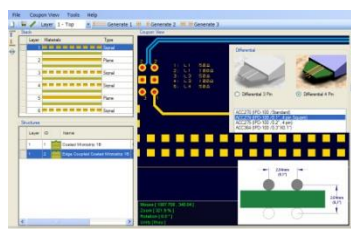
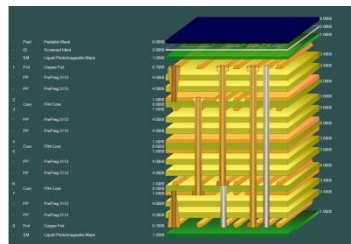
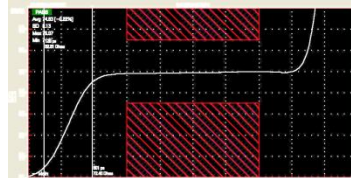
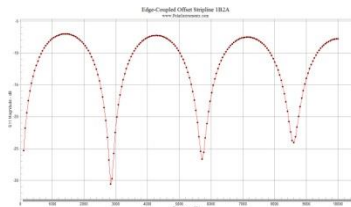
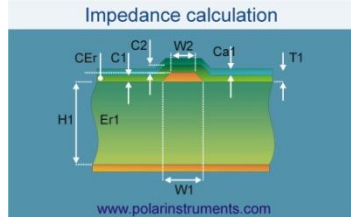




Si9000e 2021 - 2022 Preview

Richard Attrill – September 2022 (Rev 3)



Introducing the latest features of Si9000e

Welcome to a preview of Si9000e.

Since January 2021 we have released seven versions of Si9000e, each introducing a number of new features that have been requested through our Polarcare software maintenance service.

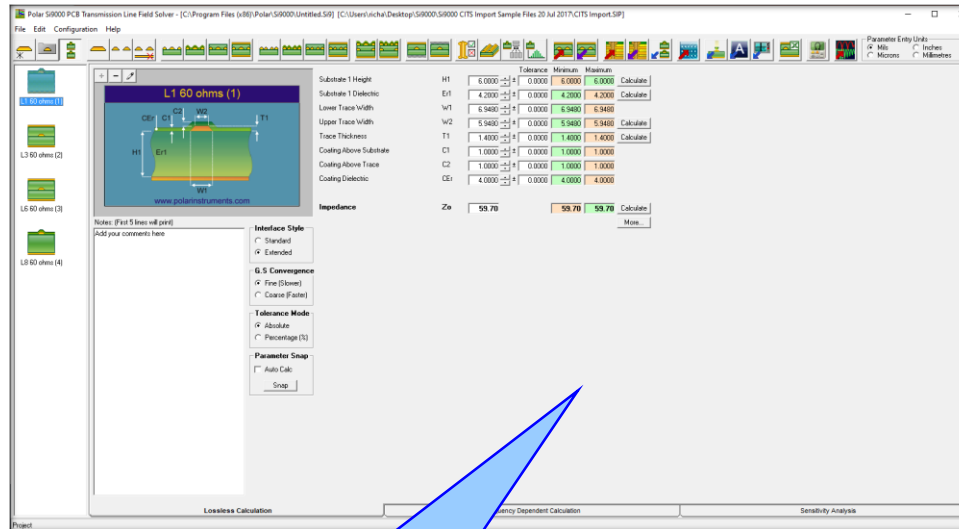
These slides are arranged in a “newest first” format. A slide containing the version number and release date precedes information detailing the new features contained in each release.

If you would like to have a web-based demonstration please contact your local Polar office, details are shown on the last slide of this presentation

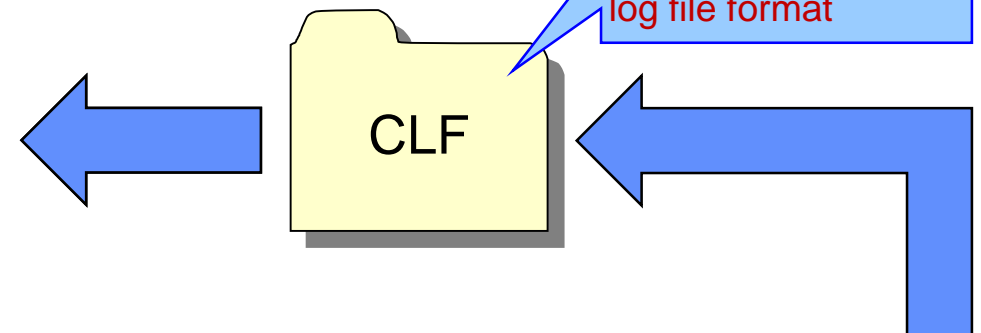
Please note: the Si9000e units have been set to Mils in the following screen grabs

Si9000e v22.09.01 (September 2022)

Enhancements to the Import Polar CITS Datalog File option

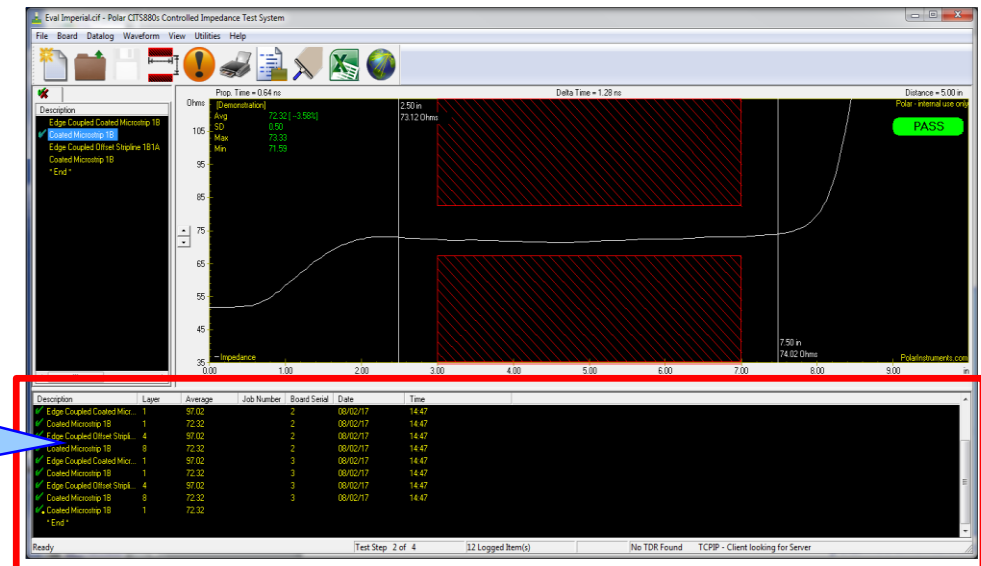


New for v22.09.01
Now supports the latest CITS880s data log file format



Overview
The Polar Si8000m / Si9000e field solver products have the capability to read a Polar CITS Data Log File (.CLF). This file contains comprehensive impedance measurement data and, along with existing modelled structure information, offers graphing capabilities and statistical analysis where the modelled and measured data can be presented together.

The Data Log of the CITS software is stored in a CLF file



Import CITS Datalog File option – feature recap

Whilst working with controlled impedance designs it is often desirable to compare the reality of the measurement data against the modelled structure.

‘Closing the loop’ between the predicted and actual measured results has a number of benefits for both the design and fabrication environments. It allows for fine tuning of the structure parameters in future manufacturing batches, statistical analysis and improved overall process control.

This capability within the Polar’s Si8000m / Si9000e field solver products allows the user to quickly import measurement data directly from the industry-standard Polar Controlled Impedance Test System (CITS).

If you are a design customer using the Si8000m / Si9000e and would like to use this feature, please request the Polar CITS Datalog File from your fabricator.

Import CITS Datalog File option – feature recap

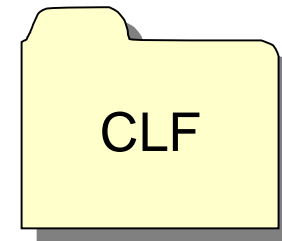
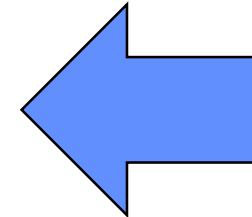
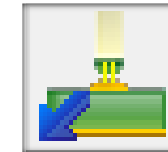
Transmission Line Field Solver - [C:\Program Files (x86)\Polar\Si9000\Untitled.Si9] [C:\Users\richa\Desktop\Si9000\Si9000 CITS Import Sample Files 25 Aug 2022\CITS Import.SIP]

File Edit View Options Help

| | | Tolerance | Minimum | Maximum | |
|-------------------------|-----------|-----------|--------------|--------------|-----------|
| Substrate 1 Height | H1 | ± 0.0000 | 6.0000 | 6.0000 | Calculate |
| Substrate 1 Dielectric | Er1 | ± 0.0000 | 4.2000 | 4.2000 | Calculate |
| Lower Trace Width | W1 | ± 0.0000 | 6.9480 | 6.9480 | |
| Upper Trace Width | W2 | ± 0.0000 | 5.9480 | 5.9480 | |
| Trace Thickness | T1 | ± 0.0000 | 1.4000 | 1.4000 | |
| Coating Above Substrate | C1 | ± 0.0000 | 1.0000 | 1.0000 | |
| Coating Above Trace | C2 | ± 0.0000 | 1.0000 | 1.0000 | |
| Coating Dielectric | CEr | ± 0.0000 | 4.0000 | 4.0000 | |
| Impedance | Zo | | 59.70 | 59.70 | |

Notes: (First 5 lines will print)
Add your comments here

Interface Style
 Standard
 Extended



Import CITS Datalog File option – feature recap

Step 1 : Read CITS Log File

Filename: C:\Users\richa\Desktop\Si9000\Si9000 CITS Import Sample Files 25 Aug 2022\CITS Imp...

Instrument Model: CITS880 Instrument Serial No: 17581

Data Log Record Count: 160 Per Board / Coupon: 4 Board / Coupon Count: 40

Step 2 : Select Data Log Record

Data Log Records: Description - L01, Layer - 1, Nominal - 60.00

Project Structure: L1 60 ohms (1)

Description: L01 Layer: 1

Nominal Impedance: 60.00 Tol+ %: 10.00 Tol- %: 10.00

Graph Settings

Impedance Options :
 Nominal Impedance
 Minimum / Maximum
 Impedance Options :
 Nominal Impedance
 Tolerances (plus / minus)
 Impedance Results :
 Fail
 Short

Picked Data Point Information

Maximise Print Export

Callout 1: Once the CITS CLF data log file has been identified the software reads key information – Instrument Model, Serial Number, Data Log Record Count, Tests per Board / Coupon

Callout 2: A Data Log Records dropdown list built from the data log file, allowing the user to select the appropriate test records they would like to view / plot

Callout 3: The Project Structure dropdown presents a list of structures currently available within the Project. Together with the Data Log Records dropdown it allows the user to quickly match the data log records against the correct structure

Callout 4: It is possible to plot the modelled and measured impedance data in a number of ways. The following slides provide more details

Import CITS Datalog File option – feature recap

Step 2 : Select Data Log Record

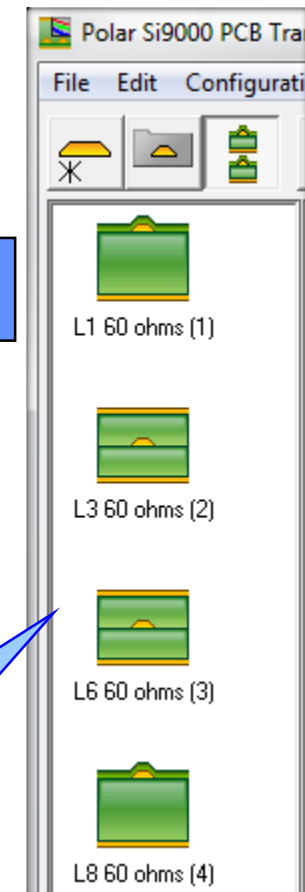
| | |
|-------------------|---------------------------------------------------------|
| Data Log Records | Description - L01, Layer - 1, Nominal Impedance - 60.00 |
| Project Structure | Description - L01, Layer - 1, Nominal Impedance - 60.00 |
| Description | Description - L03, Layer - 3, Nominal Impedance - 60.00 |
| Nominal Impedance | 60.00 Tol+ % 10.00 Tol- % 10.00 |

Each test record type found in the data log file is listed in the drop down. In this case there are four tests.

Step 2 : Select Data Log Record

| | |
|-------------------|---------------------------------------------------------|
| Data Log Records | Description - L01, Layer - 1, Nominal Impedance - 60.00 |
| Project Structure | L1 60 ohms (1) |
| Description | L1 60 ohms (1) |
| Nominal Impedance | L3 60 ohms (2) |
| | L6 60 ohms (3) |
| | L8 60 ohms (4) |

To match one of the four modelled structures from the Project group against a data log test record simply select the structure from the Project Structure dropdown

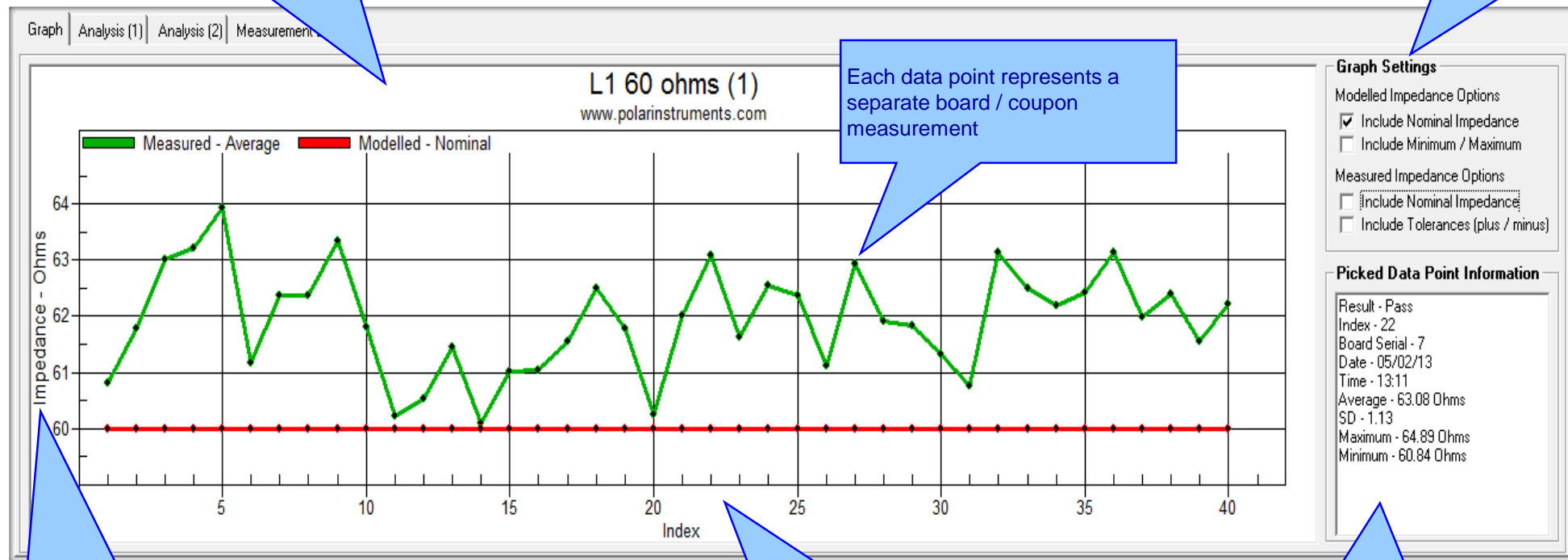


Four structures loaded into the Project group

Import CITS Datalog File option – feature recap

The Graph tab provides a number of plot options. In this case the measured data is shown in Green, the modelled data in Red

Graph Settings allow the selection of modelled / measured data to be plotted



Each data point represents a separate board / coupon measurement

The y-axis is the measured impedance for each board / coupon

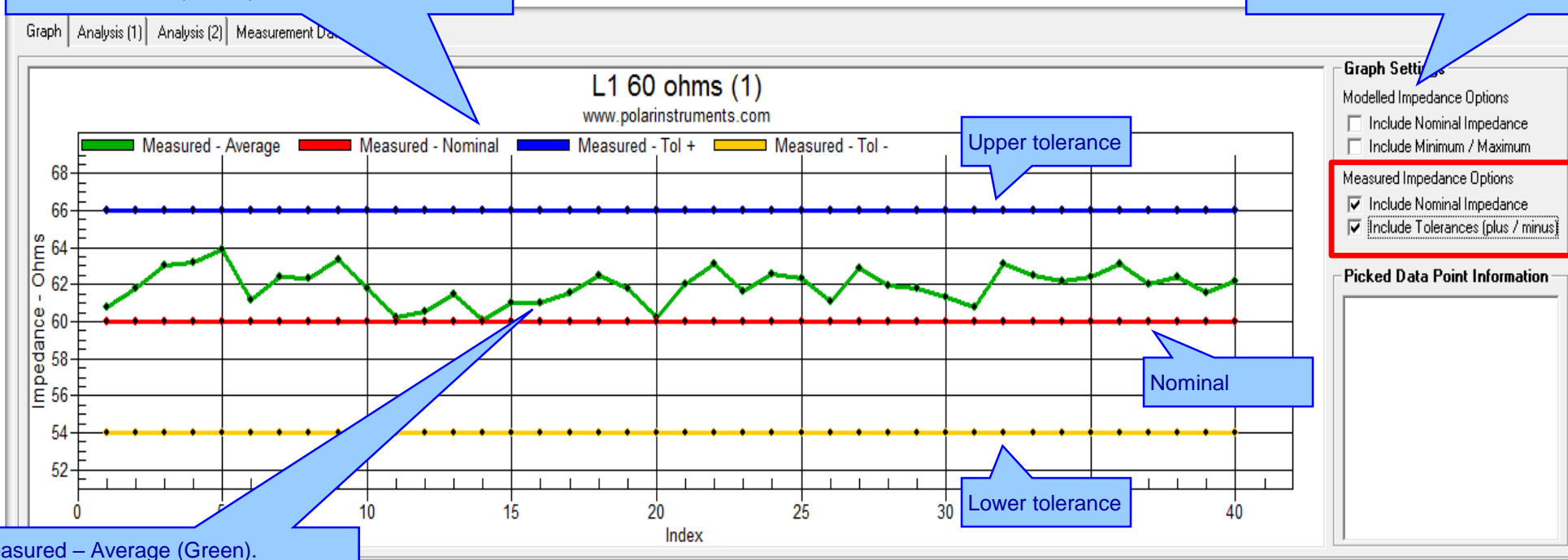
The x-axis is the identifying Index of the board / coupon read from the data log file

It is possible to pick a measured data point, key information is displayed here

Import CITS Datalog File option – feature recap

In this case the Graph contains:
Measured – Average (Green)
Nominal (Red)
Upper Tolerance (Blue)
Lower Tolerance (Yellow)

Graph Settings allow the selection of modelled / measured data to be plotted



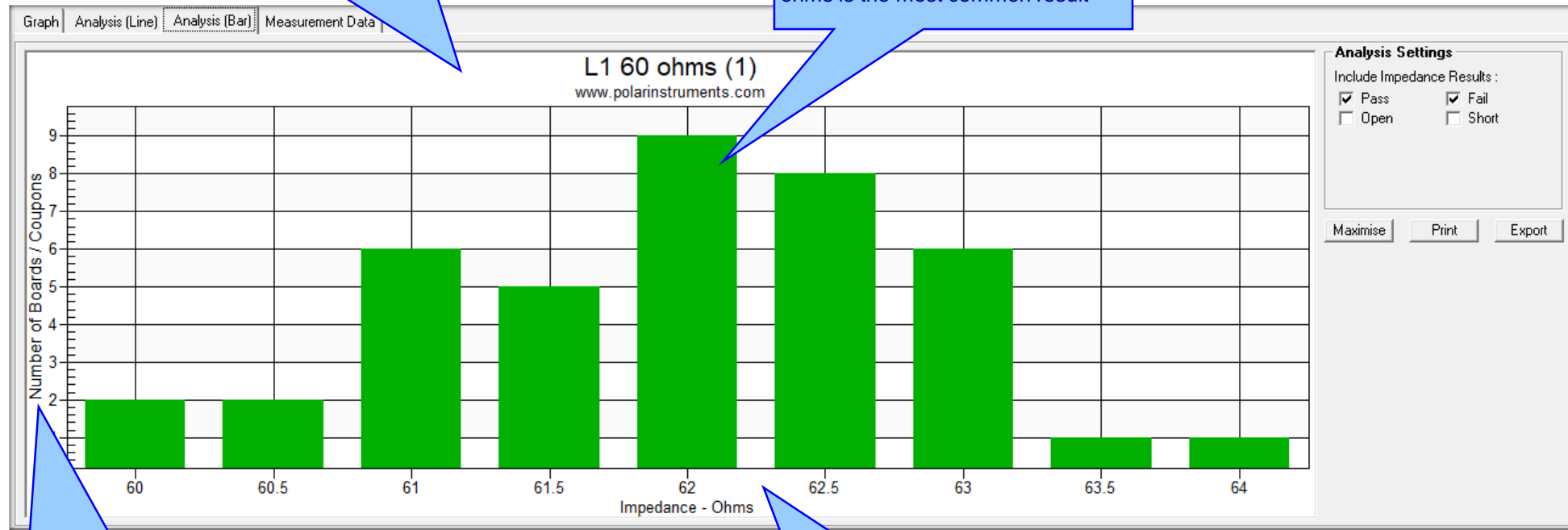
Measured – Average (Green).
Whilst reading slightly higher than the Nominal (60 ohms) all measured data points are within the upper and lower tolerance bands

Import CITS Datalog File option – feature recap

Analysis options:

This bar chart shows the distribution of measurement results over an impedance range

From this batch of 40 board / coupon measurements, 62 +/- 0.25 ohms is the most common result



The y-axis is the number of boards / coupons that fall within a given impedance as detailed on the x-axis

The x-axis is the measured impedance in 0.5 ohm increments

Import CITS Datalog File option – feature recap

Measurement Data:

The CITS Data Log data may also be viewed in a data grid layout. This is especially useful for viewing the Result data (Pass / Fail)

| Result | Index | Board Serial | Date | Time | Average | SD | Maximum | Minimum | Station | Description | Layer | Nominal | Tol+ % | Tol- % | Instrument | Serial No |
|--------|-------|--------------|----------|-------|---------|------|---------|---------|------------------|-------------|-------|---------|--------|--------|------------|-----------|
| Passed | 1 | 24 | 05/02/13 | 12:48 | 60.8 | 0.8 | 61.9 | 59.56 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 2 | 29 | 05/02/13 | 12:50 | 61.77 | 0.95 | 63.21 | 59.93 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 3 | 17 | 05/02/13 | 12:51 | 63.01 | 0.94 | 64.48 | 61.68 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 4 | 39 | 05/02/13 | 12:52 | 63.22 | 1.07 | 64.62 | 61.29 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 5 | 8 | 05/02/13 | 12:59 | 63.93 | 0.95 | 65.32 | 62.2 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 6 | 10 | 05/02/13 | 13:00 | 61.17 | 0.89 | 62.69 | 59.63 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 7 | 32 | 05/02/13 | 13:01 | 62.38 | 0.88 | 63.58 | 60.72 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 8 | 21 | 05/02/13 | 13:01 | 62.37 | 0.82 | 63.88 | 60.98 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 9 | 4 | 05/02/13 | 13:02 | 63.35 | 0.68 | 64.41 | 61.75 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 10 | 33 | 05/02/13 | 13:03 | 61.81 | 0.78 | 62.95 | 60.09 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 11 | 18 | 05/02/13 | 13:03 | 60.22 | 0.62 | 61.48 | 59.09 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 12 | 3 | 05/02/13 | 13:04 | 60.54 | 0.75 | 62.1 | 59.19 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 13 | 15 | 05/02/13 | 13:05 | 61.46 | 0.73 | 62.83 | 60.12 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 14 | 2 | 05/02/13 | 13:05 | 60.09 | 0.67 | 61.24 | 58.57 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 15 | 23 | 05/02/13 | 13:06 | 61.01 | 0.78 | 62.4 | 59.69 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 16 | 5 | 05/02/13 | 13:07 | 61.05 | 0.63 | 62.14 | 59.49 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 17 | 6 | 05/02/13 | 13:07 | 61.54 | 0.8 | 62.98 | 60.11 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 18 | 76 | 05/02/13 | 13:08 | 62.49 | 0.92 | 63.44 | 60.32 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 19 | 11 | 05/02/13 | 13:09 | 61.79 | 0.83 | 63.08 | 60.37 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 20 | 31 | 05/02/13 | 13:09 | 60.25 | 0.65 | 61.37 | 58.85 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 21 | 12 | 05/02/13 | 13:10 | 62.01 | 0.69 | 63.24 | 60.65 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 22 | 7 | 05/02/13 | 13:11 | 63.08 | 1.13 | 64.89 | 60.84 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |
| Passed | 23 | 19 | 05/02/13 | 13:11 | 61.63 | 0.72 | 62.81 | 60.19 | _TEST STATION 1_ | L01 | 1 | 60 | 10 | 10 | CITS880 | 17581 |

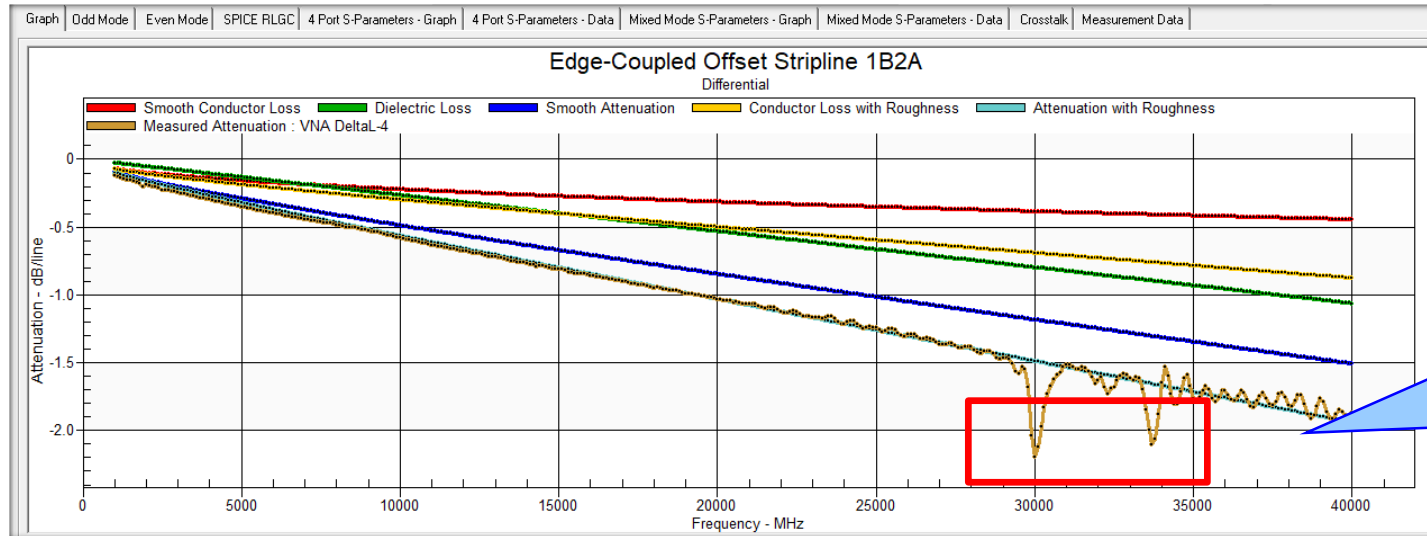
New Manually Set Y-Axis option for the All Losses plot

The screenshot displays the Polar Si9000 PCB Transmission Line Field Solver interface. The central window shows a 3D model of an 'Edge-Coupled Offset Stripline 1B2A' with parameters like Length of Line (LL: 1000.00), Trace Conductivity (TC: 5.80E+07), and Loss Tangent (TanD: 0.0195). Below the model is a table of parameters including Rise Time (Tr: 10), Frequency Minimum (FMin: 1000.000), Frequency Maximum (FMax: 40.000), and Frequency Steps (FSteps: 391). The main plot area shows 'Attenuation - dB/line' vs 'Frequency - MHz' for the 'Edge-Coupled Offset Stripline 1B2A' Differential mode. The plot includes several data series: Smooth Conductor Loss (red), Dielectric Loss (green), Smooth Attenuation (blue), Conductor Loss with Roughness (yellow), Attenuation with Roughness (cyan), and Measured Attenuation: VNA Delta-4 (brown). A blue callout box on the right side of the plot area contains the following text:

- The new 'Manually Set Y-Axis' option provides more control over how the All Losses plot is presented.
- The All Losses plot defaults to Y-axis auto-scale, where the Y-axis is resized to fit all data series.
- When the 'Manually Set Y-Axis' option is checked, the Y-axis min and max values can be fixed to user-defined values.
- This is especially useful after importing measurement data (brown) which often has measurement error artefacts that are not useful when comparing against the modelled data.

In the bottom right corner of the plot area, a settings panel is visible with the 'Manually Set Y-Axis' checkbox checked. Below this checkbox, the 'Y Min (dB)' is set to -1.9500 and the 'Y Max (dB)' is set to 0.0000. A 'Loss Budget (dB)' field is also present, set to 0.0000. The 'Picked Data Point Information' section is empty.

New Manually Set Y-Axis option for the All Losses plot



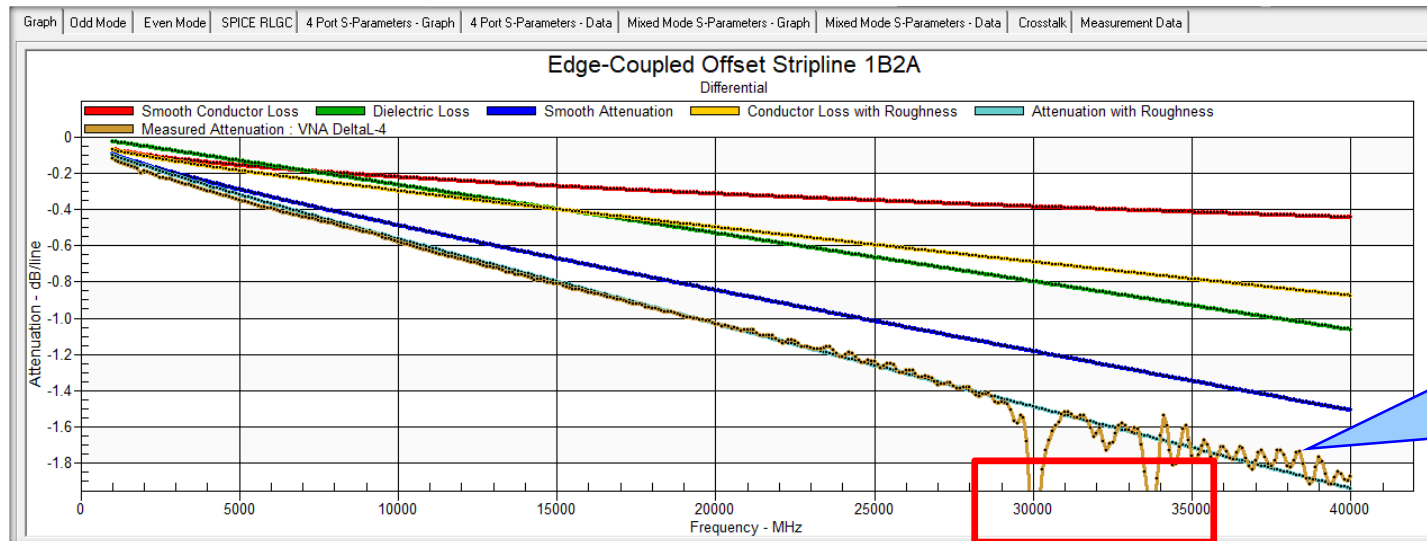
Manually Set Y-Axis

Y Min (dB) Y Max (dB)

-1.9500 0.0000 Refresh

'Manually Set Y-Axis' unchecked, the Y-axis will auto-scale.

Notice the plot will scale the Y-axis to include all the measurement data including the measurement error artefacts



Manually Set Y-Axis

Y Min (dB) Y Max (dB)

-1.9500 0.0000 Refresh

'Manually Set Y-Axis' is checked, the Y Min is set to -1.95 dB

Notice the plot will fix the Y-axis min / max to the values specified, the measurement error artefacts will be ignored.

Enhancements to the Import Touchstone Format option



Edge-Coupled Coated Microstrip 2B

www.polarinstruments.com

Read Touchstone File

Filename: C:\Users\vicha\Desktop\ECCM2B 2Inch.s4p

Overlay Calculated S-Parameter Data

Import

Touchstone files contain S-Parameter data exported from VNA instruments and modelling software, including the Polar Si9000e.

The Si9000e allows a Touchstone file to be imported (green) and then compared against the structure currently being modelled (red).

Graphing options exist to display Magnitude, Phase and present S-Parameters as a Smith chart.

V22.09.01 enhances the Import Touchstone Format option to support S-Parameter data from a wider range of frequencies.

4 Port S-Parameters - Graph | 4 Port S-Parameters - Data

S21

www.polarinstruments.com

Graph Options

Magnitude Phase

Smith

Data Series

S11 S12 S13 S14

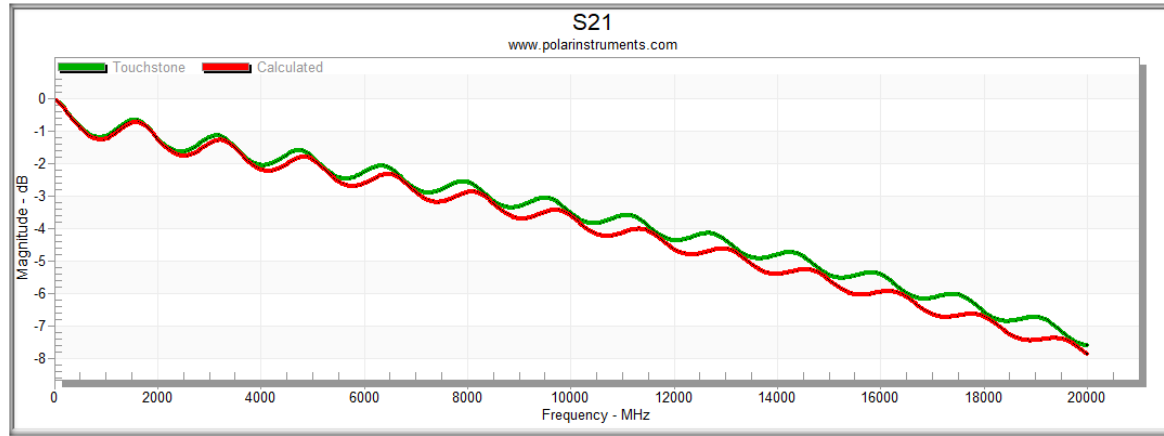
S21 S22 S23 S24

S31 S32 S33 S34

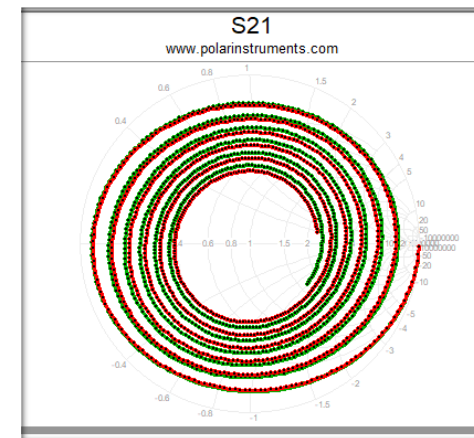
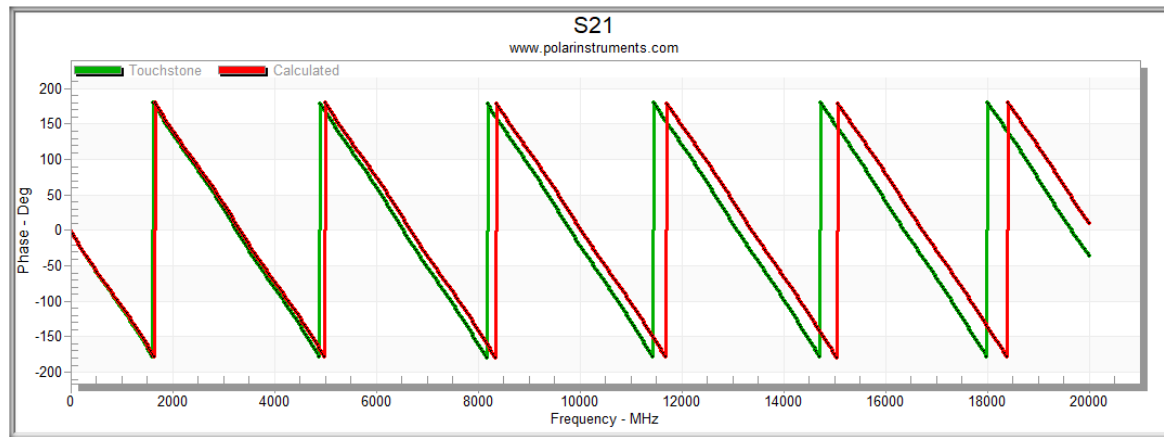
S41 S42 S43 S44

Maximise Print Export

Enhancements to the Import Touchstone Format option



In this example a Touchstone 4-port file (.S4P) has been imported into the Si9000e. Magnitude, Phase and Smith Chart are shown for S21



Si9000e v22.04 (April 2022)

New Differential Via Calculation capability

The screenshot displays the Polar Si9000 PCB Transmission Line Field Solver interface. A red box highlights the 'Via Checks' icon in the toolbar. A blue callout box points to this icon with the following text:

The new Via Checks toolbar option. This Differential Via Calculation is now part of a new tabbed Via Checks dialog accessible from the toolbar. It also contains the Via Stub Check and Via Pad / Anti Pad Coaxial Calculation that were previously present on the main interface

The main interface shows a cross-sectional diagram of an 'Edge-Coupled Coated Microstrip 1B' with various parameters labeled: $H1$, $Er1$, $C1$, $C2$, $S1$, $W1$, $W2$, $T1$, $C3$, and CEr . The 'Differential Impedance' section shows a calculated value of $Z_{diff} = 85.02$. The 'Interface Style' is set to 'Extended', 'G.S. Convergence' is set to 'Fine (Slower)', and 'Tolerance Mode' is set to 'Absolute'. The 'Parameter Snap' section has 'Auto Calc' checked and a 'Snap' button.

| Parameter | Value | Tolerance | Minimum | Maximum | Action |
|------------------------------|--------|-----------|---------|-----------|-----------|
| Substrate 1 Height (H1) | 8.5000 | 0.0000 | 8.5000 | 8.5000 | Calculate |
| Substrate 1 Dielectric (Er1) | 4.2000 | ± | 4.2000 | 4.2000 | Calculate |
| Lower Trace Width (W1) | 5.0000 | ± | 0.0000 | 9999.9999 | |
| Upper Trace Width (W2) | 4.0000 | ± | 0.0000 | 9999.9999 | |
| Trace Separation (S1) | 2.2810 | ± | 0.0000 | 9999.9999 | |
| Trace Thickness (T1) | 1.2000 | ± | 0.0000 | 9999.9999 | |
| Coating Above Substrate (C1) | 1.0000 | ± | 0.0000 | 9999.9999 | |
| Coating Above Trace (C2) | 1.0000 | ± | 0.0000 | 9999.9999 | |
| Coating Between Traces (C3) | 1.0000 | ± | 0.0000 | 9999.9999 | |
| Coating Dielectric (CEr) | 4.2000 | ± | 0.0000 | 9999.9999 | |

New Differential Via Calculation

Via Checks
Close

Via Stub Check
Via Pad / Anti-Pad Calculation
Differential Via Calculation

Differential Via Calculation

www.polarinstruments.com

Please refer to the parameters in parentheses when reading [Application Note](#)
Courtesy of Bert Simonovich, Lamsim Enterprises Inc

Note: The model works for a simple differential pair structure with no pads and several planes throughout the board. If there is, say, only a 4 or 6 layer stackup, there will not be sufficient excess capacitance from the planes so the accuracy will suffer. When planes are spaced like modern designs it will be more accurate.

Anti-Pad Style

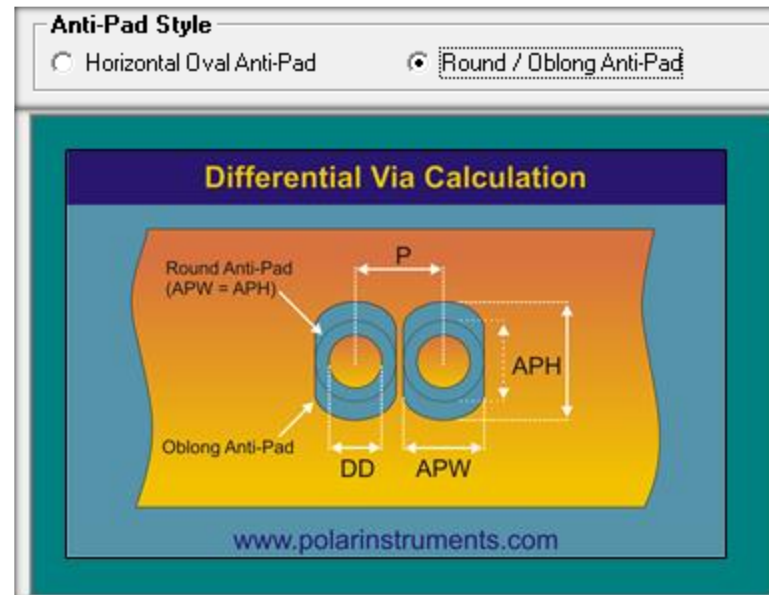
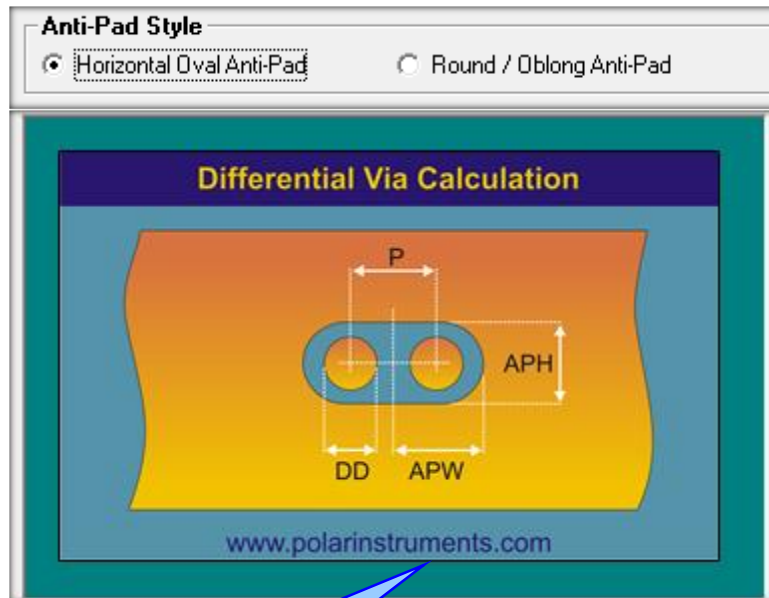
Horizontal Oval Anti-Pad Round / Oblong Anti-Pad

| | | | |
|-------------------------------|-------|---------|--|
| Drill Diameter (t) | DD | 15.0000 | |
| Via Pitch (S) | P | 35.0000 | |
| Anti-Pad Width (b) | APW | 50.8000 | |
| Anti-Pad Height (w') | APH | 50.8000 | |
| Dielectric Constant (Dkz) | Dkz | 3.6350 | |
| Dielectric Anisotropy (%) | | 0.00 | |
| Odd Mode Impedance (Zvia) | Zodd | 42.44 | |
| Differential Impedance | Zdiff | 84.88 | |
| Effective Dielectric Constant | DkEff | 4.4430 | |

Calculation results are presented here

Enter via structure parameters by either keying the dimension values or use sliders to gauge the impact of varying each parameter

New Differential Via Calculation



Two different selectable
Anti-Pad Styles available

New Differential Via Calculation

Via Checks

Via Stub Check | Via Pad / Anti-Pad Calculation | Differential Via Calculation

Please refer to the parameters in parentheses when reading [Application Note](#)
 Courtesy of Bert Simonovich, Lamsim Enterprises Inc

Note: The model works for a simple differential pair structure with no pads and several reference planes so the accuracy will be high. There will not be sufficient excess capacitance in the vias and reference planes so the accuracy will be high.

The Application Note link provides further details of how the model works

AP8204.pdf 1 / 9 100%

A Practical Alternative to 3D Via Modeling

You are a backplane designer and have been assigned to engineer a new high-speed, multi-gigabit serial link architecture from several line cards to multiple fabric switch cards across a backplane. These links must operate at 6GB/s day one and be 10GB/s (IEEE 802.3KR) ready for product evolution. The schedule is tight, and you need to come up with a backplane architecture to allow the rest of the program to progress on schedule.

HLD Plan

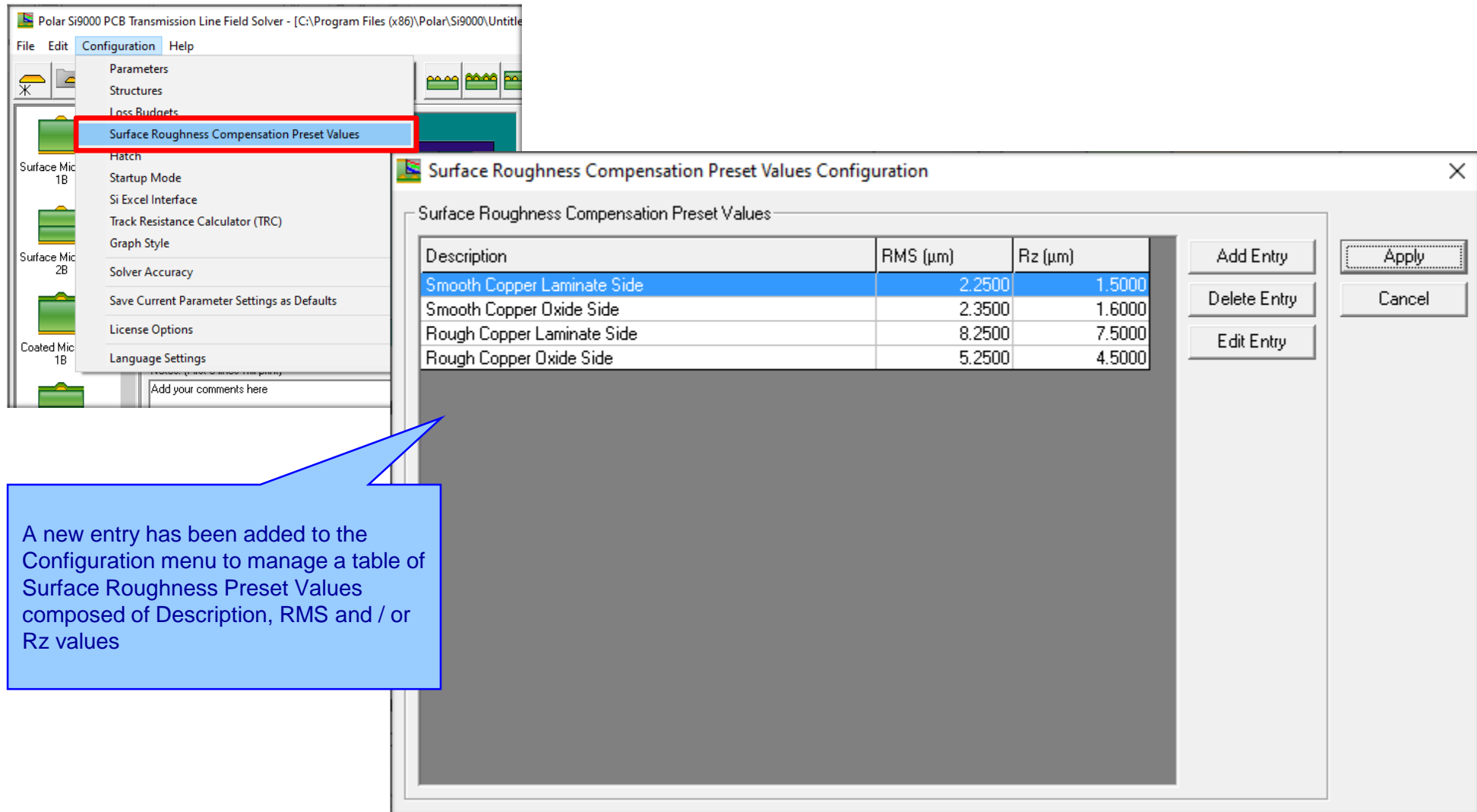
You come up with a concept you think will work, but the backplane is thick with over 30 layers. There are some long traces over 30 inches and some short traces of less than 2 inches between card slots. There is strong pressure to reuse the same connector you used in your last design, but your gut tells you its design may not be good enough for this higher speed application.

Finally, you are worried about the size and design of the differential via footprint used for the backplane connectors because you know they can be devastating to the quality of the received signal. You want to maximize the routing channel through the connector field, which requires you to shrink the anti-pad dimensions, so the tracks will be covered by the reference planes, but you can't easily quantify the consequences on the via of doing so.

You have done all you can think of, based on experience, to make the vias as transparent as possible without

Si9000e v22.03 (March 2022)

New Surface Roughness Compensation Preset Values option



The screenshot shows the 'Configuration' menu with the following options: Parameters, Structures, Loss Budgets, **Surface Roughness Compensation Preset Values**, Hatch, Startup Mode, Si Excel Interface, Track Resistance Calculator (TRC), Graph Style, Solver Accuracy, Save Current Parameter Settings as Defaults, License Options, and Language Settings. The 'Surface Roughness Compensation Preset Values Configuration' dialog box contains the following table:

| Description | RMS (μm) | Rz (μm) |
|-----------------------------|-----------------------|----------------------|
| Smooth Copper Laminate Side | 2.2500 | 1.5000 |
| Smooth Copper Oxide Side | 2.3500 | 1.6000 |
| Rough Copper Laminate Side | 8.2500 | 7.5000 |
| Rough Copper Oxide Side | 5.2500 | 4.5000 |

Buttons in the dialog box include: Add Entry, Delete Entry, Edit Entry, Apply, and Cancel.

A new entry has been added to the Configuration menu to manage a table of Surface Roughness Preset Values composed of Description, RMS and / or Rz values

New Surface Roughness Compensation Preset Values option

The Hammerstad / Groisse dialog has been updated with the addition of '<<<' options to select the required Surface Roughness Preset Values.

Once chosen the roughness preset item Description and RMS value are passed back to the surface roughness dialog.

| Description | RMS (μm) | Rz (μm) |
|-----------------------------|-----------------------|----------------------|
| Smooth Copper Laminate Side | 2.2500 | 1.5000 |
| Smooth Copper Oxide Side | 2.3500 | 1.6000 |
| Rough Copper Laminate Side | 8.2500 | 7.5000 |
| Rough Copper Oxide Side | 5.2500 | 4.5000 |

New Surface Roughness Compensation Preset Values option

Surface Roughness Compensation - Huray

| Description | RMS (μm) | Rz (μm) |
|-----------------------------|----------|---------|
| Smooth Copper Laminate Side | 2.2500 | 1.5000 |
| Smooth Copper Oxide Side | 2.3500 | 1.6000 |
| Rough Copper Laminate Side | 8.2500 | 7.5000 |
| Rough Copper Oxide Side | 5.2500 | 4.5000 |

The Cannonball-Huray dialog has been updated with the addition of '<<' options to select the required Surface Roughness Preset Values.

Once chosen the roughness preset item Description and Rz value are passed back to the surface roughness dialog.

Cannonball-Huray Model

Matte-side: Rz Matte (1.5000 μm)

Drum-side: Rz Drum (1.6000 μm)

www.polarinstruments.com

Enable Cannonball-Huray

Matte-Side Roughness

Rz Matte (μm)

Smooth Copper Laminate Side

Drum-Side Roughness

Rz Drum (μm)

Smooth Copper Oxide Side

Si9000e v22.02 (February 2022)

Track Resistance Calculator (TRC Plus) enhancements

Substrate 1 Height H1 2.5000 ± 0.0000 2.5000 2.5000 Calculate

Substrate 1 Dielectric Er1 4.2000 ± 0.0000 4.2000 4.2000 Calculate

Lower Trace Width W1 3.9752 ± 0.0000 3.9752 3.9752

Upper Trace Width W2 2.9752 ± 0.0000 2.9752 2.9752 Calculate

Trace Thickness T1 0.7000 ± 0.0000 0.7000 0.7000 Calculate

Coating Above Substrate C1 1.0000 ± 0.0000 1.0000 1.0000

Coating Above Trace C2 1.0000 ± 0.0000 1.0000 1.0000

Coating Dielectric CEr 4.2000 ± 0.0000 4.2000 4.2000

Impedance Zo 50.00 50.00 50.00 Calculate More...

Notes: (First 5 lines will print)
Add your comments here

Interface Style
 Standard
 Extended

G.S. Convergence
 Fine (Slower)
 Coarse (Faster)

Tolerance Mode
 Absolute
 Percentage (%)

Parameter Snap
 Auto Calc

Lossless Calculation | Frequency Dependent Calculation | Sensitivity Analysis

The optional TRC Plus calculator includes a number of enhancements including new graphing capability.

Selecting this toolbar option will pass the current structure dimensions to the TRC Plus in order to calculate the track resistance

Track Resistance Calculator (TRC Plus) enhancements

The screenshot displays the TRC Plus software interface for calculating track resistance. It includes a 3D model of a microstrip with dimensions $W1$, $W2$, $T1$, and LL . The material is set to Si9000. The graph plots Resistance Ω against Line Length (Mils), showing a linear relationship. A callout box highlights the graphing feature, and another callout points to the dimension input fields.

Material & Calculated Impedance

- Material: -- From Si8000 / Si9000 --
- Calculated Impedance (Z_0): 50
- Resistivity (Ohm Metres): $1.724E-08 \Omega m$
- TCR: $5.80E+07 S/m$

Track Dimensions

- Lower Trace Width ($W1$): 3.9752
- Upper Trace Width ($W2$): 2.9752
- Trace Thickness ($T1$): 0.7000
- Length of Line (LL): 8000.0000

Graph Data

| Line Length (Mils) | Resistance Ω |
|--------------------|---------------------|
| 0 | 0.00 |
| 8000 | 2.2323 |

Track Resistance Calculator (TRC Plus) enhancements

The screenshot displays the TRC Plus software interface. On the left, a 3D model of a "Single Ended Coated Microstrip 1B" is shown with dimensions: Lower Trace Width (W1), Upper Trace Width (W2), Trace Thickness (T1), and Length of Line (LL). The material is set to Si9000.

The input parameters are as follows:

| Parameter | Value |
|---------------------------------|----------------------------|
| Material & Calculated Impedance | -- From Si8000 / Si9000 -- |
| Calculated Impedance (Zo) | 50 |
| Resistivity (Ohm Metres) | 1.724E-08 Ω m |
| Conductivity (Siemens / m) | 5.80E+07 S/m |
| Temp. Coefficient (/ °C) TCR | 0.00386 |
| Reference Temp. (°C) | 20 |
| Operating Temp. (°C) | 20 |
| Track Dimensions | |
| Lower Trace Width (W1) | 3.9752 |
| Upper Trace Width (W2) | 2.9752 |
| Trace Thickness (T1) | 0.7000 |
| Length of Line (LL) | 8000.0000 |
| Units | Mils (selected) |
| Track Resistance Ω | 2.2323 |
| Voltage Drop (Single Trace) | |
| Current (Amps) | 1 |
| VD (Volts) | 2.232285 |

The TDR plot on the right shows "TDR indicative Ω " on the y-axis (ranging from 49.00 to 53.00) and "Line Length (Mils)" on the x-axis (ranging from -1000 to 9000). The plot shows a constant resistance of 50.00 Ω until approximately 0 mils, then a linear increase to approximately 52.25 Ω at 8000 mils. A blue callout box points to the plot with the text: "TDR View provides an indicative impression of the effect of the distributed resistance in a PCB transmission line when tested on a TDR based test system, for example the Polar CITS880s."

The "TDR View" control panel at the bottom right is highlighted with a red box and contains the following settings:

- TDR View
- On
- Adjust Y Scale: ▲ ▼

Si9000e v21.09 (Sept 2021)

Project Graphing – Introduction *(requires the Si Projects feature)*

It is often useful to compare the results from similar structures, especially with frequency dependent calculations where changing just one or two parameters can have significant impact.

Until now the Si9000e Quick Solver graphing has focused on a single structure, for instance the All Losses graph will display a single plot that includes multiple data series for the same structure.

The new Project Graphing option calculates all the results for a group of structures contained in the Project and then plots the selected data series (total attenuation, conductor loss or dielectric loss etc) on the same graph.

A single graph that combines results from multiple structures is useful in a number of ways. Comparing the impact of different dielectric materials, different roughness, sensitivity analysis for lossy calculations and many more uses.

Project Graphing

A project with five structures, all with matching parameters and Zo of 50 ohms. The only difference between the structures is the loss tangent (TanD), ranging from 0.001 to 0.030

The Projects right-click menu contains a new Graphing option. When selected the Si9000e runs a full frequency dependent calculation for each structure in the project and stores the results.

The following new dialog then displays ...

| | | Tolerance | Minimum | Maximum | |
|------------------|-----------|-----------|-------------|-------------|-----------|
| H1 | 4.3098 | ± 0.0000 | 4.3098 | 4.3098 | Calculate |
| Er1 | 4.2000 | ± 0.0000 | 4.2000 | 4.2000 | Calculate |
| W1 | 7.0000 | ± 0.0000 | 7.0000 | 7.0000 | |
| W2 | 6.0000 | ± 0.0000 | 6.0000 | 6.0000 | Calculate |
| T1 | 1.2000 | ± 0.0000 | 1.2000 | 1.2000 | Calculate |
| C1 | 1.0000 | ± 0.0000 | 1.0000 | 1.0000 | |
| C2 | 1.0000 | ± 0.0000 | 1.0000 | 1.0000 | |
| CEr | 4.2000 | ± 0.0000 | 4.2000 | 4.2000 | |
| Impedance | Zo | | 0.00 | 0.00 | Calculate |

The Project Structure List provides options to choose which structures from the Project are plotted. Individual structures can be toggled between selected / deselected by double-clicking the grid row

Project Structure List

| # | Structure | Name | Selected | Colour |
|---|-----------|------------|----------|--------|
| 0 | | TanD=0.010 | Yes | Red |
| 1 | | TanD=0.015 | Yes | Green |
| 2 | | TanD=0.020 | Yes | Blue |
| 3 | | TanD=0.025 | Yes | Yellow |
| 4 | | TanD=0.030 | Yes | Cyan |

Dbl-Click grid row to toggle Selected status.

Select All Unselect All
Select SE Select Diff

Selected Structure Information

Structure Type : Coated Microstrip 1B

| | |
|--------|----------|
| H1 | 4.3098 |
| Er1 | 4.2000 |
| W1 | 7.0000 |
| W2 | 6.0000 |
| T1 | 1.2000 |
| C1 | 1.0000 |
| C2 | 1.0000 |
| CEr | 4.2000 |
| Zo | 50.01 |
| LL | 1000.00 |
| TC | 5.80E+07 |
| TanD | 0.0100 |
| Tr | 10 |
| FMin | 500.000 |
| FMax | 10.000 |
| FSteps | 20 |

Frequency Distribution : Linear
Result Presentation : Length of Line
Extended Substrate Data : Constant Er / TanD
Surface Roughness Compensation : Hammerstad

Graph

Attenuation with Roughness
www.polarinstruments.com

Legend: TanD=0.010 (Red), TanD=0.015 (Green), TanD=0.020 (Blue), TanD=0.025 (Yellow), TanD=0.030 (Cyan)

Graph Settings

Display Settings
Attenuation with Roughness

Mode for Differential Structures only
Differential

X-Axis Range
Frequency Minimum: 0MHz 0GHz
Frequency Maximum: 10000MHz 10GHz

Picked Data Point Information

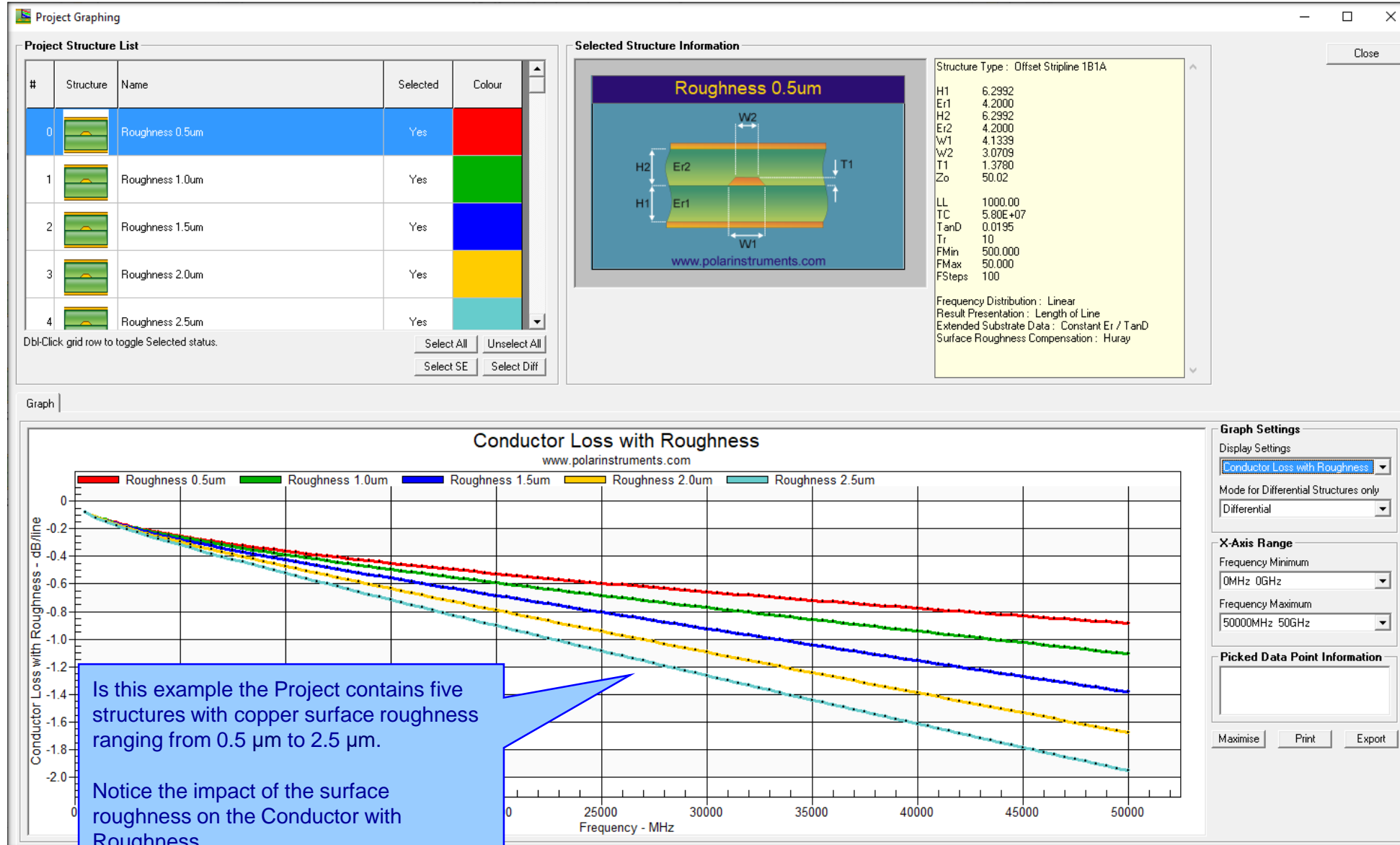
Maximise Print Export

Is this example the Project contains five structures with loss tangent (TanD), ranging from 0.001 to 0.030.

Notice the impact of the changing loss tangent on the Attenuation with Roughness (total attenuation)

The calculated results for each structure of the Project are plotted here. The structures are named and colour coded to allow for easy identification.

Summary parameter information for the selected Project Structure List grid row is shown here.



Project Graphing

Project Structure List

| # | Structure | Name | Selected | Colour |
|---|-----------|--------------|----------|--------|
| 0 | | 3/2.5/2.378 | Yes | Red |
| 1 | | 3.5/3/2.7551 | Yes | Green |
| 2 | | 4/3.5/3.1783 | Yes | Blue |
| 3 | | 4.5/4/3.6647 | Yes | Yellow |
| 4 | | 5/4.5/4.2267 | Yes | Cyan |

DoubleClick grid row to toggle Selected status.

One or more Structures has greater than 175 data points. Mouse over for more info.

Select All Unselect All
Select SE Select Diff

Selected Structure Information

Structure Type : Edge-Coupled Offset Stripline 1B1A

| | |
|-------|--------|
| H1 | 8.0000 |
| Er1 | 3.5000 |
| H2 | 8.5000 |
| Er2 | 3.5000 |
| W1 | 3.0000 |
| W2 | 2.5000 |
| S1 | 2.3780 |
| T1 | 0.6000 |
| Zdiff | 100.01 |

| | |
|--------|----------|
| LL | 1000.00 |
| TC | 5.80E+07 |
| TanD | 0.0020 |
| Tr | 10 |
| FMin | 100.000 |
| FMax | 20.000 |
| FSteps | 200 |

Frequency Distribution : Linear
Result Presentation : Length of Line
Extended Substrate Data : Causally Extrapolate Er / TanD
Surface Roughness Compensation : Huray

Close

Graph

Attenuation with Roughness

www.polarinstruments.com

Graph Settings

Display Settings
Attenuation with Roughness

Mode for Differential Structures only
Differential

X-Axis Range
Frequency Minimum: 0MHz 0GHz
Frequency Maximum: 20000MHz 20GHz

Picked Data Point Information

Maximise Print Export

10 differential structures using the same dielectric substrate materials but with differing trace widths / separations to achieve Zdiff = 100 ohms.

Notice that whilst all structures are 100 ohms, the structures with narrower trace widths are significantly more lossy than those with wider trace widths.

Project Graphing – Summary

- The new Graphing option for Si Projects provides useful plots that contain data from multiple structures
- There are numerous uses for this type of option - comparing the impact of different dielectric materials, different roughness, sensitivity analysis for lossy calculations and more
- ‘What if’ scenarios where one structure in the project would use the current design parameters and the second structure would contain a modified set based on a newer material. The plots comparing the original versus the new material will instantly show the impact
- Useful to both fabricators and design companies

Populate a Project from Sensitivity Analysis Results

(requires the Si Projects feature)

When using the Sensitivity Analysis option it is often useful to examine the calculated results in more details. It is now possible to auto-create a Project containing structures based upon the Sensitivity Analysis results data.

The following slides provide further details:

Populate a Project from Sensitivity Analysis Results

Coated Microstrip 1B

Diagram labels: C_{E1} , C_1 , C_2 , W_2 , T_1 , H_1 , E_{r1} , W_1

Impedance vs Changing Parameter(s)

| | | | |
|--------------------|---------|--------|-----------|
| Parameter | H1 | None | Calculate |
| Range Start Value | 3.0000 | 4.0000 | |
| Range Finish Value | 12.0000 | | |
| Increment | 1.0000 | 1.0000 | |

Constant Impedance vs Changing Parameters

| | | |
|-----------------------------------|-------------------|-----------|
| Parameter | W1 | Calculate |
| Target Impedance | 50.0000 | |
| Process Window: Minimum / Maximum | 67.5000 / 82.5000 | |

Graph Settings

- 2D (selected) / 3D
- Display Series: Constant Impedance
- Target Impedance: 0.0000 (Refresh)

Picked Data Point Information

| | |
|-----------|-------|
| H1 (Mils) | 5.000 |
| W1 | 8.436 |

Coated Microstrip 1B - 50 Ohms

The plot shows Substrate Height (H1) X-axis and the Trace Width (W1) Y-axis. Each data point represents the H1 / W1 parameter values to achieve 50 ohms.

| H1 (Mils) | W1 (Mils) |
|-----------|-----------|
| 3.0 | 4.5 |
| 4.0 | 6.0 |
| 5.0 | 8.436 |
| 6.0 | 10.5 |
| 7.0 | 12.5 |
| 8.0 | 14.5 |
| 9.0 | 16.5 |
| 10.0 | 18.5 |
| 11.0 | 20.5 |
| 12.0 | 22.5 |

Populate a Project from Sensitivity Analysis Results

The screenshot shows the Polar Si9000 PCB Transmission Line Field Solver interface. The main window displays a 'Coated Microstrip 1B' diagram with parameters H1, Er1, W1, C1, C2, and CEr. A 'Results' tab is active, showing a table of calculated results. A right-click menu is open over the table, highlighting the 'Create Project Structures' option. A sidebar on the left shows a list of 10 project structures created from the results.

Table: Impedance vs Changing Parameter(s)

| H1 | Er1 | W1 | W2 | T1 | C1 | C2 | CEr | Zo | Calc Success |
|---------|--------|---------|---------|--------|--------|--------|--------|---------|--------------|
| 3.0000 | 4.2000 | 4.7096 | 3.7096 | 1.2000 | 1.0000 | 1.0000 | 4.2000 | 50.0095 | Yes |
| 4.0000 | 4.2000 | 6.5638 | 5.5638 | 1.2000 | 1.0000 | 1.0000 | 4.2000 | 49.9943 | Yes |
| 5.0000 | 4.2000 | 8.4360 | 7.4360 | 1.2000 | 1.0000 | 1.0000 | 4.2000 | 49.9913 | Yes |
| 6.0000 | 4.2000 | 10.3381 | 9.3381 | 1.2000 | 1.0000 | 1.0000 | 4.2000 | 49.9909 | Yes |
| 7.0000 | 4.2000 | 12.2522 | 11.2522 | 1.2000 | 1.0000 | 1.0000 | 4.2000 | 49.9953 | Yes |
| 8.0000 | 4.2000 | 14.1663 | 13.1663 | 1.2000 | 1.0000 | 1.0000 | 4.2000 | 49.9973 | Yes |
| 9.0000 | 4.2000 | 16.0923 | 15.0923 | 1.2000 | 1.0000 | 1.0000 | 4.2000 | 50.0056 | Yes |
| 10.0000 | 4.2000 | 18.0303 | 17.0303 | 1.2000 | 1.0000 | 1.0000 | 4.2000 | 49.9967 | Yes |
| 11.0000 | 4.2000 | 19.9567 | 18.9567 | 1.2000 | 1.0000 | 1.0000 | 4.2000 | 49.9867 | Yes |
| 12.0000 | 4.2000 | 21.8823 | 20.8823 | 1.2000 | 1.0000 | 1.0000 | 4.2000 | 50.0058 | Yes |

Project Structures List:

- H1=3.0000 W1=4.70...
- H1=4.0000 W1=6.56...
- H1=5.0000 W1=8.43...
- H1=6.0000 W1=10.33...
- H1=7.0000 W1=12.25...
- H1=8.0000 W1=14.16...
- H1=9.0000 W1=16.09...
- H1=10.0000 W1=18.03...

The Results tab contains the calculated results data used for the Sensitivity Analysis plot

The right-click menu now has a new Create Project Structures option. On selection the software will create an individual structure per row of the Results grid and add it to the Project. In this example there are 10 result rows so 10 structures will be created

The Project now contains 10 structures. Notice the structure name is auto-assigned based upon the sensitivity analysis parameters selected. In this example the H1 and W1 parameter values are used

Copy Results to Clipboard (for Excel)
Create Project Structures

Populate a Project from Sensitivity Analysis Results

The structure name is auto-assigned from the sensitivity analysis parameters / result

Once the Project has been generated the structures within work in exactly the same way as if they were created manually.

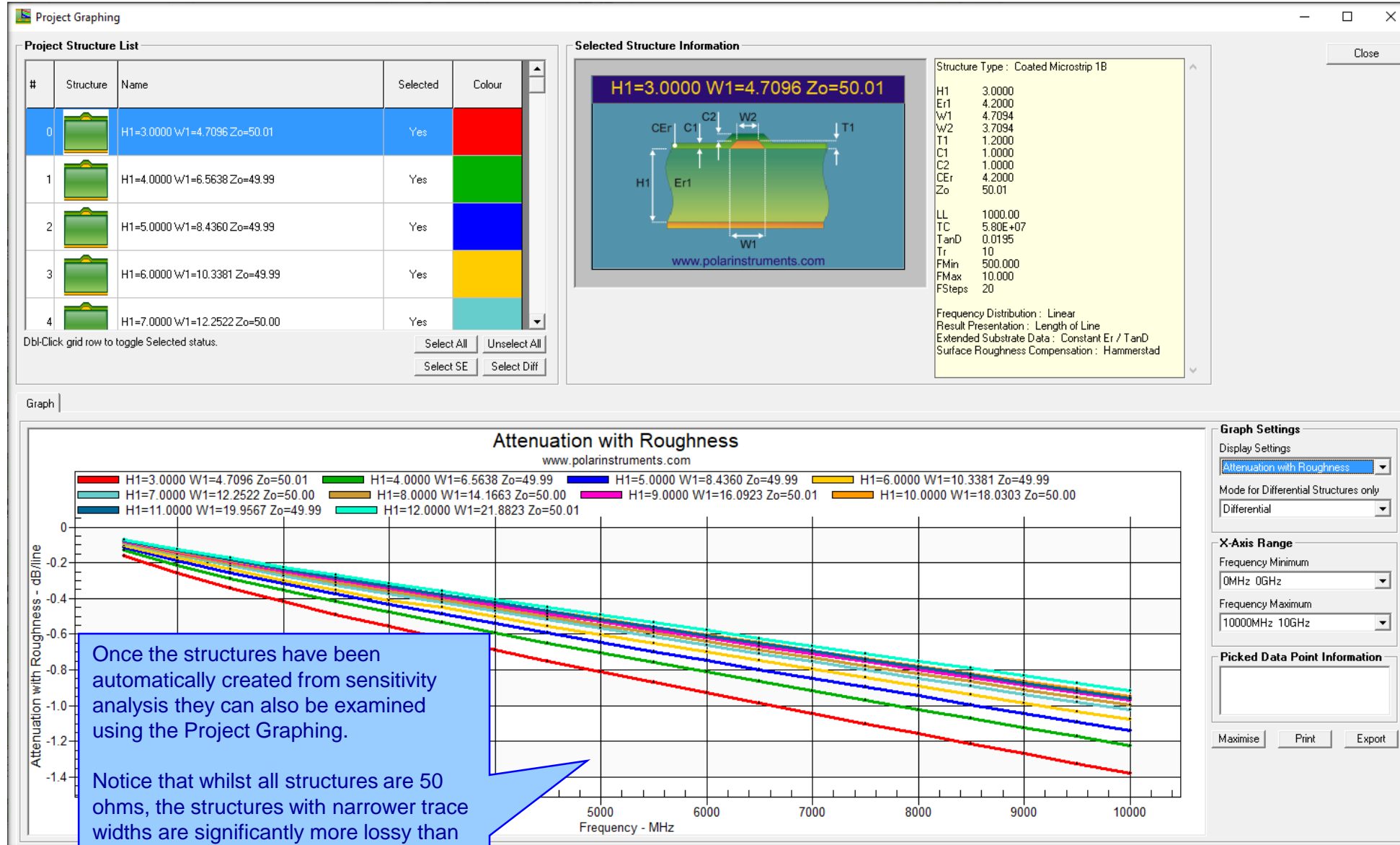
The parameter values / results used for the structure name

| Parameter | Tolerance | Minimum | Maximum | Calculate |
|---------------------|-----------|--------------|--------------|-----------|
| H1 | ± 0.0000 | 5.0000 | 5.0000 | Calculate |
| Er1 | ± 0.0000 | 4.2000 | 4.2000 | Calculate |
| W1 | ± 0.0000 | 8.4360 | 8.4360 | Calculate |
| W2 | ± 0.0000 | 7.4360 | 7.4360 | Calculate |
| T1 | ± 0.0000 | 1.2000 | 1.2000 | Calculate |
| C1 | ± 0.0000 | 1.0000 | 1.0000 | Calculate |
| C2 | ± 0.0000 | 1.0000 | 1.0000 | Calculate |
| CEr | ± 0.0000 | 4.2000 | 4.2000 | Calculate |
| Impedance Zo | | 49.99 | 49.99 | Calculate |

Structure Name: H1=5.0000 W1=8.4360 Zo=49.99

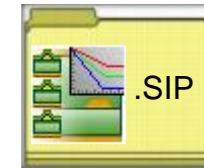
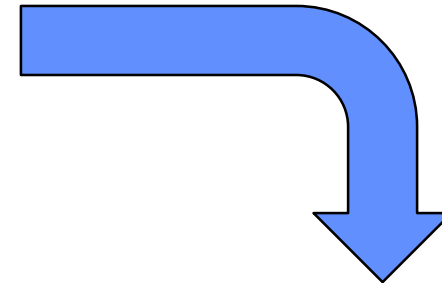
Project List:

- H1=3.0000 W1=4.70...
- H1=4.0000 W1=6.56...
- H1=5.0000 W1=8.4360 Zo=49.99**
- H1=6.0000 W1=10.33...
- H1=7.0000 W1=12.25...
- H1=8.0000 W1=14.16...
- H1=9.0000 W1=16.09...
- H1=10.0000 W1=18.03...



Populate a Project from Sensitivity Analysis Results

| | | |
|-------------------------|-----------|--------------|
| Substrate 1 Height | H1 | 5.0000 |
| Substrate 1 Dielectric | Er1 | 4.2000 |
| Lower Trace Width | W1 | 8.4360 |
| Upper Trace Width | W2 | 7.4360 |
| Trace Thickness | T1 | 1.2000 |
| Coating Above Substrate | C1 | 1.0000 |
| Coating Above Trace | C2 | 1.0000 |
| Coating Dielectric | CEr | 4.2000 |
| Impedance | Zo | 49.99 |



Save the newly created project to the Si Project file format (.SIP) so that it can be recalled at a later date.

Populate a Project from Sensitivity Analysis Results - Summary

- As separate structure in a Project it is now possible to examine the results in a lot more detail than when in sensitivity analysis
- Lossy calculations can be performed and compared
- As a Project the structure data can be stored as a .SIP file and recalled later
- Useful to both fabricators and design companies

Surface Roughness Goal Seek option

New option to back calculate the surface roughness value for a structure from the insertion loss measurement data. The measurements can be generated using the Polar Atlas system or others that are capable of measuring insertion loss.

Cyan = Modelled Attenuation with Roughness (insertion loss)

Brown = Insertion Loss measurement data from Polar Atlas

The screenshot shows the Polar Si9000 PCB Transmission Line Field Solver interface. The main window displays a graph titled "Edge-Coupled Offset Stripline 1B2A Differential". The graph plots "Attenuation - dB/line" on the y-axis (ranging from 0 to -2.0) against "Frequency - MHz" on the x-axis (ranging from 0 to 40,000). The legend includes: Smooth Conductor Loss (red), Dielectric Loss (green), Smooth Attenuation (blue), Conductor Loss with Roughness (yellow), Attenuation with Roughness (cyan), and Measured Attenuation : VNA Delta-L4 (brown). The graph shows that the measured attenuation (brown) closely follows the modelled attenuation with roughness (cyan). The "Surface Roughness Compensation" section on the right has the "GoalSeek" button highlighted with a red box. The "Surface Roughness Compensation" section also includes options for "Smooth", "Hammerstad", "Groisse", and "Huray". The "Graph Settings" panel on the right shows "Display Series" set to "All Losses" and "Differential". The "Picked Data Point Information" panel shows "Frequency (MHz) : 25000.000" and "Measured Attenuation (dB) : -1.240".

Surface Roughness Goal Seek option

Surface Roughness Goal Seek [Close]

Step 1 : Enter Total Attenuation from measurement

| | | | |
|---------------------------------|---------------------------------------|--------------------------------------|----|
| | Freq (Hz) | dB / LL | |
| Total Attenuation (S21 / SDD21) | <input type="text" value="2.50E+10"/> | <input type="text" value="-1.2400"/> | << |

Step 2 : Calculate Dielectric and Conductor Loss

| | | |
|------------------------------------------------------------------------|--------------------------------------|-------------|
| | dB / LL | |
| Dielectric Loss | <input type="text" value="-0.5930"/> | [Calculate] |
| Conductor Loss with Roughness (Total Attenuation - Dielectric Loss) | <input type="text" value="-0.6470"/> | |

Step 3 : Calculate Surface Roughness

| | | | |
|---------------------------------------------------------------------|-------------------------------------|-------------|----|
| Cannonball-Huray Rz (μm) | <input type="text" value="2.2729"/> | [Calculate] | >> |
| Surface Roughness: 2.2729 Conductor Loss with Roughness: -0.6451 | | | |

Setup Goal Seek Parameters

| | | | |
|---------------------------------------|-------------------------------------|--------------------------------------|-------------------------------------|
| | Min | Max < T1/2 | Conv. |
| Cannonball-Huray Rz (μm) | <input type="text" value="0.1000"/> | <input type="text" value="17.4831"/> | <input type="text" value="0.0030"/> |

[i]

Step 1

Key in or pick the total attenuation (S21 / SDD21) at a given frequency from the insertion loss measurement data

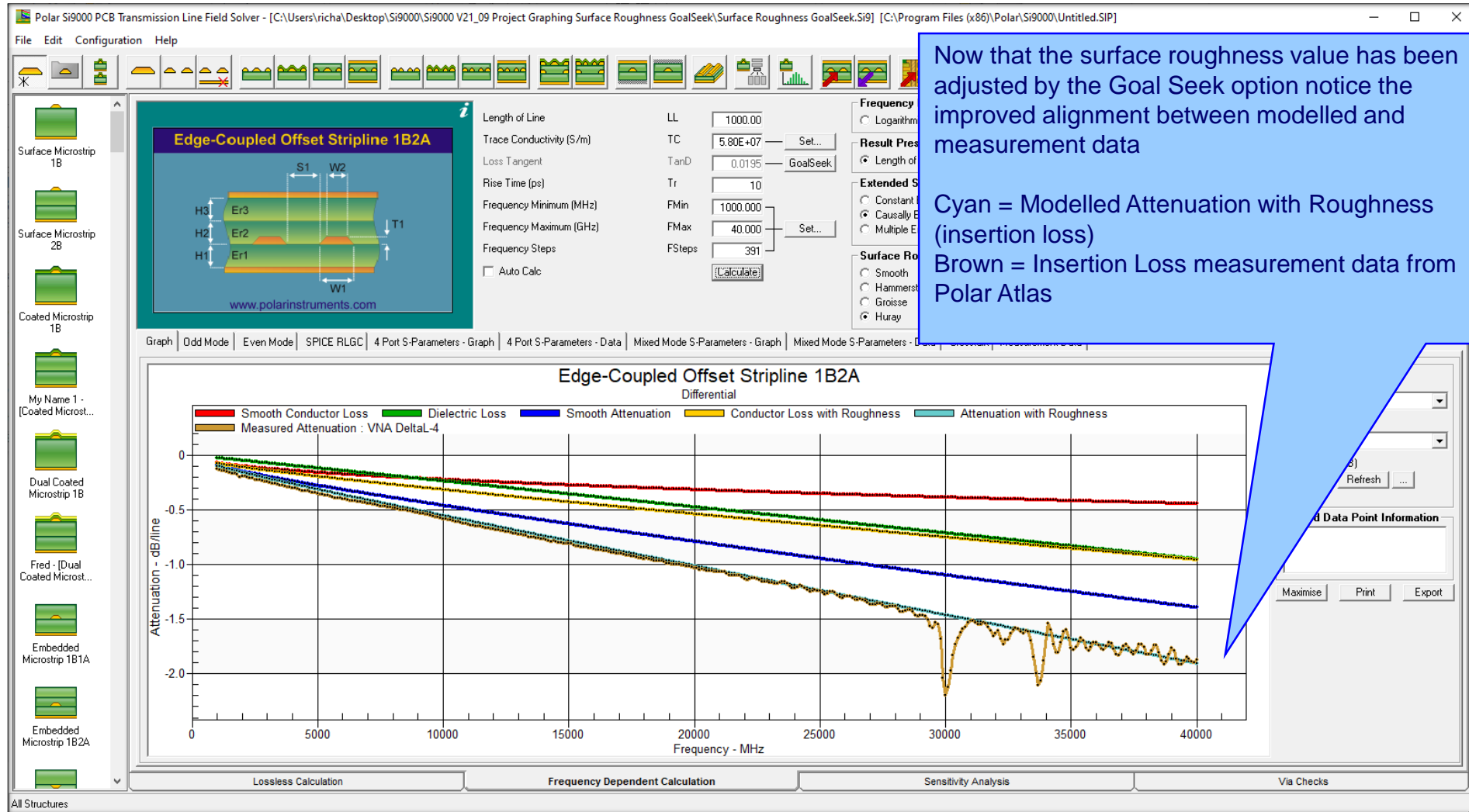
Step 2

Calculate the dielectric loss for the frequency entered from the current structure parameters. Subtracting this calculated dielectric loss from the total attenuation will leave the target conductor loss

Step 3

Use the Si9000 Goal Seek algorithm to vary the surface roughness until it matches the required value to achieve the conductor loss as calculated in Step 2. In this example a Surface Roughness of 2.2729 μm is required

Surface Roughness Goal Seek option



Track Resistance Calculator (TRC Plus)

The new TRC Plus calculator includes a number of enhancements including:

- Support for longer Length of Line (LL) values
- Support for Temperature Coefficient of Resistance

Surface Microstrip 1B

Attenuation - dB/line vs Frequency - MHz

| Frequency (MHz) | Smooth Conductor Loss (dB/line) | Dielectric Loss (dB/line) | Smooth Attenuation (dB/line) | Conductor Loss with Roughness (dB/line) |
|-----------------|---------------------------------|---------------------------|------------------------------|-----------------------------------------|
| 1000 | -0.05 | -0.05 | -0.10 | -0.15 |
| 2000 | -0.08 | -0.10 | -0.20 | -0.25 |
| 3000 | -0.10 | -0.15 | -0.30 | -0.35 |
| 4000 | -0.12 | -0.20 | -0.40 | -0.45 |
| 5000 | -0.14 | -0.25 | -0.50 | -0.55 |
| 6000 | -0.16 | -0.30 | -0.60 | -0.65 |
| 7000 | -0.18 | -0.35 | -0.70 | -0.75 |

Parameter Entry Panel:

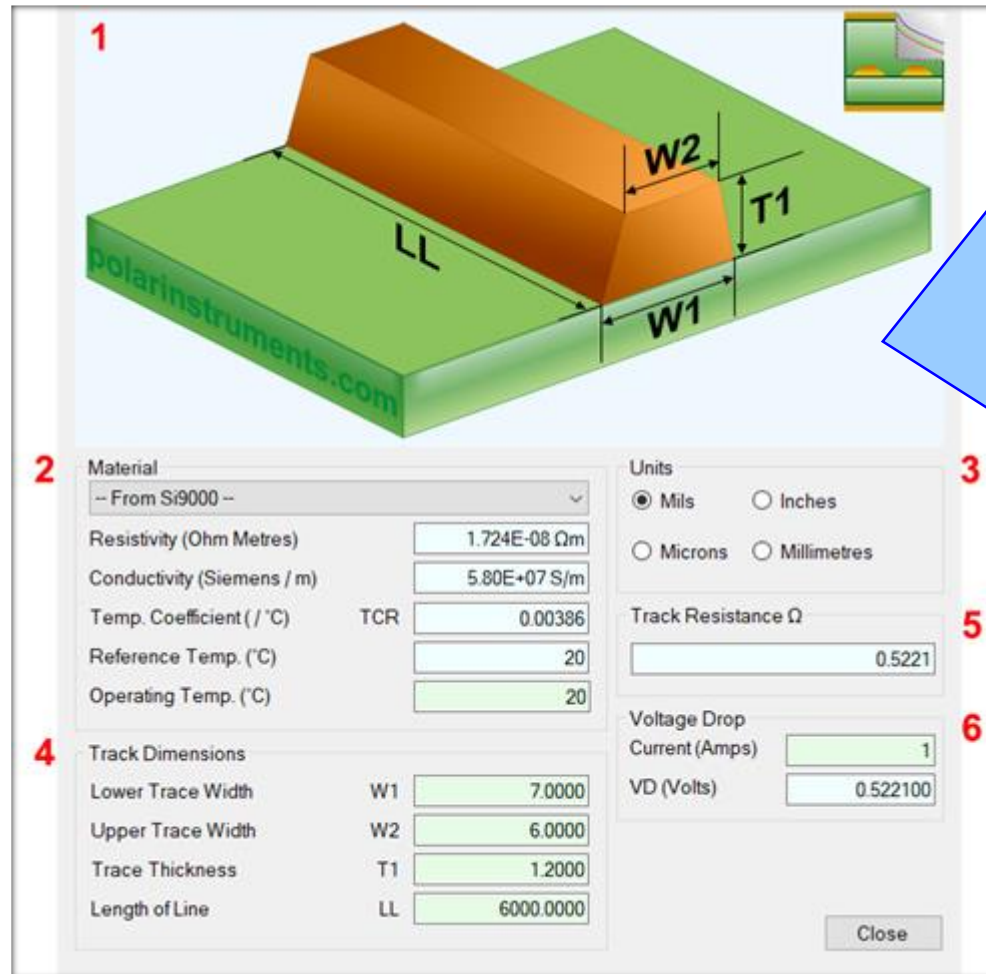
| | |
|------------------------------|----------------------|
| Material | -- From Si9000 -- |
| Resistivity (Ohm Metres) | 1.724E-08 Ω m |
| Conductivity (Siemens / m) | 5.80E+07 S/m |
| Temp. Coefficient (/ °C) TCR | 0.00386 |
| Reference Temp. (°C) | 20 |
| Operating Temp. (°C) | 20 |
| Track Dimensions | |
| Lower Trace Width W1 | 7.0000 |
| Upper Trace Width W2 | 6.0000 |
| Trace Thickness T1 | 1.2000 |
| Length of Line LL | 1000.0000 |

Track Resistance Ω : 0.0870

Voltage Drop Current (Amps): 1

VD (Volts): 0.087000

Track Resistance Calculator (TRC Plus)



1 Interactive track material image.

2 Material selection and properties.

3 Units.

4 Track or trace dimensions.

5 Resistance result.

6 Voltage Drop calculation result.

| Material | Resistivity (Ohm Metres) | Conductivity (Siemens / m) | Temp. Coefficient (/ °C) TCR | Reference Temp. (°C) | Operating Temp. (°C) |
|-------------------|--------------------------|----------------------------|------------------------------|----------------------|----------------------|
| -- From Si9000 -- | 1.724E-08 Ωm | 5.80E+07 S/m | 0.00386 | 20 | 20 |

| Track Dimensions | Value |
|----------------------|-----------|
| Lower Trace Width W1 | 7.0000 |
| Upper Trace Width W2 | 6.0000 |
| Trace Thickness T1 | 1.2000 |
| Length of Line LL | 6000.0000 |

| Units | Track Resistance Ω | Voltage Drop |
|--------------------------------------------------------------------|--------------------|----------------------|
| <input checked="" type="radio"/> Mils <input type="radio"/> Inches | 0.5221 | Current (Amps): 1 |
| <input type="radio"/> Microns <input type="radio"/> Millimetres | | VD (Volts): 0.522100 |

1. Interactive track material image.

Clicking on a track parameter label will highlight the associated Track Dimension field (text box). Enter data into the active field.

Double-clicking anywhere on the image will bring up the Materials Editor.

2. Material selection and properties

Select the material via the drop-down list.

Fields coloured in light-blue are not directly editable but the field values can be in the Materials Editor.

Fields coloured in light-green are editable by the user. For example, Operating Temperature will determine a material's resistivity at that temperature, which in turn will be applied in calculating the track resistance.

3. Units

Switch to your preferred units by clicking the associated option button – imperial units include Mils (Thou) and Inches; for metric units choose Microns (Micrometres) or Millimetres.

4. Track or trace dimensions

Enter or change track dimensions in the Track Dimensions in the chosen units.

5. Resistance result

Calculation of the track resistance. The result should update immediately upon any changes to the editable (light-green) fields.

6. Voltage Drop calculation result

The calculated Voltage Drop is displayed in the VD (Volts) text box

Other enhancements

- Monte Carlo Analysis. New option added to export the Iterations / Results to Clipboard (for Excel), accessible from the right-click menu
- Causally Extrapolated Substrate Data. New option added to export the Results to Clipboard (for Excel), accessible from the right-click menu

Si9000e v21.04 (April 2021)

Monte Carlo Analysis maximum iteration increased to 9000

Coated Microstrip 1B

www.polarinstruments.com

| | Nominal | Tol (Abs) | Minimum | Maximum | Mean | Std Dev |
|-------------------------|-----------|------------------|---------|---------|--------|---------|
| Substrate 1 Height | H1 | 8.5000 ± 0.0000 | 8.5000 | 8.5000 | 8.5000 | 1.0000 |
| Substrate 1 Dielectric | Er1 | 4.2000 ± 0.0000 | 4.2000 | 4.2000 | 4.2000 | 0.0000 |
| Lower Trace Width | W1 | 14.9629 ± 0.0000 | 14.9629 | 14.9629 | 7.0000 | 0.0000 |
| Upper Trace Width | W2 | 13.9629 ± 0.0000 | 13.9629 | 13.9629 | 6.0000 | 0.0000 |
| Trace Thickness | T1 | 1.2000 ± 0.0000 | 1.2000 | 1.2000 | 1.2000 | 0.0000 |
| Coating Above Substrate | C1 | 1.0000 ± 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| Coating Above Trace | C2 | 1.0000 ± 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| Coating Dielectric | CEr | 4.2000 ± 0.0000 | 4.2000 | 4.2000 | 4.2000 | 0.0000 |
| Impedance | Zo | 49.99 | 49.99 | 49.99 | | |

Settings
 Iterations:

It is now possible to run a Monte Carlo Analysis for 9,000 calculations on any selected structure

Graph | Iterations / Results

Coated Microstrip 1B - Monte Carlo Analysis

www.polarinstruments.com

Results Summary

Impedance - Zo

Nominal:

Minimum (worst case):

Maximum (worst case):

Monte Carlo Analysis

Mean:

Standard Deviation:

Import from Atlas enhanced to support measurement data to 50GHz

The Polar Atlas VNA Delta-L insertion loss test system now exports measurement data up to 50 GHz.

The Si9000e Import from Atlas option allows the insertion loss measurement data (brown data series) to be overlaid on the All Losses plot.

In this example the Anritsu ShockLine™ instrument was used, Delta-L maximum frequency set to 40GHz

Graph Settings
 Display Series: All Losses
 Differential: Differential
 Loss Budget (dB): 0.0000 Refresh ...

Picked Data Point Information
 Maximise Print Export

Si9000e v21.01 (January 2021)

Monte Carlo support added for Dual Coated structures

Edge-Coupled Dual Coated Microstrip 1B

| | Nominal | Tol (Abs) | Minimum | Maximum | Mean | Std Dev |
|-----------------------------|---------|-----------------|---------|---------|--------|---------|
| Substrate 1 Height | H1 | 8.5000 ± 0.0000 | 8.5000 | 8.5000 | 8.5000 | 0.5000 |
| Substrate 1 Dielectric | Er1 | 4.2000 ± 0.0000 | 4.2000 | 4.2000 | 4.2000 | 0.0000 |
| Lower Trace Width | W1 | 7.0000 ± 0.0000 | 7.0000 | 7.0000 | 7.0000 | 0.0000 |
| Upper Trace Width | W2 | 6.0000 ± 0.0000 | 6.0000 | 6.0000 | 6.0000 | 0.0000 |
| Trace Separation | S1 | 5.9669 ± 0.0000 | 5.9669 | 5.9669 | 5.9669 | 0.0000 |
| Trace Thickness | T1 | 1.2000 ± 0.0000 | 1.2000 | 1.2000 | 1.2000 | 0.0000 |
| Coating Above Substrate | C1 | 1.0000 ± 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| Coating Above Trace | C2 | 1.0000 ± 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| Coating Between Traces | C3 | 1.0000 ± 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| Coating Dielectric | CER | 4.2000 ± 0.0000 | 4.2000 | 4.2000 | 4.2000 | 0.0000 |
| 2nd Coating Above Substrate | CS1 | 1.0000 ± 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| 2nd Coating Above Trace | CS2 | 1.0000 ± 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |

| | Nominal | Tol (Abs) | Minimum | Maximum | Mean | Std Dev |
|----------------------------|---------|-----------------|---------|---------|--------|---------|
| 2nd Coating Between Traces | CS3 | 1.0000 ± 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| 2nd Coating Dielectric | CSEr | 4.2000 ± 0.0000 | 4.2000 | 4.2000 | 4.2000 | 0.0000 |

Differential Impedance

Zdiff: 99.99

Settings: Iterations: 500, Normal Distribution (Mean/Std Dev)

Graph | Iterations / Results

Edge-Coupled Dual Coated Microstrip 1B - Monte Carlo Analysis

The Monte Carlo Analysis option now supports Dual Coated structures

Results Summary

Impedance - Zdiff

Nominal: 99.99

Minimum (worst case): 95.41

Maximum (worst case): 102.72

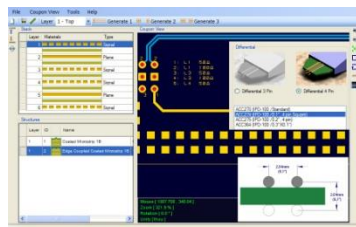
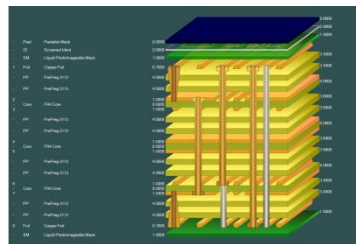
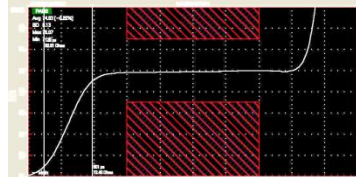
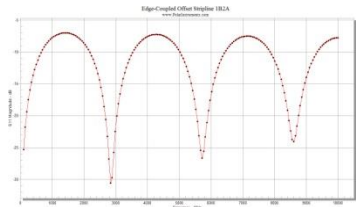
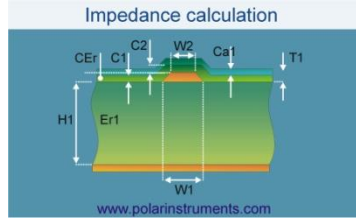
Monte Carlo Analysis

Mean: 99.94

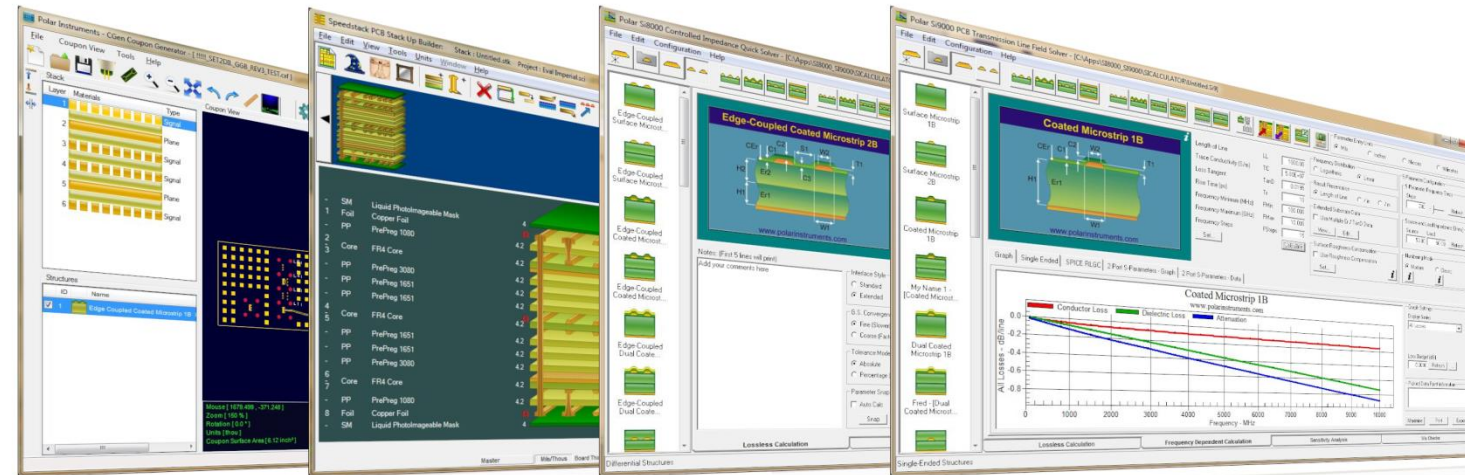
Standard Deviation: 1.11

Other enhancements

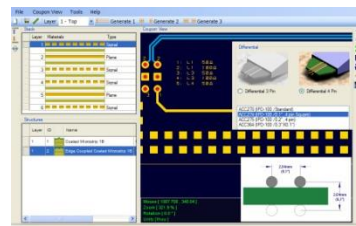
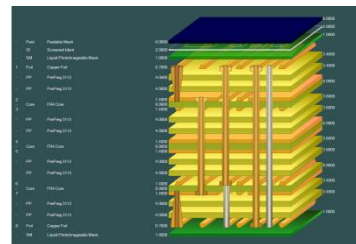
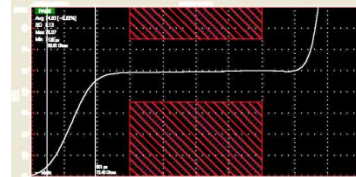
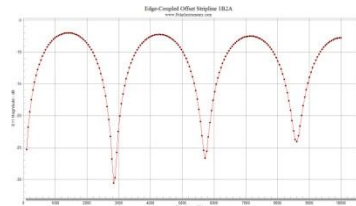
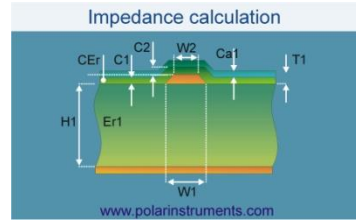
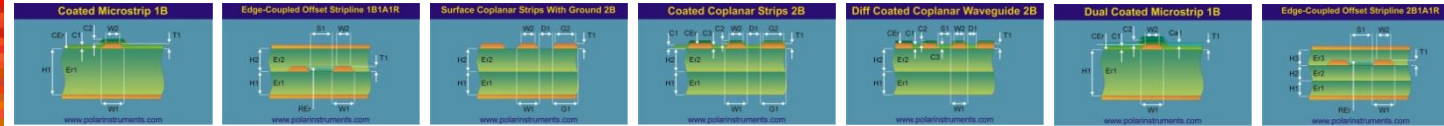
- FlexNet Publisher / FLEXIm v11.17.2.0 supported



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