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Research Article

Design of Coaxial Feed Microstrip Antenna by inserting P-I-N Diode to Improve Return Loss and Gain

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Abstract

In this paper, a new design of microstrip patch antenna is consider in which it is insert a p-i-n diode on ground plane of the antenna. Analytically observation has been demonstrated the different parameters i.e. return loss, gain, active vswr, and axial ratio in our designed antennas. Here, a coaxial feed technique has been manipulated for the microstrip patch antenna at 2.4 GHz. The improvement in return loss is -2.287dB has been obtained at 1.98 GHz for ranges the operating frequency from 1.5 to 3.5 GHz. It also has been obtained gain total as 5.7960dB at 1.98 GHz with phi 0 deg and theta 0 deg and VSWR, axial ratio etc. better with conventional antennas. These type antennas has application in the satellite communication, aerospace, radars and biomedical applications etc.

Keywords: *Microstrip Antenna (MSA), wireless application, coaxial feed, Return Loss (S11), p-i-n diode, axial ratio, gain.*

1. Introduction

[1]The fundamental concept for this paper is to outline a coaxial feed microstrip antenna using the switching condition by insertion of p-i-n diode. Microstrip patch antenna becomes very popular day by day because of its ease of analysis and fabrication, low cost, light weight, easy to feed and their attractive radiation characteristics [Singh, *et al*, 2013]. The transmission line model is the simplest of all and it gives good physical insight [Kumar, *et al,* 2012]. The microstrip antenna suits the features very well except for its narrow bandwidth. A Microstrip fed antenna which consists of a rectangular patch with rectangular shaped slot incorporated into patch is presented for ultra wide band application with enhanced bandwidth. The proposed antenna achieves an impedance bandwidth [Yadav, *et al.* 2014]. The antenna can be optimized for a desired performance in terms of gain, bandwidth and VSWR by varying its parameters [Raina, *et al.* 2012]. There are four main component of antenna such as substrate, patch, ground plane and line fed. Here the antenna means basic design of microstrip patch antenna, in which a substrate is sandwiched between the patch and ground In general, microstrip antenna structure consists of a thin sheet of low-loss insulating material called the dielectric substrate. The patch is generally made of conducting material such as copper or gold and can take any possible shape. A rectangular patch is used as the main radiator [Rachmansyah, *et al.* 2011]. The substrate material mainly used for design technique is Rogers RT duroid 5880(tm) with ϵr=2.2 for high gain [Sandeep, *et al.* 2012]. The open circuit microstrip lines radiate more power when fabricated on thick low dielectric substrate. It is fully covered with a metal on one side, called the ground plane, and partly metalized on the other side where the circuit or antenna patterns are printed. The main advantage of this feeding scheme is that the feed can be placed at any desired location on the patch in order to match cable impedance with the antenna input impedance [Kraus, *et al.* 2014]. This feeding method has easy to fabricate and has low spurious radiation [Singh, *et al.* 2014]. Coaxial feed has also advantages of simplicity of design through the positioning of the feed point to adjust the input impedance level [Garg, *et al.* 2001]. Also, for thicker substrates, the increased probe length makes the input impedance more inductive, leading to matching problems [Kumar, *et al.* 2012].

2. Structure of Microstrip Patch Antenna

The central resonant frequency of the proposed antenna is 2.4 GHz. Duroid material substrate (relative permittivity of 2.2, relative permeability of 1 and dielectric loss tangent of 0.0009) is utilized. A conventional patch antenna designed on duroid substrate (εr = 2.2, substrate thickness = 3.2 cm) with infinite ground plane resonates at frequencies 2.4 GHz (2400-2484 MHz).

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The most important consideration in selection of the feeding technique is the efficient power transfer of the power between the radiating structures i.e. impedance matching between two. The point of excitation is adjustable to control the impedance match between feed and antenna parameters. Because of the simplicity of design through the positioning of the feed point to adjust the input impedance level in coaxial feed, it is used coaxial feed technique in proposed structure. Input impedance values depend on the model selected for the excitation. The coaxial feed line is connected to the ground plane and coaxial center conductor after passing through the substrate is joint with patch metallization. . The designed model and geometrical configuration of microstrip patch antenna is shown as

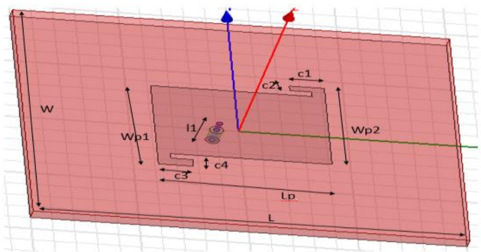

Fig.1 proposed antenna structure on simulated software

The fringing field lie outside the physical dimension of patch (length*width) i.e. fraction of field. Mechanically strong, thick substrate increases the radiate power and reduce its conductor loss[Garg, *et al.* 2001].

Patch: The length of the patch (Lp) considered as 40mm,width the patch at both side be (Wp1 and Wp2) is 35mm. Other patch measurement details are as below:

C1=8mm, C2=3mm, C3=8mm, C4=3mm.
Ground: length=100mm and width=90mm.
Substrate: Substrate length= 100mm, Substrate width= 90mm, Substrate thickness=3.2mm.
P-i-n diode insert in the ground plane of the proposed microstrip antenna which will work like a switch. For diode we obtained two switching condition i.e. on and off. The diode shows improvement in the final obtained result of simulation of proposed design.

3. Result and Discussion

It is observed that the return loss -22.7901dB at 'ON' condition of the diode and -20.403at 'OFF' condition of the diode. The return of the proposed are shown in figure 2. The VSWR, gain, and axial ratio of the proposed antenna is shown in Figure 3 (a, b, c) respectively. The obtained gain total will be 5.7960dB on obtained frequency at phi 0deg and theta 0deg at 'ON' condition. For off condition it is 5.7828dB on obtained frequency at phi 0deg and theta 0deg. Simulated outputs show that the designed antenna could be a good candidate for wireless applications.

The VSWR measured as 1.2621dB and 1.6634dB for ON and OFF condition in the proposed antenna. The ratio of major and minor lobes are the axial ratio. It may vary

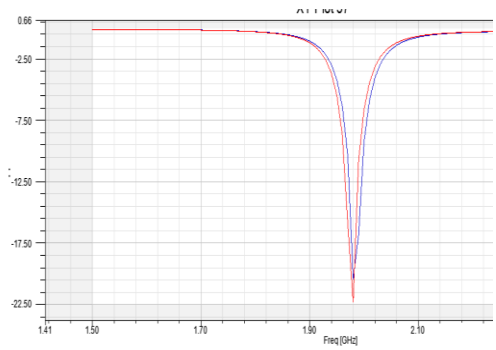

Fig.1 return loss from 1 to infinite [Garg, *et al.* 2001]. The axial ratio is obtained as 18.9799dB and 19.2201dB for ON and OFF condition in proposed antenna at phi 0deg

Conclusions

Finally, the optimum result of the coaxial feeding techniques in microstrip patch antenna on duroid substrate for wireless applications has been investigated. The proposed microstrip patch antennas can be fabricated and analyzed further due to simple structure. The different parameters like return loss, VSWR, gain, axial ratio, polarization ratio are plotted for antenna. A improvement occure in the antenna parameter (i.e. return loss and gain) by inserting the p-i-n diode. The performance properties are analyzed for the optimized dimensions and the proposed antenna works well at the required wireless application.

References

Ramesh Garg, B. Prakash, B. Inder and I. Apisak,(2001) Microstrip Antenna Design Handbook, *Artech House*, Inc, USA.

John D Kraus, Ronald J Marhefka, Ahmad S khan(2014), Antennas and Wave Propagation", fourth edition*, McGraw Hill Education* (INDIA).

RSA Raja Abdullah, D. Yoharaaj and Alyani Ismail(2006) Bandwidth Enhancement Technique in Microstrip Antenna for Wireless Applications, *PIERS Online*, VOL. 2, NO. 6.

Parminder Singh, Anjali Chandel, Divya Naina(2013) Bandwidth Enhancement of Probe Fed Microstrip Patch Antenna, *International Journal of Electronics Communication and Computer Technology (IJECCT*), Volume 3 Issue 1.

Arvind Yadav, Dr. Kuldip Pahwa (2014) Design & Parametric Study Of Rectangular Slot Microstrip Patch Antenna For Uwb Applications, *IJEEE*, Vol. 1, Issue 3.

K Praveen Kumar, K. Sanjeeva Rao, T. Sumanth, N. Mohana Rao, R. Anil Kumar, Y.Harish(2012) Effect of Feeding Techniques on the Radiation Characteristics of Patch Antenna: Design and Analysis, *International Conference on Recent Advances and Future Trends in Information Technology (iRAFIT) Proceedings published in International Journal of Computer Applications® (IJCA*).

Gurdeep Singh, Jaget Singh (2014), Comparative Analysis of Microstrip Patch Antenna With Different Feeding Technique, *International Journal of Advanced Research in Electrical*, Electronics and Instrumentation Engineering Vol. 3, Special Issue 5, December.

Tanveer kaur Raina, Mrs. Amanpreet Kaur & Rajesh Khanna (2012), Design of Aperture Coupled Micro-Strip Patch Antenna for Wireless Communication Applications at 10Ghz (X BAND), *International Journal of Electronics Engineering*, 4 (1), 2, pp. 25–28.

Rachmansyah, Antonius Irianto, and A. Benny Mutiara, Designing and Manufacturing (2011), Microstrip Antenna for Wireless Communication at 2.4 GHz, *International Journal of Computer and Electrical Engineering*, Vol. 3, No. 5.

B.Sai Sandeep, S. Sreenath Kashyap(2012),Design And Simulation Of Microstrip Patch Array antenna for wireless communications AT 2.4 GHZ, *International Journal of Scientific & Engineering Research,* Volume 3, Issue 11.