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# Single Feed Dual Band Circularly Polarized Microstrip Patch Antenna

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***Abstract*—A design for dual band circularly polarized Microstrip Antenna (MSA)is presented in this paper. Microstrip line feed is used to energize the patch. CST microwave studio softwareis used to simulate the antenna design. Dual resonant frequencies are obtained by inserting a slot in patch. Resonant frequencies are obtained at 2.22GHz and 2.9GHz showing return loss of -18dB. Circular polarization is achieved by energizing the patch at two adjacent edges through a power divider. Axial ratios obtained at these frequencies are below the practical limit of 3dB.**

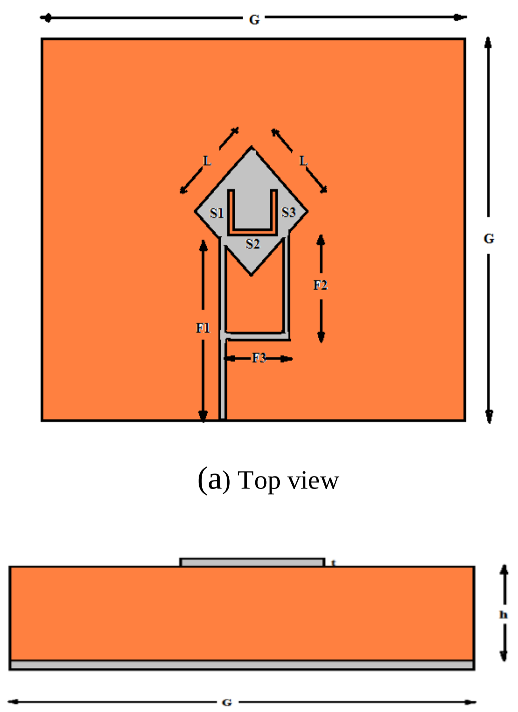
## I. INTRODUCTION

Microstrip patch antennas are one of the most widely used antennas today. These antennas are low profile, cost efficient, mechanically robust and conformable to any surface. These antennas are most commonly operated in microwave frequency range and find applications in mobile communication, missile technologies, aircrafts and radars [1]. At times, dual frequency band operational antenna is required. Dual band antenna increases the capacity of the system by providing alternative of another frequency band [2]. For certain applications, circularly polarized antenna is preferred as with linearly polarized antenna there is weak reception of signal if transmitter and receiver antenna are not properly oriented. With circularly polarized antenna orientationof transmitter and receiver antennas are not important [3].

This proposed MSA consist of square patch which has a U letter shaped slot in it. Because of slot fundamental resonant frequency is perturbed and a new resonance mode is excited. The value of new resonant frequency may be higher or lower than the fundamental resonant frequency[4]. Circular polarization is obtained by feeding the patch at two adjacent edges by a power divider. Circular polarization is obtained if two orthogonal modes are excited with a 90 degree phase difference between them [5, 6].In this paper, thedesigned patch produces resonant frequencies at 2.2GHz and 2.9 GHz respectively. At both of these frequencies patch is circularly polarized. The rest of the paper is organized as follows:Geometry of the designed microstrip antenna is discussed in Section II. Results obtained on simulation of antenna are discussed in Section III and work is concluded in section IV.

## II. ANTENNA DESIGN

The geometry of the proposed antenna is depicted in Fig. 1. A square patch is placed over dielectric substrate Arlon AD250 of relative permittivity 2.5 and height 2.58mm.Beneath substrate there is ground plane of dimension $60\times60mm^2$.Side of square patch is taken equal to 28.28mm and thickness is taken equal to 0.01mm. Microstrip line feed is used to energize the patch and length is optimized to obtain best result. Patch is cut out to make a slot for dual resonant frequencies and as a result it attains shape of letter U. Slot lengths are given in table 1 below. Adjacent edges are fed through power divider so that required 90 degree phase difference between orthogonal modes for circular polarization could be generated.




(a) Top view

(b) Side view

Fig.1 Geometry of the proposed antenna.

Fig. 1(a) andFig. 1(b) show the top view and side view of the antenna structure, respectively.Various dimensions are given in the table 1.

Table 1 Dimensions of the proposed MSA

| PARAMETER | VALUE(mm) |
|---|---|
| G | 60 |
| L | 28.28 |
| F1 | 50 |
| F2 | 25 |
| F3 | 28 |
| t | 0.01 |
| H | 2.58 |
| S1 | 16 |
| S2 | 14 |
| S3 | 16 |

## III. SIMULATION RESULTS

The proposed MSA is simulated using CST microwave studio software and corresponding return loss and axial ratio has been obtained. The reflection coefficient of the antenna is shown in Fig. 2.Two resonant frequencies are obtained at 2.907 GHz and 2.22 GHzand for each of the resonant frequencies return loss less than -18dB is obtained.

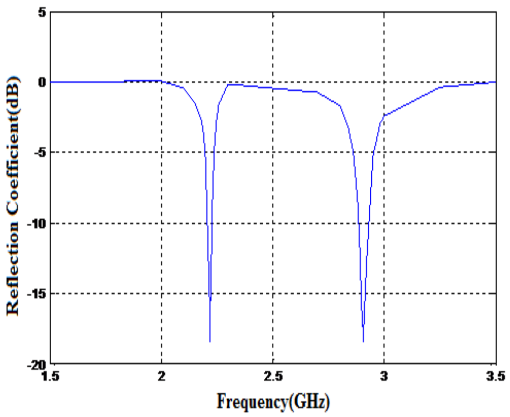



Fig. 2 Reflection coefficient of the antenna.

The Fig. 3(a) shows axial ratio versus frequency curve. Axial ratio less than practical limit of 3dB at resonant frequency2.2GHz is obtained which shows antenna is circularly polarized for this resonant frequency.

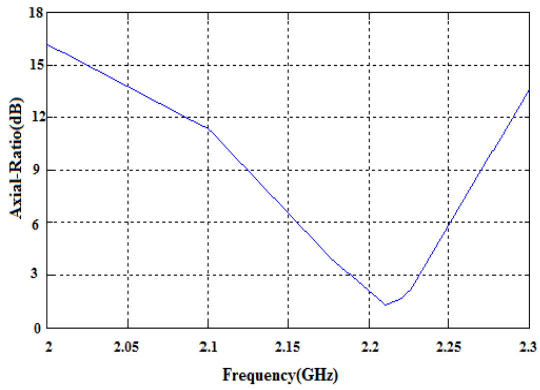



Fig. 3(a) Axial ratio vs frequency plot

Figure 3(b) below gives the axial ratio at another resonant frequency of 2.9GHz.Again axial ratio is less than 3dBfor resonant frequency and hence circular polarization is attained.

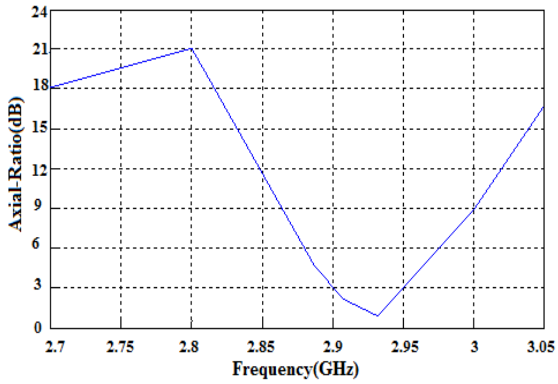
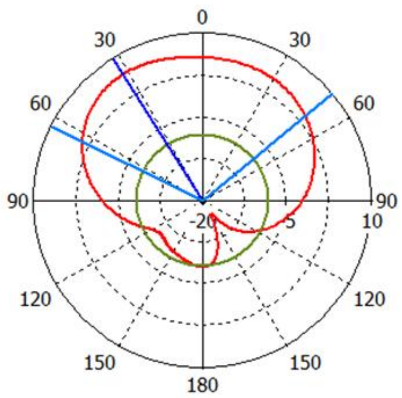
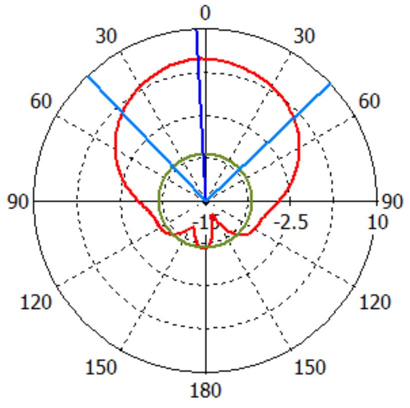



Fig. 3(b) Axial ratio vs frequency plot

Radiation pattern at 2.907 GHz of the proposed antenna is shown in Fig. 4. Maximum lobe magnitude of 6.7dBi obtained.

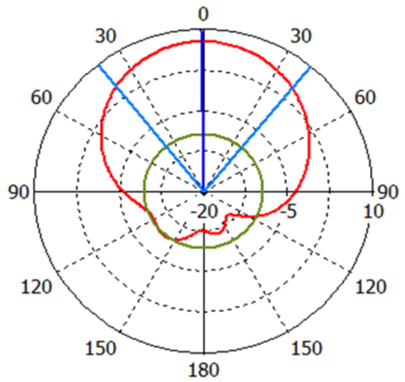



(a) Phi=90 degree

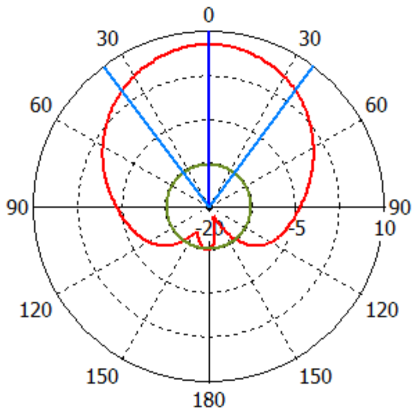



(b) Phi=0 degree
Fig.4 Radiation pattern of the antenna at 2.907 GHz.

Radiation pattern at 2.22 GHz of the proposed antenna is shown in Fig. 5. Maximum lobe magnitude of 7.8 dBiis obtained.




(a) Phi=90 degree




(b) Phi=0 degree
Fig. 5 Radiation pattern of the antenna at 2.22 GHz.

## IV. CONCLUSION

The design of a dual band circularly polarized antenna is presented in this paper.Dual resonant frequencies are generated by inserting a U letter shaped slot in the patch and circular polarization is achieved by feeding the edges of patch by power divider. Patch is simulated using CST microwave studio software. Simulation results show return loss of less than -18dB at resonant frequencies 2.22GHz and 2.907GHz respectively. At these frequencies patch is circularly polarized as axial ratio less than 3dB is attained. Because of simple design patch can be used in array formation. The designed antenna can be used in radar systems for 2.9GHzresonant frequency and in medium capacity point to point communication for 2.22GHz resonant frequency.

## V. REFERENCES

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