

A Review on the Performance of Monopole Antennas for ISM Band

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Abstract

In this research work the performance analysis of different monopole antennas for ISM band is investigated. Performance parameters that are investigated includes Gain of antenna, Input impedance of antenna, VSWR of antenna and Gain of antenna. The structure of different monopole antennas is designed and simulated by High Frequency Structure Simulator.

Index Terms— Wire antenna, Dipole antenna, monopole antenna, VSWR, Bandwidth, Return loss.

Introduction

In the last decades a huge development had been done in designing the devices for industrial, medical and for scientific applications. For interconnection of these devices, we need antennas to communicate among these devices. Wire antennas are easy to design, inexpensive with relatively high gains. Two main types of wire antennas include dipole antenna and monopole antenna. The structure of dipole antenna is as shown in Fig (1). It consists of two metallic conductors which are fed at the center of conductors. The gap size between the conductors do not affect the performance of antenna. The length of antenna decides the operative frequency of antenna. Length (L) of antenna required to operate on a particular frequency(f) is related by

$$L = \frac{\lambda}{2} \text{ Where } \lambda = \frac{3 \times 10^8}{f}$$

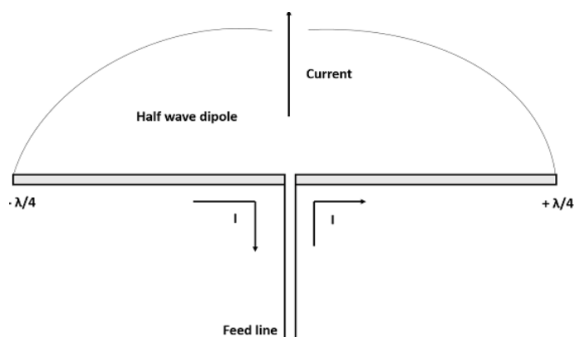


Figure 1. Dipole Antenna

Contrary to dipole antenna monopole antenna is having only one pole. Signal is fed in monopole antenna between lower pole of antenna and ground.

Different types of monopole antennas that are investigated in this research includes

- Wire monopole antenna.
- Circular disc monopole antenna.

Structure of wire monopole antenna is as shown in Fig.2.

Generally, length L of monopole antenna is taken as

$$L = \frac{\lambda}{4}$$

Wire antennas radiate in a direction perpendicular to the axis of dipoles. In this research we will simulate monopole and dipole antenna using High Frequency Structure Simulator. And will investigate the performance of these antennas for ISM Band.

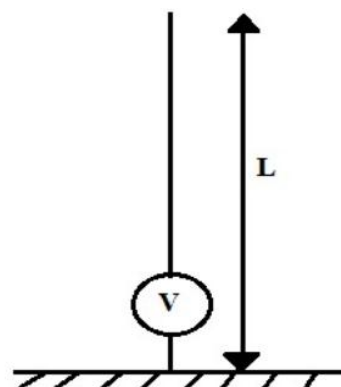


Figure 2. Wire monopole Antenna

Structure of Circular disc monopole antenna is as shown In Fig (3).

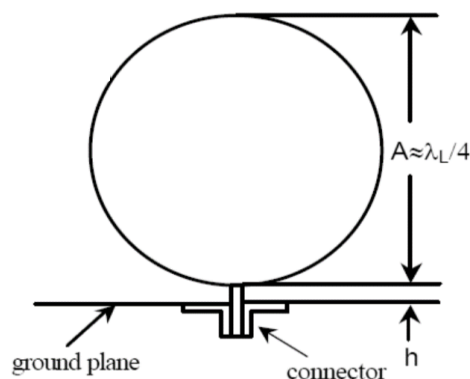


Figure 3. Circular disc monopole Antenna

In circular disc monopole antenna instead of using wire we are using circular disc as the radiating element.

Diameter of circular disc is kept as $\frac{\lambda}{4}$

As Proposed by design equations in [1-5] Dimensions of wire antenna for operative frequency of 2.4 GHz are given below

Table 1 Dimensions of Wire antenna

S.No.	Name of Parameter	Value
1	Operative Frequency	2.4 GHz
2	Monopole Length	2.71 cm
3	Monopole radius	.086 cm
4	Feed Gap	.086 cm
5	Ground plane width	10 cm

Table 2 Dimensions of Circular Disc Monopole antenna

S.No.	Name of Parameter	Value
1	Operative Frequency	2.4 GHz
2	Disc Diameter	2.71 cm
3	PIN height	.50 mm
4	PIN Diameter	.50 cm
5	FEED GAP	.025 mm
5	Ground plane width	10 cm

2. Results and Discussion

The structure of Wire monopole Antenna designed using High Frequency Structure Simulator for 2.4 GHz is shown in Fig (4).

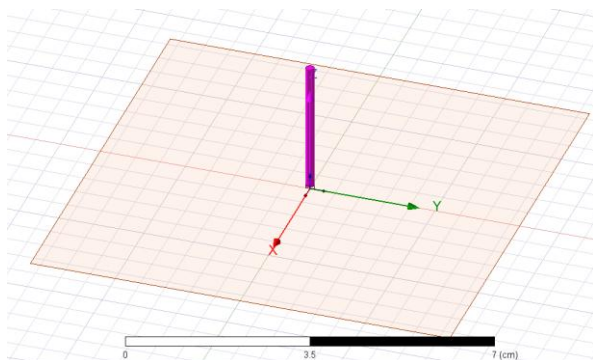


Figure 4. Structure of Wire monopole Antenna

Input Impedance of designed antenna is shown in Fig 5. Obtained Input impedance is around 29.63 Ω .

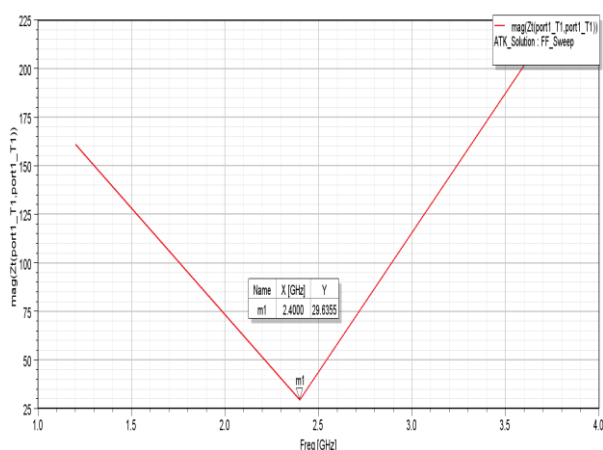


Figure 5. Input impedance of Dipole antenna

The scattering parameter at Port 1 is measured to be -12 db. and is shown in Fig (6). This indicates a good matching between source and antenna.

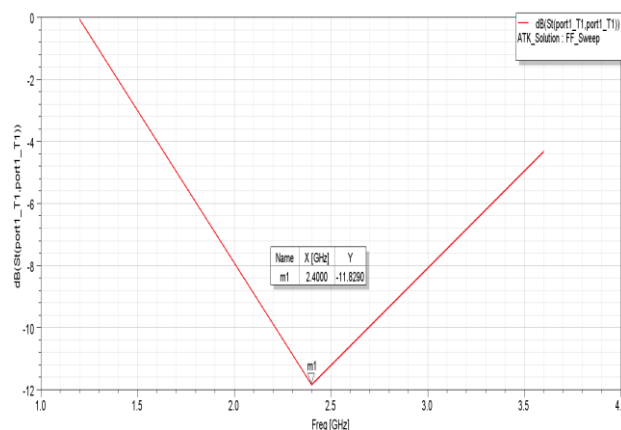


Figure 6. S₁₁ graph of dipole antenna.

VSWR of designed dipole antenna is shown in Fig (7). Obtained VSWR is around 1.68 which indicate good matching between source and load.

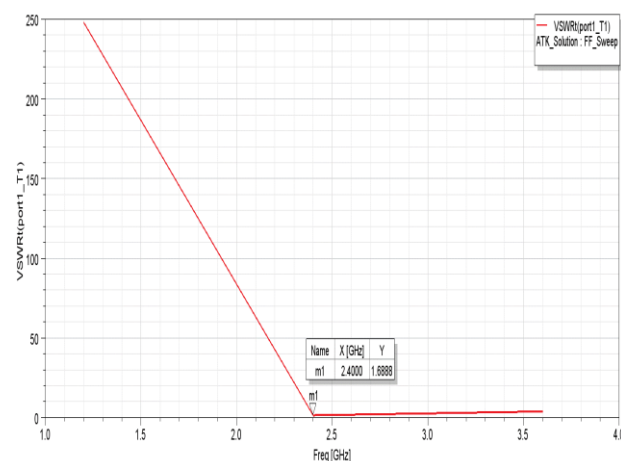


Figure 7. VSWR graph of dipole antenna.

The Radiation Pattern of designed dipole antenna is shown in Fig (8). A gain of 1.58 dB is achievable from designed dipole antenna.

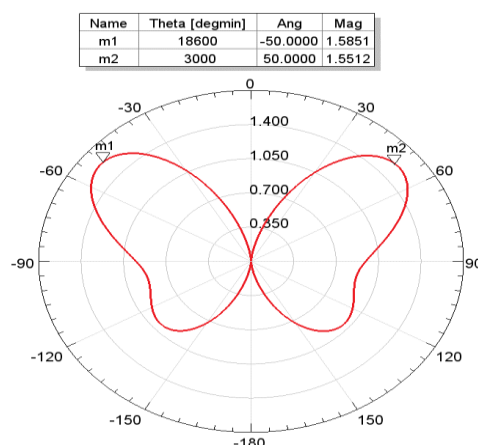


Figure 8. Radiation Pattern of planar dipole antenna.

Structure of Circular disc monopole antenna designed using HSSS is shown in Fig (9). Input Impedance of designed antenna is shown in Fig 10. Obtained Input impedance is around 19.63Ω .

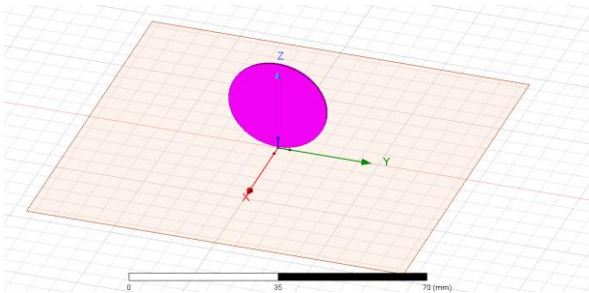


Figure 9. Structure of circular disc monopole Antenna

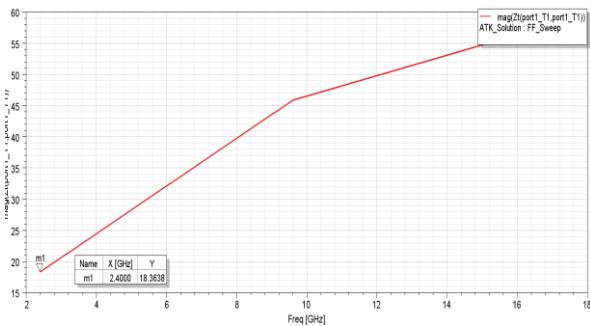


Figure 10. Input impedance of Circular disc monopole antenna

The scattering parameter at Port 1 is measured to be -6.6 db. and is shown in Fig (11).

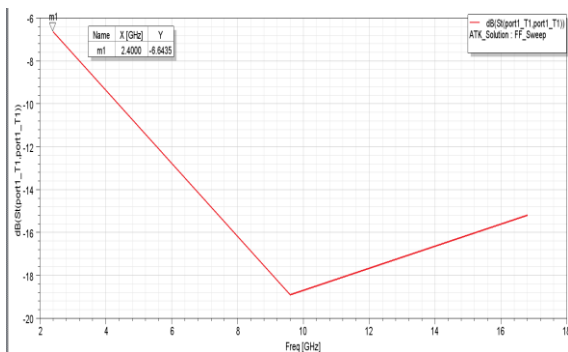


Figure 11. S_{11} graph of circular disc monopole Antenna

VSWR of designed dipole antenna is shown in Fig (12). Obtained VSWR is around 2.74.

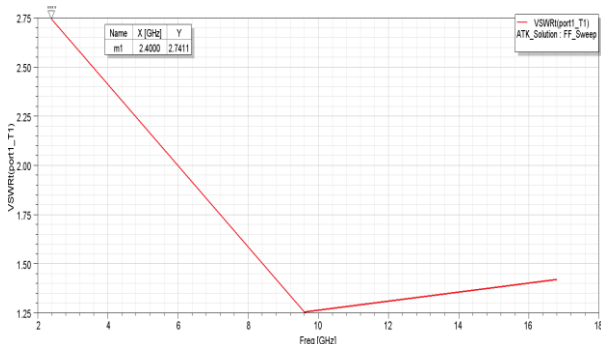


Figure 12. VSWR graph of circular disc monopole Antenna

The Radiation Pattern of designed circular disc monopole Antenna is shown in Fig (13). A gain of 1.59 dB is achievable from this Antenna

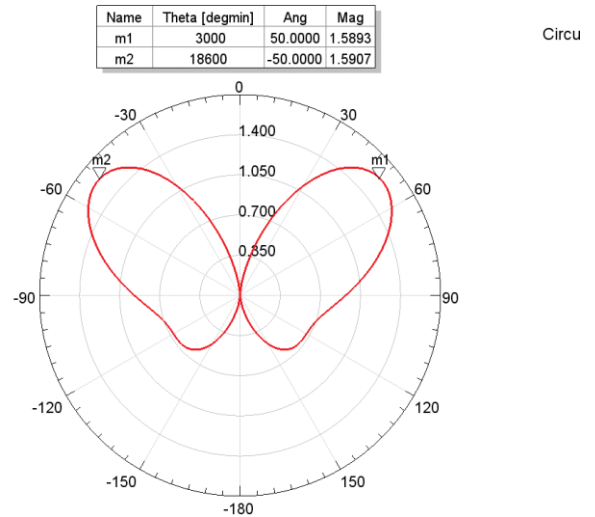


Figure 13. Radiation Pattern of Circular disc monopole antenna

Conclusion

A wire and Circular disc monopole antenna are designed in this research. A comparison of these antennas is presented below

Table3.

S.No.	Performance Parameter	Wire monopole Antenna	Circular disc monopole antenna
1	Input Impedance	29.63 Ω .	19.63 Ω .
2	VSWR	1.68	2.74
3	S_{11}	-12 dB	-6.6 dB
4	Gain	1.58 dB	1.59 dB

It can be concluded that wire monopole antenna bears better performance characteristics than Circular disc monopole antenna

References

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