DESIGN AND ANALYSIS OF HAIRPIN WHIP ANTENNA FOR WIRELESS APPLICATIONS

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Abstract: A revolution in science of electronics and communication has become prominent in the last few decades, with the potential to create a paradigm shift in thinking about simulation theories. Recent wireless and mobile communication schemes needs antenna which must have low profile, superior directivity and gain with condensed minor lobes. This demand is completed by a hairpin whip antenna for wireless applications at 3.75GHz, 6.425 GHz and 9.35 GHz. The main aim is to get the exact simulation and results that we obtain from analyzing a simple monopole antenna.

Keywords: Monopole, Antenna, Gain, Simulation, Frequencies, Return Losses.

1. INTRODUCTION

The Wideband wireless communications, with low power level and high data rate transmissions propelled great research interests for wireless communications applications[5]. a lot of research works were there on the design of wideband antenna. Monopole antenna[1] can get very wide frequency bandwidth an easy Geometry it is one of usual example however the radiation pattern of the monopole wide band antenna. Undergoes quick transformations with frequency and it limits practical applications. Wide band antenna is one more usual example of hair pin whip antenna.

The main focus is to find the accurate simulation and results that we find from analyzing a simple monopole antenna. Examination of number of antenna elements and comparision of the realistic characteristics of the antenna[2] with the ideal one has been done. An established dipole antenna is used to begin things and from there study is carried forward with the examination of antenna using the same software over its particular range of frequency. The name hairpin is so called since the antenna is in the form of hairpin which is a slender U-shaped part of wire, shell, etc. Modern car radio, cellular communications, personal wireless devices, and medical instruments use the application [5]of hairpin monopole antenna for better performance and efficiency.

This exacting type of antenna has been one of the most researched and widely used antennas due to its capabilities of being used as a single part and also along with other antennas to boost their performance standards.

2. BASIC STRUCTURE

One-half of a folded dipole antenna is prepared to function above the ground plane so as to function as a folded monopole type of antenna. This is the fundamental construction of the hairpin monopole antenna. Under these conditions, the input impedance is one-half that of a half-wave folded dipole, for a faultlessly conducting ground plane in circular shape. Figure illustrates the basic folded monopole or hairpin antenna. The difference between a basic folded monopole antenna and a hairpin is that the hairpin is noticeably shorter. The radiation resistance. is decreased by shortening an antenna. General Dynamics developed a 10(c) kW hairpin antenna only 14 feet high that tuned the 30-MHz range in two bands: 2 to 8 MHz and 8 to 30 MHz.

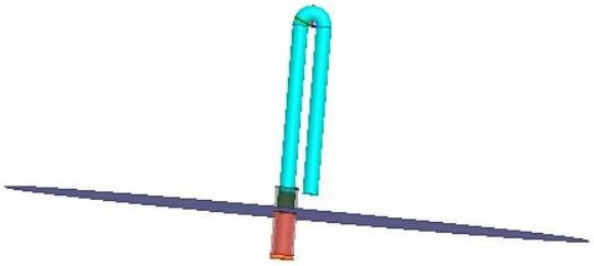

Fig.1 Basic structure of hairpin whip antenna

Introduction to software:

The industry customary for simulating 3-D, full-wave, EM fields is the ANSYS HFSS software. HFSS stands for High Frequency Structural simulator[10]. Its gold-standard exactness, advanced solvers, and high performance computed technology makes it a critical tool for engineers tasked with executing the accurate and quick design in high-frequency and high-speed electronic devices and platforms. A high-tech solving technology is offered by HFSS based on the finite element, integral equation, asymptotic and complicated mixed methods used to solve a broad range of microwave, high speed digital and RF applications. HFSS follows finite element method technique. This software is developed by ansys

Design and implementation

Design implementation starts with design of usual dipole antenna[3] through HFSS software ,after that coaxial cable [6] implementation is done in HFSS [10]soft ware followed by steps for designing hairpin antenna with necessary parameters as shown in the table

1. Now to make the hairpin whip antenna, we take elements from the dipole antenna as well as the coaxial cable.

2. Create a new project file and cut out a monopole from the dipole antenna that we constructed earlier.

3. Similarly we use the coaxial cable to provide a supply to the monopole using a rectangular plate that has an assigned excitation in the form of "Lumped Port". We connect the coaxial cable just beneath the monopole to get the best results.

4. Cover the entire setup with a cylindrical volume or any other volume that is considerably larger than our setup.

5. The antenna formulated as a result of this procedure is the "Hairpin Monopole Antenna".

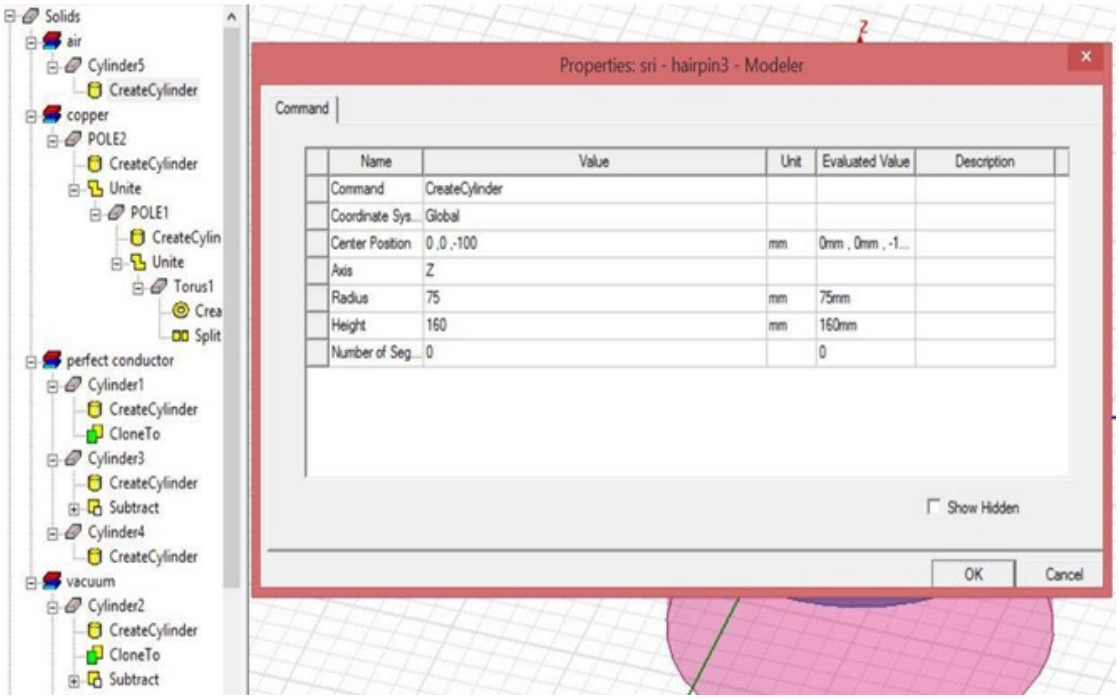

Fig.2 Properties of an Antenna Shown In Software

Table.1Measurements of Hair Pin Antenna

Units	Mm
Solution frequency	3.75GHz, 6.42GHz,9.35GHz
Torus	Minor radius 2 Major radius 3
Cylinder 1	Radius 2 Height 40
Cylinder 2	Radius 2 Height 40
Circle radius	75
Lumped port	4*5
Co-axial feed line	Radius 2 Height 10
Radiation	Radius 75 Height 120

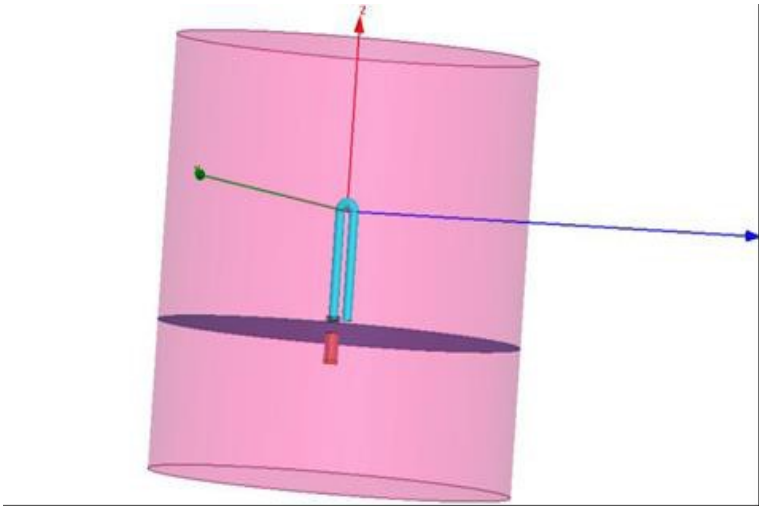

Fig.3 Design and implementation of antenna using HFSS

3. SIMULATION RESULTS AND DISCUSSION

Return losses: If there is an impedance matching in the antenna design it produces accurate return losses [8] at desired frequencies as shown in the following simulation results. At 3.75 GHz the return loss produced as shown below.

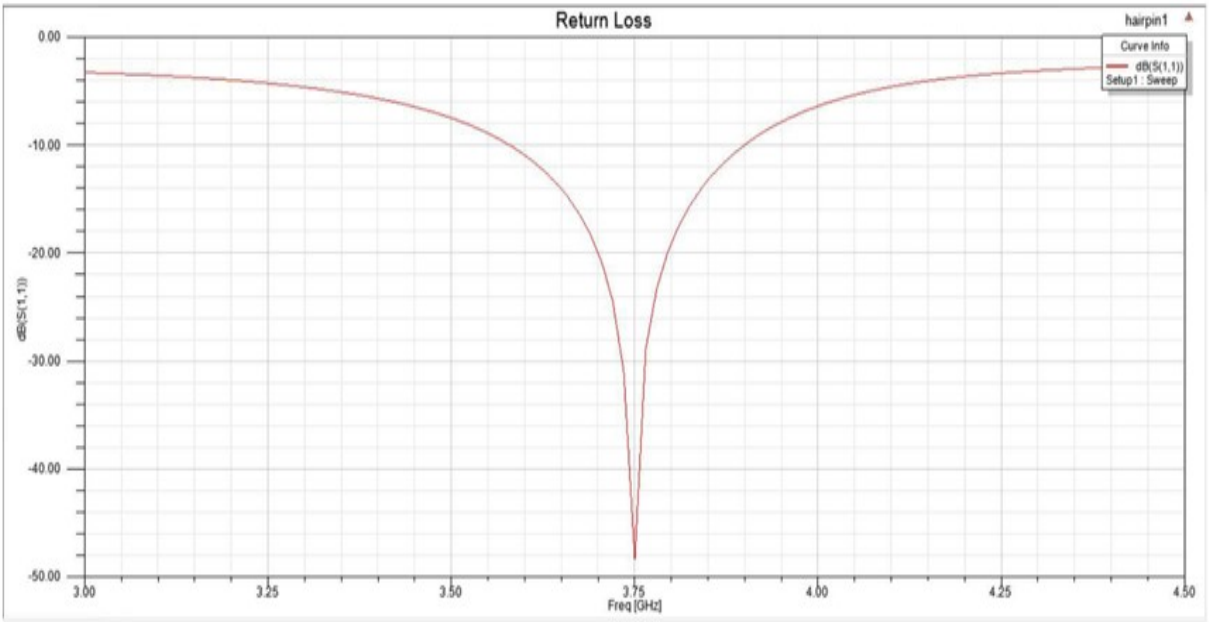

Fig 4: Return losses curve at 3.75 GHz for hairpin monopole antenna

VSWR Curve: VSWR produced in the antenna design shown below which gives efficiency of the antenna.

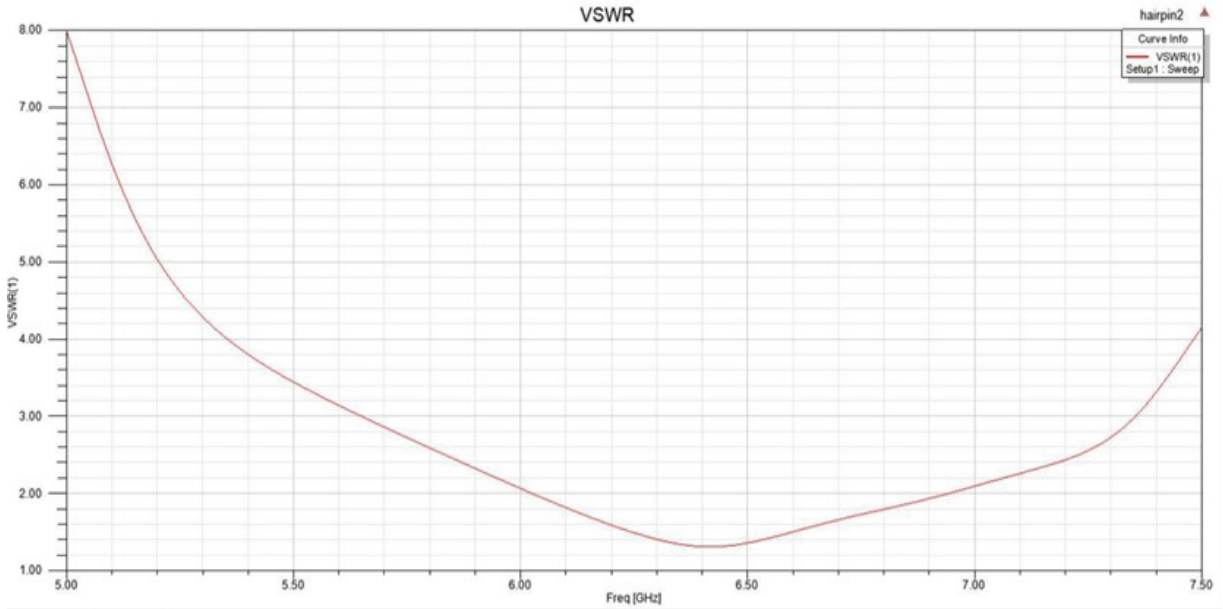

Fig.5 VSWR curve at 6.425 GHz for hairpin monopole antenna

Impedance matching curve: Plot of impedance matching in the design of hair pin antenna for wave propagation [9] as shown below.

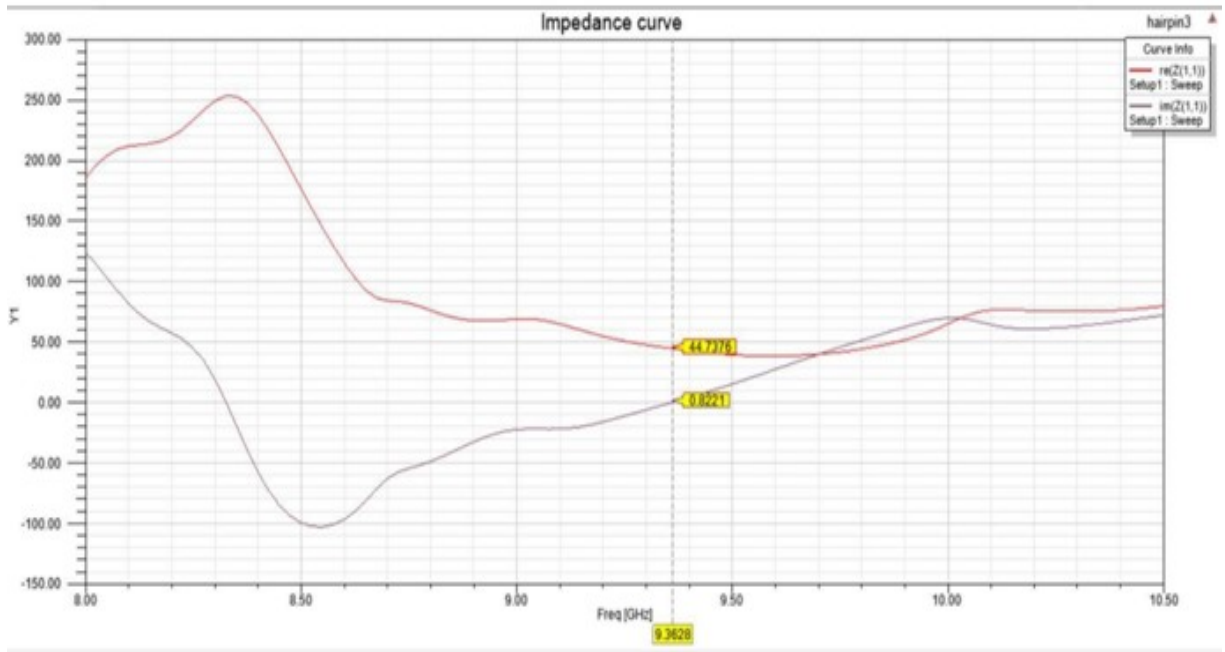

Fig.6 Impedance matching curve of the antenna at 9.35GHz for hairpin monopole antenna

3D Polar Plot: Below plot shows 3D polar plot for hairpin antenna with improved gain and directivity at 3.75 GHZ as compared to previous simulation of the normal monopole antenna.

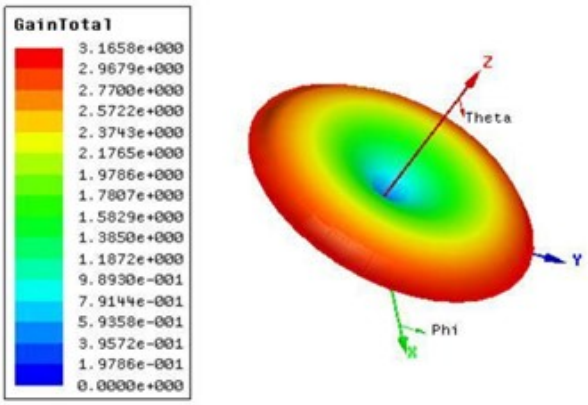

Fig.7 3D polar plot for hairpin antenna with improved gain and directivity at 3.75 GHZ

4. CONCLUSION

In this paper, we designed a Hair pin whip antenna for wireless applications with improved parameters .This antenna offers the gain of 3.16dB better gain and more directivity at 3.75 GHz and other wideband frequencies. The results of the hairpin whip antenna are very similar to that of a traditional monopole antenna. The results are further improved by making changes in the structure of the antenna.

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