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# Design a Z Shape Antenna with a Coplanar Waveguide Transmission Line

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**ABSTRACT**: This paper presents design of a Z shaped antenna with a coplanar waveguide transmission line. A review is presented here to demonstrate some properties & radiation pattern in 3D. In order to verify the simulation result need to solve some equation. The behaviour of Z shaped antenna is analysed through simulation. Its performance investigated by simulation results obtained from-180 degree to +180 degree for rE total and obtained a good gain a round 2.3 GHz. Z shaped antenna mainly use in order to reduce the effective area of the receiving antenna to receiving microwave power in high electric field regions. It's also Converting electromagnetic radiation in space into electrical currents in conductors or vice-versa, depending on whether it is being used for receiving or for transmitting, respectively. Passive radio telescopes are receiving antennas. Our designing aim is to describe radiation pattern both 3D and normal and discuss obtained gain.

**KEYWORDS:** Microstrip, Coplanar waveguide, Impedance, HFSS, Bandwidth.

## I.INTRODUCTION

In recent years demand for small antennas on wireless communication has increased the interest of research work on compact microstrip various kind of shaped antenna design among microwaves and wireless technology. To support the high mobility necessity for a wireless telecommunication device, a small and light weight Z shape antenna is likely to be preferred. For this purpose compact Z shaped antenna is one of the most suitable applications. The development of Z shaped antenna for wireless communication also requires an antenna with more than one operating frequencies. This is due to many reasons, mainly because there are various wireless communication systems and many telecommunication operators using various frequencies. However, the general Z shaped patch antennas have some disadvantages such as narrow bandwidth etc. Enhancement of the performance to cover the demanding bandwidth is necessary [1]. But overhead those drawbacks Z shaped antenna is now most popular antenna.In the design of a Z shape antenna with a coplanar waveguide, the shape of the Z antenna patch, the ground plane, and the geometry of the ground plane slots are of great importance. Proposed Z shaped have included rectangular ones. Different methods, such as the truncated slot on the antenna patch, have been pro-posed for increasing impedance bandwidth .Recently, some coplanar waveguide (CPW) Z antennas have been reported. In most reported antennas, up to now, the slots have been used for improving the lower frequency of the band and enhancing the upper frequency of the band. In this paper, a novel Fed Z antenna without slot on the patch or ground plane is proposed with a Z shaped form. In this antenna, using a pair of Z-shape combined (ESC) design on the patch, a proper control on the upper and lower frequencies of the band can be achieved. In addition, on the ground plane, a pair of ESC form is located for improving impedance matching and optimizing gain [2]. Coplanar waveguide is a type of electrical transmission line which can be fabricated using printed circuit board technology, and is used to convey microwave-frequency signals. On a smaller scale, coplanar waveguide transmission lines are also built into monolithic microwave integrated circuits. Conventional coplanar waveguide (CPW) consists of a single conducting track printed onto a dielectric substrate, together with a pair of return conductors, one to either side of the track. All three conductors are on the same side of the substrate, and hence are coplanar. The return conductors are separated from the central track by a small gap, which has an unvarying width along the length of the line. Away from the central conductor, the return conductors usually extend to an indefinite but large distance, so that each is notionally a semi-infinite plane.

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The advantages of coplanar waveguide are that active devices can be mounted on top of the circuit, like on microstrip. More importantly, it can provide extremely high frequency response since connecting to coplanar waveguide does not entail any parasitic discontinuities in the ground plane. One disadvantage is potentially lousy heat dissipation. However, the main reason that coplanar waveguide is not used is that there is a general lack of understanding of how to employ it within the microwave design community.

## II.BACKGROUND

Basically Z shaped antenna using dielectric resonator to obtain desired resonant frequency for wave application. Related work on Z shaped antenna is not very much. The Z shaped antenna consists four bricks of unequal size fused together these bricks are excited by simple microstrip patch lines. Now-a-days z shaped antenna is used for various types of working and research field. First it was used in cellular distributed antenna system (DAS). DAS system actually used in radio base station. After that demand of Z shape antenna increasing day by day then it is used in failure recovery and redundancy. In this field antenna needs high frequency bandwidth connectivity and Z shaped is best for high frequency. Then is used in metro network services. Using Z shape antenna total cost of metro network services comes half. It is more flexible to used z shaped antenna in network field. Now Z antenna is used in most upgrading WiMAX technology. The need to deliver higher bandwidth to customer is the main moto of mobile company and all features are available on WiMAX technology. Basically WiMAX technology depends on high frequency antenna and Z antenna are most preferable. There are many application for Z antenna some of them are given below:

- Radar and Imaging.
- Location and Tracking.
- Vehicle Radar System.
- Medical Applications.
- Satellite Communication System.

## III.DESIGN AND METHODOLOGY

The dielectric constant of the substrate is closely related to the size and the bandwidth of the Z shape antenna. Low dielectric constant of the substrate produces larger bandwidth. The resonant frequency of Z shape antenna and the size of the radiation patch can be similar to the following formulas while the high dielectric constant of the substrate results in smaller size of antenna [3].

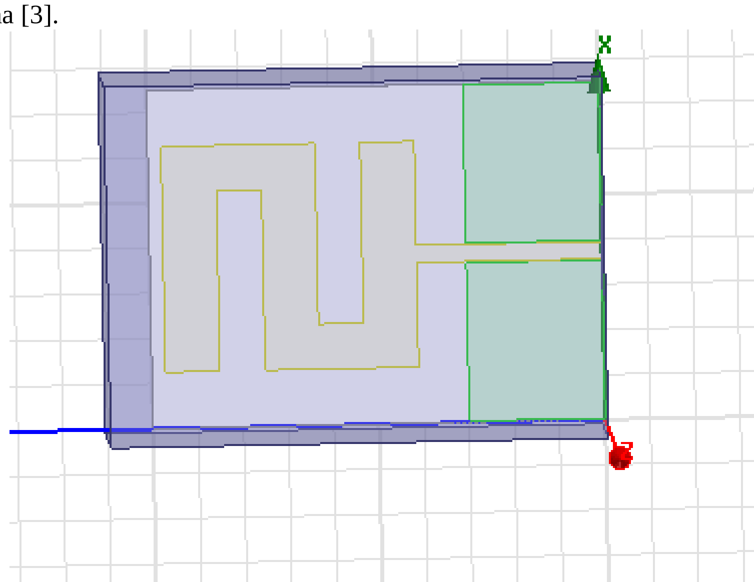

Figure 1: Z shape antenna

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Figure 1 shows the geometry of the design of Z shape with a coplanar waveguide transmission line in which the Length of ground plane of Antenna is 38.4 mm and Width is 46.8 mm, L & W of the patch is 28.8 mm & 37.2 mm.

First step of methodology for this paper is designing a surface. Ansoft HFSS is choose for simulation. Ansoft HFSS is one of the most imperial electromagnetic software which allows to simulation for microwave and radio system. In this simulation Fr4 substrate was used. Then need value from equations for designing a structure of Z shape antenna. After that need to create port. Port creation is very essential for obtain gain. There are two port one is far field port and another one is near field port. Completing simulation need to check if there is any error it will shows in the screen but if there is no error simulation will be complete. Then it's time to check the simulation results. There are many results we need few of them basically we need radiation pattern, xy plot, 3D imaging. Last step is data table which is in the port report.

## IV. EQUATIONS AND VARIABLES

The patch width, effective dielectric constant, the length extension and also patch length are given by

$$w = \frac{C}{2f\sqrt{\varepsilon r}}$$

where *c* is the velocity of light, e is the dielectric content of substrate, *f* is the antenna working frequency, W isthe patch non resonant width, and the effective dielectric constant is egiven as,

$$\varepsilon_{eff} = \frac{(\varepsilon_r + 1)}{2} + \frac{(\varepsilon_r - 1)}{2}\left[1 + 10\frac{H}{W}\right]^{-\frac{1}{2}}$$

The extension length Δ is calculates as,

$$\frac{\Delta L}{H} = 0.412\frac{(\varepsilon_{eff} + 0.300)\left(\frac{W}{H} + 0.262\right)}{(\varepsilon_{eff} - 0.258)\left(\frac{W}{H} + 0.813\right)}$$

By using above equation we can find the value of actual length of the patch as,

$$L = \frac{c}{2f\sqrt{\varepsilon_{eff}}} - 2\Delta L$$

## V.SIMULATION RESULTS & TABLE

The antenna simulation pattern is a measure of its power or radiation distribution with respect to a particular type of coordinates. We generally consider spherical coordinates as the ideal antenna is supposed to radiate in a spherically symmetrical pattern [4]. However antenna in practice are not Omni directional but have a radiation maximum along one particular direction. Z shape antenna is a broadside antenna where in the maximum radiation occurs along the axis of the antenna [5].

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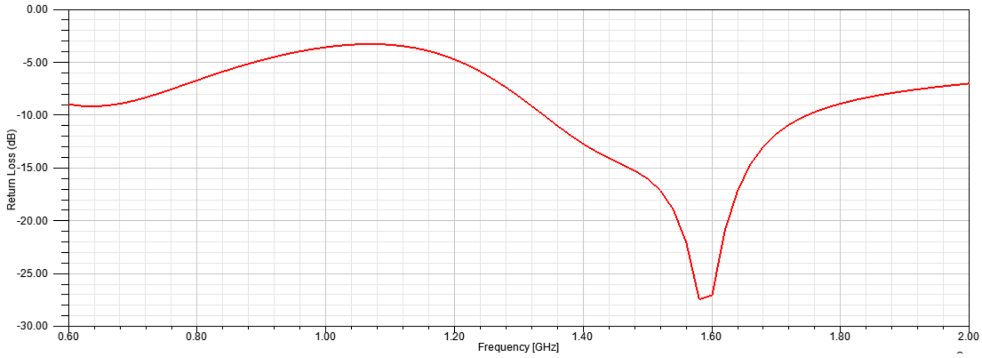


Figure 2: Graph of Return loss.

In Figure 2 presents the graph of the return loss. It is clearly shown that lowest return loss is found at 1.60 GHz. And highest return loss found at 1 GHz frequency. Overall average return loss is not very effective.

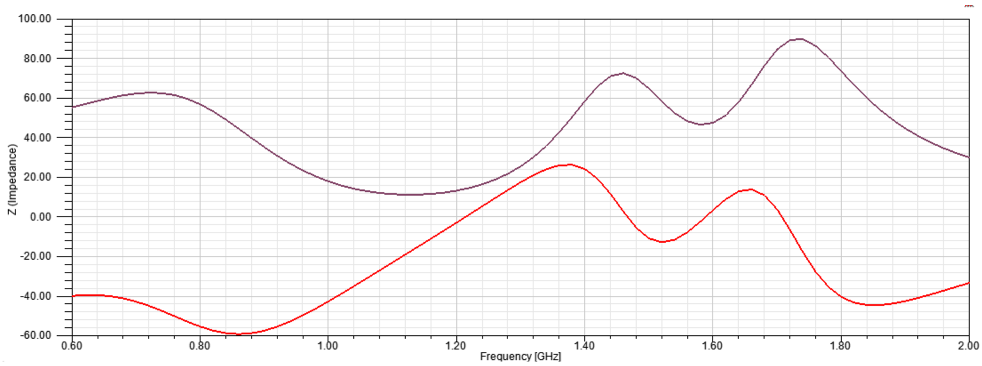


Figure 3: Frequency Vs Imaginary Impedance Graph.

In figure 3 describe the Impedance graph. There are two lines. One of them the upper one represents Imaginary Impedance graph and other one presents Real Impedance graph. We got Imaginary values are the highest in every frequency rather than real impedance graph. When frequency is 1.70 GHz found the highest impedance values for both graph.

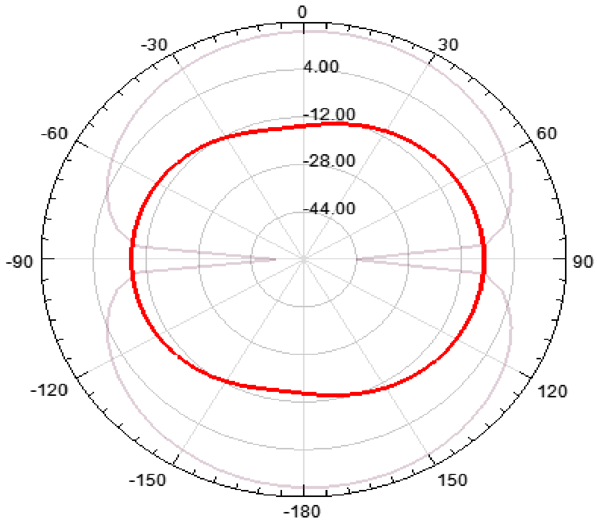


Figure 4: Radiation pattern of Z shape coplanar waveguide antenna.

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In figure 4 describe the radiation graph. There are two lines. One of them the upper one light colour graph represents Z shape antenna with coplanar waveguide and other one presents dark red graph represents with using coplanar waveguide. We got without coplanar values are the highest in every angel rather than other graph.

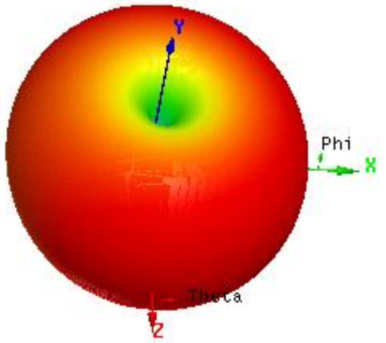


Figure 5: 3D pattern of Z shape antenna.

Figure 5 presents basic 3d pattern of Z shape antenna with using coplanar waveguide transmission line.

| | Theta [deg] | rETotal [V]<br>Setup : LastAdaptive<br>Freq='0.9GHz' Phi='0deg' |
|---|---|---|
| 1 | -180.000000 | 447.377879 |
| 2 | -175.000000 | 440.121530 |
| 3 | -170.000000 | 431.593863 |
| 4 | -165.000000 | 421.963485 |
| 5 | -160.000000 | 411.437042 |
| 6 | -155.000000 | 400.249550 |
| 7 | -150.000000 | 388.653887 |
| 8 | -145.000000 | 376.910252 |
| 9 | -140.000000 | 365.276345 |
| 10 | -135.000000 | 353.998841 |
| 11 | -130.000000 | 343.306583 |
| 12 | -125.000000 | 333.405660 |
| 13 | -120.000000 | 324.476369 |
| 14 | -115.000000 | 316.671854 |

We found at least 73 values from our simulation here we submit 14 values as a sample.it is clearly shown that it follow per 90 degree cycle that means per 90 degree its values at the nadir point and after that complete 90 degree it is in crest point.

## VI.CONCLUSION

This thesis detailed the various aspects associated with the modelling of Z shape antenna with coplanar guide transmission line. One of the goal was introduction of HFSSasa simulation tool for electromagnetic analysis. An effort was understanding of the design process in HFSS, which aid the reader in building any simulation in HFSS [6]. In this paper a compact size Z shaped antenna has been designed having good impedance matching as well as high antenna; efficiency of about 95% is achieved. The proposed antenna has larger impedance bandwidth of 43.578% covering the frequency range from 1.696 GHz to 2.646 GHz which is suitable for PCS-1900, GSM andWLAN IEEE802.11b applications. Obviously there are some limitations of Z shape antenna some of them are listed below:

- Its effective dielectric constant is lower.
- Layout is very compact.
- Shunt element is quite low.

## VII. ACKNOWLEDGEMENT

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## BIOGRAPHY

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