Design CPW-Fed Printed Monopole UWB Antenna for Band Notched Applications

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***Abstract*—A coplanar waveguide (CPW)-fed printed monopole UWB antenna is proposed. The antenna has dual band notched characteristics for ultra-wideband (UWB) applications. The proposed CPW-fed antenna consist of stepped feed line, stepped ground plane, stepped rectangular patch, U-slot, and C-slot to improve the bandwidth. By removing a C shaped slot and a U shaped slot from stepped patch, the band reject property is obtained at 3.4GHz/4.4GHz. The antenna is designed on the FR4 epoxy substrate with 24 (length) x 24 (width) surface area. A 50Ω Co-Planar Waveguide (CPW) transmission line is used to feed the printed stepped patch. The design and simulation of the antenna is completed by High Frequency Structure Simulator (HFSS) software. High Frequency Structure Simulator is frequency domain simulation software. Finite Element Method (FEM) method is in HFSS software used for antenna structure optimal design and performance simulation. The simulation result shows that, the compact antenna has good results including consistent radiation patterns, stable gain, with better return loss, broadband impedance matching.**

Keywords—CPW-fed, UWB antenna, feed lines, monopole antenna.

I. INTRODUCTION

An antenna is a specialized transducer that converts radio frequency (RF) field into alternating currents (AC) or vice_ versa. In recent year, Ultra Wide-Band (UWB) antennas plays vital role in wireless communication system after the Federal Communication Commission (FCC) ruling in Feb 2002 for spectrum's 3.1 to 10.6 GHz commercial use of the UWB communication system[1]. Ultra Wide-Band (UWB) occupies 500 MHz signal bandwidth. Now a day, the increase growth of ultra wide-band wireless technology has motivated researchers to design a compact size of UWB antenna. This is because UWB antenna has some merits as high speed data rate, simple structure, low cost, and extremely low spectral power. UWB antenna having so many types such as TEM horn, spiral, Vivaldi, bow-tie and dielectric loaded antenna, which covers entire 3.1-10.6 GHz frequency band. UWB also have wide applications in short range and high speed wireless system such as medical imaging, ground penetrating radar, C-band, HIPERLAN, Worldwide Interoperability for Microwave (Wimax), most among them is Wireless Local Area Network (WLAN). WLAN operate with center frequency of 2.4 GHz, 5.2GHz and 5.8 GHz, which create interference with functioning of UWB system. By designed band notched characteristics the electromagnetic interference is avoided in UWB system. Band notched characteristics obtained by removing different shaped slots like as U-slot, C-slot, and L-slot etc. from the patch of antenna.

Design of UWB monopole antennas mainly include two types as printed planar monopole antenna and metal plate antenna. Mostly planar printed monopole antenna used in UWB application as they have the regular shapes such as circular, elliptical, rectangular, square, hexagonal, pentagonal and modified elliptical etc. Printed monopole antenna is compact in structure, good radiation patterns and easy to fabricate. The antenna increases their band width by changing the shape of the ground plane and radiation patch. For example, in [2]-[4], the circular and rectangular monopole antenna were modified and proposed antenna show very large impedance bandwidth. In [5]-[6], impedance bandwidth of the antenna is upgraded by the way of CWP-fed. In [7], band notched characteristics has obtained by removing C-shaped slot in radiator and one rectangular slot in ground plane.

Finite Element Method (FEM) method is used for antenna structure optimal design and performance simulation. Finite Element Method (FEM) is frequency domain technique based full-wave computational technique. A full-wave computational technique gives a complete solution to Maxwell's equations within the computational space for all conductors. This paper proposed a compact and simple CPW fed monopole antenna with band notched characteristic on 3.4GHz and 4.4GHz. The band notch characteristics are achieved by removing U shaped and one C shaped slot from patch and feed by 50 Ω transmission line. The optimization of the design and subsequent simulations are done with HESS software which is based on FEM. The proposed antenna provides a good bandwidth with VSWR<2. Both return loss and gain of the antenna are affected by dielectric constant of substrate. The center frequency of the band notched finely balanced by changing the position and dimension of the slots. Fig.1. show design methodology flow chart for CPW-fed monopole antenna.

II. ANTENN DESGIN

Figure.2 shows the geometry and configuration of UWB monopole antenna with dual band characteristic Antenna consists of rectangular patch, steeped ground plane feed lines

to improve the input impedance bandwidth and radiation patterns. Antenna is printed on FR4 epoxy substrate with thickness of 1.5mm and relative permittivity or dielectric constant of 4.4 and tangent loss of 0.002. The printed monopole antenna has compact size 24x24 mm2. As shown in figure an one U shaped and C shaped slot are cut on the stepped patch to achieve band notch characteristics, which is used to avoiding electromagnetic interference. The CPW fed transmission line is designed with 50Ω characteristic impedance with 3mm feed line width and 2.5mm ground gap. HFSS is frequency domain simulation software based on FEM which gives a better simulation results in terms of radiation pattern and stable gain and consistent input impedance bandwidth. The design parameter are L0=24mm, W0=24mm, H0=10mm, H2=4mm, SW1=20.6mm, Slot1=0.2mm, SW2=8.8mm, SS2=2.4mm, Slot2=0.2mm, GW1=8mm, CW1=3mm, CH1=2mm, CH2=5mm, CH3=8.5mm.

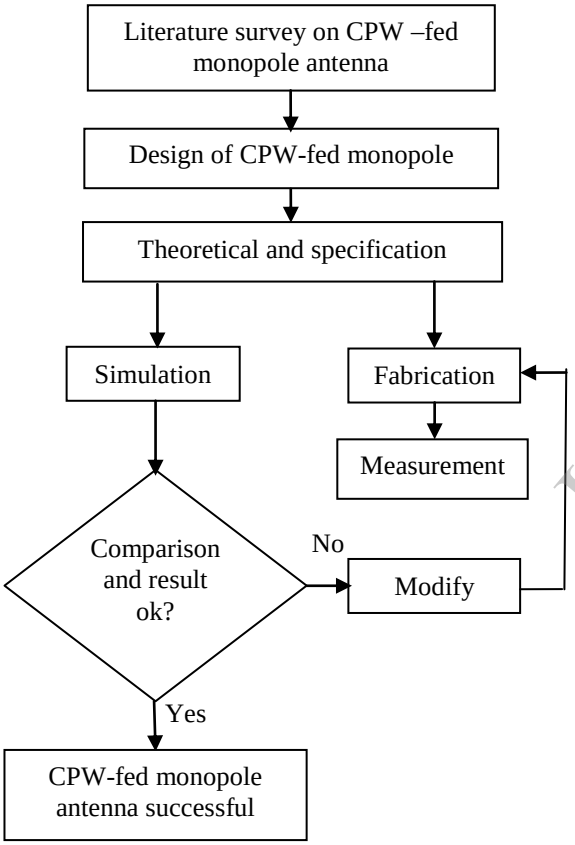


Fig.1. Design Methodology Flow Chart

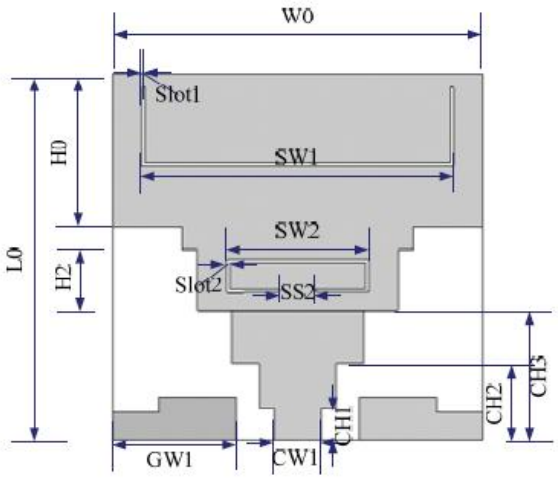


Fig.2. Geometry of CPW-Fed Monopole Antenna

III. RESULT AND DISCUSSION

The CPW-fed printed monopole antenna simulated by HFSS software, which gives a better performance of returns loss, radiation pattern for both E-plane and H-plane, stable gain and VSWR. The frequency domain characteristic of the antenna is obtained by using the Finite Element Method (FEM) of the simulation data. Fig. 3 show simulated results show that the antenna has return loss with -10dB impedance bandwidth covering the frequency range 5-10.6GHz with the modified rectangular in the ground plane and radiation patch, good impedance matching is obtained, and the return loss.

The simulated VSWR of the dual band notched antenna is shown in figure 4. It is noted from the simulated results that the antenna covers the frequency range 5-10.6GHz and has dual band notched characteristics (VSWR>2) in the 3.4 GHz and 4.4GHz. Center frequency of band notched band is affected by the length and location of C-slot and U-slot.

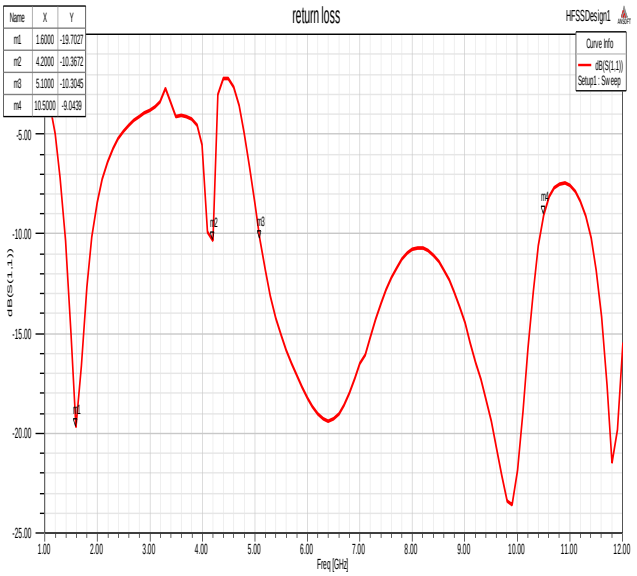


Fig.3. Simulated Return Loss of Proposed Antenna

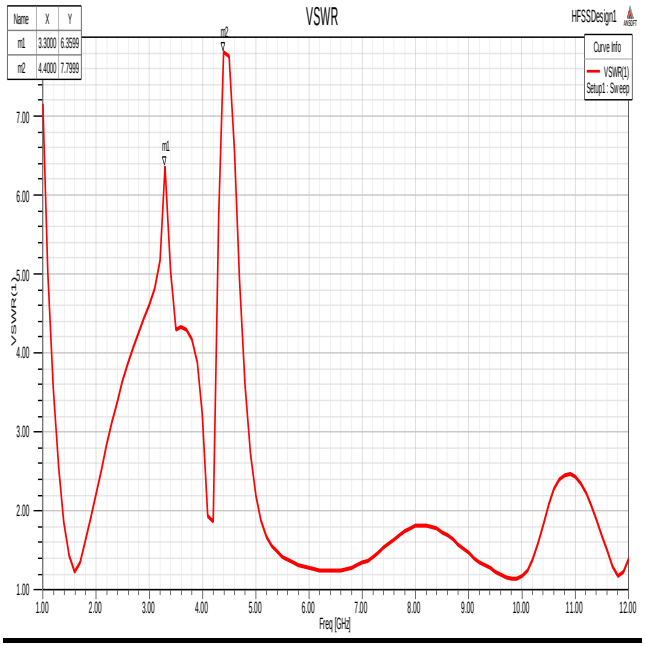
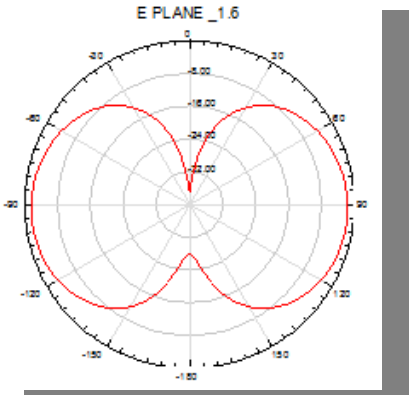
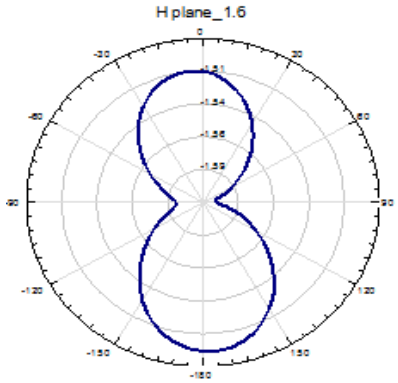


Fig.4. Simulated VSWR of Proposed Antenna

The far-field radiation characteristics at 1.6, 4.2, 6.4 and 9.8 GHz are given in Figs. 5-8, respectively.

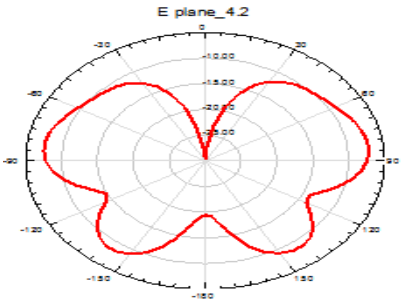


a) E-plane

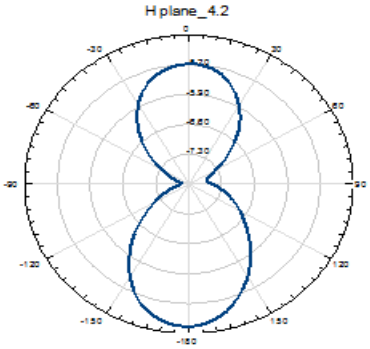


b) H-plane

Fig. 5. Simulated Radiation Patterns at 1.6 GHz.

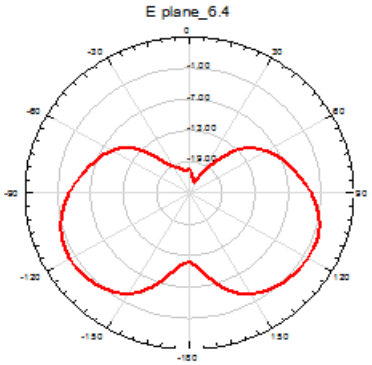


a) E-plane

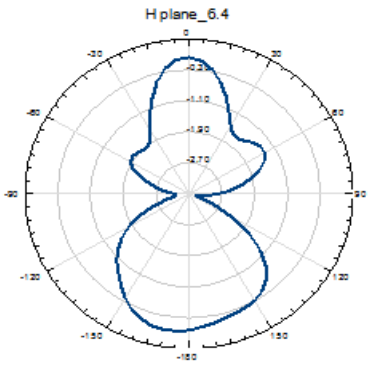


b) H-plane

Fig. 6. Simulated Radiation Patterns at 4.2 GHz.

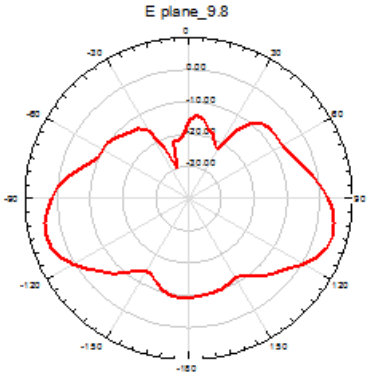


b) E-plane

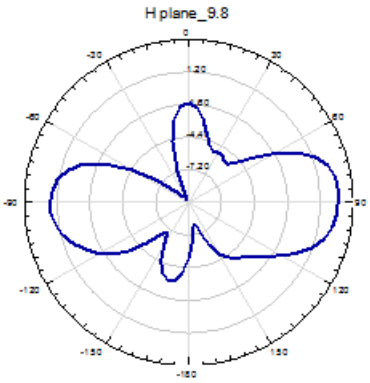


b) H-plane

Fig. 7. Simulated Radiation Patterns at 6.4 GHz



a) E-plane



b) H-plane

Fig. 8. Simulated Radiation Patterns at 9.8 GHz.

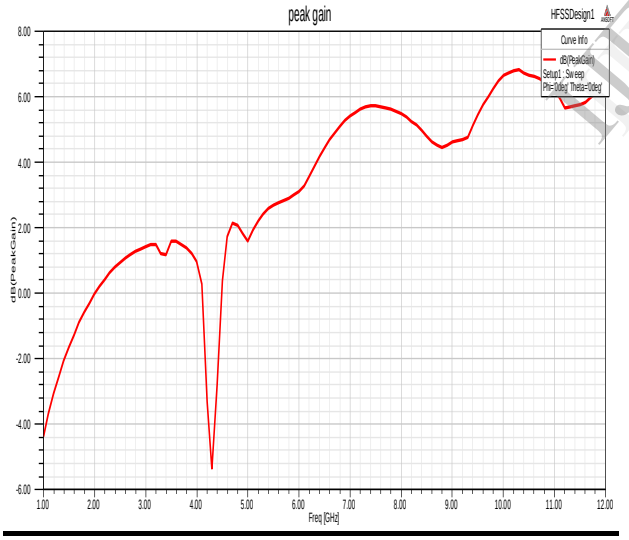


Fig.9. Simulated Peak Gain of Proposed Antenna

Figure 9 show simulated peak gain of proposed antenna. Figure shows that the gain decreases abruptly at 4.2GHz. Which mean good band-notched characteristic have been obtained and interference can be minimized for UWB antenna.

IV. CONCLUSIONS

A compact CPW-Fed printed monopole antenna with band notched characteristic for ultra wideband applications has been implemented in this paper. FEM in the frequency domain technique has been used for simulation, to cover a wide frequency range with time domain code. The total antenna size is 24x24 mm2. The antenna has simple structure, compact size, easily fabricated on epoxy substrate with low manufacturing cost and good wideband characteristic. Use of the U slot and C slot, the gain performance of antenna is increased over the entire operation bandwidth. Its -10 db band is extended up to 8.5 GHz. Band notched characteristics at 3.1GHz and 5.2 GHz are separately achieved by removing one C-slot and U-slot in the stepped radiation patch. Simulation results show that, the antenna has improved results in terms of returns loss, gain, and radiation patterns.

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