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Re-configurable Microstrip patch antenna applicable for Ultra wide (UW) band

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Abstract: *The designed antenna is about elliptical Microstrip patch antenna with a slot where two diodes are placed on the slot. The design of the antenna is based on diode conditions ON and OFF. This antenna is tested and simulated and the gain of antenna is being improved for different conditions at two frequencies 8.5306GHz and 8.7143GHz. Slot antenna works in single band and multiband frequency. The antenna has a substrate designed on FR4epoxy. A variation in parameters like radiated power, gain and directivity is achieved. Working and testing is done by utilizing simulator Ansoft HFSS. The results are checked and evaluated for the proposed antenna.*

Key Words: *Reconfigurable*, **Elliptical**, **Ultra Wide band**, **Slots, Diodes.**

1. INTRODUCTION

More than the past period of years the antennas have played very decisive role in the area of wireless communication. With the growing and increasing of the broadband technologies microstrip patch antenna is mostly favored. [1]-[3] It is utilized in numerous areas like satellite communication, aircrafts, missiles, GPS system and broadcasting. Certain credits of antenna are low cost light weight low profile, small size, polarization.[4][6] Basically the advancement of dual band antennas for the extension in the wired antennas was done . The configuration of internal handset antennas are accomplished by rectifying the size of small antenna.[6] With broadening of the cellular communication the dual frequency came into scenario having a useful benefit comparatively exquisite electric aspects, compressed in geometry, cheap and adequate function that can be established for a single coaxial feeding.[7][8] Likewise, the Reconfigurable Antennas has a great significance in wireless communication consist extensively for defense and in the market. The antenna could be reconfigured making use of the diodes.[9] It has the potential to modify the operating frequency, radiation pattern & polarization in form of real time.[11]Moreover, when the antennas are Reconfigurable the polarization involves linear, right- hand & left- hand polarization.[12]
The extreme hindrances of patch antenna bandwidth is restricted, gain is not high, little efficiency, lesser power and inadequate polarization. Therefore, in order to conquer the indicated numerous obstacles few resolutions have been recommended for instance slots, coaxial probe feeding techniques and diodes. [1-2]

Furthermore another specific approach is the utility of peculiar model of the patch which aims resonance at frequency & hides surface current waves considering modes. Since the relevance of the applicability of Elliptical Patch antenna came into existence the consequence of the fact that category regarding insignificant character sketch of antenna have larger capacity. We can also regulate contrasting shapes in the manner of circular, rectangular, square, helical & elliptical shape.[2] Considering the polarization of ellipse the tangential part of the elliptical angle shows the proportion of minor axis to major axis.[10] Including the consideration of slots where diodes are positioned the gain, low permittivity & bandwidth of patch antennas can be progressed. Through controlled slots, Patch antennas get impacted. Diodes and capacitor have a positive display on patch antenna.[4] Henceforth this conditions can execute the demands for the evolution of wireless technologies.

1.1 Antenna Configuration

In this antenna the dimension of the substrate is 30mm x 30mm x 1.8mm at position -15, -15, 0. The material used for the substrate is FR4epoxy. Dimensions are 0mm x 0mm x 1.8mm where radius is taken as 7mm and ratio 2. The elliptical patch has been divided into two section by a slot and in between the divided section two square slots are notched placing two diodes into square shape. The material of the diode taken is copper. Both the dimension of diode is 2mm x 2mm x 1mm. The copper diodes behaves as a switch. The coaxial feeding is terminated using cylinder 2 and cylinder 3 as pec. Slot with two diodes are attached to the patch.

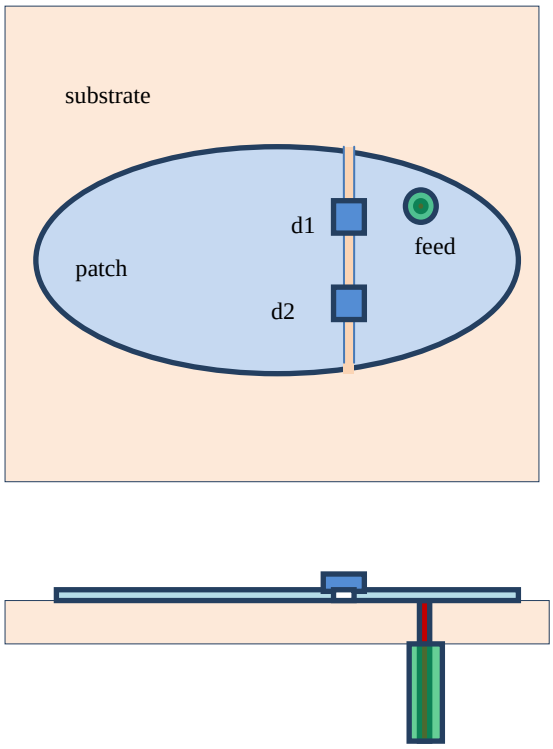
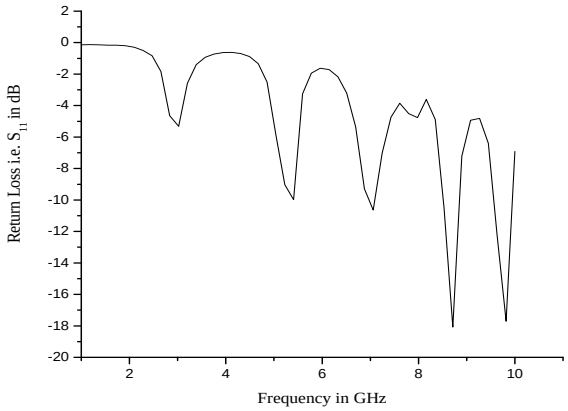


Fig-1: Structure of the Antenna

2. Tables, Simulations and Results

Table -1: Switching operation of diodes

Conditions of Diode	Return loss(dB)	VSWR	Gain (dBi)	Directivity (dB)	Radiation (GHz)
D1 & D2 ON	-16.3520	2.6647	2.7020	6.1813	8.5306
D1 ON & D2 OFF	-14.9163	3.1533	3.0943	6.4005	8.7143
D1 OFF & D2 ON	-18.08	2.1783	2.8568	6.1427	8.7143
D1 & D2 OFF	-15.5134	2.9396	3.1475	6.3420	8.7143



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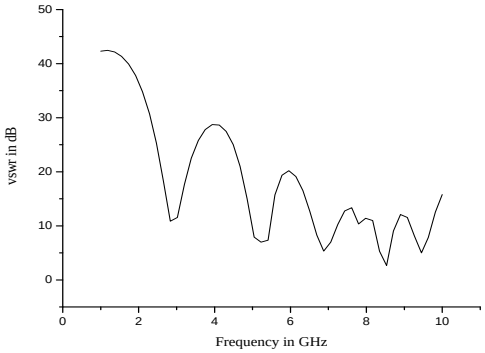

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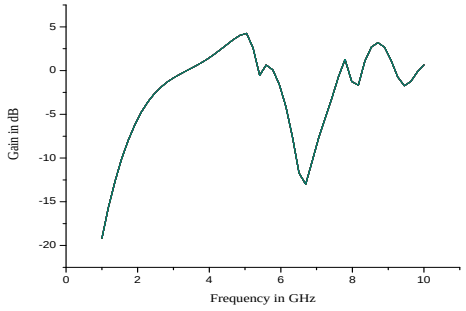

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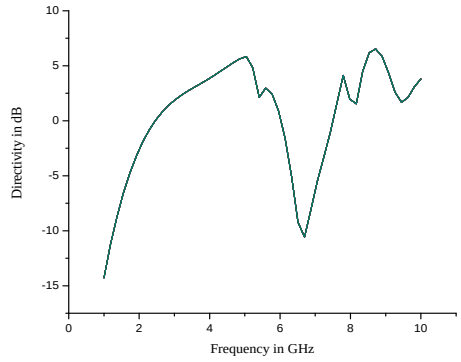

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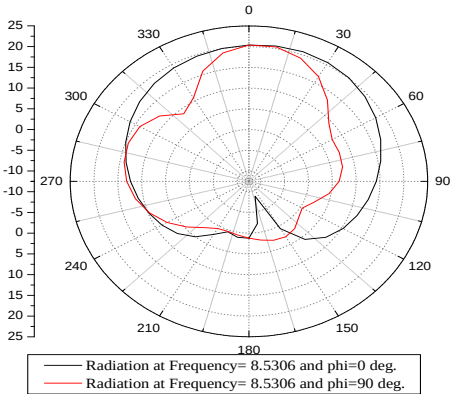

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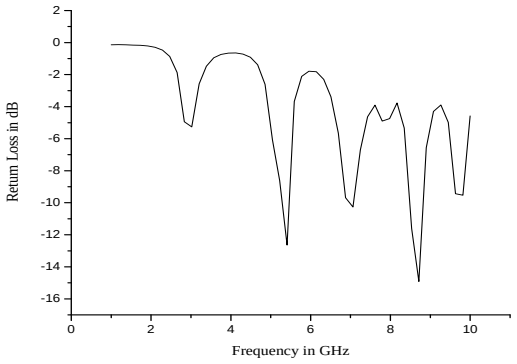
Fig-3: Diode D_1 and D_2 both in ON condition, (a) Return loss (b) vswr, (c) Gain, (d) directivity, and (e) Radiation pattern

The Figure-3 shows that when both the diodes are ON the values are as follows R1 =85 ohm; L1=0.1nH; C1= not assigned; R2=85ohm; L2=0.1; C2= not assigned which shows the return loss as -16.3520dB, VSWR 2.6647, Gain of the antenna is 2.7020 and the Directivity is 6.1813dBi at radiation frequency 8.5306GHz.



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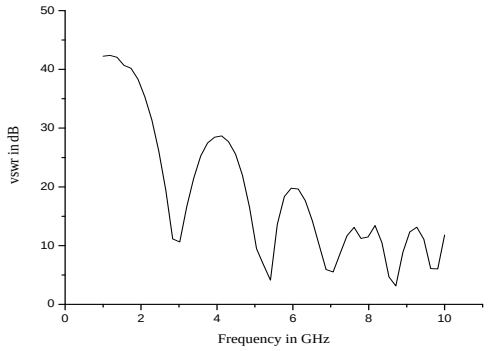

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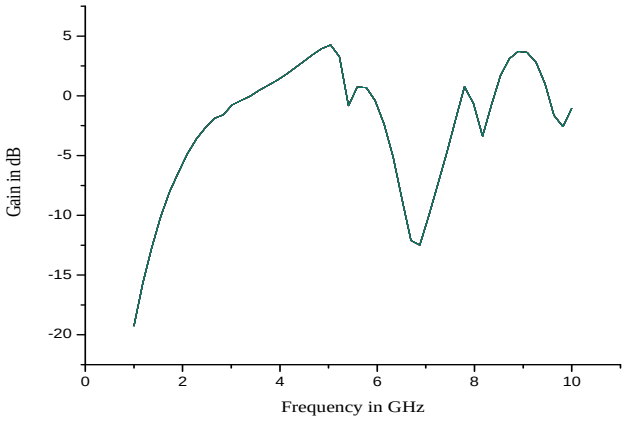

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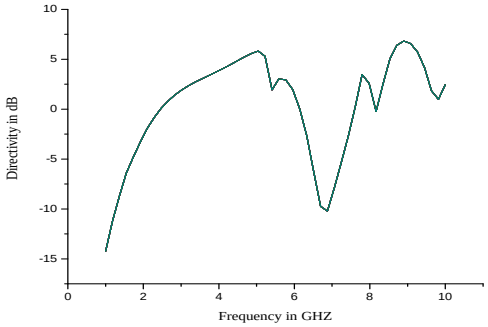

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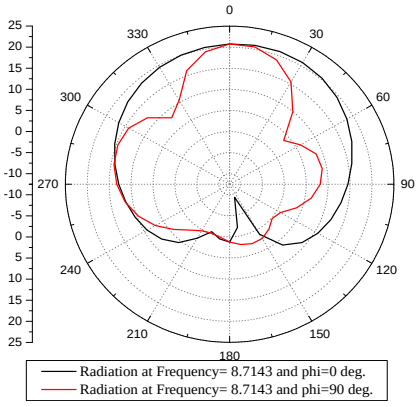

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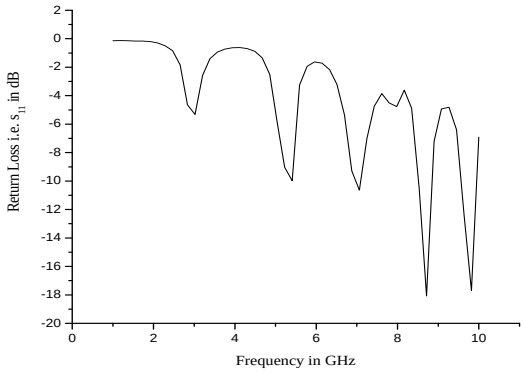
Fig-3: Diode D_1 on and D_2 in off condition, (a) Return loss (b) vswr, (c) Gain, (d) directivity, and (e) Radiation pattern

Figure-3 shows when Diode d1 ON and d2 OFF the values are R1= 85ohm; L1=0.1nH; C1= not assigned; R2= 85kohm; L2= 0.1; C2=100pF. The return loss S11 is -14.9163, VSWR 3.1533, Gain of the antenna is 3.0943, Directivity is 6.4005 at radiation frequency 8.7143GHz.



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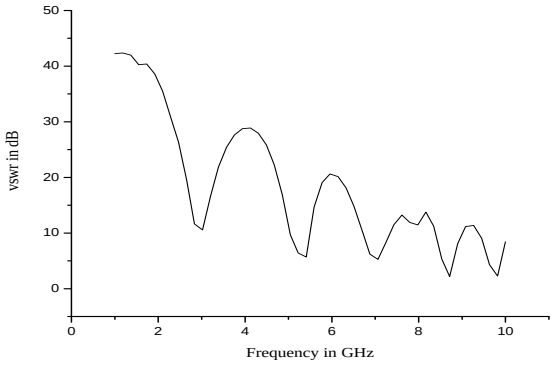

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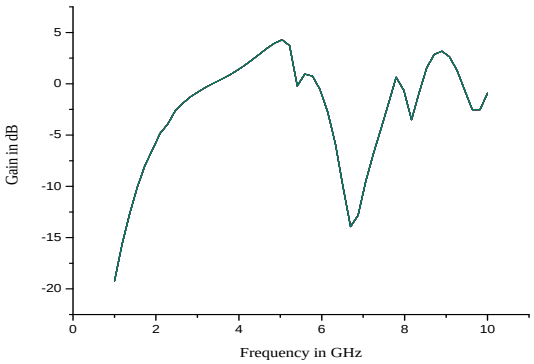

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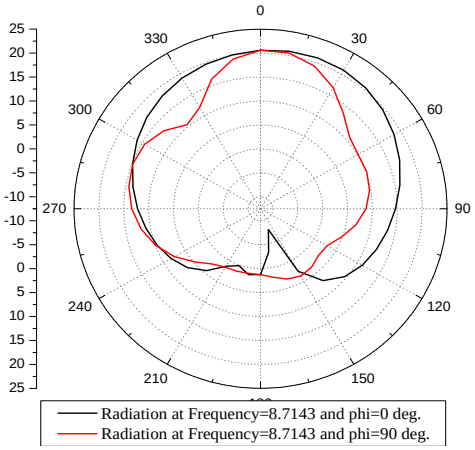

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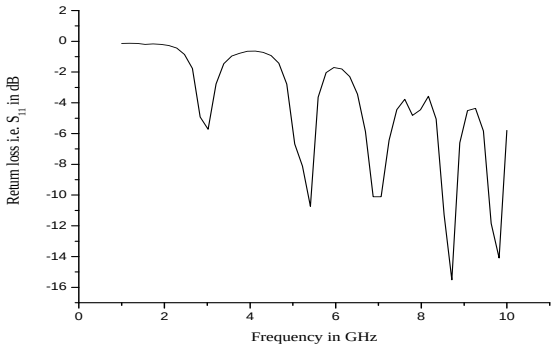
Fig4: Diode D_1 off and D_2 in on condition, (a) Return loss (b) vswr, (c) Gain, (d) directivity, and (e) Radiation pattern

Figure- 4 shows for condition D1 OFF and D2 ON the values are R1=85 kohm; L1= 0.1nH; C1= 100pF; R2=85ohm; L2= 0.1; C2= not assigned which indicates the antenna return loss as -18.08 dB, VSWR 2.1783, Gain 2.8568dBi and Directivity 6.1427dBi at radiation frequency 8.7143GHz.



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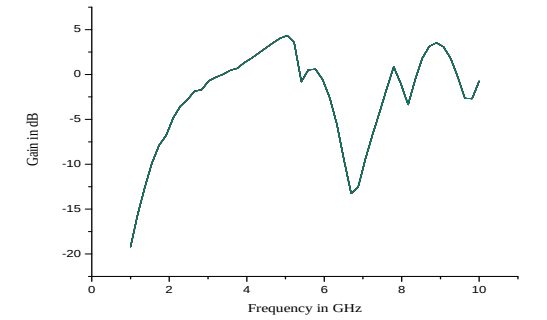

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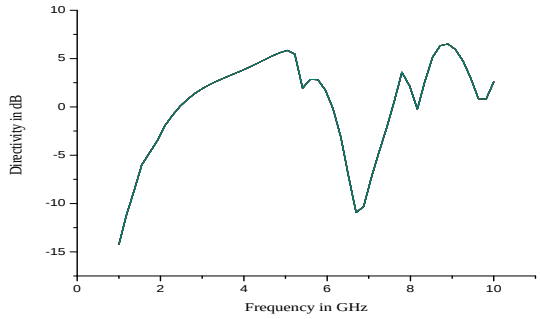

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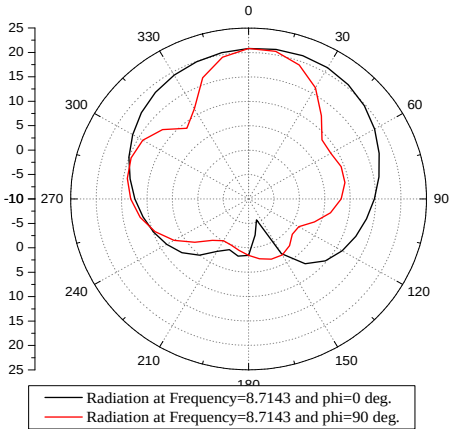

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Fig-5: Diode D_1 and D_2 both in ON condition, (a) Return loss (b) vswr, (c) Gain, (d) directivity, and (e) Radiation pattern

When both the diodes are OFF the values of the antenna are R1=85kOhm; L1=0.1nH; C1=100pF; R2=85kOhm; L2=0.1nH; C2=100pF the figure-5 shows the return loss -15.5134dB, VSWR as 2.9396, Gain of the antenna 3.1475dBi, Directivity 6.3420dBi at radiation frequency 8.7143GHz.

3. CONCLUSIONS

The behavior of the diode towards elliptical patch are studied for varied conditions of diode switching detecting the properties of the designed antenna comparatively return loss, vswr, gain, directivity and radiation frequency. The termination showing return loss is analyzed in terms of S-parameters S_{11}. Fig 1 demonstrates the purposed antenna of Return loss S_{11} as -16.35dB at 8.53GHz. The VSWR for first condition is 2.6. Gain of the antenna denotes as 2.7dBi and the directivity 6.1813dB.

The Fig 2 presents the 2nd condition of diode operation causing the value of the Return loss S_{11} at 8.7GHz that is -14.9163dB. VSWR obtained is 3.15, the antenna Gain acheived is 3.09dBi and Directivity becomes 6.4dB. Likewise, Fig 3 and Fig4 radiates at similar resonance frequency 8.7143GHz due to the value of capacitance determined. The frequency increments from 8.5GHz to 8.7GHz but with dissimilar parameters. The Return loss for 3rd and 4th conditions are -18.08dB and -15.5dB. The Gain and directivity of the antenna becomes better from the first condition. In addition, the diode conditions the table displays the details of switching operation activating in a patch antenna. It is clearly revealed that when the Diode D1 is ON and D2 is OFF a good return loss, VSWR, Gain and Directivity is derived. Return loss S11 -18.08 dB radiating at 8.7GHz frequency has a satisfying VSWR of 2.1 whose antenna gain is 2.8dBi and directivity of 6.1427dB. This is accessed by unceasingly harmonizing the capacitance of the diode. The Return loss for the last condition S_{11} at 8.7GHz frequency is -15.5dB. Also, the radiation patterns shows the polarization of the antenna.

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