

Development and Design of Compact Antenna on Seven Segment Pattern

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Abstract— In this paper we have proposed the design of antenna which works at the frequency 8.5GHz. The proposed antenna will be designed on single sided FR4 sheet or copper clad board. We have also proposed various designs on the radiating patch using seven segment patterns. The main idea behind using concept of seven segment type patterns is that, using the same antenna we can get various designs which can be operated at different frequencies. We can connect the various segments using switch and then using the same antenna we can get various alpha-numeric design.

Keywords— Microstrip; Resonant frequency; Directivity; Gain; Radiation pattern; Return loss; IE3D; seven segment; Switch; Ground patch

I. INTRODUCTION

An Antenna is usually a metallic device for radiating and receiving radio waves. Antennas are employed in systems such as radio and television broadcasting, point-to-point radio. A micro-strip Antenna or microstrip patch antenna (MPA) consists of a conducting patch of any non-planar or planar geometry on one side of a dielectric substrate and a ground plane on other side [1]. The material which has the dielectric constant in the range of $2.2 \leq \epsilon_r \leq 12$ can be used as substrate. It is a printed resonant antenna for narrow-band microwave wireless links requiring semi-hemispherical coverage. Due to its planar configuration and ease of integration with microstrip technology, the microstrip patch antenna has been deeply used. The rectangular and circular patches are the basic and most commonly used microstrip antennas. A microstrip patch antenna finds tremendous attention because of several advantages which it has over the conventional antennas such as compactness. Some of the merits of micro-strip patch antenna are low profile, light weight, low volume, low cost and can easily be integrated with the microwave integrated circuits [8]. A patch antenna is also known as a rectangular microstrip antenna. It is a type of radio antenna with a low profile, which can be mounted on a flat surface. It consists of a flat rectangular sheet or "patch" of metal, mounted over a larger sheet of metal called a ground plane. They are usually employed at UHF and higher frequencies because the size of the antenna is directly tied to the wavelength at the resonant frequency. A single patch antenna provides a maximum directive gain of around 6-9 dB. The ability to create high gain arrays in a low-profile antenna is one reason that patch arrays are common on airplanes and in other military applications [5]. Using the basic design of the antenna for the frequency range 8-12 GHz, we will be designing different antennas using the seven segment pattern on the patch. The Microstrip patch antennas are known for their performance and their robust design, fabrication and their extent usage. The advantage of this Microstrip patch antenna is easy to design, is very compact, is very light weight etc. The output parameters of the different designs on the seven segment pattern will be compared according to the change in the design and can be used for different specific applications [4].

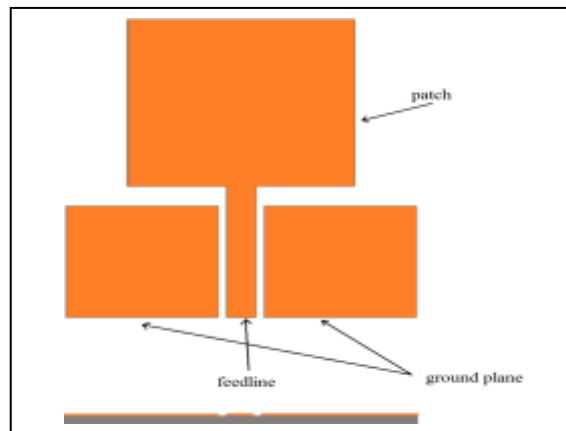


Fig 1: Antenna design

II. MODELLING

Antenna Design

For the purpose of designing a microstrip patch antenna, the following basic software is required:

- **Integral Equation in Three Dimension (IE3D) :**

Electromagnetic simulation is an advanced technology to yield high accuracy analysis and design of complicated microwave and RF printed circuits, antennas, high speed digital circuits and other electronic components. IE3D is an integrated full wave electromagnetic simulation and optimisation package for analysis and design of 3D and planar microwave circuit, antenna, digital circuits and high speed printed circuit boards (PCB). Since its formal introduction in 1993 IEEE International Microwave Symposium (IEEE IMS 1993), the IE3D has been adopted as an industrial standard in planar and 3D electromagnetic simulation. The IE3D has become the most versatile, easy to use, efficient and accurate electromagnetic simulation tool. This software is used for the design of single sided microstrip patch antenna. After the length and width of the antenna is calculated, the required antenna is designed using IE3D software. The resonant frequency, bandwidth, radiation patterns, directivity and gain are obtained using IE3D software.

The feed line provides positive feed to the radiating patch and the two ground planes are provided with negative feed.

We selected the resonant frequency to be 8.5GHz. After various attempt the final design was achieved. The dimension of the Main design is as follow.

We have tried to keep the patch in Square shape as Square Shape gives a high gain with respect to Rectangular or circular shape [6]. The design consist of

1. Radiating Patch
2. Ground Patch
3. Feed line

The patch dimension are 12mm x 12mm, similarly the ground patch is of 8mm x 8mm. A feed line is given to the radiating patch which is of dimension 1.5mm x 9.5mm.

RESULT AND DISCUSSION

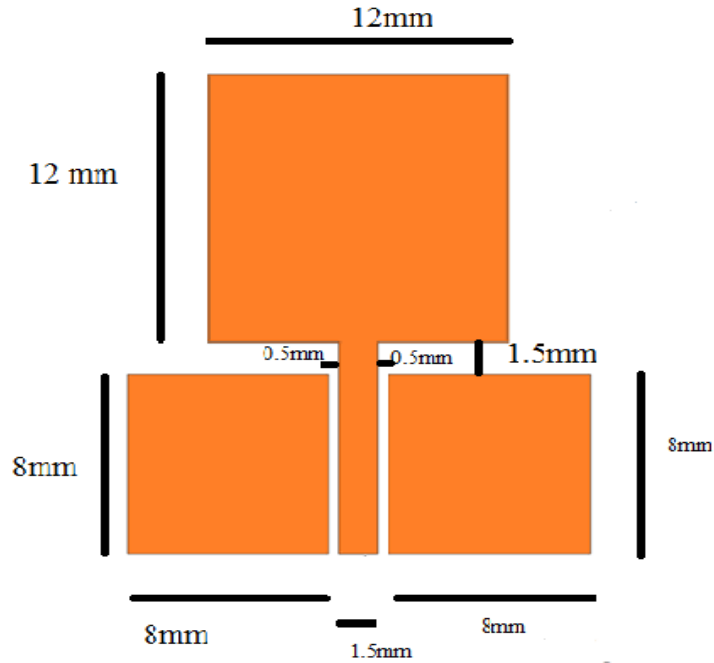


Fig 2: Main antenna design

S-Parameters Display

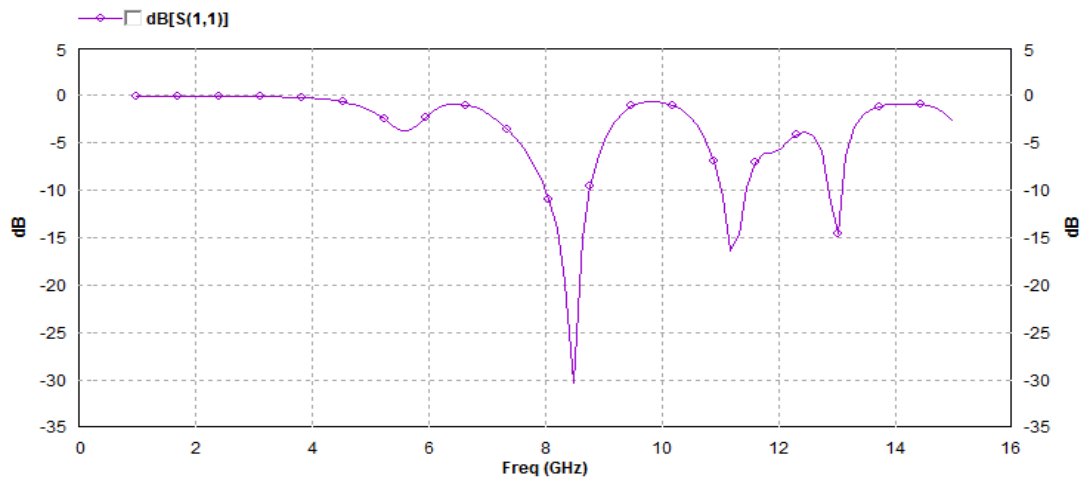


Fig 3: S-parameter of main antenna design

Various designed obtained

On the radiating patch which is 12mm x 12mm we have designed various alpha-numeric values. Design which have response in acceptable range are shown below with their s parameters.

To obtain the design we can use switch between the joins.

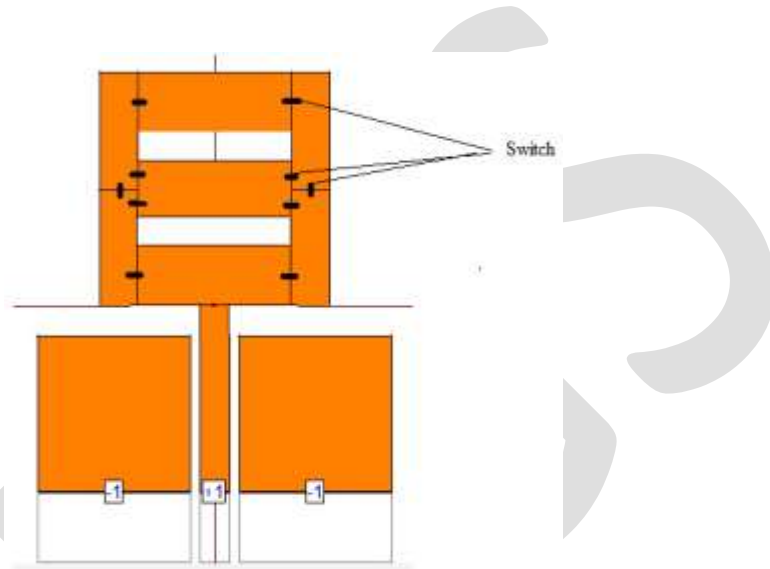
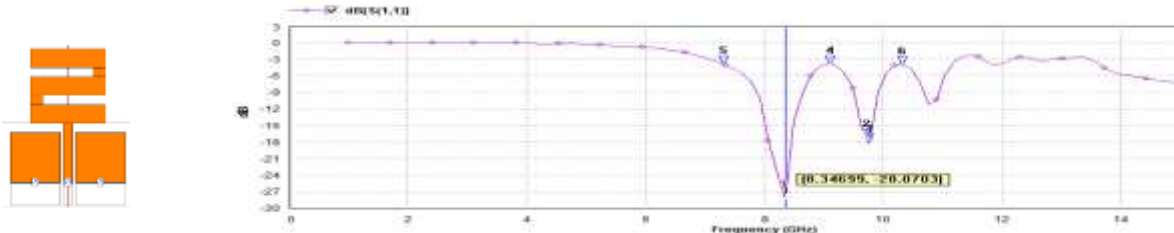
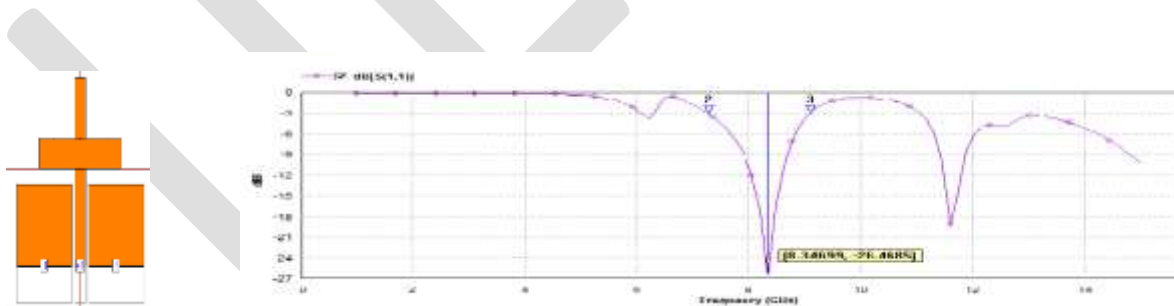


Fig 4: seven segment pattern antenna with switches between two patches

Few Designs and their s-parameter obtained using the seven segment pattern antennas are as follows.



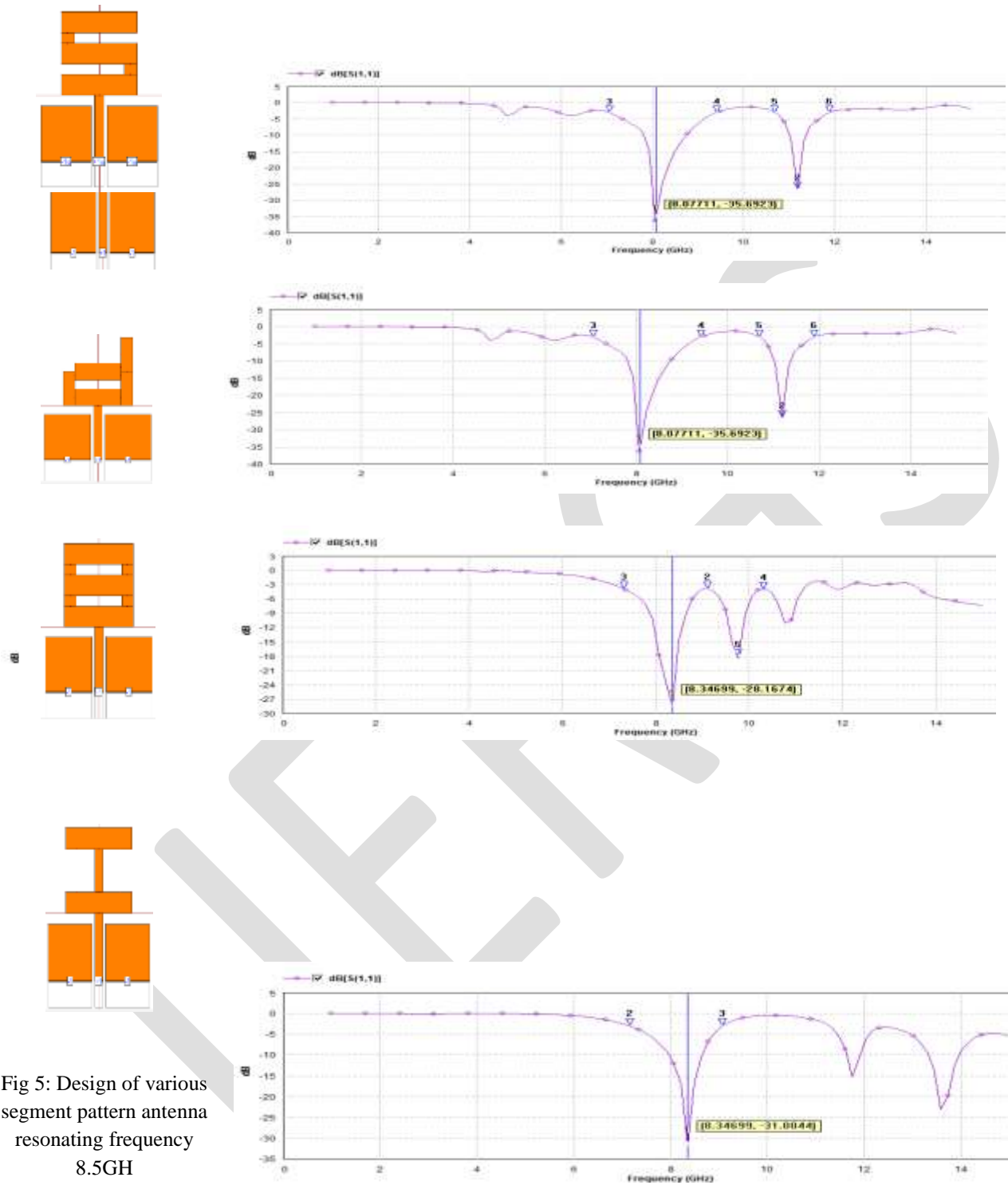


Fig 5: Design of various segment pattern antenna resonating frequency 8.5GH

seven with around

CONCLUSION

This paper focuses on antenna working in high frequency. The frequency chosen was 8.5 GHz and accordingly the design was obtained. Then various designs are presented which are made from seven segment pattern. In this process we concluded that the same design can be used to design multiple numbers of antennas by switching on/off the switches between two metallic strips. While going through the design we discovered that if we take mirror image of a design for example- b and d, they give same response in terms of s

parameter. We also came to a conclusion that the distance between radiating patch and ground patch also known as feed gap must be 1.5mm in order to get good response. If the feed gap is increased, the response of antenna deteriorates.

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