International Journal of Applied Engineering Research ISSN 0973-4562 Volume 9, Number 24 (2014) pp. 31003-31005

Performance Evaluation of Dipole Antenna for Various Applications

Dr Monish Gupta
Electronics & Communication Engg Dept.
University institute of Engg & Technology, Kurukshetra University
Kurukshetra, India

Abstract
In this research a wire dipole antenna for GSM band and a planar dipole antenna for ISM band is designed. The operative frequency for wire dipole antenna in our design is 1350 MHz which lies in the center of GSM Band. Planar dipole antenna is designed for 2.4 GHz. Performance evaluation of antenna is done on the basis of Gain, return loss, Voltage Standing Wave Ratio, and Bandwidth. High Frequency Structure Simulator (HFSS) is used for simulating the designed antenna.
Index Terms— Wire dipole antenna, planar dipole antenna VSWR, Bandwidth, Return loss.

Introduction
GSM band is the range of frequencies allocated by International Telecommunication Union for the operation of GSM Mobile. Antennas are essential components for mobile communications which involve transfer of voice and data between transmitter and receiver mobile devices and between various networks. GSM antennas are generally mounted on tower and are connected to base station through coaxial lines. It is the performance of antenna which dictates the performance of communication network because area coverage by the network and strength of received and transmitted signal depends upon the performance of antenna. Several antennas are used
by GSM network but due to its simplicity, efficiency, Omnidirectional radiation pattern, higher band width and low designing cost dipole antennas are most commonly used antennas in GSM networks [1-6]. The structure of dipole antenna is as shown in Fig (1). It consists of two poles of metal fed at the center. Each antenna is designed for a particular frequency.

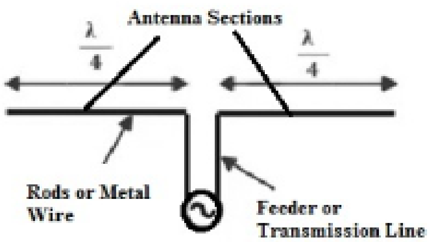

Figure.1 Structure of dipole antenna

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

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

Another type of dipole antenna is planar dipole antenna. This antenna is most suitable for wireless indoor applications duet to its conformal and planar structure. The structure of planar dipole antenna is as shown in Fig (2).

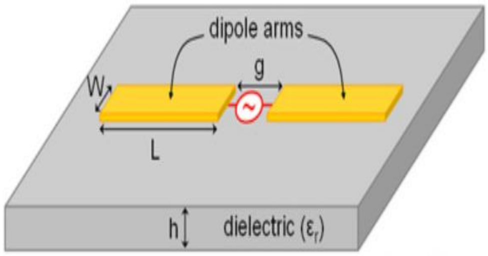

Figure.2 Structure of Planar dipole antenna

The planar dipole antenna requires a substrate for its design. Parameters of substrate concerned are the dielectric constant of substrate and height of the substrate.
The design parameters of dipole antenna and planar dipole antenna as proposed by [1-9] are presented in Table 1 and Table 2 respectively.

Table 1 Dipole antenna design parameters

S. No.	Name of Parameter	Value
1	Resonant Frequency	1.35 GHz
2	Dipole Length	10 Cm
3	Dipole radius	.17 cm
4	Feed Gap	.17 cm

Table 2 Planar Dipole antenna design parameters

S. No.	Name of Parameter	Value
1	Resonant Frequency	2.4 GHz
2	Dipole Length	5 Cm
3	Dipole width	.10 cm
4	Feed Gap	.10 cm
5	Substrate Material	Duriod
6	Substrate height	.16 cm

In this research a dipole antenna and a planer dipole antenna are designed by using High Frequency Structure Simulator (HFSS). The performance parameters which include Input impedance, VSWR, scattering parameters and gain are extracted to evaluate the performance of antenna.

Results and Discussion

The structure of Dipole Antenna designed using High Frequency Structure Simulator for 1.35 GHz is shown in Fig (3).

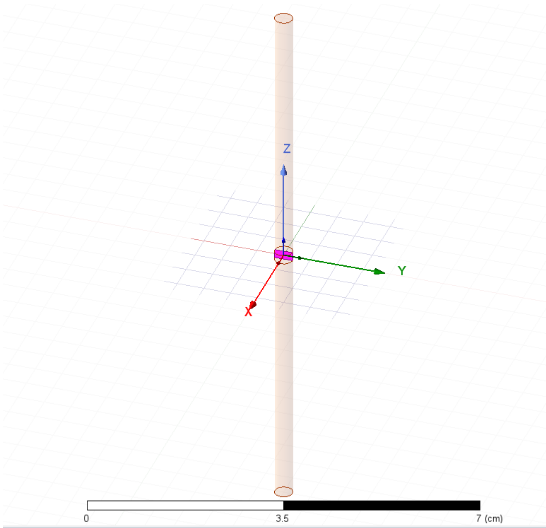

Figure 3. Structure of Dipole Antenna

Input Impedance of designed antenna is shown in Fig (4). Obtained Input impedance is around 66.70 Ω.

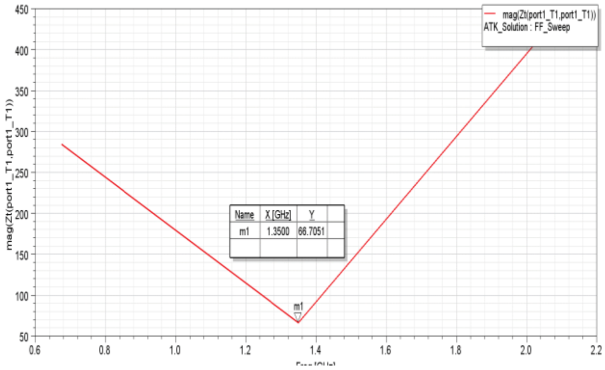

Figure 4. Input impedance of Dipole antenna

The scattering parameter at Port 1 is measured to be -16 db. and is shown in Fig (5). This indicates a good matching between source and antenna.

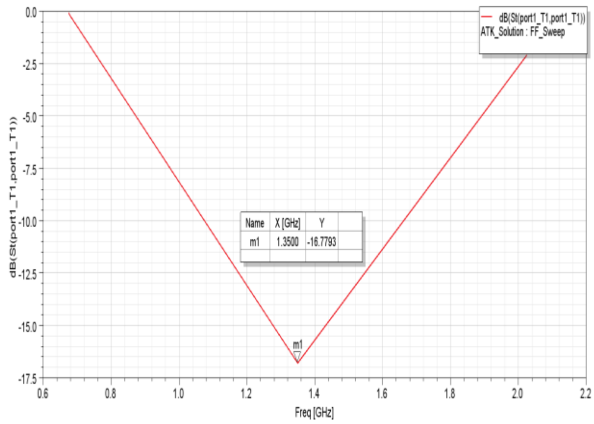

Figure 5. S_{11} graph of dipole antenna.

VSWR of designed dipole antenna is shown in Fig (6). Obtained VSWR is around 1.0 which indicate good matching between source and load.

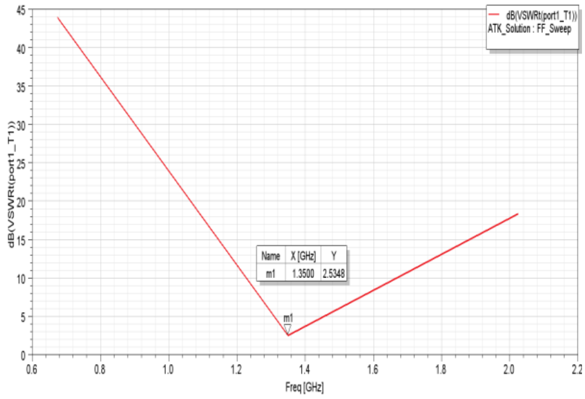

Figure 6. VSWR graph of dipole antenna.

The Radiation Pattrn of designed dipole antenna is shown in Fig (7). A gain of 2.4 dB is achievable from designed dipole antenna.

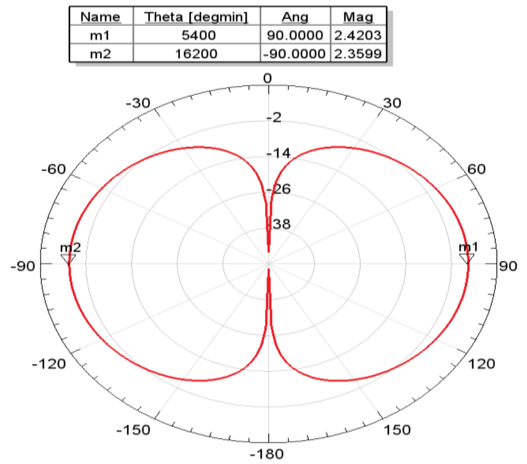

Figure 7.Radiation Pattern of dipole antenna.

The structure of Planar dipole Antenna designed using High Frequency Structure Simulator for 2.4 GHz is shown in Fig (8).

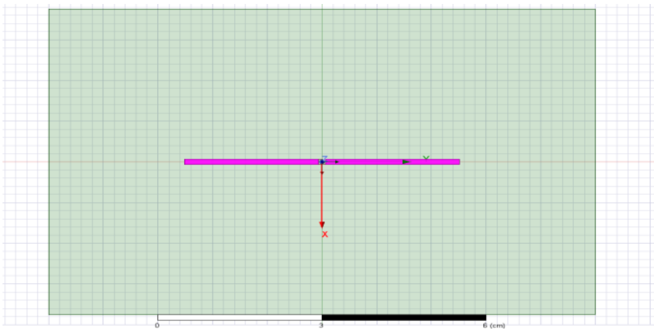

Figure 8. Structure of planar Dipole Antenna

Input Impedance of designed antenna is shown in Fig (9). Obtained Input impedance is around 55 Ω.

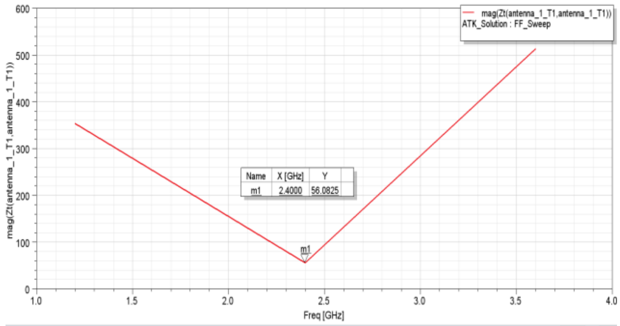

Figure 9. Input impedance of planar dipole antenna

The scattering parameter at Port 1 is measured to be -24 db. and is shown in Fig (10). This indicates a good matching between source and antenna.

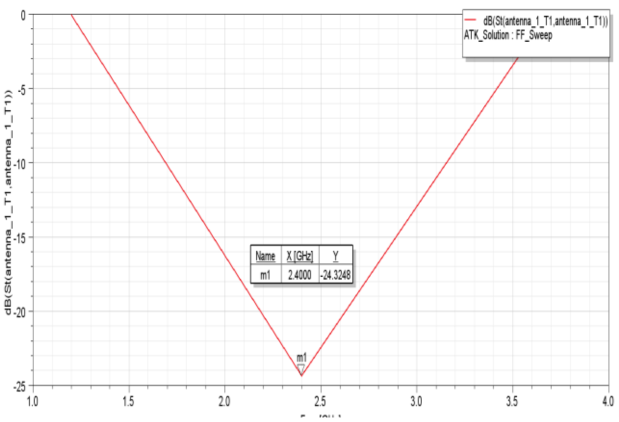

Figure 10. S_{11} graph of planar dipole antenna.

VSWR of designed dipole antenna is shown in Fig (11). Obtained VSWR is around 1.0 which indicate good matching between source and load.

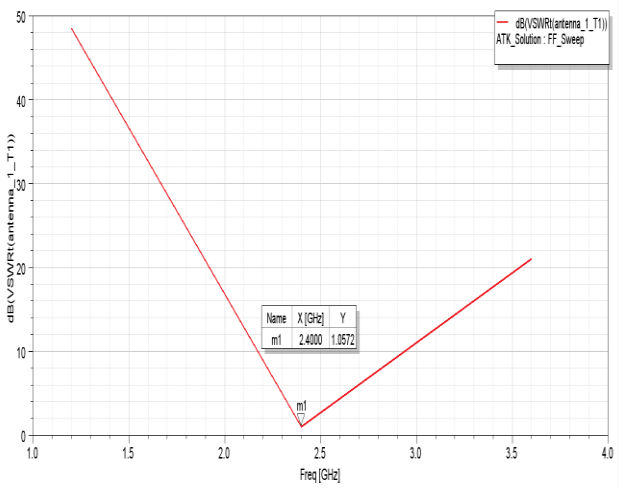

Figure 11.VSWR graph of dipole antenna.

The Radiation Pattrn of designed dipole antenna is shown in Fig (12). A gain of 2.590 db is achievable from designed planar dipole antenna.

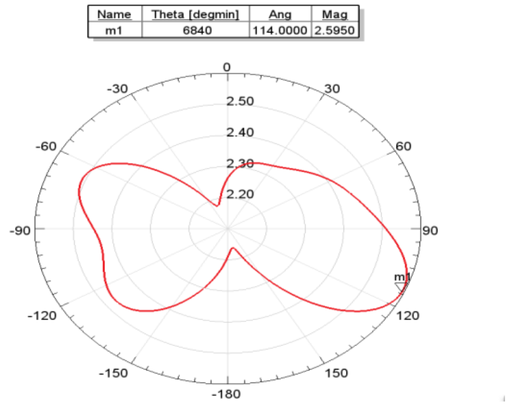

Figure 12. Radiation Pattern of planar dipole antenna.

Conclusion

A wire and planar dipole antenna are designed in this research. A comparison of these antennas is presented below

Table3.

S.No.	Performance Parameter	Wire Dipole Antenna	Wire Dipole Antenna
1	Input Impedance	66.70 Ω.	55 Ω.
2	VSWR	1.00	1.00
3	S_{11}	-16 dB	-24 dB
4	Gain	2.4 dB	2.590 dB

References

[1] I.J. Bahl and P. Bhartia, “Micro Strip Antennas”, Artech House, 1980.
[2] C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
[3] J. D. Kraus, “Antennas”, 2^{nd} edition, McGraw Hill, 1988.
[4] M. Alexander M. Salter B. Loader and D. Knight "Broadband calculable dipole reference antennas" IEEE Transactions. Electromagnetic Compatibility. Vol. EMC-44, No. 1 pp. 45-58, Feb. 2002.
[5] Jamaluddin M. H., Rahim, M. K. A., Abd. Aziz, M. Z. A. & Asrokin, A. 2005. Microstrip dipole antenna analysis with different width and length at 2.4 GHz. Asia Pacific conferences on applied electromagnetic, pp. 41-44. DOI: 0-7803-9431-3
[6] J. M. Floc’h and H. Rmili, “Design of Multiband Printed Dipole Antennas Using Parasitic Elements,” Microwave and Optical Technology Letters, Vol. 48, No. 8, 2006, pp. 1639-1645. doi:10.1002/mop.21714.
[7] Yi Huang, Kevin Boyle, “Antennas from Theory to Practice” Wiley; 1st edition, 2008.
[8] Shingo Tanaka, Yongho Kim & Hisashi Morishita. 2008. Wideband Planar Folded Dipole Antenna with Self-balance Impedance Property, IEEE Transaction on Antennas and Propagation, Vol. 56(5):1223-1228. DOI: 10.1109/TA
[9] X. Li, Yang, L., Gong, S.X. & Yang, Y.J. 2009. DualBand And Wideband Design of A Printed Dipole Antenna Integrated With Dual-Band Balun. Progress In Electromagnetics Research Letters, Vol. 6, pp:165-174