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Compact Planar Inverted L-Antenna for Mobile Wimax Applications

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ABSTRACT

A highly compact and an optimized design of an inverted-L shaped printed monopole antenna with a circular ground plane is proposed. To make the designed antenna suitable for implementation it is embedded in FR-4 substrate and is presented. The antenna is designed to operate at 3.5GHz. It is suitable for mobile WiMAX applications with return loss (S11) <-10 Db. The size of the antenna is 30x11.36x1. The antenna design is simulated using the tool CAD FEKO 2014. The antenna design has good return loss and radiation characteristic in the required frequency band. The radiation pattern obtained from the proposed antenna is an omni-directional radiation pattern in the E and H plane over the frequency ranges.

Keywords: Iris Recognition, Visual Cryptography, Segmentation, Localisation, Visual Cryptography, Log Gaber Wavelet

I. INTRODUCTION

Wireless communications have been developed widely and rapidly in the modern world especially during the last decade. In the near future, the development of the personal communication devices will aim to provide image, DMB (Digital Multimedia Broadcasting), video telephony, and speech and data communications at any time-anywhere around the world using the WLANs (Wireless Local Area Networks). Rapid advances of various WLAN protocols have sparked the requirements for miniaturized multiband antennas with suitable frequency bands appropriate for the Wi-Fi (IEEE 802.11 standard) and mobile WiMAX (IEEE802.16e-2005 standard) applications are highly desirable. The Wi-Fi operates in the 2.4 GHz band (2.4 GHz-2.5 GHz) and 5 GHz band (5.15-5.35 GHz, 5.47-5.725 GHz and 5.725-5.875 GHz). The mobile WiMAX operating bands are 2.3 GHz (2.3-2.4 GHz), 2.5 GHz (2.5-2.7 GHz) and 3.5 GHz (3.4-3.6 GHz).

In recent years, the demand of compact, smaller than palm size communication devices has increased significantly. Communication system demands for antennas to exhibits some standard properties such as reduced size, moderate gain broad band and multiband operation. Now a day's PILA are in huge demand for the compact handheld wireless devices because these antennas have simple structure, small size, low cost. Because of these attractive features PILA are likely to be used in multiband applications. The typical PILA has $\lambda/4$ patch length instead of the conventional $\lambda/2$ and consists of a ground plane, a feed wire feeding the resonating top plate, a top plate element, and a DC-shorting plate that is connecting the ground and the top plate at one end of the resonating patch.

It is realized that some low-profile microstrip and printed slot antennas are required for Wi-Fi and mobile WiMAX operations which can overcome the constraints of size, weight, cost, performance, installation complexity and aerodynamic profile. To meet the mentioned constraints, Inverted-L antenna is one of the good candidates. This paper presents the numerical analysis of inverted-L antenna to realize the 3.5 GHz mobile WiMAX with acceptable return loss, gain and VSWR.

II. METHODS AND MATERIAL

Antenna Structure

Antenna structure under investigation is designed to operate at 3.2-3.9 GHz which is covering almost the entire WiMAX band. Most preferred frequency band for mobile communication. The finite ground is a circle of radius 30mm. The dimensions of the top plate are (L1 W) is 30mm and 1 mm respectively and the bottom plate dimensions are (L_2 W) is 11.36 mm and 1 mm respectively. The dielectric substrate is used which is made up of FR4 of 4.4.The width of the substrate is 1.6 mm. The antenna is excited through the coaxial probe at feed point. Coaxial probe provides better impedance match.

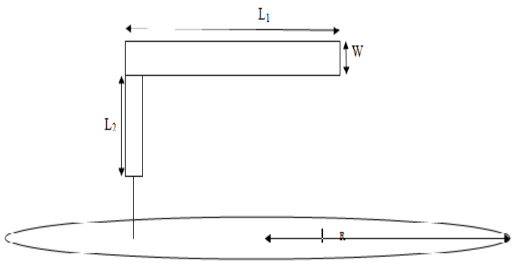

Figure 1. The structure of a PILA with a finite ground plane

III. RESULTS AND DISCUSSION

The resonant frequency of the PIFA is proportional to the effective length of the current distribution. Figure 2 shows that we are getting a resonant frequency of 3.5 GHz, for which antenna was initially designed. For -10 dB return loss antenna is covering a frequency range of 3.2 GHz to 3.9 GHz. At 3.5 GHz the reflection coefficient comes to -27 db means that 27 db power is reflecting back. This frequency range is covering WiMAX band. However for mobile phone application purpose we can also take the result of -8 dB or -6dB return losses into consideration.

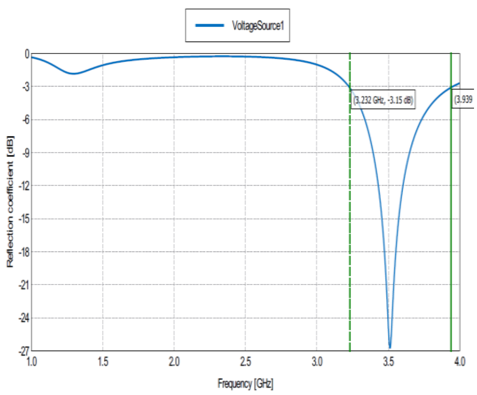

Figure 2. Return Loss

VSWR or Voltage Standing Wave Ratio is a ratio of peak voltage on the minimum amplitude of voltage of standing wave.

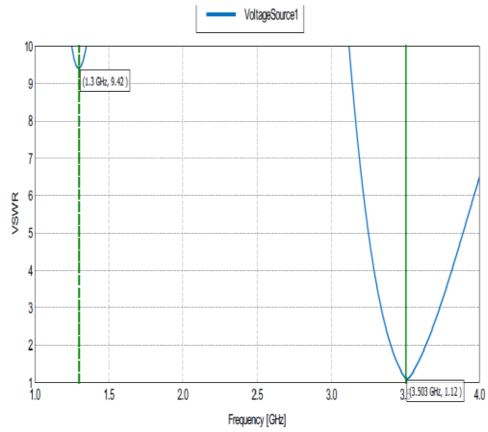

Figure 3. VSWR plot

Figure 3 shows the graph of VSWR (voltage standing wave ratio) against frequency. Corresponding to -10 dB return loss VSWR of 2:1 is taken into consideration. From figure it is clearly visible that for the entire frequency range of interest, the value of VSWR is below 2. It is also seen that at the resonant frequency of 3.5 GHz the values of VSWR is nearly 1 which indicates perfect impedance matching at the resonant frequency. It is seen that for the desired range of frequencies the reactive part of impedance is nearly 0 ohm, while the resistive part of impedance is nearly 50 ohm. Thus in this way matching at the antenna input port is good.

The radiation pattern of an antenna is a mathematical function or a graphical representation of radiation properties as a function of space coordinates. In most cases, the radiation pattern is determined in the far-field region and is represented as a function of directional coordinates.

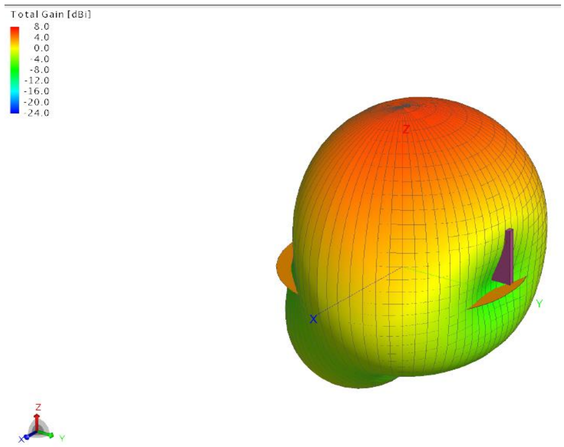

Figure 4 . D Radiation pattern

The 3D view for gain of PILA is also shown in Fig.4. for 3.5GHz. A 3-D polar plot also computed which provides a nearly omnidirectional radiation pattern. Presence of nulls at φ=0 deg is due to the fact that conducting base (ground) plate is being used. Gain of the L- antenna comes out to be 8 dB as shown in the figure 4.

IV. CONCLUSION

A Planar Inverted-L Antenna for WiMAX applications (3.2-3.9 GHz) has been designed successfully. The proposed structure has a dimension of 30 x 11.36 mm^2 over the ground plane of radius 30 mm which can easily be implanted in the small space available within the mobile device. The proposed structure is having a impedance bandwidth ranging from 3.232 GHz to 3.939 GHz covering WiMAX band. Antenna has a resonating frequency at 3.5 GHz frequency. For getting the impedance bandwidth we are taking -6 dB as the reference return loss, which is acceptable for mobile phone applications. The VSWR, input impedance plot along with parametric study of some key parameters is presented. The radiation pattern and current density plots of the antenna are also presented. The peak realized gain varies from 8 dB to 4 dB in the desired operating band.

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