DIFFERENT SHAPES AND FEEDING TECHNIQUES OF MICROSTRIP PATCH ANTENNA

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Abstract - This Paper presents the study of Microstrip patch antenna for communication system. In this paper, the gain obtained for three different shapes(rectangular patch, square patch and circular patch) of microstrip patch antenna is studied carefully with microstrip feeding. The main objective of this paper is to design and observe the performance of different shapes of antenna by gain and efficiency of the microstrip patch antenna. Use the microstrip patch antenna in every where there is small space and high efficiency of antenna is needed i.e. in our mobiles and many communication systems. Observe that by change in the shape of antenna the gain and efficiency of the antenna is also changes.

Keywords : Microstrip patch antenna, Gain, Microstrip feeding , Efficiency, Communication System

I. INTRODUCTION

A Microstrip patch antenna made up of radiating plate which is patch on one side of a dielectric substrate and that substrate is grounded to the another side, as shown in fig. 1. The basic principles of operation in Microstip or Patch antenna is patch performs approximately as a resonant cavity or short circuit walls on top and bottom and open-circuit walls on the sides as in the cavity only certain modes are allowed to occur at different resonant frequencies ($TE_{(0,0,1)}$, $TM_{(1,0,1)}$). If The antenna is excited at a resonant frequency, a strong field is set up inside the cavity and a strong current is produce on the bottom of the surface and this will produce a significant radiations. The microstrip or patch antenna has various advantages over the other antennas i.e light weight, inexpensive and easy to integrate with accompanying in electronics. Since the Microstrip antenna are often integrated with other Microstrip circuitry, a compromise must be reached between good antenna performance and circuit design. The radiating element are photo etched along with the feed lines on the dielectric substrate [1].

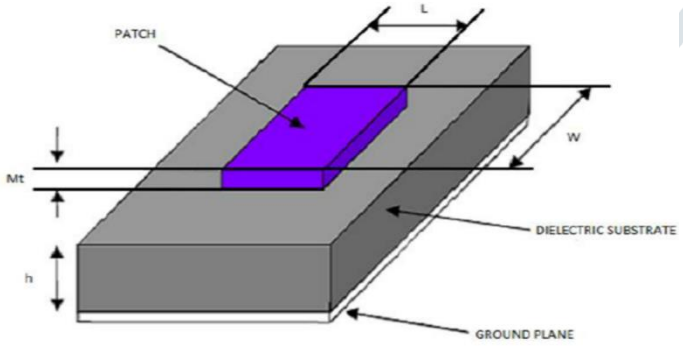

Fig : 1 (Micrstrip Patch Antenna)

The radiating patch may be different shapes i.e. square, rectangle, circular or any other configuration the antenna can be 3D in structure it is flat and that is the reason patch antennas are sometimes referred to as Planar antennas. These type of antenna is use in different types of industry such as medical applications, satellite and of course even in the military systems just like in the rockets, aircrafts missiles .As, the microstrip antenna has a low gain and a narrow bandwidth. To overcome its limitation of narrow band impedance bandwidth and low gain and many techniques have been proposed. In microstrip patch antenna there are some well known methods to increase the bandwidth of patch antennas, such as, cutting a resonant slot in the patch, reduced ground plane, the use of thick substrate, the use of a low dielectric substrate, the use of a low dielectric substrate, the use of various impedance matching feeding techniques, the use of slot antenna geometry and multi-resonator stack configurations that reduces the limitations of the microstrip patch antennas. The most commonly employed microstrip antenna is a rectangular patch which looks like a

truncate patch transmission line. It is approximately of one-half wavelength long. When air is used as the dielectric substrate, the length of the rectangular microstrip antenna is approximately one-half of a free-space wavelength[2].

II. FEEDING TECHNIQUE

This technique is very important to radiate the signal from the antenna that process is known as feeding of the antenna. In order to feed the antenna there are many techniques to feed them the different techniques are used and a feedline is used to excite to radiate by direct or indirect contact.

There are four most popular techniques are :-

1. Coaxial Probe Feed,
2. Microstrip Line,
3. Aperture Coupling,
4. Proximity Coupling.

Coaxial probe feeding :- In this feeding method the inner conductor of the coaxial is attached to the radiation patch of the antenna while the outer conductor is connected to the ground plane, as shown in fig. 2. Advantages of coaxial feeding are easy of fabrication, easy to match and its disadvantages are narrow bandwidth, Difficult to model specially for thick substrate[2].

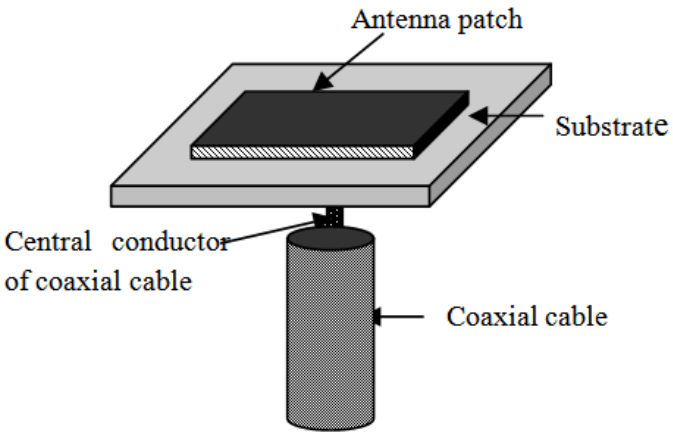

Fig : 2 (Coaxial Probe Feed)

Microstrip line feed :- In this method conducting strip connecting to the patch and therefore can be consider as extension of patch, as shown in fig. 3. It is simple to model and easy to match by controlling the inset position[2]. The disadvantage of this method is that as substrate thickness increases, surface wave and spurious feed radiation increases which limit the bandwidth.

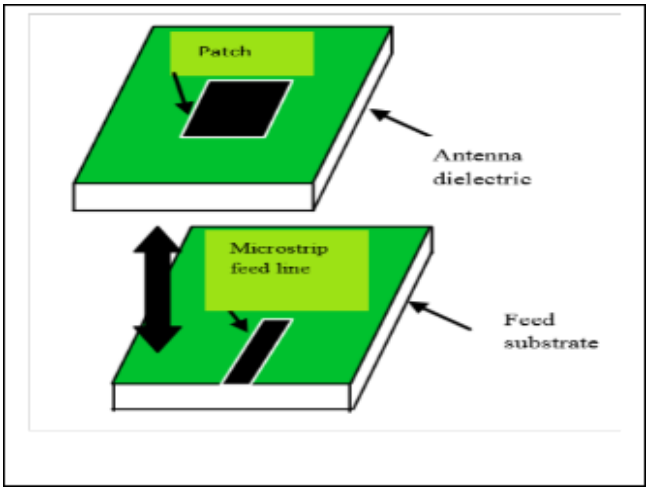

Fig : 3 (Microstrip Line Feed)

Aperture coupled feed :- This method consist of two different substrate separated by a ground plane. On the bottom side of lower substrate there is a microstrip feed line whose energy is coupled to the patch through a slot on the ground plane separating two substrates, as shown in fig. 4. This arrangement allows independent optimization of the feed mechanism and the radiating element[3].

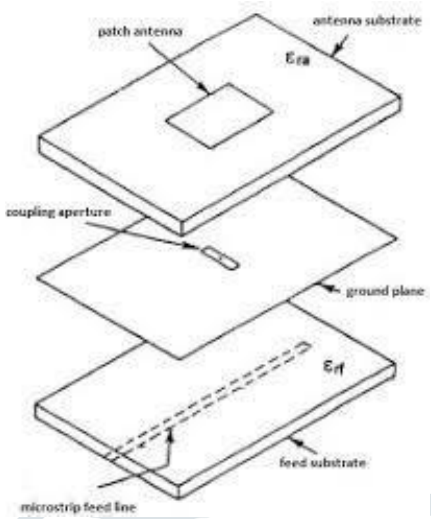

Fig. : 4 (Aperture Coupled Feed)

Proximity coupling feed :- In this method the largest bandwidth, has low spurious radiation. The fabrication is difficult[3]. Length of feeding stub and width-to-length ratio of patch is used to control the match. Its coupling mechanism is capacitive in nature, as shown in fig. 5.

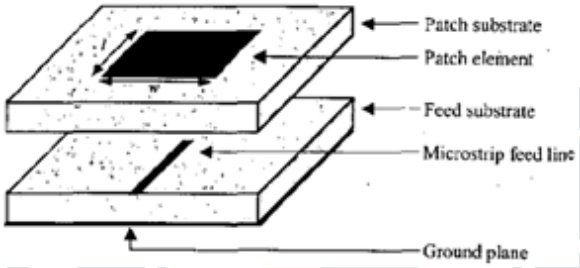

Fig:- 5 (Proximity Coupling Feed)

III. ANTENNA DESIGN

The design of antennas with the rectangular patch, square patch and circular patch and each one is compared with and without slots on the ground plane[3].

A. RECTANGULAR PATCH ANTENNA LAYOUT

The layout window is used for the physical design of the rectangular patch antenna. The physical design can be created directly in the layout window, or be designed in the schematic and then converted into the layout window.

The rectangular patch of the antenna is being excited by feed which is done by edge feed, a probe feed or coaxial feed or an aperture feed. When the patch is excited by feed a charge distribution is being established between the ground plane and the patch. The attractive forces are being setup between the planes i.e., patch underneath and the ground plane. The patch antennas radiate in the first case due to the fringing fields between the underneath of the patch and the ground plane. For good antenna performance, a thick dielectric substrate having a low dielectric constant is desirable since this provides better efficiency, larger bandwidth and better radiation[4]. The layout window is used for the physical designing the model. The physical design can be created directly in the layout window, or be designed in the schematic and then converted into the layout window.

B. SQUARE PATCH ANTENNA LAYOUT

The proposed antennas consist of square patch of dimensions $6X6mm^2$. The geometry of square patch without slots and with a slot at the ground plane respectively. The patch antennas radiate in the first case due to the fringing fields between the underneath of the patch and the ground plane, as shown in fig. 6. For good antenna performance, a thick dielectric

substrate having a low dielectric constant is desirable since this provides better efficiency, larger bandwidth and better radiation[5].

You can make a square patch and add an inset feed to match the impedance. It can use probe feed alternatively. Square patch can generate two degenerated modes if properly excited hence it is normally used in circular polarizations[4].

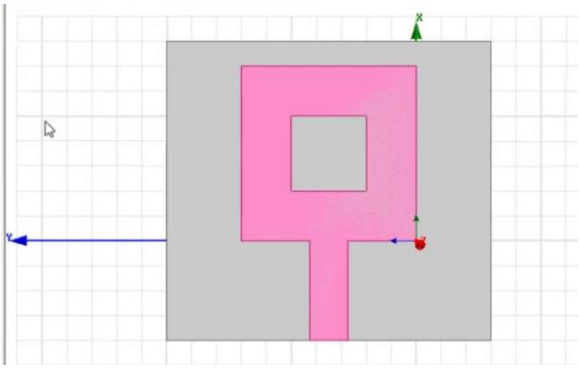

Fig. 6 (Square Patch Antenna)

C. CIRCULAR PATCH ANTENNA LAYOUT

The circular patch antenna is widely use in the GPS tracking system. The mode supported by the circular patch antenna can be found by treating the patch, ground plane and the material between the two as a circular cavity[5]. The radius of the patch is the only degree of freedom to control the modes of the antenna, as shown in fig. 7. The antenna can be conveniently analyzed using the cavity model. The cavity is composed of two electric conductors at the top and the bottom to represent the patch and the ground plane and by a cylindrical perfect magnetic conductor around the circular periphery of the cavity, as shown in fig. 7. The dielectric material of the substrate is assumed to be truncated beyond the extent of the patch[3].

$$a = \frac{F}{\left\{1+\frac{2h}{\pi\varepsilon F}\left[\ln\left(\frac{\pi F}{2h}\right)+1.7726\right]\right\}^{\frac{1}{2}}}$$

$$\text{Where } F = \frac{8.791\times10^{9}}{f_r\sqrt{\varepsilon}}$$

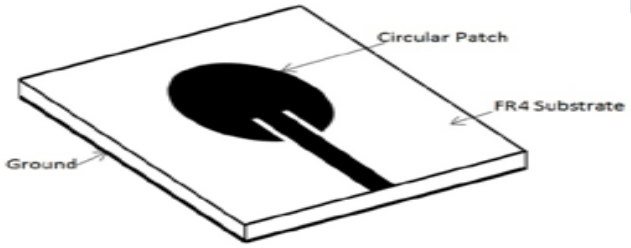

Fig: 7 (Circular Patch Antenna)

IV. CONCLUSION

In this paper, the study of microstrip patch antenna with the different shapes rectangular, square and circular patch of the antenna. Here one can conclude that microstrip antenna is widely used in our Wireless communication and medical process. In this paper, there is change in the patch shape the gain and efficiency also change accordingly to it. In this paper a comparative study of rectangular, square and circular patch antenna's have been done, different parameters have been compared on without and with slots structure of each antenna. .Thus, make it suitable for different applications. The slotted structure can be used in WLAN and Wi-MAX implementation.

V. REFERENCES

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