Visvesvaraya National Institute of Technology (VNIT), Nagpur

Waveguides and Antennas (ECL405)

Antenna Workshop Report

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Problem Statement: Fabrication of Patch Antenna with Microstrip feed at 3100MHz using FR4 substrate of 1.6mm and permitivity 4.4

Aim: To design and simulate a Patch Antenna with Microstrip feed at 3100MHz using FR4 substrate of 1.6mm and permittivity 4.4 and analyse it on the basis of Gain, Bandwidth, Radiation pattern, VSWR, S(1,1) values. Also fabricate the antenna and compare the S(1,1) graph of simulated and fabricated antennas..

Theory: Micro strip antennas are low-profile antennas. A metal patch mounted at a ground level with a di-electric material in-between constitutes a Micro strip or Patch Antenna. These are very low size antennas having low radiation. It has lesser directivity. To have a greater directivity, an array can be formed by using these patch antennas. Microstrip patch antennas have more advantages and better prospects compared to conventional antennas, such as lighter in weight, low volume, low cost, low profile, smaller in dimension and ease of fabrication and conformity. Moreover,the microstrip patch antennas can provide frequency agility, broad bandwidth, feed line flexibility and beam scanning omni directional patterning. In its basic form, a microstrip Patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other .

Advantages: The following are the advantages of Patch Antenna with micro-strip feed −

- lighter in weight.
- low volume,low cost, low profile, smaller in dimension.
- ease of fabrication and conformity.

Disadvantages: The following are the disadvantages of Patch Antenna with micro-strip feed −

- For good performance of antenna, a thick dielectric substrate having a low dielectric constant is necessary since it provides larger bandwidth, better radiation and better efficiency.
- However, such a typical configuration leads to a larger antenna size. In order to reduce the size of the microstrip patch antenna, substrates with higher dielectric constants must be used which are less efficient and result in narrow bandwidth..

Design: Patch Antenna with micro-strip feed

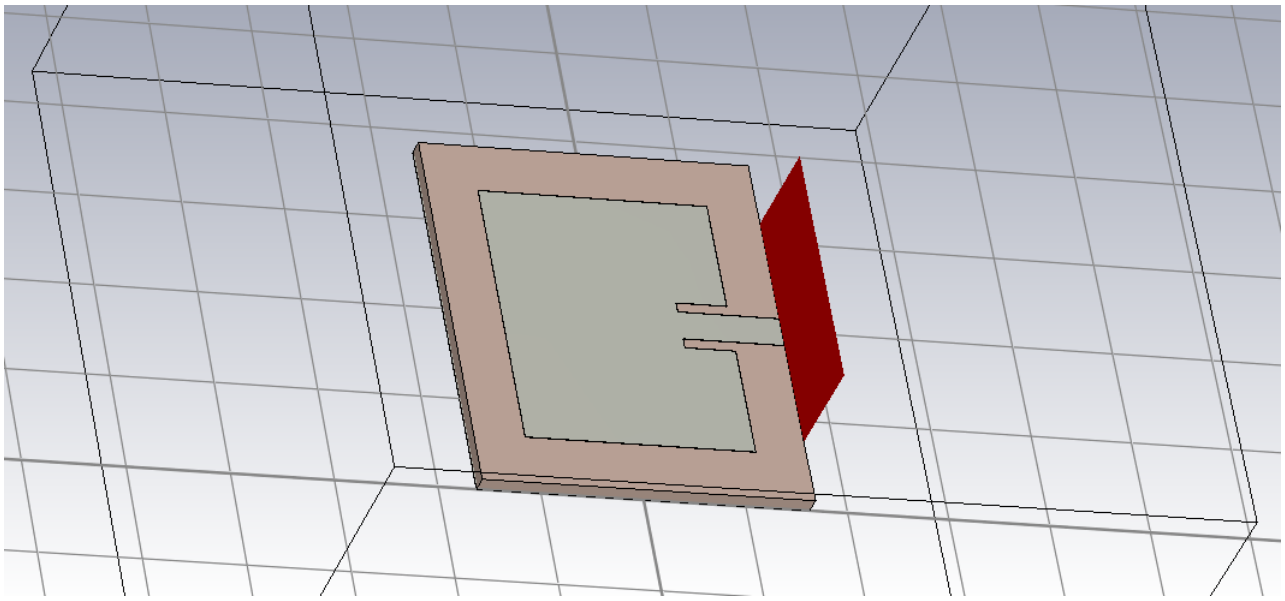

Figure 1: Patch Antenna with microstrip feed

Dimensions of the patch antenna:

Dimension	Value
Height of substrate	1.6 mm
Length of substrate	37.43 mm
Width of substrate	35.543 mm
Height of patch	0.035 mm
Length of patch	22.543 mm
Width of patch	27.43 mm
Height of ground	0.035 mm
Width of ground	35.543
Length of ground	37.43 mm
Height of feed line	0.035 mm
Width of feed line	3 mm
Length of feed line	5 mm
Length of inset	5 mm

Graphs from Simulation:

- S1,1 Parameter graph

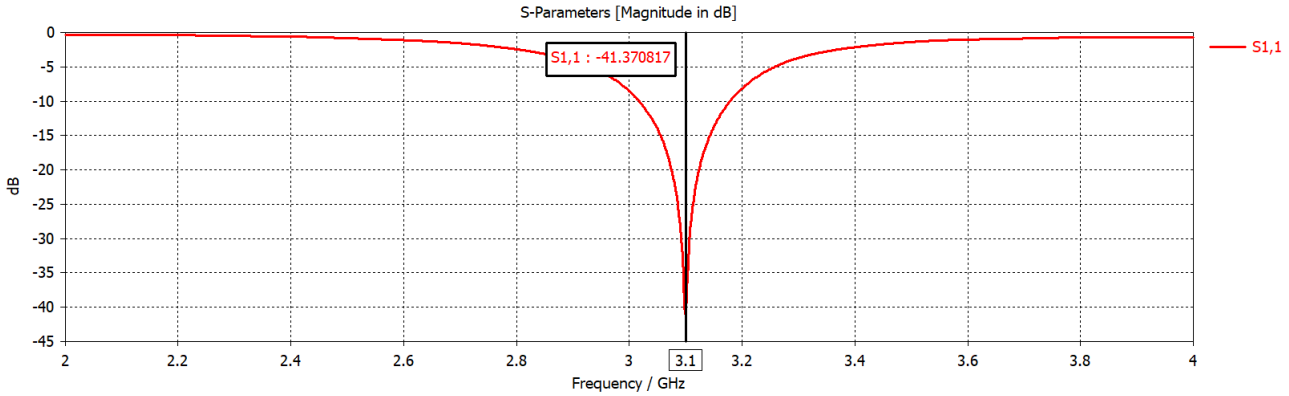

Figure 2: S1,1 parameter graph of Patch Antenna with Microstrip Feed

- VSWR

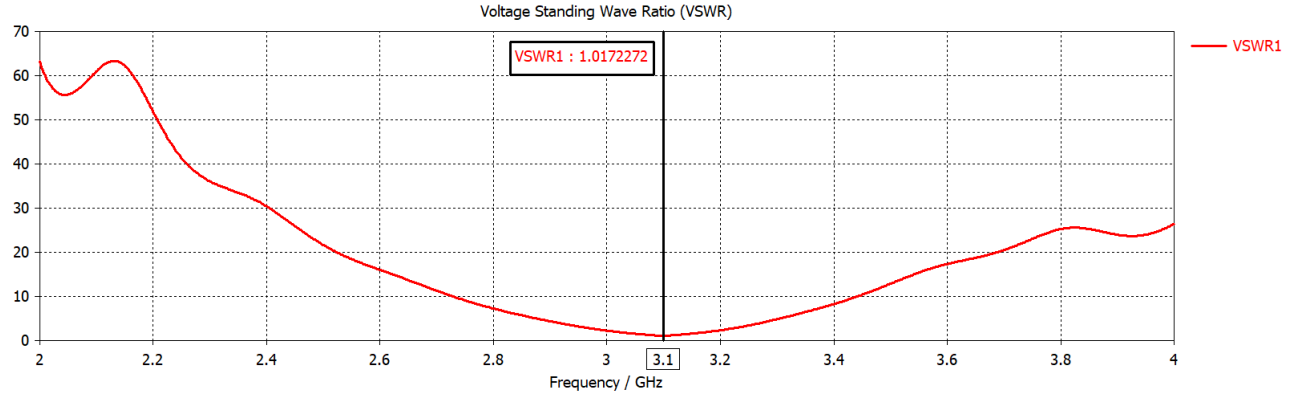

Figure 3: S1,1 parameter graph of Patch Antenna with Microstrip Feed

- Radiation Pattern

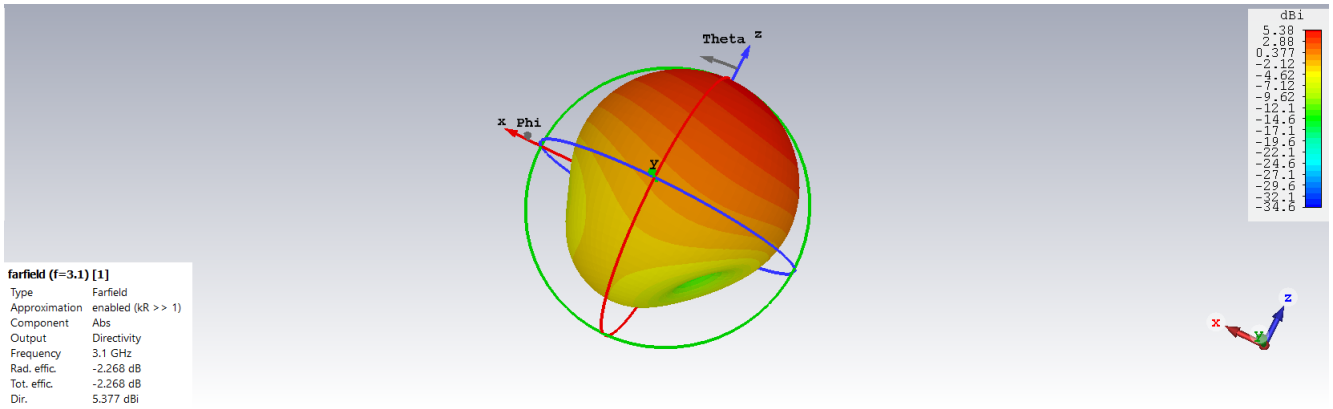

Figure 4: Radiation Pattern of Patch Antenna with Microstrip Feed

- Surface Current

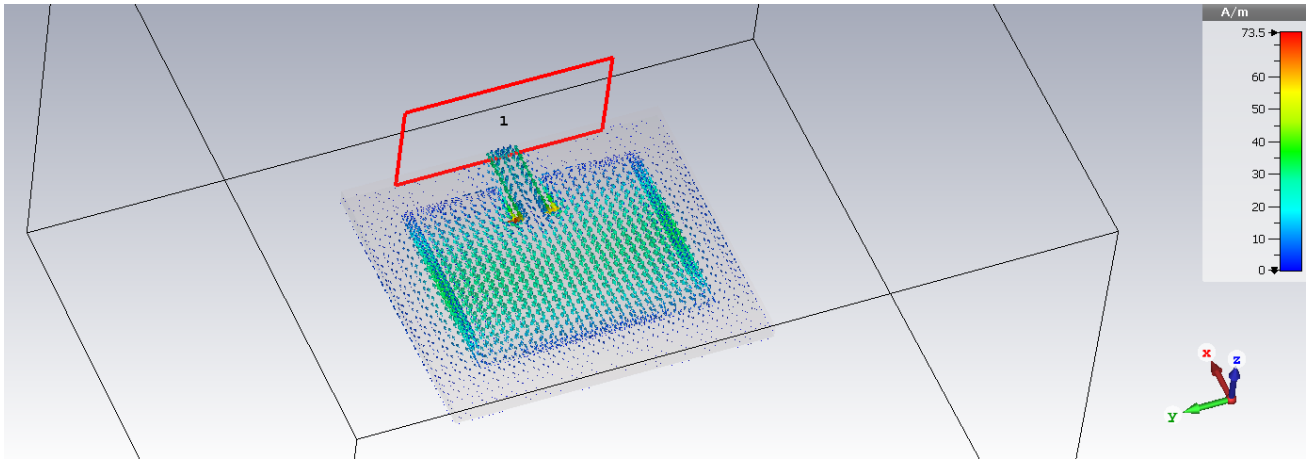

Figure 5: Surface Current Plot for Patch Antenna with Microstrip Feed

- Smith Chart

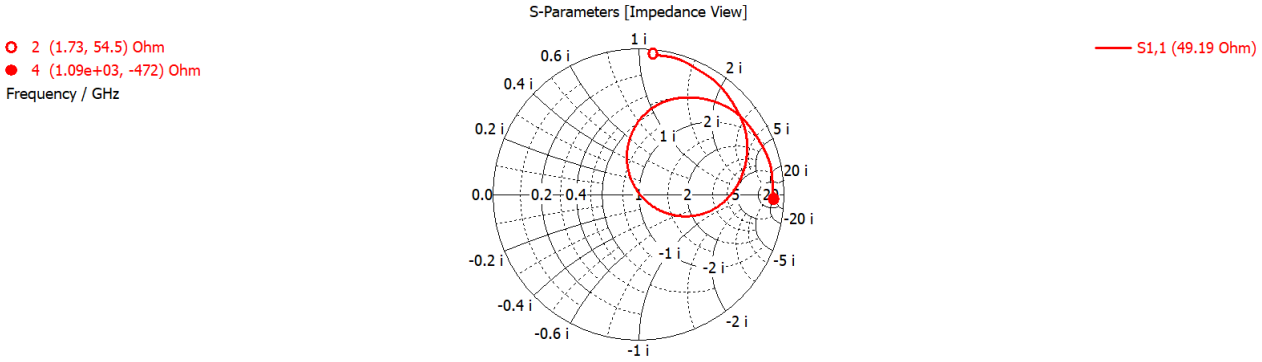

Figure 6: Surface of Patch Antenna with Microstrip Feed

Fabrication:

- Fabricated Antenna

Figure 7: Fabricated Patch Antenna with Microstrip Feed

- Graph obtained on testing the fabricated antenna

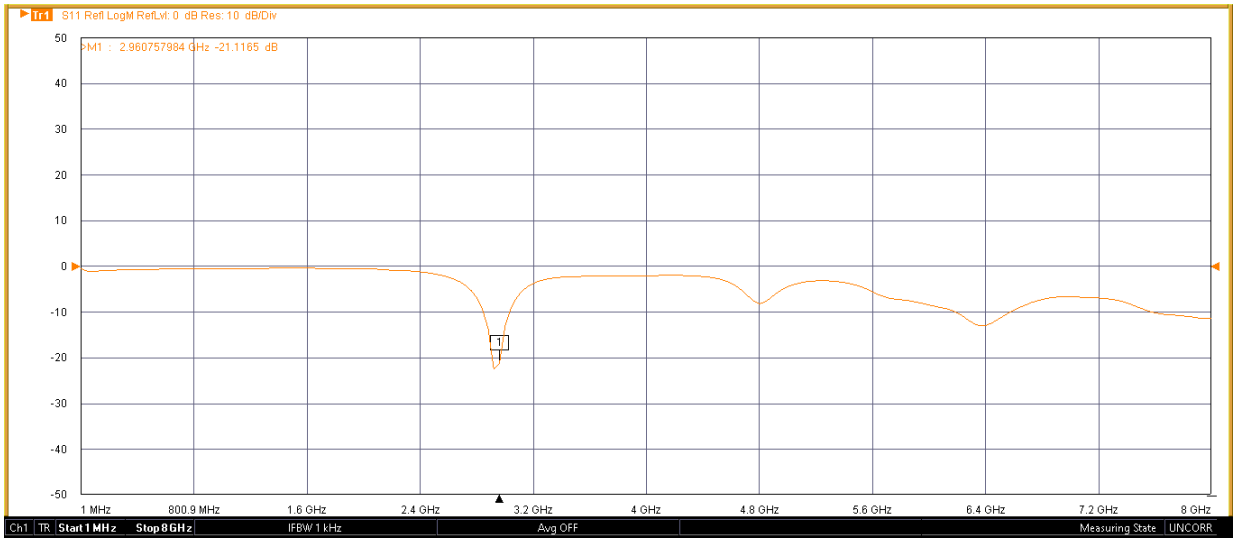

Figure 8: Graph obtained on testing the fabricated antenna

- Results obtained on testing the fabricated patch antenna:

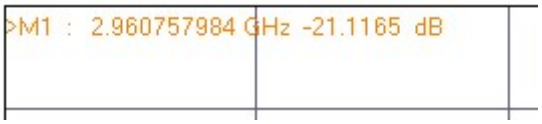

Figure 9: Result obtained on testing the fabricated antenna

Comparison between the simulated and fabricated antennas: The following results were obtained on comparing the simulated and fabricated antennas:

Property	Simulated antenna	Fabricated antenna
S1,1	-41.37 dB	-21.116 dB
Resonant Frequency	3.1 GHz	2.96 GHz

Conclusion: Patch Antenna with micro-strip feed was successfully designed and investigated for 3.1 GHz and satisfactory results were found. A gain of -21.116dB was observed.