Scientific Journal Impact Factor (SJIF): 1.711

e-ISSN: 2349-9745
p-ISSN: 2393-8161

International Journal of Modern Trends in Engineering and Research
www.ijmter.com

Design of Square Miniaturized L Band Fractal Antenna

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Abstract: This paper introduces a new square patch miniaturized antenna operating in L band. The design and analysis of the antenna is executed using IE3D electromagnetic simulation software using substrate parameter of glass epoxy FR-4 substrate. In this paper, a Square patch of 10X10 mm^2 is investigated. In further improvements, parts of the patch are removed in two iterations to obtain a miniaturized antenna. The proposed fractal antenna has a great potential of application and gives a stable radiation performance in the frequency range of 1.333 GHz to 2 GHz**.**

Keywords: L band, fractal antenna.

I. INTRODUCTION

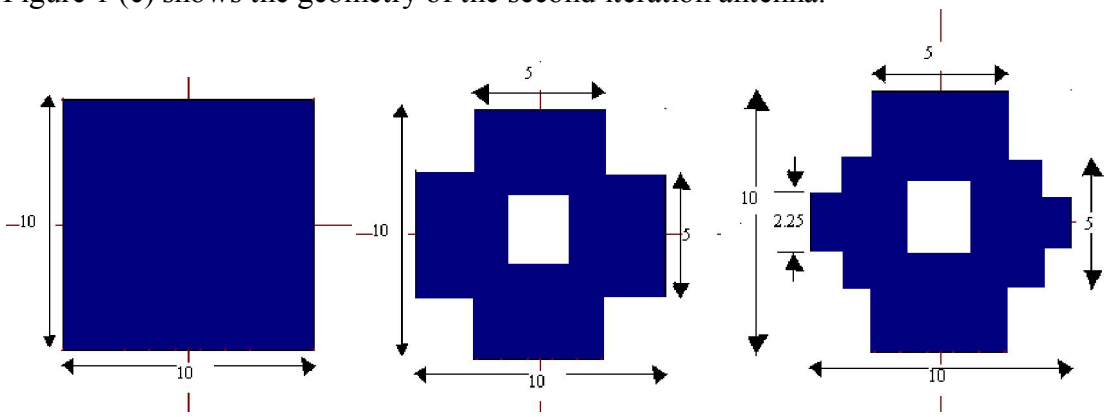
Microstrip patch antennas are used in a broad range of applications from communication systems to biomedical systems, because of its several attractive properties such as small size, low-cost fabrication, low profile, robustness, simplicity, light weight, ease of production, conformability, ease of installation and integration with feed networks. [1-2]However, despite of all these advantageous properties, two most serious limitations of the microstrip antennas are its low gain and narrow bandwidth as it limits the frequency ranges over which the antenna can perform satisfactorily. [3-4]Owing to miniaturization of communication equipments, antenna designs with reduced size received much attention. The size reduction, together with gain and bandwidth enhancement is becoming major design considerations for most practical applications of microstrip antennas for wireless communication.[6] The bandwidth can be improved by various methods like adding slots into the patch, increasing the substrate height, decreasing of substrate [5], associating several patch elements to form an array antenna [7], introducing a capacitive coupling between the radiating element and the ground plane, modifying the shape of radiating element and adding a shorting pin [8].

In this paper, a miniaturized microstrip patch antenna with microstrip line inset feed arrangement especially for aeronautical and amateur use is designed. The proposed antenna has a frequency bandwidth of about 666 MHz (1.333-2 GHz) at -10 dB return loss with 50-Ω system impedance which is sufficient to make the antenna useful for 1.4-2 GHz radar bands, TV and FM radio bands and a variety of satellite communication purposes.

II.ANTENNA GEOMETRY

Figure 1(a) shows the 3-D view of the Square patch antenna. The substrate used has a dielectric constant of 4.4 with a loss tangent of 0.0024 and thickness of 1.524 mm. This antenna is excited by a microstrip feed line. In the first iteration to size reduction a square (2.5 X 2.5 mm^2) is cut from the patch one from each corner and one from center. Figure 1(b) shows the geometry of the first iteration

antenna. In the second iteration a further square (1.25 X 1.25 mm^2) is cut from the corners of two edges. Figure 1 (c) shows the geometry of the second iteration antenna.



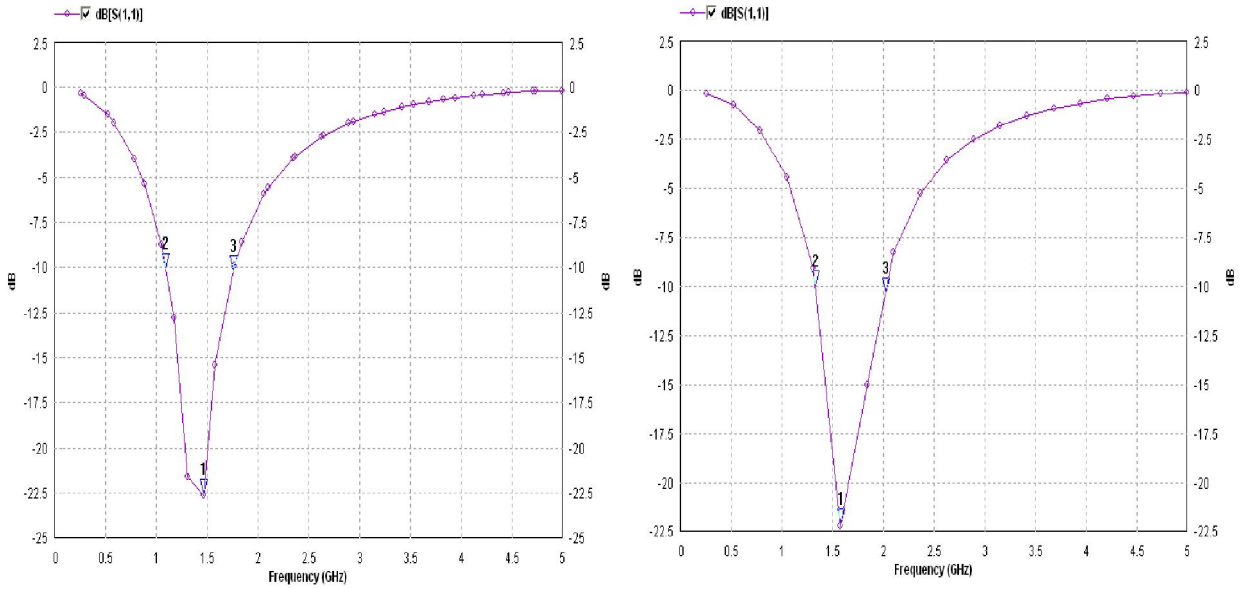
(a) (b) (c)

Figure 1 (a) Square patch antenna (b) First iteration (c) Second iteration

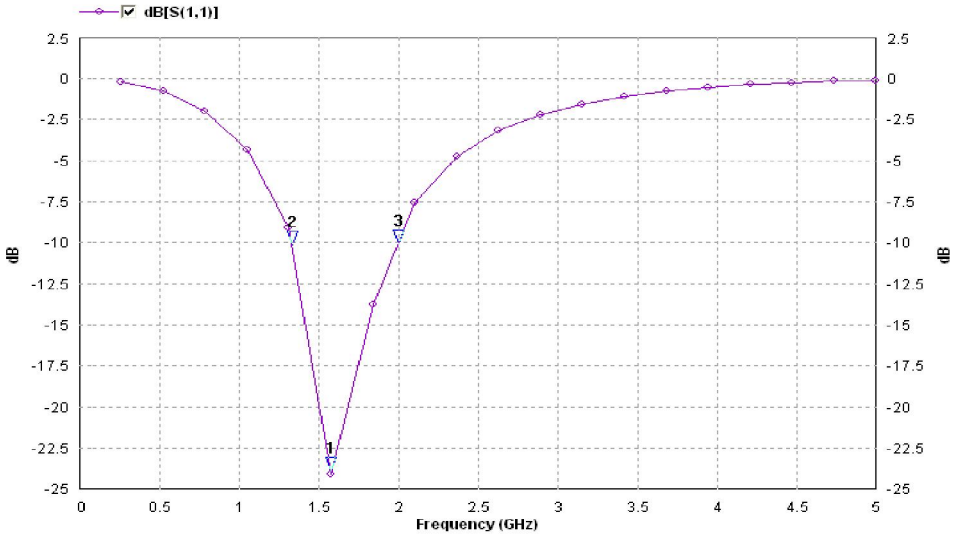
Instead of proficient in covering a wideband frequency, the proposed antenna is clearly small compared to the conventional Square antenna.

III.SIMULATED RESULT

The proposed microstrip patch antenna has been optimized by using commercially available EM simulator named Zeland IE3D. The simulated return loss results for square patch, fist and second iteration are shown in Figure 2(a), (b) and (c) respectively.



(a) (b)



(c)

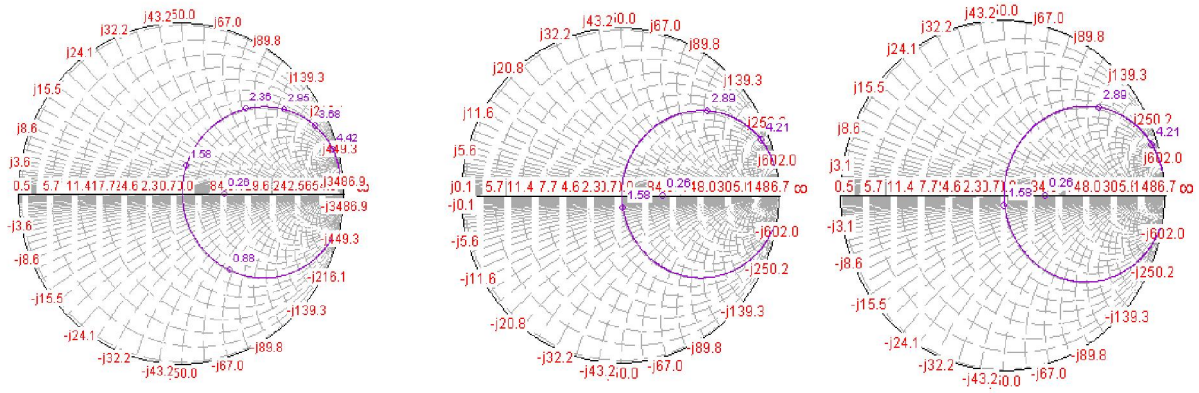
Figure 2 Return Loss Graph for (a) square patch (b) first iteration (c) second iteration

The simulated impedance bandwidth at -10 dB return loss is summarized in Table 1.

Table 1 Summary of resonance characteristics

Shape	Bandwidth (MHz, %)	Resonant frequency, f_r (MHz)
Square Patch	666, 45	1466.66
First Iteration	691.7, 43.6	1583.33
Second Iteration	666.7, 42.3	1575

The band thus obtained covers 1.333 - 2 GHz radar bands, TV and FM radio bands and a variety of satellite communication purposes. The achieved antenna impedance is approximately equal to 50 ohm which is evident from the Smith chart shown by figure 3 (a), (b) and (c).



(a) (b) (c)

Figure 3 Smith Chart for (a) square patch (b) first iteration (c) second iteration

IV.DISCUSSION AND CONCLUSION

A miniaturized microstrip patch antenna has been designed for FM radio and TV communication systems using Zeland IE3D software. The reflection coefficient is below −10 dB from 1.33 GHz to 2

GHz covering aeronautical and amateur uses, L band radar, TV and FM radio bands and a variety of satellite communication standards. With the simplicity of feeding, the investigated antenna is a good candidate for fabrication to be used for many communication applications. The antenna gives a stable radiation performance over the entire frequency band with a good impedance matching of 50 ohm. The results obtained with proposed geometry suggest that this antenna with little more improvements may be proved a useful geometry for modern communication systems.

REFERENCES

[1] J. Bahl and P. Bhartia, *Microstrip Antennas*, Artech House, Inc., London, 1980.
[2] C.A. Balanis, "Antenna Theory Analysis and Design", third edition, Wiley, New Jersey, 2005.
[3] K. L. Wong, Compact and Broadband Microstrip Antennas, John Wiley and Sons, Inc., New York, 2002.
[4] G. Kumar and K. P. Ray, Broadband Microstrip Antennas, Artech House Inc., Norwood, 2003.
[5] J. R. James and P. S. Hall, *Handbook of Microstrip Antennas*, Peter Peregronic Ltd., London, 1989.
[6] K. Singh, V. Grewal and R. Saxena, "Fractal Antennas: A Novel Miniaturization Technique for Wireless Communications", International Journal of Recent Trends in Engineering, Vol 2, No. 5, November 2009.
[7] W. F. Richards, S. E. Davidson, and S. A. Long, "Dual band reactively loaded microstrip antenna," *IEEE Trans. Ant. Prop.*, Vol. AP-33, No. 5, 556–561, 1985.
[8] S. E. Davidson, S. A. Long, and W. F. Richards, "Dual band microstrip antennas with monolithic reactive loading," *Elec.Letters*, Vol. 21, No. 20, 936–937, 1985.
[9] IE3D, Zeland Software, USA, www.zeland.com

