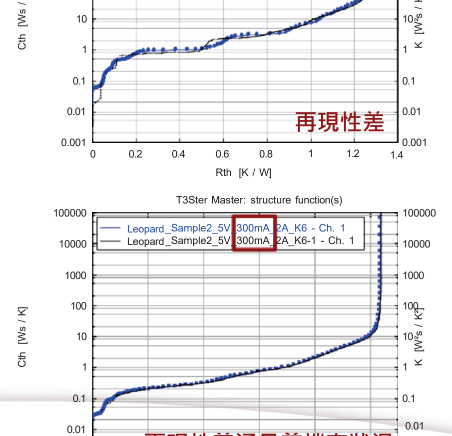
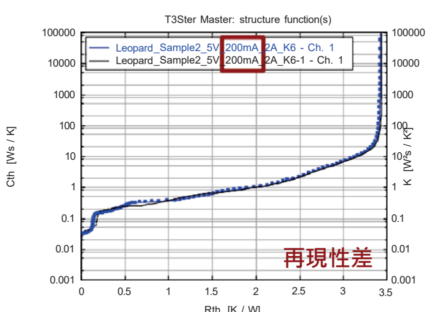
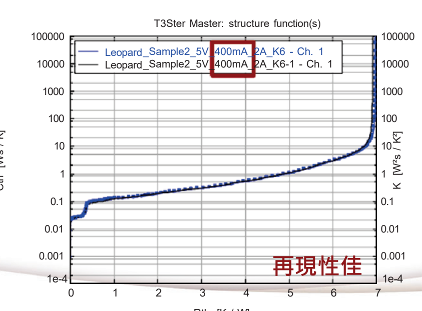
Measurement Detail_ I_M

- 調整小電(I_M)，每個小電各測試兩次，來觀察結構函數的再現性。

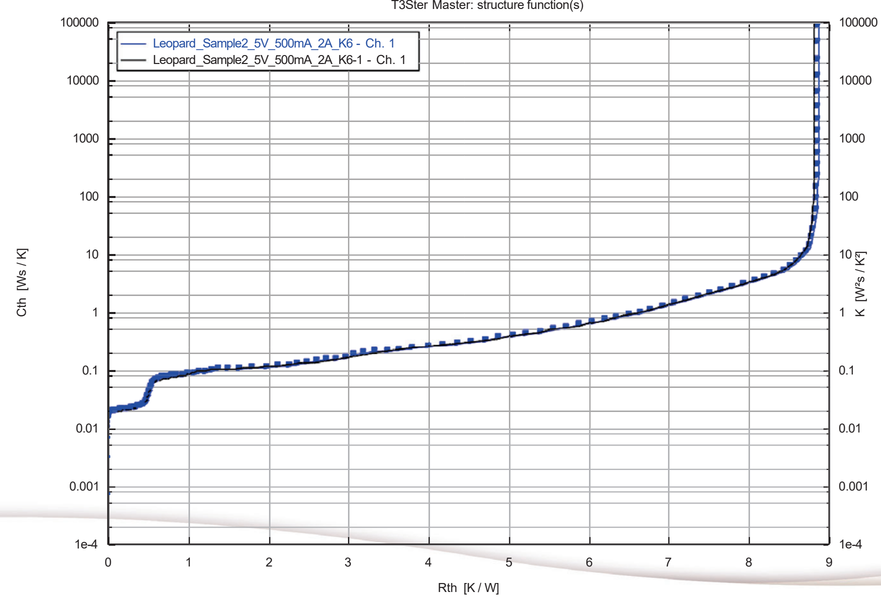






Measurement Detail _ I_M

- 小電(I_M)為**500mA**時兩條結構函數疊合良好，再現性優異。



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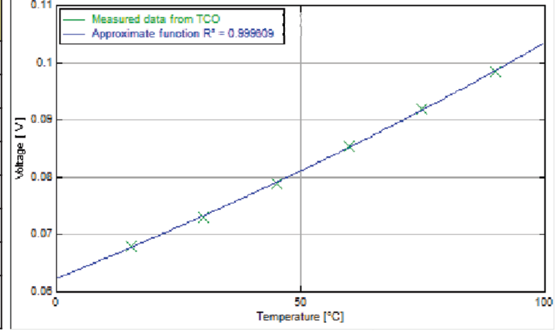
T3Ster Measurement Results- TSP Calibration – GaN

V_{GS}=5V

I_M=500mA

DUT	GaN	
Item	T (ºC)	V_F (V)
T1	15.2	0.067958
T2	30.05	0.073036
T3	45	0.078969
T4	59.93	0.085414
T5	74.8	0.091932
T6	89.8	0.098402
Sensitivity (mV/K)	0.412315 ※Sensitivity equals to TSP or K factor	

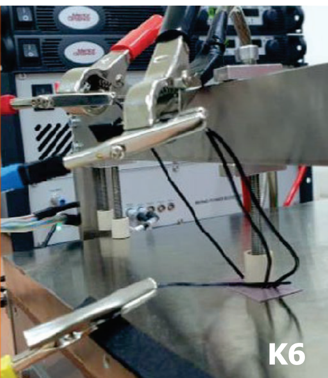


Measurement Detail_ Rthjc

- DUT put on Cold plate(水冷板)and measurement
- Measurement Parameter as bellow:

Set Parameter	GaN
V_{gs}	5V
I_M	500mA
I_H	3A
Ambient Temp.	25 °C

※Remark: I_M is sensing current and I_H is heating current.



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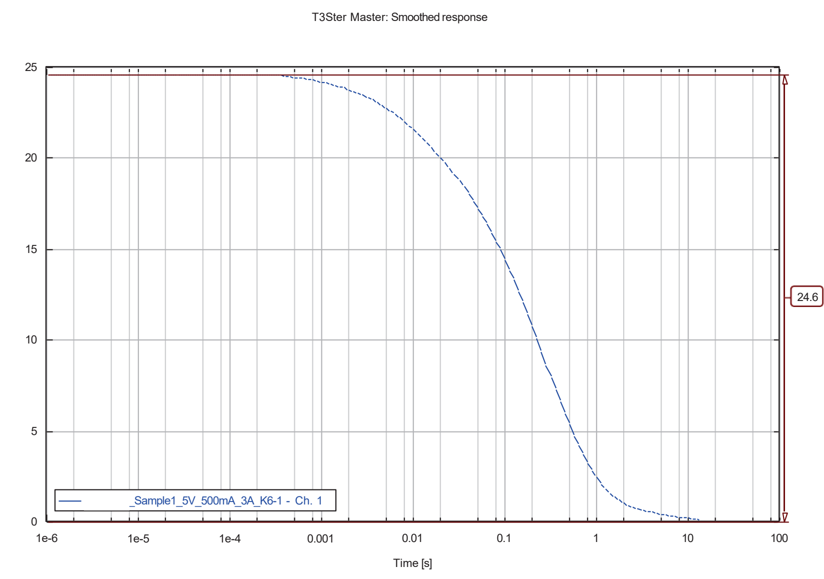
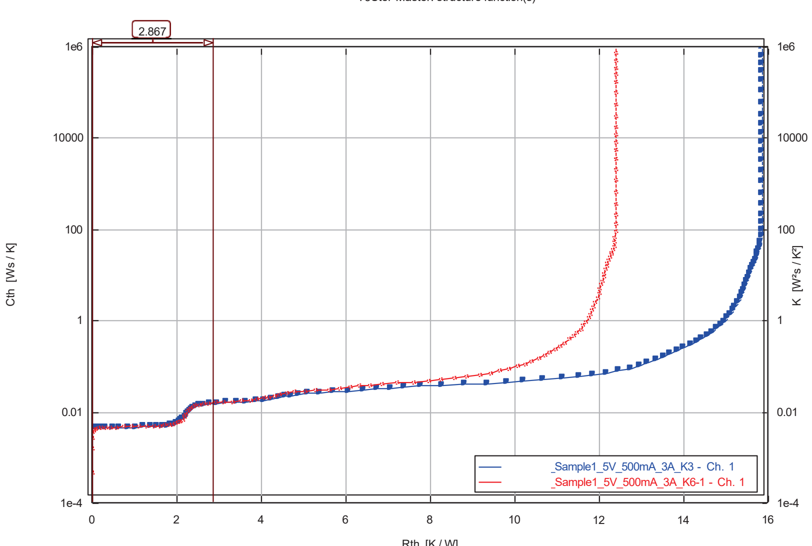
T3Ster Measurement Results -Rthjc-ΔTj and Tj- GaN

- ΔTj @ 25°C is 24.6 °C
- Tj = ΔTj + Tref.= 24.6+25



T3Ster Measurement Results-Rthjc-Structure Function- GaN

- Integral Structure Function@ 25 °C
- JESD 51-14 TDI Method
- Rthjc = 2.867K/W

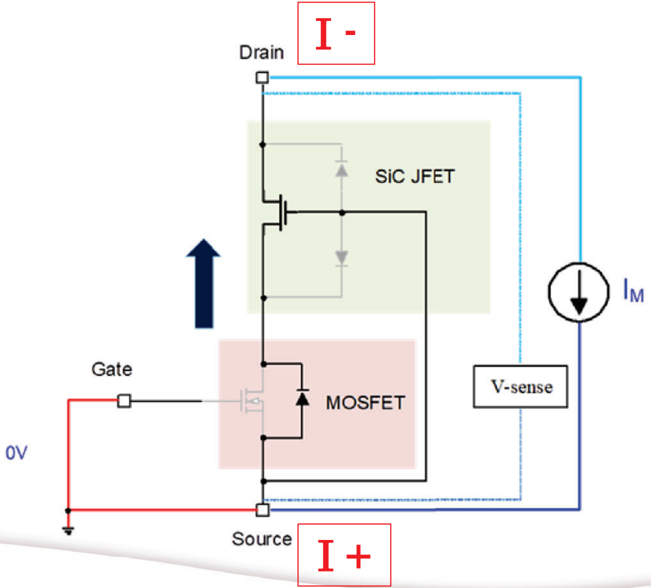


Case 2

SiC Cascode

Connect Method 1

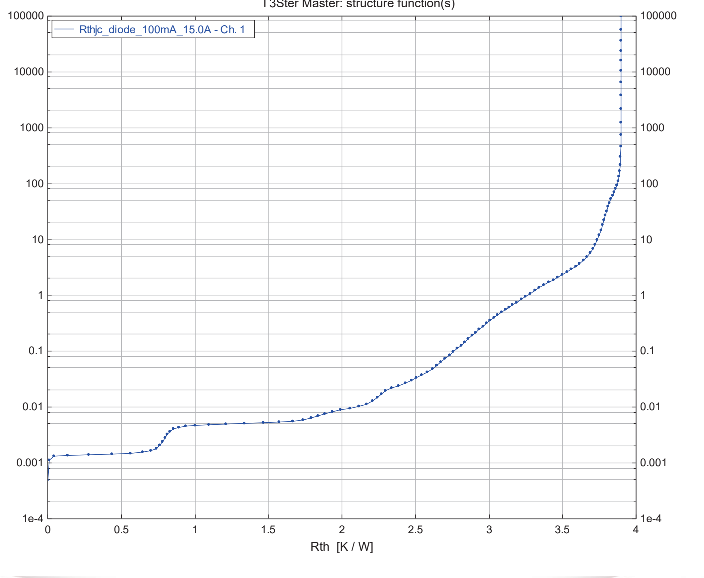
- 利用導通二極體去量測電壓變化



T3Ster Measurement Results -Method 1

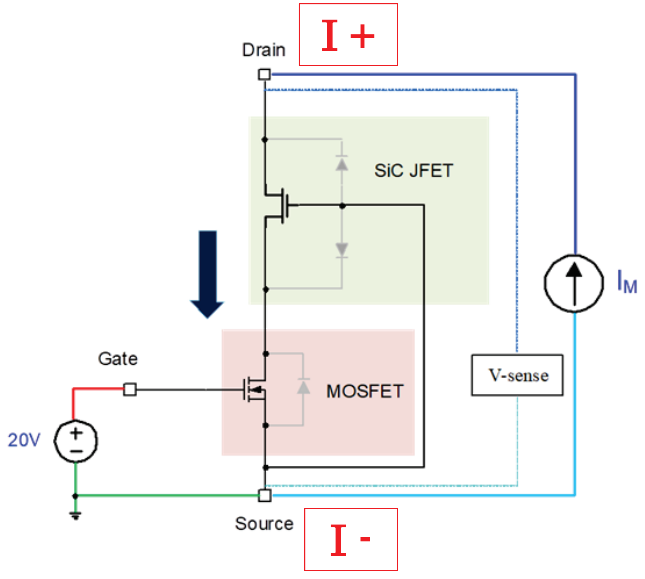
DUT	TSP	
Item	T (ºC)	V_F (V)
T1	20	0.691414
T2	40	0.655574
T3	60.1	0.61866
T4	80	0.581062
Sensitivity (mV/K)	1.83891	

Set Parameter	
V_{gs}	--
I_M	100mA
I_H	15A
Ambient	25 ºC



Connect Method 2

- 給V_{GS}開通MOSFET channel端



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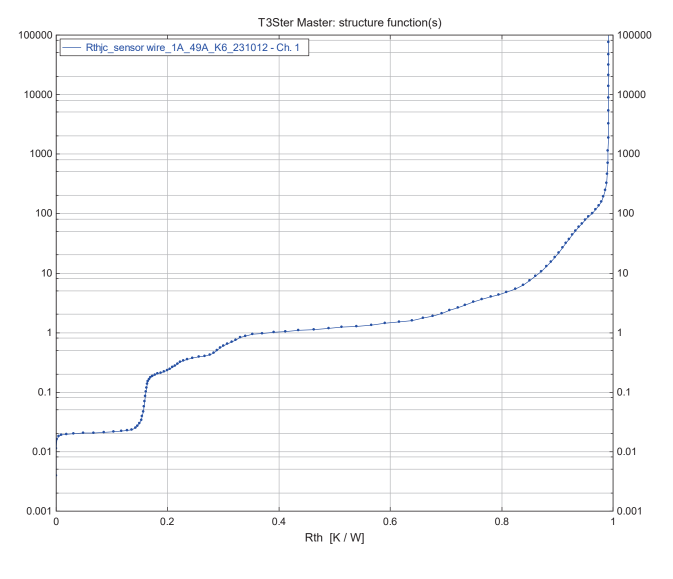
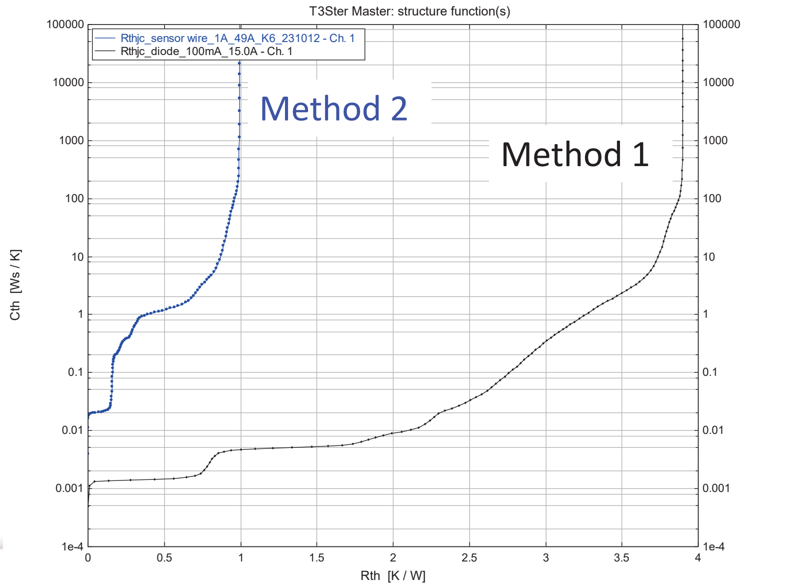
T3Ster Measurement Results -Method 2

DUT	TSP	
Item	T (°C)	V_F (V)
T1	20	0.017524
T2	30	0.018452
T3	40.1	0.019185
T4	50.1	0.020161
T5	60.1	0.021235
T6	70	0.022236
Sensitivity (mV/K)	0.0929393	

Set Parameter	
V_{gs}	20V
I_M	1 A
I_H	49 A
Ambient	25 °C



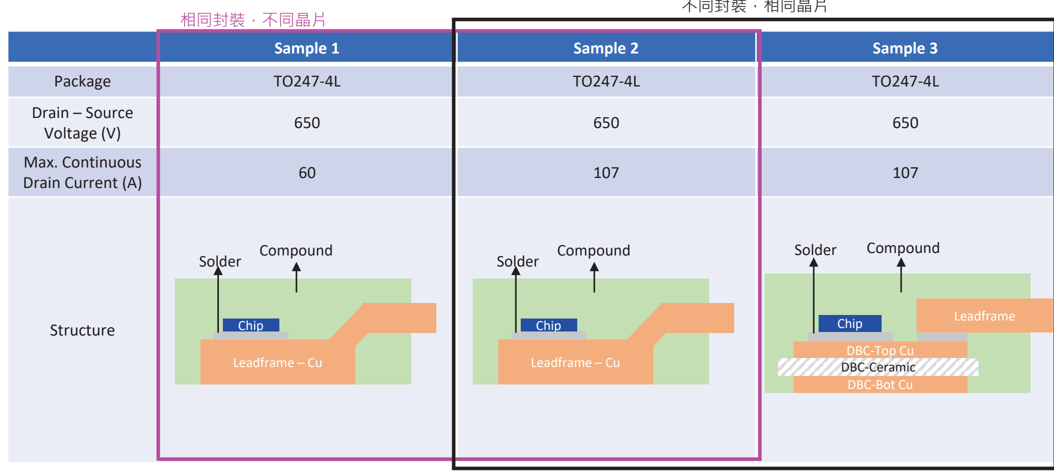
Compare Results



Case 3

Different Package Comparison

Device Description

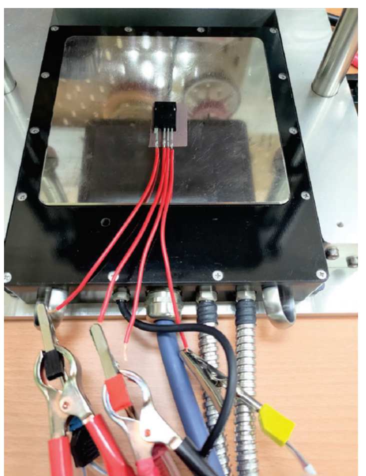


Device Description-Rthjc

- DUT put on Cold plate(水冷板)and measurement
- Measurement Parameter as bellow:

Set Parameter	Sample
V_{gs}	10V
I_M	100mA
I_H	12 A
Ambient Temp.	25 °C

※Remark: I_M is measurement current and I_H is heating current.



T3Ster Measurement Results_Rthjc_Structure Function_Sample 1

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- Integral Structure Function@ 25°C
- Use JESD 51-14
- Rthjc = 0.4235 K/W

T3Ster Master: structure function(s)

0.0909

0.1937 | 0.1389

Chip | Solder | LF-Cu

Cth [Ws / K]

Rth [K / W]

_S1_Rthjc_100mA_12.0A_K6 - Ch. 1
_S1_Rthjc_100mA_12.0A_K6 - Ch. 1 (Differential)
_S1_Rthjc_100mA_12.0A_K3 - Ch. 1
_S1_Rthjc_100mA_12.0A_K3 - Ch. 1 (Differential)

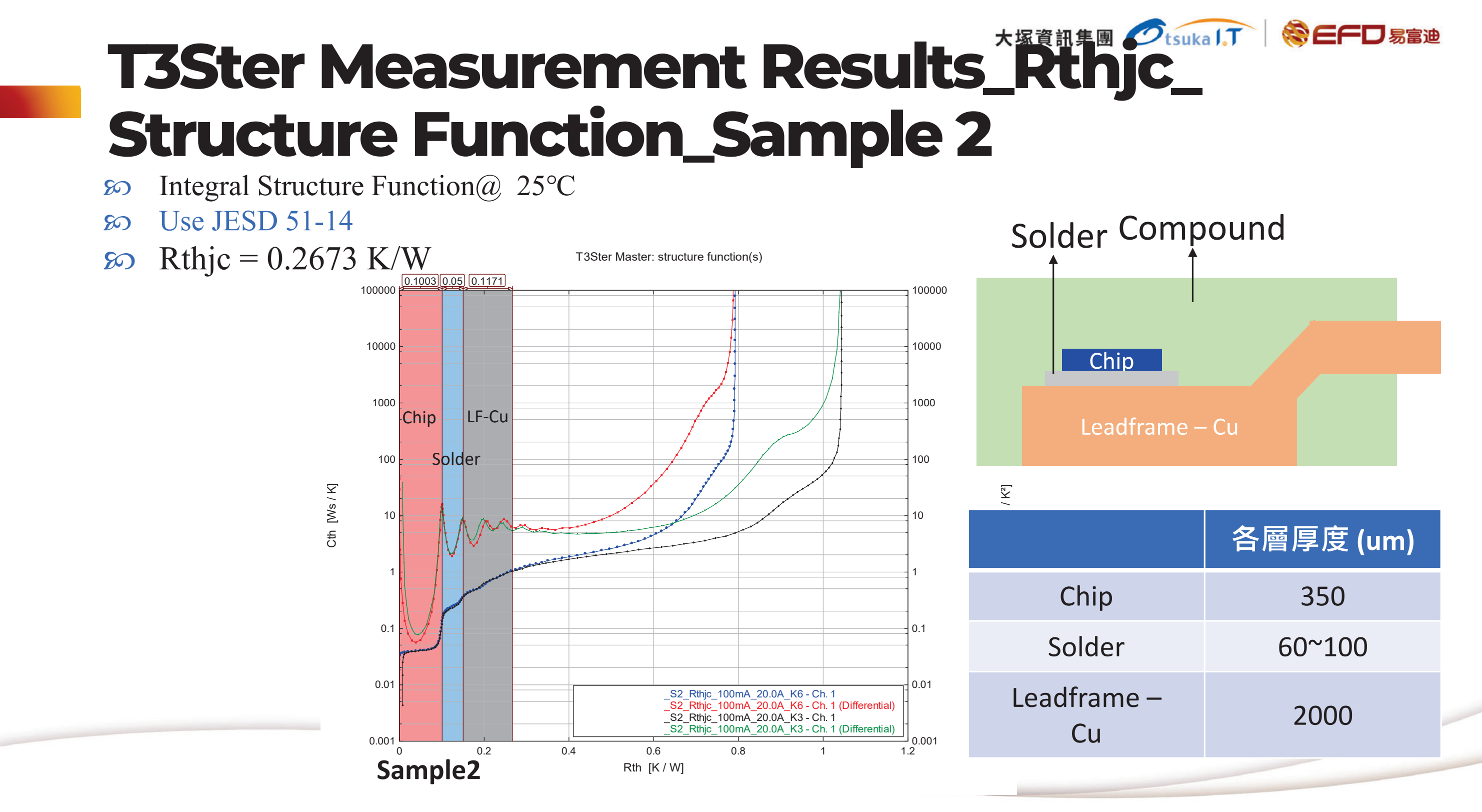
Sample1

Solder Compound

Chip

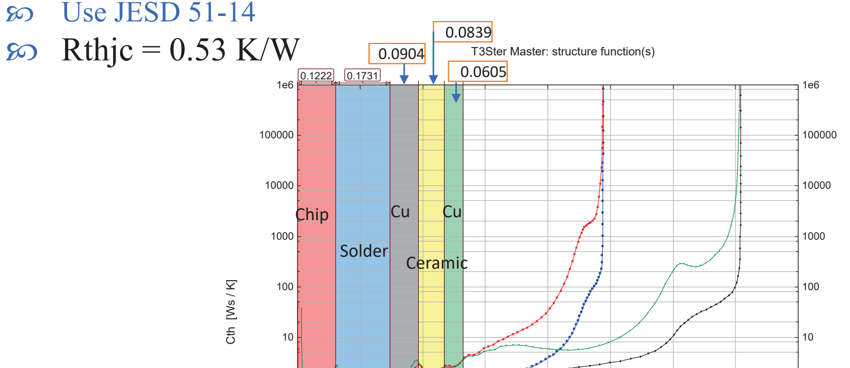
Leadframe – Cu

	各層厚度 (um)
Chip	350
Solder	60~100
Leadframe – Cu	2000

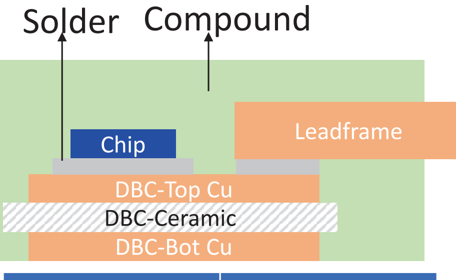


T3Ster Measurement Results_Rthjc_ Structure Function_Sample 3

- Integral Structure Function@ 25℃
- Use JESD 51-14
- Rthjc = 0.53 K/W



Sample3



	各層厚度 (um)
Chip	350
Leadframe	600
Solder	~175
DBC-top Cu	300
DBC-Ceramic	635
DBC-bot Cu	300

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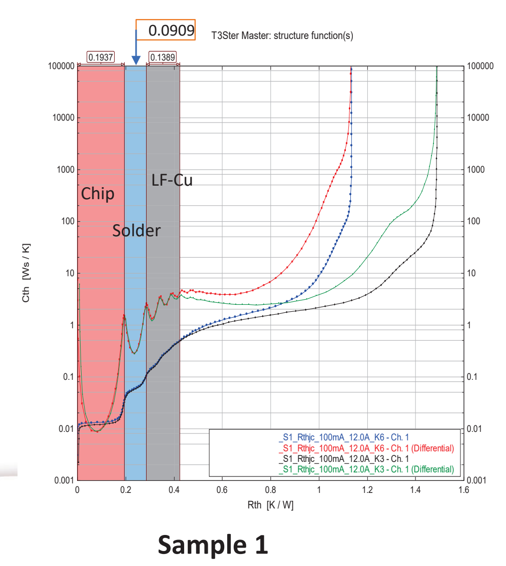
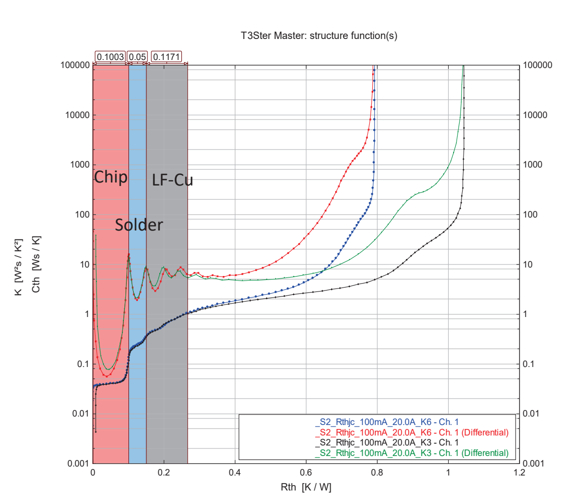
Summary_Rthjc

相同封裝，不同晶片

除了受到chip的影響，Sample 1 solder阻抗略大一點，整體熱阻被拉大



Sample 1

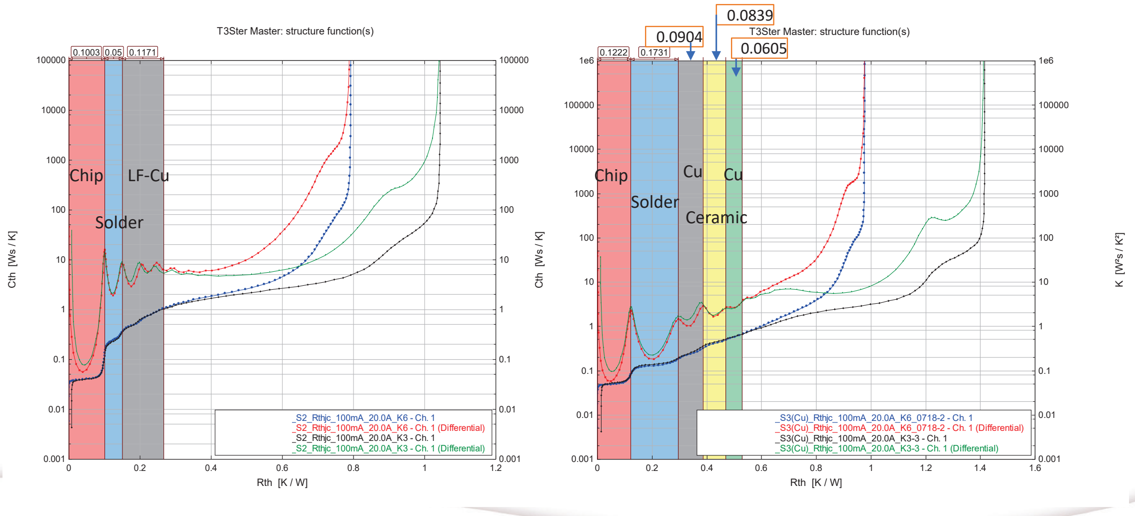


Sample 2

Summary_Rthjc

相同晶片，不同封裝

Solder的厚度不同，導致熱阻有明顯差異，Sample 3的熱阻較Sample 2高出許多。



Sample 2 **Sample 3**

THANK YOU

Contact Us

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  (捷運江子翠站 2 號出口)
- 電話：02-8772-4131 #1001(實驗室)
- 網址：www.efd.com.tw

提供給客戶的解決方案

實驗室提供客戶全面的硬體服務，包括T3Ster Demo、教育訓練、熱特性Benchmark測試、半導體元件代測以及暫態熱阻、PowerCycling壽命測試等。同時，我們也協助客戶校正熱模擬模型，提供MicRed硬體系統銷售服務，並提供客製化設備設計和建置。我們致力於為客戶提供全面的支援和解決方案。

實驗室設備

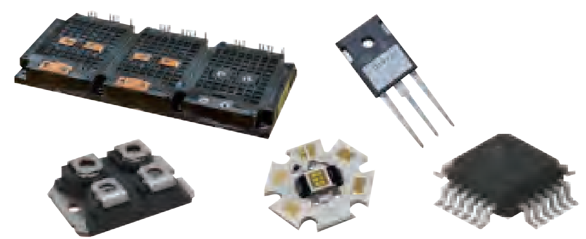
- T3Ster及T3Ster SI
- Booster + Power Supply (150V / 10A & 11V / 240A)
- Thermostat 電子晶片恆溫控制器 (0~100度)
- 大型控溫冷板 + Julabo 冰水機 (可解 400~500 W)
- 符合 JEDEC 標準的 Still Air Chamber

▲ Power Tester 功率循環測試

▲ T3Ster System 暫態熱阻量測系統

可量測之元件

- LED、Logic IC、Diode
- MOSFET (discrete or module)
- IGBT (discrete or module)
- 能通電並有電壓差變化的元件皆能量測



▲ 可測量零散元件及模組

量測可得到之結果

- 元件的 Rthjc、Rthjb、Rthja 熱阻值
- 元件的 ΔTj (junction to ambient) 溫度變化
- Zth (Thermal Impedance)
- Pulse Thermal Impedance
- SOA (Safety Operation Area)
- Structure Function 結構函數

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