Use of Super Conducting Layer for the Enhancement of Gain in Co-Axial Probe Feed Microstrip Patch Antenna

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Abstract

The microstrip patch antenna can be used for several applications in wireless communication systems. This paper presents the planning of a microstrip patch antenna to work at frequency 4 GHz. This antenna is designed using the technique co-axial probe feed. Flame Retardant four (FR-4) substrate with a dielectric constant of approximately 4.4 and a thickness of 1.575mm is used. We have proposed use of super conducting layer for the enhancement of gain in co-axial probe feed microstrip patch antenna here we have increased the gain of conventional antenna i.e. from 5.54dbi to 7.14dbi. The proposed antenna which is used to enhance the gain consists of super conducting layer which is used to increase the gain of conventional antenna. The conventional antenna resonates at 3.86GHz, producing a return loss of -13.56. The proposed antenna resonates at 3.83GHz producing return loss at -26.83.The antenna characteristics like gain, bandwidth, return loss and current density are obtained using HFSS software.

KEYWORDS—Microstrip patch antenna , Gain, Co-axial probe feed, return loss(S_{11}), HFSS

I. INTRODUCTION

Antenna plays a very important role in the field of wireless communication system. Micro strip antenna technology was developed from 1970. It offers reliableness, mobility, and straightforward transferable and needs tiny mounting surface. The arranging parameters like dielectric steady, surface of substrate and frequency chooses the execution of MCAs. The high cost of stuff steady scales down the radio wire estimate. A portion of the reception apparatuses opening radio wires, and collapsed dipole receiving wires with each sort having their own particular properties and usage. Microstrip patch antenna have discovered serious application in remote correspondence framework because of their points of interest like low profile, comparability, minimal effort manufacture and straightforward coordination with nourish network. Microstrip patch antenna is in kind of dielectric substrate sandwiched between two leading metals. The higher metal could be a divergent patch typically of copper or gold whereas lower metal plane could be a ground plane. The feeding strategies play a crucial role in impedance matching. Microstrip patch antenna are characterised by a bigger number of physical parameters than conventional microwave antenna. They will be intended to have a few geometrical shapes and dimensional however rectangular and round about microstrip resounding patches are utilized widely in a few applications. Microstrip patch antennas naturally have a low pick up and pick up improvement is some of the time requested for sensible applications. To defeat these methods assortment to strategies have been proposed. one such technique to extend the gain of the antenna is to modify the ground plane, referred to as superstrate. Microstrip antenna contains two metal layers on both sides of a dielectric material. The bottom layer patch having larger area is called ground plane and top metal layer of suitable shape is called a patch as shown in fig (1).

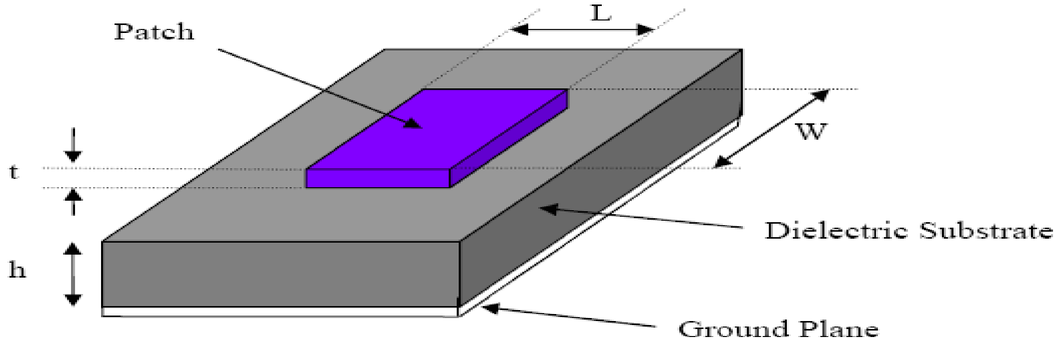

fig 1: Basic structure of microstrip patch antenna

II. LITERATURE SURVEY

vinay jhariya, prof. prashant jain, In the resent year the event in communication system needs the event of low solid, minimum weight and low profile antennas that square measure capable of maintaining high performance over wide spectrum of frequency. This technological trend has centered a lot of effort into the planning of microstrip patch antenna. The object of this paper is to style associate degree small strip line fed rectangular small strip patch associate degree antenna that operate in C-band at 5.33 GHz the antenna style is predicated on high frequency structure simulation (HFSS) software system that is infinite component method based. The HFSS software system has become the foremost versatile, simple to used, economical and correct simulation tool[1].

Alak Majumder, There are a few of microstrip recieving wire that can be utilized for some applications in correspondence frameworks. This paper introduces the look of a rectangular microstrip fix reception apparatus to control at frequency shift 2 to 2.5GHz. This reception apparatus, in view of a thickness of 1.6m Flame Retardant4 (FR4) substrate with an on conductor consistent of roughly 4.4, could be a test bolster and includes an incomplete ground plane. whenever the reception apparatus execution qualities like input electric protection, VSWR, Retrn Loss and current thickness square measure got[2].

Asmita Mhamane, Meenakshi Pawar, In the recent years the development in communication systems needs the event of low price, borderline weight, low profile antennas that area unit capable of maintaining high performance over a good spectrum of frequency. This technological trend has centered abundant effort into the planning of a Microstrip patch antenna. during this paper, we have a tendency to designed an rectangular small strip patch antenna at 3.8GHz and study the result of antenna dimension Length (L), Width (W), substrate parameter relative non conductor constant (€r) substrate thickness(h) and graph using Ansoft HFSS. It even describes the increasing result of Gain and directionality. The projected antenna additionally presents the detail steps of planning the microstrip antenna and the simulated result. The feeding technique wont to feed the antenna is coaxial probe feeding technique. microstrip patch antenna is employed in several fields like Antenna and mobile communication, Filters, PCB board model and EMC and EMI. Rogers RT/duroid substrate with an on conductor constant of roughly a pair of 0.2, may be a feed and has a partial ground plane[3].

Shitiz upreti, saurabh katiyar, In this paper, an effort is made to optimize the gain to show higher performance analysis on the premise of style and simulation results by implementing FSS structured superstrate layer with circular microstrip patch antenna at operational frequency of 5.8GHz for doctrine Band applications. during this projected antenna, co-axial feeding technique is employed so as to own higher resistance matching effects. so as to indicate our results better, we've created a comparative analysis with typical microstrip patch antenna at a similar frequency band to extend the gain, directionality and minimize the return loss of the required antenna. additionally to the present, it shows the benefits of utilizing the doctrine band and FSS superstrate layers compared to different frequency bands. Full wave 3-D simulation results is administered by victimization Ansoft primarily based HFSS package, that is, supported Finite Element technique (FEM) modeling technique[4].

III. ANTENNA CONFIGURATION

The proposed antenna consists of upper super conducting layer which is placed above the co-axial probe feed at the height of 11.635 and it is designed with the thickness of 0.1. The proposed antenna is designed with Lp=17mm, Wp=22mm, Ws=43mm, Ls=50mm, Wg=43mm, Lg= 50mm, as shown in Fig. 1(a). In the proposed Co-axial probe feed Microstrip patch antenna (CPFMPA), the conducting metal Patch is split into two rectangular halves which is placed above the Patch of CPFMPA as shown in Fig. 1(b). The rectangular Patch antenna radiates by coaxial probe.

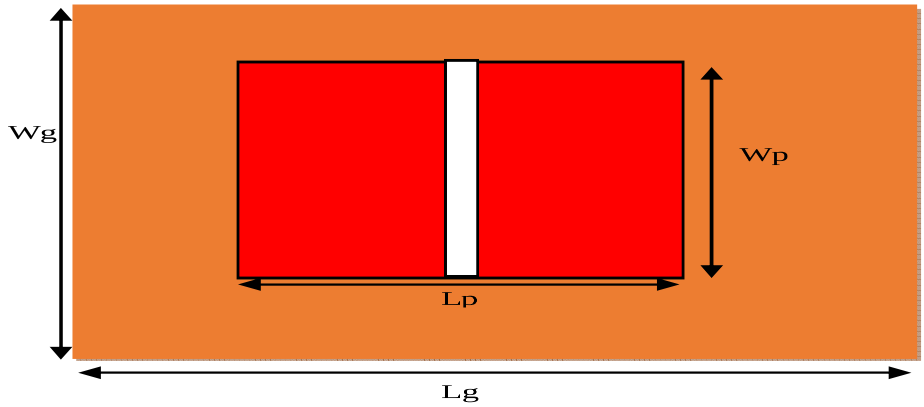

Fig.1a. Top view of proposed Co-axial probe feed microstrip patch antenna.

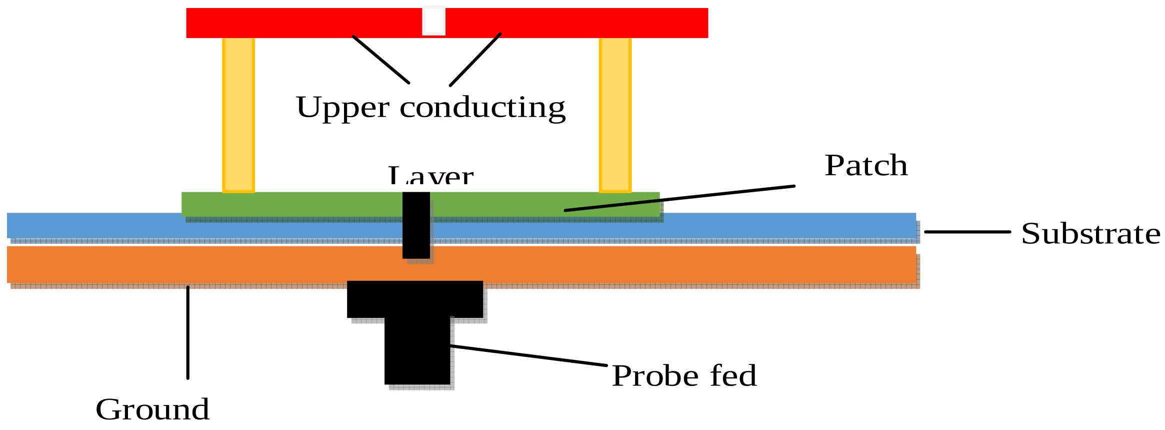

Fig.1b. Side view of proposed Co-axial probe feed microstrip patch antenna.

IV. DESIGN REQUIREMENT

There are 3 essential parameters for style of a coaxial probe feed rectangular microstrip Patch Antenna. Firstly, The resonant frequency (f_0) of the antenna should be chosen appropriately. Thefrequencyvaryusedisfrom4GHz and therefore the style antenna should be ready to operate with in this frequency vary. The resonant frequency selected for this style is 4GHz.

Furthermore, the dielectric material of the substrate (ε_r) chose for this style is metal-4 Epoxy that fuses a dielectric steady of 4.4 and misfortune digression sufficient to 0.002. The dielectric steady of the substrate material is Associate in imperative style parameter. Low dielectric constant is employed in the paradigm style because it provides higher potency and higher information measure, and lower quality issue letter of the alphabet. The low value of dielectric constant will increase the fringing field at the patch outer boundary and therefore will increase the radiated power. The projected style has patch size independent of dielectric constant. Therefore the method of reduction of patch size is by using higher material constant and metallic element-4 Epoxy is good in this regard. The little misfortune digression was dismissed inside the reproduction.

Lastly, substrate thickness is an other important role parameter. Thick substrate will increase the fringing field at the patch boundary like low material constant and therefore increases the radiated power. The peak of material substrate (h) of the microstrip patch antenna withcoaxialprobe fee d is to be utilized in c-band vary frequencies. Hence, the height of material substrate used during this style of antenna is h= 11.635 mm.

V. ANALYSIS AND DESIGN EQUATIONS

All the dimensions of the MPA shown in the table were calculated by using the rectangular patch design equations as shown below

1. Width of Patch (W) =

$$\frac{c}{2 f_0 \sqrt{\frac{\varepsilon_r + 1}{2}}}$$

2. Effective dielectric =

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

3 Effective Length= $L_{eff} = \frac{c}{2 f_0 \sqrt{\varepsilon_{reff}}}$

4 Fringfactor =

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

5. Length of Patch (L) = L_{eff} - 2ΔL

VI Results and Discussions

The proposed Co-axial probe feed Microstrip patch antenna has a upper super conducting layer which acts as a gain booster . The proposed antenna has a gain of 7.14 dbi while the conventional antenna has a gain of 5.54dbi. The conventional antenna resonates at the frequency of 3.86GHz producing a S_{11} of -13.56db and the proposed antenna resonates at the frequency of 3.83GHz producing a return loss of -26.83. The effect of reflection coefficient of the antenna is also observed and compared both conventional and proposed microstrip patch antenna an as shown in Fig. 2c

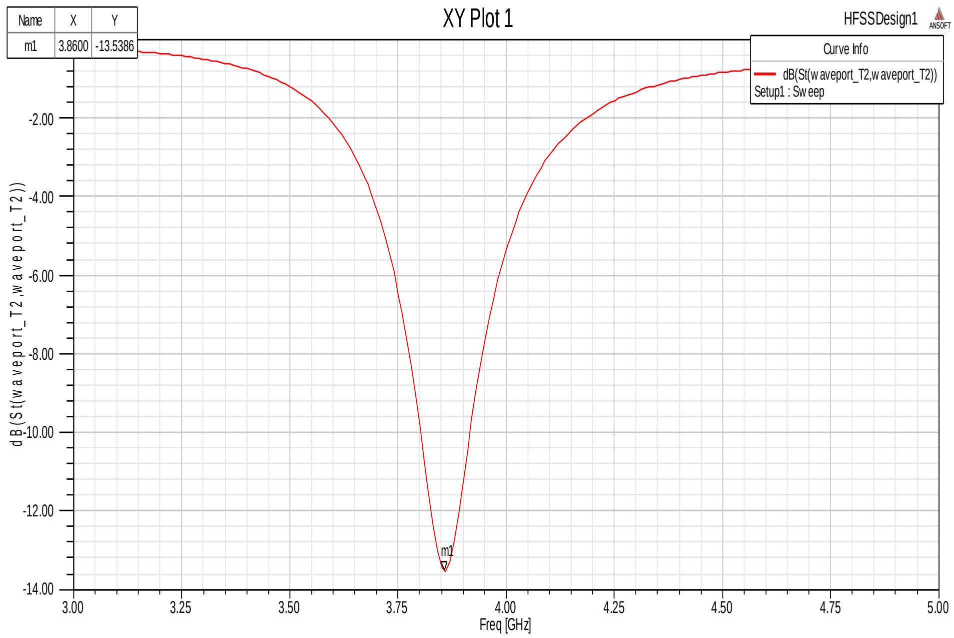

Fig .2a: s11 of conventional antenna

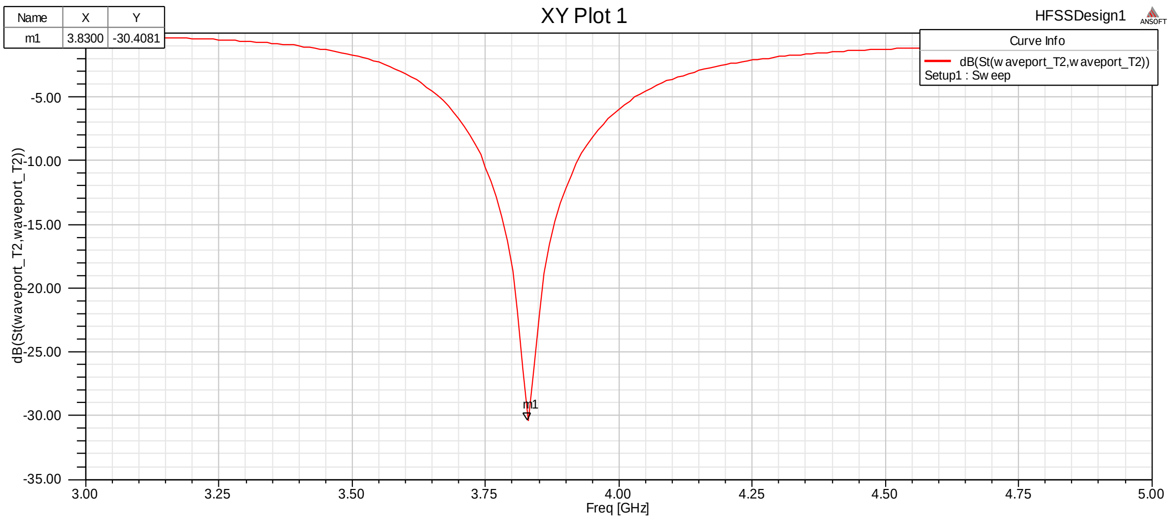

Fig .2b: s11 of proposed antenn

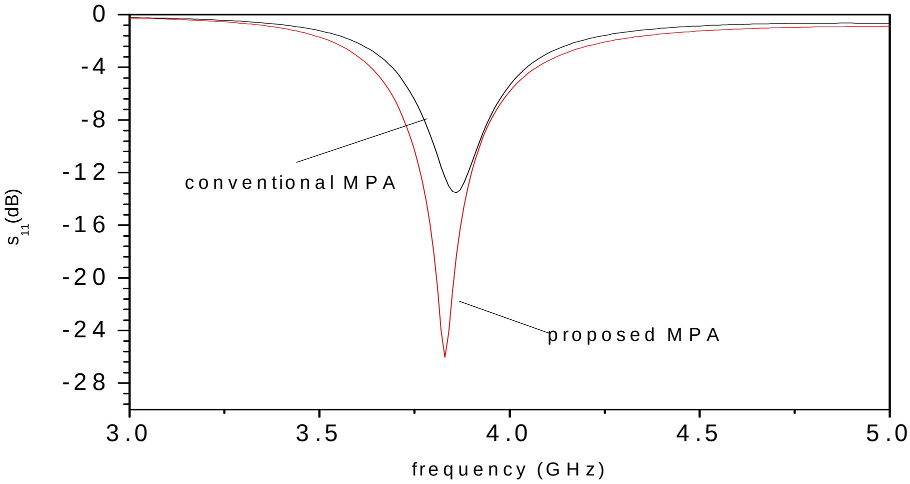

Fig.2c:comparison of return loss for conventional and proposed Microstrip patch antenna

VII CONCLUSION

The proposed Co-axial probe feed Microstrip patch antenna designed at 4GHz with upper super conducting layer. We have investigated an innovative and simple technique to enhance the gain of an CPFMPA is compared with the Conventional antenna as shown in Fig 3 and 4. Proposed CPFMPA is simple, compact, good and high gain antenna. The proposed antenna can be used in The C-band having a spectrum of 4-8 GHz (4GHz) has many applications such as WiFi, weather radar systems, Satellite Communication and Industrial-scientific-medical (ISM) applications.

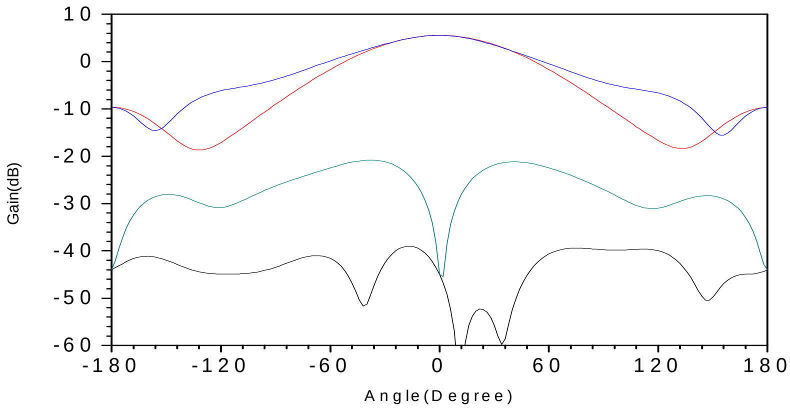

Fig.3: Gain of conventional microstrip patch antenna

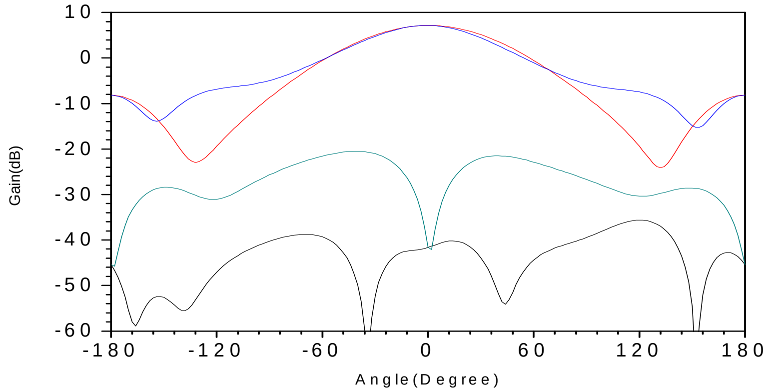

Fig.4: Gain of Proposed Microstrip Patch Antenna

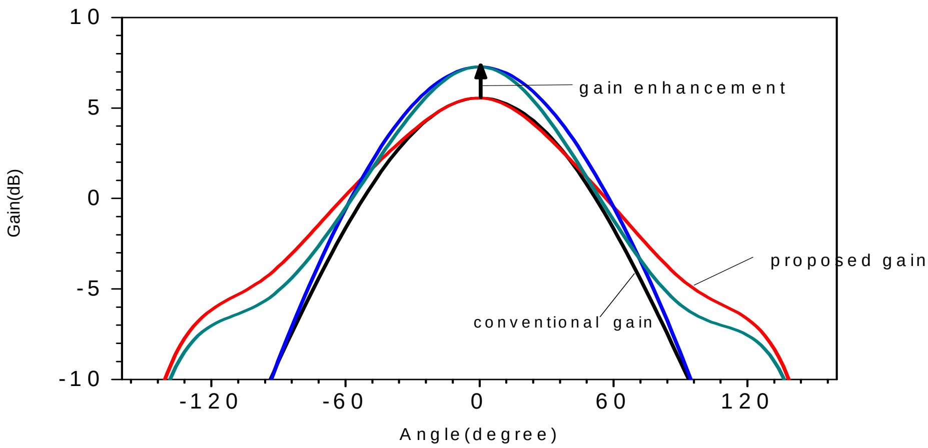

Fig.5:combined gain of both conventional antenna and proposed antenna

VIII REFERENCES

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