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Design of Multiband Microstrip Antenna for Wireless Application

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Abstract— *Design of microstrip patch antenna with coaxial fed by two rectangular slots at the edge of patch and two stair shaped slots inside the patch is discussed. The substrate of antenna is Epoxy FR4 of relative permittivity 4.4 of height 1.6mm. Dimension of antenna is 50x 50x1.6mm^3. It is design to operate in multiple bands in the frequency range (0.5-3.5GHz). Multiple bands is used for different wireless application. Design antenna is capable of operating at the resonant frequency (1.4GHz, 2.2GHz, 2.9GHz, 3.4GHz).It is applicable for both 2.2 GHz Wireless local area network and 3.3 GHz frequency application. I have obtained better reflection coefficient and good impedance bandwidth as well as good radiation characteristics of proposed antenna. Proposed antenna is achieved maximum Reflection coefficient is -41.55dB at 2.2 GHz.*

Keywords—*Multiband antenna; Microstrip antenna; Stair-shaped slot; Rectangular slot;*

I. INTRODUCTION

Microstrip antenna are worldwide known in the modern age due to compactness low profile light weight easy to fabricate on MIC(Microwave integrated circuit)[1]. Circularly polarized fed antenna consists of narrow width rectangular slot and monopole antenna for dual band operation is discussed. It is useful for various wireless applications at the 2.45 GHz and 5.2/5.8 GHz frequency [2]. A planar monopole antenna is consists of three radiating elements and one controlling strip to improve the performance of antenna [3]. T-shaped structure antenna is designed and two strips are horizontally are used as a resonator to resonate higher and lower resonant mode [4]. Tri band monopole antenna is designed for various wireless applications. It consists of two alphabetic shaped L and U slot and ground plane. It has been achieved good radiation pattern and gain over the operating bands [5]. U slots and rectangular slots is used on the patch to achieve the wide bandwidth. It provides the wide bandwidth. Air substrate is used to reduce the antenna losses and give maximum radiation intensity [6]. Alphabetic shaped L and U on the patch is used to generate the resonance for dual band operations. L shaped is etched at the feed line of microstrip antenna to achieve frequency band around 5 GHz frequencies. It combines the E and L shaped on the radiating elements to generate the band at 2.44 GHz. [7]. Wide /dual band has been achieved by through

non contacting feeding between the folded radiator and an extended PCB ground plane. Wide bandwidth of antenna can be achieved by using foam/air layer instead of Epoxy FR4 substrate. [8]. Major disadvantage of patch antenna is narrow bandwidth. There is numerous method are used to enhance bandwidth. [9].L-shaped and forked shaped is etched on the radiating elements with additional U-shaped strip to cover desired frequency bands [10]. E-shaped antenna is designed to enhance the impedance bandwidth and radiation property. [11].Quarter wave in length slots is cut on the radiating elements to achieve wide bandwidth and maximum radiation efficiency. Slotted antenna does not require any other patch or coupling feed line to improve bandwidth. [12]. In this paper, I am designed multiband antenna through two slots on the radiating elements. One is rectangular slot at the corner radiating elements and second is stair slots inside the patch. It meets the following functional range (1.36-1.43GHz, 2.16-2.23GHz, 2.90-2.96GHz, 3.36-3.43 GHz) for different wireless applications.

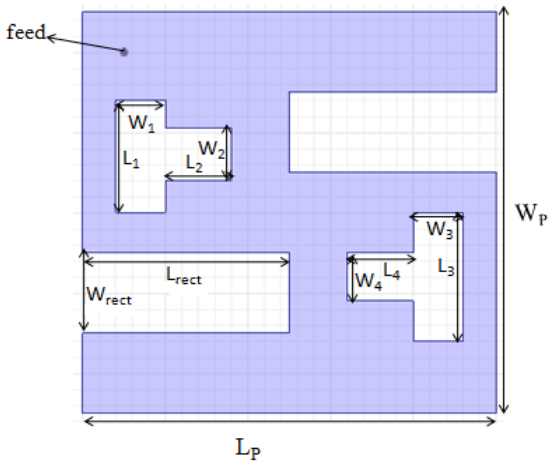

Fig.1 Configuration of design antenna

GHz). Presented antenna is verified and simulated by HFSS software version-15. It is useful for multiple applications in the communication field. It fulfils the requirements for WLAN and WIMAX applications. Good reflection coefficient is achieved by cutting the two slots on radiating elements. Quad resonant modes are achieved at (1.4GHz, 2.2GHz, 2.9GHz and 3.4GHz). Good radiation characteristics are obtained. Maximum value of reflection coefficients is -41.55(dB) at 2.2GHz frequency.

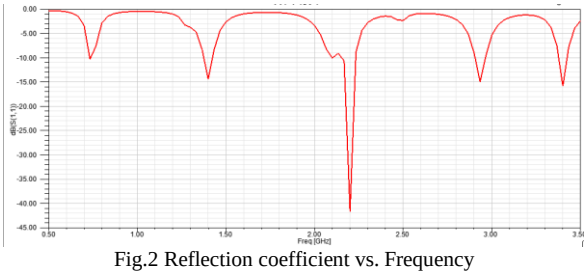

Fig.2 Reflection coefficient vs. Frequency

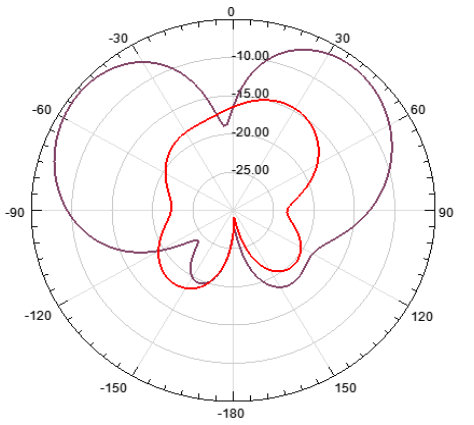

Fig.3. 2-D Radiation pattern at 3.4GHz

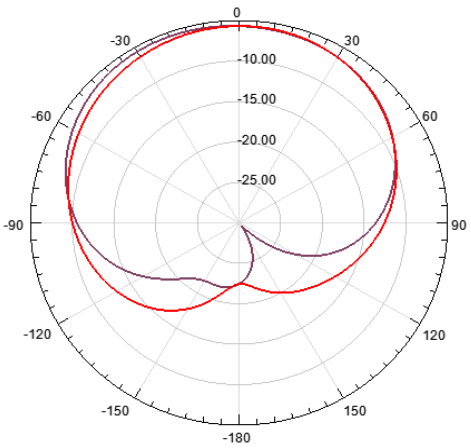

Fig.4.2-D Radiation pattern at 2.4GHz

II. DESIGN AND SIMULATION

The schematic design of coaxial feeding to proposed antenna for quad band functions are shown in fig.1.It is consists of three elements the substrate, ground plane and radiating square shaped patch. Square patch is cut by rectangular shape and square shape slot to meet the wireless application. Design of stair and rectangular slots on the radiating patch is based on the prediction that these slots are cut within the patch when proposed antenna is provided the desired resonant frequencies. When I have only cut the rectangular slot at the edge of the radiating elements obtained only three resonant frequencies within the frequency range (.5-3.5GHz). But when radiating elements is cutting with stare slot and rectangular slot inside patch obtained quad bands within the frequency range (0.5-3.5GHz).

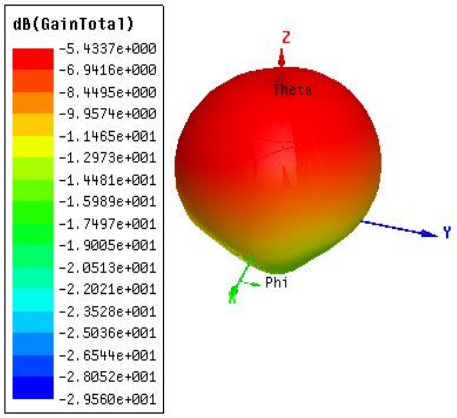

Fig.5. 3-D polar plot (gain)

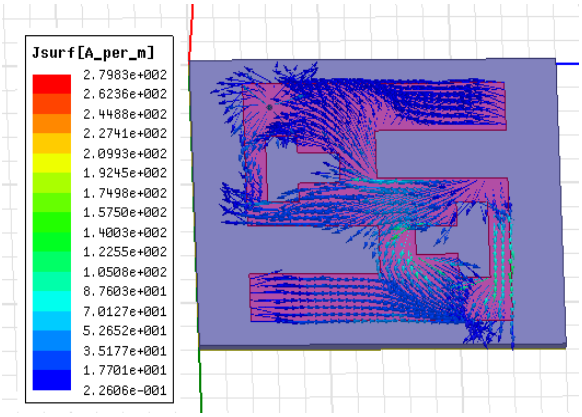

Fig.6.Surface current distribution at 2.4 GHz

It covers the following operational band (1.36-1.43GHz, 2.16-2.23GHz, 2.90-2.96GHz, 3.36-3.43 GHz). The rectangular and stair shaped slot on radiating elements is done after parametric analysis at certain position to achieve the desired resonant and. Result of proposed antenna including surface current distribution and reflection coefficient is obtained by

High Frequency Structure Simulator (HFSS) of version 15.Epoxy FR4 substrate is used with relative permittivity 4.4 and height 1.6mm. Dimension of the substrate is 70x60x1.6mm^3. length and width of radiating elements are 50mm, 50mm respectively. Parameter of the design antenna is as follows: W_{sub}=60mm,L_{sub}=70mm,L_p=50mm, W_p=50mm, L_{rect}=30mm, W_{rect}=10mm,L_1=14mm,W_1=6mm,L_2=8mm,W_2=6.5mm,L_3=16mm,W_3=6mm,L_4=8mm,W_4=6mm. Simulated results are shown quad band frequencies. I have obtained the desired resonant band after to performed the parametric analysis. Reflection coefficient of proposed antenna is depicted in figure 2.Maximum value of the reflection coefficient is obtained -41.55dB at the resonant frequency of 2.2GHz.Reflection coefficient is shown in fig.2, Radiation pattern is shown in fig.3 and fig.4, surface current distribution and 3-D polar plot are shown in fig.5 and fig.6. Patch is situated at middle of the patch for good radiation characteristics. Rectangular slot and stair shape slots are etched on the radiating elements to achieve multiple bands between frequency ranges (0.5-3.5 GHz). These multiple band is used for numerous applications for wireless communication field.

III. Result And Discussion

The simulation result of proposed antenna through HFSS software version 15 for reflection coefficient, Radiation pattern in 2-D and 3-D and surface current distribution are discussed in this paper. I have been depicted both 2-D and 3-D radiation pattern at different frequency. Peak value of reflection coefficient is -41.55dB at resonant frequency 2.2GHz. I have provided a coaxial feeding to design antenna at certain position for achieving good impedance matching. This proposed antenna is usable for numerous applications in the wireless communication field. I have obtained large surface current density at frequency 2.4 GHz. I have achieved the low impedance mismatching and good radiation characteristics of proposed antenna.

IV. Conclusion

A coaxial fed microstrip antenna through rectangular shape slot at the edge of the radiating elements and stair shaped slot inside the radiating elements are presented for numerous applications in the wireless communication field. These slots on radiating elements are etched to achieve multiple bands between frequency ranges (0.5-3.5GHz). Multiple bands are good for multiple wireless applications. Design antenna is capable of operating over the frequency band (1.36-1.43GHz, 2.16-2.23GHz, 2.90-2.96GHz, 3.36-3.43 GHz). It is provided good impedance matching and maximum reflection coefficient is -41.55dB at frequency 2.2 GHz as well as good radiation characteristics. It is usable for both WLAN and WIMAX application.

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