APPENDIX - B

COMPACT RECTANGULAR MICROSTIP PATCH ANTENNA FOR MULTIBAND APPLICATIONS

A compact rectangular microstrip patch antenna for multiband applications is presented. A patch exhibits three resonances around 1.5 GHz, 2.05 GHz and 2.5 GHz covering the GPS and UMTS Bands. The multi band characteristics of the antennas is due to the using open end meandering slots in a radiating edge which is embedded in the antenna ground plane. To achieve different frequencies excited under radiating structures. The antenna is simulated using Ansoft’s HFSS v 11.0, which shows the good agreement with simulated results. Measured return loss and radiation patterns are observed to be nearly Omni-directional which is suitable for wireless applications. The antenna has overall dimensions of only 32 x 42 mm² when printed on a substrate of dielectric constant 4.4.

1 Introduction

Due to its low profile, the microstrip antenna has found many applications in personal communication systems and owing to the miniaturization to the communication equipments, the design for reducing the size of the micro strip antenna has received much attention. An extreme compact antenna is covering a wide operational band width. In the literature, meandering technique when applied to the ground plane of the micro strip antenna was proved to be the one of the effective method in reducing the size of the micro strip antenna and enhancement of the band width [1]. Further enhancement in the antenna band width, the size reduction was very much in need. Many combinations of the radiating patch and the ground plane slots were configured and analyzed to achieve the extreme compact and broad band antennas [2]. Introduced slots in the ground plane are helped to enhance the operational band width of the terminal antenna at the upper end of the inverted frequency band. Recently, brodenining of the lower operational frequency band was achieved using two open end slots in the ground plane under the radiating element (inverted F-Type patch) [3]. It was found that the use of parallel open end slots in the ground plane decreases the resonant frequency of the ground plane and enhance the
band width of the lower operational frequency band. In this paper we present, a compact rectangular micro strip patch antenna with meandering slots in the ground plane. Two identical narrow open end slots were embedded to the antennas ground plane. These slots are aligned with an equal spacing parallel to the rectangular patch's radiating edge. A characteristic of such compact rectangular micro strip patch antenna are simulated and experimentally studied. However the size can be reduced by introducing slots in to the patch geometry.

II Antenna Design

A rectangular micro strip patch antenna of size L, W (55, 55) mm is designed to resonate at 3 different frequencies. It is constructed on a substrate with a dielectric constant $\varepsilon_r = 4.4$ and thickness $h = 1.6$ mm. This rectangular patch is feed by 50 $\Omega$, microstrip feed dimensions $(L, W) = (8, 2.47)$ mm. The microstrip feed is used to excite the patch as the planar feed makes the structure suitable for integration with associated microwave circuitry.

After a 1 mm narrow width up to 9 mm length, slots were embedded in the antenna ground plane. These slots are equally spaced at the microstrip line at a radiating edge feed $(L = 8$ mm, $W = 2.47$ mm), the strip length and width is adjusted to achieve lower return loss. The patch width is large enough in this case to increase the antenna gain considerable The geometry of rectangular microstrip antenna with open end meandering slots in the ground plane is shown in the figure 1.

The rectangular microstrip patch of size $(L = 32$ mm, $W = 42$ mm) is designed to resonate at 1.5 GHz, 2.05 GHz and 2.5 GHz respectively for 3 different frequency bands. The experimental and stimulated results are verified in terms of return loss in terms of decibels (dB) and radiation patterns, a good agreement was observed. The detailed results follow in the next section. FR4 substrate is used to fabricate the antenna.
Figure 1 Geometry and Fabricated Rectangular microstrip patch antenna.
Patch dimension: $L = 55$ mm, $W = 55$ mm, $w_1 = 32$ mm, $l_1 = 42$ mm,
$Sd = 9$ mm, $Stw = 2.47$ mm, $s11 = s12 = 9$ mm and $slw = 1$ mm.

III Experimental Results and Discussions

The prototype antenna with the proposed geometry have been fabricated and the results are verified experimentally using vector network analyzer and patch antenna has been simulated in Ansoft's HFSS v11.0 (High Frequency Structure Simulator). The antenna measurements like Return loss for the optimized feed position for the required multi frequency operations are measured and simulated. The variations of the return loss with frequency for the above said geometry is as shown in the figure 2. It is found that a good agreement between measurements and simulation is obtained. It is observed that experimentally, the return loss is minimum at 1.5 GHz, 2.05 GHz and 2.5 GHz respectively. The antenna has 4.5% (-10 dB return loss) band width ranging from 1.47 GHz to 1.52 GHz, 2.04 GHz to 2.06 GHz (at -20 dB return loss) and 2.45 GHz to 2.55 GHz (at -20 dB return loss). There is an error in the resonant frequency of measured and simulated results. The Measured and simulated radiation patterns at 1.95 GHz and 2.45 GHz are shown in the figure 3 and are found to be linearly polarized. Radiation patterns at other frequencies in the band also seen to have the similar characteristics.
Design and Analysis of a Compact Microstrip Dual Band Coplanar Antenna

Figure 2 Variation of return loss with frequency for simulated and measured curves

2.45 GHz @ PHI = 0 Degree

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IV Conclusions

Compact rectangular microstrip antenna with open end meandering slots in the ground plane is designed, fabricated and studied in detail. It is found that by inserting open end meandering slots in the ground plane, the resonance frequency of the antenna is significantly lowered and at the same time there is an enhancement in the band width gain and reduction in the antenna size. The antenna is resonated for multiband frequencies.

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References


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