Analysis of Hexagon Shaped Ultra Wide Band Antennas

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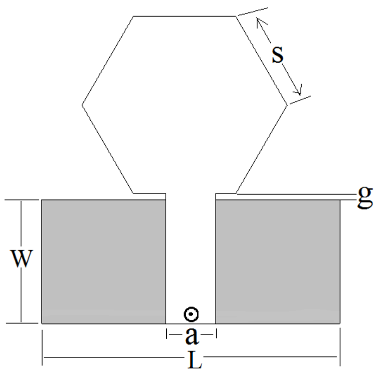
ABSTRACT
A hexagonal ultra wide antenna has been studied. First, the antenna has been fed at the base of the hexagon. Further the dimensions of the hexagon have been reduced and their effect has been studied. Next, the hexagon has been fed at one of its vertices and the effect of change in dimensions has been observed. An optimum bandwidth of 14 GHz has been obtained for both feed locations. Lastly, it has been observed that by changing the strip position along the base of the hexagon, a higher bandwidth of around 14.5 GHz has been obtained.

Keywords
Ultra wide-band micro strip antenna, planar monopole antenna, hexagon ultra wide band antenna

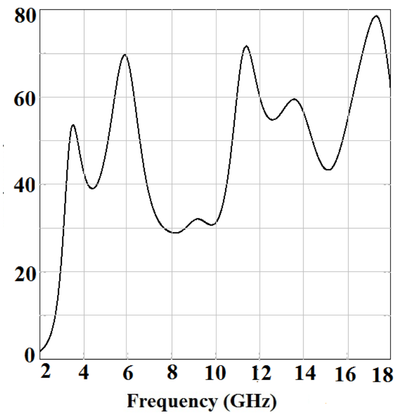
1. INTRODUCTION
In wireless applications requiring higher data rates that involve pulse communication systems, larger bandwidth (BW) (in few GHz) is needed and in such applications printed ultra-wideband (UWB) antennas have become very popular due to their small size and low cost [1]. Many micro strip variations of UWB antenna using different patch shape like, rectangular, square, circular, triangular, etc. have been reported which gives BW in few GHz [1]. Most of the printed UWB antennas are fed using micro strip line or by using coplanar waveguide fed. By using different shapes for the patch and slot, ultra wideband antennas are realized [2 – 8]. The ultra-wide band response in these structures is realized due to higher BW at the individual mode. The use of different slots changes the frequencies and impedance at individual modes to realize further increase in BW. The use of multiple slots in a patch antenna and in the ground plane results in ultra-wide band response. Depending upon the slot position with respect to the excited modes, amount of fringing fields from the slotted patch area changes, which changes the patch radiating efficiency

In this paper, a hexagonal ultra-wide band antenna has been studied and fabricated. First, the antenna is fed at the centre of the base of the hexagon. It yields a bandwidth of around 14 GHz. The dimensions of the hexagon have also been varied by chopping it on two opposite sides. This reduces the bandwidth of the antenna. Next, the hexagon has been fed at one of its vertices and it is observed that the bandwidth of the configuration remains the same. Further, this configuration has also been chopped and its bandwidth reduces by 0.5 GHz. The hexagon is then fed by offsetting its position along the base. This configuration provides an optimum bandwidth of 14.5 GHz. All antennas have been initially analyzed using IE3D software [9] using glass epoxy substrate (ε_r = 4.3, h = 1.6 mm, tan δ = 0.02).

2. BASE FED CONFIGURATION:
The hexagon has a side-length of s = 8.25 mm and the gap between the patch and the ground plane is given by g = 0.5 mm. The dimensions of the ground plane are: L = 24 mm, W = 10 mm and the strip width, a, is 4 mm. The base fed hexagonal UWB antenna is shown in Fig 1 (a) and its resonance curve graph is given in Fig.1 (b).The original configuration is then chopped first by 1 mm and then by 2 mm. A comparison of the chopped configurations with the original configuration is shown in Fig 2 (a) and (b) which depict the resonance curve and return loss plots respectively. It is observed that after chopping, the bandwidth of the configuration reduces by 0.5 GHz.

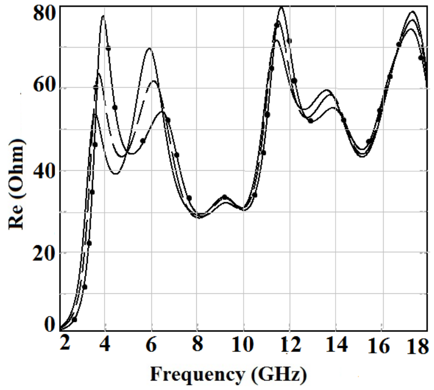


(a)

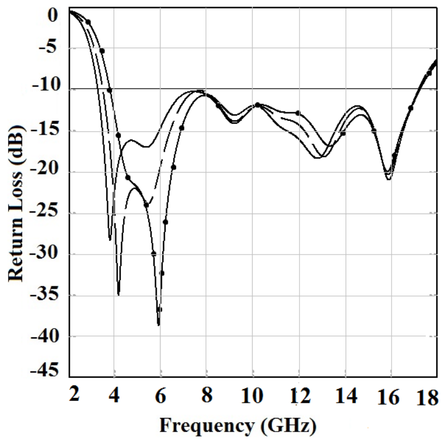


(b)

Fig.1: (a) Base-fed geometry and (b) resonance curve.



(a)



(b)

Fig.2: Comparison of (a) resonance curve and (b) return loss plot for no chop (——), 1mm chop (-----) and 2mm chop (—o—) base-fed configuration.

3. VERTEX-FED CONFIGURATION:

The vertex fed hexagonal UWB antenna is shown in Fig 3 and its resonance curve graph is given in Fig.4 (a) The original configuration is chopped on both the sides by 1 mm and then by 2 mm. A comparison of the chopped configurations with the original configuration is shown in Fig 4 (b) and (c) which depict the resonance curve and return loss plots respectively. Just as in the base-fed configuration, it is observed that after chopping, the bandwidth of the antenna decreases.

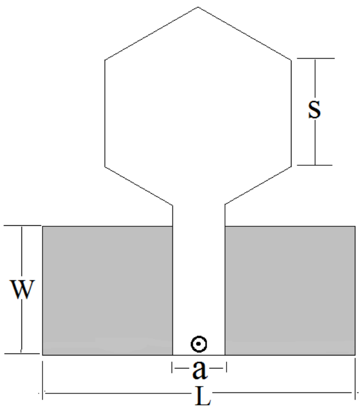
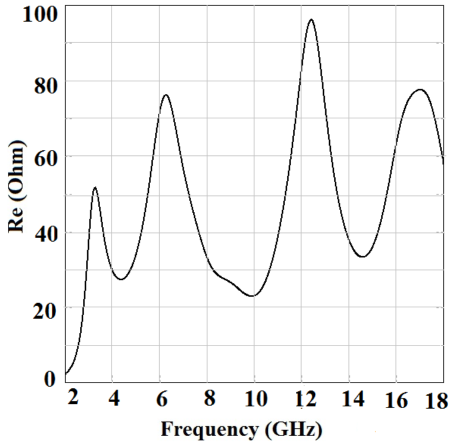
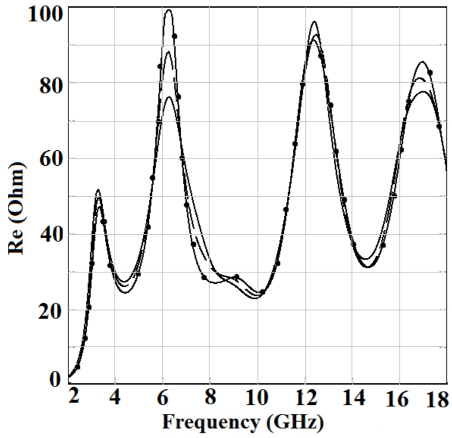


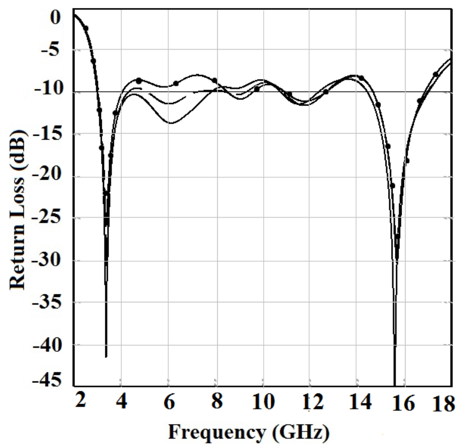
Fig.3: Vertex-fed geometry



(a)



(b)



(c)

Fig.4: (a) resonance curve , (b) resonance curves and (c) return loss plots for no chop (——), 1mm chop (-----) and 2mm chop (—o—) vertex-fed configuration.

The vertex-fed configuration can be further modified by offsetting the position of the feeding strip. The current distributions for the vertex-fed and the offset base-fed configurations is given in Fig.5 (a) and (b). For the vertex-fed configuration there are two variations along the side length whereas for the offset base-fed configuration there is only one variation along the side length. It can be observed from Fig.7 (a) that in the 12-14 GHz range, the return loss drops further, thus increasing the bandwidth.

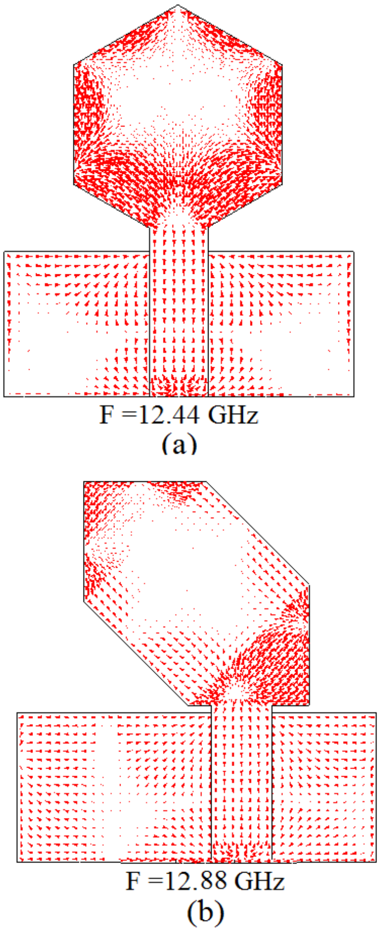


Fig.5: Current distributions for (a) vertex-fed and (b) offset base-fed configuration.

4. OFFSET BASE-FED CONFIGURATION

The offset base-fed configuration is shown in Fig.6 and its return loss plot is given in Fig.7 (a). This configuration yields a bandwidth of 14.5 GHz. A comparison of the vertex-fed and the base-fed configurations has been given. Fig.7 (b) shows the resonance curve and Fig.7 (c) shows the return loss plot.

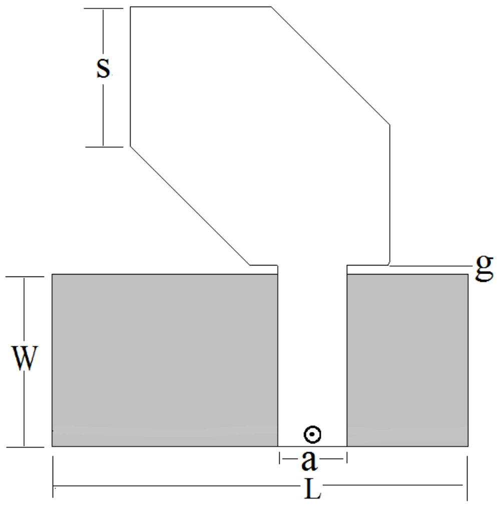


Fig.6: Offset base-fed geometry

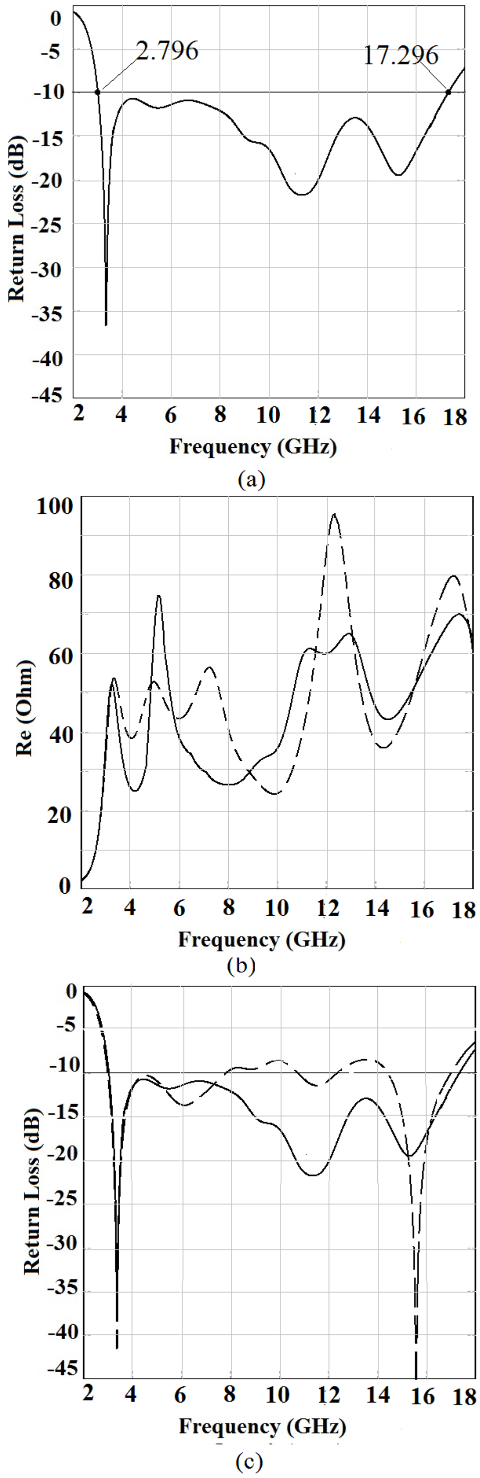


Fig.7: (a) return loss plot and (b) resonance curve and (c) return loss plot for vertex-fed (- - - -) and offset-fed (-----) configuration.

The radiation pattern is simulated and measured over the BW. The pattern at two frequencies over the BW is shown in Figs. 8 (a), (b), (c) and (d) respectively

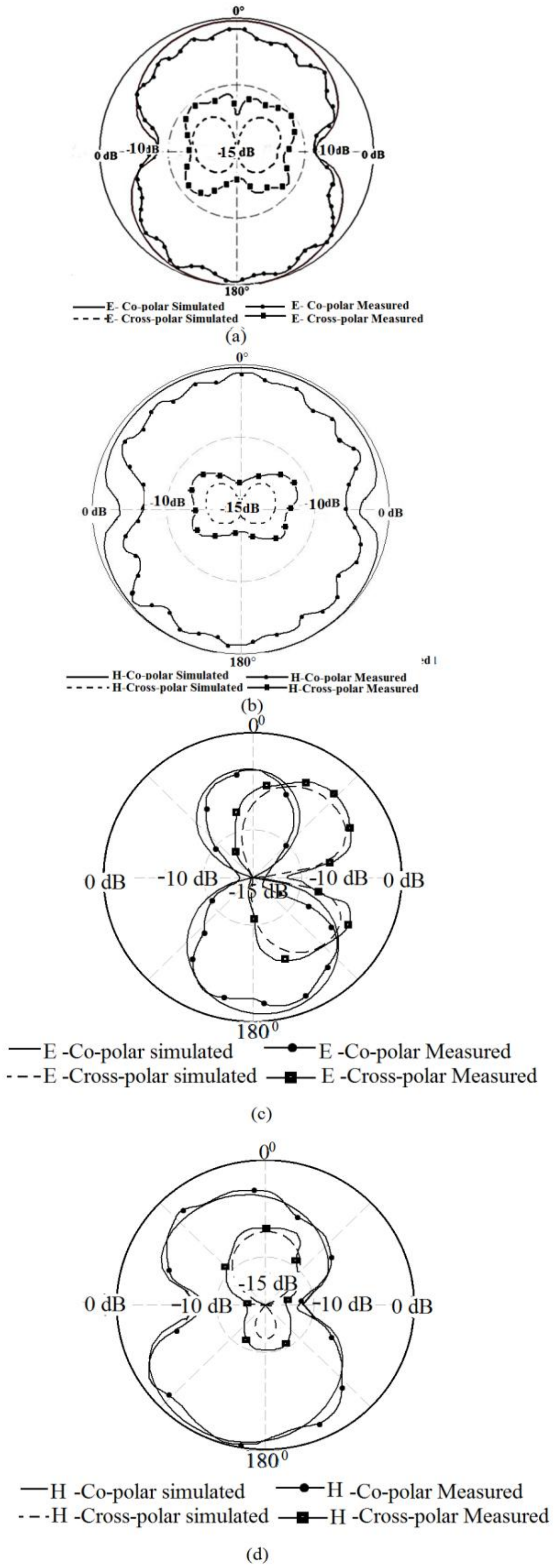


Fig. 8 Radiation pattern plots in (a) E-plane and (b) H-plane at 3GHz and (c) E-plane and (d) H-plane at 5 GHz for offset base-fed hexagonal ultra wide-band antenna.

5. CONCLUSION

A hexagonal shaped ultra wide antenna has been studied and fabricated. For a base-fed antenna the bandwidth is found to be 14 GHz. On changing the dimensions of the configuration by chopping on two sides, the bandwidth reduces. The same is observed for a vertex-fed configuration. Hence, the position of the feed line is offset for better impedance matching and a bandwidth improvement of 0.5 GHz is obtained.The hexagon shaped antenna is obtained from circular microstrip antenna. . A modal analysis of the hexagonal configuration along with the fundamental frequency formulation will be presented in further research.

6. REFRENCES

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