PERFORMANCE ANALYSIS ON EDGE-COUPLED MICRO-STRIP BAND PASS FILTER FOR KU BAND

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APPROVAL

This Thesis titled **"Performance Analysis On Edge-coupled Micro-strip Band pass filter for KU band"** submitted By Md. Mejba Uddin, Md. Mizanur Rahman and Shahin Alam to the Department of Electronics and Telecommunication Engineering (ETE), Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Electronics and Telecommunication Engineering and approved as to its style and contents. The presentation was held on May, 2018.

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DECLARATION

We hereby declare that this project is our own work and effort under the supervision of **Prof. Dr. A.K.M. Fazlul Haque, Professor, Department of Electronics and Telecommunication Engineering and Associate Dean, Faculty of Engineering,** Daffodil International University, Dhaka. It has not been submitted anywhere for any award. Where other sources of information have been used, they have been acknowledged.

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ABSTRACT

The primary purpose of this report is more to brief to the reader with a detailed and comprehensive study of theory, design, and result in the designing Edge coupled micro-strip band pass filter. This filter design is operate at frequency 12.2-12.7GHz. The approaches used to achieve this thesis are through literature review of micro-strip filter including calculation, and computer software simulation. Micro-strip technology is the best technique because it is can give accurate value and economical. This technology is design to reduce the cost compared to conventional filter that had been used before. The band pass filter has several types and design but this thesis is focused on the edge-coupled band pass filter to determine the suitable parameters. Ansoft designer SV2 Software is used to analyze the characteristic parameter and determine the insertion loss and return loss of frequency response that has been used to analyze performance quality. The band pass filter contributes to the application of satellite downlink frequency. This thesis exposes to the evaluation process of analyze edge-coupled micro-strip band pass filter.

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Introduction

1.1 Introduction

The limit of a channel is to empower a particular extent of frequencies to pass while to diminish the others. Subsequently unmistakably there is a pass-band and a stop-band. Ideally in the pass-band there should to be no tightening while in the stop-band there should to be most extraordinary debilitating. Regardless, with bona fide parts, for instance, inductors, capacitors, transmission lines and waveguides that isn't the circumstance [1]. Despite the ideal case in the pass-band there is some narrowing, which can be controlled by improving the arrangement and by suitable choice of sections. Correspondingly in the stop-band the choking can be controlled. Channels can be low-pass, high-pass, band-pass, and band-expel type. Channels are a champion among the most part used for radio repeat and furthermore for microwave trades [2] [3].

Stations are indispensable devices, in various systems and applications including remote broadband, versatile, and satellite correspondences, radar, course, distinguishing and diverse structures. Channels are liberally repeat specific parts. The isolating behavior comes to fruition repeat subordinate reactance gave by inductors and capacitors. At cut down frequencies lumped segment inductors and capacitors can be used to setup channels while at microwave frequencies lumped segment inductors and capacitors can't be used and in this way transmission line sections are used which bear on as inductors and capacitors.

Restricting the disasters in the pass-band of a channel is basic since it not simply diminishes the general setbacks for a transmitter yet moreover upgrades the hullabaloo figure when used with a recipient. The movement in the diagram of microwave channels was affected by the essentials of different systems they were made for. Generally these are military structures, satellite Communications systems, cell correspondence base-stations, and cell radio handsets. The essential repeat bunches used by these and distinctive remote correspondence structures are spread all through a wide range, from a couple of numerous MHz to a couple of a few GHz [4]. From this time forward a broad assortment of resonators and channels can be associated with these repeat bunches with a particular true objective to give the best response for the distinctive application requirements.

1.2 Objective of this paper:

The target of this venture is to outline an edge coupled band pass channel by Micro strip line for the recurrence scope of 12.2 GHz - 12.7 GHz [4]. The conceivable result of this proposal is, get the most extreme return misfortune at focus recurrence and reflection coefficient is close to zero. Likewise watch the arrival misfortune parameter for smaller scale strip and strip line plan.

1.3 Chapter over view:

In this project, the illustrated scaled down scale strip edge coupled band pass channel for 12.2 GHz - 12.7 GHz. To go to the stage to plan such a BPF progressive philosophies have been taken. These appraisals are gathered here in this proposition paper. In where section examined the outline of this task. Part 2 dialed with the Microwave channels and their attributes, diverse sorts of channel and use of them, and meaning of some vital terms are talked about in this section. Smaller scale strip band pass channel is cleared up in Chapter 3. The general hypothesis of Micro strip band pas channel plan, recurrence reaction of different channel, and substrate materials are talked about in this part. n remote interchanges band-pass channels are the most broadly utilized. For the outline of small scale strip band-pass channels, a few different procedures exist and a large portion of proposed novel channels with cutting edge qualities depend on these few structures. Part 4 is about the Filter Design and Simulation. In this part we have planned the LPF, LPF to BPF change, and physical and electrical model outline of the channel are examined. Part 5 is about the Simulated Result and Discussion. What's more, in this part we have demonstrated our reenacted result for the edge coupled miniaturized scale strip band pass channel for 12.2-12.7GHz .We additionally demonstrated the examination between strip line band pass channel and small scale strip band pass channel. It likewise examine the Return misfortune parameter and Insertion misfortune parameter for the small scale strip band pass channel and strip line bans pass channel. Furthermore, Chapter 6 is about the Conclusion, Concluding dialog, Future works are spoken to in this section and the results of this venture.

Chapter 2

MICRO STRIP ANTENNA ANDFILTER

2.1 Micro Strip Antenna

Micro strip is one sort of electrical transmission line which is manufactured in PCB (printed circuit board). To pass on flag of microwave recurrence micro strip can be utilize

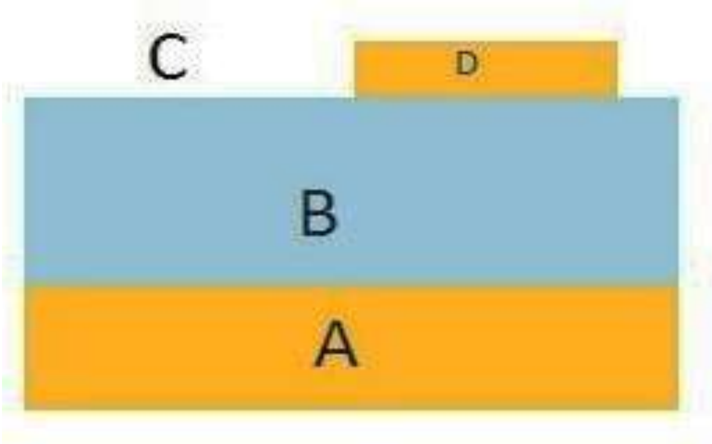

Figure 2.1: Cross section of Micro strip

In the past figure a micro strip is appeared from side view. In the setup of micro strip "D" is the ground plane, "B" is the dielectric substrate, "D" is the conveyor lastly "C" is the upper dielectric substrate. For the most part this upper dielectric substrate is air or vacuum. Radio wire, coupler, channel, control divider and so forth of microwave segments can be made with micro strip. So we can state micro strip receiving wire as a printed reception apparatus [3].

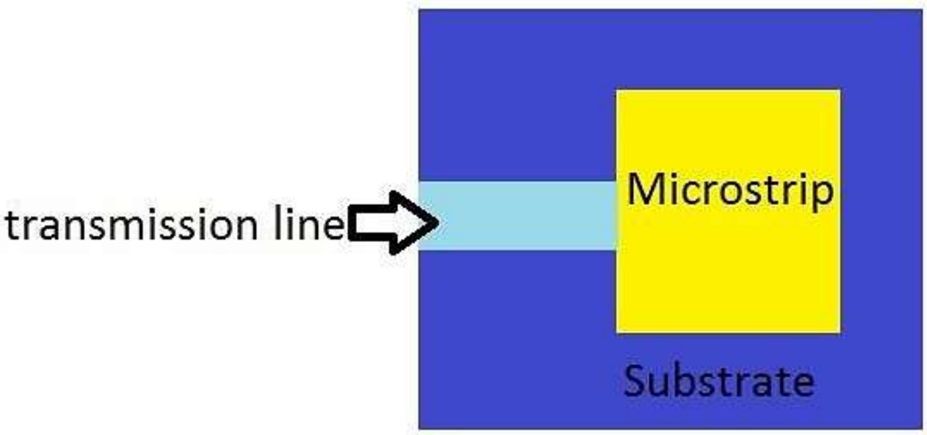

Figure 2.2: Configuration of a micro strip patch antenna

2.2Micro strip antenna classifications

Mainly there are two types of micro strip antenna. They are-

- Rectangular Micro strip (patch)antenna
- (PIFA) Planner Inverted-Fantenna

The micro strip also can be classified in two types-

a) Micro strip patch (Regular)antenna
b) Micro strip Slot antenna

2.2.1 Micro strip Patch Antenna

Micro strip radio wire is otherwise called smaller scale strip fix reception apparatus is a sort of print receiving wire. It is a position of safety radio reception apparatus which can be mounted at any surfaces. For the most part smaller scale strip fix receiving wire is connected for microwave recurrence at correspondence [5]. There is a figure given beneath that is composed in HFSS.

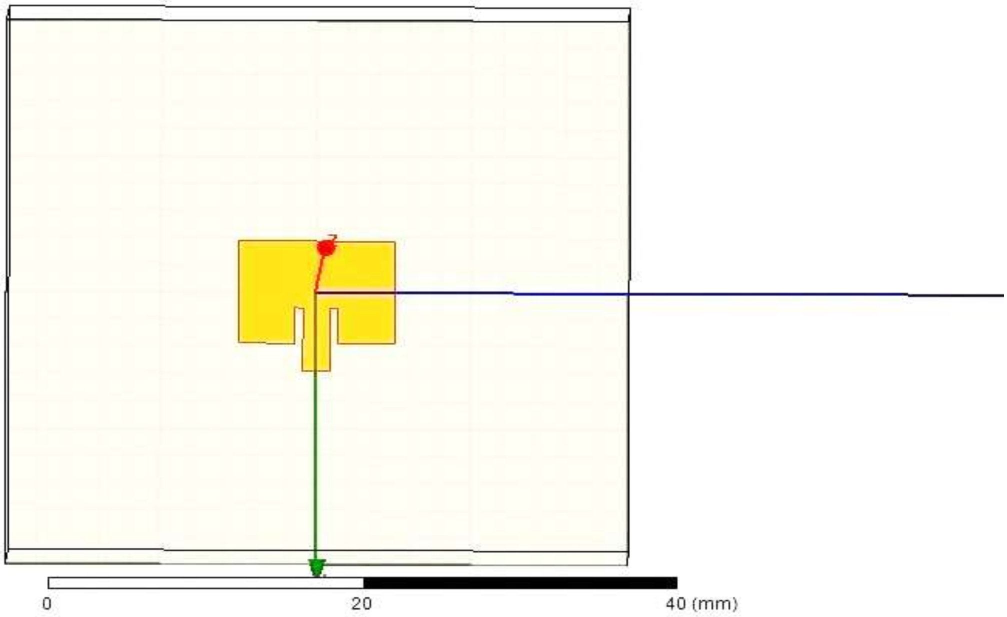

Figure 2.3: Micro strip patch antenna (Designed in HFSS)

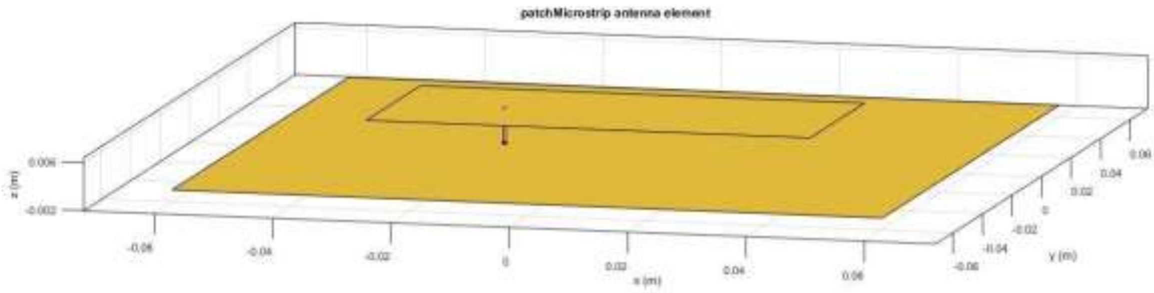

Figure 2.4: Micro strip Patch Antenna (designed in MATLAB)

2.2.2 Applications of Micro strip patch Antenna

There are so many application fields of micro strip patch antenna. Some of the application fields are given below.

I. Mobile and satellite communication applications
II. GPS (global positioning system)applications
III. RFID (radio frequency identification)
IV. WiMAX (worldwide interoperability for Microwave access)
V. Application of Rectenna (rectifier antenna)
VI. RADAR (radio detection and ranging)applications
VII. Applications on Telemedicine

2.2.3 Advantages of Micro strip patch Antenna

Micro strip patch is one of the most flexible antennas. So it has so many advantages.

Advantages of micro strip patch antenna are given.

I. Due to fabrication in PCB this antenna has very low weight.
II. Low profile.
III. Thin profile due to fabrication.
IV. No cavity backing is required.
V. Have linear and circular polarization in practical.
VI. Can be made tunable. So it can operate at two or three frequencies.

VII. Matching network (impedance matching) and feed line can be fabricated simultaneously.

2.2.4Limitations of Micro strip patch Antenna

In spite of having many advantages, micro strip patch antenna has few limitations as follows:

I. Low gain.
II. Have low efficiency.
III. In fabrication of array structured in feeding large ohmic loss occurred in the micro strip antenna.
IV. Surface wave excitation.
V. Power handling capacity is low.
VI. For fabricating of high performance array feeding structure will be more complex.

2.3 Micro strip Slot Antenna

Rectangular micro strip radio wire is generally called littler scale strip settle gathering contraption is a kind of print receiving wire. It is a place of security radio gathering mechanical assembly which can be mounted at any surfaces. Generally littler scale strip settle receiving wire is associated for microwave repeat at correspondence. There is a figure given underneath that is made in HFSS.

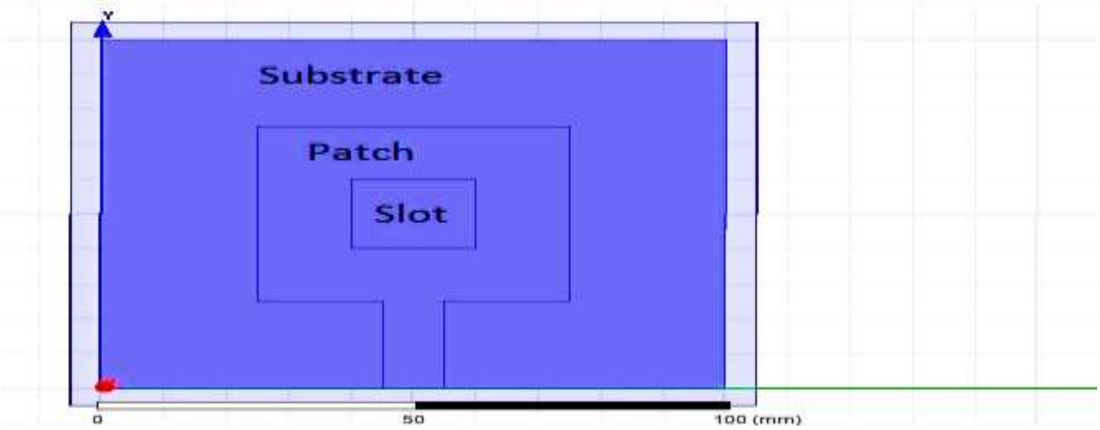

Figure 2.5: Micro strip slot antenna (Designed in HFSS)

2.3.1 Advantages of Micro strip slot Antenna]

Along with the micro strip patch antenna advantages, micro strip slot antenna has more advantages as follows:

I. Due to the patch is cut inside, it will be cost reductive
II. Directivity of micro strip slot antenna is higher than micro strip patch antenna.
III. Pick up of miniaturized scale strip opening radio wire is additionally higher than small scale strip fix receiving wire regarding both directional and omnidirectional reception apparatuses.

2.4 About Filter

Channels are for the most part recurrence specific components. A system that is intended to lessen certain frequencies however passes others without misfortune is known as a "channel". Commonly recurrence reaction include low-pass, high pass, band pass and band dismiss qualities.

As indicated by Webster's Definition discussed by Berlin," A channel is a gadget or substance that passes electric streams at specific frequencies or recurrence ranges while keeping the entry of others." Based on the frequencies they pass, the channels are named low-pass channel (LPF), high pass channels (HPF), band pass channels (BPF) and band dismiss channels (BRF) [6] [7].

2.4.1 Application of Filters

Applications can be found in for all intents and purposes any kind of microwave correspondence, radar or test and measurement framework. Channels are a standout amongst the most broadly utilized segments for radio frequency as well concerning microwave Filters while at microwave frequencies for the most part transmission line sections and waveguide components are utilized.

In portable remote gadgets an alternate sort of channel issued. It is known as the SAW (surface acoustic wave) fitter. In this plan a piezoelectric material is utilized as a part of bury digitized frame to make acoustic waves that gives the characteristic. The clearest use of channel structures obviously, is for the dismissal of undesirable signal frequencies while allowing great transmission of needed frequencies.

The most widely recognized filters of this sort are intended for low-pass, high-pass,band-pass or band-stop attenuation characteristics, for example, those appeared in above Figure. Obviously, on account of functional channels for the microwave or some other recurrence extend, these attributes are just accomplished approximately, since there is a high-recurrence restrain for any given down to earth channel structure above which its characteristics will disintegrate because of intersection impacts, resonances inside the components, and so on. Filters are likewise usually utilized for isolating frequencies in diplexers or multiplexers.

2.4.2 Microwave Filter:

Microwave channels are a standout amongst the most fundamental segments in collectors. The fundamental capacities of the channels are: (1) to dismiss bothersome flags outside the channel pass band and (2) to partitioned or add signals as per their recurrence. A decent case for the last application is the canalized collector in which banks of channels are utilized to isolate input signals [8].

Once in a while filters are additionally utilized for impedance matching. Filters are quite often utilized when a blender to decrease misleading signs because of image frequencies, neighborhood oscillator bolster through, and out-of-recurrence band clamor and flags. There are numerous books which are dedicated to channel plans.

At these frequencies, profoundly directional bars are conceivable and microwave is very appropriate for point-to-point transmission. Focusing all the vitality into a little pillar utilizing a parabolic antenna (like the well-known satellite TV dish) gives a considerably higher flag to clamor proportion, however the transmitting and accepting receiving wires must be precisely in a straight line with each other.

Electromagnetic waves at the recurrence extend 1GHz to above be alluded as microwave Recurrence. Microwave recurrence ranges are given underneath:

Table 2.1: Microwave frequency rang

Region	Band	Frequency
RF Region	HF	3Mz to 30 MHz
	VHF	30MHz to 300MHz
	UHF	300MHz to 1 GHz
Microwave region	L	1-2GHz
	S	2-4GHz
	C	4-8GHz
	X	8-12GHz
	KU	12-18GHz
	K	18-27GHz
	KA	27-40GHz
Millimeter region	V	40-75GHz
	W	75-110GHz
	MM	110-300GHz

A microwave framework incorporates a receiving wire, radio, multiplexes, waveguide (empty metal conductor interfacing the RF hardware to the reception apparatus) and encourages links. In light of limit and radio hardware, reception apparatus estimate, tower statures and landscape height will assume a noteworthy part in how it will arranged and build the framework [9]. These are four factors additionally will direct framework reliability, multi-way blurring, blur edge estimations, freshen zone freedom, impedance analysis, system decent variety and long-remove particulars.

A microwave channel is a two-port system used to control the recurrence reaction at a certain point in a microwave framework by giving transmission at frequencies inside the pass band of the filter and lessening in the stop band of the channel. Run of the mill recurrence reactions incorporate low pass, high-pass, band pass, and band-dismiss qualities. Applications can be found in virtually any kind of microwave correspondence, radar, or test and estimation framework. We restrain this instructional exercise to a system called the inclusion misfortune strategy, which utilizes organize

Amalgamation systems to configuration channels with a totally indicated recurrence reaction. The designs rearranged by starting with low-pass channel models that are standardized as far as impedance and recurrence.

Changes are then connected to change over the model outlines to the coveted recurrence rangeland impedance level. The addition misfortune strategy for channel configuration gives lumped component circuits [9]. For microwave applications such outlines normally should be altered to utilize dispersed components comprising of transmission line areas. The Richard's change and the Kuroda characters give this step. We will likewise talk about transmission line channels utilizing ventured impedances and coupled lines; filters utilizing coupled resonators will likewise be quickly depicted [6].

In microwave frequencies lumped component inductors and capacitors can't be utilized and thus transmission line areas are utilized which carry on as inductors and capacitors. Limiting the losses in the pass band of a channel is critical since it isn't just diminishes the overall losses for a transistor yet in addition enhances the commotion figure when utilized with a beneficiary.

2.4.3 Characteristics of Microwave Filters

There are numerous sorts of channels utilized as a part of microwave recipients, so it is difficult to cover all of them. A channel is a two-port system which will pass and reject signals as per their frequencies. There are four sorts of channels as indicated by their recurrence selectivity. In the illustrations that follow,fl= low recurrence fm= medium recurrence, and fh= high recurrence [10] [11]. Their names reflect their Characteristics and they are:

- A low-pass filter (LPF) which passes the low frequency signals below a predetermined value as shown in Figure 2.1

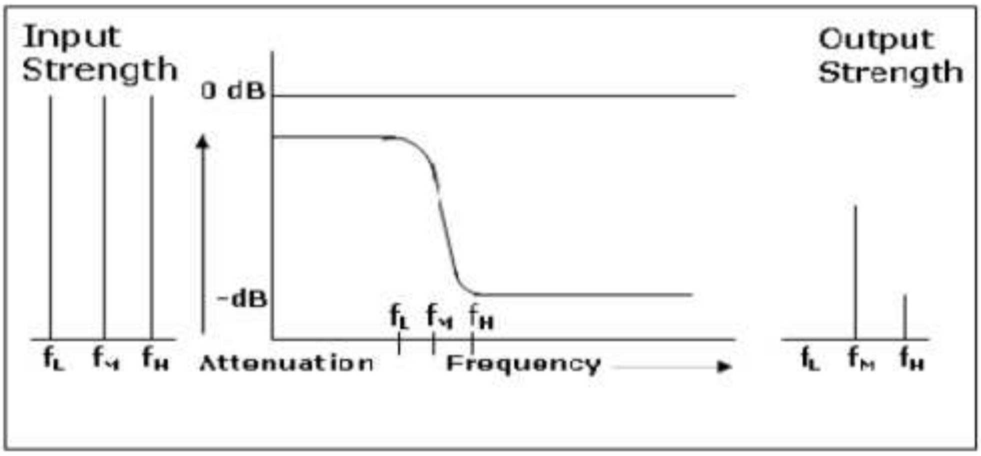

Figure 2.6: Characteristics of Low-pass filter (LPF) [3]

- A high-pass channel which passes the high recurrence motions over a foreordained an incentive as in Figure 2.2

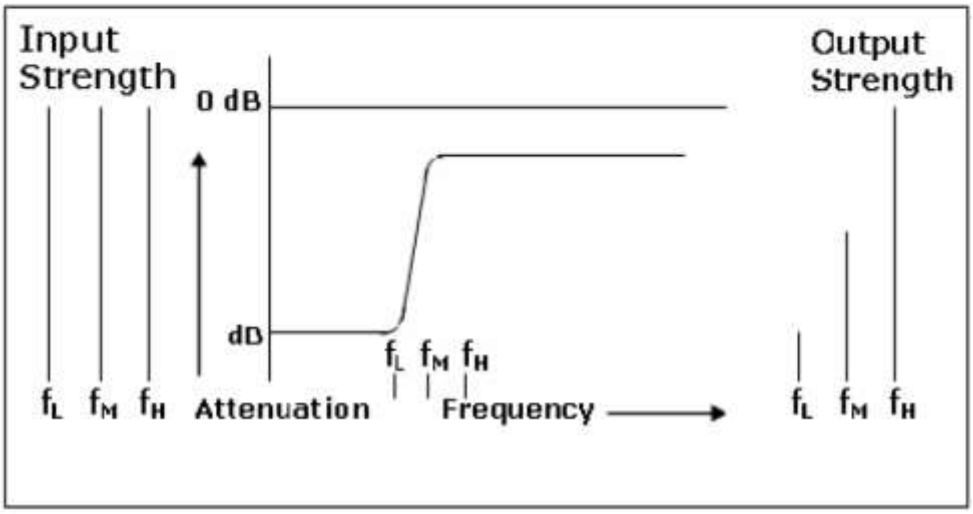

Figure 2.7: Characteristics of high-pass filter (HPF)

- Band-pass channel which passes motions between two foreordained frequencies as appeared in Figure 2.3. A band-pass channel with various skirt slants on the two sides of the pass band is here and there alluded to as a topsy-turvy channel. In this channel the sharpness of the dismissal band weakening is altogether unique above and beneath the middle recurrence. One extra note with respect to band-pass channels or channels all in all, their execution ought to dependably be looked at in the of-band areas to decide if they groups' misleading reactions. Specifically they ought to be checked at sounds of the working recurrence

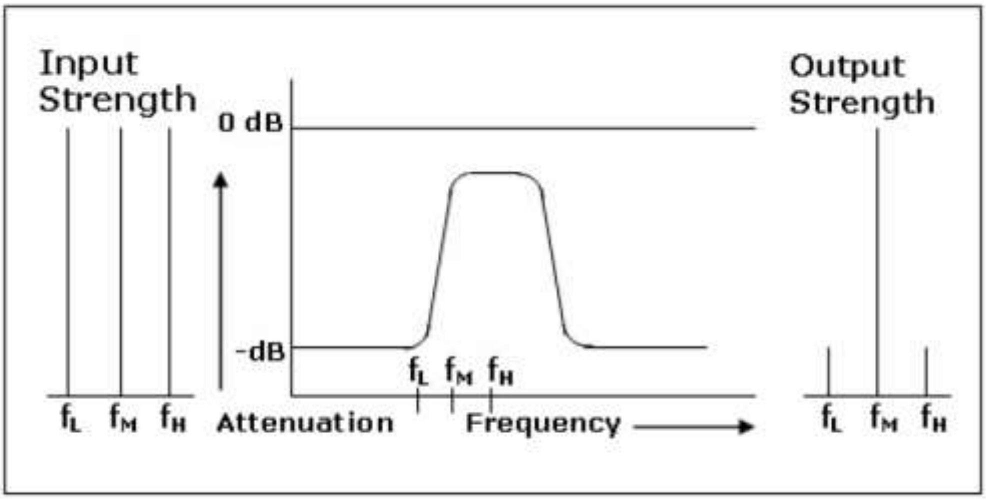

Fig 2.8: Characteristics of Band-pass filter (BPF)

- A band dismiss channel (now and again alluded to as a band stop or step channel) which rejects motions between two foreordained frequencies, for example, high power signals from the air ship's own particular radar as appeared in Figure 2.4.

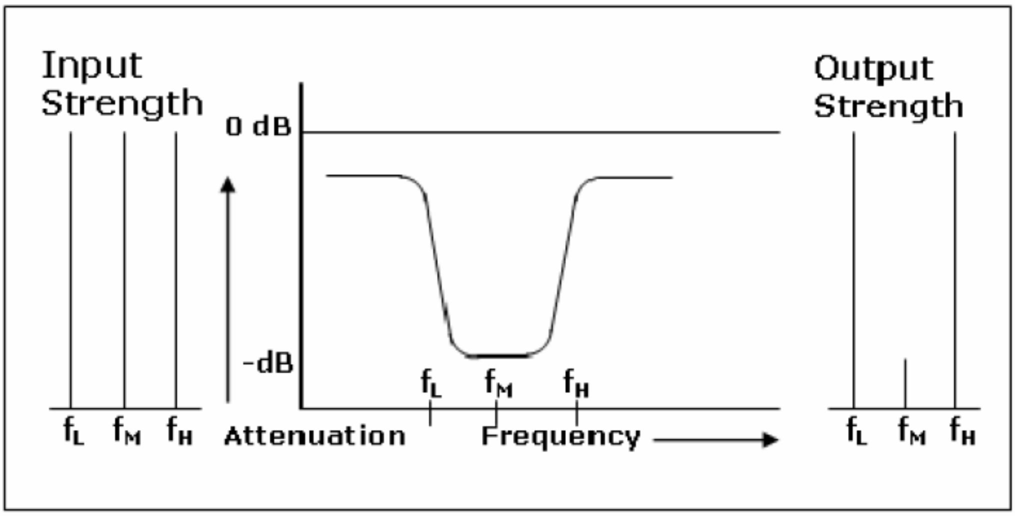

Figure 2.9: Characteristics of Band-reject filter (BRF)

All in all, channels at microwave frequencies are made out of resound transmission lines or waveguide depressions that, when joined, mirror the flag control outside the channel frequency pass band and give a decent VSWR and low misfortune inside the recurrence pass band. As such, specifications for channels are most extreme recurrence, pass band misfortune, VSWR, and dismissal level at frequency outside of the pass band. The tradeoffs for channels are a higher dismissal for a fixed frequency Pass band or a bigger recurrence pass band for a settled dismissal, which requires a filter with more resonators, which create higher misfortune, greater unpredictability, and bigger size.

2.5 Different Terms Used for Microwave Filter Design:

Radio recurrence (RF) and microwave channels speak to a class of electronic channel, intended to work on signals in the megahertz to gigahertz recurrence ranges (medium recurrence to a great degree high recurrence). This recurrence go is the range utilized by most communicate radio, TV, remote correspondence (mobile phones, Wi-Fi, and so forth.), and along these lines most RF and microwave gadgets will incorporate some sort of separating on the signs transmitted or got [12]. Such channels are usually utilized as building obstructs for duplexers and diplexers to join or separate various recurrence groups.

2.5.1 Insertion Loss

Addition misfortune is same to the distinction in dB influence estimated at the channel input and at the filter output. The power estimated at the channel input is equivalent to the deliberate power when the filters supplanted by an appropriately coordinated power meter or system analyzer. The info impedance of the measuring instrument ought to be equivalent to the characteristic impedance of the channel or framework. Unless generally determined, Mini-Circuits 'filters are intended for 50 ohm frameworks. Likewise, the power estimated at the channel yield is equal to the deliberate power when the channel is ended by a similar estimating instrument as discussed. The addition misfortune will be equivalent to the whole of three misfortune factors [13]. One is the misfortune due to the impedance jumble at the channel input, the second is because of the confuse at the channel output, and the third is because of the dissipative misfortune related with each receptive component inside the filter.

2.5.2 Return Loss

Return misfortune is a measure of the reflected vitality caused by impedance crisscrosses in a cabling system .It is a measure of the divergence in metallic transmission lines and loads. It might be also viewed as the proportion, at the intersection of a transmission line and ending impedance or other intermittence, of the abundance of the reflected wave to the sufficiency of the occurrence wave. Return misfortune is essential in applications that utilization synchronous bidirectional transmission. Conceivable reasons for over the top return misfortune incorporate vacillation in attributes impedance, link kinks, excessive curves, link coat or conductor [14]. The term Return Loss is measured through logarithm with the unit of dB or decibel. The ratio of power reflected by the antenna and the power that is feed to the antenna is called return loss. The ideal value for RL is - 9.54 dB. The relation between return loss and SWR is.

$$\text{Return Loss} = 20 \log_{10} [SWR/ (SWR-1)] \text{ dB}$$

2.5.3 Antenna Gain

On an isotropic source, how much power the antenna is transmitting in the direction of peak radiation. Isotropic antenna is a reference antenna. An isotropic antenna radiates the equal power in all direction as we can say omnidirectional antenna with proper and same radiation in each and every directions [15].

But in really no such an antenna exist. So the gain in antenna is dimensionless parameter which is the ratio of radiation pattern of isotropic antenna and another antenna. In mathematical terms,

$$\text{Antenna gain, } G = E_{antenna} * D;$$

Where Eantenna is efficiency of antenna and D is directivity.

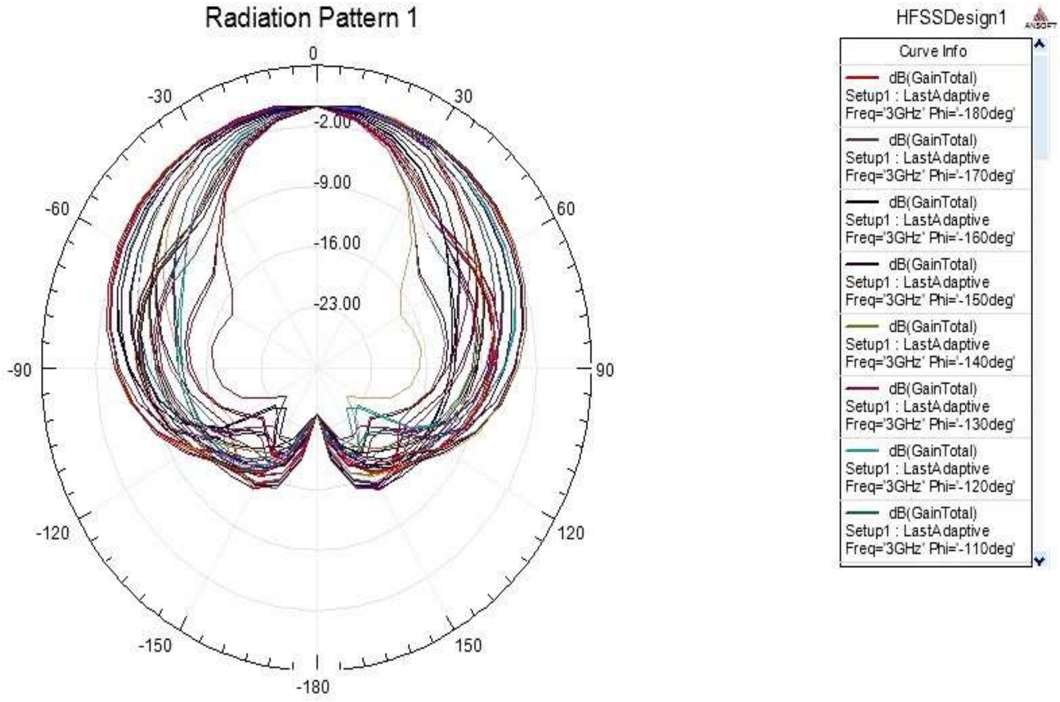

Figure 2.10: Antenna gain of a Micro strip Slot antenna designed in HFSS (High Frequency Structure Simulator)

2.5.4 Pass Band

Pass band is equivalent to the recurrence go for which the channel addition misfortune is not exactly specified esteem. For instance, a large portion of the Mini-Circuits' low-pass channel (LPF) models are specified to have a most extreme inclusion misfortune estimation of 1 dB inside the pass band.

2.5.5 Stop band

Stop band is equivalent to the recurrence go at which the channel inclusion misfortune is more noteworthy than a predefined esteem. For instance, a large portion of the Mini-Circuits' low-pass channel (LPF) models are

Described by the recurrence go where the inclusion misfortune is more noteworthy than 20 dB and 40 dB in the stop band. These two qualities are discretionary; they could easily have been decided for some different qualities. The reason for choosing 20 dB and 44) dB is twofold. One is to give the plan build a basic intends to ascertain the recurrence selectivity of the channel. The second is to permit a fast computation of the reasonableness of the channel in particular circumstance. Since 20 dB or 40 dB speak to adequate misfortune prerequisites in many systems, these qualities were picked [16] [17]. The information in this handbook gives real misfortune esteems as function of recurrence. For some, Mini-Circuit channels the stop band misfortunes can surpass 60 dB.

2.5.6 Cutoff Frequency

Cut-off recurrence, focus the recurrence at which the channel addition misfortune is equivalent to 0.1 dB It is Avery advantageous point for communicating the pass band and stop band limit focuses.

What's more, it allows an advantageous intends to standardize the recurrence reaction of a channel. For instance, if the frequency of a low-pass channel (LPF) reaction were isolated by footmen the subsequent response would be "standardized" to fro. The standardized reaction permits the outline architect to quicklyspecify the channel expected to meet his framework necessities.

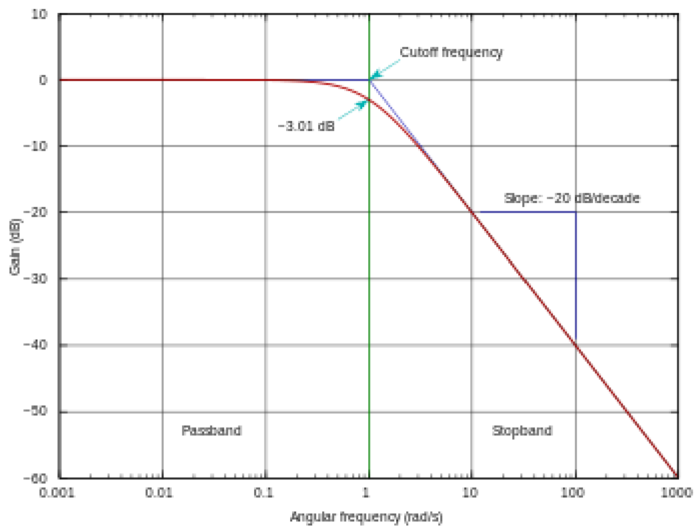

Figure 2.11: Cutoff Frequency

2.5.7 VSWR

VSWR is a measure of the impedance investigating one port of the channel while the other channel ports ended in its trademark impedance, in particular, 50 ohms. Ordinarily, the Impedance coordinate is communicated as far as return misfortune. The majority of the channel models appeared in this thesis paper are intended to exhibit a decent impedance coordinate in the pass band and a highly reflective impedance coordinate in the stop band. Ordinarily the VSWR in the focal point of the pass bandies superior to 1.2 to 1 and the VSWR in the stop band is normally 1.8 to 1, profoundly reflective. One exceptionally remarkable exemption to this VSWR trademark is the steady impedance band-pass filter arrangement. In these models, both channel ports display decent impedance coordinate in the pass band and stop band [18].

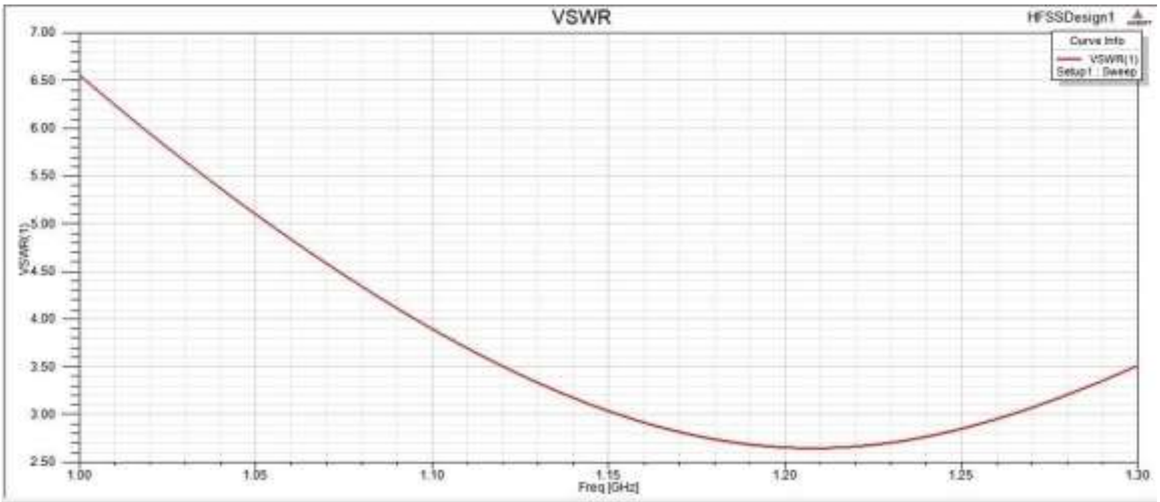

Figure 2.12: VSWR

2.6 Study of S-Parameters

A commonsense issue exit to quantify voltages and streams at microwave frequencies because direct estimations for the most part include the size and period of a wave going in a given direction. The proportional voltages and streams, and the related impedance and admittance matrices, turn out to be fairly a reflection when managing high recurrence networks. A portrayal more as per coordinate estimations, and with the thoughts of incident, reflected, and transmitted waves is given by the dissipating framework or s-lattice.

The diffusing framework relates the voltage wave's occurrence on the ports to those reflected from the ports. For a few parts and circuits, the scrambling parameters or parameters can be calculated utilizing system investigation procedures. Something else, the diffusing parameters can be measured specifically with a vector arrange analyzer.

Consider the N-port system, where Vn+ is the adequacy of the voltage wave occurrence on port n,andVn-is the sufficiency of voltage wave reflected from port n. the disseminating framework, is defined in connection to these episode and reflected voltage waves as.

$$\begin{bmatrix} V_N^- \\ V_N^- \\ . \\ . \\ V_N^- \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \ldots\ldots S_{1N} \\ S_{21} \ldots\ldots\ldots\ldots\ldots\ldots & \\ . & \\ . & \\ S_{N1} \ldots\ldots\ldots\ldots & S_{NN} \end{bmatrix} \begin{bmatrix} V_1^+ \\ V_2^+ \\ . \\ . \\ V_N^+ \end{bmatrix}$$

$$[V^-] = [S][V^+]$$

A specific element [S] matrix can be determined as

$$S_{ij} = \frac{v_{i-}}{v_{j+}}$$

Sjiis found by driving port j with an episode wave of voltage+, and estimating the reflected wave plentifulness, vi Coming out of port I. the occurrence waves on all ports aside from the jth port are set to zero, which implies that all ports ought to be ended in coordinated burdens to keep away from reflections [18]. Thus, s11is the reflection coefficient seen investigating port 1 when every single other port are terminated in coordinated burdens.

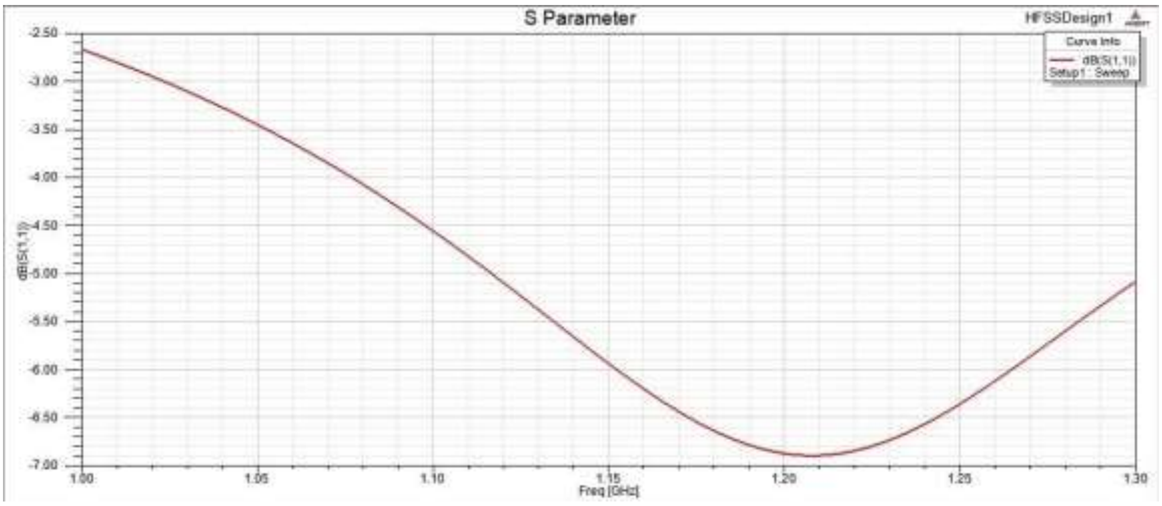

Figure 2.13: Plotting the S-Parameters

S11 is the reflection coefficient seen investigating port 1 when every single other port are ended unmatched loads.s11expressed as far as dB, and afterward it is called return misfortune.

S12 is the transmission coefficient from 2 to port 1 when every single other port are ended in Coordinated load. s12 communicated regarding dB, at that point, it is called inclusion misfortune.

An essential point to comprehend about S-parameters is that the reflection coefficient looking into port n isn't equivalent to snn, unless every single other port are coordinated. Thus, the transmission coefficient from port m to port n isn't equivalent to snm, unless every single other port are coordinated 15] [17]. The parameters of a system are properties just of the system itself (accepting the system is linear), and are characterized under the condition that all ports are coordinated. Changing the terminations or excitations of a system does not change its S parameters, but rather may change the reflection coefficient seen at a given port, or the transmission coefficient between two ports.

Since [S] is symmetric, the system is complementary. To be lossless the system fulfill the condition

$$[S11]\ 2+[S\ 12]2=1 \qquad (4)$$

Return loss can be expressed in term of reflection coefficient.

$$RL=l0log10\ [S11]\ dB \qquad (5)$$

Insertion loss can be expressed in term of transmission coefficients_n.

$$IL=10log10\ [S12]\ dB \qquad (6)$$

Return loss [0] means, the value of reflection coefficient is 1, there is no signal is transmitted. The entire wave is reflected

Chapter 3

Micro strip band-pass filter

Micro strip filters are one the most popular realizations of planar microwave filters. Proposed in1950's as one of the planar transmission lines, micro strip become very attractive technology for building passive circuits and microwave integrated circuits (MIC) in 1960's with the advent of99-percent pure alumina. Nowadays, many novel micro strip and other planar filters with advanced filtering characteristics are developed using novel materials and fabrication technologies such as HTS, liquid crystal polymers (LCP), LTCC, MMIC, and micro electro mechanic systems (MEMS) [8]. These filters as well as advanced filters built using conventional Alumina or Droid substrates are designed using novel CAD tools.

Coupled micro strip lines are employed in the design of band pass filters based on interdigital,parallel coupled and comb line structures. Using these lines stronger coupling between resonators can be achieved. This is very important in the design of band pass filters which are in general composed of a number of coupled resonators, tuned at a given center frequency of the pass band. For the design of band pass filters with wider bandwidths, stronger coupling between resonators is required. In this chapter background theory for the design of micro strip band pass filters based on the implementation of coupled lines is presented. Sections 3.2 and 3.3present brief analysis and main characteristics of micro strip lines and coupled micro striplines respectively.

3.1. Micro strip Lines

Micro strip is the most popular planar transmission structure used in MIC. Planar transmission structure is the one in which the characteristics of the circuit elements, built using this structure, can be determined by the dimensions in a single plane. This is the main requirement for transmission line to be used in MIC. Micro strip can be fabricated using photolithographic processes. Open configuration makes it easily integrated with other discrete lumped passive and active microwave devices. Micro strip transmission lines consist of a conductor printed on top of thin, grounded dielectric substrate, as it is shown in Figure 3-1 (a). The width of the conductor *t*hickness of the substrate *h* , and relative permittivity *Er*are the main important parameters.

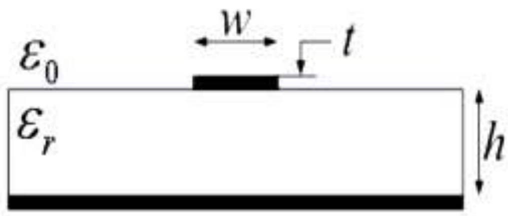

Figure.3.1: Micro strip transmission line: (a) geometry

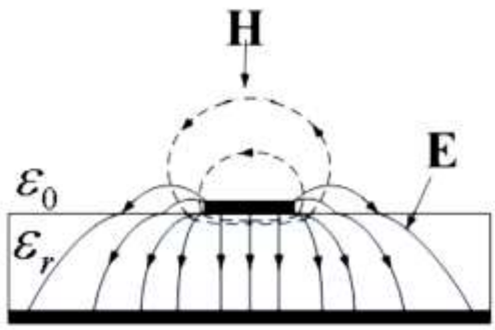

Figure3.2: Micro strip transmission line: (b) electric and magnetic field lines.

Figure.3.1: Micro strip transmission line: (a) geometry; (b) electric and magnetic field lines. Due to the abrupt dielectric interface between the air and the substrate, micro strip lines do not support pure transverse electromagnetic (TEM) propagation mode. The necessity of the

Longitude component of electric and magnetic fields can be proved using Maxwell's equations. Figure 3.1 (b) illustrates electric and magnetic fields distributions at transverse cross-sectional plane.

The analysis methods used to determine the micro strip characteristic impedance and propagation constant can be divided in two groups, quasi-static analysis methods and full wave analysis methods. Full wave analysis methods consider a hybrid mode of propagation and provide more analytically complex and rigorous solutions. These methods show that the characteristic impedance and phase velocity of the micro strip have dispersive nature, i.e. change with frequency.

Quasi-static methods consider micro strip to have pure TEM mode of propagation. Transmission characteristics are found from two electrostatic capacitances: $c_a$pacitance per unit length of micro strip line with dielectric replaced by air, and $c_a$pacitance per unit length of micro strip line with dielectric substrate [11]. These methods provide quite accurate results for the frequency up to a few gigahertzes. The effective dielectric constant defined as

$$\varepsilon_{eff} = \frac{c_o}{c_a}$$

3.2 Coupled Micro strip Lines

Two micro strip lines placed in close proximity and parallel to each other form coupled micro strip lines. These lines are the basic building elements of directional couplers and filters. There is continuous coupling between electromagnetic fields of the lines. The field distribution of the coupled micro strip lines is shown in Figure 3.3.

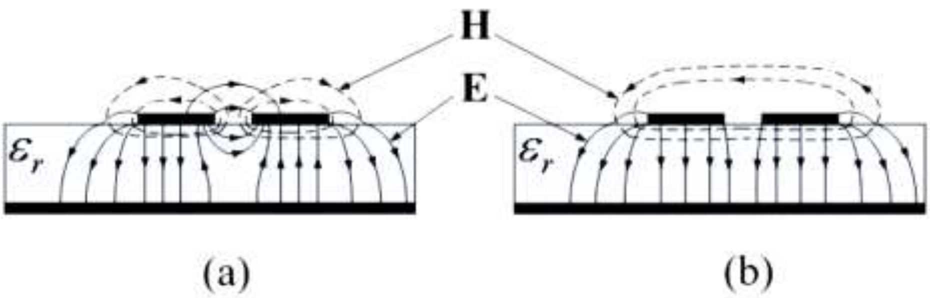

Fig.3.3: Field distribution of coupled micro strip lines: (a) odd mode; (b) even mode.

Coupled lines support two modes of propagations. Even mode exists when charges onboth lines are of the same sign, odd mode when the sign is opposite. Each of these modes of propagation has different characteristics of transmission line, namely even and odd mode characteristic impedances z_{0e}- and z_{0o}, and even and odd mode phase velocities v_{pe} and $v_{po.}$

Even and odd mode characteristic impedances of micro strip coupled lines depends on the dielectric constant $E_r$and normalized dimension *s h* and *w h* , where *s* is a width of slot of coupled micro strip lines, *w* is a width of lines and *h* is a thickness of substrate.Figure 3.4 and that will be used in the analysis presented in next chapter is:

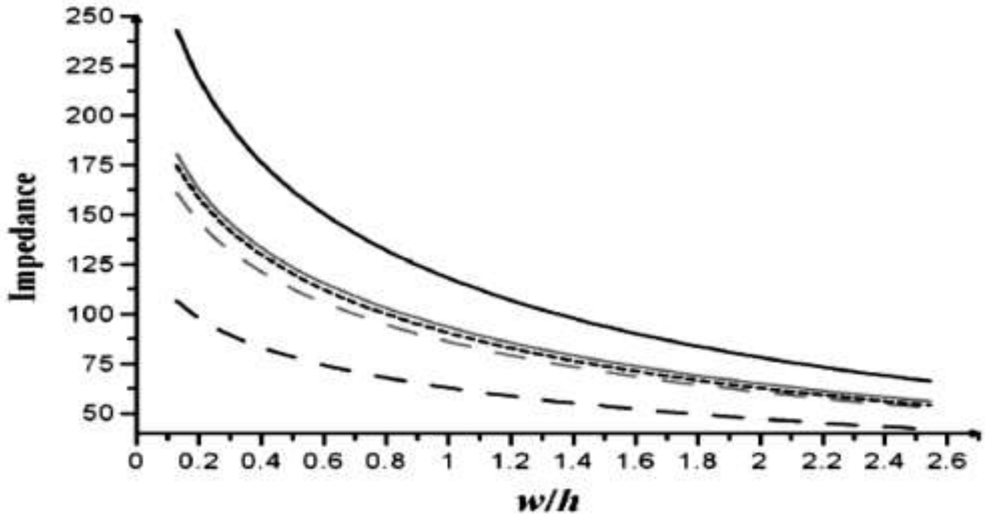

Figure .3.4: Characteristic impedances: even mode (black solid); odd mode (black dashed); single line (grey solid); arithmetic average (black dotted); geometric average (grey dashed).

The effective dielectric constants of coupled micro strip lines are not equal. The even mode effective dielectric constant is higher than the odd mode's one because for the odd mode the density of electric field lines in the air is higher than for the even mode, i.e. for odd mode relatively more electric field is concentrated in the air compared to even mode,

$$\theta = \frac{2\pi f_o}{c}\sqrt{\varepsilon_{eff}}$$

However for pure TEM coupled lines, such as for example a Strip line, the phase velocity of both modes of propagation is the same and the even and odd mode electrical lengths are equal

$$c_e = c_p + c_f + c'_f$$

$$c_o = c_p + c_f + c_{ga} + c_{gd}$$

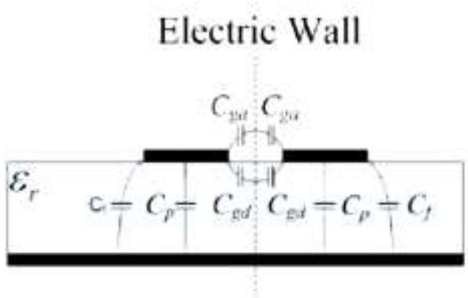

Figure.3.5: Distributed capacitances: odd mode

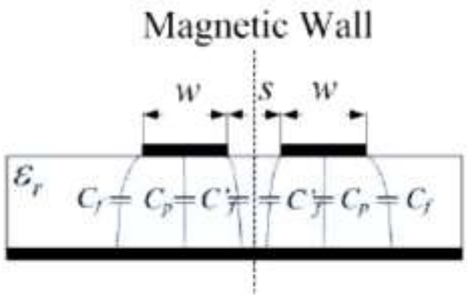

Figure.3.6: Distributed capacitances: even mode.

3.3Micro stripBand pass Filters

According to their frequency response, electronic filters are categorized into four groups: low pass, high pass, band pass, and band stop filters. In wireless communications band passfilters are the most widely used. For the design of micro strip band pass filters, several various techniques exist and most of proposed novel filters with advanced characteristics are based on these several structures.

For all types of micro strip filters in which coupling is arranged by parallel coupled lines different phase velocities between even and odd mode in coupled-line region should be taken into account. Thus, for the design of micro strip parallel-coupled-line filters, special design curves or optimization techniques are used. Parallel-coupled-line filters in which folded resonators aroused, are known as hairpin-line filters, in which half wavelength resonators have U-shaped form. The introduction of this modification substantially decreased the size of filters [7] [9].

Miniaturized hairpin resonators, in which arms of resonator are bent inside to form coupled lines region, are frequently used in the design of compact cross-coupled band pass filters. Miniaturized hairpin resonators have some similarity with square open-loop resonators, which are used to obtain capacitive and inductive coupling by only proximity coupling through fringing fields.

This type of resonators can be used to build micro strip cascaded quadruplet and other types of cross-coupled band passfilters. Another type of resonators and filters employed for compact size band pass filter are dual-mode patch and ring micro strip resonators. Both, open-loop and dual-mode resonators have been employed in the design of a huge variety of micro strip band pass filter.

Due to the development of wireless communications and the appearance of new systems there is high demand in small size, low cost filters with high performance. Therefore, miniaturization of band pass filters with improvement of their characteristics is a big challenge in modern filters design. This is achieved by improvement of conventional concepts and approaches, as well as by introduction of new topologies and designs. For example, size of parallel-coupled line filters can be reduced by bending coupled micro strip lines, while suppression of spurious harmonic or dual-band operation is achieved by the use of SIR .Implementation of band stop generating spur-lines inside resonators can also result in size reduction and spurious harmonics suppression. For miniaturized hairpin resonator filters, further size reduction with rejection of spurious harmonic has been achieved by employing either interdigital capacitors embedded in resonators, or sections with different characteristic impedances, i.e. SIR hairpin resonators. Implementation of SIR also can be used in the design of compact dual-band hairpin resonators filters, with these resonators employed on top, as well as on both, top and ground layer.

3.4Micro strip Discontinuities

Surface waves are electromagnetic waves that propagate on the dielectric interface layer of the Micro strip. The propagation modes of surface waves are practically TE and TM.Due to the practical homogeneity of the Strip line dielectric, this phenomenon can be neglected in Strip line devices and so, this section is pertinent to Micro strip lines only.

- Surface waves are generated at any discontinuity of the Micro strip. Once generated, they travel and radiate, coupling with other Micro strip of the circuit, decreasing isolation between different networks and signal attenuation. Surface waves are a cause of crosstalk, coupling, and attenuation in a multimicro strip circuit. For these reasons the surface waves are always an undesired phenomenon.

- Surface wave propagation may be reduced by cutting slots into the substrate surface just in front of an open-circuit.
- Similar to the case of radiation, surface waves are not guided by the Micro strip.
- Various techniques may be adopted to reduce radiation:
- Metallic shielding or ‘screening.

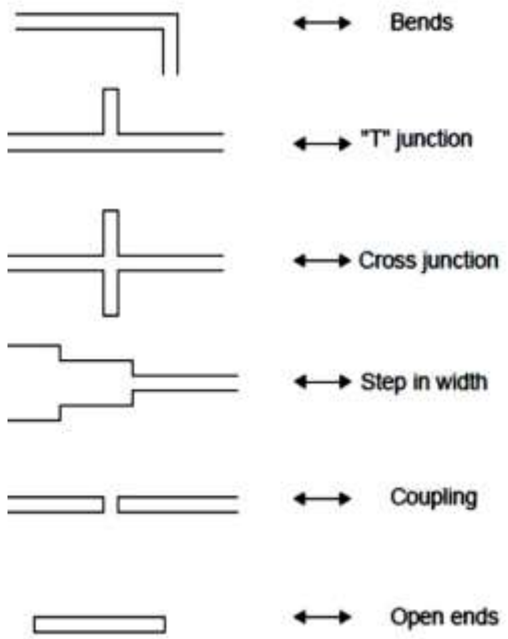

Figure 3.7: Typical Micro strip Discontinuities.

- The introduction of a small specimen of lossy (i.e. absorbent) material near any radiative discontinuity.
- The utilization of compact, planar inherently enclosed circuits (spur line filter).
- Reduce the current densities flowing in the outer edges of any metal sections and concentrate currents towards the center and in the middle of the Micro strip.
- Possibly shape the discontinuity in some way to reduce the radiative efficiency.
- A discontinuity in a Micro strip is caused by an abrupt change in geometry of the strip conductor, and electric and magnetic field distributions are modified near the discontinuity. The altered electric field distribution gives rise to a change in capacitance, and the changed magnetic field distribution to a change in

inductance. Discontinuities commonly encountered in the layout of practical Micro strip circuits are:

- Steps, Open-Ends, Bends, Gaps, and Junctions.

CHAPTER 4

ANTENNA DESIGN AND SIMULATION

Reception apparatus need to plan before essentially connected. Prior to the outlining of a reception apparatus first we have to keep in head about prerequisites as case arrangement or working recurrence , remove, directivity, how much pick up we require, single band or multi groups and so on. We have to consider the gadgets where we apply the receiving wire.

4.1. Antenna DesigningSoftware

There are such a significant number of programming projects to plan a radio wire. It additionally relies upon creation and establishment. A few cases of reception apparatus outlining programming projects are given underneath.HFSS (High Frequency StructureSimulator)

- CST (Computer SimulationTechnology)
- AntennaMagus
- MATLABetc.

4.1.1 High Frequency StructureSimulator (HFSS)

HFSS remains for High Frequency Structure test system. It is a limited component strategy solver to understand electromagnetic structure. This product utilized financially and give by ANSYS. This is overall acknowledged programming for business outline. This product is an industry standard recreation programming.

4.1.2 Computer SimulationTechnology (CST)

CST is PC reenactment innovation. The primary programming is CST Microwave Studio which is an authority apparatus utilized for 3 dimensional high recurrence part's electromagnetic reproduction.

4.1.3 AntennaMagus

One of the main reception apparatus plan programming is radio wire magus. More than 300 receiving wire database is incorporated into this product. Radio wire Magus has the database specifically instant plan. So one can plan radio wire recently in view of the inherent outline.

4.1.4 MATLAB

MATLAB is such programming that is utilized for such a significant number of things. Likewise radio wire can be planned in MATLAB. MATLAB is grid research center.

MATLAB programming has an Antenna Toolbox to outline and reproduce radio wire. With essential codes MATLAB has a rich library to get to and to plan a radio wire. Through this product one can change the incentive from the essential or customary size or execution of a receiving wire.

4.2. Designing

We need to outline a reception apparatus to use for WiMAX gadgets. Generally the WiMAX reception apparatus is miniaturized scale strip fix radio wire. In any case, we change it. We planned a small scale strip however by opening cutting inside the fix.

4.2.1 Design Objectives

Customary or general small micro strip fix receiving wire for LOS (observable pathway correspondence) the increase through directivity is normal yet with a space cut inside it will give higher pick up in radiation design at recreation result (appeared in later).

4.2.2 DesignMethodology

The receiving wire is outlined in HFSS. It mimics the 3 dimensional structures. So in outlining we have to keep in head about the receiving wire structure at the x, y and z bearing.

To start with the receiving wire ground must be planned at x and y course. At that point the dielectric substrate ought to be planned with three (x, y and z) bearing. After that the outline of fix inside the reception apparatus body is planned with three dimensional estimations. The receiving wire is outlined in HFSS. It mimics the 3 dimensional structures [17]. So in outlining we have to keep in head about the receiving wire structure at the x, y and z bearing. o start with the recieving wire ground must be planned at x and y course. At that point the dielectric substrate ought to be planned with three (x, y and z) bearing. After that the outline of fix inside the reception apparatus body is planned with three dimensional estimations.

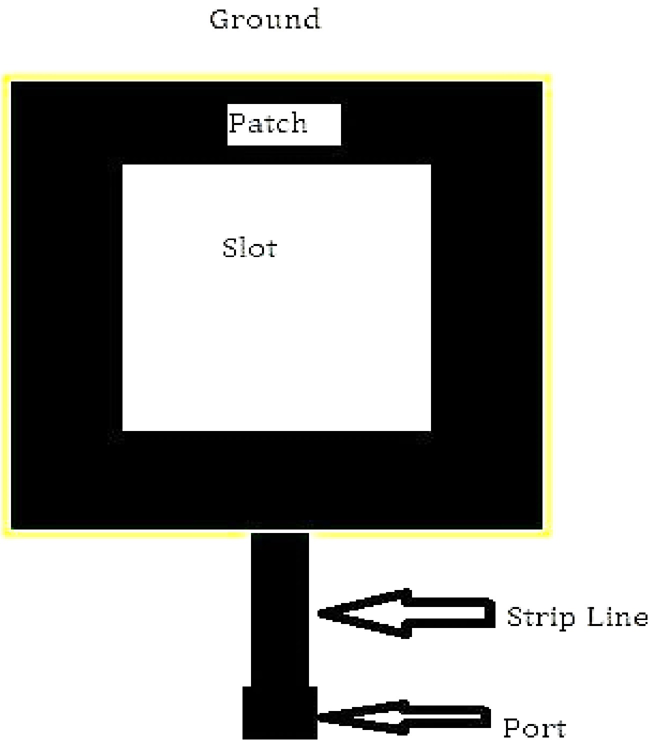

Figure 4.1: Micro strip design steps

From the patch we need to cut the slot with the positioning in x and y direction.Then a strip line is added. To add strip line we need to cut in z axis as the design and at x and y direction.Finally the port in y axis is attached according to x and y direction.

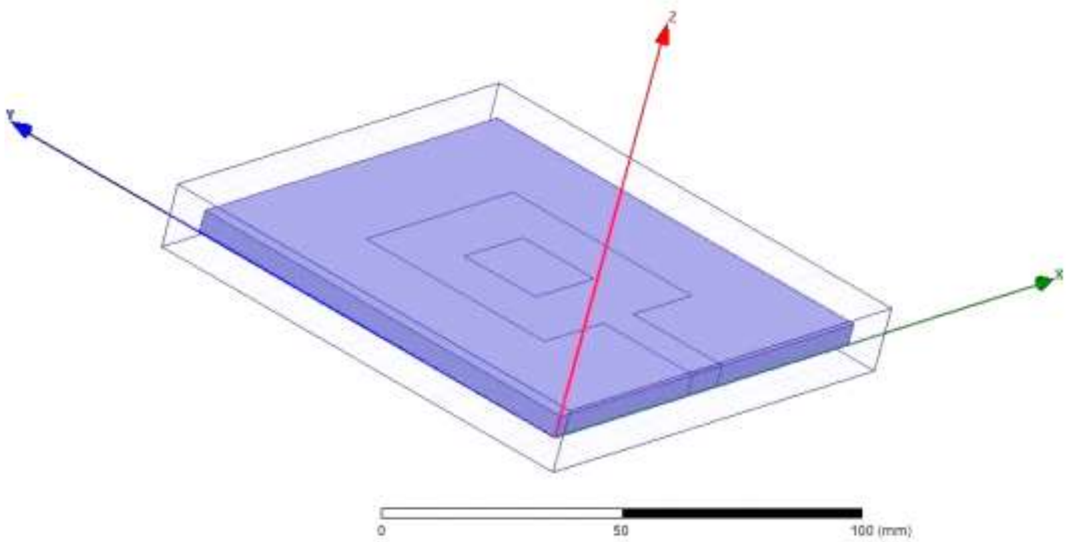

Figure 4.2: Micro strip slot antenna in HFSS

4.2.3 Parameters

For the design of micro strip patch antenna some formulas are applied Formulas:

For the resonant frequency of the antenna the equation is given below.

$$fc \quad c/(2L\sqrt{\ }\ r)$$

$$W=(c/2f)*\sqrt{\ }[2/(\epsilon r+1)]$$

$$L=Leff-2\Delta L$$

$$Leff=(c/2f)*\sqrt{\epsilon eff}$$

For calculating of length extension, ΔL

$$\Delta^{\epsilon} \frac{-}{\epsilon \quad -}$$

Here,

W- width of the antenna

L- Length of the antenna

Leff- Effective length

c- Speed of light=3*10^8

f- Resonantfrequency

∊r- Dielectric constant substrate or this is called the permittivity of the substrate which control the fringingeffect

∊eff- Dielectric constant substrate for effective area or effective dielectric constant

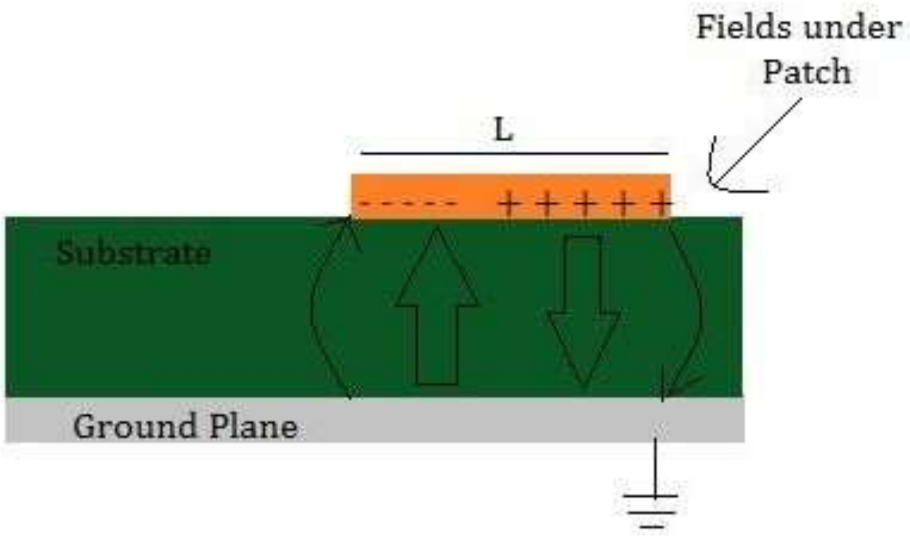

Figure 4.3: Patch Antenna with E-fields (side view)

Designing in HFSS the following parameters is used at the design of micro strip antenna's industrial values. The values with parameters are given below.

Ground:
X axis: 100mm
Y axis: 100mm

Dielectric Substrate:
X axis: 100mm

Y axis: 100mm

Z axis: 5mm

Patch:

X axis: 50mm

Y axis: 50mm

Z axis: 5mm

Position: 25, 25, 5

Slot:

X axis: 20mm

Y axis: 20mm

Position: 40, 40, 5

Strip Line:

X axis: 10mm

Y axis: 25mm

Z axis: 5mm

Position: 40, 0, 0

Port:

X axis: 10mm

Y axis: 25mm

Z axis: 5mm

Position: 45, 0, 0

Those parameters are used in the design of a micro strip slot antenna in HFSS.

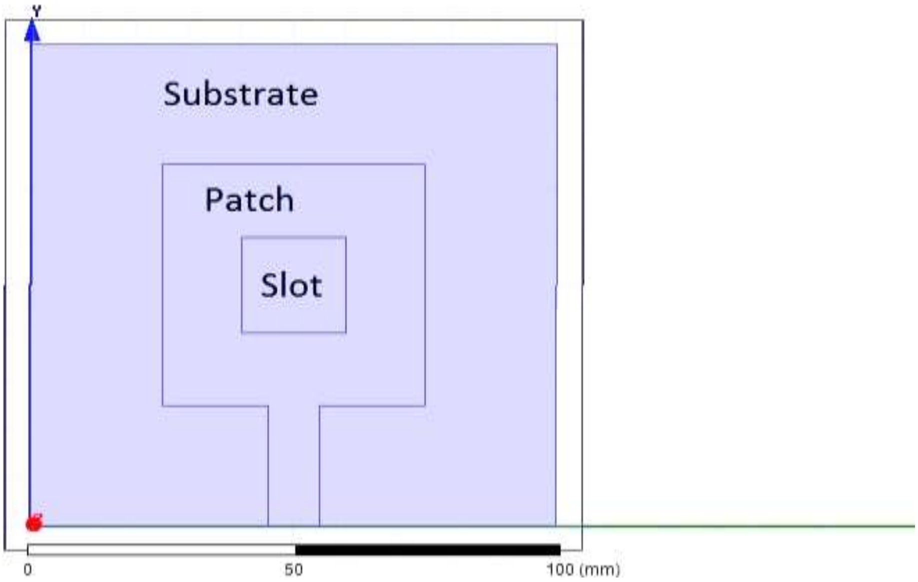

Figure 4.4: Micro strip slot antenna designed in HFSS

4.2.4 Solution FrequencySetup

Before reproduction the arrangement recurrence must be set up alongside recurrence clear. The arrangement recurrence is set up at 3 GHz. As a result of the settled miniaturized micro strip association has the recurrence extend in the middle of 2 to 11 GHz.

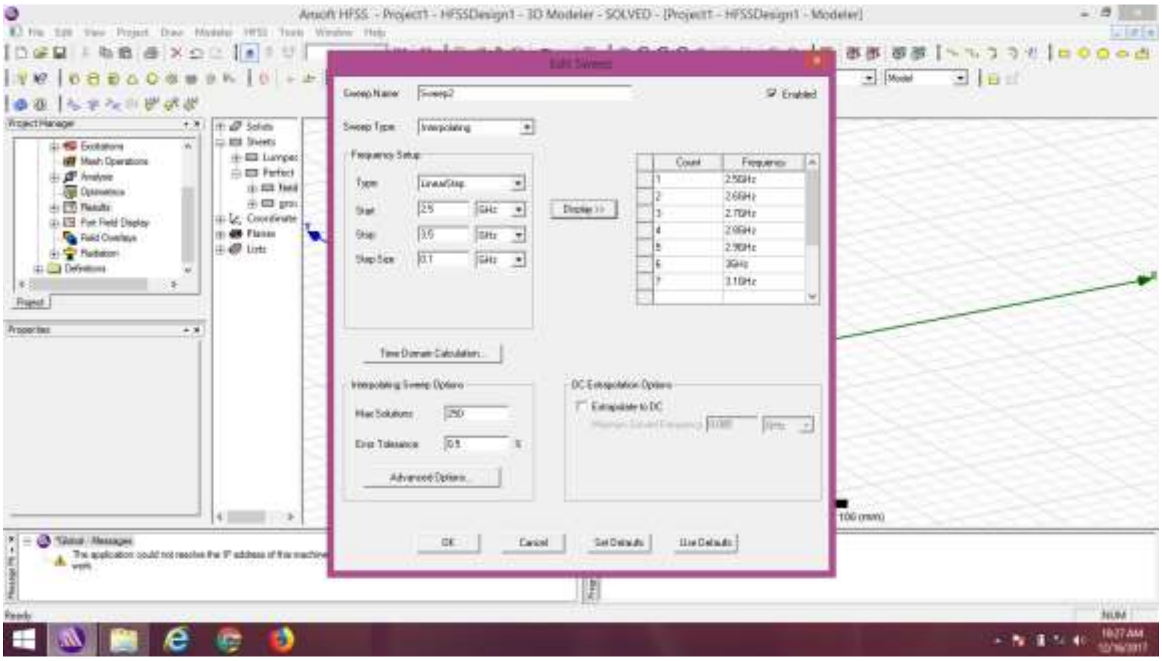

Figure 4.5: Solution frequency setup with frequency sweep

4.3 Simulation

First to setup the solution we need to set up the solution frequency as given. Then after validity check the analyzing option has to be run.Finally after the simulation we have to directly for the result.

4.4 Results:

For comparison we need to check the result of antenna gain, radiation pattern, antenna directivity, VSWR and S-parameter mainly.

CHAPTER 5

FILTER DESIGN AND SIMULATION

5.1 Design steps

The proposed filter is designed by following the five steps.

- **First step:** Determining the order and type of approximation functions to be used.
- **Second step:** Finding the corresponding low-pass prototype.
- **Third step:** Transforming the low-pass network into a band-pass configuration.
- **Fourth step:** Scaling the band-pass configuration in both impedance and frequency.
- **Fifth step:** Transforming the lumped circuit element into distributed realization.

5.1.1 Choice of Filter Type and Order:

The filter arrange is the quantity of inductive and capacitive components that ought to be incorporated into the channel plan. A decent band pass channel has insignificant flag misfortune in its pass band, and in addition a restricted pass bandwidth however much out of band constriction as could be expected [13]. Chebychevfilters have smaller pass band reaction in exchange for more swells in the pass band segment. Higher request channels can have a smaller shape factor however will be physically bigger fit as a fiddle. Reproductions demonstrated a channel request of n=3 will accomplish this objective. The required order for a filter meeting the given specifications is calculated below:

$$n = \frac{Cosh^{-1}\sqrt{\frac{10^{\frac{K_T}{10}}-1}{K-1}}}{Cosh^{-1}(\frac{f}{f_c})}$$

$$= \frac{Cosh^{-1}\sqrt{\frac{10^{\frac{10}{10}}-1}{10^{0.5}-1}}}{Cosh^{-1}(1.4)}$$

$$= \frac{cosh^{-1}\sqrt{73.759}}{cosh^{-1}(1.4)}$$

$$= \frac{2.840}{0.8670} = 3.27$$

Where LT is the minimum attenuation at frequency ft, and K = 10^(Lar/10),with Lar being the maximum ripple in dB allowed in the pass band. The following equations are used to calculate the order for edge coupled band pass filter values. Using Figure .5.1 we get the value of f/*fc=1.4*

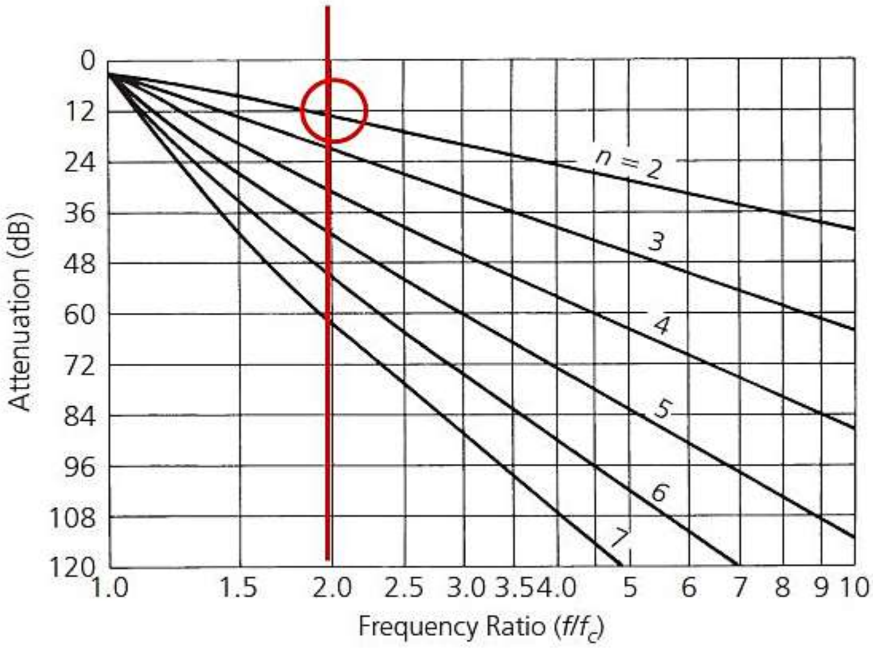

Figure.5.1: Characteristics for a Chebyshev filter with 0.5dB ripple.

The BPF circuit is reenacted with Ansoft Designer/Nexxim V2.2 Software so as to anticipate the execution of the channel. An advancement procedure has been presented along the reenactment methodology concentrating on the channel measurement so as to enhance the reaction of the channel [16]. Allude to the channel tables given in D.M Pozar and G. L. Matther to locate the accompanying coefficients for a third request chebyshev channel. Standardized component esteems for 0.5 dB swell low-pass chebyshev channel given in was g0 = 1, g1 = 1.5963, g2 =10967, g3 = 1.5963, g4 = 1.000 for simulated third order filter.Dielectric material utilized Rogers R06006 from Rogers high recurrence material determinations of edge-coupled micro-strip band pass channel.

Determinations of edge-coupled Band-Pass Filter, Specifications of Dielectric Material From ROGERS Corporation.

- Input and output impedance : Z=50 Ohms,
- Pass-band ripple =0.5 dB
- Filter order : n=3
- Pass band center frequency : 12.45 GHz
- Ripple bandwidth : 0.5 GHz

Board and substrate properties:

- Substrate : Rogers R06006
- Conductor thickness : 0.035 mm
- Dielectric constant : 6.45
- Loss tangent : 0.0027
- Substrate height : 0.787 mm

The segments are numbered from left to right. The source is associated at the left and the heap is associated with the right. The channel could be switched without influencing the reaction. The aftereffects of Z0o and Z0e, are appeared in table II, are relatively indistinguishable to that of the n=3 arrange approach, with the exception of an extra coupling area is utilized to speak to the expanded request.

Table -5.1: Element values for equal ripple band-pass filter prototypes

N	g1	g2	g3	g4	g5	g6	g7	g8	g9	g10	g11
1	0.698	1.000									
2	1.402	0.707	1.984								
3	1.596	1.098	1.567	1.000	1.000						
4	1.606	1.982	2.351	0.843	1.000	1.000					
5	1.721	1.216	2.543	1.224	1.732	1.721	1.0				
6	1.752	1.619	2.638	1.432	1.732	1.609	1.56	1.00			
7	1.729	1.609	2.678	1.389	1.728	1.567	1.72	1.567	1.00		
8	1.742	1.651	2.609	1.376	1.704	1.567	2.67	1.609	2.678	1.00	
9	1.7006	1.6322	2.6015	1.3621	1.7042	1.721	1.09	1.721	1.567	1.721	1.00
10	1.7400	1.6290	2.6380	1.315	1.7034	1.000	1.56	1.098	1.098	2.678	1.609

5.1.2 low-pass prototype

Any non-zero recurrence point on the filter reaction could be utilized as a kind of perspective for the model outline. For filter with swell in the pass band, the corner recurrence is normally characterized as the most elevated recurrence at greatest swell as opposed to 3 dB. Another case is in picture parameter filters which utilize the cut-off recurrence as opposed to the 3 dB point since cut-off is a very much characterized point in this sort of channel [9] [18].

The model filter must be utilized to create different channels of the third order. our circuit of the third-arrange low pass prototype Filter with a cut-off corner recurrence of 12.8 Hz, a most extreme pass band pick up of 0.5dB and a base stop band pick up of 20dB is developed as takes after

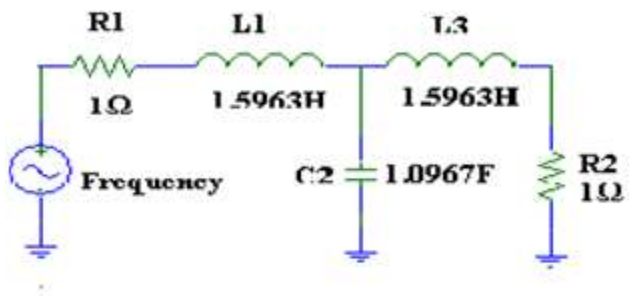

Figure.5.2: Third order low pass prototype.

In the wake of getting the low pass channel model qualities, at that point it's changed into band pass channel plan. The change from low go to band pass all shunt component of the low pass model circuit winds up parallel-resounding circuit, and all arrangement components move toward becoming series resonant circuit in Figure 5.2

5.1.3. Transforming the low pass into band-pass configuration:

The reason being I have to make my own particular change so I can join a low go with a rack utilizing a solitary change from a low go to use in the 3rd order request prototype condition. Knowing how the low pass to band pass change is inferred would make me a stride further to testing joining different filters.

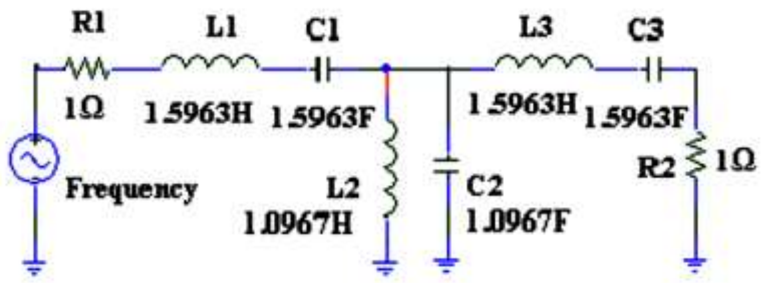

Figure. 5.3: Transformation third order low pass prototype to band pass prototype. The transformed the filter is then frequency-scaled and impedance-scaled using the following formulas.

5.1.4 Scaling the band pass configuration in both impedance and frequency:

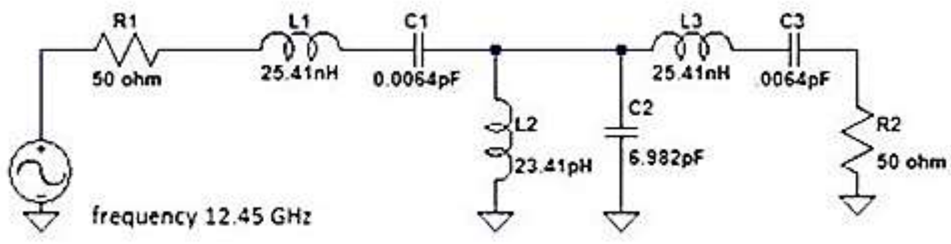

Figure.5.4: Band pass prototype for designed at center frequency.

5.1.5 Even and Odd Modes in a Coupled Transmission Line

Calculation of Odd and Even Resistances to design the micro-strip filter, an approximate Calculation is made based on the design equations. There are no of stages n = 3. The characteristic impedance$z_o$is typically 50 Ohms.

Where (g_o, $g_1...g_n$) are the element of a ladder-type low-pass prototype with a normalized cutoff Ωc = 1, and FBW is the fractional bandwidth of band-pass filter. J j,j+1 are the characteristic admittances of J-inverters and$Y_o$is the characteristic admittance of the terminating lines. The equation above will be use in edge-coupled line filter because the both types of filter canhave the same low-pass network representation [5] [15] [16].

Circuit design parameters (Impedance value from FDW and calculated impedance value) of 3rd order micro strip edge-coupled band pass filter.

Table -5.2: Impedance value from FDW and calculated impedance value.

J	Jjj+1/Y0	(Zoe)jj+1(Ω) (Calculated Results)	(Zoo)jj+1(Ω) (Calculated Results)	(Zoe)jj+1(Ω) (Simulated results)	(Zoo)jj+1(Ω)
0	0.19879	61.921	41.97	61.972	42.31
1	0.04767	52.497	47.78	52.531	47.73
2	0.04767	52.497	47.78	52.531	47.73
3	0.19879	61.921	41.97	61.927	42.31

5.2 Simulated result and discussion

In this section we discuss the results obtained from Ansoft Designer/Nexxim SV2.2 simulation software.

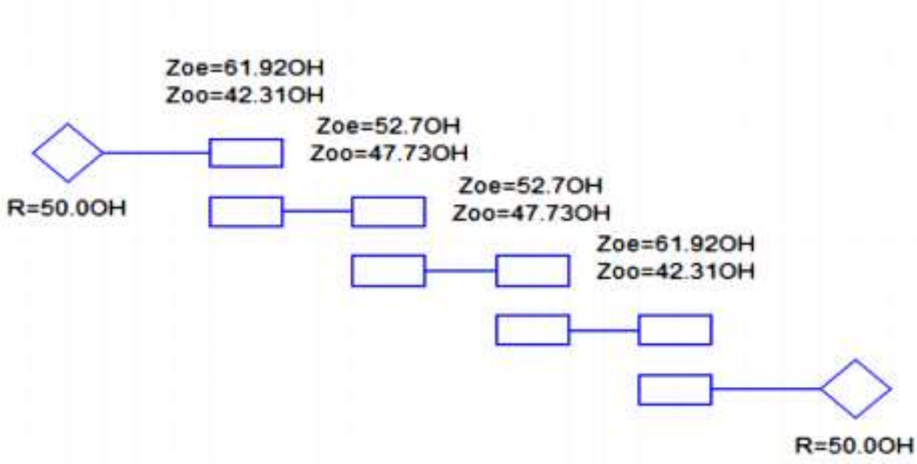

Figure 5.5: Software Result of Odd and Even Impedance of 3rd order Edge-coupled micro-strip Band-pass filter.

Figure 5.5 shows the graph for micro strip in separation is small the even mode impedance is high, and the odd mode impedance is small.

5.3 physical model configuration:

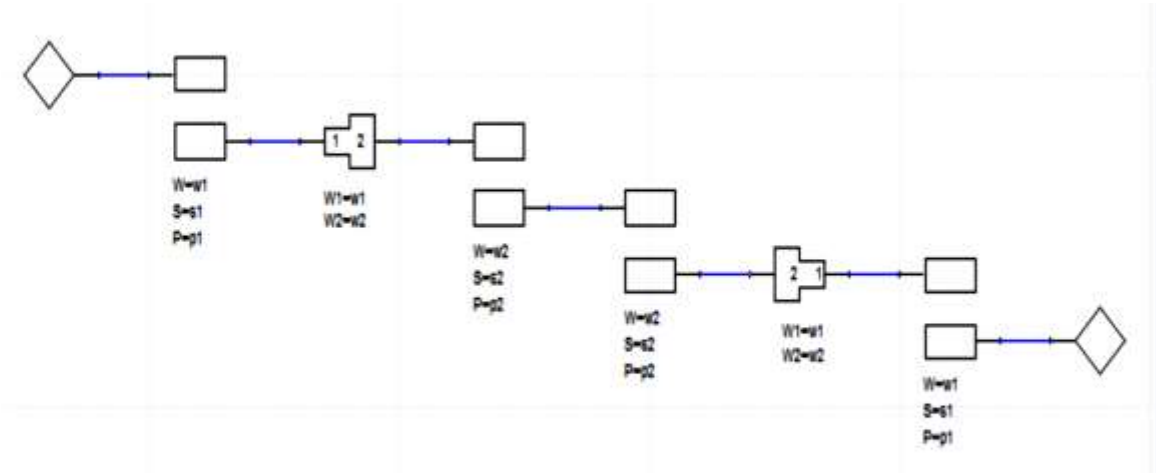

Figure. 5.6: Tuned Chebyshev band-pass filter made from Physical Model of 3rd order Edge-coupled Micro-strip Band pass Filter.

5.4 Electrical Model configuration:

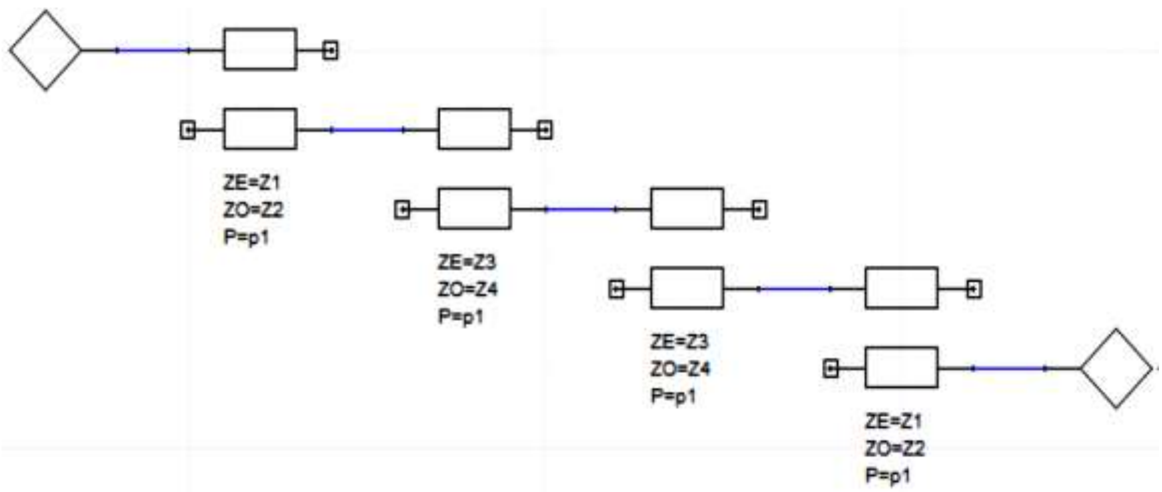

Figure 5.7: Electrical Model of 3rd order Edge-coupled Micro-strip Band pass Filter ideal transmission lines.

CHAPTER 6

SIMULATED RESULT AND DISCUSSION

6.1 Result of physical model configuration:

The general execution of edge-coupled micro-strip band-pass channel can regularly be judged by its mimicked inclusion misfortune and return misfortune result reaction. Every reenacted outcome are about indistinguishable with the figured outcomes and furthermore they are great consent to the outline particulars. Plan an edge-coupled micro-strip band-pass channel focused at 12.45 GHz with a 0.5 GHz data transfer capacity in view of Chebyshev guess [6].

Simulated Insertion Loss and Return Loss Result for physical model of 3rd order Edge-coupledMicro-strip Band pass Filter is shown in figure 6.1.

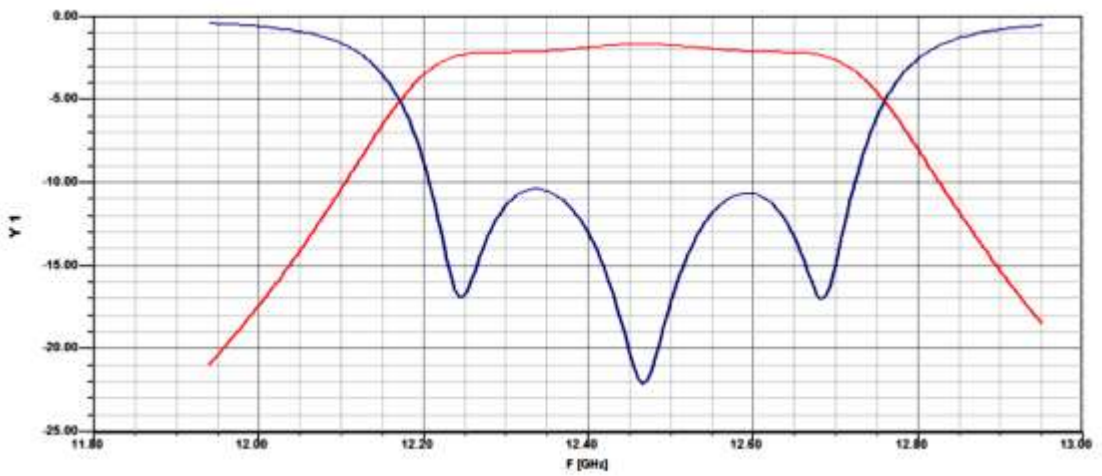

Figure 6.1: Simulated Insertion Loss and Return Loss Result for physical model of 3rd order Edge-coupledMicro-strip Band pass Filter.

6.2 Result of electrical model configuration:

Reproduced Insertion Loss and Return Loss Result for electrical model of third order Micro-strip Edge coupled Band-pass Filter is appeared in Figure 6.2. EM examination comes about because of Ansoft Designer, which shows that the reaction fulfills the outline criteria. The recreated addition misfortune is not exactly - 0.5 dB in pass band and the mimicked return misfortune is - 110dB at focus recurrence. These plots demonstrate the pass-band, stop-band, return misfortune consequences of the Ansoft Designer simulation, along with shown in Fig. 6.3

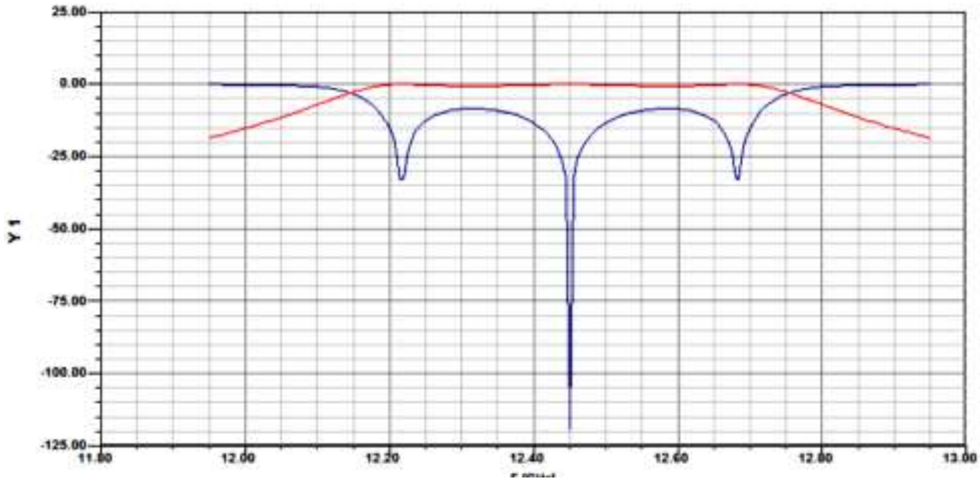

Figure 6.2: Simulated Insertion Loss and Return Loss Result for electrical model of 3rd order EdgecoupledMicrostrip Band pass Filter.

6.3 Simulated Smith Chart impedance Result:

A Smith diagram is a round plot with a great deal of entwined hovers on it. At the point when utilized effectively, coordinating impedances, with evident convoluted structures, can be made with no calculation. The smith graph can be utilized to all the while show various parameters including impedance, induction, reflection coefficient, clamor figure circle etc. Most ordinarily utilized standardization impedance of 50 ohms. By the smith diagram, we can watch the voltage standing wave proportion (VSWR) for Return misfortune (S11) parameter [18]. The VSWR is relatively close to one anytime of the circle. We realize that afilter will impeccably work when VSWR will be one. We likewise watch the quality factor for this channel from the smith diagram. Here the quality factor is close to zero for the arrival misfortune parameter. Any genuine reflection coefficient must have a greatness of not exactly or equivalent to solidarity along these lines, at the test recurrence, this might be communicated by a point inside a hover of solidarity rangeSmith chart is aset of constant resistance and constant reactance circle draw on complex Gama plane.

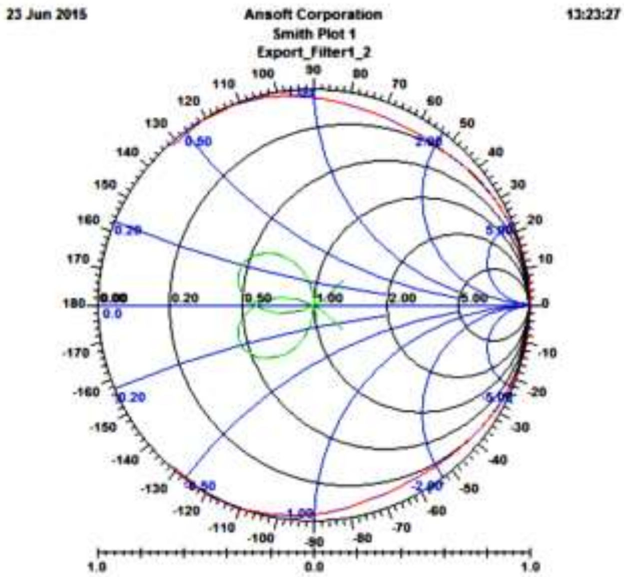

Figure 6.3: Simulated Smith Chart impedance Result of 3rd order Edge-coupledMicro-strip Band pass Filter.

The simulated insertion loss is less than -0.5 dB in pass band. Also the response is flat anduniform over the entire pass-band [3]. In addition, reflection coefficient is 0.0000001 which is nearlyequal to 0 and a perfect match exists. Therefore, the designed filter shows attractivecharacteristics for BPF applications.

6.4 Simulated layout model

In layout Figure 6.5 shows simulated layout model result of 3rd order edge-coupled micro-strip bandpass filter and Fig 4.4 show the parallel-coupled band pass filter configuration the graph formicro-strip in separation is small the even mode impedance is high, and the odd mode impedanceis small. In order to achieve the impedance pair (Zoe) = 61.9211Ω, and (Zoo) = 41.97 Ω, webuilt a table 2 and which match the values of the impedance pair. The process is visualized inlayout Figure 6.5.

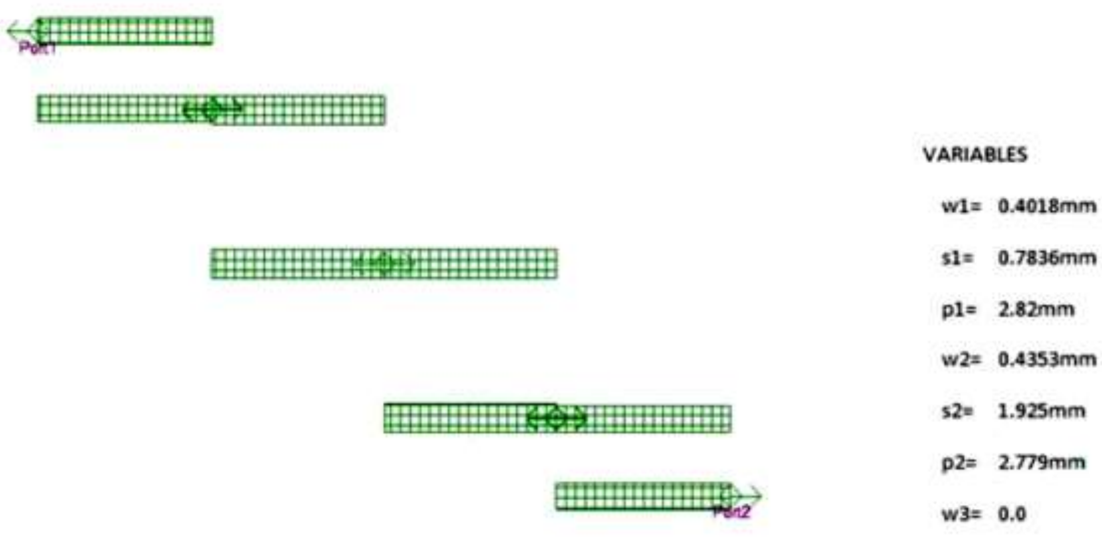

Figure 6.4: Detail dimensions of the Simulated Layout Model Result of 3rd order Edge-coupledMicro-strip Band pass Filter.

6.5 Insertion loss and Return loss parameter for stripline BPF:

Simulated Insertion Loss and Return Loss Result for electrical model of 3rd order Strip line Edgecoupled Band pass Filter is shown in Figure 6.6. The reenacted addition misfortune is not exactly -0.5 dB in pass band and the mimicked return misfortune is -74dB at focus recurrence [2] [5].

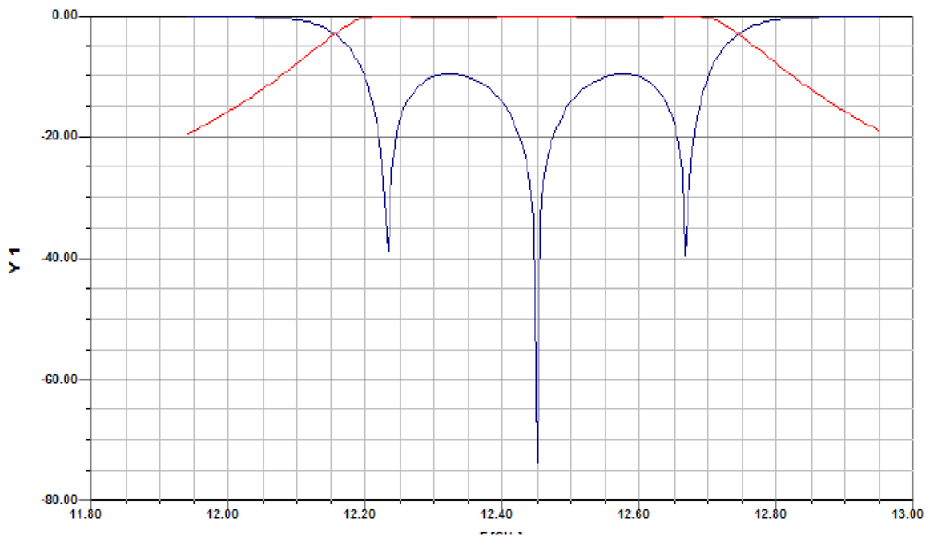

Figure 6.5: Simulated Insertion Loss and Return Loss Result for electrical model of 3rd order Edgecoupled Stripline Band pass Filter.

6.6 Comparison between stripline and micro-strip BPF:

- The simulated Return loss is less then-110db at centre frequency for the
- Micro-strip BPF.We have seen that the Return loss parameter for the “Strip line” band pass filter is -74B.
- We know that, if Return loss of a filter is lesser it would be work better.
- So from the above discussion it is clear that a strip line filter will not give a good response for this frequency.

CHAPTER 7

CONCLUSION

The work primarily focuses on the Design and analysis of Edge-CoupledMicro-strip Band Pass Filter for Ku band. This project is summarized the performance analysis on Edge-CoupledMicro-strip Band Pass Filter for Ku band. Experimental implementation of this work involves the Roger R06006 substrate withdielectric constant of 6.45 dielectric characterizations at microwave frequencies. Third-ordermicro-strip edge-coupled band pass filter is used in order to realize these objectives. The twoparameters insertion loss and return loss are to analyze to obtain a good performance of filter.The analysis insertion loss is less than -0.5 dB in the desired pass band and the analyzed returnloss is -110 dB at center frequency. Design an edge-coupled micro-strip band-pass filter centeredat 12.45 GHz with a 0.5 GHz bandwidth based on chebyshev approximation. As predicted, thesimulation in Ansoft Designer the pass band center frequency by about 12.45GHz.Through the comparison between the stripline band-pass filter it can decide that micro-strip bandpass filter is more perfect for this desired frequency band. The analyzed performance report will help to design or handle Edge-CoupledMicro-strip Band Pass Filter for Ku band and also clarify the losses and relative parameters. And Efficiency of band pass filter has increased here. Narrower bandwidth can be passed in thepass band. This project achieved desired return loss and minimum insertion loss. As It go through otherresearch paper of Edge coupled filter for different band such as Ka, U band it observe the samecases as mentioned above. And comparing to thoseresult to the final simulated result issimilar to the curve as this project found for Ku band.

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APPENDEX

LPF	Low pass filter
BPF	Band pass filter
HPF	High pass filter
BRF	Band reject filter
SAW	Surface acoustic wave fitter
VSWR	Voltage standing wave ratio
MIC	Microwave integrated circuits
LCP	Liquid crystal polymers
MEMS	Micro electro mechanic systems
LTCC	Low temperature co-fired ceramics
MMIC	Monolithic microwave integrated circuit