DESIGN and Fabrication of A WRENCH SHAPED UWB ANTENNA

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Abstract – Recently the wireless communications market is growing much faster, with the increasing demand for portable compact devices, due to the need to support higher capacities while providing higher data rates. The paper proposed a wrench shaped UWB antenna that fulfills the FCC regulations. The band is extended from 3.2 GHz to 12 GHz with omnidirectional radiation pattern. the structure is compact covering a size of 30×30 $mm^2$where the wrench shaped is of dimensions 21× 28 mm^2. It is implanted on a Roger RO4350 (Lossy) substrate layer of thickness 1.524, of εr = 3.66. The back layer of the implemented structure (ground) is loaded by a patch for tuning the notch frequency.

I. INTRODUCTION

The growth of wireless broadband communications systems including text, data, voice and video is an urgent demand. A lot of researchers where directed to the development of an antenna which fulfill the requirements for ultra-wide band applications [1-10]. Ultra wide band antenna (UWB) is a good candidate for this target. It's advantages directed the interests of researchers towards developing new shapes. On the other hand UWB signals are defined as those with either a relative bandwidth greater than 20%, or an absolute bandwidth greater than 500 MHz [1, 6, 7, 9].

The FCC attempted to introduce UWB technology for the market meanwhile dodging any conflicts that may occur with the other known narrowband technologies. They imposed aggressive restrictions for the UWB transmitted power. FCC has set a power requirement of -41.3dBm/MHz or an equivalent of 75 nanowatts/MHz for UWB systems. Such power restrictions allows UWB systems to reside below the noise floor of a typical narrowband receiver and enables UWB signals to coexist with current radio services with minimal or no interference [10,7-11].

This article presents the design, analysis , and fabrication of the wrench shaped UWB antenna with tuning notches to minimize the interference of some applications.

II. ANTENNA DESIGN

The microstrip-fed wrench-shaped UWB antenna is designed using CST Microwave Studio. It is fabricated on an Rogers RO4350 substrate (ϵ_r= 3.66, tanδ = 0.004) with overall dimensions of L × W × H, where L is 30 mm, W is 30 mm, and H is 1.524 mm. Figs. 1 and 2 show the symmetrical geometry of the designed and fabricated antenna respectively, whereas the dimensions of the wrench shaped UWB antenna is depicted in table1.

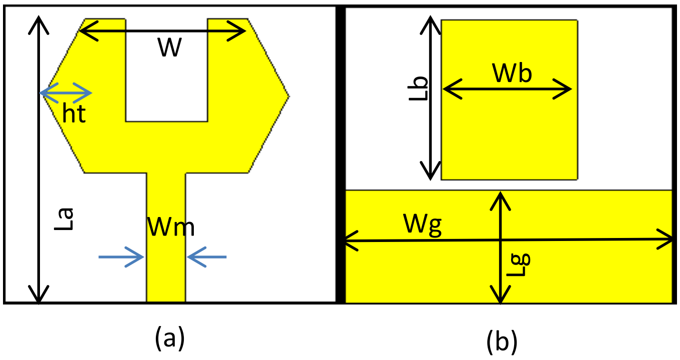


Fig.1 Antenna design
(a) top view(b) bottom view

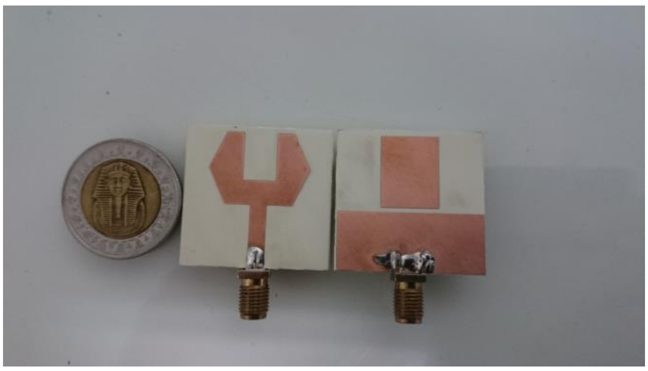


Fig.2 Fabricated wrench shaped UWB antenna

Table1: Wrench shaped antenna dimensions

Dimensions	Mm
W	14
L	15
Wm	3.36
Ht	3.5
Wb	12
Lb	15
Wg	30
Lg	12

III. SIMULATED AND MEASURED RESULTS

The simulated and measured return loss of the antenna without notch is illustrated in figure 3. It operates along the frequency range from 3.6 GHz to 12 GHz . There is a bit shift for the measured results which might be due to the setup environment which does not equip with absorbing material. To avoid the interference of WiFi and some radar applications the back layer of the antenna structure is loaded by a patch of dimension 12×15 mm^2. The simulated and measured return loss of the antenna exhibits a notch at 4.9 GHz with bandwidth 480 MHz and 10.45 GHz with bandwidth 794MHz as shown in figure 4.

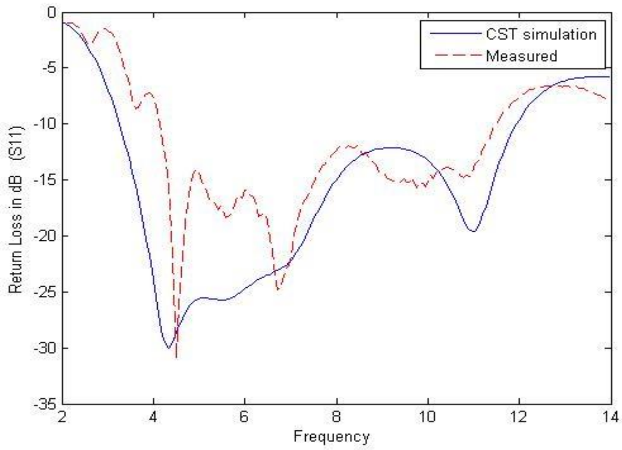


Fig.3 Return loss of a wrench shaped antenna without notch

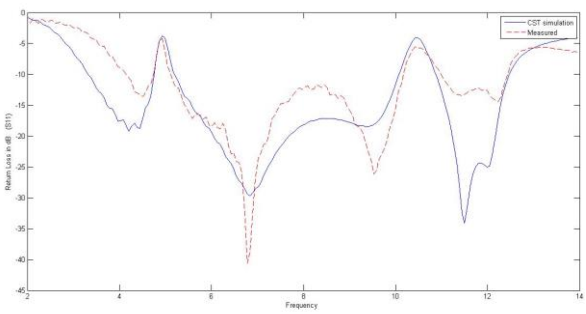


Fig.4 Return loss of a wrench shaped antenna with notch

Figure 5 illustrates a parametric sweep which obtained on the width of the patch at the back layer of the antenna structure to control the required notch.

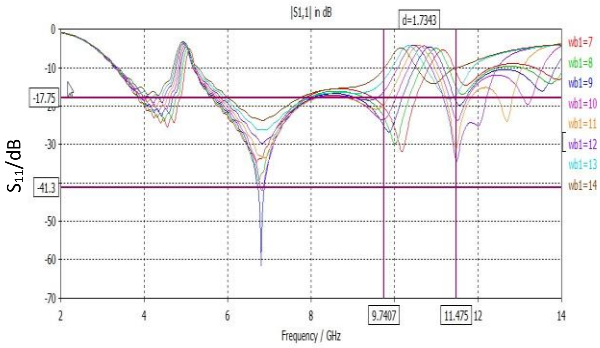


Figure 5: Parametric Sweep on the width of the patch

Figure 6 illustrates the relation between the width of notch patch and the notch frequency. It is clear that one can select the desired notch frequency according to the notch width

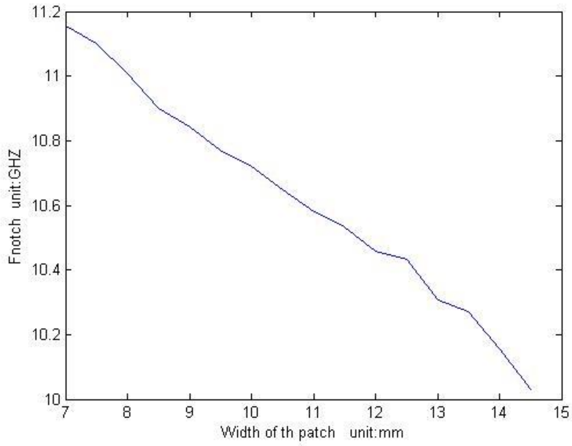


Figure 6: Relation between frequency and patch width

Figures 7 and 8 illustrate the 3D radiation pattern of the UWB antenna without notch at frequencies 4 GHz and 6 GHz. It is clear that it is an omnidirectional pattern. Moreover the E-plane and H-plane cuts at 9 GHz is shown in figures 9and 10.

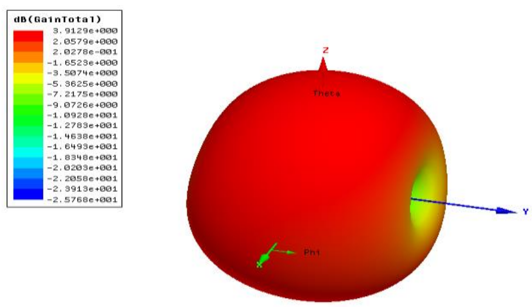


Figure 7: 3D radiation pattern of UWB antenna without notch at 4 GHz

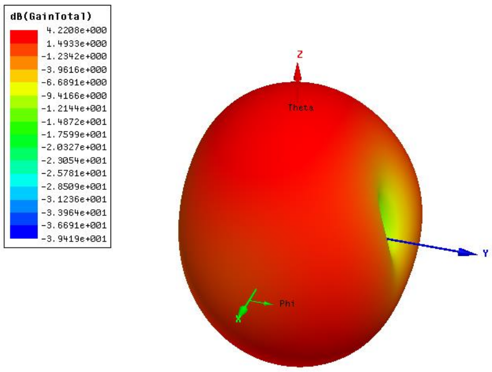
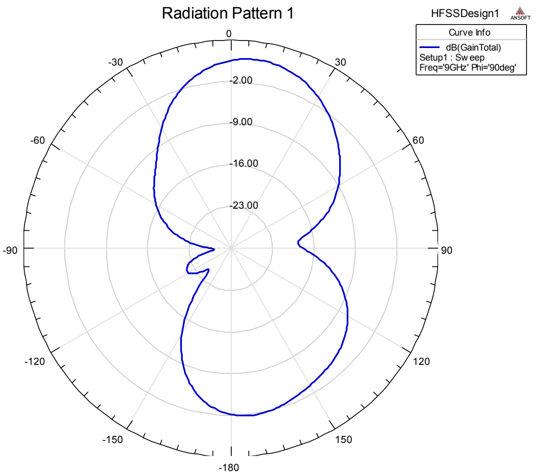
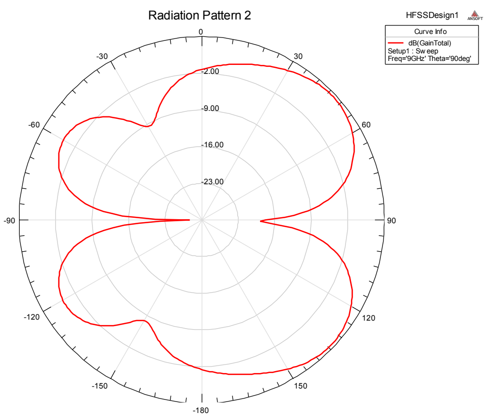


Figure 8: 3D radiation pattern of UWB antenna without notch at 6 GHz



E-plane

Figure 9: The radiation pattern of UWB antenna without notch at 9 GHz



H-plane

Figure 10: The radiation pattern of UWB antenna without notch at 9 GHz

Figure 11 illustrates the surface current at 9 GHz. It shows that the current is outlined at the antenna edges accurately.

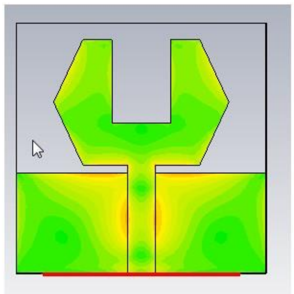


Fig.11 Surface current at 9 GHz

Figure 12 illustrates the measured and simulated group delay of the antenna along the operating band. It is clear that the group delay is within the range which is convenient for digital communications.

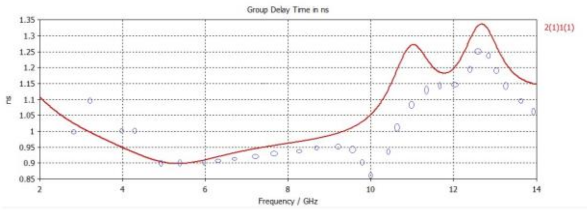


Fig.12 Group delay

V. CONCLUSION

This article has successfully designed the new-shaped UWB antenna which has proven to operate on many applications like the WiFi, WiMAX, and radar applications. This has been demonstrated throughout the research's design through a sophisticated comparison of the simulated parameters with the measured ones. Thus proving authenticity of the research, whereas the antenna operates within the band of 3.6 GHz – 12 GHz with respect to the -10dB.

VI. ACKNOLEDGEMENT

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