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# WLAN Lower Band Notch Hexagonal Monopole UWB Antenna

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***Abstract*—In this paper, we designed a novel printed micro strip fed hexagonal monopole antenna for UWB applications with WLAN lower band notch. Antenna is having hexagonal patch with modified ground plane. Antenna is simulated using CAD FEKO suit (6.2) using Method Of Moment(MOM). Hexagonal shaped antenna is fabricated using FR4 dielectric substrate with dielectric constant of 4.4 and loss tangent of 0.02. UWB antenna is of compact size 30mm × 30mm. The hexagonal antenna can provide good impedance matching from frequency range of 3.1-10.6 GHz. C-shaped notch is created in the radiating patch rejecting the undesired frequency band from 5 to 5.41 WLAN lower band. Accordingly, the mutual EMI between UWB and WLAN system can be eliminated or minimized.**

***Keywords—Hexagonal Antanna,CAD FEKO, UWB, Printed Microstrip Antenna, Monopole Antenna, WLAN lower band, C-shape notch.***

## I. INTRODUCTION

The development of ultra-wideband (UWB) applications as a part of wireless technology has increased the damand for ultra wideband antenna. The commercial usage of UWB frequency band in wireless system, from 3.1 to 10.6 GHz, was approved by Federal communication commission (FCC) in 2002 [1-2]. The printed monopole antennas which are newly proposed UWB antenna should be good candidate for future work. It has been received much attention for their compact size, omnidirectional radiation pattern, high radiation efficiency, easy to build and integrate with compact RF front ends as well as multitasking capability. Several printed monopole antennas have been proposed with different geometries [3-6]. Different types of printed monopole antennas such as rectangular, circular disc, elliptical and binomial curved shaped have been proposed for UWB applications. Here we are using rectangular structure which is modified to hexa shape. It has compact size compared to square and circular microstrip antenna for given frequency. Compact size antenna is suitable for portable communication equipments. The Printed monopole antennas fabricated on a substrate offer wide impedance bandwidth which can cover UWB. Various techniques have been proposed in recent year to broaden the bandwidth of antenna such as use of trident-shaped feeding strip, embedding a pair of notches in the two lower corners of the patch and the notch structure in the upper edge of the ground plane, this technique we used in our design. Other techniques such as using two bevel slots on the upper edge and two semicircle slots on the bottom edge of the ground plane and using a half-bowtie radiation patch with staircase. By using a pair of variable L-shaped slots, cut in ground plane, additional resonance are excited and hence bandwidth is increased up to 130% [4]. This hexagonal antenna can obtained whole UWB spectrum, there exist some narrow bands for other communication system, such as IEEE 802.11a wireless local area network(WLAN) system operating at 5.15-5.825 GHz, HiperLAN2(5.47-5.725 GHz) and (7.25-7.75 GHz) for downlink of X-band satellite communication system.



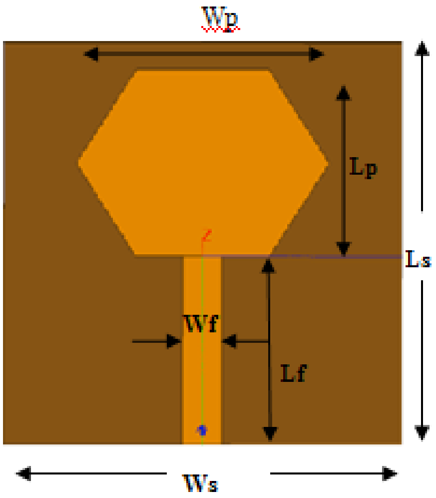
These narrowband system will cause electromagnetic interference(EMI) to the UWB system. A way to suppress this EM interference is to connect several bandstop filters to the UWB antenna. But it increases the complexity of the system[7]. This problem is solved by notching the existing frequency band from UWB frequency spectrum so that interference does not occur which is shown by various papers [1,3,5,7].

A number of strategies have been proposed to address the band-notch problem by inserting slots of different shapes and size, either in patch or ground.[2-12]. Typical slot shapes are: rectangular, C-shaped[9], pi-shaped, E-shaped[4], H-shaped and U-shaped[5,10].

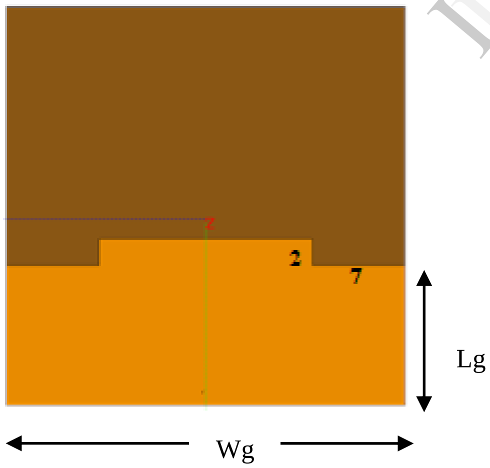
In this paper, a novel printed micro-strip fed hexagonal monopole antenna is designed and simulated. To improve bandwidth two rectangular notches inserted on the ground plane. The design of antenna is presented in the next section. Simulation is done using CAD FEKO electromagnetic software using method of moment is presented in section 3. A conclusion of proposed antenna is given in last section.

## II. ANTENNA DESIGN

The geometry of proposed antenna is shown in Fig. 1 with varied dimensions. The radiating monopole and feeding mechanism are printed on the top side of the substrate, while the ground plane is printed on bottom side. This antenna is mounted on FR-4 printed circuit board(PCB) substrate 30 x 30 $mm^2$ with a dielectric constant of 4.4 and thickness of h= 1.6mm. The microstrip feeding has a single strip with a dimension of 3 x 14 $mm^2$ to achieve 50 Ω characteristics impedance. The ground plane dimensions are chosen to be 30mm × 12.5mm and the gap between patch and partial ground plane is 1.5 mm, which is used to increase the bandwidth of antenna. The Fig. 1, (a) and (b) shows the basic geometry of planned UWB antenna with hexagonal patch and partial ground plane. The Fig. 2 shows the geometry of proposed antenna design with C-shaped notch. Fig 2 (a) shows C-shaped notch in the patch. Fig 2 (b) shows structure of C-shaped notch.




(a)

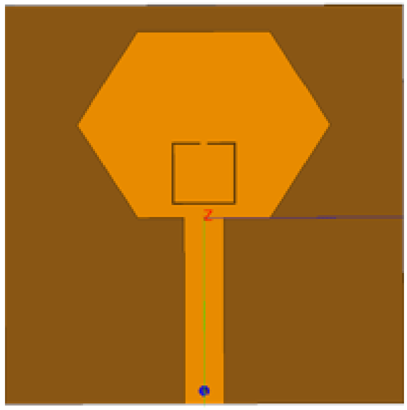



(b)

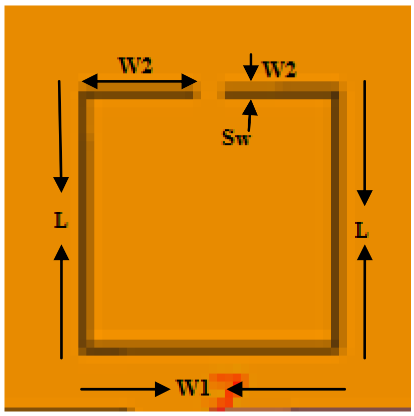
Fig. 1: Configuration of the Hexagonal UWB antenna: (a) Front view; (b) Back view

Table 1. Optimized parameter of the proposed antenna.

| Wp | Lp | Ws | Ls | Wg | Lg | Wf | Lf |
|---|---|---|---|---|---|---|---|
| 19 | 14 | 30 | 30 | 30 | 12.5 | 3 | 14 |



(a)




(b)

Fig 2: The Geometry of Proposed antenna with band notch: (a) Geometry of the proposed antenna; (b) structure of C-shaped notch

Table 2. Optimized parameter of C-shaped notch

| W1 | W2 | L | Sw |
|---|---|---|---|
| 4.85 | 2 | 4.5 | 0.10 |

## III. SIMULATION RESULTS AND DISCUSSIONS

In this section, UWB monopole antenna with various dimensions was designed. The parameter of this proposed antenna are studied by changing one parameter at a time and fixing the other. The simulated results are obtained using CAD FEKO suit (6.2) using Method Of Moment (MOM).

The curve of the simulated VSWR for hexagonal UWB antenna is shown in Fig 3. It shows that VSWR<= 2 for 3.22 to 10.7 GHz.

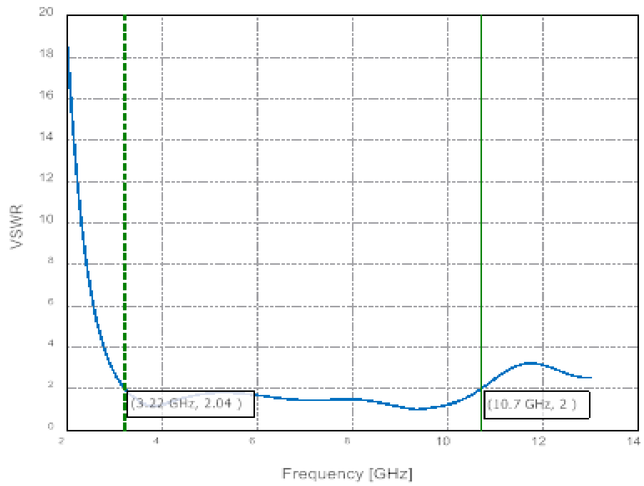



Fig 3. Simulated VSWR for Hexagonal UWB antenna

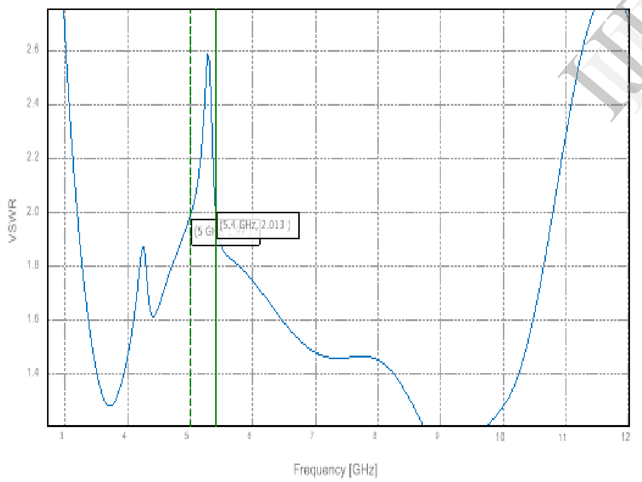



Fig 4. Simulated VSWR for proposed antenna with band notch

Above Fig 4 shows lower WLAN band notched i.e. from 5 GHz to 5.41 GHz. This is one of the narrow band system interfering with UWB. Fig 5 shows comparison of different w1 as 4.85, 4.75, 4.5. As w1 decreases notch band shifts towards higher edge and at w1= 4.85mm got good notch.

Next, Fig 6 shows comparison of different w2 as 2, 1.8, 1.7 and got good notch for w2=2. Fig 7, gives comparison of various slot width which is giving approximately similar graph at WLAN lower edge.

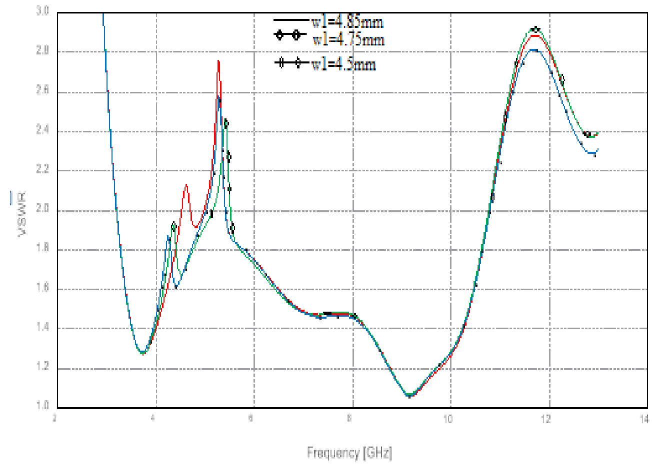



Fig 5. Simulated VSWR Characteristic for various values of w1

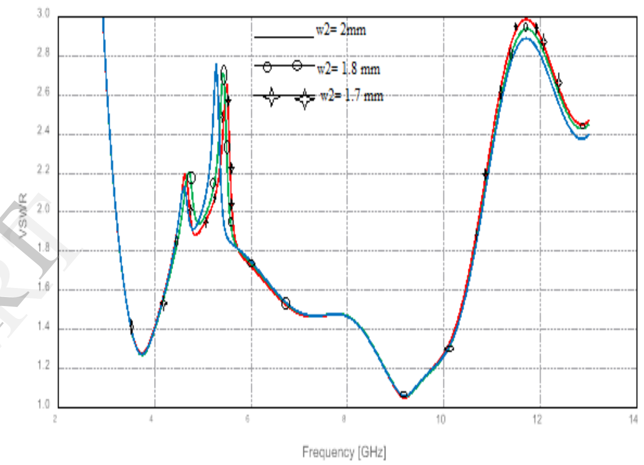



Fig 6. Simulated VSWR Characteristic for various values of w2

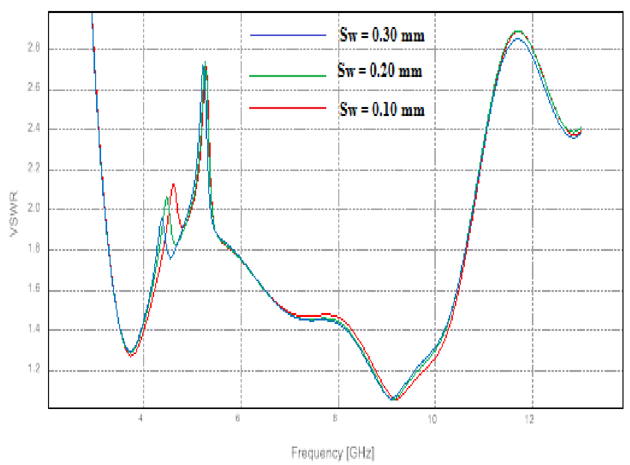
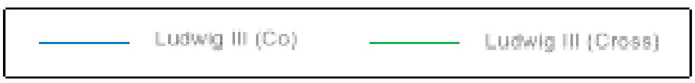
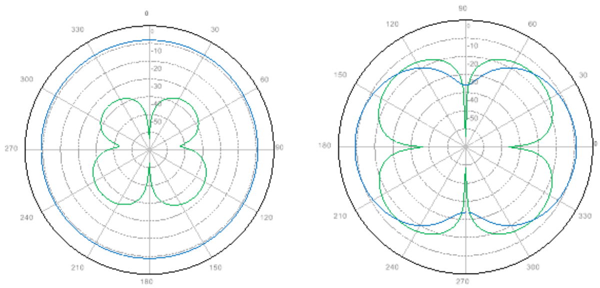
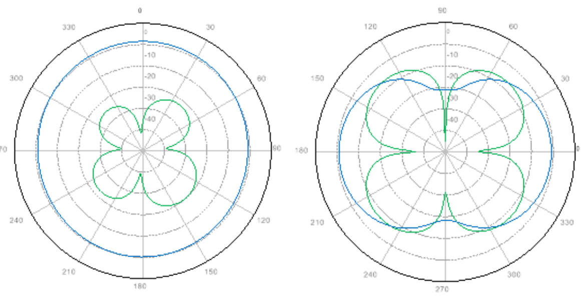



Fig 7. Simulated VSWR characteristic for various Slot width (Sw)

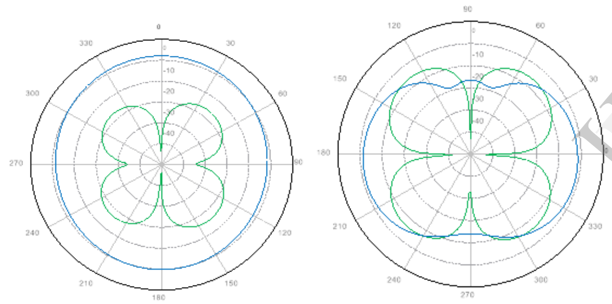




H-plane 3.22 GHz E-plane



H-plane 4.29 GHz E-plane



H-plane 5.36 GHz E-plane

Fig 8. Radiation Pattern of the proposed antenna at 3.22, 4.29, 5.36 GHz

Above Fig 8 shows radiation pattern in H-plane and E-plane at various frequencies. It shows nearly omnidirectional radiation pattern in H-plane and directional pattern in E-plane.

Fig 9 and Fig 10 shows gain and efficiency of Hexagonal UWB antenna. Gain is nearly constant at lower frequencies and goes on decreasing in higher edge. Efficiency graph shows two notch as there is peak at that frequencies. Efficiency is above 75% expect notch.

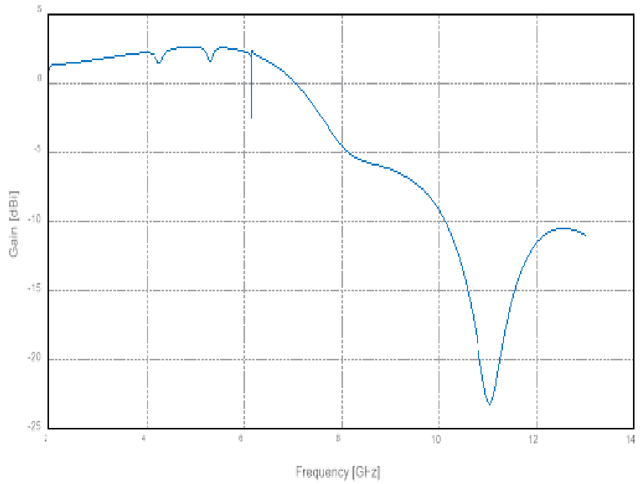



Fig 9. Antenna Gain over the frequency band

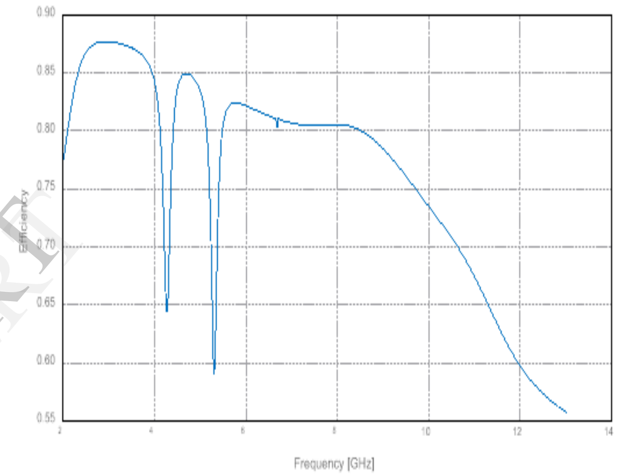



Fig 10. Antenna Efficiency over the frequency band



## IV. CONCLUSION

A Novel Printed Hexagonal Monopole UWB antenna is designed and simulated. The frequency notch function is obtained by adding a C-shape slot in the radiating patch.
The result shown here is simulated on CAD FEKO suit (6.2).
The designed hexagonal antenna shows good UWB performance and achieves band notching from 5 to 5.41 GHz to avoid interference with WLAN. This antenna is good for UWB applications.

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