COMPARSION OF MICRO STRIP RECTANGULAR & SQUARE PATCH ANTENNA for 5GHZ

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ABSTRACT : *Micro-strip or patch antennas are becoming increasingly useful they can be printed directly becoming very widespread with in the mobile phone market. Patch antennas are low cost have a low profile and are easily fabricated. In this paper we are comparing a rectangular micro-strip patch antenna & a square shaped patch antenna in loss of all essential parameters. Example:-Return loss, gain, directivity efficiency, radiation efficiency, directivity. CST micro-strip EMC Edition is used to stimulated both the antenna.*

1. INTRODUCTION

In this paper of parallel micro strip patch antenna and compare the rectangular and square. The Micro strip patch antenna is a thin square patch on one side of a dielectric substrate and the other side having a plane to the ground. The simplest Micro strip patch antenna configuration would be the rectangular patch antenna. The compare of rectangular & square all the parameters check the gain, directivity, return loss, radiation pattern, efficiency and find out the result. The micro strip patches antenna work on simulation software & VSWR software. The micro-strip antenna substrate of thickness and compare the both parameters of the dielectric substrate material. The antennas have designed by hardware kit and practical perform on the simulation software and best which of rectangular and square by through practical perform and waveforms graph and last depend on the result. The antenna consists of flat
rectangular sheet or patch of metal, mounted over a larger sheet of metal called as ground plane. The micro strip patch antenna has several advantages and disadvantages, light weight and low volume, low profile, planar configuration which can be easily and made conformal to host surface, low fabrication coast, hence can be manufactured in large quantities and disadvantages narrow bandwidth, low gain low efficiency. This paper compares the performance of micro-strip patch antenna having different shapes of the patch (Square, Rectangular) at a frequency of 5 GHz. To compare and analyze the performance, VSWR (Voltage Standing Wave Ratio) software was used. The results show that the size of the antenna will be smallest in case of square shape patch antenna followed by rectangular. These results can be very useful while designing micro strip patch antenna.

This paper considers two shapes of the patch used in micro-strip patch antenna that are as follows:

1) Square shaped patch micro-strip antenna.
2) Rectangular patch micro-strip antenna

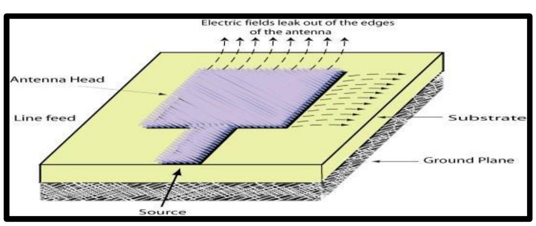


Figure 1(a) Rectangular micro strip patch antenna

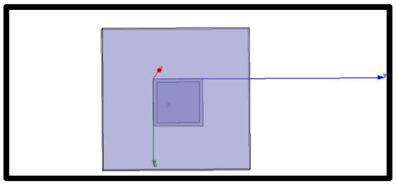


Figure-1 (b)Square shaped micro-strip patch antenna

1.1 Merits and De-merits of the Micro strip antennas

- Low weight, low volume and thin profile configurations which can be made conformal.

- Low fabrication cost, readily available to mass production.

- Required no cavity backing.

- Linear and circular polarizations are possible.

- Low grain.

- Lower gain (somewhat → -6dB)

- Large ohmic loss in the feed structure of arrays.

- Poor end fire radiator except tapered slot antennas,

- Extraneous radiation from feeds and junctions.

- Low power handling capacity (approx 100W).

2. RELATED WORK

MICROSTRIP PATCH ANTENNA

Micro strip antenna consists of very small conducting patch built on a ground plane separated by dielectric substrate. This patch is generally made of conducting material such as copper or gold and can take any possible shape [1]. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. The conducting patch, theoretically, can be designed of any shape like square, triangular, circular, rectangular, however rectangular and circular configurations are the most commonly used [1, 6]. In this project Square Micro strip Patch antenna is used. Some of the other configurations used are very complex to analyze and require large numerical computations. However Micro strip antenna has a drawback of low bandwidth and low gain. The bandwidth can be increased by cutting slots and stacking configuration and Gain can be increased by using different patch elements in an array to achieve maximum radiation characteristics [5]. In its most fundamental form, a Micro strip patch antennae consist of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side [1] is illustrated in figure 1.

Methods are being put as two different categories contacting and non-contacting. Contacting feed technique is the one where the power is being fed directly to radiating patch through the connecting element i.e. through the

Micro strip line.

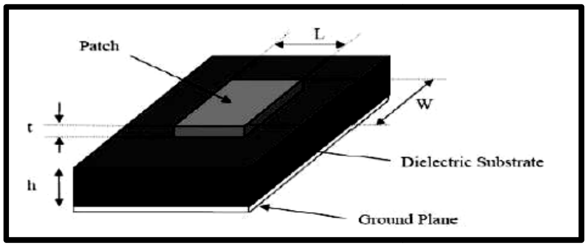


Figure 3 Structure of Micro strip Patch Antenna

Micro strip patch antennae radiate primarily because of the fringing fields between the patch edge and the ground plane. For a rectangular patch, the length *L* of the patch is usually 0.3333λ0 < L < 0.5 λ0, where

λ0 is the free space wavelength (λ0=0.125) [1, 9]. The patch is selected to be very thin such that t << λ0 (where *t* is the thickness of patch).

The height *h* of the dielectric substrate is usually 0.003 λ0 = h = 0.05 λ0. The dielectric constant of the substrate is typically in the range 1.2 = er = 12. The Micro strip patch is designed such that its pattern maximum is normal to the patch (broadside radiator). This is accomplished through proper choice of the mode of excitation beneath the patch. End-fire radiation can also be accomplished by careful mode selection. The ones that are most desirable for antenna performance are thick substrates whose dielectric constant is in the lower end of the range. This is because they provide better efficiency, larger bandwidth, loosely bound fields for radiation into space, but at the expense of larger element size [7]. Thin substrates with higher dielectric constants are attractive for microwave circuitry because they require tightly bound fields to minimize undesirable radiation and coupling, which lead to smaller element sizes; however, because of their greater losses, they are less efficient and have relatively smaller bandwidths [7]. Since Micro strip antennas are often integrated with other microwave circuitry, a compromise has to be reached between good antenna performance and circuit design.

3. PROPSED MODEL

3.1 Feed Techniques and Modeling of Micro strip Antennas

Micro strip patch antenna has various methods of feeding techniques. As these antennas having dielectric substrate on one side and the radiating element on the other. These feed techniques or methods are being put as two different categories contacting and non-contacting.

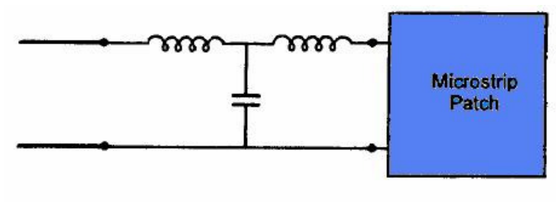
Contacting feed technique is the one where the power is being fed directly to radiating patch through the connecting element i.e. through the Micro strip line.

Non-contacting technique is the one where an electromagnetic magnetic coupling is done to transfer the power between the Micro strip line and the radiating patch. Even though there are many new methods of feed techniques the most popular or commonly used techniques are :

1. Micro strip line
2. Coaxial probe
3. Aperture coupling
4. Proximity coupling and Co planar wave guide feed

3.1.1 Micro strip Line feed

This type of feed technique excitation of the antenna
would be by the Micro strip line of the same substrate as the patch that is here can be considered as an extension to the Micro strip line, and these both can be fabricated simultaneously.



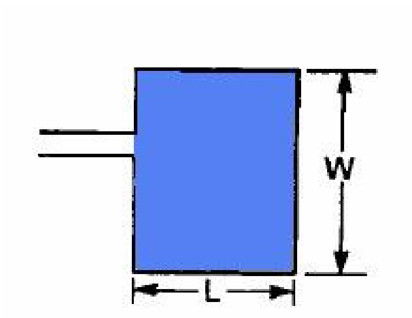


Figure 3.1.1 Micro strip Line feed

3.1. 2 Co Axial Feed Technique

This type of feed is the common technique used for the feeding of the Micro strip patch antennas. Coupling of the power through a probe is one of the basic studies that can be seen in the transfer of the microwave power.

It can be seen in the figure 3.2.2 below that the external or the outer conductor is connected to the ground plane and the inner conductor of the coaxial connector extends through the dielectric and is soldered to that of the radiating patch. The coaxial probe in this feed would be an inner conductor of the coaxial line or this can be used as the power transfer from the strip line to the Micro strip antenna from the slot in the ground plane.

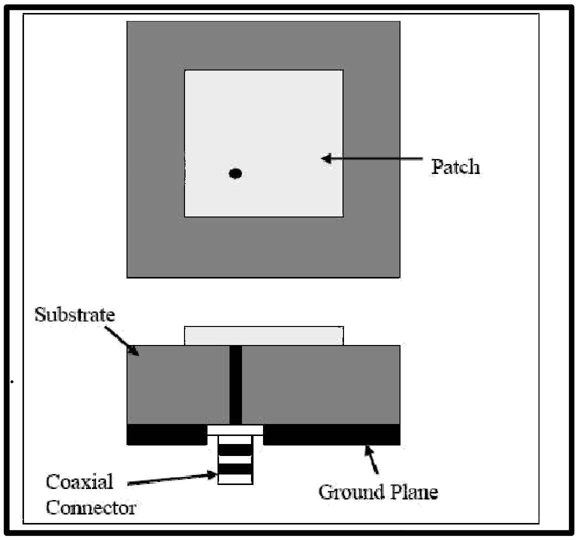


Figure 3.1. 2 Co Axial Feed

3.1.3 Aperture Coupled Feed

In this type of feed technique, the radiating patch and the micro strip feed line are separated by the ground plane as shown in Figure 3.2.3 Coupling between the patch and the feed line is made through a slot or an aperture in the ground plane.

The coupling aperture is usually centered under the patch, leading to lower cross polarization due to symmetry of the configuration. The amount of coupling from the feed line to the patch is determined by the shape, size and location of the aperture. Since the ground plane separates the patch and the feed line, spurious radiation is minimized.

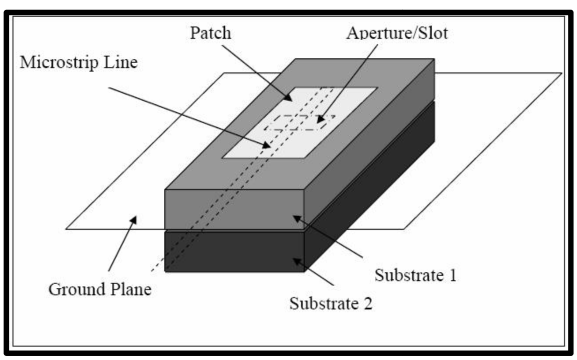


Figure – 3.1.3– Aperture Feed

3.1.4 Proximity Coupled Feed

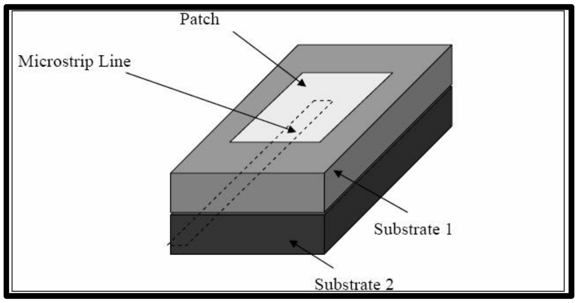


Figure – 3.1.4 – Proximity Coupled Feed

This type of feed technique is also called as the electromagnetic coupling scheme. As shown in Figure 3.3.4, two dielectric substrates are used such that the feed line is between the two substrates and the radiating patch is on top of the upper substrate. The main advantage of this feed technique is that it eliminates spurious feed radiation and provides very high bandwidth (as high as 13%), due to overall increase in the thickness of the micro strip patch antenna. This scheme also provides choices between two different dielectric media, one for the patch and one for the feed line to optimize the individual performances

4 DESIGN CALCULATIONS

4.1 Antenna parameters

Transmitter - Radiates electromagnetic energy into space Receiver - Collects electromagnetic energy from space .

4.1.1 Antenna Gain

Gain is a measure of the ability of the antenna to direct the input power into radiation in a particular direction and is measured at the peak radiation intensity.

$$S = \frac{P_0 G}{4\pi R^2} = \frac{|\mathbf{E}|^2}{\eta} \quad \text{or} \quad |\mathbf{E}| = \frac{1}{R}\sqrt{\frac{P_0 G \eta}{4\pi}} = \sqrt{S\eta}$$

4.1.2 Antenna Efficiency

The surface integral of the radiation intensity over the radiation sphere divided by the input power P is 0 a measure of the relative power radiated by the antenna, or the antenna efficiency.

$$\frac{P_r}{P_0} = \int_0^{2\pi} \int_0^{\pi} \frac{G(\theta, \phi)}{4\pi} \sin\theta \, d\theta \, d\phi = \eta_e \qquad \text{efficiency}$$

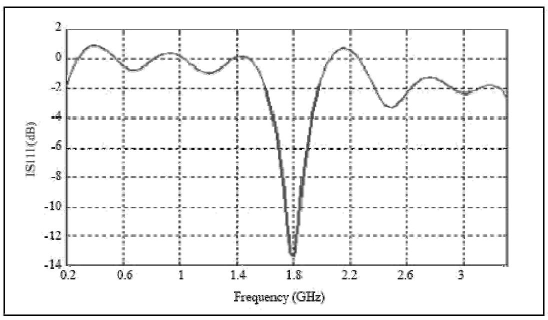
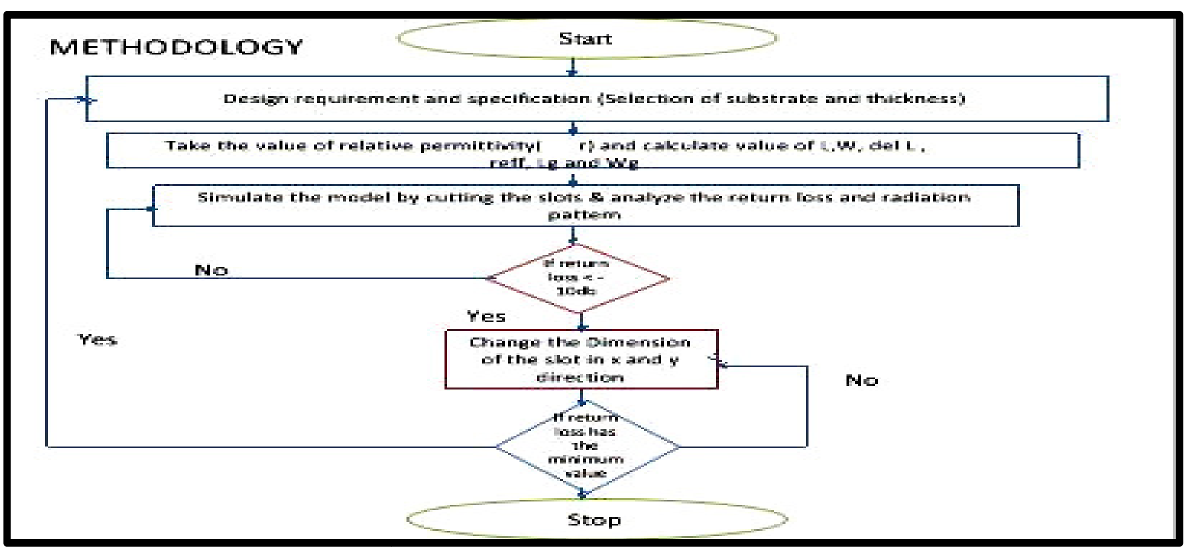


Figure 4.1.5 – RL curve of an antenna

5. FLOW CHART



4.1.3 Effective Area

Antennas capture power from passing waves and deliver some of it to the terminals.

$$P_d = S A_{\text{eff}}$$

4.1.4 Directivity

Directivity is a measure of the concentration of radiation in the direction of the maximum.

$$\text{directivity} = \frac{\text{maximum radiation intensity}}{\text{average radiation intensity}} = \frac{U_{\max}}{U_0}$$

4.1.5 Return Loss

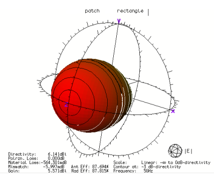
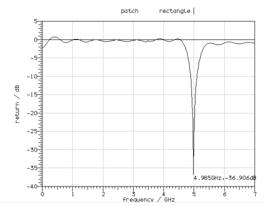
It is a parameter which indicates the amount of power that is “lost” to the load and does not return as a reflection. Hence the RL is a parameter to indicate how well the matching between the transmitter and antenna has taken place. Simply put it is the S11 of an antenna. A graph of s11 of an antenna vs frequency is called its return loss curve. For optimum working such a graph must show a dip at the operating frequency and have a minimum dB value at this frequency. This parameter was found to be of crucial importance to our project as we sought to adjust the antenna dimensions for a fixed operating frequency (say 5 GHz).

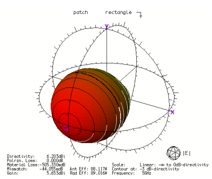
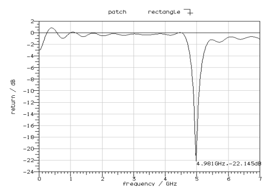
6. RESULTS AND DICUSSION

The software used to model and simulate the micro strip patch antenna. It's working on CST MICROSTRIPS Software It has been widely used in the design of patch antenna, wire antenna, and other RF/wireless antenna designs. It can be used to determine and plot the reflection parameters, Voltage Standing Wave Ratio (VSWR), current distributions as well as the radiation patterns.

ITERATION RECTANGULAR PATCH

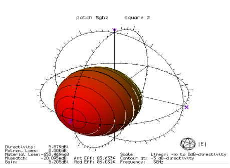
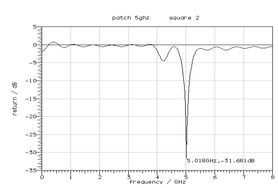
ITERATION PATCH No. Rectangular	RESONANCE FREQUENCY (fr)	RETURN LOSS (S11) in dB	ANTENNA EFFICENCY %	RADIATION EFFICENCY %	DIRECTIVITY (dbi)	GAIN (dbi)	BANDWIDTH (BW)
1	4.985 GHz	-36.906 db	87.694%	87.815%	6.115 db	5.571 db	0.04252 =4.252
2	4.980 GHz	-13.661 db	82.610%	86.702%	6.115 db	5.285 db	0.03052 =3.052
3	4.981 GHz	-13.627 db	82.589%	86.697%	6.129 db	5.284 db	0.03031 =3.031
4	4.980 GHz	-11.822 db	80.657%	86.687%	6.421 db	5.180 db	0.02409 =2.409
5	4.981 GHz	-11.759 db	12.313%	64.086%	6.116 db	-2.676 db	0.02409 =2.409
6	4.980 GHz	-10.537 db	78.662%	86.641%	6.117 db	5.074 db	0.01425 =1.425
7	4.981 GHz	-22.145db	88.117%	89.016%	6.203 db	5.653 db	0.03854 =3.854

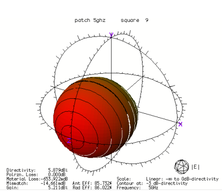
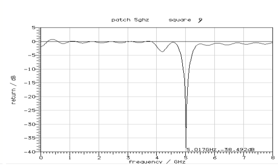



ITERATION SQUARE PATCH

ITERATION PATCH No. Rectangular	RESONANCE FREQUENCY (fr)	RETURN LOSS (S11) in dB	ANTENNA EFFICENCY %	RADIATION EFFICENCY %	DIRECTIVITY (dbi)	GAIN (dbi)	BANDWIDTH (BW)
1	4.945 GHz	-11.623 db	78.793%	87.329%	6.150 db	5.114 db	0.02244 =2.244
2	5.018 GHz	-31.681db	85.633%	86.031%	5.879 db	5.205 db	0.03985 =3.985
3	4.993 GHz	-10.524 db	78.075%	85.733%	5.990 db	4.915 db	0.01421 =1.421
4	5.019 GHz	-38.014 db	85.747%	86.148%	5.879 db	5.211 db	0.03964 =3.964
5	5.019 GHz	-34.841 db	85.748%	85.748%	5.984 db	5.211 db	0.0402 =4.02
6	5.028 GHz	-14.847 db	83.470%	86.852%	5.984 db	5.199 db	0.03620 =3.62
7	5.007GHz	-10.643 db	79.686%	87.773%	5.982 db	4.996 db	0.01857 =1.857
8	5.007 GHz	-10.694 db	79.773%	87.216%	5.983 db	5.002 db	0.01877 =1.877
9	5.017 GHz	-38.492db	85.732%	86.022%	5.879 db	5.211 db	0.04046 =4.046

7. CONCULSION

We compare the rectangular and square and which one of the best is rectangular and square. The rectangular is maximum return loss and square is minimum return loss.

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