Single Layer Symmetrical Y-Slots Wideband Microstrip Antenna Using IE3D

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ABSTRACT

Microstrip patch antennas are strong candidates for use in many wireless communication applications. The proposed antenna design approach is based on a single-layer, square patch (Length=30mm and Width=30mm) with two symmetrical Y-slots and a rectangular slot on the patch with coaxial probe feed to achieve wide band application with very low return loss. The proposed antenna is modeled using IE3D electromagnetic (EM) simulation packages namely IE3D from Zeland. The objective of this paper is to design, construct and fabricate microstrip antennas suitable for wireless application that centered at frequency 4.87 GHz. The antenna must operate within the band of 4.04GHz to 5.12GHz band. This band is currently being used for industrial, medical and scientific applications. The antenna is proposed to be used as a transmitting as well as receiving antenna in wireless network and the mentioned applications. A thick substrate FR4 which has a dielectric constant 4.4 with infinite ground broadens the bandwidth of the antenna. The proposed antenna reduced the return loss as well as increases the bandwidth of the antenna.

Keywords- *Microstrip antenna, Wide band.*

I. INTRODUCTION

Microstrip patch antenna is a key building in wireless communication and Global Positioning system since it was first demonstrate in 1886 by Heinrich Hertz and its practical application by Guglielmo Marconi in 1901. Future trend in communication design is towards compact devices. Microstrip patch antenna have been well known for its advantages such as light weight, low fabrication cost, mechanically robust when mounted on rigid surfaces and capability of dual and triple frequency operations all these features, attract many researchers to investigate the performance of patch antenna in various ways. However, narrow bandwidth came as the major disadvantage for this type of antenna. Several techniques have been applied to overcome this problem such as increasing the substrate thickness, introducing parasitic elements i.e. co-planar or stack configuration, or modifying the patch's shape itself. In order to increase the rate of data transfer in modern wireless system we require large bandwidth antenna. Many such antennas have very good bandwidth, but have bidirectional patterns which decrease the gain. Many of these feeding techniques can improve the bandwidth, but provide asymmetry in radiation pattern. Mostly aperture and electromagnetic coupling methods of feeding are used in stacked configurations to avoid the spurious radiations from the feed. The coaxial probe feed is the most popular one for electrically thick substrates; but the inductance of the probe may create the impedance mismatch which can be compensated by cutting slots on the patch.

Modifying patch's shape cutting two symmetrical Y-slots and a rectangular slot on the patch. The proposed antenna design approach is based on a single-layer, single square patch with two symmetrical Y-slots on the patch with coaxial probe feed . The antenna has a simple structure and it is designed to operate b/w 4.02 GHz to 5.12 GHz.

II. ANTENNA STRUCTURE

The basic structure of this single layer microstrip antenna in Fig. 1(a). The single square patch with two symmetrical Y-slots and a rectangular slot on the patch with coaxial probe feed. Dimensions of the proposed antenna as shown in table1-

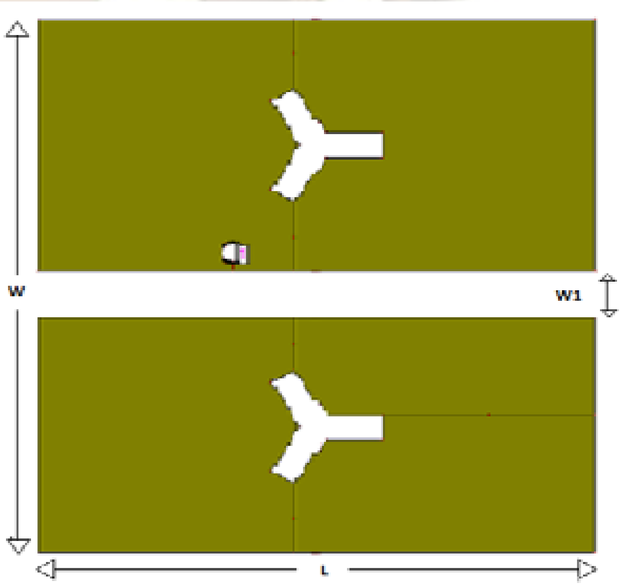

Figure 1. Single layer microstrip antenna

Table1. Dimensions of the proposed antenna

W	30mm	Tangent loss	0.025
L	30mm	Dielectric constant FR4	4.4
W1	1mm	Width and length of symmetrical Y-slot	1.5 mm & 3.5mm
Height (h)	1.59mm	Feed point	-4.5mm , 1.1mm

III. RESULTS AND DISCUSSION

The performance of the designed antenna was analyzed in term of bandwidth, gain, return loss, VSWR, and radiation pattern. The initial design of the proposed antenna is modeled using electromagnetic (EM) simulation packages namely IE3D from Zeland.

Fig. 2 shows the return loss of the proposed antenna. The proposed antenna shows the minimum return losses -31.85db at 4.87 GHZ resonant frequency. The proposed antenna shows the return loss below -10dB in the frequency range from 4.04 GHz to 5.12 GHz. The proposed antenna provide percentage bandwidth 22%.

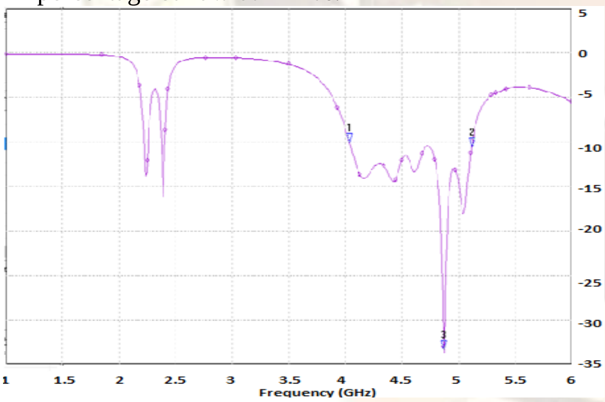

Figure.2. Return losses S11, parameter

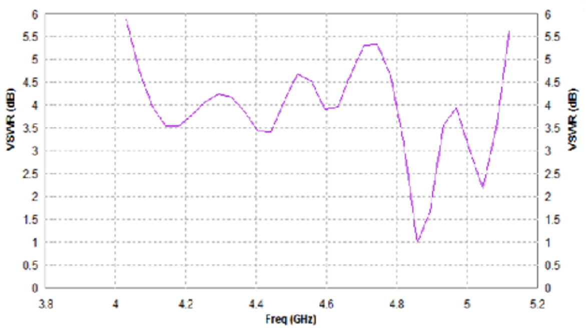

Figure 3.Variation of VSWR with the frequency

Fig.3 shows the variation of VSWR with the frequency which also shows the satisfactory result at resonant frequency i.e. VSWR with in value, less than 2.0 and minimum VSWR is found 1 at 4.87 GHz.

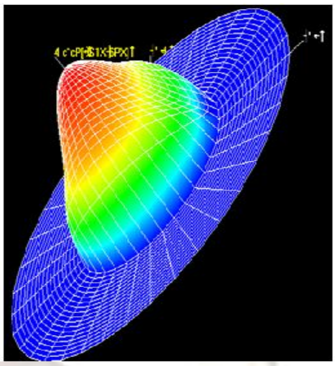

Figure 4. Radiation pattern of the proposed antenna

Fig. 5 Shows the antenna gain in dBi with respect to frequency. The proposed antenna's maximum gain is 4.33 dBi . The proposed antenna shows the gain is moderate from 4.04 GHz to 5.12 GHz.

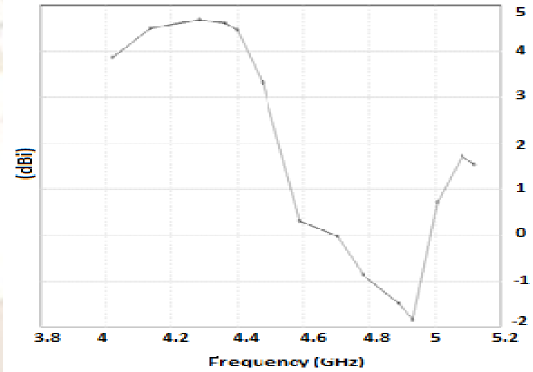

Figure.5 Antenna gain of the proposed antenna

Fig.6 Shows the Directive gain in dBi with respect to frequency. The proposed antenna shows the directive gain 7.16 dBi to 8.06 dBi in the frequency range from 4.04 GHz to 5.12 GHz.

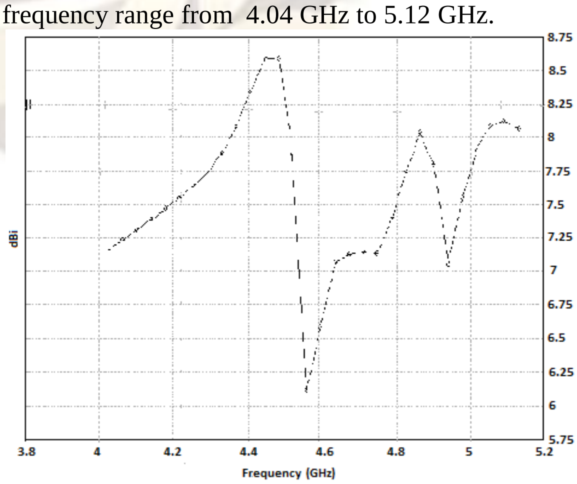

Figure 6. Directive gain of the proposed antenna

IV. CONCLUSION

The proposed antenna design approach is based on a single patch, coaxial probe feed wideband microstrip antenna. The proposed antenna shows the return loss below -10 dB between frequency range from 4.04 GHz to 5.12 GHz. The maximum directive gain is 8.6 dBi and VSWR are seen to be less than 2 and found to be minimum as 1 at frequency 4.87 GHz within the frequency band. It provides the percentage bandwidth 22%. The proposed Antenna is expected to have great potential usage in modern communication system.

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AUTHOR'S PROFILE:

Rahul Suvalka has completed his **B.E.** in Electronics and communication Engineering. from Gyan Vihar College, Jaipur affiliated to University of Rajasthan and he is pursuing his **M.Tech**. in CSP (COMMUNICATION & SIGNAL PROCESSING) from JNU JAIPUR. His area of interest are Antennas, wireless systems and filter design.

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He was awarded a degree of M.Sc (Physics) and M.Sc Tech (Electronics) from BITS Pilani. He started his professional carrier in1966 at Central Electronics Engineering Research Institute (CEERI), Pilani. During this period, indigenous know how was developed for several types of fixed frequency and tunable magnetrons of conventional and coaxial type. He headed the team for the production of specific Magnetrons for defense and transferred the know how to industries for further production. He also has several publications and a patent to his credit.

In 1979 he visited department of Electrical and Electronics Engineering at the University Of Sheffield (UK) in the capacity of independent research worker, and Engineering Department of Cambridge University Cambridge (UK) as a visiting scientist. After retirement as scientist in 2003 shifted to Jaipur and joined the profession of teaching and from last eight years working as professor and head of electronics department in various engineering colleges. At present he is working as head and Professor in the department of Electronics and Communication Engineering at JNU, Jaipur.