RF and Microwave Lab 2 Report

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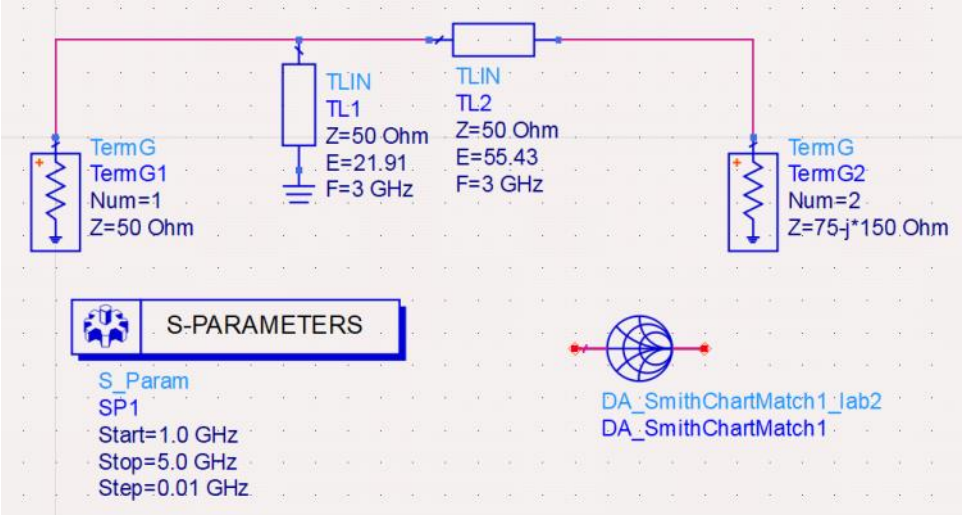
(SC22B146)

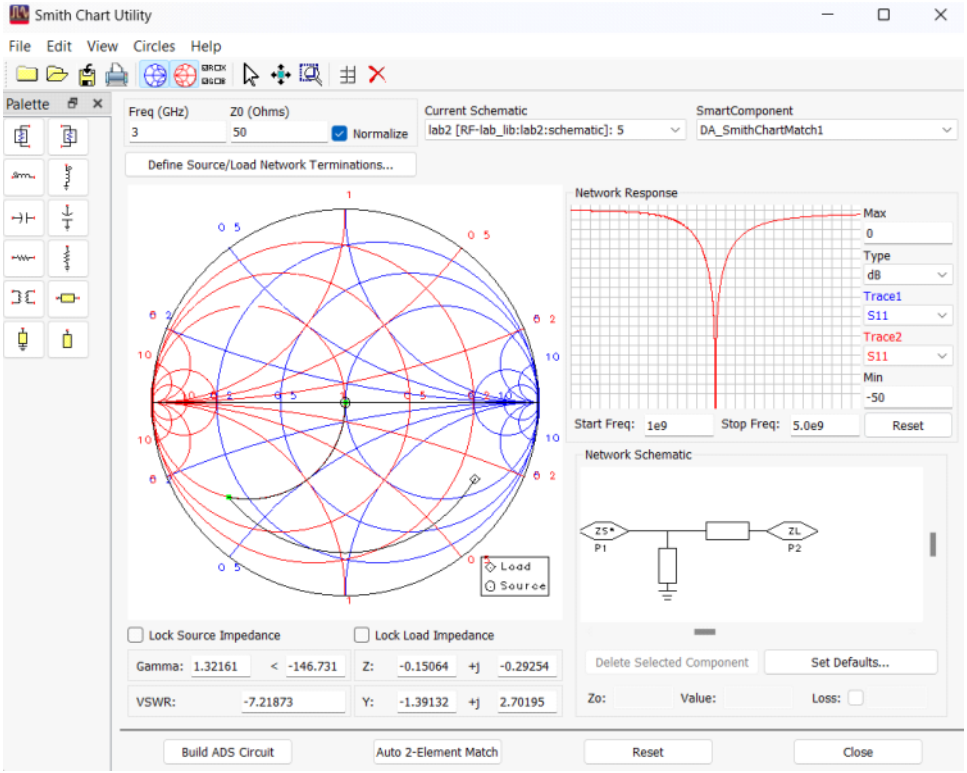
1. **Given a load impedance of 75 - j*150, design a transmission line matching port circuit to match with a source impedance of 50 ohms at 3 GHz.**

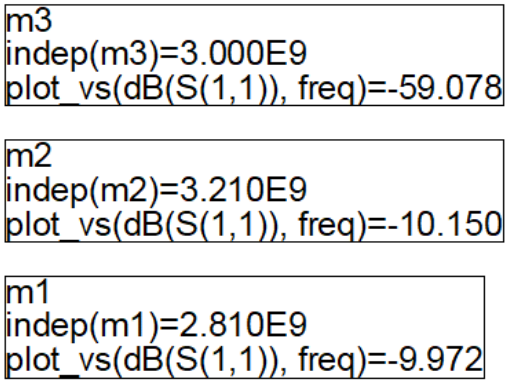
   Procedure:

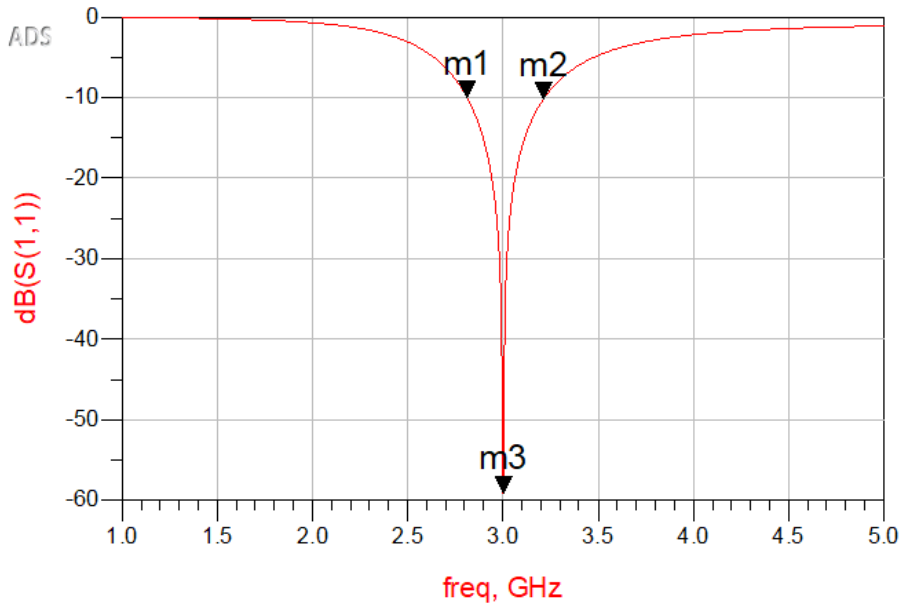
   a. Place two **TermG** components from Basic Components palette and assign them the values of 50 ohms and 75-j*150 ohms.
   b. Place a **Smith Chart Matching Network** from the **Smith Chart Matching** palette.
   c. Go to **Tools -> Smith Chart…** to open **Smith Chart Utility** by selecting the smith chart in the workspace.
   d. In the **Smith Chart Utility** window, specify the matching frequency (3 GHz), Z0 (50 Ohms), source impedance (50+j*0), load impedance (75-j*150), Max (0), Type (dB), Trace1 (S11), Trace2 (S11), Min (-50), Start Freq (8e9) and Stop Freq (16e9). Optionally lock the source and load impedances.
   e. Design a matching circuit with the help of transmission lines and short/open stub with the help of smith chart. Finally, click **Build ADS Circuit**.
   f. To open the circuit, select the smith chart and click on **Push into Hierarchy** (in the toolbox). Select and copy the relevant circuit and **Pop Out**.
   g. Then join the circuit with the **TermG**s.
   h. Now, implement the network using microstrip lines. Place a **MSUB** (microstrip substrate) component and enter the values as shown in the figure.
   i. Now, use the **LineCalc -> Start LineCalc** from the Tool and enter the respective fields. Then, click Synthesize to get the values for physical width (W) and length (L). Be sure to use the correct unit (here, mm).
   j. Now search and place **S_Param** component and set its Start, Stop and Step-size frequencies.
   k. Click on **Simulate**. A simulation window will open. Then, place a **Rectangular Plot** from the **Palette**. In **Plot Traces & Attributes** window, plot **S(1,1)** --> **Add Vs.** --> **dB** (Complex Data) --> **freq** (as independent variable). A graph will be plotted. Repeat this for **S(1,2)**.

Observations:

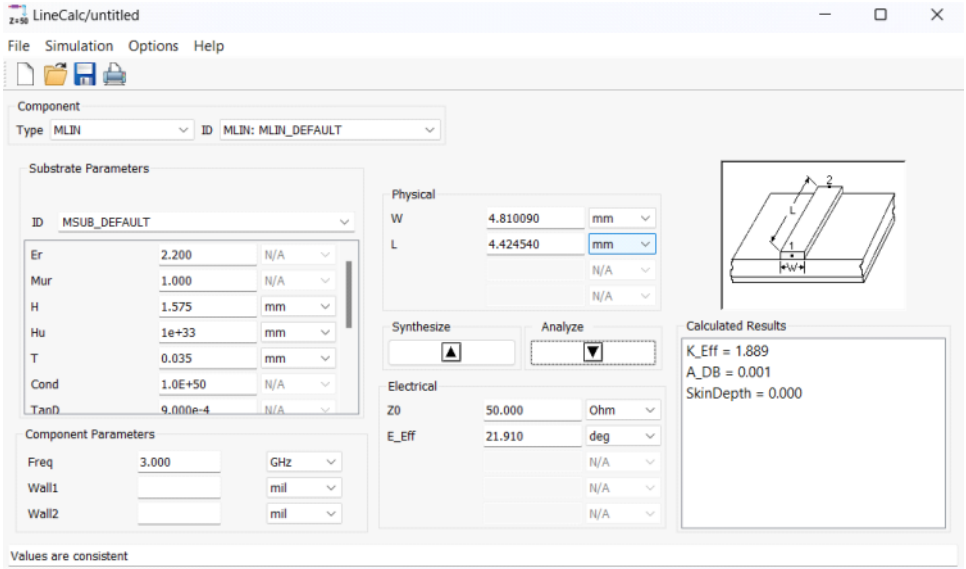


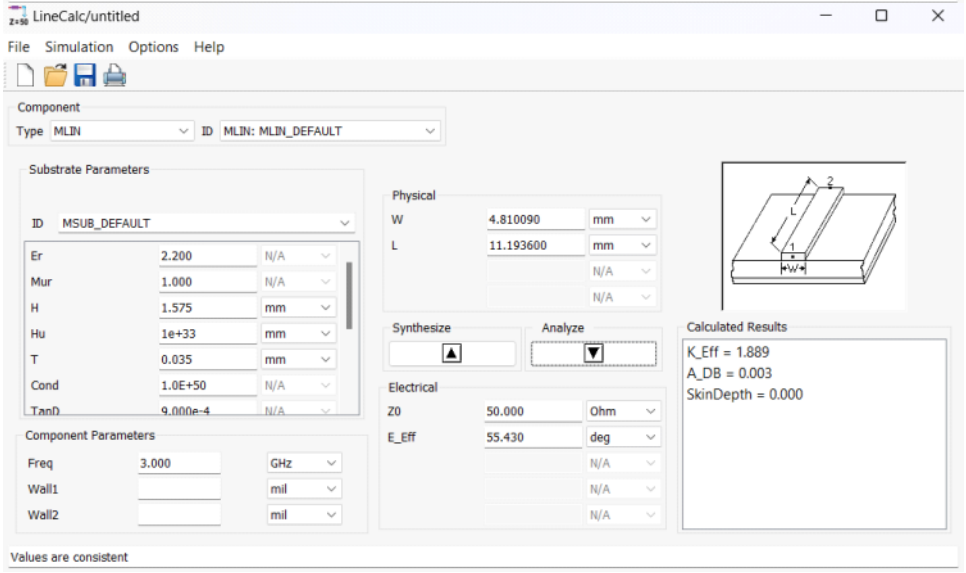






Using microstrip line:

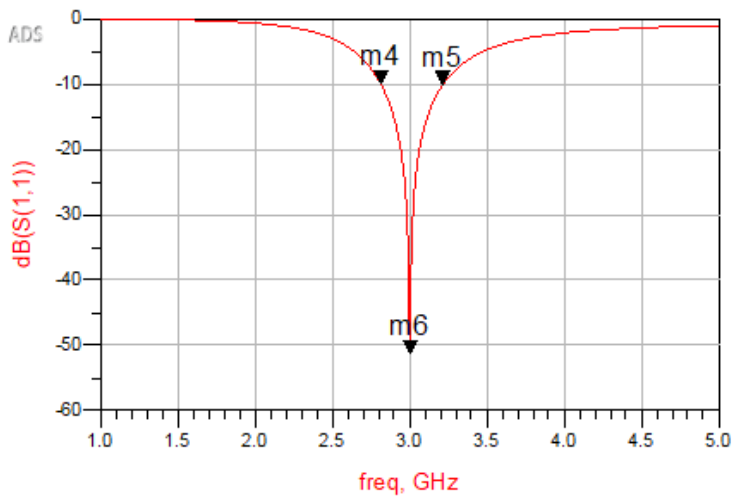


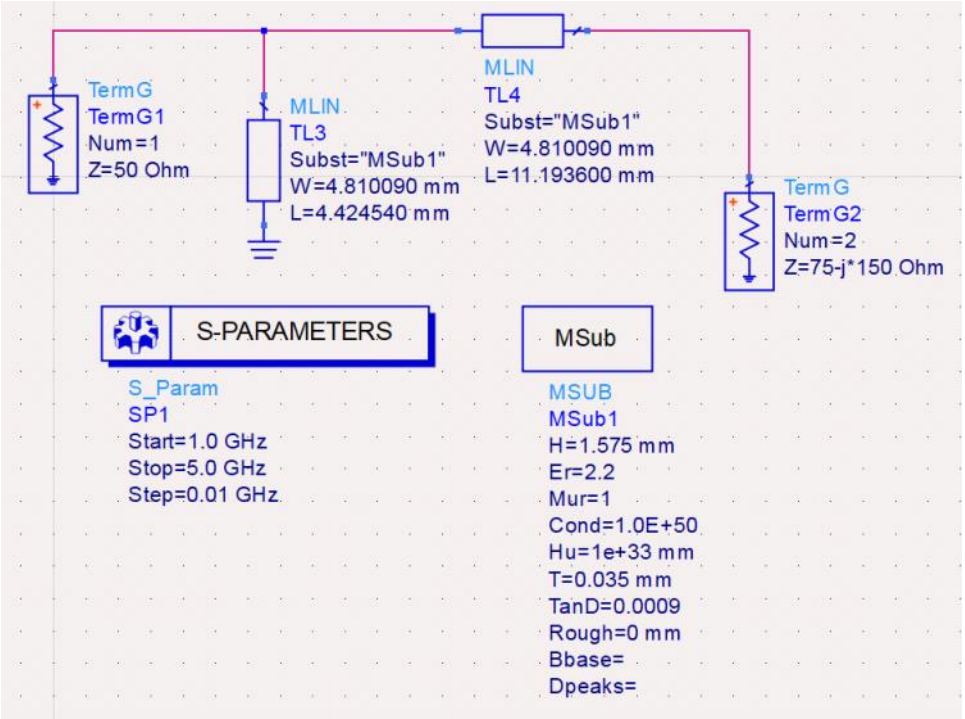


m6
indep(m6)=3.000E9
plot_vs(dB(S(1,1)), freq)=-51.274

m5
indep(m5)=3.210E9
plot_vs(dB(S(1,1)), freq)=-10.118

m4
indep(m4)=2.810E9
plot_vs(dB(S(1,1)), freq)=-9.940





Inferences:

For the matching network, we get S11 of around -40dB and bandwidth of 0.4GHz.

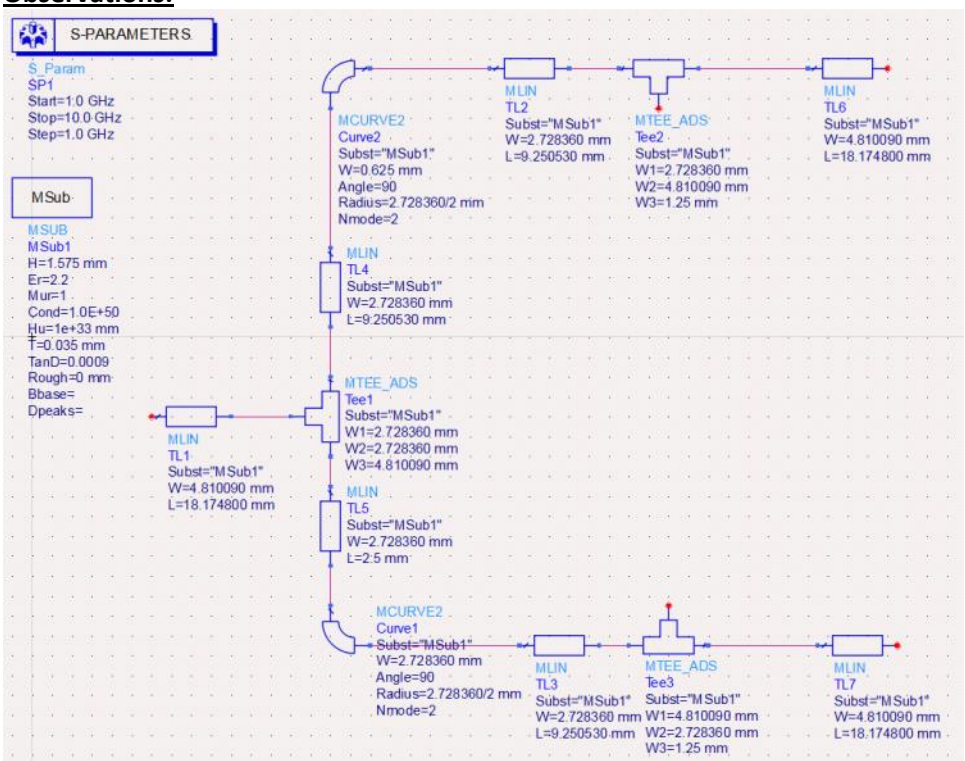
2. **Design a 1:2 Wilkinson Equal Power Divider using Microstrip line. (The operating frequency is also 5 GHz).**

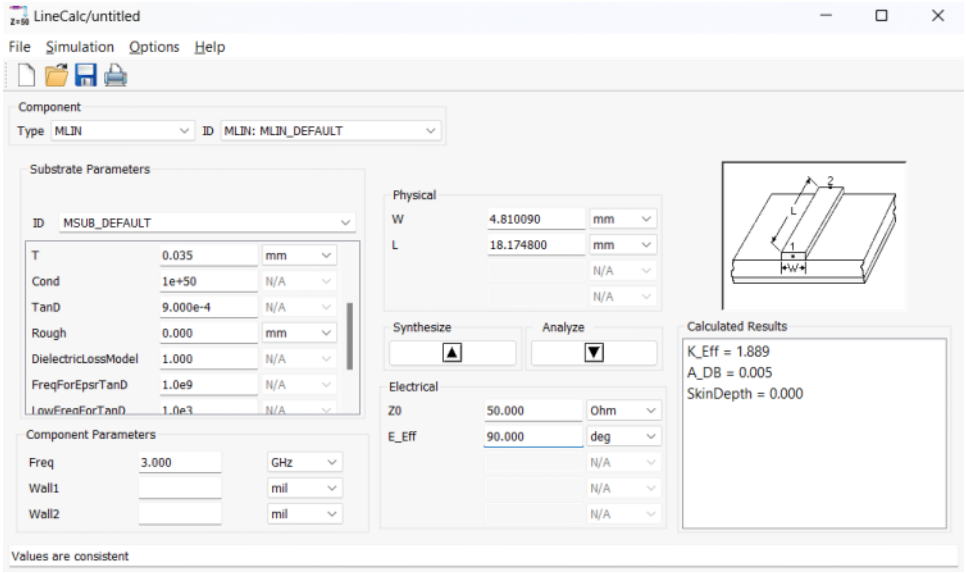
Procedure:

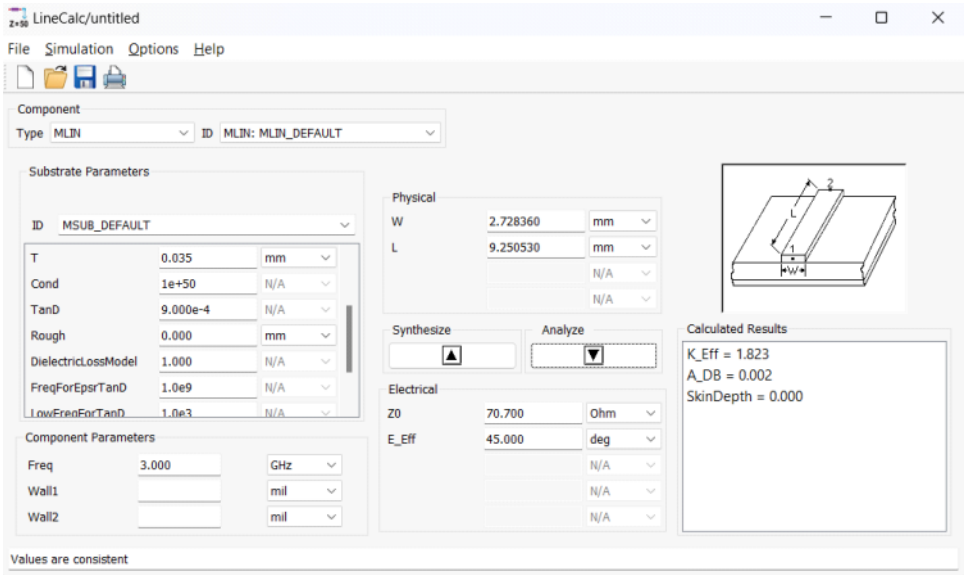
a. Design the power divider as shown in the figure with the help of MLIN, MCURVE and MTEE components.

b. Calculate their desired width and lengths using **LineCalc** tool with the entries as shown in MSub mcomponent. The widths of branch of an MTEE will be same as the width of MLIN it is facing. Same will apply for the radius of MCURVE (with angle of 90 degrees).

Observations:




LineCalc/untitled
File Simulation Options Help
Component
Type MLIN ID MLIN: MLIN_DEFAULT
Substrate Parameters
ID MSUB_DEFAULT
T 0.035 mm
Cond 1e+50 N/A
TanD 9.000e-4 N/A
Rough 0.000 mm
DielectricLossModel 1.000 N/A
FreqForEpsrTanD 1.0e9 N/A
Component Parameters
Freq 3.000 GHz
Wall1 mil
Wall2 mil
Physical
W 4.810090 mm
L 18.174800 mm
Synthesize
Analyze
Electrical
Z0 50.000 Ohm
E_Eff 90.000 deg
Calculated Results
K_Eff = 1.889
A_DB = 0.005
SkinDepth = 0.000
Values are consistent


LineCalc/untitled
File Simulation Options Help
Component
Type MLIN ID MLIN: MLIN_DEFAULT
Substrate Parameters
ID MSUB_DEFAULT
T 0.035 mm
Cond 1e+50 N/A
TanD 9.000e-4 N/A
Rough 0.000 mm
DielectricLossModel 1.000 N/A
FreqForEpsrTanD 1.0e9 N/A
Component Parameters
Freq 3.000 GHz
Wall1 mil
Wall2 mil
Physical
W 2.728360 mm
L 9.250530 mm
Synthesize
Analyze
Electrical
Z0 70.700 Ohm
E_Eff 45.000 deg
Calculated Results
K_Eff = 1.823
A_DB = 0.002
SkinDepth = 0.000
Values are consistent