A Reconfigurable U- Shaped Patch Antenna For Wireless Applications

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Abstract- *In this paper, a frequency reconfigurable microstrip patch antenna has been designed for wireless communication applications. This switchable band characteristics was achieved by introducing two diodes between the U-shaped slot. It makes the antenna reconfigurable in two operating modes: when both diodes D1 and D2 were ON, then antenna resonate at dual frequencies and in second mode when both D1 and D2 diodes were OFF then antenna resonates at five frequencies and when one diode is OFF and other is OFF, resonates at triple frequencies. FR4 Epoxy substrate having dielectric constant 4.4 and tangent loss 0.025 has been used. For the antenna simulation CST MW studio software has been used.*

Keywords- Microstrip Patch Antenna, Reconfiguration antenna, Microstrip Line feed.

I. INTRODUCTION

Today, Antennas are necessary and critical components of communication and radar systems, but sometimes their inability to adjust to new operating scenarios can limit their performance. Making antennas reconfigurable so that their behaviour can adapt with changing system requirements or environmental conditions can eliminate these restrictions and provide additional levels of functionality for any system. A reconfigurable antenna is an antenna capable of modifying dynamically its frequency and radiation properties in a controlled and reversible manner [3]. For example, reconfigurable antennas on portable wireless devices can help to improve a noisy connection or redirect transmitted power to conserve battery life. In large phased arrays, reconfigurable antennas could be used to provide additional capabilities that may result in wider instantaneous frequency bandwidths, more extensive scan volumes, and radiation patterns with more desirable side lobe distributions. In order to provide a dynamical response, reconfigurable antennas integrate an inner mechanism such as RF switches, varactors, mechanical actuators that enable the intentional redistribution of the RF currents over the antenna surface and produce reversible modifications over its properties. Reconfigurable antennas differ from smart antennas because the reconfiguration mechanism lies inside the antenna rather than in an external beam forming network. The reconfiguration capability of reconfigurable antennas is used to maximize the antenna performance in a changing scenario or to satisfy changing operating requirements.

Microstrip antenna is one of the most popular types of printed antenna. It plays a very significant role in today's world of wireless communication systems. Microstrip antennae are very simple in construction using a conventional microstrip fabrication technique. Microstrip patch antenna consists of a radiating patch on one side of a dielectric substrate (FR4) that has a ground plane (Cu) on the other side[1].

II. ANTENNA GEOMETRY AND DESIGN

In this design, a Substrate of FR-4 of relative permittivity of 4.4 is used to design the antenna. The substrate dimension is 45 mm x 40 mm x 1.6 mm. A rectangular patch is used with dimensions of 32mm x 25 mm. On the rectangular patch, U shaped slot is cut out in which two parallel strips are attached.

In between two parallel strips in the U – slot two PIN diodes D1 and D2 are inserted to provide the switching. Different adjustment of diodes provide different operating mode which defines the reconfiguration.

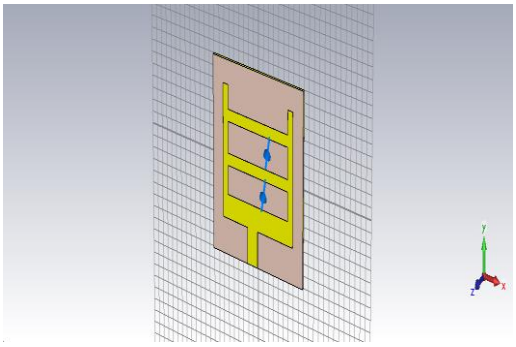

Fig 1. Geometry of the antenna

In this paper, frequency-reconfigurable U-slot microstrip rectangular patch antenna with two switchable operating modes: when both diodes D1 and D2 are ON and when both diodes are OFF has been discussed. The microstrip

line feed is used for excitation. The designed patch antenna is shown in Fig. 1.

III. SIMULATED RESULTS.

When D1 ON and D2 OFF

The simulated results shows that when D1 is ON and D2 is off, the antenna resonate at three frequencies 2.9 GHz, 3.4 GHz and 4.1 GHz.

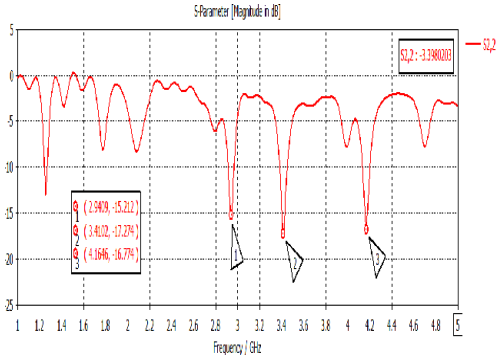

Fig. 2. Simulated Return loss S11 V/s Frequency

When D1 OFF and D2 ON

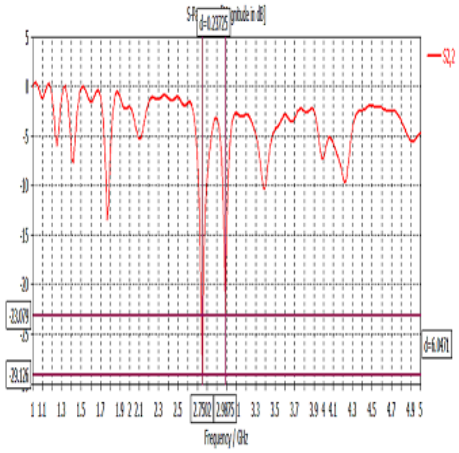

Fig. 3. Simulated Return loss S11 V/s Frequency

The simulated results shows that when D1 is OFF and D2 is ON, the antenna resonate at three frequencies 1.8 GHz, 2.7 GHz and 2.98 GHz.

When D1 and D2 both are OFF

The simulated results shows that when D1 is OFF and D2 is OFF, the antenna resonate at five frequencies 1.4 GHz, 2.8 GHz and 2.98 GHz, 3.4 GHz and 4.1 GHz.

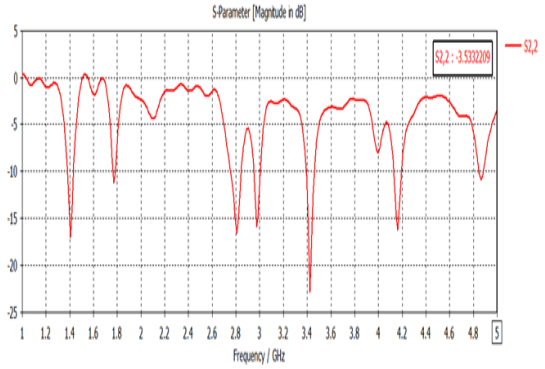

Fig. 4. Simulated Return loss S11 V/s Frequency

When D1 and D2 both ON:

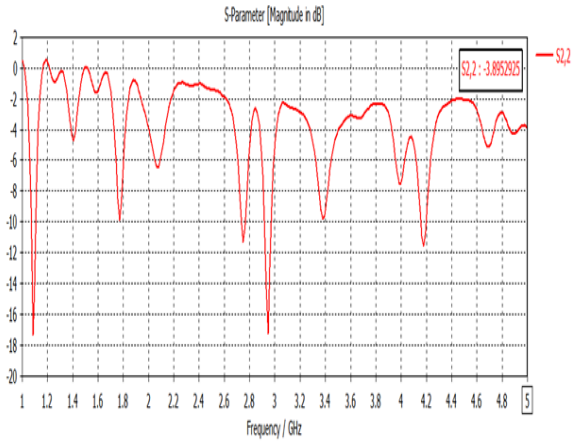

Fig. 5. Simulated Return loss S11 V/s Frequency

When both diodes are ON, the antenna resonates only at two frequencies 1.1 GHz and 2.9 GHz.

Table 1

D1	D2	Bands	Operating Frequencies
ON	OFF	TRIPLE	2.9 GHz 3.4 GHz 4.1 GHz
OFF	ON	TRIPLE	1.8 GHz 2.7 GHz 2.98 GHz
OFF	OFF	FIVE	1.4 GHz 2.8 GHz 2.98 GHz 3.4 GHz 4.1 GHz
ON	ON	DOUBLE	1.1 GHz 2.9 GHz

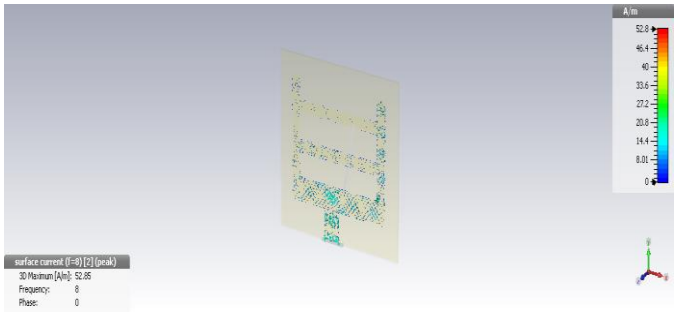

Fig. 6. Surface Current

Surface current represents the maximum effect of electric and magnetic field generation on the surface of the proposed antenna at resonant frequencies

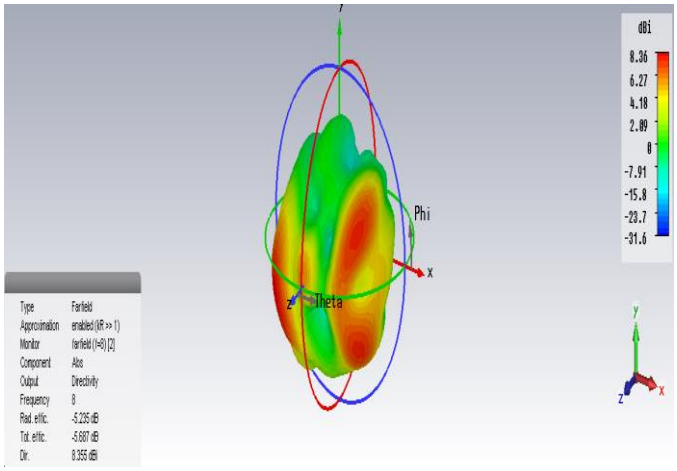

Fig. 7. Radiation Pattern

IV. CONCLUSION

The frequency reconfigurable microstrip patch antenna with two modes of the diodes has been studied with the help of CST MW software. It is found that reconfiguarbility for the two radiating modes is achieved by controlling the ON and OFF states of PIN diodes and single antenna can be exploited for the two operating modes without changing the physical dimensions of the structure.

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