International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 02 | Feb 2020 www.irjet.net p-ISSN: 2395-0072

Designing of Rectangular Patch Antenna Using CST designing Suite

Vickey Kumar Sahu[1], Suraj Kumar[2], Bhawna Kalra[3]

[1]Student, Dept. of Electronics and comm., Arya Institute of Engineering and Technology, Rajasthan, India
[2]Student, Dept. of Electronics and comm., Arya Institute of Engineering and Technology, Rajasthan, India
[3]Assistant Professor, Dept. of Electronics and comm., Arya Institute of Engineering and Technology, Rajasthan, India

---

Abstract - *An antenna with a low profile as a radio antenna which is mounted on a flat surface. Normally rectangular antenna is obtained by folding a patch antenna into a rectangular waveguide shape. Through this antenna size is greatly decreased. At the radio frequency 2-4 GHz, Vertical and horizontal length of an antenna is 150 mm and 140 mm respectively. The rectangular patch antenna is designed using the CST designing technique. Antenna resonant frequency is 1.2636 GHz, reflection coefficient is less than -28, for the frequency range of 2 GHz to 4 GHz. The substrate used in this antenna design is made up from FR4 material with dielectric constant is 4.4. With the help of particular length (35 mm) and width (3 mm) of a transmission line rectangular patch antenna various parameter excited for example S parameter, Voltage Standing Wave Ratio (VSWR), and characteristic impedance.*

1. INTRODUCTION

Microstrip patch antenna is one of the most popular and frequently used antenna in wireless communication, due to its structure, light weight, small size, and low manufacturing cost and can be easily assemble in microwave circuits [1]. Microstrip antenna consists of mainly three parts ground plane substrate and patch. It is very easy to analyse using the transmission line models which are more and more accurate for thin substrates [2].

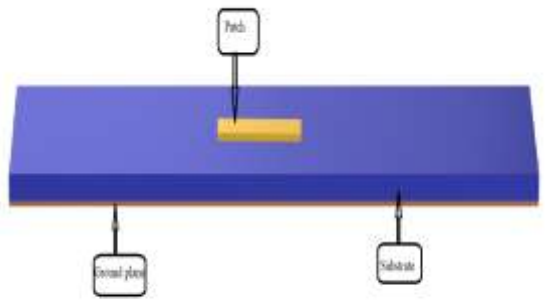

Figure -1: Rectangular patch antenna

Patch antenna is basically a directional antenna where the main power beam is formed on the patch side and very little radiation can be detected [3]. By using the Lithography technique a patch antenna is built on a dielectric substrate [4]. Microstrip have becomes more appearing technology in mobile phone markets [5], multiple band and ultra wide technology among the world. It have been widely used in various applications including short range communication, Radar, and positioning system [6]. In this paper we design a microstrip rectangular patch antenna by using a transmission line fading and get result by simulation using CST software.

1.1. DESIGNING PROCEDURE AND FORMULATION

For the better performance of the patch antenna, it requires impedance matching circuits. Input impedance of the patch antenna is associated with (w/l) ratio. Which is given by

$$z_{in} = 90\left(\frac{\varepsilon_r^2}{\varepsilon_r - 1}\right)\left(\frac{l}{w}\right)^2$$

The operating frequency is 2-4 GHz which has been conceived utilizing the substrate FR4 of dielectric constant ε_r= 4.4. The height and width of the substrate is 78 mm and 78 mm [7] [8].

Steps for the development of rectangular patch antenna [9]:

Step1: Simplify ε_r and h of substrate, a desired resonant frequency f_r and the impedance Z_c of the feeding transmission line.

Step2: Calculate width of patch by using

$$w = \frac{c}{2f_r}\sqrt{\frac{2}{\varepsilon_r+1}} \qquad \{W<L\}$$

Where:

C = velocity of light (3 x 10^8 m/s)

ε_r = Dielectric constant of the substrate

f_r = resonant frequency of antenna

Step3: Effective dieletric constant

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(\frac{1}{\sqrt{1 + \frac{12h}{w}}}\right)$$

Step4: Effective length

$$L_{e_{ff}} = \frac{C}{2f_r\sqrt{\varepsilon_{eff}}}$$

Step5: Extension length equation

$$\Delta_{L=1}h * 0.412 * \frac{(\varepsilon_{e_{ff}} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{e_{ff}} - 0.258)\left(\frac{W}{h} + 0.8\right)}$$

Step6: Length

$L = L_{e_{ff}} - 2\Delta L$

The patch dimensions is w = 3 mm * L = 50 mm

Feed dimension is $w_L = 3\ mm * L_L$ = 35 mm

The ground plane length and width is calculated as L_g = 150 mm and w_g = 140 mm respectively.

The rectangular patch antenna is designed with the help of CST simulation software.

1.2. SIMULATION RESULTS

Design and results are done using the transmission line fading:

A. The size of purposed patch antenna is 150, 140 mm (L, W). The length of the fading line is 35 mm as shown in figure 2. In this rectangular patch antenna design of 50 mm and 3mm sizes are cut to form a rectangular shape structure. The operated frequency of purposed antenna at 2-4 GHZ. The value of reflection coefficient is -28.616 dB at operating frequency 1.2636 GHz as shown in figure 3. The value of a VSWR is calculated at a particular frequency of 1.264 GHz and value of VSWR is 1.0725 as shown in figure 4. As shown in figure 5 the value of characteristics impedance is 49.1 to 49.4 impedance/ ohm.

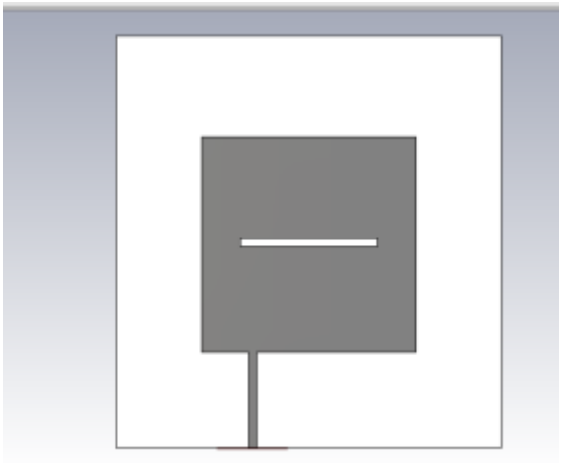

Figure -2: A rectangular microstrip patch antenna with slot

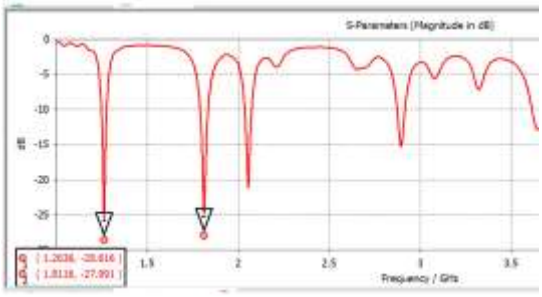

Figure -3: Reflection coefficient

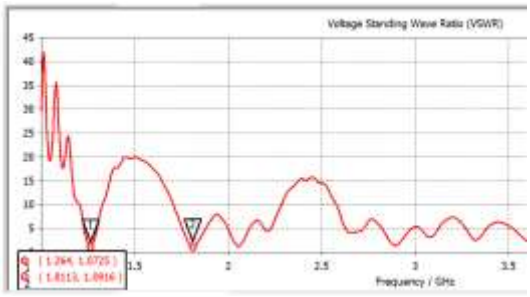

Figure -4: Voltage standing wave ratio

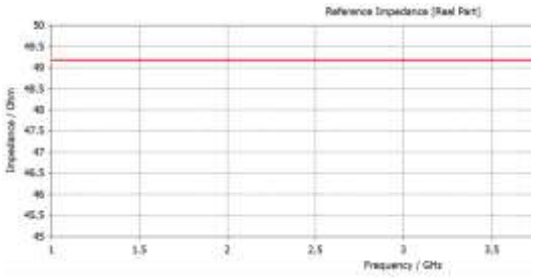

Figure -5: Characteristics impedance

RESULTS AND CONCLUSION:

The simulated designed antenna is performed on CST software. Its result is obtained at the range of 0-8 GHz for transmission line fading. The reflection coefficient of transmission line feeding is -28.616 dB and the value of VSWR is 1.0725.

REFERENCES:

[1] B.K. Kumar, P.V.V. Kishore, K. Kumar Naik, Senior Member, IEEE, "Design of Rectangular Patch Antenna with X-slots for Wireless Communications," 2018 ICICCT, 20-21 April, Coimbatore, India, 2018.

[2] Constantaine A Balanis, Antenna Theory, Analysis and Design, Third Edition, John Wiley & Sons.

[3] X.Cheng, J. Shi, J. Kim, C. Kim, David E. Senior and Yong-Kyu Yoon, "A Compact Self-Packaged Patch Antenna Folded in Rectangular Waveguide Shape, " 2011 IEEE, 3-8 July, Spokane, WA, USA, 2011.

[4] Sarkar, I., P. P. Sarkar, and S. K. Chowdhury, "A new compact printed antenna for mobile communication," 2009 Loughborough Antennas & Propagation

Conference, Loughborough, UK, November 16–17, 2009.

[5] James, J.R. and Hall, P.S.: "Handbook of Micro strip Antennas"

[6] Dr. Y. Bhomia , Dr.V. Gupta , A. Bhardwaj , N. Akhtar, " To Design and Simulate Microstrip Patch Antenna by Line Feed, " 2017 ICECTA, 21-23 Nov., Ras Al Khaimah, United Arab Emirates, 2017.

[7] M. K. Taher A1-Nuaimi and William G. Whittow "On The Miniaturization of Microstrip Line-Fed Slot Antenna Using Various Slots," Final author version. IEEE Loughborough Antennas and Propagation Conference (LAPC), Loughborough, UK, 2011.

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

[9] H. Werfelli, K. Tayari, M. Chaoui, M. Lahiani, H. Ghariani, "Design of Rectangular Microstrip Patch Antenna," 2016 ATSIP, 21-23 March, Monastir, Tunisia 201