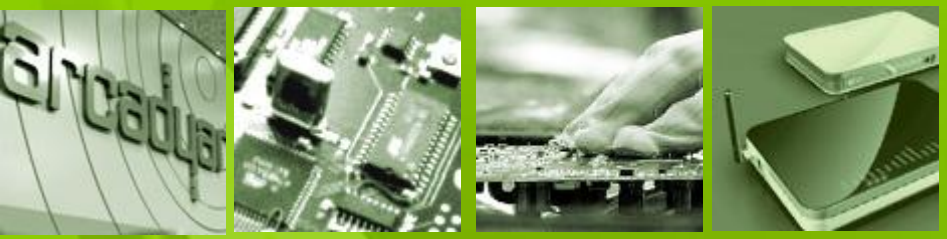


Using FloEFD : Case Studies on Networking Devices for Thermal Design

2016.11.11

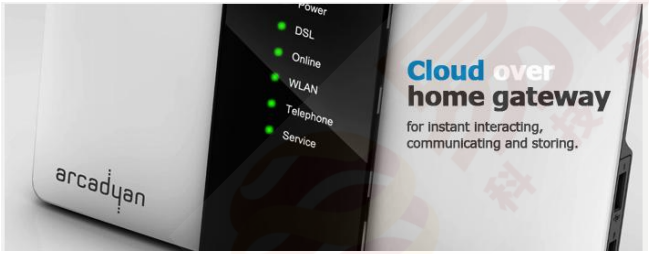
Agenda

1. Introduction of networking devices
2. The environment variables of EFD
3. The process of thermal design
4. Simulation results

Introduction of networking devices

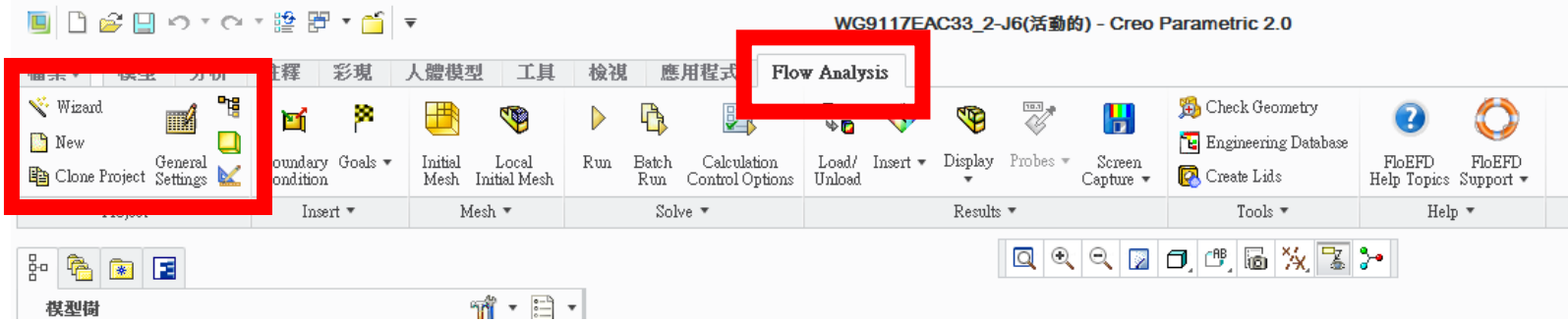
Main product

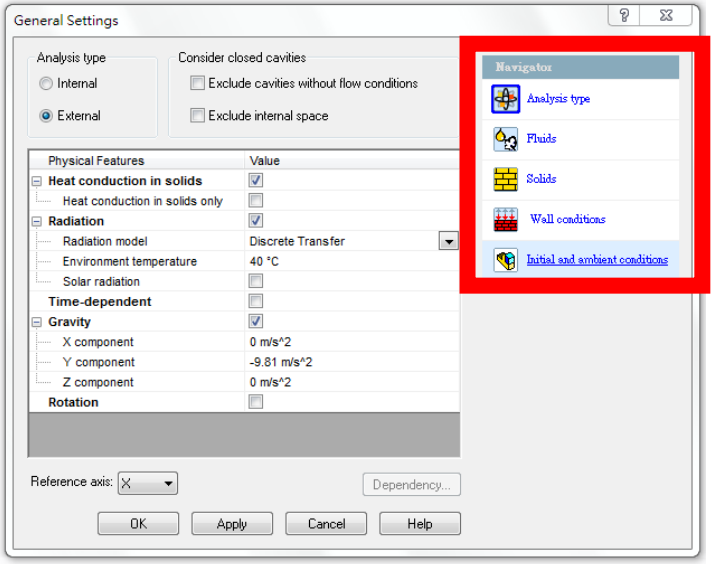
- DSL CPE
- Wireless Networking
- Fiber communication
- 3G/4G communication
- Digiital home



The environment setting of EFD

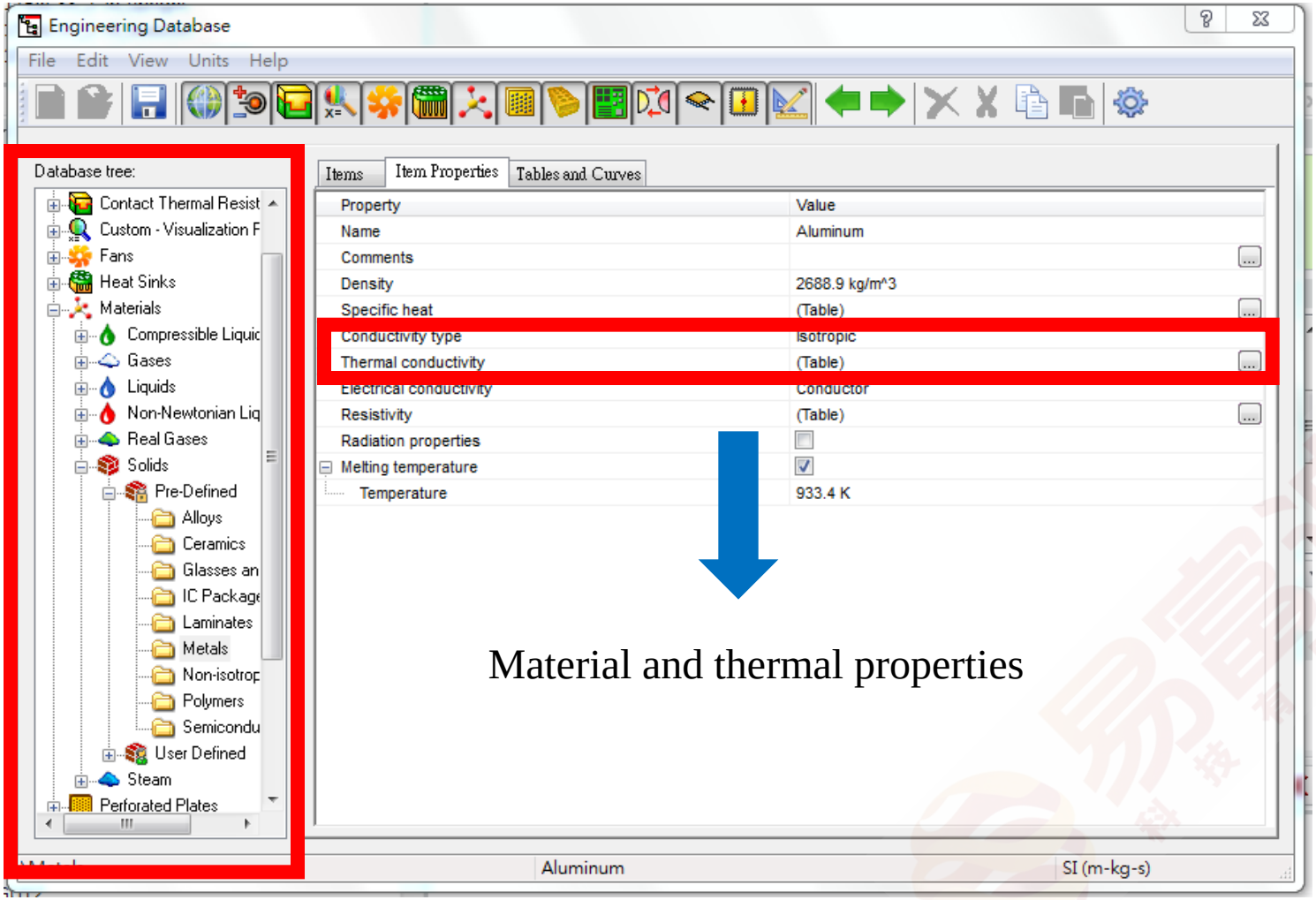
Using the Pro/e to design the 3D model to simulate.





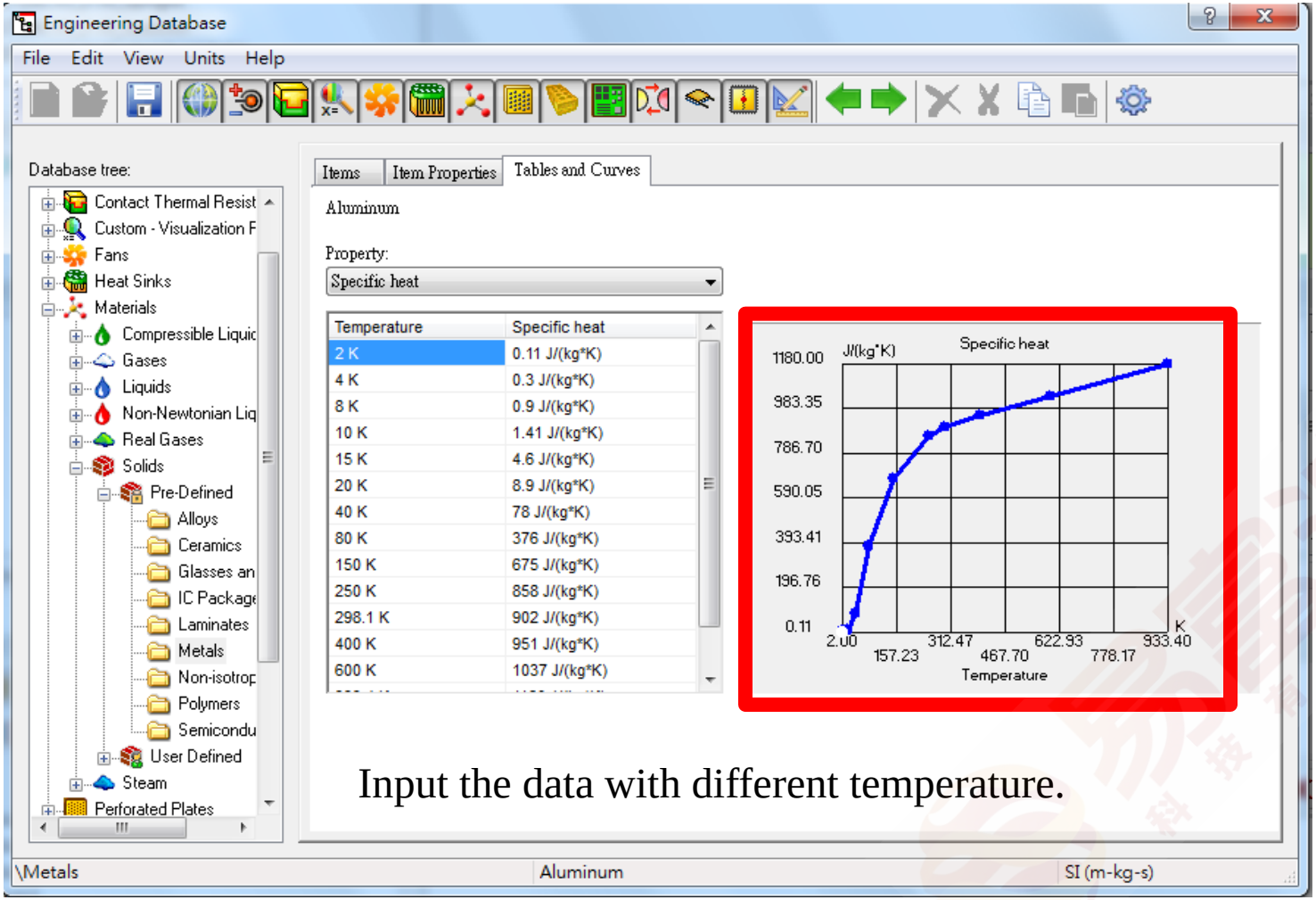
Follow the default process to setting the environment

The environment setting of EFD



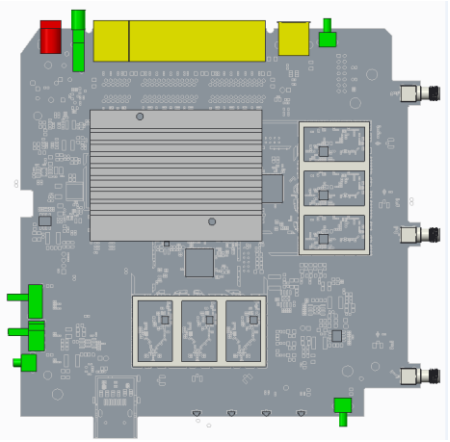
Material and thermal properties

The environment setting of EFD



Input the data with different temperature.

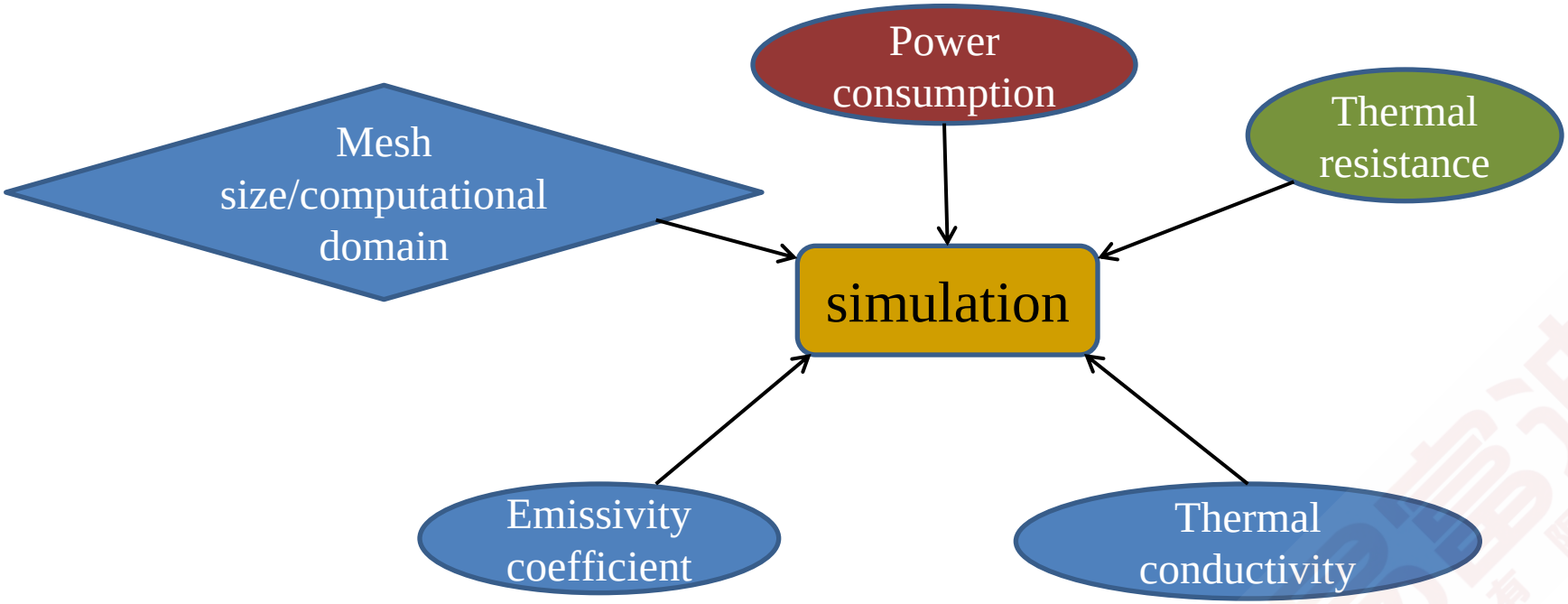
The environment setting of EFD



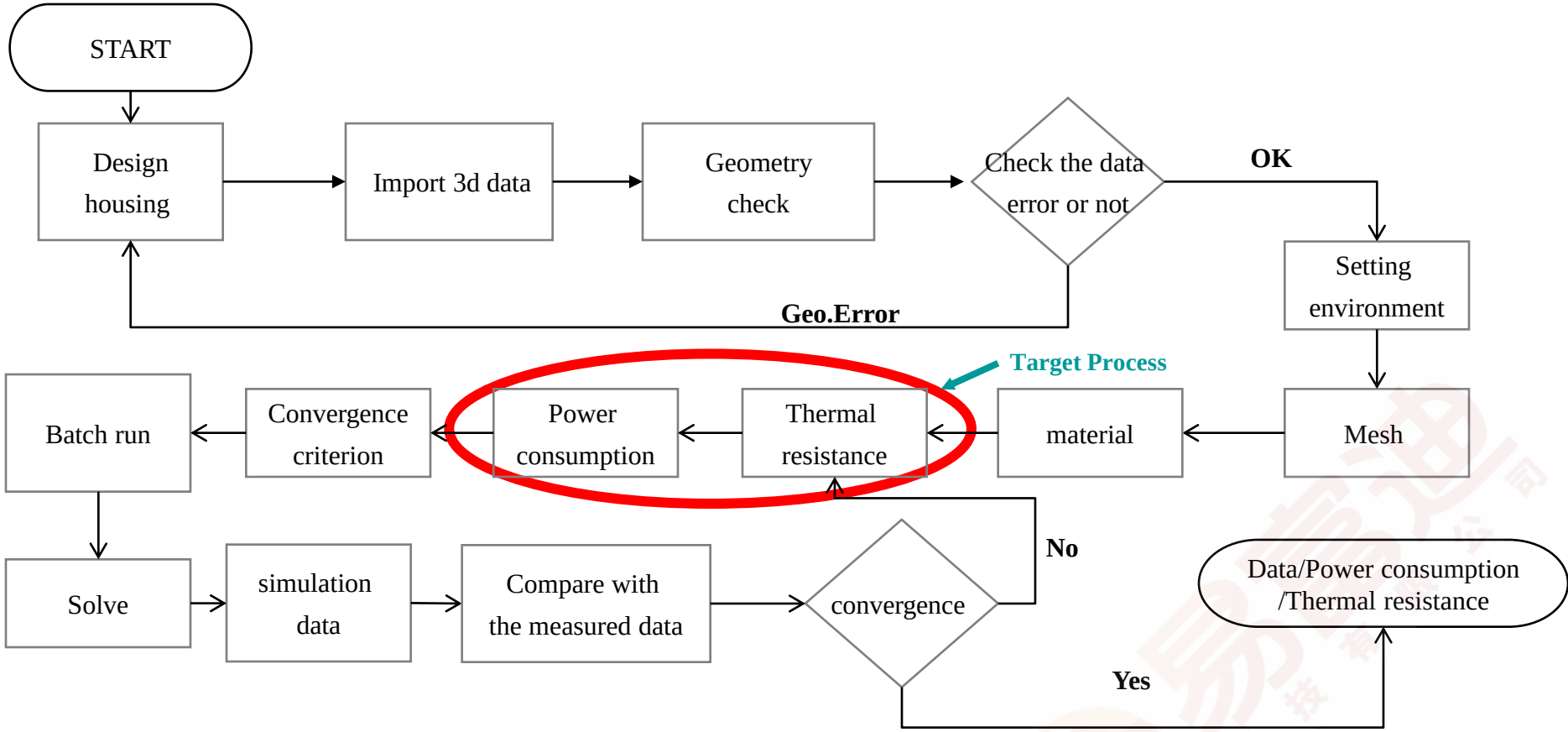
Input the data from layout to obtain the thermal conductivity

Conductor material density	8960 kg/m^3
Conductor material specific heat	385 J/(kg*K)
Conductor material conductivity	401 W/(m*K)
PCB total thickness	0.0016 m
Conducting layers	(Table)
In-plane (planar) conductivity	23.7149956 W/(m*K)
Through-plane (normal) conductivity	0.318603754 W/(m*K)
Effective specific heat	723.254549 J/(kg*K)
Number of conducting layers	4

The process of thermal design

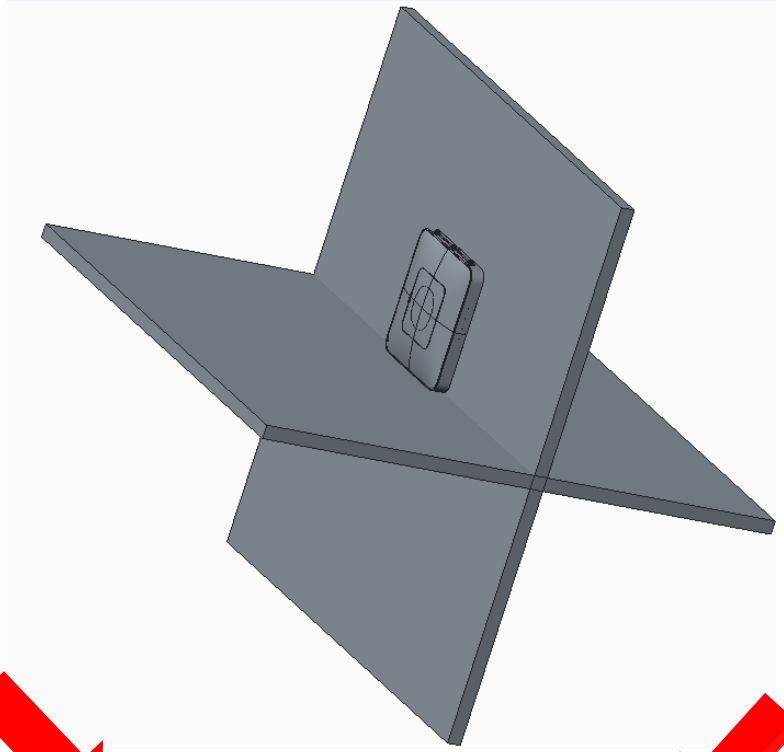


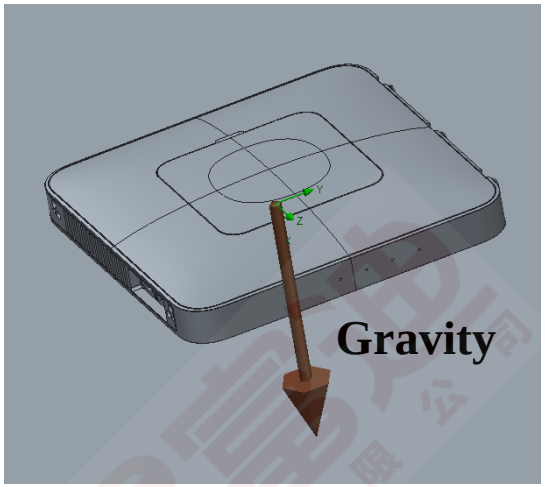
The process of thermal design



The process of thermal design

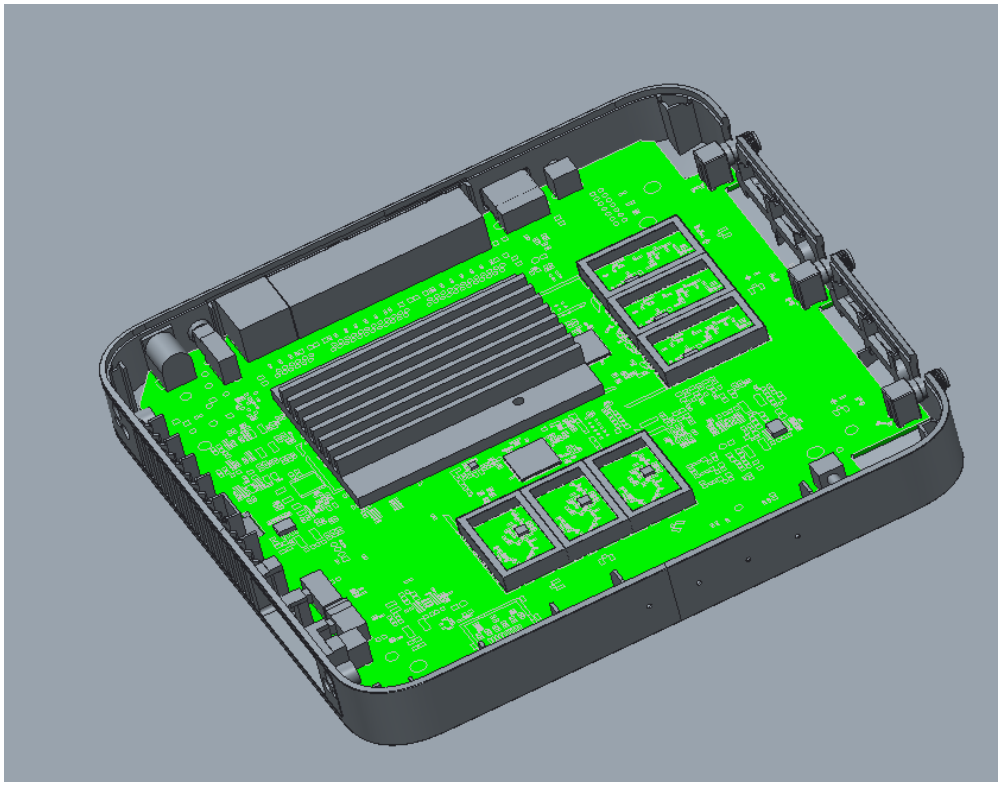
Using the same 3D model for different case





Simulate different case for lie-down and upright

The process of thermal design

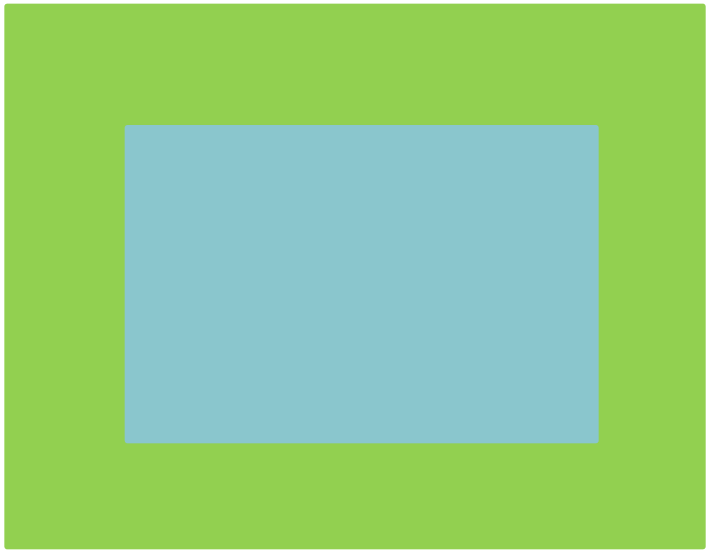


Model : natural convection (steady state)

Housing is simplified with removing unnecessary feature

The process of thermal design

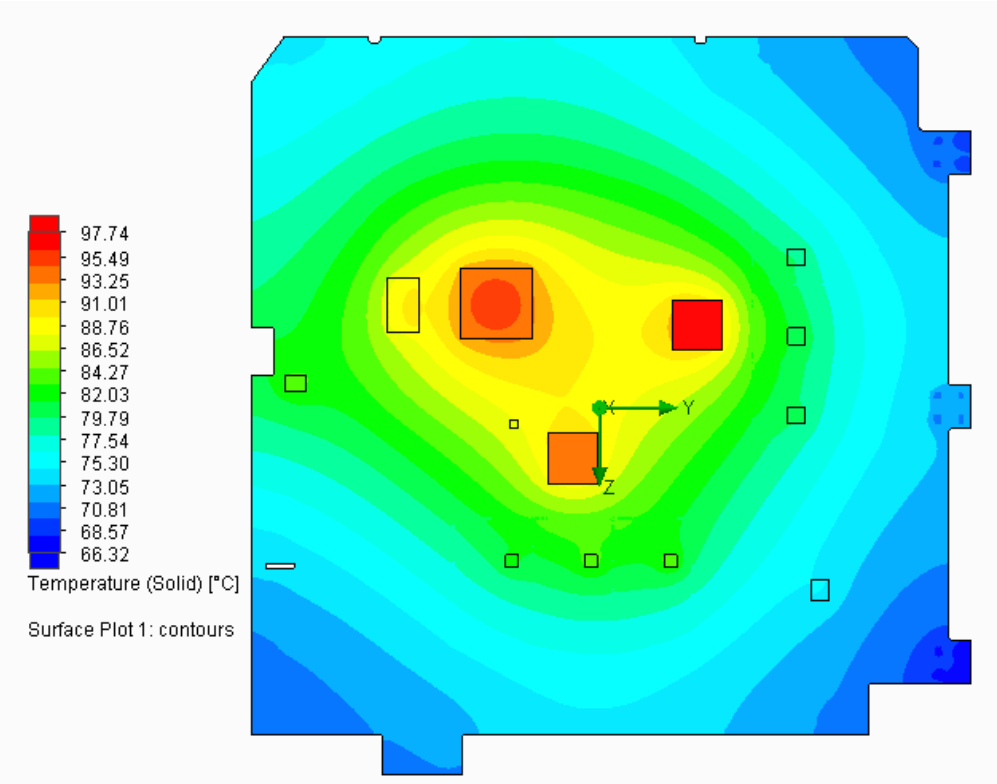
Use thermocouple to measured the chip data to obtain the properties of chip.



Using the temperature to obtain the properties of chip.(thermal resistance, power consumption…)

The process of thermal design

Temperature distribution

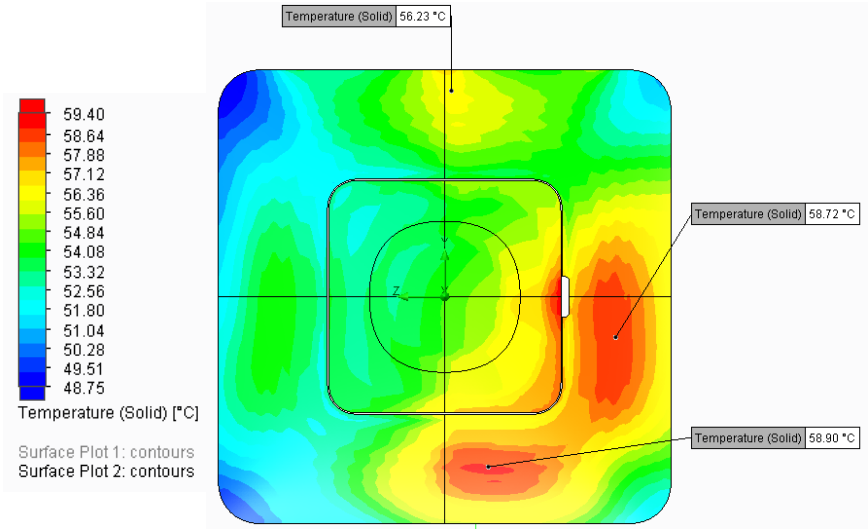


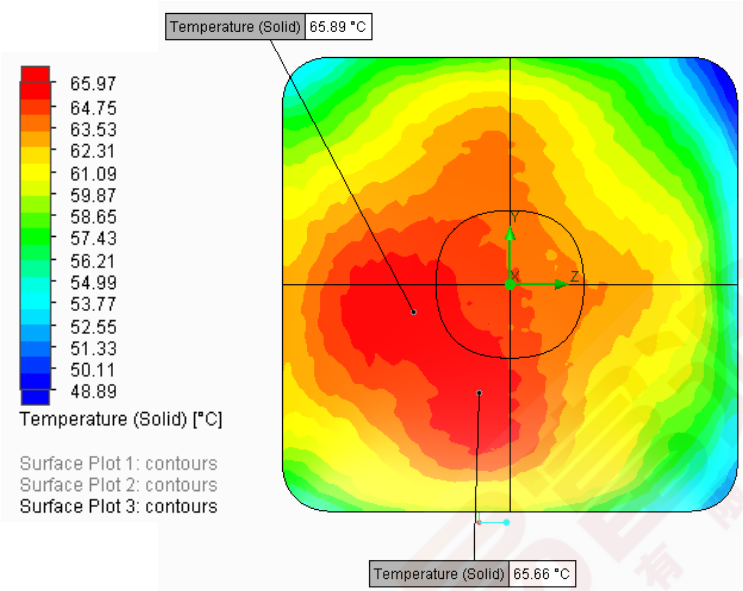
Tuning the thermal properties of chips and pc board

*Power consumption is reference on datasheet.

The process of thermal design

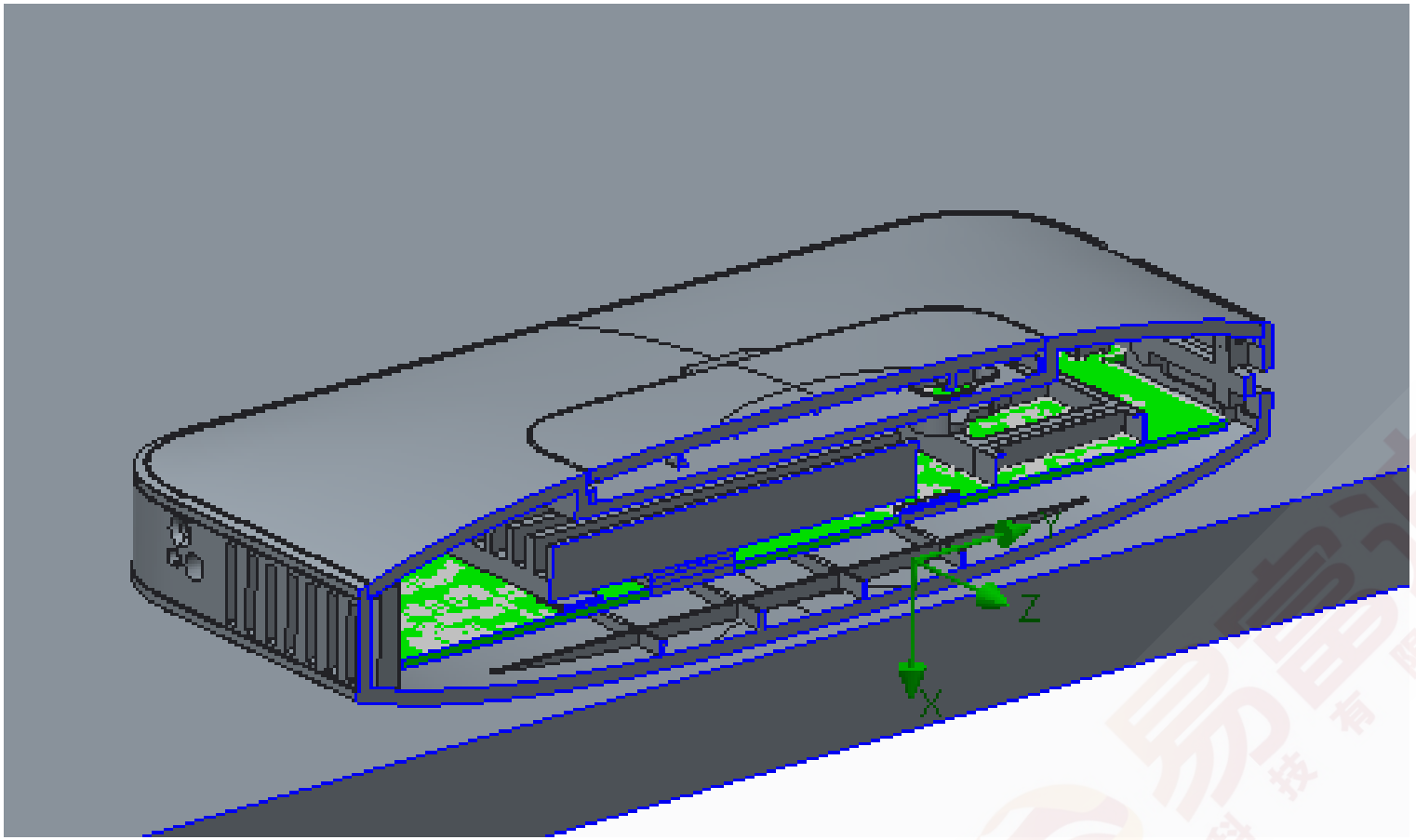
Housing temperature distribution





According to the temperature distribution to design the different feature and solution.

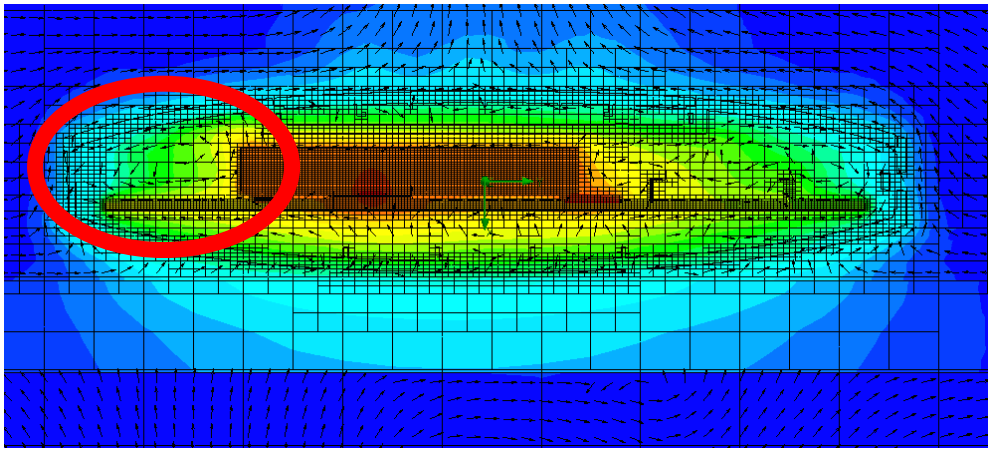
The process of thermal design

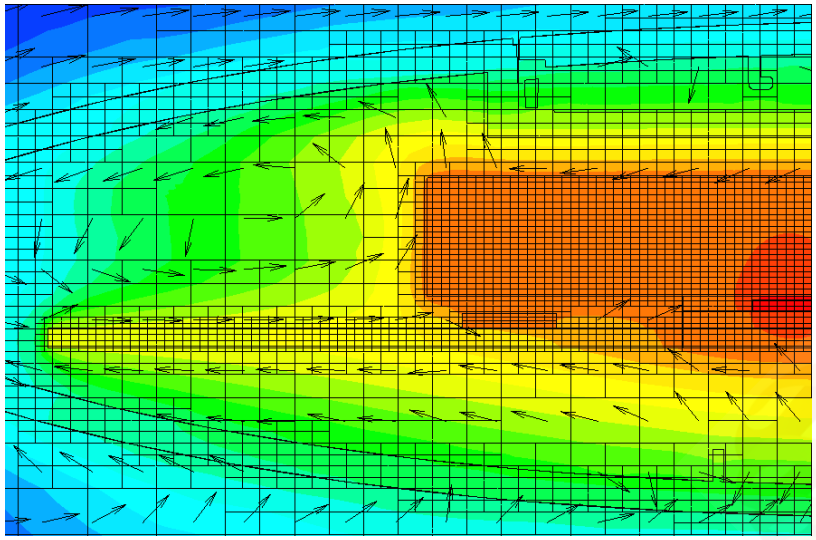


The 3D model of housing and pcba.

The process of thermal design

Partial cell : between solid and fluid

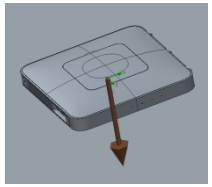




Simulation results

Upright

Component	Measured temp.(˚C)	Simulation temp.(˚C)	Error (˚C)
CPU	90.41	91.35	0.94
2.4G	86.17	84.31	-1.86
5G	91.36	90.51	-0.85
BASE-CPU	53.15	54.24	1.09
COVER-CPU	65.78	65.22	-0.56
BASE-LED	52.27	52.14	-0.13
COVER-LED	49.42	50.12	0.7

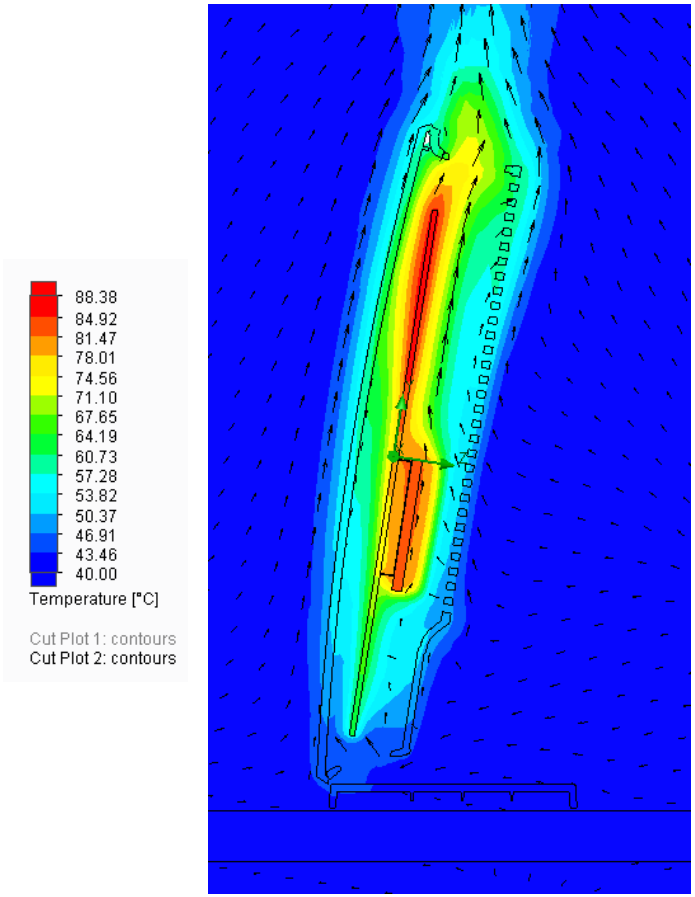


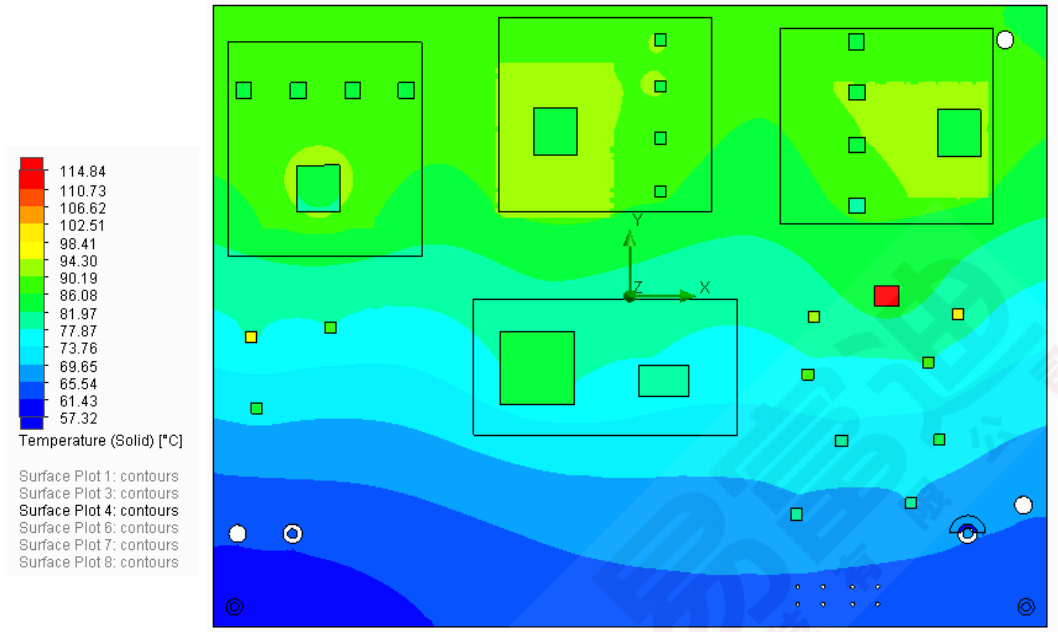
Lie-down

Component	Measured temp.(˚C)	Simulation temp.(˚C)	Error (˚C)
CPU	100.19	100.96	0.77
2.4G	95.82	94.06	-1.76
5G	98.55	97.74	-0.81
BASE-CPU	67.20	65.52	-1.68
COVER-CPU	72.93	75.32	2.39
BASE-LED	60.24	58.89	-1.35
COVER-LED	51.72	51.86	0.14

Simulation results

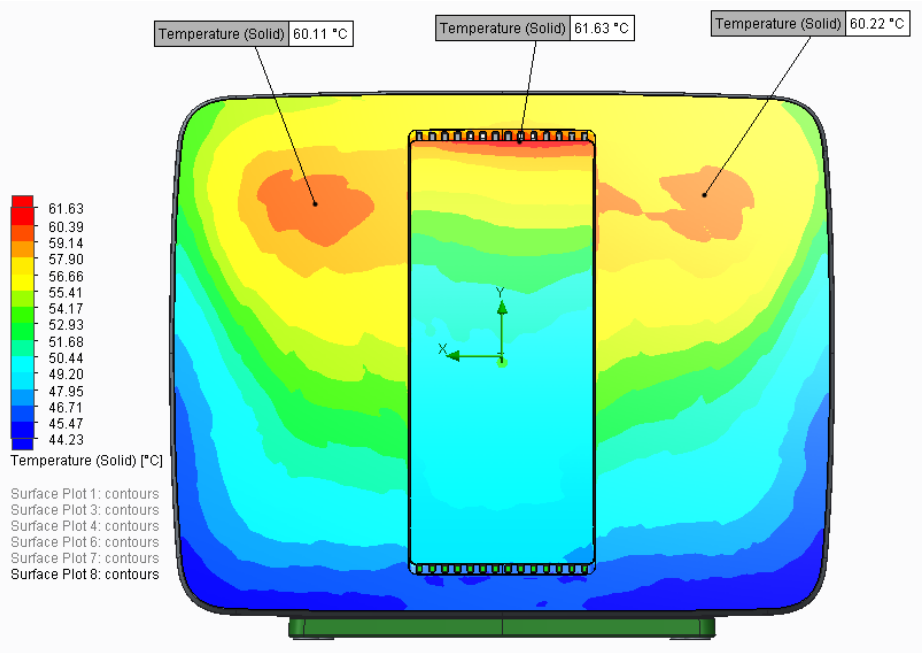
Post processing : showing the flow field and the temperature distribution of pcb

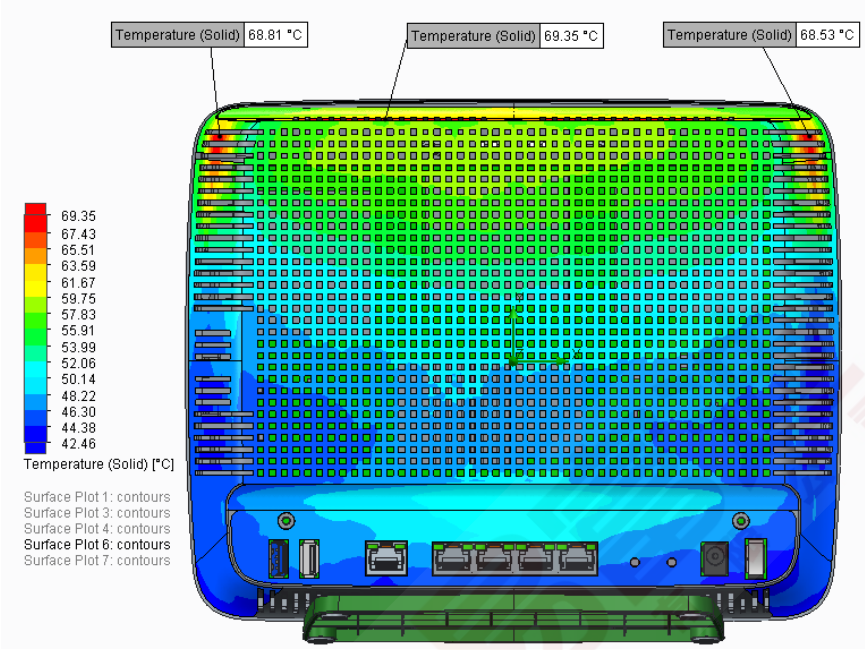




Simulation results

Post processing : put the temperature probe on housing





Thermal issue

- High performance with small housing.
- No venting hole with high power consumption.
- Power consumption, radiation and thermal resistance.
- Cost and lead time.

Thank you for your attention !