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Effects of parasitic elements in Microstrip Patch Antenna

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***Abstract*—In modern era wireless communication is the vast area of research. For wireless communication antenna plays a vital role. In this paper a U-shaped patch antenna is fabricated on FR-4 substrate which has a EBG (Electronic band gap) structure on their ground plane. The simulation is done on HFSS (high frequency structure simulator) software and experimental results are calculated through VNA(vector network analyzer). The experimental and simulated results showed great matching results. In this design parasitic elements are also attached with design and the effects of different shape parasitic elements i.e., triangular, circle, hexagon and square region in the form of return loss (S11) and bandwidth is studied. It shows through the results that effect of parasitic elements improves the results of antenna in return loss(S11) and bandwidth. In all the different kind of shapes of parasitic elements triangular shape element design give the resonant frequency 4.42 GHz experimentally and the simulated frequency is 4.11 GHz which is very good and the bandwidth and return loss for this structure is 5.83 GHz and -40 dB respectively. So, the comparative results show this antenna has Wideband applications for wireless communication from the range of 2.51 GHz to 8.34 GHz.**

Keywords—Microstrip patch antenna, HFSS, VNA, parasitic elements, EBG, return loss, Bandwidth

I. Introduction

Researchers have long been interested in the ultra-wideband frequency range of 3.1 to 10.6 GHz, which is mostly used for wireless and mobile communication [1]. Antennas are crucial to wireless system communication, and the spark discharge experiment in UWB transmission has opened up new possibilities for the development of the technology. Due of its appealing merit and ease of manufacture, this invention is currently offered commercially as public domain. [2-3]. High bandwidth is needed for mobile communication in order for future equipment to be integrated with high performance and deliver results across many bands [4-5]. Slot loaded patch [6], multilayer broadband microstrip antenna [7], multilayer structure [8], multi-banding techniques [9], defaced ground plane structure [10, 22], split ring resonator [11], and multiple slot patch [12] are just a few of the techniques that can be used to obtain broadband techniques of antenna. Meander Antenna, L-shaped line feed, miniaturize patch, and circular ring patch are some examples of antennas. Mutual coupling is increasingly recommended for wireless devices in order to reduce size while increasing efficiency and gain of antennas [17-18]. It reduces side lobes and rear lobes by acting like an artificial conductor. These are made possible through the placement of metallic conductors [19–21]. In this study, the ground is flawed to enhance antenna performance and size for multiband operations. The metallic ground plane's back side has an etched lattice pattern that is defective to improve the performance and size of the antenna for multiband operations in this paper [22-26].

II. Design of Antennas

The microstrip patch antenna has been created on a FR4 substrate with a dielectric constant of 4.4, a loss tangent of 0.025, a thickness of 1.6 mm, and an antenna width and length of 18 mm. This antenna's design incorporates a slotted microstrip line and a partial ground plane, as seen in Fig. 1. The further measurements of the antenna are as follows: Lg is 7 mm, q is 3 mm, s is 2 mm, h is 8 mm, c is 1 mm, and p is 6.5 mm. The antenna was modeled using HFSS, and the S11 properties were noted. Additionally, in compliance with industry norms, a PCB mask was used to generate the intended antennas.

The radiation characteristics of the antennas were evaluated by means of the network analyzers HP 8510C VNA and Agilent 8362B PNA. Designing a finite ground structure with a FR4 substrate and 1.6 mm thickness with alterations to a parasitic patch and a rectangular patch in comparison is the basic idea behind this structure. On the 18 x 21 mm2 substrate, the ground and the antenna are both modified. The basic assumption is that the active element has a U-shaped geometry with full ground. Many aspects of the ground are influenced by its structure, including scattering brought on by high-frequency signals emitting in undesirable frequency ranges and bandwidth. The earth is used to decrease the influence of radiation's unfavorable bend. Therefore, an EBG (electromagnetic band gap) structure is a part of the proposed ground plane. The ground plane's dimensions can be restricted to 7x18 mm2 by utilizing this EBG structure.

Patches in the EBG structure could only be 1mm by 1mm in size. In addition, the effects of the various parasitic element structures on the antenna's performance metrics were investigated. The top copper surface of the double-sided copper FR4 sheet is used to construct the U-shape patch geometry. Additionally used as a feed line is the slotted microstrip line. This slotted strip line transmits as much electricity as feasible. The U-structure patch's limbs were covered with numerous parasitic components are inject

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