Bandwidth Enhancement of a Compact Rectangular Microstrip Patch Antenna

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Abstract – In the proposed antenna design the gap coupled parasitic patches with reduced size are placed along the radiating and non radiating edges of fed rectangular micro strip patch. A patch placed close to the feed patch gets excited through the air gap or coupling between the two patches, such a patch is known as a parasitic patch. In this proposed antenna design with reduced size there is an enhancement of band width and the antenna will give satisfactory results as compared to a rectangular microstrip antenna of same design parameters without size reduction.

Index Terms - bandwidth, microstrip antenna, return loss, VSWR.

I. INTRODUCTION

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. In addition, 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. 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.

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 design 1. The patches are printed on inexpensive FR4 having dielectric constant (εr) of 4.4 and height 1.6 mm. The coaxial connector is used to feed the antenna. The 50-ohm coaxial cable with SMA connector is used for feeding. Loss tangent tan δ = 0.02, centre frequency f0 = 2.6 GHz, frequency range = 2 GHz to 3 GHz, step frequency = 0.01 GHz, length of patch L = 30 mm, width of patch W = 55 mm, probe diameter = 0.16mm, feed point locations = (-8.3, 0). 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 13.1 %.
With the same design parameters an effort is made to enhance the bandwidth if the gap coupled reduced size rectangular micro strip patch antenna is used. Fig. 6 shows the gap coupled reduced size rectangular micro strip patch antenna design 2. In this proposed antenna design the patch size is reduced by approximately 33 %, centre frequency $f_0 = 2.53 \, \text{GHz}$, frequency range = 2 GHz to 3 GHz, step frequency = 0.01 GHz, length of patch $L = 30 \, \text{mm}$, width of patch $W = 55 \, \text{mm}$, probe diameter = 0.16mm, feed point locations = (-8.3, 0). 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 gap coupled reduced size rectangular micro strip patch antenna design 2; the measured bandwidth for design 2 is equal to 20.5%.

Fig. 6: 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.
III. RESULT AND DISCUSSIONS

The simulation result of the proposed antenna has been carried out by using IE3D software. For rectangular microstrip patch antenna of design 1, the measured bandwidth is equal to 13.1% whereas for gap-coupled reduced size microstrip patch antenna of design 2, the measured bandwidth is equal to 20.5%, therefore it gives very good increment in bandwidth. The directivity of design 2 is improved as compared to design 1 over this large bandwidth and impedance is also matching. Therefore design 2 is giving satisfactory results as compared to design 1.

REFERENCES