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Rectangular Microstrip patch antenna array with Corporate Feed Network for WLAN Applications

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Abstract:

This paper deals with designing aspects of microstrip patch antenna array with corporate feed network.in this paper 1*2 microstrip patch antenna array is designed and fabricated the same.the intention of increasing the gain and focussing the electromagnetic energy in the desired direction leads to desining of antenna arrays.in this paper microstrip patcha antenna arraya is designed to operate at 4.8GHz .desired patch antenna was designed using ANSYS HFSS and the same is fabriacted using FR-4 material having thckness 1.6mm.the propsed antenna is having very less return loss for the frequency 4.8GHz and also the proposed natenna meeting the requirement of increasig gain and decreasing the beamwidth .the array of patches are fed by using a equal power divider. the simulation and practical results are comapred .

Keywords: Patch antenna array,Gain,Corporate feed,FR-4,HFSS.

I.INTRODUCTION

Antennas play a really vital role within the field of Wireless communications.in day to day wireless applications people areusing reflector antennas, Microstrip patch antennas, wave guide slot antennas, helical antennas and folded dipole antennas with every sort having their own properties and usage. Microstrip antenna technology began its speedy development within the late Nineteen Seventies [1]. By the first Nineteen Eighties basic Microstrip antenna parts and arrays were fairly well establish in term of style and modeling. within the last decades rather that other antennas printed circuit type antennas are mostly used in all satellite and radar applications because of their benefits over different divergent systems, that include: light-weight weight, reduced size, low cost, conformability and therefore the simple integration with active Devices [3].

A Microstrip Patch antenna having diverging patch on one facet of a dielectric substrate and ground plane on the opposite facet. The patch is mostly manufactured from conducting material similar to copper or gold. The diverging patch and also the feed lines square measure typically photograph incised on the dielectric substrate. Microstrip patch antennas radiate primarily because of the fringing fields between the patch edge and also the ground plane [2]. Therefore, the antenna may be fed by a range of strategies [6]. The Microstrip patch antenna feeding mechanisms are often classified into 2 types. First one is contacting and second one is non-contacting. within the contacting methodology, the RF power is fed on to the radiating patch employing a connecting component like a Microstrip line or probe feed. in non-contacting mechanism, there is no connection between patch and Microstrip. through electromagnetic field coupling power will be transferred from Microstrip to radiating patch therefore the radiating patch this includes proximity feeding and aperture feeding [5]. during this paper associate degree array of Microstrip patches are designed for wireless fidelity applications and is anticipated to work at 4.8GHz [7].

II.DESIGNING PROCEDURE

While designing the Microstrip patch antenna it is very important to consider the following parameters. They are

- Frequency of operation (f) = 4.8 GHz
- Substrate material: FR-4
- Dielectric constant of the substrate ϵ_r =4.4
- Thickness of the substrate (h)=1.6mm

The length and width of the Microstrip patch antenna are calculated using the formulae

$$w = \frac{C}{2f\sqrt{(\epsilon r + 1)/2}}$$

Therefore, w=18.257mm

The effective dielectric constant is given as:

$$\epsilon_{eff} = \frac{\epsilon r + 1}{2} + \frac{\epsilon r - 1}{2}[1 + 12\frac{h}{w}]^{-1/2}$$

Where,

ϵ_{eff} = Effective dielectric constant

ϵ_r = Dielectric constant of the substrate

h = Height of the dielectric substrate

w = Width of the patch

c= $3*10^8$ m/s

The effective length of the patch is given as: $L = \frac{C}{2f\sqrt{\epsilon_{eff}}}$

By using the above equations, the length and width of the Microstrip patch antenna are calculated and the 2-way power divider dimensions also calculated for 50 ohms and for 70.71 ohms. The cad lay out for proposed antenna is shown in the figure. The direct feeding mechanism is used to fed the RF power to the patch antenna and here array of Microstrip patches are used for increasing the gain so it's difficult to apply RF power individually to each patch so corporate feeding is proposed.

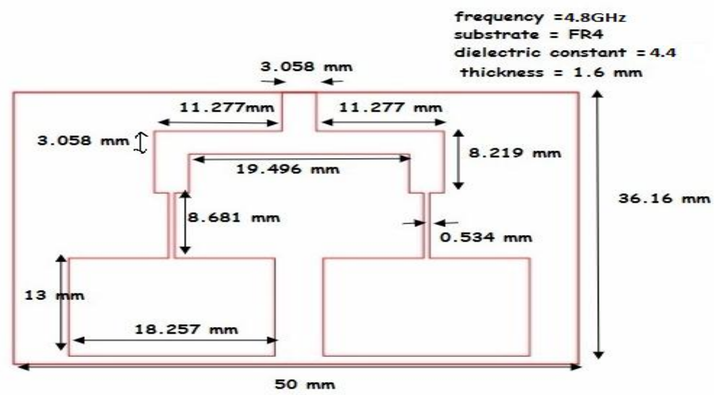

Fig.1 CAD lay out for proposed patch antenna array

Figure1shows the cad layout for the proposed antenna and all the dimensions . The overall size of the antenna is 50mm*36.16mm*1.6mm and the patch size is 18.257mm*13mm.to apply RF power to two patches power divider is designed with using quarter wave transformer.the corresponding dimensions of power divider is shown in above figure.the power divider and patch antenna both are designed for 4.8GHz .the thickness of the FR-4 substrate is considered as 1.6mm.the dielectric constant of the substrtae is considered as 4.4.

III.SIMULATION OF MICROSTRIP PATCH ARRAY

The proposed antenna simulation is completed using the ANSYS HFSS.the proposed antenna is having two radiating patches and ground plane both are designed on FR-4 substrate.to analyze the radiation properties of the antenna a vacuum box is created surrounding of the antenna and assigned it as radiation.in patch antenna there are two radiating edges and two non-radiating edges. The patch antennas are conformal to planar and non-planar surfaces. It's very easy to integrate patch antennas with other microwave circuits.in this paper patch antenna array is integrated with a 2way power divider and their overall performance is analyzed using HFSS.

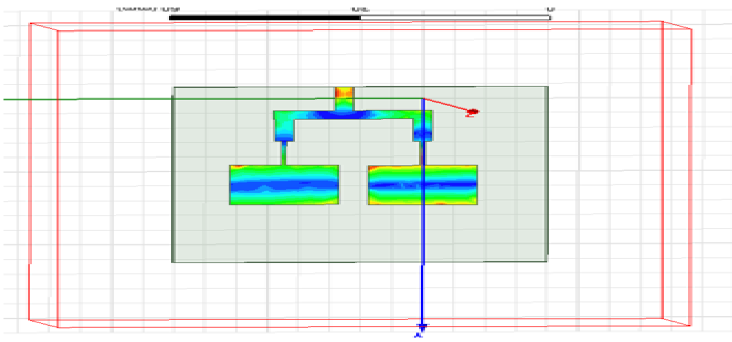

Fig.2 Rectangular Microstrip Patch antenna with Corporate Feed Network simulation model

Figure 2 shows the simulation model for porposed patch array iplemented in ANSYS HFSS.the RF power is fed to anenna array using a 2-way power divider . the power divider and patch array both are designed on the same substrate material and both are integrated.the 2-way power divider splits the input power and that power is applied to the patches.the above figure also shows the current distribution in both patches .

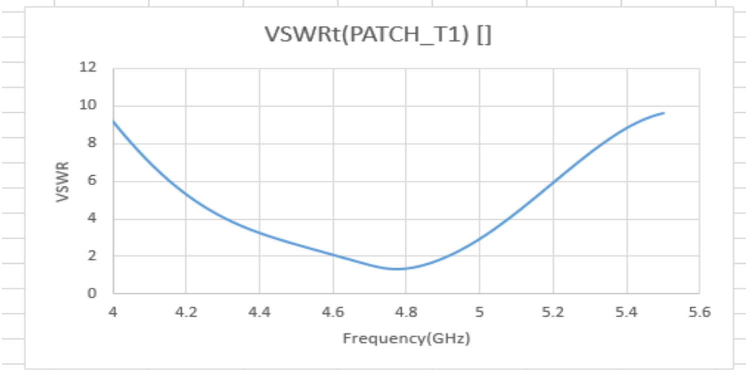

Fig.3 Frequency versus VSWR plot obatined in simulation

Figure shows the frequency versus VSWR plot obtained in simulation. the proposed antenna is having a VSWR value less than 2 at resonating frequency 4.8GHz.and the impedance band width for the antenna is nearly 300MHz.the proposed antenna is very attractive solution for WLAN applications and it provides very less return loss over the band of frequencies. the sweep frequency considered in simulation is 4GHz to 6GHz and the step frequency considered as 0.2GHz.

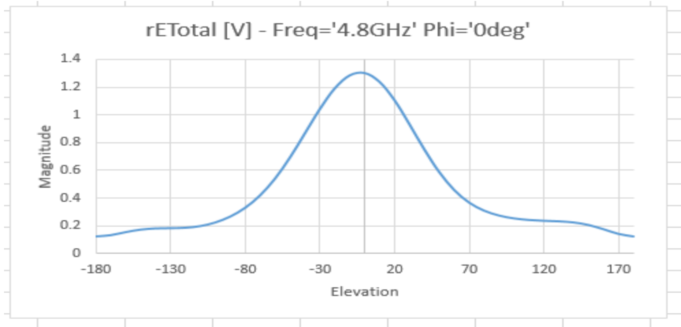

Fig.4 simulation E-Plane radiation pattern for proposed antenna

Figure 4 shows the elevation radiation pattern for the proposed patch antenna. This pattern is obtained in simulation for all theta values and particular phi=0 degree. The proposed antenna is having narrow beam width.

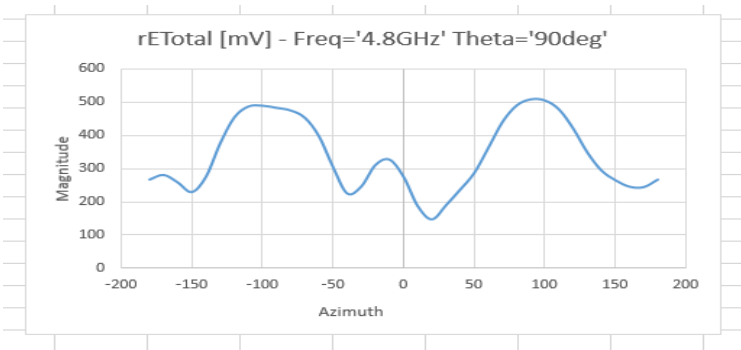

Fig.5 simulation H-Plane radiation pattern for proposed antenna

Figure 5 shows the azimuth radiation pattern for the proposed patch antenna. This pattern is obtained in simulation for all phi values and particular theta=90degrees. The proposed antenna is having narrow beam width.

IV.FABRICATION OF MICROSTRIP PATCH ARRAY

The proposed antenna was fabricated using FR-4 substrate both patch and power divider are etched on the same substrate.SMA connector is used to fee the RF power to the patch antenna.

Fig6. Microstrip Patch antenna array fabricated model

Figure 6 shows the front view and back view of proposed patch antenna array. The proposed antenna is designed on FR-4 substrate; one side of the substrate is patch array with corporate feed network and other side is fully ground plane.

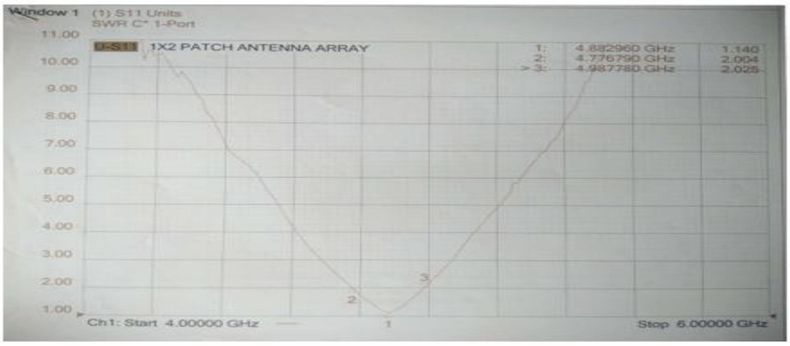

Fig 7 .Frequency versus VSWR plot obatined by network analyzer

Figure 7 shows the frequency versus VSWR plot measure using vector network analyzer. the proposed antenna is having a VSWR value less than 2 at resonating frequency 4.8GHz.and the impedance band width for the Microstrip antenna array is nearly 300MHz.

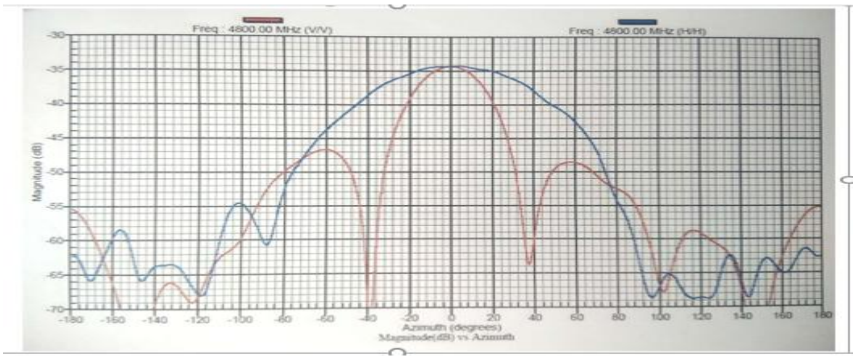

Fig 8. 2D-Radiation pattern for proposed antenna measured using digital pattern recording system

Figure 8 shows the radiation pattern for the proposed patch antenna. This pattern is obtained using digital pattern recording system in addition with EXG analog signal generator. The gain of the patch antenna array is calculated using the gain comparison method. a standard gain horn antenna is used for measuring the radiation properties of the antenna.

V.CONCLUSIONS

The proposed array is very simple and uses low cost substrate material. Corporate feed network is used and it can be simultaneously fabricated along with the antenna elements. The design provides a constant gain and directivity over a bandwidth of interest. The array shows dual band characteristics so the array structure can be conceived to avoid the use of separate antennas. The proposed antenna can be used for multiple frequencies, the number of frequency bands can be increased by proper slotting and adjusting the design parameters. The simulation results are shown in terms of return loss, VSWR, radiation pattern and gain. Good results for return loss, VSWR, Gain and the radiation characteristics of this array have been achieved. The proposed array can be used for C Band applications such as Satellite communication, Radar systems and other modern Wireless systems[6].

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