Sparameter_Variation

Where To Find This Example

AWR Version 15

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Design Notes

Adding Variation to a Two-Port S-Parameter File for Yield Analysis

This project demonstrates how to add variability to a two-port S-Parameter file in order to perform Yield Analysis. This may be necessary if you do not have enough S-Parameter files to represent statistical variations of an element. However, it should be noted that in this method, there is no correlation between the variations of the S-Parameters (such as S11 and S21), which may not be the case with the actual element. Furthermore, this may lead to the simulation of gain from a passive element.

Overview

The S-Parameter File must be formatted as a text file. Using equations in the schematic, the magnitude and phase of each S-Parameter is multiplied with a variable that is enabled for yield analysis. The redefined S-Parameters are then assigned to an S2P_BLK element. This schematic can now be used as a subcircuit.

Data Files

In order to access the contents of the S-Parameter file, the file must be in text format. If the S-Parameter file has already been imported as a Touchstone file, create a new text Data File, and copy and paste the contents of the Touchstone file into the new text file. Otherwise, import the S-Parameter file as text file type. In this project, the contents of the Data File *Afm02n5b* (Touchstone Format) was copied into *Afm02n5b_text* (Text Format).

SParam_subckt Schematic

This schematic shows how to add variability to an S-Parameter file for yield analysis. The functions **DataFile()** and **Col()** are used to access the data contained in text file *Afm02n5b_text*.

First, the frequency list of the S-Parameter file must be determined, because the simulation frequency list must equal that of the data file. Then, the magnitude and phase of each S-Parameter is assigned to a variable, which is then multiplied with another variable that represents the statistical variation of that S-Parameter. In this example, the multipliers have Statistics Mode enabled, with uniform +/- 2% variation. Right Clicking on the equations and selecting **Properties** will bring up the dialog box to edit these settings.

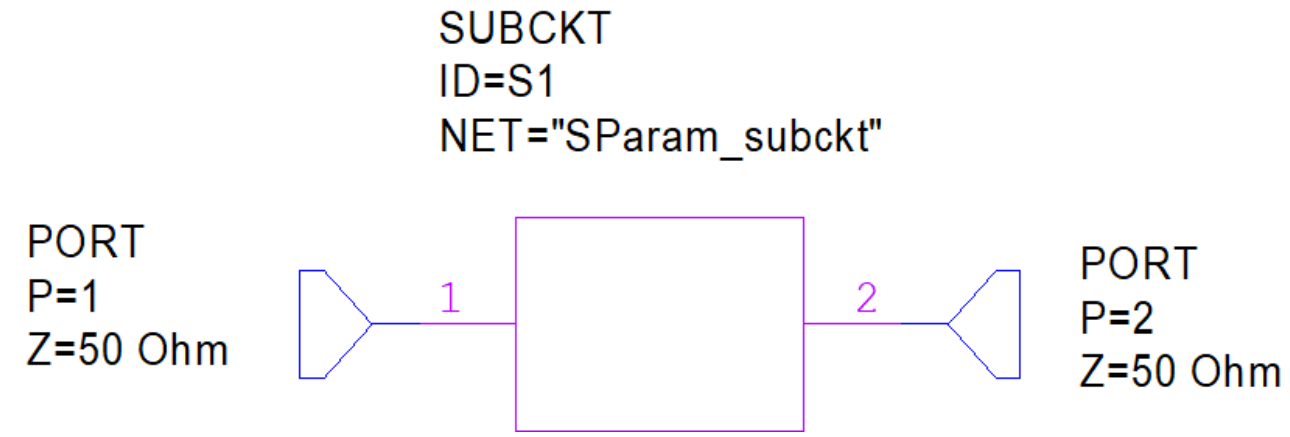
The redefined magnitude and phase of the S-Parameters are recombined into a complex number with the function **Polar()**, and assigned to an S2P_BLK element. This schematic can now be used as a subcircuit. Yield analysis can be performed either at the subcircuit level, or top circuit level.

Simulation Results

Yield analysis is performed on schematic *Top*. First simulate to compare the original S-Parameter file with the redefined S-Parameter block. The results are identical in the graphs. To perform yield analysis, select **Simulate>Yield Analysis** from the top menu. Enter the maximum number of iterations, and click on **Start**.

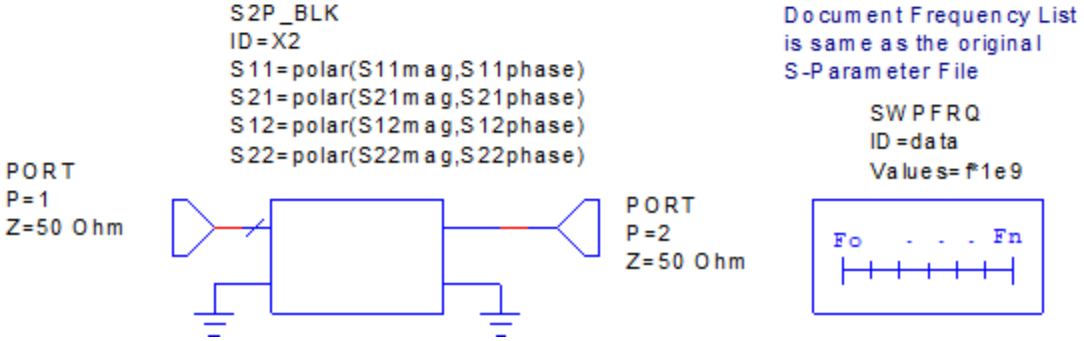
For passive, linear S-Parameters, the *sum power* graph can be enabled to check whether yield analysis results have remained passive.

Schematic - Top

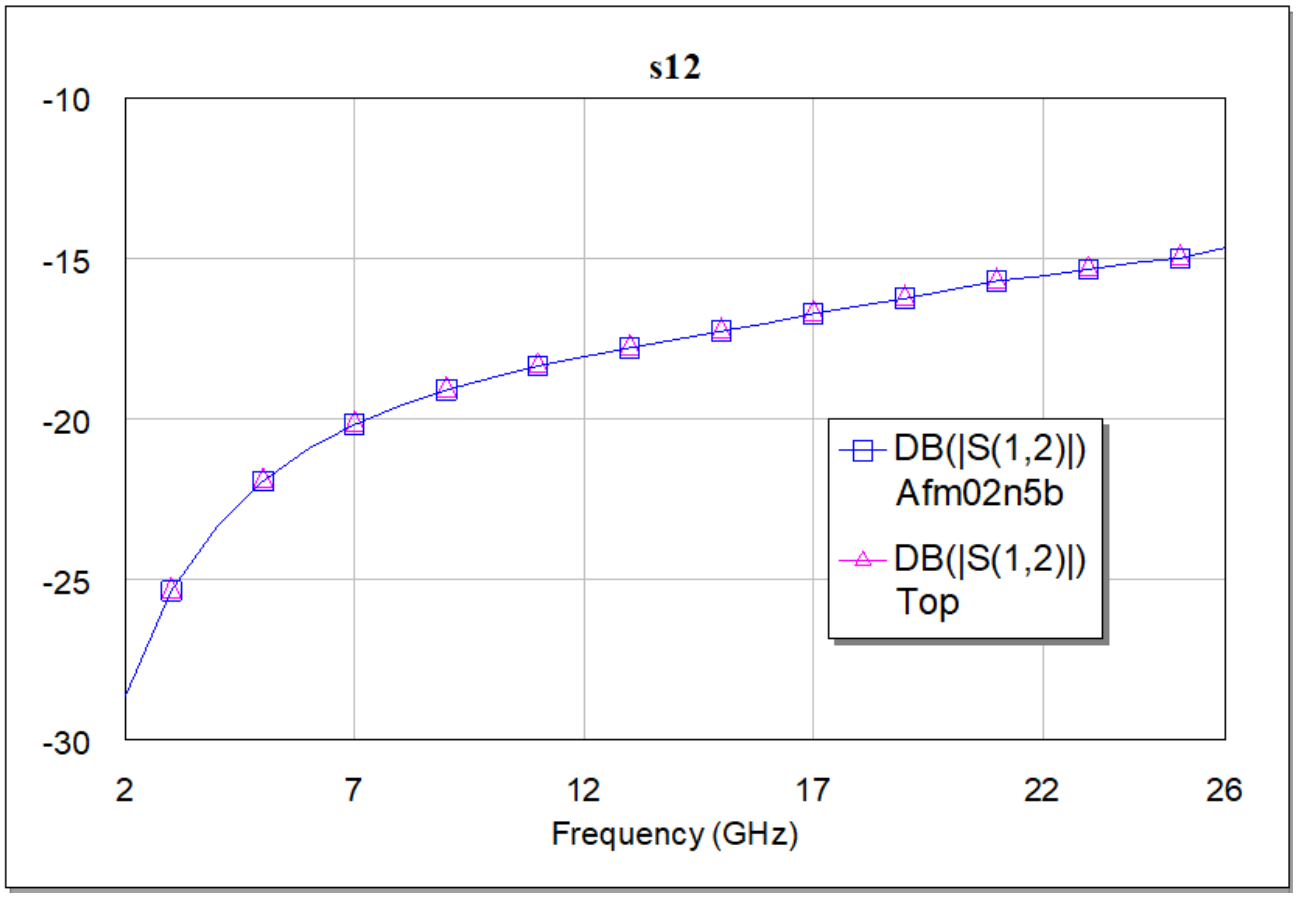


Schematic - SParam_subckt

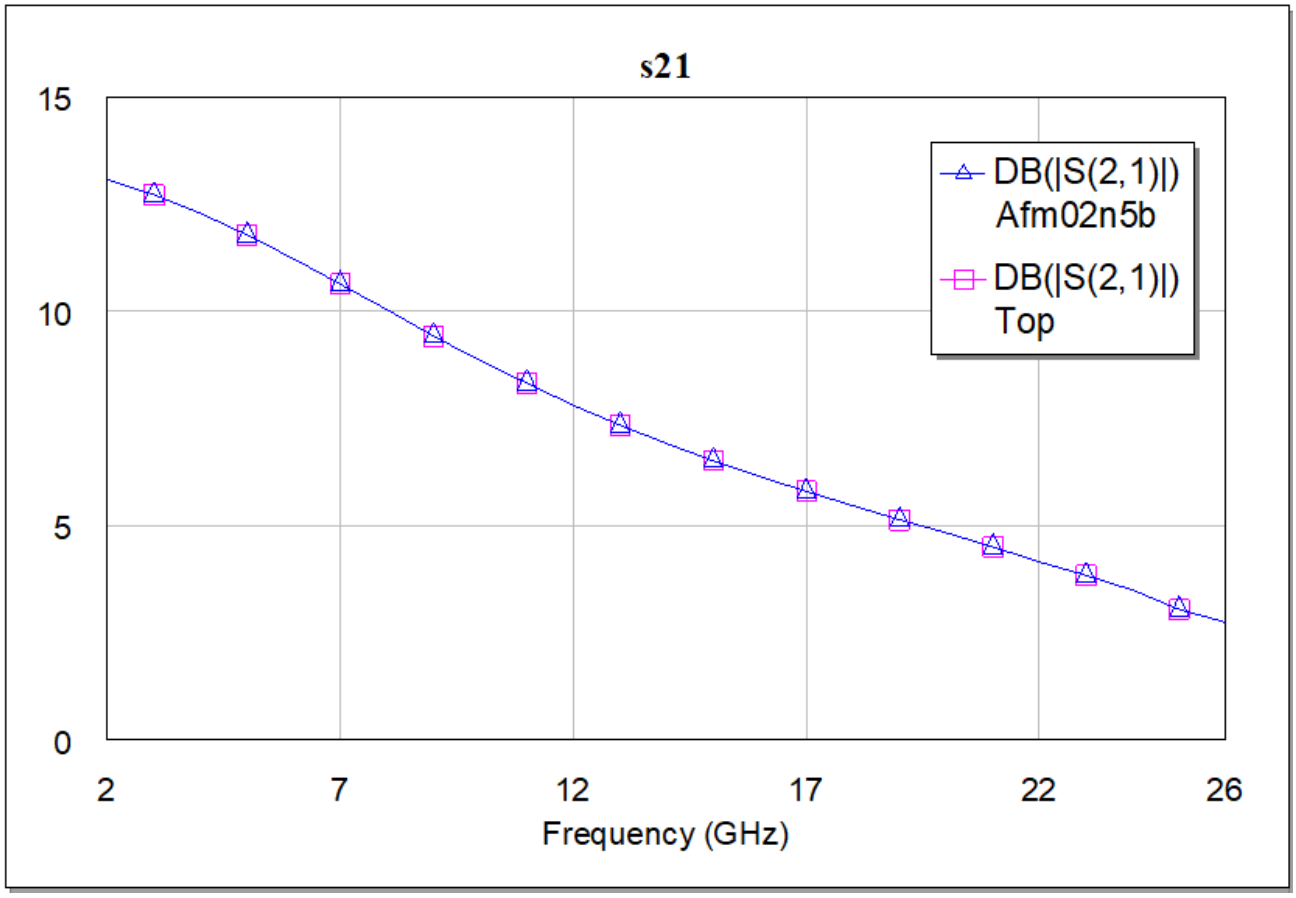
```
data = DataFile("Afm02n5b_text")

Freq List of S-Parameter file
f= Col(data,1)
f: { 2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26 }

Magnitude and Phase                Multipliers with Statistics
of original S-Parameters           Mode enabled

s11m = Col(data,2)                 s11mv=1
s11p = Col(data,3)                 s11pv=1

s21m = Col(data,4)                 s21mv=1
s21p = Col(data,5)                 s21pv=1

s12m = Col(data,6)                 s12mv=1
s12p = Col(data,7)                 s12pv=1

s22m = Col(data,8)                 s22mv=1
s22p = Col(data,9)                 s22pv=1


Redefined S-Parameters with statistical variation

S11mag=s11m*s11mv      S11phase=s11p*s11pv
S21mag=s21m*s21mv      S21phase=s21p*s21pv
S12mag=s12m*s12mv      S12phase=s12p*s12pv
S22mag=s22m*s22mv      S22phase=s22p*s22pv
```



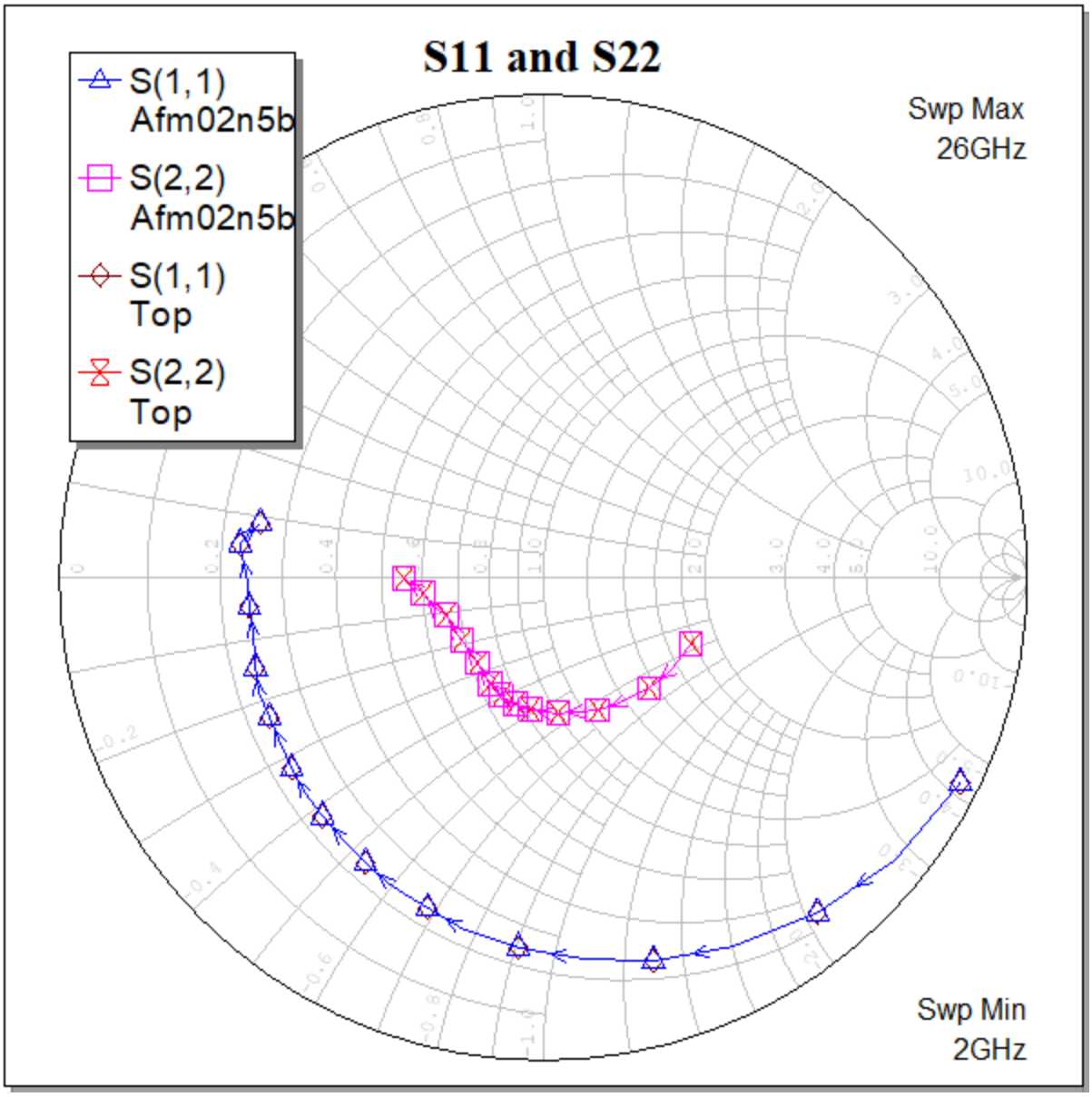
Graph - s12



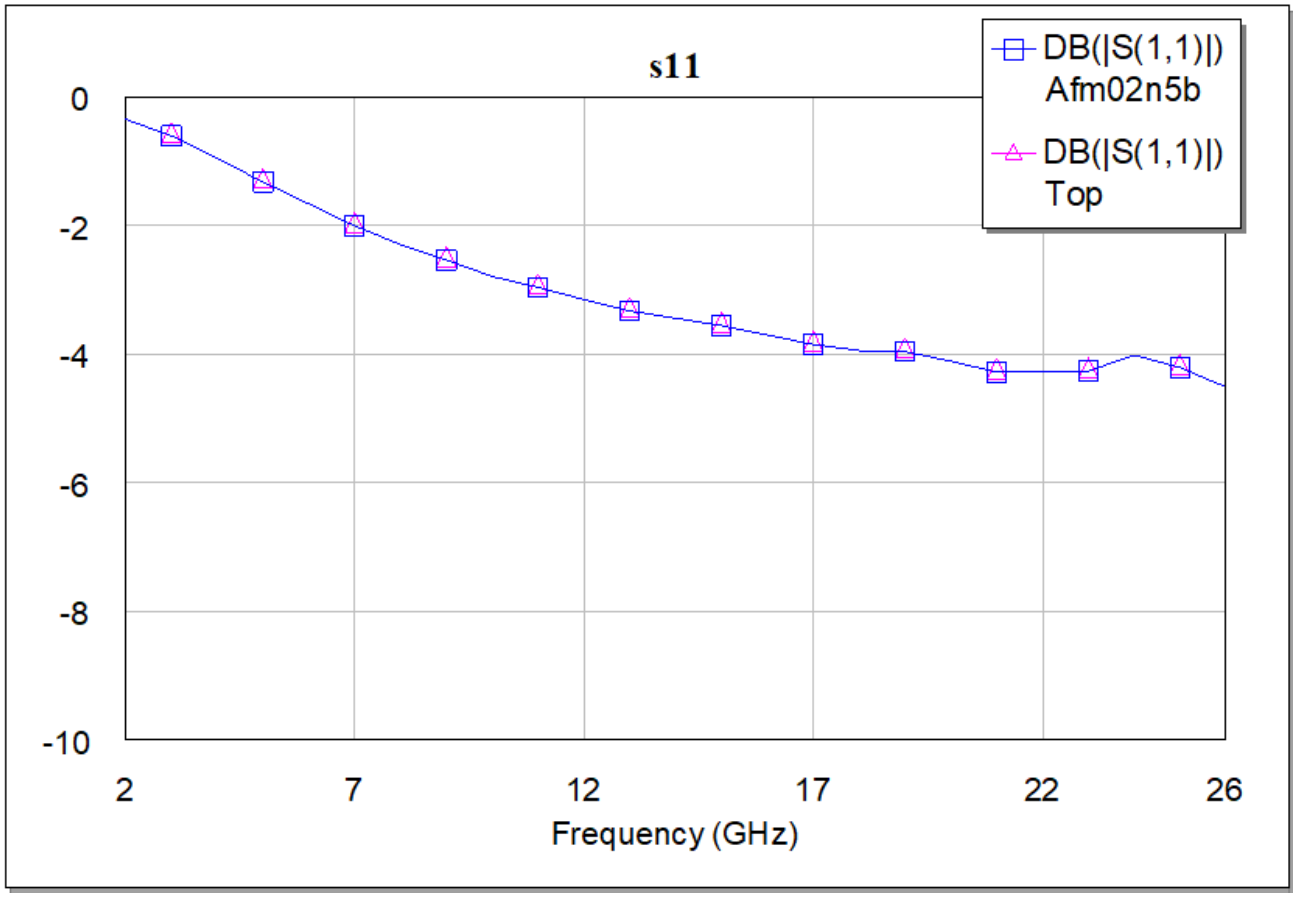
Graph - s21



Graph - S11 and S22


S11 and S22
S(1,1)
Afm02n5b
S(2,2)
Afm02n5b
S(1,1)
Top
S(2,2)
Top
Swp Max
26GHz
Swp Min
2GHz

Graph - s11


s11
DB(|S(1,1)|)
Afm02n5b
DB(|S(1,1)|)
Top
0
-2
-4
-6
-8
-10
2
7
12
17
22
26
Frequency (GHz)