International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

Flexible Vertical VHF Antenna for Mobile Station

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Abstract – The usage of VHF antenna is limited to a particular distance range over ground therefore we can use that frequency to create a wireless the communication between a vehicle and a station. As there are chances of sudden irregular movements when vehicle is on rough surface the need of flexible and omnidirectional antenna arises.

Keywords: Omnidirectional radiation, Monopole Antenna,Whip Antenna

1. INTRODUCTION

In recent decades there has been a substantial development in mobile communication systems. These recent years has seen a great world-wide activity aimed at developing mobile communication system antennas. The growing industrial and household demand generates leads to the need of better performance of compact antenna structures mounted on portable devices. Some of the desired features for these antennas include low profile geometry, ease of construction, low cost, attractive appearance, and omnidirectional radiation pattern on the azimuthal plane.

The microwave antennas are used military purposes, at the time of disasters and for expedition's purposes. We have considerable interest in the development of omnidirectional microwave antennas.

2. CONSTRUCTION

The bandwidth of normal antennas is of order up to 10% from center of frequency. For vehicles, monopole antennas are opted as they have better gain and directivity, wide radiation pattern. But the impedance bandwidth is narrow, hence matching network is applied by Genetic algorithm.

The antenna is made of ferrite rod and steel. The height of the antenna is taken to be $\lambda/4$ and the diameter is 0.1m to avoid the undesired nulls in elevation plane at higher frequencies.

MS (Mild Steel) pipe is used to contain ferrite rod and it is combined through molded PVC. Height is 4.5 feet for the constructed antenna.

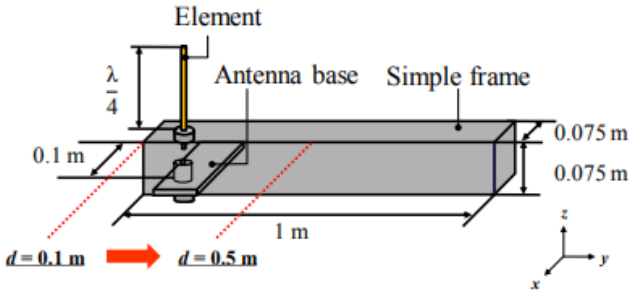


Fig 1: Design approach for antenna.

The circuit of the ferrite material consists of inductor in series with resistor. Inductor dominates at low frequency. As the frequency increases, the permeability of the ferrite material also decreases limiting the high frequency performances. High permeability is meant for matching at lower frequencies. Higher the resistivity, lower the eddy current loss thereby maintaining the magnetic properties up to certain higher frequency.

Table -1: Properties of Ferrite.

S/no	**Parameter**	**Values**
i	Constituents	MnZn
ii	Permeability	1700 F/m
iii	Resistivity	10000 Ωm
iv	Curie Temperature	≥ 110 °C

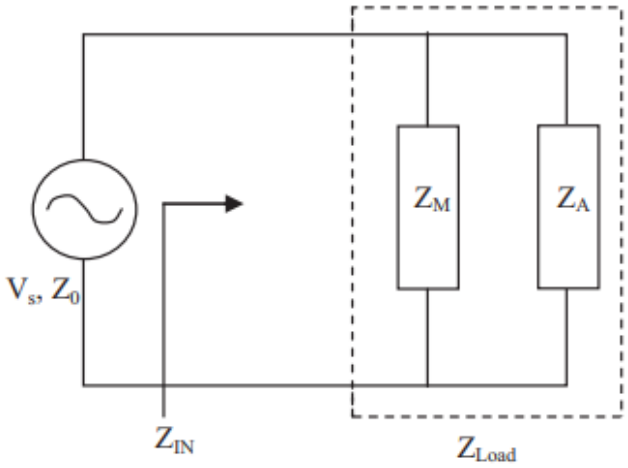


Fig 2: The equivalent circuit of antenna with matching component connected to source.

Where, Z0 = Characteristic impedance of transmission line, 50Ω.

ZA = Antenna impedance

ZM = Impedance of matching component

ZLOAD = ZA || ZM

$$Z_{IN} = Z_0 \left[\frac{Z_{Load} + jZ_0 \tan\beta l}{Z_0 + jZ_{Load} \tan\beta l} \right]$$

3. SIMULATION

Simulations of the characteristics of a whip antenna were conducted using HFSS software.

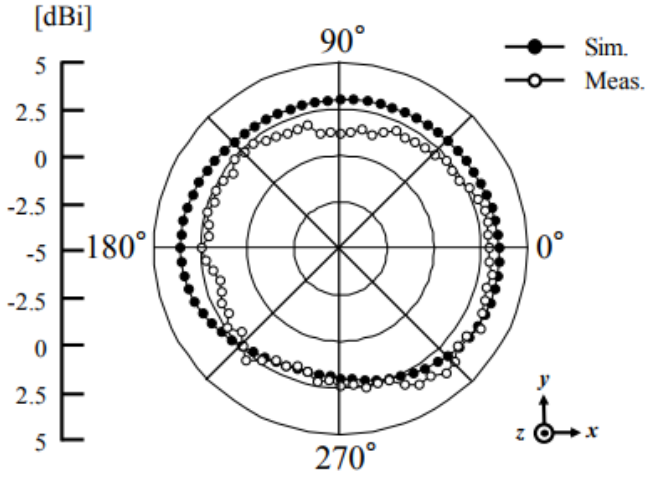


Fig 3: Simulated radiation pattern.

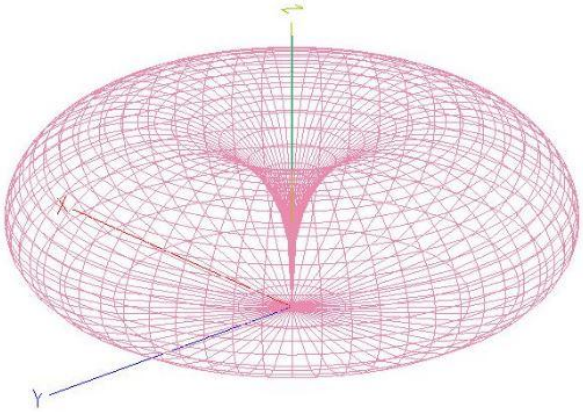
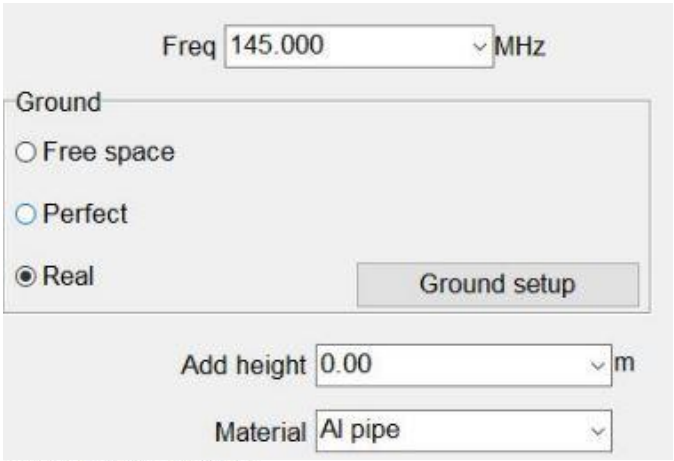


Fig 4: 3D omni-directional Radiation Pattern



WAVE LENGTH = 2.068 (m)
TOTAL PULSE = 14
THE LOWEST POINT OF ANTENNA = 0.000 M
FILL MATRIX...
FACTOR MATRIX...

PULSE	U (V)	I (mA)	Z (Ohm)	SWR
w1b	1.00+j0.00	28.82+j0.00	34.70-j0.00	1.44

CURRENT DATA...
FAR FIELD ...
NO FATAL ERROR(S)
0.01 sec

F (MHz)	R (Ohm)	jX (Ohm)	SWR 50	Gh dBd
145.0	34.7	-0.0017	1.44	---
145.0	34.7	-0.0017	1.44	---

Ga dBi	F/B dB	Elev.	Ground	Add H.	Polar.
-0.14	---	27.3	Real	0.0	vert.
-0.14	---	27.3	Real	0.0	vert.

Fig 5: Simulation parameters and calculations.

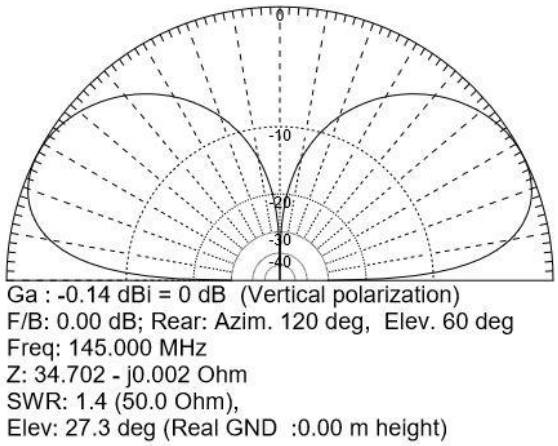


Fig 6: Bode plot.

4. CONCLUSION

The whip antenna shows good area coverage and as the circuitry is made compact it can be used when the vehicle is not on plain path. Eg Shaktimaan Truck.

Fig 7: Shaktimaan Truck.

Fig 8: The Unit flag is hoisted upon the truck due to antenna.

The antenna designed is used in Indian Army's Shaktimaan Truck as this is used in areas like Kashmir, North eastern 7 sister states and other terrains too.

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