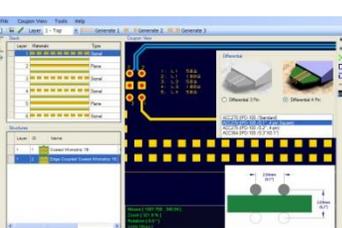
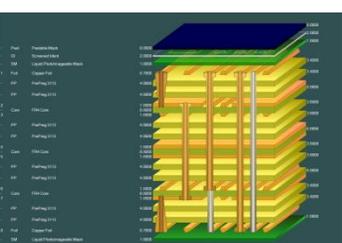
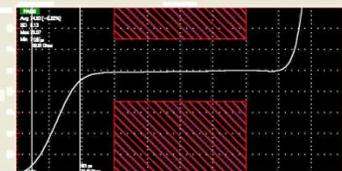
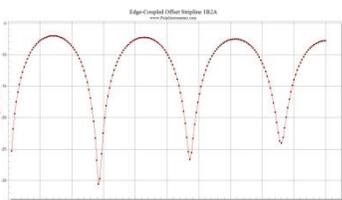
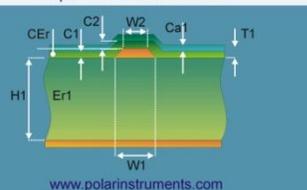


# Speedstack 2018 Introduction

Richard Attrill / John Lee – Aug 2018 (Rev 6)

## Impedance calculation



| Layer | Material                   | Thickness    |
|-------|----------------------------|--------------|
| SM    | Liquid Photoimageable Mask | 4.2          |
| 1     | Copper Foil                | PrePreg 3080 |
| 2     | PP                         | PrePreg 3080 |
| 3     | Core                       | FR4 Core     |
| 4     | PP                         | PrePreg 1651 |
| 5     | PP                         | PrePreg 1651 |
| 6     | Core                       | FR4 Core     |
| 7     | PP                         | PrePreg 1651 |
| 8     | PP                         | PrePreg 3080 |
| 9     | PP                         | PrePreg 3080 |
| 10    | Core                       | FR4 Core     |
| 11    | PP                         | PrePreg 1080 |
| 12    | PP                         | PrePreg 1080 |
| 13    | Foil                       | Copper Foil  |
| SM    | Liquid Photoimageable Mask | 4.2          |

A brief note regarding the major enhancements in Speedstack 2018.

The application and licensing changes for Speedstack 2018 are significant. If you are an existing customer currently running Speedstack 2017 or earlier, please note that all Speedstack Si and Speedstack PCB users in an organisation will need to simultaneously upgrade in order to use the 2018 license.

Importantly, as Speedstack allows comprehensive bidirectional copy and paste into Si8000m / Si9000e and CGen it is important that all products are updated to the 2018 editions at the same time.

During 2018 there have been four releases of Speedstack.

### V18.08 (August)

- Import and export for industry-standard IPC-2581 Rev B files
- Eight new coplanar structures added, requested specifically for flex and rigid-flex designs
- Online Library - new On-Premise Mode

### V18.05 (May)

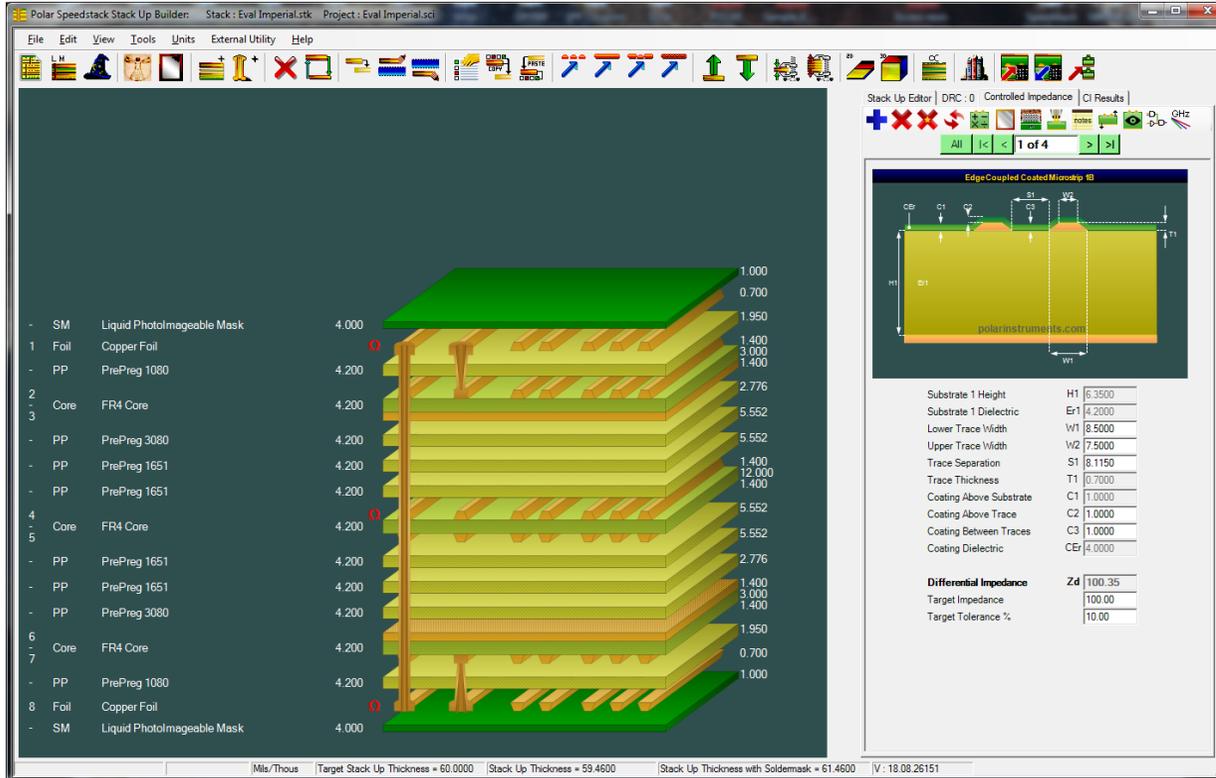
- New Cannonball-Huray method added to Surface Roughness Compensation options

### V18.03 (March) / V18.01 (January)

- Full insertion loss data per structure including roughness modelling methodology
- Insertion loss graphs and data in reports
- Rich copy / paste insertion loss data to / from Si9000e
- Export insertion loss projects to Si9000e

# Speedstack v18.08 (August 2018)

# Import / Export industry-standard IPC-2581 Rev B files

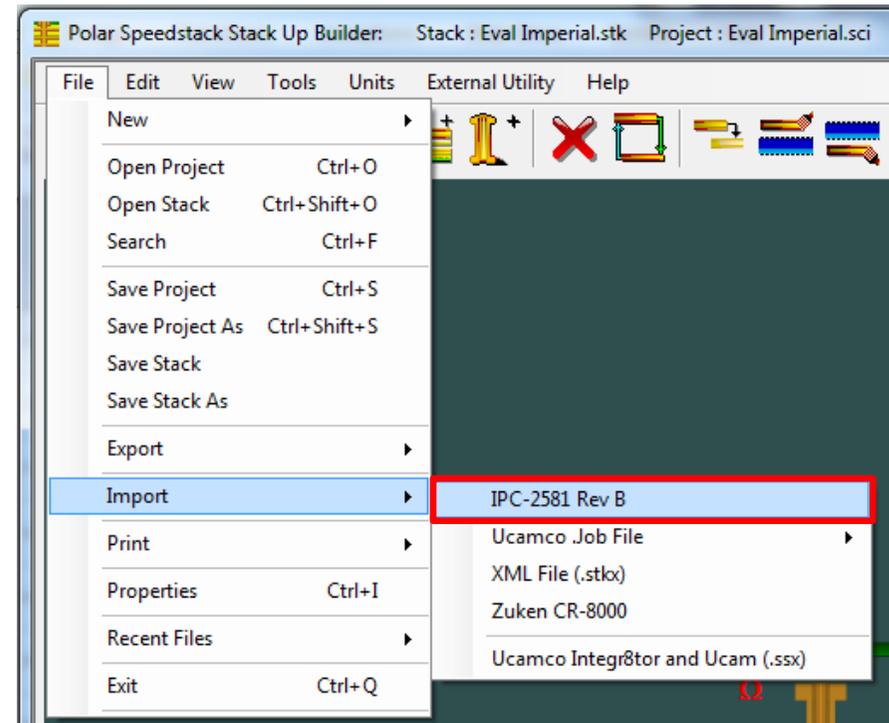
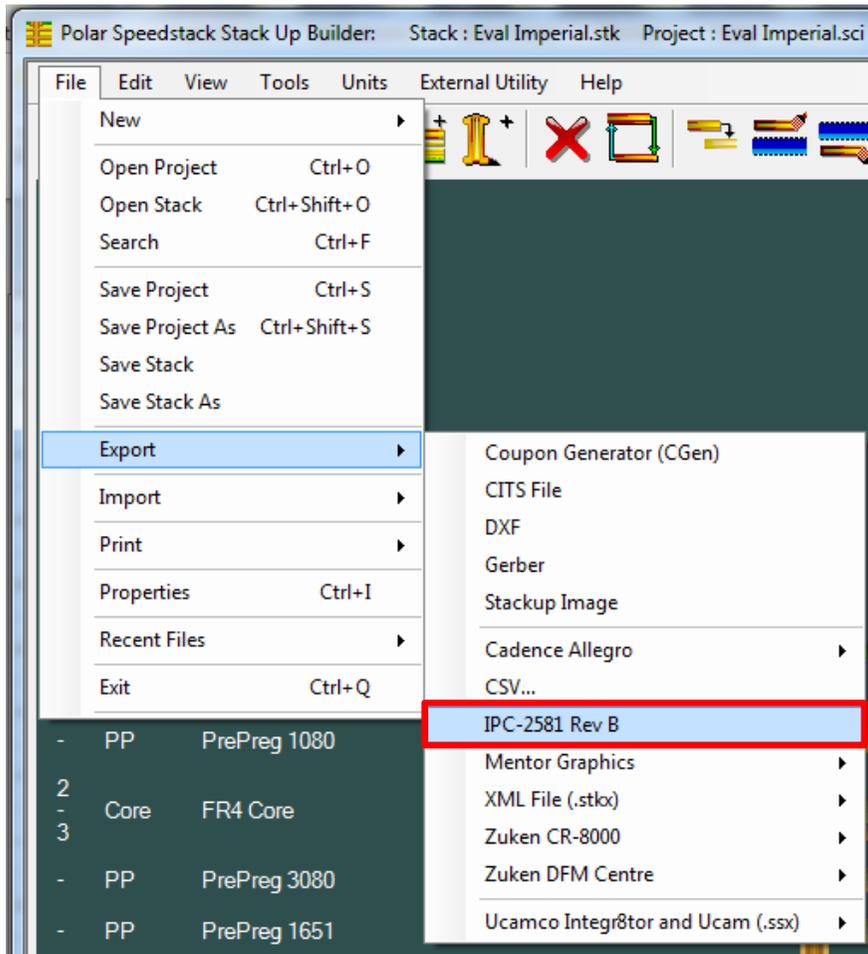


Speedstack v18.08 can export and import stack up and impedance structure data using the IPC-2581 Rev B XML file format



Other popular EDA tools can export and import IPC-2581 files, allowing easy exchange of stack up data with Speedstack

# Import / Export industry-standard IPC-2581 Rev B files



New Export and Import IPC-2581 Rev B options introduced to the File menu

# Export to IPC-2581 Rev B

A new dialog guides the user through the **Export** process.

Useful file info including Revision and Units (IPC-2581 support Inches, Millimetres and Microns)  
No support for Mils / Thou

IPC-2581 File Information

Filename: C:\Program Files\Polar\Speedstack\Samples\Eval\Imperial.xml  
Revision: B  
Units: INCH

Software Package (that generated the file)

Name: Speedstack  
Revision: 18.8.26151  
Vendor: Polar Instruments Ltd

Export Options

Export Target Impedance as the IPC-2581 Impedance data  
 Export Calculated Impedance as the IPC-2581 Impedance data

Assign Note field value as Loss Tangent: None  
Assign resin rich Dielectric Constant value: 3.5000

Display Options

Notes: 1

| Speedstack Layer Number | Layer Name        | Specification Name     | Layer Function | Side     | Thickness | TolPlus  | TolMinus | Sequence | Material Description       | Resin Content |
|-------------------------|-------------------|------------------------|----------------|----------|-----------|----------|----------|----------|----------------------------|---------------|
|                         | SOLDERMASK_TOP    | SOLDERMASK_TOP_SPEC    | SOLDERMASK     | TOP      | 0.001000  | 0.000000 | 0.000000 | 1        | Liquid PhotoImageable Mask |               |
| 1                       | L1                | L1_SPEC                | SIGNAL         | TOP      | 0.000700  | 0.000000 | 0.000000 | 2        | Copper Foil                |               |
|                         | DIELECTRIC_1      | DIELECTRIC_1_SPEC      | DIELPREG       | INTERNAL | 0.001950  | 0.000000 | 0.000000 | 3        | PrePreg 1080               | 60.00         |
| 2                       | L2                | L2_SPEC                | SIGNAL         | INTERNAL | 0.001400  | 0.000000 | 0.000000 | 4        | FR4 Core                   |               |
|                         | DIELECTRIC_2      | DIELECTRIC_2_SPEC      | DIELCORE       | INTERNAL | 0.003000  | 0.000000 | 0.000000 | 5        | FR4 Core                   | 60.00         |
| 3                       | L3                | L3_SPEC                | PLANE          | INTERNAL | 0.001400  | 0.000000 | 0.000000 | 6        | FR4 Core                   |               |
|                         | DIELECTRIC_3      | DIELECTRIC_3_SPEC      | DIELPREG       | INTERNAL | 0.002776  | 0.000000 | 0.000000 | 7        | PrePreg 3080               | 60.00         |
|                         | DIELECTRIC_4      | DIELECTRIC_4_SPEC      | DIELPREG       | INTERNAL | 0.005552  | 0.000000 | 0.000000 | 8        | PrePreg 1651               | 47.00         |
|                         | DIELECTRIC_5      | DIELECTRIC_5_SPEC      | DIELPREG       | INTERNAL | 0.005552  | 0.000000 | 0.000000 | 9        | PrePreg 1651               | 47.00         |
| 4                       | L4                | L4_SPEC                | SIGNAL         | INTERNAL | 0.001400  | 0.000000 | 0.000000 | 10       | FR4 Core                   |               |
|                         | DIELECTRIC_6      | DIELECTRIC_6_SPEC      | DIELCORE       | INTERNAL | 0.012000  | 0.000000 | 0.000000 | 11       | FR4 Core                   | 46.00         |
| 5                       | L5                | L5_SPEC                | SIGNAL         | INTERNAL | 0.001400  | 0.000000 | 0.000000 | 12       | FR4 Core                   |               |
|                         | DIELECTRIC_7      | DIELECTRIC_7_SPEC      | DIELPREG       | INTERNAL | 0.005552  | 0.000000 | 0.000000 | 13       | PrePreg 1651               | 47.00         |
|                         | DIELECTRIC_8      | DIELECTRIC_8_SPEC      | DIELPREG       | INTERNAL | 0.005552  | 0.000000 | 0.000000 | 14       | PrePreg 1651               | 47.00         |
|                         | DIELECTRIC_9      | DIELECTRIC_9_SPEC      | DIELPREG       | INTERNAL | 0.002776  | 0.000000 | 0.000000 | 15       | PrePreg 3080               | 60.00         |
| 6                       | L6                | L6_SPEC                | PLANE          | INTERNAL | 0.001400  | 0.000000 | 0.000000 | 16       | FR4 Core                   |               |
|                         | DIELECTRIC_10     | DIELECTRIC_10_SPEC     | DIELCORE       | INTERNAL | 0.003000  | 0.000000 | 0.000000 | 17       | FR4 Core                   | 60.00         |
| 7                       | L7                | L7_SPEC                | SIGNAL         | INTERNAL | 0.001400  | 0.000000 | 0.000000 | 18       | FR4                        |               |
|                         | DIELECTRIC_11     | DIELECTRIC_11_SPEC     | DIELPREG       | INTERNAL | 0.001950  | 0.000000 | 0.000000 | 19       | PrePreg 1080               | 60.00         |
|                         | SOLDERMASK_BOTTOM | SOLDERMASK_BOTTOM_SPEC | SOLDERMASK     | BOTTOM   | 0.001000  | 0.000000 | 0.000000 | 20       | Liquid PhotoImageable Mask |               |
|                         |                   |                        |                |          | 0.061460  |          |          |          |                            |               |

User-selectable options to control how the IPC-2581 data is to be exported from Speedstack

Software Package details the application that generated the IPC-2581 file. In this case Speedstack

Stack up to be exported to IPC-2581 shown in data grid form. The Layer Function determines the layer / material type

The Foil, Prepreg, Core and Solder Mask material data grid colours are determined by the Speedstack Configuration, so colour scheme familiar to users

Stack up thickness total

Speedstack IPC-2581 Rev B file imported into Cadence Allegro

| # | Name              | Types >>   |                    | Thickness >> |   | Physical >>   |              | Embedded >>     |     | Conductivity mho/cm | Dielectric Constant | Width mil | Impedance Ohm | Loss Tangent |
|---|-------------------|------------|--------------------|--------------|---|---------------|--------------|-----------------|-----|---------------------|---------------------|-----------|---------------|--------------|
|   |                   | Layer      | Layer Function     | Value mil    |   | Layer ID      | Material     | Embedded Status |     |                     |                     |           |               |              |
|   |                   | Surface    |                    |              |   |               |              |                 |     |                     | 1                   |           |               | 0            |
|   | SOLDERMASK_TOP    | Mask       | Solder Mask        | 1            |   | LIQUID PHO... |              |                 |     | 0                   | 4                   |           |               | 0.035        |
| 1 | TOP               | Conductor  | Conductor          | 0.7          | 1 | COPPER FOIL   | Not embedded | 595900          | 4.5 | 5.00                | 70.237000           |           |               | 0            |
|   |                   | Dielectric | Dielectric Prepreg | 1.95         |   | PREPREG 1080  |              | 0               | 4.2 |                     |                     |           |               | 0.035        |
| 2 | L2                | Conductor  | Conductor          | 1.4          | 2 | FR4 CORE      | Not embedded | 595900          | 4.5 | 5.00                | 43.781000           |           |               | 0            |
|   |                   | Dielectric | Dielectric Core    | 3            |   | FR4 CORE      |              | 0               | 4.2 |                     |                     |           |               | 0.035        |
| 3 | L3                | Plane      | Plane              | 1.4          | 3 | FR4 CORE      | Not embedded | 595900          | 4.5 |                     |                     |           |               | 0            |
|   |                   | Dielectric | Dielectric Prepreg | 2.77598      |   | PREPREG 3080  |              | 0               | 4.2 |                     |                     |           |               | 0.035        |
|   |                   | Dielectric | Dielectric Prepreg | 5.55201      |   | PREPREG 1651  |              | 0               | 4.2 |                     |                     |           |               | 0.035        |
|   |                   | Dielectric | Dielectric Prepreg | 5.55201      |   | PREPREG 1651  |              | 0               | 4.2 |                     |                     |           |               | 0.035        |
| 4 | L4                | Conductor  | Conductor          | 1.4          | 4 | FR4 CORE      | Not embedded | 595900          | 4.5 | 5.00                | 75.737000           |           |               | 0            |
|   |                   | Dielectric | Dielectric Core    | 12           |   | FR4 CORE      |              | 0               | 4.2 |                     |                     |           |               | 0.035        |
| 5 | L5                | Conductor  | Conductor          | 1.4          | 5 | FR4 CORE      | Not embedded | 595900          | 4.5 | 5.00                | 75.737000           |           |               | 0            |
|   |                   | Dielectric | Dielectric Prepreg | 5.55201      |   | PREPREG 1651  |              | 0               | 4.2 |                     |                     |           |               | 0.035        |
|   |                   | Dielectric | Dielectric Prepreg | 5.55201      |   | PREPREG 1651  |              | 0               | 4.2 |                     |                     |           |               | 0.035        |
|   |                   | Dielectric | Dielectric Prepreg | 2.77598      |   | PREPREG 3080  |              | 0               | 4.2 |                     |                     |           |               | 0.035        |
| 6 | L6                | Plane      | Plane              | 1.4          | 6 | FR4 CORE      | Not embedded | 595900          | 4.5 |                     |                     |           |               | 0            |
|   |                   | Dielectric | Dielectric Core    | 3            |   | FR4 CORE      |              | 0               | 4.2 |                     |                     |           |               | 0.035        |
| 7 | L7                | Conductor  | Conductor          | 1.4          | 7 | FR4 CORE      | Not embedded | 595900          | 4.5 | 5.00                | 43.781000           |           |               | 0            |
|   |                   | Dielectric | Dielectric Prepreg | 1.95         |   | PREPREG 1080  |              | 0               | 4.2 |                     |                     |           |               | 0.035        |
| 8 | BOTTOM            | Conductor  | Conductor          | 0.7          | 8 | COPPER FOIL   | Not embedded | 595900          | 4.5 | 5.00                | 70.237000           |           |               | 0            |
|   | SOLDERMASK_BOTTOM | Mask       | Solder Mask        | 1            |   | LIQUID PHO... |              | 0               | 4   |                     |                     |           |               | 0.035        |
|   |                   | Surface    |                    |              |   |               |              |                 |     |                     | 1                   |           |               | 0            |

Surface  
SOLDERMASK\_TOP Mask  
1 TOP Conductor  
Dielectric  
2 L2 Conductor  
Dielectric  
3 L3 Plane  
Dielectric  
Dielectric  
Dielectric  
4 L4 Conductor  
Dielectric  
5 L5 Conductor  
Dielectric  
Dielectric  
Dielectric  
6 L6 Plane  
Dielectric  
7 L7 Conductor  
Dielectric  
8 BOTTOM Conductor  
SOLDERMASK\_BOTTOM Mask  
Surface

Info Lock Embedded layers setup Unused pads suppression Refresh materials

Total thickness: **51.46 mil**  
Total thickness without masks: 39.46 mil

Layers: 10  
Conductor: 6  
Plane: 2  
Mask: 2

Stack up thickness total, matches value from the exported IPC-2581 data (see slide 8)

Ok Cancel Apply Help

# Import from IPC-2581 Rev B

A new dialog guides the user through the **Import** process.

Useful file info including Revision and Units (IPC-2581 support Inches, Millimetres and Microns)  
No support for Mils / Thou

User-selectable options to control how the IPC-2581 data is allocated in Speedstack

Software Package details the application that generated the IPC-2581 file. In this case Cadence Allegro

Stack up imported from IPC-2581 shown in data grid form. The Layer Function determines the layer / material type

Stack up thickness total

The Foil, Prepreg, Core and Solder Mask material data grid colours are determined by the Speedstack Configuration, so colour scheme familiar to users

Polar Speedstack Stack Up Builder: Stack : xs\_Test\_stackup\_modified.stk Project : xs\_Test\_stackup\_modified.sci

File Edit View Tools Units External Utility Help

Stack Up Editor | DRC : 1 | Controlled Impedance | CI Results

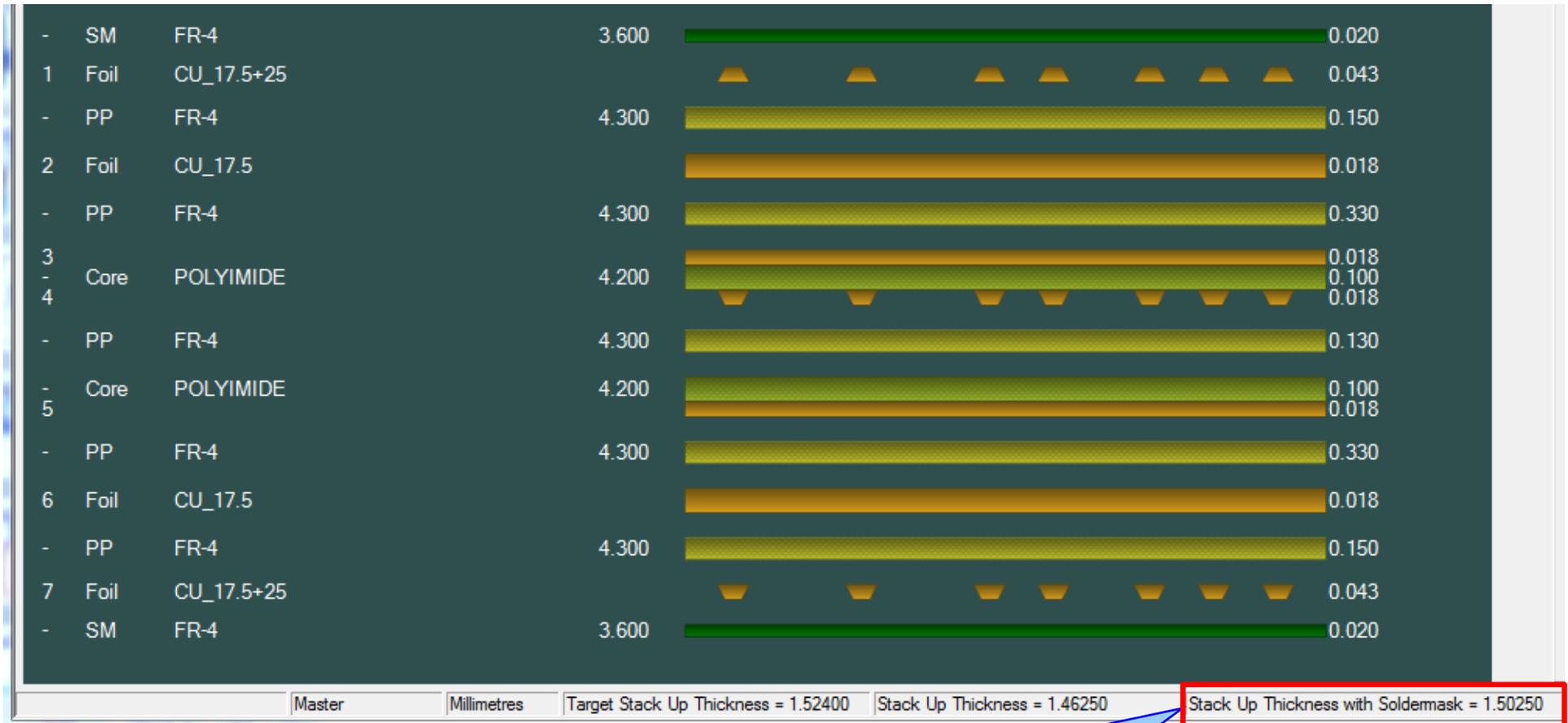
All | < | 1 of 3 | > | I

|   |      |            |       |       |
|---|------|------------|-------|-------|
| - | SM   | FR-4       | 3.600 | 0.020 |
| 1 | Foil | CU_17.5+25 | 0.043 |       |
| - | PP   | FR-4       | 4.300 | 0.150 |
| 2 | Foil | CU_17.5    | 0.018 |       |
| - | PP   | FR-4       | 4.300 | 0.330 |
| 3 | Core | POLYIMIDE  | 0.018 |       |
| 4 |      |            | 0.100 |       |
| - | PP   | FR-4       | 4.300 | 0.130 |
| 5 | Core | POLYIMIDE  | 0.018 |       |
| - |      |            | PP    | FR-4  |
| 6 | Foil | CU_17.5    | 0.018 |       |
| - | PP   | FR-4       | 4.300 | 0.150 |
| 7 | Foil | CU_17.5+25 | 0.043 |       |
| - | SM   | FR-4       | 3.600 | 0.020 |

|                         |           |              |
|-------------------------|-----------|--------------|
| Substrate 1 Height      | H1        | 0.15000      |
| Substrate 1 Dielectric  | Er1       | 4.3000       |
| Lower Trace Width       | W1        | 0.17000      |
| Upper Trace Width       | W2        | 0.14500      |
| Trace Thickness         | T1        | 0.04250      |
| Coating Above Substrate | C1        | 0.02000      |
| Coating Above Trace     | C2        | 0.02000      |
| Coating Dielectric      | CEr       | 3.6000       |
| <b>Impedance</b>        | <b>Zo</b> | <b>59.77</b> |
| Target Impedance        |           | 60.00        |
| Target Tolerance %      |           | 10.00        |

Master | Millimetres | Target Stack Up Thickness = 1.52400 | Stack Up Thickness = 1.46250 | Stack Up Thickness with Soldermask = 1.50250

IPC-2581 Cadence Allegro stack up imported into Speedstack. Individual copper and dielectric layers auto-merged to Core materials. Notice L3 / L4 as a double-sided core, L5 is a single-sided core



Stack Up Thickness with Solder Mask value of 1.5025mm matches value from the imported IPC-2581 data (see slide 11)

Import IPC-2581 Rev B

IPC-2581 File Information

Software Package (that generated the file)

Name: Allegro  
Revision: allegro\_16.6S032(7/12/2014)  
Vendor: Cadence

Import  
Cancel  
Notes: 0

IPC-2581 CONSORTIUM

Display Options

All (Stack Up and Structure Data)  
 Stack Up Data only  
 Structure Data only

To edit the data displayed below select the row, right-click menu and choose the appropriate function

Some EDA tools define all Dielectric layers as Core materials within the IPC-2581 format. In reality the actual stack up is constructed from a combination of Core and Prepreg materials

| Speedstack Layer Number | Layer Name              | Specification Name              | Layer Function | Side     | Thickness | TolPlus  | TolMinus | Sequence | Material Description | Resin Content |
|-------------------------|-------------------------|---------------------------------|----------------|----------|-----------|----------|----------|----------|----------------------|---------------|
| 1                       | TOP                     | SPEC_LAYER_TOP                  | CONDUCTOR      | TOP      | 0.001000  | 0.000000 | 0.000000 | 2        | 1OZ_COPPER           |               |
|                         | DIELECTRIC_BELOW_TOP    | SPEC_LAYER_DIELECTRIC_BELOW_... | DIELCORE       | INTERNAL | 0.005000  | 0.000000 | 0.000000 | 3        | POLYIMIDE            |               |
|                         | DIELECTRIC_2_BELOW_T... | SPEC_LAYER_DIELECTRIC_2_BELO... | DIELCORE       | INTERNAL |           |          |          |          |                      |               |
| 2                       | NONAME_1                | SPEC_LAYER_NONAME_1             | PLANE          | INTERNAL |           |          |          |          |                      |               |
|                         | DIELECTRIC_BELOW_NO...  | SPEC_LAYER_DIELECTRIC_BELOW_... | DIELCORE       | INTERNAL | 0.039000  | 0.000000 | 0.000000 | 6        |                      |               |
| 3                       | NONAME_2                | SPEC_LAYER_NONAME_2             | PLANE          | INTERNAL | 0.001000  | 0.000000 | 0.000000 | 7        |                      |               |
|                         | DIELECTRIC_BELOW_NO...  | SPEC_LAYER_DIELECTRIC_BELOW_... | DIELCORE       | INTERNAL | 0.005000  | 0.000000 | 0.000000 | 8        |                      |               |
|                         | DIELECTRIC_2_BELOW_...  | SPEC_LAYER_DIELECTRIC_2_BELO... | DIELCORE       | INTERNAL | 0.005000  | 0.000000 | 0.000000 | 9        |                      |               |
| 4                       | BOTTOM                  | SPEC_LAYER_BOTTOM               | CONDUCTOR      | BOTTOM   | 0.001000  | 0.000000 | 0.000000 | 10       |                      |               |
|                         | STACKUP THICKNESS       |                                 |                |          | 0.063000  |          |          |          |                      |               |

Set Layer Function to

- SIGNAL
- PLANE
- MIXED
- DIELCORE
- DIELPREG
- DIELADHV
- SOLDERMASK

Set Dielectric Constant / Loss Tangent values

Using the right-click menu options it is possible to redefine / improve the imported IPC-2581 data prior to generating the stack up in Speedstack

IPC-2581 File Information

File Name: [...]

Revision: [...]

Units: [...]

Import:

A

A

C

Assign:

Software Package (that generated the file)

Name:

Revision:

Vendor:

Import

Cancel

Notes: 0

Display Options

All (Stack Up and Structure Data)

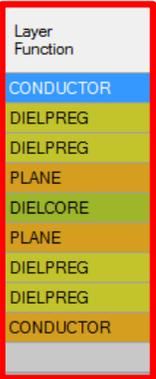
Stack Up Data only

Structure Data only

To edit the data displayed below select the row, right-click menu and choose the appropriate function

| Speedstack Layer Number | Layer Name              | Specification Name              | Layer Function | Side     | Thickness | TolPlus  | TolMinus | Sequence | Material Description | Resin Content |
|-------------------------|-------------------------|---------------------------------|----------------|----------|-----------|----------|----------|----------|----------------------|---------------|
| 1                       | TOP                     | SPEC_LAYER_TOP                  | CONDUCTOR      | TOP      | 0.001000  | 0.000000 | 0.000000 | 2        | 1OZ_COPPER           |               |
|                         | DIELECTRIC_BELOW_TOP    | SPEC_LAYER_DIELECTRIC_BELOW_... | DIELPREG       | INTERNAL | 0.005000  | 0.000000 | 0.000000 | 3        | POLYIMIDE            |               |
|                         | DIELECTRIC_2_BELOW_T... | SPEC_LAYER_DIELECTRIC_2_BELO... | DIELPREG       | INTERNAL | 0.005000  | 0.000000 | 0.000000 | 4        | POLYIMIDE            |               |
| 2                       | NONAME_1                | SPEC_LAYER_NONAME_1             | PLANE          | INTERNAL | 0.001000  | 0.000000 | 0.000000 | 5        | 1OZ_COPPER           |               |
|                         | DIELECTRIC_BELOW_NO...  | SPEC_LAYER_DIELECTRIC_BELOW_... | DIELCORE       | INTERNAL | 0.039000  | 0.000000 | 0.000000 | 6        | POLYIMIDE            |               |
| 3                       | NONAME_2                | SPEC_LAYER_NONAME_2             | PLANE          | INTERNAL | 0.001000  | 0.000000 | 0.000000 | 7        | 1OZ_COPPER           |               |
|                         | DIELECTRIC_BELOW_NO...  | SPEC_LAYER_DIELECTRIC_BELOW_... | DIELPREG       | INTERNAL | 0.005000  | 0.000000 | 0.000000 | 8        | POLYIMIDE            |               |
|                         | DIELECTRIC_2_BELOW_...  | SPEC_LAYER_DIELECTRIC_2_BELO... | DIELPREG       | INTERNAL | 0.005000  | 0.000000 | 0.000000 | 9        | POLYIMIDE            |               |
| 4                       | BOTTOM                  | SPEC_LAYER_BOTTOM               | CONDUCTOR      | BOTTOM   | 0.001000  | 0.000000 | 0.000000 | 10       | 1OZ_COPPER           |               |
|                         | STACKUP THICKNESS       |                                 |                |          | 0.063000  |          |          |          |                      |               |

Now the Layer Function has been correctly defined as Cores and Prepregs it is possible to generate the stack up



Polar Speedstack Stack Up Builder: Stack : stackup-tc-2.stk Project : stackup-tc-2.sci

File Edit View Tools Units External Utility Help

Stack Up Editor | DRC : 0 | Controlled Impedance | CI Results

| Field                              | Value   |
|------------------------------------|---------|
| Electrical Layer Count             | 4       |
| Stack Up Cost                      | 0.00    |
| Copper Thickness                   | 4.0000  |
| Dielectric Thickness               | 59.0000 |
| Solder Mask Thickness              | 0.0000  |
| =====                              | =====   |
| Target Stack Up Thickness          | 60.0000 |
| Stack Up Thickness                 | 63.0000 |
| Stack Up Thickness with Soldermask | 63.0000 |
| =====                              | =====   |

| Item | Material        | Thickness | Order |
|------|-----------------|-----------|-------|
| 1    | Foil 1OZ_COPPER | 1.000     | 1     |
| -    | PP POLYIMIDE    | 4.300     | 2     |
| -    | PP POLYIMIDE    | 4.300     | 3     |
| 2    | Core POLYIMIDE  | 39.000    | 4     |
| 3    | PP POLYIMIDE    | 1.000     | 5     |
| -    | PP POLYIMIDE    | 4.300     | 6     |
| -    | PP POLYIMIDE    | 4.300     | 7     |
| 4    | Foil 1OZ_COPPER | 1.000     | 8     |

Master | Mils/Thous | Target Stack Up Thickness = 60.0000 | Stack Up Thickness = 63.0000 | Stack Up Thickness with Soldermask = 63.0000 | V : 18.08.26151

The final stack up imported from IPC-2581 correctly defined as Foils, Cores and Prepregs

# New coplanar structures supported, specifically for flex and rigid-flex designs

The screenshot shows the Polar Speedstack Stack Up Builder interface. A blue callout box points to the 'Offset Coplanar Strips 1B2A' option in the Structure Control dialog, which is highlighted with a red box. The dialog also shows 'Offset Coplanar Waveguide 1B2A' as a supported structure. The main window displays a 3D model of the structure with various dimensions labeled (H1, H2, H3, W1, W2, G1, G2, D1, T1) and a table of material and geometric parameters.

**Structure Control Dialog:**

- Number Of Signal Tracks: Single Trace
- Target Impedance: 50.00
- Target Tolerance %: 10.0
- Total of Structures Added: 0
- Primary Reference Plane: 1
- Secondary Reference Plane: 3

**Structure Parameters Table:**

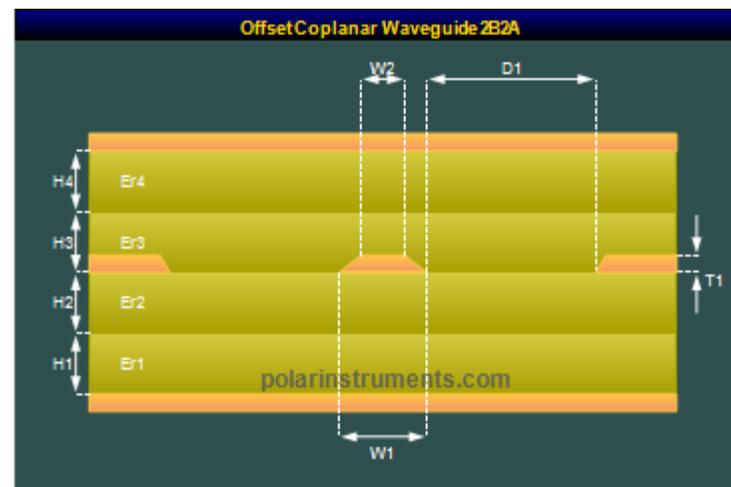
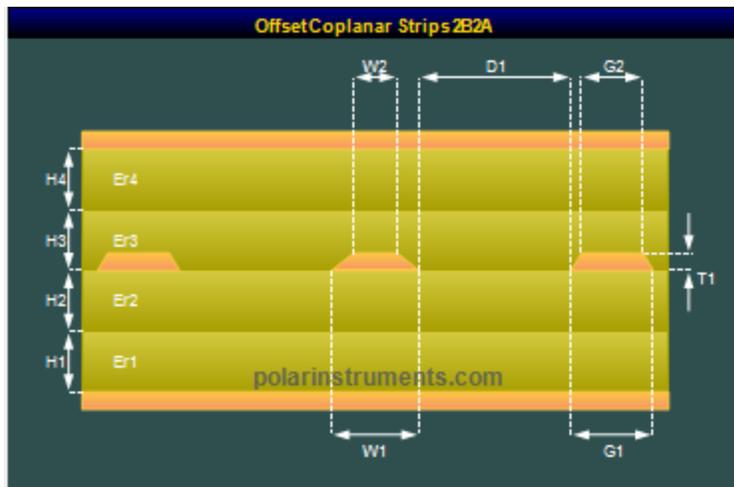
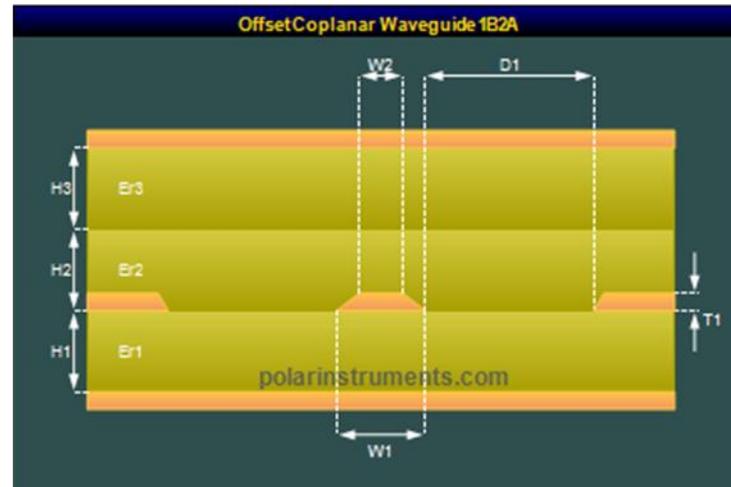
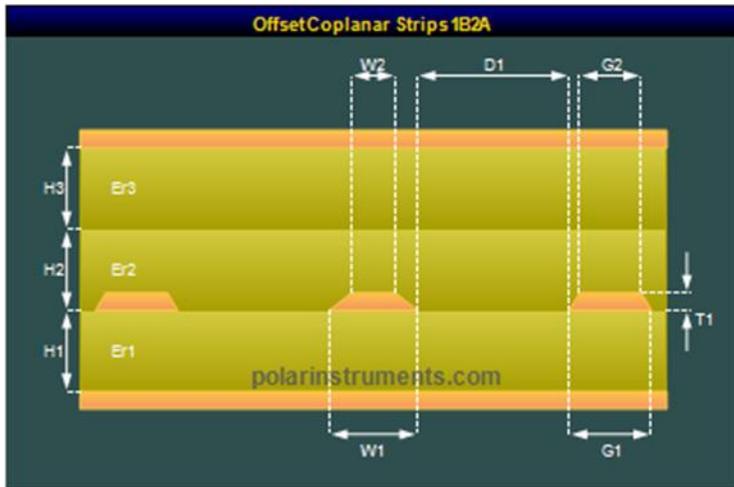
|                          |     |          |
|--------------------------|-----|----------|
| Substrate 1 Height       | H1  | 6.0000   |
| Substrate 1 Dielectric   | Er1 | 3.2000   |
| Substrate 2 Height       | H2  | 3.7000   |
| Substrate 2 Dielectric   | Er2 | 3.1000   |
| Substrate 3 Height       | H3  | 4.0000   |
| Substrate 3 Dielectric   | Er3 | 3.2000   |
| Lower Trace Width        | W1  | 7.2227   |
| Upper Trace Width        | W2  | 6.2227   |
| Lower Ground Strip Width | G1  | 100.0000 |
| Upper Ground Strip Width | G2  | 99.0000  |
| Ground Strip Separation  | D1  | 10.0000  |
| Trace Thickness          | T1  | 0.7000   |

**Impedance Table:**

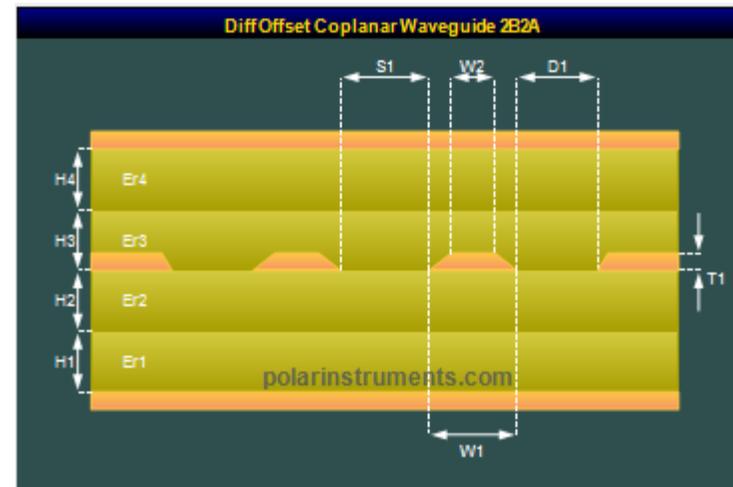
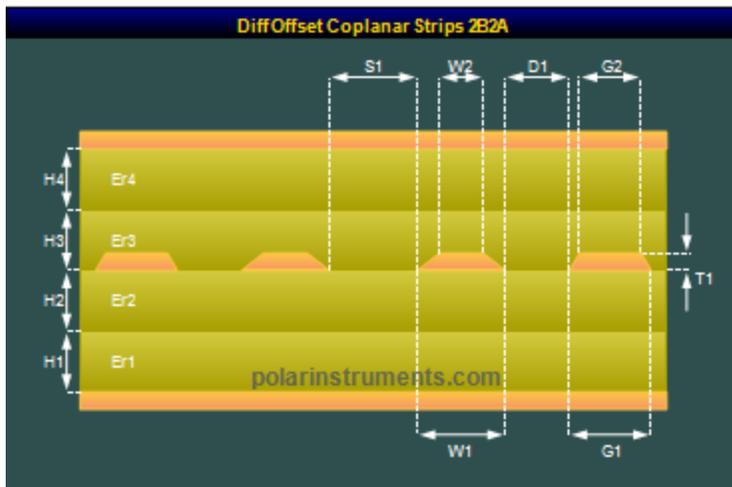
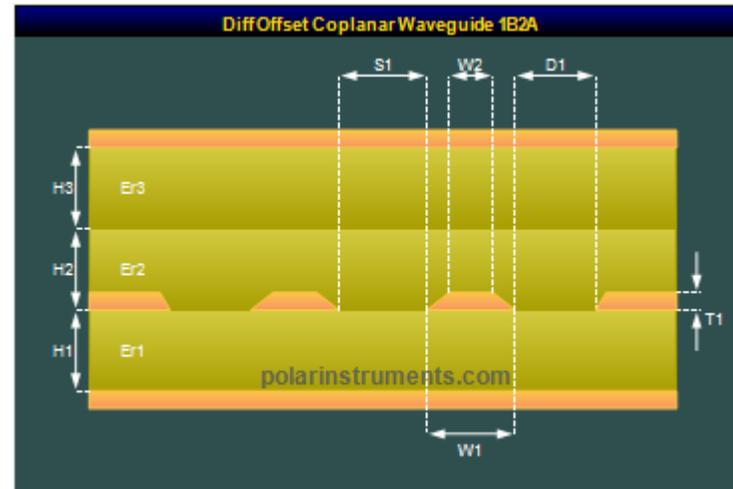
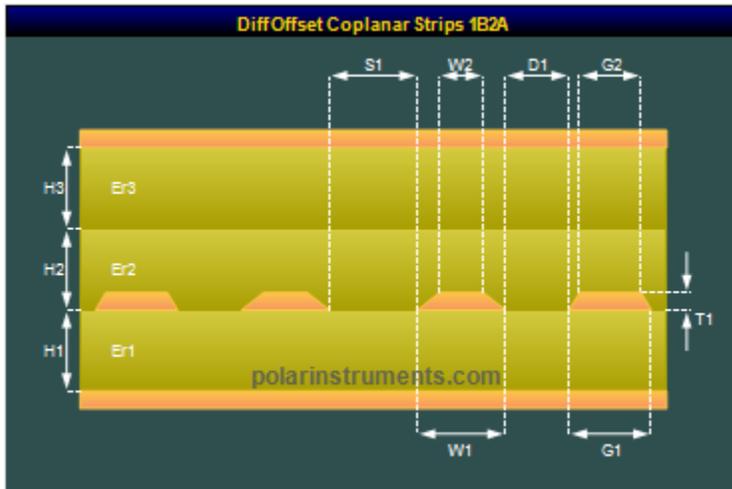
|                    |    |       |
|--------------------|----|-------|
| Impedance          | Zo | 50.17 |
| Target Impedance   |    | 50.00 |
| Target Tolerance % |    | 10.00 |

Eight new coplanar strips and waveguide structures are now supported

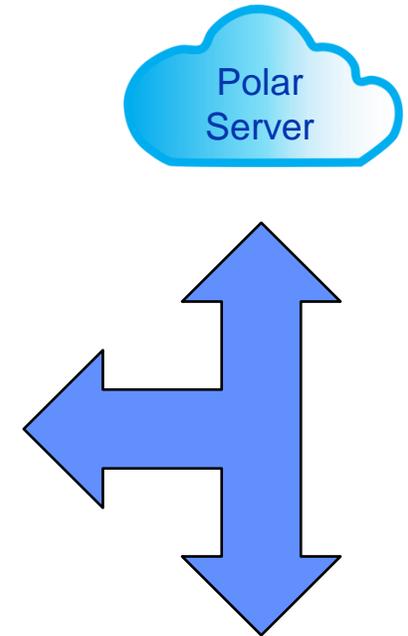
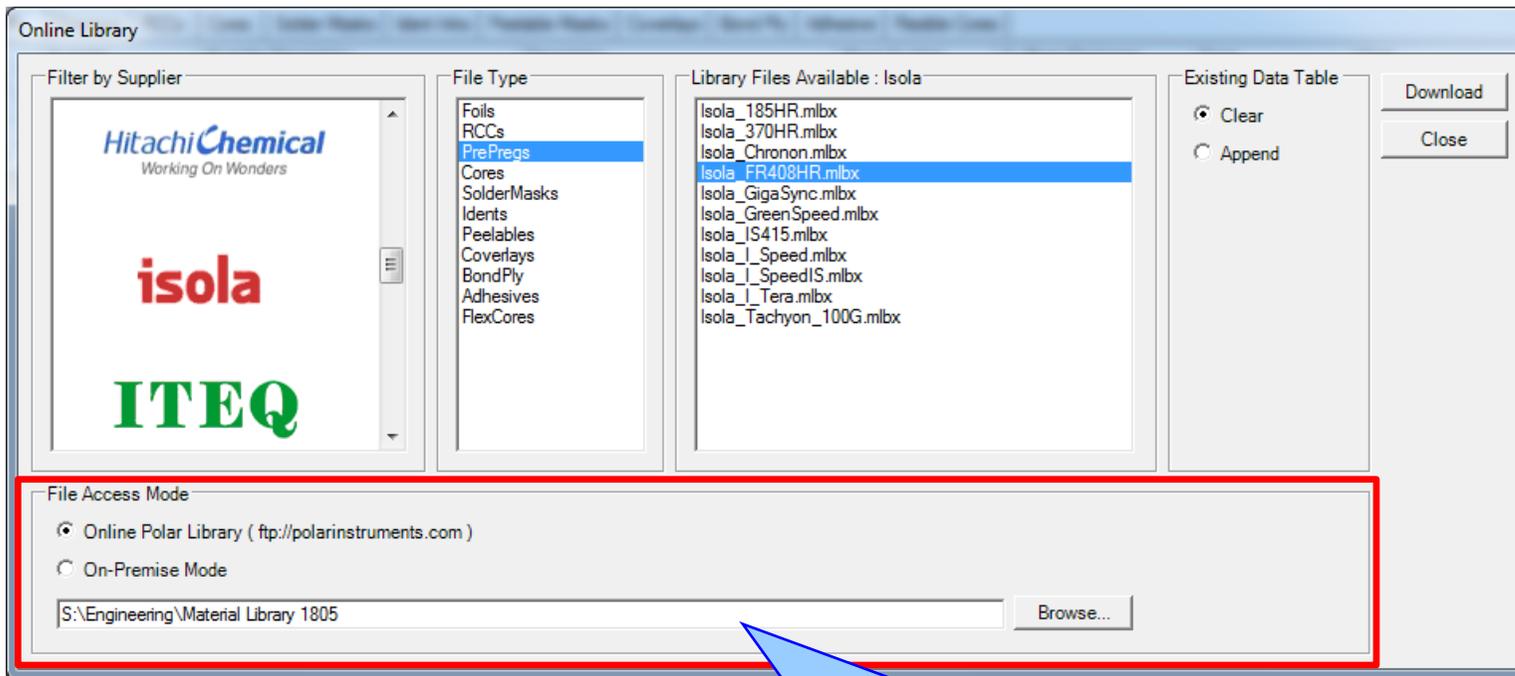
# New coplanar structures supported: four new single-ended structures



# New coplanar structures supported: four new differential structures



# Online Library – New On-Premise Mode

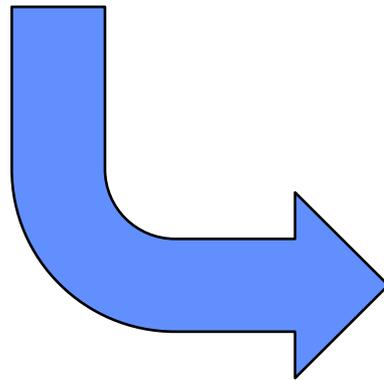
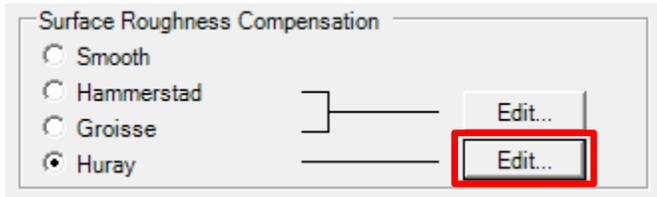


On-Premise Server

The Online Library can now access the latest material library data from either the Polar FTP Server or an On-Premise Server. The On-Premise Mode is ideal for those users where internal security policies prevent access to external FTP servers. Please contact your local Polar office for more information

# Speedstack v18.05 (May 2018)

# Cannonball-Huray Surface Roughness Method



Surface Roughness Compensation - Huray

|  |  |
|--|--|
|  | <p>Ratio of Areas: <input type="text" value="1.0000"/></p> <p>Effective Ball Radius (μm): <input type="text" value="0.2240"/></p> <p>Area of Ball Count (sq μm): <input type="text" value="1.8060"/></p> <p>Number of Balls in Area: <input type="text" value="14"/></p> |
|--|--|

Images by courtesy of Circuit Foil Luxembourg

---

**Cannonball-Huray Model**

www.polarinstruments.com

Enable Cannonball-Huray

Matte-Side Roughness

Rz Matte (μm)

Drum-Side Roughness

Rz Drum (μm)

Courtesy of Bert Simonovich, Lamsim Enterprises Inc [Application Note](#)

The Cannonball-Huray method has been added to Surface Roughness Compensation options. This requires the entry of Matte and Drum side Rz values

# Cannonball-Huray Surface Roughness Method

The Cannonball-Huray method has also been introduced to the Si9000e. The bi-directional copy / paste interface between Speedstack and Si9000e allows for the quick transfer of structure parameters between products – the new Cannonball-Huray parameters are now supported

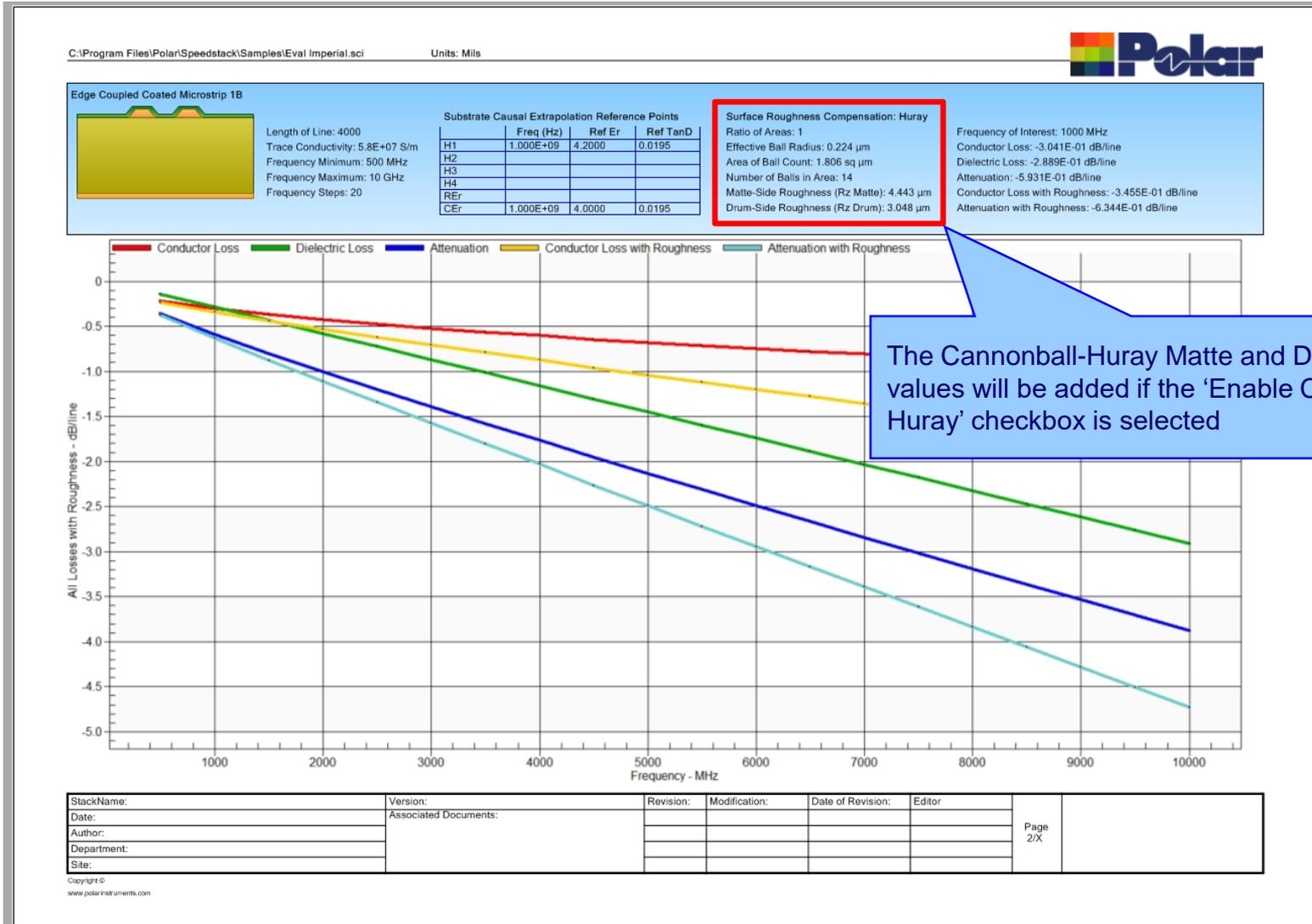
The screenshot displays the Polar Si9000 PCB Transmission Line Field Solver interface. The main window shows a 3D model of an "Edge-Coupled Coated Microstrip 1B" with various parameters like Length of Line (LL), Trace Conductivity (TC), Loss Tangent (TanD), and Frequency Distribution. A graph titled "Edge-Coupled" shows "All Losses with Roughness - dB/line" versus frequency (1000 to 4000 MHz). The graph includes curves for Conductor Loss (red), Dielectric Loss (green), and Attenuation (blue). A detailed dialog box titled "Surface Roughness Compensation - Huray" is open, showing a 3D model of the surface roughness and the "Cannonball-Huray Model" with parameters for Matte-side and Drum-side roughness (Rz Matte and Rz Drum).

# Online Material Library Enhancements

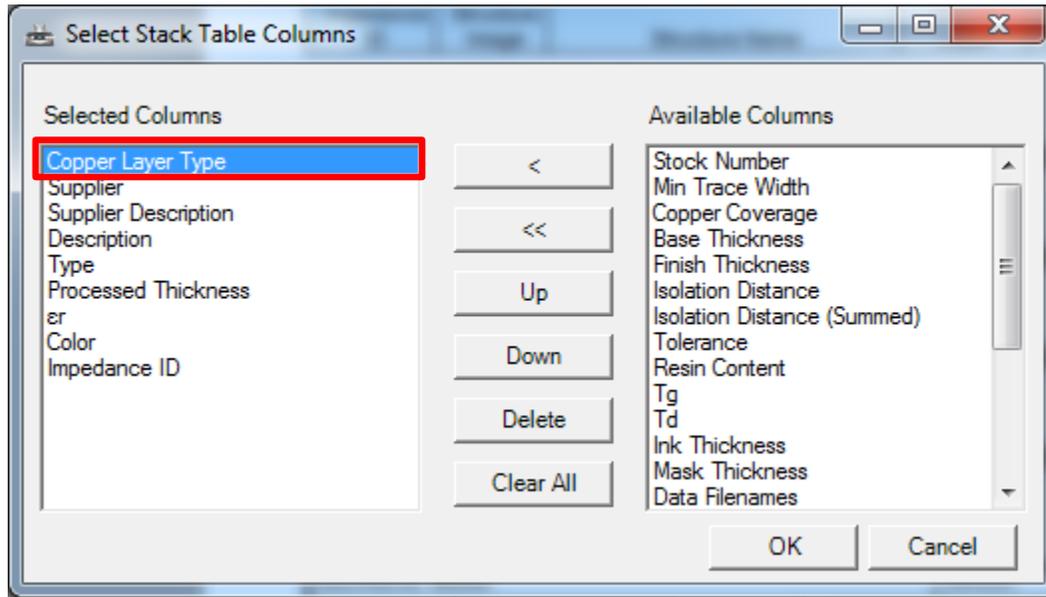
The screenshot shows the Speedstack software interface with a table of materials and an 'Online Library' dialog box open. The table lists various materials with columns for Supplier, Supplier Description, Description, Stock Number, Dielectric Base Thickness, Dielectric Finished Thickness, Dielectric Constant, Resin Content, and T<sub>g</sub>. The 'Online Library' dialog box is titled 'Online Library' and contains a 'Filter by Supplier' section with logos for isola, ITEQ, and LG Chem. It also has a 'File Type' list with 'PrePregs' selected, a 'Library Files Available : ITEQ' list with 'ITEQ\_IT\_958G.mlbx' selected, and an 'Existing Data Table' section with 'Clear' selected. There are 'Download' and 'Close' buttons.

| Foils | Prepregs | RCCs                 | Cores        | Solder Masks    | Ident Inks                | Peelable Masks              | Coverlays           | Bond Ply      | Adhesive       | Flexible Cores |
|-------|----------|----------------------|--------------|-----------------|---------------------------|-----------------------------|---------------------|---------------|----------------|----------------|
|       | Supplier | Supplier Description | Description  | Stock Number    | Dielectric Base Thickness | Dielectric Finished Thickne | Dielectric Constant | Resin Content | T <sub>g</sub> |                |
|       | ITEQ     | IT-958G-1037-2ml     | PrePreg 1037 | IT-958G-1037-01 | 2                         | 2                           | 2.99                | 73            | 17             |                |
|       | ITEQ     | IT-958G-1037-2.2ml   | PrePreg 1037 | IT-958G-1037-02 | 2.2                       | 2.2                         |                     |               |                |                |
|       | ITEQ     | IT-958G-106-2ml      | PrePreg 106  | IT-958G-106-01  | 2                         | 2                           |                     |               |                |                |
|       | ITEQ     | IT-958G-106-2.3ml    | PrePreg 106  | IT-958G-106-02  | 2.3                       | 2.3                         |                     |               |                |                |
|       | ITEQ     | IT-958G-1067-2.5ml   | PrePreg 1067 | IT-958G-1067-01 | 2.5                       | 2.5                         |                     |               |                |                |
|       | ITEQ     | IT-958G-1067-2.9ml   | PrePreg 1067 | IT-958G-1067-02 | 2.9                       | 2.9                         |                     |               |                |                |
|       | ITEQ     | IT-958G-1078-2.8ml   | PrePreg 1078 | IT-958G-1078-01 | 2.8                       | 2.8                         |                     |               |                |                |
|       | ITEQ     | IT-958G-1078-3.1ml   | PrePreg 1078 | IT-958G-1078-02 | 3.1                       | 3.1                         |                     |               |                |                |
|       | ITEQ     | IT-958G-1078-3.4ml   | PrePreg 1078 | IT-958G-1078-03 | 3.4                       | 3.4                         | 3.1                 | 68            | 17             |                |
|       | ITEQ     | IT-958G-1078-3.7ml   | PrePreg 1078 | IT-958G-1078-04 | 3.7                       | 3.7                         |                     | 70            | 17             |                |
|       | ITEQ     | IT-958G-1080-2.8ml   | PrePreg 1080 | IT-958G-1080-01 | 2.8                       | 2.8                         |                     | 62            | 17             |                |

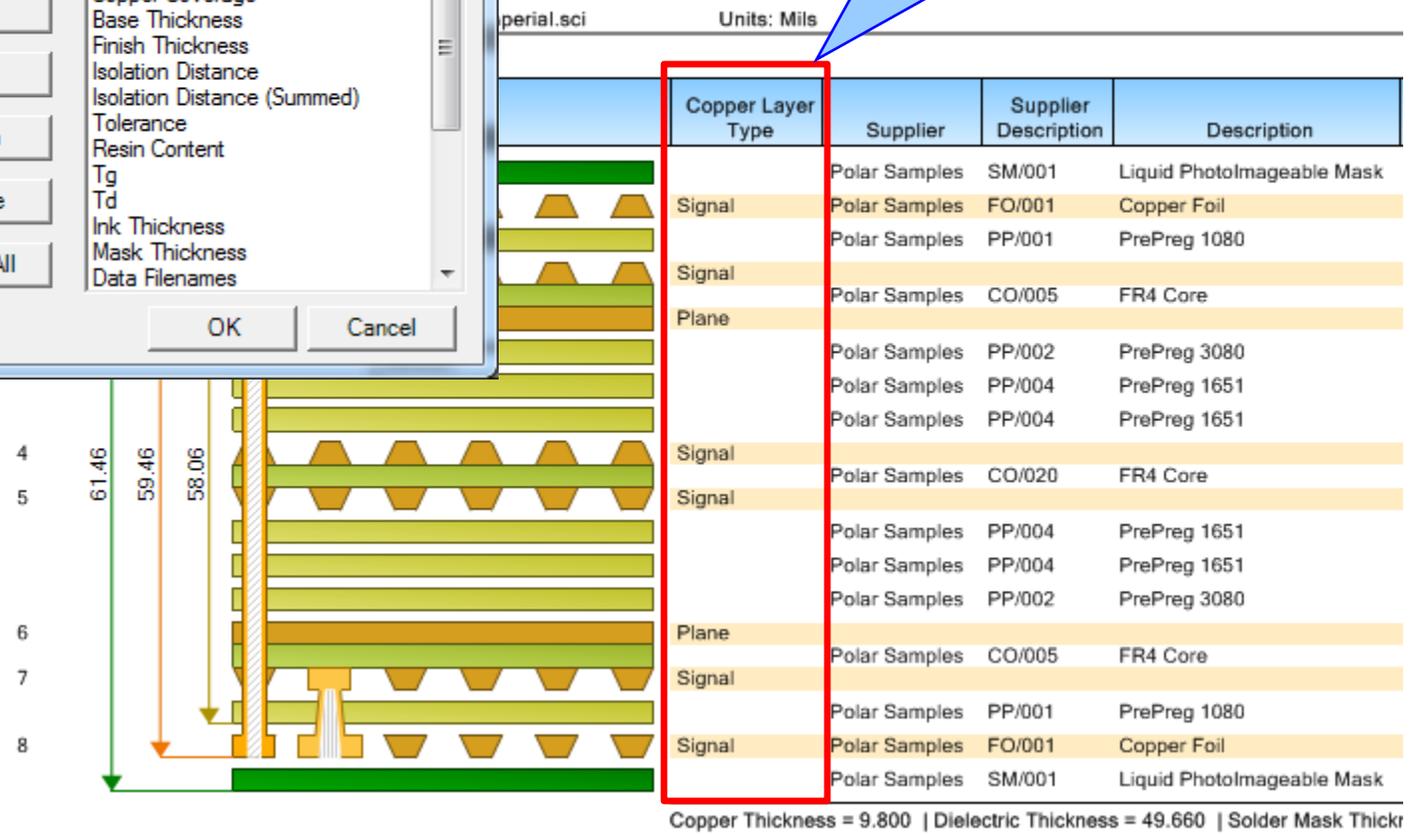
# Speedstack – Technical Report enhancements



# Speedstack – Technical Report enhancements

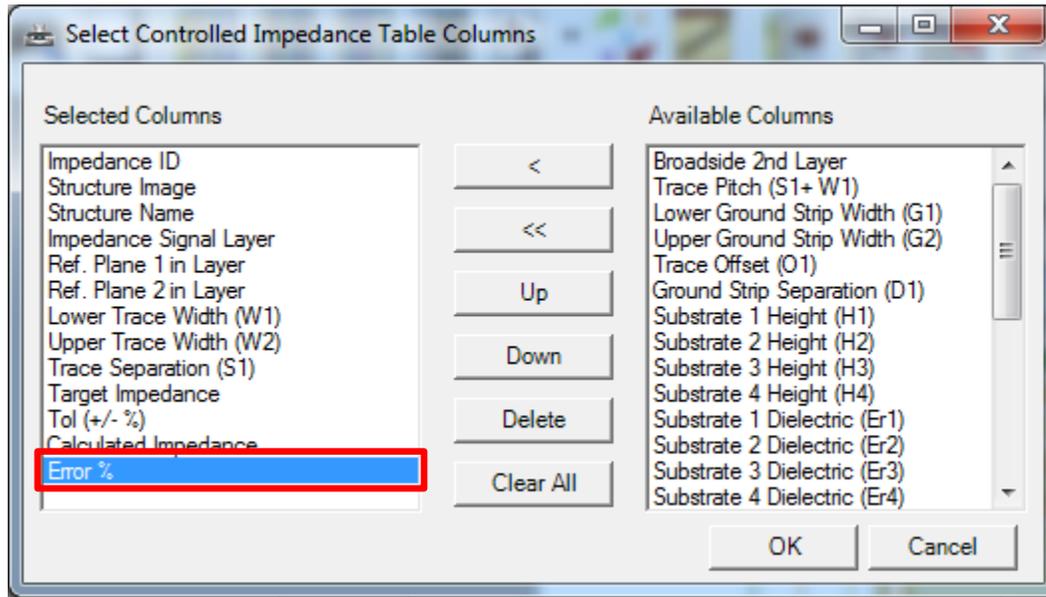


In addition to the graphical stack up image, copper layer types can be determined by a new selectable column



Copper Thickness = 9.800 | Dielectric Thickness = 49.660 | Solder Mask Thick

# Speedstack – Technical Report enhancements

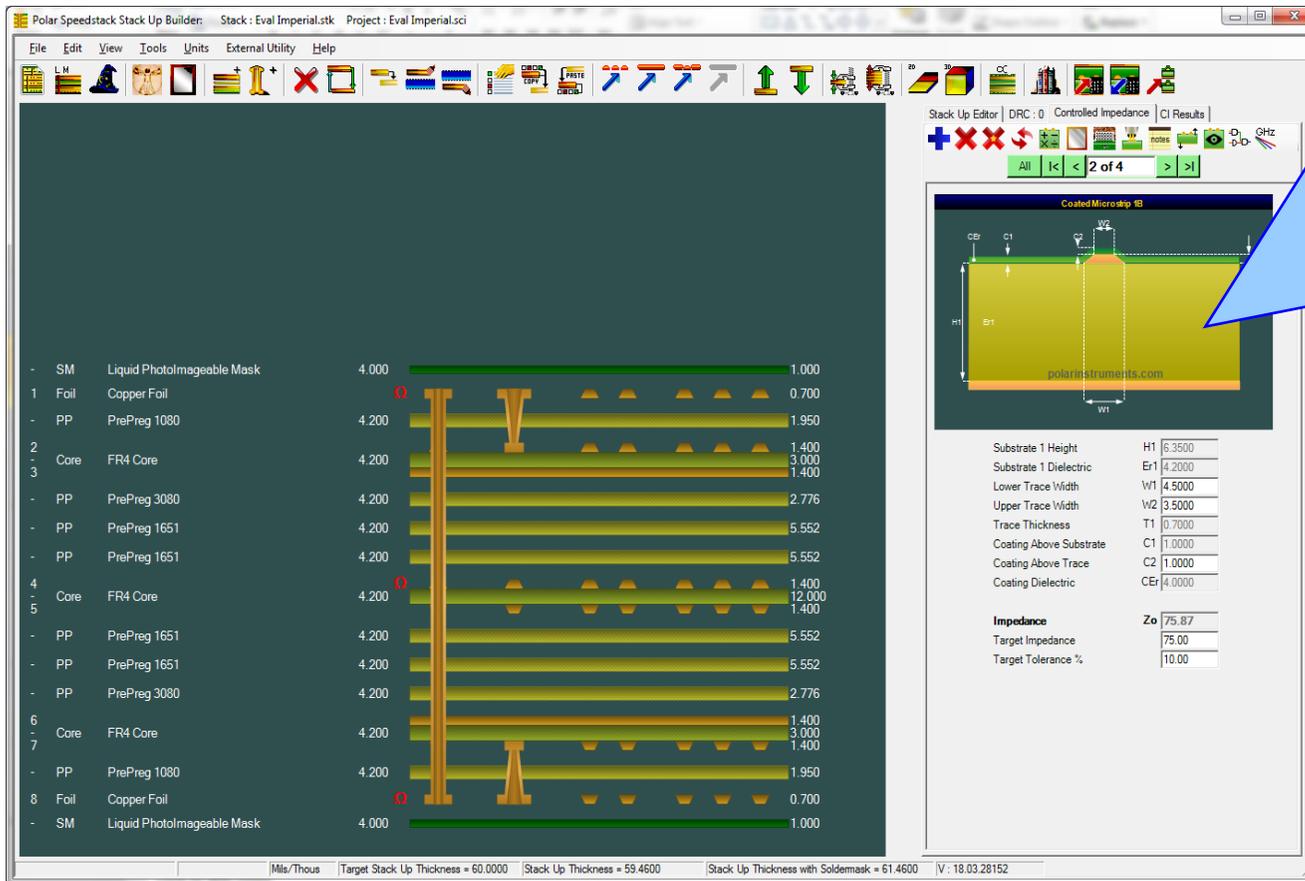


New selectable impedance table 'Error %' field. Print the Error % between the Target and Calculated Impedance

| ID | Image | Structure Name                     | Layer | in 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 | Error % |
|----|-------|------------------------------------|-------|----------|-----------------------|-----------------------|------------------------|------------------------|-----------------------|------------------|-------------|----------------------|---------|
| 1  |       | Edge Coupled Coated Microstrip 1B  | 1     | 3        | 0                     | 8.500                 | 7.500                  | 8.115                  | 100.000               | 10.000           | 100.350     | 0.3                  |         |
| 2  |       | Coated Microstrip 1B               | 1     | 3        | 0                     | 4.500                 | 3.500                  | 0.000                  | 75.000                | 10.000           | 75.870      | 1.2                  |         |
| 3  |       | Edge Coupled Offset Stripline 1B1A | 4     | 3        | 6                     | 7.250                 | 6.250                  | 8.500                  | 100.000               | 10.000           | 101.280     | 1.3                  |         |
| 4  |       | Coated Microstrip 1B               | 8     | 6        | 0                     | 4.500                 | 3.500                  | 0.000                  | 75.000                | 10.000           | 75.870      | 1.2                  |         |

# Speedstack v18.03 (March 2018)

# Speedstack – Frequency Dependent Loss Calculations



In order to calculate frequency dependent loss it is necessary to know the following critical information regarding the transmission line structure:

- Material properties including dielectric constant and loss tangent
- Conductor properties such as trace conductivity and surface roughness
- Frequency range that the transmission line structure will operate

Once this information has been gathered it is possible to run a detailed analysis of the transmission line structure for both controlled impedance and insertion loss

# Speedstack – Frequency Dependent Loss Calculations

Stack Up Editor | DRC : 0 | Controlled Impedance | CI Results

All | | < 2 of 4 > | > | > |

**Coated Microstrip 1B**

|                         |     |                 |
|-------------------------|-----|-----------------|
| Substrate 1 Height      | H1  | 6.3500          |
| Substrate 1 Dielectric  | Er1 | 4.2000          |
| Lower Trace Width       | W1  | 4.5000          |
| Upper Trace Width       | W2  | 3.5000          |
| Trace Thickness         | T1  | 0.7000          |
| Coating Above Substrate | C1  | 1.0000          |
| Coating Above Trace     | C2  | 1.0000          |
| Coating Dielectric      | CEr | 4.0000          |
| <b>Impedance</b>        |     | <b>Zo</b> 75.87 |
| Target Impedance        |     | 75.00           |
| Target Tolerance %      |     | 10.00           |

Each structure that has been added to the stack up now has a set of Frequency Dependent Properties that are accessible using this new icon.

Selecting this icon will load the following dialog.

Result presentation, show plot and table of results in preferred units.

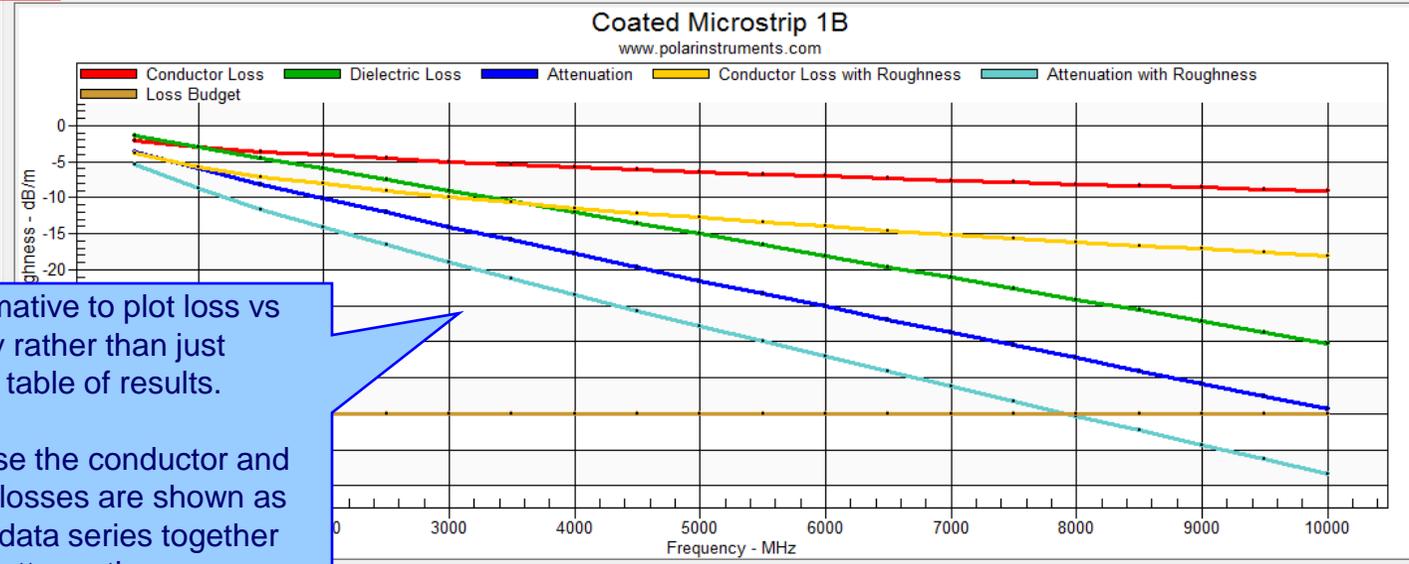
Structure image of the current selected structure

User-specifiable frequency range.

Dielectric constant and loss tangent properties for each substrate dielectric / region

Surface roughness compensation model. Hammerstad, Grosse and Huray methods supported

Graph



It is informative to plot loss vs frequency rather than just present a table of results.

In this case the conductor and dielectric losses are shown as separate data series together with total attenuation

The plot is interactive. It is possible to select data points and drill down to the underlying loss data

Length of Line LL: 1000.0000

Trace Conductivity (S/m) TC: 5.800E+07

Frequency Minimum (MHz) FMin: 500.0000

Frequency Maximum (GHz) FMax: 10.0000

Frequency Steps FStep: 20

Frequency of Interest (MHz) Freq: 4000.0000

Calculate

Result Presentation

Length of Line  / in  / m

Substrate Causal Extrapolation Reference Points

Set Er values from Stack Up materials

|     | Freq (Hz) | Ref Er | Ref TanD |
|-----|-----------|--------|----------|
| H1  | 1.000E+09 | 4.2000 | 0.0195   |
| H2  |           |        |          |
| H3  |           |        |          |
| H4  |           |        |          |
| REr |           |        |          |
| CEr | 1.000E+09 |        |          |

Surface Roughness Comp

Smooth

Hammerstad

Groisse

Huray

Print Settings

Include Loss Graph for this structure report

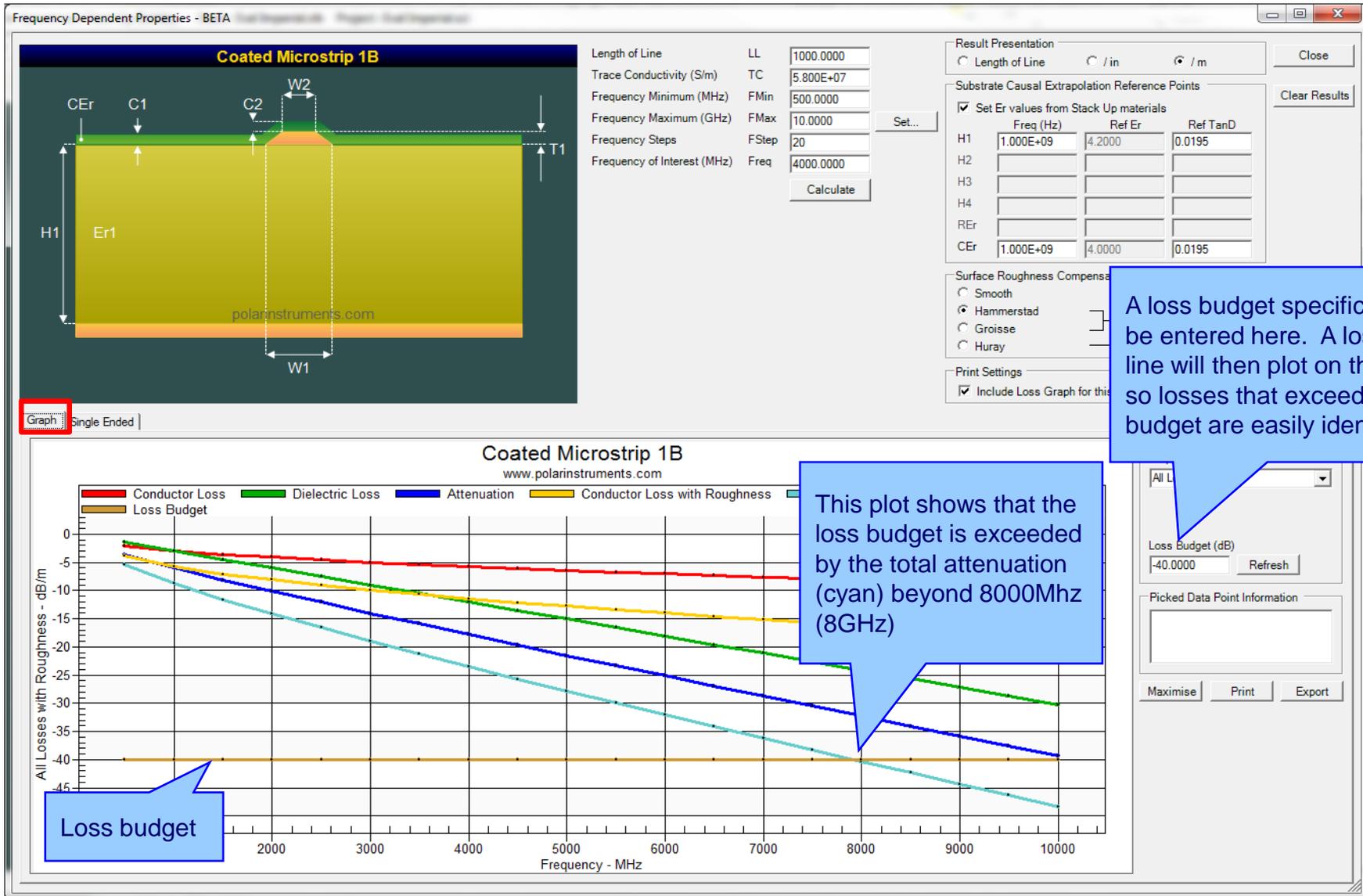
It is possible to specify a 'Frequency of Interest' as some insertion loss requirements / loss budget specifications are for a given frequency. In this case 4000MHz (4GHz)

Frequency dependent results shown as a data table

Graph: Single Ended

| Frequency Hz | Impedance Real Ohms | Impedance Imaginary Ohms | Impedance Magnitude Ohms | Inductance H/m | Resistance Ohms/m | Capacitance F/m | Conductance S/m | Skin Depth m | Conductor Loss dB/m | Dielectric Loss dB/m | Attenuation dB/m | Conductor Loss With Roughness dB/m | Attenuation With Roughness dB/m | Mo Ph: Vel m/s |
|--------------|---------------------|--------------------------|--------------------------|----------------|-------------------|-----------------|-----------------|--------------|---------------------|----------------------|------------------|------------------------------------|---------------------------------|----------------|
| 5.000E+08    | 7.656E+01           | -2.857E-01               | 7.656E+01                | 4.717E-07      | 3.750E+01         | 8.050E-11       | 4.510E-03       | 2.955E-06    | -2.127E+00          | -1.499E+00           | -3.627E+00       | -3.933E+00                         | -5.432E+00                      | 1.6            |
| 1.000E+09    | 7.656E+01           | -2.997E-03               | 7.656E+01                | 4.683E-07      | 5.312E+01         | 7.988E-11       | 9.023E-03       | 2.090E-06    | -3.013E+00          | -3.000E+00           | -6.013E+00       | -5.795E+00                         | -8.796E+00                      | 1.6            |
| 1.500E+09    | 7.661E+01           | 1.237E-01                | 7.661E+01                | 4.667E-07      | 6.525E+01         | 7.952E-11       | 1.354E-02       | 1.706E-06    | -3.699E+00          | -4.504E+00           | -8.202E+00       | -7.208E+00                         | -1.171E+01                      | 1.6            |
| 2.000E+09    | 7.664E+01           | 2.192E-01                | 7.664E+01                | 4.656E-07      | 7.255E+01         | 7.926E-11       | 1.805E-02       | 1.478E-06    | -4.111E+00          | -6.008E+00           | -1.012E+01       | -8.064E+00                         | -1.407E+01                      | 1.6            |
| 2.500E+09    | 7.668E+01           | 2.714E-01                | 7.668E+01                | 4.650E-07      | 8.101E+01         | 7.906E-11       | 2.257E-02       | 1.322E-06    | -4.587E+00          | -7.515E+00           | -1.210E+01       | -9.034E+00                         | -1.655E+01                      | 1.6            |
| 3.000E+09    | 7.672E+01           | 3.101E-01                | 7.672E+01                | 4.645E-07      | 8.865E+01         | 7.890E-11       | 2.708E-02       | 1.207E-06    | -5.018E+00          | -9.024E+00           | -1.404E+01       | -9.906E+00                         | -1.893E+01                      | 1.6            |
| 3.500E+09    | 7.676E+01           | 3.403E-01                | 7.676E+01                | 4.642E-07      | 9.568E+01         | 7.876E-11       | 3.160E-02       | 1.117E-06    | -5.413E+00          | -1.053E+01           | -1.595E+01       | -1.071E+01                         | -2.124E+01                      | 1.6            |
| 4.000E+09    | 7.680E+01           | 3.648E-01                | 7.680E+01                | 4.639E-07      | 1.022E+02         | 7.864E-11       | 3.611E-02       | 1.045E-06    | -5.780E+00          | -1.204E+01           | -1.782E+01       | -1.145E+01                         | -2.349E+01                      | 1.6            |
| 4.500E+09    | 7.683E+01           | 3.852E-01                | 7.683E+01                | 4.636E-07      | 1.084E+02         | 7.854E-11       | 4.063E-02       | 9.851E-07    | -6.125E+00          | -1.356E+01           | -1.968E+01       | -1.215E+01                         | -2.570E+01                      | 1.6            |
| 5.000E+09    | 7.686E+01           | 4.025E-01                | 7.686E+01                | 4.634E-07      | 1.142E+02         | 7.845E-11       | 4.515E-02       | 9.346E-07    | -6.451E+00          | -1.507E+01           | -2.152E+01       | -1.280E+01                         | -2.787E+01                      | 1.6            |
| 5.500E+09    | 7.688E+01           | 4.175E-01                | 7.689E+01                | 4.633E-07      | 1.197E+02         | 7.836E-11       | 4.966E-02       | 8.911E-07    | -6.761E+00          | -1.658E+01           | -2.334E+01       | -1.343E+01                         | -3.001E+01                      | 1.6            |
| 6.000E+09    | 7.691E+01           | 4.306E-01                | 7.691E+01                | 4.631E-07      | 1.250E+02         | 7.827E-11       | 5.418E-02       | 8.532E-07    | -7.057E+00          | -1.810E+01           | -2.515E+01       | -1.402E+01                         | -3.212E+01                      | 1.6            |
| 6.500E+09    | 7.693E+01           | 4.422E-01                | 7.693E+01                | 4.630E-07      | 1.300E+02         | 7.818E-11       | 5.870E-02       | 8.148E-07    | -7.346E+00          | -1.961E+01           | -2.695E+01       | -1.459E+01                         | -3.421E+01                      | 1.6            |
| 7.000E+09    | 7.695E+01           | 4.526E-01                | 7.695E+01                | 4.629E-07      | 1.346E+02         | 7.809E-11       | 6.311E-02       | 7.764E-07    | -7.630E+00          | -2.107E+01           | -2.875E+01       | -1.514E+01                         | -3.627E+01                      | 1.6            |

The 'Frequency of Interest' result is highlighted in the data table





Result presentation, losses shown for a 4000mil line (4 inch).

An example of a differential structure

Differential structures will automatically calculate for both odd and even mode

Frequency Dependent Properties - BETA

### Edge Coupled Coated Microstrip 1B

Length of Line LL:

Trace Conductivity (S/m) TC: 5.800E+07

Frequency Minimum (MHz) FMin: 500.0000

Frequency Maximum (GHz) FMax: 10.0000

Frequency Steps FStep: 20

Frequency of Interest (MHz) Freq: 1000.0000

Calculate

Result Presentation

Length of Line  / in  / m

Substrate Causal Extrapolation Reference Points

Set Er values from Stack Up materials

|     | Freq (Hz) | Ref Er | Ref TanD |
|-----|-----------|--------|----------|
| H1  | 1.000E+09 | 4.2000 | 0.0195   |
| H2  |           |        |          |
| H3  |           |        |          |
| H4  |           |        |          |
| REr |           |        |          |
| CEr | 1.000E+09 | 4.0000 | 0.0195   |

Surface Roughness Compensation

Smooth

Hammerstad

Grosse

Huray

Print Settings

Include Loss Graph for this structure on the report

Graph: Odd Mode | Even Mode

### Edge Coupled Coated Microstrip 1B

Differential

| Frequency (MHz) | Conductor Loss (dB/line) | Dielectric Loss (dB/line) | Attenuation (dB/line) | Conductor Loss with Roughness (dB/line) | Attenuation with Roughness (dB/line) |
|-----------------|--------------------------|---------------------------|-----------------------|---|--------------------------------------|
| 1000            | -0.2                     | -0.2                      | -0.5                  | -0.5                                    | -0.5                                 |
| 2000            | -0.3                     | -0.4                      | -1.0                  | -1.0                                    | -1.5                                 |
| 3000            | -0.4                     | -0.6                      | -1.5                  | -1.5                                    | -2.0                                 |
| 4000            | -0.5                     | -0.8                      | -2.0                  | -2.0                                    | -2.5                                 |
| 5000            | -0.6                     | -1.0                      | -2.5                  | -2.5                                    | -3.0                                 |
| 6000            | -0.7                     | -1.2                      | -3.0                  | -3.0                                    | -3.5                                 |
| 7000            | -0.8                     | -1.4                      | -3.5                  | -3.5                                    | -4.0                                 |
| 8000            | -0.9                     | -1.6                      | -4.0                  | -4.0                                    | -4.5                                 |
| 9000            | -1.0                     | -1.8                      | -4.5                  | -4.5                                    | -5.0                                 |
| 10000           | -1.1                     | -2.0                      | -5.0                  | -5.0                                    | -5.5                                 |

Graph Settings

Display Series: All Losses

Differential: Differential

Loss Budget (dB): 0.0000

Picked Data Point Information

Result presentation, losses shown per inch

An example of a differential offset stripline structure

Frequency Dependent Properties - BETA

### Edge Coupled Offset Stripline 1B1A

Length of Line LL: 1000.0000  
 Trace Conductivity (S/m) TC: 5.800E+07  
 Frequency Minimum (MHz) FMin: 500.0000  
 Frequency Maximum (GHz) FMax: 10.0000  
 Frequency Steps FStep: 20  
 Frequency of Interest (MHz) Freq: 4000.0000

Calculate

Result Presentation

Length of Line  /in  /m

Substrate Causal Extrapolation Reference Points

Set Er values from Stack Up materials

|     | Freq (Hz) | Ref Er | Ref TanD |
|-----|-----------|--------|----------|
| H1  | 1.000E+09 | 4.2000 | 0.0195   |
| H2  | 1.000E+09 | 4.2000 | 0.0210   |
| H3  |           |        |          |
| H4  |           |        |          |
| RER |           |        |          |
| CEr |           |        |          |

Surface Roughness Compensation

Smooth  
 Hammerstad  
 Grosse  
 Huray

Print Settings

Include Loss Graph for this structure on the report

Graph | Odd Mode | Even Mode |

### Edge Coupled Offset Stripline 1B1A

Differential

| Frequency (MHz) | Conductor Loss (dB/in) | Dielectric Loss (dB/in) | Attenuation (dB/in) | Conductor Loss with Roughness (dB/in) | Attenuation with Roughness (dB/in) |
|-----------------|------------------------|-------------------------|---------------------|---------------------------------------|------------------------------------|
| 1000            | -0.10                  | -0.15                   | -0.20               | -0.15                                 | -0.25                              |
| 2000            | -0.12                  | -0.25                   | -0.35               | -0.20                                 | -0.40                              |
| 3000            | -0.14                  | -0.35                   | -0.45               | -0.25                                 | -0.50                              |
| 4000            | -0.16                  | -0.45                   | -0.55               | -0.30                                 | -0.60                              |
| 5000            | -0.18                  | -0.55                   | -0.65               | -0.35                                 | -0.70                              |
| 6000            | -0.20                  | -0.65                   | -0.75               | -0.40                                 | -0.80                              |
| 7000            | -0.22                  | -0.75                   | -0.85               | -0.45                                 | -0.90                              |
| 8000            | -0.24                  | -0.85                   | -0.95               | -0.50                                 | -1.00                              |
| 9000            | -0.26                  | -0.95                   | -1.05               | -0.55                                 | -1.10                              |
| 10000           | -0.28                  | -1.05                   | -1.15               | -0.60                                 | -1.20                              |

Graph Settings

Display Series: All Losses

Differential: Differential

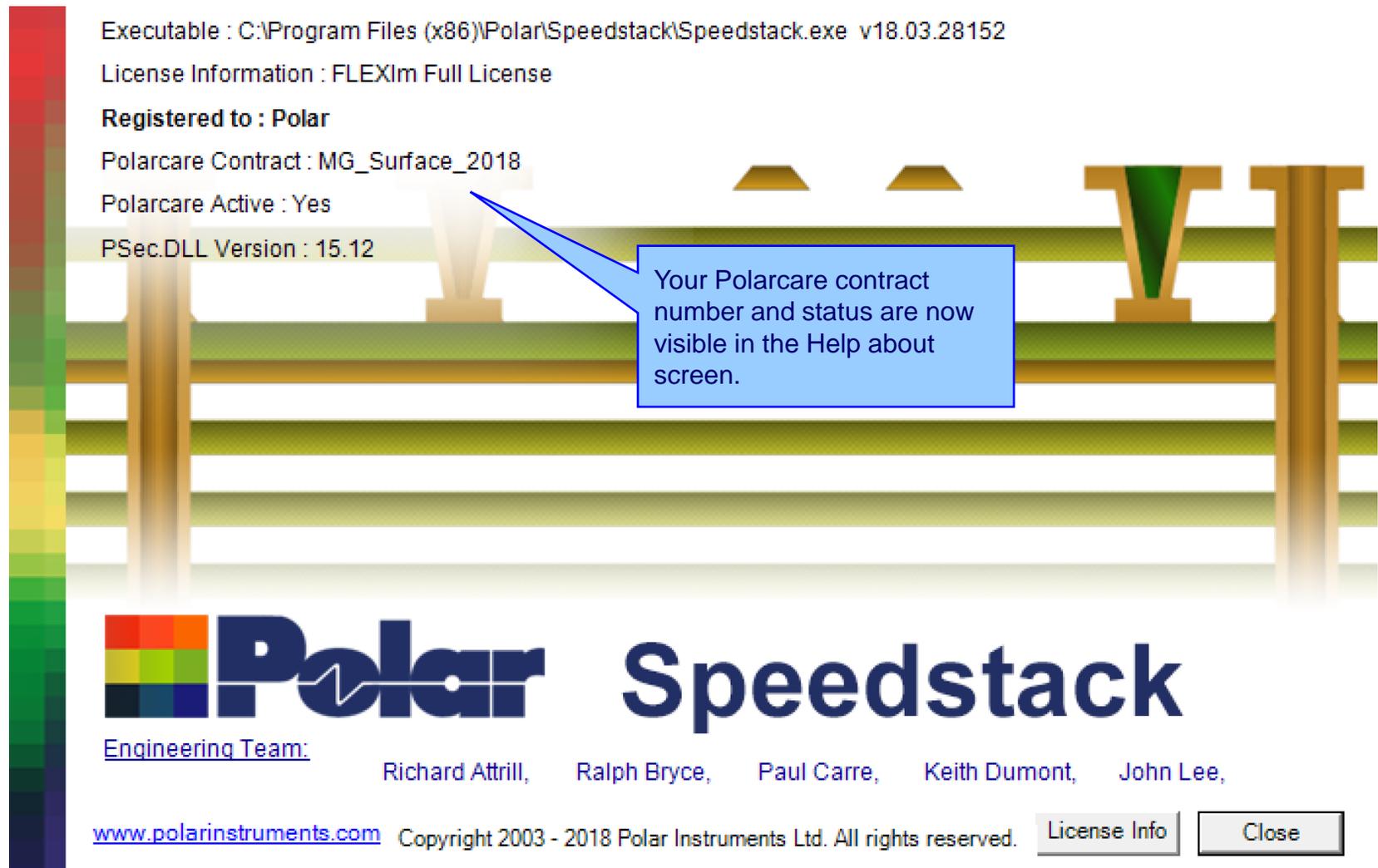
Loss Budget (dB): 0.0000 Refresh

Picked Data Point Information

Frequency (MHz): 10000.000  
 Attenuation with Roughness (dB): -1.291

Maximise Print Export

## Speedstack – Contacting Polar for support



Executable : C:\Program Files (x86)\Polar\Speedstack\Speedstack.exe v18.03.28152  
License Information : FLEXIm Full License  
**Registered to : Polar**  
Polarcare Contract : MG\_Surface\_2018  
Polarcare Active : Yes  
PSec.DLL Version : 15.12

Your Polarcare contract number and status are now visible in the Help about screen.



# Speedstack

Engineering Team: Richard Attrill, Ralph Bryce, Paul Carre, Keith Dumont, John Lee,

[www.polarinstruments.com](http://www.polarinstruments.com) Copyright 2003 - 2018 Polar Instruments Ltd. All rights reserved. License Info Close

# Speedstack – Technical Report enhancements

Informative loss vs frequency graphs have been added to the technical report

Speedstack Report Printer

File Options

**Table 1: Material Properties**

| Layer | Depth | Height | Supplier | Description | Type       | Thickness (mm) | ρ (g/cm³) | Loss (dB) | Impedance (Ω) |
|-------|-------|--------|----------|-------------|------------|----------------|-----------|-----------|---------------|
| 1     | 0.000 | 0.000  | PHI      | PHI 3000    | Substrate  | 1.000          | 4.300     | 0.000     | 300.0         |
| 2     | 0.000 | 0.000  | PHI      | PHI 3000    | Dielectric | 0.200          | 3.500     | 1.2       | 100.0         |
| 3     | 0.000 | 0.000  | PHI      | PHI 3000    | Dielectric | 1.000          | 4.300     | 0.000     | 300.0         |
| 4     | 0.000 | 0.000  | PHI      | PHI 3000    | Dielectric | 0.200          | 3.500     | 1.2       | 100.0         |
| 5     | 0.000 | 0.000  | PHI      | PHI 3000    | Substrate  | 1.000          | 4.300     | 0.000     | 300.0         |

**Table 2: Loss vs Frequency Graph Data (Approximate)**

| Frequency (MHz) | Conductor Loss (dB) | Dielectric Loss (dB) | Attenuation (dB) | Conductor Loss with Roughness (dB) | Attenuation with Roughness (dB) |
|-----------------|---------------------|----------------------|------------------|------------------------------------|---------------------------------|
| 1000            | 0.0                 | 0.0                  | 0.0              | 0.0                                | 0.0                             |
| 2000            | 0.0                 | 0.0                  | 0.0              | 0.0                                | 0.0                             |
| 4000            | 0.0                 | 0.0                  | 0.0              | 0.0                                | 0.0                             |
| 6000            | 0.0                 | 0.0                  | 0.0              | 0.0                                | 0.0                             |
| 8000            | 0.0                 | 0.0                  | 0.0              | 0.0                                | 0.0                             |
| 10000           | 0.0                 | 0.0                  | 0.0              | 0.0                                | 0.0                             |

# Speedstack – Technical Report enhancements

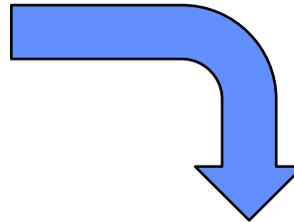


An example of the loss vs frequency graph

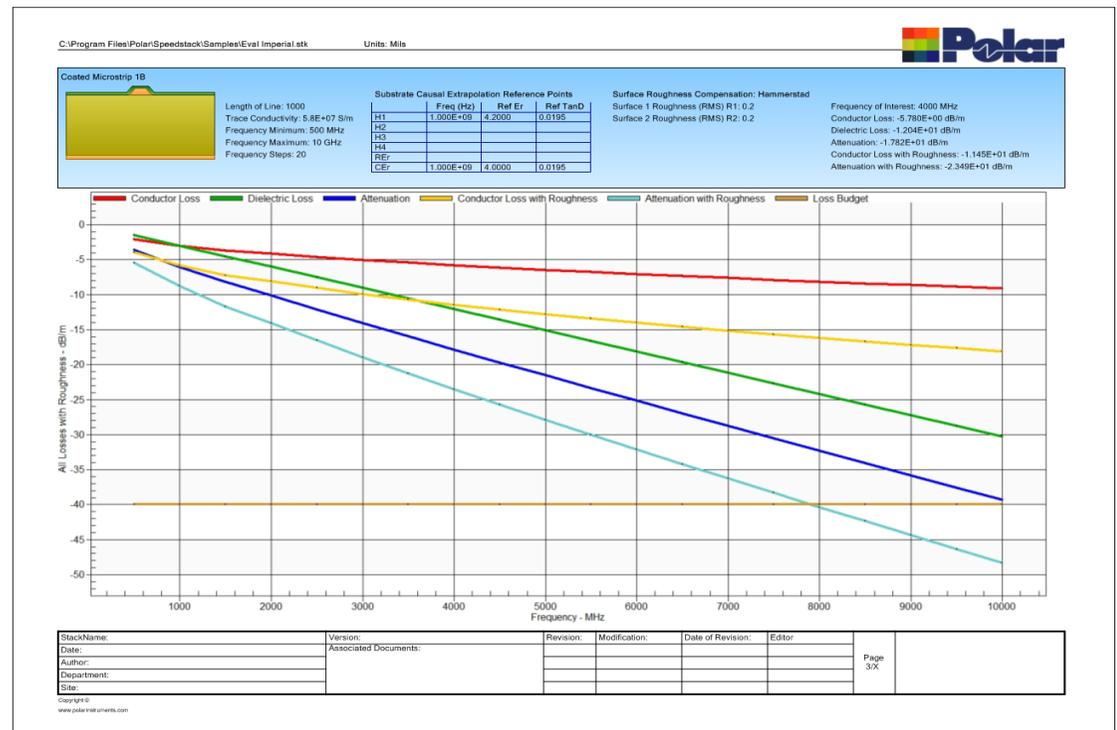
# Speedstack – Technical Report enhancements

Print Settings

Include Loss Graph for this structure on the report



'Include Loss Graph for this structure on the report' checkbox allows the user to nominate which structures will contain a separate loss graph page



# Speedstack – Technical Report enhancements

Speedstack Report Printer

File Options

C:\Program Files\Polar\Speedstack\Samples\Eval Imperial.stk Units: MILS

New user-selectable options to show a dimension arrow for 'Stack Up Thickness (solder mask to solder mask)' and 'Stack Up Thickness (laminates to laminates)'

| Layer | Stack up | Supplier      | Supplier Description | Description                 |
|-------|----------|---------------|----------------------|-----------------------------|
| 1     |          | Polar Samples | SM/001               | Liquid Photolimageable Mask |
|       |          | Polar Samples | FO/001               | Copper Foil                 |
|       |          | Polar Samples | PP/001               | PrePreg 1080                |
| 3     |          | Polar Samples | CO/005               | FR4 Core                    |
|       |          | Polar Samples | PP/002               | PrePreg 3080                |
|       |          | Polar Samples | PP/004               | PrePreg 1651                |
|       |          | Polar Samples | PP/004               | PrePreg 1651                |
| 4     |          | Polar Samples | CO/020               | FR4 Core                    |
| 5     |          | Polar Samples | PP/004               | PrePreg 1651                |
|       |          | Polar Samples | PP/004               | PrePreg 1651                |
|       |          | Polar Samples | PP/002               | PrePreg 3080                |
| 6     |          | Polar Samples | CO/005               | FR4 Core                    |
| 7     |          | Polar Samples | PP/001               | PrePreg 1080                |
|       |          | Polar Samples | FO/001               | Copper Foil                 |
| 8     |          | Polar Samples | SM/001               | Liquid Photolimageable Mask |

61.46  
59.46  
58.06

Copper Thickness = 9.800 | Dielectric Thickness = 49.660 | Stack Up Cost = 54.00 |

# Speedstack – Technical Report enhancements

Speedstack Report Printer

File Options

- Print Setup
- Page Setup
- Stack Data Table
  - Suppress
  - Stack Data Columns...
  - Show Drills (Stack Table)
  - Show Thickness Totals
  - Show Stackup Cost
  - Show Hatch Profile Data
  - Show Stackup Thickness...
  - Show Stackup Thickness Tolerance Value As...
  - Show Stackup Thickness (Solder mask-Solder mask)
  - Show Stackup Thickness (Laminate-Laminate)
  - Stackup Thickness Decimal Accuracy
- Controlled Impedance Data Table
- Frequency Dependent Loss Graphs
- Drill Data Table
- B.O.M. Data Table
- Note Field Aliases
- Print Order
- General
- Restore Default Settings

Units: Mils

| Supplier      | Supplier Description | Description                |
|---------------|----------------------|----------------------------|
| Polar Samples | SM/001               | Liquid Photolmageable Mask |
| Polar Samples | FO/001               | Copper Foil                |
| Polar Samples | PP/001               | PrePreg 1080               |
| Polar Samples | CO/005               | FR4 Core                   |
| Polar Samples | PP/002               | PrePreg 3080               |
| Polar Samples | PP/004               | PrePreg 1651               |
| Polar Samples | PP/004               | PrePreg 1651               |
| Polar Samples | CO/020               | FR4 Core                   |
| Polar Samples | PP/004               | PrePreg 1651               |
| Polar Samples | PP/004               | PrePreg 1651               |
| Polar Samples | PP/002               | PrePreg 3080               |
| Polar Samples | CO/005               | FR4 Core                   |
| Polar Samples | PP/001               | PrePreg 1080               |
| Polar Samples | FO/001               | Copper Foil                |
| Polar Samples | SM/001               | Liquid Photolmageable Mask |

Copper Thickness = 0.000 | Dielectric Thickness = 49.660 | S  
**Stack Up Cost = 54.00**

Additional user-selectable options to control the data shown beneath the stack up. For instance Stackup Cost and Hatch Profile

Importantly Speedstack 2018 allows comprehensive bidirectional copy and paste from Speedstack into Si9000e including all the relevant loss tangent, roughness and roughness method along with frequencies of interest.

The screenshot displays the Polar Si9000 PCB Transmission Line Field Solver interface. The main window shows a 3D model of a 'Coated Microstrip 1B' structure with parameters: Length of Line (LL) = 1000.00, Trace Conductivity (TC) = 5.80E+07, Loss Tangent (TanD) = 0.0195, Rise Time (Tr) = 10, Frequency Minimum (FMin) = 500,000, Frequency Maximum (FMax) = 10,000, and Frequency Steps (FSteps) = 20. The 'Surface Roughness Compensation' is set to 'Smooth'. The 'Result Presentation' is set to 'Length of Line'.

The 'Measurement Data' panel shows 'No Data Imported'. The 'Frequency Distribution' is set to 'Linear'. The 'Extended Substrate Data' includes 'Constant Er / TanD', 'Causally Extrapolate Er / TanD', and 'Multiple Er / TanD'. The 'Surface Roughness Compensation' options are 'Smooth', 'Hammerstad', 'Grosse', and 'Huray'.

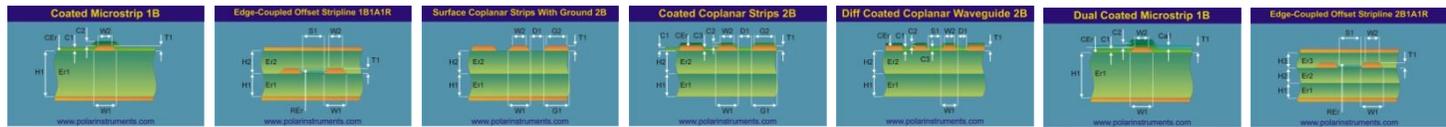
The 'Graph' panel shows a plot of 'All Losses with Roughness - dB/m' versus 'Frequency - MHz' for the 'Coated Microstrip 1B' structure. The plot includes five data series: Conductor Loss (red), Dielectric Loss (green), Attenuation (blue), Conductor Loss with Roughness (yellow), and Attenuation with Roughness (cyan). The x-axis ranges from 1000 to 10000 MHz, and the y-axis ranges from 0 to -50 dB/m. The plot shows that all loss components increase with frequency, with Attenuation with Roughness showing the most significant increase.

The 'Frequency Dependent Properties - BETA' panel shows a smaller version of the same graph and model, with parameters: Length of Line (LL) = 1000.0000, Trace Conductivity (TC) = 5.800E+07, Frequency Minimum (FMin) = 500.0000, Frequency Maximum (FMax) = 10.0000, Frequency Steps (FSteps) = 20, and Frequency of Interest (Freq) = 10000.0000.

A large blue arrow points from the 'Measurement Data' panel towards the 'Frequency Dependent Properties - BETA' panel, indicating the flow of data or the relationship between the two panels.

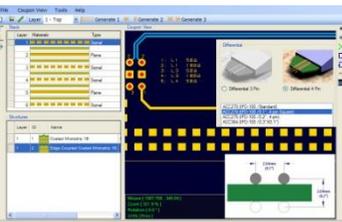
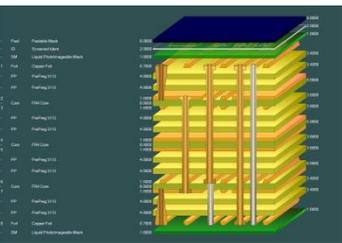
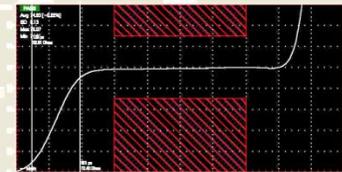
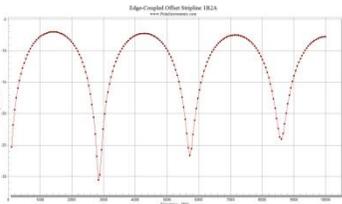
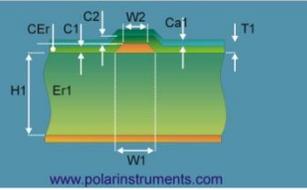
## •IMPORTANT NOTE:

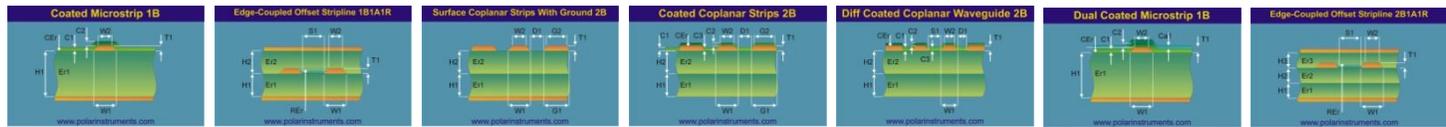
- Please contact your local Polar office for information regarding evaluation and upgrading.
- As noted earlier – there are significant changes “under the hood” in both Speedstack, its associated Si8000m / Si9000e field solvers and FlexNet license management – it is important you discuss these especially if you are running a network or WAN license.



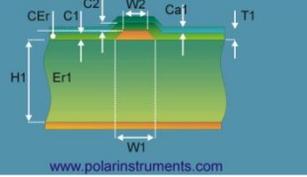
Thank you

Impedance calculation



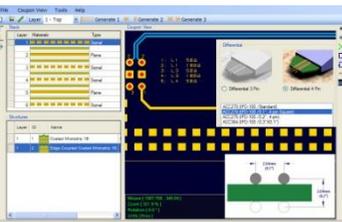
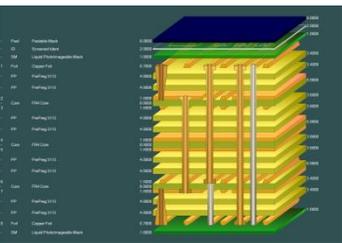
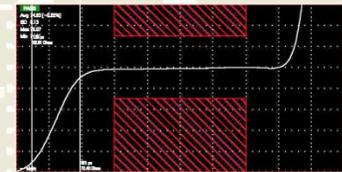
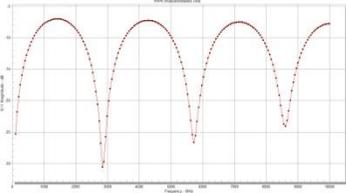


Impedance calculation



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Edge-Coupled Offset Stripline 1B2A



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