

# A Compact Broadband and High Gain Microstrip Patch Antenna with Modified Ground Plane

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**ABSTRACT:** In this article a compact broadband and high gain microstrip patch antenna is designed for wireless communication. This paper deals a new printed antenna for wireless and local area (WLAN) access points (base stations) providing wideband operation from 2.2 GHz to 6.7 GHz. The designed antenna consists of a rectangular ground plane with a slot incorporated in the ground plane. The antenna is simulated using Ansoft Designer software. The dielectric constant, thickness and loss tangent of the proposed antenna are 2.4, 1.6 mm and 0.0016 respectively. The simulated bandwidth has been obtained from 2.2 GHz to 6.7 GHz with a percentage bandwidth of 101%. The design antenna may be applicable for wide band applications in wireless communication.

**KEYWORDS:** Broadband, Wireless communication, Microstrip patch, modified ground plane.

## I. INTRODUCTION

The patch antenna is a type of antenna used to process ultrahigh frequency signals. The patch antenna is very much popular due to some inherent properties. Low cost, good compactness, small size, multi frequency operation and low power consumption all are advantageous properties. This antenna is used in different tele-communication industry to their different frequency bands. The patch antennas have some lagging performance like low gain and narrow bandwidth. Among the entire most common type antennas microstrip patch antenna is the most popular. Different shape of microstrip antenna is reported in [1-3] to enhance the impedance bandwidth. The patch antennas provide narrowband with low gain. If the bandwidth is enhanced by the removing ground plane the gain is automatically decreased to zero or negative. There are various methods to enhance the bandwidth as well as antenna gain like as modified ground plane, feeding location shifting, slot line, substrate and modified radiating patch. The designed antenna is not offer better results, but gets broad bandwidth, meaning it can process more data at once. The bandwidth may be enhanced by variation of antenna dimension [4-10]. The effect on bandwidth by the variation of slot line, antenna dimension and feeding location is not significant. The slot or slit on the patch or ground plane is more effective. In this article frequency band is enhanced by modification ground plane. The proposed antenna provides a large bandwidth from (2.2 GHz to 6.7 GHz) with max peak gain 3.5 dBi. The proposed compact antenna is simulated using Ansoft Designer software. The simulated percentage of 101% with good VSWR is achieved.

## II. ANTENNA DESIGN

The parameters and dimensions of the proposed antenna are shown in Fig. 1. The projected antenna consists of ground plane, dielectric substrate and radiating patch. The dimension of the ground plane is 40 mm X 40 mm. A rectangular slot is loaded on the ground plane of dimension 18 mm X 30 mm. The coaxial feeding point is located 20mm from left edge and 2 mm from the bottom edge of the designed antenna. The configuration of the FR4 dielectric substrate is dielectric constant ( $\mu_r=4.4$ ), with loss tangent 0.02 and thickness  $h = 1.6$  mm respectively. The projected antenna is designed and simulated using Ansoft Designer software. All the dimensions of the designed antenna are shown in Table 1.

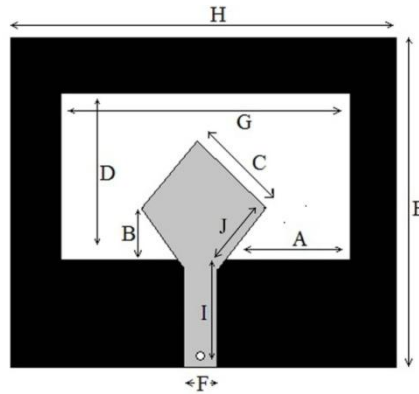


Fig. 1 Proposed microstrip patch antenna.

Table 1 Dimension of the proposed antenna. (all dimension are in mm)

Parameters	Dimensions
A	12
B	7
C	11.40
D	18
E	40
F	4
G	30
H	40
I	13
J	10.63

### III. RESULTS AND DISCUSSION

The reflection coefficient, antenna gain, VSWR and radiation of the designed antenna are shown in Fig 2 to Fig 5. From Fig 2, it is observed that the frequency band enhanced for the introduction slot on the ground plane. The broad simulated frequency band is found from 2.2 GHz to 6.7 GHz. Two resonant frequencies at 2.4 GHz and 5.6 GHz is found with minimum reflection coefficient of -33 dB and -37 dB. The maximum percentage bandwidth of 101% is found considering -10 dB frequency band. The gain of the antenna is varied with in the three frequency bands.

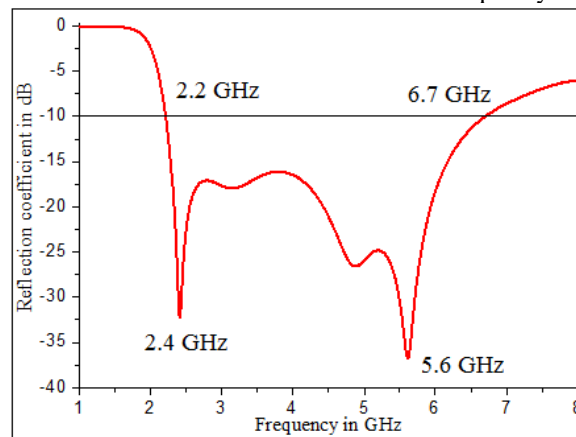


Fig. 2 Reflection coefficient versus frequency.

The maximum peak gain 3.5 dBi is found and it is varied 3 dBi to 3.5 dBi with in the first frequency band from 2.2 GHz to 5 GHz. The gain is almost stable with in the covered frequency range. The 2<sup>nd</sup> frequency band from 5 GHz to 6 GHz

is called transition band. Because in this frequency band antenna gain is abruptly changed from 3 dBi to 1 dBi. The last frequency band is defined from 6 GHz to 7.7 GHz. In this frequency band gain also stable and it is varied from 0.8 dBi to 1 dBi. A stable VSWR is observed from the designed antenna as shown in Fig 4 and it is varied from 1 to 1.5. In the frequency range 1.2 GHz to 5.6 GHz of the designed antenna offered good VSWR. H-plane and E-plane radiation pattern of the designed antenna are presented in Fig 5. The directive radiation pattern is achieved at the frequencies 2.4 GHz and 5.6 GHz.

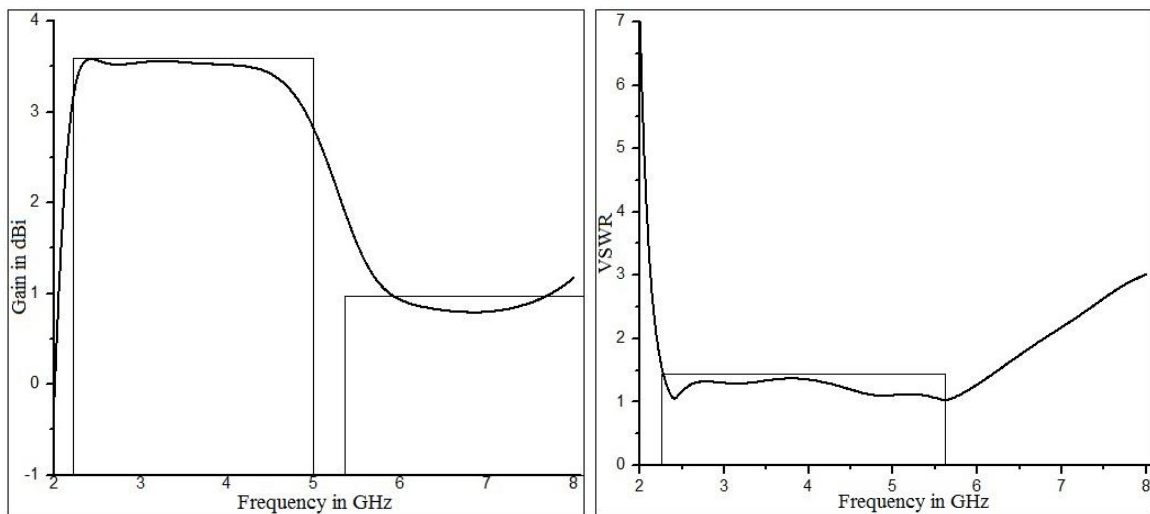


Fig. 3 Swept gain versus frequency response. Fig. 4 VSWR versus frequency response of the proposed antenna.

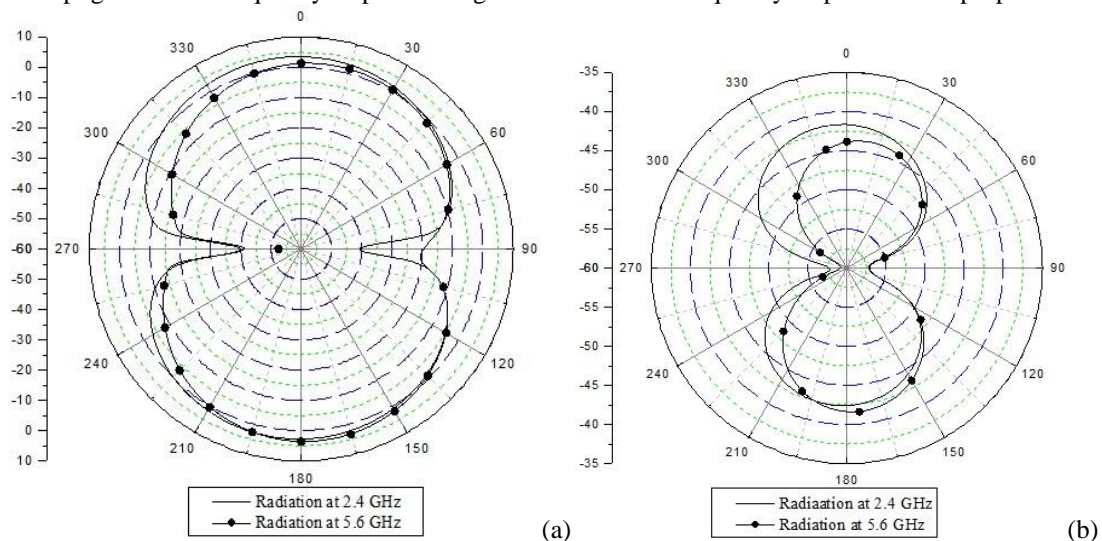


Fig. 5 Radiation pattern of the proposed antenna (a) H- plane at 2.4 and 5.6 GHz, (b) E – plane at 2.4 and 5.6 GHz.

#### IV. CONCLUSION

In this article bandwidth of the patch antenna is significantly enhanced by the modification of ground plane. The designed antenna offers broadband, high gain and good compactness. The percentage bandwidth of 101% with maximum peak 3.5 dBi simulated antenna gain and good VSWR is achieved. The gain of the antenna may be stable in the proposed frequency bands of 2.2 to 5 GHz and 6 to 7.7 GHz. The proposed antenna is applicable in modern wireless communication systems.

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