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A Wideband Multiband CPW Fed Wineglass Shaped Patch Antenna with Tuning Stub for 4G Wireless Communication Application

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Abstract: A novel design of a wineglass shaped patch antenna with tuning stub is inspected in this paper. FR4_epoxy with ε_r=4.4 is used as dielectric substrate with height 1.6 mm. The antenna resonates at design frequency 3.4 GHz and gives multifrequency response at 3.1 GHz,1 GHz and 4.4 GHz. The impedance bandwidth below -10dB return loss is 19.35 % at 3.4 GHz with return loss -25 dB. The analysis of the antenna is done using HFSS simulation tool.
Keywords: Wideband, multiband, CPW feed, tuning stub, wireless communication

I. INTRODUCTION

Microstrip Antennas are very useful and efficient different radio communication systems starting from wireless communication to satellite communication. Different techniques has been investigated to improve the performance parameters of the patch antennas like getting multi frequency multi band response or higher impedance bandwidth response, better gain.Yao Chen,Longfang Ye,Jianliang Zhuo,Yanhui Liu,Liang Zhang,MiaoZhang, and Qing Huo Liu reported a reconfigurable circular patch antenna with an arc shaped slot loaded in the ground plane in their paper[1]. They have used 5 PIN diodes for matching. By changing the length of the arc slot six frequency band reconfigurations were achieved. Nozomu Ishii, KiyohikoItoh has discussed the mechanism of tuning stub for a circular polarised annular mictrostrip antenna in their paper [2]. D. D. Krishna, M. Gopikrishna, C. K. Aanandan P. Mohanan and K. Vasudevan has discussed[3] a compact dual frequency slotted circular microstrip patch antenna with a dielectric superstrate which improves the bandwidth and lowers the resonant frequencies. The size reduction is reported to be 60 % along with better antenna performance. Surendra K roy and LalanJha has discussed the effect of the length modification of tuning stub on resonant frequency in their paper[4].In this paper a CPW fed wine glass shaped patch antenna with tuning stub is investigated for multiband operation and bandwidth enhancement.

II. DESIGN SIMULATION AND RESULTS

A wine glass shaped patch antenna is designed using HFSS tool showed in Fig.1. Here the co planar waveguide fed technique is used for feeding. The design frequency is at 2.4 GHz. A tuning stub is used for better impedance matching. FR4_epoxy with εr = 4.4 is used as dielectric substrate with height 1.6 mm. he dimension of the dielectric substrate is 55mm X 55mm . The ground plane is introduced with a circular slot of radius 17mm. All the design parameters are given in details in the below mentioned table I.

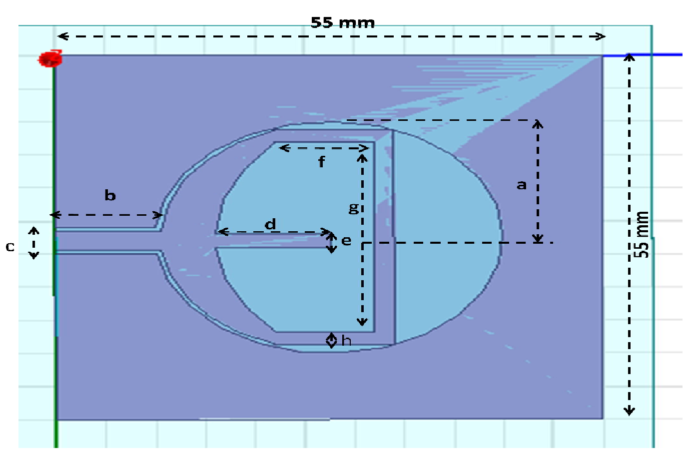

Fig 1 : A CPW fed wine glass shaped patch antenna with tuning stub

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Table I
Antenna design parameters in mm

a	b	c	d	e	f	g	h
17	10.5	3	11	2	10	13	2

Result : From the S 11 vs frequency response of the simulation it is seen that a multiband operation is achieved. The resonant frequencies are 3.1 GHz, 3.4 GHz , 4.4 GHz and 1 GHz with return loss of
-22 dB , -25 dB , -24 dB and -25 dB respectively . The -10dB impedance bandwidth is 19.35 %i.e 800 MHz at the design frequency 3.1 GHz .

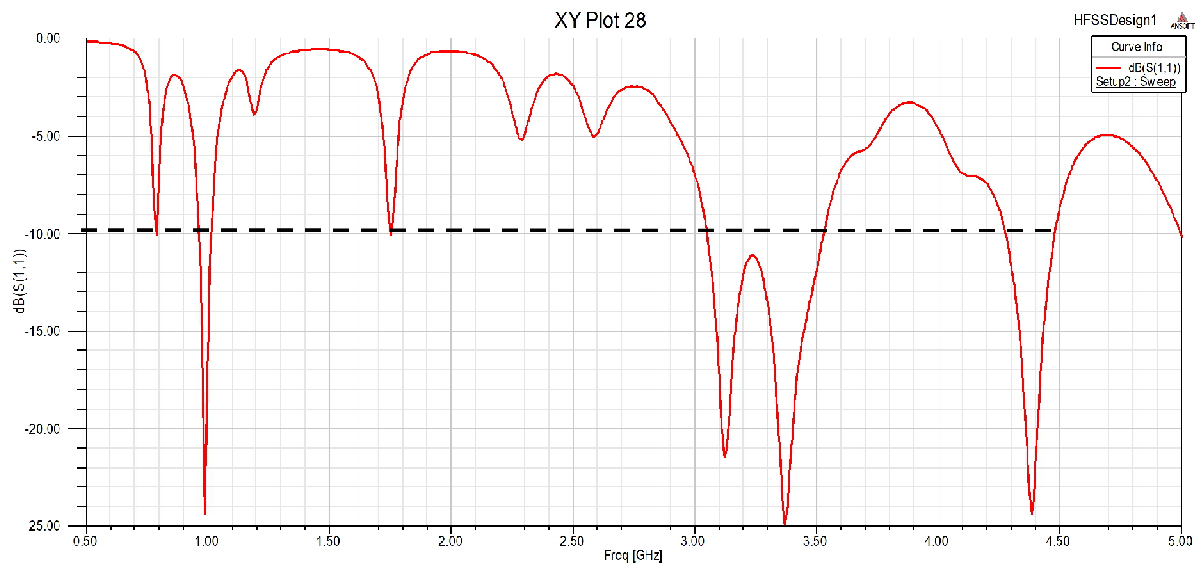

Fig 2.S 11vs Frequency response of the antenna

The computed gain of the antenna by the simulator is 11.5 dB
The tuning stub length is varied accordingly to achieve the best matching and shown in the below table II

Table II :

d in mm	$f_r$in GHz	Bandwidth in %	S11 in dB
1	3.2	15.1%	-20
2	3.2	15.4%	-20
3	3.3	14.43%	-20.5
4	3.3	16.12%	-20
5	3.3	16.36%	-21
6	3.4	17.32%	-21
7	3.4	17.58%	-22
8	3.4	18.13%	-23
9	3.4	18.56%	-24
10	3.4	18.93%	-25
11	3.4	19.35 %	-25
12	3.4	19.1%	-25

By varying the dimension of the stub it is observed that at length 11 mm it gives the best matching and bandwidth at the design frequency 3.4 GHz.
The Gain pattern and the radiation pattern is mentioned in Fig 3 and Fig 4

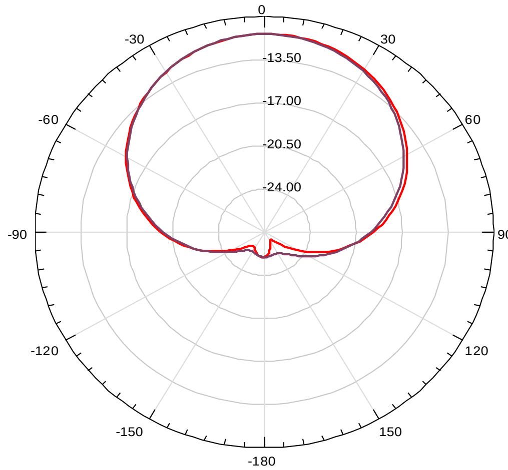

Fig 3: Gain of the antenna

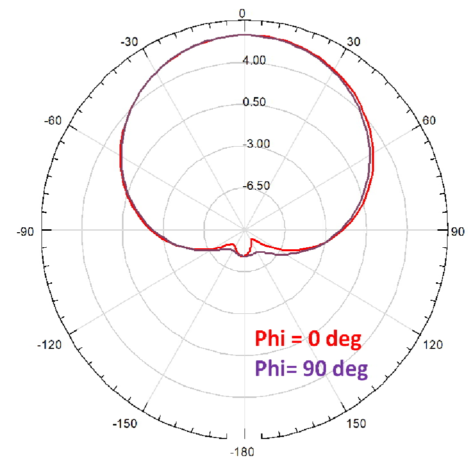

Fig 4: Radiation Pattern of the antenna

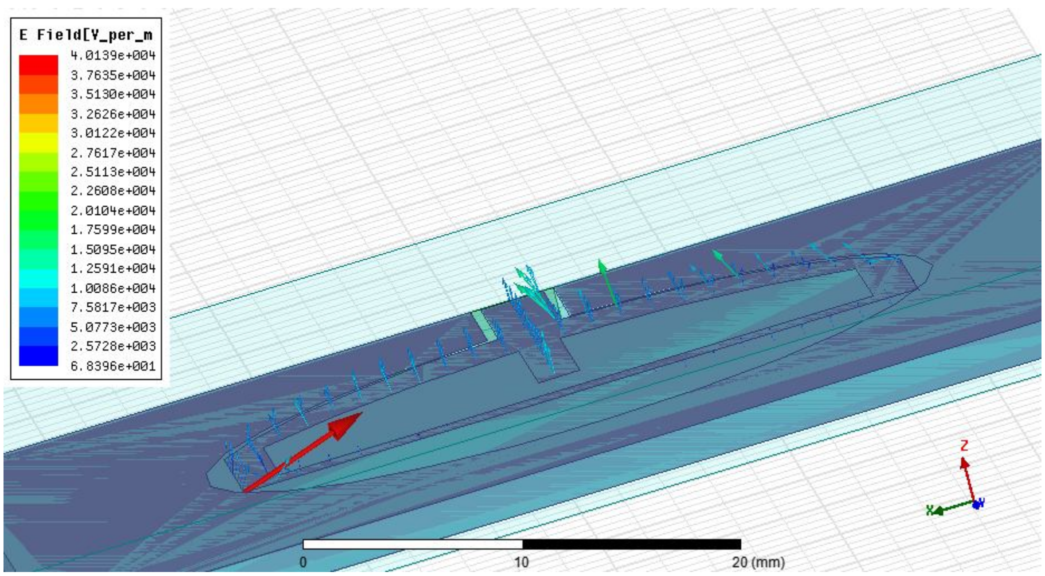

Fig 5 : E field distribution of the antenna

III. CONCLUSION

The proposed antenna in this paper resonates at 3.4 GHz (Sband) with -25 dB return loss which is applicable for satellite and optical communication.The proposed antenna also resonates at 1 GHz (IEEE L band) which is applicable for satellite navigation and telecommunication uses and 4.4 GHz (IEEE C Band) which is applicable for radio communication and wireless communication. The proposed antenna gives 19.35 % impedance bandwidth at design frequency 3.4 GHz hence wide bandwidth is achieved through this design. The proposed antenna is applicable for 4 G WIMAX application (3.4 GHz).

IV. ACKNOWLEDGEMENT

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