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A Compact O-shaped Printed ACS fed Monopole Dual-band Antenna for 2.4 GHz Bluetooth and 5GHz WLAN/WiMAX Applications

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ABSTRACT

In this research paper, a compact O shaped printed ACS fed monopole dual band antenna is proposed for the reduction of mutual coupling in addition with applications of 2.4GHz Bluetooth/WLAN, 4.9 GHz US public safety band and 4.776 GHz WLAN/WiMAX. It consists of an O- shaped radiating branch and a rectangular uniplanar ground plane, with dimensions of 20 x 12.5 x 1.6 m^3. In the design, proposed radiating structure has been printed on a low cost single layered substrate FR4. By properly tuning the radiating branches electrical lengths, two independent resonant frequencies can be obtained and tuned independently. The presented antenna also exhibits omnidirectional radiation patterns with acceptable peak gains for the desired 2.4 GHz Bluetooth band, 4.9 GHz US public band , 4.776 WLAN bands and 6.368 GHz WiMAX band applications.

I.INTRODUCTION

Multiple Input Multiple Output (MIMO) has been proposed as an important technique which improves the performance of wireless communication system. It also has the significance of improving wireless system's capacity or range. Multiple antennas can be used in this technique. Antennas play an important role as antenna's features are included in the communication channel between transmitter and receiver. Especially mutual coupling is one of the major factors which is to be considered while designing micro strip antennas. Mutual coupling leads to impedance mismatch, increase in side lobe level, occurrence of scanning blindness and reduction in gain. In addition with antenna inefficiency, correlation may also occur due to mutual coupling. In order to reduce the mutual coupling we design a compact O shaped printed ACS fed monopole dual band antenna. Nowadays, Asymmetric Coplanar Strip (ACS) feeding has become most popular technique for designing small printed antennas. By considering uniplanar ground plane ACS fed structure requires less area as compared to Coplanar wave guide (CPW) fed structures[1-6]. In the design of "compact coplanar slot antenna fed by asymmetric coplanar strip for 2.4/5 GHz WLAN operations" [1], antenna's parameters are 30x15mm^2 which yields to large size."ACS fed printed F shaped uniplanar antenna for dual band WLAN applications" [2], has the dimensions of 21x19 mm^2 which is medium in size and results in moderate gain.

Due to rapid growth in wireless technologies, circularly polarized(CP)/linearly polarized (LP) printed antennas have been found wide use and popular in modern mobile/wireless/satellite systems such as universal mobile telecommunication services (UMTS), wireless local area networks (WLAN), worldwide interoperability for microwave access(WiMAX), intelligent transport systems(ITS),international telecommunication union (ITU), and downlink of X-band satellite communication application due to certain advantages such as suppression in polarization mismatch, reduction in propagation loss and multipath effects with avert the issue of displacement.

For that reason, a single antenna with multiband CP functionality has fascinated much attention for academician and researchers for covering almost the stated bands. To accomplish this some extent, the various kinds of CP/LP printed antennas have been studied and reported by using various

methods and techniques. Design of "A compact asymmetric coplanar strip fed dual band antenna for DCS/WLAN applications"[4], has the advantage of good radiation characteristics but gives only moderate gain. So we propose an antenna which results in good radiation characteristics, compact in size and also has high gain. So ACS fed monopole dual band antennas are compact in size. By using O shaped and rectangular monopole-shaped radiating branches, two independently tunable operating bands are generated. Thus the proposed O-shaped antenna is having -10dB impedance bandwidth and applications in Bluetooth, WLAN/ WiMAX having bandwidth at 4.776 GHz and 6.368 GHz.

II. ANTENNA DESIGN

The proposed O-shaped ACS fed dual antenna configuration and evaluation stages are shown in fig1. For the simulation purpose, a 3-D high frequency electromagnetic simulation software package CST microwave studio is used.

The proposed geometry consists of an O-shaped radiating branch, rectangular shaped radiating branch and rectangular shaped uniplanar ground plane are used. These radiating branches results in excitation of two independent resonant frequencies.

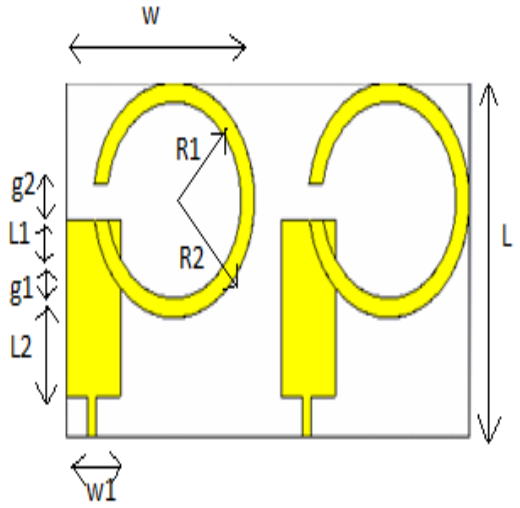


Fig.1 Proposed O-shaped ACS fed dual- band antenna

The proposed antenna is having the dimensions are listed in Table 1. To design of a compact o-shaped antenna to reduce the isolation between the antennas by properly changing the shape of the antenna placing at different instants of distances varying step by step procedure by optimization techniques in different levels of design.

Table 1: Dimensions of O-shaped antenna

S. No	Parameter	Length(in mm)
1	W	12.5
2	W1	3
3	W2	4
4	L	20
5	L1	3.1
6	L2	9.3
7	L3	4
8	g1	1.5
9	g2	1.6
10	R1	4.7
11	R2	5.9
12	G	0.5
13	Y1	30.03

III. RESULTS AND DISCUSSION

The simulated curve of return loss versus frequency is shown in Fig.2. It is observed that -10 dB impedance bandwidth having ranges at 4.776 GHz and 6.368 GHz. By considering absolute parameter specifications we can have the advantage of reduction in mutual coupling. This reduction in mutual coupling leads to increase in antenna efficiency and radiation characteristics. The return loss characteristics of antenna, mutual coupling, VSWR of the proposed antenna is depicted in Fig. 2 to Fig. 4 represents the importance of the antenna in the field of wireless applications.

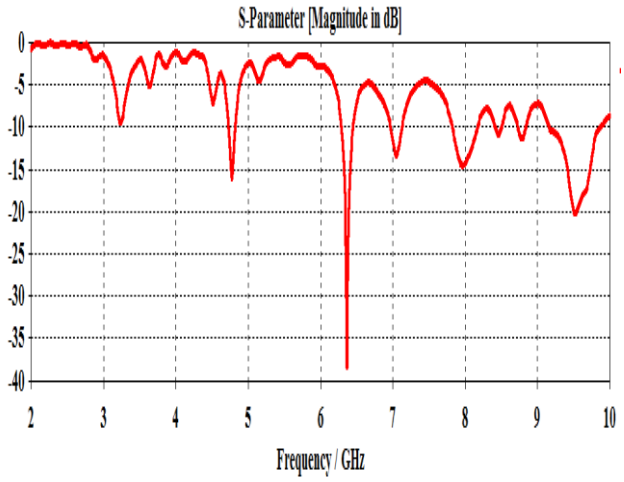


Fig. 2 Return loss characteristics of the proposed antenna.

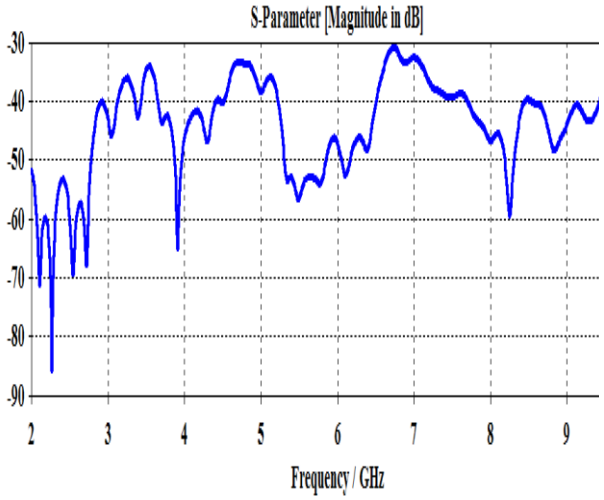


Fig. 3Mutual power coupling characteristics of proposed antenna

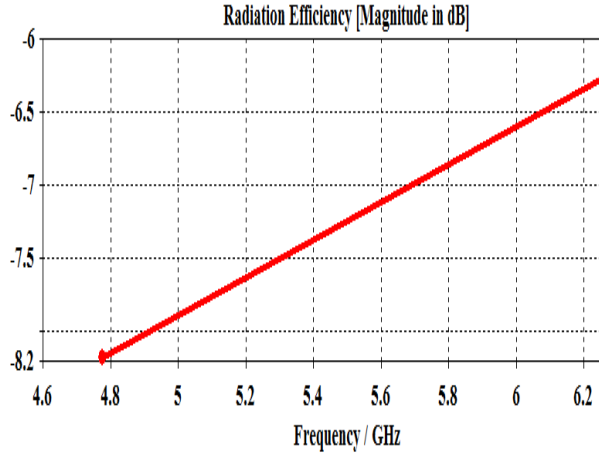


Fig. 4. Radiation efficiency

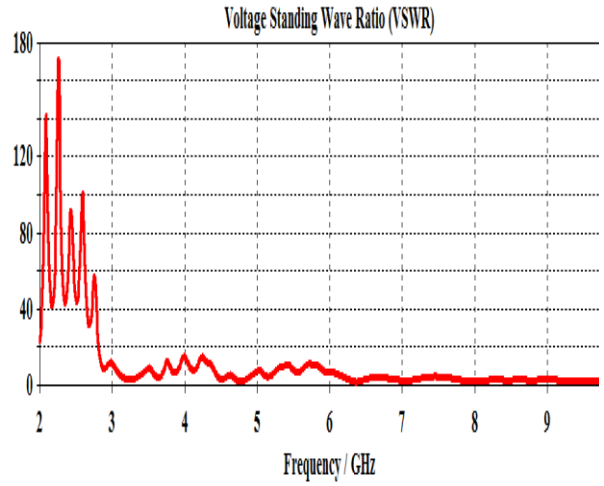


Fig. 5 VSWR characteristics of proposed antenna

The 3-D radiation patterns of the proposed antenna are simulated using CST microwave studio. From the figure, it is observed that proposed O-shaped ACS fed monopole dual band antenna exhibits omnidirectional radiation patterns with high peak gain. And S parameter variations in E-field and H-field are as shown below.

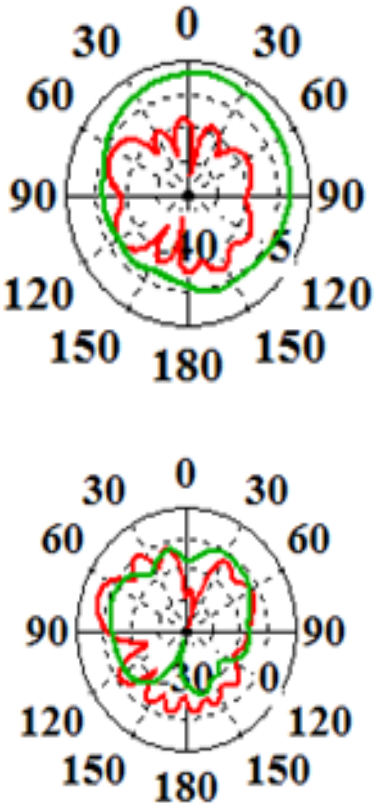
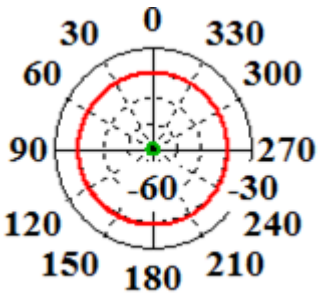


Fig. 6 E-field of proposed antenna.



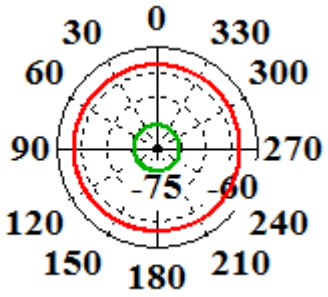


Fig. 7 H-field of the proposed antenna.

IV. CONCLUSION

In this paper, a compact O-shaped printed ACS fed monopole dual band antenna has been designed to support multiple frequency bands of WLAN and WiMAX standards. It's geometry consists of two simple structured radiating branches of O-shape and rectangular shape with asymmetric ground plane. The proposed structure offers good radiation efficiency, omnidirectional radiation patterns, high gain and reduces mutual coupling for the desired 2.4/5 GHz WLAN/WiMAX band applications.

V. ACKNOWLEDGEMENT

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VI. REFERENCES

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