International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

HALF WAVE WIRED DIPOLE ANTENNA FOR WIRELESS APPLICATIONS

Sandeep Pradhan[1] and P.K.Singhal[2]

[1,2]*Department of Electronics, Madhav Institute of Technology & Science, Gwalior, India*

ABSTRACT

A half-wave wired dipole antenna has been designed for wireless applications at 1 GHz. It is used for Aeronautical radio navigation and other wireless applications. This design is simulated and analyzed using CST Microwave Studio (MWS).Gain of 2.1 dB within the frequency band is achieved.

Keywords: Half wave dipole Antenna, CST MWS, Radiation pattern, Efficiency, Directivity.

1. INTRODUCTION

Wired antennas [1] find its origin in the theory of transmission line. A transmission line is a medium through which electromagnetic waves travel from source to the receiver. If load end of the line is left open then power radiating into space. But if the ends are opened out gradually then the radiation becomes significant. As the two ends becomes in line opposite to each other radiation becomes maximum. This becomes a wired antenna radiating power in space. This system of antenna formed is known as a dipole antenna or a wired dipole antenna after printing techniques came into picture.

The dipole antenna is a basic antenna with the theoretical unit being infinitesimal dipole antenna. The finite length dipole antenna includes a half wave dipole antenna, full wave dipole antenna, folded dipole antenna. The dipole antenna is the simplest antenna that is used in RF communications. A wired dipole antenna consists of two wires made of copper or some conductor which are placed in line with a gap in between the two wires [2]. A transmission line feed though the gap to the two wires. If the length of two wires is equal then it is called center fed dipole. Half wave dipole antenna is a dipole antenna whose length at the working frequency is half of the wavelength. Half wave dipole is a resonant antenna with the current maximum at the center and nodes at the ends. The antenna properties change with the change of length, radius of the wire, and the gap between the ends [3].

The aim of this simulation is to study the significance of wired antenna which is the root of antenna theory.Wired antennas are basic antennas but they carry their importance in this era of printed antennas. They are the simplest in construction, gain, directivity, efficiency is satisfactory. Radiation pattern is good and is cost effective. It can be designed for any frequency provided the length is not too small i.e., not less than a half wavelength. The other wired antenna includes loop antenna, helical antenna, log periodic antenna, etc. They have their own advantages.

2. DESIGNING PARAMETRS OF ANTENNA

The basic formulae for the designing of the wired dipole antenna are as follows [4-5]:

$$L = 143/f$$

$$D = 0.002\lambda$$

$$g = L / 200$$

Where, f is the resonant frequency in GHz and λ is the wavelength in mm, L is thelength of the antenna in mm, D is the diameter of wired antenna in mm and g is a gap between two arms of half-wave dipole antenna.

The parameters are calculated for 1 GHzusing the above formulae. The designed parameters value of proposed dipole antenna is shown in table 1.

Table 1: Design Parameters of the Antenna

Parameter	Value (mm)
L	143 mm
D	0.6 mm
g	0.715 mm

The proposed dipole antenna for 1 GHz is shown in figure 1.

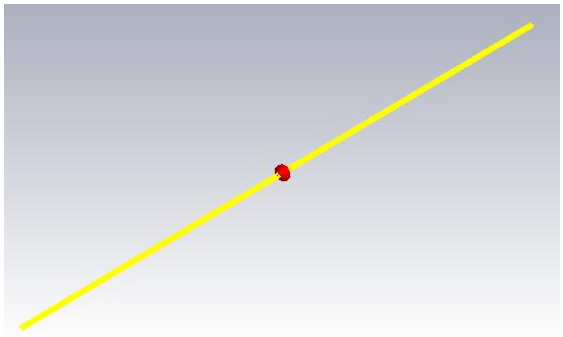


Figure 1: Half wave dipole antenna at 1 GHz.

3. RESULTS & DISCUSSION

The return loss of proposed wired dipole antenna is shown in the figure 2.

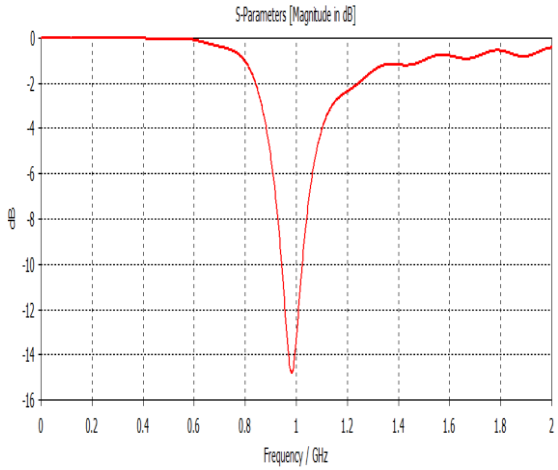
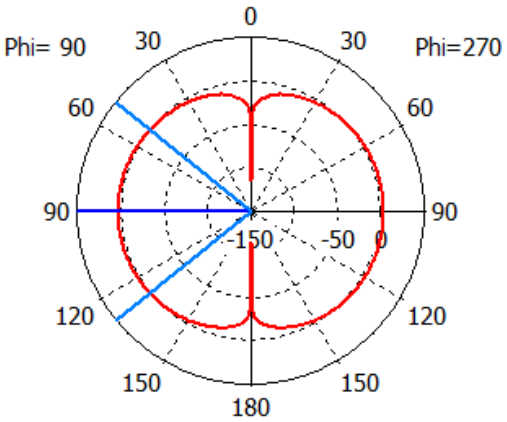


Figure 2: Return Loss of Dipole Antenna at 1 GHz.

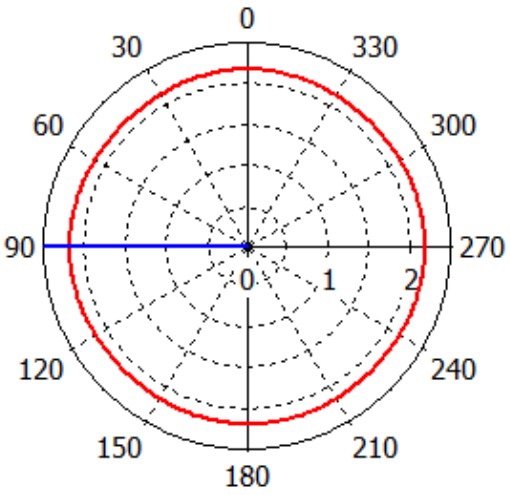
The return loss of proposed dipole antenna at 1 GHz is -14.63dB with a bandwidth of 80 MHz in the range of 0.943 GHz – 1.023 GHz.

The radiation pattern of proposed wired dipole antenna at 1GHz is shown in figure 3.

Figure 3(a) shows the bi-directional radiation in Elevation Plane (or E-plane) while omni-directional radiation are achieved in Azimuth Plane (or H-plane).



(a)



(b)

Figure 3: Simulated radiation pattern at 1GHz. (a) E-Plane (b) H-palne.

From the figure 3, its observed that the Half-Power Beamwidth of proposed antenna is 77.7^0 at the 1 GHz.

The simulated gain of proposed dipole antenna is shown in figure 4. Antenna gain is varying from 2.063 to 2.239 dB over the frequency band.

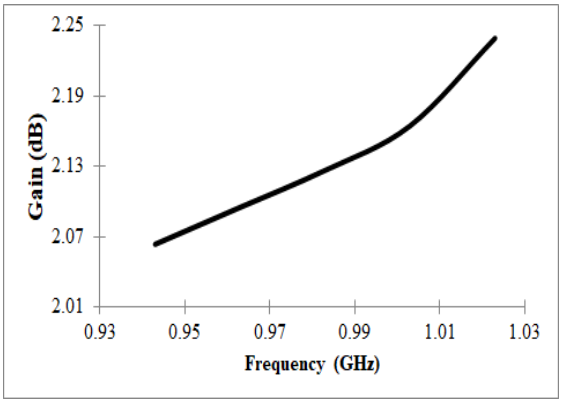


Figure 4: Simulated Gain of proposed dipole antenna.

The simulated radiation efficiency of proposed dipole antenna is shown in figure 5. Radiation effiecieny is 97% which is maximum at resonant frequency .

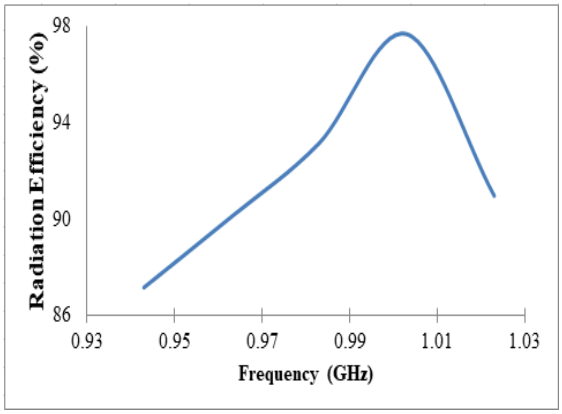


Figure 5: Simulated radiation efficiency of proposed dipole antenna.

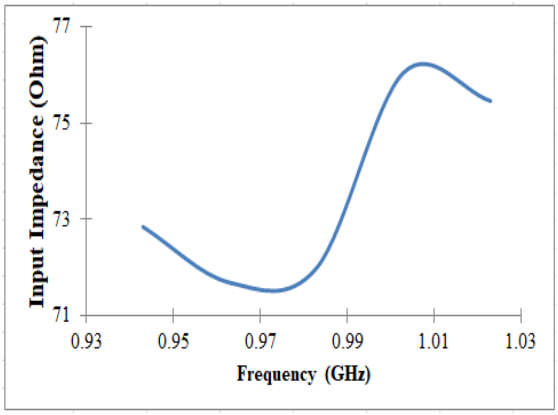


Figure 6: Simulated radiation efficiency of proposed dipole antenna.

The input impedance of proposed dipole antenna is shown in figure 6. It is clearly shown that input impedance of antenna is nearly equal to 75 Ohm which satisfied the theoretical imput imedance of half wave dipole antenna.

4.CONCLUSION

Half wave wired dipole antenna is designed & investigated for 1 GHz and found satisfactory results. Gain of average 2.1 dB, efficiency of 89% and imput impedance of 75 ohm was achieved. Proposed antenna of 80 MHz bandwidth (0.943-1.023 GHz) is used for wireless application.

REFERENCES

1. C.A. Balanis, “Antenna Theory, Analysis and Design”, Wiley India Pvt.Ltd., 3rd Edition, pp 34-35 .
2. D.M. Pozar, “Microwave Engineering”, Wiley India Pvt.Ltd., 3rd Edition, pp658-659.
3. S. R. Saunders, A. A. Zavala, “Antennas and Propagation for Wireless Communication Systems”, John Wiley & Sons, 2nd Edition, England (2007),pg. 77
4. P. Singh, A. Sharma, N. Uniyal,R. Kala, “Half-Wave Dipole Antenna for GSM Applications”, International Journal of Advanced Computer Research, Vol. 2, No. 4, Issue-6 December-2012.
5. M. Tareq, D. A. Alam, M. Islam, R. Ahmed, “Simple Half-Wave Dipole Antenna Analysis for Wireless Applications by CST Microwave Studio”, International Journal of Computer Applications, Vol. 94, No.7, May 2014, pp. 21-23.
6. P. Tawde, “Half wave dipole antenna for SatelliteCommunication Application”, International Journal of Advance Research In Science And Engineering, Vol. 4, Issue 4, April 2015, pp.104-111.
7. CST Microwave StudioSoftware version 2018.