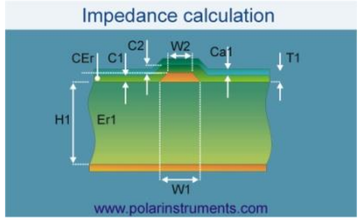
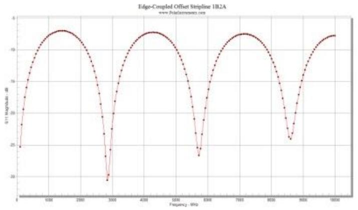
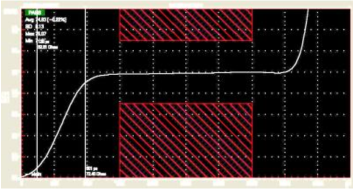
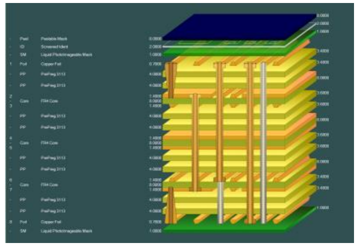
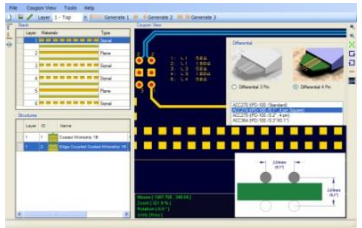










Si9000e 2021 - 2022 Preview

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.

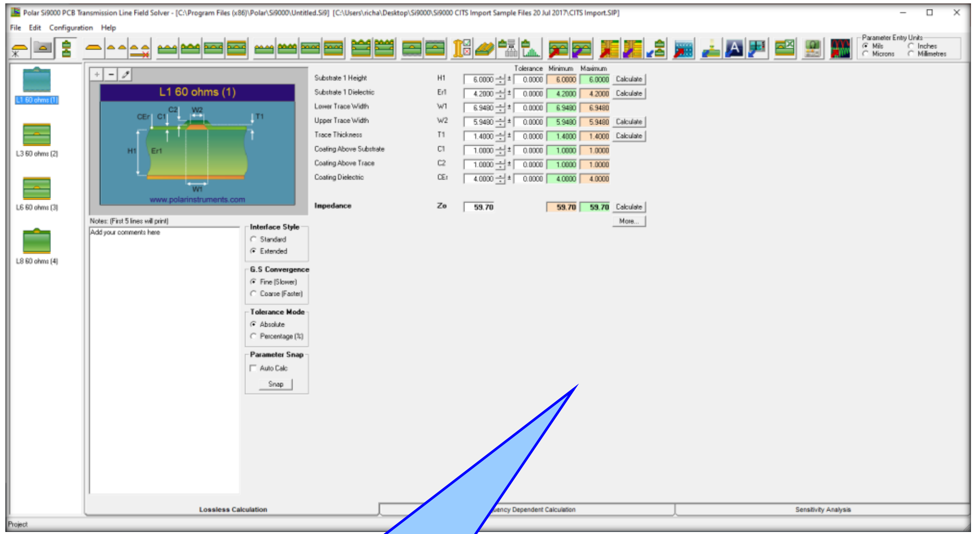
These slides are arranged in a “newest first” format. A slide containing the version number and release date precedes information detailing the new features contained in each release.

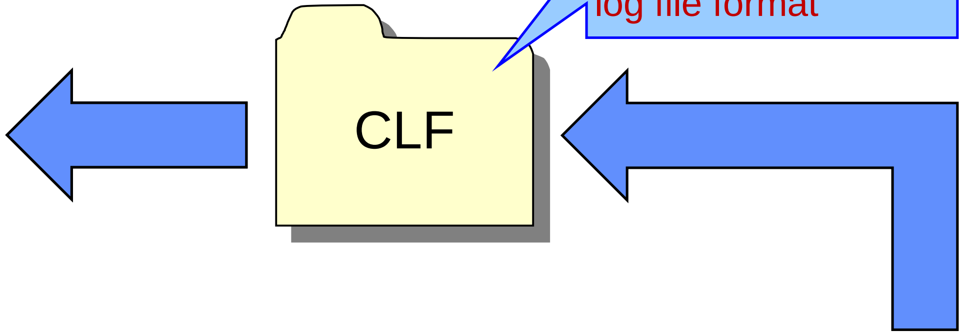
If you would like to have a web-based demonstration please contact your local Polar office, details are shown on the last slide of this presentation

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

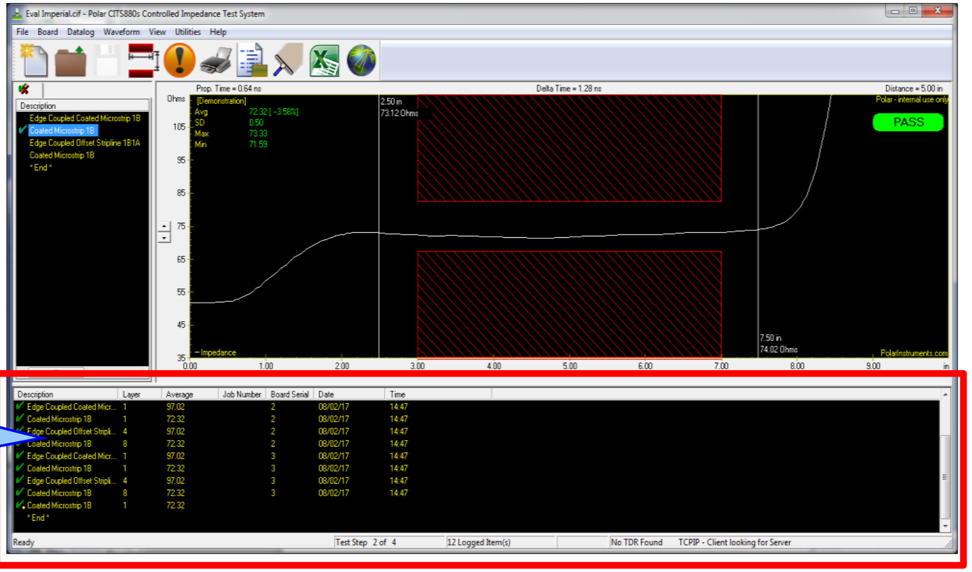
Si9000e v22.09.01 (September 2022)

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

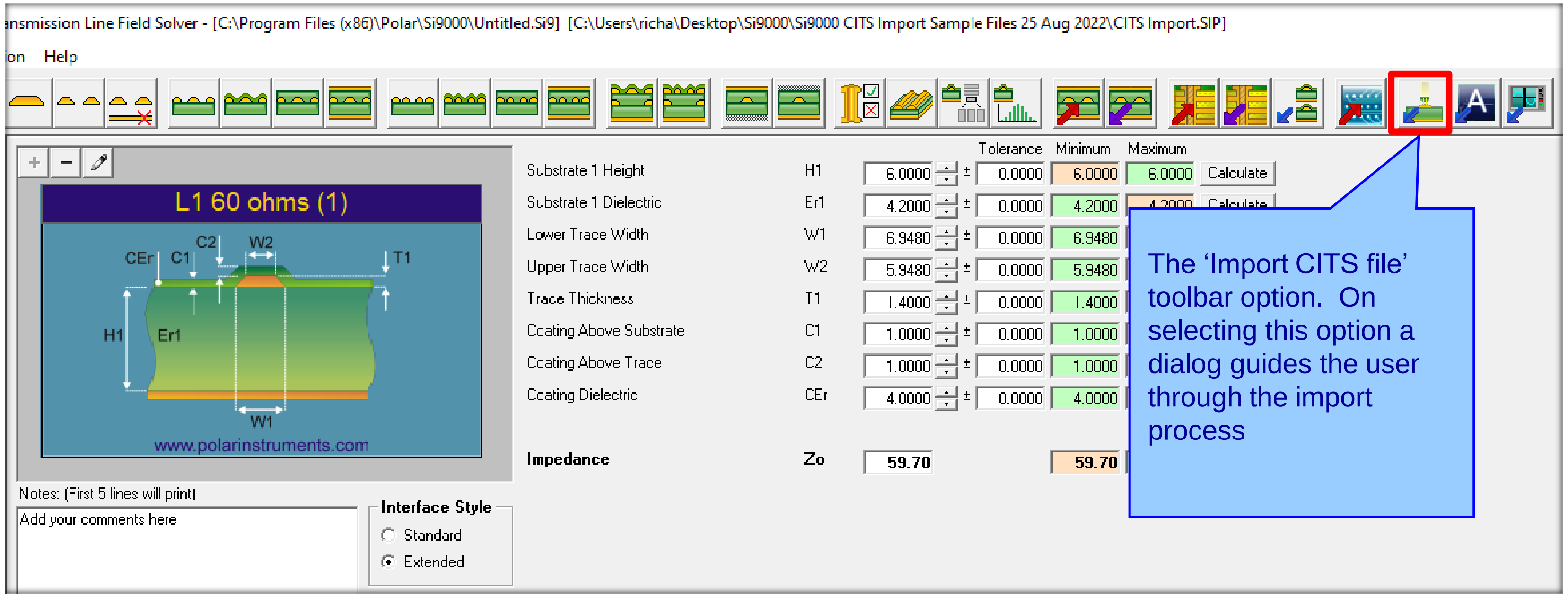
Whilst working with controlled impedance designs it is often desirable to compare the reality of the measurement data against the modelled structure.

‘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.

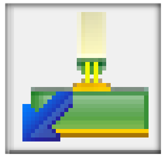
This capability within the Polar’s Si8000m / Si9000e field solver products allows the user to quickly import measurement data directly from the industry-standard Polar Controlled Impedance Test System (CITS).

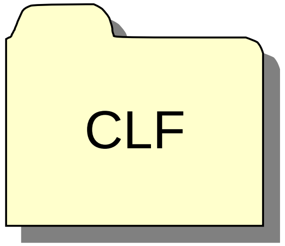
If you are a design customer using the Si8000m / Si9000e and would like to use this feature, please request the Polar CITS Datalog File from your fabricator.

Import CITS Datalog File option – feature recap

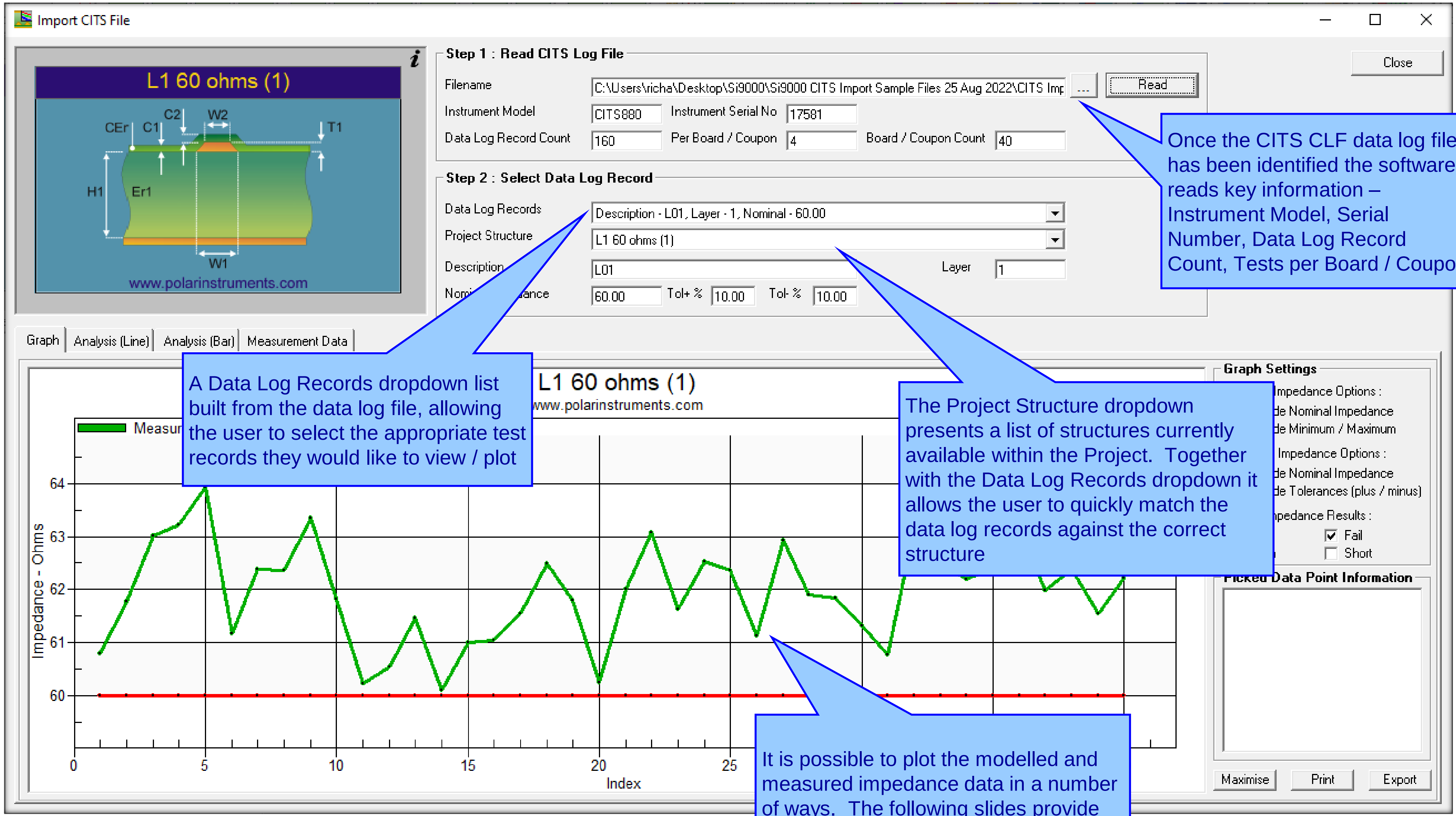


The 'Import CITS file' toolbar option. On selecting this option a dialog guides the user through the import process





Import CITS Datalog File option – feature recap



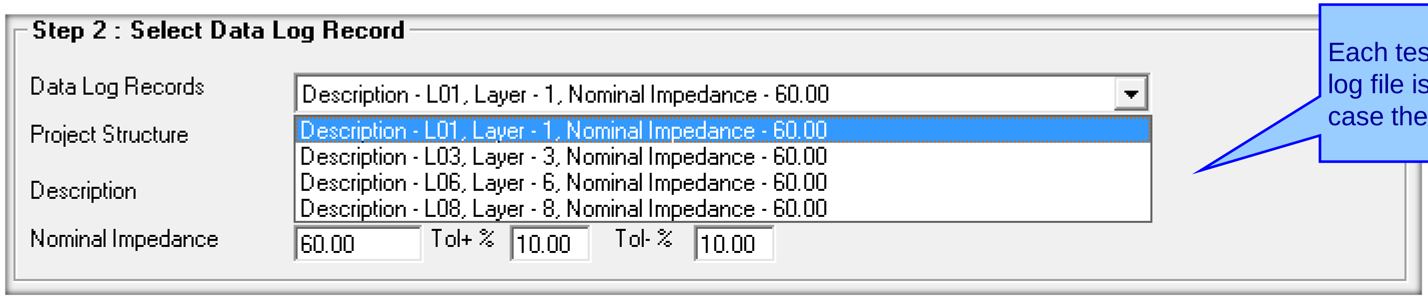
Once the CITS CLF data log file has been identified the software reads key information – Instrument Model, Serial Number, Data Log Record Count, Tests per Board / Coupon

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

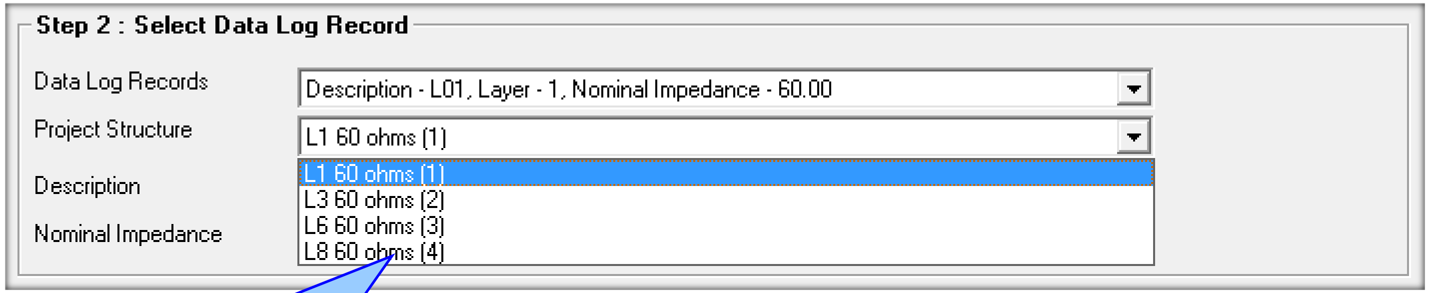
The Project Structure dropdown presents a list of structures currently available within the Project. Together with the Data Log Records dropdown it allows the user to quickly match the data log records against the correct structure

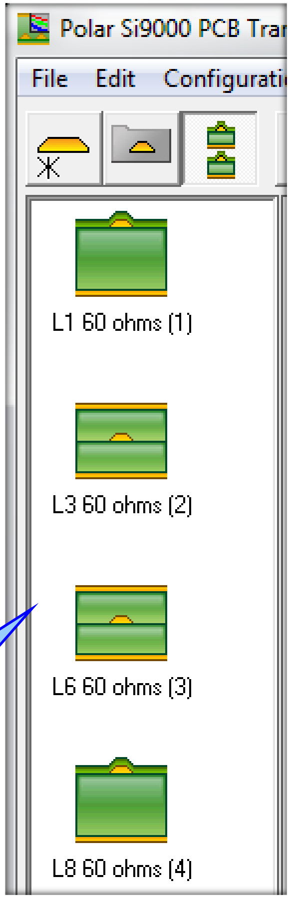
It is possible to plot the modelled and measured impedance data in a number of ways. The following slides provide more details

Import CITS Datalog File option – feature recap



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





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

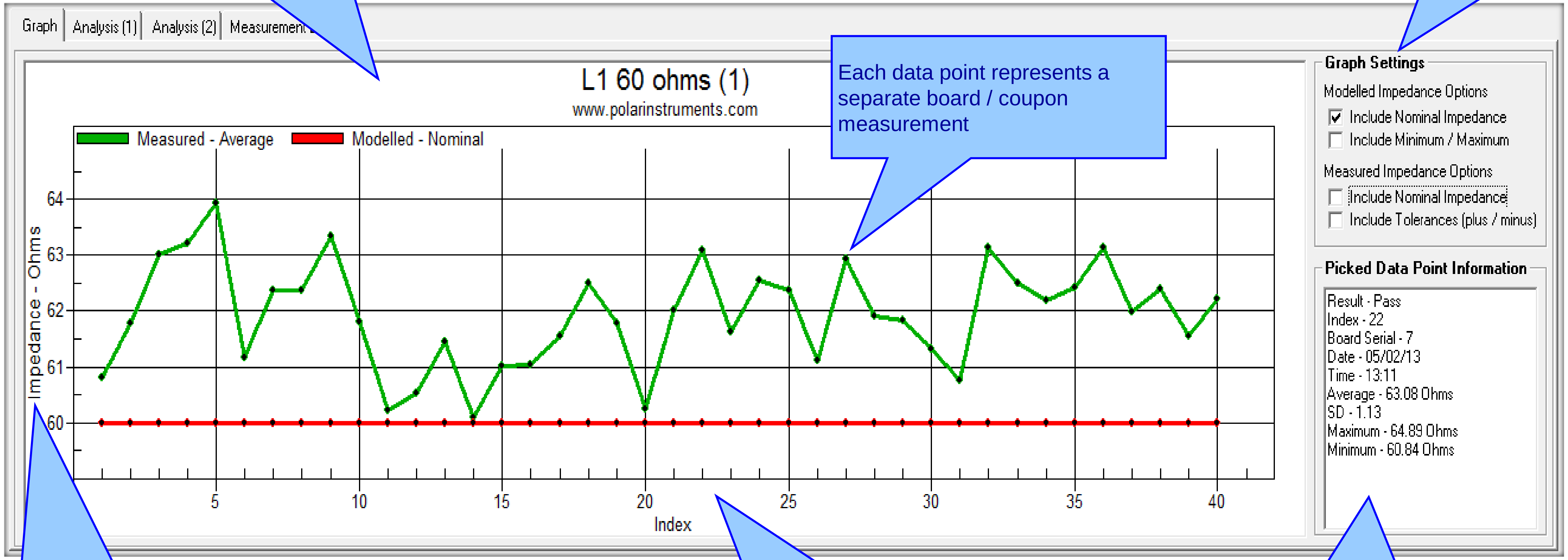
Four structures loaded into the Project group

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

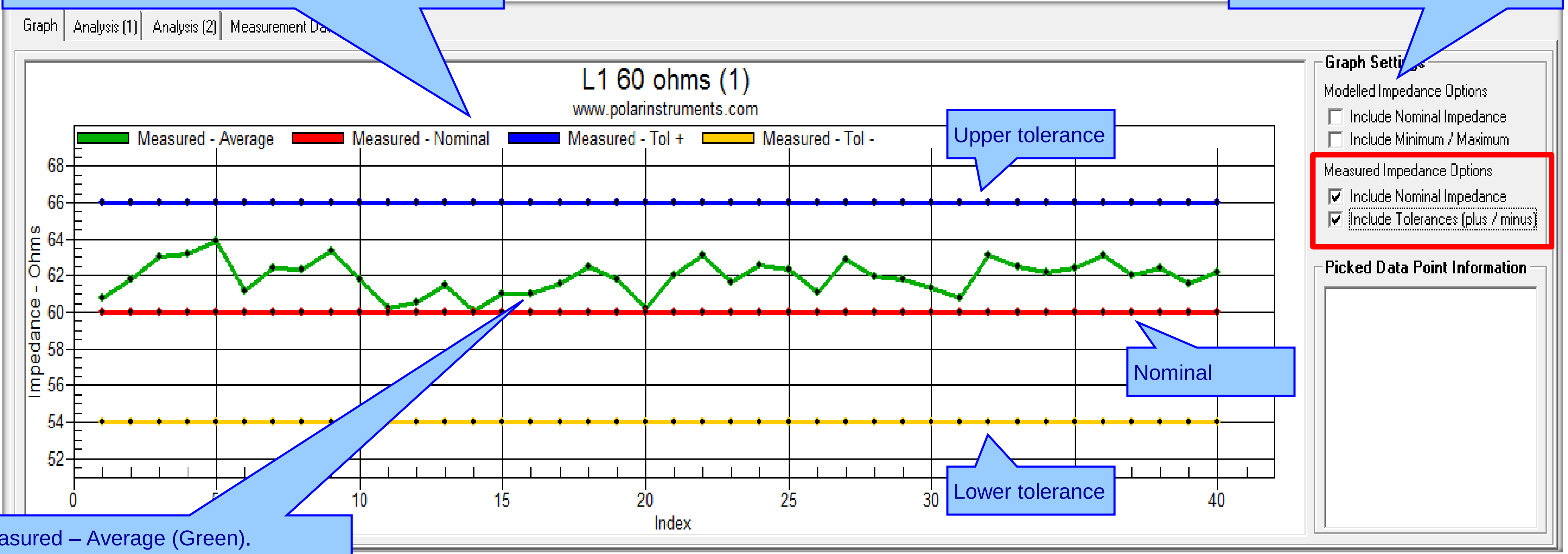
The x-axis is the identifying Index of the board / coupon read from the data log file

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

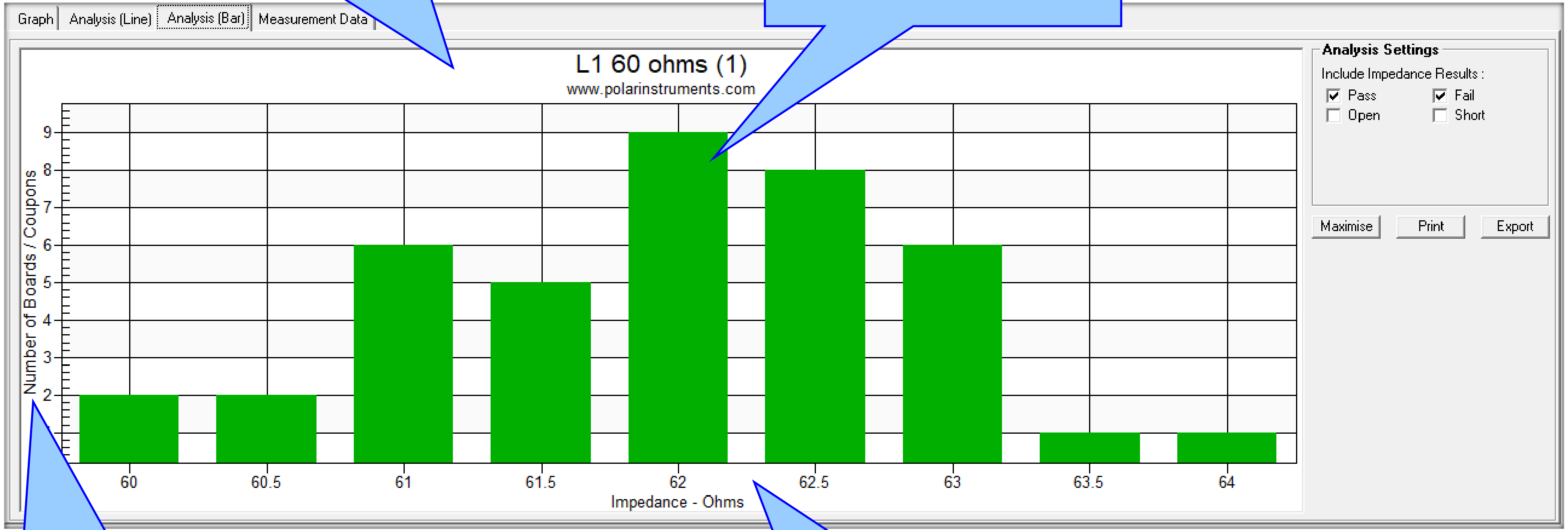


Measured – Average (Green). Whilst reading slightly higher than the Nominal (60 ohms) all measured data points are within the upper and lower tolerance bands

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

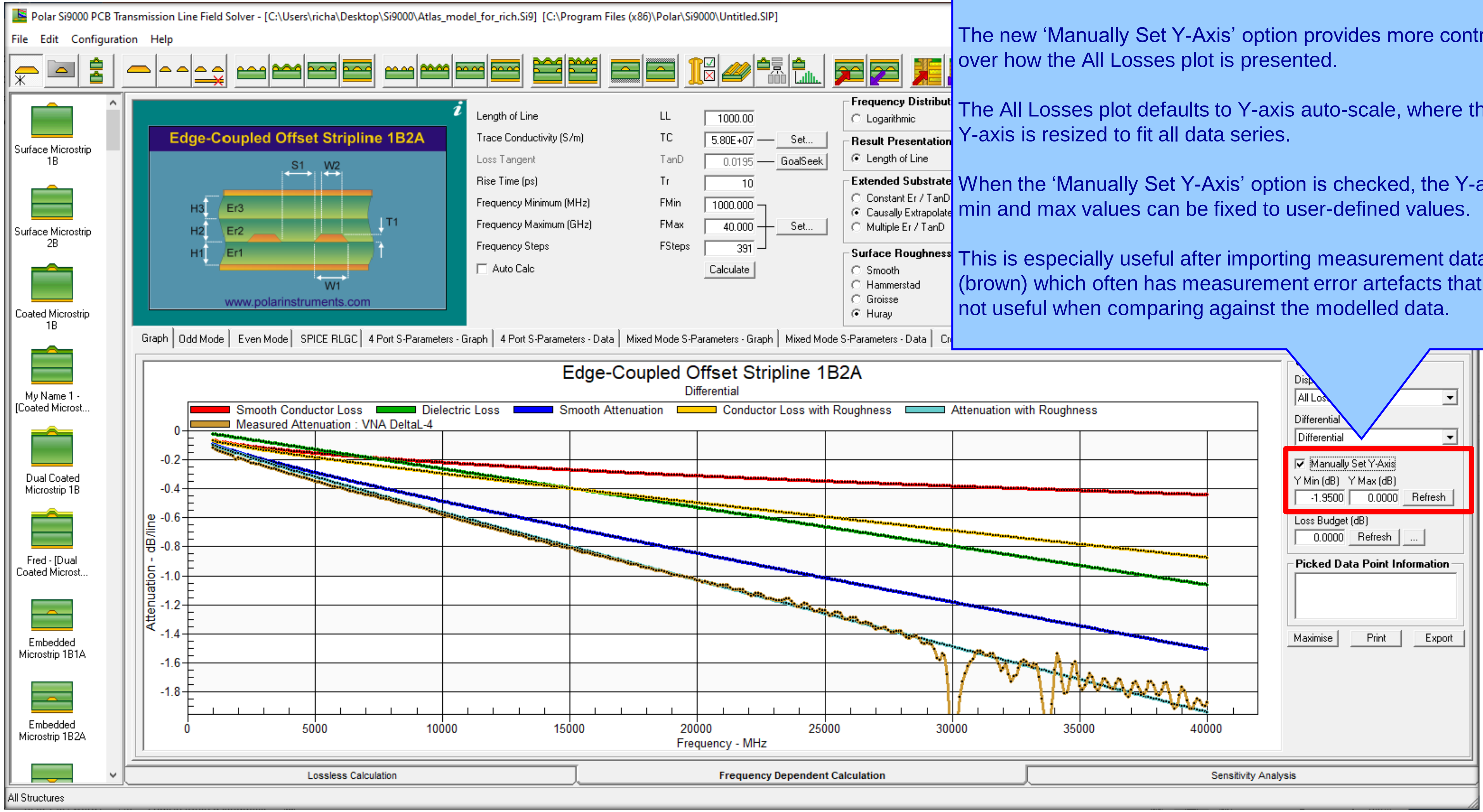
Import CITS Datalog File option – feature recap

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)

Graph | Analysis (Line) | Analysis (Bar) | Measurement Data

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



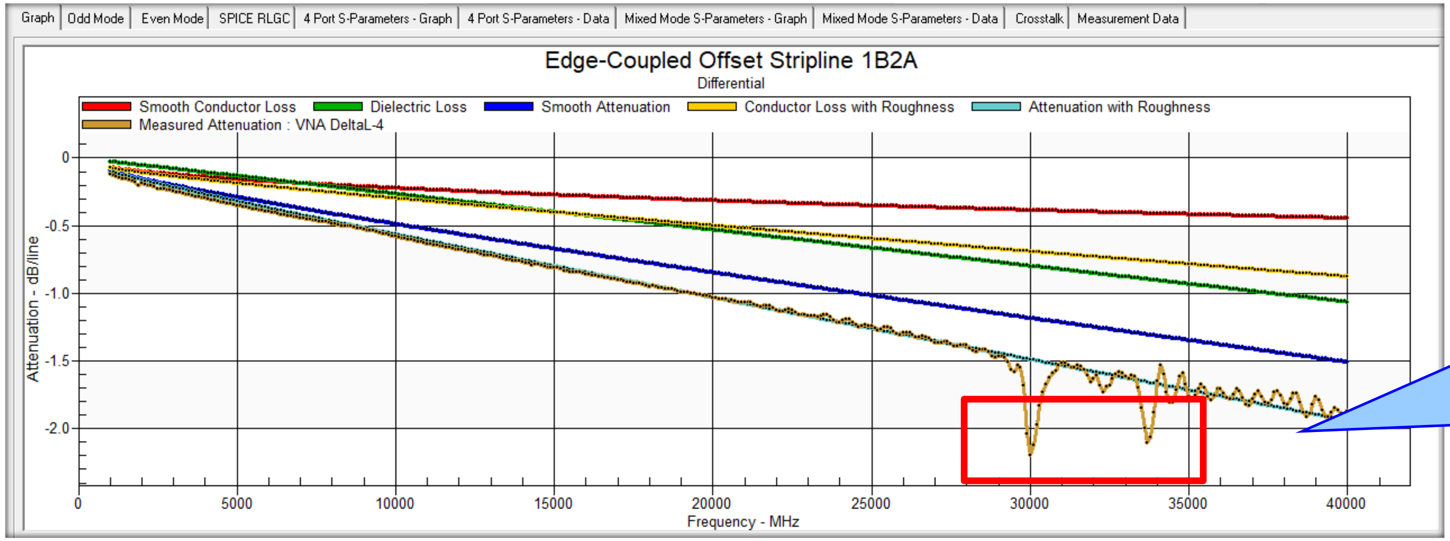
The new ‘Manually Set Y-Axis’ option provides more control over how the All Losses plot is presented.

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.

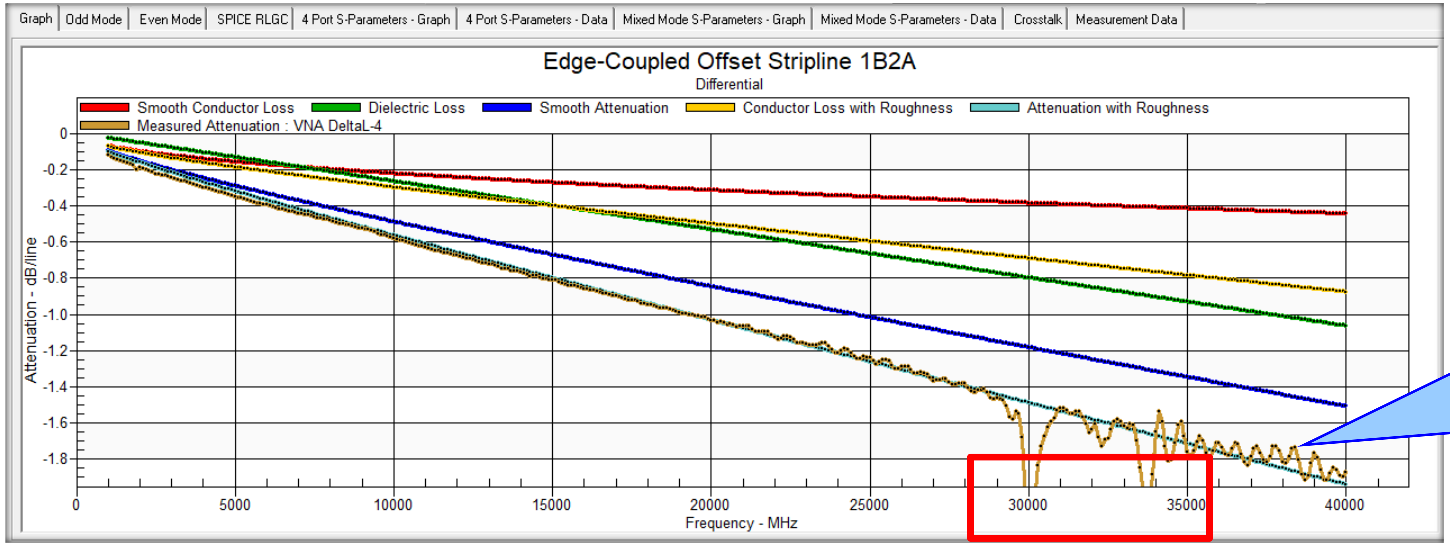
This is especially useful after importing measurement data (brown) which often has measurement error artefacts that are not useful when comparing against the modelled data.

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



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

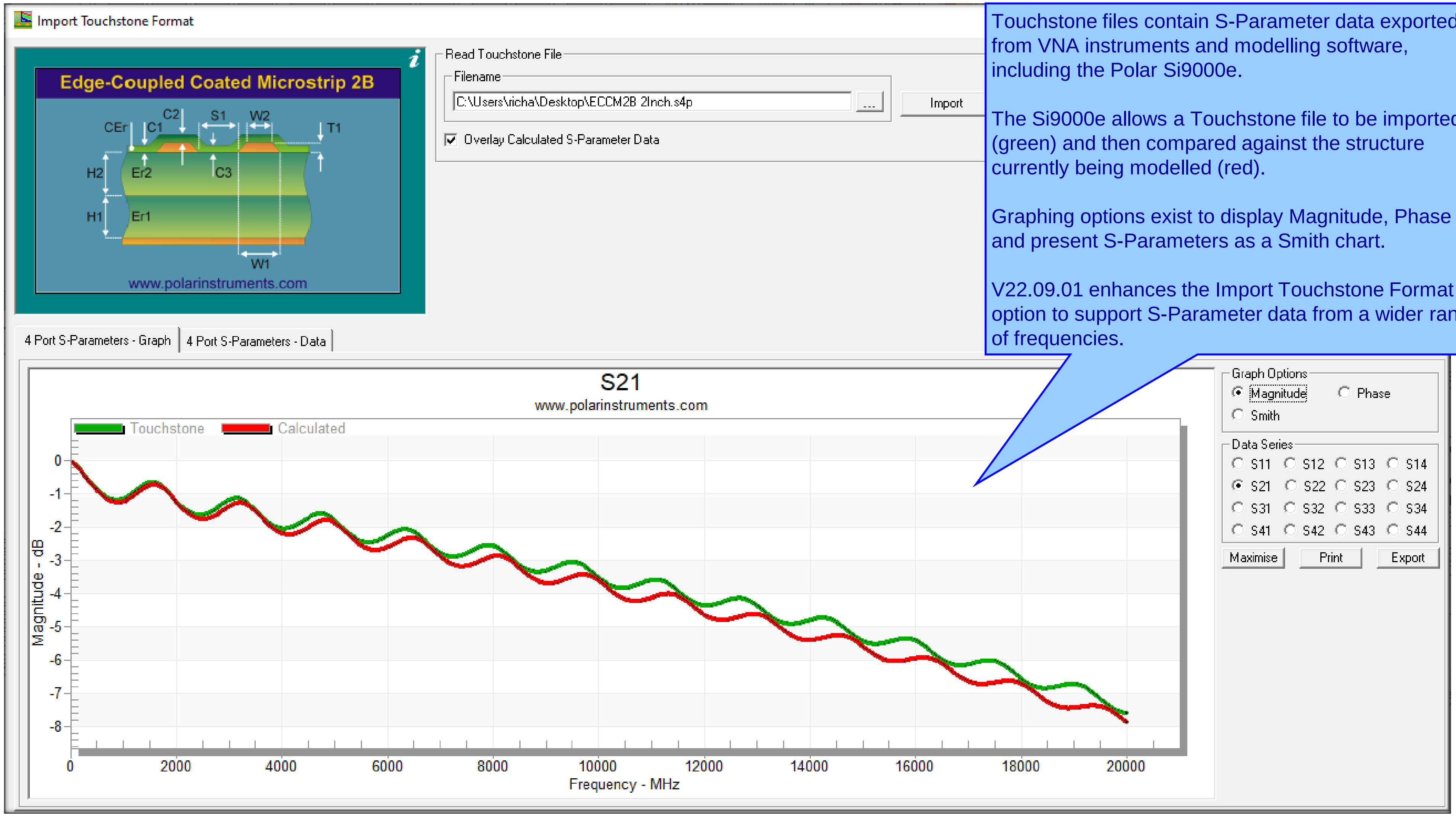
Notice the plot will scale the Y-axis to include all the measurement data including the measurement error artefacts



‘Manually Set Y-Axis’ 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



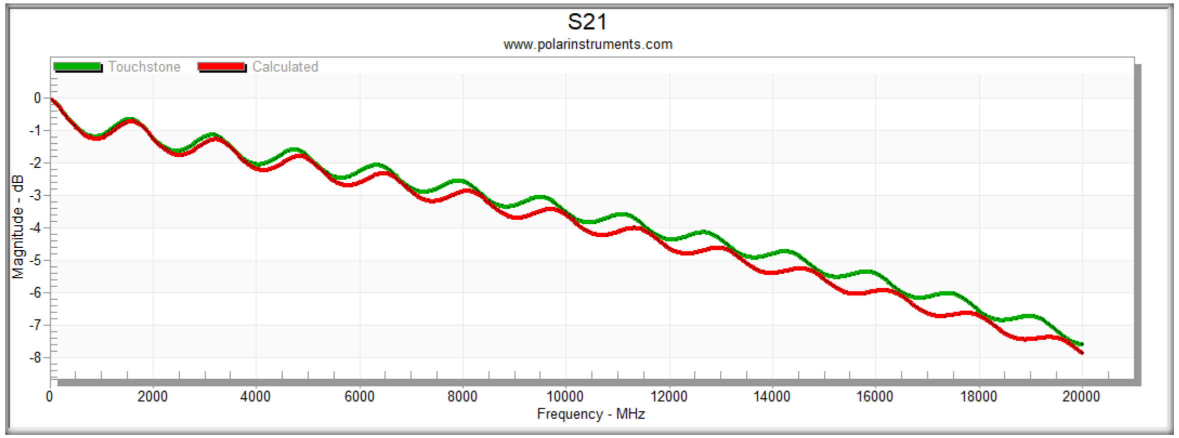
Touchstone files contain S-Parameter data exported from VNA instruments and modelling software, including the Polar Si9000e.

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

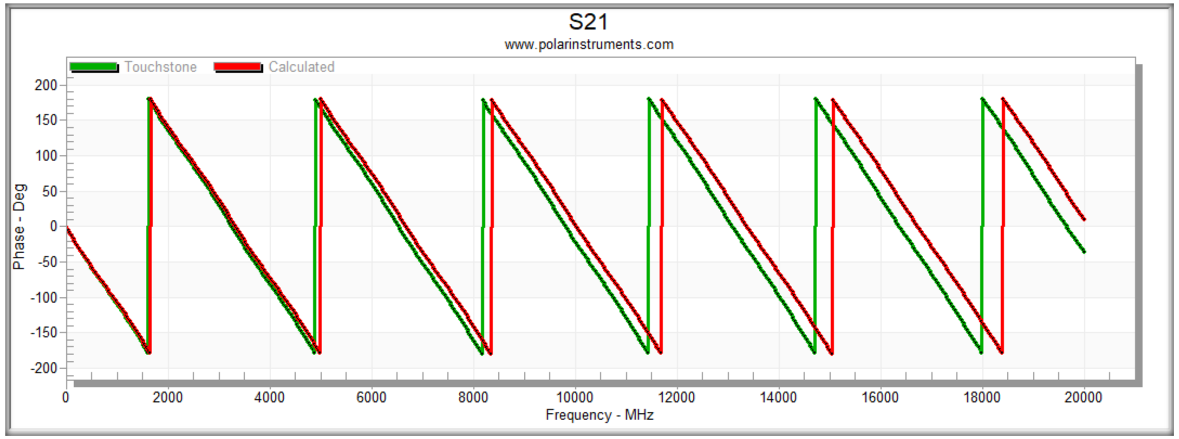
Graphing options exist to display Magnitude, Phase and present S-Parameters as a Smith chart.

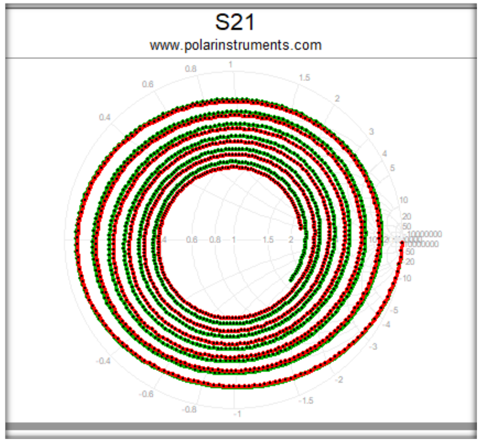
V22.09.01 enhances the Import Touchstone Format option to support S-Parameter data from a wider range of frequencies.

Enhancements to the Import Touchstone Format option



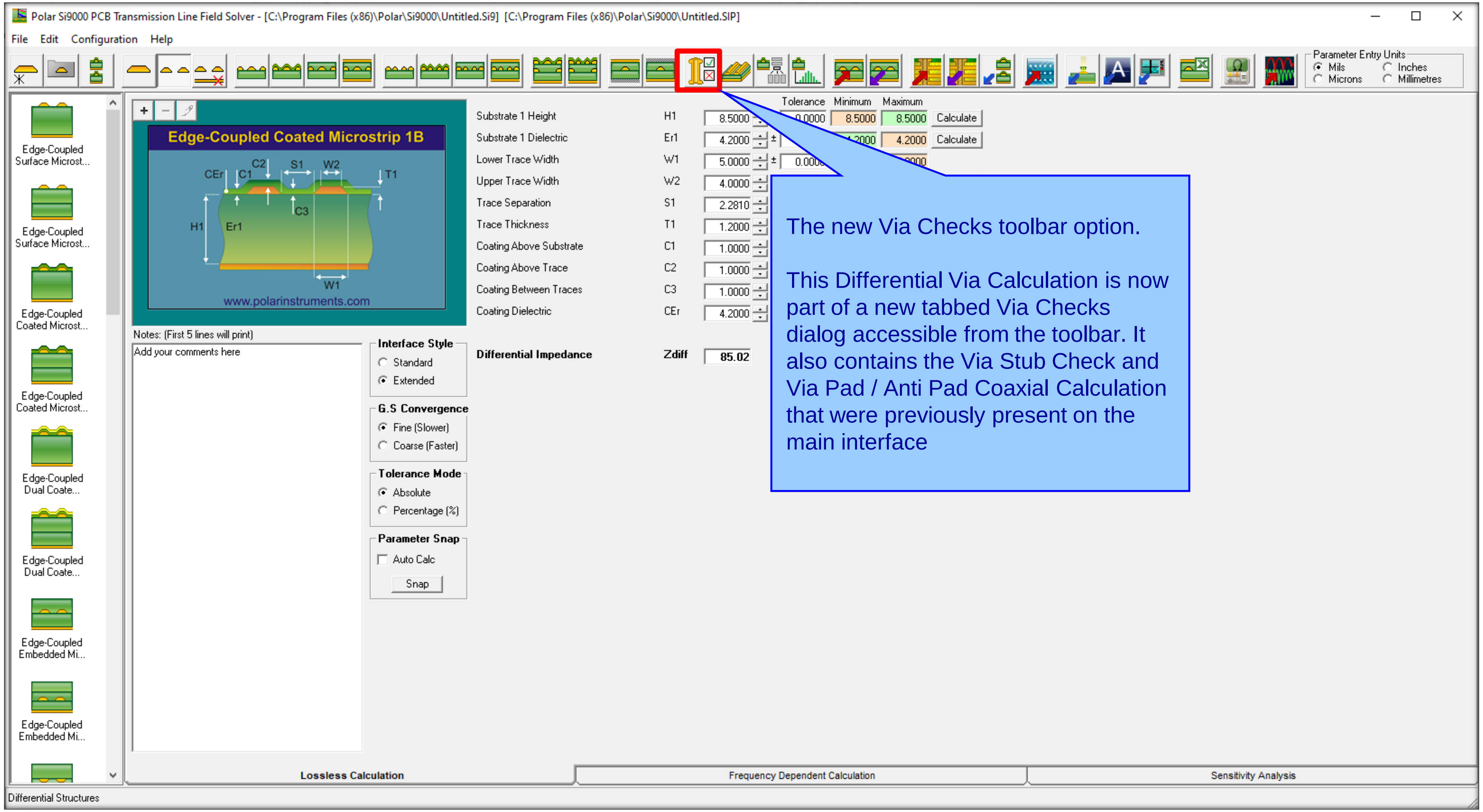
In this example a Touchstone 4-port file (.S4P) has been imported into the Si9000e. Magnitude, Phase and Smith Chart are shown for S21





Si9000e v22.04 (April 2022)

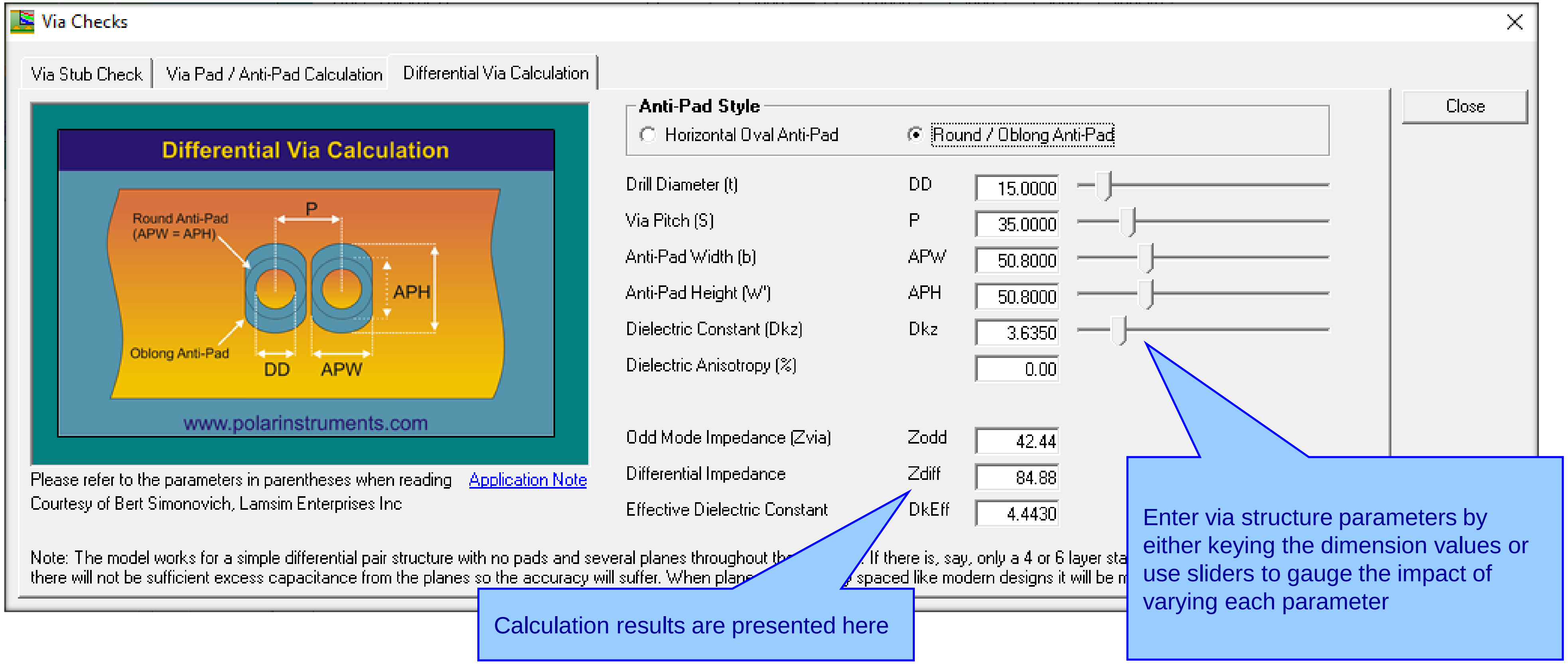
New Differential Via Calculation capability



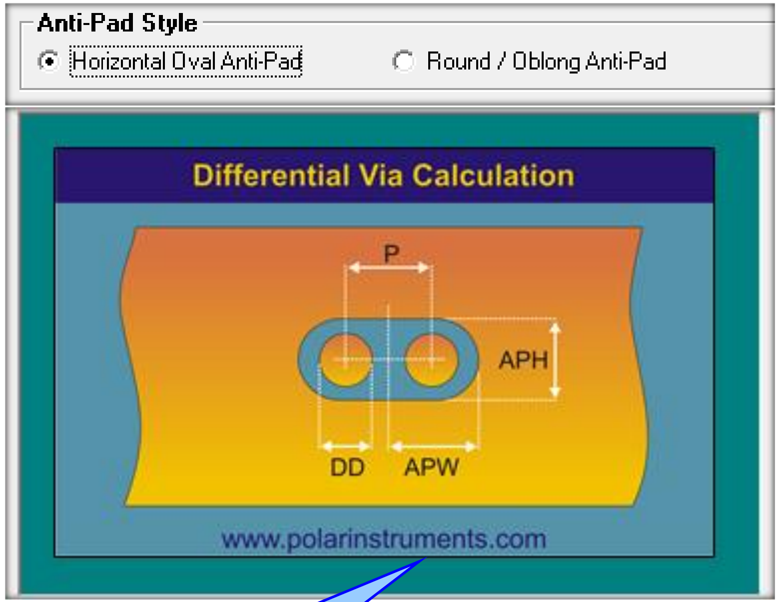
The new Via Checks toolbar option.

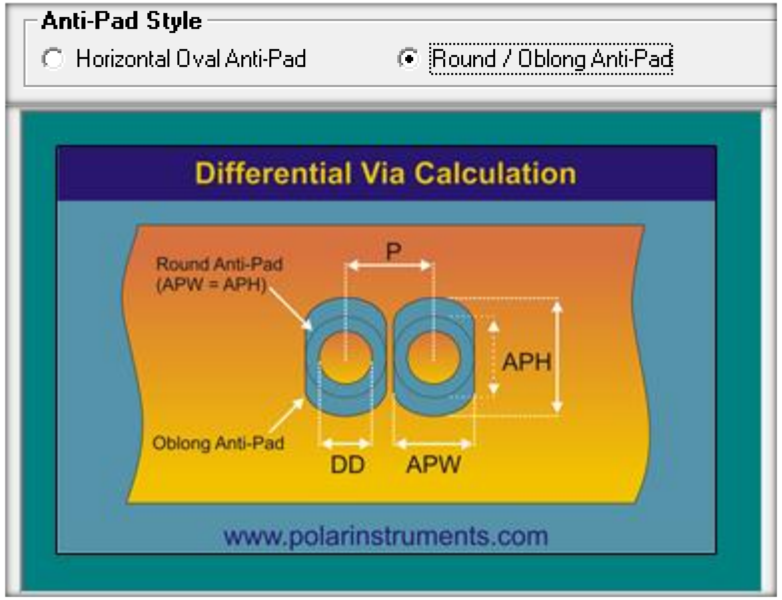
This Differential Via Calculation is now part of a new tabbed Via Checks dialog accessible from the toolbar. It also contains the Via Stub Check and Via Pad / Anti Pad Coaxial Calculation that were previously present on the main interface

New Differential Via Calculation



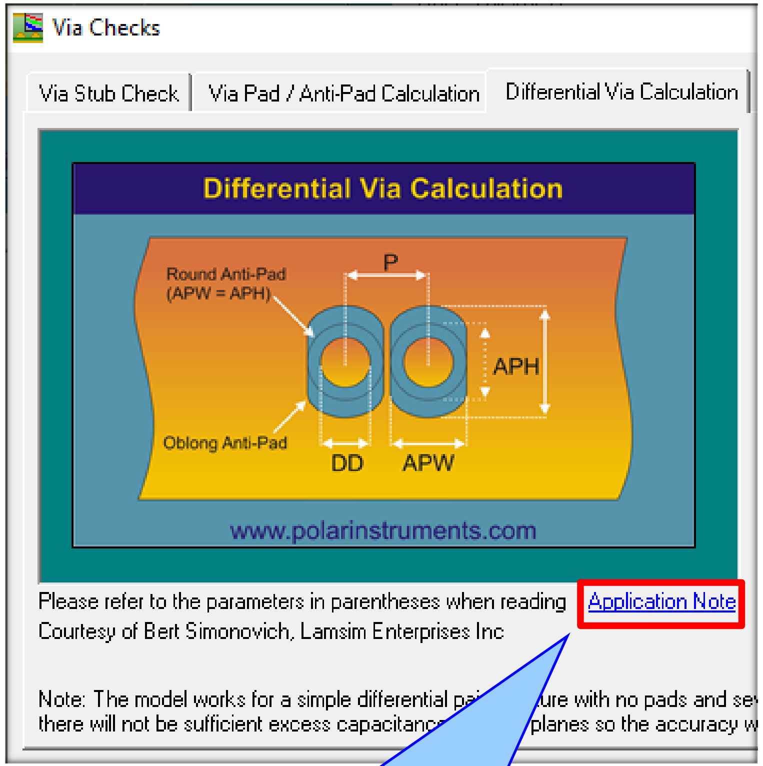
New Differential Via Calculation



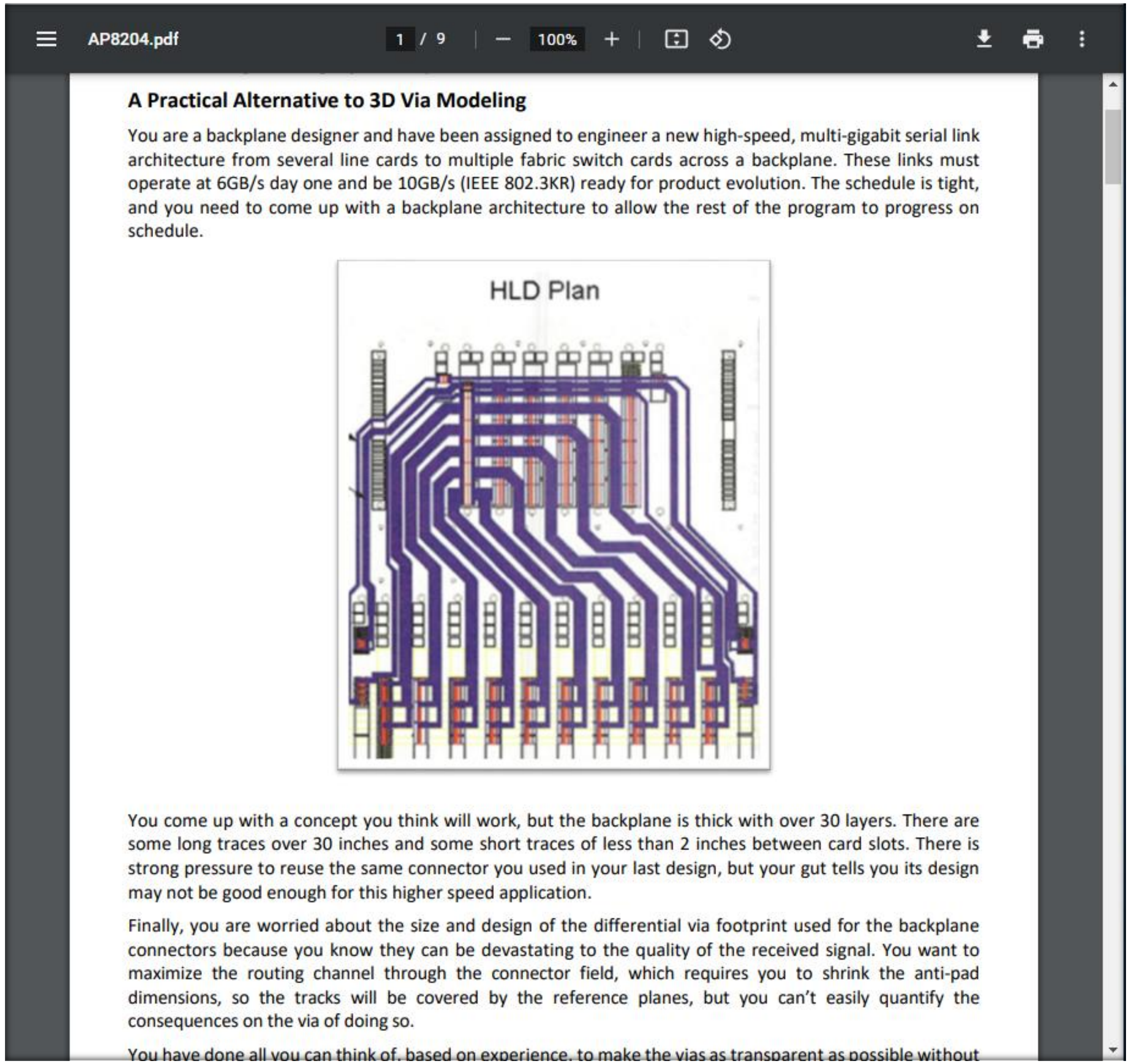


Two different selectable
Anti-Pad Styles available

New Differential Via Calculation



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



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

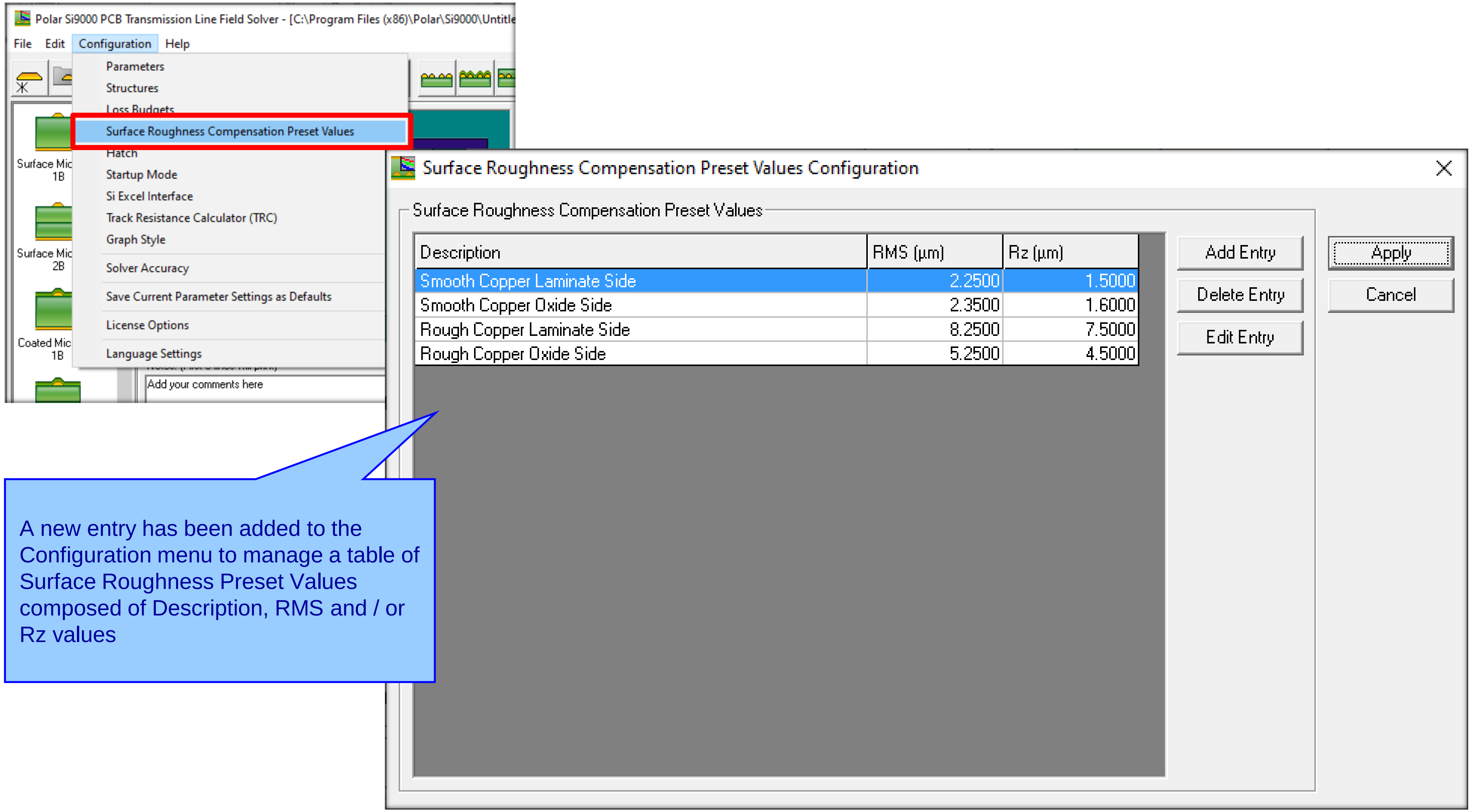
You come up with a concept you think will work, but the backplane is thick with over 30 layers. There are some long traces over 30 inches and some short traces of less than 2 inches between card slots. There is strong pressure to reuse the same connector you used in your last design, but your gut tells 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

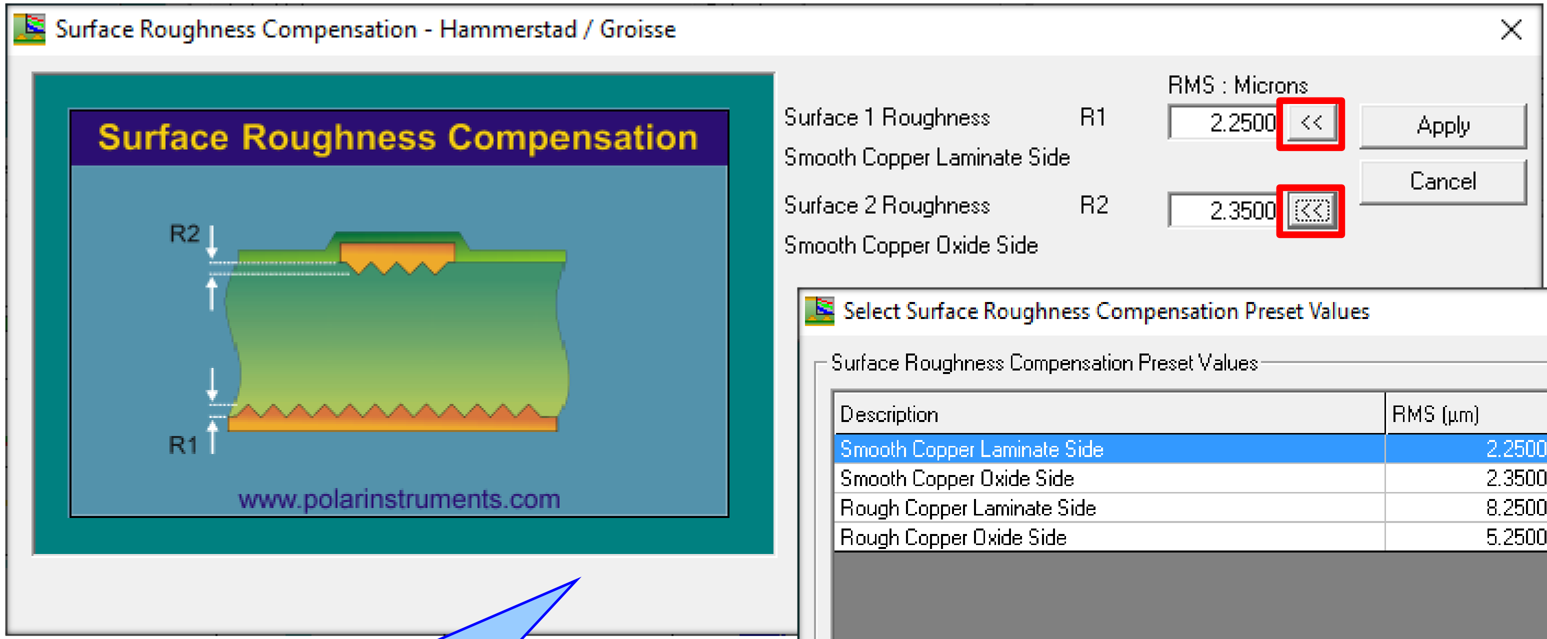
Si9000e v22.03 (March 2022)

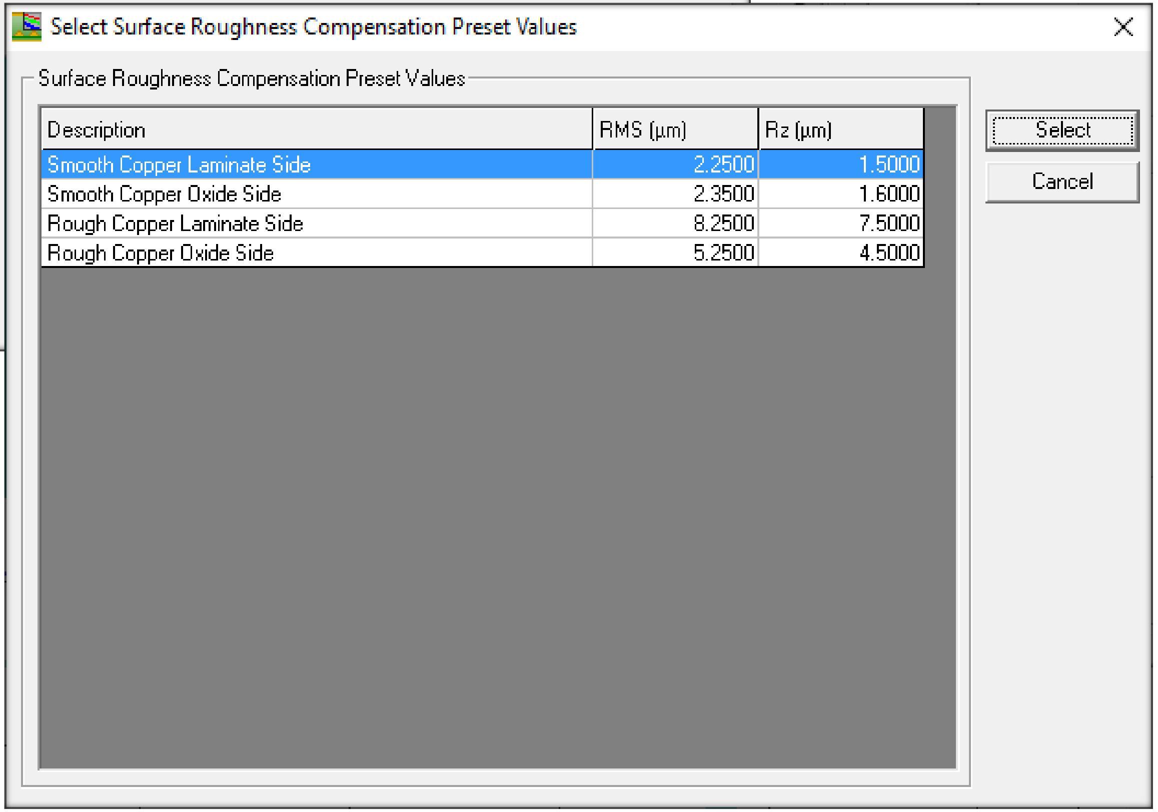
New Surface Roughness Compensation Preset Values option



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





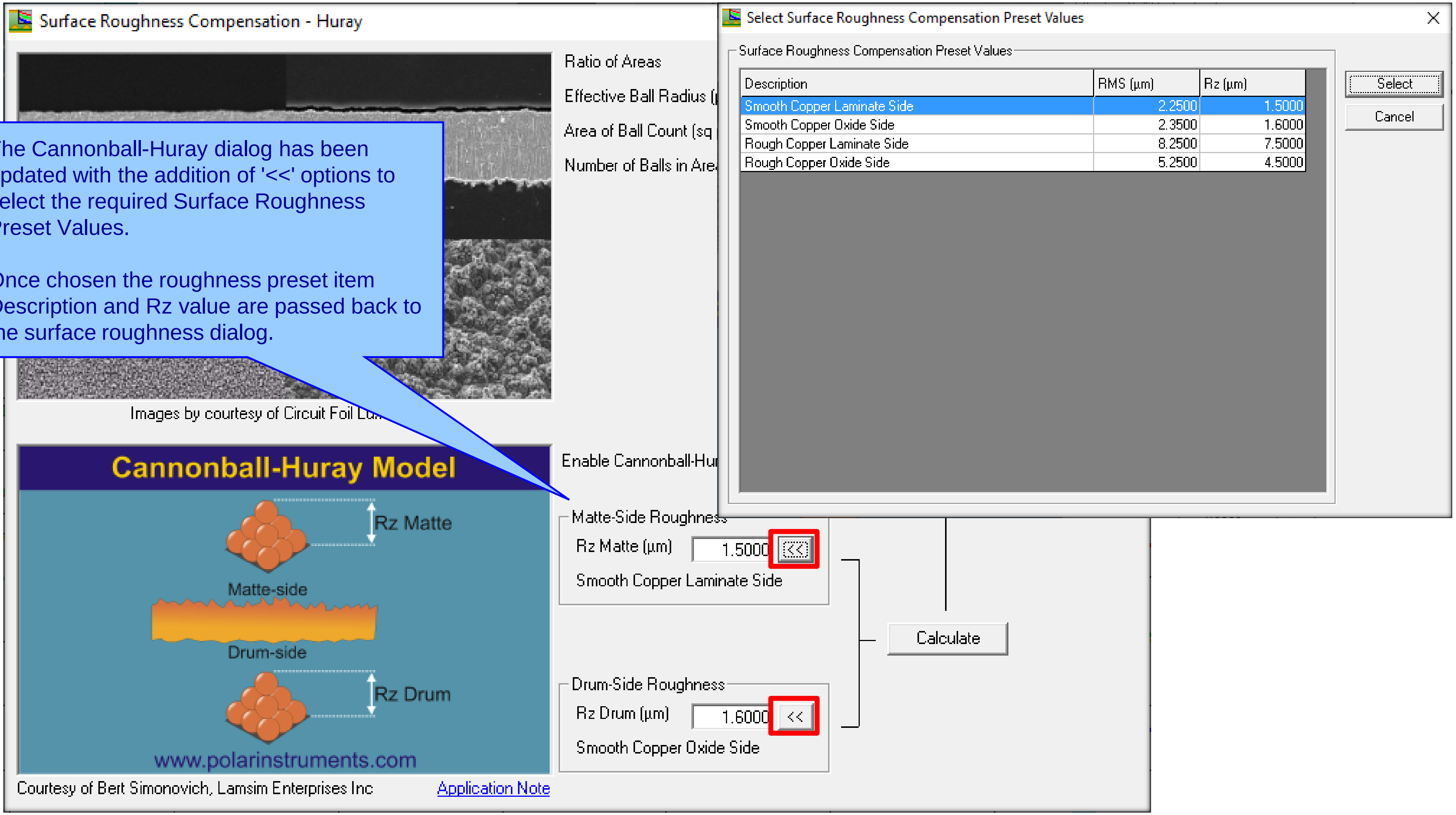
The Hammerstad / Groisse dialog has been updated with the addition of '<<' options to select the required Surface Roughness Preset Values.

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

New Surface Roughness Compensation Preset Values option

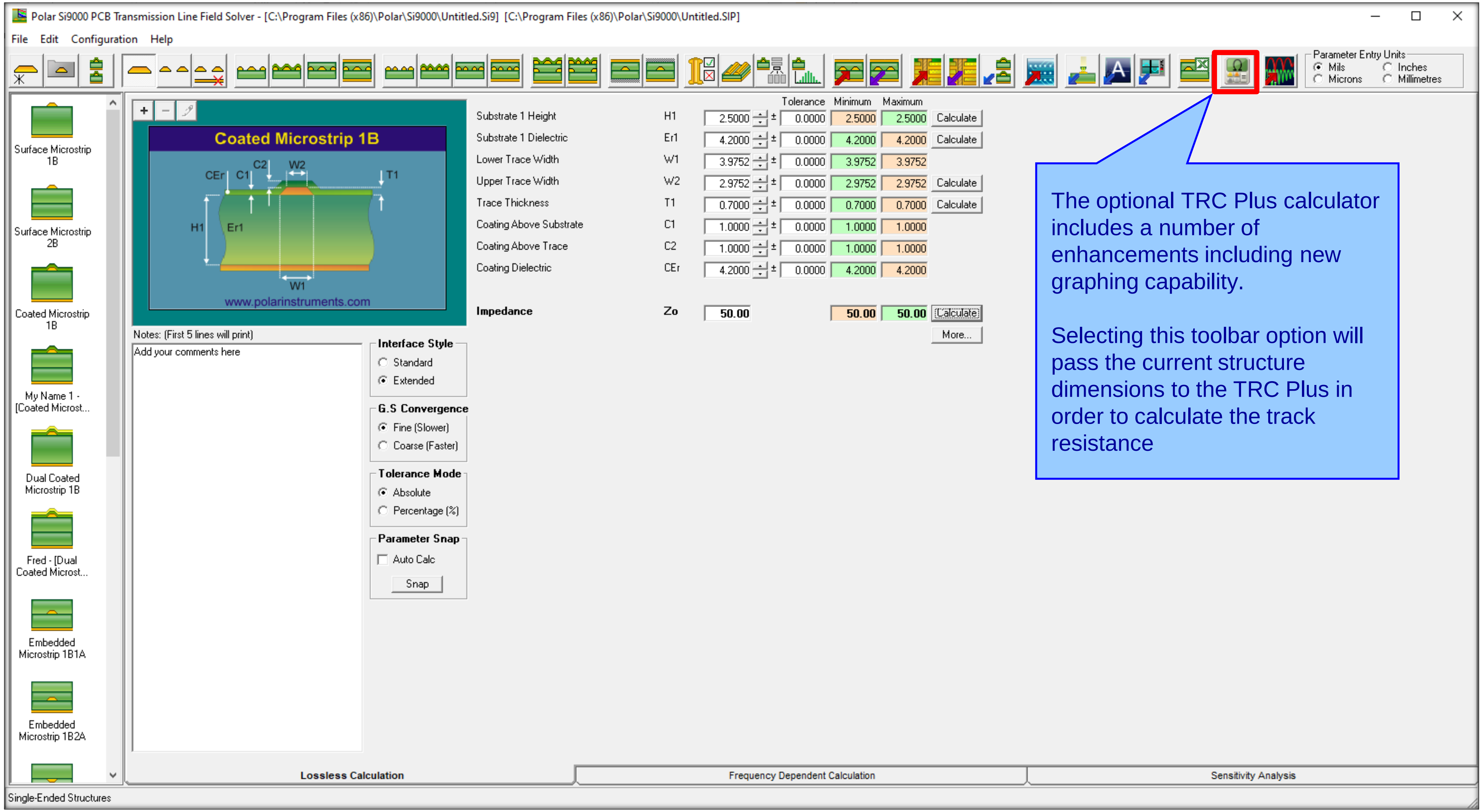
The Cannonball-Huray dialog has been updated with the addition of '<<' options to select the required Surface Roughness Preset Values.

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



Si9000e v22.02 (February 2022)

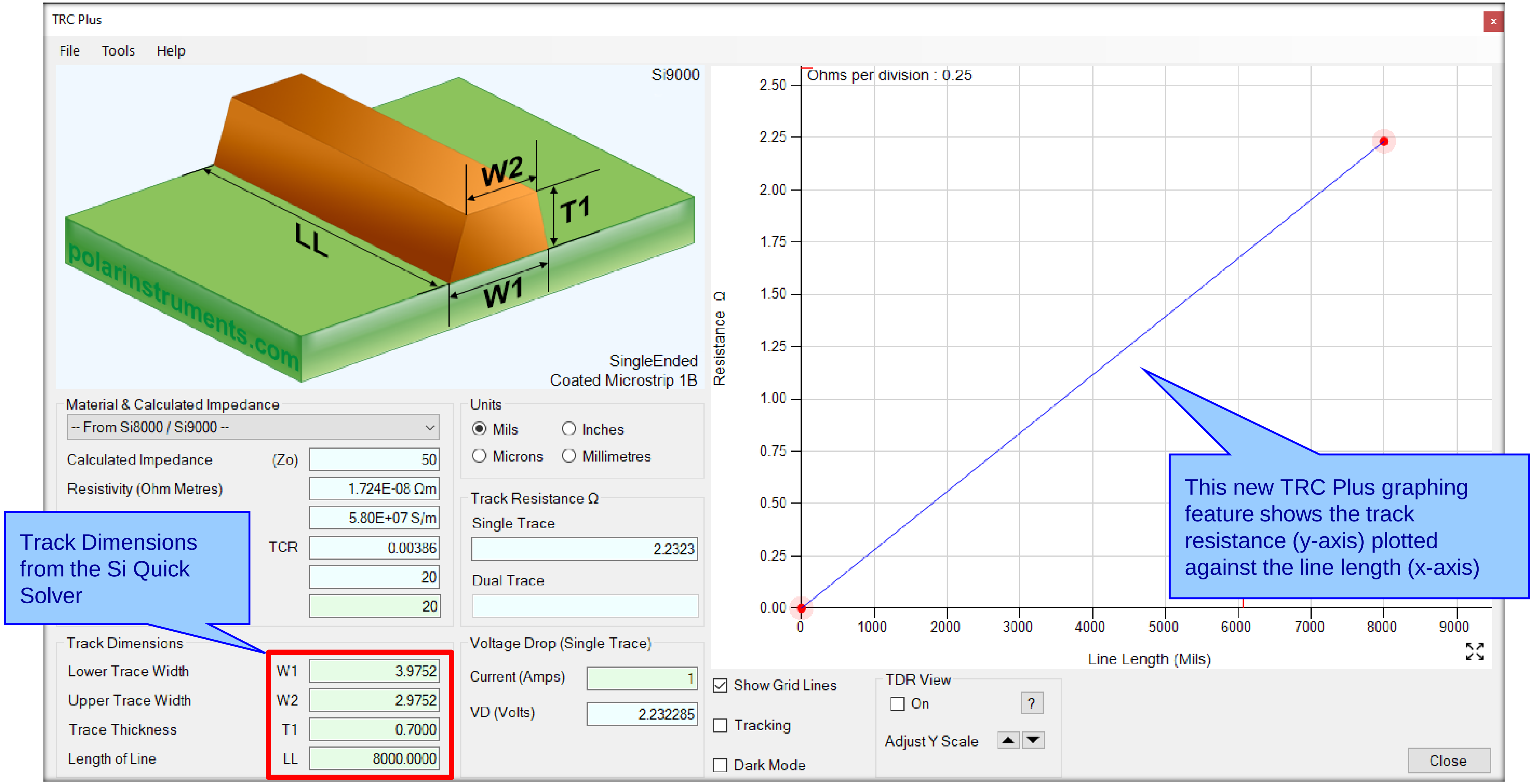
Track Resistance Calculator (TRC Plus) enhancements



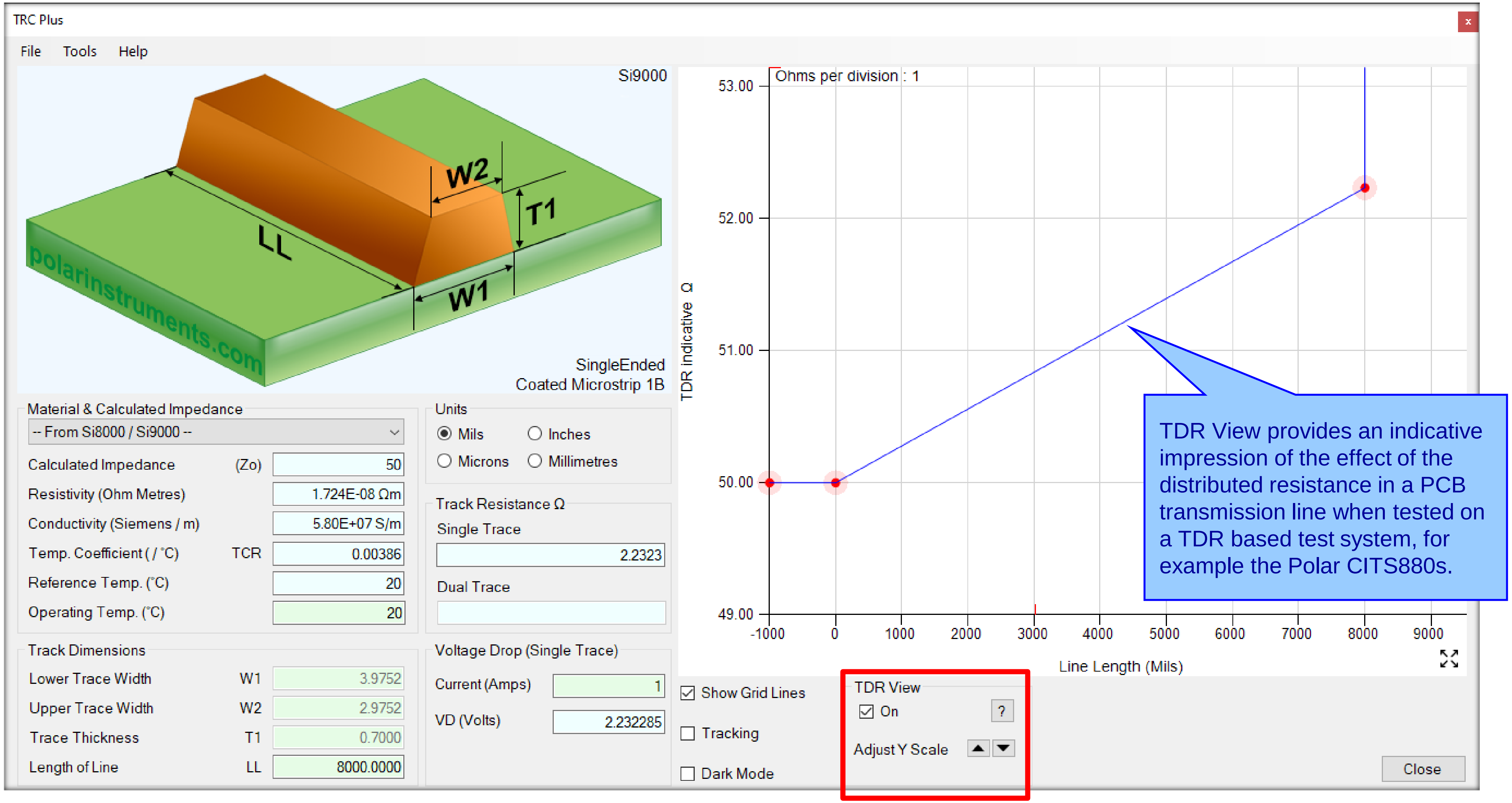
The optional TRC Plus calculator includes a number of enhancements including new graphing capability.

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



Track Resistance Calculator (TRC Plus) enhancements



Si9000e v21.09 (Sept 2021)

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

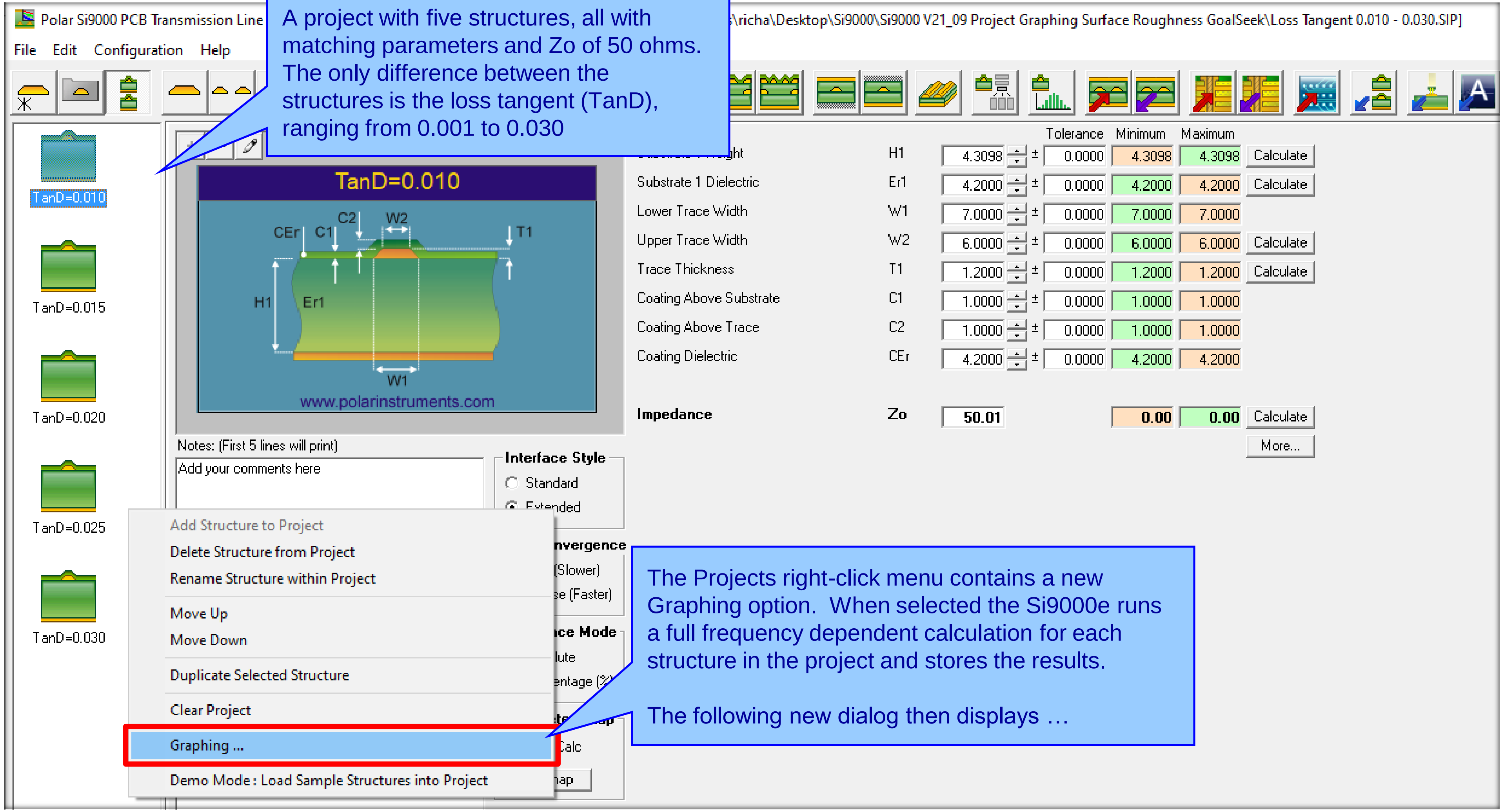
It is often useful to compare the results from similar structures, especially with frequency dependent calculations where changing just one or two parameters can have significant impact.

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

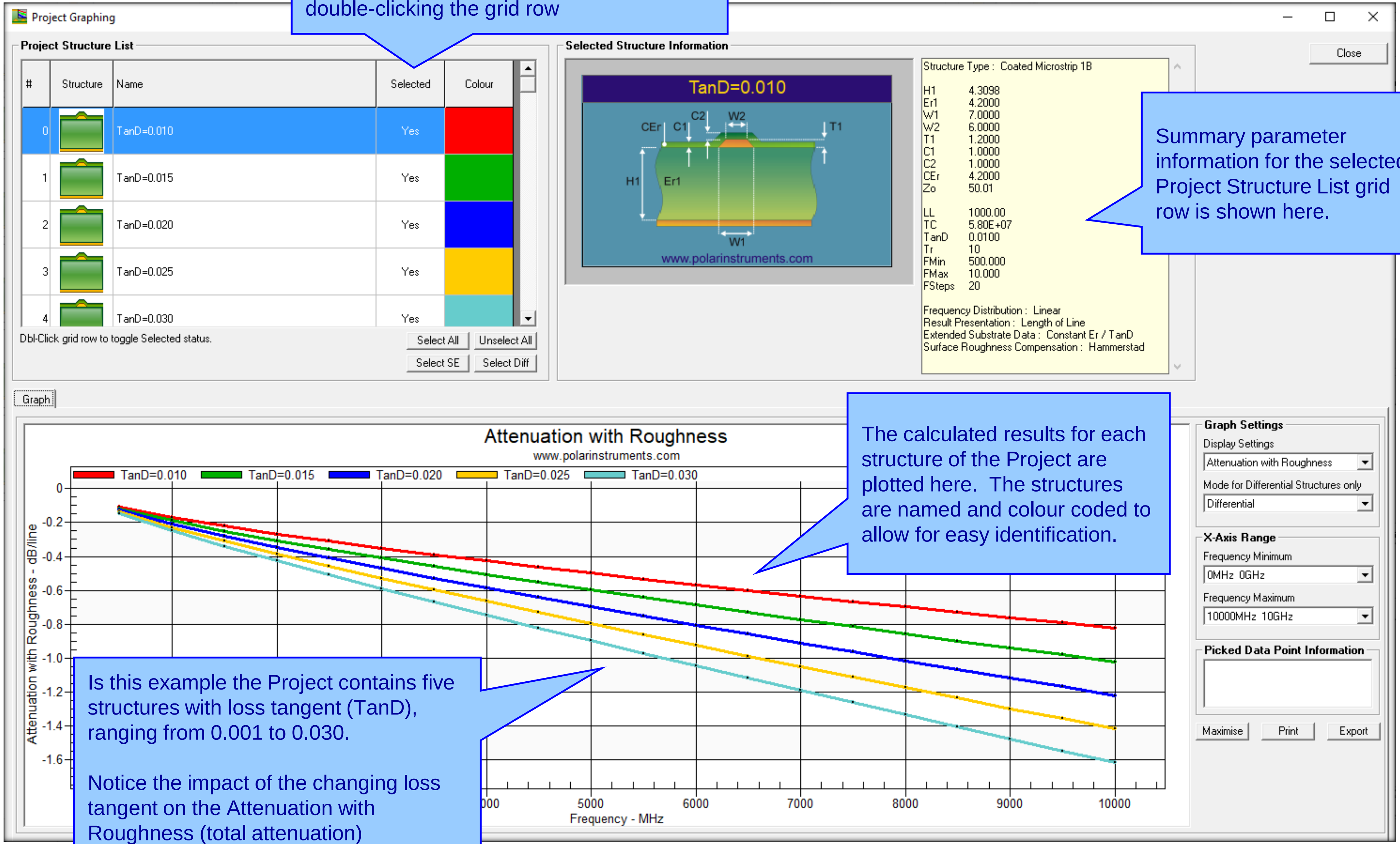


A project with five structures, all with matching parameters and Zo of 50 ohms. The only difference between the structures is the loss tangent (TanD), ranging from 0.001 to 0.030

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 …

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

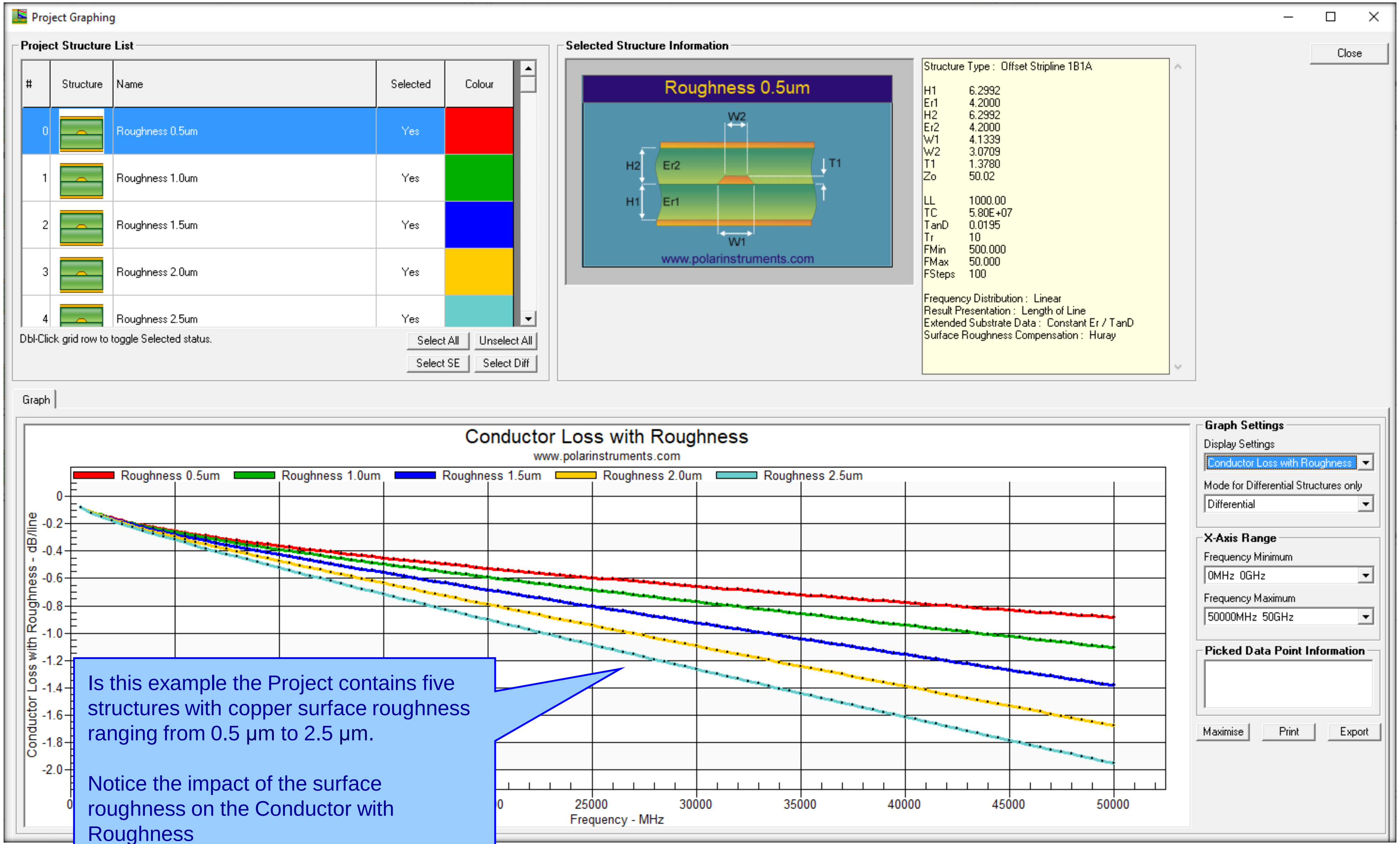


Summary parameter information for the selected Project Structure List grid row is shown here.

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

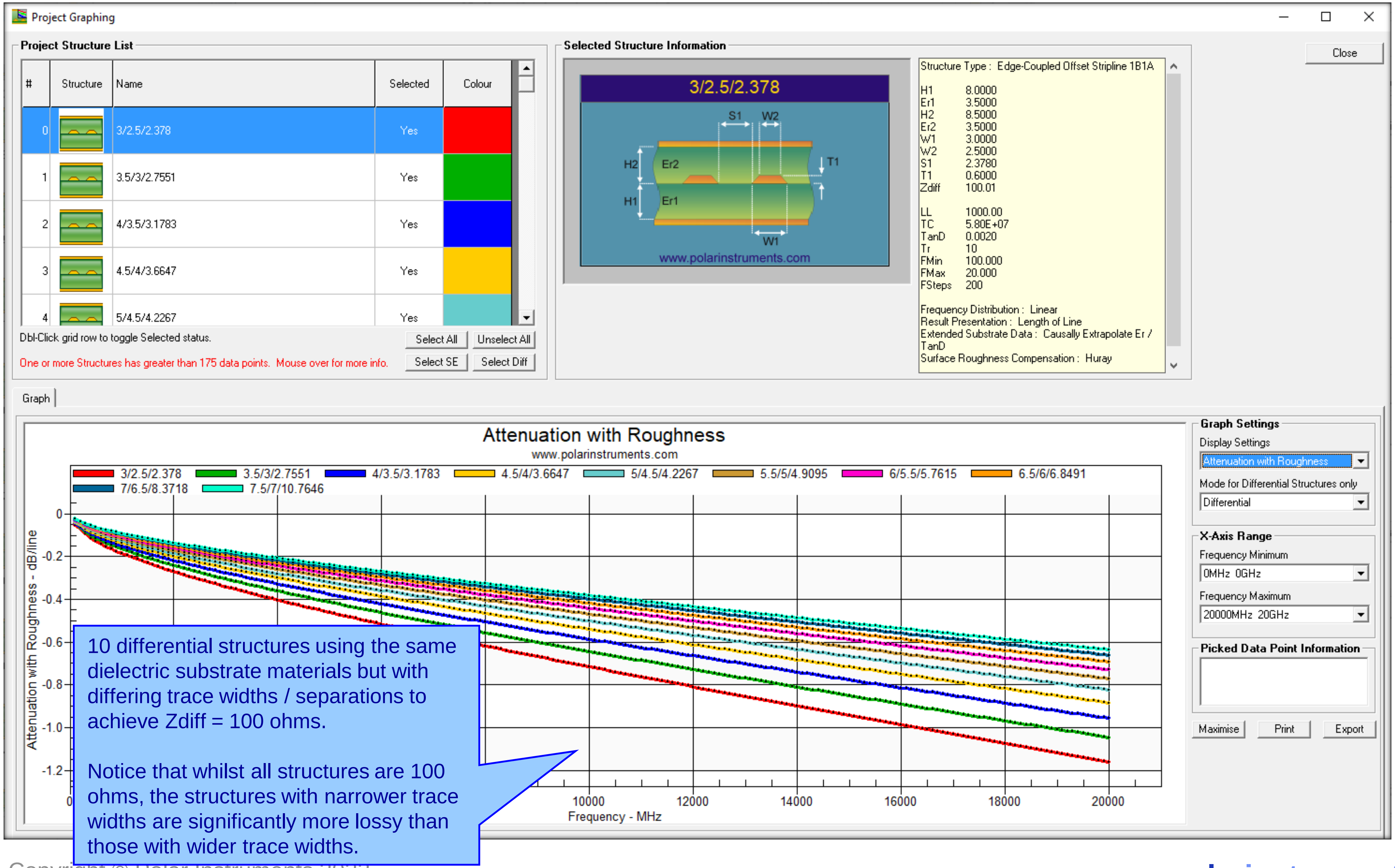
Is this example the Project contains five structures with loss tangent (TanD), ranging from 0.001 to 0.030.

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



Is this example the Project contains five structures with copper surface roughness ranging from 0.5 µm to 2.5 µm.

Notice the impact of the surface roughness on the Conductor with Roughness


Project Graphing
Project Structure List
| Structure | Name | Selected | Colour
0 3/2.5/2.378 Yes
1 3.5/3/2.7551 Yes
2 4/3.5/3.1783 Yes
3 4.5/4/3.6647 Yes
4 5/4.5/4.2267 Yes
Dbl-Click 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
3/2.5/2.378
www.polarinstruments.com
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
3/2.5/2.378
3.5/3/2.7551
4/3.5/3.1783
4.5/4/3.6647
5/4.5/4.2267
5.5/5/4.9095
6/5.5/5.7615
6.5/6/6.8491
7/6.5/8.3718
7.5/7/10.7646
Attenuation with Roughness - dB/line
Frequency - MHz
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

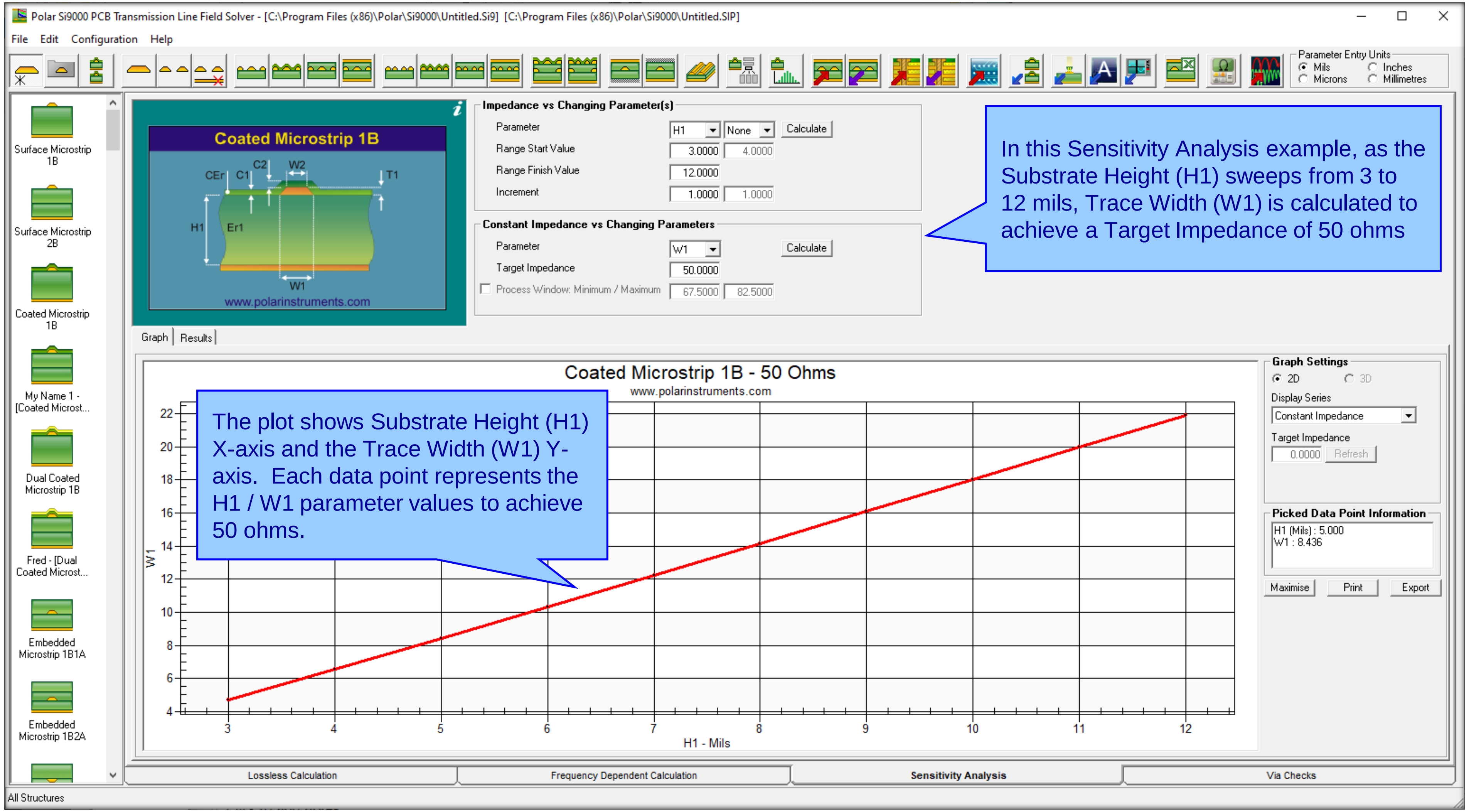
Populate a Project from Sensitivity Analysis Results

(requires the Si Projects feature)

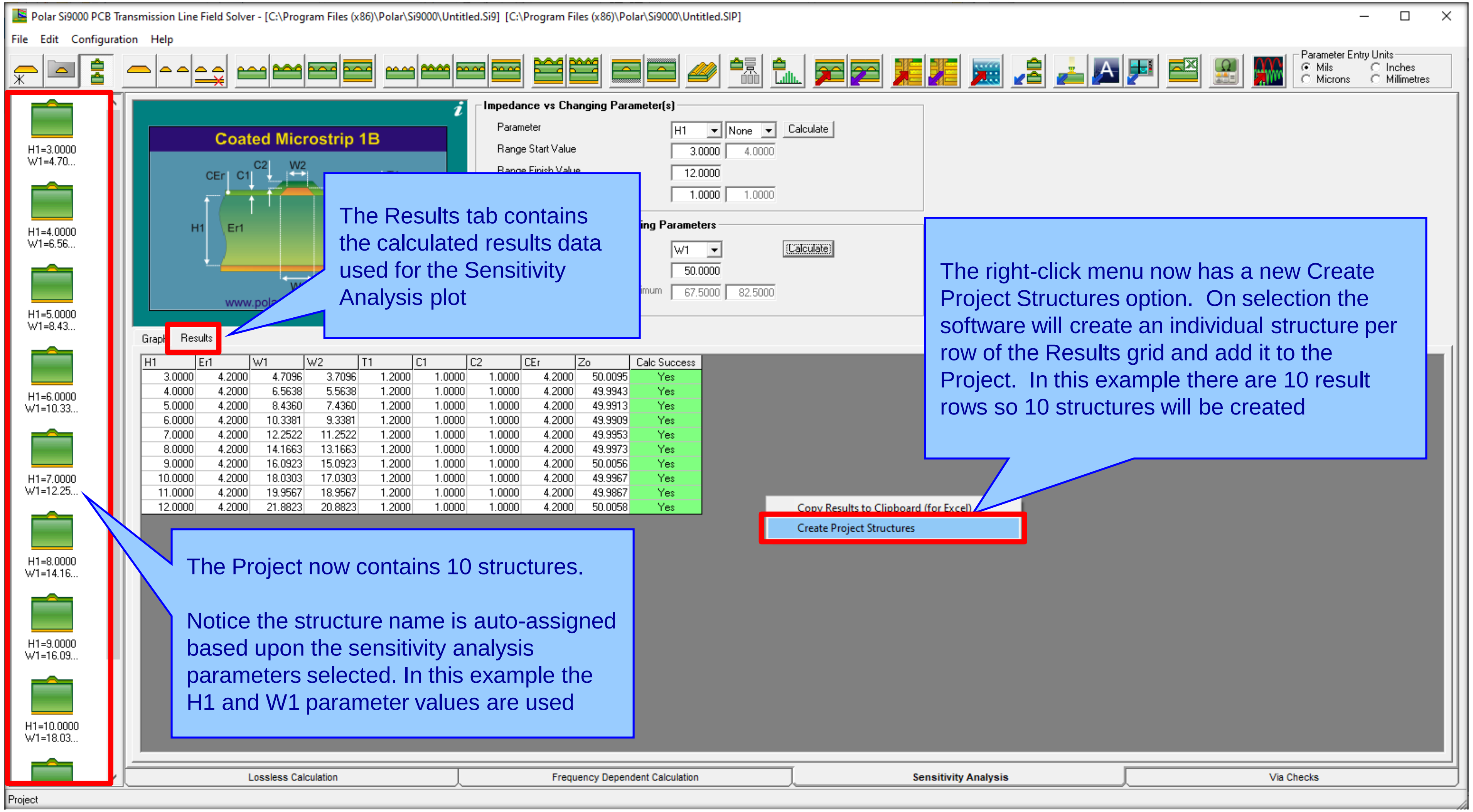
When using the Sensitivity Analysis option it is often useful to examine the calculated results in more details. It is now possible to auto-create a Project containing structures based upon the Sensitivity Analysis results data.

The following slides provide further details:

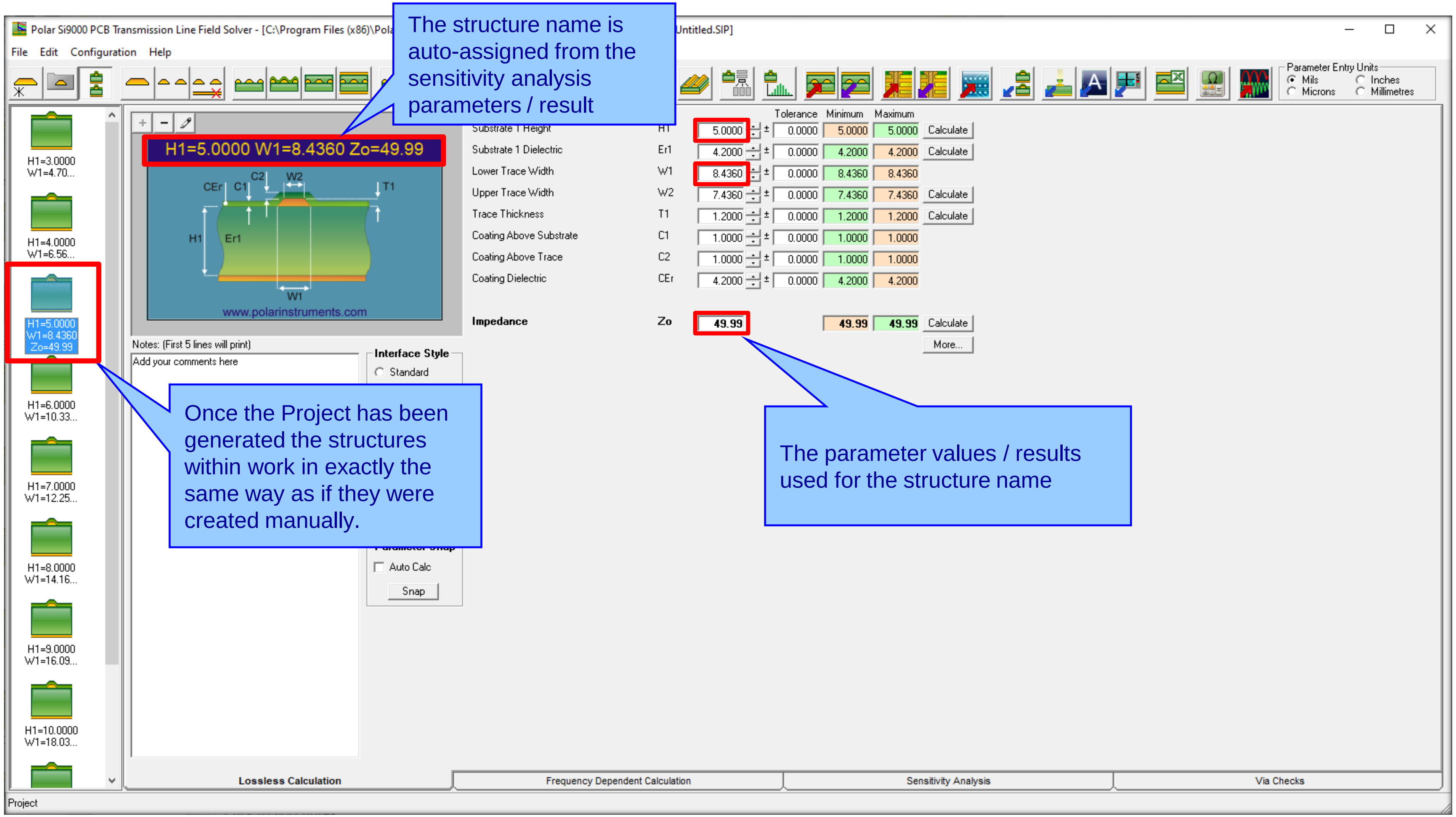
Populate a Project from Sensitivity Analysis Results

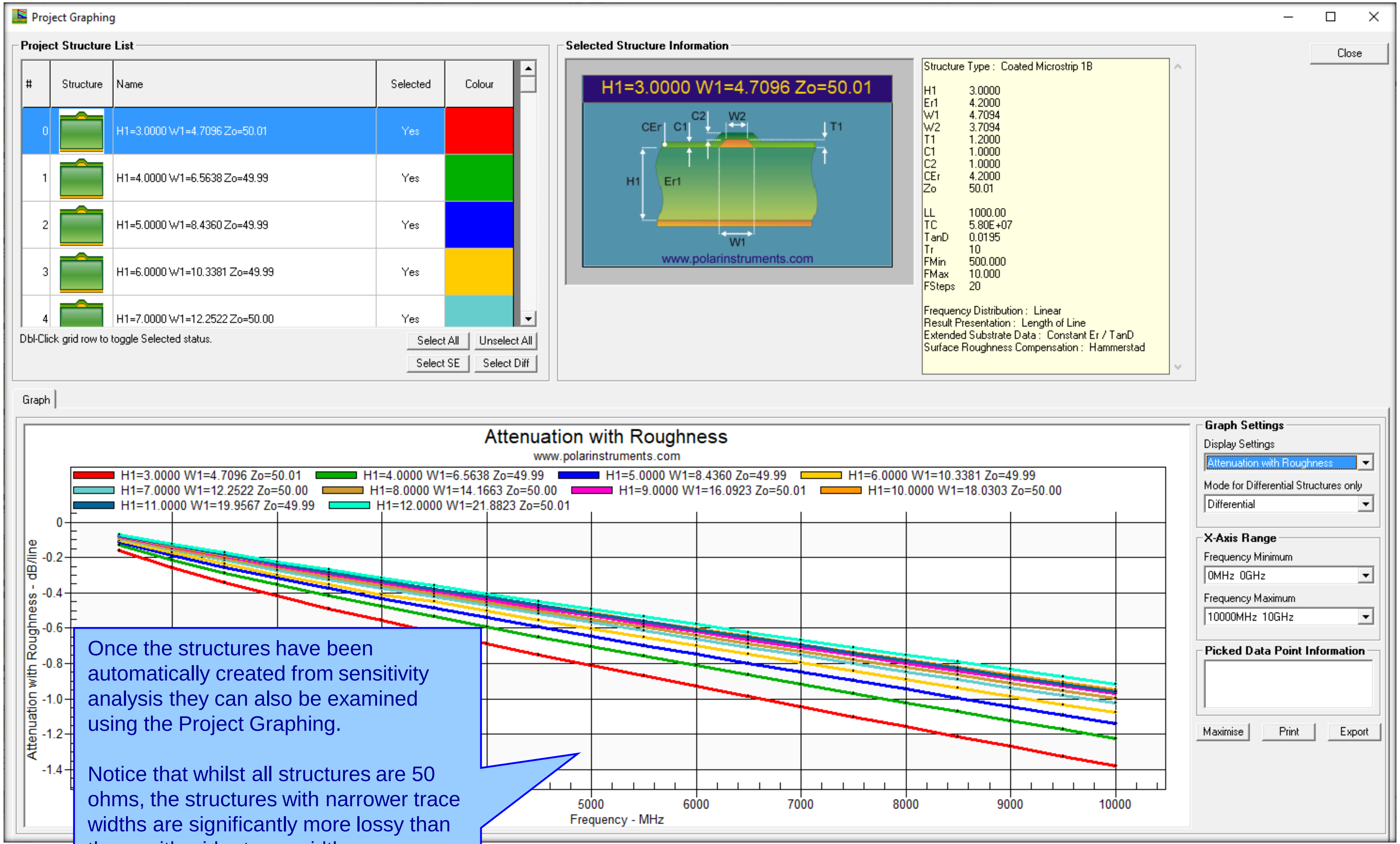


Populate a Project from Sensitivity Analysis Results



Populate a Project from Sensitivity Analysis Results

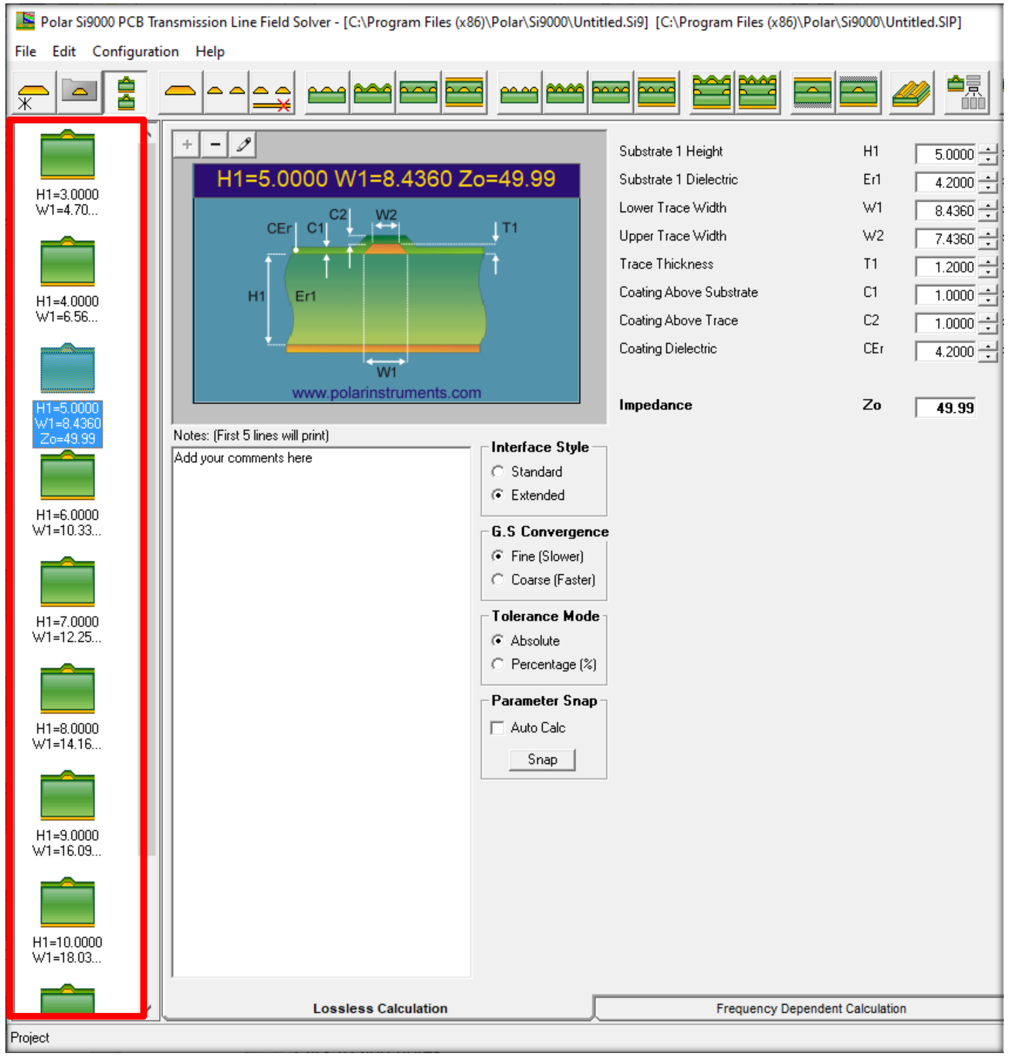


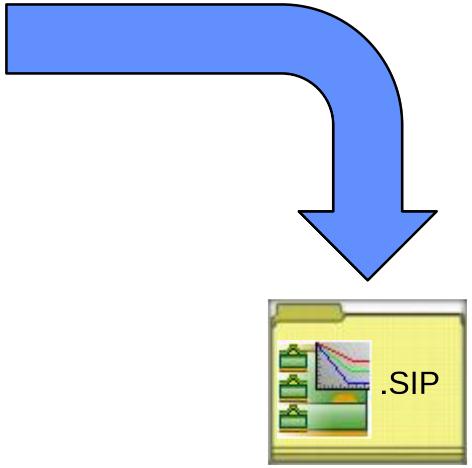


Once the structures have been automatically created from sensitivity analysis they can also be examined using the Project Graphing.

Notice that whilst all structures are 50 ohms, the structures with narrower trace widths are significantly more lossy than those with wider trace widths.

Populate a Project from Sensitivity Analysis Results





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

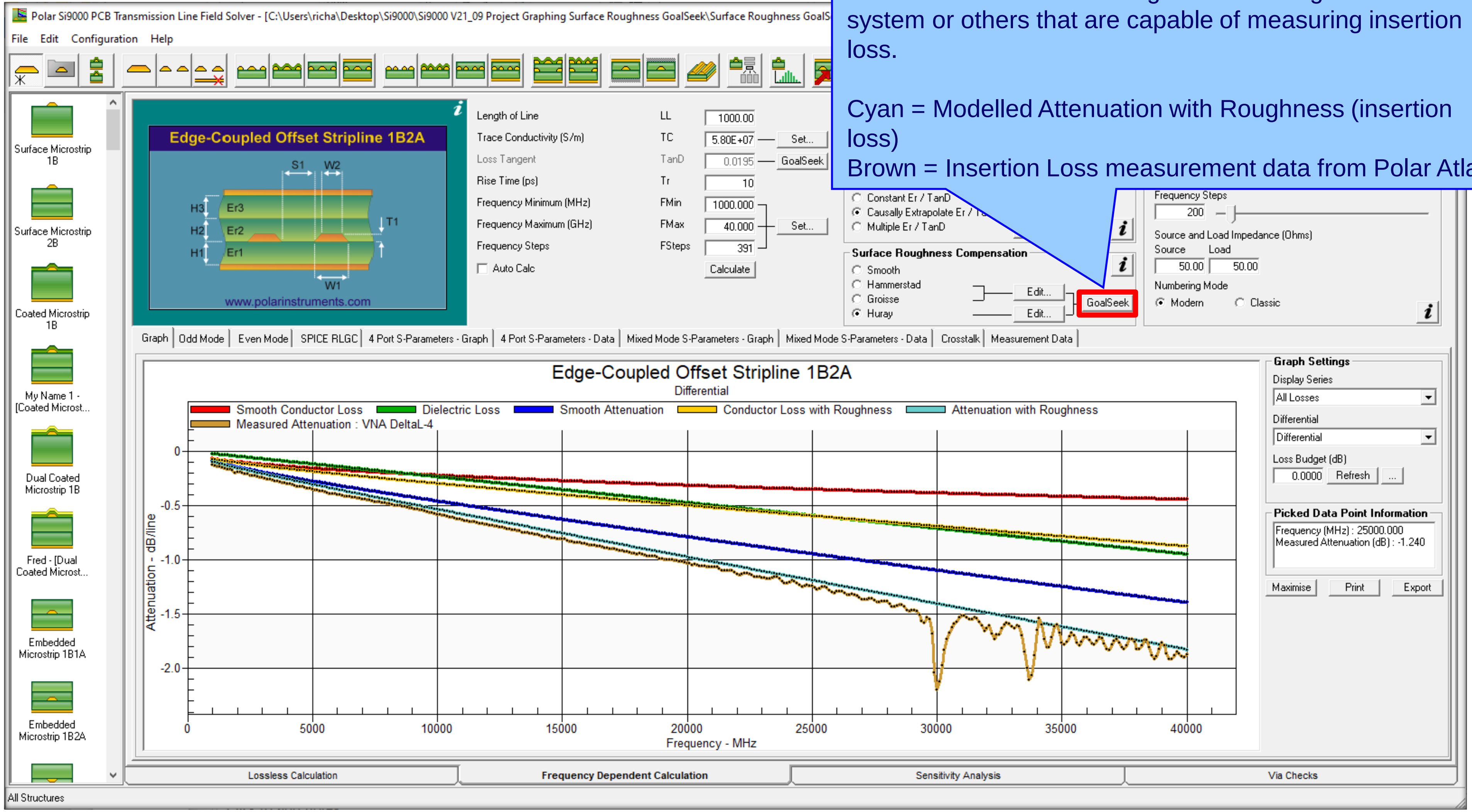
Populate a Project from Sensitivity Analysis Results - Summary

- 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

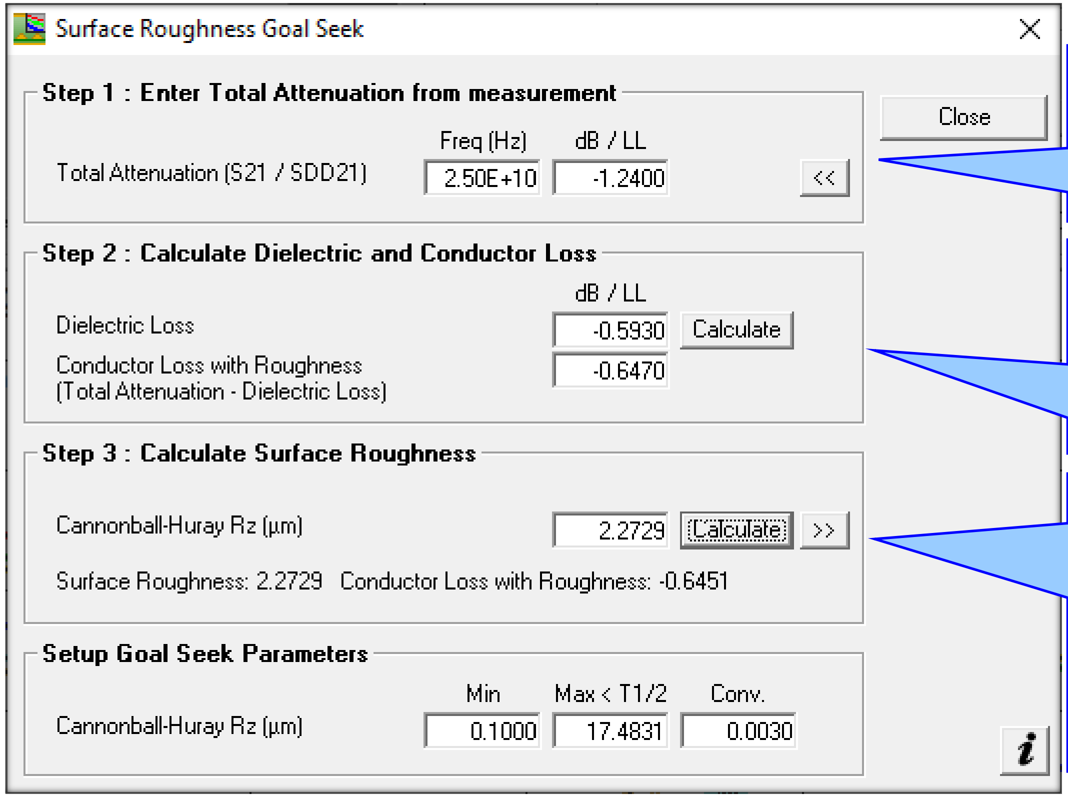
Surface Roughness Goal Seek option

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



Surface Roughness Goal Seek option

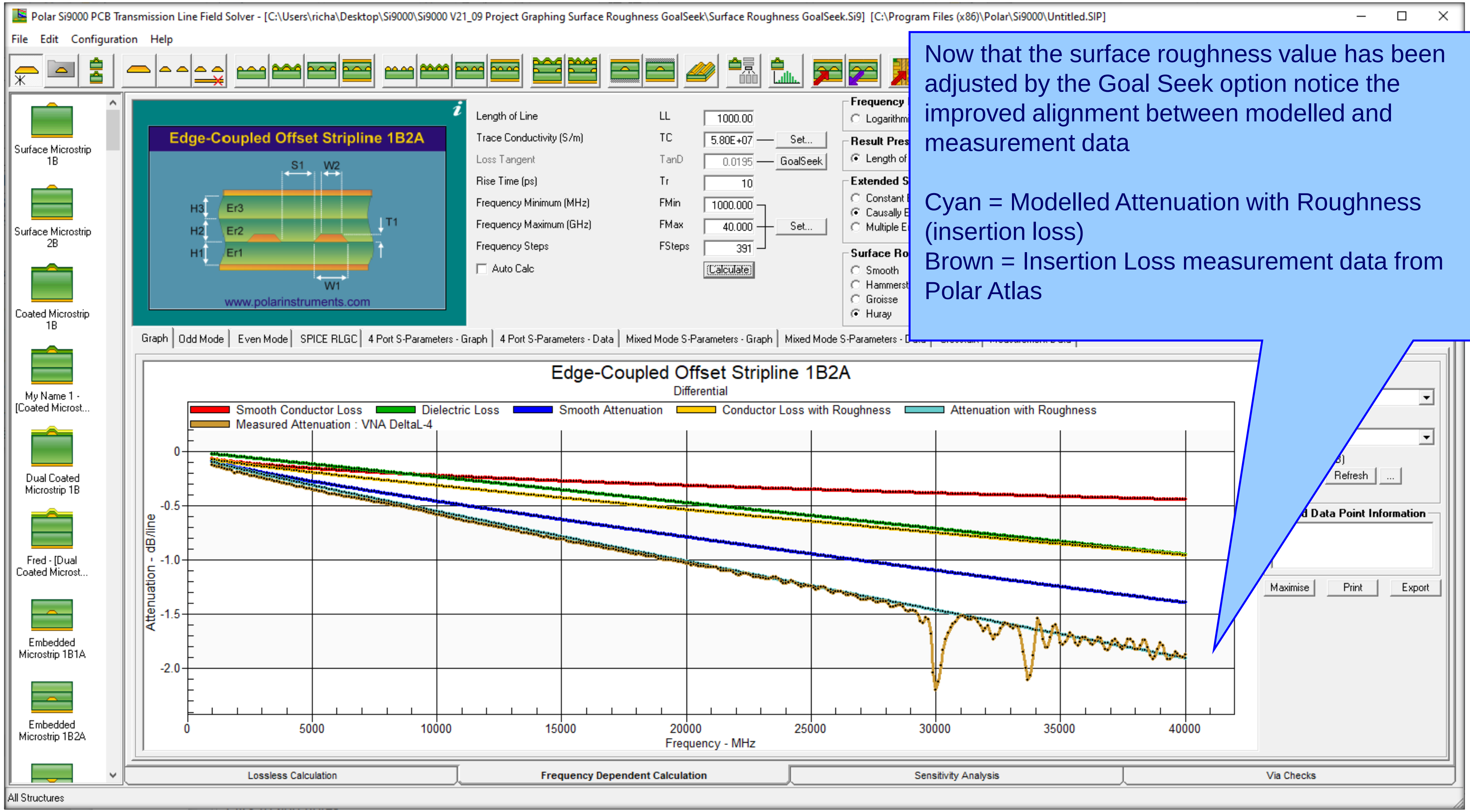


Step 1
Key in or pick the total attenuation (S21 / SDD21) at a given frequency from the insertion loss measurement data

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

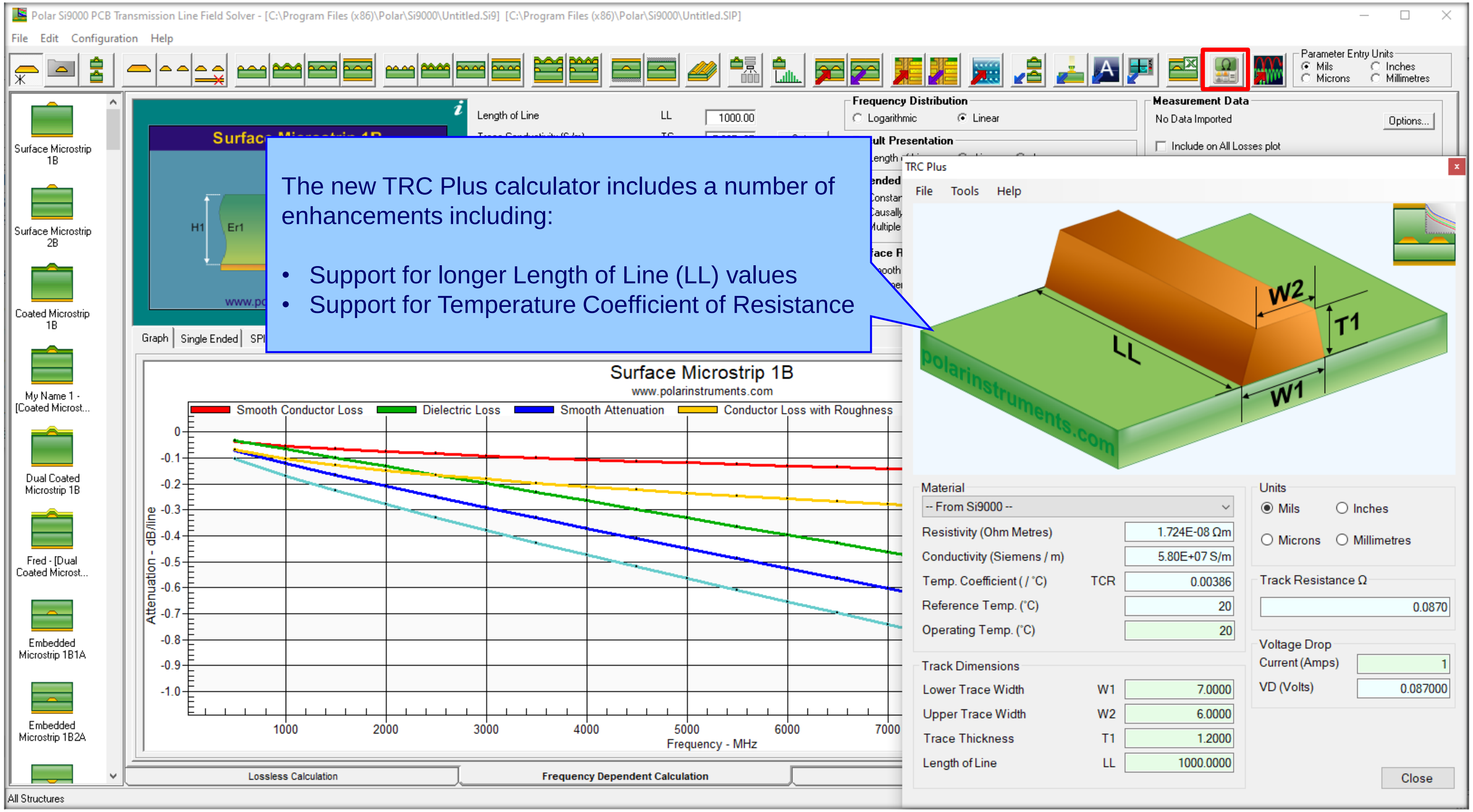
Surface Roughness Goal Seek option



Now that the surface roughness value has been adjusted by the Goal Seek option notice the improved alignment between modelled and measurement data

Cyan = Modelled Attenuation with Roughness (insertion loss)
Brown = Insertion Loss measurement data from Polar Atlas

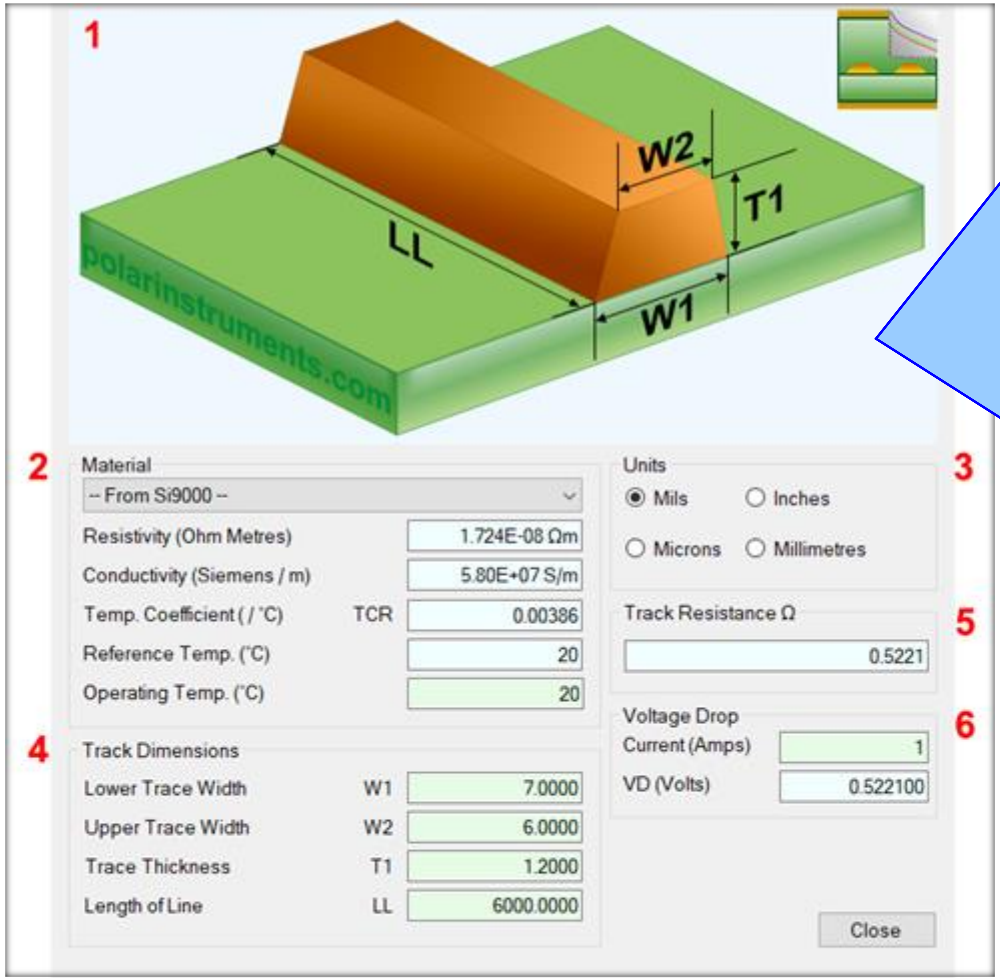
Track Resistance Calculator (TRC Plus)



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

Track Resistance Calculator (TRC Plus)



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.

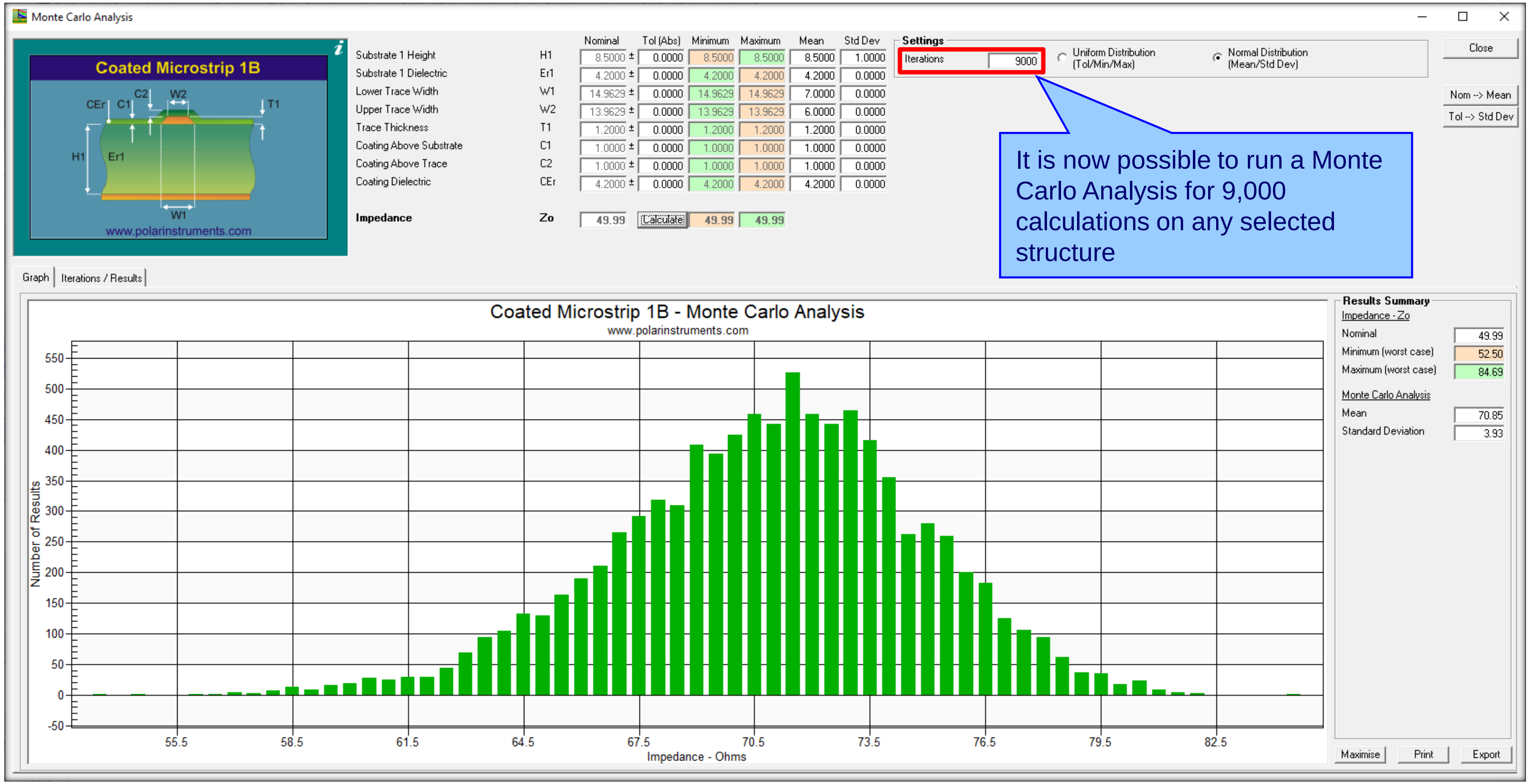
6. Voltage Drop calculation result
The calculated Voltage Drop is displayed in the VD (Volts) text box

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

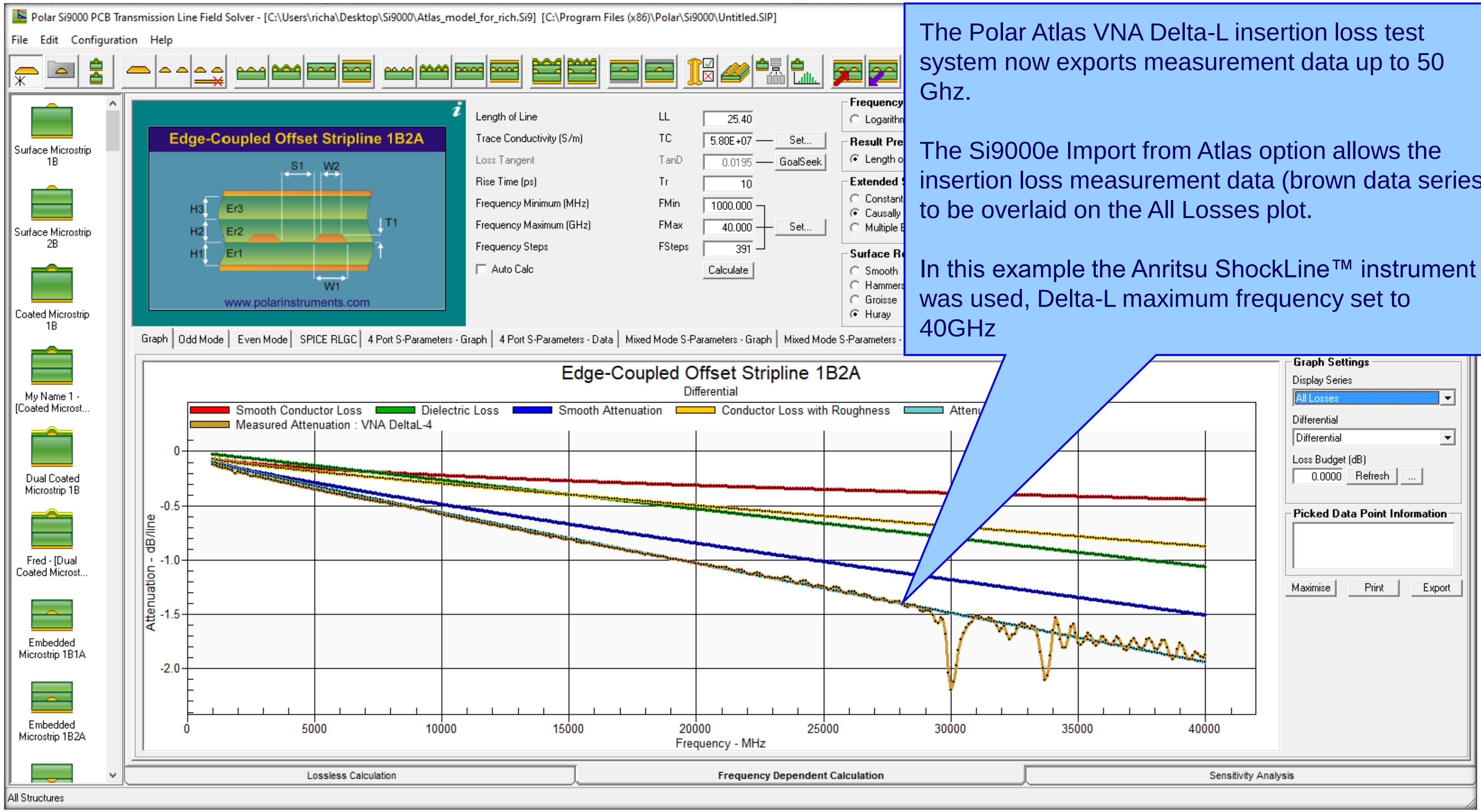
Si9000e v21.04 (April 2021)

Monte Carlo Analysis maximum iteration increased to 9000



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

Import from Atlas enhanced to support measurement data to 50GHz



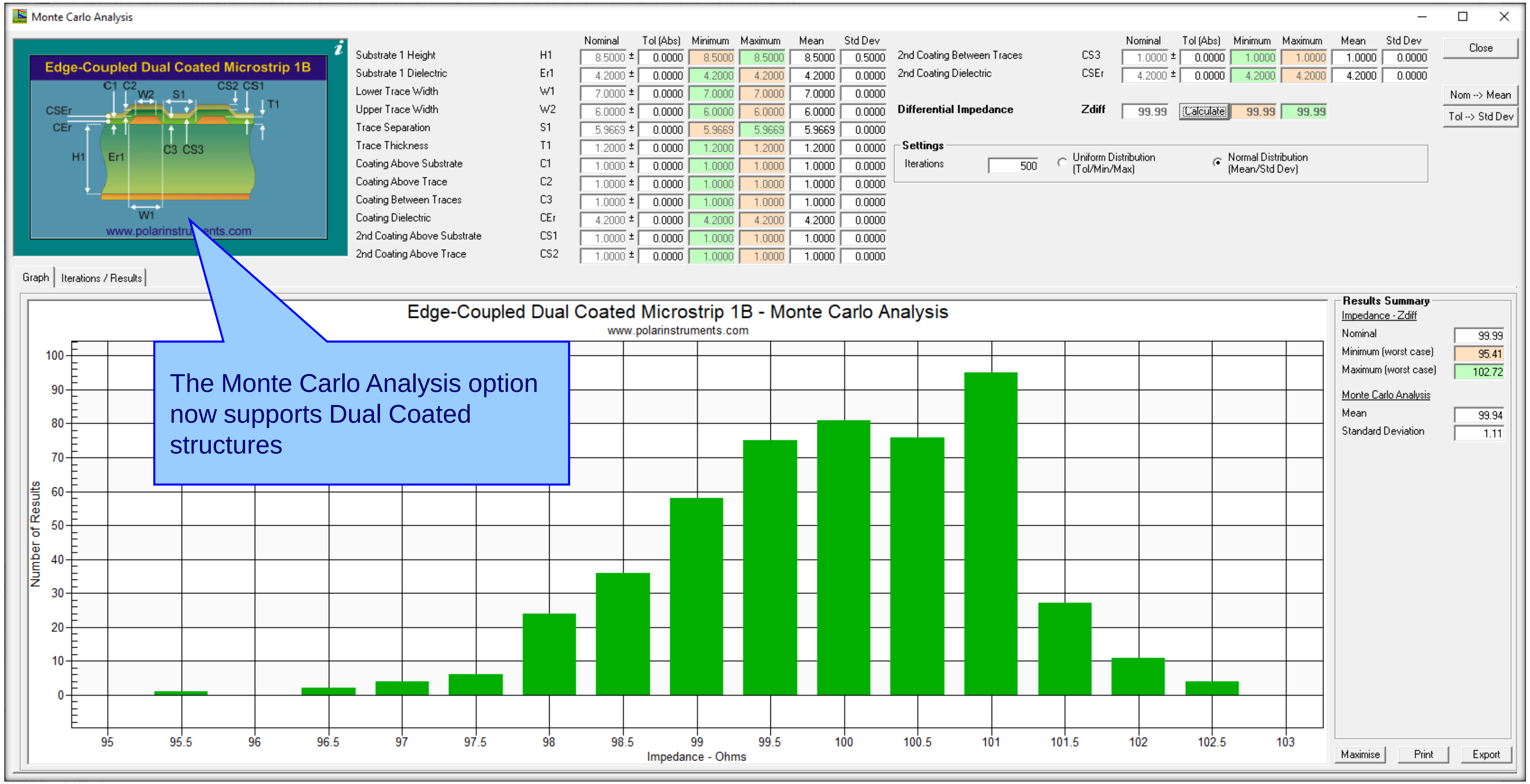
The Polar Atlas VNA Delta-L insertion loss test system now exports measurement data up to 50 Ghz.

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

Si9000e v21.01 (January 2021)

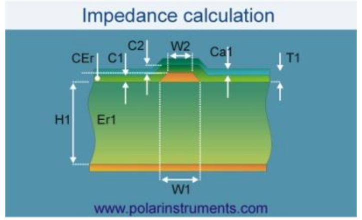
Monte Carlo support added for Dual Coated structures

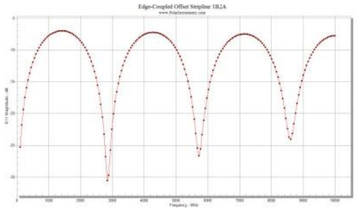


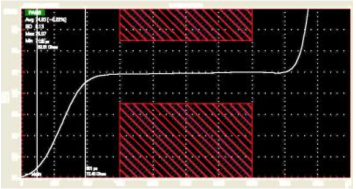
The Monte Carlo Analysis option now supports Dual Coated structures

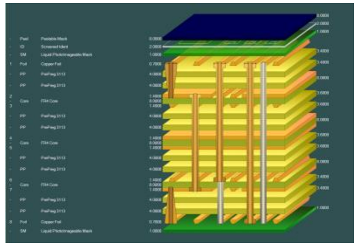
Other enhancements

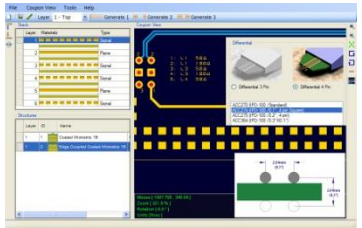
- FlexNet Publisher / FLEXlm v11.17.2.0 supported



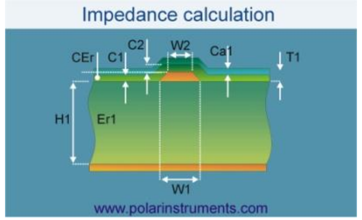


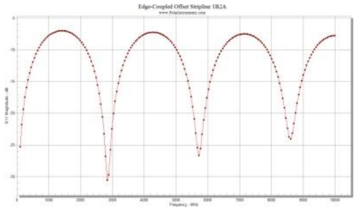


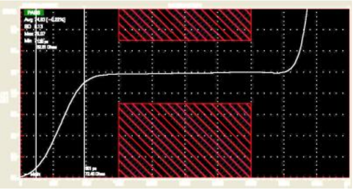


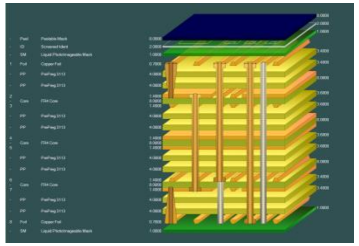


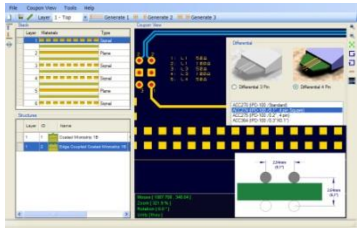
Thank you for viewing this Si9000e 2021 – 2022 preview. If you have questions we would be delighted to help you. Your local contact information is contained on the following slide











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