Open access Journal International journal of Emerging Trends in Science and Technology

Bottle Shape Cut Slot Microstrip Patch Antenna

Authors

Khushboo Naruka[1], Prof.(Dr.) Sudhir Kumar Sharma [2]

[1] Jaipur national university
Department of ECE JNU, Jaipur
Email: *hod_sadtm@jnujaipur.ac.in*

[2] Jaipur national university
Department of ECE JNU, Jaipur
Email: *narukasweety1985@gmail.com*

Abstract: This paper presents a bottle shaped cut slot microstrip patch antenna and experimentally studied on IE3D, an electromagnetic simulation package by Zeland Software Inc.. In, the presented work an rectangle patch is taken and that rectangal patch of dimensions, is cut into the slot than the previous one is removed from it ,a shaped is formed that shped is named as "A bottle shaped cut slot microstrip patch antenna ",After simulation through different frequencies the best result. A bottle shaped cut slot microstrip patch antenna is designed on a FR4 substrate of thickness 1.524 mm and relative permittivity of 4.4 and mounted above the ground plane at a height of 1.6 mm.In base shape microstrip patch antenna ,Bandwidth is 4% at 4.5GHz and 4% at 4.9GHz but In bottle shape cut slot , Bandwidth as high as 6.4 %& 4.8% at 7.10GHz & 7.82% are achieved with stable pattern characteristics, such as gain and cross polarization, within its bandwidth. Impedance bandwidth, antenna gain and return loss are observed for the proposed antenna. Details of the measured and simulated results are presented and discussed.

Keywords Microstrip antenna, Radiation pattern, Returns loss. .

Introduction

In high performance aircraft, spacecraft, satellite, and missile applications where size, weight, cost, performance, ease of installation, low profile, easy integration to circuits, high efficiency antennas may be required. Presently there are many other government and commercial applications, such as mobile radio and wireless communication [1]. To meet these requirements microstrip antenna can be used. These antennas are low profile, conformal to planar and non-planar surface, simple and inexpensive to manufacture using modern printed circuit technology, mechanically robust when mounted on rigid surface; compatible with MMIC designs and

when the particular shape and mode are selected they are very versatile in terms of resonant frequency, polarization, field pattern and impedance.

Microstrip antenna consist of a very thin metallic strip (patch) placed a small fraction of a wavelength above a ground plane. The patch and ground plane are separated by dielectric material. Patch and ground both are fabricated by using conducting material [2].The purpose of this work is to design a microstrip patch antenna using commercial simulation software like IE3D [10]. The IE3D by Zeland Software Inc. has been recently considered as the benchmark for electromagnetic simulation packages. It is a full wave, method of moment (MOM) simulator solving the distribution on 3D and multilayered structures of general shape. The primary formulation of the IE3D is an integral equation obtained through the use of Green's functions. In the IE3D, it is possible to model both the electric current on a metallic structure and a magnetic current representing the field distribution on a metallic aperture.In the base shape a rectangle patch of length 30 mm and width 40 mm as shown in figure 1 ,is studied and illustrated and for the first iteration the patch are cut into the form of shield as shown in figure 2,the radius of probe feed is taken (0.5 mm)and is taken for both the shape and kept same ,after iteration through different frequencies the base shape and cut slot shape are illustrated and compared. In this paper, a microstrip patch antenna is designed. The patch mounted on FR4 substrate (thickness=1.524mm) and above from ground plane at a height of 1.6mm. It is found that proposed design can also cause significant lowering of antennas fundamental resonant frequency due to increased length of the probe feed.

2. Antenna design

Designing an antenna in the Wi-max band meant that the antenna dimension could be bulky which is un-welcomed. Owing to it objective is to design a reduced size wide band microstrip antenna; the design idea was taken from broadband antennas to make the antenna work in a large band of frequencies of the many broadband antennas, square patch antenna was chosen [4]. This base structure does not provide good gain and Directivity so we will cut the base shaped into shaped into a structure with same feed than we get.The geometry of designed microstrip antenna is presented in fig.1 with front (top) view.

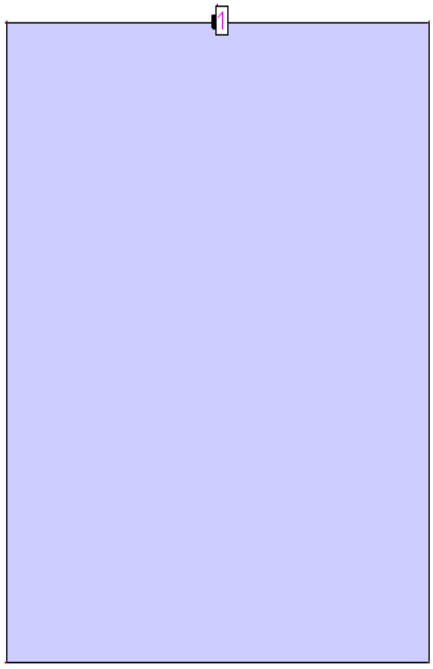

Fig.1 Geometry of proposed base shape microstrip patch antenna length= 30 mm and width 40 mm

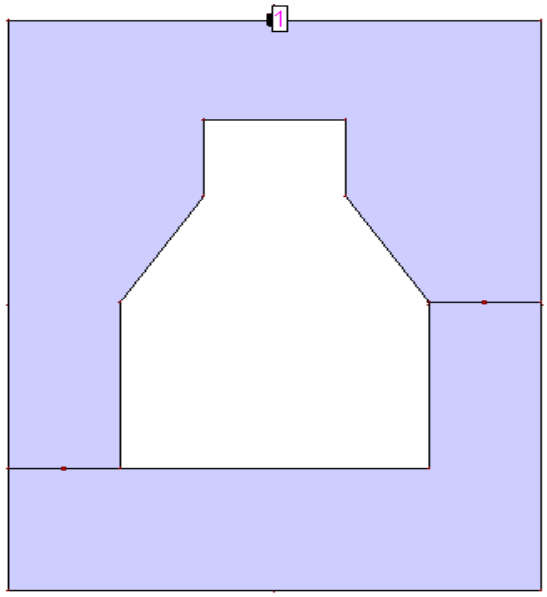

Fig.2 Geometry of proposed bottle shape cut slot microstrip patch antenna length= 30 mm and width 40 mm

This square microstrip patch antenna with bottle shape cutting slot is fabricated on a FR4 substrate of thickness 1.524 mm and relative permittivity of 4.4. It is mounted above the ground plane at height of 1.6 mm [6]. In this work, co-axial or probe feed technique is used as its main advantage is that, the feed can be placed at any place in the patch to match with its input impedance (usually 50 ohm). The software used to model and simulate the antenna was IE3D, it can be used to calculate and plot return loss, VSWR, radiation pattern, smith chart and various other parameters.

3. Result & Discussion

The proposed antenna has been simulated using IE3D by Zeland software Inc. [10]. Figure 3 shows Return loss of base shape microstrip patch antenna is -13.92 db at 4.5 GHz & -10.83db at 4.9GHz frequency .And total available impedance band width is 4% from the base shape antenna. Figure 4 Return loss of bottle shape cut slot microstrip patch antenna is -23.72 db at 7.10 GHz & -45.66 db at 7.82GHz frequency . Minimum -23.72 db.-45.66 return loss is available at resonant frequency which is significant. Figure 5 shows VSWR of base shape microstrip patch antenna is 1.4 at 4.5 GHz & 1.8 at 4.9GHz frequency .

Figure 6 VSWR of bottle shape cut slot microstrip patch antenna at antenna is 1.1 at 7.10 GHz & 1.03at 7.82GHz frequency . Figure 7 shows the relation between gain and frequency 2.6db at 4.5GHz,3.1db at 4.9GHz of base shape microstrip patch antenna. Figure 8 shows the relation between gain and frequency 4.7db at 7.10GHz, 3.5db at 7.82GHz of bottle shape microstrip patch antenna. Figure 9 Smith chart of base shape microstrip patch antenna at 50 ohm. Figure 10 Smith chart of bottle shape microstrip patch antenna at 50 ohm.Figure 11 shows the three dimensional plot of designed microstrip patch antenna.

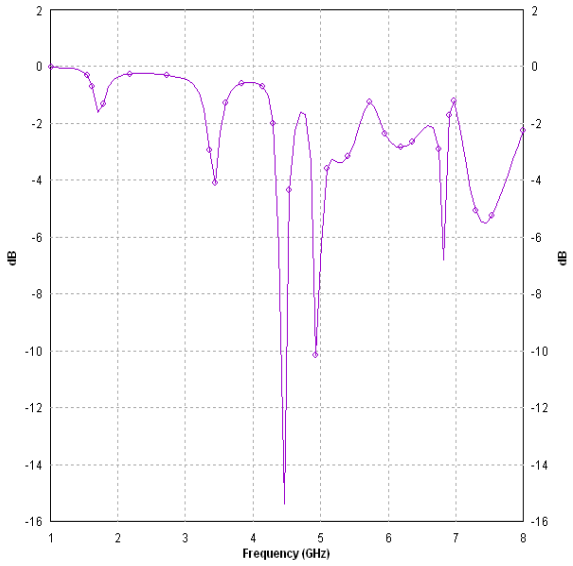

Figure 3 Return loss of double layer microstrip patch antenna is -13.92 db at 4.5 GHz & -10.83db at 4.9GHz frequency

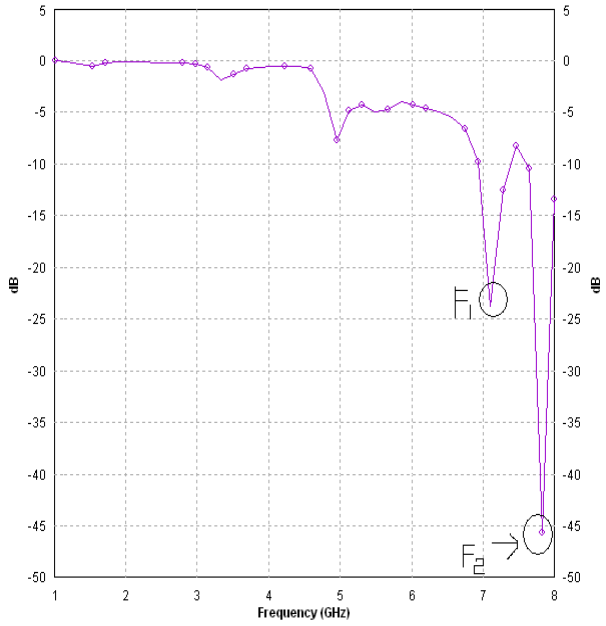

Figure 4 Return loss of bottle shape cut slot microstrip patch antenna is -23.72 db at 7.10 GHz & -45.66 db at 7.82GHz frequency

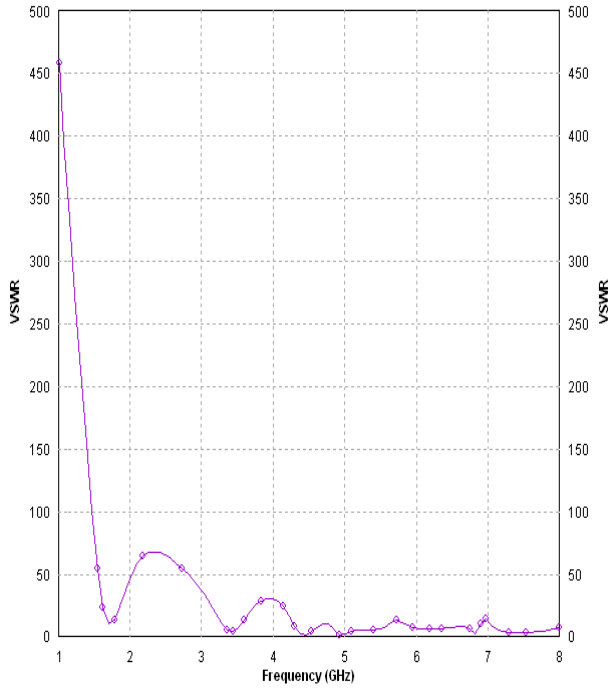

Figure 5 VSWR of base shape microstrip patch antenna is 1.4 at 4.5 GHz & 1.8 at 4.9GHz frequency

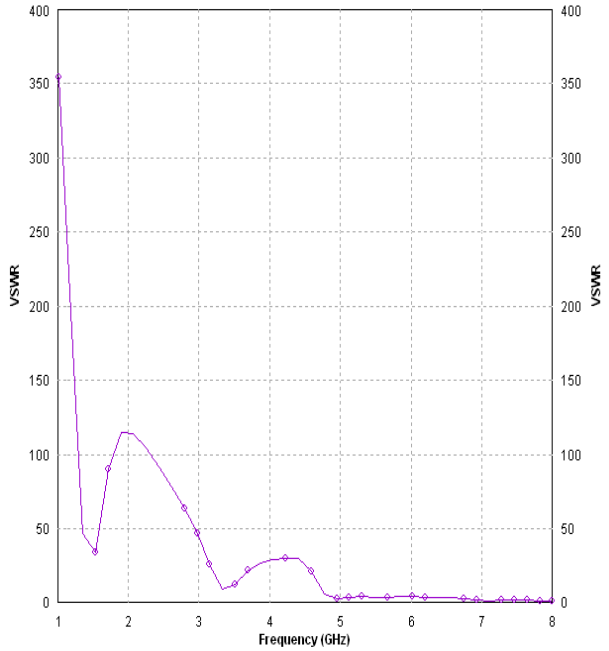

Figure 6 VSWR of bottle shape cut slot microstrip patch antenna at antenna is 1.1 at 7.10 GHz & 1.03at 7.82GHz frequency

Figure 7 shows the relation between gain and frequency 2.6db at 4.5GHz,3.1db at 4.9GHz of base shape microstrip patch

antenna.

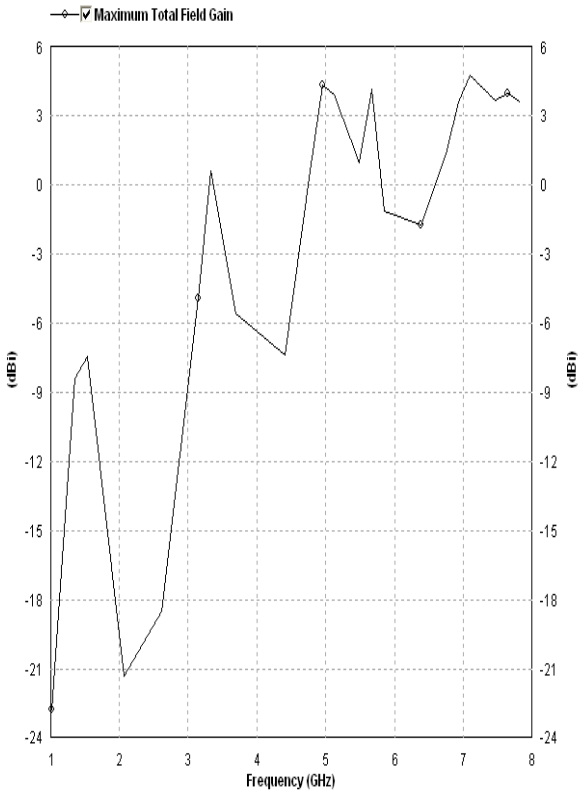

Figure 8 shows the relation between gain and frequency 4.7db at 7.10GHz,3.5db at 7.82GHz of bottle shape microstrip patch antenna.

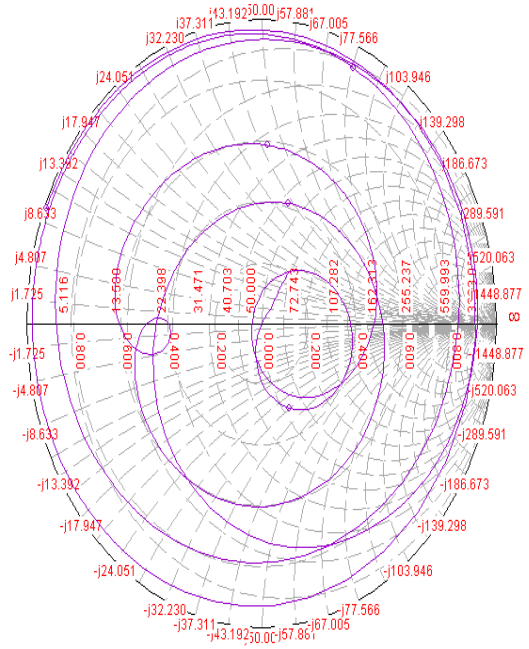

Figure 9 Smith chart of base shape microstrip patch antenna at 50 ohm

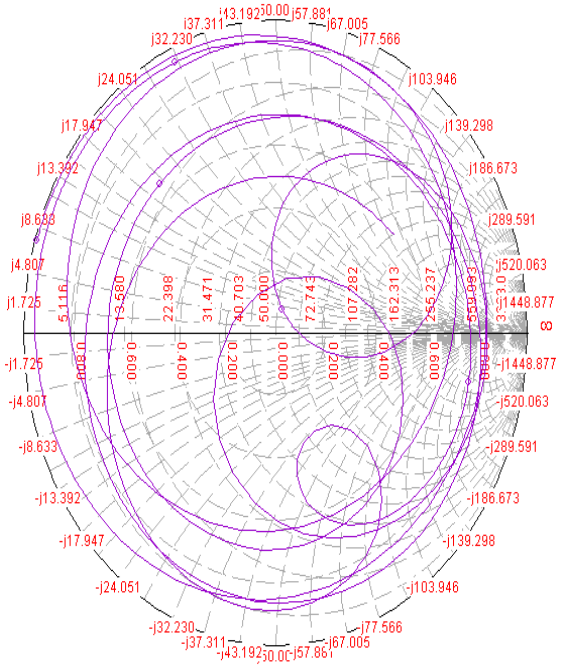

Figure 10 Smith chart of bottle shape microstrip patch antenna at 50 ohm

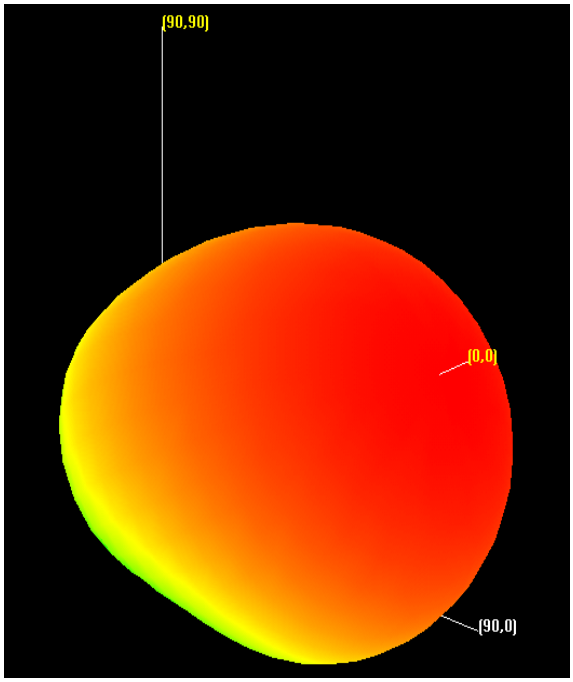

Figure 11 shows that the three dimensional plot of microstrip patch antenna

4. Conclusion

The design has demonstrated that a single probe feed bottle shape cutting slot microstrip patch antenna can be used to form an antenna with impedance bandwidth of 6.4% working in Wi-max wireless communication system These modern communication systems require antennas with broadband and/or multi-frequency operation modes. These goals have been accomplished employing slotted patch for the radiating element, with the aim to preserve compactness requirements and to maintain the overall layout as simply as possible and keeping the realization cost very low. Dual band and muti band characteristics of micristrip patch antenna which are described by all fthree antenna with good gain ,and directivity.These antennas can work in (super high frequency) and E-band ,C-band.These type of antenna can be use in LAN ,radar satellite ,satellite telivision broadcasting(DBS) etc.

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Author Profile

Khushboo naruka received the Btech. degrees in Electronics and communication engginering 2010, I am pursuing m.tech from jaipur national university. her field of interest and research are antenna desining ,communication technique,optical fiber,image and quality control.