Design and Development of Reconfigurable Patch Antenna for Wireless Communication

Kranti S Tanodi[1] B B Tigadi[2] Dr V.R.Udupi[3]
[2]Professor
[1,2,3]Department of DECS
[1,2,3]MMEC, Belgaum, India

Abstract— As the usage of wireless communication increases day by day number of antennas or single antenna with multiple functions has become inevitable. Microstrip patch antenna is widely used in telecommunication ,personal communication and wireless communication fields it is narrowband wide beam antenna fabricated by etching antenna element pattern in metal trace bounded to insulating dielectric substrate such as printed circuit board with continuous metal layer bounded to opposite side of substrate which forms ground plane. In this project we modified simple patch antenna with E shape and H shape patterns and attempts to reconfigure both patch antennas using electrically reconfigurable antenna where we are using pin diode for reconfiguration. We have designed patch antenna on FR4 substrate with dielectric constant 4.4, thickness 1.56mm with frequency of 2.4GHz and for this design we have used Microstrip line feeding. The simulation tool we used for design of patch antenna is IE3D as it is user friendly. In this project by narrowing the radiation pattern we increased the gain and directivity and decreased the return loss of an antenna.

Key words: Microstrip Antennas, Reconfigurable, P-I-N Diode, IE3D

I. INTRODUCTION

With the accelerated growth of wireless communication in the day- to-day life, reconfigurable antennas could gain the focus and attain an unavoidable position in the field. The characteristics of antenna, such as resonant frequency, radiation pattern, polarization, etc. can be reconfigured and be used in a more efficient way. Reconfigurable antennas have found their extensive applications with spatial time block coding systems and spatial multiplexing techniques. By implementing reconfigurable antennas, multiple input multiple output system capacity gets increased, and hence excellent diversity be obtained. Also, reconfigurable antennas have found their numerous applications at cellular radio system, radar system, satellite communication, smart weapon protection, etc. And, it has been found that, in mobile and satellite communications, reconfigurable antennas are useful by supporting a large number of standards. The major advantage with these reconfigurable antennas is that, they can replace a number of single function oriented antennas.

Reconfiguration of the antenna can be done by different techniques. The first one that uses Radio frequency micro electromechanical systems (RF-MEMS) PIN diodes or varactors as switching Devices are called Electrically Reconfigurable Antennas. In the second technique we use optical switches to achieve reconfiguration and such antennas are called Optically Reconfigurable Antennas. The third, achieved by means of physical alteration of the antenna radiating parts are called Physical Reconfigurable Antennas. The antennas made reconfigurable through changes in the substrate characteristics by using materials such as ferrites, liquid crystals, etc. In this paper we are going to use PIN diodes for reconfiguration.

II. BASIC DESIGN

In this paper, a compact patch antenna having dimensions *L* × *W* has been designed on substrate of thickness 1.56 mm.Here we using inset-feed slotted patch antenna. First the ground plane of Length *L* and Width *W* is made and then a rectangular patch of calculated dimensions is designed above the ground plane to increase the performance of Microstrip antenna.

Sl no	Parameter	Design
1	Operating frequency	2.4GHz
2	Dielectric constant of substrate	4.4
3	Loss tangent	0.0012
4	Thickness of substrate	1.56mm
5	Width of ground plane	47.36mm
6	Length of ground plane	37mm
7	Width of patch	38mm
8	Length of patch	30.44mm

Table 1

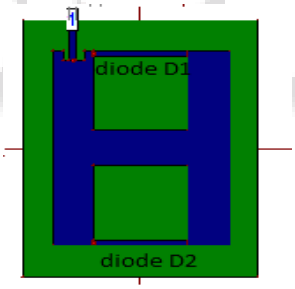

Fig. 1

III. SIMULATION AND RESULTS

The software used to model and simulate the Microstrip patch antenna is Zeeland IE3D simulation software. As is user friendly and popular for low frequency simulations. The simulation is done for four cases. Case 1: when both diodes are off state. Case2: When upper diode is on. Case3: both diodes are on state.

A. CASE1: Both Diodes Are OFF State.

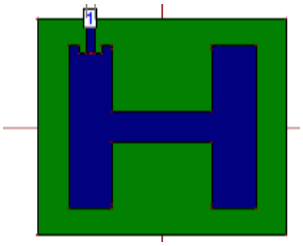

Fig. 2a: Structure

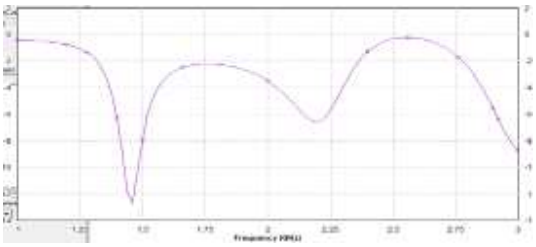

Fig. 2b: Return Loss

Fig. 2c: Gain

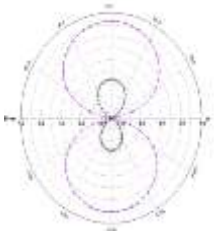

Fig. 2d: Directivity

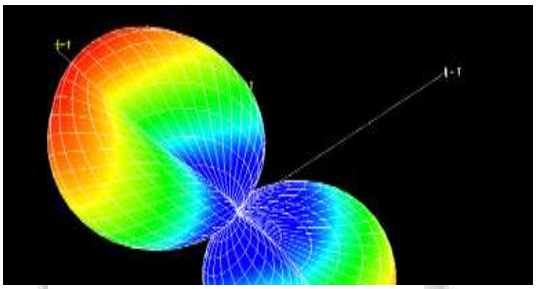

Fig. 2e: 3D Pattern

B. CASE 2: Upper Diode Is ON.

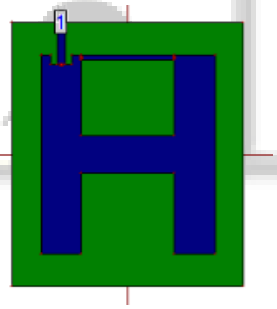

Fig. 3a: Structure

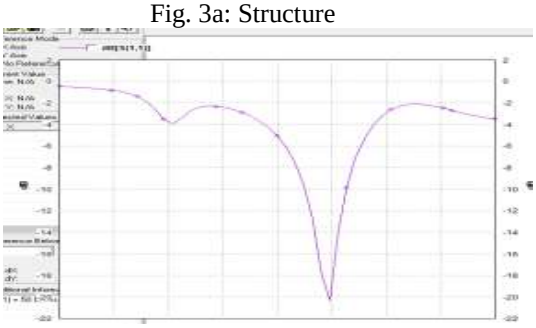

Fig. 3b: Return Loss

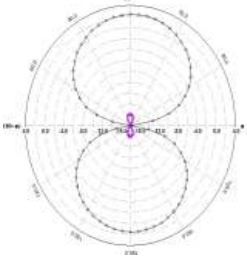

Fig. 3c: Gain

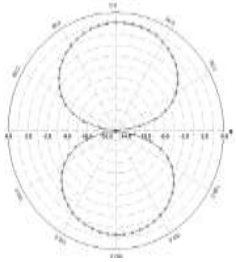

Fig. 3d: Directivity

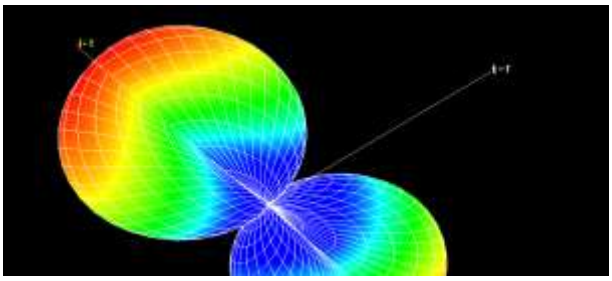

Fig. 3e: 3D Pattern

C. CASE 3: Both Diodes ON.

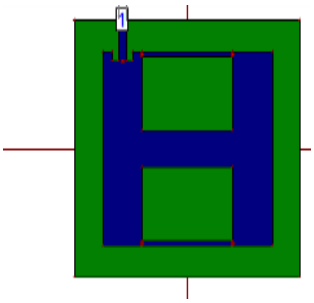

Fig. 4a: Structure

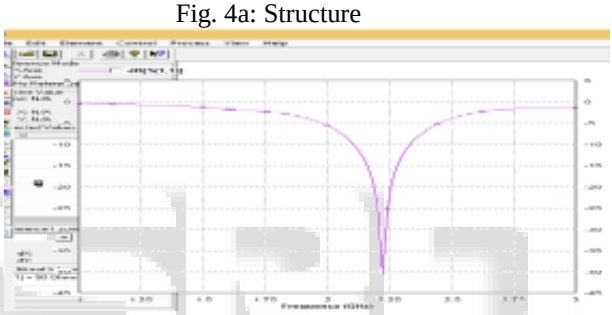

Fig. 4b: Return Loss

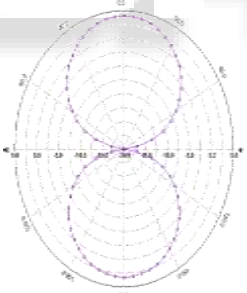

Fig. 4c: Gain

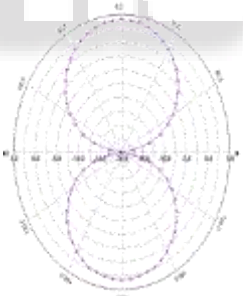

Fig. 4d: Directivity

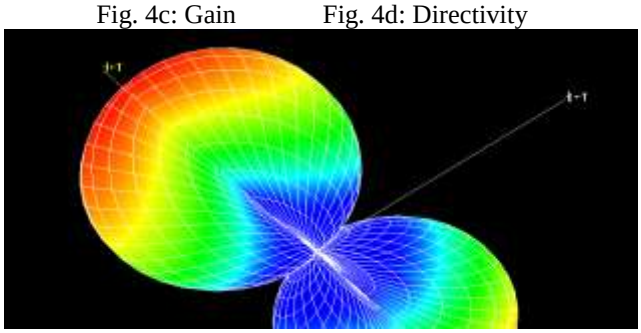

Fig. 4e:3D Pattern

IV. COMPARISION OF SIMULATED RESULTS

SL NO	DIODE STATE	RETURN LOSS (dB)	GAIN (dB)	DIRECTIVITY (dB)

1	Both OFF	-12.5dB	1.4dB	2.2dB
2	Upper ON	-20dB	3dB	3.3dB
3	Both ON	-40.5dB	4dB	4.3dB

V. TESTED RESULTS

Fig. 5: Polar Chart Without Diode

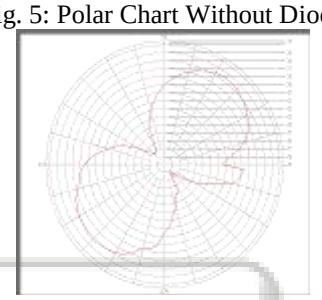

Fig. 6: Polar Chart With Diode Connection

VI. COMPARISION OF TESTED RESULTS

SL NO	DIODE STATE	GAIN(dB)	DIRECTIVITY(dB)
1	Both OFF	1.8dB	3.2dB
2	Upper ON	3.5dB	6dB
3	Both ON	4.2dB	7dB

VII. CONCLUSION

In this paper the design of reconfigurable H shaped Microstrip patch antenna is described. Here we have tested results manually and tested results and simulated results are nearly equal. This reconfigurable antenna can be used for wireless communication because the gain and directivity of an antenna is improved.

ACKNOWLEDGMENT

The euphoria and joy accompanying the successful completion of my task would be incomplete without mention of the people who rendered help and guidance throughout. So before presenting my work I wish to use this page for showing my gratitude towards them.

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