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Simulation Study of Horn Antenna on CST MW Studio Suite

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ABSTRACT—

Now-a-days the communication and data sharing has been growing very fast based on the technology advancements. The requirements for the network availability to the users are at high demand. The advanced technologies allowing all types of communication to take place. Growths in the sector of data flow have to take the better position to accomplish all requirements. As per the demand, many suitable communication based systems are also being designed. For high-speed data communication, a suitable system is also needed. We have focused on the communication system design with a pyramidal Horn antenna that can carry the signal for X band frequency (8 to 12 GHz). The Horn antenna is extensively used in the transmission and reception of RF Wireless signals. This paper highlights for the design considerations of a Pyramidal Horn antenna, which will be suitable for system operation at X – Band. The efficiencies and phase errors in the optimum design are variables and depend on the design requirements.

Keywords— Horn Antenna, Wireless communication, X band frequency, CST MW Studio Suite.

I. Introduction

One can define antenna as a metallic device which can transmit and receive the electromagnetic signals in free space as per the IEEE standard definition. The RF and Microwave signal transmission and reception is possible with a horn antenna. This antenna, by convention is used in an assembly with the waveguide feeds[1]. A flared waveguide is forms the Horn antenna and also have the look just like a "Horn". This antenna has the feature to transmit the radio waves into free space which has been carried by the waveguide[2].

The advantage of Horn Antenna is high gain. Based on the requirements the aperture size of the horn antenna and the tapper of the horn antenna adjusted to have high gain and directivity. In 1897, the Indian Radio Researcher, Sir Jagadish Chandra Bose has constructed the first Horn Antenna by his novel work in his pioneering experiments with microwave frequency. In the World War II the Radar designs stimulates the developments of Horn Antenna is the composition of a rectangular waveguide at one end and flared at the opposite end forming a Horn shape. The waveguide needed a coaxial feeding to get the excitation and the forward waves radiates from the open aperture of the Horn antenna. The radiated wave forms a very narrow beam and the antenna is having a sharp directivity and gain[3].

In the following Fig.1 the typical Horn Antenna[4] has been shown.

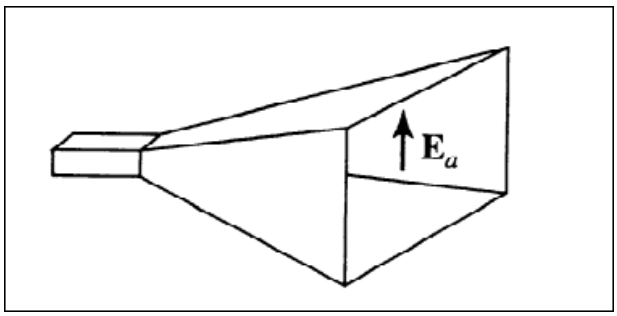

Fig. 1 Horn Antenna

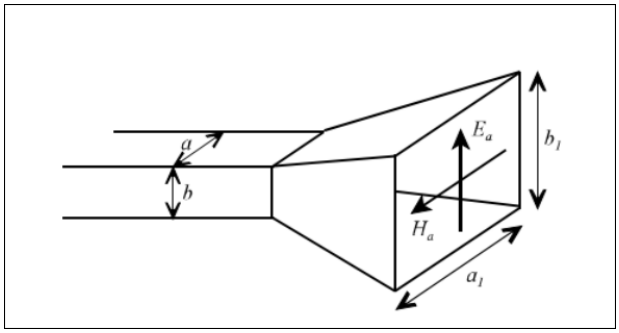

Fig. 2 Pyramidal Horn Antenna

As per the Fig.2, the following parameters are being calculated and the proposed design has been made.

$a1 = 5.5\ \lambda$ (i)

$b1 = 75.2\ \lambda$ (ii)

$a = 5.0\ \lambda$ (iii)

$b = 25.0\ \lambda$ (iv)

$\rho1 = \rho2 = 6\lambda$ (v)

where,

Wavelength, $\lambda = c / f$

Horn antenna offers several benefits when employed in that besides matching the impedance of the companion to that of free space or vice versa, it helps suppress signals travelling via unwanted modes in the waveguide from being radiated and it provides significant values of directivity and gain[5]. While it serves as communicating medium for signal interception for processing in systems, it serves in the case of transmission to illuminate dish antenna from its focal area estimated from the f/ d parameters of the parabolic dish.

II. Methodology

CST MW Studio Suite software is used for this work. The different parameters of the horn antenna are being calculated from the design parameters and design ratios.

III. Results and Discussion

The proposed Horn Antenna is showing satisfactory results in the simulation platform. We have used the CST MW Studio Suite for the modeling of the antenna. The results are being obtained by using the relevant equations for computing a1, b1, a, b etc. Here the proposed antenna is shown in the following figure.

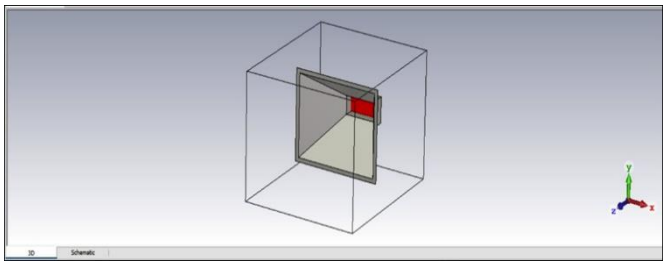

Fig. 3 Proposed antenna in the CST software

In Figure 4 the plot of VSWR vs Frequency is showing good results at 8.4 GHz.

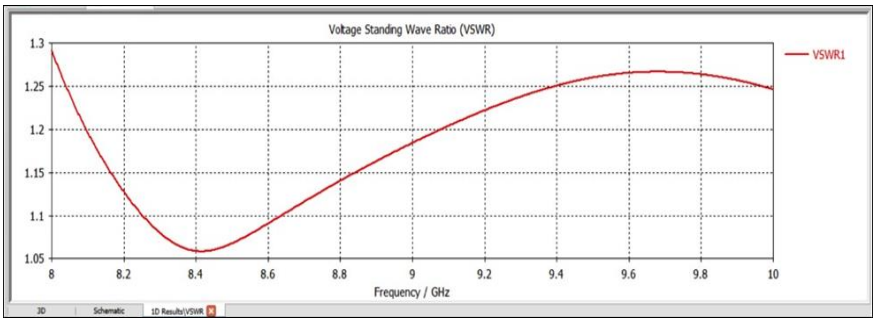

Fig. 4 VSWR vs Frequency plot

In Figure 5 the Far Field Directivity plot is shown where the result is satisfactory at X band frequency.

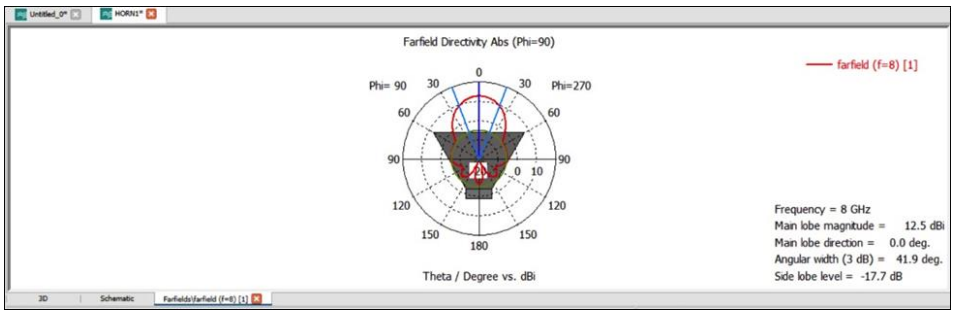

Fig. 5 Far field directivity plot

In Figure 6 the S11 vs Frequency plot is shown which demonstrates that the proposed antenna will be suitable at 8.4 GHz.

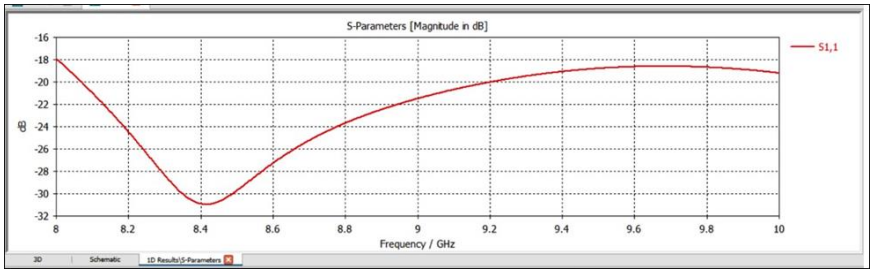

Fig. 6 S11 vs Frequency plot

In Figure 7 the Radiation Characteristics of the Proposed antenna is also showing significant characteristics.

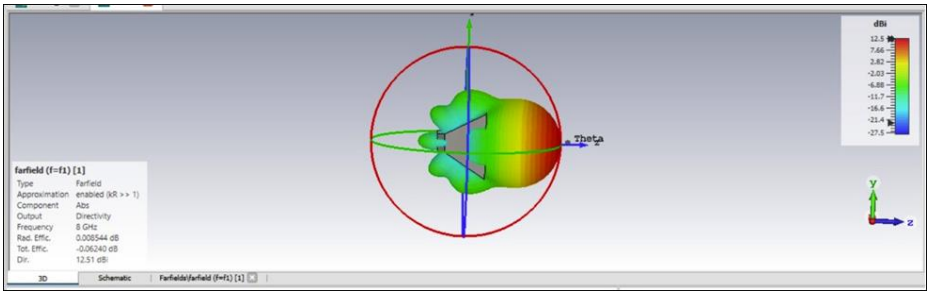

Fig. 7 Radiation characteristics of the proposed antenna

IV. Conclusion and Future Scope

In the era of Wireless communication system the Horn antennas are very useful. Besides, the consideration of the Horn antenna has been made to get the characteristics of the proposed antenna in the X Band frequency. In all, it's essential that while deciding on the intended frequency of operation, one need to define critical parameters upon which similar design would be rested similar as the cut off frequency, hence the bandwidth of the Horn antenna. As per the proposed design the antenna shown good characteristics in terms of S11, VSWR, Radiation characteristics, Directivity etc. We look forward to design the horn antenna in future for the benefit of the communication networks.

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