



Discover Better Designs, *Faster*

FloTHERM – Optimizing Thermal Management of a Chipset

Tools:

- FloTHERM

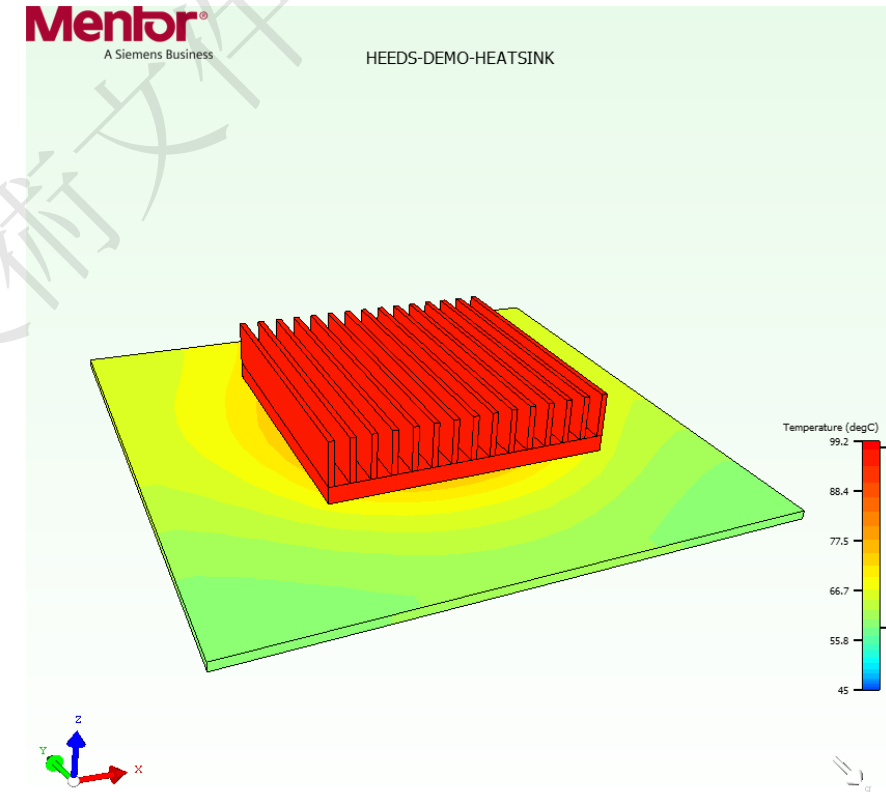
Challenge:

Minimize Hottest Junction Temperature

Minimize Heat-sink Mass

- By changing Six Variables associated with the Heat-sink Geometry

Process Flow:



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Problem Description

Objectives:

Minimize *Hottest Junction Temperature*

Minimize *Mass of Heat-sink*

(Trade-Off Study)

Variables:

$5 \leq \text{Number of internal fins} \leq 20$

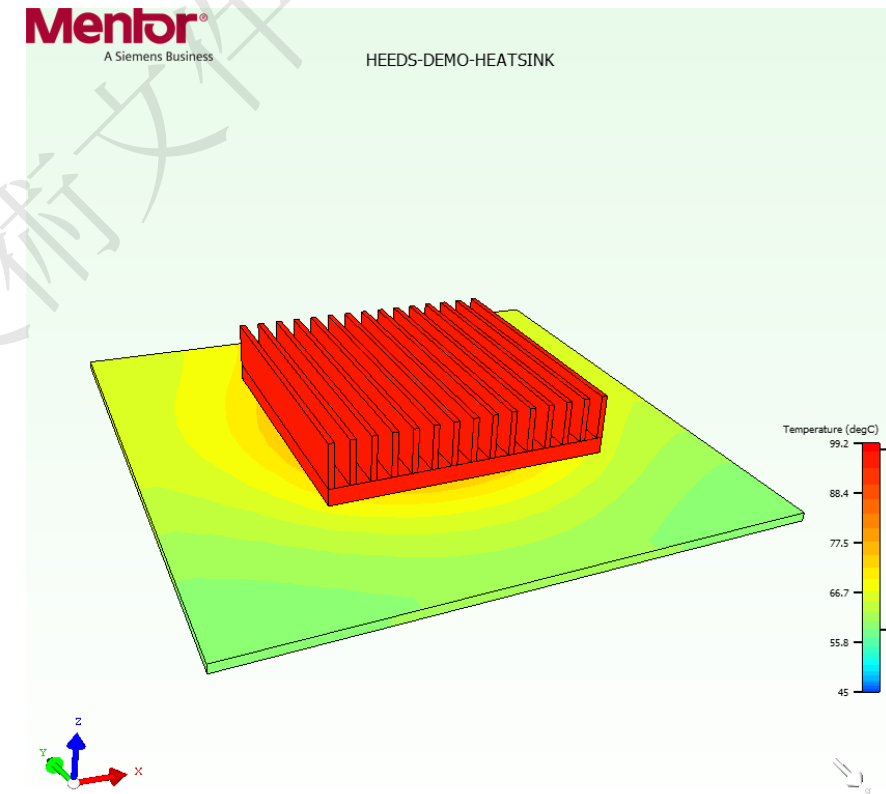
$0.005 \text{ m} \leq \text{Fin height} \leq 0.015 \text{ m}$

$0 \text{ m} \leq \text{Center gap} \leq 0.004 \text{ m}$

$0 \text{ m} \leq \text{High side fin inset} \leq 0.004 \text{ m}$

$0 \text{ m} \leq \text{Low side fin inset} \leq 0.004 \text{ m}$

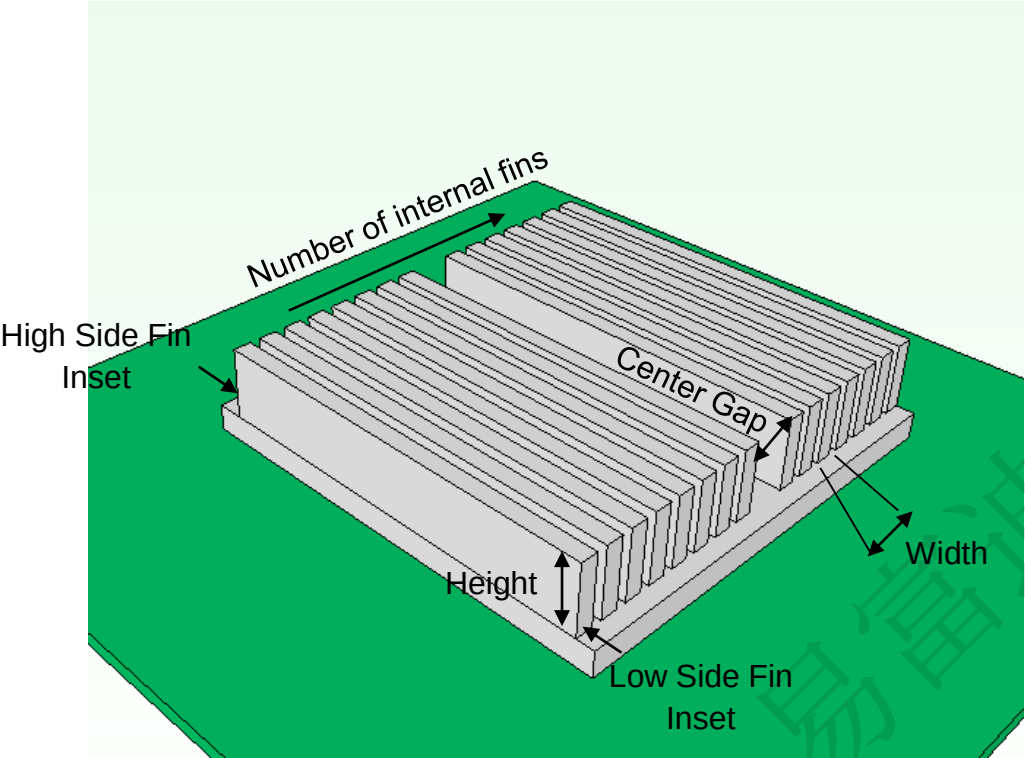
$0.001 \text{ m} < \text{Width} \leq 0.005 \text{ m}$



FloTHERM Model

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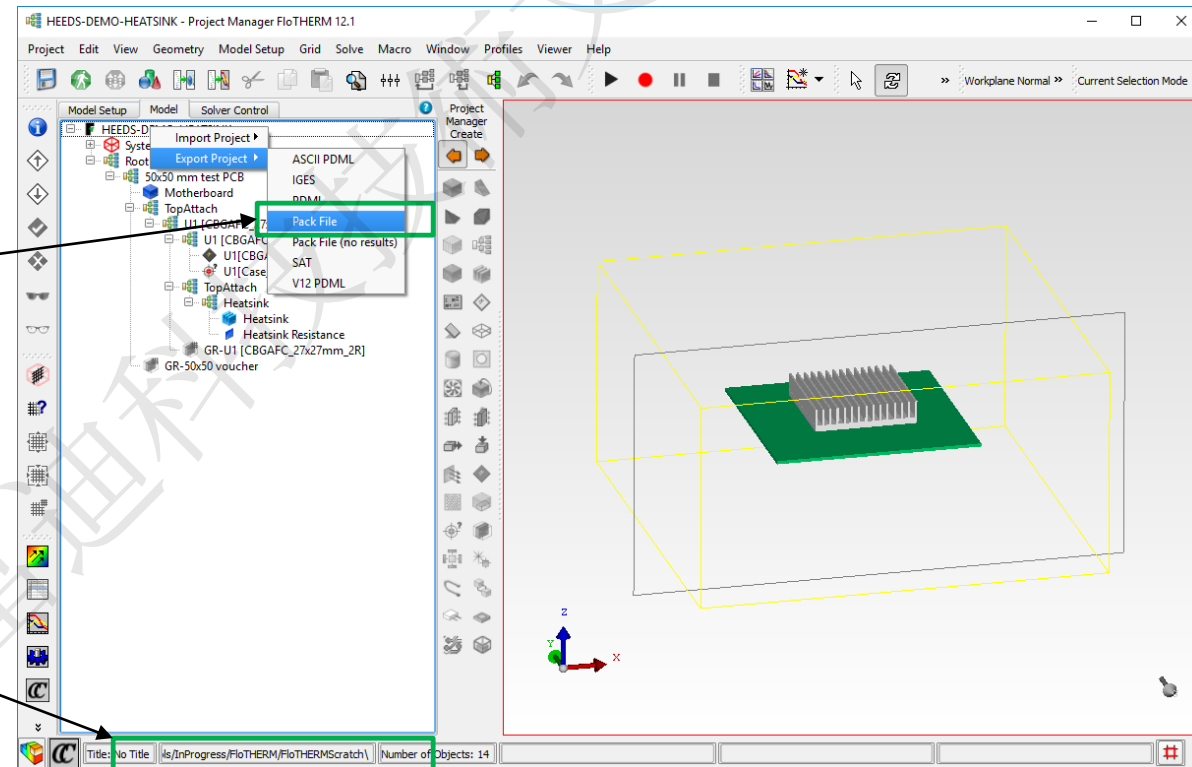
Variable Description



Variable Name	Baseline	Range
numberOfInternalFins	13	10-21
finHeight	8mm	5-20mm
centerGap	1mm	0-5mm
highSideFinInset	1mm	0-5mm
lowSideFinInset	1mm	0-5mm
width	1mm	0-5mm

Model Preparation

- From the main **Project Manager** GUI of FloTHERM, Right Click the top node of the model and select **Export Project > Pack File**.
- In the dialog that opens, save the .pack file in the scratch directory of FloTHERM. This directory is shown in the GUI



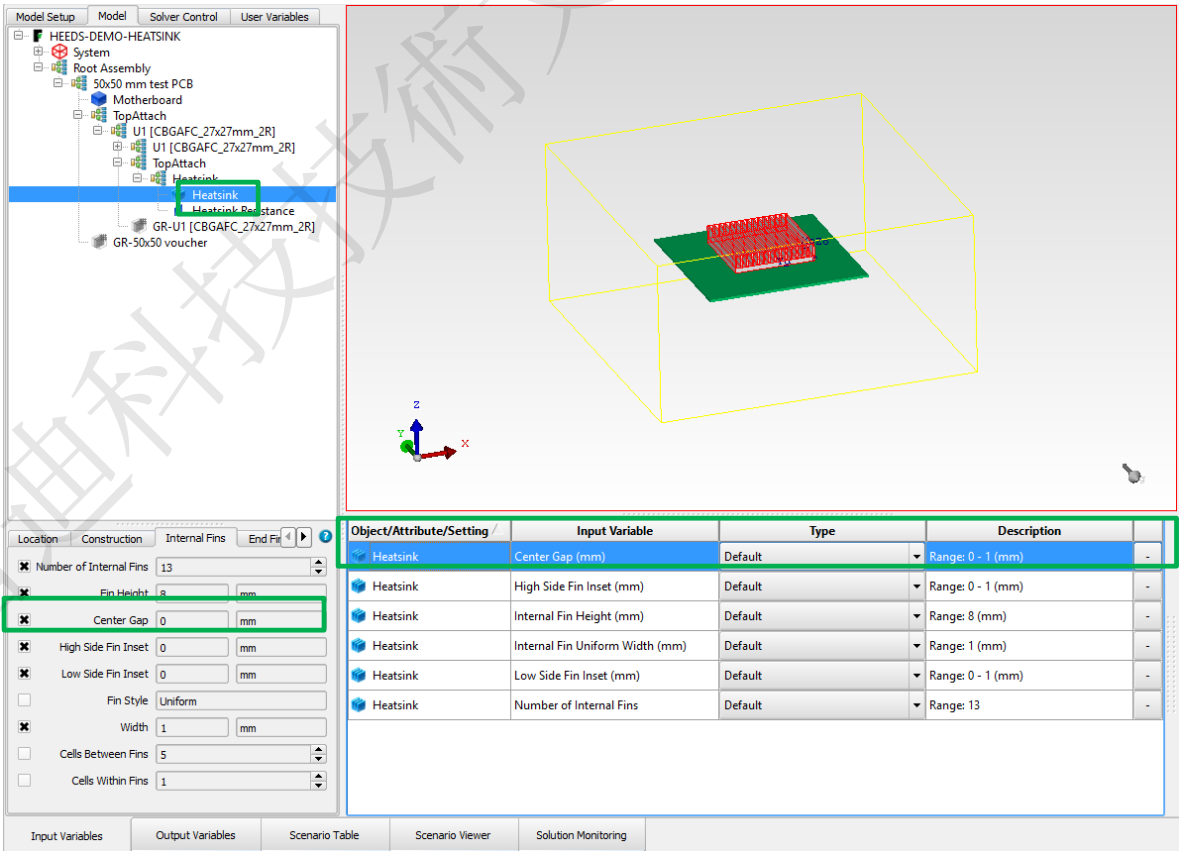
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Model Preparation

- Next open up **Command Center** from the main Project Manager interface of FloTHERM. It's button is shown as follows:



- In the **Command Center** GUI that opens, define **Input Variables** by selecting model components and ticking the check box to add them to the Input Variables Tab list.

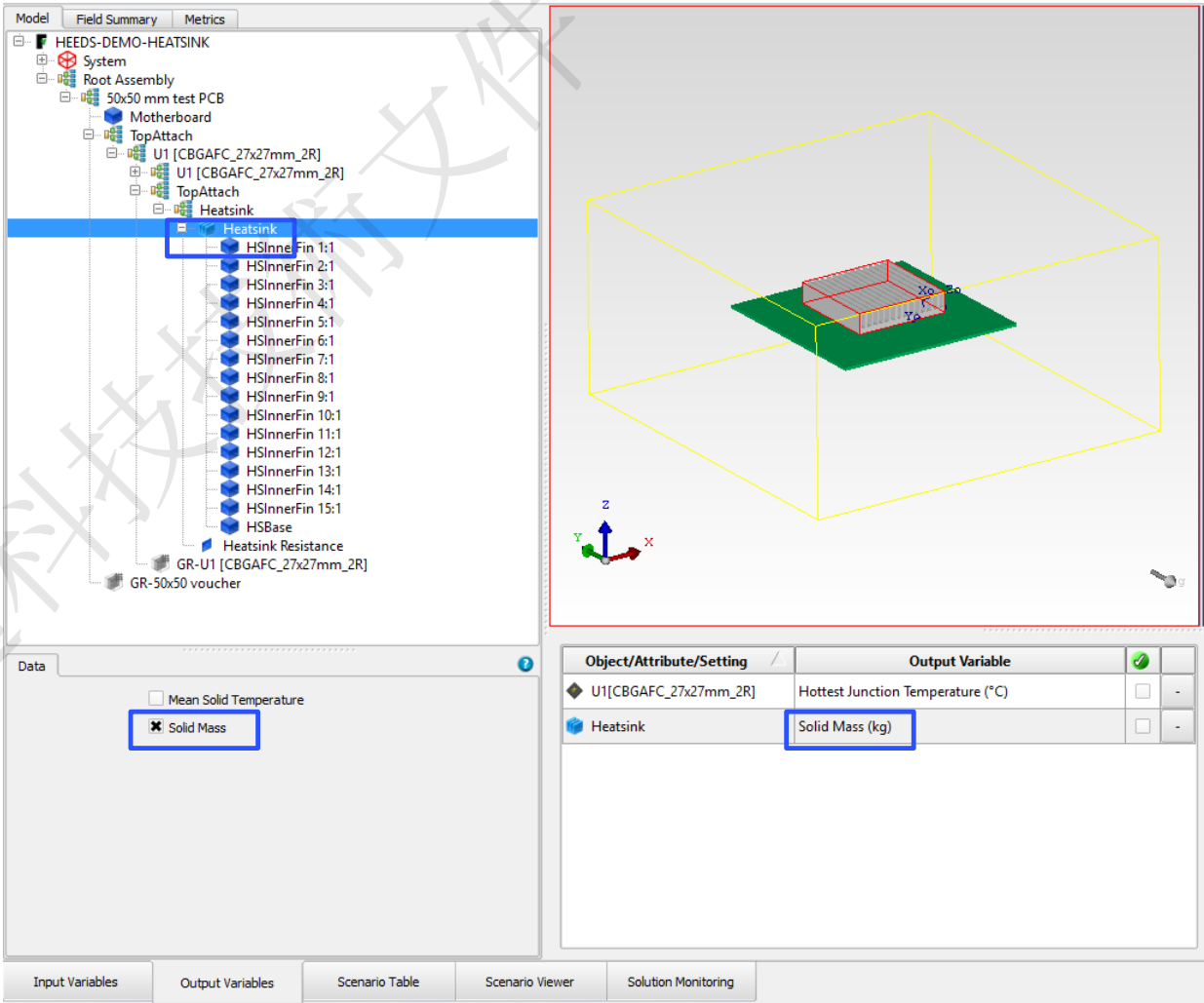


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Model Preparation

- Define **Output Variables** in a similar manner by selecting model components and ticking the check box to add them to the Output Variables Tab list.



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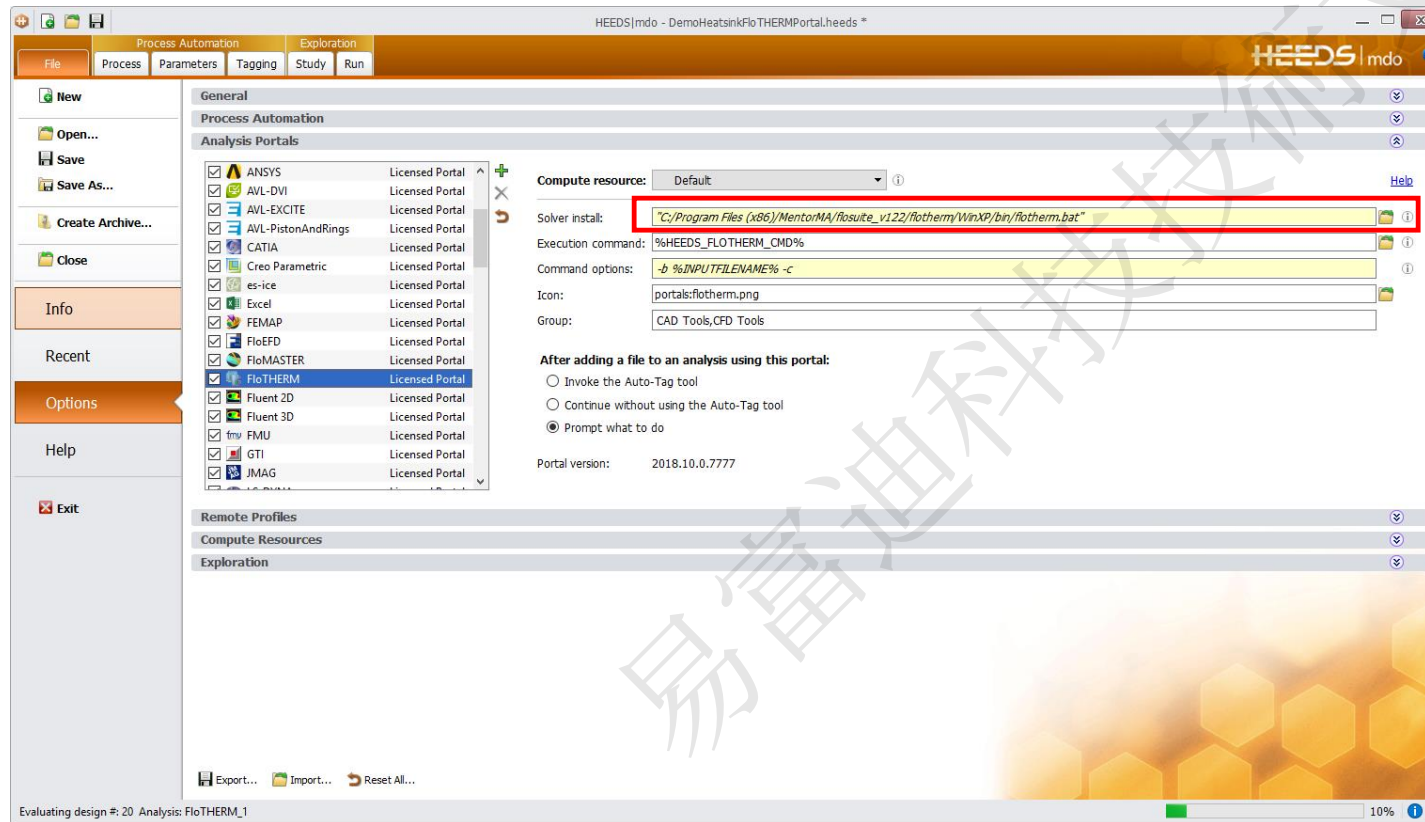
Model Preparation

- In the Scenario Table tab ensure that your Base Project converges and yields results for the Output Variables defined.

	Base Project	Append Scenario
Heatsink : Center Gap (mm)	0	
Heatsink : High Side Fin Inset (mm)	0	
Heatsink : Internal Fin Height (mm)	8	
Heatsink : Internal Fin Uniform Width (mm)	1	
Heatsink : Low Side Fin Inset (mm)	0	
Heatsink : Number of Internal Fins	13	
Solution Status	All Monitor Points Converged	
Store Results?	Full	
Initialize From	No Project	
U1[CBGAFC_27x27mm_2R] : Hottest Junction Temperature (°C)	99.235	
Heatsink : Solid Mass (kg)	0.036585	

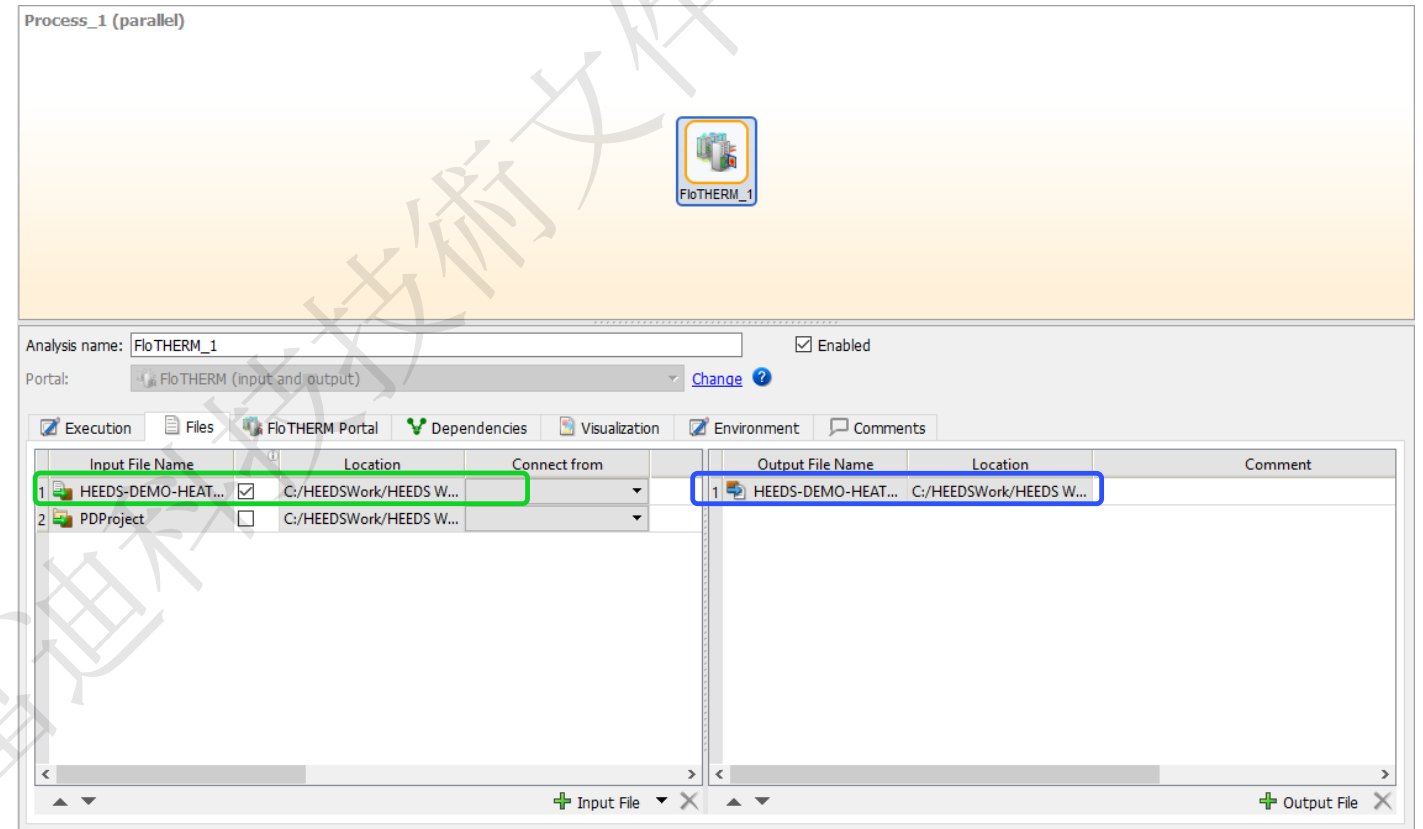
FloTHERM – Analysis Portal Preparation

- Ensure that the Solver Install in the FloTHERM analysis portal properties points to the correct location.



FloTHERM – Analysis Portal Preparation

Inside HEEDS add the FloTHERM .pack file to the **Input** files list, it will automatically be added to the **Output** files list. The project folder will also be added automatically to the **Input** files list



Note: The .pack file is not parsed, it simply contains a backup copy of your project.

FloTHERM – Analysis Portal Preparation

- For the Run Options of the FloTHERM Portal, set the desired **number of processes** to use for running each scenario.
- Customization of FloTHERM **data management** options can also be set

The screenshot displays the 'Process_1' configuration window for the FloTHERM Analysis Portal. The 'Run Options' tab is active, showing the following settings:

- Analysis name:** FloTHERM_1
- Portal:** FloTHERM (input and output) [Change ?]
- Enabled:** ☒
- Run Options:**
 - Number of processes to use:** 1
 - ☐ Clean up existing scenarios before evaluation
 - ☒ Retain new HEEDS-created scenarios after evaluation
 - ☒ Store Results
 - ☒ History Only
 - ☐ Full

FloTHERM – Tagging Input Variables

Parameters defined in the FloTHERM Command Center can be directly identified and tagged via the FloTHERM portal

Base Project	
Heatsink : Center Gap (mm)	0
Heatsink : High Side Fin Inset (mm)	0
Heatsink : Internal Fin Height (mm)	8
Heatsink : Internal Fin Uniform Width (mm)	1
Heatsink : Low Side Fin Inset (mm)	0
Heatsink : Number of Internal Fins	13
Solution Status	All Monitor Points Converged
Store Results?	Full
Initialize From	No Project
U1[CBGAFC_27x27mm_2R] : Hottest Junction Temperature (°C)	99.235
Heatsink : Solid Mass (kg)	0.036585

+

Input Type

model

Root Assembly

50x50 mm test PCB

Geometry

\\\\Heatsink

Heatsink

Input Property

Value

numberOfInternalFins 13

finHeight 0.008

centerGap 0.001

highSideFinInset 0

lowSideFinInset 0

width 0.001

Tag

Portal

Input Type

model

Root Assembly

50x50 mm test PCB

Geometry

\\\\Heatsink

Heatsink

Input Property

Value

numberOfInternalFins numberOfInternalFins

finHeight finHeight

centerGap centerGap

highSideFinInset highSideFinInset

lowSideFinInset lowSideFinInset

width width

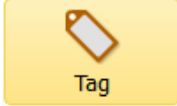
FloTHERM – Tagging Output Variables

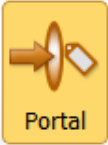
Similarly responses defined in the FloTHERM Command Center can be directly identified and tagged via the portal.

Base Project	
Heatsink : Center Gap (mm)	0
Heatsink : High Side Fin Inset (mm)	0
Heatsink : Internal Fin Height (mm)	8
Heatsink : Internal Fin Uniform Width (mm)	1
Heatsink : Low Side Fin Inset (mm)	0
Heatsink : Number of Internal Fins	13
Solution Status	All Monitor Points Converged
Store Results?	Full
Initialize From	No Project
U1[CBGAFC_27x27mm_2R] : Hottest Junction Temperature (°C)	99.235
Heatsink : Solid Mass (kg)	0.036585



Output Type	Geometry	Output Property	Value
model	\\Heatsink	solidMass	0.0365850025693142
Root Assembly	Heatsink		
50x50 mm test PCB	\\U1 [CBGAFC_27x27mm_2R]		


Tag


Portal

Output Type	Geometry	Output Property	Value
model	\\Heatsink	solidMass	Mass
Root Assembly	Heatsink		
50x50 mm test PCB	\\U1 [CBGAFC_27x27mm_2R]		

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Results



Plot views can be used to view multiple plots on the same screen which allows the user to visualize design trends more comprehensively.

