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L-Slot Dual Band Microstrip Patch Antenna for WiMax and WLAN Application

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Abstract-This paper introduces a rectangular Dual-band patch antenna that is measured for wireless communication systems. The introduced antenna is designed for WLAN and WiMAX applications. The desired tri-band operation was obtained by proper loading for a rectangular patch antenna using slots. The effect of various design parameters on design has also been analyzed using CAD FEKO 6.3 simulator using MoM. The result obtained from our simulated antenna shows 4.1% impedance matching band width at 2.4 GHz. 5.2% at 3.5 GHz. The proposed antenna can be used in future as a template to form larger arrays.

Keywords-CAD FEKO, FR4, L slot, patch antennas, WiMax, WLAN.

I. INTRODUCTION

The design of a compact dual band antenna catering to both the frequencies assigned for ISM (Industrial, Scientific and Medical) applications is very important, especially due to the explosive growth of wireless communications in recent years. The popularity of dual band mobile sets and smart phones is also increasing quite rapidly all over the world, and the growth is more pronounced in developing countries. The rapid growth of the high speed mobile communication and Internet requires the development of microwave systems such as WLANs, WIMAX along with the delivery of high speed data at affordable prices. The emphasis is also on the compact design of the headsets and smart receivers without compromising on the quality of communication. The design of a compact antenna conforming to the planar technology is one of the important steps of the overall microwave system design for high speed modern communication. A number of antenna designs (such as Inverted T-strip [1], I-shaped antennas [2], L-shaped antennas [3] and printed monopole antennas ([4], [5]) have been presented in the past for the Wi-Fi and WLAN applications. The printed monopole antennas among them have gained much attention because of their advantages such as the compact size, reduced cost, ease of fabrication, etc. The aim of this work is to design and develop a Microstrip based antenna at an affordable price, which can work at both the designated ISM bands, i.e., 2.45 GHz and 5.2 GHz designated for Wi-Fi and WLAN applications. It may be mentioned here that our work involves a detailed parametric analysis, which would help the future designers in selecting any physical parameter of the antenna depending upon the requirements. The other advantage of our approach is the selection of the FR-4 substrate, which is easily available at a very low price. The proposed antennas consist of L- slot which are controlled to operate at different frequency bands. The first band of the proposed antenna covers the WLAN frequency band (2.4-2.485 GHz), while and the second band covers the WIMAX (3.4-3.6 GHz) frequency band.

II. GEOMETRY OF ANTENNA

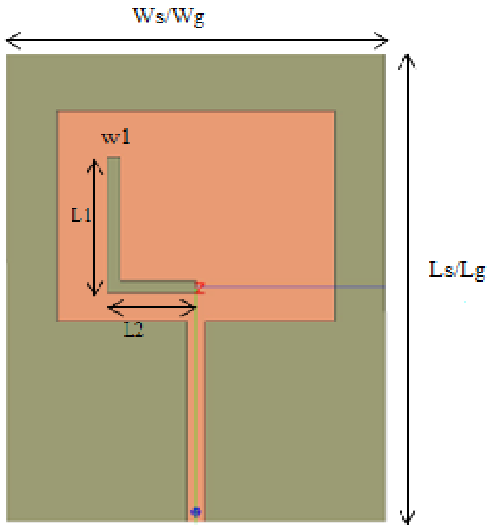

Figure 1.The proposed dual band Microstrip antenna

Figure 1 shows the actual geometry of the antenna along with its various design parameters. The L-shape patch has been derived from a rectangular antenna of size 75 mm× 60 mm, which is designed at lower band edge frequency of around 2.1 GHz. A rectangular patch of dimensions 34 mm × 44 mm. As shown, the antenna consists of L-slot. The L-slot of the structure are designed with their dimensions shown in the figure.

Microstrip feed are used and to obtain an impedance of 50 Ω. Whole structure shown in Fig. 1 designed on FR4 substrate with dielectric constant εr = 4.4 and loss tangent tan ∂ = 0.02. For the simulation purpose, the ground plane and Microstrip are considered to be made up of copper chosen from the material library of CAD EEKO simulator. The dimension of various parameters for the designed antenna is given in Table 1.

The L shaped slot used to excite the fundamental and second mode near 2.4 GHz and 3.5 GHz bands, respectively in this study.

Table 1. Antenna Dimension.

Parameters	Dimensions
Fr	2.1 GHz
Ɛr	4.4
H	1.6 mm
Lf	32 mm
Wf	3 mm
Lg/Ls	75 mm
Wg/Ws	60 mm
Lp	34 mm
Wp	44 mm
L1	20 mm
L2	14 mm
W1	2 mm

III. ANALYSIS AND RESULTS

The analysis of antenna is carried out by CAD FEKO 6.3 simulator using MoM. The Major simulation and experimental results of the antenna are given in this section.

3.1. Simulation Results

This section mainly presents the simulation results including various parameter of interest such as Reflection coefficient of the antenna, VSWR plot as function of frequency. Reflection coefficient of antenna as function of frequency are shown in fig.2, where it can observed that the antenna exhibits two resonating modes at the frequencies of 2.4 and 3.5 GHz thereby making the designed antenna suitable for both WLAN and WiMAX application.

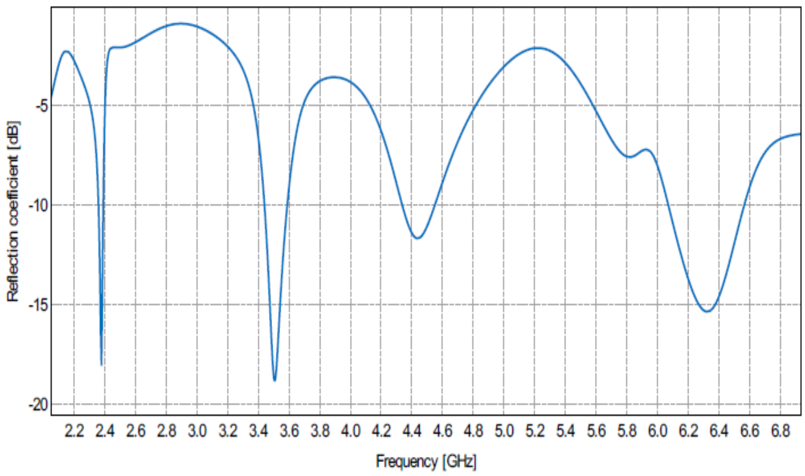

Figure 2. Reflection coefficient

The simulated VSWR plot as function of frequency for the given antenna is shown in fig. 3, where it can be seen that the value of VSWR is less than 1.5 at both the resonant frequencies. Hence, it can be concluded that the designed band i.e., 2.4GHz – 2.485GHz and 3.4GHz – 3.6GHz.

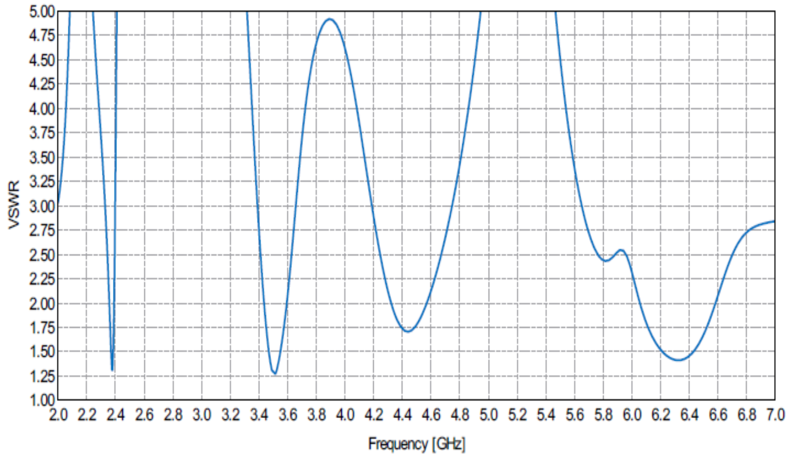

Figure 3. VSWR

3.2. Effect on S11 Characteristics

3.2.1. Effect of feed position

In Fig. 4 shows different position of feed at center, shift left by -1 and -2. Center feed is selected due to symmetry of geometry and cross polarization also minimum.

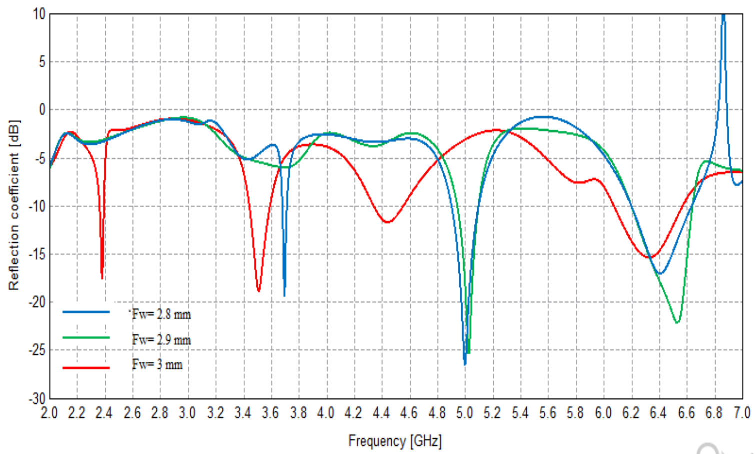

Figure 4. Effect of Micro strip position on S11

3.2.2. Effect of Changing the Feed Width

Fig 5 shows effect of changing feed width, when feed width = 3mm we get approximate result at 2.4 GHz and 3.5 GHz band.

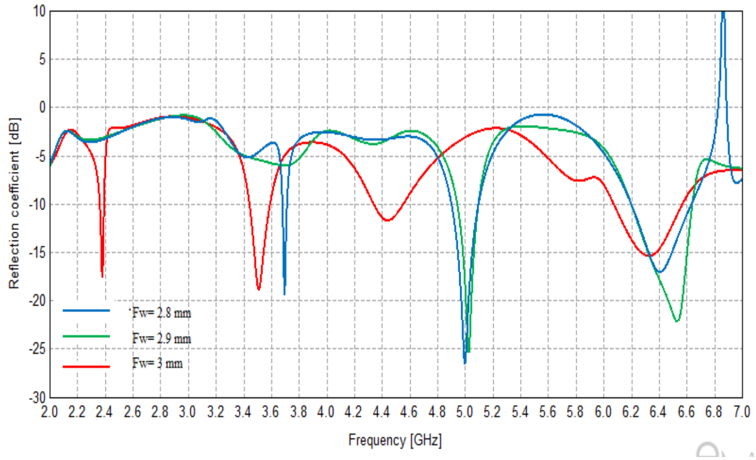

Figure 5. Effect of changing Feed width

IV. CONCLUSIONS

A planar antenna structure was proposed with slots to control surface current distribution on the patch antenna to achieve dual-band operation. We first studied the effect of position of feed line and width of feed line. Experimental measurement to our optimized antenna shows a good matching between the experimental results and the simulated results. A broadband equivalent circuit model was introduced and a good agreement of input impedance between electromagnetic simulator and modeled equivalent circuit was realized. A simplified design of a dual-band antenna capable of wireless applications in 2.4 GHz and 3.5 GHz range has been presented.

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