

Broadband & Wireless Equipment Thermal Design by FloEFD

Jay Chien

EFD Corporation

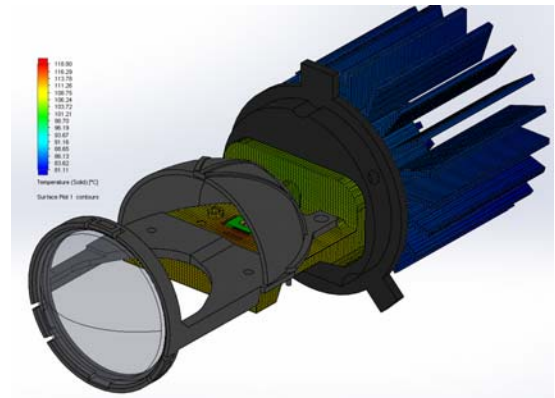
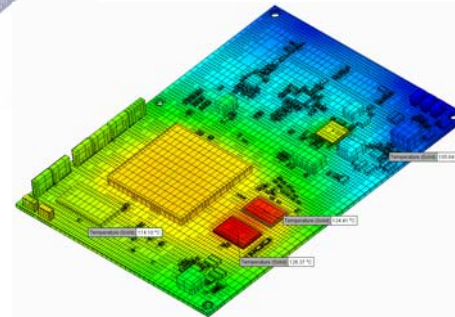
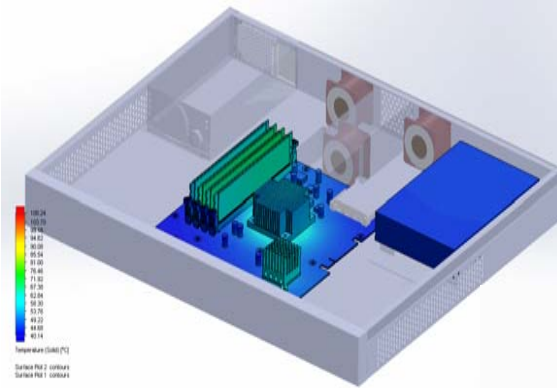
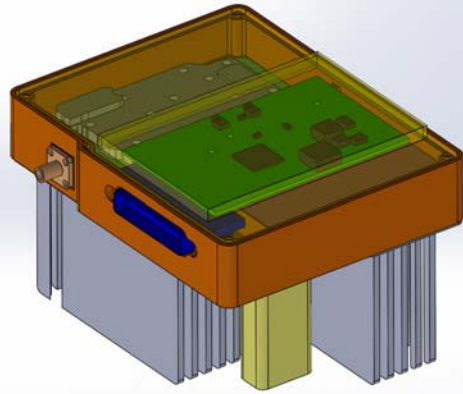
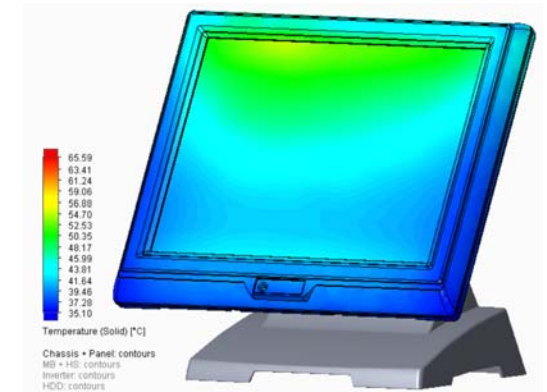
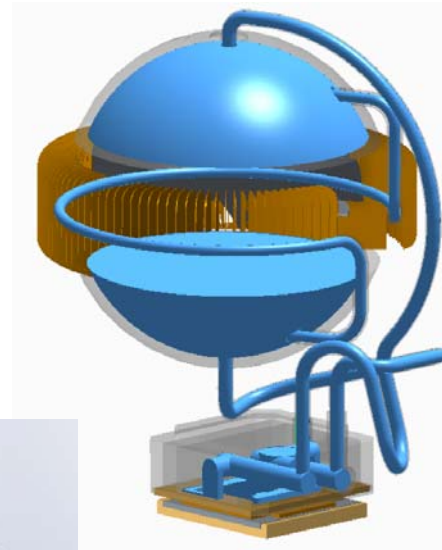
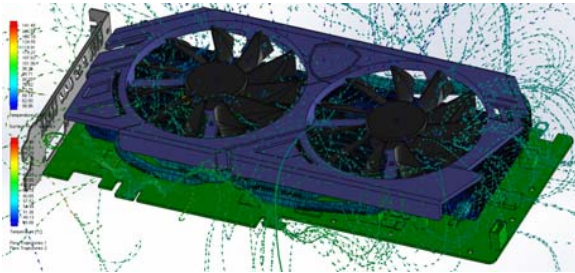
29th November 2017



About Taiwan



FloEFD application in Taiwan



About EFD Corporation

- EFD Corporation is Mentor Graphics platinum distributor. We sell all MAD software and hardware products.
- We got best performance award in the past four years.



2014



2015



2016

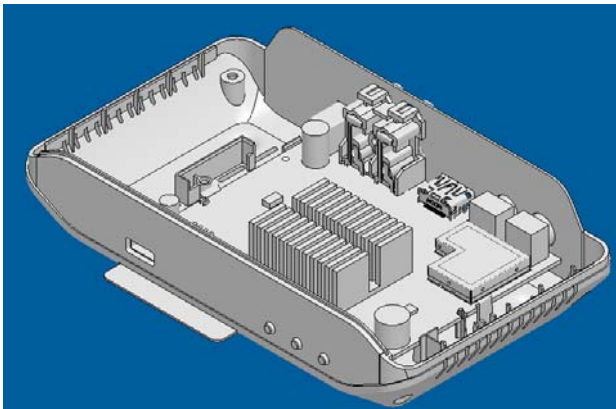


2017

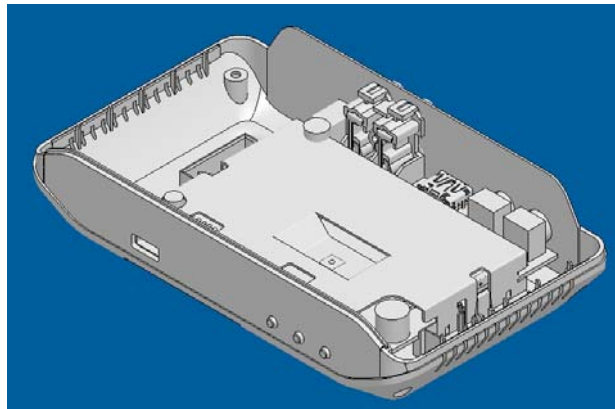
Case Study I – Heatsink Design

Motivation

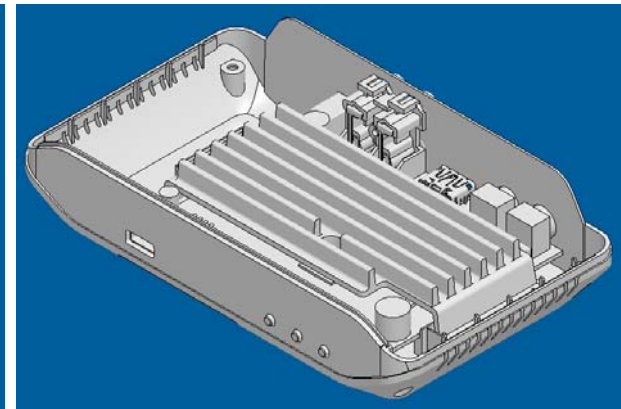
- Find the best heatsink design from the three different types.
- Compare simulation and measurement result.
- Test FloEFD software capabilities. (User is design engineer)



Type -1
(Junior Engineer)

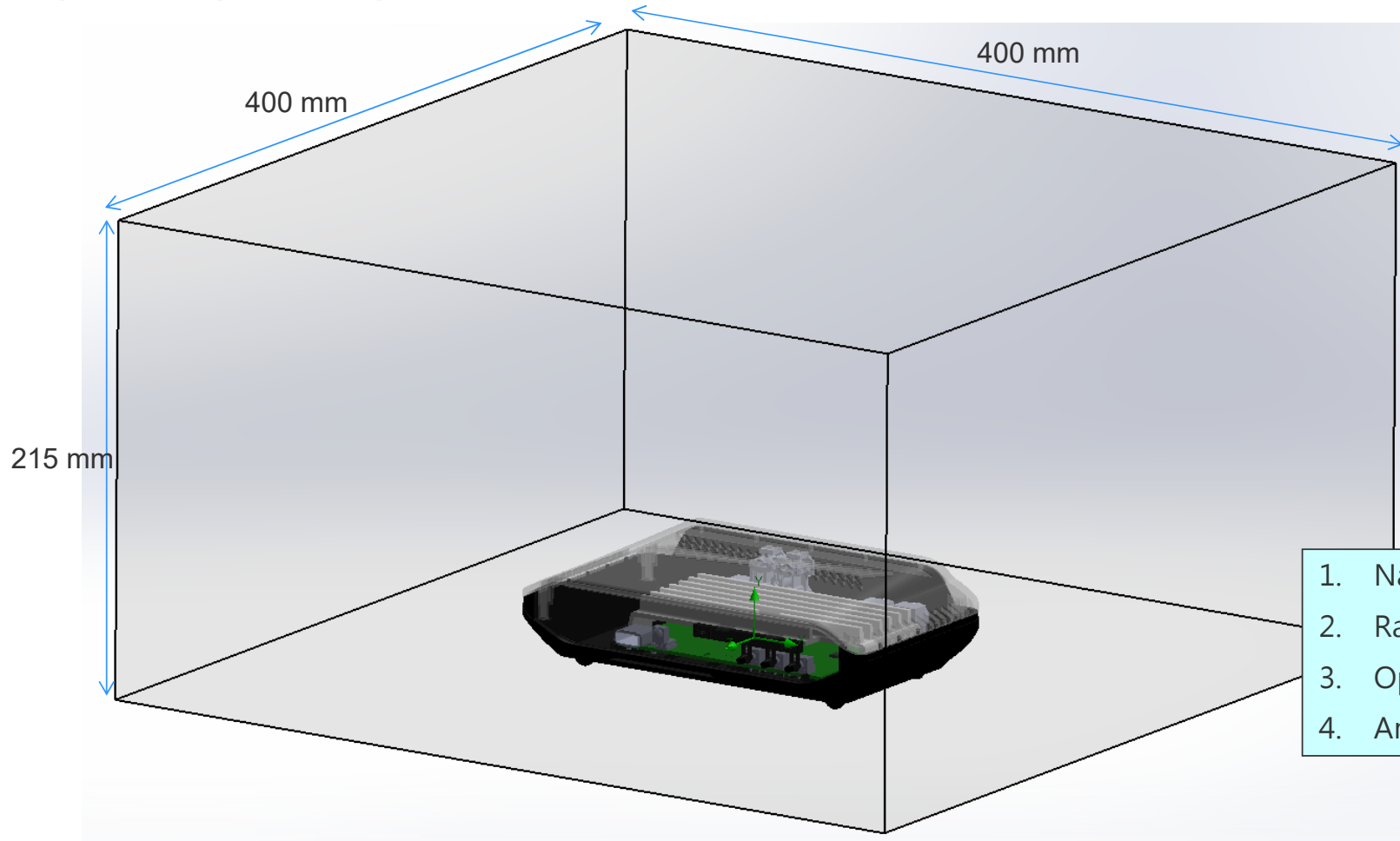


Type -2
(Senior Engineer)



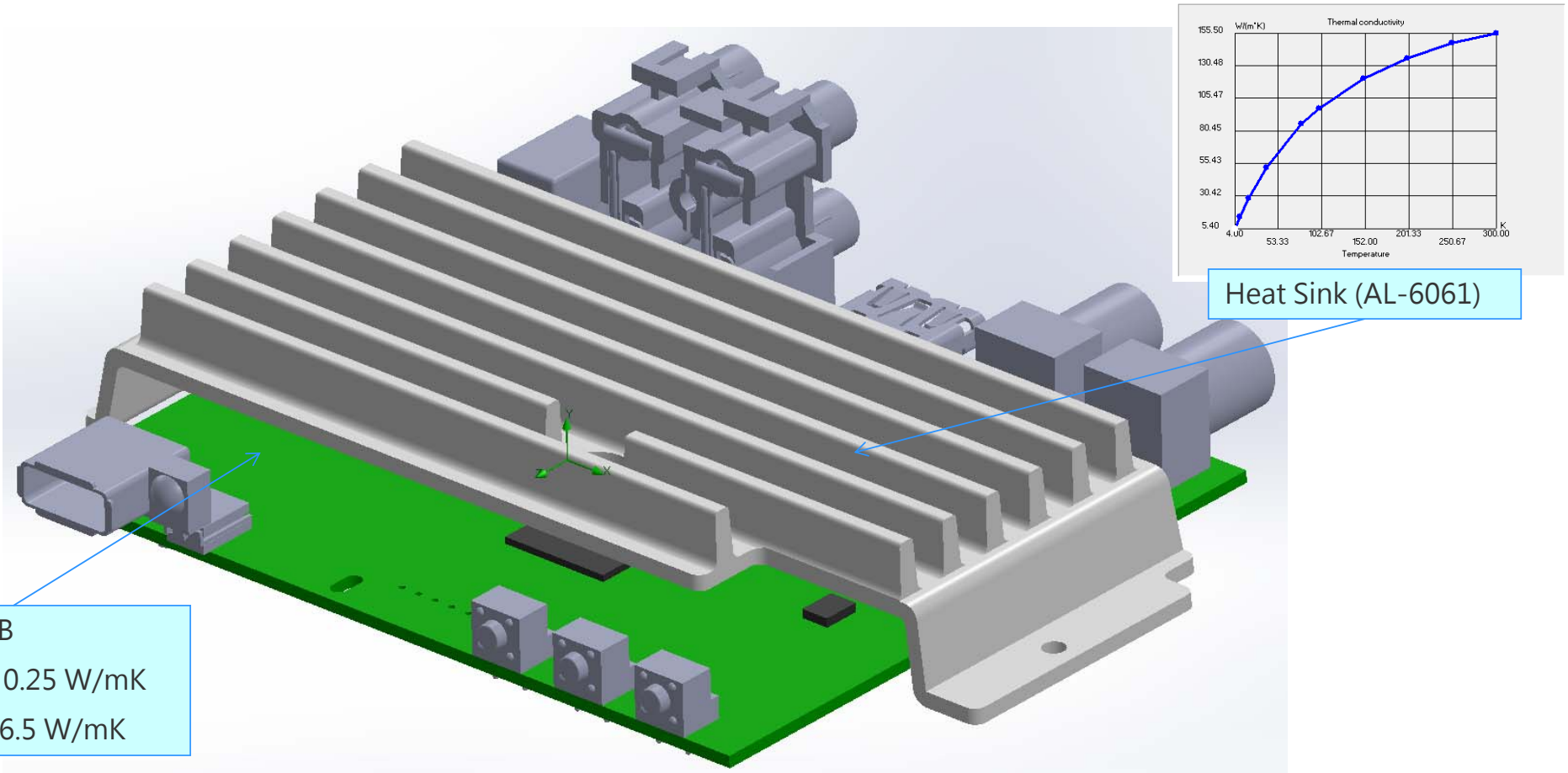
Type -3
(RD Manager)

Solution Domain

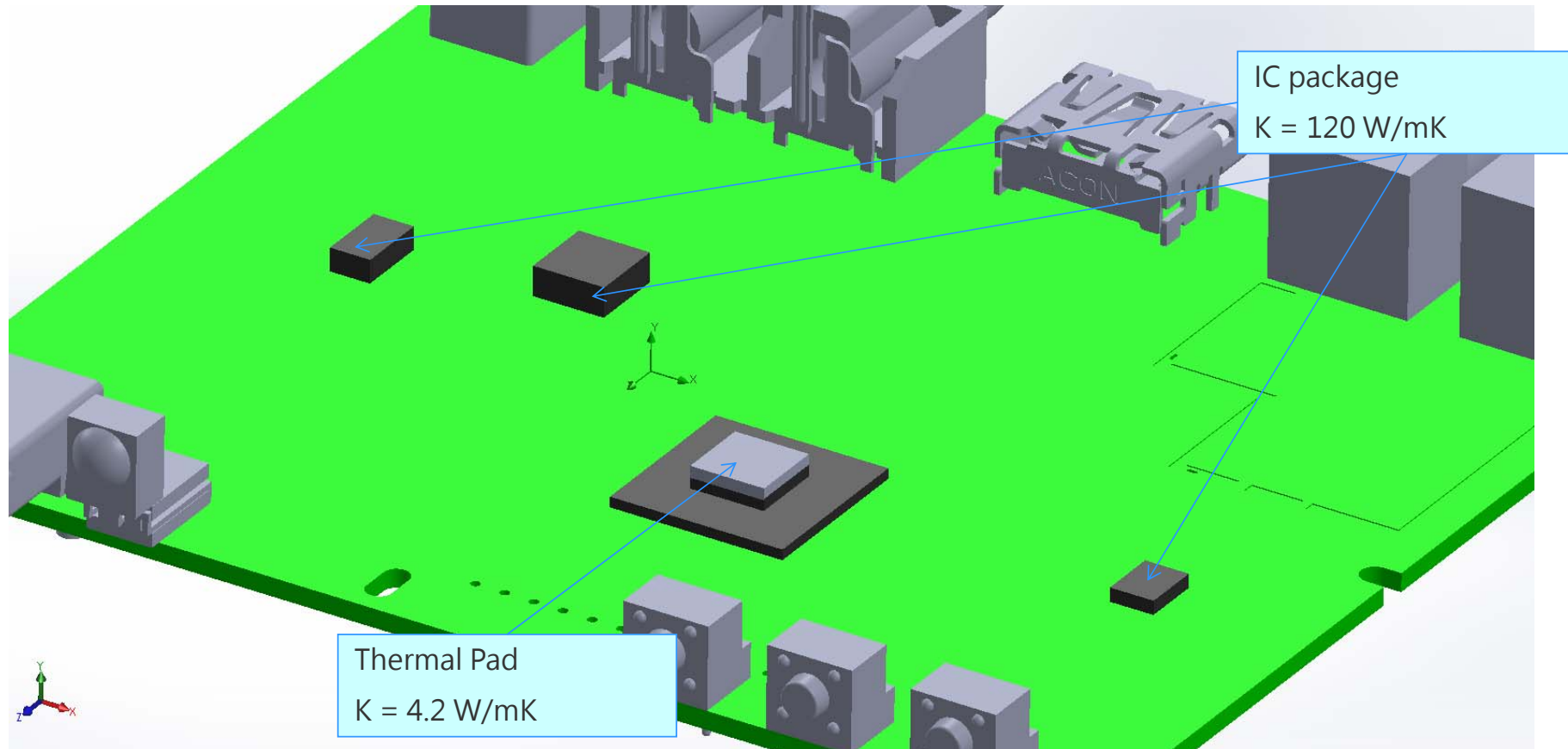


1. Natural convection analysis
2. Radiation effect
3. Open boundary condition
4. Ambient : 26 degC

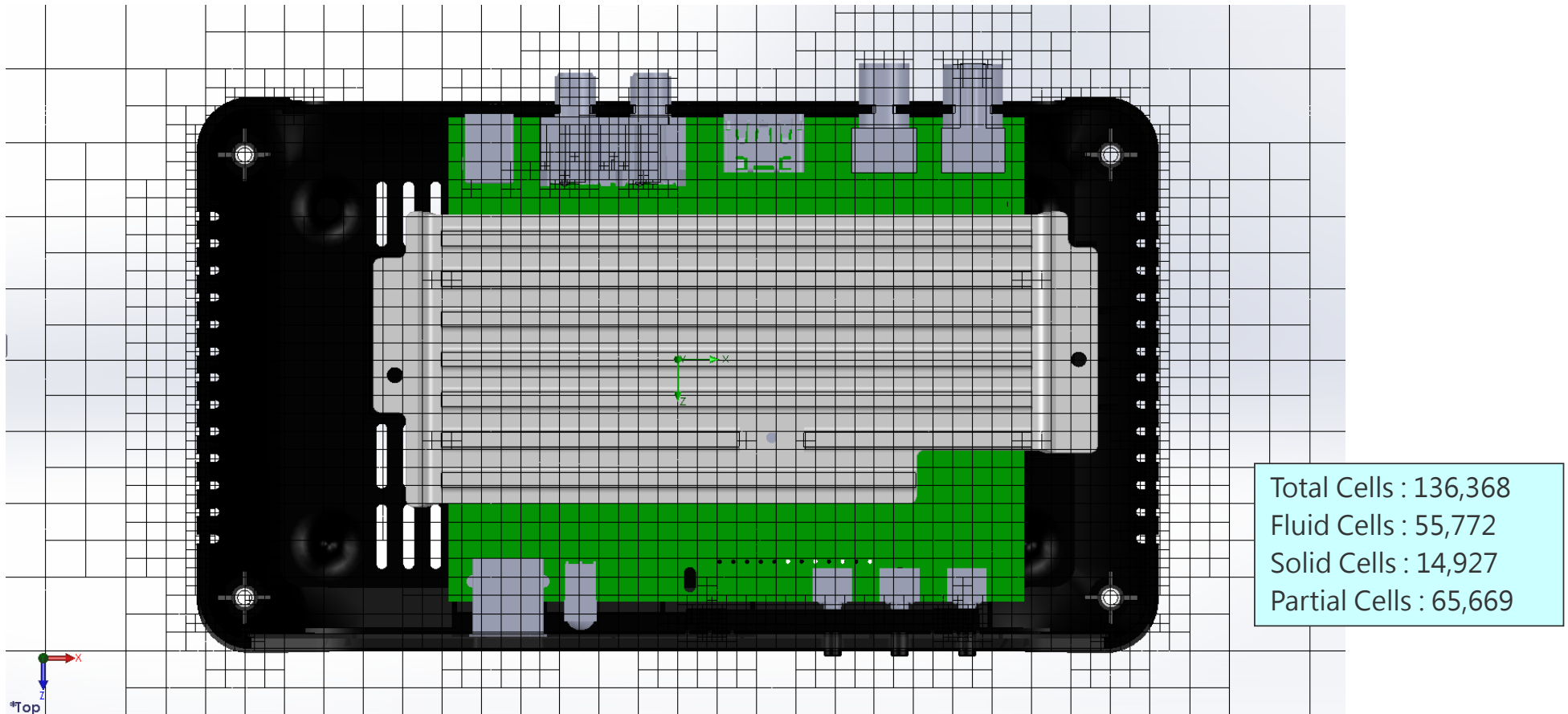
Main Components Settings



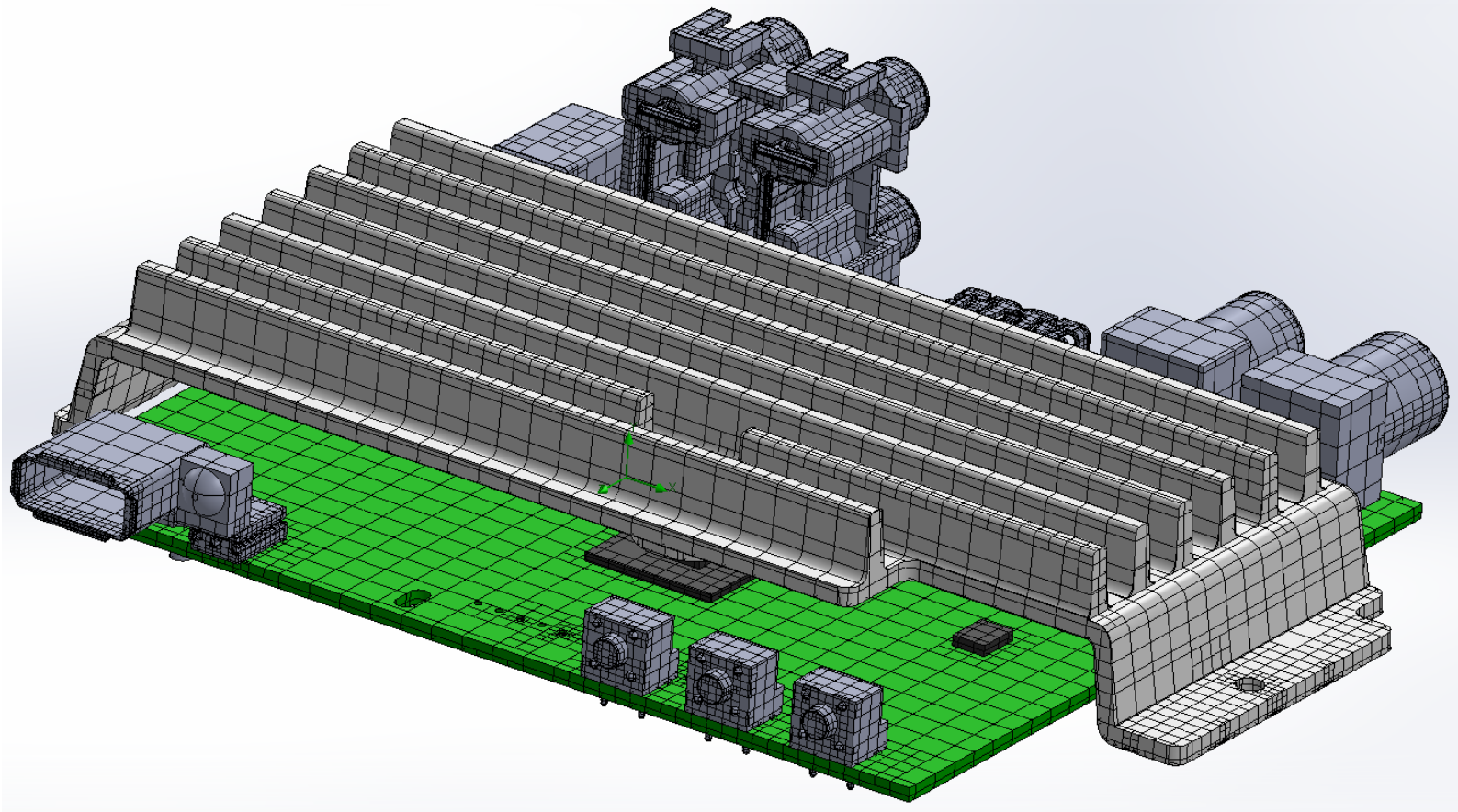
Main Components Settings



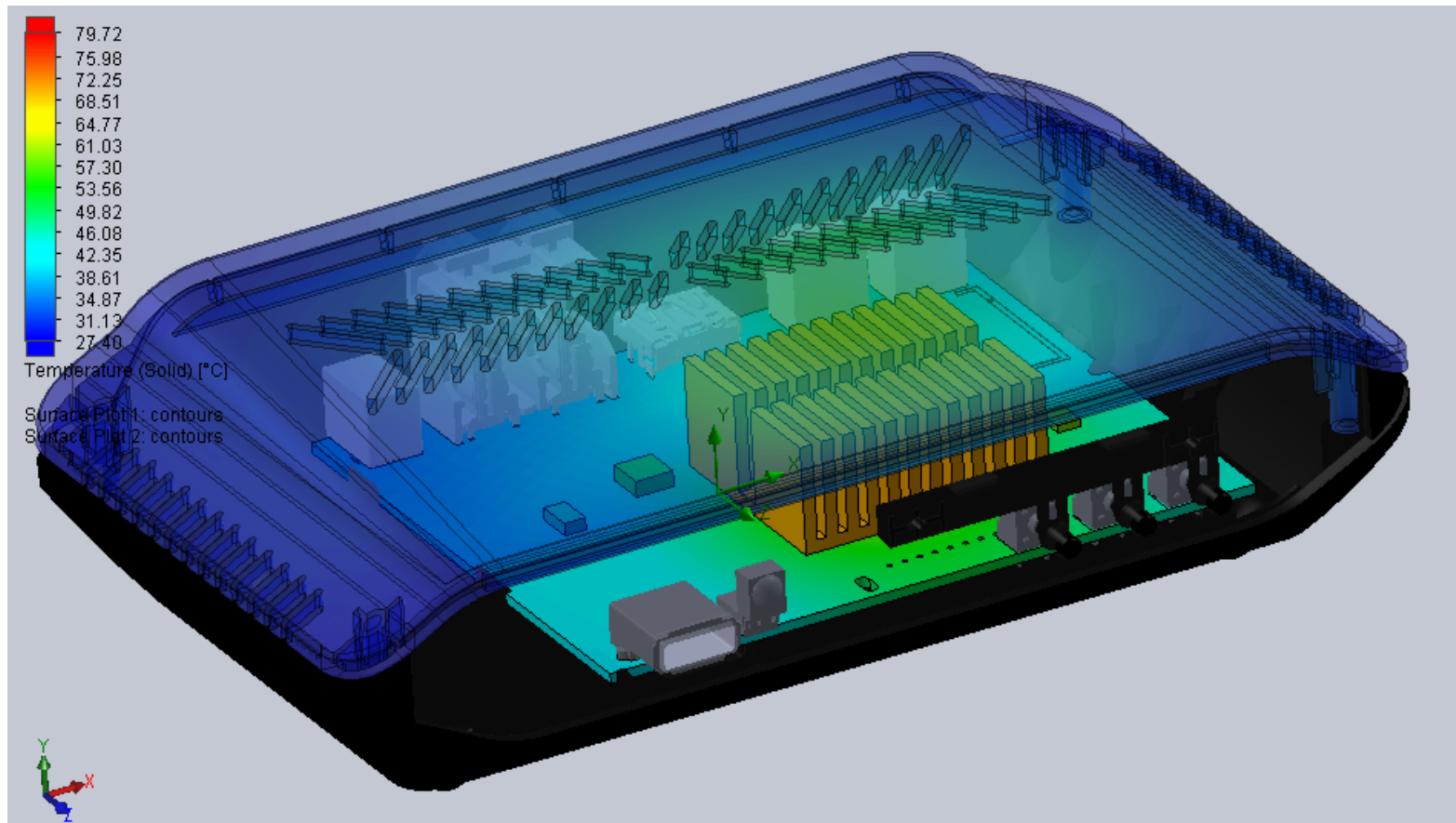
Mesh Generation



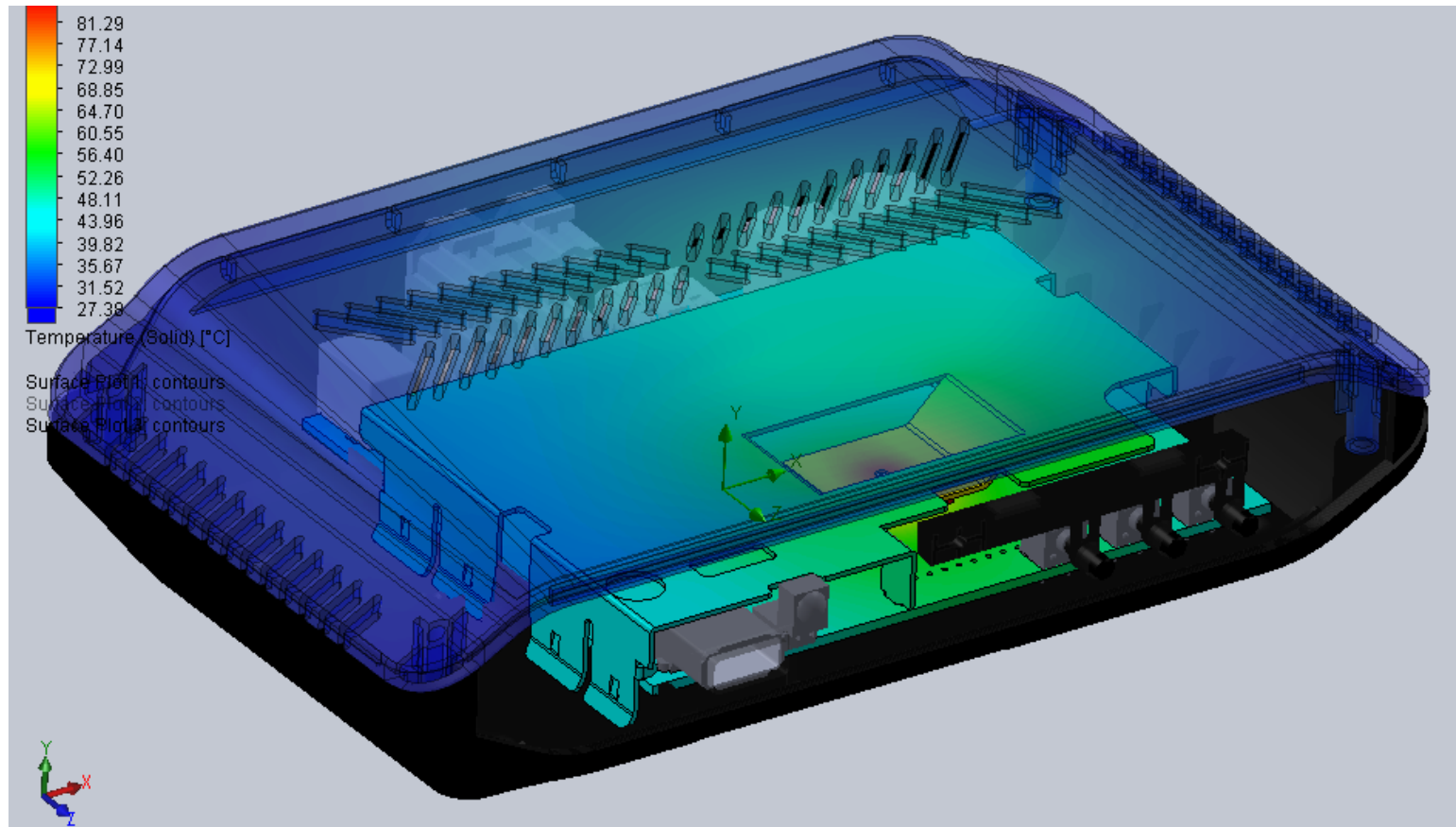
Mesh Generation



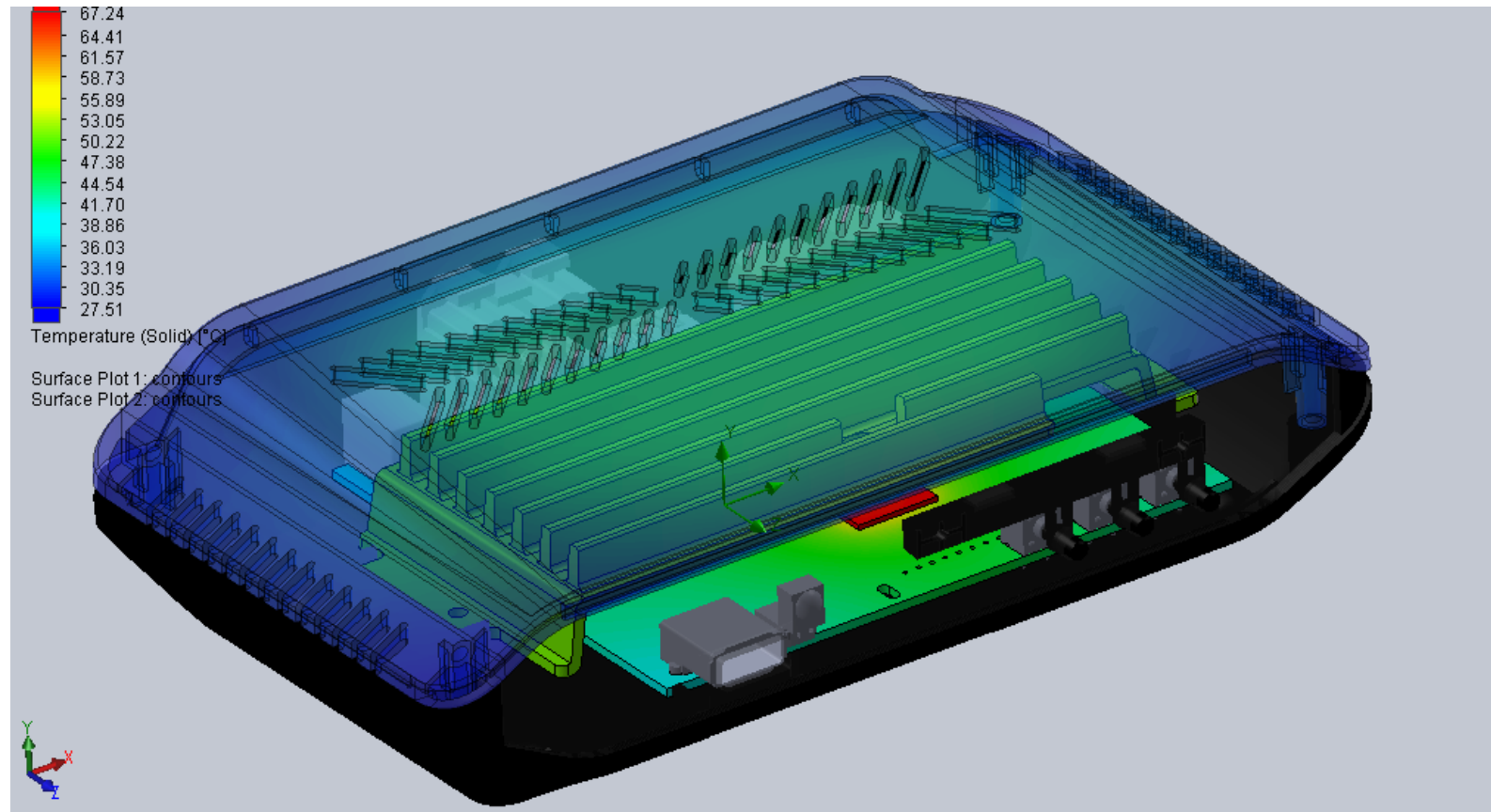
Temperature Result – Type 1



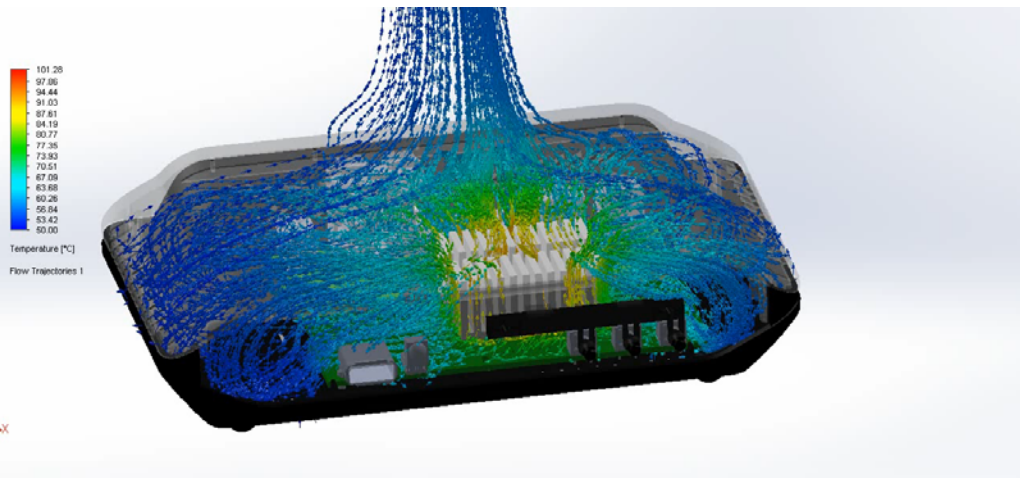
Temperature Result – Type 2



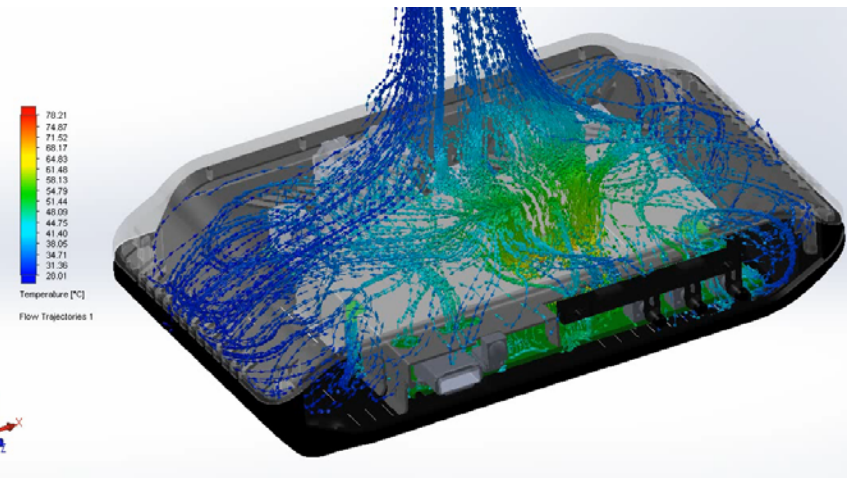
Temperature Result – Type 3



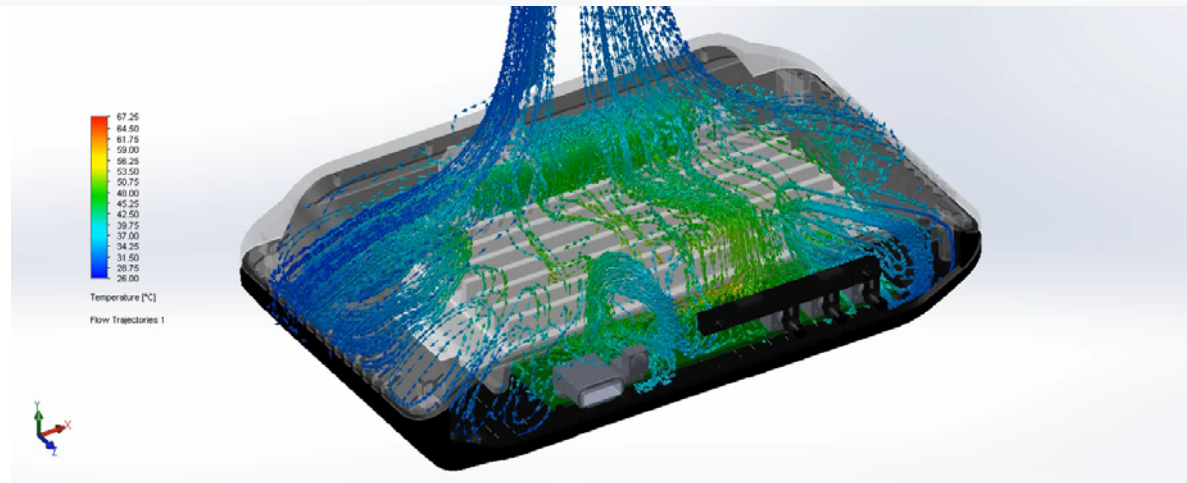
Flow Field



Type -1

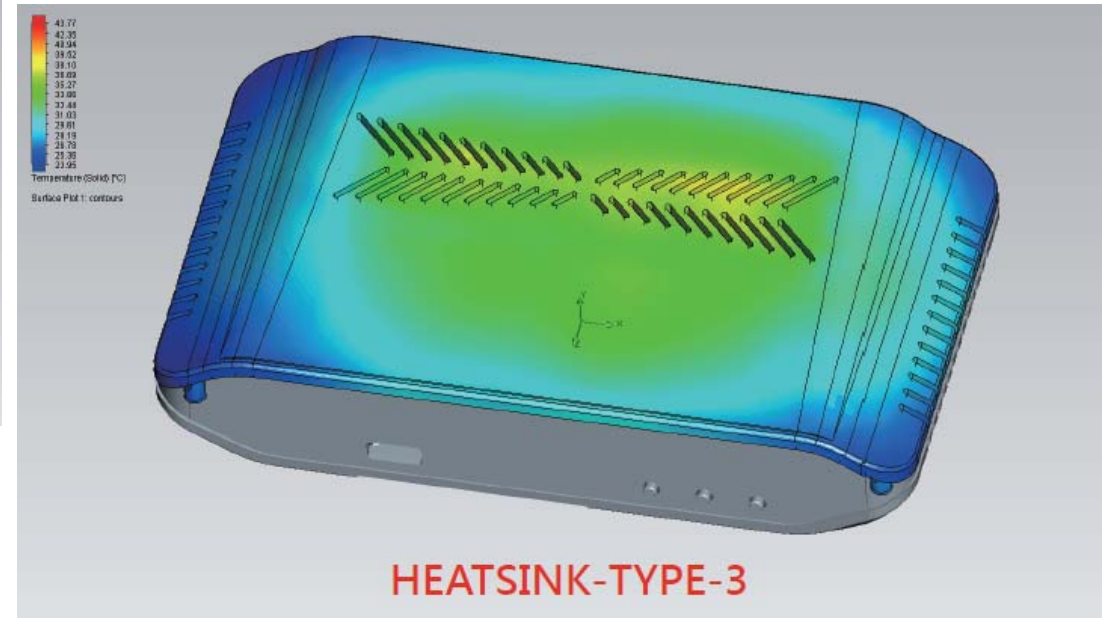
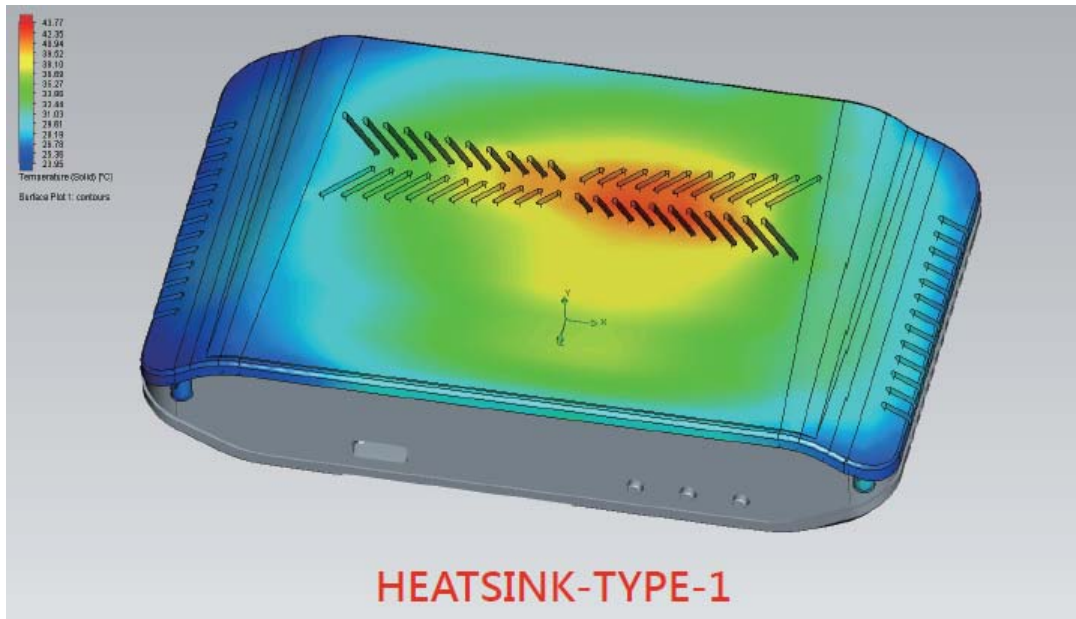


Type -2

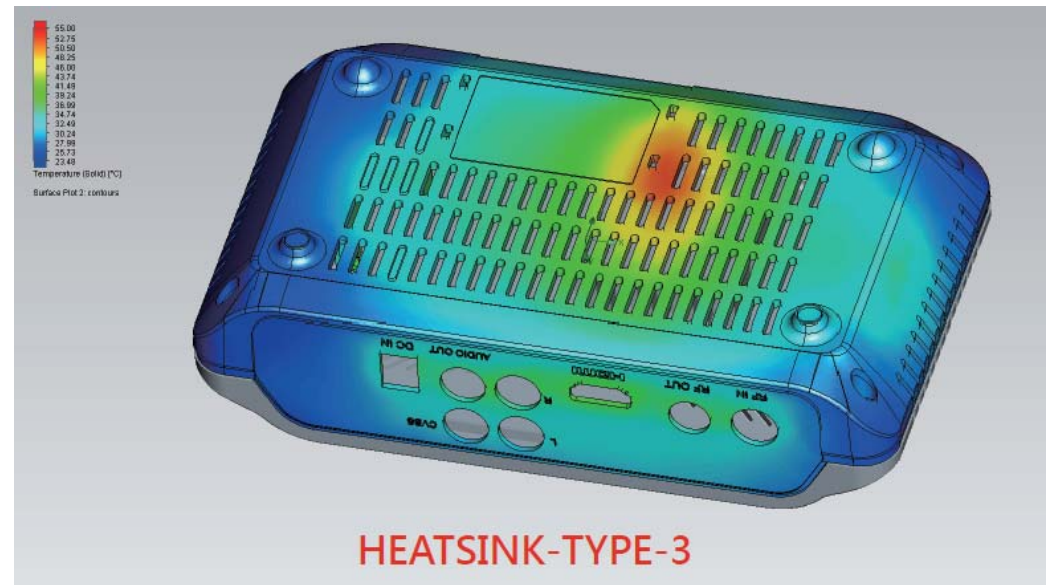
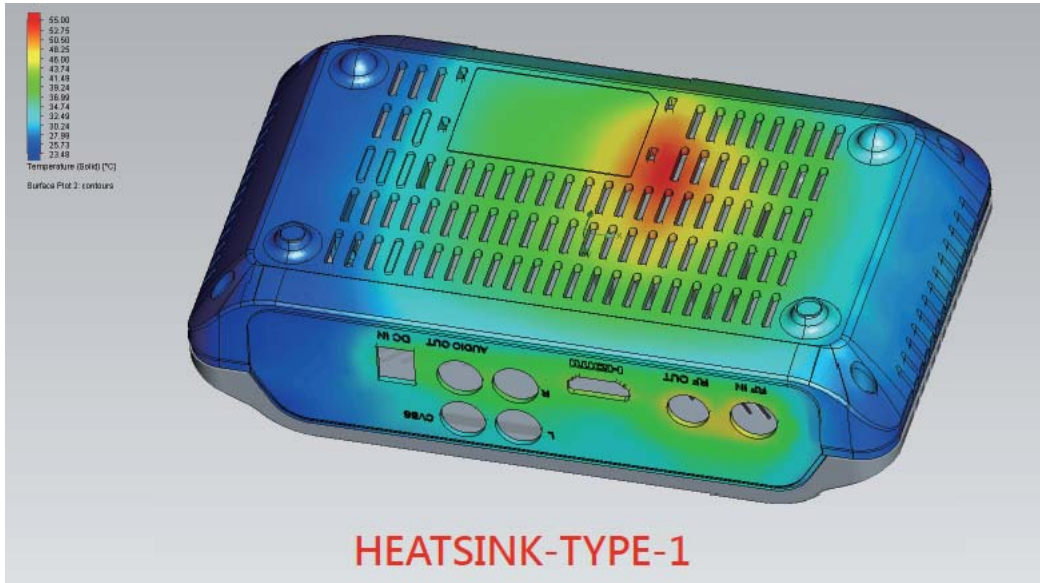


Type -3

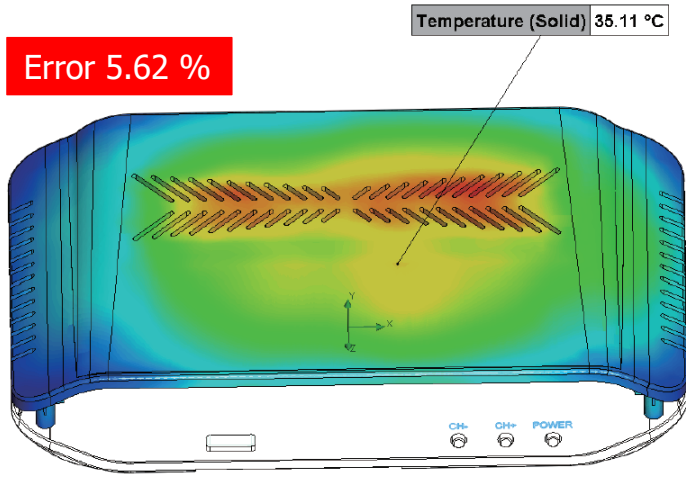
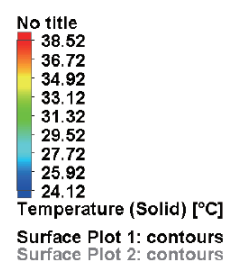
Temperature Result - Housing



Temperature Result - Housing

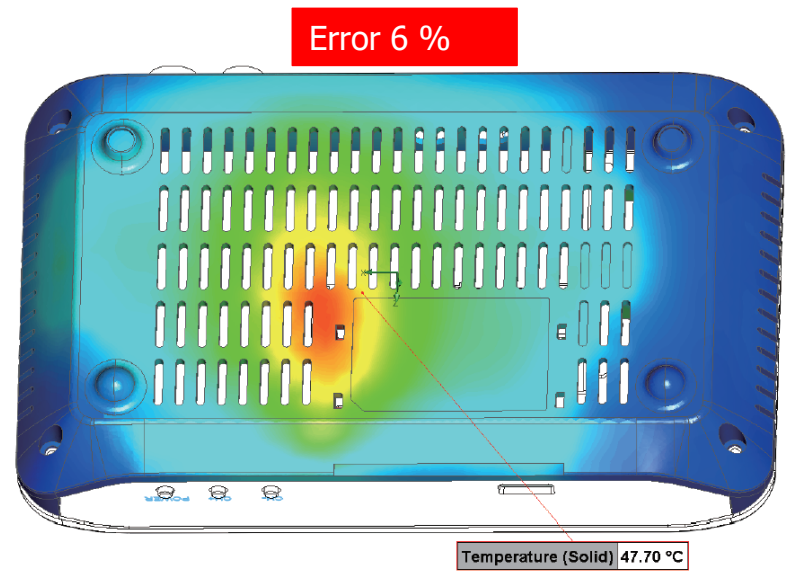
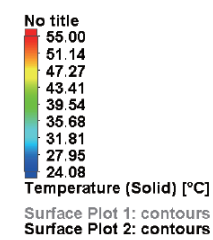


Compare with Measurement



Room temperature: +22.3°C

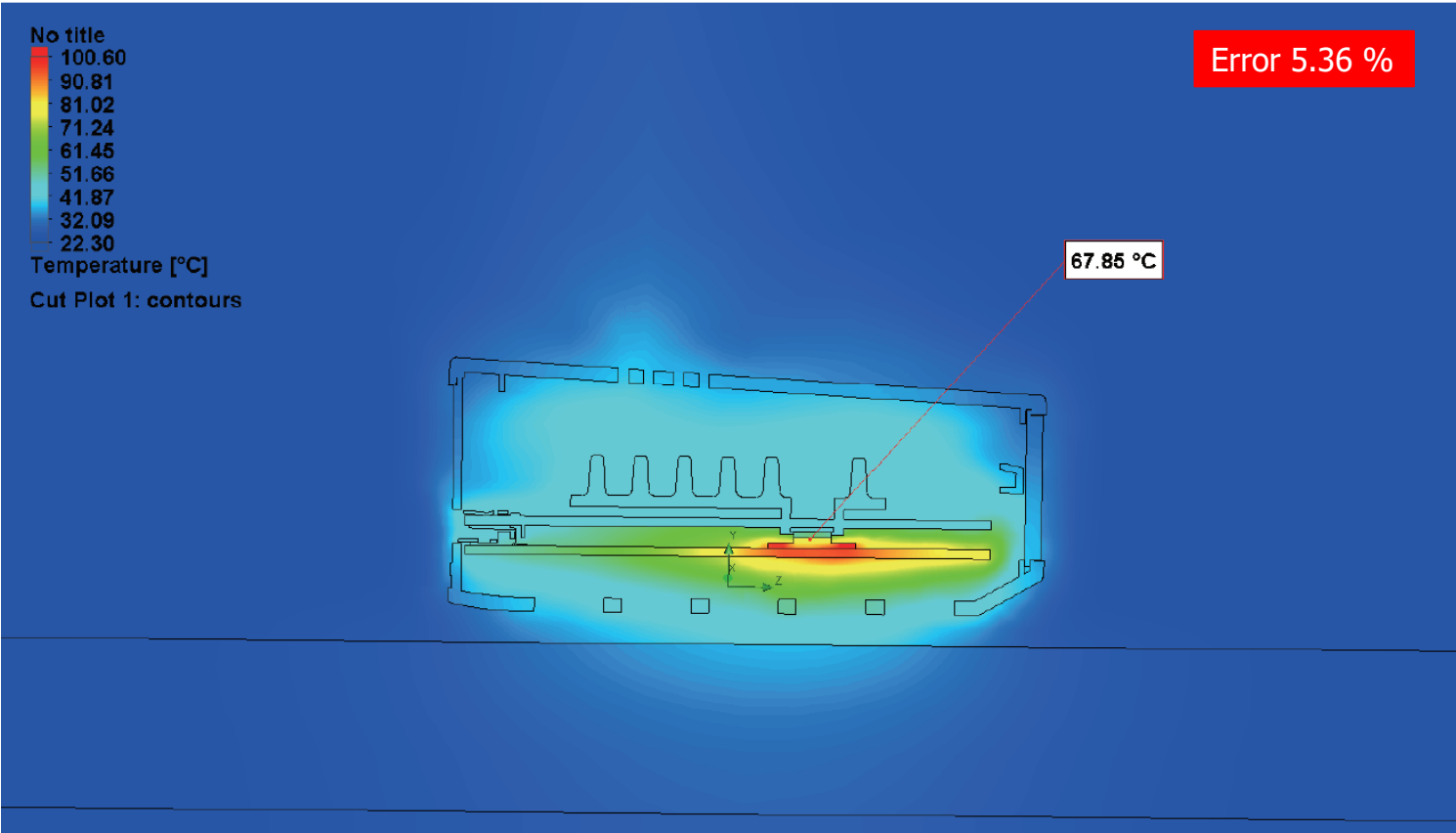
Spec.	Top side ($\Delta T < 15^\circ\text{C}$)	Down side ($\Delta T < 25^\circ\text{C}$)
UUT No		
Measure value	37.2	45.0
ΔT	14.9	22.7
Judgment	PASS	PASS



Spec.	Top side ($\Delta T < 15^\circ\text{C}$)	Down side ($\Delta T < 25^\circ\text{C}$)
UUT No		
Measure value	37.2	45.0
ΔT	14.9	22.7
Judgment	PASS	PASS

Compare with Measurement

實測	U100	BCM7563	64.4	42.1	PASS
----	------	---------	------	------	------

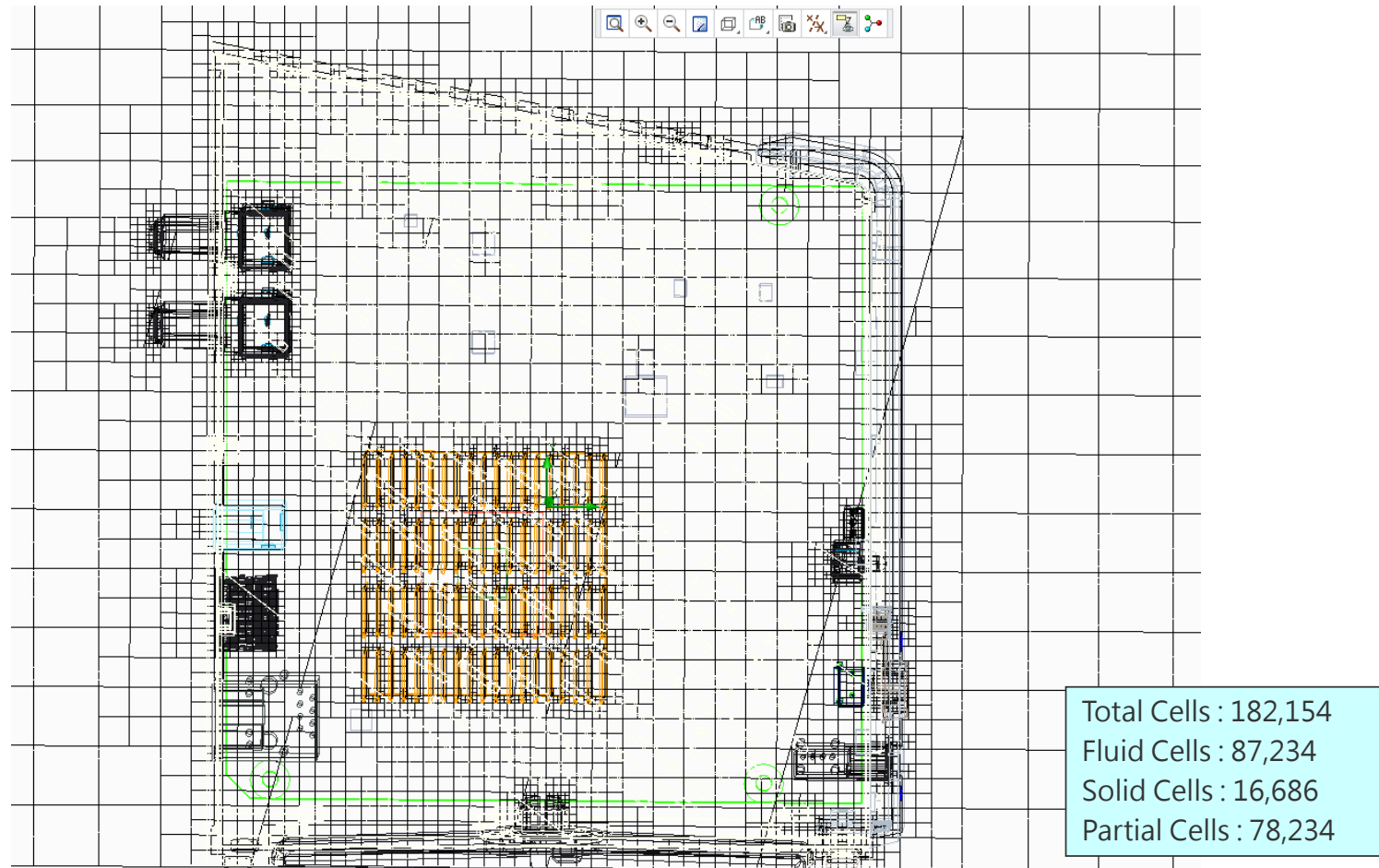


Sub Summary

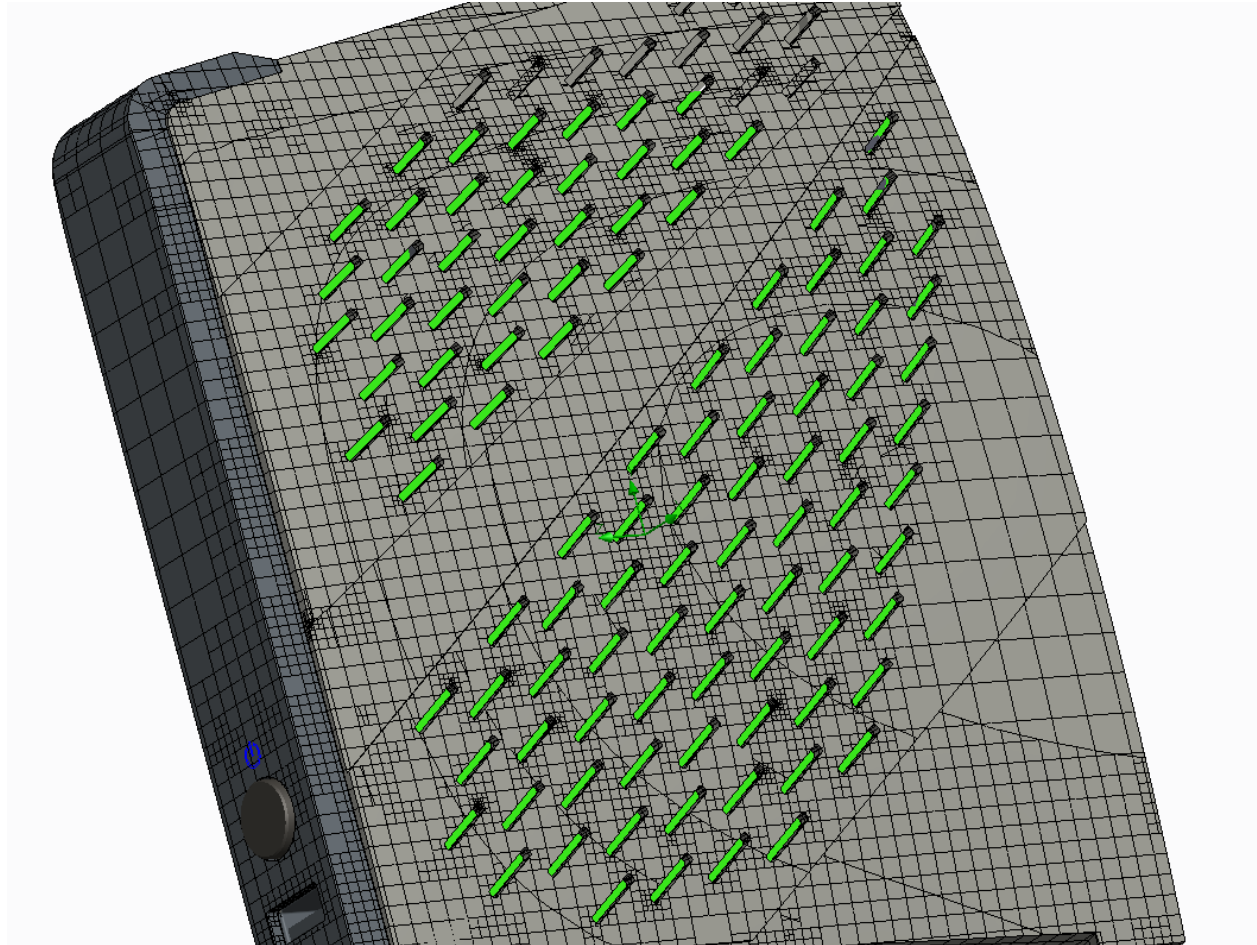
- Type 3 is the best
- If refine the mesh, the result might be better

Case Study II – Housing Design

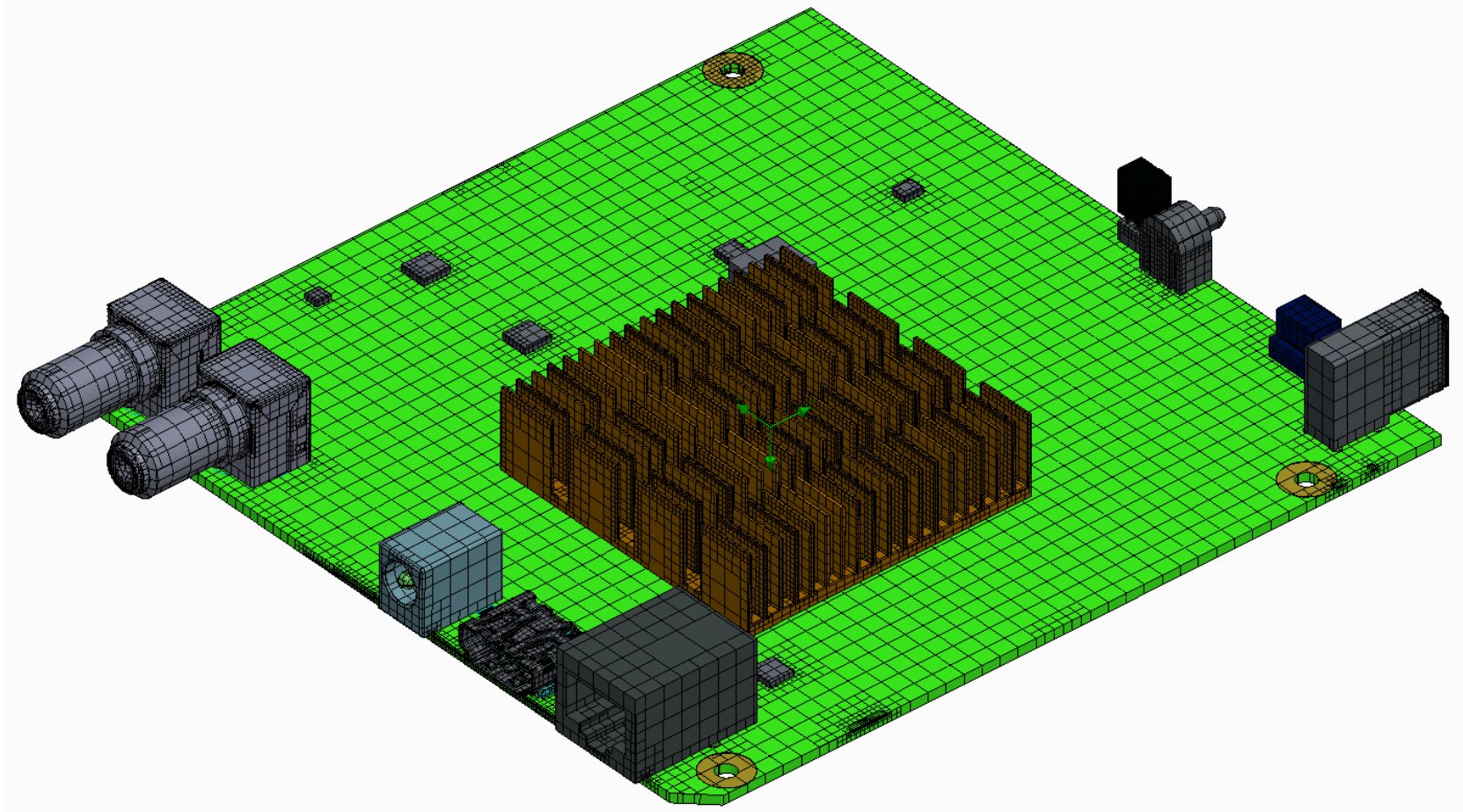
Mesh Generation



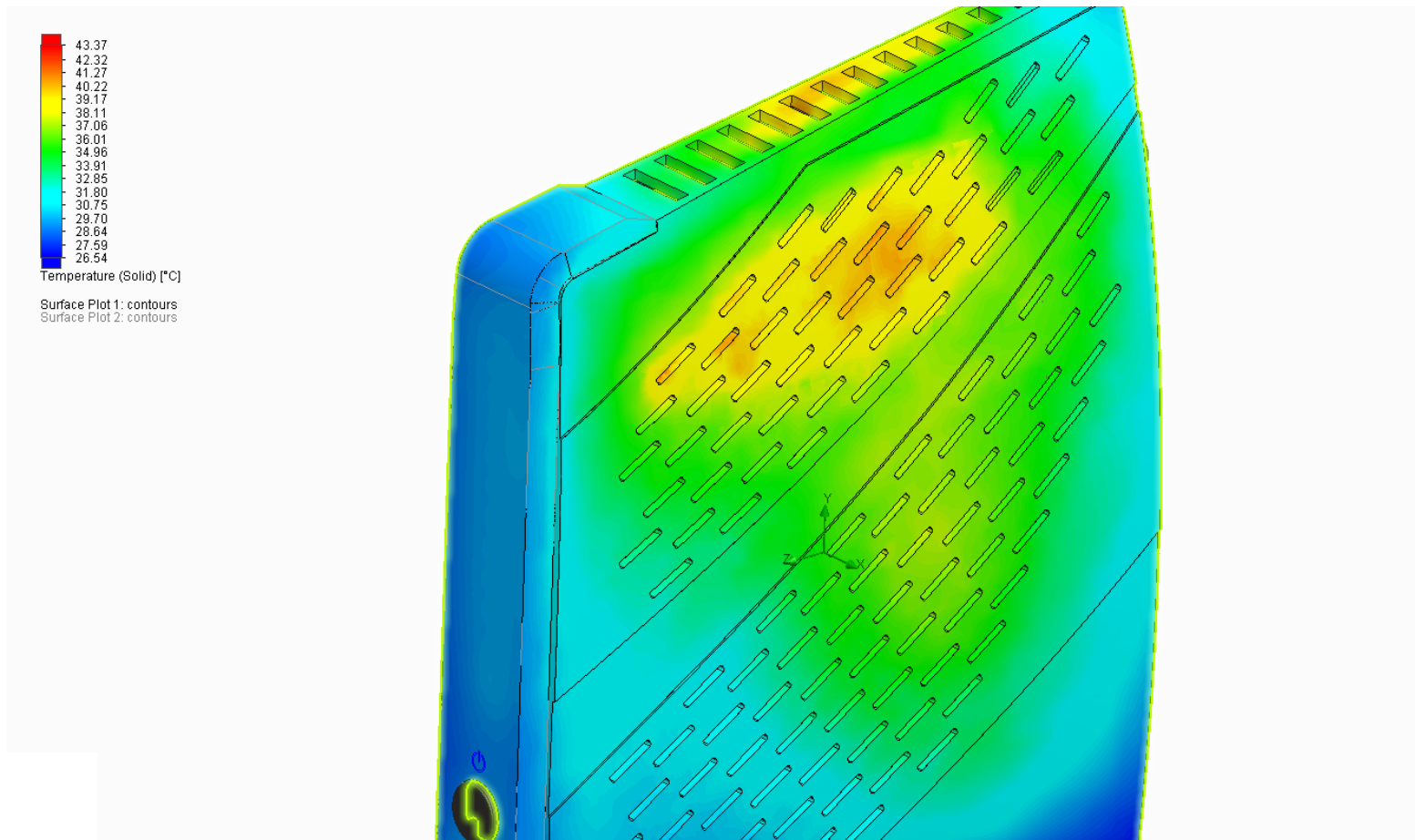
Mesh Generation



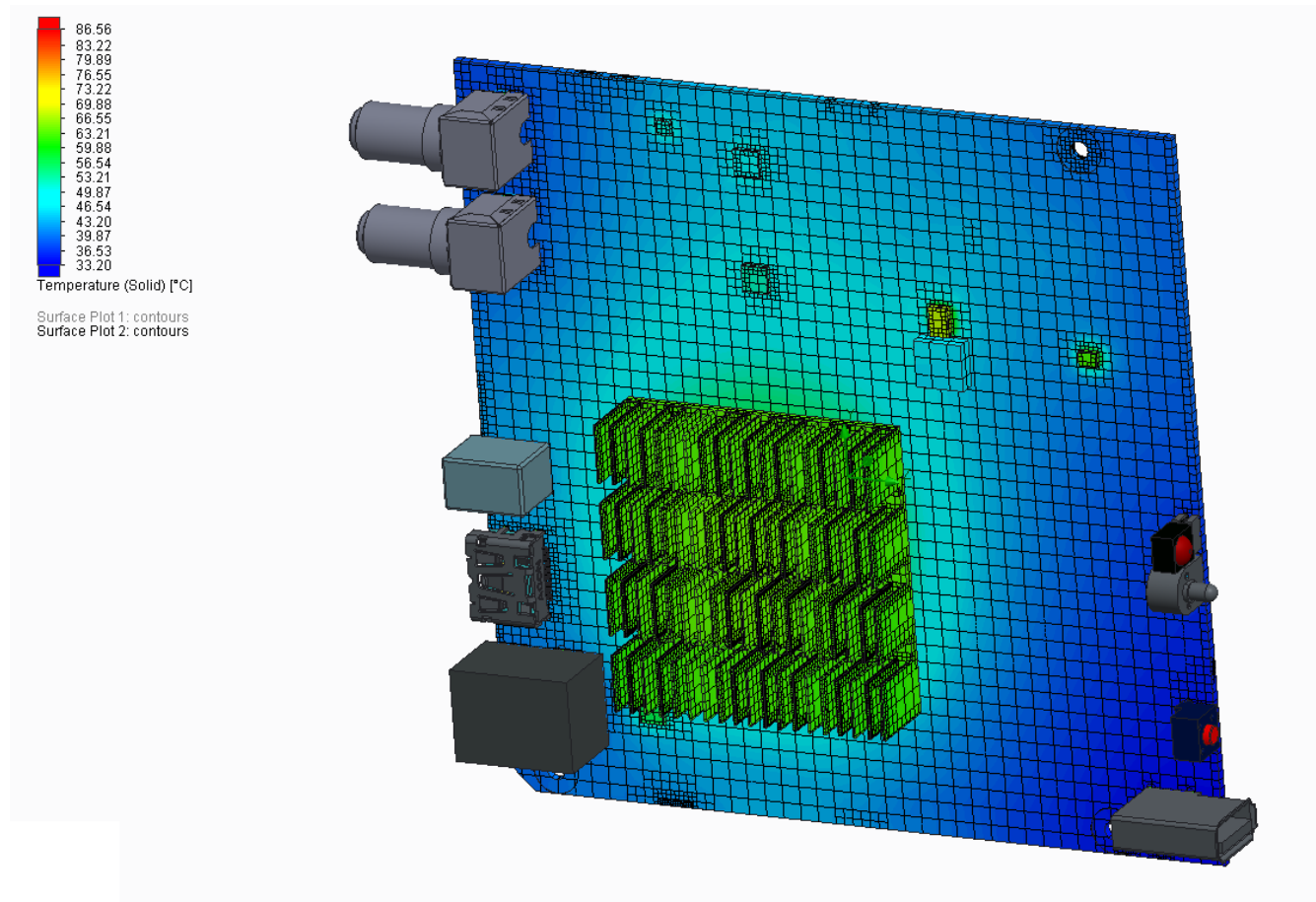
Mesh Generation



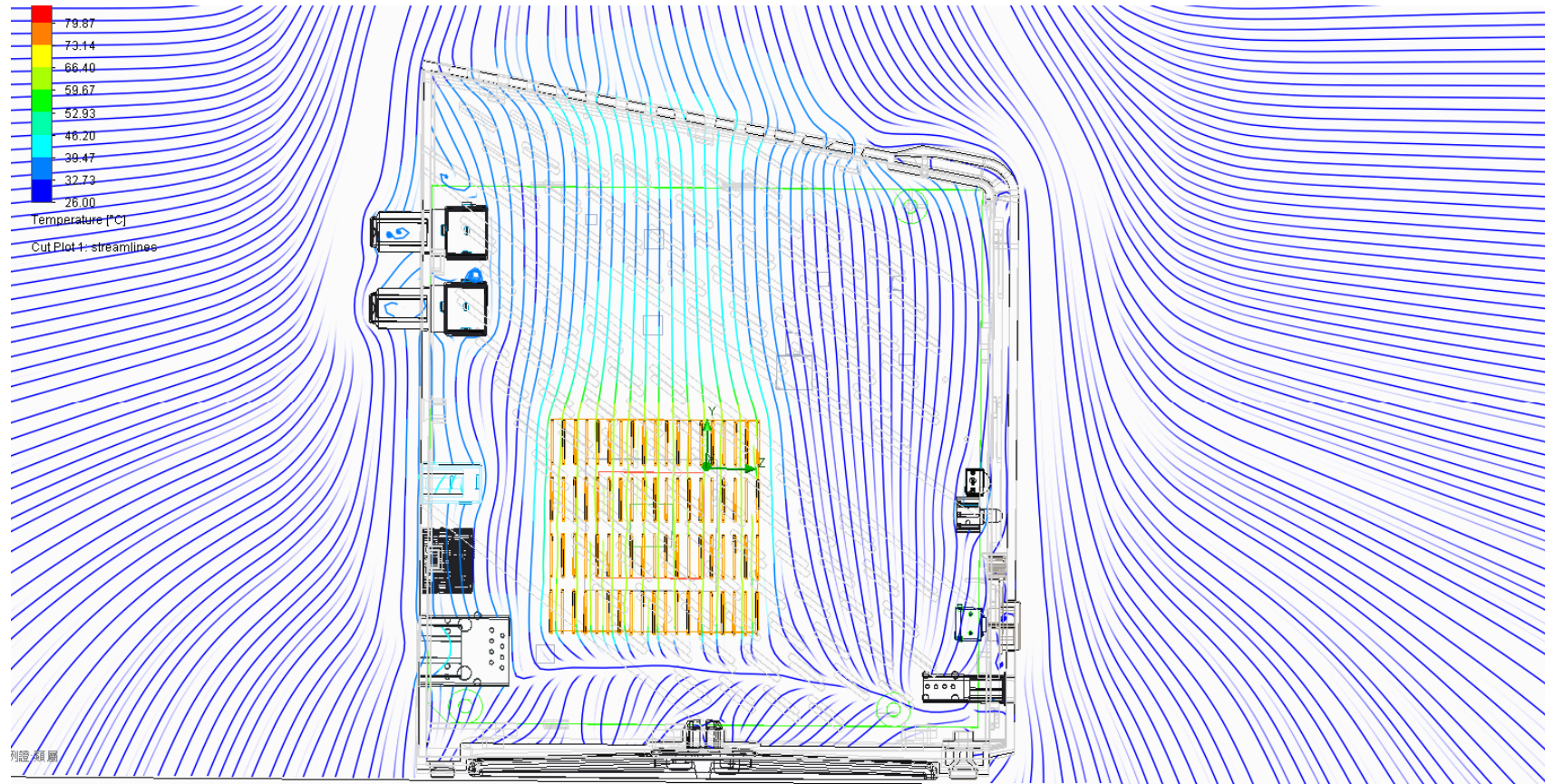
Temperature Result – Housing



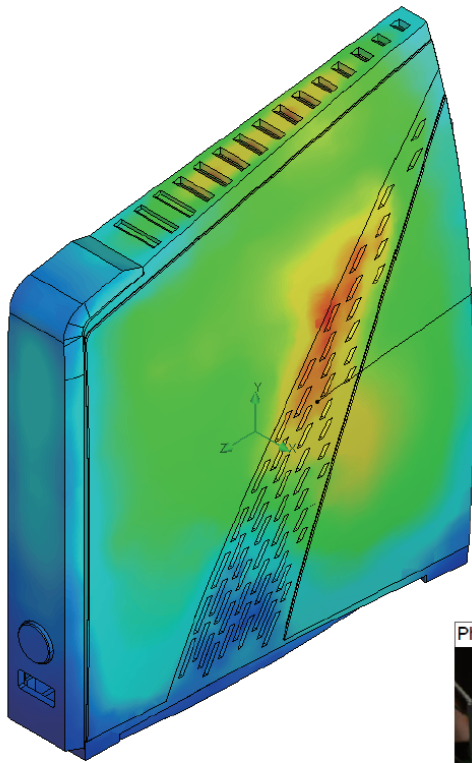
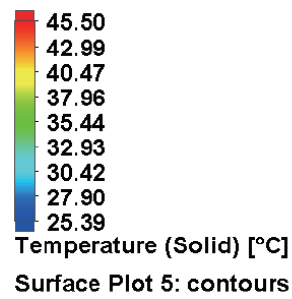
Temperature Result – PCB



Temperature Result – Flow Field



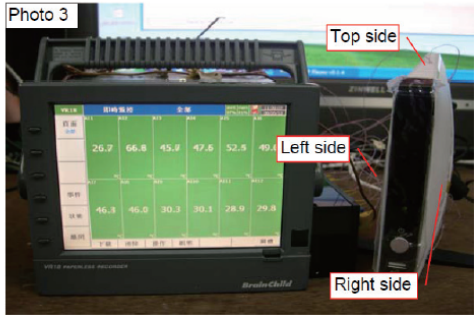
Compare with Measurement – Type A



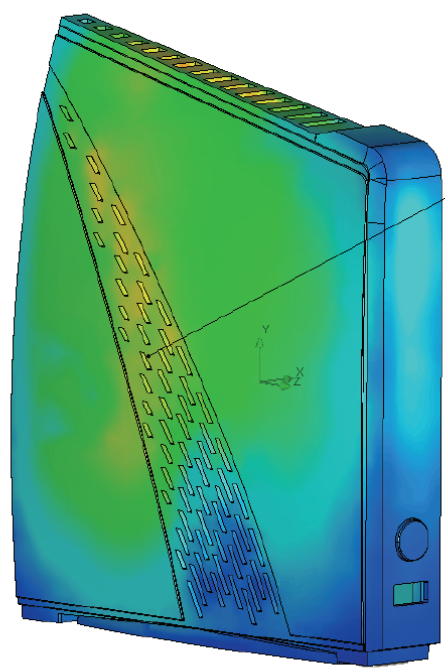
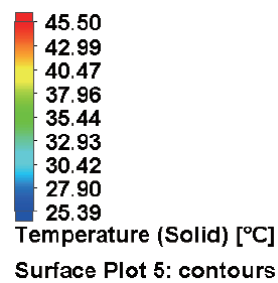
Temperature (Solid) 41.61 °C

Error 2.99 %

Right side ($\Delta T < 20^\circ\text{C}$)
40.4
17.3
PASS



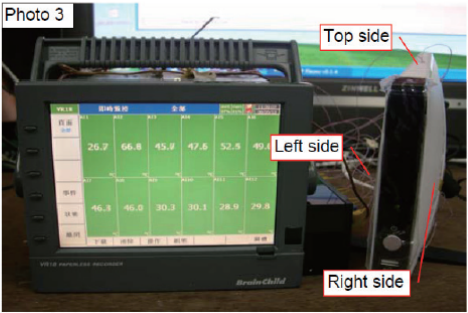
Compare with Measurement – Type A



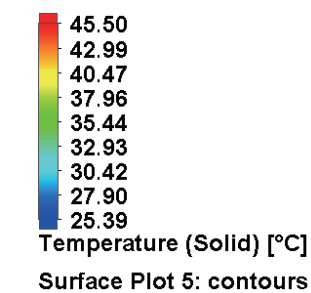
Temperature (Solid) 38.19 °C

Error 2.82 %

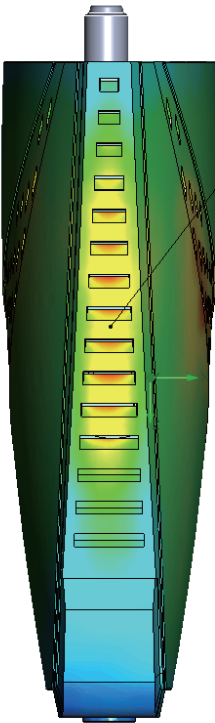
Left side ($\Delta T < 20^{\circ}\text{C}$)
39.3
16.2
PASS



Compare with Measurement – Type A

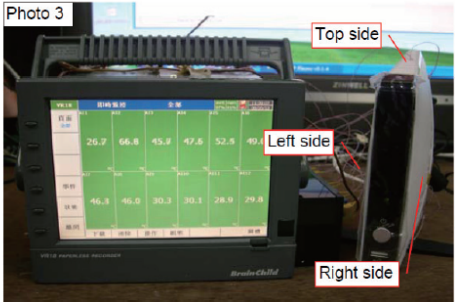


Top side ($\Delta T < 15^\circ\text{C}$)
38.7
15.6
NG

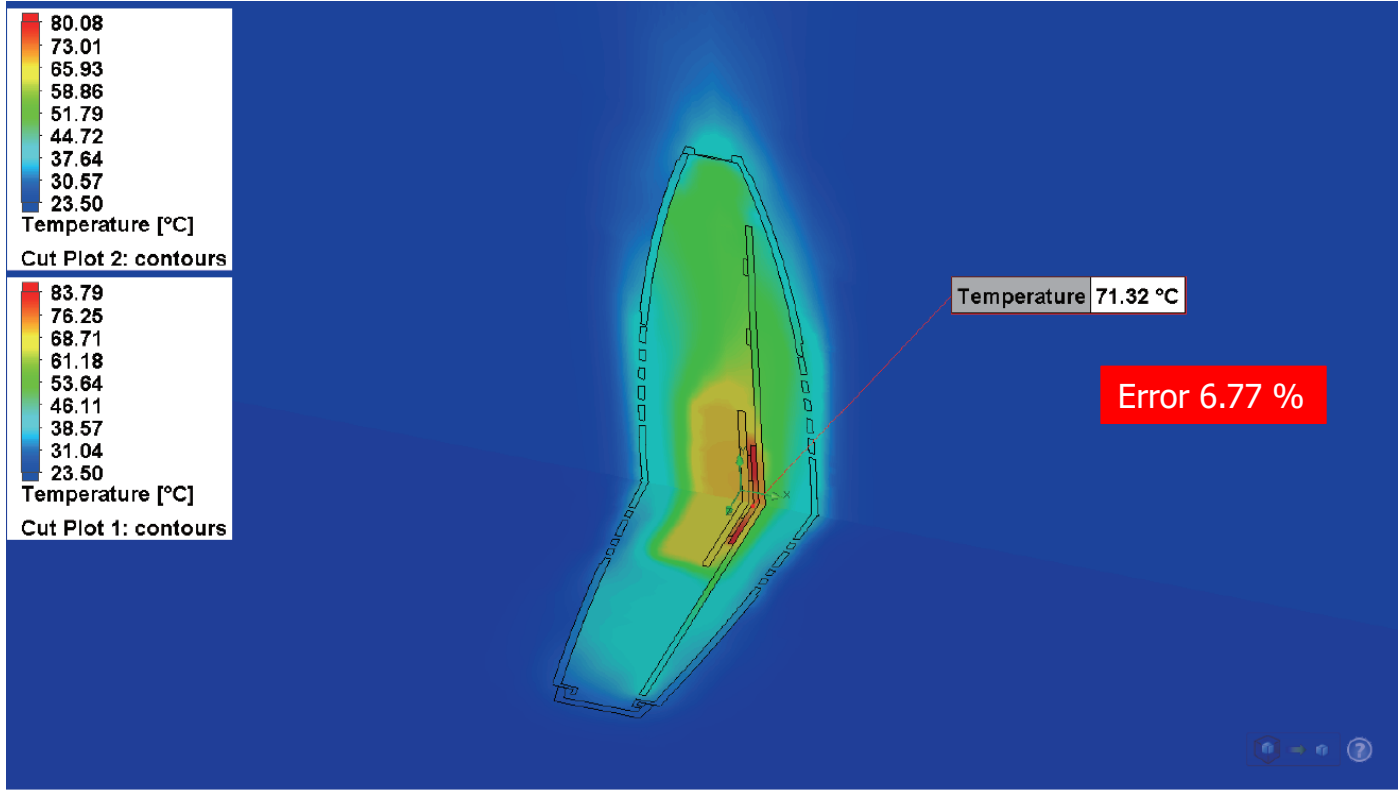


Temperature (Solid) 39.84 °C

Error 2.95 %

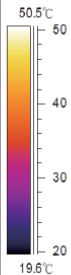
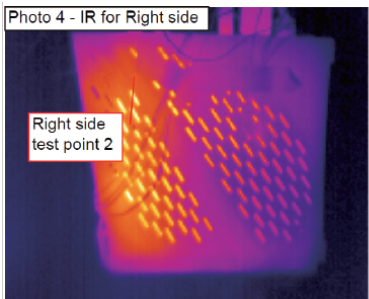


Compare with Measurement – Type A

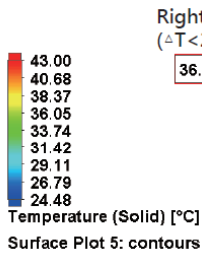
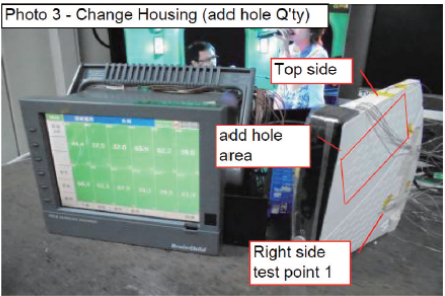


U100	BCM7424	76.5	53.4	NG
------	---------	------	------	----

Compare with Measurement – Type B

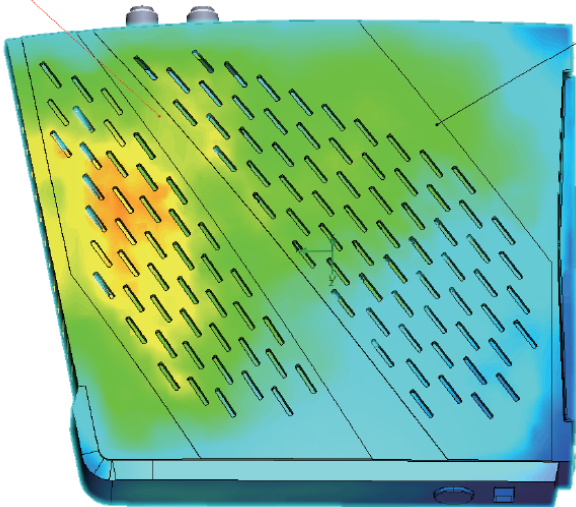


Right side - 1 ($\Delta T < 20^\circ\text{C}$)	Right side - 2 ($\Delta T < 20^\circ\text{C}$)
30.0	37.3
6.5	13.8
PASS	PASS



Right side - 2
($\Delta T < 20^\circ\text{C}$)
36.20 °C

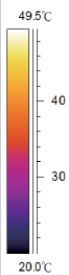
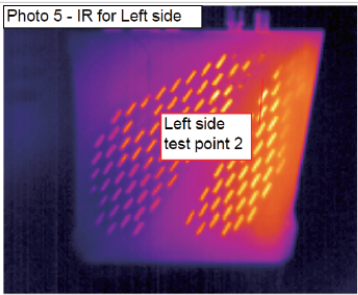
Error 2.95 %



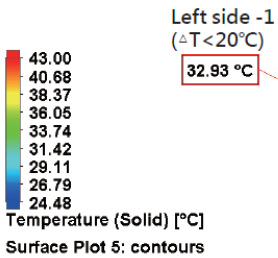
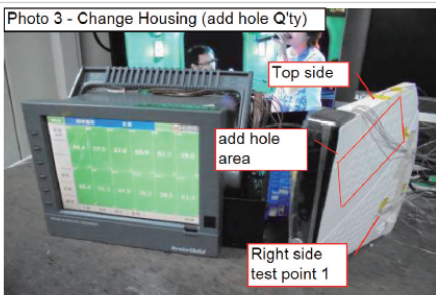
Right side - 1
($\Delta T < 20^\circ\text{C}$)
33.44 °C

Error 11.46 %

Compare with Measurement – Type B

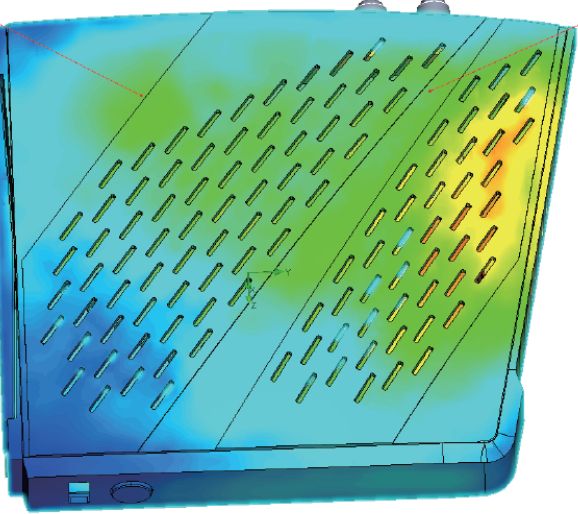


Left side -1 ($\Delta T < 20^\circ\text{C}$)	Left side -2 ($\Delta T < 20^\circ\text{C}$)
30.5	36.7
7.0	13.2
PASS	PASS



Left side -1
($\Delta T < 20^\circ\text{C}$)
32.93 °C

Error 7.96 %

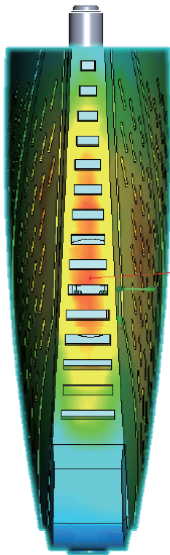
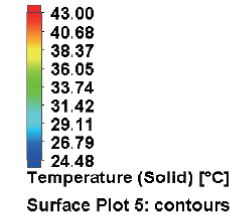


Left side -2
($\Delta T < 20^\circ\text{C}$)
32.67 °C

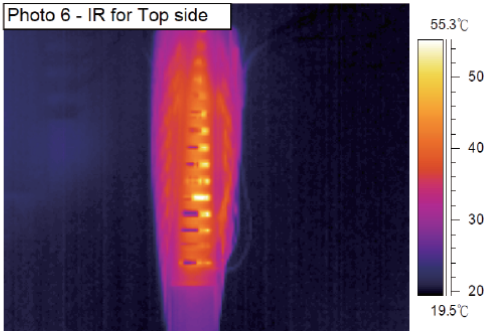
Error 10.9 %

Compare with Measurement – Type B

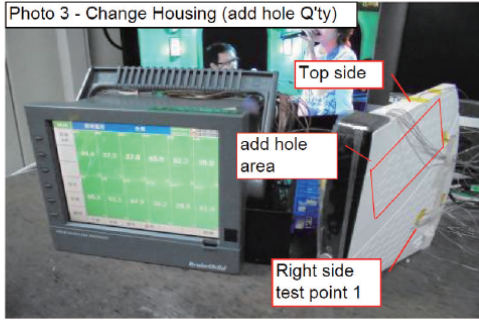
Top side ($\Delta T < 20^\circ\text{C}$)
44.6
21.1
NG



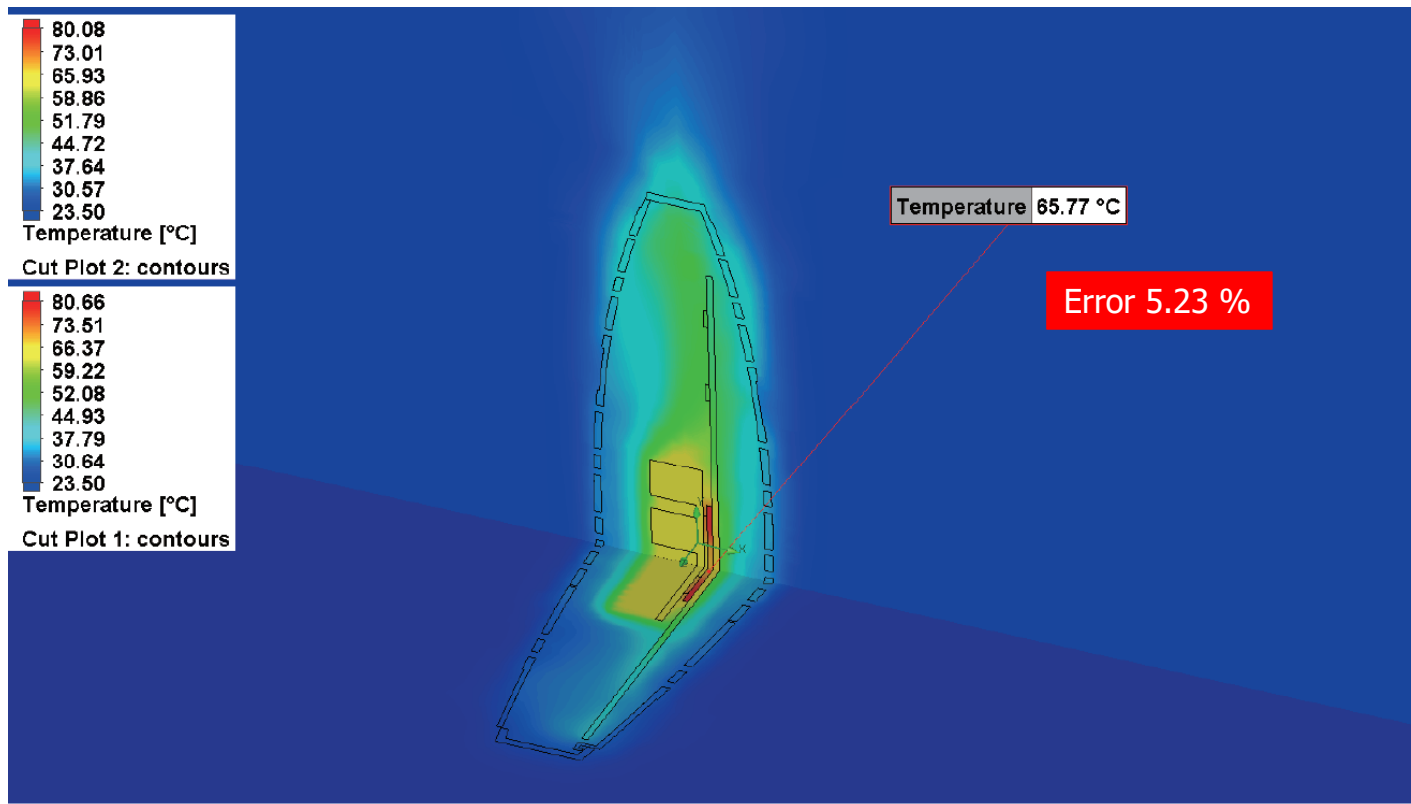
Top side
($\Delta T < 20^\circ\text{C}$)
42.01 °C



Error 5.81 %



Compare with Measurement – Type B



2	U100	BCM7424	62.5	39.0	PASS
---	------	---------	------	------	------

Sub Summary

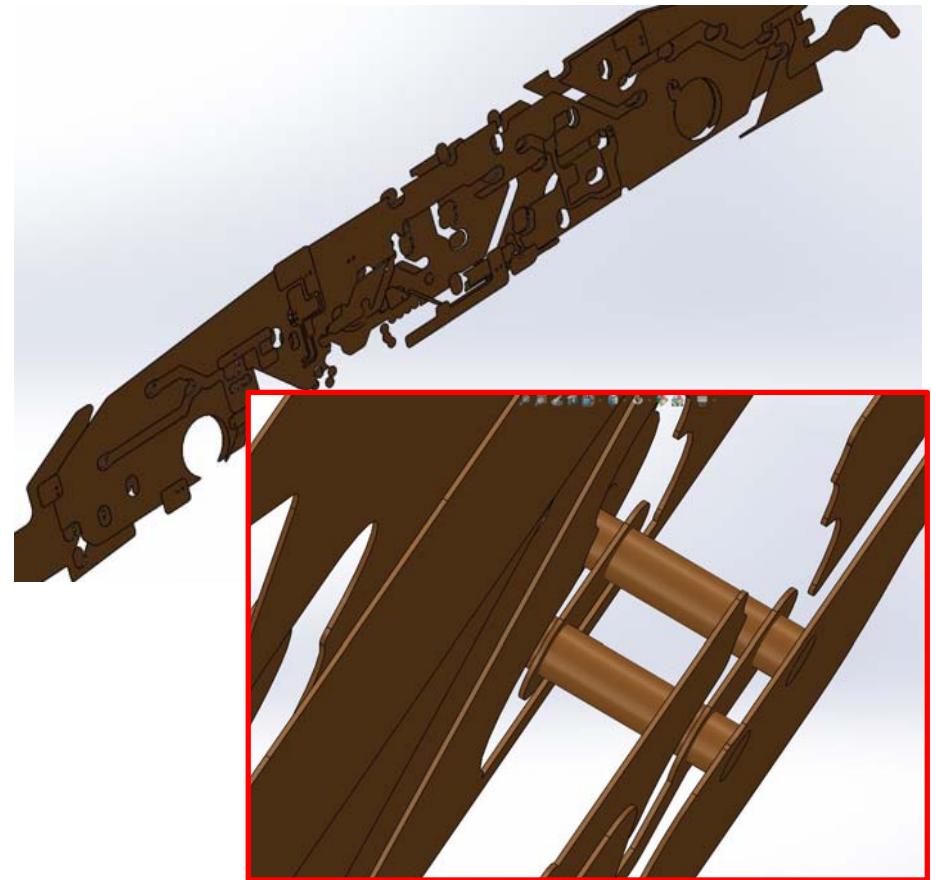
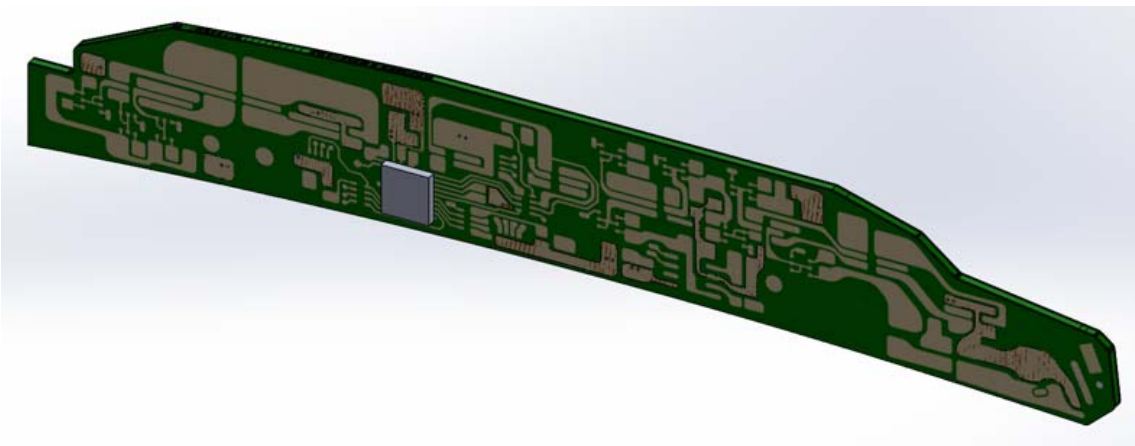
- CPU temperature decrease 14 degC with Type B housing
- If refine the mesh, the result might be better

Conclusion

- FloEFD embedding in CAD system is easy for CFD task and optimize design.
- Partial cell technology can create high quality mesh with few mesh number.
- Simulation result accuracy is acceptable.

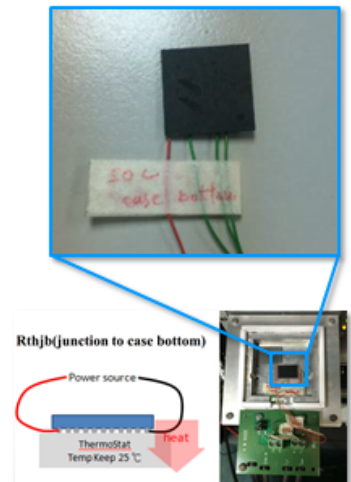
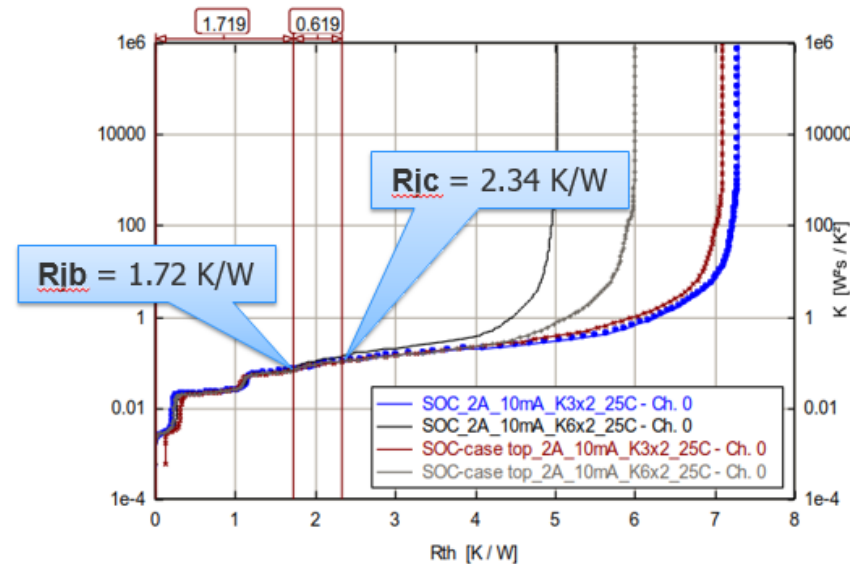
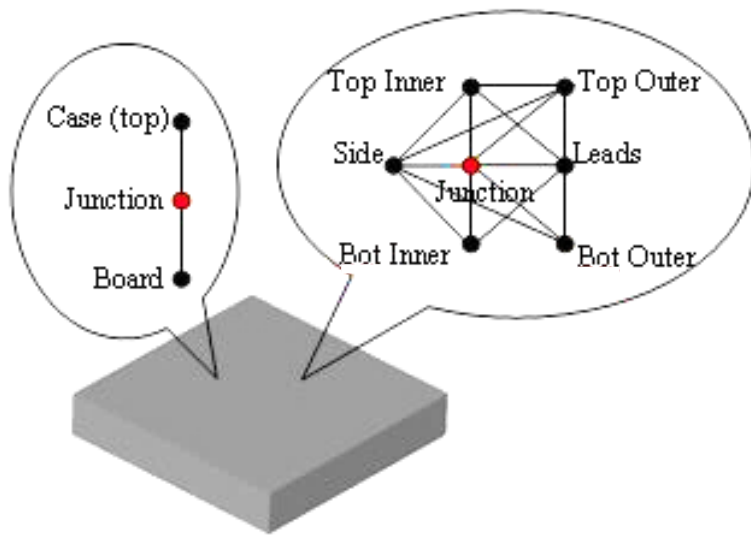
Future Work

- Use EDA Bridge module to build detail PCB model
- Use ODB++ file from EDA tools



Future Work

- Try to use T3Ster to get R_{thjc} & R_{thjb} for key component modeling.
- Use R_{thjc} & R_{thjb} data for Two-Resistor model



Thank you for your attention