

Field Solving PCB Transmission Line Design System

Edge-Coupled Coated Microstrip 2B

www.polarinstruments.com

Substrate 1 Height	H1
Substrate 1 Dielectric	Er1
Substrate 2 Height	H2
Substrate 2 Dielectric	Er2
Lower Trace Width	W1
Upper Trace Width	W2
Trace Separation	S1
Trace Thickness	T1
Coating Above Substrate	C1
Coating Above Trace	C2
Coating Between	C3



PCB transmission line design system
extracts full transmission line parameters
for insertion loss modeling

Si9000e

Accurate BEM
impedance field solver

Extract frequency-
dependent impedance

Use with single and
multiple dielectrics

Export and import
S-parameters

Model effect of copper
roughness

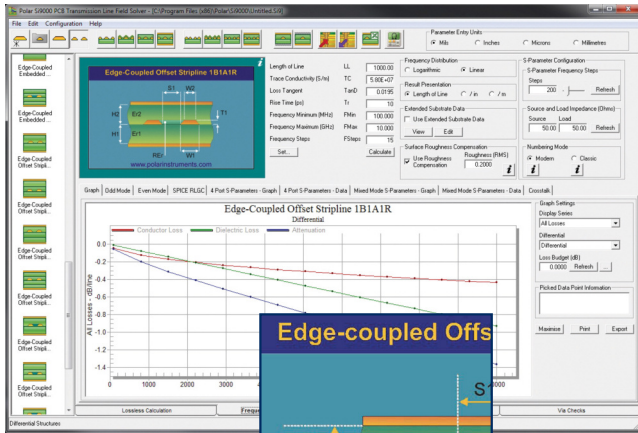
Predict manufacturing
tolerance

Graph copper, dielectric
and total loss

ϵ_r interpolation enforces
causality



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Providing fast, accurate, frequency-dependent transmission line modeling, the new Si9000e helps you to model loss and extract full transmission line parameters over a wide range of popular PCB transmission line configurations. The tool is invaluable in pre-layout calculations and in helping to determine the most cost effective transmission line structure to use in meeting your loss budget.

Simplifies transmission line modeling

Over 100 transmission line structures

Boundary element method (BEM) field solver

Extracts RLGC matrices

Calculates conductor, dielectric and insertion loss

Analyses single and multiple dielectric builds

Includes solder-mask effects

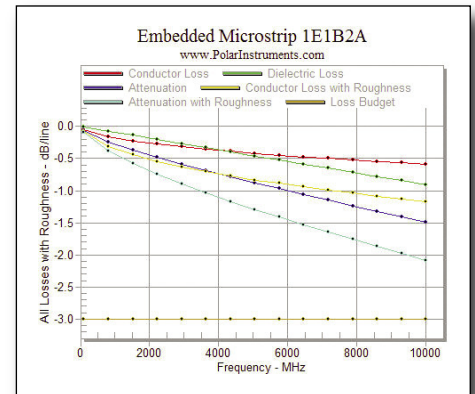
Si9000 is ideal if you work with differential busses:

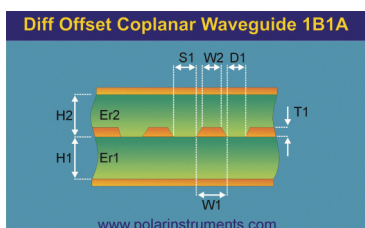
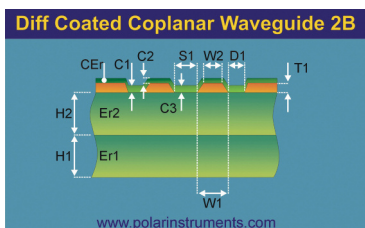
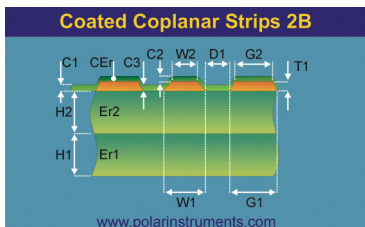
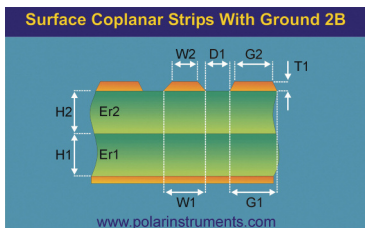
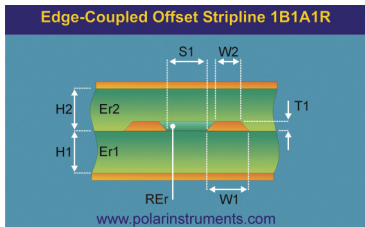
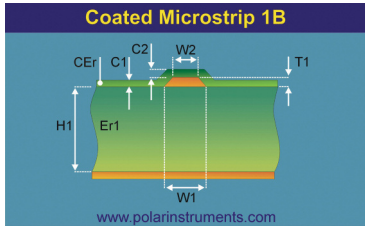
- SATA 1.5 Gb/s, 3 Gb/s, 6 Gb/s
 - Ethernet GbE
 - Xilinx RocketIO™
 - Infiniband
 - XAUI
 - HyperTransport
 - USB 1, 2, 3
 - FC-AL
- PCI Express, Gen I, II, III

An increasing number of chipsets are deploying ultra high-speed serial communications to achieve maximum performance from PCB substrate materials. Whether you are a design engineer or an advanced PCB fabricator, Si9000e is engineered to provide you with the tools to model and study the relative effects of dielectrics, copper and copper roughness on insertion loss. In addition to displaying transmission line losses, Si9000e provides you with easy-to-read graphical displays and allows you to export and import S-parameters in Touchstone™ format for analysis using other engineering tools.

Si9000e is based on Polar's proven BEM calculation engine for accurate modeling from low frequency right up to the point where the line is no longer operating in TEM mode. This is typically 100 to 140 GHz for commonly used transmission line dimensions. Offering the flexibility to meet your most common layout challenges, the Si9000e offers built-in support for over 100 popular transmission line structures.

Polar's Si9000e calculates all the losses within your PCB. Conductor, dielectric and insertion losses are calculated and the output is clearly graphed for each parameter. You can analyse single or multiple dielectric builds and evaluate solder-mask effects with flexible options for setting mask coverage as adjacent, between or above traces.



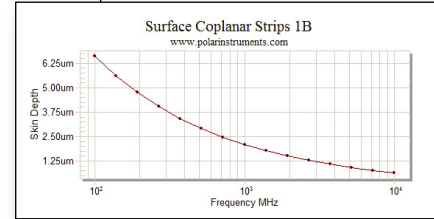
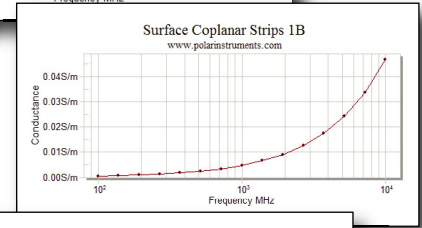
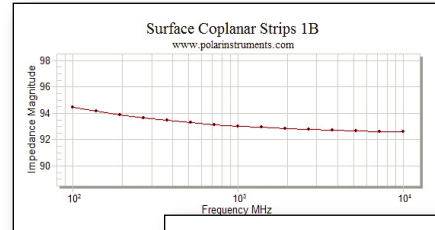


With ever-increasing speeds, the latest circuitry demands high-quality, controlled impedance printed circuit boards. Today's PCB is not just a simple electrical interconnection device; it is a critical and highly-specified component in its own right. Your challenge, therefore, is to ensure that transmission line characteristics meet the demands of the system components. The Polar Si9000e allows you to extract frequency-dependent impedance and loss, helping you ensure that the board works reliably from the first spin.

The Si9000 is an essential tool if you design high speed differential busses. The easy-to-use interface gives you a clear graphical display of transmission line characteristics against frequency. Calculated data can be easily exported in table, JPEG or Touchstone™ format, allowing further analysis using other programmes such as spreadsheets or with other signal-integrity tools. The boundary element method field solver engine allows you to use familiar analysis tools by extracting RLGC matrices and 2-port single-ended or 4-port differential S-parameters in addition to quickly plotting transmission lines. Graphing against frequency returns a wide range of parameters: impedance magnitude, conductor loss, dielectric loss, insertion loss and losses due to surface roughness, inductance, capacitance, resistance, conductance and skin depth.

With its fast and interactive operation, Si9000e lets you experiment with different transmission lines and substrates to discover how the production process will affect board performance, enabling you to select the optimal solution for each board. By making experimentation easy, Si9000e gives you a wealth of experience in a very short period of time.

Frequency-dependent calculations can be refined using extended substrate data. This ensures accurate modeling of PCB materials, simply by assigning substrate values by frequency band for material from any manufacturer. Dielectric constants are interpolated to enforce causality in the S-parameter outputs.





Integrates with Speedstack stackup design system

Increase your control over the PCB fabrication process by using Si9000e seamlessly interfaced to the Speedstack layer stackup design and documentation system. Speedstack Si is a bundled package of Si9000e and Speedstack which allows you to keep all of your stackup design data and associated transmission line materials and geometries in one convenient file, complete with clear and professional printed stackup documentation. You have the choice of generating stackups using generic or virtual materials, or specifying the base material by its manufacturer part number.

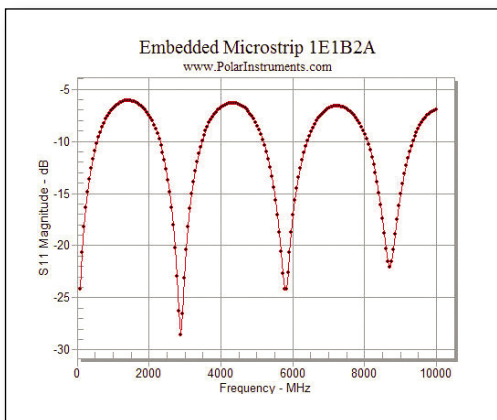
Speeds development of high layer-count builds

Links to Speedstack PCB Stackup Design System

Specifies E_r and $TanD$ across a range of frequencies

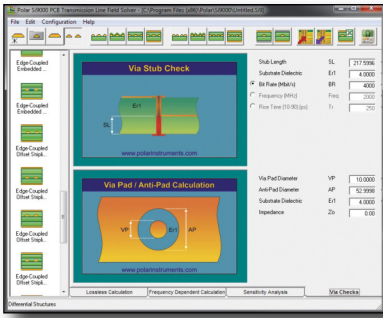
Accepts entry of data supplied by your board fabricator

Imports data from material suppliers in the Polar Material Partner programme



Save engineering time with the Si9000e

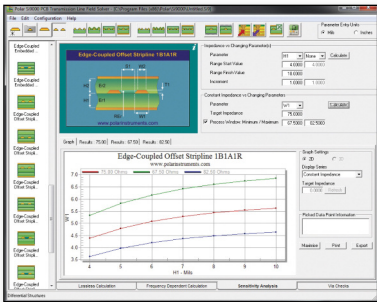
Compared with traditional methods, the Si9000e saves you time by allowing you graphically to choose the structure you need to model as well as the geometric and material data, and the range of frequencies you want to analyse. Simply selecting your preferred graphs or table format delivers accurate results, quickly and easily. Advanced users can also enter data for E_r and $TanD$ versus frequency for even greater accuracy.



Via checks

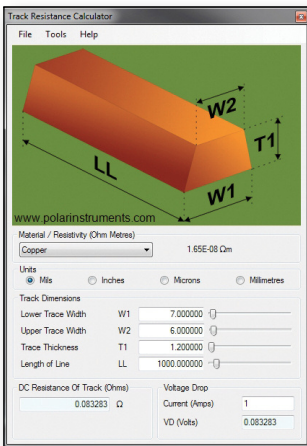
In addition to the core transmission line modeling, Si9000e lets you run some basic checks to calculate whether via stubs are likely to be visible to signals

at your chosen operating speed. Guidelines help you to make a first order match of via impedance, providing a quick and easy guide to help give your designs a solid starting point.



Process window

The addition of process-window calculations, introduced in Si9000e 2011, allows you to check the degree of process window for a given impedance. You can use these calculations to adjust designs prior to layout to ensure that you give your design the maximum possible window to keep yields up and costs down.



Track resistance calculator

An optional track resistance calculator takes the geometric trace data from the Si9000e to quickly and easily calculate both track resistance and voltage drop for a given track length.

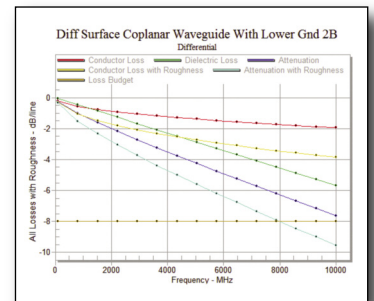
Sensitivity analysis

Sensitivity analysis gives you fast and interactive built-in graphing of impedance variation against a range of physical structure parameters.

- Graph impedance against any varying structure parameters
- Set a target impedance line on the graphs
- Export the graph data to clipboard for use in Excel
- Graph impedance for single-ended structures
- Graph differential structures:
 - Odd mode/Even/Differential/Common/All
- Export graph to JPEG for easy and convenient inclusion in your documentation.

Graphing against loss budget

In addition to its comprehensive graphing capabilities, Si9000e also gives you the ability to set a loss budget or target loss line on the frequency-dependent graph.



Licensing options

Choose from a wide range of license options, with packages which give you the best value for your investment.

Ask your local Polar office for information, or check online at polarinstruments.com.



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Si9000e Controlled Impedance Field Solver

Single ended:

- Impedance magnitude
- Skin depth
- Insertion loss S₂₁
- Conductor loss dB
- Dielectric loss dB
- Propagation velocity
- Propagation delay
- SPICE RLGC
- 2-Port S-parameters
- Surface roughness attenuation
- Causality enforced

Differential:

- Impedance magnitude
- Skin depth
- Insertion loss S_{DD21}
- Conductor loss dB
- Dielectric loss dB
- Differential propagation velocity
- Differential delay
- Odd-mode Z magnitude
- Even-mode Z magnitude
- SPICE RLGC
- 4-Port S-parameters
- Surface roughness attenuation
- Causality enforced

Licenses:

Si9000e licenses are activated by FlexNet.

A variety of licensing options is available. Check Polar website.

System requirements:

System requirements are outlined in Application Note AP605

Polarcare maintenance and support

Polarcare provides technical support as well as updates and license protection. Polarcare subscribers may submit feedback to the Polarcare development panel to influence future maintenance releases. In addition, Polarcare provides protection for your software and license against total loss from any cause. The Polarcare brochure and the Polar website include details of the full range of Polarcare benefits.

About Polar Instruments

Polar Instruments is a market leader in designing and manufacturing tools to simplify and enhance the design, fabrication and testing of printed circuit boards (PCBs). Their innovative tools include the industry-standard Controlled Impedance Test System (CITS) which provides the global PCB industry with an easy-to-use test system for high-speed digital and RF boards, as well as class-leading tools for fast and accurate design and testing of controlled impedance in PCBs. Polar also leads the industry in tools for PCB layer stackup design and documentation. Polar Instruments was established in 1976 and now has operations and channel partners in the US, UK, Europe and Asia Pacific.

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