Design of Wideband Inverted F Antenna for Wireless Communication at 5.76 Ghz

[1]Sonia Sharma, [2]Jagmehender Sheoran,[3]Devendra Rajput
[1]KIIT College of Engineering, Gurgaon-122102 (India),
[2]KIIT College of Engineering, Gurgaon-122102 (India),
[3]KIIT College of Engineering, Gurgaon-122102 (India),

Abstract

In this paper, a new wire inverted F antenna (WIFA) is proposed, which is structured by wire grid modeling of a thick WIFA. The proposed antenna is directly fed by a coaxial connector and antenna arms effectively control the excited resonant modes for the required operation, the area occupies by the antenna is 10.23mm×4.69mm. A laboratory prototype of the antenna was built and tested indicating good result. It shows 40% bandwidth for VSWR < 2.0. The wire inverted F antenna is widely used in wireless application due to its simple design, flexibility, low cost and reliable performance. This antenna is designed at 5.76 GHz. This microwave frequency is specially used for Wi-Fi and WLAN applications.

Keywords: *WIFA, slot antenna, Wi-Fi and WLAN*

1. Introduction

For wireless communication it is very important to develop small and low profile antenna for the miniaturization of communication equipment [1]. The inverted F-antenna (IFA) is practically known for its abilities to allow a simple impedance match in a low profile design and procedure for both vertically and horizontally polarized electric fields [2].Therefore IFA has already been widely used in wireless communication systems [3]. It is known that when the IFA height from a conducting ground plan is approximately one-tenth of the wavelength, the bandwidth is approximately 8% for VSWR <2.0[4,6].To broaden the IFA bandwidth, some techniques have previously been proposed including decreasing the size of the ground plane [5], adding a parasitic element [6] and introducing dual resonance concept.

However, the most successful method in bandwidth enhancement has been replacement of the IFA horizontal element by a planner conducting patch. In the present work by utilizing a technique called wire grid modeling[7],

2. Antenna Design

We start with a WIFA with a typical dimension as described in [4]. To improve bandwidth, the thickness of the antenna wires must be increased because it is well known that thicker the wires are the more is the bandwidth. But there is a restriction on the thickness of the wire .In fact results of FEKO and IE3D are true for very thin wires. Because WIFA segments are required to be very thin, increase in wire thickness decreases analysis accuracy [1].

In the next step, we apply the wire grid modeling technique [7] by transforming the structure in Fig.1 to an equivalent wire grid modeled structure with equal radii and the same dimensions. Thus as mentioned, earlier, it makes sense that we try to miniaturize the antenna as much as possible. This way BW can be controlled easily.

3. Theory

Why does this structure radiate? Let's go back and look at the antenna, shown in fig.1.The slot antenna should be half wavelength long for proper radiation. The voltage at the ends of the slot (across the aperture) must be zero because of the shorting post on either side .If the voltage is zero at the edges of the slot, then the voltage will be at a maximum a quarter-wavelength away (at the center of the slot).

The slot antenna radiates because the voltage is in phase across the entire aperture, so that the E field is vertical and line up everywhere along the slot. This also gives rise to the vertical polarization. How does this relate to the IFA? Here is the key point: If the current at the center of the slot is zero, then the slot antenna can be thought of as havingan open circuit at the center of the slot. Hence, if we break the slot in half, and get rid of the right side, we are left with the IFA antenna as shown in fig 1.Note that the IFA can support the exactly the same mode of radiation as a slot antenna. That is, since the IFA has an open circuit on the right side of the feed, the current will be zero at the point and the voltage will be a maximum exactly as in the slot antenna case. Hence, the IFA can be viewed as "half a slot antenna". And indeed, this is a valid model for the antenna. Hence, the IFA is classified as an aperture antenna, even though the aperture is not "closed" [9].

4.Conclusion

A simple structured WIFA suitable to be used in a portable wireless communication device as an internal antenna having high bandwidth (40% for VSWR<2.0) is realized and tested. The proposed antenna covers 5.55GHz to 5.90 GHz frequency range. Due to small area occupied, the proposed antenna is promising to be embedded within the different communication devices employing ISM band around 5.76 GHz is designed and tested. Because of their small size such antennas (IFA) are useful for mobile communication and WI-FI systems.

5. Acknowledgement

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6.Results

The simulated VSWR result Fig. in the range 5.35 GHz to 6.15 GHz it shown in Fig.3. It has been found that 5.48 GHz to 5.92 GHz, the value of VSWR is 2 or <2.0 being 1.35at the center frequency. The value of impedance is around 40 Ω as shown in Fig 4. The Fig.5 shows the reflection coefficient for the frequency range from 5.48 GHz to5.92 GHz and is below -10db and at the center frequency, 5.76 GHz, the value of reflection coefficient is -16 db. Other results such as gain, 3-D pattern are shown in Fig. nos. 7 to 9. Table 1 shows physical parameters of the antenna. The Fig. 2 shows photograph of proto model of the antenna.

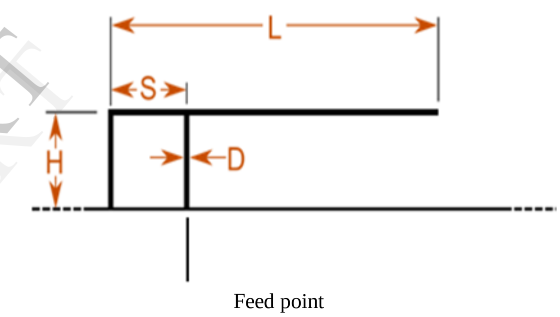

Fig.1: Schematic of IFA

Fig.2: Photo graph of actual antenna

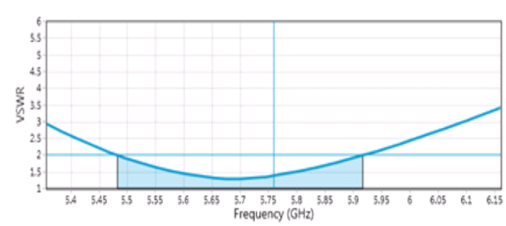

Fig.3: VSWR

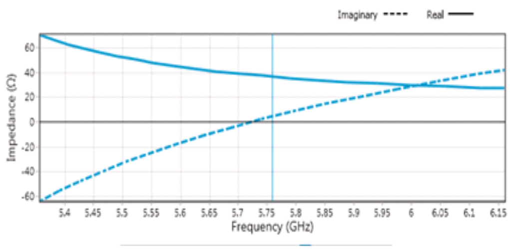

Fig.4: Impedance

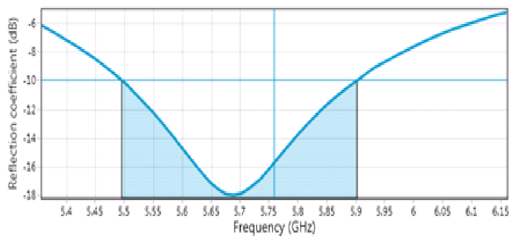

Fig.5: Reflection coefficient

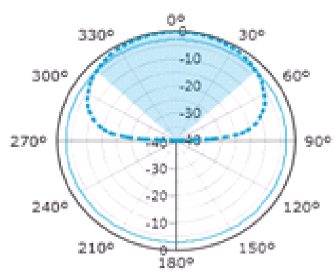

Fig.6: Horizontal gain

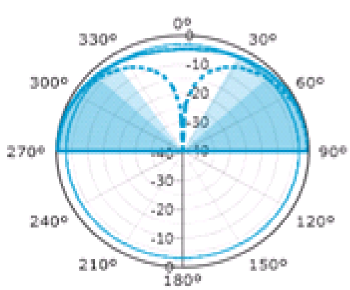

Fig.7: Verticalgain

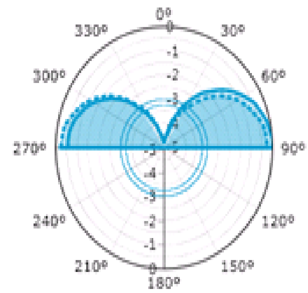

Fig.8:Total gain

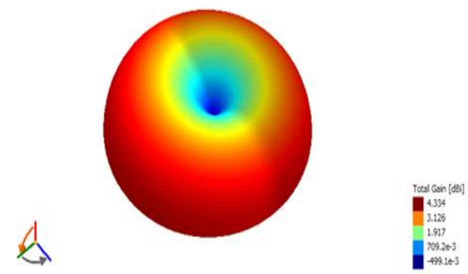

Fig.9: 3-D Radiation Pattern

Table 1:Physical parameters of antenna

Name	Description	Value
L	Element length	10.23mm
H	Element height	4.69mm
S	Feed spacing	1.36mm
D	Feed diameter	520um
X	Total length of IFA	10.23mm
Y	Wire diameter	520um
Z	Height of IFA	4.69mm

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