Circular Disk Monopole Antenna for Broadband Applications

B.Saidaiah[#1], A.Sudhakar[*2], K. Padma Raju[#3]

#1 Professor, Department of ECE, Chebrolu Engineering College, Guntur Dt, AP, India
*2 Professor, Department of ECE,RVR&JC College of Engineering, Guntur Dt, AP, India
#3 Professor, Department of ECE, JNTU Kakinada, East Godavari Dt, AP, India

Abstract- This paper describes design of circular disk monopole antenna for operating frequency 3.0GHz-20.0GHz. This proposed antenna giving superior performance over conventional antennas with high gain 17 dB, high directivity and symmetrical E-plane and H-plane characteristics which makes this antenna suitable for ultra wideband (UWB) and broad band applications. This paper presents the return loss, input impedance, radiation patterns, VSWR, E-field, H-field and current distributions using CST software.

Index Terms- UWB, VSWR, CST

I. INTRODUCTION

Modern and future wireless systems are placing greater demands on antenna designs. Many systems now operate in two or more frequency bands, requiring dual or triple band operation of fundamentally narrow band antennas. These include, satellite navigation systems, cellular systems, wireless LAN and combination of these systems. One of the most popular antennas employed in mobile communication systems is the Monopole antenna and its family [1]-[3]. The term broadband refers to a telecommunications signal or device of greater bandwidth, in some sense, than another standard or usual signal or device [4].

Some of the Broad Band antennas are much more complex than other existing single band, dual band and multi band antennas [5]-[6]. In this paper we investigate Broad Band antenna, which is basically a printed micro strip antenna with etched ground plane. The printed circular micro strip antenna is advanced antennas over conventional rectangular micro strip antennas in terms of the complexity. This Broad Band antenna has slightly high BW than previous existed one and also it has high efficiency and reduced size.

II. SUBSTRATE MATERIAL SELECTION

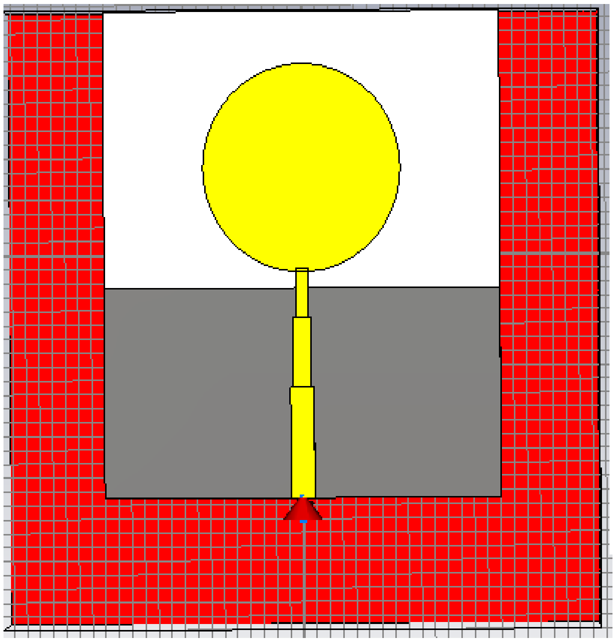
The choice of dielectric substrate will play an important role in the design and simulation of the micro strip antennas. The substrate choice depends upon permittivity, dielectric loss tangent, thermal expansion and conductivity, cost and manufacturability. In this present work we used Roger RT-duroid as substrate material for simulation of micro strip antennas.

III. DESIGN SPECIFICATION

The radiation mechanism of planar circular disc monopoles is an involved topic and has been investigated by many UWB antenna researchers [5], [6]. One method for analysing such structures can be in the frequency domain where wide band monopole operation is explained by the overlapping of closely distributed minimums in the reflection coefficient, sometimes referred to as resonances [7]. The design specifications and structure of proposed antenna on Rogers RT-6010 substrate material with relative dielectric constant 10.2, thickness of 0.83mm. The real part of antenna impedance is 50Ω at 9.5GHZ, 10.5GHz, 11.5GHz and 12.5GHz where the imaginary part of the antenna impedance equals zero, the final dimensions and structure of Broad Band antenna after doing an extensive simulation study as shown below table and figures.

Table-1 Dimensions of the Circular Disc Monopole antenna

Dimensions	Millimetres [mm]	
Width of the Substrate	W	30
Length of the Substrate	L	35
Width of the 50-Ω Feed line	Wf	1.8
Length of the 50-Ω Feed line	L_f	8
Width of the First Micro strip Line	W_1	1.4
Length of the First Micro strip Line	L_1	5
Width of the Second Micro strip Line	W_2	1
Length of the Second Micro strip Line	L_2	3.5
Radius of the Printed Disc	R	7.5
Length of the Partial Ground Plane	L_g	15.1
Width of the Partial Ground Plane	W_g	30
Substrate Thickness	H_{sub}	0.83



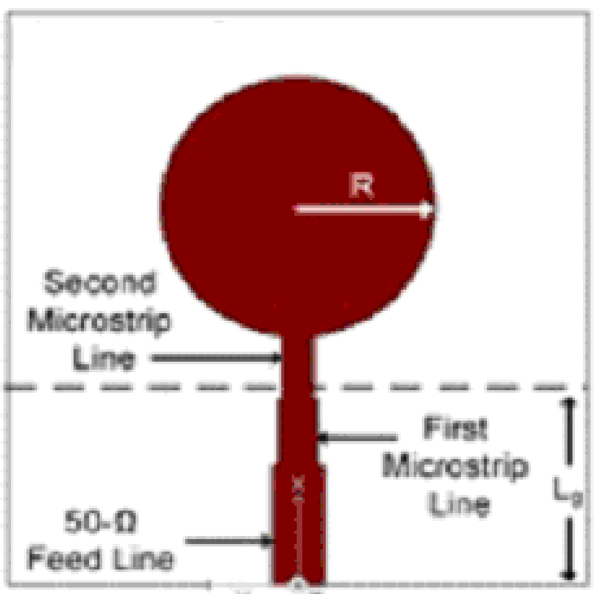


Figure 1: Compact Disc Monopole antenna

IV. RESULTS AND DISCUSSION

Figure 1 shows the CST model of Broad Band Compact Disc Monopole Antenna. Figure 2 shows the return loss of the proposed antenna.

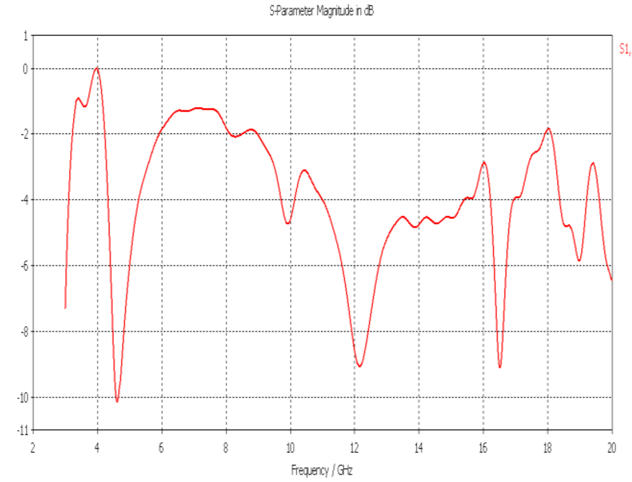


Figure 2: Frequency vs. Return loss

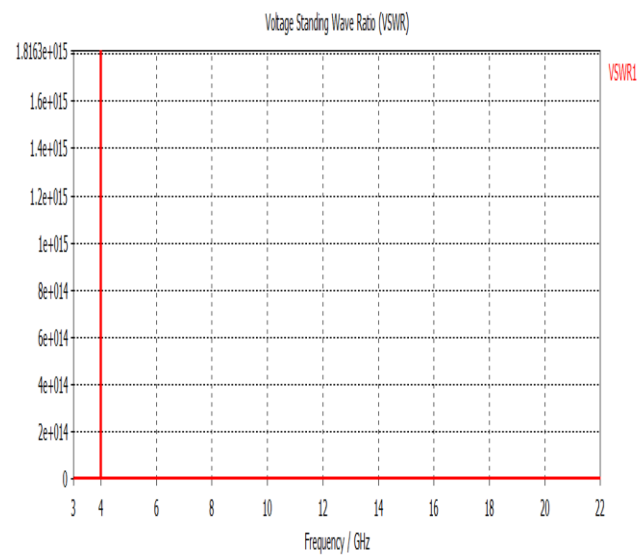
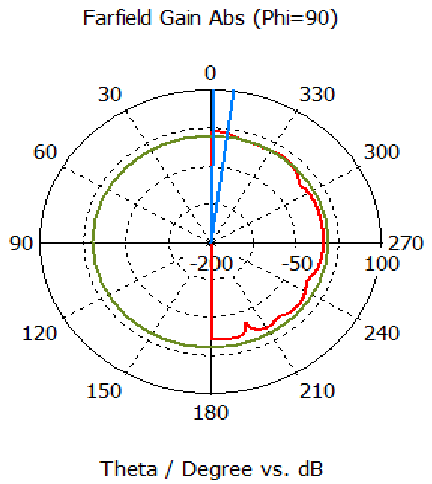


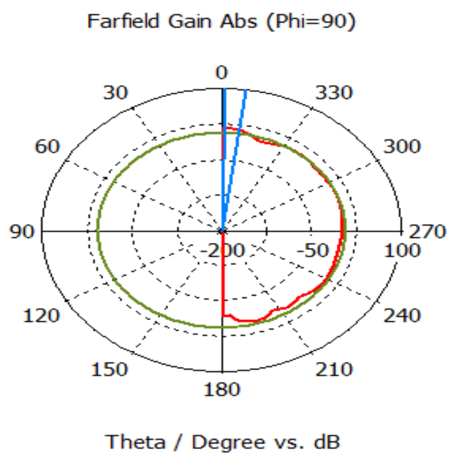
Figure 3: VSWR curve

Figure 2 shows Frequency Vs. Return loss curve for simulated values. Return loss of less than -2 dB is obtained in entire frequency range. Figure 3 shows VSWR curve.

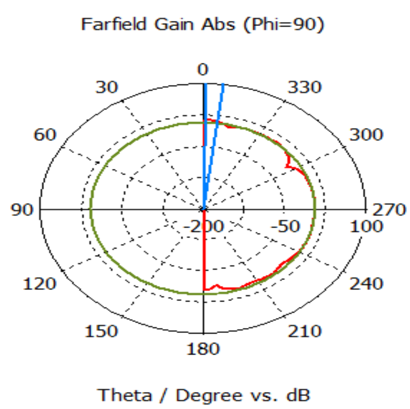
As the antenna gets excited the travelling wave gets travelled and the radiation pattern is obtained when impedance of the micro strip gets matched with the free space impedance. Symmetric radiation is obtained with low side lobes. Figure 4 shows the radiation pattern for the proposed antenna at different canter frequencies in between 3GHz to 20GHz.



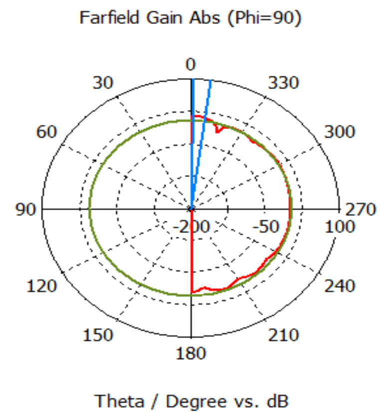
(a)



(b)



(c)



(d)

Figure 4.Circular Disc Monopole antenna:2-D Far field radiation pattern at (a) 12.5GHz (b) 11.5GHz (c) 10.5GHz (d) 9.5GHz

Figure 4 shows the 2-D radiation patterns at different frequencies 12.5 GHz, 11.5GHz, 10.5GHz and 9.5GHz . Maximum Gain of approximately 18 dB occurred at 12.5GHz and gain margin is 15.65dB is obtained from the simulated results.

The simulation time and accuracy will be influenced by the mesh. Fig.5 and Fig.6 shows the E-field, H-field current distribution generation for the proposed antenna. Average current distribution of the cross section will give the information about S-parameters.

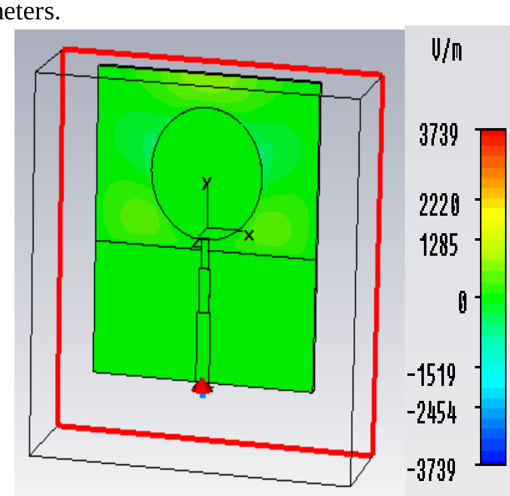


Figure 5: E-Field distribution

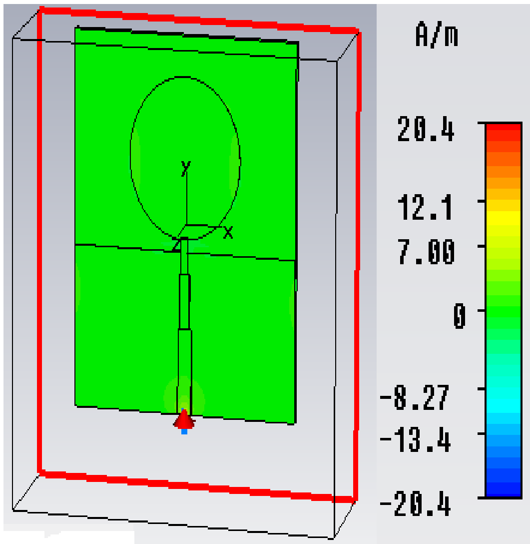


Figure 6: H-Field distribution

V. Conclusion

This paper mainly presents the design and detailed results of the Compact Disc Monopole Antenna for Broad Band Applications with Roger RT-6010 substrate material. This antenna is showing remarkable performance over the entire frequency range between 3-20GHz with high gain of 18 dB and high directivity. This proposed model is giving the confidence to use design of Broad Band antennas for the phased array applications.

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Authors

First Author – B.Saidaiah, Professor, Department of ECE, Chebrolu Engineering College, Guntur Dt, AP, India
Email id - saidaiahbandi@gmail.com

Second Author - A.Sudhakar, Professor, Department of ECE,RVR&JC College of Engineering, Guntur Dt, AP, India
Email id – alapati_sudhakar@yahoo.com

Third Author - K. Padma Raju, Professor, Department of ECE, JNTU Kakinada, East Godavari Dt, AP, India
Email id - padmaraju_k@yahoo.com.