DESIGN OF MICROSTRIP PATCH ANTENNA WITH ENHANCED BANDWIDTH

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ABSTRACT

In this work microstrip feed rectangular microstrip patch antenna for 5.2GHz IEEE 802.11 applications is proposed. The antenna is designed on Roger R03003 substrate with dielectric constant. The antenna parameters such as return loss, VSWR, gain and directivity are simulated and optimized using commercial computer simulation technology microwave studio (CST MWS). Latest optimization tools are used for desirable results. The main advantage of this antenna is that the designed structure is very simple compared to other proposed WLAN antennas and the cost for making this antenna is also low. In this work there is lot of scope for future research. As new parameters depending on applications can be added & correspondingly results will be analyzed.

Keywords: Microstrip Antenna, Monolithic Microwave Integrated Circuits, Wireless local Area Network.

I. INTRODUCTION

With rapid development of wireless communication the demand for devices that can operate in different bands is increased. However, multifrequency antennas have the advantages of surveying multiple frequencies with one antenna but the crosstalk from the neighbor bands makes them a weak choice [1]. The principal disadvantages of microstrip patch antenna are narrow bandwidth, low efficiency and small size [2]. Many researchers have been performed to enhance the bandwidth of printed antennas. To overcome this difficulty many methods and techniques are raised in the literature. The miniaturization of antenna and improvement in bandwidth can be obtained by adjusting to cut the slot in ground (DGS) and patch of microstrip antenna of proper length and width [3-5]. WLAN is a flexible data communication system which is implemented as an alternative to wired LAN. WLANs are becoming popular in a number of vertical markets such as retail, health, care, warehousing, manufacturing and academia which have profited from use of handheld terminal for real time information transmission to centralized hosts for processing [6]. WLAN are also being widely recognized as a reliable, cost effective solution for wireless high speed data connectivity.

There are three operation bands in the IEEE 802.11 WLAN standards:

- IEEE 802.11b/g (2.4 - 2.484GHz)
- IEEE 802.11a (5.15 – 5.35GHz)
- IEEE 802.11a (5.725 – 5.825GHz) [7]

- IEEE 802.11a employs the higher frequency bands and these bands are mostly used in business network due to its higher cost. Slot antennas are the very good choice for WLAN because of the ability of various frequencies ease of fabrication and compatibility with monolithic microwave integrated circuits (MMIC).

A number of WLAN antennas have been recently proposed and reported in literature [7]. For designing compact sized WLAN antennas different and interesting methodologies are used few of them are as:

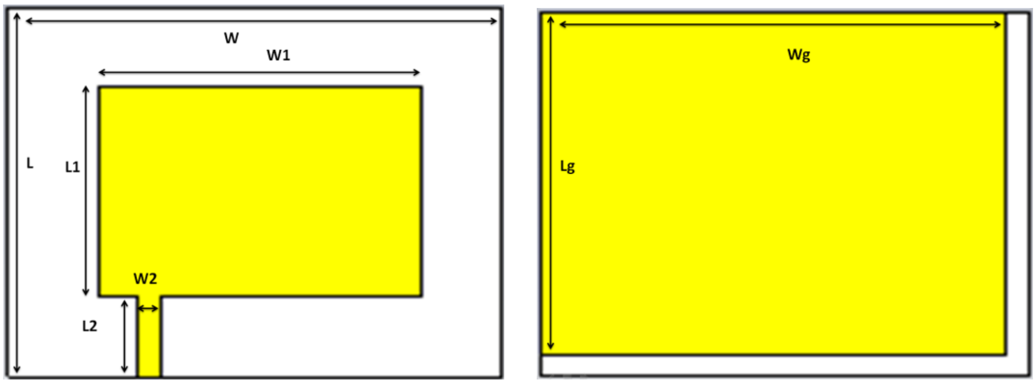
- Bending the monopole to different shapes has been used in [8]-[13].
- Effective size reduction techniques are the use of an inverted-F structure [14]-[17]. By inverted F structure achieving a compact size is a design challenge this challenge has been tackled in [18].
- The direct feed PIFA proposed in [19] was combined with parasitic element was used to generate the 5.8 GHz band.

This paper proposes a compact and simple Microstrip patch antenna. Designed antenna is operating in 5.2GHz IEEE 802.11 band. The main advantage of this antenna is this designing structure is very simple and compact as compared to other designed antennas [8]-[16]. And its bandwidth is improved using the DGS technique. As due to its simple design structure it can be easily designed and fabricated so it reduces cost and time of manufacturing this antenna and as the 5.2GHz WLAN antenna have indoor applications so the reduced cost can promote its applications in other areas too where the budget is not much high. The substrate used for designing this antenna is Roger R03003 which is good substrate material for better results.

In this paper there are three sections. The antenna design is explained in second section. In third section simulated results are mentioned of designed antenna, in results we are including the return loss, bandwidth, VSWR, gain, directivity and current distribution of proposed antenna. And in final section paper is concluded.

II. ANTENNA DESIGN

Roger R03003 substrate with the dimension of 22.18 × 23.35 mm and the thickness of 1.6 mm is used for designing this antenna the dielectric constant of this substrate is 3.5. For designing this antenna firstly we designed a simple rectangular patch antenna with patch dimensions 17.5 X 12.3 X 0.035. The microstrip feeding is used with dimension L2 = 4.8mm and W2 = 1.19mm for providing feed to this antenna as shown in Fig.1. Mcrostrip feedline is adjusted to the point on patch where best results are obtained.



(a) **(b)**

Fig .1. Proposed Antenna (a) Front View (b) Back view

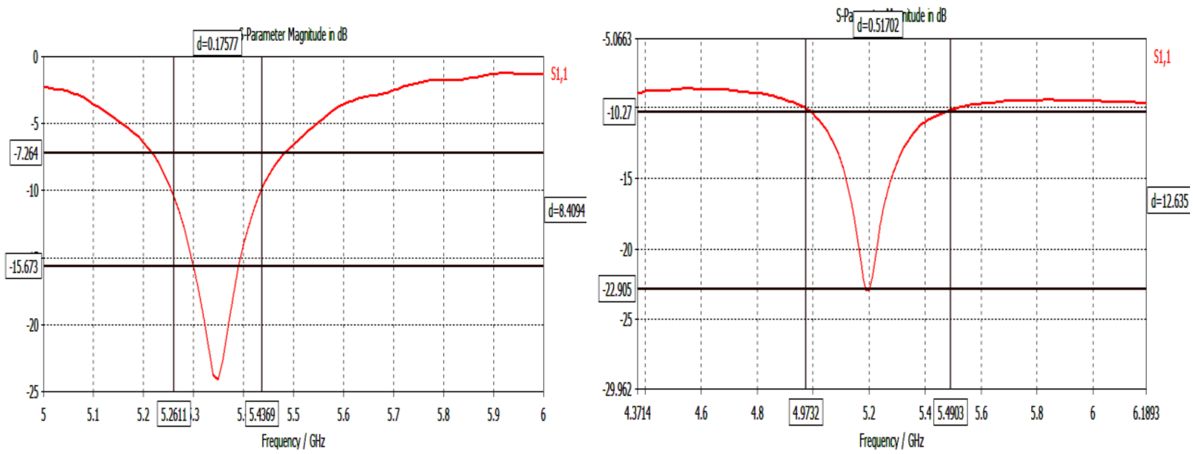
Table I Dimensions of Proposed Antenna

Antenna parameter	Value	Antenna parameter	Value
L	22 mm	W	26.4 mm
L1	12.5 mm	W1	17.3 mm
L2	4.8 mm	W2	1.2 mm
Lg	20.9 mm	Wg	25.1

By simulating the designed structure without changes in ground it is working for some band for the 5.35 GHz with bandwidth of 175MHz for IEEE802.11a WLAN band. Then its bandwidth is enhanced by making changes in ground and now its resonant frequency is 5.2GHz with bandwidth of 517MHz. Hence using DGS approx 350MHz bandwidth is increased. The geometry of the designed antenna is shown in Fig.1 and the dimensions of this antenna are listed in TABLE I.

III. RESULT AND DISCUSSION

Fig.2 (a) shows the simulated return loss of the antenna without DGS. The return loss gives the band from 5.26 to 5.43 GHz is less than -10 dB and -24.5 dB for the resonant frequency 5.35GHz. Then for enhancing the bandwidth of antenna [20], designed antenna is shown in Fig.1. Now the return loss is shown in Fig.2.(b), resonant frequency is 5.2GHz with band from 4.9 to 5.5 GHz its bandwidth is approx 520 MHz as shown in Fig.2.(b) and it under IEEE802.11 WLAN standards and it is used in indoor applications.



(a) **(b)**

Fig.2.Simulated Results for Return loss (a) without DGS (b) with DGS

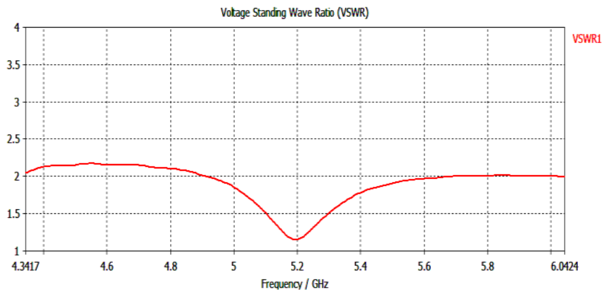


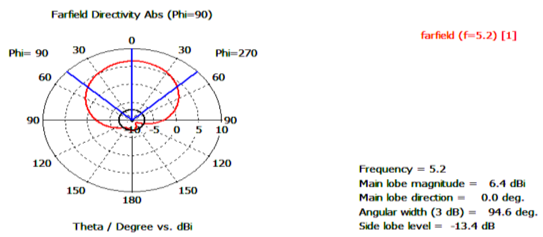
Fig.3.VSWR of Proposed Antenna

Fig.3 shows the simulated VSWR results of the proposed antenna. For microstrip antenna acceptable value of VSWR for resonant frequency should be less than or equal to 2. For this antenna VSWR at resonant frequency (5.2 GHz) is 1.19.

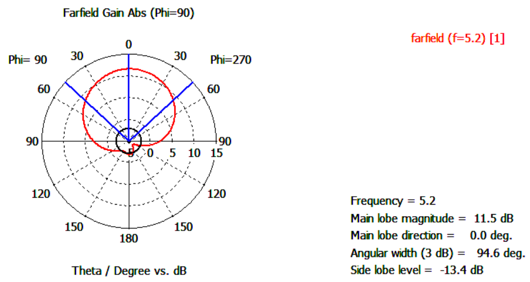
Fig.4 (a-b) shows the radiation pattern of this rectangular patch antenna at resonant frequency 5.2GHz. The antenna is representing the radiation in desired direction. The different parameters we get from radiation pattern are as follows:

- Angular width(3dB) = 94.6 Degree
- Gain(dB) = 11.5 dB
- Directivity = 6.5 dBi
- Side lobe magnitude = -13.4 dB

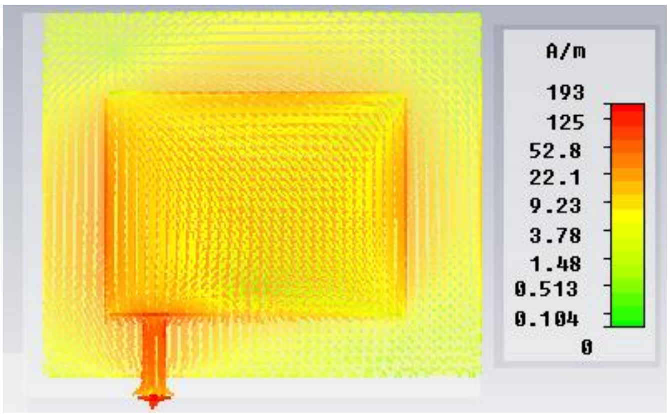
Fig.4 (c) is showing the current distribution of this antenna and as we can see that current distribution is maximum on the edges of rectangular patch.



(a)



(b)



(c)

Fig.4. Simulated Results of Proposed Antenna

(a) Gain at 5.2GHz (b) Directivity at 5.2GHz (c) Current Distribution at 5.2 GHz

IV. CONCLUSIONS

In this paper a low cost compact sized microstrip patch antenna with improved bandwidth for 5.2 GHz IEEE802.11 WLAN applications is demonstrated. For designing this antenna Roger R03003 material is used. For improving the bandwidth and other parameters of antenna DGS is introduced. The designed antenna is working for the frequency band 4.9 to 5.5 GHz with resonant frequency 5.2GHz. At the resonant frequency the return loss = -23dB, VSWR = 1.19 and gain = 11.5 dB. The simulated results are good and its simple planar geometry makes it suitable for microwave integrated circuits. In future this antenna can be converted for multiple bands so that the single antenna can be used for different wireless applications. Also this antenna can be converted to reconfigurable antenna using RF and MEMS switches.

In this field lot of research can be carried by varying the input & output parameters depending upon the the area of applications.

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