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A 10 dB Microstrip Hybrid Coupler

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ICEE'20
OCTOBER 15-17 / SARAJEVO (ONLINE)



Outline

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Introduction

- A 10 dB hybrid microstrip coupler is introduced in this paper.
- The simulated frequencies are between 1 GHz and 3GHz. The bandwidth of the coupler is between 1.5 GHz and 2.34 GHz.
- When the thickness of the dielectric was 1.51mm, S13 was -10.01 dB. The center frequency was 1.93 GHz and the input match, S11 was -28.48 dB, the isolation, S14 was -36.20 dB and the thru port, S12 was -0.46 dB.

Design Steps & Simulation Results

- Figure 1 has the top view of the coupler. As you can see, we have added four tuning stubs in the beginning of the coupler section in order to get a better input match. Figure 2 has the S parameters of the coupler.
- In this graph you are shown the values of the parameters of S11 (the input match), S12 (thru port), S13 (coupling), and S14 (isolation).

Design Steps & Simulation Results

- The parameters as you can see is presented on the curves and linear line. As it is seen coupling is -10 dB in between $f = 1.5 - 2.34$ GHz. Thru port is almost 0 dB throughout the band.
- Isolation and input match are well below -30 dB. S11 is blue, S12 is magenta, S13 is red, S14 is green.

Design Steps & Simulation Results

Figure 3 has the 3D view and figure 4 has the angle between the coupled and thru ports. It is shown in figure 4 that there are 90 degrees phase difference between these two ports which makes the coupler hybrid type.

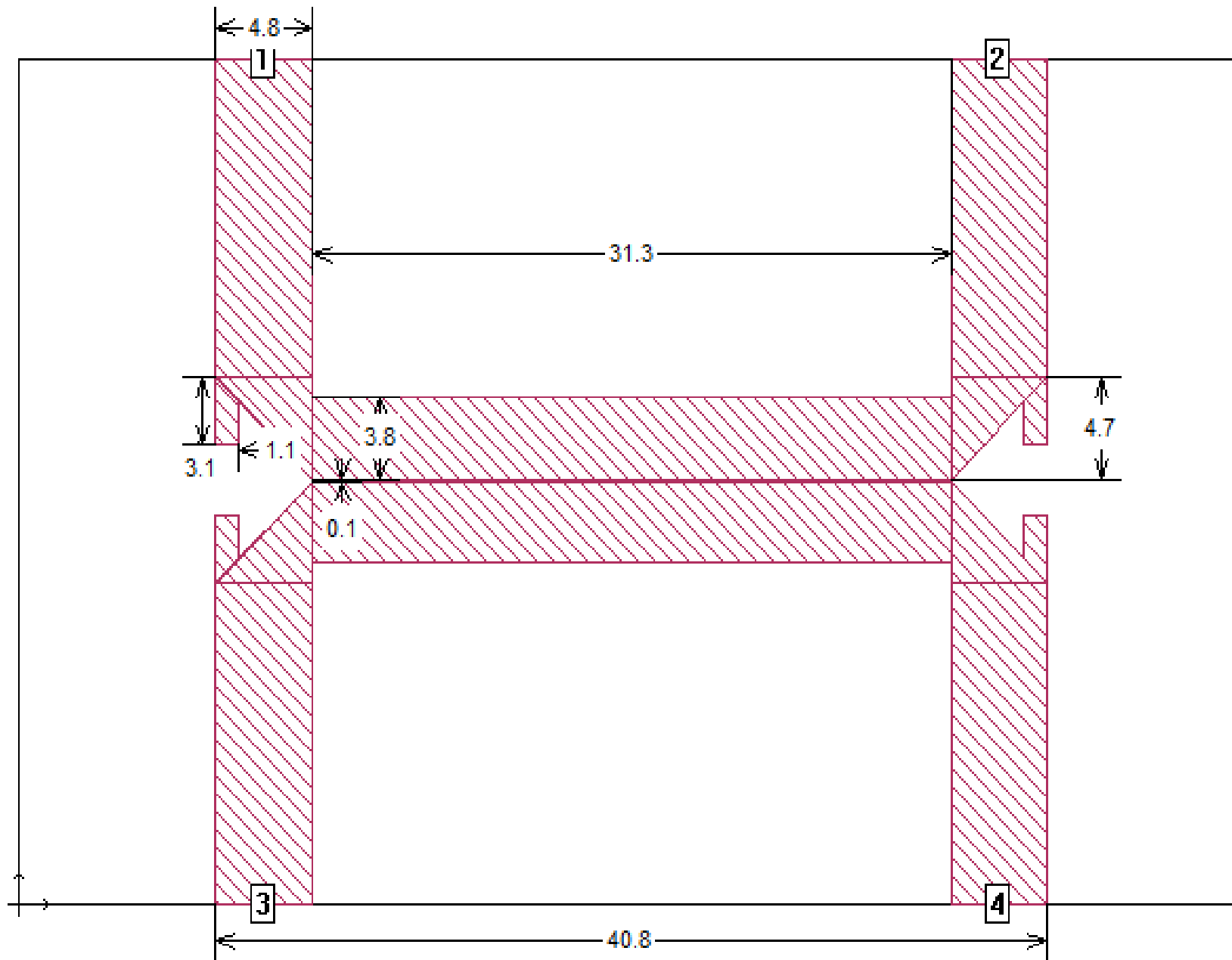


Fig. 1. Top view of the coupler

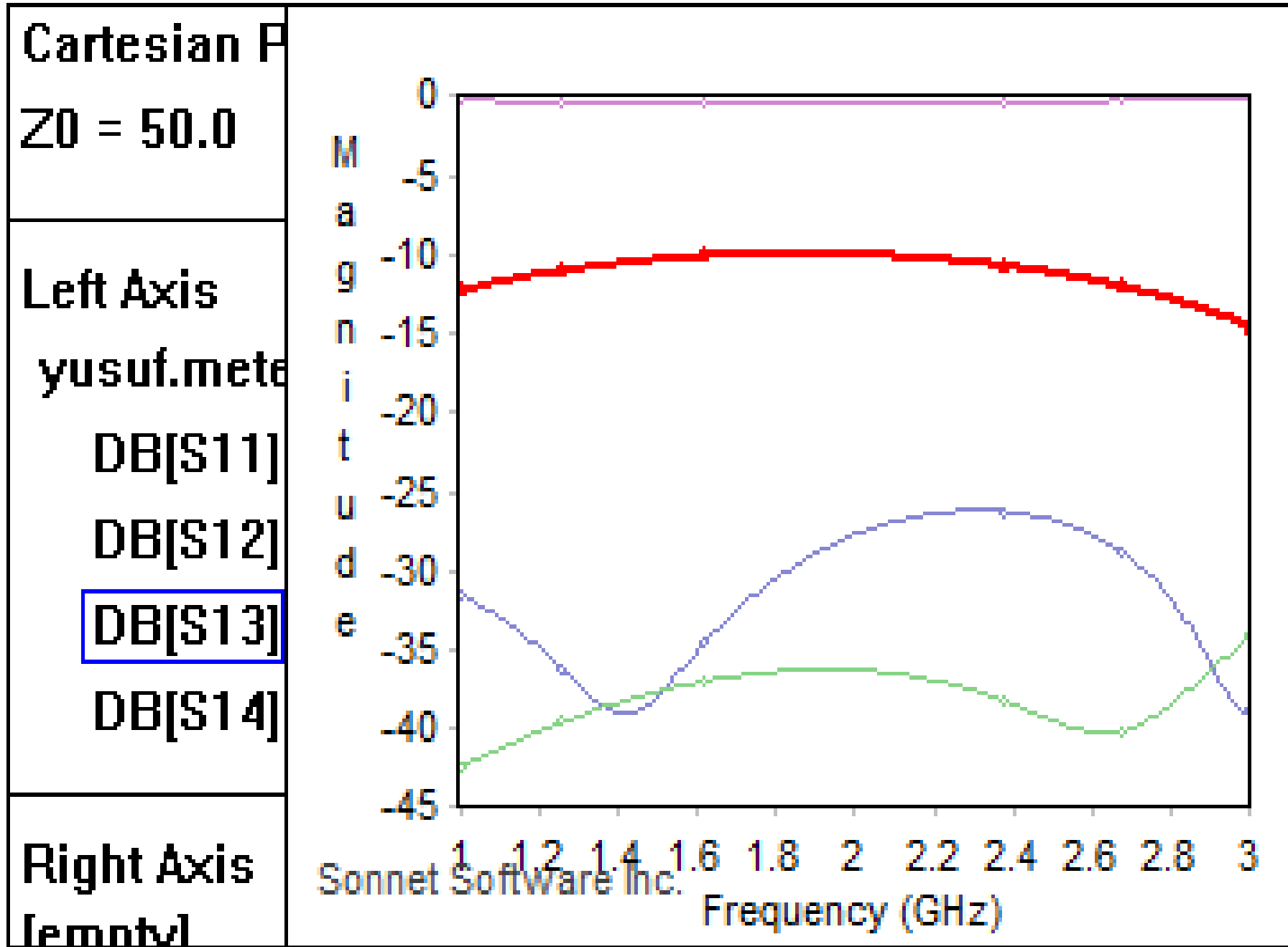


Fig. 2. S Parameters of the coupler

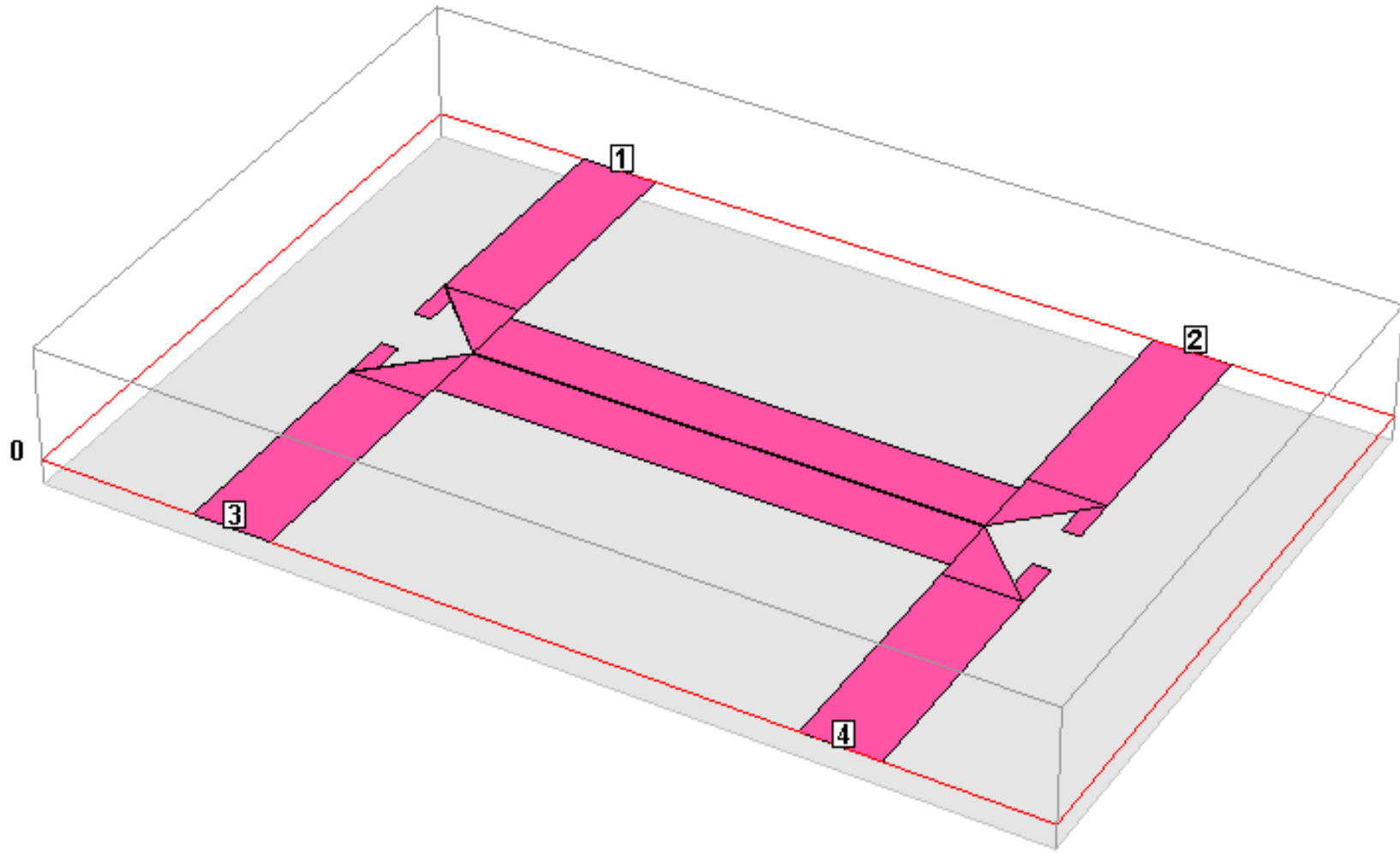


Fig.3. 3D View of the coupler

Cartesian Plot

Z0 = 50.0

Left Axis

yusuf.metehan10db s11.15

ANG[S12] 

m2: 1.0 GHz
-111.2 (Degrees)

m4: 3.0 GHz
29.38 (Degrees)

ANG[S13] 

m1: 1.01 GHz
-22.01 (Degrees)

m3: 2.99 GHz
121.3 (Degrees)

Right Axis
[empty]

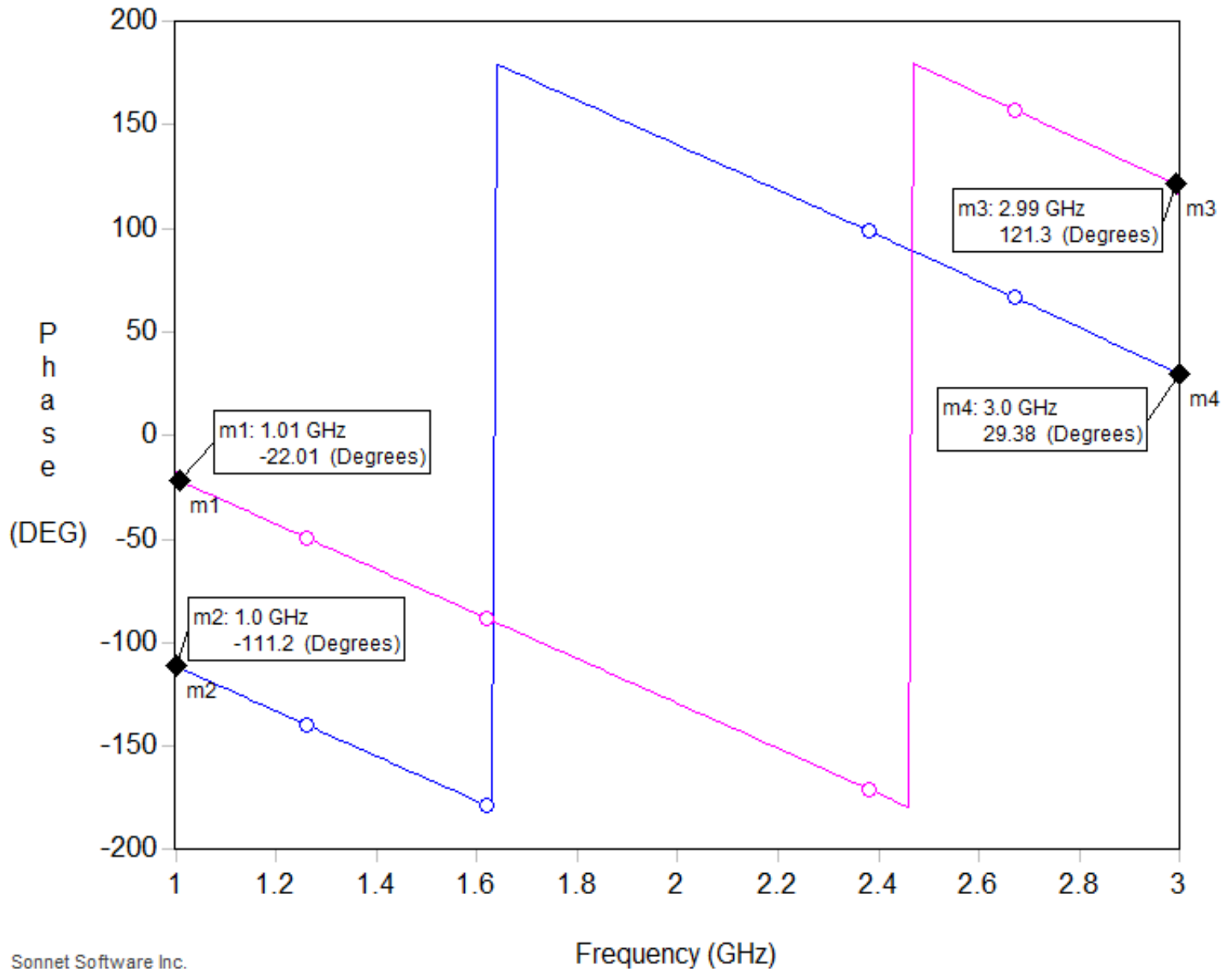


Fig. 4. Phase difference

Parametric Study

In order to check the fabrication tolerances the coupled lines dimensions were changed and finally the result of 31.2×4.2 has been decided to be used. Coupling is varied between 9.54 and 10.86 dB which shows amplitude balance as 1.32 dB within those two parametric studies performed. After that, thickness of the dielectric layer was changed and variations of the S Parameters is presented in Table I. As seen in table I, the thru port is around -4 dB. Input match (S11) and isolation (S14) are changing between -32 dB and -37 dB. Those values ensure that the conducted parametric studies have successfully yielded the expected results.

TABLE I. CHANGING THE DIELECTRIC THICKNESS

Dielectric thickness (mm)	[S11] (dB)	[S12] (dB)	[S13] (dB)	[S14] (dB)
1.51	-35.47	-0.41	-10.44	-33.72
1.53	-36.60	-0.43	-10.27	-34.51
1.55	- 36.00	-0.42	-10.30	-35.42
1.57	-32.24	-0.44	-10.14	-35.72
1.59	-31.81	-0.44	-10.17	-36.41

CONCLUSION

In this work a 10 dB microstrip hybrid coupler is designed and simulated. The simulation results show coupling bandwidth of almost 900 MHz. Input match and isolation are less than -30 dB. A parametric study was conducted for the dimensions of the coupled lines as well as the dielectric thickness. The planned future work is to fabricate the coupler.

ACKNOWLEDGEMENT

We would like to thank Sonnet Software for providing license in our lab.

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AUDIENCE QUESTIONS

THANK YOU