

Analysis of Various Shape of Planar Metal Plate Monopole Antenna for UWB Application

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Abstract—In this paper various shape planar plate monopole antenna are presented. The antennas of various shapes are elliptical, hexagonal, and circular with the same dimensions of feeder and ground plane. The proposed antennas were simulated using HFSS (HIGH FREQUENCY STRUCTURAL SIMULATOR). Simulation results and comparison for return loss (S11), gain are Presented and discussed over the UWB frequency.

Keywords— Monopole antenna, ultra-wideband frequency, return loss and gain.

I. Introduction

As the acceptance of using UWB technology was reported by the FCC in the USA of frequency range between 3.1 and 10.6 GHz, the small size and low cost are the main research goals in military and commercial applications. The UWB technology for wireless systems makes the users free from wires and enables the wireless connections of multiple devices and several users in transmission and reception. Now a day, the requirement of using wireless system is increasing with high bit rate transfer at low power consumption. The size of these systems was reduced for reliability usage, so, small UWB antenna should be designed to be comfortable with the wireless devices. In this paper Hexagonal, circular and Elliptical planar plate monopole antenna are proposed. Hexagonal, Circular and Elliptical planar plate monopole antenna has been designed. This Circular and Elliptical planar plate Monopole antenna exhibits the impedance bandwidth from 1 GHz to 13 GHz which is more than the FCC bandwidth 3.1 GHz to 10.6 GHz for wireless communication system which are suitable for ultra wide bandwidth application. Hexagonal planar plate monopole antenna has been designed this antenna exhibits the impedance bandwidth from 1 GHz to 2.6 GHz which is not suitable for ultra wide bandwidth.

The proposed antennas were simulated using HFSS (HIGH FREQUENCY STRUCTURAL SIMULATOR). HFSS is a commercial finite element method solver for electromagnetic structures. The acronym originally stood for high frequency structural simulator. It is one of several commercial tools used for antenna design, and the design of complex RF electronic circuit elements including filters, transmission lines

II. Antenna Design

Hexagonal planar plate monopole antenna

The proposed figure of the Hexagonal planar plate monopole antenna with the square ground plane on HFSS software is shown in figure 1(a). The side length l of the hexagon is 28mm. The proposed Hexagonal planar plate monopole antenna is vertically mounted above the square ground plane structure of size 300*300 mm² is shown in figure 1(a). The Hexagonal planar plate monopole antenna and single feeding strip are integrated together. Feeding strip has a uniform width

of 2 mm and a length of 1 mm and is connected to a centre of the Hexagonal planar plate monopole antenna.

The parameters for the Hexagonal planar plate monopole antenna are:

$$L = 2l$$

$$r = 3\sqrt{3}l/(8\pi)$$

For these values of L and r , the lower frequency f_L is computed from

$$f_L = 7.2/(L + r + p) \text{ GHz}$$

Where L , r , and p are in centimeters

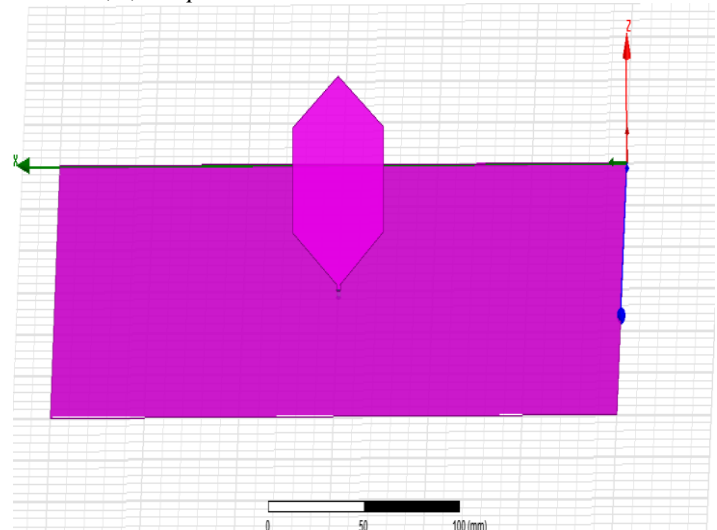


Fig 1(a)- Hexagonal planar plate monopole antenna

Circular planar plate monopole antenna

The proposed figure of the circular planar plate monopole antenna with the square ground plane on HFSS software is shown in figure 1(b). The radius a is taken equal to 25mm, The proposed circular planar plate monopole antenna is vertically mounted above the square ground plane structure of size 300*300 mm² is shown in figure 1(b). The circular planar plate monopole antenna and single feeding strip are integrated together. Feeding strip has a uniform width of 2 mm and a length of 1 mm and is connected to a centre of the circular planar plate monopole antenna. For the circular planar plate monopole antenna the values L and r of the equivalent cylindrical monopole antenna are given by-

$$L = 2a$$

$$r = a/4$$

For these values of L and r , the lower frequency f_L is computed from

$$f_L = 7.2/(L + r + p) \text{ GHz}$$

Where L , r , and p are in centimeters

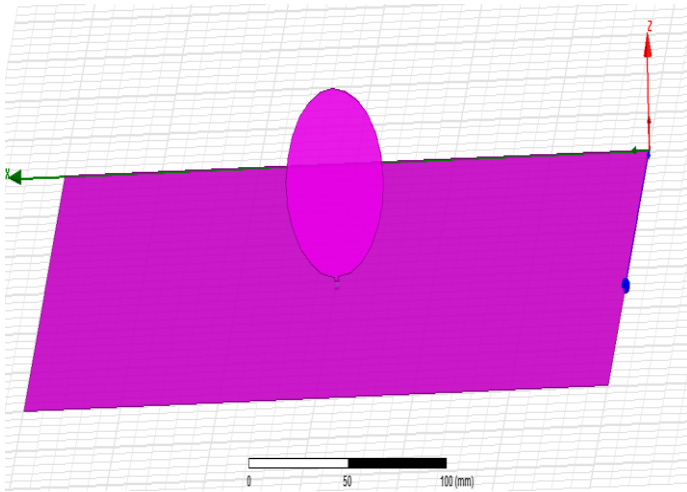


Fig 1(b)- circular planar plate monopole antenna

Elliptical planar plate monopole antenna

The proposed figure of the Elliptical planar plate monopole antenna with the square ground plane on HFSS software is shown in figure 1(c). The dimensions of the Elliptical planar plate monopole antenna (i.e., major axis length = $2a$ and minor axis length = $2b$). a is taken equal to 27mm The ellipticity ratio is chosen as a/b 1.07, The proposed Elliptical planar plate monopole antenna is vertically mounted above the square ground plane structure of size 300*300 mm² is shown in figure 1(a). The Elliptical planar plate monopole antenna and single feeding strip are integrated together. Feeding strip has a uniform width of 2 mm and a length of 1 mm and is connected to a centre of the Elliptical planar plate monopole antenna. For calculating fL of the EM antenna, the L and r of the effective cylindrical monopole are determined by equating its area as:

$$2 \pi rL = \pi ab$$

$$L = 2b$$

$$r = a/4$$

For these values of L and r , the lower frequency fL is computed from

$$fL = 7.2/(L+r+p) \text{ GHz}$$

Where L , r , and p are in centimetres

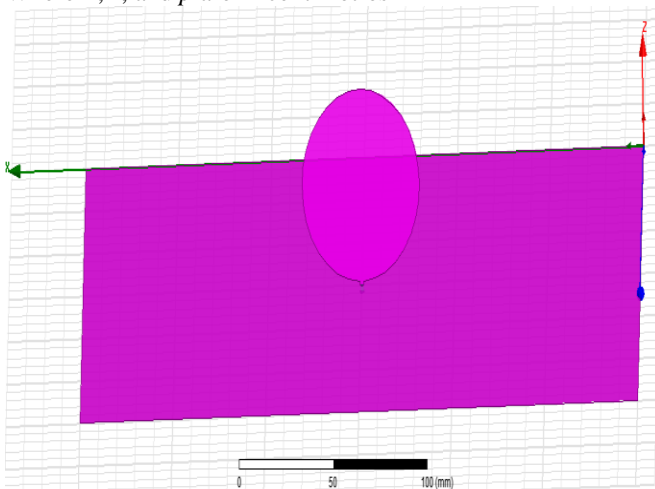
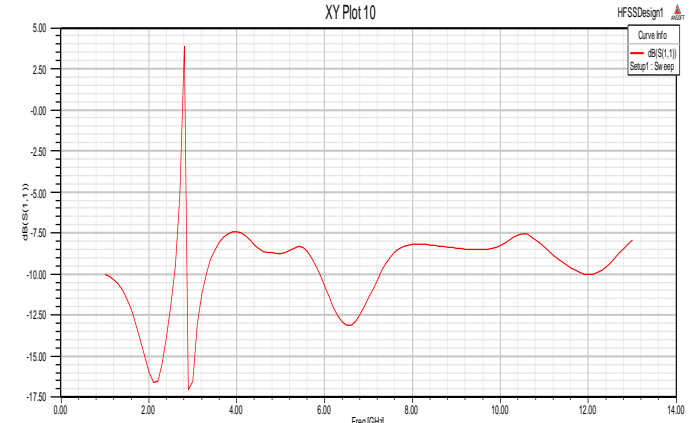


Fig 1(c)- Elliptical planar plate monopole antenna.

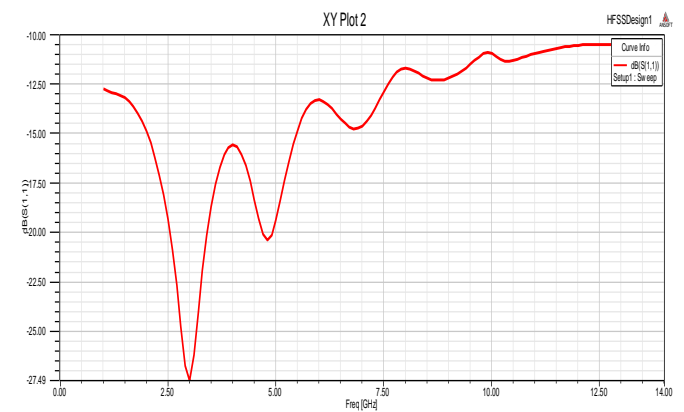
III.Simulation Results

To design planar antenna HFSS is used-
Return loss-

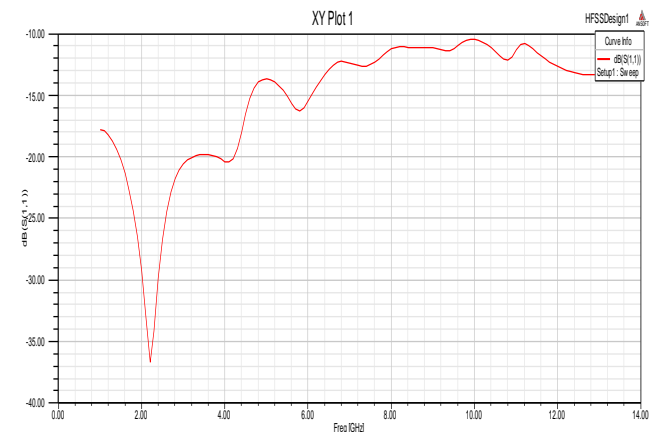
Simulated result of different designed antenna is shown in Fig 2



(a)- Hexagonal planar plate monopole antenna



(b)- circular planar plate monopole antenna

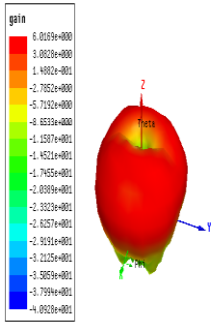


(c)- Elliptical planar plate monopole antenna.

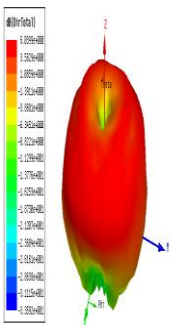
Fig2. Simulated results for Return loss

From figure(2) we can see that Circular and Elliptical planar plate monopole antenna exhibits the bandwidth from 1 GHz to 13 GHz. Hexagonal planar plate monopole antenna exhibits the bandwidth from 1 GHz to 2.6 GHz which is not suitable for ultra wide bandwidth. The hexagonal monopole antennas yield a lower BW than the circular and elliptical monopoles. But elliptical monopoles bandwidth more sharp than circular monopoles.

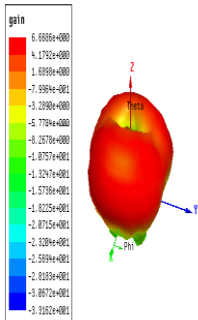
Gain-



(a)- Hexagonal planar plate monopole antenna



(b)- circular planar plate monopole antenna



(c)- Elliptical planar plate monopole antenna.

Fig3. Simulated results for Gain

From figure(3) we can see that Hexagonal planar plate monopole antenna Circular and Elliptical planar plate monopole antenna provide gain 6.01db,6.30db and6.66db respectively.

IV. Conclusion

New configurations of the Hexagonal, circular and Elliptical planar plate monopole antenna on same square ground plane using same feeding strip has been investigated. These proposed antennas can be easily constructed. Circular and Elliptical planar plate monopole antenna has been designed for ultra wide bandwidth. This antenna exhibits the bandwidth from 1 GHz to 13 GHz. Hexagonal planar plate monopole antenna has been designed .this antenna exhibits the bandwidth from 1 GHz to 2.6 GHz which is not suitable for ultra wide bandwidth. Hexagonal planar plate monopole antenna Circular and Elliptical planar plate monopole antenna provide gain 6.01db,6.30db and6.66db respectively. so Elliptical planar plate monopole antenna is more useful for UWB application.

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