Microstrip Patch Antenna Design with Different Feed Technique

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***Abstract*: While designing an antenna various parameters are considered for its performance .In this paper two antennas are designed high bandwidth antenna is designed and results are simulated on CST Microwave Studio software. Further, a comparison is made between microstrip line antenna and microstrip patch antenna with co-axial feeding. The simulated results show that the microstrip patch antenna with co-axial feeding gives better results over microstrip line designed antenna has higher bandwidth.**

***Index Terms:* Antenna, Microstrip patch antenna, Bandwidth, Simulation**

Introduction

An antenna is a device for transmitting and receiving electromagnetic signals. Application of antenna is increasing very fast as the technology is following advance trends .Maim application of antenna is in communication system for receiving and transmitting signals, to cover long distance antenna's parameter are set to get desired results. For covering long distance bandwidth should be higher for smooth communication system working.

The microstrip antennas is one of the most commonly used antennas in communication system. It has attracted a lot of attention because of their advantages such as ease of fabrication simple structure, easy integration with microwave integrated circuits. Geometric shape of a microstrip antenna comprises a radiating element on the dielectric substrate and on the other side a ground plane, as illustrated in Figure 1. There are several category of the microstrip patch antenna, can be cited some example the circular, a square radiating element, triangular, semicircular..., but the most common is rectangular element [1][2].

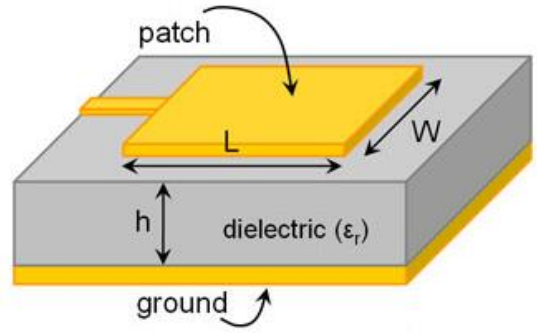


Figure 1. Rectangular Patch Antenna

II.FEEDING TECHNIQUES OF MICROSTRIP ANTENNA

The patch antennas may be powered with many methods. The processes feeding are categorized in two methods:

- In category contacting, the feeding technique is powered by means of a connecting element such as a microstrip line into the radiating patch

. • Without contact category, a transfer of power between the microstrip line and radiating element is performed with the electromagnetic field coupling. The most famous feeding techniques employed in the microstrip patch antenna are: coaxial probe, feeding technique with microstrip line and aperture or proximity coupling methods.

Feeding Techniques In this kind of feeding process (Figure.2), the edge of the microstrip patch is connected directly to a conducting strip. This feeding method offers the benefit that the conducting line can have the opportunity of engraved on same substrate of patch antenna providing a planar shape. The width of conducting element is smaller as compared at the patch antenna.

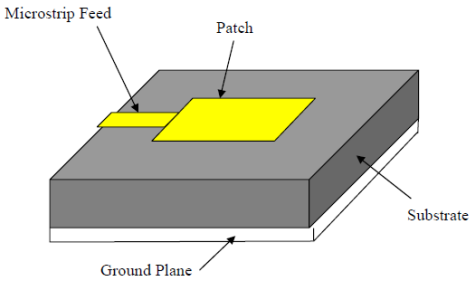


Figure 2. Microstrip line technique

Coaxial Probe Feeding Techniques The outside conductor of a coaxial connector attached at ground plane, while the inside is extends across the dielectric and is welded at the radiating element antenna. However, the disadvantage of this technique is a difficult to model and produce à narrow bandwidth. Figure 3 show this type of feed technique.

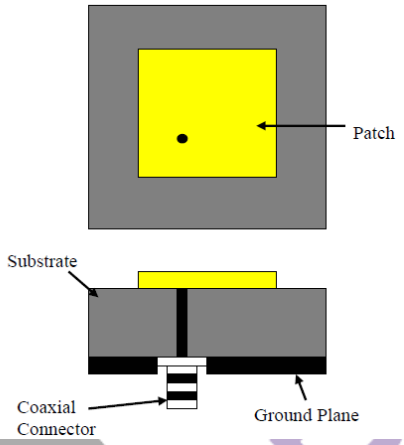


Figure 3.Co-axial Probe Feed

Feeding Techniques With Proximity coupled This feeding technique (Figure.4) utilized two dielectric substrates in order that the feed line, firstly, is between two substrates and on the other hand the radiating element is on top of the upper substrate.

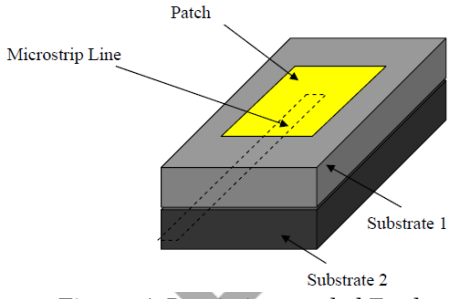


Figure 4. Proximity coupled Feed

Aperture coupled feed This type of feed technique (Fig.5), a microstrip feed line is separated by the ground plane to the radiating patch. The feed line and the radiating element is coupled through an aperture or a slot in the ground plane . The variations in the coupling will depend of width and length of the slot to improve the simulation result of bandwidths and return losses. The slot is usually centered under the radiating element [4] [5].

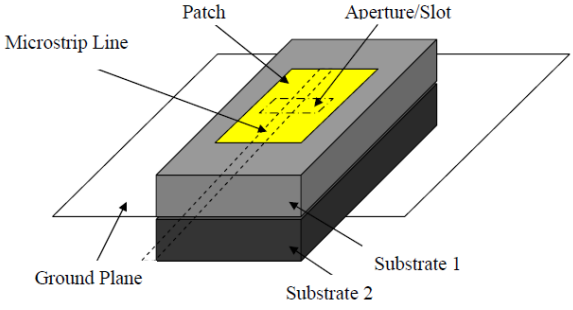


Figure 5. Aperture coupled feed

III DESIGNING PARAMTERS OF RECTANGULAR PATCH ANTENNA

A rectangular microstrip antenna is conceived for a communication application, which is operating at a frequency of 2.3 GHz. The basic steps for the development of rectangular patch antenna (RPA) are:

Step 1: A parameter Width of the radiating RPA is compute from this equation:

$$W = \frac{C}{2f_r}\sqrt{\frac{2}{\varepsilon_r + 1}} \tag{1}$$

Where

c: velocity of light, 3*108 m/s,
εr :dielectric constant of the substrate.
fr : resonant frequency of antenna

Step 2: Effective Dielectric constant of the PRA is determined as:

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(\frac{1}{\sqrt{1 + \frac{2h}{W}}}\right) \tag{2}$$

Step 3: The effective length is specified at the resonance frequency

$$L_{eff} = \frac{C}{2\,fr\sqrt{\varepsilon_{eff}}} \tag{3}$$

Step 4: Extension length of the PRA compute with this equation:

$$\Delta L = h * 0.412 * \frac{(\varepsilon_{eff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{eff} - 0.258)\left(\frac{W}{h} + 0.8\right)} \tag{4}$$

Step 5: The length " L" of the PRA is calculates as:

$$L = L_{eff} - 2\Delta L \tag{5}$$

Step 6:The ground plane dimensions:

$$L_g = 6h + L \tag{6}$$

$$W_g = 6h + W \tag{7}$$

The patch dimension is W= 37 mm * L=14 mm. The ground plane length and width are calculated as Lg=49 mm and Wg= 58 mm respectively. The proposed rectangular patch antenna is designed using CST Microwave Studio software.

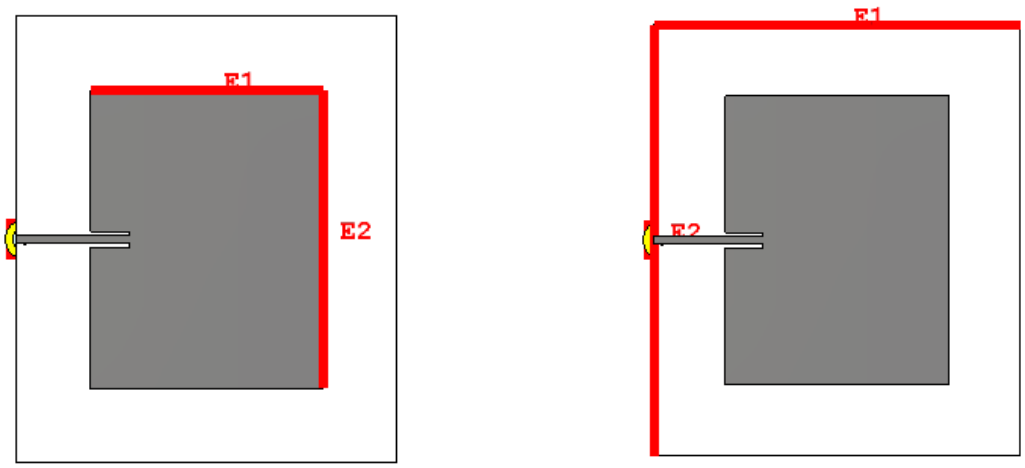
IV .DESIGN OF AN ANTENNA

In this paper two antennas are designed all the dimensions are same except that two different feeding techniques are used,which are as follows:

a) Microstrip patch Antenna with line technique:

Here microstrip patch antenna is designed with dimensions:

The patch dimension is W= 37 mm * L=14 mm. The ground plane length and width are calculated as Lg=49 mm and Wg= 58 mm respectively. The proposed rectangular patch antenna is designed using CST Microwave Studio software. Figure 6(a) shows the dimensions of patch and Figure 6(b) shows dimensions of ground plan.



(a) (b)

Figure 6.Dimensions of patch and ground plan of Microstrip patch Antenna with line technique

The above design is simulated and gives Return loss simulation result as shown in figure 7.

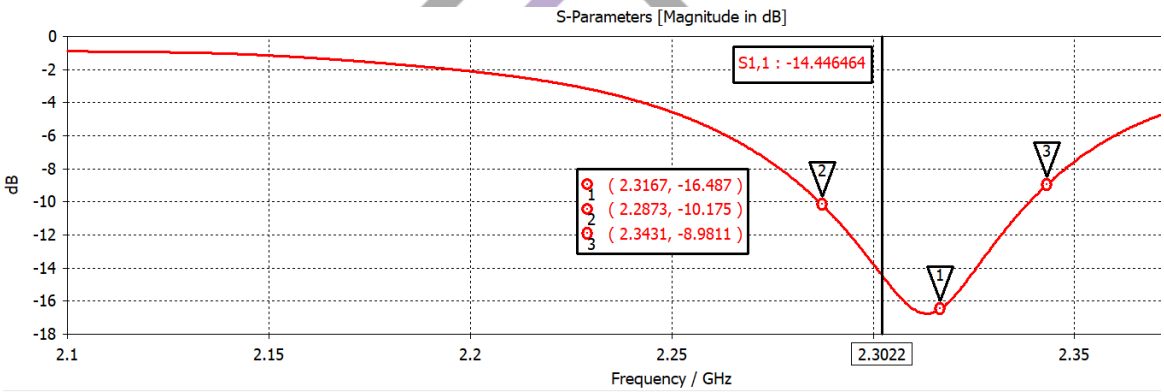


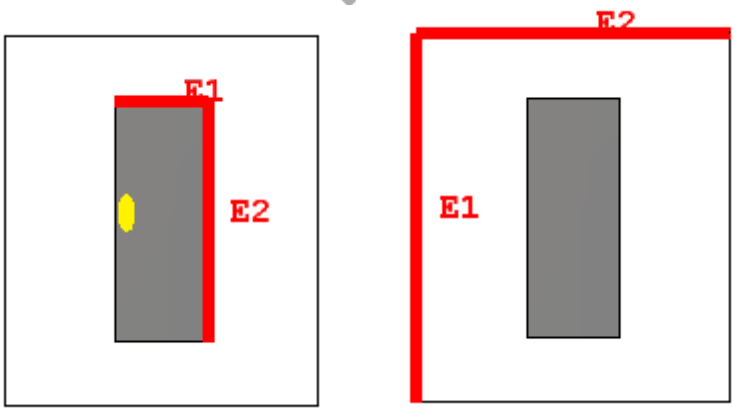
Figure 7. .Return loss of microstrip patch antenna with line technique.

After the simulation of the microstrip patch antenna with line technique, it was found that the bandwidth is 558 MHz and return loss of -16.7db.

(b) Microstrip patch Antenna with co-axial feeding technique:

Here microstrip patch antenna is designed with dimensions:

The patch dimension is W= 37 mm * L=14 mm. The ground plane length and width are calculated as Lg=49 mm and Wg= 58 mm respectively. The proposed rectangular patch antenna is designed using CST Microwave Studio software. Figure 8(a) shows the dimensions of patch and Figure 8(b) shows dimensions of ground plan.



(a) (b)

Figure 8.Dimensions of patch and ground plan of Microstrip patch Antenna with co-axial feed technique

The above design is simulated and gives Return loss simulation result as shown in figure 9.

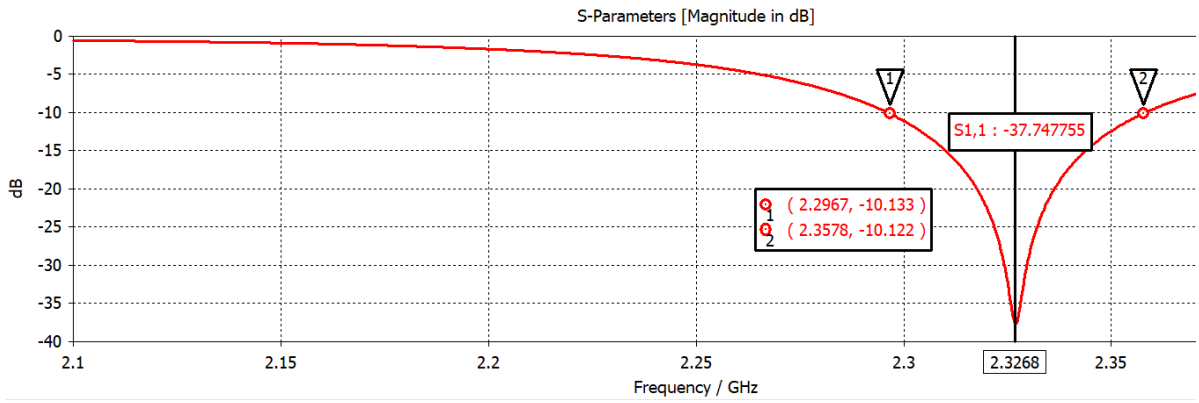


Figure 9. .Return loss of microstrip patch antenna with co-axial feed technique.

After the simulation of the microstrip patch antenna with co-axial feed technique, it was found that the bandwidth is 611 MHz and return loss of -37db.

V.CONCLUSION

From the above results of microstrip patch antenna it is found that by using co-axial feeding we get greater band width with respect to line feed technique as well as return loss. By using co-axial feed technique there is 9% increment in bandwidth .from above results it is clear that co-axial feed technique is better than line technique.

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