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Triple Band Hexagonal Meander-line Monopole Antenna for Wireless Applications

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ABSTRACT: In this paper, planar monopole antenna for wireless applications with triple band has been proposed. It simply consists of hexagonal meander-line structure and defected ground plane, which occupy a small PCB area of 50×60×1.676 mm^3. The proposed antenna has a measured impedance bandwidths of 1.689-1.781GHz, 2.49-2.71GHz and 2.75-2.98GHz which cover GSM1800 and 2.5WIMAX bands. The antenna has three distinct frequency bands centered at 1.74GHz, 2.63GHz and 2.93GHz. The radiation pattern and resonant frequency are mainly affected by meandered strip and a rectangular defected ground plane. The impedance bandwidth, current distribution, radiation patterns, gain and efficiency of the antenna are studied by computer simulation and measurement. The proposed antenna is fed by a coaxial probe through SMA connector.

KEYWORDS: Meander-line antenna, Planar monopole antenna, Small antenna, Triple band, Return loss.

1 INTRODUCTION

The emerging growth of modern wireless communication system has caused wide interests in designing wide band and multiband antennas; especially for wireless communication system and world interoperability for microwave access (WIMAX). It is well known fact that planar monopole antenna present really appealing physical features such as simple structure, small size, and low cost [1-2]. Meander-line antenna is one type of the microstrip antenna in which meandering the patch increases the path over which the surface current flows and that eventually results in lowering of the resonant frequency than the straight wire antenna of same dimensions [3-4]. The printed monopole antenna with the hexagonal meander-line structure has significant advantages. It is electrically small, Low profile antenna and has simple structure. Ground structure is realized by etching a defect in the ground plane of the planar circuits and antennas. This disturbs the shield current distribution in the ground plane and modifies transmission line parameters such as line capacitance and inductance [5-6]. In this letter a new hexagonal monopole antenna for the purpose of GSM1800 and WIMAX operations has been proposed. The antenna is originally designed as a meandered arm with defected ground plane and two parasitic meandered strips to generate the resonant responses [7]-[14]. This way, the antenna can achieve a triple band performance to simultaneously cover the most commonly used GSM1800 and WIMAX bands. The measured 10dB bandwidth are from 1.689-1.781GHz covering GSM1800 (1.710-1.785GHz) band and 2.49-2.71 GHz, 2.75-2.998 GHz band covering WIMAX MMDS (2.5-2.69GHZ, 2.7-2.9GHZ) bands respectively.

2 ANTENNA DESIGN

The geometry of the proposed hexagonal monopole antenna is presented in Fig. 1. The antenna consists of hexagonal meander line structure. The two parasitic strips are also embedded to the upper right and lower right of the hexagonal. In this novel design, the symmetric meandered monopole antenna is presented. Antenna was implemented on FR4 substrate with thickness of substrate h=1.6mm and permittivity of ε_r=4.3 and loss tangent δ=0.02 and ground of size 50×15.56mm^2.

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The total antenna dimension is 50×60×1.676mm^3. On the other side of the substrate, a conducting ground plane is placed. The proposed antenna is connected to a 50Ω Transmission line through SMA connector for signal Transmission. The design of the antenna is optimized using the CST MW Studio with the main dimensions listed in Table I. Fig. 2 shows the photograph of the fabricated antenna.

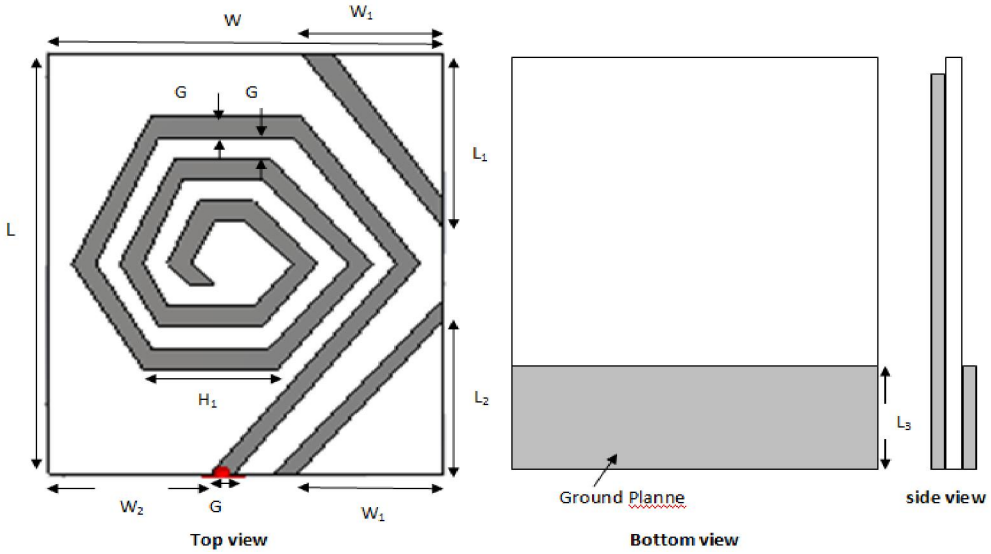


Fig. 1. Geometry of the proposed antenna

Table 1. Key dimensions of proposed antenna in millimeters

L	W	G	W_1	W_2	L_1	L_2	L_3	H_1
60	50	3	28.5	18.5	22	25	15.56	19

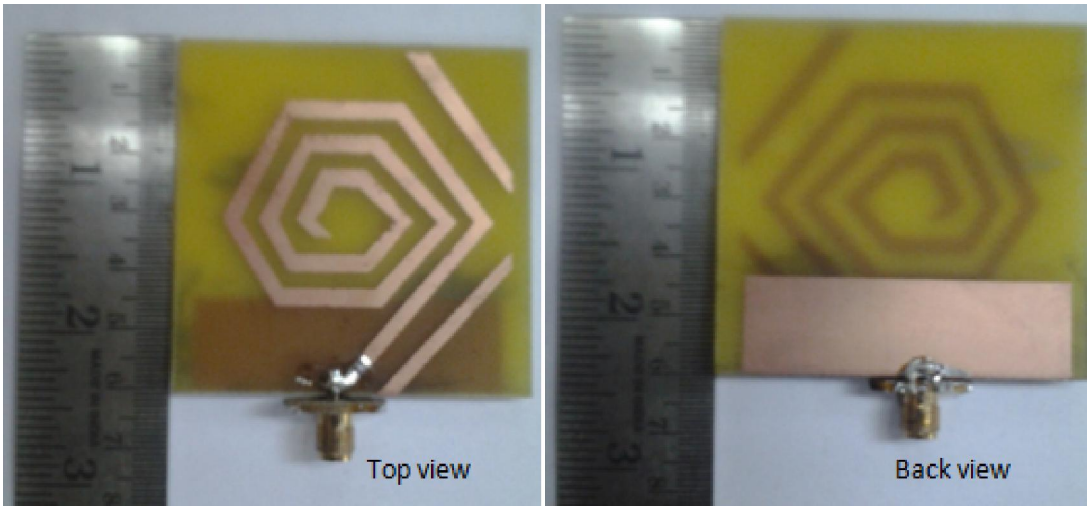


Fig. 2. Proto type of the antenna

3 RESULT AND DISCUSSIONS

In this section, the Hexagonal Meander-line Monopole antenna with various design parameters was simulated using CST Microwave Studio and experimental results of input impedance, radiation characteristics are presented and discussed here. With the insertion of Meander line structure in Monopole, results can be achieved easily. Fig. 3 shows the comparison between simulated and measured return loss of the proposed antenna. In the simulated design, the first band achieved is 1.702-1.811GHz covering GSM1800 (1.710-1.785GHZ), second band is 2.51-2.68GHz covering WIMAX (2.501-2.699) and third band is 2.71-3.01GHZ covering WIMAX MMDS (2.7-2.9GHZ). In the measured results, it is observed that first band achieved is 1.681-1.781GHz, second band is 2.49-2.71GHz and third band is 2.75-2.998GHz with return loss of -30dB, -31dB and -30.08dB respectively. From the Fig. 3 it is observed that simulation and experiment results both are same, showing good agreement between them. The reduction in the return loss ultimately improves the gain as well as the bandwidth of microstrip antenna.

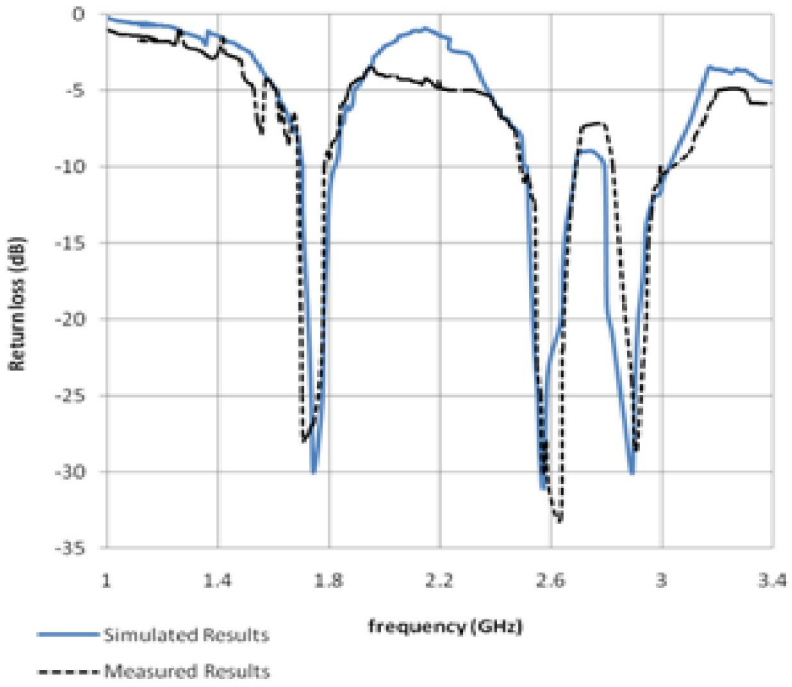
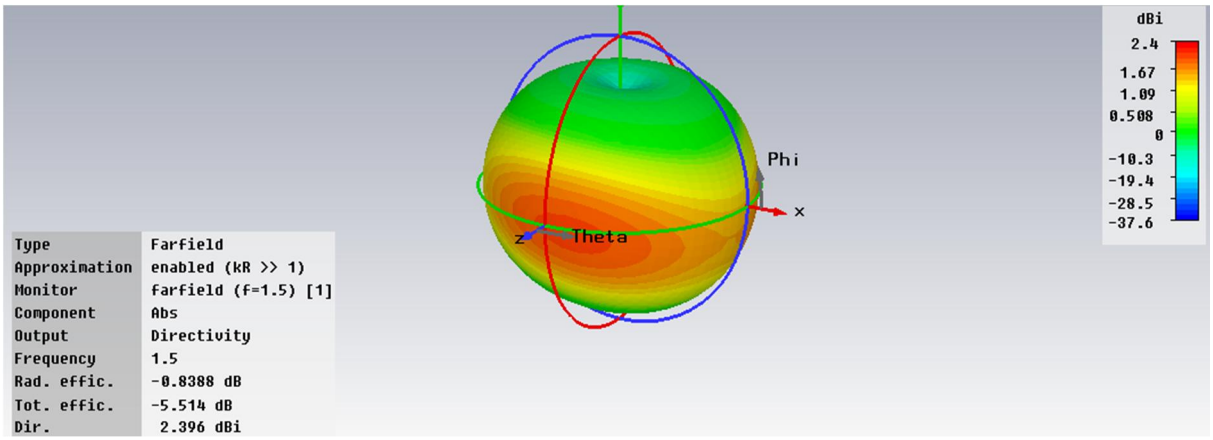
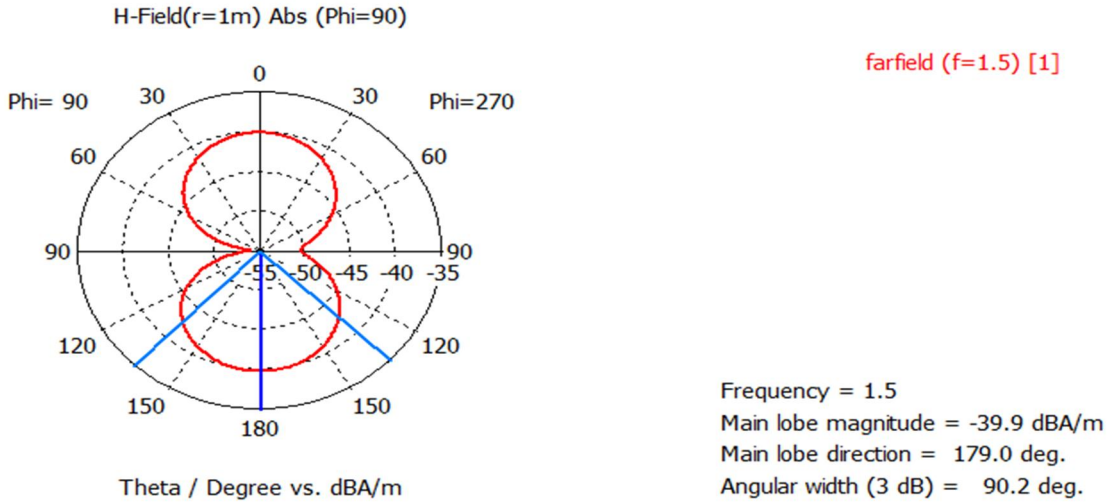


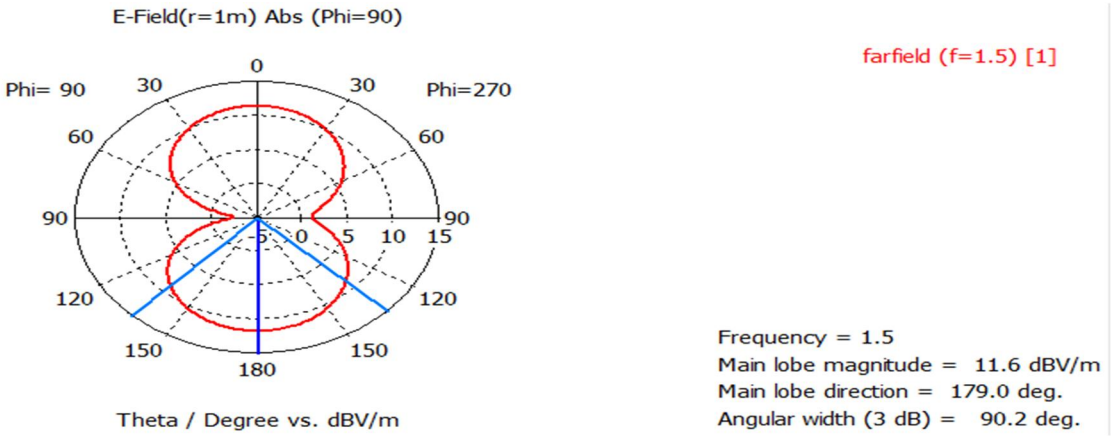
Fig. 3. Measured and Simulated Return loss



(a)



(b)



(c)

Fig. 4. (a) Radiation Characteristics Of Proposed Antenna (b) E-field Polar Plot (c) H-field polar plot

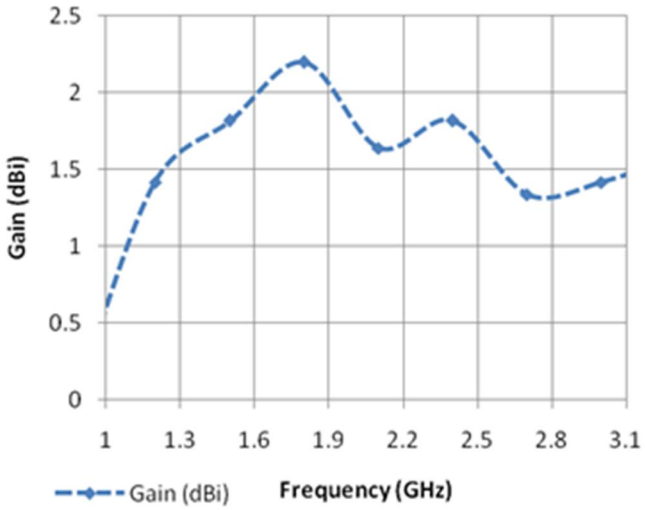


Fig. 5. Simulated Gain of proposed antenna

Simulated far field radiation pattern of the proposed antenna has been shown in Fig. 4(a) and Fig. 4(b) and 4(c) shows the E and H field polar plots of proposed antenna. Measured Gain of the antenna is shown in Fig. 5.

4 CONCLUSION

In this paper, design of printed Triple band Monopole Antenna with Meander line arms for wireless application is proposed. In this monopole antenna, Meander line structure is designed to generate a low frequency bands for GSM1800 and two more 2.5WIMAX bands. Simulation and measurement results have shown that the antenna has stable radiation pattern, high efficiency, and high gain in all the operating frequency bands.

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