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Performance Improvement of Microstrip Patch Antenna Using Defected Ground Plane

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ABSTRACT

This paper presents a design of planar microstrip patch antenna (MPA) with full ground plane which is able to operate at 5.5 GHz frequency with 200MHz band. The return loss at 5.5 GHz is -29.5dB for inset feed antenna. Maximum gain of this antenna is 5.7dB. Return loss is improved after introducing a pyramidal shaped defected ground plane at same frequency. Now the return loss is -36.81dB. All simulation work has been done on HFSSV10.

Key words: MPA antenna, Defected ground plane, HFSS, Gain, Radiation Pattern

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INTRODUCTION

A microstrip patch antenna is a type of antenna that offers a low profile, i.e. thin and easily manufacturability, which provides great advantages over traditional antennas. However, patch antennas have a main disadvantage i.e. narrow bandwidth. An antenna is a very crucial part of a wireless communication system. Overall performance of the wireless communication system is highly dependent on antenna design. If antenna is not properly designed and not perfectly matched for operating frequency than losses are occurred and system may be failed. Microstrip antenna has various characteristics like small in size, light weight, inexpensive, easy to fabrication, highly reliable in hazardous conditions like speed, atmospheric pressure etc [1]. The design procedure of microstrip patch antenna for full ground plane is given in [1-3]. This method provides dimensions of basic patch then we need to find feed point for perfect matching. In recent years lot of work have been done for improving performance of these patch antennas. There are many strategies are adopted by researchers like fractal geometry [4-6], spine geometry, stub in ground [7] and defected ground plane [8]. Defected ground plane used for introduced multiband characteristics and improve cross polarization characteristics [9-11]. In this paper defected ground plane for improving return loss of antenna is used.

GEOMETRY AND DESIGN

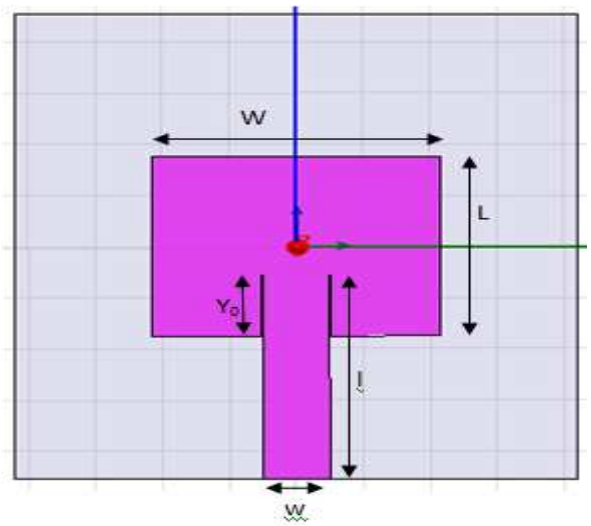

Fig. 1 Geometry of designed antenna with full ground plane

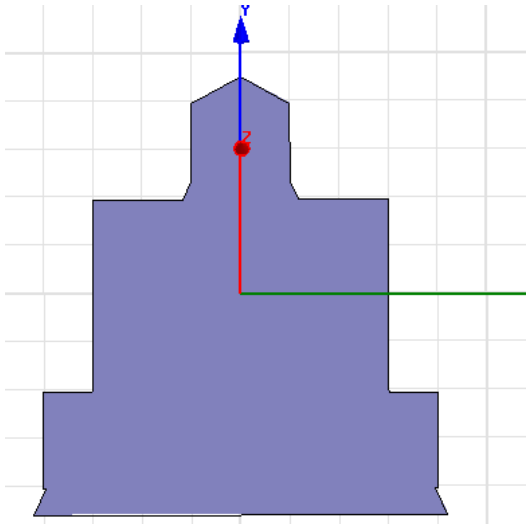

Fig. 2 Pyramidal structure of defected ground plane

Presented microstrip patch antenna is designed for 5.5 GHz on RT Duroid 5880 substrate. The height of substrate (h) is 1.59 mm and dielectric constant (εr) is 2.2. Inset feed is used for perfect impedance matching. Table 1 show the design parameters of microstrip patch antenna which calculated on above mentioned specifications.

Fig. 1 shows the geometry of designed microstrip patch antenna with full ground plane. Parametric analysis is applied on y_0 for finding perfect match point with 50 ohm strip line. Fig. 2 shows the pyramidal structure of defected ground plane which replace full ground plane in above design.

Table-1 Design Parameter of Proposed Antenna

Width of patch (W)	21.6 mm
Length of patch (L)	17.5 mm
Microstrip feed line width (w)	5 mm
Microstrip feed line length (l)	20 mm
Inset feed point (y_0)	Variable from 1mm to 7 mm

RESULT AND DISCUSSION

Fig. 3 clearly shows that minimum return loss for full ground plane antenna is -29.5 dB at 5.5 GHz frequency when inset feed point y_0 is 6 mm from edge. So y_0=6 mm is adopted throughout this work. Fig. 4 and 5 shows the E-field and H-field radiation pattern at 5.5 GHz. Maximum gain is 5.7 dB. -10 dB bandwidth of the antenna is 200 MHz for full ground. Fig. 6 shows plot between the return loss and frequency after using defected ground plane in antenna. It is clearly shows the minimum return loss is improved and value is -36.81 dB at 5.5 GHz frequency.

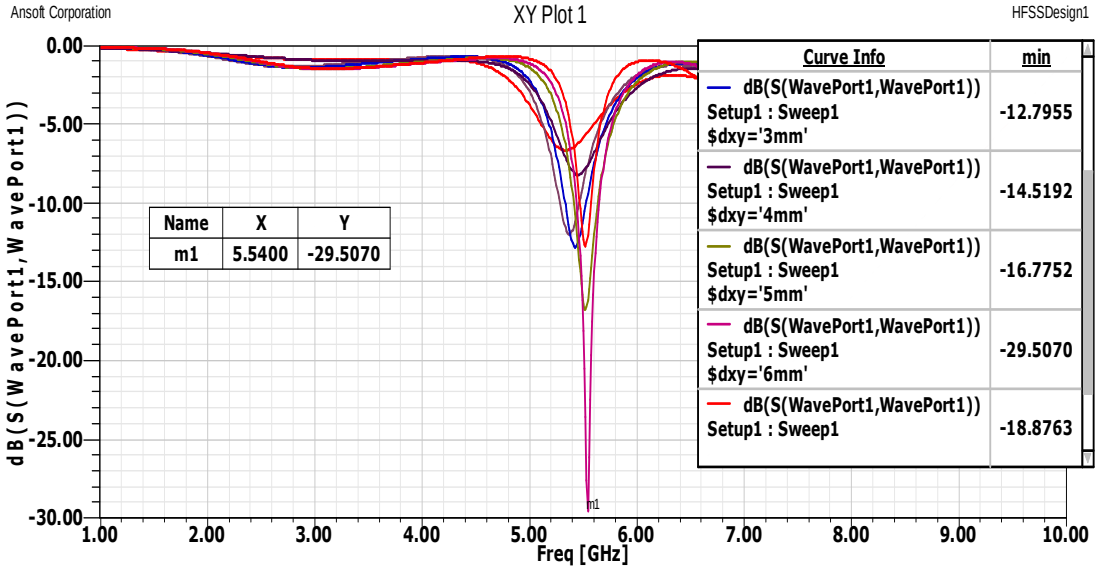

Fig. 3 Plot between Return loss and Frequency at different y_0 for full ground plane

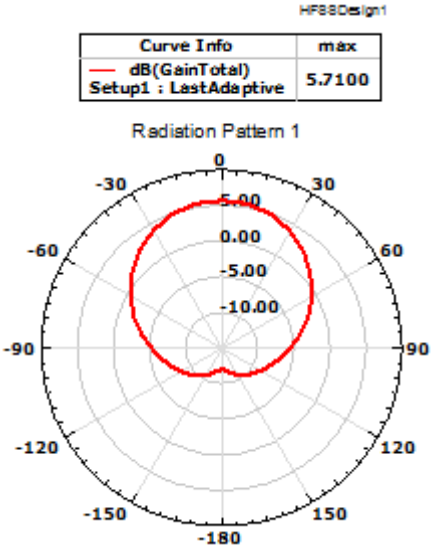

Fig. 4 E-field Radiation pattern θ all, φ=0°

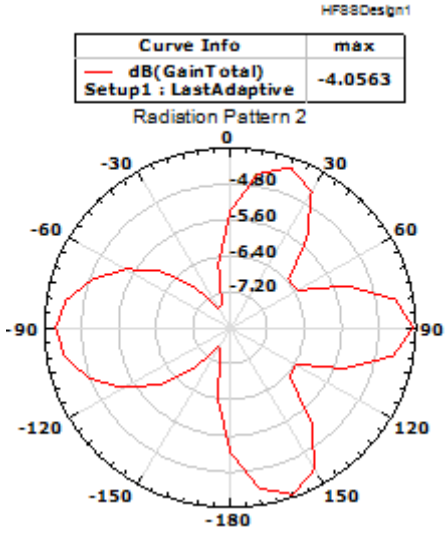

Fig. 5 H-field Radiation pattern θ=0°, φ all

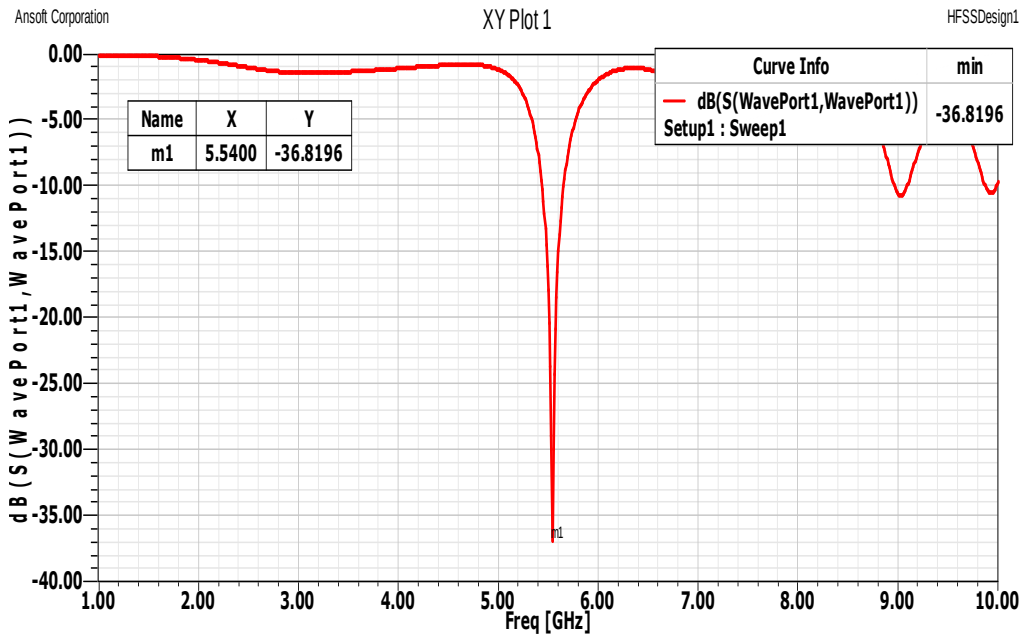

Fig. 6 Plot between return loss and frequency after using defected ground plane

CONCLUSION

A planner microstrip patch antenna is designed on 5.5 GHz frequency using conventional formula. This design shows -29.5 dB return loss for full ground plane and this same design is also shows -36.81 dB return loss for pyramidal shaped defected ground plane. So we can use defects in ground for improving return loss of microstrip patch antenna. The maximum gain is 5.7 dB and bandwidth is 200 MHz for full ground and 210 MHz for defected ground plane antenna. We can use this antenna for WLAN application. It will form a platform for researchers working in this field towards realizing the implementation of these geometries for current and future communication systems. In this way one can find enough scope of working on these highly versatile antennas.

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