VISVESVARAYA TECHNOLOGICAL UNIVERSITY

MINI PROJECT REPORT ON

"ANALYSIS OF MICROSTRIP TRANSMISSION LINE USING MATLAB"

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CERTIFICATE

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The mini project report has been approved as it satisfies the academic requirements in respect of mini project work prescribed for the said degree.

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ABSTRACT

Nowadays, microwave frequency systems, are used in many Applications. Regardless of the application, all microwave communication systems are faced with transmission line matching problem, related to the load or impedance connected to them. The mismatching of microwave lines with the load connected to them generates reflected waves. Mismatching is identified by a parameter known as VSWR (Voltage Standing Wave Ratio). VSWR is a crucial parameter on deter- mining the efficiency of microwave systems. In medical application VSWR gets a specific importance. The presence of reflected waves can lead to the wrong measurement information, consequently a wrong diagnostic result interpretation applied to a specific patient. For this reason, specifically in medical applications, it is important to minimize the reflected waves, or control the VSWR value with the high accuracy level. In this paper, the transmission line under different matching conditions is simulated and experimented. Through simulation and experimental measurements, the VSWR for each case of connected line with the respective load is calculated and measured. Further elements either with impact or not on the VSWR value are identified. Interpretation of simulation and experimental results allows to judge about improving the VSWR, and consequently increasing the microwave transmission systems efficiency.

we propose the estimation of the characteristic impedance and the effective dielectric constant of microstrip line using quasi static analysis and performances are predicted using theoretical analysis. Numerically efficient and accurate formulae based on the quasi static method for the analysis of microstrip line structures are presented. The analysis formulas for microstrip line are derived and verified with Matlab. Characteristic Impedance of microstrip line for different normalized strip width as well as for different effective permittivity is under consideration in this work.

1.Introduction:

Transmission Lines

Fig.1.1 General Image of Transmission Lines

In an electronic framework, the conveyance of intensity In an electronic framework, the conveyance of intensity requires the association of two wires between the source requires the association of two wires between the source and the heap. At low frequencies, power is considered to and the heap. At low frequencies, power is viewed as conveyed to the heap through the wire. be conveyed to the heap through the wire. In the microwave recurrence district, power is in the microwave recurrence locale, power is viewed as in electric and attractive fields that are viewed as in electric and attractive fields that are guided all around by some physical structure. Any guided all around by some physical structure. Any physical structure that will manage an electromagnetic wave physical structure that will direct an electromagnetic wave here and there is known as a here and there is known as a Transmission Line.

Fig.1.2 Transmission line

An isotropic or omnidirectional electromagnetic source emanates waves similarly every which way. In any event, when the source transmits through a profoundly mandate radio wire, its vitality spreads over a wide territory everywhere separates. This transmitted vitality isn't guided, and the transmission of intensity and data from the source to a recipient is wasteful. For effective point-to-point transmission of intensity and data the source vitality must be coordinated or guided. This can be accomplished by utilizing transmission lines. A transmission line is close to a physical association between two areas through two conductors. Any transmission of vitality through leading or nonconducting media might be viewed as a transmission line. Likewise, any directing of vitality by physical structures might be remembered for this general definition.

Instances of transmission lines incorporate equal leading wires, for example, overhead force transmission lines made of thick links and suspended from towers. Another regular sort of transmission line is the coaxial transmission line which is made of two coaxial conductors: an internal, slim, strong conductor and an external empty round and hollow conductor. The last is normally abandoned to permit greater adaptability and the two directors are protected with some dielectric material. Another sort of transmission line is the equal plate transmission line likewise called the strip line. This line comprises of two equal leading plates isolated by a dielectric chunk of a uniform thickness, for example, strips on printed circuit sheets. A transmission line is typically described by three sorts of parameters:

1. Dimensional parameters: These incorporate length, measurements of every conductor (thickness, width, distance across and so on), separating between lines, thickness of protection,

and so on. These parameters characterize the physical design of the line yet additionally assume a job in characterizing its electrical properties.

2. Material parameters: The line is made of conductors and protectors. The electrical properties of these materials are their conductivities, permittivity, and porousness. These clearly influence the manner in which a line plays out its errand.

3. Electrical parameters: These are the obstruction (R), capacitance (C), inductance (L), and conductance (G) per unit length of the line. R is because of the limited conductivity of the metal transmitters, C is because of the partition of two metal plates with a dielectric, L is because of the inductance of the conveyors and G is because of the dielectric misfortune.

At the point when a wave is driven down a transmission line of boundless length there is no force misfortune because of reflection since the line is interminable. To get total transmission for a limited length of transmission line the line should be ended by an impedance known as the trademark impedance (Z0). On the off chance that a heap equivalent to the trademark impedance is set at the yield end of any length of line, a similar impedance will show up at the information terminals of the line. Trademark impedance is altogether not the same as spillage obstruction of the dielectric isolating the two transmitters, and the metallic opposition of the wires themselves.

It is a component of the capacitance, inductance, opposition and conductance dispersed along the line's length, and would exist regardless of whether the dielectric were great (unbounded conductance) and the wires superconducting .

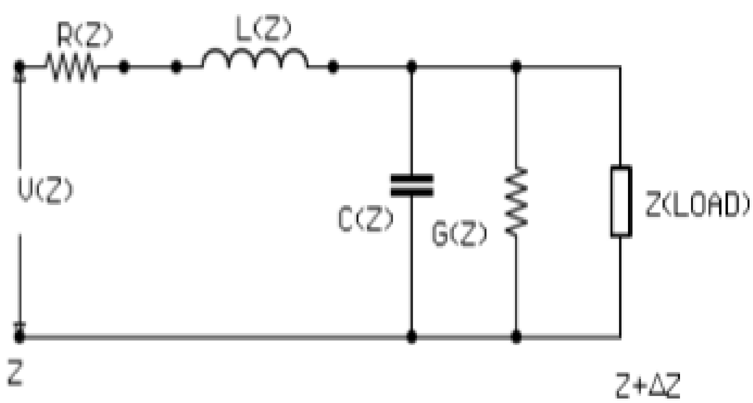

Fig.1.3 circuit Diagram

Types of transmission line:

- Co-axial lines
- Strip lines
- Micro strip lines
- Slot lines
- Coplanar lines

So these project mainly consist of microstrip transmission line

Microstrips

Microstrip is a sort of electrical transmission line which can be created utilizing printed circuit board innovation, and is utilized to pass on microwave-recurrence signals. It comprises of a leading strip isolated from a ground plane by a dielectric layer known as the substrate. Microwave parts, for example, radio wires, couplers, channels, power dividers and so forth can be shaped from microstrip, the whole gadget existing as the example of metallization on the substrate. Microstrip is accordingly significantly less costly than customary waveguide innovation, just as being far lighter and progressively smaller. Microstrip was created by ITT research facilities as a contender to stripline (first distributed by Grieg and Engelmann in the December 1952 IRE procedures).

A microstrip line is, by definition, a transmission line comprising of a strip conduit and a ground plane isolated by a dielectric medium. shows the microstrip geometry. The dielectric material fills in as a substrate and is sandwiched between the strip transmitter and the ground plane. Some run of the mill dielectric substrates are RT/Duroid. The electromagnetic field lines in the microstrip are not contained totally in the substrate. In the event that one fathoms the electromagnetic conditions to discover the field conveyances, one finds practically a totally TEM (transverse electromagnetic) design. This implies there are just a couple of districts in which there is a part of electric or attractive field toward wave proliferation. delineates the semi TEM conduct of microstrip lines. Expecting a semi TEM method of spread in the microstrip line, the stage speed is given by

$$Vp = c \sqrt{^2ef\ f}$$

where c is the speed of light (i.e., 3×108 m/s) and ²ef f is the relative dielectric steady of the microstrip. The successful relative dielectric steady of the microstrip is identified with the dielectric consistent of the dielectric substrate and furthermore considers the impact of the outside electromagnetic fields (i.e., bordering impacts must be thought of).Since

$$Z0 = r\ L\ C$$

And

$$Vp = 1 / \sqrt{LC}$$

the characteristic impedance of the microstrip line can be expressed in the form

$$Z0 = 1\ Vp\ C$$

The wavelength in the microstrip is given by

$$\lambda = Vp\ f = c\ f \sqrt{^2ef\ f} = \lambda 0 \sqrt{^2ef\ f}$$

where λ0 is the free space wavelength.

It is a great idea to have a high dielectric consistent substrate and a moderate wave engendering speed; this lessens the radiation misfortune from the circuits. Notwithstanding, at the higher frequencies . The circuits get incomprehensibly little, which limits the force taking care of capacity. For these applications one frequently picks intertwined quartz. A microstrip is additionally portrayed by its lessening. The lessening steady is an element of the microstrip geometry, the electrical properties of the dielectric substrate and the conduits, and the recurrence. There are two sorts of misfortunes in a microstrip line: a dielectric substrate misfortune and the ohmic skin misfortune in the conveyors. The misfortunes can be communicated as a misfortune for every unit length along the microstrip line as far as the weakening component α. In dielectric substrates, the dielectric misfortunes are typically littler than transmitter misfortunes. In any case, dielectric misfortunes in silicon substrates can be of a similar request or bigger than transmitter misfortunes. Microstrips additionally have radiation misfortunes.

The weaknesses of microstrip contrasted and waveguide are the for the most part lower power taking care of limit, and higher misfortunes. Additionally, in contrast to waveguide, microstrip isn't encased, and is thusly defenseless to cross-talk and inadvertent radiation. For most minimal expense, microstrip gadgets might be based on a customary FR-4 (standard PCB) substrate. However, it is frequently discovered that the dielectric misfortunes in FR4 are excessively high at microwave frequencies, and that the dielectric consistent isn't adequately firmly controlled. Therefore, an alumina substrate is normally utilized.
For a littler scope, microstrip transmission lines are likewise incorporated with solid microwave coordinated circuits.

Microstrip lines are likewise utilized in fast advanced PCB structures, where signs should be directed starting with one piece of the get together then onto the next with insignificant bending, and maintaining a strategic distance from high cross-talk and radiation.
Microstrip is fundamentally the same as strip line and coplanar waveguide and it is conceivable to incorporate every one of the three on a similar substrate.
Microstrip line is one of the most famous kinds of planar transmission lines essentially on the grounds that it tends to be manufactured by photolithographic forms and is effectively scaled down and incorporated with both latent and dynamic microwave gadgets.

A microstrip transmission line is an "elevated level" printed circuit improvement, containing a track of copper or other transport on a securing substrate. There is a "backplane" on the opposite side of the ensuring substrate, surrounded from a similar conductor. Looked at on end, there is a "hot" conductor, which is the track on the top, and an "appearance" conductor, which is the backplane on the base. A microstrip is thusly a variety of a two-wire transmission line.

In case one handles the electromagnetic conditions to find the field scatterings in the area of a microstrip, one finds for all intents and purposes an absolutely TEM (transverse electromagnetic) wave plan.

This suggests there are only two or three territories in which there is a piece of electric or alluring field toward (rather than inverse to the heading of) wave causing. This field configuration is conventionally implied as a Quasi TEM structure.

Since a segment of the electric essentialness that is taken care of in this transport course of action is recognizable all around, and some is in the dielectric, the convincing dielectric predictable for the waves on the transmission line will lie some place near that of the air and that of the dielectric. Regularly, the fruitful dielectric consistent will be 50-85% of the substrate dielectric steady, dependent upon the electromagnetic waves on the microstrip transmission line. For example, in (apparently) an air isolated microstrip, the speed of waves would be c = 3 * 10^8 meters each second. We have to detach this figure by the square establishment of the convincing dielectric consistent to find the certifiable wave speed for the veritable microstrip line.

At 10 GHz the recurrence on that apparently air isolated microstrip is thusly 3 cm; regardless, on a substrate with relative dielectric consistent of 10, the convincing dielectric predictable of the microstrip structure may be 7, and the recurrence is only 3/(sqrt{7}) = 1.13 cm. Thusly, for example, the best length for a microstrip "stub" to be used in stub impedance planning, which is near half frequency, will be just 5.6 mm when created utilizing this substrate. On the other hand, the pulse delay time between point "an" and point "b" will be expanded by almost a factor of 3 utilizing this substrate.

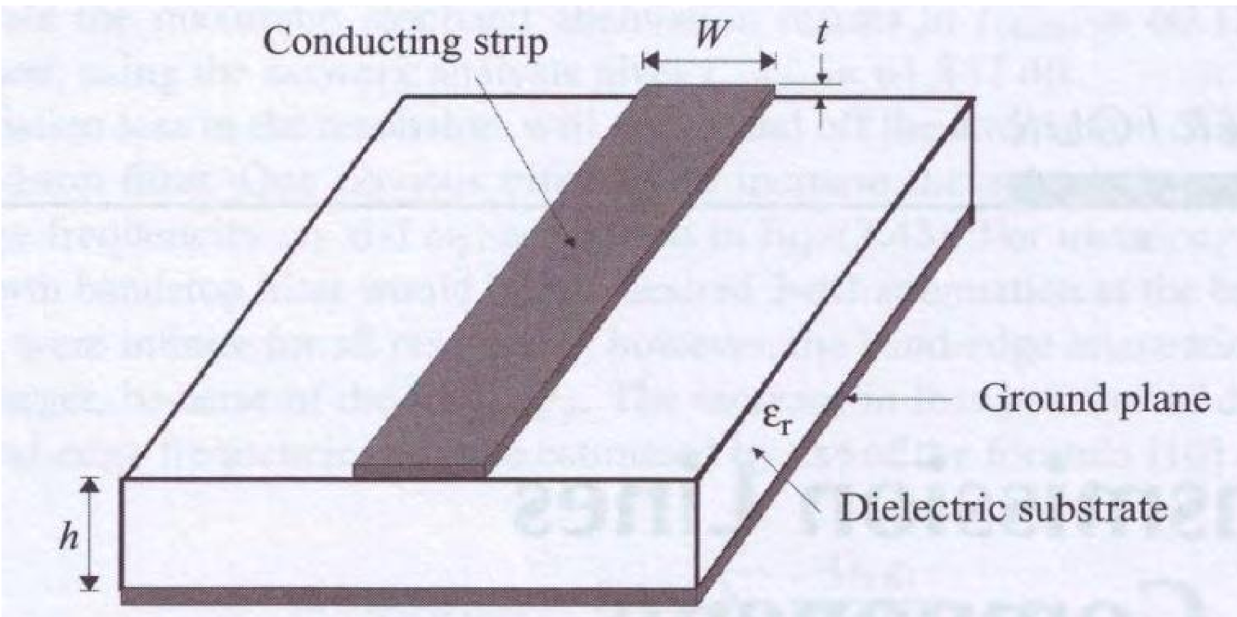

Fig 1.4. general image of microstrip

Analysis of differences between Low Analysis of differences between Low and High Frequency :

At low frequencies, the circuit components are lumped since At, low frequencies, the circuit components are lumped since voltage and current waves influence the whole circuit at a similar voltage and current waves influence the whole circuit simultaneously. time. At microwave frequencies, such treatment of circuit components At, microwave frequencies, such treatment of circuit components is preposterous since voltage and current waves don't influence the is absurd since voltage and current waves don't influence the whole circuit simultaneously. whole circuit simultaneously. The circuit must be separated into unit areas inside the circuit must be separated into unit segments inside which the circuit components are viewed as lumped. which the circuit components are viewed as lumped. to This is because the dimensions of the circuit are comparable to the wavelength of the waves according to the formula:

the wavelength of waves conferring to the formula: c/f

where, c = velocity of light

f = frequency of voltage/current

2.LITERATURE REVIEW :

THEORITICAL ANALYSIS OF MICROSTRIP LINE USING QUASI-STATIC APPROACH

Akanksha lal, Mukesh Kumar, Rohini Saxena

Conceptual In this paper we propose the estimation of the trademark impedance and the powerful dielectric consistent of microstrip line utilizing semi static investigation and exhibitions are anticipated utilizing hypothetical examination. Numerically proficient and exact formulae dependent on the semi static technique for the examination of microstrip line structures are introduced. The examination recipes for microstrip line are determined and confirmed with MATLAB. Trademark Impedance of microstrip line for various standardized strip width just as for various successful permittivity is getting looked at in this work.

Recreation and Measurements of VSWR for Microwave Communication Systems Bexhet Kamo, Shkelzen Cakaj, Vladi Koliçi, Erida Mulla

For the most part, when a transmitter is associated through a transmission line to a reception apparatus, or some other burden con-nected to, these components must match to one another, so as to empower the greatest conceivable vitality move from the transmission line to the radio wire or the heap, and thus having insignificant misfortunes. At the point when the radio wire or burden and transmission line that interfaces the transmit-ter from one side, and the reception apparatus or the heap to the opposite side, are not coordinated, vitality isn't transmitted appropriately. A piece of vitality that originates from transmitter doesn't go to the reception apparatus or the heap however it is reflected back, to the transmitter. Along these lines, a piece of the vitality that originates from the episode wave it is transmitted toward radio wire, or some other burden associated with the line, however its other piece in type of waves is reflected back. Because of the nearness of those waves, in the transmission line, a standing wave is made. In microwave radio arranging, it is important to gauge the voltage standing wave proportion so as to un-derstand the confound level in the transmission line.

3.PROPOSED SYSTEM :

One of the most testing issues related with this arrangement emerges from the way that the little strip isn't drenched in a solitary dielectric. On one side there is the board dielectric, and on the top is normally air. The procedure that has been created to deal with this test utilizes, as was referenced over, the idea of viable relative dielectric steady, ε_{eff}. This worth speaks to some halfway incentive between the relative dielectric consistent of the board material, ε_r, and that of air (accepted equivalent to 1) that can be utilized to figure microstrip parameters just as the strip were totally encircled by material of that viable relative dielectric steady.

One evident preferred position of the microstrip structure is the "open" line which makes it simple to associate parts. Then again, the design doesn't give the "protected" signal line favorable position of the strip line. Another preferred position is that microstrips can be pressed together with genuinely high thickness (different channels) with just negligible "crosstalk" impedance, and thusly loans itself well to RF and microwave IC structure.

Beside the trouble of ascertaining the estimation of ε_{eff}, there is another significant impact. It is clear that ε_{eff} will rely upon both W and h. Subsequently, the stage speed along the microstrip will rely upon these parameters. Assuming the relative permeability of all materials in the line design is well approximated by $\mu_r = 1$, the phase velocity will be given by:

$$u_p = \frac{c}{\sqrt{\varepsilon_{eff}}}$$

Since the trademark impedance (Zo) of the line will likewise rely upon these parameters, each time we have to structure a microstrip with another trademark impedance, we will be confronted with ε_{eff} the extra entanglement of managing an adjustment in stage speed (or postpone time) and therefore, the frequency of waves on that microstrip. Note this isn't an issue with coaxial link or strip line plan.

To get a thought of the scope of εeff, consider the instances of a wide W and afterward a tight W.For a wide microstrip, almost the entirety of the electric field lines will be focused between the metalplanes, like the instance of an equal plate capacitor that you concentrated in material science. Thus:

maximum εeff = εr

On the other extreme, for narrow W the electric field lines will be about equally divided between the air and the board dielectric so that:

minimum εeff = ½(εr + 1)

This gives you a range:

1/2(εr + 1) ≤ εeff ≤ εr

Several different equations have been developed for use in calculating characteristic impedance for microstrip design. Probably the most useful are the following which are reported to be accurate to within about 1%:

$$Z_0 = \frac{60}{\sqrt{\varepsilon_{eff}}} \ln\left(8\frac{h}{W} + \frac{W}{4h}\right)$$

$$\text{where } \varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[\left(1 + 12\frac{h}{W}\right)^{-1/2} + 0.04\left(1 - \frac{W}{h}\right)^2\right] \text{ for } \frac{W}{h} \le 1$$

or

$$Z_0 = \frac{120\pi}{\sqrt{\varepsilon_{eff}}\left[\frac{W}{h} + 1.393 + 0.667\ln\left(\frac{W}{h} + 1.444\right)\right]}$$

$$\text{where } \varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(1 + 12\frac{h}{W}\right)^{-1/2} \text{ for } \frac{W}{h} \ge 1$$

Notice that these are moderately clear conditions for the count of trademark impedance, given W, h, and εeff. Nonetheless, the more valuable count includes assurance ofthe W/h proportion, given a necessary trademark impedance. Here, at that point, is the structure challenge since the conditions are supernatural (don't have a shut structure answer) for the W/h parameter.

As you likely speculated, this is an occupation for MATLAB and its amazing root-discovering calculations.

Presently, just to make things more testing, we'll present a further "adjustment" to the above conditions which is an outcome of thinking about the limited thickness (t) of the microstrip.

This revision is as a "compelling" microstrip width (We), which is utilized to supplant Win those equations:

$$\epsilon_{eff}(f) = \epsilon_r - \frac{\epsilon_r - \epsilon_{eff}}{1+G(f/f_p)^2}$$

$$f_p = \frac{Z_o}{8 \pi h}$$

$$G = 0.6 + 0.009 Z_o$$

S-parameters

RF and microwave systems are frequently described utilizing dispersing or S-parameters. The S-parameters of a system give an away from translation of the transmission and reflection execution of the gadget. The S-parameters for a two-port system are 11 characterized utilizing the reflected or radiating waves, b1 and b2, as the reliant factors, and the occurrence waves, a1 and a2, as the free factors.The general equations for these waves as a function of the S-parameters is shown below:

b1 = S11a1 + S12a2

b2 = S21a1 + S22a2

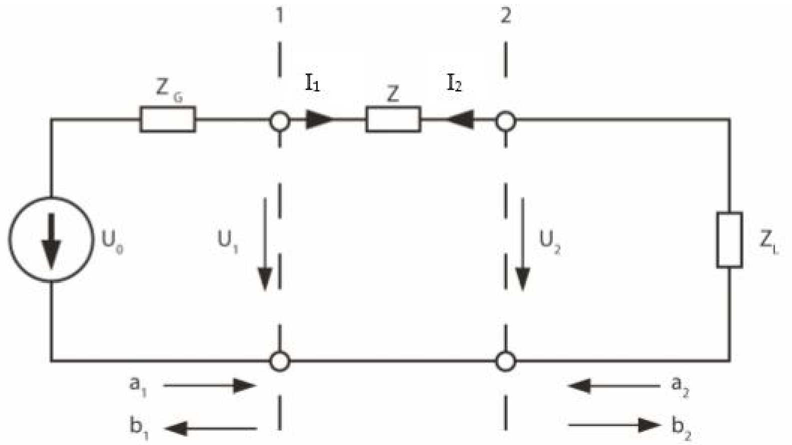

Fig.3.1 s parameters

S11 - Forward Reflection Coefficient

S21 - Forward Transmission Coefficient

S12 - Reverse Transmission Coefficient

S22 - Reverse Reflection Coefficient

Using these equations, the specific S-parameters can be resolute by taking the ratio of the reflected or transmitted wave to the incident wave with a flawless termination placed at the output. S11 = b1 a1 ¯ ¯ ¯ ¯ a2=0

S12 = b1 a2 ¯ ¯ ¯ ¯ a1=0

S21 = b2 a1 ¯ ¯ ¯ ¯ a2=0

S22 = b2 a2 ¯ ¯ ¯ ¯ a1=0

S = � � S11 S12 S21 S22 � � .

These four S-parameters completely defined by the two-port network characteristics. All recent vector network analyzers can easily the measure the S-parameters of a two-port device.

VSWR :

For the most part, a microwave correspondence framework comprises of three fundamental parts:

- Radio transmitter.
- Radio reciever.
- Link/remote channel between two antennas.

The primary components of the transmitter are: oscillator, modulator, speaker and reception apparatus. On other hand the principle components of the beneficiary are: recieving wire, low commotion enhancer, specific channel, nearby oscillator, blender, between intervene recurrence speaker, and demodulator that gives at the yield the sign to be gotten. All components in transmitter or in collector part are associated with one another utilizing transmission lines. In this way, it is too essential to even think about assessing electromagnetic waves transport over these trans-mission lines and what vitality is reflected back because of a confuse For additional investigation it is viewed as a transmission line with impedance Z0 , which is associated with a heap.

On the off chance that ZL varies from Z0 , we have a jumble among burden and line. For this situation, a piece of vitality goes to the heap and a piece of it is reflected back through line to the generator gV.The reflection coefficient along the line is defined

$$\mathrm{VSWR} = \frac{|V_{\max}|}{|V_{\min}|}$$

or, stated by voltage levels, the reflection coefficient is defined by the ratio of the reflected voltage (*Vr*) to the incident voltage (*Vi*), as:

$$\left|V_{\max}\right| = \left|V_i\right| + \left|V_r\right|$$

The incident wave and reflected wave creates so called steady wave at transmission line. The steady wave is taken as the sum of the descending wave that passes along the line to the load and reflected wave that comes back. VSWR is definite as the ratio between maximum and minimum values of the stable wave as

$$\mathrm{VSWR} = \frac{(1+|p|)}{(1-|p|)}$$

EXISTING SYSTEM :

After the detailed analysis of non-linear inductor and non-linear capacitor is carriedout,theseelementsareusedinthetransmissionlineequivalentcircuit models to observe the effect of non-linearity on complex propagation constant. This analysis considers both the elements (inductor and capacitor) as non-linear. This project presents the analysis on low pass equivalent model with non-linear inductors and capacitors.

Thecomplexpropagationconstantanddispersioncharacteristicsareobtained from the unit cell of the transmission line model .To get the complex propagation constant, the scattering matrices are obtained by exciting this unit with a voltage Gaussian pulse. Then the time domain voltages and currents are obtained by solving coupled ordinary differential equation .These coupled differential equations are converted into state-space representation . These equations are solved using the Runge-Kutta method . Allstate-variables such as voltage across the capacitor and currents through the inductors are obtained and then converted into frequency domain with the help of Fourier transform theory . The scattering matrices are obtained from the impedance parameters. MATLAB issued in implementing the equations. The scattering parameters.

Analysisofconventionaltransmissionlinemodelwithnon-linearelements

are used to get the propagation constant using by first determining the effective dielectric constant and effective permeability as suggested in . The same procedure is used for all models of transmission lines.

In the analysis part, four different circuit models have been considered as listed below. • Lowpass equivalent circuit model: In this, three different cases have been considered depending on which element is non-linear.

– Shunt capacitor is non-linear. – Series inductors are non-linear. – Both series inductor and shunt inductors are non-linear.

• High pass equivalent circuit model with shunt branch inductor as nonlinear.

• Lowpass equivalent model with Miller loading.

• High pass equivalent model with Miller loading. In Miller loading two types of loads are considered. Firstly, with the inductive loading and secondly with the capacitive loading .The analysis of Miller loading has been presented in next chapter.

Lowpass equivalent circuit model

The unit cell of the lowpass equivalent circuit model is also called as forward waves supporting structure. This circuit model is analyzed in three different cases. Initially with shunt capacitor as non-linear alone, secondly with the series inductors as non-linear and thirdly with both the series and shunt elements as non-linear.

4.Software specifications :

What Is MATLAB?

MATLAB is a superior language for specialized processing. It coordinates calculation, perception, and programming in a simple to-utilize condition where issues and arrangements are communicated in recognizable scientific documentation. Normal uses include:

- Math and calculation
- Algorithm improvement
- Modeling, reproduction, and prototyping
- Data investigation, investigation, and perception
- Scientific and building designs
- Application improvement, including Graphical User Interface building

MATLAB is an intuitive framework whose fundamental information component is a cluster that doesn't require dimensioning. This permits you to take care of numerous specialized processing issues, particularly those with framework and vector details, in a small amount of the time it would take to compose a program in a scalar noninteractive language, for example, C or Fortran.

The name MATLAB represents framework research center. MATLAB was originally composed to give simple contact to lattice programming created by the LINPACK and EISPACK ventures, which organized speak to the best in class in programming for framework calculation.

MATLAB has progressive over a time of years with influence from numerous clients. In college situations, it is the standard instructional device for starting and propelled courses in arithmetic, designing, and science. In industry, MATLAB is the device of decision for high-efficiency research, advancement, and examination.

MATLAB highlights a group of utilization explicit arrangements called tool stash. Important to most clients of MATLAB, tool compartments permit you to learn and apply specific innovation. Tool compartments are complete assortments of MATLAB capacities (M-documents) that stretch out the MATLAB condition to take care of specific classes of issues. Territories in which tool kits are accessible incorporate sign preparing, control frameworks, neural systems, fluffy rationale, wavelets, reproduction, and numerous others.

The MATLAB framework comprises of five principle parts:

- The MATLAB language.

This is an elevated level framework/exhibit language with control stream articulations, capacities, information structures, input/yield, and item arranged programming highlights. It permits both "programming in the little" to quickly make down to business discard projects, and "programming in the huge" to make total huge and complex application programs.

- The MATLAB working condition.

This is the arrangement of devices and offices that you work with as the MATLAB client or developer. It remembers offices for dealing with the factors for your workspace and bringing in and sending out information. It likewise incorporates apparatuses for creating, overseeing, troubleshooting, and profiling M-records, MATLAB's applications.

- Handle Graphics.
  This is the MATLAB illustrations framework. It incorporates significant level orders for two-dimensional and three-dimensional information perception, picture handling, movement, and introduction illustrations. It likewise incorporates low-level orders that

permit you to completely tweak the presence of illustrations just as to assemble total Graphical User Interfaces on your MATLAB applications.

- The MATLAB scientific capacity library.

This is an immense assortment of computational calculations going from rudimentary capacities like aggregate, sine, cosine, and complex math, to progressively refined capacities like lattice reverse, grid eigenvalues, Bessel capacities, and quick Fourier changes.

- The MATLAB Application Program Interface (API).

This is a library that permits you to compose C and Fortran programs that connect with MATLAB. It in-corporate offices for calling calendars from MATLAB (dynamic connecting), calling MATLAB as a computational motor, and for examining and composing MAT-records.

Advantages and Disadvantages of Microstrip line

Advantages :

- MICs can be designed with microstrip within a frequency range of few gigahertz to few tens of gigahertz.
- Microstrip lines are generally rugged structure capable of a withstanding large voltage and power.
- Transmission of both ac and dc signals are possible.
- Convenient to mount discrete devices owing to easy accessibility to top surface. Moreover, minor adjustments are possible even after fabrication of the circuit.
- The microstrip line wavelength reduces to one-third of its free space value owing to the substrate fields. Hence the distributed components diameters are relatively small.

  Some of their principal advantages are given below:

  1. Light weight and low volume.
  2. Low profile planar configuration
  3. Low fabrication cost,
  4. It Supports both, linear and circular polarization.
  5. Can be easily integrated with microwave integrated circuits
  6. Capable of dual and triple frequency operations.
  7. Mechanically robust when mounted on rigid surfaces.

Disadvantages :

- As most of the fields in a microstrip line is concentrated in the dielectric substrate hence considerably changes in the impedance and guide wavelength occurs owing to a slight change in ε, due to temperature variations or batch-to-batch variation.
- At high frequency the circuit dimension are very small thereby leading to problems in fabrication.
- Thinner substrate microstrip line permits high frequency operation but with a low quality factor.
- The conductor loss in a microstrip lines increases with increase in frequency. The lines can safely be used up to about 50GHz.

Some of their major disadvantages are given below:

1) Narrow bandwidth
2) Low efficiency
3) Low Gain
4) Extraneous radiation from feeds and junctions
5) Low power handling capacity
6) Surface wave excitation

APPLICATIONS :

Microstrip fix radio wires are expanding in ubiquity for use in remote applications due to their position of safety structure. Consequently, they are very good for implanted reception apparatuses in handheld remote gadgets, for example, mobile phones, pagers and so on.

The telemetry what's more, correspondence radio wires on rockets should be slim and conformal and are regularly microstrip fix reception apparatuses. Another zone where they have been utilized effectively is in satellite correspondence. And furthermore, Directional couplers are key segments in Network Analyzers for the straight portrayal in basically all RF/Microwave frameworks.

They can be utilized as force dividers what's more, are found in some blender applications. Couplers can be utilized in the acknowledgment of stage shifters and in the development of the Butler lattice utilized for taking care of staged exhibit radio wire frameworks. The coupled-line coupler is one of the fundamental structure squares for planar channel union. We will presently give a short diagram of a portion of the assorted utilizations of couplers to grasp investigating new topologies, for example, the MS/NRI-TL coupled-line coupler, which is the subject of this exposition.

- ## Reflectometry

The measurement of the scattering or S-parameters of a microwave network requires the ability to distinguish between the forward and backward travelling waves in the main signal line. This necessitates a linear device with directional properties such as a coupler. The key parameter of the coupler in such an application is its directivity, which is the difference between its coupling level and isolation on a logarithmic scale. The top line is the main signal line carrying power to the device under test and it is coupled to a second line with the assumption of infinite directivity. If the power is coupled backwards, then the measurements at port 1 and port 2 are proportional to the incident wave (solid line arrow) power and reflected wave (broken line arrow) power respectively. When the directivity is finite, some of the incident power appears in port 2 and a portion of the reflected power in port 1 Hence the directivity sets a lower limit to the reflected power which can be measured accurately.

- ## RF/Microwave power division

Couplers can also be used in power distribution networks such as those designed to feed antenna arrays. A popular feed network known as the Butler matrix . Each input port excites the output ports (ports 5 to 8) with equal amplitudes but a different progressive phase-shift. Hence such a network can be connected to an antenna array and the input power can be switched between ports 1 to 4 to steer the main beam of the array.

We notice the use of 4 branch-line hybrid couplers to implement the 4 × 4 Butler matrix. The structure also depicts 2 microstrip cross-over junctions each of which involves two juxtaposed branch-line couplers allowing the signal to cross past each other without the need for a multi-layer configuration.

- **Phase shifters**

A single matched transmission line can be used as a phase-shifter that provides a predetermined phase lead/lag between its input and output terminals. More sophisticated varieties that offer tunable phase shift can take the form of multiple sections of transmission lines that are switched using PIN-diodes. some of the examples are The first example that we will discuss is the Schiffman phase shifter which is used due to its broad bandwidth .

This topology provides a differential out-of-phase signal between the ports 2 and 3 in when an input signal is applied to port 1. This can also be achieved using two transmission-line segments one of which is half wavelength longer than the other at the design frequency; but such an approach is narrowband. The differential phase in this case rapidly diverges from π beyond the center frequency as the phase shift of the longer line increases faster with frequency compared to the shorter one.

5.RESULT AND DISCUSSION :

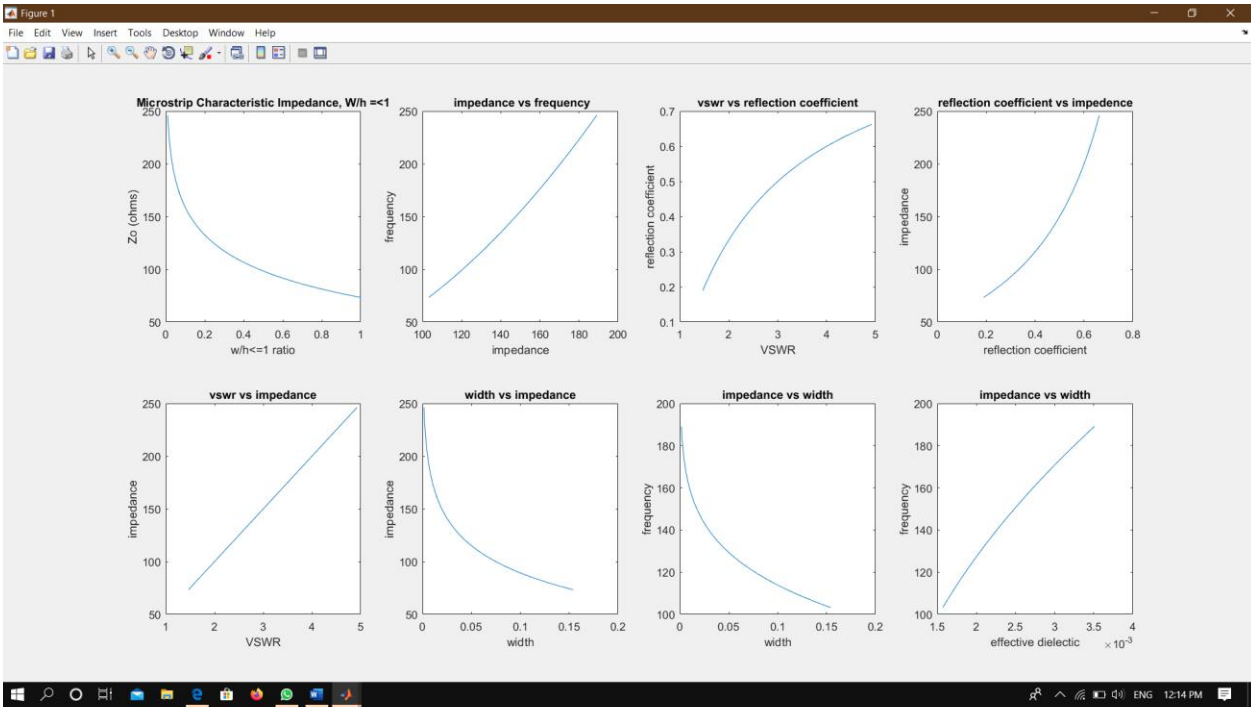

Fig 5.1 when r<1

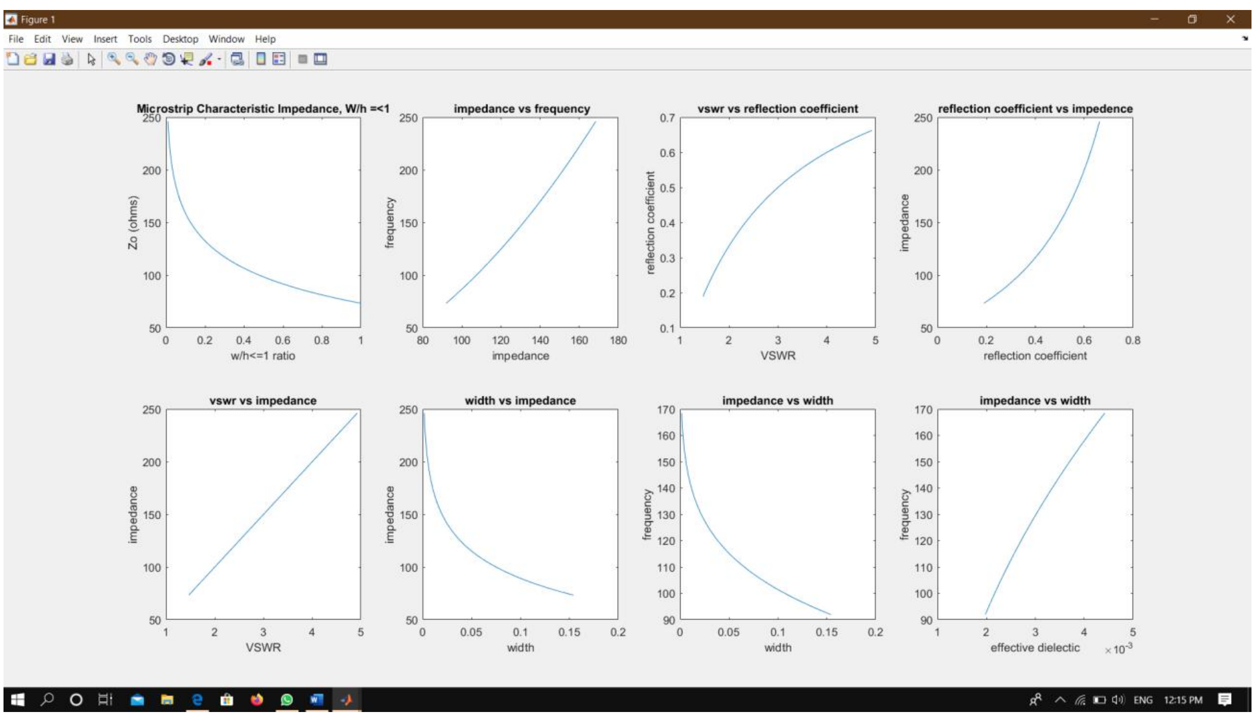

Fig 5.2 when r>1

6.FUTURE SCOPE :

Several aspects of the MS/NRI-TL coupled-line system that need further studies include the effects of loss, dispersion and the modelling of electrically large loading elements. The effect of dissipation has been examined only superficially through full-wave and circuit simulation and needs further study to determine their effects on the complex-mode band dispersion, line impedance and insertion loss of the system. Losses along with the loading reactances will limit the power handling capability of this coupler and this is yet to be investigated.

The accuracy of the circuit model developed in this work to analyse the MS/NRI-TL coupler is limited primarily by the dispersive nature of the underlying microstrip line and those of the electrically large 'lumped' loading. We compensated for dispersion by extracting the per-unit-length parameters at the design frequency and this provided us with good agreement between simulation and theory over a bandwidth less than 10 GHz. If such couplers are to be incorporated in systems with much larger bandwidth requirements such as microwave measurement systems, then the effects of dispersion merits further study.

CONCLUSION :

Analysis of microstrip transmission lines in MATLAB has been presented. Transmission lines are successfully analysed to operate at specified dielectric constant, with specified height, width and load impedance. For specified (e.g. 0 to w/h, 1 to w/h) microstrip transmission line parameters, impedance, strip width, VSWR, and reflection coefficient of the transmission lines are obtained .

The inputs are dielectric constant, height, width, load impedance.

The output of the project is

- Graph of Microstrip characteristic Impedance,W/h<=1
- Graph b/w Impedance vs Frequency
- Graph b/w VSWR vs Reflection coefficient
- Graph b/w Reflection coefficient vs Impedance
- Graph b/w VSWR vs Impedance
- Graph b/w width vs Impedance
- Graph b/w Impedance vs width
- Graph of Effective Dielectric

APPENDIX :

```
% Microstrip characteristic impedance plot, W/h ? 1

er=input('enter the dielectric constant')

w=input('enter the width')

h=input('enter the height')

ZL=input('enter the load')

r=w/h

if r<=1

r=[0.01:0.01:1]

efif=(er+1)/2+((er-1)/2)*((1+12./r).^(-1/2)+0.04*(1-r).^2)

Zo=(60./sqrt(efif)).*log(8./r+r/4)

f=0.3*sqrt(Zo/h*(sqrt(er)-1))

t=((ZL-Zo)./(ZL+Zo))

VSWR=((1+t)./(1-t))

fp=Zo./(8*3.14*h)

g=(0.6+Zo.*(0.009))

eff=0;

eff=er-((er-eff)./(1+g.*(f/fp).^2))

wff=0;

wff=w+((wff-w)./(1+(f/fp).^2))
```

```
subplot(2,3,1)

plot(r,Zo)

xlabel('W/h ratio')

ylabel('Zo (ohms)')

title('Microstrip Characteristic Impedance, W/h <1')

subplot(2,3,2)

plot(f,Zo)

xlabel ('impedance')

ylabel('fo')

title('r vs impedance')

subplot(2,3,3)

plot(VSWR,t)

xlabel('VSWR')

ylabel('reflection coefficient')

title('r vs impedence')

subplot(2,3,4)

plot(t,Zo)

ylabel('impedence')

xlabel('reflection coefficient')

title('r vs impedence')
```

```
subplot(2,3,5)
plot(VSWR,Zo)
ylabel('impedence')
xlabel('VSWR')
title('r vs impedence')
subplot(2,3,6)
plot(wff,Zo)
ylabel('impedence')
xlabel('VSWR')
title('r vs impedence')
 end
% for case 2
if r>1
 r=[1:0.01:5]
eff=(er+1)/2+((er-1)/2)*(1+12./r).^(-1/2)
Zo=(120*pi)./(sqrt(eff).*(r+1.393+0.667*log(r+1.444)))
f=0.3*sqrt(Zo/h*(sqrt(er)-1))
t=((ZL-Zo)./(ZL+Zo))
VSWR=((1+t)./(1-t))
fp=Zo./(8*3.14*h)
```

```
g=(0.6+Zo.*(0.009))
eff=0;
eff=er-((er-eff)./(1+g.*(f/fp).^2))
subplot(2,3,1)
plot(r,Zo)
xlabel('W/h ratio')
ylabel('Zo (ohms)')
title('Microstrip Characteristic Impedance, W/h ?>1')
subplot(2,3,2)
plot(f,Zo)
xlabel('impedence')
ylabel('freq')
title('Microstrip Characteristic Impedance, W/h ?>1')
subplot(2,3,3)
plot(VSWR,t)
xlabel('VSWR')
ylabel('reflection coefficient')
title('Microstrip Characteristic Impedance, W/h ?>1')
subplot(2,3,4)
plot(t,Zo)
```

```
ylabel('impedence')

xlabel('reflection coefficient')

title('Microstrip Characteristic Impedance, W/h ?>1')

subplot(2,3,5)

plot(VSWR,Zo)

ylabel('impedence')

xlabel('VSWR')

end
```