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DESIGN AND ANALYSIS OF VARIOUS MICROSTRIP PATCH ANTENNA AND IT'S PERFORMANCES

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Abstract- **Microstrip patch antenna's (MPA) are of greater use in today'sworld, that is being compared with many conventional type of antennas.MPA as more advantageous aspects and better performance range. These antennas are more efficient and as a high standard of flexibility. Thus in this paper MPA is being analysed in various Greek designs for the a thickness of 1.6mm and designed by using Advanced Design System version 2011.1(ADS). In order to improve the performance of the antenna in a better way Electromagnetic Band Gap (EBG) and Slot technique is being used in our paper.These antennas are purpose of wireless communication system. These antennas are being designed & Simulated on a substrate material of FR-4 with dielectric constant of 4.4 at an operating Frequency 3.5GHZ. Each antenna has simulated and observed with good range of Return loss and a better performance of Gain**.

Keyword-Microstrippatch antenna, line feed, slot technique, Electromagnetic band gap, return loss, gain.

1. INTRODUCTION

In wireless systems, the microstrip antennas play a vital role. Thesetypes of antennas are low cost, low profile, planar configuration, superior portability, suitable for new designs and light weight. Above all these antennas are easy for fabricated and can be easily be integrated with external circuits.

With all these advantageous aspects, the microstrip antenna as a greater flexibility and extends to civilian applications such as television, radiobroadcast, mobile systems, RFID(Radio Frequency Identification), Wi-Fi(Wireless fidelity), WiMAX(Worldwide interoperability of microwave access), MIMO(Multiple In Multiple Out) systems, GPS(Global Positioning System) and Military applications such as missile guidance, Satellite communications, Surveillance systems, Vehicle collision avoidance system, Direction finding,Radarsystem,Remote sensing, and even Biological applications like biological imaging etc., and the work for microstrip patch antennas is still in progress in finding new applications for the Future generations.Thus microstrip antenna has some disadvantages such as lesser gain, low efficiency and low bandwidth. In order to overcome these limitationsa lot of researchers have proposed different shapes of antennas, various dielectric materials, different substrate thickness and variety of feeding techniques which gives an higher efficiency and improves the capability of this antenna. In our paper we have proposed the Greek mathematical constant Alpha(α),Beta(β),Gamma(γ) and Delta(Δ) as antenna designs in order to earn a better Return Loss and a considerable frequency range for wireless communication systems.

2. MICROSTRIP PATCH ANTENNA

Among these types of antennas the most extensively used microstrip antenna is microstrip patch antenna (MPA), which is based on transmission and reception of EM waves. This patch are embedded and characterised in many wearable communication devices. A MPA consists of a conducting patch of any planar or non-planargeometry on one side of a dielectric substrate with a ground plane on the other side. It's a popular printed resonant antenna for narrow band microwave wireless links that require semi-hemispherical coverage. Due to its planar configuration and ease of integration with microstrip technology, the microstrip patch antenna has been heavily studied and is often used as elements for an array. A large number of microstrip patch antennas have been studied till date. An

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exhaustive list of geometrics along with their salient features is also available. There are two basic varieties of patches which includesrectangular and circular patch, these patches are used for the most demanding applications.

In our paper, microstrip patch antennas are used for the Greekmathematical constants of antenna designs, which give a better range of performances and comparison of return loss, gain and frequency range among them, along with that Gain of the antennas was improved by using the technique of electromagnetic band gap(EBG)

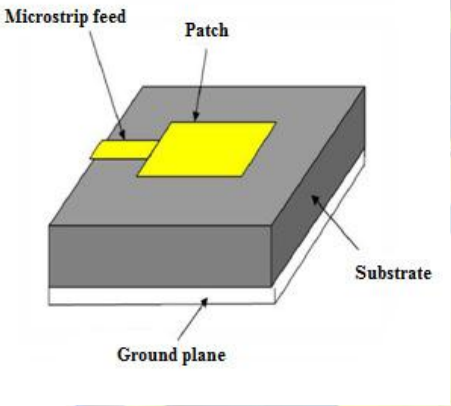

Figure 1: Basic Microstrip patch antenna

3. GAIN ENHANCEMENT TECHNIQUES

Generally so many techniques are accessible in survey of enhancing the gain of microstrip patch antennas. Among them slotting techniques is very easy and simple to improve the gain of microstrip antenna .In this paper we have designed the antennas in with and without the slots. There are various slotting shapes are there, like U-shaped slot, E-shaped slot, L-shaped slot,W-shaped slot, etc. The proposed antennas are designed by using circular shaped slots. And also we use another technique for enhancing gain of the antennas, that is electromagnetic band gap (EBG)

Electromagnetic band gap (EBG) structures are periodic structure of dielectric substance and metallic conductor.EBG structures are defined as mannered periodic entity that prevents the propagation of electromagnetic waves (EM) in prescribed band of frequency for all adventure of slants and all polarization states. The main advantage of EBG is to subdue the surface wave current. Generally enrolled attributes of EBG is to suppressing the unused substrate mode and acting as an unnatural magnetic ground plane. There are different structures of EBG In our paper to improve the gain of the microstrip antennas by using the two techniques slotting and Electromagnetic band gap (EBG).which have the advantages of low profile, light weight and are mostly considered in antenna design. Christo Ananth et al.[7] discussed about E-plane and H-plane patterns which forms the basis of Microwave Engineering principles.

4. DESIGN OF ANTENNA

The antennas are designed using the substrate FR-4 at a thickness of 1.6mm, dielectric constant is 4.4. Each designs are fed with feed method called Line feed which is the most common feeding method used in the microstripantennas.There are many methods of feeding available for micrsostrip patch antenna like,

- Line feed
- Coaxial feed
- Proximity coupled field(PCF)
- Aperture coupled field(ACF)

Among these feeding methods the most used feeding is the line feed. This type of feeding technique is more flexible and most suited for any type of design complexity in the antennas. This is simple as well as easy to use.so thus the type of feed that is being used in our proposed antennas is Line Feed.

(a) Antenna Design:

Rectangular MicrostripPatch Antenna

The rectangular microstrip patch antenna dimensions are being calculated using the following relations,

Width of the Patch:

$$W = \frac{C}{2f_o\sqrt{\frac{1+\varepsilon_r}{2}}} \qquad (1)$$

Where, C = free space velocity of light

f_0= Resonant frequency

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ε_r= Relative permittivity of the substrate

Effective Dielectric constant:

$$\varepsilon_{eff}=\frac{\varepsilon_r+1}{2}+\frac{\varepsilon_r-1}{2}[1=12\frac{}{w}]^{-1/2} \quad (2)$$

Where,h= thickness of the substrate

w=width of the substrate

Effective length:

$$L_{eff}=\frac{c}{2f_r\sqrt{\varepsilon_{reff}}} \quad (3)$$

Where,f_r= resonant frequency

Patch length extension:

$$\Delta L=0.412h\frac{\varepsilon_{reff}+0.3\ \frac{w}{}}{\varepsilon_{reff}-0.258w} \quad (4)$$

Length of the Patch:

$$L=L_{eff}-2\Delta L \quad (5)$$

Length of the Substrate:

$$L_g=6h+L \quad (6)$$

Width of the Substrate:

$$W_g=6h+W \quad (7)$$

These equations are being used to CalculatemicrostripPatch antenna width and length.

(b) Structure Of Antenna Designs

The rectangular microstrip patch antennas are consists various types of designs, among that we have designed the Greek mathematical constants of Alpha(α),Beta(β), gamma(γ),delta(Δ) structures of microstrip antennas are shown in figure 2 is given below;

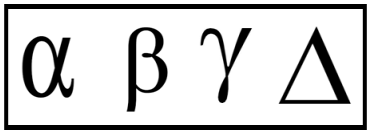

Figure 2: Alpha,Beta,Gamma,Delta microstrip patch antenna designs

In this paper we designed the Alpha,Beta,Gamma,Delta structures of microstrip patch antenna and these antennas performance are being analysed based on antenna gain and return loss .Then we used slot and EBG techniques to increased the gain of the antennas. Each design of antenna have a better gain and return loss.

5. SIMULATED RESULTS AND DISCUSSIONS

The results for each antenna design are being simulated for the operating frequency range 3.5GHz. The parameters like return loss and gain are being compared among the four Greek antenna designs along with the radiation patterns as to which design is being the best for the range of frequency for wireless communication systems.

Alpha structuremicrostrip patch antenna:

The design of alpha microstrip patch antenna parameters are noted for without slot and EBG technique and also with slot and EBG technique both sections will being analysed and noted the below comparison table .

Figure 3: Alphamicrostrip patch antenna with Various Tecniques

Beta structuremicrostrip patch antenna:

The Beta structure microstrip patch antenna parameters are being noted for both without and with ,slot and EBG technique . In that the return loss and gain, frequencies are analysed and noted the below comparison table.

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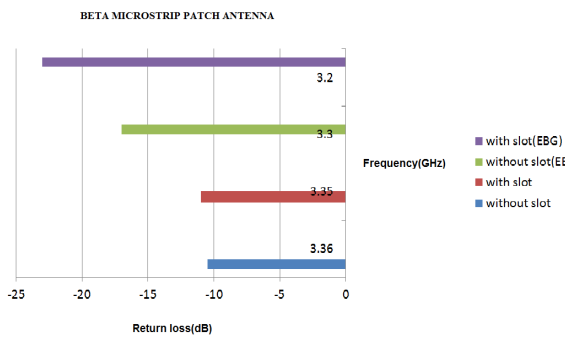

Figure 4: Betamicrostrip patch antenna with Various Tecniques

Gamma structure microstrip patch antenna:

The Gamma microstrip patch antenna parameters are being noted based on without and with slot and EBG techniques.As we analysed the return loss ,gain and frequencies .And the details are noted the below table.

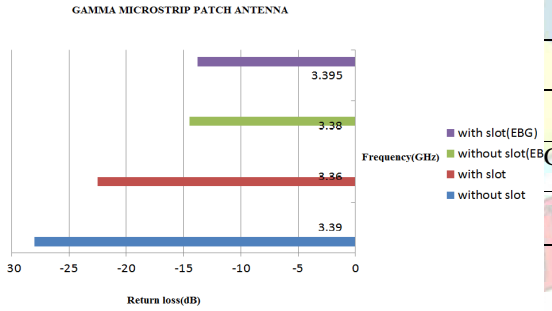

Figure 5: Gamma microstrip patch antenna with Various Tecniques

Delta structure microtrip patch antenna:

The design of delta microstrip patch antenna parameters return loss ,gain,frequencies are anaysed and noted the below comparision table .The analysis is based on without and with slot and EBG techniques.

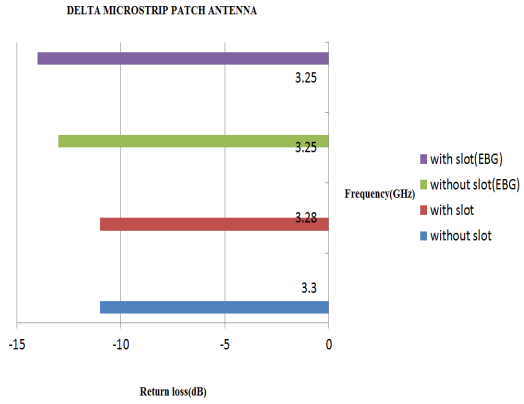

Figure 6: Delta microstrip patch antenna with Various Tecniques

Table 1: Comparison Table Microstrip patch antenna using EBG techniques

Patch/ Parameters	With EBG			
	With Slot		Without Slot	
	RL (dB)	Gain (dB)	RL (dB)	Gain (dB)
Alpha	-35	0.67	-30	0.65
Beta	-23	0.05	-17	0.70
Gamma	-13	0.60	-15	3.00
Delta	-14	3.00	-13	0.57

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Table 2: Comparison Table Microstrip patch antenna using without EBG techniques

Patch/ Parameters	Without EBG			
	With Slot		Without Slot	
	RL (dB)	Gain (dB)	RL (dB)	Gain (dB)
Alpha	-21	-1.90	-20	-1.9
Beta	-11	-2.80	-11	-2.2
Gamma	-22	-2.18	-28	-2.1
Delta	-11	1.15	-11	1.2

6. CONCLUSION

The microstrip patch antenna mostly used in Wireless communications. The purpose of this paper is to design a Greek mathematical constant α, β, γ, Δ microstrip patch antenna. To analysis the performance of microstrip patch antenna without slot and EBG technique and also with slot and EBG technique. From the simulated results, the performance of with slot and EBG technique is being improved better result of antenna gain and return loss. And these antennas are operating at a frequency 3.5GHz. So we can use this antennas in Wi-Fi, Wimax, Wireless system real time applications.

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