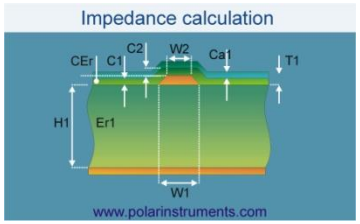
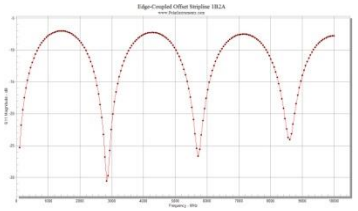
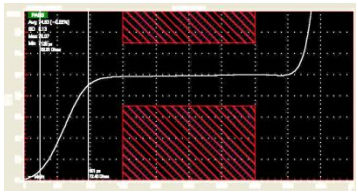
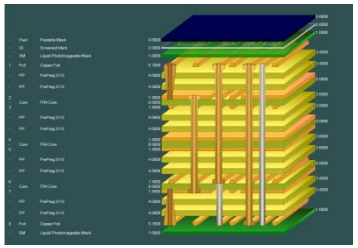
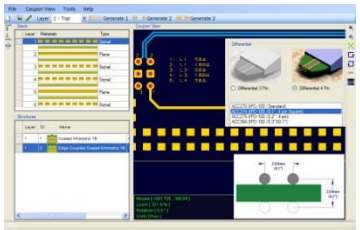










Building stackups using the Materials Library

Richard Attrill - August 2013

Welcome to Speedstack

This tutorial is one of a series of documents that will help guide you through the process of building stackups using Speedstack. The other modules in the series are as follows:

Module 1: Getting Started Guide

Module 2: Building stackups using the Materials Library

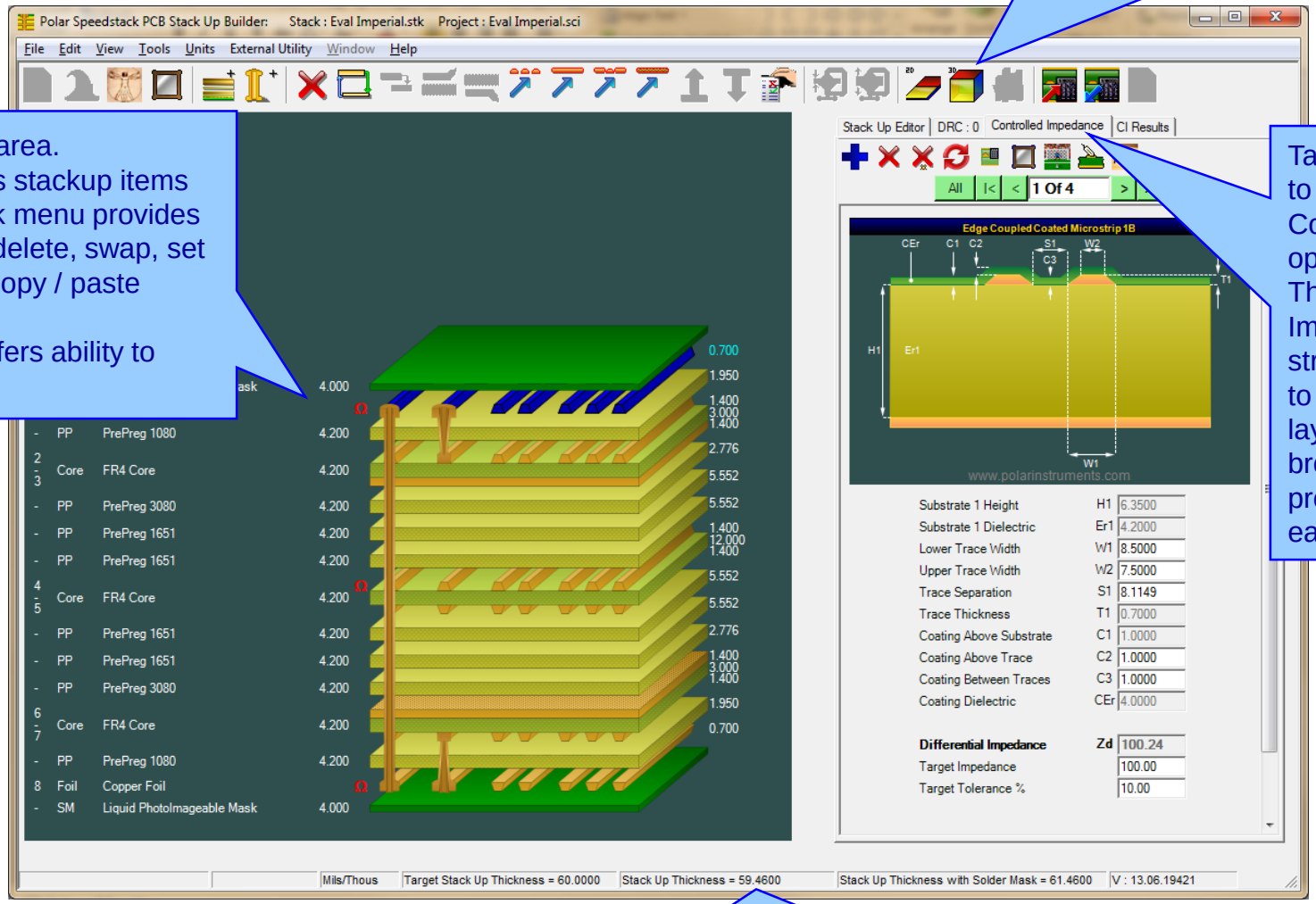
Module 3: Building a rigid-flex construction

Speedstack – Introducing the interface

Toolbar provides access to commonly used functions included add, delete and swap materials.

Stack up editor area.
Left-click selects stackup items (blue), right-click menu provides options to add, delete, swap, set properties and copy / paste materials.
Mouse wheel offers ability to zoom in / out

Tabs provide access to Stackup, DRC and Controlled Impedance options.
The Controlled Impedance tab allows structures to be added to the stack on a per layer basis. The browser buttons provide access to each structure



Stack up thickness can be monitored via the status bar

Building a stackup from scratch using the Materials Library

The following slides will guide you through the process of creating an 8 layer stackup. The stack has the following specification:

Units: Mils

Number of Layers: 8

Target stackup Thickness: 60 mils ± 10%

Signal Layers: 1, 3, 6, 8 Plane Layers: 2, 4, 5, 7. Symmetrical build

Material: Standard FR4, nominal dielectric constant ~ 4.2

Preferred Core Thickness: 8 mils

Copper Thickness: All layers 1oz copper, 1.4 mils

Building a stackup from scratch using the Materials Library (continued)

Solder Mask: Covering outer layers, 1 mil

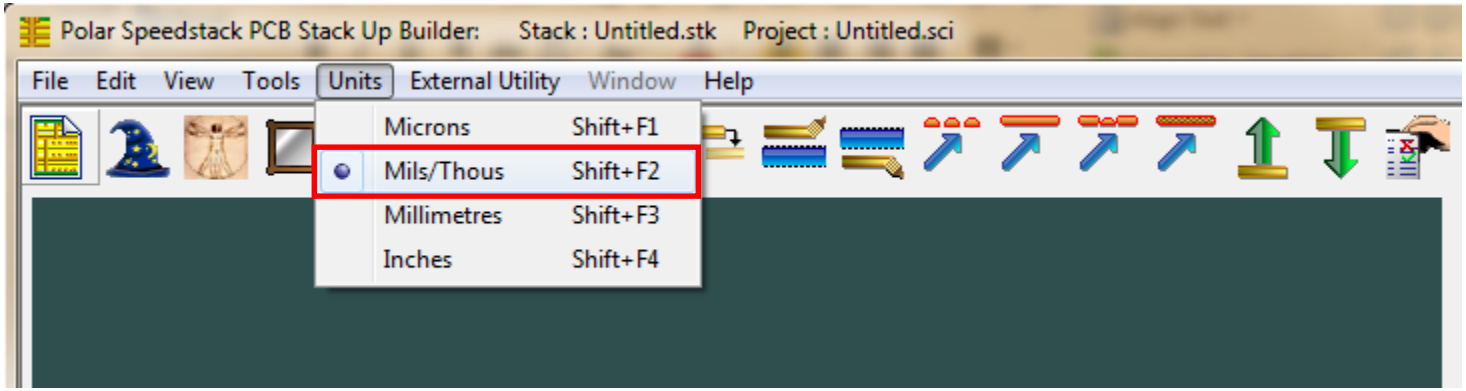
PTH drill passes: layers 1 – 8

Singled-ended impedance: 50 ohms ± 10% on layers 1, 3, 6, 8

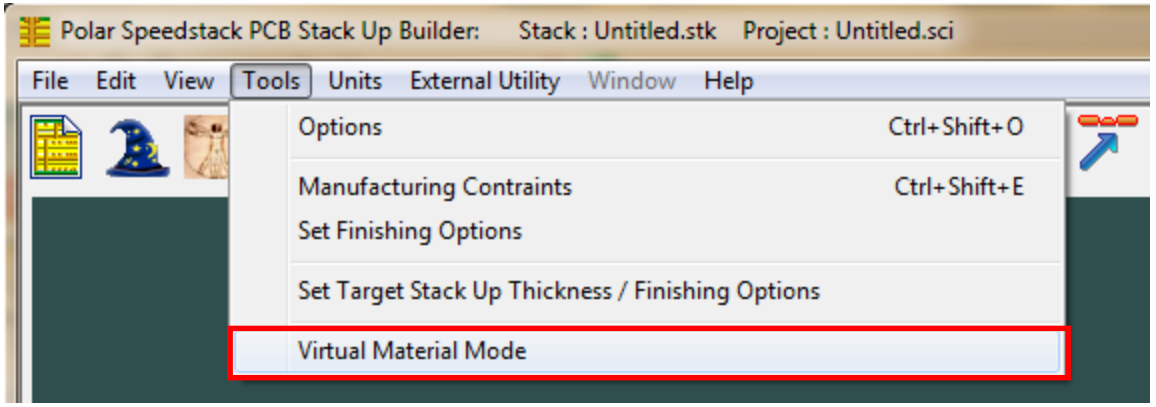
Differential impedance: 100 ohms ± 10% on layers 1, 3, 6, 8

Step 1: Setting the Units and Materials Library Mode

From the Units menu select the ‘Mils/Thou’ option

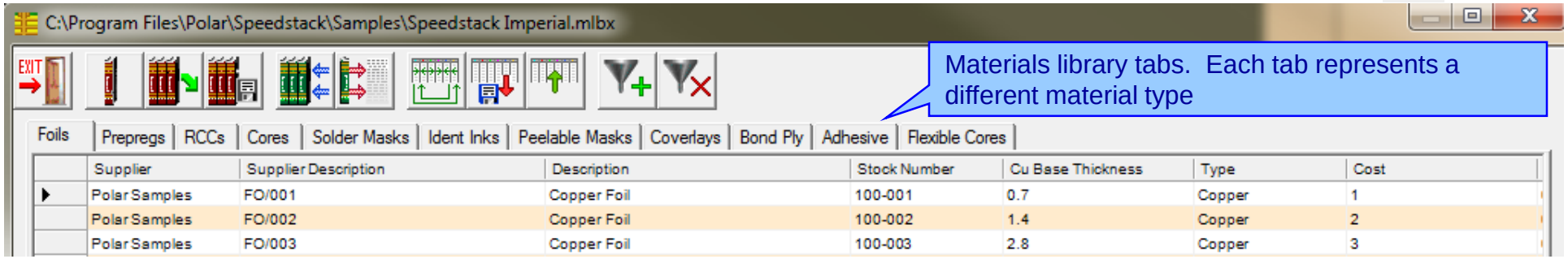


From the Tools menu de-select the ‘Virtual Material Mode’ option, this will enable Materials Library Mode. Note the enabled icon 



Step 2: The Materials Library Mode

The Materials Library is accessed by using the toolbar icon 



The library is divided into 11 material types, each type is accessible by selecting the appropriate tab. For this tutorial we will use the Polar Samples library that is supplied with Speedstack, but you may prefer to add your own materials.

It is also possible to import / export libraries in CSV format in order to access data from other systems 

Step 2: The Materials Library Mode – Material Partners

Through our Material Partners Program we are able to supply Speedstack material libraries from a number of PCB laminate vendors.

ARLON MATERIALS FOR ELECTRONICS

DOOSAN Electro-Materials

DU PONT®

GORE

isola

nelco® Subsidiary of Park Electrochemical Corp.

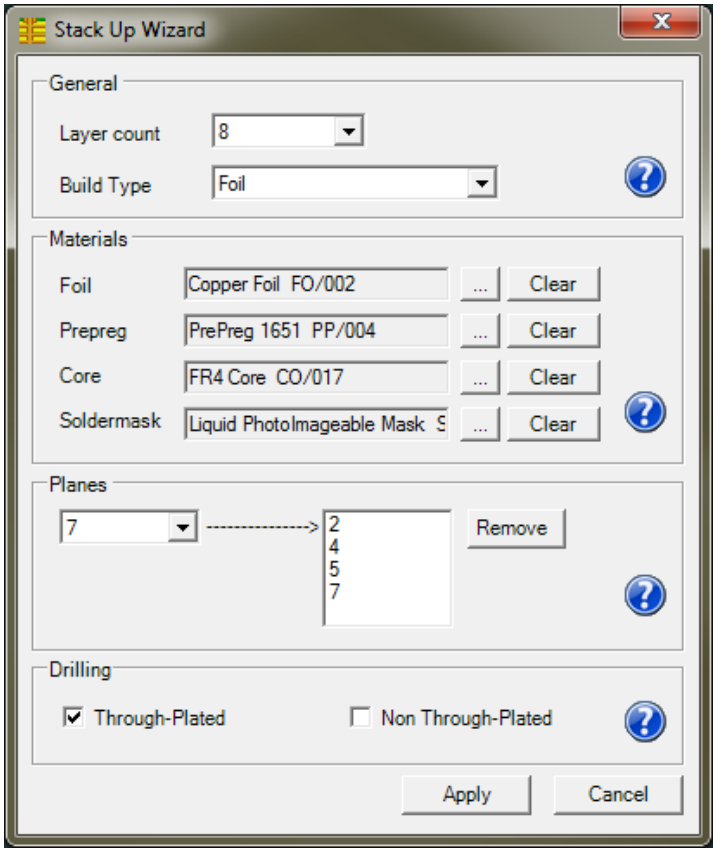
For a full list of Material Partners please visit:

http://www.polarinstruments.com/products/stackup/material_partner.html

Step 3: Using the stackup Wizard to rapidly build the stackup

Select the StackUp Wizard toolbar icon 

- Enter the Stack Data as previously described in the stack up specification
- By selecting the ... option for the Foil, Prepreg, Core and Solder Mask material types it is possible to nominate the preferred Material Library items to be used in the stackup
- The Plane Layers may be selected by choosing each layer, 2, 4, 5 and 7
- Under Drilling, check Through-Plated
- Once the fields are populated select the Apply button



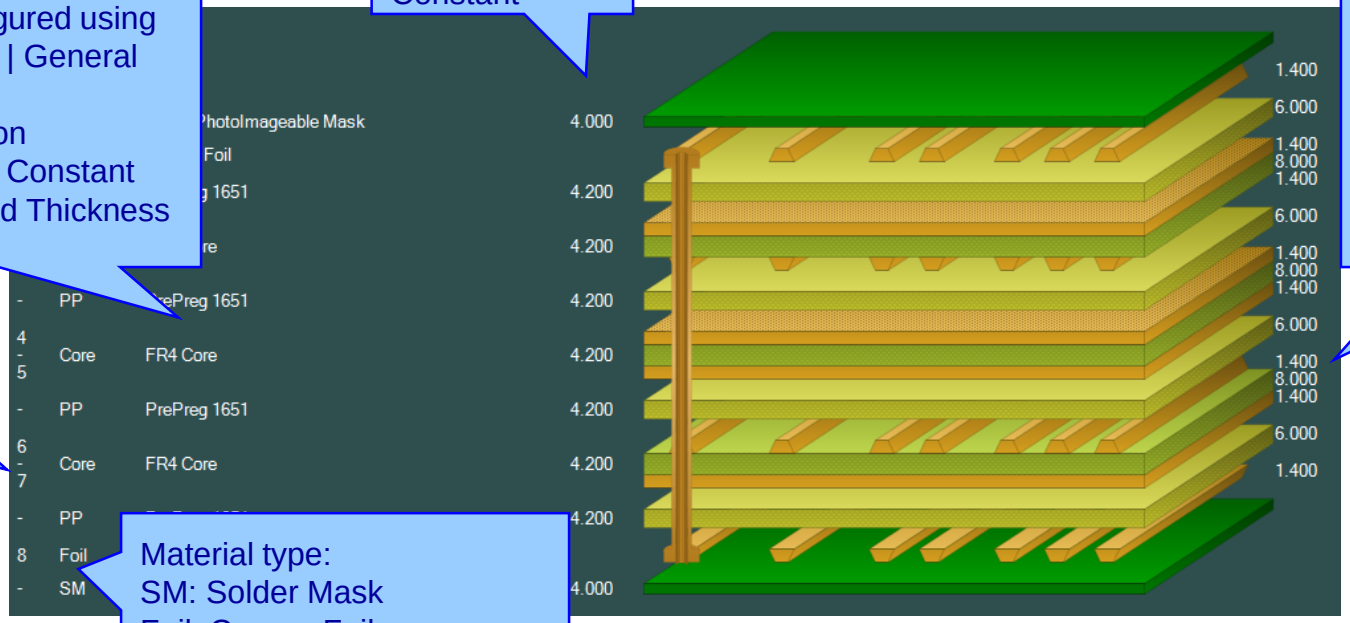
Step 3: Using the Stackup Wizard (continued)

An option to enter the stackup properties can be skipped

The stackup created by the Wizard will now be displayed

Configuring the display.
The fields displayed next to the stack can be configured using the Tools | Options | General tab. In this case:
Field 3 = Description
Field 4 = Dielectric Constant
Field 5 = Processed Thickness

Dielectric Constant



Processed Thickness:
Copper Finished Thickness
Dielectric Isolation Distance

Stack Up Thickness =
Copper Finished Thickness+
Dielectric Isolation Distance

Electrical Layer Number

Material type:
SM: Solder Mask
Foil: Copper Foil
PP: Prepreg (dielectric)
Core: Copper clad dielectric

Step 4: Saving the Speedstack project

Now that a stack has been created we can save it

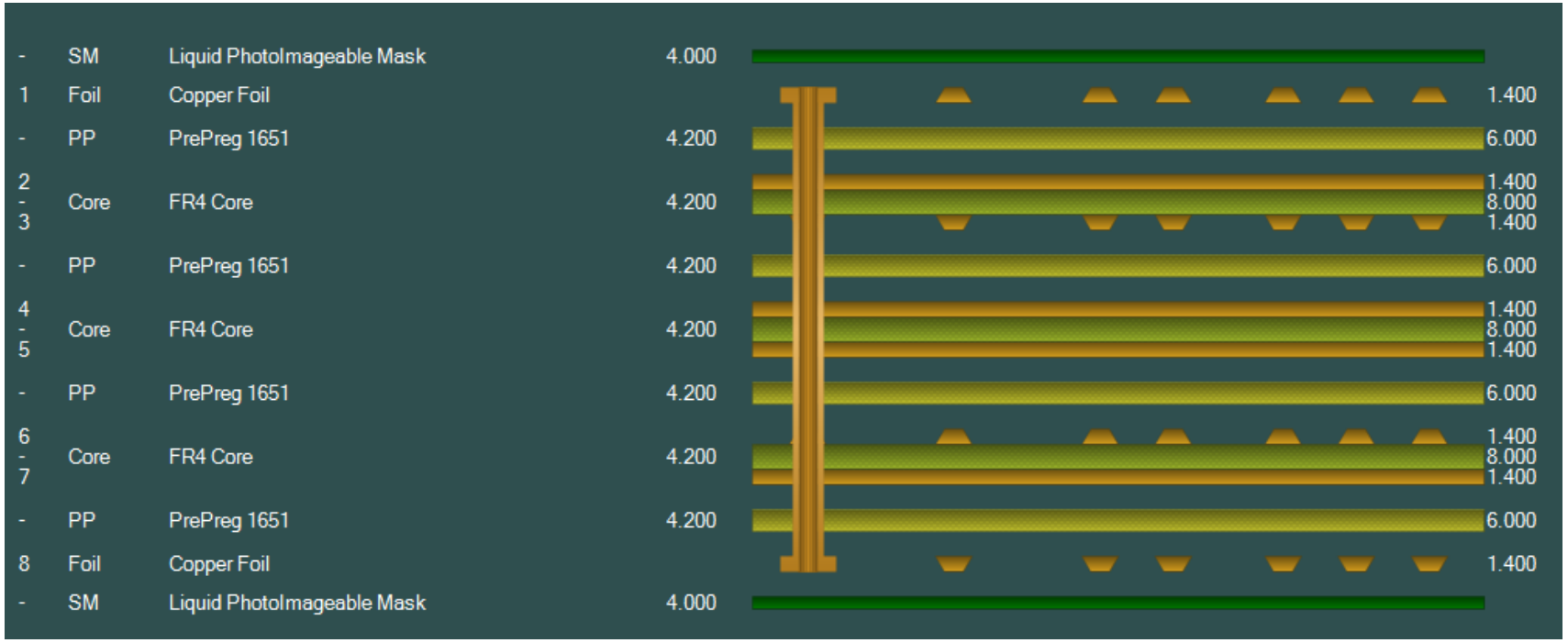
Use the File | Save Project As menu option and specify a filename

The filename will have a .SCI extension, recognisable by this icon 

Step 5: Switching between 3D and 2D display modes

It is sometimes easier to view stackup in 2D by selecting 

This will result in the following stackup display



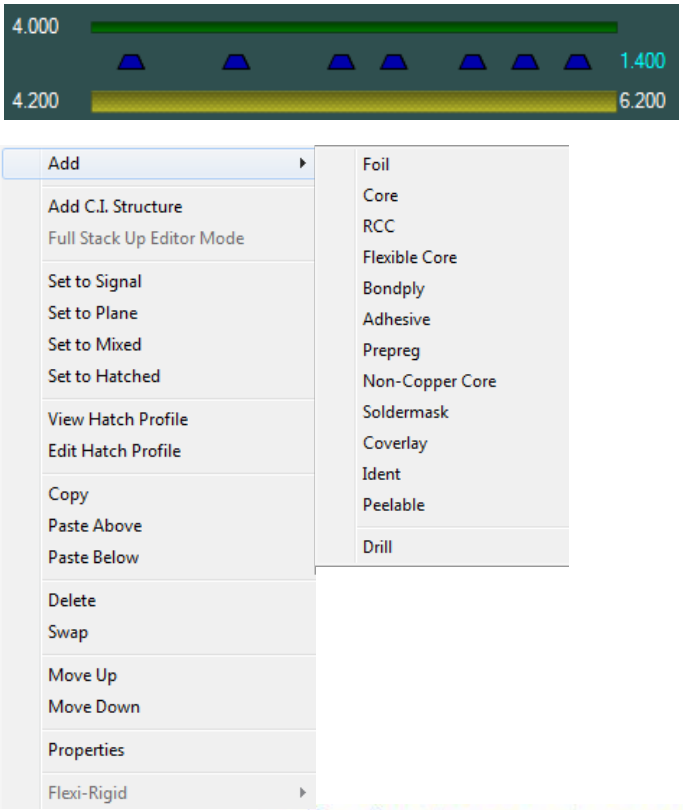
The 3D display mode can be activated by selecting 

Step 6: Editing the stackup

Once the stackup has been created using the Wizard it is possible to make changes on a per material basis using the various editing functions

- Click on the material that you wish to edit
- Selected material will highlight in blue
- Use the right-click menu and select option or use toolbar icons

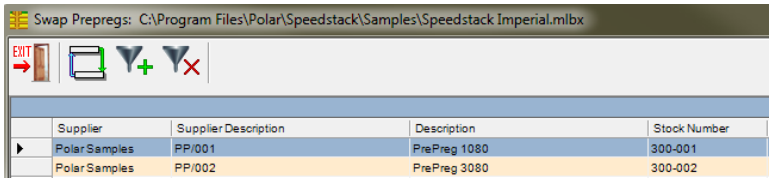
  Full details of the Speedstack editing functions can be found in the ‘Getting Started Guide’



Step 7: Swapping Materials

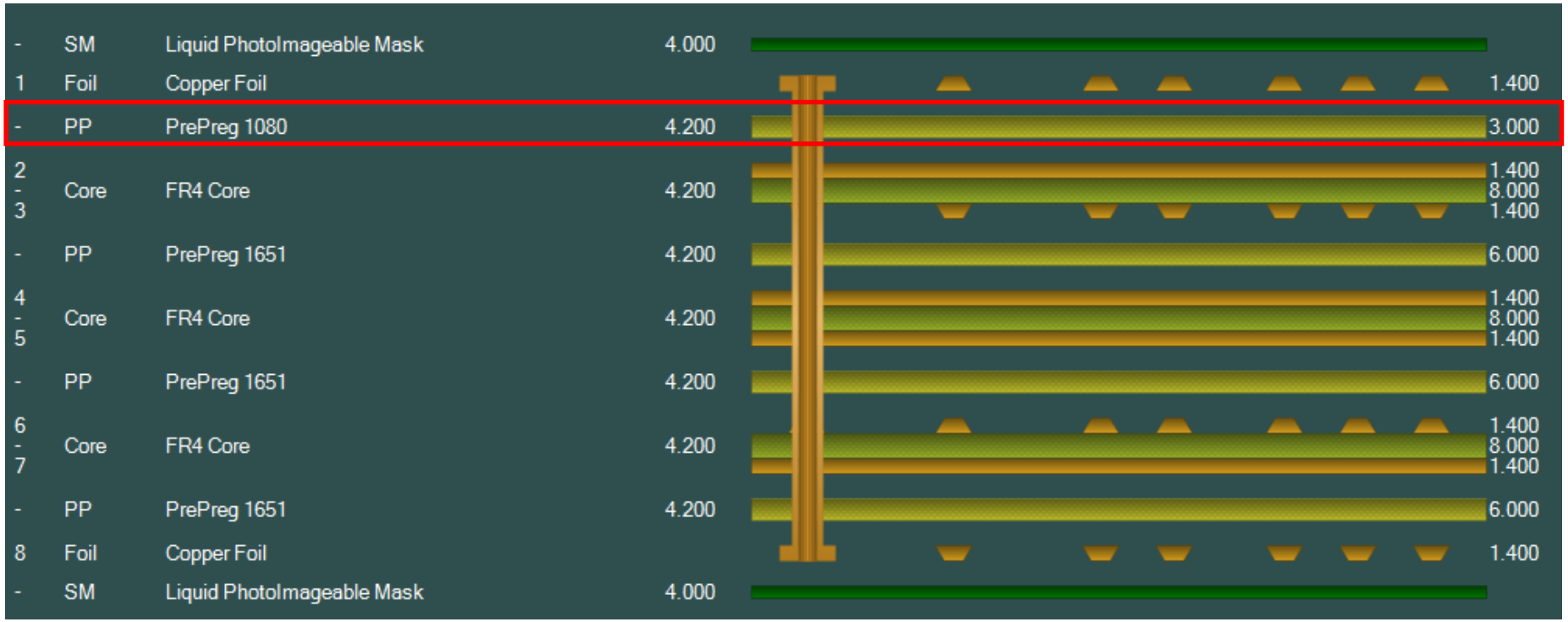
When designing stackups it is quite a common requirement to swap one set of materials for another

- Select the material that you wish to swap, in this case Prepreg 1651
- Selected the Swap option
- Choose the new item, in this case a Prepreg 1080 material
- Confirm the Swap, the existing material will now be swapped



Step 7: Swapping Materials (continued)

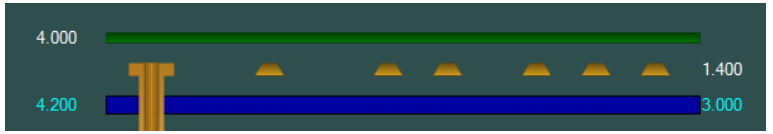
The stackup will now display the Prepreg 1080 in place of the original Prepreg 1651



Step 8: Using Copy / Paste to make rapid stack changes

It is possible to duplicate materials within the stack using the Copy / Paste functionality

- Select the material that you wish to copy, in this case Prepreg 1080 that was swapped into the stack during step 7



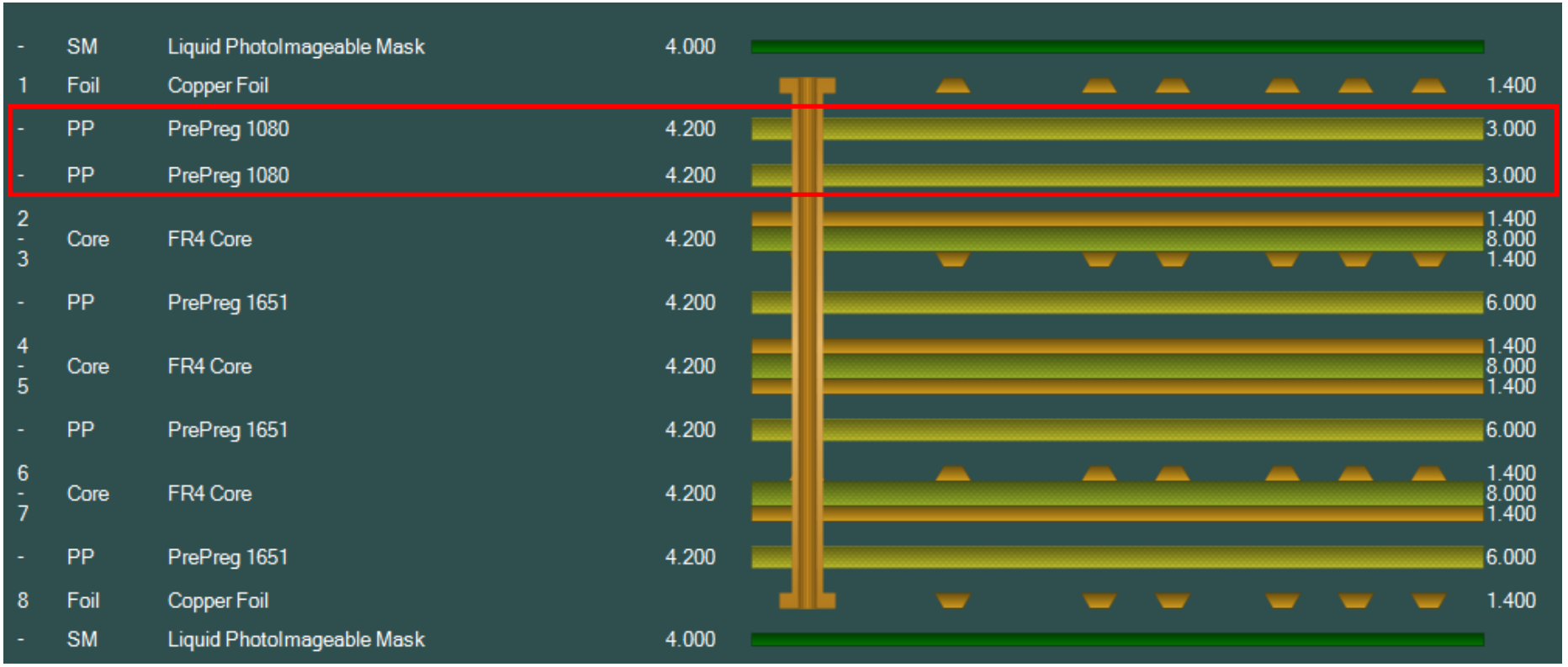
- Selected the Copy option

- Select the material in the stack immediately above where you wish to paste the Prepreg 1080

- Select the Paste Below option

Step 8: Using Copy / Paste to make rapid stack changes (cont'd)

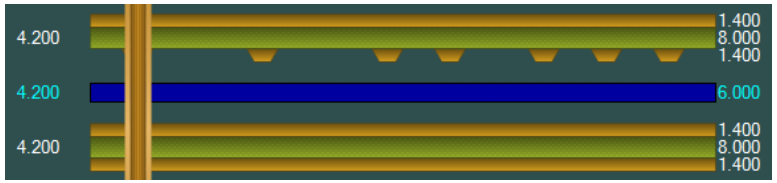
Notice that there are now two Prepreg 1080 materials between electrical layers 1 and 2



Step 9: Deleting materials

Deleting unwanted items can be required when they have been replaced with alternative items

- Select the material that you wish to delete, in this case Prepreg 1651 that exists between layers 3 and 4

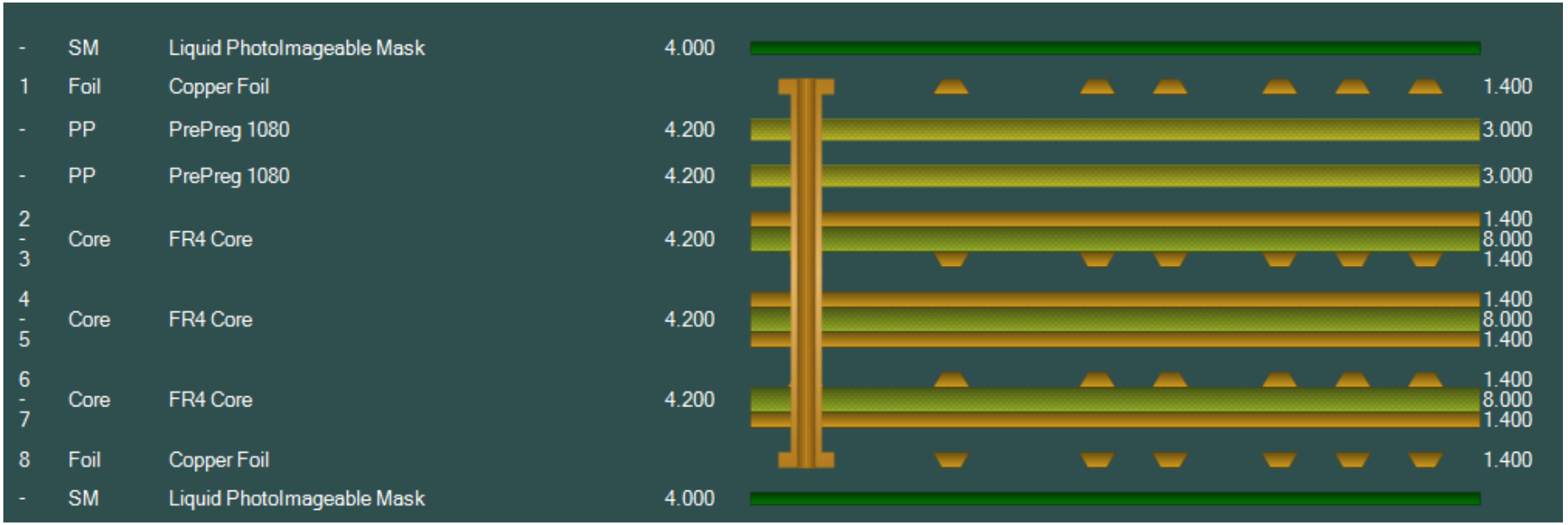


- Selected the Delete option

- Notice that the material is removed
- Repeat this process for the two remaining Prepreg 1651 materials that exists between layers 5 – 6 and 7 - 8

Step 9: Deleting materials (continued)

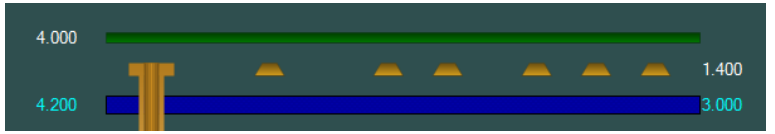
At this stage all remaining PrePreg 1651 materials have been removed from the stackup



Step 10: Using Copy / Paste to complete the stack

It is now possible to duplicate Prepreg 1080 material within the stack using the Copy / Paste functionality

- Select the material that you wish to copy, in this case Prepreg 1080



- Selected the Copy option

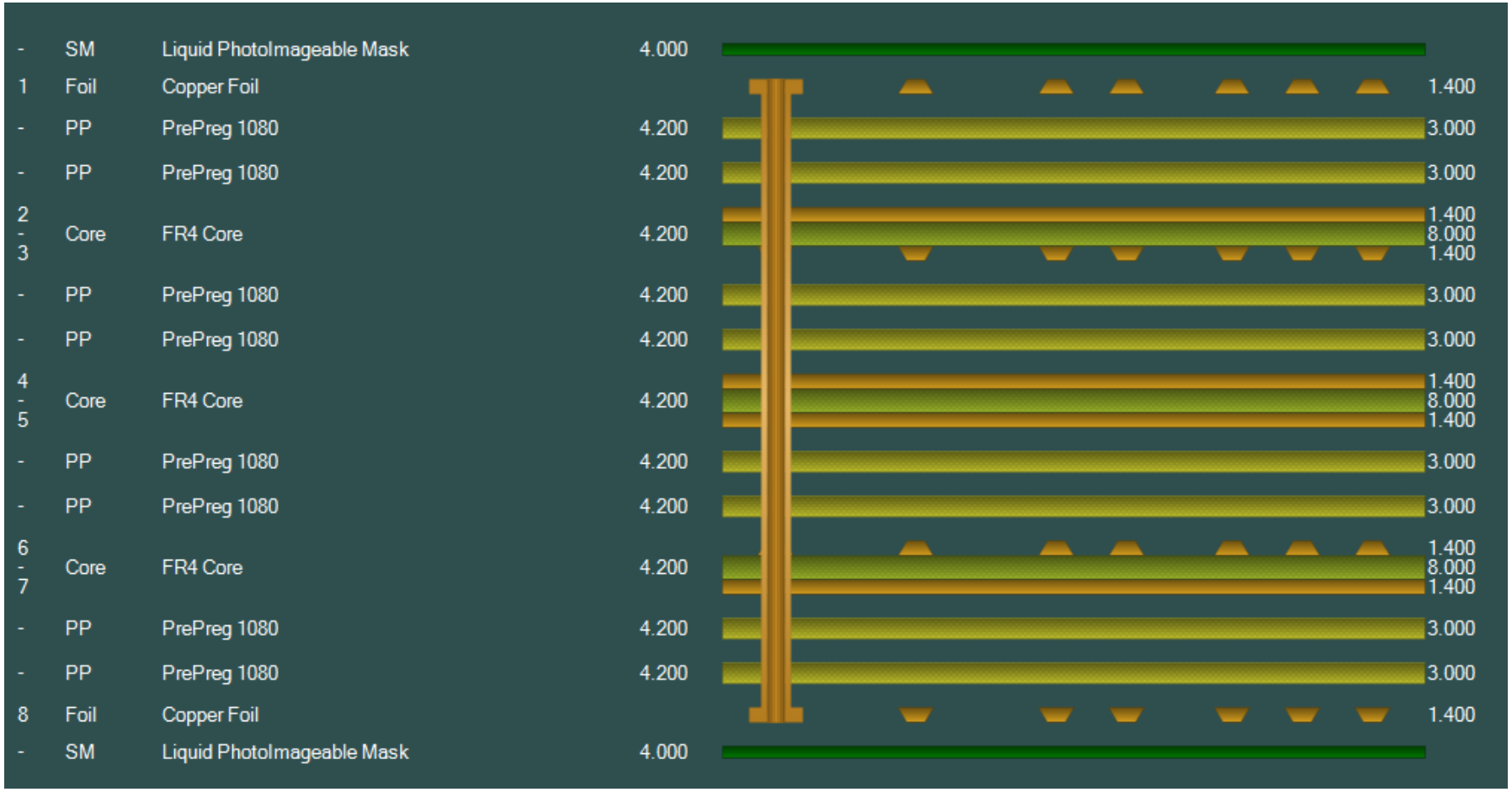
- Select the material in the stack immediately above where you wish to paste the Prepreg 1080

- Select the Paste Below option

- Repeat this process between layers 5 – 6 and 7 – 8

Step 10: Using Copy / Paste to complete the stack (continued)

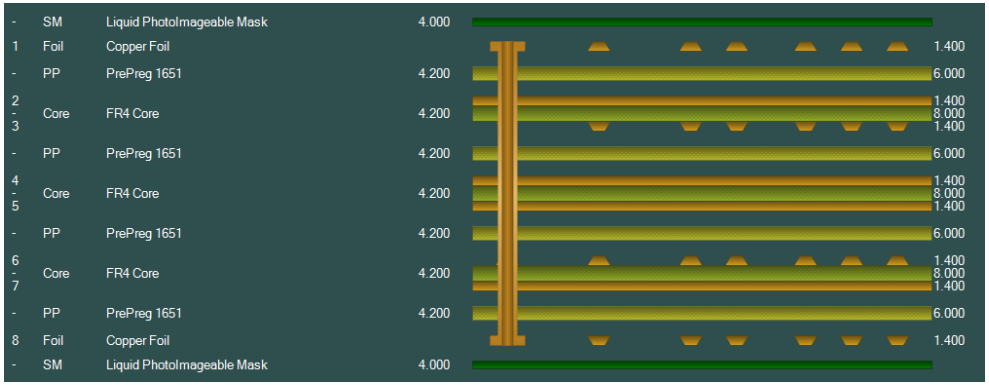
Here is the final stack using Prepreg 1080 materials throughout



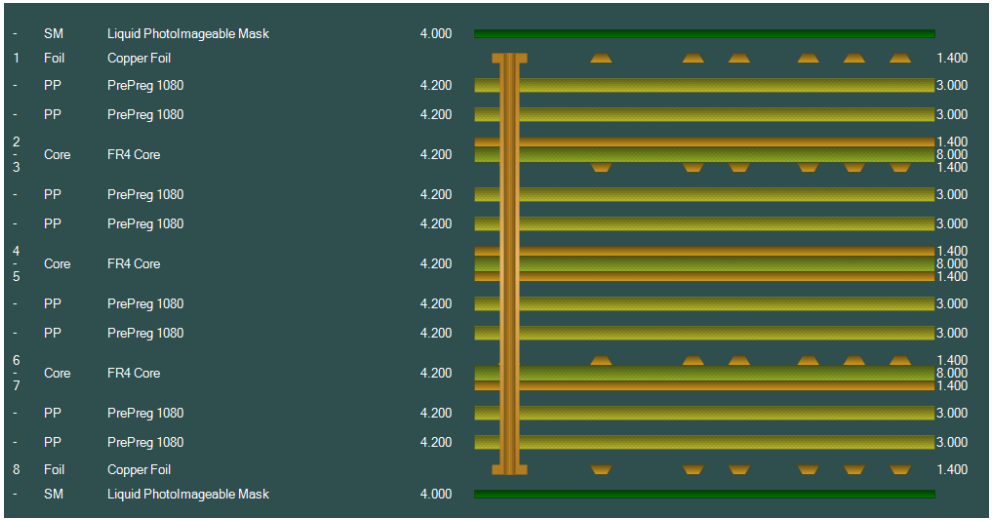
Step 10: The completed stackup

The Stackup Wizard allows you to quickly build a stackup by selecting the preferred materials from the library. Once the stack is built it is possible to quickly modify the stack by swapping materials and using the copy / paste facilities to duplicate existing preferred materials.

Stack up generated by Wizard

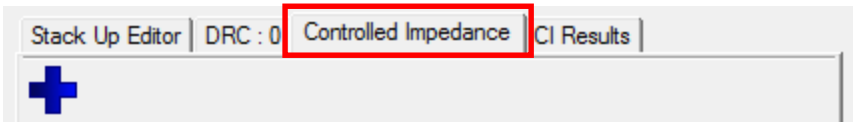


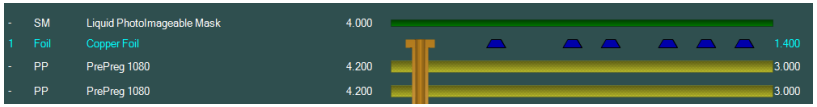
Modified stack to meet final requirements

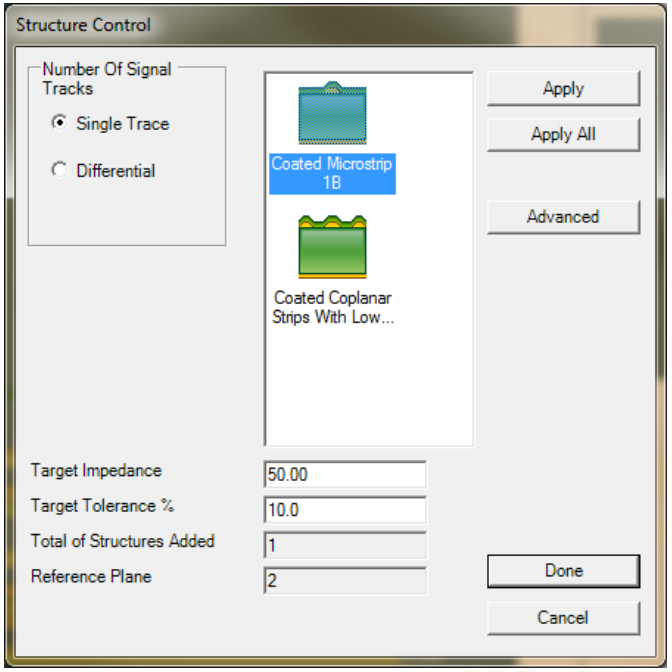


Step 11: Adding impedance structures

- Select the Controlled Impedance tab
- Click on the signal layer of the stack where the structure is to reside, in this case layer 1
- Select ✚ to add a structure, the Structure Control dialog will be displayed. Only structures appropriate to layer 1 will be offered.
- Enter Target Impedance and Tolerance as shown, select ‘Coated Microstrip 1B’ icon, Apply and then Done to dismiss dialog



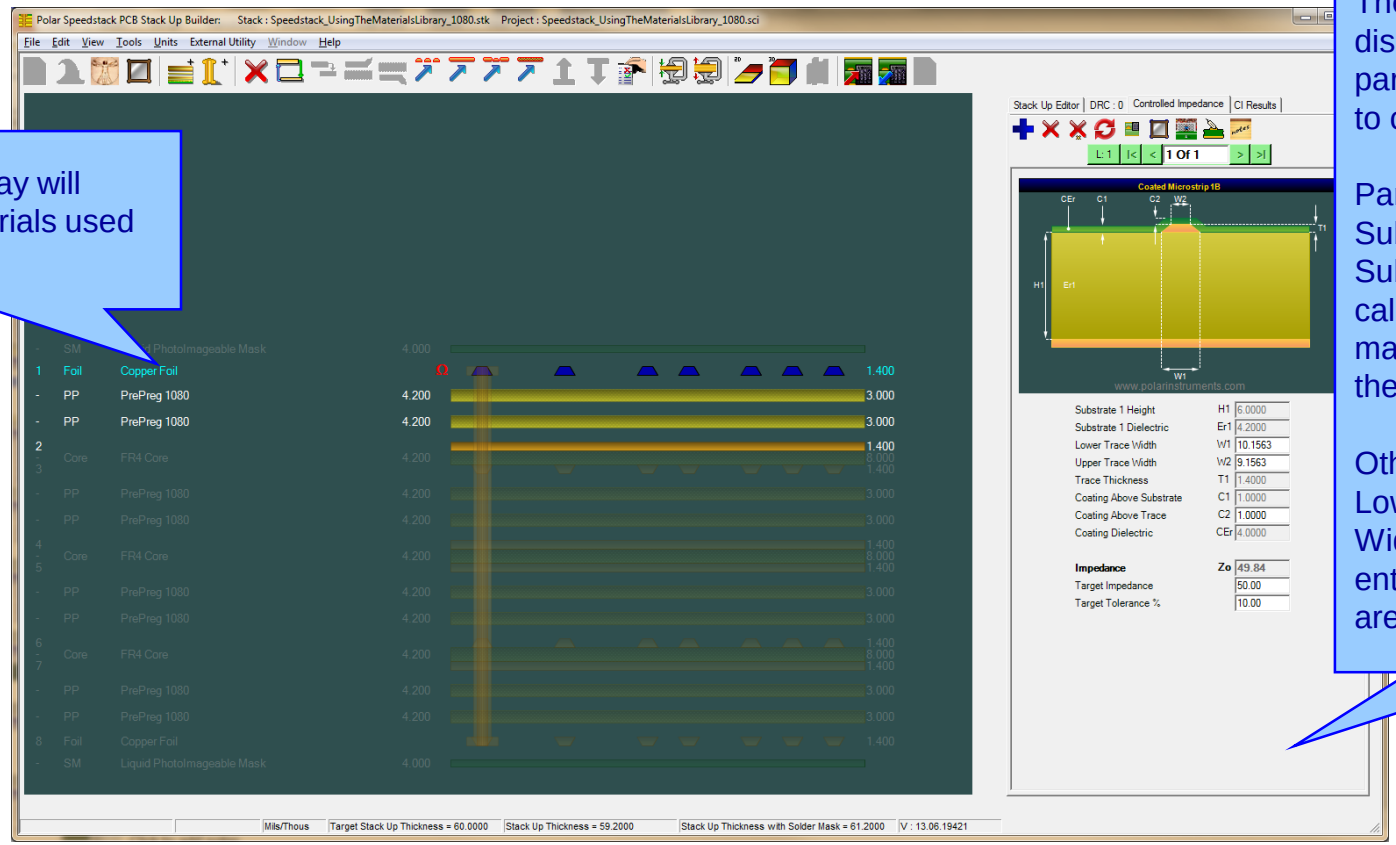




Step 11: Adding impedance structures (continued)

The new structure will appear on the controlled impedance tab

The stackup display will highlight the materials used by the structure



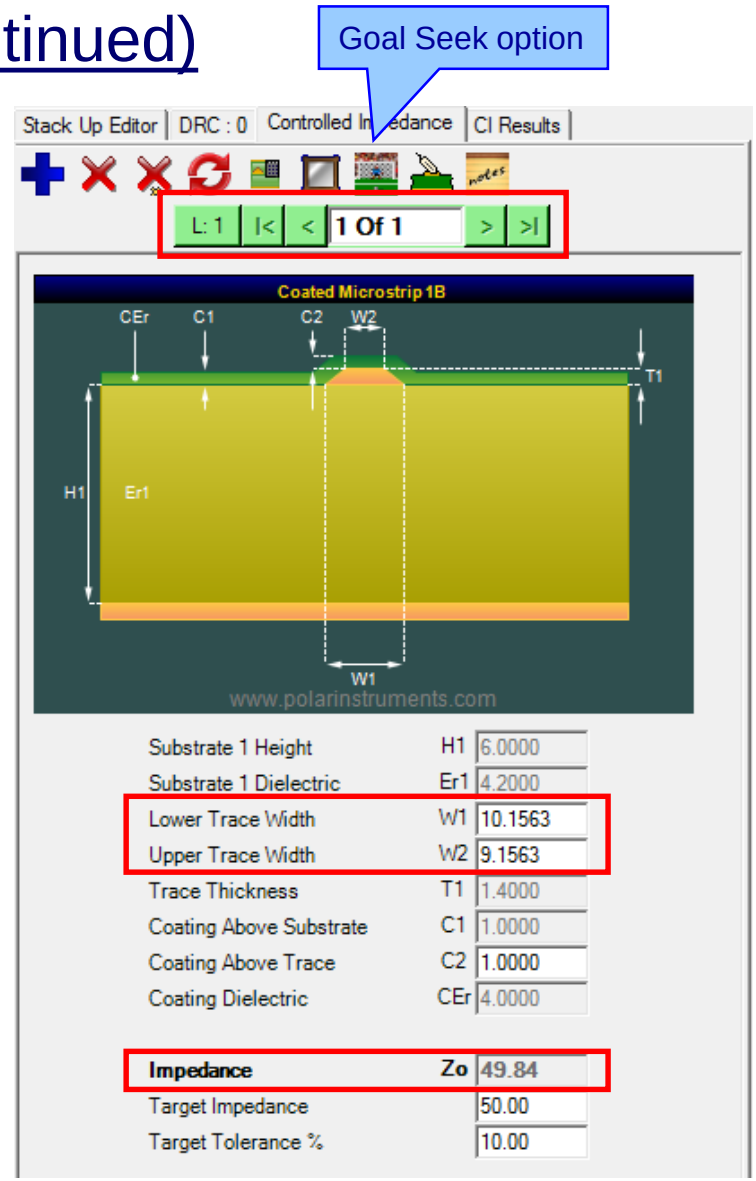
The structure image is displayed together with the parameters that are required to calculate the impedance.

Parameters such as Substrate Height (H1) and Substrate Dielectric (Er1) are calculated from the stackup materials used. Therefore, they are read-only.

Other parameters such as Lower and Upper Trace Widths (W1 / W2) may be entered by the user, these are read/write fields.

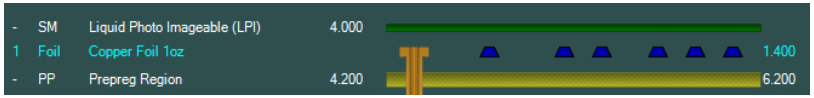
Step 11: Adding impedance structures (continued)

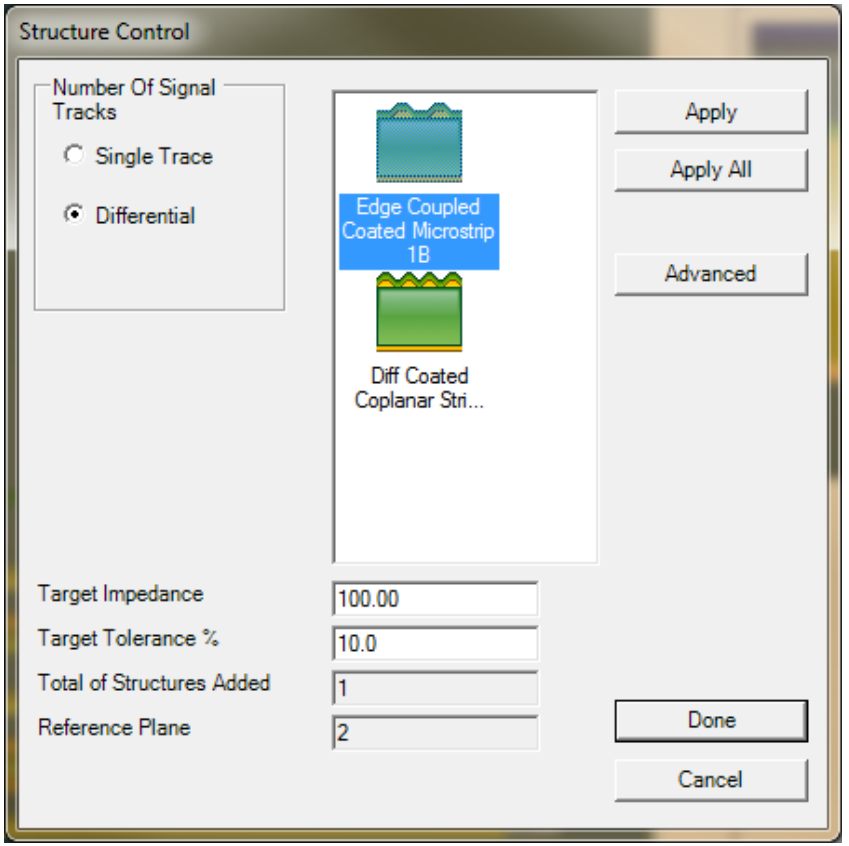
- Key in the desired trace widths
- Click on the to Rebuild and Calculate the impedance structures
- Notice that the Impedance (Zo) result updates
- Use the option to Goal Seek parameter(s) in order that the Target Impedance is met. Select ‘W1 / W2 only’ and watch Speedstack adjust these parameters to achieve the 50 ohms Target Impedance
- Notice that the trace widths (W1/W2) and the impedance results (Zo) updates
- Green indicator denotes within tolerance



Step 11: Adding impedance structures – differential

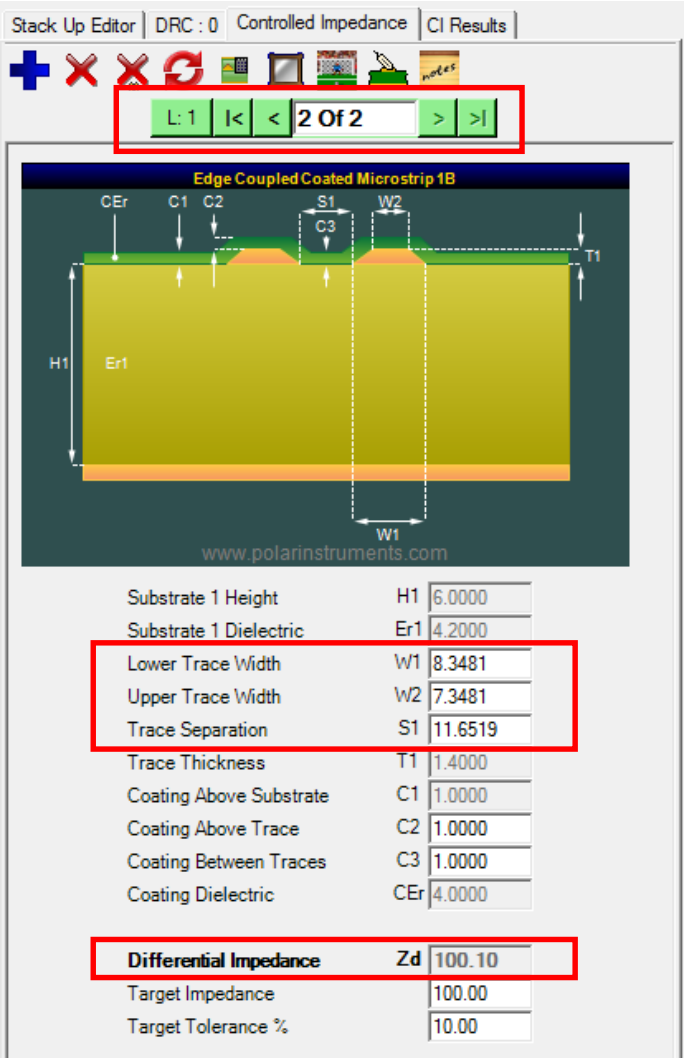
- Click on layer 1 of stack
- Select ✚ to add a structure, select Differential, enter Target Impedance and Tolerance as shown, choose ‘Edge Coupled Coated Microstrip 1B’, Apply and then Done to dismiss dialog
- The differential structure will be added to the stack. Notice that this is structure 2 of 2.





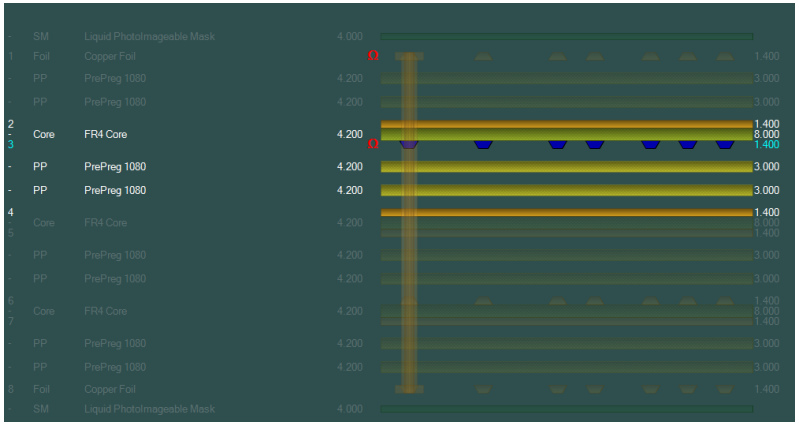
Step 11: Adding impedance structures - differential

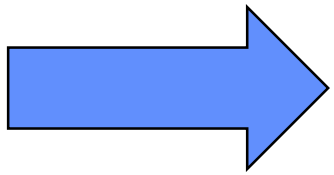
- Key in the desired trace widths / separation
- Use the  option to Goal Seek parameter(s) in order that the Target Impedance is met. Select ‘W1 / W2 constant pitch’ and watch Speedstack adjust these parameters to achieve the 100 ohms Target Impedance
- Notice that the trace widths and separation (W1 / W2 / S1) and the impedance results (Zd) updates
- Green indicator denotes within tolerance

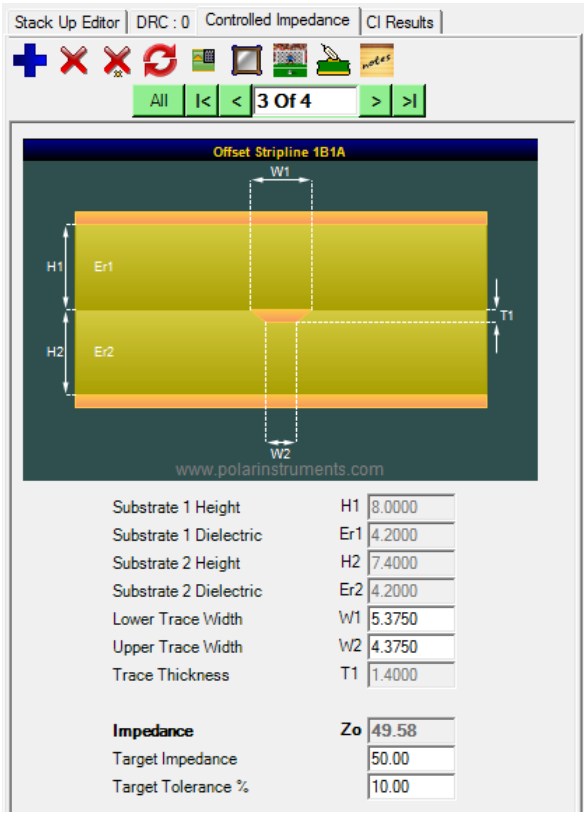


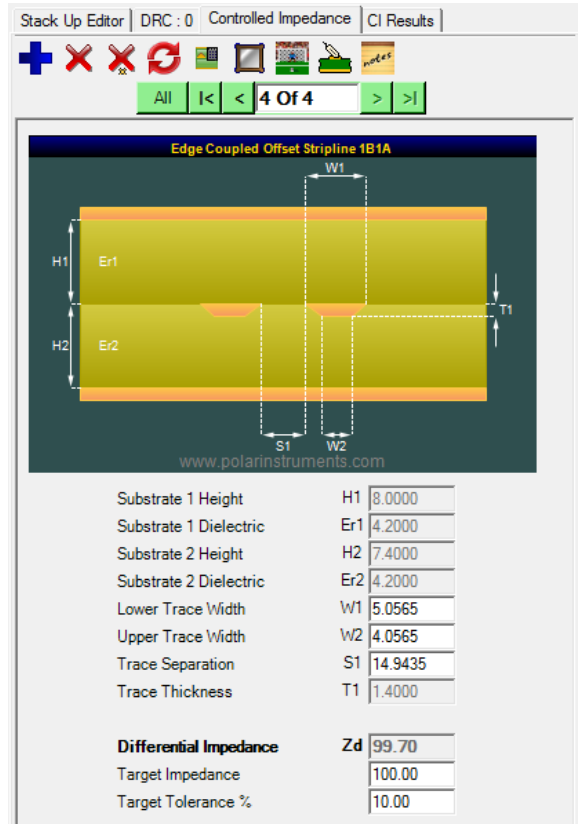
Step 11: Adding impedance structures – layer 3

Follow the same process to add single-ended 50 ohms and differential 100 ohms structures to layer 3.



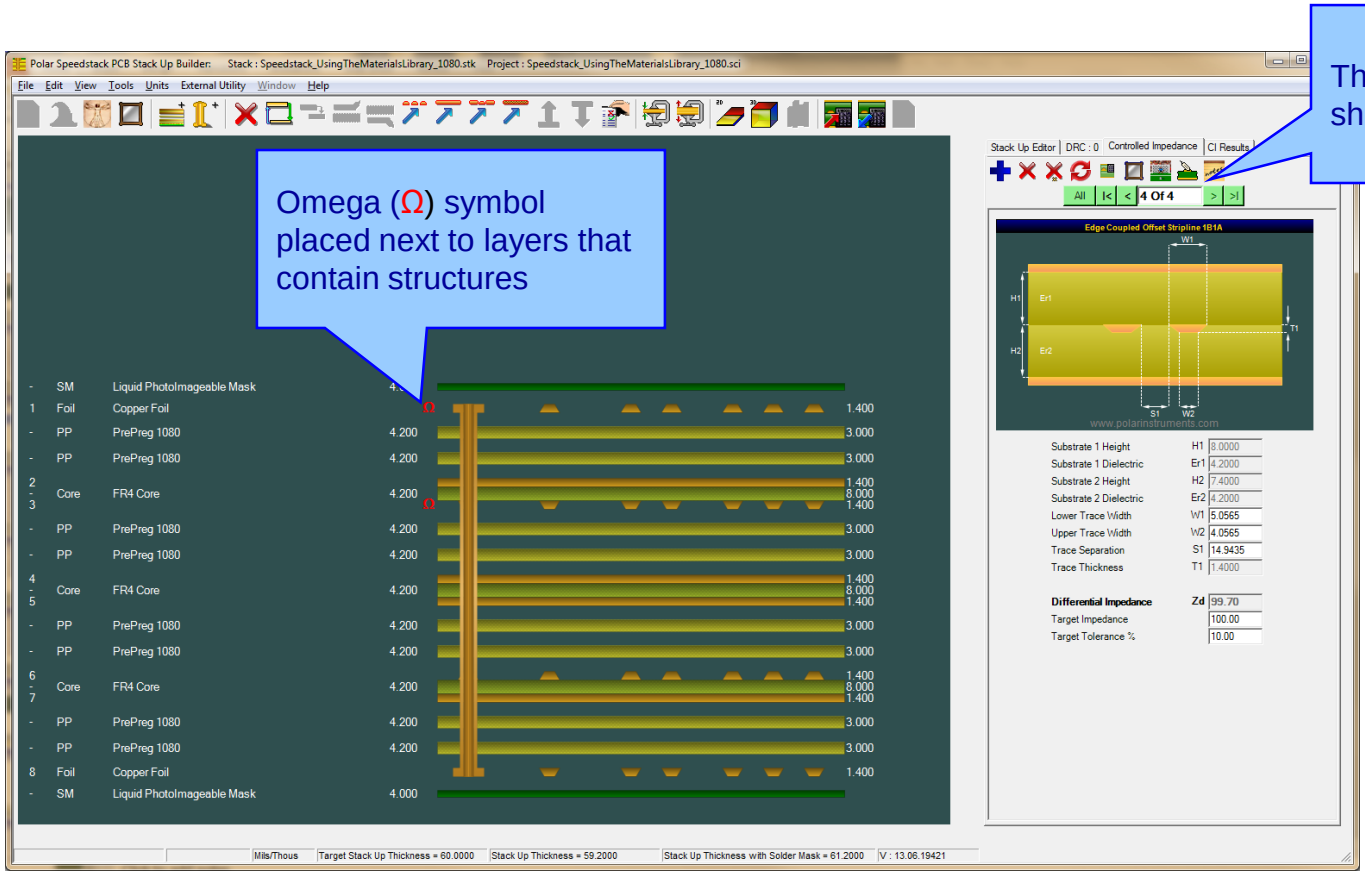






Step 11: Adding impedance structures

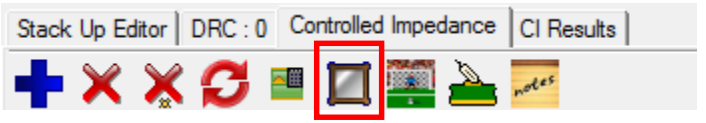
At this point we have four structures, two on layer 1, two on layer 3

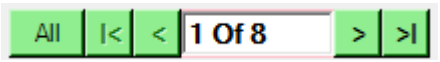


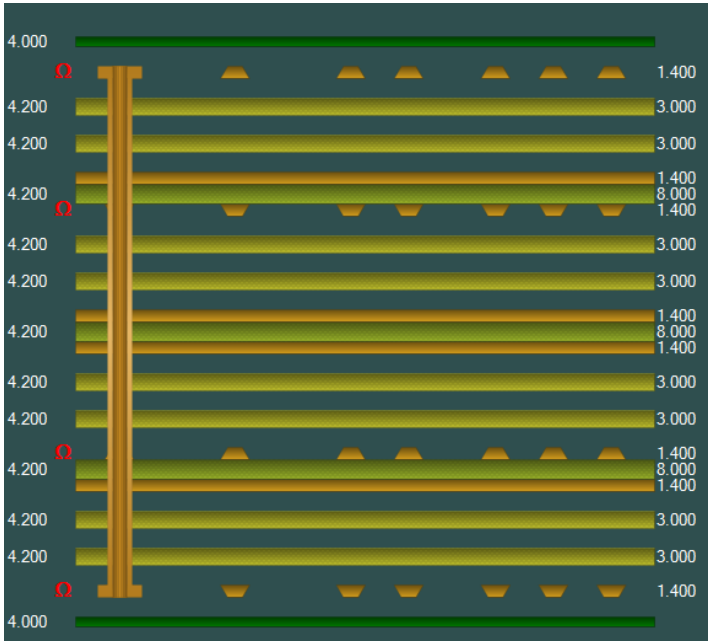
Step 11: Adding impedance structures – mirroring structures

- As the stack is symmetrical, selecting ‘Mirror Structures’ will place four more structures on the lower half of the stack
- At this point the structure browse control will display eight structures in total
- The Ω symbol is now placed next to layers 1, 3, 6, 8

- This is an appropriate stage to save the stackup project as described in Step 4

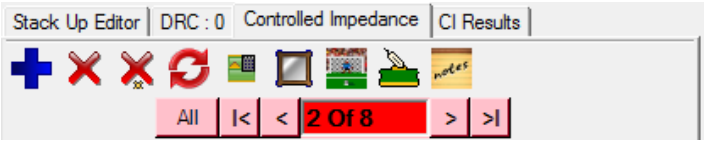






Step 12: Impedance structures – other information

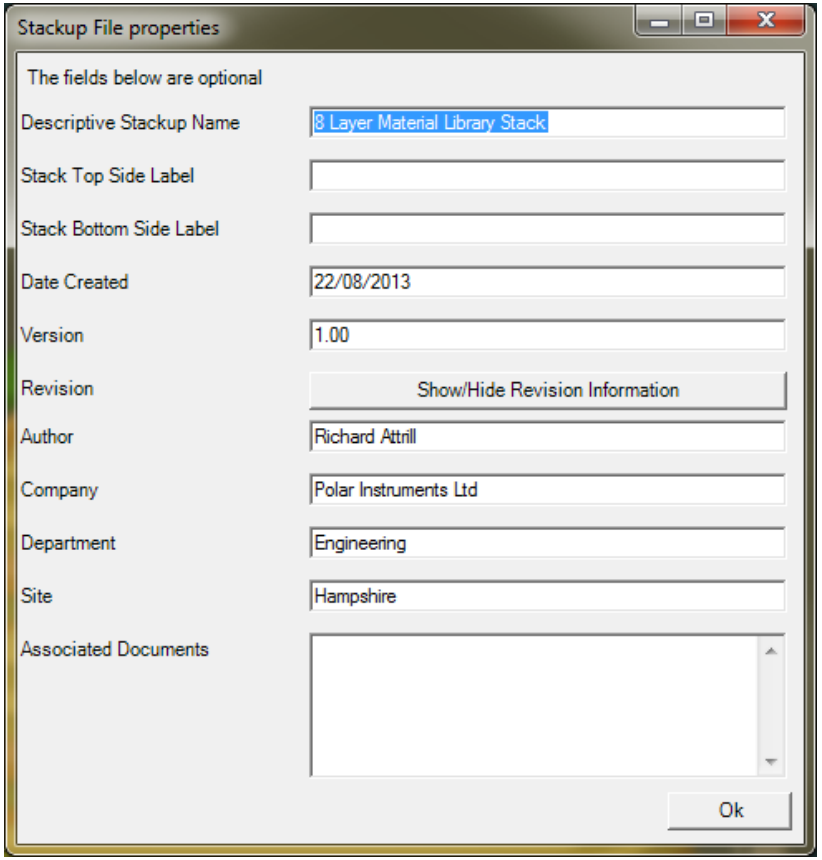
- If changes are made to the stackup that effect the impedance structures, a ‘Rebuild’ warning is displayed
- Click on the  to rebuild the structures with the latest stackup information and re-calculate the impedance results
- If the structure browse control indicator displays red it denotes a structure impedance result outside tolerance. In this case structure 2 of 8. This usually can be resolved by using the Goal Seeking function to adjust trace widths / separation



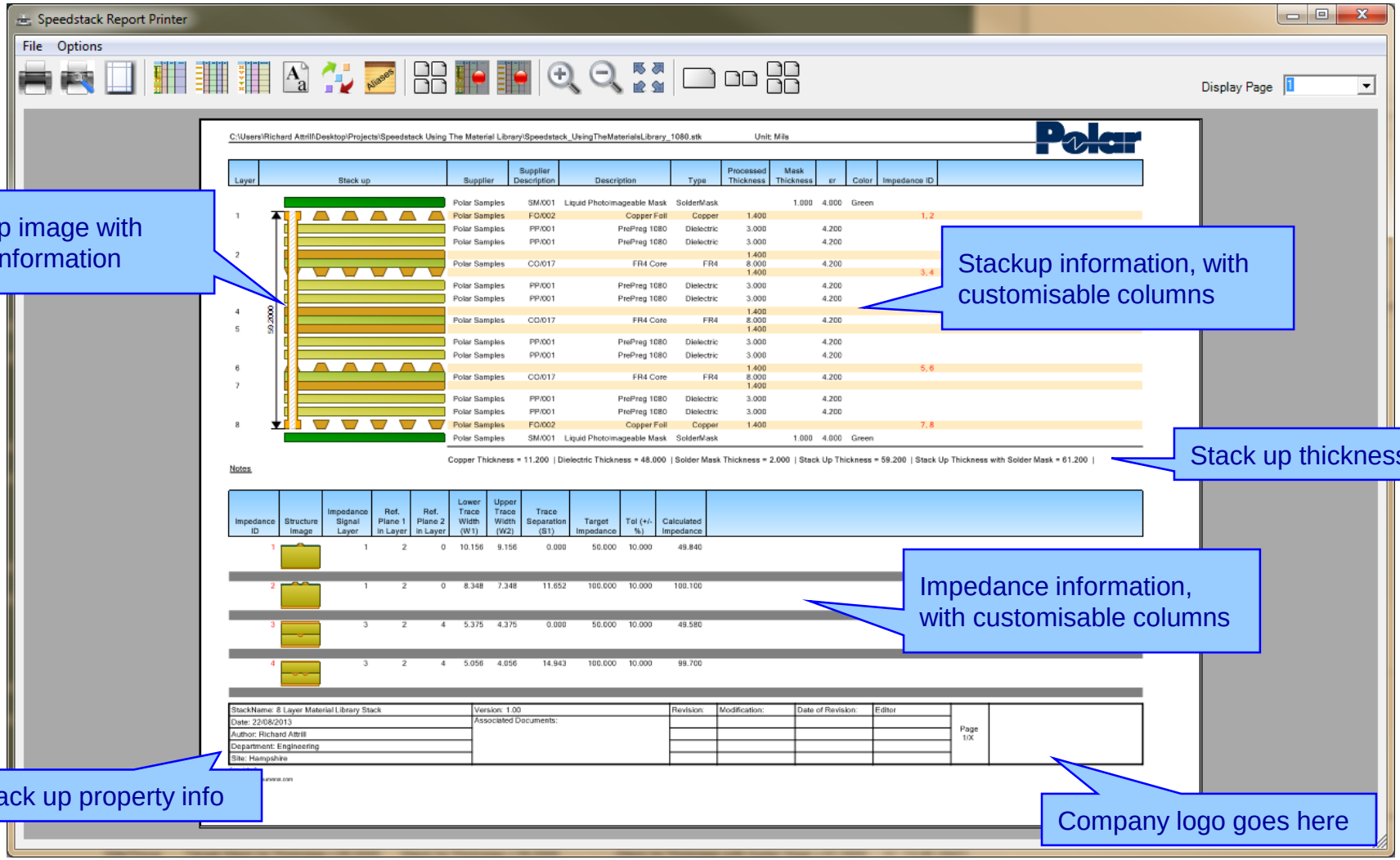
Step 13: Printing a technical report

The 8 layer stackup within drilling and impedance structure information is now complete, the final step is to generate a technical report

- Use the File | Properties option to add useful information about the stackup, such as descriptive stackup name, date created, author and company information
- Load the Technical Report option by using the File | Print | Technical Report

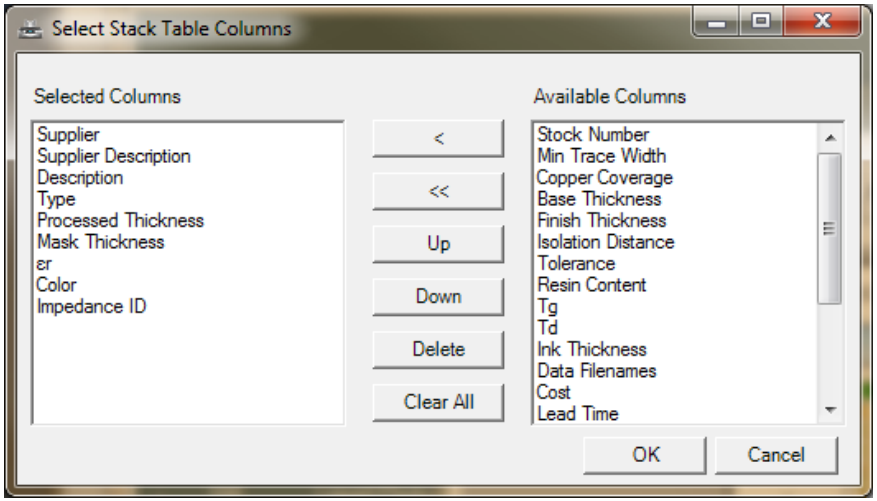


Step 13: Printing a technical report (continued)

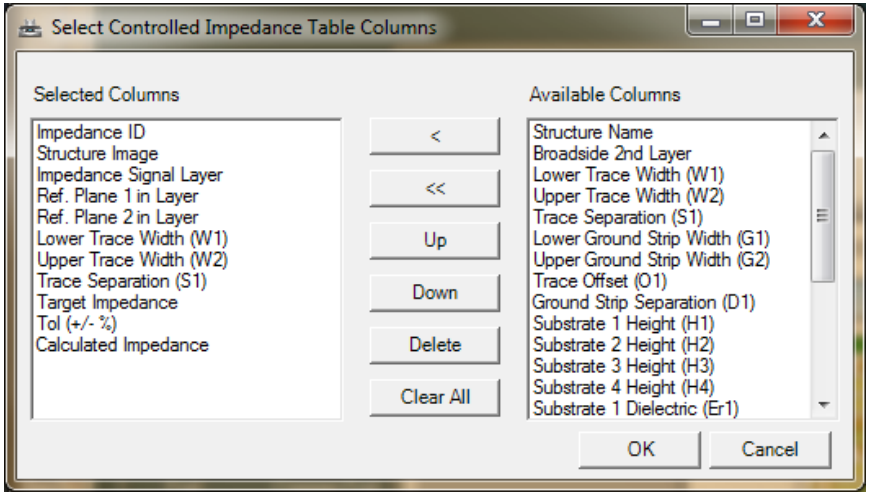


Step 13: Printing a technical report (continued)

- Use the  Select Stack Data Columns option to select the fields that you wish to print next to the stackup graphic

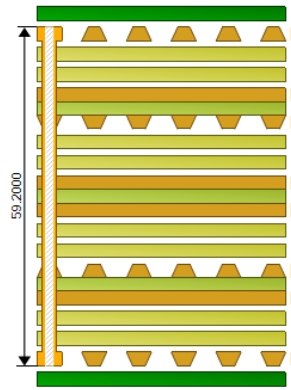


- Use the  Select Impedance Data Columns option to configure the impedance structure table



Step 13: Printing a technical report (continued) – sample output

C:\Users\Richard Attrill\Desktop\Projects\Speedstack Using The Material Library\Speedstack_UsingTheMaterialsLibrary_1080.stk Unit: Mils



Layer	Stack up	Supplier	Supplier Description	Description	Type	Processed Thickness	Mask Thickness	εr	Color	Impedance ID
		Polar Samples	SM/001	Liquid PhotoImageable Mask	SolderMask		1.000	4.000	Green	
1		Polar Samples	FO/002	Copper Foil	Copper	1.400				1, 2
		Polar Samples	PP/001	PrePreg 1080	Dielectric	3.000		4.200		
		Polar Samples	PP/001	PrePreg 1080	Dielectric	3.000		4.200		
2						1.400				
		Polar Samples	CO/017	FR4 Core	FR4	8.000		4.200		
3						1.400				3, 4
		Polar Samples	PP/001	PrePreg 1080	Dielectric	3.000		4.200		
		Polar Samples	PP/001	PrePreg 1080	Dielectric	3.000		4.200		
4						1.400				
		Polar Samples	CO/017	FR4 Core	FR4	8.000		4.200		
5						1.400				
		Polar Samples	PP/001	PrePreg 1080	Dielectric	3.000		4.200		
		Polar Samples	PP/001	PrePreg 1080	Dielectric	3.000		4.200		
6						1.400				5, 6
		Polar Samples	CO/017	FR4 Core	FR4	8.000		4.200		
7						1.400				
		Polar Samples	PP/001	PrePreg 1080	Dielectric	3.000		4.200		
		Polar Samples	PP/001	PrePreg 1080	Dielectric	3.000		4.200		
8		Polar Samples	FO/002	Copper Foil	Copper	1.400				7, 8
		Polar Samples	SM/001	Liquid PhotoImageable Mask	SolderMask		1.000	4.000	Green	

Copper Thickness = 11.200 | Dielectric Thickness = 48.000 | Solder Mask Thickness = 2.000 | Stack Up Thickness = 59.200 | Stack Up Thickness with Solder Mask = 61.200 |

Notes

Impedance ID	Structure Image	Impedance Signal Layer	Ref. Plane 1 in Layer	Ref. Plane 2 in Layer	Lower Trace Width (W1)	Upper Trace Width (W2)	Trace Separation (S1)	Target Impedance	Tol (+/- %)	Calculated Impedance
1		1	2	0	10.156	9.156	0.000	50.000	10.000	49.840
2		1	2	0	8.348	7.348	11.652	100.000	10.000	100.100
3		3	2	4	5.375	4.375	0.000	50.000	10.000	49.580
4		3	2	4	5.056	4.056	14.943	100.000	10.000	99.700

StackName: 8 Layer Material Library Stack	Version: 1.00	Revision:	Modification:	Date of Revision:	Editor	Page 1/X
Date: 22/08/2013	Associated Documents:					
Author: Richard Attrill						
Department: Engineering						
Site: Hampshire						

Copyright ©
www.polarinstruments.com

Summary

You have now completed the ‘Building stackups using the Materials Library’ tutorial.

If you have any questions please feel free to contact your local Polar office at:
www.polarinstruments.com/distrib/international_offices.html

or contact us at polarcare@polarinstruments.com

Thanks again for using Speedstack.