Journal of Advanced Research in Wireless, Mobile and Telecommunication
Volume 4, Issue 2 - 2021, Pg. No. 8-11
Peer Reviewed Journal

Article

Design of Circular Microstrip Patch Antenna for Wireless Application

Basavalinga Swamy[1], CM Tavade[2], Kishan Singh[3]

[1]Assistant Professor, Department of Electronics and Communication Engineering, Lingaraj Appa Engineering College, Bidar, Karnataka, India.
[2]Principal, Department of Electronics and Communication Engineering, Basavakalyan Engineering College, Basavakalyan
[3]Professor, Department of Electronics and Communication Engineering, Guru Nanak Dev Engineering College, Bidar, Karnataka, India.

I N F O

Corresponding Author:
Basavalinga Swamy, Department of Electronics and Communication Engineering, Lingaraj Appa Engineering College, Bidar, Karnataka, India.
E-mail Id:
basushastri22@gmail.com
How to cite this article:
Swamy B, Tavae CM, Singh K. Design of Circular Microstrip Patch Antenna for Wireless Application. *J Adv Res Wire Mob Telecom* 2021; 4(2): 8-11.

Date of Submission: 2021-11-15
Date of Acceptance: 2021-12-08

A B S T R A C T

In this paper a Open Stubs loaded Circular Microstrip Antenna (OSCMSA) is designed and analyzed. This antenna resonates from 2.26 GHz to 10.06 GHz of frequencies and exhibits multiband operation. In this design inset feed arrangement is used to excite antenna. The other antenna parameters like return loss, bandwidth, VSWR, current distribution, and radiation pattern are studied and discussed.

Keywords: OSCMSA, Bandwidth, VSWR, MSA

Introduction

Wireless communication systems are rapidly expanding in the microwave spectrum. Microstrip Antennas (MSA) have grown in popularity in recent decades due to inherent characteristics such as light weight, low cost, simple design, and the ability to resonate at multiple frequency bands,[1-2] which eliminates the need for multiple antennas for various wireless applications.

The literature mentions a number of ways and procedures. Cutting slots of various geometries on the radiating patch, such as rectangular, triangular, H-shape, U-shape and so on, can enable antenna downsizing and many frequency bands.[3-6]

Furthermore, in today's communication era, designing a single antenna capable of both transmission and reception would be a difficult task. Slits on circular microstrip antennas are used in a similar study for multi-band operation and virtual size reduction.[7] The loading of the circular patch antenna with open stubs is proposed in this study as a simple solution for multiple frequency operation. This method is not commonly used in the literature.

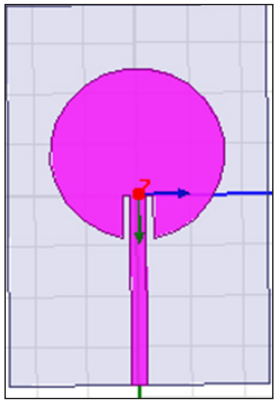

Figure 1.Top view geometry of CCMSA

Consideration for Antenna Design

The proposed antenna was created using a Conventional Circular Microstrip Antenna (CCMSA) designed for a 2.4 GHz frequency. OSCMSA geometry is depicted in Figure 1. The radiating patch of size W×L is etched on a glass epoxy substrate with dielectric constants ε_r = 4.4 and tan δ = 0.02, dimensions X× Y and thickness h = 0.16 cm.

The circular microstrip patch antenna design calculations yielded a radius of 16.96 mm.

Table 1.Parameters of Antenna Design

Feeding technique	N inset feed ED
Ground Plane	75mm*50 mm
Radius of Circular Patch	16.96 mm
Substrate thickness	1.6 mm
Operating Frequency	2.4 GHz
Substrate dielectric constant	ε_r = 4.4

Figure 2, depicts the OSCMSA configuration. The length Ls and width Ws of all the open stubs from S1 to S4 are the same. The open stubs S3 and S4 are inserted vertically from the bottom side of the patch's radiating edge, whereas the open stubs S1 and S2 are inserted vertically from the top side of the patch's radiating edge. All stubs have a width of 1.5 mm and a length of 9.5 mm.

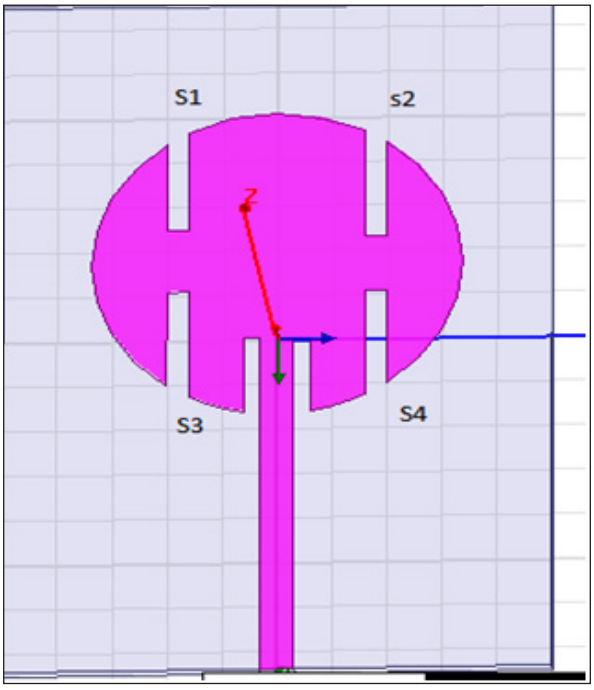

Figure 2.Top View Geometry of OSCMSA

Simulation Outcomes and Discussion

To model and simulate the conventional and open stub loaded microstrip antenna structures, the Ansoft HFSS Electromagnetic (EM) 3-D tool is used. It is also used to plot and calculate antenna characteristics such as return loss, resonant frequency, and radiation pattern, bandwidth and so on. Table 2, summarizes the simulated results.

Table 2.Summary of Results

Antenna	Resonating frequency in GHz	Return loss in dB	Bandwidth %
CCMSA	2.4	-25.34	5
OSCMSA	f_1= 2.26	-35.84	137.61
	f_2= 6.07	-20.38	14.49
	f_3= 8.28	-17.39	12.68
	f_4= 10.06	-20.77	11.13

Figure 3, depicts the CCMSA return loss versus frequency. The resonant frequency for CCMSA is 2.4 GHz and return loss is -25.34dB.

From the Figure 4, it is clear that, the OSCMSA resonates for four bands of frequencies from 2.26 GHz to 10.06GHz, i.e. f1= 2.26 GHz, f2 = 6.07 GHz, f3 = 8.28 GHz and f4 = 10.06 GHz, with their respective bandwidths, BW1 = 137.61%, BW2 = 14.49%, BW3 = 12.68% and BW4 = 11.13%.

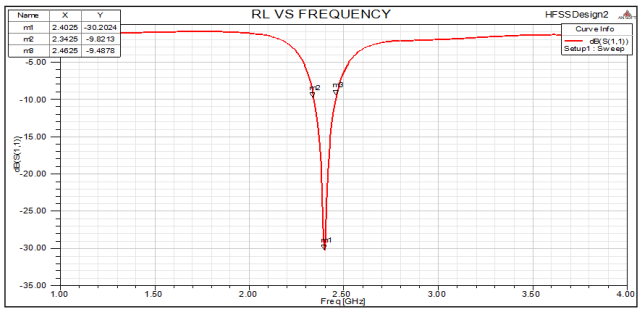

Figure 3.Frequency Dependent Variations in Return Loss of CCMSA

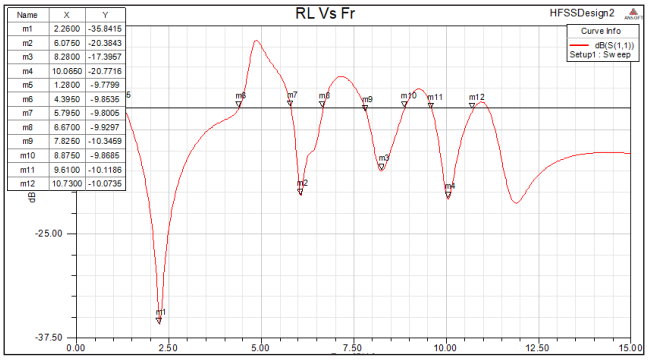

Figure 4.Frequency Dependent Variations in Return Loss of OSCMSA

Figure 5, shows the radiation patterns of CCMSA and OSCMSA at four resonating frequencies (v). The measured radiation pattern of a CCMSA designed for 2.4 GHz, which is broadside in nature and linearly polarized. At 2.26 GHz,

The proposed antenna's emission pattern shows a slight tilt to the left side of the 00, whereas at 6.07 GHz, the same antenna shows a slight tilt to the right side of the 00. At 10.06 GHz, the O SCMSA also exhibits a symmetric co-polar pattern around the 00.

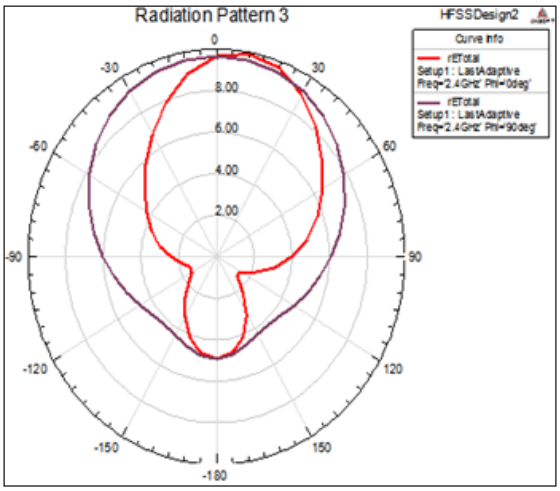

Figure 5.Radiation Patterns Simulation of CCMSA

From Figure 6, it is clear that, the VSWR valves of OSCMSA are 0.2804dB, 1.6671dB, 2.3339dB and1.5940dB.

With their respective frequencies f1= 2.26 GHz, f2 = 6.07 GHz, f3 = 8.28 GHz and f4 = 10.06 GHz, respectively.

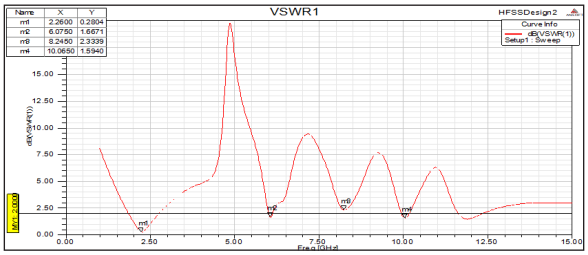

Figure 6.VSWR of OSCMSA

Current distribution of OSCMSA at J, E and H fields are shown in Figure 7, 8 and 9.

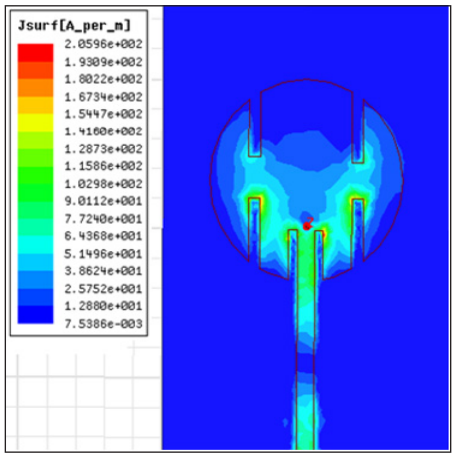

Figure 7.Current Distribution at J-Field

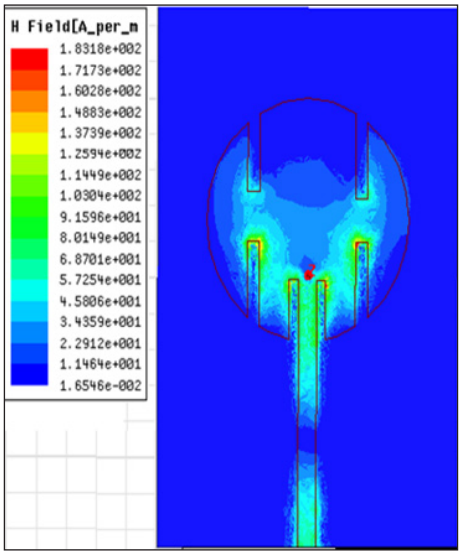

Figure 8.Current Distribution at H-Field

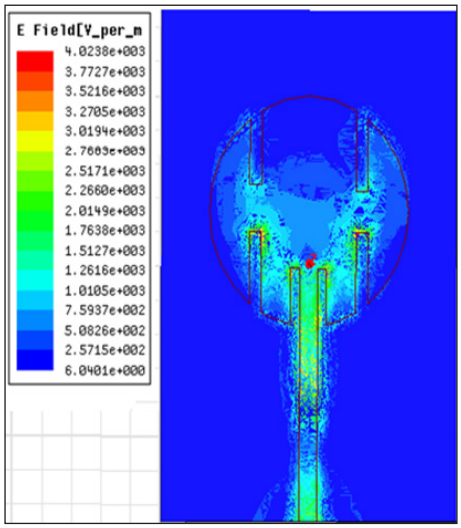

Figure 9.Current Distribution at H-Field

Conclusion

The antennas designed by CCMSA and OSCMSA are examined and discussed. The frequency range of the proposed antenna is 2.28 GHz to 10.06 GHz. The OSRMSA can now operate in multiband mode with a wide band width, reduced VSWR and enhanced broadside radiation characteristics thanks to the addition of open stubs. The antenna's design is simple and it could be beneficial in S, C and X band applications.

Acknowledgments

We are grateful to VGST for authorizing the purchase of HFSS Software for Simulation by the R and D Centre, Electronics and Communication Department, GNDEC Bidar.

References

1. Sheta AF, Mohra A, Mahmoud SF. Multi-band operation of compact H-shaped microstrip patch antenna.

Microwave Opt Technol Letter 2002; 35(5): 363-367.
2. Sheta AF, Mohra A, Mahmoud SF. Modified compact H-shaped microstrip antenna for tuning multi-band operation. 25th National Radio Science Conference (NRSC), Tanta university, Tanta, Egypt.
3. Sze JY, Wong KL. Slotted rectangular microstrip antenna for bandwidth enhancement. *IEEE Trans Antennas Propag* 2000; 48(8): 1148-1152.
4. Wu JW, Hsiao HM, Lu JH et al. Dual broadband design of rectangular slot antenna for 2.4 and 5GHz wireless communication. *IEEE Electron Lett* 2004; 40(23).
5. Chakraborty U, Chatterjee S, Chowdhury SK et al. Triangular Slot Microstrip Patch Antenna for Mobile Communication. India conference (INDICON), Annual IEEE. 2010; 4-7.
6. Siddiqui NA. Truncated Rectangular Microstrip Antenna with H and U Slot for Broadband. *International Journal of Eng Sc and Techno* 2013; 5(1): 114-118.
7. Gudda J, Hadalgi PM. Compact Novel Design of Slit Loaded Microstrip Antenna for WLAN and Wi-max Applications. 2015; 4(3).