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SIwave与Icepak无缝电-热协同仿真

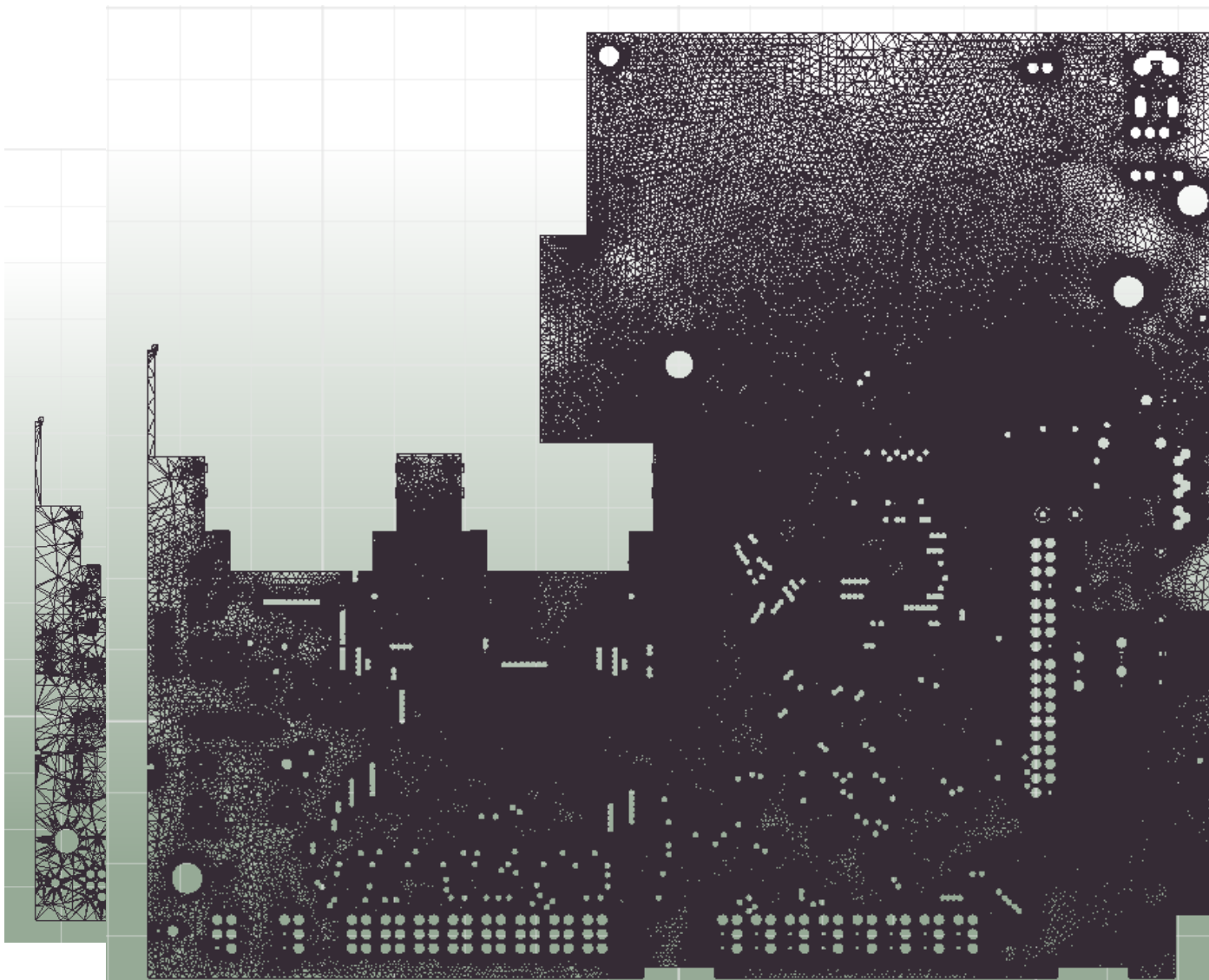
- 褚正浩 / 高级应用工程师

SIwave – 直流分析

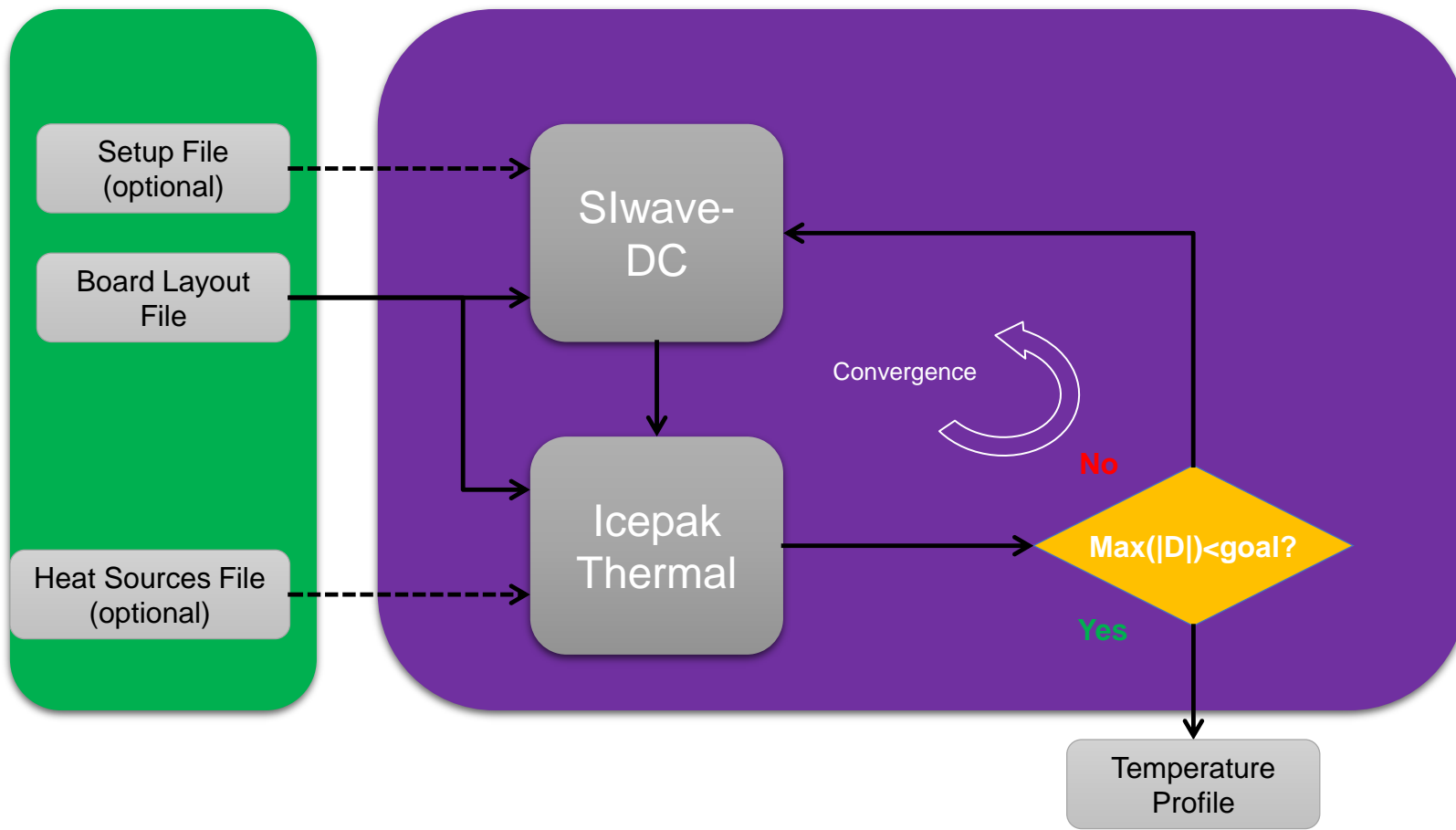
- 专门用来预测封装和电路板上直流电源供电问题
 1. 求解器使用独特的自适应网格细化技术来确保高精度结果，对包含铜皮、走线、过孔、键合丝、焊球和凸点等电子设计元素的芯片、封装和电路板进行准确预测。
 2. 生成如下分析结果
 - 电源和地网络上的直流电压跌落 (V)
 - 电源和回流路径上的直流电流密度分布 (Amps/Area²)
 - 流进流出过孔的电流量
 - 功率密度分布(W/Area²)和每层功耗(Watts)
 3. 生成.html报告自动判别用户预先定义的pass/fail判据

DC 自适应网格优化

- 1次自适应迭代
- 3次自适应迭代
- 10次自适应迭代
- 20次自适应迭代



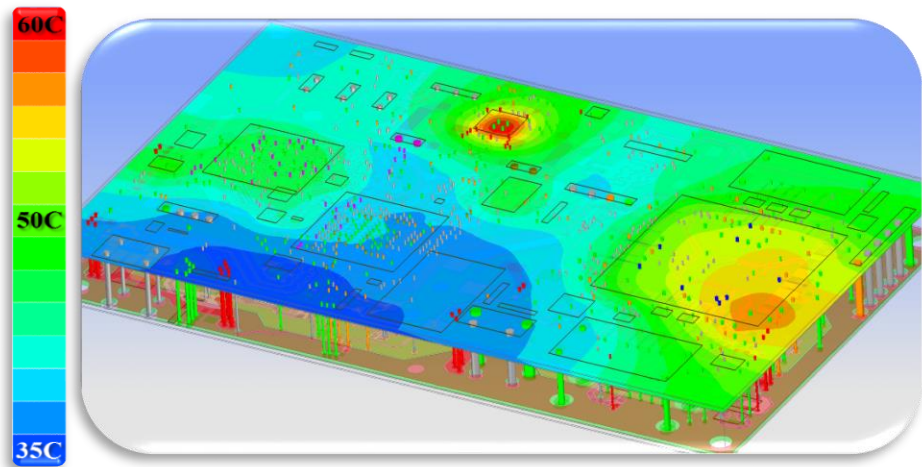
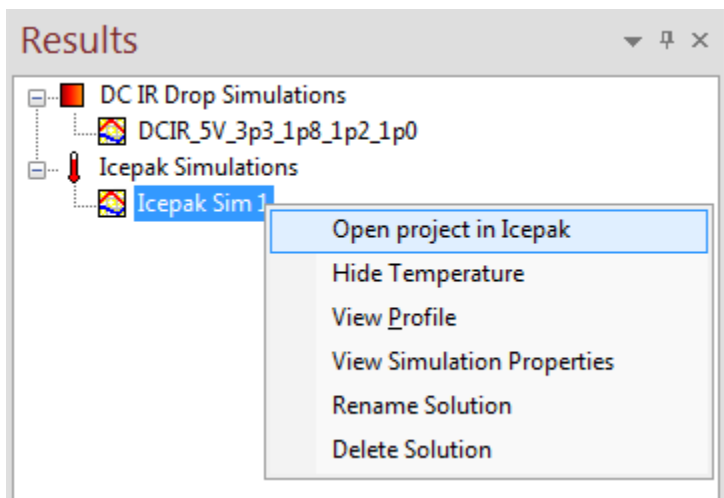
SIwave-DC 与 Icepak 耦合



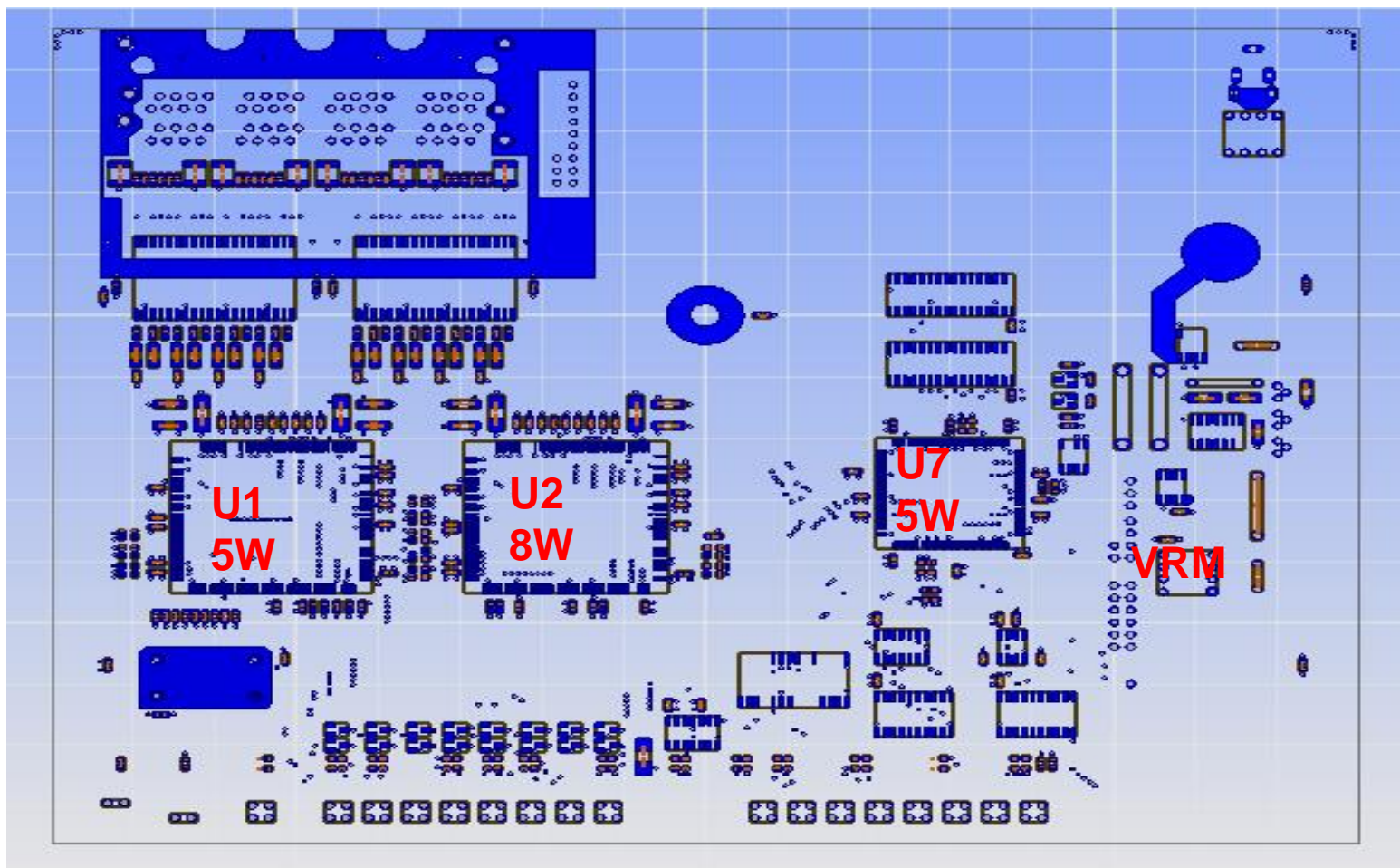
统一接口的端到端自动流程

SIwave 调用Icepak Solver

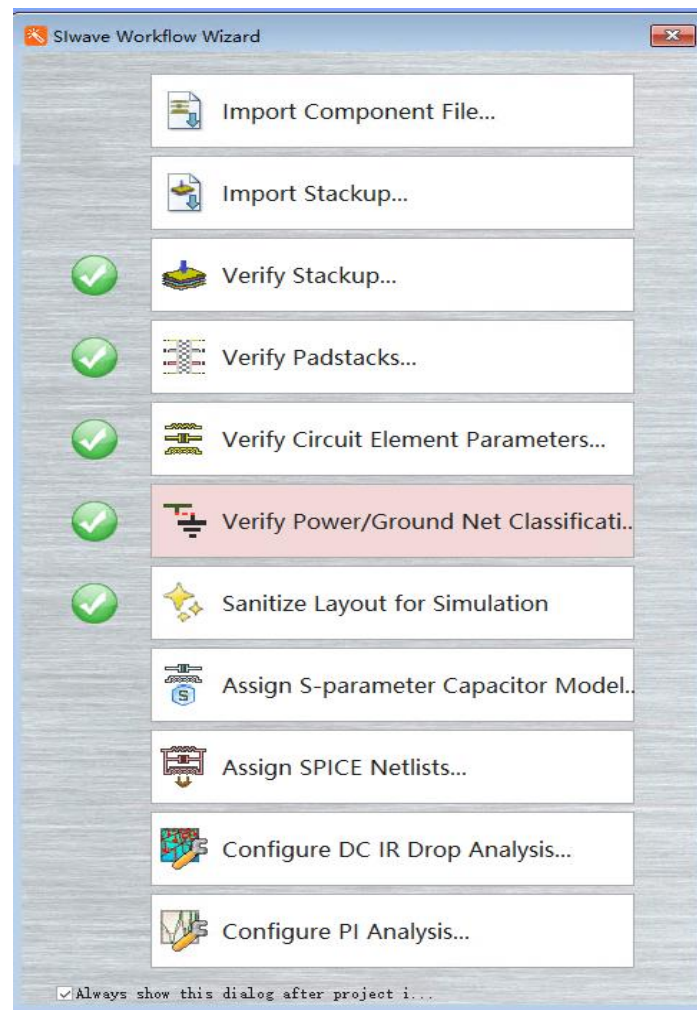
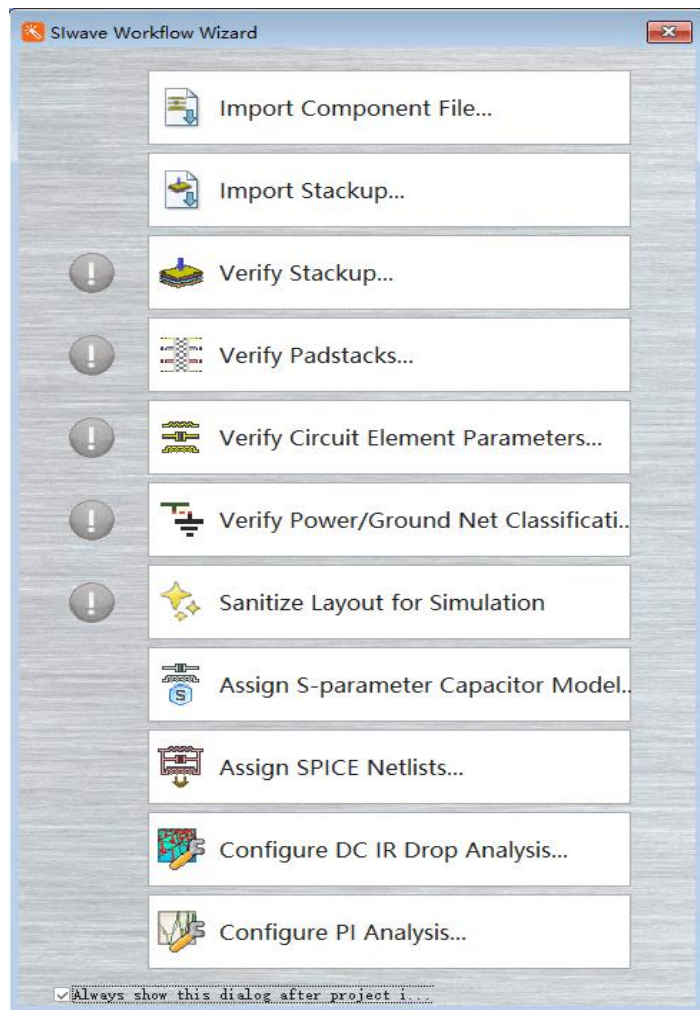
- 在SIwave中直接进行包含焦耳热的热分析
 - Icepak Solver:
 - 焦耳热
 - 考虑传导热
 - 强制对流热分析
 - 空气可沿PCB平行或垂直方向流动
 - 自然对流分析
 - 包含简化cabinet结构
 - 可设置器件功率
 - 可直接在Icepak GUI中打开工程文件



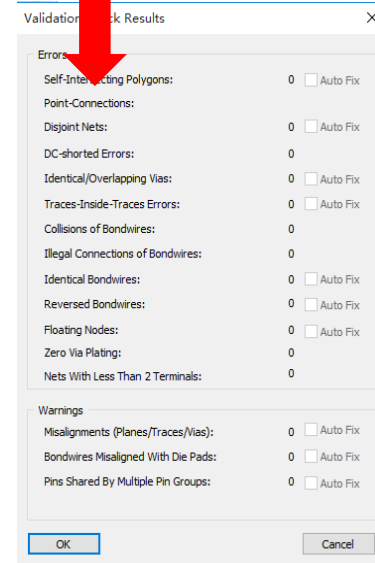
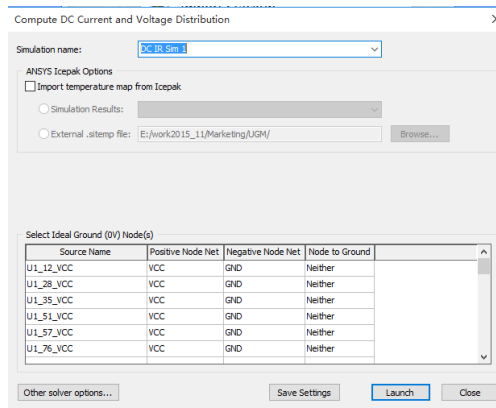
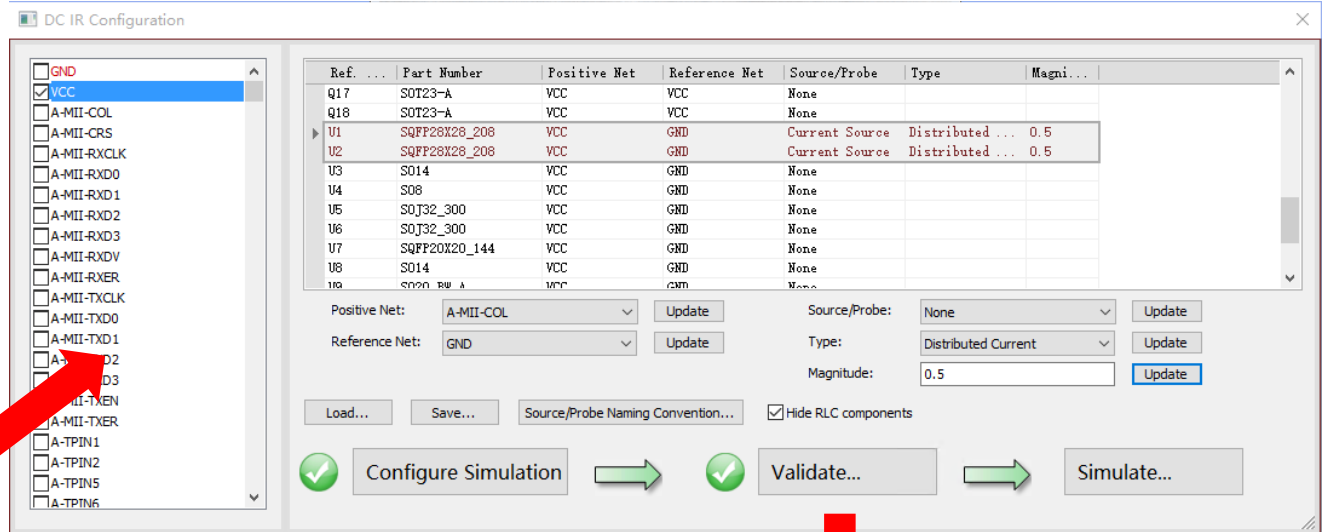
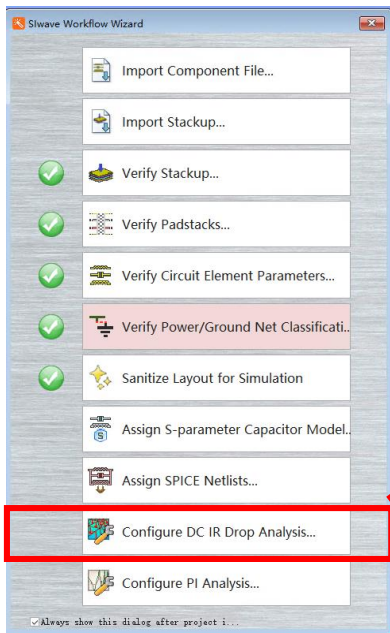
SIwave仿真案例



SIwave-直流分析---向导式操作



SIwave-直流分析---向导式操作



SIwave-DC直流分析结果-接收端电压

DC Simulation Element Data(DC IR Sim 1)

Bondwires | Current Sources | Metallization | Vias | Voltage Probes | Voltage Sources

Source Name	Parallel R Current / A	Voltage / V
U1_170_VCC	3.596224917020e-08	1.798112458510e+00
U1_201_VCC	3.596245452637e-08	1.798122726319e+00
U1_203_VCC	3.596251227663e-08	1.798125613832e+00
U1_204_VCC	3.596252384945e-08	1.798126192473e+00
U1_205_VCC	3.596252405249e-08	1.798126202625e+00
U1_206_VCC	3.596254916919e-08	1.798127458460e+00
U1_51_VCC	3.596273211373e-08	1.798136605686e+00
U1_28_VCC	3.596273926783e-08	1.798136963391e+00
U1_35_VCC	3.596279450942e-08	1.798139725471e+00
U1_99_VCC	3.596320543966e-08	1.798160271983e+00
U1_96_VCC	3.596324820805e-08	1.798162410403e+00
U1_84_VCC	3.596329985807e-08	1.798164992903e+00

Fit Selection

Export Close

SIwave调用Icepak

EDIT GEOMETRY CIRCUIT ELEMENTS VIEW VISIBILITY TOOLS EXPORT SIMULATION RESULTS

Compute SYZ Compute Compute Compute Compute Signal Net Impedance Crosstalk SIwizard... TDRwizard... Options... Compute Options... Compute AC Compute SYZ HFSS 3D Options... Compute Compute Compute PI PDN Channel Icepak... Parameters... Resonant Modes... Frequency Sweeps... Far Field... Near Field... Analyzer Scan... Scan... RLCG... Currents... Parameters... Layout... Q3D Extractor (TPA) RLGCG 3D Mesh Advisor... Builder...

Icepak Simulation Setup

Simulation Setup Thermal Environment Component Configuration Icepak Cabinet Size

Setup Name: Icepak Sim 1

DC Sim Results: DC IR Sim 1

Thermal Simulation Type

Conduction (PCB only - no components)

Convection (Components optional)

Meshing Detail

Basic Detailed Exhaustive

Number of cores to 20

Save Settings Launch Close

设置求解类型

设置仿真核数

SIwave调用Icepak

Icepak Simulation Setup

— □ ×

Simulation Setup | Thermal Environment | Component Configuration | Icepak Cabinet Size

Forced Convection (Fan Driven Flow)

强制对流，可设置风速大小及方向

Flow Settings

Speed: m/s Direction:

Temperature: °C

Natural Convection ("Still" Air)

自然对流

Natural Convection Settings

Gravity Vector: i + j + k m/s²

Temperature: °C

Save Settings

Launch

Close

SIwave调用Icepak

Icepak Simulation Setup

Simulation Setup | Thermal Environment | Component Configuration | Icepak Cabinet Size

Type	Part	Ref Des	Include	Length ...	Width (...)	Height ...	Power Dissipati...	Heat ...
Integrated C...	S08	U12	<input type="checkbox"/>	4.470	7.112	5.000	0.250	<input type="checkbox"/>
Integrated C...	S08	U14	<input type="checkbox"/>	4.470	7.112	5.000	0.250	<input type="checkbox"/>
Integrated C...	SOJ32_300	U5	<input type="checkbox"/>	19.710	8.839	5.000	0.250	<input type="checkbox"/>
Integrated C...	SOJ32_300	U6	<input type="checkbox"/>	19.710	8.839	5.000	0.250	<input type="checkbox"/>
Integrated C...	SQFP20X20_144	U7	<input checked="" type="checkbox"/>	22.924	22.924	5.000	5.000	<input type="checkbox"/>
Integrated C...	SQFP28X28_208	U1	<input checked="" type="checkbox"/>	31.432	31.432	5.000	5.000	<input type="checkbox"/>
Integrated C...	SQFP28X28_208	U2	<input checked="" type="checkbox"/>	31.432	31.432	5.000	8.000	<input type="checkbox"/>
Discrete Device	S08	Q19	<input type="checkbox"/>	4.470	7.112	5.000	0.250	<input type="checkbox"/>
Discrete Device	SOP40_A	TX1	<input type="checkbox"/>	24.790	17.272	5.000	0.250	<input type="checkbox"/>
Discrete Device	SOP40_A	TX2	<input type="checkbox"/>	24.790	17.272	5.000	0.250	<input type="checkbox"/>
Discrete Device	SOT23-A	Q1	<input type="checkbox"/>	3.581	2.946	5.000	0.250	<input type="checkbox"/>
Discrete Device	SOT23-A	Q10	<input type="checkbox"/>	3.581	2.946	5.000	0.250	<input type="checkbox"/>
Discrete Device	SOT23-A	Q11	<input type="checkbox"/>	3.581	2.946	5.000	0.250	<input type="checkbox"/>
Discrete Device	SOT23-A	Q12	<input type="checkbox"/>	3.581	2.946	5.000	0.250	<input type="checkbox"/>
Discrete Device	SOT23-A	Q13	<input type="checkbox"/>	3.581	2.946	5.000	0.250	<input type="checkbox"/>

Hide RLC components Hide "J" connectors

Total Components: 3 Estimated PCB Temperatures without heatsinks
 Heating Components: 3 Mean Temp: 51.5 C
 Total Component Power: 18.000 W Max Temp: 82.9 C

Edit Selected Part(s)

Include in Simulation Update Generate Heatsink Update

Power: W Update

Reset Resistor Power Add Recommended Heatsinks Fit Selection

Import Settings Export Settings

Save Settings **Launch** Close

设定仿真器件的功率大小

SIwave调用Icepak

Icepak Simulation Setup

Simulation Setup | Thermal Environment | Component Configuration | Icepak Cabinet Size

Horizontal Padding: %

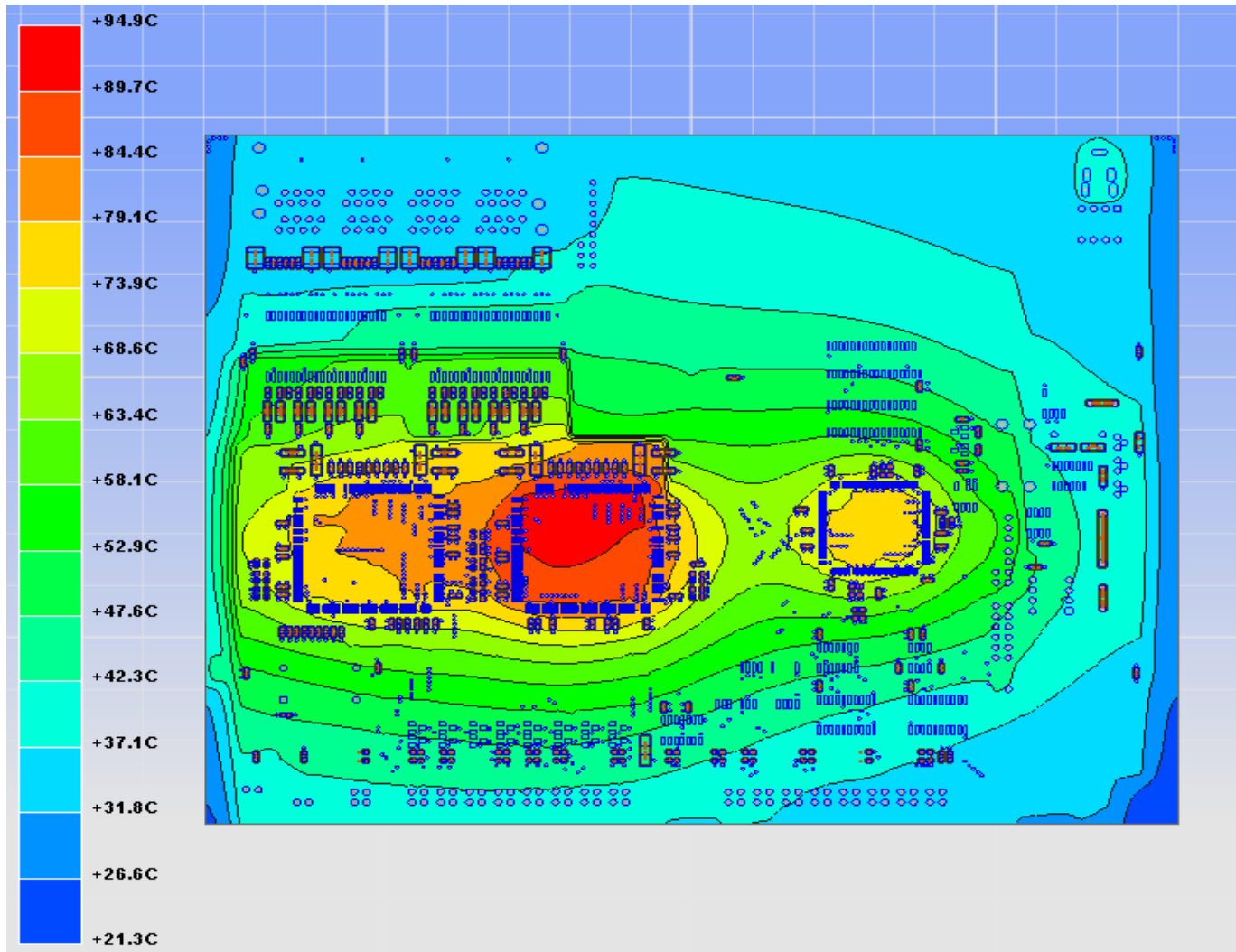
Vertical Padding: %

Vertical Padding: %

Icepak解空间大小

Save Settings Launch Close

SIwave-Icepak Thermal仿真结果

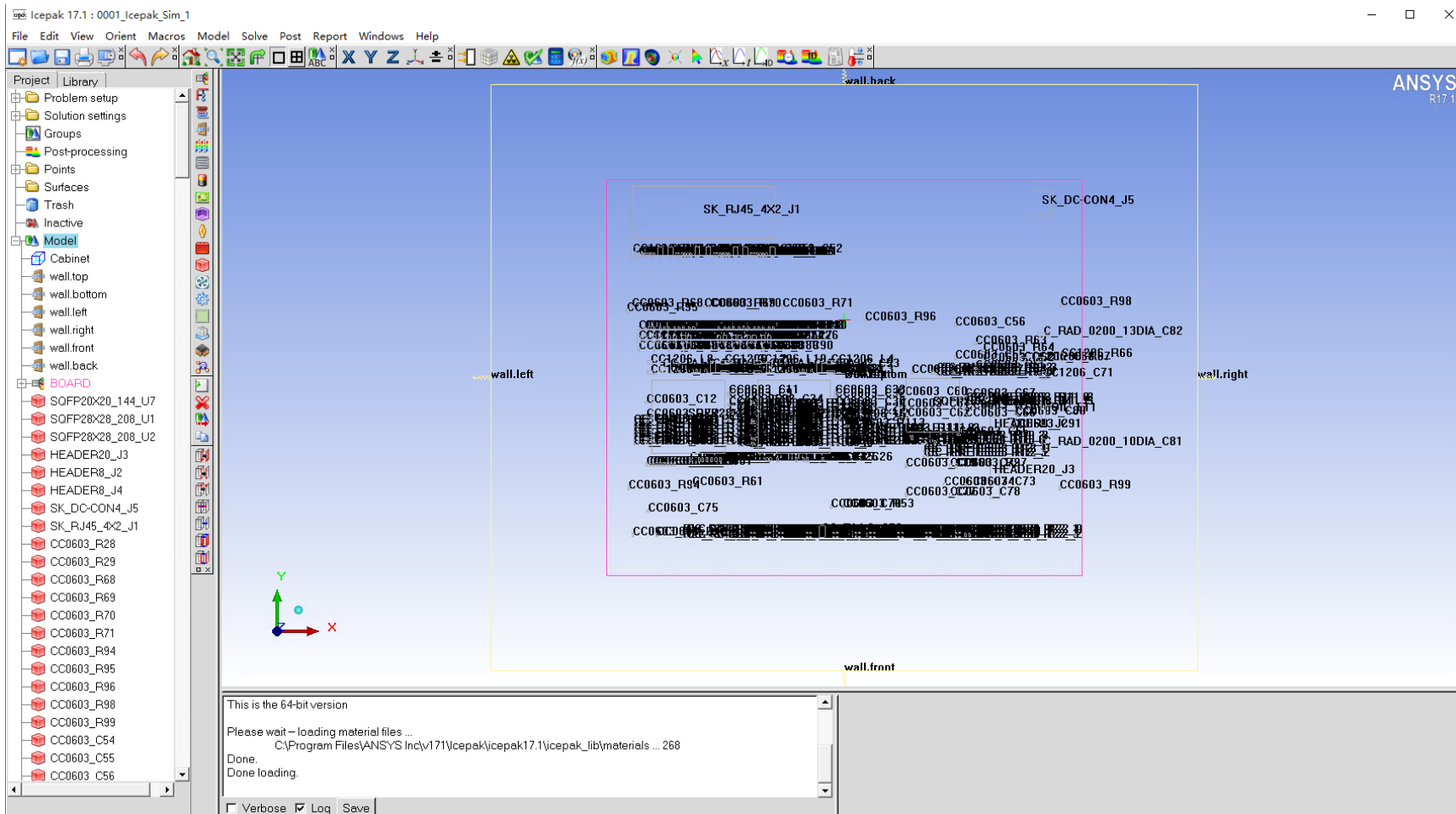


Thermal Data Plots

Elevation (mils)	Layer
65.400000	SURFACE
64.000000	SURFACE
57.000000	GND
55.600000	GND
52.090157	UNNAMED_5
43.000000	UNNAMED_5
37.600000	SIG1
36.200000	SIG1
29.200000	SIG2
27.800000	SIG2
24.290000	UNNAMED_9
15.200000	UNNAMED_9
9.800000	VCC
8.400000	VCC
1.400000	BASE
0.000000	BASE

Close

在Icepak中打开仿真工程



结论

- **SIwave的直流求解器通过电流密度的分析，得到系统上电瓶颈点，提前进行优化，降低电源失效概率。**
- **SIwave界面中直接调用Icepak求解器，设置简单方便，快速进行电热协同分析。**
- **Icepak的三维散热求解引擎保证温度仿真结果的精度。**
- **后续可继续在Icepak中进行散热方式选择，风扇设计等分析。**

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感谢聆听