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A Novel Method of Design E-Shape Microstrip Patch Antenna

Ashish Kumar Yadav and Arun Kumar Yadav

MGM's CoET, NOIDA

Abstract

The area of microstrip antennas has some inventive work in recent year and is one of the most dynamic fields of antenna theory. The ever increasing need for mobile communication and the emergence of newer technologies requires an efficient design of antenna which is smaller of size and wider frequency range .The application of this Wi-Max.The author try to increase the impedance bandwidth of the microstrip patch antenna in this paper. A low profile wideband unequal E-shaped microstrip patch antenna for the Wi-Max application is proposed in this paper. Its bandwidth is further increased by introducing composite effect of stacking of patches with partial grounding. The antenna is designed and simulated by three dimensional electromagnetic field software IE3D ZELAND.The properties of the designed antenna such as bandwidth S parameter, VSWR have been calculated in this communication.

Keywords: Microstrip patch antenna. Rectangular slot, Wi-Max, VSWR (Voltage standing wave ratio).IE3D ZEIAND (Integral Equation in 3 Dimensional).

1. Introduction

In wireless communication, there are several types of micro strip antenna the most common of which is the microstrip patch antenna. Micro strip antenna consists of very small conducting patch built on a ground plane separated by dielectric substrate. The patch antenna idea was first proposed in the early 1950, but it was not until the late 1970s that this type of antenna attention of the antenna community.The microstrip patch antenna offers the advantages of low profile. Ease of fabrication, and compatibility with integrated circuit technology. (1-12) and easily combine to form linear or planer arrays. It can generate linear, dual, and circular polarizations. The Microstrip antenna has different feeding techniques like probe fed, aperture coupled, proximity and insert feed.As conventional antenna are often bulky and costly part of an electronic system, the microstrip antenna considered as an engineering breakthrough for compact communication device and systems especially for remote uses where compactness is much desirable feature. However, conventional microstrip patch antenna suffers from very narrow bandwidth. This poses design challenge for the micro strip antenna designer to meet the broadband requirements.Serveral techniques have been used to overcome this problem such as using thick substrate with low dielectric constant. Patch loading on the same layer with the main patch, stacked multilayer patches, E-slot etched on the same patch and L –Probe feeding. The proposed antenna is designed for 6 GHz frequency with stacked unequal E-Shape patch with partial grounding. The proposed antenna is designed and simulated by using IE3D ZELAND software. The simulated microstrip patch antenna is shown in fig. 1

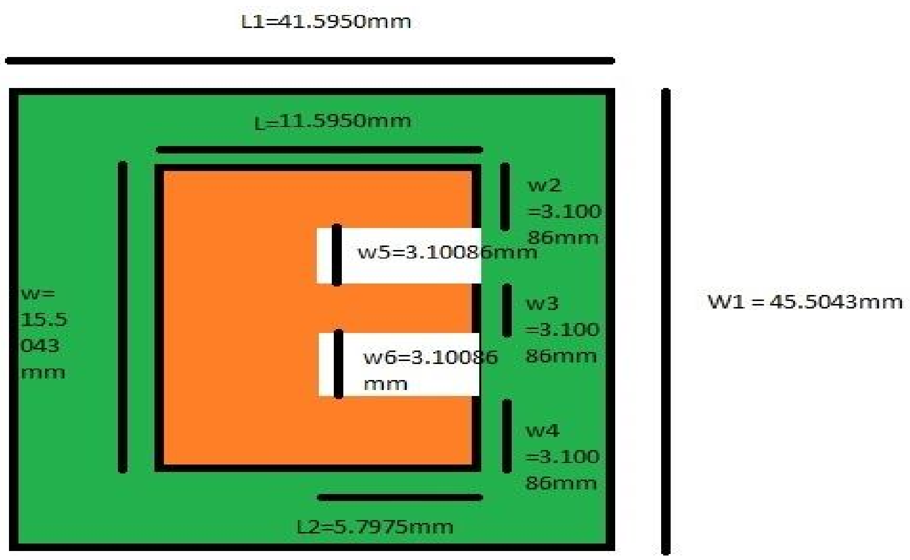

Fig. 1: Block Diagram of Proposed Antenna.

Width of ground plane (W1) = 45.5043mm
Length of ground plane (L1) = 41.5950mm
Width of patch (W) = 15.5043mm
Length of patch (L) = 11.5950mm

In this paper reduced ground plane structure and stacking of unequal E-Shape patch is investigated for enhancing the impedance bandwidth on the substrate FR4 (Dielectric constant is 4.2).

2. Design Procedure

Step 1: Determination of the Width (w): The width of the microstrip patch antenna is given by,

$$W = \frac{c}{2f_0\sqrt{\frac{\varepsilon_r+1}{2}}}$$

By substituting c=3*10^8 m/s, $\in_r = 4.2$ *and* $f\ \ f_0 = 6\,GHz$,it can be easily determined that w=15.5043mm.

Step2: Determination of effective dielectric constant ($\in_{reff}$):

The effective dielectric constant is represented by,

$$\boldsymbol{\varepsilon_{reff}=\frac{\varepsilon_r+1}{2}+\frac{\varepsilon_r-1}{2}\left[1+12\frac{h}{w}\right]^{-\frac{1}{2}}}$$

By **substituting** $\in_r$=4.2,W=15.5043mm,and h=1.6mm,it can be determined that $\in_{reff}$=3.6694.

Step 3: Determination of effective length (L_{eff}):

The effective length is given by,

$$\boldsymbol{L_{eff}=\frac{c}{2f_0\sqrt{\varepsilon_{reff}}}}$$

By substituting $\in_{reff}$=3.6694, c=3*10^8 m/s, and f_o=6 GHz, it can determined that L_{eff}=13.05087mm.

Step 4: Determination of length extension (ΔL):

The length extension may be represented by,

$$\boldsymbol{\Delta L=.412h\frac{(\varepsilon_{reff}+0.3)\{\frac{w}{h}+0.264\}}{(\varepsilon_{reff}-0.258)\{\frac{w}{h}+0.8\}}}$$

By substituting $\in_{reff}$=4.2, w=15.5043 mm and h=1.6mm,it can be determined that ΔL=0.727918mm.

Step 5: determination of actual length of patch (L):

The actual length is obtained by using expression

$$\boldsymbol{L}=L_{eff}-\boldsymbol{2\Delta L}$$

By substituting L_{eff}=13.05087mm, and $\Delta L = 0.72791mm$, the actual lenth can determined as L=11.5043mm.

3. Result and Discussion of Simulated Patch Antenna

3.1 Return LOSS

The patch antenna simulated by using ID3D ZELAND on software, after simulating the design, results is obtained as follows,

The return loss is calculated the reflection coefficient,

Return loss =$20log_{10}|S_{11}|$

Where $|S_{11}|$ is reflection coefficient.

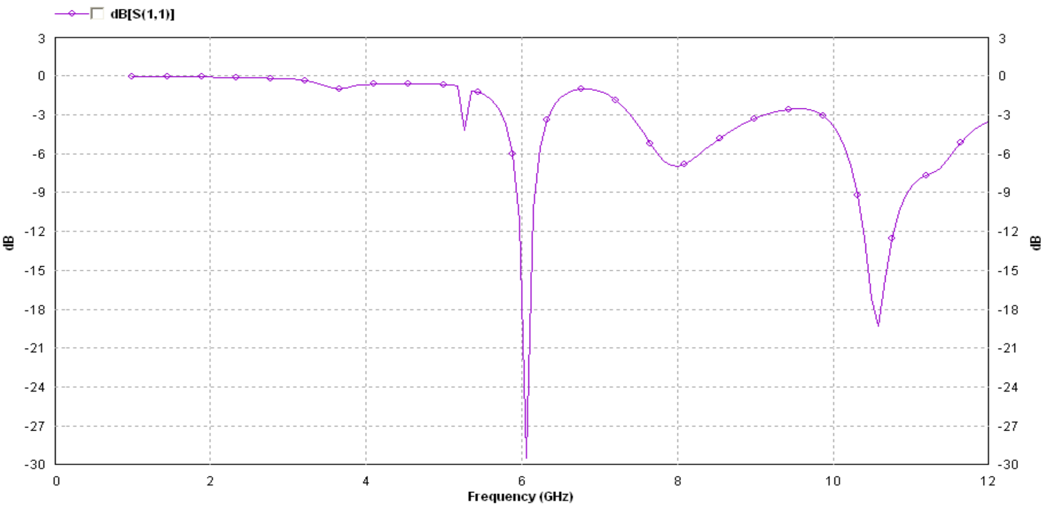

Fig. 2: Return Loss (S_{11}) of patch antenna.

From the figure 2 is found that the return loss of the unequal E- shape patch antenna is -29.44Db.further is seen that another dip is found at a frequency 11 GHz and the return loss is < -15 Db.

3.2 VSWR (Voltage Standing Wave Ratio).

The equation for the voltage standing wave ratio is.

$$S = \frac{V_{max}}{V_{min}}$$

It represent that perfect matching, this equation is represent practically difficult, therefore the available standing VSWR for fabricating the antenna is **<** 2.

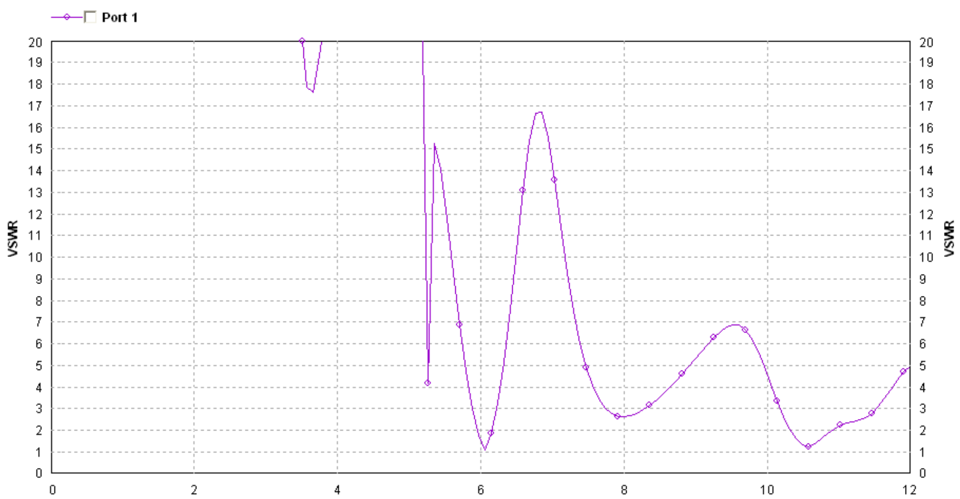

Fig. 3: VSWR of the unequal E-shape antenna.

From the above figure it is clear that the designed unequal E-Shape patch antenna provides the VSWR has 1.07.

The above figure shows that design unequal E-Shape stacked patch antenna with partial grounding having the VSWR.The above figure represents that design antenna proving less than 2 VSWR ratios which is required.

3.3 Gain vs. Frequency

The gain of an antenna is the radiation intensity in a given direction divided by the radiation intensity that would be obtained if the antenna radiated all of the power delivered equally to all directions. The definition of gain requires the concept of an isotropic radiator; that is, one that radiates the same power in all directions.

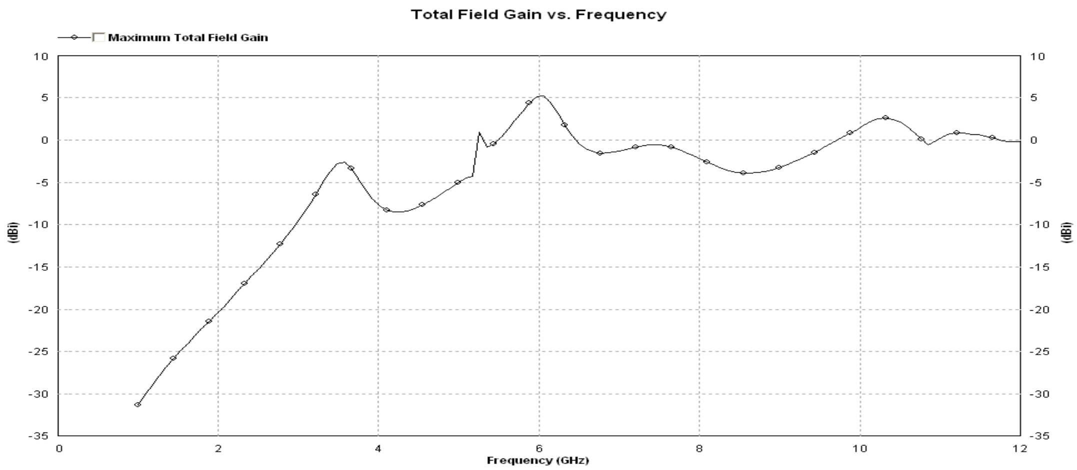

Fig. 4: Gain vs Frequency.

4. Conclusion

Micro strip antennas have become a rapidly growing area of research .their potential application are limitless, because of their light weight, compact size, and ease of fabrication. One limitation is their inherently narrow beam width. A variety of approaches have been taken, including modification of the patch shape ,experimentation with substrate parameters, mobile communication system where many frequency ranges could be accommodated by a single antenna .we here design simple and low costlier patch antenna for pervasive wireless communication by using different patch length. The results of proposed designing are effective between 1GHz - 12 GHz .proposed antenna simulated in IE3D Simulator. The simulated results of IE3D at 6 GHz is Return Loss = -29.4457dB, VSWR = 1.07123, Gain =5.1645dB. The proposed 1.6mm FR4 Substrate E- shape single band micro strip antenna effective work on 6GHz the proposed antenna work very effectively for pervasive wireless communication. Radiation efficiency is 66.5665% and antenna efficiency is 66.4916%, and incident power is 0.01w, input power is 0.00998875w, radiated power is 0.000529123w/s at the operating frequency of 6 GHz.This shows that the proposed antenna is very efficient for Wi-Max. .

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