



DAFFODIL INTERNATIONAL UNIVERSITY
B.Sc. in Electrical and Electronic Engineering

**DESIGN AND ANALYSIS OF A WIDEBAND MICRO STRIP ANTENNA
FOR HIGH SPEED WLAN**

Submitted By

Md. Rakibul Islam

Id: 152-33-216

Department of Electrical and Electronic Engineering
Daffodil International University

Submitted To

Md. Ashraful Haque

Assistant Professor

Department of Electrical and Electronic Engineering
Daffodil International University

This thesis has been submitted to the Department of Electrical and Electronic Engineering in partial fulfillment of the requirement for the degree of Bachelor of Science in Electrical and Electronic Engineering.

Department of Electrical & Electronic Engineering
Faculty of Engineering

Date of Submission: 16th July, 2019



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APPROVAL LETTER

This Project/internship titled “**Design and Analysis of a Wideband Microstrip Antenna for High Speed WLAN**”, submitted by Md. Rakibul Islam ID: 152-33-216 to the Department of Electrical & Electronic Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 16th July, 2019.

Board of Examiners:

	Name	Designation	
1	Md. Ashraful Hauque	Assistant Professor, EEE	Coordinator
2	Dr. Md. Alam Hossain Mondal	Associate Professor, EEE	Internal Member
3	Dr. Md. Abdur Razzak	Associate Professor, EEE (IUB)	External Member

Declaration

I thus declared this thesis based on the results found by myself. The work materials found by other researchers are referred to by reference. To achieve the degree, this thesis is submitted to Electrical and electronics engineering Department of Daffodil International University. This thesis has not been fully submitted for any degree prior to the degree.

Supervised by:

Mr. Md. Ashraful Haque
Daffodil International University
Assistant Professor
Department of Electrical & Electronic Engineering

Submitted by:

Md Rakibul Islam
Id: 152-33-216
Department of Electrical & Electronic Engineering
Daffodil International University

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CHAPTER 1

INTRODUCTION

1.1 Microstrip Patch Antenna

In recent years, the current trend in commercial and government communication systems has been to develop low cost, minimal weight, low profile antennas that are capable of maintaining high performance over a large spectrum of frequencies. This technological trend has focused much effort into the design of microstrip patch antennas. With a simple geometry, patch antennas offer many advantages not commonly exhibited in other antenna configurations. For example, they are extremely low profile, lightweight, simple and inexpensive to fabricate using modern day printed circuit board technology, compatible with microwave and millimeter-wave integrated circuits (MMIC) and have the ability to conform to planar and non-planar surfaces. In addition, once the shape and operating mode of the patch are selected, designs become very versatile in terms of operating frequency, polarization, pattern, and impedance. The variety in design that is possible with microstrip antennas probably exceeds that of any other type of antenna element. However, standard rectangular microstrip patch antenna also has the drawbacks of narrow bandwidth. Researchers have made many efforts to overcome this problem and many configurations have been presented to extend the bandwidth.

1.2 Contribution of the Thesis

An antenna for high speed WLAN standards covering a bandwidth from 2.5 GHz has been designed simulated in this thesis. A parametric study of E shape antenna has also been presented which can be very useful to understand the effects of various parameters on the bandwidth

1.1 Organization of the Thesis

The dissertation is mainly divided into five chapters. Introduction to WLAN, microstrip antenna and main objectives of the thesis have already been expressed in Chapter 1. Chapter 2 provides some information about basic properties of antenna and the literature review done in the process. Based on the literature review an antenna is taken for optimization. Optimization is done by simulating the antenna with variable parameters. The effects of parametric study have been summarized to understand the effect of different parameters on bandwidth, resonance and return loss. A comparison with existing antennas and proposed antenna is also briefly discussed in this chapter. Finally, conclusive discussion and scope for future works

CHAPTER 2

BACKGROUND

2.1 Antenna Characteristics

A reception apparatus is an electrical gadget which changes over electric flows into radio waves, and the other way around. It is typically utilized with a radio transmitter or radio recipient. In transmission, a radio transmitter applies a swaying radio recurrence electric flow to the reception apparatus' terminals, and the receiving wire emanates the vitality from the flow as electromagnetic waves (radio waves). In gathering, a reception apparatus captures a portion of the intensity of an electromagnetic wave so as to create a little voltage at its terminals, which is connected to a beneficiary to be enhanced. A reception apparatus can be utilized for both transmitting and accepting. So to put it plainly, reception apparatus is a gadget that is made to productively emanate and get transmitted electromagnetic waves. There are a few significant receiving wire qualities that ought to be viewed as when picking a radio wire for a specific application, for example,

Bandwidth (BW)

- Return Loss (RL)
- Gain
- VSWR
- Radiation Pattern
- Polarization

Input impedance is an important characteristic of antenna. For an efficient transfer of energy, impedances of all the elements must match each other or in other words impedance of the radio, of the antenna and of the transmission cable connecting them must be the same. Transceivers and their transmission lines are typically designed for particular impedance. If the antenna has impedance different from that, then there is a mismatch and an impedance matching circuit is required.

An antenna's bandwidth specifies the range of frequencies over which its performance does not suffer due to a poor impedance match. When a signal is fed into an antenna, the antenna will emit radiation distributed in space in a certain way. A graphical representation of the relative distribution of the radiated power in space is called a radiation pattern. The radiation pattern describes the relative strength of the radiated field in various directions from the antenna, at a constant distance. The radiation pattern is a reception pattern as well, since it also describes the receiving properties of the antenna. The radiation pattern is three-dimensional, but usually the

measured radiation patterns are a two-dimensional slice of the three-dimensional pattern, in the horizontal or vertical planes. These pattern measurements are presented in either a rectangular or a polar format.

Increase is a parameter which estimates the level of directivity of the radio wire's radiation design. A high-gain reception apparatus will specially transmit in a specific bearing. In particular, the reception apparatus gains, or power addition of a radio wire is characterized as the proportion of the force (control per unit surface) transmitted by the receiving wire toward its most extreme yield, at a self-assertive separation, isolated by the force emanated at a similar separation by a theoretical isotropic receiving wire.

As an electro-appealing wave experiences the different bits of the receiving wire system it may experience differentiates in impedance. At each interface, dependent upon the impedance facilitate, some division of the wave's essentialness will reflect back to the source, forming a standing wave in the feed line. The extent of most noteworthy ability to least power in the wave can be evaluated and is known as the standing wave extent (SWR). The SWR is for the most part portrayed as a voltage extent called the VSWR. The VSWR is consistently a genuine and positive number for receiving wires. The littler the VSWR is, the better the reception apparatus is coordinated to the transmission line and the more power is conveyed to the radio wire. The base VSWR is 1.0. For this situation, no power is reflected from the reception apparatus, which is perfect. As the VSWR increments, there are 2 primary disadvantages. The first is self-evident: more power is reflected from the receiving wire and in this way not transmitted. Be that as it may, another issue emerges.

2.2 Characteristics of Basic Microstrip Patch Antenna

In its basic form, a Microstrip Patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side as shown in Figure 2.1. Dielectric shape.

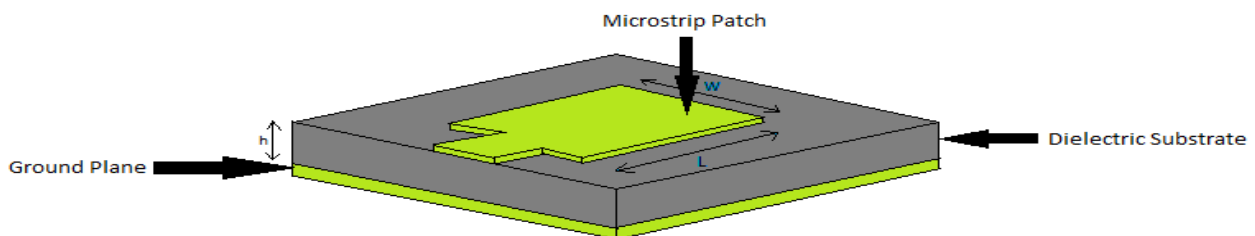


Fig 2.1 Basic Of Micro Strip Patch Antenna

. The emanating patch and the feed lines are generally photograph scratched on the dielectric substrate. So as to streamline examination and execution estimation, for the most part square, rectangular, round, triangular, and curved or some other normal shape patches are utilized for structuring a microstrip receiving wire. For our situation we are going The fix is typically made of directing material, for example, copper or gold and can take any conceivable to structure E shape fix reception apparatus on account of its double resounding attributes which results in more extensive transfer speed. The microstrip fix reception apparatuses emanate principally as a result of the bordering fields between the fix edge and the ground plane. For good execution of receiving wire, a thick dielectric substrate having a low dielectric steady is fundamental since it gives bigger transfer speed, better radiation and better proficiency. Be that as it may, such a common arrangement prompts a bigger receiving wire measure. So as to decrease the size of the Micro strip fix reception apparatus, substrates with higher dielectric constants must be utilized which are less proficient and bring about thin transfer speed. Consequently, an exchange off must be acknowledged between the receiving wire execution and radio wire measurements.

Micro strip fix receiving wires are for the most part utilized in remote applications because of their position of safety structure. Along these lines they are amazingly perfect for inserted receiving wires in handheld remote gadgets, for example, mobile phones, pagers and so on. Some of the principal advantages are given below:

- Light weight and less volume;
- Low creation cost, in this way can be produced in huge amounts;
- Supports both, direct just as round polarization;
- Low profile planar arrangement;
- Can be effectively incorporated with microwave coordinated circuits (MICs);
- Capable of double and triple recurrence activities;
- Mechanically strong when mounted on unpleasant surfaces;

A portion of their significant weaknesses are given beneath:

- Narrow data transfer capacity;
- Low effectiveness;
- Low addition;

- Low power handling capacity etc.

2.4 Advantages

A portion of the chief focal points are given underneath:

- Light weight and less volume;
- Low creation cost, along these lines can be made in huge amounts;
- Supports both, direct just as round polarization;
- Low profile planar design;
- Can be effectively coordinated with microwave incorporated circuits (MICs);
- Capable of double and triple recurrence tasks;
- Mechanically powerful when mounted on unpleasant surfaces;

2.5 Disadvantages

- Narrow data transmission;
- Low productivity;
- Low increase;
- Low power dealing with limit and so forth.

Micro strip fix reception apparatuses likewise have an extremely high radio wire quality factor (Q). It speaks to the misfortunes related with the radio wire where an enormous Q prompts limited data transmission and low effectiveness. Q can be diminished by expanding the thickness of the dielectric substrate. Be that as it may, as the thickness expands, an expanding part of the absolute power conveyed by the source goes into a surface wave. This surface wave commitment can be considered an undesirable power misfortune since it is eventually dispersed at the dielectric curves and causes corruption of the receiving wire attributes.

2.7 Analysis Of Micro strip Patch Antenna

The most famous models for the investigation of microstrip fix receiving wires are the transmission line model, hole model, and full wave model. The transmission line model is the least difficult of all and it gives great physical knowledge however it is less precise. The hole model is progressively precise and gives great physical knowledge however is unpredictable in nature. The full wave models are amazingly precise, flexible and can treat single components, limited and vast exhibits, stacked components, subjective molded components and coupling. These give less knowledge .

Cavity model : Cavity backing of the ordinary rectangular micro strip gathering mechanical assembly is being proposed. The proposed gathering devices have been mirrored. A data impedance of 71 % for $VSWR/spl les/2.00$ has been gotten from the proposed gathering mechanical assembly. Results gotten for the opening bolstered and without discouragement maintained easing wire has been taken a gander at. It has been found that by gap backing the conventional gathering contraction information move limit fabricates normal

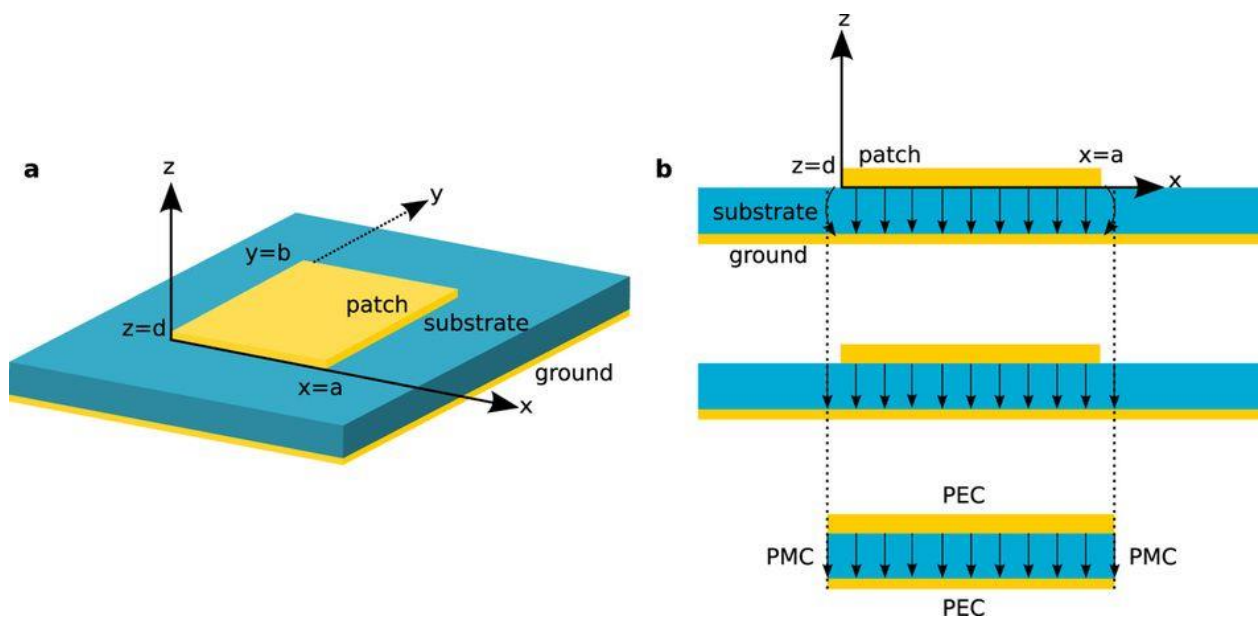


Fig 2.1: Cavity Model

Chapter 3

WHAT IS IE3D SOFTWARE

Plan ANTENNA WITH IE3D 3 IE3D is the principal SCALABLE EM structure and confirmation stage that conveys the engineers crosswise over multi-design spaces. For some organizations, there is never again only one EM issue nearby, yet a few distinct ones each displaying a remarkable bottleneck and postponing in general plan conclusion. IE3D's multi-strung and disseminated reproduction engineering and high-plan limit is the most financially savvy EM reenactment and demonstrating answer for segment level and circuit-level applications. IE3D offers the most astounding reenactment limits and quickest turnaround times for the broadest number of utilizations settling on it the best decision for improving your plan group profitability and meeting configuration plan on schedule.

The present superior receiving wire exhibit configuration requires both, enormous limit EM recreation and unit cluster cell EM structure and improvement abilities. Getting the exhibit unit cell directly from the begin is fundamental before reproducing into a bigger receiving wire cluster structure. Furthermore, on the off chance that precision is looked for, at that point the planner should be incredibly cautious with methodologies that define assessed limit conditions for unit cells utilized inside bigger exhibits. These methodologies normally experience the ill effects of poor limit confines and don't precisely demonstrate the EM conduct between unit cells, particularly for cells on the receiving wire cluster fringe. IE3D-SSD offers FASTEM to altogether investigate the applicable plan space.

3.1 GHz ANTENNA DESIGN

In this brief tutorial, we use IE3D to simulate a 2.4 GHz microstrip-fed, patch antenna. The antenna is fabricated on a 60 mil RO4003 substrate from Rogers-Corp with the dielectric constant of 3.4 and loss tangent of 0.002. In this tutorial we are not concerned about the design of this antenna and we will focus our attention on using IE3D to simulate the structure and obtain its parameters

- 1) At first I Run Zeland Program Manager. You will see a layout.

- 2) then I Run MGRID by clicking on the MGRID button (). MGRID is the main interface of IE3D, in which i can draw the layout of the circuit to be simulated. I Notice that all the fields are empty.

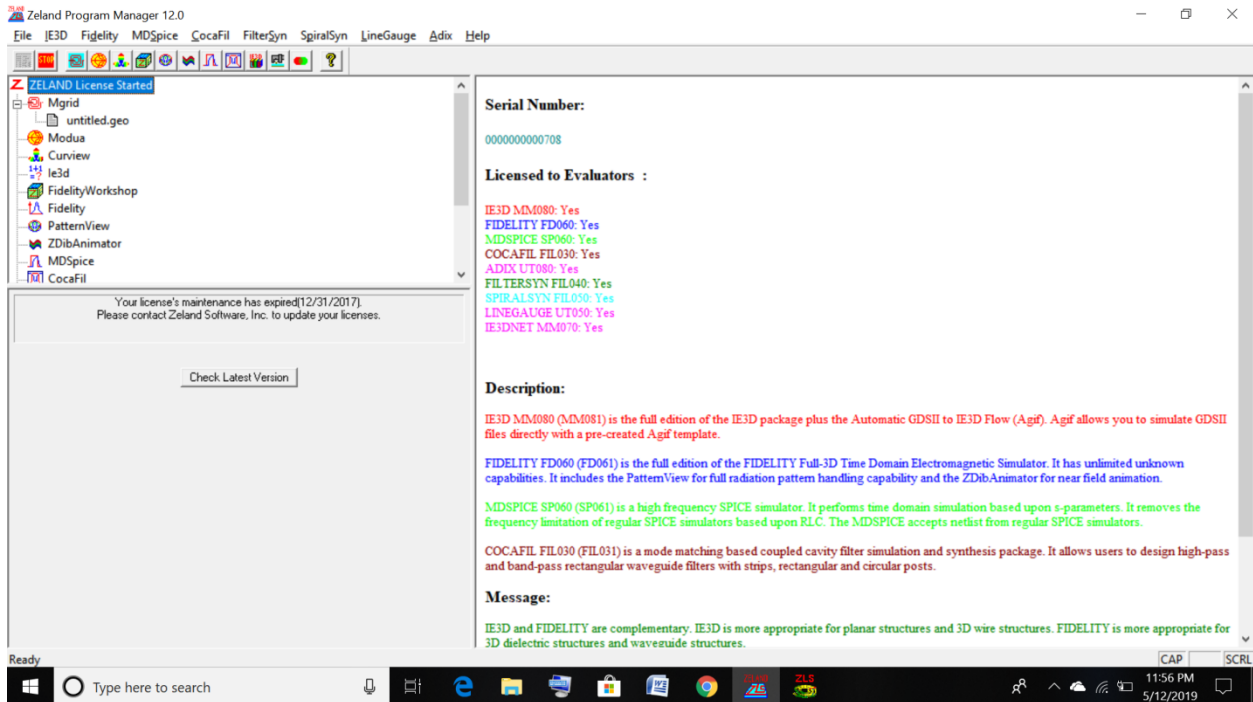
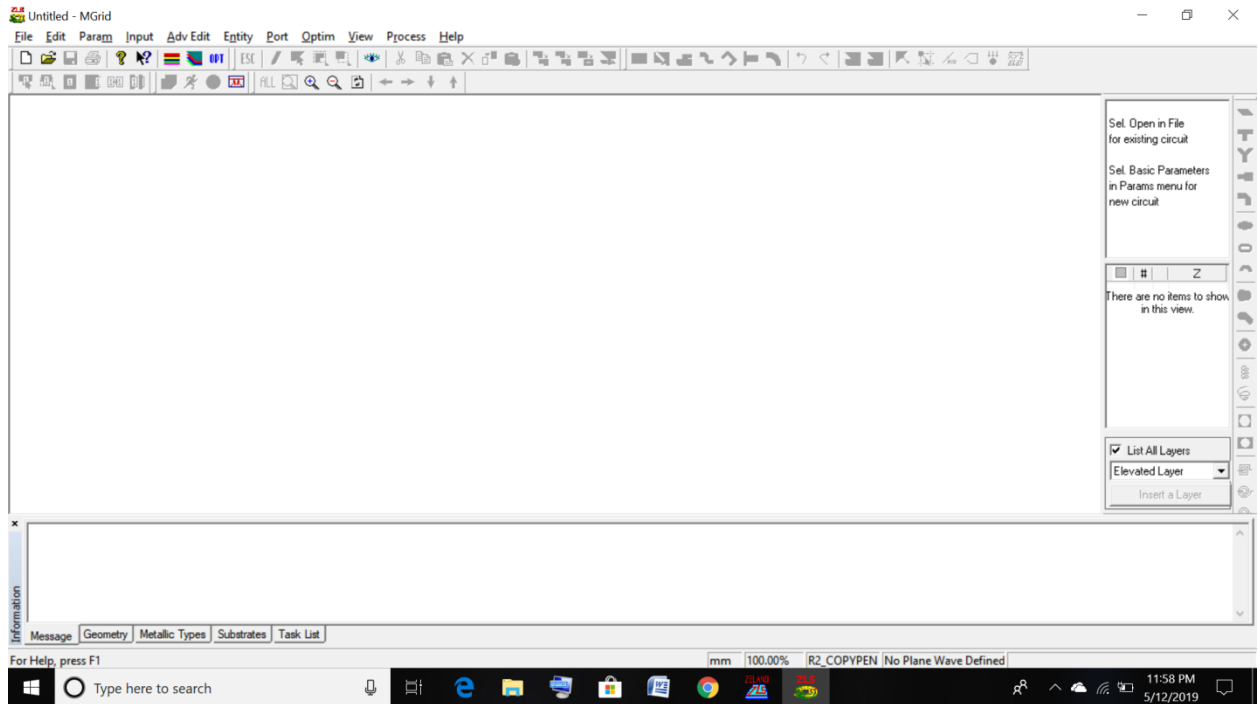


Fig 3.1

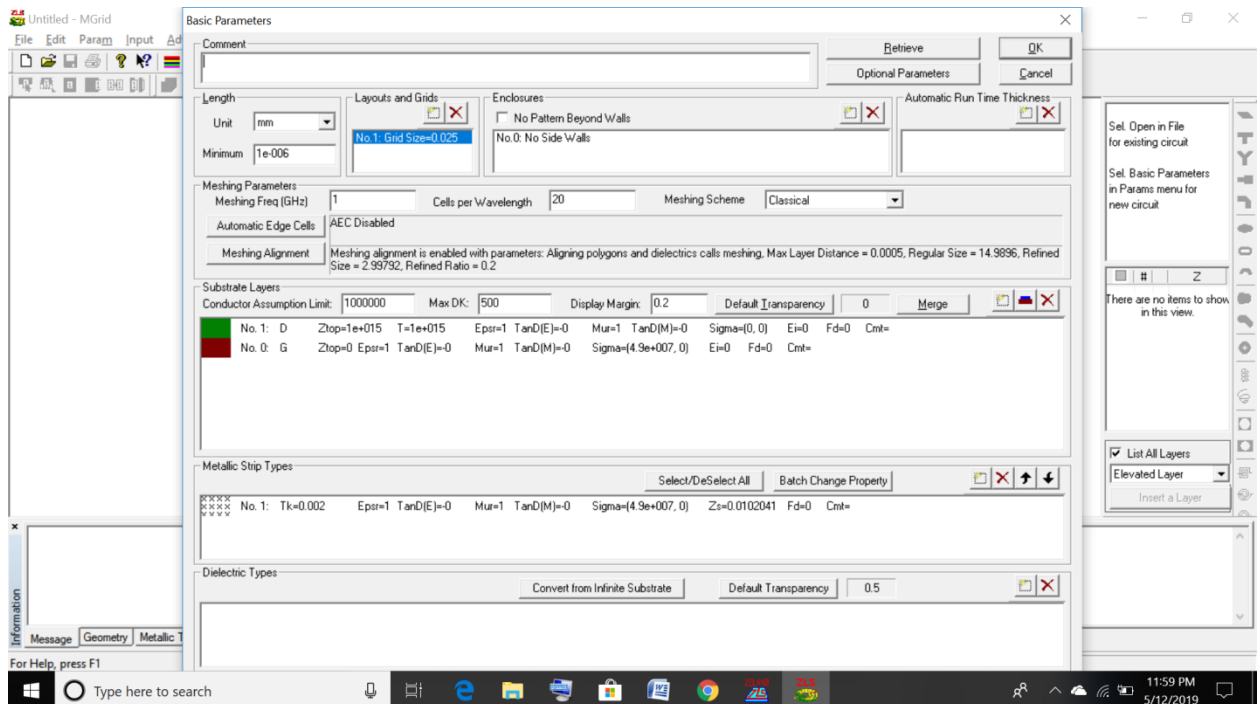
3. The essential parameter definition window springs up. You should see something like. In this window you can characterize essential parameters of the reproduction, for example, the dielectric consistent of various layers, the units and format measurements, and metal sorts among different parameters. In "Substrate Layer" segment note that two layers are naturally characterized. At $z=0$, the program consequently puts an unbounded ground plane (note the



material conductivity at $z = 0$) and a subsequent layer is characterized at unendingness with the dielectric consistent of 1.

FIG 3.2

4. In the basic parameter definition window, by click on "New Dielectric Layer" button () I saw a window.



Top surface, Ztop I Enter the z estimation of the top surface. For this circumstance, it is 1.524 mm (60 mils) b. Dielectric Constant: This field addresses the dielectric reliable of the layer. Enter 3.4 here for the dielectric steady of the RO4003C substrate c.FF

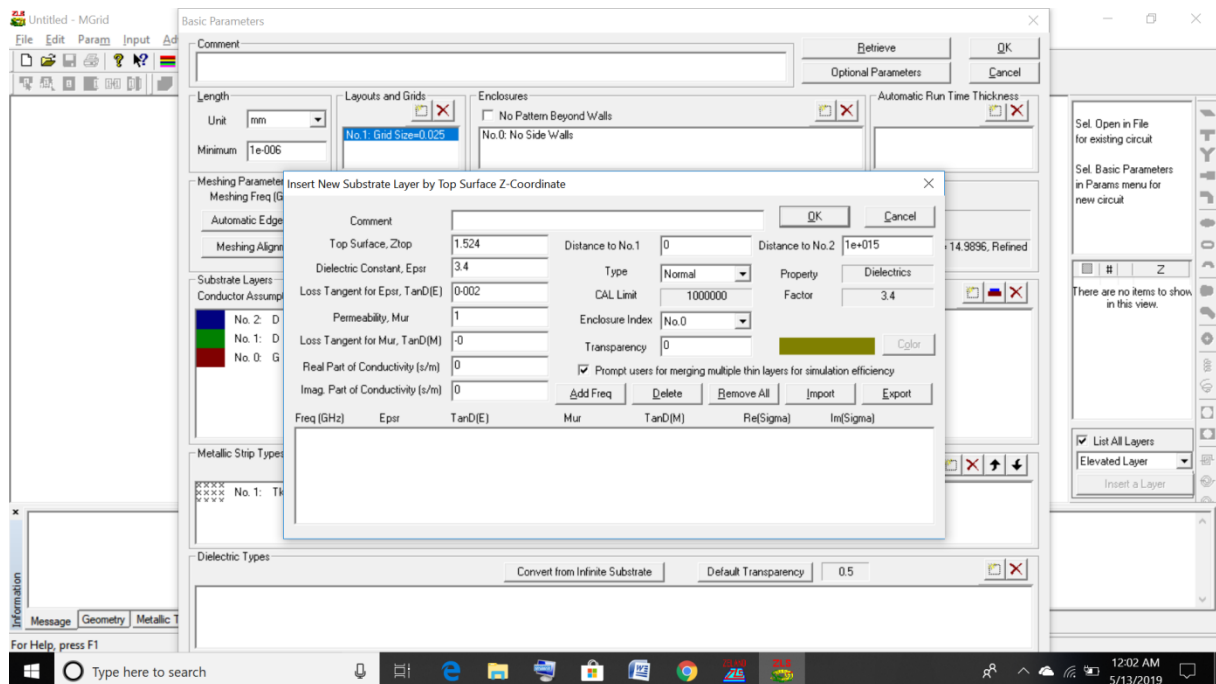


Fig 3.3

6) The accompanying stage is to draw the radio wire and the arrangement. For this circumstance we will use a rectangular fix, empowered with a clear microstrip line. The supporting microstrip line is a 50Ω line and the impedance of the recieving wire is composed to 50Ω by using an inset feed. We will pull in the structure various stages as follows in the going with advances.

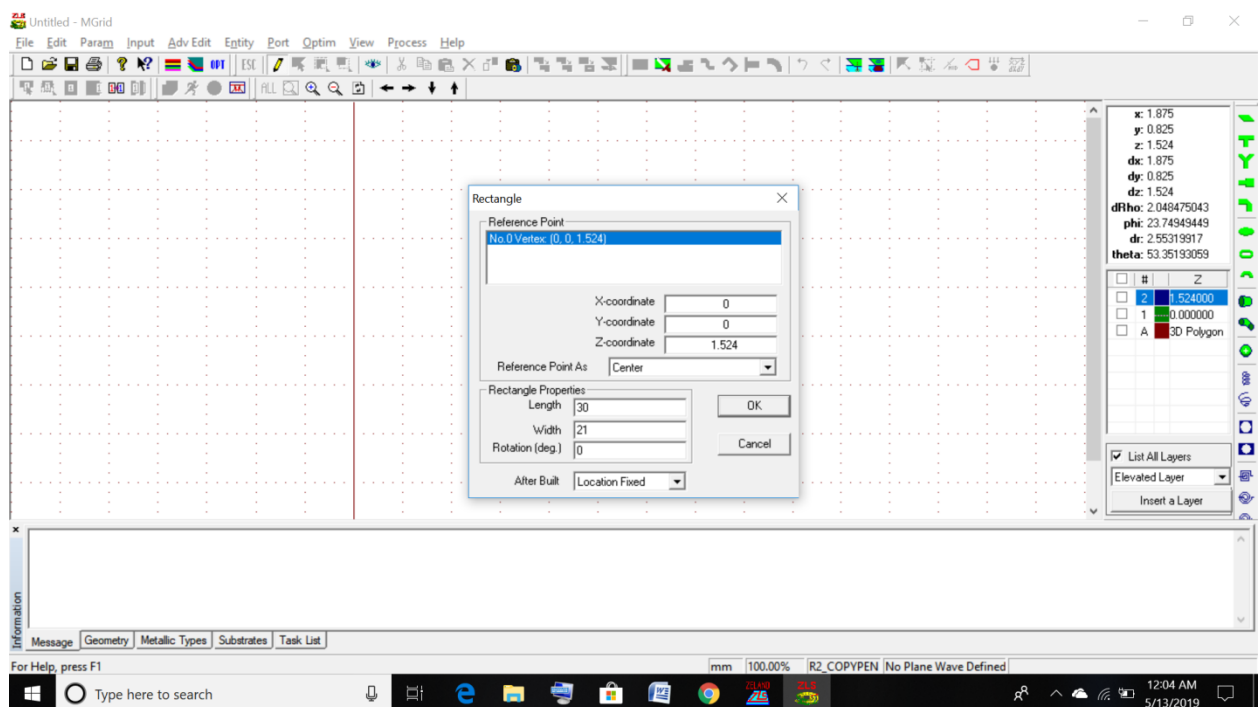


Fig 3.4

7) First, we will draw a square shape with the length of 30 mm and width of 21 mm. We can draw the arrangement physically or use the available substance to draw them. For this circumstance, we will draw them using the substance. Snap on the square shape substance get (.). Enter 30 for Length and 21 for width as showed up in Figure 6 and snap OK. Directly your organization ought to take after

8 The accompanying stage is to draw the rest of the structure. Press Shift+A. The "Support Input Absolute Location" menu springs up. In this menu, you can put a vertex at a self-decisive zone on the structure. Enter - 15 for x and - 10.5 for y regards. Your screen should look like Figure 8. Snap on OK get. The "Adjacent Vertices" menu springs up. Snap on YES to change this vertex to be related with the one at (- 15mm, - 10.5 mm). This vertex will by then be related with the one on the lower left corner of the square shape pulled in the past development

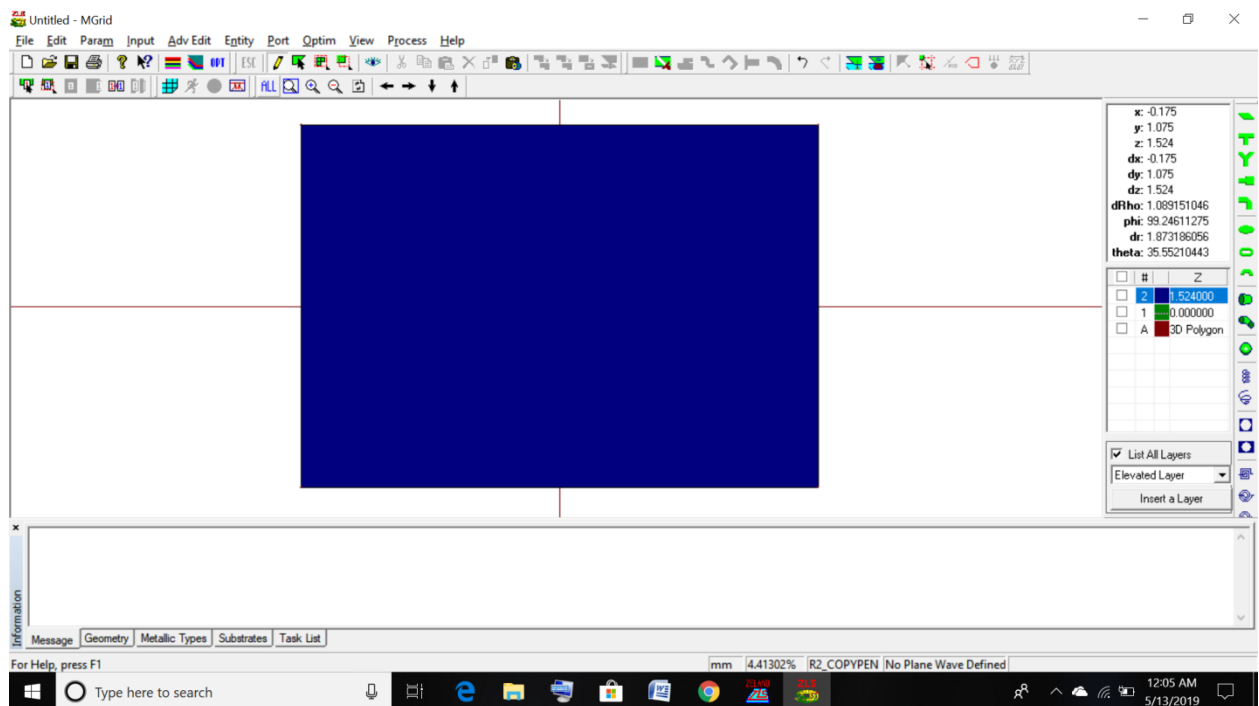
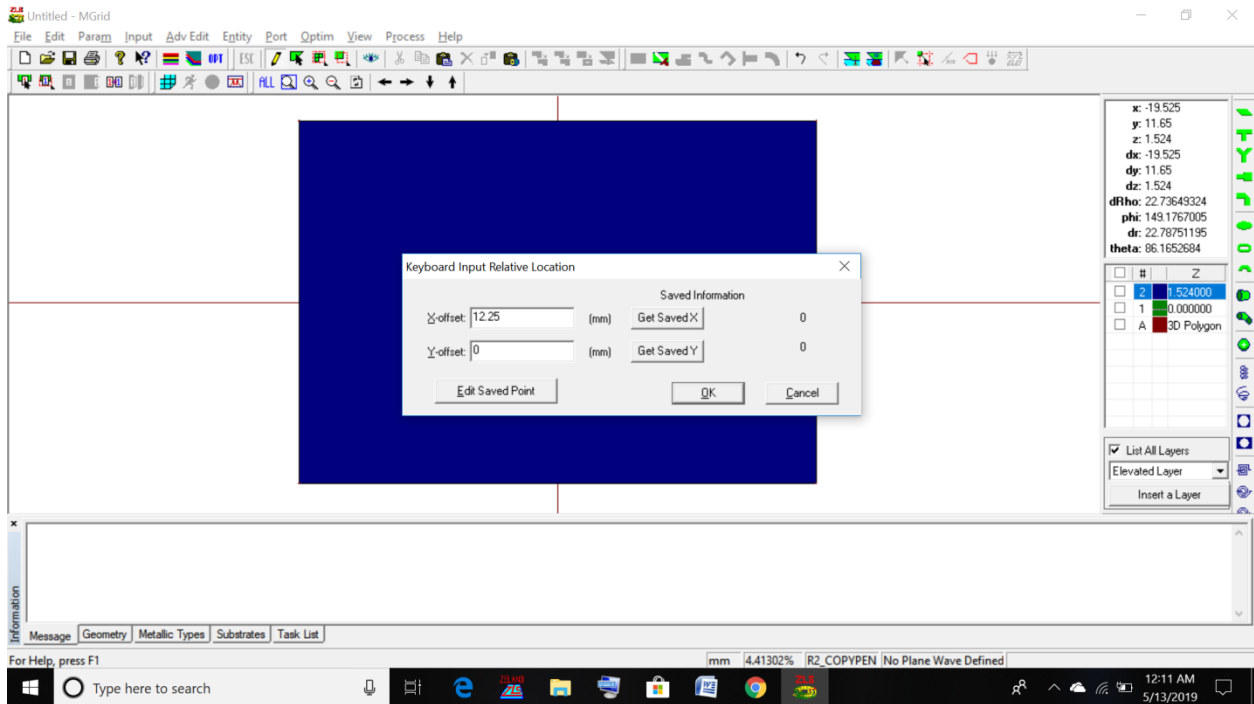


Fig 3.4

10. Then I Press Shift+R again and enter -13 in the Y-offset field. Press OK.



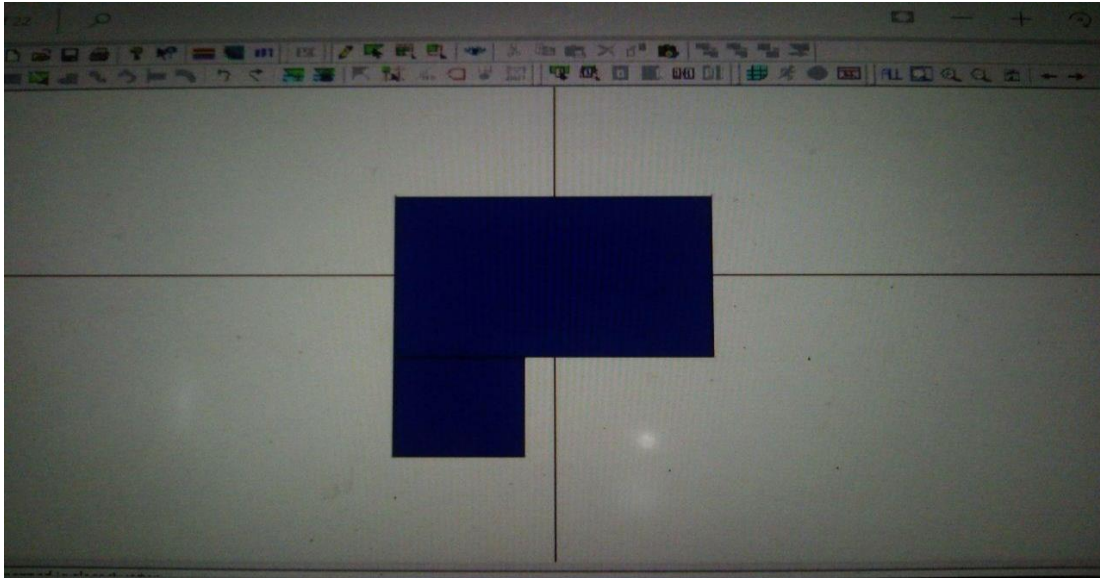
11) THEN Press Shift+F. This simple course makes a square shape using the three vertices that are entered starting at now;

12) by then I Press the "Select Polygon" get showed up in Figure 11 (). The condition of mouse cursor changes from the cross "+" to the ordinary mouse cursor ().

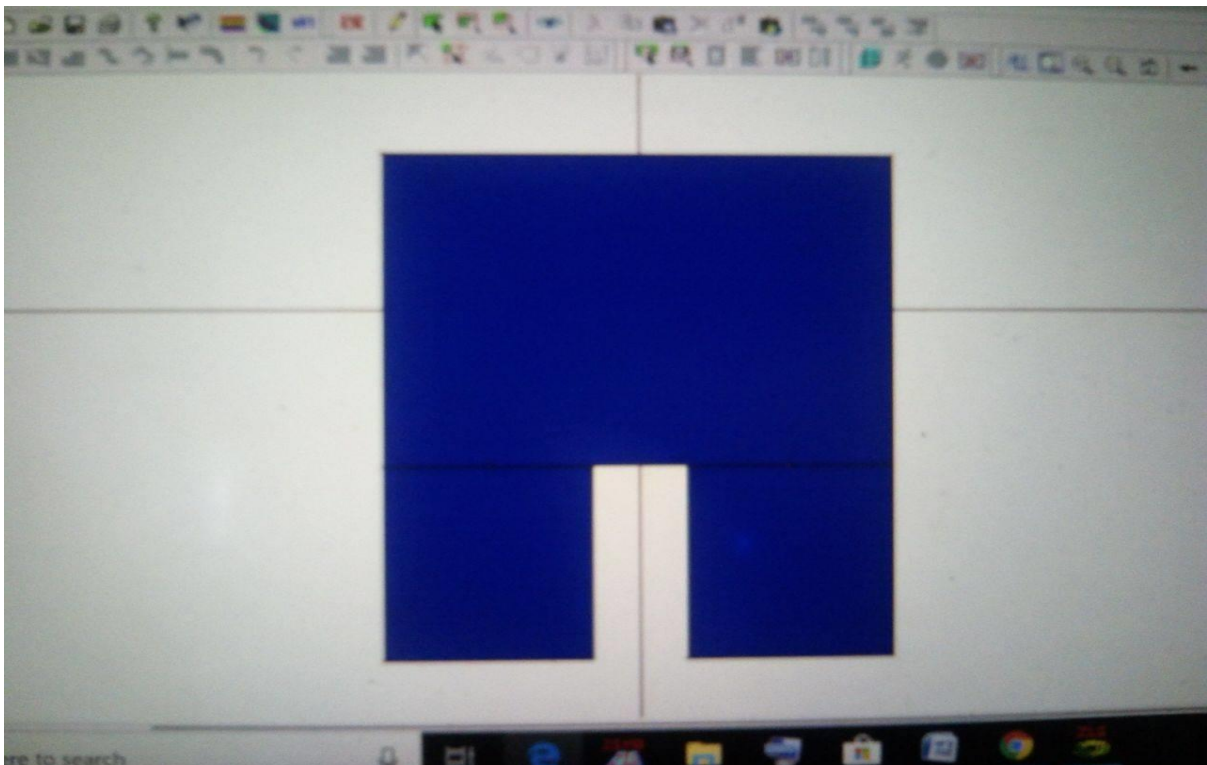
13) THEN I Move the mouse cursor on the more diminutive square shape and snap on it. It will be featured in diminish and this square shape is picked; at this stage, you can duplicate this article, annihilate it, move it, and so on. We will probably reorder this thing to make a replice.

14) Move the mouse cursor on the more modest square shape and snap on it. It will be incorporated into dull and this square shape is picked; at this stage, you can duplicate this article, erase it, move it, and so on. We will probably reorder this article to dislodge. 14. Move the mouse cursor on the more diminutive square shape and snap on it. It will be highlighted in dim and this square shape is picked; at this stage, you can copy this thing,

delete it, move it, etc. Our goal is to reorder this item to supplant.



14) Press, Ctrl+C to copy the article and Ctrl+V to stick it.. The outline of the thing to be stuck is drawn and as you move the mouse, it will move as well. You can move the cursor to the paste point encourages and click on the left catch. You can in like manner click wherever on the screen. The "Copy Object Offset to Original" menu springs up. In this menu, you can enter the bearings of the paste zone.



16. Since you understand how to draw square shapes, draw the essential sustaining line. Start by outline a little square shape with the two confining corners arranged at (- 1.75 mm, - 10.5 mm) and (1.75 mm, - 12 mm).. This is the central microstrip line continuing the fix receiving wire. In any case, the length of the microstrip line is pretty much nothing and we need to grow it.

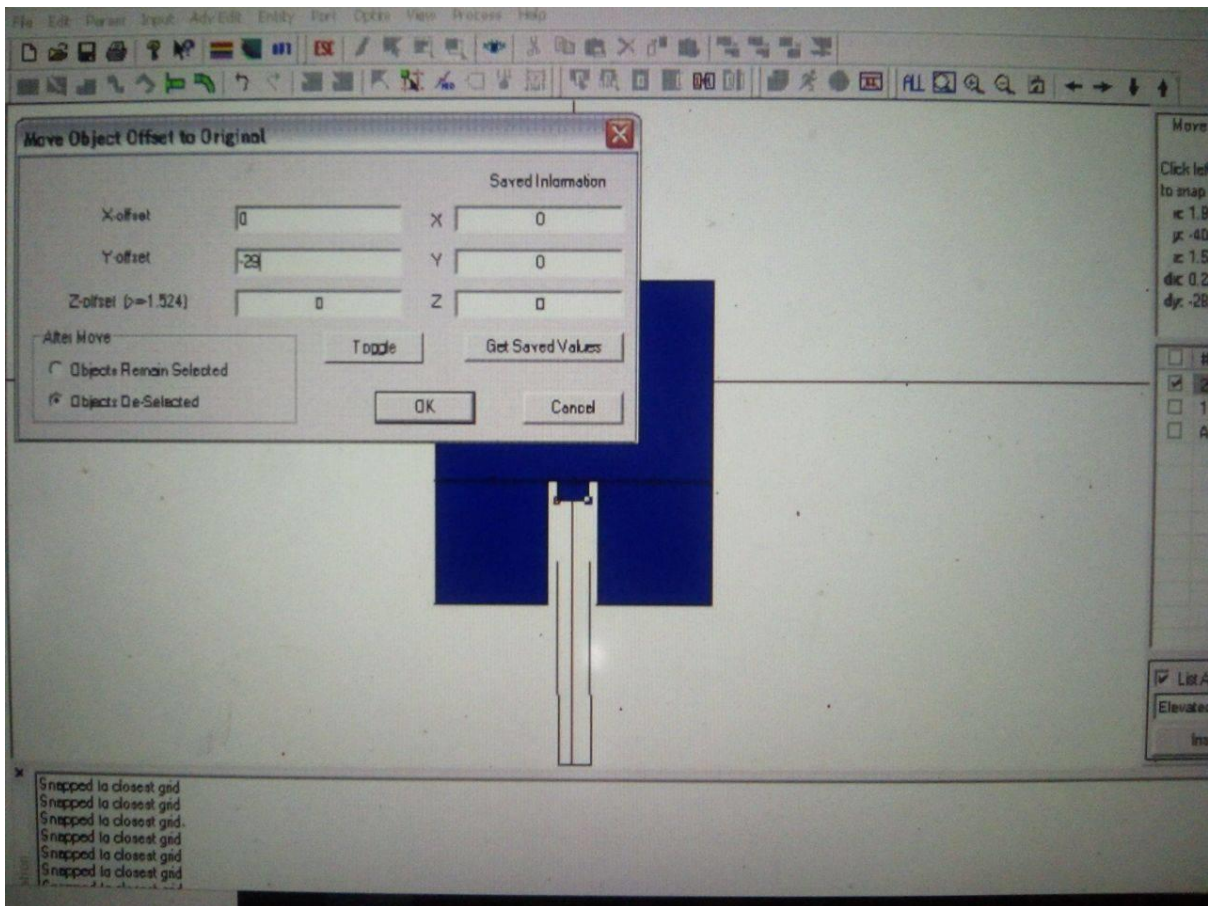
17. Press the "Select Vertices" get () afresh, the condition of the cursor changes to (). Move your mouse cursor close to the lower two vertices of the latest drawn square shape and press the left mouse get. While the catch is crushed, move the cursor and select the lower two vertices of the microstrip feed square shape. After the vertices are picked you can move them or eradicate them to change the general condition of the structure.

18. Since the two vertices are chosen, you can move them and change the length of the sustaining microstrip. While the lower two vertices are chosen, press the "Move Objects" catch () as it is appeared in Fig. 16.

19. Enter 0 for the X-balance and - 29 for the Y-balance esteems; this broadens the length of the microstrip line.

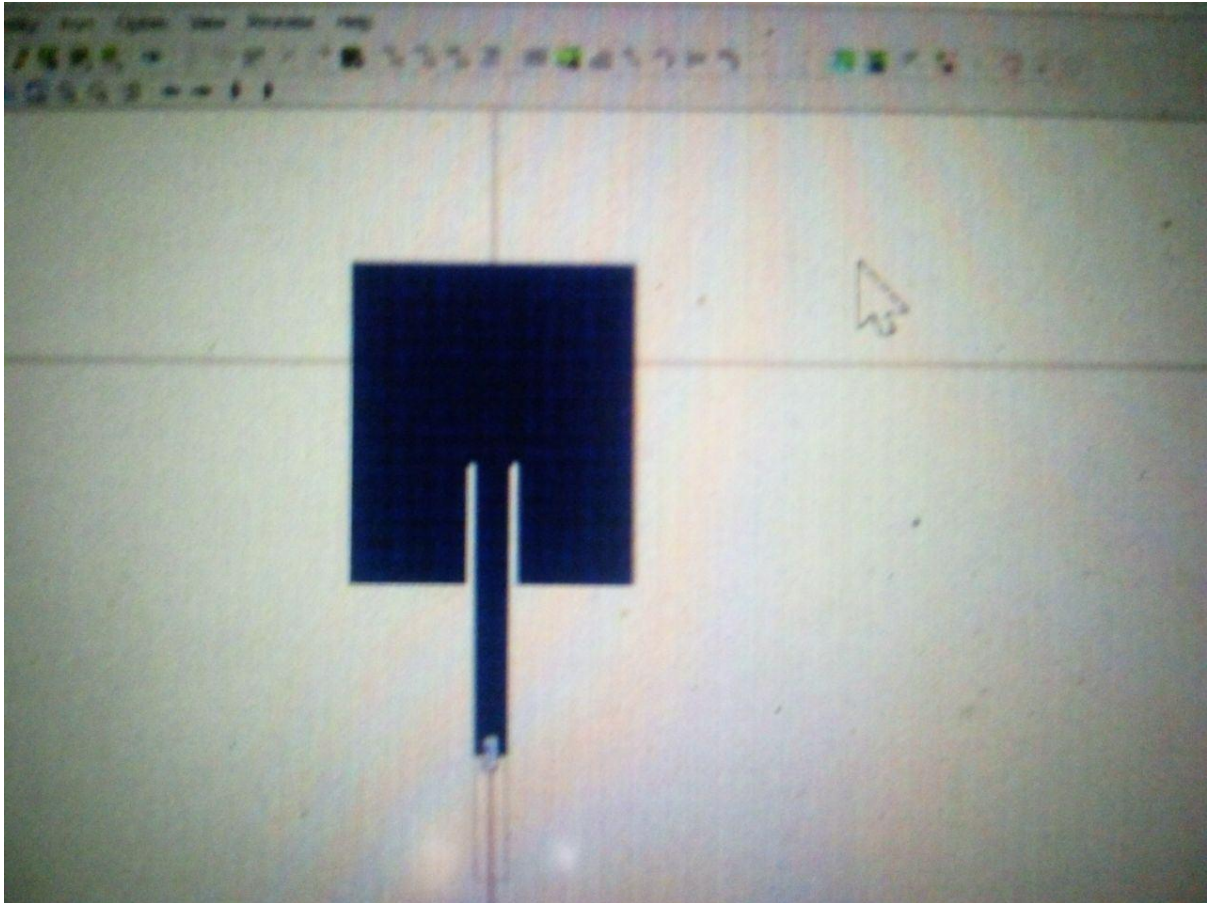
20. The following stage is to arrangement excitation. We are going to utilize a port to energize the microstrip line, which thusly encourages the fix.

21. Press the "Characterize Port Button" (). Pick "Propelled Extension" in the De-Embedding Scheme field. Leave the remainder of the fields unaltered at this stage and after that I press the OK catch.



22. The subsequent stage is to run the reenactment. Notwithstanding, before that, let us first work the structure; this work is utilized in the Method of Moment (MoM) estimation.

23, the working recurrence is 2.4 GHz. In this manner, picking 3 GHz as the most extreme recurrence ought to be OK. Enter 30 in the "Cells per Wavelength" field.



Fig

After following those steps finally result come

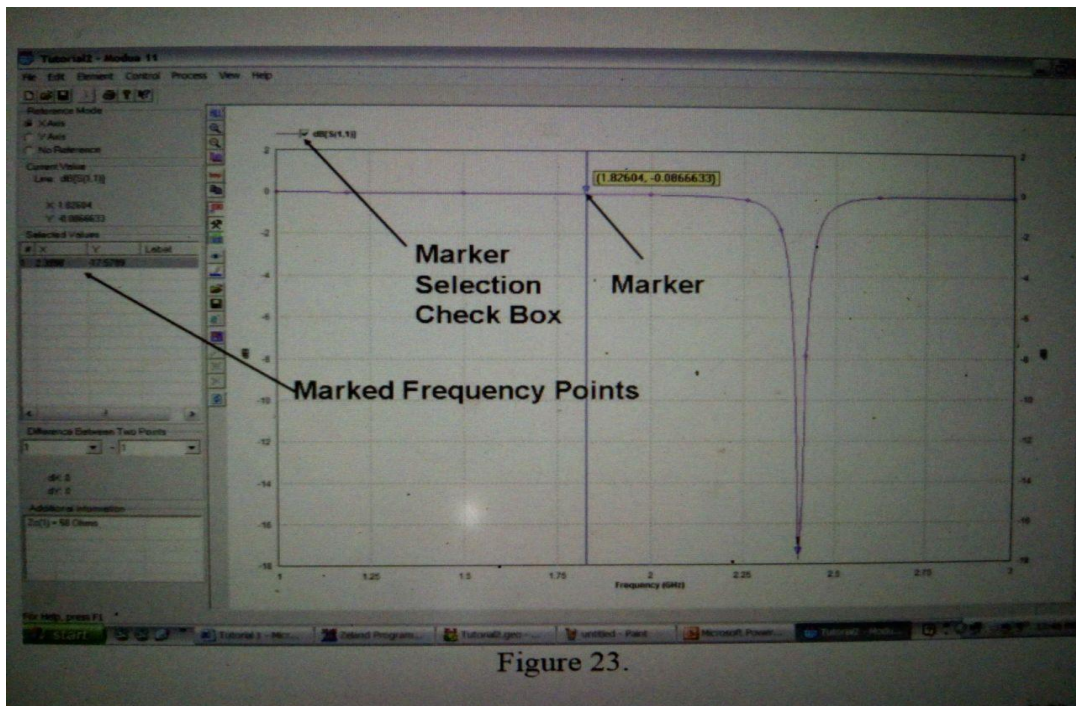
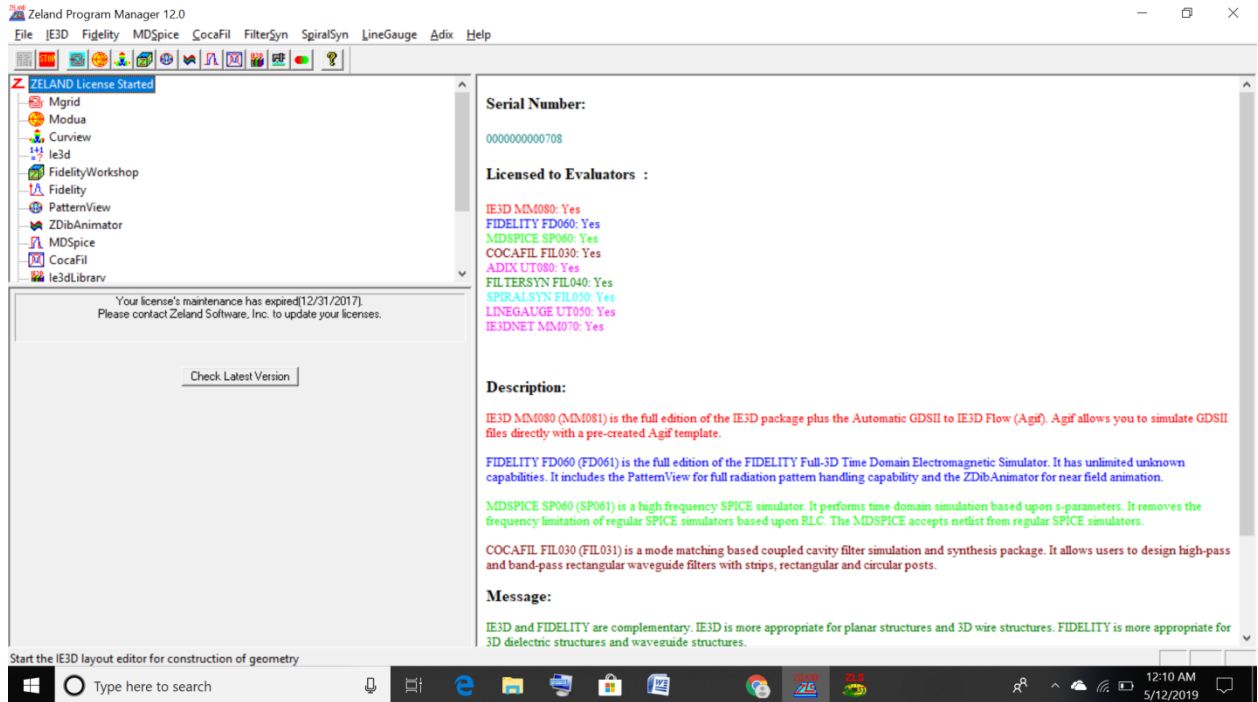


Figure 23.

CHAPTER 4

ANTENNA SIMULATION IN IE3D

1 Open mgrid



2. The fundamental parameter definition window springs up. In this window fundamental parameters of the recreation, for example, the dielectric steady of various layers, the units and design measurements, and metal sorts among different parameters can be characterized by clients. In "Substrate Layer" segment two layers are naturally characterized. At $z=0$, the program naturally puts an interminable ground plane (note the material conductivity at $z = 0$) and a subsequent layer is characterized at limitlessness.

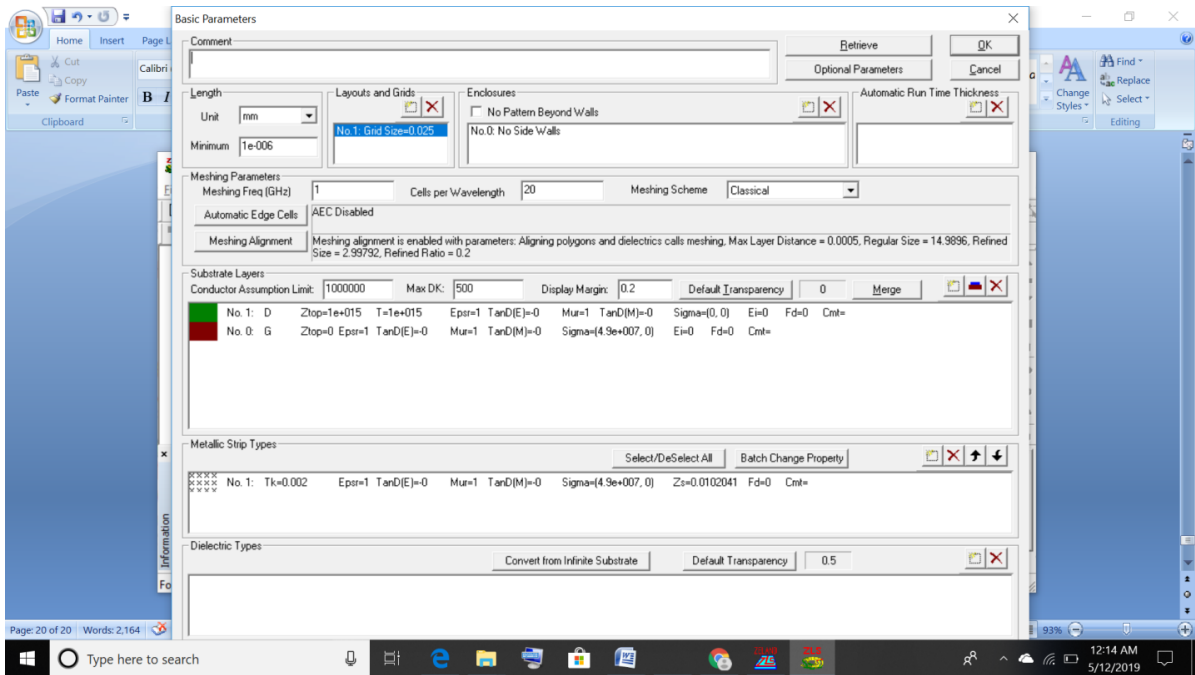
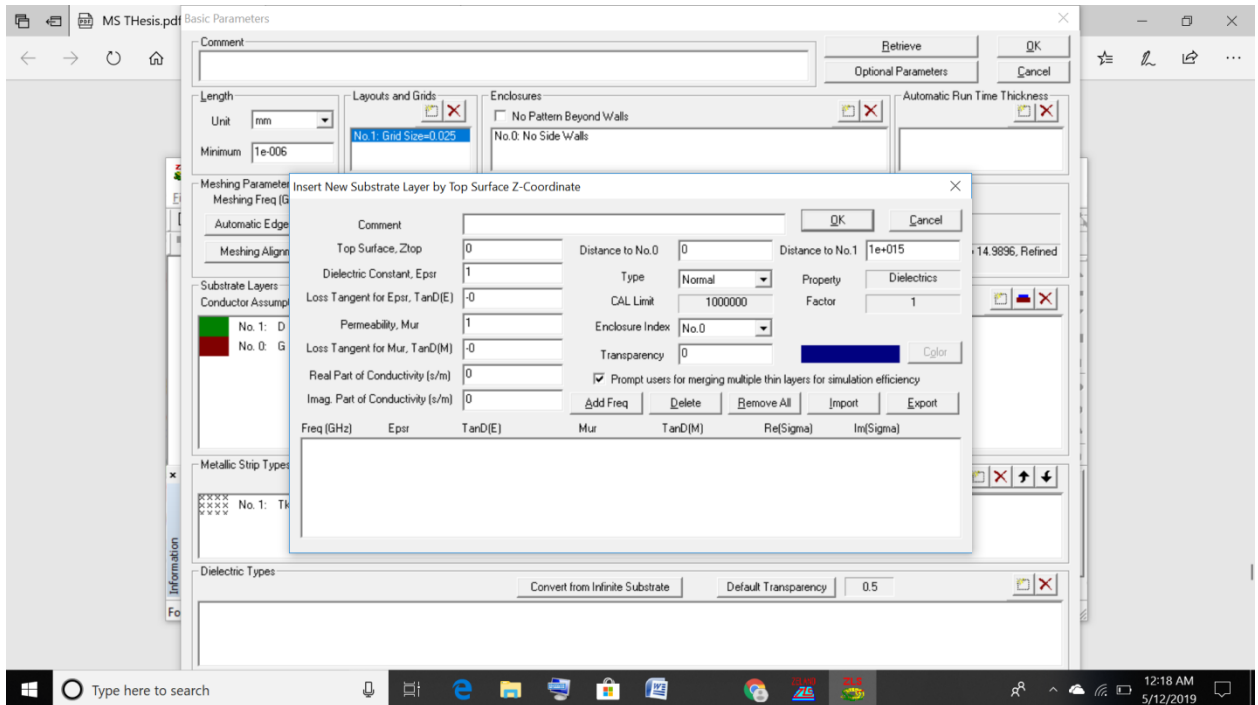
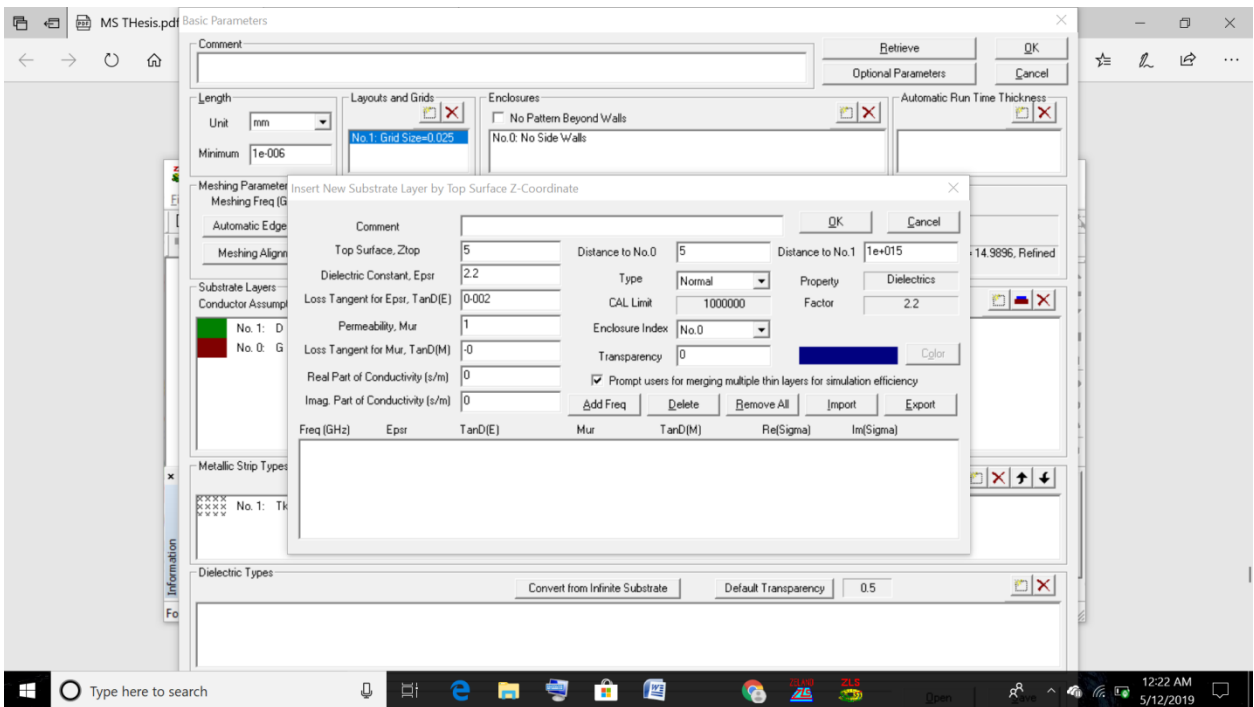


Fig 4.2

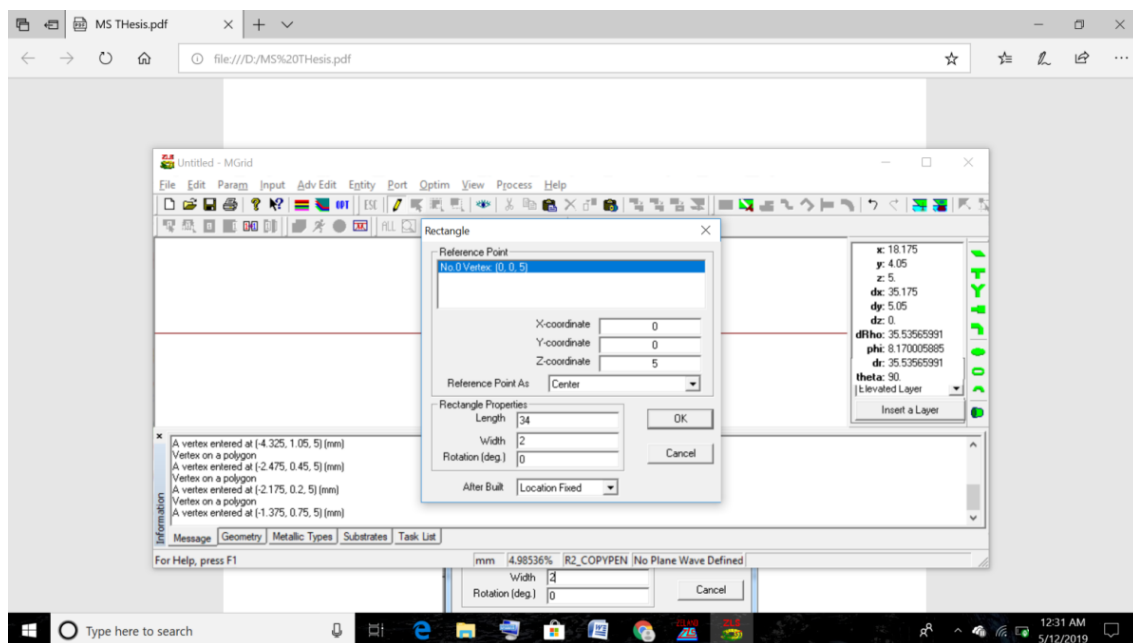
3. Click on "New Dielectric Layer" button (). Enter the basic dielectric parameters in this window: Ztop: 5; Dielectric Constant: 2.2, Loss tangent: 0.002. Click OK.



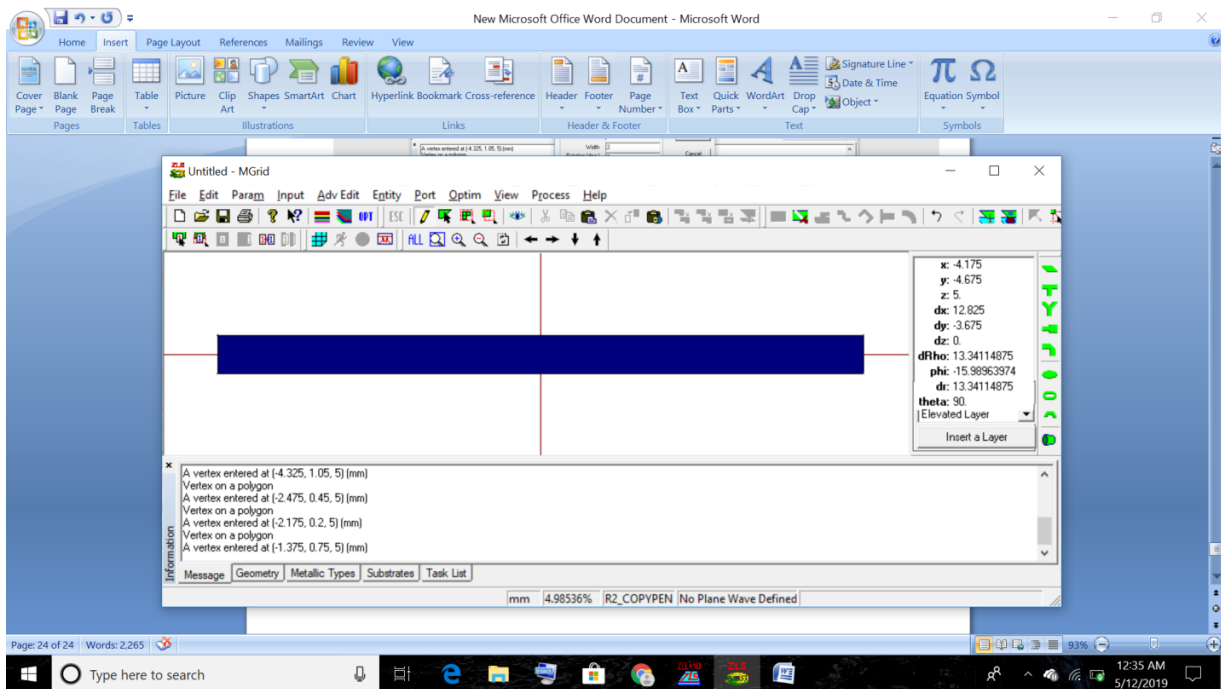
I enter 5 top surface 2.2 of dielectric constant .002 for loss tangent then press ok



Click OK again to go back to MGRID window. In Menu bar click Entity>Rectangle. Rectangle window pops up, enter Length 34, width 3 and click OK,

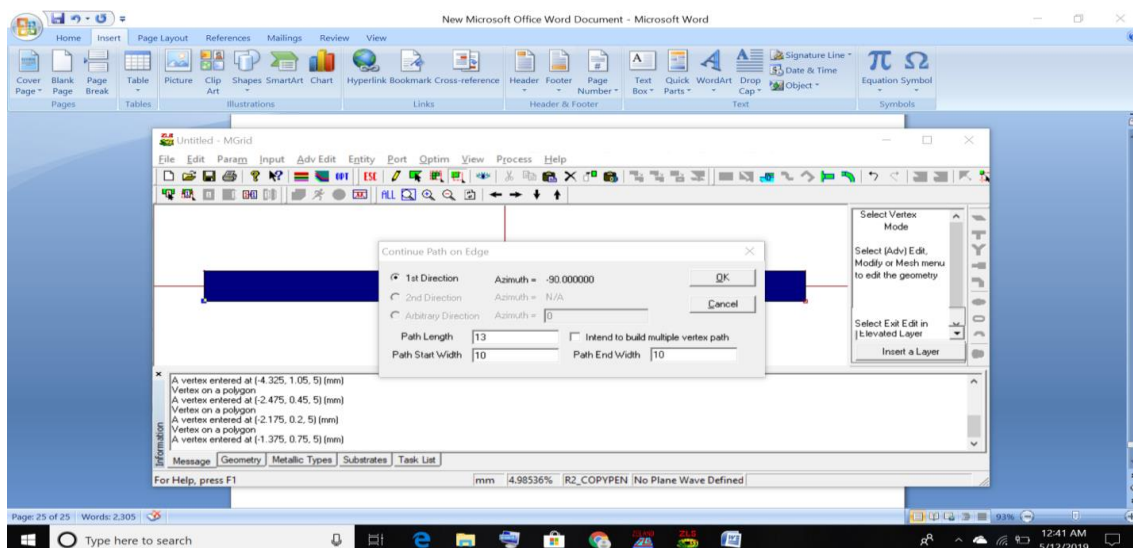


Then I Click ALL button to see the whole structure. Select two lower vertices. Click Adv Edit>Continue Straight Path. Continue Path on Edge window pops up. Enter Path Length 13, Path Start Width 10, Click OK. This shape comes clicking ok



Fig

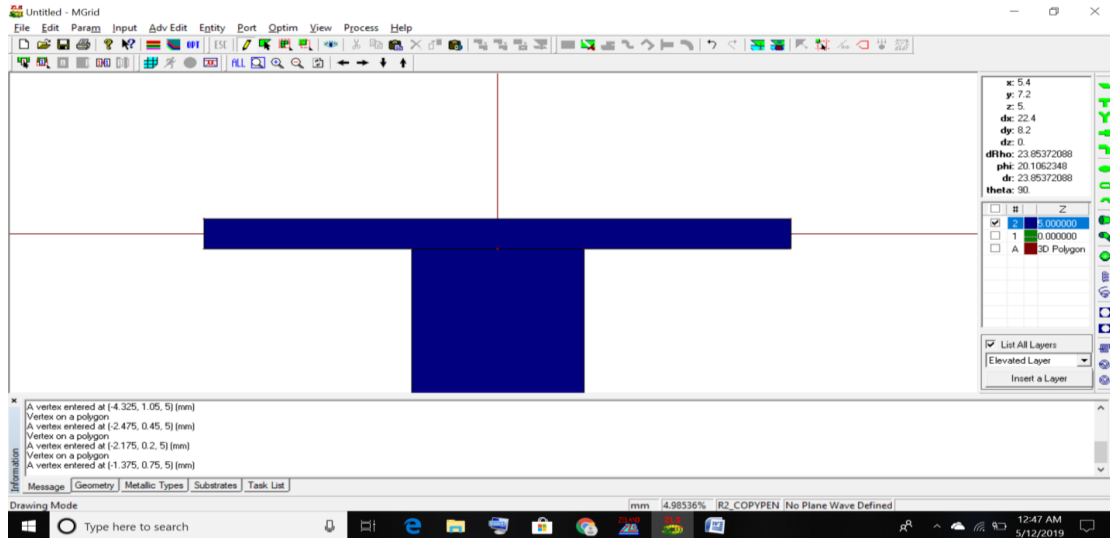
Click ALL button to see the whole structure. Select two lower vertices. Click Adv Edit>Continue Straight Path. Continue Path on Edge window pops up. Enter Path Length 13, Path Start Width 10, Click OK



Fig

Click Input>Key In Absolute Location. New window pops up, enter X coordinate -17, Y coordinate -1.5. Click OK. Program would ask to connect, always click YES. Then click Input>Key In Relative Location.

Another window pops up, enter X coordinate 9, Y coordinate 0. Click OK. Then again click Input>Key In Relative Location and enter X coordinate 0, Y coordinate -17. Click OK. Press Shift+F or Input>Form Rectangle.



Click Input>Key In Absolute Location. New window pops up, enter X coordinate -17, Y coordinate -1.5. Click OK. Program would ask to connect, always click YES. Then click Input>Key In Relative Location. Another window pops up, enter X coordinate 9, Y coordinate 0. Click OK. Then again click Input>Key In Relative Location and enter X coordinate 0, Y coordinate -17. Click OK. Press Shift+F or Input>Form Rectangle.

Now click Edit>Select Polygon, click on the left arm. Right click on it, from the menu click Copy. Click right mouse button it anywhere in the MGRID panel and click Paste. Click again in the panel. A window pops up. Enter X offset 25, Y offset 0, Click Ok. Antenna structure is now complete. Next we need to connect the feed line to the antenna. Below the figure

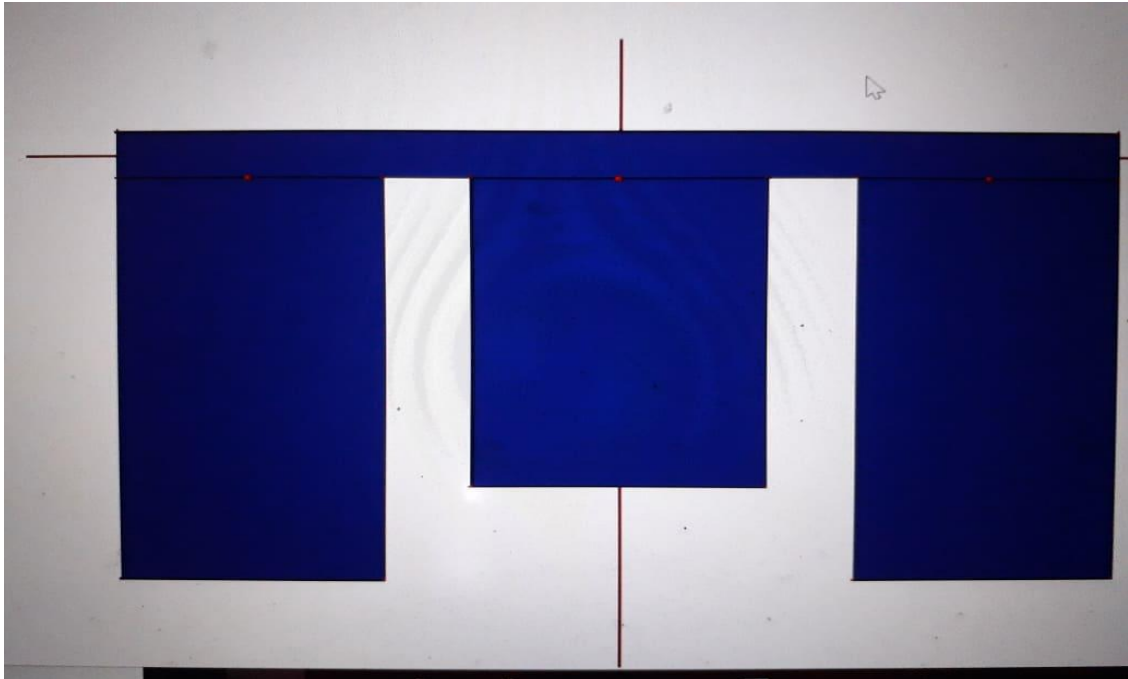


Fig: Complete antenna structure

Then Click Entity>Probe Feed to Patch. Enter (0, -12.8) as feed coordinate and click OK. The antenna is now ready for simulation. The result

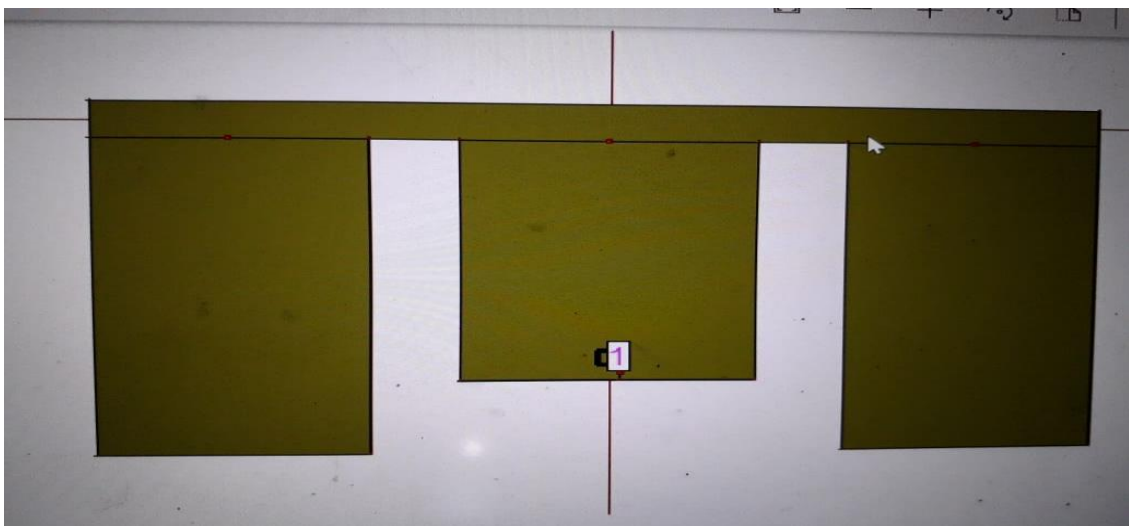


Fig: Antenna Structure with feeding Probe

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