Ka Band Microstrip Antenna Design For Space Applications

[1]Sohini Bairagi, [2]Sista Uma Harshini, [3]Soumita Das, [4]Arpita Santra
[1,2,3] B. Tech Student,[4]Assistant Professor
[1,2,3,4] Electronics and Communication Engineering Department
[1,2,3,4] Narula Institute of Technology, Kolkata, India

Abstract: As the technology advances the need of better systems are getting more importance in fields of communication. In this work a rectangular microstrip patch antenna has been designed which can be useful in the Ka(26-40 GHz) band. The design of the antenna has suitable selected to perform its response in the Ka Band. The high frequency of the microwave frequency has been selected so that the Space communication in the Ka band can be performed.

IndexTerms - **Ansoft HFSS; Microstrip patch antenna; Ka-band; Space Communication**

I INTRODUCTION:

As per the growth happening in the development of low cost, low weight, highly reliable antenna[1,2] for wireless devices. It poses a new challenge for the design of antennas in wireless communication. This study presents the design of microstrip[3] patch antenna at Ka-band frequencies. In this work the Ka band is chosen as the research works on this band is till now very low as compared to the lower microwave band or the Wireless Local Area Networks (WLAN). The proposed antenna operates above 35GHz which could be utilized in the Space applications. This work is mainly focused on rectangular shape antenna design and this antenna is designed in such a way to support above Ka band frequencies. The transmission line model[4] method is used and it has been stimulated by using Ansoft HFSS[5] software. The microstrip patch antenna[6] is very popular now a days for its superior properties. The design aspects were mainly on the patch length, width, shape and size. All relevant calculations has been made using Ansoft HFSS software and found to have a return loss S_{11} of -17.0dB and VSWR less than 2.1. The simulation study shows that the design frequency is at Ka band and above. The selection of suitable material for the design of the microstrip patch antenna is very sensitive issue. In this design the relative permeability is taken within 4.3 and shows better performance in terms of efficiency and larger bandwidths. It has also been found that the suitable selection of material for the design of Microstrip patch antenna with different values of permeability gives suitable results. For any antenna there are two field possible i.e. near and far field[7]. In this study only the far field is chosen. In this study it has been found that Ka band Micristrip antenna design[8] is possible and if we further investigate on the design issues.

II PROPOSED ANTENNA PARAMETERS:

The proposed antenna consists of the rectangular patch dimension, the relative permittivity of the substrate, the thickness of the substrate. The transmission line model[9,10] has been studied here and applied. The relative permittivity of substrate has been suitably selected within 4.3. Thickness of substrate is 1.4mm.

The design equations are required to specify the resonant frequency, width, patch thickness and dielectric constant. The patch antenna width can be given by

$W= c/[2F\{(\varepsilon_r + 1)/2\}^{-0.5}]$

c= speed of light

F=the resonant frequency

ε_r = the relative dielectric constant of the substrate

By choosing FR4 epoxy and RT Duroid 5880 the simulations has been performed.

L=length of the patch

$L=L + 2\Delta L= 32.04$ mm

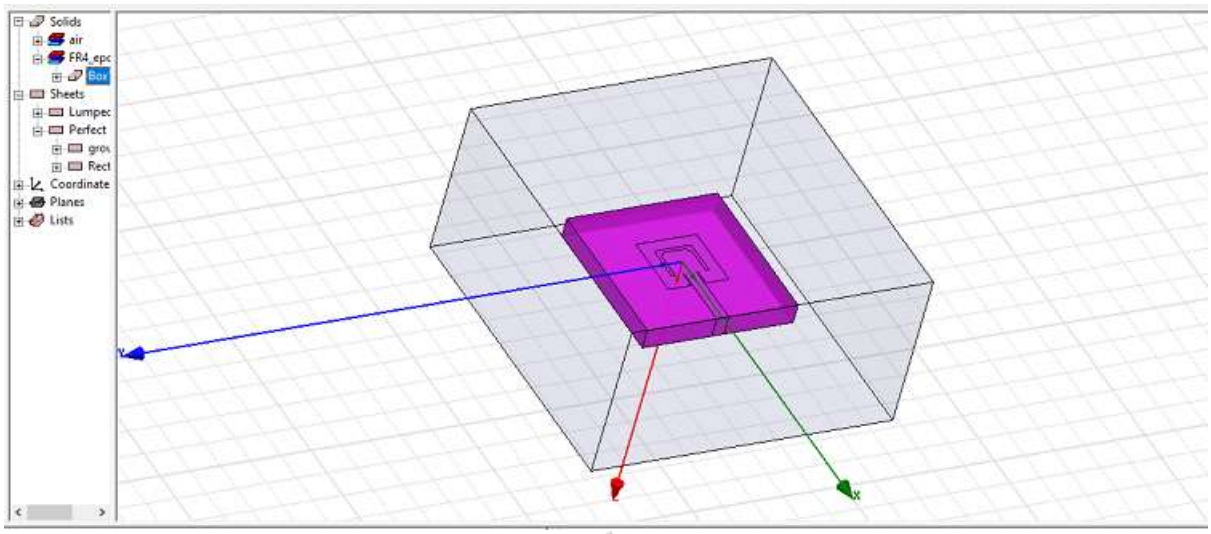

Figure 1: The microstrip antenna in the Ansoft HFSS platform

III RESULTS AND DISCUSSION:

By using Ansoft HFSS software the simulation study has been performed. The proposed antenna shows significant results as per the requirements of Ka band.

The results show good indications in terms of VSWR, radiation pattern, return loss for the microstrip antenna.

Figure 2: VSWR Plot of the Proposed antenna in Ansoft HFSS platform

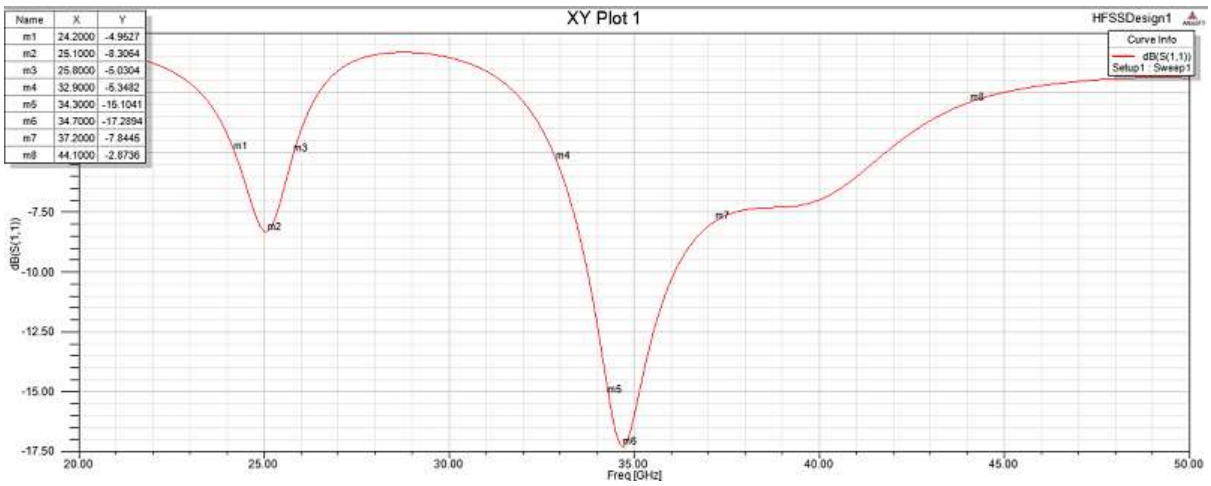

Figure 3: Return Loss

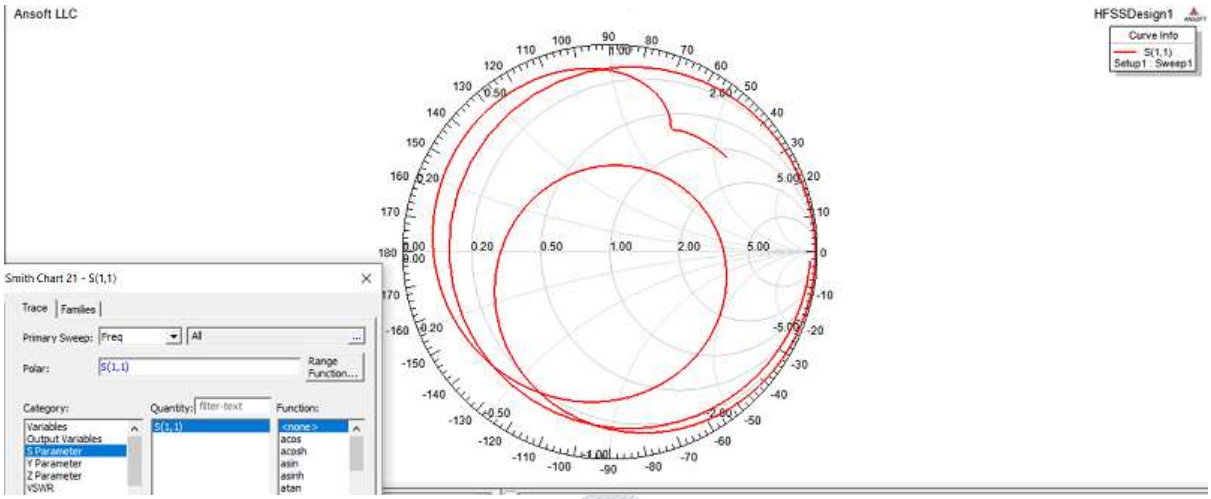

Figure 4: Radiation pattern of the patch antenna

IV CONCLUSIONS:

The antenna shows return loss of -17dB at 34.6GHz. The antenna also proves that it can be utilized in the Ka band frequency. The antenna is compact, easy to fabricate and very much suitable for space wave communications.

REFERENCES:

[1]Constantine A, Balanis, 'Antenna Theory-Analysis and Design', Second Edition, John Wiley and Sons,Inc.,1997.

[2] J.R. James, P.S. Hall. Handbook of microstrip antennas, I.E.E. Electromagnetic Waves Series 28- Peter Pereginus LTD, 1989.

[3] R.J. Mailloux, J.F. Mcllvenna and N.P. Kemweis-Microstrip Array Technology IEEE Transactions on Antennas and Propagation,Vol.29,No.1,January 1981 .

[4] H. Pues, A. Van de capelle, Accurate transmission line model for the rectangular microstrip antenna, IEEE Microwave, Antenna and Propagation Proceedings, Vol.131,Pt.December 1984.

[5] Ansoft Corporation, HFSS User's Guide, version 10 &12,Ansoft Corporation,Pittsburgh,CA,20

[6] Mahdi Ali, Abdennacer Kachouri and Mounir Samet "Novel method for planar microstrip antenna matching impedance", Journal Of Telecommunications, May 2010.

[7] Aruna Rani, R.K. Dawre "Design and Analysis of Rectangular and U Slotted Patch for Satellite Communication" International Journal of Computer Applications , December 2010.

[8] Dhivya N, Pooja Jayakumar, Prashanth Mohan, Rekha Zacharia, Vishnupriya Vasudevan, G. Prabha" Comparative Study Of Slotted Microstrip Antenna Fed Via A Microstrip Feed Line" Proceedings of 1st IRF International Conference, Coimbatore, 9th March-2014.

[9] Garg, R and Ittipiboon, A; “Micro strip Antenna Design Handbook”, Artech House, 2001.

[10] D.M. Pozar, ―Microstrip Antennas‖, Proc.IEEE, vol.80, No.1, January 1992.