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# Enhancement bandwidth using H-shaped Dielectric Resonator antenna for 3.5 GHz 5G Application

[1] KRUNAL CHAITANYAKUMAR TAILOR, [2] PROF KINJAL R SHETH, [3] ER CHANDRAGOPAL JAISWAL [1]
STUDENT: PURSUING IN LAST SEMESTER OF MASTER OF ENGINEERING , [2]ASSISTANT PROFESSOR OF ELECTRONICS AND COMMUNICATION DEPARTMENT, [3]APPLICATION SYSTEM ENGINEER
[1]ELECTRONICS AND COMMUNICATION DEPARTMENT,
[1]L.D COLLEGE OF ENGINEERING , NEAR UNIVERSITY ROAD, AHMEDABAD-380015,INDIA

***Abstract:*** A wideband H-shaped DRA Fed by Offset Microstripline is proposed in this paper ,micro stripline feed impedance is 50Ω.Antenna is designed to operating frequency 3.09GHz to 4.25GHz with 32.62% fractional Bandwidth.Wideband Achieved using H-shape of DRA .Resonant Frequency is 3.52GHz.when Broadband Characteristics using H-shaped DRA getting directional pattern at gain of 1.55dB.TE10 and TM01 mode generate at 3.52GHz .S-parameter get -27.82dB at 3.52GHz.bandwidth enhancement Using H-shaped DRA.Shifting frequency Using Width of Substrate. The DR operate at Dominant mode in Rectangular waveguide .Its radiation Pattern is Broadside. The differential feeding method for improvement of DRA .Rectangular DRA is easy to fabricated .Time Domain Analysis is used for simulation.It is work high Frequency Problem .Q factor Also depend on Bandwidth.If loaded Q factor is low Bandwidth is high.Bandwidth is inversely propotional to Q-factor.

***Index Terms - H-shaped DRA; offset Micro strip line Feed,5G Application, impedance matching, High Impedance Bandwidth, VSWR.***

## I. INTRODUCTION

The structure of DRA mainly consists of three basic components; they are first one Substrate, secondly ground (Perfect Electric Conductor) material etched on substrate and some dielectric resonating material placed above the ground, generally referred as Dielectric Resonator(DR)" .The designing of DRs and using them in structures of DRAs. If the DR placed in an open environment, Power will be lost in the radiated fields only. This fact makes dielectric resonators useful as antenna elements instead of elements in microwave circuits as energy storage devices. Different Types Of DRA used Like at Cylindrical DRA, Rectangular DRA and Hemispherical DRA[2] .But Rectangular DRA fabrication is Easy .Different Mode Generate in different Shape of DRA like As TE,TM and TEM mode ,H-shaped DRA mode Generate TE10in Rectangular Waveguide [5].It is low cost ,easy to Design[14] [15].Different Type of Feed mechanism used like as Microstripline ,Coplanar Waveguide Feed, Slot Coupled Fed ,Coaxial Feed so in this different types of feeding applied DRA . In designing, input impedance is the important parameter which is a feed to excite the DRA[9]. Input impedance as a function of frequency is to determine the bandwidth of operation and for matching the antenna use 5G application.

## II. ANTENNA DESIGN

### 2.1 Find Resonant Frequency

The schematic diagram of the proposed wideband H-shaped DRA antenna is shown in Fig. 1. First, H-shaped DRA has been designed as shown in Fig. 1.

$$f_{TE_{npm}} = \frac{c}{2\pi\sqrt{\epsilon_r \mu_r}}\sqrt{\left(\frac{X_{np}}{a}\right)^2 + \left(\frac{(2m+1)\pi}{2h}\right)^2} \quad (1)$$

The substrate of dielectric constant 4.3(FR-4)lossy and dielectric loss tangent of 0.025has been taken in this design. The antenna has been designed and simulated with CST software. Alumina Er=9.9 use for H shaped DRA and Fr-4 (Er=4.3) use for Substrate .Trucated Ground Plane use behind the Substrate.

**2.2 Find Characteristics Impedance Equation**

$$\frac{W}{H} \geq 1 \quad \varepsilon_{eff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2\sqrt{1+12\frac{H}{W}}} \tag{2}$$

$$Z_0 = \frac{120\pi}{\sqrt{\varepsilon_{eff}}\left[\frac{W}{H} + 1.393 + \frac{2}{3}\ln\left(\frac{W}{H} + 1.444\right)\right]} \Omega \tag{3}$$

.

**2.3 Find Fractional bandwidth Equation**

$$FBW = \frac{f_h - f_l}{f_c} X\ 100\% \tag{4}$$

From this equation get VSWR from reflection Coefficient.

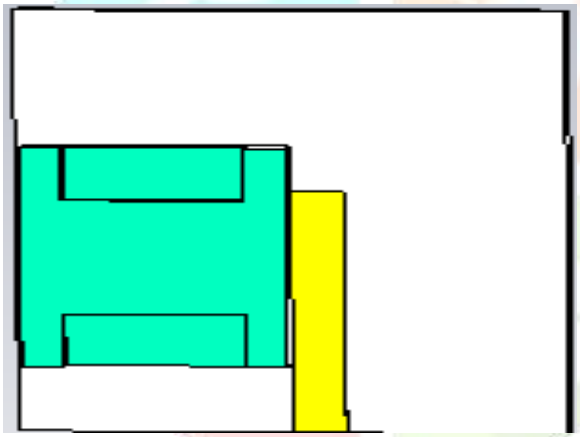

**Fig. 2.1.: Top View**

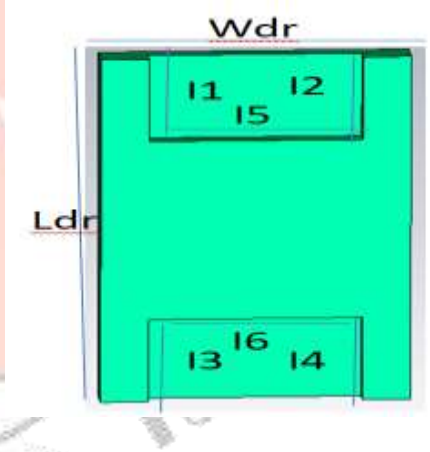


**Fig. 2.2 H-shape DRA**

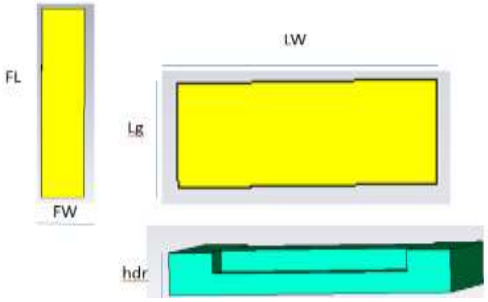


**Fig. 2.3 Microstripline And H-shape DRA Height**

| | | | |
|---|---|---|---|
| $L_s$=40 | $W_s$=30 | $T_s$=1.6 | $L_a$=10 |
| $W_a$=30 | FL=22.9 | FW=2.9 | $L_{dr}$=20.8 |
| $W_{dr}$=14.5 | $h_{dr}$=2 | I1=I2=I3=I4=5 | I5=I6=10 |

**TABLE 2.1 ALL PARAMETER ARE IN MM**

## III. SIMULATION AND RESULTS

### 3.1 Characteristics Impedance

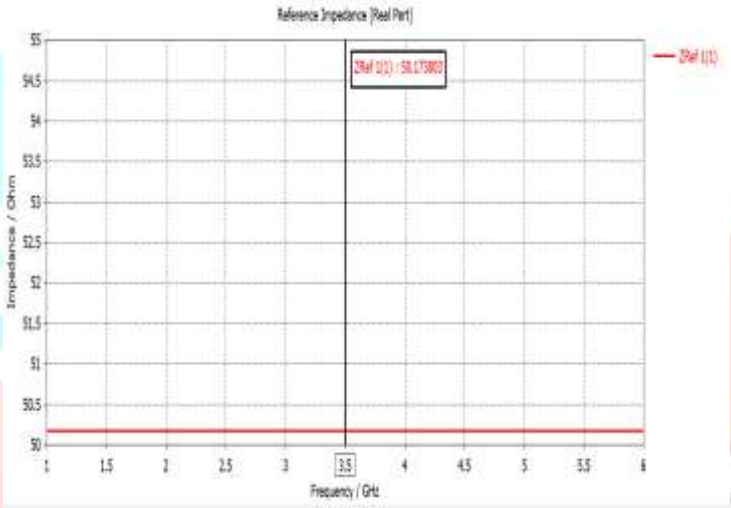


**Fig. 3.1.: Characteristics Impedance**

From Figure 3.1getting 50.17Ω from below equation[1] and [2].

### 3.2 S-parameter

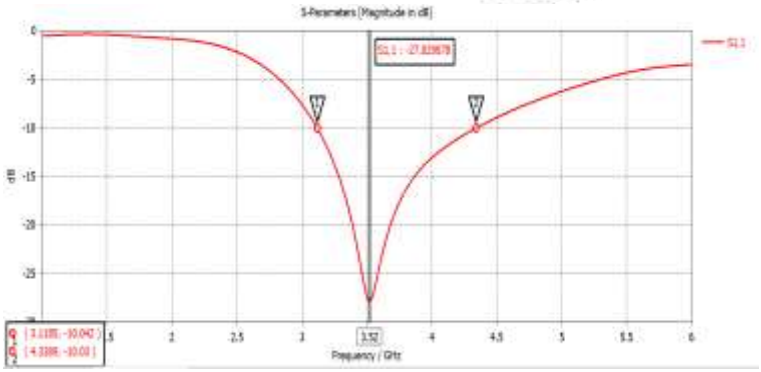


**Fig. 3.2.: S-parameter**

Simulated return loss is given in the Figure 3.2. Simulated return loss is -27.82 dB at Resonant frequency of 3.52 GHz The lowest the return loss, the minimum is the loss and the DRA can accept maximum power from the source. Both of the return loss values are lower than -27 dB which indicate good matching. simulated return loss result are in good agreement. The H shaped DRA antenna is designed to operate at 3.52 GHz. The return loss of the proposed H-shaped DRA is presented s observed from the . that for the H-shaped DRAs antenna has one Resonant frequencies at 3.52GHz The return loss at 3.52GHz is -27.82 dB with 32.62% bandwidth.

### 3.3 VSWR

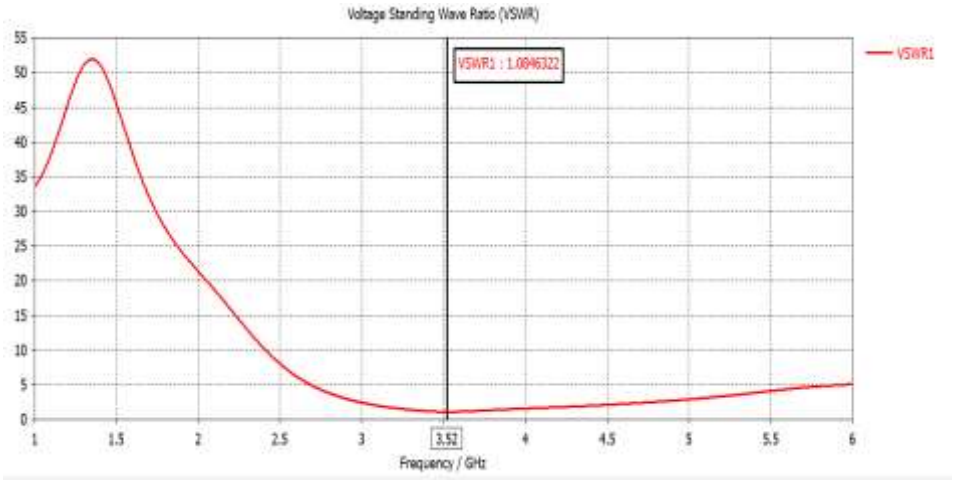


**Fig.3.3.:VSWR=1.05**

### 3.4 E-field and H-field Distribution

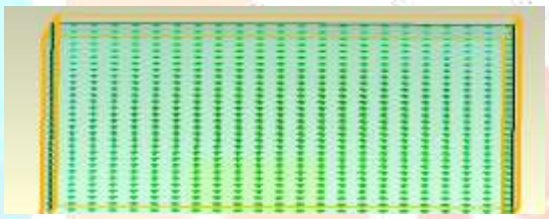

**Fig. 3.4.: E-plane Distribution(TE10mode)at 3.52GHz**

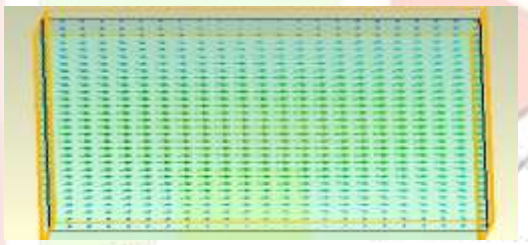

**Fig.4.5.:H-plane Distribution(TM01 Mode)at 3.52GHz**

Resonant Mode TE10 Mode and TM01 Generate E plane & H plane distribution at 3.52GHz resont Frequency in Figure3.4 and Figure 3.5 given.

**4.4 2D and 3D Fairfield Radiation Pattern**

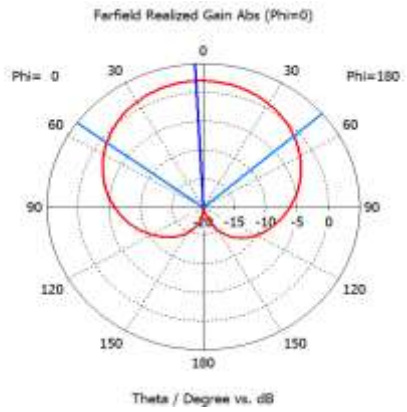


**Fig.3.6.:2D Far-field Radiation Pattern**

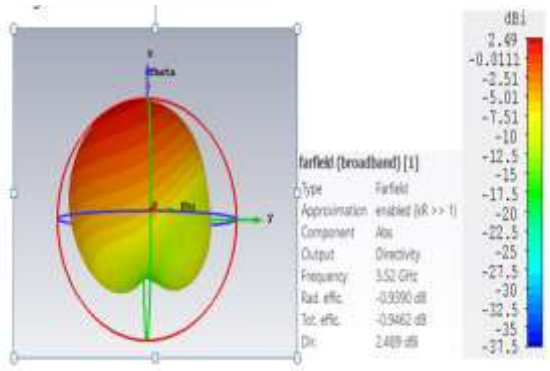


**Fig.3.7.:3D-Farfield Radiation Pattern**

From figure 3.7 getting directivity gain is 2.489dBi at 3.52GHz.so this radiation pattern is useful for 5G application for 3.5GHz frequency.

## IV.CONCLUSION

This paper present H-shaped DRA operating at3.52 GHz. H shape DRA was used as it offers more flexibility in controlling the resonant frequency 3.52GHzdue to its two aspect ratios. Hence, it Provides high degree of freedom in controlling antenna performance. Also getting 32.62% fractional bandwidth Apart from that, E-plane and H-plane of the radiation pattern indicates that this antenna is suitable to be used in 5G application for 3.5GHz frequency.

## V. ACKNOWLEDGMENT

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