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# Survey of Various 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.

## I. INTRODUCTION

Antennas are required by any radio receiver or transmitter to couple its electrical connection to the electromagnetic field. Radio waves are waves which carry signals through the air (or through space) at the speed of light with almost no transmission loss. Radio transmitters and receivers are used to convey signals (information) in systems including broadcast (audio) radio, television, mobile telephones, Wi-Fi (WLAN) data networks, trunk lines and point-to-point communications links (telephone, data networks), satellite links, many remote controlled devices such as garage door openers, and wireless remote sensors, among many others [1]. Radio waves are also used directly for measurements in technologies including RADAR, GPS, and radio astronomy. In each and every case, the transmitters and receivers involved require antennas, although these are sometimes hidden (such as the antenna inside an AM radio or inside a laptop computer equipped with Wi-Fi).

A simpler technique, with lower cost, is to replace the cylindrical stub of a conventional monopole with a planar element, yielding a planar monopole. Meinke and Gundlach, who mentioned it as a variant of the cylindrical and conical monopoles, first described the planar monopole in a textbook, in 1968 [2]. Dubost and Zisler described it more in details in 1976. They observed the wide impedance characteristics of this antenna. Later a number of different shapes have been studied which fit into this category of broadband planar monopoles antennas. Agrawal, who proposed a formula for predicting the frequency corresponding to lower edge of the impedance BW for these antennas, also studied circular and elliptical disk monopoles in 1998 [3].

### *A. Planar Monopole Antenna*

A planar monopole may be realized by replacing the wire element of a conventional monopole with a planar element. The planar element is located at a distance h above the ground plane [1]. The replacing of wire element with planar element, with various shapes, increases the surface areas of the monopoles, there by having a direct impact on BW. Planar monopole antennas provide maximum flexibility by radiating over radio terminal’s entire frequency range. They can be developed to cover frequency extremities from GSM900/NADC through GSM1800/PCS1900, IMT-2000, the 2.45GHz and 5.8GHz ISM bands and including UWB [1].

### *B. Microstrip Antenna*

This is also known as Patch Antenna because of its structure. A MSA (Micro Strip Antenna) consists of a dielectric substrate having a metallic radiating part on one side and a metallic ground plane on the other. Common microstrip antenna shapes are square, rectangular, circular and elliptical, because of easy fabrication and easy analysis; but any continuous shape can be used. Some microstrip antennas do not use a dielectric substrate and instead they use a metal patch mounted above a ground plane using dielectric spacers .

Such antennas have a very low profile, are mechanically rugged and conformable to planar and non-planar surfaces, they are often mounted on the exterior of aircrafts, or are used in mobile radio communications devices. Microstrip antennas are also relatively cheap to manufacture using modern Printed-Circuit type technology. They are usually employed at UHF and higher frequencies because the size of the antenna is directly related to the wavelength at the resonant frequency.

*C. UWB Technology*

UWB (Ultra Wide-Band) is a radio communication technology that uses very low energy pulses & it is intended for short-range-cum-high-bandwidth communications by using a huge chunk of the radio spectrum (in GHz Range) [5].

UWB communications transmit in a way that doesn't interfere with other traditional narrowband and continuous carrier wave systems operating in the same frequency band And UWB is a Very High-speed alternative to existing wireless technologies such as WLAN, Hiper LAN.

## II. RECENT DEVELOPMENTS

Anshul Agarwal in 2013 present" Investigate the Performance of Various Shapes of Planar Monopole Antenna on Modified Ground Plane Structures for L frequency Band Applications" In this , several planar such as square, circular, triangular and hexagon shaped monopole antenna with single feeding strip above the modified ground plane structure are presented.[3] It is designed for the 1-2 GHz frequency band for L-band application. Also presented the effects of feeding strip length on the impedance bandwidth.

Saswati Ghosh in June 2012 present "Design and Simulation of Band-notched Ultra Wideband Ring Monopole Antenna" This paper presents the performance of a modified planar ring monopole antenna as an UWB band-notched antenna based on the simulation results [2]. The simulated results for the return loss show that the desired bandwidth with desired frequency notch can be achieved and easily controlled by adjusting stub length and the other parameters of the antenna. The omni directional radiation pattern of a conventional monopole antenna is maintained over the frequency range [3].

Hakkı Nazlı, Emrullah Bıçak, Bahattin Türetken, and Mehmet Sezgin in 2010 present "An Improved Design of Planar Elliptical Dipole Antenna for UWB Applications".

In this paper, an enhanced planar elliptical dipole antenna design for ultra wideband (UWB) communication and impulse radar systems is presented. To enhance gain and return loss bandwidth of the antenna, elliptical slots are used on the dipole arms. The gain performance of the antenna has been increased by means of elliptical slots in the frequency range from 2.7 to 11 GHz. The radiation pattern in E- and H-plane for certain frequencies, the return loss, and the gain performance are presented [4].

Weng, Y.F. Cheung, S.W.; Yuk, T.I. in 2010 present "Effects of ground-plane size on planar UWB monopole antenna" Planar monopole antennas have found widespread applications in wireless communication systems. Their advantages of compact size, omnidirectional radiation pattern and wide impedance bandwidth make them good candidates for the designs of ultra-wideband (UWB) antennas. This paper investigates the effects of the dimensions of the rectangular ground-plane on the return loss and efficiency of an elliptical planar monopole antenna for UWB applications [4]. Computer simulation and measurement are carried out on a group of nine antennas with different rectangular ground plane sizes. The efficiency is affected more by the width rather than by the length of the ground plane while the length of the ground plane affects the lower cutoff frequency.

Xue Ni Low, Zhi Ning Chen,Terence S. P. See in October 2009 present "A UWB Dipole Antenna With Enhanced Impedance and Gain Performance"In this paper planar dipole antenna is proposed with enhanced impedance and gain performance across an ultrawideband (UWB) operating bandwidth of 3.1–10.6 GHz. The proposed antenna consists of two semi-elliptical-ended arms connected by a shorting bridge. With the shorting bridge, the length of the antenna is reduced and the radiation performance in terms of gain is improved especially at higher frequencies [8].

Kin-Lu Wong, Chih-Hsien Wu, and Saou-Wen Stephen Su in, April 2005 [1].proposed "Ultrawide-Band Square Planar metal-plate Monopole antenna with a Trident-Shaped Feeding Strip," A square planar metal-plate monopole antenna fed by using a novel trident-shaped feeding strip is presented. square planar monopole antenna with simple feeding strip provide impedance bandwidth of about 1.8GHz(about 1.5–3.3 GHz). With the use of the proposed trident-shaped feeding strip, the square planar monopole antenna studied shows a very wide impedance bandwidth of about 10 GHz (about 1.4–11.4 GHz), which is larger than three times the bandwidth obtained using a simple feeding strip [9].

## III. PROPOSED METHODOLOGY

*A. Calculation of the Lower Frequency of the Planar Monopole Antennas*

In a planar monopole antenna, the lower frequency corresponding to VSWR = 2 can be approximately calculated by equating its area (in this case, a rectangular disc monopole) to that of an equivalent cylindrical monopole antenna of same height $L$ and equivalent radius $r$, as described below

Which gives

$$r = W/(2\pi)$$

$$L = 0.24\lambda F$$

Where

$$F = (L/r) / (1 + L/r) = L/(L + r)$$

the wavelength λ is obtained as:

$$\lambda = (L + r)/0.24$$

Therefore, the lower frequency $f\,L$ is given by:

$$f\,L = c/\lambda = (30 * 0.24) / (L + r) = 7.2/(L + r) \text{ GHz}$$

It does not account for the effect of the probe length $p$, which increases the total length of the antenna thereby reducing the frequency. Accordingly, this equation is modified to

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

Where $L$, $r$, and $p$ are in centimeters.

*B. Design of various shapes of Planar Plate Monopole Antenna*

It configurations of the Hexagonal, circular and Elliptical planar plate monopole antenna on same square ground plane with different feeding strip length have been designed.

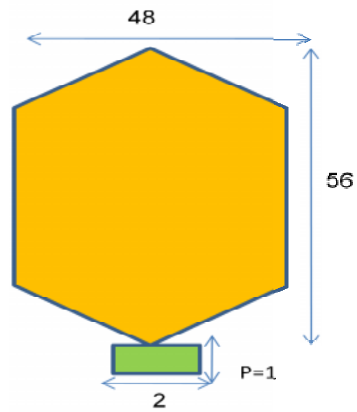
*C. Hexagonal Planar Plate Monopole Antenna*

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. 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.

For the Hexagonal Planar Plate Monopole Antenna values $L$ and $r$ of the Equivalent cylindrical monopole antenna is given by:

$$L = 2l$$

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




All dimensions in mm

**Fig. 1.** Hexagonal Planar Plate Monopole Antenna.

For these values of $L$ and $r$, the lower frequency $f\,L$ is computed from

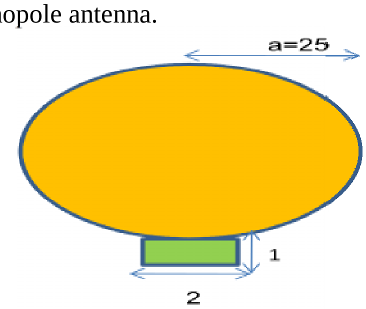
l=2.8cm

p=.1cm

$fL$ = 1.1 1GHz

*D. Circular Planar Plate Monopole Antenna*

The radius of circular planar plate monopole antenna $a$ 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.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.




All dimensions in mm

**Fig. 2.** Circular Planar Plate Monopole Antenna.

For the Circular Planar Plate Monopole Antenna values $L$ and $r$ of the

Equivalent cylindrical monopole antenna is given by:

$$L = 2a$$

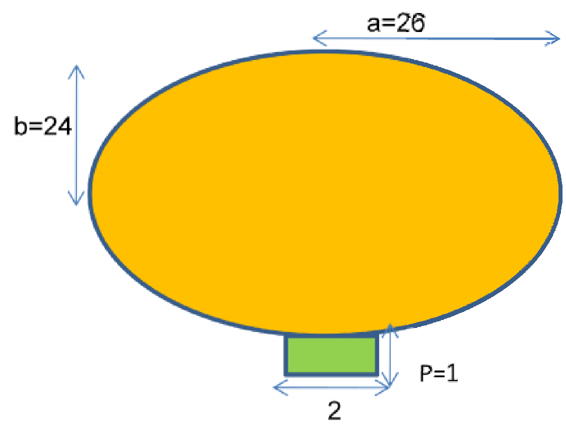
$$r = a/4$$

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

a=2.5cm, p=.1cm, *fL* = 1.25GHz

*E. Elliptical Planar Plate Monopole Antenna*

The dimensions of the Elliptical planar plate monopole antenna (i.e., major axis length = 2*a* and minor axis length = 2*b*). *a* is taken equal to 26mm The ellipticity ratio is chosen as *a*/*b* 1.08,The proposed Elliptical planar plate monopole antenna is vertically mounted above the square ground plane structure of size 300*300 mm2 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.




All dimensions in mm

**Fig. 3.** Elliptical Planar Plate Monopole Antenna.

For the Elliptical Planar Plate Monopole Antenna the *L* and *r* of the effective cylindrical monopole are determined by equating its area as:

$$2\pi\, r\, L = \pi ab$$

$$L = 2b, \quad r = a/4$$

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

a=2.6 , b=2.5 cm, p=.1cm, *fL* = 1.2 9GHz

## CONCLUSION

In this Paper, many of problems that are concerned by designers as listed below:

Many wireless applications operates at high frequency range, the main challenge in UWB antenna design is achieving the wide impedance bandwidth while still maintaining high radiation efficiency and mall size, Low-profile and efficient Ultra Wide-Band antenna for communication applications are considered as main aim of the project. Simulate and verify the antenna design in terms of Return loss, radiation pattern and gain by Electromagnetic Simulation Software High Frequency Structural Simulation (HFSS).

The prospective of UWB technology is tremendous on account of its various advantages such as the capability of providing high speed data rates at short distance transmission with low power dissolution. The rapid growth in wireless communication systems has made UWB is an outstanding technology because of accelerated advances in wireless communication systems to replace the conventional wireless technologies at present like wireless LANs, etc.

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