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Design of Microstrip Patch Antenna with Defected Ground Structure for Ultra Wide Band (UWB) Application

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Abstract - *In this article, Defected ground structure for microstrip patch antenna it's designed for Ultra wideband (UWB) frequency. In this design, a compact microstrip patch antenna with substrate 22mm×27mm using microstrip line feed is proposed. Three stubs are introduced in half ground plane to enhance the bandwidth of the antenna. The operating bandwidth of this antenna is 5.5GHZ and antenna covers the frequency range from 3.8182GHz to 6.3636GHz. The antenna is proposed to achieve broadband characteristics.*

Key words: Microstrip line feed, UWB Defected ground Structure, PCB and VSWR.

1. INTRODUCTION

Ultra-wideband (UWB) technology has transmitting information spread over a large bandwidth. they are used a very lowest energy level for the short-range, high-bandwidth communications over a large portion of the radio spectrum and it's increasing demand to integrate. In that technologies small user equipment have remarkably increased. In that time of introducing compact antennas are very high sensitive Because it is extremely thin profile (0.01-0.05 wavelength), microstrip patch antennas has found many applications in defense rockets military aircraft, missiles and satellites[1]. An microstrip patch antenna with DGS has been represented the antenna must be electronically smallest and attractive with excellent performance and It's covers the frequency range up-to 3.1- 10.6 GHz [2]. This limitation has successfully remove by receive to required similar impedance bandwidth and it was necessary to increase the parameter like size, height, volume of patch feed and matching technique [4]. Currently many researchers has published which covers the ultra-wideband and growing many technique to achieved ultra-wideband

[3-7]. 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 [5-6]. 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 [10-11]. The proposed antenna having a rectangular top patch and fed by microstrip line feed technique to increase the bandwidth with defected ground. The substrate thickness of 1.6 mm the printed circuit board it's made of FR4-epoxy dielectric constant the design print one side patch with feed and another side defected ground and they are etched on the both sides of the size of substrate considered as 22 mm × 27 mm. The antenna has been feeded with microstrip line and has width and length of 5.5 mm × 8 mm.

2. PROPOSED ANTENNA DESIGN

The microstrip patch antenna defected ground structure have designed into two steps as shown in Fig.2 In Step 1- simple rectangle united with feed and patch has been drawn on the primary surface the resonate frequency at 5.5 GHz by using the standard equations. In Step 2- Ground surface has the dimensions of 22mm × 27mm. We have cuts four slots on the ground surface. As a result

bandwidth is improved. The length and width of stub is 5.0mm × 5.5mm and 10.5mm × 15.5mm Rectangular patch and feed have been introduced to increase the excitation of resonant modes. Result of return loss plots for various frequencies shown in Fig.3 and Table 1.

Design step	f L (GHZ)	f H (GHZ)	BW (GHZ)
Step 1	3.33	4.48	1.15
	5.94	6.67	0.73

2.1 Design of Optimized Patch Antenna with Defected Ground Plane at 3.8182 - 6.3636GHz

The design of microstrip patch antenna parameters has been shown in Fig. 4. The antenna design parameters to resonate at 3.8182 GHz to 6.3636GHz have been shown in Table 1.

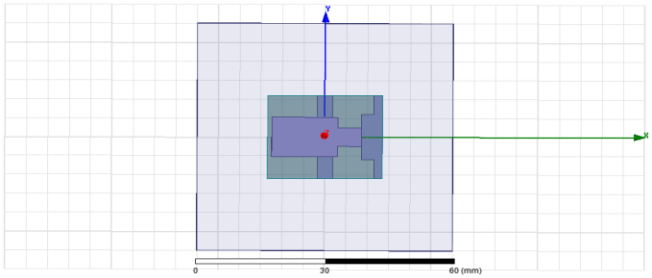
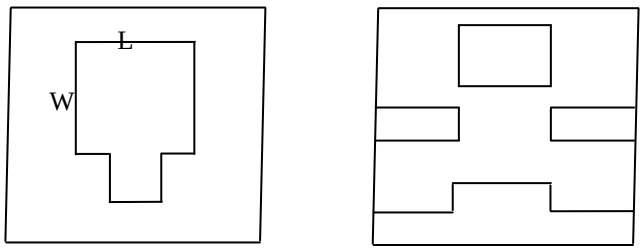


Fig-1: Basic design of the microstrip antenna with DGS.



Step 1- Patch with feed. Step 2- Defected ground.

Fig-2: Development of the design Microstrip Patch Antenna with Defected Ground

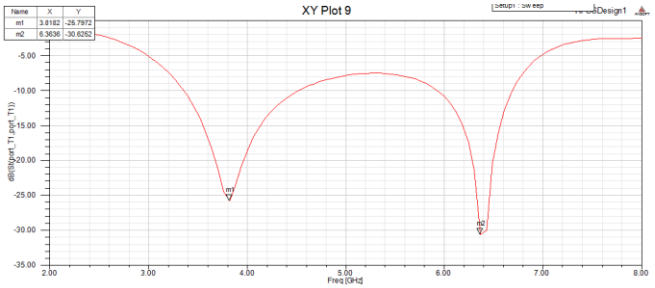


Fig-3: Return Loss (dB) Frequency (GHz) quency.

Table-1: Frequency table of return loss plots.

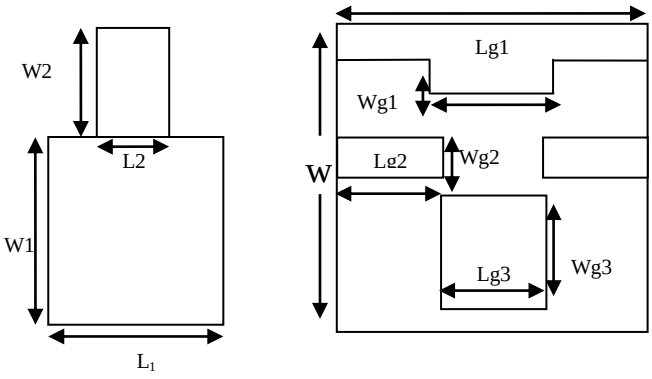


Fig-4: Dimensions of the feed patch and DGS

3. RESULT AND DISCUSSION

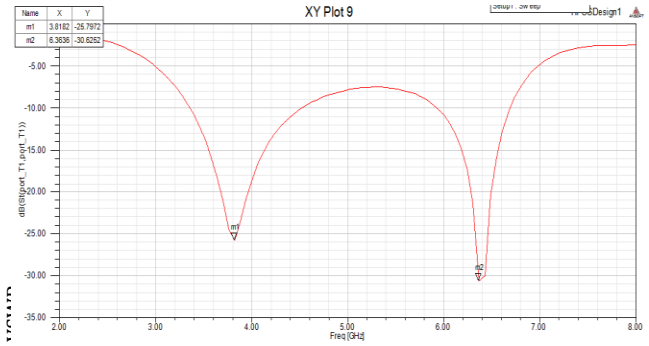
The Analyzer designed and simulate proposed antenna result is done.

Parameter	Dimension (mm)
W1	15.5
L1	10.5
W2	5.5
L2	5.0
W	27.0
L	22.0
Wg1	3.0
Wg2	3.6
L g1	12.0
L g2	8.0
Wg3	7.75
L g3	10.5

Table-2: Antenna Parameter of patch and feed.

3.1 Return Loss Plot and Bandwidth

The return loss and Bandwidth are measure of the effectiveness range of frequency and electrical energy delivered from feed which performance of the antenna. The bandwidth can be considered to the range of frequency for maximum energy transfer the return loss should be mini- mum. in figure 4 shown the S11 parameters for the proposed antenna. The antenna is required to given the return loss is less then −10 dB (VSWR lies of between 1 to 2). In Fig. 5 the graph shows that the return loss below the −10 dB is started from 3.8182 to 6.3636 GHz which covers the entire UWB applications. The bandwidth of the proposed antenna is 0.94 GHz.

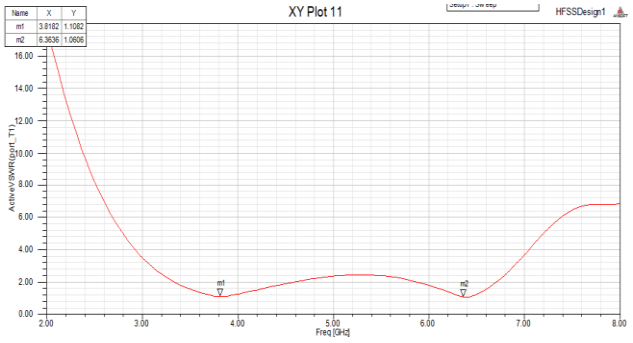


Freq (GHz)

Fig-5: Return loss plot for optimized antenna

3.2 Voltage Standing Wave Ratio (VSWR)

The voltage Standing Wave Ratio (VSWR) and is also referred to as standing wave ratio (SWR). VSWR can be derived from the level of reflection coefficient and incident waves shown in Fig. 6. If the reflection coefficient is given by Γ, (VSWR = 1+IΓI/1-IΓI. The VSWR is always a real +ve number for antenna. VSWR indicate increase in the voltage Standing Wave Ratio mismatched between the antenna and the microstrip transmission line. VSWR must to be lies between 1 and 2.



Frequency (GHz)

Fig- 6: VSWR versus frequency curve

3.3 Radiation Pattern

The radiation pattern has been represented of the radiation properties of the antenna as coordinates function in the space, it's radiates and provide the information in the form of electrical energy. The patterns described normal field power value with respect to maximum value. The radiation properties always represented in two or three (2D or 3D) dimension as shown in figure no. 7. E-plane and H-plane radiation E-plane defines is as the electrical field vector of the maximum radiation. And H-plane is magnetic field vector in the direction of maximum radiation.

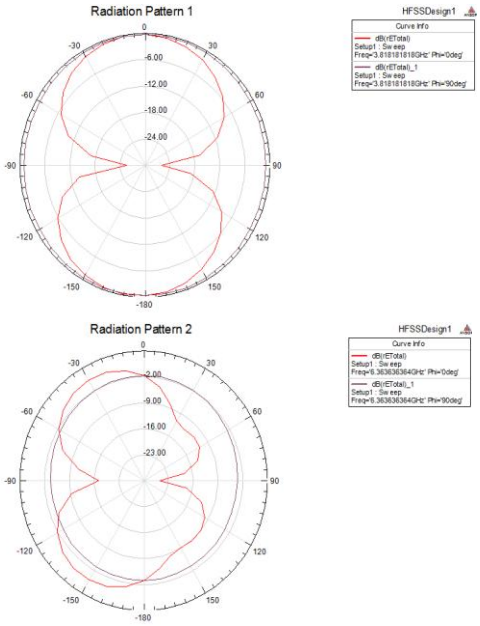


Fig-7: Radiation patterns of H and E plane at 90°.

4. CONCLUSION

In this article, a Microstrip patch antenna with defected ground structure for ultra wide band (UWB) Application. Thchinque are used for improve the bandwidth of the antennas they have compact size microstrip antenna with defected Ground Structure (DGS) its properties of Return loss, VSWR. And the return loss below −10 dB over all the frequency band. Microstrip patch antenna application in as like microstrip patch antennas has found many applications in defense rockets military aircraft, missiles and satellites Mobile Communication, Global Positioning.

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