

In the name of god

Microwave Lab Project
Designing a Branch Line coupler

Group 1

Spring 2024



a) Calculating the width and the length of each section

Component

Type MLIN

ID MLIN: MLIN_DEFAULT

Substrate Parameters

ID MSUB_DEFAULT

Er 3.550 N/A

Mur 1.000 N/A

H 20.000 mil

Hu 3.9e+34 mil

T 35.000 um

Cond 5.8e7 N/A

TanD 0.002 N/A

Rough 0.000 mil

DielectricLossModel 1.000 N/A

FreqForEpsrTanD 1.0e9 N/A

LowFreqForTanD 1.0e3 N/A

HighFreqForTanD 1.0e12 N/A

Component Parameters

Freq 2.000 GHz

Wall1 mil

Wall2 mil

Physical

W 43.224409 mil

L 891.208661 mil

Synthesize

Analyze

Electrical

Z0 50.000 Ohm

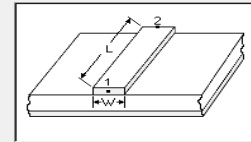
E_Eff 90.000 deg

Calculated Results

K_Eff = 2.740

A_DB = 0.035

SkinDepth = 0.058



Component

Type MLIN

ID MLIN: MLIN_DEFAULT

Substrate Parameters

ID MSUB_DEFAULT

Er 3.550 N/A

Mur 1.000 N/A

H 20.000 mil

Hu 3.9e+34 mil

T 35.000 um

Cond 5.8e7 N/A

TanD 0.002 N/A

Rough 0.000 mil

DielectricLossModel 1.000 N/A

FreqForEpsrTanD 1.0e9 N/A

LowFreqForTanD 1.0e3 N/A

HighFreqForTanD 1.0e12 N/A

Component Parameters

Freq 2.000 GHz

Wall1 mil

Wall2 mil

Physical

W 73.478740 mil

L 869.633858 mil

Synthesize

Analyze

Electrical

Z0 35.360 Ohm

E_Eff 90.000 deg

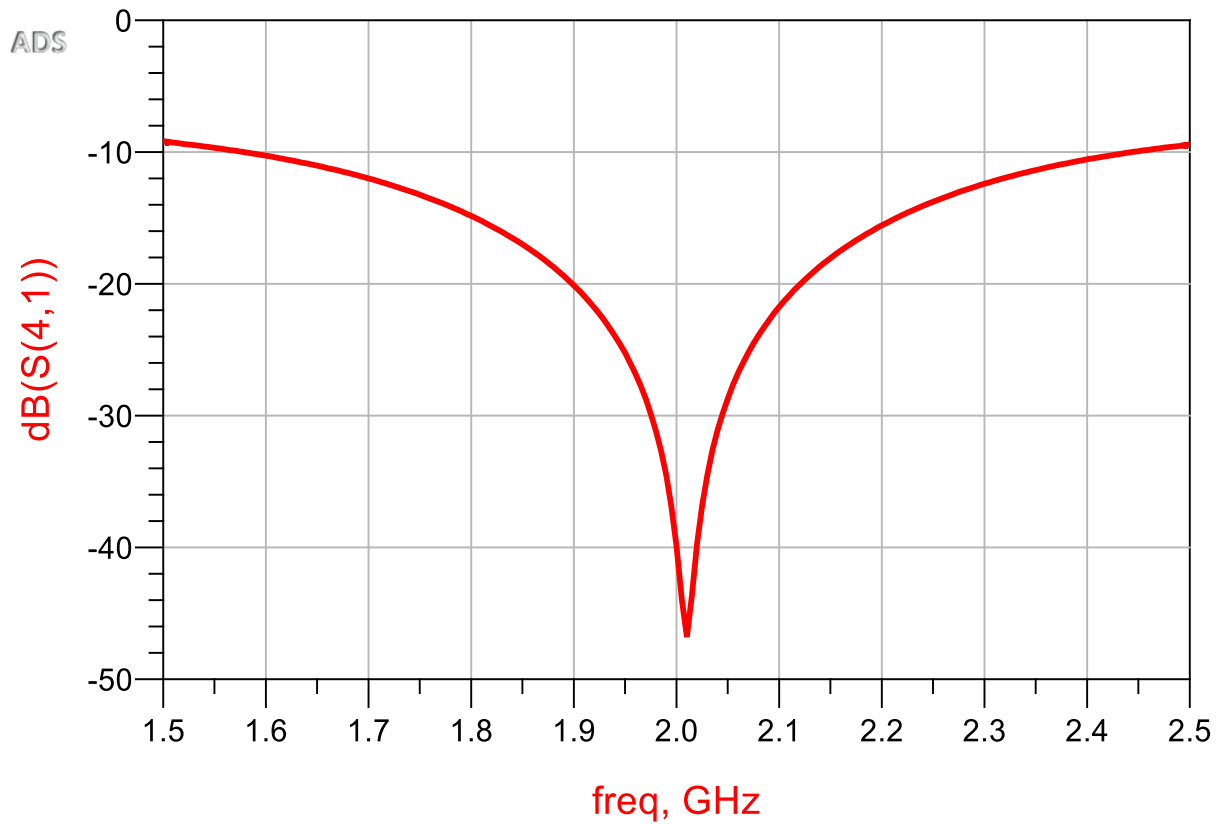
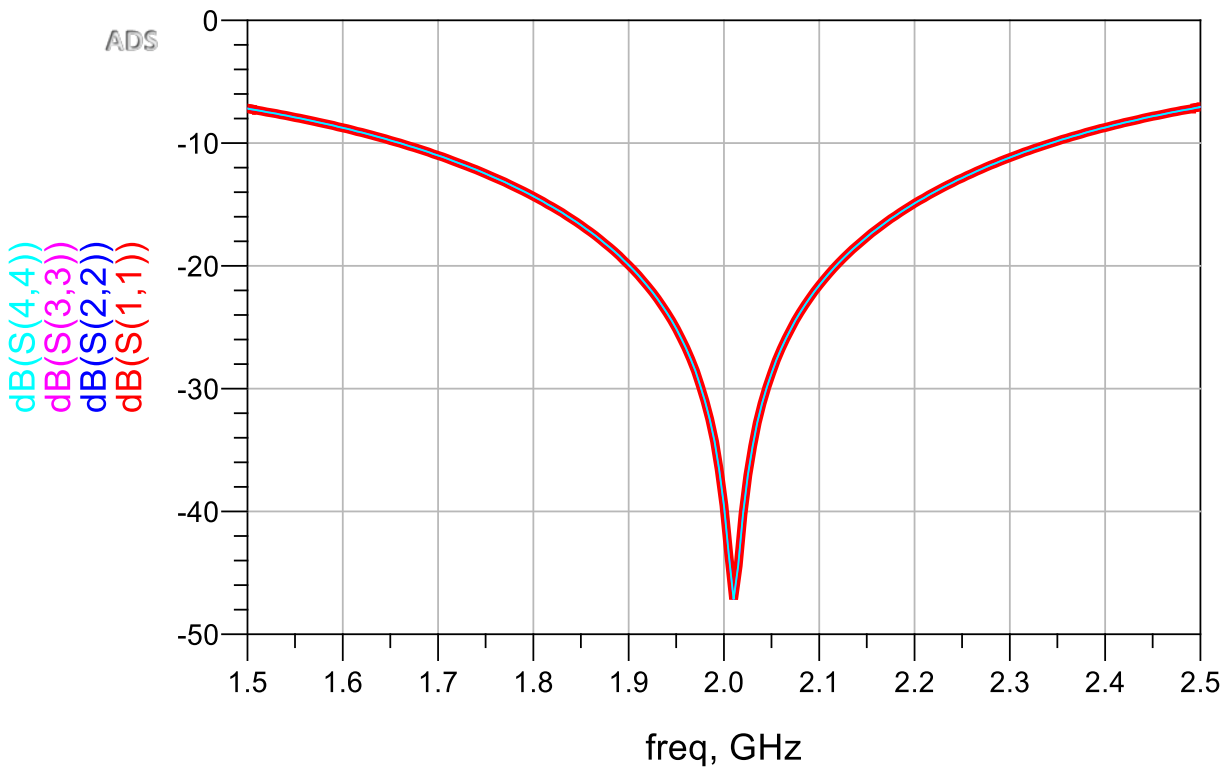
Calculated Results

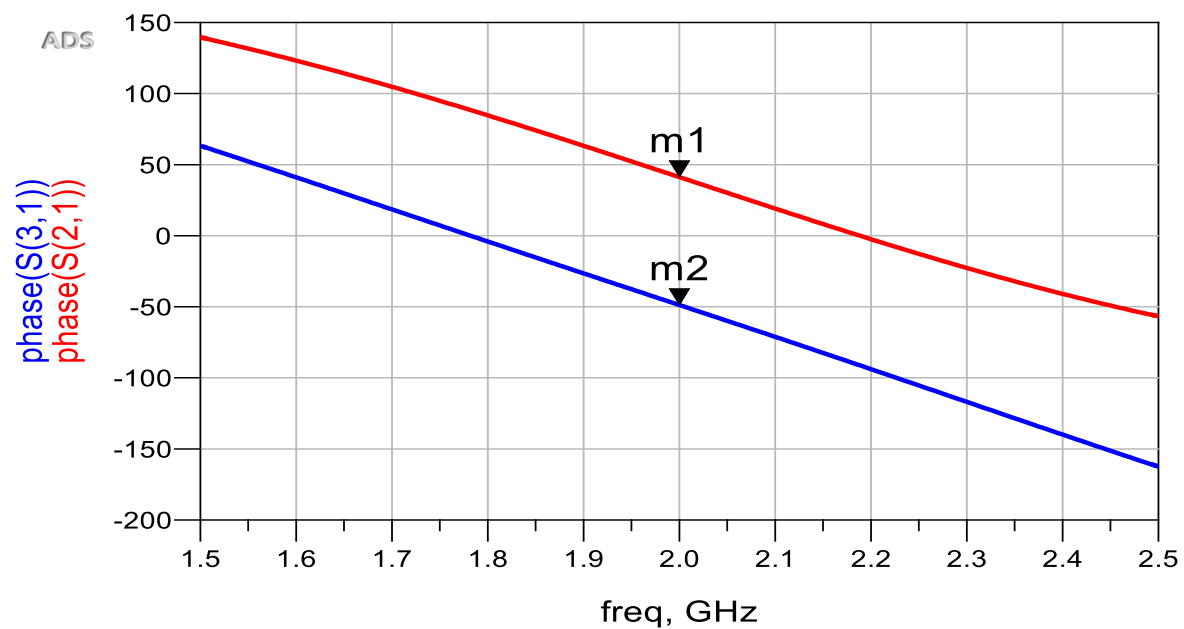
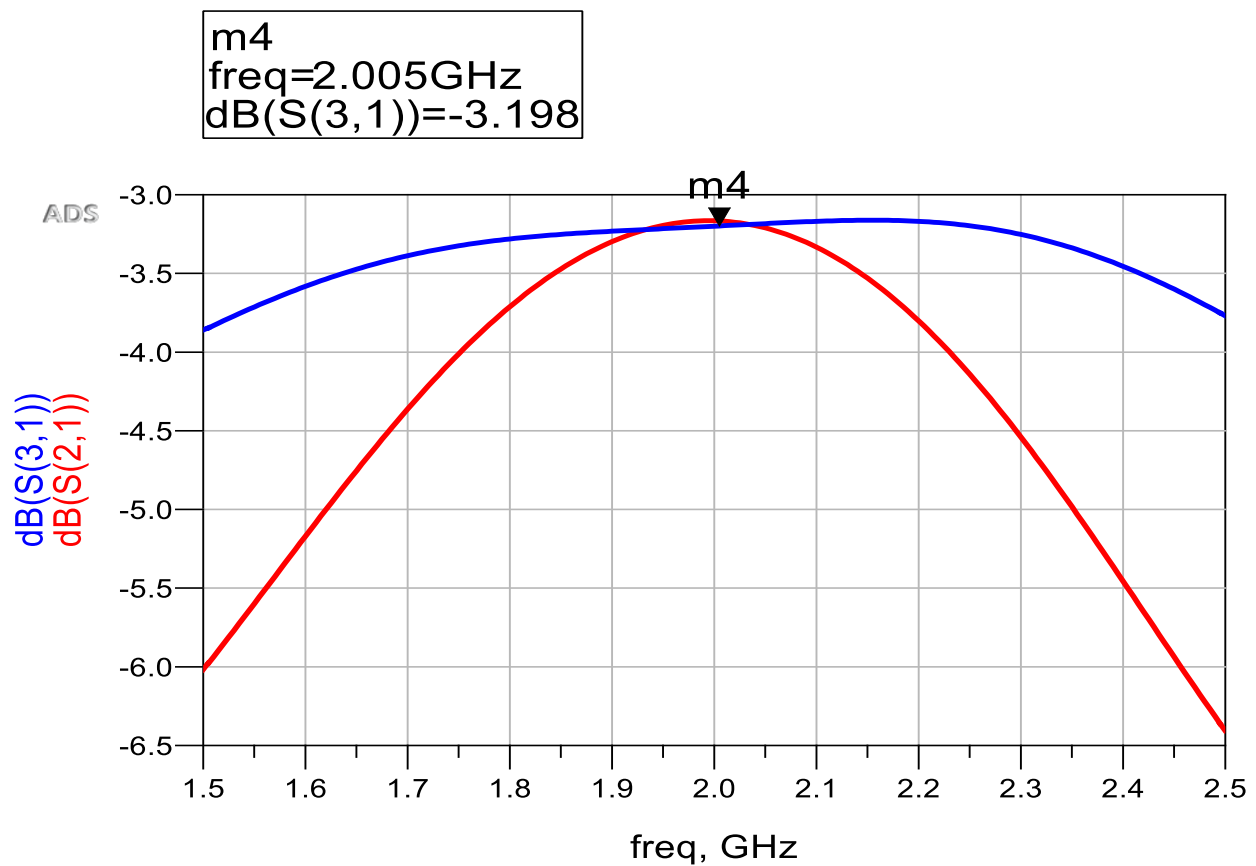
K_Eff = 2.878

A_DB = 0.032

SkinDepth = 0.058

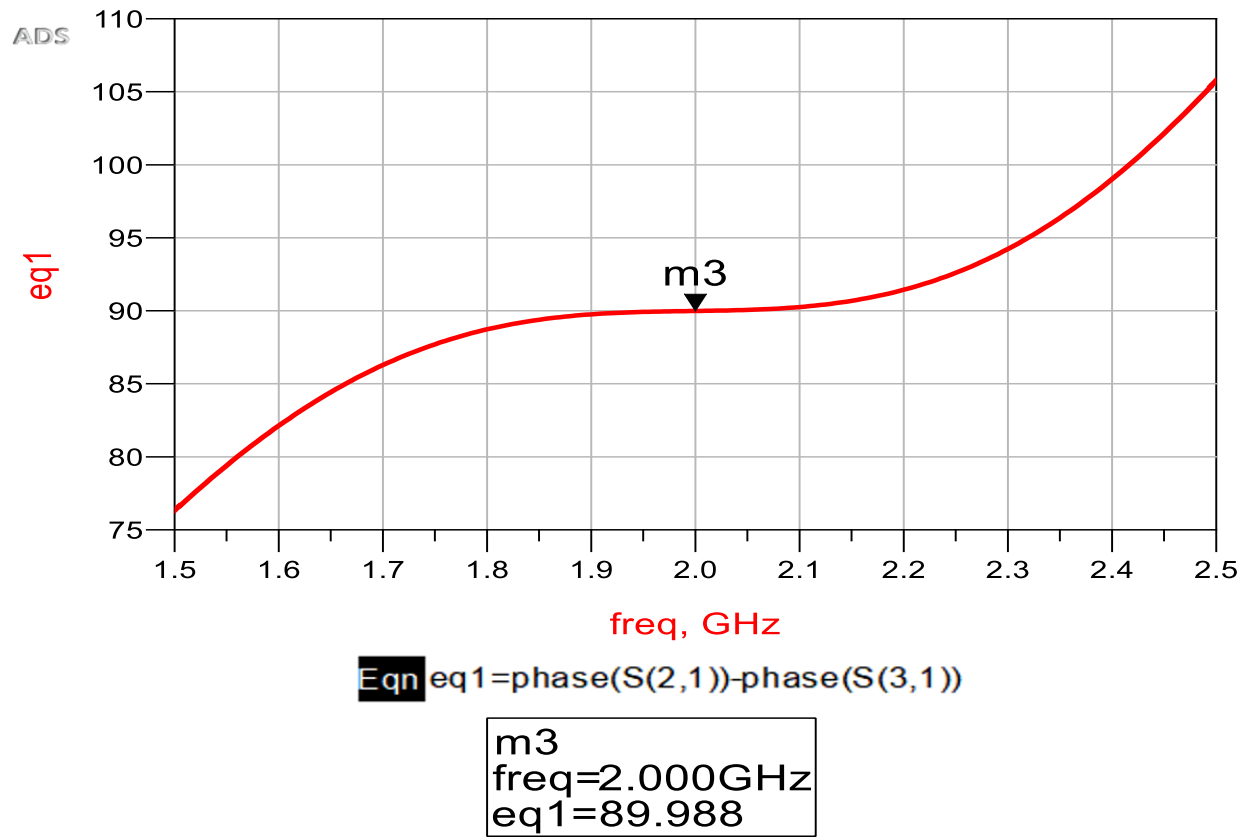
b) Results before optimizing (simulation is in the schematic environment)



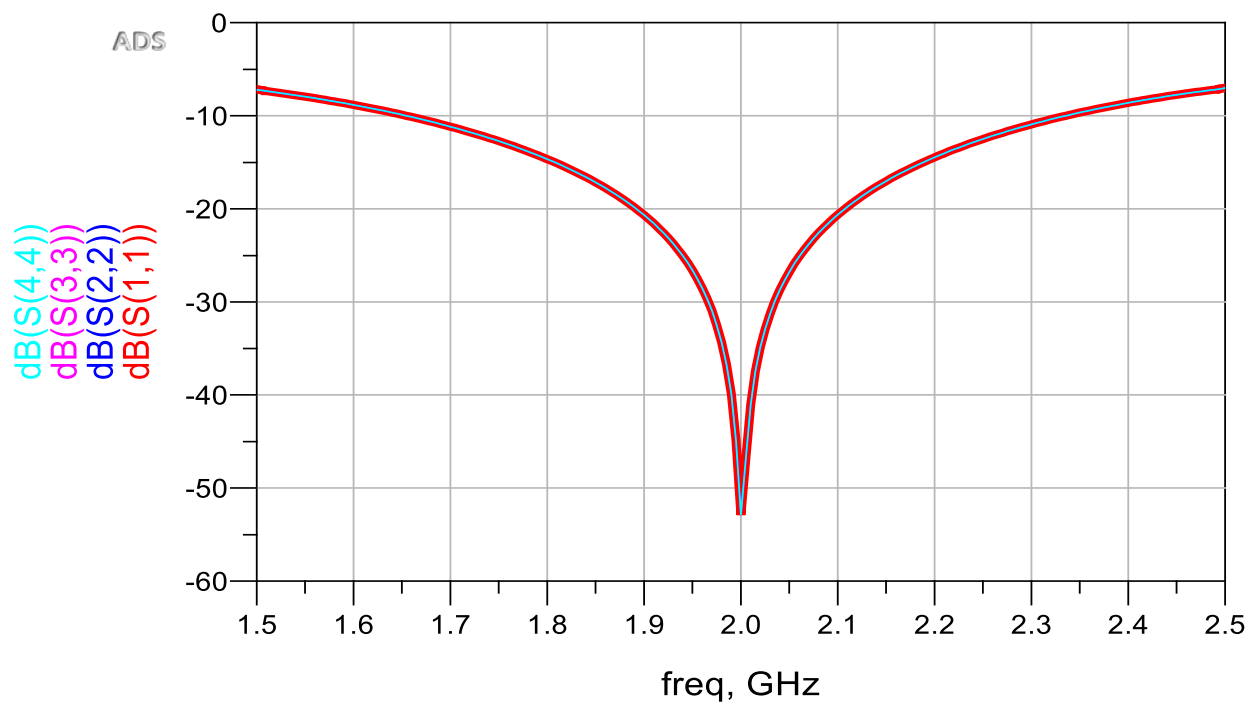


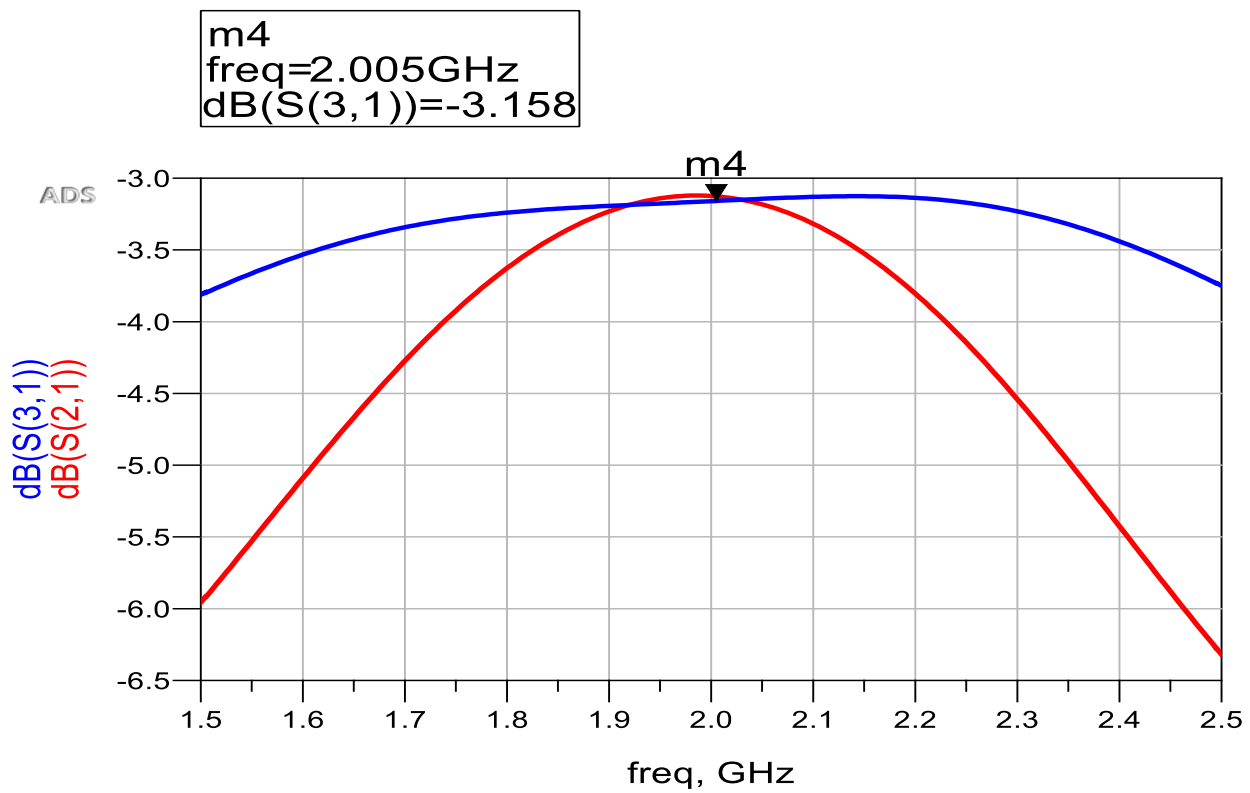
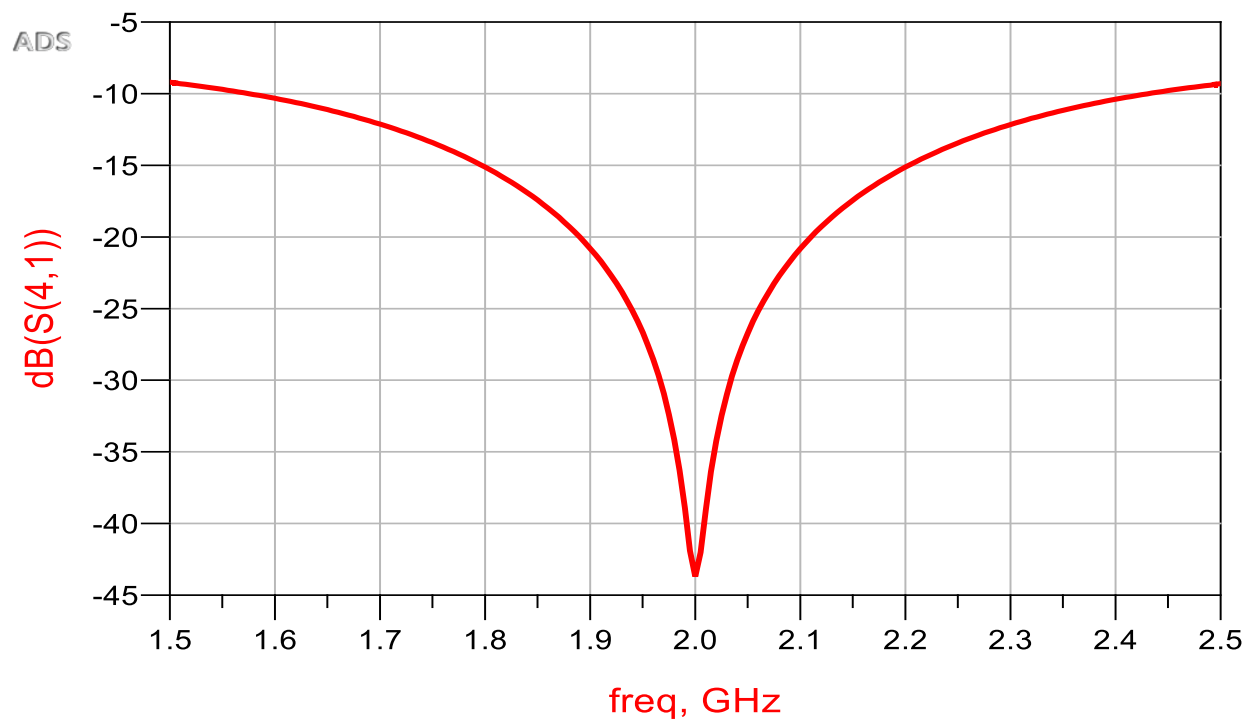
m1
freq=2.000GHz
phase(S(2,1))=41.208

m2
freq=2.000GHz
phase(S(3,1))=-48.779

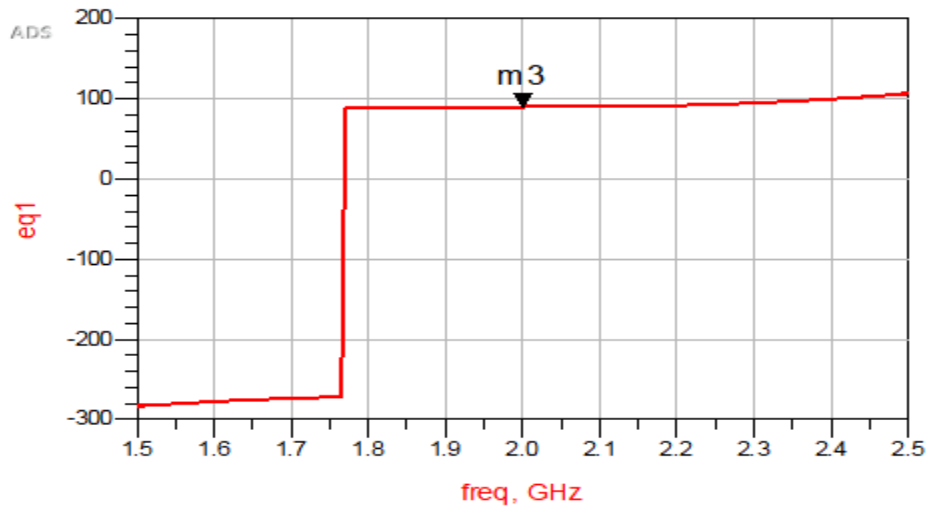


Results after optimizing (simulation is in schematic environment)



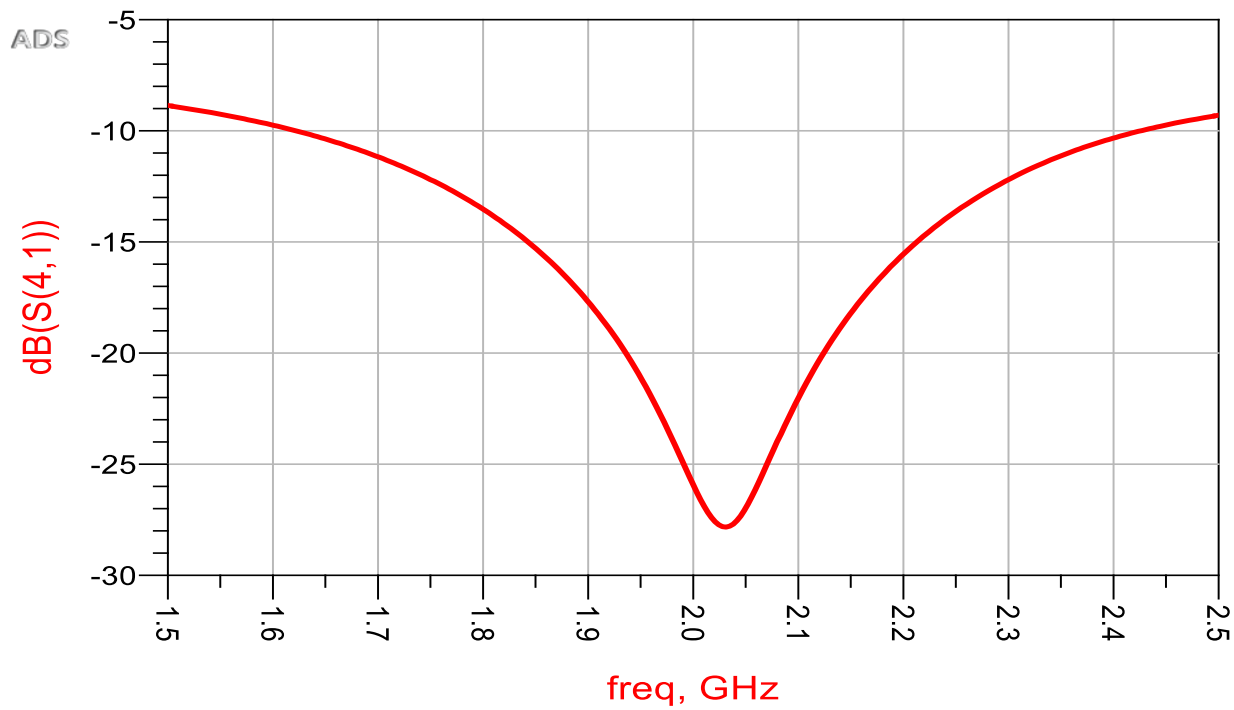
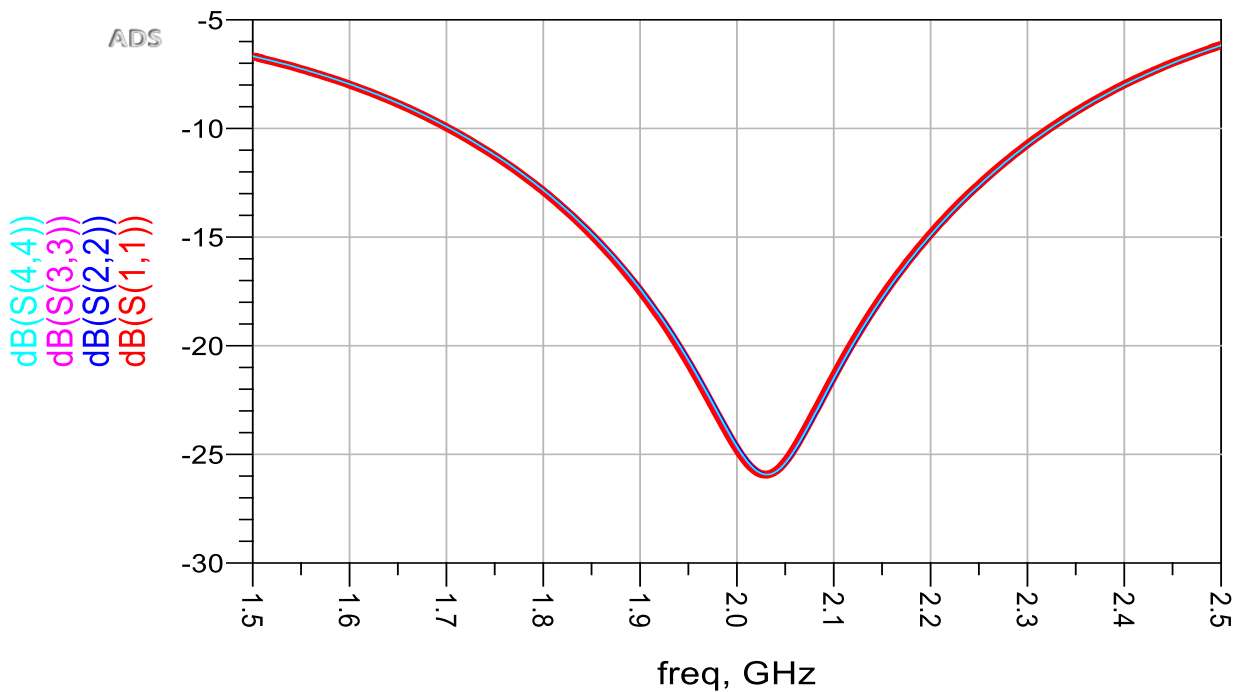


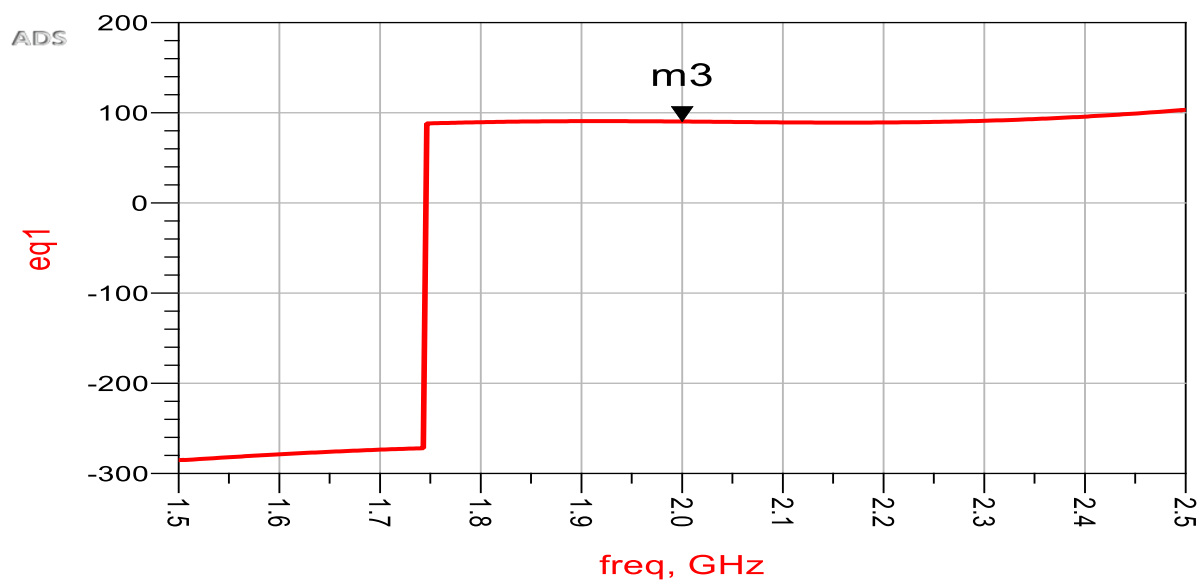
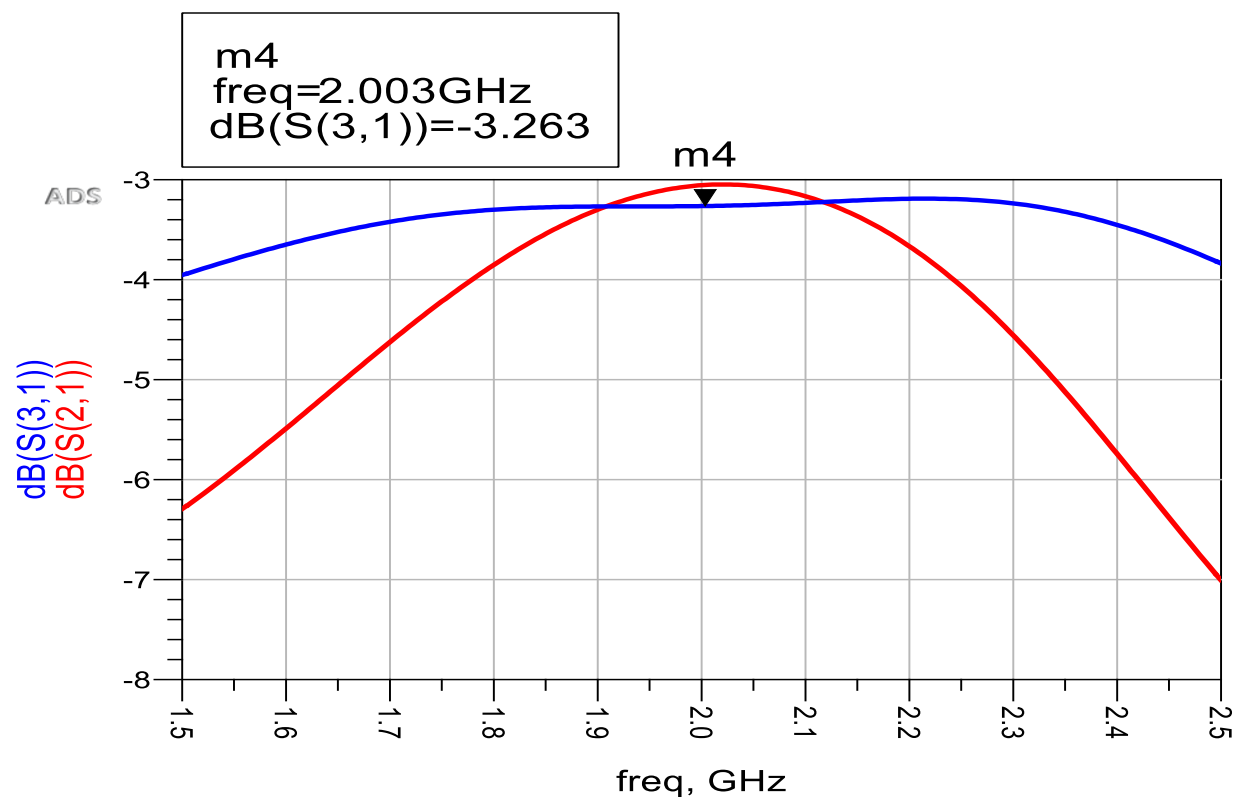
Eqn eq1=phase(S(2,1))-phase(S(3,1))



m3
freq=2.000GHz
eq1=89.997

c) Before optimizing (EM simulation)

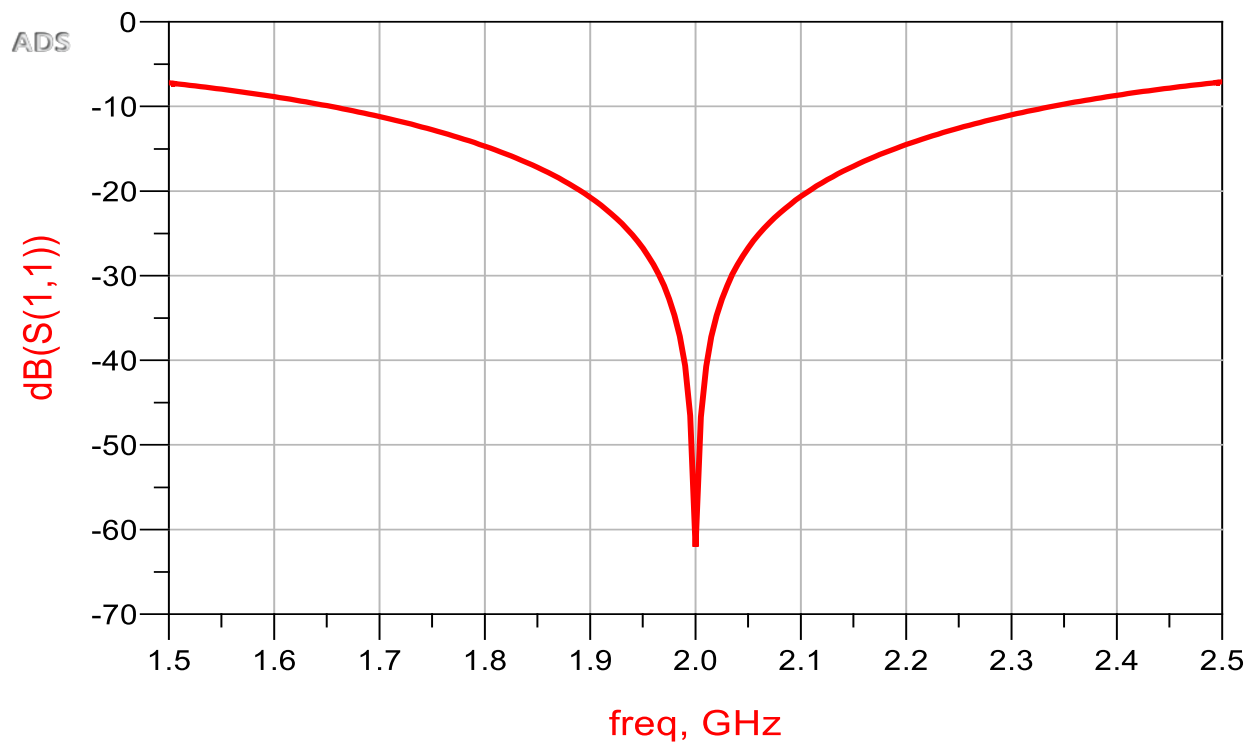


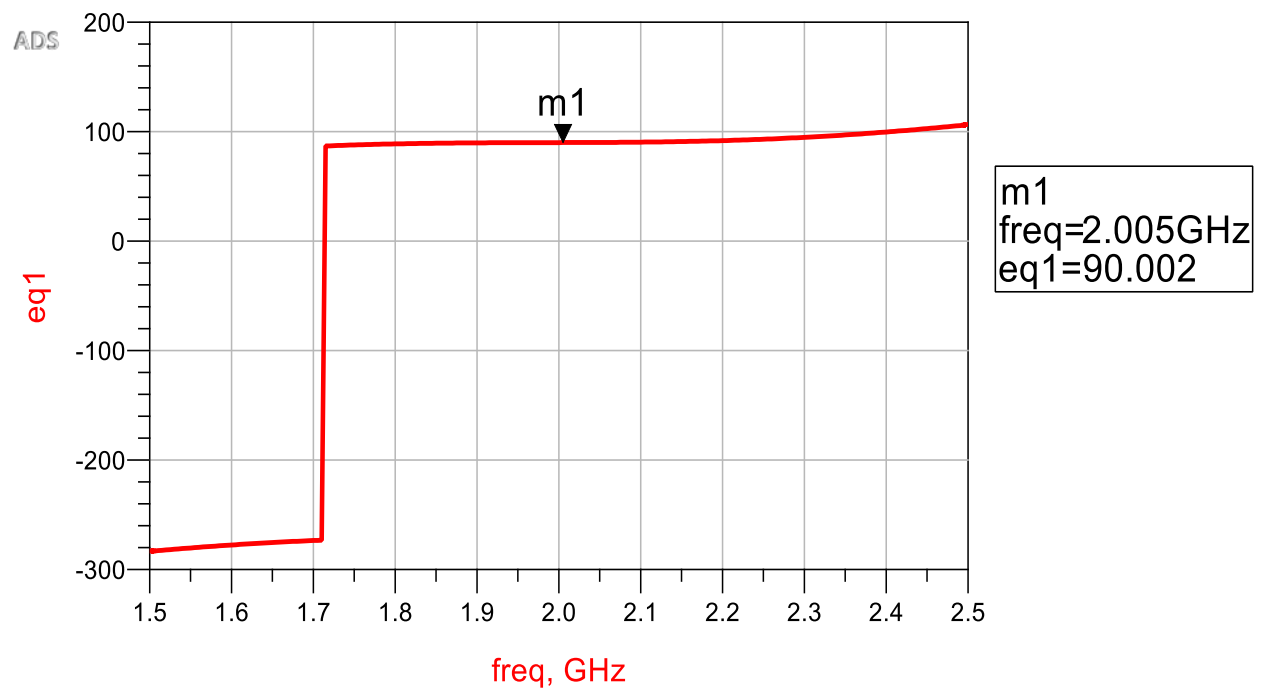
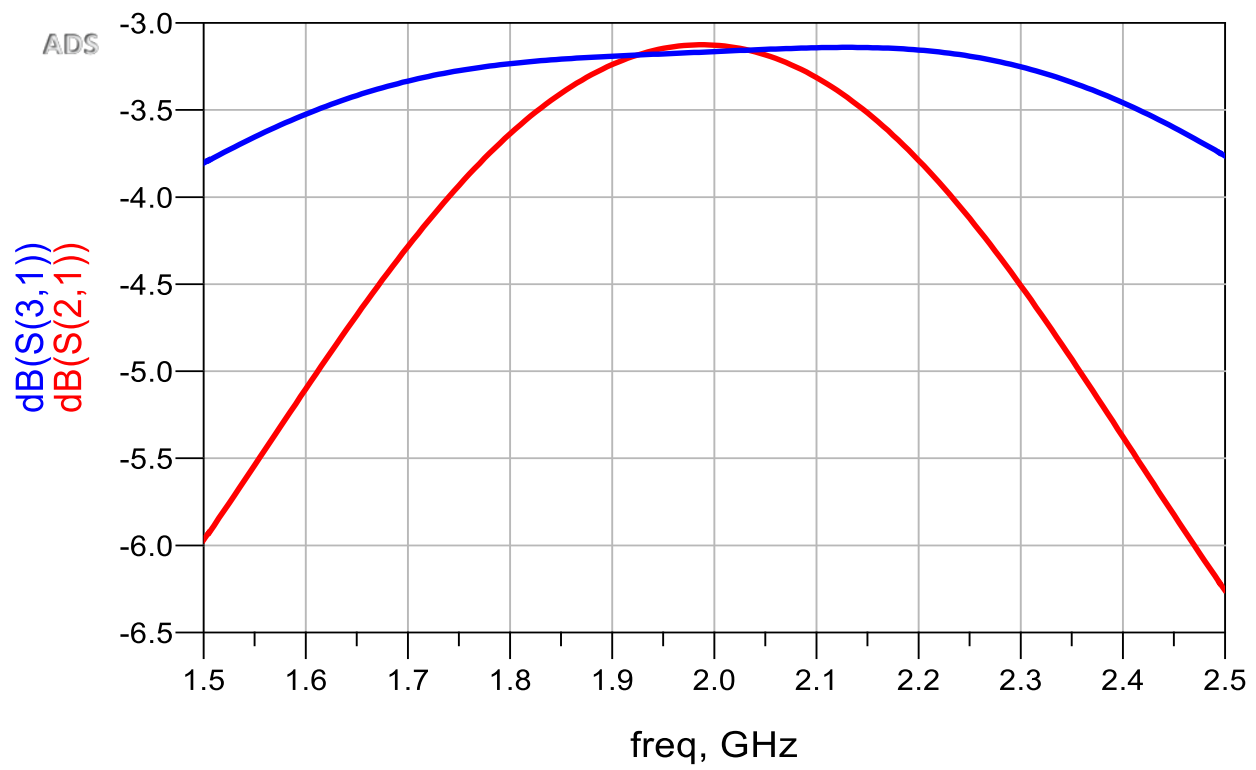


Eqn eq1=phase(S(2,1))-phase(S(3,1))

- By tuning the length of 50 ohms and 35 ohms lines, we can get a phase difference of approximately 90 degrees.
- To shift the central frequency, we can tune the length of 50 ohms and 35 ohms lines.
- To decrease return loss and to increase the isolation between ports 1 and 4, we can tune the widths of the lines.

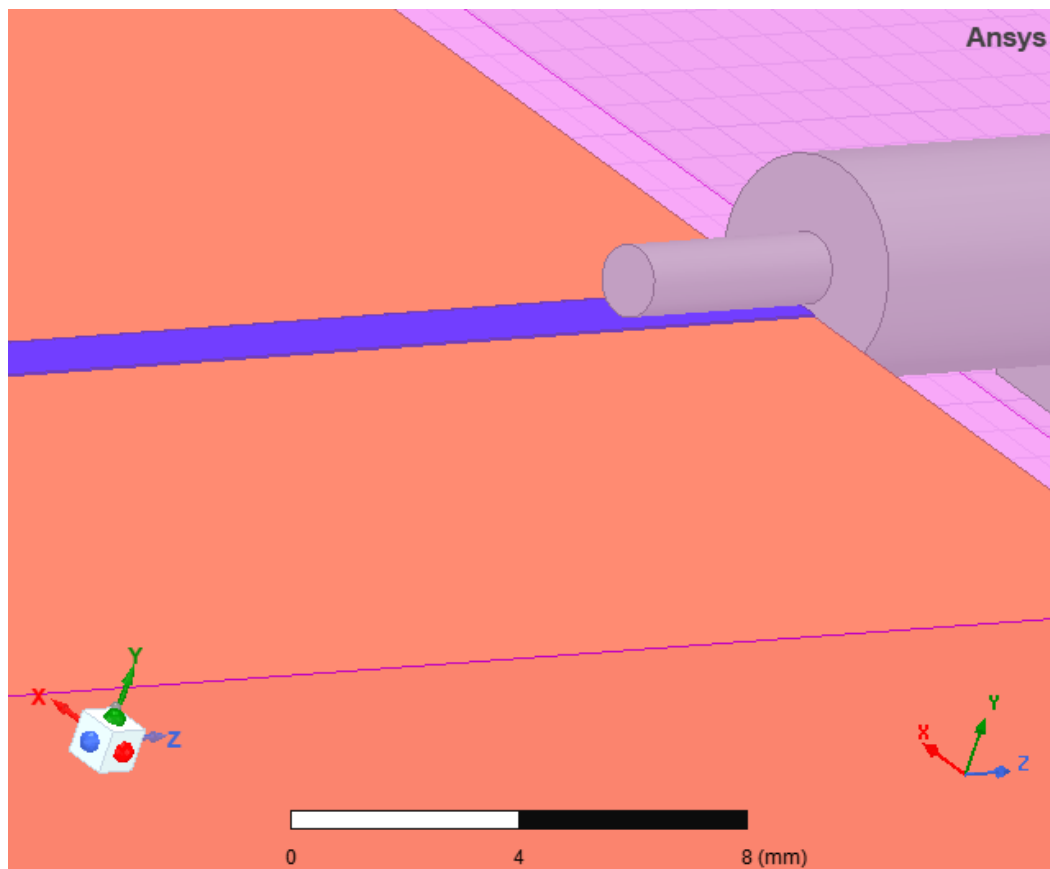
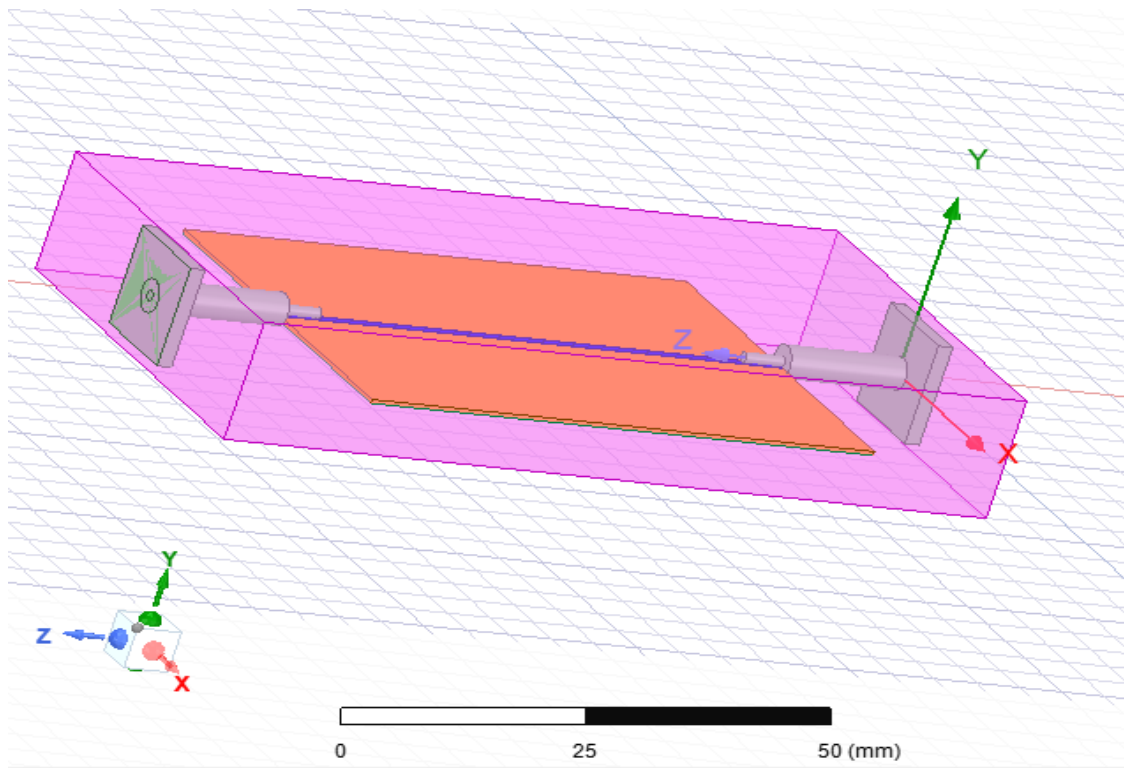
Results after optimizing (EM simulation)

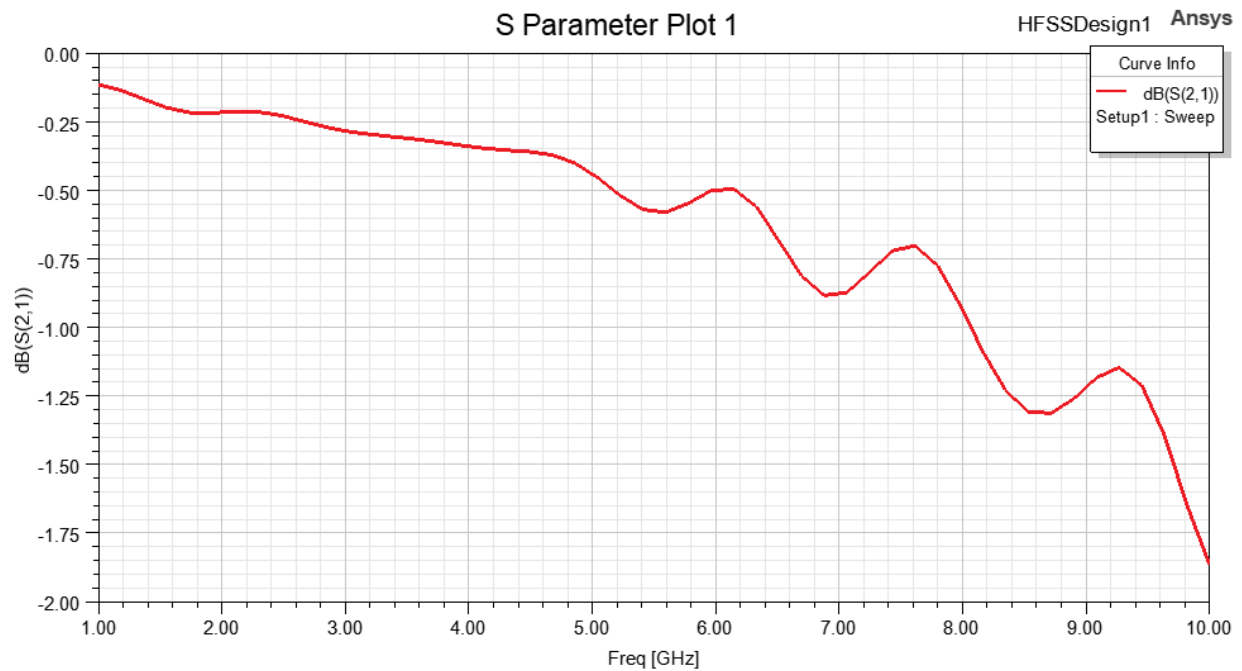
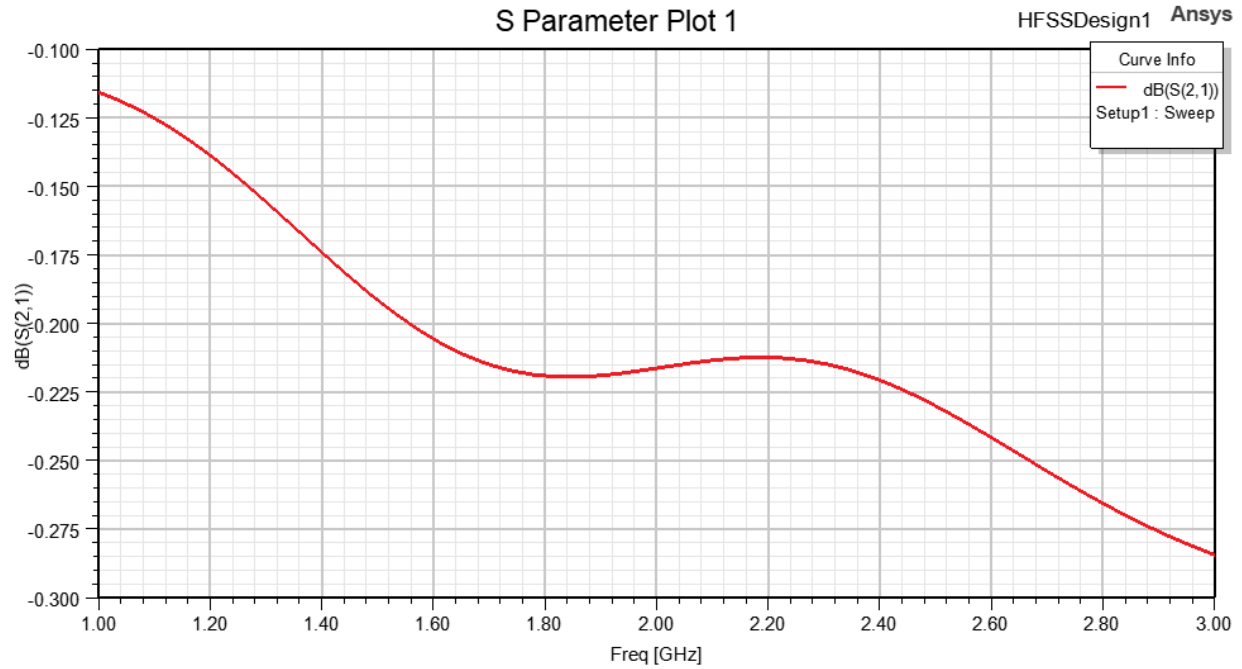




Eqn eq1=phase(S(2,1))-phase(S(3,1))

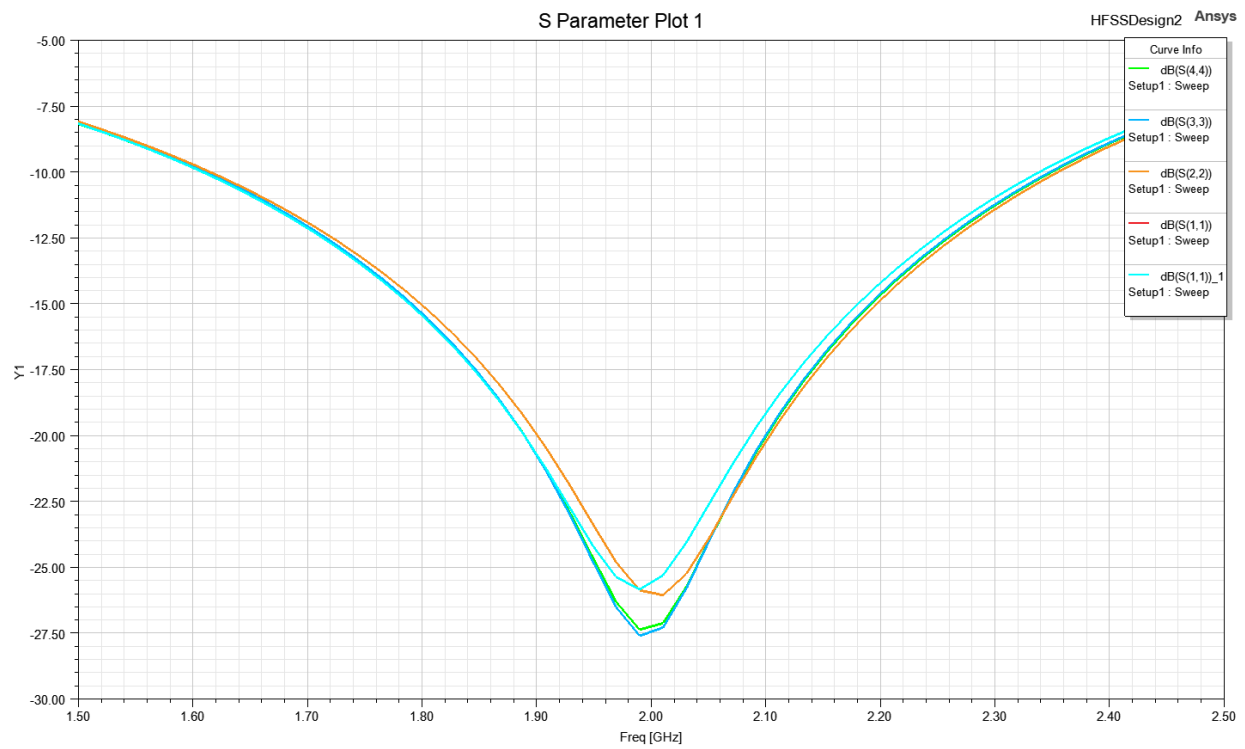
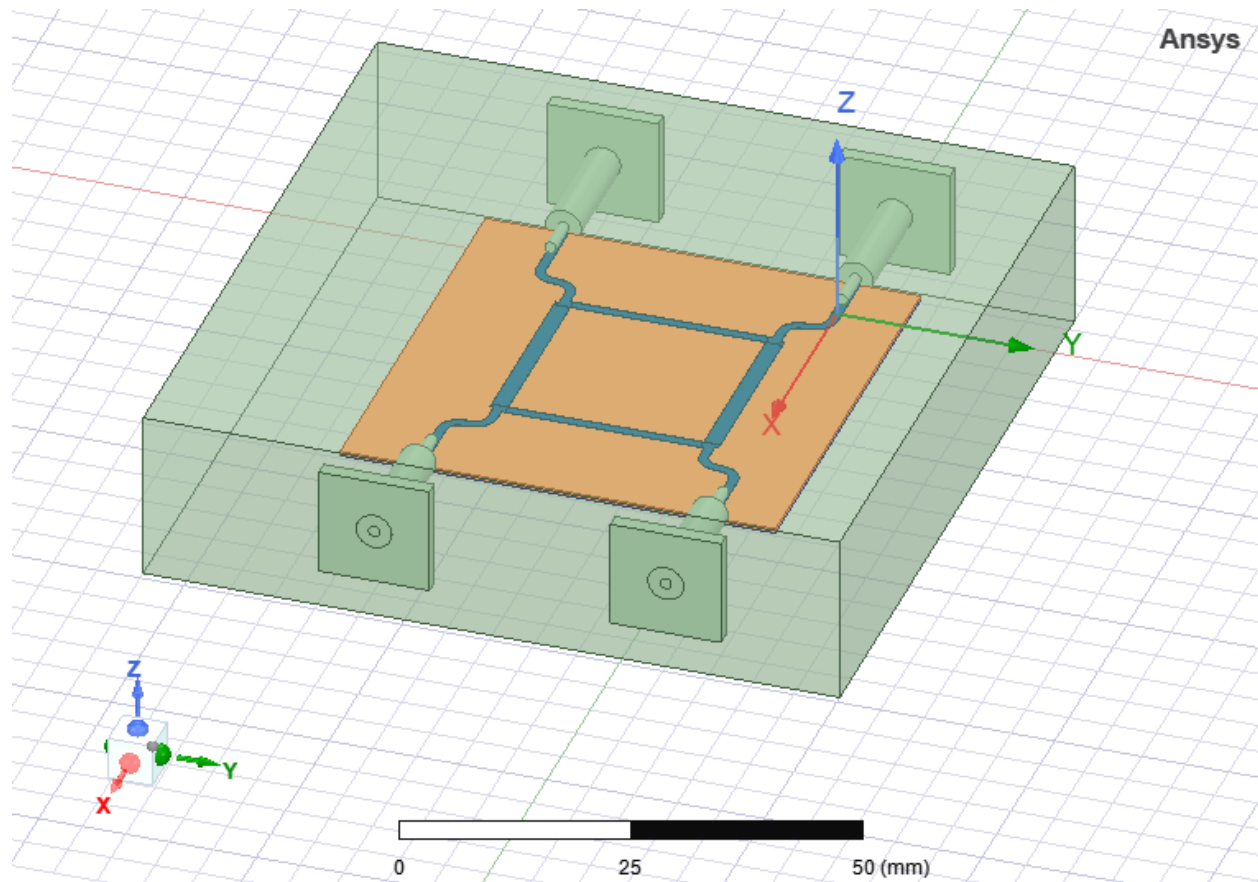
d)

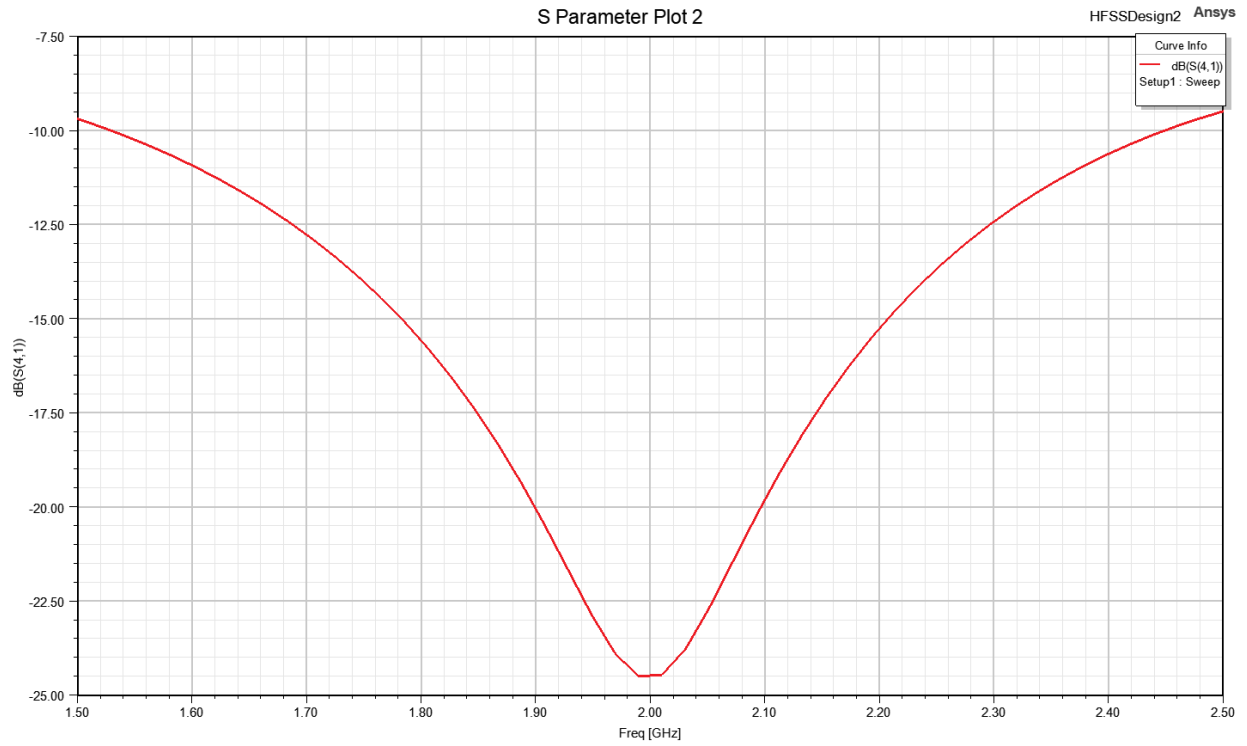




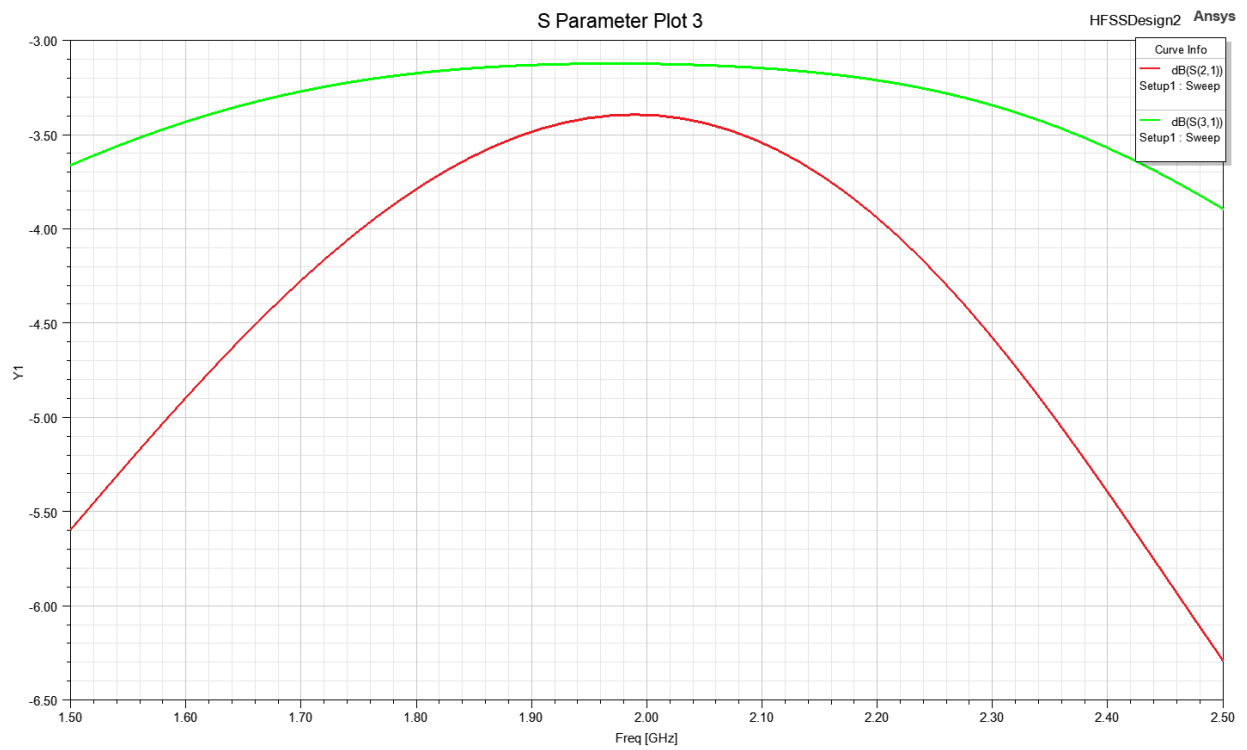
For frequencies higher than 5 GHz, it is not convenient to use this connection.

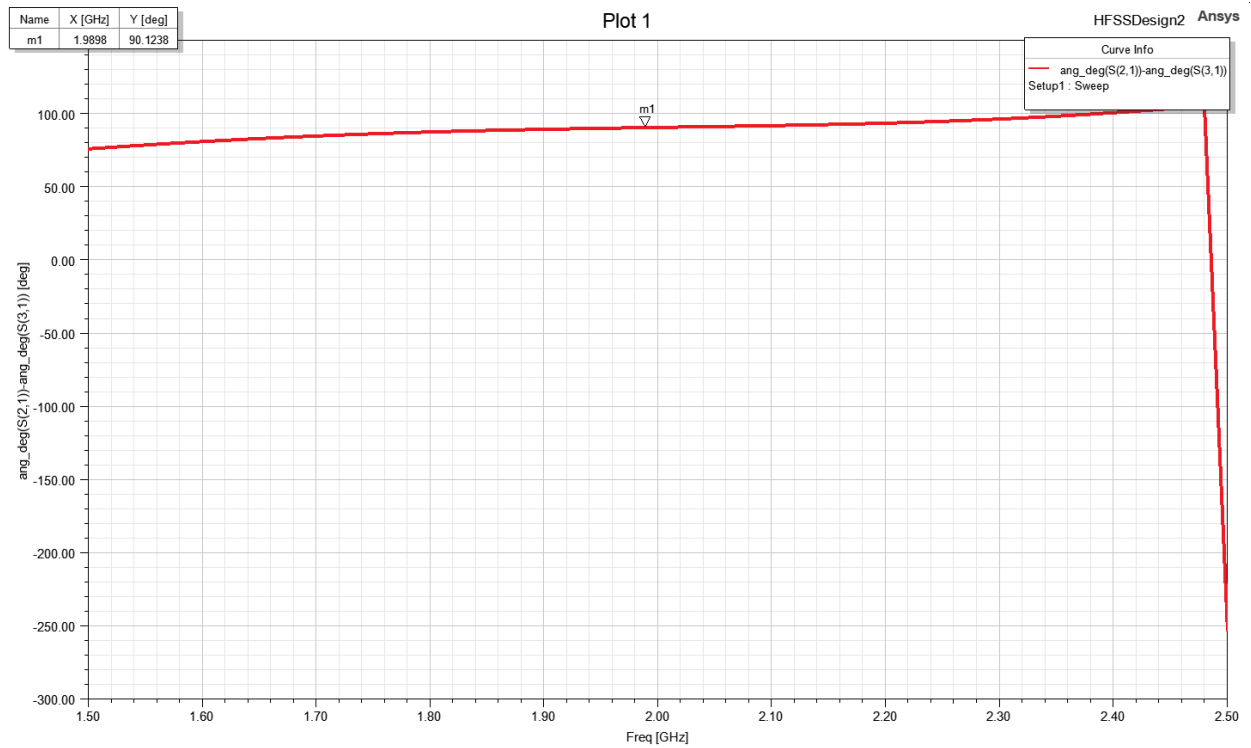
e)



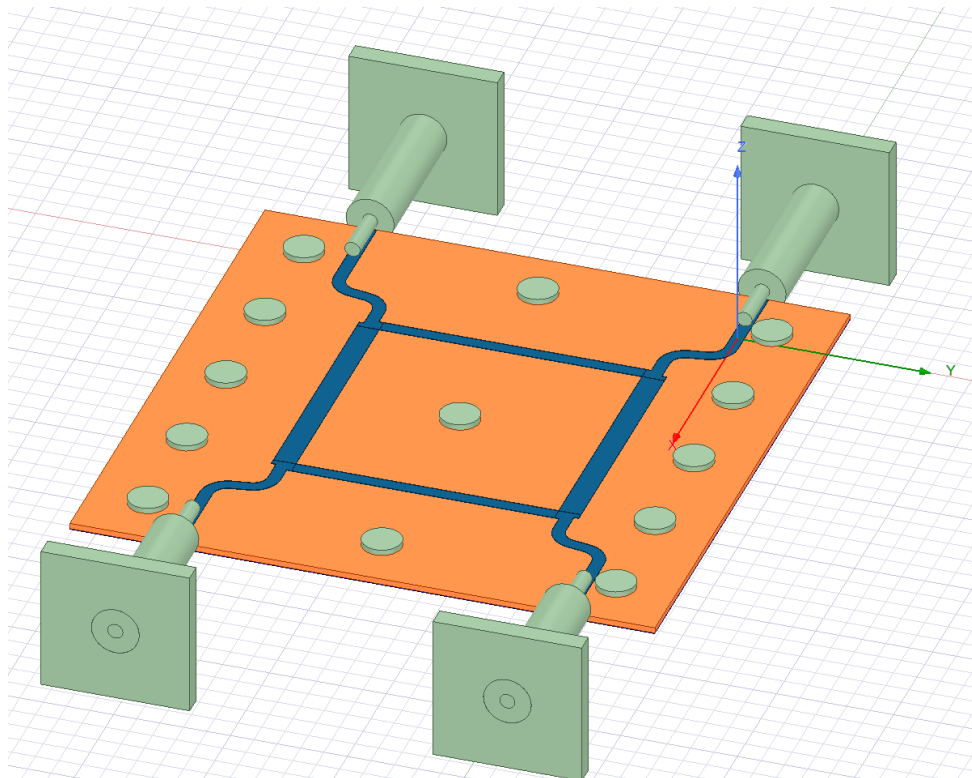


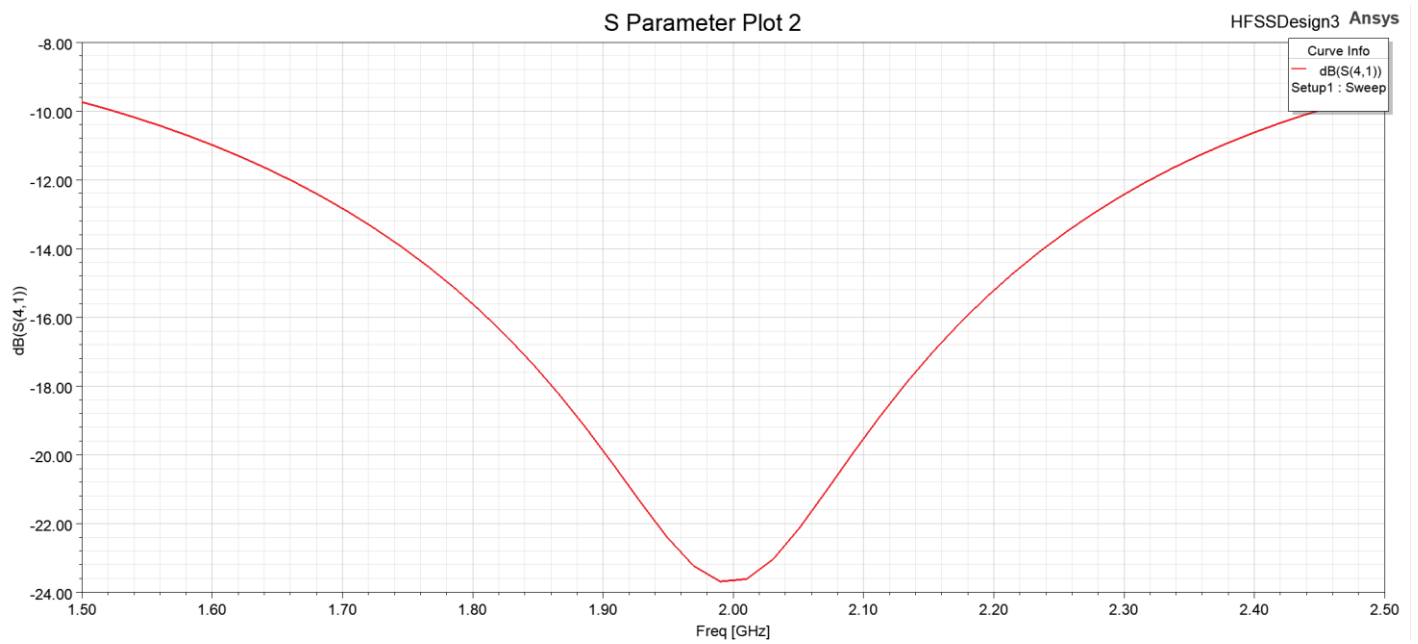
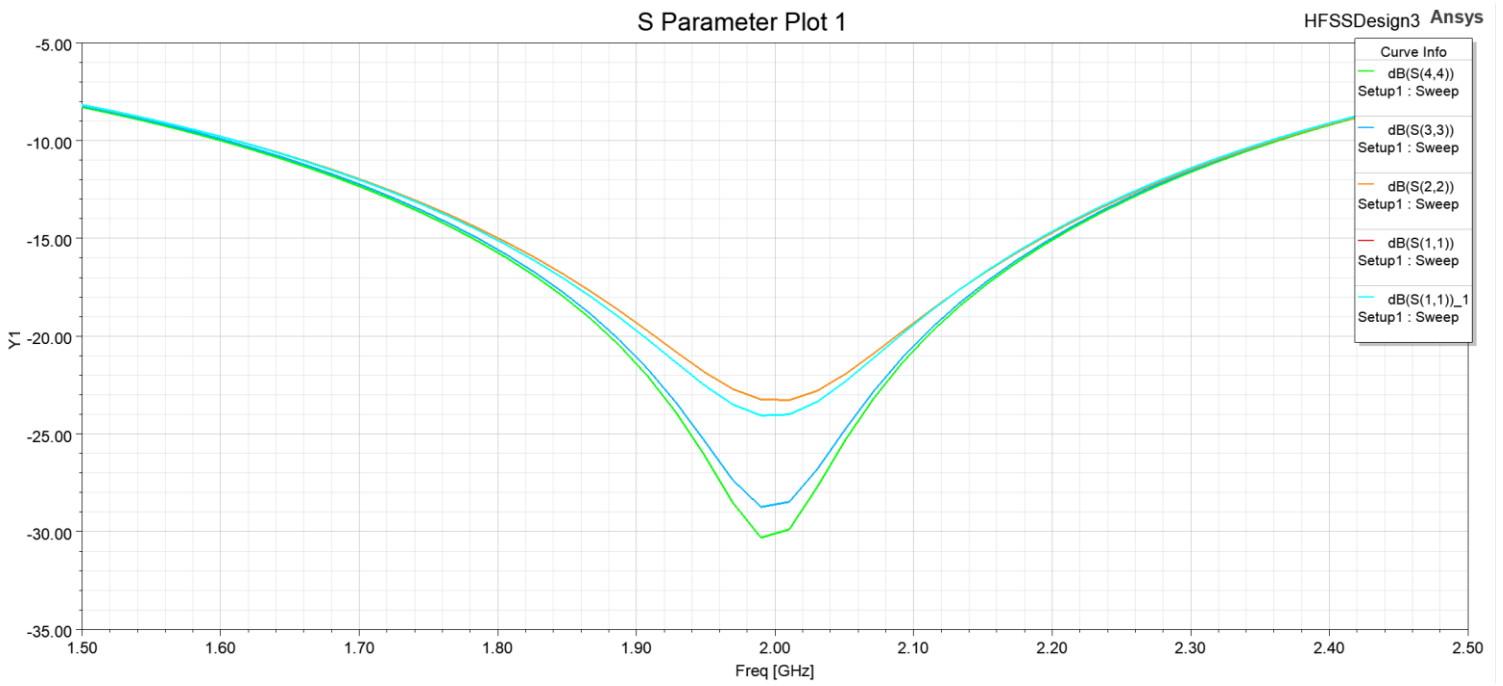
-15 db bandwidth: 1.8GHz- 2.2GHz \approx 0.4GHz

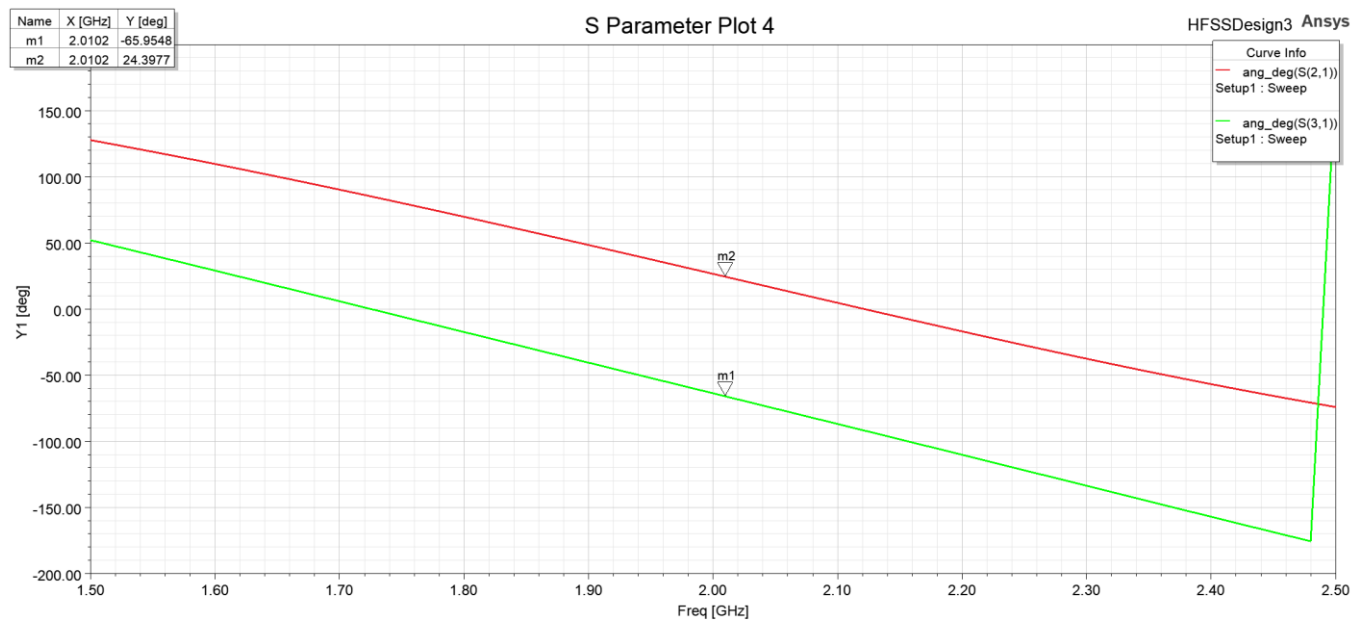
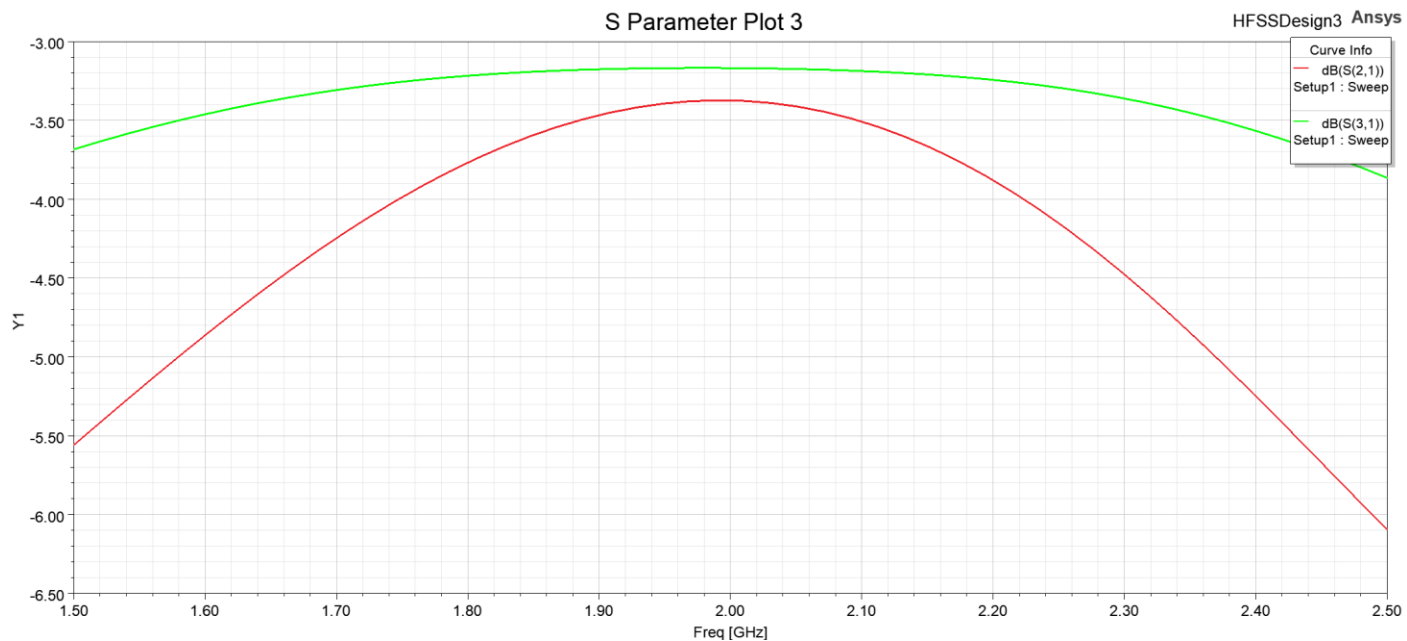




Results after adding the pins



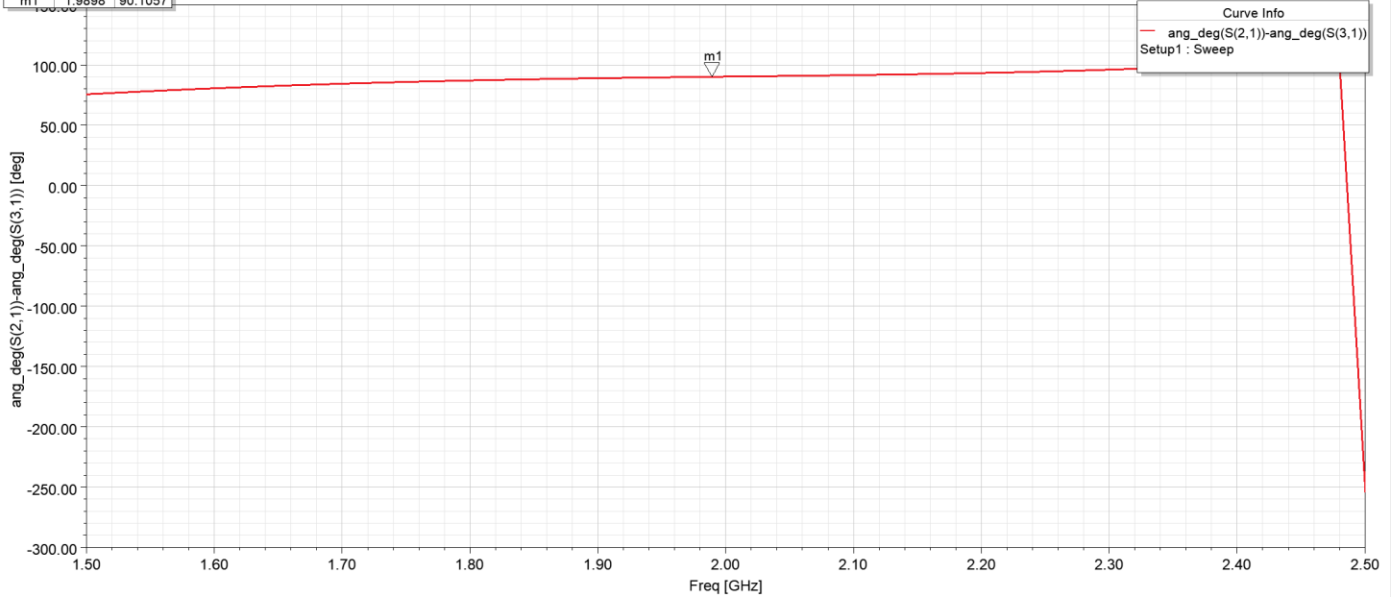




Name	X [GHz]	Y [deg]
m1	1.9898	90.1057

Plot 1

HFSSDesign3 Ansys



f)

