

Using FloEFD : Case Studies on Networking Devices for Thermal Design

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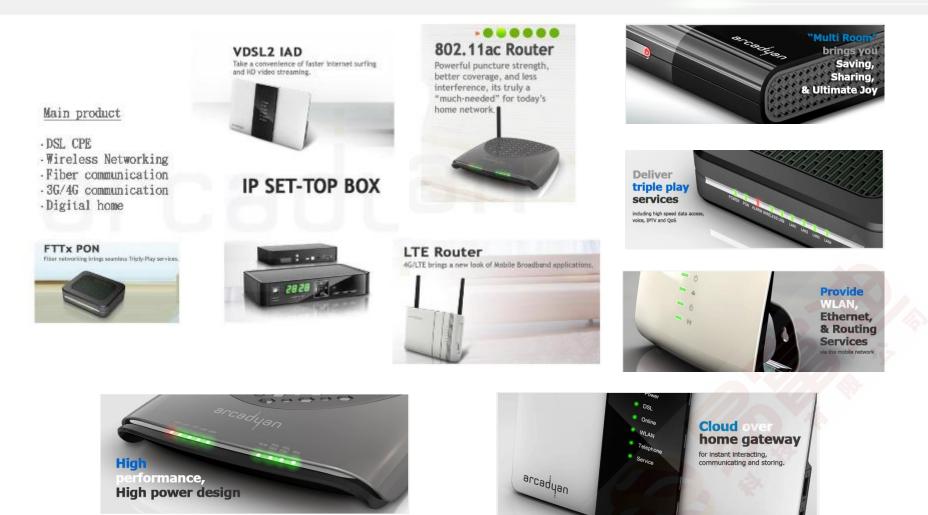
2016.11.11

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

Introduction of networking devices





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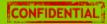
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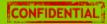
Using the Pro/e to design the 3D model to simulate.

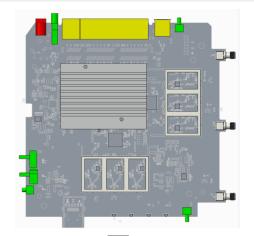


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🗄 🍣 Fans 👘 👘	Comments			
🗄 🛗 Heat Sinks	Density	2688.9 kg/m^3		
📄 🏃 Materials	Specific heat	(Table)		
🖅 👌 Compressible Liquic	Conductivity type	Isotropic		
🗄 🛶 Gases	Thermal conductivity	(Table)		
🖽 👌 Liquids	Electrical conductivity	Conductor		
🗄 👌 Non-Newtonian Liq	Resistivity	(Table)		
🖶 📣 Real Gases	Radiation properties			
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🖃 籠 Pre-Defined	Temperature	933.4 K		
Alloys Alloys Ceramics Glasses an IC Package Laminates Metals Polymers Polymers Semicondu User Defined Steam Steam	Material and thermal properties			
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🗄 👌 Compressible Liquic	Temperature	Specific heat				pecific heat		
🖽 🛶 Gases	2 K	0.11 J/(kg*K)	_	1180.00 J/	/(kg*K) ^D			
🗄 🗄 Liquids	4 K	0.3 J/(kg*K)	_					
🛓 🔥 Non-Newtonian Liq	8 K	0.9 J/(kg*K)		983.35				
🕀 📣 Real Gases	10 K	1.41 J/(kg*K)	_	786.70				
🛓 🖶 🦈 🌍 Solids	15 K	4.6 J/(kg*K)	_					
📥 🧌 Pre-Defined	20 K	8.9 J/(kg*K)	=	590.05				
Alloys	40 K	78 J/(kg*K)						
Ceramics	80 K	376 J/(kg*K)		393.41	<+ +			
🛅 Glasses an	150 K	675 J/(kg*K)		196.76				
🛅 IC Package	250 K	858 J/(kg*K)		130.10				
🛅 Laminates	298.1 K	902 J/(kg*K)		0.11				ĸ
Metals	400 K	951 J/(kg*K)		2.00	312.47 157.23	622.9 467.70	93 933. 778.17	.40
🛅 Non-isotrop	600 K	1037 J/(kg*K)	-			emperature		
Polymers Semicondu Semicondu Semicondu Perforated Plates Input the data with different temperature.								
\Metals		Aluminum					SI (m-kg-s)	

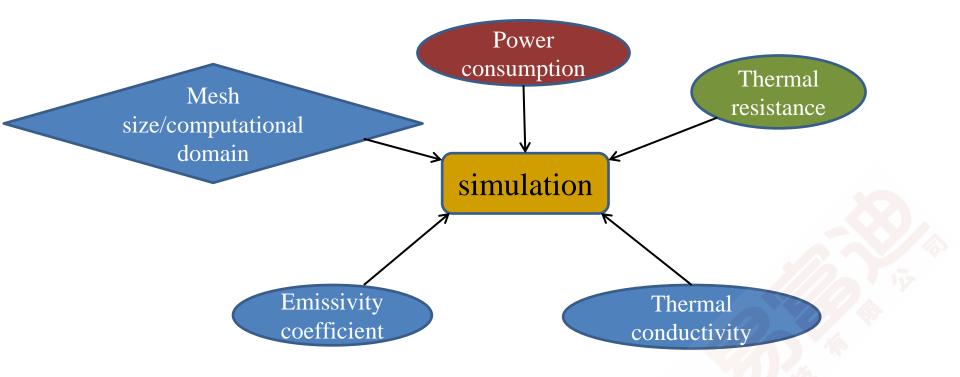




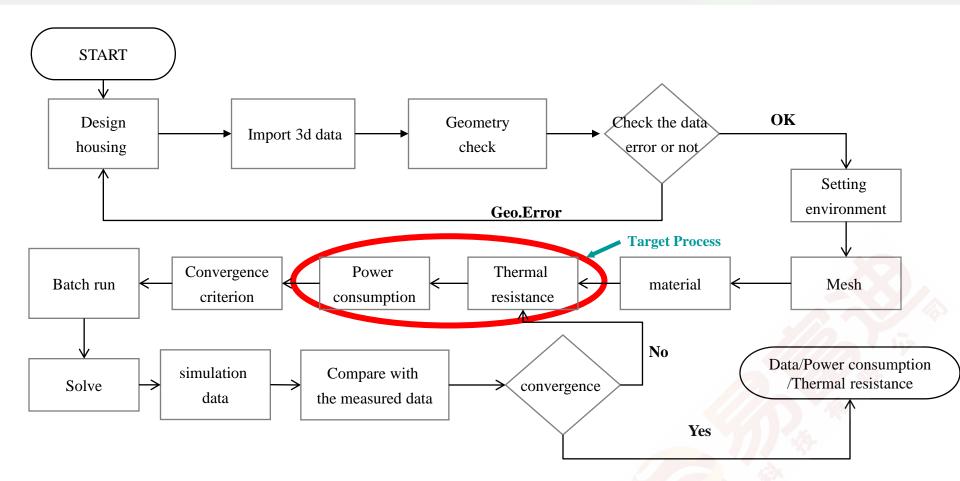
Input the data from layout to obtain the thermal conductivity

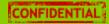
Conductor material density	8960 kg/m^3
Conductor material specific heat	385 J/(kg*K)
Conductor material conductivity	401 W/(m*K)
PCB total thickness	0.0016 m
Conducting layers	(Table)
In-plane (planar) conductivity	23.7149956 W/(m*K)
Through-plane (normal) conductivity	0.318603754 W/(m*K)
	1050 15700 Lgl 40
Effective specific heat	723.254549 J/(kg*K)
Number of conducting layers	4



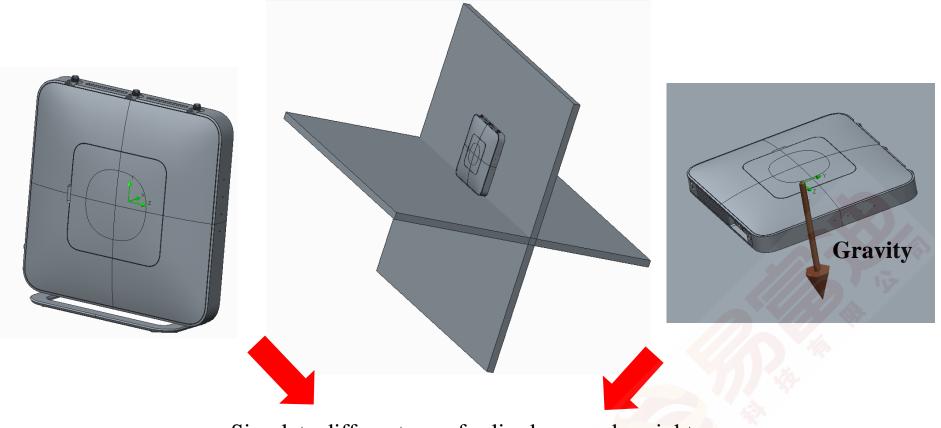






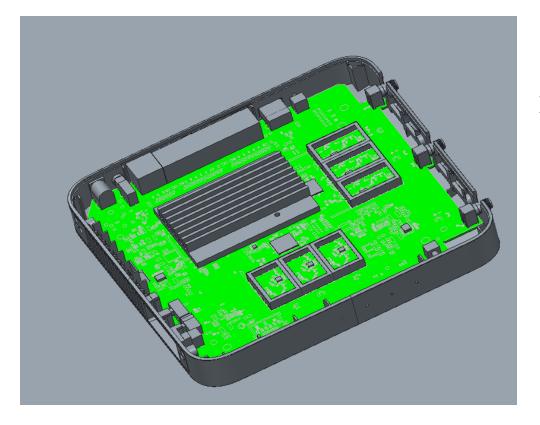


Using the same 3D model for different case



Simulate different case for lie-down and upright





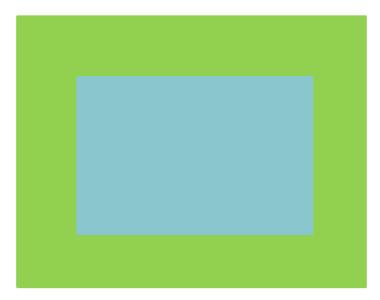
Model : natural convection (steady state)

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Housing is simplified with removing unnecessary feature

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

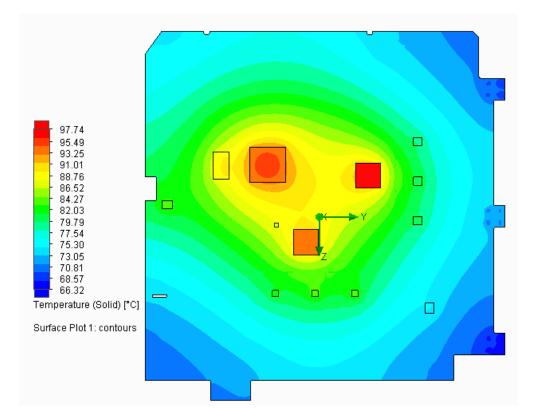




Using the temperature to obtain the properties of chip.(thermal resistance, power consumption...)



Temperature distribution

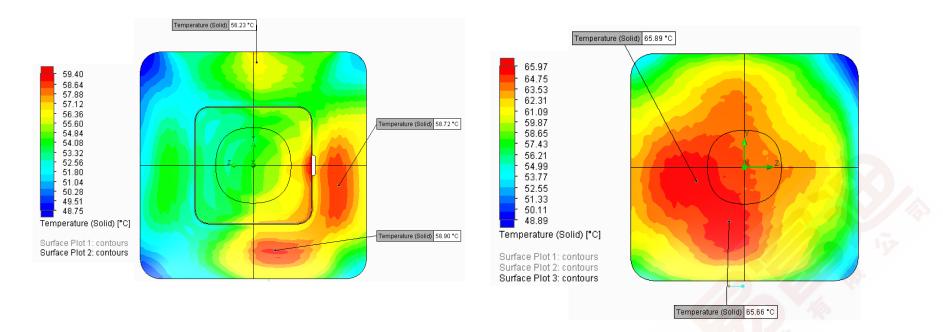


Tuning the thermal properties of chips and pc board

*Power consumption is reference on datasheet.

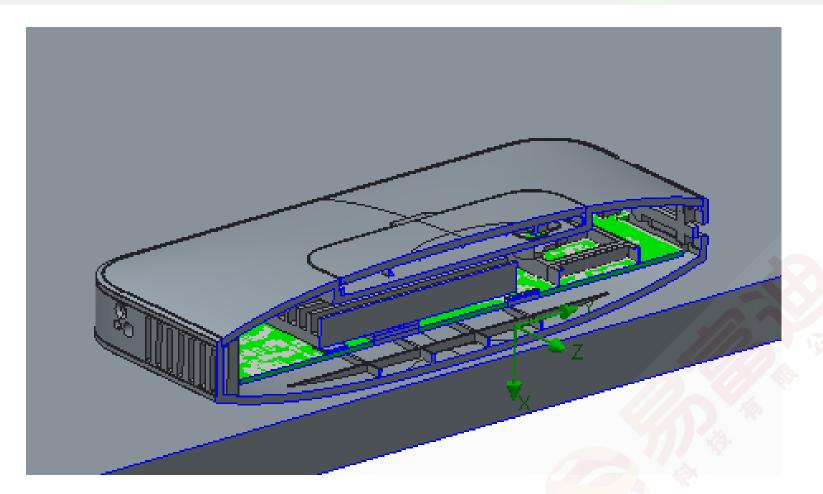


Housing temperature distribution



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



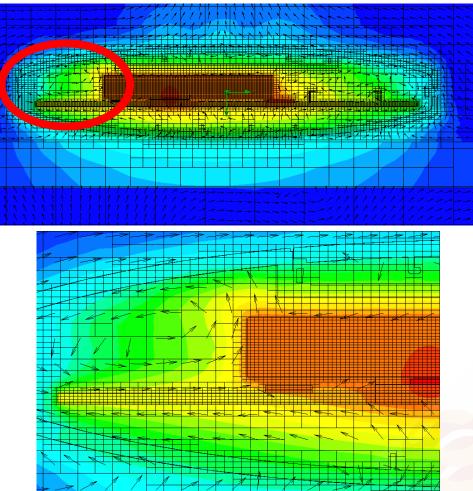


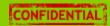
The 3D model of housing and pcba.



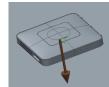
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Partial cell : between solid and fluid





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Lie-down

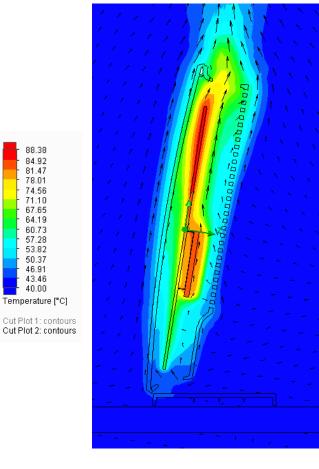
Component	Measured temp.(°C)	d temp.(°C) Simulation temp.(°C)	
CPU	100.19	100.96	0.77
2.4G	95.82	94.06	-1.76
5G	98.55	97.74	-0.81
BASE-CPU	67.20	65.52	-1.68
COVER-CPU	72.93	75.32	2.39
BASE-LED	60.24	58.89	-1.35
COVER-LED	51.72	51.86	0.14

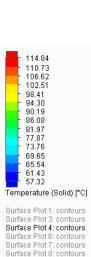
τ	Jpright
Measured temp.(°C)	Simulatio temp.(°C
90.41	91.35

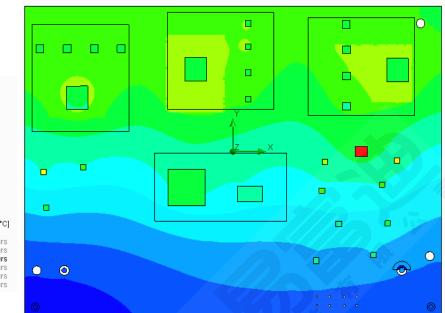
Component	Measured temp.(°C)	Simulation temp.(°C)	Error (°C)	
CPU	90.41	91.35	0.94	
2.4G	86.17	84.31	-1.86	
5G	91.36	90.51	-0.85	
BASE-CPU	53.15	54.24	1.09	
COVER-CPU	65.78	65.22	-0.56	
BASE-LED	52.27	52.14	-0.13	
COVER-LED	49.42	50.12	0.7	



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

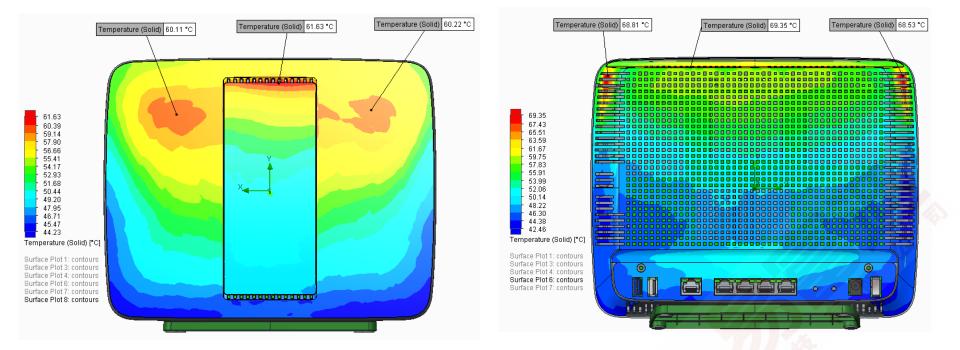






Simulation results

Post processing : put the temperature probe on housing





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• High performance with small housing.

 \blacklozenge No venting hole with high power consumption.

• Power consumption, radiation and thermal resistance.

• Cost and lead time.





Thank you for your attention !



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