A Planar Inverted Feed Antenna for WiMAX and GPS Applications

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ABSTRACT---The mobile phone commerce is glooming exponentially in the twenty first century. The novelty in Planar Inverted Feed Antenna (PIFA) has a massive position in it. It has a coaxial probe feed and numerous shorting pins in excess of the intended patch antenna. Flame Retardant (FR4) substrate is used in intending of antenna. The recompense in initiating the Defected Ground Structure (DGS) over the patch as well as Defected Microstrip Structure (DMS) was scripted in the intended antenna. The intended petite outline, worth effective and the antenna can be used in the functions similar to Global Positioning System (GPS) at 1.49 GHz reverberating frequency, Worldwide Interoperability for Microwave Access (WiMAX) at 2.53 GHz and 3.5 GHz reverberating frequencies respectively. Simulation is prepared through High Frequency Structural Simulator (HFSS).

Keywords- Defected Ground Structure (DGS), PIFA, Defected Microstrip Structure (DMS), Rectangular Patch, GPS, WLAN, WiMAX.

I. INTRODUCTION

Mobile communiqué manufacturing is flourishing exponentially day by day as the prerequisite for the mobile phones is on the ascend [1]. As the dimension of the hand-held diplomacy used in mobile communiqué is plummeting radically, deceitful an antenna that hysterics the dimension of mobile forms a most important fraction of investigate in mobile commerce [2]. PIFA configurations are subdued in the antennas to create them supplementary feasible for the mobile communiqué [3].

GPS mechanism is essential in mobile communiqué as positioning the communiqué campaign are decisive throughout the communiqué progression [4]. Integrate the GPS with WiMAX third generation (3G) communiqué will decrease the dimension and prerequisite of detach strategy for mobile communiqué and GPS [5].

The Defected Ground Structure (DGS) over the patch as well as Defected Microstrip Structure (DMS) was scripted such that they are engraved in the position plane and are used to modify the essential reverberating frequencies as per the favored functions [6].

II. PROPOSED ANTENNA DESIGN

The intended antenna is a multiband PIFA antenna for GPS and WiMAX functions. Devious a rectangular patch antenna appearance the base of antenna plan that was intended based on the subsequent equations (1-6) [7]. Let the elevation of the substrate used for antenna intend be *h*, the width of the patch be *W*, the dielectric invariable of the substrate is $\varepsilon_r$then the effective dielectric invariable ε_{re} is established by the subsequent equation.

$$\varepsilon_{re} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\,\frac{h}{W}\right]^{-\frac{1}{2}} \quad (1)$$

The effectual length of the patch is indicated by L_e and can be established by the subsequent equation

$$L_e = L + 2\Delta L \quad (2)$$

whereas, ΔL significance can be establish from the accommodating equation.

$$\Delta L = 0.412\,\frac{(\varepsilon_{re} \pm 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{re} - 0.3)\left(\frac{W}{h} + 0.8\right)} \quad (3)$$

The reverberation frequency f_0 for any TM_{mn}mode where m and n are the modes of the rectangular patch antenna can be established by the alternate that is identified by the values of the subsequent equation.

$$f_0 = \frac{C}{2\sqrt{\varepsilon_{re}}}\left[\left(\frac{m}{L}\right)^2 + \left(\frac{n}{W}\right)^2\right]^{\frac{1}{2}} \quad (4)$$

The intended width (W) of the antenna can be dogged with the next equation.

$$W = \frac{C}{2 f_0\sqrt{\frac{(\varepsilon_r + 1)}{2}}} \quad (5)$$

The effectual length of the rectangular patch antenna L_e for a reverberation frequency f_0 is establish by the subsequent equation

$$L_e = \frac{C}{2 f_0\sqrt{\varepsilon_{re}}} \quad (6)$$

The recommended antenna plan is equipped over an FR4 substrate and the antenna is wound up by means of a coaxial feed. PIFA configurations are prepared in the antenna by commence two shorting pins that incite the multiband possessions in the intended antenna. Annular loop configuration is formed in the patch and ground plane for the favored function. The intended antenna has front scrutiny as exposed in Fig. 1, which demonstrates annular loop configuration embossed in patch region. The intended antenna has bottom scrutiny as exposed in Fig. 2, which demonstrates the annular loop configuration imprinted in ground plane region.

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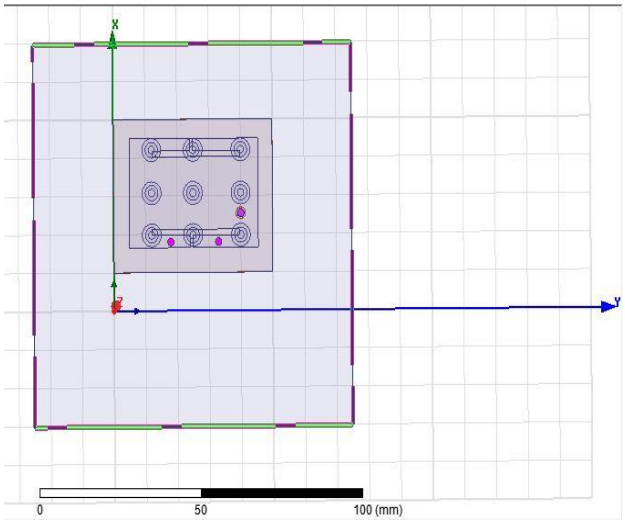

Fig. 1. Front side of devised Antenna

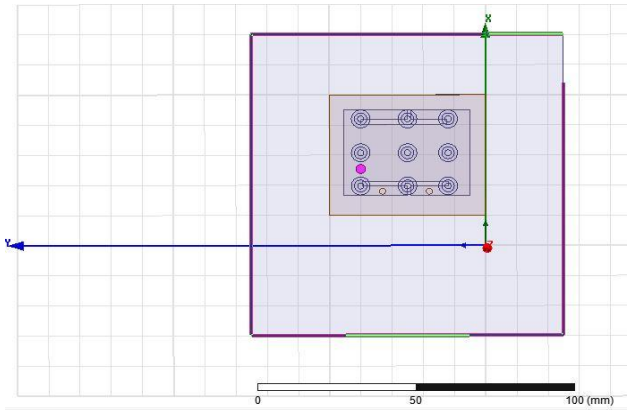

Fig. 2. Bottom side of devised Antenna

III. RESULTS AND DISCUSSION

The recommended antenna was deliberate and replicated using HFSS platform. The intended return loss of the antenna is plotted in Fig. 3. The VSWR scheme of intended antenna is exposed in Fig. 4. The intended antenna has a return loss value of -29.4556 dB for the reverberating frequency significant of 1.49 GHz which is suitable for the GPS function, -22.1634 dB return loss value for the 2.53 GHz reverberating frequency in count to -21.9052 dB return loss significant for the reverberating frequency 3.5 GHz that is suitable for WiMAX mobile communiqué standard. The emission prototype of the intended antenna at 1.49 GHz, 2.53 GHz and 3.5 GHz are exposed in Fig. 5, Fig.6 as well as Fig. 7.

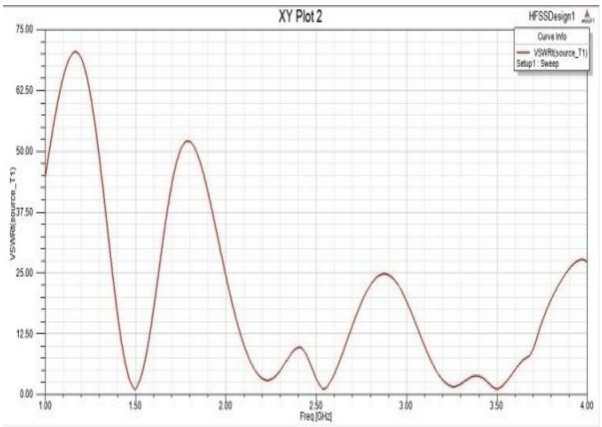

Fig. 3. Return Loss of devised Antenna

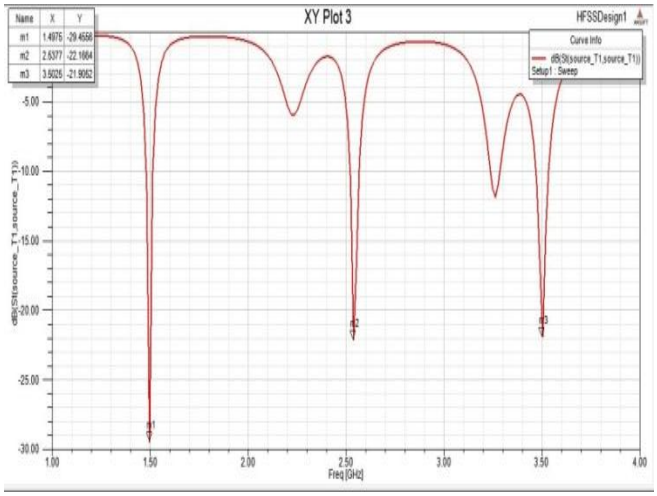

Fig. 4. VSWR of devised Antenna

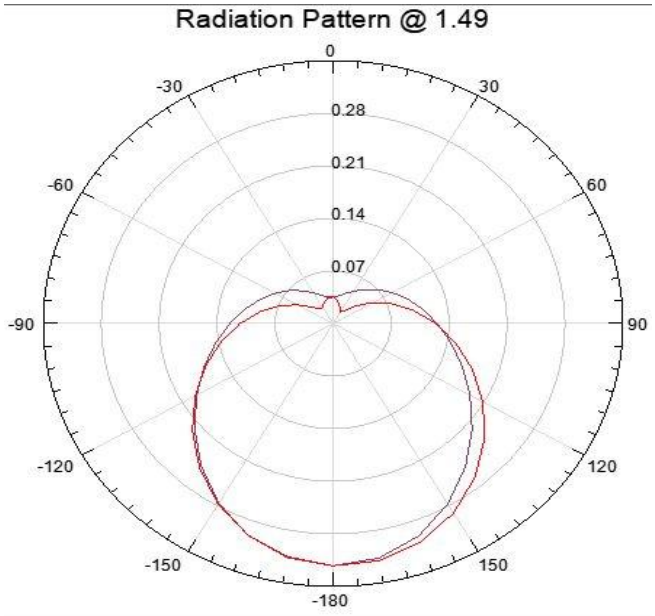

Fig. 5. Radiation pattern of devised antenna at 1.49 GHz

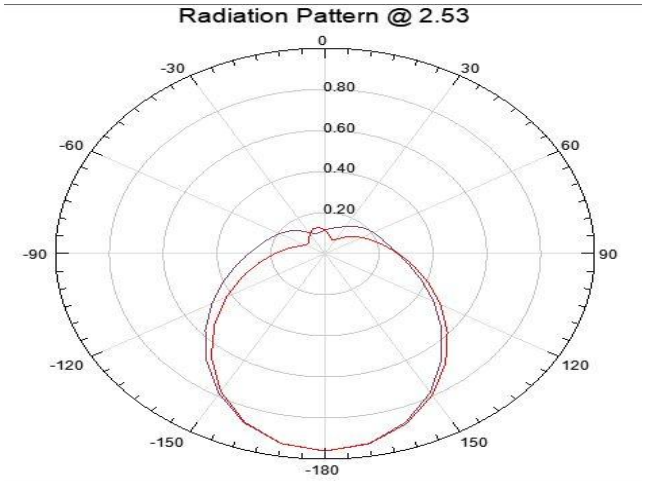

Fig. 6. Radiation pattern of devised antenna at 2.53 GHz

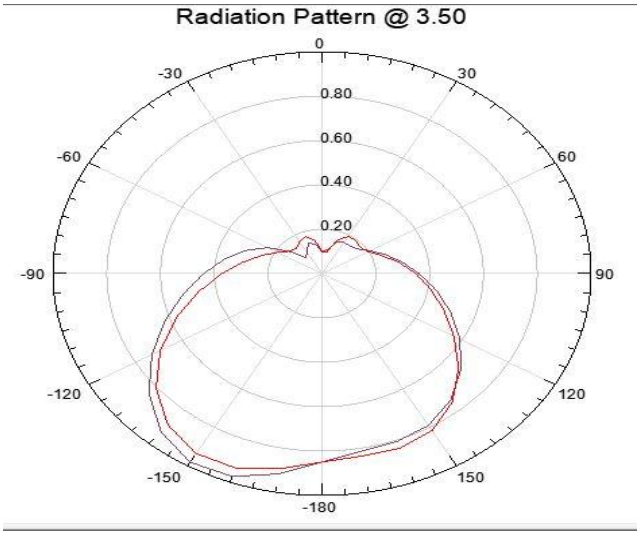

Fig. 7. Radiation pattern of devised antenna at 1.82 GHz

The reverberating frequency at 1.49 GHz has 0.17 dB gain, 2.53 GHz has a gain of 1.53 dB and 3.5 GHz has a gain of 2.2 dB. The emission prototype is directional prototype for the exact function.

IV. CONCLUSION

A multiband PIFA structured antenna for GPS communication and WiMAX functions are intended by initiated PIFA structures and annular loop structures in the predesigned rectangular patch antenna. The planned antenna can be activated at the preferred applications and is authenticated through the return loss and VSWR plots.

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