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Design of Microstrip Dipole Antenna at Various Ground Plane

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Abstract: This paper overviews the effects of ground planes on proposed microstrip dipole antennas at a centre frequency of 2.4 GHz. By using the shorting plane technique 23.25% bandwidth with minimum return loss of -36 db is obtained. With this technique dual band microstrip dipole antenna is obtained. These antennas are designed on a FR-4 substrate on double sided PCB with a dielectric constant of 4.4. These antennas are low cost, easy to design, light weight and easy to convince for mass production.

Keywords: dipole antenna, compact antenna, microstrip antenna, resonant antenna.

I. INTRODUCTION

In modern wireless communication systems many researchers have been focused on the development of wideband antenna. Low profile, low cost, low weight and easy to design antennas can accommodate several wireless communication system over an entire operating frequency band with excellent bandwidth; radiation pattern and return loss are in demand. In this paper, the effect of ground plane in tapered microstrip dipole antenna is obtained. Microstrip dipole antennas are very popular because the bandwidth of microstrip dipole antenna is very high as compared to the microstrip patch antenna. Microstrip dipole antenna is a good and easy approach for a device where in Omni direction pattern is required.

II. ANTENNA GEOMETRY

Proposed dual band microstrip dipole antennas are printed on a 1.6mm thick double sided, low cost FR-4 printed circuit board with a dielectric constant of 4.4 at the centre operating frequency of 2.4 GHz. The length, width & height of substrate are taken respectively 3λg, λg and λg\10.5, where λg is the quarter guided wavelength at operating frequency of 2.4 GHz. The total length of dipole arm is L=41mm including the gap between arms. At the designed frequency the width of dipole arm is approximated, that is 0.169λg. All parameters of ground plane are taken in terms of λg.

III. SIMULATION AND RESULT

A proposed microstrip dipole antenna with tapered arm has been simulated with HFSS 13.0 from ANSYS software. The simulation results for all microstrip dipole antennas with different ground plane are discussed in term of bandwidth response and input return loss.

Design 1:
The microstrip dipole antenna with rectangular hatched ground plane is shown in figure 1. The total length of hatched rectangular ground plane in addition with microstrip bend is 1.169λg, and the width of ground plane is 0.169λg. The bandwidth of proposed microstrip dipole antenna is 484.9MHz and 6MHz. With this return loss at -30.94db band -11.545db a dual band microstrip dipole antenna is obtained.

Design 2:
Proposed microstrip dipole antenna with truncated polygon from one side ground plane is shown in figure 2. The bandwidth of proposed microstrip dipole antenna is 515.2MHz and 60.6MHz with the return loss at -30.94db and -11.545db.

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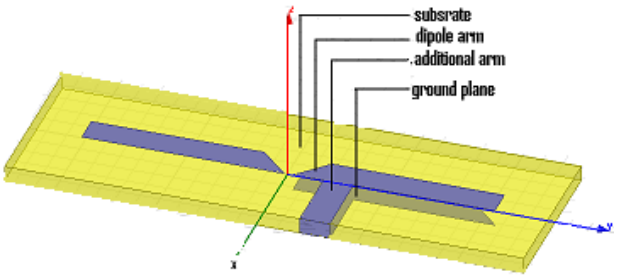

FIGURE 1: MICROSTRIP DIPOLE ANTENNA WITH TAPERED GROUND PLANE

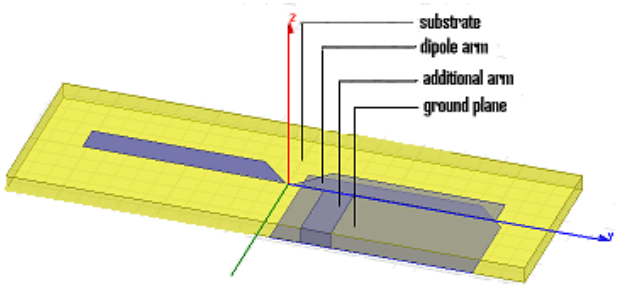

FIGURE 2: MICROSTRIP DIPOLE ANTENNA WITH TRUNCATED POLYGON FROM ONE SIDE GROUND PLANE

Design 3:

The microstrip dipole antenna with rectangular ground plane of dimensions length L=1.5λg and width W=0.5λg is shown in figure 3. The resultant value of bandwidth and return loss is 545MHz and 60.6MHz, -23.77db and -24.66db respectively.

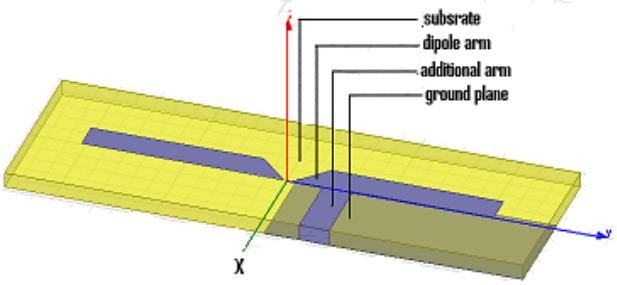

Figure 3: Microstrip dipole antenna at half rectangular ground plane

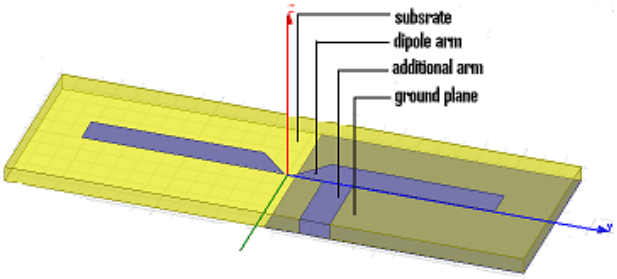

Figure 4: Microstrip dipole antenna at rectangular ground plane

Design 4:

In proposed antenna, the ground plane is considered to be the half of the substrate. The length and width of ground plane is L=1.5λg and W=λg. A microstrip dipole antenna with rectangular ground plane is shown in figure 4. The return loss and operating bandwidth of the proposed antenna are -36.27db, -16.78db and 606MHz, 90.9MHz respectively.

Here, figure 5 shows the simulated return losses of microstrip dipole antenna at different ground plane. From all simulated result it is observed that the bandwidth of proposed microstrip dipole antenna at rectangular ground plane is higher than the all other ground planes. The comparative results of dipole antenna in terms of return loss and bandwidth at all ground plane are shown in table 1.

TABLE I

S.NO.	Relation between all microstrip dipole antenna with different ground plane		
	Ground plane design	**Bandwidth**	**Return loss**
1	Rectangular hatch with microstrip bend	484.9MHz And 6MHz	-30.94db And -11.545db
2	Truncated polygon from one side	515.2MHz And 60.6MHz	-39.88db And -32.64db
3	Rectangle (L=1.5λg,W=0.5λg)	545MHz And 60.6MHz	-23.77db And -24.66db
4	Rectangle (L=1.5λg, W=λg)	606MHz And 90.9MHz	-36.27db And -16.78db

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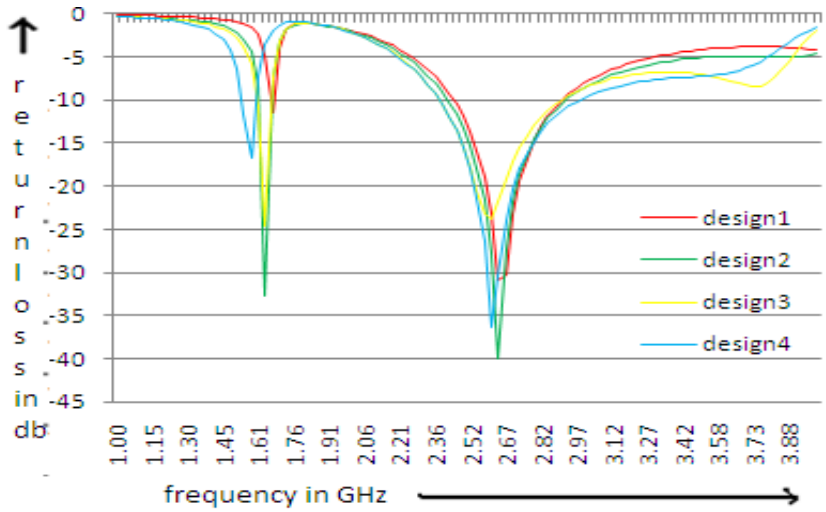

Figure 5: Return loss of Microstrip dipole antenna at different ground plane

IV. CONCLUSION

The performance of dual band microstrip dipole antenna with different ground plane has been analyzed at a frequency of 2.4 GHz for wideband application. Shorting plate between the ground plane and dipole arm improve the bandwidth of antenna as well as provide double band. By using this shorting plate we obtain maximum bandwidth of 23.25% with minimum return loss of -36 db.

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Biography

Nitali garg received her Bachelor of Engineering (Electronics and communication) from Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal in 2009 and currently she is pursuing M-tech (digital communication) from the same institute. Her research fields focus on microstrip antenna analysis and designing

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