A Review Paper on A Novel Technique for Realization of Circular Polarization in Planar Inverted F Antenna

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Abstract— In this paper various techniques for realization of circular polarization in Planar Inverted F Antenna for Nano satellite applications at 2.4Ghz (s-Band) is presented and several research works done on PIFA are categorized and discussed. PIFA is most commonly used and extensively demanded antenna especially in mobile communication because of its low profile, moderate gain, good radiation pattern, multiband operation.

Key words: Circular Polarization, Planar Inverted F Antenna

I. INTRODUCTION

The communication systems currently used on nanosatellites are usually well-proven commercial. Education, Disaster Monitoring, Exploration of Resources, Agriculture Support. The use of Nano Satellites can provide several cost effective solutions to the economy of Developing countries helping them to achieve desired goals and contribute towards a balanced use of resources and conserving the environment. The Planar Antenna used is Planar inverted F antenna that is in small size, low weight, capable of operating in multiband frequency, good radiation patterns, easy integration with other active devices and its limitation can be achieved by various techniques. Mostly this antenna is used for mobile wireless communication but it has advantage that it can be used for Nano satellite application by generating circular polarizationThe Planar inverted–F antenna (PIFA) was first appeared in the IEEE literature by the year 1987. PIFA is widely used in portable wireless devices and also in the modern wireless communication systems. PIFA supports high transmission data rates, small size, low profile, moderate gain, multiple band coverage. The other major advantage is effortless fabrication, low manufacturing cost. PIFA is a promising antenna for the future technology due to adjustability of its structure. Moreover, the inherent bandwidth of PIFA's is higher than the bandwidth of the conventional patch antenna. PIFA structure is easy to hide in the casing of the mobile handset as compared to monopole, rod & helix antennas. Also, PIFA has reduced backward radiation towards user's head and body which further minimizes SAR and improves performance [2]. They can resonate at much smaller antenna size and by cutting slots in radiating patch, resonance can be modified. Proper shape of the patch and positions of feeding and shorting pins results in multiband operation.

Circular polarization (CP) is beneficial in wireless and satellite communication system due to insensitivity to transmitter and receiver orientation, effective coverage area, enhances weather penetration and reduces the effect of multipath reflection [6].

Planar Inverted F Antenna The Inverted F antenna has transformed the horizontal element from a wire to a plate resulting in the so called Planar Inverted-F Antenna (PIFA). It has a self-resonating structure with purely resistive load impedance at the frequency of operation. PIFA is an antenna which is not only small in size but also has wide bandwidth and high efficiency. Variation of length, distance and location of the feed and shorting point, height of the radiator etc. affects the electrical performance of these antenna structures. Typical configuration of PIFA is shown in fig. 1. The antenna is fed through feeding pin which connects to the ground plane through the dielectric substrate. The shorting pin and shorting plate allows good impedance matching achieved with the patch above ground plane of size less than $\lambda/4$. Resulting PIFA structure is of compact size than conventional $\lambda/2$ patch antennas.

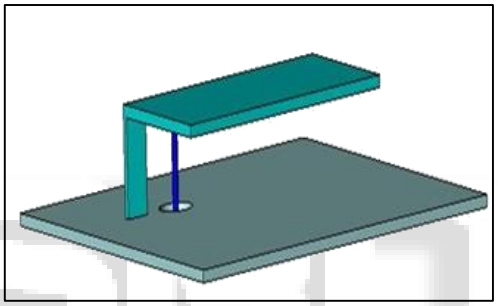

Fig. 1: Geometry of Planar Inverted F Antenna

II. VARIOUS TECHNIQUES FOR GENERATING CP IN PIFA

In this technique the study on the circular polarized patch antenna by using double circle slots technique in single patch and X-polarized patch antenna. The operating frequency for the proposed antenna is 2.4GHz with 29.86MHz of bandwidth and return loss is -34.85dB. The circular polarization (CP) operation was obtained by implemented double circle slot at centre of circular patch antenna. Based on simulation, it obtained a gain of 6.79dB with minimum axial ratio (AR) is 1.75dB [5].

Similarly in this technique the asymmetrical elements' length of upper and below truncated edges is the new parameter to fulfil the requirement of circular polarization (CP). The proposed antenna has a simple structure, consists of 2 x 2 patch antenna as its radiating elements and a single coaxial connector at the ground layer is used as a feed. The dimension of each patch antenna is 25.65 mm x 25.4 mm x 1.67 mm. Asymmetry truncated edge technique between upper and below patch is used and optimized to produce a circular polarization performance as well as high gain. This antenna is capable to produce a Right-Hand Circular Polarization (RHCP) with an axial ratio of 0.351 dB operated at 2.6 GHz frequency band. The presented antenna successfully reaches 7.510 dB of gain and - 31.10 dB of reflection coefficient at the resonant frequency. The antenna design has a big potential for outdoor LTE

application used as it improve the coverage robustness capability due to circular polarization characteristics[1].

Following technique here gives us developing circular polarization in PIFA .A broadband circular polarized two-element planar inverted-F antenna (PIFA) with pattern diversity and high isolation for multimode satellite navigation is reported. Circular polarization characteristic of the proposed antenna is achieved by introducing a cross branch at its corner of the ground. The modified PIFA structure gives the antenna a broadband impedance band-width characteristic. A prototype is fabricated and measured. The results show that this circular polarized antenna with compact dimension has broadband from 1.1 to 1.7 GHz and good isolation of 14 dB between the two elements over the whole band, which makes the antenna suitable for handheld terminal application of multi-mode satellite navigation [3].

In this technique "Planar Inverted-F Antenna (PIFA) Array with Circular Polarization for Nano Satellite Application" Arranging the 4 PIFAs in circle and each of the antennas have 90° consecutive phase difference. Copper wire was used to connect each of the PIFAs with micro strip feeding network which is located on the bottom of the substrate at frequency band of 2.35Ghz ,gain of 4dbi,Return loss of -10dbi and axial ratio of 1.21dbi[2].

III. Antenna Configuration

PIFA can be thought of as a combination of the inverted-F (IFA) and the short-circuit rectangular micro strip antennas. Quarter-wavelength Patch Antenna, which leads into the Planar Inverted-F Antenna (PIFA). It is small and has a low profile, making it suitable for mounting on portable equipment. It is a variant of monopole where the top section has been folded down so as to be parallel with ground plane. This is done to reduce the height of the antenna, while maintaining resonant training length.

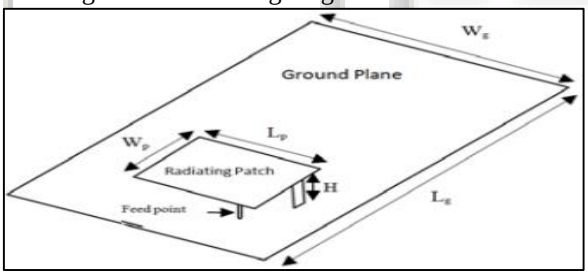

Fig. 2: Cross section of the Planar Inverted F Antenna

Dimensions of PIFA can be calculated by the following equations:

1) Calculation of patch
   For calculating the width
   w=C/2F_r.√2/ ε_r +1

$$\varepsilon_{reff}=(\varepsilon_r+1/2)(\varepsilon_r-1/2).(1+12(w/h)$$

2) Calculation of length
   ΔL/h =
   0.428.(ε_{reff}+0.3/ε_{reff}0.258).(w/h+0.264)/(w/h+0.8)
   L=C/(2.fr.√ε_{reff})-2ΔL
3) Calculation of Planar Inverted F Antenna

$$F_1 = C/4\sqrt{\varepsilon_r}L_1$$

L_1+L_2=λ/4

$$L_{1+}L_2 - W = \lambda/4$$

IV. Design of Planar Inverted F Antenna in ADS tool

Actual Design of PIFA using ADS tool at 2.4 GHz by using above equations. Substrate material used here is FR4 having dielectric constant of 4.6mm & using Perfect Conductor. Figure below shows the layout of the antenna. Cross branches at the corner is design for generating circular polarization.

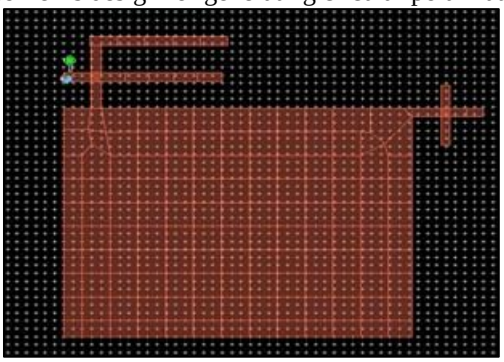

Fig. 3: Layout of PIFA in ADS

V. Applications

These are the applications of Planar Inverted F Antenna:

- Mobile Communication
- Satellite communication
- Direct broadcast services

VI. Conclusion

This paper represents past study on planar inverted f antenna. After study of various research papers it can be concluded that with the suitable technique circular polarization can be generated in this antenna and thus can be useful in nanosatellite applications

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