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Design Analysis of Slotted Rectangular Microstrip Patch Antenna for Improved Bandwidth

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Abstract: In this paper a small slotted microstrip patch antenna. The design and simulation has done for efficiently perform between4.5GHz to 5.8GHz. In a conventional rectangular patch, a 45 degree cut has introduced in three different coordinate, the design has achieved. A gain of 3.2dB the proposed antenna performs at 5.415 GHz with -28.72dB return loss and with 2:1 VSWR. The proposed antenna is simulated IE3D commercial software version12.

Keywords: Coaxial Feed, Elliptical patch, Finite ground, Linear Polarization (LP), Microstrip patch antenna (MSA) .

I. INTRODUCTION

Micro strip patch antennas are used in various wireless applications. Rectangular and circular microstrip antennas are widely used in communication receivers or antenna arrays. They have low profiles and light weight and are easy to fabricate and integrate. With the proliferation of personal wireless communication, designers search for small antennas for portable receivers. Many methods, such as addition of slots, parasitic elements and superstrate to the basic structure [1-3]. In this paper rectangular patch is chosen for better response with a good linear polarization can be easily by exciting the patch rather than another shapes means of the proper selection of both the feed position on nearly about to the diagonal.

That the optimum linear polarization can be obtained when the driving point is placed on or near to the diagonal of the rectangle patch. In this paper the changing of the behaviour of the patch with respect to reducing of the finite ground, changing the feed location and also changing the dielectric height. Truncation of finite ground is responsible for widening of impedance bandwidth [4].Details of the proposed compact LP design are described, and typical experimental results are presented and discussed [5]. However, conventional microstrip patch antennas have the disadvantages of narrow bandwidth, polarization impurity, low gain which would not be suitable for modern communication systems.

The addition of a simple rectangular patch using off-centred probe feed and a cut of 45 degree at three different coordinates resulting an ultra-wide band antenna. The proposed design is simulated on 1.59 mm thick FR4 substrate and 1 mm air stacking is also capable of generating better polarization. Better impedance band width is achieved by introducing air stack.

II. ANTENNA DESIGN

The geometrical representation of proposed antenna is shown in Fig.1. The antenna is mounted on 1mm foam and FR4 substrate with a thickness of 1.59 mm. The antenna is fed by a coaxial transmission line. Synthesis and analysis of this proposed design were performed using IE3D v 12.1 commercial software. In rectangular patch the optimum linear polarization can easily obtained by exciting through the diagonal. After truncating the ground 10% bandwidth was achieved. The addition of three cut of infinite length at 45 degree elevation at three different coordinate and air stacking of 1mm have enhance the bandwidth of the proposed design.

Previously we have seen that the size of the ground plane will significantly affect the resonant frequency, the input resistance and directivity of a rectangular Microstrip antenna [6]. The basic parameters of the proposed design are also shown in Fig. 1. IE3D simulation software works on Method of Moments where a finite ground is required. For this design a finite ground of W_1= 60 mm through Y-axis and L_1= 50 mm through Y-axis is taken. The dimension of the proposed patch is W_2= 30 mm, L_2= 20 mm. After selection of a suitable position for feed point, then finite ground is reduced towards upside down. After the finite ground gradually truncated the gain above 4dB is achieved with multi-band. Also a good axial ratio is achieved with 2:1 VSWR.

III. RESULTS

Initially started with a finite ground of W1= 60 mm and L_1= 50 mm without any slot in the patch and also no air stacking. In order to get proper impedance band width and gain introducing of slots and reducing the finite ground need to be adjusted accordingly. The resulted geometry of the proposed geometry is shown in Fig. 2.

Simulated input impedance matching data of the design is shown in smith chart in Fig. 3(a). Form the smith chart; it is vividly represents the wide band impedance matching with a good impedance bandwidth. The antenna band width is extending from 4792-5758 MHz or 18% bandwidth with 2:1 VSWR. Computed current distributions are concentrated at the edge of the slots. The peak gain is about to 3.2dB is shown in Fig. 3(b).

At the resonant frequency 5.415 GHz with a return loss of -28.7dB is shown in Fig. 3(c). Also the effect of the finite ground is also plotted with respect to gain, band width are shown in graphical presentation Fig. 4. The changing of optimum result is also responsible for truncating the finite ground. Changing the probe feed position is also responsible of the ultra bandwidth.

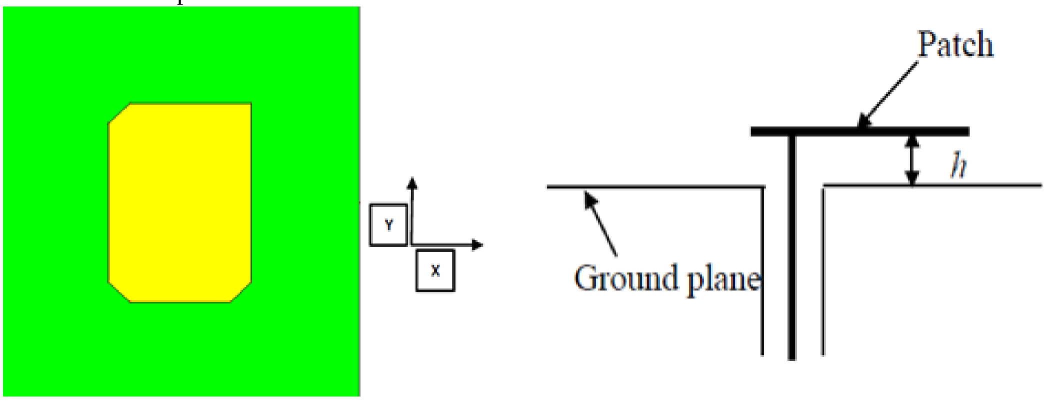

Fig. 1: Antenna geometrical configuration. The parameters are W1=60mm, L1=50mm, W2= 30 mm, L2= 20 mm, h=2.59 mm, εr=4.4.

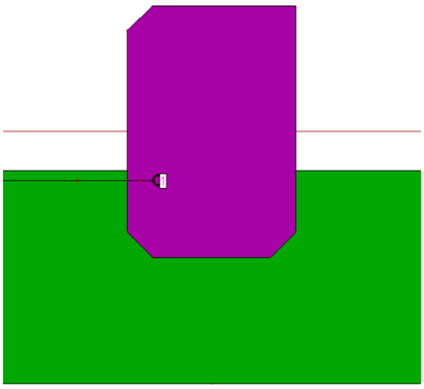

Fig. 2: Antenna geometrical representation after slotted the patch and truncating the ground.

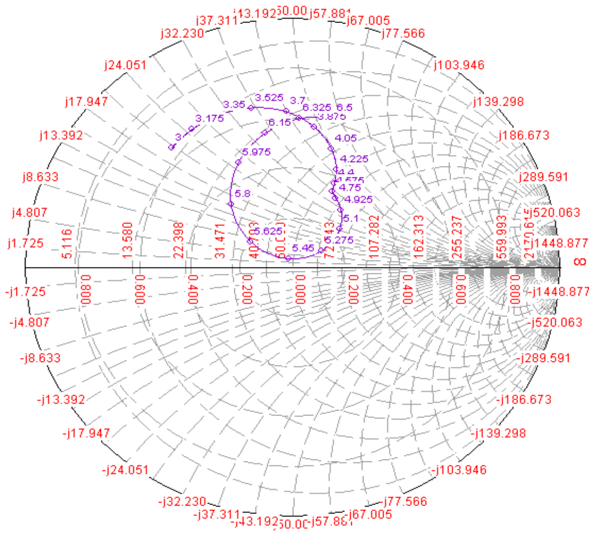

Fig. 3(a) Smith chart

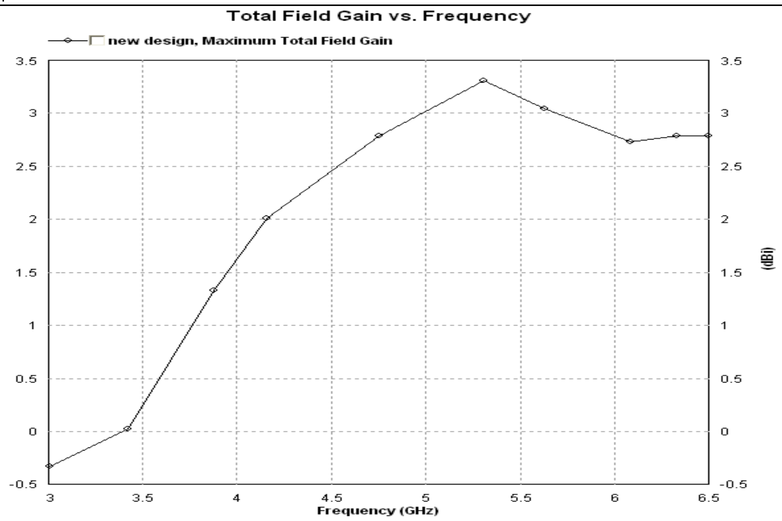

Fig. 3(b) Optimum gain

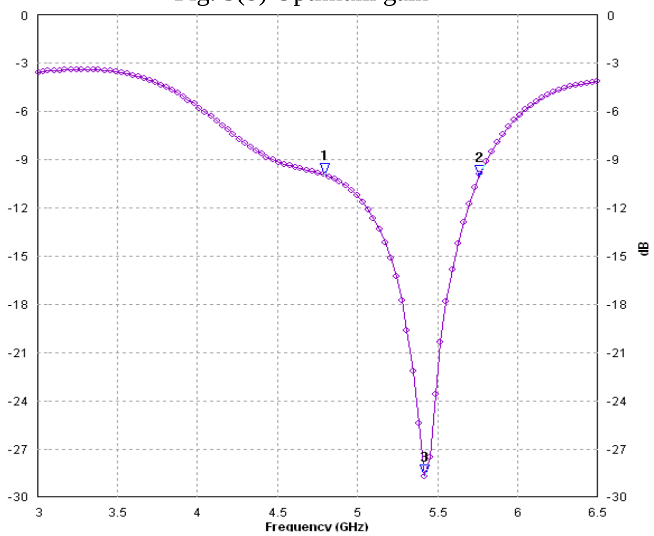

Fig. 3 (c) Return loss.

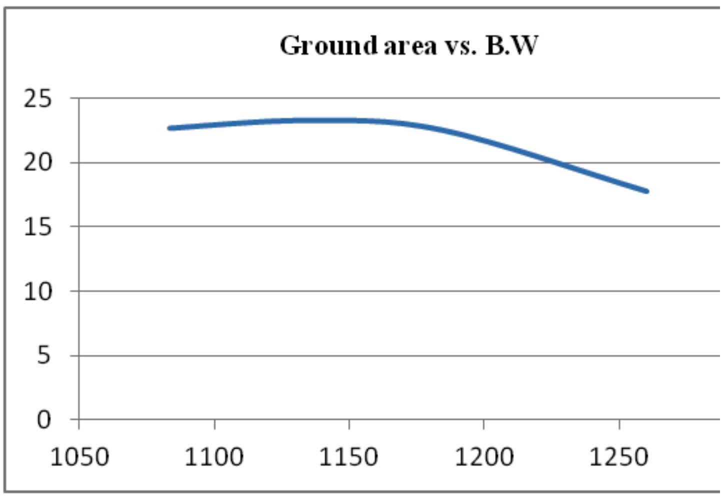

Fig. 4: (a) Finite ground vs. Band width

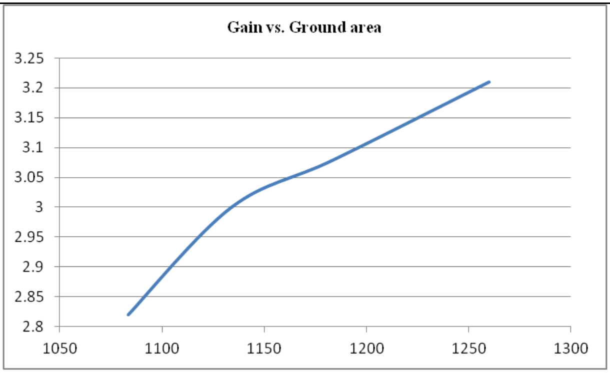

Fig. 4: (b) Finite Ground vs. Optimum gain.

IV. CONCLUSION

In this paper two techniques are reported to enhance bandwidth and reduce the antenna size. The techniques are depending on exciting the mode (TM01) with close resonant frequency. The first technique depends on the cut at 45 degree elevation in the patch to meander the current path whereas the second technique is truncating the finite ground. We could reach size reduction by 20% and double the bandwidth by using the first technique. By using the second technique size of the antenna was reduced by 60% and enhances the bandwidth by two times its value as compare to the conventional rectangular patch antenna.

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