CPW FED UWB Monopole With Double Band Notch Antenna With Compact Size

Behnaz MOJAVERNAJAF[1], Yashar ZEHFOROOSH[1]

ABSTRACT

In this paper the new antenna structures firstly a modified band-notched compact printed half-elliptical monopole antenna is proposed for ultra-wideband (UWB) applications. Wider impedance bandwidth can be achieved by carving two sectors on top-side of the semi-ellipse-shaped patch. Two connected arc-shaped slots with a variable angle between them are inserted in the patch to act as a filter structure. The proposed antenna is etched on a FR4 substrate with the size of 25 × 25 × 1.6 mm3 and optimized to operate over the frequency band between 2.5 and 15GHz for VSWR<2, omitting the undesired frequency band

Keyword: *Ultra Wide Band, CPN, Microstrip, Antenna*

1. INTRODUCTION

Ultra-wideband antennas have attracted great attention in the recent years [1-6]. However, over the designated UWB frequency range, there are existing narrow bands used by worldwide interoperability for microwave access (WiMAX) operation in the 3.3{3.7 GHz band and wireless local area network (WLAN) in the 5.15{5.825 GHz band. Therefore, it is desired to design the UWB antenna with dual- notched bands in 3.3-3.7 GHz and 5-6 GHz to minimize the potential interference. Recently, a number of UWB antennas with band-notched characteristics have been discussed [7-{14] and various methods have been used to achieve band notched function, such as embedding a slot of different shapes in the radiating patch [7-10], using parasitic patches [11, 12], embedding a slit in the feeding strip [13], or etching split ring resonator (SRR) coupled to the feed-line [14]. However, each approach above only creates one single altering frequency and is not able to provide satisfactory skirt characteristics and a sufficient rejection bandwidth. In addition, all of the antennas mentioned above have concerned no more than two notched bands and most of them only have one notched band, which cannot fulfill dual or multi-rejected band function. A few dual or multi-rejected band UWB antennas were presented [15, 16]. However, the band-notched characteristics of these antennas are not desirable to avoid the interference problem within the UWB operating band. Obtaining high effective band-notched characteristics is a challenging issue. The main problem of the band rejected function design is the difficulty

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of controlling bandwidth of the notched band, and few band-notched UWB antennas with controllable rejected bandwidth have been presented. In this paper as shown in follow section the new UWB antenna with dual band notch is presented.

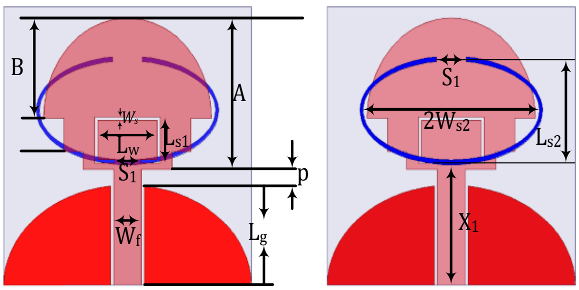


Fig.1. *antenna configuration*

Table 1. *Antenna dimensions*

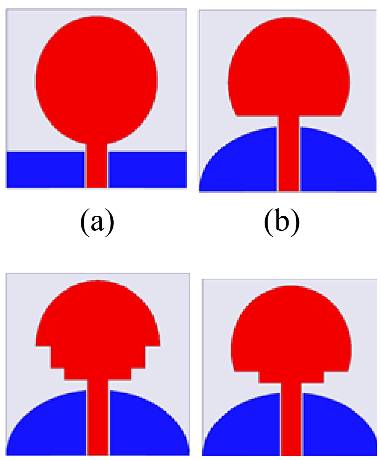
A	13.6mm	Ls1	4.1mm	Ls2	9.7mm
B	9mm	Lw	6.6mm	Ws2	9mm
p	1.48mm	Wf	3mm	Ws	0.3mm
S1	2.6mm	Lg	9mm	X1	10.8mm

2. ANTENNA CONFIGURATION AND DISCUSSION

Figure 1 shows the structure and dimensions of the proposed antenna, whose conductor is fabricated on an inexpensive FR4 substrate with the dielectric constant of εr = 4.4 and the substrate thickness of h = 1.6 mm. The antenna shape were modified using the Ansoft High Frequency Structure Simulator (HFSS). Then the optimal dimensions were determined from experimental adjustment. The dimensions of the designed antenna, including the substrate, is L × W = 25 × 25 mm2. A 50Ω CPW feedline with width of Wf = 3 mm with gap distance of 0.3mm and length of X1=9 mm, is used to feed. The antenna is symmetrical with respect to the longitudinal direction.

The basic antenna structure consists of a truncated ground plane with rectangular shape and a circular patch with. In this structure, the slot is added in the corner of radiating element, because provides a wideband behavior with a relatively good matching [5], also on the ground of the substrate, the ground changed to elliptical shape. The modified radiation patch is created two other rectangular shape slit as an impedance matching element to control the impedance bandwidth of a square monopole (at steps 3 and 4 of Fig.2) [6], because it helps matching the patch with the two-step feedline in a wide range of frequencies. This is because the truncation creates a capacitive load that neutralizes the inductive nature of the patch to produce nearly-pure resistive input impedance [1].

The dimensions of the notch (2Ls+2Lw-S1) embedded in the radiation patch plane are important parameters in determining the sensitivity of rejection band of 5.5GHz. The variation of Lw and S1 parameters is shown in Fig.4 (a, b). For creation band rejection of antenna in centered frequency of 3.5GHz, an elliptical shape is embedded in other side of patch.



(a) (b)

(c) (d)

Fig 2. *Antenna steps for designing*

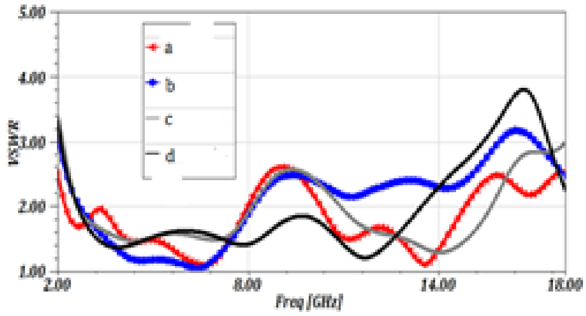
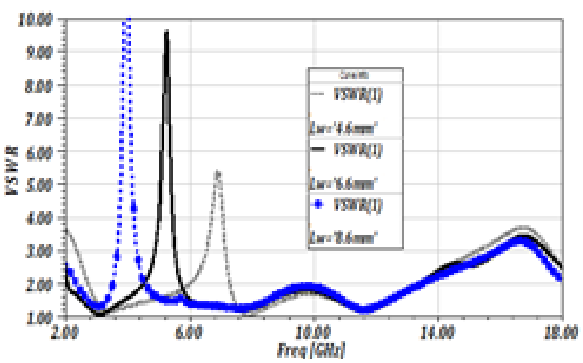


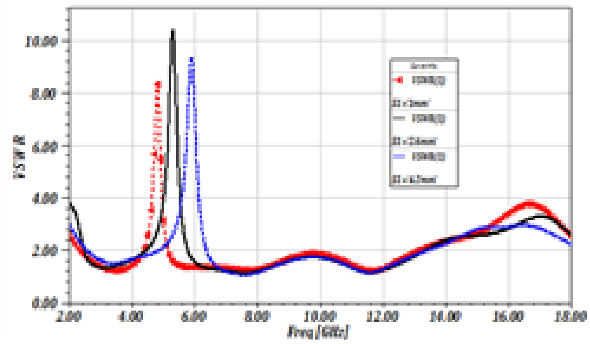
Fig.3 *VSWR variation of antenna designing steps in Fig 2*

3. RESULT AND DISCUSSION

Figure 5 illustrates the simulated and measured return loss curves of the proposed antenna against the frequency. A good agreement between the simulated and measured results has been observed. The measured results indicate that the -10 dB impedance bandwidth of the proposed antenna is in the frequency range from 2.5 to 15 GHz, which cover the bandwidth of the FCC definition for UWB indoor communication systems. It is also seen that the proposed antenna exhibits a notched band of 3.5 and 5.5GHz. The slight deviation of measured results from simulated one is mainly due to fabrication errors. The radiation characteristics of the proposed antenna are measured in a 5:5m × 5m × 3m anechoic chamber with an Agilent E8362C network analyzer along with far field measurement software.



(a)



(b)

Fig. 4 *The variation of Lw and S1 parameters*

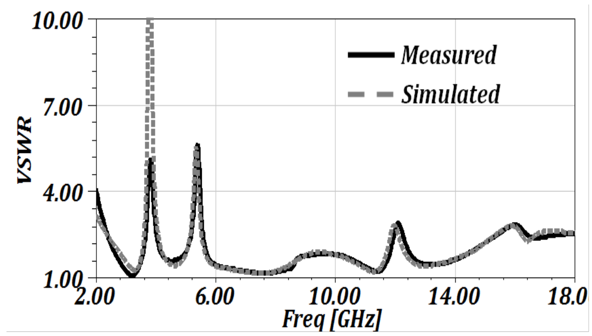


Fig.5 *comparison between simulated and measured VSWR*

It is observed from Figure 6 that at low frequency of 3 GHz both E-and H-plane radiation patterns are Omni-directional. As the frequency increases, both the planes become slightly directional due to higher order harmonic and nulls introduced in the patterns as expected. Despite of band notched structure, the proposed antenna with single band notch characteristics can exhibit stable radiation patterns and retains its Omni-directionality throughout the operating band. Figure 7 shows the measured peak gain of the proposed band notch antenna in the UWB frequency range. It is seen that the antenna achieved good gain throughout ultra-wide frequency band except at notched bands. The photograph of fabricated antenna is presented in Figure 8.

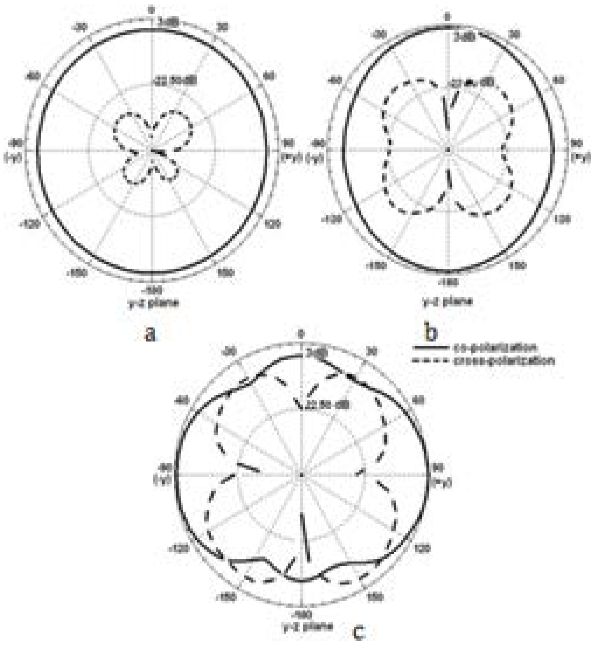


Fig. 6 measured radiation patterns of the proposed antenna for two planes at (a) 3.0 GHz, (b) 6.0 GHz and (c) 8.0 GHz

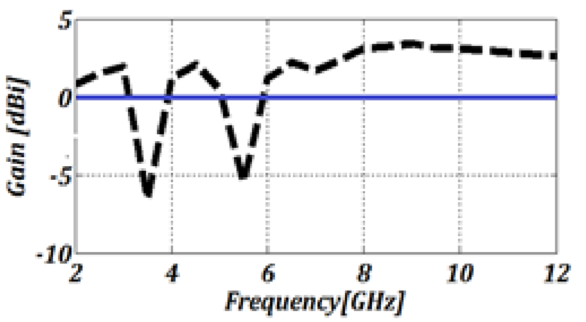


Fig. 7 measured peak gain of the proposed band notch antenna

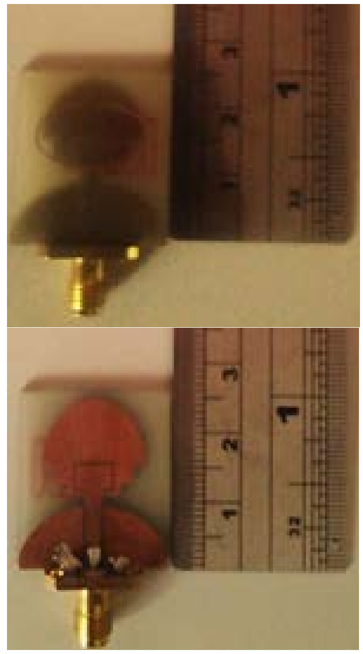


Fig. 8 photograph of fabricated antenna

4. CONCLUSION

A compact UWB monopole antenna with triple band-notched characteristics is presented and investigated. We have discussed that by etching C-shaped slot in the patch and placing an elliptical C shaped under patch of radiating patch, double band-notched characteristic is achieved. The radiation patterns in the H-plane are nearly omnidirectional over the entire UWB band. The gain is stable with a sharp decrease in the designed notched bands. Consequently, the proposed antennas are expected to be a good candidate in various portable UWB systems.

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