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ANALYSIS OF RETURN LOSS AND GAIN OF MICROSTRIP, HORN AND DIPOLE ANTENNA FOR 2.4 GHZ FREQUENCY

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ABSTRACT – Antenna is the most fundamental part in wireless communication system. Antenna transforms electrical signal into Radio frequency signal and vice versa. Antennas are of various kind and having different properties.

The purpose of this paper is designing and simulation of some basic antenna (i.e., Microstrip antenna, Horn antenna, Dipole antenna). The designing and simulation process is completes on HFSS software. These antennas are designed for operating frequency 2.4 GHz.

In this paper, we analyze the return loss and gain of the proposed antenna.

Key words: Microstrip antenna, Horn antenna, Dipole antenna, HFSS, return loss, gain

I. INTRODUCTION – As per the modern world needs, communication plays a vital role in human lives and the antenna is the essential part of any wireless communication system. Antenna converts electrical signal into radio waves and vice-versa. Basically, antenna is the device used to send information in form of electromagnetic wave signal to communicate in unguided way.There are different antennas for different applications. Antennas are useful mode to communicate in form of audio, video, graphically.

In this paper, we design antennas for operating frequency 2.4 GHz.This frequency is unlicensed used for WLAN and Bluetooth model. According to Ira Kelpz, deputy chief, office of engineering and technology, this band of frequency (2400- 2483.5 MHz) is attractive to gadget makers and it is free to use.

In this paper we discuss about some basic antenna (i.e., Microstrip antenna, Horn antenna, Dipole antenna) .we compare their return loss and gain.

Microstrip antenna- Microstrip antenna was introduced in the 1950's. Microstripantennas are becoming increasingly useful because they can be printed directly onto a circuit board. Microstrip antennas are becoming very widespread within the mobile phone market. Microstripantenna has three main portions i.e., patch, substrate and ground. Ground

and patch is made up of highly conductive material and patch is made up of dielectric material. The performance of microstrip antenna is depending on the substrate material. For substrate we use FR4-eproxy dielectric material with 4.4 dielectric constant.

Horn antenna –Horn antenna is an antenna that consists of a flaring metal waveguide shaped like a horn to direct radio waves in a beam. Horns are mainly used as antennas at UHF and microwave frequencies. A horn antenna is used to transmit radio waves from a waveguide (a metal pipe used to carry radio waves) out into space, or collect radio waves into a waveguide for reception.

Dipole antenna –A dipole antenna is the simplest and widely used class of antenna. A dipole antenna commonly consists of two identical conductive elements such as metal wires and rods. Most commonly it consists of two conductors of equal length oriented end-to-end with the feedline connected with them. The driving current from the transmitter is applied, or for receiving antenna the output signal to receiver is taken, between the halves of the antenna.

II. PROPOSED ANTENNA GEOMETRY

a. MICROSTRIP ANETENNA

For microstrip antenna design, the calculation for length and width of substrate and patch is important. Dielectric substrate material is also plays a major role in the performance of microstrip antenna.

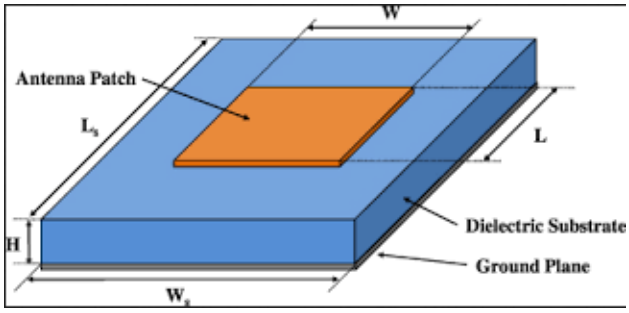

Fig: microstrip antenna geometry

Parameters	Values(in mm)
Height of substrate(H)	1.5
Dielectric constant of substrate	4.4
Length of substrate(L_s)	60
Width of substrate(W_s)	60
Length of patch(L)	29.5
Width of patch(W)	38
Length of feedline	17
Width of feedline	2

b. HORN ANTENNA

In the construction of horn antenna the dimensions of waveguide and flared horn are important.

A[m]	B[m]	a[m]	b[m]	P_H[m]	P_E[m]	R_p[m]	L_H[m]	L_E[m]
0.321	0.242	0.1103	0.0557	0.272	0.232	0.2000	0.2074	0.2015

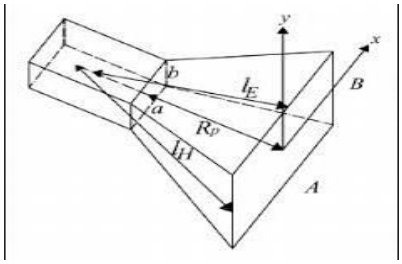

Fig: Horn antenna geometry

c. DIPOLE ANTENNA

Dipole antenna has the simplest geometry structure, it consists of two identical conductive metal rods which is separated by a feed portion. The working performance of dipole antenna is depends on the dimensions of two poles and feed portion.

Dimensions of parameters	Values(mm)
Poles length	19.25
Poles radius	3
Gap between poles	10

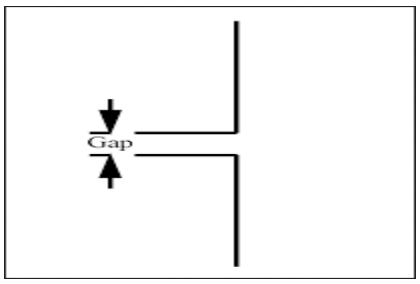

Fig: dipole antenna geometry

III. ANTENNA DESIGNED IN HFSS

a. MICROSTRIP ANTENNA

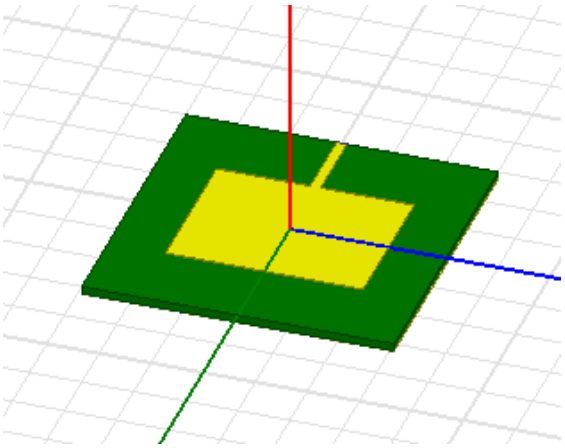

Fig: Proposed rectangular microstrip patch antenna design using HFSS software

b. HORN ANTENNA DESIGN

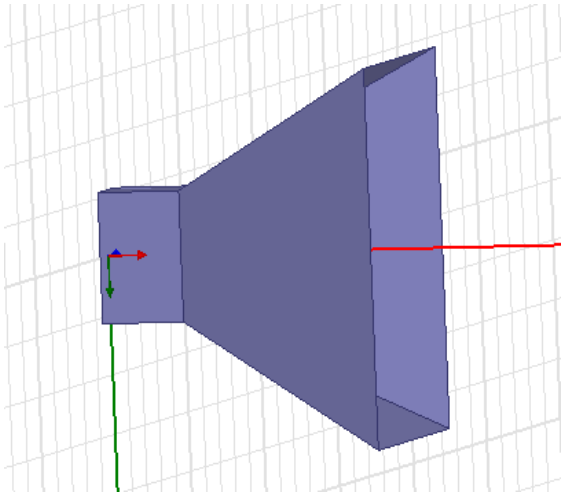

Fig: Proposed Horn antenna design using HFSS software

c. DIPOLE ANTENNA DESIGN

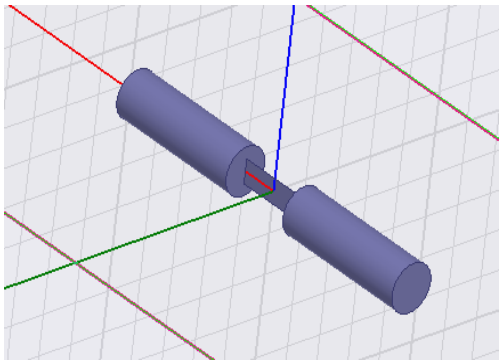

Fig: Proposed dipole antenna design using HFSS software

IV. SIMULATED RESULTS IN HFSS

Proposed antennad model are simulated using HFSS and output parametrs like return loss and gain are to be anslysed. Simulated results of the proposed model will be discussed to analyse the performance.

A. RETURN LOSS – it is the power reflected by the antenna at the end of the transmitter/receiver. Lower the RL value , higher will be the efficiency of antenna .

- Return loss is a measure of how well devices or lines are matched. A match is good if the return loss is high. A high return loss is desirable and results in a lower insertion loss.
- Return loss is expressed with the negative sign.
- Basically, return loss is the ratio of reflected to incidentpower

  Return loss(dB)= $10\log_{10}(P_r/P_i)$.

Where, P_r is the reflected power and P_i is the incident power.

a. MICROSTRIP ANTENNA :

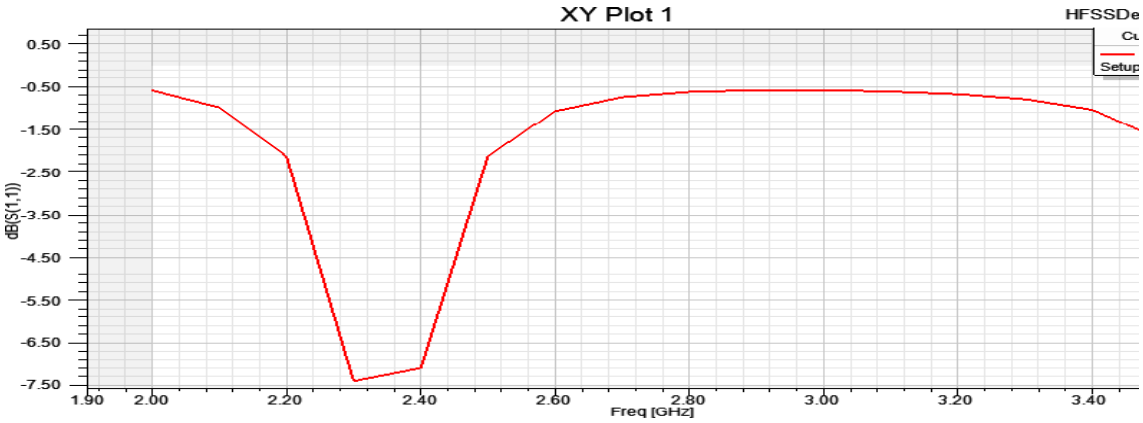

Fig: Return loss Vs frequency plot of the proposed microstrip antenna

In the above figure (S11/return loss Vs frequency), the return loss for 2.4 GHz frequency is about -7 dB.

b. HORN ANTENNA :

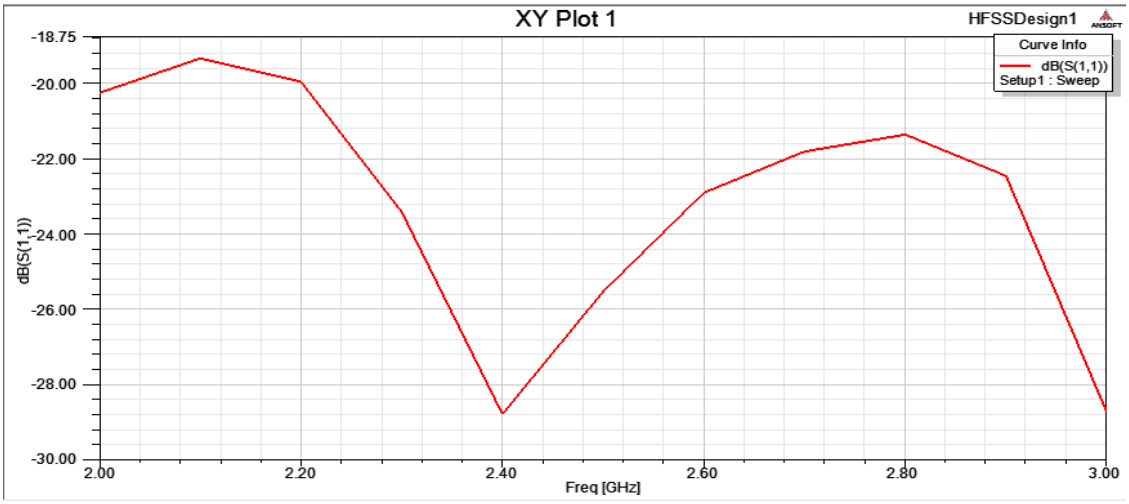

Fig: Return loss Vsfrequency plot of the proposed horn antenna

So, here we can observe that the return loss for 2.4 GHz frequency is -28.4 dB.

c. DIPOLE ANTENNA:

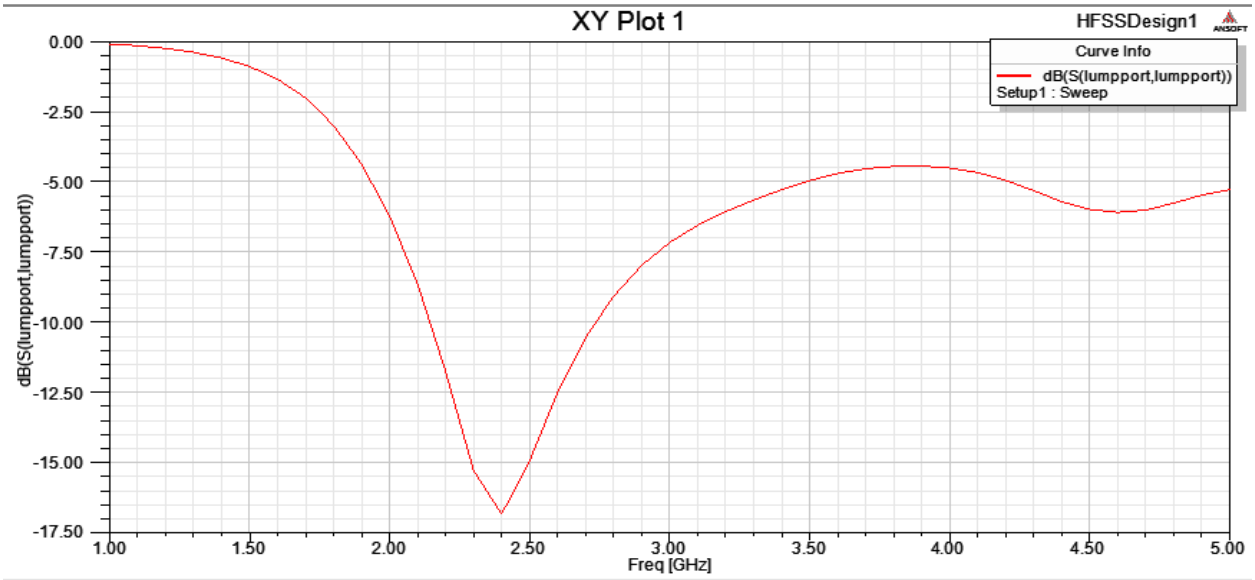

Fig: Return loss Vs frequency plot of the proposed dipole antenna

Here, the return loss is observed about -16.50 dB.

B. GAIN: Gain of the antenna is defined as "the ratio of the intensity, in a specified bearing, to the radiation intensity that would be gotten if the power putative by the antenna remained exuded isotropically". We take 3D plot of gain at resonating frequency of proposed antenna.

- Gain is the most important parameters of the antenna which also tells about the directivity of the antenna. when none of the direction is mentioned ,then the maximum gain is
- In a transmitting antenna, the gain describes how well the antenna converts input power into radio waves headed in a mentioned direction.
- In a receiving antenna, the gain describes how well the antenna converts radio waves arriving from a particular direction into electrical power.

a. MICROSTRIP ANTENNA:

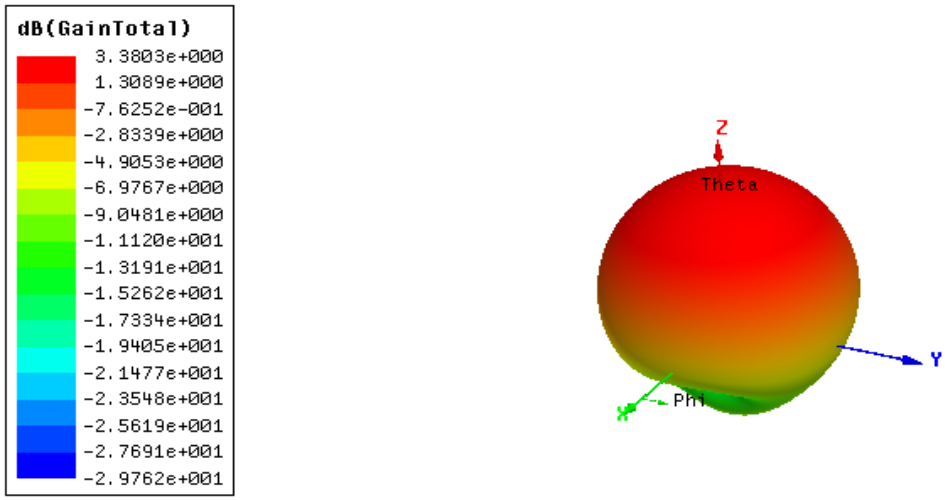

Fig: 3D gain plot of microstrip antenna at 2.4 GHz

Here , we can observe that the gain of the proposed microstrip antenna is 3.3 dB.

b. HORN ANTENNA :

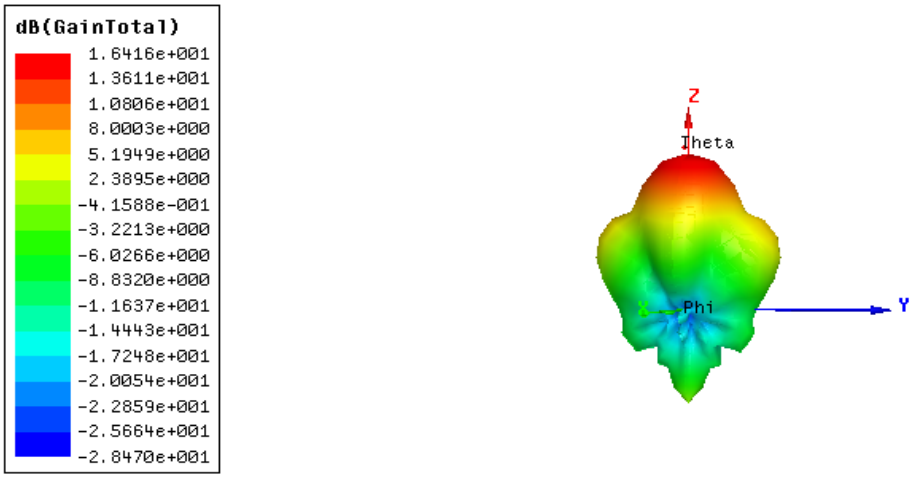

Fig: 3D gain plot of horn antenna at 2.4 GHz

For the above proposed horn antenna, the maximum gain is observed about 8 dB.

c. DIPOLE ANTENNA :

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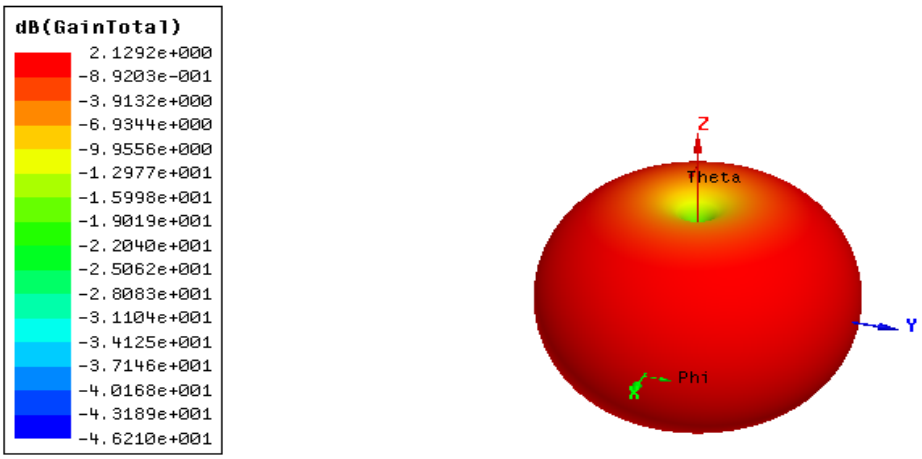

Fig: 3D gain plot of dipole antenna at 2.4 GHz

The gain for the proposed dipole antenna is noted about 2.1 dB.

V. CONCLUSIONS

In this paper, we analyzed about the return loss and gain of the proposed antenna. The proposed design of antennas simulate successfully. The design of proposed antenna completed using HFSS software. As observed, the return loss for microstrip antenna is -7 dB, for horn antenna it is observed as -28.4 dB and for dipole antenna it is found equals to -16.50 dB. So in these three proposed design, horn antenna has the minimum return loss i.e., efficiency of the proposed horn antenna from the all proposed design is maximum.

With respect to the above discussion the gain of horn antenna is found to be maximum. As mentioned above, these all proposed design works for the required frequency 2.4 GHz.

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