**IOSR Journal of Engineering (IOSR JEN)** **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 05-09

# A Dual Band Rectangular Microstrip Patch Antenna For Wi-MAX And WLAN Application

Miss. Kakade A. S[1],Prof. G.U Kharat [2]
[1](E&Tc, SPCOE, Otur (Junnar), Pune)
[2](E&Tc, SPCOE,Otur(Junner),Pune)

***Abstract:*** *A microstrip fed rectangular patch antenna with dual band operation is proposed for Wi-MAX and WLAN application. Structure of our proposed antenna consist of a rectangular patch (radiating element), ground plane and microstrip line (50ohm). A model of antenna is fabricated using a FR4 dielectric substrate with a dielectric constant of 4.4 and loss tangent of 0.02. To check the performance of proposed antenna, return loss, radiation pattern (E and H plane) and current distribution results are obtained on the CADFEKO software. From simulated (-10dB) return loss, it is obtained that lower frequency band has frequency range from 3.3-3.6GHz (Wi-MAX). Higher frequency band has frequency range from 5.1-5.8GHz (WLAN).*
***Keywords****—microstrip fed, rectangular patch, Wi-MAX, WLAN, dual band operation,FR4 substrate*

## I. Introduction

In the recent years, the study on microstrip patch antennas has made great progress. Microstrip patch antennas have more advantages. In the next generation network, we required higher data rate and small size devices. In the wireless communication world, microstrip patch antennas become more popular because they have various features and advantages such as easy fabrication at low cost, low weight, low profile and low losses.

Now-a-days uses of dual band or multiband antennas are increased as compared to single band antennas. Many microstrip antennas of different patch structures with different techniques can be designed for obtaining dual band or multiband response. A radiating patch (rectangular shape) is located on the top of the dielectric substrate. For wireless service requirements, dual and multi band antennas have been playing a very important role. In recently wireless communication, antennas cover a wide range of application. In mobile devices, such as handheld computer and smart phones, WLAN and Wi-MAX are most widely used applications.

The propose model has simple design geometry with low profile and low weight. Section 2 describes the proposed antenna design geometry. Section 3 shows simulated return loss, radiation pattern at 3.3 to 3.6 GHz. Finally section 4 gives a short conclusion.

## II. Antenna Design

Design mode of proposed compact microstrip fed patch antenna, with a dual band operation is as shown in the fig.1. In this antenna design, radiating patch and microstrip feed line are mounted on the same side of the substrate and ground structure is mounted on another side of substrate. FR4 substrate with dielectric constant of 4.4, loss tangent of 0.02 and 1.6 mm substrate height is used.

Following formulas are used to design dual band antenna:-

$$L_{eff} = L + 2\,\Delta L3.3 \qquad (1)$$

$$W = \frac{c}{\left[2f_0\sqrt{\frac{(\varepsilon_r+1)}{2}}\right]} \qquad (2)$$

$$f_0 = \frac{c}{2L\sqrt{\varepsilon_r}} \qquad (3)$$

$$\varepsilon_{reff} = \frac{\varepsilon_{reff}+1}{2} + \frac{\varepsilon_{reff}-1}{2}\left[1+\frac{12h}{W}\right]^{\frac{-1}{2}} \qquad (4)$$

$$\frac{\Delta L}{h} = 0.412\,\frac{(\varepsilon_{reff}+0.3)\left(\frac{W}{h}+0.264\right)}{(\varepsilon_{reff}-0.258)\left(\frac{W}{h}+0.8\right)} \qquad (5)$$

Where $L_{eff}$ = Effective length of the patch, W= Width of the patch, $f_0$= Resonant Frequency, $\varepsilon_{reff}$= Effective dielectric constant, $\varepsilon_r$= Dielectric constant of substrate, ΔL=Extension along length, h= Substrate height, W= Width of substrate.

### *A. Design of printed rectangular slot antenna*

In this section we discussed design of printed rectangular patch antenna which is shown in fig. 1

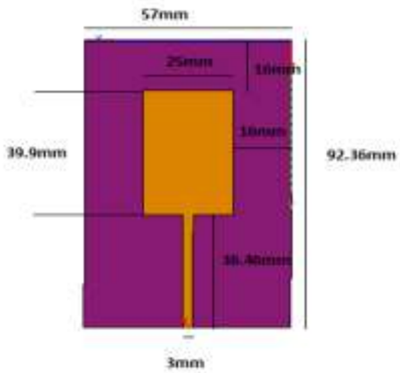



**Fig 1** Design of rectangular patch antenna

### *B. Parametric study of printed rectangular patch antenna*

Parametric study of printed rectangular microstrip patch antenna is conducted by varying the length and width of the radiating patch and feed line. Graph of simulated VSWR versus frequency for simple microstrip patch antenna is shown in fig. 2 .For simple microstrip antenna VSWR<=2 is obtained from 3.448GHz-3.588GHz for Wi-MAX band and from 5.1GHz-5.9GHz for WLAN band.

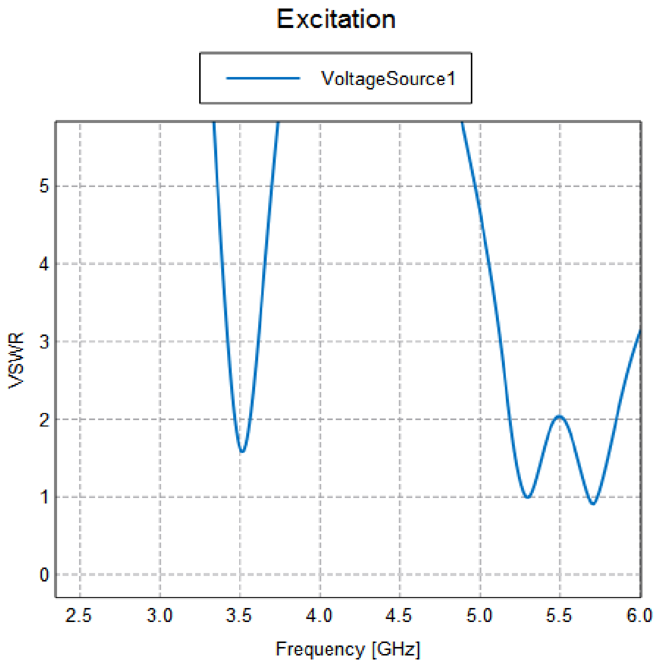



**Fig. 2** Simulated VSWR versus frequency for simple rectangular microstrip patch antenna

*C. **Effect of patch length***

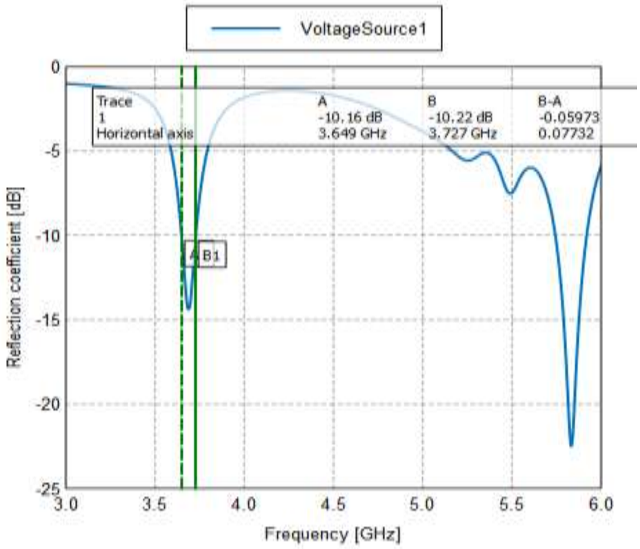



**Fig 3** Simulated RC versus frequency of simple rectangular Microstrip patch antenna with patch length variation

Parametric study is carried out by changing one parameter at a time and other parameter kept constant. In this study, length of patch is changed from 39.9mm to 38.0mm. Decrease in patch length results in shifting of resonance frequency of both Wi-MAX and WLAN band. For final design 30.9mm patch length is selected as better reflection coefficient and VSWR is obtained.

***D. Effect of patch width***

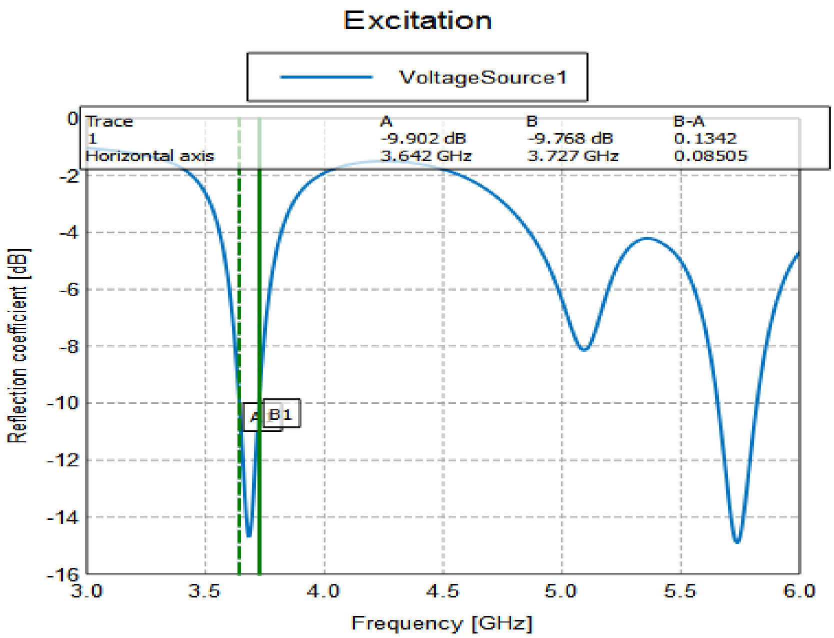



**Fig 4** Simulated RC versus frequency of simple rectangular microstrip patch antenna with width variation

Parametric study is carried out by changing one parameter at a time and other parameter kept constant. In this study, width of patch is changed from 25mm to 26mm. Increase in patch width results in shifting of resonance frequency. For final design 25mm patch width is selected as better reflection coefficient and VSWR is obtained.

***E. Radiation characteristics***

a) Radiation characteristic describe the energy directed by antenna. Fig 5 shows the radiation pattern at 3.45GHz

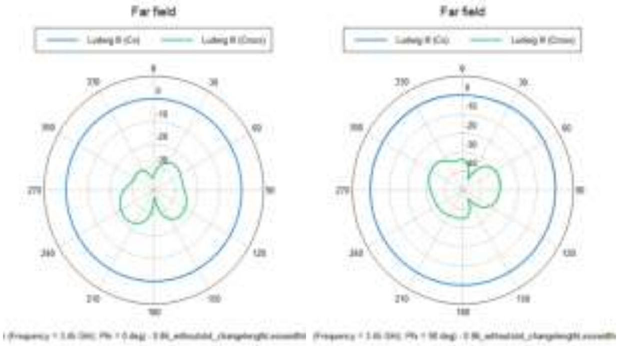



**Fig. 5** Radiation pattern of proposed rectangular microstrp patch antennas for Wi-MAX band

Radiation characteristic describe the energy directed by antenna. Fig 5 shows the radiation pattern at 5.475GHz

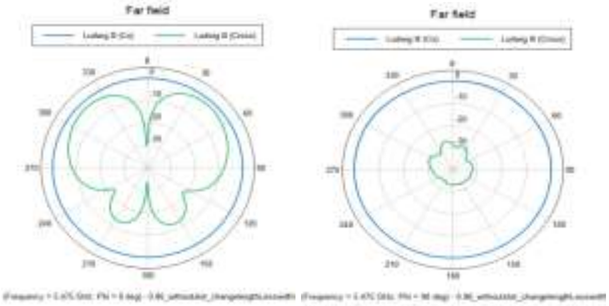
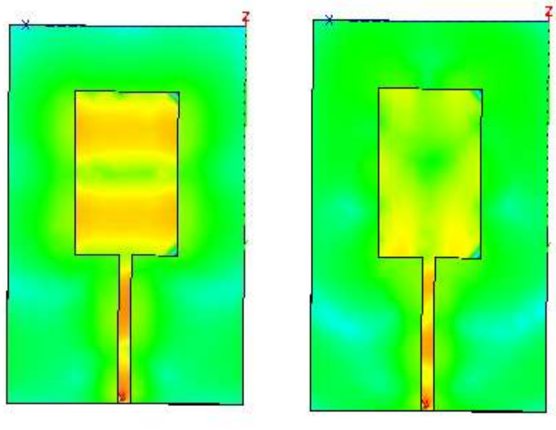



**Fig. 5** Radiation pattern of proposed rectangular microstrp patch antennas for WLAN band

At resonance frequency band maximum current flows in radiating patch. Current distribution of proposed antenna is as shown in fig 6.



**a) distribution for** Wi-MAX band **b) Current distribution for** WLAN band

**Fig 6** Current distribution at the resonance frequency of proposed antenna

## III. Results

Obtained simulated results are better and it provides a bandwidth from 3.4GHz- 3.5GHz.

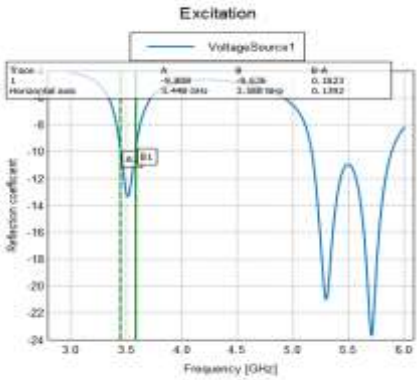



**Fig.3** Simulated RC versus frequency for Wi-MAX band

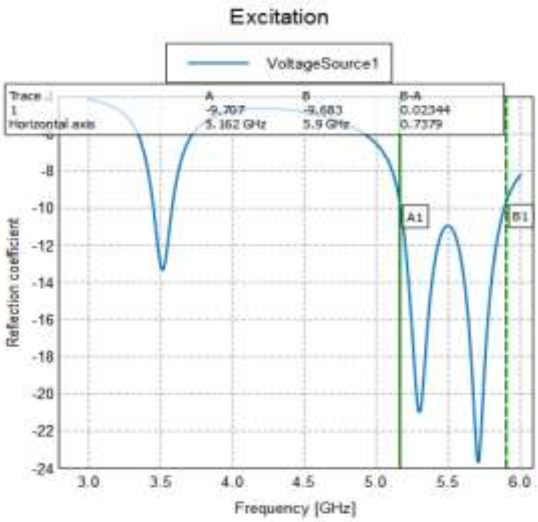



**Fig.4** Simulated RC vrsus frequency for WLAN band

## IV. Conclusions

In this paper, a compact microstrip-fed patch antenna with dual band operation is reported for WLAN and Wi-MAX, applications with simulated results. The antenna exhibits dual band operation and resonates over 3.448-3.588 GHz (lower frequency band) and 5.162-5.9 GHz (higher frequency band). Also, we have obtained VSWR between 1 to 2 , positive gain, impedance approximately 50 ohms, Reflection coefficient below -10 dB and we have also observed the results for radiation pattern along E and H plane i.e. co and cross polarization.

## References

[1]. G. A. Deschamps, “Microstrip microwave antennas”, 3rd USAF Symp. on Antennas,1953.
[2]. Gutton and G. Baissinot, “Flat aerial for ultra-high frequencies”, French Patent No. 703113,1955.
[3]. E. V. Byron, “A new flush-mounted antenna element for phased array application”,Proc. Phased-Array Antenna Symp., 1970.
[4]. R. E. Munson, “Single slot cavity antennas assembly”, U.S. Patent No. 3713 162, Jan. 23, 1973.
[5]. J. Q. Howell, “Microstrip antennas”, Int. Symp. Antennas Propagates. SOC.,Williamsburg, VA, Dec., pp.177-180, 1972.
[6]. H. D. Weinschel, “Progress report on development of microstrip cylindrical arrays for sounding rockets”, Physic. and Sci. Lab., New Mexico State Univ., Las Cruces, 1973.
[7]. G.G. Sanford, “Conformal microstrip phased array for aircraft tests with ATS-6”, Proc. Nat. Electronics Conf., vol. 29, Oct.
[8]. J. Q. Howell, “Microstrip antennas”, ZEEE Trans. Antennas Propagates., vol. AP-23, no. 1, pp. 90-93, Jan. 1975.
[9]. J. R. James and G. J. Wilson, “New design techniques for microstrip antenna arrays”, in Proc. 5th European Micro. Conf., Hamburg, Sept., 1975, pp. 102-106.
[10]. Balains C. A, “Microstrip Antennas”, Antenna Theory, Analysis and Design, Third Edition ,John Wiley & Sons, pp-811-876, 2010.
[11]. Pratap N. Shinde, Jayashree P. Shinde,”Design of compact pentagonal slot antenna with bandwidth enhancement for multiband wireless applications “,2015.
[12]. Uma Nagar, Seema Nagar, R.S. Meena,”A Compact Mictrostrip-Fed Slot Antenna with Dual band Operation.”,2013.
[13]. “Different IEEE Wireless Standards” http://compnetworking.about.com/cs/wireless80211/a/aa80211standard.htm
[14]. “Introduction to WiMAX standard”,http://en.wikipedia.org/wiki/WiMAX