Communications on Applied Electronics (CAE) – ISSN : 2394-4714
Foundation of Computer Science FCS, New York, USA
Volume 6 – No.5, December 2016 – www.caeaccess.org

Comparison of Microstrip Antenna

Nazahat Jahan Balur
Department of Electronics & Telecommunication Engineering
Rajiv Gandhi Institute of Technology
Mumbai

ABSTRACT

The numerous advantages of microstrip patch antennas have made them a great choice for various wireless communication applications. These antennas can be designed using IE3D and HFSS software's. The software used for this antenna design is IE3D as its faster comparatively. The designed antenna simulated results has been compared with the implemented antenna results and has been compared with the other simulated multiband antenna. This antenna has a basic feed which is coaxial type.

Keywords

IE3D, HFSS, micro strip, patch, antenna, return loss.

1. INTRODUCTION

The antenna designed for frequency of 2.4GHz which is basically an ISM band. Comparison of implemented antenna has been made for parameters like characteristic impedance (Zo), voltage standing wave ratio (VSWR) and return loss (S11) with simulated antenna. These patch antennas have some unique features like providing both circular and linear polarizations, inexpensive and can be easily fabricated, compatible with micrometer and millimeter integrated circuits. These antennas operate at GHz frequency range applications for example satellite communications, wireless local area network applications, command and control, etc. Although these are having some disadvantages, its used in numerous applications because of low cost and low weight.

Important parameter of any antenna is the bandwidth. As the substrate thickness increases bandwidth increases However, increasing the substrate thickness lowers the quality factor of the cavity, which increases spurious radiation from the feed, as well as excitation of higher order modes in the patch. Also, it becomes difficult to match when feeding with a coaxial probe, since a thicker substrate results in a larger probe inductance appearing in series with the patch impedance. However, efforts has been done to improve the bandwidth of the microstrip antenna, by using alternative feeding schemes [1]. Another way of improving bandwidth is by adding U slot in the patch, slots provide tunability in frequency, if resonant frequency of patch and slots are close then it may lead to wider bandwidth hence multiband operation can be obtained. Slots have capacitive effect which cancels out inductive effect of coaxial probe feed [2]. In addition, slots are advantageous then shorting pins used in MSA, as shorting pins leads to poor gain and degradation of radiation pattern [2-3].

2. SIMULATED ANTENNA

For the coaxial feed the center of patch is taken as origin. The feed point must be located at that point on the patch, where the input impedance is 50Ω for the resonant frequency, which can be determined by trial and error basis [4].

Common techniques used for broad banding and surface area minimization are thick substrate, U slot, L probe feed, further a dual band antenna is a better option for broadband microstrip antenna (MSA). Dual resonance is obtained by cutting the square slot in the patch [5]. Dual band operation is also obtained by using two U shaped slots. In comparable to stacked patch antenna U-slot antenna is used for high frequency operation (3GHz) as stacked patch antenna has increased thickness and issues aligning various layers precisely. The results of U-slot antenna are better than stacked antenna, this can be achieved by varying slot dimensions [6].

In this, a simple technique to design and simulate multiband resonance antenna is used by loading U-slot and square slots in the patch with simple coaxial feed [7]. This has been designed to reduce the overall size and weight of the antenna, which eases installation and to achieve antenna operation in S band and C band with an improved bandwidth. Comparison of simulated results [7] with implemented results for single band has been shown along with comparison of the results of results [7] with the results [8] has been analyzed. The antenna has been designed with inset feed for four frequency band operation [8].

3. COMPARISOIN OF ANTENNAS

3.1 Simulated and Implemented Antenna Comparison

The simulated antenna for multiband operation has been implemented and tested using network analyzer of 3 GHz. Figures below shows different parameters of antenna which was experimentally measured using network analyzer. Figure1 shows the VSWR Vs Frequency graph in which VSWR at 2.23GHz is 1.3. Figure2 shows implemented impedance graph with respect to frequency in GHz, as seen impedance at 2.23GHz is 47Ω, which is close to standard 50Ω coaxial connector. Figure3 shows the reflection co-efficient parameter, as seen the S_{11} coefficient at 2.23GHz is -33dB, which is also very close to simulated result [7]. Figure 4 shows VSWR circles on smith chart which was obtained in network analyzer.

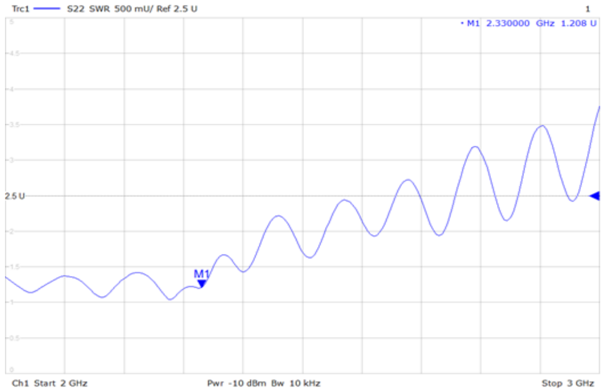

Figure 1. Voltage Standing Wave Ratio Vs Frequency Plot Experimentally

Communications on Applied Electronics (CAE) – ISSN : 2394-4714
Foundation of Computer Science FCS, New York, USA
Volume 6 – No.5, December 2016 – www.caeaccess.org

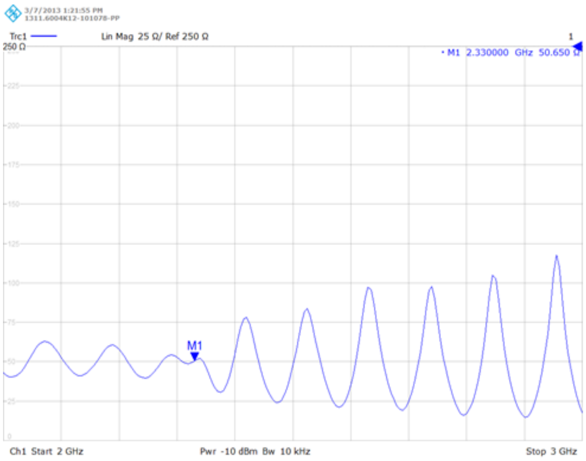

Figure 2 Characteristic Impedance (Zo) Vs Frequency Plot Experimentally

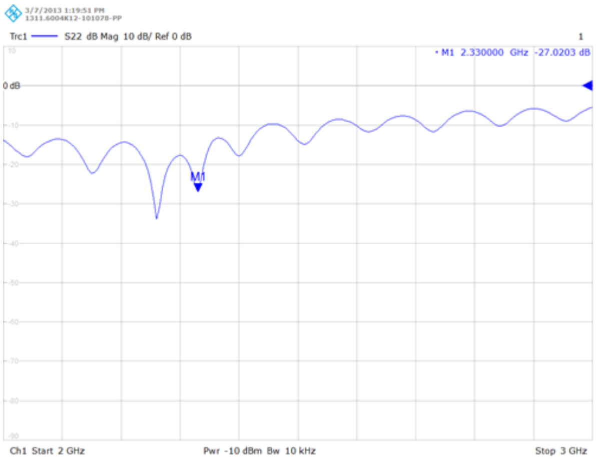

Figure 3. Reflection Coefficient (S_{11}) Vs Frequency Plot Experimentally

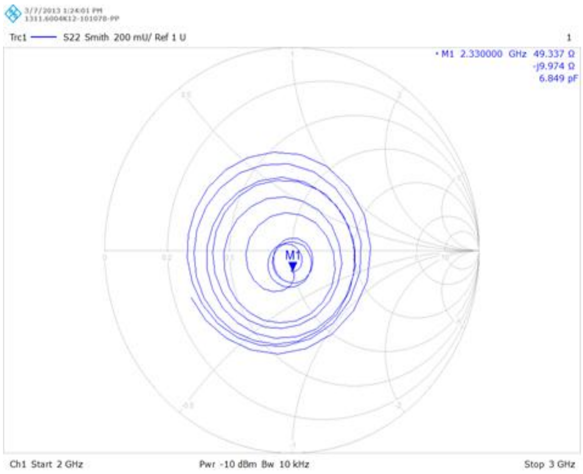

Figure 4. Voltage Standing Wave Ratio circles on Smith Chart Experimentally

As seen the all the above mentioned implemented parameters are in close agreement with the simulated results. The antenna was simulated from 2GHz to 6GHz frequency range, but the implemented antenna was tested experimentally for frequency range of 2GHz to 3 GHz, using vector network analyzer of 3GHz bandwidth, Table1 below lists the simulated and implemented experimental results in 2 to 3GHz frequency range.

Table 1. Lists the comparison between simulated and experimented results.

Antenna/Parameter's at 2.23 GHz	RL in dB	VSWR	Zo in Ω
Simulated using IE3D [7]	-30.6	1.06	48.6
Fabricated (Tested Experimentally)	-33	1.3	47.5

3.2 Simulated and Reference Antenna Comparison

The multiple slots loaded rectangular microstrip antenna with multiple frequency operation, with moderate bandwidth and linear polarization have been simulated and implemented for S band and C band applications [7]. The results of the rectangular patch antenna viz. the return loss, VSWR plot, antenna efficiency, radiation efficiency shows effectiveness of the design with the moderate gain and directivity. The simple design presented here has been implemented using coax-feed microstrip antennas to radiate in a good multi band mode. Increase in bandwidth in all bands can be achieved by varying substrate thickness, length and width of the slots. The implemented experimental results are closely agreeing with the simulated results [7].

Table 2 below compares the simulated antenna results [7] with results [8] in terms of bandwidth.

Table 2. Comparison of proposed Antenna with reference

Text	RL in dB	BW in MHz	resonating bands	fo in GHz	Type of substrate	Type of Feed
Proposed antenna design simulated results [7]	-30.06 -21.657 -20.33 -16.975	49.83 49.51 71.2 52.91	4	2.23 4.1 4.8 5.46	Fiber glass epoxy (h= 1.56 mm)	Coa xial prob e feed
A Com pact L-slit Microstrip antenna for GSM, Bluetooth, Wi-MAX & WLAN Appli- -cations [8]	-29 -14 -15 -29	10 15.1 35.1 56.1	4	1.85 2.4 3.44 4.31	Epoxy (h= 1.58m m)	Inset feed

It's been noted from Table2 results that the proposed antenna [7] giving the improved results comparable to [8] in terms of return loss and bandwidth for four resonating frequencies with the simplest type of feed.

By placing co-axial feed diagonally, circularly polarized multiband antenna can be achieved which is more advantageous then linear polarization. Also, an array can be implemented using this microstrip antenna by using proper feeding techniques, as arrays has advantage of improved directivity and hence enhanced gain.

4. ACKNOWLEDGMENTS

I have great pleasure in presenting this paper on “Comparison of Microstrip Antenna". I take this opportunity to express my sincere thanks to the Dr. U.V. Bhosle, Principal RGIT, Mumbai, for providing the guidelines, support, encouragement and the suggestions in my work.

I thank Prof. K.G. Sawarkar, Head of Dept. of Electronics and Telecommunication Engineering at RGIT, Mumbai for being very encouraging during the progress meetings.

I wish to express my deep gratitude to all my colleagues at RGIT, Mumbai for their encouragement and support.

I thank Mr. Ashfaque Anees for his helpful suggestions and encouragement. Finally, I extend my special thanks to Nisa Anees for her cooperation during my research work.

5. REFERENCES

[1] K.P. Ray and Girish Kumar: “Broadband Microstrip Antennas, Artech House Antennas and Propagation Library”. 2003.

[2] Balanis: “Antenna Theory Analysis and Design”, John Wiley and sons, Inc, 2nd edition

[3] William F. Croswell: “Slot Antennas”, The McGraw-Hill Companies, Copyright 2007

[4] Kin-Lu Wangl: “Compact and Broadband Microstrip Antenna”, John Wiley and sons, Inc, copyright 2002

[5] Ramesh garg, Prakash Bharatia: “Microstrip Antenna Design Handbook”, Artech House, copyright 2001, Boston London.

[6] Vedaprabhu and K.J. Vinoy: “A Double U-slot Patch Antenna with Dual Wide Band Characteristics”, IEEE Trans Antenna and Propagation 2010.

[7] Nazahat Jahan Balur, Prof. Sukanya Kulkarni, “Design of Multiband Microstrip Antenna”, International Journal of Advance Research in Computer Science and Electronics Engineering(IJARCSEE), Vol 1, Issue 1, March 2012, ISSN:2277-9043.

[8] Barun Mazumdar: “A Compact L-slit Microstrip antenna for GSM, Bluetooth, WiMAX & WLAN Applications”, International Journal of Engineering Research and Applications(IJERA), Vol. 2, Issue 5, September-October 2012, pp.687-691.