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U-Shaped Monopole Antenna for UWB Applications

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Abstract: A simple low cost and compact printed dual-band U-Shaped monopole antenna for ultra wide band applications is proposed. Dual-band operation covers two frequency bands in between 3.1-10.6GHz (UWB) are obtained by using U-Shaped monopole radiating patch and a rectangular ground patch. The proposed antenna is fed by 50-Ω microstrip line and fabricated on a low-cost FR4 substrate having dimensions 42(L_{sub})×24(W_{sub}) × 1.6 (H) mm^3.The antenna structure is designed and simulated. Measured S_{11} is <=10 dB over 3.1–12 GHz. Simulation results show that the design has better reflection coefficient.

Key Terms—*Dual band, Monopole Antenna, Printed Antenna, Ultra wideband (UWB).*

I.INTRODUCTION: Ultra wideband (also known as UWB or as digital pulse wireless) is a wireless technology for transmitting large amounts of digital data over a wide spectrum of frequency bands with very low power for a short distance. The frequency range of Ultra wideband technology is spectrum (3.1GHz-10.6GHZ). It also offer many advantages like high data rate at short ranges (500 mbps at 10 feet), low power (baseband modulation), multipath immunity (path delay >> Pulse width), relatively simple receiver architecture. This has led to huge research in Ultra wideband (UWB). Now FCC (Federal communications commission) approved UWB for commercialization. The applications of WIMAX (Worldwide Interoperability for Microwave Access) are these can be used in Broadband Wireless Access and also as Wi-Fi hotspots. Wireless local-area network (WLAN) applications operating in 5.15– 5.825 GHz interfere with UWB systems.

Communications satellites use a wide range of radio and microwave frequencies. Military applications combine the need for high performance and reliability with some of the hardest environmental conditions. Here, a simple, easy to fabricate, compact, micro strip fed printed dual band antenna for UWB applications is designed. This antenna is composed of a u-shaped radiating element fed by a 50 Ω micro strip line and a rectangular shaped ground plane. And a pair of rectangular strips placed on both sides of the u-shaped monopole. A rectangular monopole placed at the centre of the u-shaped monopole.

II. ANTENNA DESIGN: Figure 1 shows the evolution of the proposed printed dual band monopole antenna. The structure is evolved from the circular shape.

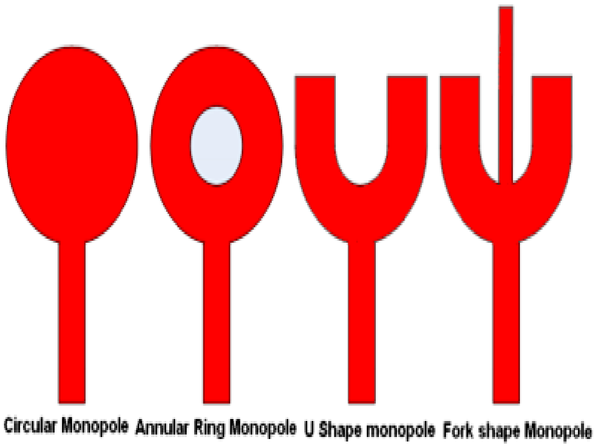

Figure 1: Evolution of the proposed dual band antenna.

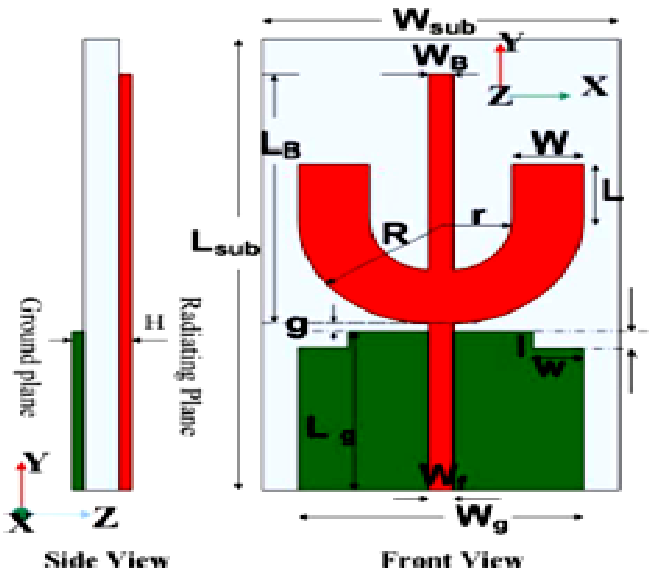

Figure 2: Geometry of proposed dual-band U-shaped monopole antenna.

Parameters	R	r	L_g	W_g	G	W_f	L=W	W	L	W_B	L_B
Values	10.2	4	12.7	20.4	0.5	2.4	6.2	3.5	1	2	27

The geometry of the proposed antenna is shown in Fig. 1. It is fed by a 50-microstrip line and made-up on a 1.6-mmthick FR4 substrate with 42×24mm facade area. The relative permittivity and loss tangent of the substrate is 4.4 and 0.02, respectively. The antenna structure is a discrepancy of a circular monopole antenna. The radius (R) of the circular monopole is R=10.2[10]. Where g is the gap between the radiating patch and f_L ground plane, and is the lowest resonant frequency corresponding to VSWR =2. Then antenna is designed by taking a circular ring of 10.2mm radius and a circular ring of 4mm radius is removed from the circular ring of 10.2mm radius. Here only a single band is partially observed in the simulation result. To get dual band, a curved ring is designed by removing a hemispherical ring from the circular ring and simulation results are observed. Here the reflection coefficient obtained is not up to the mark. So to obtain good results two rectangular strips are placed on both sides at the top of curved ring, resulting in a U-shaped monopole antenna. Here the reflection coefficient is better when compared to the previous stage. To achieve the desired dual-band characteristics UWB operations, a rectangular monopole is placed in the innermost portion of U-shaped monopole antenna. The antenna provides a dual-band operation due to two different resonating elements. The central rectangular monopole resonates over Bluetooth band while the U-shape element resonates over UWB band [9].

III. PARAMETRIC STUDY OF PROPOSED ANTENNA:

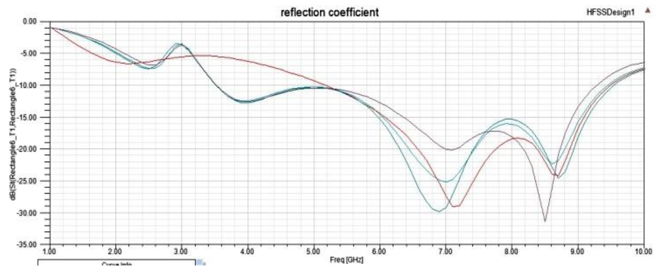

Figure 3: Waveforms for different lengths of monopole

Various parameters are considered to define the performance of a u-shaped dual band antenna such as length of the monopole (L_m), length of the rectangular strip placed on the left side of the U-shaped patch (LRL), length of the rectangular strip placed on the right side of the U-shaped patch (RRL), the width of the left rectangular strip (LWR). Along the above mentioned, antenna performance also depends on ground plane size and shape.

The waveforms for different lengths of rectangular monopole are shown in the figure 3. The reflection coefficient which is obtained by taking the values of rectangular monopole as L_m=6.2 and the values of the rectangular strips on both sides are LRL=6.2 and RLR=6.2 are not effective. So, to get effective reflection coefficient the measurements are changed frequently and a perfect waveform which represents the effective reflection coefficient is obtained at the values of rectangular monopole as $L_{m=}$39.2 and rectangular strips as LRL=5mm and RLR=6.2mm and also the width LRW=6.2mm.For this, the first band at 3.9 GHz operates for WIMAX applications, the second band at 7GHz operates for satellite applications and finally the third band obtained at 8.5GHz used for military requirement for land, airborne and naval radars. The below figure 4 shows the effective reflection coefficient waveform.

Figure 4: Reflection coefficient of desired waveform

IV. CONCLUSION: A simple, low cost and compact printed u-shaped dual band antenna for UWB applications with WLAN band notched characteristic is proposed. This micro stripline fed antenna can be easily integrated. Dimensions of U-shaped monopole govern the UWB band. The proposed antenna provides more than 80% antenna efficiency and gain varies from 2.18–3.098–5.15 GHz (low band) and 5.948–11.434 GHz (high band) for UWB applications with effective control over operating bands. Accordingly, the proposed antenna is a good candidate for integrated UWB systems.

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