MULTIBAND PLANAR INVERTED F-ANTENNA FOR WIRELESS LOCAL AREA NETWORK APPLICATION

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Abstract
In wireless Local Area Network (WLAN) applications antenna is a key element where nodes are working at different frequencies. Various antennas designed on the Printed Circuit Board (PCB) have been proposed for IEEE 802.11 a/b/g standard with ISM band.
Proposed Antenna works at WiMAX and WLAN Frequencies, 3.78GHz and 5.79GHz respectively. Antenna is designed and simulated using High Frequency Structural Simulator(HFSS 13.0) software. HFSS is high performance full wave electromagnetic(EM) field simulator, which integrates simulation, visualization solid modeling and automation. Antenna is fabricated on PCB, and assembled SMA connector.

Keywords

Planar Inverted-F Antenna (PIFA), HFSS,WLAN.

1. INTRODUCTION

Nowadays, even the smart phones have an inbuilt WLAN capabilities. However the wireless LAN's are subjected to various wireless conditions with respect to the interference level, radio coverage and there by normally they cannot always provide satisfactory signal reception to users. This reduces the data rate and throughput.

The antenna is key element in realization of future wireless application where multimode terminals are working over several frequencies. In recent years a great number of antennas have been developed for wireless LAN application. Various antennas designed on the printed circuit board (PCB). To enhance the communication capability of a unit cell, a combo system with 802.11a/b/g standards is currently developed. In this combo system, the antennas are like transceivers operating in 3.78 GHz and 5.79 GHz frequency bands but the space allocated for the antennas is usually quite limited, particularly for those at the client terminal (PCMCIA or USB interface). In order to reduce the antenna size, a Multiband antenna with a single input port is needed. This antenna should not only have good input impedance match but also offer proper antenna gains (with peak gain larger than 0dBi) and radiation patterns as Omni directional. The planar inverted-F antenna (PIFA) is widely used because of several advantages such as easy to fabricate, input impedance compatibility with no outer circuit, having omnidirectional pattern, etc. However, its length is limited to be a quarter wavelength of the operating frequency, which usually occupies quite a few amount of space in PCB.

2. OBJECTIVE

Besides, the single inverted-F antenna can only be operated at the certain resonant frequency, which is unable to supply the market needs of Multiband applications. A solution to this, we propose a spiralled PIFA antenna structures by means of spiralling an inverted-F antenna [as Figure. 1] which achieves Multiband operation which in turn operates at 3.78 GHz and 5.79 GHz frequency bands.

3. METHODOLOGY

The proposed spiraled PIFA antenna structure is shown in Figure1. The spiral inductor loaded on the antenna can be realized both Multiband operation and miniaturizes the size of the conventional inverted-F antenna.

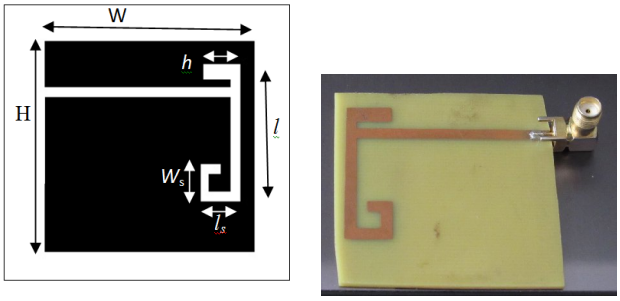

Figure1: Proposed spiralled PIFA Antenna

In the proposed spiraled PIFA Antenna structure, the Microstrip feed line is connected to a horizontal metal line with one end short-circuited and the other end open-circuited. The metal line and the ground plane form a quasi transmission line. It is easy to derive that as the total length of this quasi transmission line equals a quarter of wavelength, the input reactance vanishes due to the Resonance of the inductor-like short-circuited line and the capacitor-like open-circuited line. The spiralled PIFA of Figure 1 was simulated on FR4 substrate with thickness 0.8mm, and W x H =46mm x 46mm. The antenna occupies an area of l x h = 33mm x 10mm with width 2mm. The other parameters are l_s = 10mm, w_s =9mm and gap of the spiral is 0.5mm. The ground plane is of 46mm x 30mm.

4. RESULTS

4.1 Return Loss

The proposed antenna is found to be resonant at different frequencies namely 3.78GHz and 5.79GHz with the return loss of -1.3595dB and -6.925dB respectively. The corresponding Bandwidth's are 550MHz and 530MHz respectively.

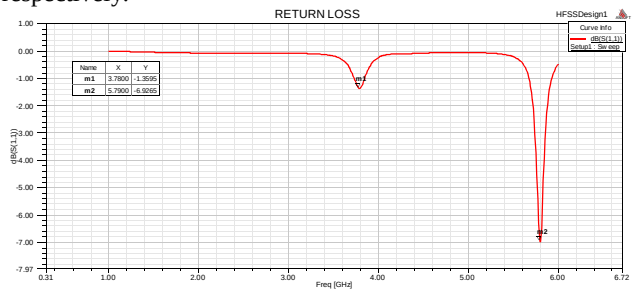

Figure 2: Return Loss of Antenna

4.2 Gain

The field gain of the antenna ranges from 2.51dBi to 6.34dBi.

4.3 VSWR

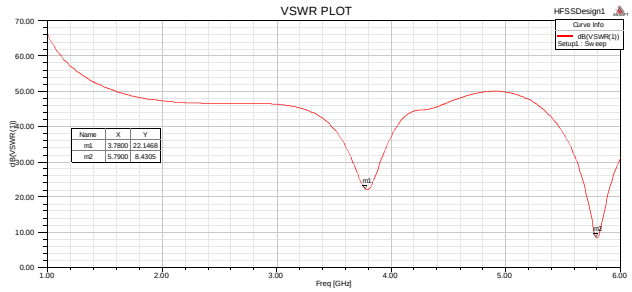

Figure 3: Antenna VSWR plot

4.4 Radiation Pattern

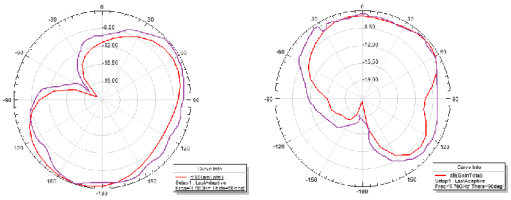

Figure 4:Radiation Pattern for 3.78GHz and 5.79GHz

4.5 3D Polar Plot

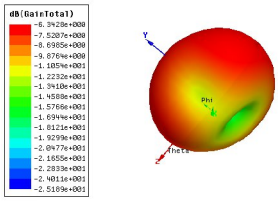

Figure 5: 3D polar plot

5. CONCLUSION

Spiraled PIFA related multiband antennas have been designed and simulated using HFSS13.0 software, fabricated on PCB and assembled SMA connector. Tested on Vector Network Simulator (VNA). Simulated and Tested results are approximately similar. Hence proposed design is suitable for WLAN applications.

6. FUTURE SCOPE

6.1 Improving Bandwidth
6.2 Avoiding Interference between frequencies
6.3 Tri or Quad Band Design
6.4 Reduction in size

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