REVIEW PAPER ON COMPARATIVE ANALYSIS OF MICROSTRIPLINE AND COAXIAL FEEDING TECHNIQUES FOR DIFFERENT MICROSTRIP PATCH ANTENNAS

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Abstract

In this paper, performance analysis of microstrip line feeding and coaxial feeding is made for rectangular and square patch antennas designed for same frequency. The square patch antenna resonates at 3.4GHz and 3.42GHz and the rectangular patch antenna resonates at 3.42GHz and 3.45GHz frequencies. The design, model and simulation of two different types of microstrip patch antennas have been studied. The frequency operation for square patch antenna with microstipline feeding technique gives the impedance bandwidth of 0.91% which is 2.25% more when compared to coaxial feeding. Similarly the frequency for rectangular patch antenna with microstripline feeding technique also studied. For this model the impedance bandwidth shown here is 2.45%. But with coaxial feeding technique the rectangular patch antenna shows bandwidth enhancement of 17.96%. The variation in the resonating frequency, return loss, bandwidth and gain of proposed antennas due to the different feeding technique using different shape of radiating patches has been discussed and presented. These antennas find applications in WLAN and Wi-Fi connectivity.

Keywords: *Coaxial feeding technique, equilateral triangular microstrip antenna, microstripline feeding technique, microstrip patch antenna*

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1. INTRODUCTION

Microstrip patch antennas (MPAs) are attractive for their well known efficient features such as compatability with monolithic microwave integrated circuits. The Utilization of MPAs has become diverse because of their small size and light weight. Rapid cost effective fabrication is especially important when it comes to prototyping of antennas for their performance evolution. As wireless applications require more and more bandwidth, the demands for wideband antennas operating at higher frequencies become inevitable [1]. Inherently microstrip antenna has narrow bandwidth and low efficiency and their performance greatly depends on the substrate parameters such as its dielectric constant, uniformity and loss tangent. In this regard several comparative studies have been performed.

MPAs can be fed in a variety of ways: 1) Contacting and 2) Non-contacting. In contacting method RF power is fed directly to the radiating patch using a connected element, they are microstrip feed and coaxial feed [1-3]. In non-contacting method electromagnetic coupling is done to transfer the power between the feedline and radiating patch they are aperture coupled feed and proximity coupled feed [1, 3, 6]. In this study a comparative analysis has been done considering coaxial and microstrip line feeding techniques [2]. Mirostrip antennas have found applications especially in the field of medical, military, mobile and satellite communications. The antennas are simulated using HFSS software.

2. DESCRIPTION OF THE ANTENNA GEOMETRY

The patch has been designed on FR4 substrate of relative permittivity 2.4 and thickness (h) 1.2mm. The substrate material chosen for this study have low cost and convenient availability. Hence can be used for microstrip antenna array prototyping. Here to start with simple microstrip patch antenna with coaxial feed is designed for rectangular microstrip antenna (RMA) and square microstrip antenna (SMA). The geometry of co-axial fed antenna is as shown in figure 1. In this feeding the inner conductor of the coaxial connector extends from the ground plane through the substrate and is soldered to the radiating patch while the outer conductor extends from ground up to substrate [5]. Impedance matching is done using probe position.

Similarly, for microstripline feeding technique (MFT) the patch has been designed on FR4 substrate of relative permittivity 2.4 and height (h) 1.6mm. The geometry of microstripline fed antenna is as shown in figure 2. The main advantage of microstrip line feed is one of the easier method to fabricate and therefore can be considered as extension of patch. It is simple to model and easy to match by controlling the inset position. As the substrate thickness increases, as surface wave spurious feed radiation increases which limits the bandwidth. This is the main disadvantage of this method [2].

3. EXPERIMENTAL RESULTS

The obtained bandwidth for this co-axial feeding technique (CFT) for SMA and RMA are 0.89 to 2.89% [2, 5] respectively. The main advantage of this type of feeding scheme is that the feed can be placed at any desired location inside the patch in order to properly match with its input impedance. This method is easy to fabricate and has low spurious radiation. Its major drawback is that it provides narrow bandwidth and is difficult to model, since a hole has to be drilled in the substrate and connector protrudes outside the ground plane. Thus making it completely planar for thick substrates, the bandwidth can be improved by various methods [2].

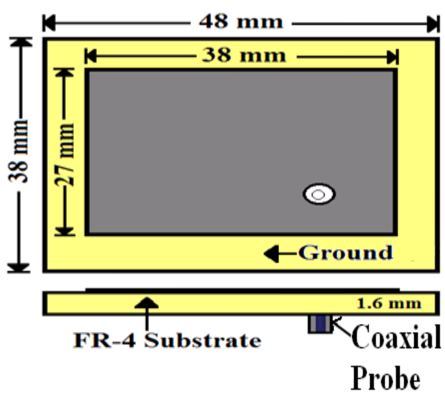


Fig – 1: Coaxial microstrip patch antenna

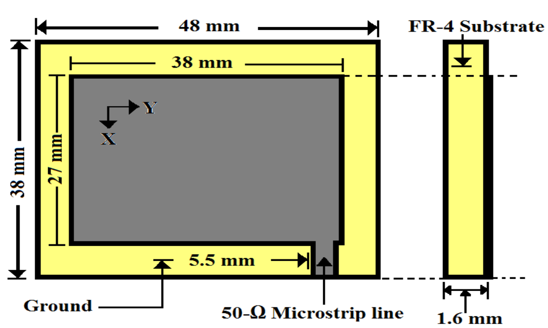
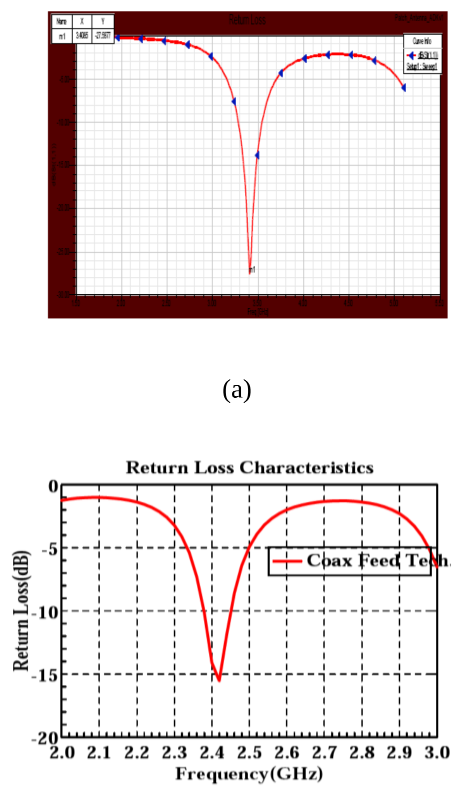


Fig – 2: Microstripline fed patch antenna

The return loss curve for the square and rectangular patch antenna using coaxial feeding is −28.5dB and −15.52 dB which is shown in figure 3(a) and 3(b). The impedance bandwidth of coaxial fed SMA and RMA are 0.89% and 2.89% respectively. Similarly, variation of return loss less than −10dB versus frequency of microstripline fed RMA is measured and as shown in figures 4(a) and 4(b). The impedance bandwidth for SMA and RMA is 0.91% and 2.45% respectively [2-5].

4. RESULT ANALYSES

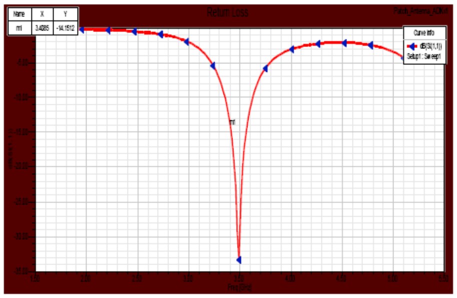
The variation of return loss less than –10dB versus frequency for the proposed antennas is measured. The impedance bandwidth of RMA with co-axial feed technique shows 17.96% enhancement when compared to the MFT. But, for the SMA with MFT 2.25% improvement is achieved when compared to CFT. The SMA and RMA both antennas shows gain enhancement through CFT. This shows the superiority of CFT in achieving gain enhancement rather the bandwidth enhancement. The gain of SMA with CFT is 121.25 times more when compared to the MFT. Similarly for RMA the gain is 1.4 times more with CFT than MFT. We notice that for the CFT the gain is more as compared to the MFT.



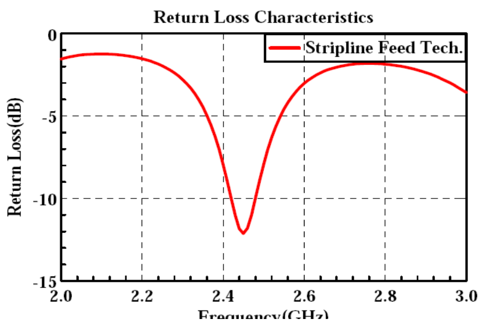
(a)

(b)

Fig – 3: Variation of return loss versus frequency for coaxial fed (a) SMA and (b) RMA.



(a)



(b)

Fig – 4: Variation of return loss versus frequency for microstripline fed (a) SMA and (b) RMA.

From the observations the coaxial feed technique gives the better results as compared with the microstripline feeding technique as return loss and gain are concerned. The resonating frequency, return loss, bandwidth and gain of proposed antennas for the study are tabulated in Table 1.

Table -1: Comparison table for CFT and MFTs with different antenna parameters

Types of feeding techniques	**Frequency in (GHz)**	**Return loss in (dB)**	**Band-width in (%)**	**Gain in (dB)**
CFT 1)square 2)recangular	3.4 2.4	-28.5 -15.52	0.89 2.89	7.93 1.2
MFT 1)square 2)rectangualr	3.4 2.4	-14.1 -12.13	0.91 2.45	0.0654 0.862

5. CONCLUSIONS

The proposed square and rectangular patch antennas studied here are designed by coaxial feeding and microstripline feeding techniques. Their output parameters are comparatively studied, analysed and presented in this paper. The study conclude that, the coaxial feeding technique has more advantageous for antenna parameters , such as return loss, gain and input impedance in specified frequency range as compared to the microstrip line feeding technique. Overall the coaxial feeding is giving better results for all antenna parameters compared to microstrip line feeding excluding bandwidth. Such antenna finds applications in WLAN and WI-FI connectivity.

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BIOGRAPHIES

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