Dual Band Dual Polarized Microstrip Patch Anetenna

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***Abstract*—This paper represents the design of single feed, dual band microstrip antenna showing dual polarized behavior of radiations for the wireless environment. Proposed antenna has been designed for 5 to 5.8 GHz frequency having dimensions of 35.8mm X 39.72mm X 1.6mm, which results in dual band operations including (5.02GHz- 5.19GHz) and (5.51GHz-5.71GHz) WLAN band.Truncating the patch has been carried out to achieve the elliptical polarizations (EP) with the same geometry.Within two bands, WLAN band has made to operate in elliptically polarized characteristics, with axial ratio 6db at 5.61GHz, giving orthogonal E-field distributions for both bands. The single feed EP geometry accomplishes the advantages of simplicity and simple structure when it is used for MIMO (Multiple-InputMultiple-Output) applications and WLAN application.The simulation were carried out using HFSS and hardware testing was done on VNA.**

Keywords—dual band , polarization , Truncated micro strip patch antenna.

I. INTRODUCTION

Wireless service providers have discussed the adoption of polarization diversity and frequency diversity schemes in place of space diversity approach to take advantage of the limited frequency spectra available for communication. Due to the rapid development in the field of satellite and wireless communication there has been a great demand for low cost minimal weight, compact low profile antennas that are capable of maintaining high performance over a large spectrum of frequencies.Compact microstrip antennas capable of dual band dual polarized radiation are very suitable for applications in wireless communication systems that demand multibands, frequency reuse and polarization diversity[2].

In wireless communication systems, the transmitting and receiving sections must be aligned with same physical orientation between them, which specifies that end to end antennas must have same orientations to achieve best quality receptions of a desired signals or bands with superlative filtering properties[3]. The same orientation of antennas at terminal side represent a linearly polarized (LP) radio system implying that both antennas have either horizontal or vertical radiating electric field strength vectors. With LP antenna system one can take advantage of simplicity while designing antenna but, it limits the scope of wireless communication as both antennas must have same orientations among them. With elliptically polarized (EP) antenna, there is no any limit about antenna placements. EP antennas can take benefits of asymmetrical orientations between transmitting and receiving antennas[1]. Also, antenna placements do not have any significant effects on bandwidths and other parameters due to two orthogonal E-field distributions giving orthogonal current distributions between radiating regions

II. ANTENNA DESIGN

Microstrip antenna can be modeled on a flame retardant (FR)-4 substrate, as it is beneficial due to its countless mechanical and electrical extents into different environmentalconditions along with good fabrication characteristics[4].

Fig. 1 shows the truncated square reference microstrip antenna with the dimension of 12.8 × 13.5mm and truncated length 3.5mm. The used substrate has thickness of 1.6mm and dielectric constant 4.4. The antenna corners are truncated with patch length equal to 12.8mm and width 13.5mm. The initial truncation length is kept 1mm, which is subsequently increased by 0.5mm in each successive step. The designs were then simulated and it is found that the maximum return loss is achieved with truncation length of 3.5mm and beyond which it reduced rapidly. The proposed single microstrip feed line consist of edge fed for good return loss and inset fed for proper impedance matching and a pair of truncated corners for compact elliptical polarization operation.

Square slot at the centre of the patch is inserted to get the dual frequency operation in the WLAN band as shown in the Fig.1.

The length of the patch determines the resonance frequency[3] ; thus it is a critical factor for narrowband patch.The equation shown below was used to calculate the length of the patch:

$$L_{eff} = \frac{C}{2f_0\sqrt{\epsilon_{eff}}}; L_{eff} = L - 2\Delta L;$$

The ΔL is the length extension due to the fringing field and can be calculated using the equation.

The width is critical in terms of power efficiency, antenna impedance and bandwidth[3]. It is largely dependent on the operating frequency and the substrate dielectric constant. For an effective radiator, practical width that leads to good radiation efficiencies is given by;

$$W = \frac{c}{2f\sqrt{\frac{\epsilon_{reff}+1}{2}}};$$

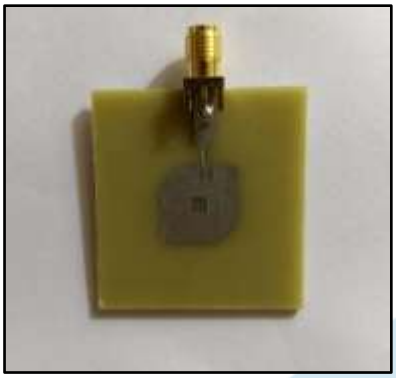

Fig.1 Geometry of DBDP micro strip patch antenna.

Parameters	Calculated Values
Resonance frequency (F_r)	5.2GHz
Relative permittivity of substrate ($\in_r$)	4.4
Substrate height (h)	1.6mm
Substrate length (L_s)	35.8mm
Substrate width (W_s)	39.72mm
Patch length (L_p)	13.5mm
Patch width (W_p)	12.8mm
Feed line length (L_f)	10mm
Feed line width (W_f)	3.059mm
Edge fed line length (L_{eff})	3.64mm
Edge fed line width (W_{eff})	1mm

Table 1 Calculated values of proposed DBDP micro strip patch antenna.

III. RESULTS AND DISCUSSION

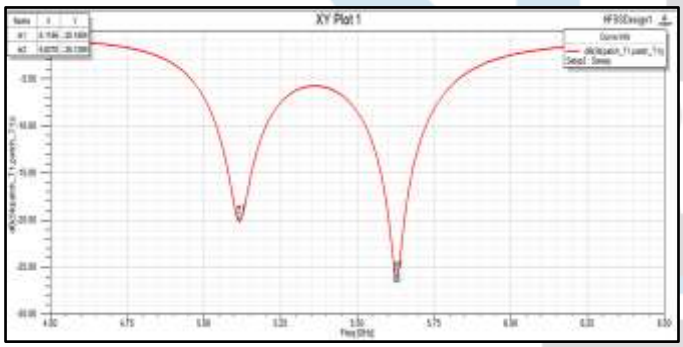

Fig.2 Return loss for 5.11GHz=-20db and for 5.62GHz=-25db

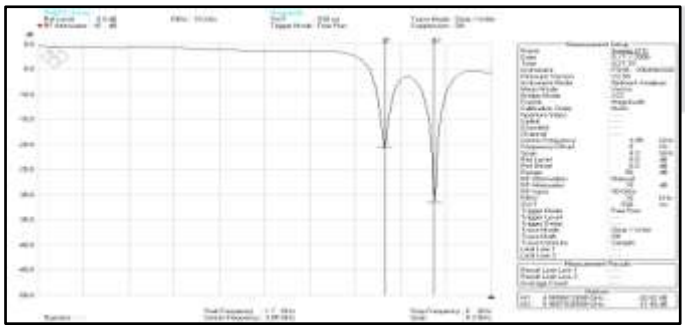

Fig.3 VNA Tested Return loss for 4.99GHz=-20db and for 5.46GHz=-31db

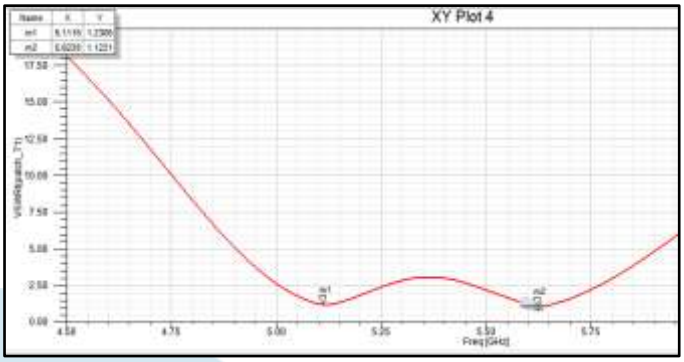

Fig.4 VSWR at 5.11GHz=1.23 and at 5.62GHz=1.12

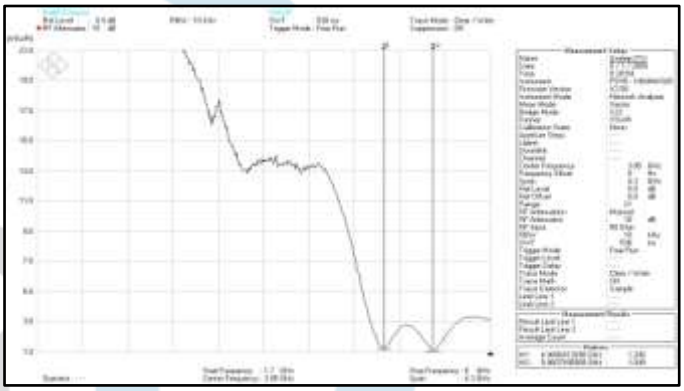

Fig.5 VNA Tested VSWR at 4.99GHz=1.20 and at 5.46GHz=1.04

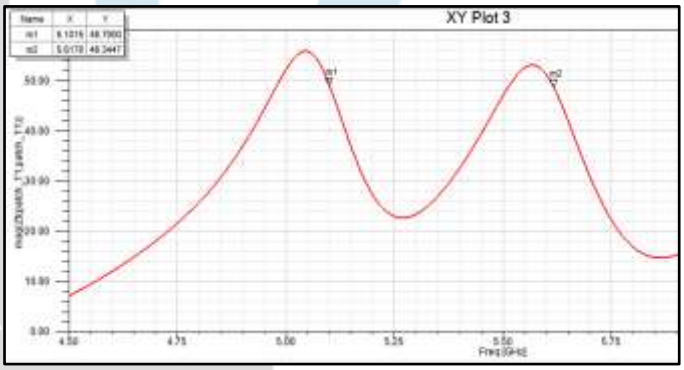

Fig.5 Impedance at 5.11GHz=48.70Ω and at 5.62GHz=48.34Ω

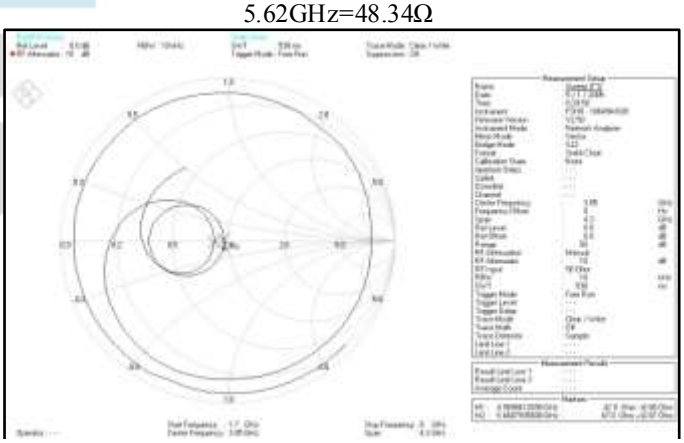

Fig.6 VNA Tested Impedance at 4.99GHz= 42Ω and at 5.46GHz=47Ω

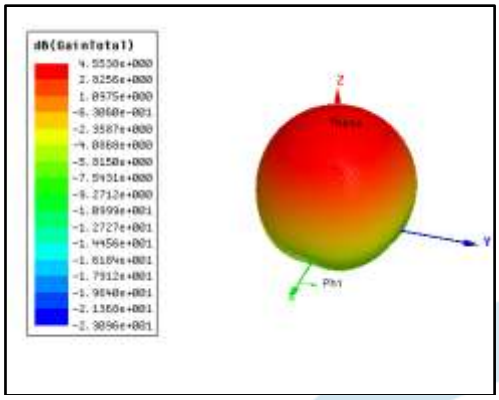

Fig.7 Gain at 5.11GHz=4.55db

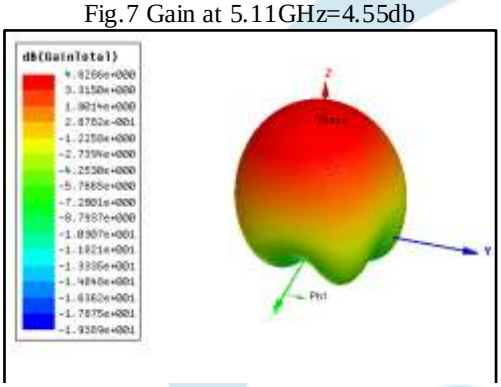

Fig.8 Gain at 5.62GHz=4.82db

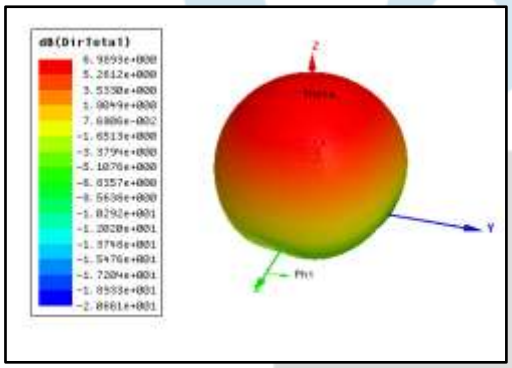

Fig.9 Directivity at 5.11Ghz=6.99db

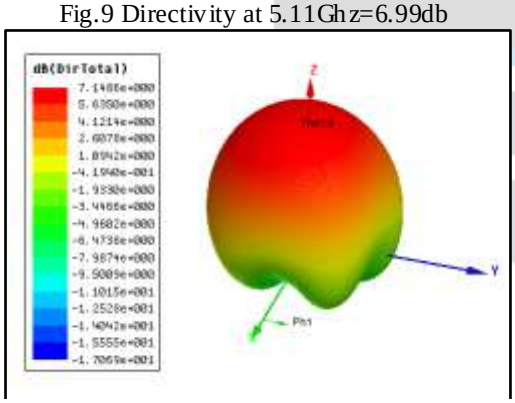

Fig.10 Directivity at 5.62GHz=7.14db

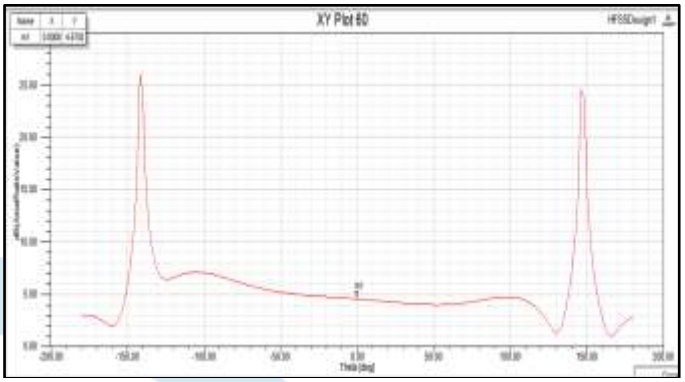

Fig.11 Axial Ratio at 5.6GHz=4.57db

IV. CONCLUSION

The work in this paper primarily focuses on the design of dual band and dual polarized microstrip antennas. Dual frequency as well as dual polarization obtained in the same antenna with single feed. Dual band dual polarization is obtained at 5.1GHz having linear polarization and 5.6GHz with ellipticalpolarization. Thus we havecompletedthe study of dual band and dual polarized microstrip patch antenna.

V. REFERENCES

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