IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 1 Issue 2, April 2014.

www.ijiset.com

ISSN 2348 - 7968

Design and Analysis of Metamaterial Based Rectangular Patch Antenna For WIMAX Application.

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Abstract

In this paper metamaterial based rectangular patch antenna is designed for WIMAX application which is centered at 3.6 GHz and the antenna characteristics namely return loss, VSWR, radiation pattern are analyzed. Here the antenna is designed using rectangular patch antenna with left handed metamaterial. The Return loss, VSWR of the designed antenna are -14.69, 1.45 respectively. The size of the antenna is 100x90x2mm^3 which is much compact and meeting the requirement of WIMAX application. Hence this antenna could be used for WIMAX application.

Keywords—*Patch Antenna, Metamaterial and WIMAX.*

1.Introduction

In coming years the need of the communication devices are increased due to decrease the size. The greater integration of electronics the communication devices become smaller. The IEEE 802.16 has been established the new standard known as WIMAX (Worldwide Interoperability For Microwave Access). The WIMAX can be covered up to 50 km radius. There are three allocated band of WIMAX are Low band(2.5 – 2.69 GHz), Middle band(3.2 – 3.8 GHz), Upper band(5.25 – 8 GHz) [1].

The microstrip patch antenna have some advantages are low cost, easy to integrate and weightless. Some application such as wireless communication systems, mobile phones and laptops are integration in very good candidate of microsrtip patch antenna[2].

2.Theory

An antenna is a device that is radiate and receive radiated electromagnetic waves. There are several important antenna characteristics should be considered when choosing an antenna for our application as follows:

- ☐ Antenna radiation pattern
- ☐ Return loss
- ☐ VSWR

The radiation pattern of an antenna is a plot of relative field strength of the radio waves emitted by the antenna at different angles. Return loss is the loss of signal power resulting from the reflection caused at the discontinuity in a transmission line. VSWR is the Voltage Standing Wave Ratio defined as reflected power of the Transmission line.

The microstip patch antenna are used increasely because patch can be printed directly on the circuit board. In mobile phone market the microstrip antenna are used widespread [7]. Patch are low profile, low cost and easily fabricated consider the microstrip antenna are shown in figure 1.

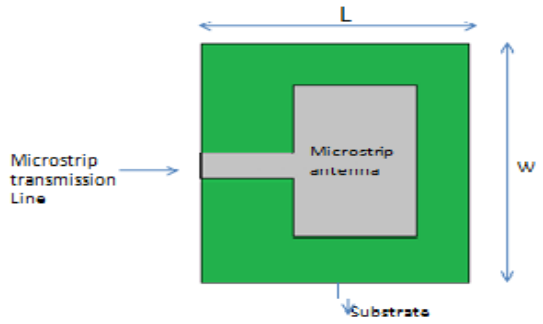

Fig 1 Microstrip patch antenna

The microstrip antenna are fed on the center of the substrate. The feed line is inserted into the microstrip patch. The ground and microstrip feed line are mode a high conductivity metal copper in patch antenna. L is the length and W is the width of the patch antenna. The probe can be coupled with microstrip feed to introduce the electromagnetic energy to the patch. The electric field of the patch is maximum (positive) at one side and minimum (negative) on other side, and zero at the center[11].

The metamaterial can be used to design these rectangular patch antenna. it does not found in nature it can be arranged by microscopic materials such as metals and plastics in repeating patterns [2].

3. Antenna Design

Typically there are three essential parameters are required to design rectangular microstrip patch. The frequency operation of the patch are selected by using the resonance frequency. The WIMAX frequency ranges are Low band (2.5 – 2.69 GHz), Middle band(3.2 – 3.8GHz), Upper band(5.25–8 GHz) . So the antenna must be designed to operate this frequency range.

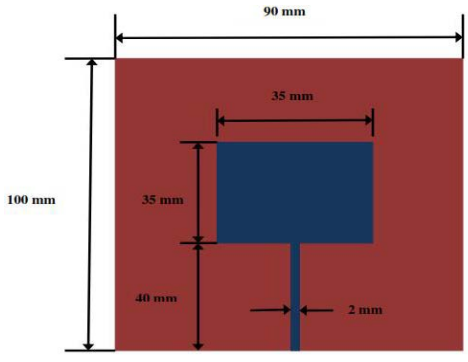

Fig. 2 Front view of patch antenna

In this paper 3.6 GHz can be selected at resonant frequency. The substrate can be made up of FR4 Epoxy with 4.4 dielectric constant. These substrate have dielectric constant it can be reduced the antenna dimension. The High Frequency Structure Simulator(HFSS) can be used to design this antenna. The left handed metamaterial can be used for this design.

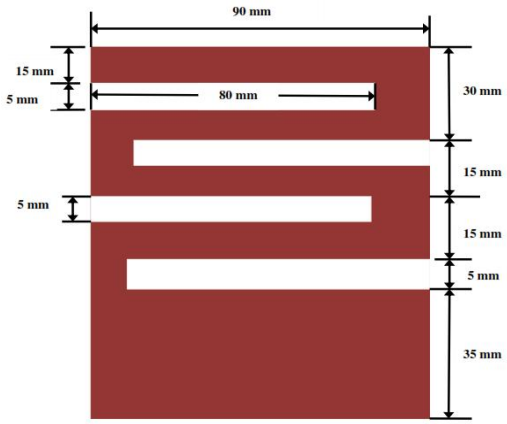

Fig. 3 Back view of designed Antenna

4 .Results And Discussions

The designed structure of the antenna using HFSS is given figure 4.

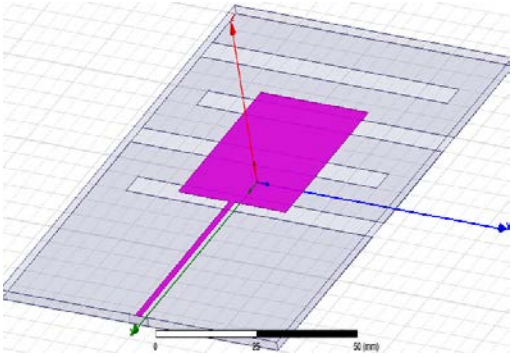

Fig. 4 Designed Rectangular Patch Antenna

The frequency response of the rectangular patch antenna is drawn between response frequency versus return loss. Normally acceptable return loss value is -6dB. In this paper we get a return loss is -14.69dB and corresponding frequency level is 3.6GHz. The frequency response of the rectangular patch antenna is shown in figure 5.

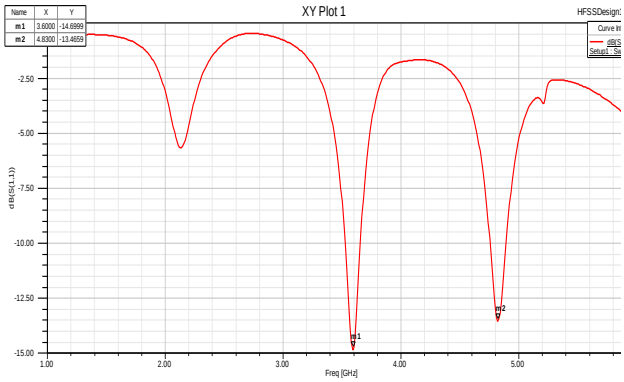

Fig .5 Frequency Response of rectangular patch antenna

Normally in antenna application the VSWR value is in between 1 to 2. This patch antenna we get the VSWR is 1.45 at the resonance frequency of 3.6GHz.

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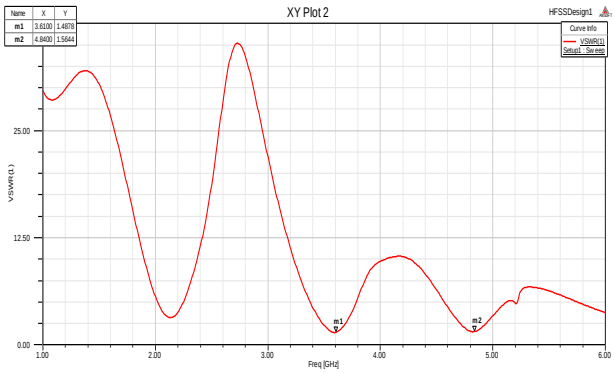

Fig. 6 VSWR of rectangular patch antenna

The radiation pattern of the antenna is a plot of the relative field strength of the radio waves emitted by the antenna at different angles. It was drawn between antenna position versus radiated power. Radiation pattern of therectangular patch antenna at 3.6 GHz is shown in figure 7.

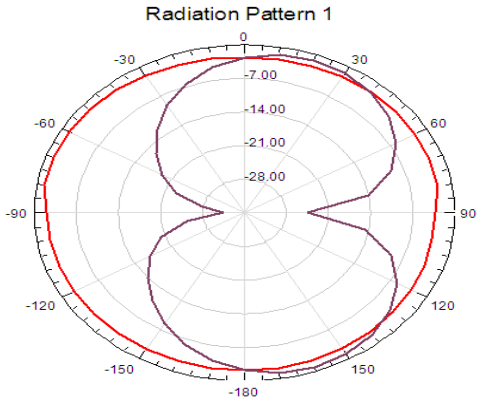

Fig. 7 Radiation Pattern of rectangular patch antenna

V.Conclusion

Thus the metamaterial based rectangular patch antenna is designed and analysed the parameters such as the Return loss, VSWR, radiation pattern in HFFS software. It is noticed that from the simulation the obtained Return loss and VSWR is -14.69 and 1.45 in 3.6 GHz respectively. The obtained results and size are meeting the basic requirement of antenna. Hence its highly useful for WIMAX application.

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