H – Shaped MSA and Modified Square WMSAWith Slot Loaded Finite Ground

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Abstract

A compact size, high bandwidth H-shaped microstrip patch antenna design with promising efficiency for wireless applications, operating at a particular frequency 3.5GHz has been proposed. A H - Shaped Micro Strip Antenna (MSA) with ground plane connected, improves the bandwidth to an appreciable 21.27 % in the frequency range of 3-4 GHz whereas with the same design parameters the simple microstrip patch antenna design conventionally givesvery low bandwidth (from 2-4 %).

Another Modified square compact Wideband Micro Strip Antenna (WMSA) having slot loaded finite ground is also proposed in this paper for dual band operation. Dual band modified square microstrip patch antenna with wideband is achieved by corner cut and inserting slits inside the edges of the radiating patch having slot loaded finite ground plane. It is observed that two operating frequencies at 3.16 and 4.21 GHz can be obtained. The obtained impedance bandwidth for 10 dB return loss for these operating frequencies are 14.24 % and 28.74 % respectively. Compactness and dual band operation with wide bandwidth of this antenna with no adverse effect to environment is widely applicable for the wireless communication systems.

Keywords: Bandwidth, wideband, dual band, return loss, finite ground, Impedance loci.

I. INTRODUCTION

The conventional microstrip patch antenna have a conducting patch printed on a grounded substrate and have the features of low profile, light weight, easy fabrication and conformability to mounting. Although microstrip antennas inherently have a narrow bandwidth [1-21] and bandwidth enhancement is usually demanded for wireless communication applications. Applications in present day mobile communication systems usually require smaller antenna size in order to meet the miniaturization requirements of mobile units. Thus size reduction and bandwidth enhancement are becoming major design considerations for practical applications of microstrip antennas. In addition microstrip antennas are manufactured using printed circuit technology, so that mass production can be achieved at a low cost. A Microstrip antenna in its simplest configuration consist of a very thin ($t << \lambda_0$ where λ_0 is the free space wavelength) metallic strip (patch) placed a small fraction of a wavelength ($h << \lambda_0$, usually $0.003\ \lambda_0 \leq h \leq 0.05\ \lambda_0$) above a conducting ground plane. A wide range of dielectric substrate thickness and permittivity can be used and the special case when the strip and ground are separated by an air space. The electromagnetic simulation of the proposed antenna designs have been carried out using IE3D software of Zeland Software and may be fabricated with no adverse effect to environment. VSWR, input impedance, return loss, smith chart, directivity, antenna gain, radiating efficiency and radiation pattern etc. can be evaluated using IE3D software.

II. ANTENNA DESIGN SPECIFICATIONS

i. PROPOSED ANTENNA DESIGN 1

In this proposed antenna design 1, formation of H- shape on patch layer gives very effective results in all its radiation parameter along with enhancement in its band width which is our main concern. Fig. 1 shows the proposed rectangular microstrip patch antenna design 1. The Antenna operates at resonance frequency f_c = 3.5 GHz. The proposed antenna design gives enhanced bandwidth with 21.27 % in the frequency range of 3 GHz to 4 GHz with feed point locations = (-11.75, 1.3). Fig. 2 shows the variation of return loss with frequency for proposed antenna design 1. Fig. 3 shows the impedance loci for proposed antenna design 1. Fig. 4 shows the variation of directivity vs frequency for proposed antenna design 1.

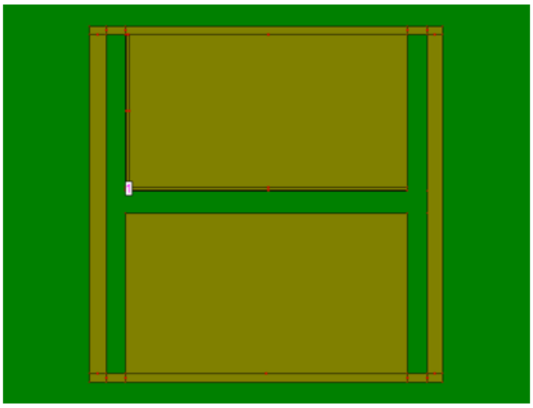

Fig. 1: Rectangular microstrip patch antenna of proposed design 1.

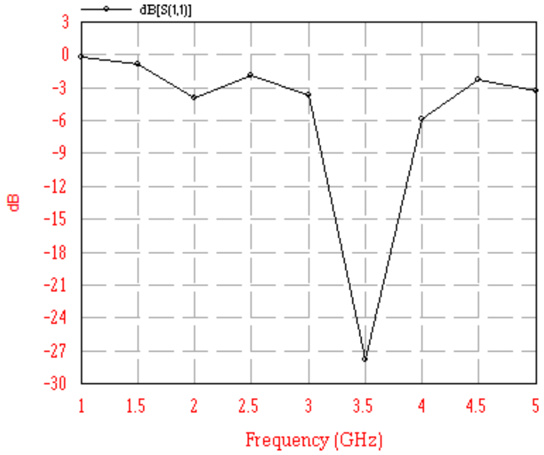

Fig. 2: Variation of return loss with frequency for proposed antenna design 1.

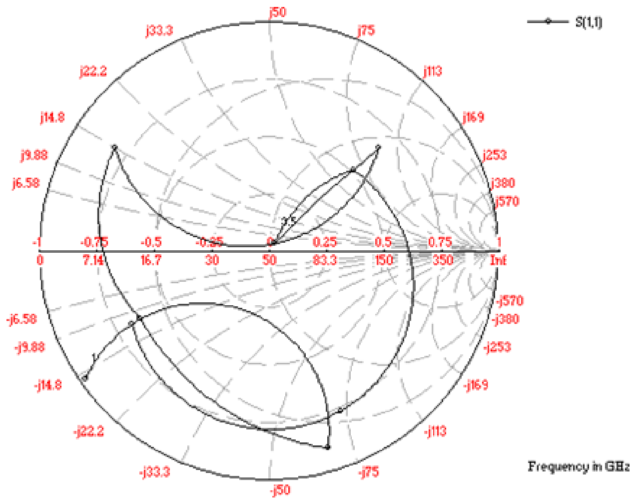

Fig. 3: Impedance Loci for design 1.

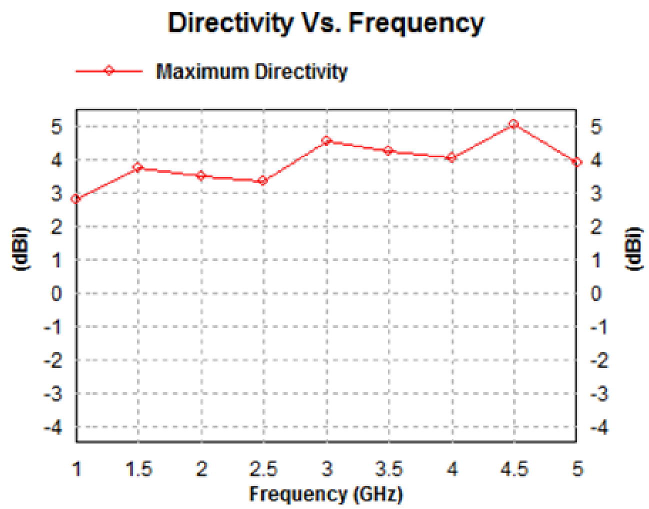

Fig. 4: Directivity vs. Frequency for design 1.

RESULT AND DISCUSSIONS

The simulation results of the proposed antenna design 1 have been carried out by using IE3D software. The simple microstrip patch antenna design gives very low bandwidth (from 2-4 %) whereas with the same design parameters proposed H-shape microstrip patch antenna design gives enhanced bandwidth of 21.27 % which is quite a good increment in the bandwidth. After simulating & analyzing all the parameters the antenna is acceptable for various wireless communication applications.

ii. PROPOSED ANTENNA DESIGN 2

In this proposed antenna design 2, the modified square patch is printed on inexpensive FR4 (copper-cladded plate) having dielectric constant (Ꞓr) of 4.4, loss tangent tan δ = 0.02 and substrate height 1.6 mm. In this patch antenna design 2, dual band modified square microstrip patch antenna with wideband is achieved by corner cut and inserting slits inside the edges of the radiating patch having slot loaded finite ground plane. The 50-ohm coaxial cable with SMA connector is used for feeding the microstrip patch antenna. Fig 5 shows the front view of modified square microstrip patch antenna with slot loaded finite ground plane. It is observed that two operating frequencies at 3.16 and 4.21 GHz can be obtained, within the frequency range 2 GHz to 5 GHz with step frequency =

0.01 GHz, In this proposed modified square patch antenna design 2, length of patch L = 30 mm, width of patch W = 30mm with slot loaded finite ground plane of the dimension L

= 45 mm and W = 45 mm and square slot of dimensions 10 mm × 10 mm at the centre position, feed point locations at the patch is (-10.775, -12). Fig 6 shows the back view of modified square microstrip patch antenna 2 with slot loaded finite ground plane. Fig 7 shows the variation of return loss with frequency for the proposed antenna design 2; the impedance bandwidth is taken from the 10-dB return loss. Fig 8 shows the variation of directivity (in dBi) with frequency for the proposed antenna design 2. Fig 9 shows the Impedance loci (Smith chart) for the proposed antenna design 2. Here due to modified square microstrip patch antenna design 2 with corner cut and inserting slits inside the edges of the radiating patch having slot loaded finite ground plane, the obtained impedance bandwidth for 10 dB return loss for these operating frequencies are 14.24 % and 28.74 % respectively. The other radiation characteristics of the proposed antenna design for these operating frequencies are also coming out to be satisfactory. Compactness and dual band operation with wide bandwidth makes this antenna practically useful for the application of wireless communication.

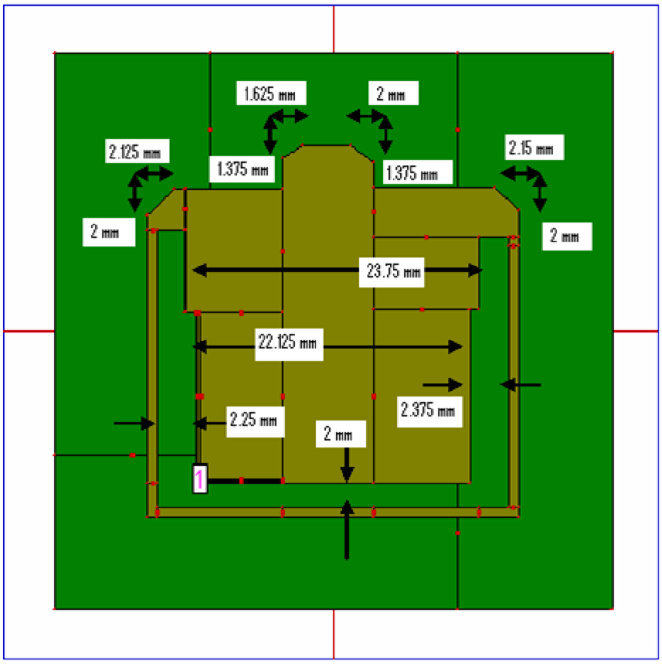

Fig. 5: Front view of modified square microstrip patch antenna design 2 with slot loaded finite ground.

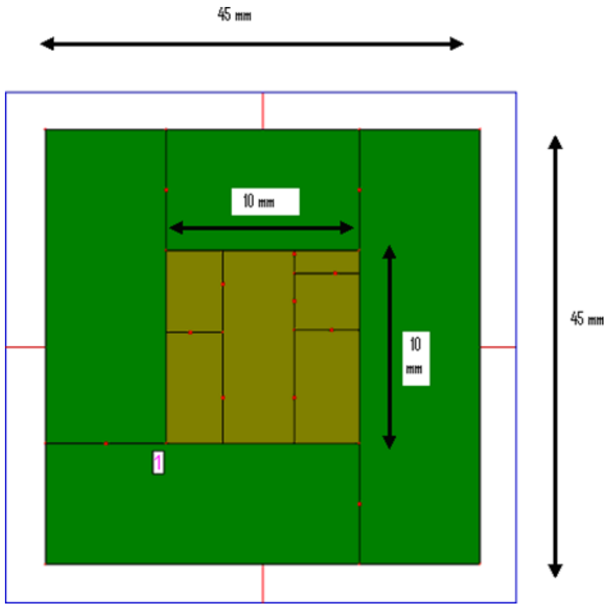

Fig. 6: Back view of modified square microstrip patch antenna design 2 with slot loaded finite ground.

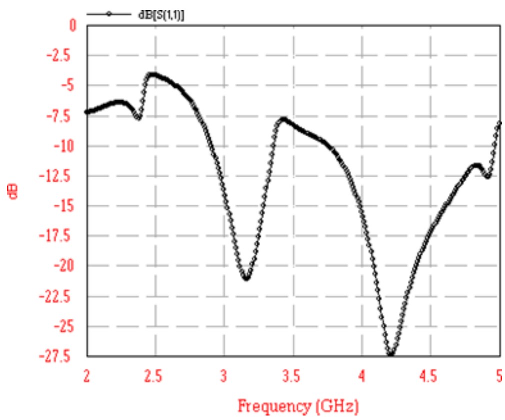

Fig. 7: Variation of return loss with frequency for proposed antenna design 2.

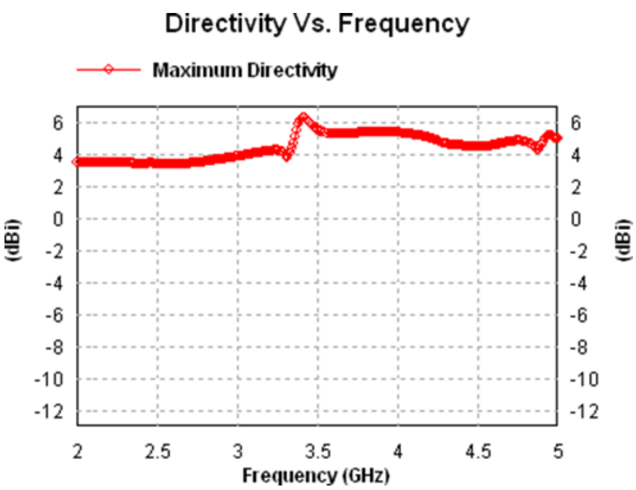

Fig. 8: Variation of directivity with frequency for proposed antenna design 2.

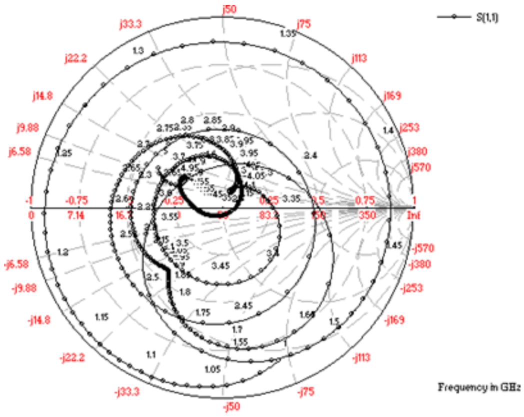

Fig. 9: Impedance loci for proposed antenna design 2

RESULT AND DISCUSSIONS

The simulation result of the proposed antenna design 2 has been carried out by using IE3D software. For dual band modified square microstrip patch antenna with corner cut and inserting slits inside the edges of the radiating patch having square slot loaded finite ground plane, two operating frequencies at 3.16 and 4.21 GHz are being obtained. The obtained impedance bandwidth for 10 dB return loss for these operating frequencies are 14.24 % and 28.74 % respectively, Compactness and dual band operation with wide bandwidth of this antenna makes it practicallyapplicable for the wireless communication systems.

III. CONCLUSION

The simple microstrip patch antenna design gives very low bandwidth (from 2-4 %) whereas with the same design parameters proposed H-shape microstrip patch antenna design 1 gives enhanced bandwidth of 21.27 %.

For dual band modified square microstrip patch antenna with corner cut and inserting slits inside the edges of the radiating patch having square slot loaded finite ground plane, two operating frequencies at 3.16 and 4.21 GHz are being obtained. The obtained impedance bandwidth for 10 dB return loss for these operating frequencies are 14.24 % and 28.74 % respectively.

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