Modified Square Wideband Microstrip Patch Antenna with Finite Ground Plane

Alok Agarwal, P.K. Singhal

Abstract- This paper presents a modified square microstrip patch antenna design with finite ground plane to increase the impedance bandwidth. It is observed that the conventional microstrip patch antenna design of the same design parameter with infinite ground plane gives bandwidth 2-3 %, whereas this modified square microstrip patch antenna design with finite ground plane gives the impedance bandwidth about 50.13 % of the center frequency at 3.79 GHz. The antenna design is compact and optimized for wireless communication applications. The electromagnetic simulation of the proposed antenna has been carried out using IE3D software of Zeland Software.

Index Terms— Bandwidth, directivity, finite ground, microstrip antenna, return loss, smith chart, wideband

1. INTRODUCTION

Conventional microstrip patch antenna in general have a conducting patch printed on a grounded substrate and have the attractive features of low profile, light weight, easy fabrication and conformability to mounting. However, microstrip antennas inherently have a narrow bandwidth and bandwidth enhancement is usually demanded for practical applications in wireless communication. The size reduction and bandwidth enhancement are major design considerations for practical applications of microstrip antenna. For this reason, studies to achieve compact and broad band operations of microstrip antennas have greatly increased [4]. Microstrip patch antennas are widely implemented in many commercial applications of wireless communication. Microstrip patch antennas are manufactured using printed circuit technology, so that mass production can be achieved at a low cost.

Compact microstrip patch antennas have recently received much attention due to the increasing demand of small antennas for mobile and wireless communications equipment. For achieving microstrip antennas with a reduced size at a fixed operating frequency, the use of a high-permittivity substrate is an effective method. By using finite ground plane the impedance bandwidth and antenna efficiency can be enhanced. The antenna's ground plane can be meandered by inserting several meandering slits at its edges or slot can be introduced at the ground plane. The obtained impedance bandwidth for a compact design with a meandered ground plane can be greater than that of the corresponding conventional microstrip antenna [3].

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The electromagnetic simulation of the proposed antenna has been carried out using IE3D software of Zeland Software. VSWR, input impedance, return loss, smith chart, directivity, antenna gain, radiating efficiency, radiation pattern etc. can be evaluated using IE3D software.

2. ANTENNA DESIGN SPECIFICATION

In this proposed antenna design, the modified square patch is printed on inexpensive FR4 (copper-cladded plate) having dielectric constant (Єr) of 4.4, loss tangent tan δ = 0.02 and height 1.6 mm. In this patch antenna design, an effort has been made to enhance the bandwidth due to modified square micro strip patch antenna with finite ground plane. The 50-ohm coaxial cable with SMA connector is used for feeding the microstrip patch antenna. Fig 1 shows the modified square microstrip patch antenna of proposed antenna design. In this proposed antenna design, with center frequency f_0 = 3.79 GHz within the frequency range 2.5 GHz to 5 GHz, step frequency = 0.01 GHz, In this proposed antenna design, length of patch L = 30 mm**,** width of patch W = 30 mm, with finite ground plane of the dimension L = 45 mm and W = 45 mm and feed point locations at the patch is (-11.9,-12). Fig 2 shows the variation of return loss with frequency for the proposed antenna design; the impedance bandwidth is taken from the 10-dB return loss. Fig 3 shows the variation of directivity (in dBi) with frequency for the proposed antenna design. Fig 4 shows the variation of efficiency with frequency for the proposed antenna design. Fig 5 shows the Impedance loci (Smith chart) for the proposed antenna design. Here due to modified square micro strip patch antenna with finite ground plane of this antenna design; the impedance bandwidth, determined from the 10-dB return loss, is coming out to be 50.13 % of the center frequency at 3.79 GHz. Bandwidth for the proposed antenna design is sufficiently high and other

radiation characteristics are also satisfactory and stable over the entire frequency range considered.

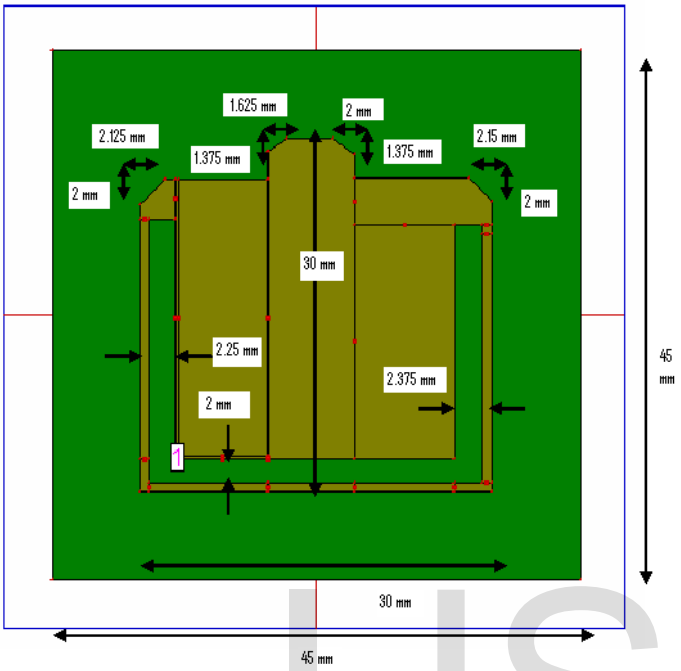

Fig. 1: Modified square microstrip patch antenna with finite ground plane

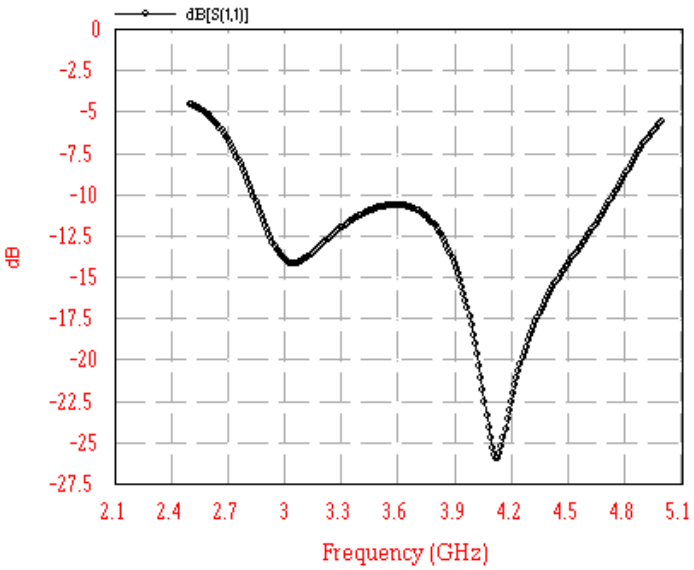

Fig. 2: Variation of return loss with frequency for proposed antenna design

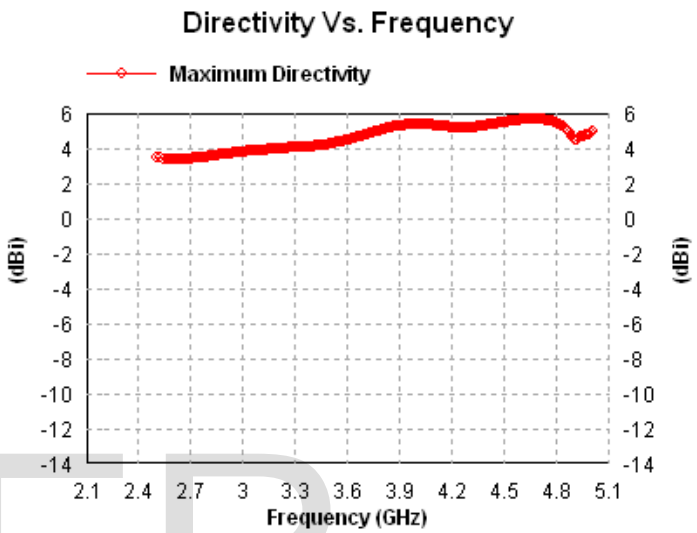

Fig. 3: Variation of directivity with frequency for proposed antenna design

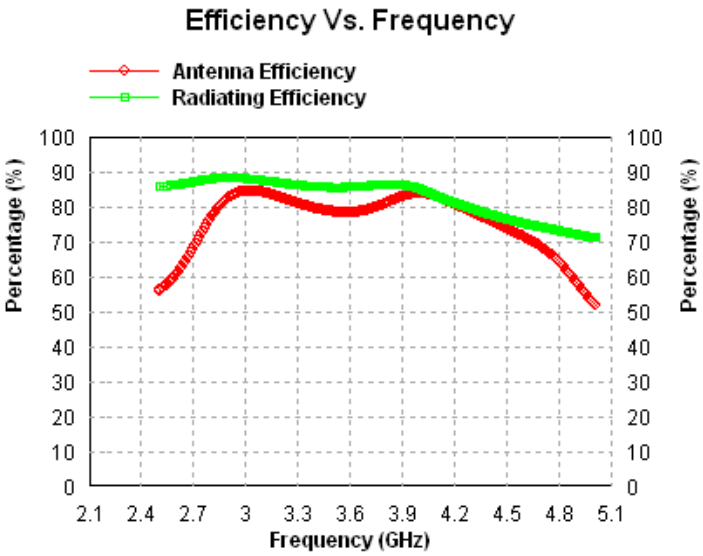

Fig. 4: Variation of Efficiency with frequency for proposed antenna design

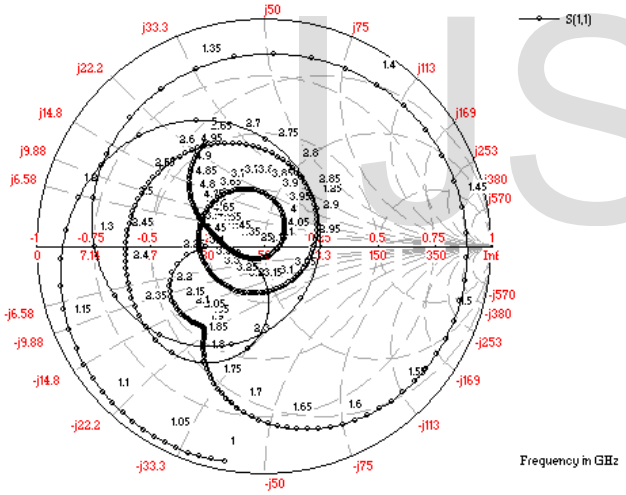

Fig. 5: Impedance loci for proposed antenna design

3. Result and Discussions

The simulation result of the proposed antenna design has been carried out by using IE3D software. For modified compact square microstrip patch antenna with finite ground plane of this antenna design; the impedance bandwidth, determined from the 10-dB return loss, is coming out to be 50.13 % of the center frequency at 3.79 GHz. This is very much increased and optimized as compared with conventional microstrip patch antenna design of the same design parameter with infinite ground plane and can be utilized for wireless communication applications.

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