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Design and Implementation of Wideband Antenna Using Defected Ground Structure (DGS) for Ultrawide band Application

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ABSTRACT: This paper proposes a modified widebandantenna for ultra wideband application. These microstrip patches are excited using microstrip line feed technique.To improve the gain performance quadrature portion of the circle part is removed both upper and lower edge corners and adding triangular slot in the ground plane model using Defected Ground Structure (DGS).It is designed in variety of shapes in order to obtain enhanced gain and bandwidth.The resonant frequency is 6.85 GHz and the flame retardant (FR4) substrate is used with dielectric constant 4.3 and thickness about 1.6mm. The optimization is achieved by varying the length and width parameters. During simulation process the gain, s-parameter,sradiation pattern, and directivity of proposed antenna has been obtained. The feed network is designed and optimized using Computer Simulation Technology(CST) to cover a frequency range is 3.1 GHz to 10.6 GHz.

KEYWORDS: Microstrip patch antenna, Defected Ground Structure,Microstrip line feed.

I. INTRODUCTION

In present scenario,wideband microstrip patch antennas are attracting much attention in wide range of wireless communication systems such as radar,satellite and bio-medical telemetry systems. A microstrip patch antenna array is a group of multiple active antennas coupled to a common source or load to produce a directive radiation pattern and gain. The commercial use of the ultra wide band frequency range is 3.1 GHz to 10.6 GHz.Generally FR-4 substrate, is widely used to design a wideband antenna.The thick substrate designs described in this paper retain the advantages of simplicity and smaller size [4].For increased bandwidth of a patch antenna array a thicker substrate is used and therefore requires a microstrip line feeding technique.This gives rise to an increase in spurious radiation from the probe feeding technique[10].The single fed type has the simplest structure.It does not require external circuitary to excite circular polarization.The ultra wideband frequency range is 3.1 GHz to 10.6 GHz.

The ultra wide band technology are choosen for the purpose of highly secured,low cost and low complexity.It is used in various applications like radar,airbone and military communication.There are various methods are used to improve the gain performance.The antenna was initially developed two orthogonal dipoles with different lengths.Incase of any demand for circular polarization band parasitic elements were employed to produce additional circular polarization so the structure gets complexity.

This planar ultra wide band antenna consists of a rectangular patch etched on flame retardant (FR-4) substrate with 50 ohm feed line.The rectangular patch has one round cut at each corner with one slot in the ground plane.This is achieved by adding slots with different shapes in the patch,feed and ground plane or using defected ground structure(DGS).The measurement results agree with a slight shift in the lower and upper and edge frequency[9].The wideband unidirectional circularly polarized array antenna with a truly planar structure which integrates the feeding network on a single substrate.Four parasitic slots are etched at the edges of the ground plane to improve the gain performance when the height is reduced.Here we are using stacked patches technique.This technique is applicable for multilayer network not for a single layer network[13].

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This paper is organized as follows.In section II design equations of the antenna is introduced. In section III detailed analysis of the design model is done and results areobserved.Section IV concludes the paper.

II. DESIGN EQUATIONS

The conventional microstrip antenna design method is used here.Designing the patch antenna is to employ the following equations(1-4).Fig 1 shows the basic structure of themicrostrip antenna.

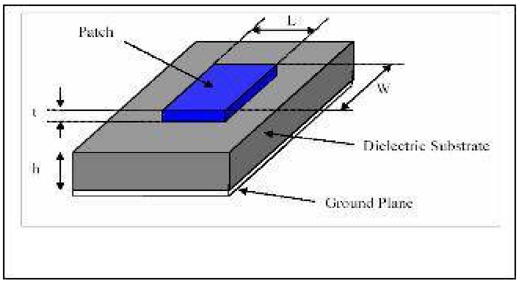

Figure 1 Structure of microstrip patch antenna

$$W = \frac{c}{2fr}\sqrt{\frac{2}{\varepsilon_r + 1}} \qquad (1)$$

c-Free space velocity of light,3x10^8
fr-Resonant frequency
εr-Dielectric constant

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(1 + \frac{12h}{w}\right)^{-0.5} \qquad (2)$$

where,
εr - Dielectric constant
h-Height of dielectric substrate
W-Width of the patch

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ε_{reff}-Effective dielectric constant

$$L_{eff} = L + 2\Delta L \quad (3)$$

where,

Leff-Effeectivelength
ΔL-Change in length
Patch length Extension(ΔL):

$$\Delta L = 0.412h \frac{(\varepsilon_{reff} + 0.3)(\frac{w}{h} + 0.264)}{(\varepsilon_{reff} - 0.3)(\frac{w}{h} + 0.8)} \quad (4)$$

III. DESIGN ANALYSIS

A DESIGN STRUCTURE OF WIDEBAND ANTENNA

A wideband antenna in its simplest configuration consists of a radiating patch on one side of a dielectric substrate which has a ground plane on other side.The patch conductors usually made of copper can be virtually assumed to be any shape.The radiating elements and the feed lines are usually photo etched on the dielectric substrate.

The structure of the proposed low-profile wide band antenna is shown in figure-2.The FR4 substrate with tan δ=0.012.The figure-2 represents the following dimension of wideband antenna design.It is possible the feed can be placed at any desired location inside the patch.In addition the probe will also radiate which can lead to radiation in undesirable directions.A thicker substrate is used and therefore it requires long probe.This gives rise to an increase in spurious radiation form of the probe,increased surface wave power andincreased feed inductance.

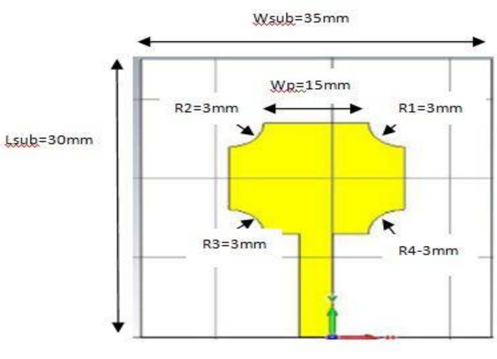

Fig 2 top view of wideband patch antenna

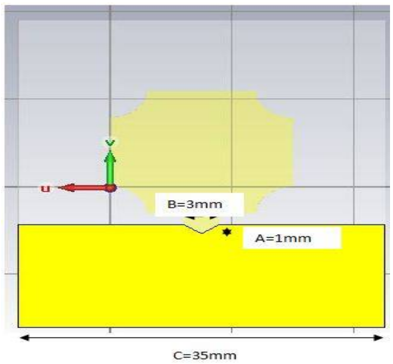

Fig 3 Bottom view of wideband patch antenna

The table 1 represents the basic design parameters value of the wideband antenna design.

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Table 1 Basic parameter value

PARAMETER	VALUE
Dielectric constant	4.6
Dielectric substrate	FR4
Loss tangent	0.012
Zo	50 ohm
Operating frequency	3.1GHz-10.6GHz
Feeding method	Microstrip line feed
Cu thickness	35 micron(1.4 mil)

III SIMULATION AND RESULTS

A.RETURN LOSS PLOT OF WIDEBAND ANTENNA DESIGN

The various parameters are obtained in the design analysis using CST Studio suite.The return loss is the loss of signal power resulting from the reflection caused at a discontinuity in a transmission line.This discontinuity can be a mismatch with the terminating load or with a device inserted in the line.It is usually expressed as a ratio in decibels(dB).The figure 4 shows the simulation results of the rectangular patch in CST Studio suite.The figure 4 shows the behaviour of the S11 parameter or the input reflection coefficient over a wide range of frequency is 3.1 GHz to 10.6 GHz.

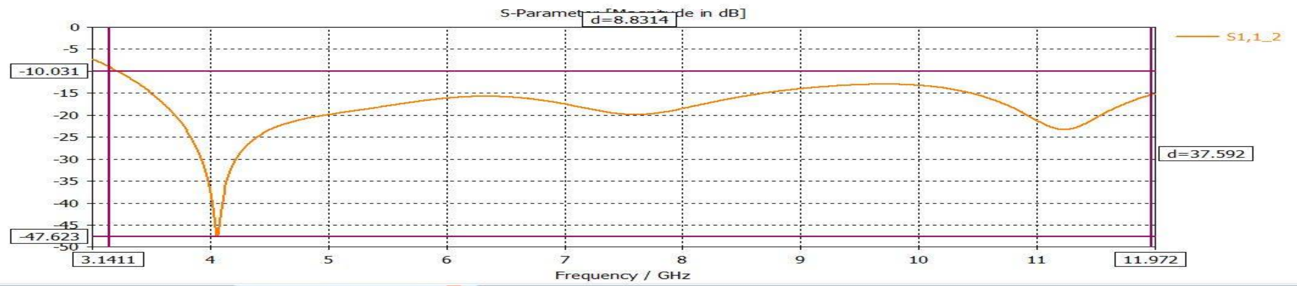

Fig 4 Return loss plot of wideband antenna design

B.VOLTAGESTANDINGWAVERATIOPLOT OF WIDEBAND ANTENNA

The Figure 5 represents the Voltage Standing Wave Ratio(VSWR) at the frequency range is 3.1 GHz to 10.6 GHz and it represents the 2-dimensional graphical representation.

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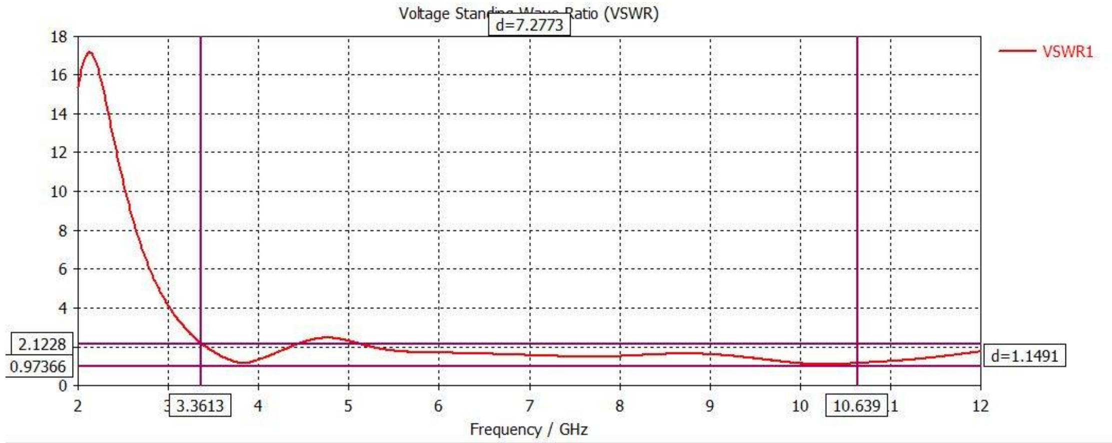
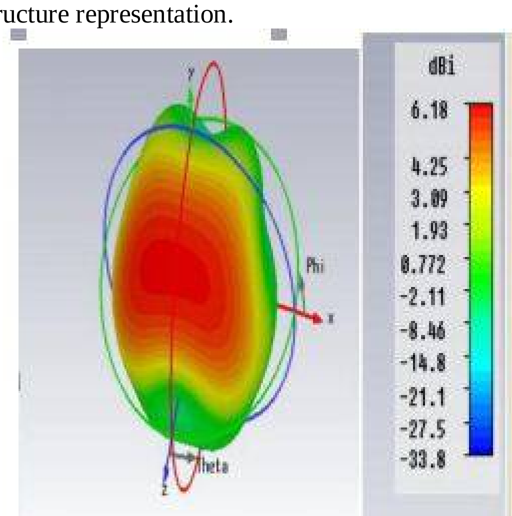


Fig 5 Voltage Standing Wave Ratio plot of wideband antenna design.

In general if the vswr range is 1 to 2 the antenna match is considered very good and little would be gained by impedance matching.

C.RADIATION PATTERN OF WIDEBANDANTENNA

The figure 6 shows the far field radiation display pattern.There is no side lobes.Figure 6 shows the directional radiation pattern of the wide band antenna design.Directivity is the figure of merit of an antenna.Here the directivity is observed to be around 6.18 dBi at the frequency range is 8.66 GHz.The figure 7 represents the directional radiation pattern with structure representation.



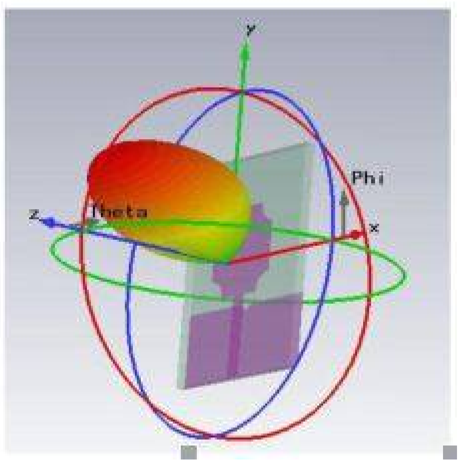


Fig. 6 Directivity pattern of wideband structure representation of 8.66GHz

Fig 7 Directional radiation pattern wideband antenna withantenna.8.66GHz

IV CONCLUSION

In this paper a wideband microstrip patch antenna is proposed.It is observerd that the return loss is reduced less than 10db and good performance parameter are obtained. The proposed antenna is designed for ultra wide band applications like Wi-Fi, Wi-Max was successfully incorporated into a single patch and single feed mechanism.The proposed patch yield desirable results between the operating frequency range. Above all the antenna was found to produce a gain of

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around 6.05 dBi and the maximum the return loss is -45dB at the frequency range is 3.1 to 10.6GHz.The proposed wideband antenna widely used in wireless communication applications.

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BIOGRAPHY

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