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PERFROMANCE COMPARISION OF RECTANGULAR AND CIRCULAR PATCH ANTENNA AT IDENTICAL PARAMETERS

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***Abstract*: In this paper, we were compared the performance of Rectangular and Circular micro strip patch antennas which are fabricated with identical materials and operating at similar range of frequency. While performing this comparative analysis in order to obtained the suitable modes of operation the dielectric constant value were chosen as 5.4 and maximum operating frequency of 3GHz. The performance comparisons of both antennas were performed with respect to impedance, admittance, VSWR, and scattering parameters for the constant value of frequency at 2.4 GHz. Further, the current radiation patterns were obtained for both antennas in 2D and 3D format using IE3D simulator.**

Keywords: Dielectric constant (epsr), Automatic edge cell (aec layer), Meshing, Directivity, Return loss, s-parameter, z-parameter, mil:-miles, rectangular microstrip patch antenna, circular microstrip patch antenna.

1. INTRODUCTION

A) MICROSRTIP PATCH ANTENNA:

Micro strip is the electrical transmission line which is use for the transmitting microwave range frequency on the Printed Circuit Board (PCB). The antenna which is fabricated by this technique is called Micro strip antenna. The patch antenna is one kind of radio antenna. It consists of a sheet or "patch" of metal, mounted over a larger sheet of metal known as ground plane. They are the original type of micro strip antenna. The two metal sheets together form a resonant piece of two same with a length of approximately half wave length of the radio waves.

The radiation mechanism arises from discontinuities at each shorten edge of the micro strip transmission line. The patch antenna mainly use in microwave application where the wavelength of signal is short enough. Where the multiple patches are use is called micro strip patch antenna. The micro strip patch antennas are very much popular in mobile communication and military applications because it can be easily printed on PCB at low cost. The micro strip antennas are mostly broadside radiators. A micro strip antenna is very versatile and suitable for wide range of resonant frequencies, polarization patterns and impedances. Due to its operational features it is mainly use in mobile communication and government security agencies. As compared to phase array antenna micro strip antenna has various extra features viz multifunction, linear and circular polarization, small volume. [1][2][4][7][8][3]

1) RECTANGULAR PATCH ANTENNA:

1.1) ANTENNA STRUCTURE:-

The rectangular patch antenna is most commonly use antenna.

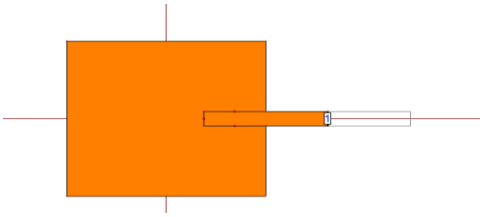

Figure 1: IE3D model of rectangular patch antenna

Length=1600 mil and Width=1500 mil

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This patch antenna has radiating patch on one side of the Dielectric substrate and another side has ground plane.This is the frontr view of the patch antenna.

2) CIRCULAR PATCH ANTENNA:

2.1) ANTENNA STRUCTURE:-

Circular patch antenna is as same as the rectangular patch antenna and it is mainly use in defense and satellite communication. Now a days Circular patch micro strip antennas are popular because they are light weight, low cost, low volume, due to less complexity the manufacturing of micro strip patch antenna is more easier and also other characteristic such as low profile and conformable due this reason antenna can use airborne and spacecraft application. [6]

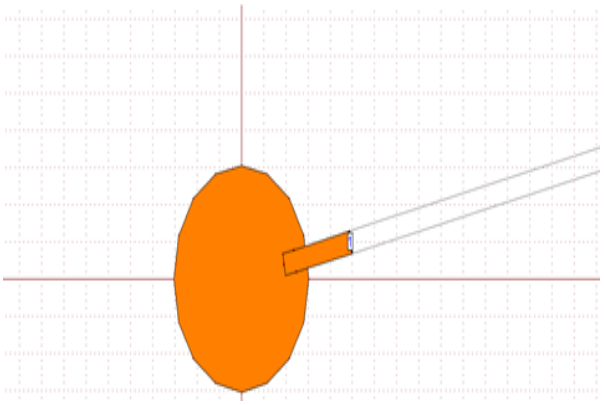

Figure 2: IE3D model of circular patch antenna

2. DESIGN METHODOLOGY

1) RECTANGULAR PATCH ANTENNA:

While designing patch antenna we required appropriate material to get maximum efficiency and the low power consumption hence we used EPSR 5.4 (DIELECTRIC CONSTANT) as the dielectric constant value increases the operating range of the antenna decreases, in IE3D software for the rectangular patch antenna z-top value is 31. Operating frequency we use that is 3 GHz.

Micro strip antenna is famous for the strip. We used to make cut in patch is Inset feed technique. In this technique the strip line is extends from the patch. This technique is use for the impedance matching. In the meshing we make AEC layer is 1 this is because the it will affect the current gain.

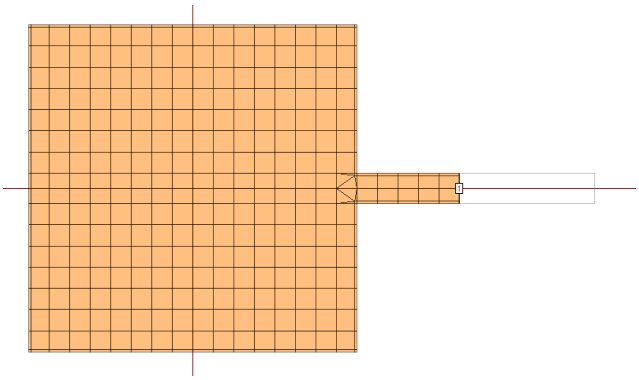

Figure 3: IE3D Model after meshing

2) CIRCULAR PATCH ANTENNA:

In circular patch antenna we used RADIUS of circular patch is 12 mil and EPSR is 5.4 for the material. Z-Top surface is as same as the rectangular patch antenna.

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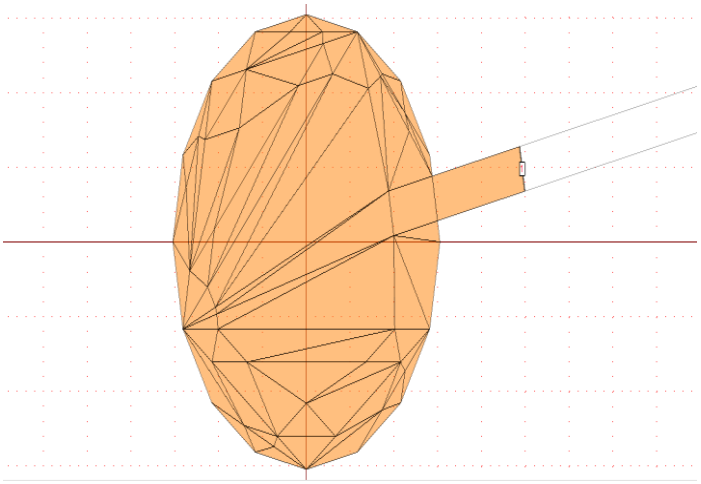

Figure 4: IE3D Model after meshing

3. SIMULATION RESULTS

The micro strip patch antennas can be analyzed in various methods, the most popular are:

- Transmission-line method (TLM)
- Cavity method (CM)
- Full-wave methods:

The final simulation results of both antenna analyzed with same range of frequency i.e., 1.8 to 3 GHz .Over this range of frequency we took 121 samples .[4][5].

1) RECTANGULAR PATCH ANTENNA:

1.1) RADIATION PATTERN (3D):

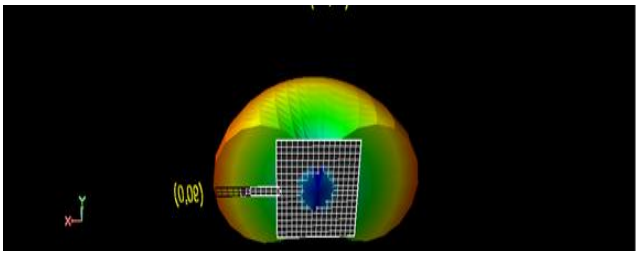

Figure 5: 3D Radiation pattern of Rectangular

1.2) RADIATION ATTERN (2D):

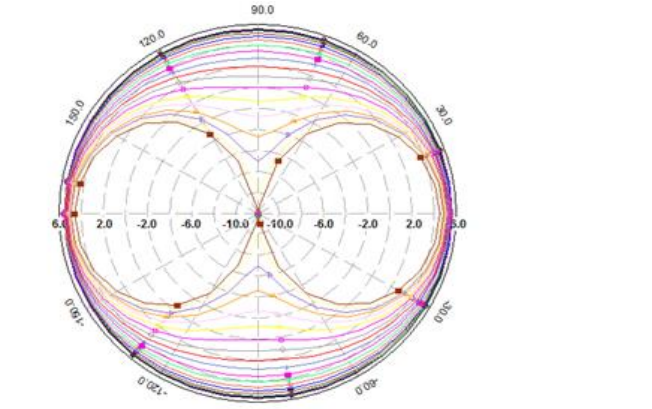

Figure 6: 2D Radiation Pattern of Rectangular

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1.3) S-PARAMETER:

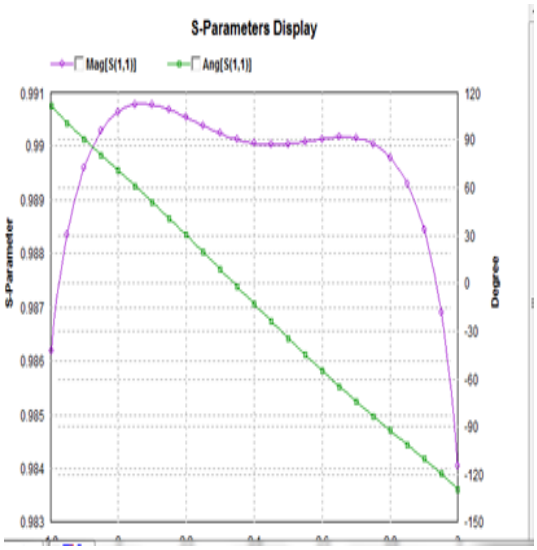

Figure 7: S-Parameter v/s Frequency

1.4) Z-PARAMETER:

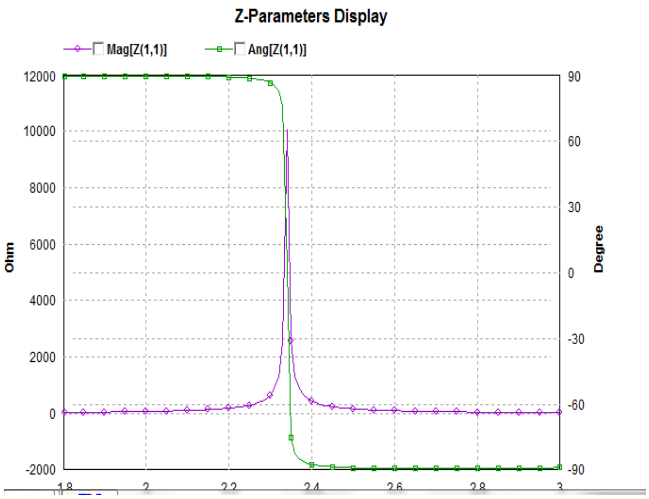

Figure 8: Z-Parameter v/s Frequency

1.5) Y-PARAMETER:

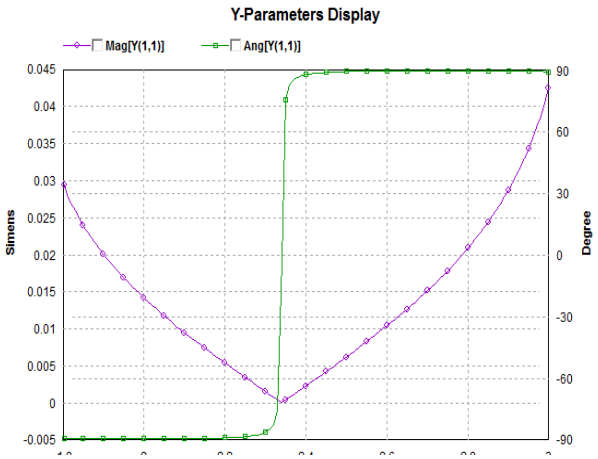

Figure 9: Y-Parameter v/s Frequency

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1.6) VSWR RATIO:

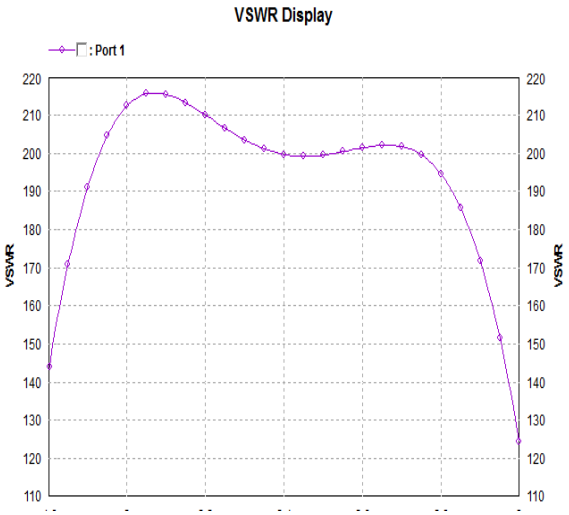

Figure 10: VSWR v/s Frequency Graph

1.7) SMITH CHART:

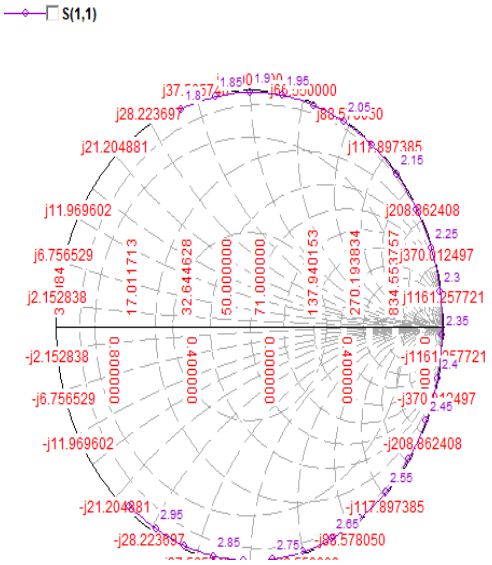

Figure 11: Smith Chart

1.8) CURRENT RADIATION:

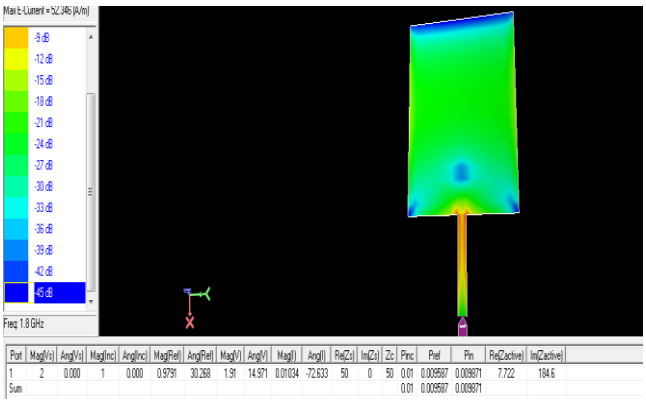

Figure 12: Current Distribution Pattern

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SIMULATION RESULTS:

2) CIRCULAR PATCH ANTENNA:

2.1) RADIATION PATTERN (3D):

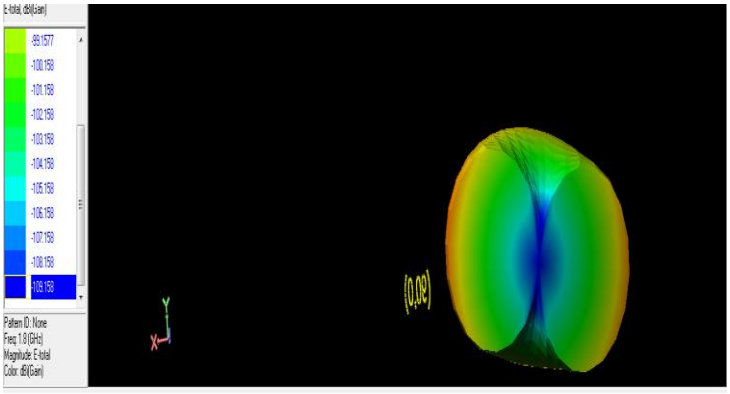

Figure 13: 3D Radiation Pattern of Circular

2.2) RADIATION PATTERN (2D):

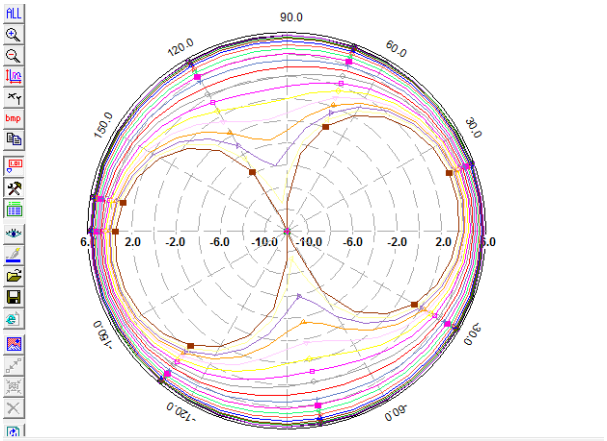

Figure 14: 2D Radiation Pattern of Circular

2.3) S-PARAMETER:

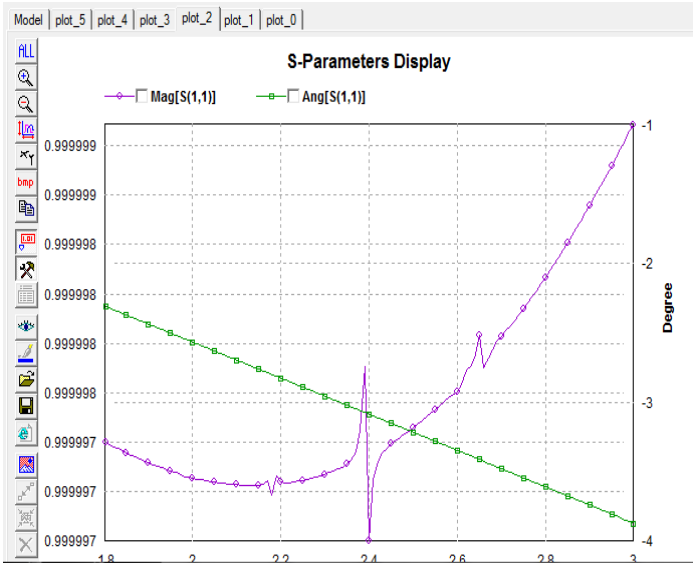

Figure 15: S-Parameter v/s Frequency

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2.4) Z-PARAMETER:

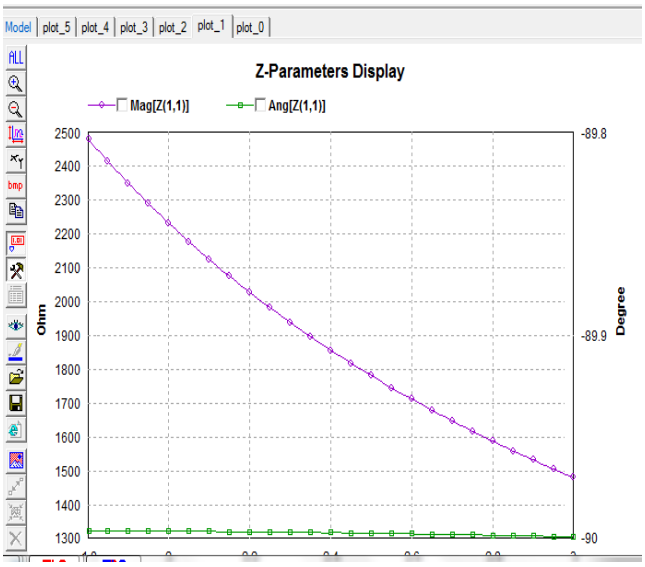

Figure 16: Z-Parameter v/s Frequency

2.5) Y-PARAMETER:

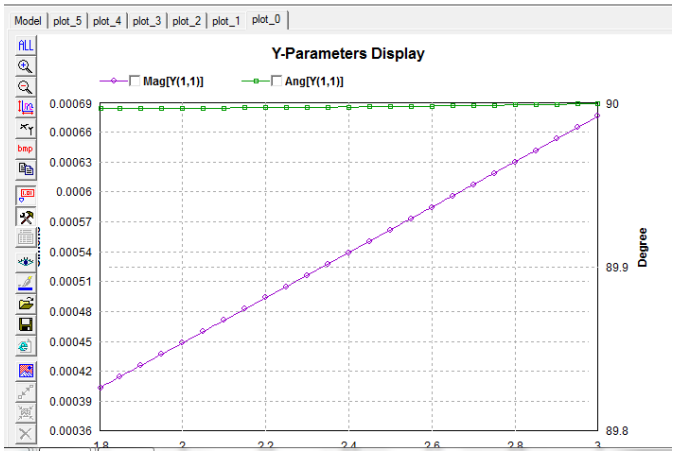

Figure 17: Y-Parameter v/s Frequency

2.6) CURRENT RADITION PATTERN:

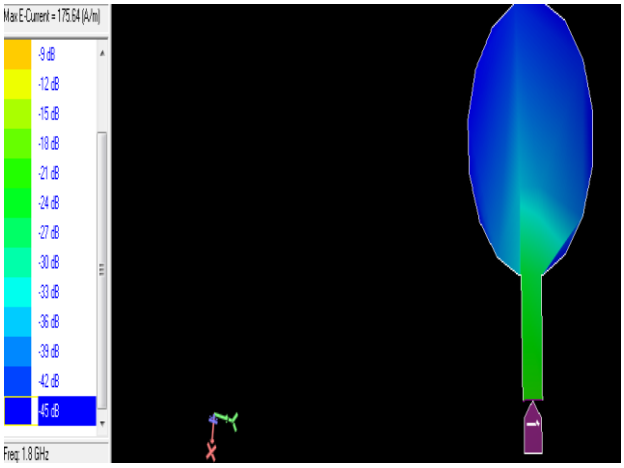

Figure 18: Current Distribution Pattern

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2.7) VSWR RATIO:

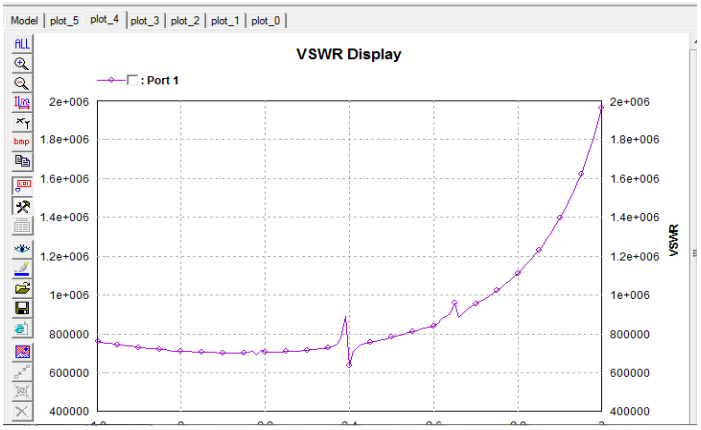

Figure 19: VSWR v/s Frequency

4. CONCLUSION

This paper was aimed to comparison of performance of Rectangular and Circular patch antenna. Both Rectangular patch and Circular patch has same parameter i.e., dielectric constant and Z-Top surface. The Z-Parameter value for Rectangular patch antenna is 1000 ohm at 2.4 GHz frequency while its 2400 for the circular patch antenna. The Y-Parameter value for Rectangular patch antenna is 0.005 simens at 2.4 GHz frequency while for Circular patch it is 0.00051 simens. S-Parameter for the Rectangular patch antenna is 0.98 at 2.4 GHz frequency while the circular patch antenna it is 0.9999.Gain of Rectangular patch antenna is -13.9719 dBi and the directivity is 5.53981 dBi. While for the Circular patch antenna gain is about 15 dBi and directivity is about 7. The current gain is about 45.1 dBi for both antennas. This due to the dependence of the current gain on AEC layer we used AEC ratio 1 for both the antenna.

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