Introduction to Icepak in AEDT

Module 2 – Lecture 2: ECAD Import

Release 2020 R1

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- PCB Modeling Options in AEDT Icepak
  - Simple PCB Model
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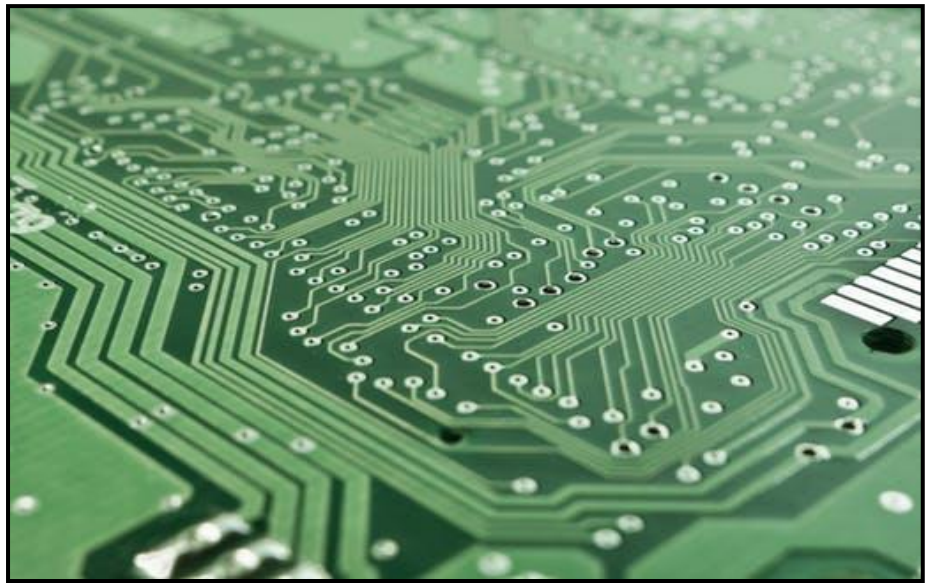
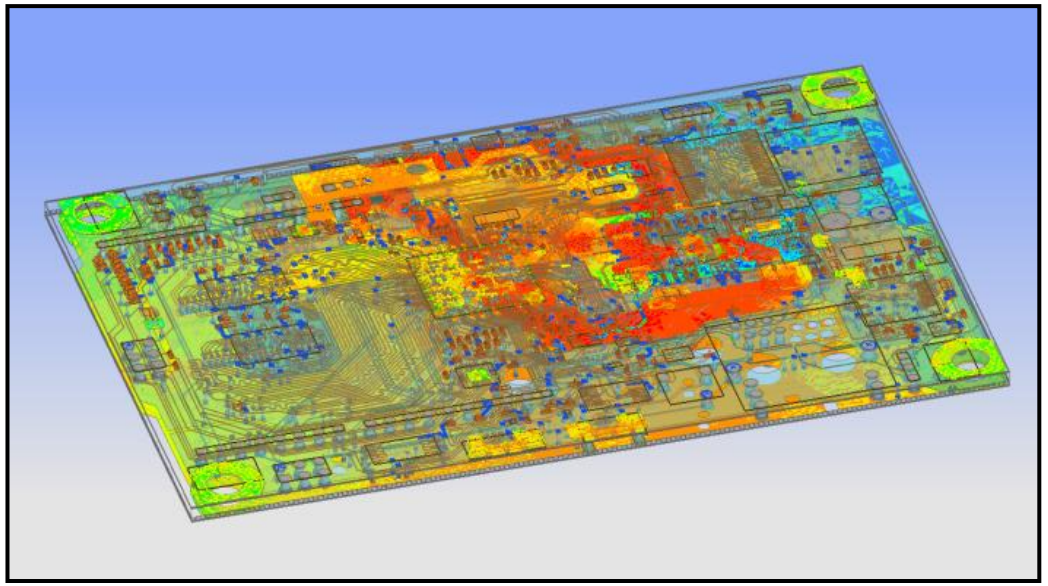
General PCB Notes

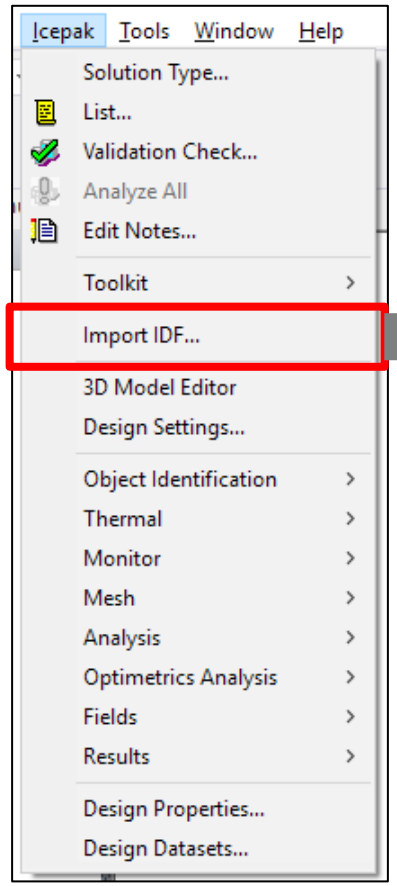
- PCBs are complex structures primarily made of layers of copper and a dielectric material
- Copper traces and vias have dimensions much smaller than the overall PCB dimension
- Discretely modeling PCB with all traces and vias is computationally expensive
- It is recommended to choose the level of detail needed in the model that gives accurate results without exorbitant mesh and run times

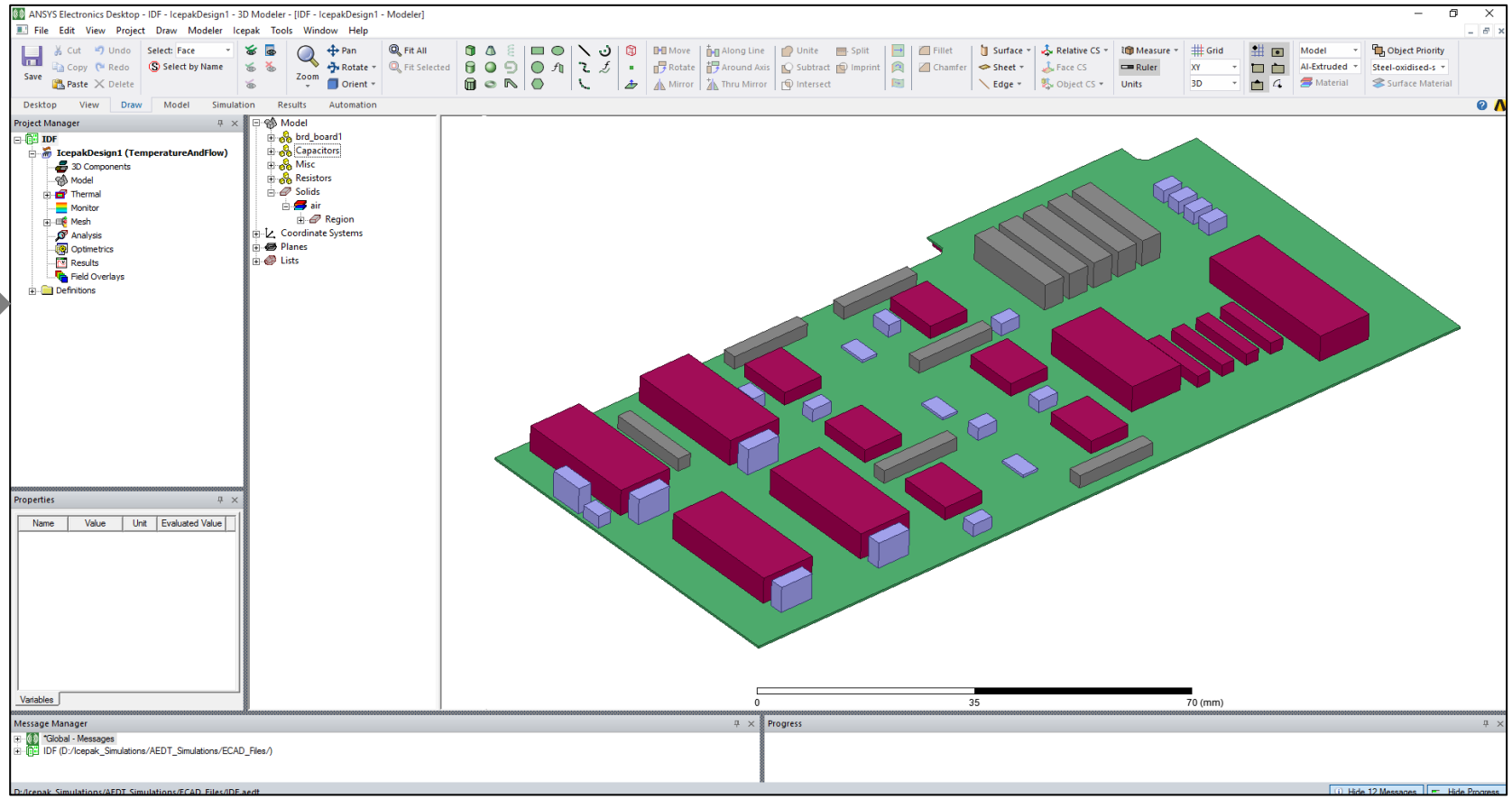




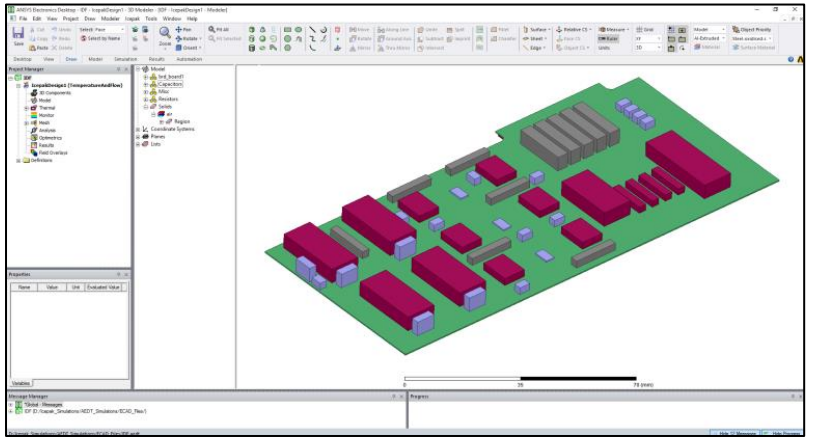
IDF Import

- IDF files can be imported directly into an Icepak design
- **IDF 2.0** and **IDF 3.0** versions are supported

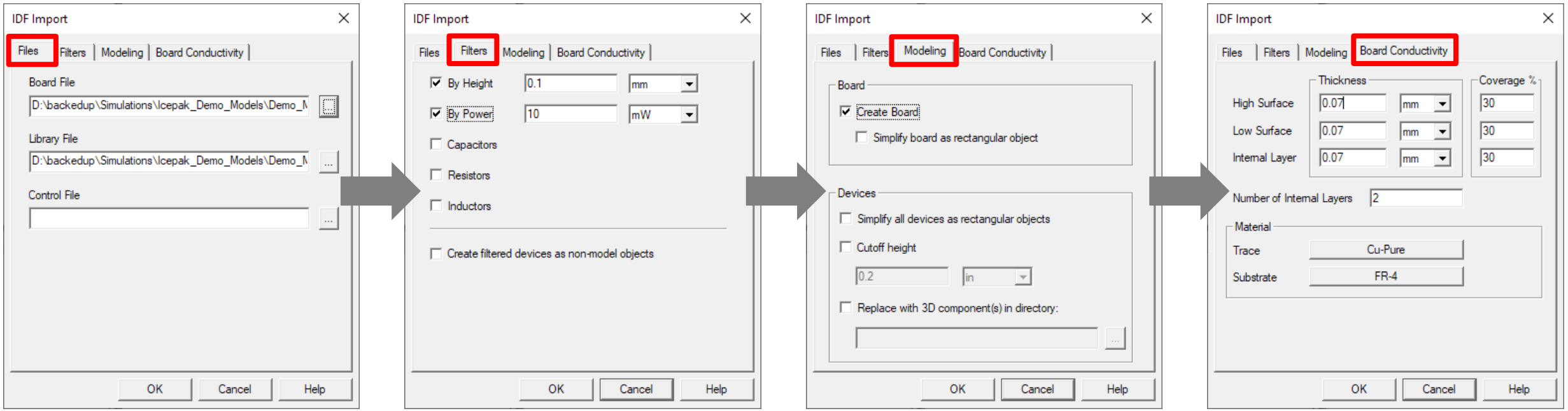




IDF Import



- Options to:
  - Filter out components (by height and power)
  - Simplify board and components as rectangular objects
  - Specify trace layer thicknesses for board thermal conductivity calculation

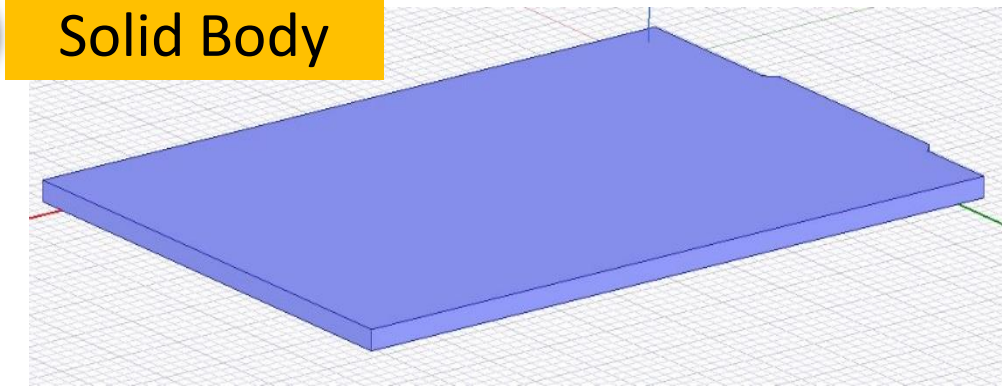


PCB Modeling Options in AEDT Icepak

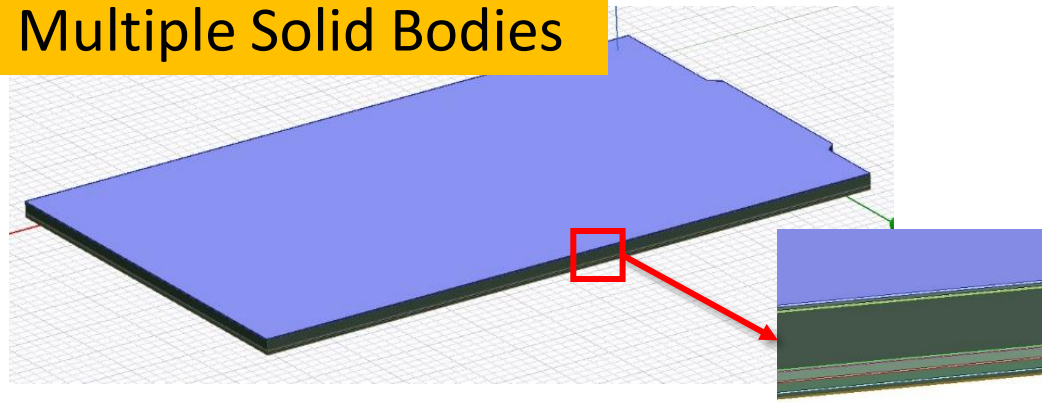
	Model	Accuracy	Mesh Size	Effort Needed	Application
1	**Solid Body**	Low	Small (few thousand at highest)	Minimum: Approximate Anisotropic Material Property needed for lumped layers. OK for models where PCB does not carry much heat (most leaves through heat sinks, etc.).	System/board level – little information available or most heat leaves through heat sinks
2	**Multiple Solid Body** (one body per layer)	Low to medium	Small-Medium (up to 100's of thousands)	PCB must be sliced between each layer and approximate Anisotropic Material needed for each later	System/board – if metal percentage per layer is available but layout is not yet complete
3	**PCB Component** (Recommended for accuracy and optimized mesh counts)	Accurate temperature and metal distribution	Medium-High (low millions)	Little effort with proper ECAD file: Trace and via information projected directly into the layers of the PCB object. Metal is localized to individual regions on individual layers. Conductivity accuracy is dependent on mesh size.	Board-level analysis, multi-physics applications
4	**Discrete modeling of all internal PCB parts**	Extremely accurate	Huge (10's of millions)	Maximum effort. Mechanical CAD model of the PCB or substrate must be discretely meshed. Large meshing and run times. Larger hardware needed for simulation.	Individual wire Joule heating. Full-detail HFSS-Icepak modeling.

PCB Modeling Options in AEDT Icepak

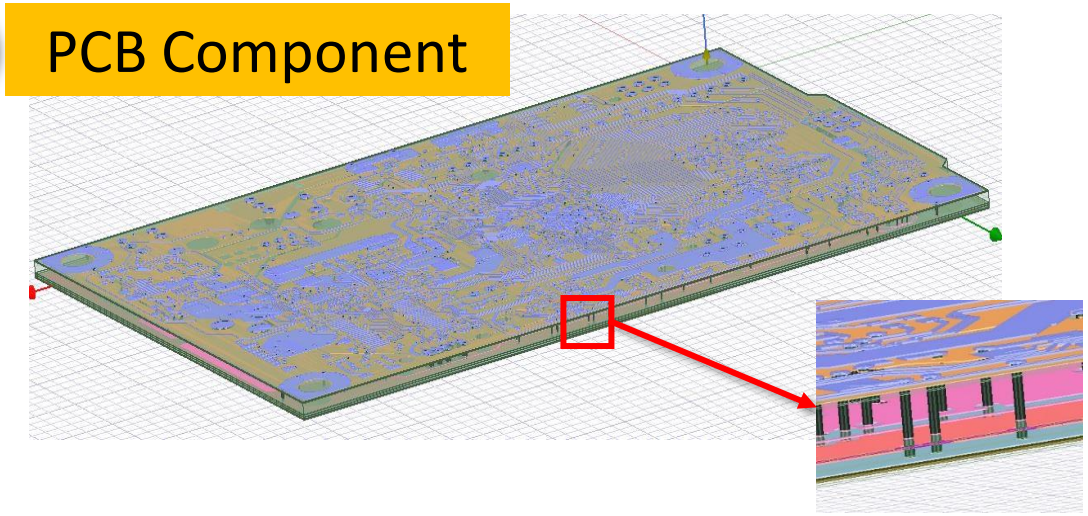
1 Solid Body



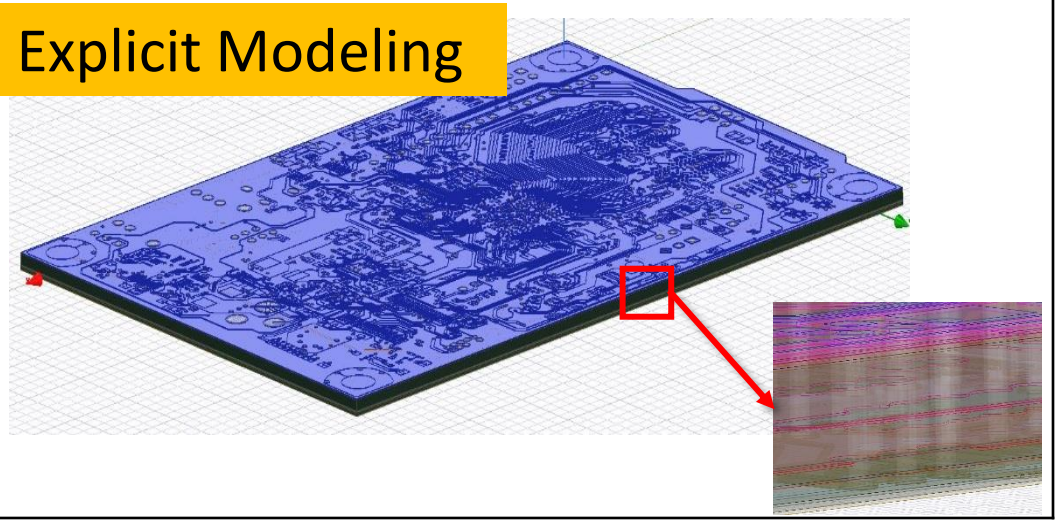
2 Multiple Solid Bodies



3 PCB Component

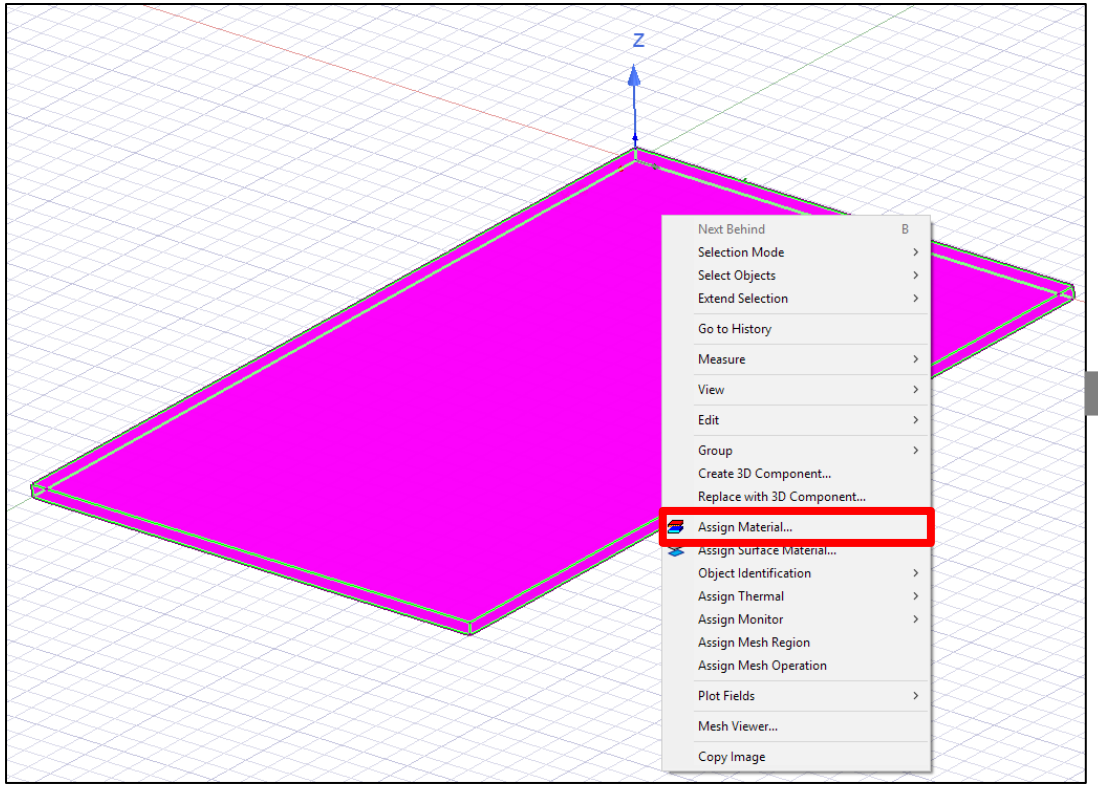


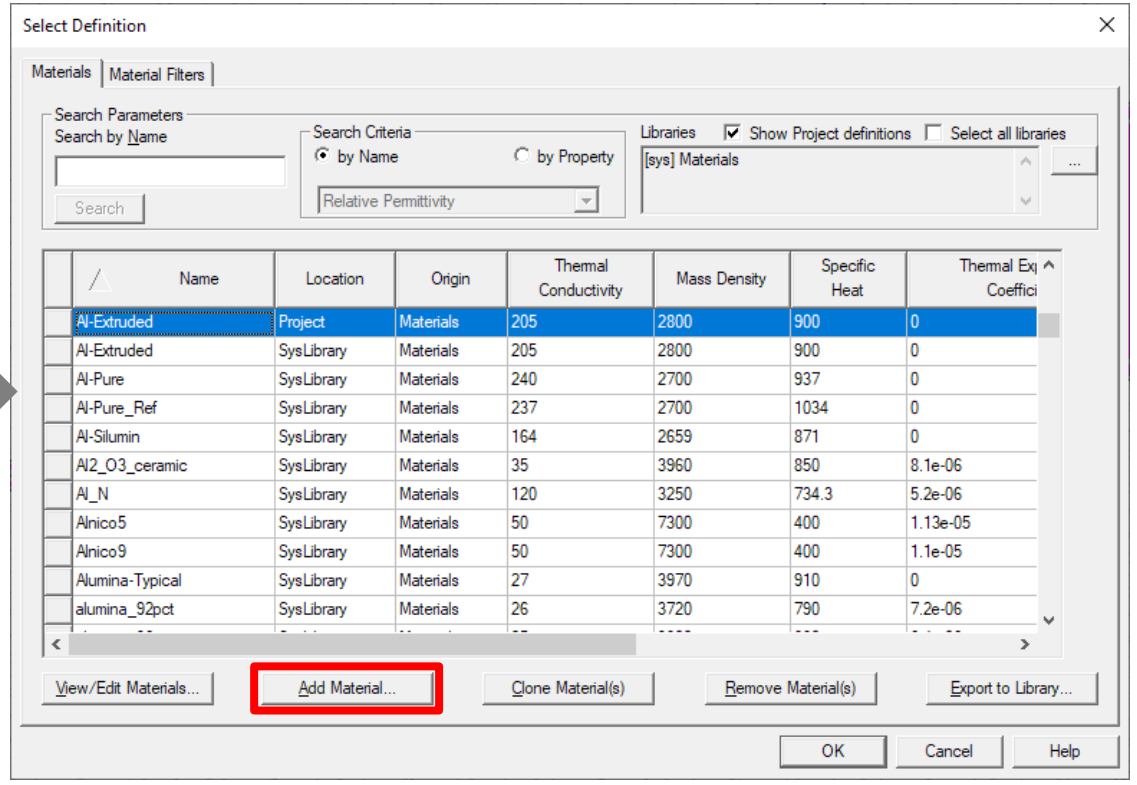
4 Explicit Modeling



Simple PCB Models

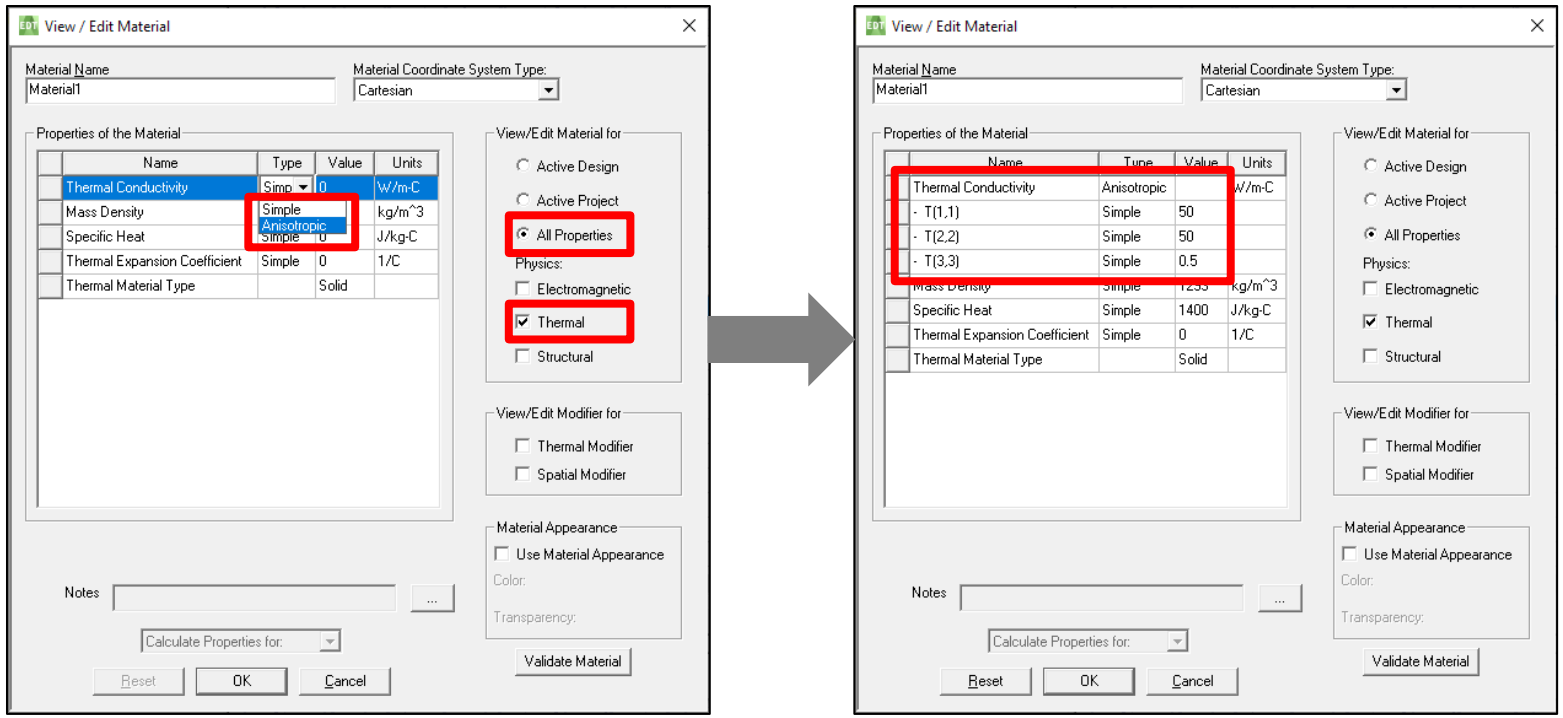
- Create either one block for the whole PCB or one block per PCB layer
- For each block, right-click and choose **Assign Material**
- Click **Add Material** to create your own material and add to the library





Simple PCB Models

- Turn on **All Properties** and **Thermal** under physics
- Change the Thermal Conductivity type to **anisotropic** (orthotropic is a planar variation of this)
- Enter **in-plane** and **through-plane** effective thermal conductivity values
- **Note**: Even if you are solving steady-state, a **non-zero value** is needed for Mass Density and Specific Heat



Simple PCB Models – Orthotropic Thermal Conductivity Calculation

- The **in-plane** and **normal-to-plane** conductivity values may be calculated as follows:

$$k_{in\text{-}plane} = \Sigma(k_i t_i) / \Sigma t_i)$$

$$k_{normal} = \Sigma t_i / \Sigma(t_i/k_i)$$

$$k_i = f_i * k_{cu} \text{ or } k_i = k_{FR4}$$

where,

f_i = fractional coverage of copper

k = conductivity of a layer (W/mK)

t = thickness of a layer (m)

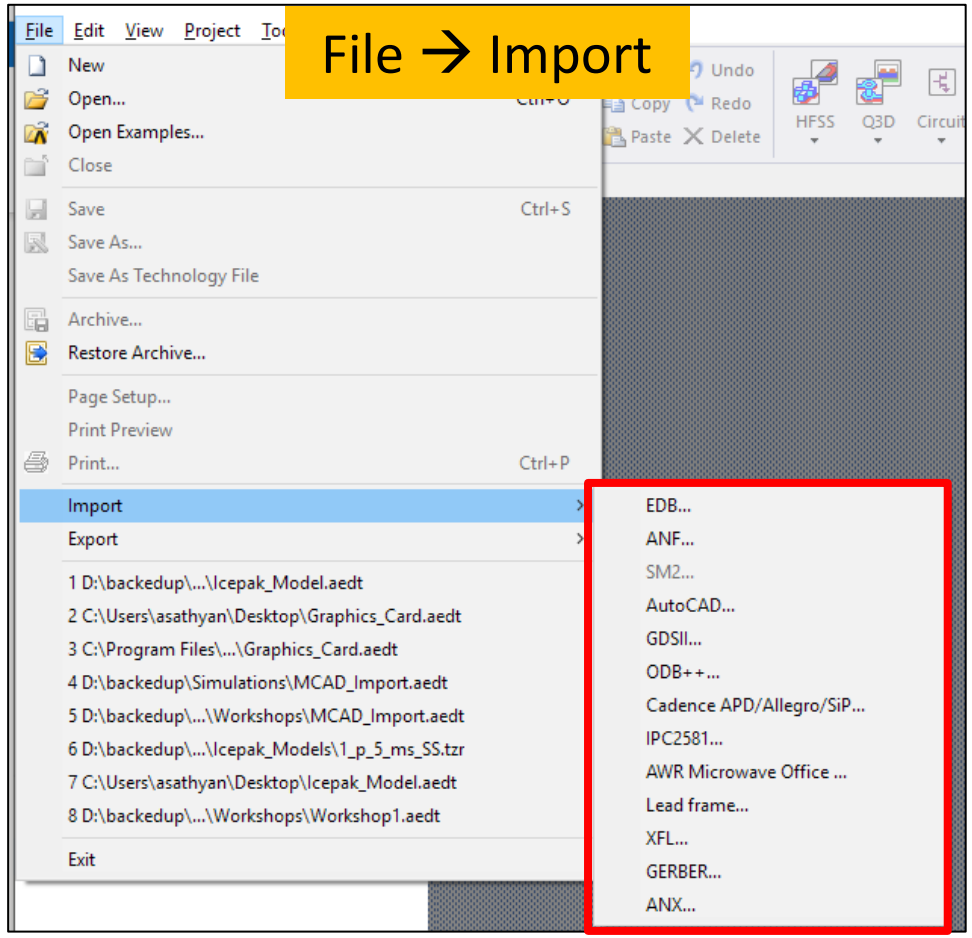
- Enter in-plane and through-plane effective thermal conductivity values
- The same calculation can be used for individual layers

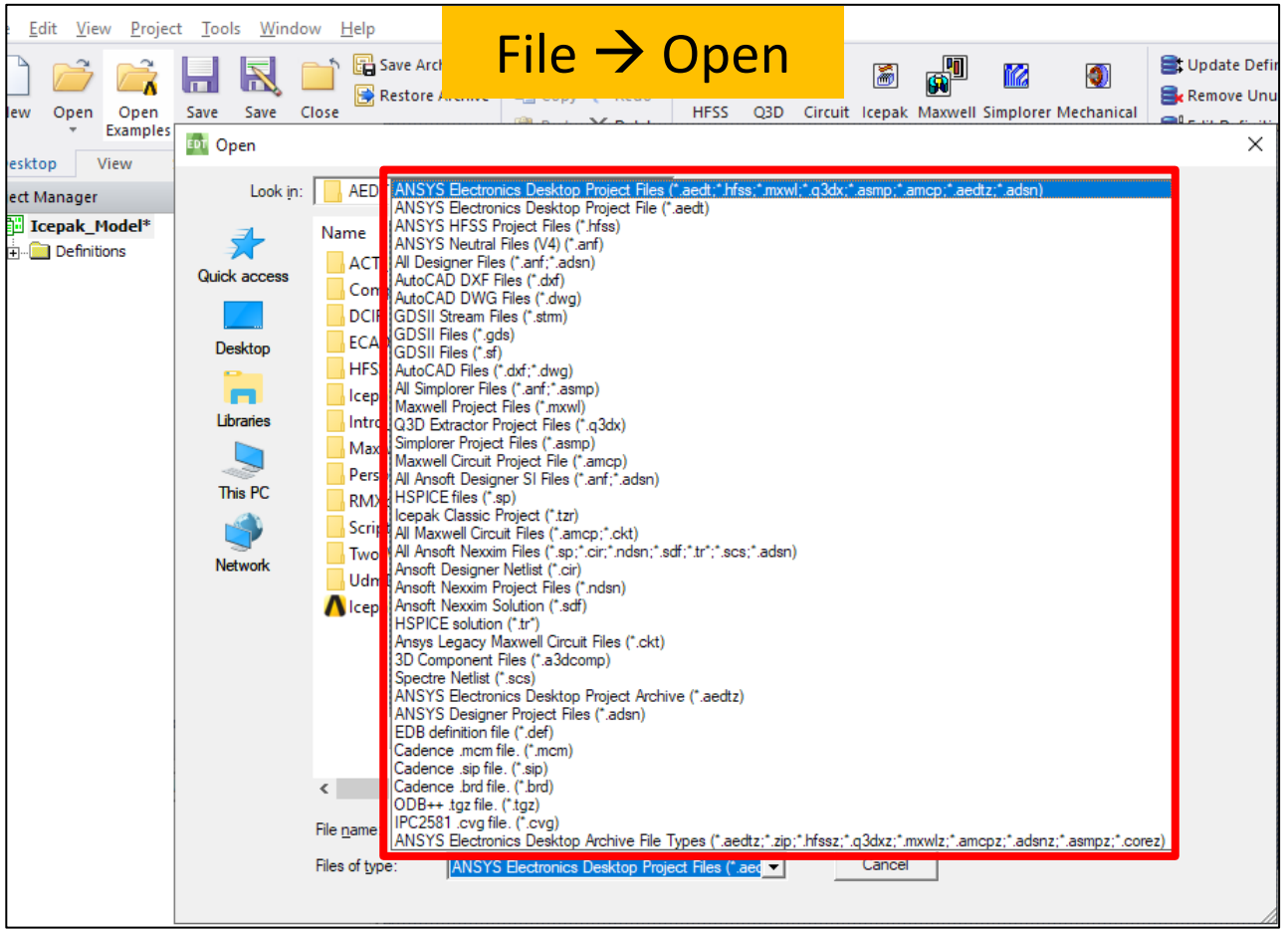
PCB 3D Component – PCB Detail without Discrete Internals

- **Step 1:** Import ECAD file using **File → Import** or **File → Open**
- **Step 2:** Insert a new Icepak Design if there is none. If you already have an Icepak Design, proceed to Step 3
- **Step 3:** Right-click 3D Components and select **Create → PCB**
- **Step 4**: Enter the PCB name, company and model number (optional)
- **Step 5:** Click **Setup Link** to specify the ECAD source
- **Step 6**: Enable **Use This Project** to use the ECAD data imported earlier as the source
- **Step 7**: Specify the power dissipation for the PCB
- **Step 8**: Choose the grid cut resolution and click **Finish** to complete the import

ECAD Import Formats

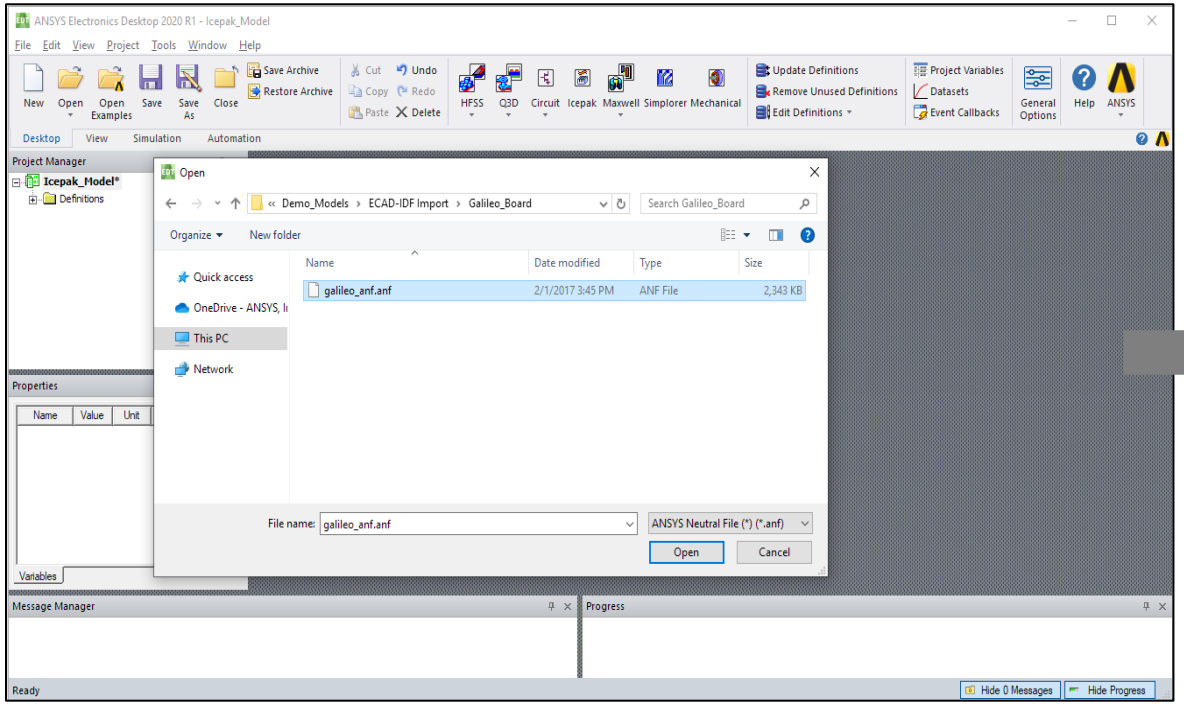
- ECAD files can be imported into AEDT using **File → Import or File → Open**
- AEDT supports different ECAD formats: **EDB, ANF, ODB++, IPC2581, GERBER etc.**

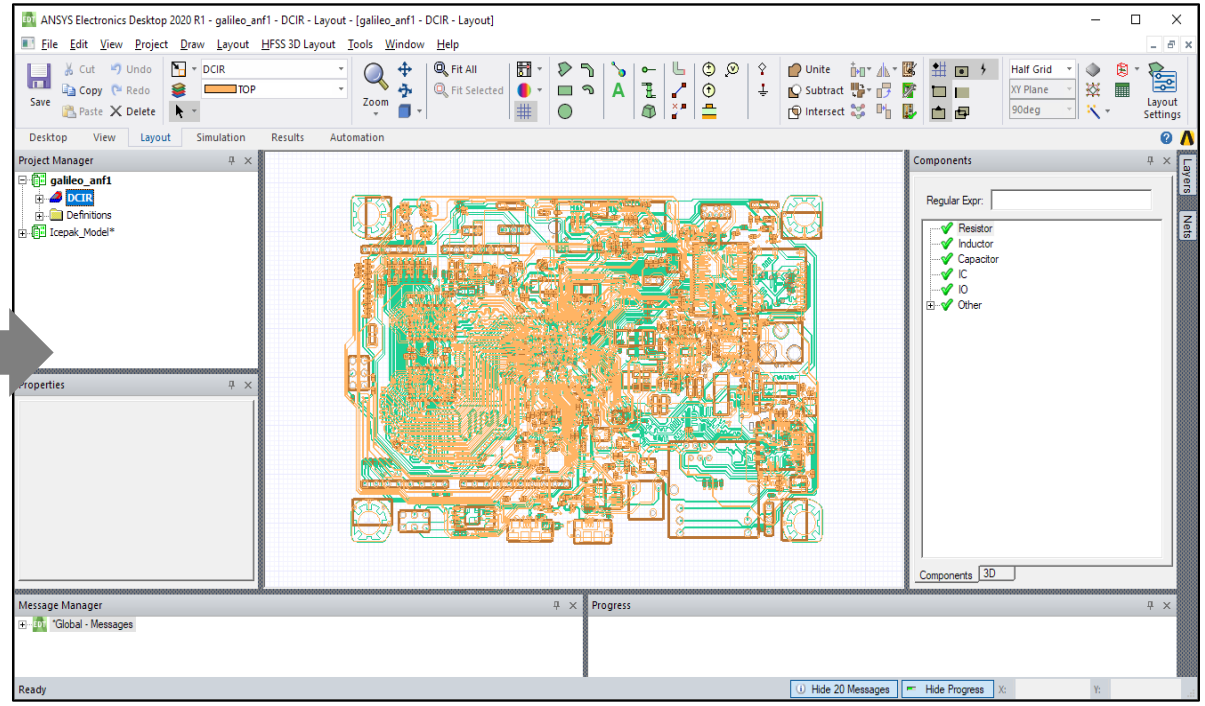




Step 1

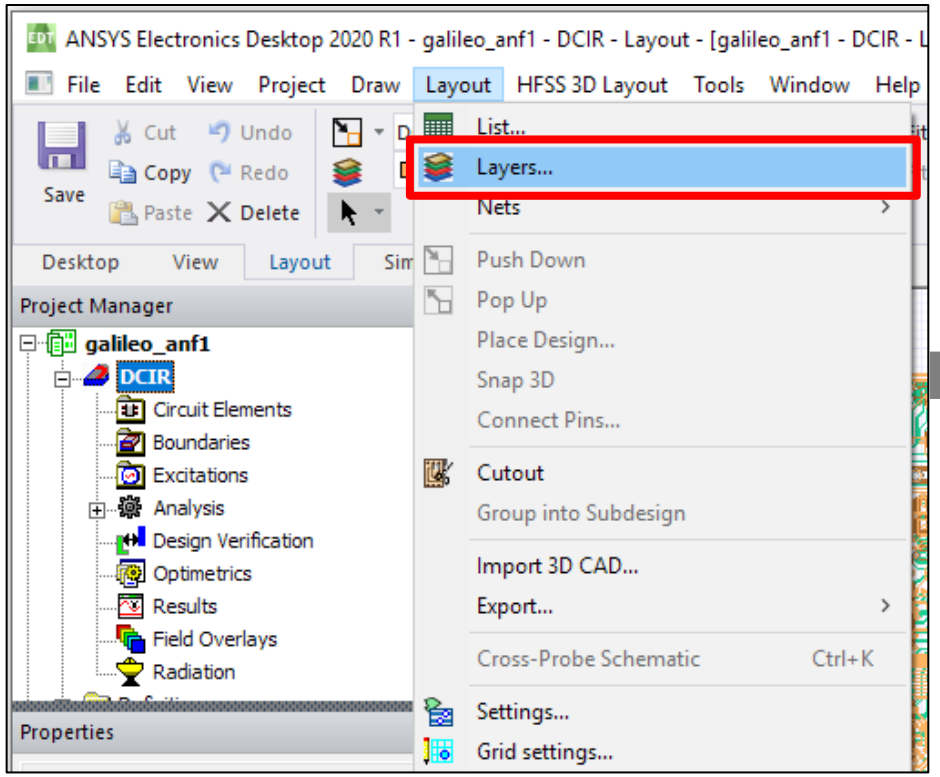
- Import an ECAD file using **File → Import** or **File → Open**
- This imports the ECAD file in a new **HFSS 3D Layout Design**

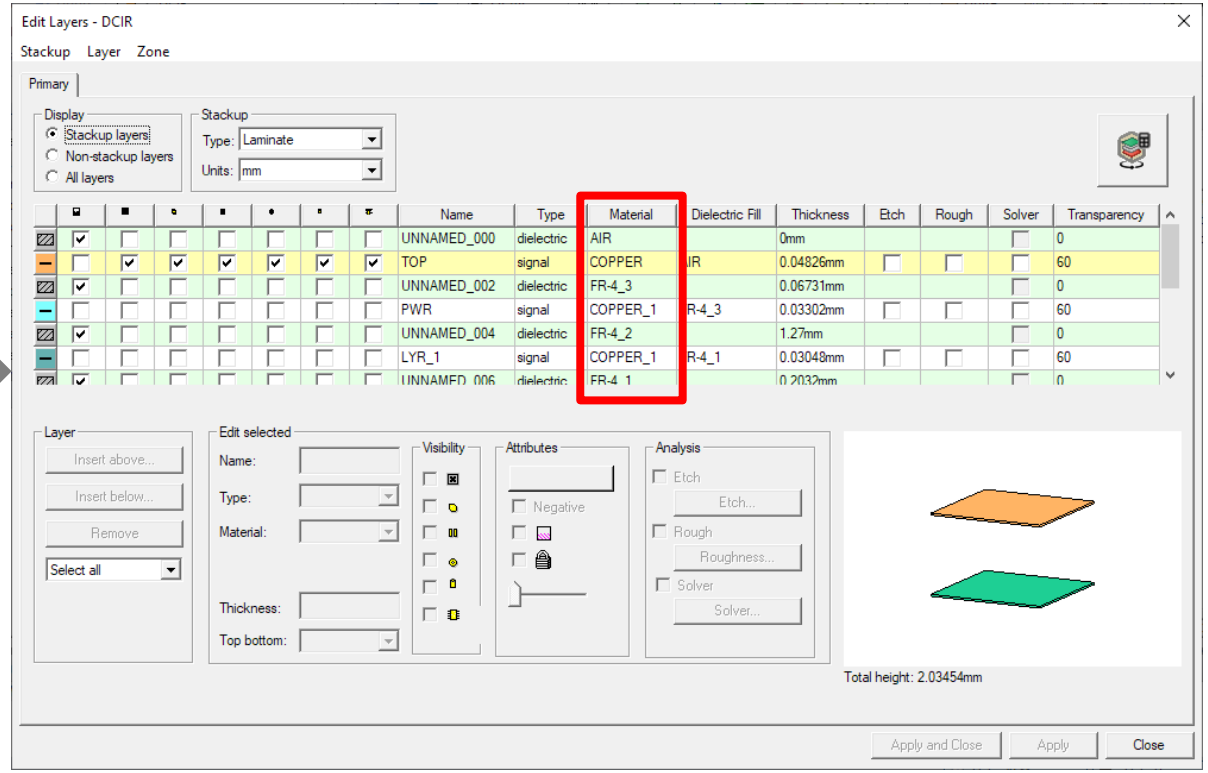




Step 1 - Continued

- In **HFSS 3D Layout**, go to **Layout → Layers** to open the **Edit Layers** panel
- Make sure that the material assignments are correct for the metal and dielectric layers
- The electromagnetic, thermal properties of these materials can be checked under **Definitions → Materials** in the Project Manager

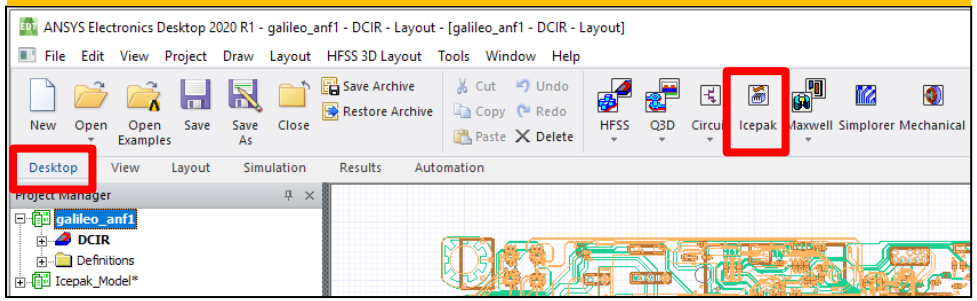




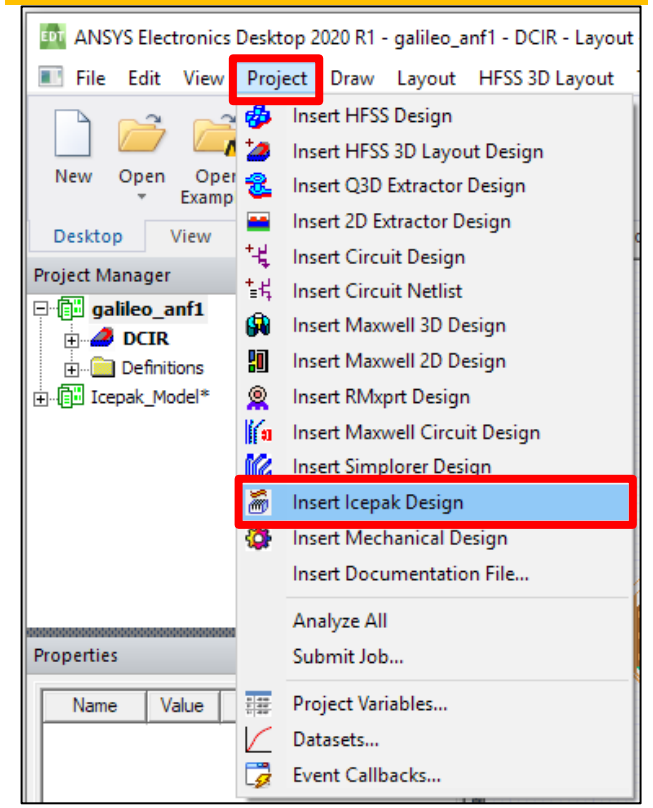
Step 2

- Insert an Icepak Design in one of the three ways below
- If you already have an Icepak design within the same Project, proceed to Step 3

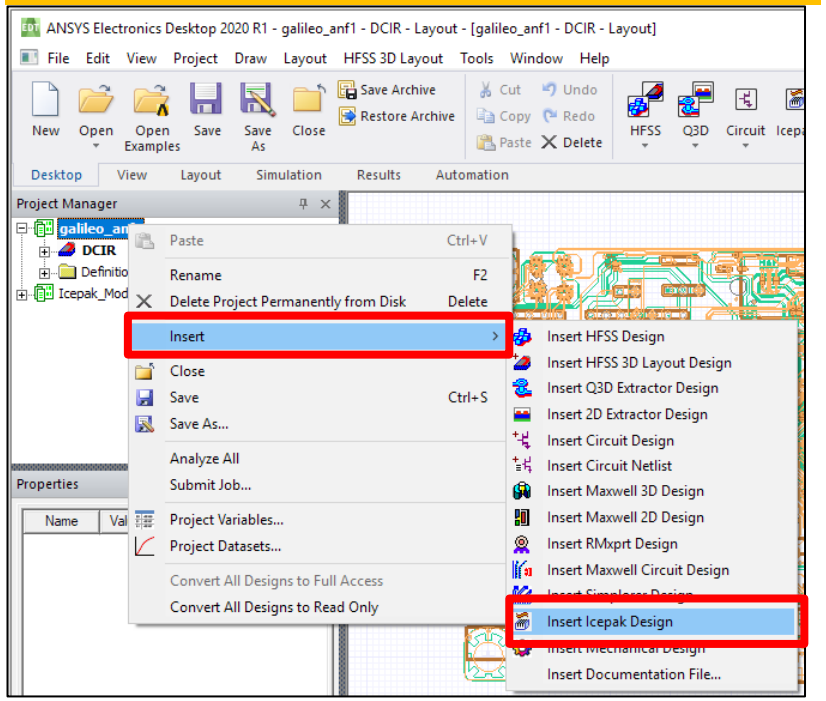
1. Desktop tab → Icepak



2. Project → Insert Icepak Design

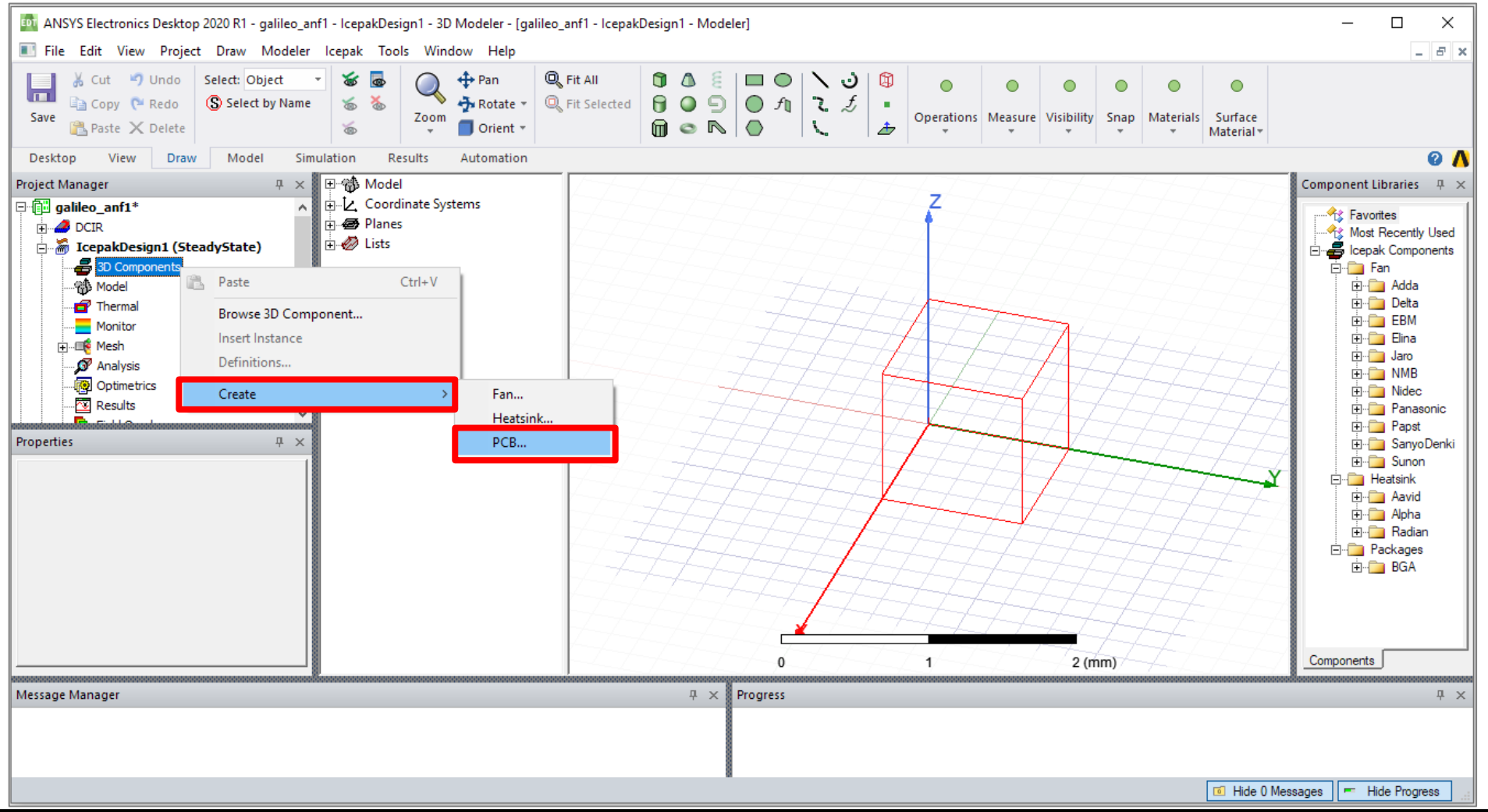


3. Right-click Project → Insert Icepak Design



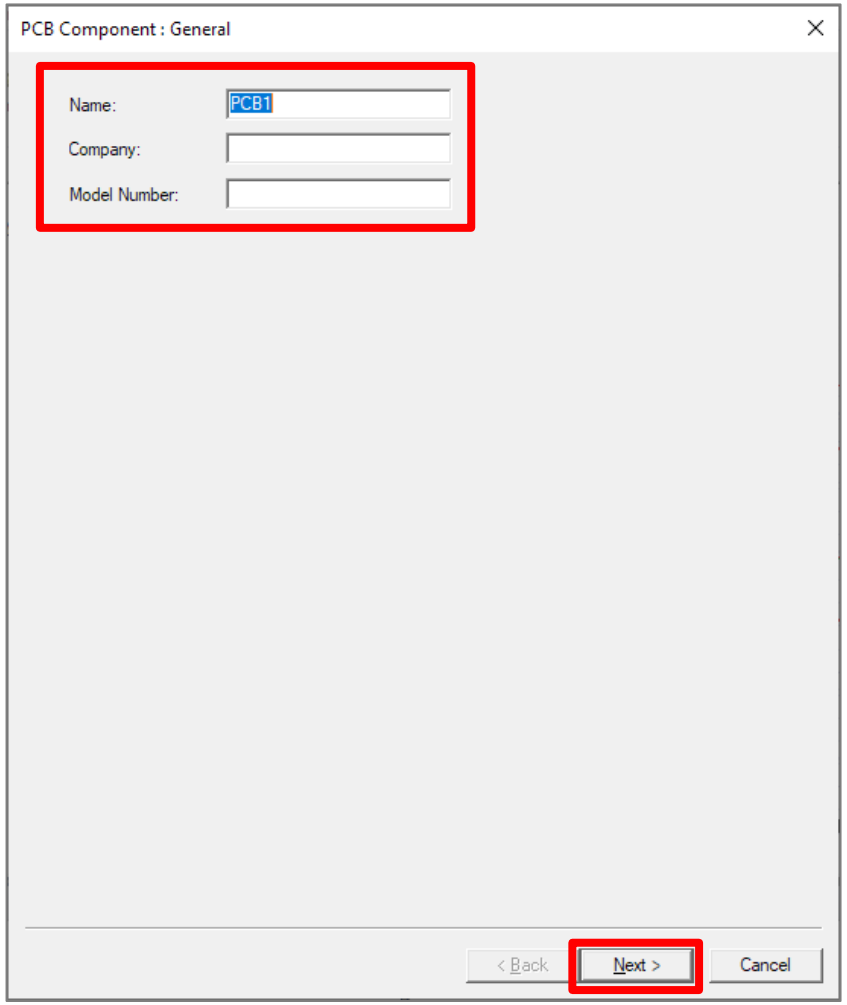
Step 3

- Expand Icepak Design, right-click 3D components and select **Create → PCB**



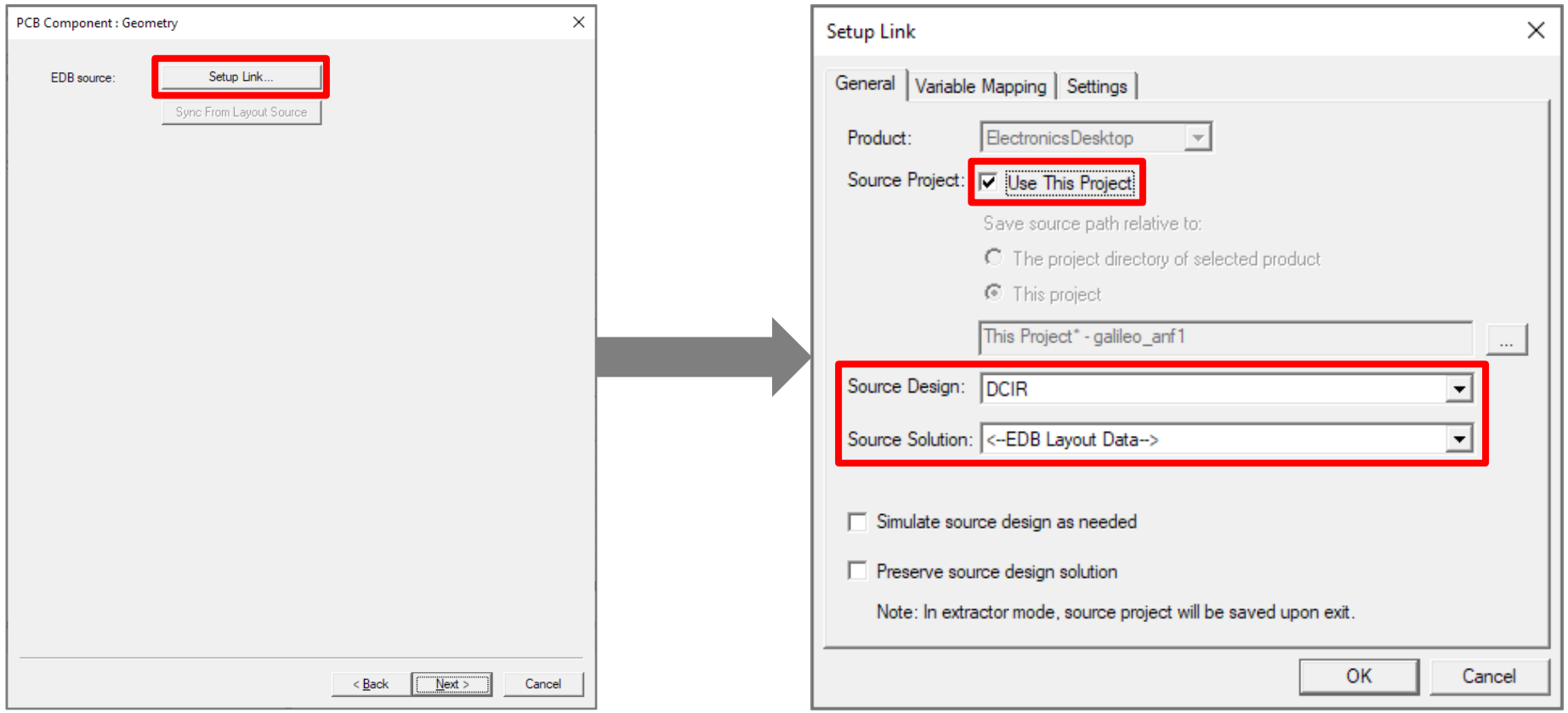
Step 4

- Enter the PCB name, company and model number (optional)
- Click **Next**



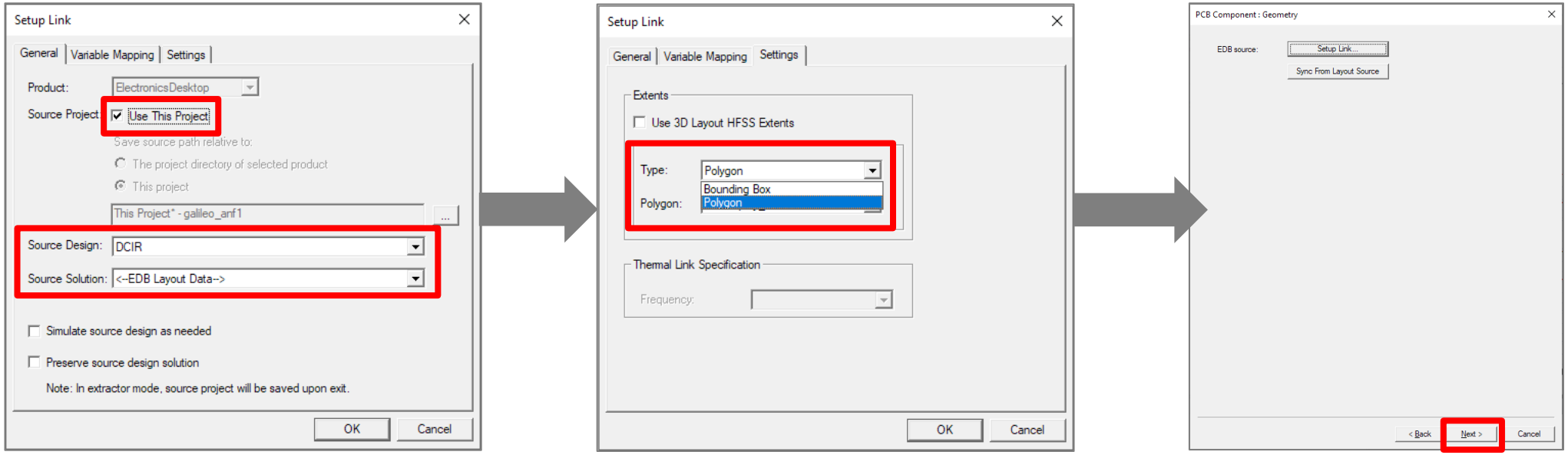
Step 5

- Click **Setup Link** to specify the ECAD source
  - Enable **Use This Project** to automatically select the ECAD Source



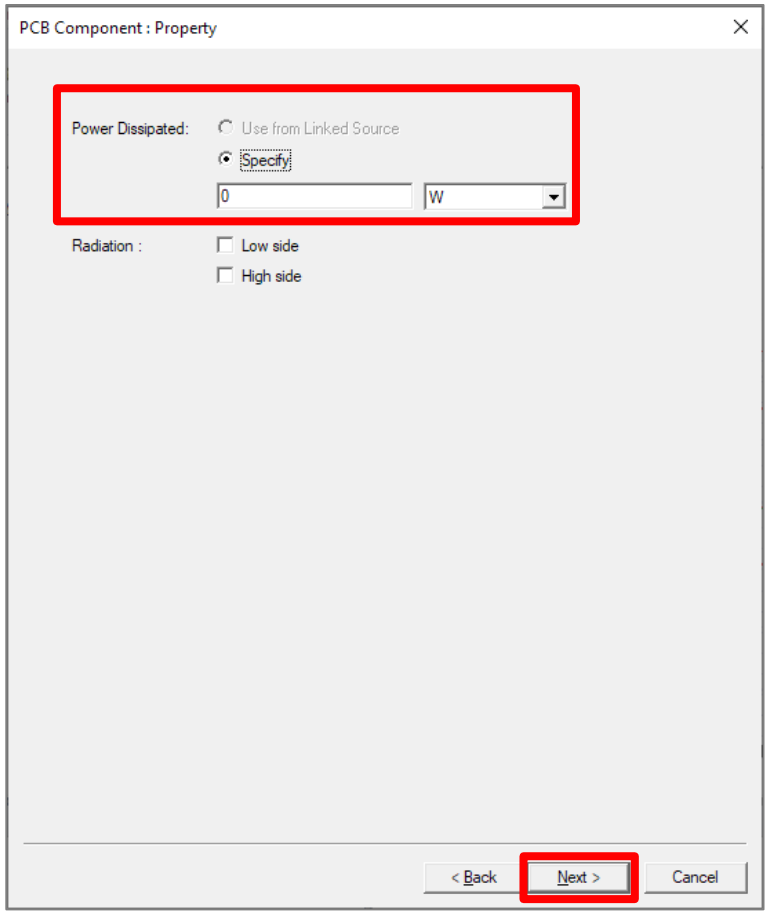
Step 6

- The **Source Design** and **Source Solution** fields are automatically populated after enabling **Use This Project** option
- Under the **Settings** tab, you can choose whether to draw the PCB outline as a polygon or a generic prism
- Click **OK** on the Setup Link panel and click **Next** on the PCB Component panel



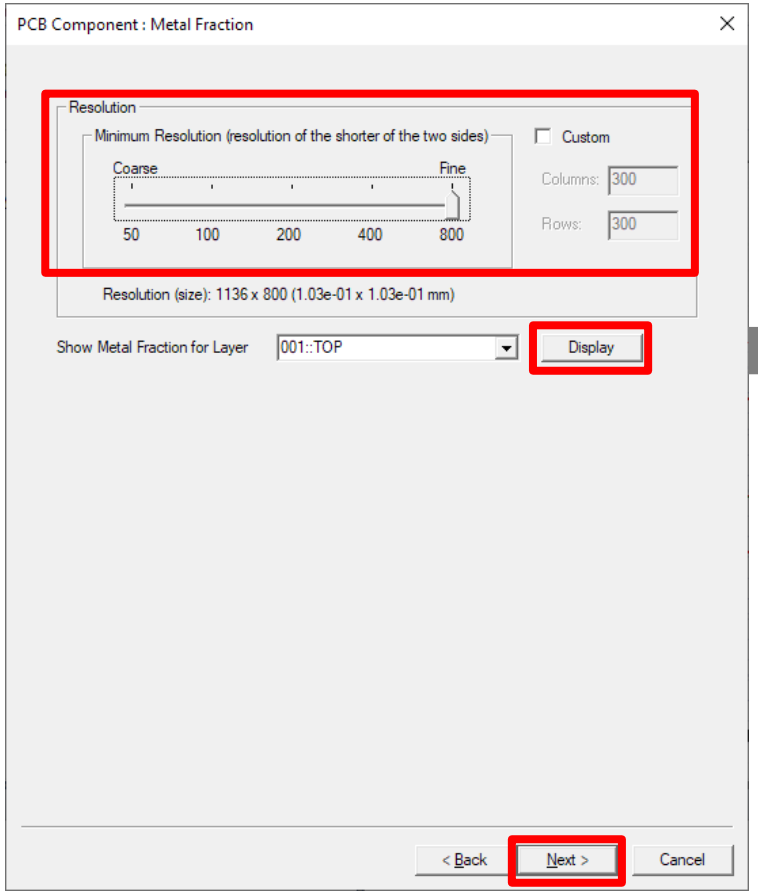
Step 7

- Specify the power dissipation in the PCB (optional for volumetrically distributed internal heating)
- Click **Next**

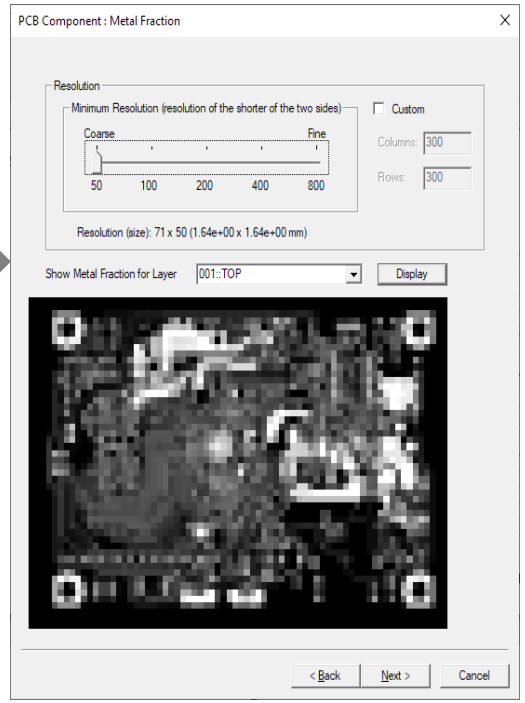


Step 8

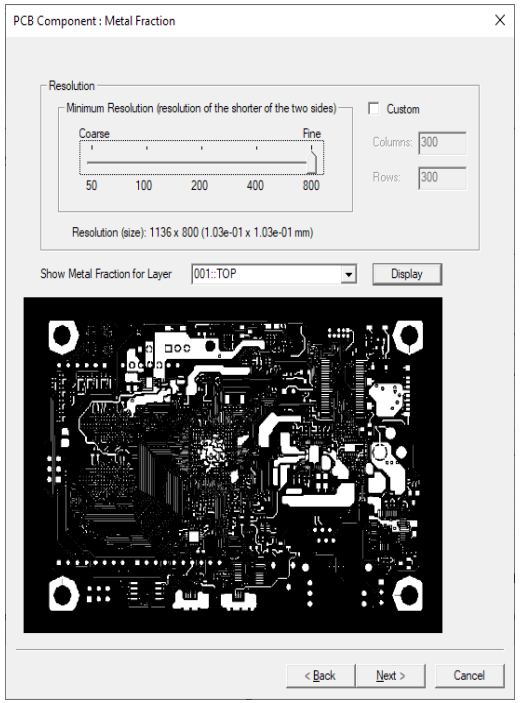
- Choose the grid cut resolution and click **Display** to view the metal fraction
- Click **Next**, and click **Finish** in the Parameters panel to close the PCB Component panel



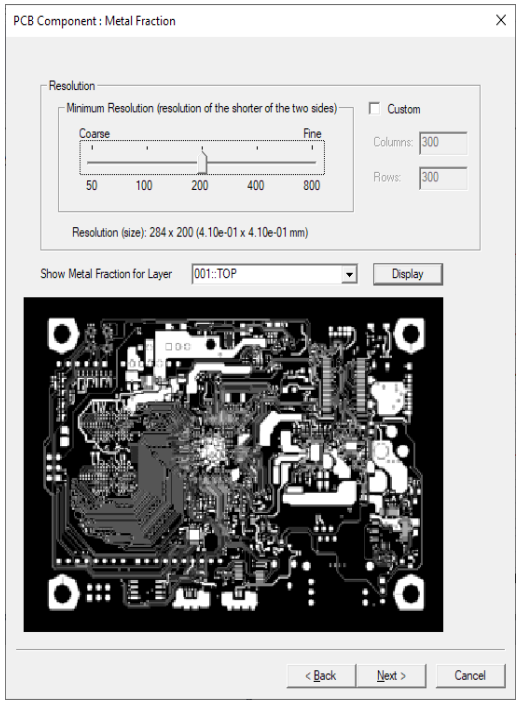
Coarse



Medium

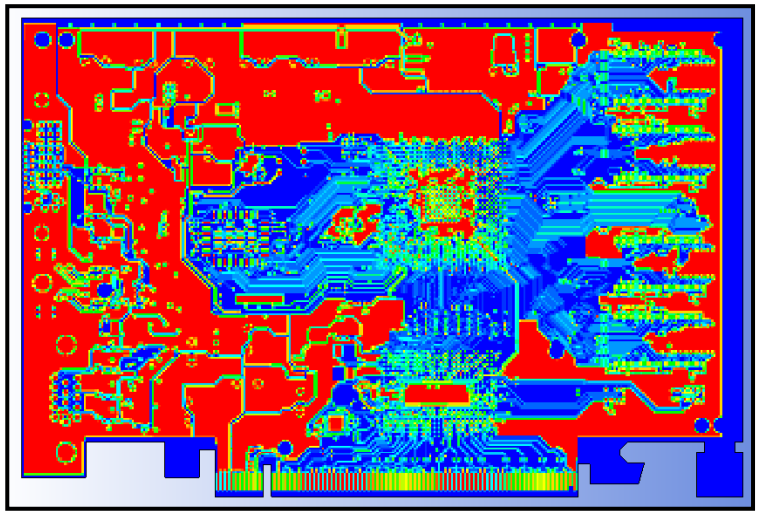


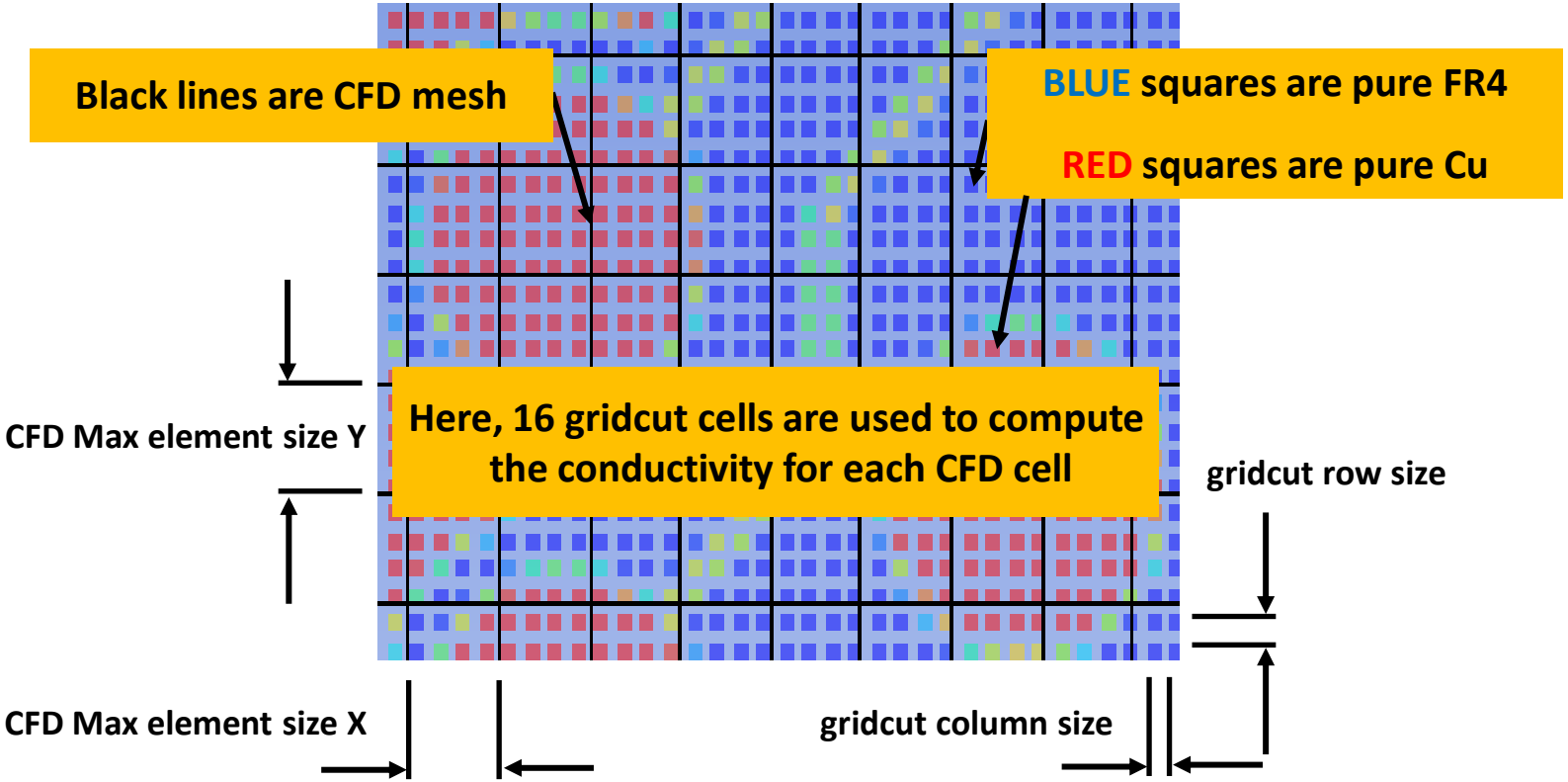
Fine



PCB Component: Trace Mapping using Gridcut Approach

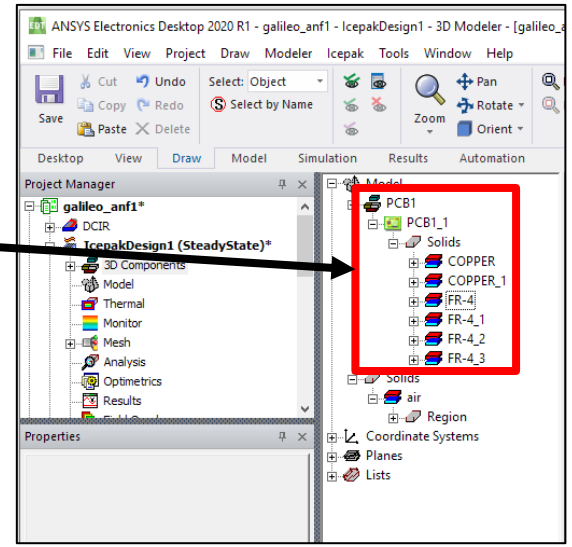
- **Gridcut**
  - Uses metal fractions to estimate the conductivity vector at each point in the mesh
  - Metal fraction computed on a separate background Cartesian grid
- **Benefits**
  - Reduces mesh complexity
  - Faster Solvers
  - Simplifies Automation

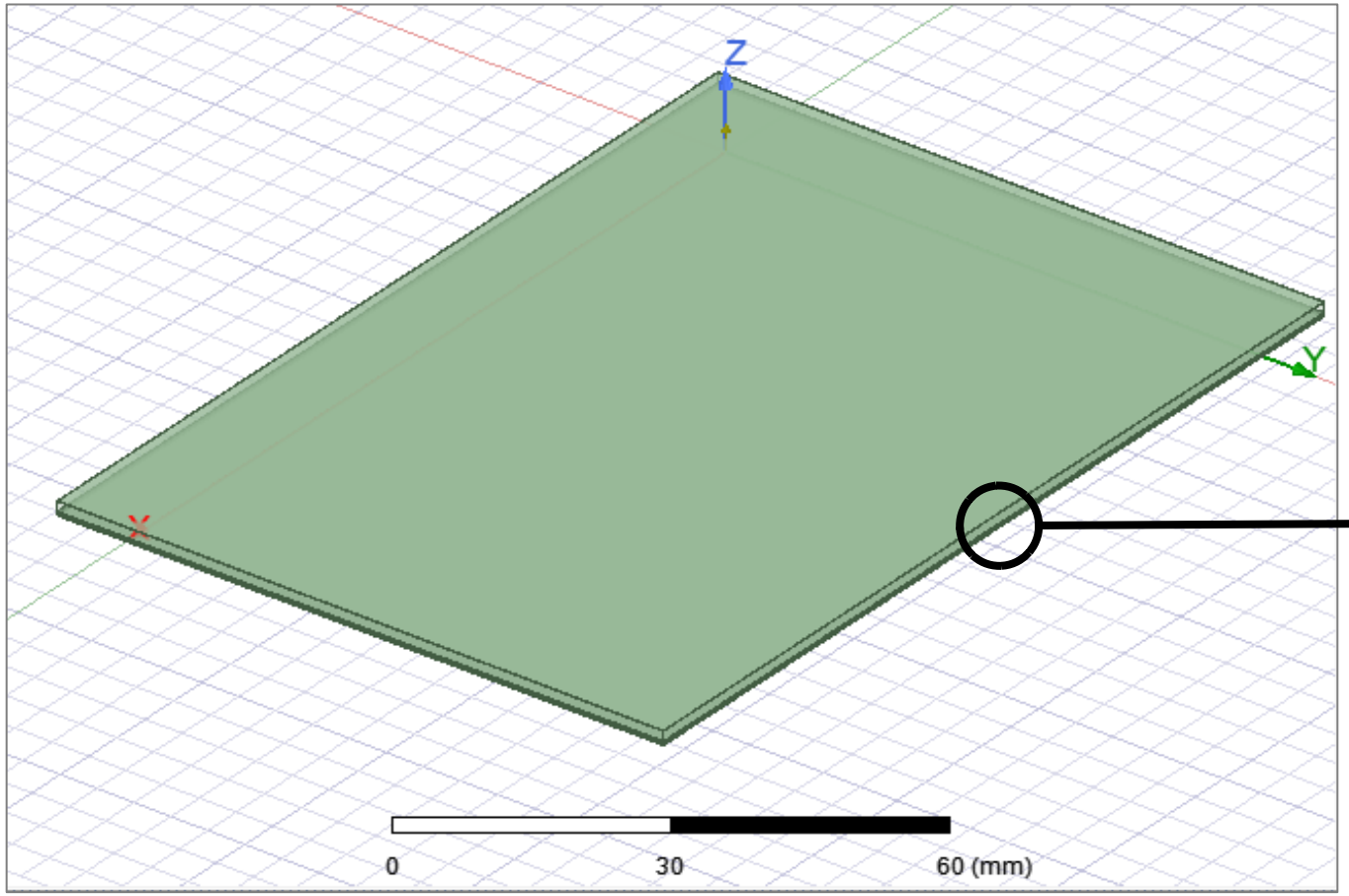


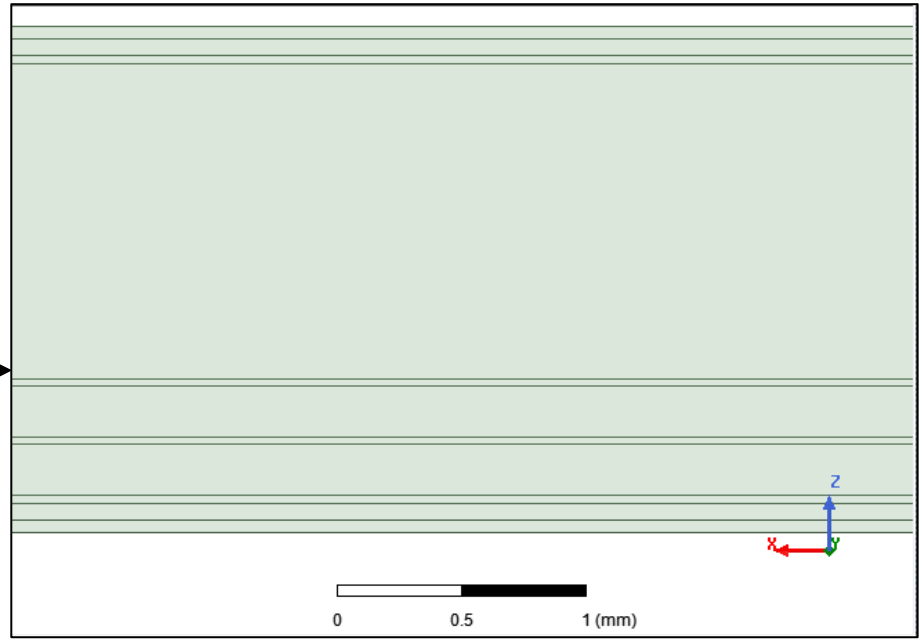


Step 8

- The PCB object is created and is shown in the History Tree
- Each layer is modeled separately

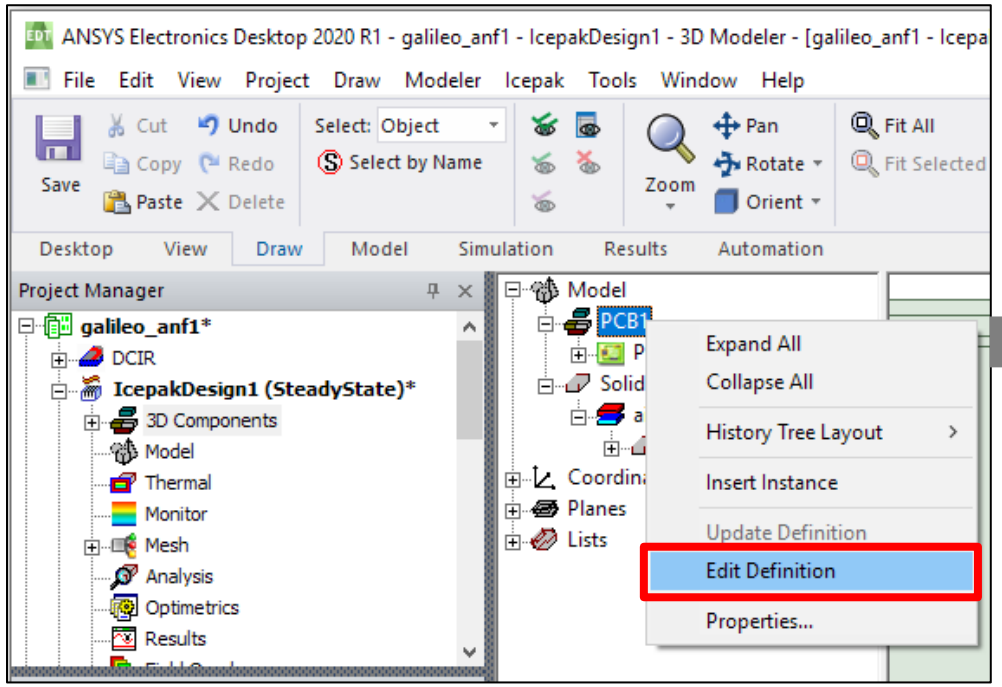


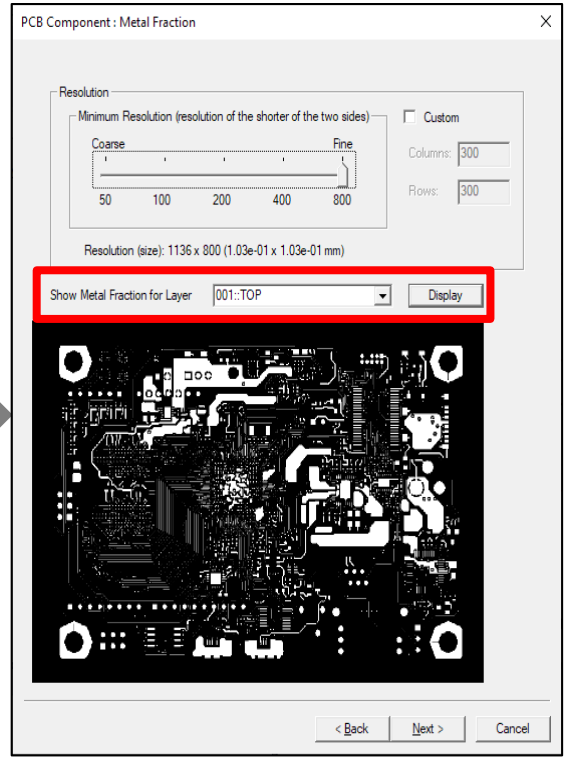




Metal Fraction Display

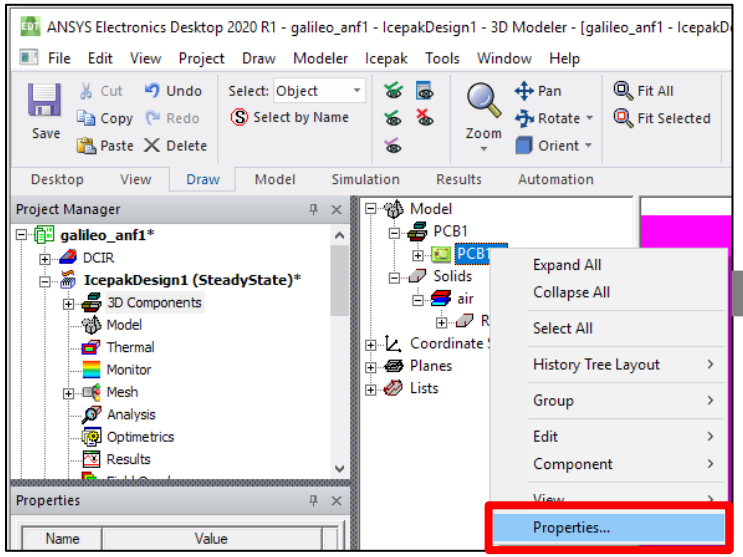
- To review or change the gridcut resolution, right-click on the PCB component in the History Tree and select **Edit Definition**
- In the **PCB Component** panel, click **Next** until you get to the Metal Fraction step
- Select the Resolution, Layer and click **Display** to view the metal fraction
- Sharper images indicate more accurate metal distribution

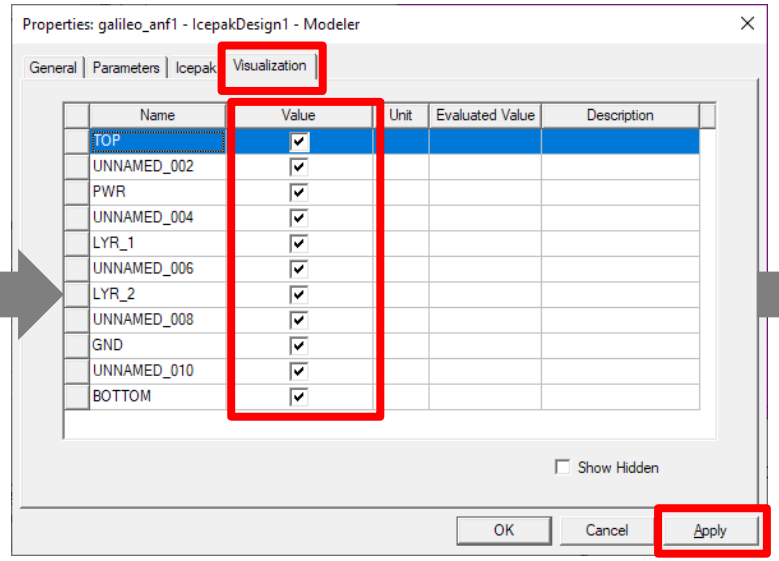


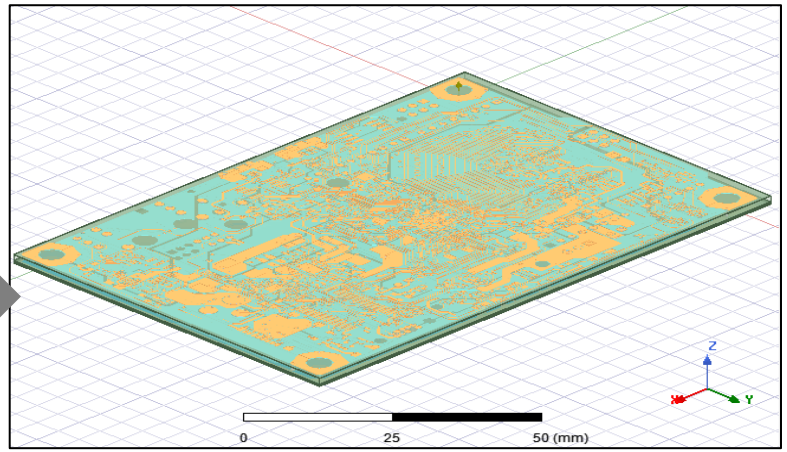


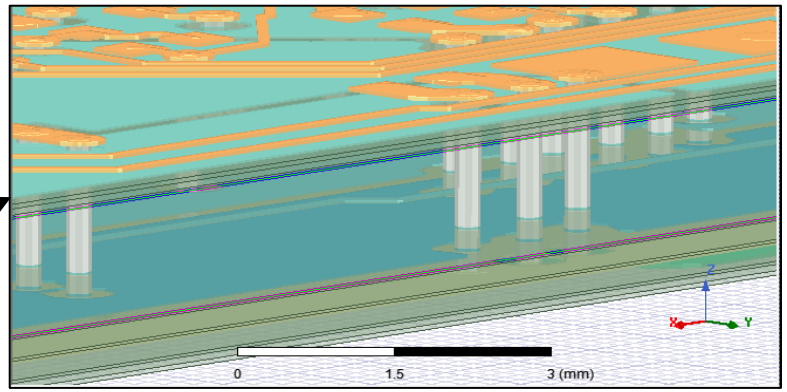
Detailed Trace Import PCB Imaging

- To make the PCB to look more realistic, right click on the PCB object (under the PCB drop-down) and select **Properties**
- Under the **Visualization** tab, enable all layers under **Value** column





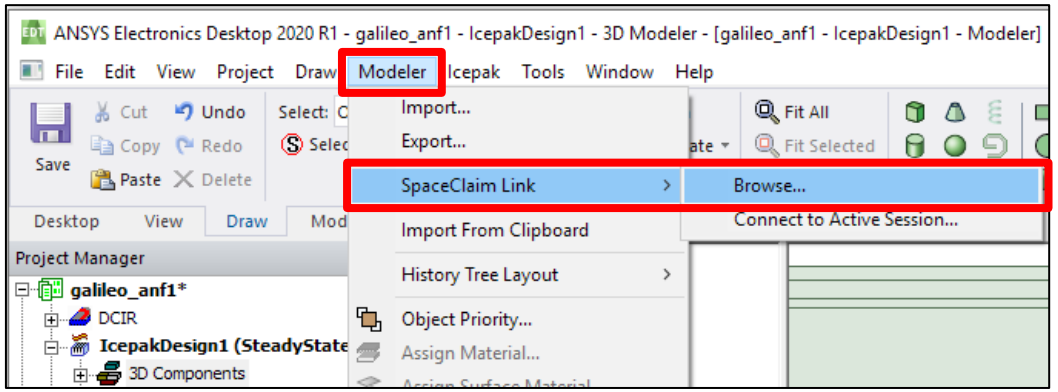


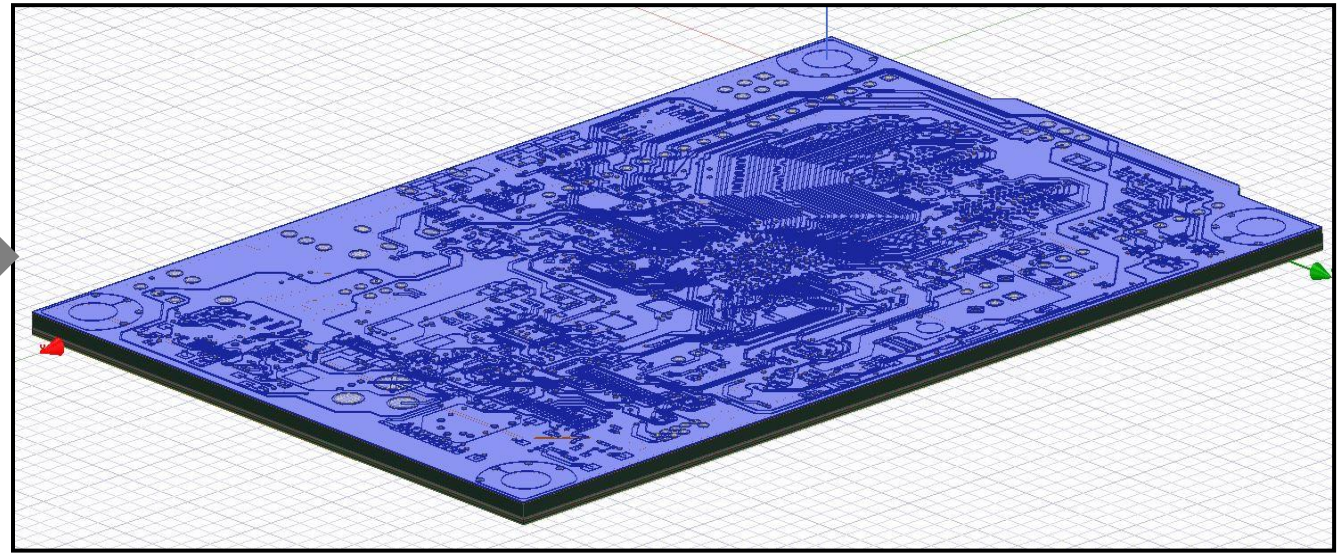


Metal layers will be shown as solid-filled drawings and vias will show as 3D objects

Explicit Modeling of traces in AEDT Icepak

- Use **ANSYS SpaceClaim** as preprocessor
  - Import board file into ANSYS SpaceClaim
  - Open Icepak in an AEDT project
  - Go to **Modeler → SpaceClaim Link → Browse**, and select the SpaceClaim file
  - While all geometries are in full-3D, work to make a good mesh. Time for solver runs will be much higher.





End of presentation