

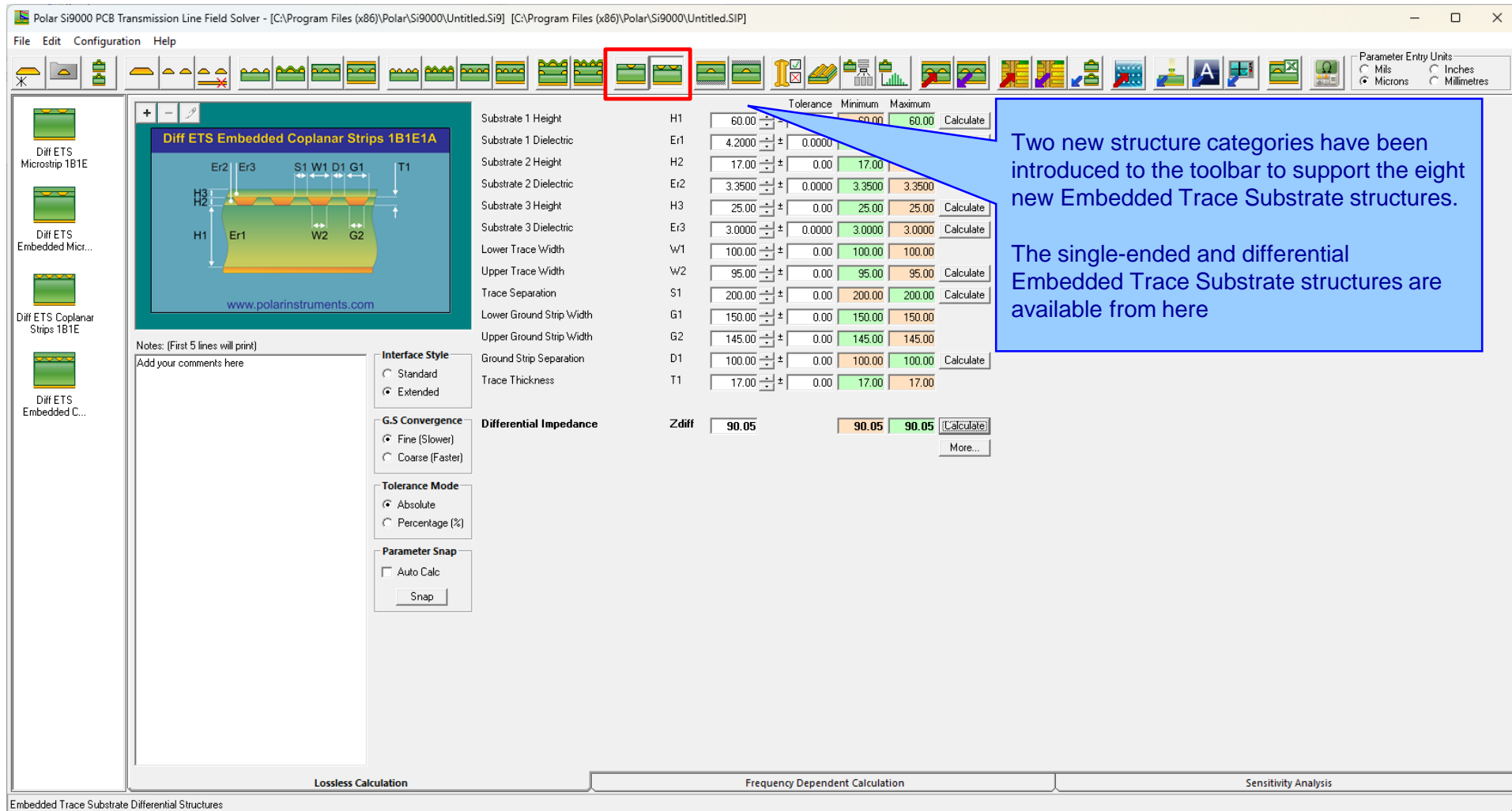
Si9000e 2025 Cumulative updates

Richard Attrill – Sept 2025 (Rev 11)



v25.09.01 (Sept 2025)

New Embedded Trace Substrate (ETS) structures

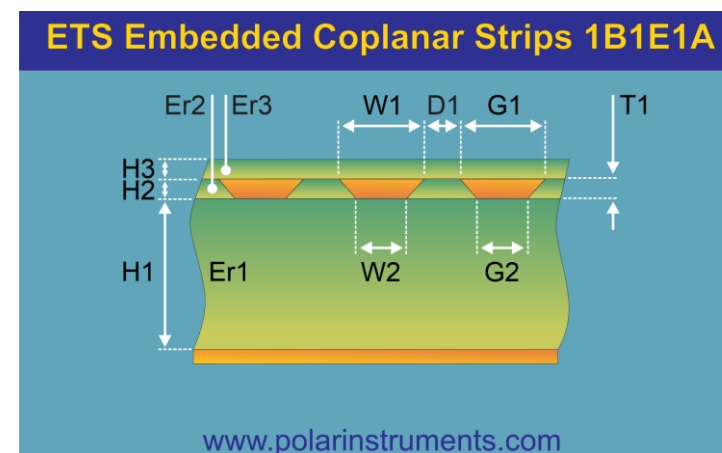
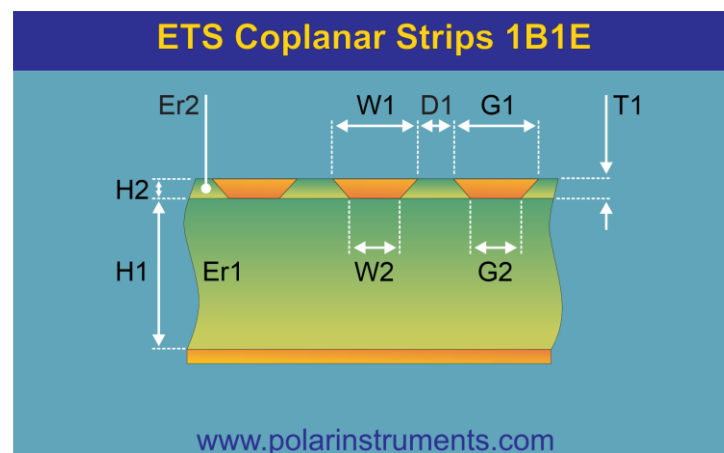
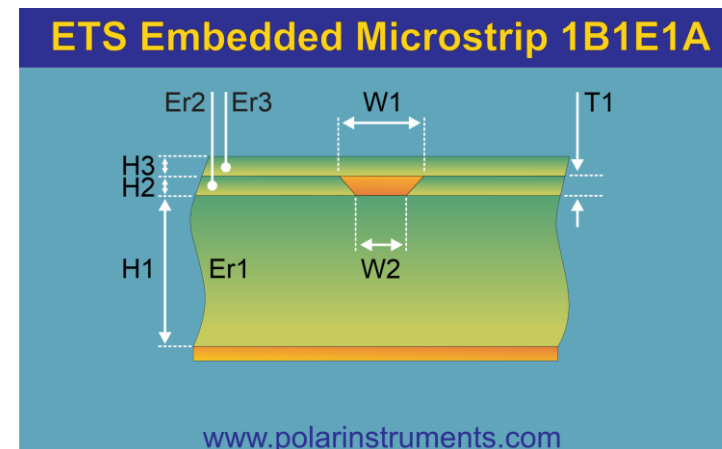
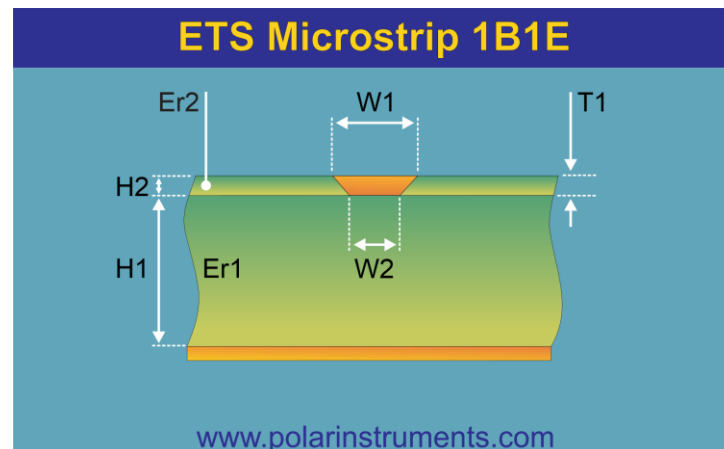
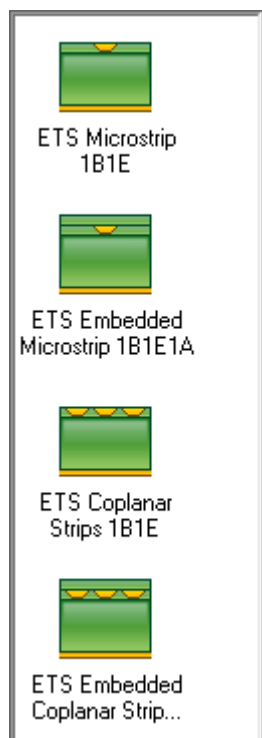


Two new structure categories have been introduced to the toolbar to support the eight new Embedded Trace Substrate structures.

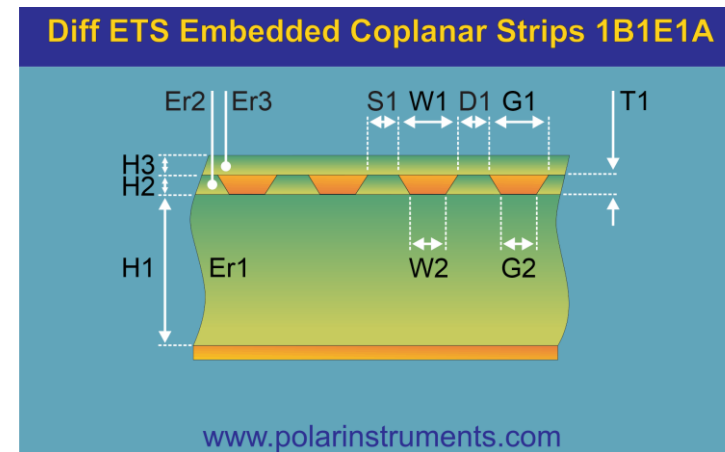
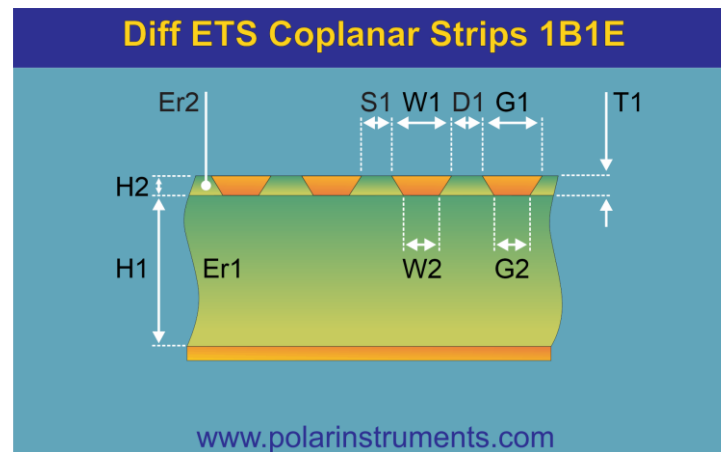
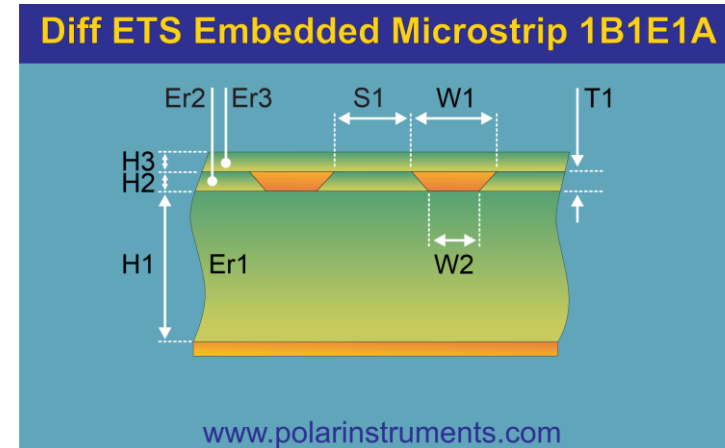
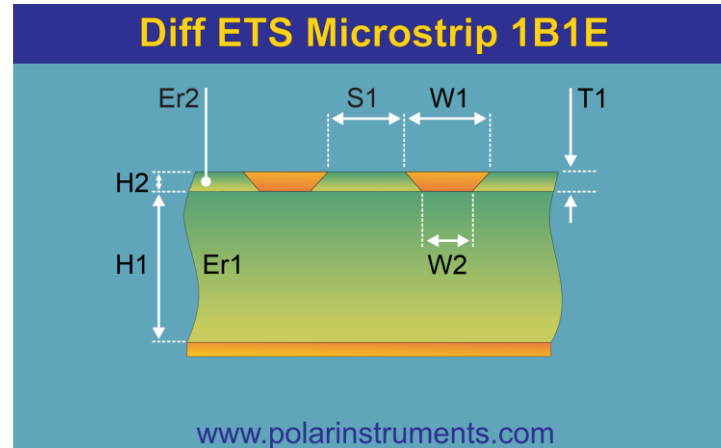
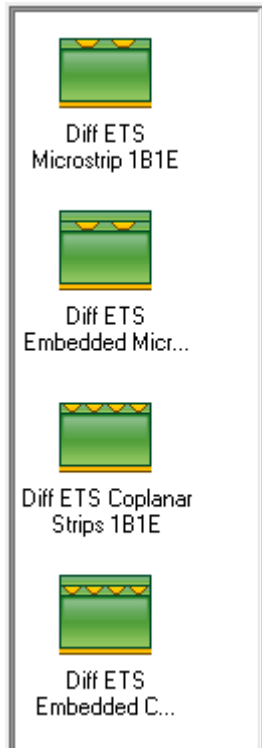
The single-ended and differential Embedded Trace Substrate structures are available from here

Parameter	Value	Tolerance	Minimum	Maximum	Calculate
Substrate 1 Height	H1	60.00	60.00	60.00	Calculate
Substrate 1 Dielectric	Er1	4.2000	0.0000		
Substrate 2 Height	H2	17.00	0.00	17.00	
Substrate 2 Dielectric	Er2	3.3500	0.0000	3.3500	Calculate
Substrate 3 Height	H3	25.00	0.00	25.00	Calculate
Substrate 3 Dielectric	Er3	3.0000	0.0000	3.0000	Calculate
Lower Trace Width	W1	100.00	0.00	100.00	Calculate
Upper Trace Width	W2	95.00	0.00	95.00	Calculate
Trace Separation	S1	200.00	0.00	200.00	Calculate
Lower Ground Strip Width	G1	150.00	0.00	150.00	Calculate
Upper Ground Strip Width	G2	145.00	0.00	145.00	Calculate
Ground Strip Separation	D1	100.00	0.00	100.00	Calculate
Trace Thickness	T1	17.00	0.00	17.00	Calculate
Differential Impedance	Zdiff	90.05	90.05	90.05	Calculate

New Embedded Trace Substrate (ETS) structures – single-ended



New Embedded Trace Substrate (ETS) structures – differential



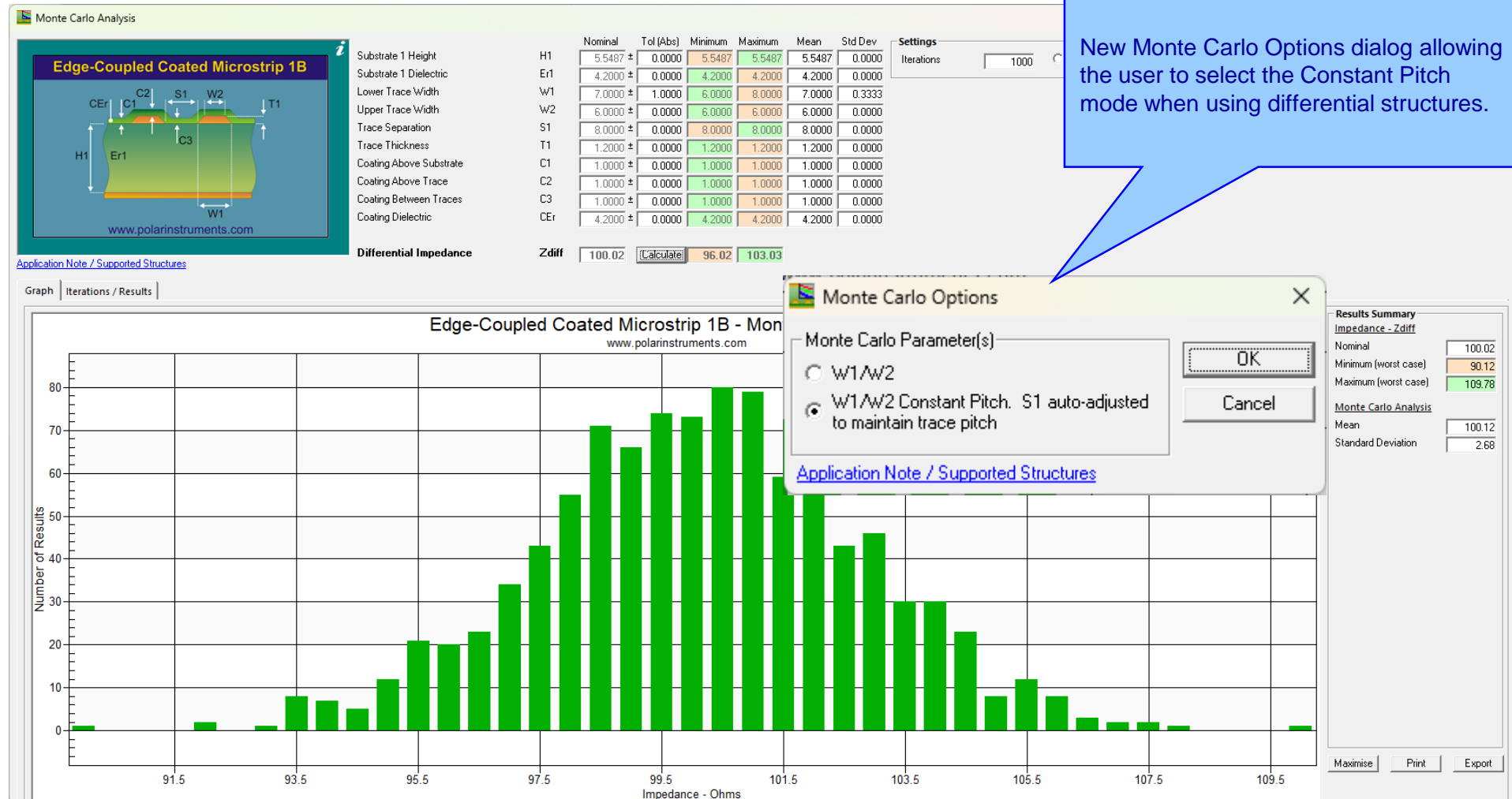
New Embedded Trace Substrate (ETS) structures

Please note:

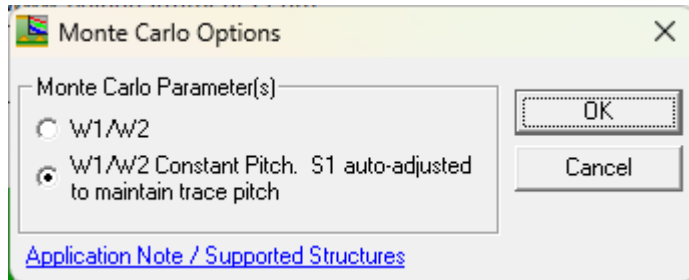
When using the ETS structures the Substrate 2 Height (H2) and Trace Thickness (T1) values must match. When using functions like Snap, it might require some adjustments to the parameter defaults found within the Configuration | Parameters dialog

v25.04.16 (April 2025)

Monte Carlo enhancements – new Constant Pitch option for differential structures

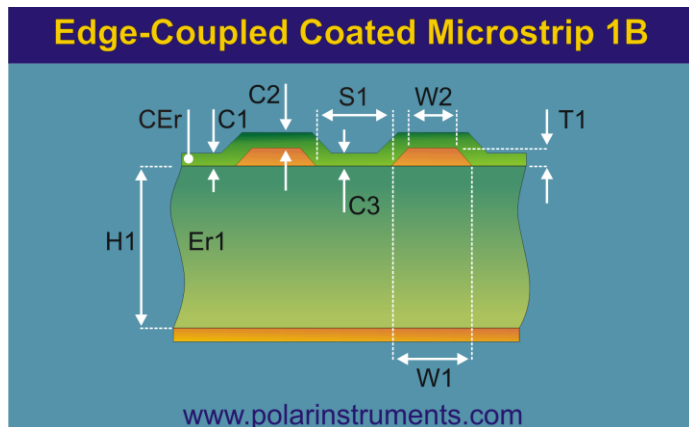


Monte Carlo enhancements – new Constant Pitch option for differential structures



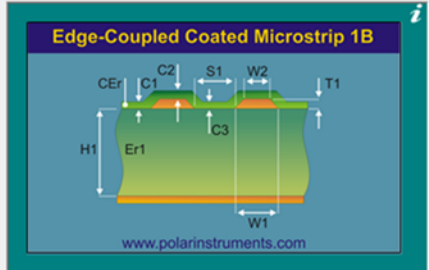
New Monte Carlo Options dialog has two selections:

1. W1/W2 will randomise W1/W2 independently of S1, so when W1/W2 randomise the S1 value will either be the same as the structure nominal value if no Monte Carlo values are set for S1, or S1 will randomise independently of W1/W2. For both of these scenarios, the trace pitch for each calculation will be different.
2. W1/W2 Constant Pitch will randomise W1/W2 and then calculate S1 based upon the current trace pitch. Trace Pitch is calculated by $(W1 / 2) + S1 + (W1 / 2)$ or simplified to $W1 + S1$. In the examples shown, which uses the default parameter values, the trace pitch is 15 mils. W1/W2 Constant Pitch is the new functionality introduced with v25.04.16



	Nominal
H1	5.5487 ±
Er1	4.2000 ±
W1	7.0000 ±
W2	6.0000 ±
S1	8.0000 ±
T1	1.2000 ±
C1	1.0000 ±
C2	1.0000 ±
C3	1.0000 ±
CEr	4.2000 ±
Zdiff	100.02

Monte Carlo enhancements – new Constant Pitch option for differential structures



Edge-Coupled Coated Microstrip 1B

Substrate 1 Height: H1
Substrate 1 Dielectric: Er1
Lower Trace Width: W1
Upper Trace Width: W2
Trace Separation: S1
Trace Thickness: T1
Coating Above Substrate: C1
Coating Above Trace: C2
Coating Between Traces: C3
Coating Dielectric: CEr

Differential Impedance

Nominal Tol (Abs) Minimum Maximum

H1 5.5487 ± 0.0000 5.5487 5.5487
Er1 4.2000 ± 0.0000 4.2000 4.2000
W1 7.0000 ± 1.0000 6.0000 8.0000
W2 6.0000 ± 0.0000 6.0000 6.0000
S1 8.0000 ± 0.0000 8.0000 8.0000
T1 1.2000 ± 0.0000 1.2000 1.2000
C1 1.0000 ± 0.0000 1.0000 1.0000
C2 1.0000 ± 0.0000 1.0000 1.0000
C3 1.0000 ± 0.0000 1.0000 1.0000
CEr 4.2000 ± 0.0000 4.2000 4.2000

Zdiff 100.02 Calculate 96.02 103.03

Application Note / Supported Structures

Graph Iterations / Results

H1	Er1	W1	W2	S1	Pitch	T1	C1	C2	C3	CEr	Zodd	Zeven	Yes
5.5487	4.2000	7.4335	6.4335	7.5665	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	48.2461	63.0420	Yes
5.5487	4.2000	7.4669	6.4669	7.5331	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	48.1136	62.9500	Yes
5.5487	4.2000	6.7580	5.7580	8.2420	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	51.0255	65.0000	Yes
5.5487	4.2000	7.1191	6.1191	7.8809	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.5161	63.0000	Yes
5.5487	4.2000	6.4883	5.4883	8.5117	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	52.1980	66.0000	Yes
5.5487	4.2000	7.2958	6.2958	7.7042	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	48.7271	63.5051	Yes
5.5487	4.2000	7.1683	6.1683	7.8317	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.3144	63.9423	Yes
5.5487	4.2000	6.5631	5.5631	8.4369	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	51.8702	66.1527	Yes
5.5487	4.2000	6.9550	5.9550	8.0450	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	50.1951	64.6942	Yes
5.5487	4.2000	7.1374	6.1374	7.8626	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.4407	64.0496	Yes
5.5487	4.2000	6.9184	5.9184	8.0816	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	50.3483	64.8259	Yes
5.5487	4.2000	6.9649	5.9649	8.0351	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	50.1540	64.6588	Yes
5.5487	4.2000	6.6195	5.6195	8.3805	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	51.6246	65.9377	Yes
5.5487	4.2000	7.0496	6.0496	7.9504	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.8020	64.3574	Yes
5.5487	4.2000	6.6302	5.6302	8.3698	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	51.5783	65.8972	Yes
5.5487	4.2000	6.7573	5.7573	8.2427	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	51.0286	65.4139	Yes
5.5487	4.2000	6.6587	5.6587	8.3413	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	51.4521	65.7825	Yes
5.5487	4.2000	7.1516	6.1516	7.8484	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.3828	64.0003	Yes
5.5487	4.2000	6.9592	5.9592	8.0408	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	50.1778	64.6793	Yes
5.5487	4.2000	7.0264	6.0264	7.9736	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.8983	64.4397	Yes
5.5487	4.2000	7.2296	6.2296	7.7704	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.0652	63.7312	Yes
5.5487	4.2000	7.1121	6.1121	7.8879	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.5447	64.1380	Yes
5.5487	4.2000	7.0414	6.0414	7.9586	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.8359	64.3864	Yes
5.5487	4.2000	7.0722	6.0722	7.9278	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.7087	64.2777	Yes
5.5487	4.2000	7.2747	6.2747	7.7253	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	48.8824	63.5767	Yes
5.5487	4.2000	6.6542	5.6542	8.3458	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	51.4717	65.7996	Yes
5.5487	4.2000	6.8492	5.8492	8.1508	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	50.6397	65.0772	Yes
5.5487	4.2000	7.0140	6.0140	7.9860	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.9497	64.4837	Yes
5.5487	4.2000	6.9793	5.9793	8.0207	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	50.0939	64.6073	Yes
5.5487	4.2000	7.5201	6.5201	7.4799	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	47.9034	62.7558	Yes
5.5487	4.2000	7.1833	6.1833	7.8167	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	49.2531	63.8903	Yes
5.5487	4.2000	6.8700	5.8700	8.1300	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	50.5518	65.0013	Yes
5.5487	4.2000	6.8111	5.8111	8.1889	15.0000	1.2000	1.0000	1.0000	1.0000	4.2000	50.7996	65.2153	Yes

Switching to the Iterations / Results tab will allow you to check the structure values for each calculation.

With the W1/W2 Constant Pitch mode enabled, notice how the randomised W1 plus the calculated S1 now total the trace pitch of 15 mils, so for the top row $W1\ 7.4335 + S1\ 7.5665 = 15\ \text{mils}$. Every row will have a trace pitch of 15 mils

A new Pitch column has been introduced to allow the trace pitch to be verified.

All the Iterations / Results tab data can be exported to other tools for further analysis by using the right-click | Copy Result to Clipboard facility

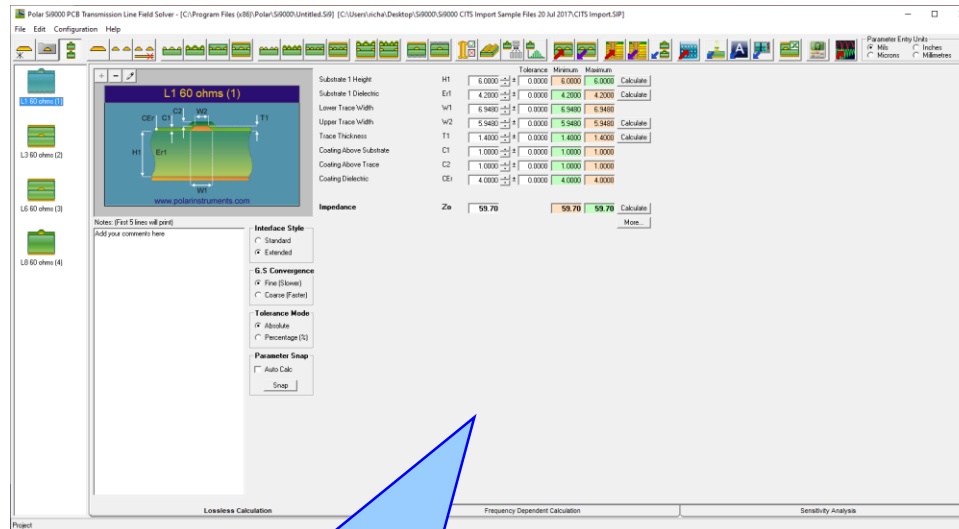
Monte Carlo enhancements – new Constant Pitch option for differential structures

Please view this application note for further information and supported structure list

<https://www.polarinstruments.com/support/si/AP8209.html>

v25.02.01 (February 2025)

Enhancements to the Import Polar CITS Datalog File option

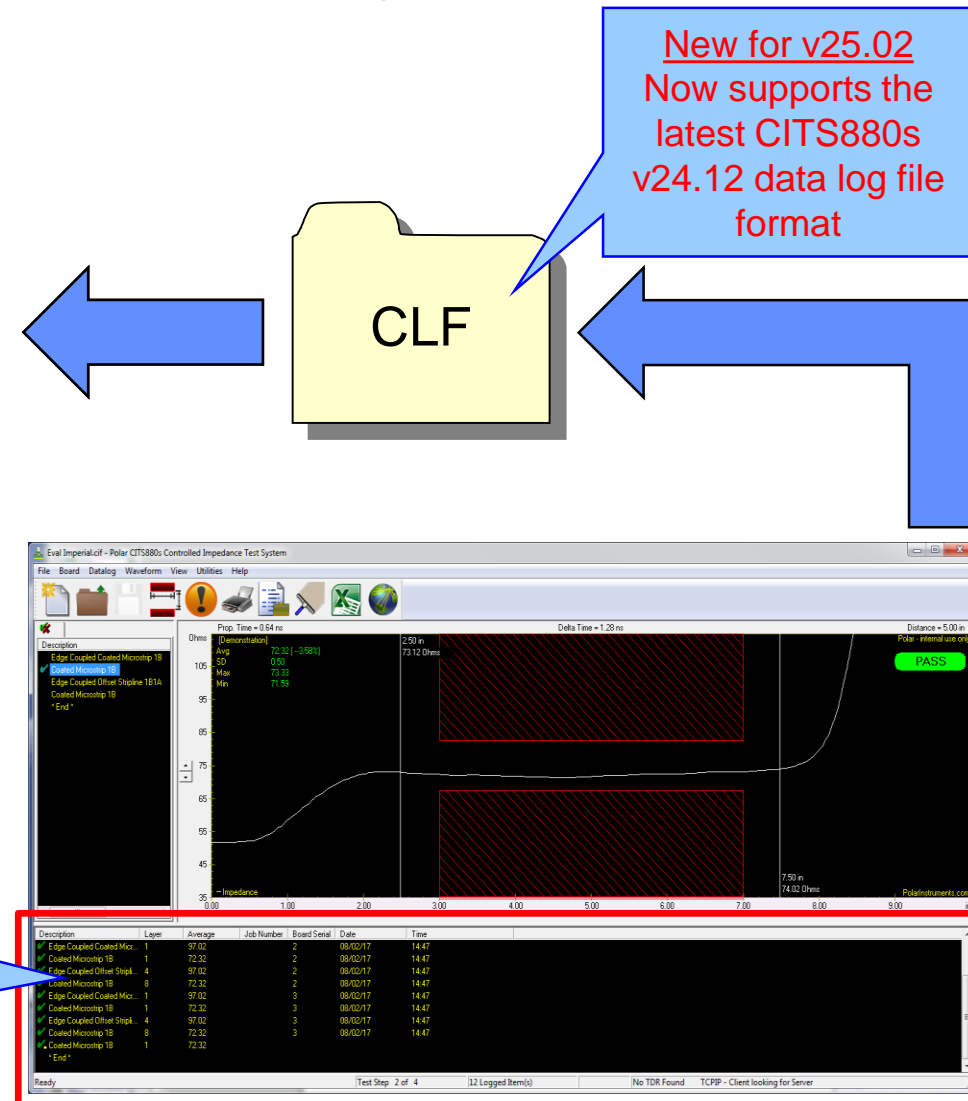


Overview

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.

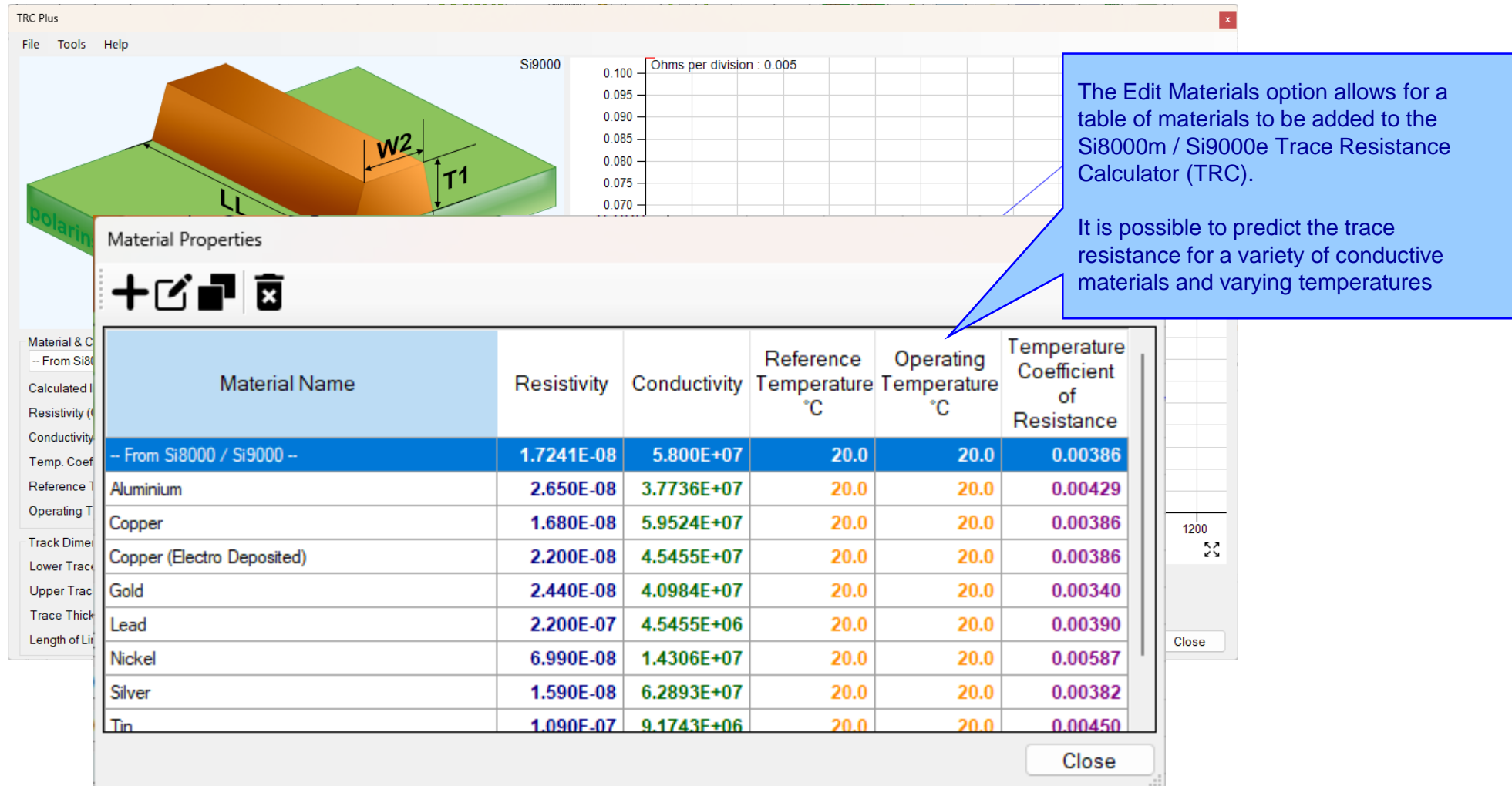
****See slides in v22.09.01 for further information on this feature**

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



v25.01.01 (January 2025)

TRC Plus - Edit Materials option now improved



The Edit Materials option allows for a table of materials to be added to the Si8000m / Si9000e Trace Resistance Calculator (TRC).






It is possible to predict the trace resistance for a variety of conductive materials and varying temperatures

Material Name	Resistivity	Conductivity	Reference Temperature °C	Operating Temperature °C	Temperature Coefficient of Resistance
-- From Si8000 / Si9000 --	1.7241E-08	5.800E+07	20.0	20.0	0.00386
Aluminium	2.650E-08	3.7736E+07	20.0	20.0	0.00429
Copper	1.680E-08	5.9524E+07	20.0	20.0	0.00386
Copper (Electro Deposited)	2.200E-08	4.5455E+07	20.0	20.0	0.00386
Gold	2.440E-08	4.0984E+07	20.0	20.0	0.00340
Lead	2.200E-07	4.5455E+06	20.0	20.0	0.00390
Nickel	6.990E-08	1.4306E+07	20.0	20.0	0.00587
Silver	1.590E-08	6.2893E+07	20.0	20.0	0.00382
Tin	1.090E-07	9.1743E+06	20.0	20.0	0.00450

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 Graphing

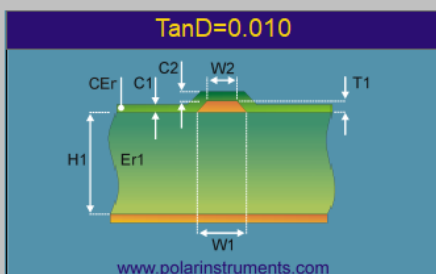
Project Structure List

#	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

TanD=0.010



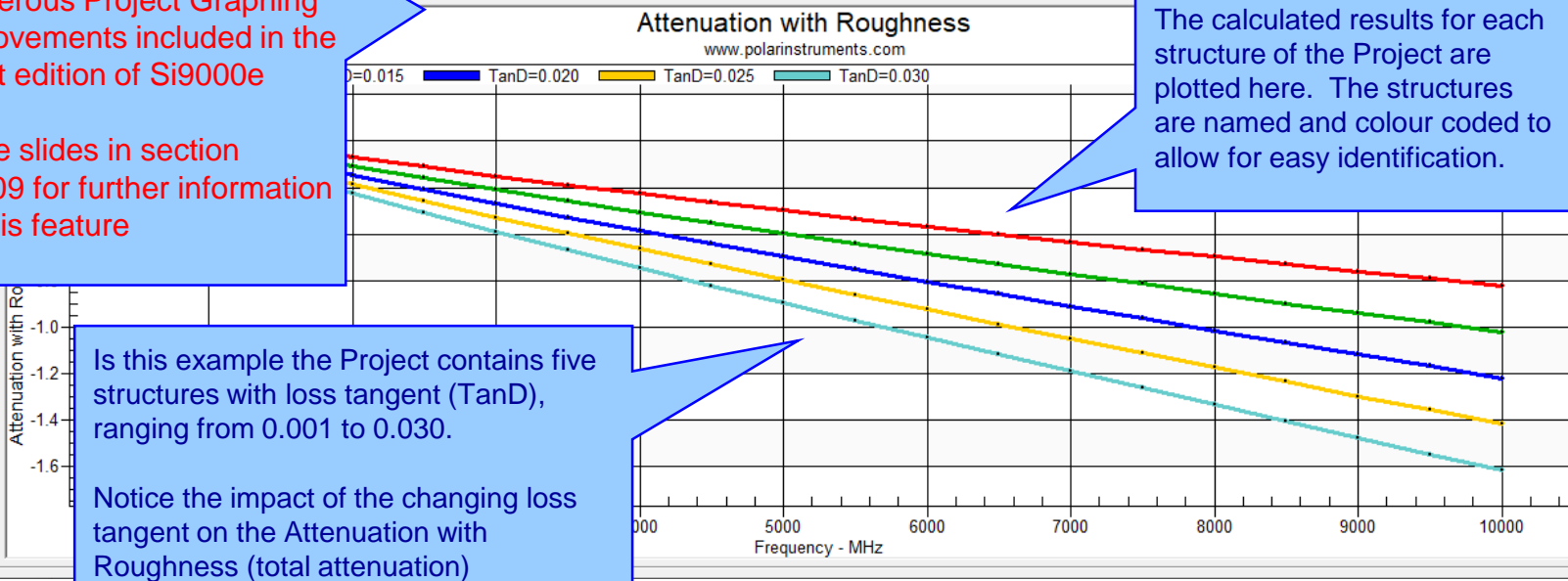
Structure Type : Coated Microstrip 1B
 H1 4.3098
 Er1 4.2000
 W1 7.0000
 W2 6.0000
 T1 1.2000
 C1 1.0000
 C2 1.0000
 CEr 4.2000
 Zo 50.01
 LL 1000.00
 TC 5.80E+07
 TanD 0.0100
 Tr 10
 FMin 500.000
 FMax 10.000
 FSteps 20
 Frequency Distribution : Linear
 Result Presentation : Length of Line
 Extended Substrate Data : Constant Er / TanD
 Surface Roughness Compensation : Hammerstad

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

New for v25.01

Numerous Project Graphing improvements included in the latest edition of Si9000e

**See slides in section v21.09 for further information on this feature



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

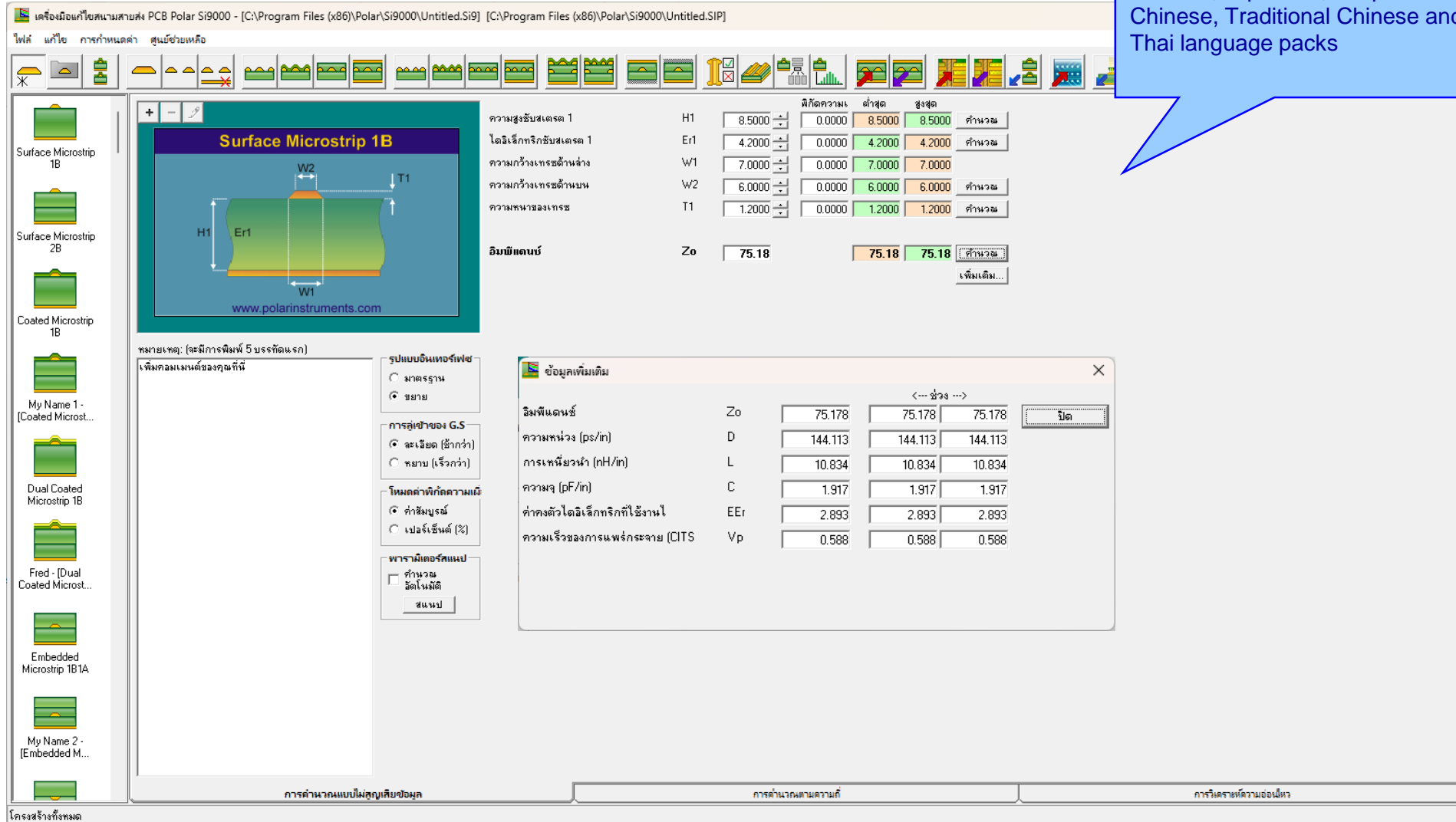
Is this example the Project contains five structures with loss tangent (TanD), ranging from 0.001 to 0.030.

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

v24.10.01 (October 2024)

Multilingual Support - Thai language added

Si9000e now supports English, German, Japanese, Simplified Chinese, Traditional Chinese and Thai language packs



หน้าจอโปรแกรมคำนวณสายส่ง PCB Polar Si9000 - [C:\Program Files (x86)\Polar\Si9000\Untitled.Si9] [C:\Program Files (x86)\Polar\Si9000\Untitled.SIP]

ไฟล์ แก้ไข การกำหนดค่า ศูนย์ช่วยเหลือ

Surface Microstrip 1B

Surface Microstrip 2B

Coated Microstrip 1B

My Name 1 - [Coated Microst...]

Dual Coated Microstrip 1B

Fred - [Dual Coated Microst...]

Embedded Microstrip 1B1A

My Name 2 - [Embedded M...]

ความสูงชั้นสเตรต 1 H1 8.5000 0.0000 8.5000 8.5000 จำนวน

ไดอิเล็กทริกชั้นสเตรต 1 Er1 4.2000 0.0000 4.2000 4.2000 จำนวน

ความกว้างเทรซด้านล่าง W1 7.0000 0.0000 7.0000 7.0000

ความกว้างเทรซด้านบน W2 6.0000 0.0000 6.0000 6.0000 จำนวน

ความหนาของเทรซ T1 1.2000 0.0000 1.2000 1.2000 จำนวน

อิมพีแดนซ์ Zo 75.18 75.18 75.18 จำนวน

เพิ่มเดิม...

หมายเหตุ: (จะมีการพิมพ์ 5 บรรทัดแรก)

เพิ่มคอมเมนต์ของคุณที่นี่

รูปแบบอินเทอร์เฟซ

☐ มาตรฐาน

☒ ชยาย

การใส่สายของ G.S

☒ ละเอียด (ช้ากว่า)

☐ พยายาม (เร็วกว่า)

โหมดค่าที่ก่อดความถี่

☒ ค่าสัมบูรณ์

☐ เปอร์เซ็นต์ (%)

พารามิเตอร์คแนป

☐ จำนวน

☐ อัตราโน้ต

สรุป

ข้อมูลเพิ่มเติม

<... ช่วง ...>

อิมพีแดนซ์	Zo	75.178	75.178	75.178	ปิด
ความหนาแน่น	D	144.113	144.113	144.113	
การเหนี่ยวนำ (nH/in)	L	10.834	10.834	10.834	
ความจุ (pF/in)	C	1.917	1.917	1.917	
ค่าคงตัวไดอิเล็กทริกที่ใช้งาน	EEr	2.893	2.893	2.893	
ความเร็วของการแพร่กระจาย (CITS)	Vp	0.588	0.588	0.588	

การคำนวณแบบไม่สูญเสียข้อมูล

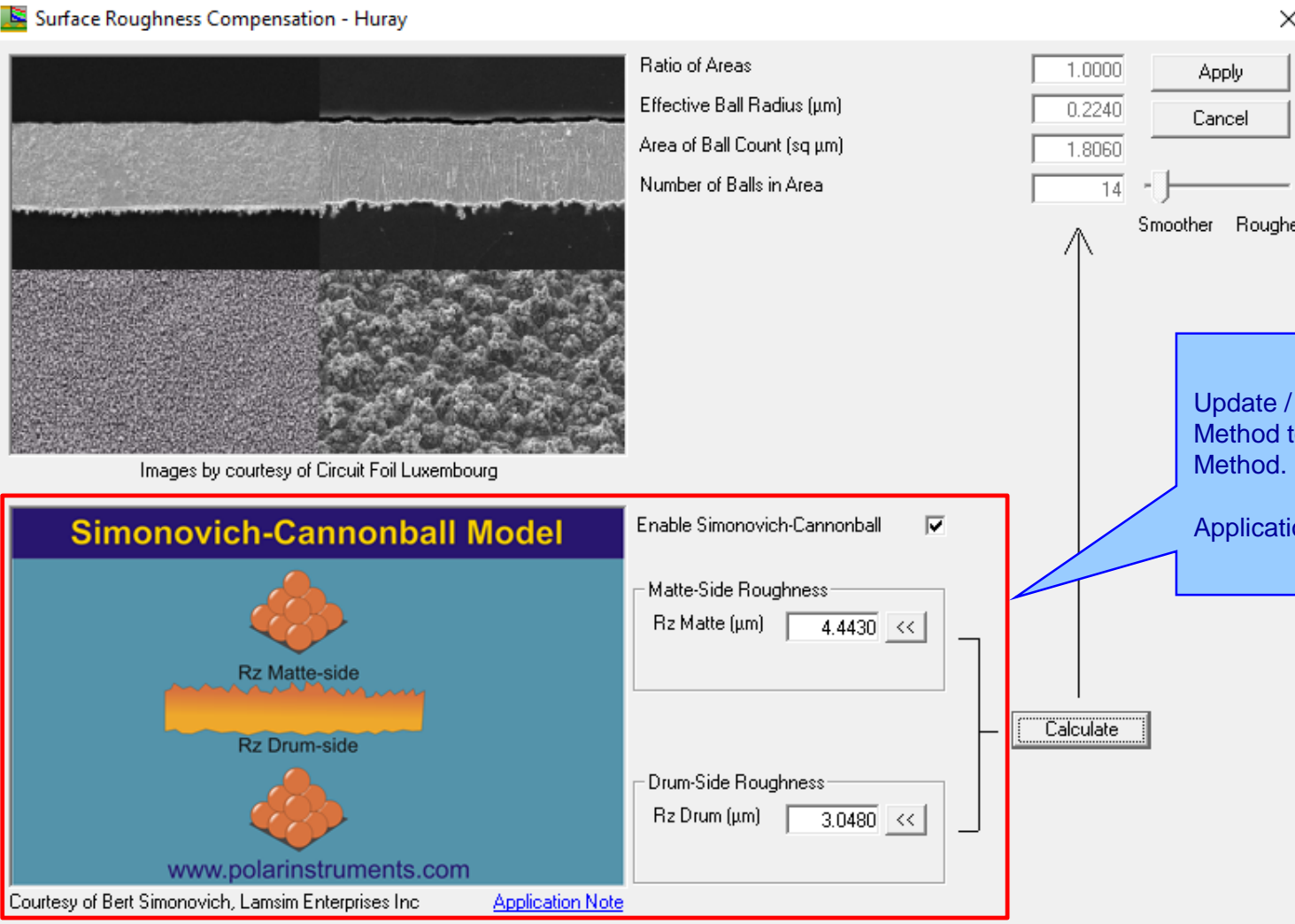
การคำนวณตามความถี่

การกระจายความถี่

โครงสร้างทั้งหมด

v24.03.13 (March 2024)

Update Cannonball-Huray Method to Simonovich-Cannonball Method



Surface Roughness Compensation - Huray

Ratio of Areas: 1.0000

Effective Ball Radius (μm): 0.2240

Area of Ball Count ($\text{sq } \mu\text{m}$): 1.8060

Number of Balls in Area: 14

Buttons: Apply, Cancel

Slider: Smoother, Rougher

Images by courtesy of Circuit Foil Luxembourg

Simonovich-Cannonball Model

Enable Simonovich-Cannonball: ☒

Matte-Side Roughness

Rz Matte (μm): 4.4430 <<

Drum-Side Roughness

Rz Drum (μm): 3.0480 <<

Calculate

www.polarinstruments.com

Courtesy of Bert Simonovich, Lamsim Enterprises Inc

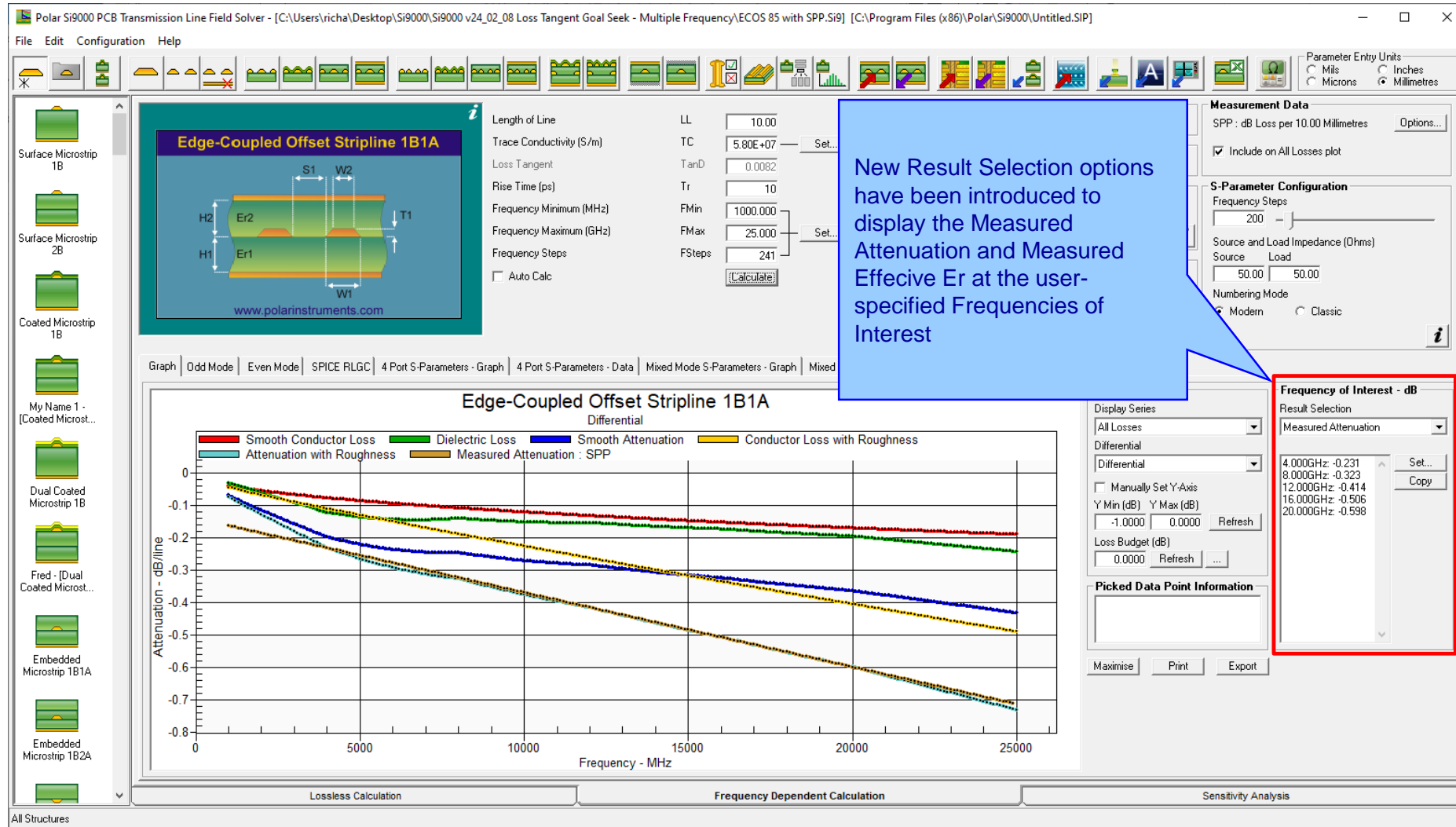
[Application Note](#)

Update / rebrand of the Cannonball-Huray Method to Simonovich-Cannonball Method.

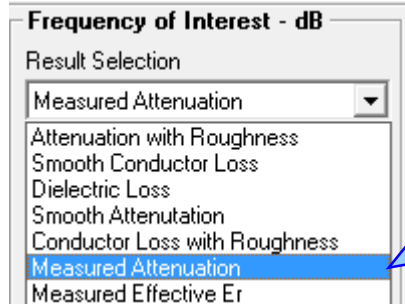
Application Note now links to two papers

v24.02.08 (February 2024)

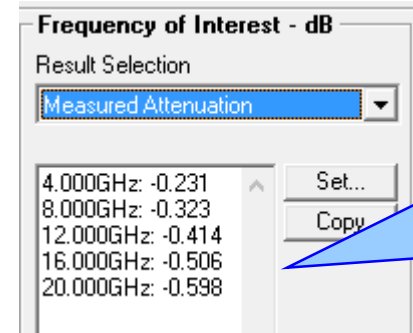
New Frequency of Interest option enhancements



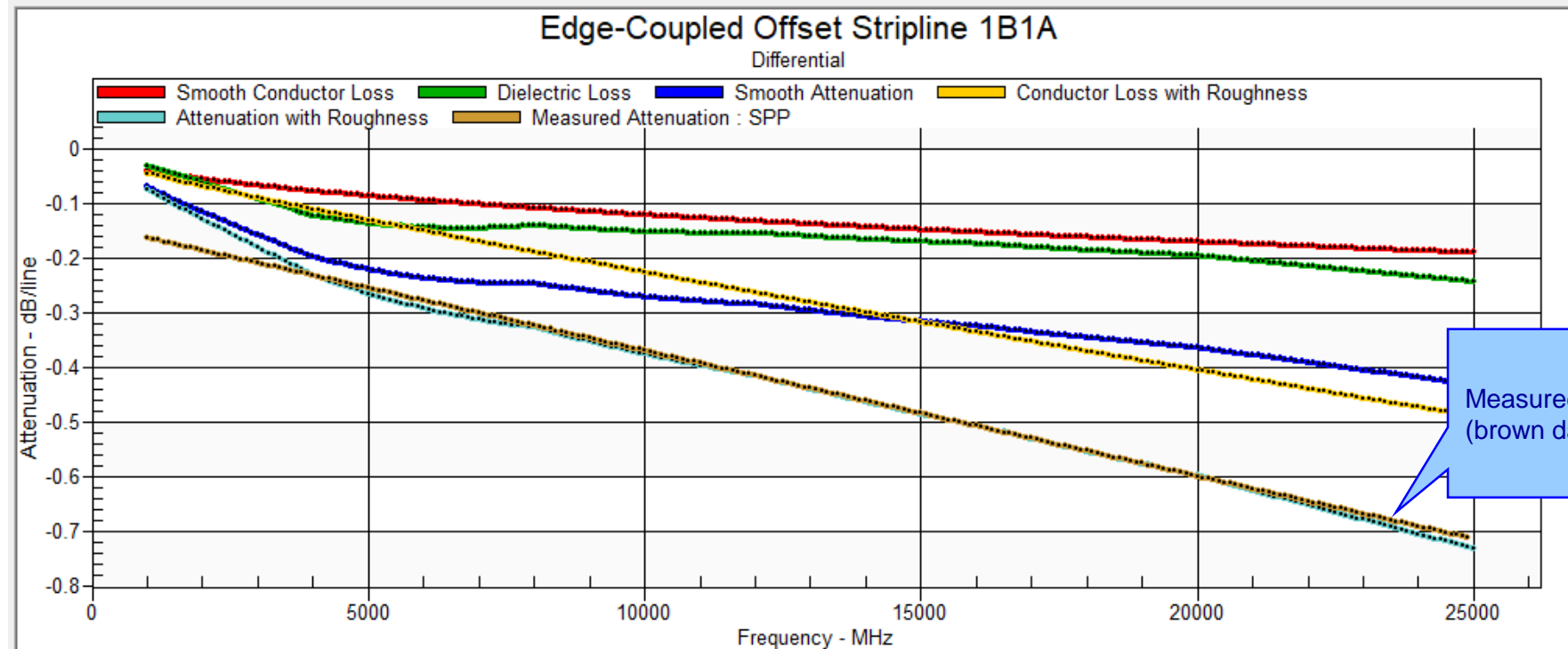
New Frequency of Interest option enhancements



When importing insertion loss measurement data from the Polar Atlas it is often useful to know the exact measured attenuation dB values as specific frequencies. The new Result Selection options have been introduced to achieve this.

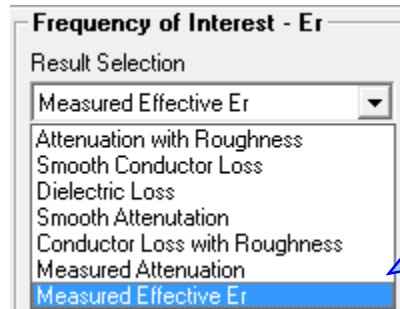


In this example the Frequency of Interest values have been set to 4, 8, 12, 16 and 20GHz. The measured attenuation (brown data series on the plot below) is examined and the dB loss values at those frequencies are displayed here

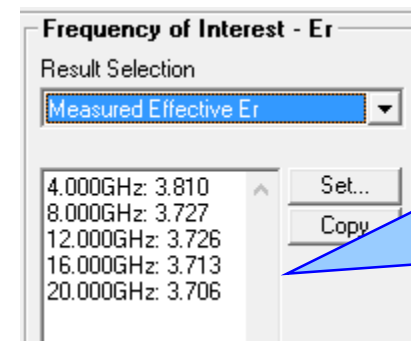


Measured Attenuation (brown data series)

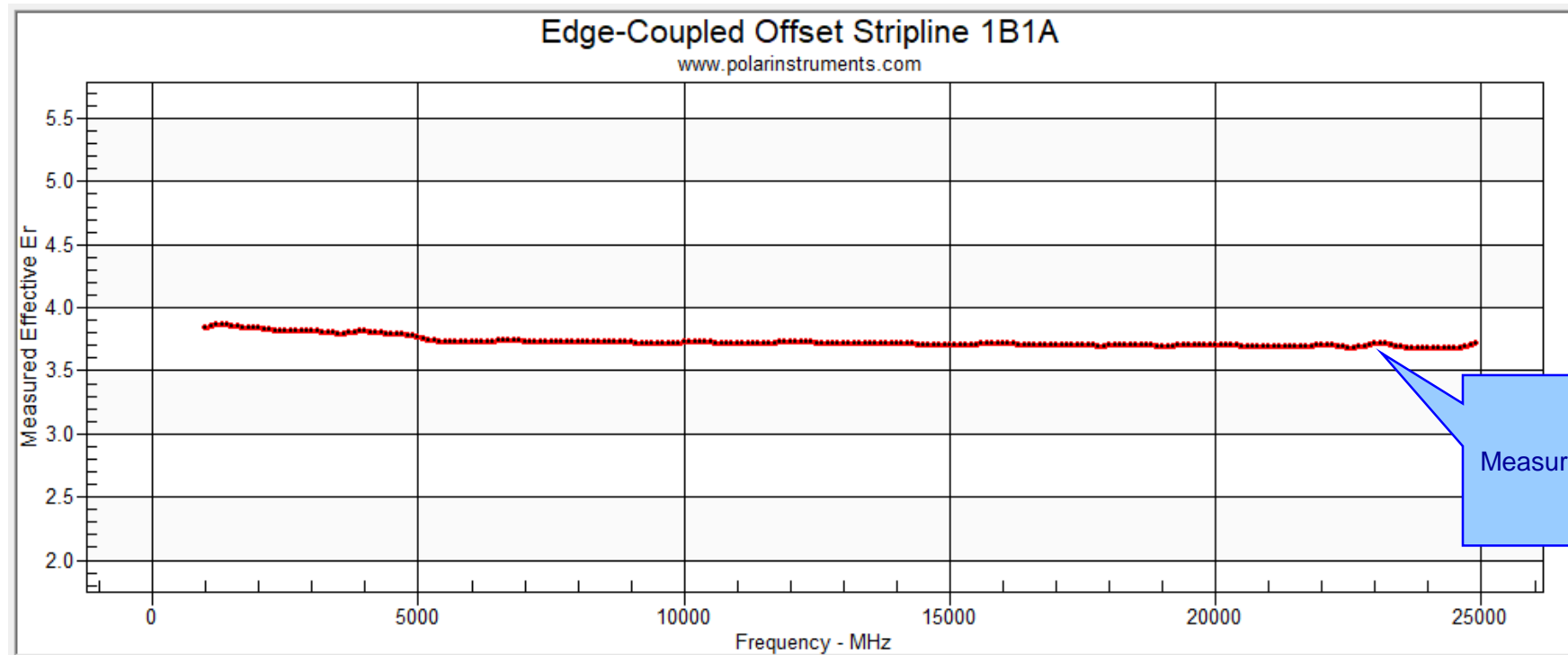
New Frequency of Interest option enhancements



Similar to the new Measured Attenuation selection, it is now possible to select the Measured Effective Er.

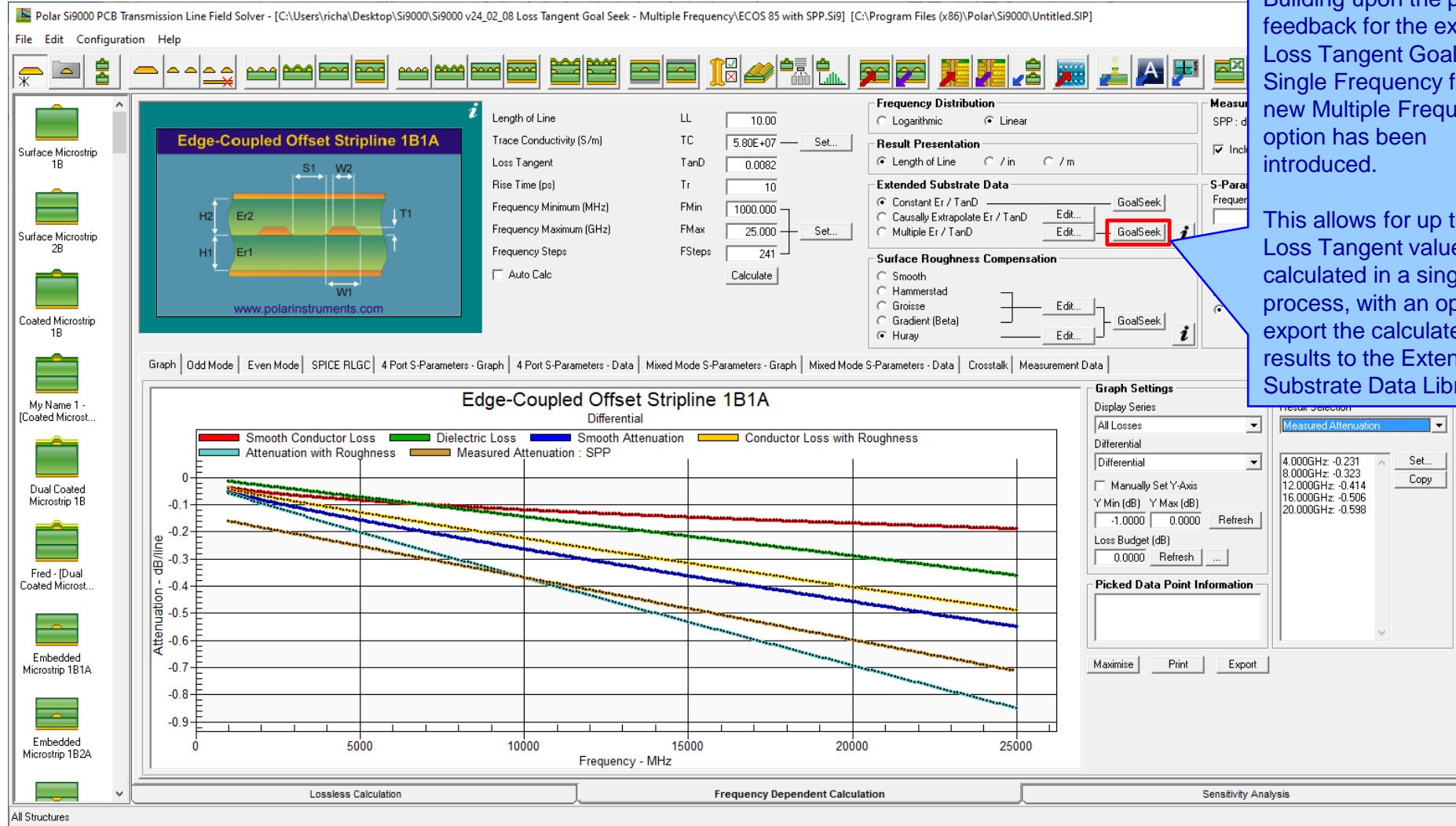


Using the same Frequency of Interest values of 4, 8, 12, 16 and 20GHz, the imported measurement data is examined and the effective dielectric constant values at those frequencies are displayed here



Measured Effective Er

New Loss Tangent Goal Seek – Multiple Frequency option



Building upon the positive feedback for the existing Loss Tangent Goal Seek – Single Frequency facility, a new Multiple Frequency option has been introduced.

This allows for up to five Loss Tangent values to be calculated in a single process, with an option to export the calculated results to the Extended Substrate Data Library

The new Loss Tangent Goal Seek - Multiple Frequency option allows for up to five Loss Tangent values to be calculated in a single process.
The input data and results for each frequency are contained in a separate column.

Loss Tangent Goal Seek

Step 1 : Enter Total Attenuation from measurement and Dielectric Constant values for each frequency

Frequency	Hz	4.00E+09	8.00E+09	1.20E+10	1.60E+10	2.00E+10	Set from FOI
Total Attenuation (S21 / SDD21)	dB / LL	-0.2310	-0.3230	-0.4140	-0.5060	-0.5980	
Substrate 1 Dielectric	Er1	3.8100	3.7270	3.7260	3.7130	3.7060	Set from EEr
Substrate 2 Dielectric	Er2	3.8100	3.7270	3.7260	3.7130	3.7060	
Substrate 3 Dielectric	Er3	3.8100	3.7270	3.7260	3.7130	3.7060	
Substrate 4 Dielectric	Er4	3.8100	3.7270	3.7260	3.7130	3.7060	
Coating Dielectric	CEr	3.8100	3.7270	3.7260	3.7130	3.7060	
2nd Coating Dielectric	CSEr	3.8100	3.7270	3.7260	3.7130	3.7060	
Separation Region Dielectric	REr	3.8100	3.7270	3.7260	3.7130	3.7060	

Please Note: If you wish to Goal Seek less than five frequencies, set the Frequency in the unused columns to 0 Hz.
When using the 'Set from FOI' option the Total Attenuation data used will depend on Frequency of Interest Result Selection dropdown setting on the main interface. The first frequency / attenuation values will be supported. For differential structures, the differential / odd mode results will be used.

Step 2 : Calculate Conductor and Dielectric Loss

	dB / LL	-0.1102	-0.1872	-0.2618	-0.3334	-0.4030	Calculate
Conductor Loss with Roughness	dB / LL	-0.1102	-0.1872	-0.2618	-0.3334	-0.4030	
Dielectric Loss (Attenuation - Conductor Loss)	dB / LL	-0.1208	-0.1358	-0.1522	-0.1726	-0.1950	

Step 3 : Calculate Loss Tangent

Loss Tangent	TanD	0.0171	0.0095	0.0072	0.0061	0.0055	Calculate
Loss Tangent	TanD	0.0171	0.0095	0.0072	0.0061	0.0055	

0.0055 Dielectric Loss: -0.1935

Step 4 : Export Results as an Extended Substrate Data table (optional)

Extended Substrate Data Table Name
Loss Tangent Goal Seek Results

Export

Frequency Hz	Dielectric Constant Er	Loss Tangent TanD
4.00E+09	3.8100	0.0171
8.00E+09	3.7270	0.0095
1.20E+10	3.7260	0.0072
1.60E+10	3.7130	0.0061
2.00E+10	3.7060	0.0055

Please Note: After you Export the results to an Extended Substrate Data Table it will be necessary to select this table using the Multiple Er / TanD - Edit option

Setup Goal Seek Parameters

	Min	Max	Conv.
Loss Tangent Goal Seek Parameters	0.0010	0.5000	0.0020

Close

The calculated Conductor and Dielectric Loss results will be displayed here

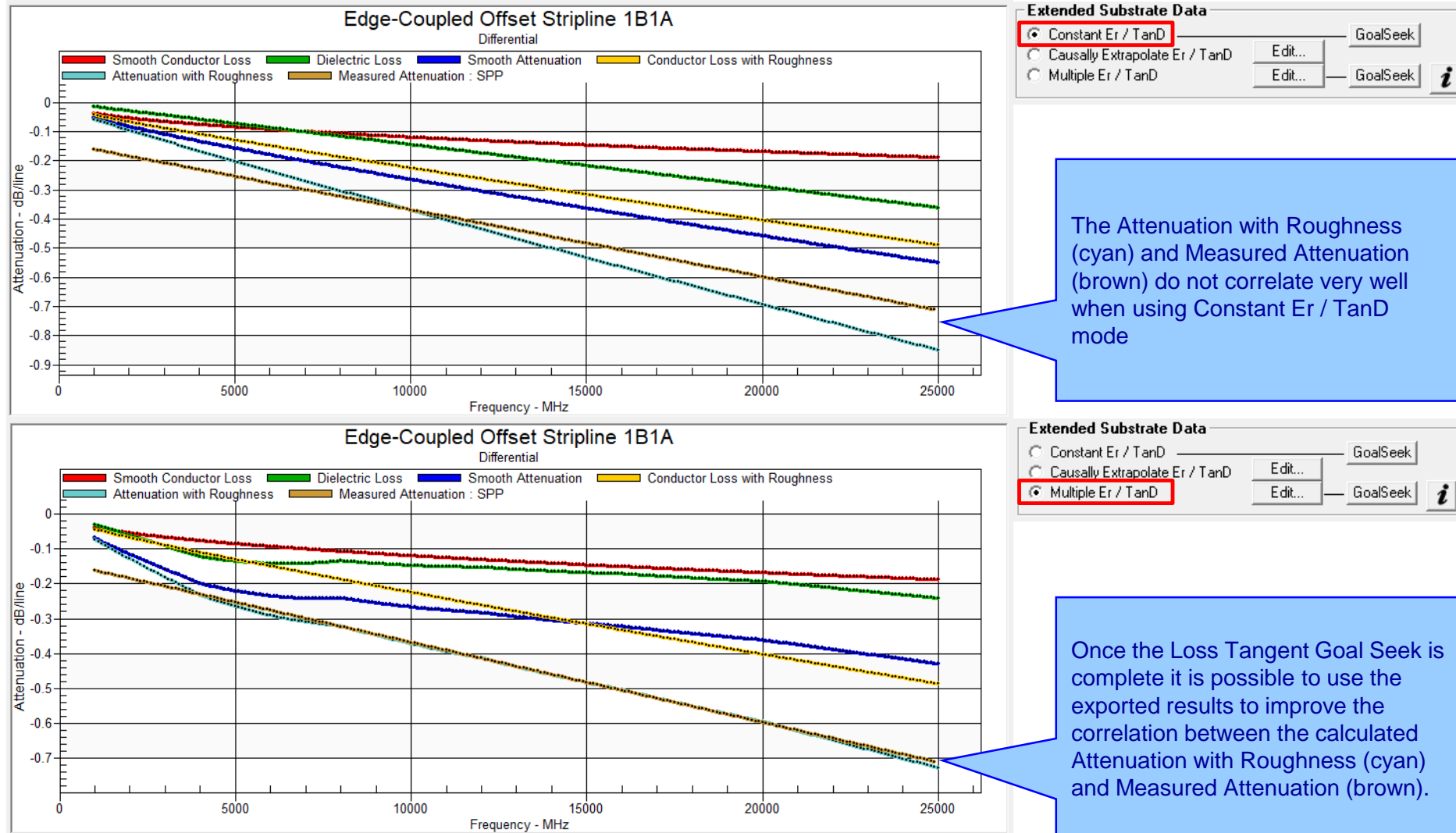
The calculated Loss Tangent results will be displayed here

The results can also be exported to the Extended Substrate Data Library

The input parameter data can be keyed in or the Set from FOI (Frequency of Interest) button will automatically set the Frequency and Total Attenuation values from the main dialog.

Dielectric Constant varies with frequency so the Set from EEr button will populate these fields from the Measured Effective Er data

New Loss Tangent Goal Seek – Multiple Frequency option



v24.01.01 (January 2024)

Enhancements

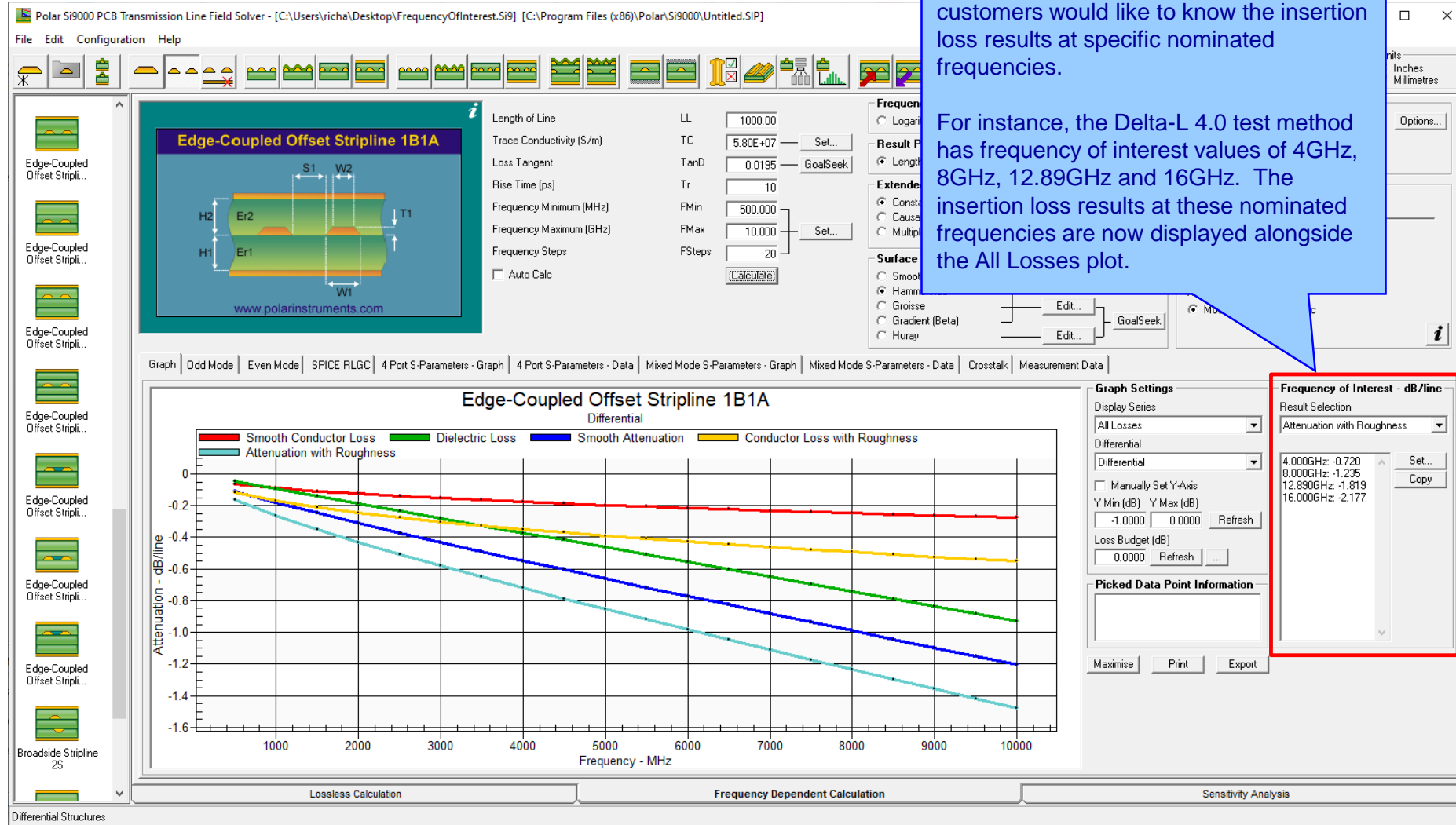
- From 2024 the Track Resistance Calculator (TRC) will be running on the Microsoft .Net Framework 4.8. It has migrated as a result of customer IT policy requests.

v23.09.21 (September 2023)

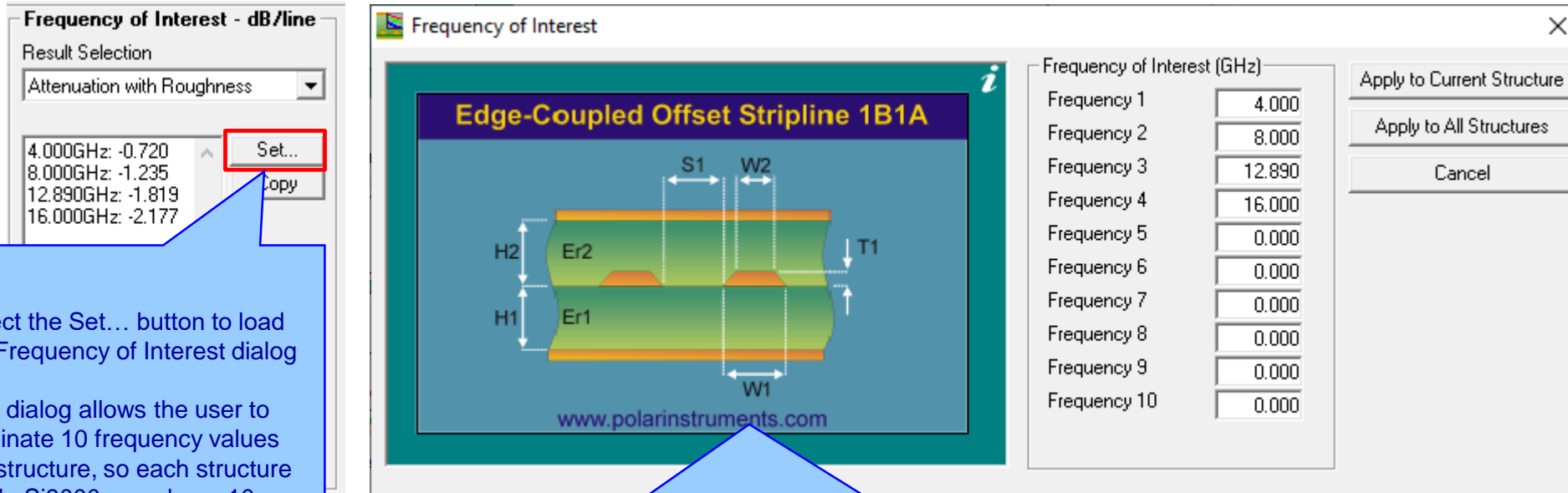
New Frequency of Interest option added

In addition to the insertion loss plots that are generated with Si9000e, some customers would like to know the insertion loss results at specific nominated frequencies.

For instance, the Delta-L 4.0 test method has frequency of interest values of 4GHz, 8GHz, 12.89GHz and 16GHz. The insertion loss results at these nominated frequencies are now displayed alongside the All Losses plot.



New Frequency of Interest option added

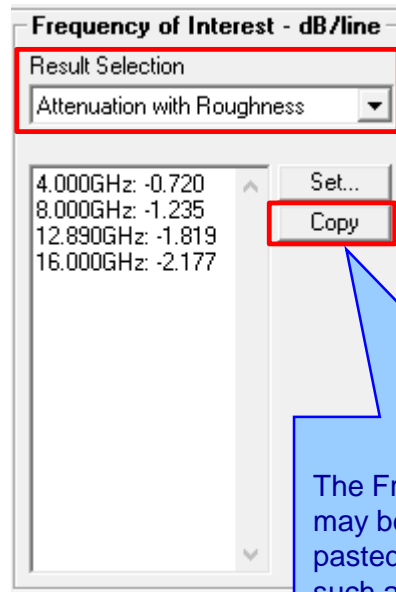


Select the Set... button to load the Frequency of Interest dialog

This dialog allows the user to nominate 10 frequency values per structure, so each structure inside Si9000e can have 10 unique frequency values.

- Selecting Apply to Current Structure will place those frequency values with the current selected structure so the next time the structure is calculated the results for each specified frequency will be placed on the main dialog, giving immediate feedback of the results at those frequency values.
- Selecting Apply to All Structures will place those same nominated frequency values on all structures in the Si9000e, including those structures that exist in a Project.
- In this example we have keyed in the four Delta-L 4.0 frequencies of 4GHz, 8GHz, 12.89GHz and 16GHz

New Frequency of Interest option added



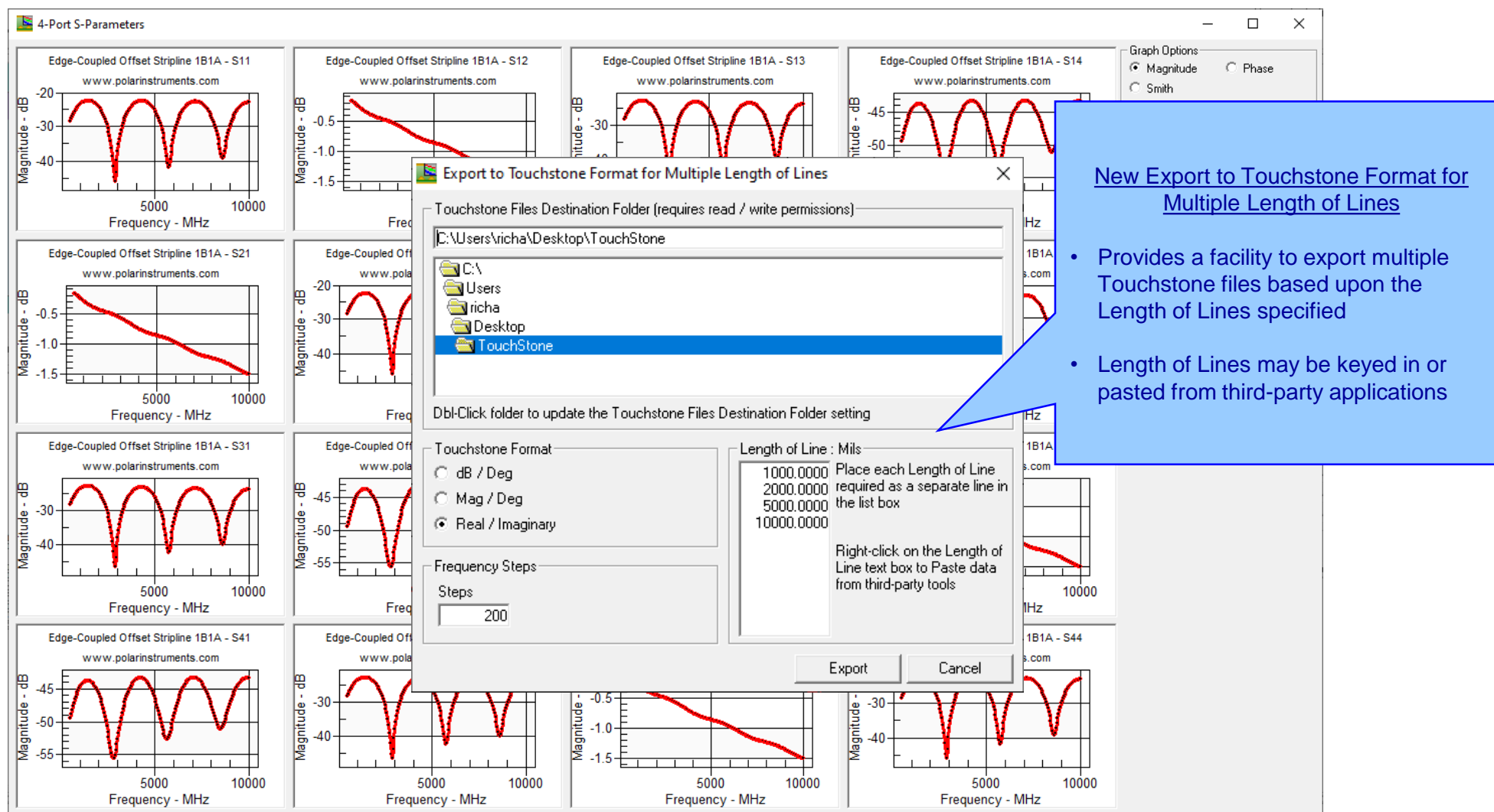
Use the Result Selection dropdown to choose which loss result is displayed. The options available are Attenuation with Roughness, Smooth Conductor Loss, Dielectric Loss, Smooth Attenuation and Conductor Loss with Roughness.

Like the All Losses plots, the formatting of the dB results will match that as specified by Result Presentation, so the dB results will be by /Length or /inch or /metre

The Frequency of Interest results may be copied to the clipboard, then pasted to third-party applications such as Excel

v23.08.02 (August 2023)

New Export to Touchstone Format for Multiple Length of Lines

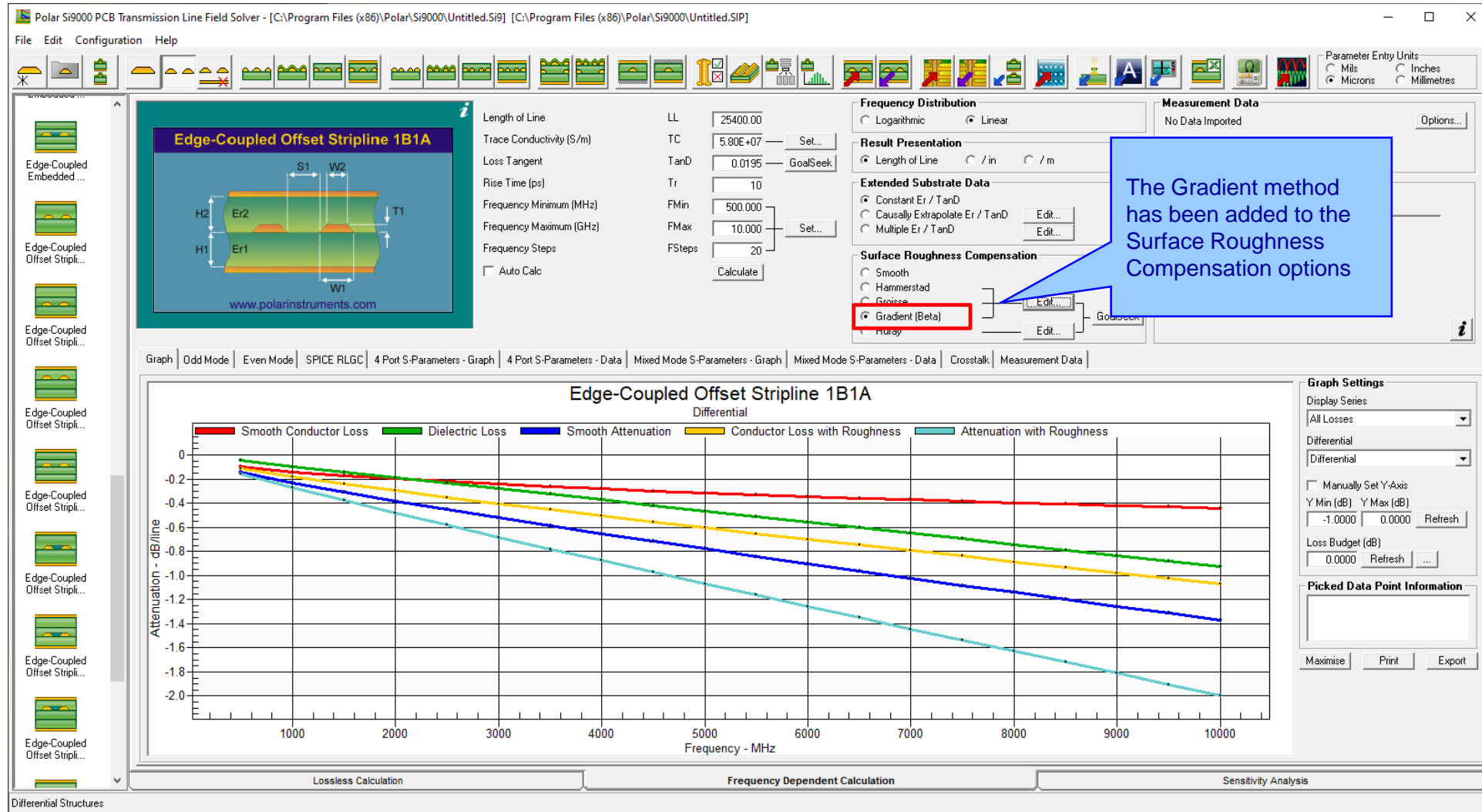


New Export to Touchstone Format for Multiple Length of Lines

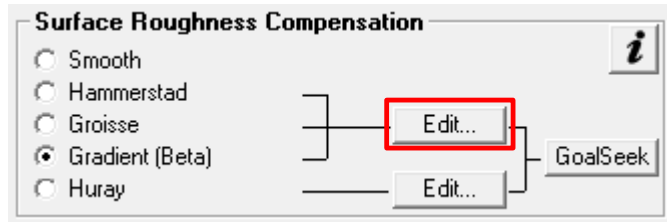
- Provides a facility to export multiple Touchstone files based upon the Length of Lines specified
- Length of Lines may be keyed in or pasted from third-party applications

v23.06.01 (June 2023)

New Gradient Surface Roughness Compensation Method added

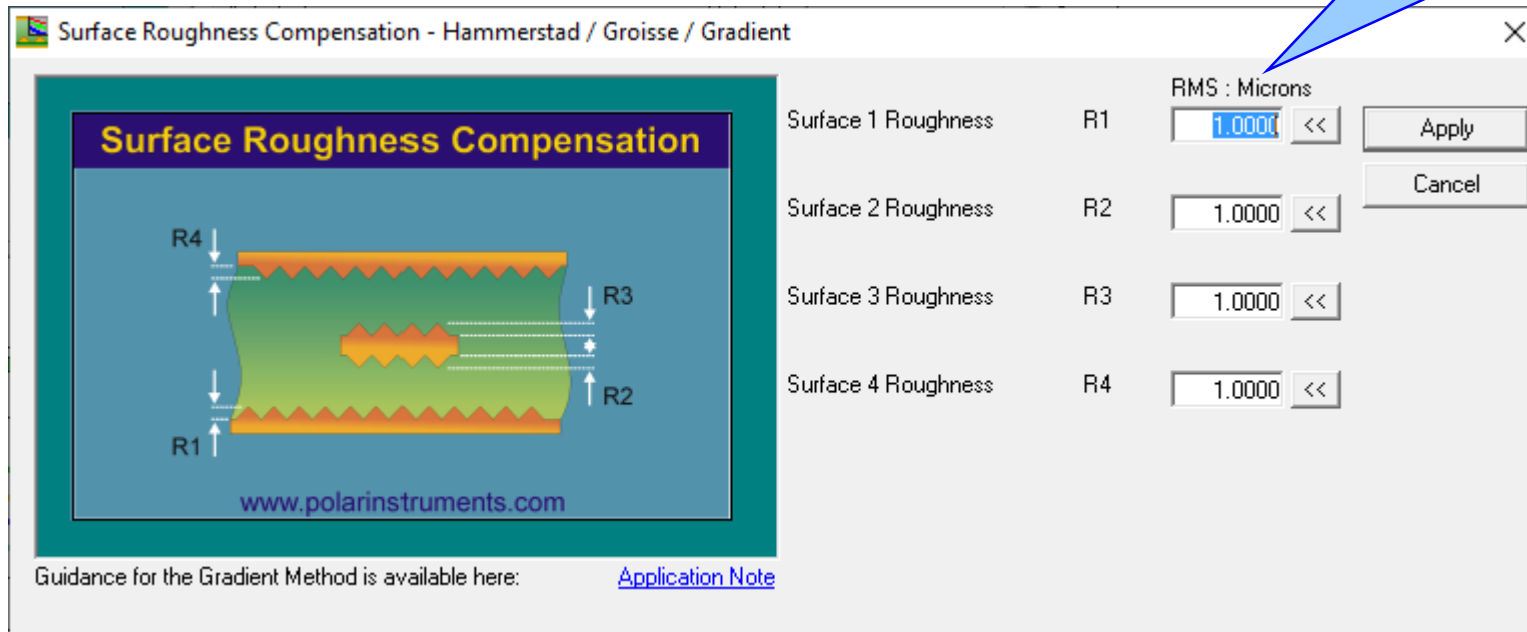


New Gradient Surface Roughness Compensation Method added

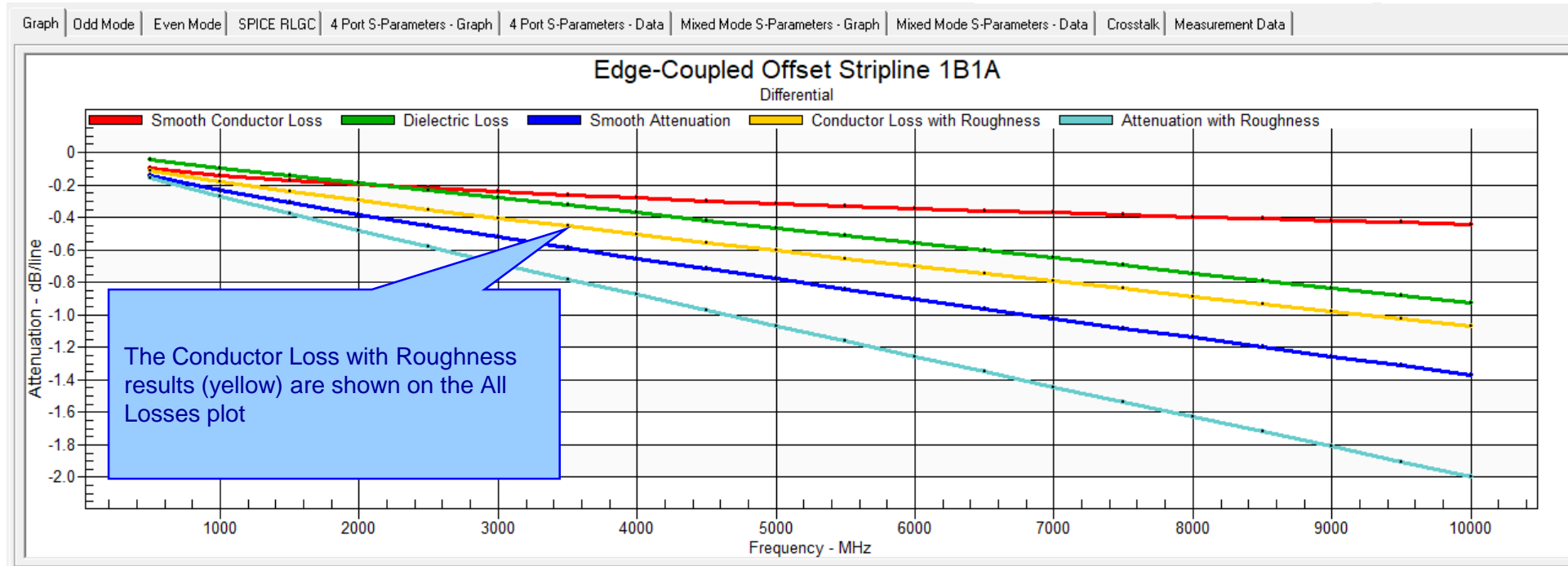


Selecting the Edit button will allow the RMS roughness values to be entered.

In this example 1 μ m roughness for all significant surfaces



New Gradient Surface Roughness Compensation Method added



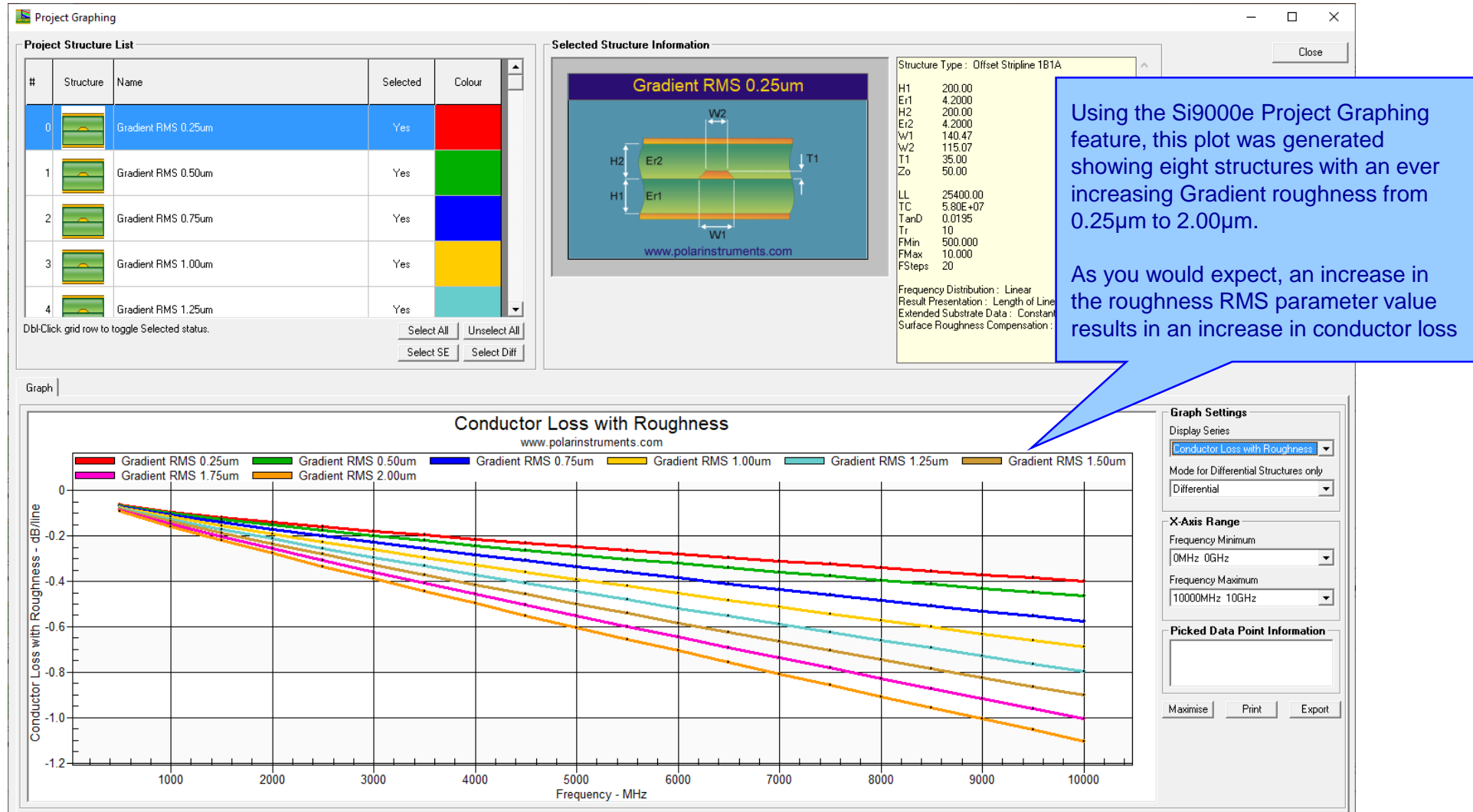
New Gradient Surface Roughness Compensation Method added

Graph Odd Mode Even Mode SPICE RLGC 4 Port S-Parameters - Graph 4 Port S-Parameters - Data Mixed Mode S-Parameters - Graph Mixed Mode S-Parameters - Data Crosstalk Measurement Data																	
Frequency Hz	Impedance Real Ohms	Impedance Imaginary Ohms	Impedance Magnitude Ohms	Inductance H/line	Resistance Ohms/line	Capacitance F/line	Conductance S/line	Skin Depth m	Smooth Conductor Loss dB/line	Dielectric Loss dB/line	Smooth Attenuation dB/line	Conductor Loss with Roughness dB/line	Attenuation with Roughness dB/line	Modal Phase Velocity m/s	Alpha Np/line	Alpha dB/line	Beta rad/line
5.000E+08	3.161E+01	-3.664E-01	3.161E+01	5.955E-09	7.989E-01	5.964E-12	3.653E-04	2.955E-06	-9.873E-02	-4.717E-02	-1.459E-01	-1.128E-01	-1.599E-01	1.348E+08	1.841E-02	-1.599E-01	5.921E-01
1.000E+09	3.138E+01	-2.268E-01	3.138E+01	5.869E-09	1.253E+00	5.964E-12	7.307E-04	2.090E-06	-1.399E-01	-9.376E-02	-2.337E-01	-1.792E-01	-2.730E-01	1.358E+08	3.142E-02	-2.730E-01	1.176E+00
1.500E+09	3.126E+01	-1.675E-01	3.126E+01	5.827E-09	1.660E+00	5.964E-12	1.096E-03	1.706E-06	-1.715E-01	-1.403E-01	-3.118E-01	-2.391E-01	-3.794E-01	1.363E+08	4.368E-02	-3.794E-01	1.757E+00
2.000E+09	3.119E+01	-1.330E-01	3.119E+01	5.799E-09	2.043E+00	5.964E-12	1.461E-03	1.478E-06	-1.982E-01	-1.867E-01	-3.849E-01	-2.957E-01	-4.824E-01	1.366E+08	5.554E-02	-4.824E-01	2.337E+00
2.500E+09	3.113E+01	-1.097E-01	3.113E+01	5.779E-09	2.410E+00	5.964E-12	1.827E-03	1.322E-06	-2.217E-01	-2.331E-01	-4.548E-01	-3.501E-01	-5.832E-01	1.368E+08	6.714E-02	-5.832E-01	2.916E+00
3.000E+09	3.109E+01	-9.260E-02	3.109E+01	5.763E-09	2.766E+00	5.964E-12	2.192E-03	1.207E-06	-2.429E-01	-2.795E-01	-5.224E-01	-4.028E-01	-6.823E-01	1.370E+08	7.856E-02	-6.823E-01	3.495E+00
3.500E+09	3.105E+01	-7.937E-02	3.105E+01	5.750E-09	3.112E+00	5.964E-12	2.557E-03	1.117E-06	-2.624E-01	-3.259E-01	-5.883E-01	-4.543E-01	-7.802E-01	1.372E+08	8.982E-02	-7.802E-01	4.072E+00
4.000E+09	3.102E+01	-6.871E-02	3.102E+01	5.739E-09	3.452E+00	5.964E-12	2.923E-03	1.045E-06	-2.806E-01	-3.723E-01	-6.529E-01	-5.047E-01	-8.770E-01	1.373E+08	1.010E-01	-8.770E-01	4.650E+00
4.500E+09	3.100E+01	-5.988E-02	3.100E+01	5.730E-09	3.785E+00	5.964E-12	3.288E-03	9.851E-07	-2.976E-01	-4.187E-01	-7.163E-01	-5.543E-01	-9.730E-01	1.374E+08	1.120E-01	-9.730E-01	5.227E+00
5.000E+09	3.097E+01	-5.241E-02	3.097E+01	5.721E-09	4.114E+00	5.964E-12	3.653E-03	9.346E-07	-3.138E-01	-4.650E-01	-7.788E-01	-6.032E-01	-1.068E+00	1.375E+08	1.230E-01	-1.068E+00	5.803E+00
5.500E+09	3.095E+01	-4.597E-02	3.095E+01	5.714E-09	4.437E+00	5.964E-12	4.019E-03	8.911E-07	-3.291E-01	-5.114E-01	-8.405E-01	-6.515E-01	-1.163E+00	1.376E+08	1.339E-01	-1.163E+00	6.379E+00
6.000E+09	3.094E+01	-4.034E-02	3.094E+01	5.707E-09	4.757E+00	5.964E-12	4.384E-03	8.532E-07	-3.438E-01	-5.577E-01	-9.015E-01	-6.992E-01	-1.257E+00	1.377E+08	1.447E-01	-1.257E+00	6.955E+00
6.500E+09	3.092E+01	-3.536E-02	3.092E+01	5.702E-09	5.073E+00	5.964E-12	4.750E-03	8.197E-07	-3.579E-01	-6.040E-01	-9.619E-01	-7.464E-01	-1.350E+00	1.377E+08	1.555E-01	-1.350E+00	7.531E+00
7.000E+09	3.091E+01	-3.091E-02	3.091E+01	5.696E-09	5.387E+00	5.964E-12	5.115E-03	7.899E-07	-3.714E-01	-6.503E-01	-1.022E+00	-7.931E-01	-1.442E+00	1.378E+08	1.662E-01	-1.442E+00	8.095E+00
7.500E+09	3.089E+01	-2.691E-02	3.089E+01	5.691E-09	5.697E+00	5.964E-12	5.480E-03	7.631E-07	-3.845E-01	-6.967E-01	-1.081E+00	-8.395E-01	-1.530E+00	1.378E+08	1.769E-01	-1.530E+00	8.649E+00
8.000E+09	3.088E+01	-2.327E-02	3.088E+01	5.686E-09	6.005E+00	5.964E-12	5.846E-03	7.389E-07	-3.971E-01	-7.430E-01	-1.140E+00	-8.855E-01	-1.618E+00	1.379E+08	1.875E-01	-1.618E+00	9.193E+00
8.500E+09	3.087E+01	-1.995E-02	3.087E+01	5.682E-09	6.310E+00	5.964E-12	6.211E-03	7.168E-07	-4.093E-01	-7.893E-01	-1.199E+00	-9.311E-01	-1.720E+00	1.380E+08	1.981E-01	-1.720E+00	9.831E+00
9.000E+09	3.086E+01	-1.690E-02	3.086E+01	5.678E-09	6.613E+00	5.964E-12	6.576E-03	6.966E-07	-4.212E-01	-8.356E-01	-1.257E+00	-9.764E-01	-1.812E+00	1.380E+08	2.086E-01	-1.812E+00	1.041E+01
9.500E+09	3.085E+01	-1.409E-02	3.085E+01	5.674E-09	6.914E+00	5.964E-12	6.942E-03	6.780E-07	-4.328E-01	-8.819E-01	-1.315E+00	-1.021E+00	-1.903E+00	1.381E+08	2.191E-01	-1.903E+00	1.098E+01
1.000E+10	3.084E+01	-1.148E-02	3.084E+01	5.671E-09	7.213E+00	5.964E-12	7.307E-03	6.609E-07	-4.441E-01	-9.282E-01	-1.375E+00	-1.066E+00	-1.994E+00	1.381E+08	2.296E-01	-1.994E+00	1.155E+01

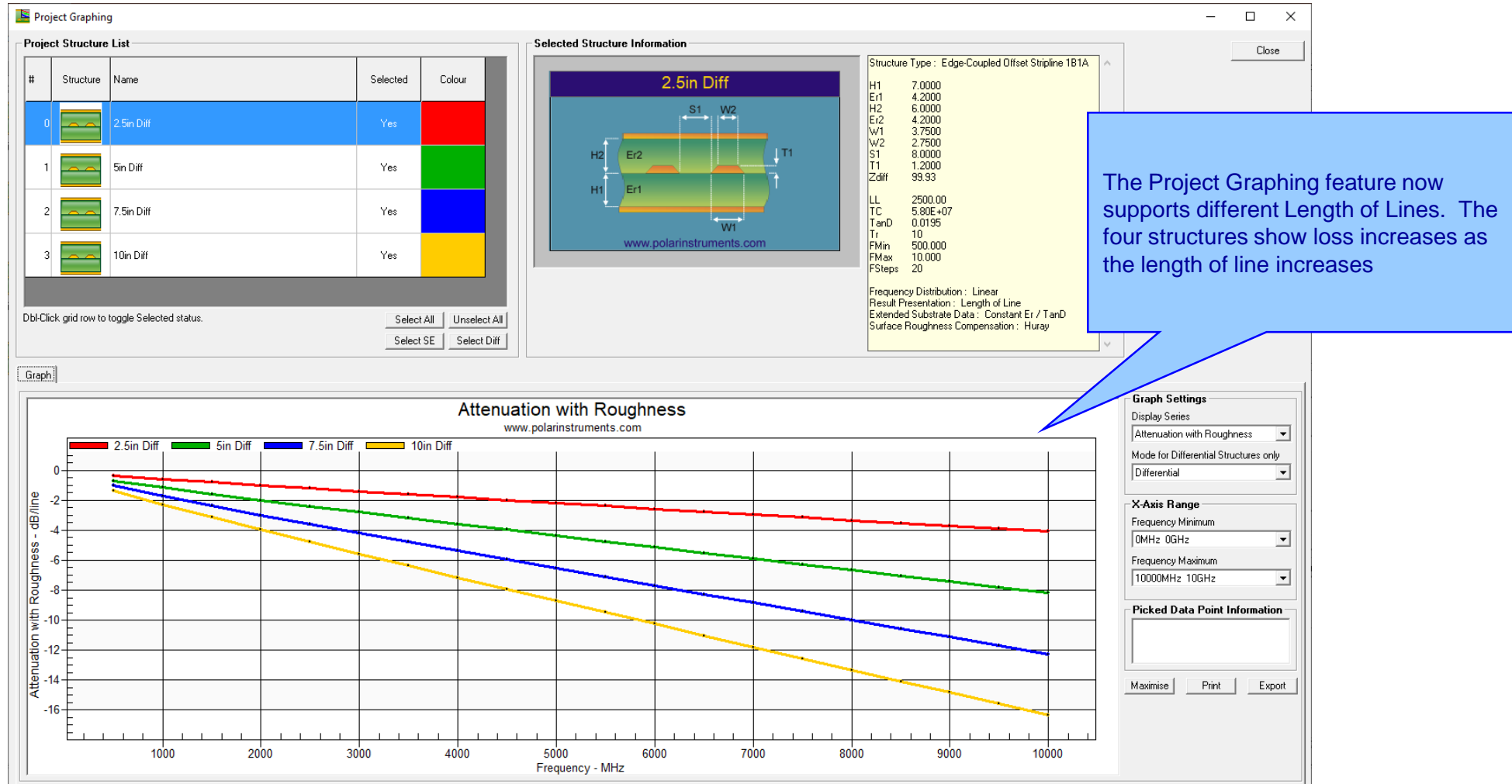
The Conductor Loss with Roughness results data is also shown alongside the other field solver results.

The complete set of results can be exported to third-party tools like Excel using the right-click menu | Copy Results to Clipboard

New Gradient Surface Roughness Compensation Method added



Project Graphing Enhancements - now supports structures within the Project with varying Length of Line

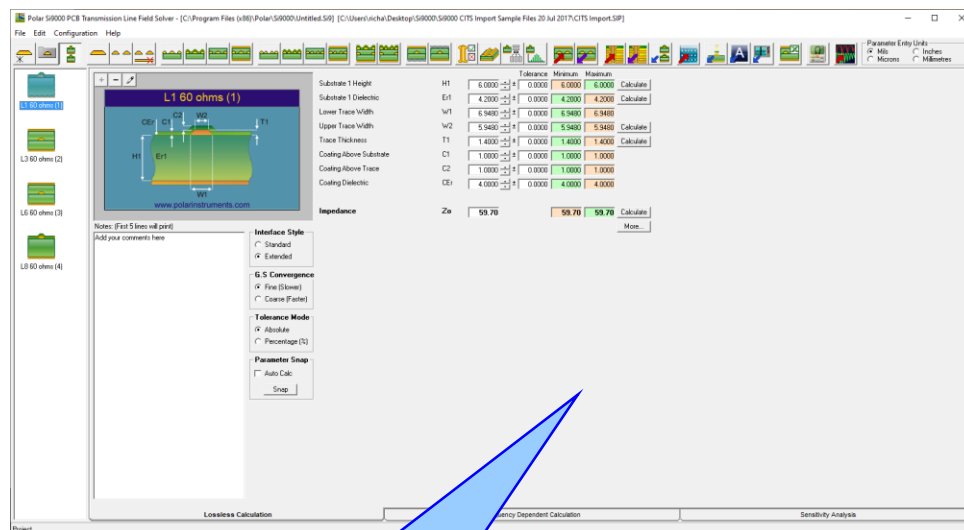


Other enhancements

- FlexNet Publisher / FLEXIm v11.19.0.0 supported

v22.09.01 (September 2022)

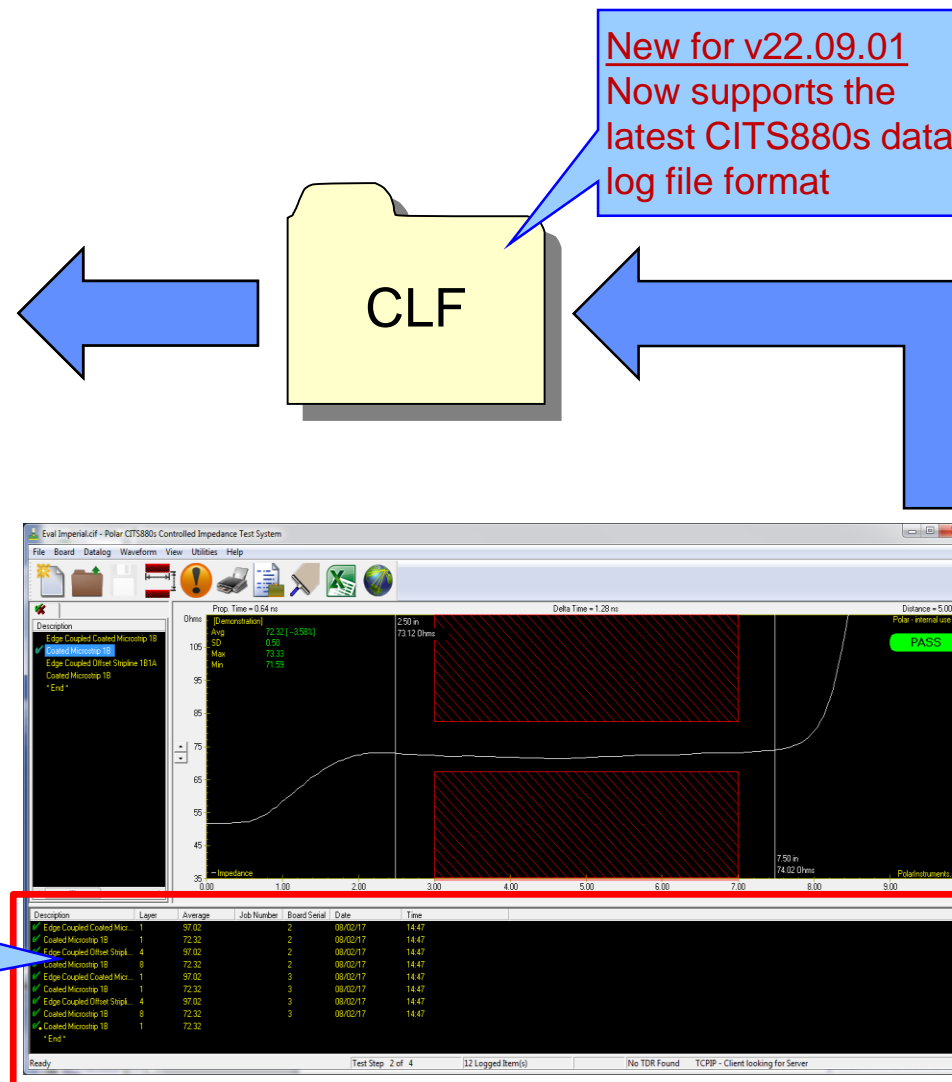
Enhancements to the Import Polar CITS Datalog File option



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.

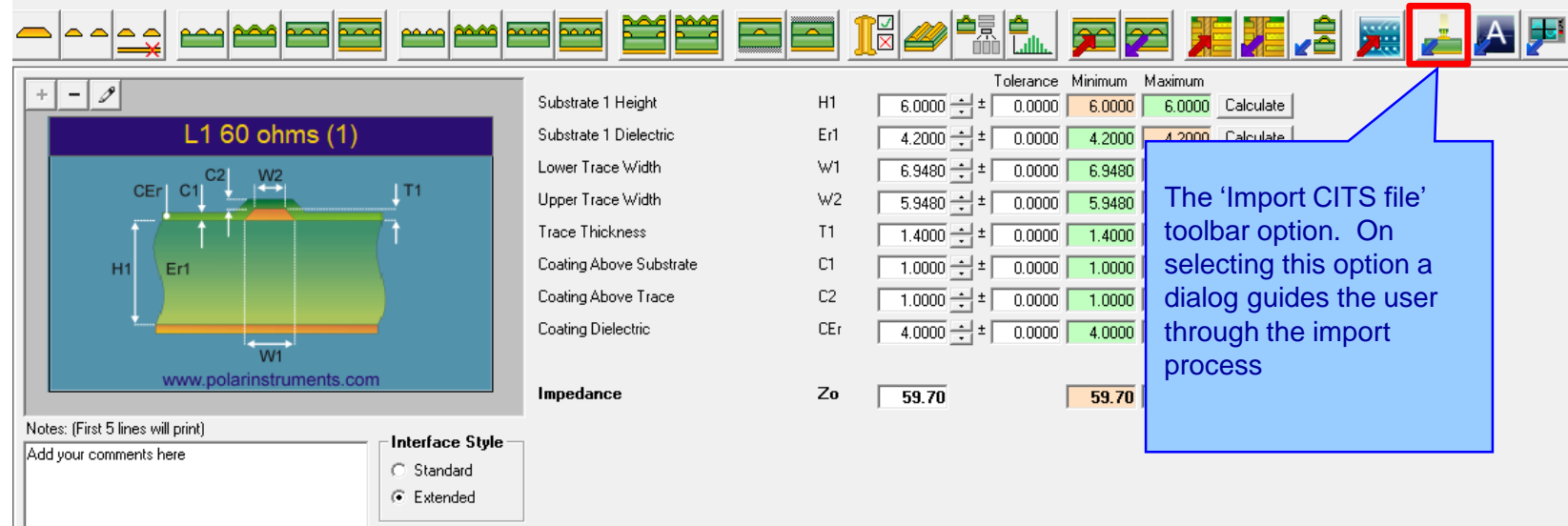
This capability within the Polar’s Si8000m / Si9000e field solver products allows the user to quickly import measurement data directly from the industry-standard Polar Controlled Impedance Test System (CITS).

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]

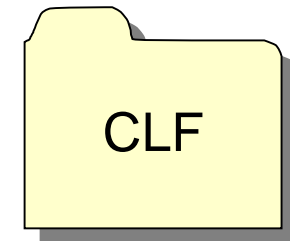
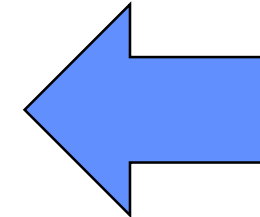
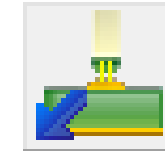
on Help



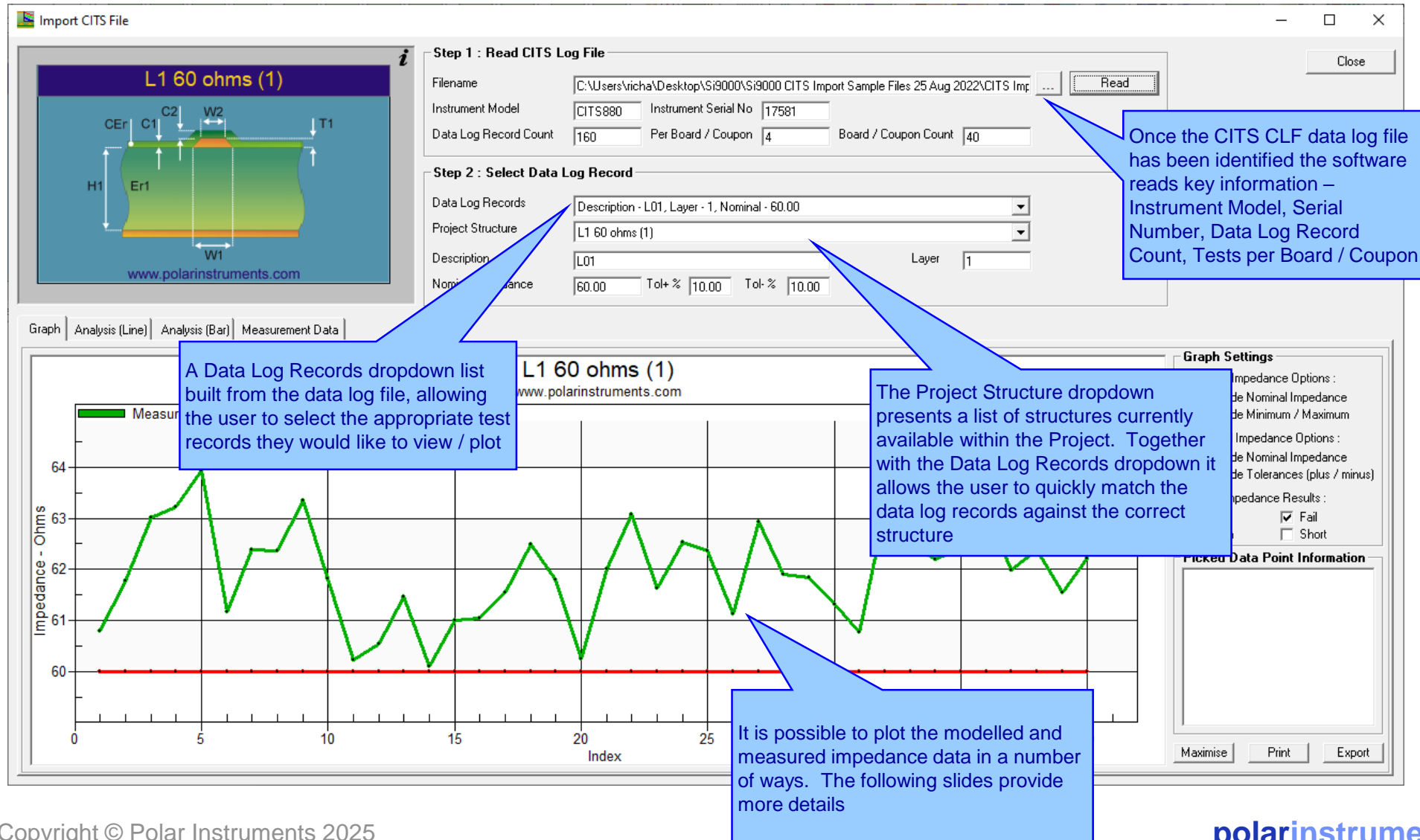
The 'Import CITS file' toolbar option. On selecting this option a dialog guides the user through the import process

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

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... **Read**

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: 60.00 Tol+ %: 10.00 Tol- %: 10.00

Graph Settings

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

Picked Data Point Information

Maximise Print Export

L1 60 ohms (1)

www.polarinstruments.com

Impedance - Ohms

Index

Measure

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

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

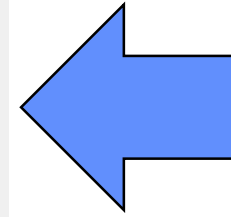
Data Log Records: Description - L01, Layer - 1, Nominal Impedance - 60.00

Project Structure: L1 60 ohms (1)

Description: L1 60 ohms (1)

Nominal Impedance: L3 60 ohms (2)

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



Polar Si9000 PCB Tran

File Edit Configurati

L1 60 ohms (1)

L3 60 ohms (2)

L6 60 ohms (3)

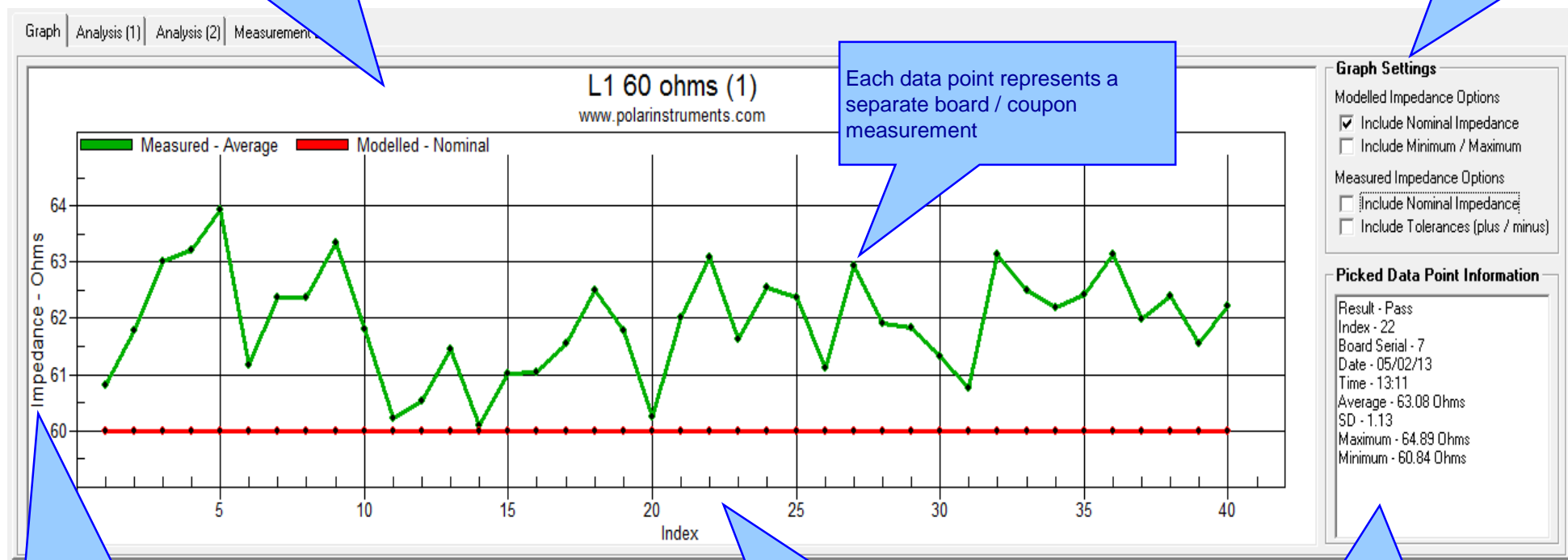
L8 60 ohms (4)

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

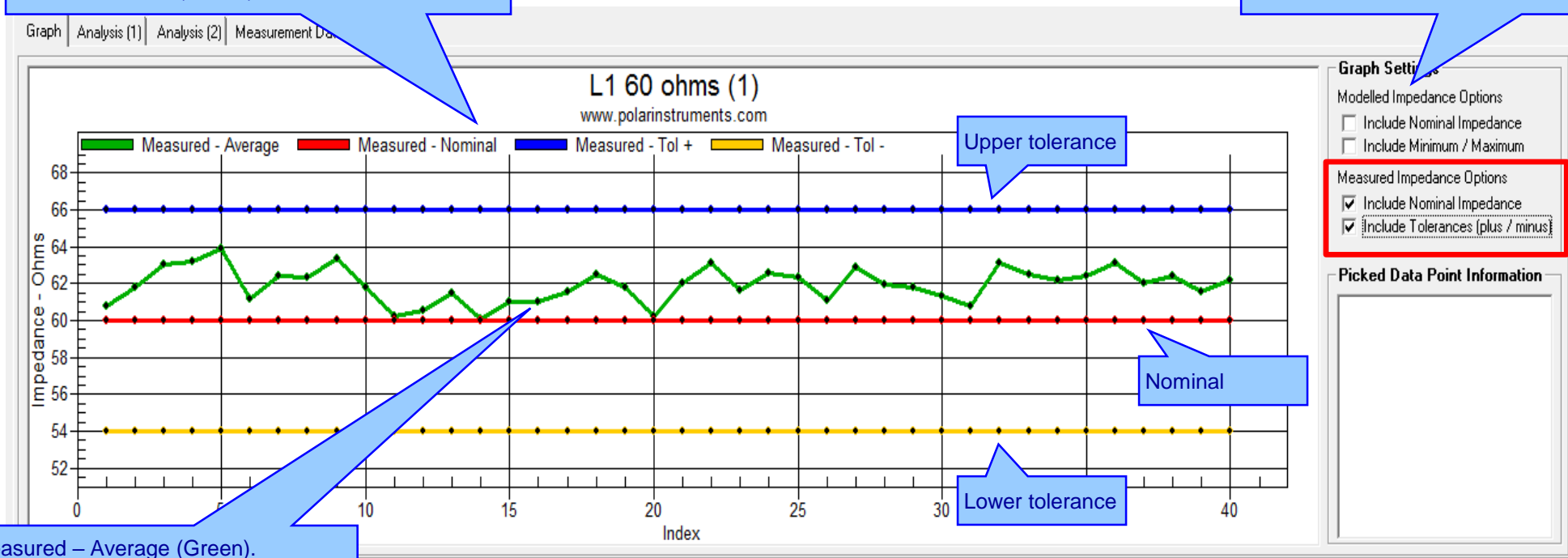
The x-axis is the identifying Index of the board / coupon read from the data log file

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



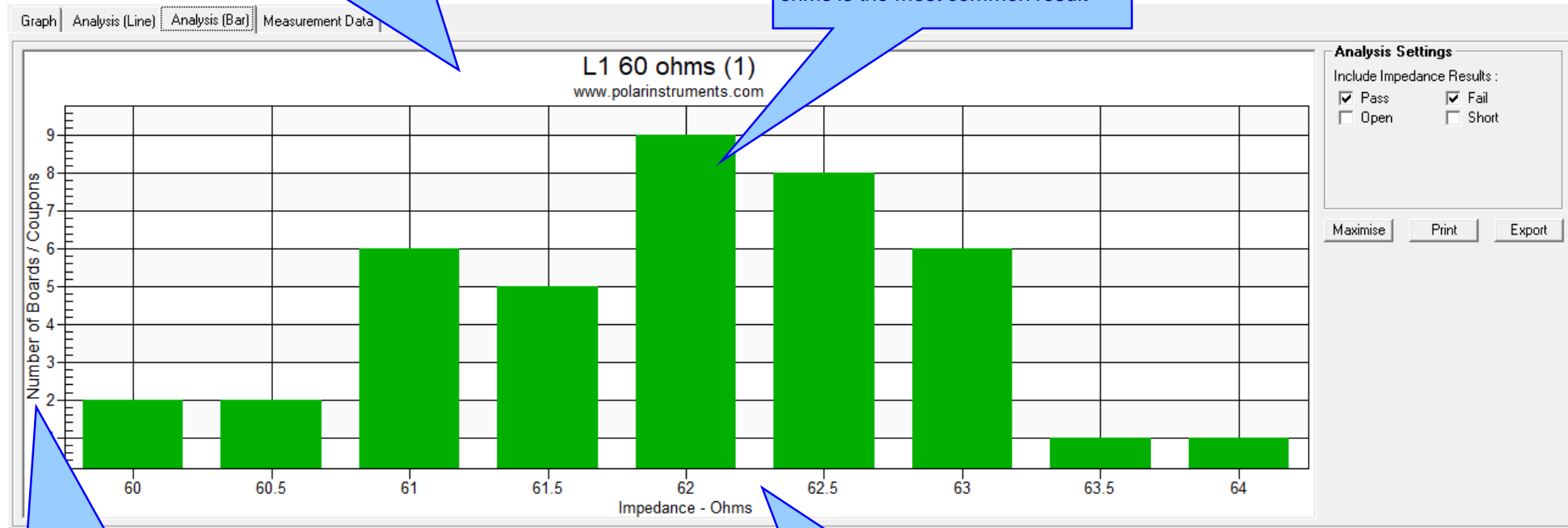
Measured – Average (Green).
Whilst reading slightly higher than the Nominal (60 ohms) all measured data points are within the upper and lower tolerance bands

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

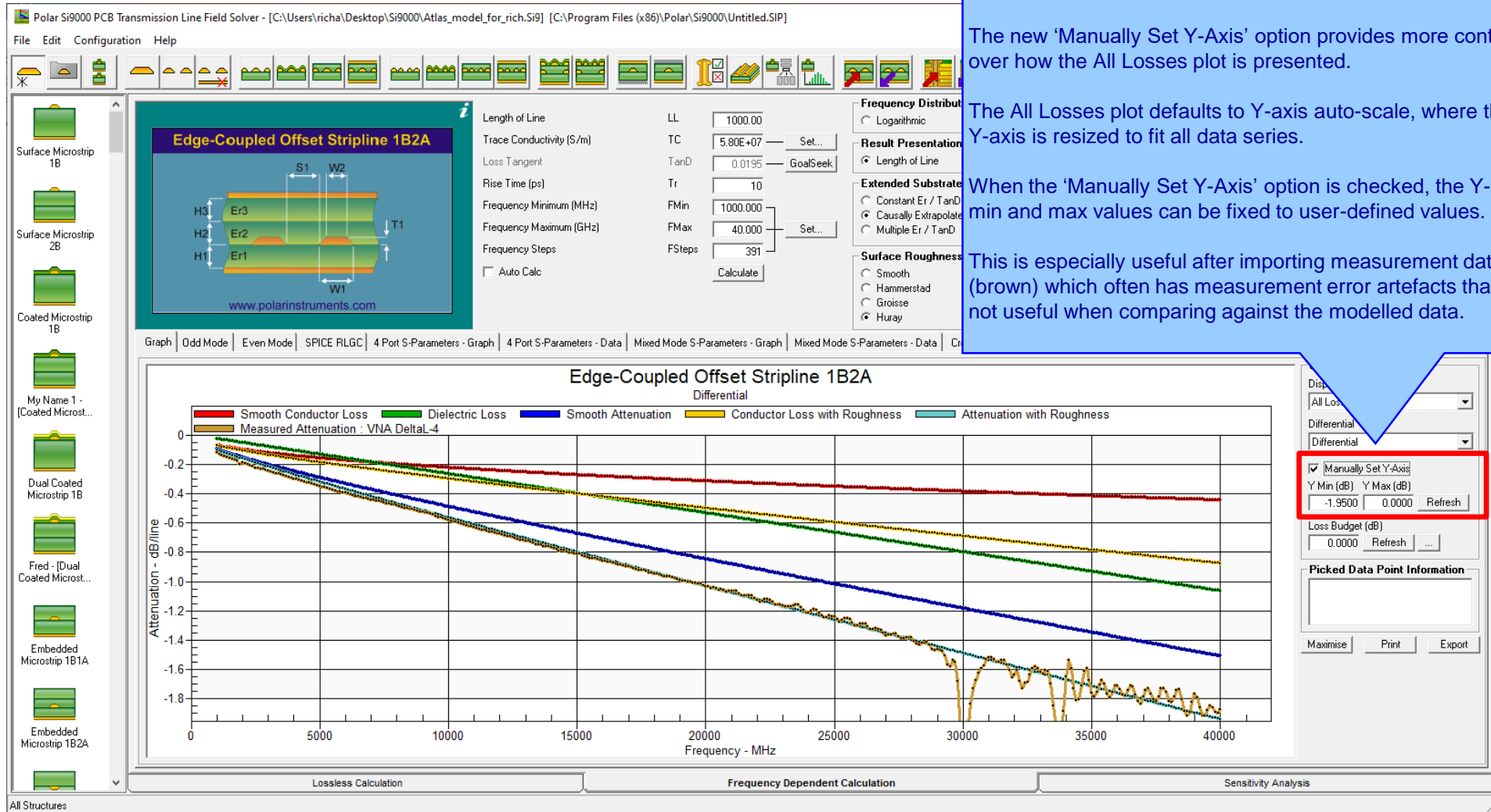
Import CITS Datalog File option – feature recap

Measurement Data:

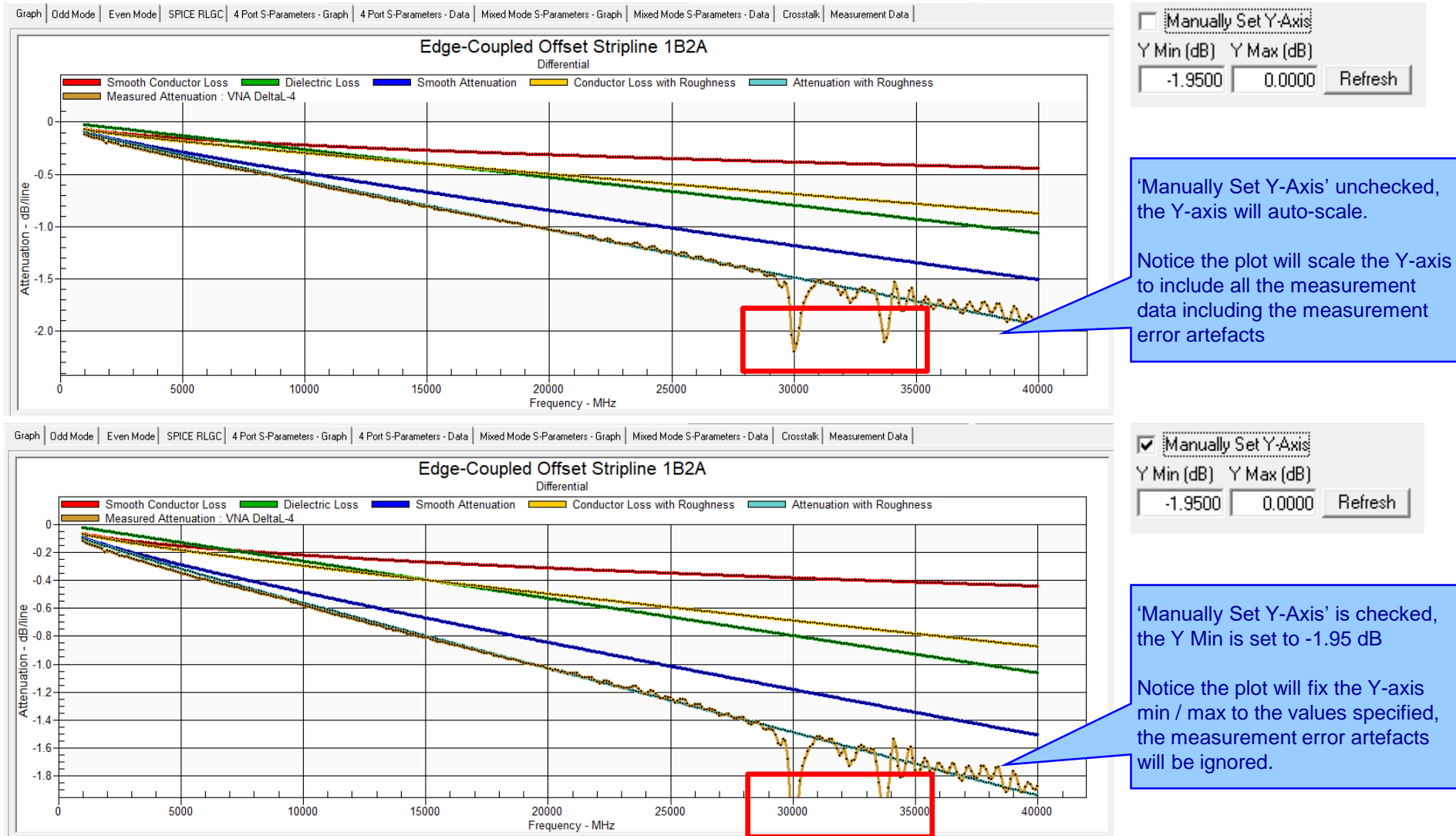
The CITS Data Log data may also be viewed in a data grid layout. This is especially useful for viewing the Result data (Pass / Fail)

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

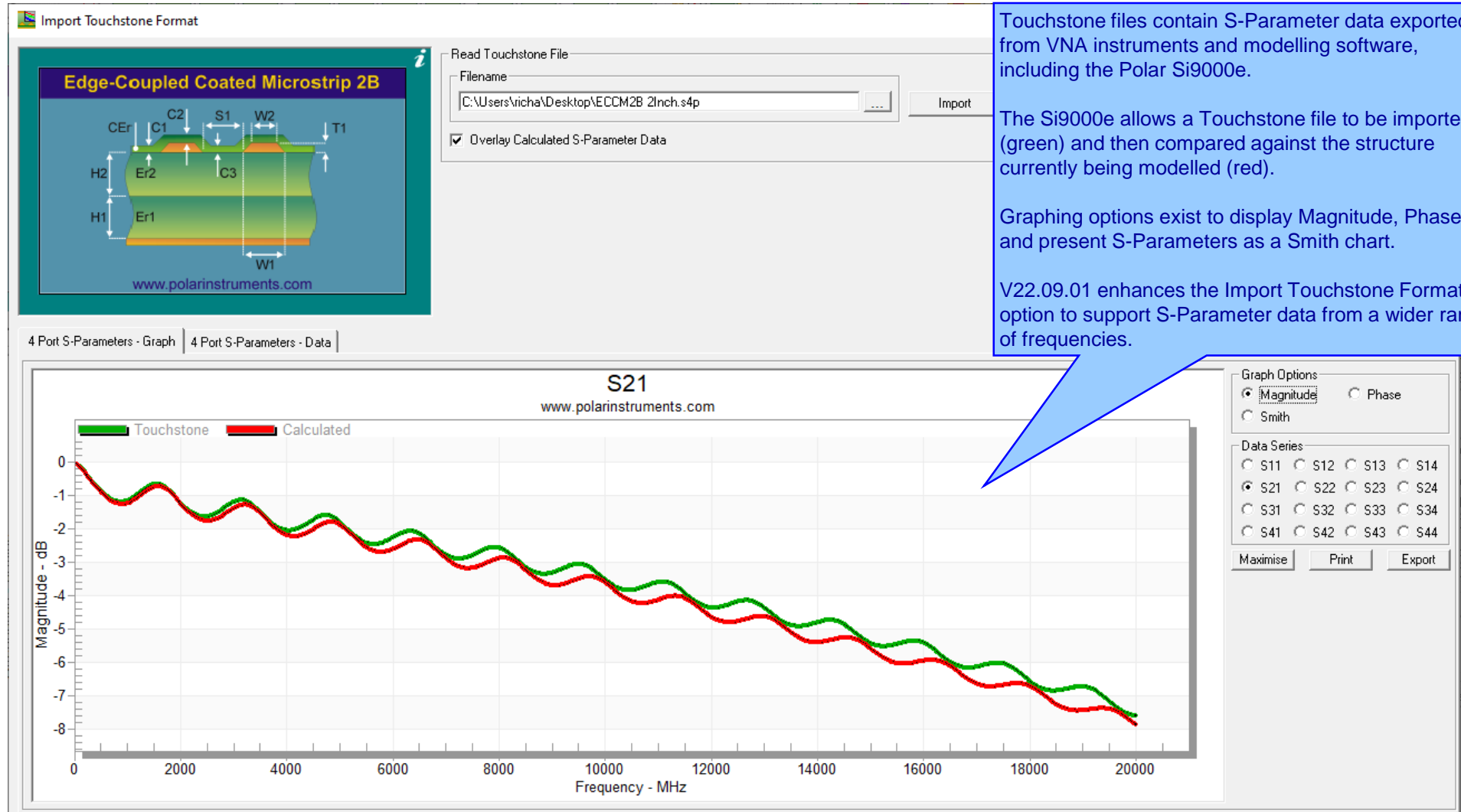
New Manually Set Y-Axis option for the All Losses plot



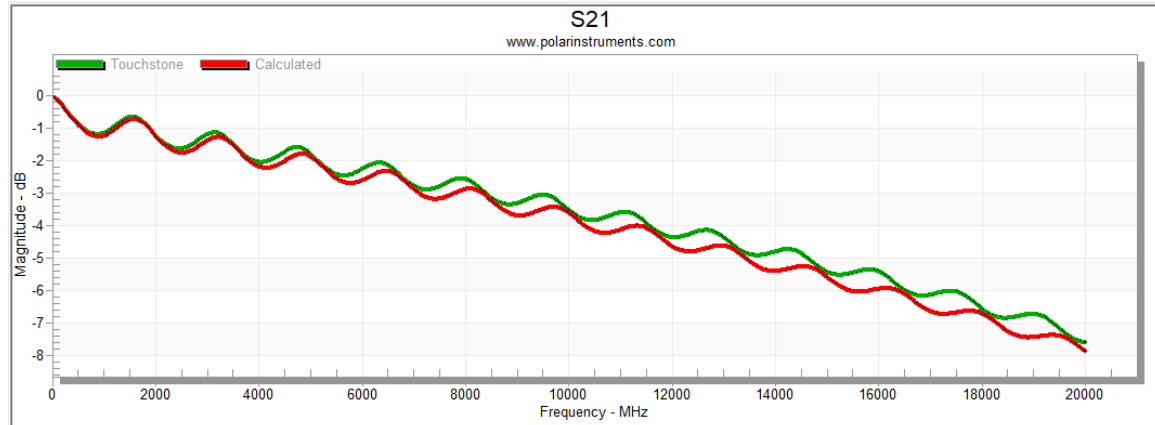
New Manually Set Y-Axis option for the All Losses plot



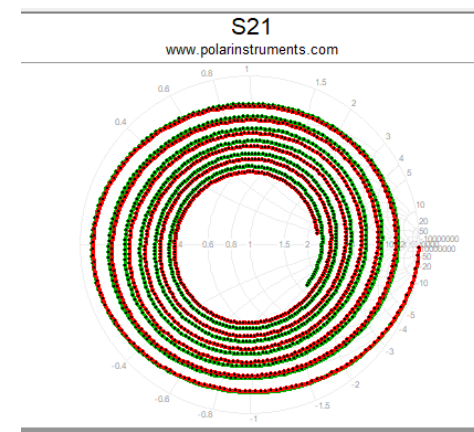
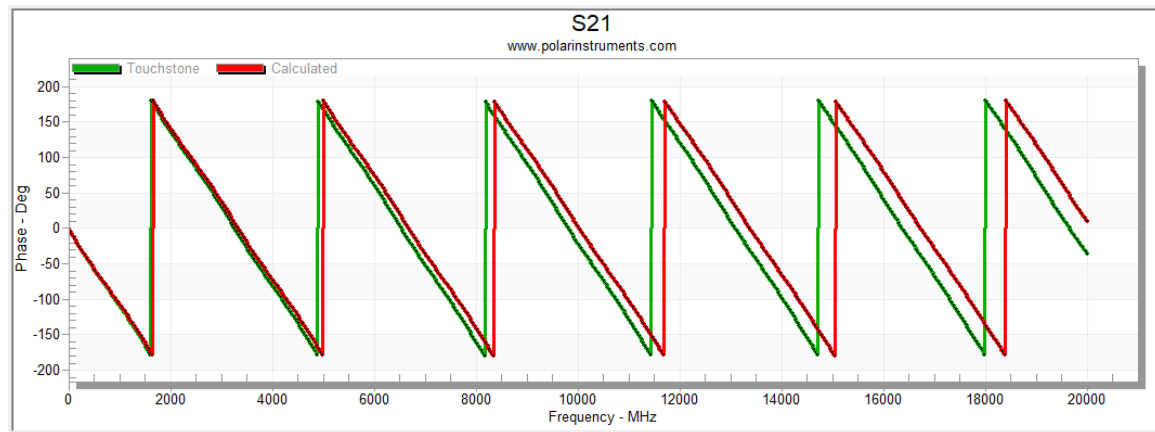
Enhancements to the Import Touchstone Format option



Enhancements to the Import Touchstone Format option

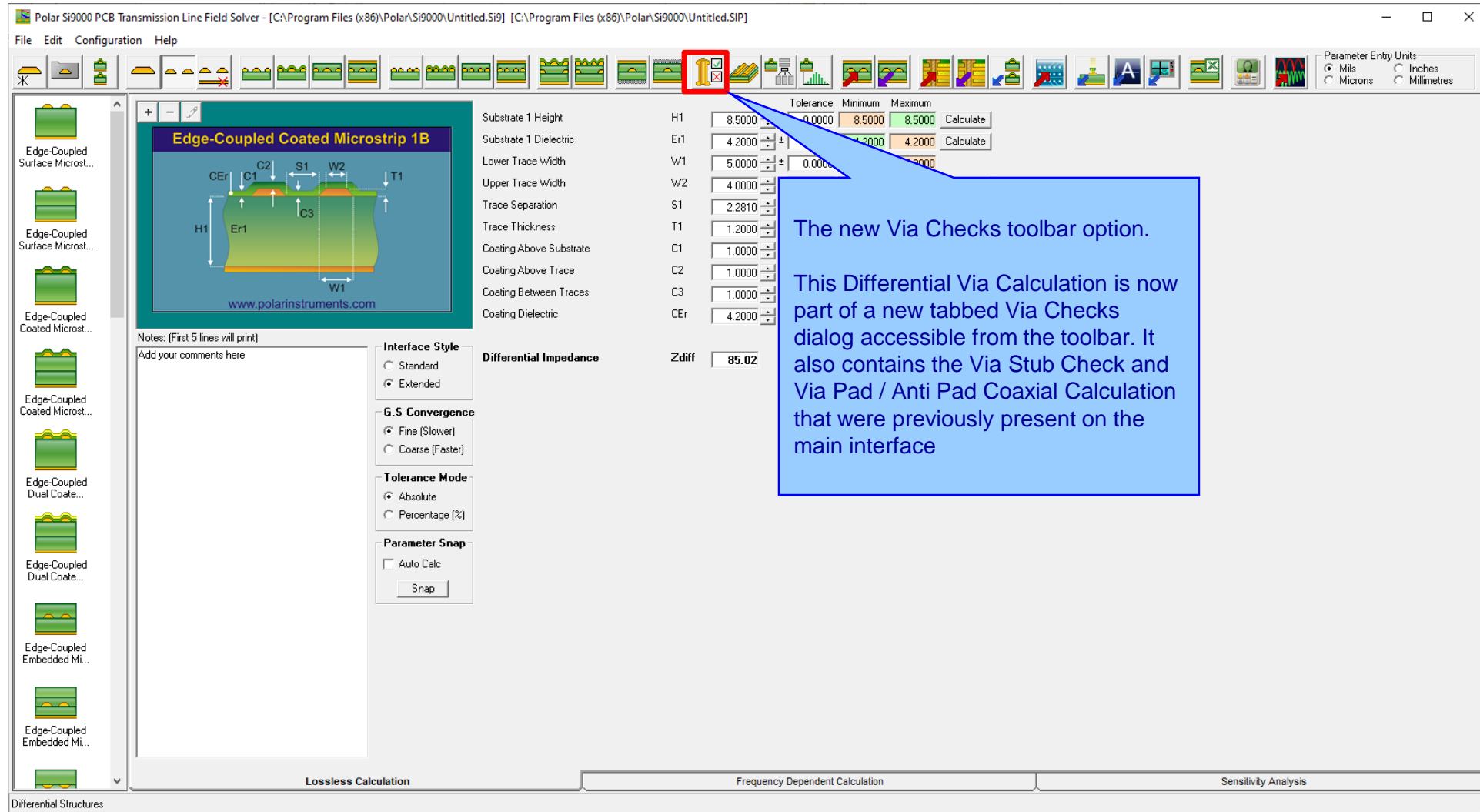


In this example a Touchstone 4-port file (.S4P) has been imported into the Si9000e. Magnitude, Phase and Smith Chart are shown for S21



v22.04 (April 2022)

New Differential Via Calculation capability



Polar Si9000 PCB Transmission Line Field Solver - [C:\Program Files (x86)\Polar\Si9000\Untitled.Si9] [C:\Program Files (x86)\Polar\Si9000\Untitled.Si9]

File Edit Configuration Help

Parameter Entry Units
☒ Mils ☐ Inches
☐ Microns ☐ Millimetres

Edge-Coupled Surface Microst...
Edge-Coupled Surface Microst...
Edge-Coupled Coated Microst...
Edge-Coupled Coated Microst...
Edge-Coupled Dual Coate...
Edge-Coupled Dual Coate...
Edge-Coupled Embedded Mi...
Edge-Coupled Embedded Mi...

Edge-Coupled Coated Microstrip 1B

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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
Snap

Differential Impedance

	Tolerance	Minimum	Maximum	Calculate
H1	8.5000	0.0000	8.5000	Calculate
Er1	4.2000	4.2000	4.2000	Calculate
W1	5.0000	0.0000	5.0000	Calculate
W2	4.0000			
S1	2.2810			
T1	1.2000			
C1	1.0000			
C2	1.0000			
C3	1.0000			
CEr	4.2000			
Zdiff				85.02

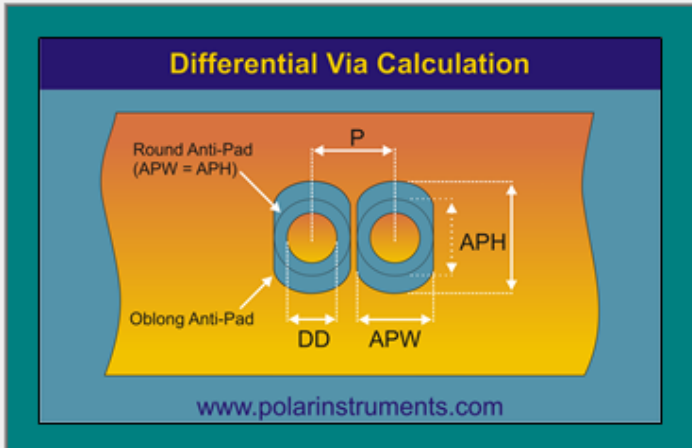
Lossless Calculation Frequency Dependent Calculation Sensitivity Analysis

Differential Structures

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



Differential Via Calculation

Round Anti-Pad (APW = APH)

Oblong Anti-Pad

DD, APW, APH, P

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

Anti-Pad Style

☐ Horizontal Oval Anti-Pad ☒ Round / Oblong Anti-Pad

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

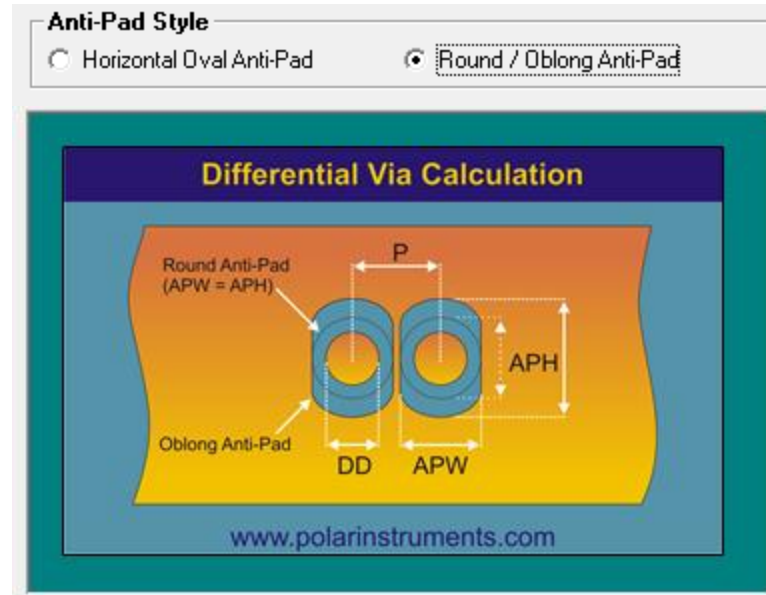
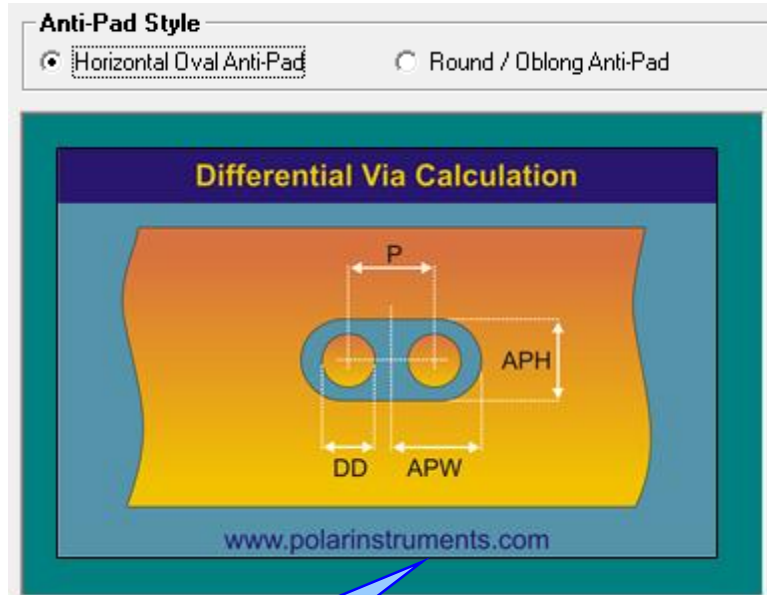
Please refer to the parameters in parentheses when reading [Application Note](#)
Courtesy of Bert Simonovich, Lamsim Enterprises Inc

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.

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

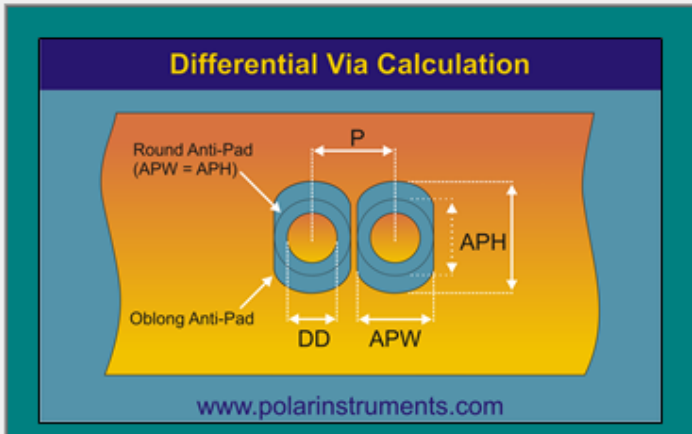


Two different selectable
Anti-Pad Styles available

New Differential Via Calculation

Via Checks

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



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

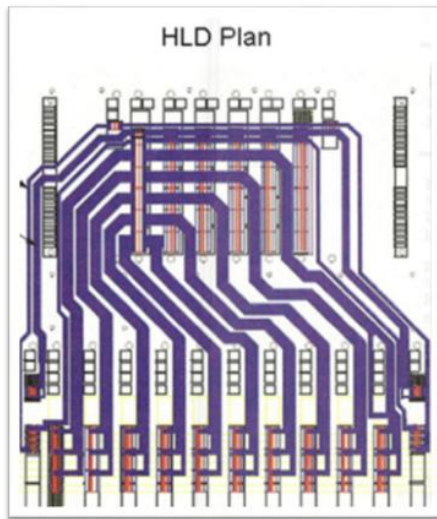
Note: The model works for a simple differential pair structure with no pads and several reference planes so the accuracy will be high.

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

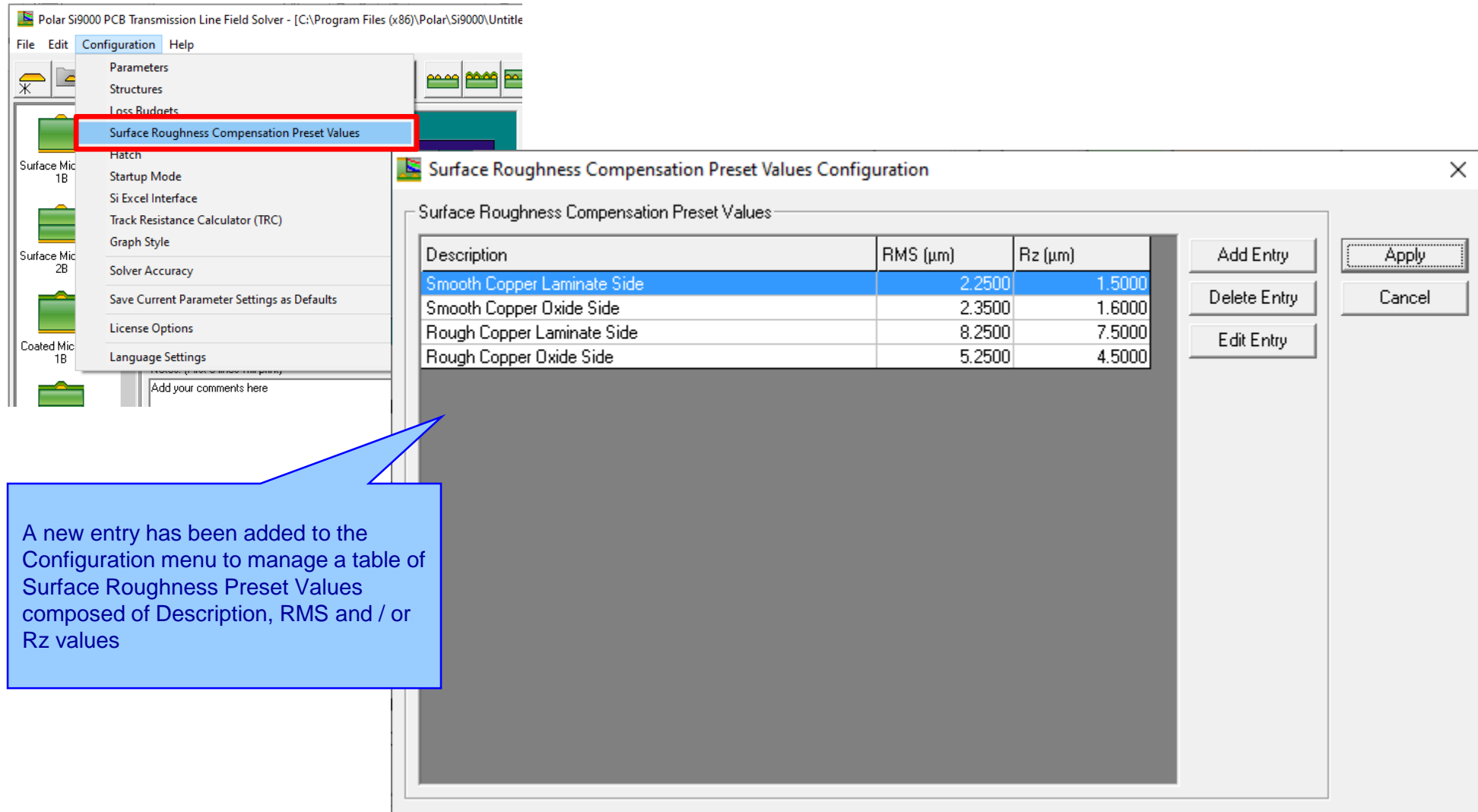
You come up with a concept you think will work, but the backplane is thick with over 30 layers. There are some long traces over 30 inches and some short traces of less than 2 inches between card slots. There is strong pressure to reuse the same connector you used in your last design, but your gut tells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

v22.03 (March 2022)

New Surface Roughness Compensation Preset Values option



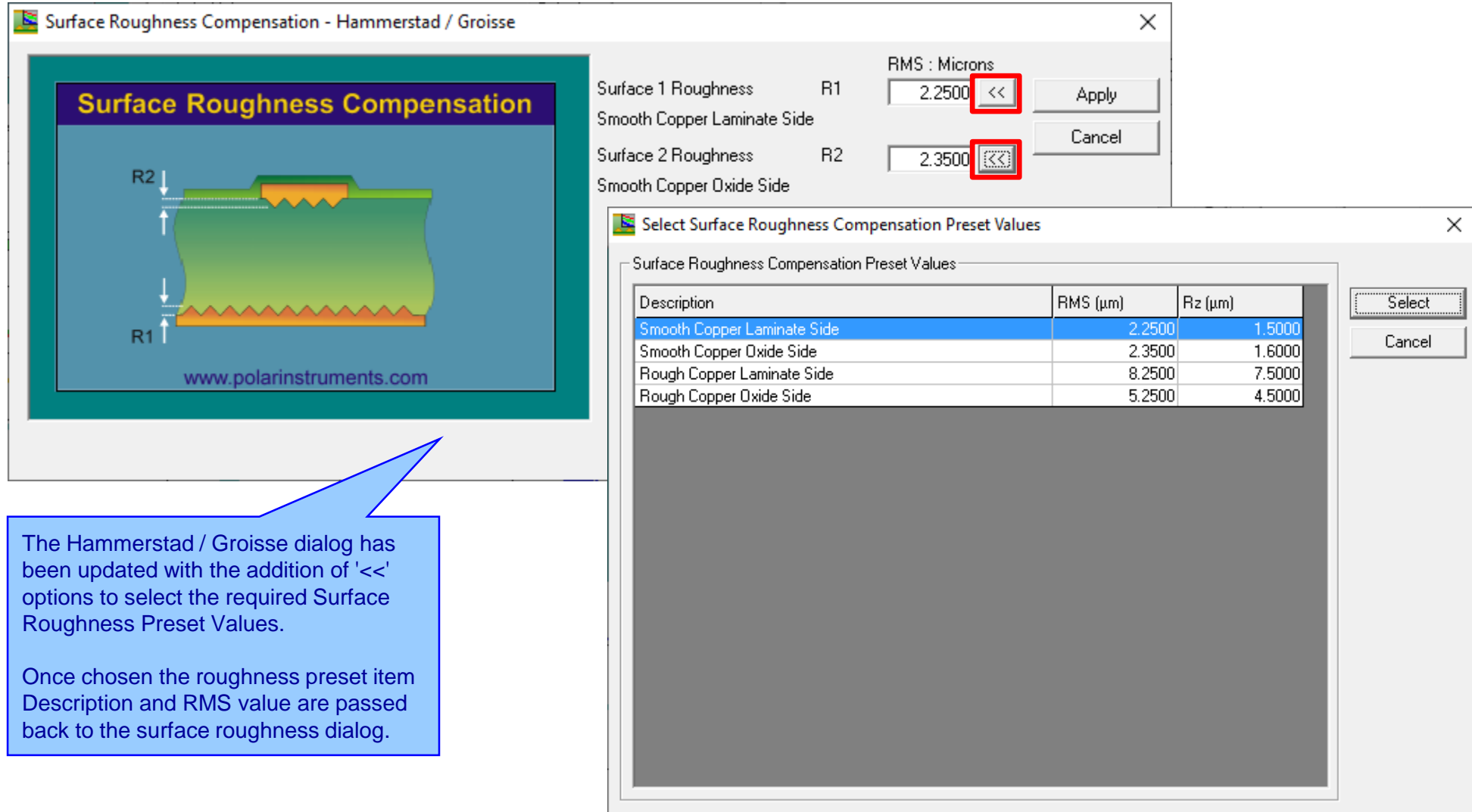
The screenshot shows the Polar Si9000 PCB Transmission Line Field Solver application. The 'Configuration' menu is open, and the 'Surface Roughness Compensation Preset Values' option is highlighted. A dialog box titled 'Surface Roughness Compensation Preset Values Configuration' is displayed, showing a table of preset values for surface roughness compensation.

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 dialog box also includes buttons for 'Add Entry', 'Delete Entry', 'Edit Entry', 'Apply', and 'Cancel'. A blue callout box points to the 'Add Entry' button, indicating that a new entry has been added to the table.

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 main dialog, "Surface Roughness Compensation - Hammerstad / Grosse", features a diagram on the left showing a cross-section of a surface with roughness parameters R1 and R2. The right side contains input fields for "Surface 1 Roughness R1" (2.2500) and "Surface 2 Roughness R2" (2.3500), both with a red box highlighting the "<<" button. Below these are "Apply" and "Cancel" buttons.

The sub-dialog, "Select Surface Roughness Compensation Preset Values", displays a table of preset values:

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 "Smooth Copper Laminate Side" row is highlighted in blue. "Select" and "Cancel" buttons are on the right.

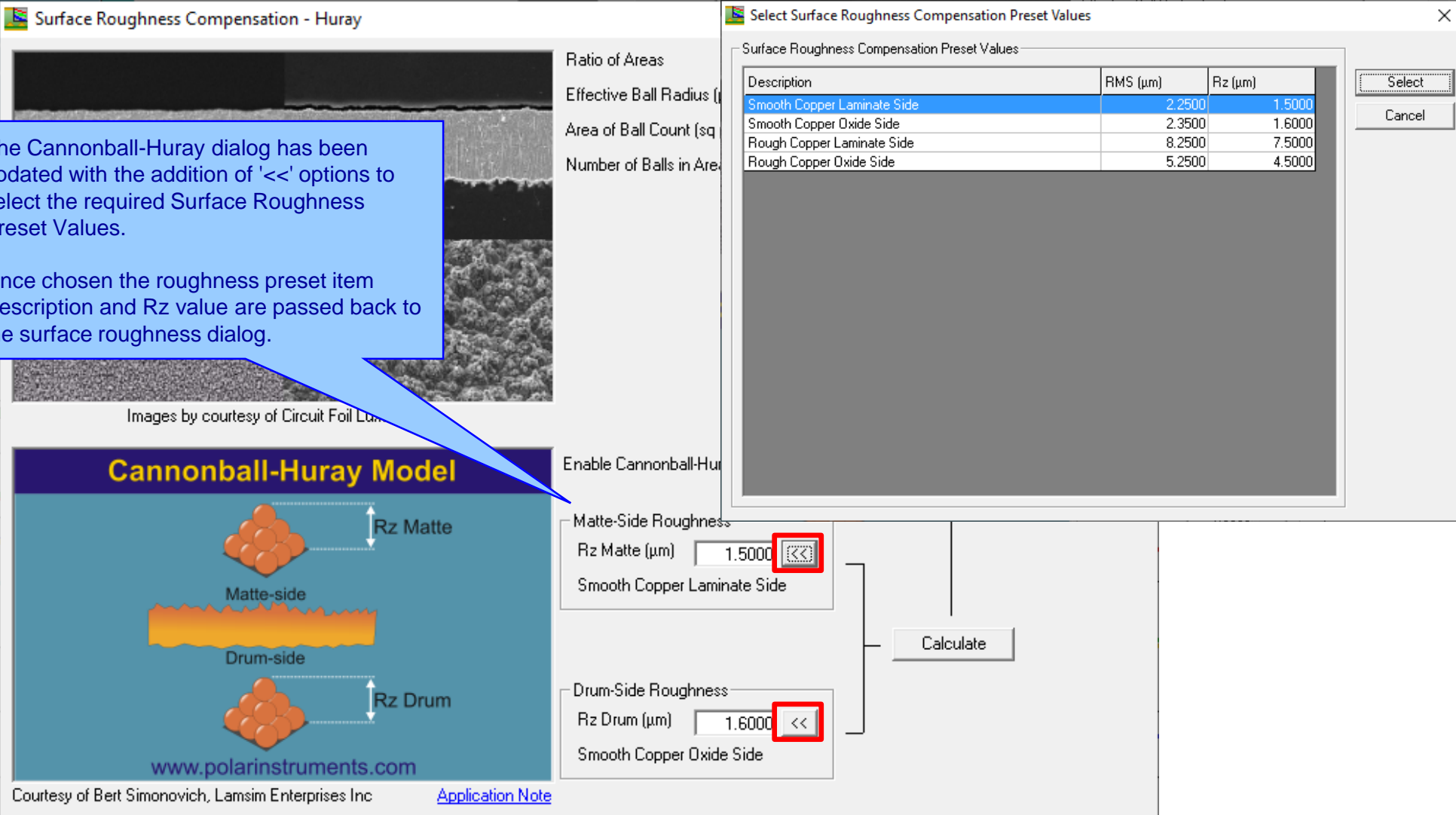
The Hammerstad / Grosse dialog has been updated with the addition of '<<' options to select the required Surface Roughness Preset Values.

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.



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

Cannonball-Huray Model

Matte-Side Roughness

Rz Matte (μm) 1.5000 <<

Smooth Copper Laminate Side

Drum-Side Roughness

Rz Drum (μm) 1.6000 <<

Smooth Copper Oxide Side

Calculate

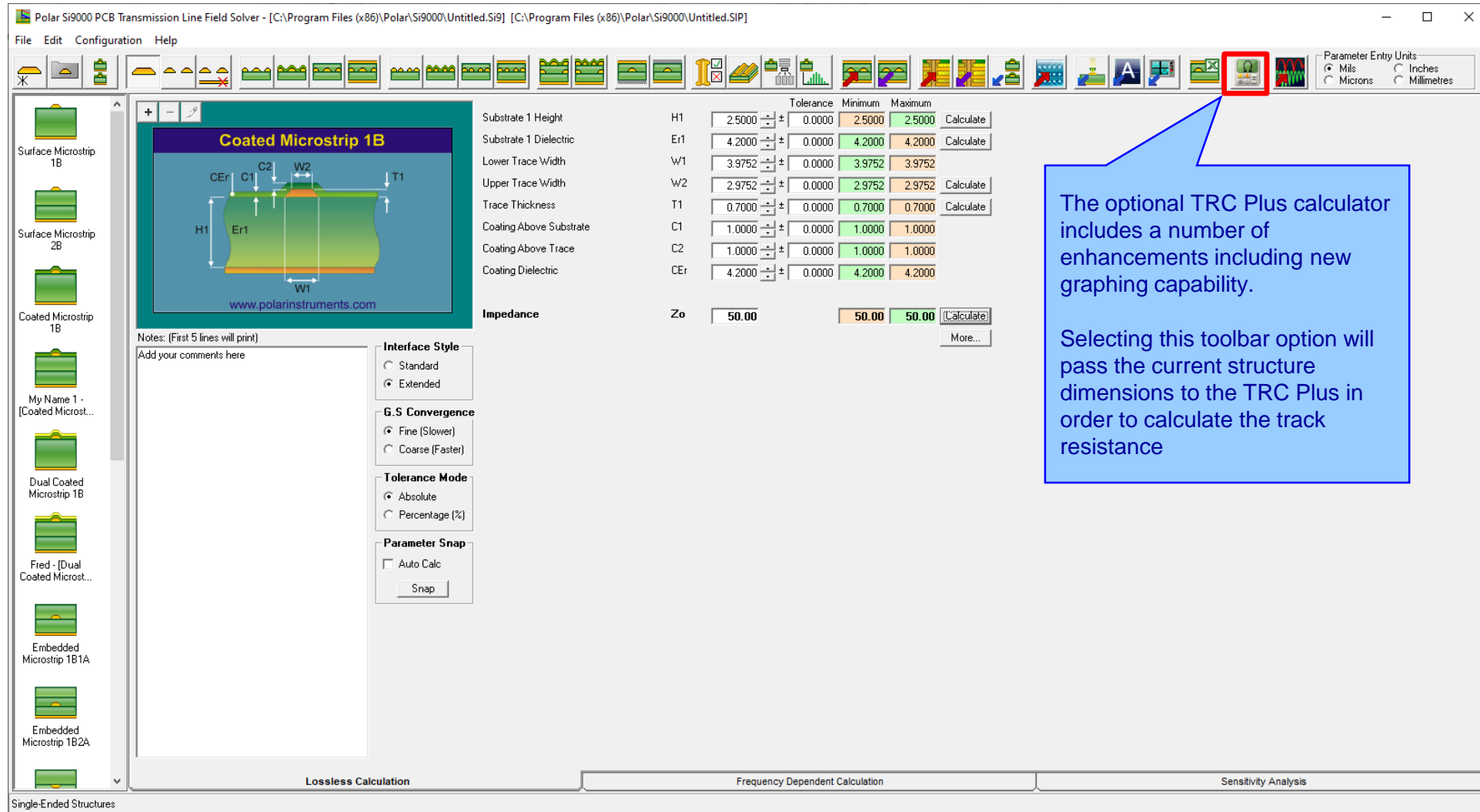
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Courtesy of Bert Simonovich, Lamsim Enterprises Inc

[Application Note](#)

v22.02 (February 2022)

Track Resistance Calculator (TRC Plus) enhancements



Polar Si9000 PCB Transmission Line Field Solver - [C:\Program Files (x86)\Polar\Si9000\Untitled.Si9] [C:\Program Files (x86)\Polar\Si9000\Untitled.SIP]

File Edit Configuration Help

Surface Microstrip 1B

Surface Microstrip 2B

Coated Microstrip 1B

My Name 1 - [Coated Microst...

Dual Coated Microstrip 1B

Fred - [Dual Coated Microst...

Embedded Microstrip 1B1A

Embedded Microstrip 1B2A

Single-Ended Structures

Coated Microstrip 1B

CEr C1 C2 W2 T1 H1 Er1 W1

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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

		Tolerance	Minimum	Maximum	
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...

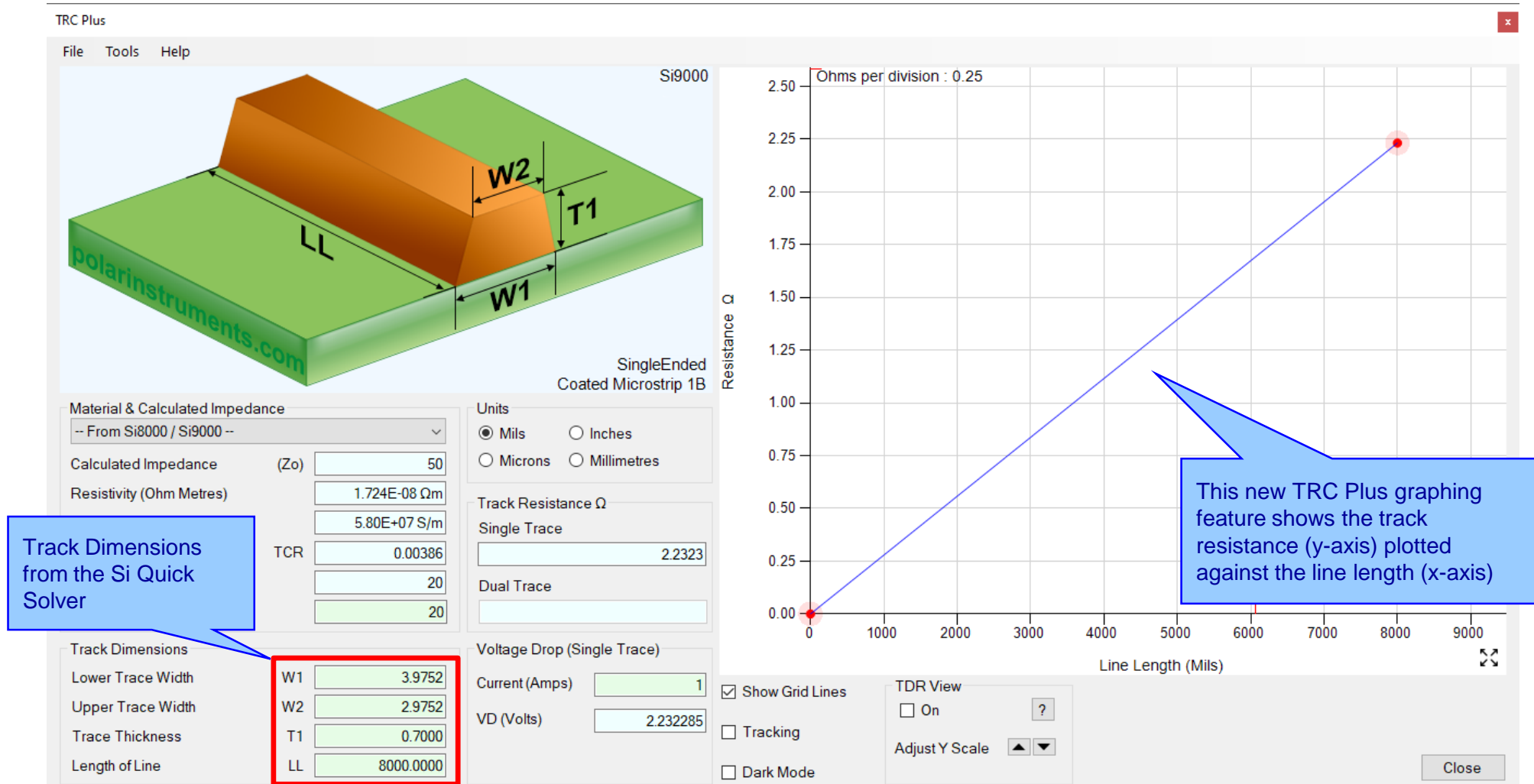
Parameter Entry Units
☒ Mils ☐ Inches
☐ Microns ☐ Millimetres

Lossless Calculation Frequency Dependent Calculation Sensitivity Analysis

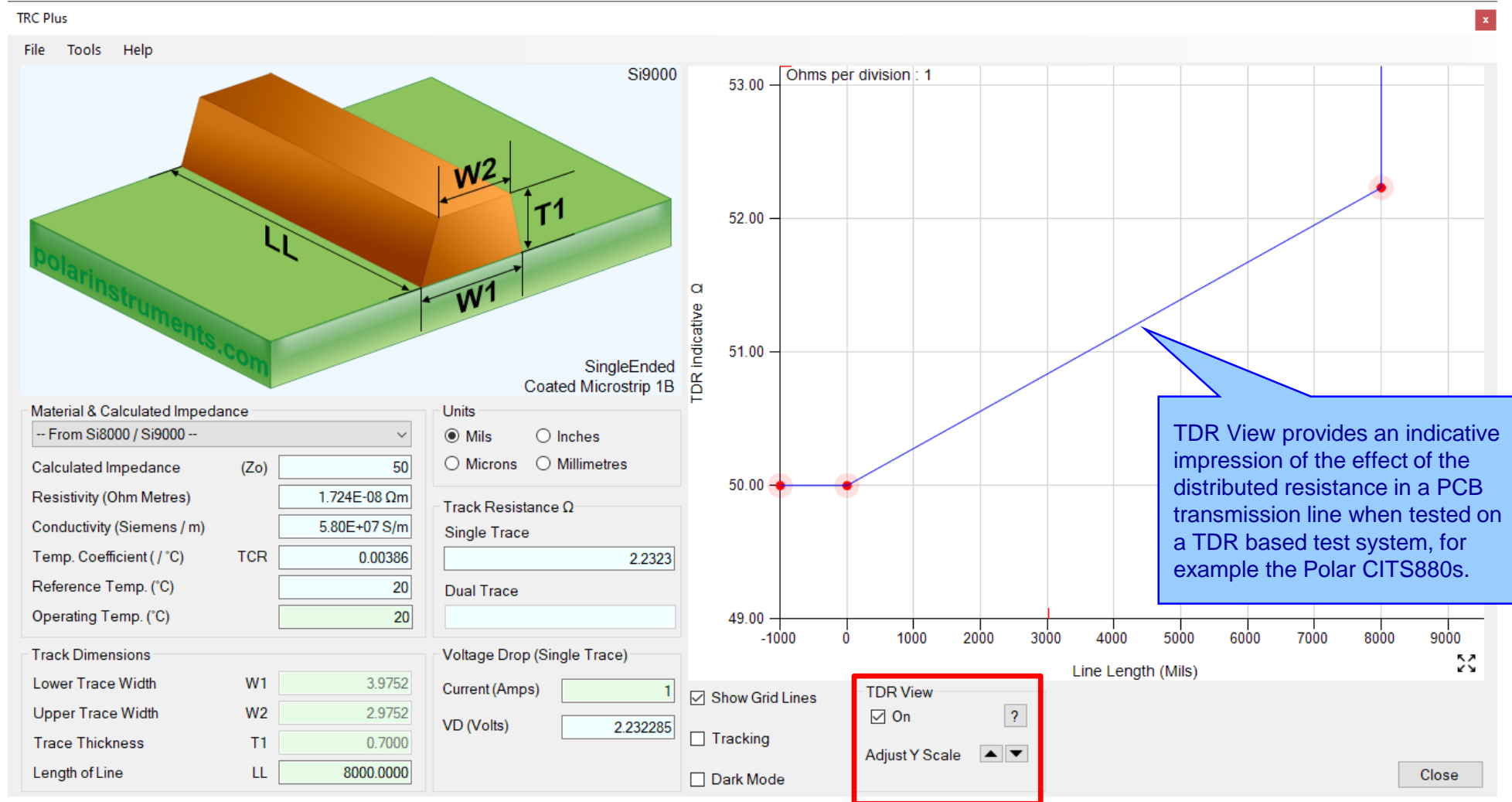
The optional TRC Plus calculator includes a number of enhancements including new graphing capability.

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



Track Resistance Calculator (TRC Plus) enhancements



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.

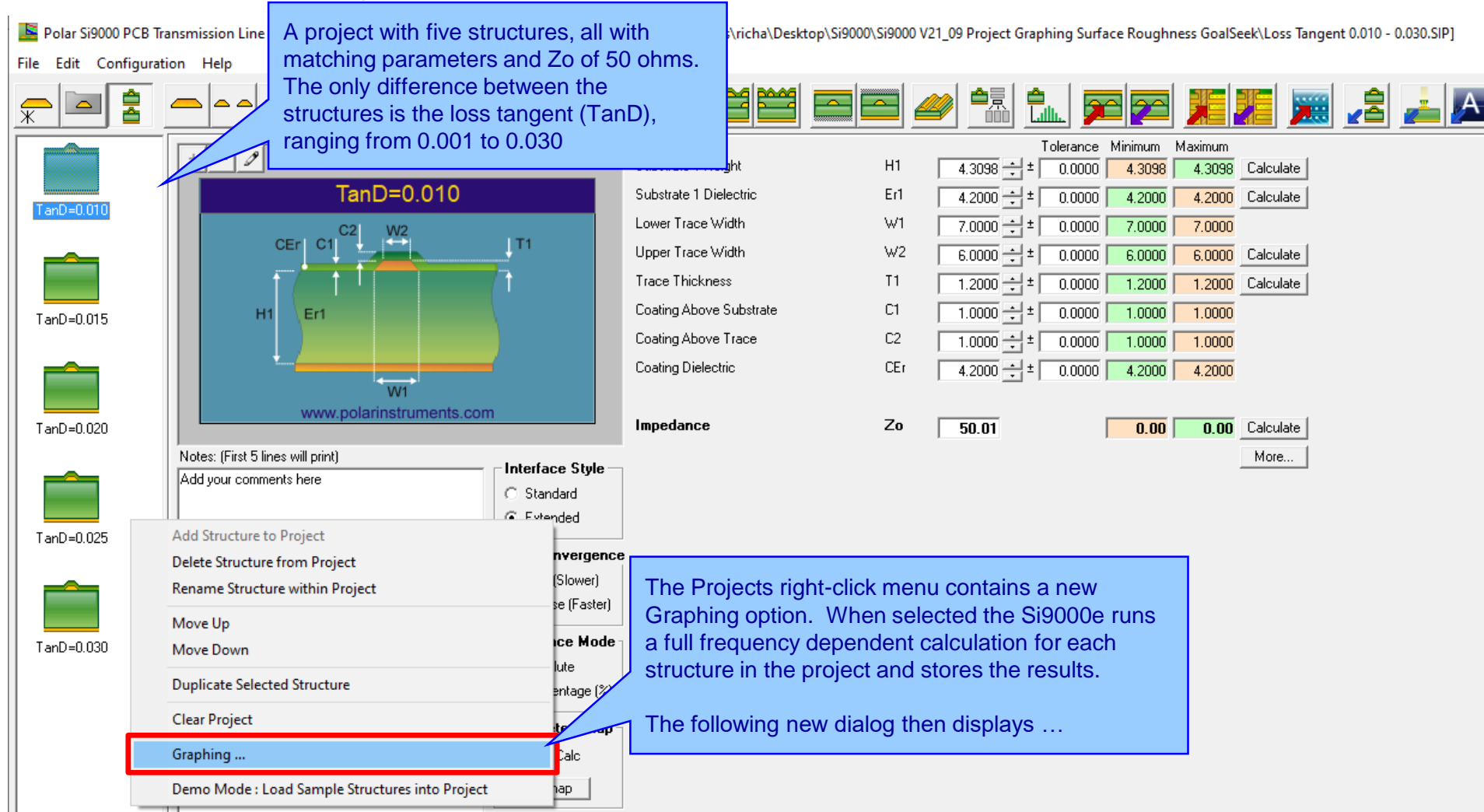
A single graph that combines results from multiple structures is useful in a number of ways. Comparing the impact of different dielectric materials, different roughness, sensitivity analysis for lossy calculations and many more uses.

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 ...



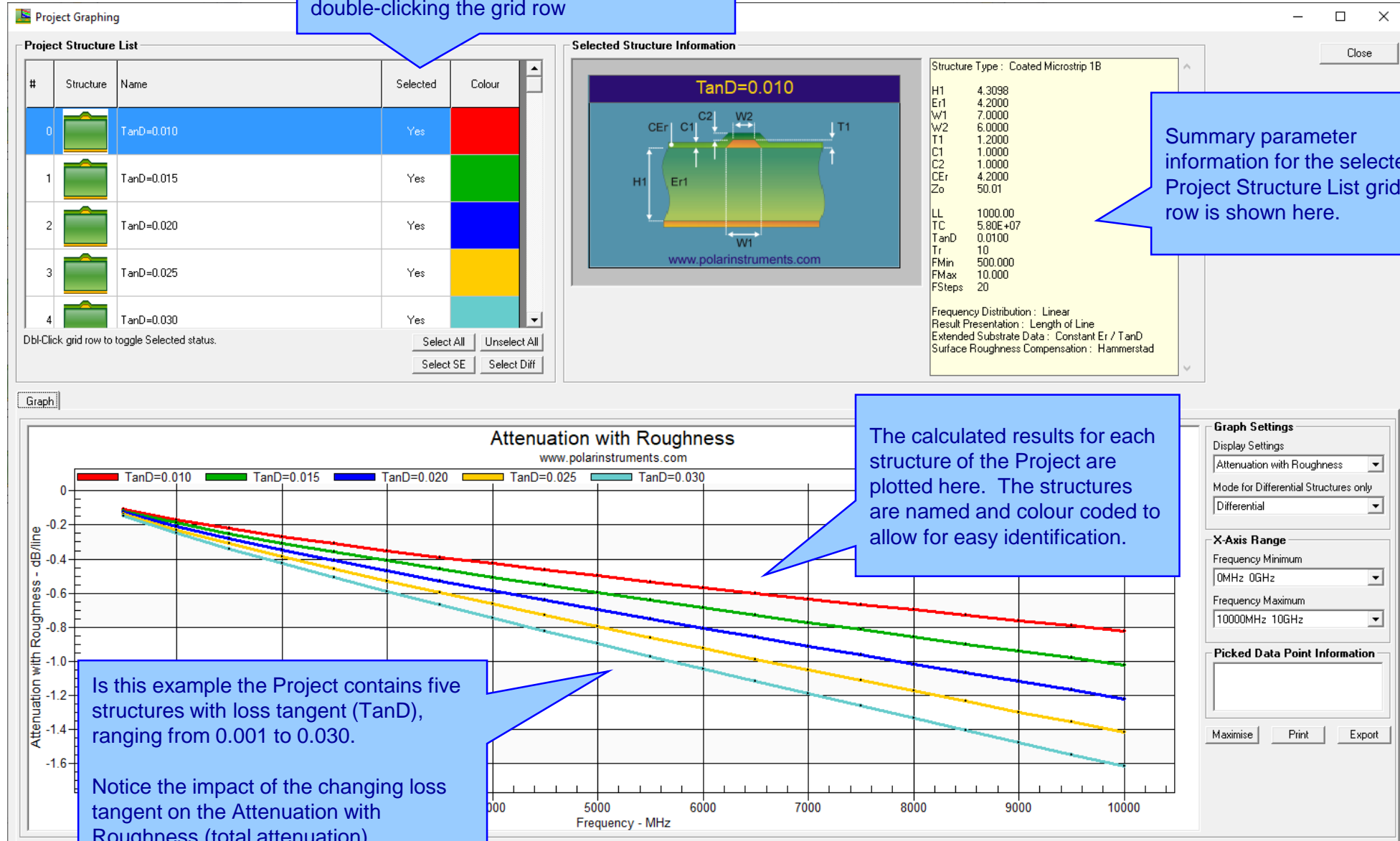
The screenshot shows the Polar Si9000 PCB Transmission Line software interface. The main window displays a cross-section diagram of a PCB structure with parameters: TanD=0.010, H1, Er1, C1, C2, W1, W2, and T1. The left sidebar shows a list of structures with TanD values: 0.010, 0.015, 0.020, 0.025, and 0.030. The right sidebar shows a table of parameters and their values.

		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	50.01	0.00	0.00	Calculate

The right-click menu is open, showing the following options:

- Add Structure to Project
- Delete Structure from Project
- Rename Structure within Project
- Move Up
- Move Down
- Duplicate Selected Structure
- Clear Project
- Graphing ...
- Demo Mode : Load Sample Structures into Project

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

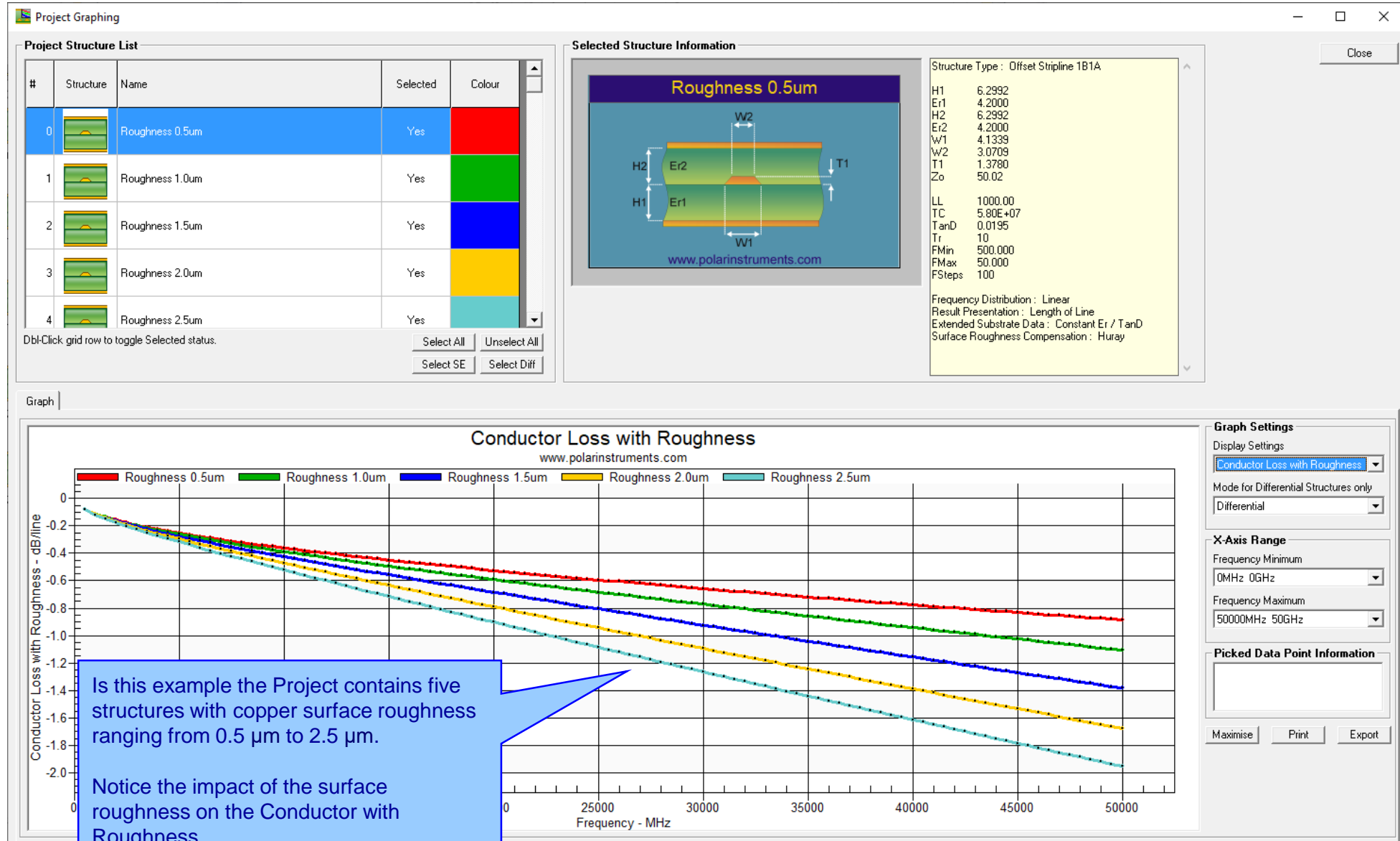


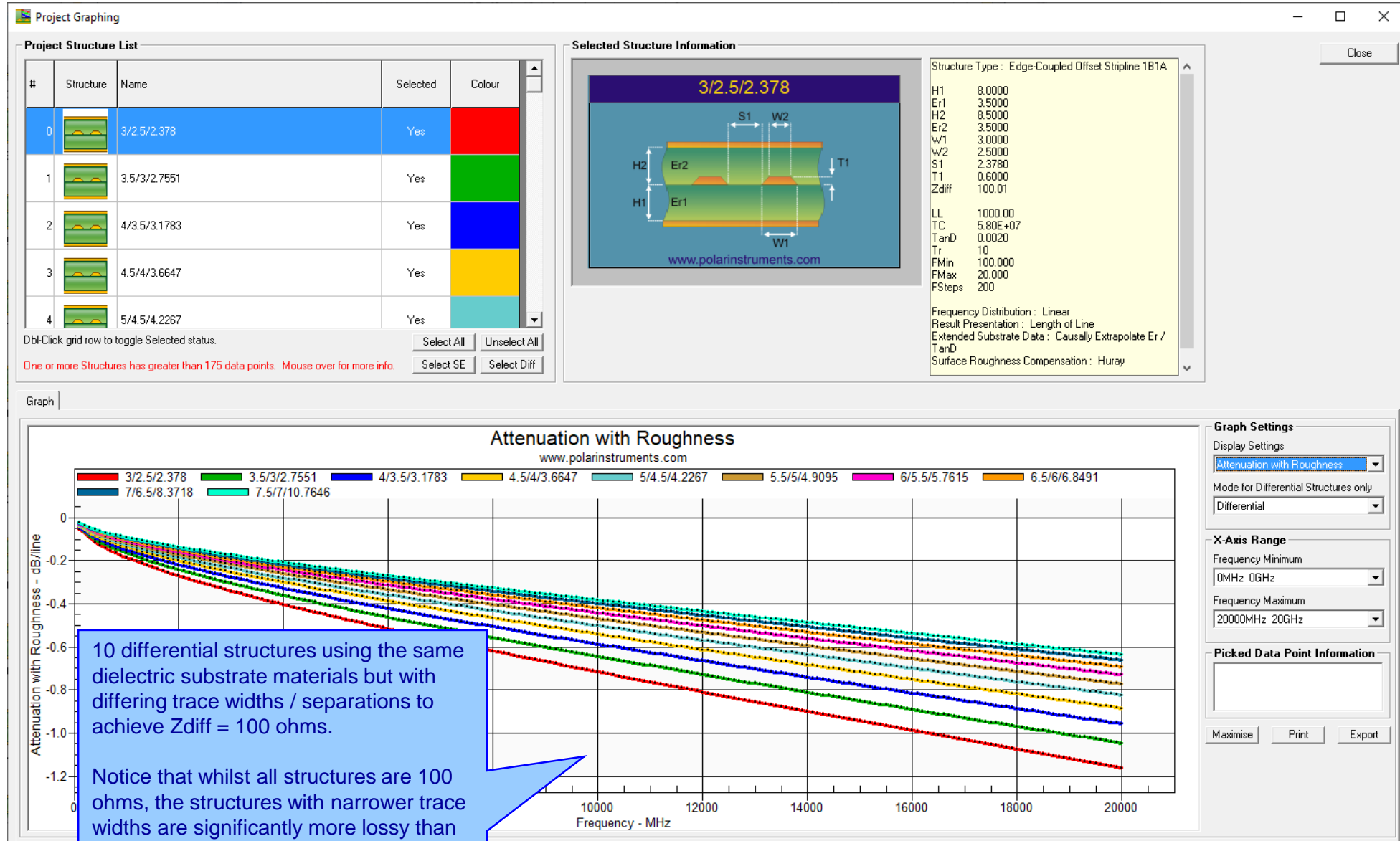
Summary parameter information for the selected Project Structure List grid row is shown here.

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)





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

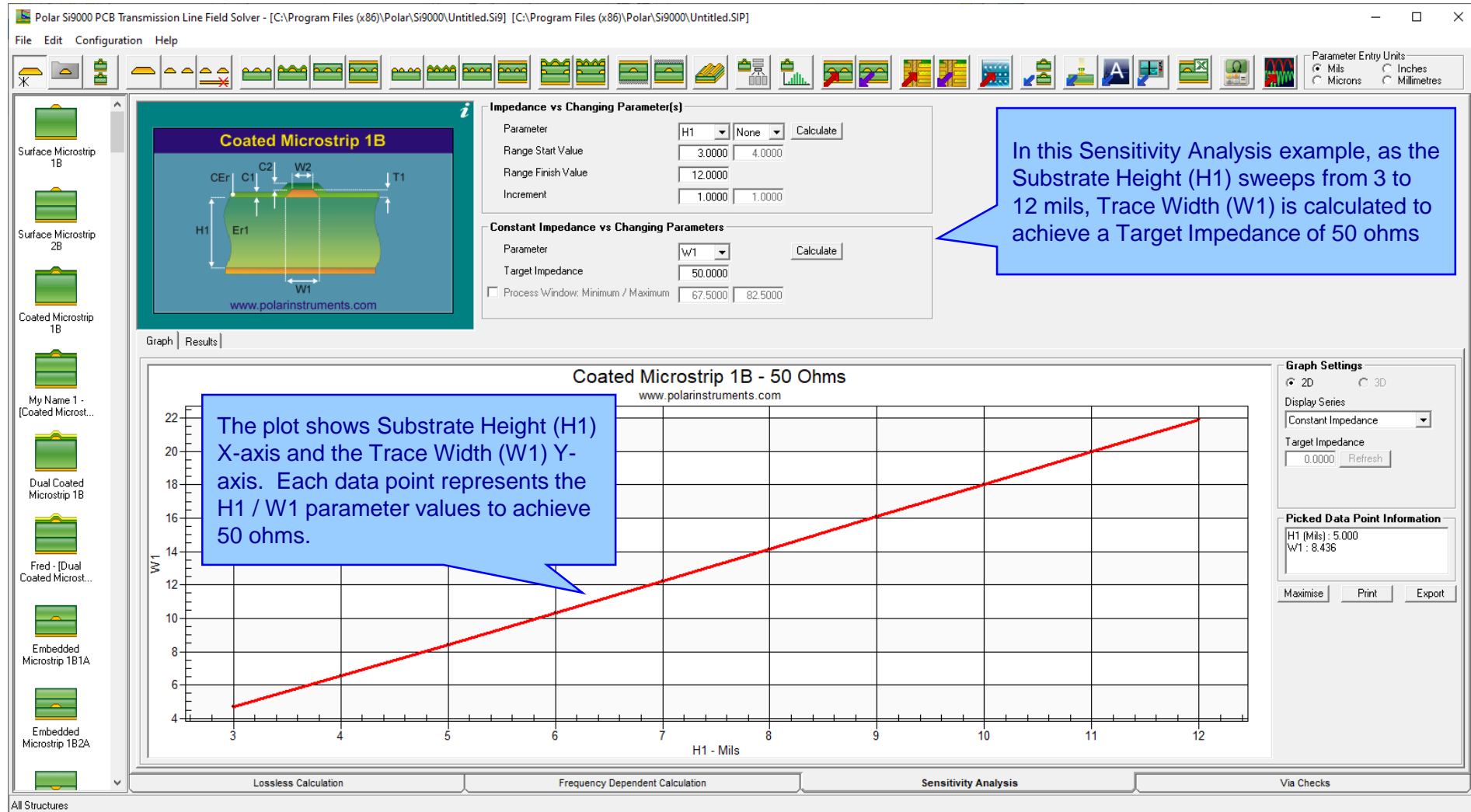
Populate a Project from Sensitivity Analysis Results

(requires the Si Projects feature)

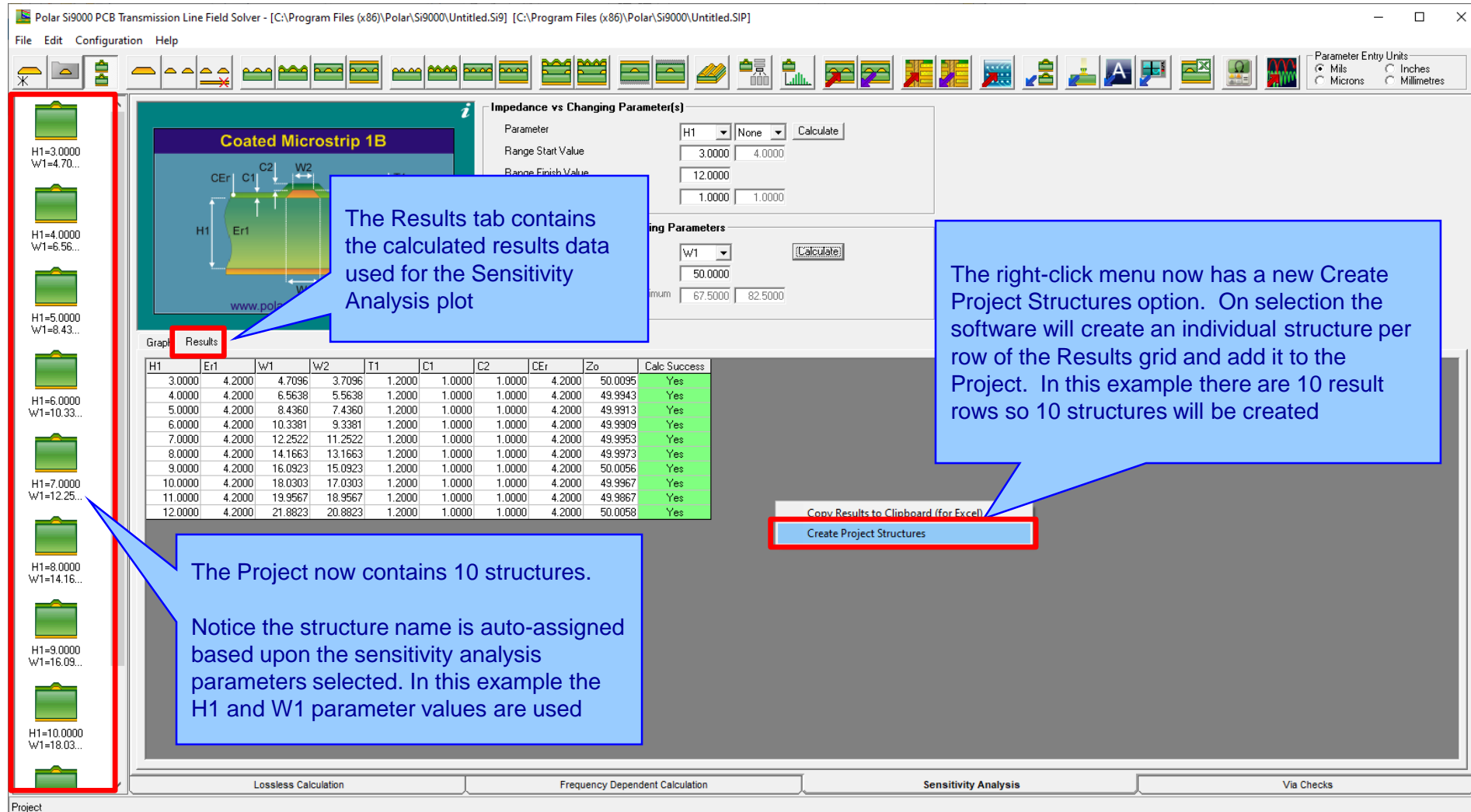
When using the Sensitivity Analysis option it is often useful to examine the calculated results in more details. It is now possible to auto-create a Project containing structures based upon the Sensitivity Analysis results data.

The following slides provide further details:

Populate a Project from Sensitivity Analysis Results



Populate a Project from Sensitivity Analysis Results



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

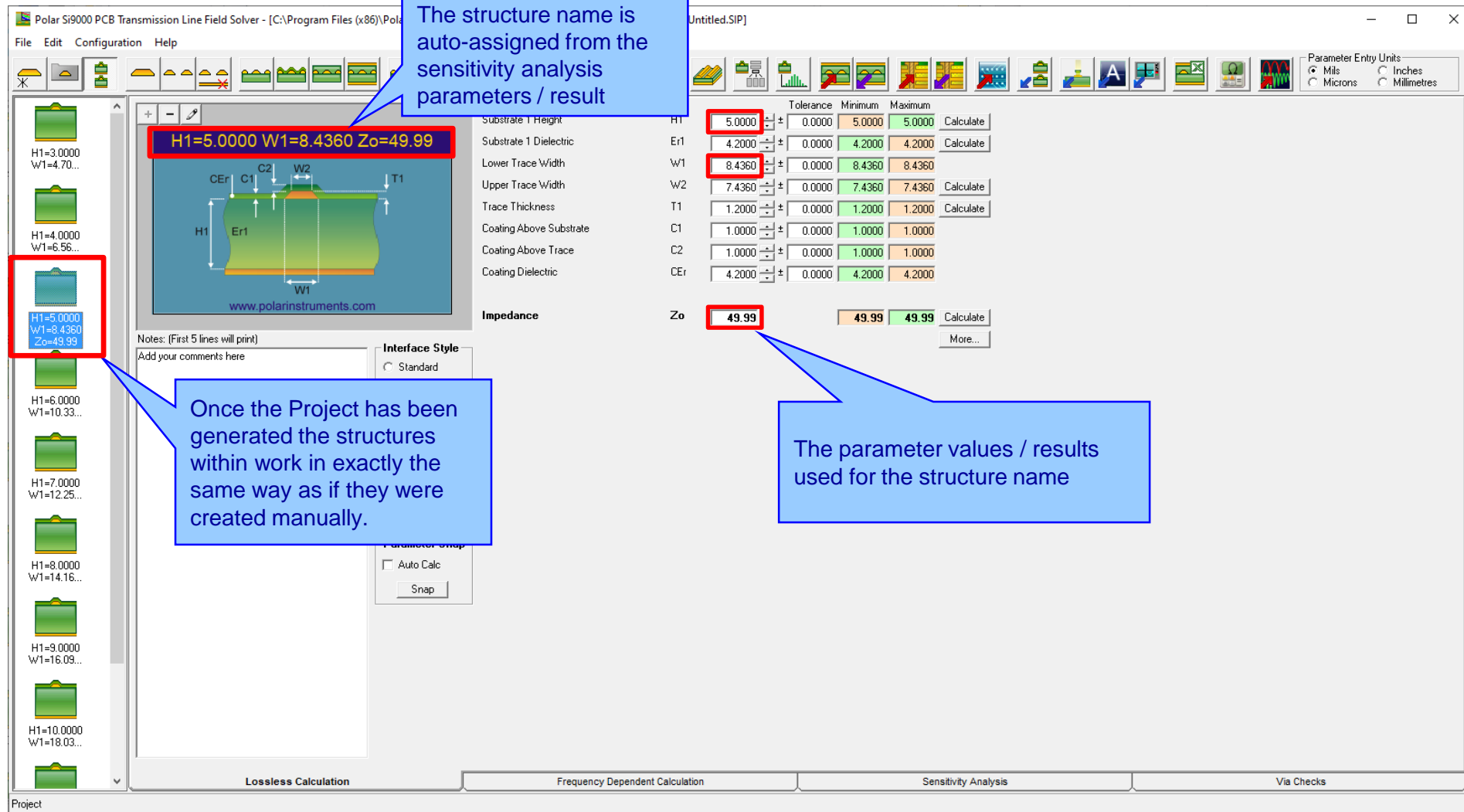
The Project now contains 10 structures. Notice the structure name is auto-assigned based upon the sensitivity analysis parameters selected. In this example the H1 and W1 parameter values are used

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



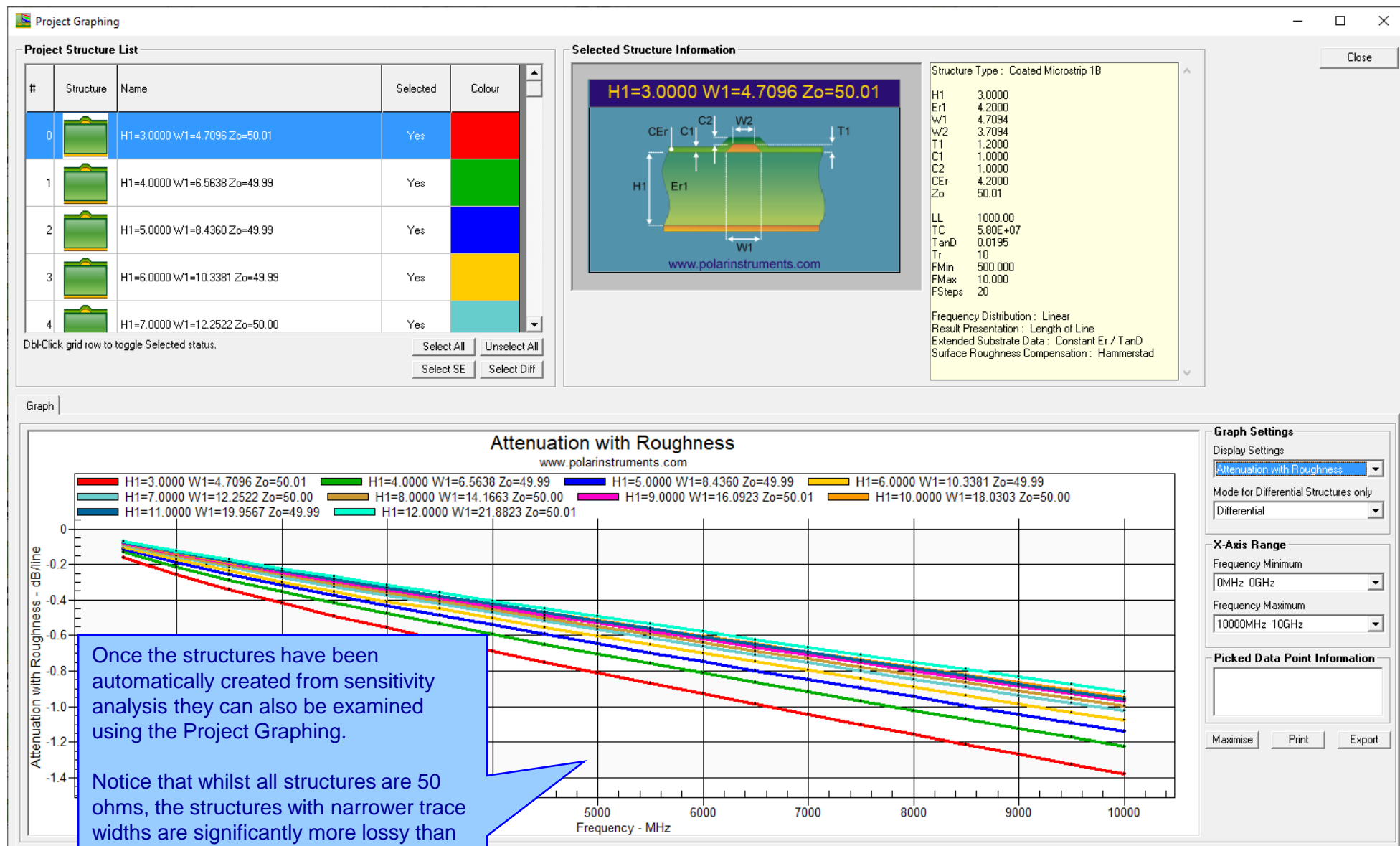
The screenshot displays the Polar Si9000 PCB Transmission Line Field Solver interface. The main window shows a cross-sectional diagram of a PCB structure with parameters H1, W1, Zo, C1, C2, W2, T1, Er1, and CEr. The structure name is auto-assigned from the sensitivity analysis parameters / result, as indicated by the callout: "The structure name is auto-assigned from the sensitivity analysis parameters / result".

The left sidebar shows a list of project structures. The selected structure is highlighted with a red box and labeled: "H1=5.0000 W1=8.4360 Zo=49.99". A callout points to this structure: "Once the Project has been generated the structures within work in exactly the same way as if they were created manually."

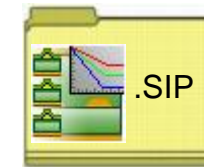
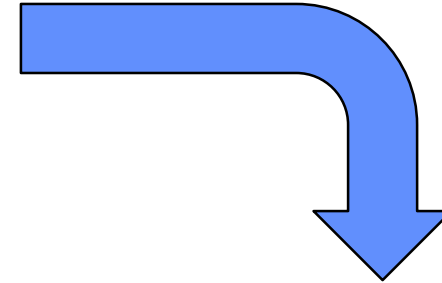
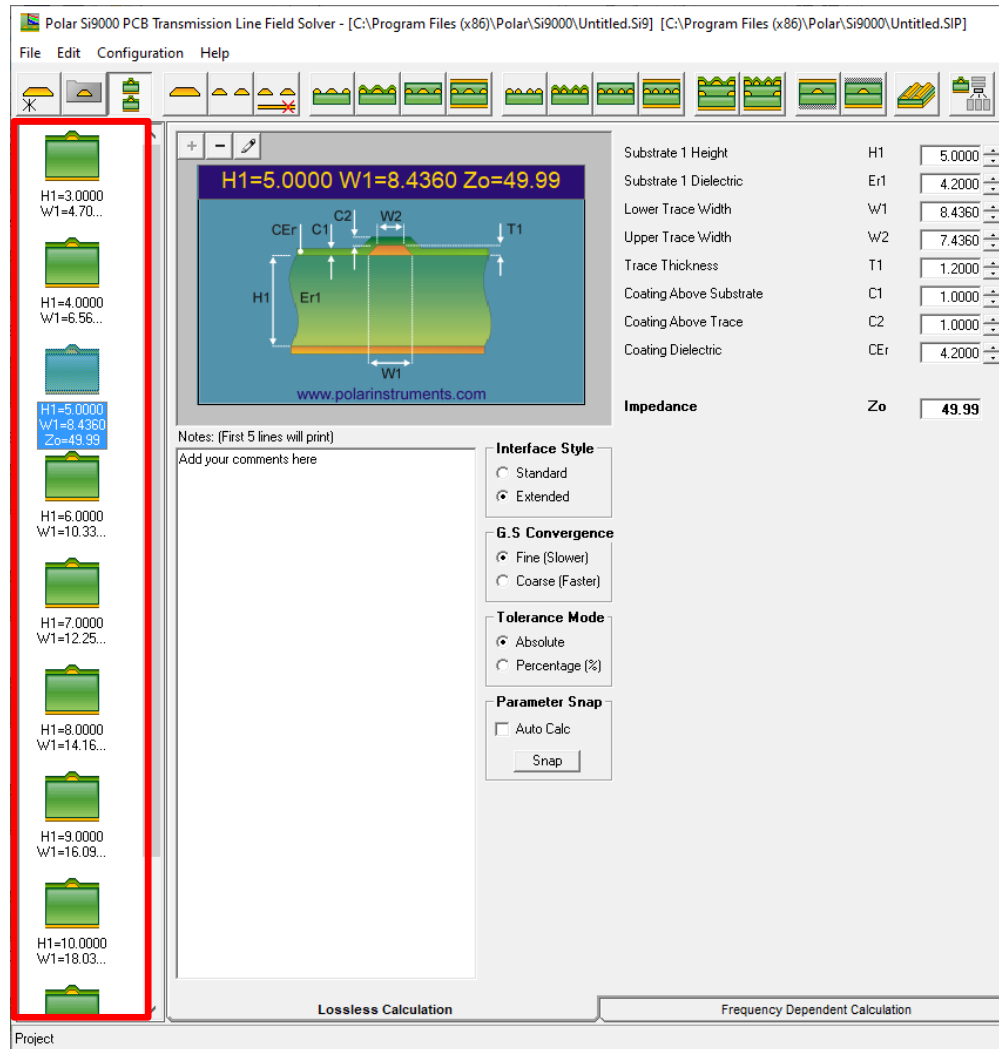
The right sidebar shows the parameter entry table. The parameters are listed with their tolerance, minimum, and maximum values. The Zo parameter is highlighted with a red box and labeled: "The parameter values / results used for the structure name".

Parameter	Tolerance	Minimum	Maximum	Calculate
H1	5.0000	5.0000	5.0000	Calculate
Er1	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
Zo	49.99	49.99	49.99	Calculate

The bottom status bar shows the current calculation mode: Lossless Calculation, Frequency Dependent Calculation, Sensitivity Analysis, and 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

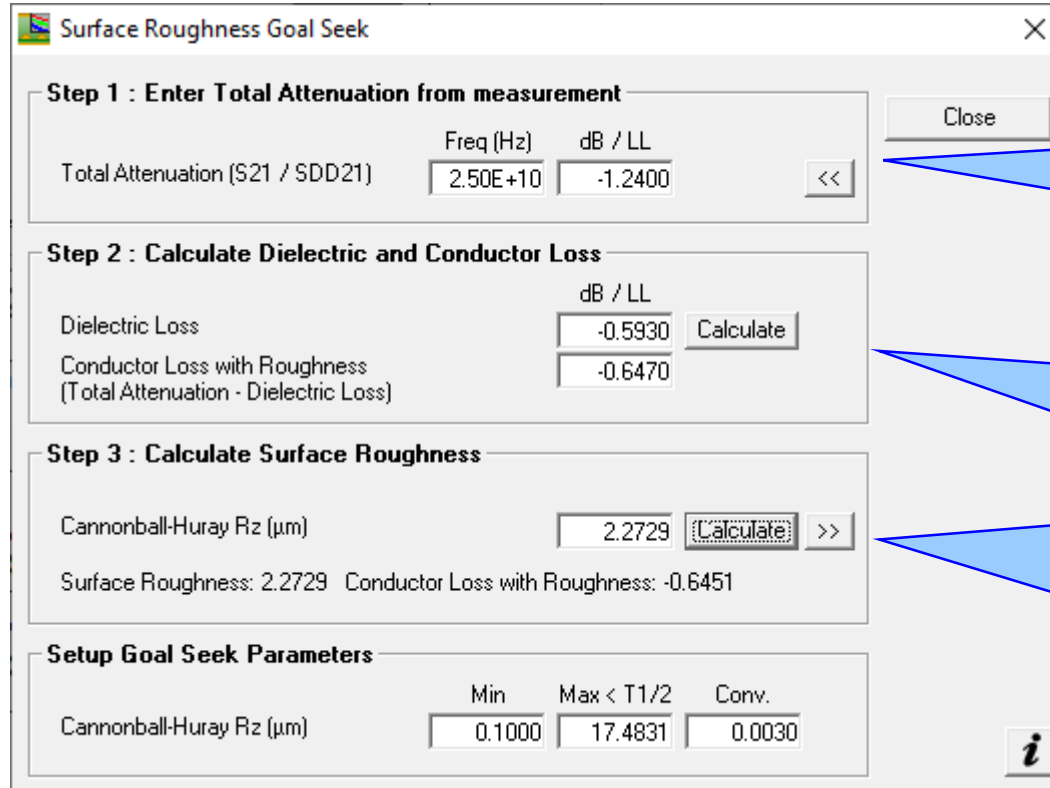
New option to back calculate the surface roughness value for a structure from the insertion loss measurement data. The measurements can be generated using the Polar Atlas system or others that are capable of measuring insertion loss.

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

	Freq (Hz)	dB / LL
Total Attenuation (S21 / SDD21)	2.50E+10	-1.2400

Close

Step 2 : Calculate Dielectric and Conductor Loss

	dB / LL
Dielectric Loss	-0.5930
Conductor Loss with Roughness (Total Attenuation - Dielectric Loss)	-0.6470

Calculate

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

	Min	Max < T1/2	Conv.
Cannonball-Huray Rz (μm)	0.1000	17.4831	0.0030

i

Step 1

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

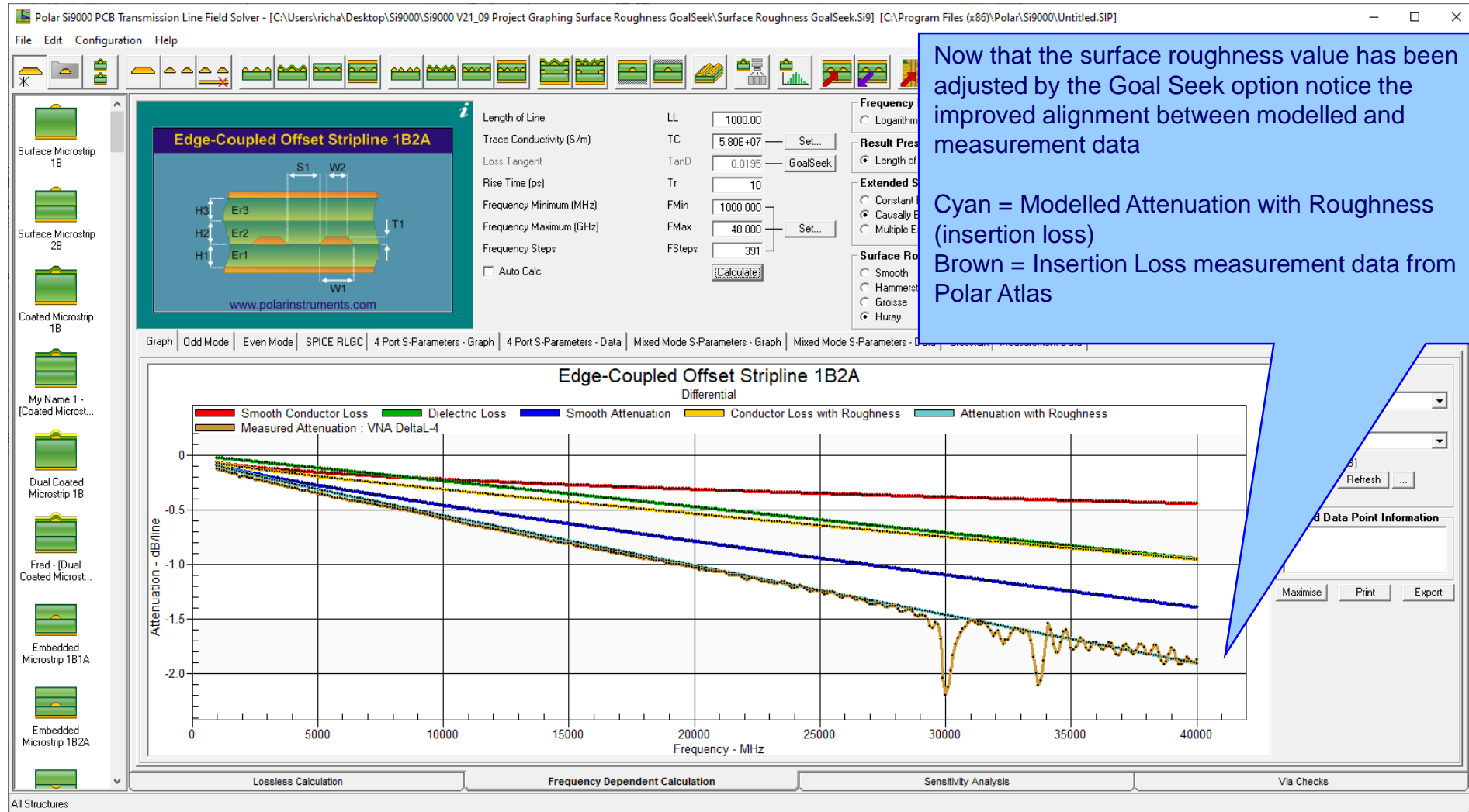
Step 2

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

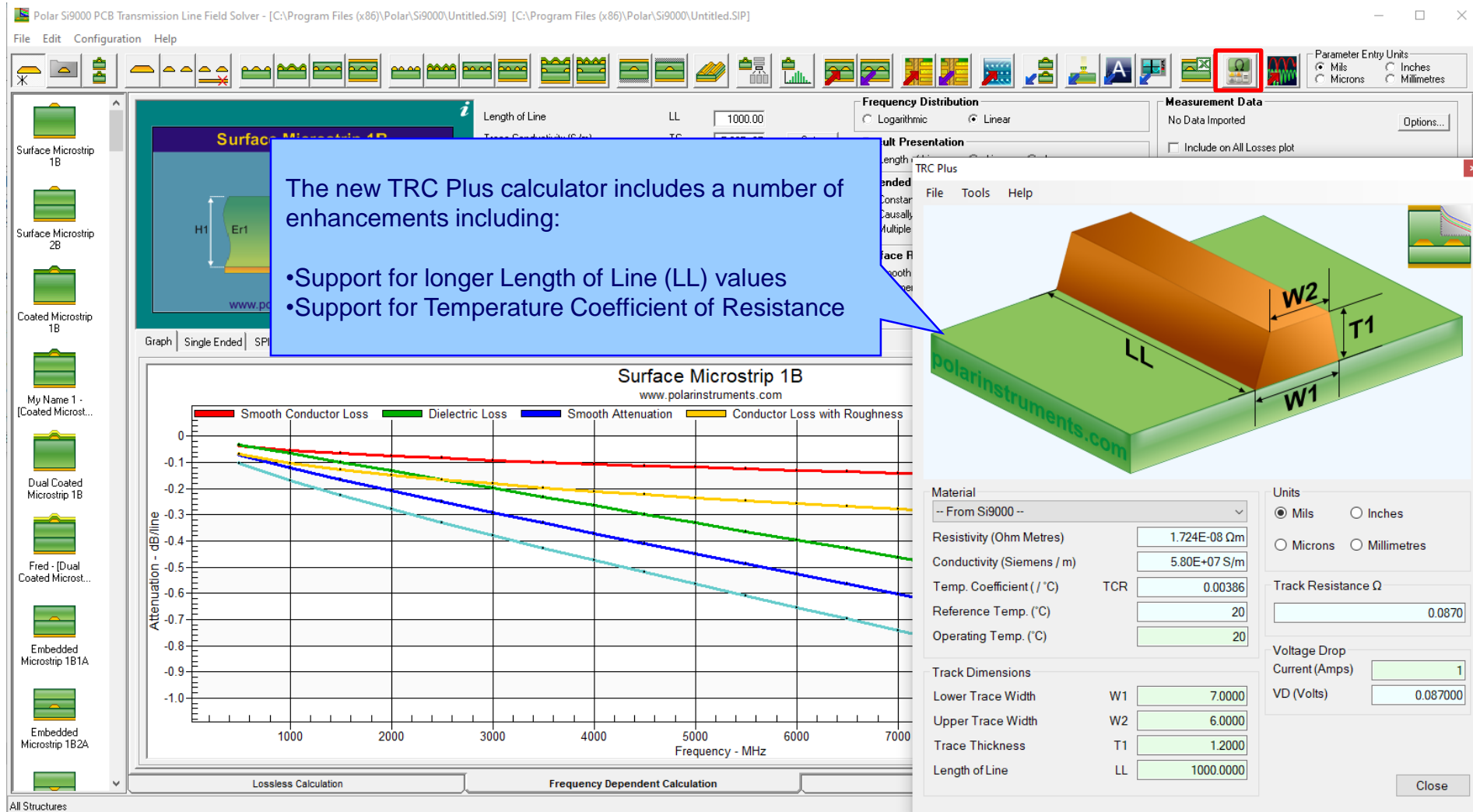
Step 3

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

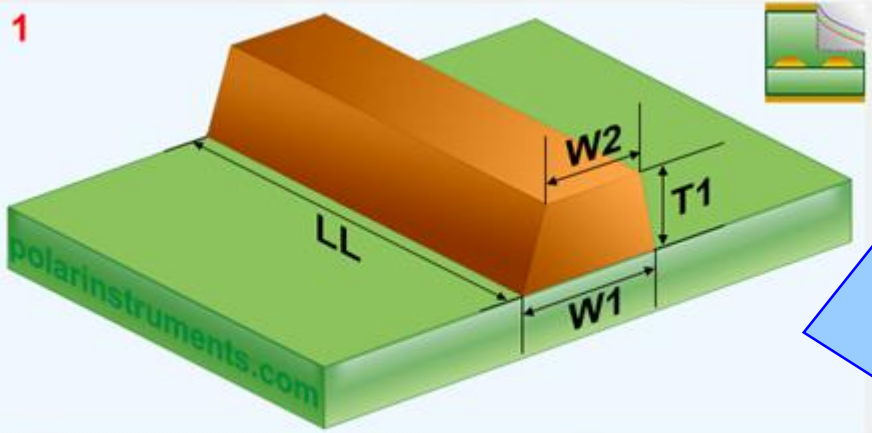
Surface Roughness Goal Seek option



Track Resistance Calculator (TRC Plus)



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

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

Units: ☒ Mils ☐ Inches ☐ Microns ☐ Millimetres

Track Resistance Ω: 0.5221

Voltage Drop

Current (Amps): 1

VD (Volts): 0.522100

5

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

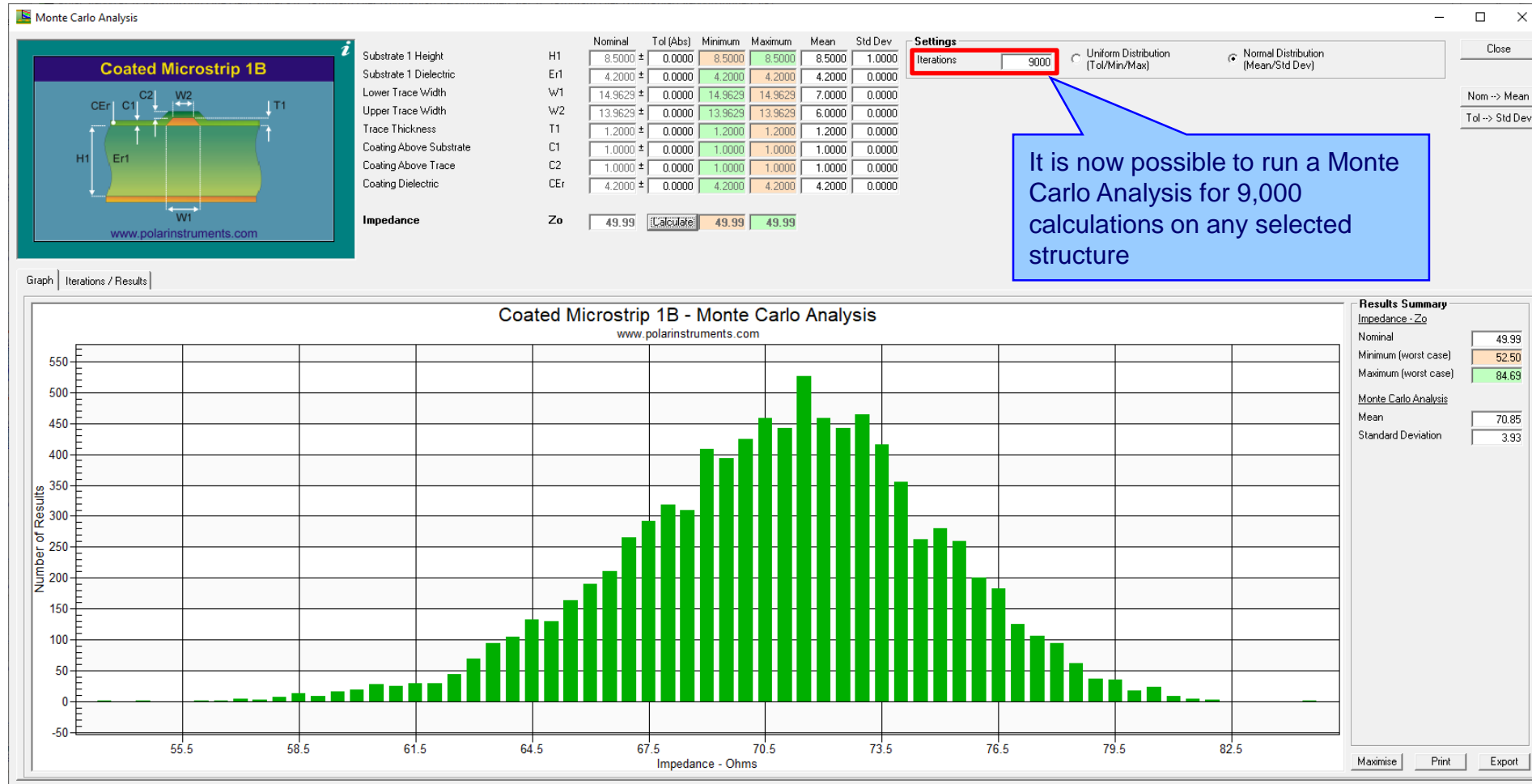
The calculated Voltage Drop is displayed in the VD (Volts) text box

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

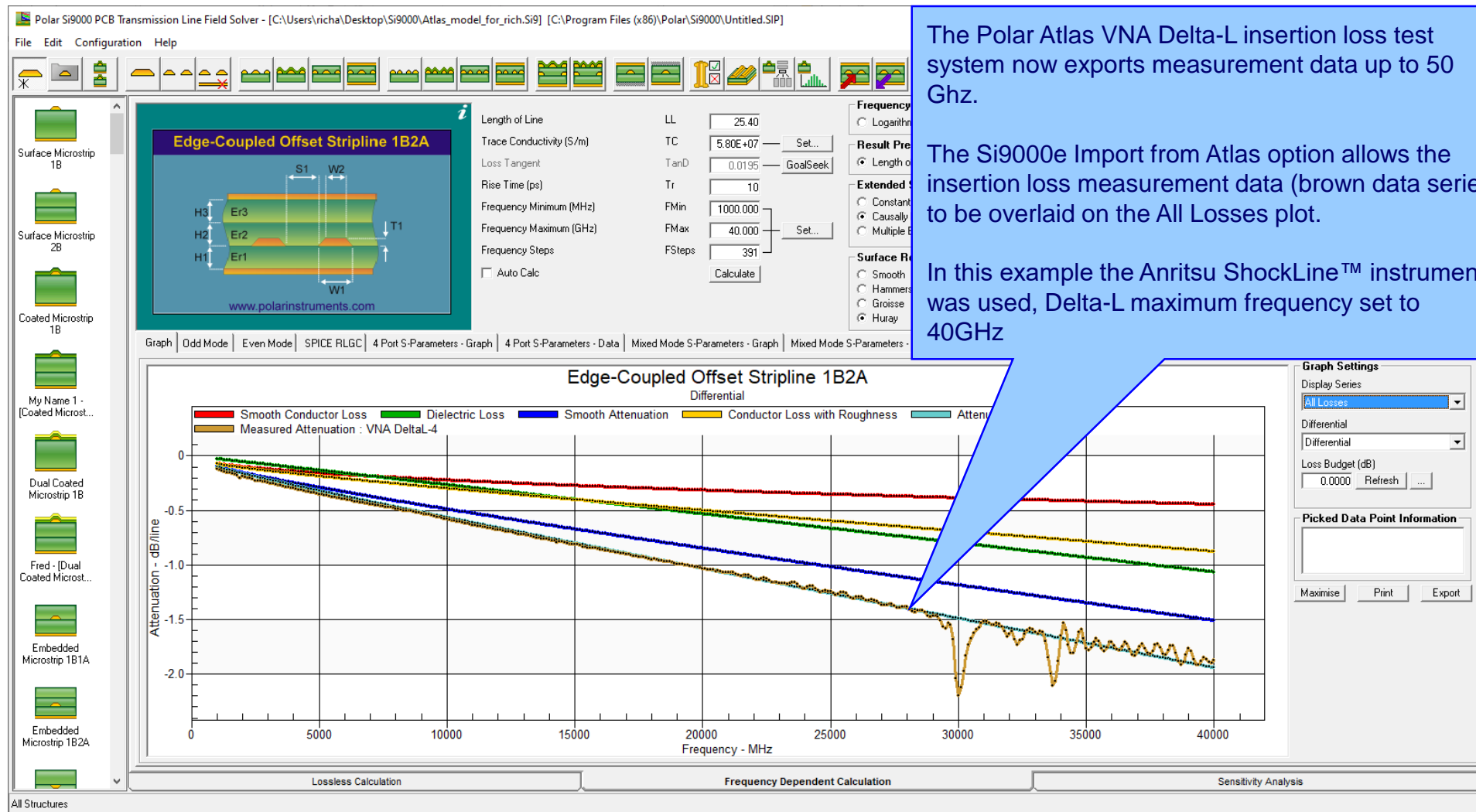
v21.04 (April 2021)

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



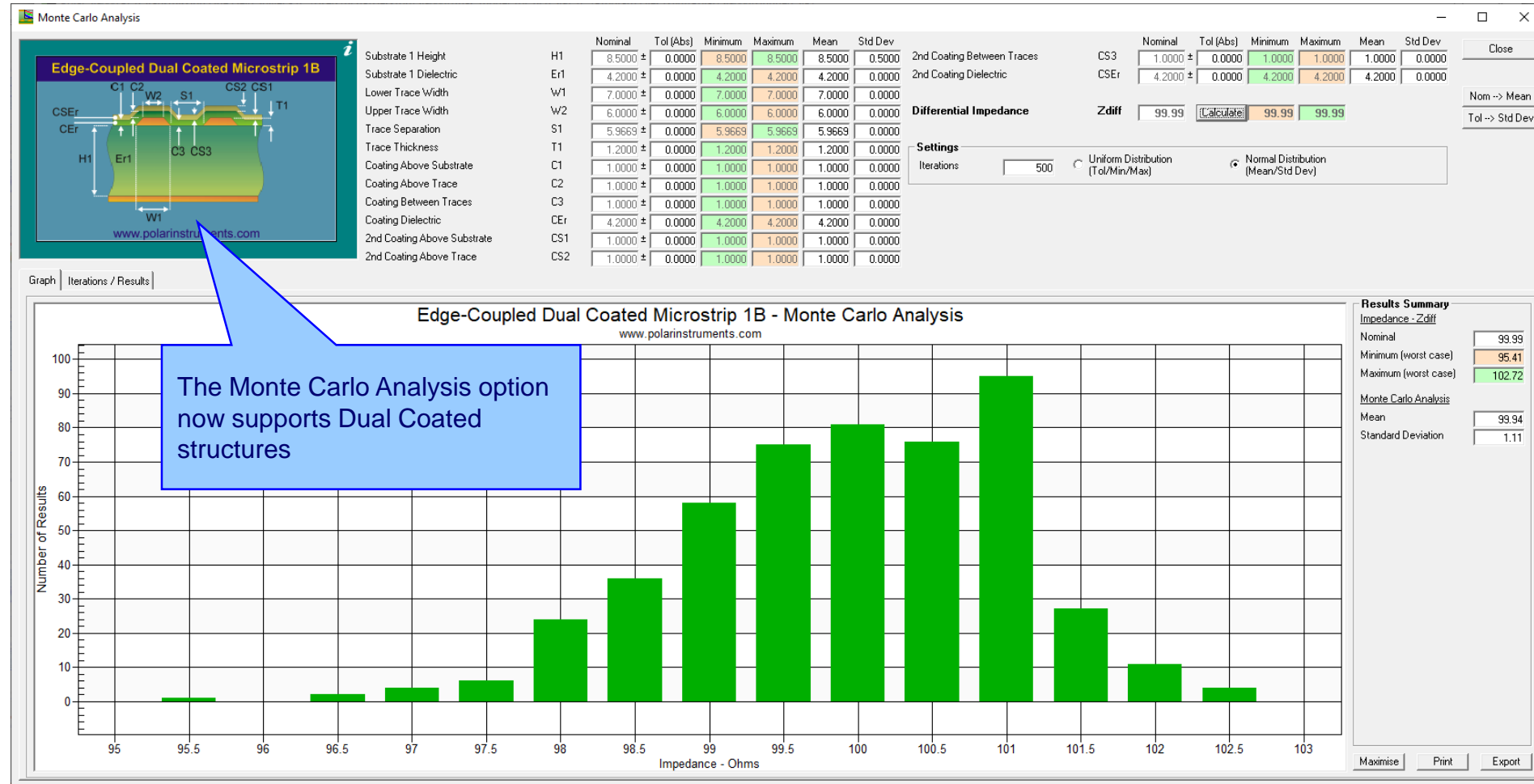
The Polar Atlas VNA Delta-L insertion loss test system now exports measurement data up to 50 GHz.

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

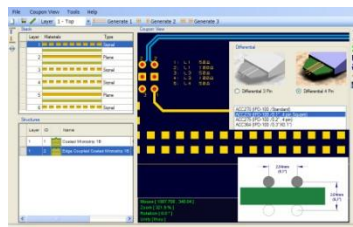
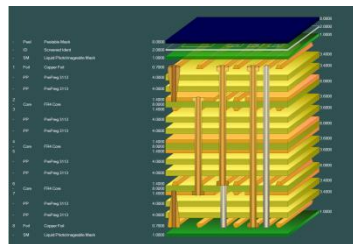
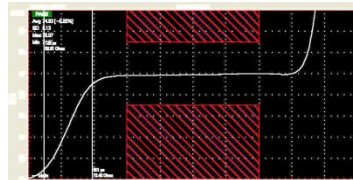
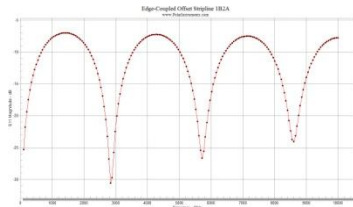
v21.01 (January 2021)

Monte Carlo support added for Dual Coated structures



Other enhancements

- FlexNet Publisher / FLEXIm v11.17.2.0 supported

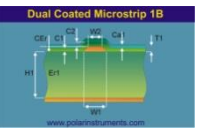
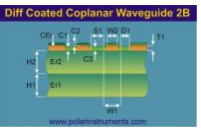
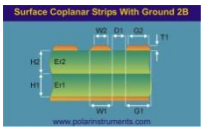
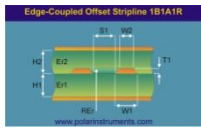
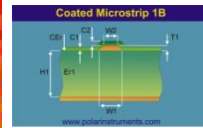
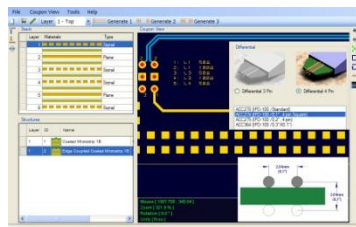
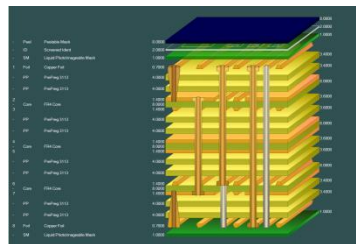
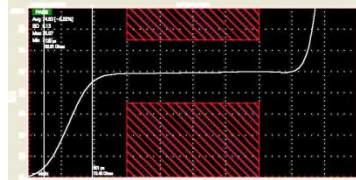
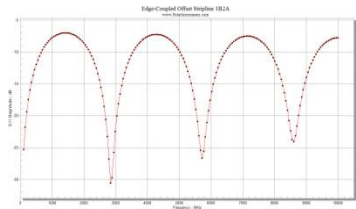
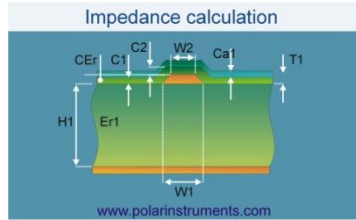


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