Design and Analysis of Fabricated Rectangular Microstrip Antenna with Defected Ground Structure for UWB Applications

Sandeep Toshniwal, Tanushri Mukherjee, Prashant Bijawat, Sanyog Rawat and Kanad Ray

Abstract This research paper proposes to design and fabrication of MS patch antenna with defected ground structure. In the proposed design, the geometry operates from 3.2 GHz to 5.06 GHz and provides impedance bandwidth of 45.3%, having stable pattern characteristics over the entire range. Antenna is fabricated on a FR-4 epoxy substrate (h = 1.59 mm), and IE3D simulation software is used.

Keywords MS patch antenna · Bandwidth · Defected ground structure VSWR · Smith chart

1 Introduction

UWB systems have been used extensively, because of their intrinsic advantages like minute dimension, greater data rate, high bandwidth, easy to integrate, and less power consumption. UWB utilizes the frequency spectrum ranging from 3.1 to 10.6 GHz allocated by the FCC [1–8]. In this bandwidth, a number of additional licensed systems exist for which the ultra-wide band systems cause the interference. [9–14].

S. Toshniwal · T. Mukherjee
Department of ECE, Kautilya Institute of Engineering and Technology, Jaipur, India
e-mail: toshniwal.sandeep@gmail.com

P. Bijawat
Department of ECE, MNIT, Jaipur, India

S. Rawat
Department of ECE, Manipal University, Jaipur, Rajasthan, India
e-mail: sanyograwat@gmail.com

K. Ray (✉)
Amity School of Applied Science, Amity University Rajasthan, Jaipur, India
e-mail: kanadray00@gmail.com

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The **defected ground structure** (DGS) is a recent method, where the metal ground plane of a microstrip patch is purposely customized to improve antenna performance.

MS patch antennas have various advantages like low profile, less weight, inexpensive, and easy fabrication. For the handheld wireless devices like cellular phones, pagers microstrip antennas are extremely compatible with embedded antennas. But patch antenna has many disadvantages as less gain and bandwidth. Some other problems which will occur while using microstrip patch antennas are surface waves in the substrate layer. Due to the surface waves, excitation losses the gain and BW of antenna will decrease. So to overcome that entire drawback, there have been inventions of the new technique called **defected ground structure** [15–23].

2 MS Patch Antenna Design (with Defected Ground Plane)

The design of a rectangular MS patch antenna with defected ground plane is shown in Fig. 1. The MS patch antenna is fabricated on the FR-4 dielectric substrate (h = 1.59 mm and tan δ = 0.02). A radiating patch (10 mm × 12 mm) and a feed of size (1.9 mm × 8 mm) are printed on the same surface of the FR-4. The antenna performance (BW and gain) is enhanced by taking defected ground plane of dimension of 30 mm × 60 mm. Using defected ground, a bandwidth of 1.8 GHz and gain 4 dBi is achieved.

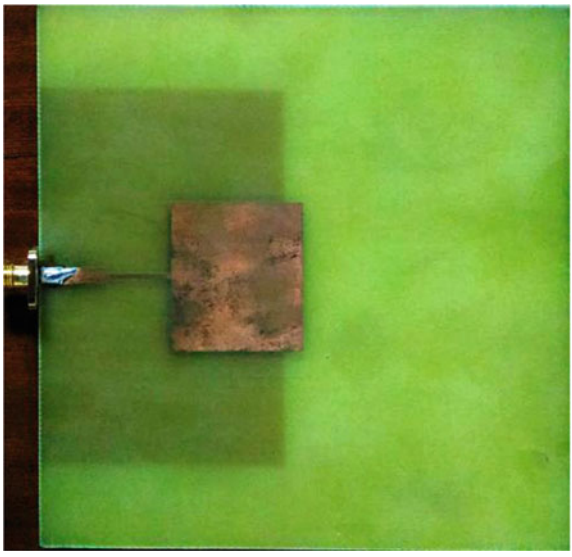

Fig. 1 Fabricated MS patch antenna with finite ground plane

3 Results and Discussion

Measured results of design are presented in this section, Fig. 2 represents the return loss (S11) curve for the fabricated design. The antenna is efficiently operating from 3.23 to 5.061 GHz. The proposed antenna exhibits bandwidth of 1.8 GHz (45.3%).

Figure 3 represents the VSWR with frequency curve for fabricated design. The voltage standing wave ratio falls below 2 for the preferred band (Fig. 4).

Figure 5 represents the Smith chart for fabricated MS patch antenna.

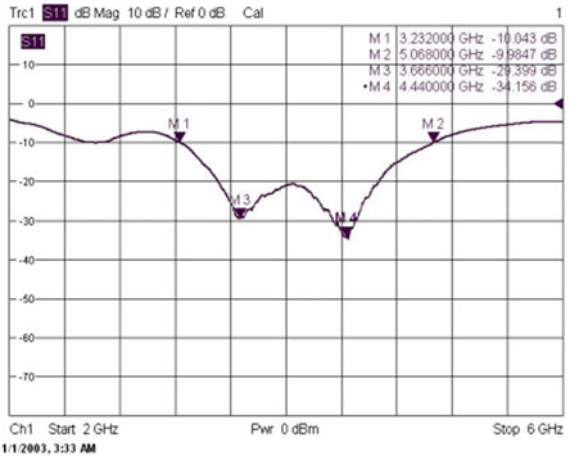

Fig. 2 Return loss (S_{11}) curve for fabricated design-I

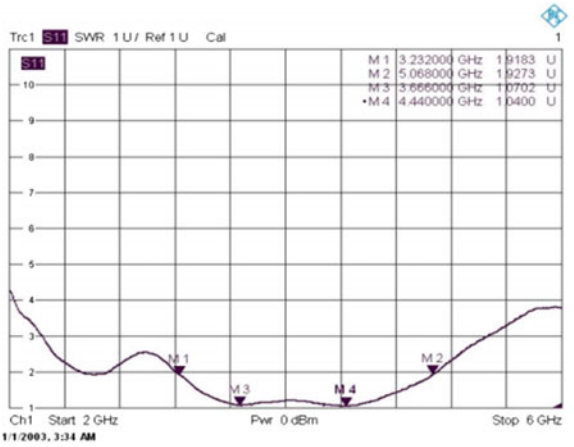

Fig. 3 VSWR with frequency curve for fabricated design-I

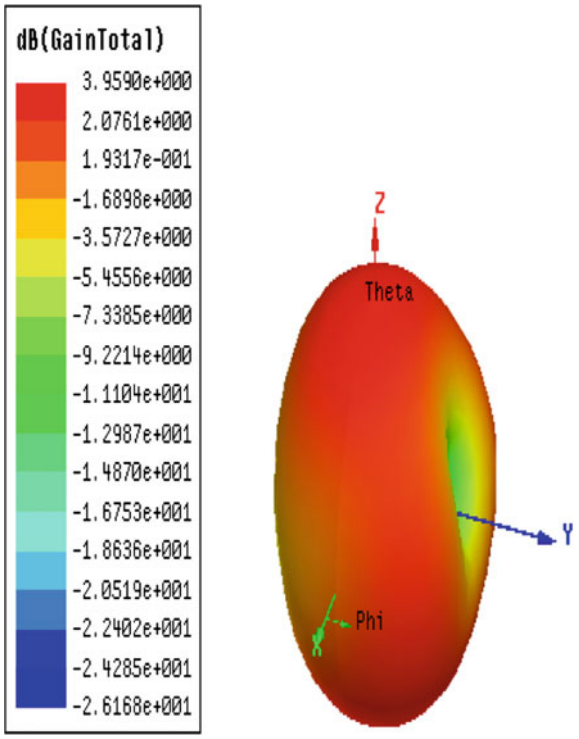

Fig. 4 Radiation pattern of MS patch antenna-I

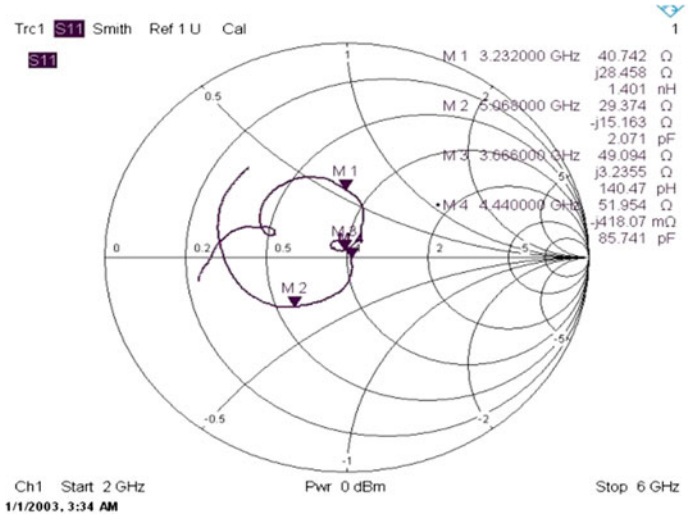

Fig. 5 Smith chart of fabricated MS antenna design-I

4 Conclusions

The proposed design showed a broad bandwidth MS patch antenna can be fabricated with **defected ground** plane with rectangular patch. A BW of 2.36 GHz (45.3%) is achieved. The bandwidth of antenna with defected ground with simple patch increases up to 45.3% and in antenna with defected ground with modified patch increases up to 47%. Also, the gain of modified patch has been amplified up to 4 dBi. The modified antenna can be used for ultra-wide band applications of wireless communication.

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