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Designing and Simulation of Three T-Slotted Antenna using double feeding method

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Abstract*: Antenna plays an important role in communication system. Different types of antennas are used for different applications. Patch antenna is a special kind of antenna which is used because of its small size and easily mounted of other devices. A three T-shapped microstrip patch slotted antenna is prposed in this paper The proposed antenna consists FR4 substrate with relative permittivity of 4.4, loss tangent 0.001. The thickness of substrate is 1.6 mm on which a patch is taken and eitched T-slots. The proposed work is simulated using Transmission line feed and probe feed by IE3D software. This optimized design of proposed antenna by varying dimension of this slotted antenna, 0-4 GHz frequency range having bandwidth 44.6% for transmission line feed and 8- 16 GHz having bandwidth of 9.8%. This proposed antenna is used for different frequency band, Wi-Max, and WLAN application.

Keywords: *Microstrip patch antenna,T- slotted antenna, WLAN, coaxial feed..*

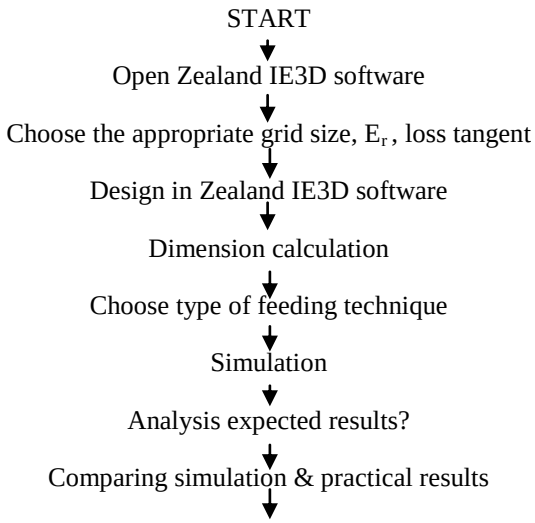
I INTRODUCTION

In communication system we use many techniques to transfer information from source to receiver. These techniques can be wired and wireless, one from these is antenna .Antenna is a device which helps to communicate, transmit and receive signals. In antenna we have many different types one of them is slotted microstrip patch antenna. The slotted microstrip patch antenna uses in the modern wireless communication .These antenna are small in size, less weight, and cheap. In ISM band, aforesaid antennas can be used in Satellite communication, near field communication (NFC), Bluetooth devices and Cell phones [1]. The materials used for micro strip patch are copper and gold. In the proposed antenna basically two feeding techniques are used. First one is Transmission line feed and second is probe feed. Fabrication techniques are used to fabricate the micro strip antennas [1]. The design simulated using IE3D Software [2] for parameters like return loss, VSWR, smith chart, Radiation pattern and the comparison of these results is reported. This result shows the comparison of return loss, bandwidth, VSWR on two different feeding methods.

II ANTENNA DESIGN

In the proposed slotted microstrip patch antenna, slots are cut on a simple patch for getting desired results. In this proposed work the basic parameters used are in mgrid and the grid size of the patch is 0.025mm, top surface is 1.6, the dielectric constant is FR4 substrate and the loss tangent is 0.001. The thicher substrate is mechanically strong and it will increase the radiated power, improve impedance, bandwidth and reduces the loss. These are the basic parameters of proposed patch antenna. As the proposed antenna consists rectangular patch so the length and width of the patch is 10-10(mm). The design antenna is used for broadband frequency, Wi-Max. The design frequency of this antenna is 0-4 GHz and 8-16 GHz for transmission and probe feed respectively.

A. Steps of designing antenna in IE3D software



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With all these steps we use two types of feeding methods in this paper transmission line feed and coaxial probe feed. In last we compare the results of these two feeding techniques which are microstrip line feeding and coaxial line feeding.

B. Microstrip Line Feed

In this type of feed technique, a conducting strip is connected directly to the edge of the micro strip patch as shown in Figure 1. The conducting strip is smaller in width as compared to the patch and this kind of feed arrangement has the advantage that the feed can be etched on the same substrate to provide a planar structure [1].

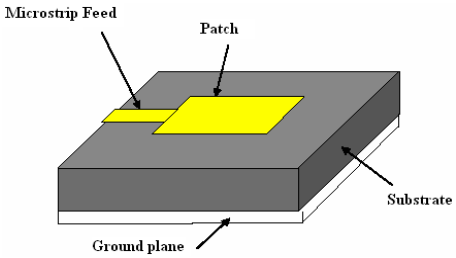

Figure 1: Microstrip Line Feed

C. Coaxial Feed

The Coaxial feed or probe feed is a very common technique used for feeding Micro strip patch antennas[14]. As seen from Figure 2, the inner conductor of the coaxial connector extends through the dielectric and is soldered to the radiating patch, while the outer conductor is connected to the ground plane [1].

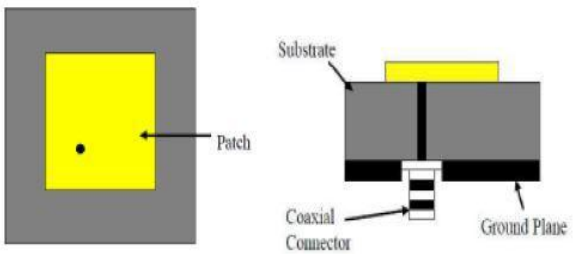

Figure 2: Coaxial Feed

D. Design Parameters

the following parameters are used for designing the proposed antenna:-

(i) Effective Dielectric constant:-

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}} \quad (1)$$

Where:

h- Height of substrate

ε_r - Dielectric constant of given material

W - Width of the Patch

ε_{reff} - Effective dielectric constant

(ii) Extended length:-

$$\Delta L = 0.412h\frac{\left(\varepsilon_{reff} + 0.3\right)\left(\frac{W}{h} + 0.264\right)}{\left(\varepsilon_{reff} - 0.258\right)\left(\frac{W}{h} + 0.8\right)} \quad (2)$$

(iii) Effective length:-

$$L_{eff} = L + 2\Delta L \quad (3)$$

(iv) Width of the patch:-

$$W = \frac{c}{2f_0\sqrt{\frac{(\varepsilon_r + 1)}{2}}} \quad (4)$$

Where c - speed of light

By using these parameters practical results of the design is achived.. Now the results of proposed design using both techniques are follow as :-

III SIMULATION RESULTS

A. Design and results using transmission feeding

Patch size of propose antenna is 10-10mm (L,W) respectively the feeding length is -5mm as shown in figure 3 below. In this design t slot is cut for the range of frequency 8-16Ghz. By using probe feed.The return loss, bandwidth, radiation pattern, gain,VSWR are shown in table 1.

Figure 4 represents the variation in return loss with respect to frequency. Value of VSWR can be calculated at a particular frequency with the help of figure 5. The values of impedance ,VSWR and reflection coefficient can be calculated by using smith chart which is shown in figure 6.

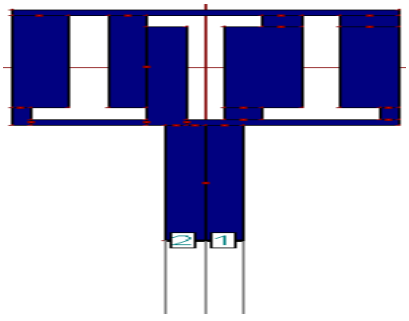

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Figure 3: Model of antenna using transmission line feed

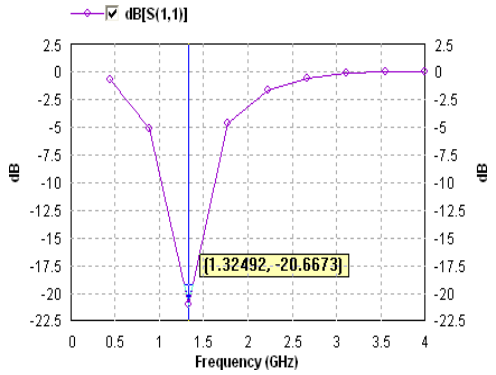

Figure 4 Frequencies vs. Return Loss

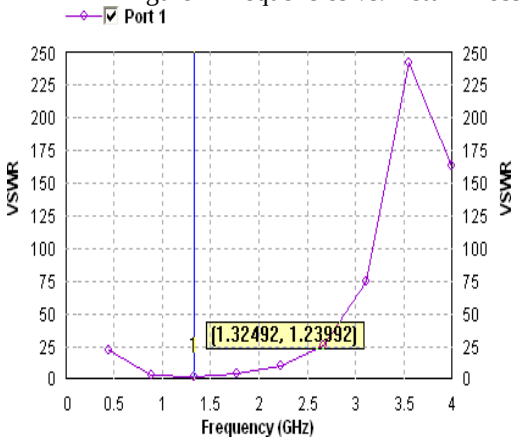

Figure 5: Frequencies vs. VSWR

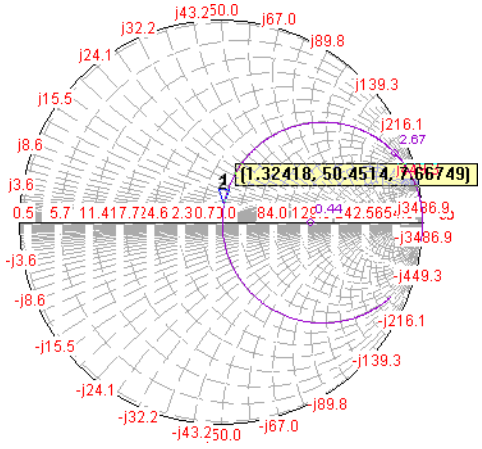

Figure 6: Smith chart

B. Design and results using coaxial probe feeding

Patch size of propose antenna is 10-10mm (L,W) respectively having feed points0.3,5 as shown in fig 3 below . In this design we cut t slots and the frequency range is 8- 16 GHz resonant at 13.33 GHz. After designing we perform simulation by using probe feed. The proposed antenna is operated at 11-20 GHz. The return loss, bandwidth, radiation pattern, gain,VSWR are shown in table 1.

After designing simulations are performed by using probe feed [15]. Proposed model using probe feeding is shown in figure 7. The value of return loss can be calculated at a particular frequency which is represented in figure 8. Variation in the value of VSWR with frequency can be measured from the figure 9. And figure 10 represents the VSWR and impedance value on the smith chart.

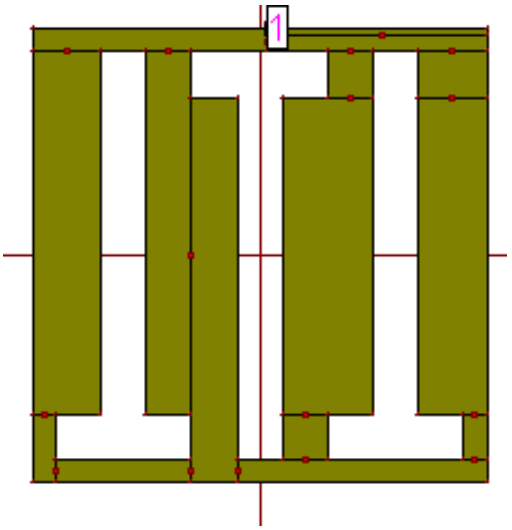

Figure 7: Model of antenna using probe feed

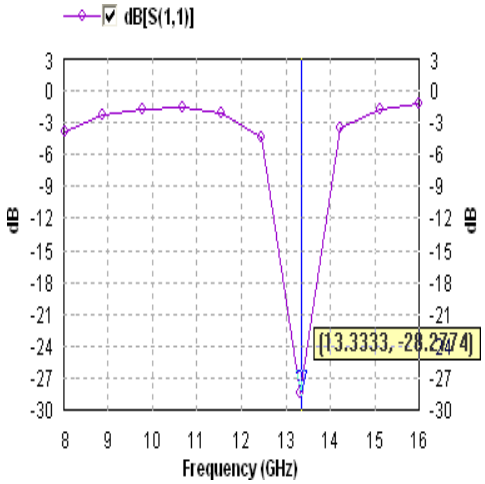

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Figure 8: Frequencies vs. Return Loss

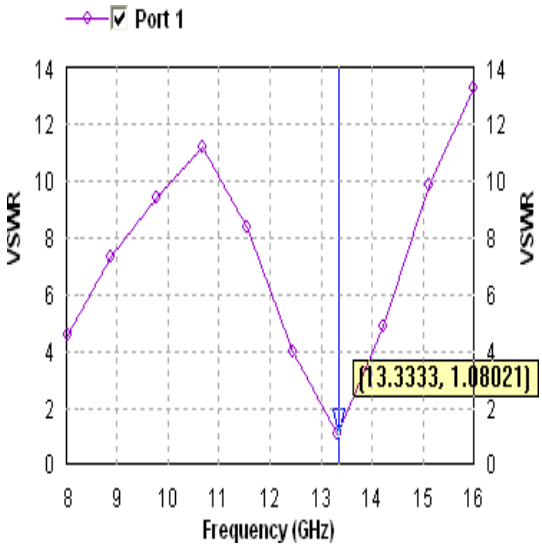

Figure 9: Frequencies vs. VSWR

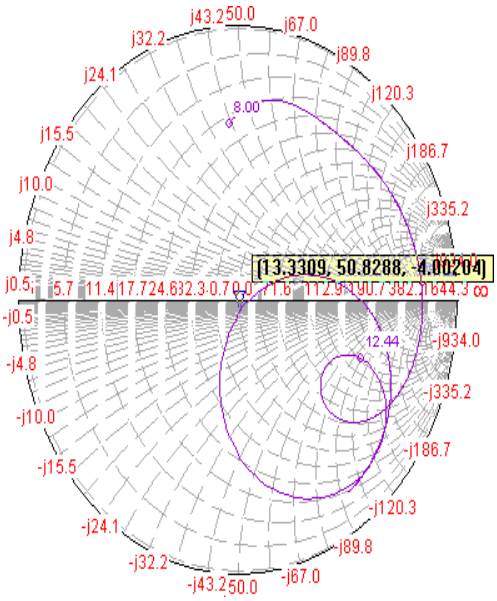

Figure 10: Smith chart

TABLE 1: COMPARISON OF RESULT

Feeding Techniques	Transmission Line Feed	Coaxial Line
Resonant frequency	1.32492GHz	13.33GHz
Band width	44.6%	9.8%
VSWR	1.2399	1.08
Return loss	-20.6673db	-28.27db

Table 1 represents experimental values of proposed work for transmission line feeding and coaxial feeding. Results shows that transmission line feeding provides more bandwidth compared to coaxial line feeding.

IV RESULT AND CONCLUSION

At last we conclude that the proposed antenna performance was simulated & optimized by IE3D software. The simulated result were obtained at the frequency range of 0-4, 8-16 GHz for transmission and probe feed respectively. The return loss of transmission line feeding is -20.696 db resonant at 1.32492 GHz and -28.27 db for probe feeding resonant at 13.33 GHz. After comparision we conclude that the result of antenna in transmission line feed is more negative than probe feeding as shown in table 1. The bandwidth of proposed antenna is 44.6% for transmission line feed and 9.8% for probe feed which is suitable for wideband frequency WLAN and Wi-Max.

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