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A Wideband U & Rectangular Slotted Rectangular Shaped Micro-strip Patch Antenna for Broadband Application

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Abstract-In this paper we present a proposed design for single layer Rectangular micro-strip patch antenna by cutting a U shaped and rectangular shaped slot in the Rectangular patch. Using proposed antenna design and probe feeding at proper position we find the resultant return loss, VSWR and large bandwidth. We are using IE3D simulation software for designing and analysis. We have observed that using slotted patch antenna and using probe feed at proper location we can get better return loss, VSWR and large bandwidth.

Keywords- Slotted U shaped Rectangular micro-strip patch antenna, return loss, VSWR, radiation pattern, large bandwidth.

1. Introduction:-

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 [2]. Micro-strip patch antenna is widely considered to be suitable for many wireless applications, even though it usually has a narrow bandwidth [3]. The bandwidth of microstrip antenna may be increased using several techniques such as use of a thick or foam substrate, cutting slots or notches like U slot , E shaped , H shaped patch antenna, introducing the parasitic elements either in coplanar or stack configuration, and modifying the shape of the radiator patch by introducing the slots [8-11]. The stacked patch antenna have multilayer structure consisting of several parasitic radiating elements placed one above the other and above the driven element[4]. 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 a U shaped and rectangular shaped slots are cut. By cutting a slot in micro-strip patch enhance its bandwidth.

2. Antenna Design:-

The proposed antenna design by cutting a U shaped and rectangular shaped slots in Rectangular patch as shown in fig. (1). Cutting of theses 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 [6].

$$f = \frac{C}{2L\sqrt{\varepsilon}} \quad (1)$$

$$W = \frac{C}{2f}\sqrt{\frac{2}{\varepsilon+1}} \quad (2)$$

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

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=30mm and W=38mm. Inside this rectangular patch a U shaped and rectangular shaped slots are cut. The antenna is fabricated on a substrate of dielectric constant 4.4 and thickness h=1.6mm. The probe feeding is used for optimum results.

The feed point must be located at that point on the patch, where the input impedance of patch matched with feed for the specified resonating frequency.

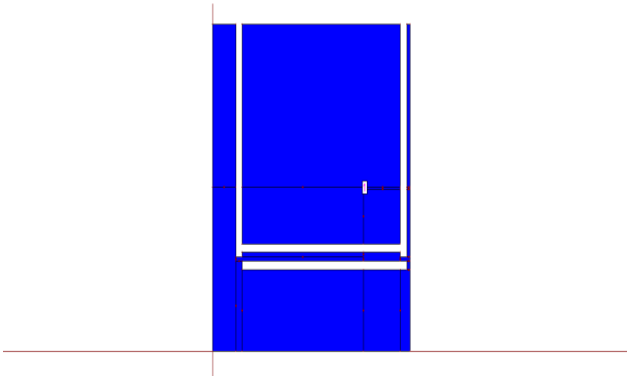

Figure (1): Proposed Rectangular Micro-strip Patch Antenna with U shaped and rectangular shaped slots

3. Antenna Result:-

The simulation of micro-strip patch antenna is done by using IE3D simulation software. The variation of return loss with frequency of rectangular patch antenna with U shaped and rectangular shaped slots is 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 to reckon with [2]. The VSWR graph for a U shaped and rectangular 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 and rectangular shaped slot loaded rectangular micro-strip patch antenna as shown in fig. (1) is 220 MHz and it is about 7.77% and the best return loss (S_{11}) is -33.37 dB at 2.76 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 and rectangular shaped Slotted rectangular micro-strip patch antenna.

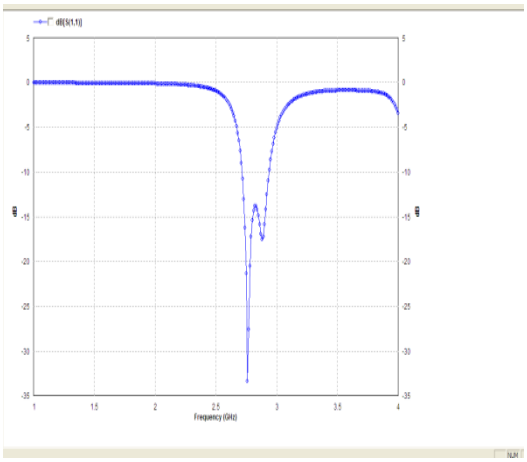

Figure (2): Return loss of the Proposed Rectangular Micro-strip Patch Antenna with U shaped and rectangular shaped slots

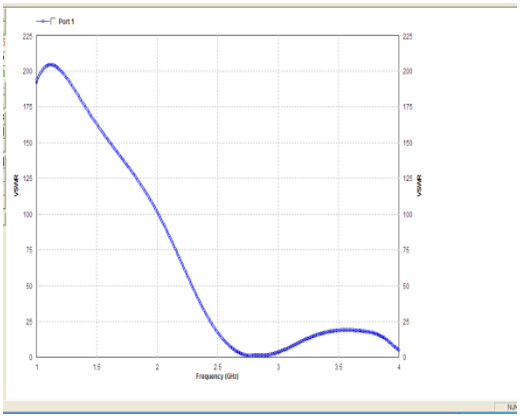

Figure (3); VSWR of the Proposed Rectangular Micro-strip Patch Antenna with U shaped and rectangular shaped slots

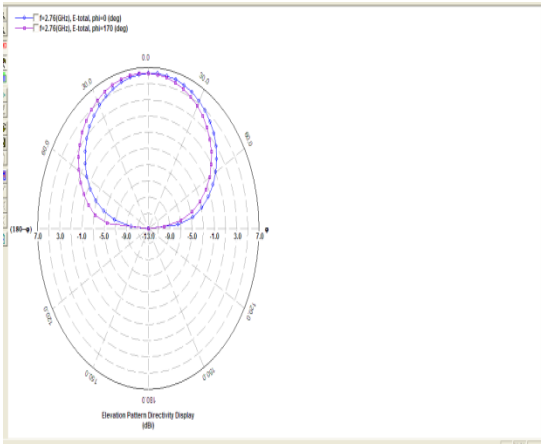

Figure (4): Radiation pattern in 2D of the Proposed Rectangular Micro-strip Patch Antenna with U shaped and rectangular shaped slots

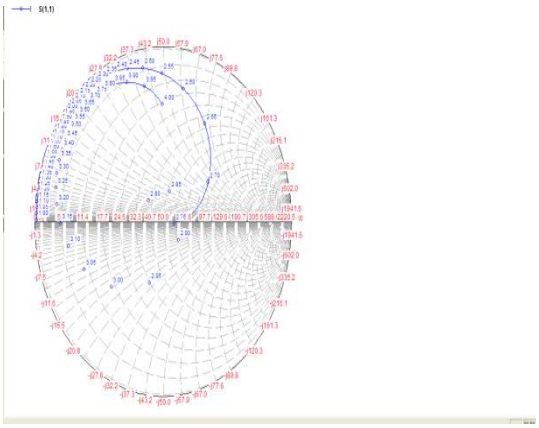

Figure (5): Smith chart of the Proposed Rectangular Micro-strip Patch Antenna with U shaped and rectangular shaped slots

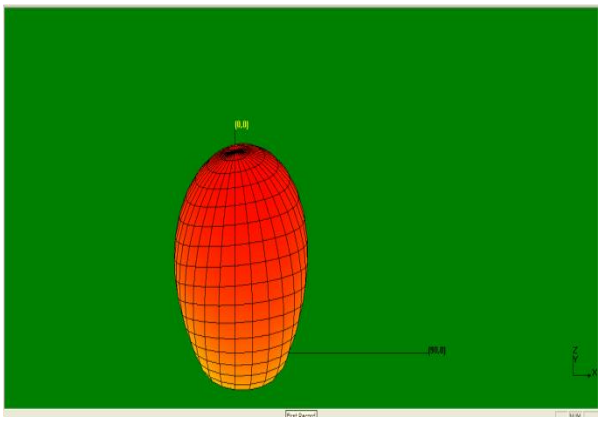

Figure (6): Radiation pattern in 3D of the Proposed Rectangular Micro-strip Patch Antenna with U shaped and rectangular shaped slots

4. Conclusion:-

It is observed that a probe feed, U & Rectangular Slotted Rectangular Shaped Micro-strip Patch Antenna is presented. The proposed antenna has a compact size of (30 x 38 x1.6) and

it can effectively covers the Bluetooth application and it can also use other wireless communication system.

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