

Design and Analysis of Multiband Microstrip Antenna for Wireless Applications

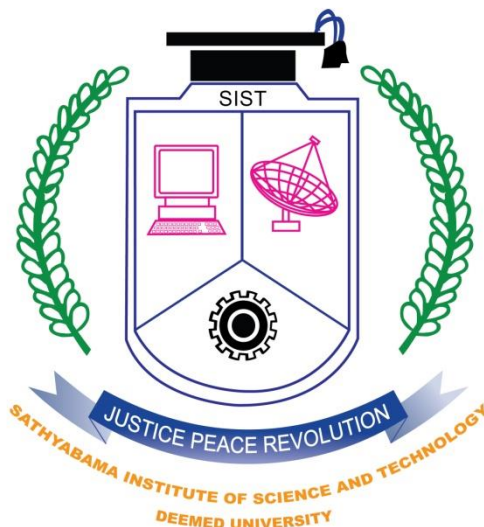
Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering Degree in

Electrical and Electronics Engineering

by

Pendem Srinivasa Jagan Mohan (Reg No. 37130308)



**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

April 2021



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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Pendem Srinivasa Jagan Mohan (Reg. No. 37130308)** who carried out the project entitled **"Design and Analysis of Multiband Microstrip Antenna"** under our supervision from December 2020 to April 2021.

Dr. I. Rexline Sheeba M.E., Ph.D
Internal Guide

Dr. T. Ravi M.E., Ph. D
Head of the Department

Submitted for Viva voce Examination held on _____

Name:

Signature:

Internal Examiner

External Examiner

DECLARATION

I **Pendem Srinivasa Jagan Mohan** (Reg no. 37130308) entitled **“DESIGN and Analysis of Multiband Microstrip Antenna”** done by me under the guidance of **Dr. I. Rexline Sheeba M.E., Ph.D** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

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ACKNOWLEDGEMENT

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Theoretical

A multiband microstrip fixed receiving wire is planned and taken care of by microstrip line, which comprises three transmitting components working in 7.5GHz. This radio wire is carried out on FR4-Epoxy dielectric substrate, arlon Teflon, Rogers. Its reduced size is with activity in the remote neighborhoods and overall interoperability for microwave access correspondence. The proposed receiving wire boundaries like return misfortune, gain, and radiation design in 2D and 3D measurement, current thickness is recreated utilizing Sonnet 13.0. It utilizes the Method of Moment (MOM), splendid illustrations to give you unmatched execution and knowledge to the entirety of your 3D EM issues.

CONTENTS

NO.	TITLE	PAGENO.
	THEORETICAL	5
	FIGURES	8
	TABLES	9
	ABBREVIATIONS	10
1	INTRODUCTION	
	1.1 MICROSTRIP ANTENNA	11
	1.2 AIM	11
	1.3 MOTIVE	12
	1.4 SCOPE	12
	1.5 LITERATURE SURVEY	12
	1.6 ADVANTAGES	15
2	Microstrip antenna	
	2.1 BLOCK DIAGRAM	16
	2.2 MICROSTRIP ANTENNA	17
	2.3 DIRECTIVITY	18

2.4	RETURN LOSS	18
3	DESIGN METHODS	
3.1	FLOW CHART	20
4.	PROPOSED SYSTEM	
4.1	CREATING SUBSTRATE	22
4.2	GROUND	24
4.3	PATCH	24
4.4	FEED LINE	25
4.5	PORT	25
4.6	BOUNDARY	26
4.7	SIMULATION RESULT ANALYSIS	28
5.	Conclusion	33

FIGURES

FIGURE No.	TITLE	PAGE No.
2.1	Block Diagram	16
2.2	Microstrip patch antenna	17
3.1	Flow chart	20
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SYMBOLS

Σ	-	Efficiency
ϕ	-	azimuth
θ	-	altitude
Δl	-	length Extension
GHz	-	Gigahertz
Σr	-	Relative Permittivity
h	-	Thickness
L_{eff}	-	Effective Length
c	-	Speed of Light
f_0	-	Resonant Frequency
w	-	Width
dB	-	Decibel

Abbreviation

HFSS	-	High-frequency structure simulator
ISSN	-	International Standard Serial Number
WLAN	-	Wireless Local Area Network
PCB	-	Printed Circuit Board
IOT	-	Internet of things
ADAS	-	Advanced driver assistance system

INTRODUCTION

1.1 Microstrip Antenna

The microstrip receiving wire has various valuable properties like little size, minimal effort manufacture, low profile, lightweight, simplicity of establishment, and combination with feed organizations. There are various states of radio wire contingent upon its application. By and large, the microstrip radio wire has numerous remarkable and alluring properties. low profile, lightweight, being conservative and similar to a mounting structure, simple manufacture and mix with strong state gadgets. There are various and notable strategies to build the data transmission of receiving wires, including increment. In this manner, the interest in multiband receiving wire is expanding, particularly to lessen the number of radio wires installed in joining numerous applications on a solitary receiving wire.

1.2 AIM OF THE PROJECT

To accomplish small-scale radio wire with preferred execution over customary one. To utilize the hexagonal with a rectangular formed fix. To examine the proposed plan as far as return misfortune and Gain. To recreate the plan in HFSS programming.

1.3 MOTIVE

A miniature strip line-taken care of receiving wire with two quarter frequency openings of various lengths which emanate at 2.5 GHz and 5.6 GHz, is utilized as a radio wire component.

1.4 SCOPE

To accomplish small receiving wire with preferable execution over conventional one. To utilize the hexagonal with a rectangular molded fix. To dissect the proposed plan as far as return misfortune and Gain

1.5 LITERATURE SURVEY

Uma Shankar Modani¹ (2017)

“Multi-Frequency Microstrip Patch Antenna Designing Techniques”

Proposing reduced radio wires that incorporate diverse remote norms is an indispensable subject of exploration. Taking a gander at the work done in recent years, the call for multi-recurrence receiving wires have expanded colossally. In this audit paper, different plan procedures for demonstrating a multi-band radio wire are talked about and looked at. Radio wire boundaries like impedance transmission capacity, acquire, radiation design, and so forth are likewise talked about.

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Satish Shelke (2018)

"Microstrip fix radio wire for WIMAX and WLAN application"

Microstrip Antenna has numerous benefits and can undoubtedly introduced in framework. Double band or Multiband radio wire has the primary part for Wireless correspondence framework. Both are practical, solid, adaptable and rapid information network. This paper presents a writing study on various sorts of emanating patches, taking care of procedures and substrates. Additionally, we talk about the boundaries of recieving wire, diverse feed methods, fundamentals of microstrip radio wire and benefits and hindrances of transmitting patch radio wire.

Amit Singh1 (2016)

"Opened Microstrip Antennas"

A minimal rectangular low profile opened microstrip receiving wire with various shape designs like S, U, Double U, and E-shape cut out of a rectangular Microstrip radio wire by bringing space into them. Space inclusion improves the transfer speed of these reduced radio wires upgrading their value in wideband applications. This paper additionally examines the innovation consolidated to achieve the necessary change as far as improved execution. The exhibitions of the radio wire are shown alongside estimated and mimicked results.

Puneet Khanna (2015)

“Deserted Wideband and Multiband Microstrip Patch Antennas”

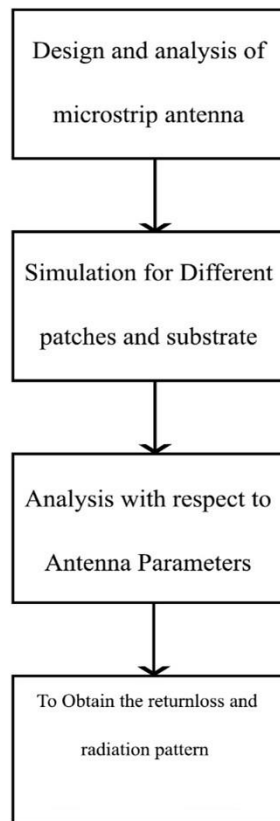
As of late, the remote specialized gadget builds the interest of minimized wideband and multiband microstrip fix receiving wire. A little radio wire size is needed for convenient correspondence frameworks. Microstrip fix receiving wire is utilized, in light of its low volume and slight profile qualities. Various strategies or procedures are utilized by the specialists for accomplishing wideband, for example, changing the actual elements of the receiving wire, changing the states of ground plane, CPW took care of method which is talked about further in this paper. At last the paper is finished up with comments and future extent of work. A comprehensive writing study of the different techniques utilized for planning wideband and multiband microstrip receiving wire is attempted. Instances of strategies utilized for accomplishing higher data transmission are analyzed alongside the normal radio wire designs.

1.6 ADVANTAGES

More modest size for compact correspondence equipment's. Works for higher frequencies like 2.4ghz or high.

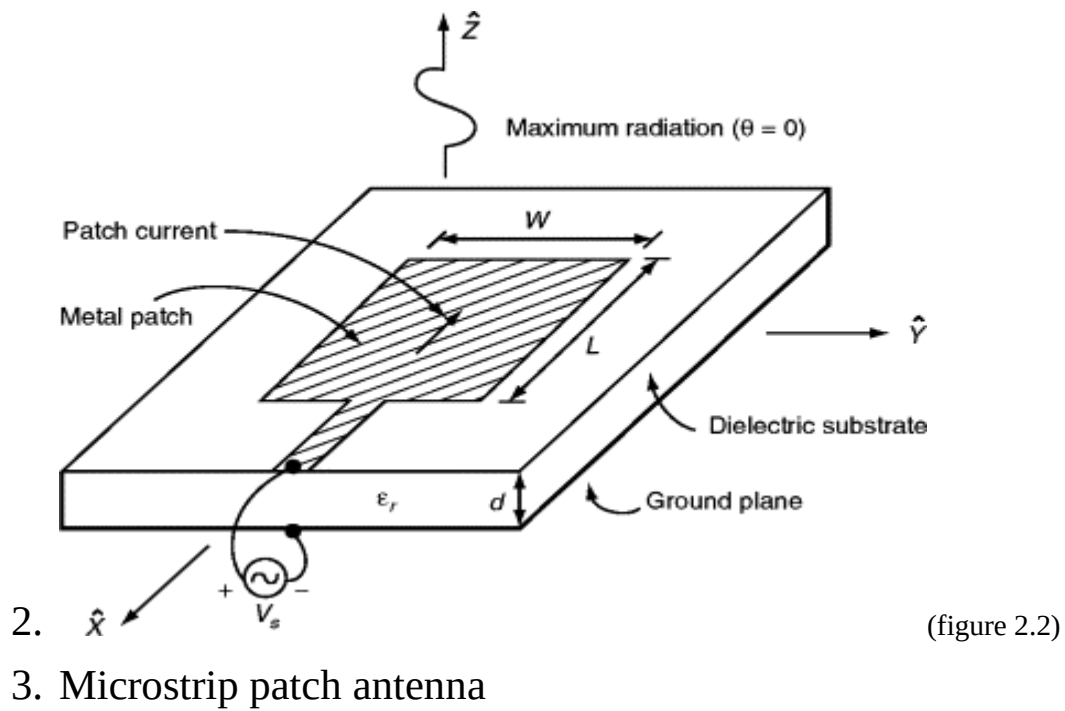
1. Microstrip Antenna

2.1 Block diagram



(Figure 2.1)

2.2 MICROSTRIP PATCH ANTENNA



2.4 DIRECTIVITY

A receiving wire's directivity is controlled by its radiation design, how the emanated power is disseminated with heading in three measurements. All radio wires are directional to a more noteworthy or lesser degree, implying that they emanate more force in certain ways than others. The heading is indicated herein circular directions, (θ, ϕ) where θ is the elevation or point over a predefined reference plane (like the ground), while ϕ is the azimuth as the point between the projection of the provided guidance onto the reference plane and a predetermined reference course (like north or east) in that plane with determined sign (either clockwise or counterclockwise).

The dispersion of yield power as an element of the potential headings, (θ, ϕ) is given by its radiation force $U(\theta, \phi)$ (in SI units: watts per steradian, $W \cdot sr^{-1}$). The yield power is gotten from the radiation force by coordinating the last overall strong points $d\omega = \cos\theta \, d\theta \, d\phi$

2.5 RETURN LOSS

Return misfortune is a significant boundary when testing a receiving wire. It is identified with impedance coordinating and the most extreme exchange of force hypothesis. It is additionally a proportion of the adequacy of a radio wire to convey force from source to receiving wire. The return misfortune (RL) is characterized by the proportion of the

episode influence of the radio wire (P_{in}) to the influence reflected back from the receiving wire of the source (P_{ref}) the numerical articulation is

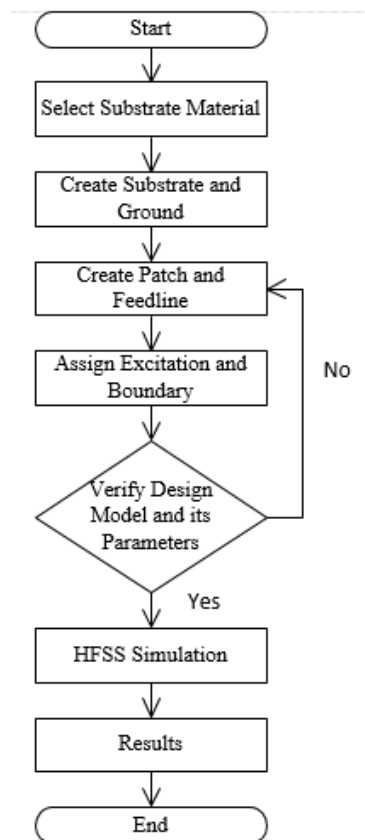
$$R = 10\log_{10}(P_{in}/P_{ref})$$

3.DESIGN METHODS

After the conversation of the improvement on detailing in past areas, the methodology for planning a rectangular microstrip fix receiving wire is clarified. In this system, there are three fundamental boundaries for the plan: the recurrence of activity f , the dielectric steady of the substrate Σ_r and the stature of the dielectric substrate h

For a given Σ_r and h , we plan a microstrip radio wire for the resounding recurrence f_r (discovering the width and length of the fix).

3.1 Flow Chart



(figure 3.1)

Start the process by selecting the substrate material. After selecting a substrate create the substrate and ground. Create the patch and feedline. After creating the patch and feedline assign excitation and boundary. Verify the design model and its parameters. After this simulate and get the results.

4. PROPOSED SYSTEM

The receiving wires far-field, s-boundary. In this plan, wideband recurrence is set in a reconfigurable receiving wire that has three switchable states including and a super wideband and other recurrence band state. In a one triple-band state is introduced which incorporates any remaining frequencies utilized in wearable receiving wires. The single triple-band state receiving wire works over an impedance transfer speed of 3.5 to 4GHz. It is fit for working in 4 recurrence groups and for 3 applications as worked in by one radio wire. The scaling down is done in different altered U-formed radiators with extra I-molded and L-molded strips planned hopefully to accomplish the insignificant return misfortune over the four groups of recurrence range.

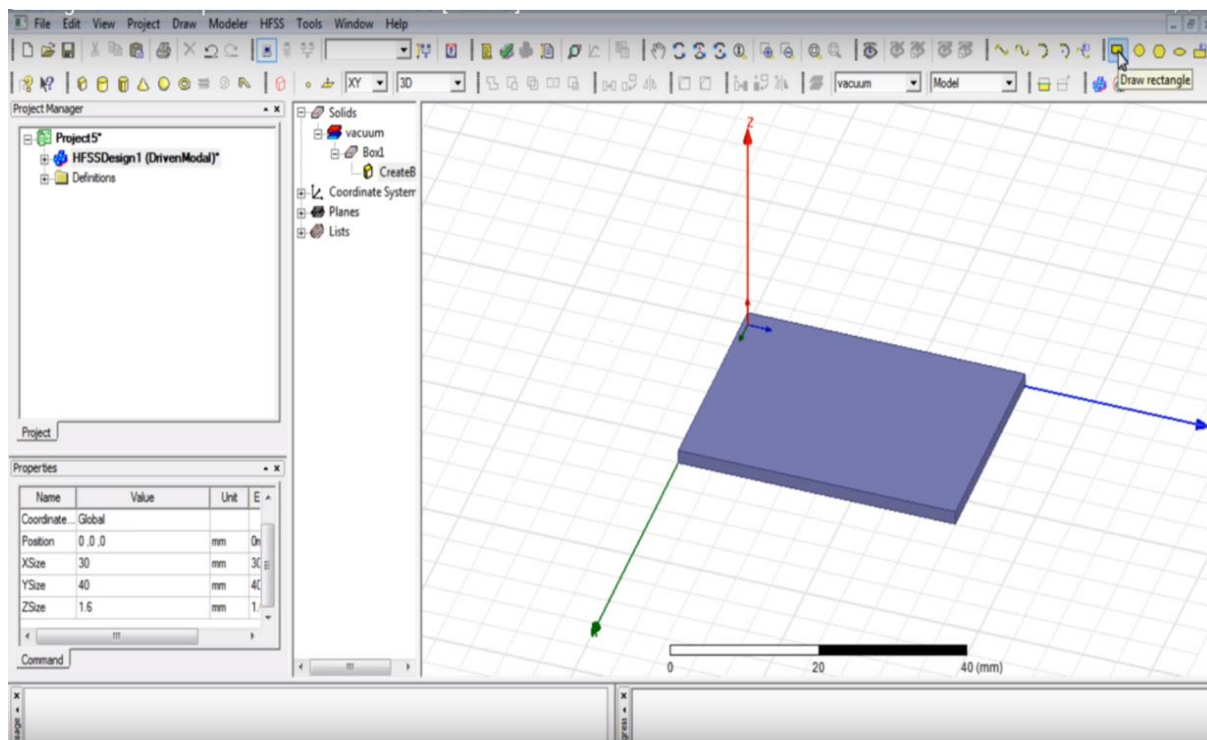
4.1 CREATING SUBSTRATE

The substrate is a base or holder on which microstrip fix (metallic sheet) radio wire is created and it assumes a significant part in microstrip receiving wire working. The substrate in microstrip receiving wires is basically required for the mechanical help of the radio wire. To offer this help, the substrate should comprise a dielectric material, which may influence the electrical exhibition of the radio wire, circuits, and transmission line. A substrate must, in this way, all the while fulfill the electrical and mechanical necessities, which is some of the time hard to meet.

Substrate (dielectrics) are utilized for improved electrical and mechanical steadiness. They are utilized to lessen the size of the radio wire (higher permittivity, lower size) and can assist with creating removal current which produces time differing Magnetic Field (by Ampere's Law). This can thus deliver a time-shifting Electric Field (by Faraday's law) and a spreading EM field is made. Consequently, a substrate can upgrade receiving wire's radiation ability.

To plan a microstrip fix receiving a wire from the outset the fashioner is to choose the substrate material and its thickness. Along these lines, if the originator has an unmistakable origination about the impact of changing substrate material and its thickness on the exhibition of the receiving wire, it will be simpler to plan a radio wire. Proper determination of dielectric material and its thickness is a significant errand for planning a microstrip fix receiving wire.

Substrates used are Arlon 25FR, Rogers RO3003, FR4_epoxy, Teflon.



(Figure 4.1)

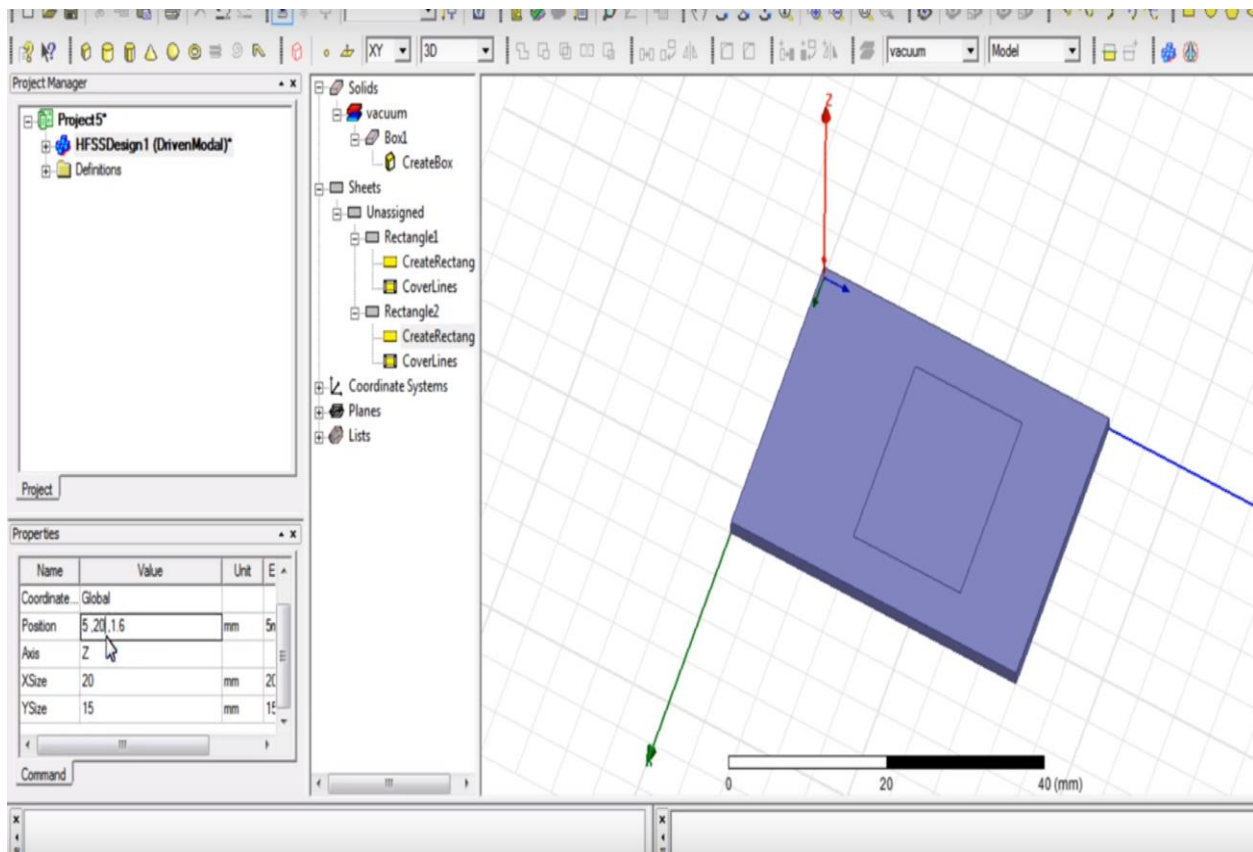
4.2 GROUND

A ground plane is an electrically conductive surface, normally associated with an electrical ground.

4.3 PATCH

The patch used is hexagon with rectangle.

band activities. Position:3.5,5,1.6 Axis: z X size :9 Y size: 12

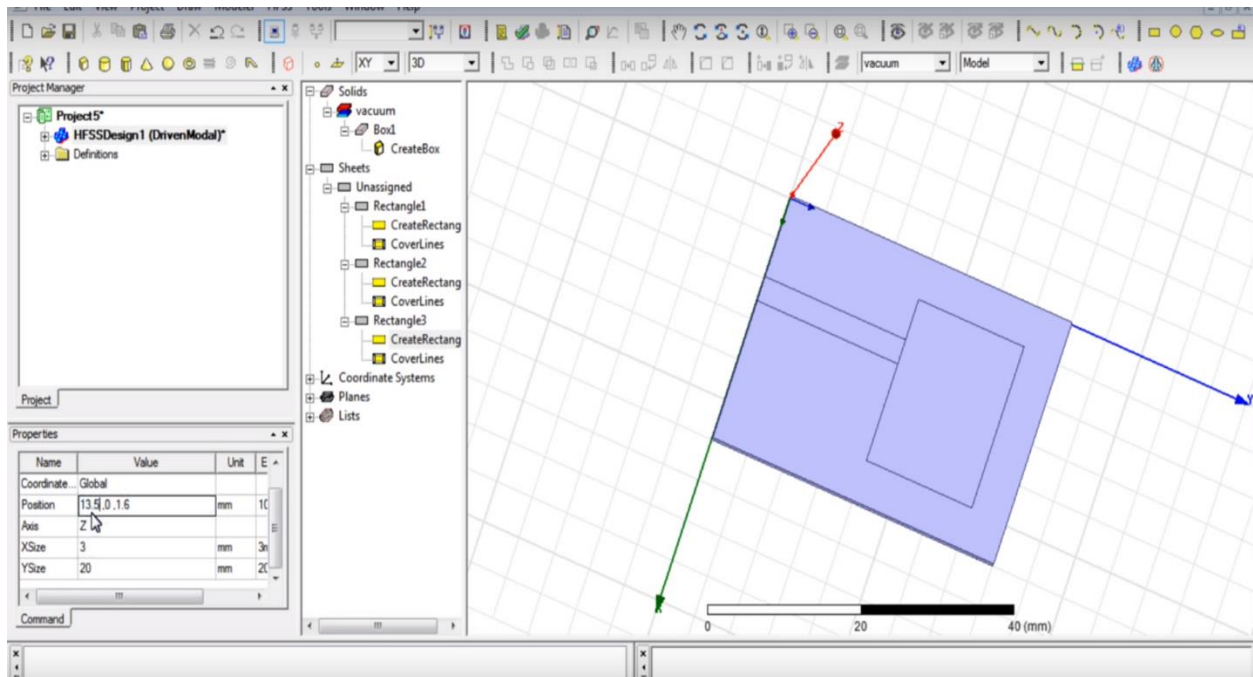


(figure 4.3)

4.4 FEED LINE

A radio receiving wire, the feed line (feedline), or feeder, is the link or other transmission line that associates the receiving wire with the radio transmitter or recipient.

Position: 7,0,1.6 Axis: z Xsize: 2 Y size: 5



(figure 4.4)

4.5 PORT

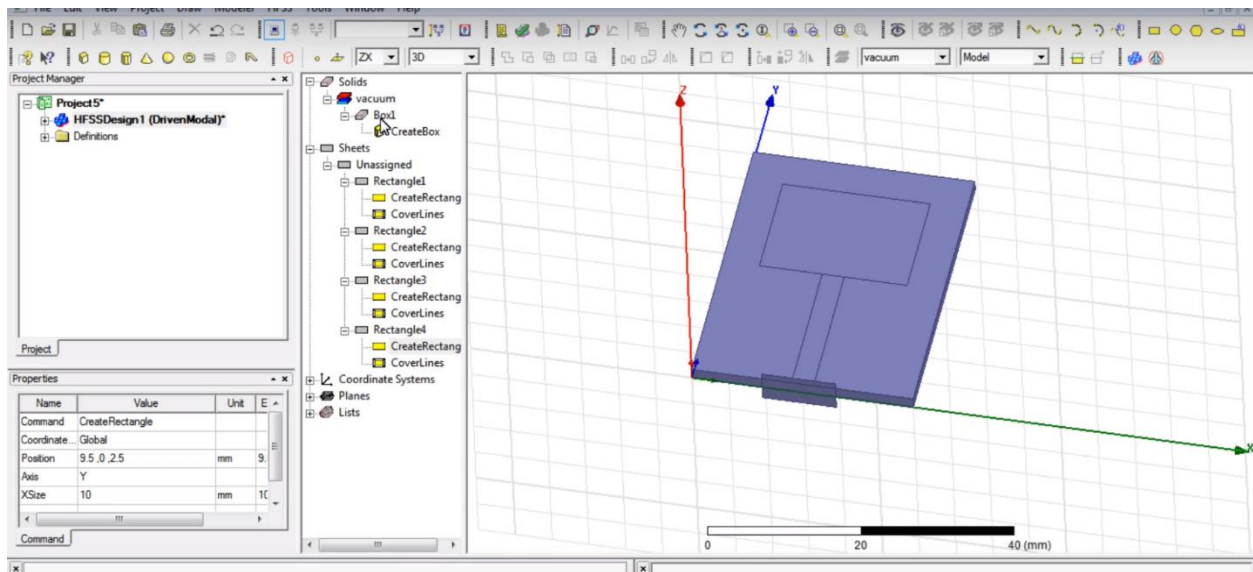
A radio wire port is by and large utilized as a nonexclusive term for signal transmission under indistinguishable channel conditions. For each LTE working mode in the downlink bearing for which a free channel is accepted (for example SISO versus MIMO), a different sensible receiving wire port is characterized

Position: 7,0,1.6

Axis: y

X size: 2

Z size:- 1.6



(figure 4.5)

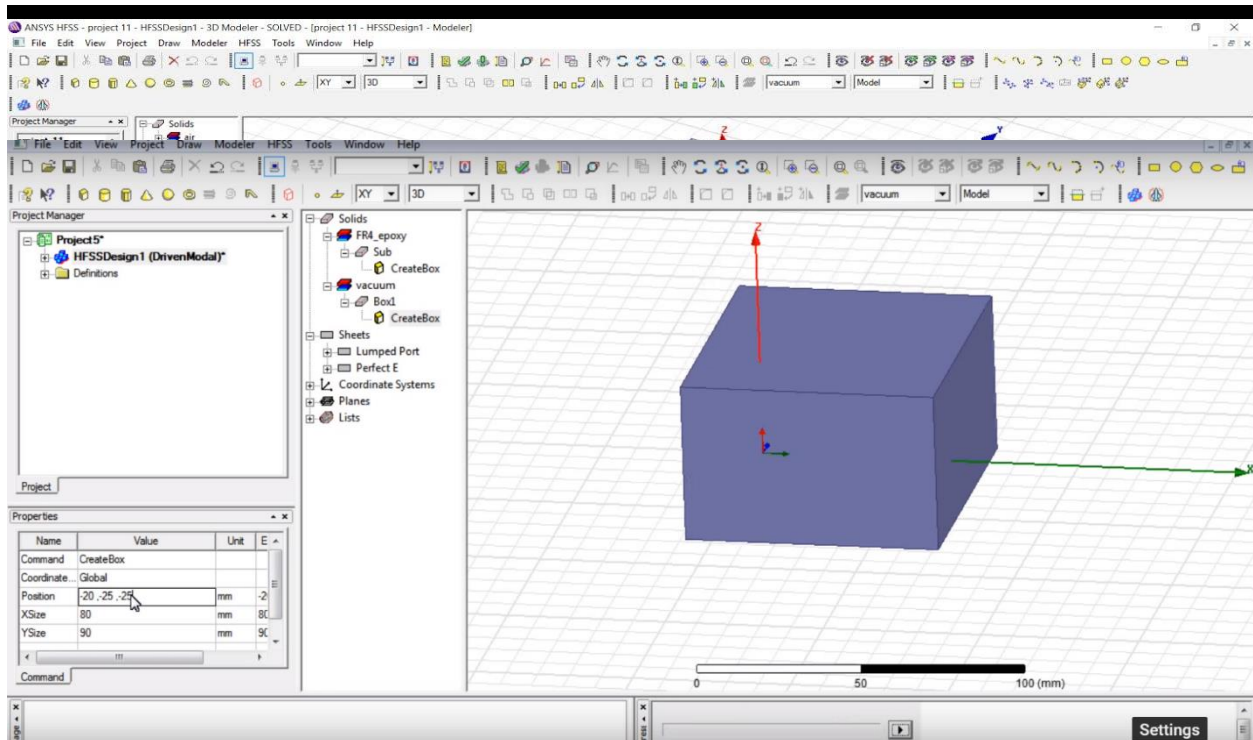
4.6 BOUNDARY

Position: -3.4,-3.4,-3.4

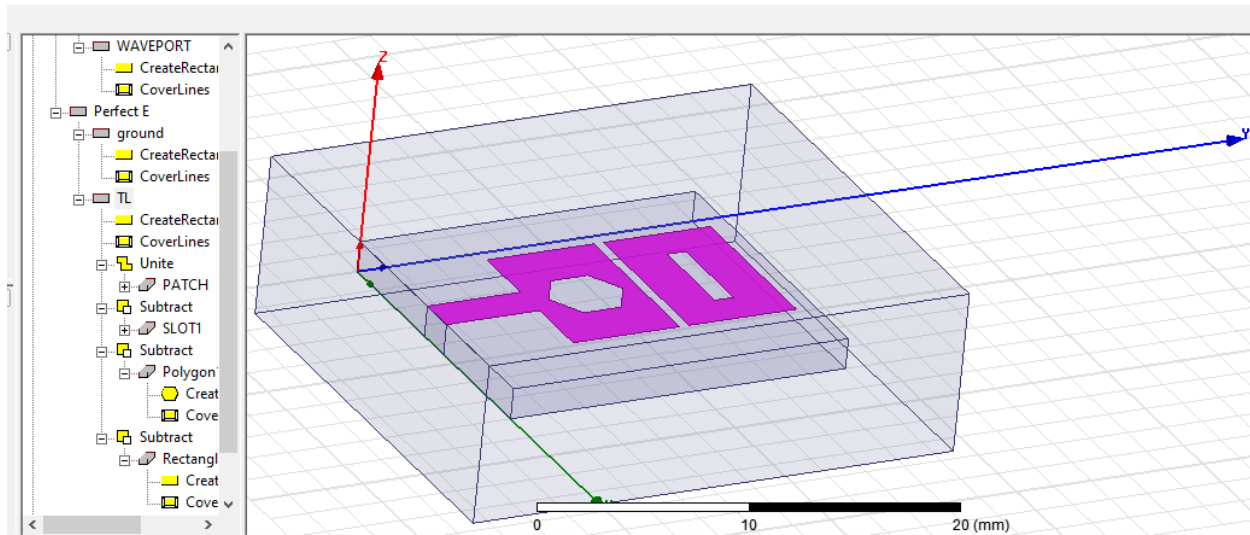
X size: 22.8

Y size: 25.8

Z size: 8.4



(figure 4.6)



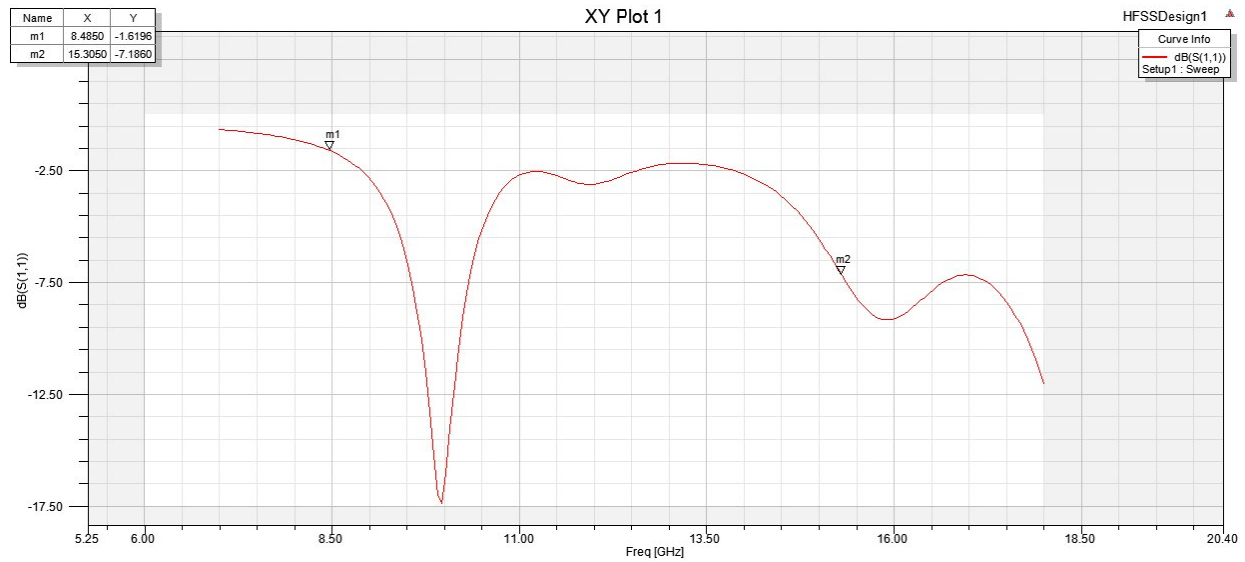
MICROSTRIP PATCH ANTENNA

4.7 Simulation Result Analysis

Simulation result analysis with different substrates is

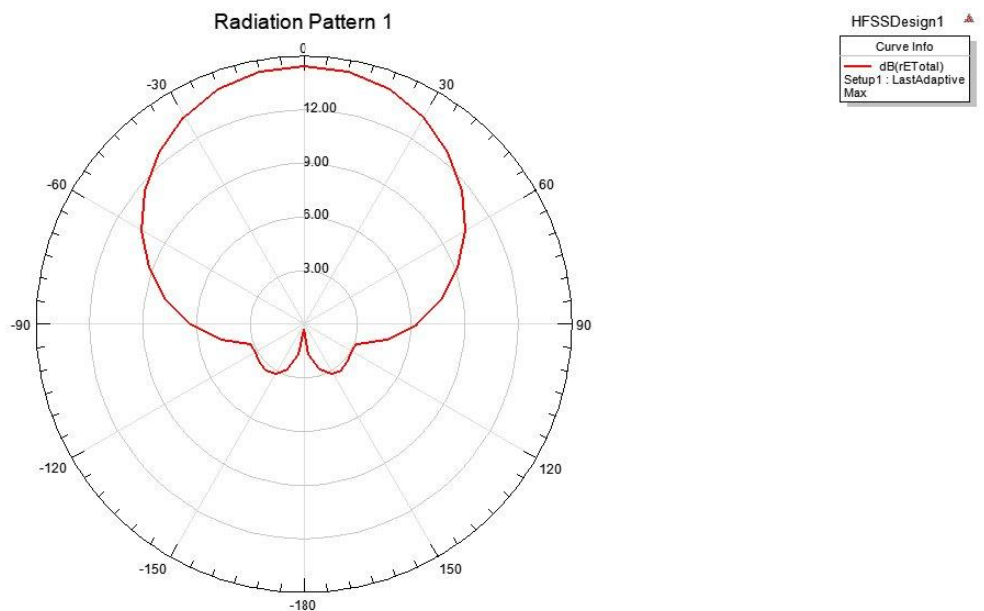
Rogers R03003

S11 parameter proposed at 7.5 GHZ



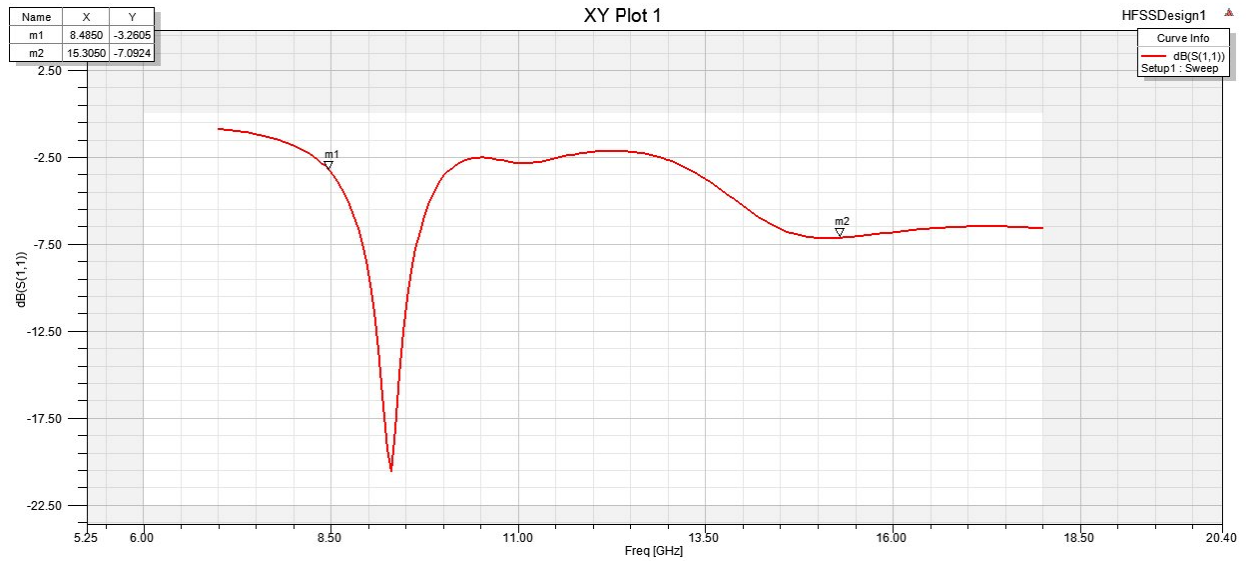
(Figure 4.7)

Radiation pattern at 7.5GHz

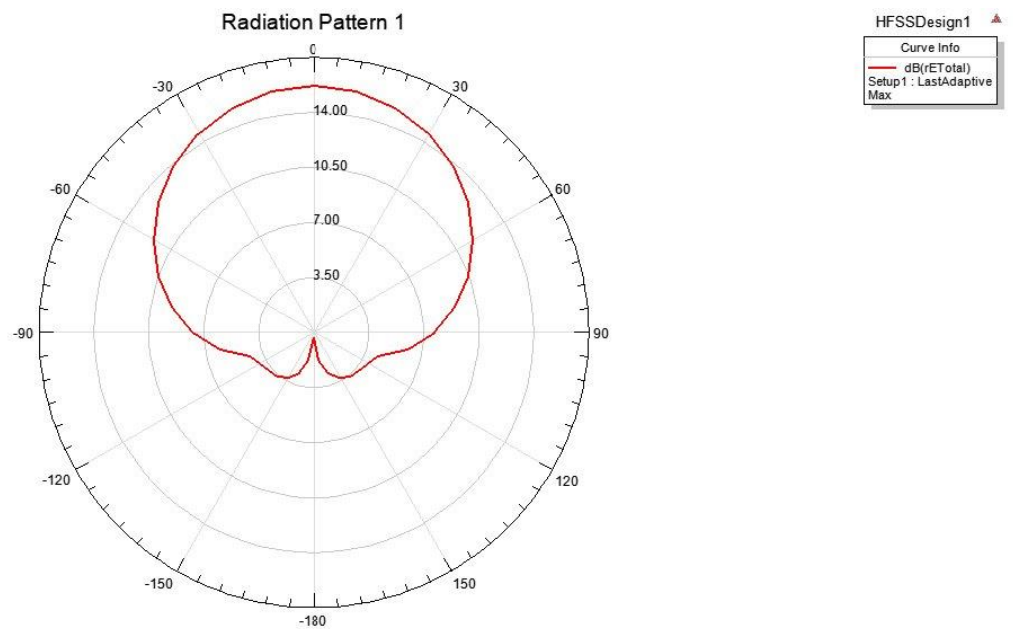


Arlon 25FR

S11 parameter at 7.5GHz

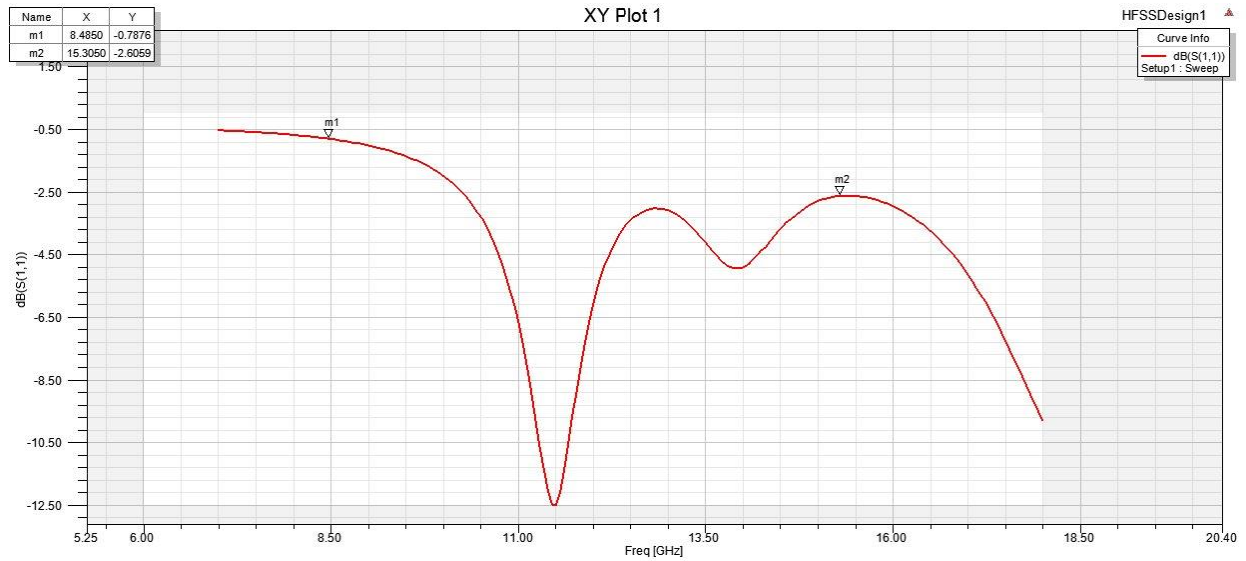


Radiation Pattern at 7.5GHz

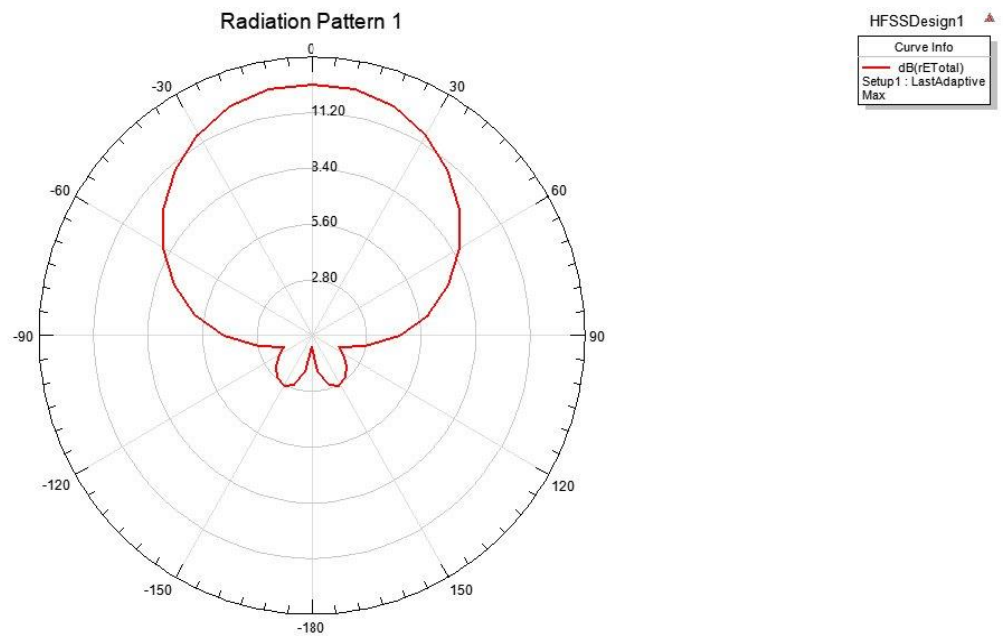


Teflon

S11 parameter proposed at 7.5GHz

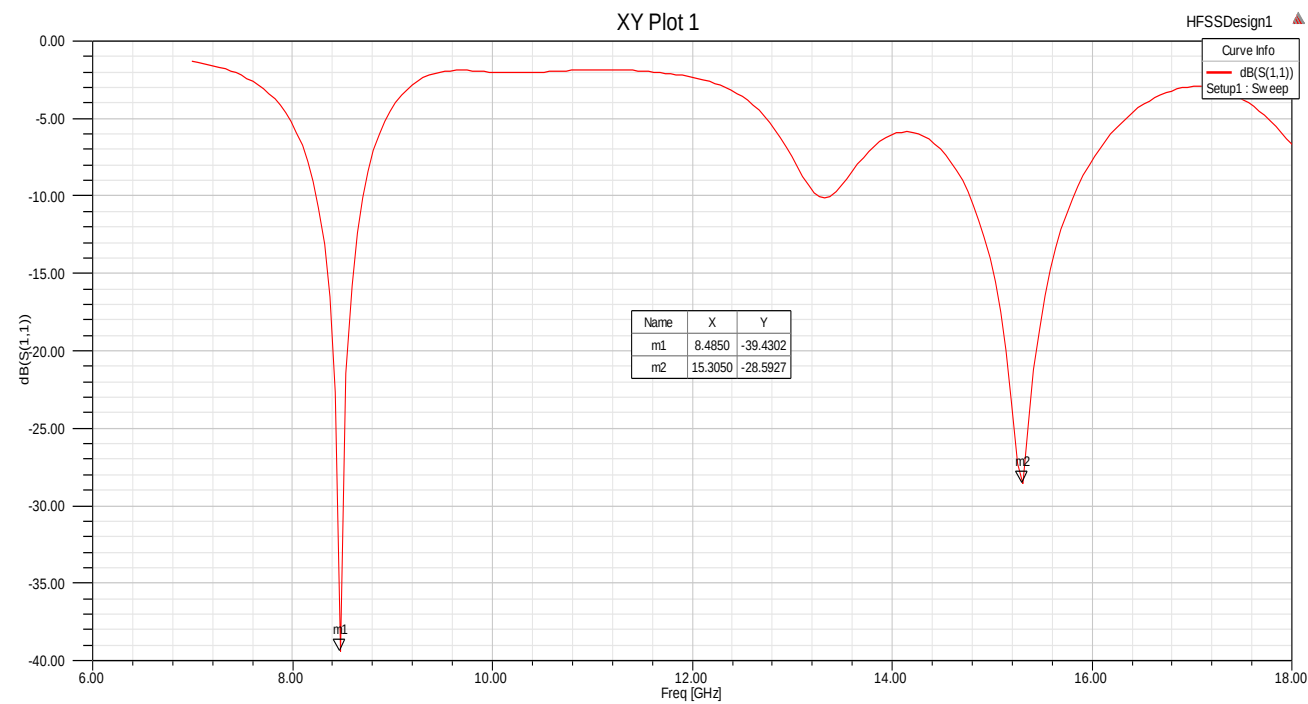


Radiation Pattern at 7.5GHz

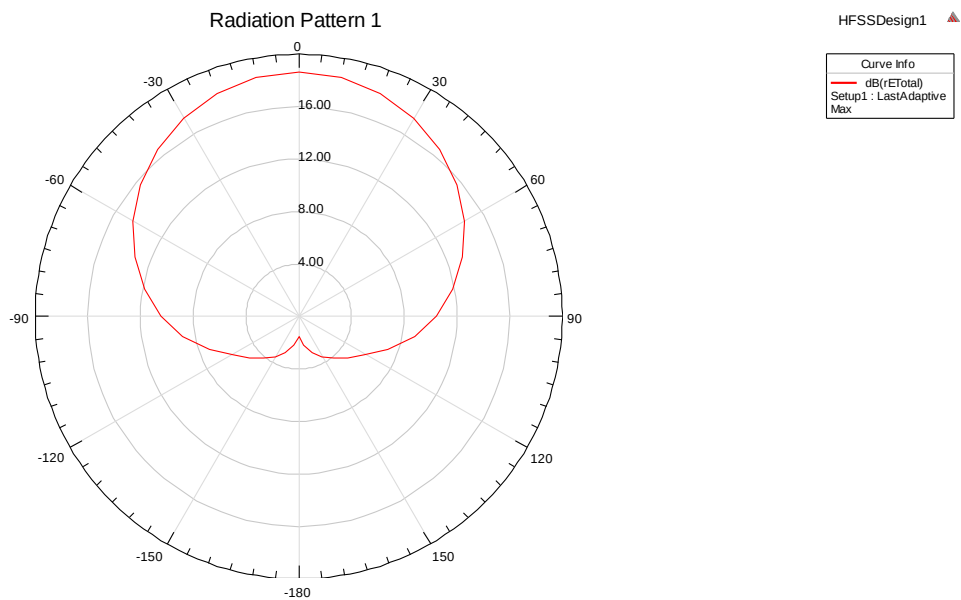


FR4_Epoxy

S11 parameter Proposed at 7.5GHz



RADIATION PATTERN OF 7.5 GHZ



The results are done at frequency range of 7.5 GHz. for Rogers R03003 substrate material have -17 dB, for Arlon 25FR substrate material have -21db, for Teflon substrate material have -12 dB, for FR4_Epoxy substrate material have -38 dB .

5. Conclusion

Thus, a microstrip patch antenna has been simulated on HFSS simulation software A Multiband Microstrip Antenna which is suitable for wireless application designed and analyzed for different substrates like Rogers, FR4_Epoxy, Teflon, Arlon. In our project we got a different return loss. but we obtain a good return loss in FR4_Epoxy substrate material with -38 db.

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antena5

by Qqq Qqq

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Satish Shelke (2018)

"Microstrip fix radio wire for WIMAX and WLAN application"

Microstrip Antenna has numerous benefits and can undoubtedly introduced in framework. Double band or Multiband radio wire has the primary part for Wireless correspondence framework. Both are practical, solid, adaptable and rapid information network. This paper presents a writing study on various sorts of emanating patches, taking care of procedures and substrates. Additionally, we talk about the boundaries of receiving wire, diverse feed methods, fundamentals of microstrip radio wire and benefits and hindrances of transmitting patch radio wire.

Amit Singh1 (2016)

"Opened Microstrip Antennas"

A minimal rectangular low profile opened microstrip receiving wire with various shape designs like S, U, Double U, and E-shape cut out of a rectangular Microstrip radio wire by bringing space into them. Space inclusion improves the transfer speed of these reduced radio wires upgrading their value in wideband applications. This paper additionally examines the innovation consolidated to achieve the necessary change as far as improved execution. The exhibitions of the radio wire are shown alongside estimated and mimicked results.

Puneet Khanna (2015)

“Deserted Wideband and Multiband Microstrip Patch Antennas”

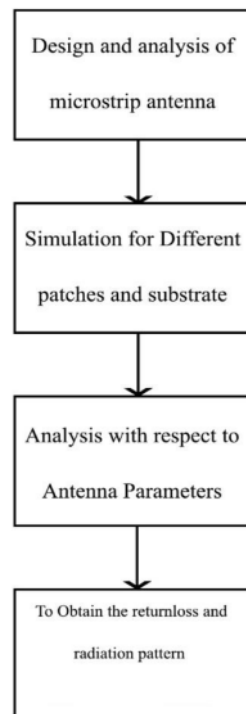
As of late, the remote specialized gadget builds the interest of minimized wideband and multiband microstrip fix receiving wire. A little radio wire size is needed for convenient correspondence frameworks. Microstrip fix receiving wire is utilized, in light of its low volume and slight profile qualities. Various strategies or procedures are utilized by the specialists for accomplishing wideband, for example, changing the actual elements of the receiving wire, changing the states of ground plane, CPW took care of method which is talked about further in this paper. At last the paper is finished up with comments and future extent of work. A comprehensive writing study of the different techniques utilized for planning wideband and multiband microstrip receiving wire is attempted. Instances of strategies utilized for accomplishing higher data transmission are analyzed alongside the normal radio wire designs.

1.6 ADVANTAGES

More modest size for compact correspondence equipment's. Works for higher frequencies like 2.4ghz or high.

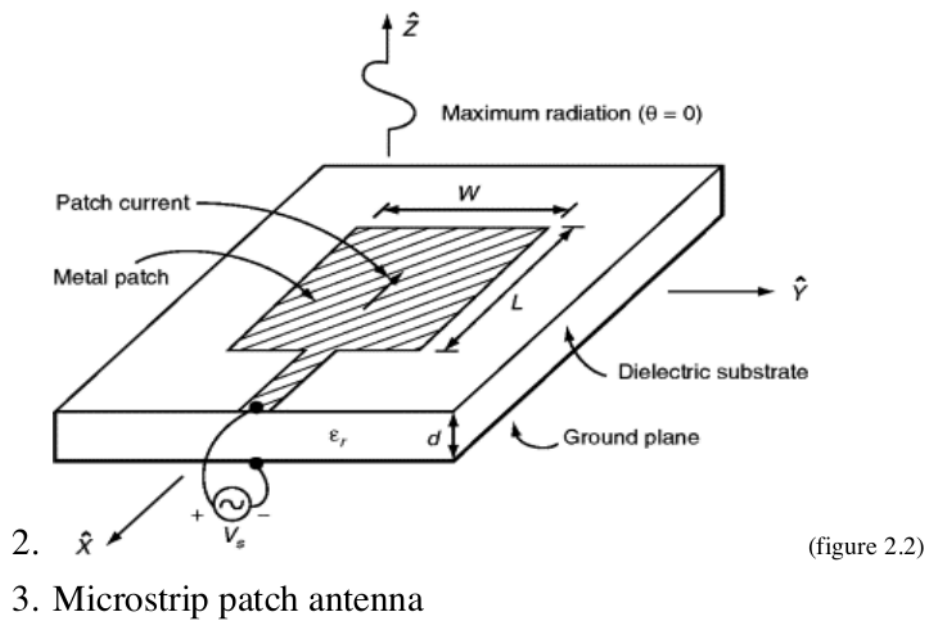
1. Microstrip Antenna

2.1 Block diagram



(Figure 2.1)

2.2 MICROSTRIP PATCH ANTENNA



2.4 DIRECTIVITY

A receiving wire's directivity is controlled by its radiation design, how the emanated power is disseminated with heading in three measurements. All radio wires are directional to a more noteworthy or lesser degree, implying that they emanate more force in certain ways than others. The heading is indicated herein circular directions, (θ, ϕ) where θ is the elevation or point over a predefined reference plane (like the ground), while ϕ is the azimuth as the point between the projection of the provided guidance onto the reference plane and a predetermined reference course (like north or east) in that plane with determined sign (either clockwise or counterclockwise).

The dispersion of yield power as an element of the potential headings, (θ, ϕ) is given by its radiation force $U(\theta, \phi)$ (in SI units: watts per steradian, $\text{W}\cdot\text{sr}^{-1}$). The yield power is gotten from the radiation force by coordinating the last overall strong points $d\omega = \cos\theta \, d\theta \, d\phi$

2.5 RETURN LOSS

Return misfortune is a significant boundary when testing a receiving wire. It is identified with impedance coordinating and the most extreme exchange of force hypothesis. It is additionally a proportion of the adequacy of a radio wire to convey force from source to receiving wire. The return misfortune (RL) is characterized by the proportion of the

episode influence of the radio wire (P_{in}) to the influence reflected back from the receiving wire of the source (P_{ref}) the numerical articulation is

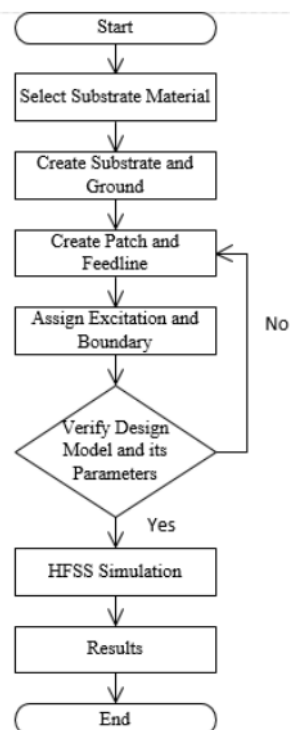
$$R = 10\log_{10}(P_{in}/P_{ref})$$

3.DESIGN METHODS

After the conversation of the improvement on detailing in past areas, the methodology for planning a rectangular microstrip fix receiving wire is clarified. In this system, there are three fundamental boundaries for the plan: the recurrence of activity f , the dielectric steady of the substrate Σ_r and the stature of the dielectric substrate h

For a given Σ_r and h , we plan a microstrip radio wire for the resounding recurrence f_r (discovering the width and length of the fix).

3.1 Flow Chart



(figure 3.1)

Start the process by selecting the substrate material. After selecting a substrate create the substrate and ground. Create the patch and feedline. After creating the patch and feedline assign excitation and boundary. Verify the design model and its parameters. After this simulate and get the results.

4. PROPOSED SYSTEM

The receiving wires far-field, s-boundary. In this plan, wideband recurrence is set in a reconfigurable receiving wire that has three switchable states including and a super wideband and other recurrence band state. In a one triple-band state is introduced which incorporates any remaining frequencies utilized in wearable receiving wires. The single triple-band state receiving wire works over an impedance transfer speed of 3.5 to 4GHz. It is fit for working in 4 recurrence groups and for 3 applications as worked in by one radio wire. The scaling down is done in different altered U-formed radiators with extra I-molded and L-molded strips planned hopefully to accomplish the insignificant return misfortune over the four groups of recurrence range.

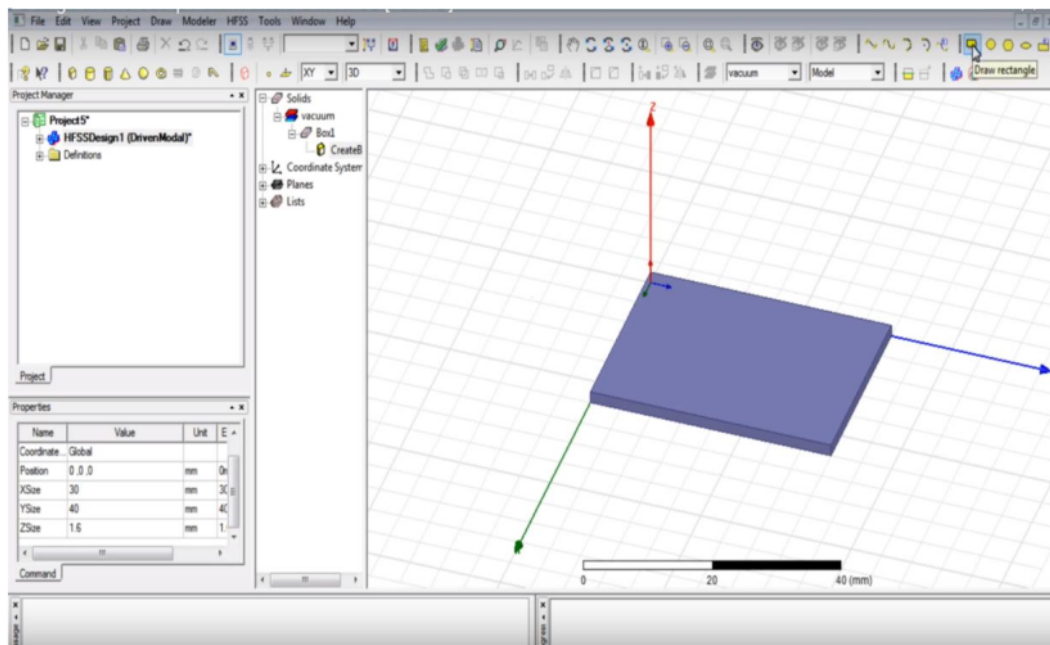
4.1 CREATING SUBSTRATE

The substrate is a base or holder on which microstrip fix (metallic sheet) radio wire is created and it assumes a significant part in microstrip receiving wire working. The substrate in microstrip receiving wires is basically required for the mechanical help of the radio wire. To offer this help, the substrate should comprise a dielectric material, which may influence the electrical exhibition of the radio wire, circuits, and transmission line. A substrate must, in this way, all the while fulfill the electrical and mechanical necessities, which is some of the time hard to meet.

Substrate (dielectrics) are utilized for improved electrical and mechanical steadiness. They are utilized to lessen the size of the radio wire (higher permittivity, lower size) and can assist with creating removal current which produces time differing Magnetic Field (by Ampere's Law). This can thus deliver a time-shifting Electric Field (by Faraday's law) and a spreading EM field is made. Consequently, a substrate can upgrade receiving wire's radiation ability.

To plan a microstrip fix receiving a wire from the outset the fashioner is to choose the substrate material and its thickness. Along these lines, if the originator has an unmistakable origination about the impact of changing substrate material and its thickness on the exhibition of the receiving wire, it will be simpler to plan a radio wire. Proper determination of dielectric material and its thickness is a significant errand for planning a microstrip fix receiving wire.

Substrates used are Arlon 25FR, Rogers RO3003, FR4_epoxy, Teflon.



(Figure 4.1)

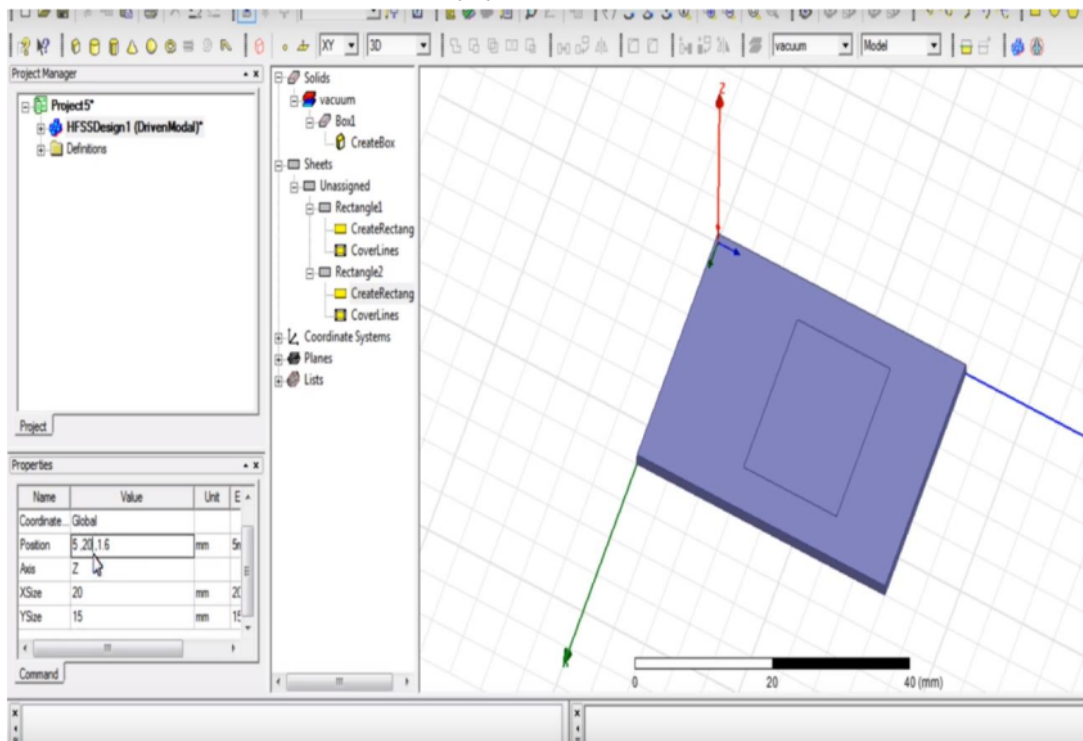
4.2 GROUND

A ground plane is an electrically conductive surface, normally associated with an electrical ground.

4.3 PATCH

The patch used is hexagon with rectangle.

band activities. Position:3.5,5,1.6 Axis: z X size :9 Y size: 12

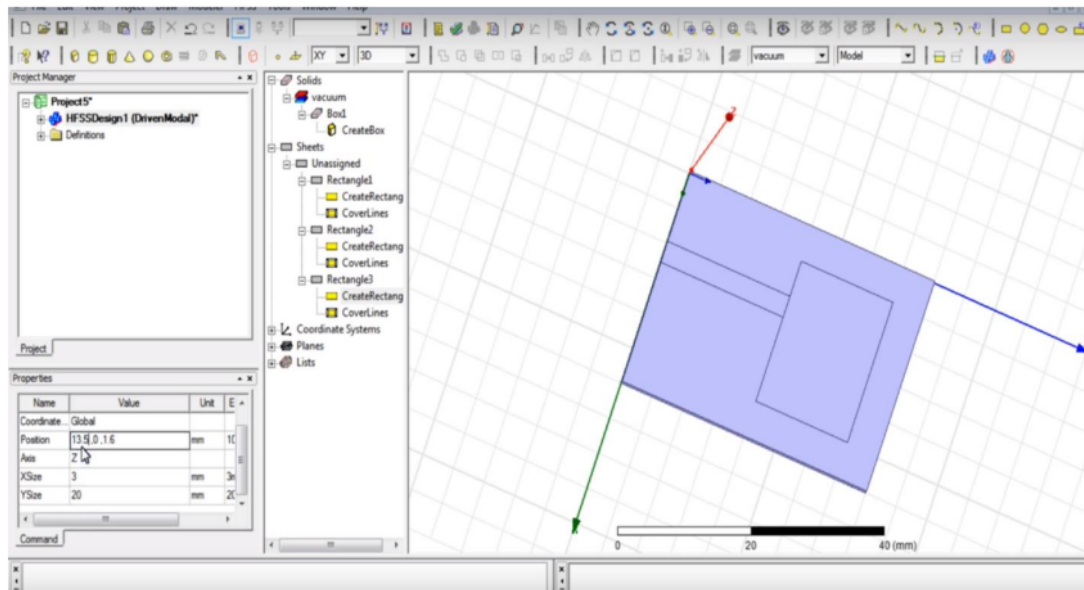


(figure 4.3)

4.4 FEED LINE

A radio receiving wire, the feed line (feedline), or feeder, is the link or other transmission line that associates the receiving wire with the radio transmitter or recipient.

Position: 7,0,1.6 Axis: z Xsize: 2 Y size: 5



(figure 4.4)

4.5 PORT

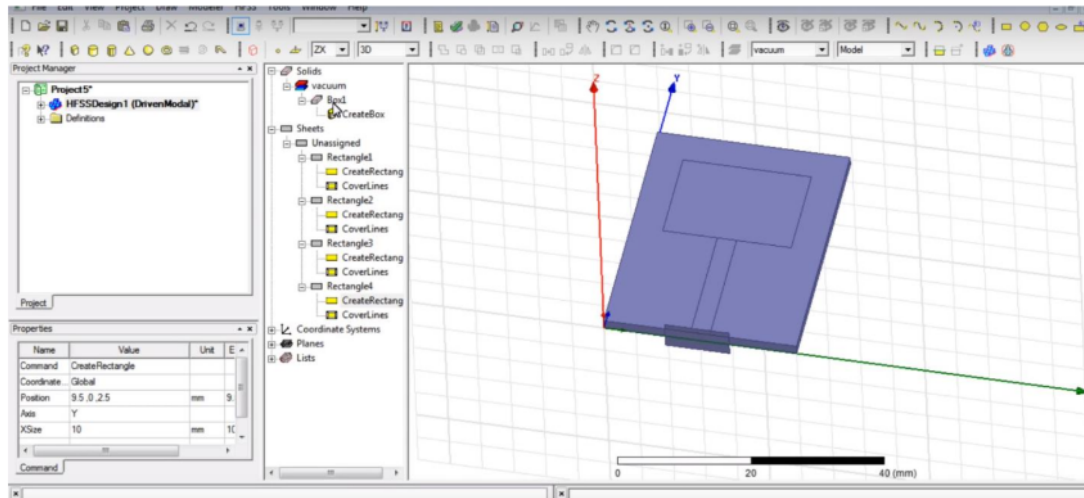
A radio wire port is by and large utilized as a nonexclusive term for signal transmission under indistinguishable channel conditions. For each LTE working mode in the downlink bearing for which a free channel is accepted (for example SISO versus MIMO), a different sensible receiving wire port is characterized

Position: 7,0,1.6

Axis: y

X size: 2

Z size:- 1.6



(figure 4.5)

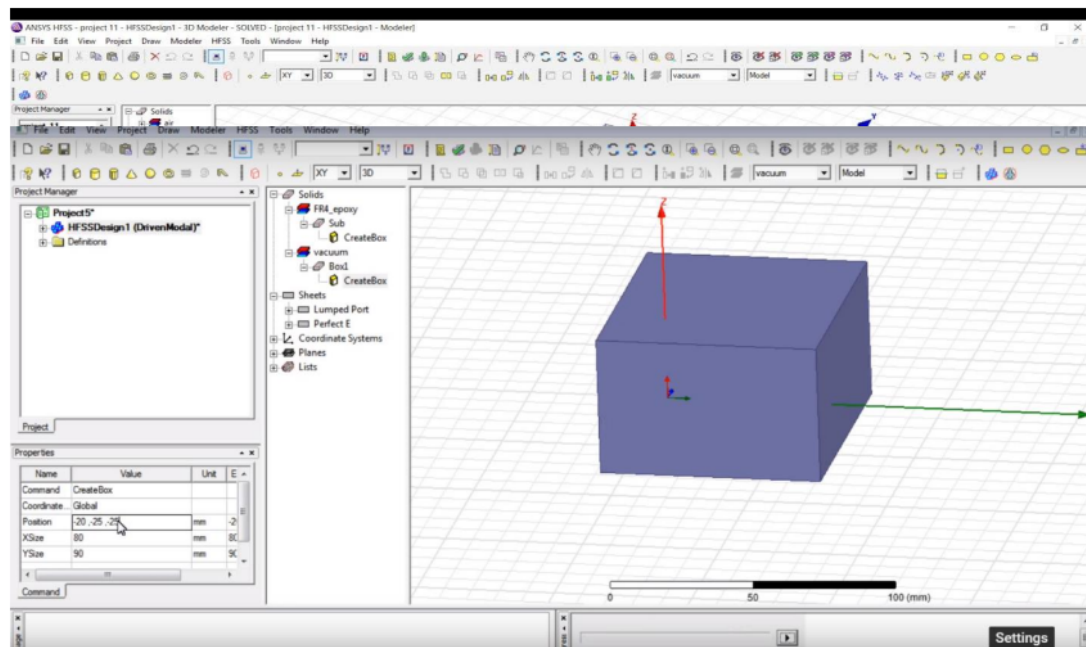
4.6 BOUNDARY

Position: -3.4,-3.4,-3.4

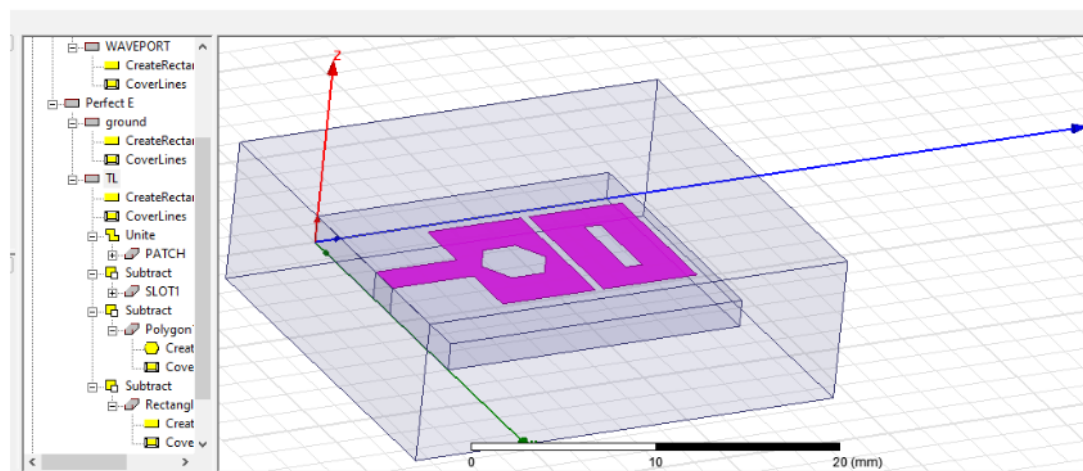
X size: 22.8

Y size: 25.8

Z size: 8.4



(figure 4.6)



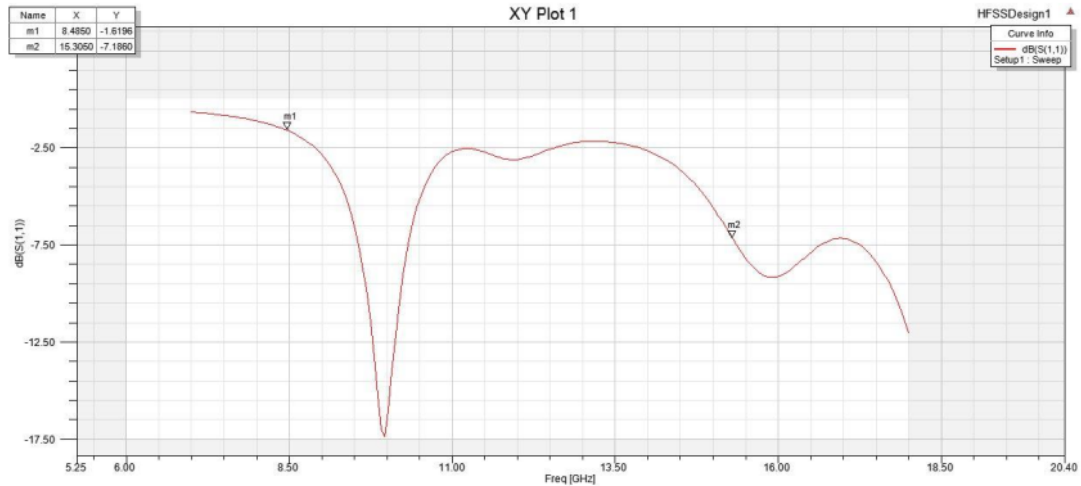
MICROSTRIP PATCH ANTENNA

4.7 Simulation Result Analysis

Simulation result analysis with different substrates is

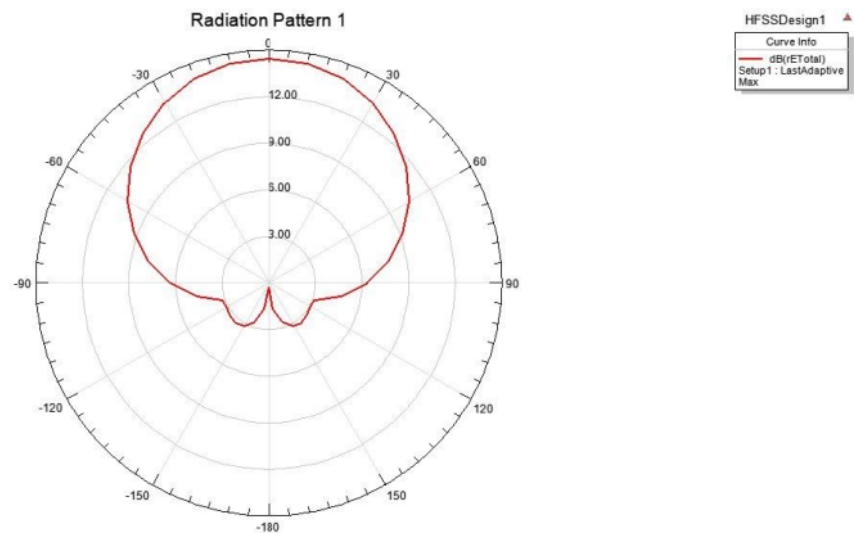
Rogers R03003

S11 parameter proposed at 7.5 GHz



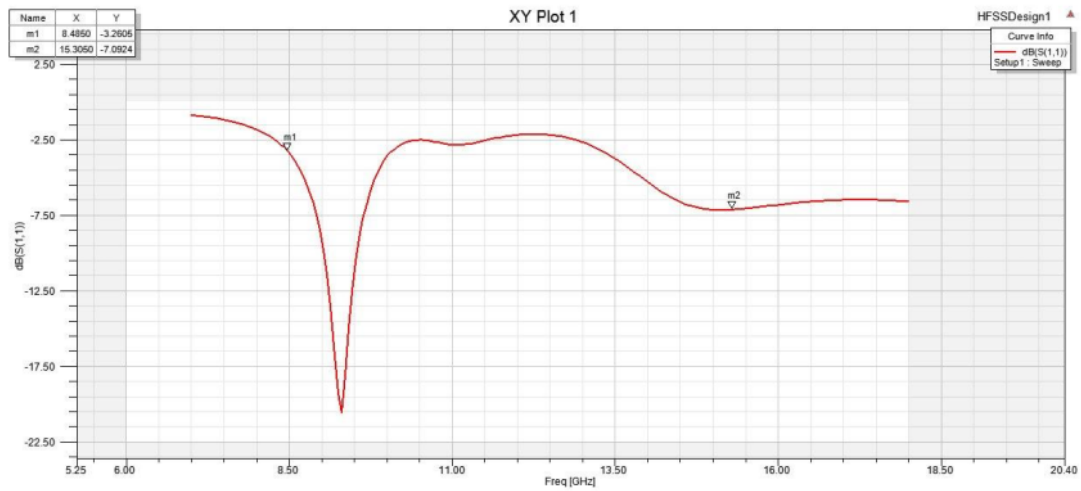
(Figure 4.7)

Radiation pattern at 7.5GHz

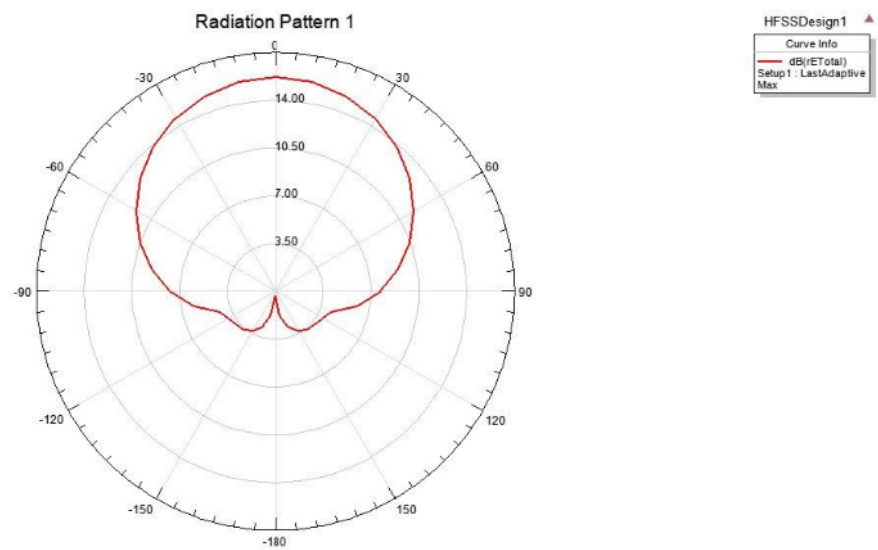


Arlon 25FR

S11 parameter at 7.5GHz

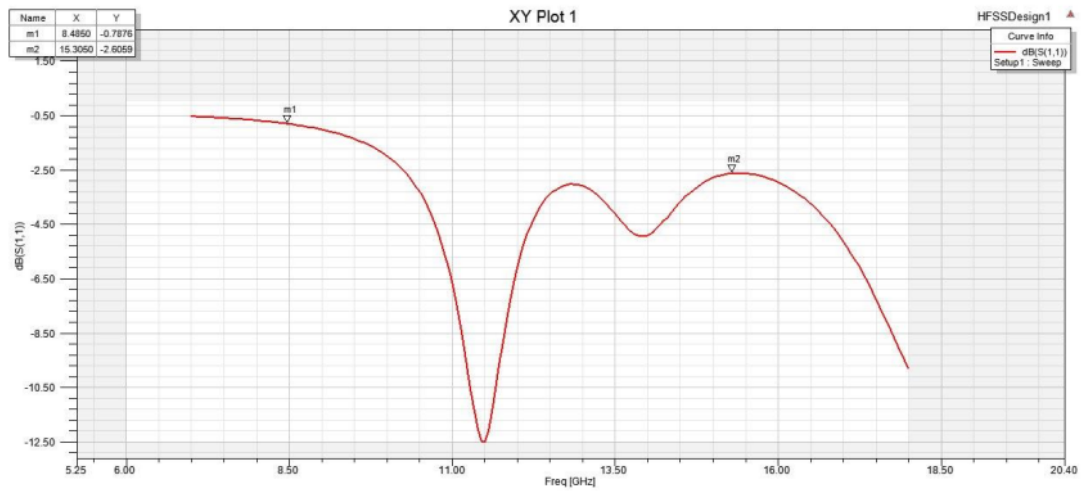


Radiation Pattern at 7.5GHz

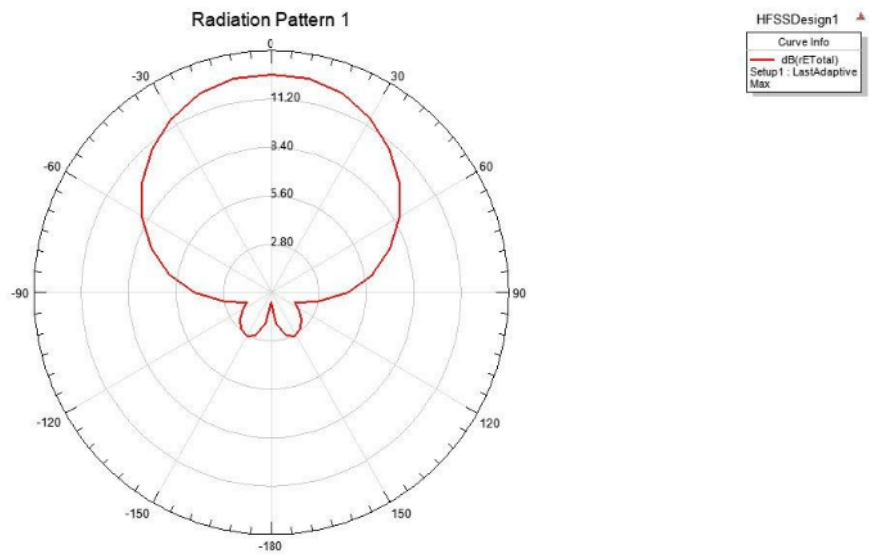


Teflon

S11 parameter proposed at 7.5GHz

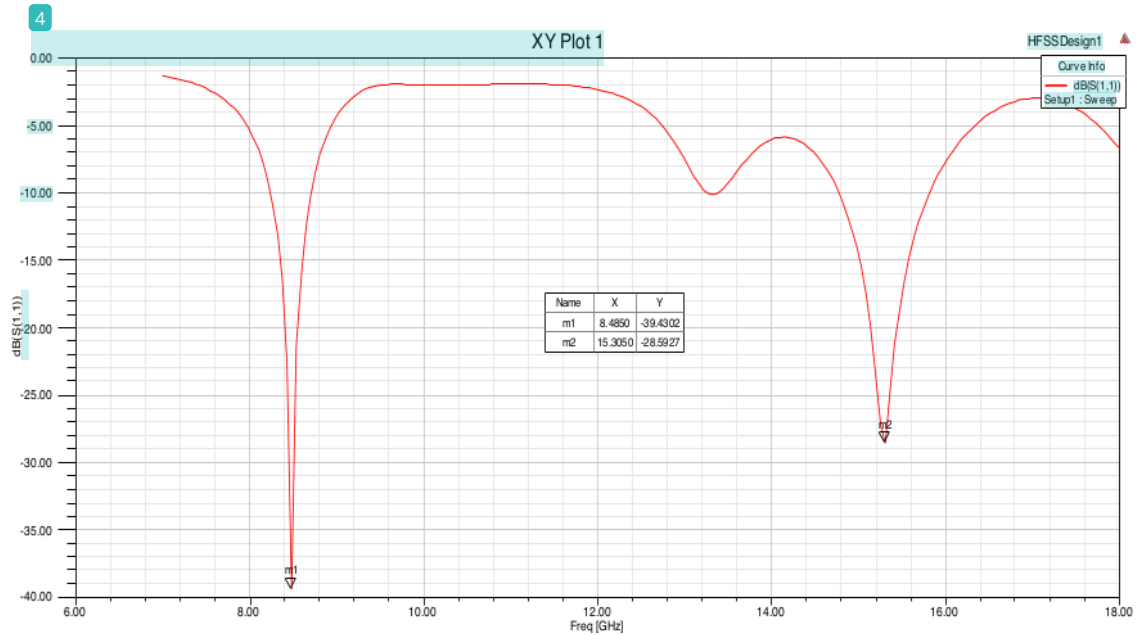


Radiation Pattern at 7.5GHz

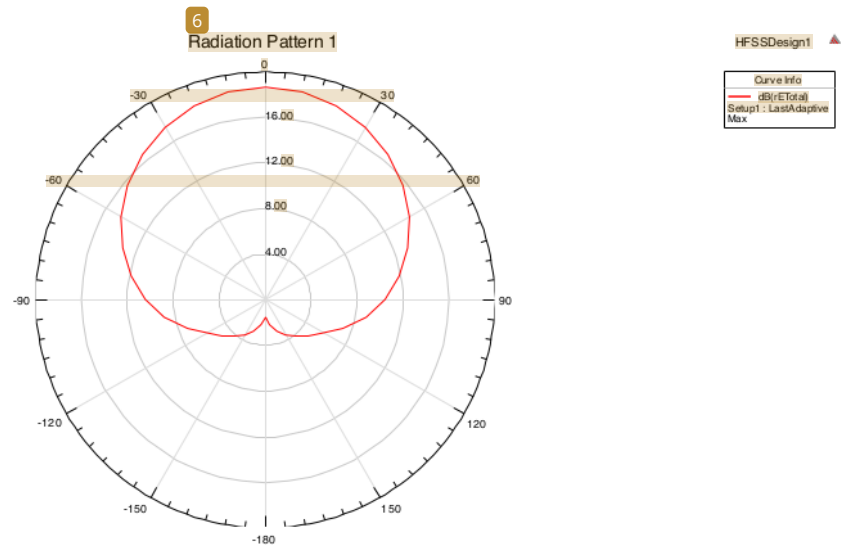


FR4_Epoxy

S11 parameter Proposed at 7.5GHz



RADIATION PATTERN OF 7.5 GHZ



The results are done at frequency range of 7.5 GHz. for Rogers R03003 substrate material have -17 dB, for Arlon 25FR substrate material have -21db, for Teflon substrate material have -12 dB, for FR4_Epoxy substrate material have -38 dB .

5. Conclusion

Thus, a microstrip patch antenna has been simulated on HFSS simulation software A Multiband Microstrip Antenna which is suitable for wireless application designed and analyzed for different substrates like Rogers, FR4_Epoxy, Teflon, Arlon. In our project we got a different return loss. but we obtain a good return loss in FR4_Epoxy substrate material with -38 db.

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