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Printed Circular Monopole Antenna

Prof. P. A. Chaudhari[1], Snehal R. Gaykhe[2], Aishwarya N. Darekar[2], Swati K. Bagal[2]

Assistant Professor, Dept. of E&TC, SVIT, Nashik, India[1]

B. E Student, Dept. of E&TC, SVIT, Nashik, India[2]

ABSTRACT: As we all knows Antenna is very essential component in wireless technology. Wireless system are involving towards development of new application with broadband access and also the higher data rates .In communication system one of the most important component is "antenna" which makes the communication between two distinct points possible. Antennas are used in all types of wireless communication. Printed antennas are known as the micro strip antennas. Micro strip antennas becomes very popular day by day because of its easy of analysis and fabrication, low cost, light weight, easy to feed and their attractive radiation characteristic.[12]Printed antenna has numerous advantages. It is very challenging for the antenna engineers to reduce the size of the antenna while maintaining the performance parameters such as voltage standing wave ratio (VSWR), wide bandwidth and symmetric radiation patterns [1]. This paper consist of partial implementation of circular monopole antenna and mathematical analysis which is basically micro strip antenna with partial ground plane and rectangular micro strip feed line. The simulation is done by using IE3D software for different application.

KEYWORDS: Circular discmonopole, micro strip line-fed, printed antennas.

I. INTRODUCTION

At present we are witnessing a very rapid growth of wireless communications and in this process antennas with extremely large bandwidth are in demand .So that various application are covered with fewer or preferably with a single antenna. Printed monopole antennas give very large impedance bandwidth with reasonably good radiation pattern [4]. The printed monopole antenna can be viewed as a special case of micro strip antenna configuration. Printed monopole antennas are truly planner and have radiation pattern similar to that of dipole antennas. This monopole can be integrated with other components on printed circuit boards, have reduced size on dielectric substrate, are without back in ground plane are easy to fabricate. Printed antennas, commonly fabricated which is ideally suited for UWB technology-based low-cost systems [12].

They usually radiate different frequency components from different parts of the antenna, which distorts and stretches out the radiated waveform. Recently, several broadband monopole configurations, such as circular, square, elliptical, pentagonal and hexagonal, have been proposed for UWB applications.[12] These broadband monopoles feature wide operating bandwidths, satisfactory radiation properties, simple structures and ease of fabrication [4].

Printed Monopole Circular Antenna Design: Design of Printed monopolecircular antennawith the feed line are discussed here. Formulae to calculate (VSWR=2) frequency for printed monopole is presented. A patch is fabricated on dielectric substrate (commonly FR4).Beyond the substrate it can be assumed that very thick air dielectric substrate (€r=1) exists. It makes microstrip antenna configuration on thick substrate with €r is closer to 4.7 which yields large bandwidth [12].

II. RELATED WORK

In[6], Authors presents the printed circular disc monopole antenna fed by micro strip line. The performance of the antenna in terms of its frequency domain characteristics is mostly dependent on the feed gap, the width of the ground plane and the dimension of the disc. The first resonant frequency is directly associated with the dimension of

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the circular disc because the current is mainly distributed along the edge of the disc. The radiation patterns of printed circular disc monopole antennas are nearly Omni-directional over the entire 10 dB return loss bandwidth[6].

Authors presents the effect of ground plane and compared the effect of the small reflectors plan for circular CPW and the prototype antenna. Ground plane can increase the gain and directivity of antenna and it gives the multiband characteristic also. The impendence bandwidth between 1.2GHz to more than 12GHz is suitable for VSWR <2 and the antenna gain between 4-8.19 dBi [13].

III. GEOMETRY

Printed monopole circular antenna with feed position is shown in fig.1. These antenna generally fabricate on FR4 substrate (€r=4.7) with back in ground plane. A circular disc monopole with a radius r=10mm and a 50Ω micro strip feed line is printed on the same side of the dielectric substrate (FR4 substrate of thickness 1.5 mm and relative permittivity 4.7 was used).L and W and denote the length and the width of the dielectric substrate respectively. The width of the micro strip feed line is fixed at W1=2.6mm to achieve 50 Ω impedance. On the other side of the substrate, the conducting ground plane with a length of L1=20mm only covers the section of the micro strip feed line. h is the height of the feed gap between the feed point and the ground plane [6].

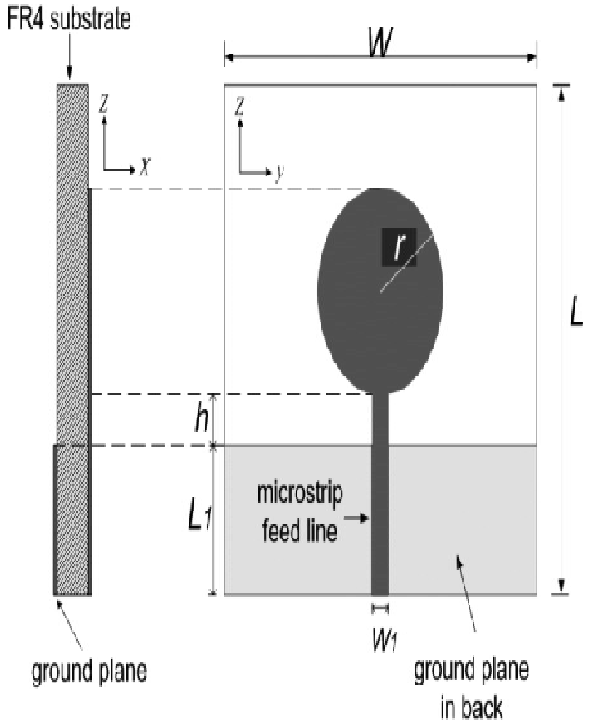

Fig.1-Geometry of printed circular monopole antenna [6]

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IV. MATHEMATICAL ANALYSIS [1]

- ***Centre Frequency*:** It can be given by,
  $FC = F1+F2\ /2= 10.6+3.1/2 = 6.85GHz$

- ***Dielectric Constant (εr) and (εe)*:** For the antenna to be design have FR4 substrate & for this substrate €r=10 mm Also thickness of substrate used is h=0.3mm.
  Effective Dielectric Constant is given by,
  $\epsilon e=\epsilon r+1/2* (1+0.3h) = 3.1065$

- ***Effective Radius (ae) and Radius (a):***
  $ae=8.791/Fc\ \sqrt{\epsilon e}= 7.3mm$
  $ae= a+h \quad a=ae-h= 7.3-1.5cm=5.8mm$

- ***Width of Ground Plane (Wg):*** $Wg=1.38*c/Fc*\sqrt{\epsilon e}=0.0342mm$

- ***Length of Ground Plane (Lg):*** $Lg=0.36*c/Fc*\sqrt{\epsilon e}=8.9mm$

- ***Width of Feed Line (Wf):*** $\lambda g=c/Fc*\sqrt{\epsilon r}=0.02cm=2mm$
  $Wf=\lambda g/2= 1mm$
  $letWf= 1mm$

- ***Length of Feed Line (Lf):***
  $Lf \gg Wf= 7mm$
  $Lf=L1+h=20+0.3=20.3$

V. SIMULATION AND RESULTS

All the parameters are summarized in following table. By using IE3D simulator the design is made & simulated. As the design have FR4 substrate & partial ground plane. Following graph show simulated results for design.

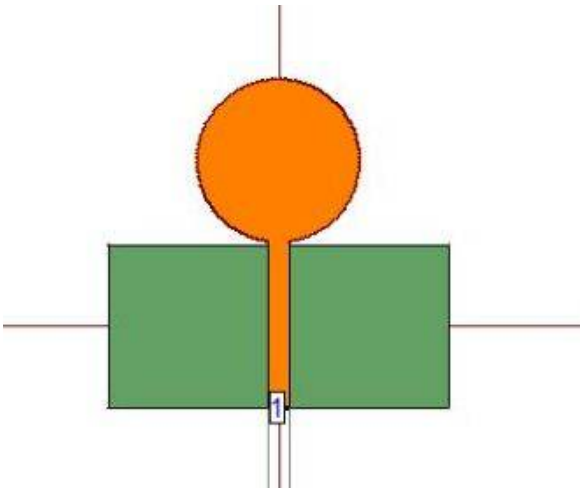

Fig.2. Designs by using IE3D simulator

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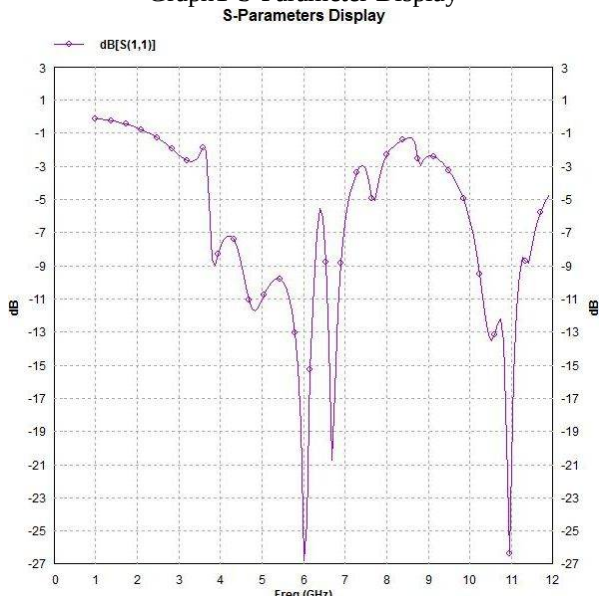
Table1-Summary of Analysis.

Parameter	DesignedValue (inmm)	SelectedValue(inmm)
Widthofsubstrate(W)	42	42
Lengthofsubstrate(L)	50	50
Widthof feedline (WF)	1	2.6
Lengthoffeedline(LF)	20.2	20.3
Widthofpartialgroundplane(Wg)	0.4	0.4
lengthofpartialgroundplane (Lg)	0.01	20
Radius ofPrintedDisk(a)	8.1	10
Substrate thickness (h)	1.5	1.5

S-parameter result are shown in the below fig. which shows that S11 parameter below -10dBs for 4.5GHz to 6.1GHz & 10.3GHz to 11.2GHz frequency bands.

Graph1-S-Parameter Display



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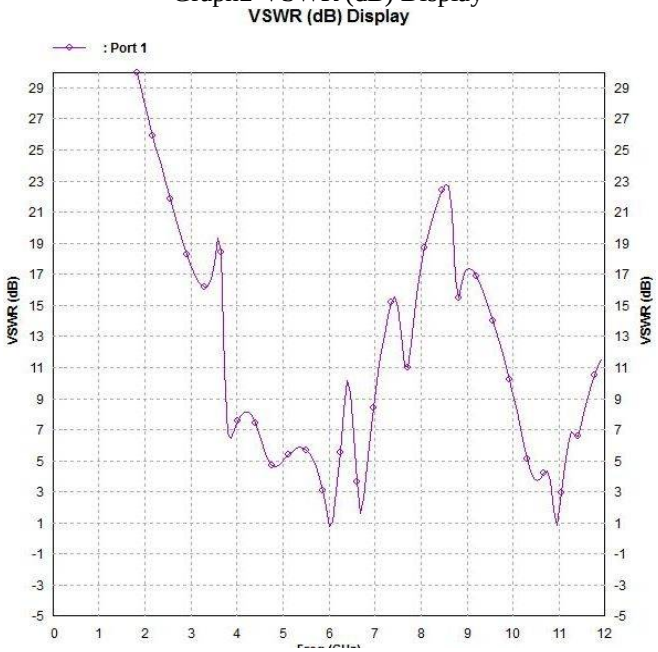
VSWR graph is shown in below fig. it shows VSWR has value near to 2dB for 5.9GHz to 6.2GHz & 6.7GHz to 6.9 GHz also10.6GHz to 10.9GHz i.e. triple band frequency.

Graph2-VSWR (dB) Display



VI. CONCLUSION

As this paper is based on partial implementation of the design having the results but not for the complete band. The designed antenna can be used for triple band application.

VII. ACKNOWLEDGMENT

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