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A briefstudy on basic antenna types for wireless communications

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Abstract:

As wireless communication plays a major role in this modern world, every communication engineer must have basic knowledge on electromagnetic radiation, antennas and its types. So, in this paper we are going to give information on three types of antennas which operate at different frequency. Here we depict the design calculations and fabrication of Microstrip patch antenna, fixed monopole and flexible monopole antenna.

Keywords — wireless communication, electromagnetic waves, antenna fabrication, Microstrip patch, flexible monopole.

I. INTRODUCTION

An antenna acts as matching systems between sources of electromagnetic energy and space and is used to radiate electromagnetic energy effectively in desired directions. Antenna can be stated in many forms. A few of such standard definitions as per the IEEE 1451983 standard is expressed below. An antenna means for radiating or receiving radio waves. An antenna is any device that converts electronic signals to electromagnetic waves (and vice versa) effectively with minimum loss of signals. Various materials are utilized to design and fabricate antennas, in which the following materials are widely used, such as Copper sheet, Brass sheet, Brass rod, BNC connector, soldering equipment. A few basic antenna types are shown in the following figure 1and 2.

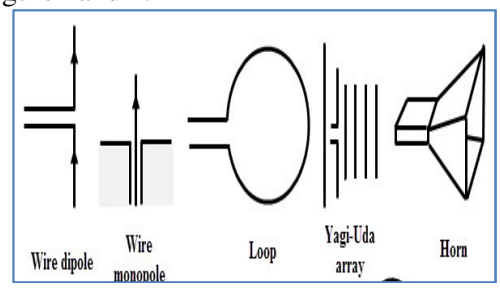

Figure 1: Basic Antenna types

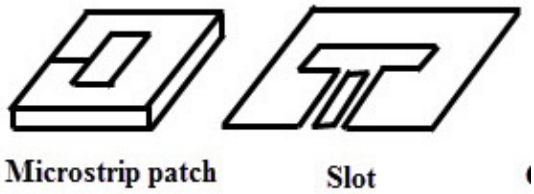

Figure 2: Microstrip and Slot antenna.

With the evolution of antennas the communication world had experienced tremendous improvement in speed of communication. Also with implantation of various smart technologies the services mainly in military, civilian, and in education system drastic changes has been witnessed. Generally antenna is a transceiver. It receives electromagnetic fields and converts them into the respective currents and the voltages. The scientist Maxwell summarized the concepts

$L=0.48\times\lambda_g$	$W=1.5\times L$	$G=H\times 16+W$
L =5.76cm	W=8.64cm	G=11.84cm

II. MICRO STRIP PATCH ANTENNA

Circular polarization:

Circular polarization (CP) is usually a result of orthogonally fed signal input. When two signals of equal amplitude but 90^0phase shifted the resulting wave is circularly polarized. Circular polarization can result in Left hand circularly polarized (LHCP) where the wave is rotating anticlockwise, or Right hand circularly polarized (RHCP) which denotes a clockwise rotation. The main advantage of using CP is that regardless of receiver orientation, it will always receive a component of the signal. This is due to the resulting wave having an angular variation. The basic relations used to design microstrip antenna.

$$f=V_0/(2*L_{eff}*\sqrt{\varepsilon_{eff}})$$

Where, V_0 = velocity of light in free space.
L_{eff} = Effective length of the antenna.
$\mathcal{E}_{eff}$ = Effective dielectric constant.

Microstrip antenna design and its calculations are discussed below.

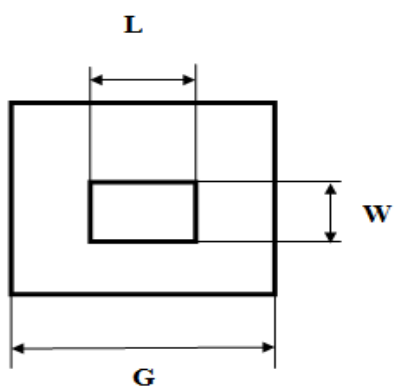

Figure3: microstrip antenna design

Table 1: Design calculations

Length of patch(L)	Width of patch(W)	Length and width of ground plane(G)

The narrow band rectangular patch antenna is shown in figure 4.

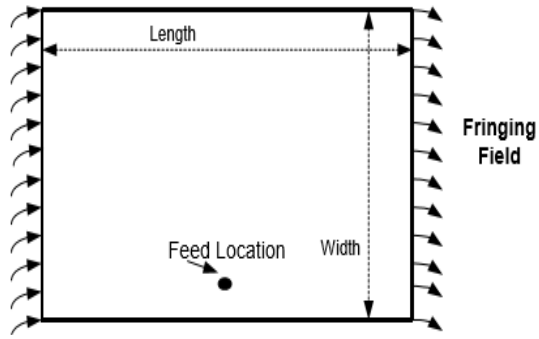

Figure4: Narrow band patch antenna

With the above measured dimensions of the microstrip antenna and by following the below mentioned antenna fabrication procedural steps the antenna is designed.

Step 1: Firstly, take the brass sheet will be used as ground plane and it is cut into a square shape of length G=11.84cm.

Step 2 :Copper sheet is cut in a rectangular form of length L=5.76cm and width w=8.64cm.

Step 3: Then cut the copper sheet opposite corners in a curved shape at length side less than 1cm. By taking the reference as curved path cut the copper piece in a rectangular shape to diagonally on both sides so that the length should be maintained at least 1cm in between them from the centre.

Step 4: Later, this copper sheet is patched over the brass sheet and a small hole is made at the length side of the copper sheet as shown in the figure.

Step 5: By soldering a BNC connector we can have "*Microstrip antenna*".

The practically designed patch antenna is shown in the following figure.

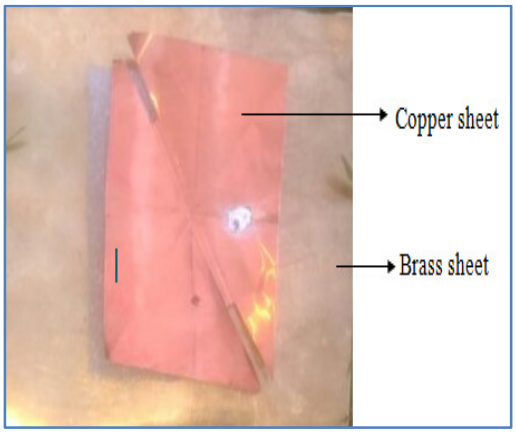

Figure 5: Fabricated patch antenna

Fixed monopole Antenna:

Design calculations for Fixed monopole monopole antenna are listed below. Operating frequency, f =900MHz then, λ= C /fλ =3×10^8/9×10^8 soλ =0.33cm.

Table 2: Monopole antenna design calculations

Length of antenna(L)	Ground size(G)	Radius of monopole(r)
L=λ/4	G =3 λ/2π	r=λ/200
L =8.25cm	G =15.75cm	r=0.165cm

The fabrication steps are as follows. Step 1: Firstly cut the brass sheet in circular shape by taking the radius of 0.45cm. Step 2: Now take required size of brass rod of dimensions 33cm&8.25cm as we calculated above.Step 3: By considering the values design the fixed antenna by cutting ground as circle & fixing the brass rod in it and at last solder at the centre.Step 4: Then BNC connector is fixed. The practically designed monopole antenna is shown in figure6.

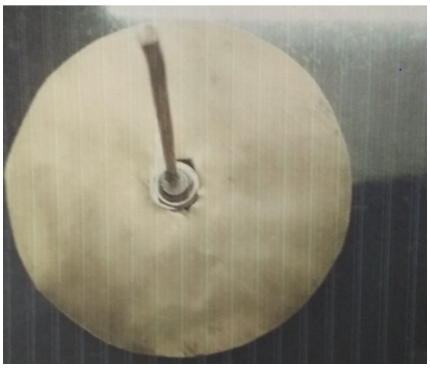

Figure6: Fixed monopole antenna

Flexible monopole Antenna:

The design Calculations of the flexible monopole antenna are shown below. f=800MHz, then λ=C /f, λ=3*(10^8)/9800*10^6) , λ=0.375m.

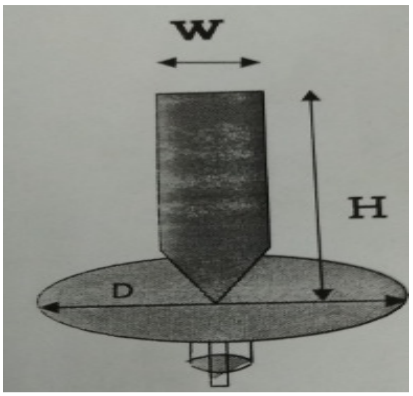

Figure7: Flexible monopole antenna.

Required dimensions for designing flexible monopole antenna are shown in the following table.

Table 3: Flexible monopole antenna dimensions.

Height of the copper sheet(H)	Width of copper sheet(W)	Diameter of bronze sheet(D)
H=0.27λ	W=0.1λ	D=3λ/2π
H=0.10125m	W=0.0375m	D=0.179m

Fabrication steps of the flexible monopole antenna are given below.

Step 1: Take a copper sheet and cut it with the dimensions, Length as 10cm and width as 3cm.Step 2: Take a bronze sheet in circular shape which is having the diameter of 10cm.Step 3: Make a small hole at the origin of the circular bronze metal sheet to place connector in the origin.Step 4: Cut the copper metal sheet according to the measurement.The applications of the various microstrip patch antenna, flexible monopole and the fixed monopole antennas are discussed below.

The microstrip patch antenna is small in size and is flexible hence it finds numerous applications. Microstrip patch antennas are widely popular in mobile phone market.Medical appliances.Micro strip patch antennas are used for communication purposes especially in military and civil applications.Micro strip antennas are used for number of wireless applications such as WLAN, Wi-Fi, Bluetooth and many other applications.

The Fixed monopole antenna is the basic types of antenna and hence it finds basic applications. Used for GSM, Bluetooth and USB Application with dual band-notched characteristics. Used in buildings, ships, space crafts and automobiles. The flexible monopole antenna is the modified version of the fixed monopole antenna type. The applications of the flexible monopole antenna are given as follows. Wireless communication WI-FI Modem.Medical applications in imaging diagnosis and treatment.
A comparative study of the antenna fabrications are given below.

Table 4: Comparison of different antennas

parameter	Microstr-ip patch antenna	Fixed Monopole antenna	Flexible monopole antenna
weight	low	more	light
Fabrication cost	low	high	Very low
Operating frequency	2.4GHz	900MHz	800MHz
Band width	narrow	narrow	Enough
Efficiency	low	low	high

III. CONCLUSIONS

The various antenna types are studied, designed and their respective fabrication methodologies are presented in this paper. Also the concerned applications of the suitable antennas are discussed.

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