Design and Analysis of Z Shape Micro Strip Patch Antenna for Wideband Application

Namrata Mire[1] Mahesh Mule[2] Neha Ninawe[3] Pratik Bawne[4]
[1]Assistant professor [2,3,4]B.E. Student
[1,2,3,4]Department of Electronics Engineering
[1,2,3,4]DBACER, RTMNU, Nagpur, Maharashtra

Abstract— The area of micro strip antennas has seen some inventive work in recent years and it is one of the most dynamic fields of antenna theory. In this paper presents design of Z shape antennas. The aim of this paper is to improve the bandwidth, gain and return loss. The main features of these antennas are compact dimensions and operating frequency is 0.6GHZ to 2.4 GHZ. The antenna is designed using FR4-epoxy Substrate with a dielectric constant of 4.4 and thickness 1.6 .The properties of antenna such as bandwidth return loss, VSWR, gain has been obtained and compared result between HFSS 13 and VNA antenna measurement.

Key words: Z Shape patch antenna, Return Loss, VSWR, Impedance, Ansoft HFSS 13

I. INTRODUCTION

In Wireless communication, there are several types of micro strip antenna the most common of which is this micro strip. Microstrip antenna consists of very small conducting patch patch built on a ground plane separated by dielectric substrate. The patch shapes such as the square, rectangular, circular, triangular, semicircular, elliptical shapes are used. The micro strip patch antenna offers the advantages of low profile, ease of fabrication and compatibility with integrated circuit technology. The patch antenna idea was first proposed in the early 1950s but it was not until the late 1970s that this type of antenna attracted serious attention of the antenna community. 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 WLAN(802.11b) and GSM applications.

A. Design process:

The antenna's resonant properties were predicted and optimized using High Structure simulation software Ansoft version 13. The design procedure begins with determining the length, width and the type of dielectric substance for the given operating frequency. Then using the measurements obtained above simulation has been setup for the basic rectangular micro strip antenna and the parameters are optimized for the best impedance matching.

Antenna	Length	Width	Height
Z shape MPA	28.8mm	37.2mm	1.6mm

Table 1:

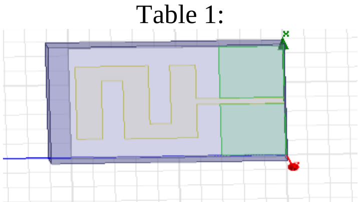

Fig. 1: Z shape antenna

Microstrip patch antennas can be fed by a variety of methods. These methods can classified into two categories- contacting and non-contacting. In the contacting method, the RF power is fed directly to the radiating patch using a connecting element such as a Microstrip line. In the non-contacting scheme, electromagnetic field coupling is done to transfer power between the Microstrip line and the radiating patch. The four most popular feed techniques used are

1) Microstrip line
– Coaxial probe (both contacting schemes), Aperture coupling
– Proximity coupling (both non-contacting schemes). The feed technique used in our patch antennas is micro strip line feed.

B. Flow chart:

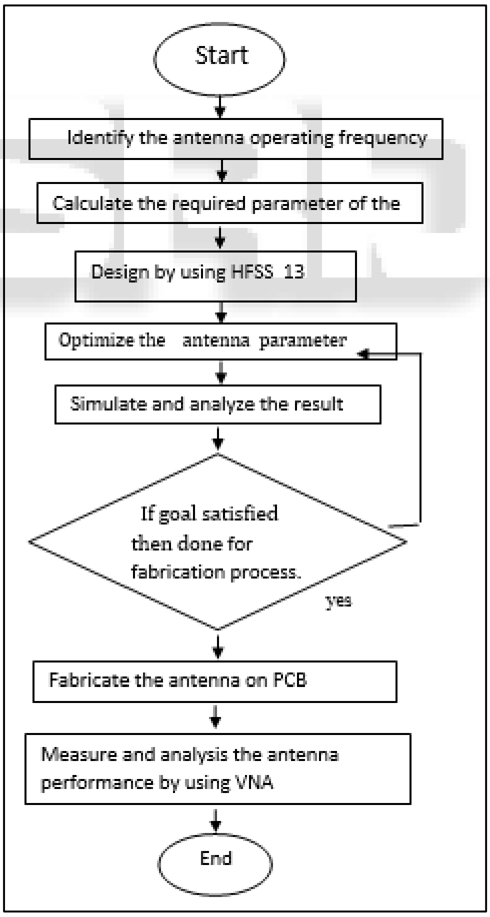

Fig. 2:

II. PHOTOLITHOGRAPHIC PROCESS

Photolithography, also termed optical lithography or UV lithography, is a process used in micro fabrication to pattern parts of a thin film or the bulk of a substrate. It uses light to transfer a geometric pattern from a photo mask to a light-sensitive chemical "photo resist", or simply "resist," on the substrate. A series of chemical treatments then either engraves the exposure pattern into, or enables deposition of a new material in the desired pattern upon, the material underneath the photo resist. For example, in complex integrated circuits, a modern CMOS wafer will go through the photolithographic cycle up to 50 times

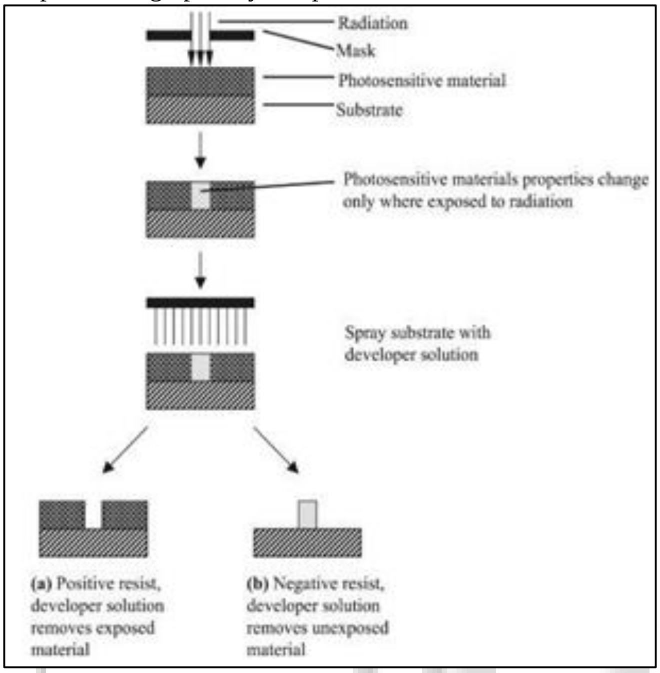

Fig. 3:

III. VECTOR NETWORK ANALYZER (VNA)

A network analyzer is an instrument that measures the network parameters of electrical networks.

Today, network analyzers commonly measure s–parameters because reflection and transmission of electrical networks are easy to measure at high frequencies, S-parameter describe the input-output relationship between ports (or terminals) in an electrical system. S11 would be the reflected power radio 1 is trying to deliver to antenna 1. But there are other network parameter sets such as y-parameters, z-parameters, and h-parameters.

Network analyzers are often used to characterize two-port networks such as amplifiers and filters, but they can be used on networks with an arbitrary number of ports.

A Vector Network Analyzer (VNA) measures both amplitude and phase properties. Measures both amplitude and phase properties.

IV. MATHEMATICAL ANALYSIS

For designing any antenna main parameters are considered such as:

1) Resonating frequency.
2) Substrate.
3) Relative dielectric constant of substrate.
4) Height h of substrate.

We are going to design our antenna on ISM band i.e. on 2.4 GHz so our aim is.

To design patch at 2.4 GHz, the dimensions of the patch Antenna structure should be as follows Resonating frequency –fr=2.4GHz

1) Substrate used –FR4epoxy
2) Relative dielectric constant of r=4.4 substrate-
3) Height h of substrate-h=1.6mm

A. *Steps of Calculations:*

Resonant frequency

$$f_c \approx \frac{c}{2L\sqrt{\varepsilon_r}} = \frac{1}{2L\sqrt{\varepsilon_0 \varepsilon_r \mu_0}}$$

Formula for calculating width (W) 1.ffective dielectric constant is e given 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.

V. SIMULATION RESULTS

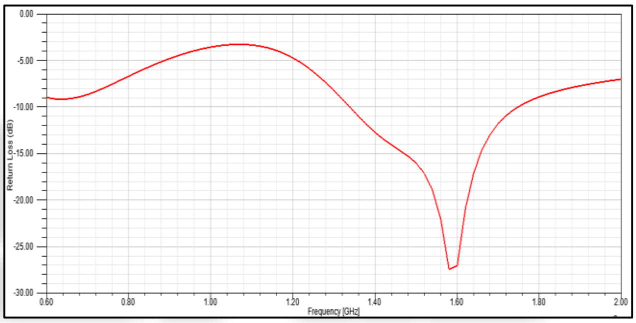

Fig. 4: Return loss of Z shape Antenna (graph)

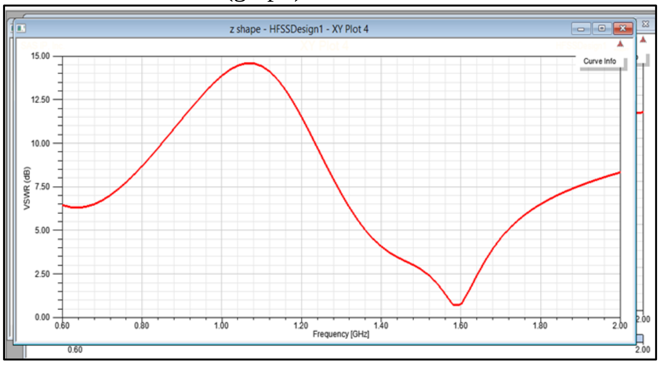

Fig. 5 :Frequency Vs VSWR of Z shape antenna (Graph)

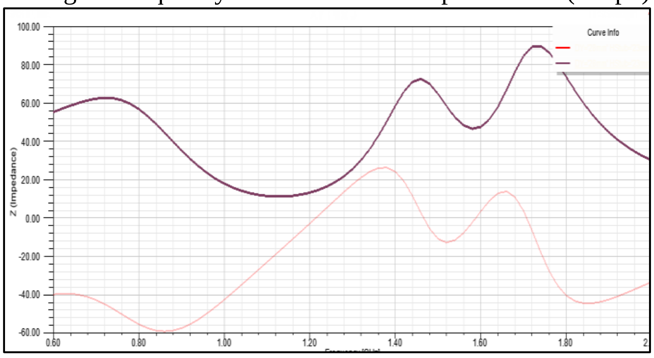

Fig. 6: Frequency Vs Impedance graph in above graph

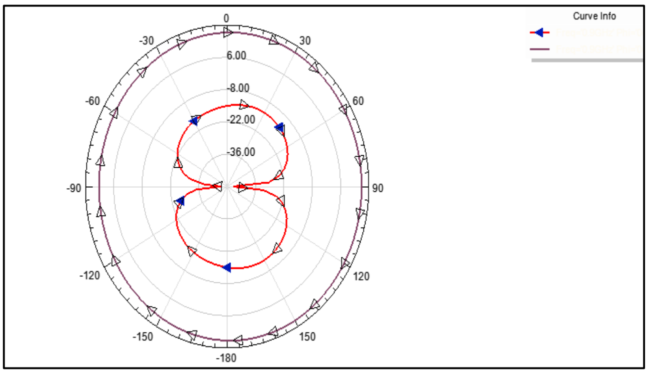

Fig. 7: Radiation pattern of Z shape Microstrip patch Antenna

Antenna	frequency	F_L	F_h	RETURN LOSSES	VSWR	IMPEDANCE
Z shape micro strip patch Antenna	2.4	1.6	1	-27.8	-27Db	1.70

Table 1: Result

VI. PCB Fabrication Images

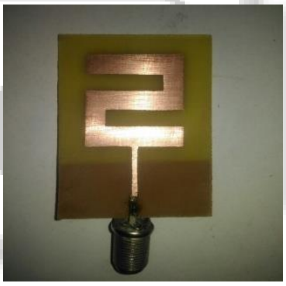

Fig. 8: z shape fabricated MPA(Front)

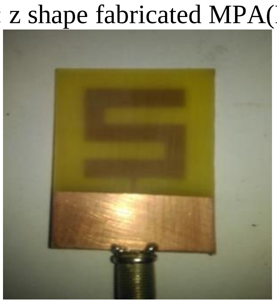

Fig. 9: fabricated MPA (Back)

VII. Conclusions

The Z shape micro strip patch Antenna was designed & analyze for WLAN application. The simulated results have shown a good return loss, VSWR and radiation pattern. The higher return loss found at 1.60 GHz and lowest return loss found at 1 GHz. The proposed design has result VSWR value of 1 which shown a positive approach for perfect matching. Moreover, the designed antenna can be easily fabricated .It provides increased bandwidth and it has achieved good return losses. Thus we say that the proposed antenna can be considered as good candidate for applications.

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