DRD
TECHNOLOGY

Improve PCB Thermal Reliability with Ansys SIWave and IcePak

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20-Jan-26

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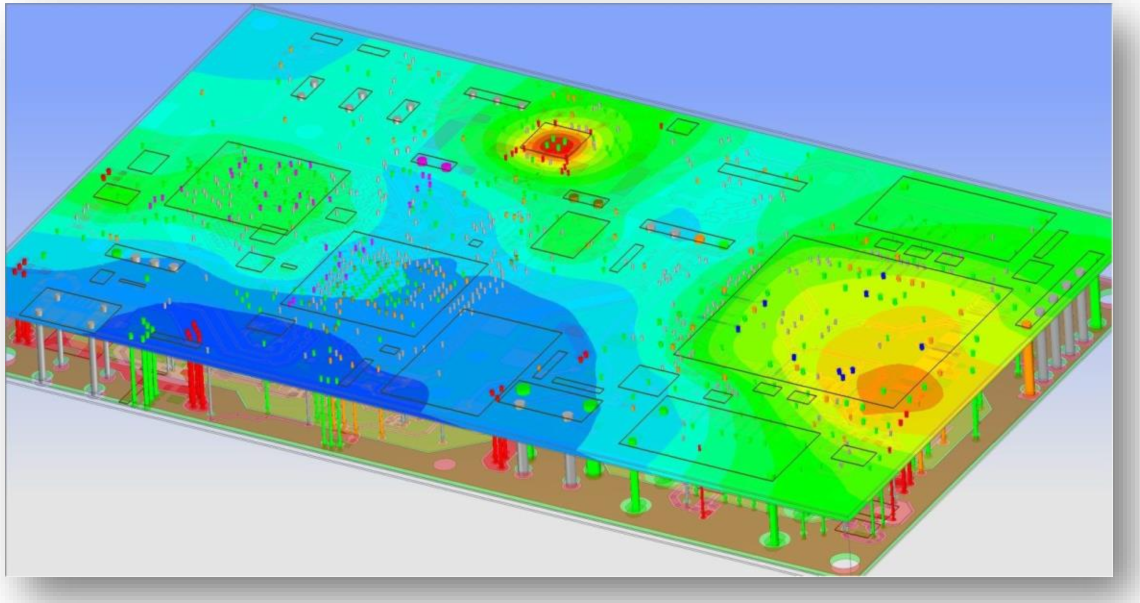
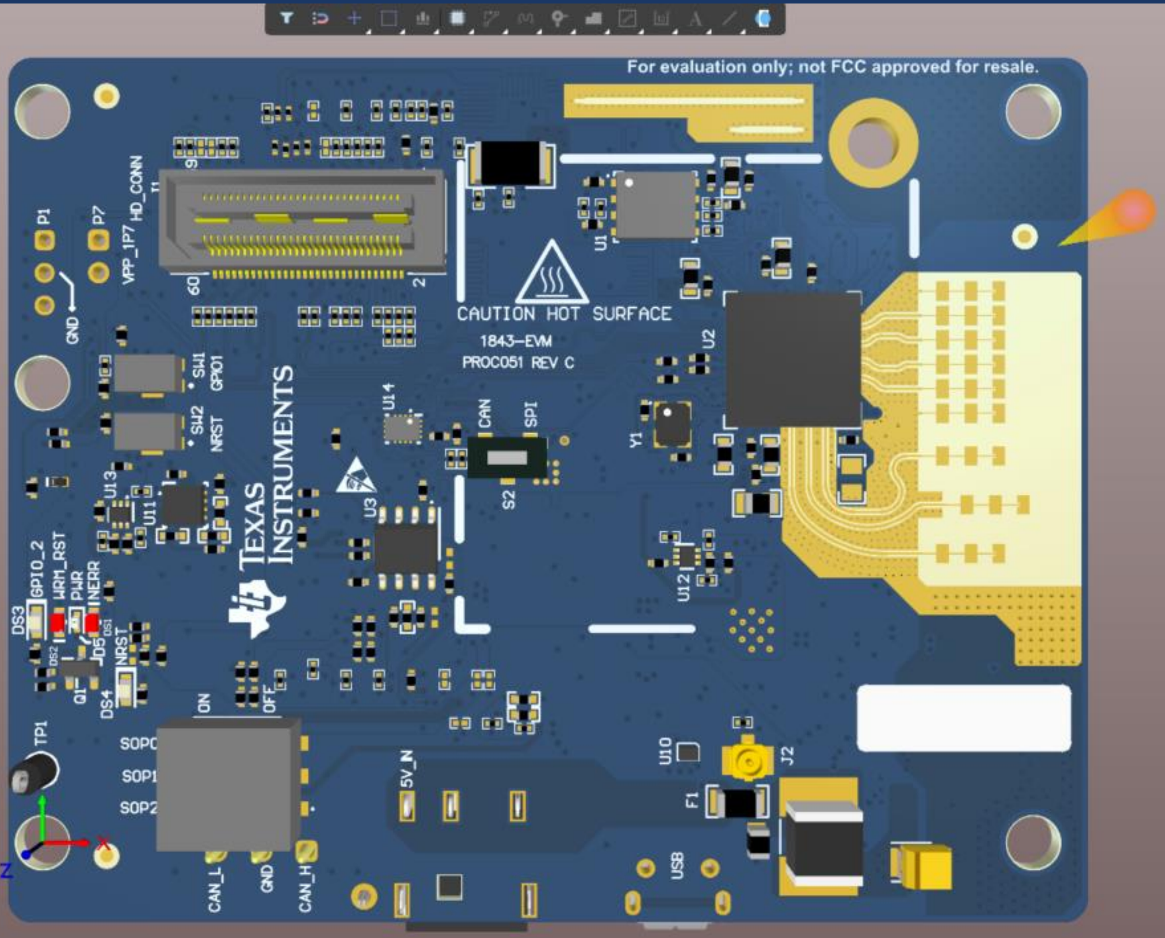
Problem Overview

- ***Thermal management of PCBs can be challenging***
    - Predicting thermal behavior in simulation is highly valuable



- With simulation, we can include:
    - PCB heat sources
        - Component devices
        - Ohmic losses in copper traces / planes
    - Thermal Environment
        - Enclosure?
        - Stagnant air? Forced air?
        - Heat sinks?
- Reduce number of board spins
- ECAD to full thermal results in *minutes*
- We will demo the workflow to:
    - ***Altium ECAD export -> EM Trace Loss Calculation (DCIR) -> Temperature Distribution, Trace and Component Loss***

Altium

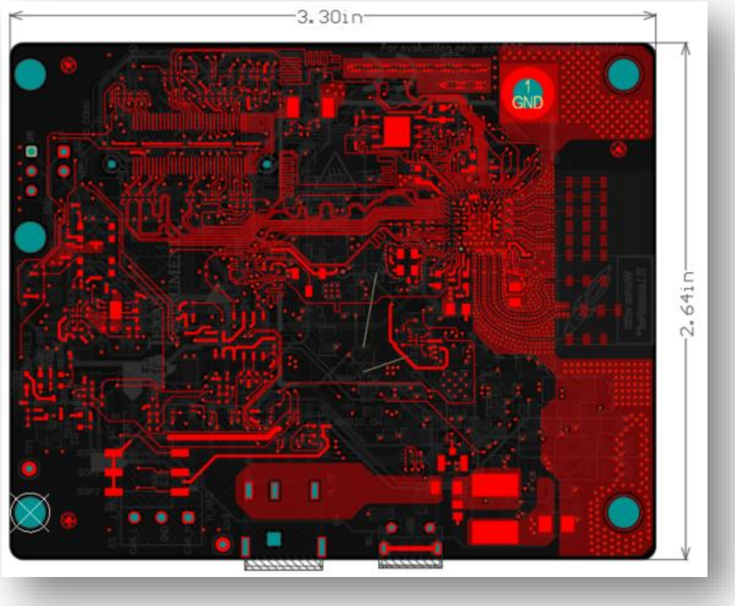

For evaluation only; not FCC approved for resale.
CAUTION HOT SURFACE
1843-EVM
PROC051 REV C
TEXAS INSTRUMENTS
HD_CONN
VPP_1P7
P1
P7
GND
SW1
GPIO1
SW2
NRST
U14
CAN
SPI
S2
U1
U2
Y1
U3
U11
U13
U12
GPIO_2
WRM_RST
PWR
NERR
DS3
DS4
NRST
Q1
TP1
ON
OFF
SOP0
SOP1
SOP2
CAN_L
GND
CAN_H
5V_IN
U10
J2
F1
USB

PCB Details

- Texas Instruments IWR1843BOOST
- Single-chip, 76-GHz to 81-GHz industrial radar sensor evaluation module
- 6 Layers

Thermal Simulation (Icepak)

- 2.5A - Max current draw
  - Will modify to show software capability



.EDB Plugin/Export

- Released in 2019
  - Altium/Ansys partnership specifically for file conversion
  - Contains Trace Info, RLCs, Vias, 3D Components, Board Stackup, etc.
- Install *Ansys EDB Exporter*
  - *Current User Information > Extensions & Updates > Software Extensions > Ansys EDB Exporter*
- Export Altium file as .edb
  - File -> Export > Ansys EDB
  - Save to desired directory

Ansys EDB Exporter

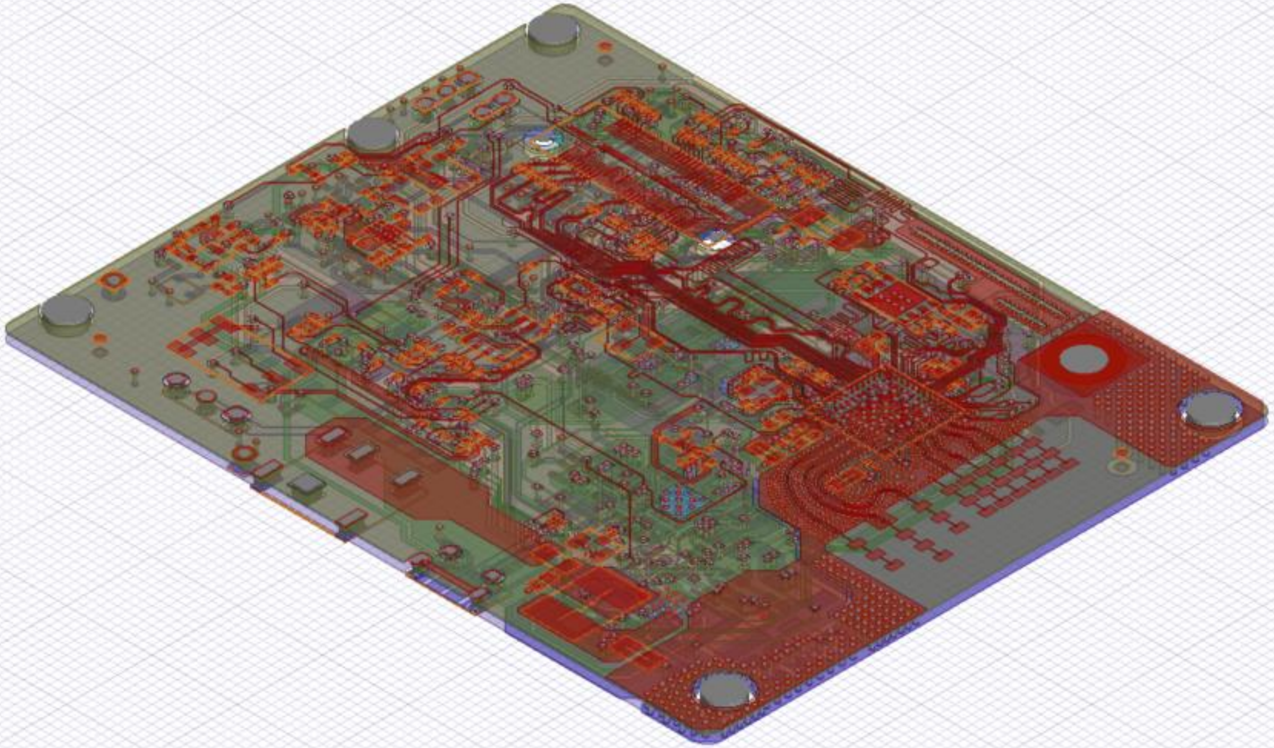
Created by: Altium, Inc.
Version: 1.0.55.1565
Release Date: 6/27/2025
Vault: Global
Description: Ansys EDB Exporter

Release notes

Ansys EDB Exporter

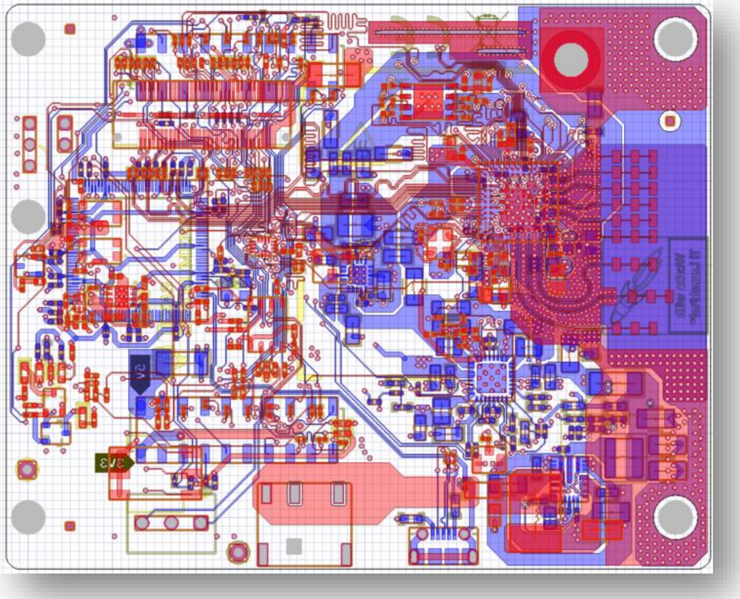
Altium – EDB Exporter Extension

Ansys



AEDT Import

- Open Exported File in AEDT,
  - File > Import > EDB...
- Verify Layer Stackup
  - Check Materials, Fill, Thickness, etc.
  - Make Necessary Changes

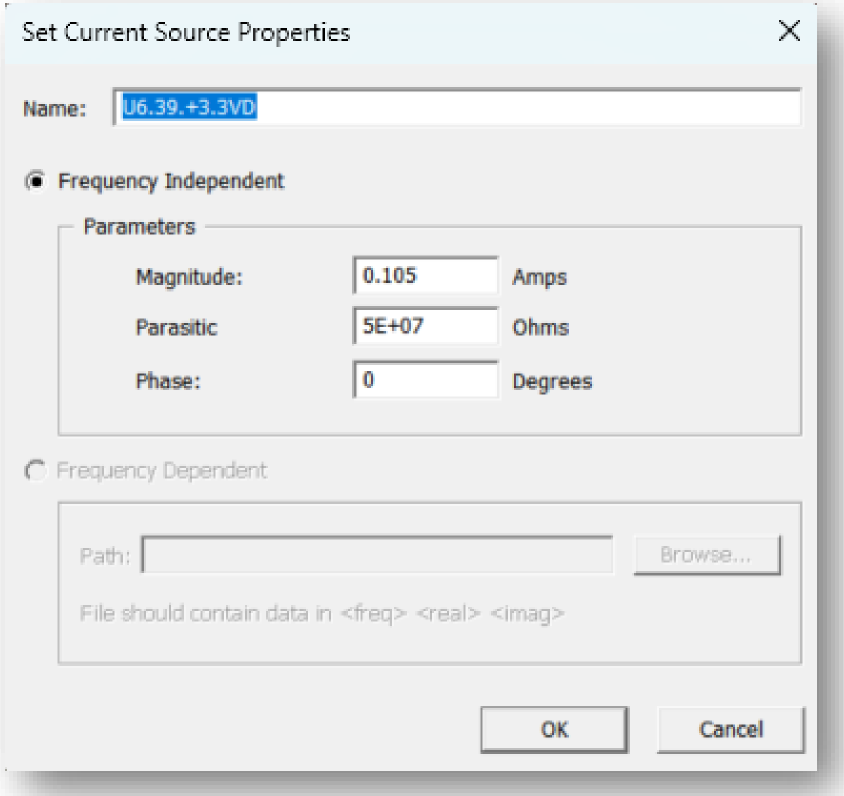


								Name	Type	Material	Dielectric Fill	Thickness	Etch	Rough	Solver	Transparency
🟥	☑	☑	☑	☑	☑	☑	☑	TOP	signal	copper	FR4_epoxy	1.6mil	☐	☐	☐	60
▨	☑	☑	☑	☑	☑	☑	☑	Dielectric1	dielectric	Rogers 4835		4mil			☐	60
🟨	☑	☑	☑	☑	☑	☑	☑	L2	signal	copper	370HR Prepreg 1080	1.2mil	☐	☐	☐	60
▨	☑	☑	☑	☑	☑	☑	☑	Dielectric2	dielectric	370HR Prepreg 1080		5.7mil			☐	60
🟦	☑	☑	☑	☑	☑	☑	☑	L3	signal	copper	370HR Prepreg 1080	1.2mil	☐	☐	☐	60
▨	☑	☑	☑	☑	☑	☑	☑	Dielectric3	dielectric	370HR Prepreg 1080_2		28mil			☐	60
🟩	☑	☑	☑	☑	☑	☑	☑	L4	signal	copper	370HR Prepreg 1080	1.2mil	☐	☐	☐	60
▨	☑	☑	☑	☑	☑	☑	☑	Dielectric4	dielectric	370HR Prepreg 1080		5.84mil			☐	60
🟪	☑	☑	☑	☑	☑	☑	☑	L5	signal	copper	370HR Prepreg 1080	1.2mil	☐	☐	☐	60
▨	☑	☑	☑	☑	☑	☑	☑	Dielectric5	dielectric	370HR Prepreg 1080_3		4mil			☐	60
🟦	☑	☑	☑	☑	☑	☑	☑	BOTTOM	signal	copper	FR4_epoxy	1.6mil	☐	☐	☐	60

Source Setup

- Voltage Sources
  - U8 – RNL0022A @ 3V3 (Buck)
  - P6 – PJ-051AH @ 5V (5V$_{in}$)
- Current Sources
  - U8 - RNL0022A @ 2.5A (Buck)*
  - U6 – PDT0128 @ 105mA (CPU)

- Two Ways to Configure
  1. Right Click > DCIR > Voltage/Current Source
     - Select (+) and (-) with Pop-Up Dialog Box
  2. Select (+) pin > Ctrl + Select (-) Pin > Right Click > DCIR > Voltage/Current Source



Set Current Source Properties

Name: U6.39.+3.3VD

● Frequency Independent

Parameters

Magnitude: 0.105 Amps

Parasitic 5E+07 Ohms

Phase: 0 Degrees

○ Frequency Dependent

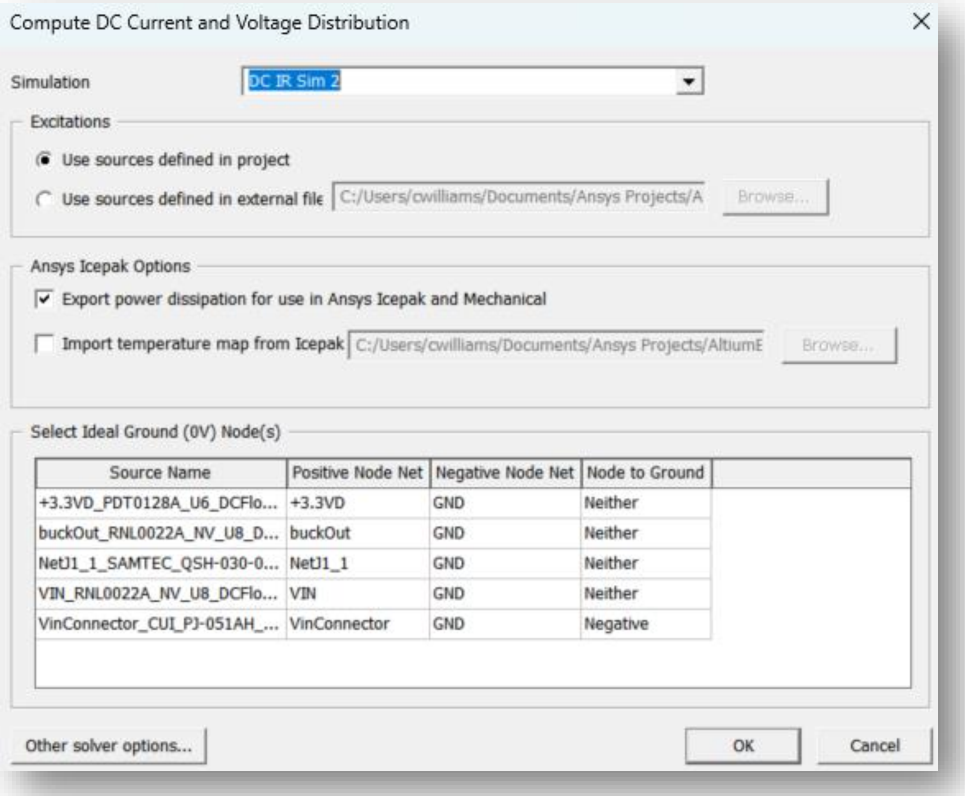
Path:

File should contain data in <freq> <real> <imag>

DCIR Simulation

- Simulation> DCIR
    - ✓ *Use sources defined in project*
    - ✓ *Export power dissipation for use in Ansys Icepack and Mechanical*
- Validate & Analyze

- DCIR can find:
    - ✓ Current choke points
    - ✓ Voltage drop across plane
    - ✓ Current and Power densities
    - ✓ Via currents
    - ✓ Ohmic loss


Compute DC Current and Voltage Distribution

Simulation: DC IR Sim 2

Excitations

● Use sources defined in project

○ Use sources defined in external file C:/Users/cwilliams/Documents/Ansys Projects/A

Ansys Icepak Options

☑ Export power dissipation for use in Ansys Icepak and Mechanical

☐ Import temperature map from Icepak C:/Users/cwilliams/Documents/Ansys Projects/AltiumE

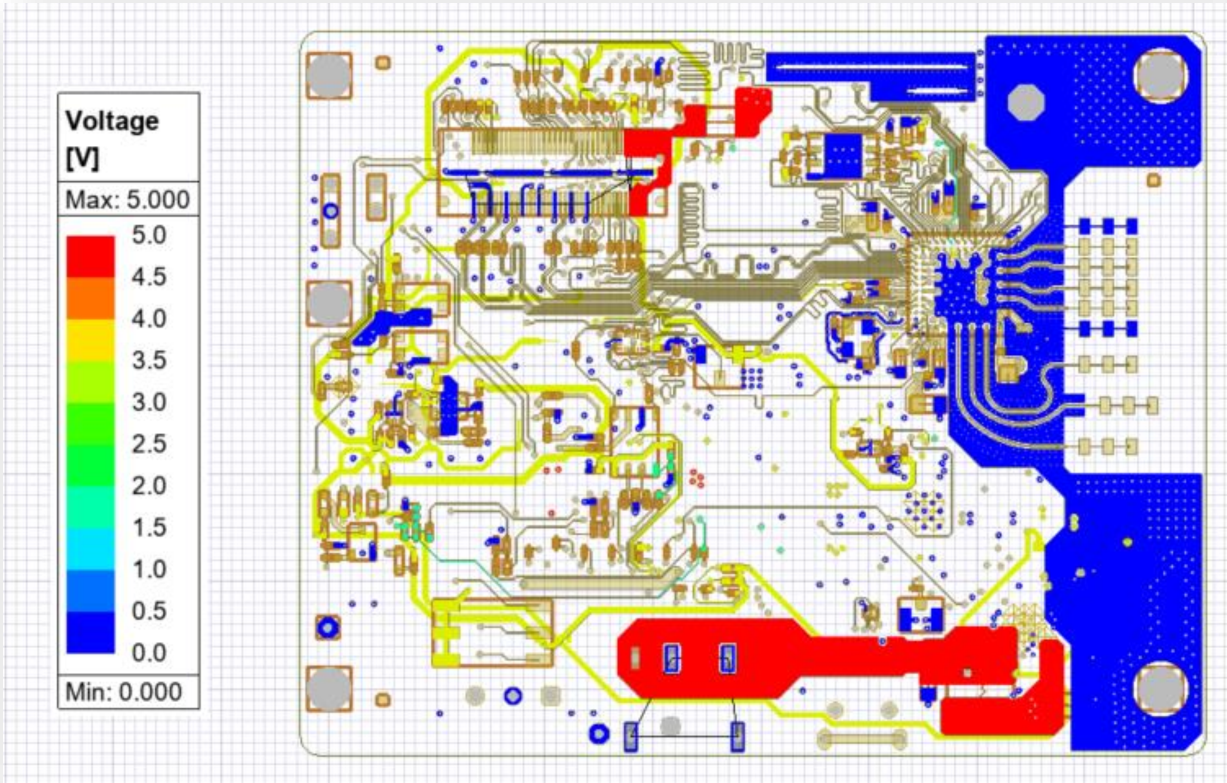
Select Ideal Ground (0V) Node(s)

Source Name	Positive Node Net	Negative Node Net	Node to Ground
+3.3VD_PDT0128A_U6_DCFlo...	+3.3VD	GND	Neither
buckOut_RNL0022A_NV_U8_D...	buckOut	GND	Neither
NetJ1_1_SAMTEC_QSH-030-0...	NetJ1_1	GND	Neither
VIN_RNL0022A_NV_U8_DCFlo...	VIN	GND	Neither
VinConnector_CUI_PJ-051AH_...	VinConnector	GND	Negative

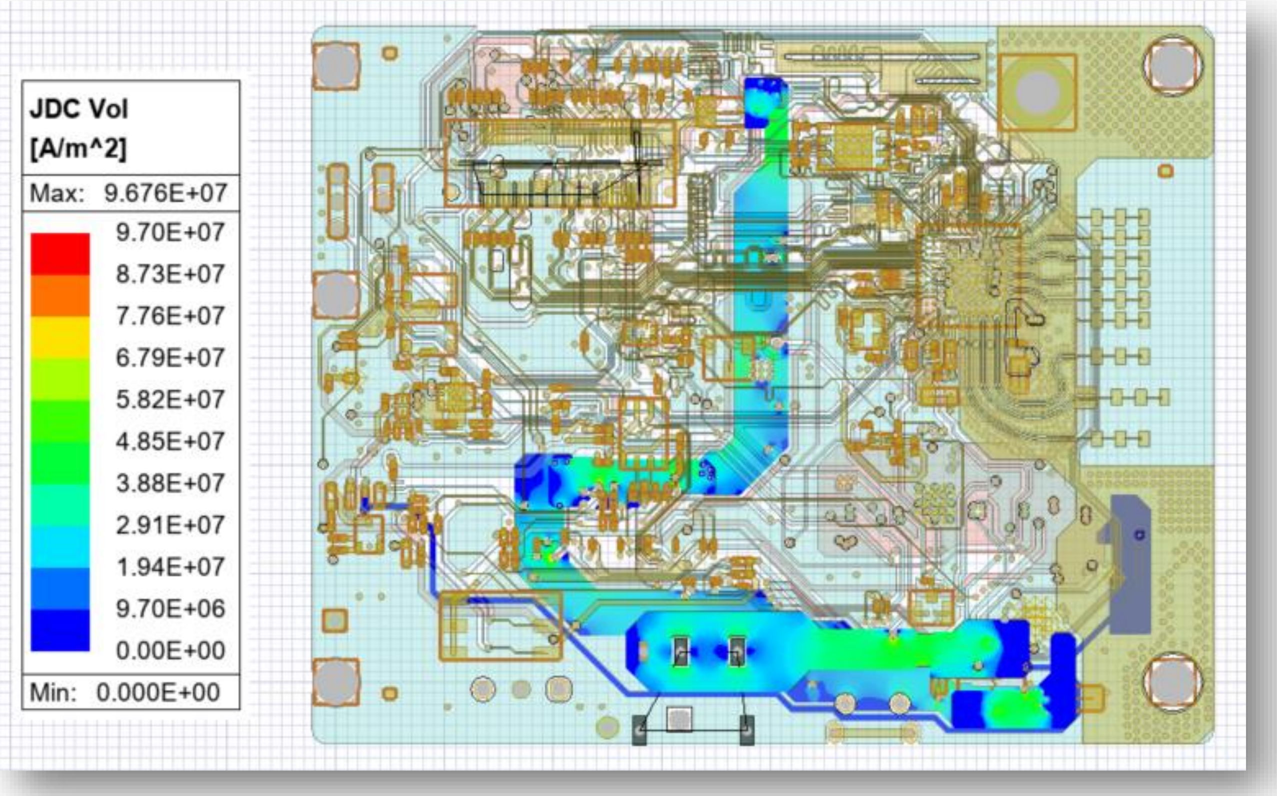
DC IR Results

- Verify Solution
- Field Overlays > Plot DCIR Fields
    - Volume Current Density
    - Voltage
    - Power Density

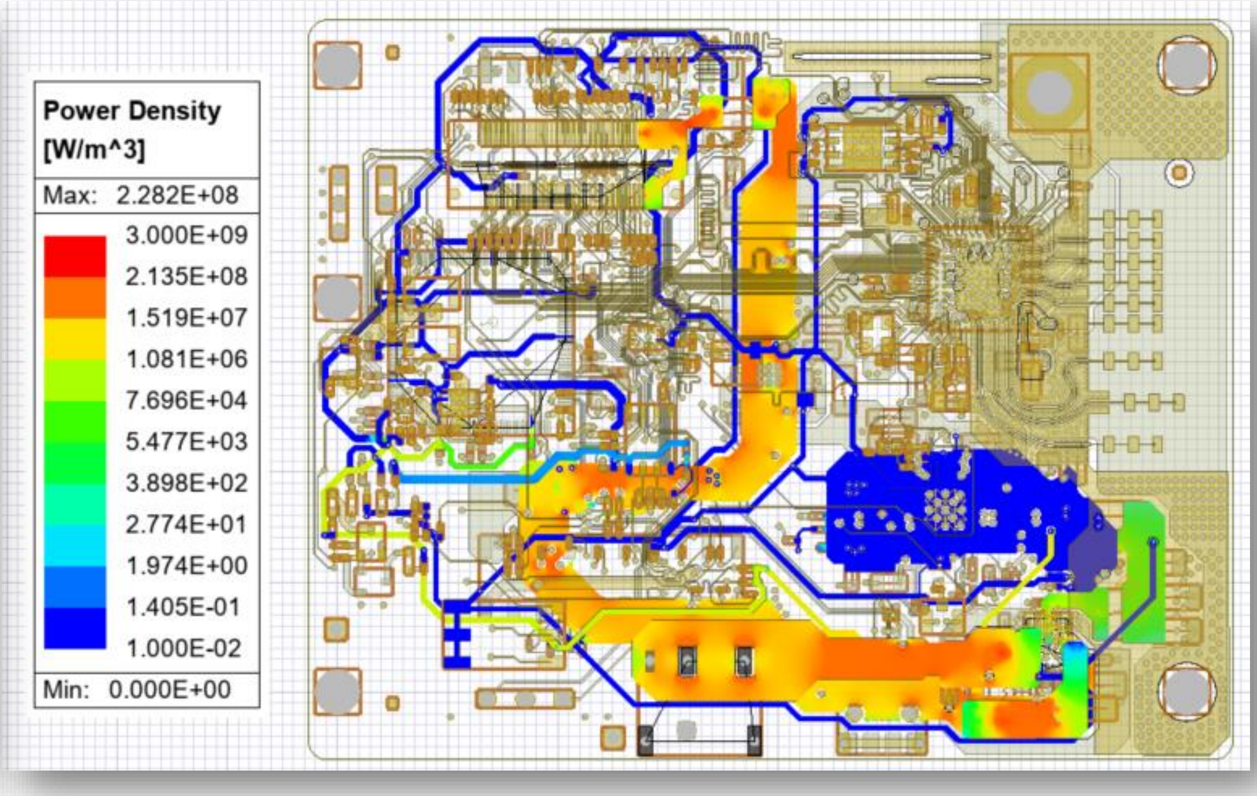
- Performance Specs
    - 6-core, 12th Gen i7 w/ 64GB RAM, Laptop
    - 250k triangles
    - 4 adaptive passes
    - 43s simulation time



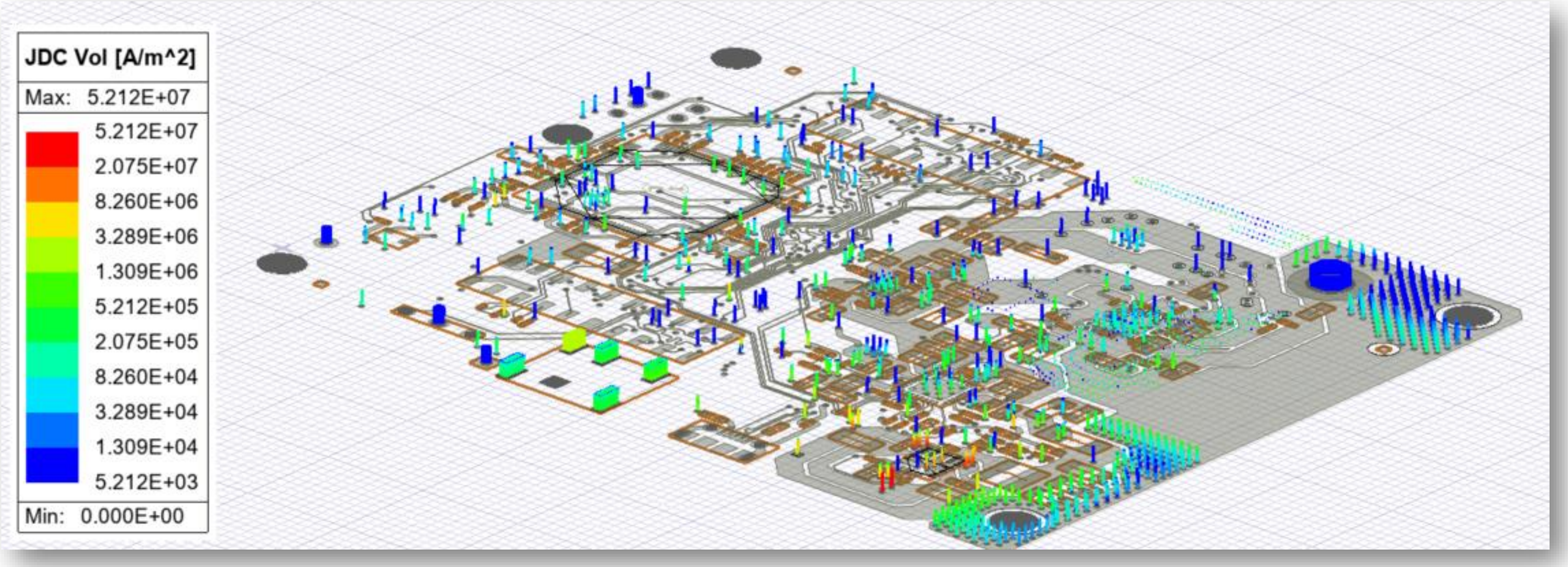
DC IR Simulation - Voltage



DC IR Simulation – Current Density

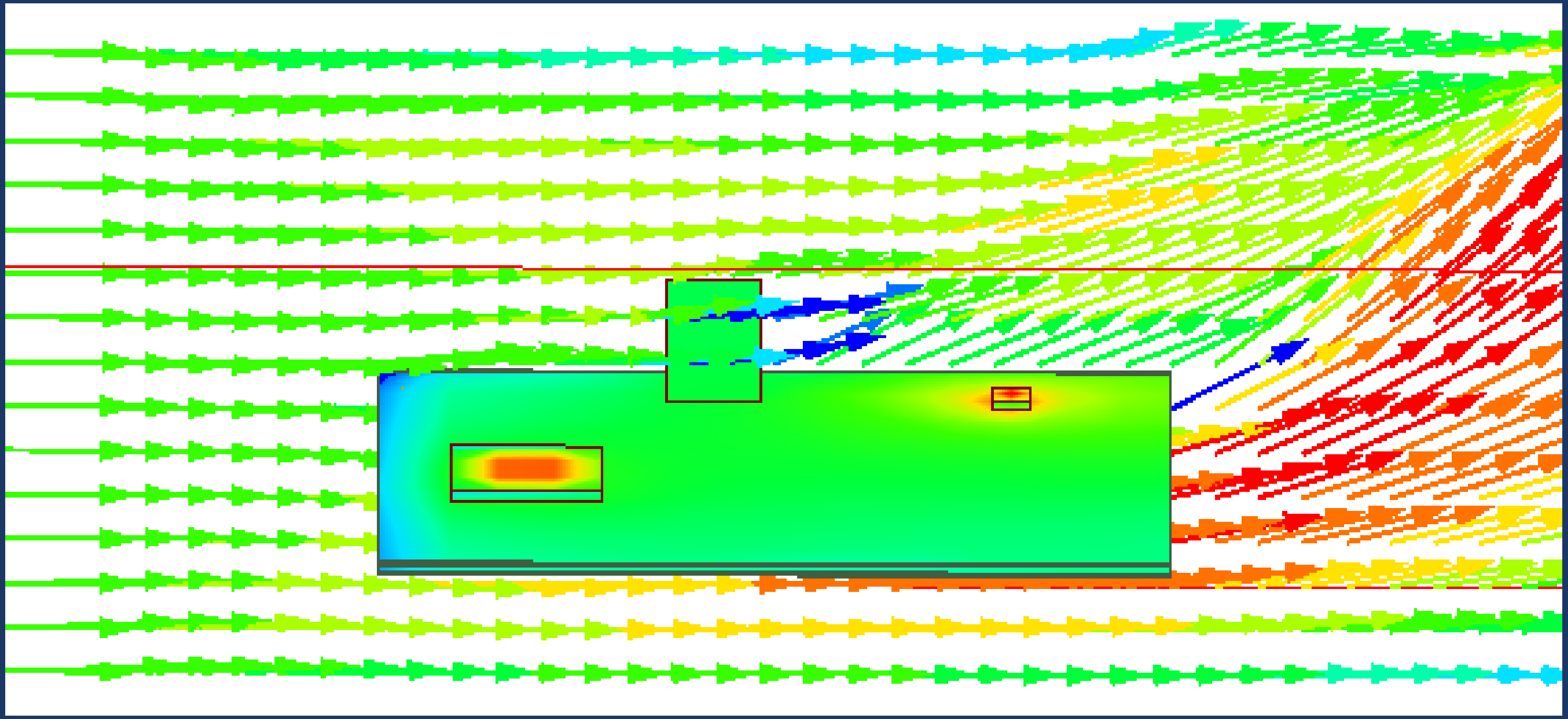


DC IR Simulation – Power Density



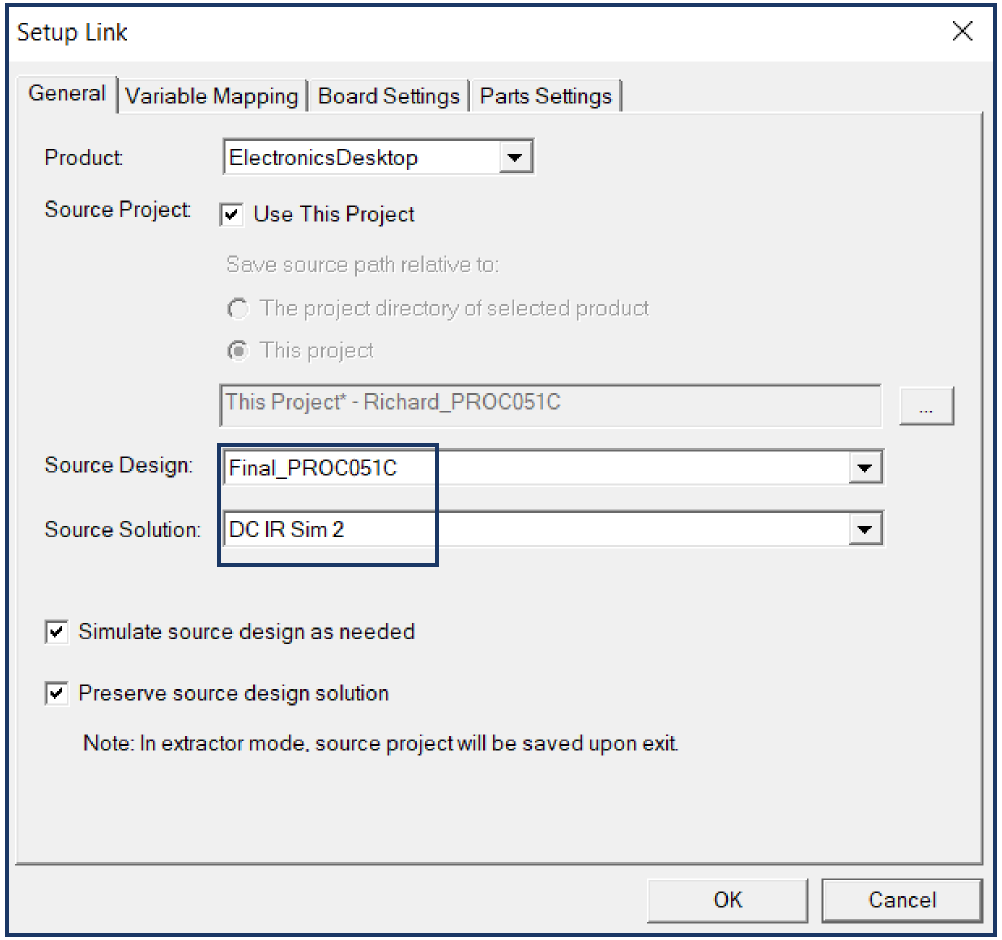
DC IR Simulation – Via Current Density

Thermal Setup



PCB Component

- Create PCB Component
    - 3D Components > Create > PCB...
- Reference/Link the 3D Layout DCIR Project
    - Metal Fraction Mesh
    - Map EM losses into Icepak and convert to thermal solution



Setup Link

Product: ElectronicsDesktop

Source Project: ☑ Use This Project

Save source path relative to:

○ The project directory of selected product

● This project

This Project* - Richard_PROC051C

Source Design: Final_PROC051C

Source Solution: DC IR Sim 2

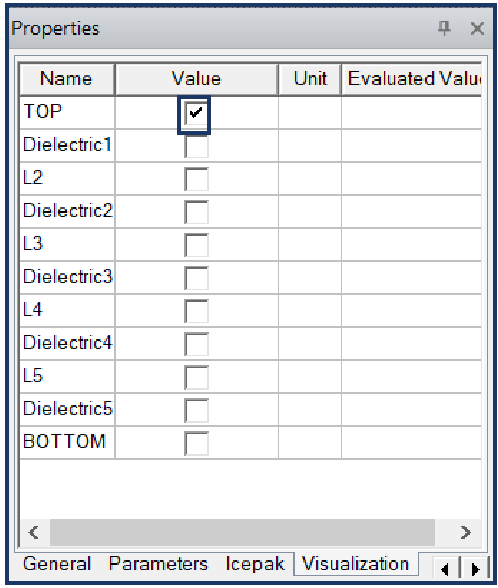
☑ Simulate source design as needed

☑ Preserve source design solution

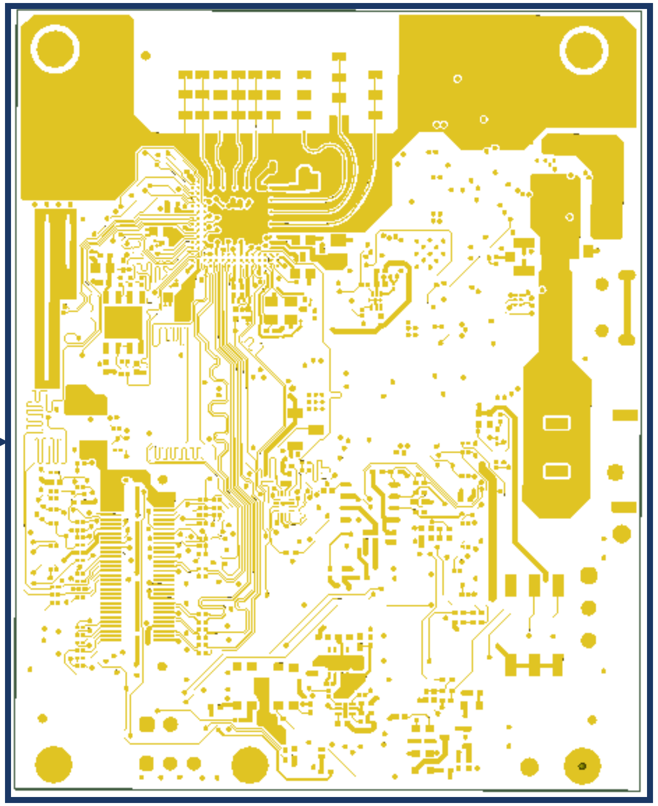
Note: In extractor mode, source project will be saved upon exit.

PCB Component

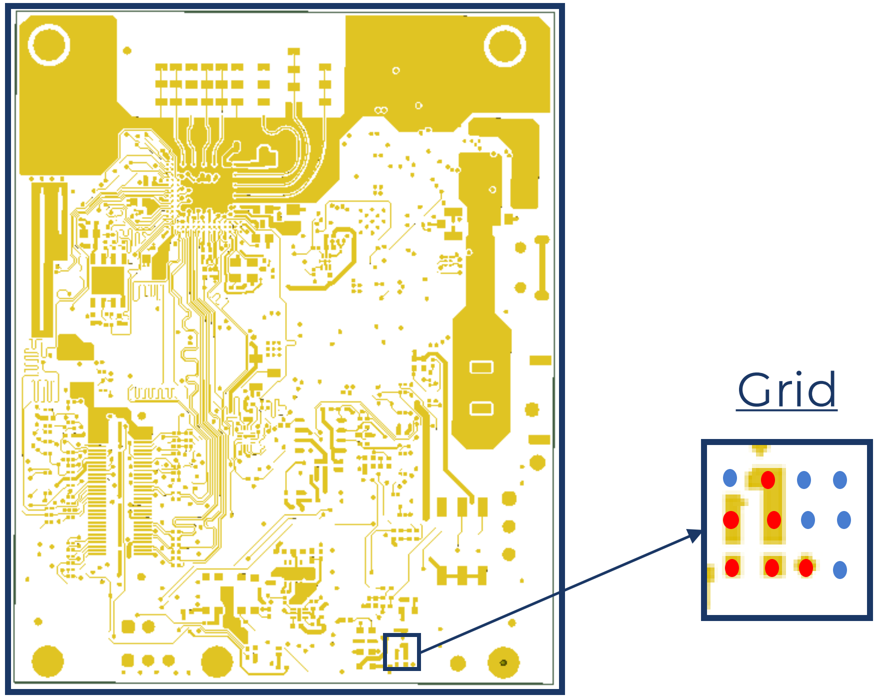
- Visualize PCB Component
  - PCB > Visualization > Layer



Name	Value	Unit	Evaluated Valu
TOP	☑		
Dielectric1	☐		
L2	☐		
Dielectric2	☐		
L3	☐		
Dielectric3	☐		
L4	☐		
Dielectric4	☐		
L5	☐		
Dielectric5	☐		
BOTTOM	☐		



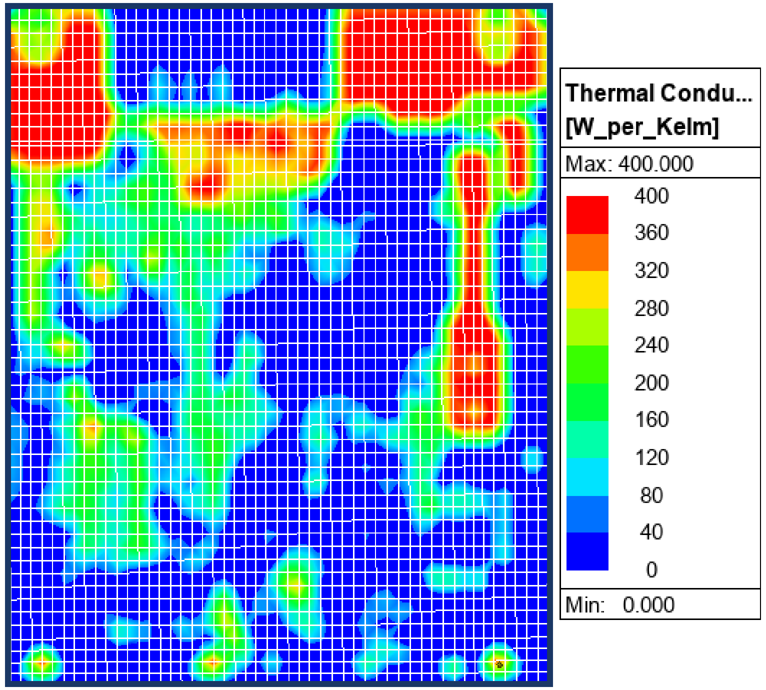
Metal Fraction Mesh



Grid

● Copper

● FR-4

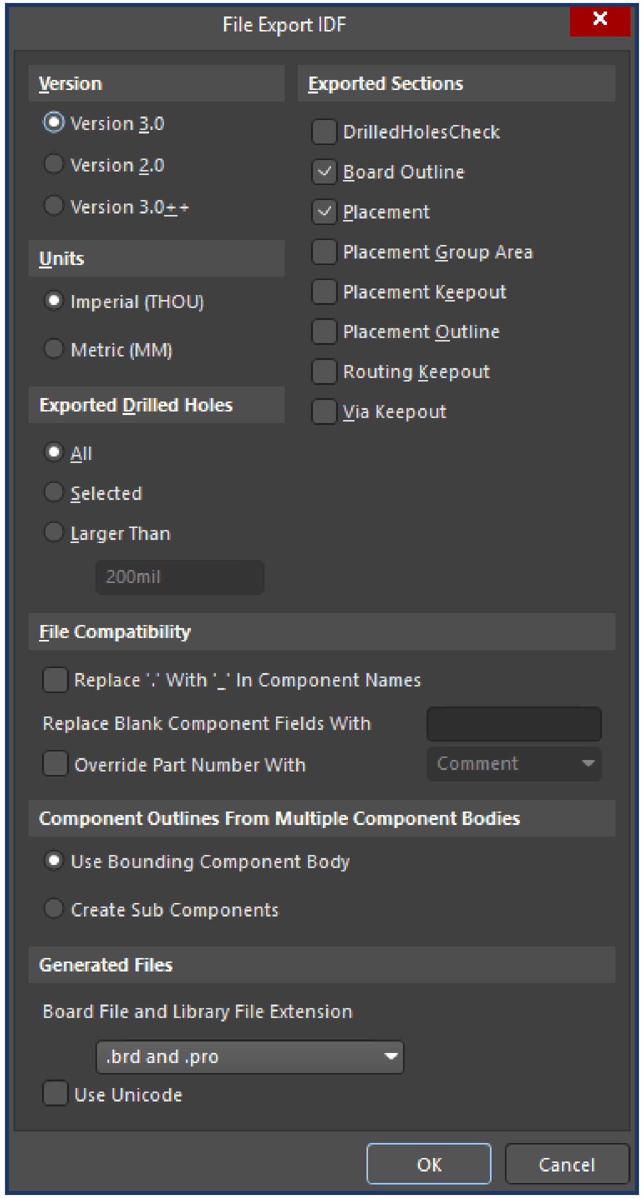


Altium IDF Export

- Export board-level components via IDF
    - File > Export > IDF Board...

- Exports the MCAD geometry of board and components.

- Best practice for bringing in board-level components into Icepak.



File Export IDF

Version

● Version 3.0
○ Version 2.0
○ Version 3.0++

Units

● Imperial (THOU)
○ Metric (MM)

Exported Drilled Holes

● All
○ Selected
○ Larger Than
200mil

Exported Sections

☐ DrilledHolesCheck
☑ Board Outline
☑ Placement
☐ Placement Group Area
☐ Placement Keepout
☐ Placement Outline
☐ Routing Keepout
☐ Via Keepout

File Compatibility

☐ Replace '.' With '_' In Component Names
Replace Blank Component Fields With
☐ Override Part Number With: Comment

Component Outlines From Multiple Component Bodies

● Use Bounding Component Body
○ Create Sub Components

Generated Files

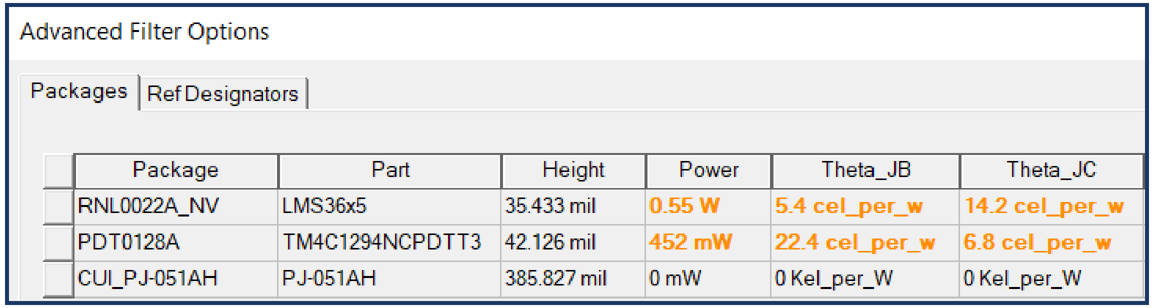
Board File and Library File Extension: .brd and .pro
☐ Use Unicode

Icepak IDF Import

- Import board-level components via IDF
  - Icepak > Import > IDF…

- Reference the Board (.brd) and Library (.pro) File.

- Filter out board-level components not relevant to DCIR > Thermal and assign material properties from technical sheets.

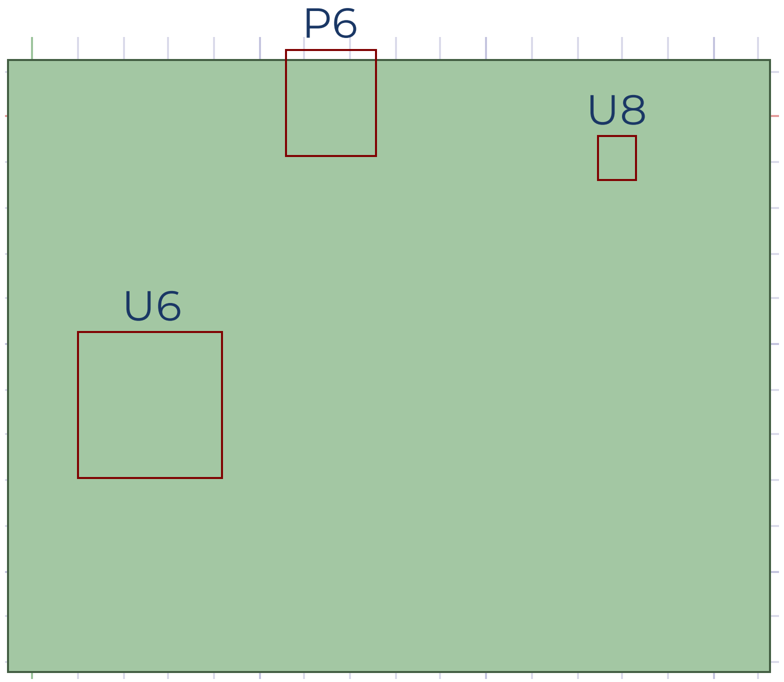


Advanced Filter Options

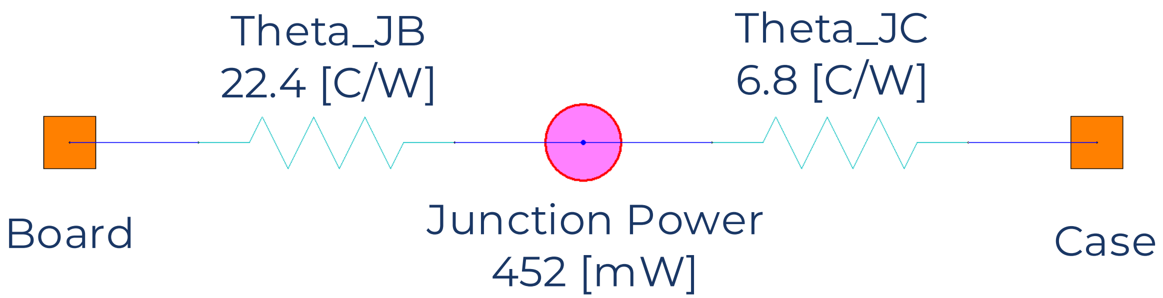
Package	Part	Height	Power	Theta_JB	Theta_JC
RNL0022A_NV	LMS36x5	35.433 mil	0.55 W	5.4 cel_per_w	14.2 cel_per_w
PDT0128A	TM4C1294NCPDTT3	42.126 mil	452 mW	22.4 cel_per_w	6.8 cel_per_w
CUI_PJ-051AH	PJ-051AH	385.827 mil	0 mW	0 Kel_per_W	0 Kel_per_W

Note: Technical sheets typically represent board-package material properties using thermal resistances. This is because board-packages are geometrically complex and are comprised of several different materials. Representing these packages using a thermal resistance network is the most efficient way to model a system.

Thermal Network



U6 Thermal Network


Theta_JB
22.4 [C/W]

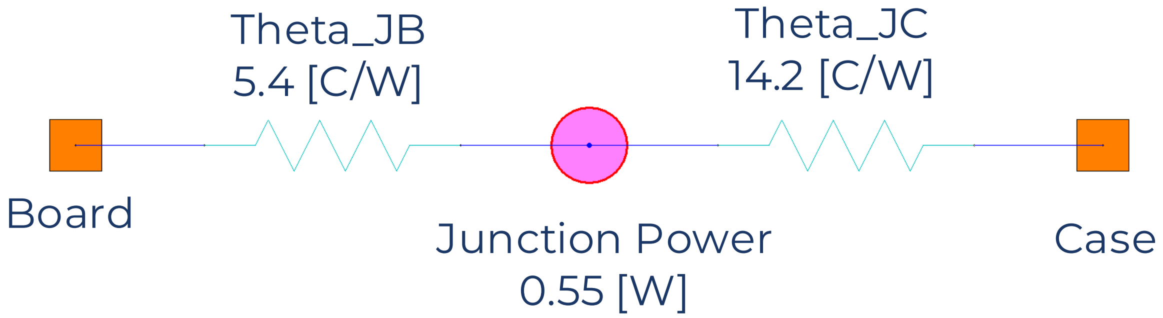
Theta_JC
6.8 [C/W]

Board

Junction Power
452 [mW]

Case

U8 Thermal Network


Theta_JB
5.4 [C/W]

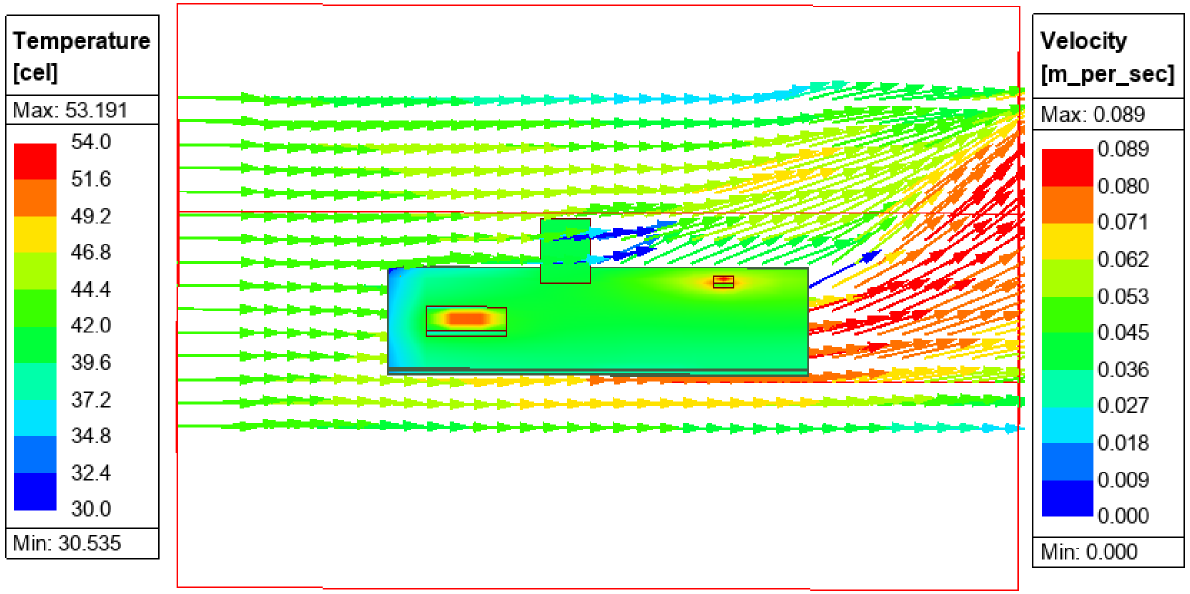
Theta_JC
14.2 [C/W]

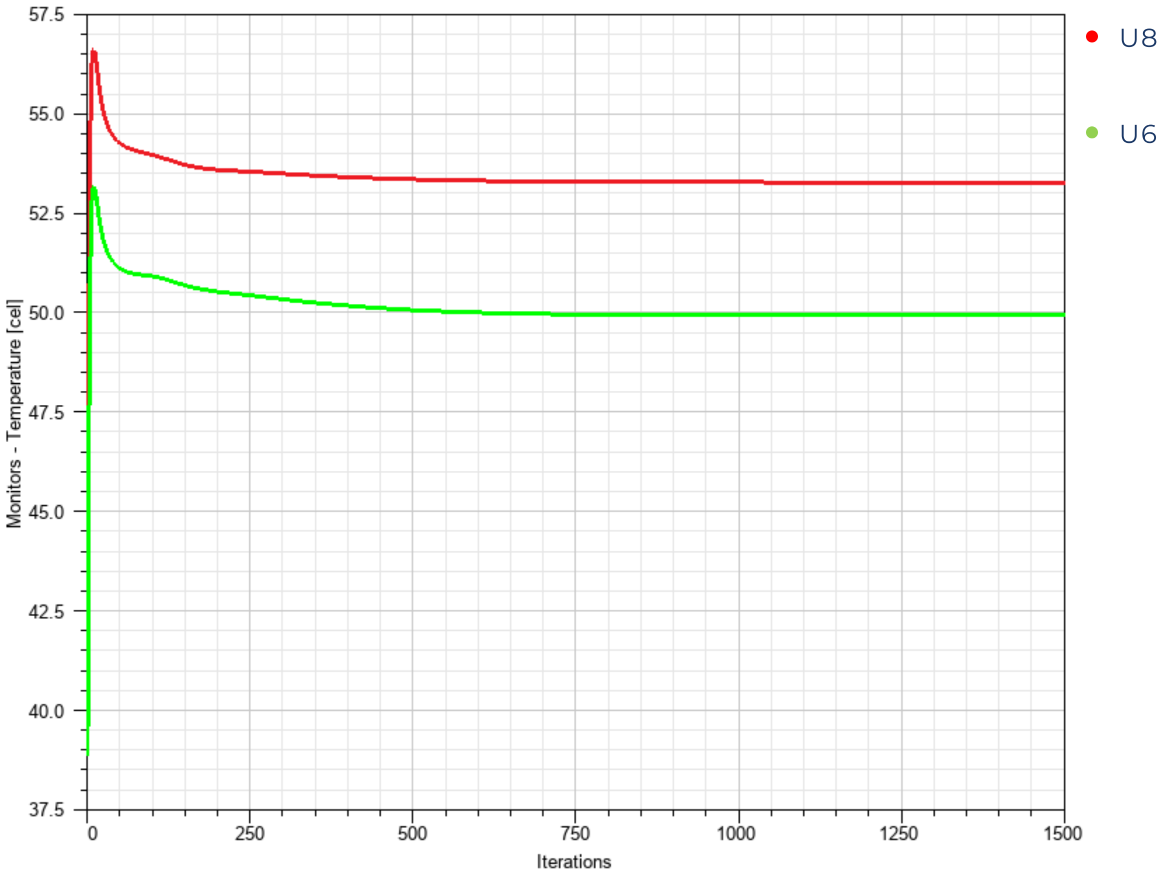
Board

Junction Power
0.55 [W]

Case

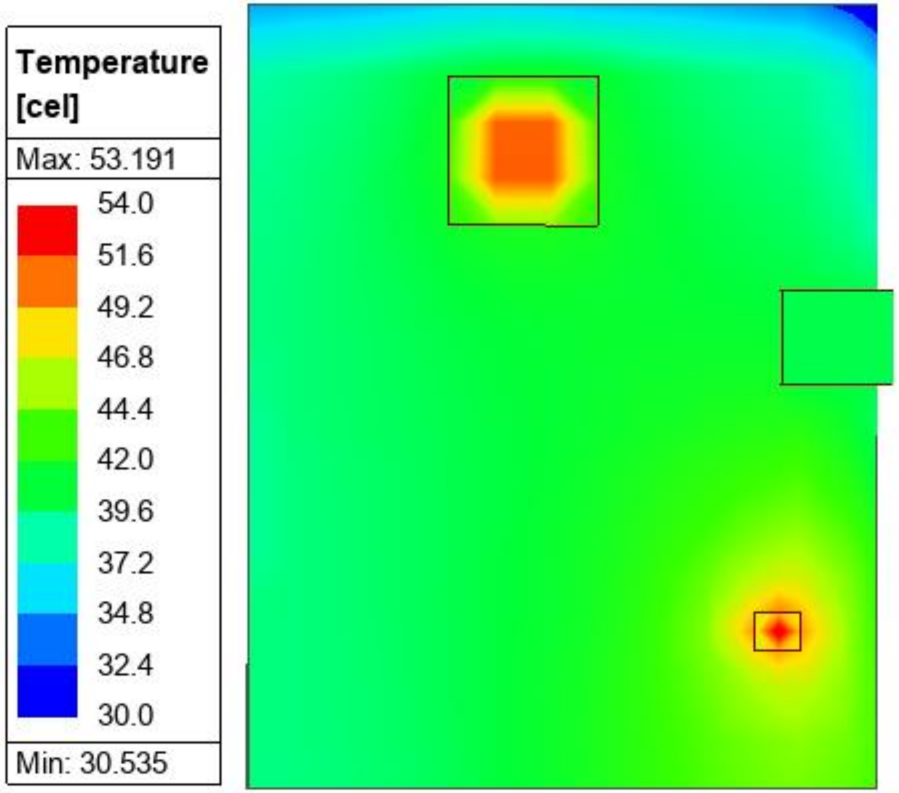
Thermal Results



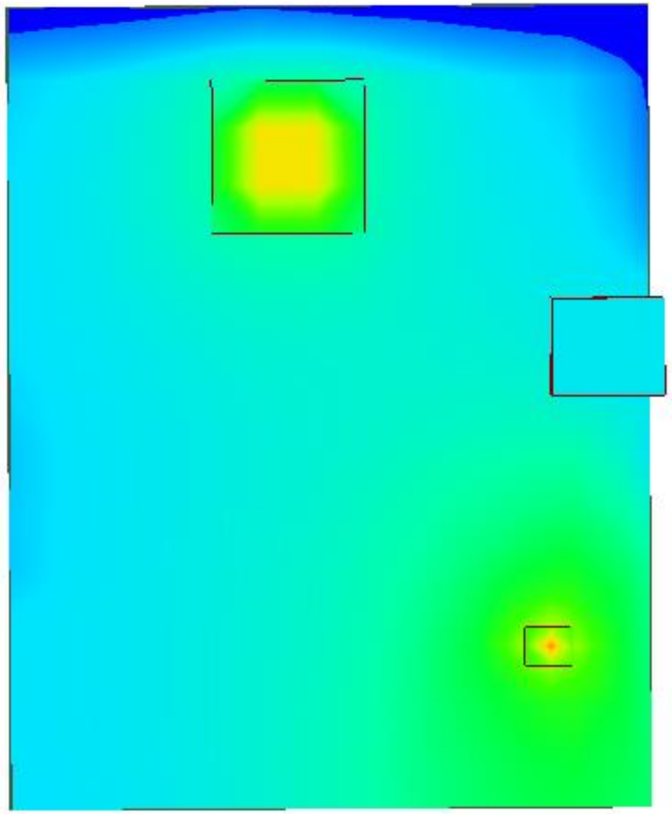


Thermal Results

With Board EM Losses



Without Board EM Losses



Summary and Discussion

- Effortless ECAD to simulation tools
  - DCIR for Ohmic losses
  - Icepak for temperature distribution
    - Component and trace losses
    - Metal Fraction Mesh
  - Solution time on the order of minutes

- Questions?
- Comments?

- Thank You!!