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# Design of patch antenna of frequency 2.483GHz for Medical Applications

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**Abstract**

Antenna technology is growing at a much faster rate in every field of communication. Antenna has now become a vital player in the medical sector. It is being used for many kinds of medical applications such as hyperthermia, cancer treatment, tumor detection, head and neck cancer treatment, remote health monitoring, speech sensing, self-monitoring, digestive monitoring etc. In this project T-shape antenna is designed in the CST (Computer Simulation Technology) Microwave Studio software[2]. Now based on the requirement of the antennas shape, it is altered and the frequency is measured until the required frequency 2.483 GHz is obtained [1]. It is a trial and error process. The process of cutting and re-designing is done until the output frequency is obtained. By analyzing the properties of various types of Antenna it is found that Microstrip Antennas are more efficient when compared to the other types. So, the Microstrip Antenna is used as a feed which includes several medical applications like detection of brain tumor and ablation of larger organs[2]***Key Words*:** E Power Amplifier; Power Added Efficiency; gain; output voltage; rectifier; High Frequency applications.

# 1 Introduction

Medical field today holds a prominent place as a means of improving medical diagnosis and treatment. Today patient monitoring, deep brain simulations endoscopy are a few examples of the medical applications that can take advantage of remote monitoring system and body implantable unit[1]. Wirelessly transferring diagnostic information from an electronic device implanted in the human body for human care and safety, such as a pacemaker, to an external RF receiver. In recent years, various types of medical applications of antennas have widely been investigated and reported, which includes diagnosis as well as treatment of various chronic diseases. In antenna is an electromagnetic radiator that creates an electromagnetic field to proceed out from the transmitting antenna to the receiver's antenna. It converts the electromagnetic wave into electrical signals that are applied to the receiver's input stages. Antennas are essential components of all radio equipment, and are used in radar, cell phones, satellite communications and also in as wireless devices[2].

# 2 MICROSTRIP ANTENNA

With study on properties of different types of Antennas, Microstrip Antenna is preferred. It contains three layers, in which the top surface is the conducting substrate, the lower surface is the ground plane and the middle layer is the patch layer.

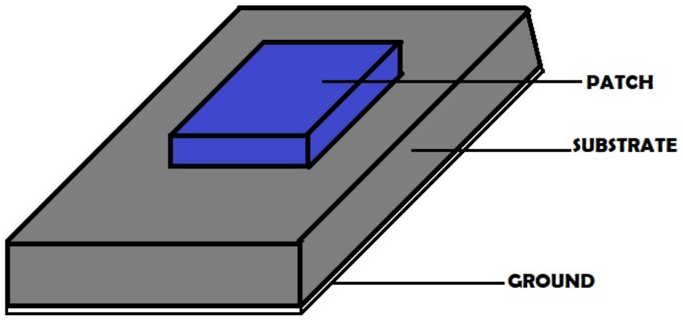


Figure 1 1 shows the different layers of Microstrip Antenna. These types of Antennas are also known as Printed antennas as it looks similar to the printed circuit boards. The Microstrip Antennas are so thin and they are used in several applications [2].

### 2.1 Feeding Techniques

There are four feeding techniques in which microstrip line feeding technique is preferred. The main advantage of microstrip feeding technique is that it is very easy to fabricate, It has low spurious radiations and it can easily inserted in to the substrate[2].

## 3 III. WORKFLOW AND DESIGNING

### 3.1 Workflow

The Fig. 2 illustrates the work flow of our project. A new project is created which creates a new template. The application area in which the work flows is MWRF optical and Antenna is the field in which the shape is designed. The Antenna type chosen for designing is patch type antenna. By choosing all the required field the designing platform is created and the T shaped design is then designed in it. The feeing used in the design is Microstrip feeding. Now the result is analysed. The required frequency for the project is 2.48356 GHz. If the required frequency is not obtained, then the shape is re-designed until the output frequency is obtained [3].

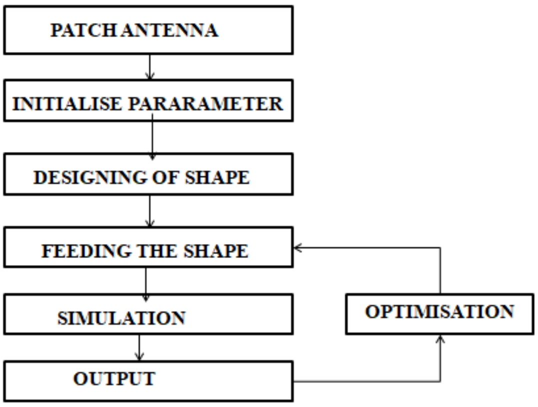


Figure 2 Work flow of the project

## 3.2 Dimension Analysis

The shape in which the antenna should be designed is first determined. The shape of the antenna which is designed is T SHAPED. Before designing the shape directly in the studio the dimensions of the shape is first calculated and the antenna design is designed roughly. By initializing the length, width the Patch Antenna is designed. The below table 1 shows the dimensions [3].

The Width of the Patch:

W=[c((r+1)/2)-1/2 ]/2f0

The length of the patch:

L=[c/(2 f0 (e ) -1/2 )]-2L

Where, e =( r+1)/2+(( r-1)/2)[(1+12h)/w] -1/2

With respect to the proposed dimensions for the parameter the shape of the Antenna is designed[3].

## 3.3 Designing of the shape

With the above mentioned dimensions the shape of the antenna is roughly designed and the desired shape is analysed with respect to the formulae that is used to design the shape. Fig. 3 shows the Design of the shape.

Table 1: DIMENSIONS FOR THE PARAMETER

| PARAMETERES | DIMENSION(mm) | DISCRIPTION |
|---|---|---|
| Fi | 16 | Feeding Length |
| Gpf | 1 | Feeding Height |
| Hs | 1.6 | Substrate Height |
| Ht | 0.35 | Patch Thickness |
| L | 26 | Substrate Length |
| Lg | 2*l | Ground Length |
| w | 26 | Substrate Width |
| wf | 1.830 | Feed Width |
| wg | 2*W | Ground Width |

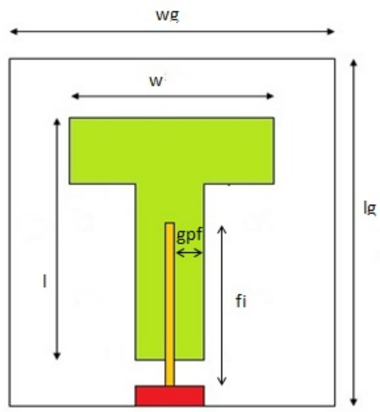


Figure 3 Design of the shape

# 4 DESIGNING WITH CST STUDIO

The proposed shape is now designed in the CST Microwave Studio is shown in Fig. 4. With the above dimensions the ground is first designed with a copper metal. The shape is designed in such a way that the length of the substrate is greater than the length of the ground. The patch is of thickness 0.035mm and the impedance match of the patch is 50 .A Microstrip Line feed is fed between the patch and the port which sets the path for the radiated pattern to flow [4]. The Specifications of the Design is mentioned in the Table 2.

Table 2: SPECIFICATION OF THE DESIGN

| PARAMETERES | SPECIFICATION |
|---|---|
| Antenna Frequency | 2.483GHz |
| Thickness of Copper | 0.035mm |
| Di electric Constant | 4.7 |
| Substrate Material | FR 4 Lossy |
| Height of the substrate | 1.6mm |

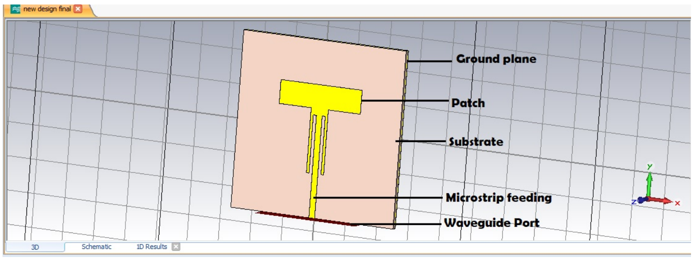


Figure 4 Design in CST

## 5 OBTAINED OUTPUT AND SIMULATION

After feeding the design, The design is simulated and thus the output is obtained. The shape is re designed and simulated until the expected output waveform is obtained. Fig 6 illustrates the obtained output of the design.

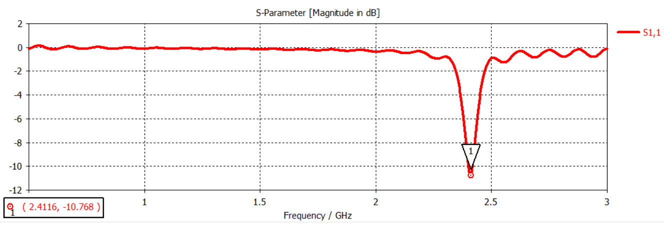


Figure 5 The output for the designed Antenna

The S11 plot explains the return loss or reflected power of the antenna. It is also known as reflection Co-efficient. This plot Undergoes the following criterias : The power from the antenna will be reflected but there will be no radiation if S11 = 0dB, 3dB of power will be delivered to the antenna and -7dB is the reflected power of the antenna when S11 = -10dB.

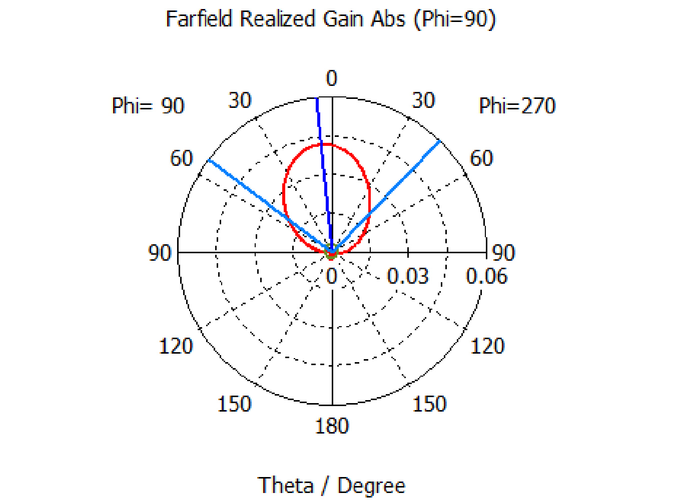


Figure 6The polar output of the design.

The radiation pattern is shown in the fig. 7. The polar output of the design depends on the orientation of the antenna. Pi and theta cut planes will gives the polar radiation patterns. It also depends upon the feed network of the Design.

# 6 COMPARITIVE STUDY

With the same parameters, the shape is now fed with a coaxial feed. The shape is Simulated and the Output is Obtained. As a comparative Study their Outputs Characters and Efficiency is Compared [5].

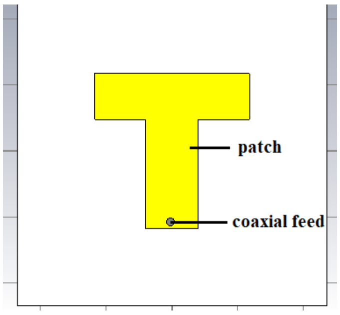


Figure 7 Front View of the coaxial feed

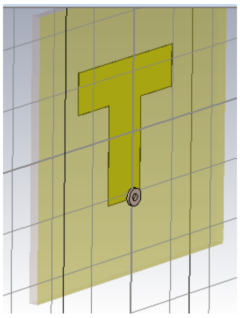

Figure 8 Back View of the coaxial feed

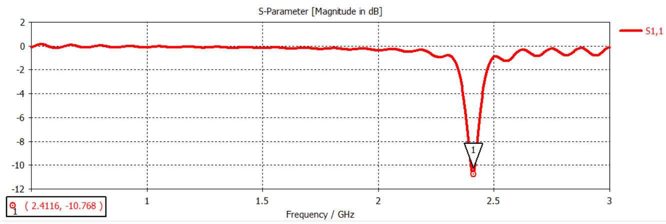


Figure 9 Simulated Output

Fig. 8 shows the Front View of the Design. Here instead of microstrip feed coaxial feed is used and it is simulated. Fig 9 shows the ground of the design. The wave guide port is inserted at the back side of the coaxial feed. Thus after designing the shape the design is simulated and a output of 2.3509 GHz is obtained. Fig. 10 shows the simulated output for the coaxial Feed.

# 7 APPLICATIONS

The design of the project mainly focuses on the medical application, it is designed in a frequency of 2.483 GHz, which includes several medical applications like detection of skin tumor, lung, tumor, ablation of larger organs etc.. These applications are applicable for the particular frequency in which this antenna is designed. There are several applications for respective frequencies [2].

# 8 CONCLUSION

Thus by various analysis and study a patch antenna a Microstrip feeding is designed in the Microwave studio platform and thus a output of frequency 2.4 GHz is obtained. And we have thus compared the design of Shapes with two different Feeding Techniques Microstrip feeding and Coaxial Feeding.

# 9 Acknowledgement

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