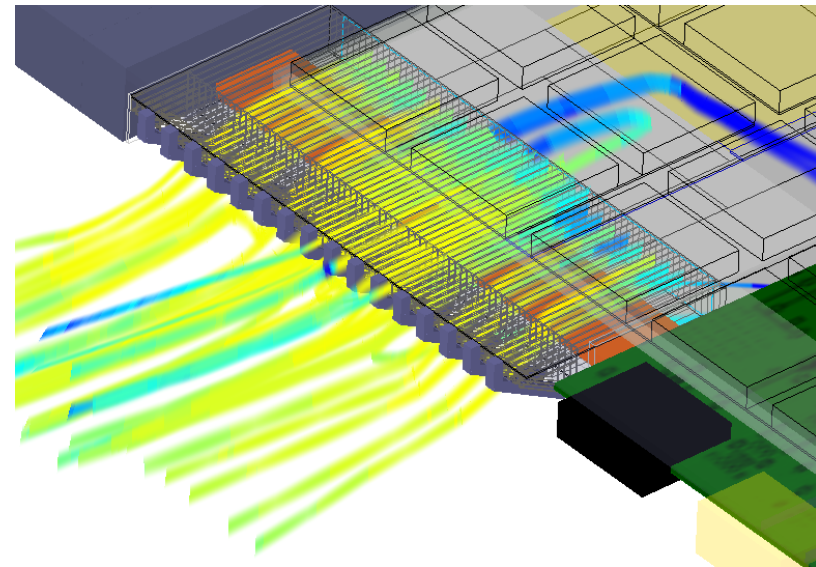


Apply Compact Heat Sink Model

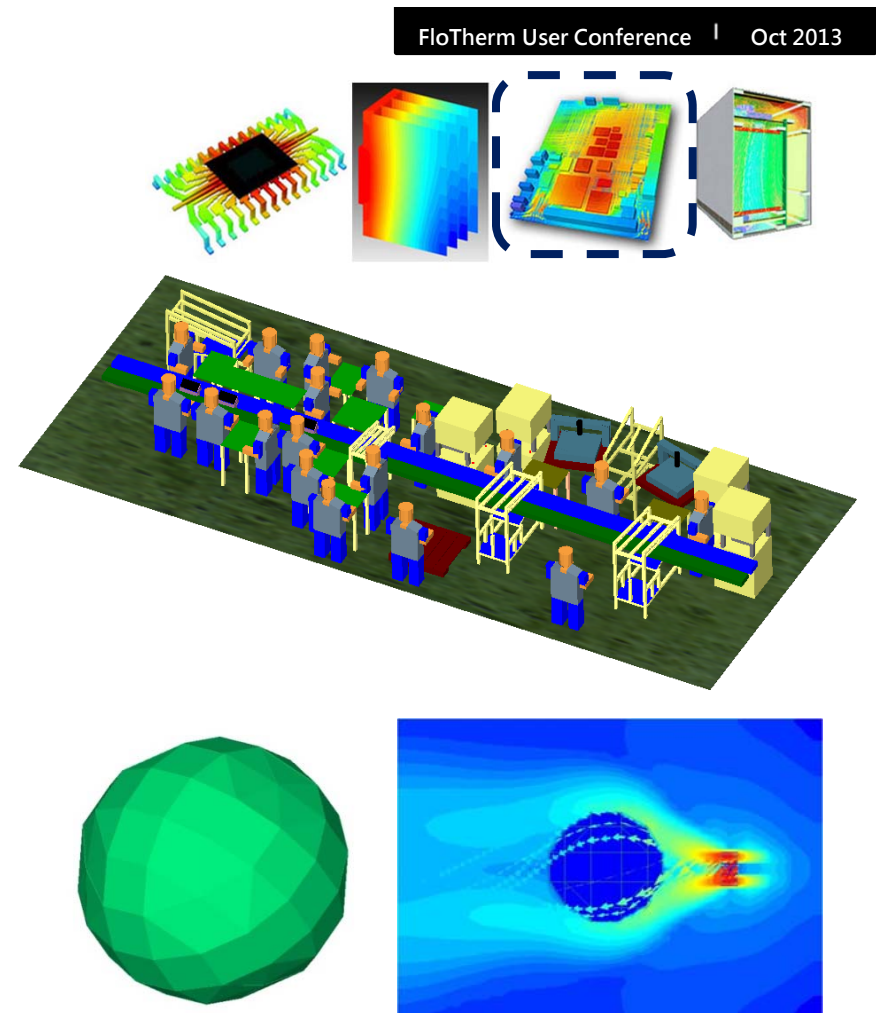
Hank Chung, TPE HQ

2013/11/13



History

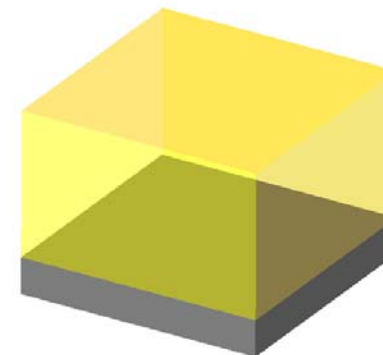
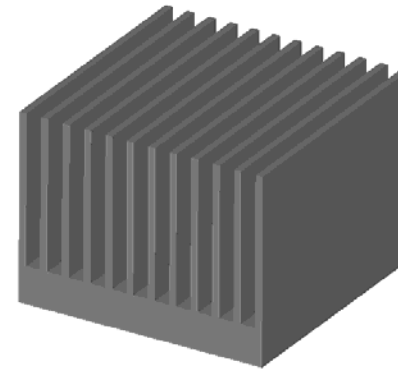
- **CFD Purpose**
 - 仿真 (Flow and temperature)
 - 優化 (Optimize)
- **Software Selection**
 - Convenience
 - Geometry Detail
 - Grid generation
 - Calculating Speed
- **Fundamental**
 - Process and patient
 - Theory



3 CONTENTS

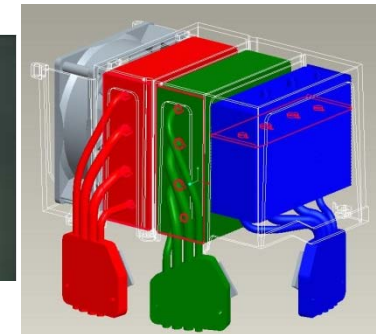
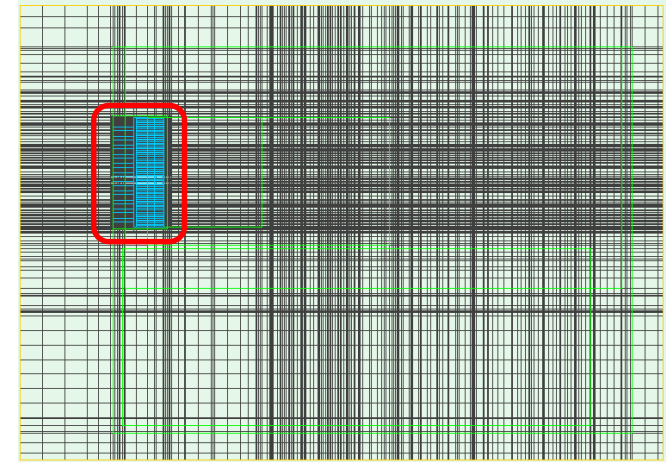
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- 01 Introduction
- 02 Default Compact Heat Sink Models
- 03 Surface Exchange Function
- 04 Procedure
- 05 Example
- 06 Summary

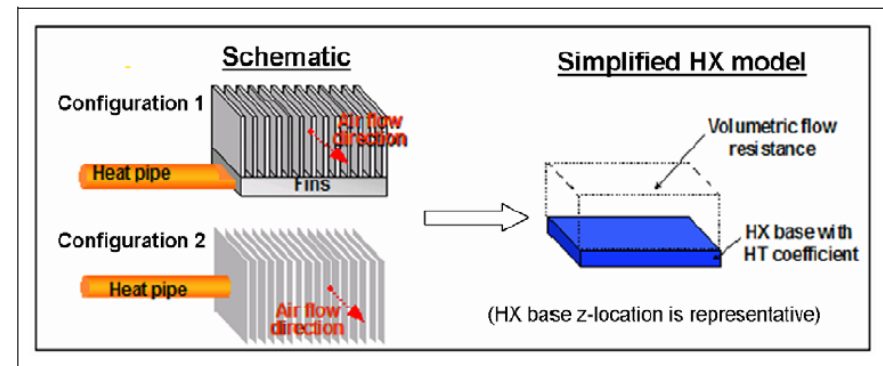
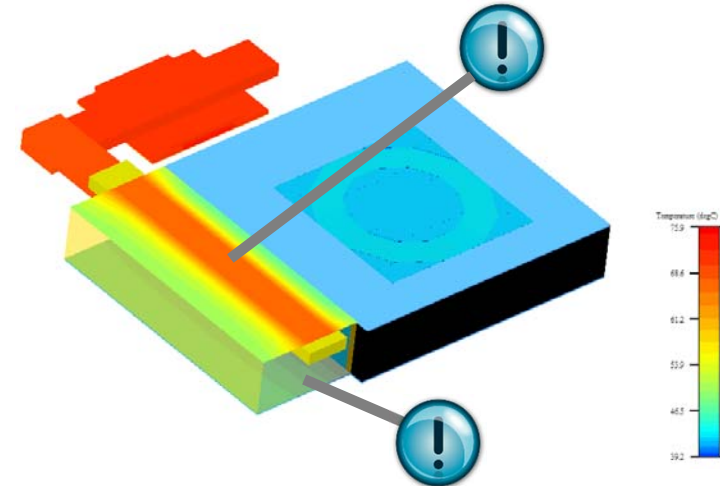
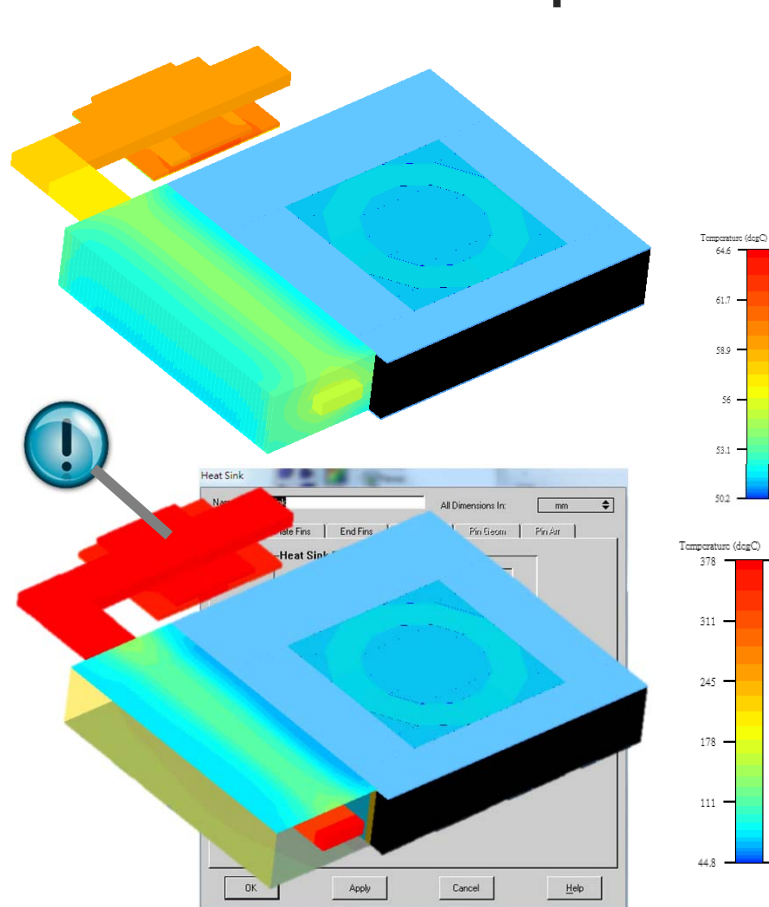


01 Introduction

1. In order to save calculation lead time
 - a) Standard model in library
 - b) Save grid number
 - c) Avoid big aspect ratio
2. Improve the exactness
 - a) Refer to experiment data
 - ① Non-uniform flow
 - ② Complex geometry
 - b) Improve enclosure temperature around heat sink

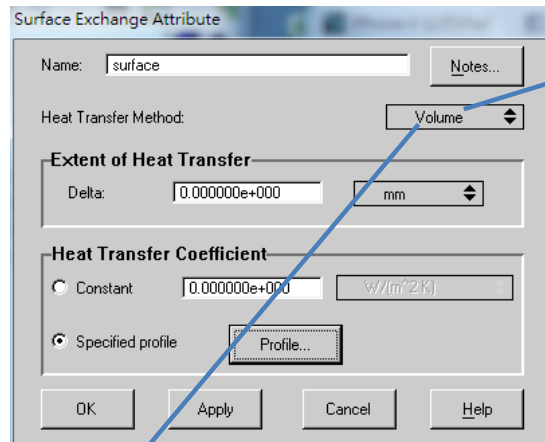


02 Default Compact Heat Sink Models

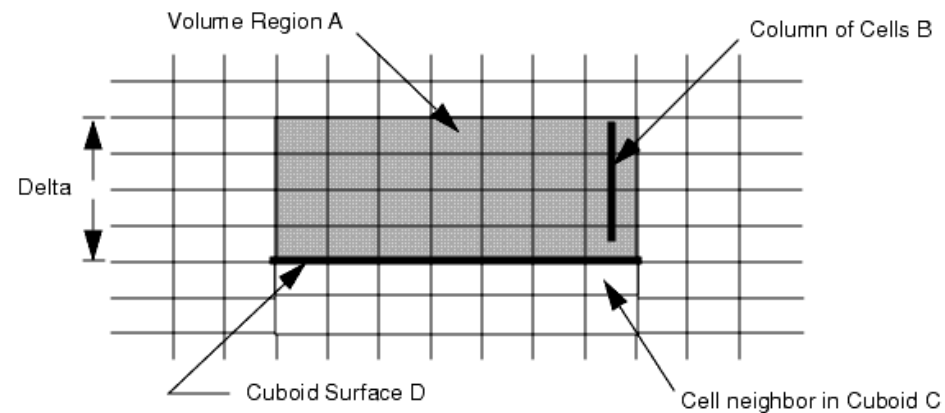


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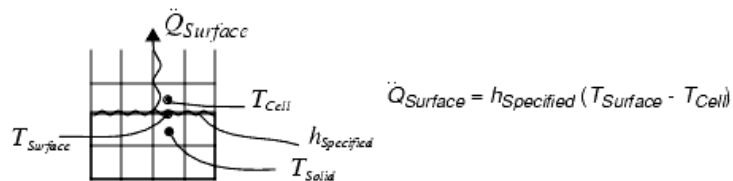
03 Surface Exchange Function



Volume



Surface

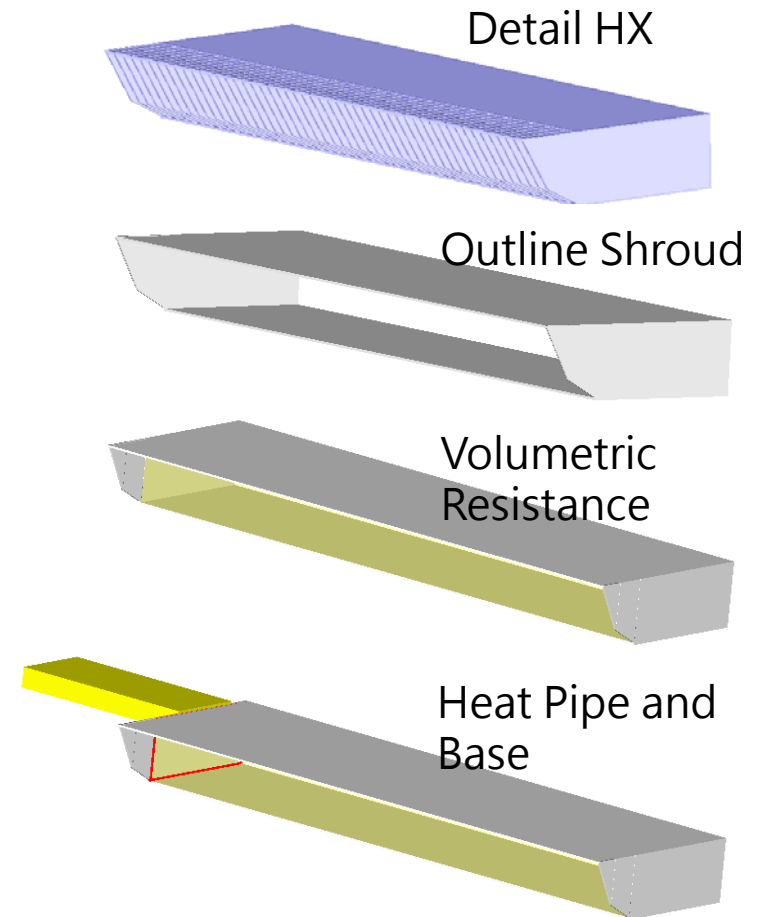


When the **Specified profile** heat transfer coefficient option is selected,

$$Q_{tot} = \frac{T_{mean} - T_{in}}{R}$$

04 Procedure

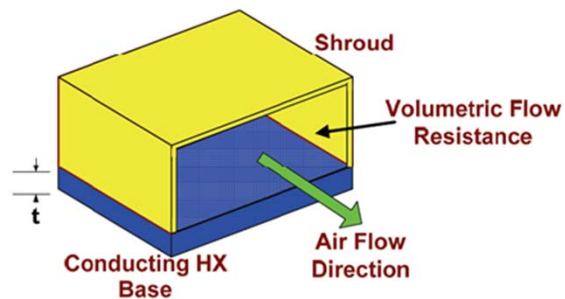
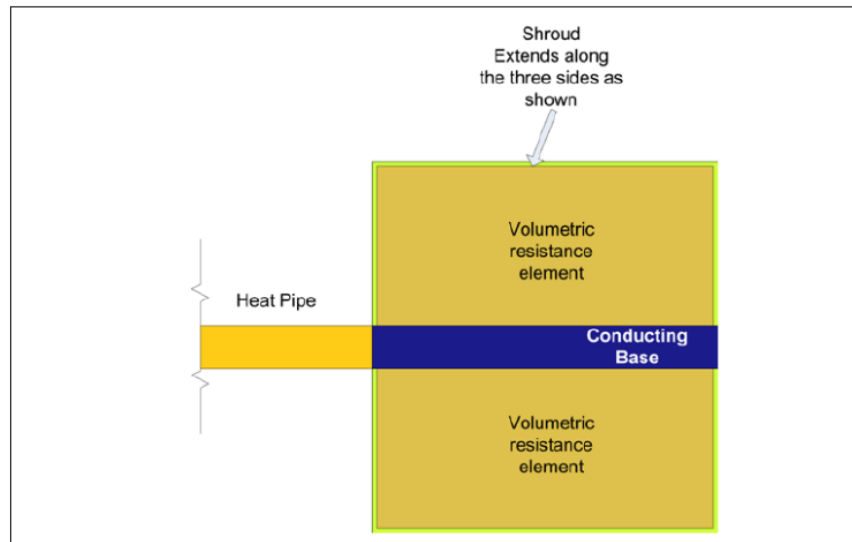
1. Define HX dimension and outline shroud in drawing board
2. Measure flow resistance (m/s, Pa)
3. Measure HX thermal resistance (m/s, °C/W)
4. Create volumetric flow resistance
5. Select base and define delta
6. Specify thermal resistance profile



8 04 Procedure Shroud

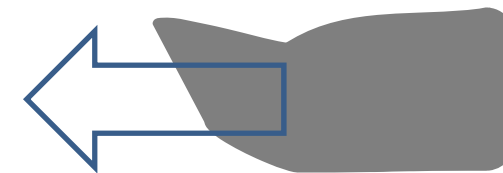
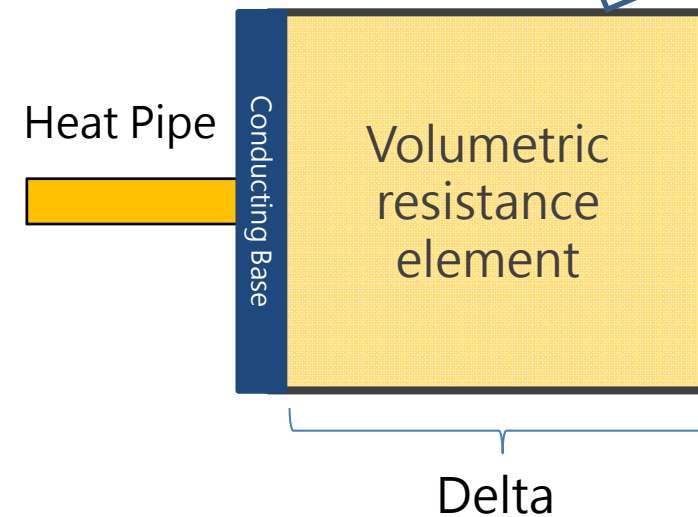
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Shroud Extends along the three sides



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9 04 Procedure Flow Resistance

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Spreadsheet from

MentorMA\flosuite_v93\flotherm\examples\XML
\Spreadsheets\Advanced-Resistance.xlsm

Density	1.16 kg/m ³	Geometry	X _{length}	0.0586 m
Viscosity	1.84E-05 Ns/m ²		Y _{length}	0.0059 m
		<i>If planar, set Z_{length} to</i>	Z _{length}	0.0137 m

CLEAR DATA

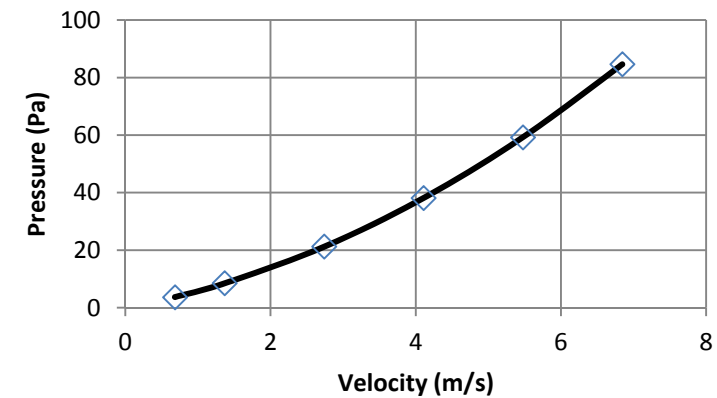
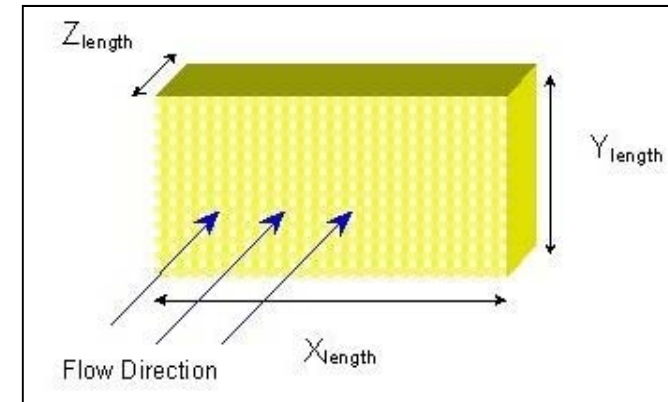
Velocity (m/s)	Pressure (Pa)
0.684	3.63
1.369	8.4815
2.738	21.252
4.107	38.118
5.476	59.216
6.845	84.624

Results

Number of data points	6
A	3.71E+07 1/m
B	142.0944 1/m
R ²	0.999999

Save Options	
Name	Vent
Library Folder	c:\Resistances

SAVE XML



◇ Input Data — Curve Fit

10 04 Procedure Thermal Profile

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Surface Exchange Attribute

Name:

Heat Transfer Method:

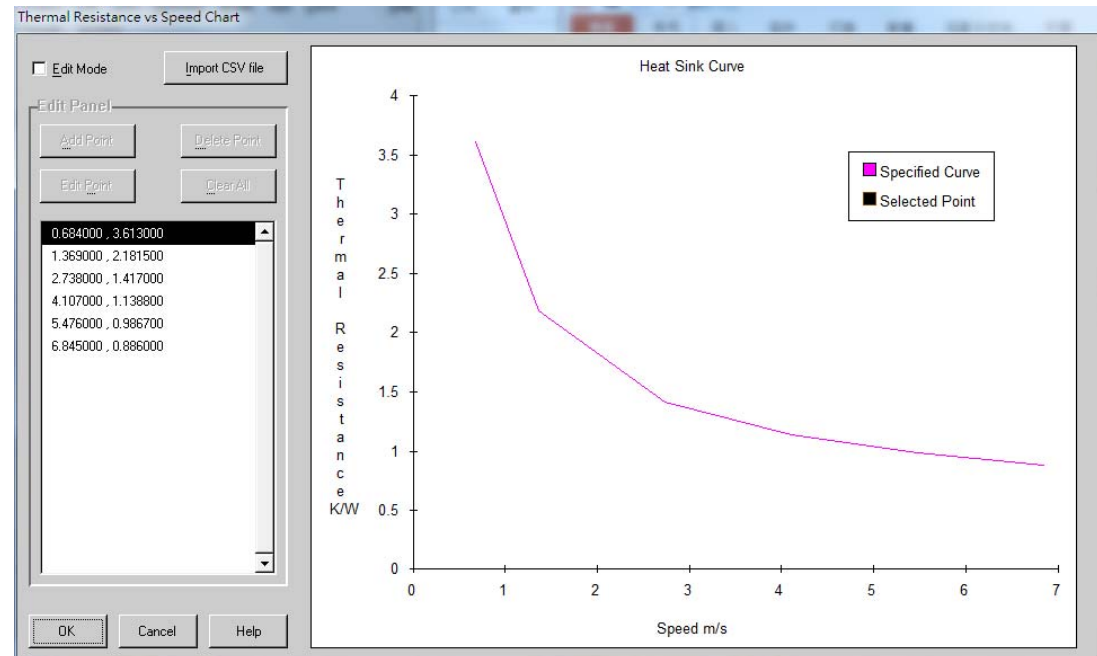
Extent of Heat Transfer

Delta:

Heat Transfer Coefficient

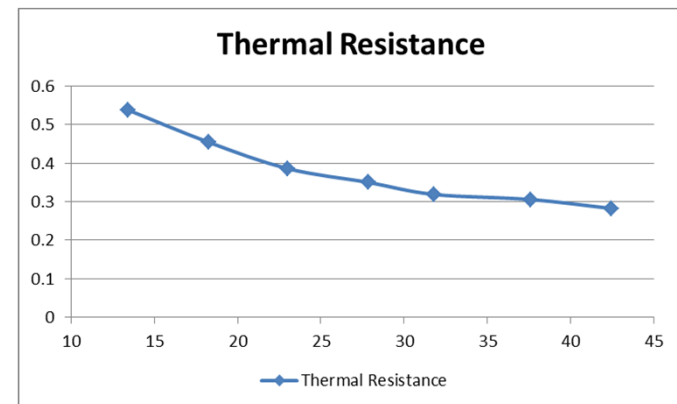
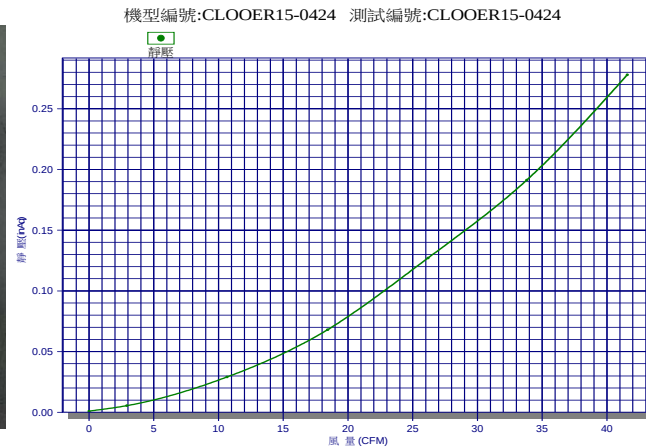
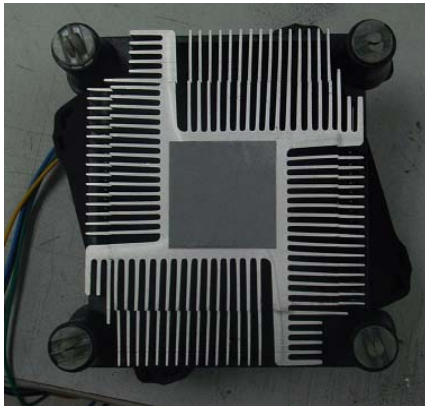
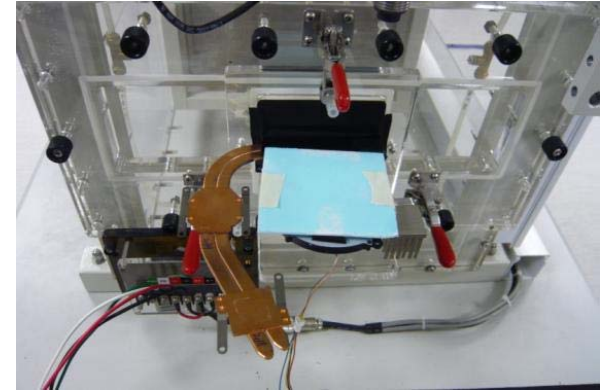
☐ Constant

☒ Specified profile

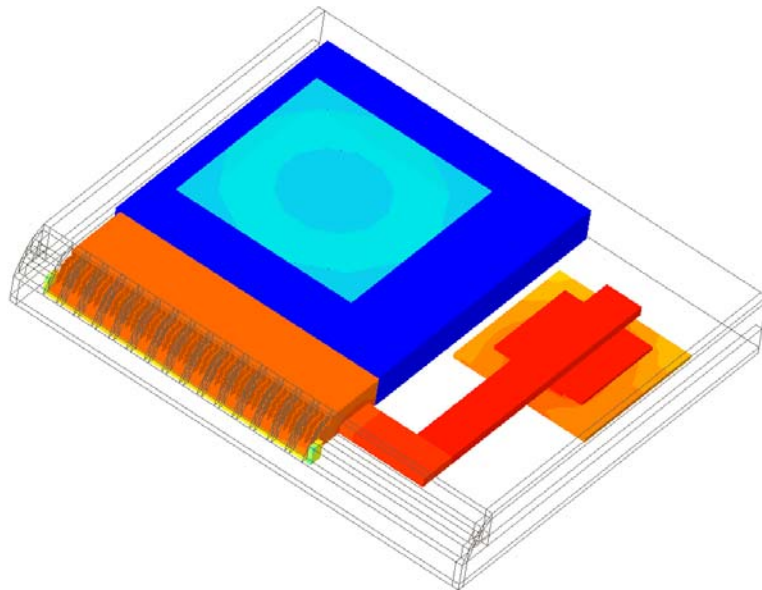


05 Example

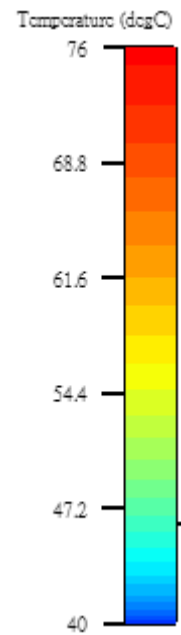
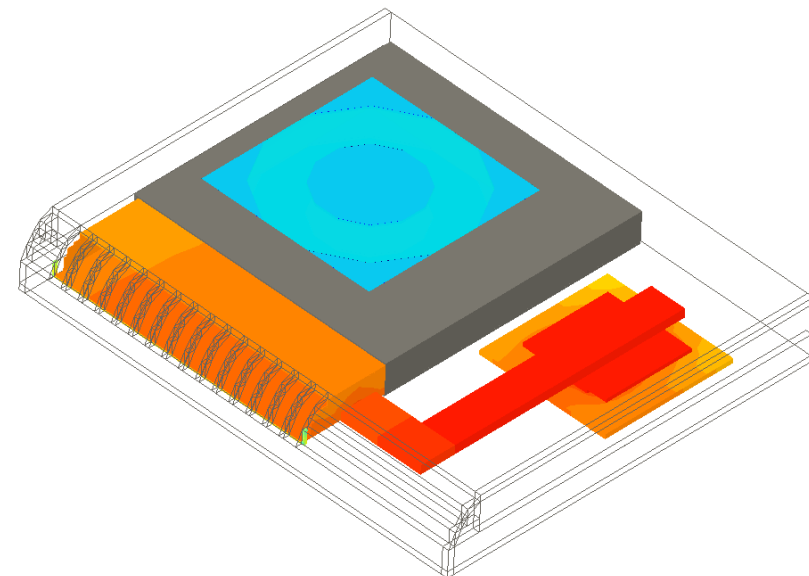
- Wind tunnel to check flow resistance by adjust fan voltage and inlet condition
- Measure HX thermal resistance with different flow rate and power dissipation



Detail Model, 71.4°C

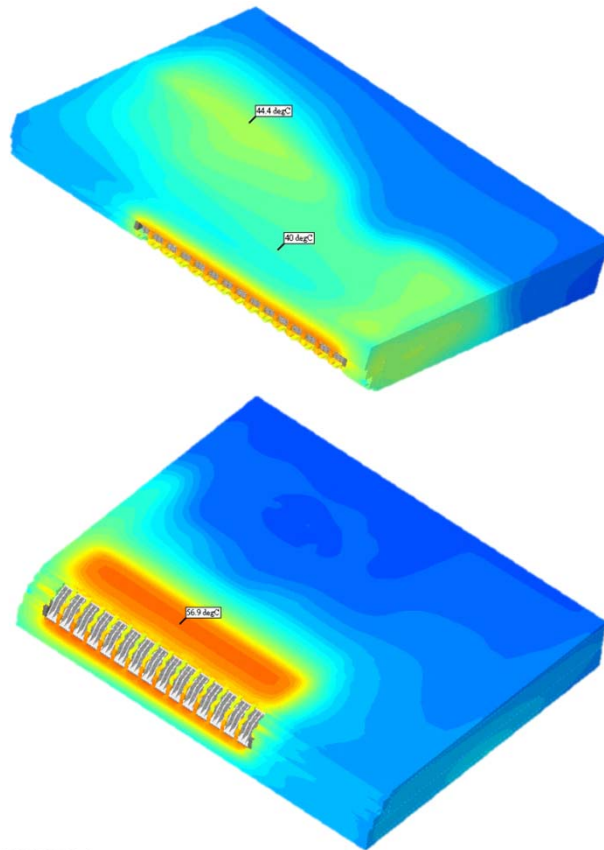


Compact Model, 71.22°C



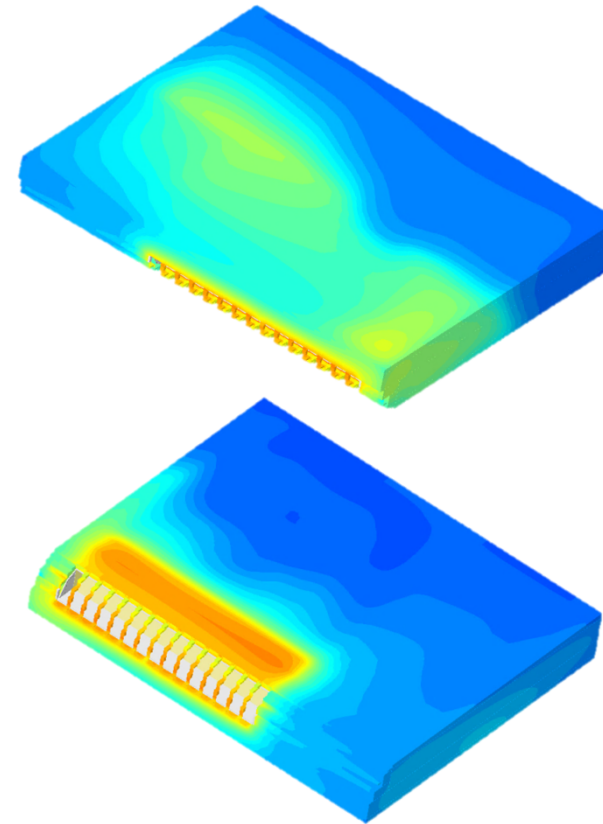
13 05 Example Chassis Temperature

Detail Model



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Compact Model



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06 Summary

- Think about CFD purpose before you start it → How detail you need
- Using experimental data to build a compact heat sink model can save more calculating time and hardware resources with good %CA
- Must consider heat loss from heater to ambient and from pipes
- FloTHERM is really a useful tool for Pegatron developing products



thank you.