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Design of Meandered PIFA Antenna for Wireless Application

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***Abstract*—A novel multiband planar inverted-F antenna with meander line and slots applied on the radiating patch has been introduced. The proposed structure consist of rectangular meander line on radiating patch which reduce the size and improve the characteristics of antenna as compared to conventional PIFA. The antenna has been designed on FR4 substrate which is cheap and easily available with ground plane dimension of 70x40x1.5676 mm^3 and radiating meandered patch has dimension 40x20 with height 4 mm above the substrate. . The antenna is covering mobile WiMAX (2.7161-2.8640 GHz) band, broadband wireless application or fixed/mobile application (3.7499-3.8470 GHz) band and x-band (8-12 GHz), is suitable for weather radar, and some communications satellites.**

***Keywords*—PIFA, Meander Line, Return loss, Multiband, Gain**

I. Introduction

As the advancement in wireless communication rapidly growing, demand of the small size, multiband, low profile, multifunction antenna is increasing. Planar inverted-F antenna (PIFA) is one of the most promising candidate which fulfill these requirements. PIFA has advantage of low profile, low cost, easily fabrication. PIFA basically consist of ground plane, top patch, shorting pin, feed pin [1]. But the narrow bandwidth of PIFA is one of the limitation, therefore it is necessary to broaden the bandwidth for use in mobile phones and other applications [2]. In order to improve the bandwidth characteristics, antenna has transformed the horizontal element from a wire to a plate resulting in the so called planar inverted-F antenna (PIFA). It has a self-resonating structure with purely resistive load impedance at the frequency of operation. Variation of length, distance and location of the feed and shorting point, height of the radiator etc. affects the electrical performance of these antenna structures [3]. As the size of the antenna decreases to meet the requirement for mobile handset, gain of an antenna also decreases. In order to overcome the limitations of conventional PIFA of single band operation, low gain, narrow bandwidth and it further reduce the size of the antenna, meandered planar inverted F antenna is designed in this paper [4]. Meander PIFA antenna is used where it can resonate broadband and produces circular, horizontal and vertical polarizations. It also achieves high gain which higher than that of other antennas in the market [5].

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II. Antenna Structure Design And Consideration

The antenna dimensions are shown in Fig. 1.(b). The length and width of the ground plane is, L_G=70 mm, W_G=40 mm, and substrate is FR4 epoxy whose thickness is 1.5676 mm and relative permittivity is 4.4, dielectric tangent loss is .02. The length and width of the top radiating patch is, L_T=40, W_T=20, and height of top patch from ground is 5.5676 mm, whereas T_1=27 mm, T_2=17 mm, T_3=3 mm. The top radiating patch has been connected to the ground plane with the help of a shorting strip of thickness 5 mm.

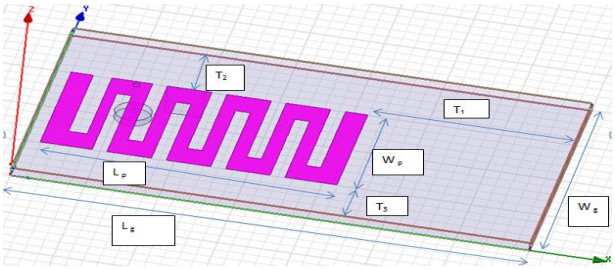

Figure 1(a) Dimensions of the Meandered Planar Inverted F Antenna

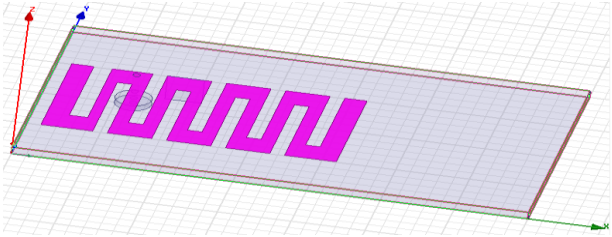

Figure 1(b) Meandered Planar Inverted F Antenna (PIFA)

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The diagram of the proposed PIFA with meandered top patch is shown in Fig. 1. (b). In this paper, a meandered structure has applied on the top radiating patch for multiband application. It is noted that, by applying meander structure on conventional PIFA, size of the antenna can further be reduces, achieve multiband operation. Simulated results shows that gain of antenna has increased comparable to that reported in [1].

III. Results and Discussion

The antenna performance is simulated with the help of ANSOFT HFSS [6]. HFSS stands for high frequency structure simulator. HFSS is a high performance full-wave electromagnetic (EM) field simulator. ANSOFT HFSS can be used to calculate parameters such as S parameters, resonant frequency, and field. The S parameters of the proposed antenna is shown in Fig. 2, which shows the reflection performance of the antenna at different frequencies. Fig.3(a), (b) and (c) shows the radiation pattern of antenna at 8 GHz, 2.8 GHz and 3.8 GHz. Fig.4 shows the 3 dimensional polar plot of meander PIFA, which shows total gain 5.8339 dB. By applying meander slot on radiating patch, it covers WiMAX (2.7161-2.8640 GHz) band, broadband wireless application or fixed/mobile application (3.7499-3.8470 GHz)band and x-band (8-12 GHz). By changing the dimensions of the slots, position of coax feed and shorting plate, characteristics of the antenna changed. It is also noted that when number of slots increases, gain of the antenna also increases and get return loss less than -15 db. Fig.4 shows 3D polar plot of total gain of an antenna. Fig.5 shows the electric field distribution on radiating patch, in which red color shows high electric field, blue color shows low electric field and green color shows medium electric field.

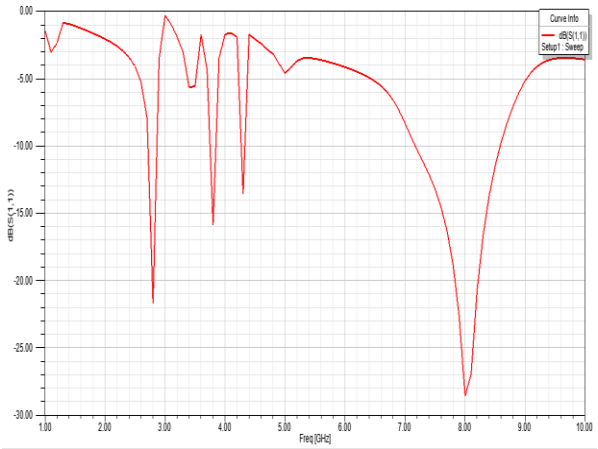

Figure 2 Simulated Magnitude of the S_{11} Parameters of Proposed Antenna

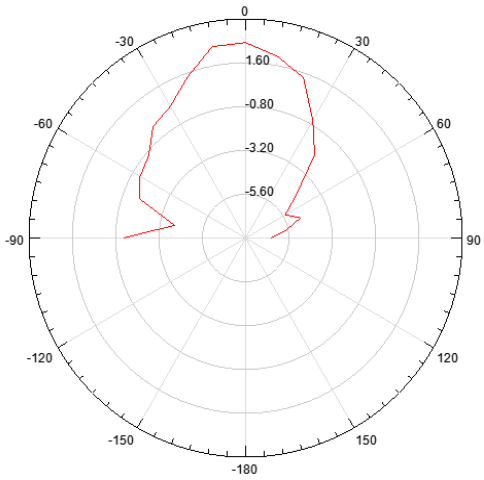

Figure 3(a) Radiation Pattern at Frequency 8 GHz, phi=60°

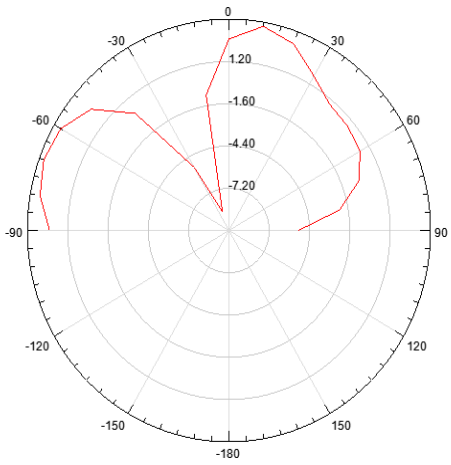

Figure 3(b) Radiation Pattern at Frequency 2.8 GHz, phi=60°

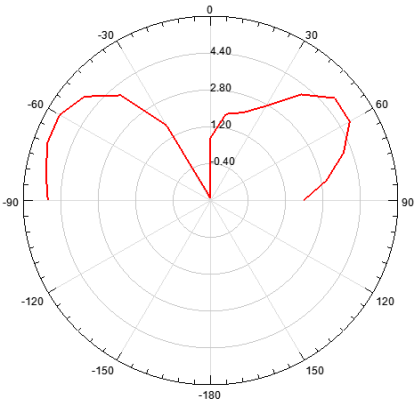

Figure 3(c) Radiation pattern at frequency 3.8 GHz, phi=60°

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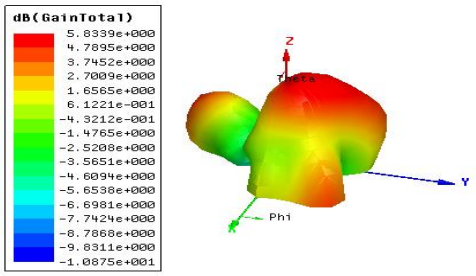

Figure 4 Three Dimensional Polar Plot of Gain

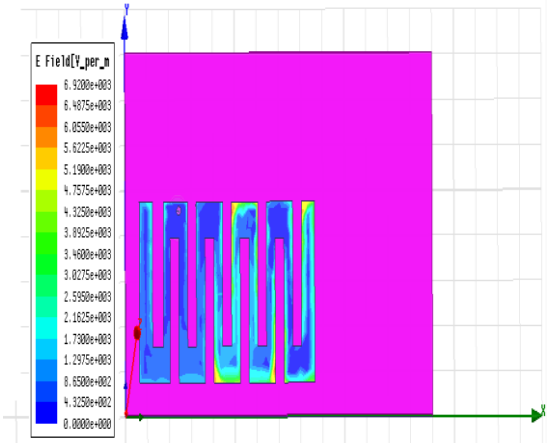

Figure 5 Electric Field Distribution on Radiating Patch (V-per-m)

IV. Conclusion

A novel multiband planar inverted F antenna with meander slot on the radiating patch to cover WiMAX (2.7161-2.8640GHz) band, broadband wireless application or fixed/mobile application (3.7499-3.8470 GHz) band, x-band (8-12 GHz) band. In this structure, number of slots has extended up to 9, which is more as compared to [1]. Proposed antenna achieved 5.8339 dB which has enhanced as compared to [1].

V. References

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