

A Compact Dual Band Microstrip Patch Antenna

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ABSTRACT-In this paper a compact microstrip patch antenna with dual frequency band is presented. Based on the simulation, several characteristics of antenna are investigated and the design procedure is described. The design of the microstrip patch antenna which is proposed here shows two frequency bands, first one in the range of 5-6 GHz and second one in the range of 8-9 GHz. A compactness of 66.11% is achieved in this proposed design.

KEYWORDS-Microstrip antenna, gain, return loss, resonating frequency, slots.

I. INTRODUCTION

Microstrip antennas are getting popular day-by-day in various field of communication due to its numerous advantages such as low compact design, planar profile, ease of fabrication, conformability with shaped surface etc. In this antenna a dielectric layer is sandwiched between two metallic layers. The metallic layer from which wave radiates is called the radiating patch and the other metallic layer which is grounded is called the ground plane. It is used with patches of several shaped such as rectangular, square, circle, triangle, ring etc.

An extensive research work on Size reduction of these antennas is going on now-a-days all over the world especially for their application in mobile communication, GPS systems etc. In other hand multifrequency operation is needed in various Radar systems. Various techniques are reported already to get multiple frequency bands and compactness. By incorporating two slots in radiating edges of patch, two resonating frequencies have been achieved [1]. Besides incorporating slots in patch radiating edges meandering slots in non radiating edges gives a considerable amount of size reduction with multiple frequency operation [2]. Using cross slot shape and varying the ratio of cross slot length in both of the metallic layers, a good compactness can be obtained also [3]. By randomly cutting slots in both of the planes, a good compactness can be obtained [4-5]. Using fractal shaped patch, compactness is also achieved [6]. A compact dual frequency broadband operation is done using gap-coupled structure [7] and an inset-fed rectangular microstrip patch antenna with double-P slots [8]. In this paper compactness and a dual band operation is presented which shows that slots have been cut in both of the radiating patch and ground plane.

II. ANTENNA DESIGN

The software named 'Ansoft designer v2 2' which works on the principle of MOM is used for investigation here. Metallic layers used are of copper and dielectric layer used is fr4_epoxy whose dielectric constant is 4.4 there is gap of 1.6 mm between the two metallic layers. Coaxial feeding technique is used here. Three structures are presented in this paper starting with rectangular shaped radiating patch and ground plane. Each structure is investigated by considering its reflection co-efficient and gain characteristics. The structures given here are selected after a good number of simulations. In the figures, the colored part indicates the metallic layer and white part indicates slot. At first a radiating patch of dimension of 9mm x 8mm and a ground plane of dimension of 30mm x 30mm have been taken which is shown in fig 1 with the location of the feed point then in the 2nd structure two modifications have been made. In the 1st step two parasitic patches of the same dimension are introduced in two sides of the main radiating patch The 2nd step shows two parasitic patches are joint coupled to the main patch this structure is shown in fig 2 In the 3rd structure a rectangular slot of length 10mm and breadth of 5mm is cut into the ground plane which is shown in fig 3

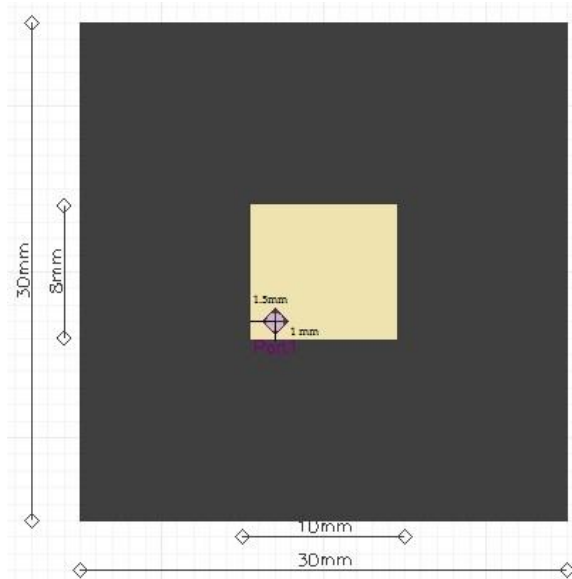


Fig.1 Top view of the 1st antenna structure

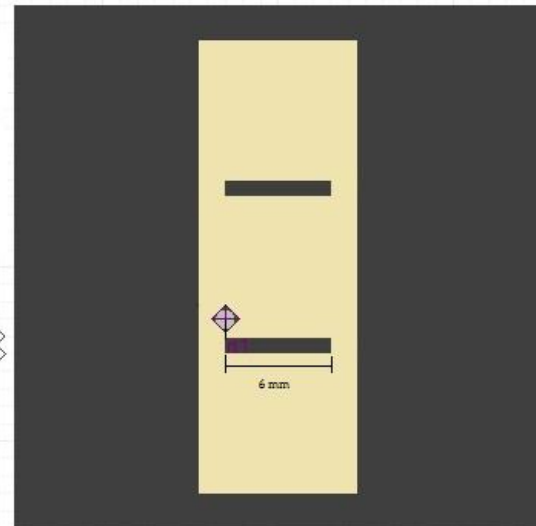


Fig. 2 Top view of the 2nd antenna structure

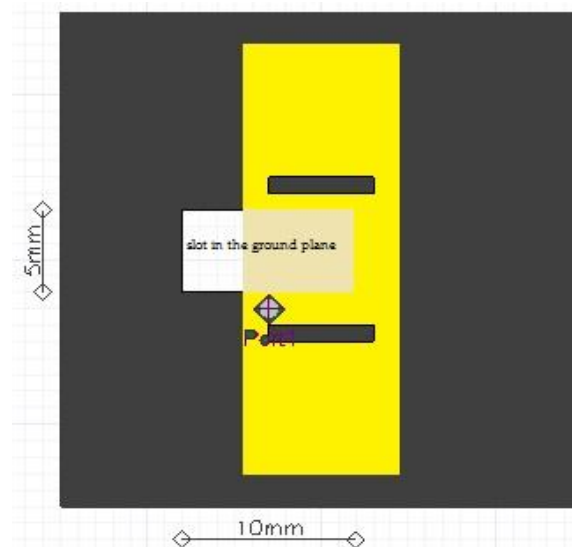


Fig.3 Top view of the 3rd antenna structure

III. RESULTS

The 1st antenna resonates (Fr) at 9.84 GHz with lower cut-off frequency (Fl) of 9.66 GHz and higher cut-off frequency (Fh) of 9.96 GHz. The impedance bandwidth as calculated is 3.04%. A maximum gain of 3.61 dBi is shown in this band. The plot of return loss and swept gain are shown in fig: 4 & fig: 5 respectively for the 1st design. A dual band is observed for the 2nd structure. The value of the lower cut-off, resonating and higher cut-off frequency of the two bands are 7.03 GHz, 7.18 GHz, 7.37 GHz and 9.71 GHz, 9.85 GHz, 10.02 GHz respectively. The impedance bandwidth as calculated is 4.73% for the 1st band and that for the 2nd is 3.14%. Maximum gain observed in these two bands are 4.88 dBi & 1.7 dBi respectively. The return loss and the swept gain plot for the 2nd design are shown in fig: 6 & fig: 7 respectively. The return loss plot for the 3rd structure also shows two frequency bands. The value of the lower cut-off, resonating and higher cut-off frequency for the 1st band are 5.64 GHz, 5.73 GHz, & 5.82 GHz respectively and that for the 2nd band are 8.43 GHz, 8.54 GHz, & 8.64 GHz. The bands are having an impedance bandwidth of 3.14% & 2.45% respectively. A maximum of

3.06 dBi & 1.98 dBi of gain are obtained in these two frequency bands. The return loss and swept gain plot for this 3rd antenna are shown in fig: 8 & fig: 9 respectively.

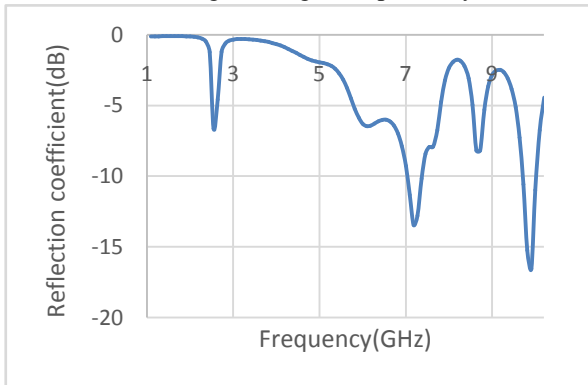


Fig. 4 Reflection coefficient plot of the 2nd antenna structure

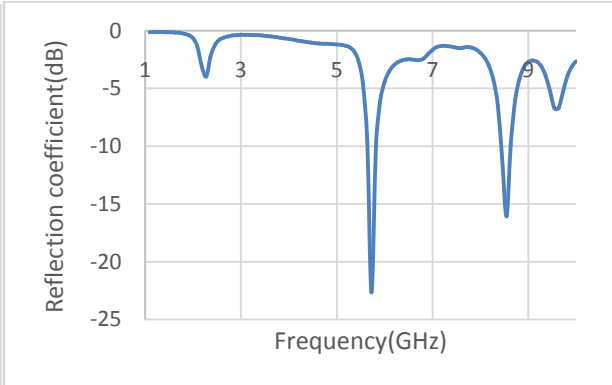


Fig. 5. Reflection coefficient plot of the 3rd antenna structure

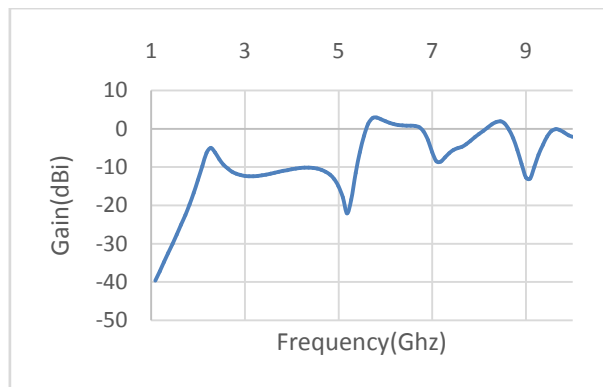


Fig. 6 Swept gain plot of the 3rd antenna structure

Table: 1 shows a comparison of the resultant data a: obtained for the three structures.

Table 1: Comparison of data

Design no.	F1-Fr-Fh (GHz) [considering -10 dB axis]	B.W. %	Gain {dBi}	Compatness %
1	9.66-9.84-9.96	3.04	3.61	-
2	7.03-7.18-7.37, 9.71-9.85-10.02	4.73, 3.14	4.88, 1.7	46.79
3	5.64-5.73-5.82, 8.43-8.54-8.64	3.14, 2.45	3.06, 1.98	66.11

IV. CONCLUSIONS

Two antenna structures presented here show dual-band operation with positive gain and moderate impedance bandwidth. The design proposed here .i.e. the 3rd antenna structure results in a significant amount of size reduction which is 66.11%. The compactness is increased significantly from 2nd to 3rd structure by incorporating a slot in the common area of the radiating patch and ground plane. Though not practically tested, it is a good result based on software simulation. With increasing demand for compact antennas day-by-day for mobile and other wireless communication, this antenna structure would really be useful. It can also be implemented in dual-band application such as Synthetic Aperture Radar (SAR), Global Positioning System (GPS) etc.

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