Design and Analysis of E Shaped Microstrip Patch Antenna for L Band Applications

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Abstract- In this work, an E shaped Micro strip patch antenna was developed andthe antenna operates in the frequency range from 100 MHz -1 GHz . The proposed antenna is built using Erlonwith Probe feed technique. The design and simulation of E shape patch antennas is widely used in mobile cellular phones today. The archived band can be optimized by change parameters of E-shaped antenna. The variations in the design structure from E-shaped antenna are three edge slot cut in the structure. The proposed antenna by embedding three edges slit in to rectangular E shaped radiating patch, cover the application such as WLAN 1 GHz is realized for VSWR within 1.48.

Key Words- Patch antenna, HFSS, Dielectric constant

I. INTRODUCTION

Microstrip antennas are becoming very prominent in the cellular market. Patch antennas are low profile and are having no problems fabricated. The patch antenna, microstrip transmission line and floor aircraft are manufactured from excessive conductivity metal (typically copper). The patch is of length L, width W, and sitting on the pinnacle of a substrate (a few dielectric circuit board) of thickness h with permittivity εr. The thickness of the floor aircraft or of the microstrip isn't significantly crucial. Typically the height h is an awful lot smaller than the wavelength of operation, but need to now not be lots smaller than 0.1/2 of a wavelength (1/40th of a wavelength) or the antenna performance could be degraded. An antenna is an electrical conductor or a machine of conductors which is "that part of a transmitting or receiving gadget this is designed to radiate or obtain electromagnetic waves"[1]. A Microstrip antenna includes a skinny metallic conductor that is bonded to skinny grounded dielectric substrates. The size miniaturization of Microstrip patch antenna is critical in many of the modern day sensible programs, like that of Wireless nearby region networks(WLAN's), cellular cell handsets, international position satellites (GPS) and other upcoming wireless terminals. Patch antennas play a completely vast position in today's international of wi-fi communication systems. A Microstrip patch antenna (Fig 1) [3] is relatively simple in construction and makes use of a traditional Microstrip fabrication approach which contains of the etching of the antenna element sample in a steel trace that's bonded to an insulating dielectric substrate, inclusive of a printed circuit board(PCB), with a continuous metallic layer bonded to the alternative side of the substrate which acts as the ground aircraft. The most generally used Microstrip patch antennas are rectangular patch antennas, or even circular patch antennas are widely used.

Microstrip antennas are applicable within the GHz range (f > zero.5GHz). For lower frequencies, their dimensions come to be too large. Linear polarization and circular polarization may be acquired with Microstrip antennas. Circularly polarized microstrip antennas had been broadly used in many applications along with the cell, satellite tv for pc communications, radars and worldwide positioning systems (GPS), RFID programs, Wireless LAN. Circular polarization presents greater mobility and freedom within the orientation angle among a transmitter and a receiver in comparison with a linearly polarized microstrip antenna.

II. LITERATURE SURVEY

In most of the literature it is reported that slot length equals either half wave or quarter wave in length to realize multiple frequencies. However recent study showed that slot reduces resonance frequency of higher order orthogonal patch mode that yields multiple frequencies. The broadband MSAs are realized when the coupling between two resonant modes is controlled such

that the loop is formed inside VSWR = 2 circle. Instead of cutting the slots on the radiating patch, broadband or dual band configurations have been realized by cutting the slots in the ground plane, i.e. by using defected ground plane structure. However the reported work on defected ground plane MSAs does not provide any insights into the functioning of broadband or dual band response in terms of patch resonant modes.

The first aspect is the design of ordinary square microstrip antenna and the second one is the design of slot reduce H-shaped microstrip antenna. A simple microstrip line type feed mechanism with quarter wavelength Long Branch line used to energized patch. The most important problem is to look at the bandwidth development of the microstrip antenna. Rectangular microstrip antenna and H-formed microstrip antenna have been designed and simulated using high-frequency shape simulator (HFSS). H-formed microstrip antenna produced the reduction in length and higher bandwidth (9.5%) in evaluation to rectangular microstrip antenna (three.5%).

In [2] they proposed that broadband slotted MSA for wireless application. By using stacked configuration, slicing slot the bandwidth identical to 19.70% is finished. The antenna is fed via a coaxial probe feeding technique and designed the use of stacking configuration. The designed antenna operates within the frequency variety of 2.713 to a few.304 GHz. The antenna is designed the use of air as a dielectric substrate among the ground aircraft and patch and simulated at the Zeland IE3D software program. They concluded that the proposed geometry is designed using air as a dielectric among the ground plane and patch, the stacked configuration has given a better bandwidth 19.70 % as traditional square microstrip antenna.

In [3], novel defected floor systems (DGS) are proposed to enhance the return loss, compactness, advantage and radiation efficiency of a square microstrip patch antenna. The performance of the antenna is characterized with the aid of the -shape, measurement & the vicinity of DGS at a specific function on the ground plane. By incorporating a peacock formed a slot of choicest geometries at suitable location at the floor plane, go back loss is improved from -23.89 dB to -43.79 dB,radiation efficiency is stepped forward from 97.66 % to a hundred% and compactness of 9.83% is obtained over the traditional antenna and the patch antenna with superstar-formed DGS can improve the impedance matching with better return loss of -35.053 dB from -23.89 dB and compactness of nine% is completed.

III. ANTENNA GEOMETRY

Generally the MSA are thin metallic patches of various shapes etched on dielectric substrate of thickness *h*, which usually is from $0.003\lambda_0$ to $0.05\ \lambda_0$. The substrate is usually grounded at the opposite side. The dimensions of the patch are usually in the range from $\lambda_0/3$ to $\lambda_0/2$. The dielectric constant of the substrate $\in_r$ is usually from 2.2 to 12.

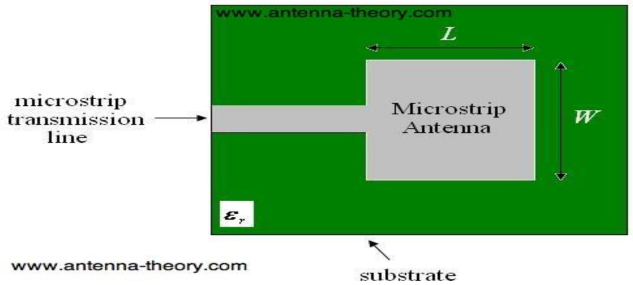

Fig.1: Microstrip patch antenna

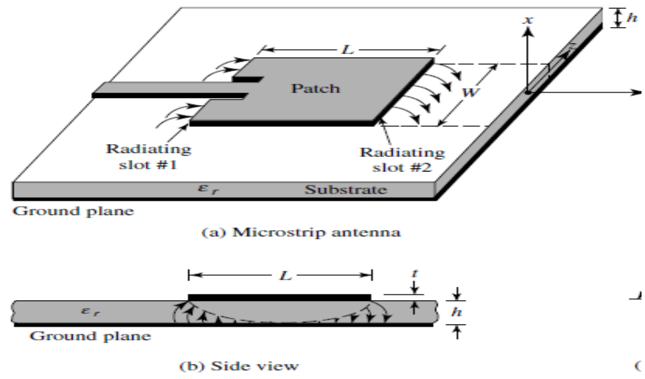

Fig.2: Top and side views of Microstrip patch antenna

IV. HFSS(High frequency structure simulator) Tool

Ansoft HFSS Fundamentals What is HFSS? HFSS is a high-performance full-wave electromagnetic(EM) field simulator for arbitrary 3D volumetric passive device modeling that takes advantage of the familiar Microsoft Windows graphical user interface. It integrates simulation, visualization, solid modeling, and automation in an easy-to-learn environment where solutions to your 3D EM problems are quickly and accurately obtained. Ansoft HFSS employs the Finite Element Method(FEM), adaptive meshing, and brilliant graphics to give you unparalleled performance and insight to all of your 3D EM problems. Ansoft HFSS can be used to calculate parameters such as SParameters, Resonant Frequency, and Fields. Typical uses include:

V. ANTENNA SIMULATION AND RESULTS

The computer simulation is carried out to study the VSWR, Return loss and polar plot of the designed antenna using HFSS software.

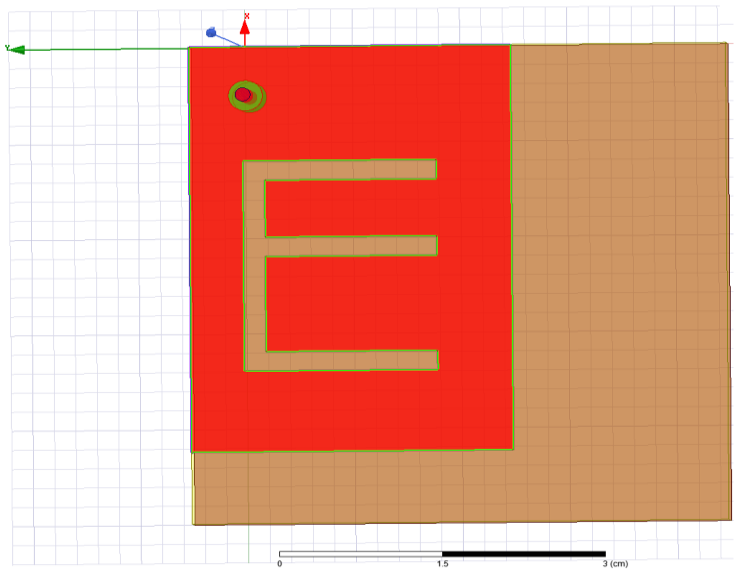

Fig.3: Simulated designed antenna - Top view

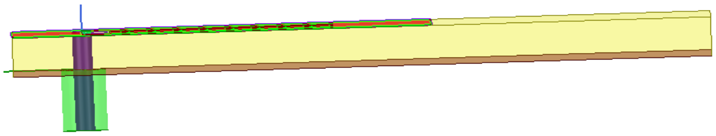

Fig.4: Side view of the antenna

Impedance matching has been done to a 50 ohm SMA port, which is configured through an incline micro strip to coaxial transition. The two stepped impedance matching circuits are inserted to achieve the required VSWR less than 2.0. Here dielectric loss tangent 0.01 and dielectric constant 0.1 substrate values considered.

The S parameter S11 depicts the Return Loss, with the resonant frequency at 100 MHz-1GHz and a return loss of about -10 dB as shown from the figure. The S11 (Return Loss) parameter indicated the amount of power that is lost to the load and does not return as a reflection. This parameter was found to be of crucial importance to our project as we sought to adjust the antenna dimensions for a fixed operating frequency.

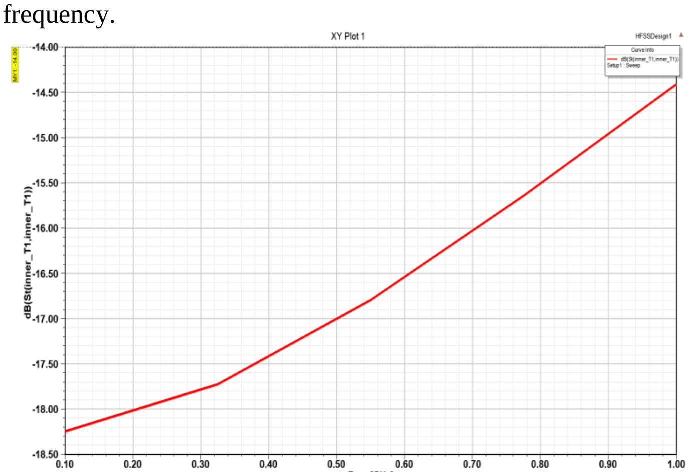

Fig.5: Return loss

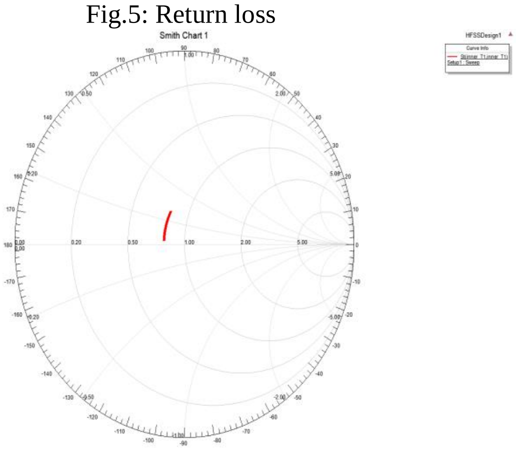

Fig.6: Polar plot

Voltage Standing Wave Ratio(VSWR) The simulated results of VSWR shown in Figs. It is clear from these figures that the VSWR value is less than 2 over the operational frequency range

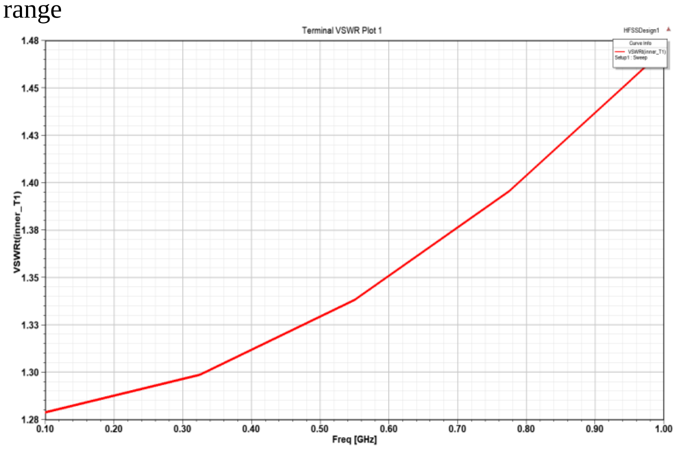

Fig.7: VSWR plot

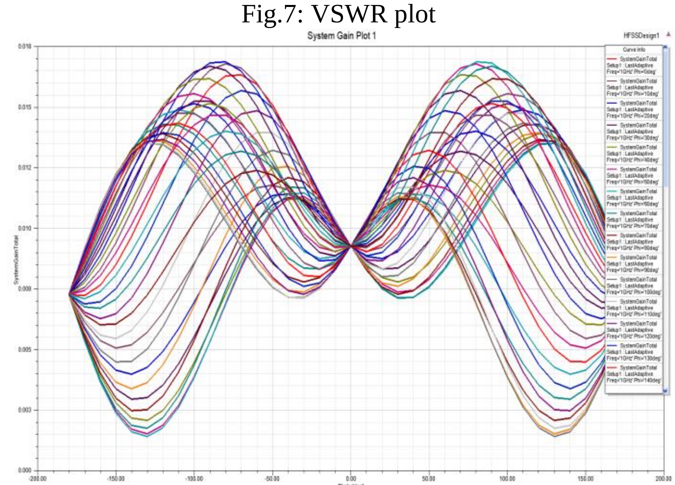

Fig.8: Scanning Angles

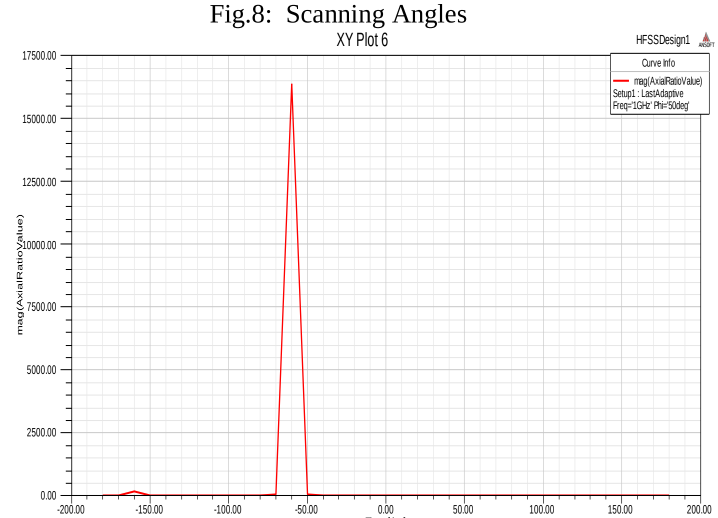

Fig.9: circular polarization at 1GHz

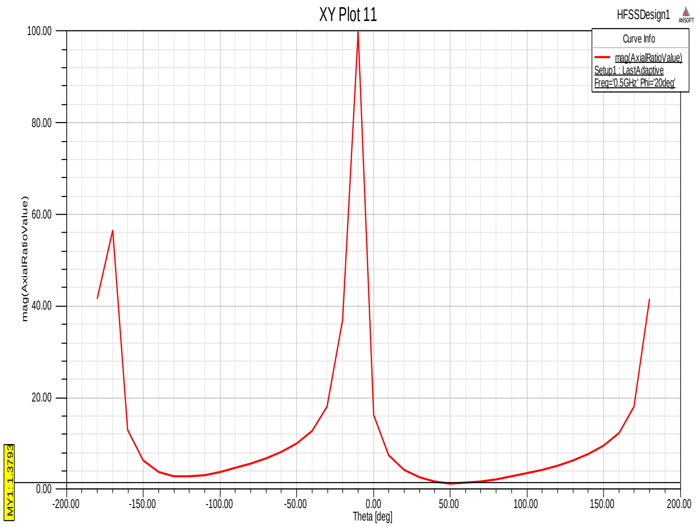

Fig.10: circular polarization at 500MHz

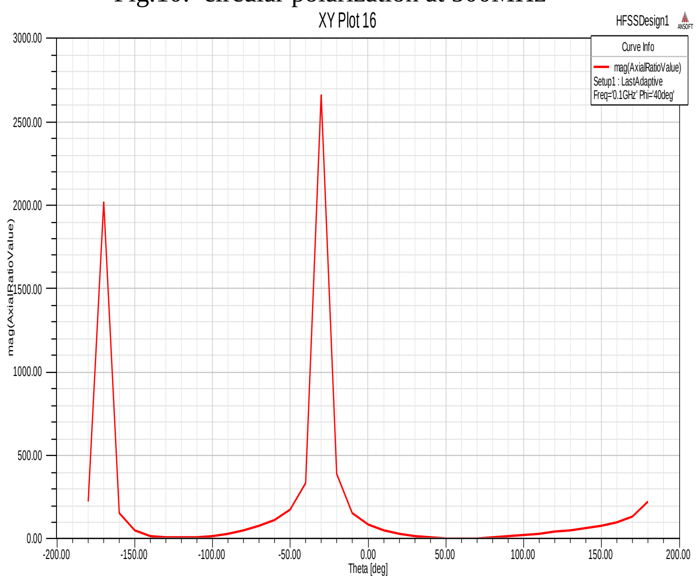

Fig.11: circular polarization at 100MHz

VI. FABRICATION AND MEASURED RESULTS

The fabricated antenna without and with absorber are shown in Fig 6.1-6.2.

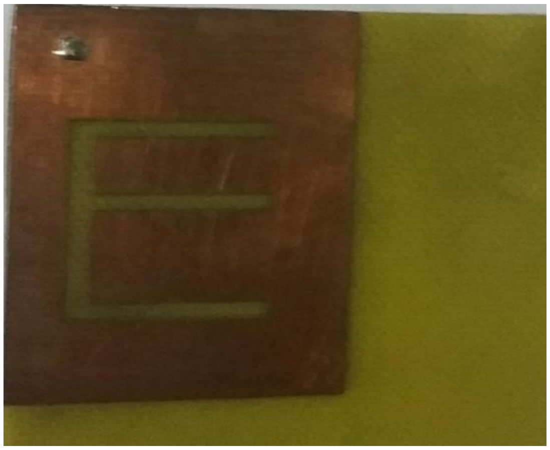

Fig.12: Fabricated antenna Top view

Fig.13: Fabricated antenna Back view

VII. EXPERIMENTAL RESULTS

The printed antenna tested by using Vector Network analyzer and it operating from 100 MHz-1GHz range.

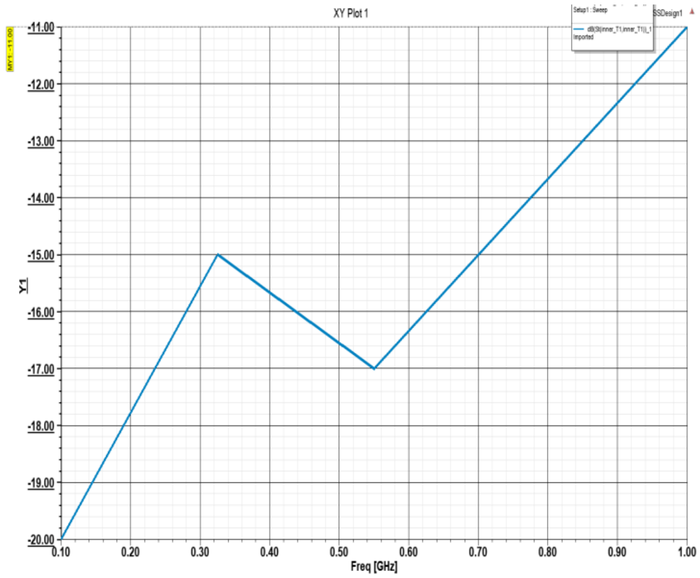

Fig.14: Input impedance

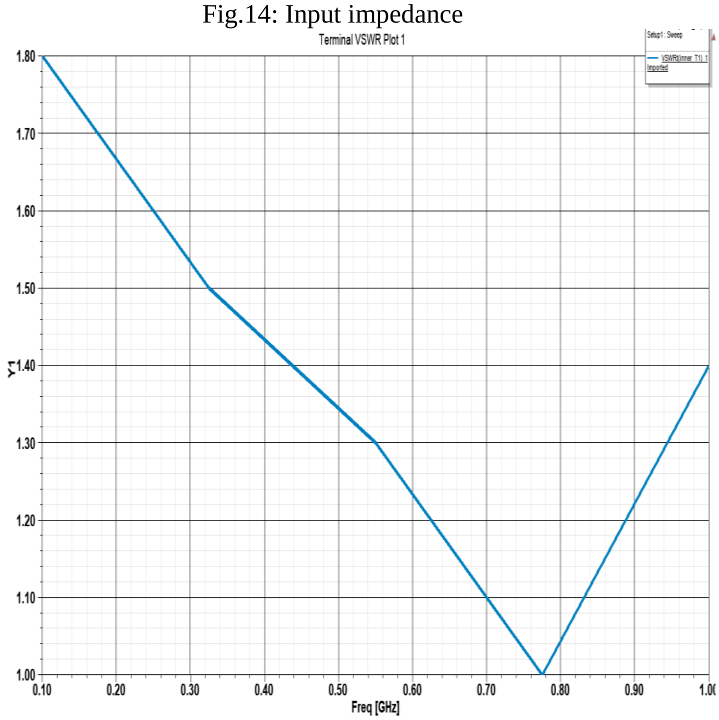

Fig.15: Frequency v/s VSWR plot

VIII. CONCLUSION

In this work a novel Microstrip E shaped patch antenna at resonant frequency of 100 MHz-1 GHz has been reported. The Return loss and the other important parameters of VSWR, Scanning effects and return loss have been studied. The antenna's radiating elements are the main patch it is possible to design the Microstrip patch antenna at band of frequencies like L band. All parameters will be improved due to stacking of substrate, since effective dielectric constants get increased. The narrow beam gets rid off interference that permits reception-inside building where signals are too weak to be picked up by standard antenna. It delivers 10 times less radiations to user's head without any shielding device. It makes battery to last longer. The antenna is fabricated by using dielectric loss tangent 0.01 and dielectric constant 0.1 substrate values considered.The overall working of antennas was understood and the Return loss and VSWR v/s frequency plots were studied and their implications were understood.

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