ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 3, Issue 4, October 2013

Design Rectangular Microstrip Antenna for Direct Broadcast Satellite

Neha Bhandari[1], Nikita Gosavi[2],Tazeen Shaikh[3].
[1]Neha Bhandari (MPSTME, NMIMS UNIVERSITY)
[2]Nikita Gosavi (MPSTME, NMIMS UNIVERSITY)
[3]Tazeen Shaikh (MPSTME, NMIMS UNIVERSITY)
MPSTME,NMIMS university,Bhakti Vedant Swami Marg,JVPD Scheme, Vile-Parle(W),Mumbai-4000056

Abstract— In this paper, Rectangular microstrip antenna (RMSA) is designed by creating three V-shaped slots operating at the resonant frequency 12.79 GHz. The patch is designed having thickness of 1.1 mm and dielectric constant of 2.4 yielding bandwidth of 900 MHz Antenna Efficiency achieved is 84%. Direct broadcast satellite is a term used to refer to satellite television broadcast intended for home reception. DBS uses the upper portion of Ku band which ranges from 12 – 18 GHz. The analysis is done using the Zealand IE3D software based on method of moment.

Index Terms—**Direct Broadcast System (DBS), IE3D simulator, Microstrip antenna, Patch length.**

I. INTRODUCTION

A patch antenna is a type of radio antenna with a low profile, which can be mounted on a flat surface. Microstrip antennas consist of very thin patch placed at small fraction of a wavelength above the ground plane. The patch and ground plane are separated by dielectric sheet [1]. The specialty about these antennas is that they can be easily fabricated, light in weight, low cost, small in size [2]. Nowadays, microstrip patch antennas are becoming useful because they can be printed directly onto the circuit board. In this paper, analysis of microstrip antenna is done using Transmission –line model. Transmission –line model is the easiest of all, its gives god physical insight [1]. Microstrip antennas are widely used for wireless applications. Ku-band (12-18 GHz) is used for most satellite communication systems particularly satellite TV; Broadcasting Satellite (BSS); Fixed Satellite Systems (FSS);Direct Broadcast Satellite (DBS) [3]; VSAT system; Marine communication [4]. The Ku band is also used for high resolution mapping and satellite altimetry. The most important use of the Ku Band is tracking the satellite within the ranges roughly from 12.87 GHz to 14.43 GHz [5]. In this paper the microstrip patch antenna is designed for use in a DBS at 14 GHz. With its higher power and superior video and audio quality, Direct Broadcast Satellite (DBS) communications is proliferating worldwide. Many new DBS Systems are evolving and with the introduction of HDTV, DBS technology is predicted to become even more prevalent. Design Parameters for the microstrip antenna: The return loss is at 12.79 GHz frequency. Bandwidth is 900 MHz . This design of three V-shaped patch antenna is having dielectric constant of 2.4 and center frequency of 12.79 GHz.
VSWR is 1.2.

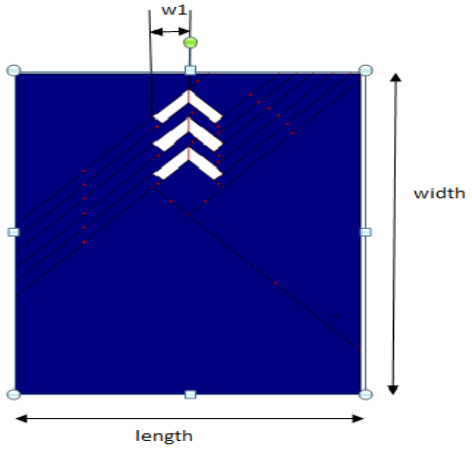

Fig 1: V- shape Microstrip Patch Antenna

II. MATHEMATICAL ANALYSIS

To design a rectangular microstrip patch antenna following parameters such as dielectric constant (ε_r), resonant frequency (f_o), and height of the substrate (h) should be considered for calculating the length and the width of the patch [6].
Width of patch (w):

$$W = \frac{C}{2 f_0 \sqrt{\frac{\varepsilon_r + 1}{2}}}$$

Effective dielectric constant of antenna:

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[\frac{1}{\sqrt{1 + \frac{12h}{W}}}\right]$$

Effective dielectric length of antenna:

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 3, Issue 4, October 2013

$$L_{eff} = \frac{C}{2 f_0 \sqrt{\varepsilon_{eff}}}$$

The extended length of antenna (ΔL):

$$\Delta L = 0.421\, h \frac{\left(\varepsilon_{reff} + 0.3\right)\left[\frac{w}{h} + 0.264\right]}{\left(\varepsilon_{reff} - 0.258\right)\left[\frac{w}{h} + 0.8\right]}$$

The length is:

$$L = L_{eff} - 2\Delta L$$

III. ANTENNA DESIGN

The antenna design shown in fig. 1 has three v shape rectangular microstrip patch antenna with the following dimensions: length=6.9832 mm, width =8.2174 mm and they are cut into the slots w1=1 mm, w2=1 mm.
The proposed antenna has:-
Patch length=6.9832mm.
Patch width=8.2174 mm.
Cut width w1=1 mm.

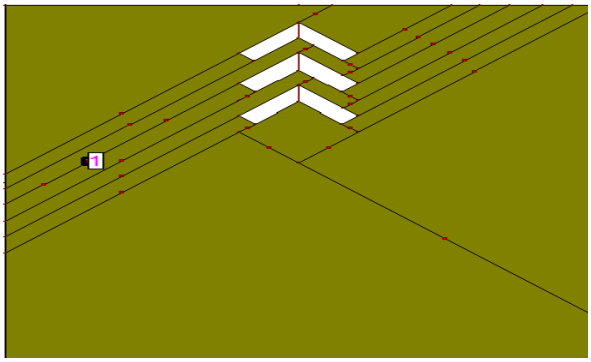

Fig 2: V- shaped Microstrip Patch Antenna with feed

TABLE I: OPTIMISED ANTENNA PARAMETERS

ANETENNA PARAMETERS	VALUES
RESONANT FREQUENCY	12.79 GHz
DIELECTRIC CONSTANT	2.4
THICKNESS(H)	1 mm
LENGTH(L)	6.9832 mm
WIDTH(W)	8.2174 mm
CUT WIDTH(W1)	1 mm

The proposed antenna simulated using IE3D simulator is best operated at frequencies 12.79 GHz.

IV. RESULT AND DISCUSSION BN

The microstrip patch antenna is designed with center frequency 12.79 GHz; dielectric constant of 2.4 and thickness 1.1 mm. This antenna is simulated in IE3D Zealand software [7]. The return loss curve is shown in fig. 4 with the return loss of -20.65 dB at 12.79 GHz.

1. *Smith chart:*

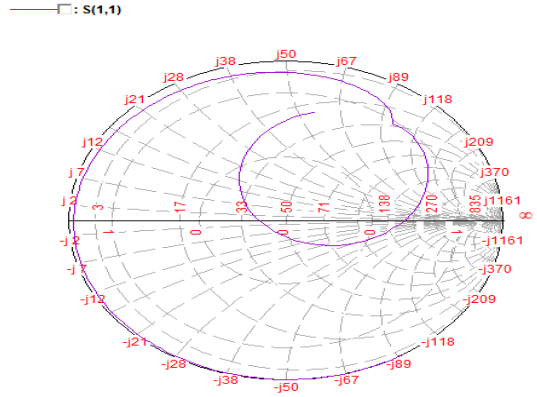

Fig 3: Smith Chart of proposed antenna

2. *Return Loss:*

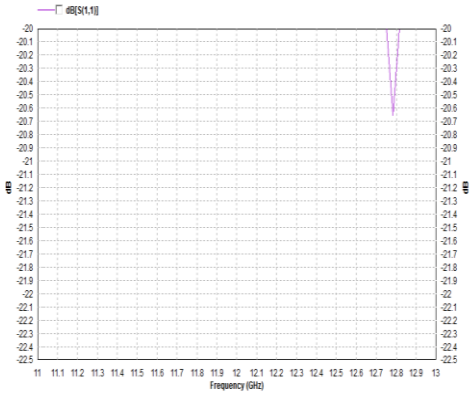

Fig 4: Return Loss v/s Frequency

Return loss at 12.79 GHz = -20.65 dB.

3. *VSWR:*

Fig.5 Shows the VSWR value of 1.2 at frequency of 12.79.The VSWR value of microstrip antenna is between 1 and 2.

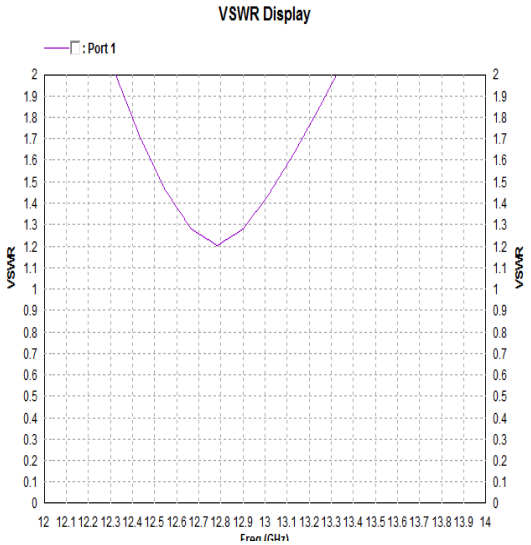

Fig 5: VSWR Vs Frequency for Proposed Antenna

VSWR=1.2 at frequency 12.79 GHz.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 3, Issue 4, October 2013

4. Axial Ratio:

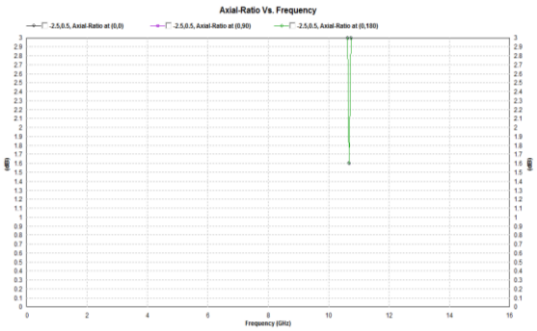

Fig 6: Axial Ratio Vs Frequency of Proposed Antenna Axial Ratio at 12.79 GHz=1.6dB.

5. RADIATION PATTERNS:

A. Elevation Pattern:

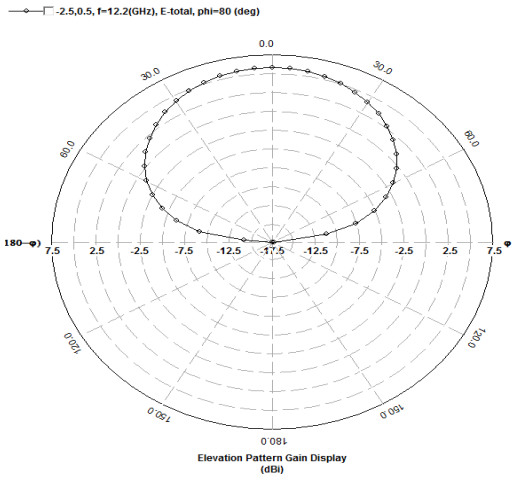

Fig 7: Elevation Pattern

B. Azimuth Pattern:

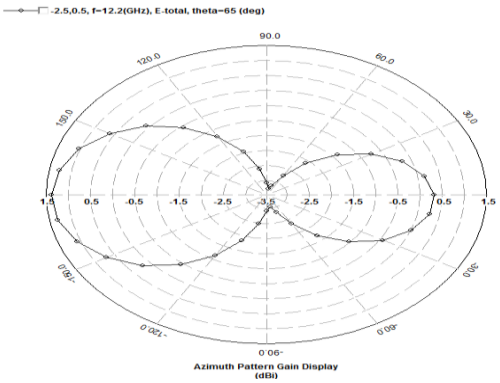

Fig 8: Azimuth Angle

V. CONCLUSION

The research motivation of this paper is to design RMSA by creating 3 V-shaped slots for Direct Broadcast Satellite operating at resonant frequency 12.79 GHz. The proposed antenna provides the wide bandwidth of 900 MHz along with antenna efficiency of 84 %. The axial ratio and VSWR of proposed antenna is 1.6 dB and 1.2.The antenna has been designed and simulated using IE3D software. Thus the proposed microstrip patch antenna is suitable for implementing it in the Direct Broadcast Satellite. Proposed Antenna is expected to have great potential usage in DBS system.

REFERENCES

[1] C. A. Balanis, "Antenna Theory, Analysis and Design", John Wiley & sons.

[2] Debatosh Guha, "Broadband Design of Microstrip Antenna: Recent Trends and Development".

[3] Supriya Jana, Bipadtaran Sinhamahapatra, Sudeshna Dey, Arnab Das, Bipa Datta, Moumitan Mukherjee, Samiran Chatterjee, "Single Layer Monopole Hexagonal Microstrip Patch International Journal of Computational Engineering Research (ijceronline.com), ISSN:2250-3005(online), Vol. 3 Issue. 1, January 2013, PP.110-115.

[4] Supriya Jana, "Hexagonal microstrip printed antenna design and analysis of gain for KU- band application", ISSN 0976 – 6464 Volume 4, Issue 3, May–June,2013pp.83-96,www.iaeme.com/ijecet.asp.

[5] Supriya Jana, Bipadtaran Sinhamahapatra, Sudeshna Dey, Arnab Das, Bipa Datta, Moumita Mukherjee, Santosh Kumar Chowdhury, Samiran Chatterjee,"Single Layer Monopole Hexagonal Microstrip Patch Antenna for Satellite Television" , International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307,Volume-2, Issue-6, January 2013.

[6] Mahmoud Abdipour, Gholamreza Moradi, Reza Sarraf Shirazi'A. , "Design procedure for active rectangular microstrip patch antenna".

[7] Zealand Software Inc. IE3D: MoM-Based EM Simulator. Web: http://www.zeland.com.

[8] Direct Broadcast Satellite Communications: An MPEG Enabled Services.