# Multiple Frequencies Microstrip Antenna with Shorted Ground Plane

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***Abstract**: "Metamaterial" attracts scholars of various areas and research grown rapidly in this area. The unusual response of these metamaterials are frequently generated by artificially made-up additions or in homogeneities embedded in a host medium or associated to or implanted on a host surface. A microstrip antenna based on the idea of metamaterial has been proposed in this work. Several aspects of the antenna such as size, radiating frequency, bandwidth, beamwidth, gain and directivity have been taken under consideration. With this design the antenna radiates at 1.245 GHz, 1.627 GHz & 1.849 GHz. Return losses at these frequencies are -15.2 dB, -42.5 dB and -14.3 dB respectively.*

**Keywords**: *Multiple Frequency Antenna, Patch Antenna, Microstrip, Metamaterial.*

## I. INTRODUCTION

Proposed work has tried to capture the development in this area through the selected authors. What is the meaning of metamaterial? Meaning of "meta" is beyond or away from in ancient Greek. Material with prefix "meta" has been used to express the materials with exceptional features not easily obtainable in environment [1]. By varying the chemistry, factually and conservatively the purpose or performance of materials can be altered. This is a long known fact [2]. Science inquires how nature works and technology inquires how the works of nature can be utilized. Metamaterial based small antennas are proposed to offer to manipulate the near field boundary conditions which could result in antenna size minimization. Metamaterial antennas open a way to overcome the restrictive gain-bandwidth limits for small antennas [3, 4].

## II. DESIGN DESCRIPTION

A single layer antenna has proposed in this chapter. Dimensions of this antenna are 100 mm X 100 mm. Substrate FR-4 is sandwiched between two metallic layers. The permittivity of this substrate is taken as 4.4. There is a rectangular cut at metallic ground and substrate plane. Dimensions of this cut are 10 mm X 50 mm. A circular short has been inserted, which shorted the ground metal and upper patch metal. The radius of this short is 5 mm and its center is at (25 mm 40 mm). Antenna has been energized by a discrete port. The coordinates of this port are (50 mm, 50 mm). Top view of this layer is shown in figure 6.1.1. Location of the feed and short have also shown in this figure. Figure 6.1.2 shows the top view of the antenna. This design has been simulated with the help of simulation software.

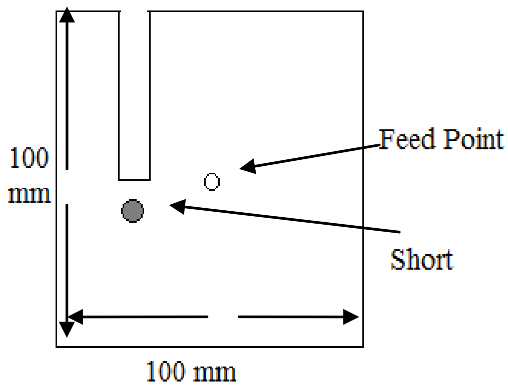


Figure 1: Top view of ground plane

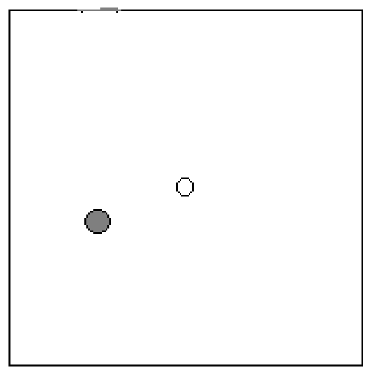

Figure 2: Top view of antenna

## III. SIMULATION RESULTS

Antenna design, proposed in this paper has simulated to investigate the responses of the antenna. With this design the simulation result shows that the antenna radiates at three frequencies. These three frequencies are 1.245 GHz, 1.627 GHz & 1.849 GHz. Return losses at these frequencies are -15.2 dB, -42.5 dB and -14.3 dB respectively. Simulation results and laboratory results of the Return Loss (in dB) for the fabricated antenna are shown in figure 3. The bandwidths at these frequencies are about 5 MHz only.

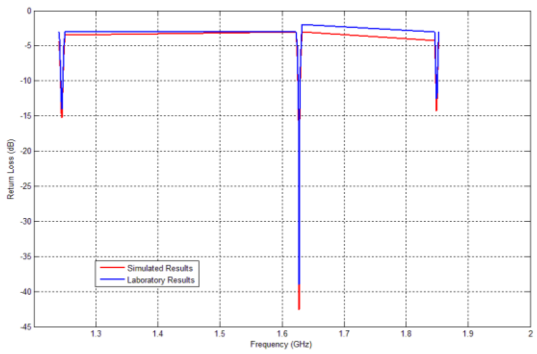


Figure 3: Variation of the magnitude of Return Loss with Frequency

Figure 4 shows the variation of Gain with Frequency. At the radiating frequencies, the gains (in dB) of the antenna are 4.88, 3.17 and 3.22 respectively. Figure 5 shows the variation of directivity with frequency. At radiating frequencies, the directivities (in dB) of the antenna are 4.9, 4.24 and 3.53.

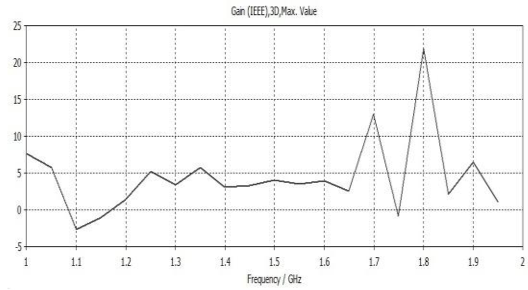


Figure 4: Variation of Gain (in dB) with Frequency

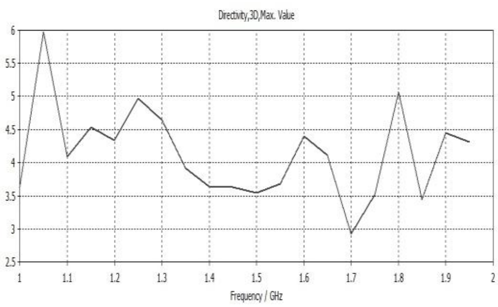


Figure 5: Variation of Directivity (in dB) with Frequency

## IV. CONCLUSIONS

Length and width of this antenna are more than the previous three antennas. As we increased the dimensions, radiating frequency decreased. With this design, we get three radiating frequencies. Return Loss is less than 10 at 1.245 GHz, 1.627 GHz and 1.849 GHz. The minimum Return loss is -42.54 at 1.627 GHz. The directivities (in dB) at these radiating frequencies are 4.9, 4.24 and 3.53 respectively. The gains (in dB) of this proposed antenna at these radiating frequencies are 4.88, 3.17 and 3.22 respectively. Both directivity and gain have been slightly improved with respect to the designs discussed in previous chapter. But bandwidth has narrowed. The maximum 3 dB beamwidth of this antenna is $140.3^0$. Hence we get a multi frequency antenna with improved Return Loss, Gain and directivity. But size is bigger and bandwidth is reduced. This antenna can radiate at three different frequencies with reasonable separation between them. Designs proposed up to this chapter are single layer designs. In the next chapter, a double layer antenna has proposed and efforts are made to improve the Return Loss and reduce the side lobs. Next design explains this work.

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