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Research Article

A Novel Design of Dual Band Microstrip Antenna for Wireless Application

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Abstract:- **A simple and compact inset fed dual band microstrip antenna is presented. The proposed antenna has a low profile and can easily be fed by using a 50 ohms microstripline. The proposed antenna covers all the 2.4/4.2 GHz WLAN/ RADIO ALTIMETERS operating bands, IEEE WLAN protocol 802.11 b/g employs 2.4 GHz. The antenna is simulated using An soft's HFSSv11. Which shows good agreement with simulated results, Measured Return loss and Radiation patterns are observed to be nearly omnidirectional, moderate gain and wide frequcency band suitable for wireless applications. The antenna has an overall dimension of only 29.5mm x 38 mm x1.6mm, when printed on a FR4 substrate of dielectric constant 4.4.**

Keywords- **WLAN, Dual Band, Slots, Microstrip antenna, Radio Altimeters.**

I. INTRODUCTION

Wireless communications have developed greatly and demand for designing low profile antennas has grown. To fulfill the requirements of modern hand held communication devices, WLAN, PCS, UMTS & BLUETOOT and with ability to integrate more than one communication standard in a single compact module development of compact dual band antenna with omnidirectional radiation properties and moderate gain is prime interest. Many techniques have been used to develop antennas which fulfill the needs of modern communication systems. Printed monopole antennas are a good choice for the short range communication device because of this low cost, lightweight and easily fabrication, Slot loaded monopole antennas and cpw-fed antennas, with dual band characteristics, it's also find for wireless applications. However there is a limit of these antennas to obtain the wide band characteristics especially at 5 GHz band for both WLAN and WIMAX applications as reported. [2-6]The present scenario in the wireless communication systems indicates a shift of operating frequency bands for various reasons. In this we proposed a dual band microstrip antenna capable of serving the needs of wireless applications, And in this paper a new application is studied for the resonant frequency of 4.2ghz for radioaltimeters.Various antenna parameters are optimized using a An soft's high frequency structured simulator [HFSS], and the prototype of the antenna was constructed and tested using network analyzer by adjusting the dimensions of the slots in the patch. Details of the antenna design, simulated and experimental results are presented and discussed.

II. PROPOSED ANTENNA GEOMETRY

Fig 1. Shows the proposed geometry of the dual band slot patch antenna with complete dimensions. It is constructed on a substrate with dielectric constant, Er=4.4 and thickness h= 1.6mm, the dimension of radiating patch of width of 38mm and height of 29.5mm. The dimension of the ground plane has width of 48mm and height of 40mm.The antenna is excited using a 50 ohms insect feeding. Later two identical slots of w=2mm, l=16mm, were embedded in the patch and are equally placed symmetric to the radiating edge of patch as shown. Here the microstip insect feed makes structure suitable for integration with microwave circuitry. The antenna bandwidth shows dependence on both slots length and width and therefore some fine tuning is needed to achieve peak resonance for dual bands at 2.4ghz/4.2ghz.

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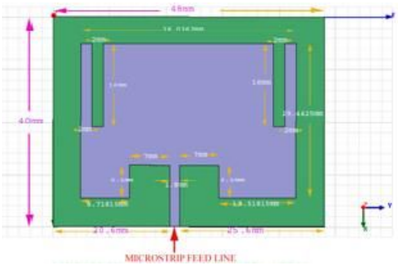

Figure1. Geometry of dual band microstrip antenna

III. DESIGN SPECIFICATIONS

The three essential parameters for the design of a dual band Microstrip Antenna are [1].

- Frequency of operation (f_o): The resonant frequency of the antenna must be selected appropriately. The Personal Communication System (PCS) uses the frequency range from 1850-1990 MHz, Hence the antenna designed must be able to operate in this frequency range. The resonant frequency selected for our design is 2.4 GHz. Dielectric constant of the substrate (ε_r), the dielectric material selected for our design is FR4_epoxy which has a dielectric constant of 4.4. A substrate with a high dielectric constant has been selected since it reduces the dimensions of the antenna.
- Height of dielectric substrate (h): For the Microstrip patch antenna to be used in wireless applications, it is essential that the antenna is not bulky. Hence, the height of the dielectric substrate is selected as 1.6 mm. Hence, the essential parameters for the design are:
- $f0$ = 2.4 GHz
- εr= 4.4
- h = 1.6 mm

Step 1: Calculation of the Width (W):

The width of the Microstrip patch antenna is given by equation (1)

$$W = \frac{c}{2f_o\sqrt{\frac{(\varepsilon_r+1)}{2}}}$$

--1

Substituting c = 3e8 m/s, ε_r = 4.4 and f_o = 2.4GHz, we get: W = **0.0380363=38.0363mm**

Step 2: Calculation of Effective dielectric constant (ε_{reff}):

Equation (2) gives the effective dielectric constant as:

$$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[1+12\frac{h}{W}\right]^{-\frac{1}{2}}$$

---2

Substituting ε_r = 4.4, W = 38.0363 mm and h = 1.6 mm we get: **ε_{reff} = 4.0858**

Step 3: Calculation of the Effective length (L_{eff}):

Equation (3) gives the effective length as:

$$L_{eff} = \frac{c}{2f_o\sqrt{\varepsilon_{reff}}}$$

--3

Substituting ε_{reff} = 4.0858, c = 3e8 m/s and f_o = 2.4 GHz we get: **L_{eff} = .03092=30.920mm**

Step 4: Calculation of the length extension (ΔL):

Equation (4) gives the length extension as:

$$\Delta L = 0.412h\frac{(\varepsilon_{reff}+0.3)\left(\frac{W}{h}+0.264\right)}{(\varepsilon_{reff}-0.258)\left(\frac{W}{h}+0.8\right)}$$

-----4

Substituting ε_{reff}=4.0858, W = 38.0363 mm and h = 1.6 mm we get: ΔL = **.7388mm**

Step 5: Calculation of actual length of patch (L):

The actual length is obtained by re-writing equation for L (5) as shown

$$L = L_{eff} - 2\Delta L$$

----5

Substituting L_{eff} = 30.920 mm and ΔL = .7388 mm we get: **L = .0294425=29.4425mm**

Step 6: Calculation of the ground plane dimensions (L_g and W_g):

The transmission line model is applicable to infinite ground planes only. However, for practical considerations, it is essential to have a finite ground plane. And that similar results for finite and infinite ground plane can be obtained if the size of the ground plane is greater than the patch dimensions by approximately six times the substrate thickness all around the periphery. Hence, for this design, the ground plane dimensions would be given as

Lg=6h+L=6(1.6mm)+29.4425mm=.03904=39.04 mm=40mm
Wg=6h+W=6(1.6mm)+38.0363mm=.0476=47.63 mm=48mm

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IV. RESULTS AND DISCUSSIONS

A prototype of the antenna is constructed and measured. Fig. 2& 3 shows the simulated and measured return loss of the antenna. The experimental curves show that a dual band is obtained from 2.25 GHz to 2.48 GHz and from 4.12 GHz to 4.29 GHz with good impedance matching. At the -8dBi retunloss that is VSWR = 2:1, The bandwidth at 2.4Ghz and 4.2Ghz bands are covering the WLAN/RADIO ALIMETERS, exhibiting good percentage bandwidth.

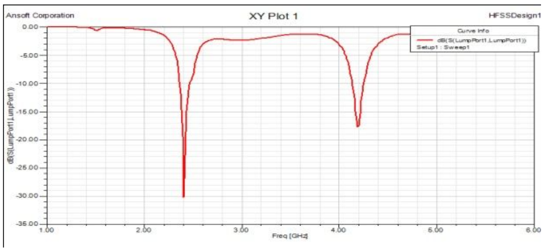


Figure2. Simulated return loss characteristics of antenna

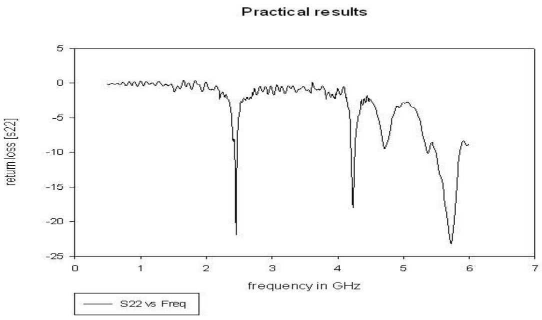
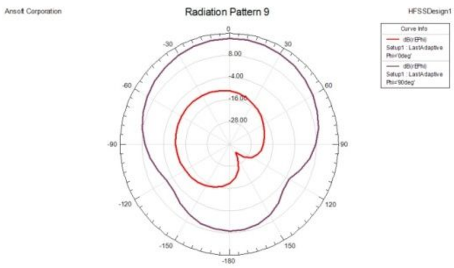


Figure3. Measured return loss characteristic of antenna

The simulated and experimental radiation patterns of the antenna at 2.4 GHz and 4.2 GHz bands are shown in Fig .4, 5, 6& 7.Anear omnidirectional patterns is obtained in the two bands. The antenna is polarized along x-axis in the lower band and along y-axis in higher band.



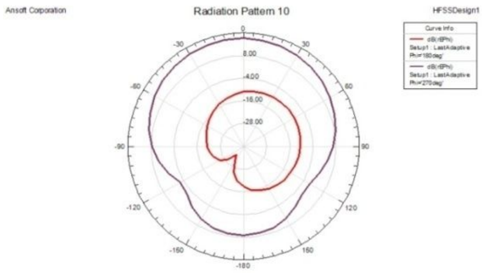
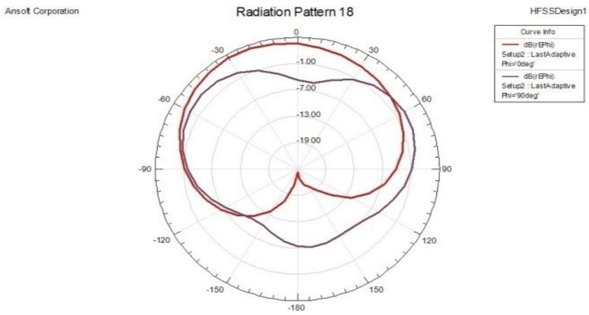


Figure4. Radiation pattern for phi=0, 90,180,270 deg at 2.4GHz



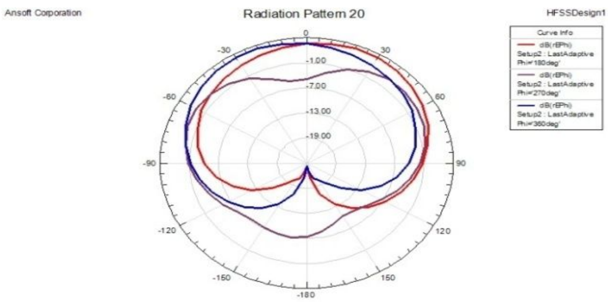
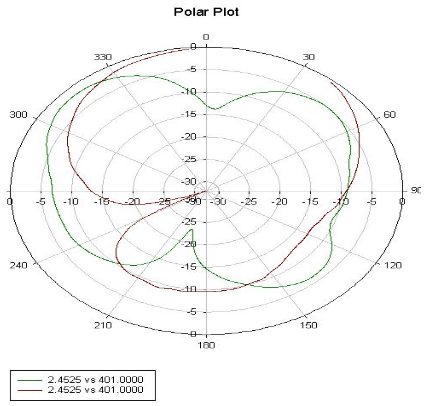


Figure5. Radiation pattern for phi=0, 90,180,270,180 deg at 4.2GHz

V. EXPERIMENTAL RESULTS



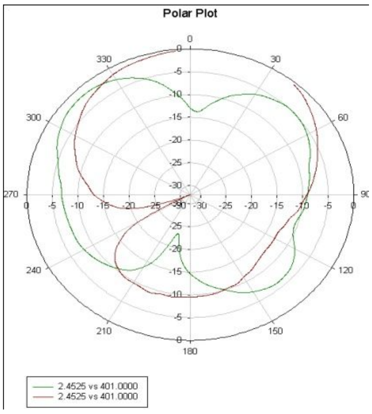


Figure6. Radiation pattern for E-plane pattern at 2.4GHz and H-plane pattern at 2.4GHz

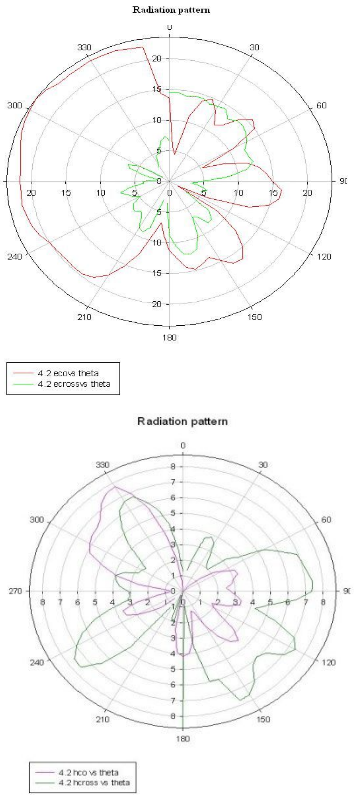


Figure7.Radiation pattern for E-plane pattern at4.2GHz and H-plane pattern at 4.2GH

The simulated current distribution of the antenna at the typical frequencies 2.4 GHz &4.2 GHz as shown in Fig.8&9, it is observed that the antenna current is concentrated more on the inset-feeding line and the edge of the slots. Where both x- and y-components of the curent exist over the operating frequency range, which indicates that the radiation characteristics are to be stable as well.

The gain of the antenna is also measured using gain comparison method. It has an average gain of 2.3dBi and 3.2dBi in the 2.4 GHz and 4.2 GHz bands, respectively. The final fabricated dual band antenna is shown in Fig.10.

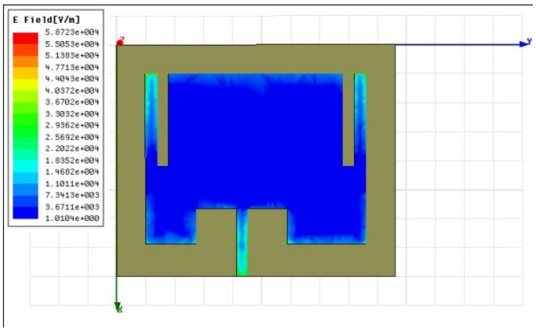


Figure8. Electric field distribution in the inset fed Dual band Patch Antenna

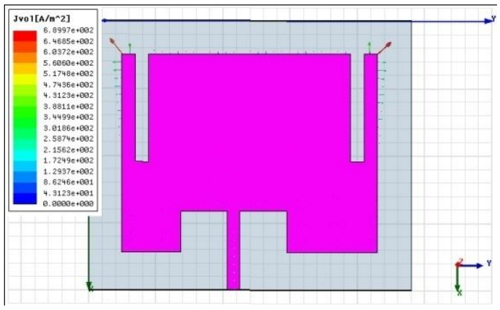


Figure9. Current distribution in the inset fed Dual band Patch Antenna

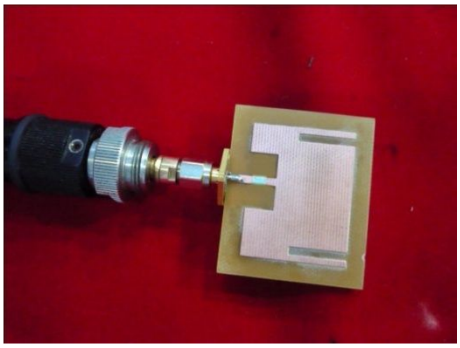


Figure10. The final fabricated dual band microstip antenna

VI. CONCLUSION

In this paper, a compact inset fed dual band microstrip antenna design have been proposed for WLAN/RADIO ALTIMETERS applications. The characteristics of the proposed antenna have been simulated and validated experimentally. The measured results were found to agree reasonably well with the simulated data. Effects of varying the slots size of the radiating elements on the antenna, resonant frequencies and impedance, bandwidths have also been studied, Excellent return loss, radiation patterns, higher gain and low cross-polarization make the antenna suitable for its use in WLAN/RADIO ALTIMETERS applications

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REFERENCES

[1] Pozar, *David M., Microwave Engineering, Second Edition*, Wiley, New York 1998.

[2] Liu,w.-c, and c,f. hsu, "*Dual band CPW-fed Y-shaped monopole antenna for PCS/WLAN application"*, Electron let. Vol.41, No.18, pg 390-391. 2005.

[3] Chen, s.-b., y-c, jiao f,-s. Zhang and q,-z, liu, "*Modified T-shaped planar monopole antenna for multiband operations,*" IEEE Transactions on Microwave theory and Techniques, vol.54. No.8, pg 3267-3270, August 2006.

[4] Wen-chung liu, Chao-ming wu,Nien-chang chu,, "*Acompact CPW-fed slotted patch antenna for dual band operations* ", Antennas &wireless propagation letters, IEEE,25 Feb 2005.

[5] G.Augustin, S.V.Shynu, PMohanan, C.K.Aanandan, and K.Vasudevan, "Compact dual band antenna for wireless access point", IEE Electronics Letters, Vol. 42, No.9, April 2006.

[6] Chih-Yu huang, Hsiao-Cheng lin, and Jieh-sen KUO, "Dual band monopole antenna excited by a capacitive coupling feed for WLAN application", Microwave and optical technology letters Vol 49. No.5, 1135-1138, 2007.

[7] Deepti Das Krishna,M.Gopikrishna and C.K. Anandan, "A CPW fed Triple band monopole antenna for WiMAX/WLAN applications slot antenna'', IEEE proceedings of 38th European microwave conference, pp.897-900, 2008.

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