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Analysis and Design of Microstrip Antenna with Defected Ground Structure for UWB Application

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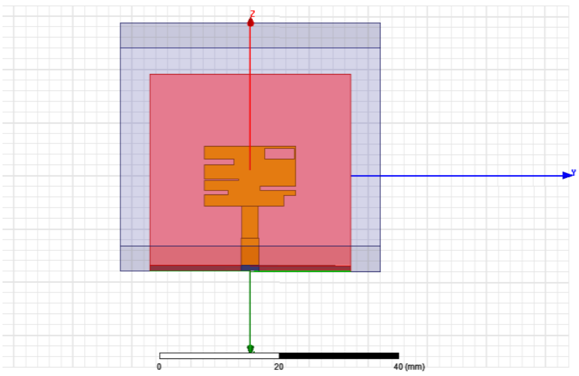
***Abstract*— In this paper a small size microstrip antenna with DGS (Defected ground structure) is designed and analyzed for UWB (Ultra Wide Band) application. This antenna cover the complete frequency range of 3.1 to 10.6 GHz with a very small geometry as compared to a conventional antenna Dielectric substrate use in this antenna is Fr-4. This antenna is designed with a dimension is 36mm × 34 mm on a dielectric substrateFr-4 whose permittivity ε_r =4.4 and height h = 1.6 mm. The result for return losses and radiation patterns is simulated by using HFSS (High Frequency structure simulation) software. The ground element of the proposed antenna is taken in the form of defected ground structure (DGS).**

Keywords*— Microstrip Antenna, UWB, DGS, Wide band, HFSS

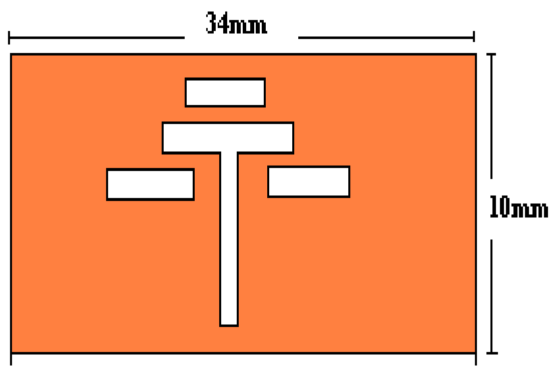
I. INTRODUCTION

Micro strip patch antenna is wide beam width, narrowband antenna. And consists of three major part there is ground, patch, substrate (here used FR-4). There are numerous substrates that can be used for the design of microstrip antennas, and their dielectric constants are usually in the range of $2.2 \le \varepsilon_r \le 12$ [4][5] [6]. In this paper used Defected Ground Structure technology. Defected Ground Structure is unique technology to reduce the antenna size. A DGS may come in a variety of geometries and sizes, depending upon their mode of application, as well as the frequency of operation [8][9]. The formatter will need to create these components, incorporating the applicable criteria that follow. The Defected Ground Structure (DGS) technology are various type there is Dumbbell-shaped, Square heads connected with U slots, H-shaped[9], Meander line, U-shaped[9], T-shaped, DGS in T-shaped and rectangular shaped. And Ultra wide band range (UWB) released by Federal Communications Commission (FCC) since 2002. It Covers frequency range 3.1 GHz to 10.3 GHz.[2] [3].The ultra-wideband (UWB) systems advantages is it is consist high speed data, small size, not expensive, low complexity[1-4]. This antaean is simulated by HFSS. HFSS is integral equation and method of the moment based Electromagnetic simulator.

I I. ANTENNA GEOMETRY AND EQUATION



(a)



(b)

Fig.1- Microstrip antenna on FR-4 Substrate

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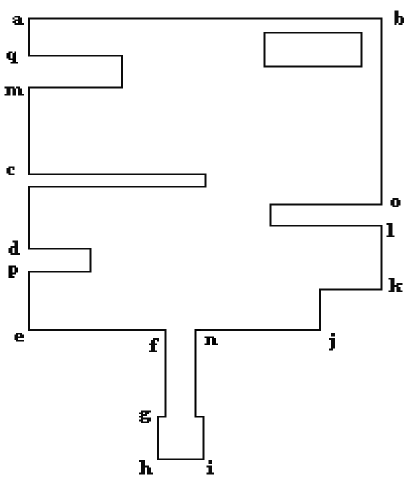

Fig. 2- Patch of antenna

TABLE 1. ANTENNA DIMENSION

S.NO	Description	Value in mm.
1	Antenna length	36
2	Antenna width	34
3	Antenna thickness	1.6

TABLE 2. ANTENNA PATCH DIMENISON (mm)

ab	15.4	pe	2.2
bo	7.5	cm	2.7
lk	2	qa	2.5
fg	6	dc	1.8
hi	3		

$$W = \frac{c}{2 f_r}\sqrt{\frac{2}{\varepsilon_r + 1}} \quad \text{......(1)}$$

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}} \quad \text{......(2)}$$

$$\Delta L = 0.412h\frac{(\varepsilon_{reff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)} \quad \text{......(3)}$$

$$L = \frac{c}{2 f_r \sqrt{\varepsilon_{eff}}} - 2\Delta l \quad \text{......(4)}$$

Where,

c = Velocity of light in free space
f_r = Resonant frequency
h = Height of the substrate
ε_r = Dielectric constant of the dielectric
ε_{eff} = Effective dielectric constant of substrate
ΔL = Fringing field
L = Length of the substrate
W = Width of the substrate

This is equation determine the value of substrate of width , effective dielectric constant of substrate, Fringing field, Length of the substrate

II. ANTENNA RESULT

1)- Return loss versus Frequency

In the Fig.3 show simulation result for return loss versus Frequency graph of microstrip patch antenna with Defected ground structure for UWB application. which is provide five bands at different frequencies such as 3.26 GHz, 4.55GHz, 6.72 GHz, 7.76 GHz and 9.36 GHz along with their different Return Loss values. This graph behavior is multi-band. At the frequencies i.e. 3.26 GHz, 4.55 GHz, 6.72 GHz and 7.76 GHz and 9.36 GHz obtained Return Loss values are -51.87 dB, -20.96 dB, -24.15dB, -21.51 dB and -39.10 dB. Which is show in Table 3.

TABLE 3. Return Losses vs Frequency

Frequency	3.26 GHz	4.55 GHz	6.72 GHz	7.76 GHz	9.3 GHz
Return Loss	-51.87	-20.96	-24.15	-21.51	-39.10

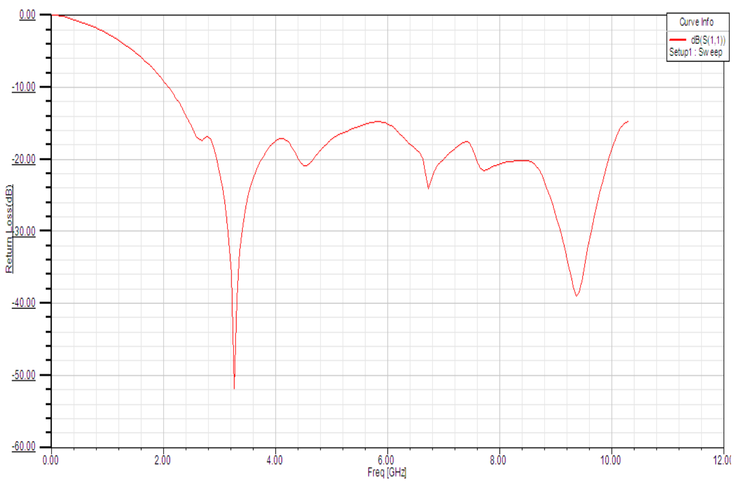

Fig.3- The Return loss versus frequency (GHz) plot for antenna design.

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2)- VSWR versus Frequency

In the Fig.4 show result for VSWR versus Frequency graph of microstrip patch antenna with Defected ground structure for UWB application. which is provide three different VSWR value at the frequencies i.e. 4.55 GHz, 6.72 GHz and 7.76 GHz obtained VSWR values are 1.55 , 1.07, and 1.46. Which is show in Table 4.

TABLE 4. VSWR VS Frequency

Frequency	4.55 GHz	6.72 GHz	7.76 GHz
VSWR	1.55	1.07	1.46

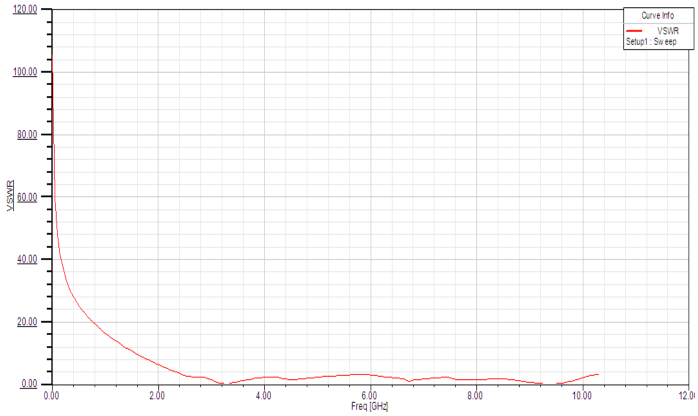

Fig. 4 - VSWR versus frequency (GHz) plot for antenna design.

3)- 3D Radiation Pattern of antenna

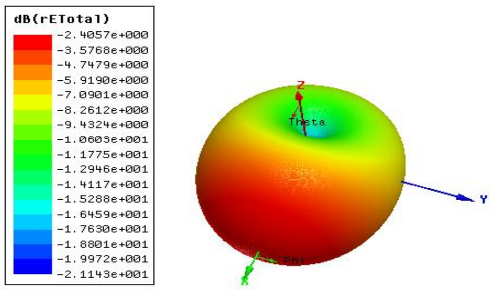

Fig. 5 - 3D Radiation Pattern of Antenna

IV. CONCLUSION

In this work, a Microstrip antenna with DGS for ultra wide band (UWB) Application has been design and simulated. This is a new patch antenna with defected Ground Structure (DGS) properties: improved Return loss (S11 db), VSWR. And the size of this antenna is small. Fundamental parameters are modeled with the equations and estimated with HFSS software. Microstrip patch antenna application in as like Mobile Communication, Global Positioning System, Interoperability for microwave access (Wi-Max), WLAN, Cognitive Radio, and UWB

V. REFERENCES

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