Subject: About the View S-Parameters Tool

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The View S-Parameters Tool analyzes S-parameter file data to display its reflection coefficients, transmission characteristics and reverse transmission characteristics.

This tool is one of the many free web-based tools available to use on the web site: **https://www.serdesdesign.com**

This tool is at the web-site: **https://www.serdesdesign.com/home/view-sparameters-tool/**

Discussion

A SerDes channel typically is a differential signal transmission channel. A hardware SerDes channel is typically characterized by measuring its N-port S-parameters and is typically a 4-port. The 4-port differential input ports are typically port 1 (+) and port 3 (-). The associated differential output ports are typically port 2 (+) and port 4 (-). The differential characteristic (Port 1 - Port 3 vs. Port 2 - Port 4) is the channel transmission characteristic and the S-Parameter data is versus frequency.

See S-parameter detail in References > S-Parameter Channel Examples.

S-Parameter data inherently is used to represent SerDes system channels, transmit (Tx) or receive (Rx) integrated circuit (IC) input or output analog buffers, IC packaging, and more.

The S-Parameters for an N port device are typically represented with the symbol Sij, where i represents the port of interest with an output wave, and j represents the port with an incident input wave, with i and j being integers in the range 1 to N. Thus, S21 means port 2 contains the measured output wave and port 1 has the incident input wave.

Within the View S-Parameters Tool, S-Parameters can be viewed for their reflection characteristics (i=j), transmission characteristics (i>j), or reverse transmission characteristics (i<j). The characteristics are viewed with magnitude (dB) and phase (deg) versus frequency. Additionally, the passivity factor for the S-Parameters can be displayed versus frequency.

For more detail on the data and graphs available from this web site, see the article: and Typical View SParameters Characteristics and Displays...

Use the tool by following these steps.

Step 1: Define the system.

1. Define System

Name	Description	Entry Value(s)	Status	Type	Limits	Comment
SParamFile	S-parameter file	Channel_25Gbps.s4p Choose File No file chosen		File		Upload a file (Touchstone 1.0 format) or list previously uploaded file.
NumSPorts	Number of ports	4		Integer	>= 1	For S-parameter file

Choose an S-parameter file with fil extension sXp where X is an integer is the range [1, 2, 3, 4, 8, 12, …] where X is a multiple of 4 beyond 12.

List the number of s-parameter ports: NumSPorts whould be the same as X.

Step 2: Setup the analysis.

2. Setup Analysis

Name	Description	Entry Value(s)	Status	Type	Limits	Comment
AnalysisName	Analysis name	SParametersTest		String		Alpha-numeric characters or underbar - case sensitive - start with alpha character
MeasurementPorts	List of S-parameter ports for measurement	1, 2, 3, 4		Integer array	[1, NumSPorts]	Must not have duplicate ports. Maximum of 4 entries
UnWrapPhase	Unwrap phase vs frequency	1		Integer	[0, 1]	0 = No; 1 = Yes

Set the analysis name; it can remain as the default name.

List up to 4 measurement ports. Let ‘i’ and ‘j’ be the S-parameter ‘output pin’ and ‘input pin’ respectively. The Sii parameters are reflection coefficients. The Sij parameters with ‘i’ > ‘j’ are considered to be transmission coefficients. The Sij parameters with ‘i’ < ‘j’ are considered to be reverse transmission coefficients.

The displayed analysis phase results are displayed in degrees and will be the unwrapped degrees when ‘UnWrapPhase’ is set to ‘1’.

3. Run the analysis by selecting the ‘Run’ button.

3. Run Analysis

Select to run analysis	Run		Waiting to run

4. Display the desired results.

4. Display Results

Display	Action
Analysis log file	Open
1. Passivity check	Open
2. Reflection Sii magnitude	Open
3. Reflection Sii phase	Open
4. Transmission Sij, i>j, magnitude	Open
5. Transmission Sij, i>j, phase	Open
4. Reverse Sij, i less than j, magnitude	Open
7. Reverse Sij, i less than j, phase	Open

Additional Notes and Equations.

For the default file Channel_25Gbps.s4p, the analysis log file is displayed here:

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View SParameters setup.
Define_SParameters: SParamFile = Channel_25Gbps.s4p, NumSPorts = 4
Setup_Channel_Analysis: AnalysisName = SParametersTest, MeasurementPorts = [ 1, 2, 3, 4 ], UnWrapPhase = 1

Reading S-Parameter file.
S-Parameters reference resistance = 50
S-Parameters has 12801 frequencies with fmin = 1e+07 and fmax = 4e+10.
S12, S21 are not recipricol. Max difference is 38.8548 dB at freq[10439] = 3.26237e+10.
S13, S31 are not recipricol. Max difference is 6.20561 dB at freq[9489] = 2.96557e+10.
S14, S41 are not recipricol. Max difference is 40.1432 dB at freq[11709] = 3.65915e+10.
S23, S32 are not recipricol. Max difference is 45.5311 dB at freq[11471] = 3.58479e+10.
S24, S42 are not recipricol. Max difference is 0.289553 dB at freq[4558] = 1.42502e+10.
S34, S43 are not recipricol. Max difference is 30.2431 dB at freq[11453] = 3.57917e+10.
S-Parameter file data is passive.

Writting Spectrum files.

Exiting View SParameters with success; run time = 1 sec.
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S-parameter passivity is defined at each frequency based on the relationship: [S]†[S] where [S] is the scattering matrix, and † denotes the conjugation and transposition of a matrix. The calculated passivity measure is the minimum eigenvalue of [I]-[S]†[S] where [I] is the identity matrix. S-Parameters are passive, if [S]†[S] is less than or equal to one and are lossless if [S]†[S] is equal to one.

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