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A Compact CPW Fed Triangular Shaped Slot Antenna for WiMax Applications

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***Abstract*—In this paper, a CPW fed triangular shaped slot antenna is proposed. The proposed CPW fed antenna is easy to be integrated with radio frequency/microwave circuitry for low manufacturing cost. The antenna, which occupies a small size of 24(L) ×21(W) ×1.6(H) mm^3, is simply composed of a triangular radiating patch with a collar stub on an inexpensive FR4-epoxy substrate with dielectric constant ε_r =4.4. By carefully selecting the length and height of collar stub and dimensions of triangle, good pass band characteristic of proposed antenna can be obtained, so that operating band covering 3.38 GHz to 3.78 GHz(VSWR <2) can be achieved . The simulated results also demonstrate that the proposed antenna has good radiation patterns, constant gain(2.5dBi$\pm$ 1.5dBi)and around 95% efficiency across the operating band and is thus suitable to be integrated within the portable devices for WiMax applications. By controlling the dielectric constant (Substrate), thickness of the dielectric layer, dimensions of patch, vertical spacing L3 and thickness of the conductor strip, we can realize the antenna for different band of impedance matching.**

***Keywords*—** Antenna, CPW-Fed, *IEEE 802.16*, WiMax, Slot

1. INTRODUCTION

The growing demand of wireless services requires the definition of new standards able to provide an increased degree of mobility for the end-user and a higher speed of data transmission. Among emerging standards, one of the most promising is *IEEE 802.16 Worldwide Interoperability for Microwave Access* (generally called *WiMax*). WiMax is a telecommunications technology that provides wireless transmission of data using a variety of modes, from point-to-multipoint links to portable and fully mobile internet access. The Coplanar wave guide transmission lines are becoming increasing popular in MMIC fields because of its lower radiation leakage and less dispersion than microstrip lines.

IEEE 802.16 air interface for 10 to 66 GHz. It delivers a standard for point to multipoint Broadband Wireless transmission in the 10-66 GHz band, with only a line-of-sight capability. IEEE 802.16 adopted three frequency bands namely lower band (2.5 - 2.69 GHz), median band (3.4 - 3.6 GHz) and upper band (5.72 – 5.85 GHz) for WiMax communication system. IEEE 802.16a is an amendment to 802.16 and delivers a point to multipoint capability in 2-11 GHz band. It requires non-line-of-sight (NLOS) capability [2]. In such a framework, the available band between 3.4-3.6 GHz turns out to be particular interest since it does not require LOS propagation and can be usefully exploited for end-user wireless portable devices. The proposed simple slot antenna is designed to obtain unidirectional radiation pattern at resonant and relatively higher gain in the median band of IEEE 802.16.

The fundamental parameters of the antenna such as return loss, VSWR, gain, directivity and radiation patterns are obtained. All meets the acceptable antenna standards. Simulation tool, based on the method of moments (MOM)-ZELAND IE3D version 12.0 has been used to analyze and optimize the antenna.

2. ANTENNA GEOMETRY

Figure 1 shows the geometry of the designed single layer antenna. The antenna has overall dimensions of 24 mm ×21mm and dielectric substrate of FR-4 (thickness: 1.6 mm, ε_r =4.4) is used.

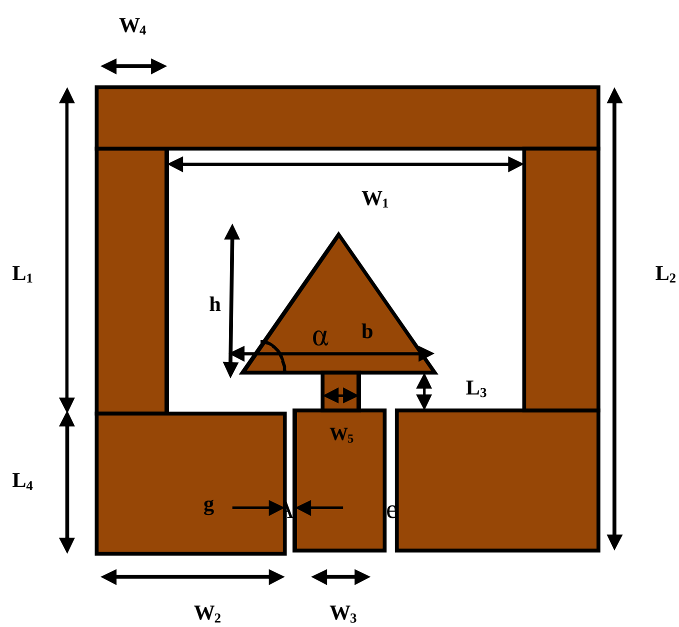

Figure 1 shows the geometry

The optimal parameters can be chosen as W_1=20 mm, W_2=8 mm, W_3=6 mm, W_4=2 mm, W_5=5 mm, L_1=13 mm, L_2=21 mm, L_3=1.5 mm, L_4=8 mm, b=10 mm, h=3.5 mm and $\alpha=45^o$ based on the extensive simulation using IE3D.

Table 1.Antenna dimensions

PARAMETER	W_1	W_2	W_3	W_4
VALUE	20 mm	8 mm	6 mm	2 mm
PARAMETER	W_5	L_1	L_2	L_3
VALUE	5 mm	13 mm	21 mm	1.5 mm
PARAMETER	L_4	b	h	g
VALUE	8 mm	10 mm	3.5 mm	1 mm

3. EFFECT OF DESIGN PARAMETER

It has been shown in the simulation that the return loss depends on the size of the triangular patch, angle of triangular patch α, stub width W_5 and stub height L_3. So these parameters should be optimized for maximum impedance matching.

A. *The effect of collar stub width*

Figure 2 is the simulated return loss curves for different value of stub width. It can be seen in figure 2 that the return loss curves have similar shape for stub width and minimum of -55.03dB at W_5=5 mm.

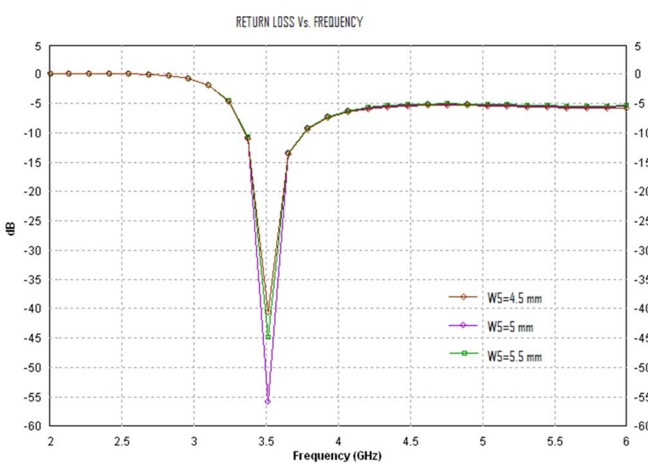

Figure 2: Simulated return loss for different value of stub width W_5

B. *The effect of triangle's angle α*

Figure 3 plots the simulated return loss curves with different angles ($\alpha=90^o$, 60^o, 45^o and 30^o) when stub height is fixed as 3.5mm. It is observed in the figure 3 that the shapes of return loss curves are almost same but return loss curves vary substantially. It is noticed that return loss is maximum for $\alpha=90^o$ and minimum for $\alpha=45^o$.

C. *The effect of stub height L_3*

The simulated return loss curves with optimal angle $\alpha=45^o$, W_5=5 mm for different stub heights are presented in figure 4. It is observed in the figure 4 that the return loss is optimum at L_3=1.5 mm.

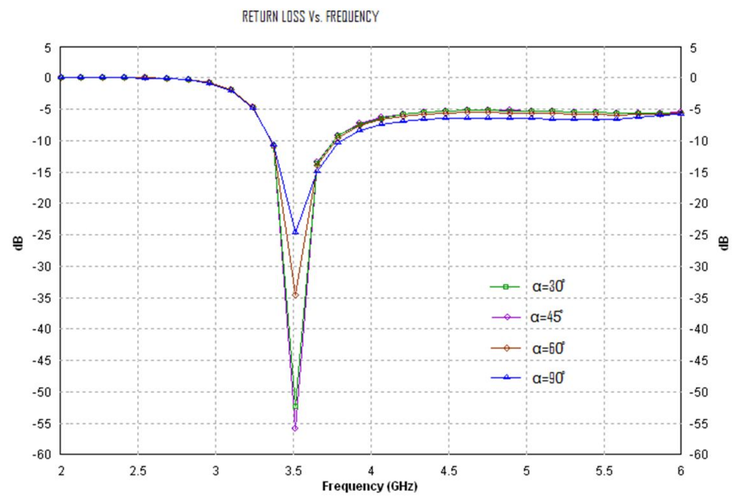

Figure 3: Simulated return loss for different values of α

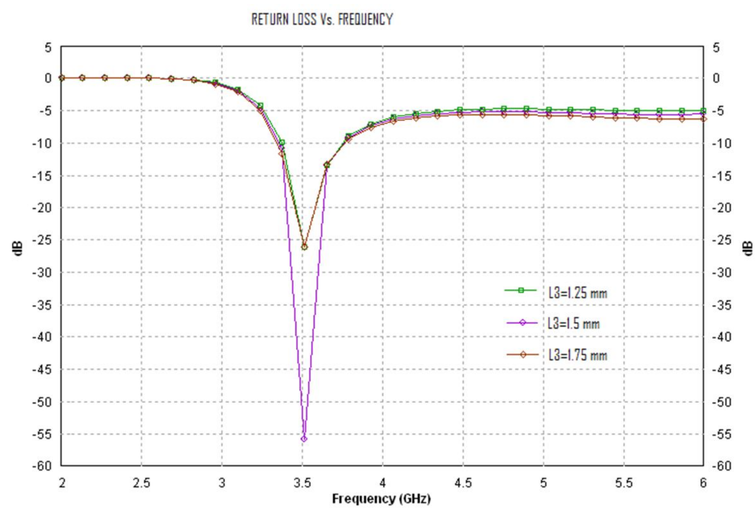

Figure 4: Simulated return loss for different value of stub height L_3

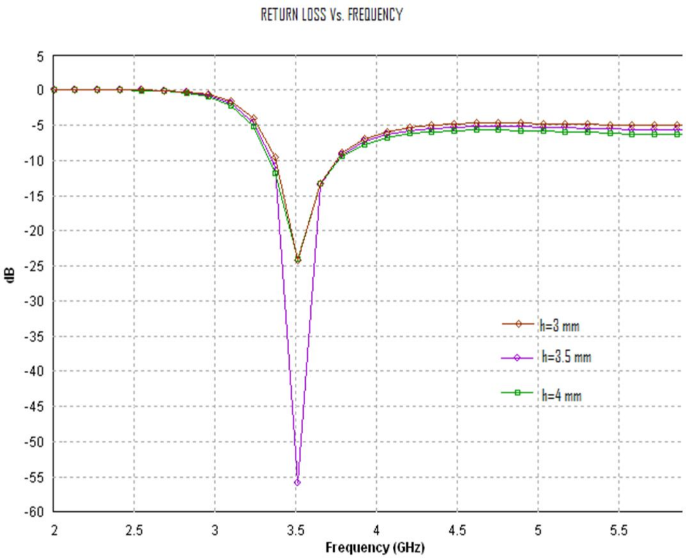

Figure 5: Simulated return loss for different value of triangle's height h

D. The effect of Triangle's height

The simulated return loss curves with α=45^{o}, W5=5mm and optimal stub height L_3 =1.5 mm for different triangle height h are presented in figure 5. It is observed in figure 5 that the return loss curves vary substantially with height h. The return loss is optimum at h=3.5mm.

E. The effect of Triangle's base

Figure 6 shows the simulated return loss curves with optimal values of α, L_3 and h. It designates that b=10 mm is optimal value.

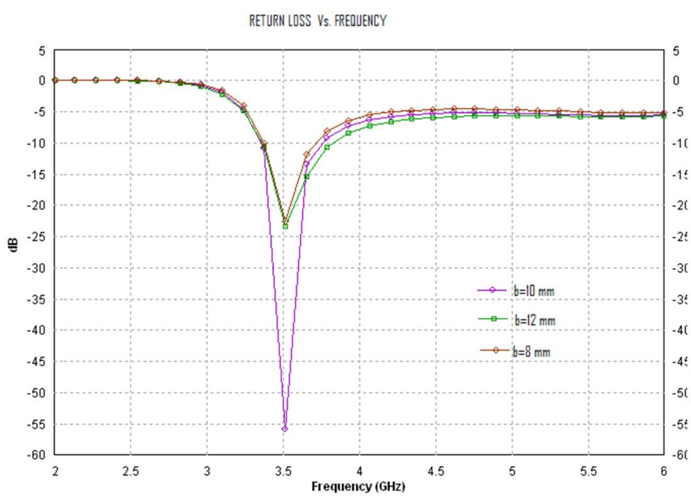

Figure 6: Simulated return loss for different values of triangle's base b

4. RESULT AND DISCUSSION

The simulated return loss of proposed antenna for the optimum value of parameters is shown in figure 7. Antenna should have return loss less than or equal to -10dB or VSWR should be between 1 and 2.

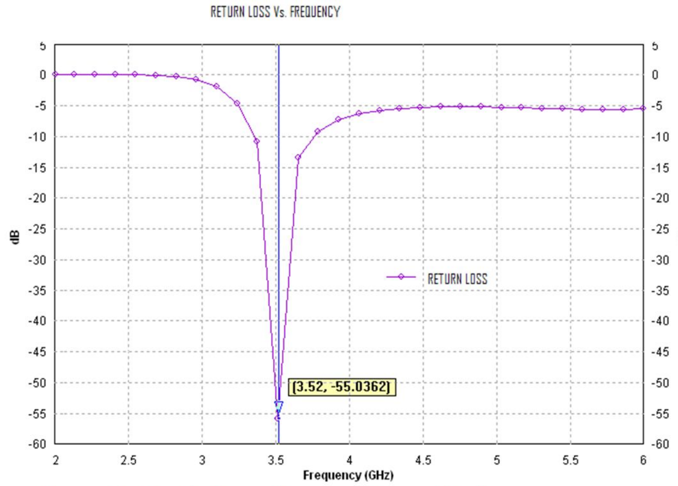

Figure 7: Variation of return loss with frequency

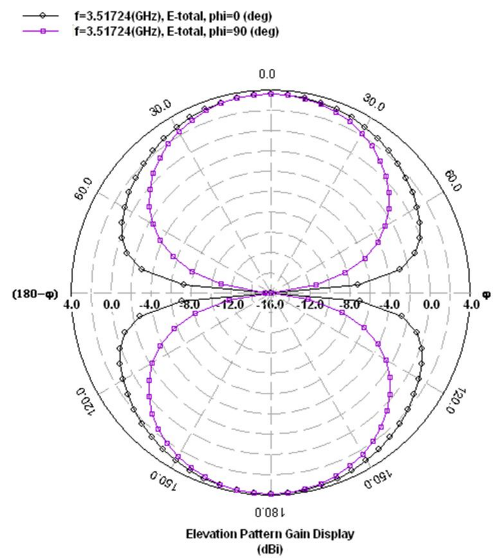

Figure 8: Simulated radiation pattern at 3.52 GHz

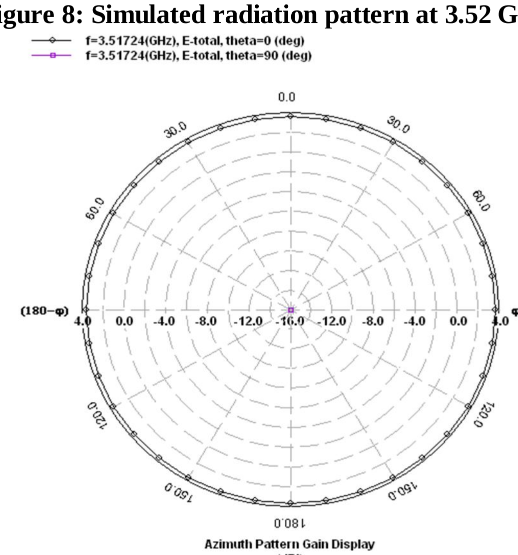

Figure 9: Simulated azimuthal radiation pattern at 3.52GHz

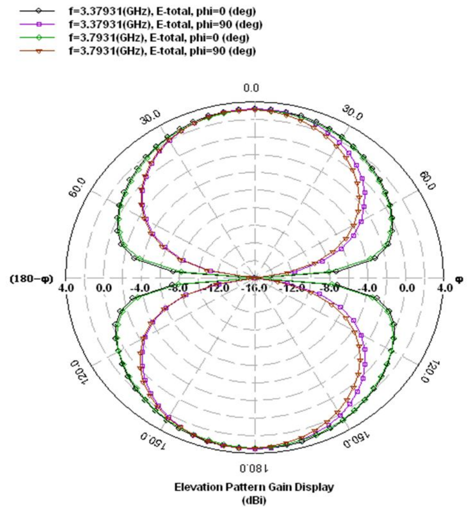

Figure 10: Elevation radiation patterns at 3.3 GHz and 3.7 GHz

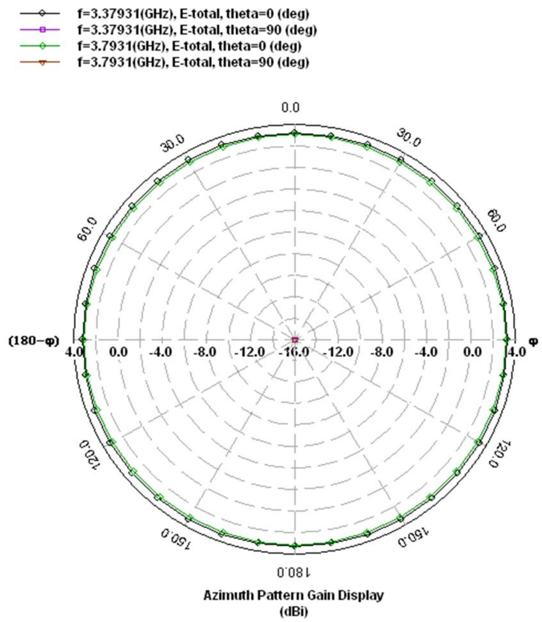

Figure 11: Azimuthal radiation patterns at 3.3 GHz and 3.7 GHz

The proposed antenna bandwidth covers the range of 3.38 to 3.76 GHz assigned for median band of WiMax applications with -55.04 dB return loss at resonant frequency 3.52GHz.

Figure 10 is elevation radiation pattern at edge frequencies 3.3GHz and 3.7 GHz. Figure 11 is azimuthal radiation pattern at edge frequencies 3.3GHz and 3.7 GHz. Figure 10 and 11 show that radiation patterns are very good throughout the bandwidth compared to other antennas.

Figure 12 and 13 show the simulated antenna gain and efficiency of the proposed antenna versus frequency respectively.

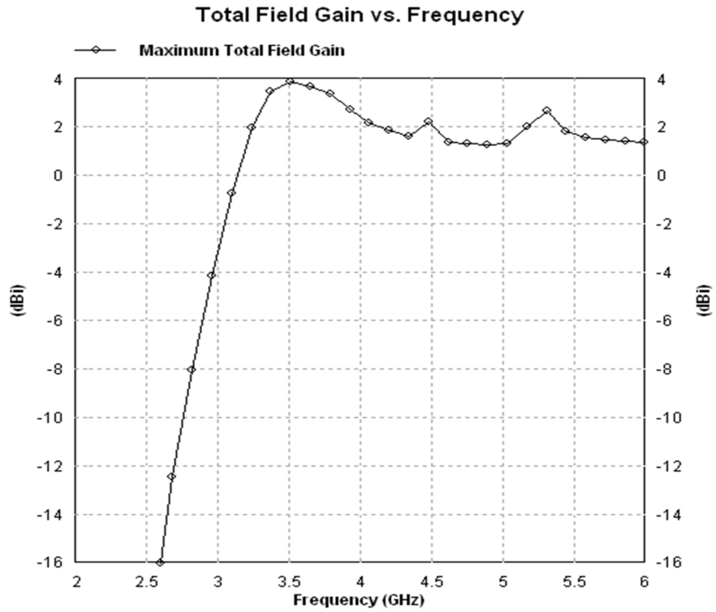

Figure 12: Simulated antenna gain

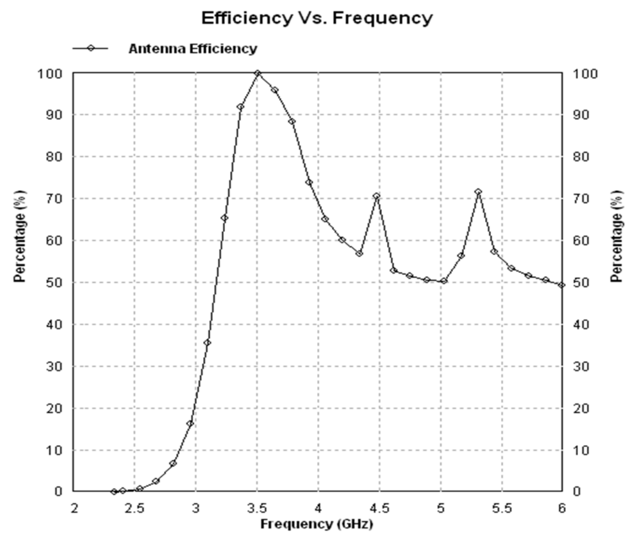

Figure 13: Simulated antenna efficiency

Figure 12 and 13 show the simulated antenna gain and efficiency of the proposed antenna versus frequency respectively. The gain is constant (2.5dBi$\pm$ 1.5dBi) throughout the bandwidth and efficiency also above 95% in the required frequency band.

5. CONCLUSION

A CPW fed triangular shaped antenna for WiMAX application has been presented. The optimum performance of antenna is obtained at 45^o, L_3=1.5 mm, h=3.5 mm and W_5=5 mm. Compared with conventional designs, the antenna has a simple and small structure and great impedance matching. Simulated results demonstrate that the appreciable gain is achieved across the operating band. For this reason, the proposed antenna is well suited to be integrated within various portable devices for WiMAX systems.

REFERENCES

1. IEEE standard for Local and Metropolitan Area Network. Part 16: Air
2. Interface for Fixed Broadband Wireless Access Systems, IEEE
3. Std.802.16-2004, Oct. 2004.
4. "WiMAX technology for LOS and NLOS environments", WiMAX Forum
5. Ceser Morals-Silva and Jing Wang "CPW-fed Arrow-Shaped Slot
6. Antenna Design for Ultra Wideband (UWB) Applications",
7. RF-MEMS Transducers group, University of South Florida, Tampa F1,
8. 33620,USA, 2009 IEEE
9. Ms. N. Gunavathi, Ms. R. Pandeeswari and Dr. S. Raghavan, "A CPW – Fed Octagon– Shaped aperture Antenna for Lower Band UWB Applications", IEEE - INDICON 2009, Gujarat , India, Dec'18-20, pp.289-292, 2009.
10. Ms. N. Gunavathi, Ms. R. Pandeeswari and Dr. S. Raghavan, "A CPW – Fed Cross – Shaped Monopole Antenna for 5 GHz WLAN and Higher Band UWB Applications", IEEE International Conference on -Applied Electromagnetic Conference'2009 (IEEE–AEMC- 2009), Kolkata, India, Dec'14-16, 2009.
11. Mr.T.Shanmuganantham, Dr.S.Raghavan, "Novel Printed CPW-Fed Slot Antenna for Wireless Applications", Microwave Optical Technology Letters, Wiley Interscience (MOTL), USA, Vol.52, No.6, pp.1258-1261, June2010.