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# Design & Simulation of Triple Band Micro Strip Patch Antenna for FPV, Wi-Max and W-Lan Application

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**Abstract**

This paper presents a Rectangular micro-strip patch antenna by cutting three horizontal slots. It is triple-band antenna, which operates at three resonant frequencies 1.2, 3.2 & 4.5GHz.Which is a new multi-band micro strip antenna, using projected antenna design and micro strip feeding at proper location we find the resultant return loss, VSWR and bandwidth. For this design of micro strip antenna we have used FR-4 substrate which has permittivity of 4.4 and thickness 1.6, loss tangent is 0.02. FEKO simulation software has used for designing and analysis. We have observed that using triple slotted patch antenna and using micro strip at centre feed, we can get better return loss, VSWR bandwidth and multiband.

Keywords: Return loss, VSWR , bandwidth.

## I. INTRODUCTION

The rapid advancement in the wireless communication field in the past few decades has led to the improvement of more efficient antenna design to be used for various cutting edge applications. Antenna is an important structure in any wireless communication system and good antenna design definitely improves the overall performance of the system. Most applications require low cost, minimum weight, low profile antennas that are capable of providing high performance over a large range of frequency. The continuous improvement in modern integrated circuit technology has made sure that the size and weight of wireless electronic system must keep on reducing. In order to work with miniature size electronic system, high performance antenna designs are the need of the time. All the above mentioned needs are best met by micro strip antennas. They are easily fabricated and are also easy to integrate into arrays or into microwave printed circuits. The design of high performance micro strip antenna has always been a challenge for the antenna designers Micro-strip patch antenna consists of a radiating patch which is generally made of conducting material such as gold or copper and can take any possible shape.

The radiating patch and the feed lines are usually photo etched on the dielectric substrate which have a ground plate as shown in Fig. 1.

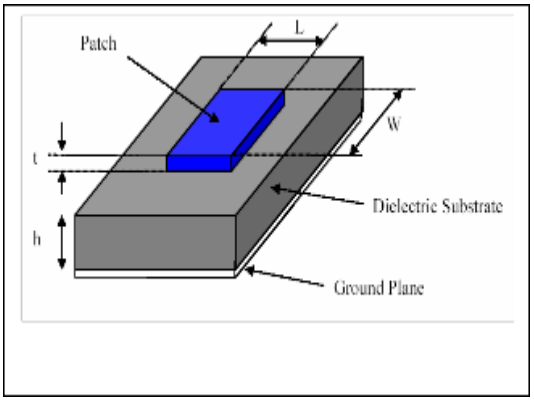


Figure 1. Structure of a micro-strip patch antenna

In this paper a proposed antenna design is taken, three antennas are designed where slots on path are made at different positions and thus final results are taken out.

## II. SYSTEM MODEL

For getting tri-band antenna we have taken 3 Rectangular micro-strip patch antenna by cutting three horizontal slots at different positions. The dimensions of the proposed antenna are

The dimensions of the antenna layout are

Lg= 24 mm, Wg= 16 mm

Dimension of the patch:-

Lp=12 mm, Wp=8 mm

Dimension of the slots on the patch:-

L1=L2=L3= 8.9 mm

Gap between slots:-

G1=2.1 mm, G2=1.3 mm

**A. Rectangular patch antenna with a single slot.**

In the first geometry a slot is introduced at the left side of the patch. The dimension of the antenna , patch and the slot are taken as mentioned above. Fig-2 show the geometry of the first antenna.

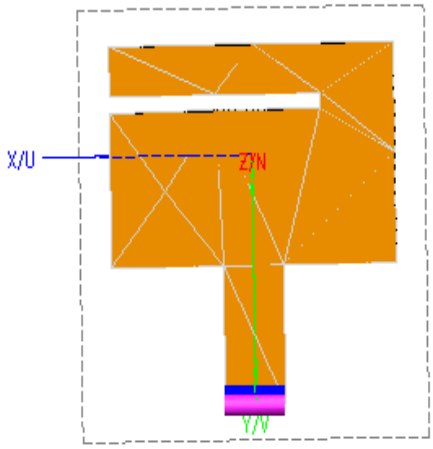


Fig-2 Geometry of first antenna with a single slot

**B. Rectangular patch antenna with double slots.**

In the second geometry a slot is introduced at the right side of the patch , the placement of this slot is just below the first slot. The dimension of the antenna , patches and the slot are taken as mentioned above. Fig-3 show the geometry of the second antenna.

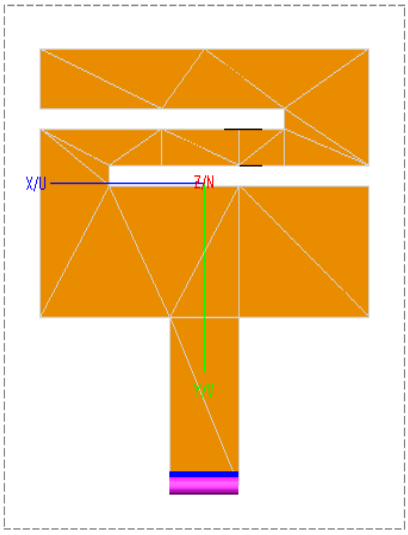


Fig-3 Geometry of second antenna with double slots

**C. Rectangular patch antenna with triple slots.**

In the third geometry a slot is introduced at the left side of the patch , the placement of this slot is just below the second slot and in line with the first one. The dimension of the antenna , patches and the slot are taken as mentioned above. Fig-4 show the geometry of the third antenna.

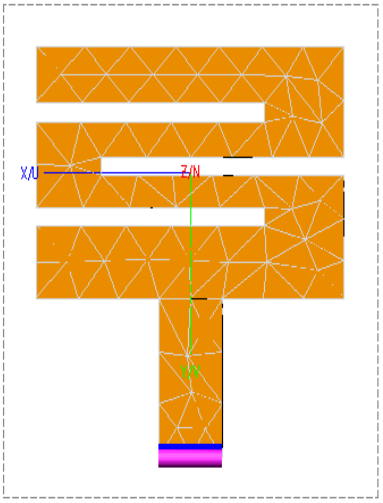


Fig-4 Geometry of third antenna with triple slots

## III . Simulation/Experimental Results

This section presents the electromagnetic simulation results that were obtained by using CAD-FEKO software to validate the electrical performance of the proposed micro-strip patch antennas. The simulation software allows calculation and plotting different quantities in the time and frequency domains, such as VSWR vs. frequency, bandwidth and the S-parameter plots, and so on.

**Simulated results for antenna 1**

In the antenna 1 only one slot is cut on the patch, by cutting a single slot on the patch we get a dual band antenna.

**1) Return loss and the bandwidth**

Fig-5 shows the plot for return loss and the bandwidth for antenna 1 with a single slot.

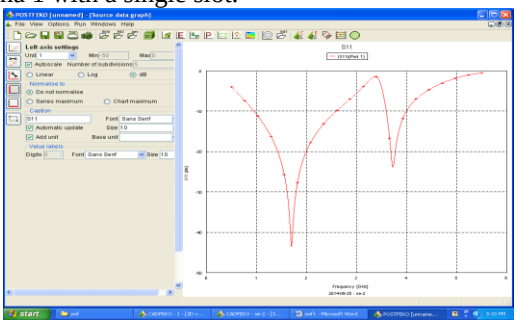

Fig-5 plot for return loss and the bandwidth for antenna 1 with a single slot.

The graph shows the return loss of the antenna with a single slot, it can be seen that we get the graph at two resonant frequency i.e. at 1.8 Ghz and at 3.8 Ghz.
It is a dual band antenna with bandwidth of 1.6 and 0.4 GHz.

**2)VSWR**

Fig-6 shows the plot for VSWR for antenna 1 with a single slot

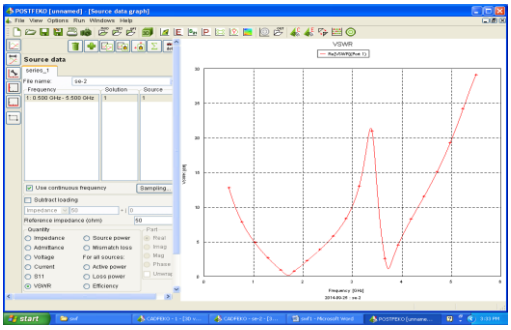

Fig-6 plot for VSWR for antenna 1 with a single slot
The resonant frequencies are at 1.8 GHz and 3.8 GHz , at these resonant values the value of VSWR is nearly 1.8

**Simulated results for antenna 2**

In the antenna 2 one more slot is cut on the patch just below the first cut, by cutting a another slot on the patch we get a dual band antenna.

**1) Return loss and the bandwidth**

Fig-7 shows the plot for return loss and the bandwidth for antenna 2 with double slots

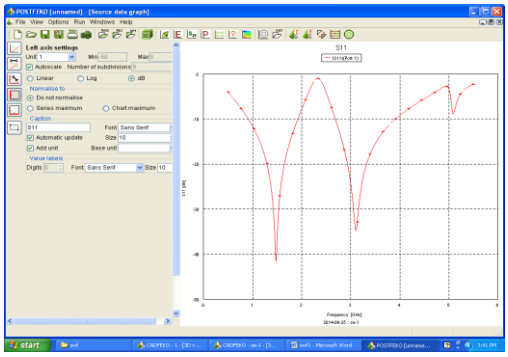

Fig-7 plot for return loss and the bandwidth for antenna 2 with double slots.

It can be seen we get two resonant frequencies when two slots are introduced. The values are 1.5 GHz and 3.1 GHz .
It is a dual band antenna with bandwidth of 1 and 1.2 GHz

**2)VSWR**

Fig-8 shows the plot for VSWR for antenna 2 with double slots

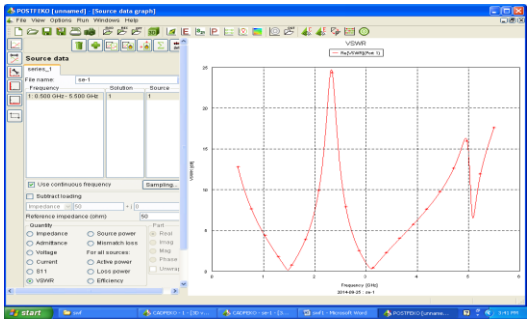

Fig-8 plot for VSWR for antenna 2 with double slots
The resonant frequencies are at 1.5 GHz and 3.1 GHz , at these resonant values the value of VSWR is nearly 2.1

**Simulated results for antenna 3**

In the antenna 3 total 3 slots are cut on the patch, by cutting another slot on the patch we get a triple band antenna.

**1) Return loss and the bandwidth**

Fig-9 shows the plot for return loss and the bandwidth for antenna 3 with triple slots.

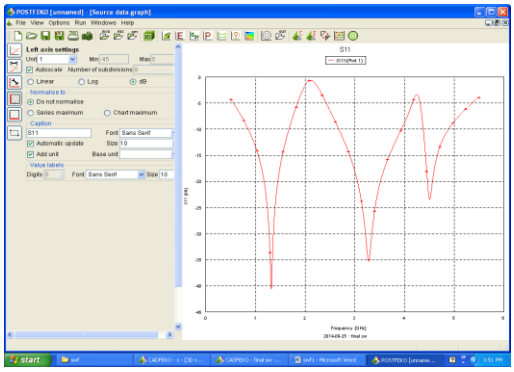

Fig-9 plot for return loss and the bandwidth for antenna 3 with triple slots.

It can clearly be seen that we are getting three resonant frequency which can be used for different applications, the resonant frequencies are at 1.2, 3.2 and 4.5 GHz.

It is a triple band antenna with bandwidth of 0.9GHz ,1.2 GHz and 0.5 GHz

**2)VSWR**

Fig-10 shows the plot for VSWR for antenna 3 with triple slots

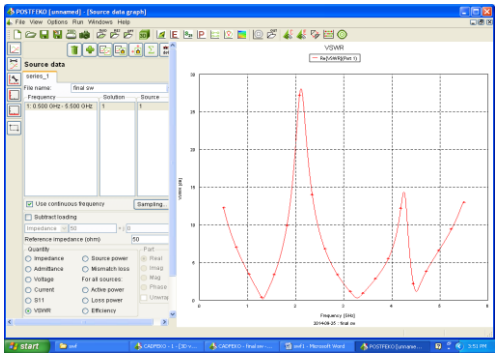

Fig-10 plot for VSWR for antenna 3 with triple slots

The resonant frequencies are at 1.2GHz ,3.2GHz and 4.5GHz, at these resonant values the value of VSWR is nearly 2.5

TABLE 1.
COMPARISION OF DIFFERENT GEOMETRY

| S. No. | Antenna parameters | Simulation Measurement | | |
|---|---|---|---|---|
| | | Antenna 1 | Antenna 2 | Antenna 3 |
| 1. | Resonant frequency(GHz) | 1.8 | 1.5 | 1.2 |
| | | 3.8 | 3.1 | 3.2 |
| | | | | 4.5 |
| 2. | VSWR | 1.8 | 2.1 | 2.5 |
| 3. | Bandwidth(GHz) | 1.6 | 1 | 0.9 |
| | | 0.4 | 1.2 | 1.2 |
| | | | | 0.5 |

## Conclusions

In this work, the aim was targeted at improving the factors like return loss, VSWR and bandwidth of micro-strip antennas constructed with FR-4 substrate which has permittivity of 4.4. We have selected three patch antennas and slots are made at different position and the simulated results compared to find the best results. The results obtained clearly show that factors like return loss, VSWR and bandwidth of micro-strip antennas are best obtained in the third geometry where 3 slots are introduced, We get a triple-band antenna, which operates at three resonant frequencies 1.2, 3.2 & 4.5GHz.Which is a new multi-band micro strip antenna.

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