Original Article

Design of Narrow Slotted Rectangular Microstrip Antenna

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ABSTRACT

This paper presents a design of narrow slotted rectangular microstrip antenna and experimentally studied on Ansoft Designer v-2.2.0 software. This design technology is achieved by cutting all three slots in microstrip antenna and placing a single coaxial feed. Rectangular patch antenna is designed on a FR4 substrate of thickness 1.6 mm and relative permittivity of 4.4 and mounted above the ground plane at a height of 3 mm. Bandwidth as high as 13.78% 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]

However the major disadvantage of the microstrip patch antenna is its inherently narrow impedance bandwidth. Much intensive research has been done in recent years to develop bandwidth enhancement techniques.[9] These techniques includes the utilization of thick substrates with low dialectic constant .The use of electronically thick substrate only result in limited success because a large inductance is introduce by the increased length of the probe feed, resulting few percentage of bandwidth at resonant frequency.

In this paper, rectangular microstrip antenna with narrow slits tips is proposed. The patch mounted on FR4 substrate (thickness=1.6mm) and above from ground plane at a height of 3 mm. It is found that proposed design can also cause significant lowering of antennas fundamental resonant frequency due to increased length of the probe feed.

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, rectangular patch antenna was chosen.[4] Hence the chosen shape of the patch was cutting of all three tips, with an aim to achieve smaller size antenna.[5] The geometry of rectangular microstrip patch antenna is presented in fig. 1 with front view and side view.

This rectangular microstrip patch antenna with narrow slits is fabricated on a FR4 substrate of thickness 1.6 mm and relative permittivity of 4.4. It is mounted above the ground plane at height of 3 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 truncated tip rectangular patch antenna was Ansoft designer V-2.2.0, it can be used to calculate and plot return loss, VSWR, radiation pattern, smith chart and various other parameters.[10]

RESULTS AND DISCUSSION

The proposed antenna has been simulated using Ansoft Designer v-2.2.0 software.[11] Fig. 2 shows the variation of return loss with frequency. Plot result shows resonant frequency 8.73 GHz. And total available impedance band width of 380 MHz that is 13.78% from the proposed antenna. Minimum -28.64 db return loss is available at resonant frequency which is significant. Fig. 3 shows the input impedance loci using smith chart.

Input impedance curve passing near to the 1 unit impedance circle that shows the perfect matching of input. Fig. 4 shows the VSWR of the proposed antenna that is 1:1.03 at the resonant frequency 8.73 GHz. Good broadside radiation pattern obtain in fig. 5.

CONCLUSIONS

The design has demonstrated that a single probe feed rectangular patch antenna with narrow slits can be used to form an antenna with impedance bandwidth of 13.78% working in Wi-max wireless communication system with resonant frequency 8.73 GHz. 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. In future by cutting slots on rectangular microstrip antenna reduced patch size and improved bandwidth can be achieved.

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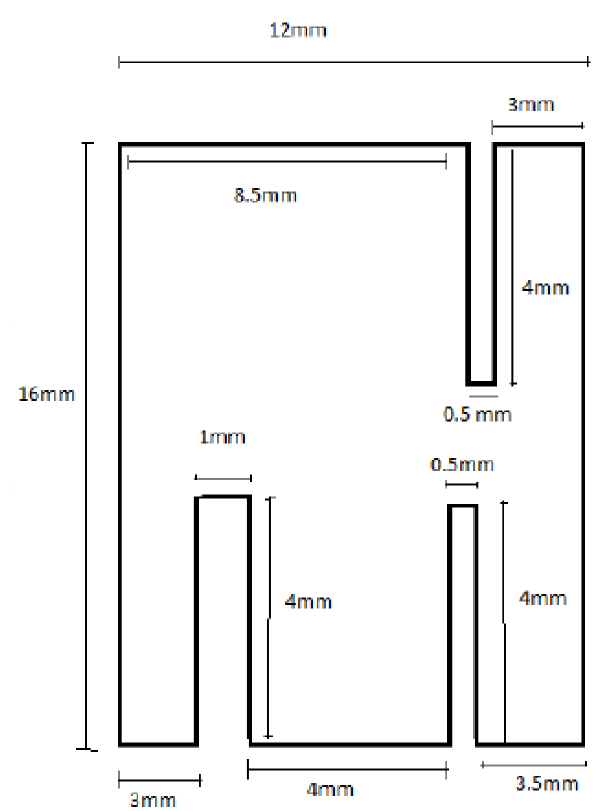

Figure 1. Geometry of proposed rectangular microstrip antenna with dimensions a=16mm, b=12mm, h=3mm, t=1.6mm

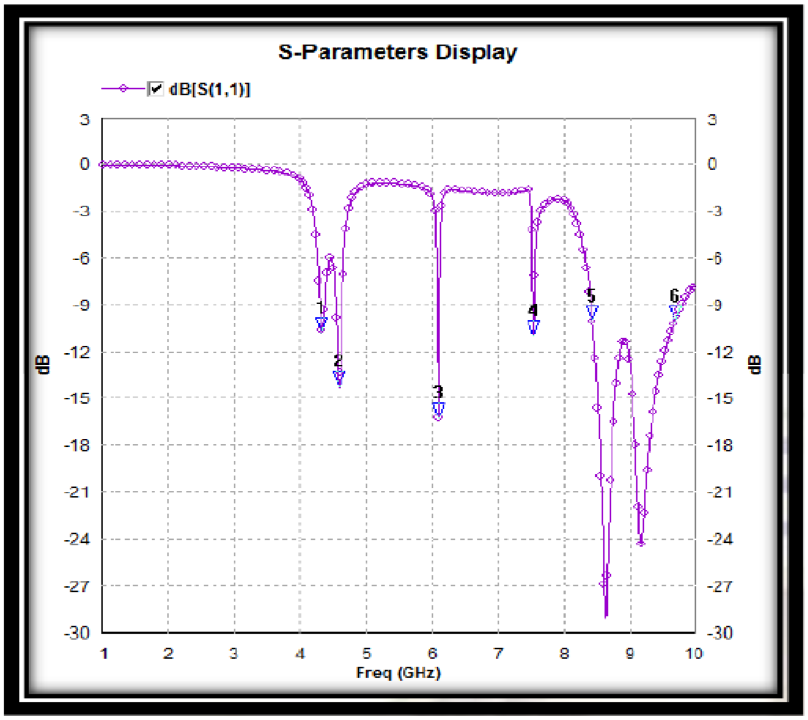

Figure 2. Return loss vs. Frequency curve for proposed antenna

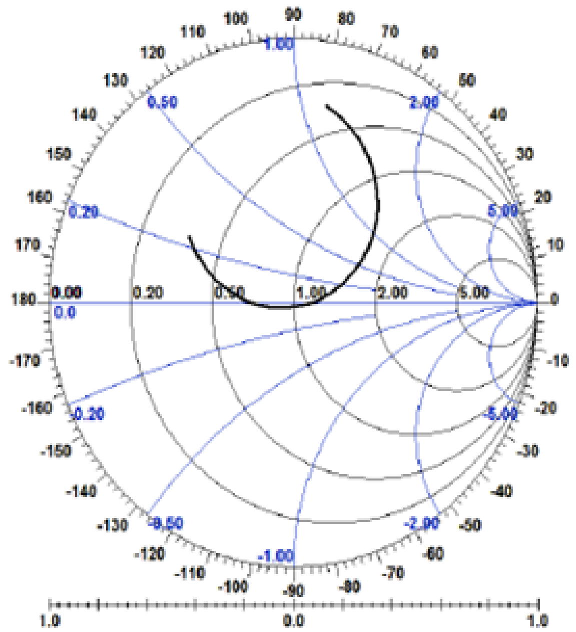

Figure 3. Input impedance loci using smith chart

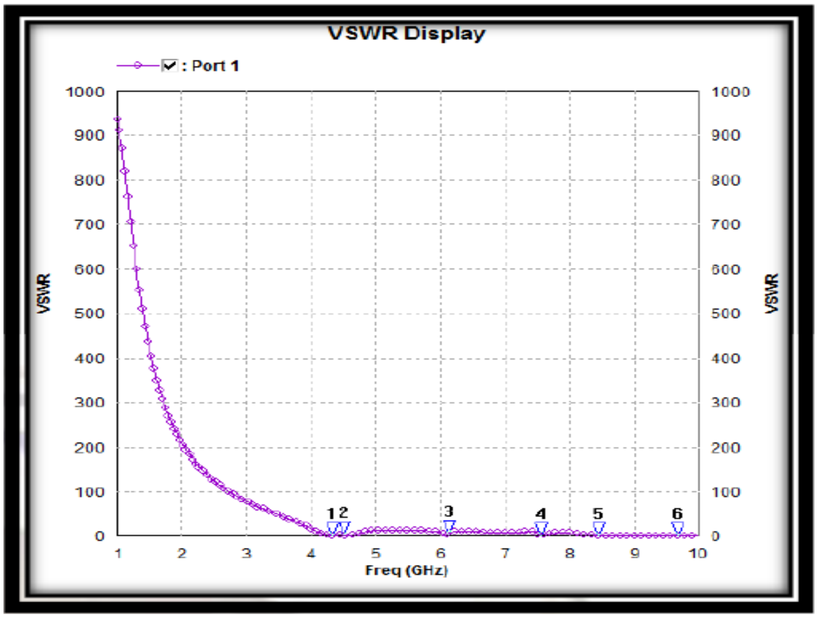

Figure 4. VSWR vs. Frequency curve for proposed antenna

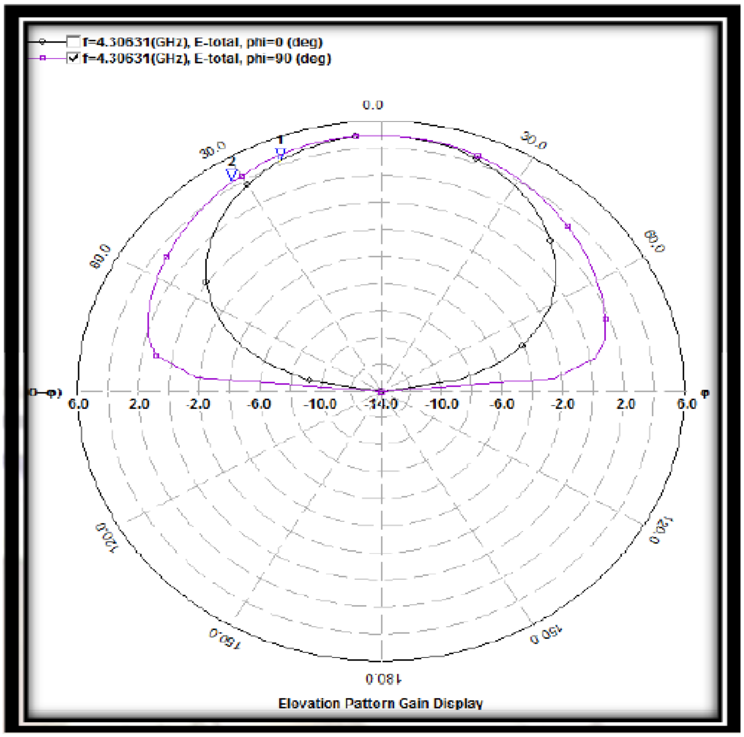

Figure 5. Radiation pattern of proposed antenna