DUAL PORT CIRCULARLY POLARIZED DUAL'T'-SHAPE DRA FOR UWB APPLICATION

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Abstract: Dual port circularly polarized dual T-shaped DRA for ultra wide band (UWB) applications is proposed. A T-shaped DRA is inscribed into a similar T-shaped DRA of same relative permittivity **εr** =9.8, a pair of micro strip feed stubs is printed on the bottom of a substrate with defected ground plane. The structure resonates with a frequency of 8.66 GHz and 7 GHz at S(1,1) and S(1,2) respectively ,in the UWB frequency range from 3.1 GHz to 10.6 GHz. A Peak gain of 7.5dBi and 9dBi was observed at 7GHz and 8.6GHz respectively. The axial ratio of the antenna is less than 3dB and resonates at 6.25 GHz. The radiation efficiency is almost 95% entire the band 3.1 GHz to 10.6 GHz. Simulation process was done by using ANSYS HFSS 13.0.

Index terms **– UWB, Dual-port, circular polarization, DRA, radiation efficiency**.

I. INTRODUCTION

In recent years UWB (ultra wide band) has become an important area of interest as demand for applications using high data rate and low power requirements. UWB technology gained strength when Federal Communication Commission (FCC) provided unlicensed frequency range of 3.1 GHz to 10.6 GHz for its applications. A planar UWB antenna with compact size of 26mm×13mm with L-shape feeding has been studied [1]. An I-shaped slot acting as a defected ground structure is presented where the size of the antenna was 26mm×26mm has been observed in[2].Dual sense Circularly Polarized (CP) antennas are utilized to reduce fading loss and realize frequency reuse. Dual port circularly polarized multi-layered square-ring slot antenna for Ku-band satellite communication has been studied [3].A single layer dual CP antenna resonating at 11.5 GHz was introduced using orthogonal T- coupled feed lines [4].Wireless communications systems which include wireless audio, medical imaging, cognitive radio systems, data and video distribution demands high data rate services such demands are fulfilled by UWB Technology. A dual-port UWB antenna having dielectric permittivity of 4.4 with size 36mm×40mm has been studied [5].

From past three decades, Dielectric resonator antenna's (DRA's) have become a favorable choice in the field of antenna design [6] because DRA's are light weight, low cost and flexible to design antenna for many wireless applications. Dual port UWB DRA with hybrid configuration having dimensions of 27.2mm×13mm and operating range 2.94 GHz to 11.4 GHz with dielectric permittivity of 10.2 has been reported in [7].DRA technology is widely increasing in modern communication systems. Now a days communication systems are operated at millimeter wave bands for high data rate transmission [8]. DRA has as high as 95% radiation efficiency up to 10 GHz, due to its dielectric nature [9].

In this perspective a dual port circularly polarized DRA with T-shaped structure has been proposed. Configuration of antenna and analysis of design with results have been made on subsequent sections. Section II contains antenna design configuration and section III contains results and discussion and conclusions are given in section IV.

II. CONFIGURATION OF THE ANTENNA

Dual port circularly polarized antenna has T-shape dielectric resonator(DR) is inscribed into a similar T-shape DR structure both having relative permittivity of 9.8 and height H . Antenna geometry and 3D view is shown in Fig.1 . A pair of stubs 50Ω transformers are printed on the bottom of a substrate with size L1×W,and thickness having h_s=0.8mm is shown in Fig.2. Substrate has relative permittivity of 2.65 and loss tangent 0.003. There is defected ground plane on one side of the substrate and feed lines on the other side of it. The DRA and ground plane lay on the same side. The bottom view of the antenna is shown in Fig.3.

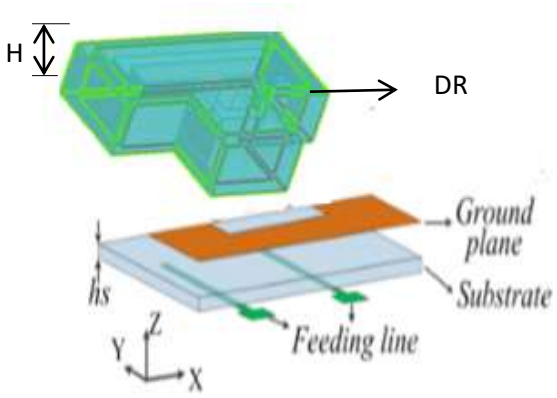


Fig.1-3D view of Antenna

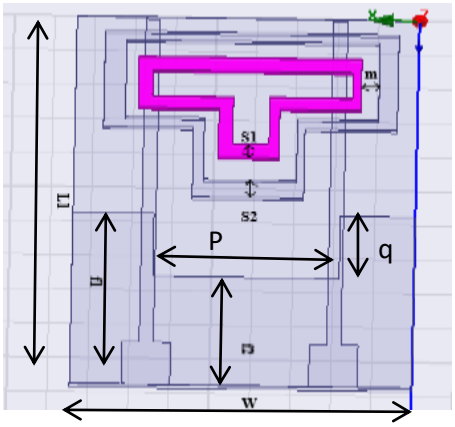


Fig.2 – Top View

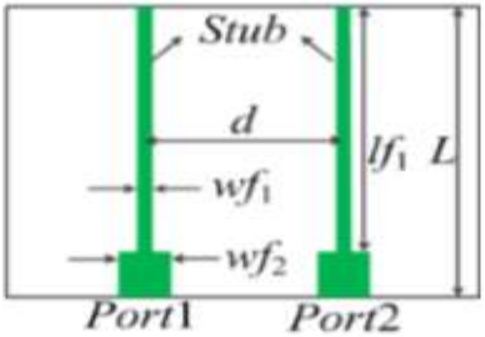


Fig.3 – Bottom View

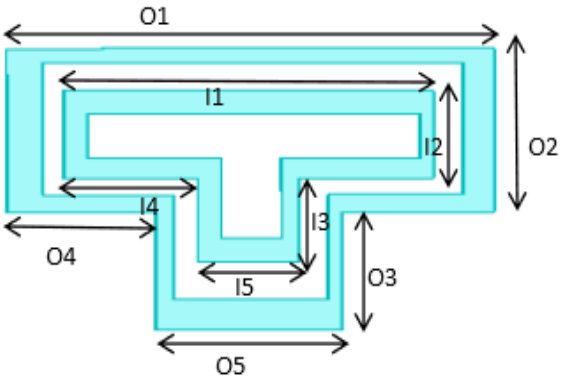


Fig.4 – DRA Top View

DRA consist of two parts inner and outer parts which are named as I and O respectively as shown in Fig.4. Inner DRA is inscribed in outer DRA. The optimal design parameters for proposed antenna are given as follows
$H=3, h_s=0.8, L_1=21.73, W=16.9, m=0.88, f_1=10,$
$f_2=6.33, p=9.2, q=3.67, S_1=0.8, S_2=1.04, O_1=14.5, O_2=5.6, O_3=4, O_4=4.4, O_5=5.5, I_1=11, I_2=3, I_3=2.85, I_4=4, I_5=3, L=21.4, wf_2=2.4, wf_1=0.7,$
$lf_1=18.9, d=8.56$, Units:mm. The proposed antenna is simulated and observed by using ANSYS HFSS in driven terminal modal.

III. RESULTS AND DISCUSSION

The simulations were performed by using ANSYS HFSS 13.0. The return loss plot S_{11}(dB) and S_{12}(dB) of the proposed antenna is shown in Fig.5. The reflection coefficient S_{11} is below -10 dB along (8.2-8.85)GHz and reflection coefficient S_{12} is below -30 dB along (6.75-7.25)GHz both covering under (3.1-10.6)GHz UWB spectrum band. Here $S_{21}<S_{11}$ shows that good isolation between two ports of the antenna. The Fig.6 shows axial ratio in dB of proposed antenna. The axial ratio less than 3dB shown is suitable for circular polarization and bandwidth in this case is found to be 100MHz (5.8-6.8 GHz) which resonates at 6.25 GHz. The peak gain of 7.5dBi and 9dBi was observed at 7GHz and 8.6GHz respectively as shown in Fig.7. The radiation efficiency is shown in Fig.8 which is almost at 96% covering the band (3.1-10.6)GHz UWB spectrum. The 2D radiation pattern for the proposed antenna at 7 GHz, 8.6 GHz are shown in Fig.9 and Fig.10 respectively. The 3D polar plots at 6.25 GHz,7 GHz and 8.6 GHz are shown in Fig.11.

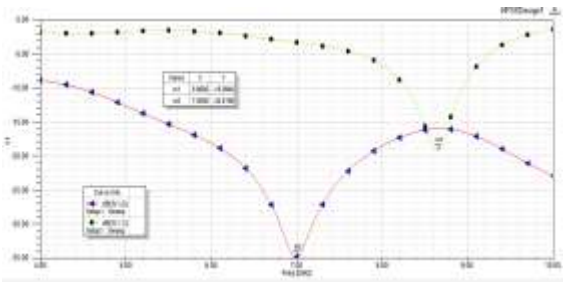


Fig.5-Return loss plot

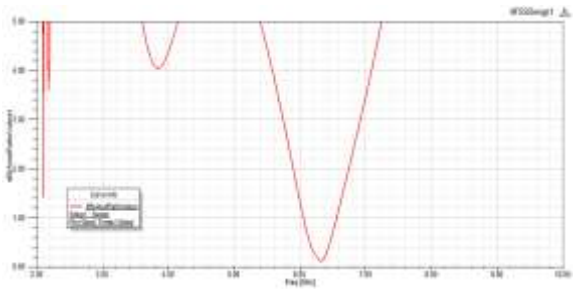


Fig.6-Axial ratio Vs Frequency

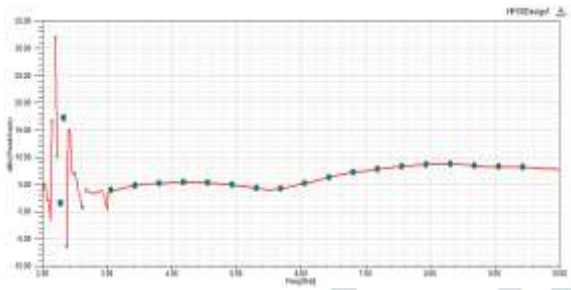


Fig.7-Peak Gain plot Vs Frequency

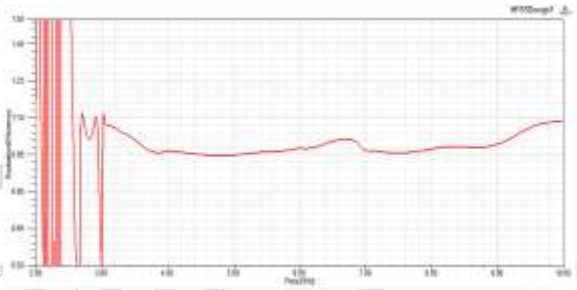


Fig.8- Radiation efficiency

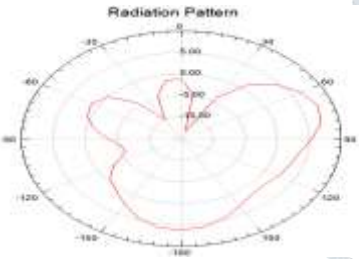


Fig.9-2D Radiation Pattern at 7 GHz

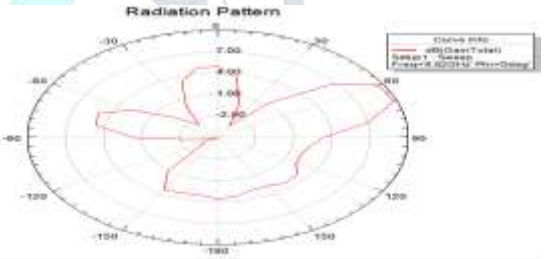
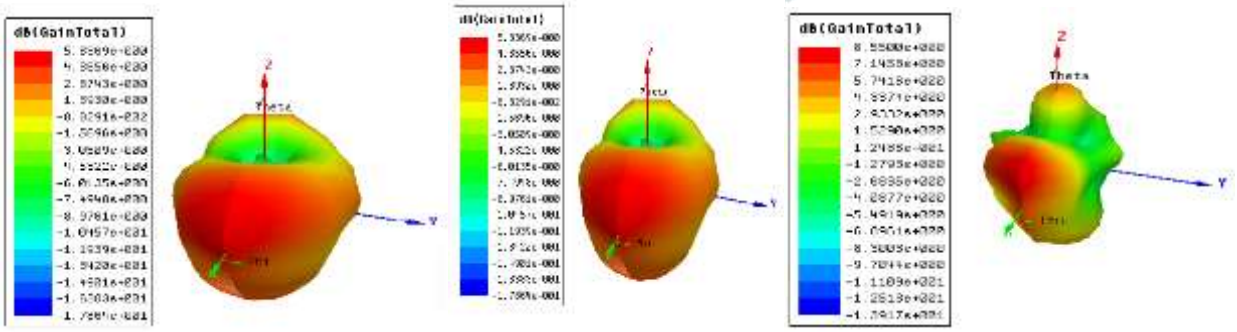


Fig.10-2D Radiation Pattern at 8.6GHz



Gain at 6.25 GHz Gain at 7 GHz Gain at 8.6 GHz

Fig.11-3D Gain plot at 6.25 GHz, 7 GHz, 8.6 GHz

IV. CONCLUSION

Dual port circularly polarized T-shaped dielectric resonator antenna (DRA) for UWB (Ultra Wide Band) application have been designed and simulated using ANSYS HFSS 13.0. The simulated results are shown that UWB antenna covers the band of

3.1GHz to 10GHz which is suitable for sensing spectrum, radar, medical imaging and cognitive radio systems .This antenna shows good polarization purity with 96% radiation efficiency and more than 5 dB gain.

REFERENCES:

[1] Yanfang_Wang; Fuguo Zhu; Steven Gao, " Investigation of Dual-Polarized Ultra-Wideband Antenna with Directional Patterns", IEEE International conference on ubiquitous wireless broadband (ICUWB) , page no:1-3,2016.

[2] Zhang, J.-Y., F. Zhang, W.-P. Tian, and Y.-L. Luo, "ACS-fed UWB-MIMO antenna with shared radiator," Electronics Letters, Vol. 51, No. 17, 1301–1302, 2015.

[3] Mahrukh Khan, Zhenchao Yang, "Dual-Circular-PolarizedHigh-EfficiencyAntennafor Ku-Band Satellite Communication", IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS,VOL no.13,2014.

[4] M. Khan K. F. Warnick, " Noise figure reduction by port decoupling for dual circular polarised microstrip antenna", Electronic Letters,Vol.50,No.23, pages:1662-1664,2014.

[5]A. Shaikh, R.Saleem, A.K.Brown , "Reconfigurable Dual-port UWB diversity antenna with high port isolation", Electronic Letters,Vol.50,No.11, pages:786-788,2014.

[6] A. Petosa. "*Dielectric Resonator Antenna Handbook*". Atlantic Publishers and Distributors. 2007.

[7] Yongfeng Wang, Naizhi Wang, TayebA, "Integrated Ultrawideband/Narrowband Rectangular DielectricResonatorAntennaforCognitiveRadio", IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS,VOL no.13,2014.

[8] Z. H. Tu, Y. P. Zhang, C. Luxey, A. Bisognin, D. Titz, and F. Ferrero, "*A ceramic antenna for tri-band radio devices*," IEEE Trans. Antennas Propag., vol. 61, no. 11, pp. 5776–5780, Nov. 2013

[9] Qinghua Lai, Georgios Almpanis, "*Comparison of the Radiation Efficiency for the Dielectric Resonator Antenna and the Microstrip Antenna at Ka Band,"* IEEE Trans. Antennas Propag., vol. 56, no. 11, Nov 2008