ISSN 2229-5518

A Two-Sleeve Dual Band Antenna for Wireless Applications

Shikha Sukhija, Sukhdeep Kaur

Abstract—This paper describes the two sleeves dual band antenna design for the wireless Application. This proposed antenna operates simultaneously at 3.5 and 5.2/5.8 GHz (WiMax and WLAN services) spectrum. Effects of varying the different parameters on the antenna performance have been studied. This compact antenna fed by 50ohm microstrip line is low profile and very easy to manufacture.

Key Words— Dual-band, ISM, Microstrip, Notch, Sleeves, WiMAX, WLAN

1 Introduction

ANTENNA design has become one of the most active fields in the communication studies. Wireless technology has expanded rapidly not only for commercial but also for military purposes. Wireless technology provides less expensive alternative and a flexible way for communication. Antenna is one of the important elements in the RF system for receiving or transmitting the radio wave signals from and into the air as the medium. One of the types of antenna is the microstrip antenna [1]. The microstrip antenna has been said to be the most innovative area in the antenna engineering, thanks to its low material cost and its easiness of fabrication which the process can be made inside universities or research institutes .Wireless communications continue to enjoy exponential growth in the cellular telephony, wireless Internet, and wireless home networking arenas. The wireless networks include wireless local area networks (WLAN). The IEEE 802.11 group has been responsible for setting the standards in WLAN. One major technology exists in the industrial ISM bands: 2.4-2GHz.4835 GHz, 5.15 GHz -5.35 GHz, and 5.725 GHz -5.825GHz. On the other hand, WiMAX technology has emerged as a feasible solution, because of its inherent features that holds great promise for the future of wireless communications. Worldwide Interoperability for Microwave Access is the next stage to a broadband as well as a wireless world, extending broadband wireless access to new locations and over longer distances, as well as considerably reducing the cost of bringing broadband to new areas. WiMAX (802.16) technology offers greater range and bandwidth than the other available or forthcoming broadband wireless technologies such as Wireless Fidelity (Wi-Fi) and Ultra-wideband (UWB) family of standards.

Therefore the antenna is required to operate at two or more frequency bands for WiMAX and WLAN systems[2], [3], [5], [6].Some of the desired features for these antennas include broad bandwidth, simple impedance matching to the feed line and low profile. In this paper, design of the dual band microstrip antenna for wireless commutation applications in 3.5 GHz and 5.8 GHz industrial, scientific and medical (ISM band) bands is proposed [4].

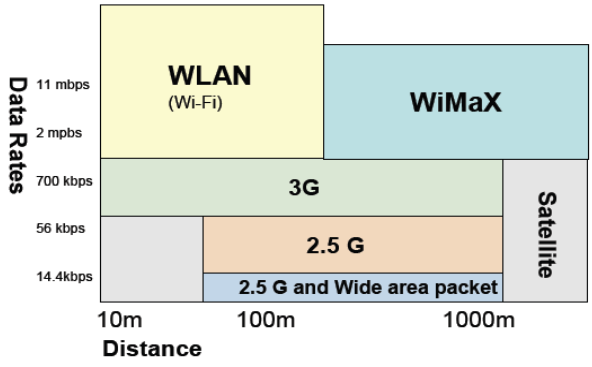

Fig. 1. Wireless Technologies.

In this paper, we demonstrate a novel and simple dual-band design of the printed monopole antenna. Simply by designing the two tuned branches side by side, dual-band operations for a printed monopole antenna can be easily obtained. The two side branches are called as Two-sleeves in this paper. In this case, the proposed monopole antenna looks like as to have two sleeves which has same or different dimensions and is referred to as the Two-sleeve monopole antenna in this study. Details of the antenna and effect of changing ground shapes, notches, and dimensions of the sleeves are described.

2 Antenna Design and Simulation Results

2.1 Design Specification

The design of the proposed antenna is shown in Fig. 2.

- *Shikha Sukhija is currently pursuing masters degree program in electronics & communication engineering in JCD college of Engineering from KUK, India,E-mail: shikhasukhija@yahoo.co.in,shikha.sukhija@yahoo.co.in*
- *Sukhdeep Kaur is Associate Professor in J.C.D. college of engg., Sirsa, Haryana,India,Email id: ersukhdeepkaur@gmail.com*

The Antenna is printed on an FR4 substrate having dimensions 40*40 sq. mm. with thickness 1.2 mm and relative permittivity 4.4 and dielectric loss tangent 0.02. A 50Ω microstrip line used to excite the antenna. The ground plane is set to L4*W (15*40) sq. mm. The width of the microstrip line is W3=4mm.The two sleeves has length of L1=35mm,L2=10mm having width w2 about 3mm. and W1=10mm & L3=5mm.

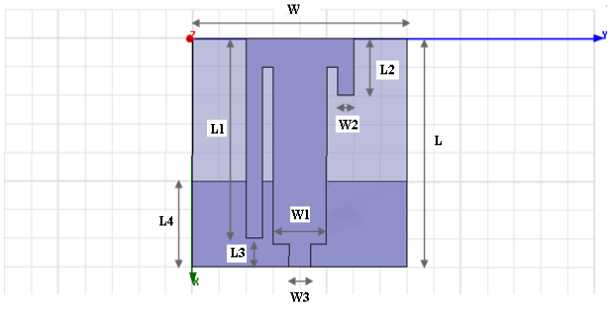

Fig. 2. Design Configuration of the proposed Antenna.

The Antenna Characteristics with different length of sleeves is studied as shown in the Fig 3 in accordance with the following Table 1

TABLE 1
CHARACTERISTICS OF THE PROPOSED ANTENNA

Antennas	L1, L2 in mm	Freq. Range
Antenna 1	35, 10	3.25-3.60GHz & 5.00-5.75GHz
Antenna 2	35,20	3.12-3.55GHz & 5.15-5.95GHz
Antenna 3	32,32	3.20-3.75Ghz & 5.00-6.15GHz
Antenna 4	35,35	3.30-3.60 GHz & 5.15-5.95GHz

2.2 Results

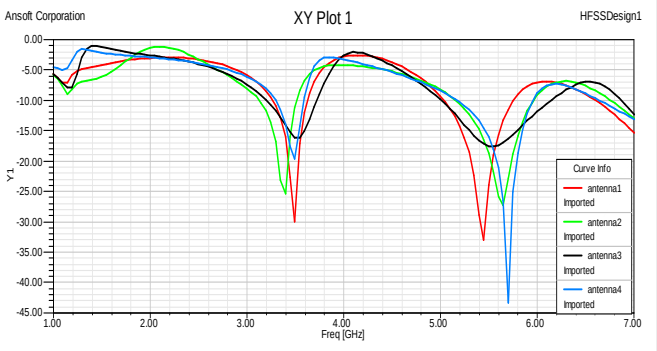

Fig. 3. Variation of return loss with frequency for the proposed antenna.

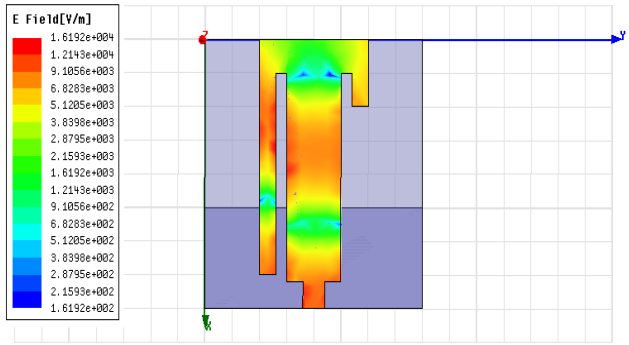

Fig. 4. E-Field distribution of the proposed antenna at 3.5 GHz.

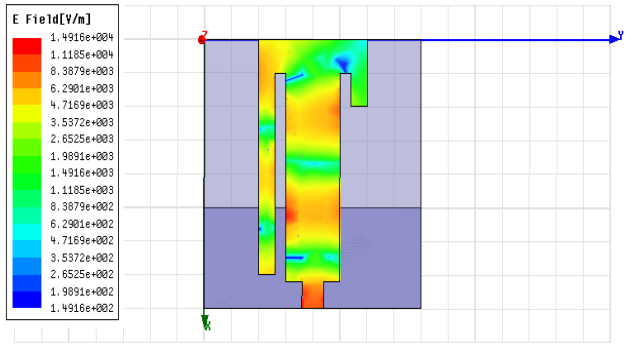

Fig. 5. E-Field distribution of the proposed antenna at 5.5 GHz.

The Simulation is carried out by Ansoft HFSS 11.0 software. Fig.4 and Fig.5 shows the results for Electric field distribution at 3.5 and 5.5 GHz freq. respectively. Here we can see that with the help of tuning sleeves, we have the bandwidth from 3.30GHz to 3.60 GHz (about 300 MHz) at 3.5 GHz frequency band and from 5.15GHz to 5.95 GHz (about 800MHz) at 5.5 GHz frequency band.

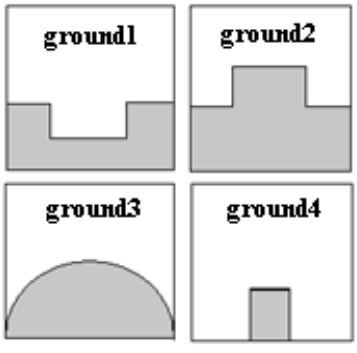

Fig. 6. Various ground shapes

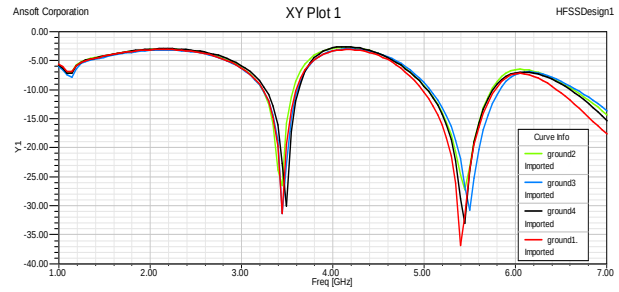

Fig. 7. Variation of return loss with different ground shapes for the proposed Antenna.

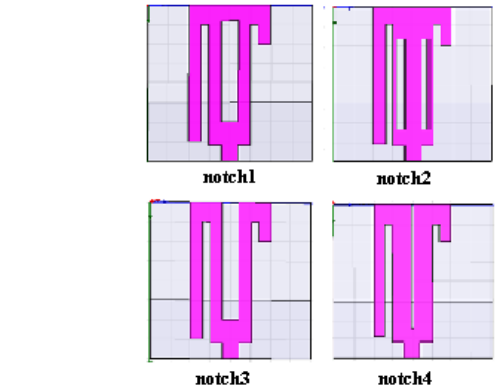

Fig. 8. Different notches cut from the substrate.

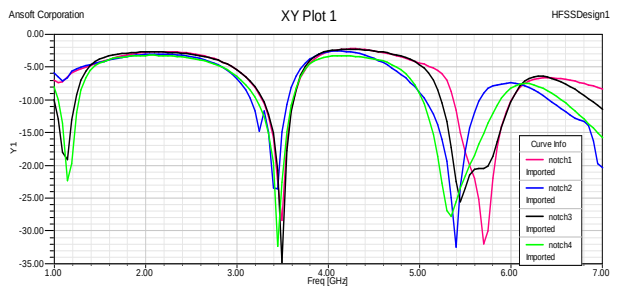

Fig. 9. Variation of return loss with different notches cut for the proposed Antenna.

Fig. 6 . shows different shapes of the ground & corresponding results for these ground shapes are shown in the fig.7. [7].On the other hand , this paper also shows the variation in return loss graph for different notches. Fig.8. shows different notches cut from the substrate & Fig.9. shows the variation of the return loss for the respected notch.

Therefore, the antenna in this paper can cover five bands: 3.3GHz, 3.5GHz, & 5GHz band which is again segmented into three 100MHz sub bands a lower band (5.15-5.25 GHz) a middle band (5.25-5.35GHz) and an upper band (5.725-5.825GHz).Fig.10. and Fig. 11. shows the polar plot representation for this proposed Two-sleeve antenna. It was observed that two tuning different parameters playing a very important role in functionality of the antenna. This proposed antenna has the efficiency of about 80%.

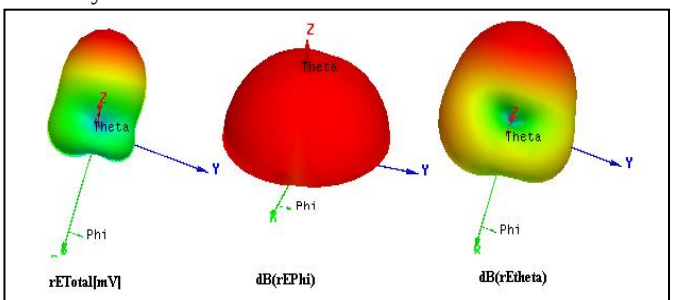

Fig. 10. 3D polar plot at 3.5 GHz

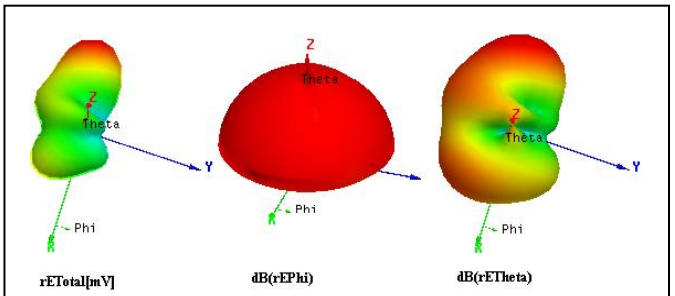

Fig. 11. 3D polar plot at 5.5 GHz

3 Acknowledgments

I specially thanks to ER. SUKHDEEP KAUR for giving this opportunity to work under her supervision and for sharing her great knowledge and experience with me.Researches in [1], [2], [3], [4] contributed great information for this paper.

4 Conclusion

Dual-band operations of a Two-Sleeve monopole antenna have been demonstrated. Designed Antenna is suitable for WiMAX and WLAN operations in the 3.5 and 5.5 GHz bands have been studied, and good antenna performances of the operating frequencies across both of the 3.5 and 5.5 GHz bands have been obtained. Effects of varying different parameters have also been studied.

References

[1] Chien-Yuan Pan., "Dual Wideband Printed Monopole Antenna for WLAN/WiMAX Application", IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS,pp.149-151, VOL. 6, 2007

[2] Y.-L. Kuo and K.-L. Wong, "Printed double-T monopole antenna for 2.4/5.2 GHz dual-band WLAN operations," *IEEE Trans. Antennas Propag.*, vol. 51, no. 9, pp. 2187–2192, Sep. 2003.

[3] Nguyen Van TrinhW″, Designing Dual-band Antenna for WiMAX″, The 2009 International Conference on Advanced Technologies for Communications

[4] S. H. Choi, J. K. Park, S. K. Kim, and H. Y. S. Kim, "Design of dual-band antenna for the ISM band using a backed microstrip line," *Microw.Opt. Technol. Lett.*, vol. 41, no. 6, pp. 457–460, Jun. 2004.

[5] C.-Y. Huang and P.-Y. Chiu, "Dual-band monopole antenna with-shorted parasitic element," *Electron. Lett.*, vol. 41, no. 21, pp.1154–1155, Oct. 2005.

[6] M. N. Suma, R. K. Raj, M. Joseph, P. C. Bybi, and P. Mohanan, "A compact dual band planar branched monopole antenna for DCS/2.4 GHz WLAN applications," *IEEE Microw.Wireless Compon. Lett.*, vol.16, no. 5, pp. 275–277, May 2006.

[7] C.-Y. Pan, C.-H Huang, and T.-S. Horng, "A novel printed monopole antenna with a square conductor-backed parasitic plane for dual-band WLAN applications," in *Proc. IEEE Antennas Propag. Soc. Int. Symp.Dig.*, 2004, vol. 1, pp. 261–264.