International Journal of Electronics and Communication Engineering and Technology (IJECET)
Volume 8, Issue 2, March - April 2017, pp. 32–35, Article ID: IJECET_08_02_005
Available online at
http://www.iaeme.com/IJECET/issues.asp?JType=IJECET&VType=8&IType=2
ISSN Print: 0976-6464 and ISSN Online: 0976-6472

TRIPLE BAND RECTANGULAR MICROSTRIP ANTENNA WITH CIRCULAR SLOT

Jagadevi Gudda
Research Scholar, Department of Applied Electronics,
Gulbarga University, Kalaburagi, Karnataka, India

Dr. P. M. Hadalgi
Professor, Department of Applied Electronics,
Gulbarga University, Kalaburagi, Karnataka, India

ABSTRACT

In this paper, a rectangular patch microstrip antenna with a circular slot on the ground plane has been designed and analyzed. By incorporating a circular shape defected ground structure (CS-DGS) into the ground plane of the rectangular patch, triple bands are obtained from 2.55 GHz to 5.57 GHz. A peak gain of 7.74 dB is achieved, retaining the nature of broadside radiation characteristics. The proposed antenna may find application in modern wireless communication systems.

Key words: CS-DGS, triple band, Gain, Radiation characteristics

Cite this Article: Jagadevi Gudda and Dr. P. M. Hadalgi, Triple Band Rectangular Microstrip Antenna with Circular Slot, *International Journal of Electronics and Communication Engineering and Technology*, 8(2), 2017, pp. 32–35.
http://www.iaeme.com/IJECET/issues.asp?JType=IJECET&VType=8&IType=2

1. INTRODUCTION

Recently there has been a growing demand of microwaves in various applications resulting in an interest to improve antenna performances. Wireless communication systems and instruments like wireless local area networks (WLAN), cellular phones etc. require small size, low cost, light weight antennas. The selection of microstrip antenna technology can fulfill these requirements [1-3]. Significant advances in the design of microstrip antennas have been presented over the last decades. Defected ground structure is one of the techniques used to reduce the antenna size [4]. From the literature, various design techniques using DGS have been found for Bluetooth and WLAN applications [5-6]. DGS is realized by inserting a shape defected on a ground plane of antennas. This defect disturbs the shield current distribution in the ground plane depending on dimension of the shape. This disturbance will influence the input inductance and capacitance of transmission line. DGS are widely used in modern communication system to make the system effective. Hence, in this paper a microstrip antenna with DGS technique is presented.

2. ANTENNA DESIGN

The top view and bottom view of circular slot on the ground plane of rectangular patch microstrip antenna (CSGPRPMA) is shown in Figure 1 and Figure 2 respectively. In Figure 1, the CS-DGS is drawn with dotted lines to indicate that it is located on the bottom of the substrate. The artwork of the proposed antenna is prepared by using Auto-CAD software to achieve better accuracy and is fabricated using low cost glass epoxy substrate material of area X x Y having thickness h = 0.16 cm and dielectric constant ε_r = 4.2. The circular slot with radius R = 0.5 cm is inserted on the ground plane of the rectangular patch of size L x W designed for the frequency of 3.2 GHz. A simple 50 Ω microstripline feed structure of length L_f and width W_f is used to excite the antenna at the center of the rectangular radiating patch. The quarter wavelength transformer of length L_t and width W_t is used to match the impedance between radiating patch and microstripline feed.

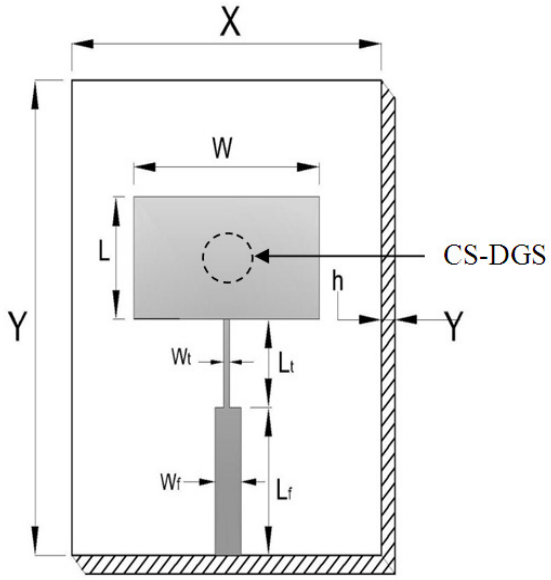

Figure 1 Top view of CSGPRPMA

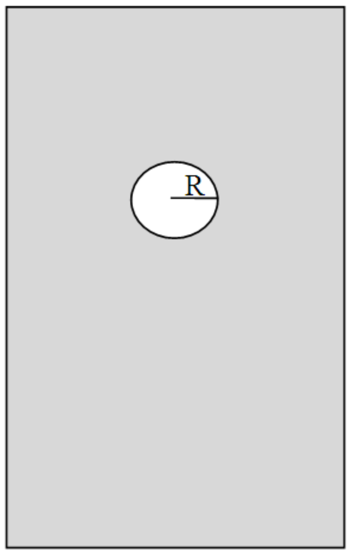

Figure 2 Bottom view of CSGPRPMA

The design parameters of the proposed antenna are listed in Table 1.

Table 1 Antenna design parameters

Antenna parameters	X	Y	L	W	L_f	W_f	L_t	W_t	R
Dimensions in cm	5.3	9.82	2.24	2.91	2.183	0.317	1.372	0.078	0.5

3. EXPERIMENTAL RESULTS

The simulation of the CSGPRPMA is carried out using High Frequency Structure Simulator (HFSS) software and Vector Network Analyzer (Rohde Schwarz, Germany make ZVK model 1127.8651) is used to measure the experimental return loss less than -10dB.

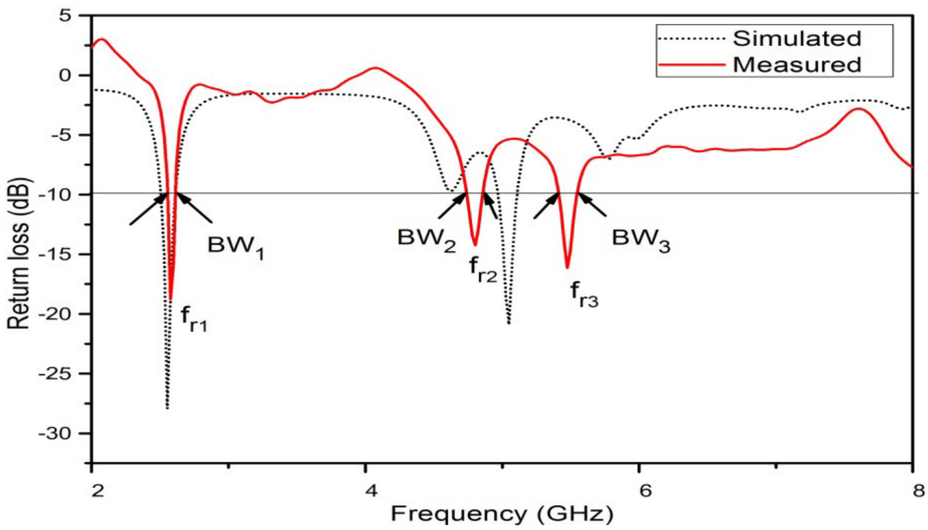

Figure 3 Return loss versus frequency of CSGPRPMA

Figure 3 shows the return loss versus frequency of CSGPRPMA. From this graph the experimental bandwidth (BW) is calculated using the formula,

$$\text{Impedance Bandwidth} = \text{BW}\ (\%) = \frac{f_H - f_l}{f_r} \times 100\% \qquad (1)$$

where f_L and f_H are the lower and upper cut-off frequencies respectively when their return loss reaches -10dB and f_r is the center frequency of the operating band. From this figure it is seen that the antenna resonates at three frequency bands f_1, f_2 and f_3 at 2.57 GHz, 4.8 GHz and 5.48 GHz respectively. The magnitude of experimental bandwidth calculated using the equation (1) is found to be BW_1 = 1.945 % , BW_2 = 2.7 % and BW_3 = 3.28 %. The first band BW_1 is due to the fundamental resonance of the patch and other bands BW_2 and BW_3 are due to circular slot on the ground plane of the rectangular patch. Further, it is noted that, by inserting circular slot on the ground plane, the virtual size reduction of 19.68% is achieved. The simulated result of proposed antenna is also shown in Figure 3. From the graph, it is observed that simulated and experimental results are in good agreement with each other.

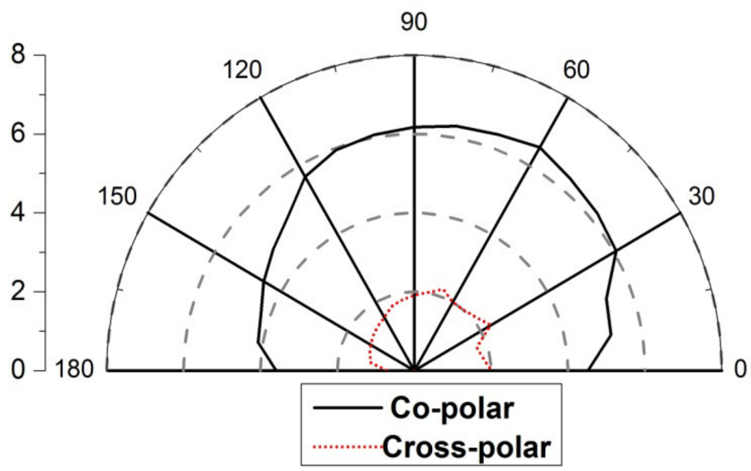

Figure 4 Radiation pattern of CSGPRPMA at 2.57GHz

Co-polar and cross polar radiation pattern of CSGPRPMA at 2.57 GHz are as shown in Figure 4. From these figures it is seen that, the pattern is broadside and linearly polarized.

The gain of CSGPRPMA is calculated using absolute gain method given by the formula,

$$(G)dB = 10\log\left(\frac{Pr}{Pt}\right) - (G_t)dB - 20log\left(\frac{\lambda_0}{4\pi R}\right)dB \qquad (2)$$

where G_t is the gain of pyramidal horn antenna and R is the distance between the transmitting antenna and the antenna under test(AUT). The power received by AUT, P_r and the power transmitted by standard pyramidal horn antenna P_t are measured independently. The maximum gain measured for CSGPRPMA is found to be 7.74 dB.

4. CONCLUSION

The proposed antenna operates for triple frequency bands from 2.57 GHz to 5.48 GHz. It is constructed by placing circular slot on the rectangular patch microstrip antenna to achieve a maximum gain of 7.74 dB with virtual size reduction of about 19.68 %. The radiation characteristics are broadside and linearly polarized. The CSGPRPMA may find application in modern wireless communication systems.

ACKNOWLEDGEMENTS

The authors would like to thank the Dept. of Science & Technology (DST), Govt. of India, New Delhi for sanctioning Vector Network analyzer to this Department under FIST project.

REFERENCES

[1] C.A. Balanis, "Antenna theory: analysis and design", Third edition, John Wiley & sons Inc., 2005.

[2] R.B. Waterhouse, "Microstrip patch antenna, a designer guide", Kluwer Academic publishers 2003.

[3] I.J. Bahl, P. Bhartia, "Microstrip Antennas", Dedham, MA, Artech House, 1980.

[4] Vivek Singh Kushwah, Geetam Singh Tomar, "Size reduction of Microstrip Patch Antenna using Defected Microstrip structures", International Conference on Communication Systems and Network Technologies, 2011.

[5] Rajeshwar Lal Dua, Himanshu Singh, Neha Gambhir, "2.45 GHz Microstrip Patch antenna with Defected Ground Structure for Bluetooth", *International Journal of Soft Computing and Engineering*, Vol.1, Issue-6, January 2012, pp-262-265.

[6] Mouloud Challal, Arab Azrar and Mokrane Dehmas, "Rectangular Patch Antenna Performances Improvement Slotted Rectangular shaped for WLAN Applications", *International Journal of Computer Science*, Vol.8, Issue 3, No.1, May 2011, pp-254-258.

[7] Kawa ABDOULA, Circularly Polarized Aperture Coupled Microstrip Short Backfire Antenna with Two Rings, *International Journal of Electronics and Communication Engineering and Technology*, 8(2), 2017, pp. 13–25.

[8] Jolis Gupta and Deshraj Shakya. Design of Microstrip Diplexer Using Lowpass Filter and Hybrid Bandpass Filter. *International Journal of Electronics and Communication Engineering & Technology*, 6 (12), 2015, pp. 07-12.