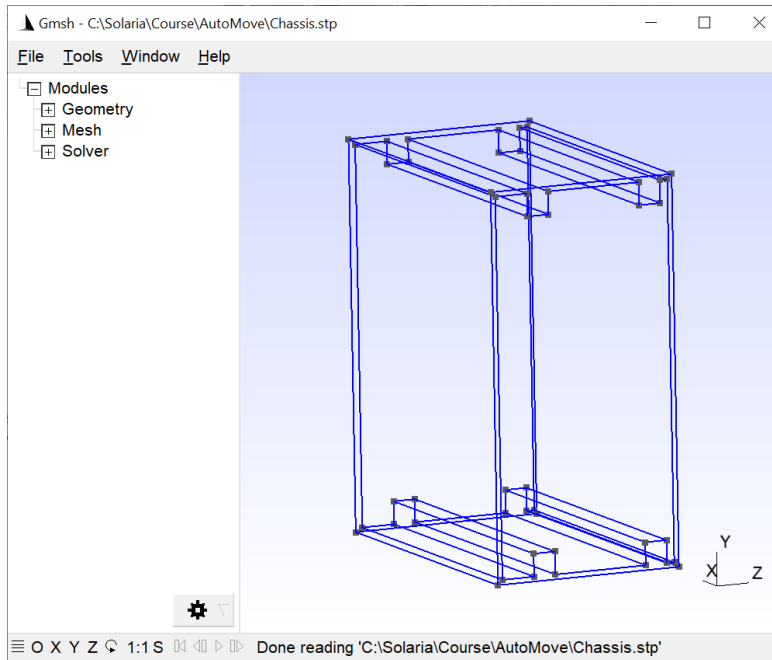


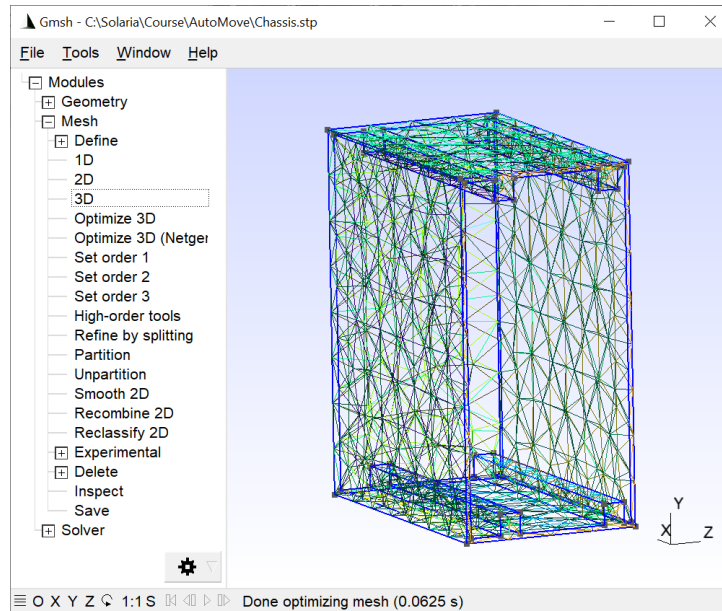
# Merging the Chassis and PCB

## Importing the MCAD meshed model into Solaria

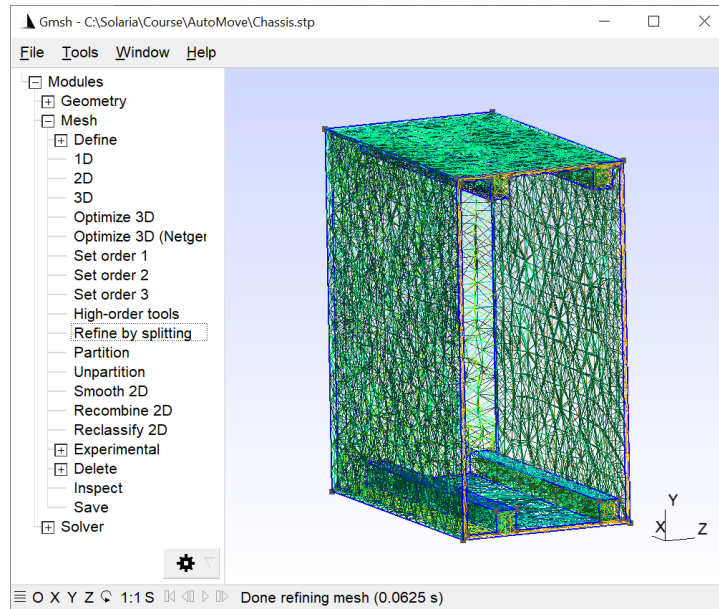
Launch Gmsh then select **File>Open** then select Chassis.stp.



Expand **Mesh** then select **3D**.



Select **Refine by splitting**.



Select **File>Save Mesh**.

In Solaria, select **File>Import Geometry>Gmsh mesh**. We only want 3D elements so uncheck **2D Elements**. Hit **Import** then select the file just generated.

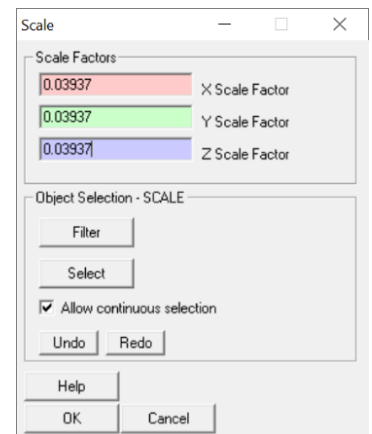
### Changing the chassis units from millimeters to inches

It was noticed that the stl file units were in millimeters so they needed to be changed to inches to agree with the PCB model.

Select **Edit>Scale**

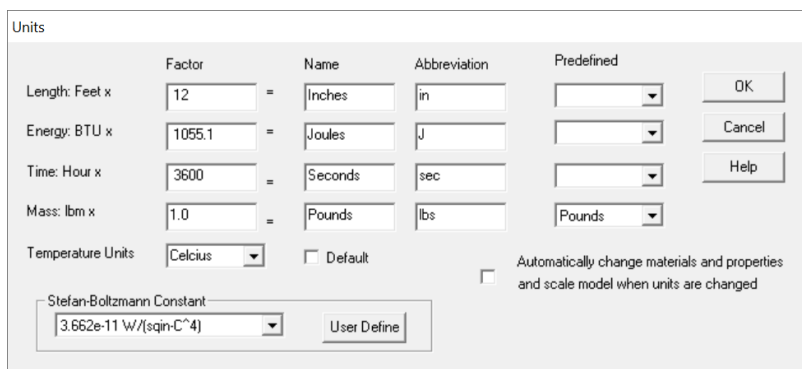
Enter 0.03937 for the X, Y and Z factors (note that you can copy and paste)

Hit **Select** and box in the entire model

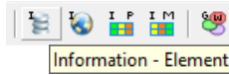


### Define model units

- Select **Model>Units**
- Use the **Predefined** dropdown list to select the units to be used. They should be inches, Joules, seconds, pounds and Celsius.



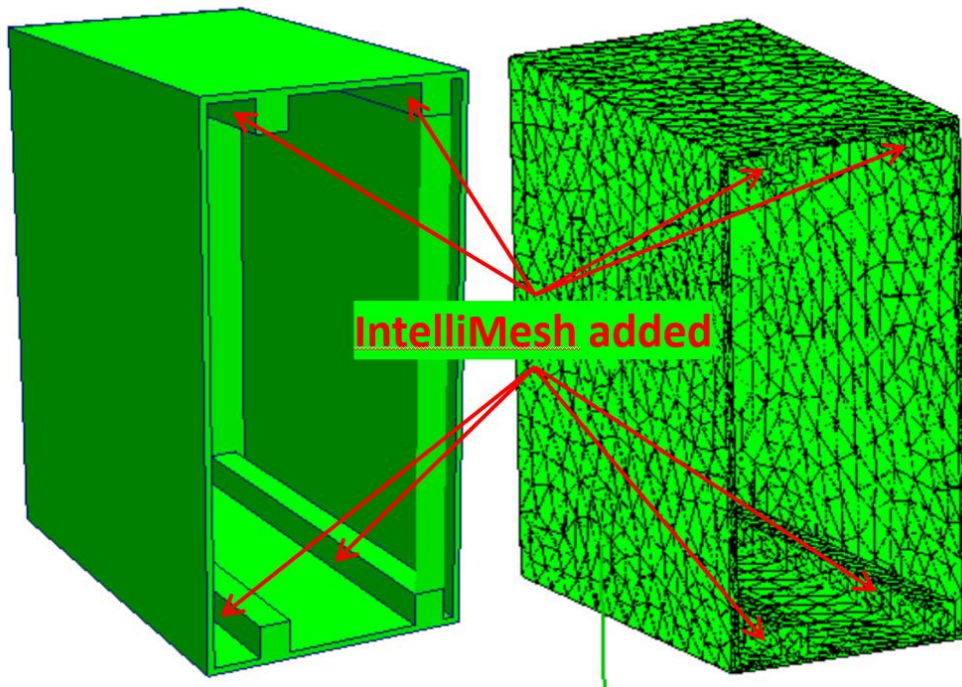
### Define a material for the chassis



- Select **Information>Element** or the **Information - Element** toolbar button. Hit **Select** then click on an element in the model. You can see the element references Property 1. Close the dialog.
- Select **Information>Property**
  - Double click in the Property 1 area.
  - Enter Chassis for the **Property Name**
  - Hit the **Edit Material** button
  - Select Al Alloy 6061-T6 from the **Material Library** dropdown list.
  - Select the black Property Color box to change the material color.
  - Close the Material and Property dialogs.
  - Back in the Information Properties dialog you can see that there are many properties that are not referenced. They were created for the 2D elements that were not imported. Hit the **Clear** button then hit Yes to the next dialog.
  - Close the dialog.

### Define IntelliMesh Master surfaces in the chassis model

In Solaria, IntelliMesh Master surfaces need to be added along the card guides, where the PCBs make thermal contact. IntelliMesh is being used to thermally connect two different models with different meshes.



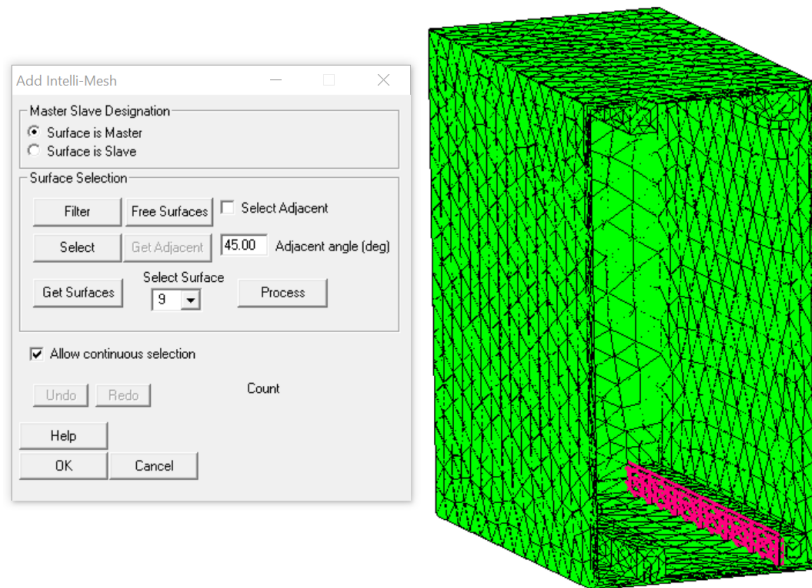
Select **Add>IntelliMesh**

Hit the **Get Surfaces** button

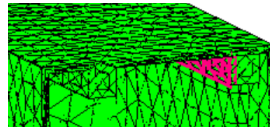
Select the drop-down list under **Select Surface**.

Using the down arrow on the keyboard, keep clicking until the surface shown is highlighted.

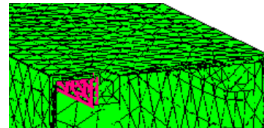
When it is, hit the **Process** button. This will create IntelliMesh Master elements to the highlighted surface.



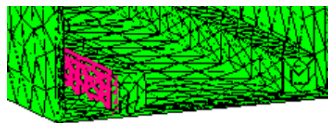
Again, select the drop-down list and click down to surface 17 then hit Process



Again, select the drop-down list and click down to surface 21 then hit Process



Again, select the drop-down list and click down to surface 25 then hit Process



### **Add Interface elements on the bottom of the chassis to a fixed temperature coldplate**

Select **Add>Interface>Extrude Surface**

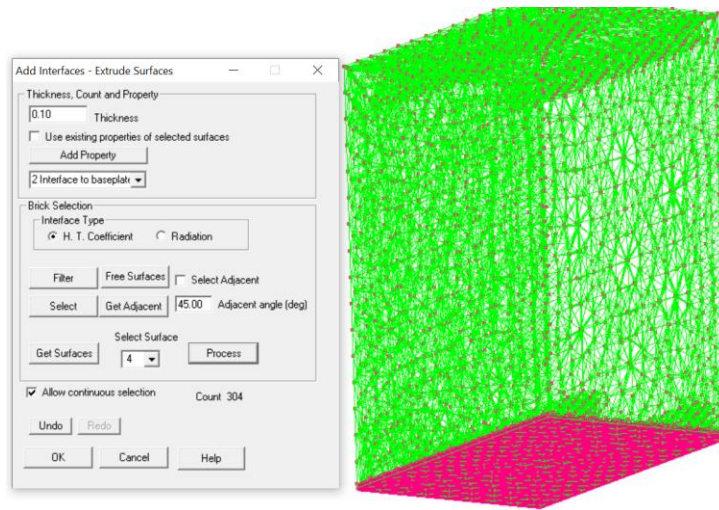
Hit **Add Property** and enter a Temperature of 25C, a heat transfer coefficient of 0.1 and a Property name of "Interface to baseplate". Hit **OK** to close the dialog.

Change the **Thickness** to 0.1".

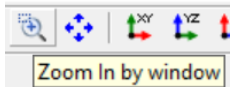
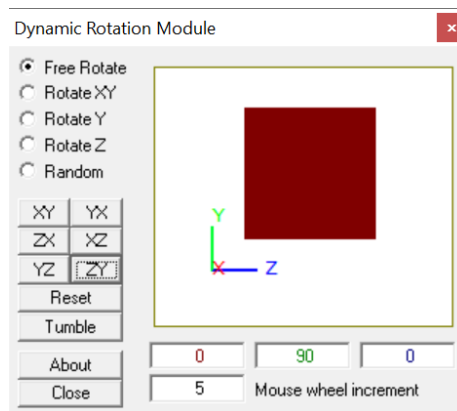
Select **Get Surfaces**

From the drop-down list, select the surface that highlights the chassis bottom, as shown.

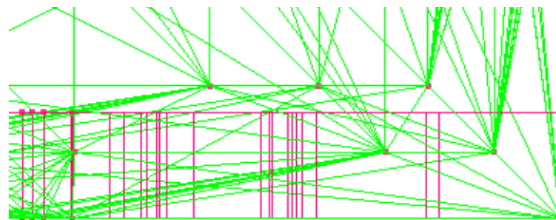
Hit the **Process** button.



Double click anywhere on the screen. Select the **ZY** button the hit **Close**.



Select **Zoom In by window** toolbar button and window in on the lower right corner of the model. The red elements below are the Interface elements just generated. Apparently, the tetrahedron elements don't follow the right hand rule and were extruded in the wrong direction.



### Put the Interface elements in a Group

- Select **Group>Quick Group**
- Hit the **Property** button then check the Interface to baseplate Property. Hit the **Hide** button.
- Hit the **Process** button under the **Property** button. Hit **Close**.

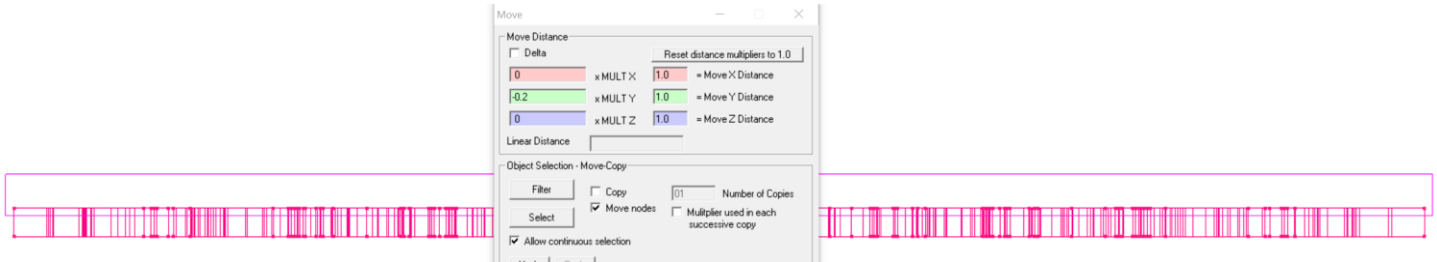


- Select **Zoom to extent of object**

Move the top nodes down in the negative Y direction twice the element thickness, 0.2 inches.

- Select **Edit>Copy and Move**

- Check **Move nodes**
- Hit the **Select** button then box in the top nodes as shown below.



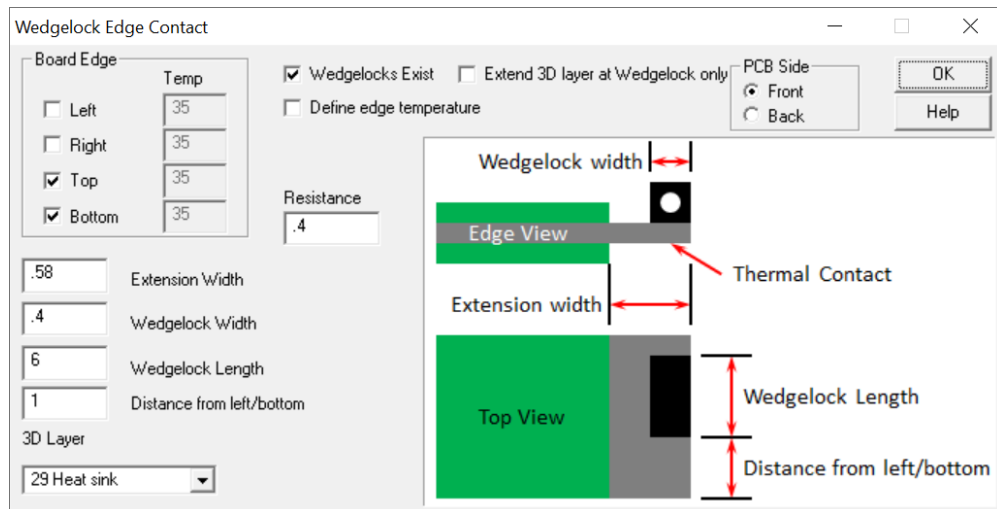
- Hit **OK** to close the dialog.
- Select **Group>Echo All**

### Add boundary nodes to the Interface elements

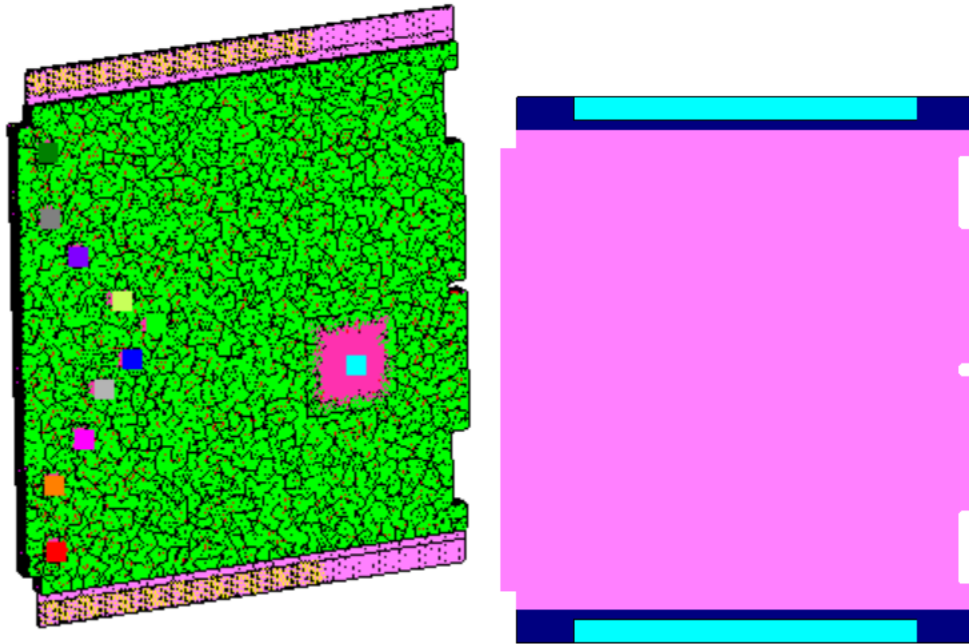
- Select **Add>Boundary Nodes**
  - Select the Interface to baseplate Property.
  - Hit **Select** then box in the bottom most nodes.
  - Close the dialog.

### Create the PCB in SolariaPCB

The PCB below was generated by SolariaPCB by importing an ODB++ file. The board is cooled by using an aluminum frame bonded to the backside of the board. The frame extends beyond the board outline on the top and bottom. Wedgelocks in the extended area clamp the board to the chassis. This was added to the SolariaPCB model using the Wedgelock Edge Contact feature. Note that the Define edge temperature checkbox is *not* checked. In this case, IntelliMesh Slave surfaces will be created in the thermal contact areas.

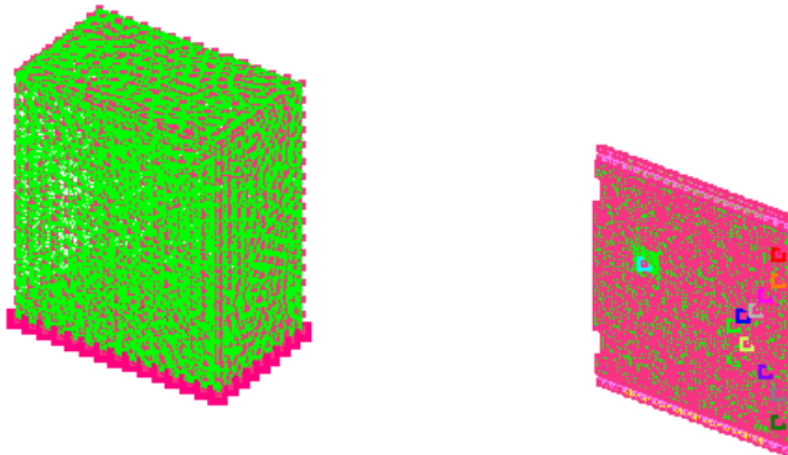






### Merge the chassis model with the PCB model

- With the chassis model on the screen, select **File>Open Model**.
- Select the file PCB.
- When asked if you want to merge the model with the current model, hit Yes.
- In the **Merge Models** dialog, enter 20 for the **X** translation. This will ensure that the two don't go on top of each other. Hit the Apply button. Hit Yes to the next three dialogs.



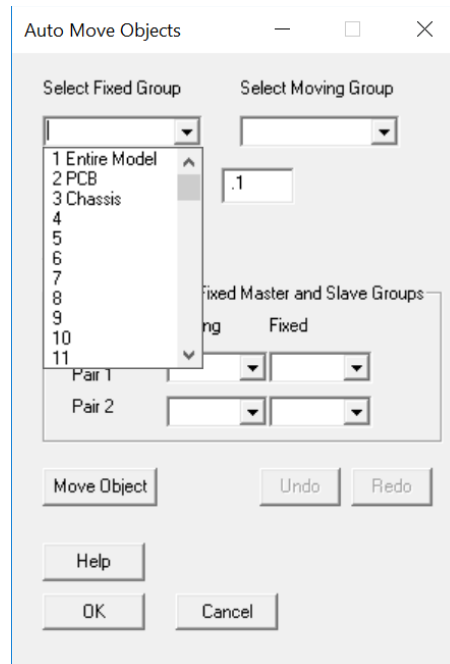
### Put the chassis and the PCB into Groups

- Select **Group>Edit**
  - Select Group number 2
  - Hit the **Clear** button to make sure nothing already exists in the group.
  - Hit **Select** then box in the chassis model.
  - Enter Chassis for the group name at the top.
  - Now select Group number 3
  - Again, hit **Select** then box in the PCB.

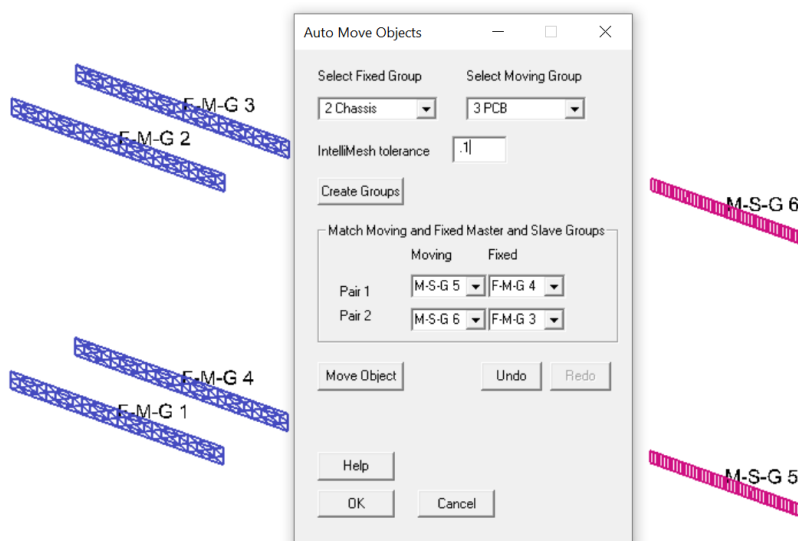
- Enter PCB for the Group name.
- Close the dialog.

Now the PCB needs to be rotated then moved into place in the chassis. A gap is needed between the Master and Slave IntelliMesh surfaces, less than the IntelliMesh tolerance.

Select **Modify>Auto Move Objects**. The dialog shown below will come up. First select the Group that is fixed, in this case the chassis, then select the Group that will move, in this case the PCB. Once they are selected, hit the **Create Groups** button.



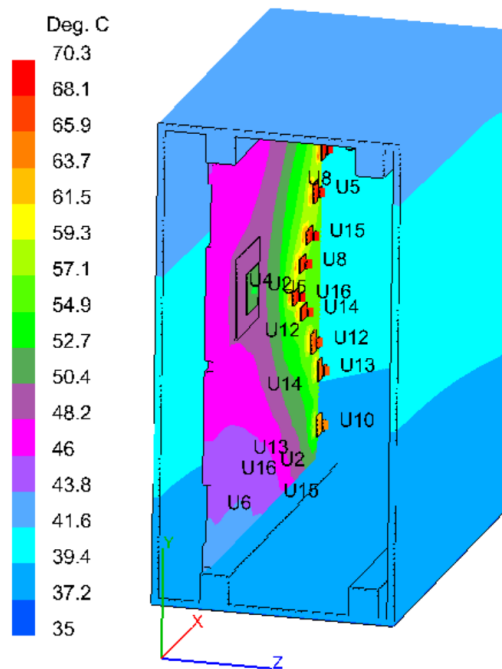
Each group of IntelliMesh surfaces will automatically be shown with their given names. If the name starts with F, then it is a Fixed IntelliMesh group. If the name starts with M, then it is a Moving IntelliMesh group. Next, from the **Moving** and **Fixed** drop down, select which Moving IntelliMesh surface should match up with the Fixed IntelliMesh surface. In this example we are selecting two pairs. Pair up F-M-G 4 with M-S-G 5 and F-M-G 3 with M-S-G 6.





Next hit the **Move Object** button.

Close the dialog then solve the model.



The following describes the **Move Object** process.

First the moving object, in this case the PCB, is rotated so it is on the same plane as the chassis IntelliMesh surfaces.

It does this by:

- 1) The centers and overall dimensions of the IntelliMesh Groups are calculated.
- 2) It determines what planes the Fixed and Moving IntelliMesh surfaces are on by determining what dimension is zero. For instance, if it is on the XY plane then the Z dimension or thickness of the nodes defining the IntelliMesh surfaces must be zero.
- 3) Next, the normal direction is determined for each IntelliMesh Group. This is based on the element face the IntelliMesh surfaces lies on. When the Master and Slave surfaces are aligned, the normal must be pointing towards each other. This therefore goes into determining the rotation, positive or negative.
- 4) The geometric center of the moving object is calculated
- 5) The Moving Group is then rotated onto the correct plane.

Next, if necessary, the PCB is rotated on plane to align the Master and Slave surfaces.

This is done by:

- 1) The centers and overall dimensions of the IntelliMesh Groups are recalculated because they have changed because of the first rotation.
- 2) The geometric center of the moving object is recalculated
- 3) If two pairs of IntelliMesh Groups were selected, then:
  - a. A line connecting the centers of the Fixed pair is compared to a line connecting the centers of the Moving pair. If they are both horizontal or both vertical then which end

the first pair is on is used to determine if the Moving Group needs to be rotated 180 degrees.

- b. If the lines are normal to each other, the Moving Group is rotated 90 degrees. Which end the first pair is on is used to determine if the rotation is positive or negative.
- 4) If one pair of IntelliMesh Groups were selected, then:
- a. A check is made to see if the long and short dimensions of the Fixed and Moving IntelliMesh groups are aligned. If they are not, then the Moving group is rotated 90 degrees.
  - b. If a 90 degree rotation is needed, then the distance between the center and left and right edges of the Moving and Fixed IntelliMesh groups are compared to determine if the rotation should be negative or positive. Note that if there is symmetry in the IntelliMesh groups and there is not symmetry in the Moving object then it may be necessary to rotate the Moving object manually.
- 5) The Moving Group is rotated on the plane to the correct orientation.

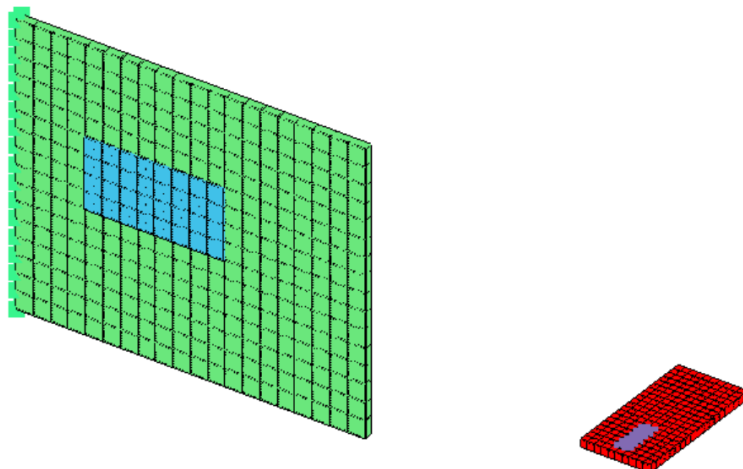
The Moving Group is next moved into place. This is done by:

1. The centers and overall dimensions of the IntelliMesh Groups are recalculated because they have changed because of the first rotation.
2. The geometric center of the moving object is recalculated
3. The centers of the first pair are used to get the X, Y and Z displacement.
4. The direction normal to the plane is adjusted to create a gap of half the IntelliMesh tolerance defined in the dialog.
5. The Moving Group nodes are then moved.

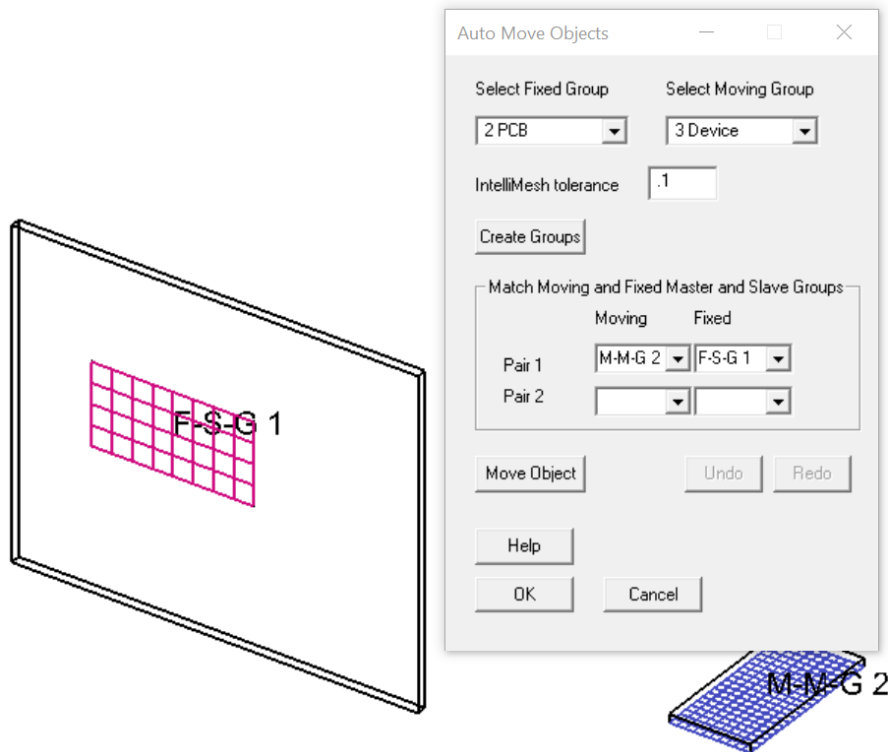
The PCB is then automatically moved into place. All you have to do now is solve for temperatures.

### Example 2 – Simple single pair

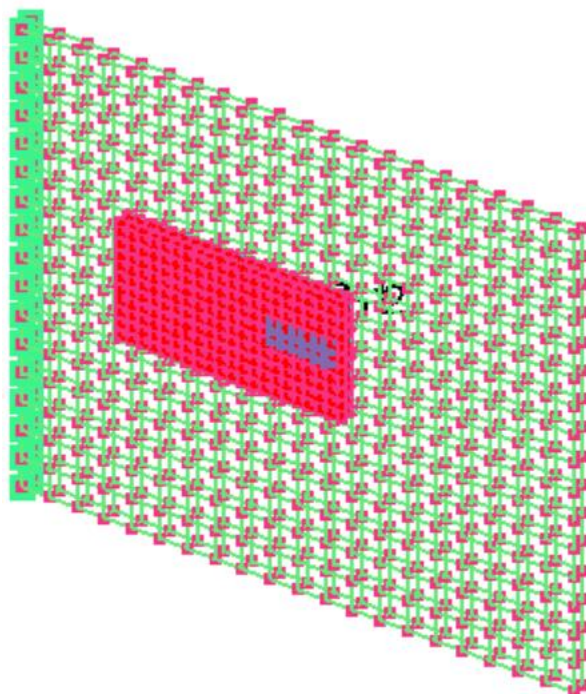
Below is a simple example of a PCB, green, and a device, red. The blue area on the PCB are Interface elements with Slave IntelliMesh on their surface. The bottom side of the red area has Master IntelliMesh on the underside surface.



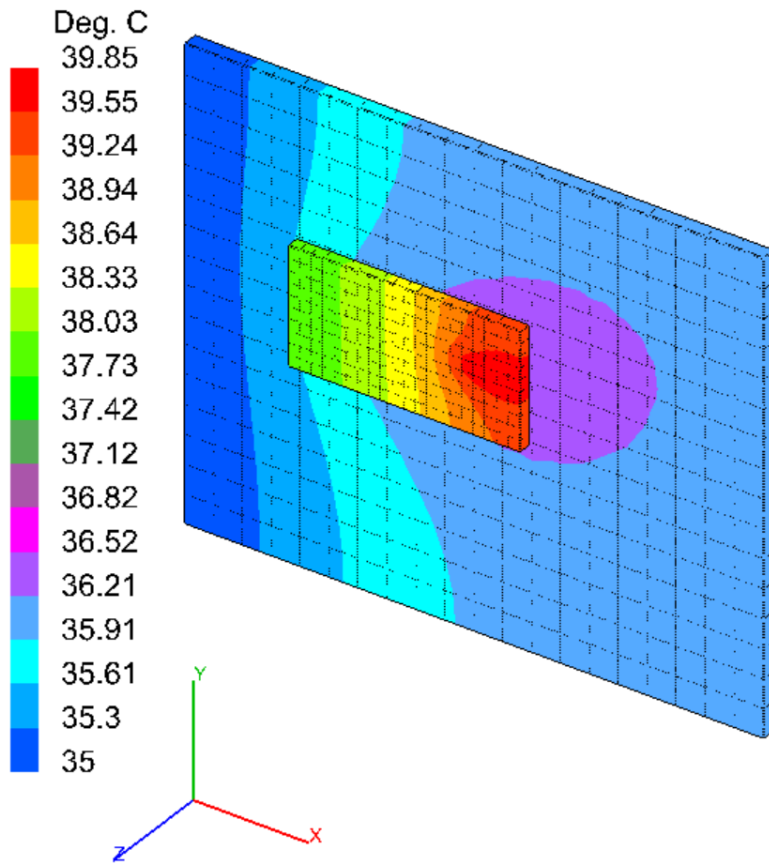
Select **Modify>Auto Move** Objects then select the Fixed Group, the PCB, then select the Moving Group, the Device then hit the **Create Groups** button. Notice that the Moving and Fixed groups are automatically selected correctly since there is only one of each.



Hit the **Move Object** button.

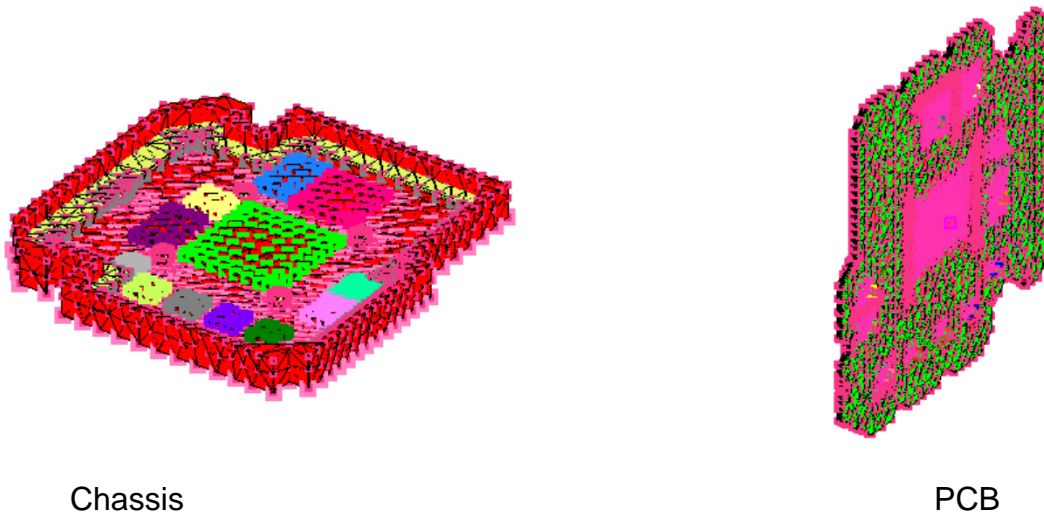


All you have to do now is solve for temperatures.

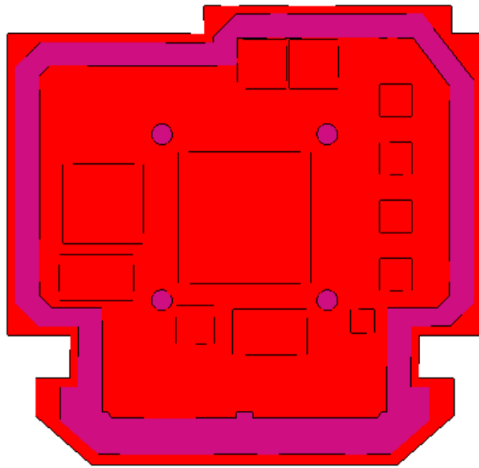


### Example 3 – Complex shapes

Below shows a tetrahedron meshed chassis and a PCB that was created by SolariaPCB.



The left picture below shows the chassis, red, with IntelliMesh surfaces, purple. On the underside of the PCB on the right are IntelliMesh surfaces.

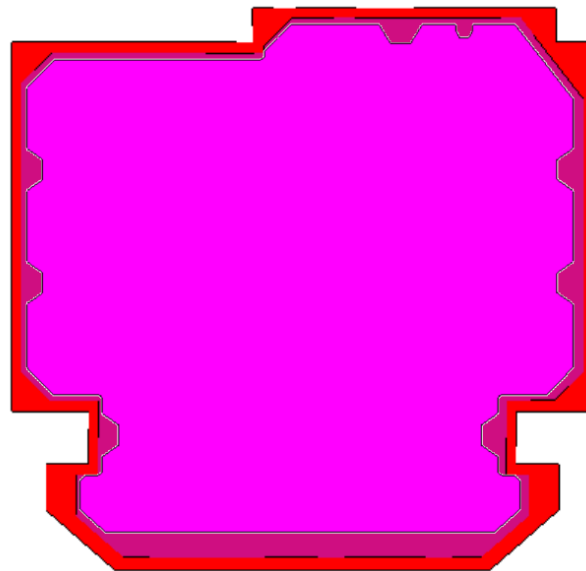


Chassis



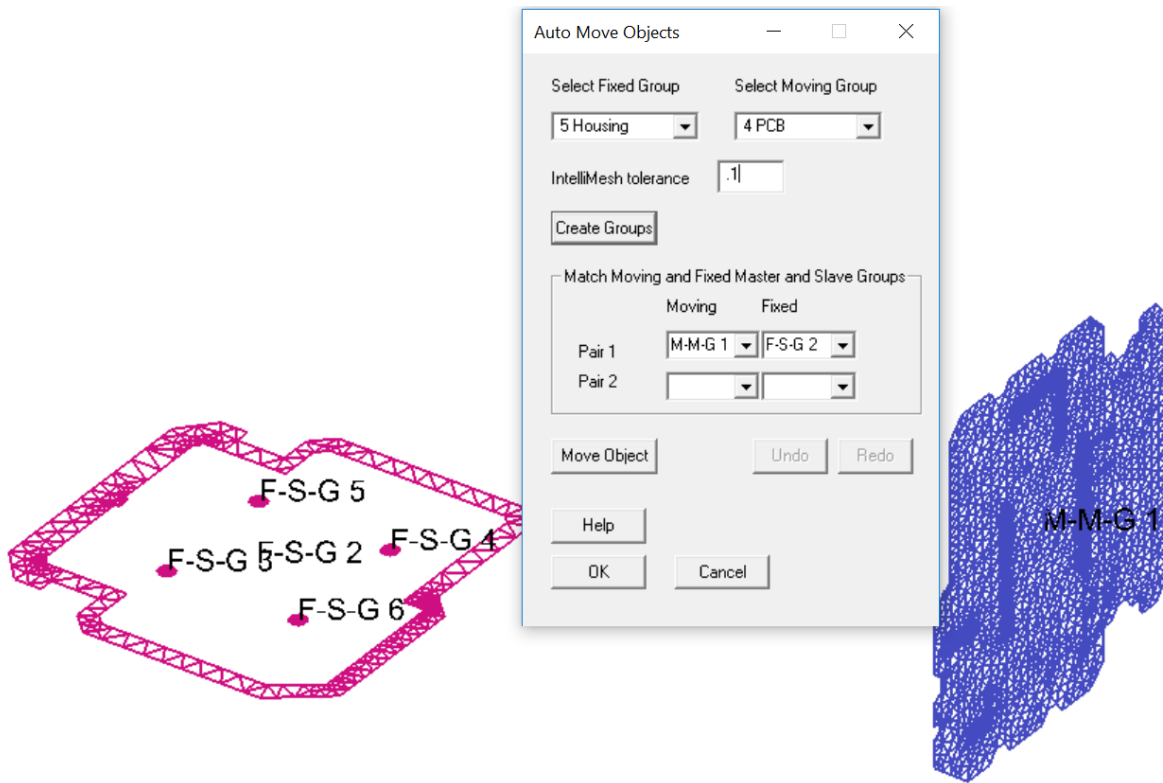
PCB

The goal is to rotate and move the PCB into the correct place within the chassis.

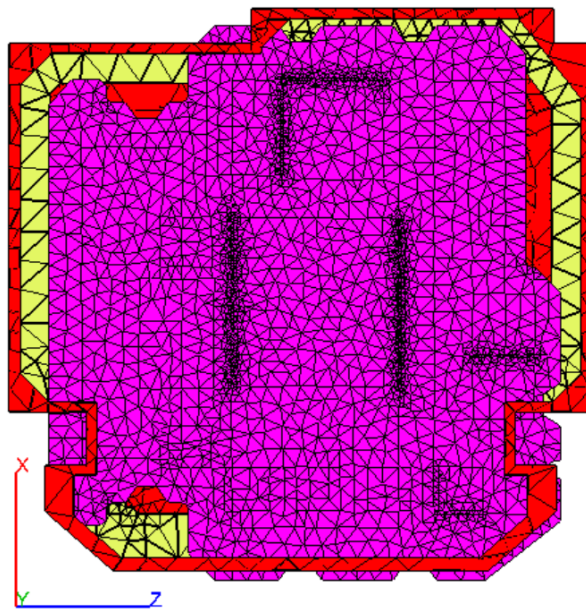


Chassis and PCB merged

In the Auto Move Objects dialog, the Housing and PCB Groups were selected then the **Create Groups** button was hit. Since there is only one Move IntelliMesh group, it was automatically selected. IntelliMesh group F-S-G-2 was selected for the Fixed group. The IntelliMesh group name is located at the geometrical center of the IntelliMesh, therefore at the center of the PCB. The **Move Object** button was next hit.

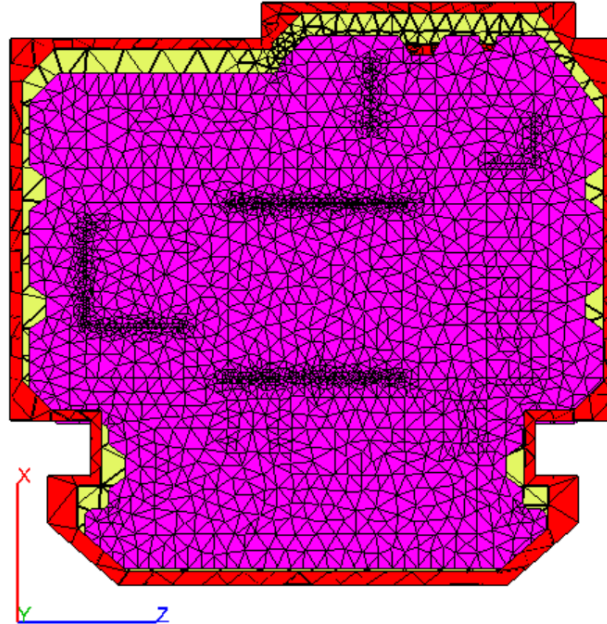


It is obvious from the picture below that the in-plane rotation based on the logic given earlier was incorrect. But the IntelliMesh are facing each other correctly and they are the correct distance apart. The PCB just needs to be rotated about the Y axis positive 90 degrees. This is easily done manually.





Display only the PCB Group. Now select **Edit>Copy and Rotate**. Select **Rotate about the Y axis** and enter 90 degrees for the rotation. Be sure to check **Rotate Nodes**. Now check **Select Rotation Axis** and then click on a node at the center of the PCB. Hit the **Select** button the box in the entire PCB. When you view the entire model, you will probably see something like that below. It will be rotated differently depending on the node selected.



Now the PCB needs to be moved very slightly. There is a little known feature in Solaria called **Edit>Grab and Pull**. It is used to select Nodes and manually, using the mouse, move the nodes selected. Since we can visually see where the PCB needs to be, it is perfect for this operation.

Put into a Group just the PCB. Select **Edit>Grab and Pull**. Hit the **Select** button and box in the PCB. Now view the entire model by selecting **Group>Echo All**, while leaving the **Grab & Pull** dialog up. Hold the left mouse button down and slowly and carefully drag the PCB into place, resulting in yellow around the PCB as shown below.

