KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY

Deemed to be University U/S 3 of the UGC Act, 1956

Microwave and Antenna Laboratory

(5^{th} Semester)

Lab Report 8

Aim of the Experiment: Design and analysis of Magic Tee.

Software to be used: CST Studio Suite (Student Version)

Theory: A Magic Tee or Hybrid Tee is a 4 port waveguide tee that is a combination of an E-Plane and H-Plane waveguide Tee. A magic tee is ideally lossless. But the biggest disadvantage of magic tee is that reflections arise within it due to impedance mismatches, which causes some level of power loss. These reflections can be minimized by optimizing matching.

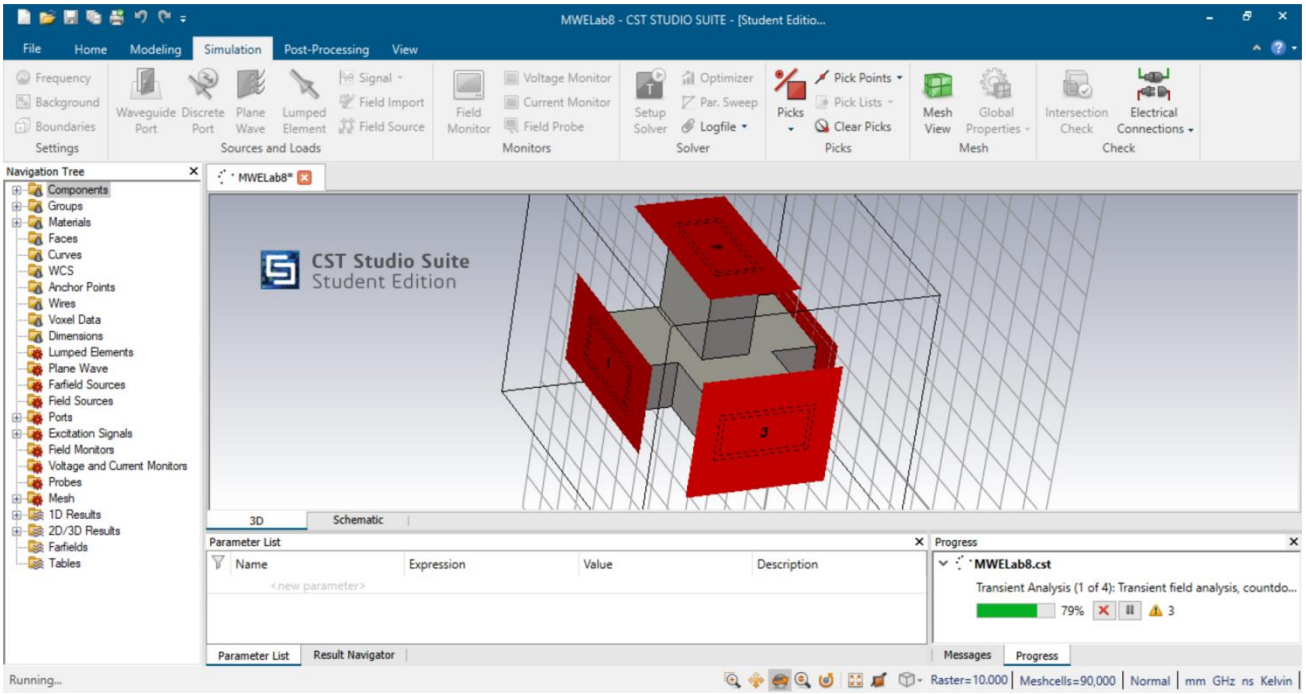
Design:

- **Calculation of cut off frequency of dominant mode**

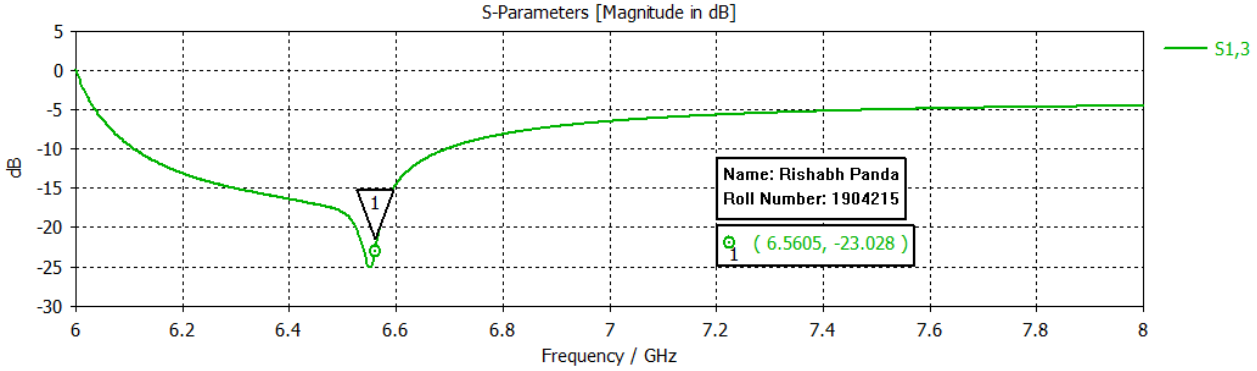
Since a = 20 mm, we have the cut-off frequency as follows

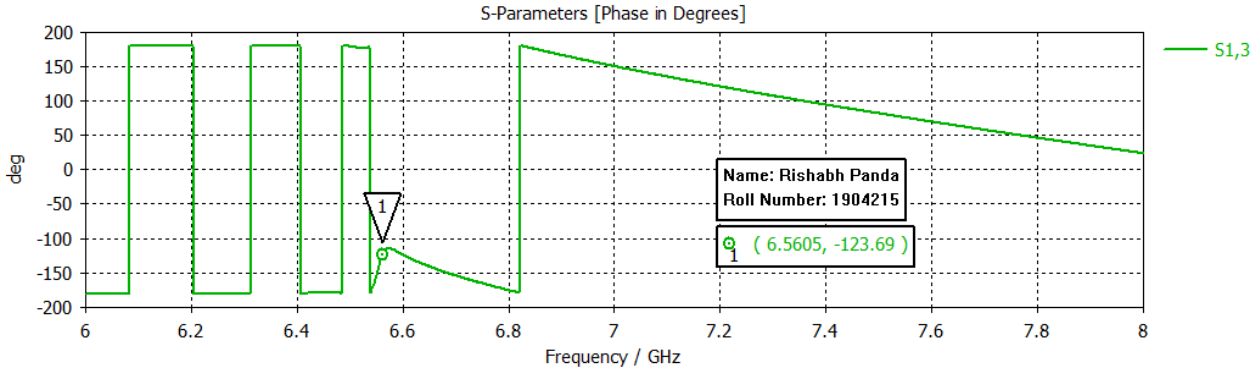
$$f_c = \frac{c}{2a} = \frac{3 \times 10^8}{2 \times 22.86} = 6.561 \times 10^9 \text{ Hz} = 6.56 \text{ GHz}$$

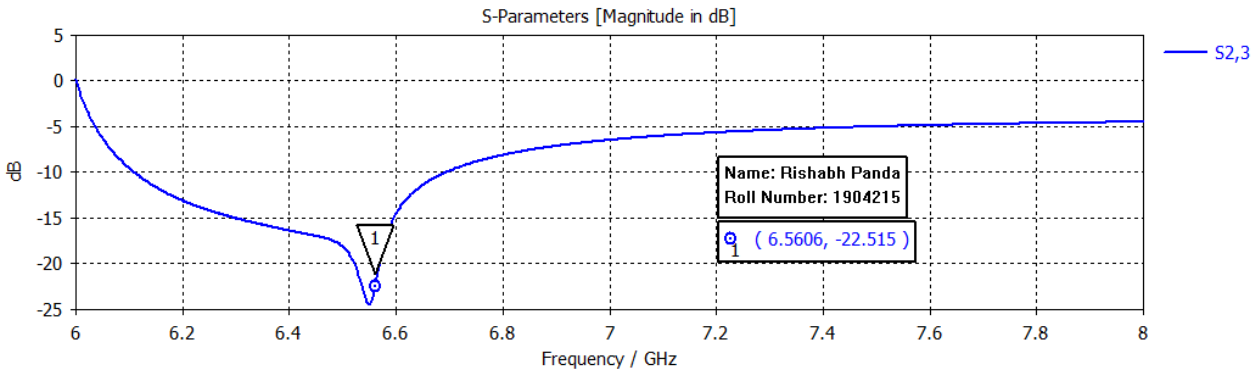
- **Structure**

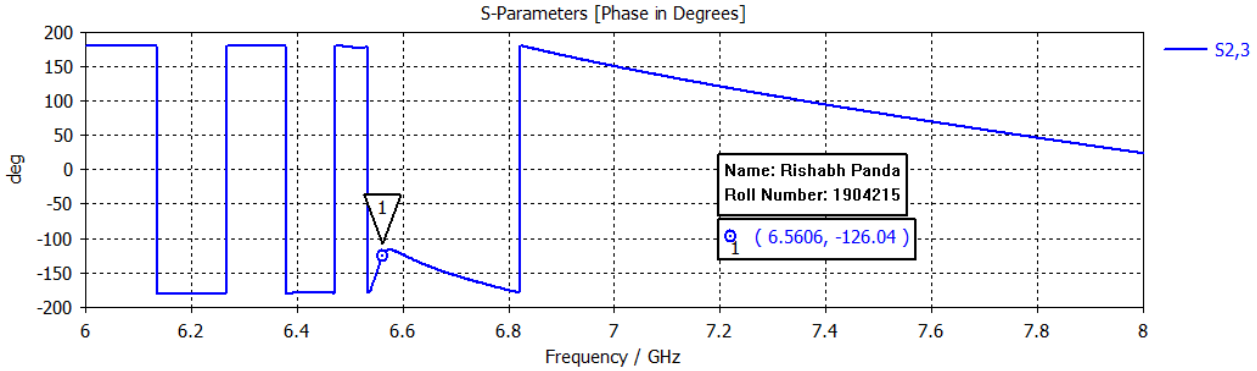


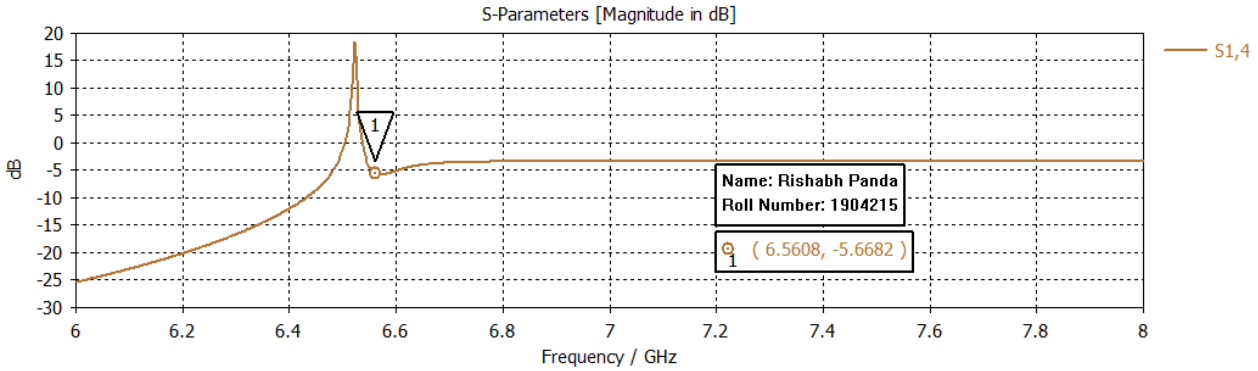
- **S parameters (phase and magnitude) of Magic Tee**

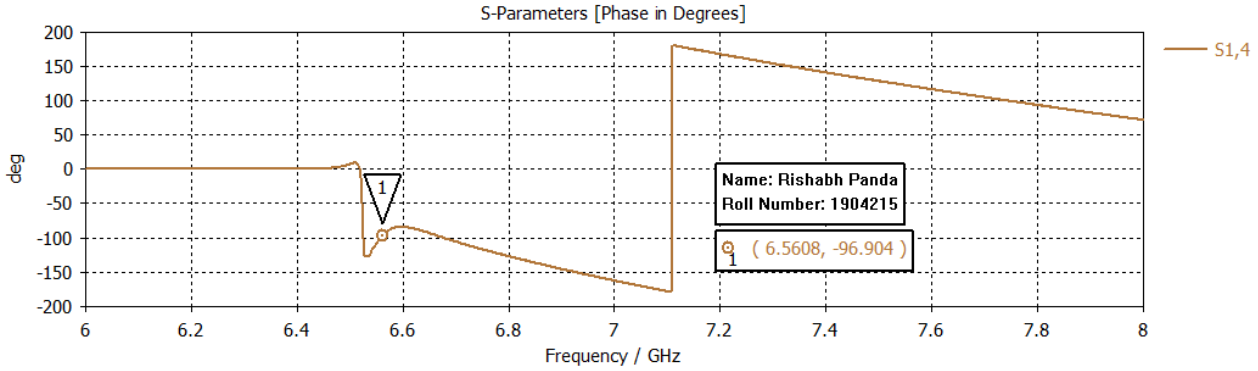


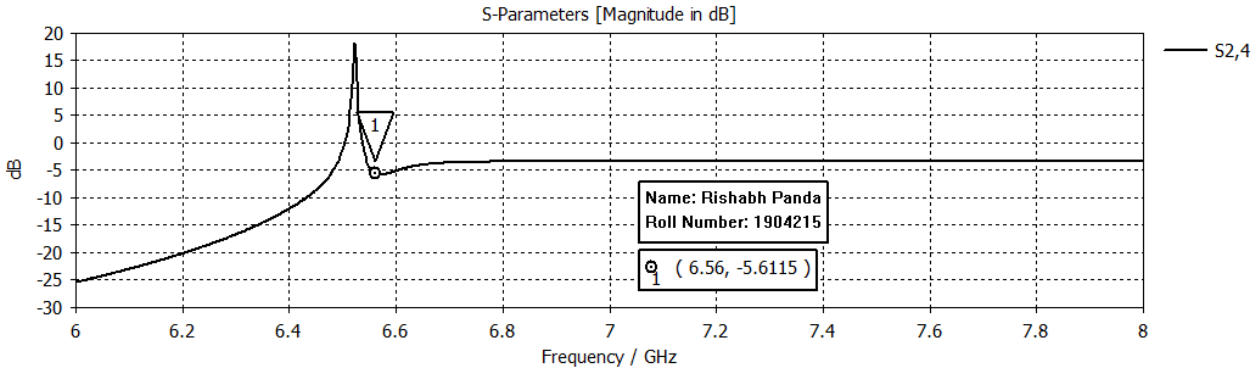


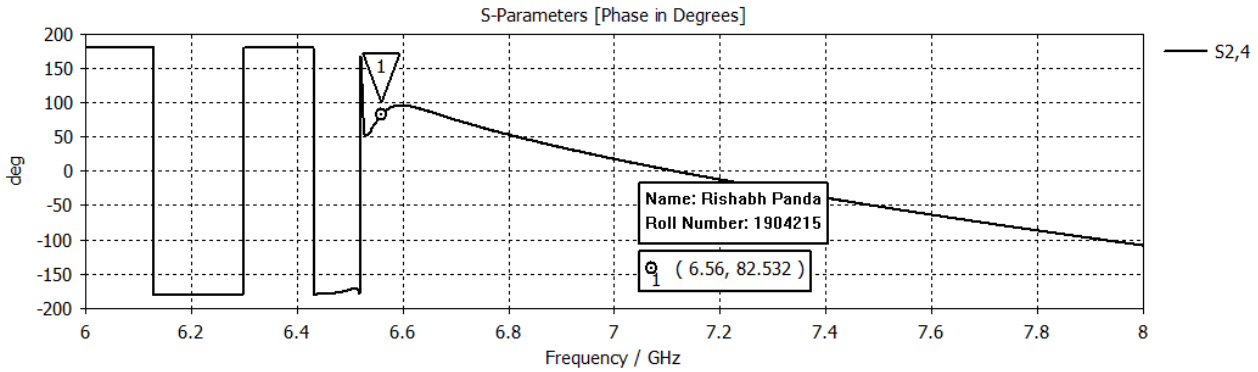





S-Parameters [Magnitude in dB]
dB
Frequency / GHz
S1,4
Name: Rishabh Panda
Roll Number: 1904215
(6.5608, -5.6682)


S-Parameters [Phase in Degrees]
deg
Frequency / GHz
S1,4
Name: Rishabh Panda
Roll Number: 1904215
(6.5608, -96.904)


S-Parameters [Magnitude in dB]
dB
Frequency / GHz
S2,4
Name: Rishabh Panda
Roll Number: 1904215
(6.56, -5.6115)


S-Parameters [Phase in Degrees]
deg
Frequency / GHz
S2,4
Name: Rishabh Panda
Roll Number: 1904215
(6.56, 82.532)

Observations:

Phase of S13 = -123.69 degrees

Phase of S23 = -126.04 degrees

$\Delta = S13 - S23 = 2.35 \text{ degrees} \approx 0 \text{ degrees}$

Hence it is observed that S13 and S23 are same

Phase of S14 = -96.904 degrees

Phase of S24 = 82.532 degrees

$\Delta = S14 - S24 = 179.436 \text{ degrees} \approx 180 \text{ degrees}$

Hence it is observed that S14 and S24 have a 180 degree phase difference

Conclusion

The design and analysis of Magic Tee having inside dimension of **22.86 mm** x **10.16 mm** with wall thickness of **1.27 mm** was performed and its S parameters (S13, S23, S14, S24) has been studied. The parameters were calculated at the cut-off frequency of 6.56 GHz corresponding to the dimension 'a' as 22.86 millimeter.

It was observed that the S14 and S24 plots have a 180 degree phase difference, whereas S13 and S23 are same in terms of phases with a zero computed phase difference.

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