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A Comparative Study in Different Structures of Microstip Patch Antenna Design

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Abstract. Microstrip antenna consists of a metallic patch on a grounded substrate. It may be rectangular or circular patches. MSA become very popular for its ease of analysis and in fabrication, attractive radiation characteristics and low cross polarization radiation. In this paper, the proposed antennas are selected as UWB self-complementary Monopole antennas. I represent here the comparative study of Microstrip rectangular and hexagonal Patch antenna and their characteristics like Radiation pattern, VSWR vs. frequency, s-parameter vs. frequency, Impedance vs. frequency, current density etc.

1. Introduction

In self-complementary antenna, the complementary structure of antenna is identical with its original structure. UWB means very low energy level for short range and high bandwidth of the radio spectrum. At present UWB technology put more importance on small printed antennas because fabrication procedure is very simple and it can be easily integrated with other components on the same PCB. The monopole microstrip antennas are studied to demonstrate the enhancement technique of bandwidth.

According to surveying of many Research papers [1-7]. I have analyzed here different matching techniques by simulation. These matching techniques provide better frequency response characteristics curve within ultra wide band. The impedance matching performance of simulated antennas are improved and gain also enhanced and perfect impedance matching leads to the rejection of narrow band of frequency, i.e., antenna functioning as a band reject element. Better band rejection improves the notching performance. So, the antenna used as a notch filter. The structures of the proposed antennas are constructed on Ansoft simulation software, high frequency structural simulator (HFSS).

2. Design and Structure of Proposed Antenna

Schematic design for Hexagonal structure of antenna is given below in Figure 1.

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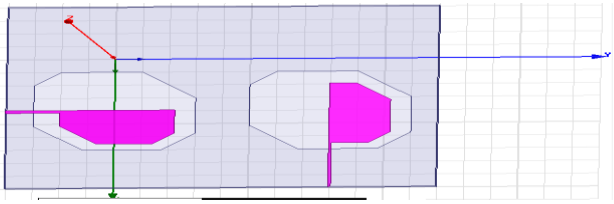

Figure 1. Structure of antenna [Hexagonal patch for 2-element].

Table 1a. Shows the different measured parameters of proposed Hexagonal patch

Configuration	Parameter	Name	Thickness	x (mm)	y (mm)	z (mm)
Hexagonal patch 2 element	Dielectric Substrate	FR4	1.6	-20	-20	0

Table 1b. Shows the different measured parameters of proposed Hexagonal patch

Configuration	Parameter	Name	Thickness	x (mm)	y (mm)	z (mm)
Hexagonal patch 2 element	Dielectric Substrate	FR4	1.6	70	80	1.6

Schematic design for Square patch structure of antenna is given below in Figure 2.

Figure 2. Structure of antenna [Square patch for 2-element].

Table 2a. Shows the different measured parameters of proposed Square patch

Configuration	Parameter	Name	Thickness	x (mm)	y (mm)	z (mm)
Hexagonal patch 2 element	Dielectric Substrate	FR4	1.6	-20	-20	0

Table 2b. Shows the different measured parameters of proposed Square patch

Configuration	Parameter	Name	Thickness	x (mm)	y (mm)	z (mm)
Hexagonal patch 2 element	Dielectric Substrate	FR4	1.6	70	80	1.6

3. Results and Analysis

3.1. VSWR vs. Frequency

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After simulation, different characteristic curves of proposed antennas are given below.

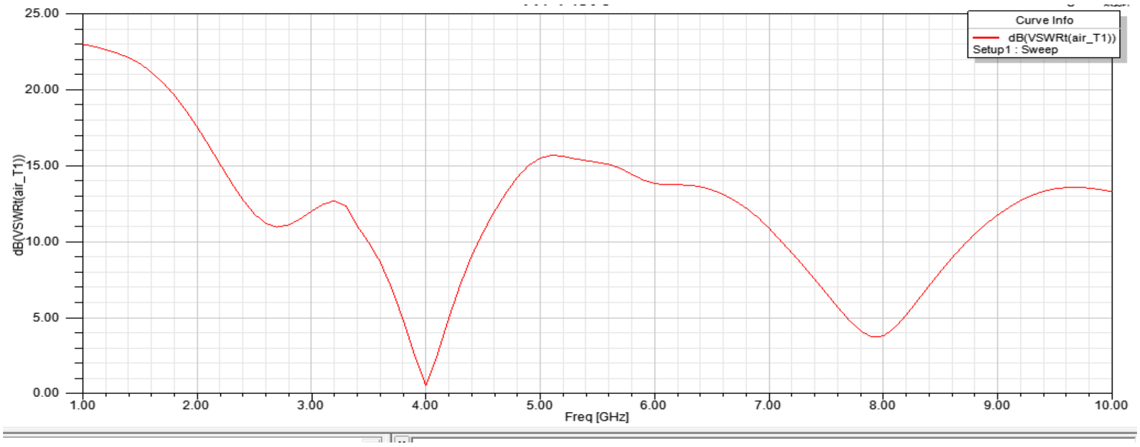

Figure 3. VSWR vs. Frequency of the Hexagonal structure for 2-element patch Antenna.

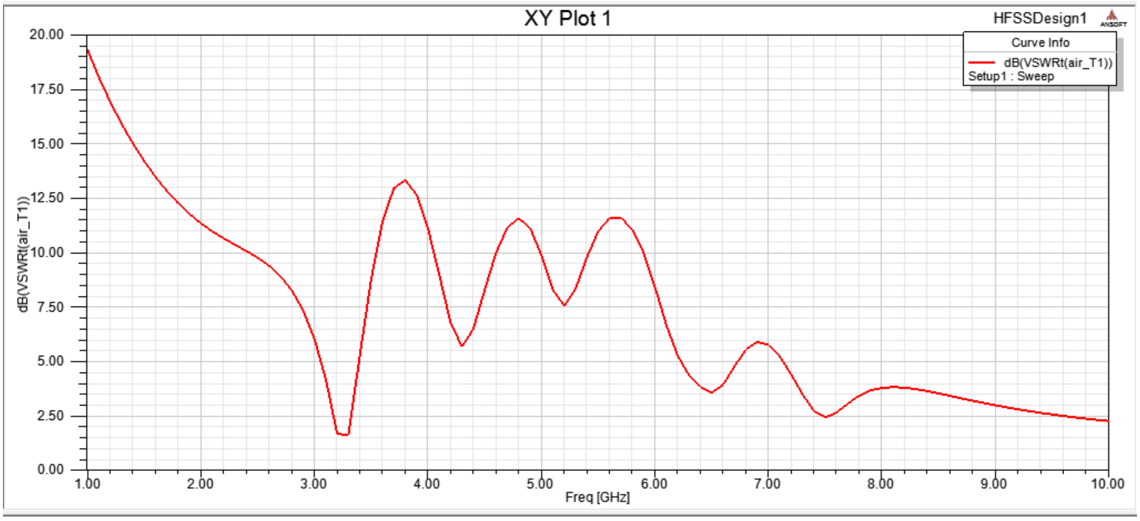

Figure 4. VSWR vs. Frequency of the Square structure for 2-element patch Antenna.

3.2. S11 vs. Frequency

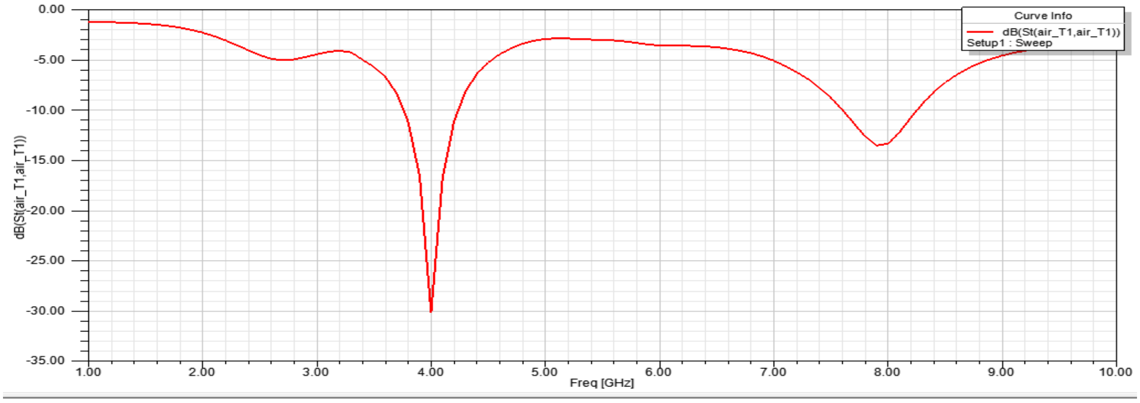

Figure 5. S11 vs. Frequency of the Hexagonal structure- 2-element patch Antenna.

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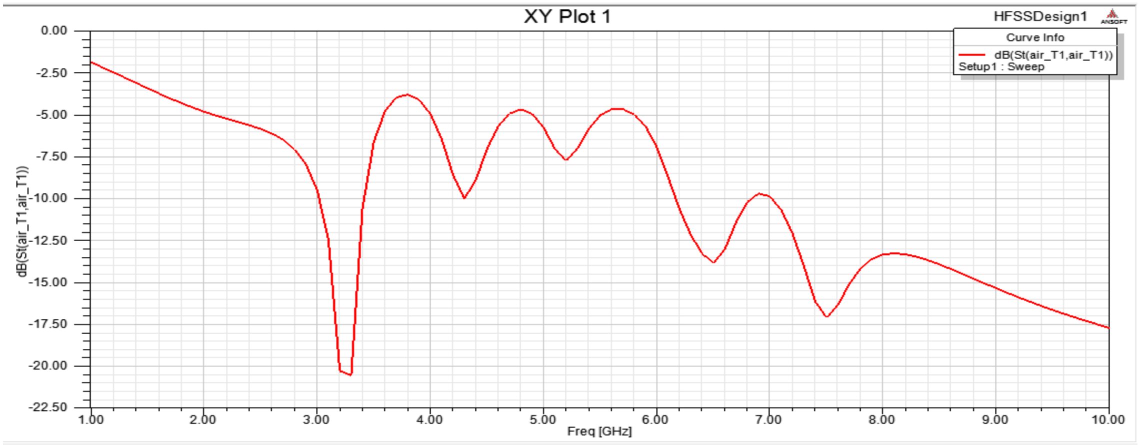

Figure 6. S11 vs. Frequency of the Hexagonal structure- 2-element patch Antenna.

3.3. S12 vs. Frequency

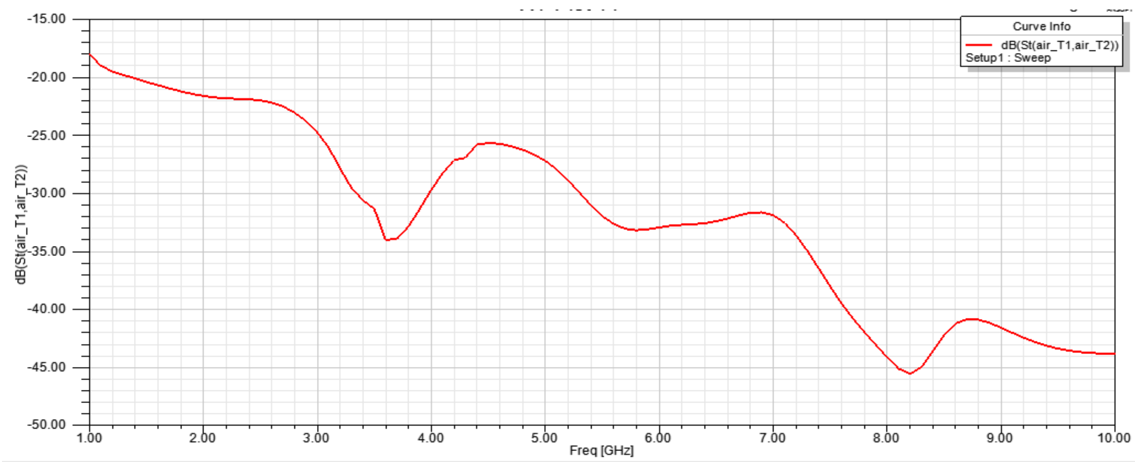

Figure 7. S12 vs. Frequency of the Hexagonal structure- 2-element patch Antenna.

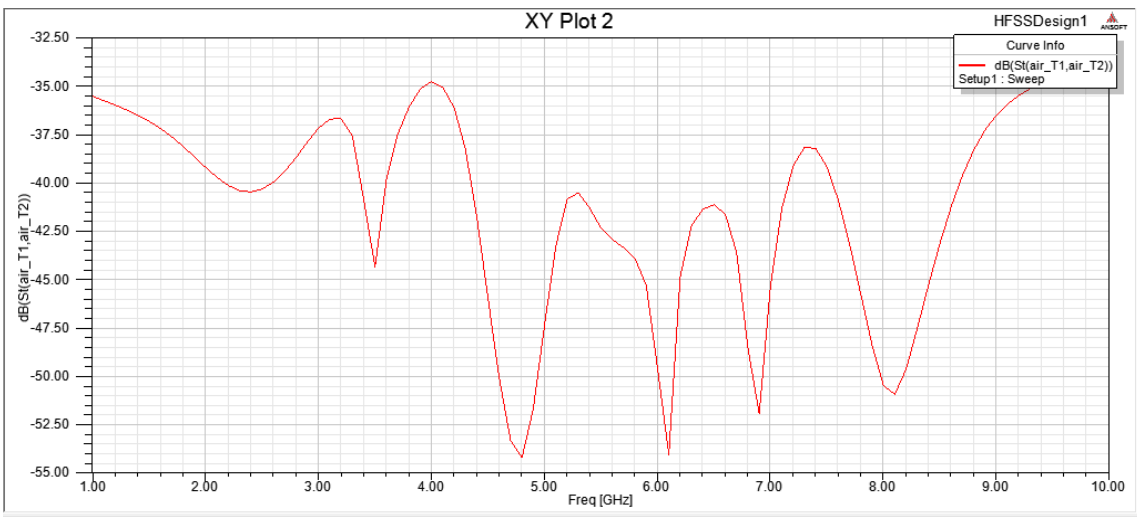

Figure 8. S12 vs. Frequency of the Hexagonal structure- 2-element patch Antenna.

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3.4. Radiation Pattern

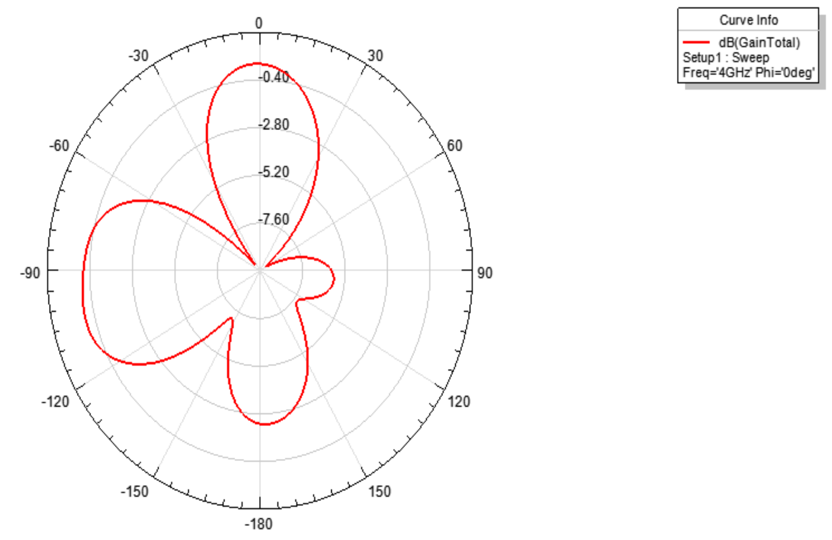

Figure 9. Radiation pattern Total gain of the Hexagonal structure for 2-element patch Antenna at phi 0 deg.

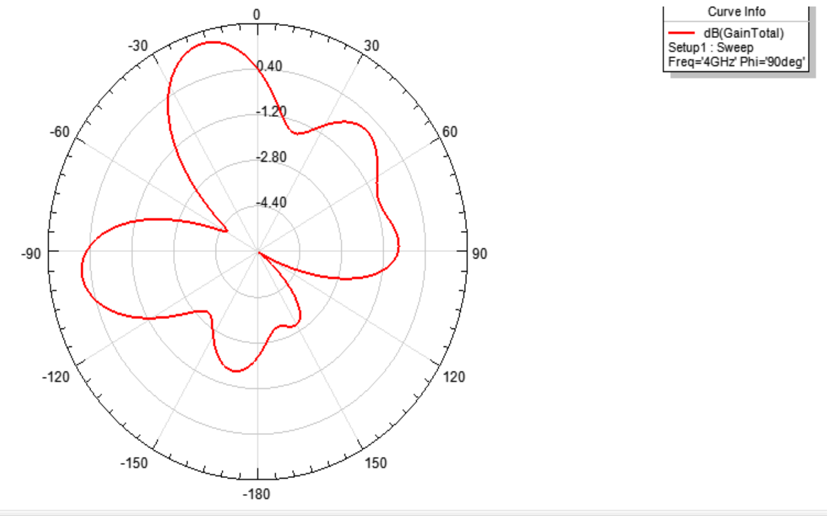

Figure 10. Radiation pattern Total gain of the Hexagonal structure for 2-element patch Antenna at phi 90 deg.

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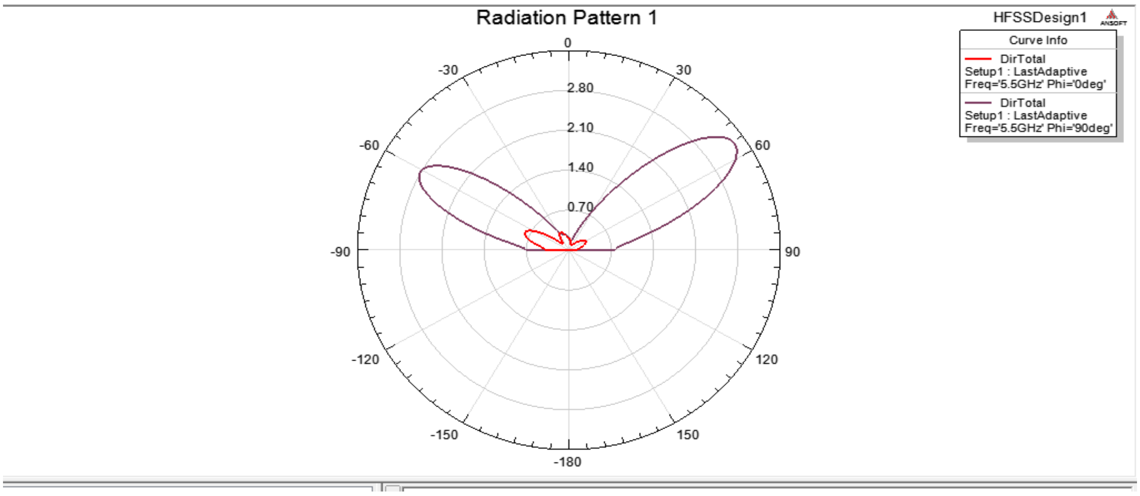

Figure 11. Radiation pattern of the Square structure **-** 2-element patch Antenna at phi 0 deg. & 90 deg.

3.5. Smith Chart

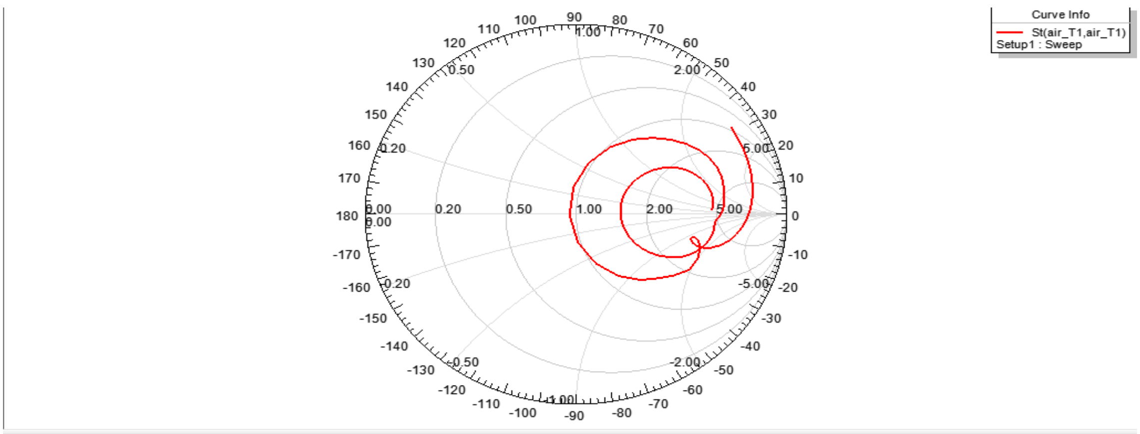

Figure 12. Smith chart of the Hexagonal structure for 2-element Patch Antenna.

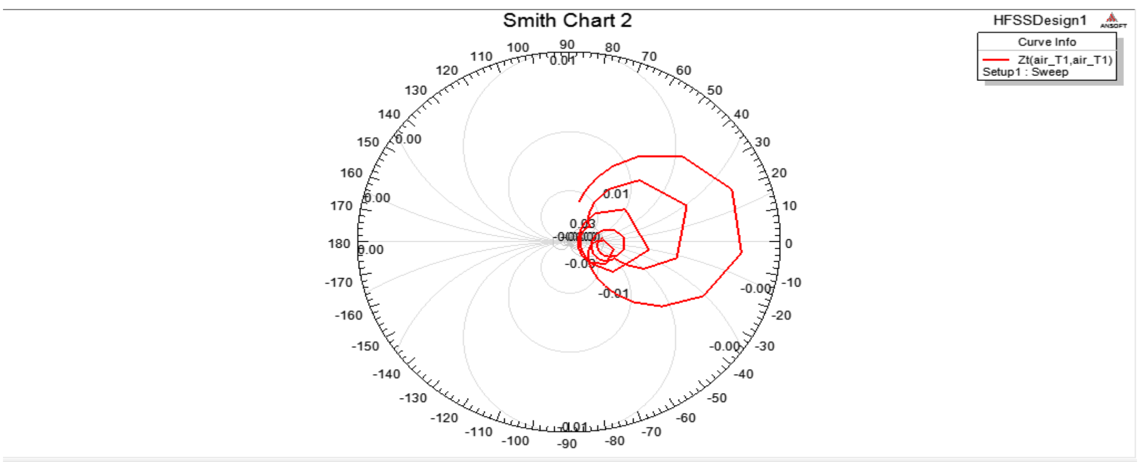

Figure 13. Smith chart of the Square structure for 2-element Patch Antenna.

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3.5. 3D Polar Plot

Figure 14. 3D Polar plot of the Hexagonal structure for 2-element patch Antenna.

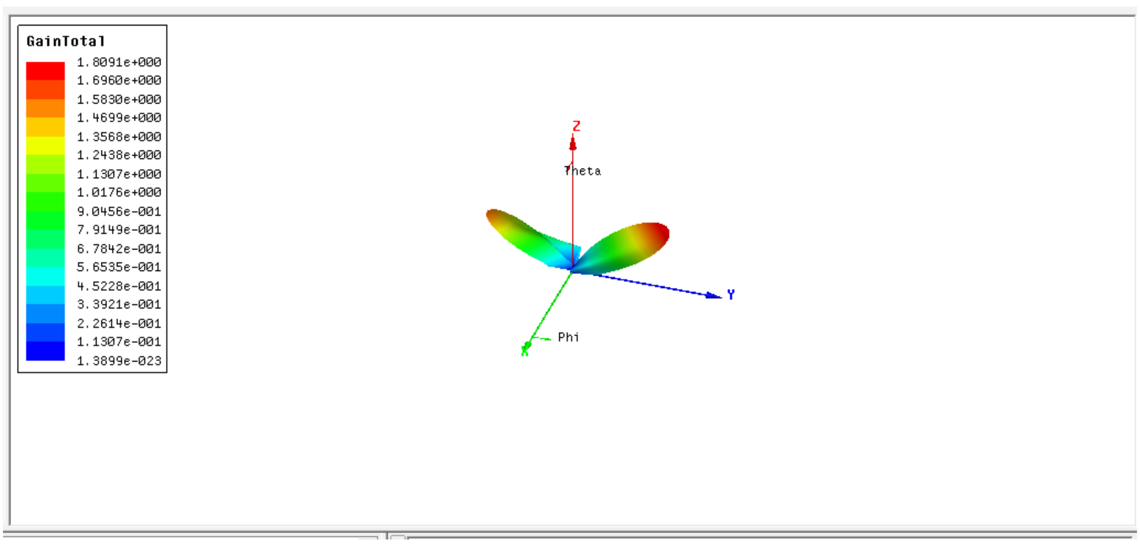

Figure 15. 3D Polar plot of the Square structure for 2-element patch Antenna.

3.6. Current Density

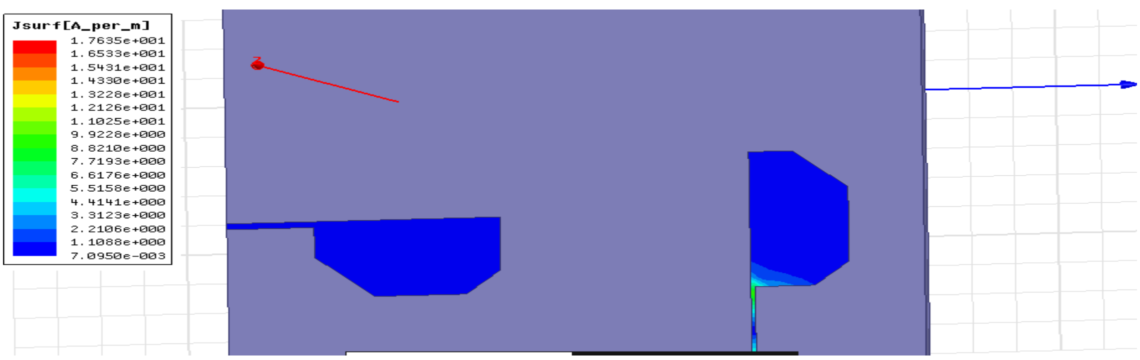

Figure 16. Current density of the Hexagonal structure for 2-element patch Antenna.

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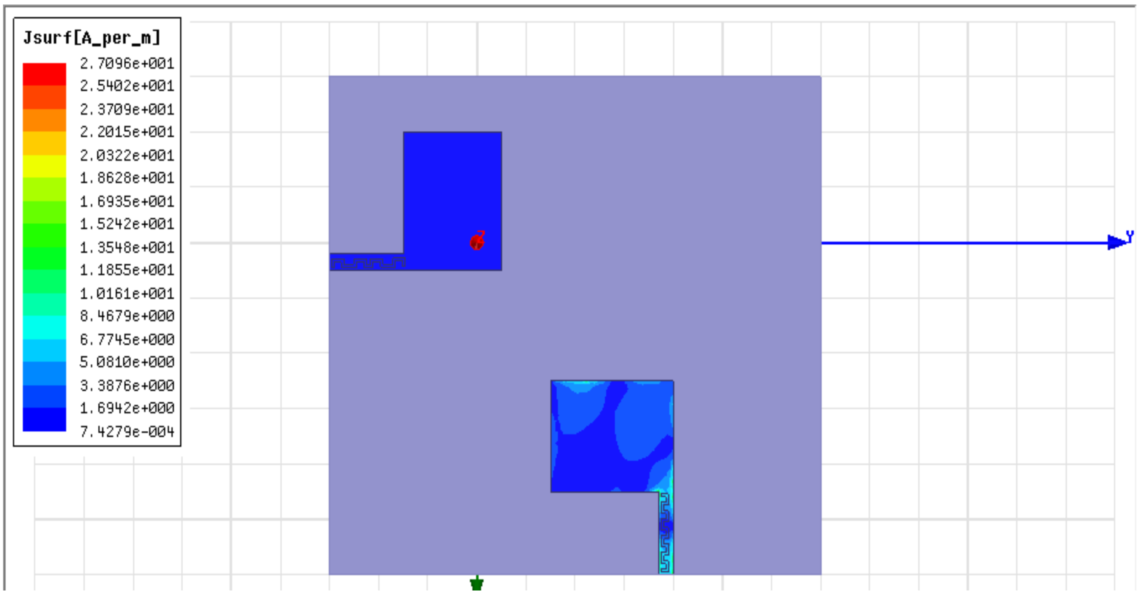

Figure 17. Current density of the Square structure for 2-element patch Antenna.

4. Results and Discussion

Figure 3. & Figure 4. shows VSWR vs. Freq. plot of the Hexagonal patch and Square patch antenna. Result shows that, proposed Hexagonal patch antenna consists wide bandwidth (VSWR<2) of (2.8 – 9.4) GHz. with band stop frequency of (3.3 – 5) GHz and (7 - 9) GHz. which allocated for WLAN, HIPER LAN technologies and Square patch antenna also consists UWB but range is less than Hexagonal patch. S11 vs. Frequency plot of Hexagonal patch [Figure 5.], shows that S11 is at 30 dB. But, S11 vs. Frequency plot of Square patch [Figure 6.] is not better than Hexagonal patch. S12 of proposed Hexagonal patch antenna [Figure 7.] also below 30 dB. On the other side, S12 of Square patch antenna [Figure 8.] is very poor. Figure 12. shows the Smith chart of proposed Hexagonal patch antenna and Figure 13. shows Smith chart of proposed Square patch antenna. From Figure12. and Figure 13, designed Square patch antenna obtained low impedance than Hexagonal patch antenna due to self-complementary structure.

The resonating frequency is 4GHz which is working within the Microwave band (C band). The Radiation pattern of designed Hexagonal patch antenna is shown in Figure 9 and Figure 10, which shows omnidirectional nature. Radiation pattern of designed Square patch antenna is shown in Figure 11. Which also provides high gain but less than Hexagonal patch antenna.

Current density of proposed Hexagonal patch antenna is shown in Figure 16. It shows that, surface current is highly concentrated in one part of 2 element Hexagonal patch. In another part, surface current slightly less concentrated in the corner of the patch and in the feed line.

Current density of proposed Square patch antenna is shown in Figure 17. It shows that, surface current is highly concentrated in one part of 2 element Hexagonal patch. In another part, surface current slightly is very less concentrated in the top corners of the patch and in the feed line.

5. Conclusion

According to the Simulation study, we get, proposed Hexagonal patch antenna gives better result than Square patch antenna in impedance matching, better gain, and enhancement of radiation. The speed of response for UWB is very high in case of Hexagonal patch antenna than Square patch antenna.

Acknowledgements

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