SIERPIENSKI & CROWN SQUARE FRACTAL SHAPES SLOTTED MICROSTRIP PATCH ANTENNA

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Abstract: A new Sierpienski & Crown Square Fractal Shapes Slotted Microstrip Patch Antenna is proposed. A patch antenna is a narrowband, wide-beam antenna. These antennas are low profile, conformal to planar and non-planar surface, simple and inexpensive to manufacture using modern printed circuit technology, mechanically robust when mounted on rigid surface, compatible with MMIC designs and when the particular shape and mode are selected they are very versatile in terms of resonant frequency, polarization, field pattern and impedance. Microstrip patch antenna consist of a very thin metallic strip (patch) placed a small fraction of a wavelength above a ground plane. The patch is generally made of conducting material such as copper or gold and can take any possible shape.

This paper presents a design of Sierpienski & Crown Square Fractal Shapes Slotted Microstrip Patch Antenna and experimentally studied on IE3D software. This design is achieved by cutting Sierpienski & Crown Square Fractal Shapes Slots in a patch. With Sierpienski & Crown Square Fractal Shapes patch antenna is designed on a FR4 substrate of thickness 1.524 mm and relative permittivity of 4.4 and mounted above the ground plane at a height of 6 mm. Bandwidth as high as 36.6% are achieved with stable pattern characteristics, such as gain and cross-polarization, within its bandwidth. Impedance bandwidth, antenna gain and return loss are observed for the proposed antenna. Details of the measured and simulated results are presented and discussed.

Index Terms - Bandwidth, Sierpienski & Crown Square Fractal Shapes, Return loss, microstrip antenna.

INTRODUCTION

A microstrip antenna consists of conducting patch on a ground plane separated by dielectric substrate. In the late 1970s [4,5], the rapid development of microstrip antenna technology began. By the early 1980s basic microstrip antenna elements and arrays [7] were fairly well established in terms of design and modeling, and workers were turning their attentions to improving antenna performance features (e.g. bandwidth), and to the increased application of the technology[9]. One of these applications involved the use of microstrip antennas for integrated phased array systems, as the printed technology of microstrip antenna seemed perfectly suited to low-cost and high-density integration with active MIC or MMIC (monolithic microwave integrated circuit) phase shifter and T/R circuitry[16]. Low dielectric constant substrates are generally preferred for maximum radiation. The conducting patch can take any shape but rectangular and circular configurations are the most commonly used configuration [2]. Other configurations are complex to analyze and require heavy numerical computations. A microstrip antenna is characterized by its Length, Width, Input impedance, and Gain and radiation patterns. Various parameters of the patch antenna and its design considerations will discussed in the subsequent part. The length of the antenna is nearly half wavelength in the dielectric [6]; it is a very critical parameter, which governs the resonant frequency of the
antenna [11]. There are no hard and fast rules to find the width of the patch.

I. ANTENNA DESIGN

In a Wide-band operations of antenna have presented to satisfy various wireless applications. In this section, we demonstrate the validity of our proposed designed antenna through the simulation results. One of the main design features that make the PCB of Sierpienski & Crown Square Fractal Shapes Slotted Microstrip Patch Antenna, simple to use is the feeding with largest element. This configuration allows you to directly attach a coaxial cable feed to the microstrip transmission line on the board without having to use a matching network [13].

The design idea was taken from broadband antennas to make the antenna work in a large band of frequencies of the many broadband antennas [3,8]. Hence the chosen shape of the patch is Sierpienski & Crown Square Fractal Shapes Slotted Microstrip Patch Antenna, with an aim to achieve smaller size antenna. The Sierpienski & Crown Square Fractal Shapes Slotted Microstrip Patch Antenna is presented in fig.1 with front (top) view.

![Geometry of proposed Sierpienski & Crown Square Fractal Shapes Slotted Microstrip Patch Antenna](image)

This Sierpienski & Crown Square Fractal Shapes Slotted Microstrip Patch Antenna is fabricated on a FR4 substrate [15] of thickness 1.524 mm and relative permittivity of 4.4. It is mounted above the ground plane at height of 6 mm. In this work, transmission line feed technique is used as its main advantage is that, the feed can be placed at any place in the patch to match with its input impedance (usually 50 ohm) [17]. The software used to model and simulate the Sierpienski & Crown Square Fractal Shapes Slotted Microstrip Patch Antenna was IE3D, it can be used to calculate and plot return loss, VSWR, radiation pattern, smith chart and various other parameters.

II. RESULTS AND DISCUSSION

The proposed antenna has been simulated using IE3D software [12]. The physical parameters of all antennas are...
the same, but the resonant frequency decreased as the iteration order increased, thus the electrical length of the ground plane also decreased in their resonant frequency for the proposed patch antenna. The input characteristics of the fabricated small-size Sierpienski & Crown Square Fractal Shapes Slotted Microstrip Patch Antennas [18] with different parameters are measured through a Vector Network Analyzer. Fig.2 shows the variation of return loss with frequency. Plot result shows resonant frequency 1.2 GHz. And total available impedance bandwidth of 440 MHz that is 36.6% from the proposed antenna. Minimum -22.06 dB return loss is available at resonant frequency which is significant. Fig.3 shows the input impedance loci using smith chart. Input impedance curve passing near to the 1 unit impedance circle that shows the perfect matching of input. Fig.4 shows the VSWR of the proposed antenna that is 1.18 at the resonant frequency 1.2 GHz.

In order to have a strong coupling among the element, a microstrip line is introduced between them. Then all the elements are coupled mostly by a guided wave through the microstrip line. Based on the measurement results, we can discuss the property of the proposed Sierpienski & Crown Square Fractal Shapes Slotted Microstrip Patch Antenna. From these results, it is observed that the proposed technique can achieve a maximum size reduction and better results that is good than the results obtained from other shapes.

IV CONCLUSIONS

Microstrip patch antennas are increasing in popularity for use in wireless applications due to their low-profile structure. Therefore they are extremely compatible for embedded antennas in handheld wireless devices such as cellular phones, pagers etc... The telemetry and communication antennas on missiles need to be thin and conformal and are often in the form of Microstrip patch antennas. Another area where they have been used successfully is in Satellite communication. An Ultra Wide Band Microstrip Sierpienski & Crown Square Fractal Shapes Slotted Microstrip Patch Antenna is presented. Simulation and measured results of our design show more than -22.06 dB return loss at the resonant frequency of 1.2 GHz and VSWR less than 1.18 at this frequency.
This novel design can be adjusted to work in higher frequencies which make it possible to add more slots and thus get higher gains. With the aim to preserve compactness requirements and to maintain the overall layout as simply as possible and keeping the realization cost very low.

REFERENCES
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