2010 Second International conference on Computing, Communication and Networking Technologies

A Compact CPW-fed Arrow Shaped Monopole Antenna for UWB applications

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Abstract—**A compact Ultra wide band Arrow-shaped antenna fed by Coplanar Waveguide (CPW) is presented. The antenna has compact size of 17 mm x 18 mm. It provides band width ranging from 3.7 GHz to 10.8 GHz. The bandwidth can also be varied by varying extrusion depth T and width of arrow shaped structure W_2, and Ultra wide bandwidth is achieved. Details of antenna are presented with parametric study. The fundamental parameters return loss, VSWR, radiation pattern are obtained, which meet standard specifications. Method of moments based IE3D simulator is used to analyze antenna. Radiation pattern curves were drawn at resonant frequencies and discussed. It provides satisfactory performance and small structure makes antenna suitable for Ultra wide band wireless applications.**

Keywords-VSWR, CPW fed, Arrow shaped structure, radiation pattern, gain

I. INTRODUCTION

Ultra wide band technology provides promising solutions for future communication systems due to excellent immunity to multi path interference, large bandwidth. Recently CPW fed wide slot antennas became popular because of wide bandwidth, low cost and ease of integration with radio frequency. But they cannot cover entire ultra wide frequency band (3.1 GHz to 10.6GHz) specified by FCC for commercial purpose. So, Coplanar Wave Guide-fed UWB antennas became popular. Several UWB antennas have been studied for UWB applications [1-3]. Among newly proposed antenna design, the planar monopole antennas [4-5] are better for UWB applications due to small size and stable radiation pattern. UWB antennas can be fed by micro strip line [6-7] or coplanar waveguide [8-10].

In UWB wireless communication system, the digital information signals are transformed into impulse or non sinusoidal signals with very short pulse below nanoseconds. This technique provides fast communication in hundreds of Mbps. A good UWB antenna should have ultra wide band width, high radiation efficiency, directional or Omni directional radiation pattern.

So, we have proposed an Arrow-shaped monopole antenna which covers entire UWB band. It provides stable radiation pattern and high radiation efficiency. The antenna geometry is introduced in section II. The antenna parameters return loss, radiation characteristics are discussed in section III. The effect of width of arrow shaped structure W_2 and T on the antenna return loss and bandwidth also investigated. Radiation pattern curves were drawn and discussed for the proposed antenna. The gain of the antenna is varying from 2 dBi to 5.28 dBi in the operating band. Conclusions are given in section IV.

II. ANTENNA STRUCTURE

The antenna is simulated with low cost FR4 substrate with relative permittivity $\varepsilon_r = 4.4$ and thickness h = 1.6 mm. The antenna has size of 17 mm x 18 mm. The 50 Ω CPW feed line has centre width W_3 = 2 mm and gap between centre conductor and ground 'g' is 0.5 mm. The geometry of proposed antenna is shown in Fig. 1.

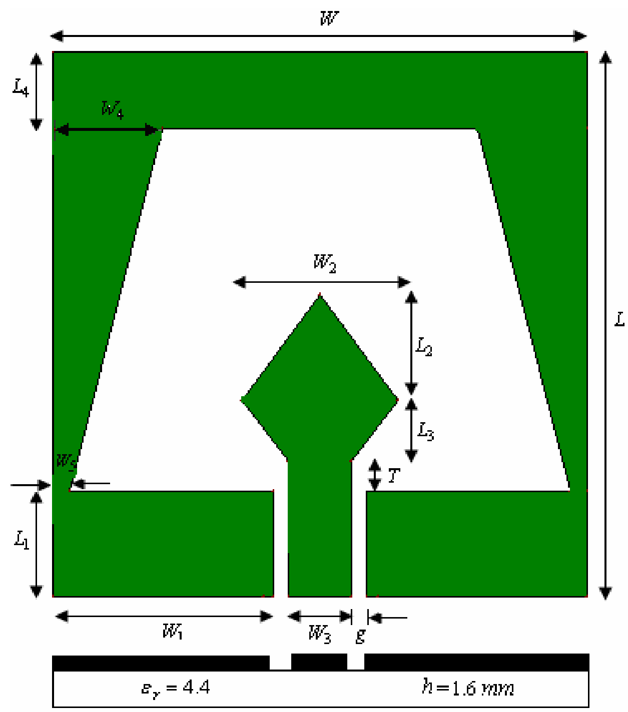


Fig. 1 Proposed antenna structure

The various optimized configuration parameters of antenna are W = 17 mm, W_1 = 7 mm, W_2 = 5 mm, W_2 = 2 mm, W_4 = 3.5 mm, W_5 = 0.5 mm, L = 18 mm, L_1 = 3.5 mm, L_2 = 3.5 mm, L_3 = 2 mm, L_4 = 2.5 mm, g = 0.5 mm, T = 1 mm. The trapezoidal shaped slot provides good impedance matching for the proposed antenna

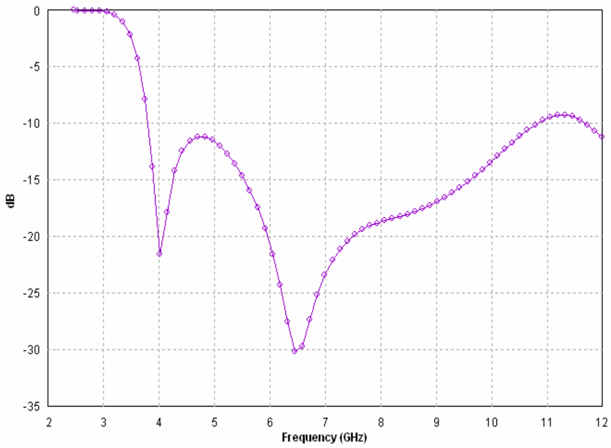


Fig. 2 Proposed antenna return loss vs. frequency

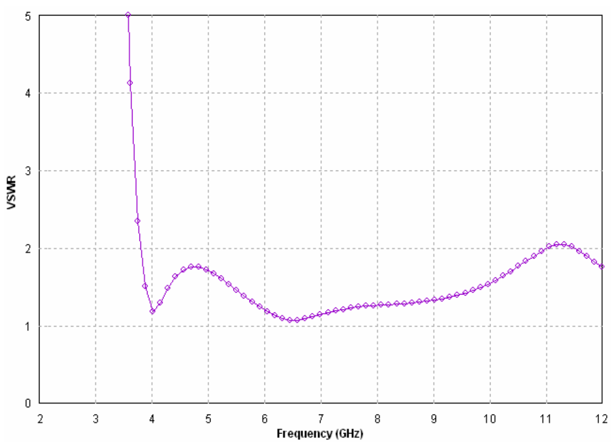


Fig.3. Proposed antenna VSWR vs. frequency

III. RESULTS AND DISCUSSION

The proposed antenna was simulated and optimized using Zeland IE3D simulator. The simulated return loss curve for the proposed antenna is shown in Fig. 2. The curve shows that the proposed antenna achieves an impedance bandwidth ranging from 3.7 GHz to 10.8 GHz for return loss below -10db. The antenna has impedance bandwidth of 7.1 GHz.

A. Parametric Study

The effect of extrusion depth T on return loss is also studied. When T is 0 mm, band width is 3.55 GHz because of presence of notch up to 5.9 G Hz. When T is increased from 0 mm to 1 mm, impedance bandwidth increases drastically. The lowest frequency is more affected where as highest frequency is slightly affected. The width of arrow shaped structure W_2 on the antenna return loss is also observed. When W_2 is increased from 3 mm to 7 mm, the resonant frequencies are affected and the impedance band width decreases slightly. So, impedance band width is more sensitive to T than W_2. So, the optimized values for T and W_2 are 1mm and 5 mm respectively. The effects of T and L_2 on return loss and impedance bandwidth are shown in Fig. 4 and 5 and are represented numerically in Table1 and Table 2.

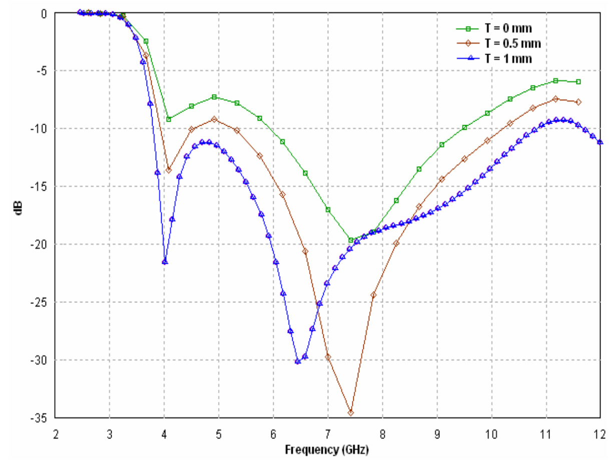


Fig. 4 Return loss vs. frequency for the proposed antenna with T = 0, 0.5, 1 mm

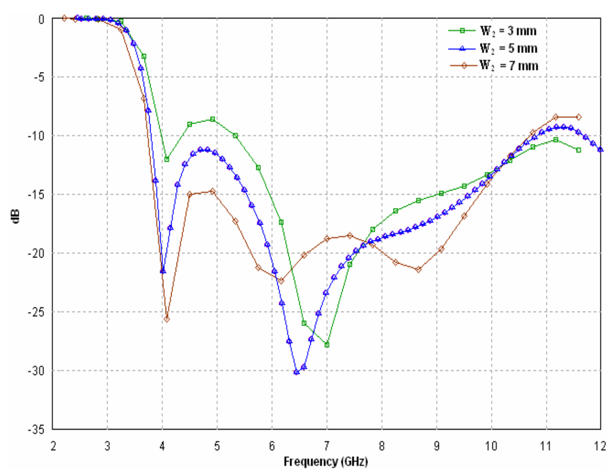


Fig. 5 Return loss vs. frequency for proposed antenna with W_2 = 3, 5, 7 mm

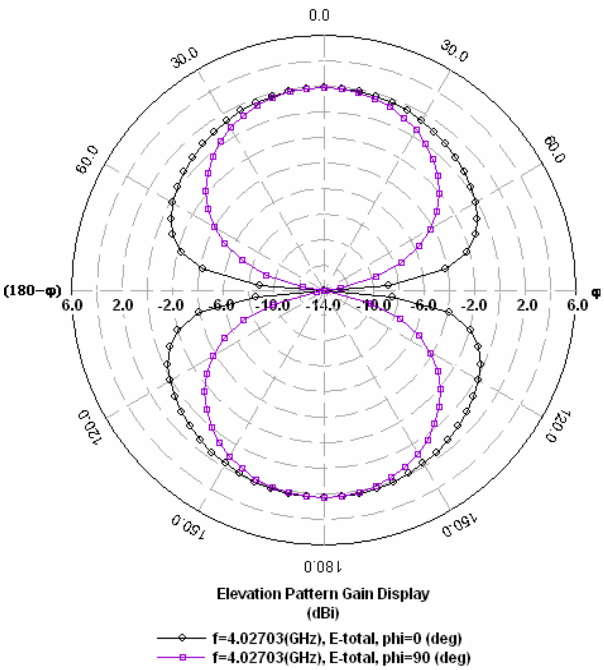
Table1: Effect of T on return loss and impedance Bandwidth

T (mm)	Resonant frequency (Ghz)	Impedance Band width (Ghz)
0	7.4	3.55
0.5	4.1, 7.4	5.52
1	4.02, 6.45	7.03

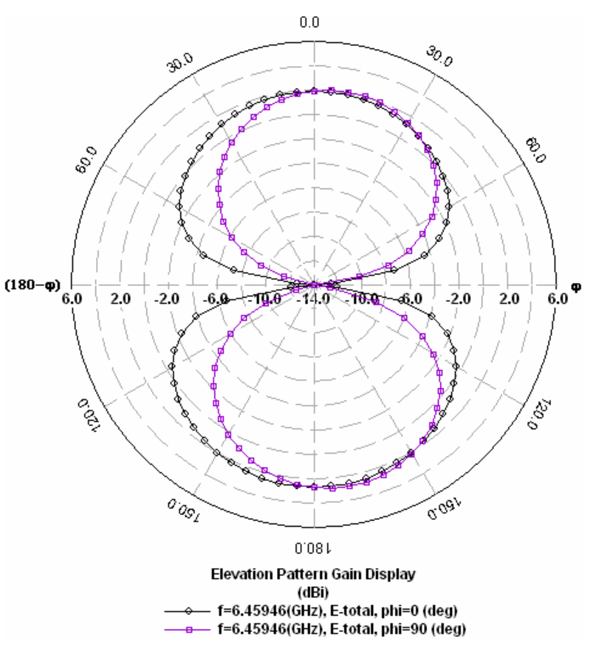
Table2: Effect of W_2 on return loss and impedance Bandwidth

L_2	Resonant frequency (Ghz)	Impedance Band width (Ghz)
3	4.08, 7	7.1
5	4.02, 6.45	7.03

7	4.06, 6.15, 8.66	6.95



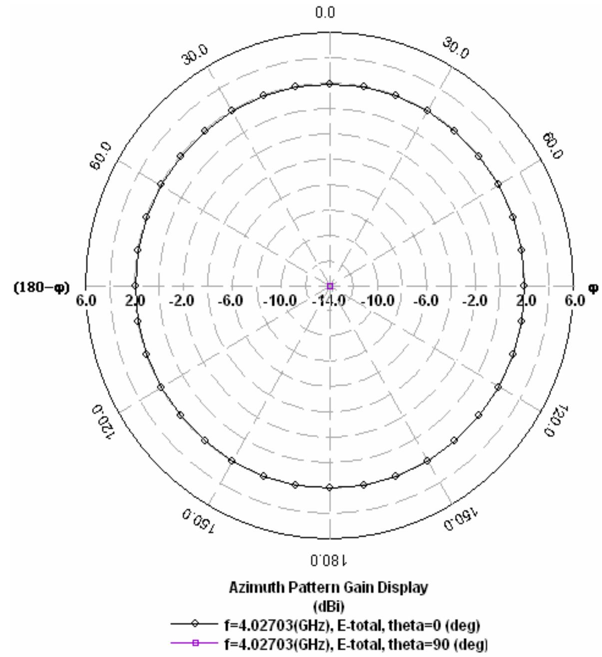
(a)



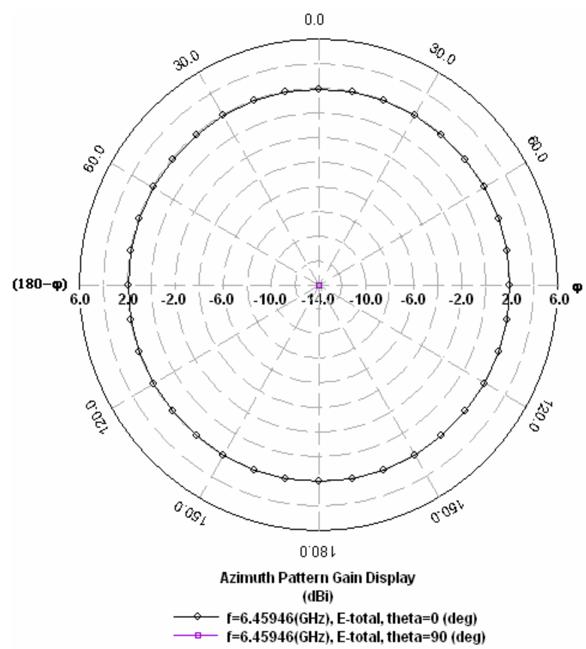
(b)

Fig. 6 (a) and (b) Elevation radiation pattern at 4.02, 6.45 GHz

Far field radiation characteristics were also studied. The Fig. 6 and 7 show co-polarization and cross polarization radiation patterns in Elevation and Azimuthal planes at 4.02 GHz and 6.45 GHz respectively. The radiation patterns are Omni directional in Azimuthal plane and monopole like in Elevation plane.



(a)



(b)

Fig. 7 (a) and (b) Azimuthal radiation pattern at 4.02, 6.45 GHz

The different frequencies across the band width in Fig.6 and Fig. 7 show similar radiation patterns. So, stable radiation patterns have been obtained for proposed antenna. The gain is nearly constant in pass band as shown in Fig 8.

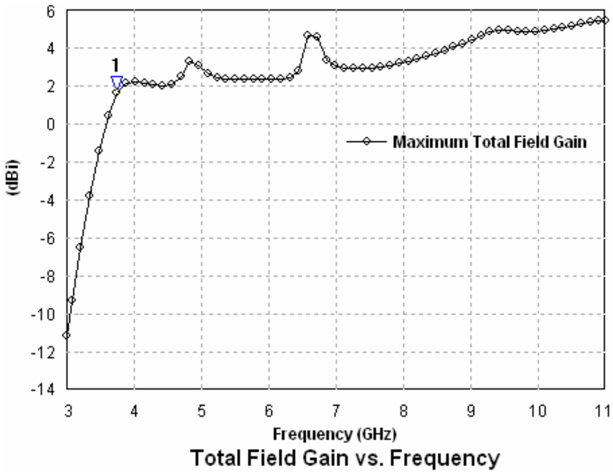


Fig. 8 Total field gain vs. frequency

The gain is 2.18 dBi at 4.04 GHz and 2.74 dBi at 6.45 GHz. The gain is varying from 2 dBi to 5.28 dBi in the operating band.

IV. CONCLUSIONS

A compact Arrow-shaped antenna is presented for CPW applications. The simulated results show that the antenna has impedance band width of 7.1 GHz. It has constant gain and stable radiation pattern over the entire operating frequency band. The return loss, gain and radiation pattern of antenna have been investigated. The radiation patterns of antenna are Omni directional in Azimuthal plane and monopole like in Elevation plane. The antenna has highest gain of 5.28 dBi at frequency of 10.4 GHz in the operating band. The antenna provides promising solution for UWB wireless communication systems.

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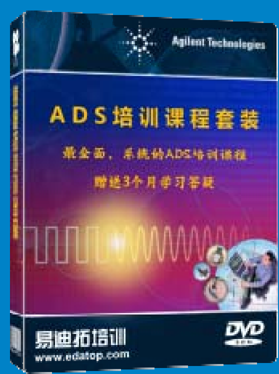

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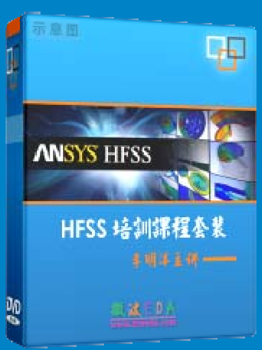

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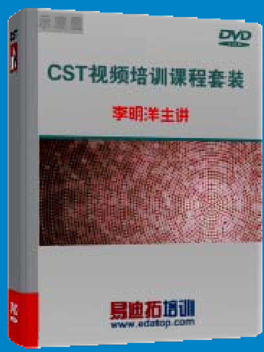

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