Scientific Journal Impact Factor (SJIF) : 3.518
International Journal of Modern Trends in Engineering and Research
ISSN (ONLINE) : 2349 - 9745 ISSN (PRINT) : 2393 - 8161

PERFORMANCE ANALYSIS OF SQUARE SHAPED MICROSTRIP PATCH ANTENNA FOR S BAND APPLICATION

Pradeep Kumar Sharma[1], Ritesh Saraswat[2] and Jitendra Jangir[3]
[1]*Sr. Assistant Professor, Jodhpur Institute of Engineering & Technology, Mogra, Jodhpur, India*
[2]*Associate Professor ,, Jodhpur Institute of Engineering & Technology, Mogra, Jodhpur, India*
[3]*Department of ECE, Assistant Professor, Jodhpur Institute of Engineering & Technology, Mogra, Jodhpur, India*

Abstract—Microstrip patch antenna is a narrowband and wide beam antenna which is generally fabricated by etching process in which the antenna element pattern will be bonded with metal trace to an insulating dielectric surface. For forming the ground plane on the other side, there will be continuous metal layer bonded with substrate. Microstrip antenna has square, rectangular, circular, elliptical and annular ring which are general shapes. In this paper we have studied the effect of antenna dimensions Length (L), and substrate parameters relative Dielectric constant (ε_r) on the Radiation parameters of Bandwidth and Return Loss. For this purpose, CST platform has been used. The frequency band 2-4 GHz is assigned as S band which is used in the applications such as satellite, Wi-Fi, Bluetooth ,cellular phones etc. The proposed method has been applied on the square Microstrip patch antenna and conclusions have been drawn on the frequency of 3.055 GHz on which the antenna has been tuned. The results have been shown for antenna in simulated manner as well as practical results.

Key words- Band width, Radiation, Return Loss.

I. INTRODUCTION

Microstrip antennas are attractive due to their light weight, conformability and low cost. A microstrip patch antenna consists of conducting patch on a ground plane which is separated by dielectric substrate. [1][2] But this concept was undeveloped till the revolution in electronic circuit miniaturization and large-scale integration in 1970. After that there were so many authors who have described the radiation from the ground plane by a dielectric substrate for different configurations. The work which was done by Munson on micro strip antennas for use as a low profile flush mounted antennas on rockets and missiles represented that this was a practical concept for use in many antenna system problems. After that various mathematical models were developed for this antenna and its applications were realized to many other fields. Its importance can be seen by counting the number of papers, articles published in the journals for the last ten years show the importance gained by this antenna. The micro strip antennas are considered as the present day antenna designer's choice.

II. DESIGNING

As we are going to deal with the square shaped microstrip patch antenna in this paper, so we must have the knowledge about the designing equations which will be used while designing them. The designing equations consist of the variation in the width and length of the antenna.

The proposed length l = 23 mm, w = 31 mm designed on FR4-epoxy substrate with relative permittivity = 4.4 and thickness h =0.8 mm. This square patch antenna has been resonated at 3.055 GHz frequency.

It also has the use of permittivity which plays an important role in the designing of the antenna.

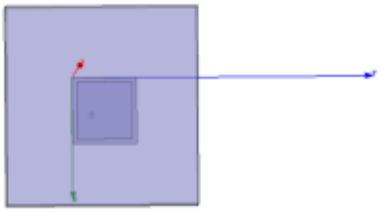

Figure 1 Square Shaped Microstrip patch

The value of L for Square shaped Microstrip patch antenna will be calculated by the use of transmission line model equation:

$$L = \frac{c}{2fo\sqrt{\varepsilon_r}}$$

The effective dielectric constant can be given by the equation as:

$$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{(\varepsilon_r-1)}{2}(1 + 12h\backslash w)^{-½}$$

III. RESULTS

The results have been obtained for this antenna both on simulation basis and practical basis. For simulation CST platform has been used and for the practical results vector network analyzer has been used.

Square Patch Resonance Frequency:

The figure 2 below is representing the value of parameter S_{11} as it is called reflection parameter. Since we know that S parameters are preferred at the high frequency analysis because

(i) At high frequency Z, Y, h parameter become complex in nature.

(ii) It is difficult to obtain short and open circuit condition at high frequency that is why we use s parameters at high frequency because in S parameters we utilize the condition of matching the impedance. In the figure given below at the 3.055 GHz frequency, S_{11} has been obtained as -27.26507 dB.

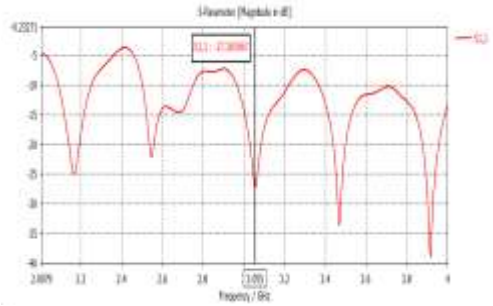

Figure 2 Resonance Frequency of Square Shaped Microstrip Patch Antenna

S Parameter Value:

The figure 3 below is representing the variation of S parameter as we are changing the frequency. As we know that we prefer the value of magnitude which is below -10 dB in magnitude. Since we know that the return loss also depends upon the value of S_{11} parameter. The return loss is defined as the loss of signal power due to discontinuity in the transmission line or the optical fiber. It also refers to that part of the signal which cannot be absorbed by the end of transmission line.S_{11} has been obtained as -27.26507 dB.

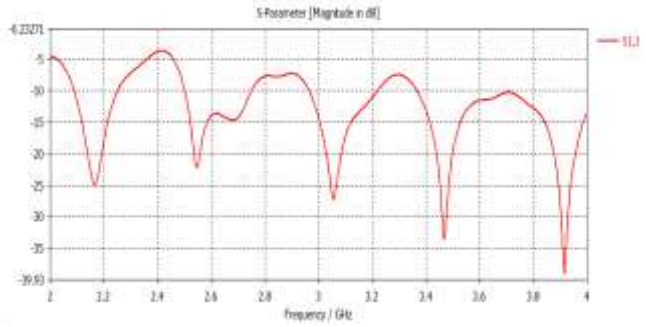

Figure 3 S Parameter Value of Square Shaped Microstrip Patch Antenna

Bandwidth:

As we know the value of bandwidth plays an important role in determining the efficiency of any device. The bandwidth of the antenna depends on various parameters such as shape of the patch, resonant frequency, dielectric constant and thickness of the substrate which has been used for the designing of the patch. If we want enhance the bandwidth than we will have to improve the impedance bandwidth of the antenna element. So the figure 4 is representing the value of bandwidth around my frequency of interest at which square patch antenna has been resonated. From the figure the value of bandwidth is 0.25237 GHz.

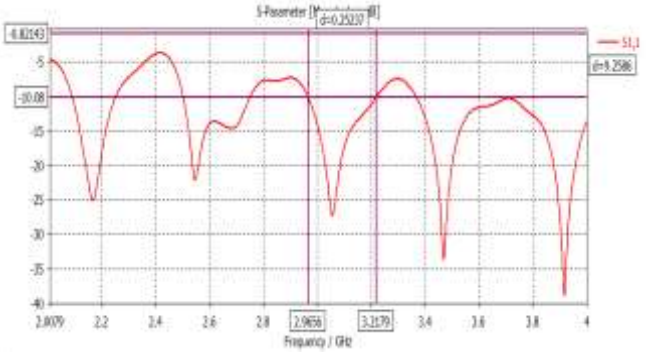

Figure 4 Bandwidth of Square Shaped Microstrip Patch Antenna

Practical Result:

Square Shaped Microstrip Patch Antenna:

The result which has been shown in the figure 5 is the result obtained from network analyzer. This result shows that the value of S_{11} parameter is around -17.78325461 dB at frequency of nearly 3.15710696 GHz. By seeing this response we can easily see that there is a difference between the results obtained practically and by simulation.

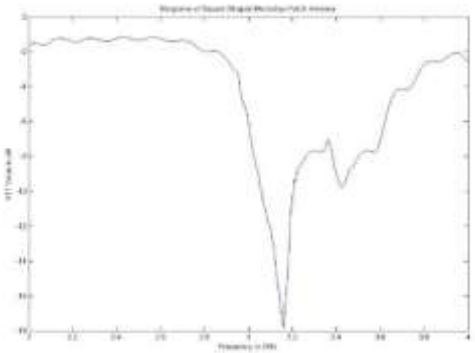

Figure 5 Response of Square Shaped Microstrip Patch Antenna

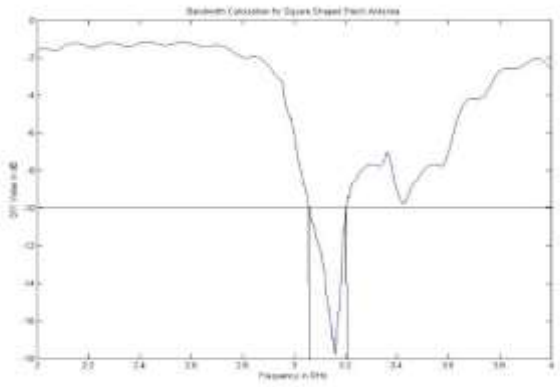

Figure 6 Bandwidth of Square Shaped Microstrip Patch Antenna

The figure 6 is giving information about the bandwidth of Square shaped microstrip patch antenna and the value of bandwidth for this antenna is around 0.156210 GHz. As we know that higher the bandwidth better will be for the antenna analysis.

Table 1: Representing the Values for Square Shaped Microstrip Patch Antenna

S. No.	Parameters	Simulation Based Value	Practical Value
1	S_{11}	-27.26507 dB	-17.78325461dB
2	Bandwidth	0.25237 GHz	0.156210 GHz

IV. ACKNOWLEDGMENT

We are thankful to Mr.Lalit Panwar Scientist 'D', Defence Lab, Jodhpur and Mr. Raj Kumar Jani, Scientist 'D', Defence Lab, Jodhpur for providing their guidance, inspiration and innovative technical discussions whenever required.

V. CONCLUSION

The practical result has been obtained with the help of Vector Network Analyzer. These results are also indicating the behavior of this antenna and we can conclude from the practically obtained result is that there is a variation in both the result.

As from the result we can conclude that:

(a) Impact of Shape on Return Loss:

Based on the value of return loss which is -27.26507 dB for the Square shaped microstrip patch antenna we can say that the value of return loss can be reduced by proper selection of material and shape of the antenna.

(b) Impact of Shape on Bandwidth:

The Square Shape Microstrip Patch antenna is having bandwidth which may be increased by proper tuning and designing of the antenna.

REFERENCES

[1] Sanjeev Sharma, Bharat Bhushan, Shailender Gupta and Preet Kaur, "Performance Comparison of Micro-strip Antennas with Different Shape of the Patch", International Journal of u- and e- Service, Science and Technology Vol. 6, No. 3, June, 2013.

[2] V. Saidulu, K. Srinivasa Rao, P.V.D. Somasekhar Rao, "The Characteristics of Rectangular and Square Patch Antennas with Superstrate", International Journal of Engineering Sciences & Emerging Technologies, ISSN: 2231 – 6604 Volume 6, Issue 3, pp: 298-307 ©IJESET, Dec. 2013.

[3] D. Rakesh, P. Rakesh Kumar, Prof. Habibulla Khan, K. CH. Sri Kavya, B.T.P. Madhav, K. Prabhu Kumar, S BalaDurga Prasad, "Performance Evaluation of Microstrip Square Patch Antenna on Different Substrate Materials", Journal of Theoretical and Applied Information Technology, ISSN: 1992-8645, E-ISSN: 1817-3195, Vol.26 No.2, April 2011.
[4] Mr. Sandeep Kumar, Mr. Subodh Kumar Tripathi, Mr. Nitin Kumar, Mr. Rachit Aggarwal, "Design of Microstrip Square-Patch Antenna for Improved Bandwidth and Directive Gain", International Journal of Engineering Research and Applications (IJERA), ISSN: 2248-9622 www.ijera.com VOL. 2, ISSUE 2, PP.441-444, MAR-APR 2012.
[5] Harvesh Singh Panwar, Firoz Khan, Puneet Khanna, "Design & Analysis of Square Microstrip Patch Antenna", International Journal of Recent Technology and Engineering (IJRTE), ISSN: 2277-3878, Volume-2, Issue-3, and July 2013.
[6] Yogesh Kumar Gupta, R. L. Yadava, R. K. Yadav, "Performance Analysis of 2.3 GHz Microstrip Square Antenna Using ADS", International Journal of Research in Management, Science & Technology, (E-ISSN: 2321-3264) Vol. 1; No. 2, December 2013.
[7] V.R. Anitha, and S. Narayana Reddy, "Design of an 8X1 Square Microstrip Patch Antenna Array", International Journal of Electronic Engineering Research, Volume 1 Number 1 pp. 71-77, Research India Publications, 2009.
[8] P.K.Singhal, BhawanaDhaniram, and Smita Banerjee, "A Stacked Square Patch Slotted Broadband Microstrip Antenna", Journals of Microwaves and Optoelectronics, Vol. 3, No. 2, August 2003.
[9] N.MohamedSabidhaBanu, Dr.M. RamkumarPrabhu, U.T. Sasikala, "Design A Square Microstrip Patch Antenna for S-Band Application", IOSR Journal of Electronics and Communication Engineering (IOSR-JECE), e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 10, Issue 2, Ver. ,PP 24-30, Mar - Apr.2015.
[10] PriyaUpadhyay, Richa Sharma, "Design and Study of Inset Feed Square Microstrip Patch Antenna for S-Band Application", International Journal of Application or Innovation in Engineering & Management (IJAIEM),Volume 2, Issue 1, ISSN 2319 – 4847, January 2013.
[11] AmriteshKshetrimayum, Milan Singh, "Design of Square Patch Microstrip Antenna for Circular Polarization Using IE3D Software".
[12] SatyaprakashTignath, Laxmi Srivastava, Devdutt Sharma, "Triple Band Square Patch Antenna", Current Research in Engineering, Science and Technology (CREST) Journals, ISSN 2320-706X.

