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Design and Simulation of Rectangular Shape MSA with Slots for WLAN Applications

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Abstract: In this paper, CPW design of microstrip patch antenna for WLAN standard is presented. The proposed design consists of Pi structure and circle which are designed on FR4 substrate. This paper holds the parametric study of different antenna parameters. The proposed structure is providing frequency bands from 2.35-2.84 GHz, 4.25-4.64 GHz, 5.14 -5.83 GHz such that total bandwidth is 1.57 GHz or 31.5%.The antenna performance antenna parameters like radiation pattern and antenna gain also presented in this paper.

Keywords: WLAN, Microstrip Antenna and Pi Shape.

I. INTRODUCTION

There is sharp increase in the demand of designing micro strip patch antenna for WLAN applications because WLAN communication system has evolved at a very high rate during last decade [1-2]. Modern communication systems and instruments such as Wireless local area networks (WLAN), mobile handsets require lightweight, small size and low cost. The selection of microstrip antenna technology can fulfill these requirements [1-3]. Many micro strip patch antenna has been designed for WLAN operation are in the 2.4 GHz band (2.4-2.484 GHz) and 5.2-5.8 GHz (5.15-5.35 GHz/5.725-5.825 GHZ).Micro strip patch antenna have is also popular because of its small size and weight ease of fabrication and compatibility with printed circuit [4-5]. With these advantages microstrip patch antenna have some drawback of low gain and narrow bandwidth etc [6].In this paper designing and simulation of a CPW micro strip patch antenna consisting of a rectangular patch with Pi shape and a circle cut slot is presented for WLAN application .By adding the nunber of slot in the rectangular patch the performance of antenna can be improved. The simulation process provides the radiation pattern, gain and bandwidth of the proposed structure which shows that the proposed structure is suitable for WLAN applications. Details of the proposed structure and the results are discussed in the next section.

II. ANTENNA STRUCTURE AND GEOMETRY

The figure 1 shows geometery of the proposed structure. Pi and circle slot shaped was printed on an inexpensive FR4 substrate of thickness 1.6 mm and relative permittivity 4.4. A 50-ohm feed-line of width Wf =3.1 mm was used to excite the antenna. "FR4" means "flame retardant" and type 4 indicates woven glass reinforced epoxy resin. Spacing between the ground plane and feed line is denoted by'd' is equal to 2.4 mm and spacing between rectangular patch and ground plane is denoted by's' is equal to 2.6 mm. The diameter of the circle is 6.74 mm. The length of the rectangular patch L is 32.6mm and width W is 25.5mm.Other designing parameters are as Lg=15.4mm,Wg=14.6mm,L_f=18.1mm,W_f=3.1mm,L_1=23.3mm,L_2=7.2mm,L_3=8mm,L_4=4.5mm,L_5=13.9mm,L_6=7.6mm,W_1=5.39mm,W_2=4.95mm,W_3=4.02mm. Total volumetric size of the proposed antenna is 1.33 cm^3.

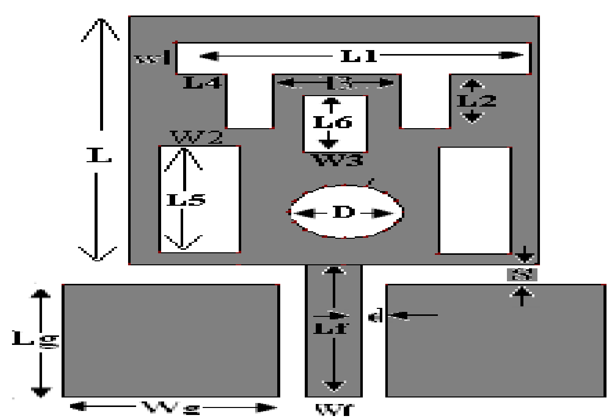


Figure.1Geometry of the proposed Antenna

For fabrication purpose, simple screen printing & chemical etching is used for proposed antenna pattern creation on the substrate. The fabricated design of the proposed structure is depicted in figure 2.

Figure. 2 Prototype of the proposed Structure

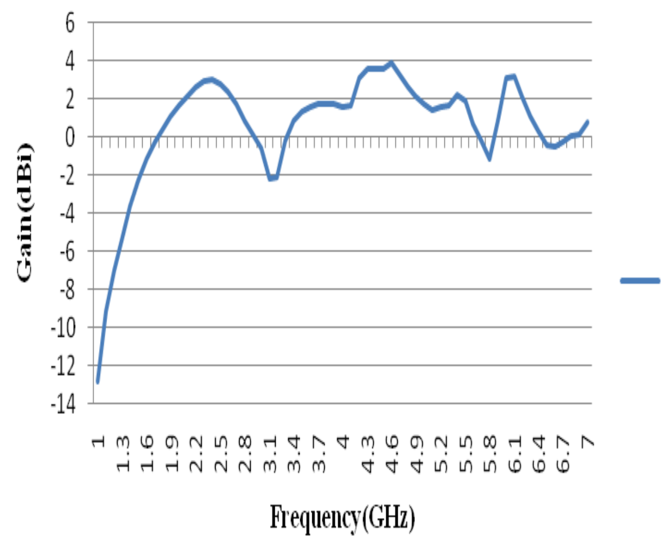


Figure 4 Simulated Gain of the proposed Antenna

III. RESULTS AND DISCUSSION

In this section the simulated return loss, radiation pattern, current distribution pattern, gain is discussed. The simulated result for return loss in dB for the proposed structure is depicted in figure 3 which shows that proposed structure is suitable for complete WLAN frequency bands. In the simulated frequency response, three resonant modes at frequency of 2.35, 4.25 and 5.14 GHz can be seen. The lower mode has an impedance bandwidth of 490 MHz (2.35-2.84GHz), with respect to the centre frequency at 2.59 GHz. The middle mode has an impedance bandwidth of 390 MHz (4.25-4.64 GHz). For the higher mode proposed antenna has an impedance bandwidth of 690 MHz (5.14 -5.83 GHz), with respect to the centre frequency at 5.44 GHz. After considering all the frequency modes total impedance bandwidth of the proposed structure is 1.57 GHz or 31.5 %.

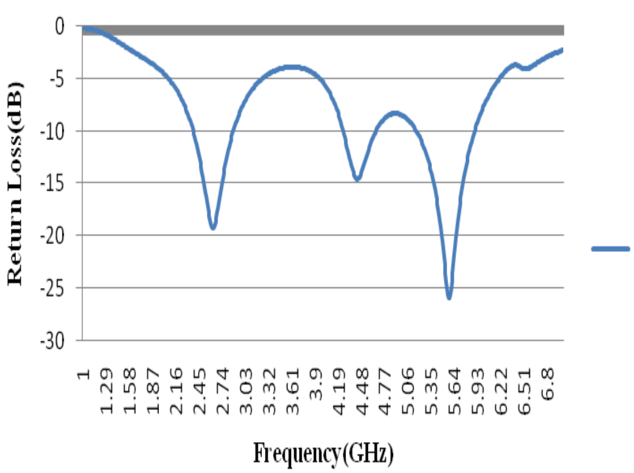


Figure 3 Return Loss of the proposed Antenna

The maximum gain of the proposed structure is 4.01 dBi at 4.62 GHz frequency.The relation between simulated gain and frequency of the proposed structre is depicted in figure 4.

The current distribution pattern of the proposed structure is simulated in Max E-Current with the scale of dB (for example 0 dB means 300.038 A/m) means maximum current density is 300.038 A/m. The maximum current density in the proposed geometery is 11.28 A/m.The current density distribution pattern is depicted in figure 5. The colours represent the average strength of the current density at a specific point. The red colour represents the strong current density where as blue colour represent the weak current density.

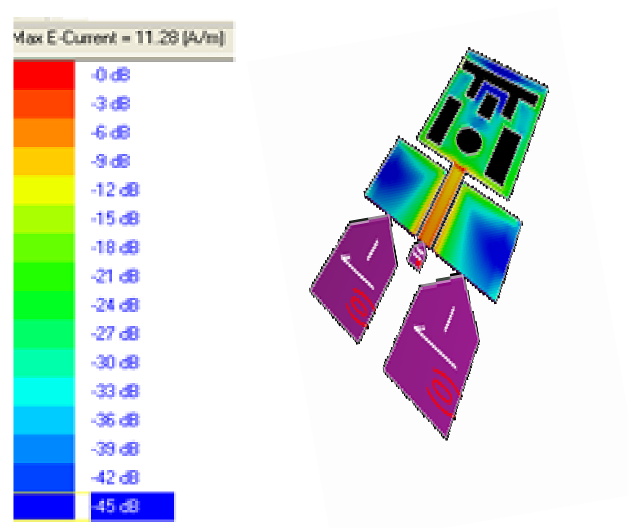
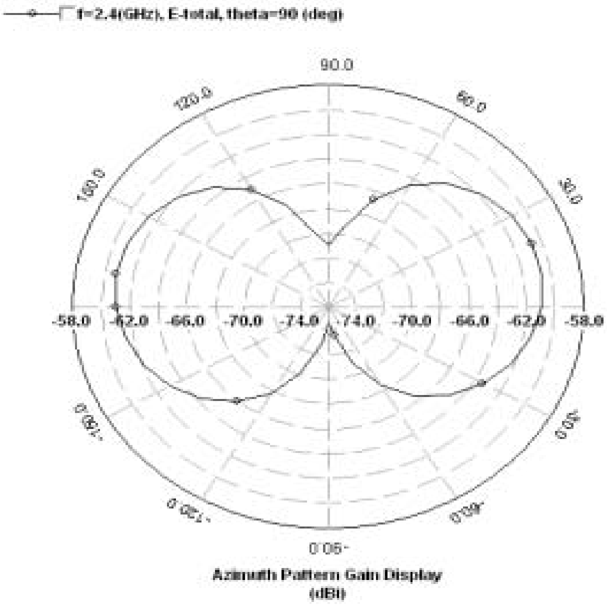


Figure 6 Curent Distribution Pattern of proposed Antenna

Radiation characteristics of the proposed structure are shown by the figures 7 and 8 which plot the simulated radiation patterns in both the elevation and azimuthal direction at 2.4 and 5.5 GHz, respectively for the proposed antenna. The radiation pattern of the proposed structure is showing the combined graphical repersentation of Azimuth plane and Elevation plane. A stable radiation patterns have been obtained for the proposed antenna. Monopole-like radiation patterns is observed.



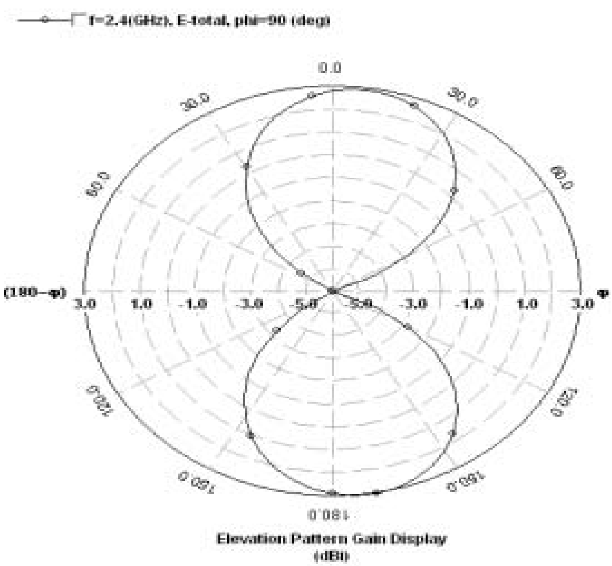
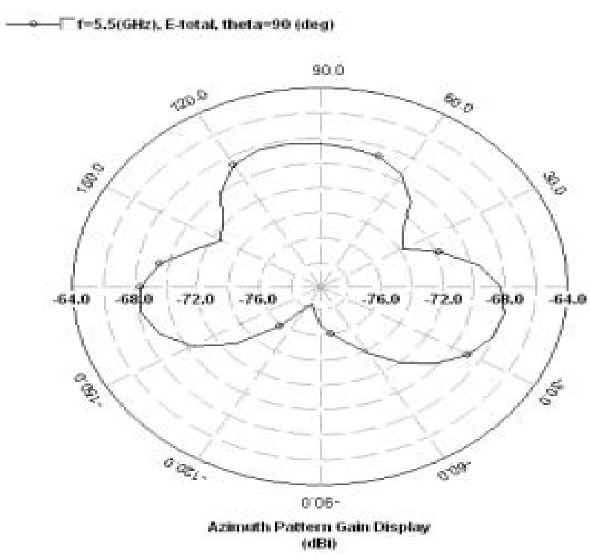


Figure 7 Azimuth & Elevation Plane Radiation Pattern at 2.4 GHz



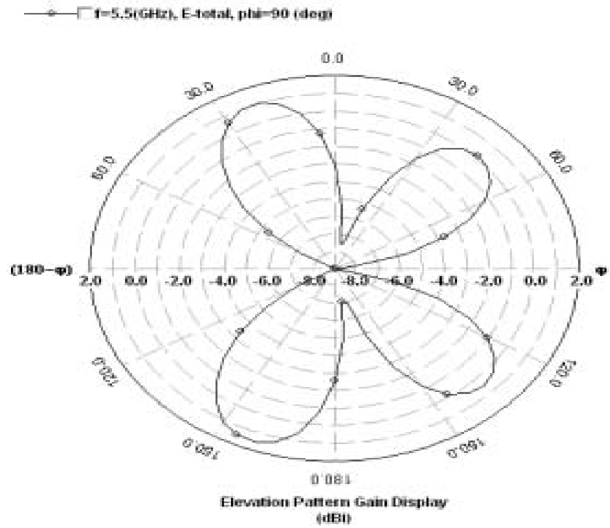


Figure 8 Azimuth & Elevation Plane Radiation Patern at 5.5 GHz

Three Dimensional pattern of the proposed structure is shown in figure 9 which shows that proposed structure is providing omnidirectional pattern.

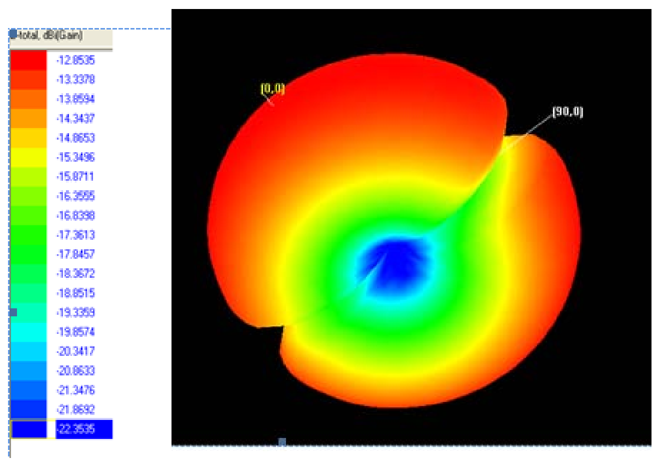


Figure 9 Three Dimensional Pattern of the proposed Antenna

IV. PARAMETRIC STUDY

The geometrical parameters of the antenna were changed one by one and after several cycle of changes, the optimized values for these parameters were obtained. Following stages lists the values of optimized parameters of the antenna which shows the effect of the various geometrical parameters on the antenna performance.

Stage1: At the intial stage such as when no cut slit is in the rectangular patch antenna the proposed structure is providing the frquency bands from 2.54 GHz to 2.96 GHz at -11.82 dBi return loss. Total impedence bandwidth at this stage is .42 GHz.

Stage2:When straight slits are added to the rectangular patch then in the simulated frequency response, three resonant modes at frequency of 2.54 GHz and 5.82 GHz are obtained (2.54 GHz-2.94 GHz, 5.82 GHz-6.1 GHz).Total impedence bandwidth is increase from .42 GHz to .68 GHz.

Stage3:When a circle is added then impedence bandwidth is increased from .68 GHz to .69 GHz.

Stage4:When a Pi shape slit is added the resonant modes are 2.21 GHz, 3.49 GHz, 5.29 GHz can be seen from the figure 10.The total impedence bandwidth at this stage is 1.07 GHz (2.21 GHz - 2.57 GHz, 3.49 GHz - 3.97 GHz ,5.29 GHz - 5.52 GHz). The proposerd structure is resonating at three modes 2.35 GHz , 4.25 GHz, 5.14 GHz. The lower mode of WLAN has an impedance bandwidth of 490 MHz (2.35 -2.84 GHz), or about 18.70% with respect to the centre frequency at 2.59 GHz. The higher mode of WLAN has an impedance bandwidth of 690 MHz (5.14 -5.88 GHz), or about 12.86% with respect to the centre frequency at 5.44 GHz. The resonant mode from 4.25 GHz to 4.64 GHz has impedence bandwidth 390 MHz or 8.77%.Total impedence bandwidth of the proposed structure is 1.57GHz or 31.5%. The effect of different parametres can be seen from from figure 10.

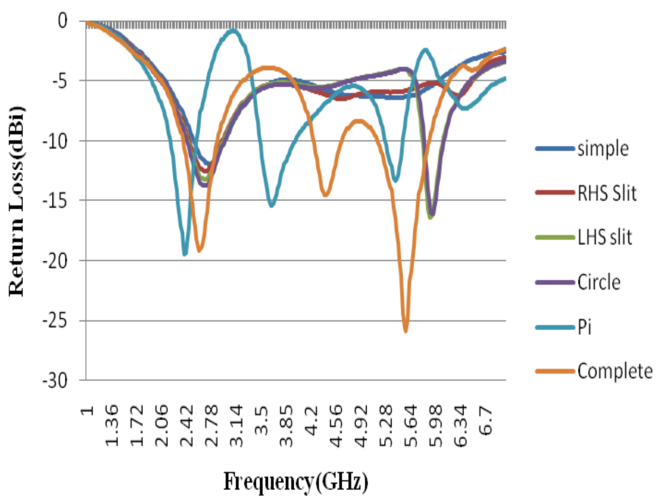


Figure 10 Parametric Study of the proposed Antenna

V. CONCLUSIONS

In this paper, a CPW feeding Pi and circle shape slot micro strip patch antenna is proposed. Simulated results of the proposed structure are showing that the proposed structure is providing frequency bands for WLAN applications with impedance bandwidth of 31.5%.The effects of different parameters on the antenna performance has been shown by parametric study. Other antenna parameters like radiation pattern and gain of the proposed structure are acceptable.

VI. REFERENCES

[1]. C.A. Balanis, “Antenna theory: analysis and design,”Third edition, John Wiley & sons Inc., 2005.

[2]. T. A. Milligan, “Modern antenna design,” John Wiley & Sons, INC, 2005

[3]. Liu Wen-Chung, “Broadband Dual-Frequency CPW-Fed Antenna with a Cross-Shaped Feeding Line for WLAN Application,” Microwave and Optical Technology Letters, vol. 49, pp. 1739-1744, 2007

[4]. M.T. Islam, “Broadband E-H Shaped Microstrip Patch Antenna for Wireless Systems,” Progress in Electromagnetics Research, PIER 98, 163-173, 2009

[5]. Liu, H.-W., C.-H. Ku, and C.-F. Yang, \Novel CPW-fed planar monopole antenna for WiMAX/WLAN applications," IEEEAntennas and Wireless Propagation Letters, Vol. 9, 240{243, 2010

[6]. Liu, W.-C., C.-M. Wu, and N.-C. Chu, \A compact CPW-fed slotted patch antenna for dual-band operation," IEEE Antennas and Wireless Propagation Letters, Vol. 9, 110-113, 2010.