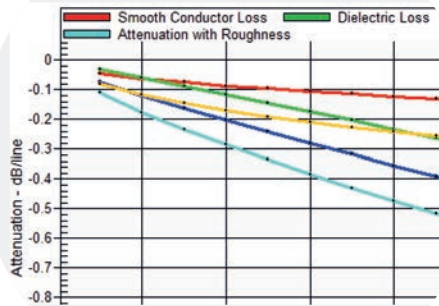
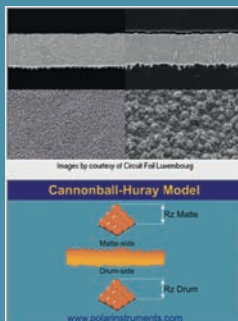




## PCB Insertion Loss Field Solver



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



## Si9000e

Export and import S-parameters

Model effect of copper roughness

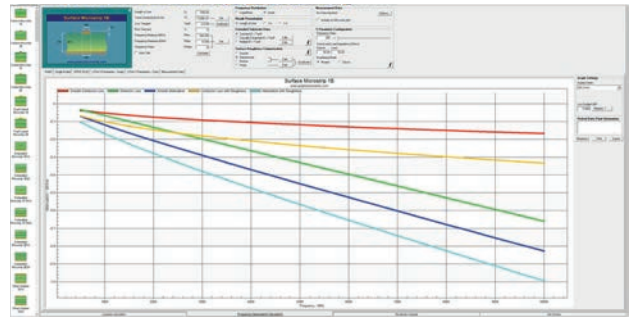
Predict manufacturing yield

Graph copper, dielectric and total loss

## Introduction



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

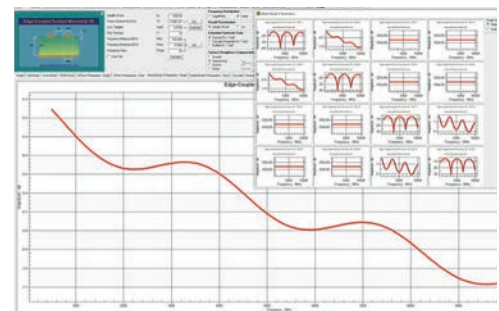
Analyses single and multiple dielectric builds

Includes solder-mask effects

Si9000e is ideal for working with transmission lines for ultra high speed serial communications.

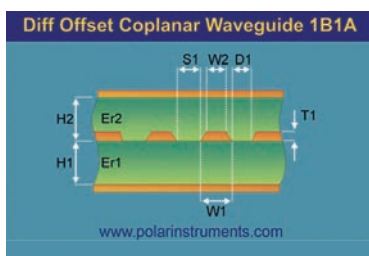
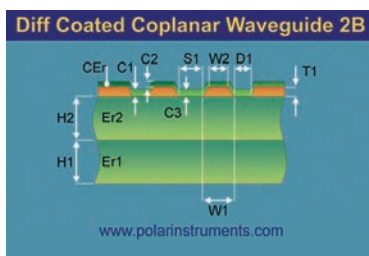
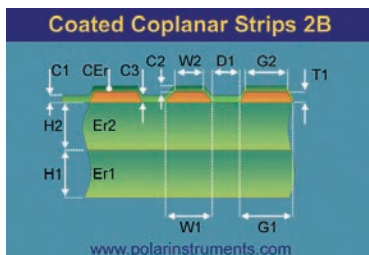
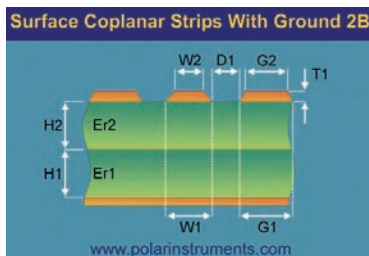
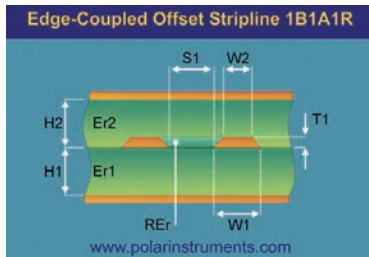
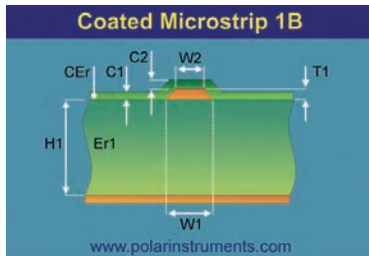
An increasing number of chipsets are deploying ultra highspeed serial communications to achieve maximum performance from PCB substrate materials. Whether you are a design engineer or an advanced PCB fabricator, Si9000e is engineered to provide you with the tools to model and study the relative effects 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.

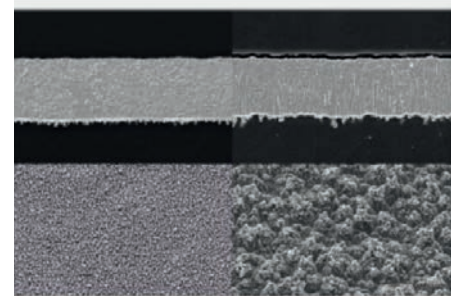


With ever-increasing speeds, the latest circuitry demands high-quality, controlled impedance printed circuit boards. Today's PCB is not just a simple electrical interconnection device; it is a critical and highly-specified component in its own right. Your challenge, therefore, is to ensure that transmission 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.

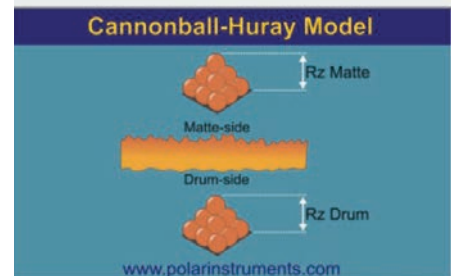
The Si9000e is an essential tool if you design high speed differential busses. The easy-to-use interface gives you a clear graphical display of transmission line characteristics against frequency. Calculated data can be easily exported in table, JPEG or Touchstone™ format, allowing further analysis using 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.

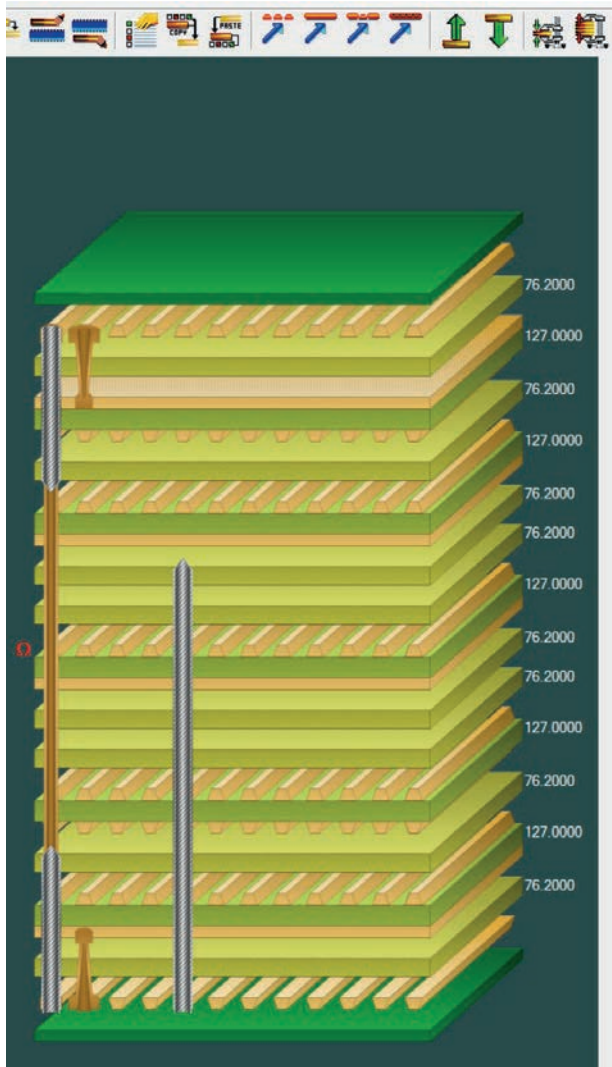


Images by courtesy of Circuit Foil Luxembourg





## 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

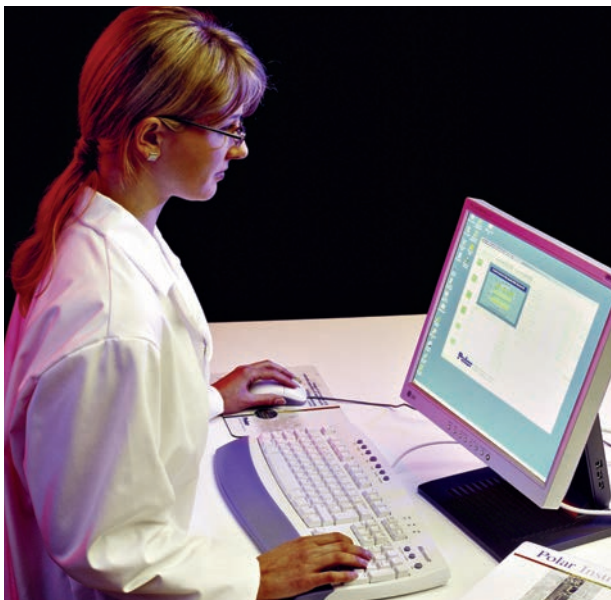
Obtain Er and TanD from a table of values or extrapolate causally from one key frequency.

Accepts entry of data supplied by your board fabricator

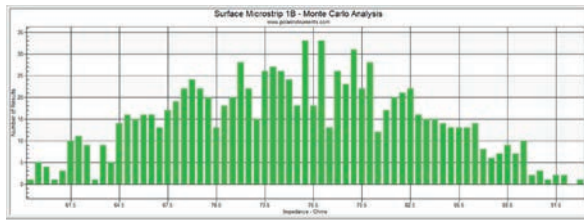
Imports data from material suppliers in the Polar Material Partner programme via Speedstack

## Save engineering time with the Si9000e

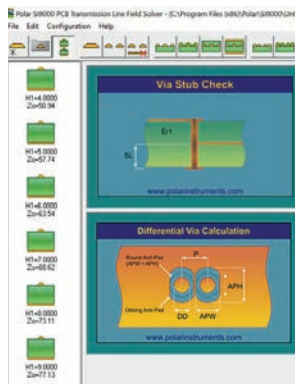
Compared with traditional methods the Si9000e saves you time by allowing you graphically to choose the structure you need to model as well as the geometric and material data and the range of frequencies you want to analyse. Simply selecting your preferred graphs or table format delivers accurate results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



## Monte Carlo analysis

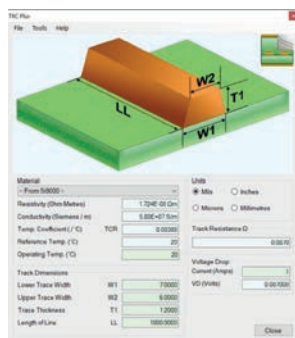


With inbuilt Monte Carlo analysis you can enter production tolerances and simulate the yield of a production run, and check that any outliers are either rare enough to be acceptable, or ensure that your entire run is predicted to be well within specification.



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.

## 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.

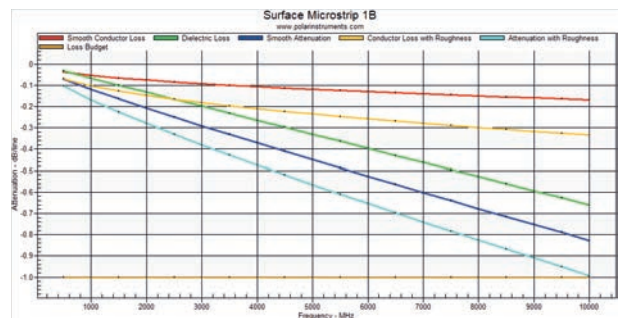
## Sensitivity analysis

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
- Use the optional projects feature to create loss sensitivity graphs.
- 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](http://polarinstruments.com).



## Si9000e PCB Insertion Loss Field Solver

The Si9000e is ideally suited for ultra high speed lines where broadband modeling and insertion loss are required. To model the characteristic impedance of lossless PCB transmission lines and lines operating up to 2 – 3GHz refer to the Si8000m.

### Models:

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

### Insertion loss SDD21

- 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
- Causal S-parameters

### 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

### Roughness compensation:

Hammerstad  
Grisse  
Huray  
Cannonball / Huray

### Options:

Projects – save groups of structures as a set, or create project from a sensitivity analysis report.

TRC Plus – rapidly calculate trace DC resistance and temperature sensitivity.

### 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). 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 Speedstack PCB and Si which leads the way in documenting PCB layer stackup across the PCB supply chain. Established in 1976 with operations and channel partners in the US, UK, Europe and Asia Pacific.

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