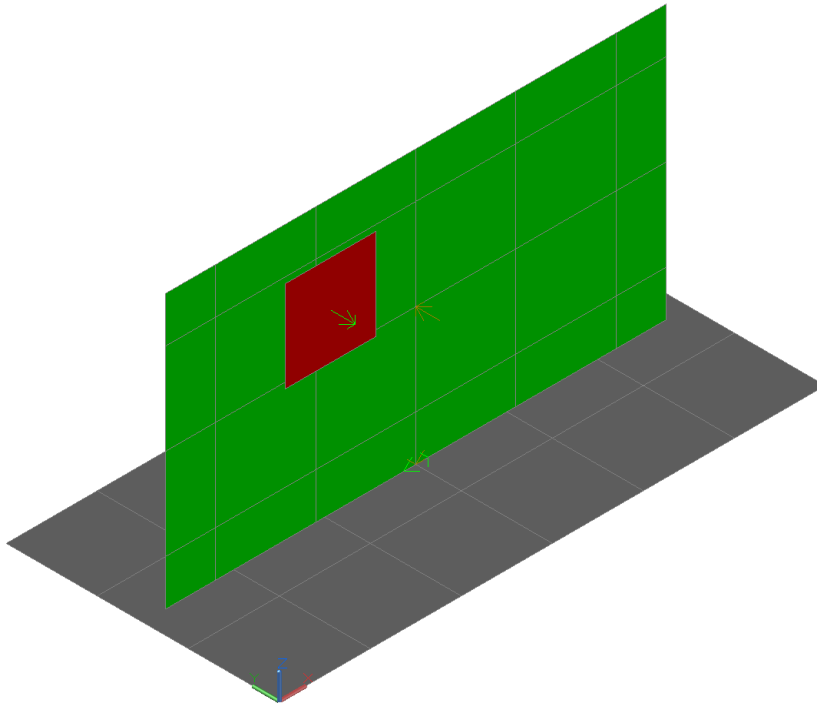# Modeling a Circuit Board with Aggregate or Laminate Properties

This model starts with the completed Circuit Board tutorial. Copy the `board.dwg` file and the TdThermo.tdp file to a new folder (the new folder should be somewhere like My Documents or Desktop so the user has full read/write access). Open the new copy of `board.dwg`.

For this example, the circuit board is 1.59 mm thick with two 1-oz/ft2 copper layers (35·m, each). The conductivity of the copper is 390 W/m·K and the FR-4 is 0.25 W/m·K. Using standard methods of combining the conductivities, the in-plane conductivity should be approximately 17.4 W/m·K and the through-thickness conductivity should be approximately 0.26 W/m·K.

Since the assumptions of this example are in SI units, the model units can be changed to SI.

1. Select **Thermal** > **Preferences**

2. On the **Units** tab, select the **SI** button in the **Reset Units To** region.

3. Select **OK**.

Create Basic Properties – Copper

1. Open Thermophysical Properties (**Thermal** > **Thermophysical Properties** > **Edit Property Data...**)

2. Type **copper** into the **New property to add** field and press **<ENTER>**.
3. Complete the **Edit Thermophysical Property – copper** dialog as shown below.
4. Select **OK**.

Create Basic Properties – FR4

1. Type **FR4** into the **New property to add** field and press **<ENTER>**.
2. Complete the **Edit Thermophysical Property – FR4** dialog as shown.
3. Click **OK**.

Create Laminate Property

1. Type **Laminate Circuit Board – 2 copper planes** into the **New property to add** field and press **<ENTER>**.
2. Select **Laminate** from the **Use Properties** drop-down.
3. Increase the **Number of Layers** field to **2** using the arrows.
4. Beside **Layer 1**, choose **copper** for the **Material**.
5. Under **Thickness**, enter **7e-5**.
6. Beside **Layer 2**, choose **FR4** for the **Material**.
7. Under **Thickness**, enter **0.00152** (0.00159 – 7e-5).
8. Verify the conductivity values by switching to the **Basic** tab.
9. Select **OK**.

Create Aggregate Property

Aggregate materials can be used to create laminates since materials can be arranged in parallel or series in the primary directions. Instead of layer thicknesses, the user must provide volume fraction.

1. Type **Aggregate Circuit Board – 2 copper planes** into the **New property to add** field and press **<ENTER>**.
2. Select **Aggregate** from the **Use Properties** drop-down.
3. Increase the **Number of Materials** field to **2** using the arrows.
4. Type **1** for **Kx scaling** and **Ky scaling** (the materials are parallel)
5. Type **0** for **Kz scaling** (the materials are in series)
6. Beside **Layer 1**, choose **copper** for the **Material**.
7. Under **Volume Fraction**, enter **0.044** (7μm/1.59mm).
8. Beside **Layer 2**, choose **FR4** for the **Material**.
9. Under **Volume Fraction**, enter **0.956**.
10. Verify the conductivity values by switching to the **Basic** tab.
11. Select **OK**.

Create a property alias

A property alias allows switching between multiple materials from case to case. Using an alias, you can run cases with each of the material definitions and compare the results.

1. Expand Common panel and select Thermophysical Property Alias.

2. Click Add.

3. Type **alias Circuit Board** for Alias Name and select one of the following properties for Select Property:

   - Aggregate Circuit Board – 2 copper planes

   - Fr4 2 oz copper

   - Laminate Circuit Board – 2 copper planes

Apply the property alias

Property aliases are applied just like materials.

1. Edit the green circuit board.

2. On the **Cond/Cap** tab, select **alias Circuit Board** for **Material**.

Note: Placing the cursor over the Material name will show which material the alias is currently referencing.

Overriding a Property Alias in a Case Set

Each case set can have its own assignment of materials to aliases.

Note: This model will require a boundary node and conductor from the boundary to a surface to run. If you wish to run the model, you must add those items.

1. Edit a case set.

2. On the Props tab, click Alias under Thermophysical Properties

3. Double-click the alias to assign. You can double-click in either column.

4. Choose the material to use for the case set.

Note: The Alias button will contain an asterisk (*) if an alias is set in the Alias Override window.

Closing the model

The tutorial is complete. You may close the model with or without saving.