International Journal of Research in Engineering, Science and Management
Volume 5, Issue 6, June 2022
https://www.ijresm.com | ISSN (Online): 2581-5792

Simulation of Rectangular Microstrip Patch Antenna with Defected Ground Structure of H-Shape for C-Band Applications

M. Jayamanmadha Rao[1], B. V. S. Satwika[2], D. Kowshik[3*], B. Srikavya[4]

[1]Professor, Department of Electronics and Communication Engineering, Aditya Institute of Technology and Management, Tekkali, India
[2,3,4]B.Tech. Student, Department of Electronics and Communication Engineering, Aditya Institute of Technology and Management, Tekkali, India

***Abstract*: The advancement of wireless communications has been amazing in recent years, with much of the focus on shrinking the size of micro strip antennas. This employs a high permittivity dielectric substrate, Defected Microstrip Structure, and Defected Ground Structure (DGS) at the ground plane. Using the DGS, this proposal proposes a low-cost compact edge fed rectangular patch antenna. The suggested H-shape antenna with a defective ground structure resonates in the C-Band. The suggested antenna's Return Loss, Radiation Pattern, and Gain indicate that it offers potential qualities for a variety of wireless communication applications. Ansoft HFSS software will be used to mimic the performance of DGS antennas.**

***Keywords*: HFSS, microstrip, patch, defected ground structure.**

1. Introduction

A microstrip patch antenna, in its most basic form, is made up of a radiating patch on one side of a dielectric substrate and a ground plane on the other. The patch is usually constructed of conductive metals like copper or gold and may be moulded into any shape. On the dielectric substrate, the radiating patch and feed lines are usually photo etched. Because of the fringing fields that occur between the patch edge and the ground plane, microstrip patch antennas emit. A thick dielectric substrate with a low dielectric constant is excellent for improved antenna performance because it gives better efficiency, larger bandwidth, and better radiation. However, such a setup necessitates a larger antenna. Higher dielectric constants imply lower efficiency and a smaller bandwidth. The following items are required to create a Microstrip patch antenna. As a result, the antenna size and performance must be balanced.

2. Literature Survey

Based on prior work with microstrip antennas, a literature survey of microstrip patch antennas is discussed. According to the findings, the microstrip patch antenna has a number of distinct advantages, including light weight, low cost, low profile, planar configuration, ease of conformal, superior portability, suitability for arrays, ease of fabrication, and easy integration with external circuitries, to name a few, all of which make it an obvious choice. Adding capacitor/inductor with a negative charge a single virtually rectangular microstrip radiator reactively loaded with active negative capacitor can provide high gain, as can composite-resonator microstrip antennas using metamaterial resonators that provide wide bandwidth and high gain. The poor gain of typical microstrip antenna elements is another issue that must be addressed. Because operating frequencies are proportional to antenna electrical size, the remaining limitation of traditional microstrip antennas is the reduction of their relatively large size, particularly at lower microwave frequencies. The wavelength of the rectangular microstrip antenna (RMSPA) should be roughly half that of a half-guided wavelength. This limitation was approached mathematically by Wheeler and Chu. In response to the growing need for smaller and smaller wireless communication devices, several attempts have been undertaken to reduce antenna size and construct electrically compact microstrip antennas. One of the most efficient ways to reduce the size of microstrip antennas is to use inductive or capacitive loading. Using composite metamaterial resonators, the size of a microstrip antenna can be reduced.

Due to its ability to give broader bandwidths than dielectric substrates, magneto-dielectric substrates have been used extensively to miniaturize microstrip antennas. Fractal topologies (geometries made up of self-similar structures) have cleared the way for a unique method of miniaturizing antennas.

3. Methodology

FEKO, IE3D, CST, HFSS, and other simulation software are available. Because of its user-friendly interface and better accuracy for complicated geometrics, we employ version 12.0 of the HFSS (High Frequency Structure Simulator).

This electromagnetic structure solution employs the finite element method. For modelling three-dimensional full-wave electromagnetic fields, HFSS is the industry standard. Its accuracy, advanced solver, and high-performance computing technologies have made it a must-have tool for engineers designing high-frequency and high-speed electrical components that are both exact and fast.

*Corresponding author: kowshikdabbeeru@gmail.com

A. *Dielectric Material*

In answer to a request from Michael Faraday, William Whewell (dia + electric) invented the term dielectric. A perfect dielectric is a substance that conducts no electricity at all. a dielectric, insulating, or weak conductor of electric current. Because dielectrics, unlike metals, lack loosely connected, or free, electrons, they create almost no current when exposed to an electric field.

Ex - Air, FR4 epoxy, Bakelite, duroid, quartz glass, foam, polystyrene, Plexiglas, fused quartz, E glass, RO4725XR, RO4730JXR, rogers RT/duroid 5870/5880, Teflon, Taconic CER-10, Taconic RF-30, Taconic RF-35.

B. *Dimensions of DGS*

1) *Defective Ground Structure*

DGS occurs when an etched periodic or non-periodic cascaded design defect disrupts the shield current distribution in the ground plane of a planar transmission line (e.g., microstrip, coplanar, and conductor backed coplanar wave guide).

Under the ground plane's microstrip on the initial DGS model, there was a dumbbell-shaped flaw. The ground plane under the microstrip line has been implanted with a range of geometries in varied forms. Rectangular dumbbells, circular dumbbells, spirals, "U," "V," "H," crosses, and concentric rings are just a few of the types offered. Meander lines, split ring resonators, and fractals are some of the most advanced structures that have been investigated.

C. *Full Wave Analysis*

Electrically enormous constructions are routinely subjected to full-wave analysis, also known as high frequency analysis (physical size is significantly larger than wavelength). Full-wave solvers such as Ansoft HFSS and CST Microwave Studio are well-known. The fields described by the equations are typically time-variant/frequency-dependent. Full wave analysis means solving the entire set of Maxwell's equations without using any simplifying assumptions, according to a straightforward explanation that facilitates comprehension.

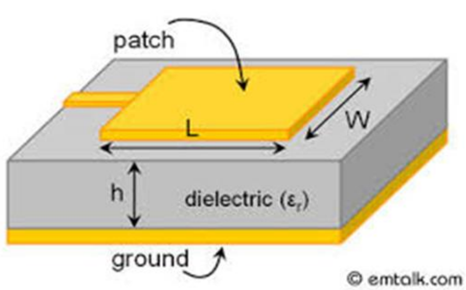

Fig. 1.

4. Working Model

Step 1: Begin the HFSS.
Step 2: Insert an HFSS design.
Step 3: Determine the Ground Plane.
Step 4: Creating a defective structure.
Step 5: Unite and Subtraction.
Step 6: Creating and applying a substrate properties.
Step 7: Creating a patch.
Step 8: Set up the feeding line.

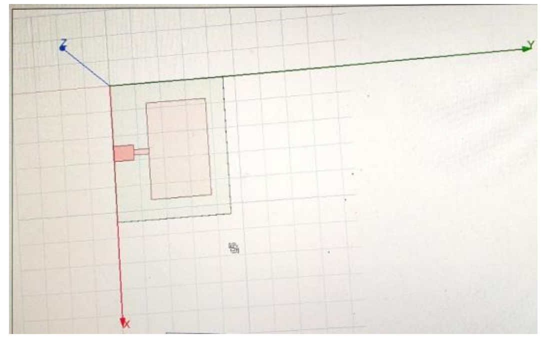

Fig. 2.

Step 9: Giving Excitation to planes.

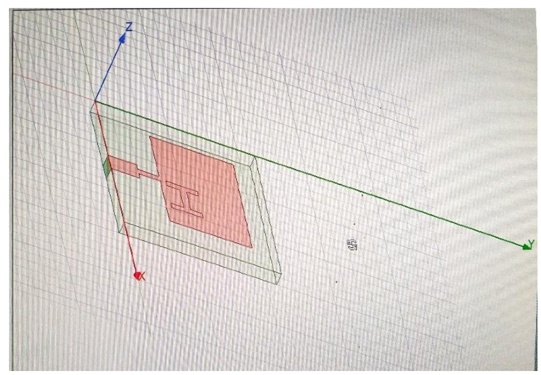

Fig. 3.

Step 10: Setup for the analysis.
Step 11: Incorporate a frequency sweep.
Step 12: Validation of the model.
Step 13: Make a backup of the project.
Step 14: Analyze.
Step 15: Solution data.
Step 16: Examining the outcomes.
Step 17: Create a VSWR report.
Step 18: Pattern of Radiation.
Step 19: Different structures of DGS.

5. Results

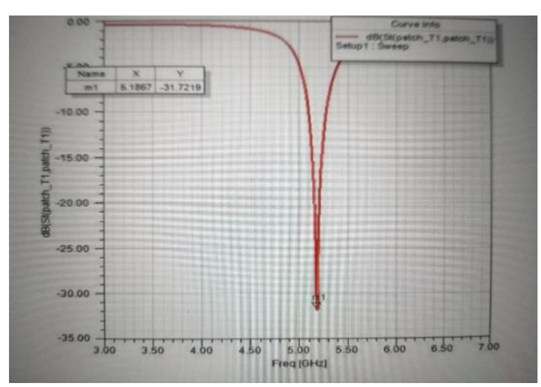

Fig. 4. Return loss

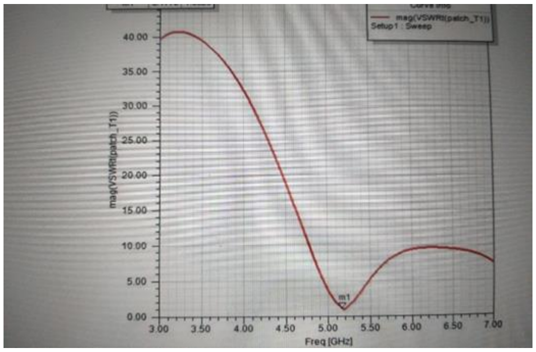

Fig. 5. VSWR characteristics

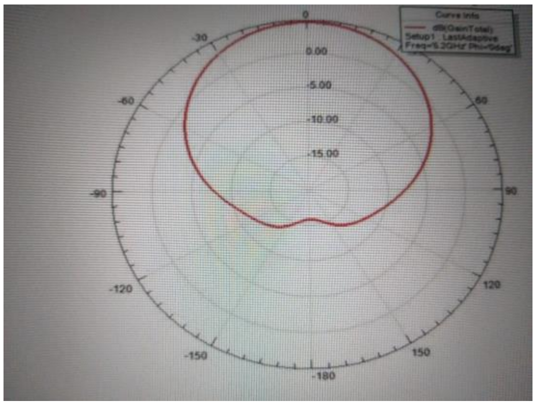

Fig. 6. Gain characteristics

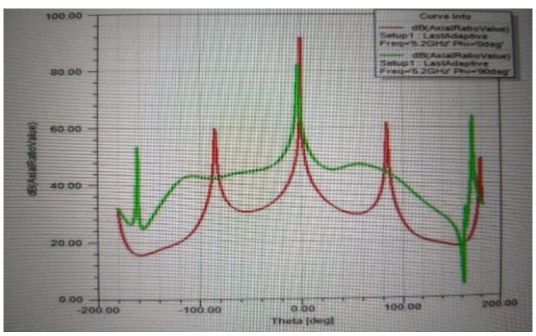

Fig. 7. Axial plot

6. Conclusion

A Finite Ground Plane Monopole antenna has been proposed to cover the WiMAX and WLAN bands. Simulation is used to optimize the proposed antenna's numerous parameters. The recommended antenna prototype was developed and simulated using Ansoft HFSSv12 software. According to return loss bandwidths shown in Software, the antenna resonates at 5.24GHz GHz with improved return loss. The following are some of the advantages of the antenna that has been proposed: The Federal Communications Commission in the United States has approved cordless phones operating at 5.2 GHz to use seven frequency bands. It has almost Omni-directional radiation, as well as low gain and efficiency, making it perfect for next-generation wireless communication systems.

Acknowledgement

Dr. A.S. Srinivasa Rao, Principal-AITAM, provided support for this project. We appreciate the hard work put in by our Aditya Institute of Technology and Management employees, who provided insight and information that considerably aided the research, even if they didn't agree with all of the paper's interpretations. Dr. B. Rama Rao, Head of Department ECE – AITAM, assisted with technique and methodology, and Dr. M. Jayamanmadha Rao provided insightful comments on the study.

References

[1] L. C. Paul and M. M. Islam, "Proposal of Wide Bandwidth and Very Miniaturized Having Dimension of μm Range Slotted Patch THz Microstrip Antenna Using PBG Substrate and DGS", 20th Intern. Confe. of Computer and Inform. Tech. (ICCIT), 22-24 December, 2017.

[2] D. Chatterjee and A. K. Kundu, "Performance analysis and comparative study of microstrip patch antenna using aperture coupled and proximity coupled feeding methodology", 2017 International Conference on Computer Communication and Signal Processing (ICCCSP), pp. 1-7, 2017.

[3] F. A. Dahri, R. A. Soomro, S. A. Memon, Z. Memon and M. H. Memon, "An Optimized Inset Feed Circular Cross Strip Antenna Design for C-Band Satellite Links", Int. Jour. of Adv. Computer Science and Applications, vol. 9, no. 5, 2018.

[4] R. Ritronnasak, T. Charoenpru and L. Waranon, "Integration and Installation of The Low Cost C-band Receiving System for Himawari-8 Satellite", 2018 15th International Conference on Electrical Engineering /Electronics Computer Telecommunications and Information Technology (ECTI-CON), pp. 732-735, 2018.

[5] M. A. Rahman, M. A. Mamun, S. Datto and M. S. Anower, "Improvement of Circular Shaped Microstrip Patch Antenna Performances Using Triangular and Pentagonal Shaped Patches", American J. of Engg. Research, vol. 9, no. 1, Feb. 2020.