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A Minimized Triangular – Meander Line PIFA Antenna for DCS1800/WIMAX Applications

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ABSTRACT: A novel multiband Triangular – Meander Line Planar Inverted - F Antenna (PIFA) has been introduced. The proposed PIFA antenna consists of a triangle shaped meandered – line radiating patch. The proposed antenna operates in the DCS1800 (1.710-1.880 GHz), Mobile WIMAX (2.5-2.69 GHz) and Fixed WIMAX (3.4-3.8 GHz) bands efficiently. Classic triangular PIFA shows very low bandwidth and also operates in a single frequency band. Therefore, the combination of Meander–Line and PIFA antenna improves the proposed antenna characteristics. It also increases the current path. The proposed antenna is covering the size of 50 × 36 × 9.276 mm and showing the overall gain of 3.028 dB.

KEYWORDS: Meander – Line, Planar Inverted – F Antenna (PIFA), Return Loss.

1 INTRODUCTION

In recent years, the wireless communication industry has demanded the equipments of low profile, multifunctional, high efficiency and better performance [1], [2]. Wireless networks such as WIMAX and mobile networks such as GSM need the equipments, which can be handled easily and show better performance as well. Therefore, PIFA and Meander – Line structures have come into interest.

PIFA antenna has the advantage of low profile structure, better efficiency and greater bandwidth [3], but also has the disadvantage of singe band operation. By combining the structures of PIFA and Meander – Line, one can get the better performance in the respect of gain, bandwidth, efficiency and VSWR. Therefore the disadvantage of Meander–Line structure of having low bandwidth and low radiation efficiency has also been overcome [4]-[8].

In this paper, for obtaining better characteristics, Meander – Line approach has been combined with a Triangular PIFA antenna. Also, a comparison among the characteristics of the simple triangular PIFA antenna and Meandered – Line Triangular PIFA antenna has also been included in this research. For each one, the antenna design, return loss graph, 3D pattern, E-field and H-field pattern has also been presented.

2 ANTENNA DESIGN

In this section, the design of the proposed antenna has been discussed along with a general triangular PIFA antenna.

2.1 TRIANGULAR PIFA ANTENNA

The characteristics of Triangular PIFA antenna have first been analyzed. For which, a PIFA antenna with a triangular radiating patch has been designed and simulated. The antenna design has been pictured in Fig. 1. The side of the triangular patch has been kept 32.37 mm. The size of the ground plate is 50 × 36 mm. The radiating patch has been connected to the

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ground with the help of a shorting strip of thickness 5 mm. This shorting strip is making the ground defective. The substrate used is Epoxy Glass (FR4) having relative permittivity 4.4, loss tangent 0.02 and height of 1.6 mm.

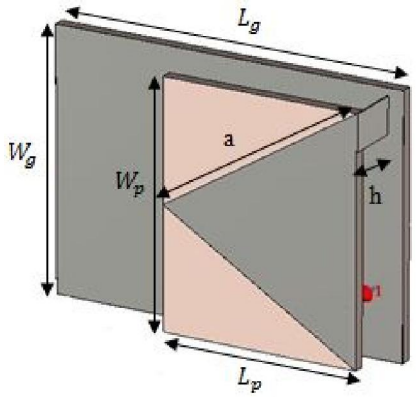


Fig. 1. Triangular PIFA Antenna

2.2 TRIANGULAR MEANDER – LINE PIFA ANTENNA

To improve the characteristics of PIFA antenna and to overcome the disadvantage of PIFA of single band operation, Meander – Line structure has been introduced in the triangular radiating patch. The proposed antenna has been pictured in Fig. 2. The Meander – Line patch consists of 3 mm thick Meandered strip, covering the area of previous triangular patch and this is now connected to the ground plate with the help of a shorting strip. The total size occupied by this whole structure is 50 × 36 × 9.276 mm. The coaxial feed is positioned at 4 mm from the right end. The patch is kept 7.6 mm above the ground.

The physical dimensions of the proposed antenna have been given in table 1.

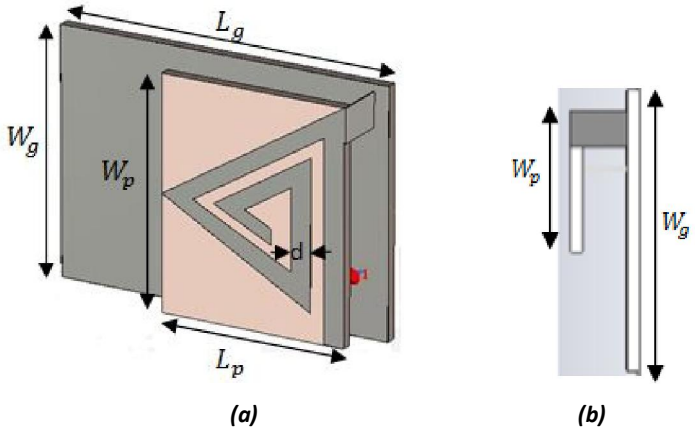


Fig. 2. Proposed triangular Meander – Line Antenna (a) Perspective view, (b) Side view

3 COMPUTATIONAL RESULTS

The PIFA has been simulated in the CST-MWS environment. With the insertion of meandered structure in PIFA antenna, multiband results can be achieved easily. The comparison results of the return loss of both the antennas have been shown in figure 3. The graph shows that the triangular PIFA antenna is operating in a single band centered at 1.9 GHz, while triangular meander-line PIFA antenna is showing triple band operation. The bands achieved, are DCS1800 (1.710-1.880 GHz), Mobile WIMAX (2.5-2.69 GHz) and Fixed WIMAX (3.4-3.8 GHz). The gain (IEEE) of 3.028 dB has been achieved. The bandwidth for the triple bands obtained, are 9.47%, 7.32% and 11.11% respectively.

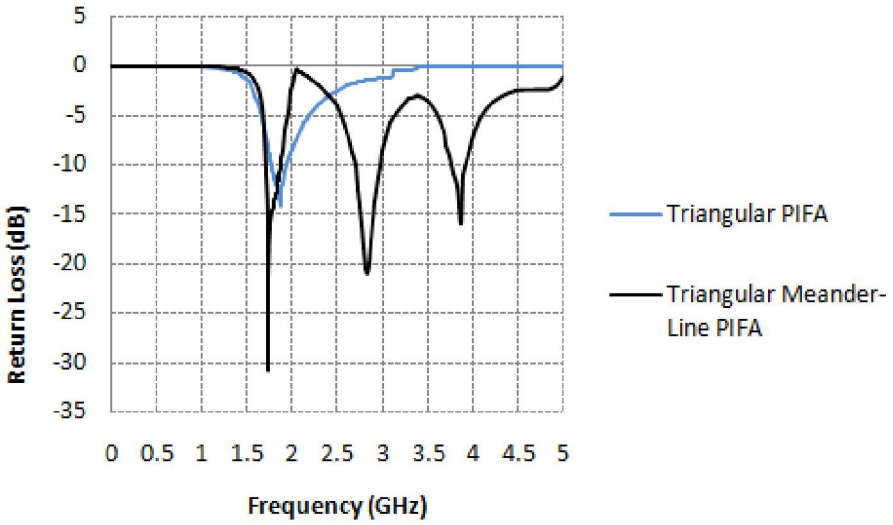
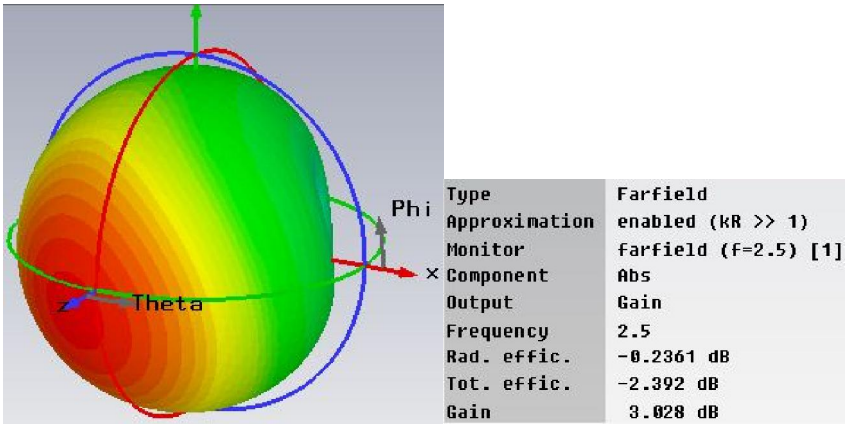


Fig. 3. Comparison between S-Parameter pattern of Triangular PIFA and Triangular Meander-Line PIFA

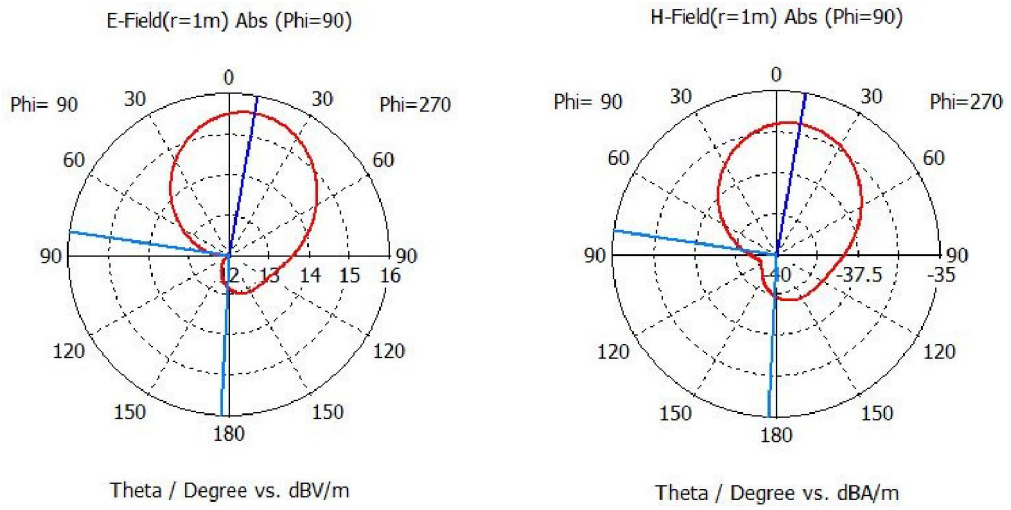
Table 1. Physical Dimensions of the proposed antenna (All in mm)

Elements	Dimensions
Ground Size	50 × 36
Side of the Triangular Patch	32.37
Air Gap Size	7.6
Width of the Shorting Plate	5
Shorting Plate Thickness	0.2
Height of Shorting Plate	7.638

The 3-Dimensional radiation pattern of the proposed antenna has been shown in figure 4(a), with the directivity of 3.268 dBi. The total efficiency of the proposed antenna is 57.65%, while triangular PIFA antenna is showing the efficiency of 43.66%. The E-field and H-field patterns have been shown in Fig. 4(b), 4(c) respectively.



(a)



(b) *(c)*

Fig. 4. (a) 3-Dimensional Radiation Pattern, (b) E-field Pattern, (c) H-field Pattern

The peak gain has also been analyzed which is shown in Fig. 5. This graph is showing that the peak gain is greater than 5.04 dB in the operating bandwidth.

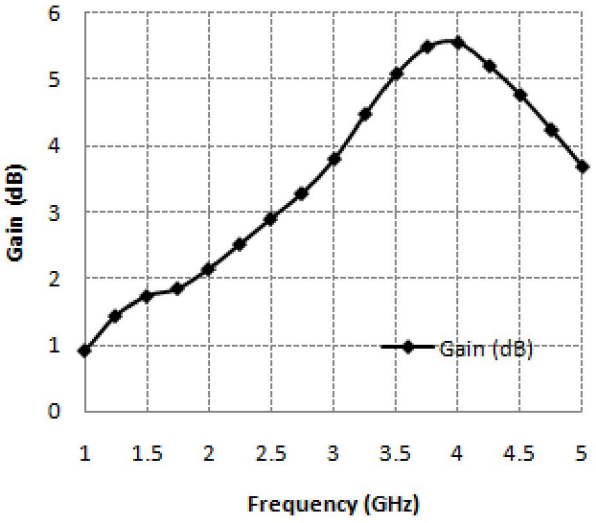


Fig. 5. Simulated Peak Gain of the Triangular Meander-Line PIFA antenna

4 CONCLUSION

A Triangular Meander-Line PIFA antenna has been designed and simulated, which is operating in triple bands and showing the application in mobile and wireless communication. A comparison has been shown among the characteristics of proposed antenna and triangular PIFA antenna. It has shown that the introduction of meander-line structure into the PIFA antenna made the antenna better with respect to bandwidth, gain, efficiency and multiband operation.

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