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

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ABSTRACT

In this paper a techniques for realization of circular polarization in Planar Inverted F Antenna at 2.4GHz (S-Band) by using cross in the design is obtained and this can be used in Nano satellite applications is presented. 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.

Keywords: *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 polarization The 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 λ/4. Resulting PIFA structure is of compact size than conventional λ/2 patch antennas.

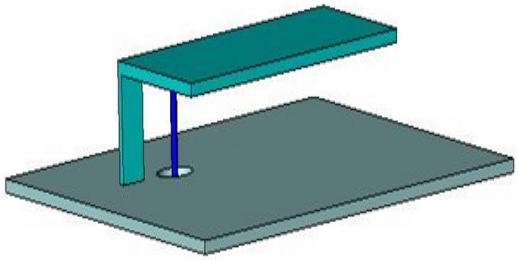


Fig. 1 Geometry of Planar Inverted F Antenna

II. 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.

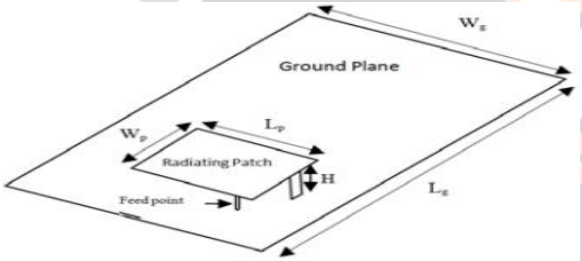


Fig. 2 Cross section of the Planar Inverted F Antenna

Dimensions of PIFA can be calculated by the following equations:

A. Calculation of patch
For calculating the width

$w=C/2F_r.\sqrt{2}/\ \varepsilon_r +1$

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

B. Calculation of length

$\Delta L/h = \quad 0.428.(\varepsilon_{reff}+0.3/\varepsilon_{reff}\,0.258).(w/h+0.264)/(w/h+0.8)$

$L=C/(2.fr.\sqrt{\varepsilon_{reff}})-2\Delta L$

C. Calculation of Planar Inverted F Antenna

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

$L_1+L_2=\lambda/4$

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

III. 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.

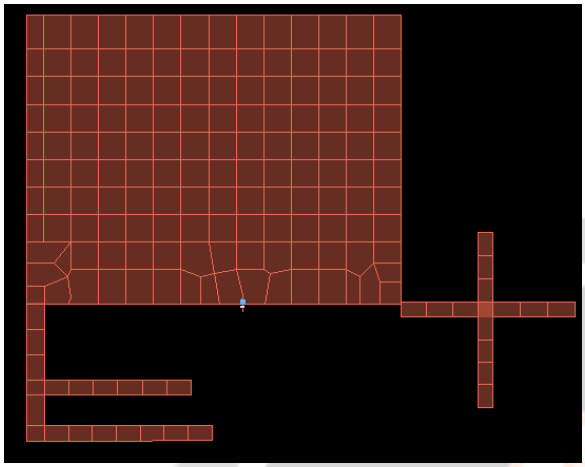


Fig. 3 Layout of PIFA in ADS

TABLE I
DIMENSIONS OF THE P ROPOSED A NTENNA

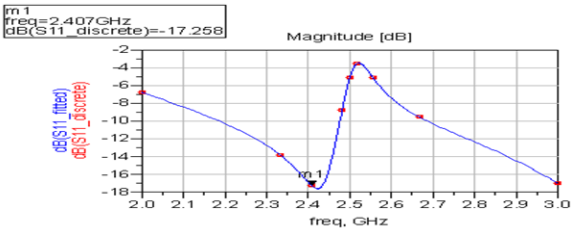
Parameters	L(mm)	W(mm)
Patch Dimensions	28.80mm	37.35mm
F Dimensions	L1(16.68mm)	1.5mm
	L2(14.89mm)	1.5mm
Cross Dimensions	17.6mm	2.1mm

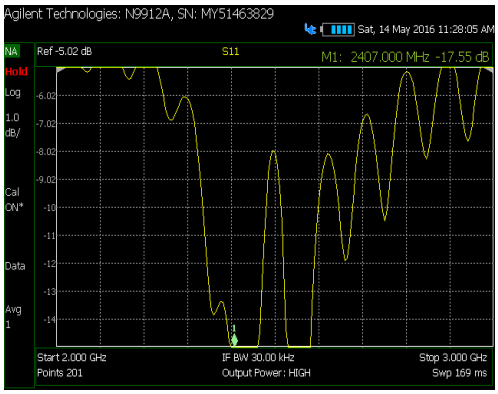
IV. SIMULATED AND MEASURED RESULTS

To verify the proposed antenna design, a prototype is fabricated as shown in Fig. All the measured results are carried out in network analyser of agilent technologies.

A) *Return loss*

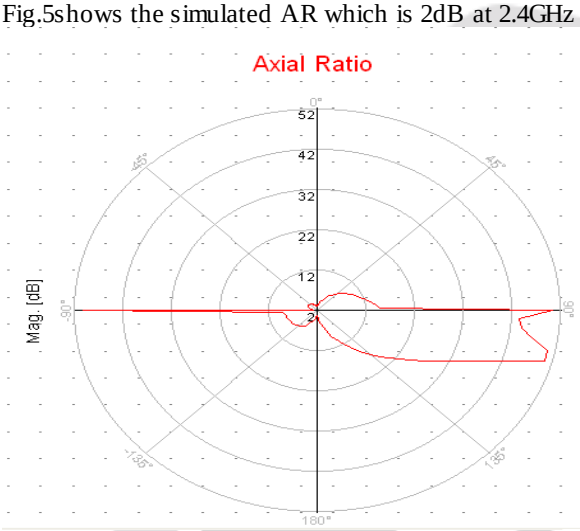
The simulated and measured return loss of the proposed antenna are shown in Fig. 4return loss obtained is -17.25dB .





B) *AR*

Fig.5shows the simulated AR which is 2dB at 2.4GHz frequency.



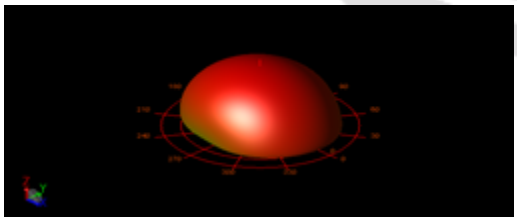
C)*Gain*

The Gain obtained is as shown in fig. the gain of the antenna is 7.4 dB and Directivity is 6.9dB.

Gain(dB)	7.4dB
Directivity(dB)	7.4dB

D)*Radiation Pattern*

3D radiation Pattern is as shown in the fig.



V. APPLICATIONS

These are the applications of Planar Inverted F Antenna:

- Mobile Communication
- Satellite communication
- Direct broadcast services
- Navigation
- Bluetooth applications

VI CONCLUSION

A Novel Technique for Realization of Circular Polarization in Planar Inverted F Antenna is presented here. Although simple in structure a skillful design of antenna is presented by introducing Inverted F structure and cross on its corner.Parameter like Gain,return loss and axial ratio are achieved with good results.This can be used in Nano Satellite application.

VII. ACKNOWLEDGEMENT

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