International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 9, September- 2014

Series-fed Microstrip Patch Antenna Array

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***Abstract*— There are many types of microstrip patch antenna that can be used for applications of communication systems. This paper presents the design of a series-fed microstrip patch antenna array to operate at the frequency of 3.4 GHz. Two types of feeding techniques are used here. One is transformer feed and the other one is inset feed. This antenna array is based on FR-4 substrate material. The proposed array antenna is designed on HFSS simulation software. After simulation, the antenna performance characteristics such as return loss, VSWR and radiation Pattern are measured.**

Keywords— Microstrip patch antenna array, transformer feed, inset feed, FR-4.

I. INTRODUCTION

Antennas play a very important role in the field of wireless communication system. Some of the antennas are parabolic reflector antennas, micro-strip patch antennas, slot antennas, and folded dipole antennas and each type having their own properties and use. It is perfect to categorize antennas as the backbone and the driving force behind the latest advances in wireless communication technology. Microstrip antennas have found applications mainly in the field of medical, military, mobile and satellite communications. Their usage has become diverse because of their small size and light weight. Fast and cost effective fabrication is especially essential when it comes to the prototyping of antennas for their performance estimation.

A Microstrip Patch antenna comprises of a patch element, which is a radiating material on one side of a dielectric substrate and a ground plane on the other side of it. Because of the presence of the fringing field between the patch edges and ground plane, micro-strip patch antennas primarily radiate. Micro-strip antennas are having a larger number of physical considerations as compared to conventional antennas. They can be designed with many geometrical forms and dimensions.

In this paper, the design of series-fed microstrip patch antenna array for communication system applications is presented. This antenna is designed on FR-4 substrate and its performance characteristics which include Return Loss and gain are obtained from the simulation. Three element array is designed in which basic element is transformer fed and the other two elements are inset-fed. In order to improve the performance of the array antenna open circuited stubs are also used on the transmission line. The proposed array antenna is simulated by using Ansoft HFSS software. Fig 1 shows the single microstrip patch antenna.

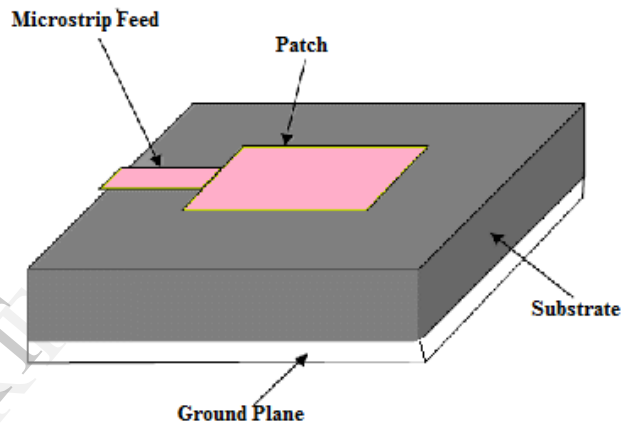

Fig. 1: Single Microstrip Patch Antenna

II. ANTENNA GEOMETRY

Micro strip antenna consists of very small conducting patch which can take any possible shape like square, triangular, circular, and rectangular. In this paper Square Micro strip Patch antenna is used because square patch antenna have few benefits, including the cheap price, flexibility, and ease of manufacture. To achieve high directivity, low profile nature is obvious as well as small size of antenna is required. Metallic patch placed on a small portion of wavelength above a ground plane. Dielectric substrate material separates the two, the patch element and the ground plane. The radiating patch and the feed lines are designed on the substrate material using etching technique.

Micro strip antennas have limitations of low bandwidth and low gain. The bandwidth of the micro-strip patch antenna can be increased by using U-shaped slots or stacked patch configuration. This paper shows the configuration of proposed microstrip array antenna. It is composed of three radiating patches, one is transformer fed and the other two patch elements are fed by inset feeding. As the magnitude of current is small at the ends of a radiating patch and it rises in magnitude toward the centre of the patch, the input impedance of the patch could be reduced if the patch is fed closer to the centre. This is done by using an inset

feeding technique. Microstrip Patch antenna with inset feeding is shown in Fig 2.

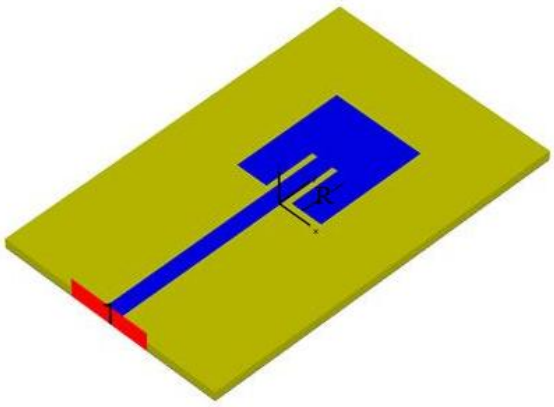

Fig. 2: Inset feed patch antenna

The voltage is also decreased by the equal amount that the current increased. Hence, using Z=V/I, Equation 1 represents the input impedance of patch antenna

$$Zin\ (R) = Cos2\ (\Pi\ R/L)\ Zin\ (0) \qquad (1)$$

Fig 3 shows the configuration of three element microstrip patch antenna array.

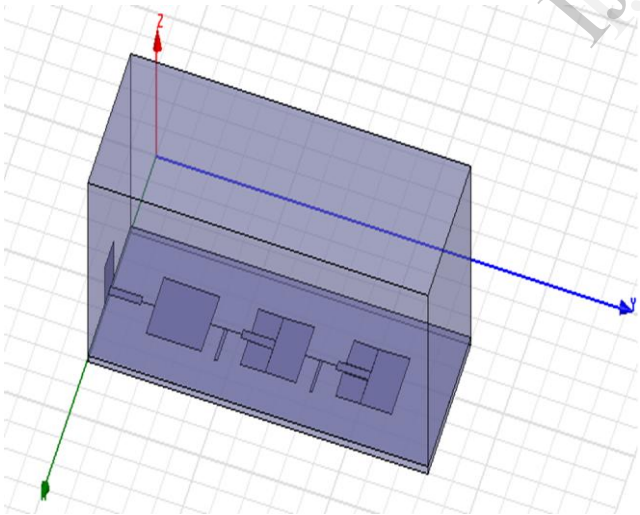

Fig 3: Geometry of proposed 3 element array antenna

III. DESIGN REQUIREMENT

The design frequency is 3.4 GHz. FR-4 substrate material is selected for designing array antenna whose dielectric constant is 4.4 The substrate's dielectric constant is an essential design parameter. The small value of dielectric constant upturns the fringing field at the patch edges and thus the radiated power is increased.

Substrate thickness is another important design parameter. Thick substrate material again increases the fringing field at the patch edges like low dielectric constant and thus increases the radiated power. Hence, the height of dielectric substrate used in this design is h= 1.6mm.

The dimensions of feed line and square patch are 12.359 mm x 3.063 mm and 21.23 mm x 21.23 mm respectively with inset feed at 11.915 mm.

IV. SIMULATIONS AND RESULTS

Fig 4 presents the simulated return loss of proposed array antenna. The simulation is done by using the commercially available electromagnetic simulation software HFSS (high frequency structure simulator).

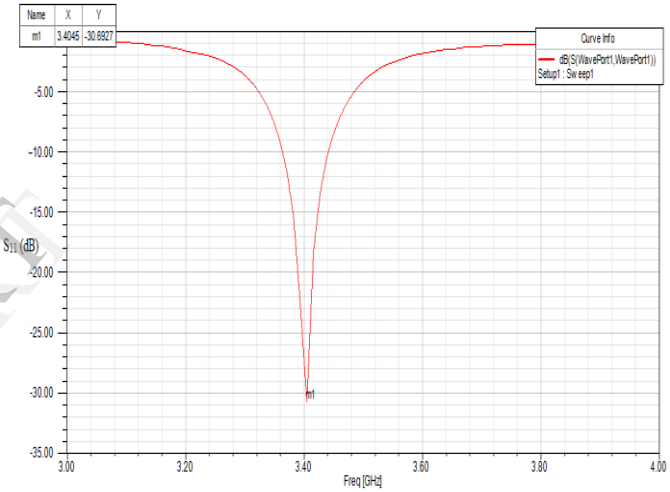

Fig 4: Simulated Return Loss of proposed array

Fig 5 shows the voltage standing wave ration, which is 1.06 at the frequency of 3.4 GHz.

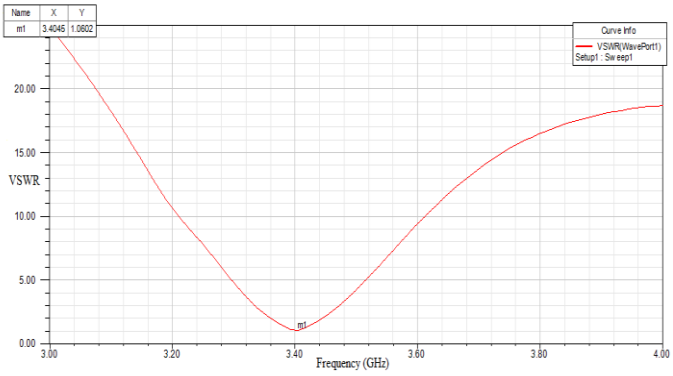

Fig 5: Simulated VSWR of proposed array

The radiation pattern is used to represent the radiation properties of antenna as a function of space coordinates. Fig 6 shows the radiation pattern of array antenna.

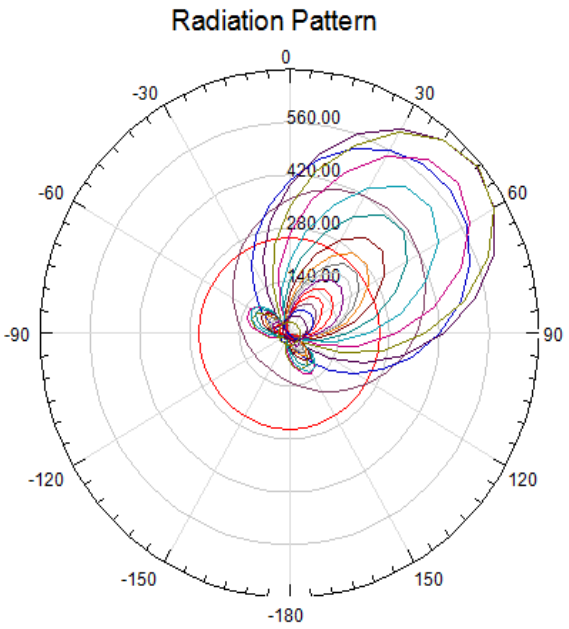

Fig 6: Radiation Pattern of array antenna

V. CONCLUSION

In many applications essentially in wireless communication, it is essential to design very high directive antennas to meet the demand of long distance communication. An array antenna design with two feeding techniques has been successfully designed and simulated. Besides representing, return loss and VSWR of -30.69 dB and 1.06 have been obtained respectively. The simulation results show that the Inset feeding technique provides good impedance matching as compared to the other feeding techniques. Thus, the proposed array antenna is suitable for wireless communication system application.

ACKNOWLEDGMENT

We sincerely thank Ajay Kumar Garg Engineering College for providing the framework to accomplish our work.

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