Microstrip Antenna Design On Wlan and Dbs Applications

Ritu Lavania[1], Ashish Duvey[2], Prasant Badal[3]
Electronics and Communication Engineering, RGPV
SRCEM, Banmore, India

Abstract—*Low profile, light weight, easily mounted and broad bandwidth are the key characteristics for antenna designed for wireless applications. The bandwidth of the microstrip antenna usually ranges for several percent. This paper define the 25% of bandwidth of the range from 2.28GHz to 2.81GHz, at this range perform various applications.*

Keywords—*Printed circuit board (PCB) antenna, MSA, IE3D Software.*

I. INTRODUCTION

Microstrip antennas have many unique and attractive
Properties-low in profile, light in weight and conformable in
structure, and easy to fabricate and to be integrated with solid-state devices. Recently, microstrip antennas can be seen for use in radio systems with differently signal operation as well. For example, a differentially-driven microstrip antenna integrated with a push-pull power amplifier in Gallium. which makes the push-pull power amplifier more compact and efficient. However, the narrow bandwidths limit their applications in modern wireless communication systems.

Generally a Conventional microstrip antenna has a radiating patch of any planar geometry (e.g. square, rectangular, Circular, Ellipse and ring). Microstrip patch antennas are increasing in popularity for use in wireless applications due to their low-profile structure. Therefore they are extremely compatible for embedded antennas in wireless devices such as cellular phones, pagers etc. The telemetry and communication antennas on missiles need to be thin substrate[1].

WLAN antenna requires being low profile, light weight and broad bandwidth. The microstrip antenna suits the features very well except for its narrow bandwidth. The WLAN antenna should have a minimum bandwidth of 100MHz to fully utilize the WLAN band based on the 802.11b standard. Although the required operating frequency range is from 2.4 GHz to 2.5 GHz, at least double the bandwidth is required to avoid expensive tuning operations and to cause uncritical manufacturing. Therefore, there is a need to enhance the bandwidth of the microstrip antenna for WLAN applications. [2]

This paper defines the bandwidth at which applications can perform over a range of the microstrip antenna without increasing the lateral size and the complexity of the
microstrip antenna too much. This bandwidth of microstrip
antenna can be deployed for the WLAN application operating at a frequency of 2.45 GHz.
The frequency bandwidth simulated using An software IE3D with VSWR< 2 of the antenna covers 2.28GHz to 2.81GHz over 3 GHz.[3]

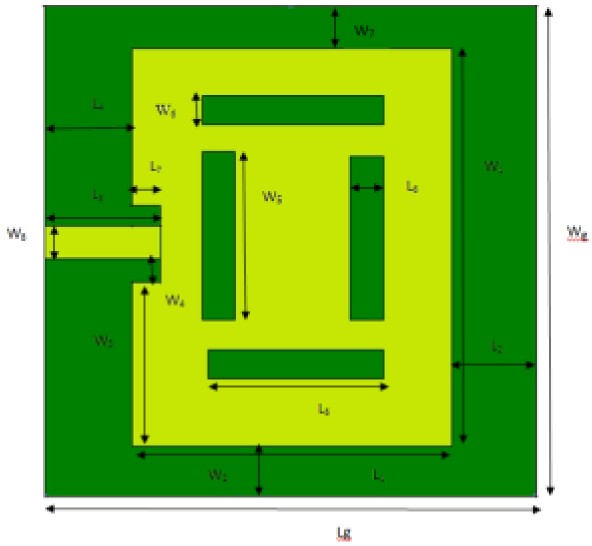

Fig. 1The configuration of the proposed design of microstrip antenna.

II. ANTENNA DESIGN

Fig. 1 shows the configuration of the proposed design of microstrip antenna which consists of a rectangular patch with four holes in the mid of the rectangular patch and a truncated ground plane. The proposed antenna, which has compact dimension of 30.4 mm 40.6 mm , is constructed on FR4 substrate with thickness of 1.6 mm and relative dielectric constant of 4.2. The width of the microstrip feedline is fixed at
6.8 mm. On the front surface of the substrate, a rectangular patch with size of is printed. The rectangular patch has a distance of to the ground plane printed on the back surface of the

substrate[d]. By digging the four holes of suitable dimensions at the mid of rectangular patch, it is found that much enhanced impedance bandwidth can be achieved for the proposed antenna. The dimension of the notch embedded in the truncated ground plane and feed gap distance are important parameters in determining the sensitivity of impedance matching. The optimal dimensions of the designed antenna are as follows:Lg= 33.4, Wg= 40.6, L_1 =13.8 , L_2=4.8,L_3=6.8,L_4= 4.8, L_5 = 10,L_6 =2, W_1 = 31,W_2 = 4.8,W_3 =13.5,W_4 =1, W_5 =10,W_6=2, W_7=4.8, W_8=2. all dimensions are in mm.The four digged rectangulars having length and width are 10 and 2 mm.

It is found that the designed antenna satisfies all the requirements in frequency band ranging 1 GHz to 3 GHz.

III. FORMULA USED

The length and width of rectangular patch antenna are calculated from given below equations .Where c is the velocity of light, ε_r is the dielectric constant of Substrate. The transmission line model is used to infinite ground plane.

1. Width (W) Calculation:

The width of the microstrip patch antenna can be calculated by the given equation as follows;

$$w = \frac{c}{2f_o\sqrt{\frac{\varepsilon_r + 1}{2}}}$$

2. Calculation of effective dielectric constant (Ereff):

The following equation gives the effective dielectric constant is given by

$$\varepsilon_{re} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(1 + \frac{12h}{W}\right)^{-\frac{1}{2}}$$

3. Calculation of length extension (Δl) :

The following equation gives the length extension in terms of (W/h) ratio and effective dielectric constant.

$$\frac{\Delta l}{h} = 0.412\,\frac{(\epsilon_{reff}+0.3)(\frac{W}{h}+0.264)}{(\epsilon_{reff}-0.258)(\frac{W}{h}+0.8)}$$

4. Calculation of actual length of patch (L):

The following equation gives the length of patch as,

$$\text{Le} = \text{L} + 2\Delta\text{L}$$

IV. RESULTS AND DISCUSSIONS

Various graphs result from the analysis of the patch by giving the feed point location x = 0.5 mm and y = 19.5 mm are shown in figures.

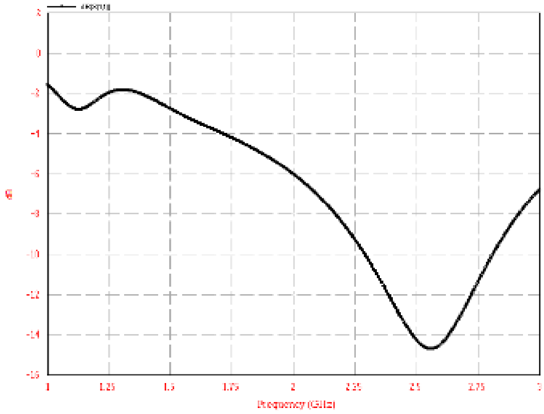

Fig. 2 Bandwidth of proposed microstrip antenna.

Fig 2 shows the graph of return loss verses frequency. The total bandwidth is calculated at operating range 2.28 to 2.81 GHz.

Fig 3 shows the Smith chart verses frequency plot shows the input impedance which should be ideally used for impedance matching.

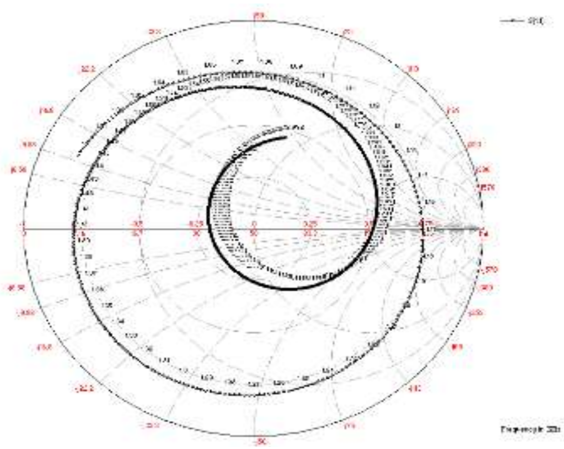

Fig. 3 Smith-chart of proposed microstrip antenna.

Fig 4 shows the graph of VSWR. The value of VSWR should be less than 2 for desirable communication.

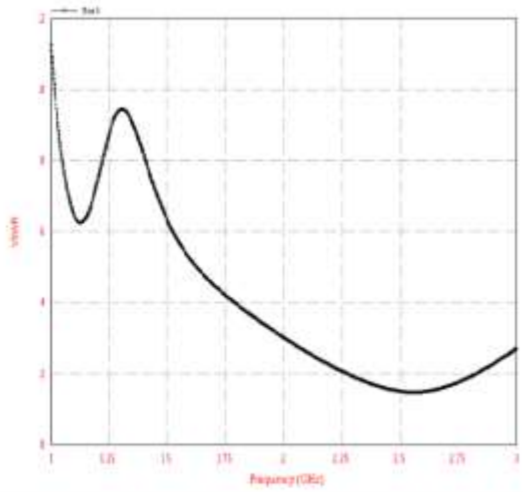

Fig. 4 VSWR Vs. Frequency of proposed microstrip Antenna.

I. CONCLUSION

A novel compact microstrip-fed antenna has been proposed and implemented for WLAN and DBS application. The proposed antenna has a simple configuration and is easy to fabricate. To obtain the required bandwidth for these applications, the sizes of holes of the patch have been optimized by parametric analysis. The designed antenna satisfies the 14 dB return loss requirement from 2.28 to 2.81 GHz and provides good radiation patterns. Experimental results show that the proposed antenna could be a good candidate for hand held WLAN and DBS applications.

References

[1] Girish Kumar and K.P. Ray, "Broadband Microstrip antennas" Artech House 2003.

[2] C.A. Balanis, "Antenna Theory", 2nd Ed., John wily & sons, inc., New York.1982.

[3] James j., and P.S. Hall (Eds), "Handbook Of Microstrip Antenna", Peter Peregrinus, London, UK, 1989.

[4] Rajeev Shankar Pathak, Arun shukla, vinod kumar singh "Design Of Broadband Microstrip Antenna Umts/Wlan/Wimax Applications".

[5] RSA Raja Abdullah, D. Yoharaaj, and Alyani Ismail Universiti Putra Malaysia (UPM), Malaysia. "Bandwidth Enhancement Technique in Microstrip Antenna for Wireless Applications", PIERS ONLINE, VOL. 2, NO. 6, 2006.

[6] Jihak Jung, Wooyoung Choi, and Jaehoon Choi, "A Small Wideband Microstrip-fed Monopole Antenna" Member IEEE. IEEE microwave and wireless components letters, vol. 15, no. 10, october 2005.

[7] Ramesh Garg, PrakashBartia, InderBhal and ApsiakIttipiboon, "Microstrip Antenna Design." Hand Book, Artech House, Norwood, MA, 2001.

[8] Srilakshmi.A Associate professor, Vasavi college of Engineering, ECE department, Hyderabad, India, N.V.Koteswara Rao Head and Professor of ECE, CBIT, Hyderabad, India, D.Sreenivasa Rao Professor of ECE, JNTUH,Hyderabad , India, "Bandwidth Enhancement Using Figure Eight Shaped Slot Antenna", International Journal of Engineering Research and Applications (IJERA), Vol. 2, Issue 4, June-July 2012.

[9] Akash Agrawal, , Assistant Professor, Electronics And Communication Engineering, Shri Ram Institute Of Information Technology, Banmore, Madhya Pradesh, India, Narendra Kumar Garg Assistant Professor, Electronics And Communication Engineering, Amity University, Gwalior, Madhya Pradesh, "Reduction In The Size Of Rectangular Microstrip Patch Antenna", International Research Journal Of Engineering And Technology (IRJET) Volume: 02 Issue: 02 | May-2015.

[10] Md. Maruf Ahamed, Kishore Bhowmik, Abdulla Al Suman, "Analysis And Design of Rectangular Microstrip Patch Antenna On Different Resonant Frequencies For Pervasive Wireless Communication", International Journal Of Scientific & Technology Research VOLUME 1, ISSUE 5, JUNE 2012.

[11] Amandeep Bath, Abhishek Thakur, Jitender Sharma, Prof. Basudeo Prasad Electronics & Communication Department IGCE, Punjab, India Design of a rectangular Patch Antenna IJEEE, Vol. 1, Issue 1 (Jan-Feb 2014).

[12] Alok Tiwari, Brijesh Pandey, Abitha V K, Raghvendra Mishra, Amit Vasudeo Rane and Jaya Suryawanshi, "Simulation of ultra-wideband co-planar boat microstrip patch antenna with IE3D software for wireless communication." International Science Organisation.