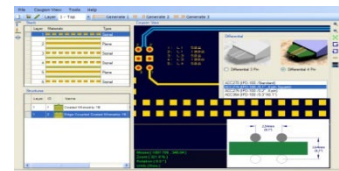
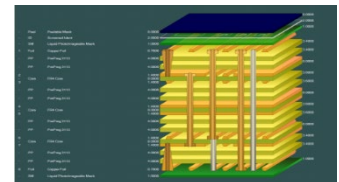
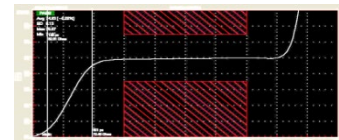
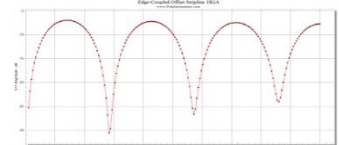
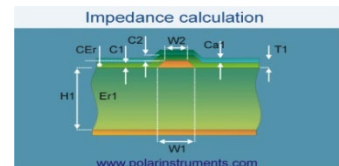




Si9000e Powerful graphing with projects option

November 2024



Powerful graphing capability with projects option

This brief presentation introduces the powerful graphing capability of Si9000e which lets you graph a variety of production variations using a combination of sensitivity analysis and the combined graphical capabilities in the Si Projects option.

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

These features available since Si9000e v21.09
(Sept 2021) – projects option required

Project Graphing – Introduction *(requires the optional 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.

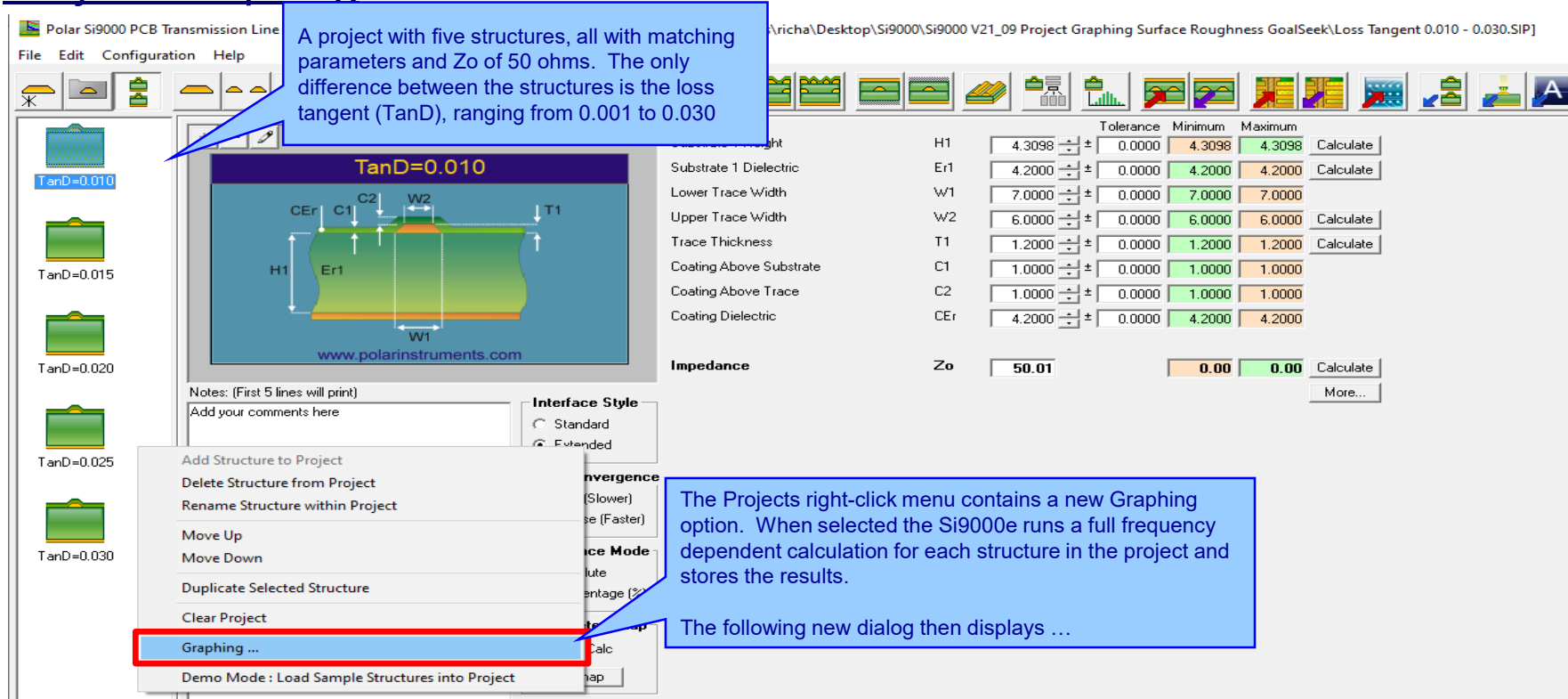
Until now the Si9000e Quick Solver graphing has focused on a single structure, for instance the All Losses graph will display a single plot that includes multiple data series for the same structure.

The Project Graphing capability 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 Z_0 of 50 ohms. The only difference between the structures is the loss tangent ($TanD$), ranging from 0.001 to 0.030



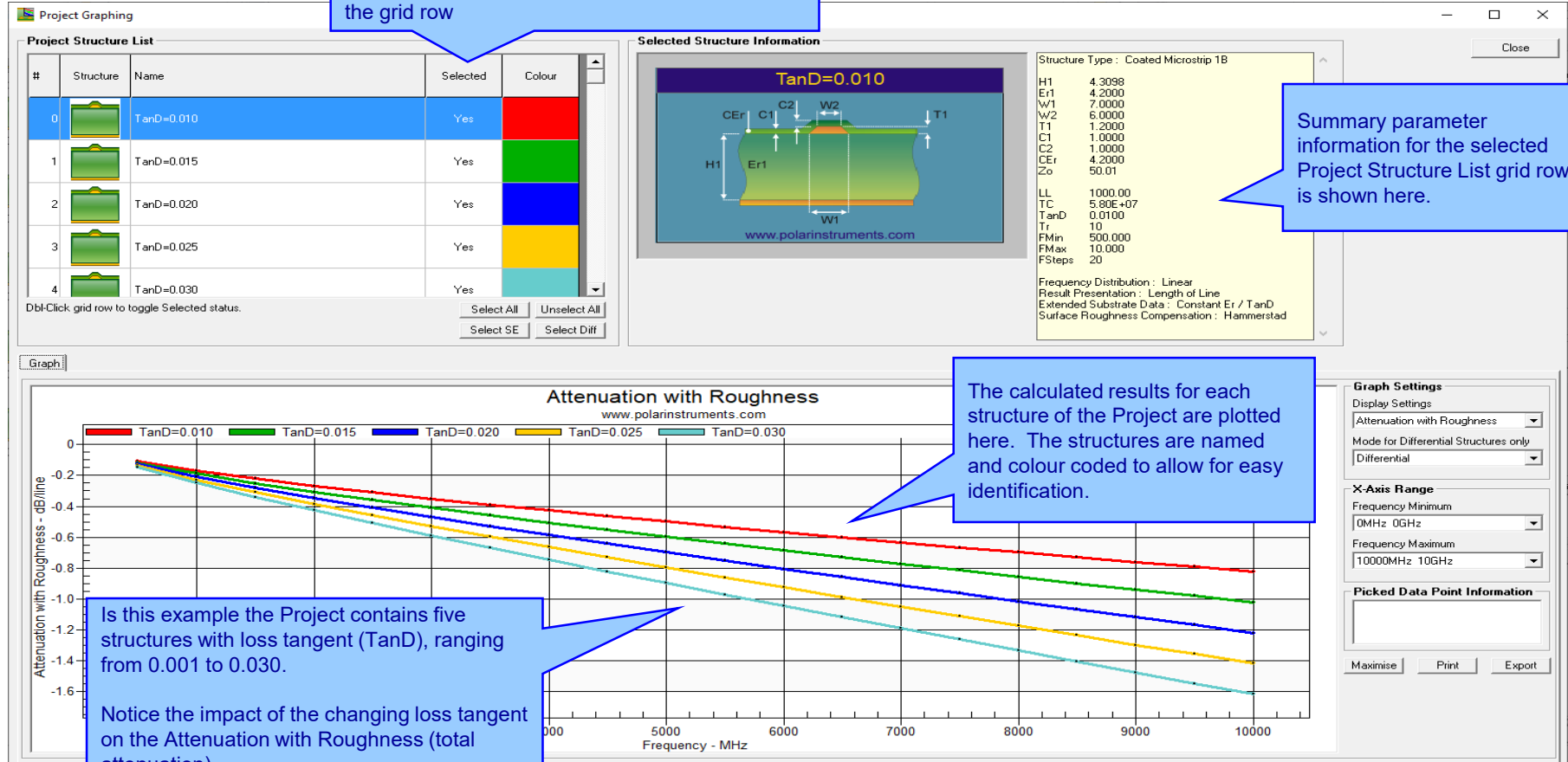
The Projects right-click menu contains a new Graphing option. When selected the Si9000e runs a full frequency dependent calculation for each structure in the project and stores the results.

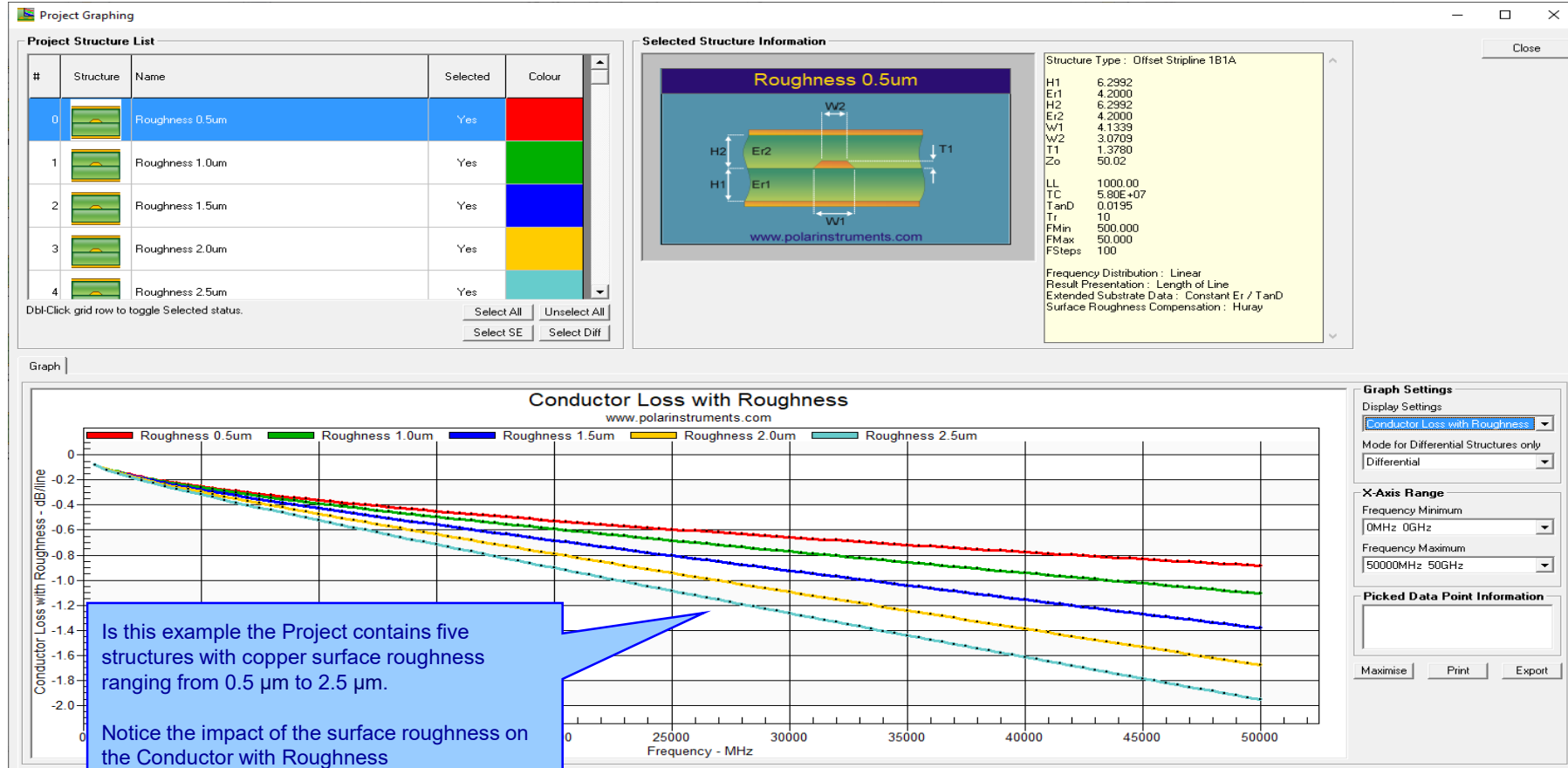
The following new dialog then displays ...

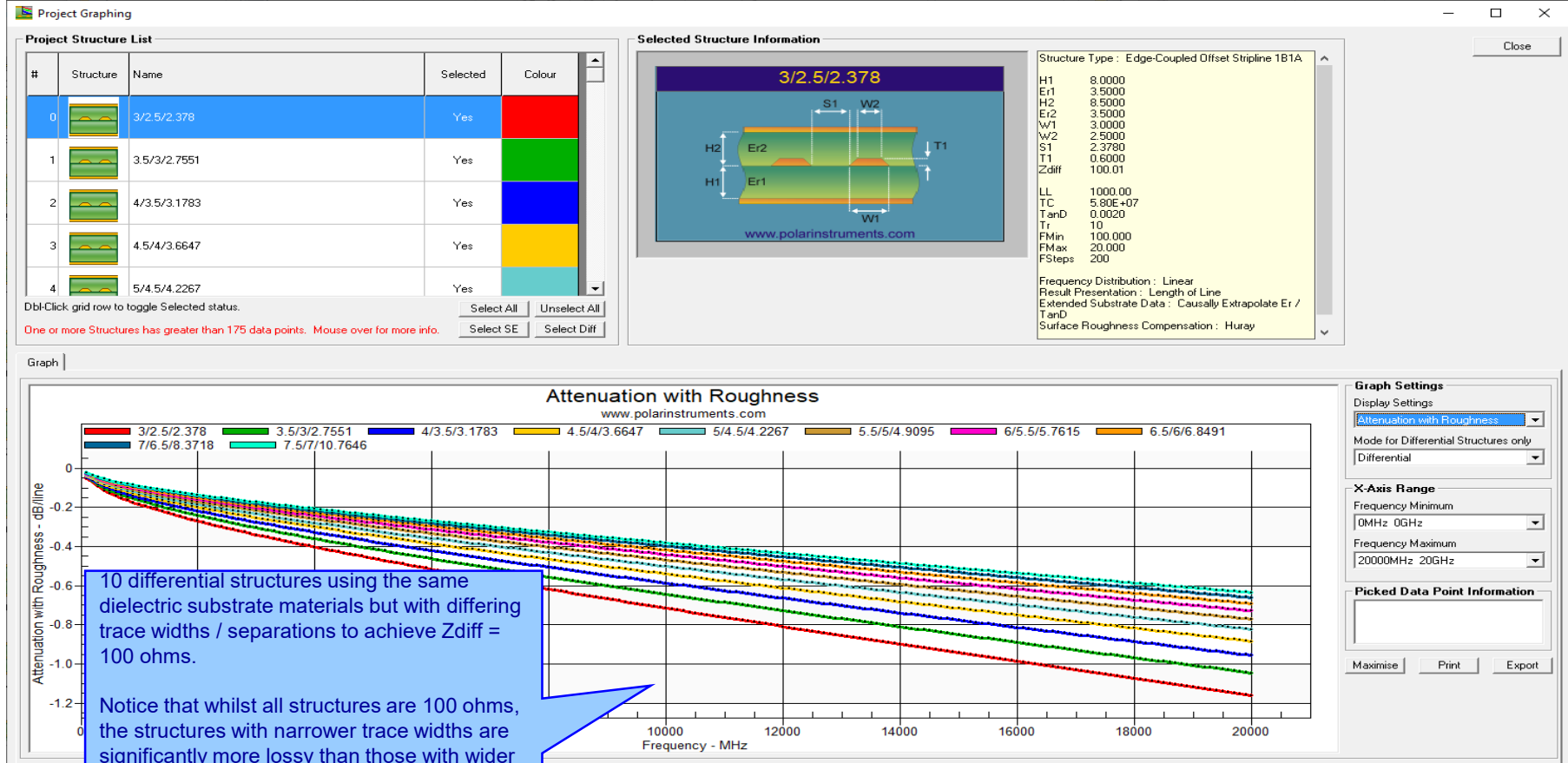
Parameter	Value	Tolerance	Minimum	Maximum	Action
H1	4.3098	± 0.0000	4.3098	4.3098	Calculate
Er1	4.2000	± 0.0000	4.2000	4.2000	Calculate
W1	7.0000	± 0.0000	7.0000	7.0000	Calculate
W2	6.0000	± 0.0000	6.0000	6.0000	Calculate
T1	1.2000	± 0.0000	1.2000	1.2000	Calculate
C1	1.0000	± 0.0000	1.0000	1.0000	Calculate
C2	1.0000	± 0.0000	1.0000	1.0000	Calculate
CEr	4.2000	± 0.0000	4.2000	4.2000	Calculate
Zo	50.01		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

Si9000e Graphing with projects option







Project Graphing – Summary

- The Graphing capability for the Si Projects option 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

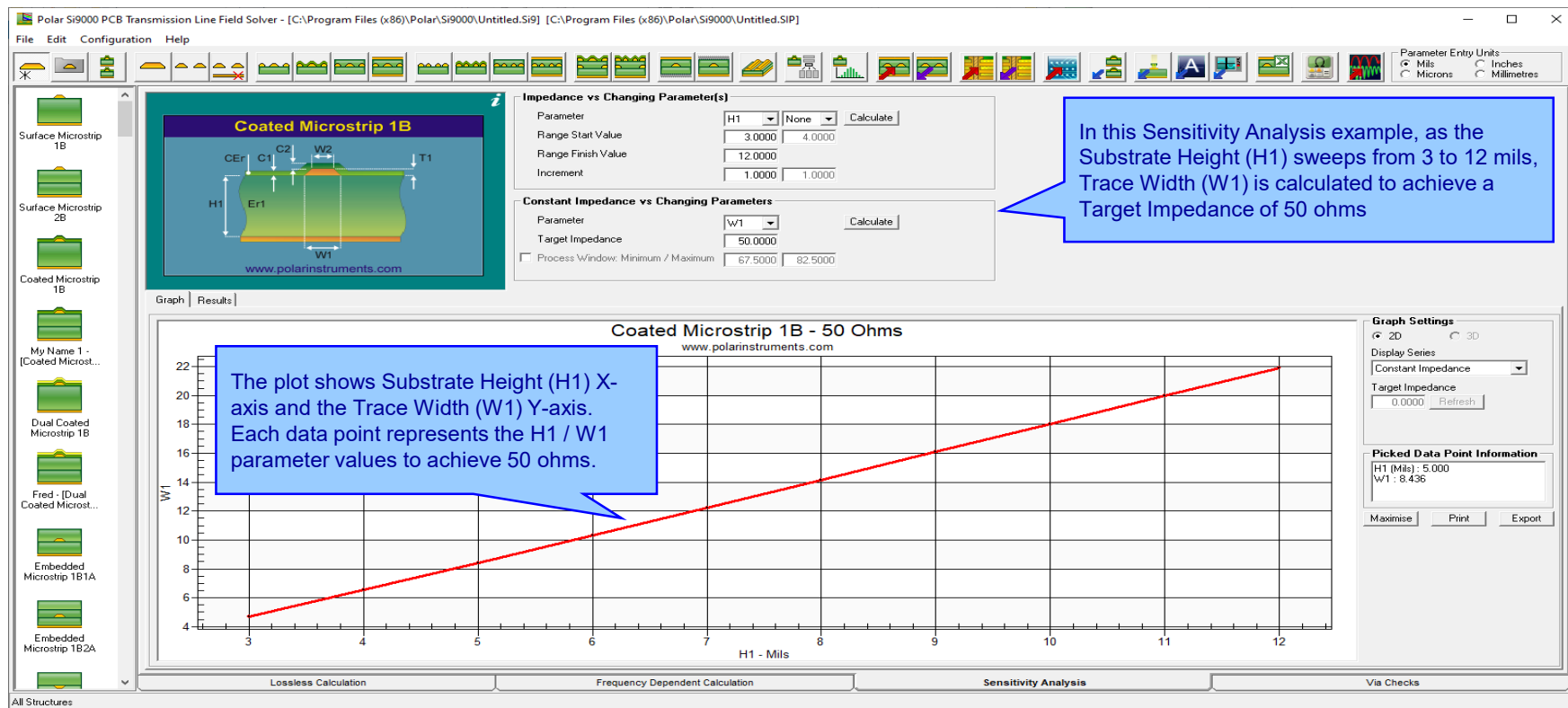
Populate a Project from Sensitivity Analysis Results

(requires the Si Projects feature)

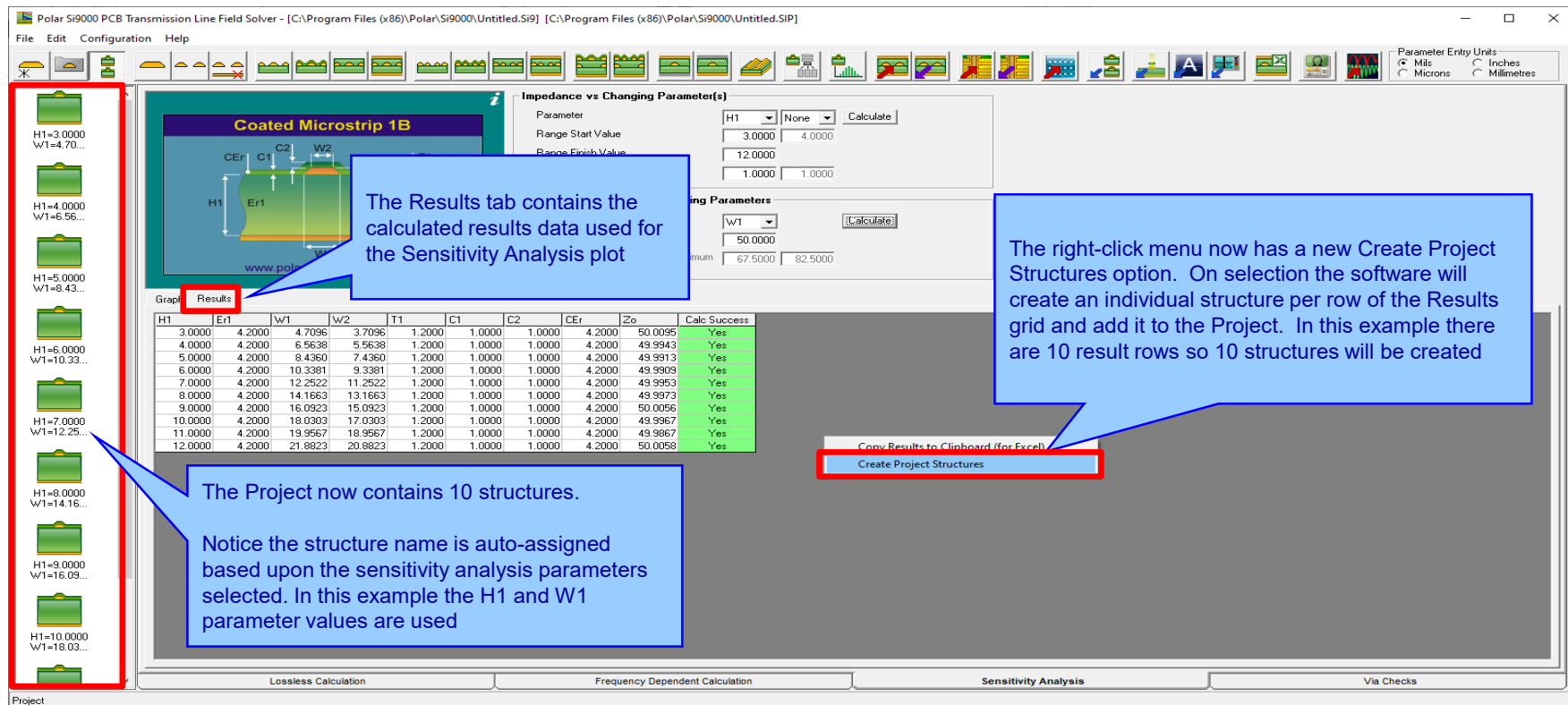
When using the Sensitivity Analysis option it is often useful to examine the calculated results in more details. It is now possible to auto-create a Project containing structures based upon the Sensitivity Analysis results data.

The following slides provide further details:

Populate a Project from Sensitivity Analysis Results



Populate a Project from Sensitivity Analysis Results



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.

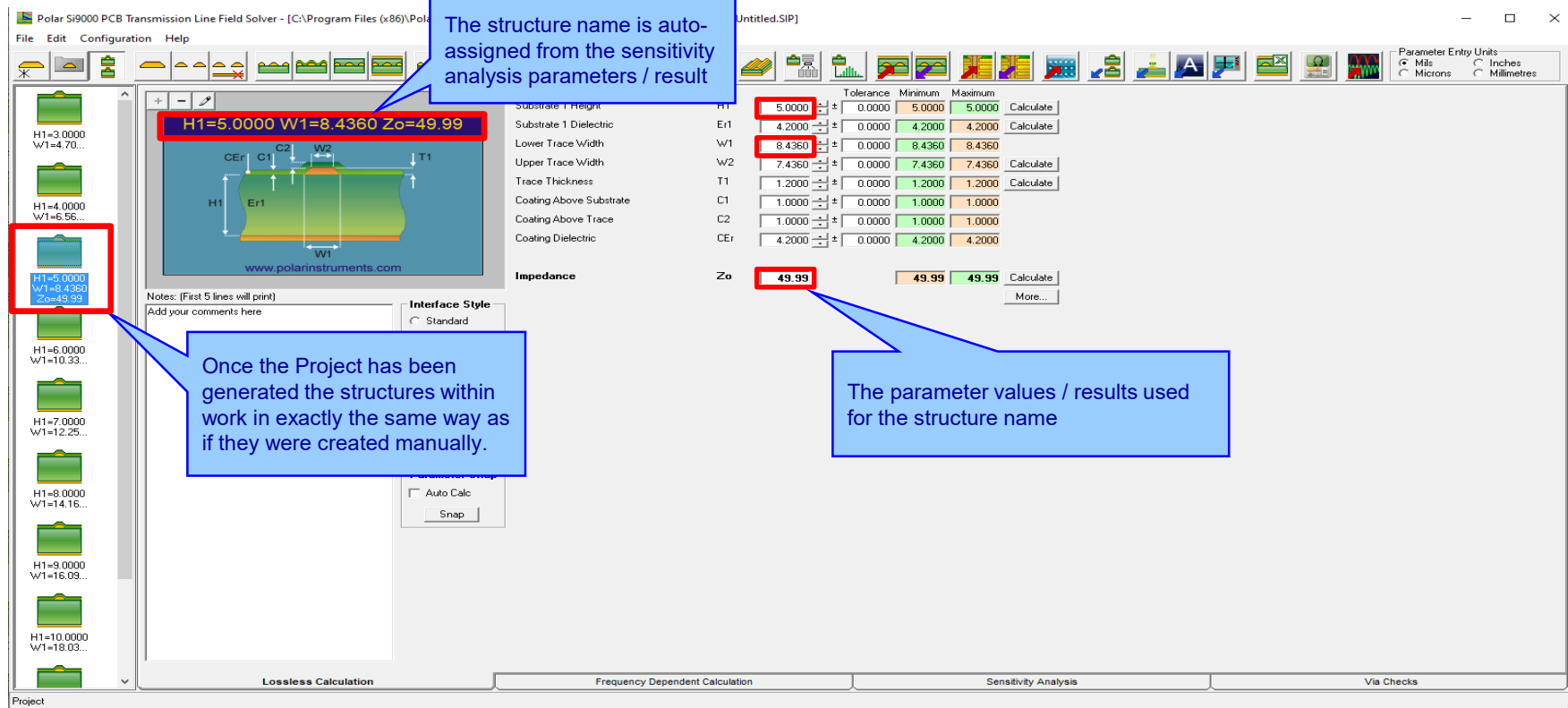
Notice the structure name is auto-assigned based upon the sensitivity analysis parameters selected. In this example the H1 and W1 parameter values are used

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

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

Structure 1 Height: $H1=5.0000$ W1=8.4360 $Z_0=49.99$

Substrate 1 Dielectric: $E_r1=4.2000$

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: $Z_0=49.99$

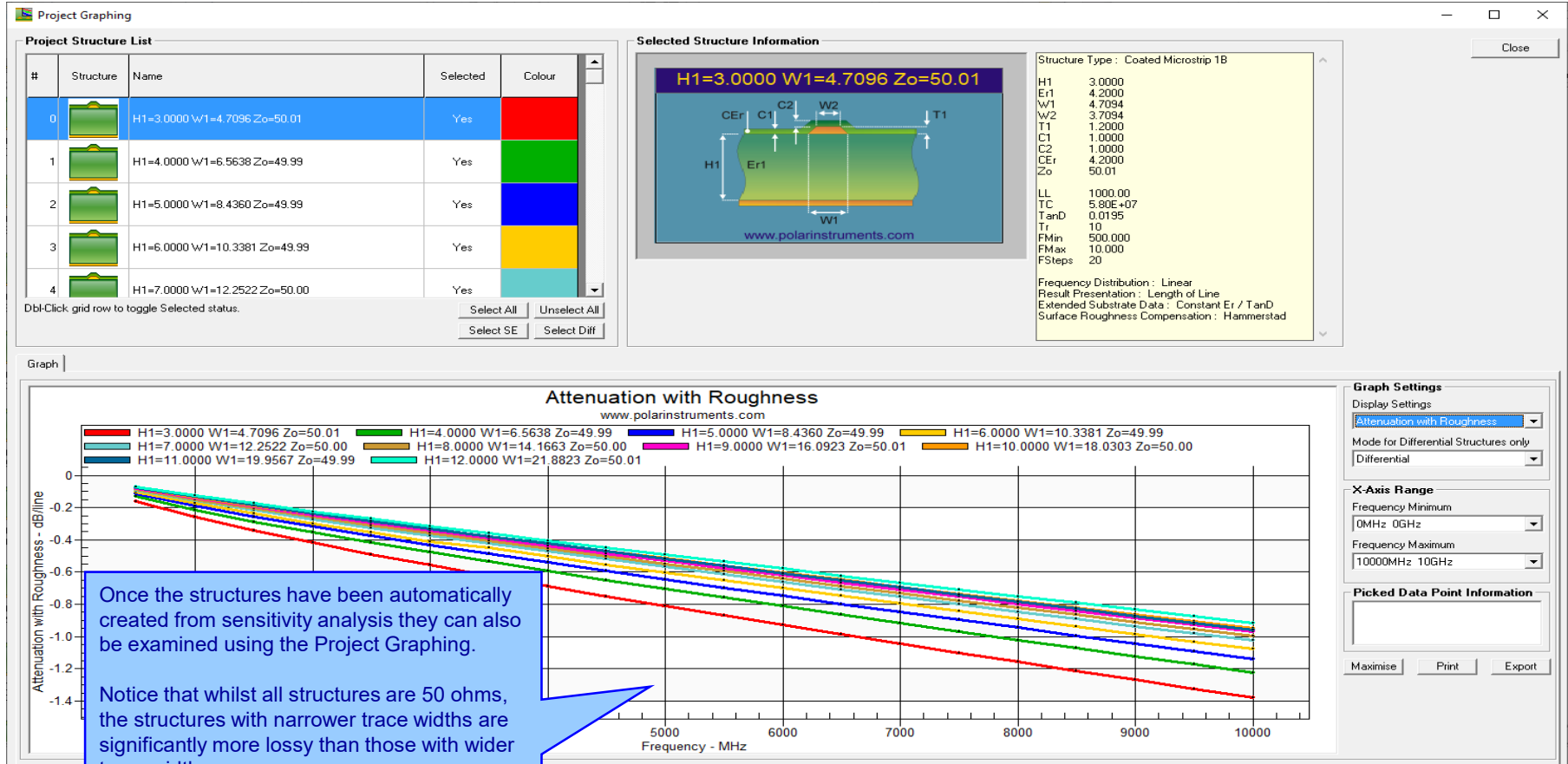
Parameter	Tolerance	Minimum	Maximum	Calculate
H1	5.0000	5.0000	5.0000	Calculate
E _{r1}	4.2000	4.2000	4.2000	Calculate
W1	8.4360	8.4360	8.4360	Calculate
W2	7.4360	7.4360	7.4360	Calculate
T1	1.2000	1.2000	1.2000	Calculate
C1	1.0000	1.0000	1.0000	Calculate
C2	1.0000	1.0000	1.0000	Calculate
CEr	4.2000	4.2000	4.2000	Calculate
Z ₀	49.99	49.99	49.99	Calculate

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

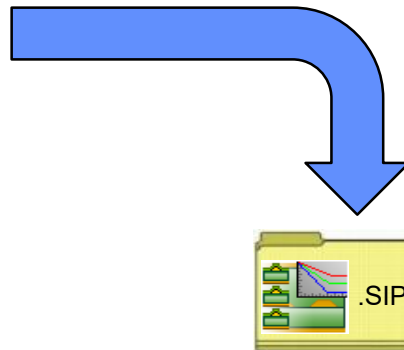
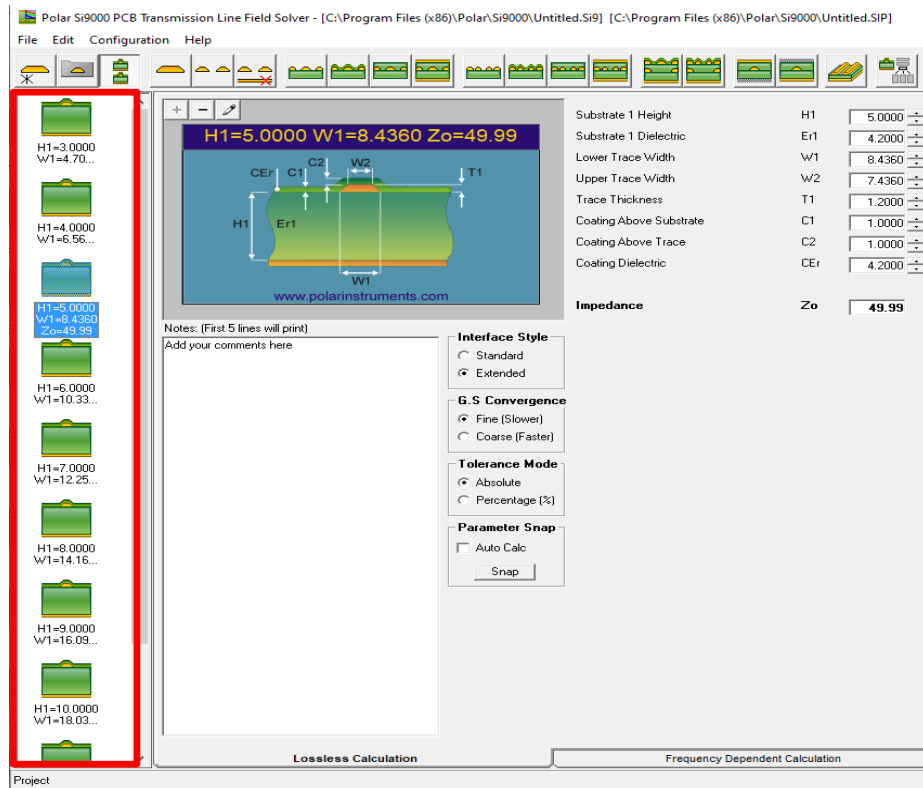
Interface Style
☐ Standard

Parameter Snap
☐ Auto Calc

Lossless Calculation Frequency Dependent Calculation Sensitivity Analysis Via Checks



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.

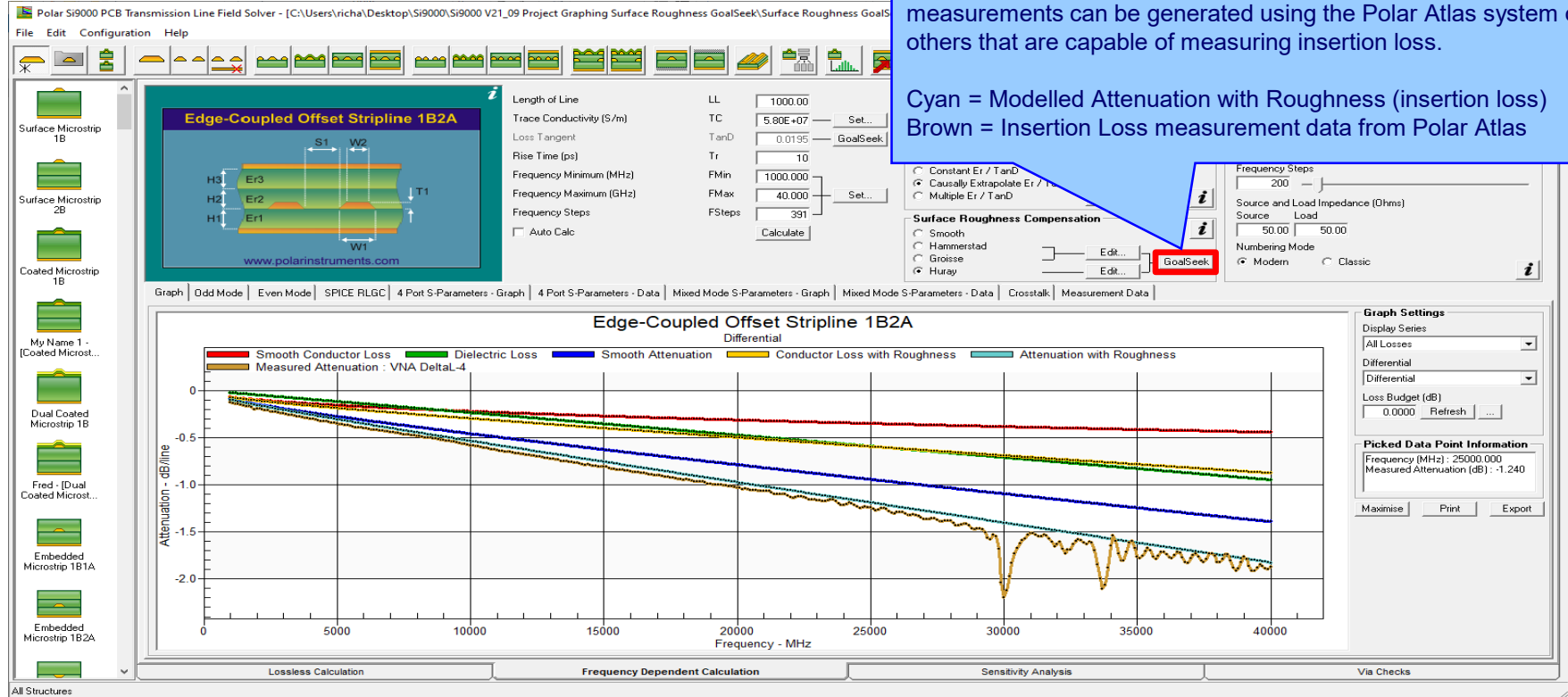
Populate a Project from Sensitivity Analysis Results - Summary

- 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

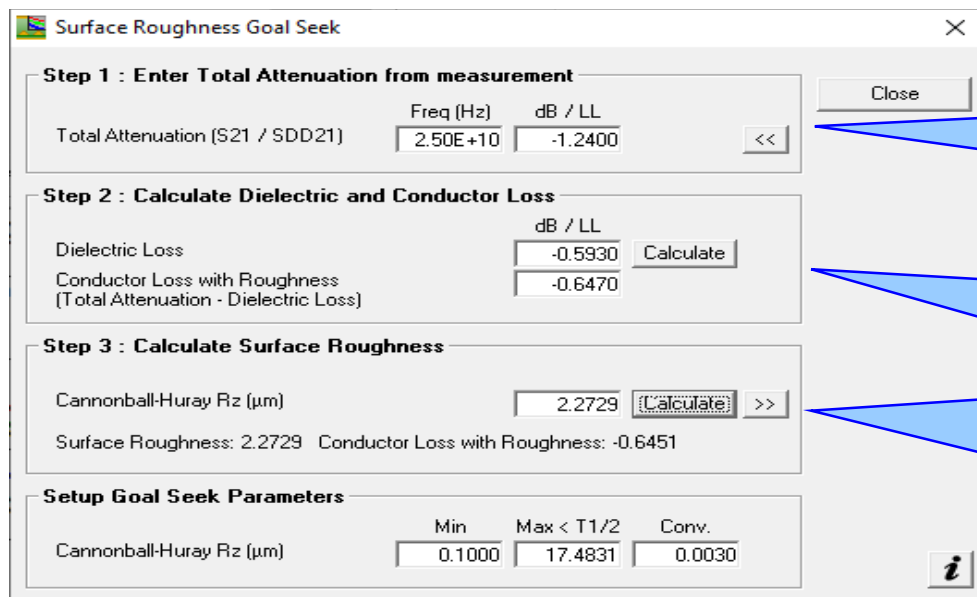
Surface Roughness Goal Seek option

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



Surface Roughness Goal Seek

Step 1 : Enter Total Attenuation from measurement

Total Attenuation (S21 / SDD21) Freq (Hz) dB / LL

2.50E+10 -1.2400 <<

Step 2 : Calculate Dielectric and Conductor Loss

Dielectric Loss dB / LL

Conductor Loss with Roughness
(Total Attenuation - Dielectric Loss)

-0.5930 Calculate

-0.6470

Step 3 : Calculate Surface Roughness

Cannonball-Huray Rz (μm) 2.2729 Calculate >>

Surface Roughness: 2.2729 Conductor Loss with Roughness: -0.6451

Setup Goal Seek Parameters

Cannonball-Huray Rz (μm) Min Max < T1/2 Conv.

0.1000 17.4831 0.0030

Close

i

Step 1

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

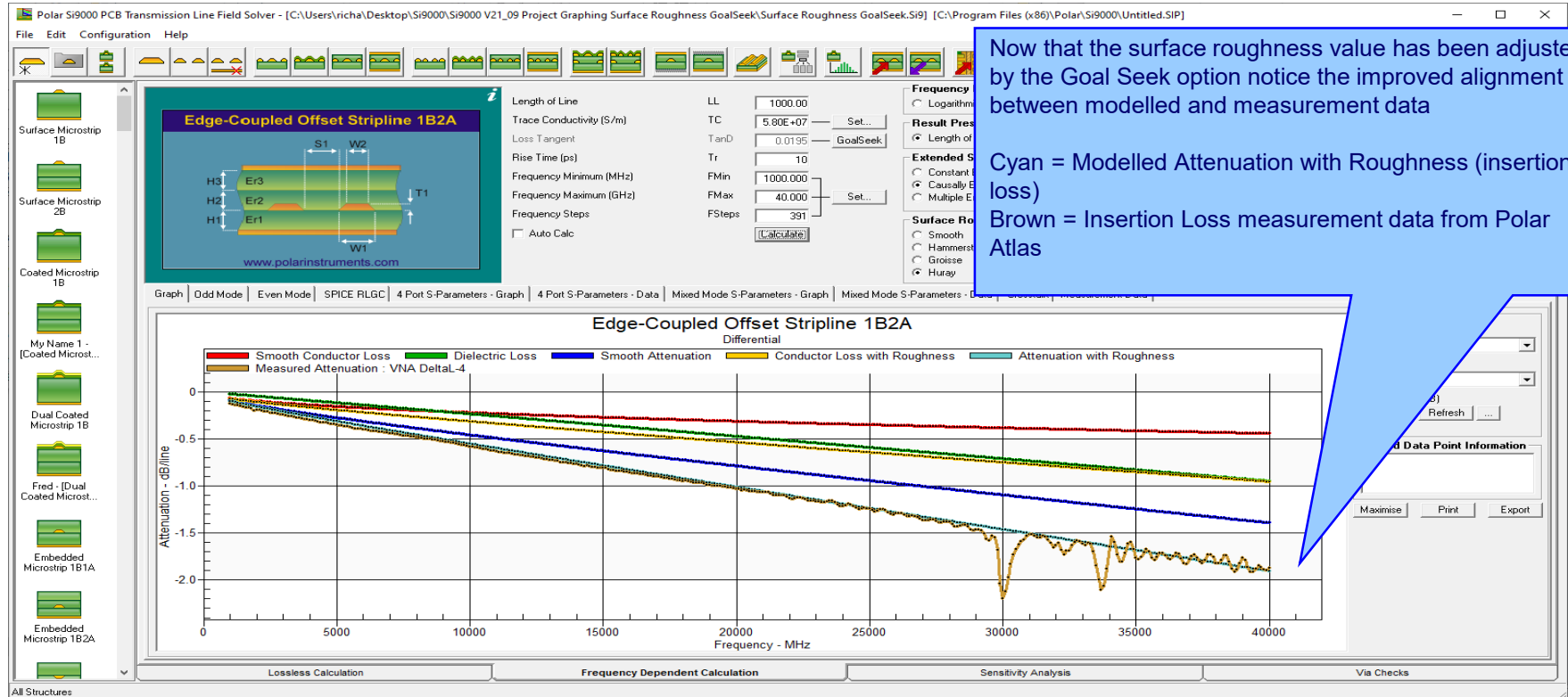
Step 2

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

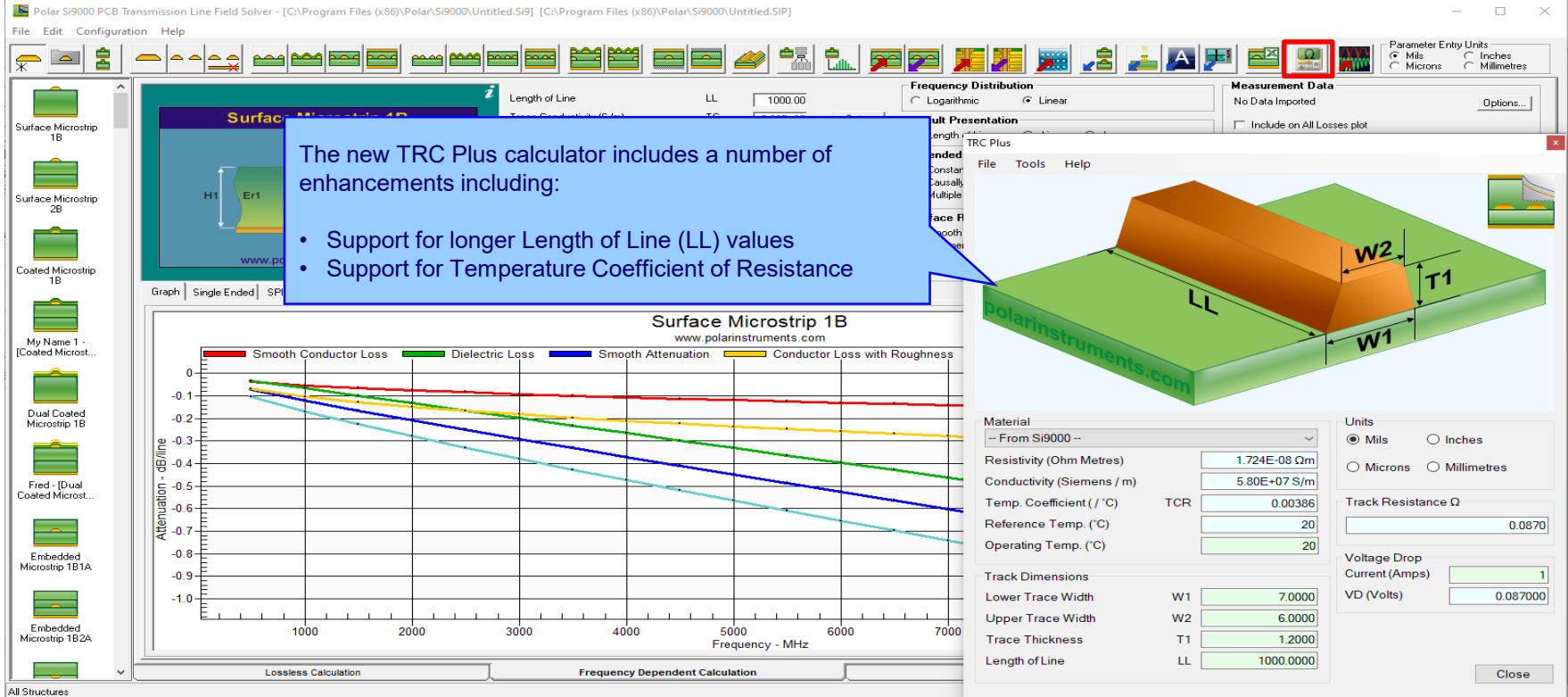
Step 3

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

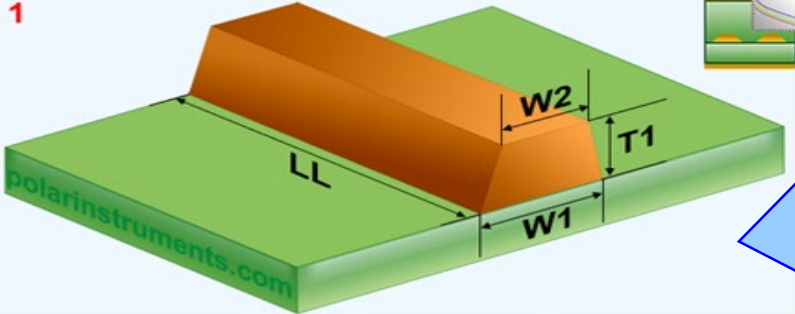
Surface Roughness Goal Seek option



Track Resistance Calculator (TRC Plus)



Track Resistance Calculator (TRC Plus)



1

2

Material: -- From Si9000 --

Resistivity (Ohm Metres): 1.724E-08 Ωm

Conductivity (Siemens / m): 5.80E+07 S/m

Temp. Coefficient (/ °C): TCR 0.00386

Reference Temp. (°C): 20

Operating Temp. (°C): 20

3

Units: ☒ Mils ☐ Inches

☐ Microns ☐ Millimetres

Track Resistance Ω: 0.5221

4

Track Dimensions

Lower Trace Width W1: 7.0000

Upper Trace Width W2: 6.0000

Trace Thickness T1: 1.2000

Length of Line LL: 6000.0000

5

Voltage Drop

Current (Amps): 1

VD (Volts): 0.522100

6

Close

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

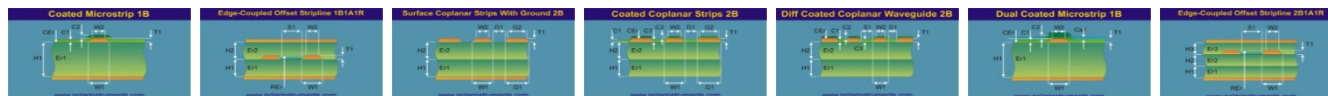
Calculation of the track resistance. The result should update immediately upon any changes to the editable (light-green) fields.

6. Voltage Drop calculation result

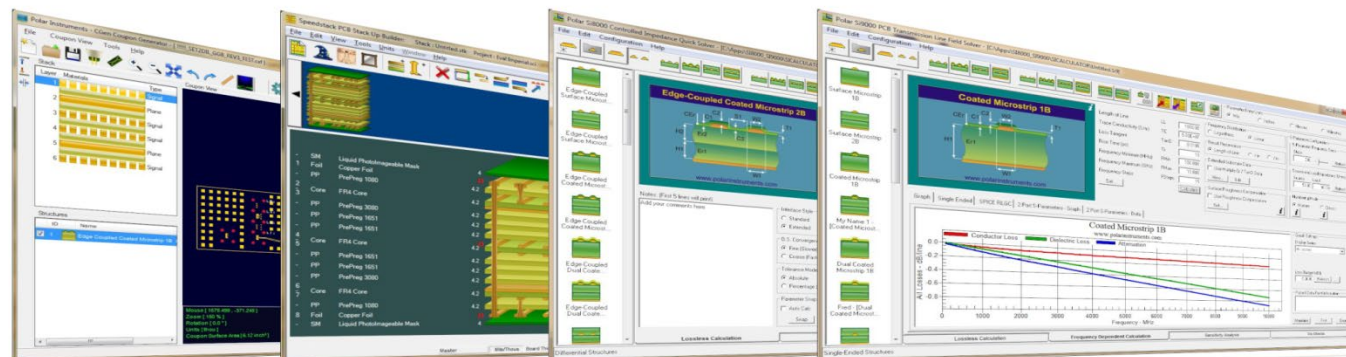
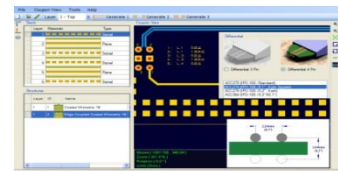
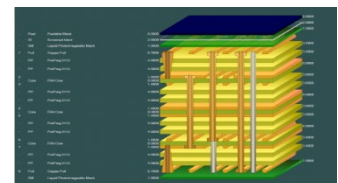
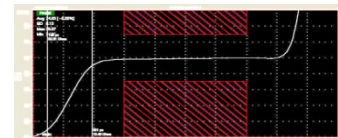
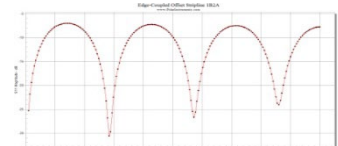
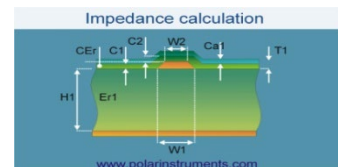
The calculated Voltage Drop is displayed in the VD (Volts) text box

Other enhancements

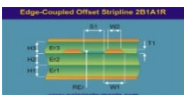
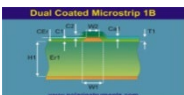
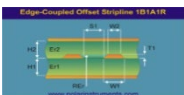
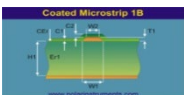
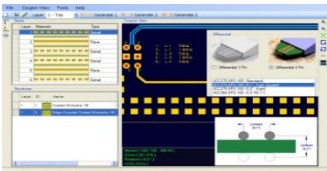
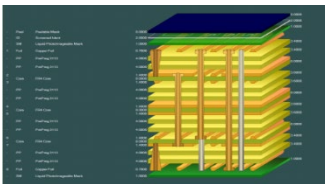
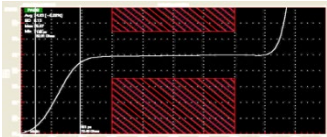
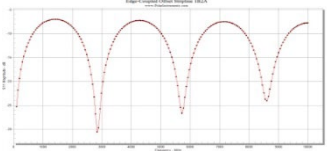
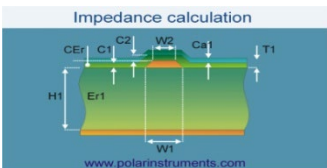
- Monte Carlo Analysis. New option added to export the Iterations / Results to Clipboard (for Excel), accessible from the right-click menu
- Causally Extrapolated Substrate Data. New option added to export the Results to Clipboard (for Excel), accessible from the right-click menu



Thank you for viewing this introduction to the graph capabilities of Si9000e projects option. Any questions please contact local Polar office



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