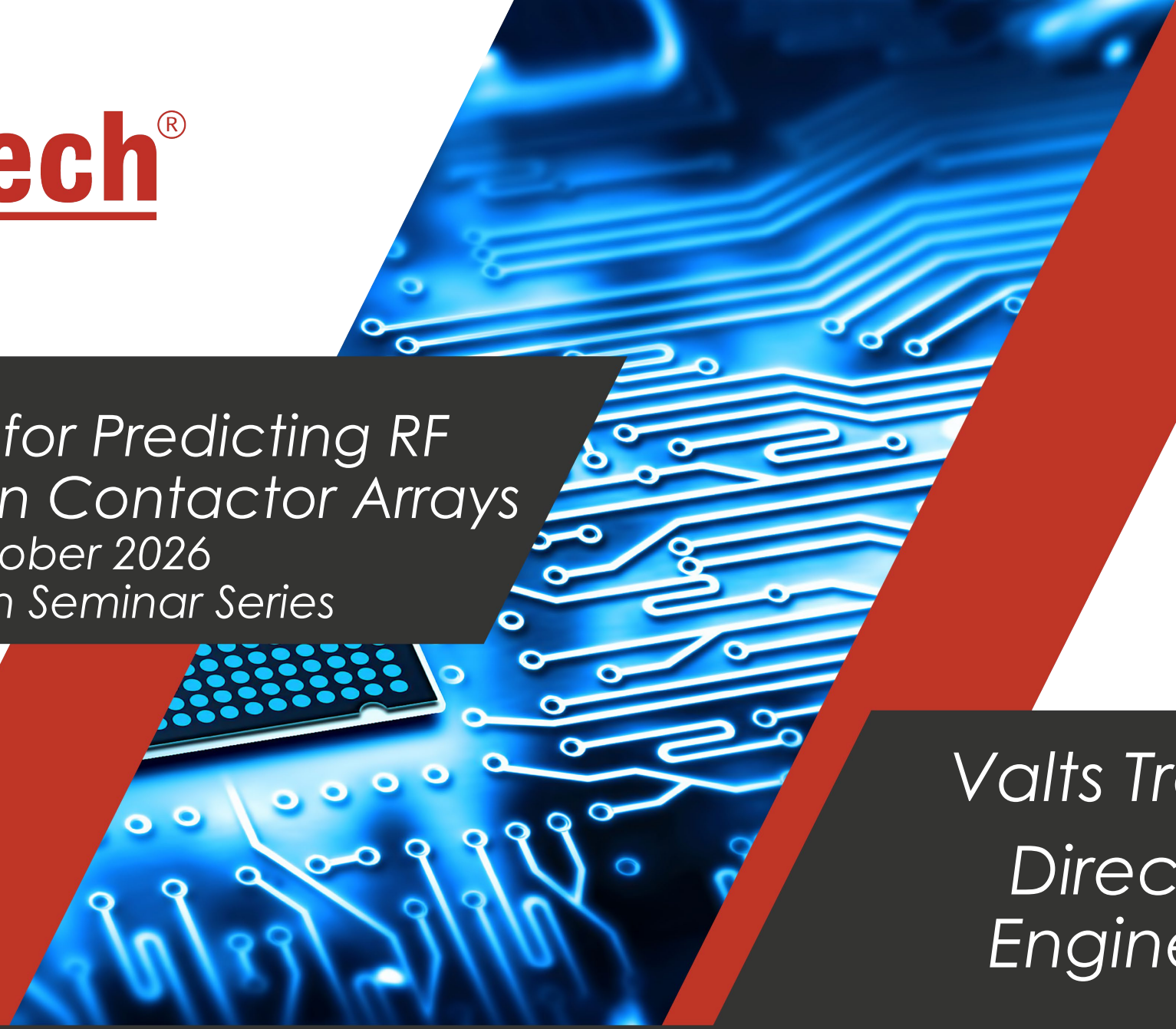
Johnstech®

Useful Tools for Predicting RF Performance in Contactor Arrays

October 2026

Johnstech Seminar Series



Valts Treibergs

Director of Engineering

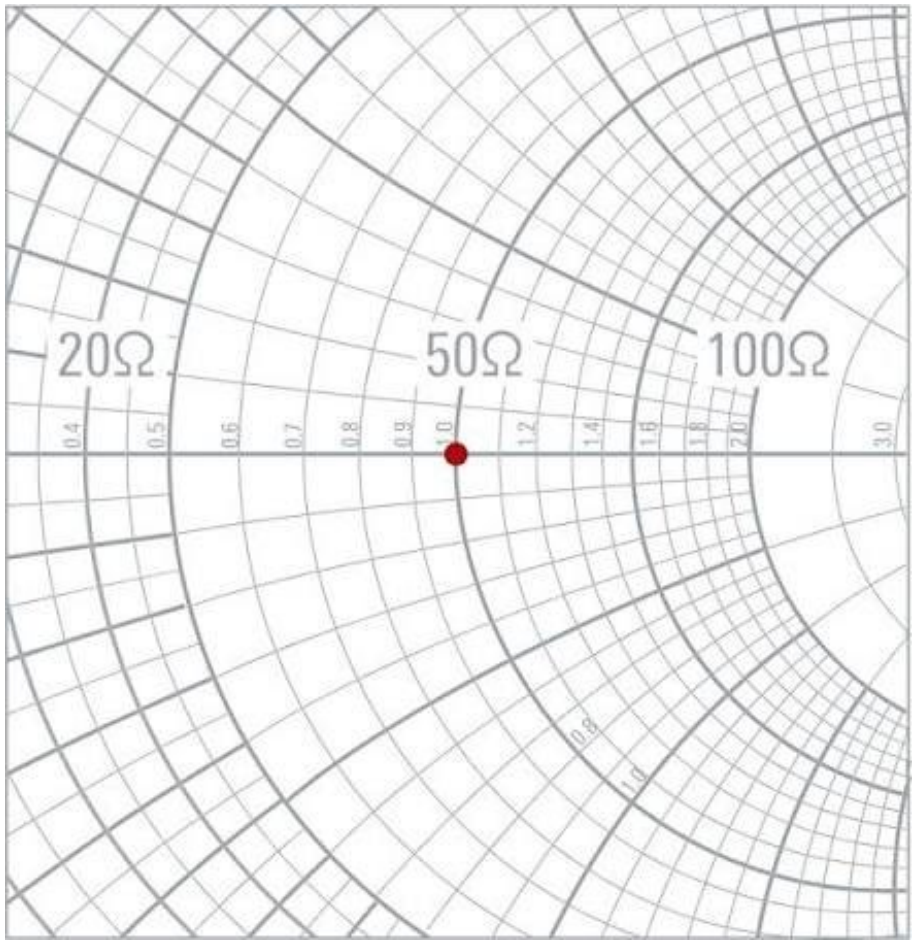
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Seminar Agenda

- RF Signal Integrity refresher
- Existing RF analysis for array socket products
  - HFSS Modeling and simulation
  - Insertion Loss, Return Loss, Crosstalk
  - Inductance, Capacitance and Impedance
  - Analog RF vs. Digital – some thoughts
  - Tools – Plotting and Calculating
- Universal 'Library' approach to custom simulations
  - 32 Port S-Parameter libraries of contactors
  - Using S-Parameter files for DUT configurations
- Break
- uSimmics – A FREE Tool that works!
  - How Johnstech Apps Engineers use this tool
- Type of models and schematics using S32p files
- Example Analyses and a live demonstration
- Questions and wrap-up



This is a Smith Chart – We will not be discussing this

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RF Basics – A Refresher

- Electrical simulations/measurements on new probe technology are done because the contactor is a critical interface between the device under test (DUT) and the test system and can impact the device performance under test.

<u>Signal Integrity (High-Frequency Performance)</u>

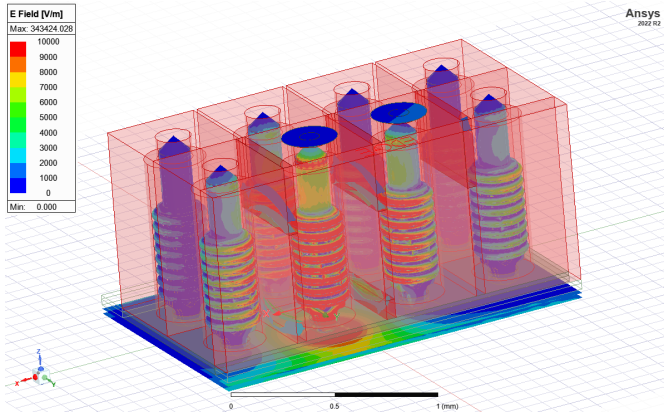
- Evaluate impedance, capacitance, and inductance of probe configurations.
- Predict insertion loss, return loss, and crosstalk at GHz+ frequencies.
- Optimize geometry to minimize distortion of high-speed signals.

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Measured and Simulation Electrical Performance

Simulations

Ansys HFSS is used to perform 3D electromagnetic simulations of our test contactors, enabling detailed analysis of signal integrity, impedance control, insertion loss, and crosstalk across a wide range of ground and signal configurations.



Measurements

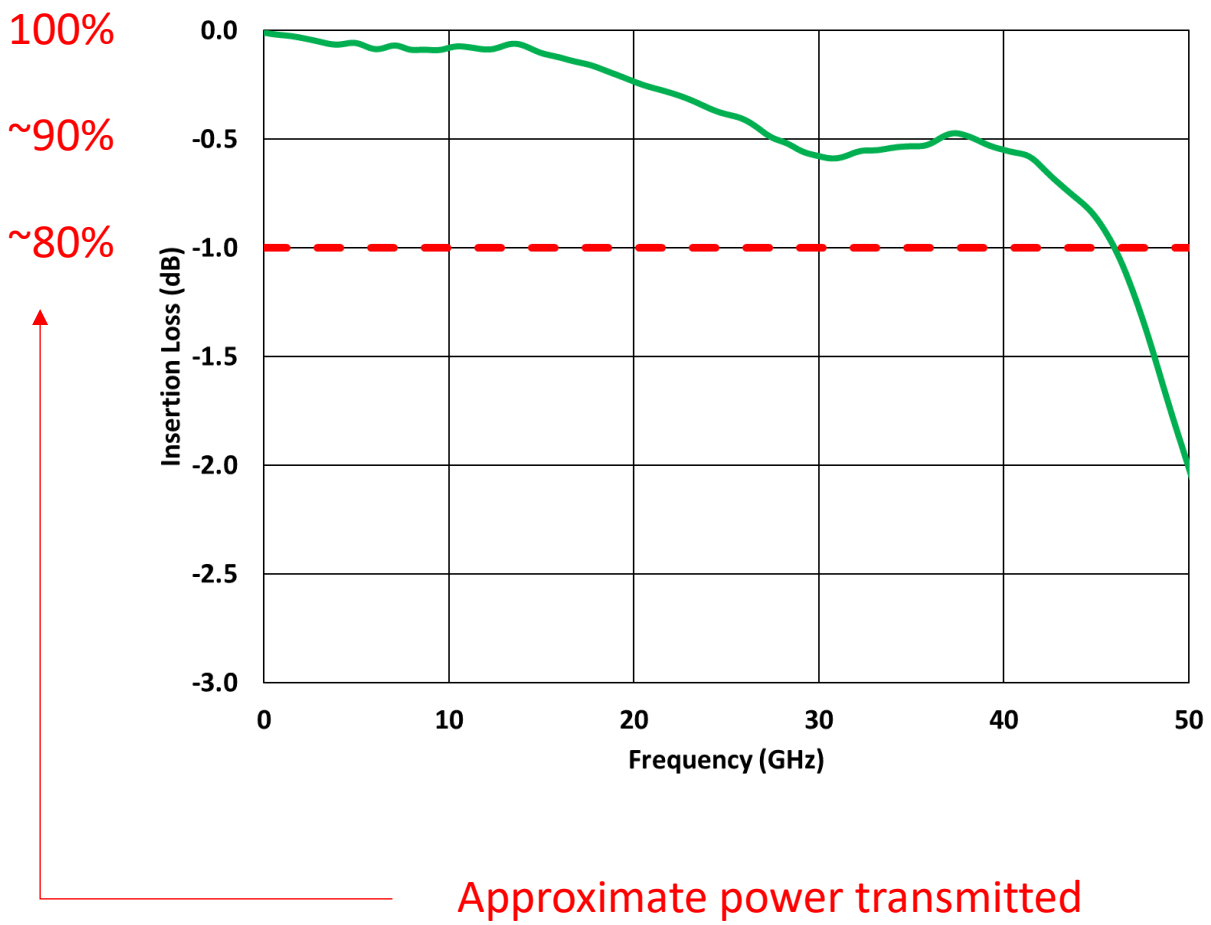
To validate simulations with actual behavior of the built hardware from DC to 67 GHz.

Time and frequency domain measurements are made.

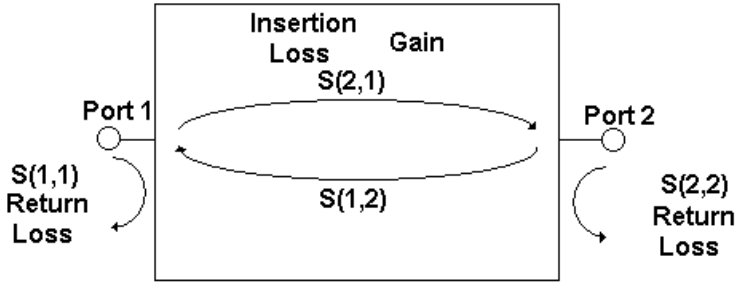


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Metrics: Insertion Loss



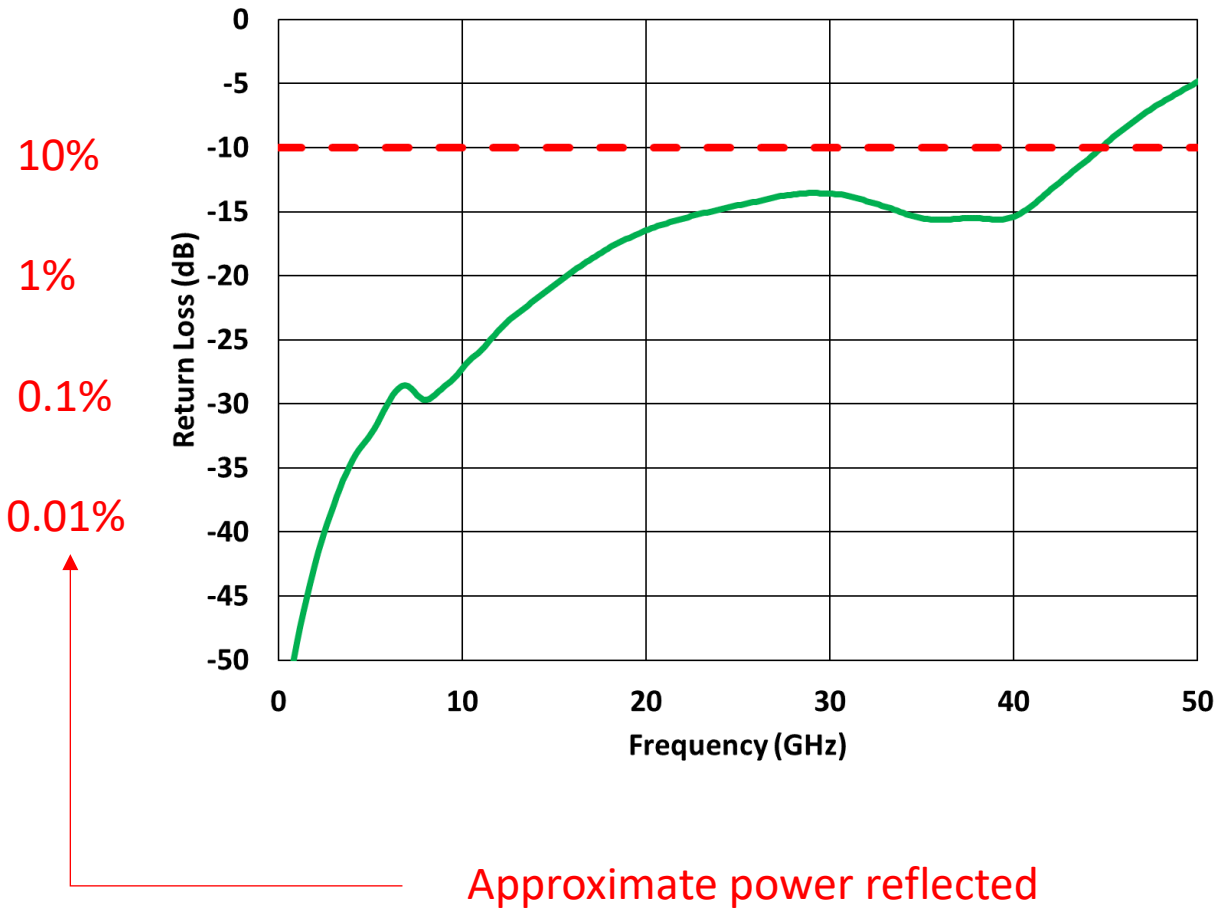
- Insertion Loss is the loss of signal power between two points in a circuit due to resistance, material absorption or impedance mismatch.
- $S_{21} = 10 * log_{10}(\frac{P_{in}}{P_{out}})$



S(2,1) = S(1,2) For Ideal Passive Parts

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Metrics: Return Loss



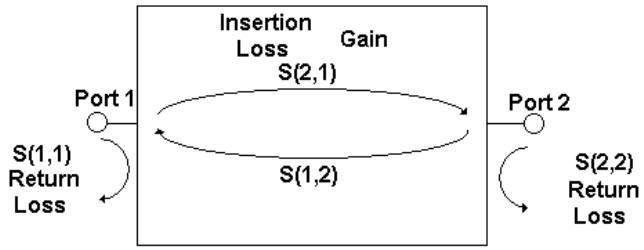
- Return Loss is the amount of power reflected back to a generator from a load due to impedance mismatch.
- $S_{11} = 10 * log_{10}(\left|\frac{P_{reflected}}{P_{incident}}\right|)$

or

- $S_{11} = -20 * log_{10}(|\Gamma|)$

where

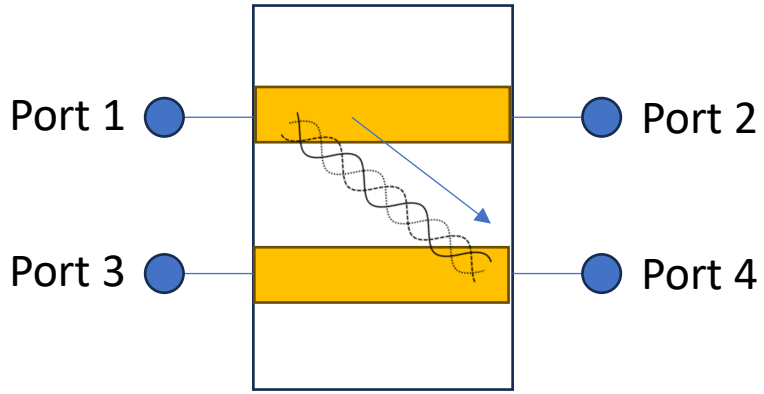
$$\Gamma = \frac{(Z_L - Z_0)}{(Z_L + Z_0)}$$



S(2,1) = S(1,2) For Ideal Passive Parts

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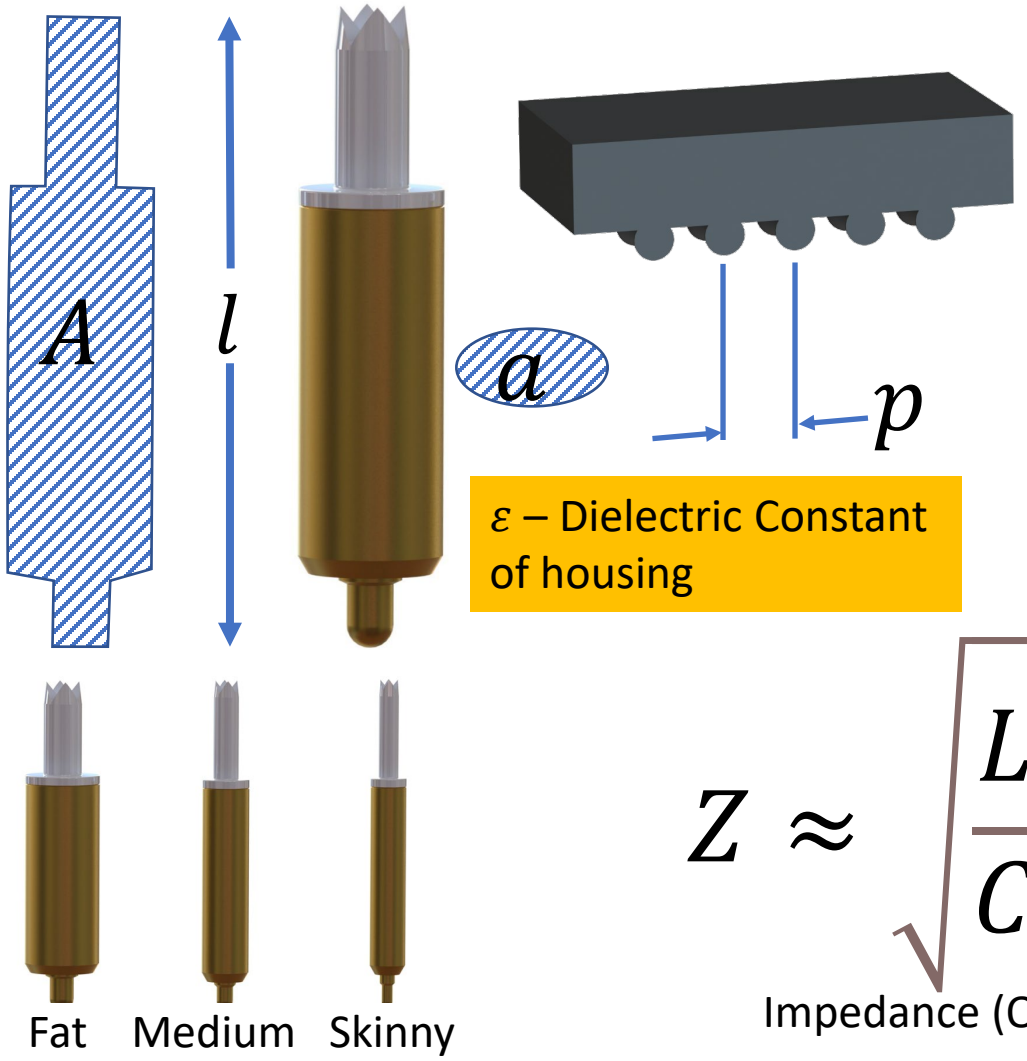
Metrics: Crosstalk



- Crosstalk is the coupling of undesired signals between lines.
- $S_{41} = 10 * log_{10}\left(\frac{P_4}{P_1}\right)$
  - P_1 is the input power at Port 1
  - P_4 is the power received at Port 4 from Port 1

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Bare-Bones Basics About Spring Probe RF Transmission



ε – Dielectric Constant of housing

	Fat Probe	Medium Probe	Skinny Probe
Length (l)	constant	constant	constant
X-sect Area (a)	largest	medium	smallest
Inductance (L)	smallest	medium	largest
Facing Area (A)	largest	medium	smallest
Contact Pitch (p)	constant	constant	constant
Dielectric(ε)	constant	constant	constant
Capacitance (C)	largest	medium	smallest

$$Z \approx \sqrt{\frac{L}{C}}$$

Impedance (Ohms)

$$C \propto \frac{\varepsilon A}{p}$$

Capacitance (pF)

$$L \propto \frac{l}{a}$$

Inductance (nH)

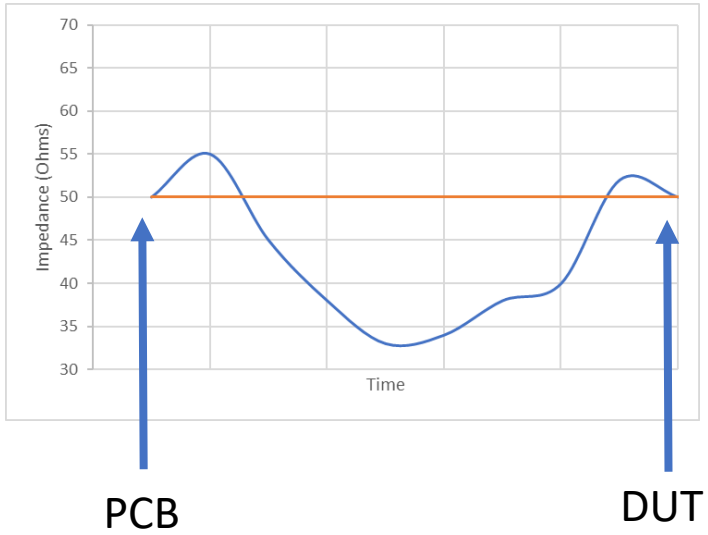
CONFIDENTIAL

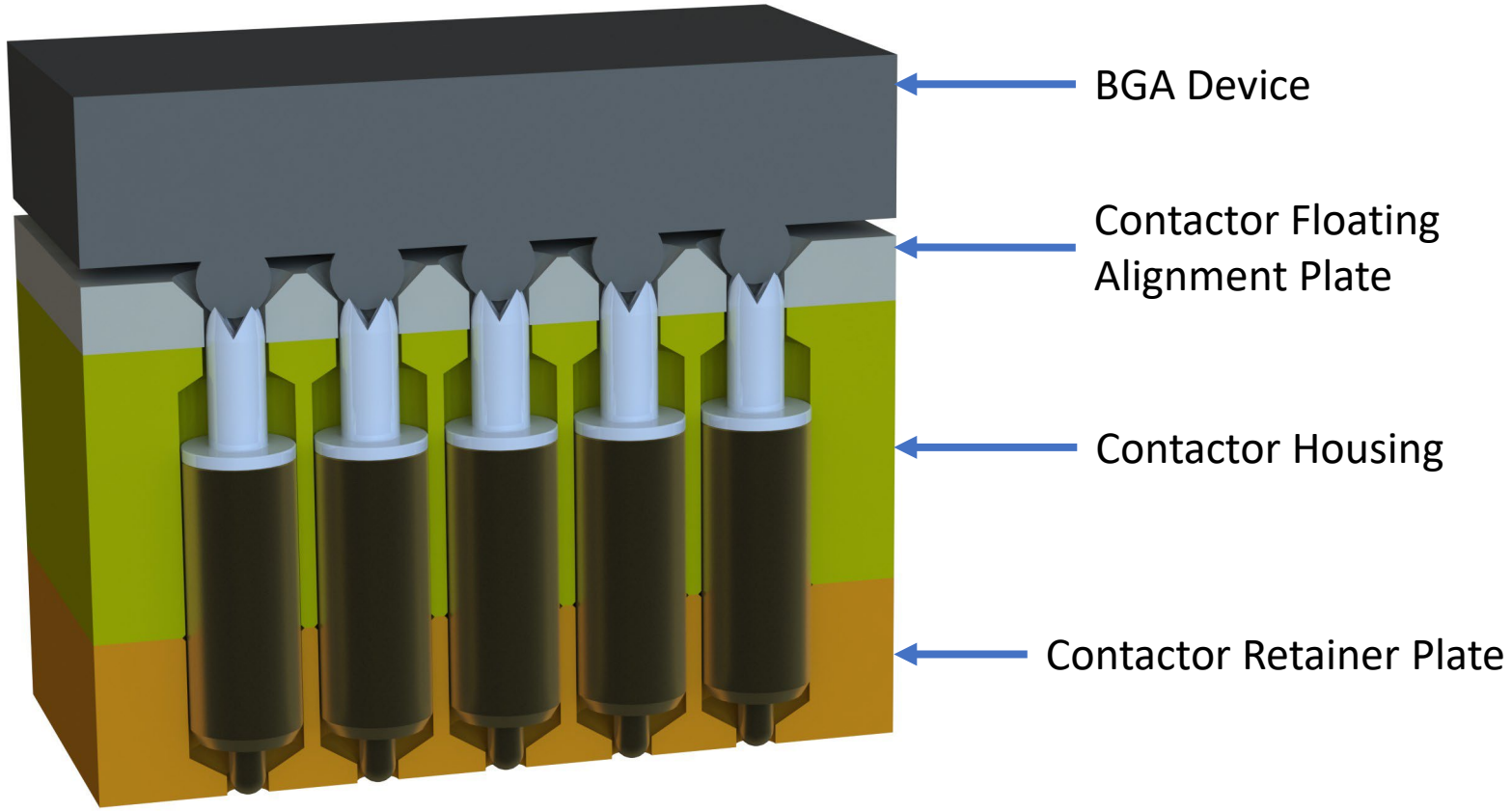
Typical Spring Probe Contactor at Native DUT Pitch

Probe Spring Probe – Native Pitch

50 Ohm constant impedance is desired

TDR – Impedance Profile





Contactor shown at test height – fully compressed

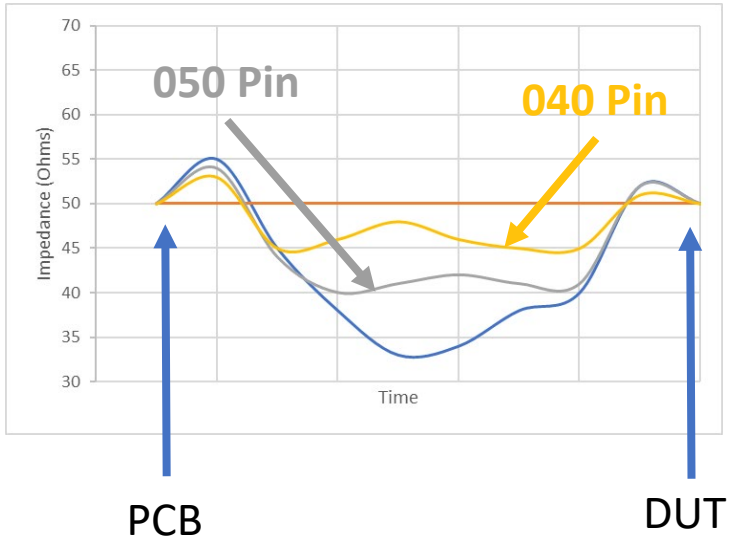
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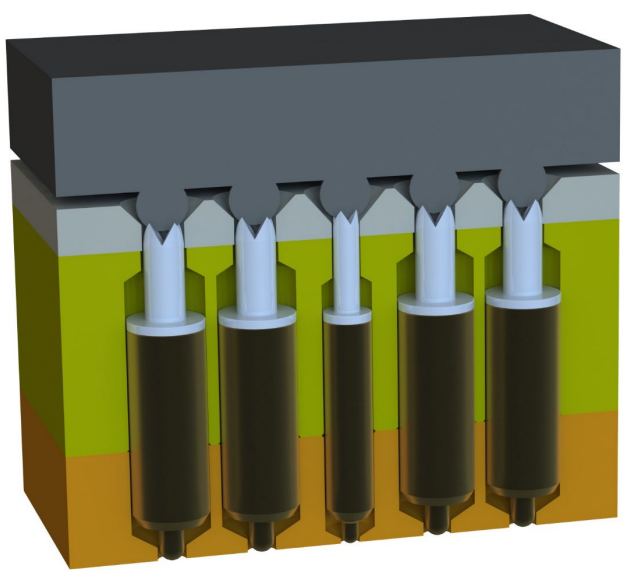
Probe – Use Smaller Probe to Increase Impedance

Spring Probe – Smaller signal pins

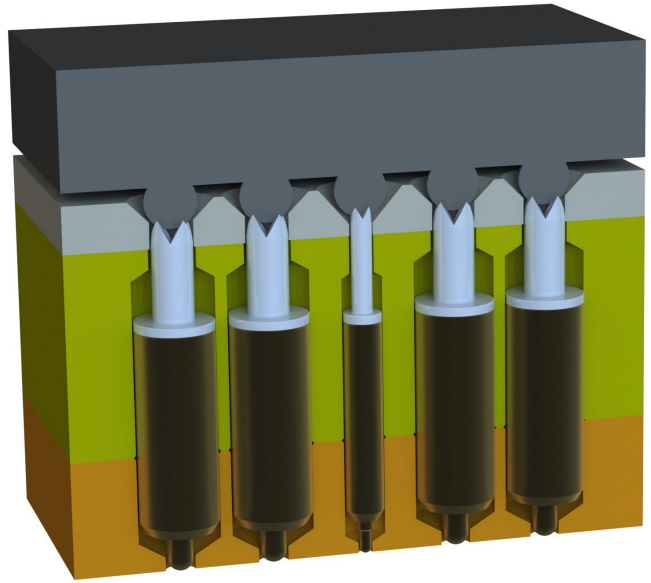
Impedance increases closer to 50 Ohms

TDR – Impedance Profile





050 Signal Pin



040 Signal Pin

A decreases

a decreases

» Z Increases

$$Z \approx \sqrt{\frac{L}{C}}$$

Impedance (Ohms)

$$C \propto \frac{\varepsilon A}{p}$$

Capacitance (pF)

$$L \propto \frac{l}{a}$$

Inductance (nH)

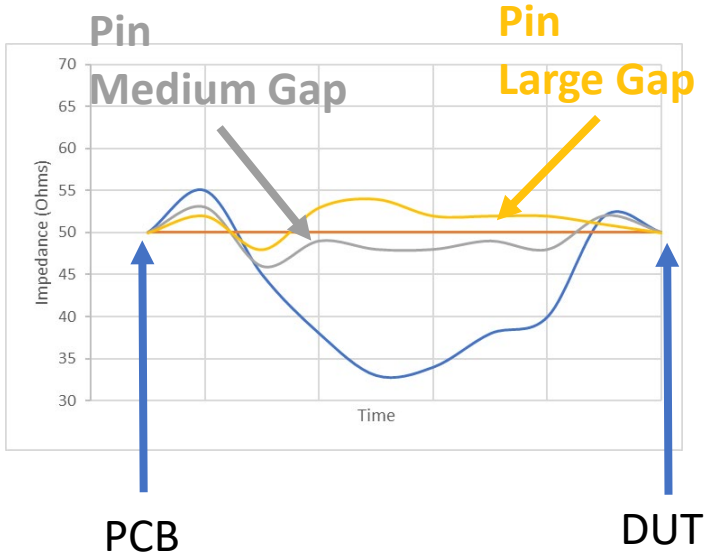
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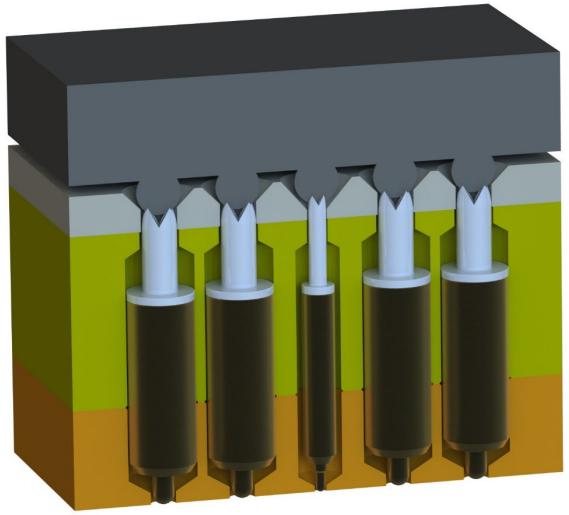
Use Smaller Probe And Air Gap

Spring Probe – Smaller signal pins
Air gap – lower ε

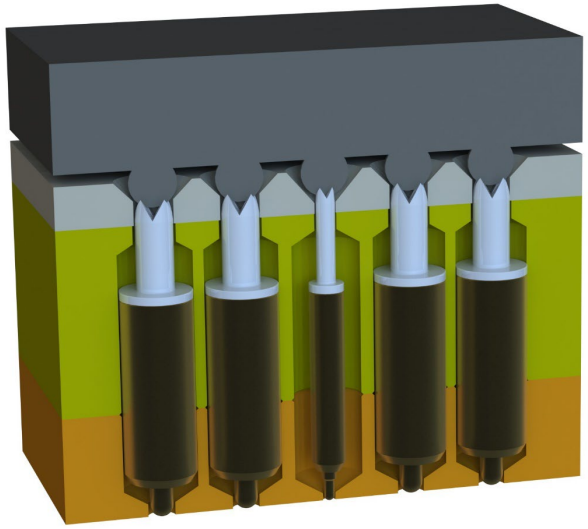
Impedance increases closer to 50 Ohms

TDR – Impedance Profile





Med Signal Pin – Medium Air Gap



Med Signal Pin – Large Air Gap

A decreases
a decreases
ε decreases
» Z Increases more

$$Z \approx \sqrt{\frac{L}{C}}$$

Impedance (Ohms)

$$C \propto \frac{\varepsilon A}{p}$$

Capacitance (pF)

$$L \propto \frac{l}{a}$$

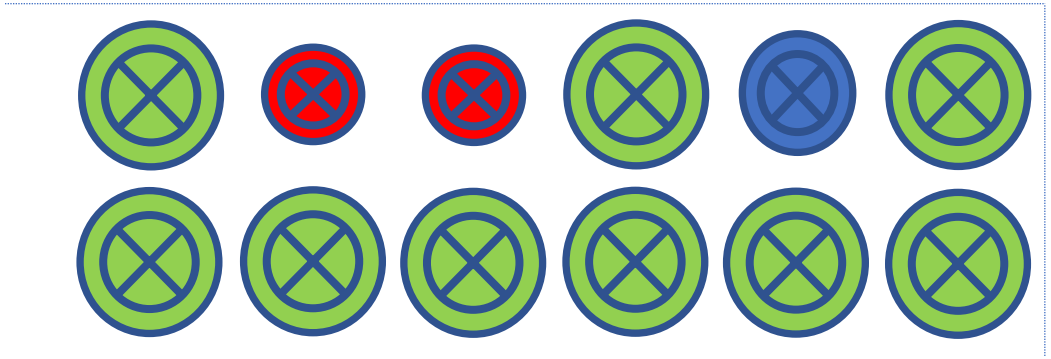
Inductance (nH)

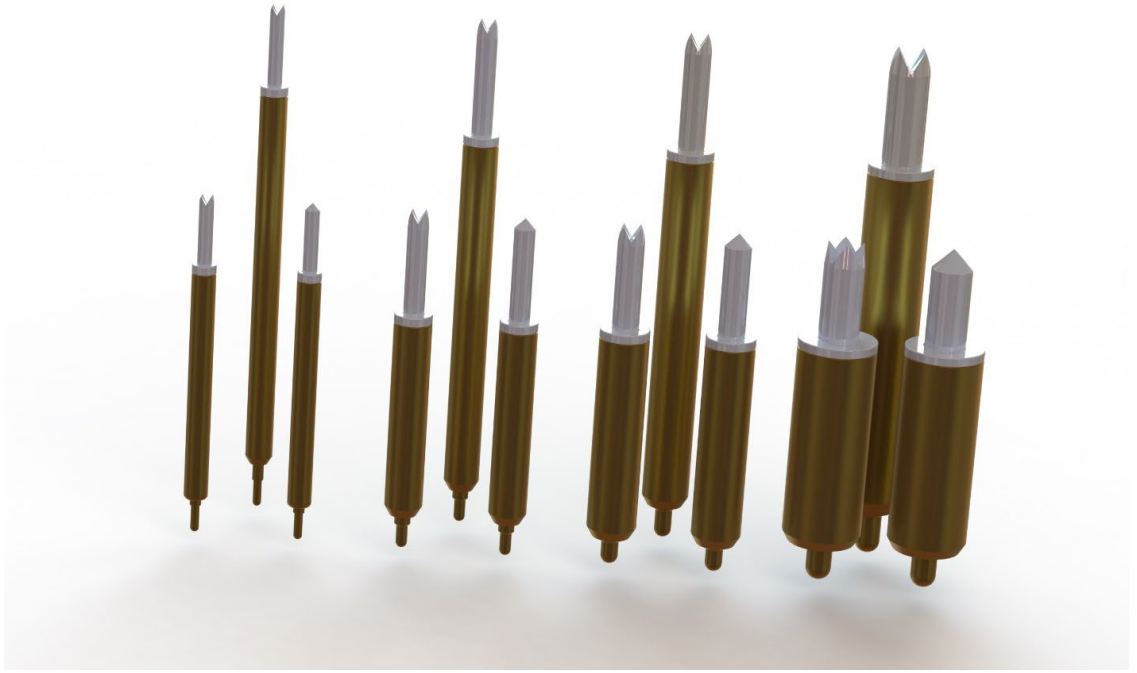
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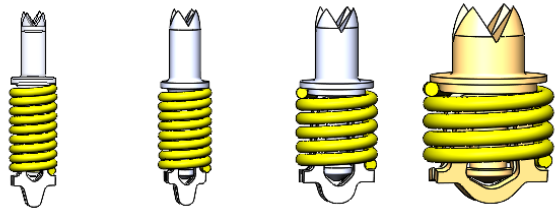
Johnstech Common Test Heights - S Parameter Tuning

- All of Johnstech Spring Probe lines share common test heights:
  - HERØHF – 1.0mm
  - HERØHC – 2.5mm
  - SHOTO – 3.0mm
  - YARI – 4.5mm
  - Coming soon HERØUC – 3.2mm

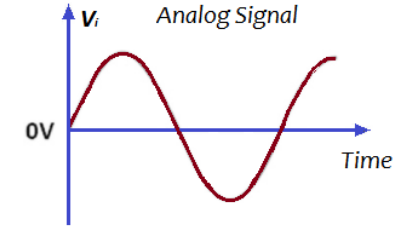
This allows for J-Tuning!

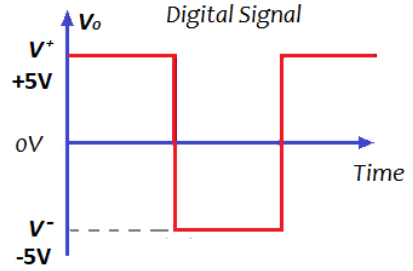


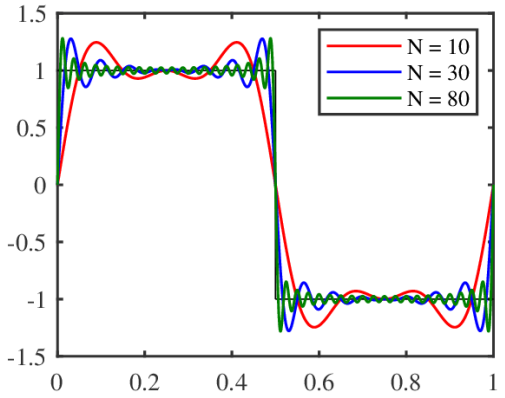




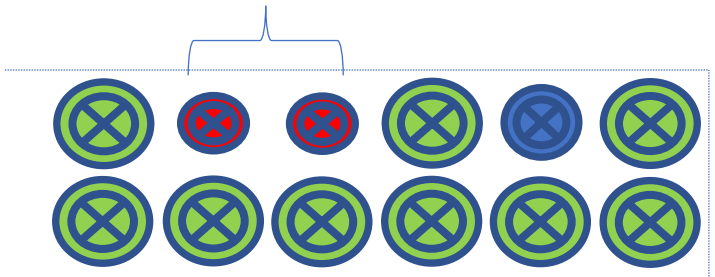
Analog vs Digital

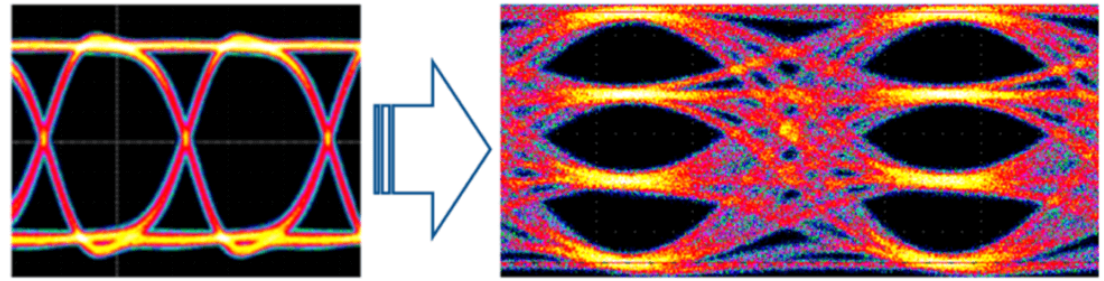






- Digital signals are bits of data transmitted as ones and zeros
- Most digital applications use differential signaling
- The square wave can be broken down into frequencies to approach a better approximation of the true square
- Digital modulation is the way the data bits are broken down: Pulse Amplitude Modulation (4-level) is PAM-4
- Differential pairs are used commonly
- Cleaner impedance profiles result in higher channel bandwidth:
  - Cleaner ‘eye’, lower BER, lower jitter, less ringing



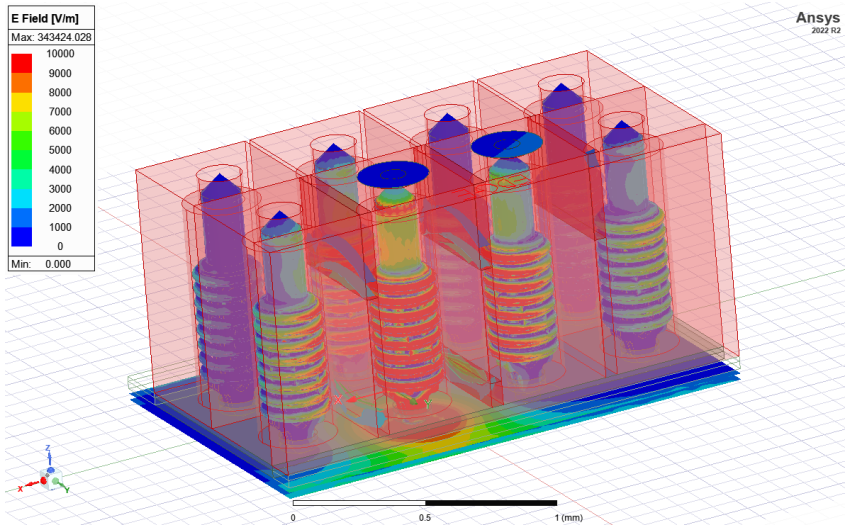


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'Usual' Tools Used for RF Analysis

Simulations

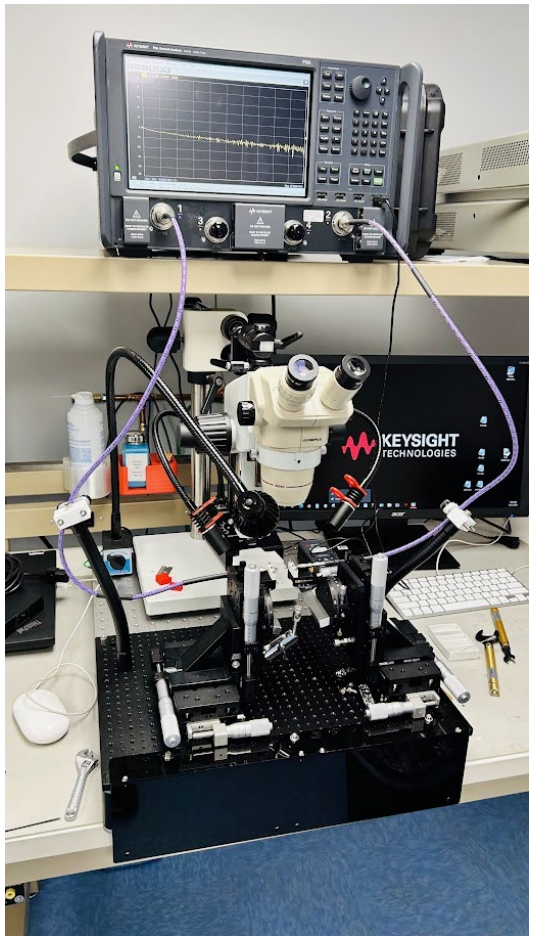
Ansys HFSS is used to perform 3D electromagnetic simulations of our test contactors. This is Finite Element Analysis of the governing Maxwell's Equations of the electrical system



Measurements

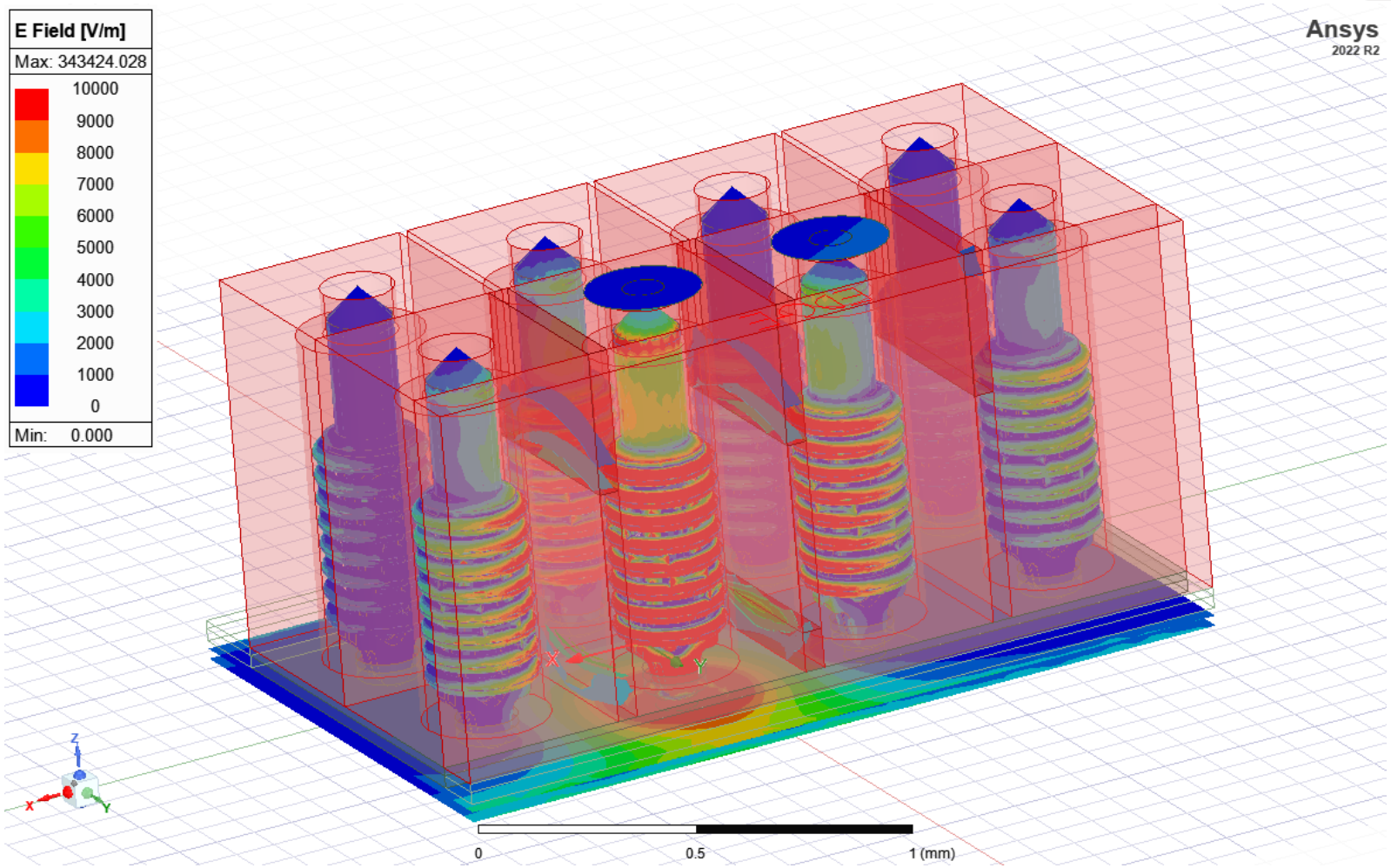
Vector Network Analyzers measure actual behavior of the built hardware from DC to high GHz.

Time and frequency domain measurements are made



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HFSS Example - Inputs

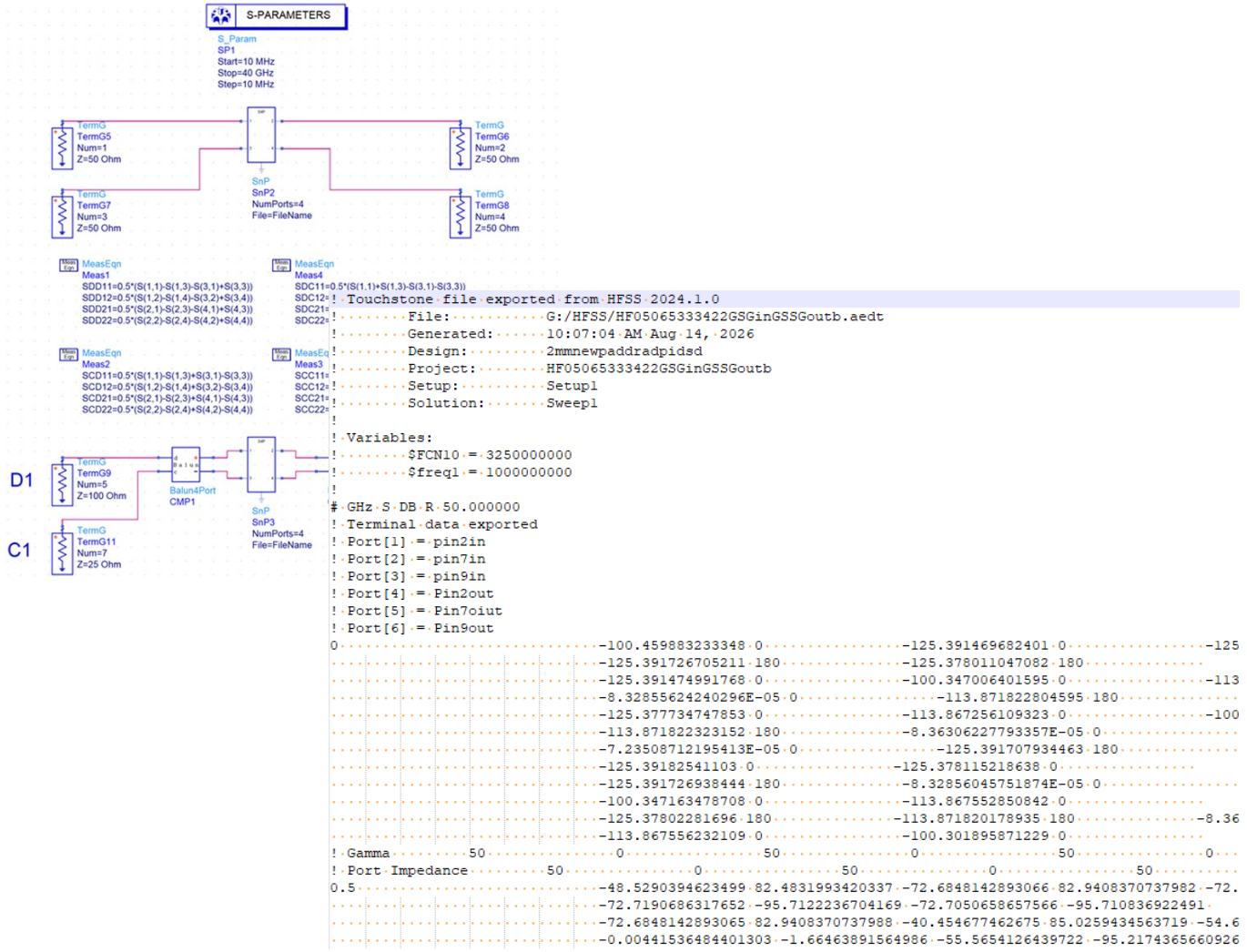


- Geometry from CAD:
  - Spring probe
  - Housing
  - Air gap
  - DUT
  - PCB
  - Ports – (where does signal go in and out)
- Material Properties:
  - Dielectric constant
  - Loss tangent
  - Conductive elements
- Boundary conditions

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What Do You Get from HFSS or VNA Measurements?

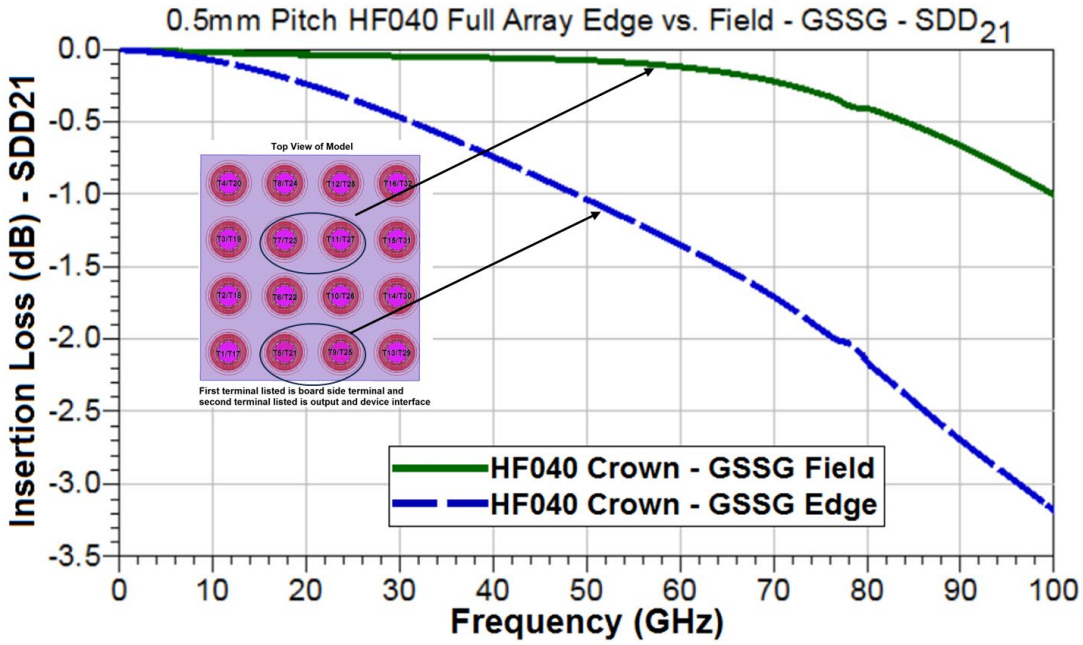
- S-Parameter Files! (Touchstone files)
  - Industry Standard text-file format
  - Definition of Input/Output ports (any # of ports)
  - Insertion Loss and Return Loss over a set of frequencies
- Once we have the S-Parameter files – ANY parameter can be plotted and analyzed



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RF Performance – Plotted from S-Parameter Files

- The performance of any probe technology depends not only on the contactor design also on the signal and grounding configuration.
- Additionally, the quality of the ground has a major influence on signal integrity
  - Number of grounds
  - Proximity of grounds
  - Symmetry of grounds

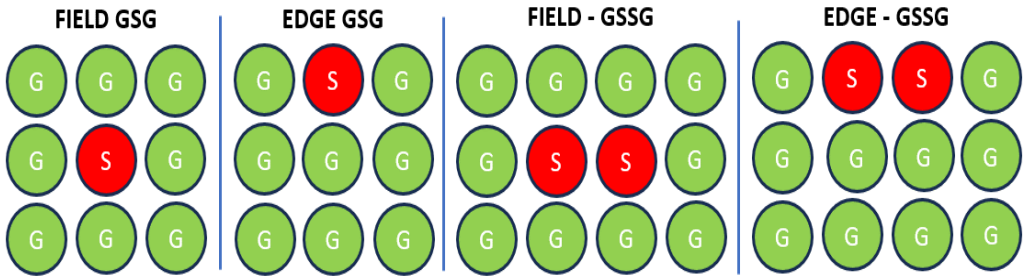


https://www.johnstech.com/wp-content/uploads/2024/10/The-Impact-of-Grounding-on-RF-Performance.pdf

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RF Performance – Insertion Loss Calculated from S-Parameter Files

- Frequency (GHz)
- S_{21} Insertion Loss
  - -1dB Threshold
- Tip-style options



HERØHF Electrical Specifications – RF Insertion Loss – GSG/GSSG

Specification (GHz) GSG		0.3		0.4		0.5		0.65		0.8		1		1.27	
		Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field
HF030	Crown	HF030													
	Spear														
HF040	Crown			HF040											
	Spear														
HF050	Crown					HF050									
	Spear														
HF080	Crown							HF080							
	Spear														

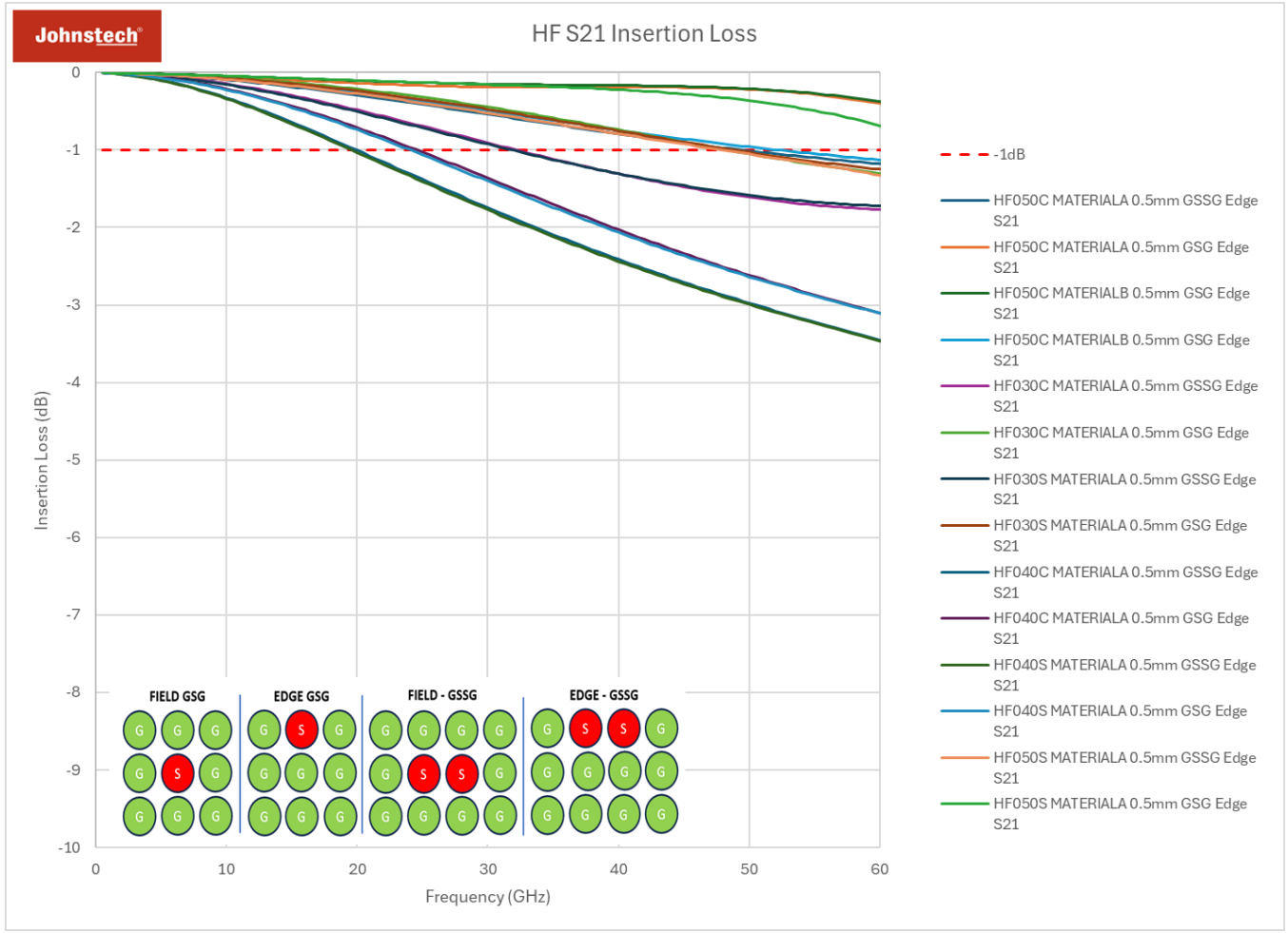
Specification (GHz) GSSG		0.3		0.4		0.5		0.65		0.8		1		1.27	
		Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field
HF030	Crown	HF030													
	Spear														
HF040	Crown			HF040											
	Spear														
HF050	Crown					HF050									
	Spear														
HF080	Crown							HF080							
	Spear														

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RF Performance – Insertion Loss Plotted from S-Parameter Files

- Frequency (GHz)
- S_{21} Insertion Loss (dB)
- Tip-style options:
  - S=Spear
  - C=Crown

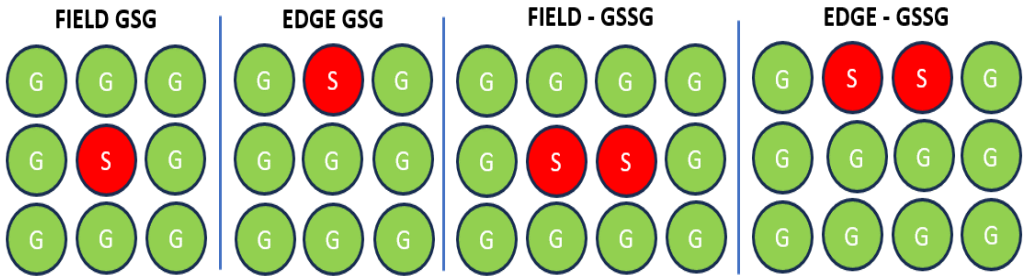
HERØHF® Electrical Specifications – RF Insertion Loss Example – GSG/GSSG with 0.5mm Pitch DUT



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RF Performance – Return Loss Calculated from S-Parameter Files

- Frequency (GHz)
- S_{11} Return Loss
  - -10 dB threshold
- Tip-style options



HERØHF® Electrical Specifications – RF Return Loss – GSG/GSSG

Specification (GHz)	GSG	0.3		0.4		0.5		0.65		0.8		1		1.27	
		Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field
HF030	Crown	HF030													
	Spear														
HF040	Crown			HF040											
	Spear														
HF050	Crown					HF050									
	Spear														
HF080	Crown							HF080							
	Spear														

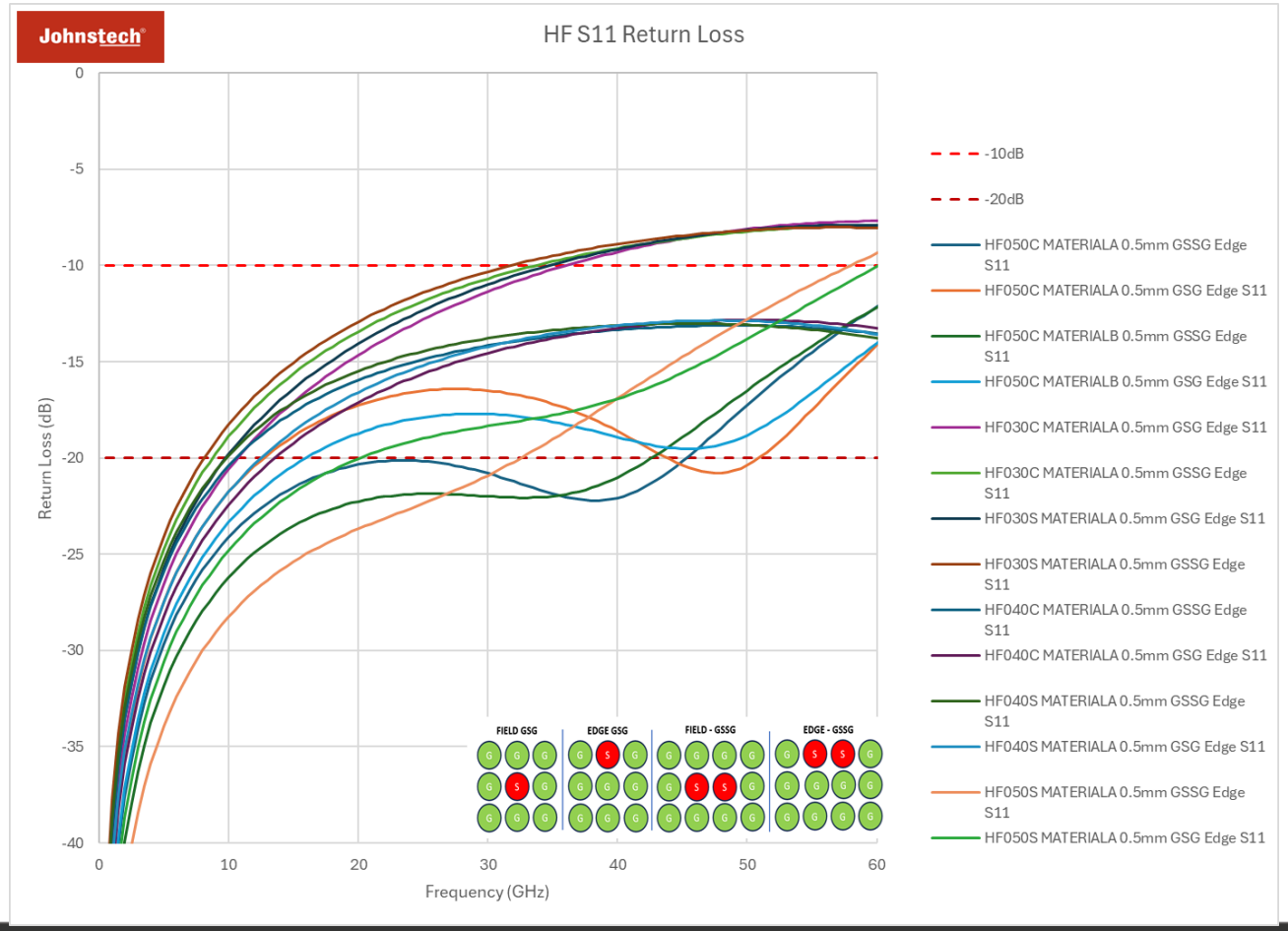
Specification (GHz)	GSSG	0.3		0.4		0.5		0.65		0.8		1		1.27	
		Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field
HF030	Crown	HF030													
	Spear														
HF040	Crown			HF040											
	Spear														
HF050	Crown					HF050									
	Spear														
HF080	Crown							HF080							
	Spear														

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RF Performance – Return Loss Plotted from S-Parameter Files

- Frequency (GHz)
- S_{11} Return Loss (dB)
- Tip-style options:
  - S=Spear
  - C=Crown

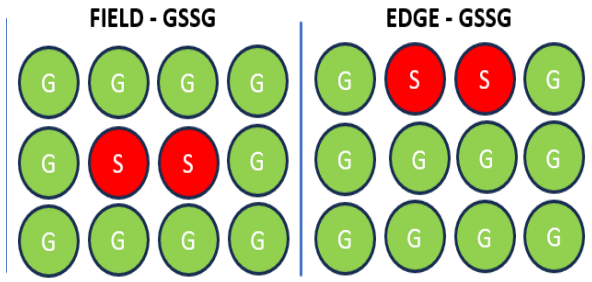
HERØHF® Electrical Specifications – RF Return Loss Example – GSG/GSSG with 0.5mm Pitch DUT



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RF Performance – Inductance Calculated from S-Parameter Files

- Inductance (nH)
- Derived from simulated and/or measured S-parameters
- Housing material options
- Tip-style options



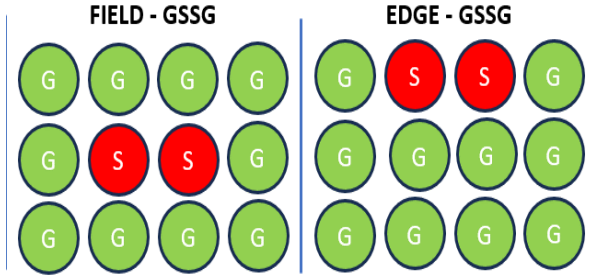
HERØHF® Electrical Specifications – Inductance

Inductance (nH):	HF030				HF040				HF050				HF080			
	MATL A		MATL B		MATL A		MATL B		MATL A		MATL B		MATL A		MATL B	
	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field
0.30																
Crown	0.221	0.262	0.295	0.262												
Spear	0.306	0.272	0.306	0.272												
0.40																
Crown	0.387	0.341			0.378	0.305										
Spear	0.395	0.349			0.395	0.319	0.393	0.318								
0.50																
Crown	0.444	0.399			0.468	0.365			0.296	0.261	0.297	0.261				
Spear	0.452	0.407			0.480	0.376			0.319	0.282						
0.65																
Crown					0.487	0.429			0.388	0.334					0.247	0.286
Spear					0.501	0.443			0.409	0.353			0.265	0.305		
0.80																
Crown									0.453	0.387			0.355	0.305	0.355	0.305
Spear									0.423	0.361			0.374	0.322	0.374	0.322
1.00																
Crown													0.427	0.364		
Spear													0.445	0.381		
1.27																
Crown													0.478	0.421		
Spear													0.496	0.437		

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RF Performance – Capacitance Calculated from S-Parameter Files

- Capacitance(pF)
- Derived from simulated and/or measured S-parameters
- Housing material options
- Tip-style options



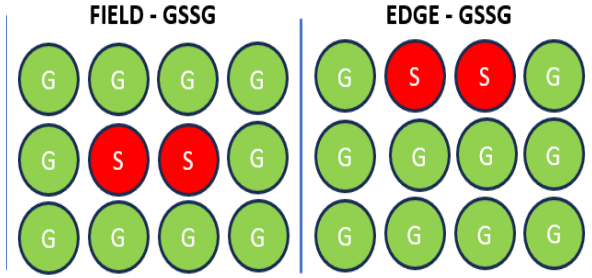
HERØHF® Electrical Specifications – Capacitance

Capacitance (pF):	HF030				HF040				HF050				HF080			
	MATL A		MATL B		MATL A		MATL B		MATL A		MATL B		MATL A		MATL B	
	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field
0.30																
Crown	0.166	0.142	0.125	0.144												
Spear	0.127	0.147	0.123	0.142												
0.40																
Crown	0.115	0.125			0.141	0.125										
Spear	0.114	0.125			0.138	0.123	0.138	0.123								
0.50																
Crown	0.115	0.119			0.135	0.116			0.168	0.187	0.159	0.177				
Spear	0.112	0.116			0.136	0.116			0.160	0.179						
0.65																
Crown					0.110	0.112			0.149	0.161					0.200	0.188
Spear					0.108	0.111			0.147	0.159			0.205	0.193		
0.80																
Crown									0.153	0.156			0.184	0.191	0.184	0.191
Spear									0.195	0.200			0.182	0.190	0.183	0.176
1.00																
Crown													0.180	0.187		
Spear													0.178	0.185		
1.27																
Crown													0.184	0.186		
Spear													0.180	0.181		

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RF Performance – Impedance Calculated from S-Parameter Files

- Impedance (Ω)
- Derived from simulated and/or measured S-parameters
- Housing material options
- Tip-style options



HERØHF® Electrical Specifications – Impedance By DUT Pitch

Impedance (Ω)	HF030				HF040				HF050				HF080			
	MATL A		MATL B		MATL A		MATL B		MATL A		MATL B		MATL A		MATL B	
	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field	Edge	Field
0.30																
Crown	36.5	43.0	48.6	42.7												
Spear	49.1	43.0	49.9	43.8												
0.40																
Crown	58.0	52.2			51.8	49.4										
Spear	58.9	52.8			53.5	50.9	53.4	50.8								
0.50																
Crown	62.1	57.9			58.9	56.1			42.0	37.4	43.2	38.4				
Spear	63.5	59.2			59.4	56.9			44.7	39.7						
0.65																
Crown					66.5	61.9			51.0	45.5					35.1	39.0
Spear					68.1	63.2			52.7	47.1			36.0	39.8		
0.80																
Crown									54.4	49.8			43.9	40.0	43.9	40.0
Spear									46.6	42.5			45.3	41.2	45.2	42.8
1.00																
Crown													48.7	44.1		
Spear													50.0	45.4		
1.27																
Crown													51.0	47.6		
Spear													52.5	49.1		

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Real-World – It Is HARD!

- Complex HFSS modeling of multiple input/output ports in a socket model takes a long time to model and simulate – hours to days
  - Models are simplified as much as possible
  - Simulations are run to lower frequencies to reduce time
- VNA measurements:
  - Need special fixturing and de-embedding techniques (errors)
  - Limited usually to 2 or 4 ports MAX
  - Precise calibration required
  - Requires very high skill level for accurate measurements

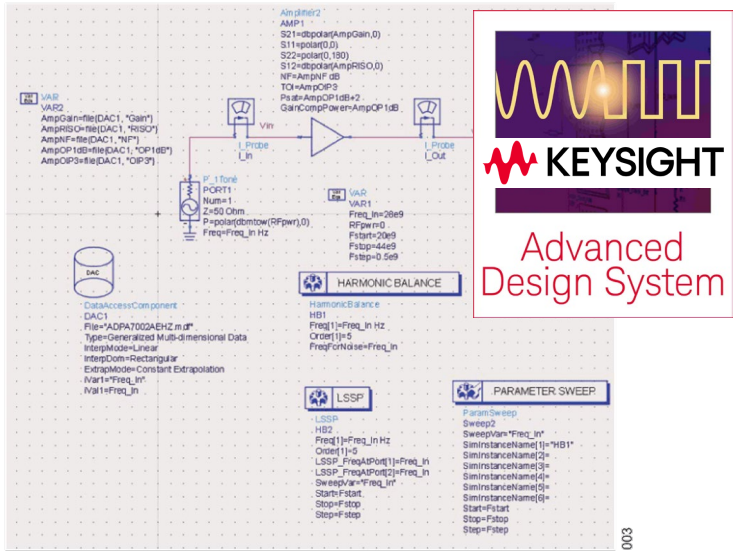


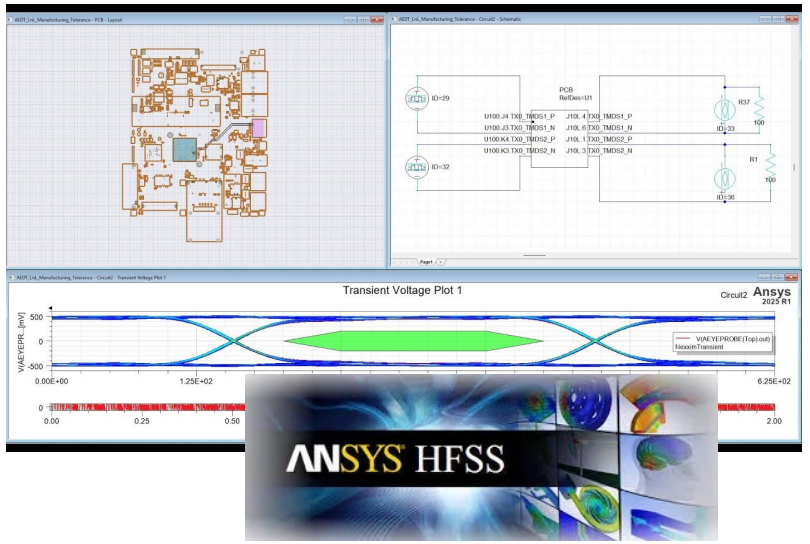
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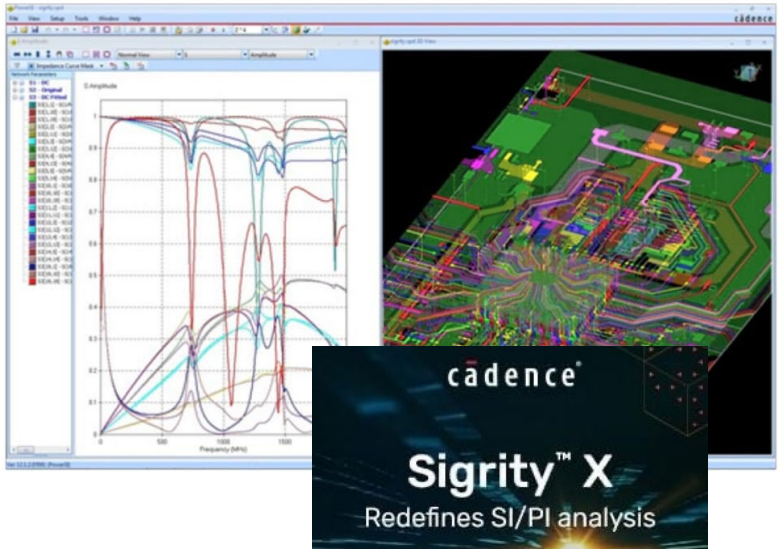
Available Tools For S-Parameter Analysis

- Expensive Tools
  - Keysight ADS
  - Ansys HFSS + Circuit
  - Cadence Sigrity

- Import .sNp Touchstone files
- Channel simulation
- Eye diagrams
- BER estimation
- TDR/TDT
- COM calculations
- Equalization modeling
- Mixed circuit + EM simulation





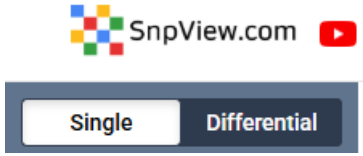


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Available Tools For S-Parameter Analysis

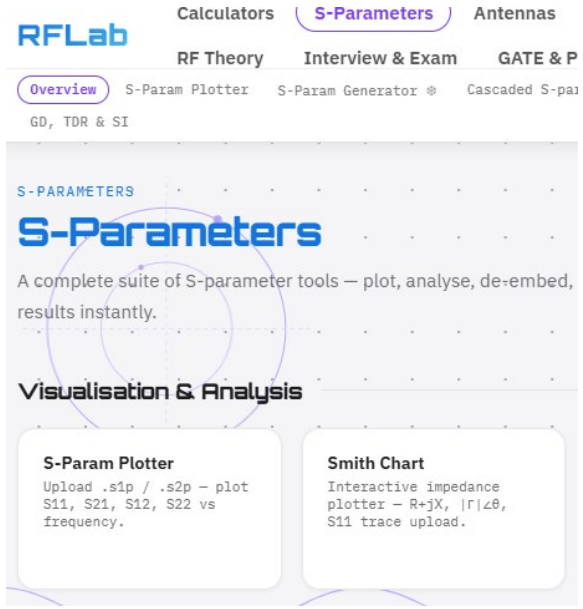
- Other Tools
  - Matlab RF Toolbox
  - Python + Scikit-RF library (free)
  - Simbeor
- Web-based tools (All Free)
  - EverythingRF S-Parameter Viewer
  - RFLab Tools
  - SnpView.com
- Free Software:
  - S-View Classic (from Microsoft Store)
  - TstoneLab (from Microsoft Store)
  - Touchstone Viewer Studio FREE (from Microsoft Store)
  - uSimmics

- Import .sNp Touchstone files
- Touchstone import
- TDR
- Eye diagrams
- COM calculations
- PCIe/CXL analysis





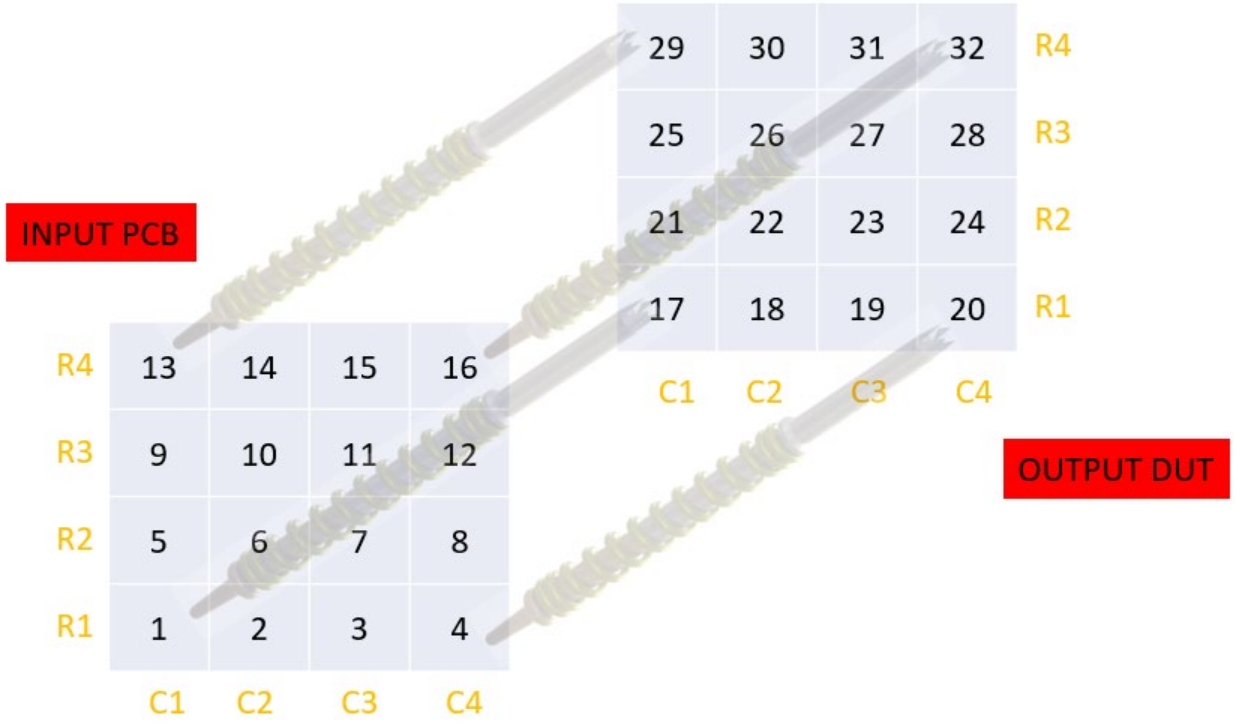




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New Approach – S-Parameter Library – 4x4 Arrays

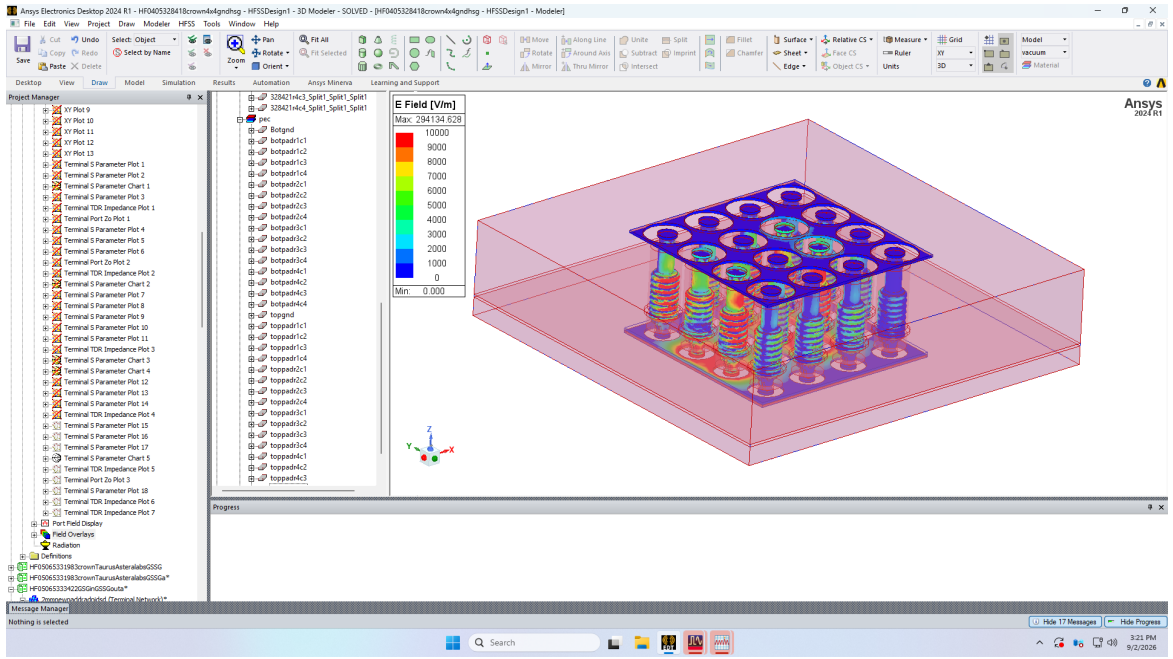
- Create a library of S-Parameter files of sockets by:
  - Spring probe type
  - Housing material type
  - Standard DUT Pitch
  - Define a 4x4 grid of probes
    - Universally defined input/output ports
    - 32 Port S-Parameter file
- Simulations set up and batch-run on servers

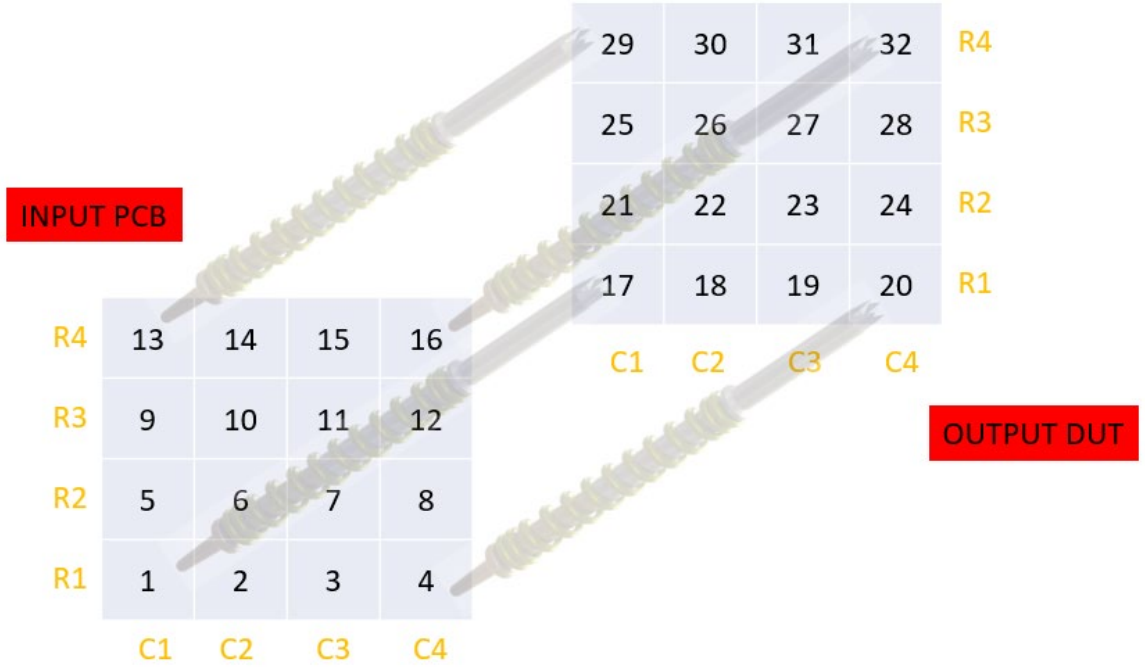


16 Input ports and 16 output ports -> S32 S-Parameter Files

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New Approach – S-Parameter Library – 4x4 Arrays



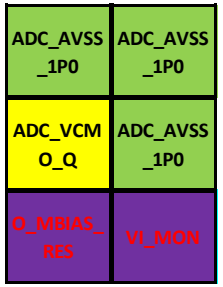


16 Input ports and 16 output ports -> S32 S-Parameter Files

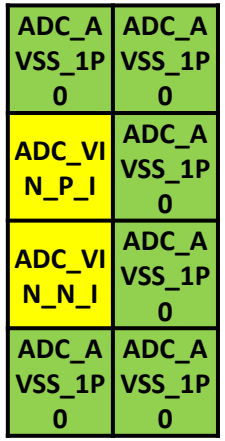
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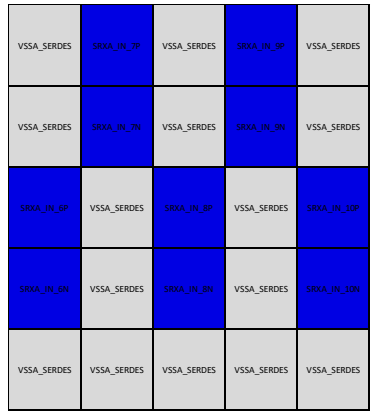
Why 4x4 Arrays?

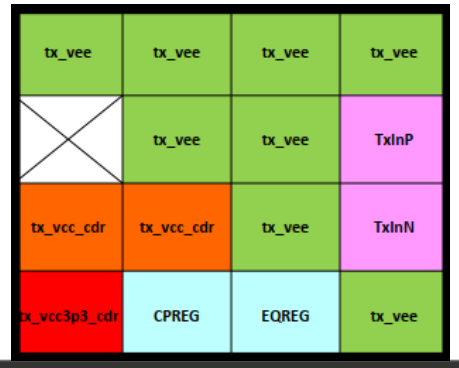
- 4x4 arrays are a reasonable compromise for modeling and analysis
- Is usually large enough to fit standard DUT pinouts

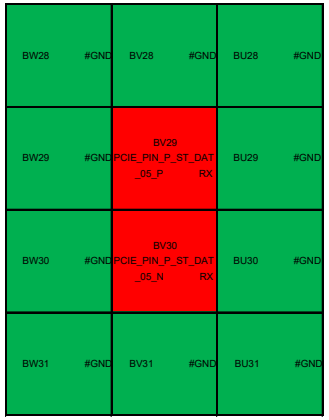


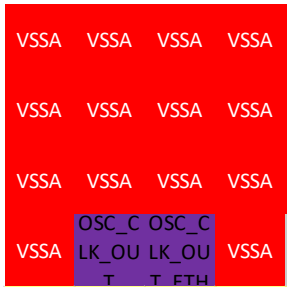


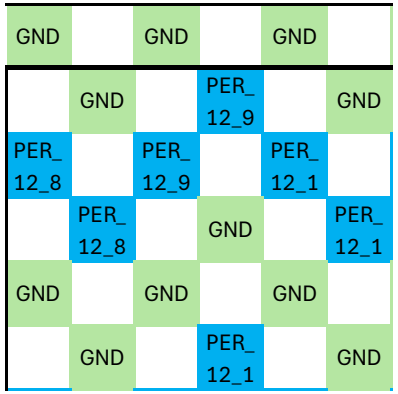












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Break Time





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Recap of the Seminar So Far

- We discussed:
  - RF Basics – Inductance, Capacitance, Impedance
  - Return Loss, Insertion Loss, Crosstalk
  - How do these parameters impact socket performance?
  - S-Parameter files
  - Tools available for an engineer to study RF parameters

- Now let's see some examples and use the best FREE S-parameter analysis tool



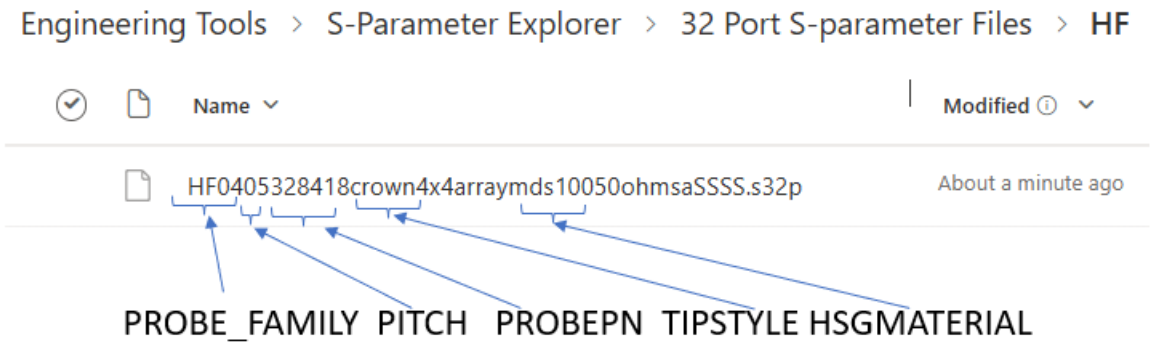
uSimmics

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How Johnstech Uses uSimmics

- Johnstech engineering has created a vast library of 32-port S-Parameter files to analyze new customer applications
- Schematic templates have been made so Applications Engineers can quickly analyze a customer DUT signal requirement
- This saves time! Faster technical answers! Faster quotes! Less formal HFSS simulation needed in many cases

- You can use this same philosophy and use the same tools help you optimize your test cell





S32p Library

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uSimmics Overview

https://qucsstudio.de/

About

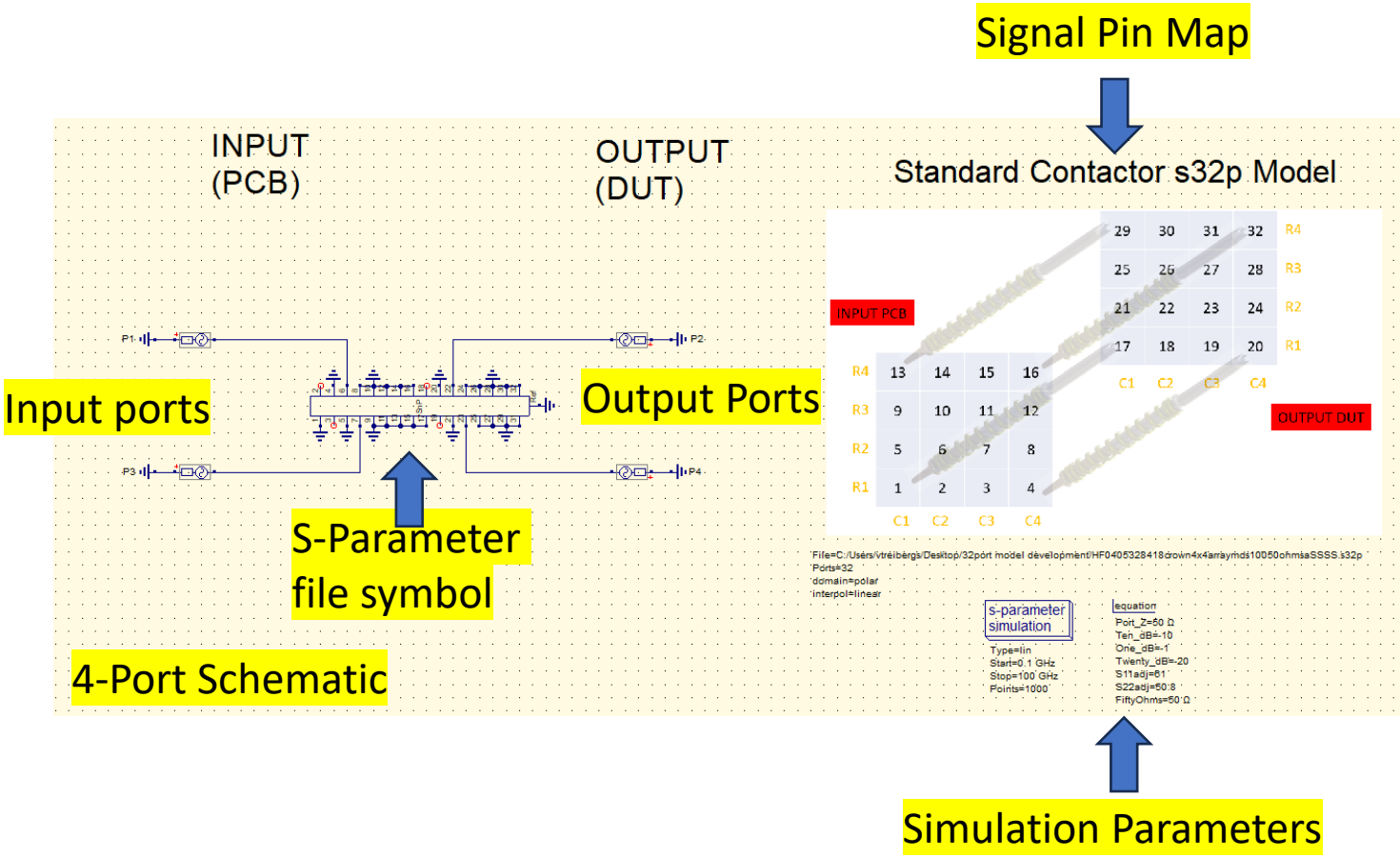
This application is mainly a circuit simulator that has evolved out of the project **Qucs**, but isn't compatible with it. Many things have been completely reworked. It's meant as a development environment for electrical engineers (graphical user interface, circuit simulator, PCB layouting, numerical data processing etc.), which can compete even with professional products. The application uses Qt4® by the Qt Company® as graphical user interface.

- uSimmics (Qucs Studio) is Windows software that is freeware that is based on the Open-Source Qucs project
- This is a free circuit-simulator that has many of the same features that is found in ADS and other commercial software
- S-Parameter simulations can easily be done, and n-port Touchstone SnP files can be used in the circuits

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Create An Appropriate Schematic

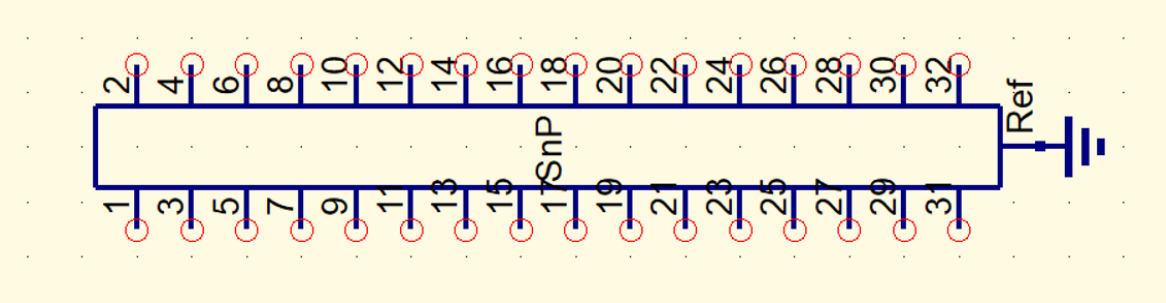
- Open a schematic file from a template
- 4-port models:
  - P1, P3 input
  - P2, P4 output
- 2-port models:
  - P1 input
  - P2 output
- N-port models possible

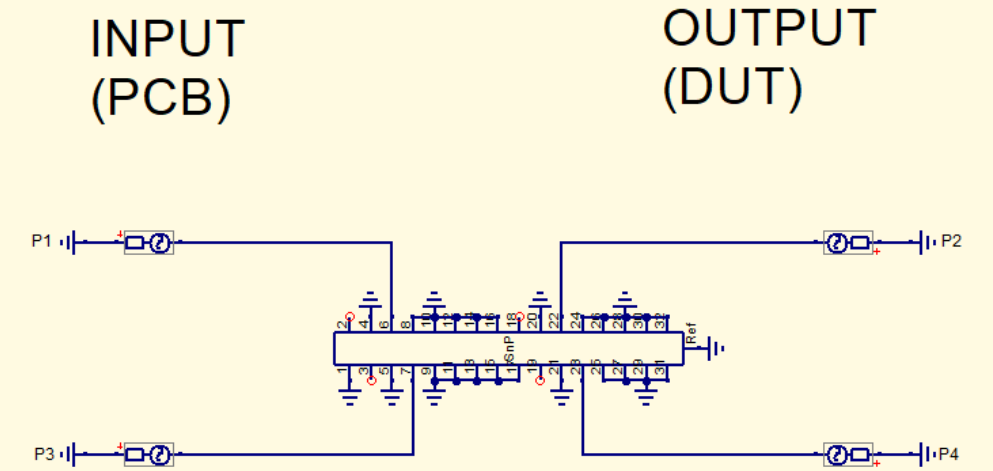


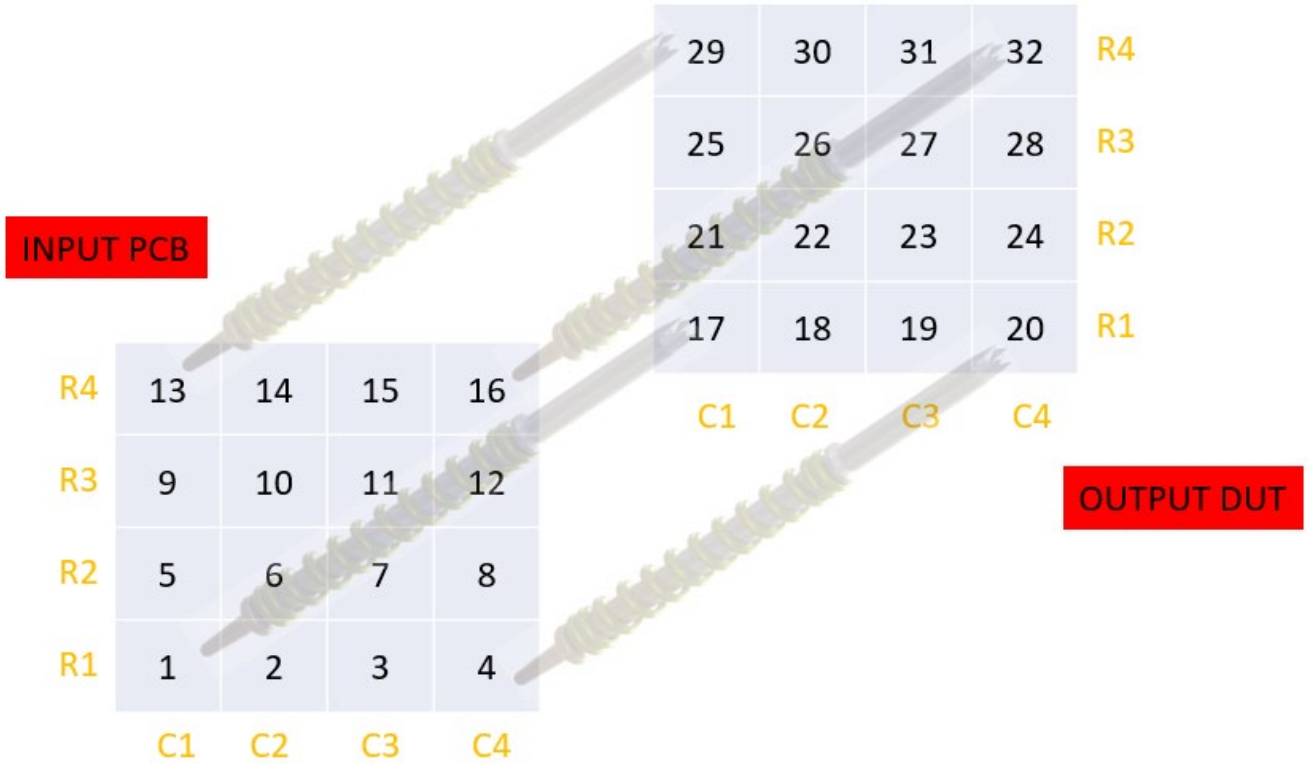
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32 Port Generic Contactor Model – 4-Port – GSSG Analysis

- PCB connections - Ports 1-16
- DUT connections - Ports 17-32



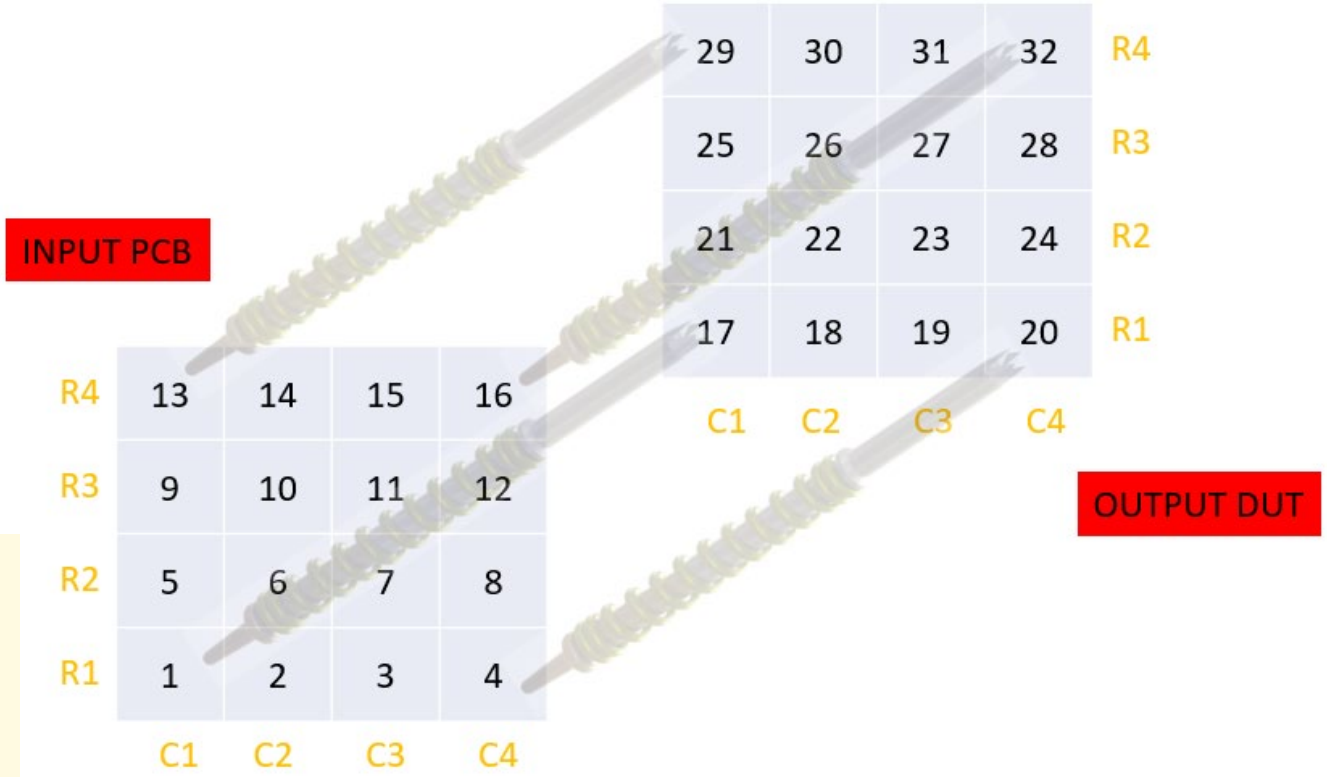


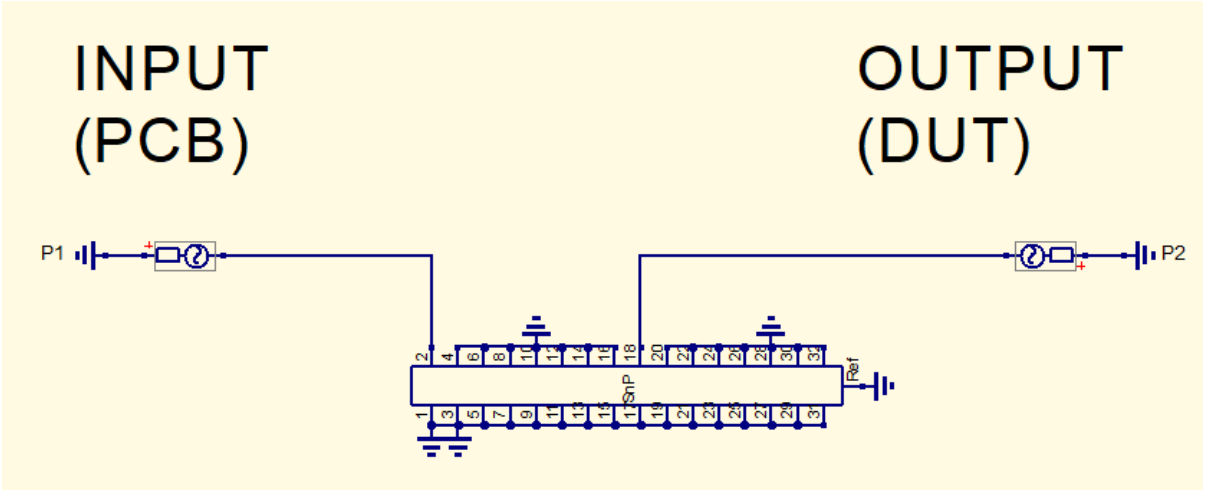


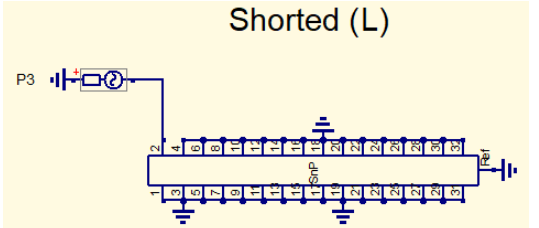
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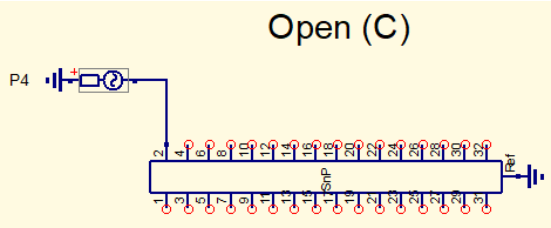
32 Port Generic Contactor Model – 2-Port – GSG Analysis

- PCB connections - Ports 1-16
- DUT connections - Ports 17-32
- Open/Short analysis for L and C extraction possible







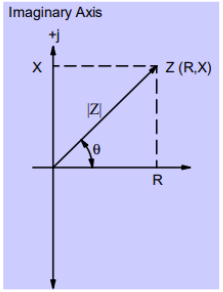


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2-Port Analysis – Extraction of Capacitance and Inductance

- Open circuit:
  - Zero current flowing through L and R
  - Capacitive reactance is dominant
- Short circuit:
  - All current bypasses C and G
  - Inductive reactance is dominant
- uSimmics converts to Z parameters and does the complex math:
  - C-> plots 1/(ω*imag(Z(S[1,1]))
  - L->plots imag(Z(S[1,1])/(ω)
- Plots over frequency – choose a 'low and flat' region

$$Z = R + jX = |Z|\angle\theta$$

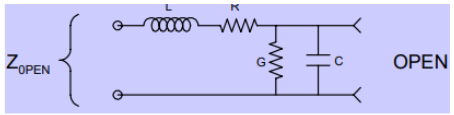


INDUCTIVE: $jX>0$

CAPACITIVE: $jX<0$

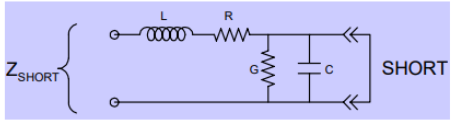
$$X_C = \frac{1}{2\pi fC} = \frac{1}{\omega C}$$

$$X_L = 2\pi fL = \omega L$$



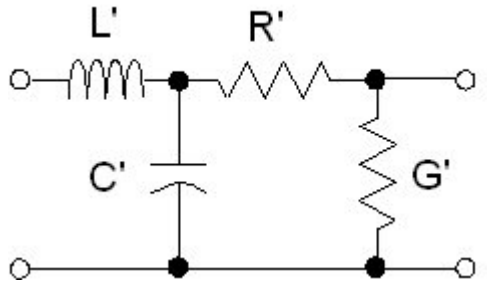
$$Z_{OPEN} = \frac{1}{G_{OPEN} + j\omega C_{OPEN}}$$

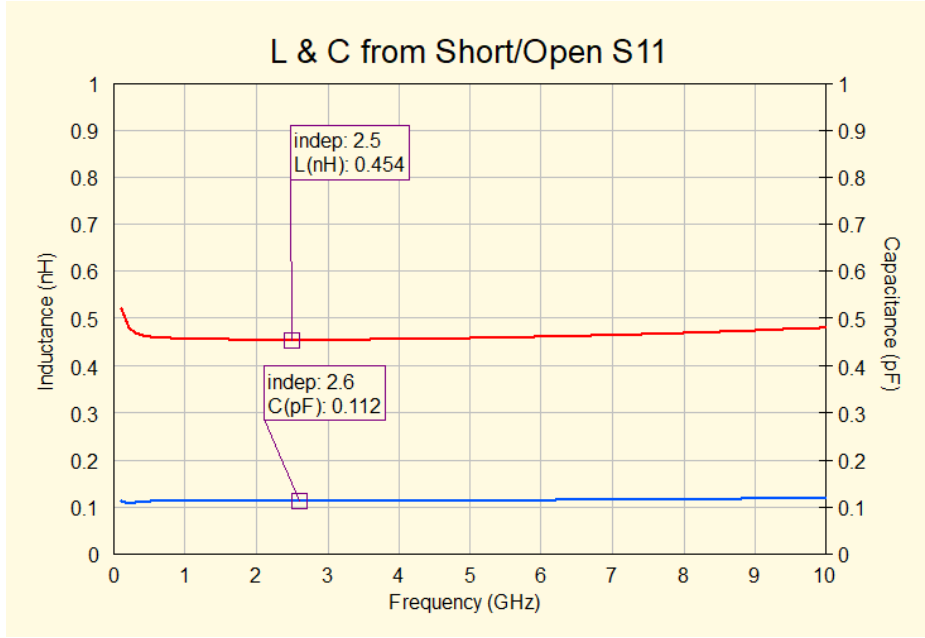
$$\left(R_{OPEN} + j\omega L_{OPEN} << \frac{1}{G_{OPEN} + j\omega C_{OPEN}}\right)$$



$$Z_{SHORT} = R_{SHORT} + j\omega L_{SHORT}$$

Lossy Transmission Line Circuit Model

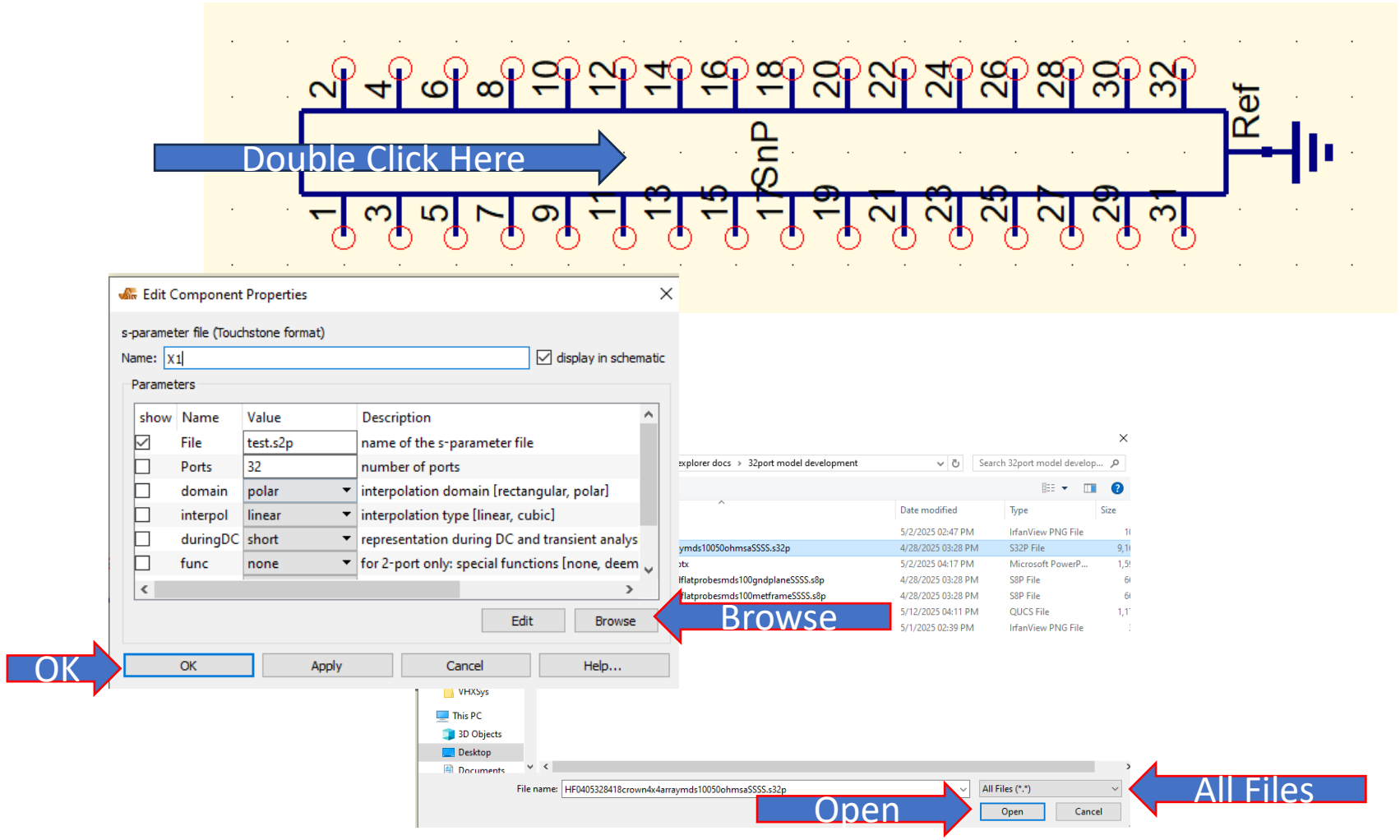




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Schematics with 32-port S-Parameter Files

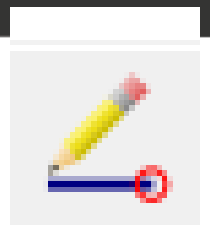
- Double-click the schematic symbol
- Click “Browse” and navigate to the proper S-parameter file
  - You may have to select “All Files(*.*)”
  - Click “Open”
- Click “OK”



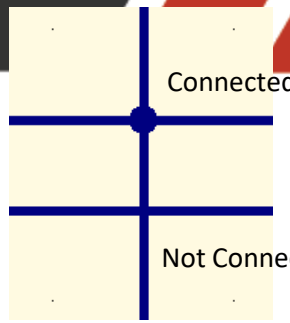
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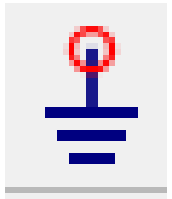
Creating The Circuit

- Point S-Parameter symbol to proper file
- Map pinout to closely match the customer DUT – connect Ports P1-P4 to S-parameter symbol using Wire Symbol
- Connect grounds using Ground Symbol
  - Multiple grounds can be connected with wires – no difference in results
- Missing pins - no connect at PCB and DUT
- Delete a Ground or Wire:
  - Select element and hit “Delete” key
  - Or select Delete from Top Toolbar and click multiple elements
  - Can select multiple elements by dragging a box with your mouse or Ctrl-Click select
- Move elements for clarity
  - Click and drag any existing element
- Undo/Redo work as expected!



Wire Symbol – Top Toolbar
Filled dot = connected
No dot = not connected

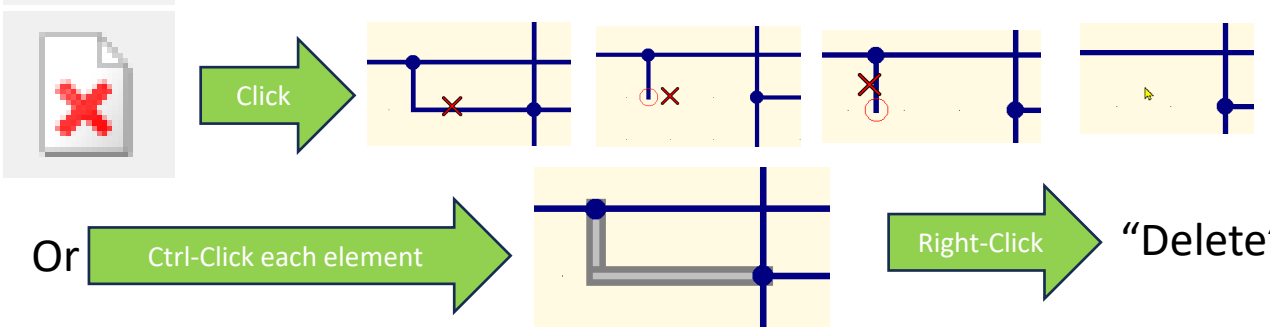




Ground Symbol – Top Toolbar
Right-Click to rotate symbol by 90°



Delete Symbol – Top Toolbar

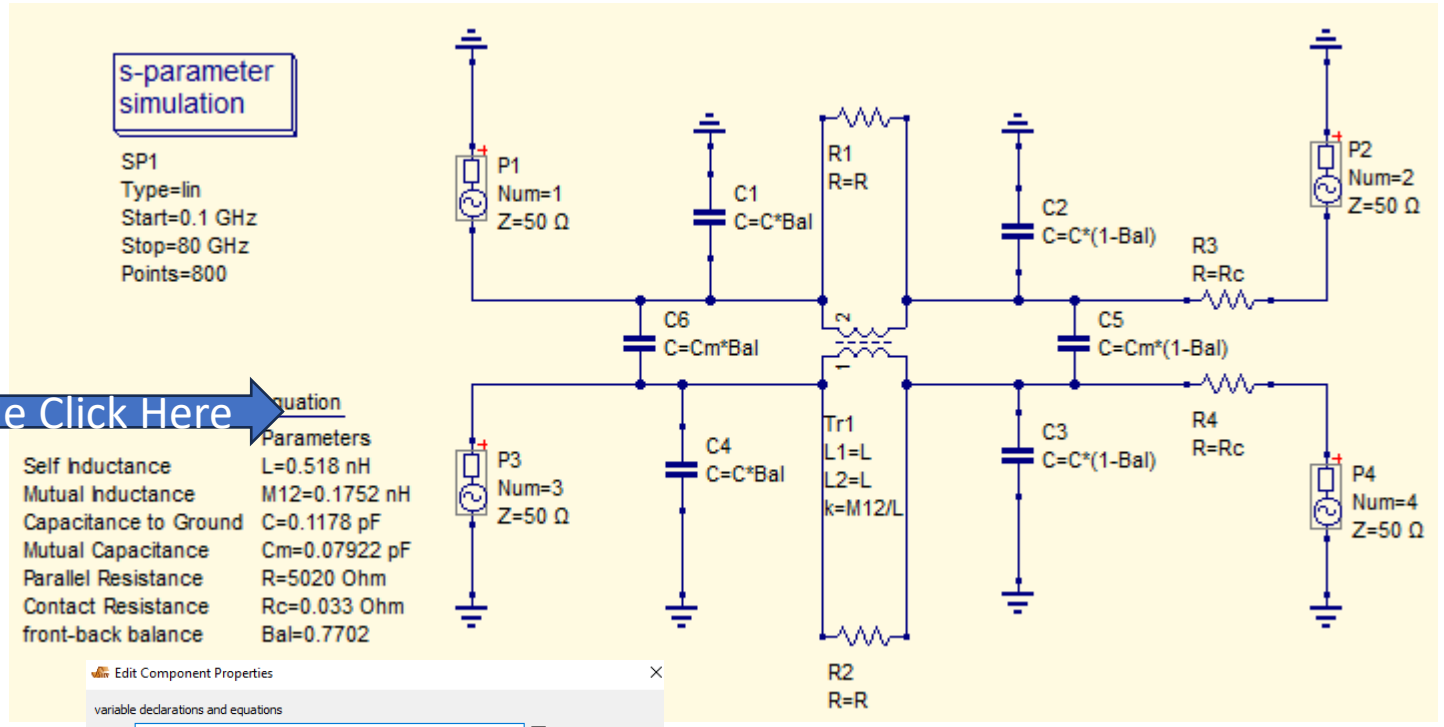


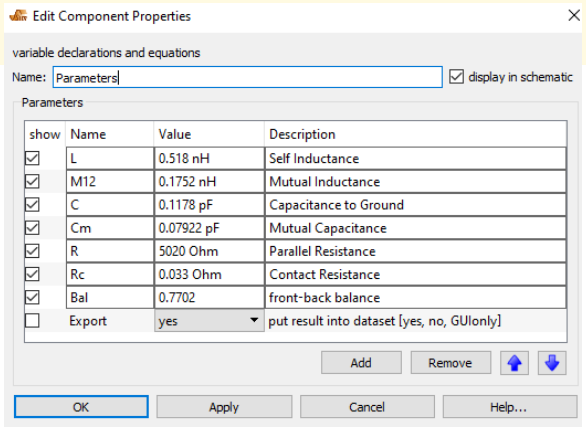
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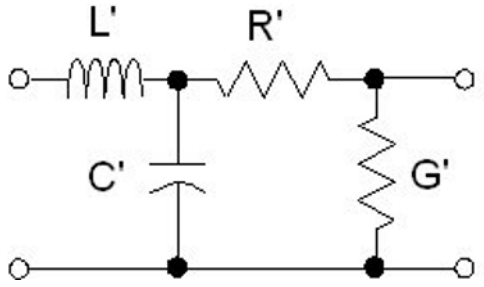
Port Equivalent Circuit Model – 4-Port – GSSG Analysis

- Used for low-frequency analysis (10GHz max)
- PCB connections - Ports 1 and 3
- DUT connections - Ports 2 and 4
- Enter parameters into Equations section – double-click
- Try Tuning function and see what happens







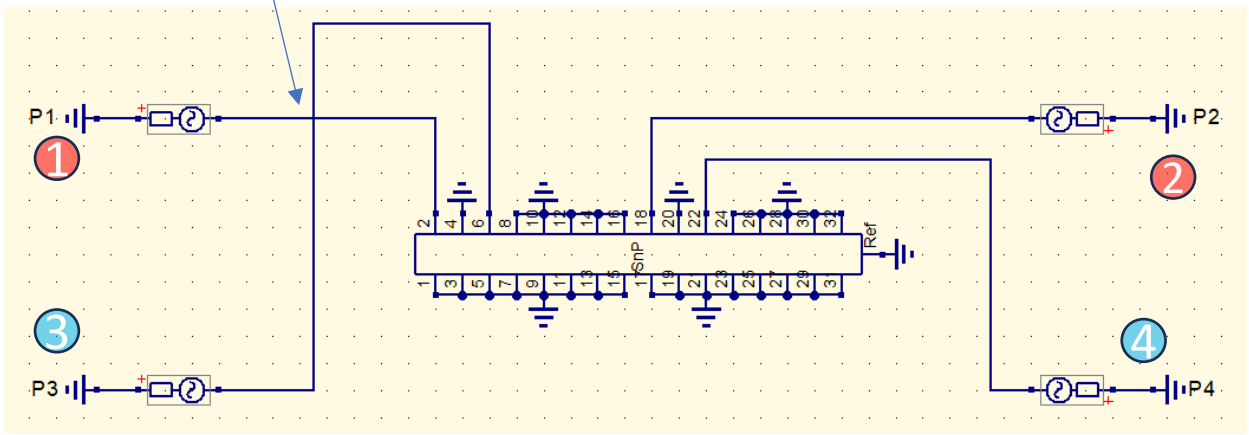


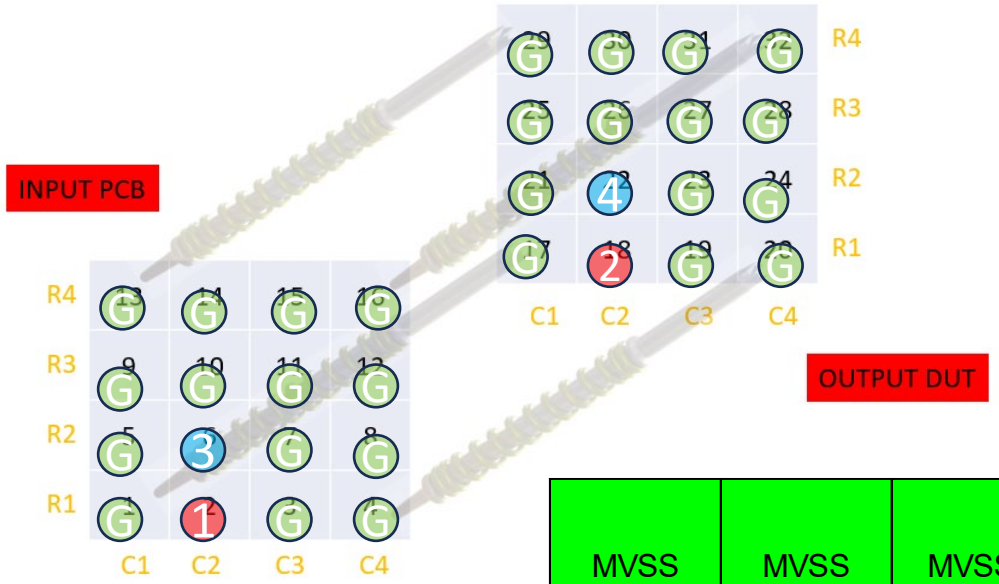
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Device Pin-Out Examples

- Differential digital signaling
  - Requires 4-port schematic
- Rotation/side of signaling ports do not matter
- Ground every other pin: PCB and DUT side

Note not connected here





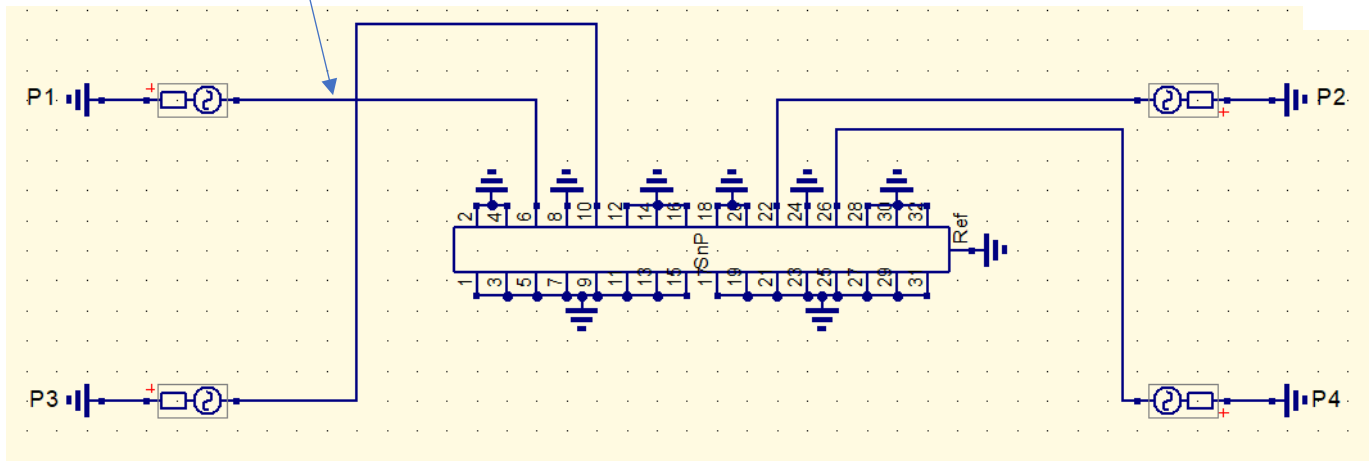
MVSS	MVSS	MVSS	AK
MVSS	MTX_13N	MTX_13P	AL
MVSS	MVSS	MVSS	AM
23	24	25	

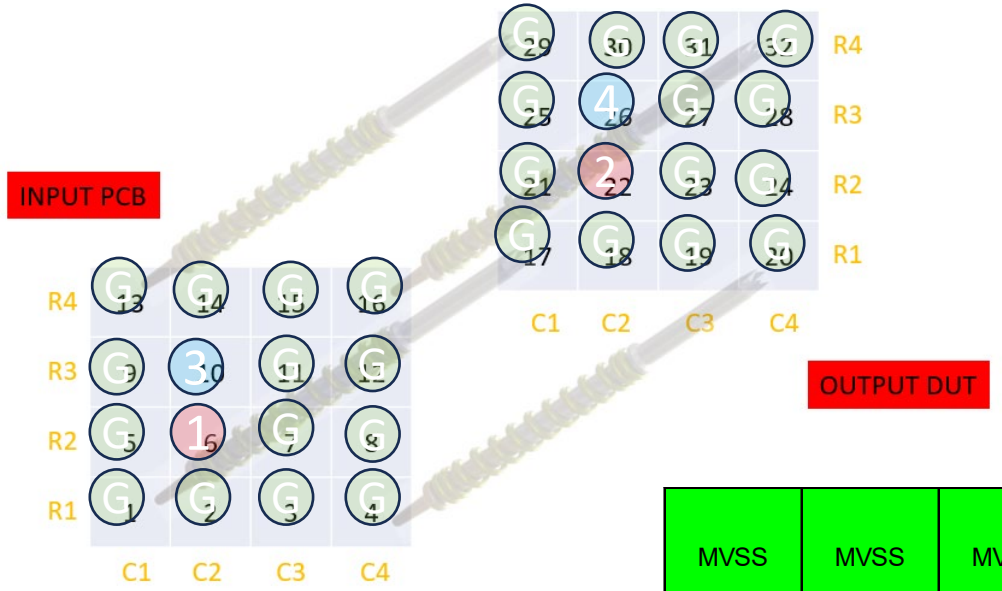
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Device Pin-Out Examples

- Differential digital signaling
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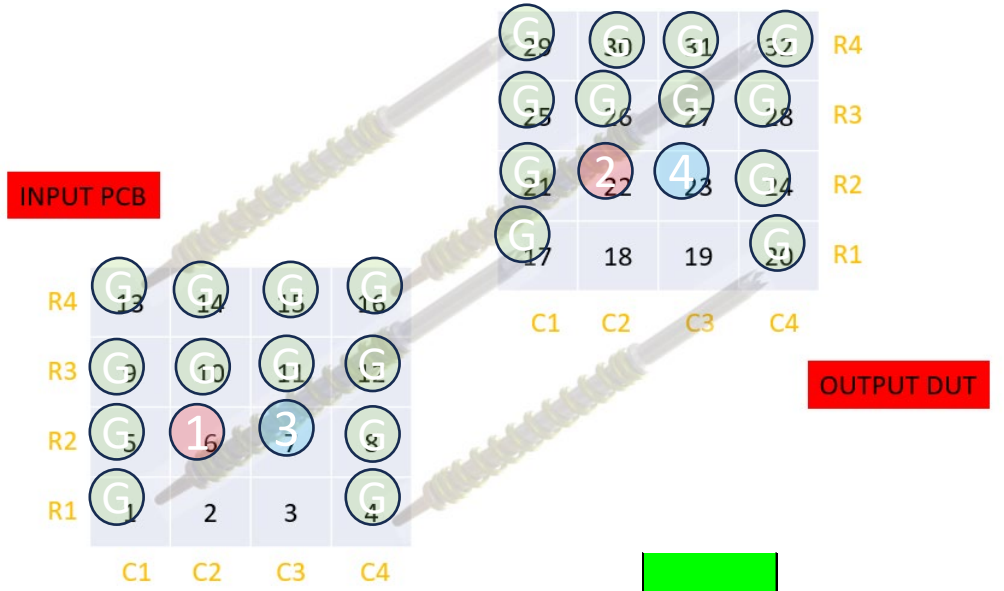


MVSS	MVSS	MVSS
MVSS	MRX_10P	MVSS
MVSS	MRX_10N	MVSS
MVSS	MVSS	MVSS

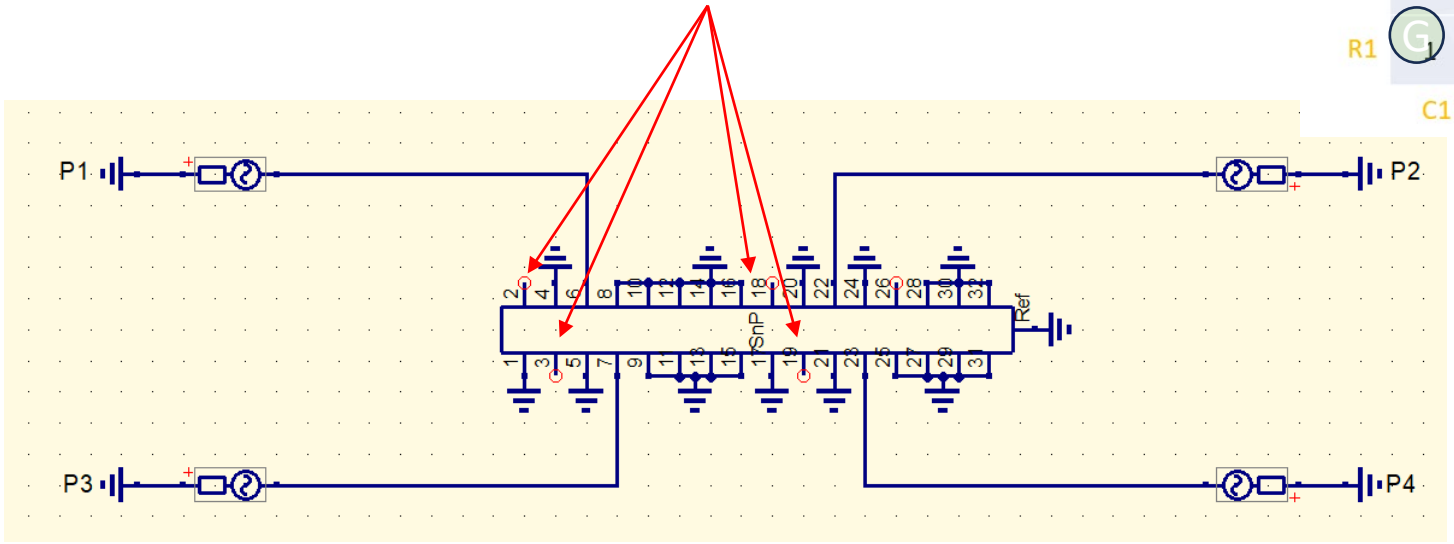
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Device Pin-Out Examples

- Differential digital signaling – edge inset one row
  - Requires 4-port schematic
- Rotation/side of signaling ports do not matter
- Ground every other pin: PCB and DUT side
- If missing probe – no connect PCB and DUT side



Note not connected – probe missing



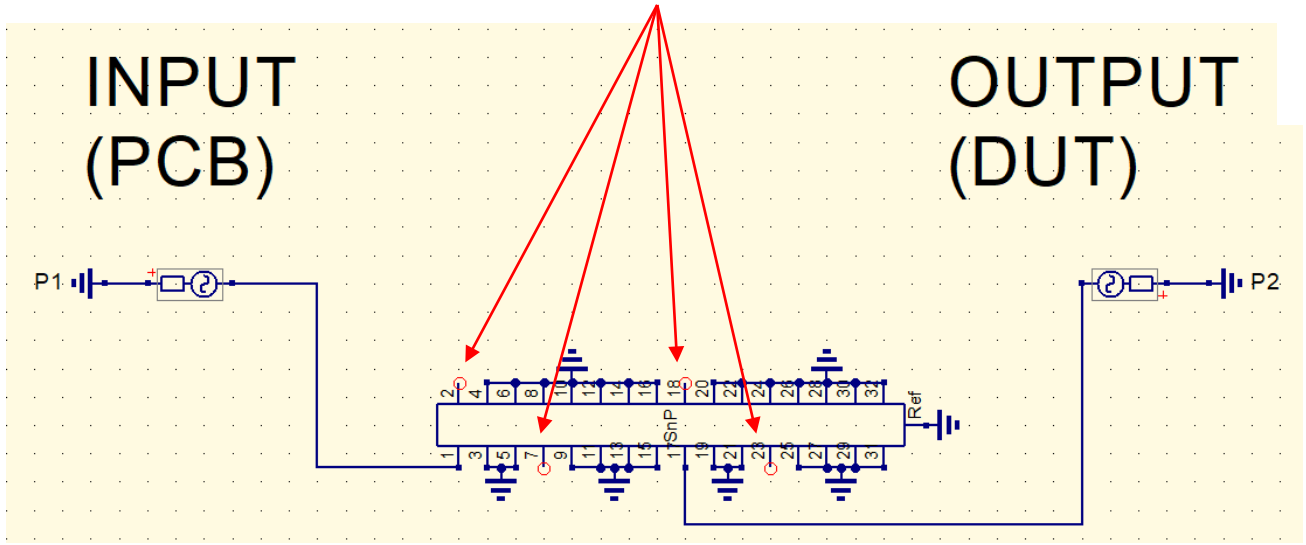
HVSS			HVSS
HVSS	HTX_10P	HTX_10N	HVSS
HVSS	HVSS	HVSS	HVSS

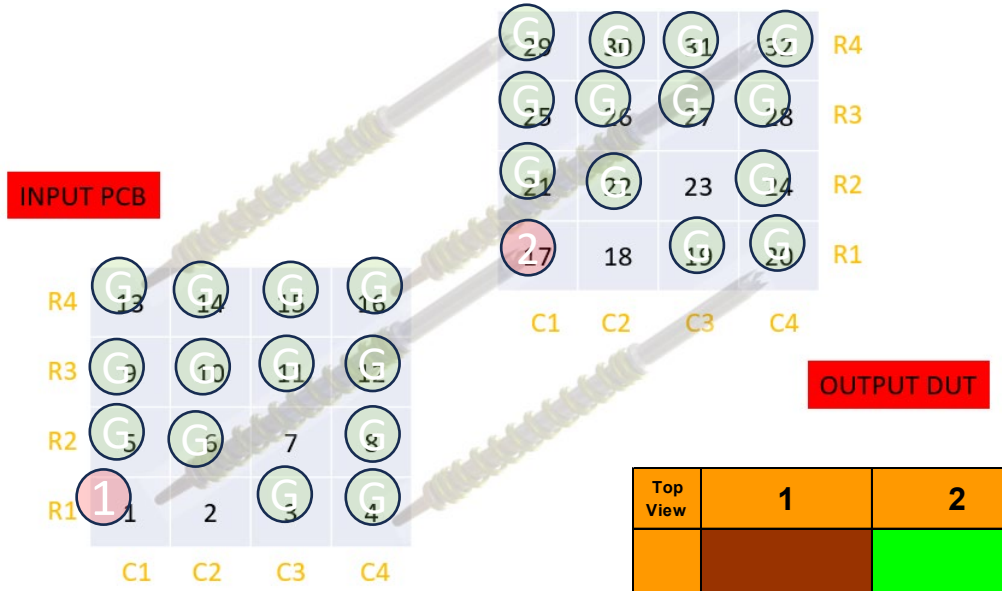
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Device Pin-Out Examples

- Single-ended – analog antenna
  - Requires 2-port schematic
  - Corner signal
  - Not optimal ground
- Rotation/side of signaling ports do not matter
- Ground every other pin: PCB and DUT side
- Nearby misc signal pins – no connect PCB and DUT side

Note not connected – misc I/O



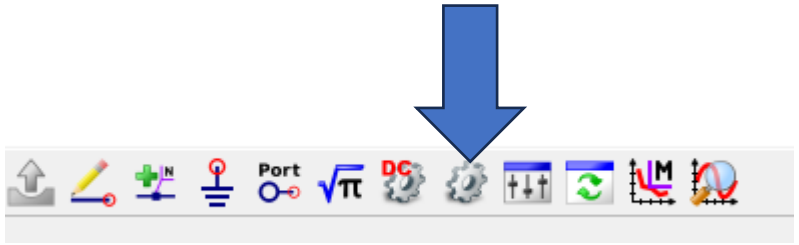


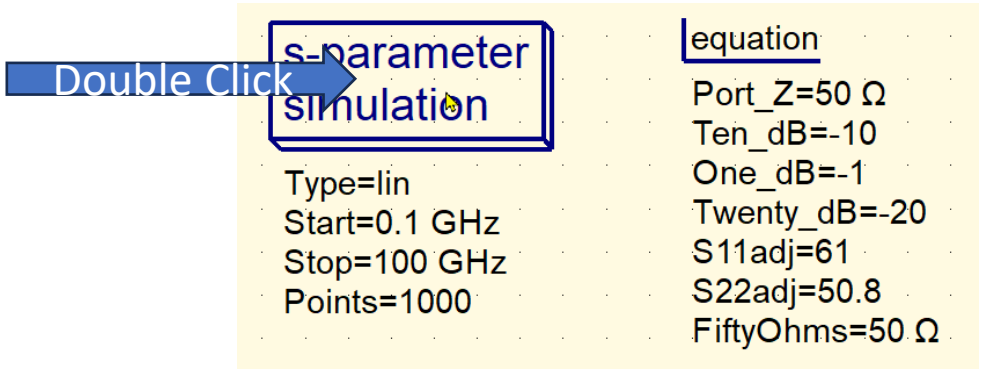
Top View	1	2
A	ANT-IN	GND
B	GPIO_12	GND
C	GND	GPIO_12

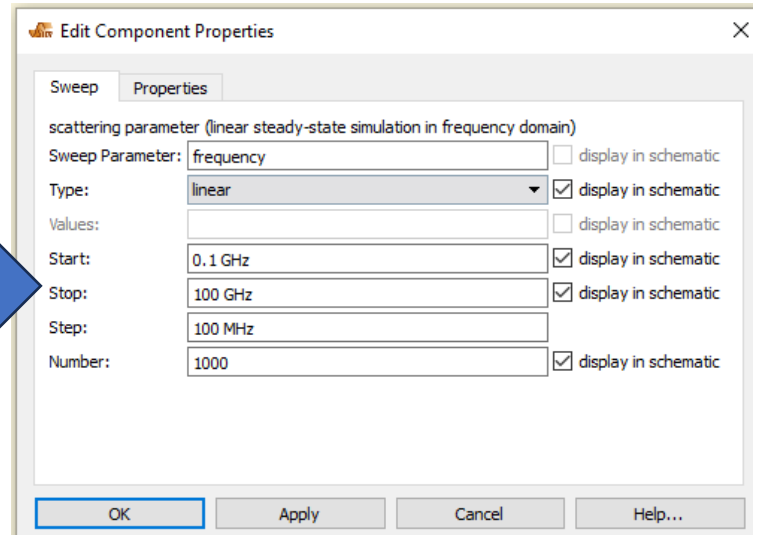
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Running The S-Parameter Model

- Load the proper s32p file in the model
- Set up S-parameter simulation to required parameters: Start/Stop frequency, step size, etc.
- Once your circuit is defined and all parameters are set – click the gear icon on the top toolbar to execute



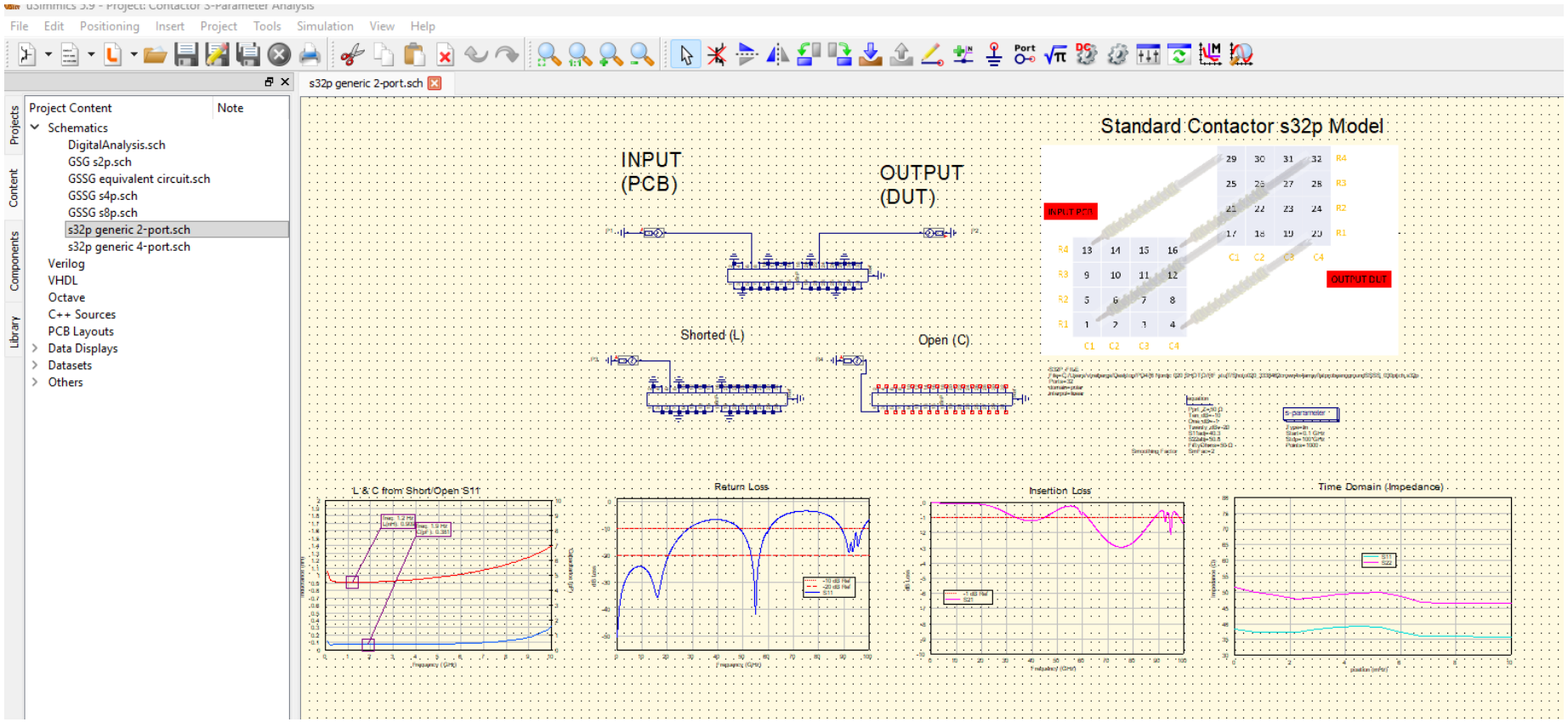




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General Model Setup – Single-Port Template

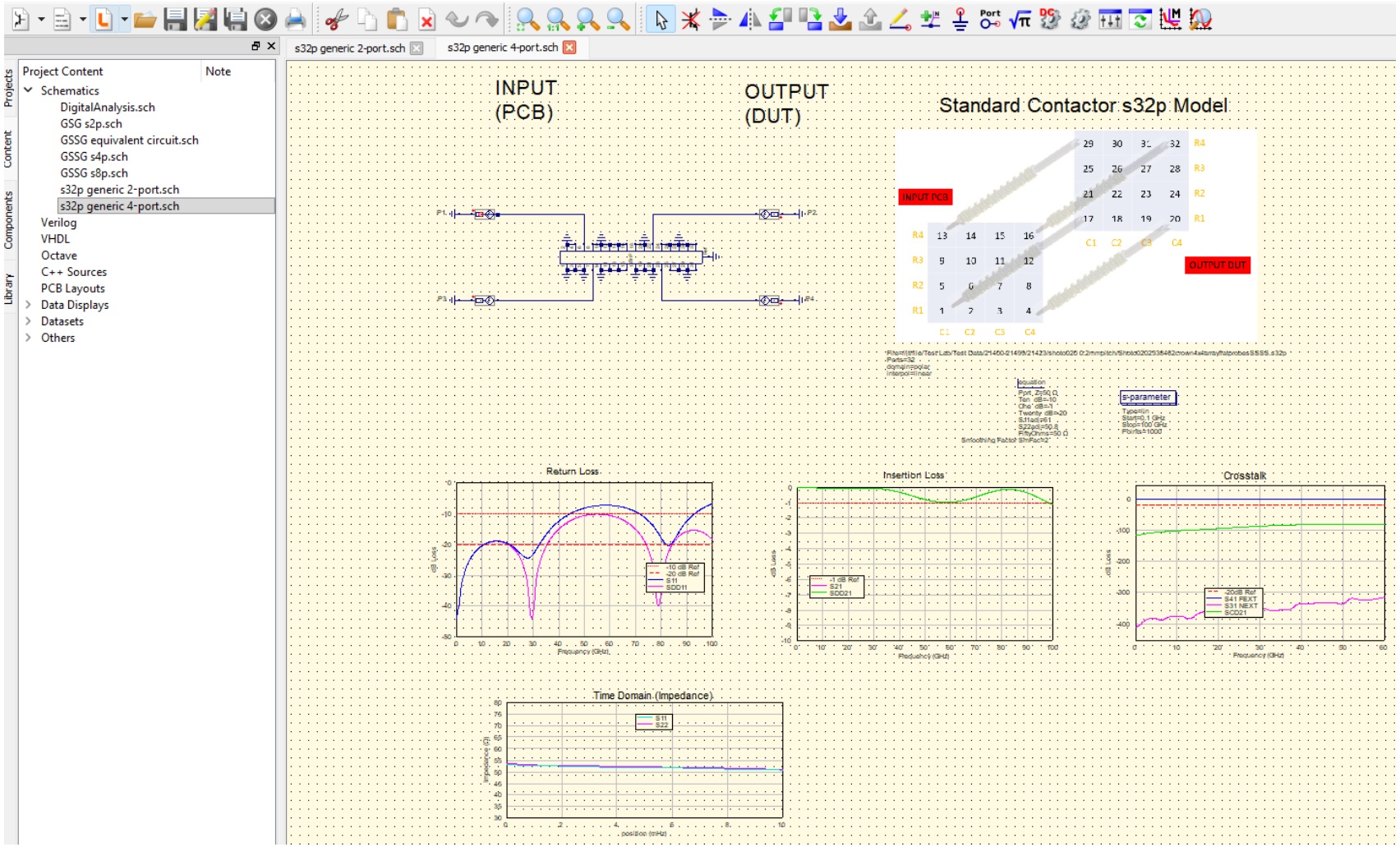
- Single input and output line
  - Antenna ports
  - RF in/out lines
  - Other signals
- Insertion Loss
- Return Loss
- L and C
- Time Domain



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General Model Setup – 4-Port Differential Template

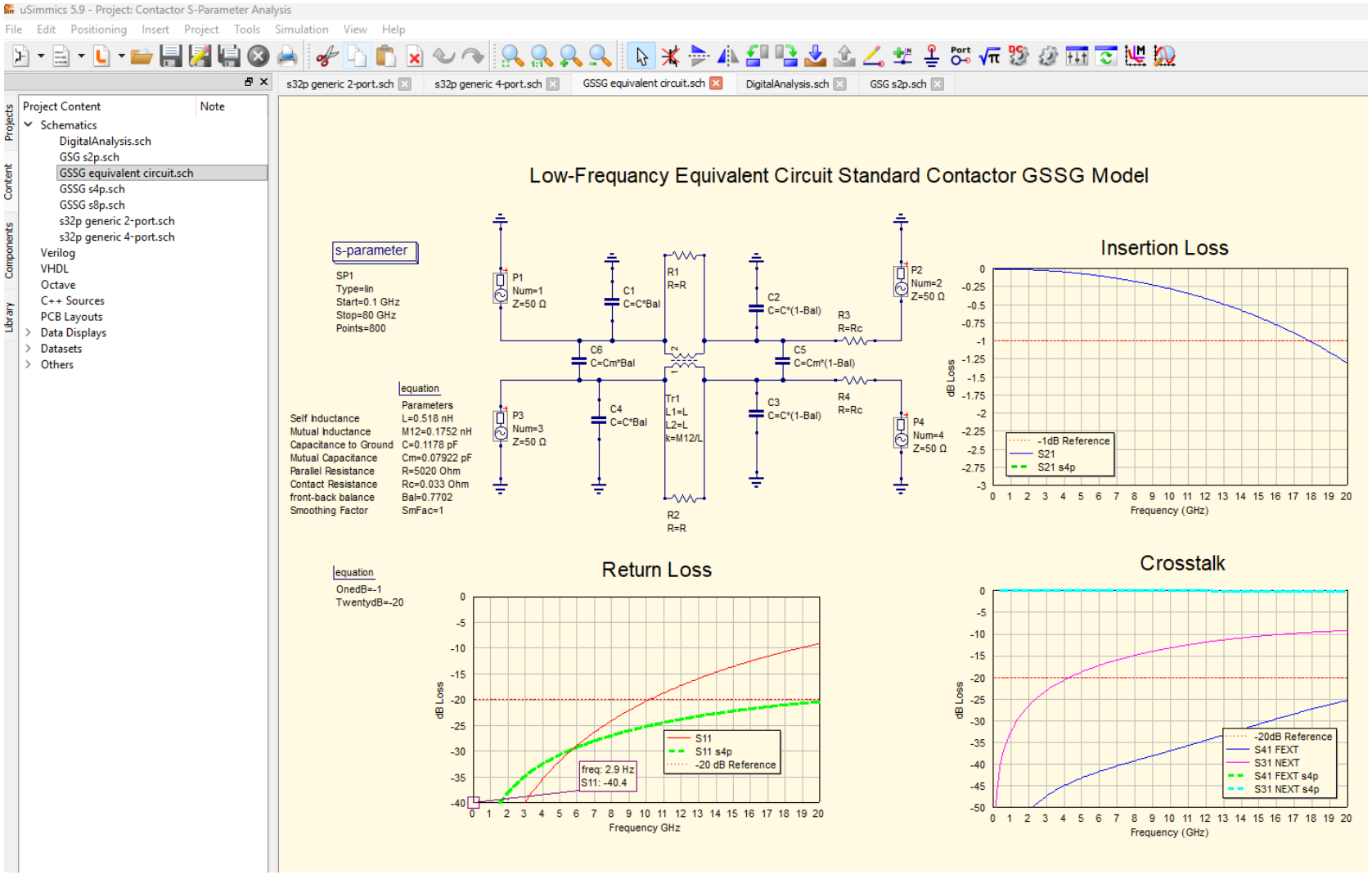
- Differential input and output lines
- Insertion Loss
- Return Loss
- Crosstalk
- L and C
- Time Domain
- Digital-Common mode conversions



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General Model Setup – Lumped Element 4-Port Template

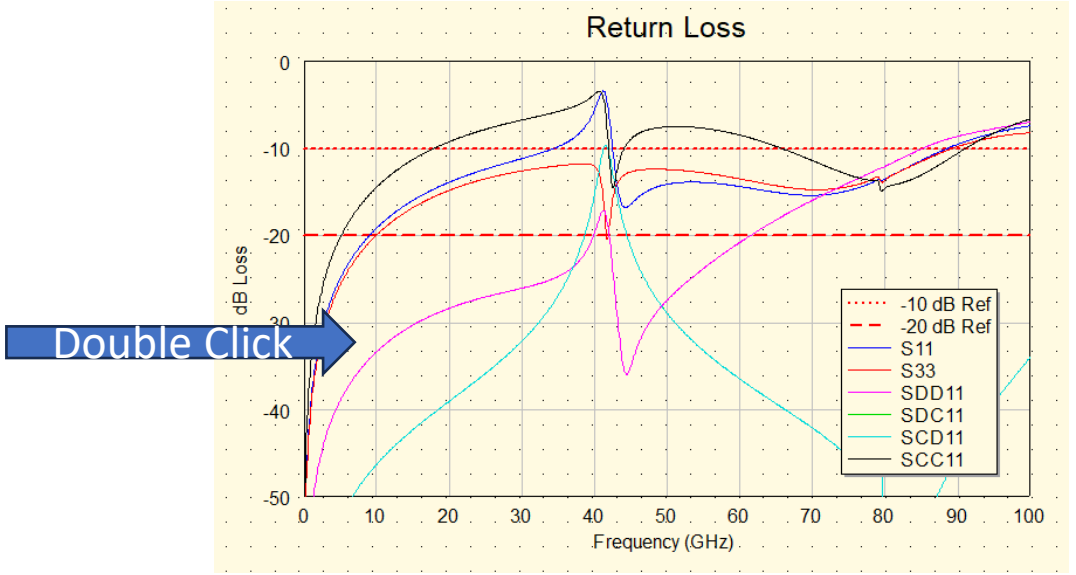
- Differential input and output lines
- Insertion Loss
- Return Loss
- Crosstalk
- L and C
- Time Domain
- Digital-Common mode conversions

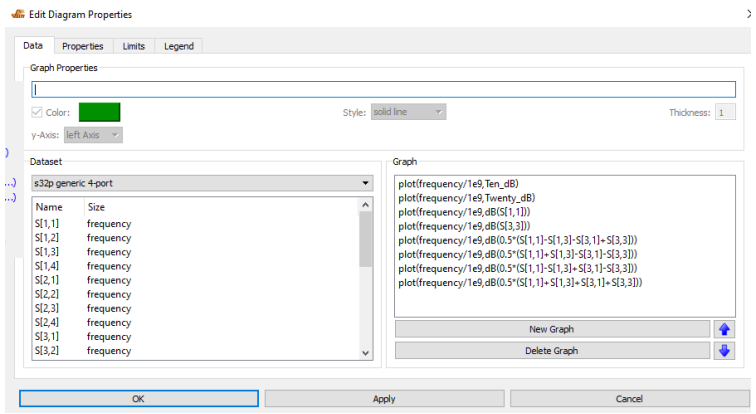


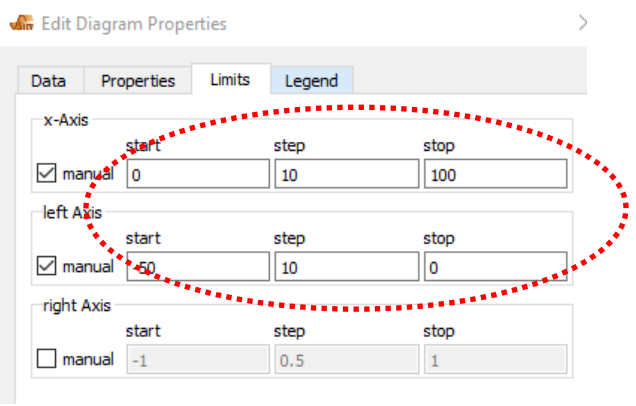
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uSimmics Plots – The Basics

- All schematics have basic plots defined:
  - S_{21} Insertion Loss
  - S_{11} Return Loss
  - S_{31}/S_{41} Crosstalk (4-port)
  - L and C (2-port)
- Double-click any plot to see the detailed parameters and formulas
- Frequency domain results plot in dB vs. GHz
- Plot limits can be set from the 'Limits' tab



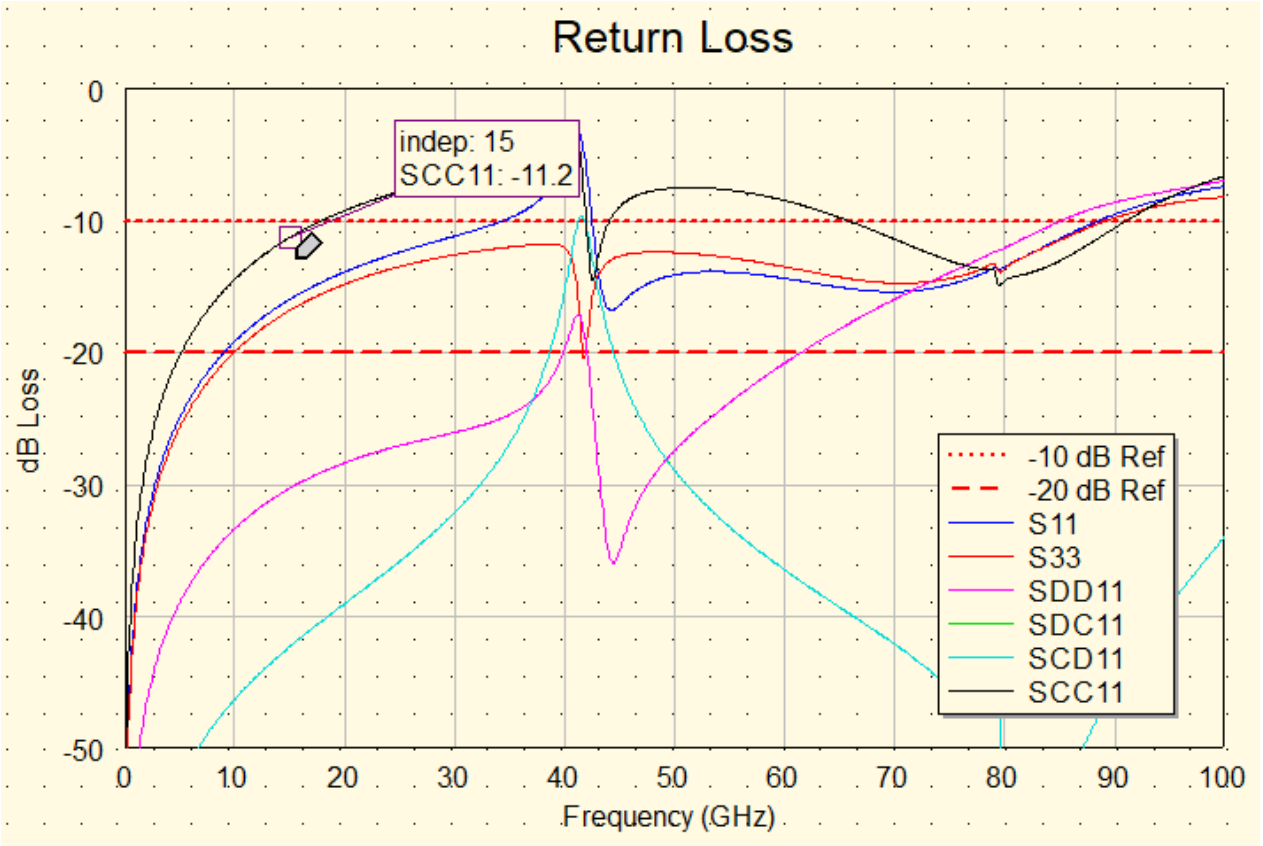




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uSimmics Plots – The Basics

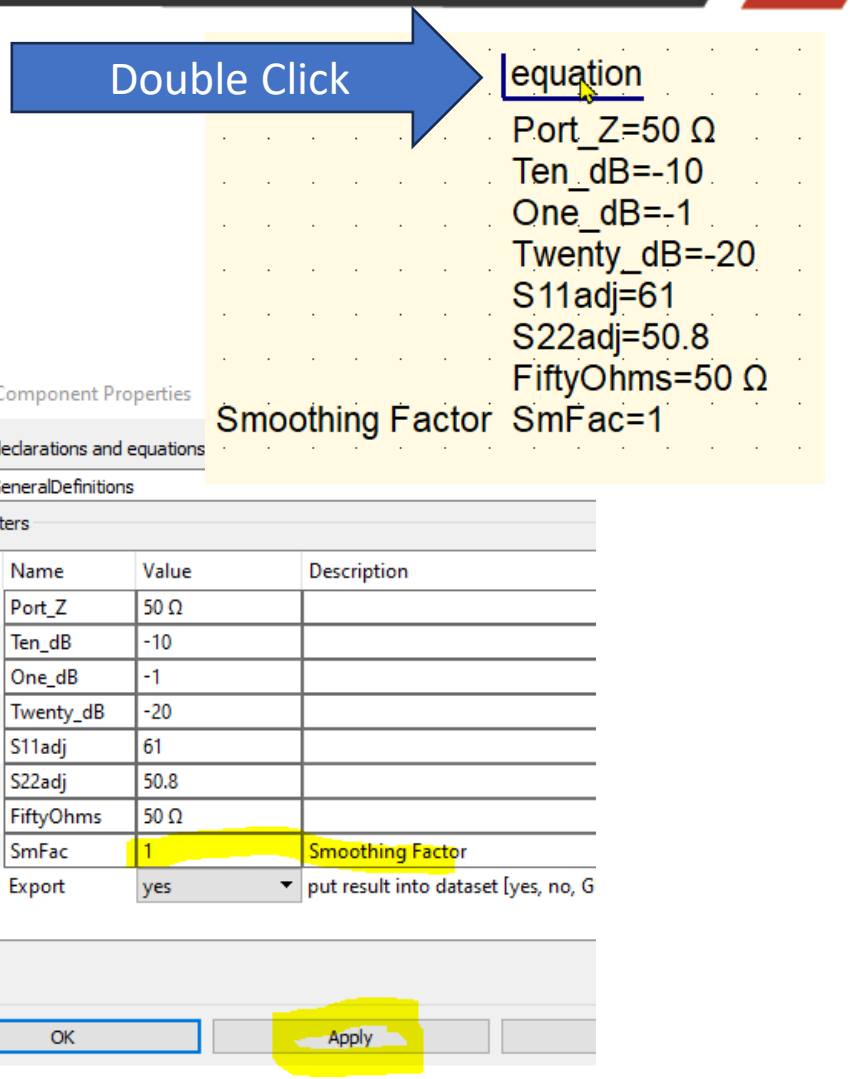
- Any marker can be added to any plot:
  - Click the  from the top toolbar
  - Click the plot
  - Slide the marker to where needed
- Delete the marker by selecting it and hit ‘Delete’



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uSimmics Plots – Smoothing Plots

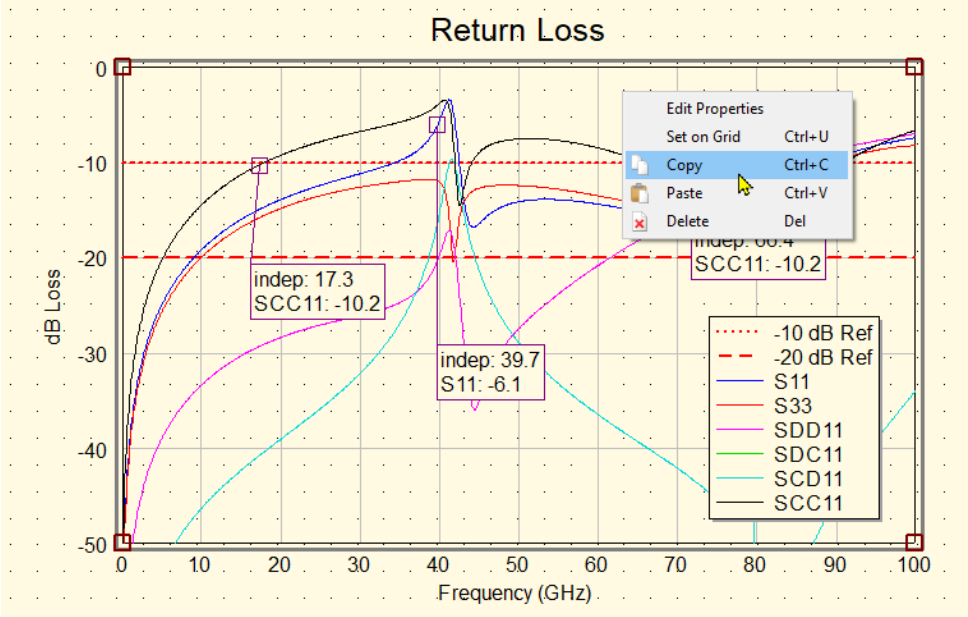
- Smoothing to data plots applies a ‘Moving Average’ function
- Smoothing Factor (in equation table):
  - 1 = no smoothing applied
  - 5 = slight smoothing
  - 10 or more – heavy smoothing
- Double click the equation block to change the Smoothing Factor (SmFac) and hit ‘Apply’
- Resimulate 



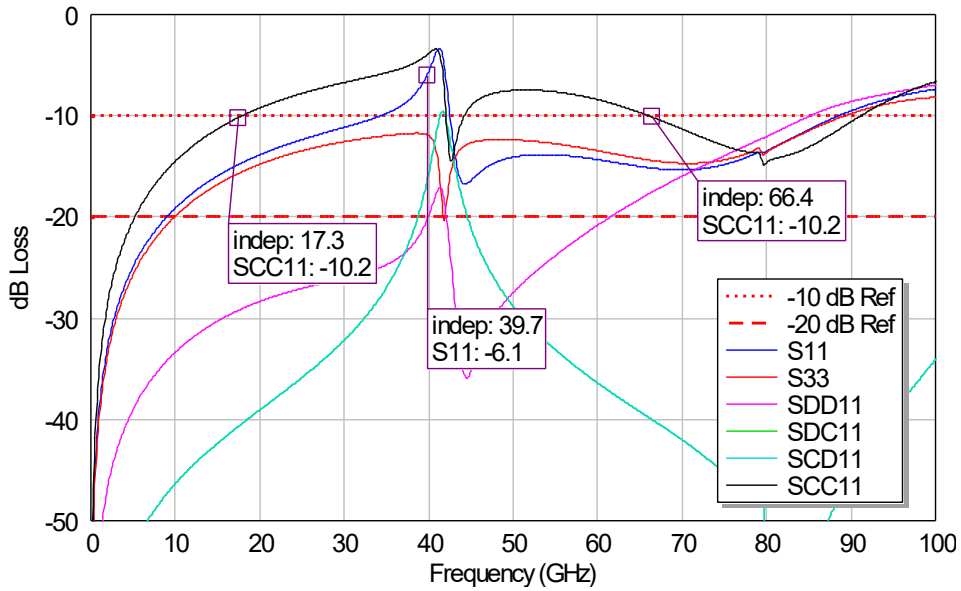
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uSimmics Plots – The Basics – Copying Plots to Other Apps

- Use a Screenshot tool
- Or Right-Click a plot region and Copy
- Paste into any other application as a picture – background is transparent – note that plot title does not copy over



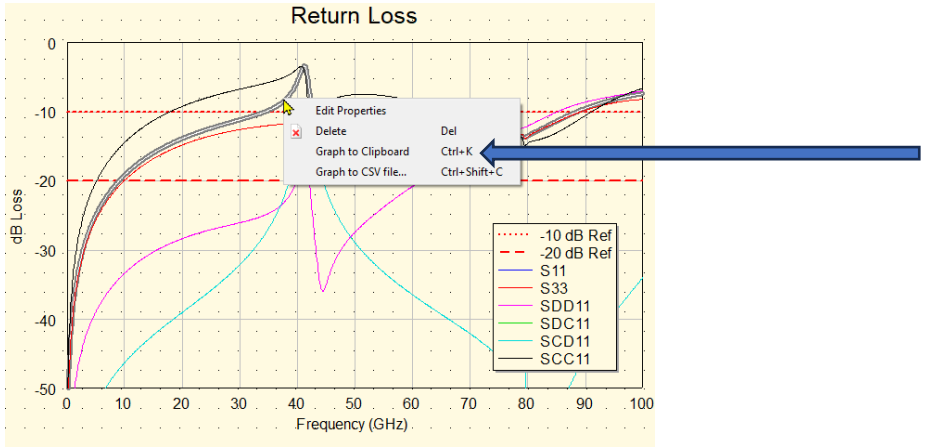
Paste

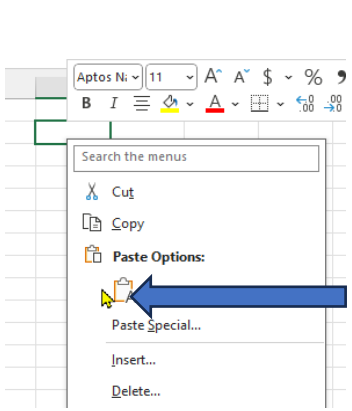


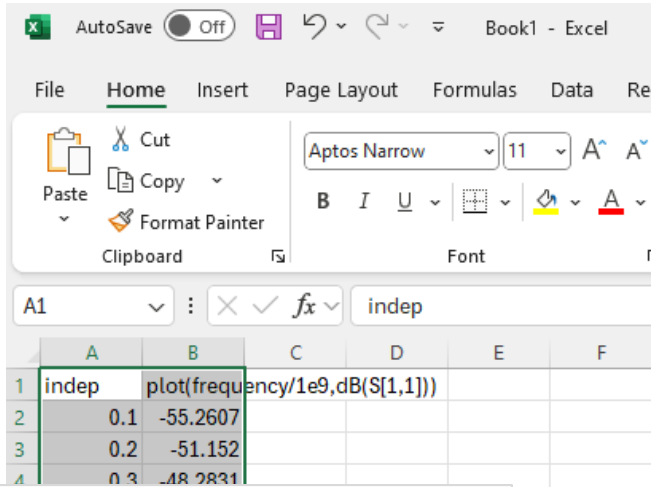
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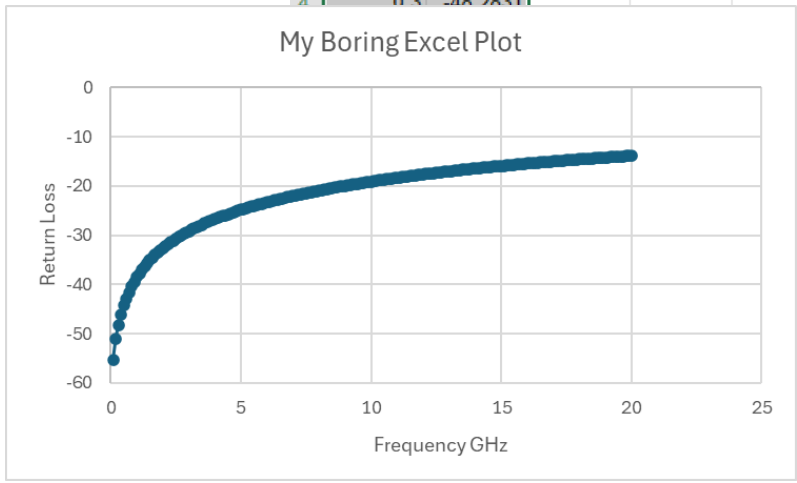
uSimmics Plots – The Basics – Export Data To Excel

- If the uSimmics plots are not adequate, data can be exported to Excel
  - Right-click graph you want to export
  - Select ‘Graph to Clipboard’ or Ctrl-K
  - Paste into Excel and do whatever you wish
    - Frequency and Y-values will be in adjacent columns





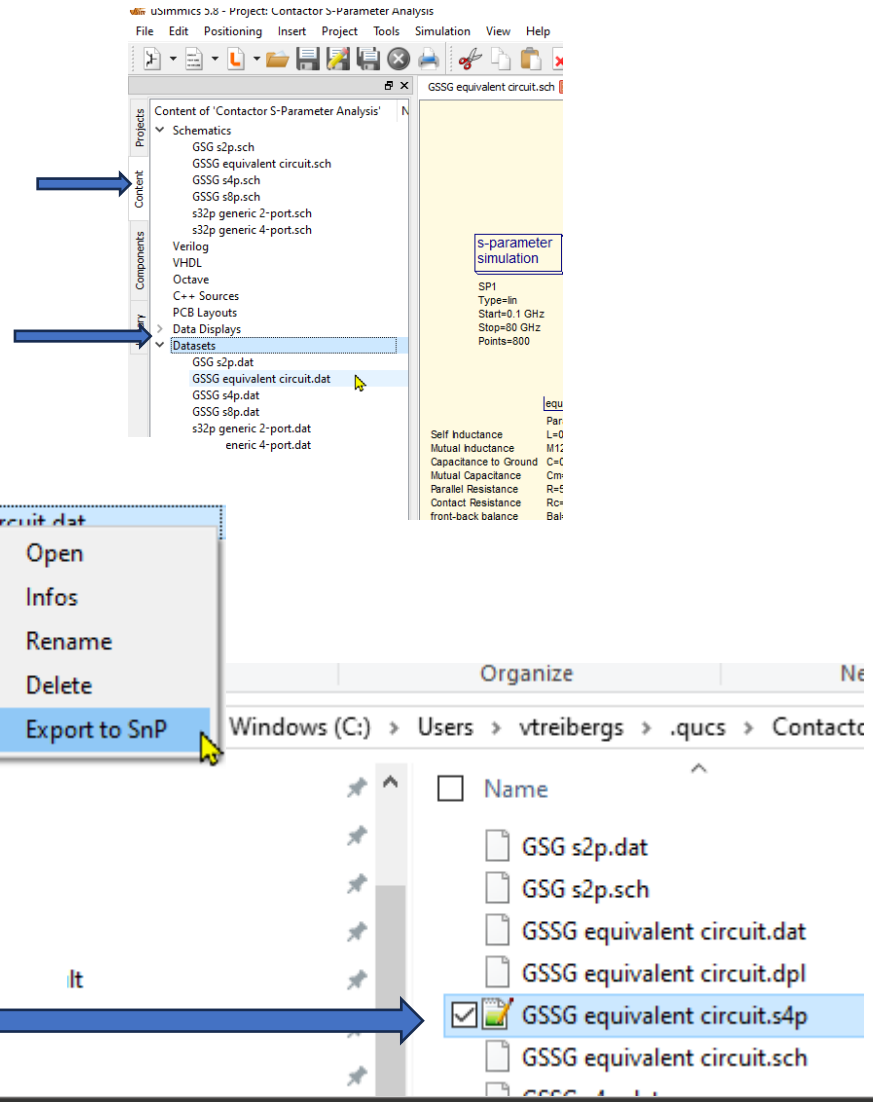




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uSimmics Plots – Exporting Touchstone SnP Files

- 2-port or 4-port analysis files can be exported to Touchstone (SnP) files from any uSimmics analysis
- After a circuit has been run and looks correct, select:
  - ‘Content’ tab on left
  - ‘Datasets’
  - Right-Click on appropriate .dat file
- SnP file is created at location: C:\Users\xxxxx\.qucs\Contactor S-Parameter Analysis_prj



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Let's Run Some Live Demonstrations!

- 4-port - Johnstech HF040 at 0.5mm pitch
- 2-port - Johnstech HF050 at 0.5mm pitch
  - Compare L & C values depending on grounding
  - Compare Insertion Loss vs. grounding
  - TDR

Live Demo Time!!!

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Thank You!

- The smart use of simple tools will give engineers insights into socket performance
- Johnstech will always support our customers with innovation and support – from NPI through production test!

- Questions?

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