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Compact Microstrip Patch Antennas-A New Approach

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Abstract

A new microstrip patch antenna with considerable reduction is size, similar radiation characteristics to those of an equivalent rectangular microstrip patch antennas is proposed. A relationship is proposed that for finding out the resonant frequency of the geometry, without increasing the aperture area, the geometry refers to reducing the resonant frequency compared to conventional microstrip patches. This article describing the development of a relatively compact microstrip patch antennas.

Keywords: microstrip antenna, small antennas

Introduction

Microstrip antennas have a number of advantages over conventional antennas, namely smaller in size, light weight, less cost, and conformal nature. However it has many applications, for example hand held mobile communication systems, half wave microstrip antennas etched on a low cost dielectric substrate , still too large to be accumulated on the portable phone. A well-known approach is to reduce the size of a half wave patch to a quarter wave, to introduce a shorting wall at one end of the radiating edges. Although circular and rectangular gentries are most commonly used, other geometries can also be considered depending upon the applications. There are number of techniques for increasing the resonant frequency of microstrip patch antennas [1-3]. In this paper we present a new geometry for patch antennas reduced size which will give a low resonant frequency by modifying of the patch geometry (without increasing the patch area). The resonant frequency of the new design antenna becomes much lower than that of patch of conventional patch antenna.

In a basic aperture coupled patch antenna the radiating microstrip patch element is etched on the top of the antenna substrate, and the microstrip feed line is etched on the bottom of the feed substrate. Thus the thickness and dielectric constant of these two substrates can be independently chosen to optimize the specific electrical functions of the radiation and circuitry. Although the original prototype antenna used a circular coupling aperture, it was quickly realized that the use of a rectangular slot would improve the coupling, for a given aperture area, due to its increased magnetic polarization capability. Aperture coupled microstrip antennas involve more than a dozen material and dimensional parameters, and we summarize the basic trends with variation of these parameters below: antenna substrate dielectric constant, antenna substrate thickness, microstrip patch length, microstrip patch width , feed substrate dielectric constant, feed substrate thickness, slot length, slot width, feed line width, position of the feed line relative to the slot, position of the patch relative to the slot[4-5].

Advantages of microstrip patch antennas

1. Microstrip feed lines are easy to create, easy to match by controlling inset position, and easy to model. However, as substrate thickness increases, surface waves and spurious feed radiation increase, which limits the bandwidth for practical designs.

2. Microstrip antennas are relatively inexpensive to manufacture and design due to the simple two-dimensional physical geometry. They are commonly employed at UHF and higher frequencies because the antenna size is directly related to the wavelength at the resonant frequency.

Radiation pattern:

We are interested in determining and measuring the electromagnetic wave intensity at a remote location, which is represented by the radiation pattern that emanates from an antenna. This distant point is at a point in space where the wave is thought to be flat and oriented normal to the antenna. The two field components of the radiation pattern are a field vector and a field vector. The radiation pattern is the variation of the electric field as a function of angle. Cartesian coordinates or polar coordinates can be used to depict the radiation pattern. More antenna characteristics related to microstrip patch antennas, including radiation pattern, efficiency, quality factor, directivity, gain, and more, will be covered in later sections of this work.

DIRECTIONAL ANTENNAS

Speaking of omnidirectional antennas that radiate in all directions is synonymous with the term dipole antenna. An additional type of antenna is directed antennas. A directional antenna is one that emits power in a single, concentrated direction. like in microwave communications, directional antennas can be fixed in a particular spot and pointed in the direction of the receiver (or broadcaster); like in radar, they may need capabilities for rotation. Antenna quality is determined by the antenna's ability to concentrate power in one direction more than in others. This ability is commonly described by terms like gain, directivity, front-to-back ratio, half-power HPBW beamwidth, and many more. as well as antenna specifications. We'll talk about these characteristics later

Design and Theoretical details

The schematic diagram of the antenna is shown in the figure 1.

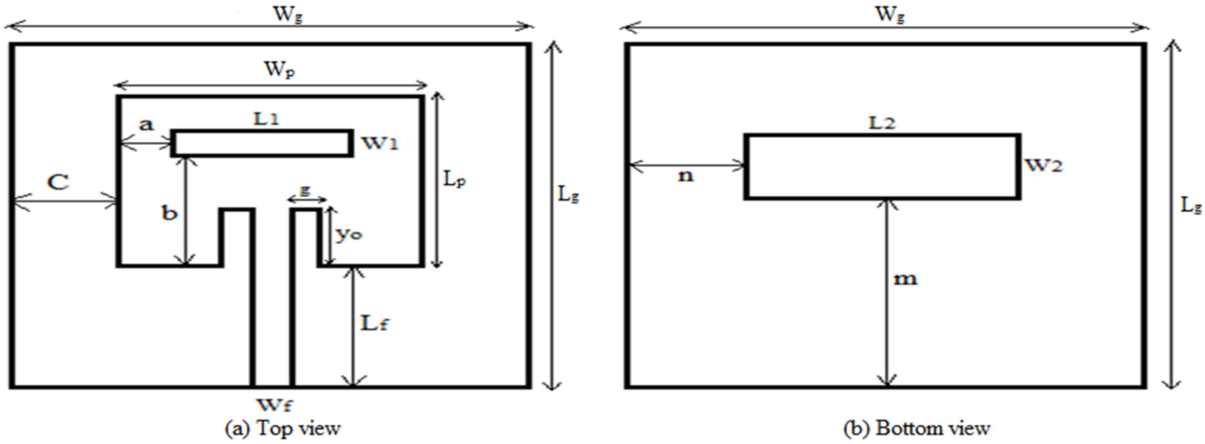
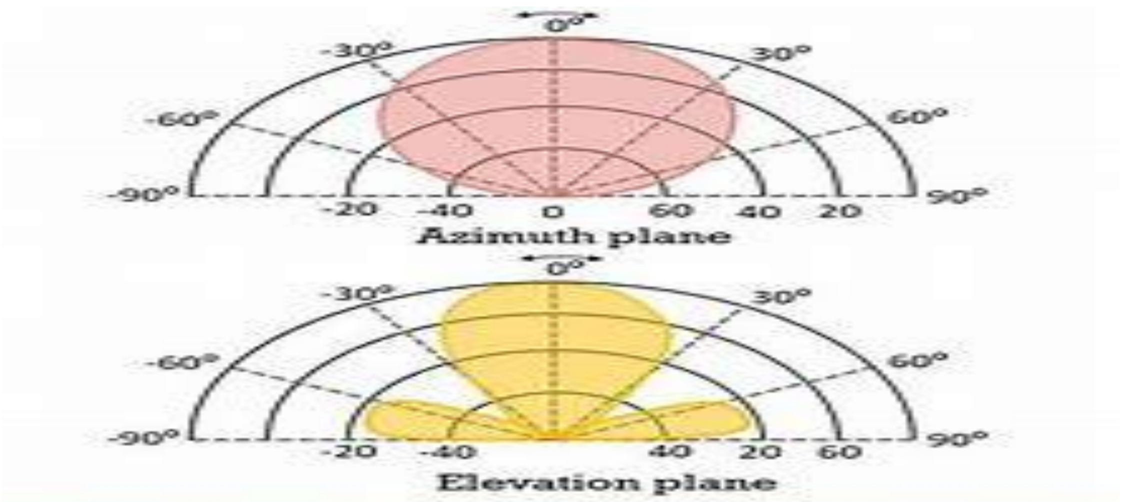


figure 1. Geometry of the proposed microstrip antenna for dual-band antenna

The resonant frequency of the modified structure for the TM10 mode is calculated by modifying the standard equation for a rectangular patch antenna as given below

$f_r = c/2\sqrt{\epsilon_r}\, L\ (1.152)/R)$



Radiation Patterns of Patch or Microstrip Antenn

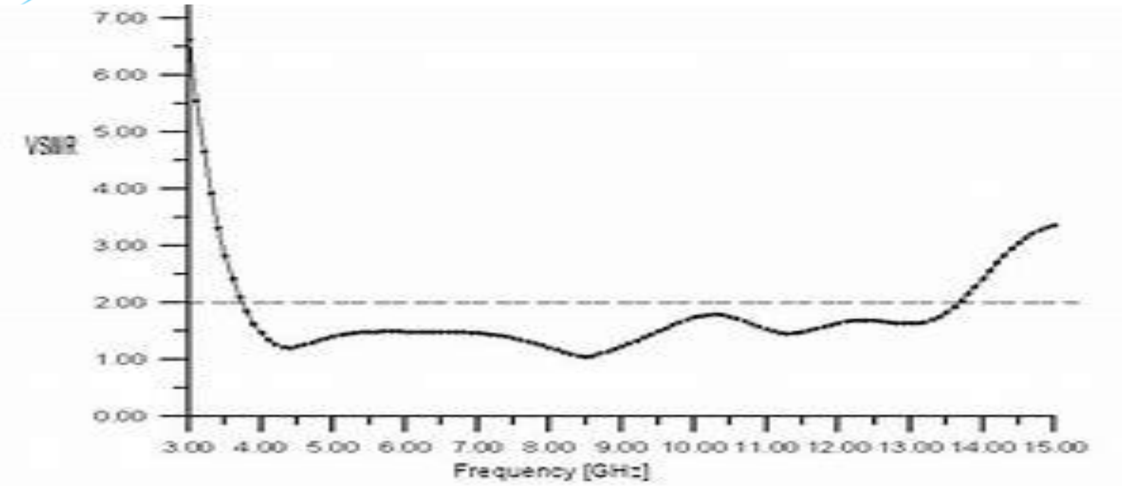


Fig: Vswr for compact microstrip patch antenna

Conclusions:

A new compact microstrip antenna geometry with a method of lowering the resonant frequencies and having comparable characteristic with a standard rectangular and e-shaped rectangular or circular shape can be developed. A theoretical approach has been developed for calculating the resonant frequency of the new antennas. It may find many applications in arrays and planar phased arrays.

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