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PERFORMANCE AND ANALYZE OF CROSS DIPOLE ANTENNA WITH PARASITIC ELEMENTS

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***Abstract* —** The broadband Circularly polarized (CP) crossed dipole antenna is presented. The proposed antenna consists of crossed bowtie dipole with four unequal cross slots and four unequal parasitic rectangular strips. The sequential phases of crossed bowtie dipole contain cross slots that can generate a CP mode. The proposed antenna contain two asymmetric bowtie dipole antenna. The one CP mode are generate by parasitic strips due to sequentially rotated configuration. The broadband CP operation is achieved by combining of the crossed bowtie dipole with cross slot and parasitic strips. The experimental and simulated results are studied in arranged manner. The proposed antenna achieved a wide impedance bandwidth and axial ratio bandwidth are shown. The proposed antenna produces a peak gain of 6.84 dBi .

Index Terms- Circular polarization (CP), Broadband, Asymmetric bowtie, Crossed bowtie dipole, parasitic elements.

I. INTRODUCTION

Circular polarization (CP) antennas are used in modern wireless communication systems because it is one of the important polarisation type of electromagnetic waves. CP antennas can suppress multipath interference, mitigate polarization mismatch and combat Faraday effect. In recent year a Broadband CP antenna have been highly demanded because of its high data rate communication and high speed transmission

Crossed dipole is an excellent candidate for realization of CP antenna. Crossed dipole antenna has simple structure, wide band and low cost. A single-feed CP crossed dipole antenna exbhits a 3 dB axial ratio bandwidth (ARBW) of 15.6% are presented [15]. It contains 2*2 array arrangement in a sequentially rotated configuration [2] and has bandwidth upto 39.2% [13]. Initially A wideband CP operation are proposed by several techniques such as employing multiple radiators, loading parasitic elements and dipoles with wideband responses [12] contain a two unequal orthogonal dipoles that suffers a narrow ARBW of 7.55%. From a previous antenna define has contain a one CP mode and limited IBW and ARBW. In this proposed antenna contain two CP modes. It has a wide IBW and an admirable ARBW. It also produce an exceptional peak gain in dBi.

II. ANTENNA DESIGN AND ANALYSIS

The proposed antenna are shown in Fig. 1. It consists two crossed bowtie dipole, four cross slots and four unequal parasitic rectangular strip, printed on an FR-4 substrate with a dimension of 75mm *75mm *0.6 mm. The two vacant quarter rings connected with 90̊ phase difference of crossed bowtie dipole antenna. The cross slot present in bowtie dipole antenna used to generate one CP mode. Other additional CP mode are generated by four unequal parasitic rectangular strips presented in above of substrate. The dimension of square ground plane is Wg*Wg*2 mm^3.It used to provide unidirectional pattern.

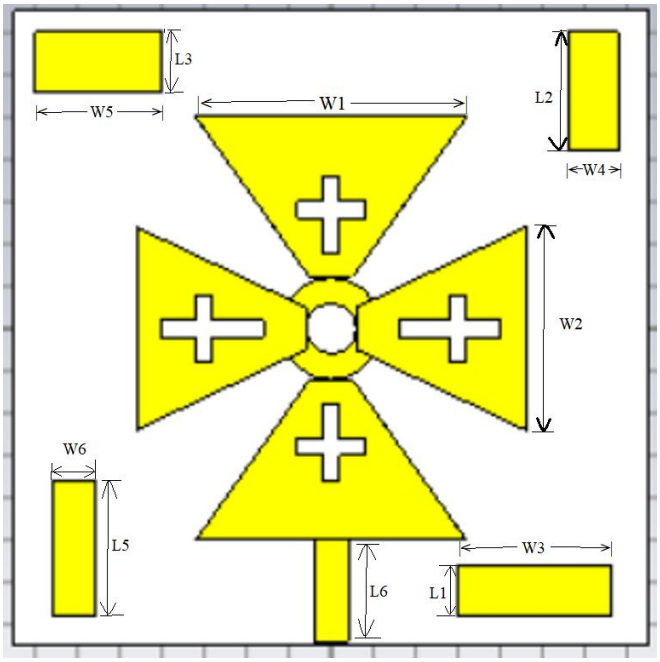


Fig. 1. The Proposed Antenna

W1	W2	L1	L2	L3
25	18	6	14	7
W3	W4	Ri	Ro	L5
18	6	3	6	26
L6	Wg	W5	H	W6
12	75	15	1.6	5

Fig. 2. Dimensions of the Proposed Antenna (Unit in mm)

The parameters for proposed antenna are shown in Fig. 2. The spheres contain different radius has inner radius (Ri) and outer radius (Ro). The Total width of ground and substrate are shown as Wg is 75 mm. By using this parameter value the proposed antenna have been designed.

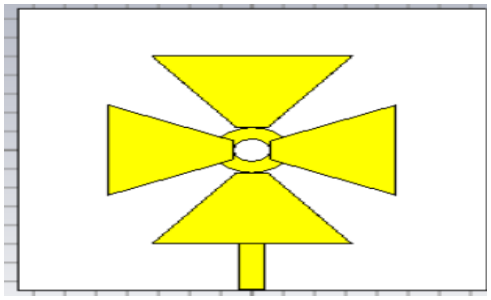


Fig. 3. Dipole Antenna

In this proposed antenna mechanism contain four type of evolution in antenna which are dipole antenna, dipole antenna with rectangular slot, dipole antenna with cross slot and cross dipole antenna with parasitic element. The dipole antenna contains crossed bowtie dipole antenna with two quarter ring that shown fig.3. Both are present in frequency range of 6.4 GHz to 6.6 GHz. The quarter ring are used for sequential rotation configuration of antenna. A dipole antenna is an fundamental type of radio antenna. It consist of the conductive wire rod that half of the wavelength presented antenna.

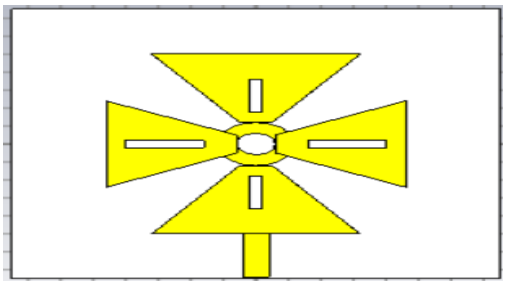


Fig. 4. Dipole Antenna with Rectangular Slot

Fig.4 explained that dipole antenna with rectangular slot. It modified from previous antenna loading with four rectangular slot that produce 5.2 dBi in an antenna. Both are presented in frequency range of 6.1 GHz to 6.7 GHz. The slot antenna is also known as aperture antenna. The slots are used to radiates electromagnetic waves that are similar to dipole antenna.

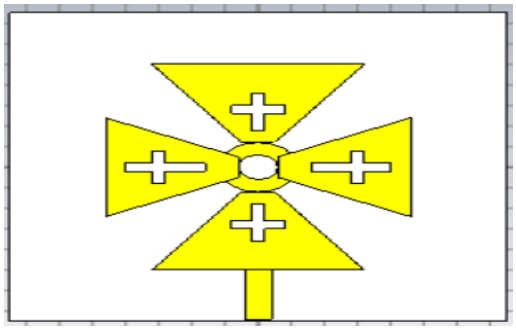


Fig. 5. Dipole antenna with cross slot

The dipole antenna inserted with cross slot produces one CP operation in frequency range upto 5 GHz that shown in Fig. 5. It produce a 3.8 dBi in 6.2 GHz to 8.2 GHz range. The cross slot are mainly used to reduced losses in an antenna. The bowtie antenna are contain two triangular metal plates above the surface. It isn't really a log periodic antenna. It improve the radiation characteristics and reduce wave interferences.

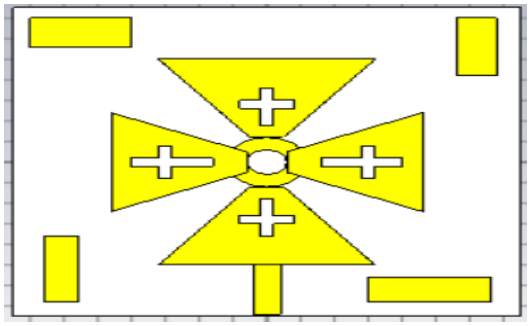
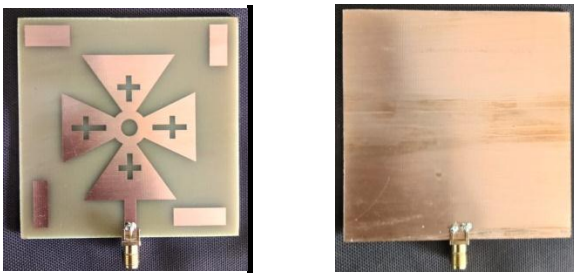


Fig. 6. Crossed dipole antenna with parasitic strip

The crossed dipole antenna with unequal rectangular parasitic strips are shown Fig. 6. To achieve a broadband CP operation, the parasitic strip are introduced in proposed antenna. The CP operation used to improved return loss in moderately. All the antenna are analyzed by CST 2019 version. From proposed antenna produced 6.84 dBi in frequency range upto 7.5 GHz. The height of antenna presented as a λ/4 with resonant frequency. By using unequal four parasitic rectangular strip to achieved proper CP operation mode. The parasitic elements doesn't have own feedline. Usually it depends on other patches feed line. The length of parasitic strips would affect the slot mood in crossed dipoles.

III. SIMULATED AND EXPERIMENTAL RESULTS

The evolution of a proposed antenna have an individual IBW and ARBW. A prototype of proposed antenna was fabricated and tested, as shown in Fig. 7. The network analyser are used for measurement. The gain, radiation pattern and AR were measured in anechoic chamber. The proposed antenna was fabricated contain FR4 has a substrate and copper has a ground and patches. A square plane of ground and substrate contain dimension 75mm *75mm *0.6mm.



(a) Top view (b) Bottom view

Fig. 7. Fabrication model of proposed antenna

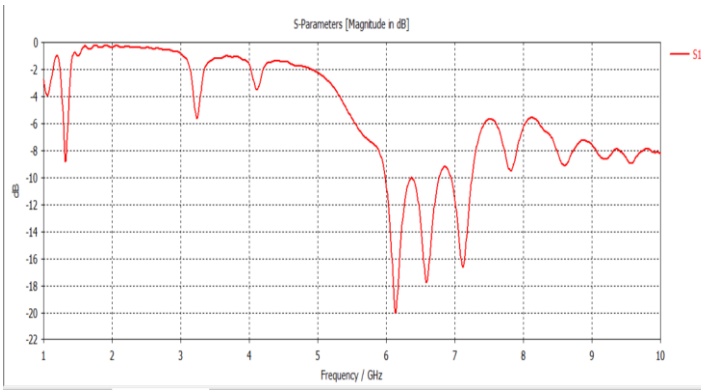


Fig. 8. |S11| of Dipole Antenna

The dipole antenna return loss are shown in Fig. 8. It has IBW from 2.4 to 8.1 GHz frequency range. It will produce 90.1% of return losses as -17.73. Then the dipole antenna has IBW and ARBW obtain in frequency range are 2.31 to 7.8 GHz that produce losses in 92.3% and gain has 5.5 dBi for simulation. The gain and return losses are measured in simulation process.

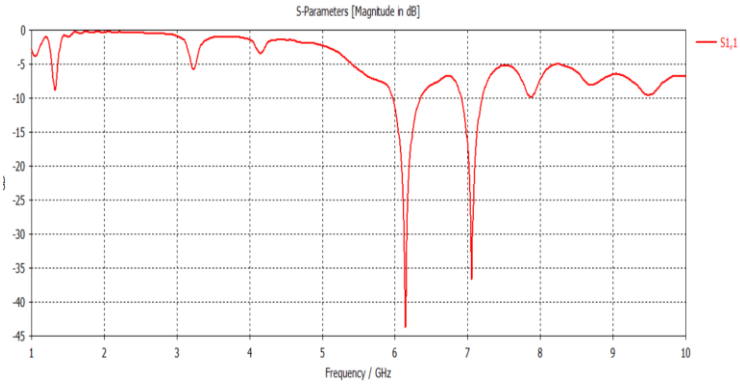


Fig. 9. |S11| of Dipole Antenna with rectangular Slot

The dipole antenna with rectangular slot are used to shift AR towards a lower frequency. It produce losses has 93.4% that have frequency range from 4.5 to 8.9 GHz. The return loss and gain are measured and simulated by individual process. It achieved return loss has -35.17 and a peak gain has 6.5 dBi. It attained as return loss has 93.2% as shown in Fig. 9.

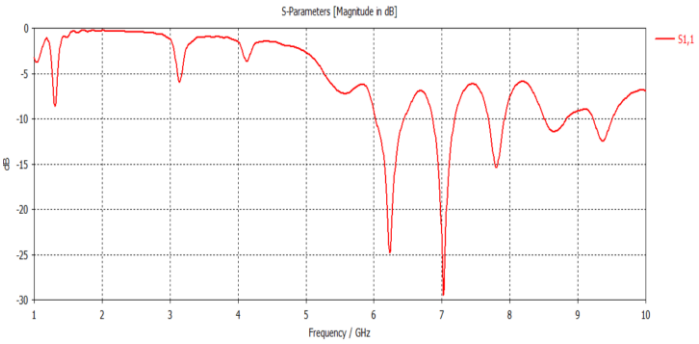


Fig. 10. |S11| of Dipole Antenna with cross slot

The Dipole antenna with cross slot achieved a return loss has -24.56 and a peak gain has 3.4 dBi. The overall return losses of crossed dipole antenna is 92.4% as shown in Fig. 10. The frequency resonator are produced in this antenna. It produced CP pattern in boresight direction except at the higher frequency. It produced higher frequency than previous antenna.

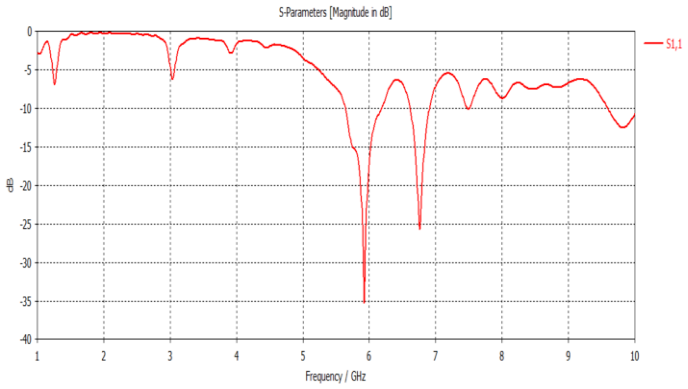


Fig. 11. |S11| of Crossed Dipole Antenna with parasitic strip (proposed antenna)

The proposed antenna contain a parasitic strip doesn't coupled with crossed dipole. The simulated result of proposed antenna produce a peak gain has 6.84 dBi and return loss has -25.5. The efficiency and directivity of proposed antenna are greater than previous antenna. The parasitic strips are produce additional CP operation in crossed dipole antenna. The overall working of return losses in proposed antenna is 95.4% as shown in Fig. 11. The working of gain in proposed antenna is 93.1% shown in Fig. 12. It produced an advantages of wider IBW and ARBW due to the two CP modes, though the overall dimension is slightly larger than those reference antennas.

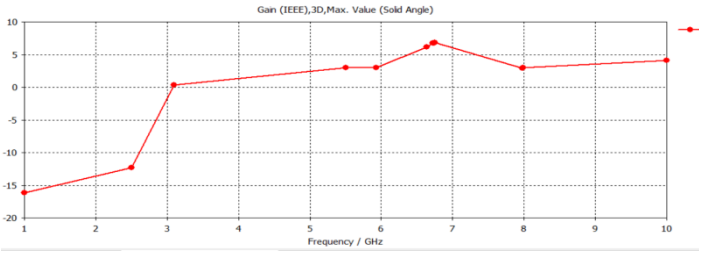


Fig. 13. Gain of Proposed Antenna

A performance of gain in all antenna are shown in fig.7 that explain details about of transmission rate property. A table of comparsion are shown in fig. 8 that explain performance of evolution of all antenna. A literature [1]-[7] work helps to design a proposed antenna. Here, λ_0 is the wavelength at the CP center frequency. It shows that the proposed antenna has the advantages of wider IBW and ARBW due to the two CP modes, though the overall Prototype is slightly differed than those of reference antenna.

Sl.no	Design	Frequency (GHz)	Return Loss	Gain (dB)
1	Dipole Antenna	6.59	-17.73	5.52
2	Antenna With Rectangular Slot	7.05	-35.17	6.51
3	Antenna with Cross slot	6.23	-24.62	2.84
4	Crossed Dipole Antenna with Parasitic Strip	6.75	-25.51	6.84

Fig. 8. Performance comparison for evolution of all antenna.

IV. CONCLUSION

The broadband crossed bowtie dipole antenna loaded with parasitic element has been investigated in this paper. The set of parasitic elements are successfully improved both IBW and ARBW by using sequentially rotated configurations. A proposed antenna used unequal parasitic strip to obtain frequency resonant. It is used to most modern radars system and microwave devices. The proposed antenna achieved 95.4% by extremely wide CP characteristics in terms of a wider IBW and ARBW in frequency range of 6 GHz to 7.5 GHz. The excellent CP operation of a broadband circularly polarized bowtie dipole antenna will be attractive for modern wireless communication system.

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