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Design of a Square Microstrip Patch Antenna

Shruti Vashist, M.K.Soni, Pramod Singal

Abstract: ***In recent years, great interest is focused on microstrip antennas for their small volumes, low profiles, good integration, low costs and good performance. With the continuous growth of wireless and mobile communication service and the constant miniaturization of communication equipment, there are higher demands for the volume of antennas, integration and working band. This paper presents a basic square shaped microstrip patch antenna for wireless communications system which is suitable for 8GHz to 11 GHz band operations. These systems may include various combinations of WiMAX (Worldwide Interoperability for Microwave Access) and wireless local-area network (WLAN). A square microstrip patch antenna is designed to operate at 9.4GHz and 11GHz. A triangular slot is cut in the square patch to provide three bands at resonant frequency of 8.36MHZ, 9.84MHz and 11GHZ. The effect of cutting the slot on the original patch is examined. This design has several advantages as the total antenna volume can be reused, and therefore the overall antenna will be compact..The results confirm good performance of the single and multiband antenna design.***

Keywords: Square Microstrip PatchAntenna (RMPA), Wimax, Wlan, multiple frequency bands.

I. INTRODUCTION

The rapid progress in wireless communications requires the development of lightweight, low profile, flush-mounted and single-feed antennas[1]. Also, it is highly desirable to integrate several RF modules for different frequencies into one piece of equipment. Hence, multi-band antennas that can be used simultaneously in different standards have been in the focus points of many research projects [2-3]. Among these standards, the following frequency bands can be mentioned.Microstrip antennas are very attractive because of their low profile, low weight, conformal to the surface of objects and easy production. A large number of microstrip patches to be used in wireless applications have been developed [4-5]. Various shapes such as square, rectangle, ring, disc, triangle, elliptic, etc. have been introduced [6-8].Various types of polarization techniques can be used to get the desired frequency range [9]. In comparison to patch elements, the antennas with slot configurations demonstrate enhanced characteristics, including wider bandwidth, less conductor loss and better isolation [10]. Particularly, the multi-slot structure is a versatile approach for multi-band and broadband design. Design is tested and the results are simulated by using commercial software IE3D and find out the optimum place to get the best performance on the return loss. A fabrication to the final design has been implemented, and then a measurement performed to compare the actual results with those simulated as shown in figures below. In this paper we present the design of basic square microstrip patch antenna, with a triangular slot giving different frequencies for different applications in wireless communications system.

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II. SQUARE MPA

1.

Multi -band operations of antenna have been presented to satisfy the needs of wireless communications system .

These types of antennas can be achieved by several techniques. Most popular techniques of designing multi-band printed antennas are to create slots in the MPA [12]. As we see several multi band microstrip antennas designs have been reported over the years [13-14]. A simple technique for achieving this has been to load the radiating patch with a slot inside the radiating patch. The resonance frequency of the new modes can be either lower or higher than the original dominant mode with either the same or orthogonal polarization and is strongly dependent on the slot dimensions. We start with basic square patch by using a substrate of FR4 (εr = 4.5) and height (h = 1.6mm) as shown below in figure. 2.1. Return loss, VSWR, Gain, frequency, radiation pattern and efficiency are simulated using commercial software IE3D which depends on the method of moment.

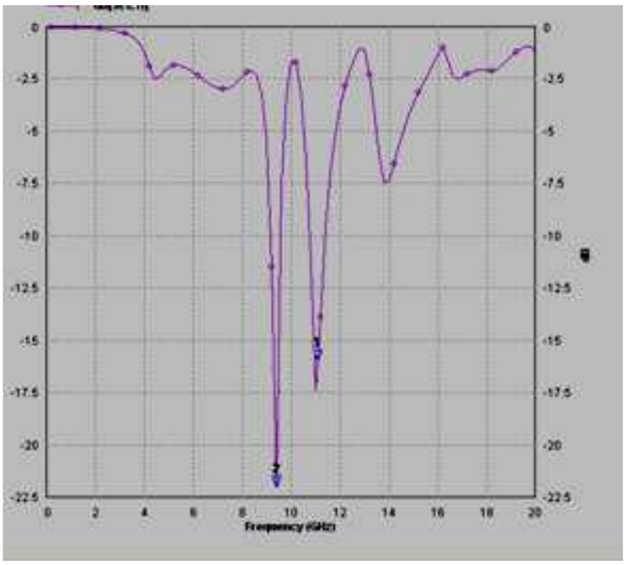

Fig 2.1 Square MPA

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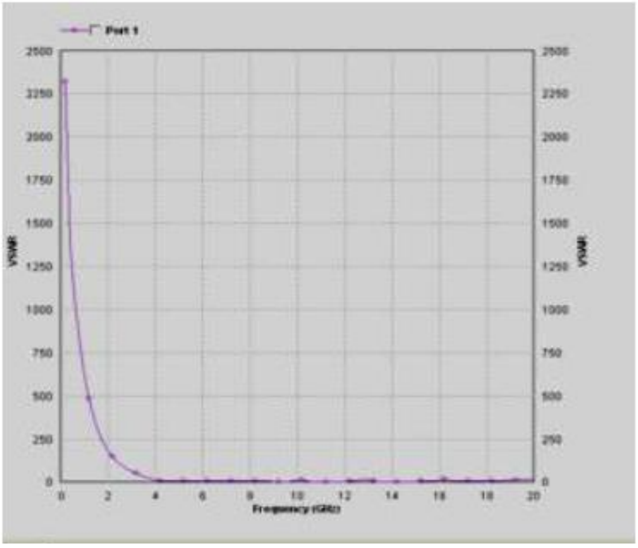

Fig2.2 Return loss for Square MPA

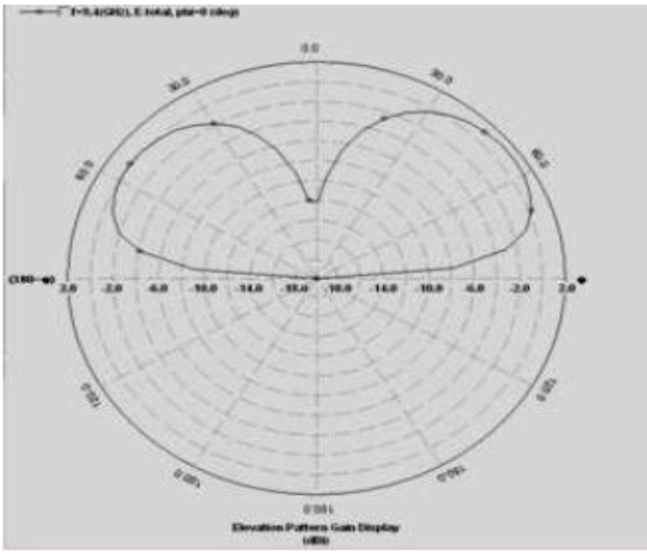

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Fig 2.5.Radiation Pattern at 11 GHz for Square MPA

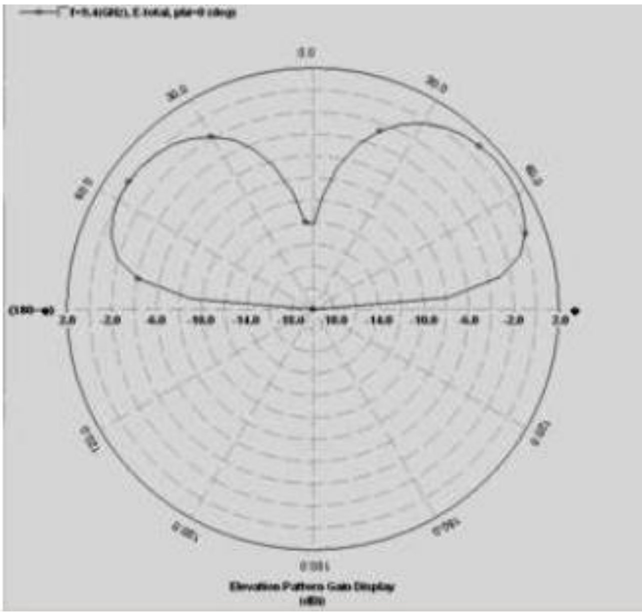

Fig 2.3.VSWR for Square MPA

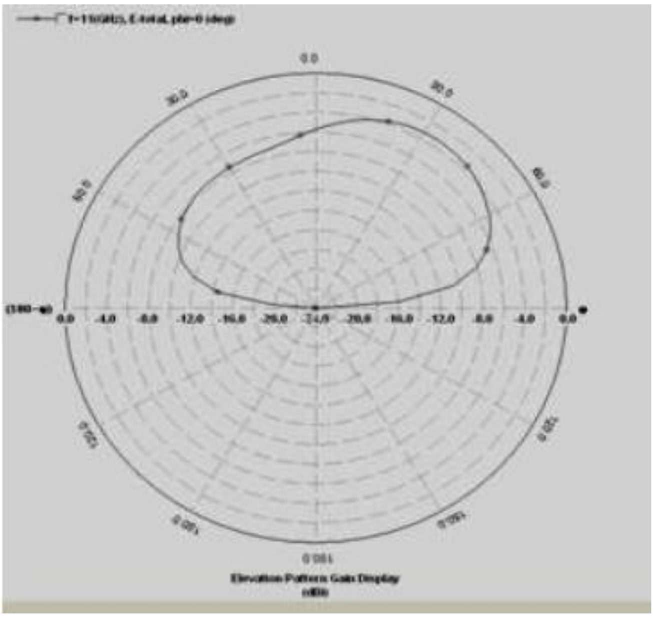

Fig 2.6. Gain Vs.Frequency for Square MPA

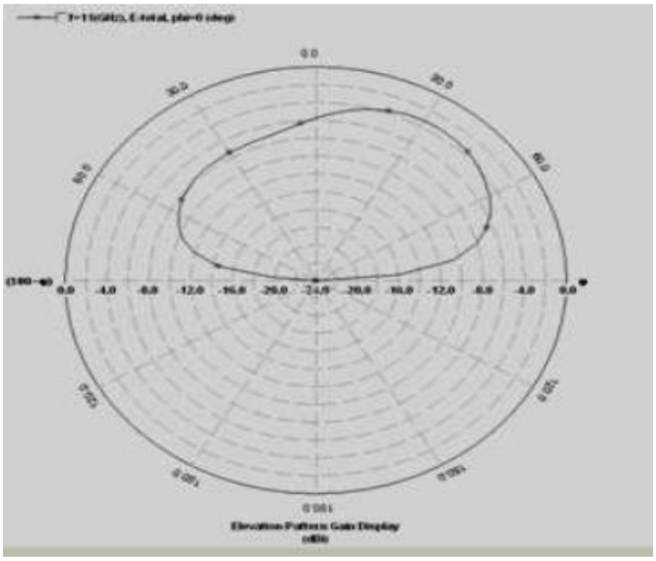

Fig2.4.Radiation Pattern at 9.4GHz for Square MPA

III. TRIANGULAR -SLOT EFFECT

The Triangular- slot insertion has some effect on the original patch parameters performance, one of the main affected parameter was the return loss shown in fig 3.2.We observe that the triangular - slot insertion has some effect on the original patch parameters performance..The resonant frequencies obtained are 8.36, 9.84 and 11GHz. The VSWR, radiation pattern are shown in the graphs below.

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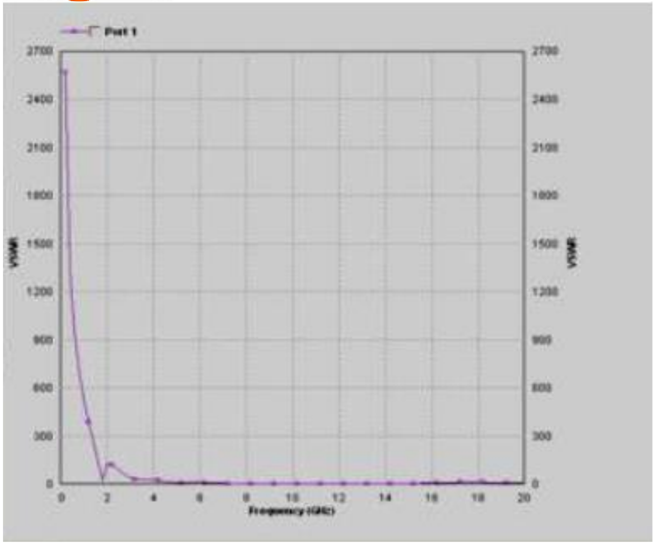

Fig 3.1 Triangular slot in square MPA

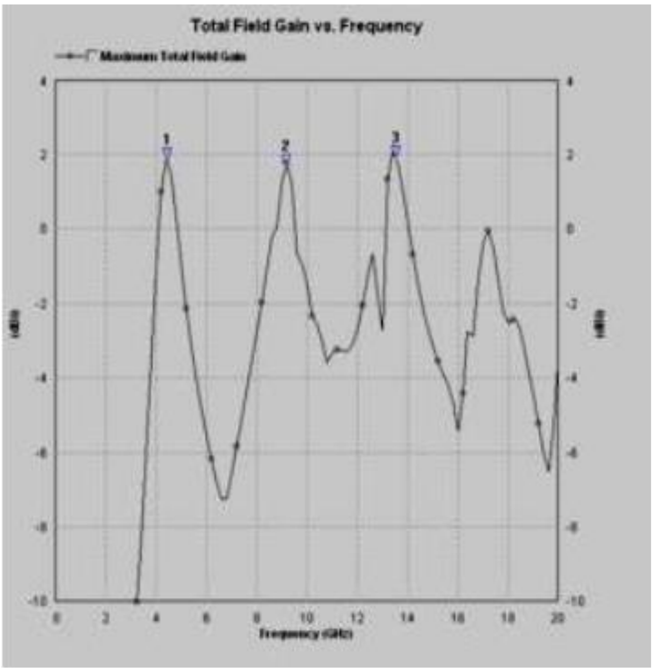

Fig 3.2 Return loss of Triangular slot in square MPA

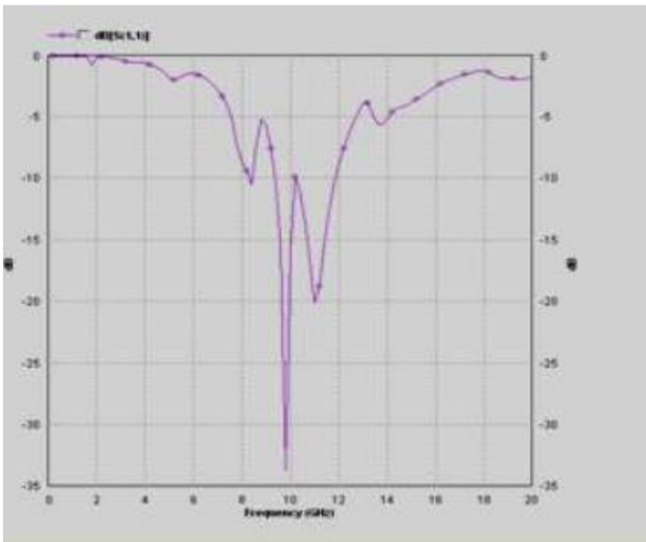

Fig 3.3 VSWR of Triangular slot in square MPA

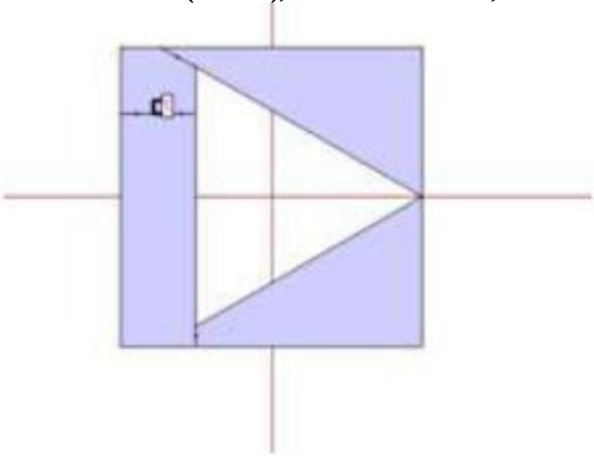

Fig 3.4 Radiation pattern of Triangular slot in square MPA at 8.36GHz

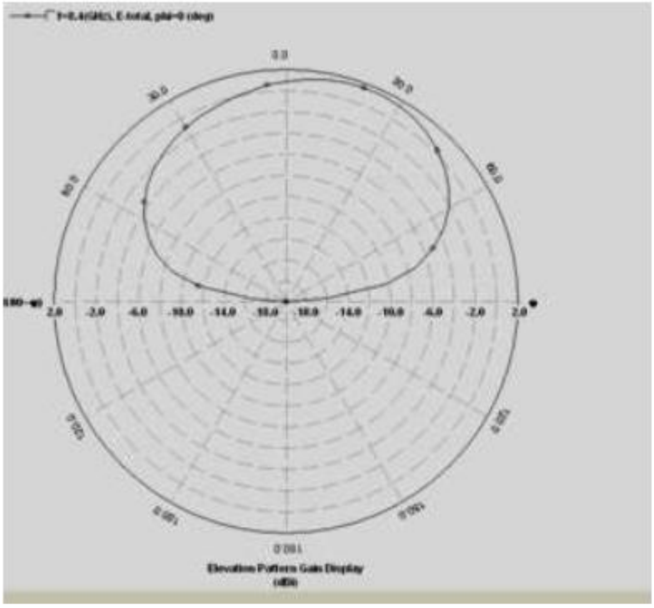

Fig 3.5 Radiation pattern of Triangular slot in square MPA at 9.84GHz

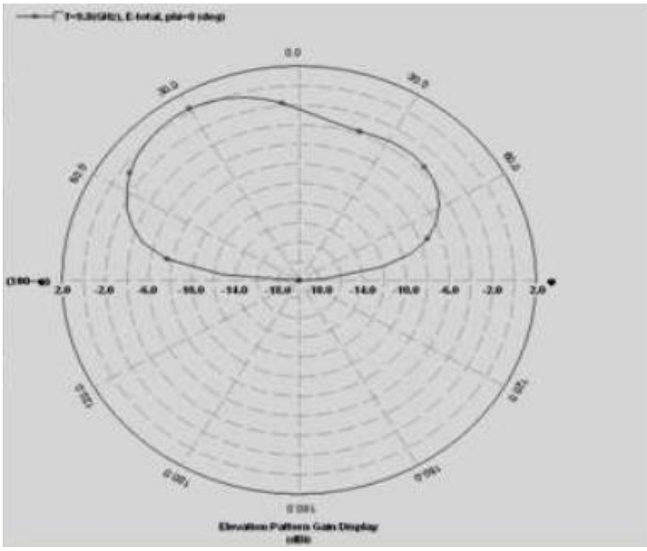

Fig 3.6.Radiation Pattern at 11 GHz for Square MPA

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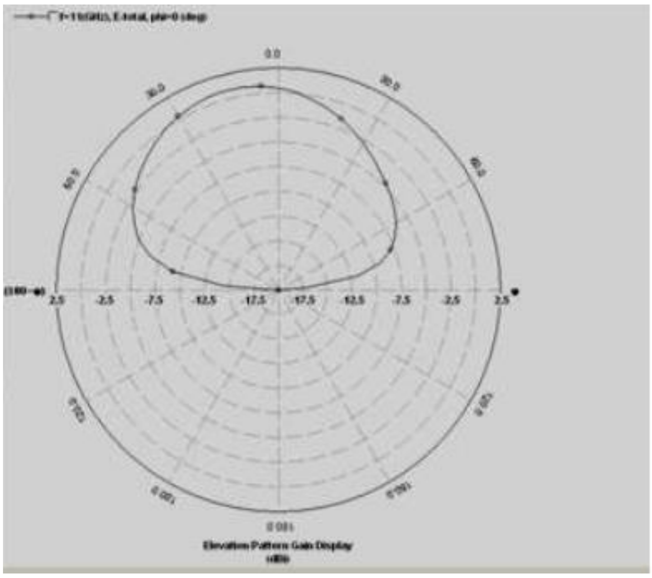

Fig 3.7 Radiation pattern of Triangular slot in square MPA at 11GHz

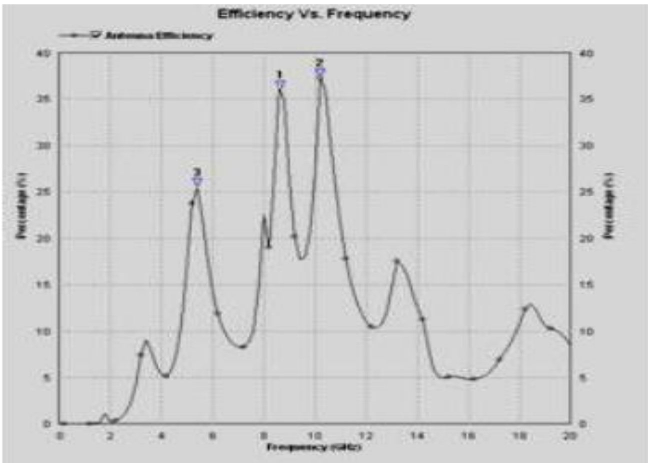

Fig 3.8 Efficiency Vs. Frequency of Triangular slot in square MPA

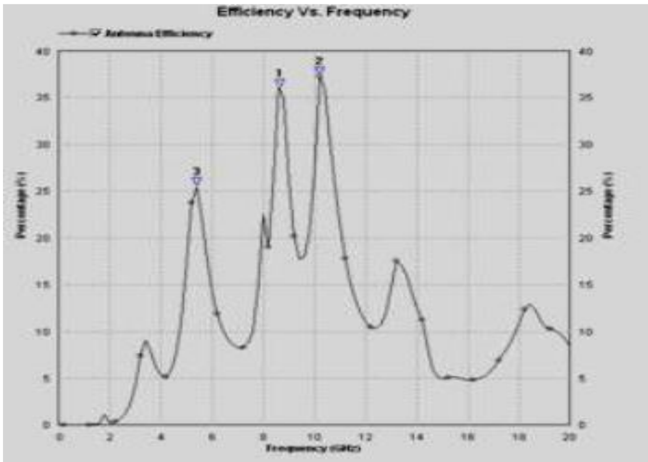

Fig 3.9 Efficiency Vs. Frequency of Triangular slot in square MPA

IV. CONCLUSION

A square microstrip patch antenna is designed to operate at 9.4 GHz and 11 GHz with circular polarization, a triangular slot is inserted thereafter in the original patch to generate other resonant at 8.36GHZ, 9.84GHZ and 11GHZ. Triangular -slot insertion effect on the original patch is examined, first arc length effect on the return loss and axial ration is examined in order to get the optimum length, and then the arc orientation effect also is examined to find out the best orientation to place the arc. The design is verified through both numerical simulations and measurement of a fabricated prototype. The results confirm good performance of the antenna design. With the application of an UHF antenna in mind, the design of the antenna had been focused mainly on the microstrip patch antenna (MPA). A MPA consists of a conducting patch of any planar or nonplanar geometry on one side of a dielectric substrate with a ground plane on the other side. The MPA has some slight advantages in its characteristics when compared with the rest in terms of the ease of fabrication, flexibility in shape as well as the higher bandwidth (2-50%).

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