Monopole Antenna for Ultra Wideband Applications

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Abstract: We aim to design a novel monopole antenna for ultra wide band applications. The designed antenna consist of monopole design fed with co-axial SMA connectors. This provides a very wide band of more than 120% for 2GHz-12GHz.The proposed antenna is of dimension 50mm X 60mm. The performance of the antenna is assess using ANSYS HFSS. The return loss and pattern measurement is done, which shows that the antenna performance was good and results were optimum within the UWB frequency range and the results are compared and verified.

Index Terms—**Monopole, Patch antenna, S11, Ultra Wide Band (UWB).**

I. INTRODUCTION

For the Ultra Wide Band antennas , conventionally we use spiral or log periodic structures which are dispersive by nature that leads to different parts of the antenna radiate at different frequency which distorts the radiated waveform.Now a days several monopole design of different structures as hexagonal, pentagonal, square, rectangle and elliptical works in the ultra wide band applications [3]-[7].Due the simplicity in structures and small cost the planar monopole antenna widely used in ultra wide band applications. As the planar monopole antenna are very useful in UWB applications therefore these days the research activity are focused on them. In the UWB communication systems, the main challenge is to design a compact antenna for wideband characteristic over the operating band [5].

Consequently, there are number of planar monopoles are designed of different geometries for these applications and have been experimentally characterized [4]. We consider a simple planar monopole structure for the required UWB applications.

II. DESIGN SPECIFICATION AND FORMULA

Microstrip patch antenna consists of a conducting patch of width W=38mm and length L=30mm on one side of dielectric substrate of thickness h=1.6 mm and dielectric constant ε_r=4.4 which has a ground plane of size 22mm X 50mm on the other side . To enhance the fringing fields that accounts for the radiation pattern of the antenna and larger bandwidth but it results in larger antenna size.

The width (W) and Length (L) of the patch has been determined using the following Formula [7].

   (i)   Calculation of Width (W):

$$W = \frac{c}{2 * f_r} \sqrt{\frac{2}{\varepsilon_r + 1}} \qquad (1)$$

Where   C= free space velocity of light ε_r= dielectric constant of the substrate

(ii). The effective dielectric constant of the rectangular microstrip patch antenna. $\frac{W}{h} > 1$

$$\varepsilon_{r_{eff}} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2} + \left(1 + \frac{12 * h}{W}\right)^{1/2} \qquad (2)$$

(iii).The resonant length of patch is not exactly equal to the physical length due to the fringing fields on the sides of patch. The actual length of Patch (L)

$$L = \frac{c}{2 * f_r * \sqrt{\varepsilon_r}} \qquad (3)$$

(iv)Effective length L_{eff} of patch is longer than its physical length and is given as:

$$L_{eff} = L - 2\Delta L \qquad (4)$$

(v). Increase in patch length:

$$\frac{\Delta L}{h} = 0.412 \frac{\left(\varepsilon_{r_{eff}} + 1\right)\left(\frac{W}{h} + 0.244\right)}{\left(\varepsilon_{r_{eff}} - 0.258\right)\left(\frac{W}{h} + 0.8\right)} \qquad (5)$$

DESIGN AND ANALYSIS OF PATCH ANTENNA

The monopole design of the microstrip patch antenna is mention in figure 1. The mention parameter are mention in table 1.

(a) **(b)**
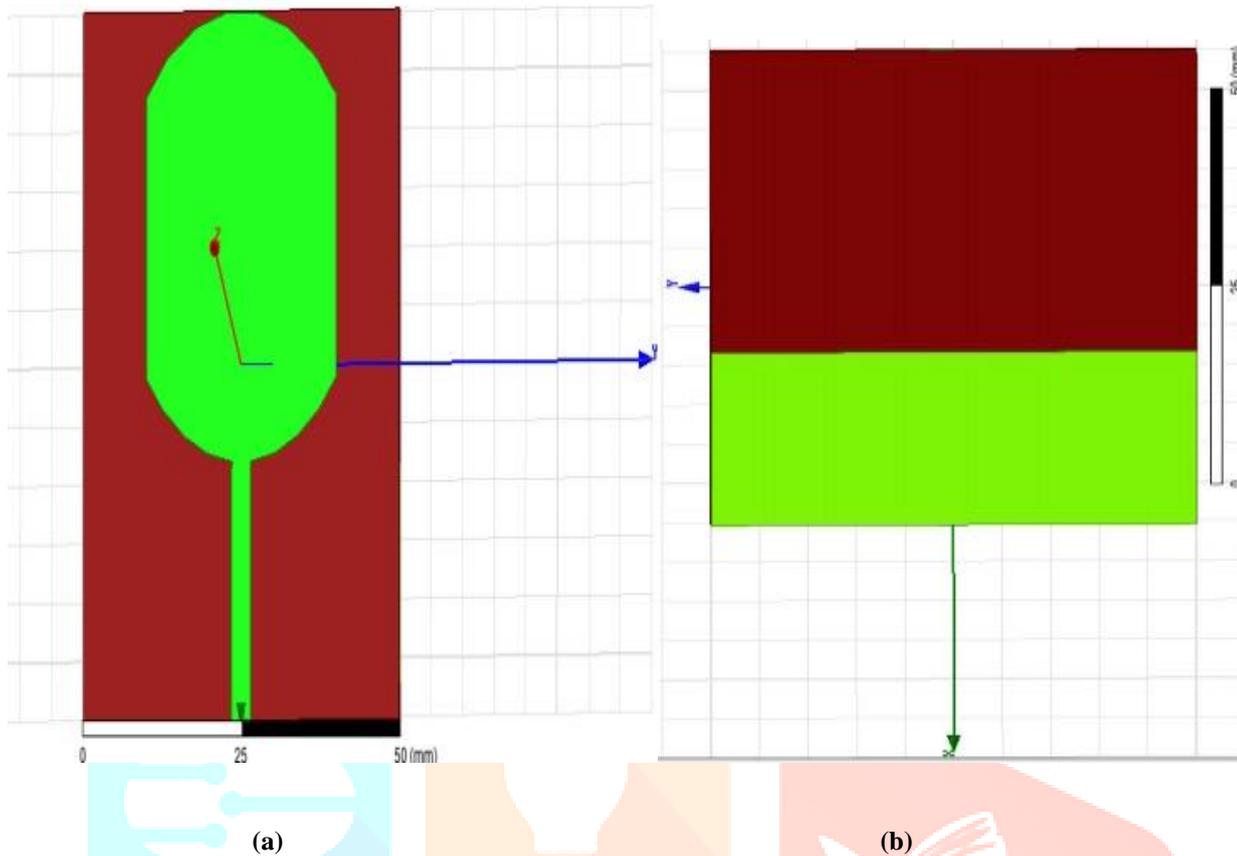
Figure 1 . (a) top (b) Bottom Geometry of the monopole structure Design (HFSS).

The antenna is fed by a CPW transmission-line, which can be easily integrated with other CPW-based microwave circuits printed on the same substrate. The CPW feed was connected to the coaxial cable through a standard 50 SMA connector. The main advantage of the CPW is that all the conductors lie on the same plane and therefore there is no need for via/holes which makes it easy to connect shunt and series lumped element. Other important properties   CPW is that the line impedance and phase velocity are less dependent on the substrate height than on the aspect ratio.

A designed patch was chosen as the monopole radiating element [2]. The power is fed into the monopole structure by a desired structure of microstrip transmission line and then we connect a coaxial cable to a feed using a standard 50 ohm SMA connector. The length of the patch was adjusted according to the general design guideline that the lowest resonance is determined when the length of the monopole, approximately λg/4 [1].

III.   RESULT OF SIMULATED ANTENNA

The proposed rectangular patch antenna is fabricated on FR-4 substrate as shown in Fig. 2.and Fig. 3. Different parameters drawn and plotted in HFSS software, the results obtained by the simulation of the microstrip patch monopole antenna with coaxial feed. We performed measurements of various parameters and radiation characteristics of antenna.
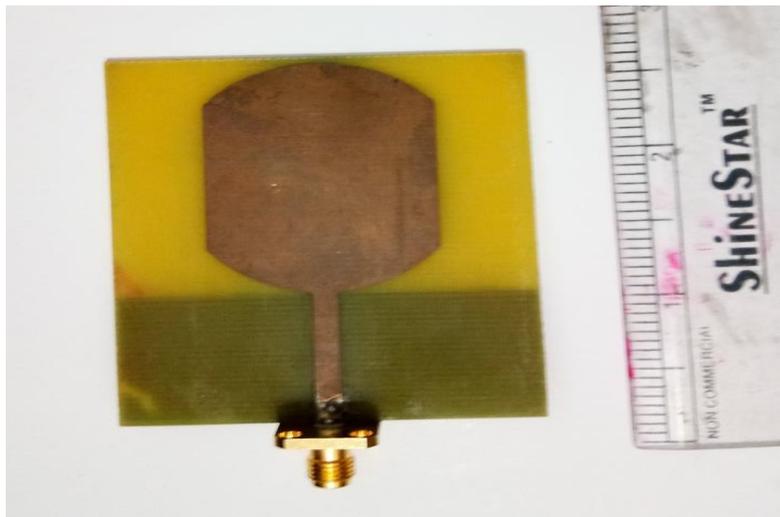
Figure 2. Top side of fabricated patch antenna
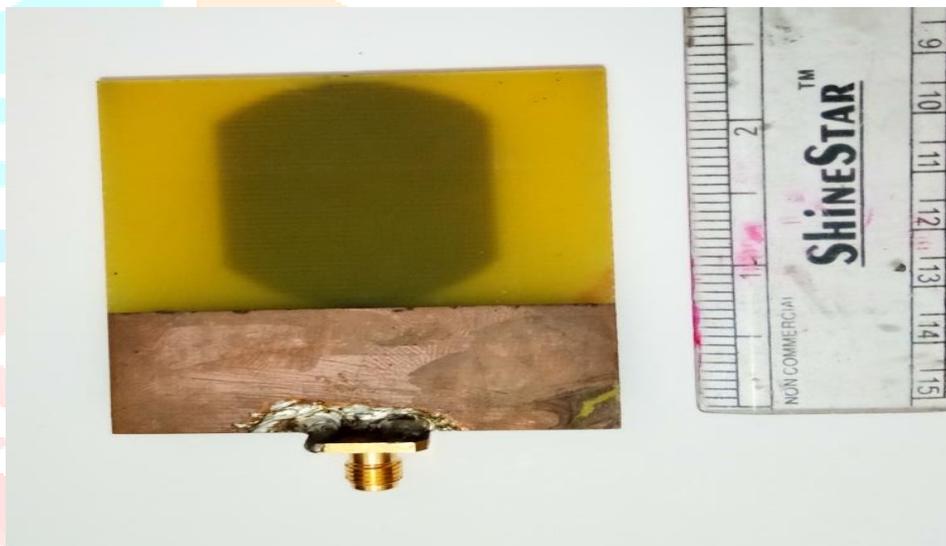
Figure 3 bottom   side of the

fabricated patch antenna

To study the effect of proposed antenna geometry on reflection coefficient (S11), voltage standing wave ratio (VSWR), the radiation pattern the simulated results are analyzed. Here in this design monopole with microstrip feed is simulated. With that we can obtain vertical polarization radiation of the antenna.
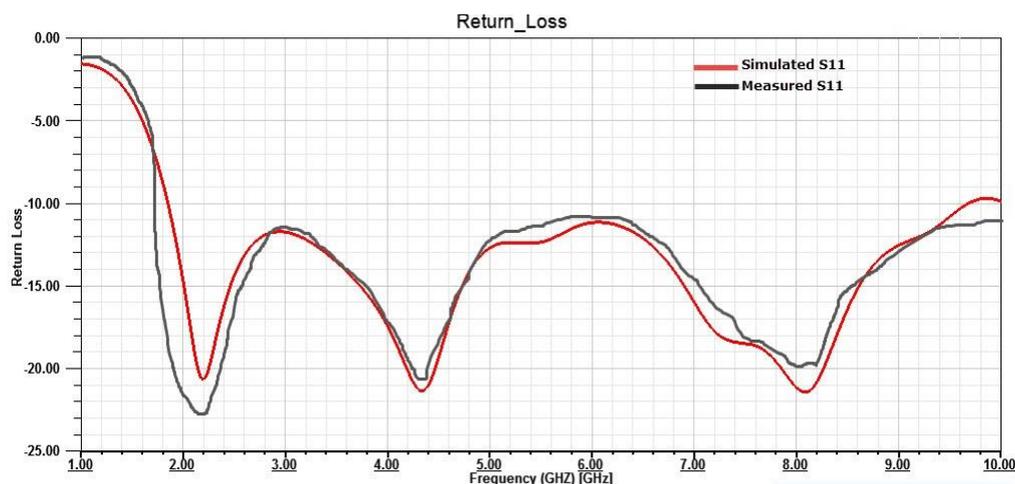
Figure 4 shows the Simulated and Measured   s11 parameter of the microstrip antenna.
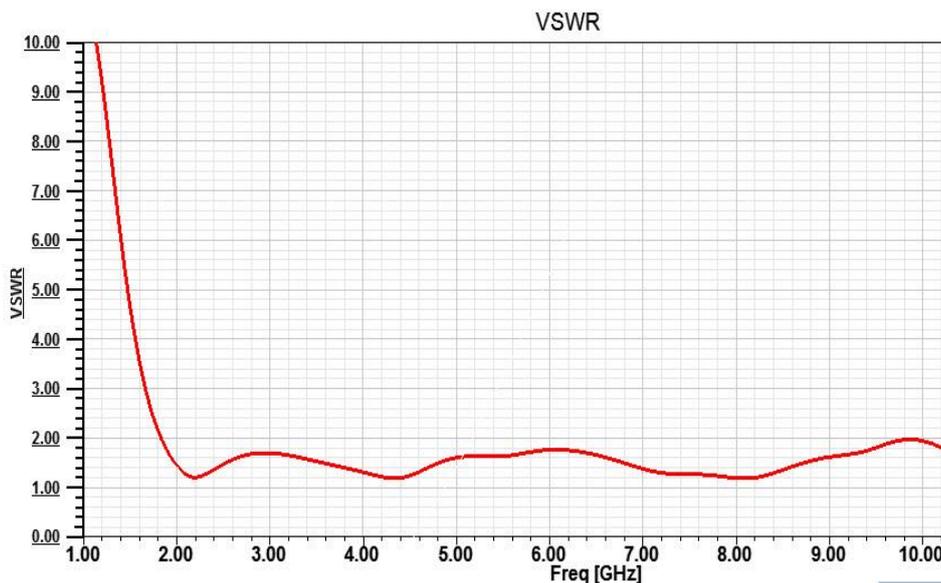
Figure 5 VSWR of the designed antenna (HFSS).

VSWR defined as measurement of matching of the antenna with the transmission line impedance. . A perfectly matched antenna would have a VSWR of 1:1. This indicates how much power is reflected back or transferred into a transmission line. VSWR obtained from the simulation is below as shown in Fig. 5
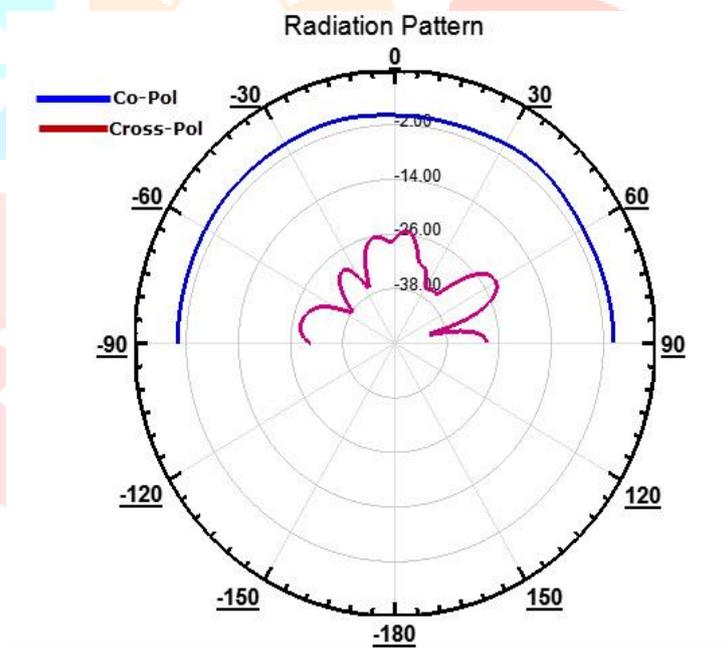
Figure 6.cross and co-polarization of monopole antenna.

Figure 6 gives the relationship between the co-polarization (desired) and cross-polarization (undesired) components. Moreover, it gives a clear picture as to the nature of polarization of the fields propagating through the patch antenna Moreover, it gives as a clear picture to the nature of polarization of the fields propagating through the patch antenna. After observing the current distribution on the patch we can conclude that the antenna is vertically linearly polarized.

IV. CONCLUSION

In the mention paper, we proposed the compact monopole antenna for the Ultra wideband applications. The fabricated antenna satisfies the 10 dB return loss requirement for the required frequency range. The graph which we get after simulation of microstrip antenna can be stated that the designed antenna is characterized by good electrical parameter. The shape of the radiation pattern is approximately matched with theoretical assumption.

V. ACKNOWLEDGMENT

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