International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 12 • Issue 2 pp. 31-35 June - Dec 2020 www.csjournals.com

Self Complementary Rectangular Microstrip Antenna for Modern Communication Systems

Malipatil Shivashankar A[1] and Nagraj Kulkarni[2]
[1]Assistant Professor in Electronics, Sharanbasveshwar College of Sc., Kalaburgi, Karnataka, India
[2]Assistant Professor in Electronics, Government College, Kalaburgi, Karnataka, India
Principal Author e-mail:**malipatilsa@rediffmail.com**

Abstract: In this paper the self complementary rectangular microstrip slot antenna is presented for modern communication system. The antenna is housed in a volume of 5X3X0.16cm^3. The low cost modified glass epoxy substrate material is used for the fabrication of the antenna. The design concept is presented. The proposed antenna gives a maximum bandwidth of 23.36 GHz. The antenna shows broadside and linear radiation characteristics with a peak gain of 4.2dB in its operating range of frequency. The experimental and simulated results are compared. This antenna may find its applications in X-band range communication systems.
Key Words: Rectangular, bandwidth, gain, radiation pattern.

1. Introduction

In recent era the use of microstrip antenna in communication system has increased because of its inherent properties like light weight, loss cost, ease of installation, planar in configuration, etc. In modern communication systems the microstrip antenna has proved a good tool for effective communication. The use of dual, triple and multiband antennas are finding the wide applications in communication application for transmit/receive purposes(1-5). The antenna with radiating slots on the patch is designed to achieve dual and triple bands with better radiation characteristics. This kind of antenna is rarely found in the literature.

2. Design considerations

The AUTOCAD software is used to do the artwork of self complementary rectangular microstrip slot antenna (SCRMSA). The low cost modified glass epoxy substrate material of relative permittivity εr= 4.2 and loss tangent of 0.01 is used for the fabrication of the antenna. The antenna operates in X-band frequency range. The antenna uses a substrate of length L = 5 cm and width W= 3 cm. The horizontal slots of length L_s= 1.6 cm and width W_s= 0.2 cm are used on the top of the antenna. The microstripline feed of length L_f = 4.69 cm and width W_f = 0.9535 cm is used on the bottom side for exciting the antenna. The distance d and d` is maintained constant at 0.575 cm and 0.89 cm respectively to obtain better return loss. The separation between the slots is taken as D which act as the varying factor for the performance evaluation of the antenna. Figure -1 shows the structure of the SCRMSA

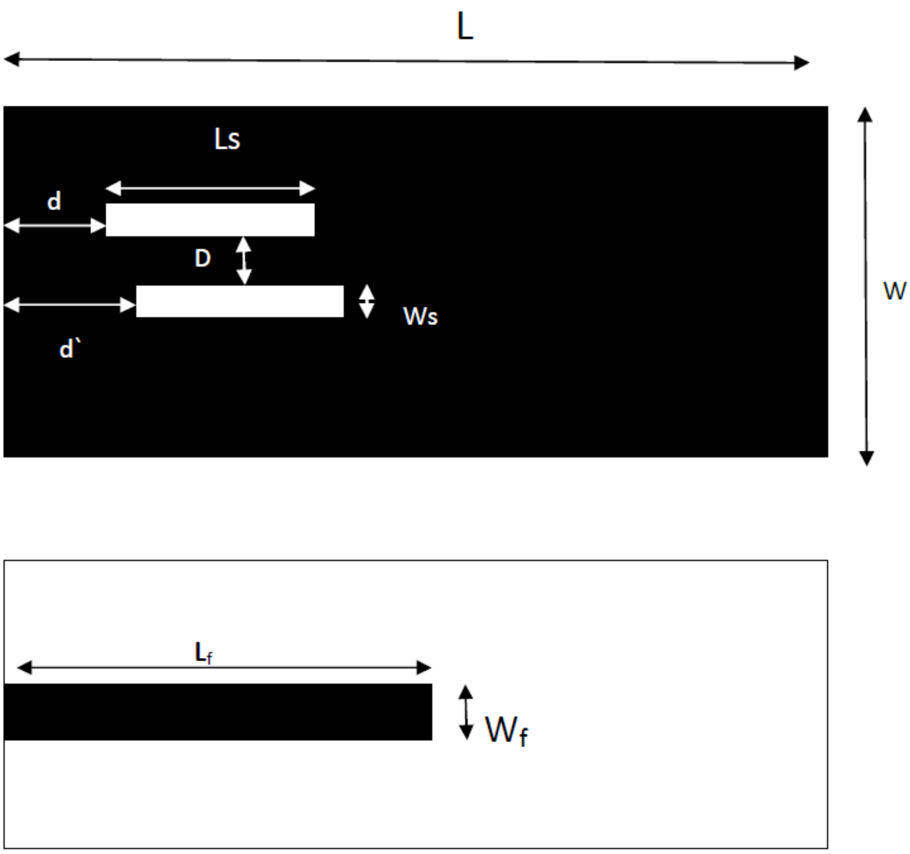

Figure-1 Structure of SCRMSA

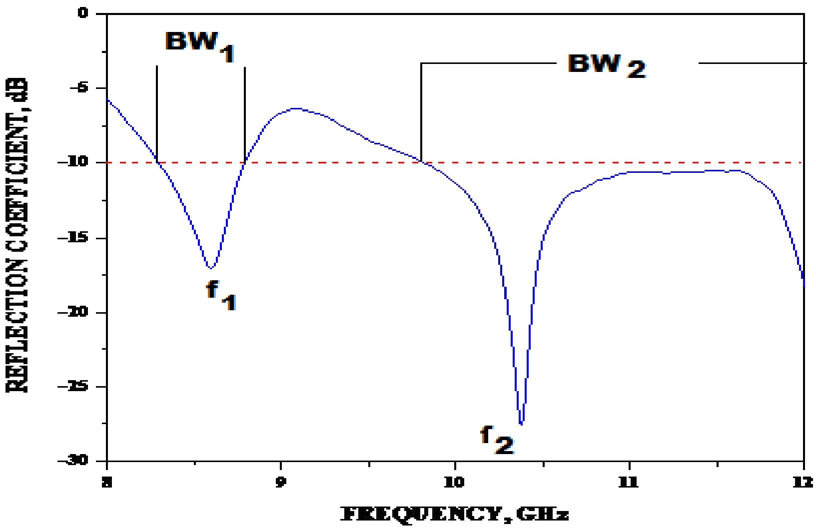

Figure-2 Variation of Return loss versus Frequency of SCRMSA when D=0.2cm

3. Result and Discussion

The Vector Network Analyser is used to measure the return loss and the Smith chart of the antenna. The HFSS software is used to simulate the SCRMSA.

From figure-2 it is clear that the antenna shows two resonant modes f_1 and f_2 with respective bandwidths BW_1 = 5.91% (8.8 GHz - 8.29 GHz) BW_2=20.29%(12 GHz - 9.79 GHz). The minimum reflection coefficient at both the resonance is found to be -17.028 and -26.722 dB respectively.

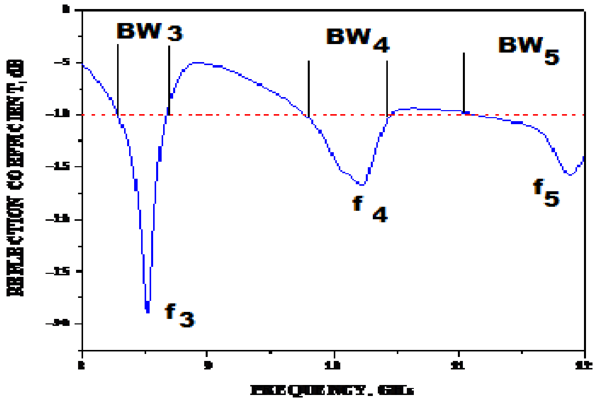

Figure-3 Variation of Return loss versus Frequency of SCRMSA when D=0.4cm

Figure-3 Shows the variation of return loss with frequency. It is clear from this figure that, the antenna shows three resonant modes f_3 , f_4 and f_5 with respective bandwidths BW_3 = 2.36 % (8.67 GHz - 8.27 GHz), BW_4 =7.51 %(10.46 GHz - 9.77 GHz) and BW_5= 9.79% (12 GHz-11.15GHz). The minimum reflection coefficient at each resonance is found to be -28.810, -16.738 and -15.767 dB respectively.

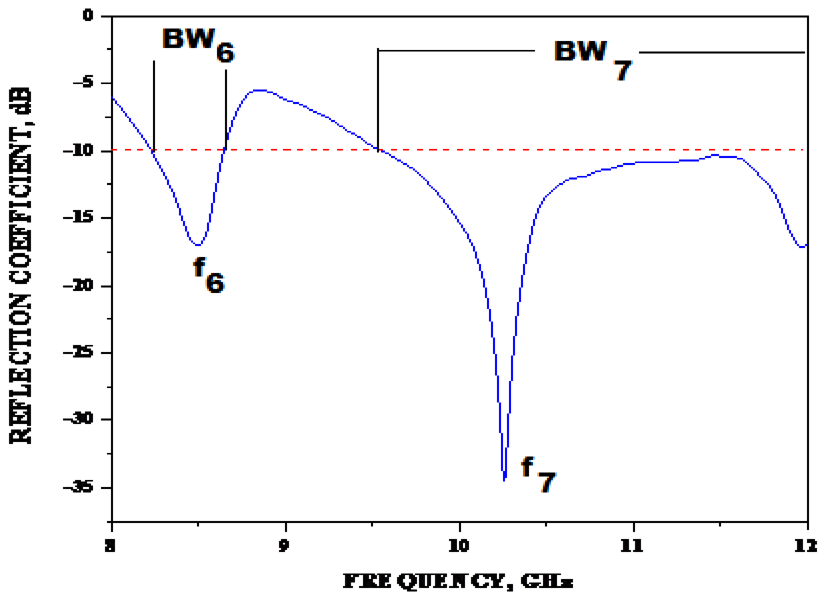

Figure-4 Variation of Return loss versus Frequency of SCRMSA when D=0.6cm

From figure-4 it is clear that, the antenna exhibits two resonant modes f_6 and f_7 with respective bandwidths BW_6 = 5.1 % (8.65 GHz - 8.22 GHz) and BW_7 =23.36 %(12 GHz - 9.52 GHz). The minimum reflection coefficient at both the resonance is found to be -17.028 and -26.722 dB respectively. The minimum reflection coefficient at both the resonance is found to be -17.041 and -34.543 dB respectively.

International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 12 • Issue 2 pp. 31-35 June - Dec 2020 www.csjournals.com

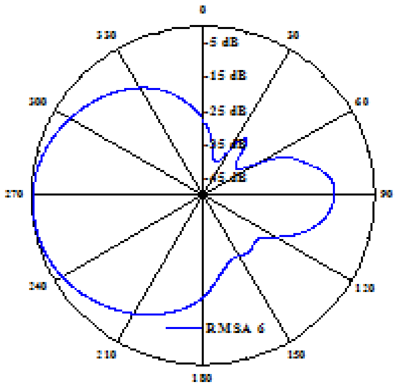

Figure-5 Radiation pattern of SCRMSA(D=0.2 cm)

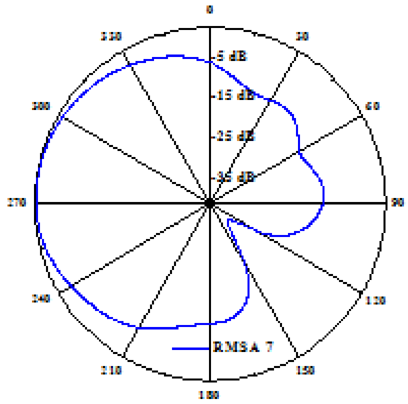

Figure-6 Radiation pattern of SCRMSA(D=0.4 cm)

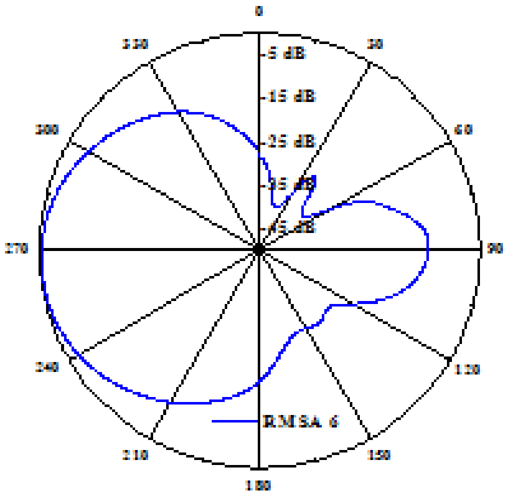

Figure-7 Radiation pattern of SCRMSA(D=0.6 cm)

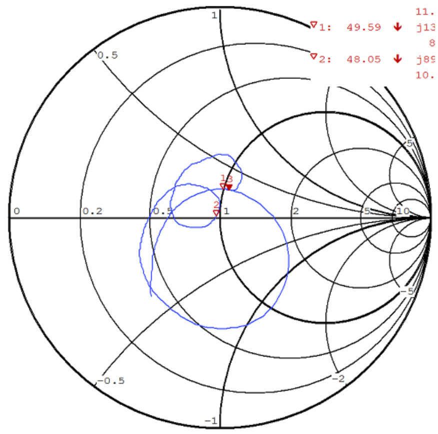

Figure-8 Smith Chart typical antenna

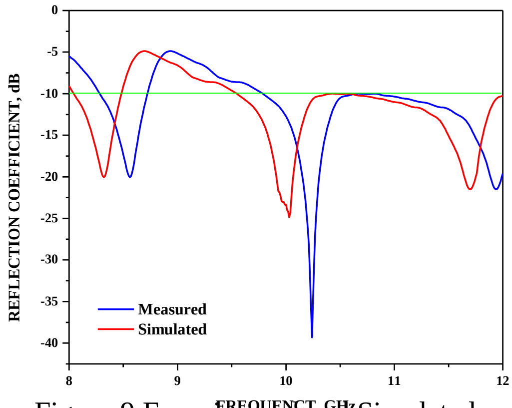

Figure-9 Experimental and Simulated results

Figure-10 Photograph of SCRMSA

Figures 5 to 7 show the radiation patterns of the proposed antenna in their operating frequencies it can be seen that, the patterns are broadside and linearly polarised with no side and back lobes. Figure – 8 shows the Smith chart of the typical antenna. From this figure it is clear that, the circles are concentrated at the centre of the graph which indicates the good impedance matching of the antenna. It is seen from Figure -9 that the experimental and simulated results are in good agreement with each other. Figure 10 shows the photograph of the SCRMSA.

4. Conclusion:

The proposed antennas are light weight and handy in nature. These antennas exhibit broadside and linearly polarised radiation patterns. The antenna operates in X-band of frequencies. The maximum bandwidth of 23.36 GHz and over all bandwidth of 74.32 GHz is obtained which is very useful in SAR and X-band communication systems.

References

[1] Constantine A. Balanis, Antenna Theory Analysis and Design, John Wiley and Sons, Inc., New York, 1982.
[2] I. J. Bhal and P. Bharatia, Microstrip Antennas, Dedham, MA: Artech House, 1981.
[3] David M. Pozar, Microwave Engineering, Addison Wesley Publishing Company, Inc. 1990.
[4] Kai Fong Lee and Wei Chen, Advances in Microstrip and Printed Antennas, Wiley-Interscience Publication, John Wiley and Sons, INC. New York 1997.
[5] K. D. Prasad, Antenna and Wave propagation, Satya Prakashan, New Delhi, 1993.
[6] K. C. Gupta, R. Garg and I. J. Bahl, Microstrip Lines and Slot Lines, Mass. Artech, House, 1997.
[7] M. Kulkarni, Microwave and Radar Engineering, Umesh Publications, 1998.
[8] John D. Kraus, Antennas, McGraw-Hill, Book Company, Inc., United States of America, 1950.
[9] Thomas S. Laverghetta, Microwave Materials and Fabrication Techniques, Artech Inc. USA, 1985.
[10] H.G. Booker, "Slot aerials and their relation to complementary wire aerials", J. IEE (London), Pt. III A, Vol. 93, pp. 620-626, 1946.