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Design and Implementation of Frequency Reconfigurable Microstrip Patch Antenna

K.Vidhya

AbstractIn this paper, radio wire recurrence reconfiguration is finished utilizing a proficient method. Traditional radio wires work at a specific recurrence run henceforth it is intended for explicit application and we can't work it on different frequencies. This proposed radio wire is equipped for changing to two distinct frequencies of 2.4 GHz and 2.754 GHz. Stick diode MA4P274-1141T has been presented on the ground plane. Stick diode which can switch among two diverse recurrence groups. The anticipated recieving wire has been planned utilizing RT/Duroid substrate with a relative dielectric steady of 2.2, misfortune digression of 0.0009 and thickness of 1.575 mm. Contrasted with regular recieving wires, reconfigurable radio wires talked about in this paper work at two distinctive recurrence ranges and furthermore it improves the exhibition. In this paper a smaller recurrence reconfigurable microstrip fix recieving wire has been given less return misfortune and high gain in contrast and the customary one. HFSS programming is utilized for reenactment and examination.

Keywords- Microstrip Patch Antenna, Frequency Reconfigurable Antenna, PIN Diode.

I. INTRODUCTION

With increment in number of remote correspondence framework and improvement of current satellite correspondence, particularly if there should be an occurrence of MIMO framework, numerous applications requires coordinated, versatile, multifunctional radio wires. Reconfigurable recieving wire speaks to late advancements in radio wire plan that progressively changes recurrence, design polarization and radiation example to modifiable structures that can be adjusted.

The reconfiguration of a radio wire is accomplished by changing the transmitted fields of the recieving wire's viable gap. It depends on a deliberate adjustment of the reception apparatus flows or a reconfiguration of the radio wire's emanating edges. This redistribution of properties brings about an adjustment in the recieving wire's functionalities. Such difference in capacities enables clients to propose reconfigurable radio wires for different remote correspondence stages. There are four reconfiguration properties that a reconfigurable recieving wire can accomplish. A radio wire can show a reconfigurable recurrence of activity, a reconfigurable radiation design, a reconfigurable polarization conduct, or a blend of any of these properties [3], [4].

A radio wire engineer picks a technique that satisfies the constrained prerequisites and at the same time completes the gathering contraption arrangement task profitably. There are a couple of reconfiguration frameworks that have been proposed since the rising of reconfigurable gathering mechanical assemblies. The proposed reconfiguration techniques are parceled into four significant arrangements: electrical, optical, mechanical, and material distinction in changes to interface and separate gathering contraption parts similarly as to redistribute the recieving wire streams. Radio repeat scaled down scale electro mechanical structures (RF-MEMS) have been proposed for coordination into reconfigurable radio wires since 1998 [7]. Various structures have gone to RF MEMS to reconfigure their introduction. RF MEMS set up together reconfigurable recieving wires depend regarding the mechanical advancement of these progressions to achieve reconfiguration. The separation of RF-MEMS is outstandingly high and they require insignificant power use. The trading speed of RFMEMS is in the extent of 1–200 µsec which may be seen as low for a couple of utilizations [10]

Stick diodes or varactors have gave off an impression of being a quicker and an increasingly smaller option in contrast to RF-MEMS. The exchanging rate of a PIN diode is in the scope of 1–100 nsec [4]. Reconfigurable reception apparatuses utilizing PIN diodes have increasingly powerful reconfiguration capacity [14]. Other reconfigurable radio wires resort to varactors where changing the biasing voltage can bring about shifting the capacitance of the relating varactor. Such radio wires appreciate an immense tuning capacity that depends on coordinating a variable capacitance into the recieving wire structure. It is critical to demonstrate that while electrical exchanging parts may show proficient reconfiguration capacity, they require a fitting structure of their biasing systems.

The new procedure of PIN diode is utilized as the exchanging gadget. There are different reconfiguration parameters, for example, recurrence, polarization, radiation design, input voltages and compound examples [8]. Here we are executing recurrence reconfigurable reception apparatus since it is most likely simple component to change. It changes the recurrence starting with one then onto the next. This recurrence exchanging should be possible by utilizing PIN diode exchanging hardware.

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* Correspondence Author
Dr.K.Vidhya*, Associate Professor/ECE Department, Sri Ramakrishna EngineeringCollege,Coimbatore, India. vidhya.k@srec.ac.in

Stick diodes are having points of interest of less inclusion misfortune, gives better confinement, and influence taking care of limit is high and minimal effort.

In the event of example reconfiguration, it is identified with radiation example of individual reception apparatus and we can't transform it in various ways.

Polarization configurability exhibited by straight polarization or roundabout polarization [11]. The microstrip recieving wires are utilized for mimicking the reconfigurable radio wire in programming instrument.

HFSS programming is utilized for getting reproduction results. The fix reception apparatuses give preferred position of light weight, less size, low manufacture cost, equipped for double and triple recurrence perception. The primary point is to smaller size of recieving wire consequently we use fix radio wire.

Here we dissect the reenacted outcomes in HFSS programming, and we get return loss of not exactly - 29dB shows reception apparatus proficiency. The recurrence tuning is accomplished by embeddings switches and relying upon the status of switch the scope of recurrence activity is chosen.

For plan of reconfigurable radio wire we use microstrip fix reception apparatus. Microstrip recieving wires are planar resounding depression that break from their edges and emanate EM waves. It comprises of emanating patch on one side of a dielectric substrate having a ground plane on opposite side.

Fix radio wires are appointed various names, for example, printed recieving wires, microstrip fix reception apparatuses or basically Micro Strip Antennas (MSA). Microstrip radio wires are regularly utilized where thickness and comparability to the host surface are key prerequisites [1]. Since the fix radio wires can be legitimately imprinted onto a circuit board, these are ending up progressively prominent inside the cell phone advertise. These are minimal effort, have a position of safety and are effectively created. In elite flying machine, rocket, satellite, and rocket applications, microstrip radio wires are generally utilized. By and by there are numerous other government and business applications, for example, versatile, radio and remote interchanges where microstrip fix recieving wires are being given inclination [2].

II. P ROPOSED ANTENNA

A repeat reconfigurable arrangement is proposed by using microstrip fix gathering mechanical assembly with introducing PIN diode between openings, which wears down the trading system, i.e., ON-OFF state technique. Reconfiguration of the gathering mechanical assembly might be done in single part similarly as multipart recieving wire. In single part gathering contraption, spaces are cut in to the recieving wire to flow the present and reconfigurable fragments are acquainted in the openings with achieve reconfiguration while in multipart radio wire, to achieve reconfiguration, current is scattered in specific parts or all parts. Reconfigurable radio wire is principally used in workstation, round phone, remote structure, Multiple Input Multiple Output System (MIMO), ultra wide band structure and security based system, moreover it will in general be used in various other application by changing their functionality[12],[13].

In this paper a reconfigurable microstrip fix gathering mechanical assembly is proposed with spaces cut in ground plane with substrate PIN diode has been displayed between these openings on the ground plane [10]. The recieving wire made two various repeat bunches between 2.4 GHz and 2.754 GHz

III. ANTENNA CONFIGURATION

In this area the plan prospect of the radio wire is appeared as Figure 1. The material utilized in this structure is RT/Duroid as substrate with an overall permittivity of 2.2 and thickness of 1.575 mm. The element of the recieving wire is demonstrated by Length (L) = 7.19 mm and width (W) = 4.905 mm. The length of feed line is 4.678 mm. The feed line width is 0.493 mm.

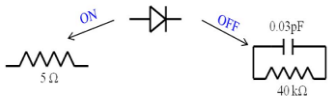

Fig 1. PIN Diode Equivalent Circuit Model

Fig 1 shows the equivalent circuit model of PIN diode which is used in this work. This diode will switch over from ON/OFF state at two different frequencies.

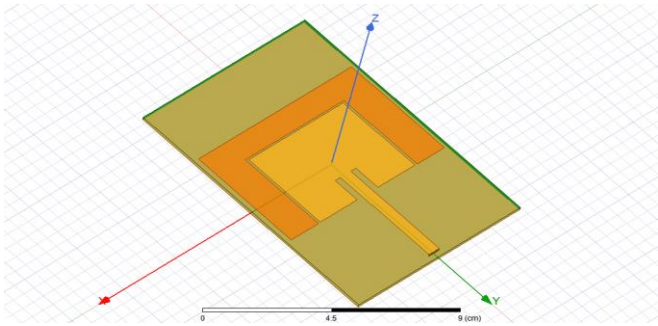

Fig.2. Microstrip Patch Antenna

IV. IMPLEMENTATION OF ANTENNA

For organizing downsized scale strip reconfigurable recieving wire, genuine substrate material ought to be picked. For this situation, RT/Duroid can be utilized as a substrate. RT/Duroid material gives the base standard to the PCB substrate, it passes on a productive upkeep of cost, assorted electrical properties, manufacturability, execution and strength. A substrate having a high dielectric unsurprising is to be picked with the target that radio wire estimations are decreased and transmitted power can be broadened [5] and it is appeared in figure 2.

For plan of reconfigurable radio wire, microstrip fix gathering gadgets are utilized. Microstrip gathering mechanical congregations are planar resonating pit that break from their edges and transmit EM waves. They contain transmitting patch on one side of a dielectric substrate having a ground plane on converse side. The essential fix recieving wire plan strategy is as appeared in figure 3.

Proposed radio wire structure is organized in HFSS programming mechanical get together.

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To make radiation a space or nature for the fix recieving wire is made by embeddings an air box around social affair gadget [6]. An air box must be embedded in to show open space in perspective on which the radiation from the structure isn't reflected back and completely ingested. From now on rectangular fix gathering mechanical get together arrangement is encased in an air holder so as to accomplish reconfiguration.

The preoccupation of downsized scale strip fix reconfigurable radio wire is utilizing PIN diode relying on the status of PIN diode for example on/off the full rehash is resonated. Rehashed postponed outcomes of rectangular fix recieving wire are gotten. The two noisy frequencies organized are 2.754 GHz when switch is ON and 2.4 GHz when switch is OFF.

The proposed radio wire arrangement is having full frequencies as 2.4 GHz and 2.754 GHz. The social event mechanical get together is mimicked utilizing HFSS programming instrument which is skilled one. The proposed radio wire is having lessened structure and outfits direct mix and creation with different areas of microwave correspondence [9]. Separating the cognizant outcomes and repeated outcomes gives generally incredible result. The plan and execution system stream graph of microstrip fix reception apparatus is given below.

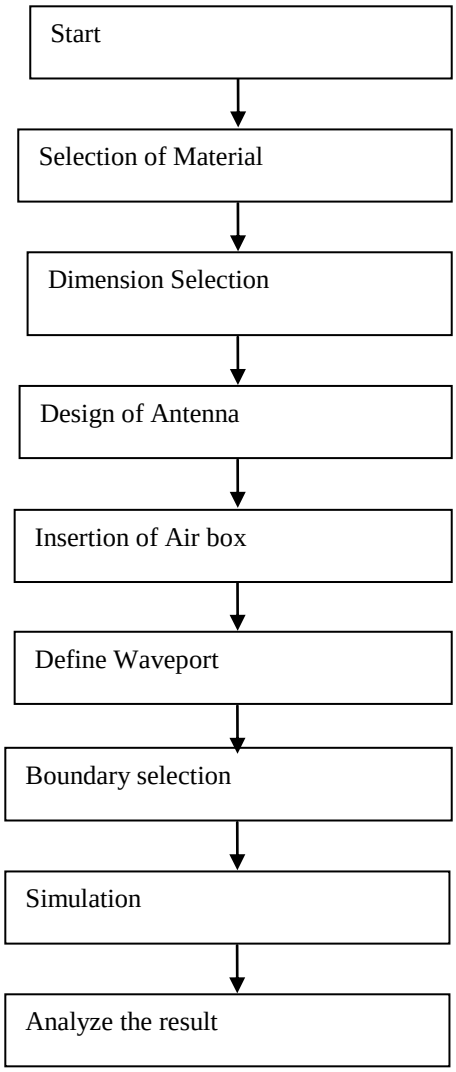

Fig.3. Implementation Procedure Flow Chart

V.RESULTS

The reproduction of microstrip fix reconfigurable recieving wire is finished utilizing HFSS programming utilizing PIN diode relying upon the status of PIN diode for example on/off the thunderous recurrence is reverberated. Following figures demonstrates the reproduced consequences of rectangular microstrip fix reception apparatus. The two thunderous frequencies structured are 2.4 GHz when switch is OFF and 2.754 GHz when switch is ON as appeared in figures underneath.

A .Simulation Results for Diode OFF condition

Figure 4 shows the variation of the Return loss with frequency for PIN diode switching phenomenon of OFF condition. Return loss is measured in terms of S_{11} in dB. At frequency f = 2.4 GHz return loss is measured as -20.4349 dB at switching condition (OFF). The return loss measured value is less better than the conventional antenna.

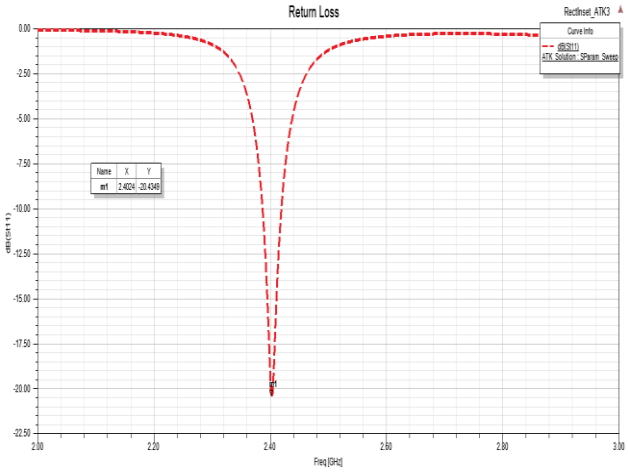

Fig.4. Simulated Result of Return loss

The Figure 5 shows the variation of VSWR with frequency. The value of VSWR has been obtained at f = 2.4 GHz VSWR is 1.6676 with switching condition (OFF).

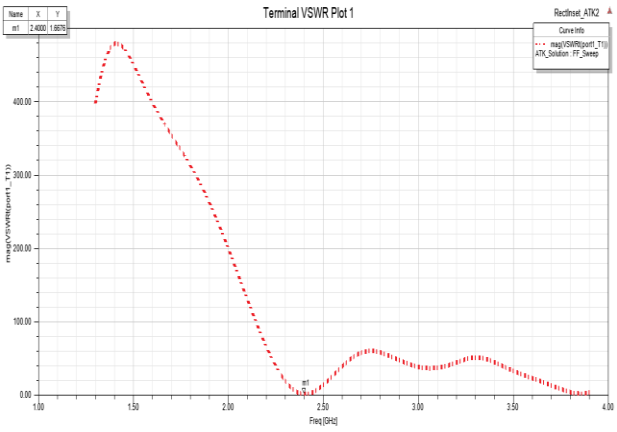

Fig. 5. Simulated Result of VSWR

Figure 6 shows the three dimensional radiation pattern of microstrip patch antenna at f = 2.4 GHz when the diode switching condition is OFF.

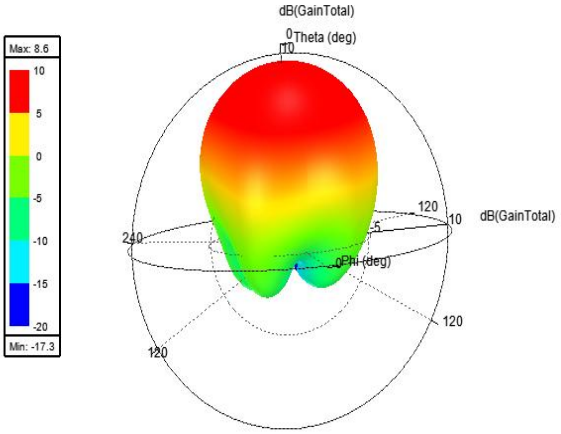

Fig. 6. Simulated Result of 3D Radiation Pattern

Figure 7 shows the two dimensional radiation pattern of microstrip patch antenna at f = 2.4 GHz when the diode switching condition is OFF and radiation efficiency obtained is 27.58 % from this simulation result.

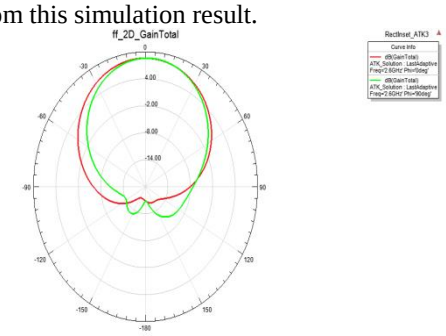

Fig..7. Simulated Result of 2D Radiation Pattern

Figure 8 shows the Gain vs. frequency graph. At frequency f = 2.4 GHz the gain measured is 8.6116 dB and half power beam width obtained is 60.9749 degree at switching condition (OFF)

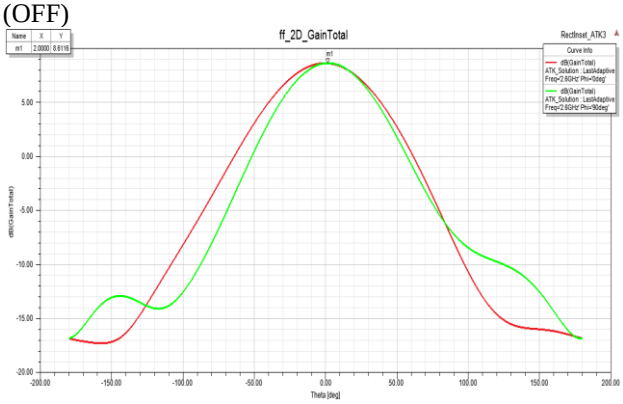

Fig.8. Simulated Result of Gain

Figure 9 shows the input impedance graph. At frequency f = 2.4 GHz the input impedance measured is 1.1818 – 0.0984i when the switching is in OFF condition.

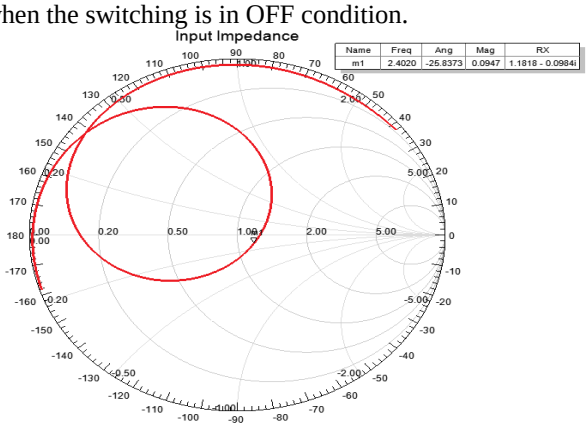

Fig. 9. Simulated Result of Input Impedance

B.Simulation Results for Diode ON condition

Figure 10 shows the variation of the Return loss with frequency for PIN diode switching phenomenon of ON condition. Return loss is measured in terms of S_{11} in dB. At frequency f = 2.754 GHz return loss is measured as -29.2612 dB at switching condition (ON). The return loss measured value is less better than when it is in OFF condition

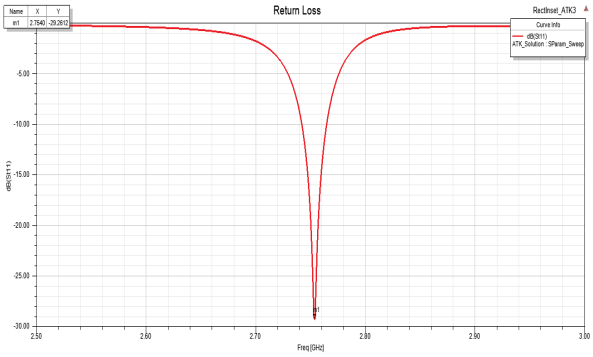

Fig 10. Simulated Result of Return loss

The Figure 11 shows the variation of VSWR with frequency. The value of VSWR has been obtained at f = 2.754 GHz VSWR is 1.1727 with switching condition (ON)

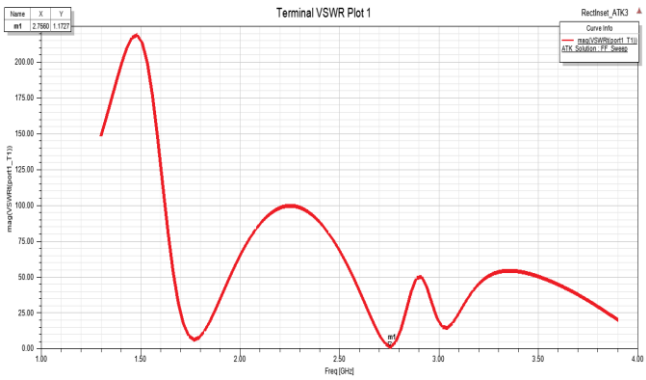

Fig 11. Simulated Result of VSWR

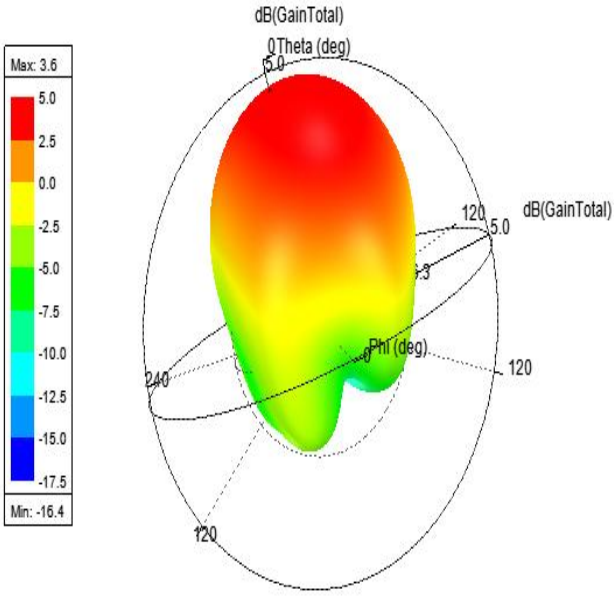

Fig 12. Simulated Result of 3D Radiation Pattern

Figure 12 shows the three dimensional radiation pattern of microstrip patch antenna at f = 2.754 GHz when the diode switching condition is ON.

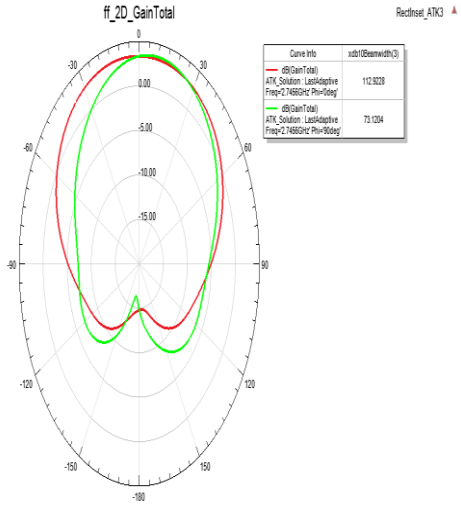

Fig 13. Simulated Result of 2D Radiation Pattern

Figure 13 shows the two dimensional radiation pattern of microstrip patch antenna at f = 2.754 GHz when the diode switching condition is ON and radiation efficiency obtained is 27.58 % from this simulation result.

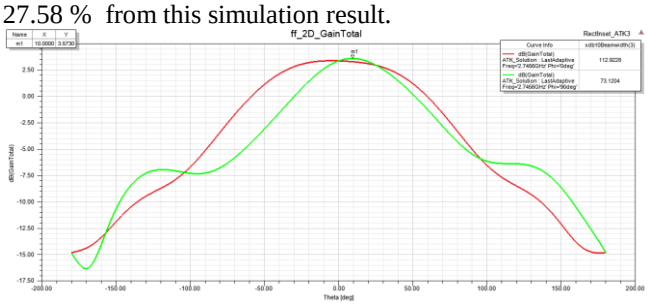

Fig.14. Simulated Result of Gain

Figure 14 shows the Gain vs. frequency graph. At frequency f = 2.754 GHz the maximum gain measured is 3.57 dB and half power beam width obtained is 72.3683 degree at switching condition (ON)

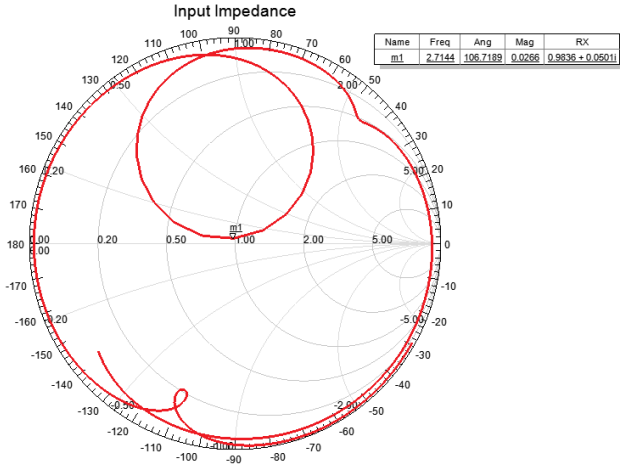

Fig.15. Simulated Result of Input Impedance

Figure 15 shows the input impedance graph. At frequency f = 2.754 GHz the input impedance measured is 0.9836 – 0.0501i when the switching is in ON condition.

Table 1 shows the summarized values of Return Loss, VSWR, Gain, Radiation efficiency, Half Power Beam Width, Input Impedance obtained at two different frequencies at two different switching conditions ON and OFF.

Table 1. Simulation Result Comparison

Simulation Output Parameters	Diode Switching Condition (OFF)	Diode Switching Condition (ON)
	f = 2.4 GHz	f = 2.754 GHz
Return loss	- 20.4349 dB	- 29.2612 dB
VSWR	1.6676	1.1727
Gain	8.6116 dB	3.57 dB
Radiation Efficiency	27.58 %	27.58 %
HPBW	60.9749º	72.3683º
Input Impedance	1.1818 – 0.0984i	0.9836 – 0.0501i

The output simulation parameters obtained are maximum when the PIN diode is in OFF condition compared to PIN diode is in ON condition.

VI. CONCLUSION

The proposed reception apparatus configuration is having thunderous frequencies as 2.4 GHz and 2.754 GHz. The radio wire is reenacted utilizing HFSS programming instrument which is proficient one. The proposed recieving wire is having reduced structure and furnishes simple reconciliation and manufacture with different segments of microwave correspondence. Contrasting and recreated results gives excellent execution.

To accomplish recurrence configurability PIN diode has been utilized which can deliver two diverse recurrence band ranges. This reception apparatus has moderately great Return misfortune, Gain, VSWR, Radiation effectiveness, HPBW and Input impedance and it is reduced in size.

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