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Dual-Band Microstrip Patch Antenna for Wireless Application

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ABSTRACT

The antenna is very essential element of communication as it is used for a transmitting and receiving electromagnetic waves. Today Communication devices such as mobile phones become very thin and smarter, support several applications and higher bandwidth where the microstrip antennas are the better choice compare to conventional antennas. WLAN (Wireless Local Area Network) has been established by the IEEE 802.11a working group,also it works with frequency band(5.10-5.50 and 5.85-6.25 GHz) This paper presents a literature survey of slotted microstrip patch antenna's these are dual-band rectangular MSA ,Single S-slot MSA, Multi band H shaped MSA , U- slot MSA, compact L- slot MSA for Wi-MAX and WLAN applications with variety of substrates and slots. In this paper we also discussed the basics of microstrip antennas with their advantage and disadvantages.
Keywords: Microstrip Antennas Return Loss

I. INTRODUCTION

The study of micro strip patch antennas has made a great progress in the recent years, compared with the conventional antennas. The next generation networks we require higher data rate and size of devices are much smaller. In this evolution two important standards are Wi-MAX and WLAN. For success of these wireless applications we need efficient and small antenna in wireless is more and more important in our life portable antenna technology has grown along with cellular and mobile technologies. Microstrip antennas (SA) have characteristics low cost and also low profile which proves Microstrip antennas (MSA) to be well required for WLAN/Wi-MAX application systems.

For High mobility necessity and multiple frequency are demands for wireless communication devices increase the interest for compact, low-profile.frequency ranges of 5.10–5.50 and 5.85–6.25 GHz in the US. Proposed a dual-band/wideband packaged antenna for IEEE 802.11a WLAN band (5.10–5.55 and 5.725–6.25 GHz) application. However, the design compactness was reduced with the dimension of the antenna (28 *9 *3 mm) and printed circuit board (PCB) size (120* 80* 2 mm). Different techniques for WLAN dual-band designs are reported in [2]–[4]. However, these microstrip antennas are not specifically designed for WLAN 802.11a. Therefore, this design considerations are to satisfy and the required impedance bandwidth necessary for WLAN dual-band applications with maintaining the proper separation frequency gap between them.

II. METHODS AND MATERIAL

A. Geometry of Antenna

It is observed that the slot Antenna impedance is increased when the length of the slot is gradually increased and the position of slots are shifted toward radiating edge.results in enhancement of the slow wave factor, and thus the resonant frequency moves toward the lower value. It is also observed that due to the higher slow wave factor, the resonant frequency of the slotted antenna are moves to lower values are more rapidly with respect to the slotted antenna when the ground slot is added to them.

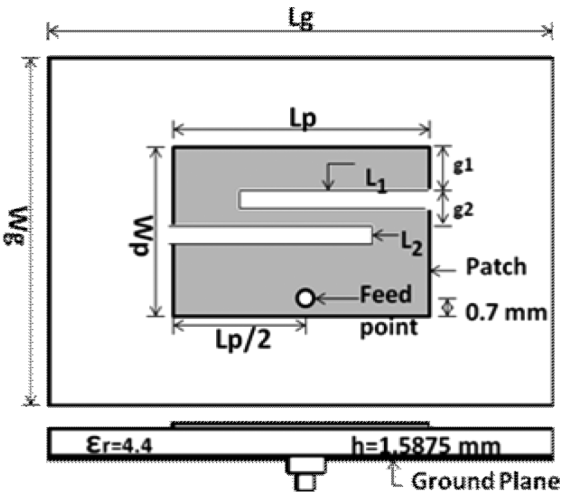


Figure 1. Geometry of the Dual-band Microstrip antenna.

B. Literature Survey

Compact Dual-Band MSA for WLAN Application has been proposed for microwave access and wireless applications. Results in compact antenna with better omnidirectional radiation pattern for proposed operating frequencies. It can be observed that the peak gain can be higher than 3dBi at 5.2 GHz. [1]

A Dual-band antenna with compact radiator for 2.4/5.2/5.8 GHz WLAN applications is developed. In this antenna exhibits wideband characteristics that depend on various parameters such as U-slot dimensions, probe fed patch. This antenna shows 37% impedance bandwidth with more than 90% antenna efficiency and is suitable for 2.3/2.5GHz WiMAX and 2.4/5.2 GHz WLAN application. [2]

A Rectangular MSA to Enhance Bandwidth at 2.4 GHz for WLAN Application has been proposed in this paper. In this bandwidth of antenna has been improved. This antenna was presented for satellite and WLAN application. [3]

A microstrip patch antenna for dual band WLAN application is proposed. In this paper a dual band L-shaped Microstrip patch antenna is printed on a FR-4 substrate for WLAN systems, and achieves frequency range from 5.1GHz to 6.1 GHz with maximum gain of 8.4 and 7.1 dB in lower and higher frequency bands respectively.[4]

A compact rectangular patch antenna has been presented for Wi-MAX and WLAN application. This antenna has compact, simple structure cost effective, and suitable for all frequency bands of Wi-MAX and WLAN applications. [5]

C. Advantages and Disadvantages

Microstrip patch antenna has several advantages over conventional microwave antenna with one of the similarity of frequency ranges from 100 MHz to 100 GHz same in both type. The various advantages and disadvantages are.

Advantages

1. Low weight
2. Low profile
3. Require no cavity Backing
4. Linear & circular polarization
5. Capable of dual and triple frequency operation
6. Feed lines & matching network can be fabricated simultaneously

Disadvantages

1. Low efficiency
2. Low gain
3. Large ohmic losses in feed structure.
4. Low power handling capacity
5. Excitation of surface wave
6. Polarization purity is difficult to achieve.
7. Complex feed structure required high performance arrays

D. Formulae for Rectangular patch dimensions

Sr no.	Parameter	Formulae
1.	Width of patch , W	$W = \frac{c}{2fo\sqrt{(\varepsilon_r+1)/2}}$
2.	Length of patch , L	$L = L_{eff} - \Delta L$
2.(i)	Normalized extension length, $\frac{\Delta L}{h}$	$\frac{\Delta L}{h} = 0.412 \frac{(\varepsilon_{reff}+0.3)\left[\frac{W}{h}+0.264\right]}{(\varepsilon_{reff}-0.258)\left[\frac{W}{h}+0.8\right]}$
2.(ii)	Effective Length (L_{eff})	$L_{eff} = \frac{c}{2fo\sqrt{(\varepsilon_r)}}$
2.(iii)	Effective dielectric constant , ε_{reff} $(\frac{W}{h} \gg 1)$	$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[1+12\frac{h}{W}\right]^{-1/2}$
3.	Length (L_g)and Width (W_g) of Feed-line	$L_g = L + 6h$, $W_g = W + 6h$

E. Design Specification

1. *fo* = 5.45 GHz
2. *Єr* = 4.4(FR4 epoxy),
3. *h* = 1.6 mm
4. Feed Technique: Coaxial Feed

F. Antenna Design

The proposed antenna comprises two slots L1 and L2 The upper one is single-L1 slot with ground slot also bottom side L2 slot with ground slot. Having better performance of antenna parameter.

III. RESULT AND DISCUSSION

Simulated Results

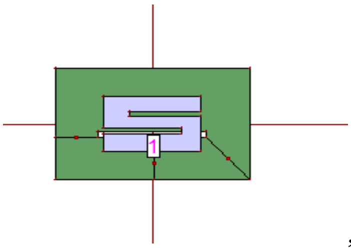
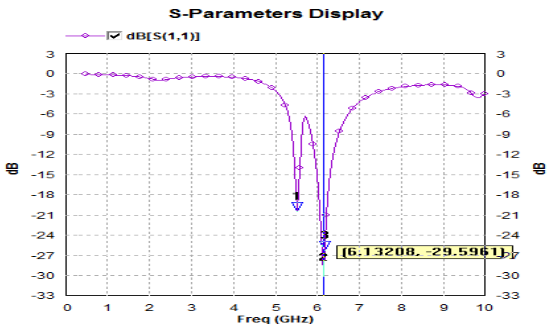
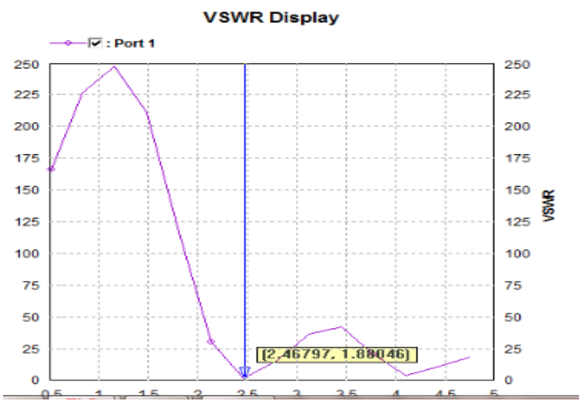


Figure 2. Antenna with ground slot (central) Geometry



Above design frequency 5.47 GHz Return loss is -20.45dB and 6.1 GHz RL is -29.59 dB

Figure 3. S11 for the proposed antenna



For above frequency 5.47 GHz VSWR is 1.39 and 6.1 GHz VSWR is 1.07

Figure 4.VSWR for the proposed antenna

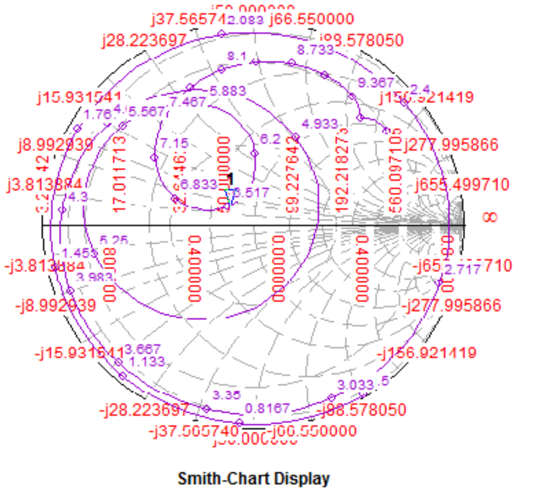


Figure 5. Smith Chart

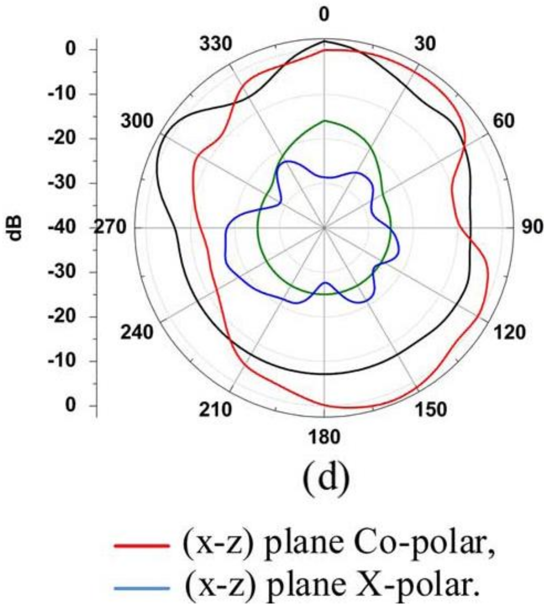


Figure 6. Radiation Pattern

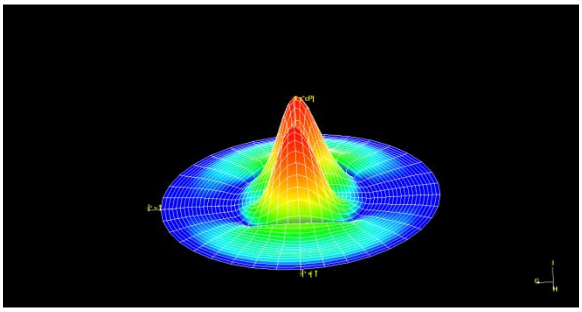


Figure 7. Gain

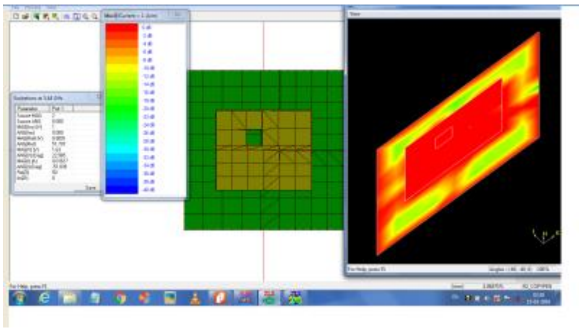


Figure 8. Current Distribution

IV. CONCLUSION

Dual-band MSA is presented this paper. By referring various research papers it is concluded that low power and Low gain handling capacity can be overcome through slotted patch.Also Improve basic parameters of antenna have been studied. A compact dual-band MSA antenna is designed and analyzed to support the IEEE 802.11a wireless LAN band (5.10-5.50 and 5.85-6.25 GHz) Primarily, two 10-dB impedance bands of the dual band are separately generated by two different designs of compact RMSA with same dimensional slotted ground-plane structures. these two designs are combined to form of the geometry of the dual-band antenna. Overall, the design technique used for dual-slotted dual-band antenna using two separate single-slotted MSA is successfully for the application in IEEE 802.11a WLAN band (5.10-5.50 and 5.85-6.25 GHz).

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