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A Triple-Band Monopole Microstrip Patch Antenna for Wireless Communications

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ABSTRACT: In this article a triple-band monopole microstrip patch antenna is designed and analyzed. The proposed antenna consists of T shaped microstrip patch and ground plane with rectangular slits on the patch and ground plane respectively. The proposed antenna provides a triple-band of bandwidth 1.65 GHz-1.8 GHz, 3.45 GHz-4.4 GHz and 7GHz-7.55 GHz respectively. The proposed antenna provides notches at the frequencies of 1.75 GHz, 3.85 GHz and 7.25 GHz. The simulated results of the proposed antenna exhibit good transmission coefficient, stable gain and radiation pattern at the operating frequencies. The proposed monopole antenna is very popular in wireless communication system for multiband applications. The proposed antenna is simulated using Ansoft designer software.

KEYWORDS: Microstrip patch, modified ground plane, multiband, wireless communication.

I. INTRODUCTION

The Ultra wideband (UWB) communication systems have become very popular in wireless communication system. The ultra wideband first approved in the year 2002 for the 3.1–10.6 GHz unlicensed band [1]. The frequency range for UWB systems can interfere with existing frequency band. The narrowband wireless communication systems is effected by the UWB frequency ranges, such as the wireless local area network (WLAN) for IEEE 802.11a is operating at 5.15–5.35, 5.7–5.825 GHz, and IEEE 802.16 WiMAX system operating at 3.3–3.6 GHz. The modern communication system is growing rapidly. Day by day the number of subscriber is increased rapidly, but as our requirement of the communication system, design antennas are not fulfilling our demand. In the wide band communication system some part of wide-band may be wasted. If the wide-band can divided into multiband, then multiple numbers of subscribers can use different frequency band over the broad-band. This processes may be satisfied our demand as well as reused wastage frequency band for wireless communication. The strong development in the field of wireless communications, the demand of multi-band antennas are important for integrating more than one communication standards in a single compact system. Modern design antennas are compact size, simple structure, and easy integration with the circuit, the multi-band monopole antenna is attractive for WLAN/WiMAX applications [2-5]. The huge number of related antenna is designed for wireless communications [6–9]. There are some drawbacks of the design antenna found in the different author research works. The size of the antenna is very large and compactness is very poor. In this paper design antenna is compacted and small size, which overcome some drawbacks of the past research work. In this paper a rectangular slits is incorporated in the patch as well as ground plane to reduce the size of the proposed antenna and divided wideband into multi band. The proposed triple-band monopole microstrip patch antenna consists of FR4 substrate with dielectric constant 4.4 and thickness 1.6 mm and two metal plates, one is ground plane and other is radiating patch. The proposed antenna is simulated using Ansoft designer software and investigated gain, return loss and radiation pattern. The design antenna is very popular in modern wireless communication system.

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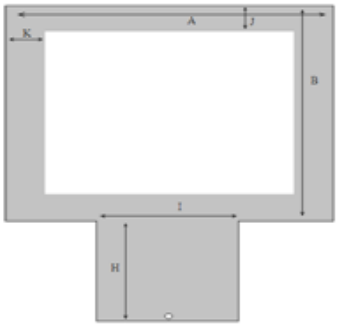

Fig.1. Proposed ground plane.

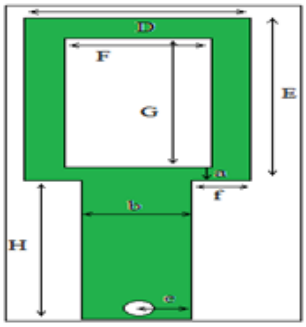

Fig.2. Proposed microstrip patch.

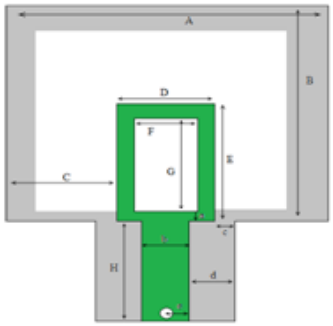

Fig.3. Proposed microstrip patch antenna

II. ANTENNA DESIGN

The ground plane, microstrip patch and proposed triple-band monopole microstrip antenna are illustrated in Figure 1, Figure 2 and Figure 3 respectively. The proposed antenna is printed on FR4 substrate of thickness 1.6mm with dielectric constant 4.4 and loss tangent 0.0018. All the dimension of the proposed antenna is shown in Table 1.

Table 1 Geometrical dimension of proposed antenna. (all dimension in mm)

Parameters	Dimensions	Parameters	Dimensions
A	40	J	3
B	30	K	4
C	13	a	2
D	14	b	6
E	16	c	3
F	8	d	7
G	11	e	3
H	14	f	4
I	20	-	-

III. RESULTS AND DISCISSION

Figure 4 shows the return loss versus frequency response of proposed antenna. The simulated results covered the frequency range from 1.65 GHz to 7.55 GHz. The proposed antenna exhibit three resonating frequency at 1.75 GHz, 3.85 GHz and 7.25 GHz with the frequency band 1.65 GHz-1.8 GHz, 3.45 GHz-4.4 GHz and 7GHz-7.55 GHz respectively. The proposed antenna provides notches at frequencies of 1.75 GHz, 3.85 GHz and 7.25 GHz respectively.

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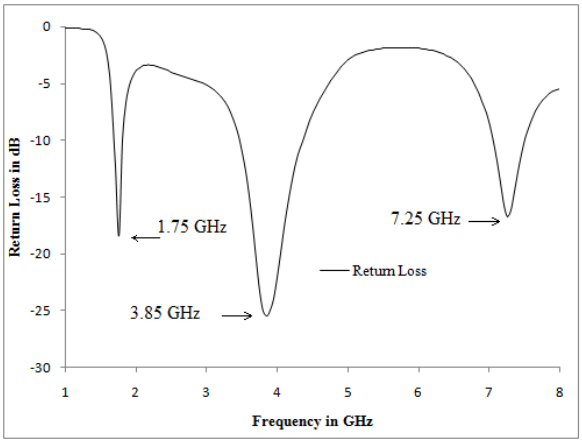

Fig.4. Return loss versus frequency plot.

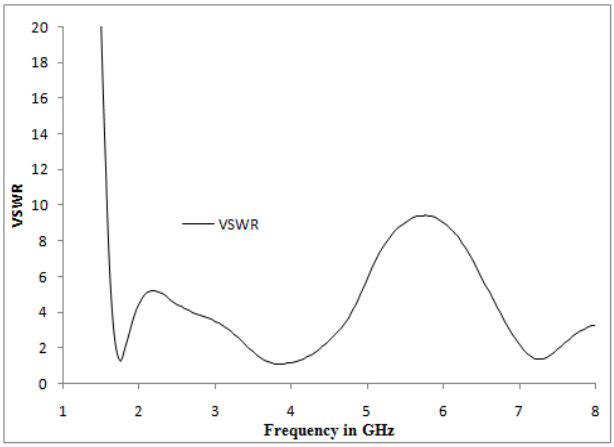

Fig.5. VSWR versus frequency response.

The VSWR, 3-D input gain, Far field distribution and Radiation pattern of the proposed triple-band monopole microstrip patch antenna is shown in Figure 5, Figure 6, Figure 7 and Figure 8 respectively. The simulated maximum positive 3.5 dBi gain is achieved at the resonance frequency of 3.85 GHz. The simulated results is almost follow the theoretical one. The simulated radiation pattern is investigated at for Phi =0 deg and Phi = 90 deg at different resonance frequency.

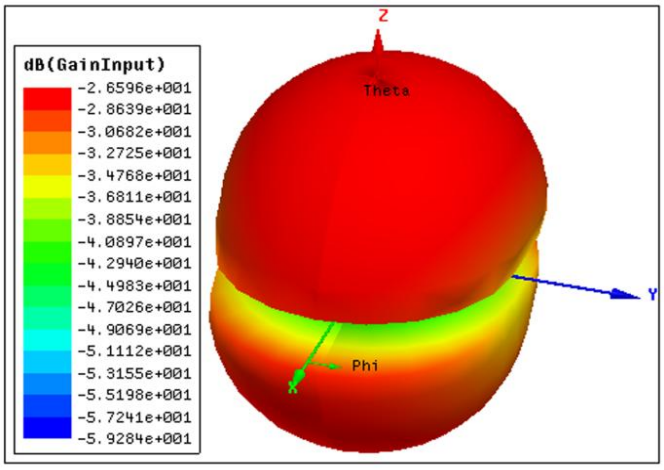

Fig.6. 3-D input gain of the proposed antenna.

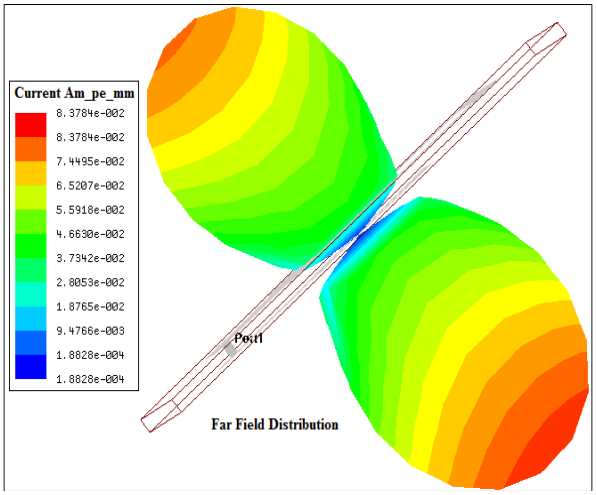

Fig.7. Far field distribution of the proposed antenna.

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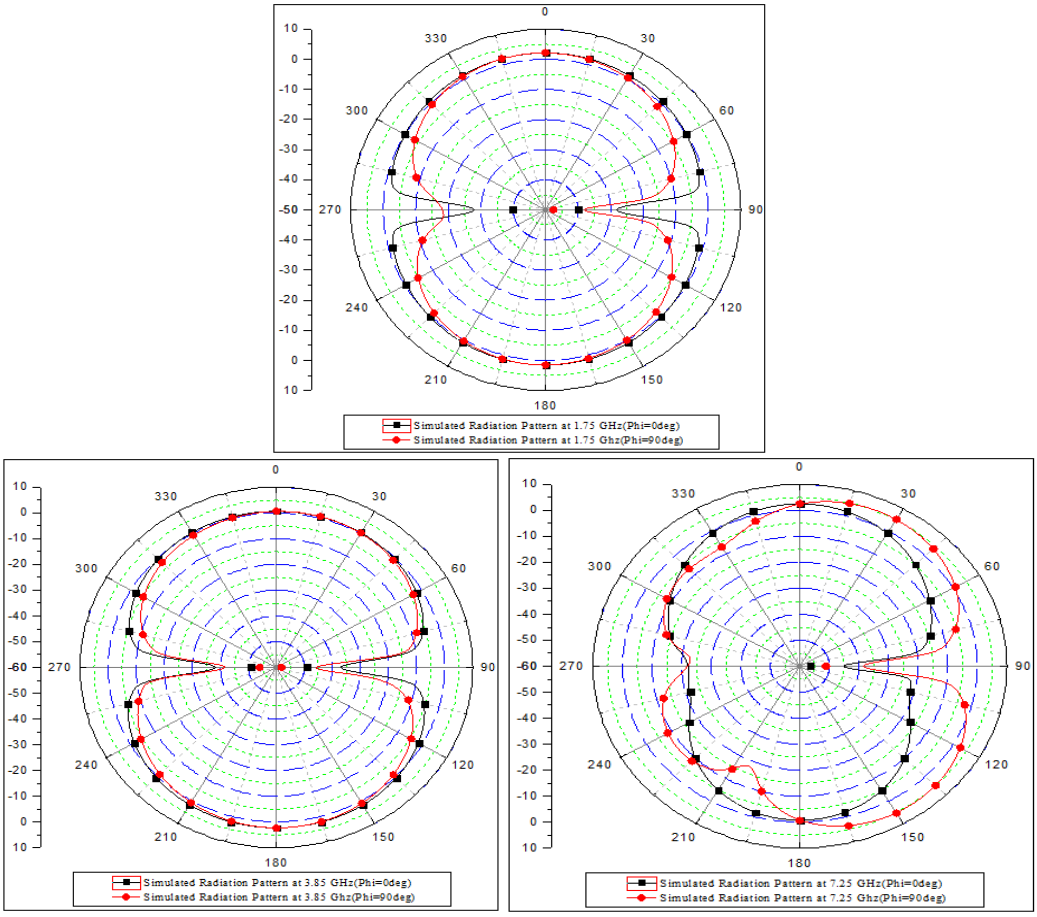

Fig.8. Radiation pattern of proposed antenna at different frequencies.

IV. CONCLUSION

A compact triple-band monopole microstrip patch antenna has been presented and analyzed. The proposed antenna is compact and small sized compared to the previous research work for multi-band application. Three notches are achieved by two slits loaded in the patch and ground respectively. The frequency interference issues are addressed properly. The return loss, bandwidth, swept gain and radiation pattern are investigated at the three resonating frequencies properly. The proposed antenna is very much effective in wireless communication systems.

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BIOGRAPHY

Miss.Priti Rai is a 4th year student of Modern Institute of Engineering and Technology in Electronics and Communication Engineering Department. She is presently working towards the B.Tech Degree. Her area of interest is Microstrip Antenna.

Mr. Kalyan Mondal received the B.Tech and ME degrees in Electronics and Communication Engineering from Kalyani Govt. Engineering College, West Bengal, India in 2008 and Bengal Engineering and Science University Shibpur, Howrah, India in 2011 respectively. His research interests are Broadband Microstrip patch antennas and Filter. He is currently working toward the Ph.D degree at Kalyani University.