# DESIGN AND ANALYSIS OF PLANAR INVERTED F-ANTENNA (PIFA): A REVIEW PAPER

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***Abstract***

*The recent growth in multiple-frequency mobile communication-based devices has led to the development of patch antennas that enable multiband and wideband operations. There is a growing market for both commercial and personal applications for miniaturised and cost-effective antennas. These demands are served by Planar Inverted F Antenna (PIFA) designs. The Planar Inverted-F Antenna (PIFA) can be seen as a monopoly antenna formed from a quarter wavelength antenna and is now commonly used in mobile and portable radio applications due to its many attractive features such as simple design, lightweight, low cost, low profile, conformal nature, built-in structure, and reliable performance. Various PIFA designs that are low-profile, high-gain and endorse multiple frequencies have been introduced in this review paper.*

***Keywords:*** *Antenna Design, Multiband Operations, Planar Inverted F-Antenna (PIFA), Wireless Communication, Mobile Communication.*

## I. INTRODUCTION

Henry Hertz reported the existence of electromagnetic waves in 1886 and developed a wireless system of communication. Wireless networking has advanced quite rapidly in recent years and researchers are focusing on developing a low-profile antenna. The measurements are lowered accordingly to satisfy these specifications [1]. Today's need to support multiple wireless apps is an antenna that facilitates multiband operations and is limited in size [2]. The Planar Inverted F Antenna (PIFA) can be considered to develop from the patch antenna by adding a shorting pin at different positions from the patch to the ground. Parallel inductance to antenna impedance is given by the shortening pin [3].

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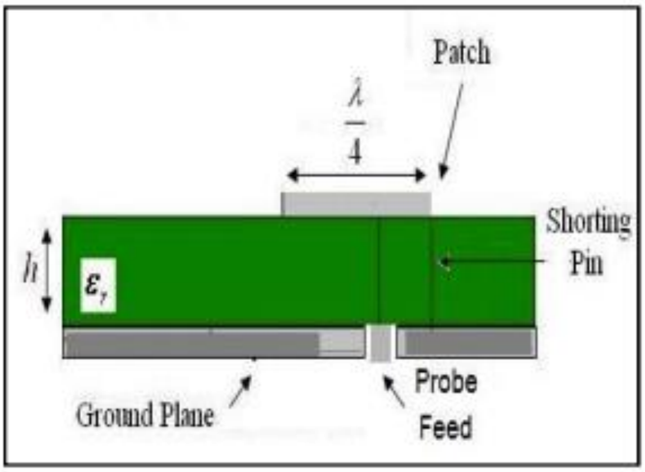


Fig. 1 Shows the Geometry of Planar Inverted F-Antenna.

The Planar Inverted F Antenna resonates at a wavelength of a quarter and thus takes less space than other antennas. The antenna's form looks like an inverted F, and is thus called a Planar Inverted F Antenna (PIFA). The Omni-directional pattern of the Planar Inverted F Antenna provides high gain in vertical and horizontal directions. The Planar Inverted F Antenna is a type of Inverted F Antenna (IFA) in which a bandwidth-increasing wire radiator is replaced by a plate. A rectangular planar portion that is positioned over a ground plane and a shorting plate is the Inverted F Antenna [4]. The Planar Inverted F Antenna has decreased height and a resonant trace length is preserved. Bandwidth plays an important role in the design of PIFA and the size of the ground plane is highly affected. Efficiency is decreased by the environmental losses incurred by PIFA [5].

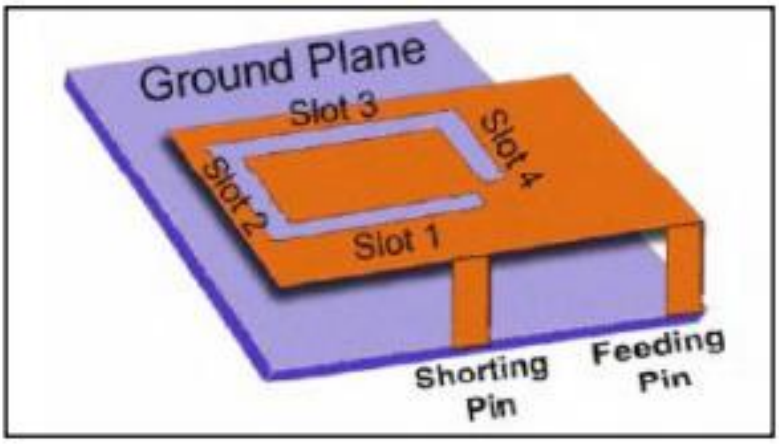


Fig. 2 Illustrates the Configuration of PIFA with four slots on top patch.

The width W of the DRA antenna can be determined by utilizing the following equation [6].

$$w = \frac{c}{2\, f_r \sqrt{\frac{(\varepsilon_r + 1)}{2}}}$$

Where
$f_r$ denotes the resonant frequency, and
r represents substrate dielectric constant

The effective dielectric constant ($\varepsilon_{reff}$) of DRA antenna is derived by using the following equations.

$$\varepsilon_{reff} = \frac{(\varepsilon_r + 1)}{2} + \frac{(\varepsilon_r - 1)}{2} \sqrt{\left(1 + 12\frac{h}{W}\right)}$$

Where h denotes the height of the antenna and W denotes the width.

The length of the antenna may be measured by applying the following equation.

$$L = \frac{c}{2\, f_r \sqrt{\varepsilon_{reff}}}$$

The antenna length extension is calculated by applying the equation below.

$$\Delta L = 0.412\, h \frac{\left(\varepsilon_{reff} + 0.3\right)\left(\frac{W}{h} + 0.246\right)}{\left(\varepsilon_{reff} - 0.258\right)\left(\frac{W}{h} + 0.8\right)}$$

Here W represents the width and h denotes the height.

The real length ($L_{eff}$) of the antenna can be calculated by using the following formula.

$$L_{eff} = L + 2\Delta L$$

## II. LITERATURE REVIEW

A paper on the construction of reconfigurable slot antennas was carried out by Peroulis et al. This paper addresses the idea of a lightweight, efficient and electronically adaptable antenna. A single-fed resonant slot filled with a series of PIN diode switches is the basic antenna configuration. The antenna tuning is achieved by changing its effective electrical length, which is controlled by the solid state shunt switches' bias voltages along the slot antenna. Since the architecture is based on a resonant configuration, without needing a reconfigurable matching network, an effective bandwidth of 1.7:1 is obtained through this tuning. This bandwidth selects four resonant frequencies from 540-890 MHz and, for all resonant frequencies, achieves very close matching. The theoretical and experimental behavior of the antenna parameters is defined and it is demonstrated that the frequency tuning remains largely unchanged by the antenna's radiation pattern, efficiency and polarization state [7].

## III. DISCUSSION AND CONCLUSION

Different Planar Inverted F Antenna (PIFA) designs are studied in detail in this paper. It has been shown that it is easy to produce and has simple structures for PIFA. Compared to other traditional antennas, PIFA offers much better coverage when considering SAR (Specific Absorption Rate). PIFA's bandwidth is also greater than that of other antennas. It can therefore be inferred that wireless innovations are projected to have a promising future for PIFA. The analysis paper explains the different antenna architectures used for 4G mobile devices in planar inverted-F (PIFA) antennas. Low profile structures with multiband characteristics have been targeted by the antennas designed by different researchers. It is also shown that, compared to other antennas, the different architectures of planar inverted-F antennas show multiband/wideband characteristics, minimise SAR and have much better reach. Researchers can therefore make better planar inverted-F antenna designs in terms of expense, execution and easy integration with different wireless communication equipment.

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