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Design and Analysis of 5.5 GHz Rectangular Horn Antenna for Wifi Applications

Sandhya S[1], Dr. Ganashree T S[2], Sandeep Vedagarbham[3], Pundaraja[4]

[1]*M.Tech Student, Dept. of TCE, Dayananda Sagar College of Engineering, Bengaluru, Karnataka*
[2]*Associate Professor, Dept. of TCE, Dayananda Sagar College of Engineering, Bengaluru, Karnataka*
[3]*Chief Technical Officer, Lambdoid Wireless Communications, Bengaluru, Karnataka*
[4]*Design Engineer, Lambdoid Wireless Communications, Bengaluru, Karnataka*

Abstract - *The Rectangular Horn antenna is used as a feeder to a dish antenna as it provides high gain, directivity, wide bandwidth and matched voltage standing wave ratio(VSWR).*

In this paper a dual polarized rectangular horn feed is designed for 5.5 GHz center frequency for Wifi applications. The rectangular horn antenna is designed using Computer Simulation Tool (CST) software which is a commercially available electromagnetic simulator. The described antenna is expected to be cost effective with high gain and high directivity covering a wide band width and ranging from 5.25 GHz to 5.75 GHz with a return loss of -18 dB.

The outcomes showed that the most elevated horn antenna gain of 12.1dB was obtained at 5.5 GHz, which is a frequency used for wifi applications. The rectangular horn antenna can be used on ships as well as on the sea for the boat range boosting and increasing the level of power which is received for the intra wireless communications.

Key Words: *Wifi Applications, Rectangular Horn Antenna, CST Software, Feeder, Return Loss, VSWR*

1. INTRODUCTION

A rectangular horn antenna serves a similar work for electromagnetic waves that an acoustical horn improves the sound waves in a melodic instrument. It gives a continuous change structure to coordinate the impedance of a cylinder to the impedance of free space, empowering the waves from the cylinder to emanate productively into space.

A straight forward open-finished waveguide is used as a receiving antenna, without the horn, the sudden end of the conductive dividers causes an unexpected impedance change at the gap, from the wave impedance in the waveguide to the impedance of free space. At the point when radio waves going through the waveguide hit the opening, this impedance-step mirrors a huge part of the wave vitality down the guide toward the source, so not the majority of the power is transmitted. This is like the reflection at an open-finished transmission line or a limit between optical mediums with a low and high list of refraction, as at a glass surface. The reflected waves cause standing waves in the waveguide, expanding the SWR, squandering vitality and potentially overheating the transmitter. The little opening of the waveguide causes huge diffraction of the waves issuing from it, resulting in a wide radiation pattern without much directivity.

2. DESIGN OF HORN ANTENNA

Design of rectangular horn antenna based on the basic antenna parameters of tuning frequency ranging from 5.25 GHz to 5.75 GHz with a center frequency 5.5 GHz.

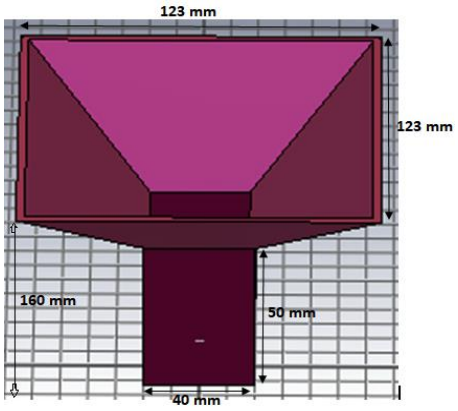

Figure 1: Rectangular Horn Antenna

The Design dimensions of horn antenna structure is shown in Figure 1. The rectangular horn antenna is divided into two sections, one is waveguide section and another one horn section.

The waveguide is having the following dimentions Width:40 mm, Height:40 mm and Length: 50 mm. the horn part is having the same Width & Height of 123 mm and overall horn length is 160 mm.

3. DESIGN CALCULATIONS

The length of dual pole antenna is exactly $\lambda/4=13.62$, where $\lambda=54.5$ for 5.5 GHz frequency.

Following dimensions are the rectangular horn antenna dimensions which are used to calculate the horn antenna parameters:

X=123, Y=123, L=160

Where, X is Width of horn antenna
Y is Height of horn antenna
L is Length of horn antenna

$Gain=10*A/\lambda^2$
$=10*15129/(54.5)^2$
$=50.93$
$=10\log(50.93)$
Gain =17.06 dB
$\Phi v=51*\lambda/Y$

Where, Φv- Vertical beam width
Φh- Horizontal beam width
$=51*54.5/123$
Φv =22.59°

$\Phi h=70*\lambda/X$
$=70*54.5/123$
Φh=31.09°

$\lambda/4$ =13.62 ------>Length of dual pole antenna

4. SIMULATION RESULTS

The Rectangular horn Antenna is designed for wifi applications is simulated in CST software and simulation results are given below:

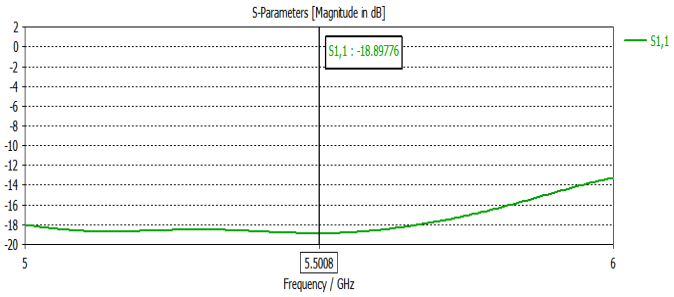

Figure 2: Return loss of Horn Antenna at Pole 1

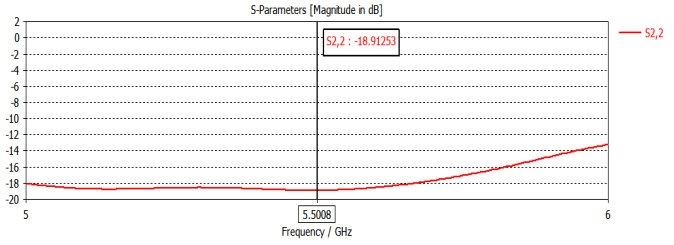

Figure 3: Return loss of Horn Antenna at Pole 2

As seen in Figure 2 & 3,The S-parameter of horn antenna is measured, the s11 value of horn antenna is -18.89 dB at pole 1 and -18.91 dB at pole 2, frequency ranging from 5.25 GHz to 5.75 GHz.

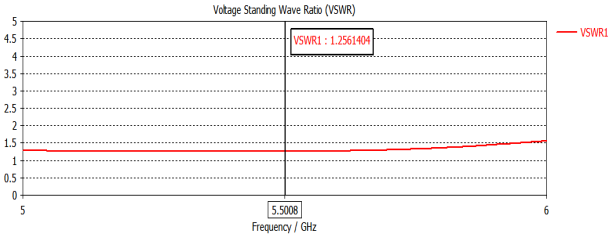

Figure 4: VSWR of Horn Antenna at Pole 1

The figure 4 shows that VSWR of horn antenna and it measures 1.25 at 5.5 GHz at pole 1.

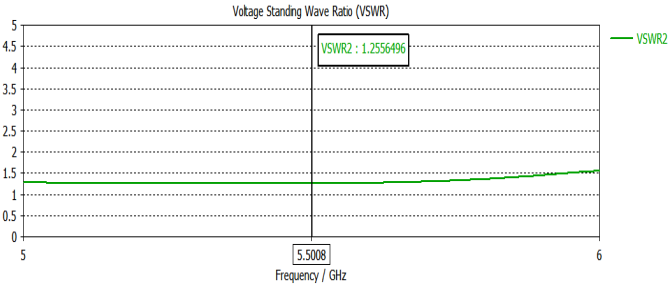

Figure 5: VSWR of Horn Antenna at Pole 2

The figure 5 shows that VSWR of horn antenna and it measures 1.25 at 5.5 GHz at pole 2.

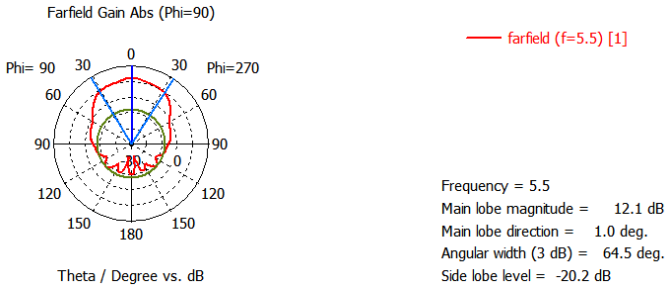

Figure 6: Polar Gain Plot of Horn Antenna at Pole 1

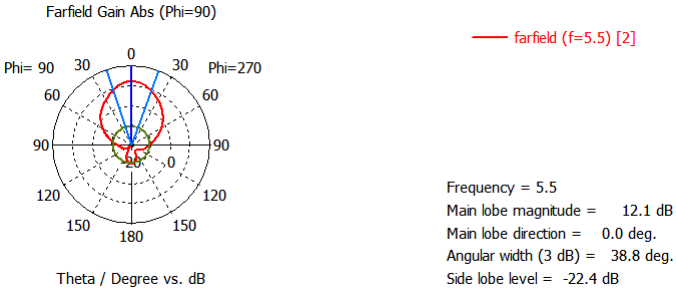

Figure 7: Polar Gain Plot of Horn Antenna at Pole 2

The gain of the proposed antenna is measured using simulation tool, the gain of an antenna is 12.1 dB as shown in figures 6 & 7.

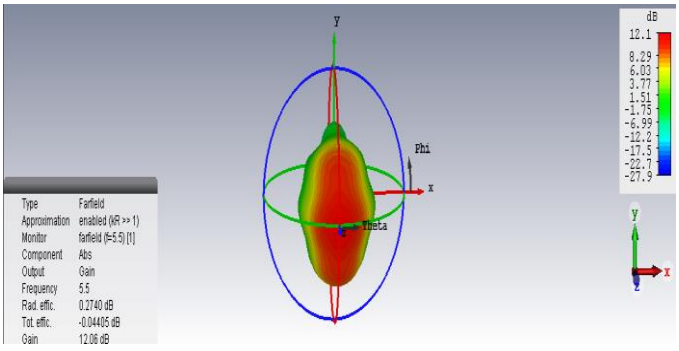

Figure 8: 3D Plot of Horn Antenna

The 3D view of the Horn antenna is shown in the figure 8.

5. CONCLUSION

The Rectangular horn antenna for Wifi applications is designed and simulated in CST software with a frequency is ranging from 5.25 GHz to 5.75 GHz for the center frequency 5.5 GHz, the gain of horn antenna is 12.1 dB at 5.5 GHz frequency. The system is matched with 1.25 VSWR at 5.5 GHz with acceptable return loss of -18.8 dB.

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