Parametric Analysis of Dual Band Triple Notch antenna for Internet of Vehicles

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Abstract - In this work we designed dual band triple notch antenna at Radio Frequency (3 – 30 GHz) for satellite and wi-Fi applications at Super High Frequency.Initially a simple patch antenna was created further three slots were made in the patch to improve the antenna parameters. The maximum reflection coefficient achieved is -23dB at 12.5GHz and -43.8dB at 27GHz. The simulation was carried out using CST software.

Key words: Triple Band, Internet of Vehicles (IoV),VSWR.

I. Introduction

The Internet of Vehicles (IoV) has been attracting considerable attention in universities as well as business in recent years due to its enormous scientific and business potential. The fast expansion of cars has given rise to a number of problems that the Internet of cars (IoV) may successfully mitigate or address. It can also significantly increase mobility, security, and intellect. Greater interaction connections are able to be employed to create a system of transportation that is more secure and organized. For instance, because satellite connectivity has the benefits of broad coverage, flexible internet access, and excellent dependability, it has significant promise for use in the Internet of Vehicles. In addition, the installation of 5G networks and immediate vehicular radars inside of cars enhances the usefulness of the Internet of vehicles. In order to improve automotive security for IoV, immediate vehicle radar systems are capable of identifying adjacent items and offer contextual awareness in the kind of of separation, speed, and inclination information. In meantime, 5G networking systems—which may increase system bandwidth, transport dimension, and frequency efficiency—play a crucial role in enabling high data rates for IoV [1]. Since these networks operate at a variety of frequency ranges, it is typically necessary to use many distinct antennae for signals transmission and reception for different networks. However, this results in a number of issues, including decreased network capacity, greater antennae obstruction, and electromagnetic disturbance. A high-speed internet, high-gain, dual aperture antennae with multiple bands of frequencies operation at once is widely needed to address these issues. Patch antennas, which are currently being utilized in automobiles, have shown to be a dependable option for a variety of uses because of their small traits, high gain, cost-effectiveness, and easy feeding. Yet, because of the components' intrinsic narrow-band characteristics and the difference in temporal timing delay, patch antennae often have a limited bandwidth. An ultra-wideband (UWB) patch antennas might be a desirable option if it might be made to do several tasks in one emitting opening, including satellite communications, 5G mobile data transmission, and immediate vehicular surveillance. In the past few decades, several techniques were developed to increase the bandwidths of the patch antennae. The purpose of the sub-wavelength cell configuration was to increase the patch transmitters range. The patches effective spectrum was increased by using the just one layer multi-resonance architectures as cell units. A lower phase inaccuracy was attained as a consequence of the multi-resonance component cell capacity to produce enough phase alterations at various frequency ranges, improving the spectrum [2]. Greater throughput is needed for the next generation's (5G) wireless transmission network in order to fulfil the rising needs for more data. This network will offer bigger storage space and huge item connection, as well as reduced total latency and enhanced user satisfaction. Moving up to the wavelength frequencies is a potential option; however, a Friis Transport Equations indicates that this will result in higher free-space route losses. Higher-gain antennae may be used to offset the significant loss, although the trade-off is a smaller emission beam width with correspondingly less range. Thus, in order to provide many wavelengths with significant yield across the central station and the cell phone in the forthcoming 5G structures, beam-steerable directed arrays with phases are utilized, as detailed.

II. Design of the proposed antenna

First a millimetre range microstrip patch antenna with copper substrate was designed and the return loss was -2dB to increase further the antenna parameters secondly we introduced the slot in the proposed antenna. The proposed antenna was designed using CST software.The antenna width was 16 x 0.16 x 10 mm. The slots were made at different lengths.The antenna layout is shown in Fig 1 and Fig 2.

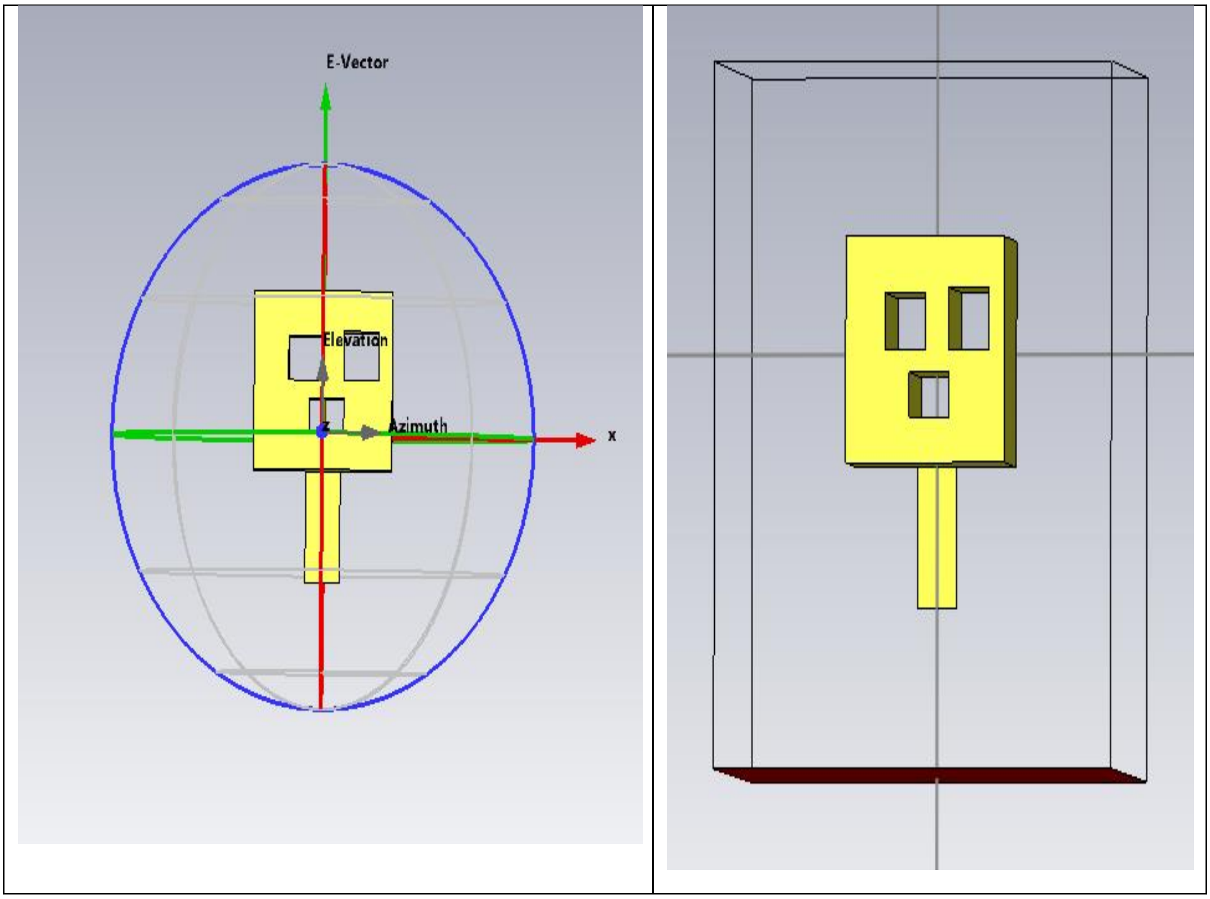


Fig.1 . Layout of the proposed Antenna Design

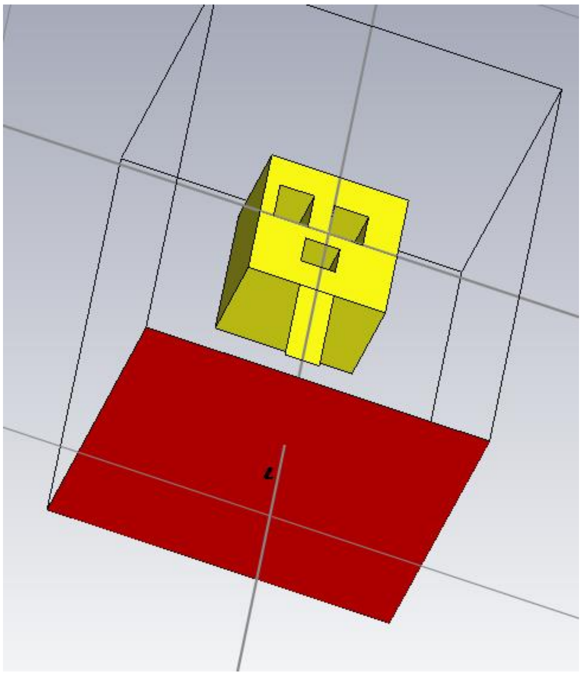


Fig.2. Plane Excitation model for the triple notch antenna

III. Results and Discusssions

A propagation device has the ability to both send and receive signals over Electromagnetic waves. If it receives messages, the antenna's structure is regarded as the point of origin (an exit) to the rest of the system that serves as the load that receives the signal (an entry) and includes a device that receives or measuring equipment. When the receiving antenna is sending out messages, it is thought of as the transmitter's or measuring device's load (an inputs) rather than an output of the device [3]. With the assistance of the electrical switch message, the recommended input/output terminal circuitry may drive either an elevated or decreased current with only one outcome controlling circuitry. Additionally, an output controlling register is used to individually operate one output of the drive system, which is made up of numerous stages. For a result, a design that uses the intended adaptable ports for inputs and outputs can minimize energy use and facilitate the connection of semiconductors with various energies. The Fig 3 shows the input and output port characteristics.

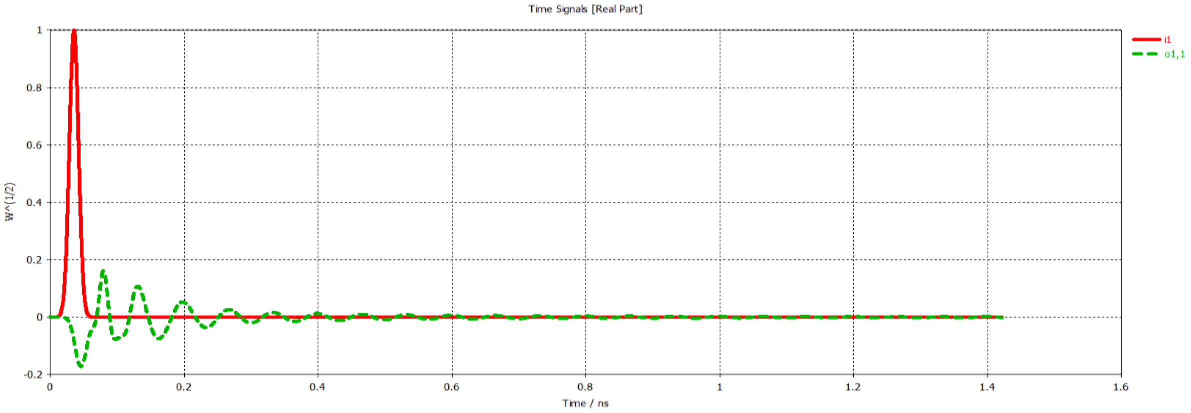


Fig.3. Signal from input and output port

The reflection coefficient, as it relates to antenna and collectors is the measurement of the amount of the electromagnetic energy that gets caught by a resistance mismatch in the medium used for transmission. The proportion to the intensity of the wave being reflected to the peak of the initial wave called its reflection coefficient. The VSWR and the coefficient of reflection are not the same [4]. While the wave propagation ratio whether it be electricity or current—looks at the proportion of the highest and a minimum electricity levels inside the transmission line resulting in the forward-facing and conveyed power, the coefficient of refractive index measures the amount of the initial spectrum which is observed. The maximum reflection coefficient achieved is -23dB at 12.5GHz and -43.8dB at 27GHz shown in Fig.4.

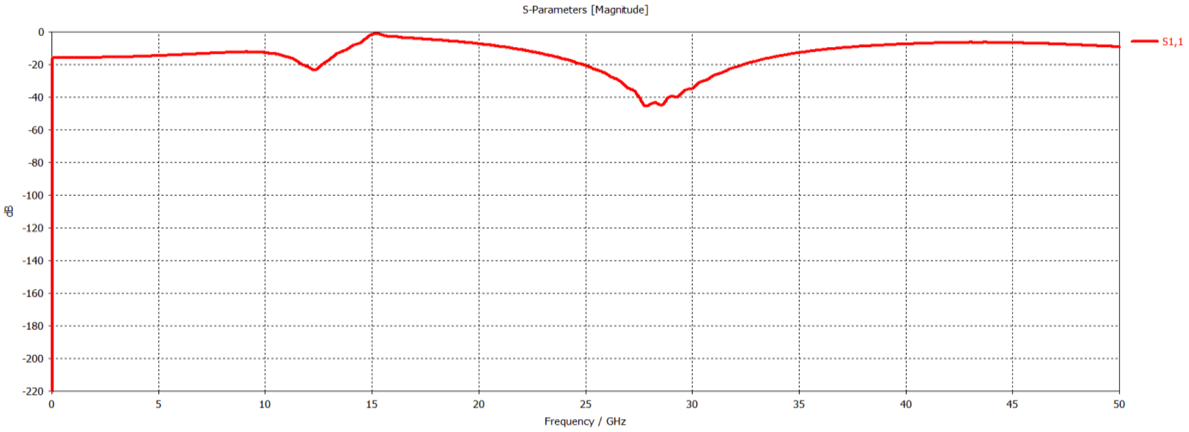


Fig.4. Reflection Coefficient for triple notch antenna

To accomplish the intended or required power distribution, it is normally preferable that the resistance of the device that is attached to an electrical generator equal the impedance concerning the input signal it transmits. The range of impedance which is typically utilized in Radio frequency application is 50 ohms, however such a measurement is by hardly required. Whenever the transmitter is listed with a 50 ohm demand, its maximum power rating will be achieved when the electrical load reaches that value as well [5]. The highest power is transmitted because a transmitter's power supply often has a rating for a particular load impedance, which even though the transmitting devices output resistance may be different from 50 ohms.The reference impedamnce is shown in Fig 5.

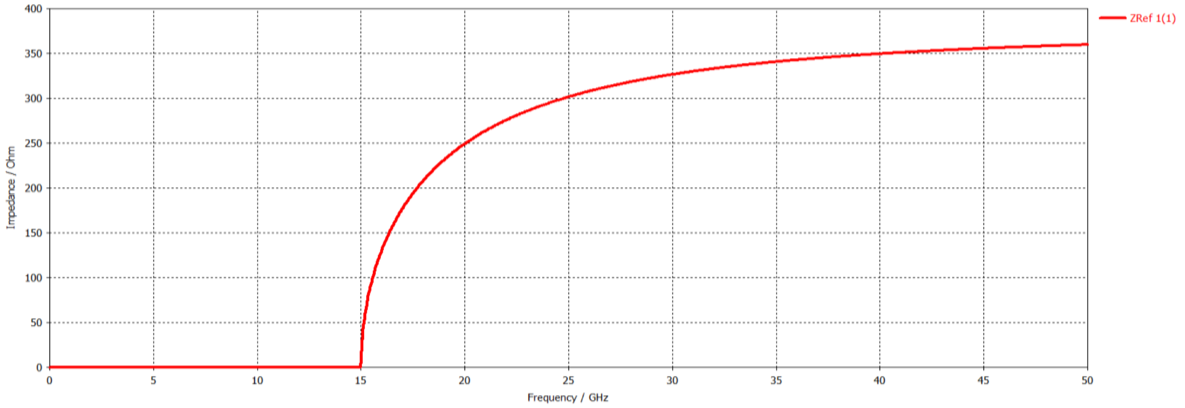


Fig.5. Reference impedance for the proposed antenna

The amount of radiation that a transmitter radiates when it is attached to a real transmitter is measured by its overall radiating power. Total Radiated Power is a dynamic estimation as it sends data via an antenna using a powered transceiver. The total radiated power represents the outcome of calculating and adding the entire power gained over all available directions [6].The radio transmitter cannot output an equivalent amount of power for each resistance the antenna links to, which is why the loss of energy resulting from the antenna's distance from 50 Ohms is not only connected to mismatched losses in this case. In the worst case scenario, a communications device will produce zero if a fuse or short circuit is placed across its electrical connections. The power distribution is shown in Fig 6.

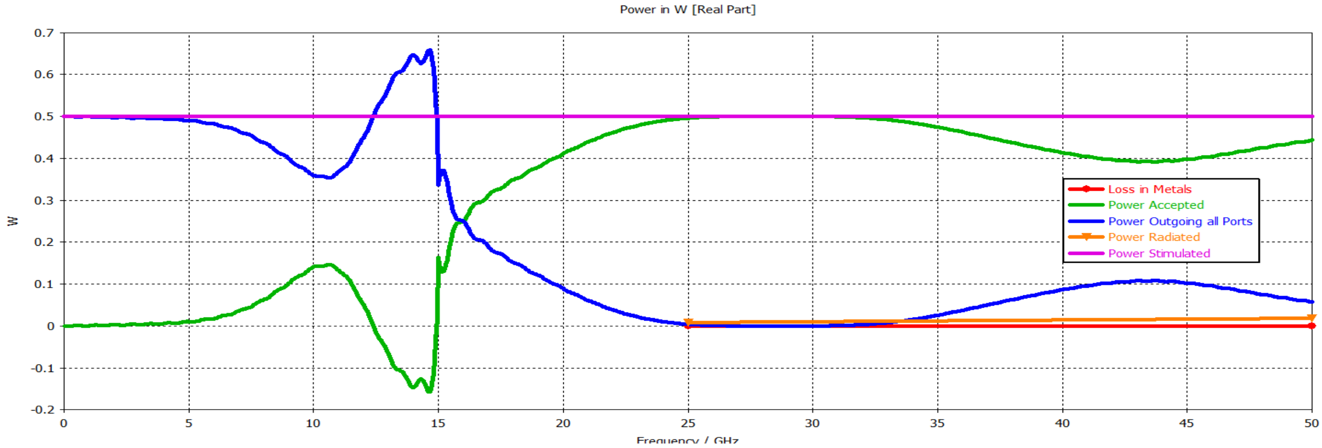


Fig.6. Power Radiated in Watts for the proposed antenna

Here the radiation distribution showcase structure to fill the opening, resistively across triple slots, and concentrate on exhibiting the properties of the radiated energy. Structures are calculated over homogeneous half-spaces featuring different attributes as well as a variety of settings, including free-space. In order to investigate the actions as an indicator of elevation over ground level and separation from the transmitting device's feeding particular, energy distribution structures are shown in Fig 7.

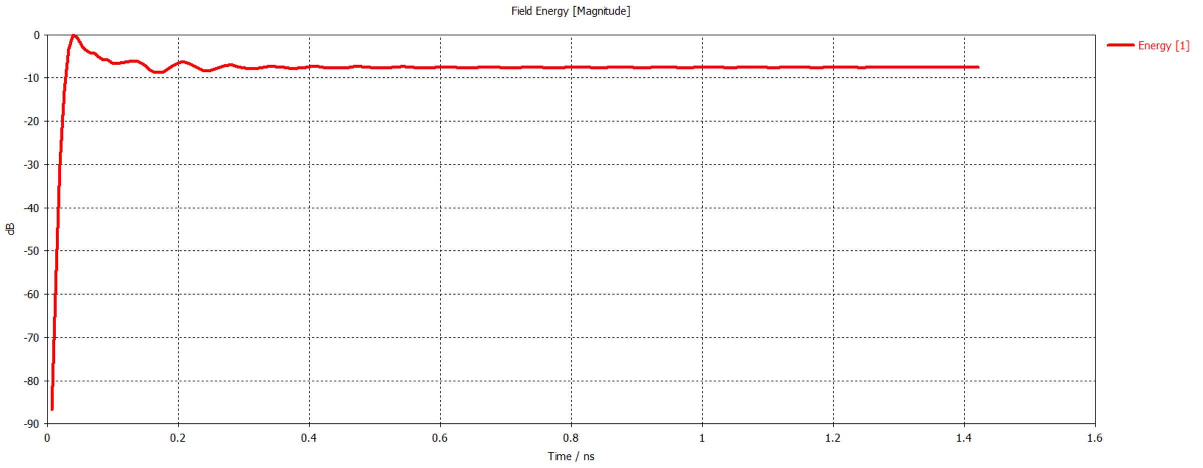


Fig.7. Energy distribution from the field for the proposed antenna

The efficiency of insulation is based on the imbalance of impedance between electromagnetic impulses in space and materials like metals. In particular, an electromagnetic radiation in air has a far-field impedance of 377 Ω.The Metal Surface Impedance for the proposed antenna is shown in Fig 8.

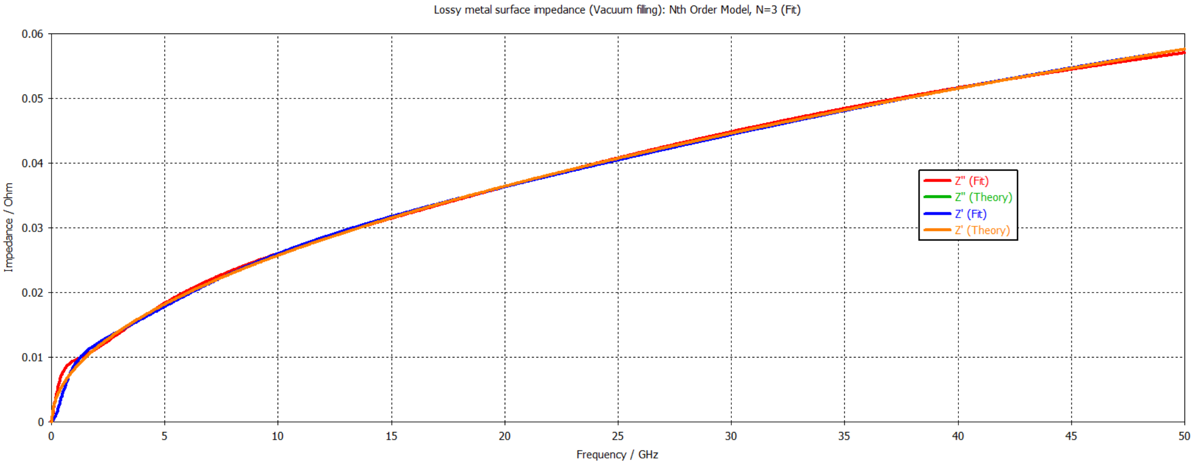


Fig.8. Metal Surface Impedance for the proposed antenna

The propagation constant for the proposed antenna is 419.17 micro meter at 25GHz shown in Fig 9.

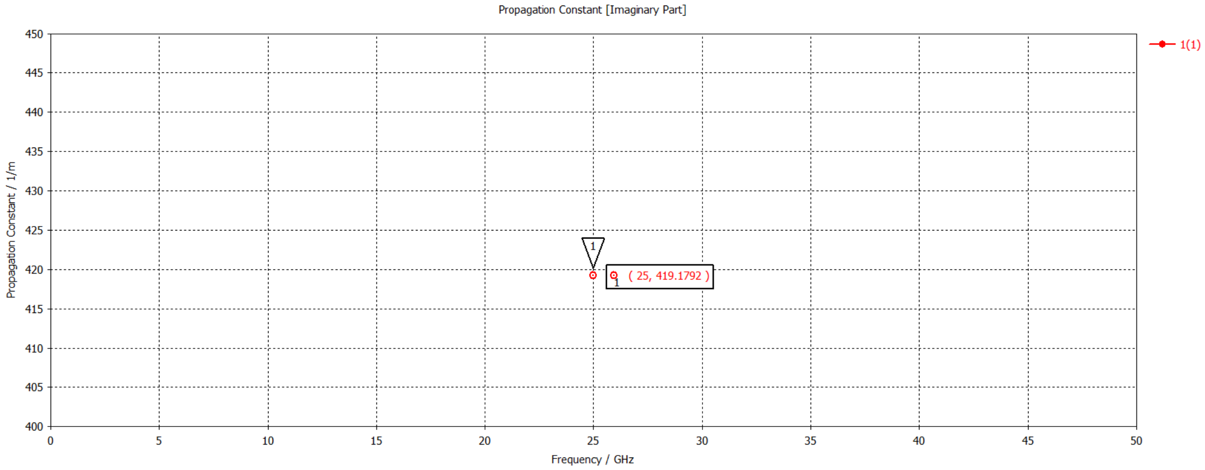


Fig.9. Propagation constant for the proposed antenna

The cut-off Frequency for the proposed antenna is at 14.99GH as show in Fig 10.

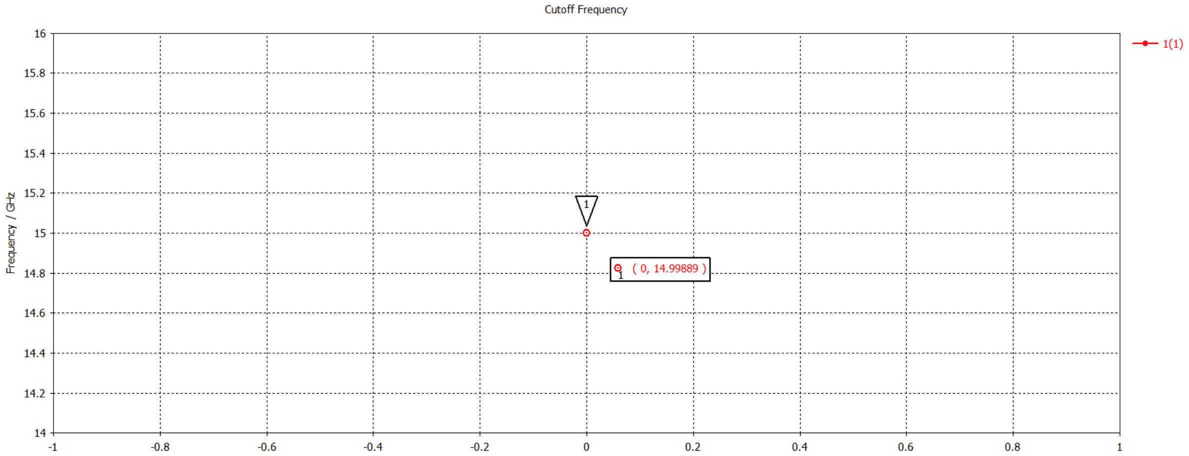


Fig.10. Cut-off Frequency for the proposed antenna

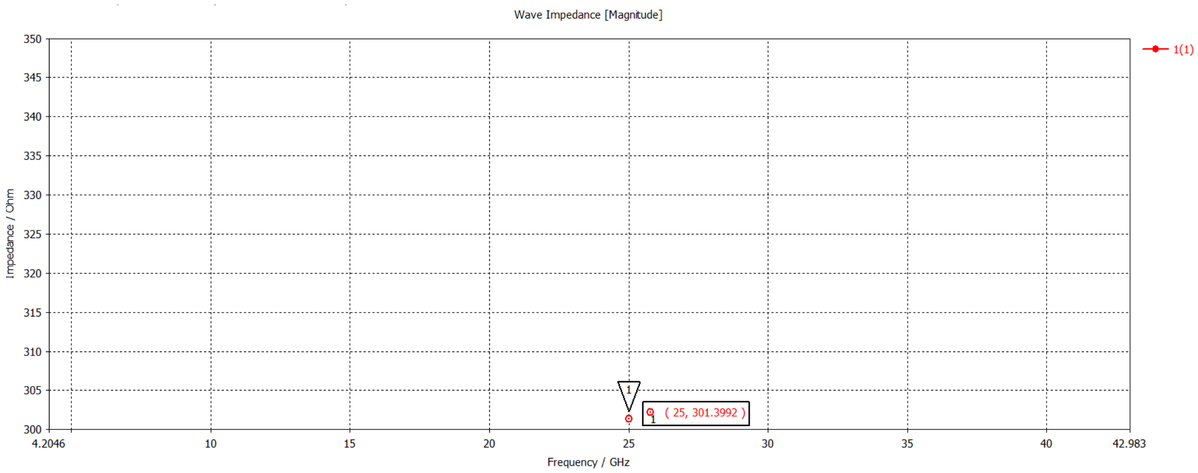
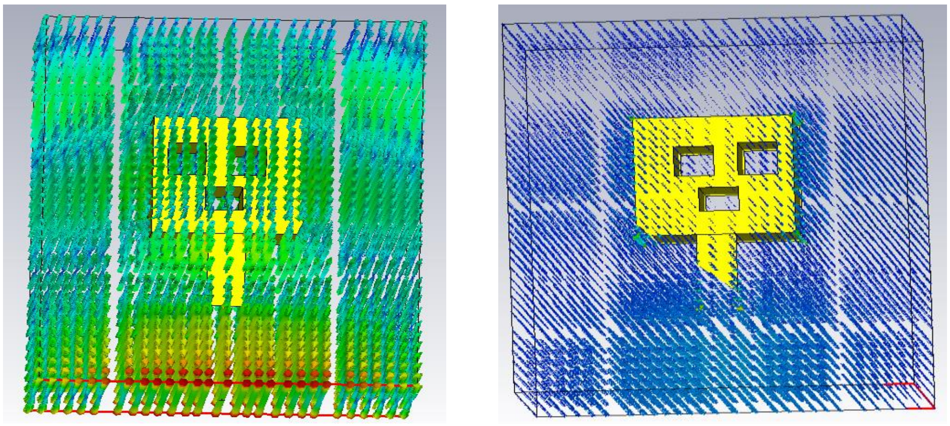
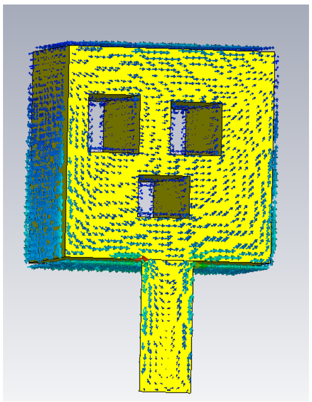


Fig.11. Wave Impedance for the proposed antenna

The wave Impedance for the proposed antenna is 301.3992 ohm at 25GHz as shown In Fig.11.The field properties and current distribution of the proposed antenna is shown in Fig.13



(a) (b)



(c)

Fig.13.(a) Magnetic Field for the proposed antenna (b) Electric Field for the proposed antenna (c) Surface Current for the proposed antenna

IV. Conclusion

A dual band triple notch antenna at Radio Frequency (3 – 30 GHz) for satellite and wi-Fi applications at Super High Frequency was designed. The maximum reflection coefficient achieved is -23dB at 12.5GHz and -43.8dB at 27GHz

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