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Comparison between Two CPW-FED UWB Antennas based on different feeding techniques

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***Abstract*— Design and analysis of a compact Ultra Wideband (UWB) slot antenna is presented in this paper. The antenna consists of a combination of rectangular and Y- shaped slot. The CPW feed is designed for 50Ω impedance. The characteristics of the designed structure are investigated by using MoM based electromagnetic solver, IE3D. The antenna was fabricated with CPW feed and transmission line feed. But after the extensive analysis of antenna with different feed, it is found that the antenna gives the better performance for Transmission line feed. For apply a CPW feed we get a bandwidth of about 812.75 MHz whereas for transmission line feed we achieve a UWB bandwidth of about 10 GHz approximately. But for transmission line feed, when the feeds are act as a parasitic element then we don't achieve a good result but when all the ports are active we achieve a UWB bandwidth. The simple configuration and low profile nature of the proposed antenna leads to easy fabrication that may be built for any wireless UWB device applications.**

***Keywords*— Transmission line feed, Compact, CPW, UWB, Impedance.**

I. INTRODUCTION

UWB is a short range unlicensed wireless communication system which has a potential to offer high capacity with low power compared with the contemporary wireless systems for short range applications. After the release of UWB for unlicensed application by the Federal Communications Commission (FCC), it receives much much lower than the resonant frequency of the conventional printed antenna with the same patch area. Attention by researchers due to its inherent properties of low power consumption, high data rate and simple configuration [1]. With the rapid developments of UWB systems, a lot of attention is being given to designing the UWB antennas. The design of antennas for UWB applications must satisfy the following requirements. They are ultra wide impedance bandwidth, omni-directional radiation pattern, constant gain high radiation efficiency, constant group delay, low profile and easy manufacturing [2]. Interestingly the planar slot antennas with CPW fed posses the features mentioned above with simple structure, less radiation loss, less dispersion and easy integration of monolithic microwave integrated circuits (MMIC)[3]. Hence, the CPW fed planar slot antennas [4-10] are identified as the most promising antenna design for wide-band wireless applications. In planar slot antennas, the slot width and feed structure affect the impedance bandwidth of the antenna. The wider slot gives more bandwidth, and the optimum feed structure gives good impedance matching [11-18]. The CPW feed line with various possible patch shapes available in the literature such as `T', cross, fork like, volcano and square are used to give wideband width [19-33]. The simulation software used for this analysis is IE3D [34]. The paper is organized as follows: Section 2: brings out the geometry of the antenna. In Section 3, simulation results and analysis are discussed. Section 4: concludes the paper.

II. ANTENNA DESIGN

The structure of the proposed antenna 1 is shown in Fig.1. Also the structure of proposed antenna 2 is shown in fig. 2. In this study, a dielectric substance (FR4) with thickness of 1.6mm and a relative permittivity of 4.4 is chosen as substrate. The CPW feed is designed for 50 Ω characteristic impedance. Both the antenna structures are same but the only difference is that there is a change in feeding techniques. In proposed antenna 1 we use a

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transmission line feed and proposed antenna 2 we use a CPW feed.

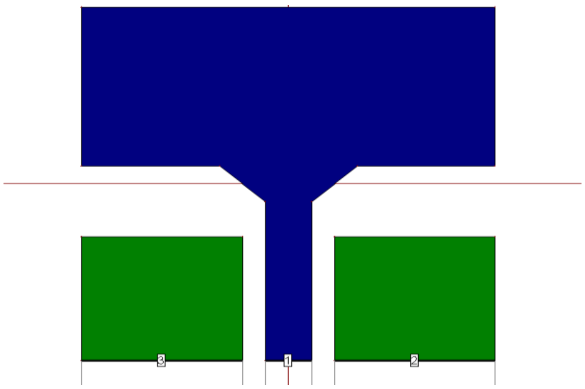

Fig 1: Structure of Proposed Antenna With Tx line

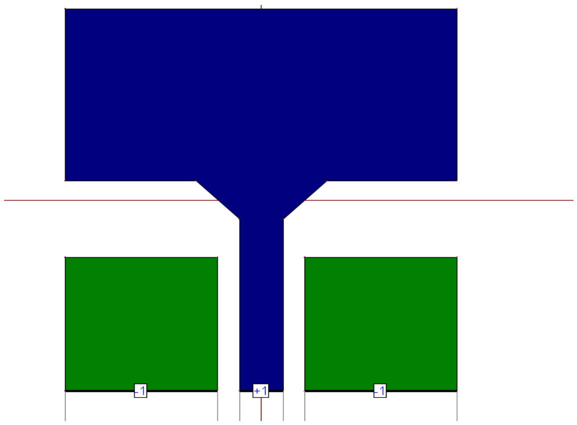

Fig 2: Structure of Proposed Antenna With CPW

The proposed antenna 1 produces ultra wide bandwidth with omni-directional radiation pattern. The wide bandwidth and impedance matching with reduced size of the antenna is achieved due to resultant of different surface magnetic currents.

III. Results And Discussion

In this section, various parametric analyses of the antenna which are inevitable for any UWB antennas are carried out and presented. The analysis and optimization were performed for the best impedance bandwidth. The simulated return loss of the proposed antenna 1 is shown in Fig.3, Fig.4, and Fig.6 where as the return loss of proposed antenna 2 is shown in Fig.7. The return loss of proposed antenna 1 with parasitic element is shown in fig 5. From fig. 7, it is clearly indicates that the impedance bandwidth of the antenna 2 is 812.75 MHz (6.70 GHz-7.51GHz) for a return loss (S_{11}) less than -10dB, whereas antenna 1 gives the better result for any microwave communication. The ultra wide band is due to the coupling between the combined rectangular and Y-Shaped slot in the top layer and the rectangular stub in the ground plane which acts as a finite ground plane. The resonant frequency and band-width are controlled by the size of the Y-Shaped slot, and rectangular stub. Proper geometrical selection of the antenna parameters results in the variation of field distribution, which in turn affects the characteristics of the proposed antenna.

For proposed antenna 1, we achieve a band-width of 10 GHz is much higher than the proposed antenna 2 and acts as a UWB antenna.

All the parameter values are summarized in the following table1, table2 and table3.

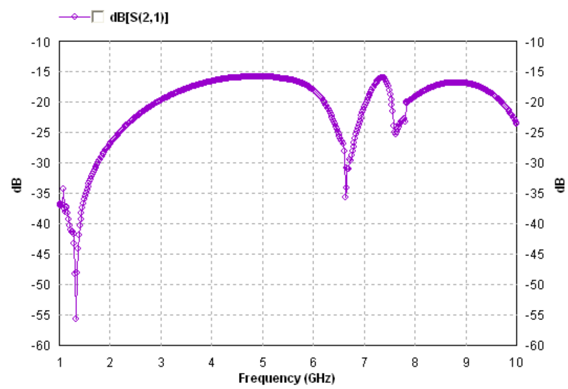

Fig 3: Return Loss of Proposed Antenna 1

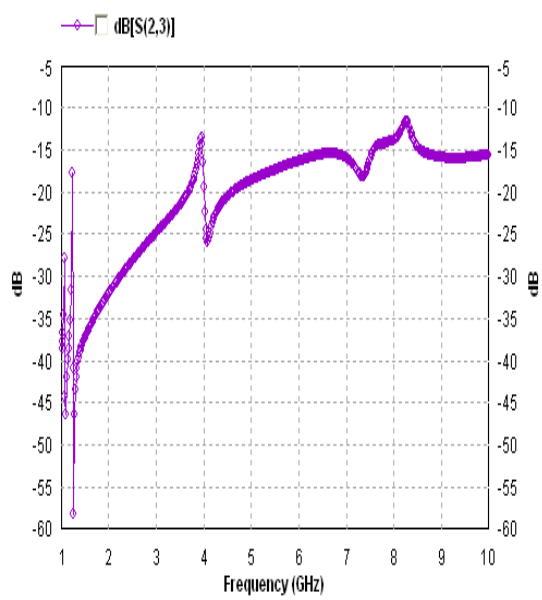

Fig 4: Return Loss of Proposed Antenna 2

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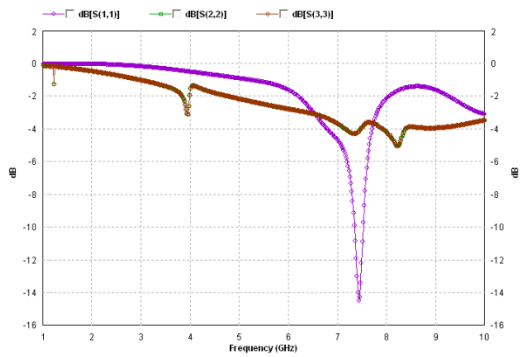

Fig 5: Combined Return Loss as a parasitic element

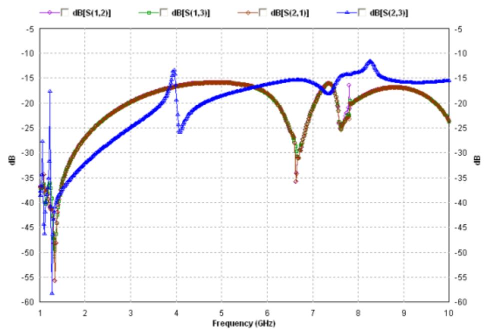

Fig 6: Combined Return Loss of Proposed Antenna 1

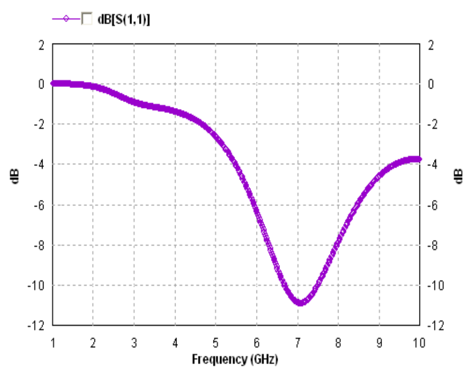

Fig 7: Combined Return Loss with CPW

For the antenna 1, E plane radiation patterns are shown in Figure 8-14.

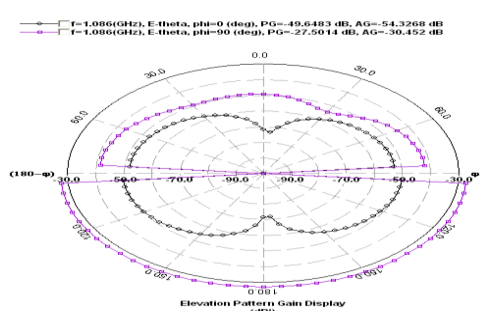

Fig 8: E-Plane Radiation pattern of Proposed Antenna 1 at centre frequency 1.086 GHz

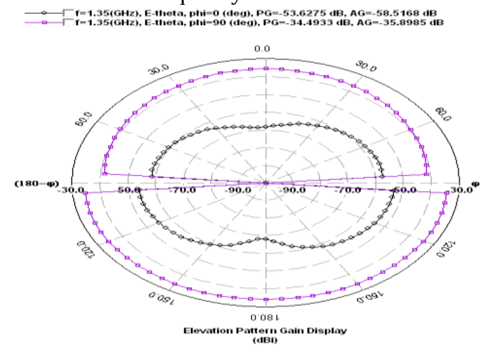

Fig 9: E-Plane Radiation pattern of Proposed Antenna 1 at 1.35 GHz

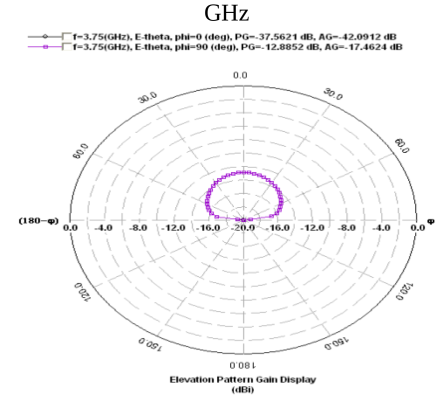

Fig 10: E-Plane Radiation pattern of Proposed Antenna 1 at centre frequency 3.75 GHz

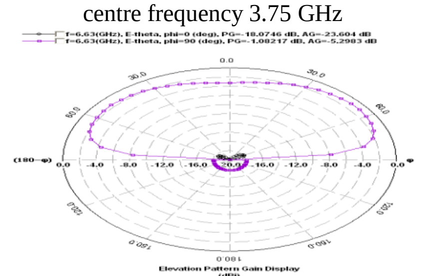

Fig 11: E-Plane Radiation pattern of Proposed Antenna 1at centre frequency 6.63 GHz

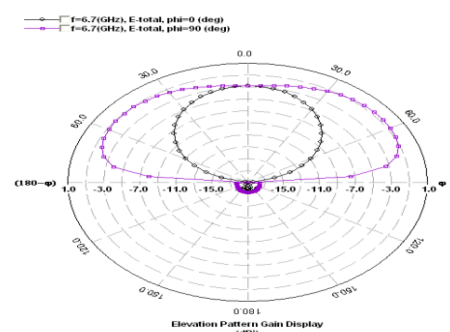

Fig 12: E-Plane Radiation pattern of Proposed Antenna 1 at 6.7 GHz

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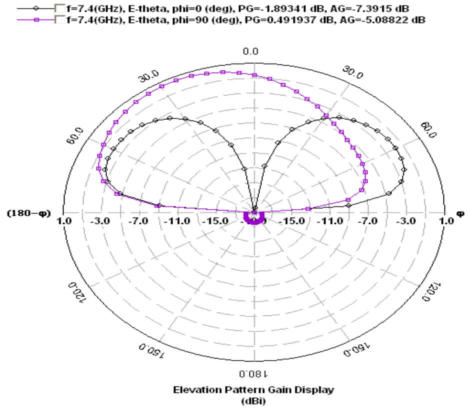

Fig 13: E-Plane Radiation pattern of Proposed Antenna 1 at 7.4 GHz

ANTENNA STRUCTURE	RESONANT FREQ			RETURN LOSS (DB)	10 DB BAND WIDTH (MHZ)
	STARTING FREQ.	ENDING FREQ	CENTRE FREQ		
1	6.70	7.51	7.02	-10	812.75
2 (Acts as a parasitic element)	7.16	7.35	---	-10	190
	7.2	---	---	-14.76	---

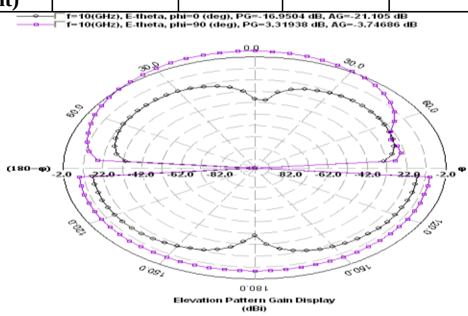

Fig 14: E-Plane Radiation pattern of Proposed Antenna 1 at 10 GHz

For the antenna 1, smith chart figure is shown in Figure 15.

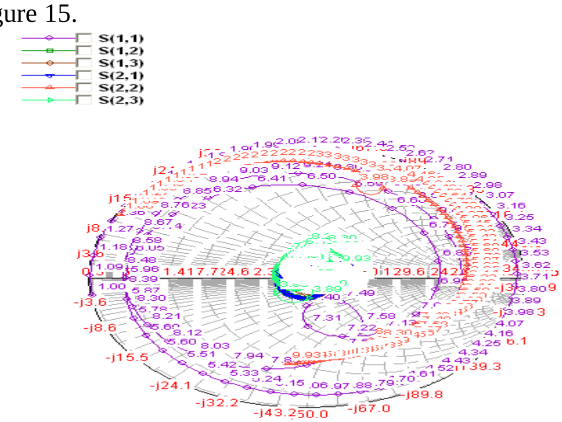

Fig 15: Smith Chart of Proposed Antenna 1

For the antenna 1, VSWR figure is shown in Figure 16.

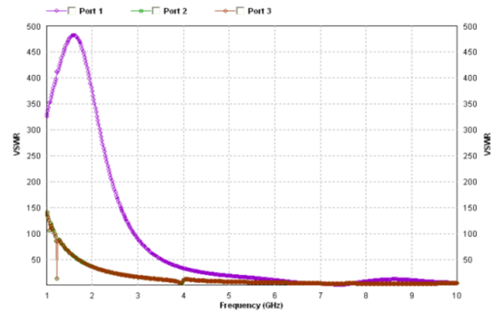

Fig 16: VSWR of Proposed Antenna 1

All the simulated results are summarized in the following tables.

TABLE I: SIMULATED RESULTS FOR ANTENNA 1 AND 2 w.r.t. RETURN LOSS

TABLE II: SIMULATED RESULTS FOR ANTENNA 1 AND 2 w.r.t. RETURN LOSS

ANTENNA STRUCTURE	RESONANT FREQ			RETURN LOSS (DB)	10 DB BAND WIDTH (GHZ)
	STARTING FREQ.	ENDING FREQ	CENTRE FREQ		
2 (Acts as a UWB antenna	1.08	10		-10	10

TABLE III: SIMULATED RESULTS FOR ANTENNA 1 AND 2 w.r.t. RADIATION PATTERN

ANTENNA STRUCTURE	RESONANT FREQUENCY (GHZ)	FREQUENCY RATIO	3 DB BEAMWIDTH (^{0})	ABSOLUTE GAIN (DBI)
2 (Acts as a UWB antenna	f_1= 1.01		170.37 ^{0}	-41.5
	f_2= 1.34	f_2/f_1= 1.33	189.35 ^{0}	-36.2
	f_3= 3.75	f_3/f_1= 3.71	158.68 ^{0}	-13
	f_4= 6.63	f_4/f_1= 6.56	156.54 ^{0}	0.5
	f_5= 6.70	f_5/f_1= 6.63	162.03 ^{0}	-1
	f_6= 7.40	f_6/f_1= 7.33	109.38 ^{0}	1
	f_7= 10	f_7/f_1= 9.90	107.32 ^{0}	3.8

IV. CONCLUSION

This paper describes the detailed analysis and implementation of a transmission line fed UWB slot antenna. The antenna has a unique Y-shaped rectangular slot combined with rectangular slot and at the ground plane two rectangular stubs are used for the application for which it is intended. However, the observed bandwidth is more in proposed antenna 1 than proposed antenna 2 which is more than sufficient for any UWB applications. The maximum return loss for proposed antenna 2 is -56 dB and minimum return loss for proposed antenna 2 is -15 dB and also the average return loss for proposed antenna 2 is -27 dB. The time domain analysis of the antenna is also performed to ensure the suitability of the proposed antenna 2 for the UWB environment. Thus, the proposed antenna 2 is simple, easy to fabricate and can be integrated into any UWB systems.

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