

A Multi (U) Slotted Rectangular Micro-strip Multiband Patch Antenna

Abhinav Bhargava, Samrat Ghosh, Savan Kumar Oad

Abstract- In this paper we present a proposed design for Rectangular micro-strip patch antenna by cutting U shaped slots in the Rectangular patch which operates at two central frequencies 1.8, 2.7GHz. Which is a new dual frequency microstrip antenna? By micro strip feeding technique proposed antenna design we find the resultant return loss, VSWR and bandwidth. For the design of the microstrip antenna we have used FR-4 substrates which have permittivity of 4.4 and thickness 3.2, loss tangent is 0.02. We are using FEKO simulation software for designing and analysis. We have observed that using slotted patch antenna and using micro strip at proper location we can get better return loss, VSWR bandwidth and multiband.

Keywords- Slotted Rectangular micro-strip patch antenna, return loss, VSWR, radiation pattern.

I. INTRODUCTION

Modern telecommunication device are require to be small and able to integrate several functionalities. The antenna used for these wireless systems must hence possess multiband capabilities but yet remain compact. Antenna is a key building in wireless communication and global positioning system(GPS) since it was first demonstrate in 1886 by Heinrich Hertz and its practical application by Guglielmo Marconi in 1901[1]. Future trend in communication design is towards compact devices. Low cost of fabrication and low profile features attract many researches to investigate the performance of a micro-strip patch antenna in various ways. Micro-strip antenna was first proposed by G.A. Deschamps in 1953. Micro-strip patch antennas are often uses where thickness and conformability to the host surfaces are the key requirements. Since patch antennas can be directly printed onto a circuit board, these are becoming increasingly popular within the mobile phone market. They are low cost, have a low profile and are easily fabricated. One of the key drawbacks of such device is their narrow bandwidth. Micro-strip patch antenna is widely considered to be suitable for many wireless applications, even though it usually has a narrow bandwidth. The bandwidth limitation can be addressed by using thick substrates, cutting slots in the metallic patch, using aperture coupled stacked patch antenna. The stacked patch antenna has multilayer structure consisting of several parasitic radiating elements placed one above the other and above the driven element. However this approach has the inherent disadvantage of increased overall thickness and issues related on aligning various precisely.

In this paper we design a rectangular micro-strip patch antenna in which rectangular shaped slots are cut. By cutting a slot in micro-strip patch enhance its bandwidth.

II. ANTENNA DESIGN

The proposed antenna design by cutting U shaped slots in Rectangular patch as shown in fig. (1). Cutting of these slots in antenna increases the current path which increases current intensity as a result efficiency is increased. First a rectangular micro-strip patch antenna is designed based on standard design procedure to determine the length (L) and width (W) for resonant frequency. The resonant frequency of micro-strip antenna and the size of the radiation patch can be similar to the following formulas.

$$f = \frac{c}{2L\sqrt{\epsilon}} \quad (1)$$

$$W = \frac{c}{2f\sqrt{\epsilon+1}} \quad (2)$$

$$L = \frac{c}{2f\sqrt{\epsilon}} - 2\Delta L \quad (3)$$

Where f is the resonant frequency of the antenna, C is the free space velocity of the light, L is the actual length of the current, ϵ is the effective dielectric constant of the substrate and ΔL is the length of equivalent radiation gap. The dimension of the patch are $L=40\text{mm}$ and $W=50\text{mm}$. Inside this rectangular patch rectangular shaped slots are cut. The antenna is fabricated on a substrate of dielectric constant 4.4 and thickness $h=1.6\text{mm}$. The microstrip feeding is used for optimum results.

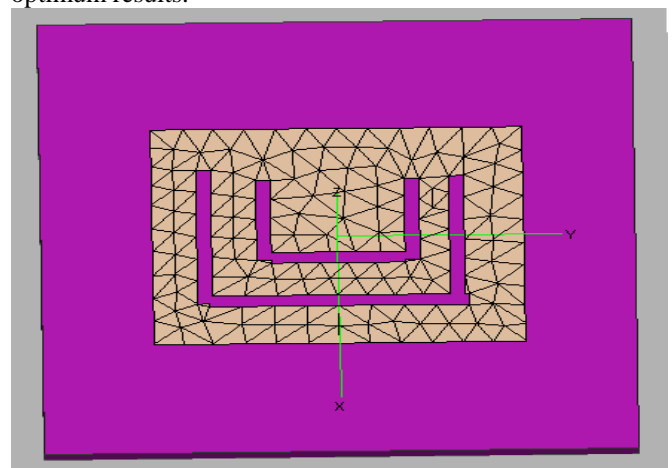


Figure (1): Proposed Rectangular Micro-strip Patch Antenna with U shaped slot.

III. ANTENNA RESULT

The simulation of micro-strip patch antenna is done by using FEKO simulation software. The variation of return loss with frequency of rectangular patch antenna with a U shaped slots

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shown in figure (2). The return loss is defined as the ratio of the Fourier transform of the incident pulse and the reflected signal. It is an important parameter. The VSWR graph for a U shaped slotted rectangular patch antenna is shown in figure (3). The VSWR indicates the mismatch between the antenna and the transmission line. For perfect matching the VSWR value should be close to unity. The simulation impedance bandwidth for the U shaped slot loaded rectangular micro-strip patch antenna as shown in fig. (1) is 100 MHz and it is about 4.5% and the best return loss (S_{11}) is -17.34 dB at 2.1 GHz. The bandwidth is calculated at the frequency range where the return loss is approximately below the -10dB. The simulated radiation pattern in 2D are shown in figure (4) and the Smith chart is shown in figure (5) and radiation pattern in 3D is also shown in figure (6) for the U shaped Slotted rectangular micro-strip patch antenna.

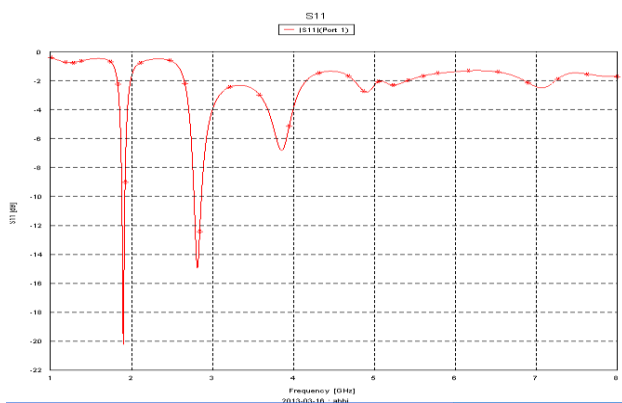


Figure (2): Return loss of the Proposed Rectangular Micro-strip Patch Antenna with U shaped slots

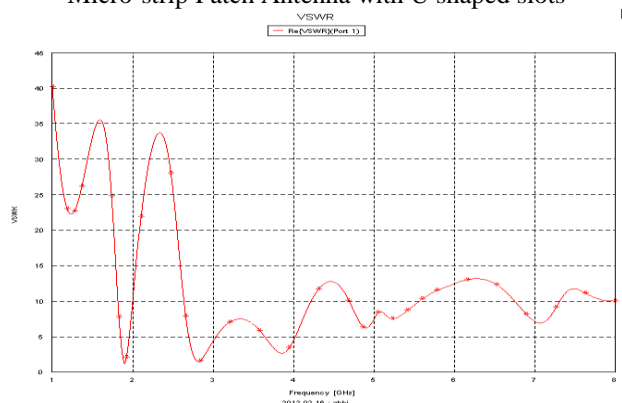


Figure (3); VSWR of the Proposed Rectangular Micro-strip Patch Antenna with U shaped slot

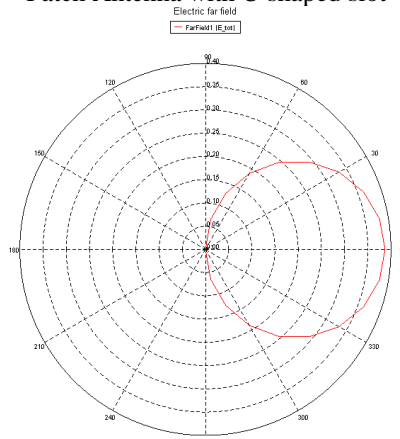


Figure (4): Radiation pattern in 2D of the Proposed Rectangular Micro-strip Patch Antenna with U shaped slot

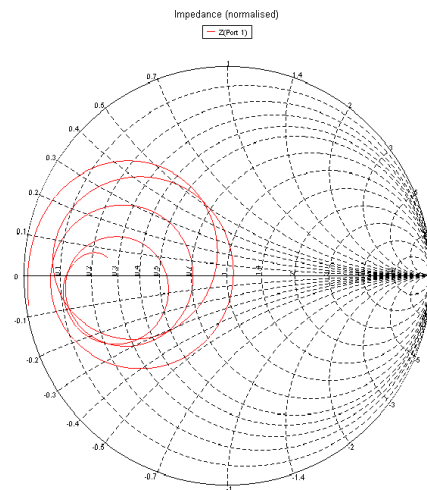


Figure (5): Smith chart of the Proposed Rectangular Micro-strip Patch Antenna with U shaped slots

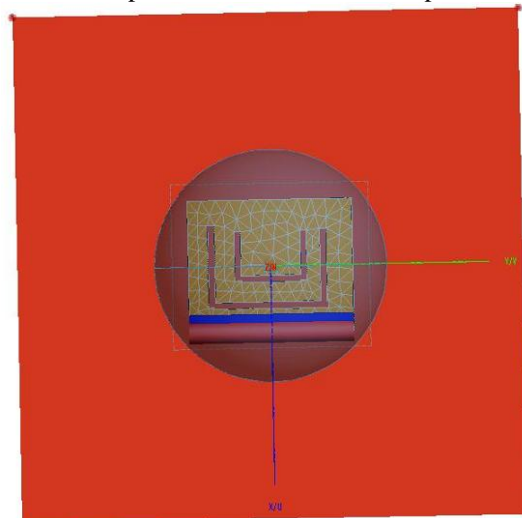


Figure (6): Radiation pattern in 3D of the Proposed Rectangular Micro-strip Patch Antenna with U shaped slots

IV. CONCLUSION

It is observed that a microstrip feed, U shaped slotted rectangular micro-strip patch antenna with multiband is presented. The proposed antenna has a compact size of (40*50) and it can effectively covers the Wi-Max application and other wireless applications (cellular mobile communication) because of multiband capabilities.

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