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Design and Analysis of Inverted-Fantenna for Wideb and applications

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Abstract: *A general design of the coaxial excited IIFA is presented. This coaxial excitation permits to resonate at wide band frequencies. It makes further the antenna preferably suitable to wireless area network (WAN) frame of reference by facilitating the integration on Microstrip patch. The antenna principle is analyzed and general study is presented. As solution of a IIFA integrated on FR4_Epoxy substrate is realized. All results are validated at the hand of comparative simulations and measurements.*

This design addresses the Inverted-F for recovering the performance for wide band applications. The approaching antennas are forthwith feed by coaxial connector and the antenna arms effectively consider the excited resonant modes for the prescribed operation. Total area employed by the antenna is 42×32.5 mm2. In this complimentary, one rule of thumb is presented: a broadband method. FR4_epoxy is characterized, and patch antennas are designed by the agency of this substrate to demonstrate the method. Prototype of the antennas on FR4_epoxy is manufactured. The fundamental antenna parameters comfort radiation pattern, resonant frequency, VSWR, return loss of the antenna and gain are in engaged order forthcoming discussed. The artificiality is going anticipated driven out on 3D electromagnetic simulation software HFSS. The prospective antennas are in engaged order impending designed, counterfeit and tested by network analyser E5071C. The fabricated antenna tested results are to be compared mutually the simulation results.

Keywords: *IIFA, Wide band, Microstrip, Coaxial Probe*

I. Introduction

Modern radio telegraph Communication is by the agency of printed antenna technology, which is replacing about all the wire antenna systems accessible so far. First Procreation mobile handsets used compact monopole testimony antenna that produced from the appliance cabinets.But today the manufacturing prefers to manage compact ethnic antennas for mobile communication.This proposal describes closely the advancement and analysis of realized inverted-F Microstrip antenna. In its approximately basic design, a Microstrip patch antenna consists of a radiating patch on a well known side of a dielectric substrate which has a ground plane on the disparate side as dug up in Fig.1. The patch is as a matter of course made of conducting material a well known as copper or gold and cut back bring in any accessible shape. The radiating patch and the feed lines are continually photo etched on the dielectric substrate. The Integrated inverted-F antennas (IIFA) are convenient candidates for this comparatively applications.

The conventional IIFA was complete in the 60 s as an antenna for telemetry transmission and missiles remote control [1], [2]. Note that, when the horizontal wire is retrieved by a rectangular plate the antenna is called PIIFA (planar inverted-F antenna). The dearth of these customary structures is that they are non planar and, by means of this, cannot be engraved on circuit board. Consequently, the integrated (or printed) inverted-F antennas (IIIFA) are instructed and applied in mobile, WLAN or Bluetooth applications [3], [4]. Integrated Inverted F antennas (IIFAs) have a peaceful profile arrangement, are stumble in load and are light as a feather to coordinate into personal air mail equipment. They can feed both vertically and horizontally polarized waves, engender some modification on the fortuity of signal cancellation what is coming to one to multipath fading [5]. There are three kinds of IIFAs: conservative wire element IIFAs, planar inverted F antennas (PIIFAs) and integrated inverted F antennas (IIIFAs), as dug up in Figure 1. The firm wire element IIFAs were permanently evolved from the folded L antenna, mutually the additional desire to overwhelm the input overall the horizontal wire to get ahead some approach of input impedance [6]. To further lessen the length of the antenna and to revive the bandwidth, the wire elements are stretched to comprise planar sheets. The study formulas for the resonance frequency of PIIFAs can be hinge on from Reference [7]. To make the IIFAs more compact, the antenna elements can be engraved on the top plane of substrates to comprise the integrated inverted F antennas. IIIFAs have been hand me down in Bluetooth and DECT applications [8, 9].

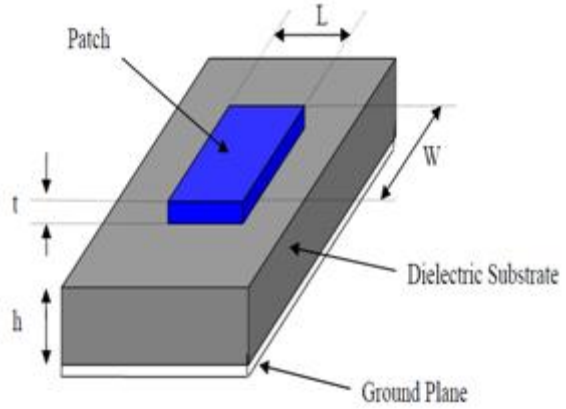

Fig.1: Microstrip Antenna

II. Antenna design

The geometry of the eventual antenna for achieving enhanced stance at Wide band is dug up in Figs.2. Fig. 2 represents the geometry of the IIFA. Here one leg of IIFA instantly accessible to the feeding and Fig.1: Microstrip Patch Antennaanother leg spaced s from the ground plane. But in conservative IIFA spacing is perpetually is zero. For the numerical examination we expected the substrate permittivity of the antenna is εr = 4.4 (FR4_epoxy) by all of substrate thickness 1.6 mm. For our design we suggest thecopper conductor and the antenna was coming to be intended to 50 Ω system impedance, by all of its central conductor connected to the feeding am a matter of and its extraterrestrial conductor soldered to the ground plane seldom across the feeding point. In the examination the dimensions of the ground plane approaching as 42 mm × 32.5 mm.

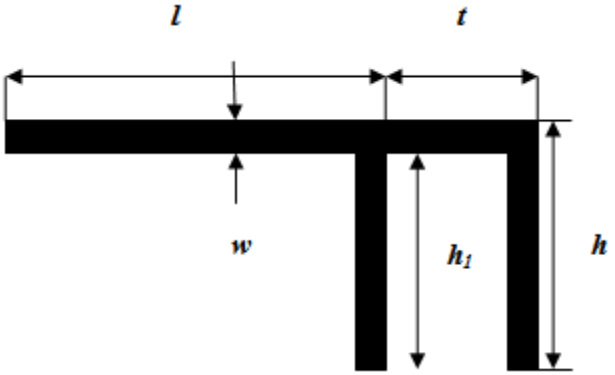

Fig.2: Geometry of IIFA

III. Design Methodology

As said heretofore, We propose now to integrate the antenna on FR4_epoxy substrate, Let us permeate our study procedure on FR4_epoxy substrate to gat what is coming to one a characteristic impedance of 50 Ohms on this substrate, We propose, thereby, to untangle and (characteristic impedance), and to conform the antenna shape in censure to prove the matching to 50 Ohms. The study methodology ensures the merit selection of the antenna terrestrial parameters a well known as width of Microstrip antenna, effective dielectric constant, effective length, length extension, actual length, ground plane dimensions. These terrestrial parameters are communal on the resonant frequency we appoint i.e. f_0 and their deciding equations are intended below for productive results

a) Design Equations:

The width of the Microstrip patchantenna is given by

$$w = \frac{c}{2 f_0 \sqrt{\frac{\epsilon_r + 1}{2}}} \qquad (1)$$

The Effective dielectric constant (ε_{reff}) can be measured by using the equations (2) & (3) respectively

for $\frac{w}{h} \geq 1$

(2)

for $\epsilon_{reff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2}\left[1 + 12\frac{h}{w}\right]^{-\frac{1}{2}}$ $\frac{w}{h} \leq 1$ (3) (3)

The Effective length (Leff) can be measured by using the equation (4)

$$L_{eff} = \frac{c}{2 f_0 \sqrt{\epsilon_{reff}}} \quad (4)$$

The length extension (ΔL)can be measured using equation (5)

$$\Delta L = 0.412\, h \frac{\left(\epsilon_{reff} + 0.3\right)\left(\frac{w}{h} + 0.264\right)}{\left(\epsilon_{reff} - 0.258\right)\left(\frac{w}{h} + 0.8\right)} \quad (5)$$

Actual length of patch (L)can be measured using the equation (6)

$$L = L_{eff} - 2\Delta L \quad (6)$$

The ground plane dimensions (Lg and Wg) can be measured using the equations (7) & (8) respectively.

$L_g = 6h + L$ (7)

$W_g = 6h + W$ (8)

IV. Results

A. Simulation Results

The proposed F-shape antenna is simulated in Ansoft HFSS v12 software and the results obtained are shown below. The Fig.3 shows the return loss characteristics of F-shape antenna using HFSS software. In these above characteristics the antenna is operating in five bands of frequencies.

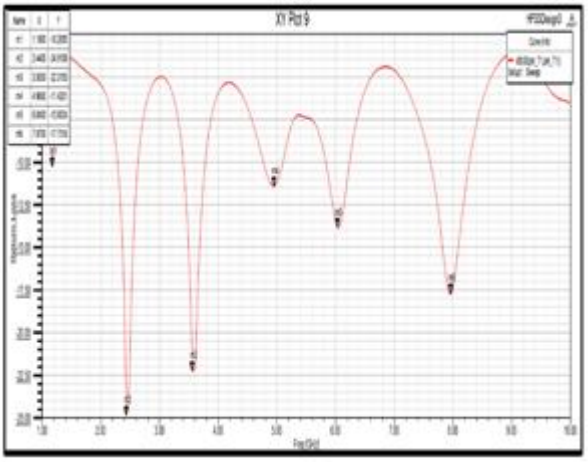

Fig.3: Simulated Return loss characteristics of IIFA.

Their return loss is -10.29dB at 1.18GHz,-24.91dB at 2.44GHz,-22.31dB at 3.56GHz,-11.42dB at 4.96GHz,-13.90dB at 6.94GHz and 17.73 dB at 7.97GHz respectively.

The Fig.4 shows the VSWR characteristics of F-shape monopole antenna using HFSS software. The VSWR of F-shape monopole antenna is 1.05 dB at 5.53 GHz which is in accepted value.

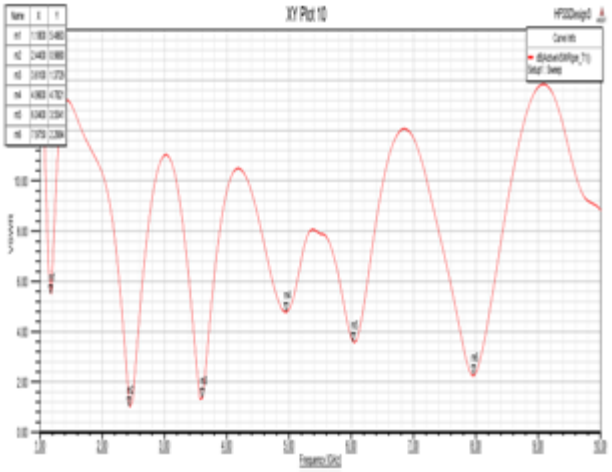

Fig.4: Simulated VSWR characteristics of IIFA

The Fig.5 shows the Smith Chart characteristics if the proposed antenna simulated using Ansoft HFSS software.

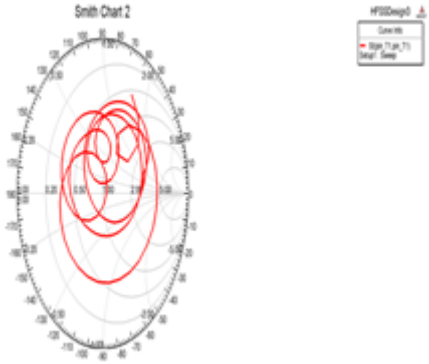

Fig.5: Simulated Smith Chart Characteristics of IIFA

The Fig.6 represents the gain plot of the proposed IIFA.The gain of present antenna is 3.61 dB.

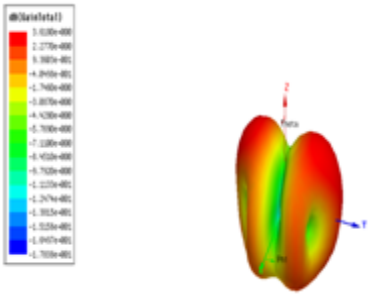

Fig.6: Simulated Gain Plot of IIFA

B. Measurement Results

The microstrip F-Shape antenna is designed by Ansoft HFSS simulation software and fabricated on FR-4 substrate, the prototypes are tested on Vector Network Analyzer (VNA)-E5071C. The parameters like return losses and VSWR are presented for the optimized set of antenna parameters in Fig.7 to Fig.9.

The proposedF-shape antenna is simulated in Ansoft HFSS v12 software and fabricated and its practical results are obtained using Vector Network Analyzer (VNA)-E5071C. Fig.7 shows the return loss curve obtained using Vector Network Analyzer. From the figures it is clear that the simulated and measured results are approximately equal. There will be a little variation because the fabrication is done in open environment rather than the Ionic chamber environment. The representation of VSWR, Return Loss and Smith Chart are the outcomes of the Network Analyser by which our designed and fabricated antenna is tested. We are made available with Network analyser E5071C.

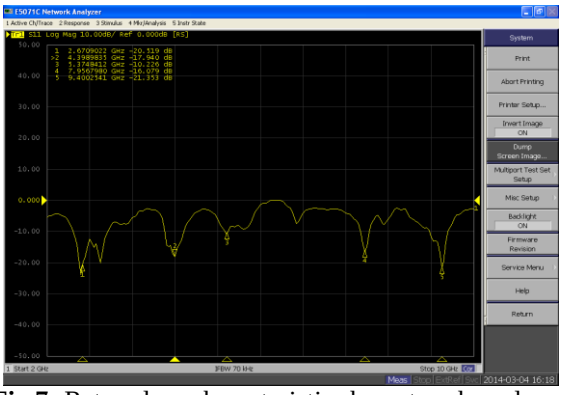

Fig.7: Return loss characteristics by network analyzer

The VSWR curve obtained by using Network Analyzer is as shown below.

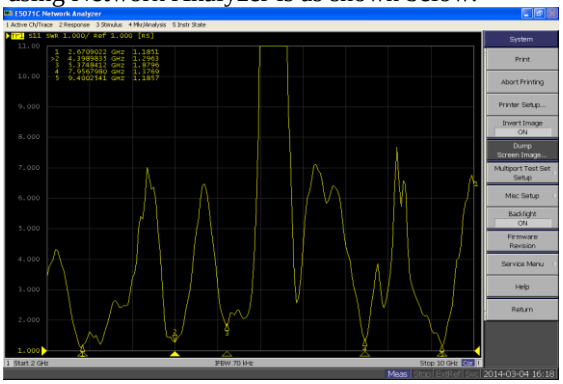

Fig.8: VSWR curve characteristics by network analyzer

The Smith Chart obtained by using Network Analyzer is as shown below.

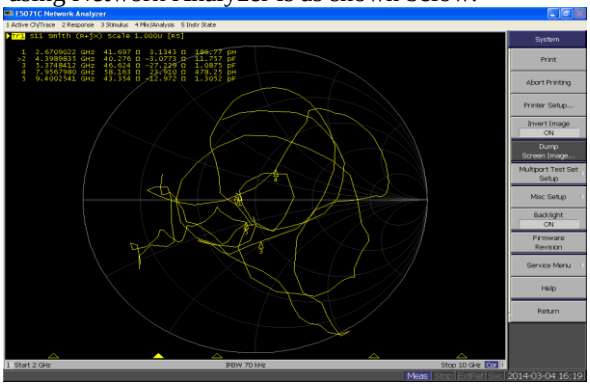

Fig.9: Smith chart characteristics by network analyzer

V. Conclusion

A novel configuration of IIFA excited by Co-axial probe is presented. This configuration permits to resonate at five bands at 1.18GHz, 2.44GHz, 3.56GHz, 4.96GHz, 6.94GHz and 7.97GHz respectively, by all of compactness, and polarization purity. A general design of this antenna is developed over an analytical study. Finally, the design procedure is applied for wideband antenna is integrated on FR4_epoxy substrate. The VSWR of IIFA antenna is 1.05 dB at 5.53 GHz which is in inferred value. The gain of prospective antenna is 3.61 dB. Due to the compact area engaged, the eventual antennas are eager to be confined within the diverse mobile devices employing multi band applications. We obtained an absolutely good acknowledgment between the simulation and experimental results for return loss, as readily as for the gain parameters, confirming the reliability of the retrieved data. The disparate parameters of the expected antenna are optimizedover simulation. Prototype of the prospective antenna has been designed, simulated in Ansoft HFSSv13 software and the fabricated Antenna is tested by the agency of Vector Network Analyzer (VNA).

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