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Design and Simulation of Reconfigurable E-Shaped Microstrip Patch Antenna for Wireless Communication

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***Abstract* – Microstrip patch antenna widely used in communication area because it offers low profile, narrow bandwidth, high gain, and compact in size. It has big disadvantage of narrow bandwidth. To improve the bandwidth and gain E-shaped technique is used, it is efficient to enhance the bandwidth of antenna. The feeding point of antenna is very important for efficient operation, so coaxial feeding technique is applied to microstrip patch antenna for impedance matching. A microstrip E-shaped patch antenna is designed successfully which attains a bandwidth of 332.9MHZ at -24dB return lo with centre frequency of 5.4 GHz and also it attains maximum directivity of 5.33dBi. This Antenna is simulated using HFSS which employs finite element method.**

***Keywords* – Directivity, Feed Position, Gain, Bandwidth Return Loss.**

I. Introduction

Microstrip patch antennas are a well suited for wireless communication and satellite communication systems due to their attractive features of small size, low cost and weight, conformability, and ease of manufacturing, so these antennas have been developed in the last decades increasingly [1-2]. In many applications, the main issue of microstrip patch antennas is their limitation of bandwidth. In recent years, many efforts have been dedicated to the bandwidth improvement of microstrip patch antennas. Many techniques have been employed for achieving wide bandwidth [3-7].

In this paper we improve bandwidth and gain of patch which has been presented the good bandwidth improvement. The rectangular MSA has been realized by cutting E-shaped yields broader bandwidth. A microstrip E-shaped patch antenna is optimized for simplicity in design and feeding is proposed.

The E-shaped patch antenna is consist of rectangular patch with coaxial probe feeding is shown in figure 1. The antenna parameters Ls, Ws, Ps, h, Xf, and Yf have a crucial effect on the performance of the antenna. Optimum selection of these parameters allows the antenna to operate over a wide range of frequencies for modern trends in wireless communication systems. A E-shaped introduces the capacitive component in the input impedance to counteract the inductive component of the probe. Also to compensate the increasing inductive effect due to the slots, thickness of the substrate is increased; therefore as thickness increases the bandwidth increases accordingly [8-9]. Parameters of the antenna such as return loss, VSWR and directivity are discussed in this paper. The finite element method is used for analysis. The proposed configuration was optimized using the HFSS verison13.0 software.

II. E-Shaped Patch Antenna

Design of E- patch antenna is depicted in figure 1. The antenna has a single patch of length L, width W and infinite ground plane separated by substrate of single dielectric materials (ROGERS RT DURIOD) with relative permittivity 2.2. The radiating patch is fed by a coaxial probe at a position (X_f,Y_f) for proper excitation of the antenna over a broad bandwidth. Centre frequency chosen for this design is 5.4GHz.

Rectangular Microstrip antennas without E-shaped have large inductive reactance in the input impedance of patch, due to thick substrate. So E-shaped introduces a capacitive component in the input impedance that compensates for the inductive component of the coaxial probe.

III. Design of E-Shaped Patch Antenna

Design of microstrip patch antenna depends mainly upon three parameters, namely substrate and its dielectric constant, height of the substrate and resonant frequency [10]. In this paper, selected three parameters are: Resonant Frequency (fr) = 5.4GHz, Dielectric constant (εr) = 2.2, Height of the dielectric substrate (h) = 1.6mm. The coaxial probe feed is applied at location 1 is (14,3) and The width of antenna is 22mm and length is 20mm.

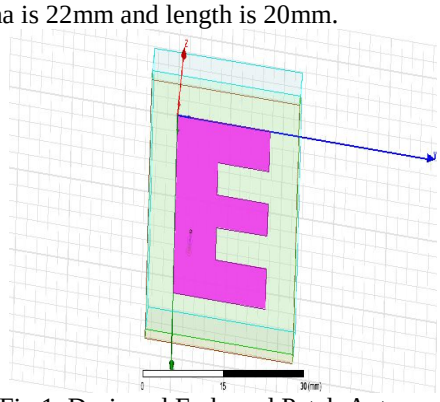

Fig.1. Designed E-shaped Patch Antenna

IV. Result & Discussion

The simulation is done by varying feeding positions in all direction over the microstrip patch antenna and s-parameter (S_{11}) is studied and noted for each simulation, this is shown in Figure 2. Thus the enhanced bandwidth of E-shaped microstrip patch antenna is obtained as 5.41GHZ. The obtained bandwidth is 333MHz.

The simulated result of S_{11} scattering parameter (return loss) of E-shaped microstrip patch antenna is presented in figure 2. From figure 3 the value of VSWR is within 1 to 2 in the operating range i.e. 1.12 at 5.4GHz. The directivity of this antenna is 5.311dBi as shown in figure 4. The input

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impedance matching and broadside radiation pattern are shown in figure 5 & 6 respectively. E-shaped patch antenna is matching at near 50ohm.

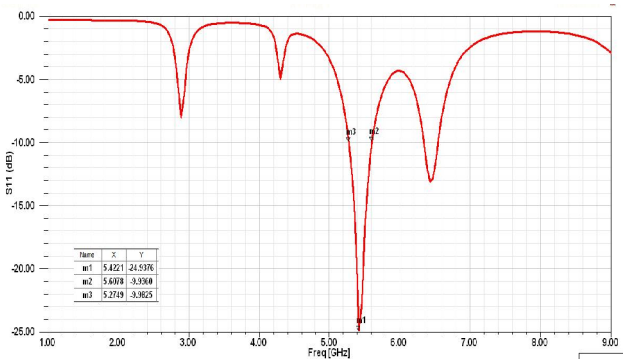

Fig.2. Return loss of E-shaped Patch Antenna

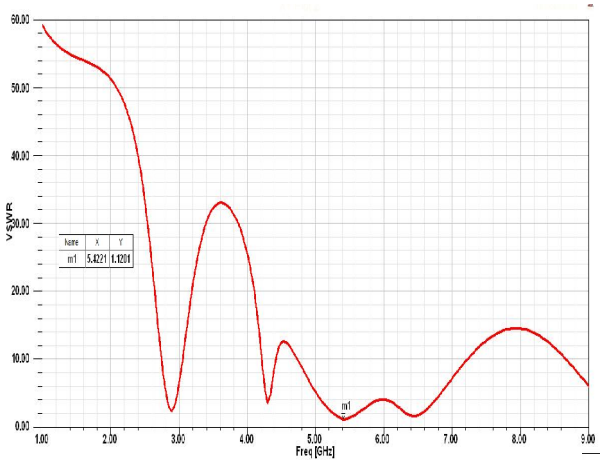

Fig.3. VSWR of E-shaped Patch Antenna

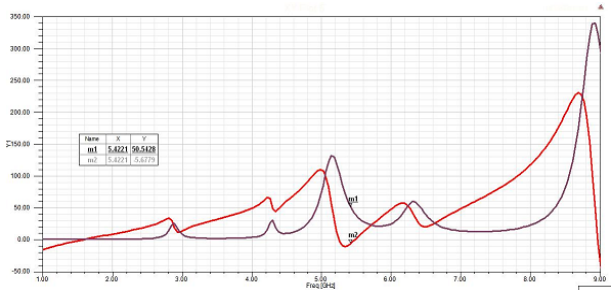

Fig.3. Impedance of E-shaped Patch Antenna

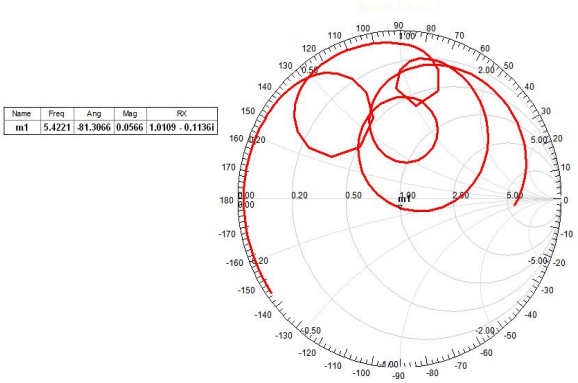

Fig.5. Smith chart

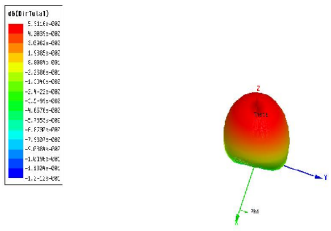

Fig.6. Radiation Pattern

V. CONCLUSION

The results analysis indicates that the microstrip antenna have good broadband performance in return loss, gain and radiation pattern. The main aim is achieved to improve bandwidth and gain of the microstrip patch antenna, it has been obtained by using slot symmetrically to one of the axis of patch. E-shaped microstrip antenna has been designed and simulated using HFSS software version 13, which use finite element method. This antenna gives impedance bandwidth of 332.9MHZ at -24 dB return loss with center frequency of 5.4GHz and maximum directivity of 5.31dBi. This antenna is well suit for wireless communication area.

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