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Design And Analysis Of Microstrip Patch Antenna Using Multistandard Patch Design And Rectangular Fractal Antenna

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ABSTRACT

The demand of small size electronic systems has been increasing for several decades. The physical size of systems reduces due to advancement in integrated circuits. Presently, there are many other commercial applications, such as mobile radio and wireless communications where they require low weight, size, cost, performance ease of installation low profile antenna. To meet this requirement micro strip patch antenna has been proposed. In this project, it proposes the design of multiband re-configurable micro strip patch antenna for wireless technology. And the effect of substrate and feeding properties on the performance of micro strip patch antenna is presented. The basic idea of this paper is to get the multiband functionality of micro strip reconfigurable patch antenna by analysing the different types of substrate and different types of feeding technique. The design is being simulated using ADS.

INTRODUCTION

Antenna is a transducer designed to transmit or receive electromagnetic waves. Microstrip antenna has several advantages over conventional antenna. It consists of a radiating patch on one side of dielectric substrate and has a ground plane on other side. Microstrip antennas are used for many commercial purposes due to their light weight and low cost. The recent demands of compact wireless devices propel the demand of pattern reconfigurable antennas. Reconfigurable microstrip antenna provides numerous application and offer more versatility as compared to conventional antennas which offer one function in a single antenna. They can provide diversity function in operating frequency, radiation pattern and polarization to mobile communications. The main disadvantages of microstrip patch antenna radiation performance including narrow bandwidth. Various techniques have been included to overcome these disadvantages. Microstrip patch antenna have been largely used on a lot of useful applications, because of their inherent characteristics of low-cost, low-

profile, case of fabrication, light weight, conformability and integration with RF devices. The new cellular telephone generations integrate several communications systems at once such as GSM/DCS, Wi-Fi standards, UMTS…etc. which leads to a large need of a multi frequency microstrip patch antenna. The unique property of microstrip patch antenna is its two-dimensional structure. As a flat antenna arrays can have a large aperture with corresponding high gain but having low volume and weight. The dielectric layer can be manipulated to fit different applications. Air dielectric has very low loss, making patch arrays useful for wireless communication system. Where its low weight and high gain are also valuable. When used with the high dielectric constant material such as ceramics the effective wavelength is much smaller and the antenna can be greatly reduced in size. Many GPS antenna take advantage of this property to reduce relatively large size of the l-band patch, resulting in compact antennas, often with integrated with the assembly.

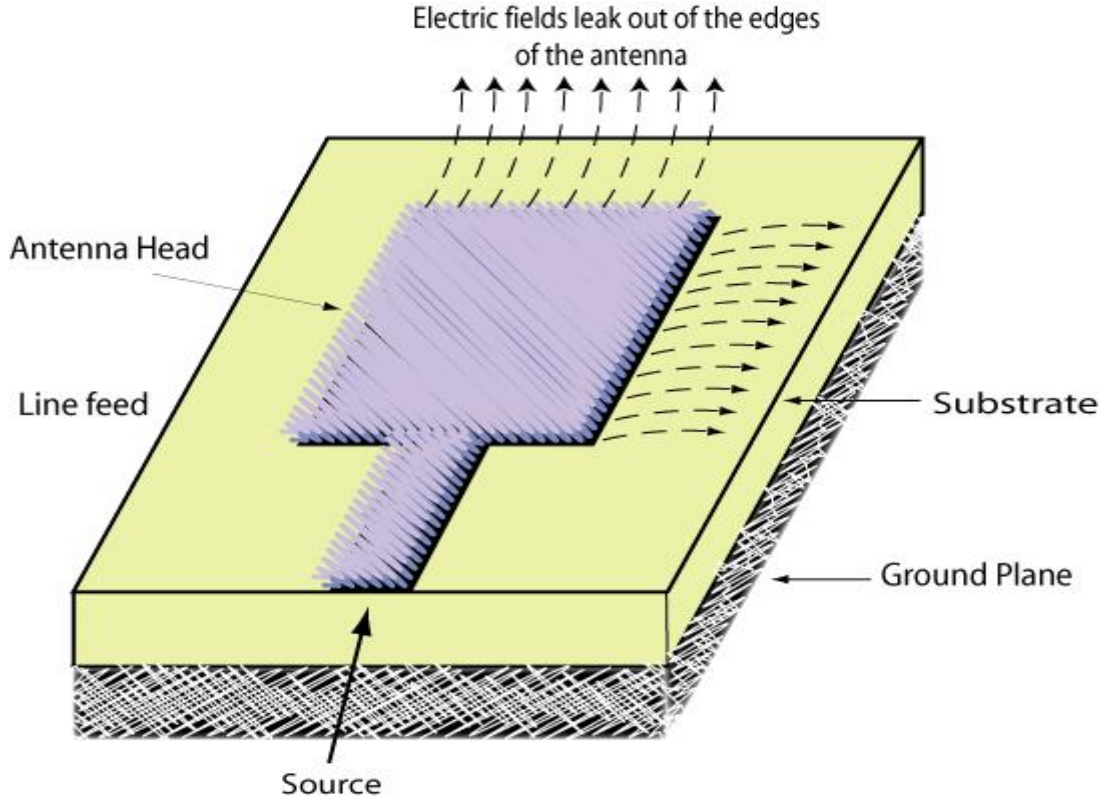


Figure 1 Microstrip patch antenna

ANTENNA DESIGN

The proposed antenna is designed with multistandardstructure using ADS software. Here dimensions is calculated using basic formulas and the calculated value for length is l=22mm, w=40mm. Future laptops may have multiple standard operation capability and also explore the benefits of MIMO systems, for capacity enhancement. Multiple antenna elements are necessary in such systems which make use of diversity.

Mechanical robustness and aesthetic reasons lead naturally to including built-in antennas in laptops. Amidst the possible solutions [1-3] we have chosen to use antennas developed from planar structures. These antennas can be easily accommodated in the available space behind a laptop LCD matrix. Besides simple rectangular patches, L-bent microstrip-like patch antennas [4] have been introduced due to its almost omnidirectional properties and impedance bandwidth.

Formulas for calculating the antenna design theoretically is given below

1. *Calculation of Width (W)*

The width of the patch element (W) is given by

$$W = \frac{C}{2 f_o \sqrt{\frac{\varepsilon_r + 1}{2}}}$$

2. *Calculation of Effective dielectric constant (ε_{reff})*

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{w}\right]^{1/2}$$

3. *Calculation of the Effective length*

$$L_{eff} = \frac{C}{2 f_o \sqrt{\varepsilon_{reff}}}$$

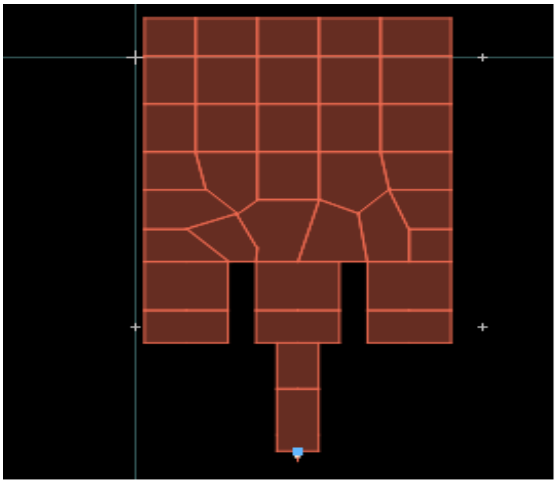
4. *Calculation of the length extension*

$$\Delta L = 0.412h\frac{(\varepsilon_{reff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)}$$

5. *The actual length (L) of patch*

$$L = Leff - 2\Delta L$$

PROPOSEDDESIGN



This antenna is designed to the cover range between 0Hz to 10GHz.ADS tool is used to cut to shapes and measure the dimensions. While designing the antenna the main thing which we have to consider is feeding type and substrate that we used based on that the output will vary. In this design the feeding technique used is line feeding and substrate that used for designing the antenna is Rogers Duroid 5880. For each frequency the radiation pattern can simulated. One of the radiation pattern is given in the below radiation pattern diagram.

3D VIEW OF PROPOSED DESIGN

3D view of multistandard patch antenna is given here.

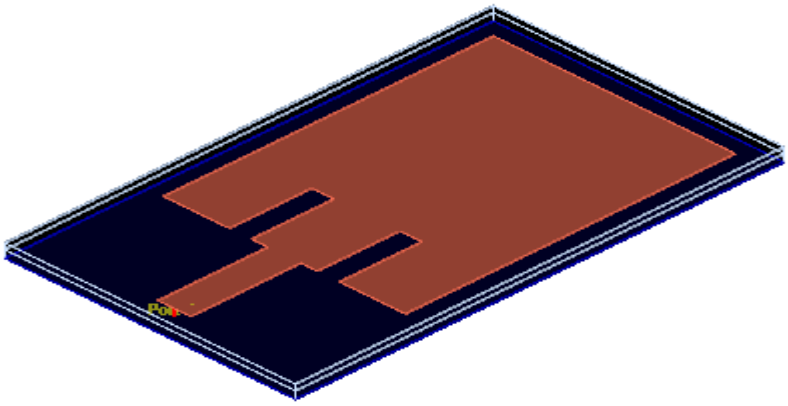


Figure 2 3D view

RETURN LOSS

Return loss is the main factor that we have to take care while designing the antenna. Return loss is nothing but loss of power in the signal returned/reflected by a discontinuity in the transmission line or optical fiber. Discontinuity will happen due to mismatch with the terminating load or with a device inserted in the line. For good antenna the return loss should be less than -10db. In this antenna design we have achieved -23.153db return loss. This antenna has good coverage in the frequency range of 5.573GHz.

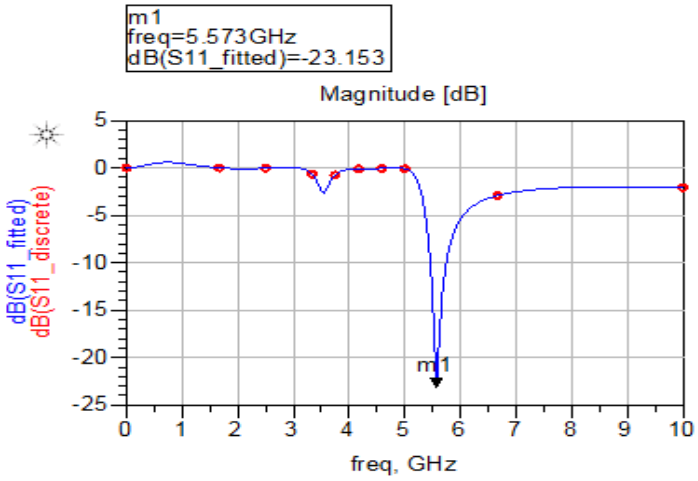


Figure 3 Return loss

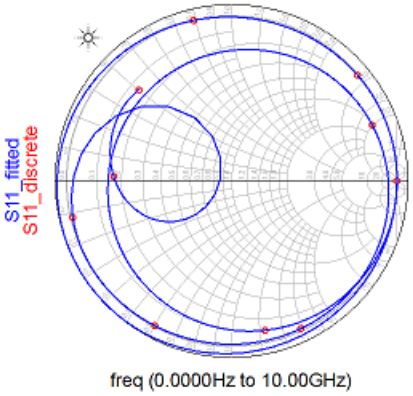


Figure 4 Smith chart

RADIATION PATTERN

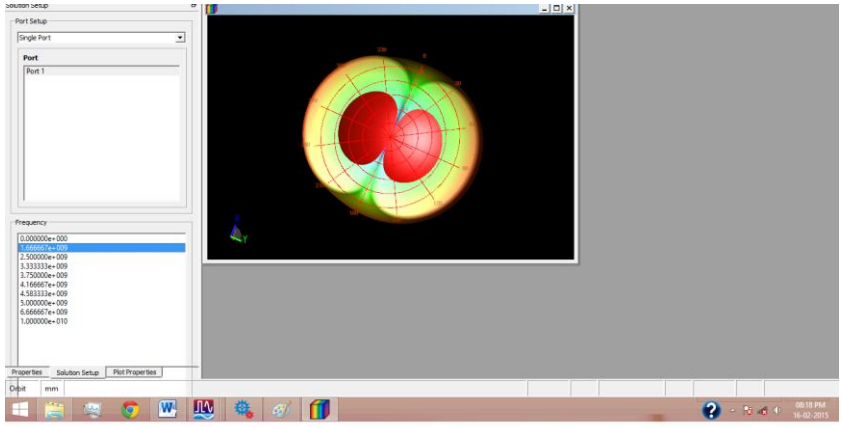


Figure 5 Radiation pattern

Since this antenna is designed to cover the range between 0Hz to 10GHz we can see radiation pattern for different range. In the above fig one of the radiation patterns is simulated and shown.

RECTANGULAR FRACTAL ANTENNA

A fractal antenna is an antenna that uses a fractal, self-similar design to maximize the length, or increase the perimeter (on inside sections or the outer structure), of material that can receive or transmit electromagnetic radiation within a given total surface area or volume.Such fractal antennas are also referred to as multilevel and space filling curves, but the key aspect lies in their repetition of a motif over two or more scale sizes, or "iterations". For this reason, fractal antennas are very compact, multiband or wideband, and have useful applications in cellular telephone and microwave communications. A fractal antenna's response differs markedly from traditional antenna designs, in that it is capable of operating with good-to-excellent performance at many different frequencies simultaneously. Normally standard antennas have to be "cut" for the frequency for which they are to be used—and thus the standard antennas only work well at that frequency.

PROPOSED DESIGN

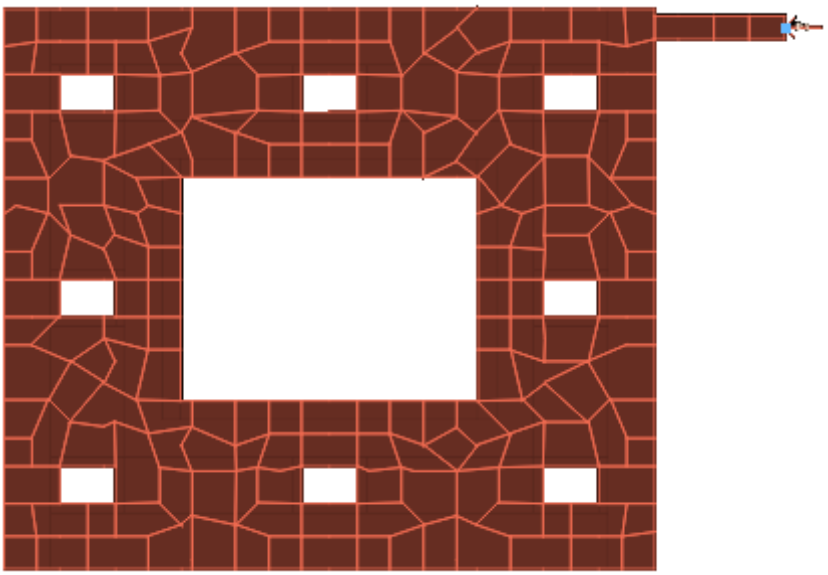


Figure 6 Rectangular fractal antenna

In this design length width calculated as same as multi standard patch antenna structure and its mesh frequency is in the range of 9.5GHz. Dimensions of this antenna is l=17.5mm and width=15mm.

3D VIEW OF PROPOSED ANTENNA

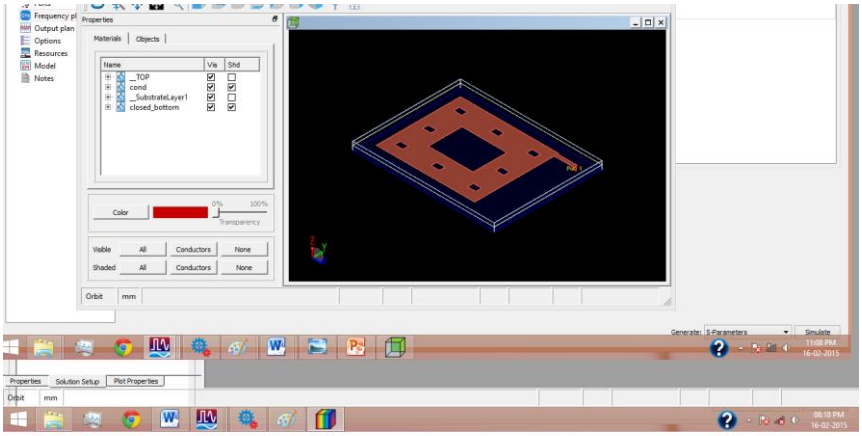


Figure 7 3D view

RETURN LOSS

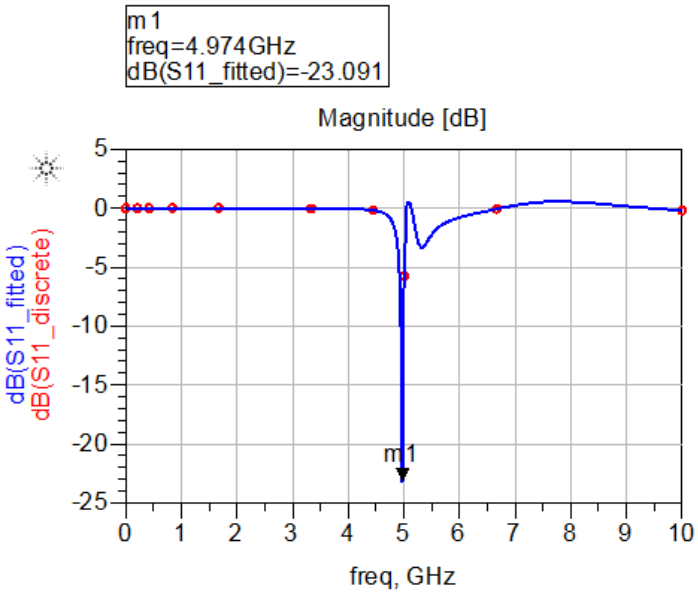


Figure 8 Return loss

As said earlier for good antenna design return less should be less than -10db. Here the return loss calculated is -23.091 it achieved the result perfectly. And this antenna coverage is very good in the frequency range of 4.974GHz.

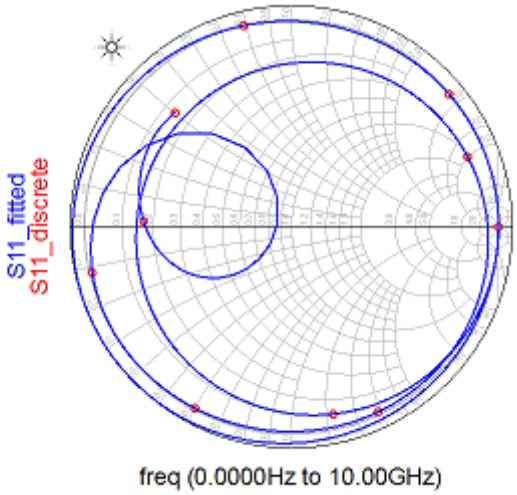


Figure 9 Smith chart

RADIATION PATTERN

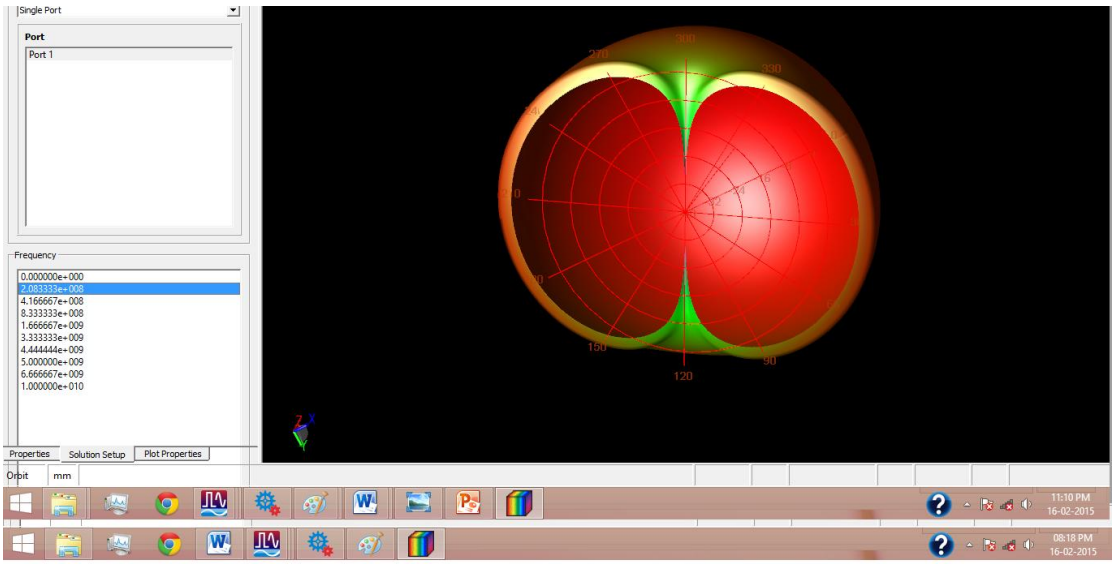


Figure 10 Radiation pattern

This antenna is also designed to support the frequency range from 0Hz to 10GHz and its coverage is good in the range of 4.974 radiation pattern for every frequency can viewed by simulating the design.
And one of the radiation pattern is given in the above.

CONCLUSION

Antenna was designed with multistandard shape to achieve a different radiation pattern between the frequency ranges of 0Hz to 10GHz. And the return loss was achieved above -20db that is -23.153db. In future it can be optimized and can get better output.

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