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Design and Analysis of Slotted Multiband Microstrip Patch Antenna with Defect Ground Structure for Wi-Fi/WLAN/Wi-Max Applications

Ambika James[1], Abhinav Bhargava[2], A. K. Shrivastava[3]

[1]M Tech Scholar Gyan Ganga Institute of Technology & Management, Bhopal, India
[2]Asst. Professor, Department of Electronics and Communication Engineering, GGTIM, Bhopal, India
[3]Head, Department of Electronics and Communication Engineering, GGTIM, Bhopal, India

Abstract - In this paper, A Multiband Slotted Microstrip Antenna with DGS is designed and is characterized by multibanding with increase in Modified Slotted Structure using Ansoft HFSS antenna simulation software. This paper focuses on the designing of miniature microstrip antenna with coaxial probe feed and modifying its patch and ground plane to achieve increase in number of bands so that it can be used for various wireless applications like Wi Fi/ WLAN/ Wi Max etc.

Keywords- DGS, Multi band, Microstrip Antenna, MSR, Modified Structure Resonator.

1. INTRODUCTION

Recently, the necessity for the design of an antenna having multiband operation has increased since such an antenna is necessary for integrate more than one wireless communication standard in a single compacted system to effectively promote the portability of a current individual wireless system. For this order, the developed antenna must not only be with a multiband operation but also have a plain structure, compressed size, and effortless integration with the circuit. Among the known multiband antenna prototypes, the planar antenna with various structures has become a common aspirant because of its attractive characteristics include low shape and lightness, low cost, and flexible structure for exciting wide impedance bandwidth or multi significance mode, and desirable radiation characteristics [3].

However, the complexity in designing antenna challenges like when the sizes of the antenna reduce and the number of working frequency bands increase. So far, for size reduction, bandwidth enhancement, and resonance-mode increment, many antennas have been proposed by employ. Various promising feed structures such as the coaxial probe, the microstrip feed , and the coplanar waveguide (CPW). In these presented monopole antennas, a large solid ground plane having the shape of a rectangle with slots, circle, or ellipse is usually adopt. Different from this, a prominent ground structure named defected ground structure (DGS) has recently been investigate and found to be a simple and efficient method to reduce the antenna size as well as incite additional resonance modes [4].Designing of antenna in this paper is done by HFSS antenna software simulation, with the standard parameters like permittivity of ε_r=4.4, probe feed, tangent loss of 0.02 and overall 50 x 50 mm ground plane.

2. ANTENNA DESIGN

The design of a slotted microstrip antenna (Antenn1,2 3, 4 and 5) using coaxial probe feeding technique satisfying the given specifications: As for the substrate selection, the major thought will be the dielectric constant.

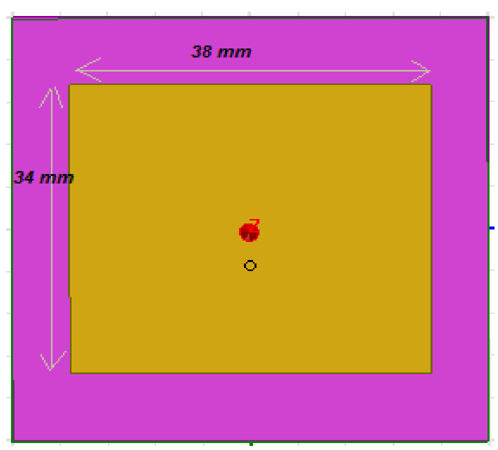

Figure 1.The conventional patch antenna

A high dielectric will result in a small patch size but this will normally reduce bandwidth efficiency and might have difficulty in fabricating a very small patch size antenna The conventional microstrip antenna is miniature in size the overall dimension of the 50 mm X 50 mm in length and width with the patch dimension of 34 x 38 mm provides the one of the objective of compact size. The probe feed is at distance of 2.45 mm.

As shown in Figure 1, the conventional patch antenna.

- **Patch Dimensions:**

  L=38 mm W=34 mm
  ε_r =4.4 Tangent Loss = 0.01

- **Feed Line Dimensions**:

  Radius =1.3 mm
  Ground Plane: 50x50 mm
  Feed: Co-axial probe feed (wave port)

- **DGS Dimensions (mm) :**

  L_p=14.22 ρ=2.45
  g=6, w_1=9,
  a=4, t= 2.89,
  d=1.3, h=1.575

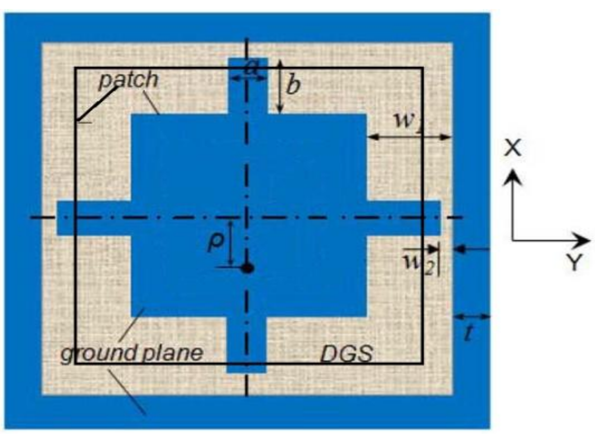

Figure 2 Proposed designs for DGS with parameters

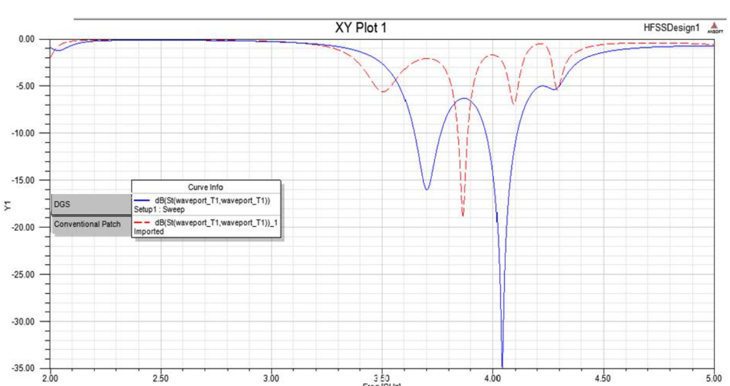

Figure 3 Return Loss of Antenna 1 and Antenna 2 with DGS (S_{11} in dB).

With the above parameters, a microstrip patch antenna is designed and simulated for the range of 2.5 GHz to 6 GHz, which is commonly used for wireless communication systems. In Figure 2, designed structured on the HFSS is shown. Antenna 1 is conventional Patch and Antenna 2 is Patch with DGS (Defect Ground Structure. Figure 3 shows the return loss of conventional patch and DGS patch.

The design of a slotted microstrip antenna (Antenna 3, 4, 5)

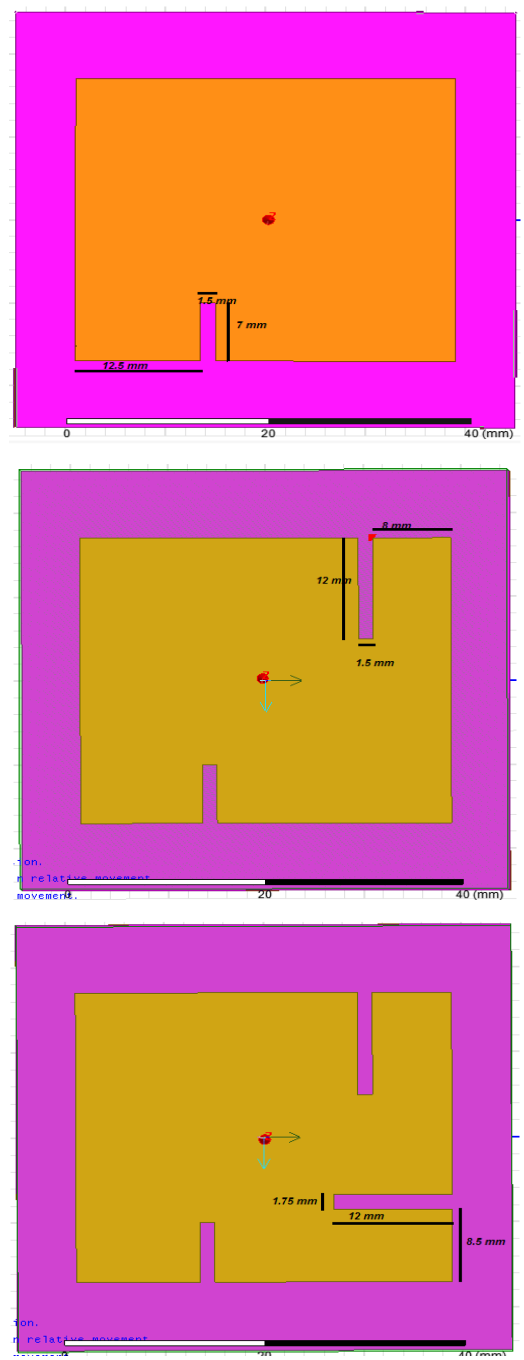

Figure 4 a) Antenna 3, b) Antenna 4 and c) Antenna 5

3 SIMULATION AND RESULTS

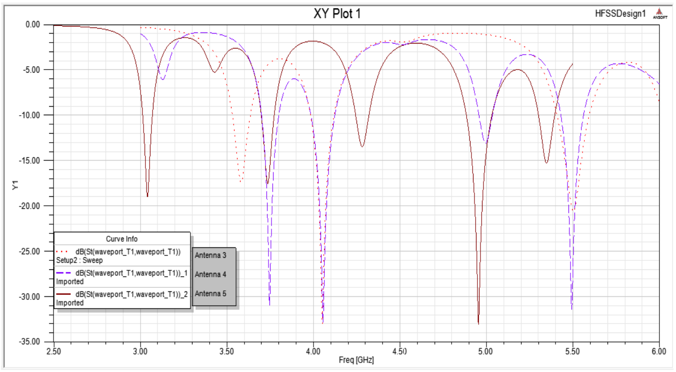

Figure 5 S_{11} for antenna 3, antenna 4 and antenna 5

We commenced our work by designing a conventional patch antenna with rectangular patch then we introduced defect in the ground plane. As a results a dual band antenna was simulated with appropriate parameters for better functioning antenna. Our next stage was to introduce slots in the rectangular patch. The cutting of first rectangular slot resulted in triband microstrip design antenna 3. The second slot resulted in four- band microstrip antenna 4. And last but not the least third rectangular slot was introduced in the rectangular patch which resulted in pentavalent band microstrip antenna 5 which was then termed as multiband microstrip antenna. The final results satisfy all the parameters of an efficient antenna

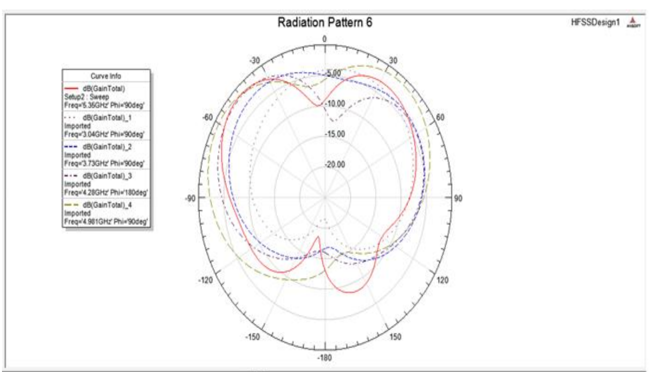

Figure 6 Radiation pattern for antenna 3, 4 and 5.

Geometry	**No. of bands**	**Resonant freq GHz**	**S_{11} (dB)**	**Directivity**	**Gain**	**B/W (MHz)**
Antenna1	**1**	3.86	-18.84	2.66	0.52	45
Antenna 2	**2**	3.61	-14.88	2.66	3.5	114
		3.93	-24.58	3.2	3.8	128
Antenna 3	**3**	3.58	-17.4	5.58	4.26	100
		4.05	-32.95	3.98	4.66	140
		5.5	-20.6	4.9	2.26	190
Antenna 4	**4**	3.74	-30.8	4.63	4.05	110
		4.05	-32.8	3.66	3.67	140
		4.99	-13	4.06	4.56	110
		5.49	-30.7	4.42	3.92	140
Antenna 5	**5**	3.04	-18.9	2.88	3.65	65
		3.73	-17.5	4.66	3.66	88
		4.28	-13.4	4.89	4.06	95
		4.98	-33	3.84	2.26	163
		5.35	-15.2	2.26	2.74	110

4 CONCLUSION

We proposed a multiband microstrip patch antenna which works very efficiently in wireless application. The designed antenna works efficiently under all conditions with low return loss and proper impedance matching. This miniature multiband band antenna has wide application in GPS/GSM, WiMax Wi-Fi/WLAN of wireless communication. The unique feature of these antennas is its compact and small size.

REFERENCES

[1] C.A. Balanis, Antenna Theory, 2nd Ed., John wiley & sons, inc., New York.1982.

[2] John D. Kraus, Ronald J Marhefka, Ahmad S khan " Antennas & Wave Propagation" Tata McGraw Hill Education Private Limited, Fourth Edition P500-522, 1988

[3] Chandrakanta Kumar, Mohammad Imtiyas Pasha, and Debatosh Guha, "Microstrip Patch With Non proximal Symmetric Defected Ground Structure (DGS) for Improved Cross-Polarization Properties over Principal Radiation Plane", IEEE Antennas and Wireless Propagation letters, vol. 14, , pp. 1412–1414, 2015

[4] Mahdi Moosazadeh And Sergey Kharkovsky, *Fellow, IEEE, "*Compact And Small Planar Monopole Antenna With Symmetrical L- And U-shaped Slots For WLAN/Wimax Applications*",* IEEE Antennas And Wireless Propagation Letters, Vol. 13, 2014, pp. 388-391

[5] Wen-Chung Liu, Chao-Ming Wu, and Yang Dai," Design of Triple-Frequency Microstrip-Fed Monopole Antenna Using Defected Ground Structure", vol.59 ,no.7, July 2011.

[6] Muhammad D. Guha and Y. M. M. Antar, Microstrip and printed antennas new trends, techniques and applications. Hoboken, NJ, USA: Wiley, 2010, ch. 12..

[7] D. Guha, M. Biswas, and Y. M. M. Antar, "Microstrip patch antenna with defected ground structure for cross polarization suppression, "IEEE Antennas Wireless Propag. Lett. vol. 4, pp. 455–458, 2005.

[8] R. D. Hydrae and M. N. Moghadasi, "Introduction of a novel technique for the reduction of cross polarization of rectangular microstrip patch antenna with elliptical DGS," *J. Electromagn. Waves Appl.*, vol. 22, pp.1214–1222, 2008..

[9] D. Guha, C. Kumar, and S. Pal, "Improved cross-polarization characteristicsof circular microstrip antenna employing arc-shaped defectedground structure (DGS)," IEEE Antennas Wireless Propag. Lett., vol.8, pp. 1367–1369, 2009.

[10] M. Esa, U. Jamaluddin, and M. S. Awang, "Antenna with DGS for improved performance," in Proc. IEEE Asia-Pacific Conf. Appl. Electromagn., 2010, pp. 1–4.

[11] C. Kumar and D. Guha, "Nature of cross-polarized radiations from probe-fed circular microstrip antennas and their suppression using different geometries of defected ground structure (DGS)," *IEEE Trans. Antennas Propag.*, vol. 60, no. 1, pp. 92–101, Jan. 2012.

[12] C. Kumar and D. Guha, "Defected ground structure (DGS)-integrated rectangular microstrip patch for improved polarization purity with wide impedance bandwidth," *IET Microw., Antennas Propag.*, vol. 8, no. 8,pp. 589–596, Jun. 2014.

[13] Ambika James and Abhinav Bhargava, "Design and Analysis of Microstrip Rectangular Patch Antenna with Defect Ground Structure for Wimax Applications", *International Journal Of Scientific Progress And Research (IJSPR), ISSN: 2349-4689, Volume-12, December, 2015*.