DESIGN OF MINIATURE ANTENNA FOR ULTRA WIDE BAND APPLICATIONS

Andran Naveen Prakash J[1], Arvind G.P[2], Asuvaitha Priyadharshini A[3], Murali Krishna A.G[4]

[1,2,3]Students, Department of Electronics and Communication Engineering, Valliammai Engineering College, SRM Nagar, Kattankulathur
[4]Assistant Professor, Senior Member, Department of Electronics and Communication Engineering, Valliammai Engineering College, SRM Nagar, Kattankulathur

---***---

Abstract - *Nowadays mobile communication systems are demanded in increased bandwidth for voice and data applications. The most communication system supporting with these in multiple wireless standards it is imperative to employ antennas which can cover the bands. The multiband antennas radiate at specific discrete frequencies. However, the primary design of antenna includes the gain, radiation pattern purity over different frequencies. The frequency band designed by this study is from 5 GHz to 10.5 GHz for targeting the UWB applications. The return loss is under the value of -10db. The miniature antenna is fed by micro strip line and built on a FR-4 substrate. While etching slots on the patch as it reduces the effective radiation aperture resulting in a lower gain values of the ground plane. To exhibit the suitability of designed fabrication technique and highlight their benefits and drawbacks and simulated results are compared with expected results.*

***Key Words*: waveguide, 'n' shaped patch, Wide Band, slotted Micro strip**

1. INTRODUCTION

The transmitters and the receivers involved required antennas for all cases, even if some are hidden in the computers equipped with WIFI or radio. The antenna is also known as the transitional structure between the free space and the guiding space [1]. It is required by any radio receiver or transmitter to couple its electrical connection to the EM field. They provide radio waves are EM waves which carry the signals through the air or space at the speed of light. Radio transceivers are used to convey signals/information including broadcast radio, WIFI, point to point communication links and the remote controlled devices which is used. Flexible substrates such as paper and FR-4 have small thickness, low weight, low cost and easy fabrication are used to achieve the conformability of the required devices. The antenna classification is based on the basis of radiation and basis of aperture.

A circularly polarized antenna is able to transmit/receive E field vectors of any kind of orientation. The major requirement in the present wireless world is to design the size of antenna as much as small size. The micro strip antenna is used as the most considerable choice. In high performance of the antenna in point to point and point to multipoint applications, the size, weight, cost, performance, ease of installation are constraints at the low profile antenna is required. Micro strip antenna is used to full fill the needed requirements. It is currently one of the fastest growing segments in the telecommunications industry to become a preferred communication medium in the future. The basic configuration of the antenna is a metallic patch printed on the thin, grounded dielectric substrate which has thickness "h" is usually 1.6 lam da and the thickness of the patch is denoted as "t" and above the substrate is much less than the lam da. A micro strip antenna radiates the relatively board beam to the plane of the substrate.

The End-Fire radiation can also be accomplished by the judicious modes of selection[6][8]. For the micro strip patch antenna the length and the dielectric constants of the substrates is of different ranges. To analysis the performance of the micro strip antenna are the transmission line model, the full wave model and the cavity model. Basically in the transmission-line model represents the micro strip antenna by two slots, separated by the low-impedance z c transmission line of length l. The two slots are affected by the fringing effect and the effective length, resonant frequency effective width of the devices. The feeding techniques of the antenna is used the micro strip feed, waveguide port, aperture coupling, proximity coupling with rectangular spiral part[10], and the coplanar waveguide. The micro strip feed line is a conducting strip, usually of much small width when compared with the patch feed line. Impedance matching is achieved by using feed line having 50Ω Impedance. The substrate thickness increases, surface waves and the spurious feed radiation increase for which the practical design limit of the bandwidth which has 2-5%. The equivalent circuit is applied parallel to RLC network representing a resonant patch and the series inductor represent the feed inductance of the micro strip feed line. EM field lines are focused between the micro strip line and the ground plane to excite only guided waves as the opposed to the surface waves. The micro strip antennas are mechanically robust when mounted on the rigid surface of the body/devices. It is used in the base station for the personal communication between the two nodes and has the high quality factor. The antenna can be used for radar applications with return loss of -25dB in dual[2][4][5], triple and quad bands[3].

In this paper, micro strip patch antenna is used for the large ground- based phased array of antennas. The paper is structured as follows. In section 2, antenna structure and design were explained. In section 3, the results of the simulated antenna result are discussed. The proposed antenna is in small size(15mm) with "n" shaped "c" slotted patch[7][9] and rectangular coupled coils. Finally, in section 4, conclusions are drawn.

2. A "n" SHAPED "C" SLOTTED MICRO STRIP PATCH ANTENNA STRUCTURE AND DESIGN

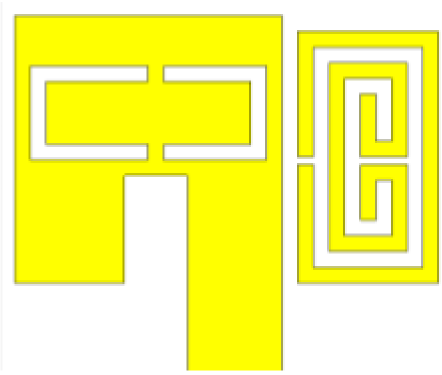

Fig.2 "n" shaped patch antenna.

The Width of the micro strip patch antenna is given by:

$$W = \frac{c}{2f_r}\sqrt{\frac{2}{\epsilon_r+1}} \qquad ....(1)$$

Where c is the velocity of light, f_r is the design frequency and dielectric ε_r

The length of patch is given by:

$$L = \frac{1}{2f_r\sqrt{\varepsilon_{reff}}\sqrt{\mu_0\varepsilon_0}} - 2\Delta L \qquad ....(2)$$

Effective dielectric:

$$\epsilon_{r_{eff}} = \frac{\epsilon_r+1}{2} + \frac{\epsilon_r-1}{2}\left[1+12\frac{h}{W}\right]^{-\frac{1}{2}} \qquad ....(3)$$

Extension length ΔL:

$$\frac{\Delta L}{h} = 0.412\frac{(\epsilon_{reff}+0.3)\left(\frac{W}{h}+.264\right)}{(\epsilon_{reff}-258)\left(\frac{W}{h}+0.8\right)} \qquad ....(4)$$

The directivity of the antenna is given by:

$$\text{directivity} = \frac{\text{maximum radiation intensity}}{\text{average radiation intensity}} = \frac{U_{max}}{U_0} \qquad ...(5)$$

3. RESULT AND DISCUSSION

The antenna is design and then simulated using 3D Electromagnetic (EM) Simulation tool of CST Microwave studio. The designed antenna is simulated and measured the value of reflection coefficient, VSWR, gain of an antenna and radiation pattern of antenna. The reflection coefficient also called as return loss. The return loss is the loss of power in the signal reflected by a discontinuity in a transmission line. The simulated designed antenna reflection coefficient (S11) plots are shown in Figure 3. The "n" shaped "c" slotted microstrip patch antenna reflection coefficient value is -24dB at 6.15 GHz.

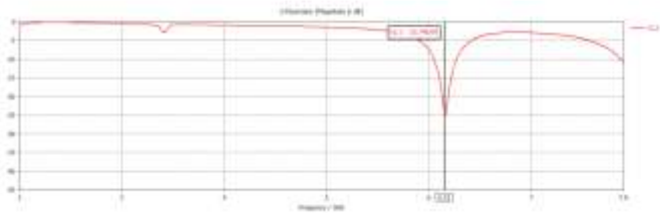

Fig.3 Simulated reflection coefficient (S11)

VSWR is a measure of how efficiently radio frequency power is transmitted from power source to load. For most antenna application VSWR value under 2 is considered. Such antennas can be described as good match. In an ideal system, hundred percent of energy is transmitted. The simulated design antenna VSWR plots are shown in Figure 4.

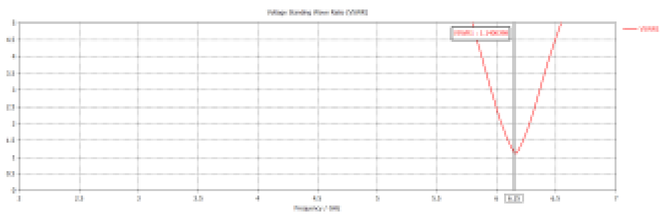

Fig.4 Simulated VSWR

The radiation pattern refers to the directional dependence of the strength of the radio waves from antenna or other source in the antenna design. The pattern of micro strip patch antenna is rather broad with maximum direction normal to the plane of an antenna. The radiation pattern is given in Figure 5.

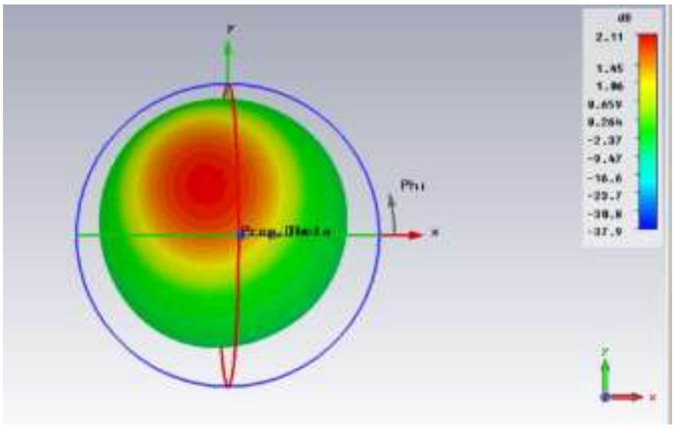

Fig.5 Radiation pattern of "n" shaped patch antenna

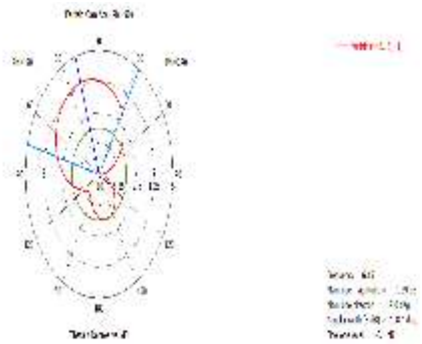

Fig.6(a)

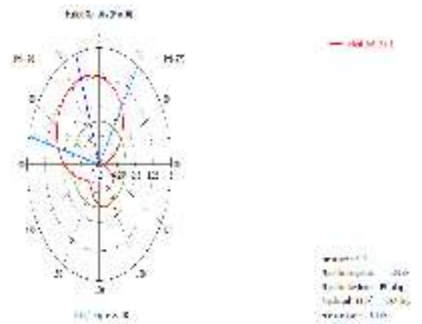

Fig.6(b)

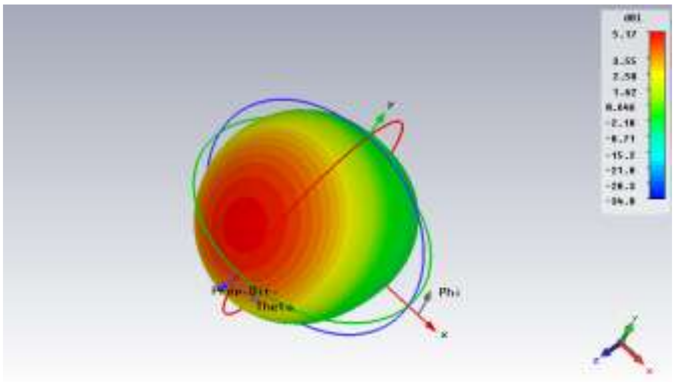

Fig.6 (c)

The directivity of an antenna that radiates equally in all directions would have effectively zero directionality, and directivity of antenna would be1or 0dB. The directivity of antennas shown in Fig.6.The term radiation efficiency of an antenna is a measure of the electrical efficiency in which they convert the radio frequency power accepted at its terminals into radiated power. Impedance matching is achieved as 50Ω and shown in Fig 7.

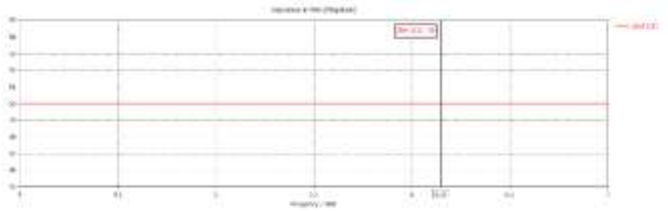

Fig.7

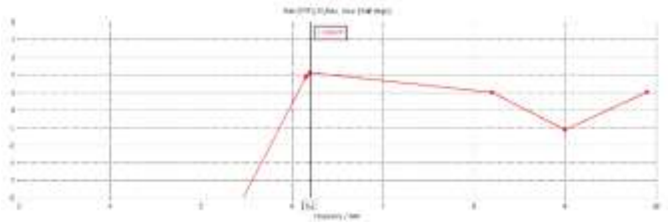

Fig.8

4. CONCLUSION

In this work, the micro strip patch antenna is designed and simulated Using CST Microwave Studio Software. They are easy to fabricate, no fraying problem and comfortable to the users. The proposed antenna performances are compared with expected results. The proposed antenna reflection coefficient is -23.74dB, VSWR is 1.14 and gain of an antenna is 2.11dB. Finally, the performance of the proposed antenna has been measured and discussed.

REFERENCES

1) S. Ullah, H. Higgins, B. Braem, B. Latre, C. Blondia, I. Moerman, S. Saleem, Z. Rahman, and K. S. Kwak, "A comprehensive survey of wireless body area networks," J. Med. Syst., vol. 36, no. 3, pp. 1065–1094, Jun. 2012.

2) A. Lai, K. M. K. H. Leong, and T. Itoh, "Dual-mode compact microstrip antenna based on fundamental backward wave," in Proc. Asia-Pacific Micro. Conf., Suzhou, China, Dec. 2005.

3) H. J. Lee, K. L. Ford, and R. J. Langley, "Switchable on/off-body communication at 2.45 GHz using textile microstrip patch antenna on stripline," Electron. Lett., vol. 48, no. 5, pp. 254–256, Mar. 2012.

4) C. H. Lin and K. Ito, “Dual-mode wearable antenna for on-/off-body wireless communications,” in Proc. International Workshop on Antenna Technology (iWAT), Sydney, Mar. 2014, pp. 286–287.

5) J. -X. Niu, “Dual-band dual-mode patch antenna based on resonant-type metamaterial transmission line,” Electron. Lett., vol. 46, no. 4, pp. 266–268, Feb. 2010.

6) R. Langley, L. Ford, and Q. Bai, “Antennas for on/off body communications,” in Proc. IET Seminar on Body-Centric Wireless Communications, London, UK, Jul. 2013, pp. 1–24.

7) J. Kelly, L. Ford, and R. Langley, “Slotline structure for on/off-body communications at 2.45 GHz,” in Proc. 2011 the Fifth European Conf. Antennas Propag. (EuCAP), Rome, Apr. 2011, pp. 525–529.

8) B. Sanz-Izquierdo, F. Huang, and J. C. Batchelor, “Covert dual-band wearable button antenna,” Electron. Lett., vol. 42, no. 12, pp.668–670,Jun. 2006.

9) Saurabh Sharma, Puneet Khanna, “Design & Simulation of Single Band C inside C Shape Slotted Rectangular Microstrip Patch Antenna for Satellite Communication”, in International Journal of Advance Research and Innovation., Vol. 1, 269-273, Mar. 2014.

10) Savya Sachi Mishra, Ashish Chaudhary and D. C. Dhubkariya, “Design and Performance Analysis of Dual Band ‘C’ slotted Rectangular Microstrip Patch Antenna for Wide Band Applications”., IJERT, Vol. 2, Issue 12, Dec. 2013.