Truncated Gap Coupled Wideband Rectangular Microstrip Patch Antenna

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***Abstract* – In the proposed antenna design the gap coupled parasitic patch with truncated corner and reduced size are placed along the non radiating edge of fed rectangular (with truncated corners and reduced size) micro strip patch. A patch placed close to the feed patch gets excited through the air gap; known as a parasitic patch. In the proposed reduced size antenna design with truncated corner and gap coupled patches, there is an enhancement of band width with satisfactory radiation characteristics like directivity, impedance matching, gain etc. Therefore the antenna will give satisfactory results as compared to a conventional rectangular microstrip patch antenna of same design parameters without size reduction. The proposed antenna design fulfills the demand of integrated RF systems. With compactness of electronic systems for mobile and wireless communication, there is an increasing demand of small and low cost antennas which gives satisfactory radiation characteristics.**

***Keywords* - bandwidth, microstrip antenna, return loss, VSWR.**

I. Introduction

Microstrip patch antennas are widely implemented in many commercial applications such as mobile radio and wireless communication. In addition, applications in present day mobile communication systems usually require smaller antenna size in order to meet the miniaturization requirements of mobile units, as the demand for increased electronic mobility grows the need for small handsets are most likely increased. A small antenna size is required as one of the important factors in portable mobile communication systems. Thus size reduction and bandwidth enhancement are becoming major design considerations for practical applications of microstrip antennas. For this reason, studies to achieve compact and broadband operations of microstrip antennas have greatly increased. In addition microstrip antennas are manufactured using printed circuit technology, so that mass production can be achieved at a low cost.

Conventional microstrip 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 [1-15] and bandwidth enhancement is usually demanded for practical applications. 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 and radiation pattern etc. can be evaluated using IE3D software.

II. Antenna Design Specification

Fig.1 shows the rectangular microstrip patch antenna of design 1. The 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. The 50-ohm coaxial cable with SMA connector is used for feeding the microstrip patch antenna. With operating frequency f_0 = 2.37 GHz, frequency range = 2 GHz to 3 GHz, step frequency = 0.01 GHz, length of patch L = 29 mm, width of patch W = 55 mm, probe diameter = 0.16mm, feed point locations = (-11.98, -0.175). Fig. 2 shows the variation of return loss with frequency for design 1. Fig. 3 shows the variation of VSWR with frequency for design 1. Fig. 4 shows the variation of directivity with frequency for design 1. Fig. 5 shows the Impedance loci for design 1. The measured bandwidth for design 1 is equal to 2.11 %, which is very narrow bandwidth and can not be utilized for wireless application.

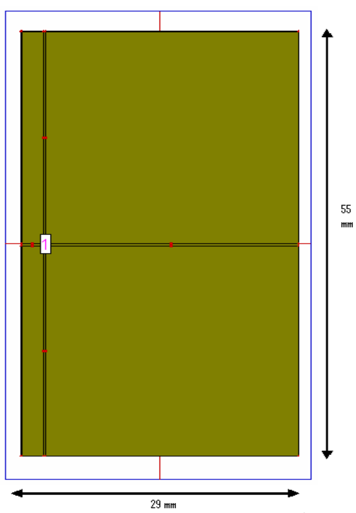

Fig. 1 Rectangular microstrip patch antenna of design 1

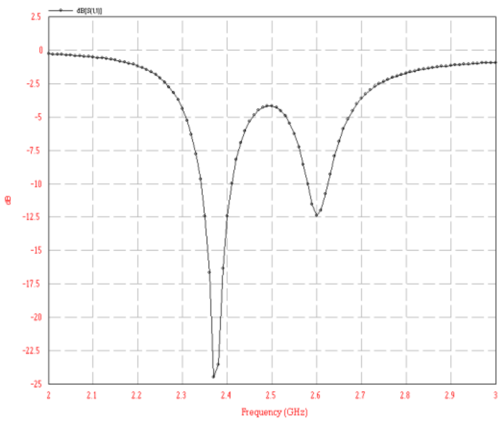

Fig. 2 Variation of return loss with frequency for design 1

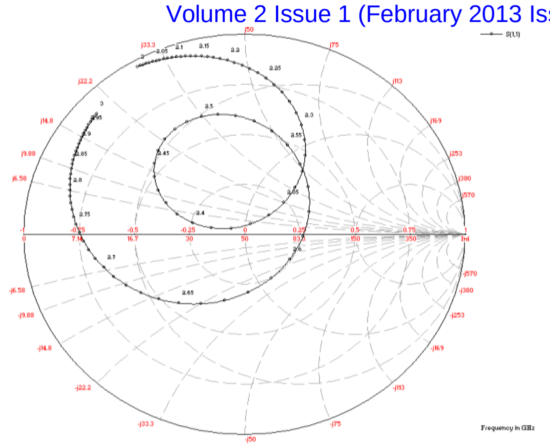

Fig. 5 Impedance loci for design 1

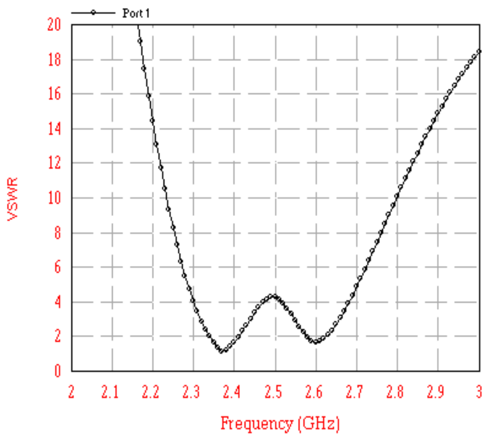

Fig. 3 Variation of VSWR with frequency for design 1

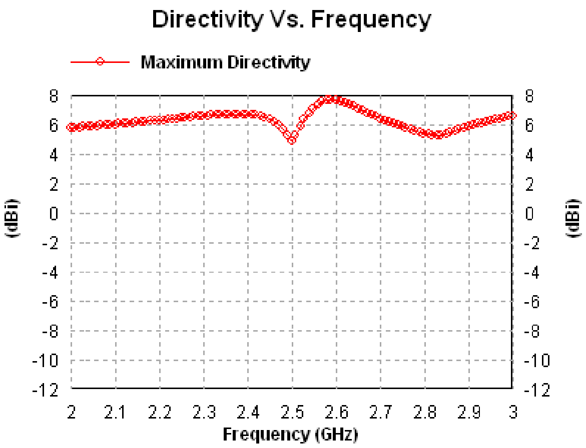

Fig. 4 Variation of directivity with frequency for design 1

With the same design parameters as in design 1, the patches are 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, an effort has been made to enhance the bandwidth in design 2. The 50-ohm coaxial cable with SMA connector is used for feeding the microstrip patch antenna. Bandwidth has been enhanced if the truncated gap coupled reduced size rectangular micro strip patch antenna is used. Fig. 6 shows the truncated gap coupled reduced size rectangular micro strip patch antenna design 2. In this proposed design 2, air gap of 0.5mm is introduced 0.425 mm below the centre horizontal axis. The operating frequency f_0 = 2.705 GHz, frequency range = 2 GHz to 3.6 GHz, step frequency = 0.01 GHz, In this proposed antenna design 2 the patch size is reduced by taking length of patch L = 24.25 mm (above air gap) and L = 23.95 mm (below air gap)**,** width of patch W = 55 mm, with three side corners are truncated, probe diameter = 0.16mm, with same feed point locations = (-11.98, -0.175) as in design 1. Fig. 7 shows the variation of return loss with frequency for design 2. Fig. 8 shows the variation of VSWR with frequency for design 2. Fig. 9 shows the variation of directivity with frequency for design 2. Fig. 10 shows the Impedance loci for design 2. Here due to truncated gap coupled reduced size rectangular micro strip patch antenna design 2; the measured bandwidth for design 2 is coming out to be 18.85 %, which is sufficiently high as compared to design 1 and other radiation characteristics are also optimized, which can be utilized for wireless applications.

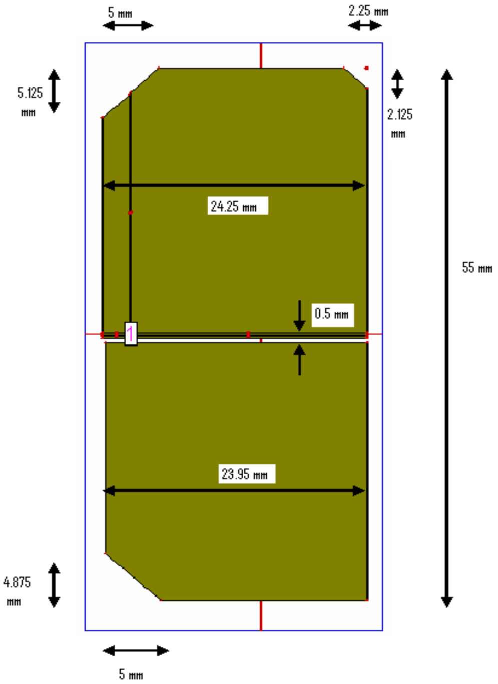

Fig. 6 Truncated gap-coupled reduced size rectangular microstrip antenna of proposed design 2

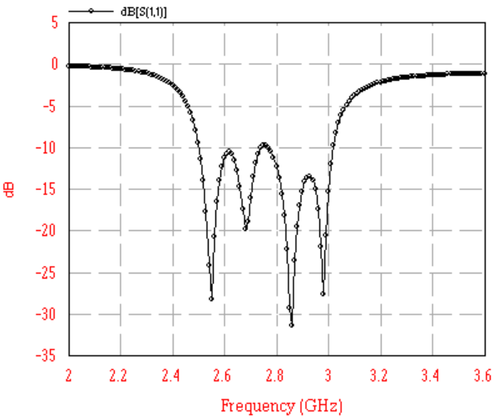

Fig. 7 Variation of return loss with frequency for design 2

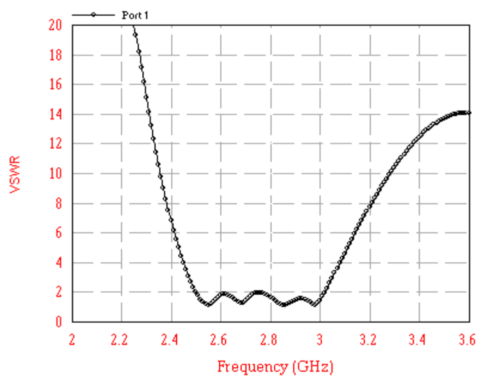

Fig. 8 Variation of VSWR with frequency for design 2

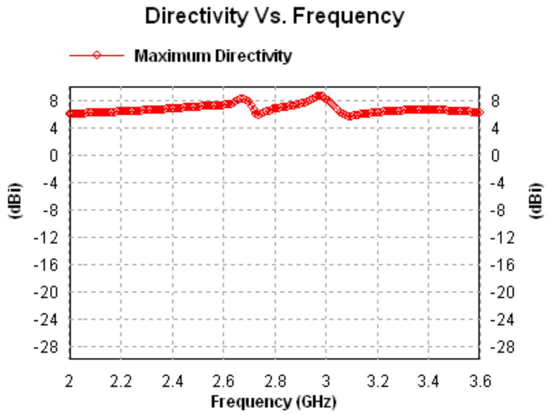

Fig. 9 Variation of directivity with frequency for design 2

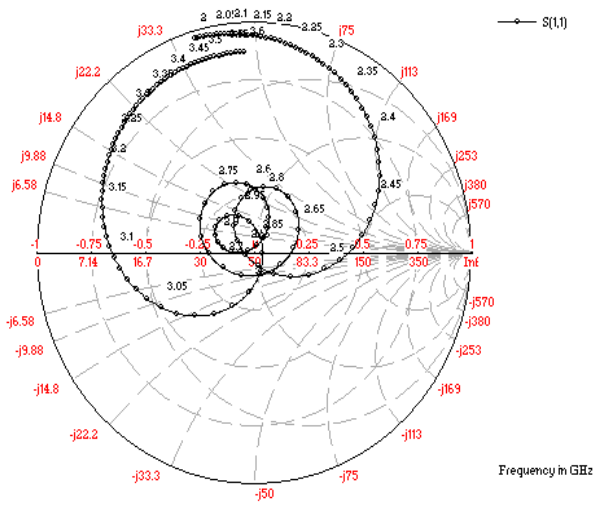

Fig. 10 Impedance loci for design 2

III. Result and Discussions

The simulation result of the proposed antenna has been carried out by using IE3D software. For rectangular micro strip patch antenna of design 1, the measured bandwidth is coming out to be 2.11%, whereas for truncated gap-coupled reduced size microstrip patch antenna of design 2, the measured bandwidth is coming out to be 18.85%, therefore it gives very good increment in bandwidth as compared to design 1. The directivity of design 2 is improved as compared to design 1 over the large bandwidth and impedance is also matching. Therefore design 2 is giving satisfactory results and fulfills the demands of mobile and wireless applications.

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