

Design of TL Shape Rectangular Patch Antenna for Global Positioning System (GPS) Applications

M.Sheriff^{#1}, M.Preethi^{#2}, G.Shobana^{#3}, P.Thanga Nandhini^{#4}

Asst. Prof, Department of Electronics and Communication Engineering, Veltech, Chennai, India ^{#1},

Student, Department of Electronics and Communication Engineering, Veltech, Chennai, India ^{#2,#3,#4}

ABSTRACT: In today's modern communication industry, antennas are the most important components required to create a communication. Microstrip antennas are the most suited for aerospace and mobile applications because of their low profile, light weight and low power handling capacity. A design of a rectangular microstrip patch antenna is developing for Global Positioning System applications. The Global Positioning System (GPS) is an aeronautics system that provides location and time information in all weather conditions, anywhere on or near the Earth. The proposed antenna is designed as TL shape with a transmission line to obtain a rectangular polarization by simulation software resulting with the frequency of 6 GHz. The antenna can be used for vehicle communication, aircraft tracking, cellular telephony, navigation etc.

KEYWORDS: Global positioning System, Microstrip patch antenna, rectangular patch, transmission line, rectangular polarization.

I. INTRODUCTION

Microstrip patch antenna are preferred than other antennas in today's modern world scenario for their compatibility in Mobile Aircraft, Satellites because of very small sizes. Hence design and development of cost effective microstrip rectangular patch antenna has become an important research area. . Microstrip antennas are inexpensive to manufacture and they offer high performance with low profile and these antennas are ideal for GPS and tracking devices. . The proposed antenna is designed as TL shape with two rectangular patch and the antenna provides rectangular polarization with a transmission line by connecting the two patches. A low cost and high performance antennas are required for commercial and automotive industry application. To meet this requirements for GPS applications, authors are focused on low profile and compact size conventional patch antennas. The conventional patch antenna uses higher permittivity substrate to reduce the bandwidth. In this novel, a rectangular patch with dielectric substrate and copper substrate is presented to provide rectangular polarization for GPS applications. The patch antenna operates in a center frequency of 6GHz. The effectiveness of proposed antenna is verified by designing a patch antenna with different ground plane and simulated. Finally, the desired compact size and inexpensive antenna is designed with no complex feeding and matching circuits are required. The details of design, performance and results are discussed below.

II. ANTENNA DESIGN PROCESS

The configuration of proposed antenna is shown in fig 1. and the dimensions of the antenna are listed below in the Table I. The proposed microstrip Patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side as shown in fig 1. The patch is generally made of conducting material such as copper and can take any possible shape. The radiating patch and the feed lines are usually photo etched on the dielectric substrate with a thickness=1.27mm and relative permittivity=10.8. The layer of dielectric substrate is placed in the copper layer named as ground with dimensions L1W1 and h1. The length, width, height of a ground plane can be L, W and h respectively which has relative permittivity of 1. A two rectangular patch named as wave port is printed perpendicularly in the two sides of the substrate layer with a length l2, width w2 and a transmission line is connected

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between them. A radiation box is etched on the top of the substrate and rectangular patch to produce excitations which is filled up with air material and the dimensions of the box is L_3 , W_3 and h_2 .

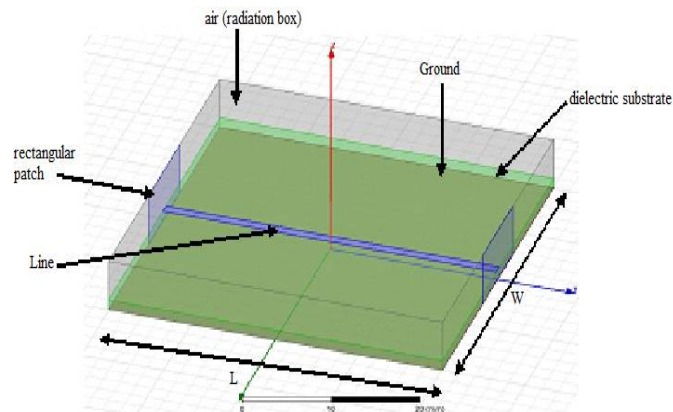


Fig 1. geometry of the polarized rectangular patch antenna

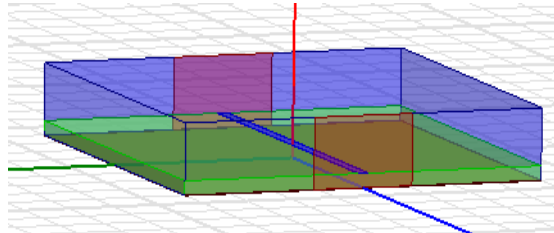


Fig 1(a) side view of the antenna

Table I

Parametric values of the patch antenna

Parameters	Values(mm)	Parameters	Values(mm)
W	40	L	40
W1	40	L1	40
W2	11	L2	-6.35
W3	40	L3	40
H	1.27	h1	1.27
h2	6.35		

The overall design of patch antenna is meshed with vacuum and it is shown in fig 2 named as mesh. Excitation can be provided by copper line to the sides of the rectangular patch, which is shown in fig 3.

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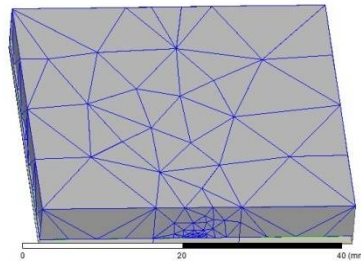


Fig 2 overall mesh of the antenna

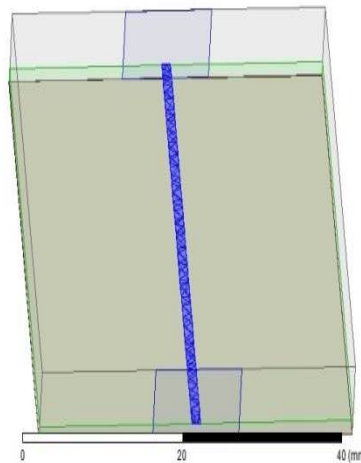


Fig 3. excitation analysis of rectangular transmission line

III. ANTENNA ANALYSIS

The is ξ_{eff} the effective permittivity of the substrate, and is the correction factor considering the presence of the different dielectric materials used on the two sides of the folded patch.

$$\xi_{eff} = 1 + q(\xi_r - 1)$$

The frequency for the proposed antenna can be calculated by using formula given as

$$f_c = 1/(2L(\xi_0 \xi_r \mu_0)^{1/2})$$

IV. RESULT AND DISCUSSION

The proposed antenna is designed to operate in the center frequency of 6GHz for GPS applications. The gain of the antenna is shown in the polar plot of fig 4 with different time, angle and function. In fig 4(a) the direction given in y parameter and the timing function of acosh. The fig 4(b) and 4(c) also describes the parameters with different timing function. The arrow mark indicates the position of the results.

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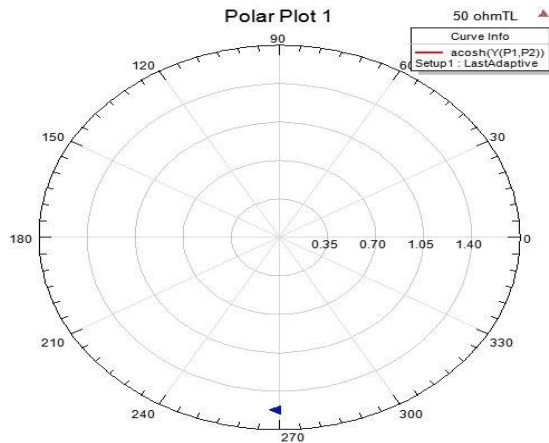


Fig 4(a) polar plot of direction and time

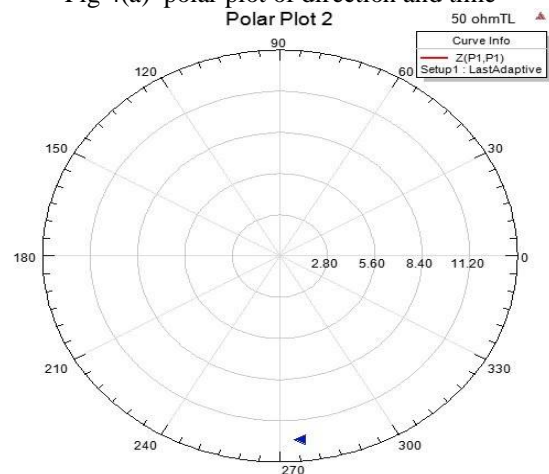


Fig 4(b) polar plot of direction and time

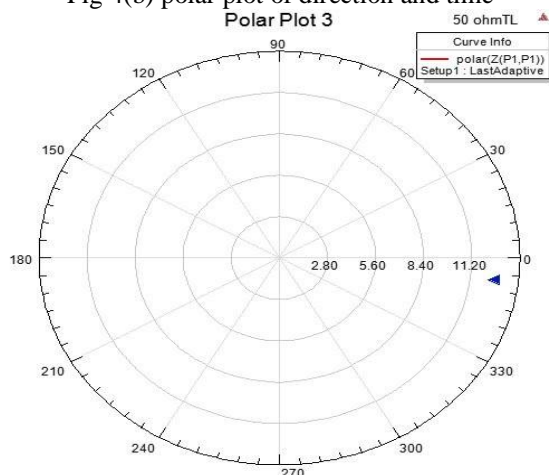


Fig 4(c) polar plot of direction and time

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The 3D pattern of the antenna is shown in fig 5 with different magnitude values.

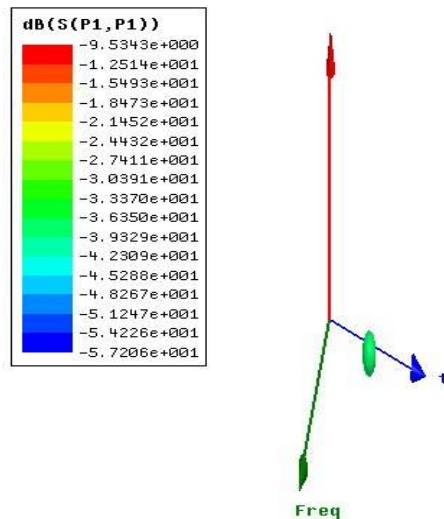


Fig 5 3D pattern of antenna

The impedance of the antenna is explained by using smith chart. The variation in impedance can be shown by using different direction parameters which is shown in fig 6.

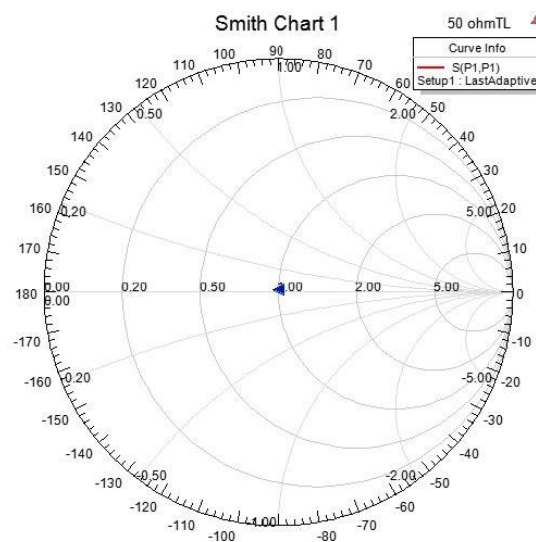


fig 6(a) impedance of antenna

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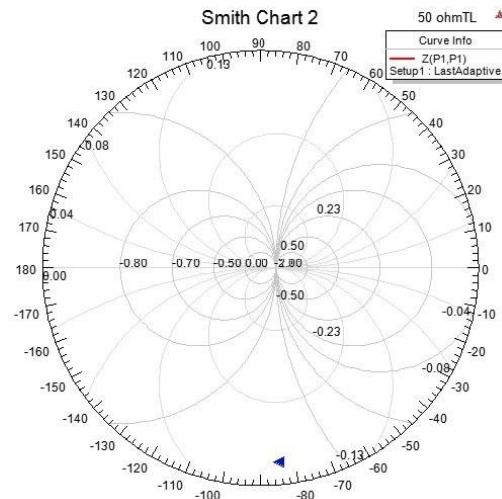


Fig 6(b) smith chart in z parameter

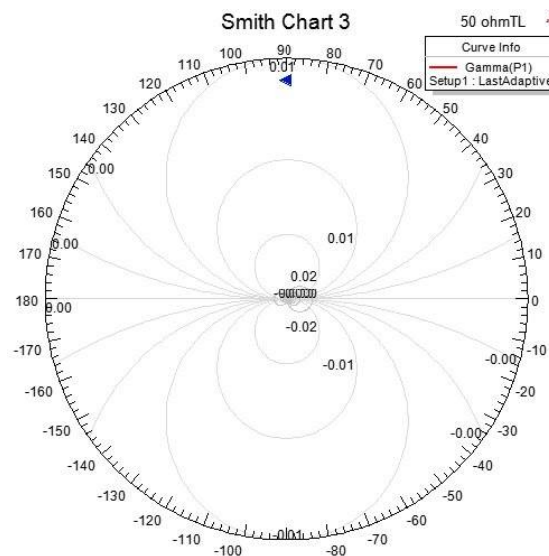


Fig (c) smith chart in gamma direction

V. CONCLUSION

A microstrip antenna with low profile and compact size is designed and fabricated with two rectangular patches and produces rectangular polarization. The antenna volume is approximately 40mm x 40mm x 7.58mm. The proposed antenna operates in 6 Ghz and it has addition features such as low bandwidth, better radiation and highly efficient. So the proposed antenna is well suitable for GPS application.

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