International Journal of Electronics and Telecommunication Systems Volume1, Issue 03 2025

Wideband Compact MSA using Finite Ground

Md. Sadiqe
Dept. of Computer, D.N. College, Faizpur, M.S, India

Research Article

Date of Submission: 10-04-2025 Date of Acceptance: 12-05-2025 Date of Publication: 15-07-2025

ABSTRACT: This work proposes a compact microstrip patch antenna for broad band operation utilizing limited ground. By cutting corners and creating slits within the radiating patch's borders, a modified square-shaped microstrip patch antenna with a finite ground plane may attain wideband. 37.47% (1630 MHz) of the center frequency at 4.35 GHz is the obtained impedance bandwidth for a 10 dB return loss. This antenna's small size and broad bandwidth make it useful for wireless communication systems.

KEYWORDS: Return loss, wideband, impedance loci, bandwidth, and finite ground.

I. INTRODUCTION

The low profile, light weight, simplicity of manufacture, and conformability to installation of conventional microstrip patch antennas, which usually include a conducting patch printed on a grounded substrate, make them attractive. However, actual wireless communication applications often need bandwidth augmentation since microstrip antennas have a restricted bandwidth by nature. Reducing size and increasing bandwidth are crucial design considerations for microstrip antennas used in practical applications. Research to achieve compact and wide-band microstrip antenna operations has significantly increased as a result [4]. Microstrip patch antennas are widely used in many commercial wireless communication applications. Microstrip patch antennas are made using printed circuit technology, which allows for inexpensive mass manufacture.

Due to the growing need for tiny antennas for wireless and mobile communications devices, compact microstrip patch antennas have attracted a lot of interest lately. Using a high-permittivity substrate is an efficient way to build microstrip antennas with a smaller dimension at a given operating frequency. Antenna efficiency and impedance bandwidth may be improved by using a limited ground plane. The ground plane of the antenna may be meandered by introducing a slot at the ground plane or by inserting several meandering slits at its margins. Compared to the analogous traditional microstrip antenna, the resulting impedance bandwidth for a small design with a meandering ground plane may be larger [3]. Zeland software has been used to simulate the electromagnetic behavior of the suggested antenna. IE3D software is being used to assess return loss, efficiency, directivity, and the Smith chart.

II. ANTENNA DESIGN AND RESULTS

A modified square micro strip patch antenna with a square slot loaded finite ground plane has been used in this patch antenna design in an attempt to increase the bandwidth. The microstrip patch

antenna is fed via a 50-ohm coaxial cable with a SMA connection. The front view of a modified square microstrip patch antenna with a slot-loaded finite ground plane is shown in Fig. 1. With a step frequency of 0.01 GHz and a center frequency of 4.35 GHz within the frequency range of 1 GHz to 6 GHz, this antenna design This modified square patch antenna design has a length of L = 30 mm, a width of W = 30 mm, a slot-loaded finite ground plane with dimensions of L = 45 mm and W = 45 mm, and a square slot with dimensions of 10 mm × 10 mm at the center position. The feed point positions at the patch are (10.85,-12). The rear view of a modified square patch antenna with a slot-loaded finite ground plane is shown in Fig. 2. For antenna design, Fig. 3 illustrates how return loss varies with frequency; the impedance bandwidth is derived from the 10-dB return loss. The directivity (in dBi) fluctuation with frequency for antenna design is seen in Fig. 4. The efficiency fluctuation with frequency for antenna design is seen in Fig. 5. The radiation pattern for the antenna design at the center frequency of 4.35 GHz is shown in Fig. 6. The impedance loci (Smith chart) for antenna design are shown in Fig. 7. The calculated input impedance of the antenna is in excellent agreement with the 50 ohm impedance at resonance frequency 4.35 GHz. In this case, the impedance bandwidth, calculated from the 10-dB return loss, is 37.47% (1630 MHz) of the center frequency at 4.35 GHz because of the modified square micro strip patch antenna with finite ground plane. The suggested antenna design has an adequate bandwidth and other radiation properties.

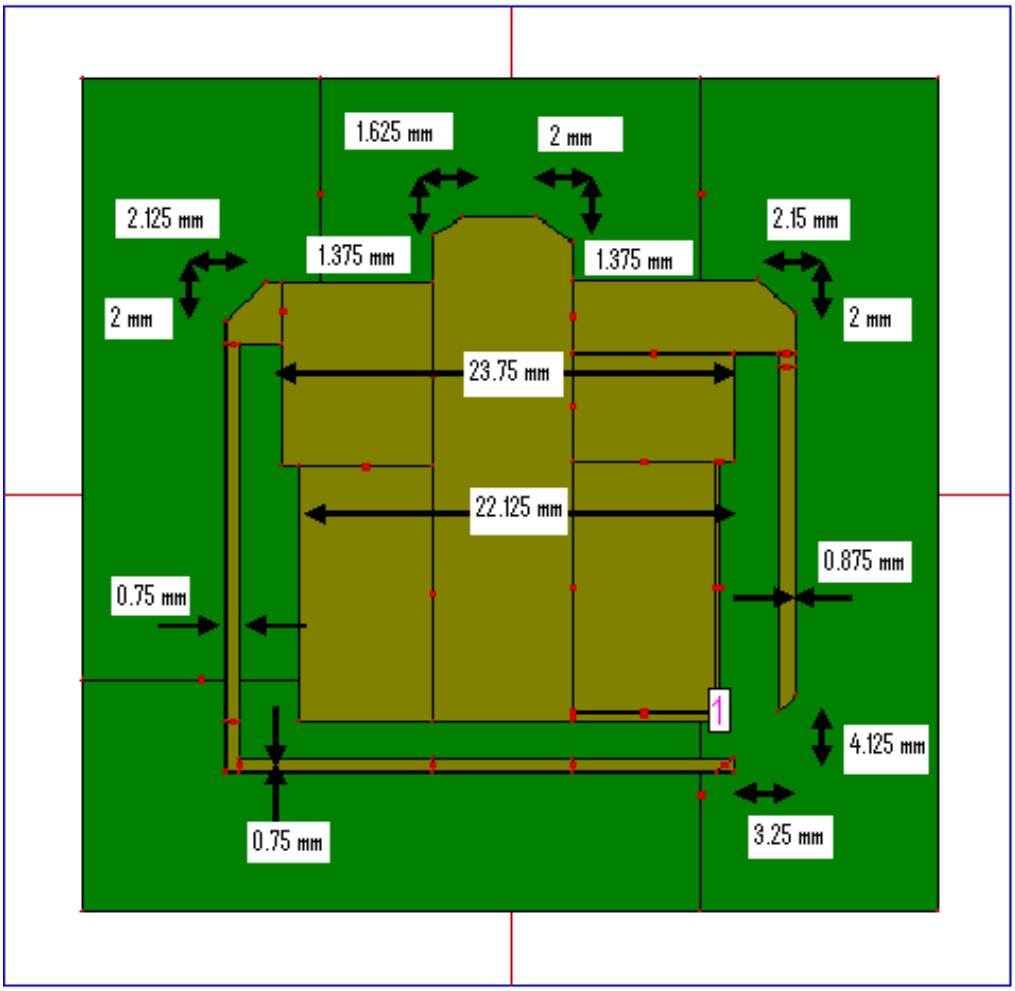


Fig. 1: A modified square microstrip patch antenna with a slot-loaded finite ground is shown from the front.

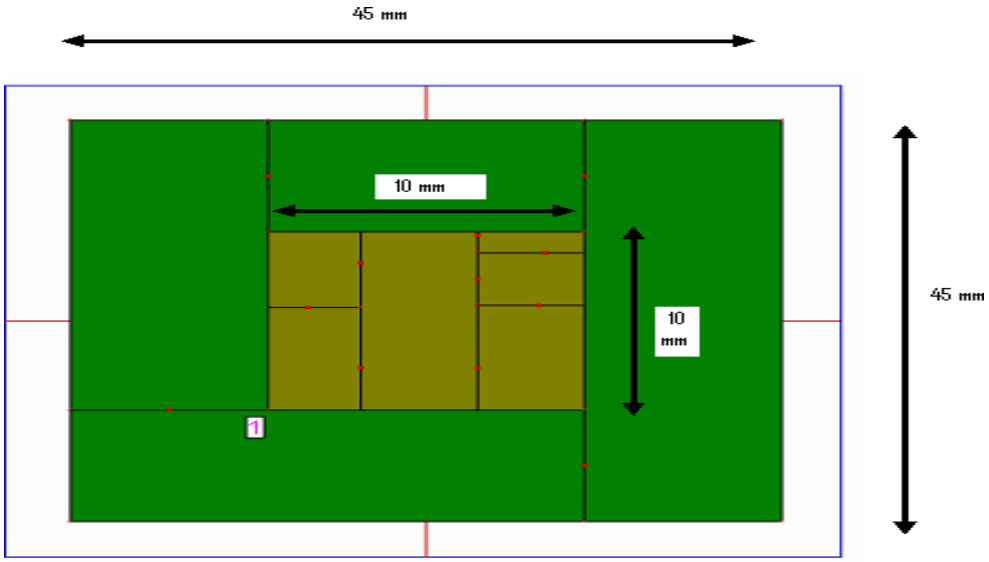


Fig. 2: A modified square microstrip patch antenna with slot-loaded finite ground is shown from the back.

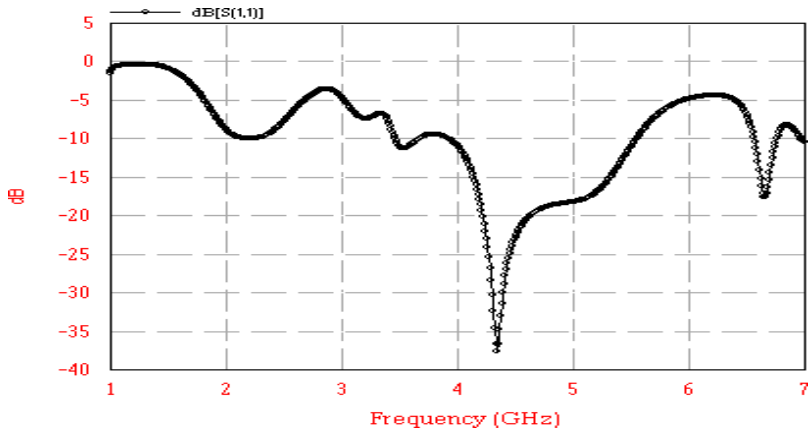


Fig. 3: Return loss variation with frequency for the suggested antenna design

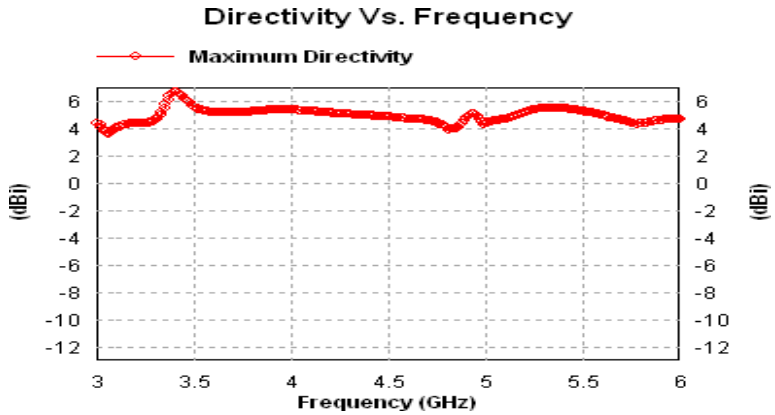


Fig. 4: Directivity variation with frequency for the suggested antenna design

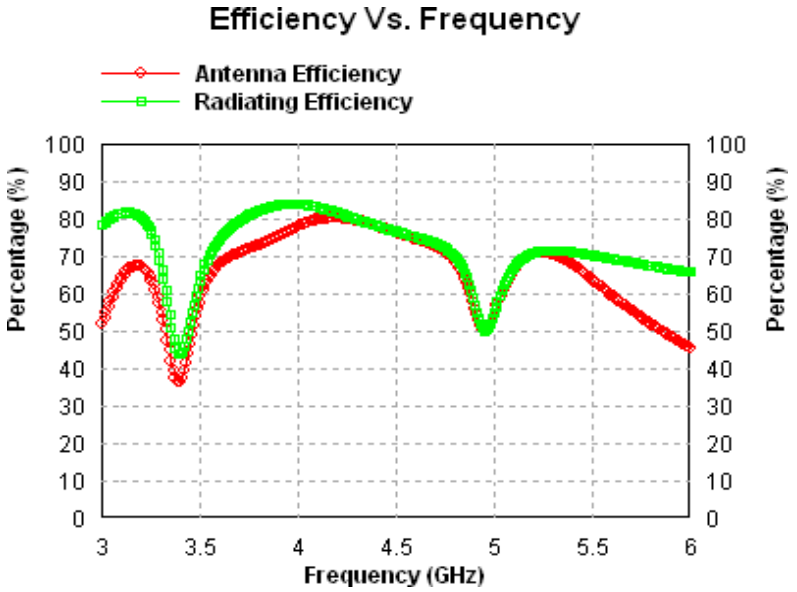


Fig. 5: Efficiency variation with frequency for the suggested antenna design.

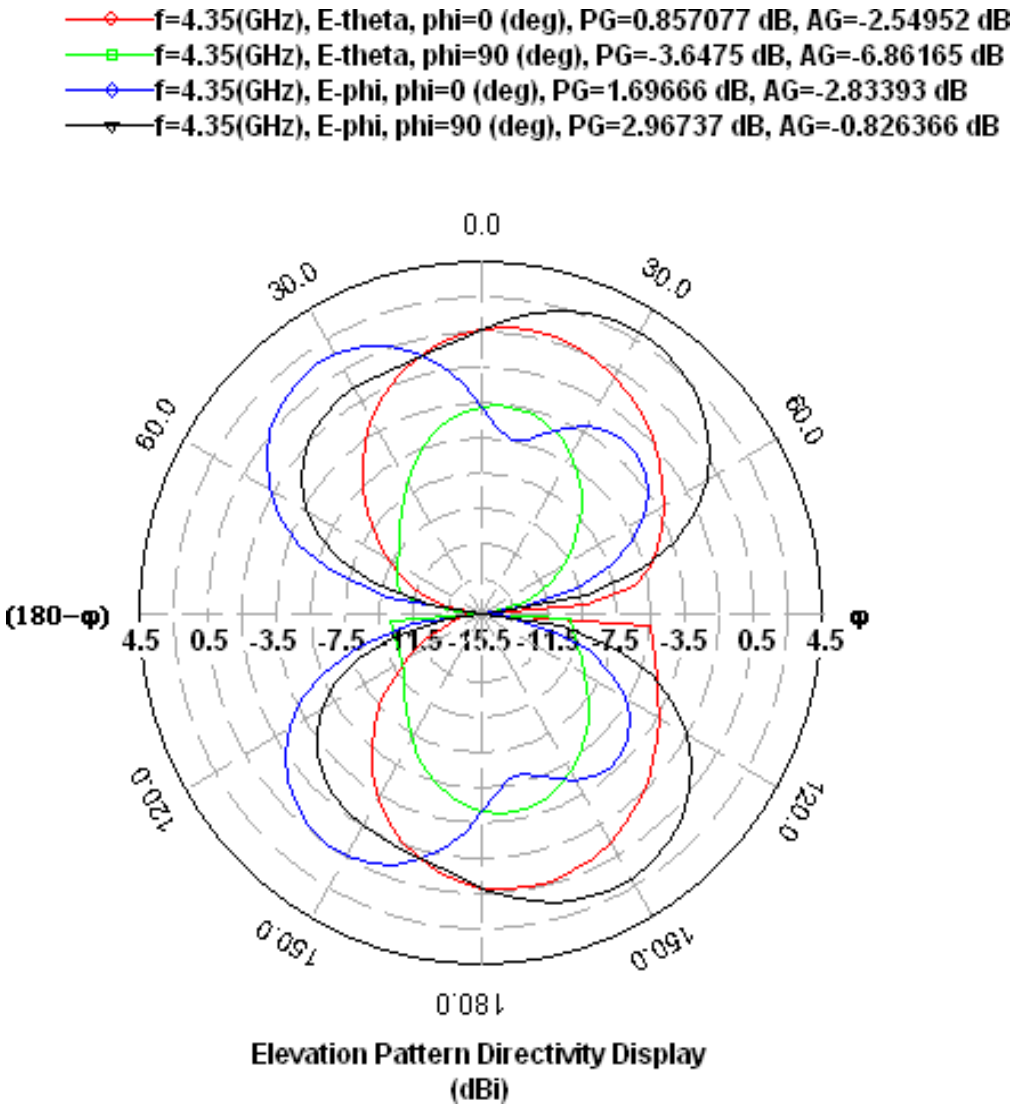


Fig. 6: Antenna design radiation pattern at center frequency f0 = 4.35 GHz

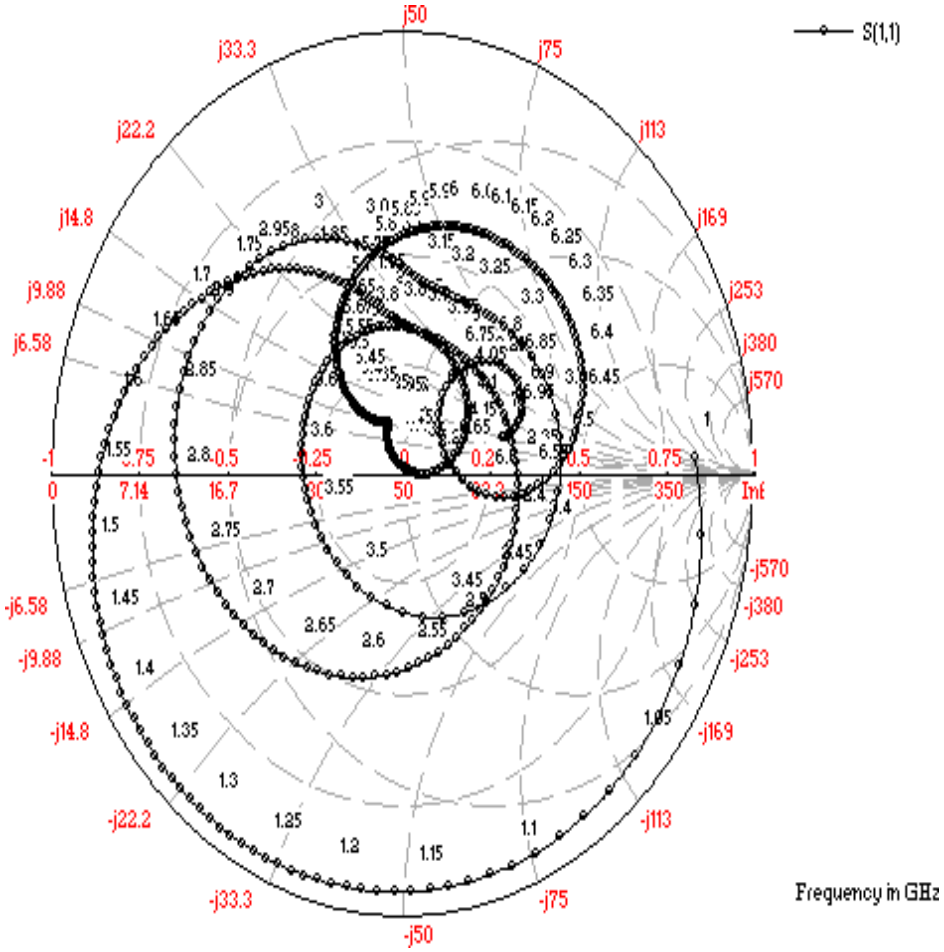


Fig. 7: Loci of impedance for the suggested antenna design

III. CONCLUSION

IE3D software was used to simulate the suggested antenna. The obtained impedance bandwidth for 10 dB return loss for a modified square-shaped microstrip patch antenna using finite ground is 37.47% (1630 MHz) of the center frequency at 4.35 GHz after corner cutting and inserting slits inside the radiating patch's edges. Other radiation characteristics are also optimized, which is very good agreement for wireless communication systems.

REFERENCES

[1] Milligan, T. A., "Modern Antenna Design," Hoboken, New Jersey: John Wiley & Sons, 2005.
[2] Garg, R., P. Bhartia, I. Bahl, and A. Ittipiboon, "Microstrip Antenna Design Handbook," Boston, London: Artech House, 2001.
[3] K. L. Wong, "Compact and Broadband Microstrip Antenna," John Wiley & Sons, New York, 2002.
[4]Kumar, G. and K. P. Ray, "Broadband Microstrip Antennas," Artech House, USA, 2003.
[5] Microstrip Antennas: The Analysis and Design of Microstrip Antennas and Arrays, D.M. Pozar and D.H. Schaubert, New York: IEEE Press, 1995.
[6] Antenna Theory Analysis and Design, C.A. Balanis. Wiley, Hoboken, New Jersey, 3rd ed., 2005
[7] "Multilayer multi resonator circular microstrip antennas for broadband and dualband operations," Microwave and Optical Technology Letters, Vol. 47, No. 5, 489–494, December 2005, Ray, K. P., S. Ghosh, and K. Nirmala.

[8] Ghassemi, N., M. H. Neshati, and J. Rashed-Mohassel, "A multilayer multiresonator aperture coupled microstrip antenna for ultra wideband operations," IEEE Applied Electromagnetic Conference 2007, Kolkata, India, December 19–20, 2007.
[9] Zehforoosh, Y., Ghobadi, C., and Nourinia, J., "Antenna design for ultra wideband applications using a new multilayer structure," PIER Online, Vol. 2, No. 6, 544–549, 2006.
[10] Kim, T., J. Choi, and J. S. Jeon, "Wideband microstrip array antenna design for PCS and IMT-2000 service," Microwave and Optical Technology Letters, Vol. 30, No. 4, 261–265, August 2001.