ANALYSIS OF TRIANGULAR SHAPED DIELECTRIC RESONATOR ANTENNA FOR C BAND APPLICATIONS

Poorti Gupta[1], Kanchan Cecil[2]

[1]Research Scholar, [2]Assistant Professor
Department of Electronics, JEC Jabalpur(M.P.)

***Abstract*: The following paper presents, a triangular dielectric resonator antenna fed by simple microstrip line and vertical strips. The designed antenna offers -10dB impedance in C band range i.e. from 5.54 Ghz to 7.44Ghz under which the impedance bandwidth is 29.27% and measured overall gain is in the range of 3.68dBi-7.52dBi. The overall size of the antenna is 50×50×20 mm^3 which is very small as compared to other designs. The three vertical strips helps in obtaining return loss $|S_{11}|$ below -10dB and the measured VSWR is between 1 to 2 in the entire frequency range. The characteristics of this antenna were studied, and good agreement was found in the measured results.**

***Index terms:* Triangular Dielectric Resonator Antenna, Impedance Bandwidth, C-Band.**

I. INTRODUCTION

Initially dielectric resonators were consider only a piece of dielectric which resonates for radio waves, usually in microwave and millimeter wavebands. From many years, dielectric resonators were used as a oscillator and filters in microwave circuits.[1]. Further studies revealed that high radiation efficiency and large bandwidth of dielectric resonators caught attention.

In 1983, S.A. Long and his team investigated the radiation pattern on resonant cylindrical cavity.[2][3][4]. Further Long and his team examined the rectangular and hemispherical dielectric resonator antennas. This grounds the future of dielectric resonator antennas.

Dielectric resonator antennas have found in many shapes like rectangular, triangular, cylindrical, hemispherical etc. On comparing with microstrip antenna, it s found that dielectric resonator antennas offer wider impedance bandwidth and comparatively of small electrical size.

In this paper, the designed dielectric resonator antenna is structured in equilateral triangular shape. The inspiration to design triangular dielectric resonator antenna for linearly polarized application is due to the fact, for a certain operating frequency and a dielectric constant, these DRAs are comparatively small than the corresponding rectangular and circular DRAs.[5].Despite the fact this saves the space which may be an advantage in application of antenna arrays.

In triangular DRAs, for a given resonant frequency 3 aspect ratios (side/height) can be chosen independently to offer more flexibility in terms of bandwidth [6].

There are types of feeding method applied to DRA like coaxial probe feed [2-4,7-9], direct microstrip feed line [10,11], strip-line [12], conformal strip-line [13], coplanar waveguide feed [6], microstrip line with vertical strips [14]and many more. Here the used feeding method is microstrip feed line with three vertical strips . The method opted for designing an antenna and results are discussed in further section.

II. ANTENNA DESIGN AND PARAMETRIC STUDIES

The proposed triangular dielectric resonator antenna is excited by simple microstrip feed line and three vertical strips are used to obtain better -10dB impedance bandwidth. The antenna geometrical values are listed in parametric Table I. The radiator part of the designed antenna consist of triangle shape roger material having permittivity of ε_r=9.8 with a side of 'a' and height 'h'. The whole antenna geometry is placed on FR4 lossy substrate of ε_r =4.3, under which we placed a L×B mm^2 ground plane. To excite the dielectric resonator three vertical strips are used of different length on each side of triangular dielectric resonator. The schematic view of proposed antenna is shown in Fig. 1.

The proposed antenna structure is simulated using cst simulation software.

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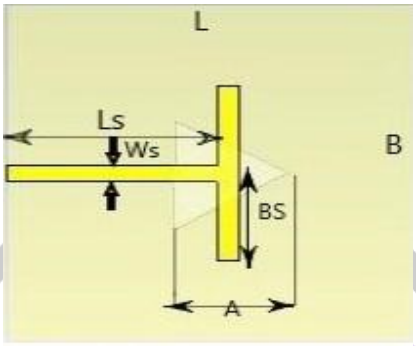
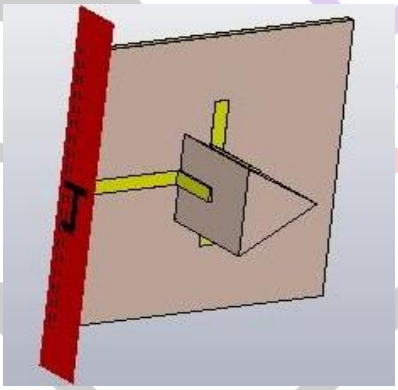
Parameters	Values
L	55
B	55
Ls	31
Ws	2.8
Bs	13
A	10
H	20
V1	10
V2	14.5
V3	11.7
W1	1.5



(a)



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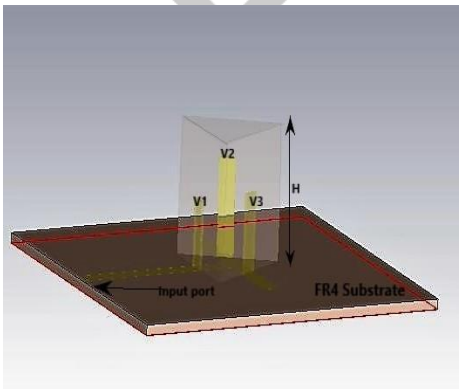


(c)

FIGURE 1. Schematic of Triangular shaped dielectric resonator antenna. (a) Top-view of proposed antenna. (b)&(c) 3D-view of antenna structure showing corresponding parameters.

III. MEASURED RESULTS

A. Return loss and -10dB Bandwidth

Return loss vs. frequency curve which is normally known as S_{11} parameter of the proposed antenna is shown in Fig.2. The obtained return loss is -28.107dB at resonant frequency of 7.0626 and the obtained -10dB bandwidth from the curve is 29.27% in the frequency range of 5.54Ghz to 7.44Ghz.

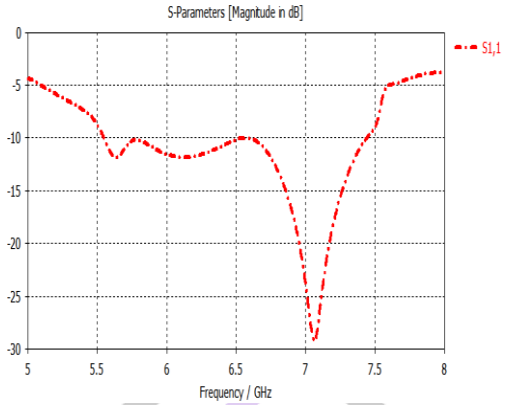


FIGURE 2.

B. Gain

The obtained gain of the designed antenna is in the range of 3.68dB to 7.52dB in the range of operating frequency, attaining highest gain of 7.52 dB at 6.9 Ghz frequency. Fig 3.(a),(b) and (c) shows the gain at respective frequencies and fig 4,5 and 6 Shows overall gain.

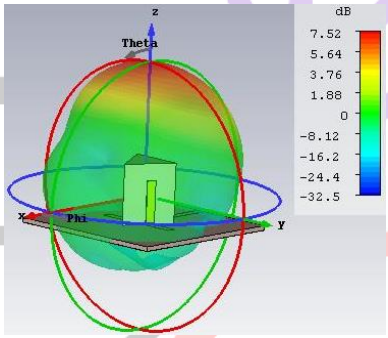
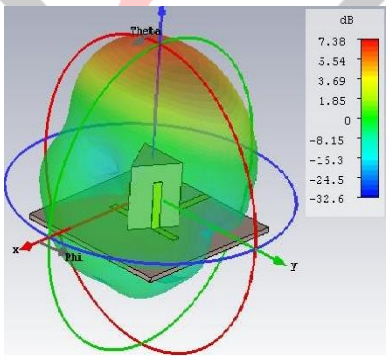
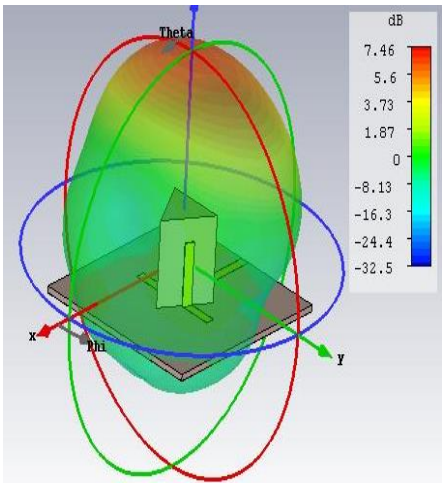


Figure 3(a) Gain at f=6.9 Ghz



(b)Gain at f=6.8 Ghz



(c)Gain at f=7 Ghz

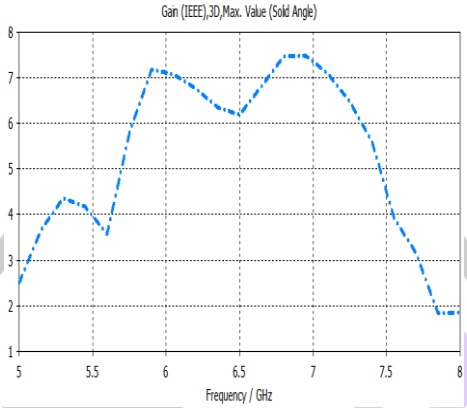


Figure 4. Overall Gain

C. **VSWR**

VSWR stands for voltage standing wave ratio defines as a function of reflection coefficient, which describes the power reflected from the antenna. The minimum value of VSWR is 1, which means no power is reflected back from the antenna. The measured VSWR here is between 1 and 2 in the operating range of frequency as shown in fig 4.

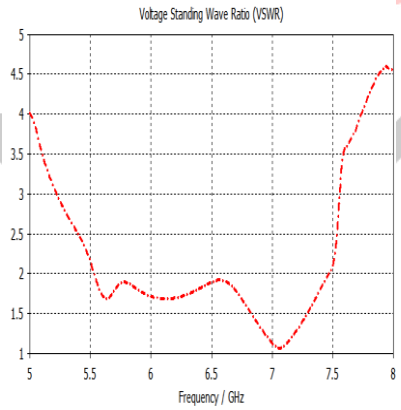


Figure 4. VSWR

CONCLUSION

A triangular Dielectric resonator antenna excited with microstrip line has been designed for C-band application .For achieving high impedance bandwidth vertical strips is used. The proposed design offers 29.27% impedance bandwidth in frequency range of 5.54 Ghz-7.44 Ghz. The overall gain of the designed antenna is in the range of 3.68 to 7.52dB in the operating frequency range which makes it desirable for C band application such as satellite communication, weather radar systems .

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