Report on

Distributed Circuit - Low Pass Filter

by

Kambli Rahul Rajeev
Jakhotia Smit Sanjay
Aher Harshal Vithalrao

Abstract

In this period, life can't be imagined without remote correspondence. It is the need of world. Essentially all correspondence systems contain a RF front end which performs flag preparing and using RF channels. Microstrip channel play a basic occupation in microwave applications. The system for step impedance low pass demonstrate channel is used to design microstrip channel. For ventured impedance channel configuration, low and high trademark impedance lines are utilized. Standard structure of microstrip low pass channels essentially consolidates either the use of shunt stubs or the meandered impedance orchestrate, which is a high-low impedance transmission line . For lower microwave frequencies the level of the generally sorted out channel is extensive. Additionally, the microstrip LPF setup utilizing typical methodologies requires significantly more prominent size to accomplish a sharp cut-off.

Keywords:
Microstrip low pass filter, stepped impedance, Richards transforms,

Contents

Abstract ii

List of Figures v

1 Introduction 1

1.1 Distributed Filters 1

1.2 Low Pass Filters 2

1.3 Microstrip 2

1.4 Motivation 3

1.5 Objective 4

2 Literature Survey 5

3 Problem Statement 6

3.1 Implementation Issues 6

3.2 Constraints 6

3.3 Why Microstrips? 7

4 Design 8

4.1 Filter Design By The Insertion Loss Method 8

4.2 Stepped Impedance Method 8

4.3 Approximate Equivalent Circuits for ShortTransmission Line Sections 9

4.4 Design Example 11

4.5 Calculation 12

5 Fabrication 15

5.1 Materials and Fabrication Technologies 15

5.1.1 Copper - Clad Boards 15

5.1.2 Thick - Film Fabrication 15

5.1.3 Thin - Film Technology 15

5.2 SMA Connector 16

5.3 PCB 17

5.4 Components 18

5.4.1 FR4 Substrate 18

5.4.2 Etching Solution 19

5.4.3 ENA Series Network Analyzer 19

5.5 Fabrication Process 20

5.5.1 Direct Toner Transfer 20

5.5.2 Photo-Resistive Laminates 21

5.5.3 Etching 24

6 Simulation and Result 25

7 Conclusion 28

Bibliography 29

List of Figures

4.1 Filter design for 12
4.2 Amplitude response of the stepped-impedance low-pass filter of, with and without losses. 13
5.1 SMA Connector 17
5.2 PCB Filter 18
5.3 FR4 Substrate 19
5.4 Etchant 20
5.5 Series Network Analyzer 21
5.6 Direct Toner Method 22
5.7 Printed mask on a Foil. 22
5.8 Placing the mask in the UV imaging frame. 24
6.1 Simulated Performance of the Stepped Impedance Low Pass Filter at 1 GHz 26
6.2 Response on ENA Series Network Analyzer 27
6.3 Measured and simulated values of the S_21*parameters.* 28

Chapter 1

Introduction

1.1 Distributed Filters

A conveyed segment channel is AN electronic channel inside which capacitance, inductance and opposition aren't restricted in isolated capacitors, inductors and resistors as they're in run of the mill channels. Its motivation is to allow an assortment of flag frequencies to pass, anyway to dam others. normal channels square measure produced using inductors and capacitors, and furthermore the circuits along these lines planned square measure spoken to by the lumped part display, that believes each segment to be ”lumped together” at one spot. That show is reasonably direct, anyway it turns out to be continuously problematic in light of the fact that the recurrence of the flag will increment, or identically in light of the fact that the wavelength diminishes. The circulated segment demonstrate applies at all frequencies, and is utilized in conductor hypothesis; a few appropriated segment parts square measure created from short lengths of conductor. inside the appropriated read of circuits, the climate square measure conveyed on the length of conductors and square measure inseparably blended along. The channel style is once in a while included exclusively with inductance and capacitance, anyway attributable to this joining of parts they can't be treated as independent ”lumped” capacitors and inductors. there's no exact recurrence higher than that appropriated segment channels ought to be utilized anyway they're especially identified with the microwave band (wavelength however one meter).

Appropriated segment channels are utilized in a few of indistinguishable applications as lumped part channels, similar to property of radio channel, band-restricting of commotion and multiplexing of the numerous signs into one channel. Dispersed part channels is likewise made to have any of the band-frames feasible with lumped segments (low-pass, band-pass, and so on.) except for high-pass, that is regularly exclusively approximated. All channel classes utilized in lumped part styles (Butterworth, Chebyshev, and so forth.) are frequently implemented utilizing a dispersed segment approach.

There are several element forms accustomed construct distributed component filters, however all have the common property of inflicting a separation on the line. These discontinuities gift a reactive electrical phenomenon to a surface movement down the road, and these reactances are often chosen advisedly to function approximations for lumped inductors, capacitors or resonators by the filter.

1.2 Low Pass Filters

Circulated segment channels are utilized in a few of indistinguishable applications as lumped segment channels, similar to property of radio channel, bandlimiting of commotion and multiplexing of the numerous signs into one channel. Circulated segment channels is likewise made to have any of the bandforms feasible with lumped parts (low-pass, bandpass, and so forth.) except for high-pass, that is normally exclusively approximated. All channel classifications utilized in lumped part styles (Butterworth, Chebyshev, and so on.) are frequently upheld utilizing a circulated segment approach.

There are a few component frames acclimated build conveyed part channels, anyway all have the basic property of incurring a partition on hold. These discontinuities blessing a responsive electrical marvel to a surface development not far off, and these reactances are frequently picked thoughtfully to work approximations for lumped inductors, capacitors or resonators,

1.3 Microstrip

Microstrip is a sort of electrical transmission line which can be made using printed circuit board development, and is used to pass on microwave-repeat signals. It includes a coordinating strip confined from a ground plane by a dielectric layer known as the substrate. In such a development corresponding and nonreciprocal withdrew portions are gained by changing the plan of the printed metallic strips, while interconnections can be made on the substrate.

Microwave portions, for instance, accepting wires, couplers, channels , control dividers and so forth can be molded from miniaturized scale strip, the entire device existing as the case of metallization on the substrate. Microstrip is thusly significantly less expensive than standard waveguide advancement, similarly as being far lighter and dynamically limited.

The drawbacks of microstrip differentiated and waveguide are the overall lower control dealing with breaking point, and higher incidents. Also, rather than waveguide, microstrip isn't encased, and is thusly helpless against cross-talk and unintentional radiation. For most decreased cost, microstrip contraptions may be founded on an ordinary FR-4(standard PCB) substrate. In any case generally found that the dielectric setbacks in FR4 are unnecessarily high at microwave frequencies, and that the dielectric constantis not enough immovably controlled. Subsequently, an alumina substrate is commonly used.

On a lsmall scale, microstrip transmission lines are also consolidated with strong microwave composed circuits. Microstrip lines are furthermore used in fast progressed PCB plans, where signs ought to be directed beginning with one bit of the party then onto the following with immaterial distortion, and keeping up a key separation from high cross-talk and radiation.

Microstrip is on a very basic level equivalent to strip line and coplanar waveguide, and it is possible to consolidate every one of the three on a comparative substrate.

Microstripis a kind of electrical transmission line which can be fabricated using printed circuit board advancement, and is used to pass on microwave-repeat signals. It includes a main strip confined from a ground plane by a dielectric layer known as the substrate.

1.4 Motivation

The inspiration for doing this venture was principally an enthusiasm for undertaking a difficult task in an intriguing territory of research. We needed to apply all the hypothetical learning which we have increased through the past scholarly long stretches of building for all intents and purposes to get our ideas clear crystal.This channel is utilized in microwave frameworks like as radars, estimation and test frameworks, satellite correspondence. This microstrip channel has preferences like minimal effort, higher selectivity and uncomplicated structure. This microstrip lines are a lot less expensive and lighter yet gives higher misfortunes.

1.5 Objective

The objective of the project give us the concepts required for designing a microstrip low pass filter,

- Microstrips.
- Determine the impedance and width of the microstrip to be used in low pass filter.
- Implementation in low pass filter design.

Chapter 2

Literature Survey

[1]In this book, microwave and RF innovation is appeared more inescapable than any time in recent memory. This is particularly valid in the business area, where current applications incorporate cell phones, cell phones, 3G and WiFi remote systems administration, millimeter wave crash sensors for vehicles, direct communicated satellites for radio, TV, and systems administration, worldwide situating frameworks, radio recurrence recognizable proof labeling, ultra wideband radio and radar frameworks, and microwave remote detecting frameworks for the earth. Protection frameworks keep on depending intensely on microwave innovation for latent and dynamic detecting, interchanges, and weapons control frameworks. There ought to be no deficiency of testing issues in RF and microwave designing soon, and there will be a reasonable requirement for specialists having both a comprehension of the basics of microwave building and the imagination to apply this learning to issues of handy premium.

[2]This letter introduces a smaller multi segment sharp-dismissal small scale strip low-pass channel. Each area is comprised of a small scale strip line area and an interdigital capacitor. The examination for enhancing the constriction shafts by modifying the finger number, and the width also, length of the smaller scale strip line segment is exhibited. The fell four-segment low-pass channel has an arrival loss of superior to 17 dB and an inclusion loss of less than 0.7 dB from dc to 1.6 GHz. The dismissal is superior to 20 dB from 2.1 to 7.5 GHz.

[3]Low impedance small scale strip lines are organized such that they function as open stubs to expand the selectivity of the channel. Utilizing the proposed procedure about 57% size decrease has been acknowledged with more keen move off qualities. An exact articulation is inferred to decide the component of resonators. For cut-off recurrence of 1.7 GHz the explored strategy has been created and tried.

[4]Complementary split ring resonators are used to design compact, low insertion loss (IL), low pass filter with sharp cut-off. A prototype filter implementing area is 0.23 0.09, being the guided wavelength at 3-dB cut-off frequency (f) 1.887 GHz. Maximum IL is within 0.5 dB up to 1.717 GHz and20-dB stop band extends up to 3.4 .

[5]This paper presents two small scale strip elliptic-work low-pass channels, one utilizing disseminated components and one utilizing a opened ground structure. The one utilizing disseminated components comprises of a miniaturized scale strip line segment in parallel with bury advanced capacitor; the other one utilizing an opened ground structure comprises of a low impedance miniaturized scale strip line with an opened ground structure cell under the focal point of the line. A transmission-line demonstrate and a fullwave recreation are utilized to ascertain the inductance/capacitance estimations of the proportionate circuits. The structure idea was approved through examinations appearing concurrences with the full-wave reenacted results.

Chapter 3

Problem Statement

There is an increasing interest for microwave frameworks to address the rising media transmission difficulties regarding size, execution and cost. Because of the improvement in satellite and portable correspondences the framework and part exertion has been made to build up an assortment of minimal low pass channels. In the structure of low pass microwave channels, the reduced size and evaation of undesable recurrence segments with wanted pass band qualities are the major concerns.This venture potrays a general plan system for smaller scale strip low pass chnnels that are utilised to pass on micrave recurence signals.

3.1 Implementation Issues

There is no specific haware to be utilized in the usage of the filters.The configuion depends on the stregies st up in the writing survey. The tranission line to be utilized can be hdled utilizing cutters and the vernier caliper to chisel the requed measurements. Becse of the abnce of exact specific hadware to decide the type of the transmission lines, precision is an issue and it ought to be cosidered. Transmsion line merials should be bouht, a record of the trade off among expse and electrical conductivity of the materials is to be gven as electrical conductivity of the mterial influences the execution of the channel.

3.2 Constraints

The lumped-compnent channel strutures fnction admirably at low frequencies, howver two issues emerge at higer RF and microwave frequencies. Initially, lumped-component induors and capators are commonly accssible just for a restricted scope of values, and can be hard to actualize at micrwave freqncies. Appropriated elements,such as open-circuited or short circuited transmission line stubs, are frequely used to surmised perfect lumped compnents. Also, at microwave frequencies the separations between channel parts isn't insignificant. The principal issue is treated with Richards' change, which can be utilized to change over lumd components to transmission line areas. Kuroda's characters would hen be able to be utilized to physically isolate channel components by utilizing transmision line sements. Since such extra transission line areas don't influence the channel reaction, this sort of configuration is called excess channel unon. It is conceible to plan micowave channels that exploit these areas to improve the channel reaction [4]; such non-repetitive combintion does not have a lumed-component partner.

3.3 Why Microstrips?

- Size matters now a days we try to minimize the size of the instruments and the maines used .Microstrip filters can so be used in space communication since they are lighters and compact . On the other hand wave-guide filters are bulky.

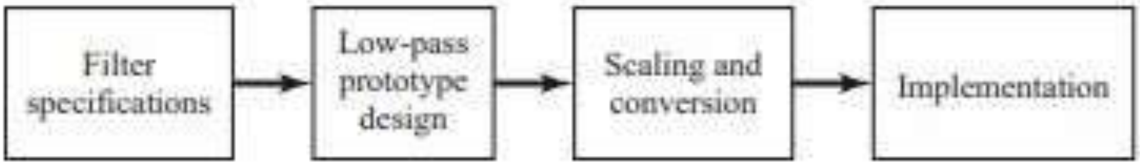
- In case of Mirstrip fiters you design with resect to transfer funions speally in stepped impedance mthod , which means you cantrol the characteristics of your filter and get the desired output. Also you can change the characteriic of the filer by using diffeent transfer functions.

- Designing the filter becomes very easy since we use software ans can optimize the results , so unlike wave-guide filters we get almost accurate results which is very crucial in communication .

- But generally microstrip have lower power handling capacity and the losses are more because wave-guides are enclsed unlike mirostrip , which makes microstrip having limation of cross-talk and unientional radiation, but nowadays several methods are being used to remove such problems .

Chapter 4

Design



4.1 Filter Design By The Insertion Loss Method

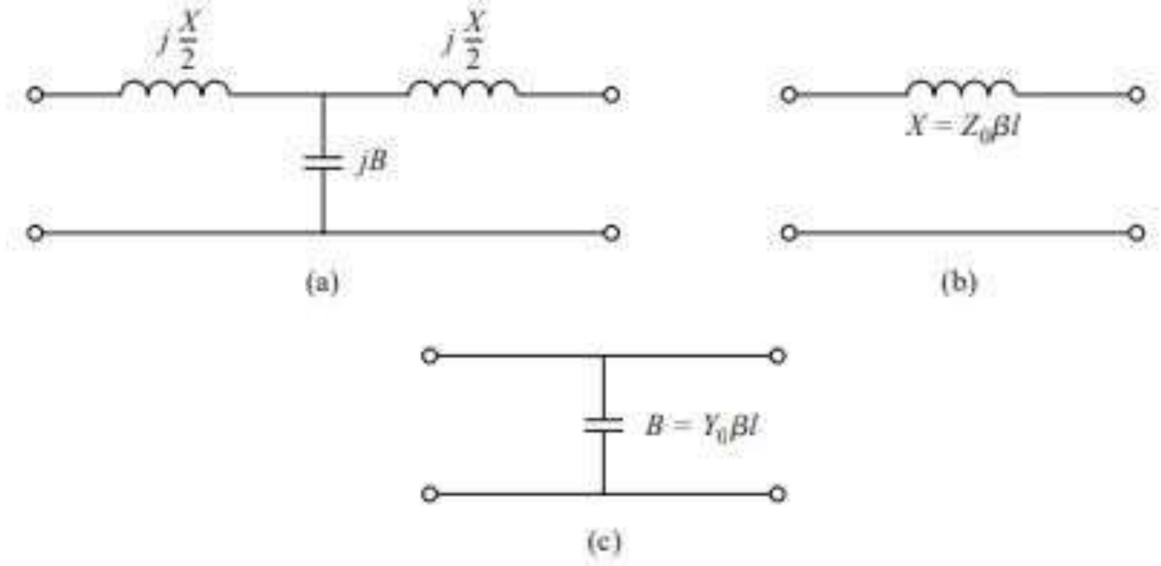
A perfect channel would have zero expansion incident in the pass-band, unbounded tightening in the stop-band, and an immediate stage response (to keep up a key separation from banner contorting) in the pass-band. Unmistakably, such channels don't exist in every practical sense, so deals must be made; in this lies the claim to fame of channel structure. The picture parameter system for the past zone may yield a usable channel reaction for explicit applications, at any rate there is no capable procedure for improving the game plan. The development hardship methodology, in any case, licenses an irregular condition of control over the pass-band and stop-band plentifulness and stage attributes, with an efficient procedure to join an ideal reaction. The fundamental course of action exchange offs can be assessed to best meet the application necessities. On the off chance that, for instance, a base extension hardship is most fundamental, a binomial reaction could be utilized; a Chebyshev reaction would fulfill a requirement for the most sharp cutoff. In the event that it is conceivable to give up the gagging rate, a prevalent stage reaction can be gotten by utilizing a quick stage channel plan. Moreover, in all cases, the thought occurrence philosophy awards channel execution to be improved in an indisputable way, to the disadvantage of a higher requesting channel. For the channel models to be talked about underneath, the sales of the channel is indistinguishable to the measure of responsive sections.

4.2 Stepped Impedance Method

A moderately simple approach to execute low-pass channels in microstrip or stripline is to utilize exchanging areas of extremely high and low trademark impedance lines. Such channels are normally alluded to as ventured impedance, or hello there Z, low-Z channels, and are well known on the grounds that they are simpler to structure and occupy less room than a comparative low-pass channel utilizing stubs.As a result of the approximations included, be that as it may, their electrical execution isn't as great, so the utilization of such channels is generally restricted to applications where a sharp cutoff isn't required.

4.3 Approximate Equivalent Circuits for Short Transmission Line Sections

We begin by finding the approximate equivalent circuits for a short length of transmission line having either a very large or a very small characteristic impedance.



We thus have the equivalent circuit shown, where

$$X/2 = Z_0 tan\beta\iota/2 \tag{4.1}$$

$$B = 1/Z_0 sin\beta\iota \tag{4.2}$$

Now assume a short length of line (say $\beta\ \iota ¡ \pi/4$) and a large characteristic impedance. Then (8.83) approximately reduces to

$$X\ '\ Z_0\beta\iota \tag{4.3}$$

$$B\ '\ 0 \tag{4.4}$$

which implies the equivalent circuit of a series inductor. For a short length of line and a small characteristic impedance,the above equation reduces to

$$X\ '\ 0 \tag{4.5}$$

$$B\ '\ Y_0\beta\iota \tag{4.6}$$

which implies the equivalent circuit. So the series inductors of a low-pass prototype can be replaced with high-impedance line sections ($Z_0 = Z_h$), and the shunt capacitors can be replaced with low-impedance line sections ($Z_0 = Z_\iota$). The ratio Z_h/Z should be as large as possible, so the actual values of Z_h and Z are usually set to the highest and lowest characteristic impedance that can be practically fabricated. The lengths of the lines can then be determined from (5.3) and (5.6); to get the best response near cutoff, these lengths should be evaluated at $\omega = \omega_c$. Combining the results of (5.3) and (5.6) with the scaling equations of allows the electrical lengths of the inductor sections to be calculated as

$$\beta\iota = L^{R_0}/Z_h(inductor) \tag{4.7}$$

and the electrical length of the capacitor sections as

$$\beta\iota = C * Z_\iota/R_0(capacitor) \tag{4.8}$$

where R_0 is the filter impedance and L and C are the normalized element values of the low-pass prototype.

4.4 Design Example

Design a stepped-impedance low-pass filter having a maximally flat response and a cutoff frequency of 2.5 GHz. It is desired to have more than 20 dB insertion loss at 4 GHz. The filter impedance is 50 ; the highest practical line impedance is 120 , and the lowest is 20 . Consider the effect of losses when this filter is implemented with a microstrip substrate having d = 0.158 cm,r = 4.2,tan δ = 0.02, and copper conductors of 0.5 mil thickness.

$$\frac{\omega}{\omega_c} - 1 = \frac{4.0}{2.5} - 1 = 0.6;$$

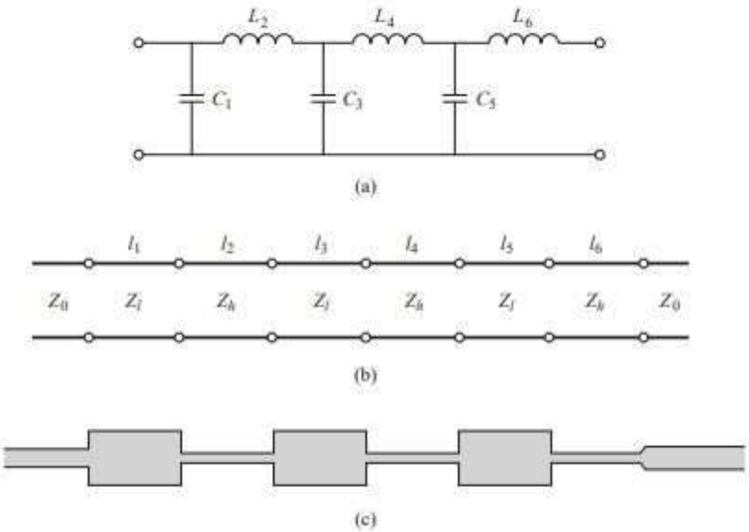


Figure 4.1: Filter design for

the figure indicates N = 6 should give the required attenuation at 4.0 GHz.

The required electrical line lengths, β i , along with the physical microstrip line widths, W_i, and lengths, i , are given in the table below.

$$\begin{aligned}
g_1 &= 0.517 = C_1,\\
g_2 &= 1.414 = L_2,\\
g_3 &= 1.932 = C_3,\\
g_4 &= 1.932 = L_4,\\
g_5 &= 1.414 = C_5,\\
g_6 &= 0.517 = L_6.
\end{aligned}$$

Section	$Z_i = Z_\ell$ or $Z_h(\Omega)$	$\beta\ell_i$ (deg)	W_i (mm)	ℓ_i (mm)
1	20	11.8	11.3	2.05
2	120	33.8	0.428	6.63
3	20	44.3	11.3	7.69
4	120	46.1	0.428	9.04
5	20	32.4	11.3	5.63
6	120	12.3	0.428	2.41

The pass-band characteristic is similar to that of the stepped impedance filter, but the lumped-element filter gives more attenuation at higher frequencies.

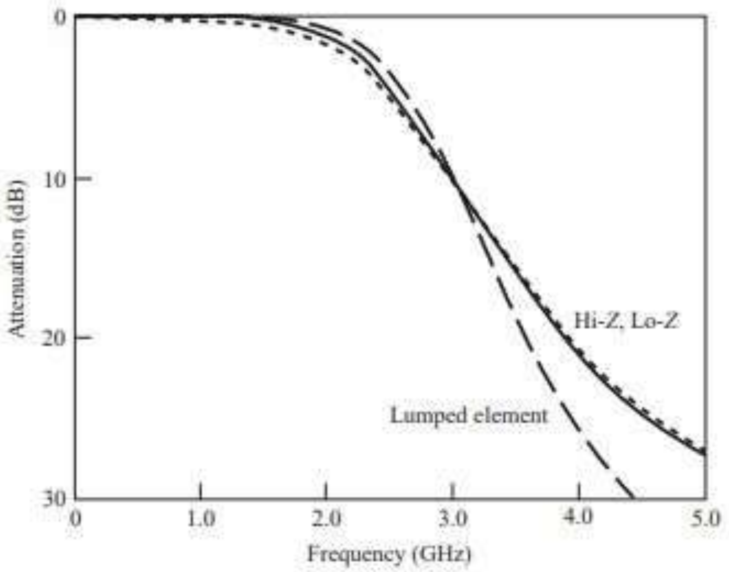


Figure 4.2: Amplitude response of the stepped-impedance low-pass filter of, with and without losses.

This is because the stepped-impedance filter elements depart significantly from the lumped-element values at higher frequencies. The stepped impedance filter may have other pass-bands at higher frequencies, but the response will not be perfectly periodic because the lines are not commensurate.

4.5 Calculation

Given

Cut-off Frequency = Fc = 1GHz

Insertion Loss(IL) = 20db at 1.6GHz

Characteristic Impedance(Zo) = 50Ω

Highest Impedance(Zh) = 120Ω
Lowest Impedance(ZL) = 20Ω
Thickness(h) = 1.6 mm
Dielectric Constant $\epsilon r = 5.4$**Solution:**

Step I:-

$$(W/W_c) - 1 \tag{4.9}$$

(1.6/1)-1 = 0.6

Step II:-

g0 = 1
C1=g1=0.517
L2=g2=1.414
C3=g3=1.932
L4=g4=1.932
C5=g5=1.414
L6=g6=0.517
g7=1

SECTION	Z_L/Z_H	βl(deg)	Wi(mm)	Li(mm)
Z_o	50	45	2.617	9.46
1	20	11.8	10.41	4.63
2	120	33.8	0.3013	12.20
3	20	44.3	10.41	17.3
4	120	46.1	0.3013	16.64
5	20	32.4	10.41	12.72
6	120	12.3	0.3013	4.44
Z_o	50	45	2.617	9.46

$$\beta - K_0\sqrt{\epsilon} * \epsilon \tag{4.10}$$

Values for β
For 20Ω = 44.44
For 120Ω = 48.34
For 50Ω = 82.96

$$K_0 = 2\pi f/c = 20{,}94 \tag{4.11}$$

$$\epsilon_e = (\epsilon_r + 1/2) + (\epsilon_r - 1/2) * 1/\sqrt{1 + 12d/W} \tag{4.12}$$

Values for $_e$
For 20Ω = 4.504
For 120Ω = 5.33

$$W/d = 8e^{A}/e^{2A} - 2 \tag{4.13}$$

$$A = Z_0/60 * \sqrt{\epsilon_r + 1/2} + \epsilon_r - 1/\epsilon_r + 1 * (0.23 + 0.11/\epsilon_r) \tag{4.14}$$

Values for A

For 20Ω = 0.7684

For 120Ω = 3.75

For 50Ω = 1.66

Chapter 5

Fabrication

5.1 Materials and Fabrication Technologies

Broadly speaking there are 3 main technologies for fabricating microstrip circuits:-

- Copper-clad boards.
- Thick-film fabrication, on ceramic substrates.
- Thin-film fabrication, on ceramic substrates, other substrates(e.g. Quartz), and integrated circuits(GaAs, InP, Si, etc).

5.1.1 Copper - Clad Boards

Here,copper is put on extensive fiber-glass or other woven or PTFE-based sheets, utilizing electro statement or rolling.photoresist is typically connected by covering a readied film onto the substrate. It may likewise be connected by dunking in a tank,or by spinning(for little circuits). The photoresistst is then presented to uv by means of a mask,and developed.the copper is then scratched away where it isn't secured by photoresist.

5.1.2 Thick - Film Fabrication

In this technology,metal and dielectric pastes are associated with a stoneware base substrate using screen printing.the screen is a fine metal wire mesh,and it has a photographic emulsion applied.the circuit configuration is duplicated onto this emulsion layer.during printing,the stick is squashed through the work where there are emulsion openings onto the substrate.the stick is then dried and ended at around 850 deg c.successive layers can be printed to from multilayer circuits.

5.1.3 Thin - Film Technology

In this innovation metal statement method, for example, vanishing are used,possibly with electroplating also for increment metal thickness.The hardware utilized is moderately expensive,and the substrate must be in a production,the need to hang tight for the chamber strain to drop down,and the restricted substrate size,are huge drawbacks.however,thinfilm inntion gives the best example definition and most astoding execution if reasonable materials are utilized.

5.2 SMA Connector

Figure 5.1: SMA Connector

SMA (SubMiniature variation A) connectors are semi-precision coaxial RF connectors made amid the 1960s as a unimportant connector interface for coaxial connection with a screw-type coupling framework. The connector has a 50 impedance. SMA is proposed for use from DC (0 Hz) to 18 GHz, anyway is most ordinarily used for hand-held radio and PDA gathering mechanical assemblies, and even more starting late with WiFi accepting wire systems and USB programming described radio dongles[citation needed]. It is furthermore regularly used in radio stargazing, particularly at higher frequencies (5 GHz+).SMA connectors can be apparently confused with the standard nuclear family 75ohm type F encourage connector (widths: Male 716 inch (11 mm) indirect or hex; female 38 in (9.5 mm) outside strings), as there is simply around a 2 mm refinement all things considered in the subtleties. Type F can't be mated with SMA connectors without the use of an adapter.The SMA name is furthermore used for a remotely similar optical fiber connector.

5.3 PCB

Figure 5.2: PCB Filter

All circuits will be manufactured utilizing a basic two-layer printed circuit board (PCB). The PCB comprises of a dielectric material, for the most part FR4 (r = 4.4), with a thickness of 62 mils, and two layers of Cu metal layer. The metal layers have a thickness of 34 m. Typically you would design the metal layers to deliver your circuit yet in light of a legitimate concern for time, the loads up have been pre-assembled to take on a standard structure. The posterior of the load up is a strong ground plane. Associations with ground must go through a ”by means of” to achieve the rear. For this lab, the design of the board is appeared in Fig.1. The information and yield of the board have impressions for SMA connectors which enable you to interface SMA links. The information and yield microstrip transmission lines are hindered intermittently which enables you to put segments in arrangement or in shunt in a stepping stool channel structure. Landing cushions with via to ground likewise show up occasionally to permit shunt segments to be patched to ground. To patch parts onto the board, utilize standard 0603 components in arrangement or in shunt.

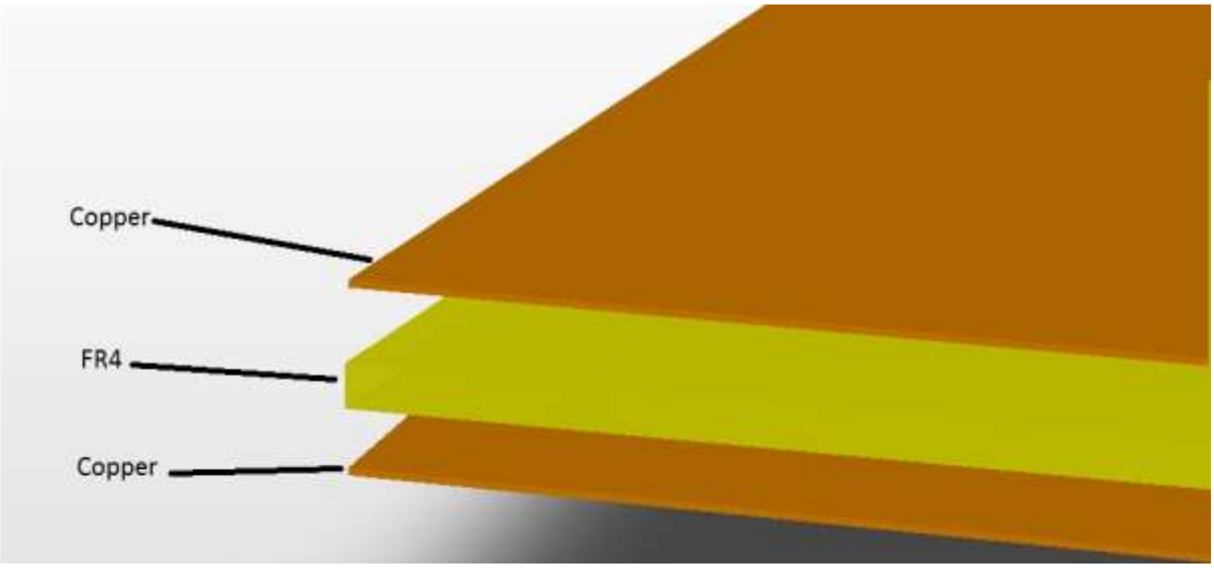


Figure 5.3: FR4 Substrate

5.4 Components

5.4.1 FR4 Substrate

”FR” stands for flame retardant, and denotes that the material complies with the standard UL94V-0. The designation FR-4 was created by NEMA in 1968. FR-4 glass epoxy is a prominent and flexible high-weight thermoset plastic overlay grade with great solidarity to weight proportions. With almost zero water assimilation, FR-4 is most regularly utilized as an electrical separator having extensive mechanical quality. The material is known to hold its high mechanical qualities and electrical protecting characteristics in both dry and muggy conditions. These traits, alongside great manufacture qualities, loan utility to this evaluation for a wide assortment of electrical and mechanical applications.

The misfortunes in FR4 increase as the repeat gets higher and start to issue basically for frequencies more than 1 GHz, twisting up persistently progressively significant as the repeat goes more than 1 GHz. The dielectric consistent isn’t so especially controlled as in ’authentic’ (proposed for the action and logically exorbitant) microwave materials.Not just for fix gathering contraption, generally we used FR-4 substrate for low repeat plans since it is negligible exertion and basic available in the market. For high repeat structures we as a rule use high dielectric steady materials.

5.4.2 Etching Solution

Figure 5.4: Etchant

Etching is a ”subtractive” strategy utilized for the generation of printed circuit sheets: corrosive is utilized to expel undesirable copper from a pre-assembled cover. This is finished by applying a brief veil that shields portions of the cover from the corrosive and leaves the ideal copper layer immaculate.

You can scratch a PCB without any other individual’s contribution, in a lab or even at home, through an essential and shabby creation process. It looks good when you wish to convey a singular or a particularly unassuming number of sheets and need to keep away from gathering costs. The illustration method is thus fruitful for a little workshop.There is a risk of wounds due to the engineered creations included.

5.4.3 ENA Series Network Analyzer

A system analyzer is an instrument that gauges the framework parameters of electrical frameworks. Today, orchestrate analyzers routinely measure s parameters since reflection and transmission of electrical frameworks are definitely not hard to evaluate at high frequencies, anyway there are other framework parameter sets, for instance, y-parameters, z-parameters, and h-parameters. Framework analyzers are oftentimes used to depict twoport frameworks, for instance, speakers and channels, anyway they can be used on frameworks with a self-confident number of ports.

The fundamental design of a system analyzer includes a flag generator, a test set, at least one collectors and show. In certain setups, these units are unmistakable in-

Figure 5.5: Series Network Analyzer

struments. Most VNAs have two test ports, allowing estimation of four S-parameters (S11,S21,S12,S22) yet instruments with multiple ports are accessible economically.

5.5 Fabrication Process

5.5.1 Direct Toner Transfer

The circuit design is printed with a laser printer on paper, put face-down on the overlay, and the toner is transferred from the paper to the copper utilizing an iron. Note that only one out of every odd paper is appropriate for this strategy, including the standard priner paper, yet a great deal of examples of overcoming adversity tell about reused magazine pages. Particularly the Reichelt electronic inventory should create great outcomes... The print must be of a not all that terribe quality, little oversights we verall will all things considered rejection in printed substance can result in unusable seeks after or even reason shortcircuits. The exchanging of the toner is soewhat dangerus as well. In the event that temperature is pointlessly high, the toner gets an excessive amount of fluid and the tracks will cloud. In the event that the temperature is extravantly low, the toner won't adhere to the copper. After the crushing you can't pull the paper away basilly like that, without pulverizing bit of the shroud. Or on the other hand posibly you need to put the spread with the paper in a water shower and hold up some time until you can begin to deliberately scour away the paper.

5.5.2 Photo-Resistive Laminates

The mask is printed on a transparent paper or foil, exposed and developed on the laminate with a UV lamp.

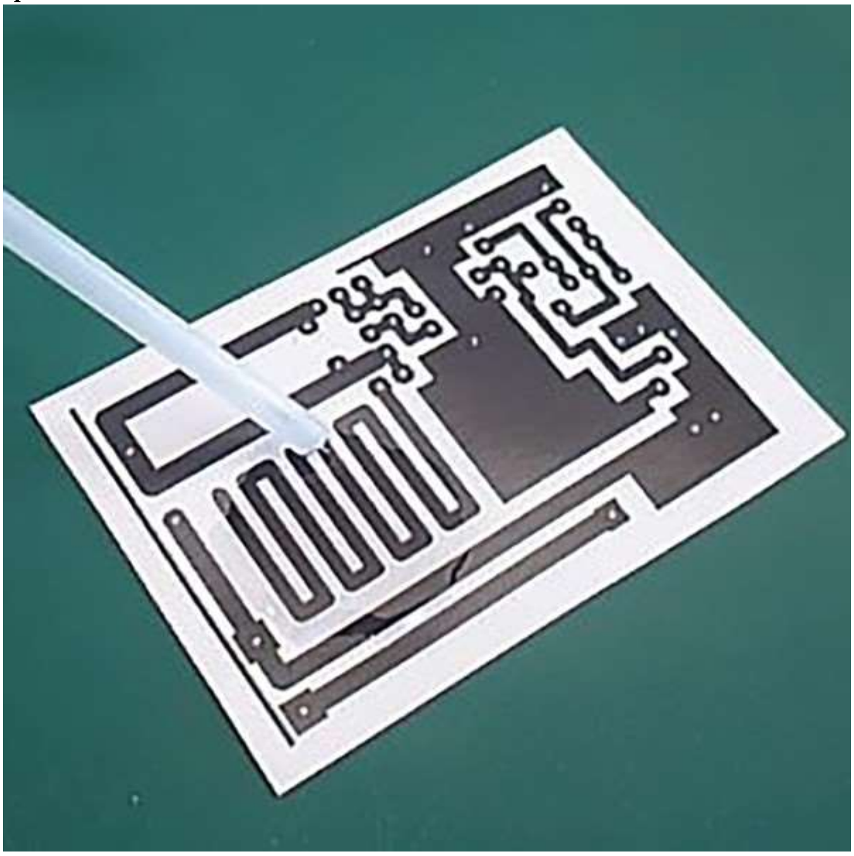


Figure 5.6: Direct Toner Method

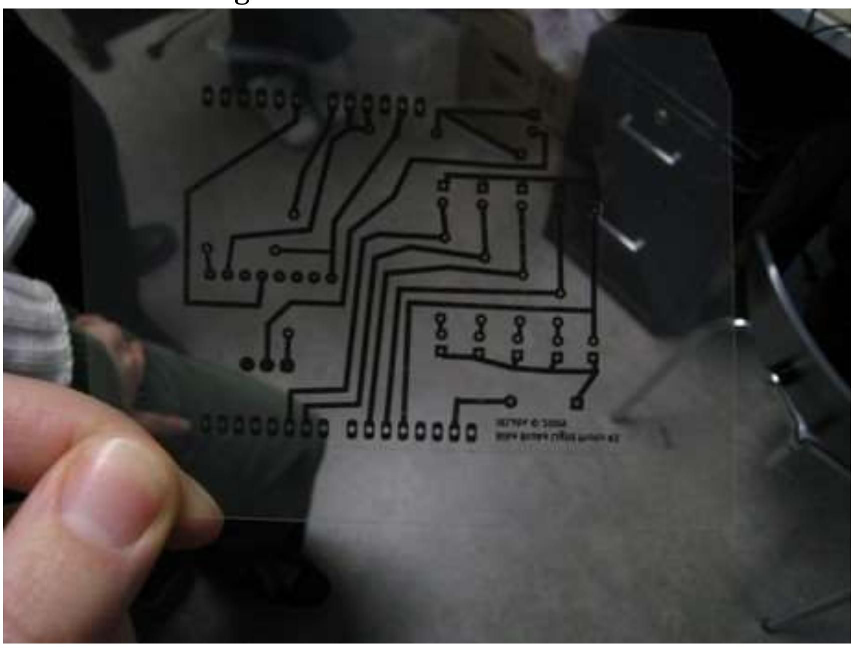


Figure 5.7: Printed mask on a Foil.

The laminates have a coating that is sensitive to light - by shining a light on them, we can transfer an image of the design to be created onto the board. Where light strikes the board, the coating weakens and creates an area of copper that will be dissolved away by the etching acid.

- Export your PCB layout using File ¿ Export ¿ Etchable PDF/SVG. If you like, you can now edit and enhance the graphics in a graphics software.
- Print the record in most noterthy goals, first on wite paper, and when fulflled, on a straightrward papr or foil. Be midful so as to set the priner alterntives to NOT ”scale to fit”.
- When engraving on foil, use either an uncommon toner or a toner dissolver sprinkle to inspire the thickness and get the print tone for the most part even.The shower should be used direct in the wake of printing, and care should be taken not to expedite any drops. After the toner dries, place the foil in the imaging plot, toner side up.
- Strip the defensive blue film off the cover and spot it in the imaging outline copper side down, over the straightforward film. Make a point not to uncover the lightdelicate layer to a lot of light amid the advancement procedure.
- Close the lid of the imaging frame, set the timer for 4 minutes and press the knob to start the exposure.
- When the imaging procedure completes, place the load up in the improvement tank for 1-2 minutes and shake it on occasion (be mindful so as not to abandon it excessively long, else it will harm the follows).

Figure 5.8: Placing the mask in the UV imaging frame.

5.5.3 Etching

We begin by setting up the straightforwardness, the photosensitive film, and the PCB board for assembling. Next, we carefully place the photosensitive film on the PCB and position the photosensitive film over the organization engraved on a straightforwardness. The photosensitive film is then presented to a short presentation of ultra violet light. The revealed film is flushed with an originator course of action. Wealth film is cleared with sodium carbonate. The remainder of the film on the PCB identifies with the model engraved on the straightforwardness. Finally, the copper unprotected by the photosensitive film is removed with an etchant.

- The layout is printed on a transparency in black ink. To improve the quality, the layout is printed twice and touched up.

- A piece of phoosensitive film with dimenions matching the layout is seleted and cut. The film shld be large enough to cover the board. Tranarent tapes are placed on both sides of the film so that one of the proctive films coveing the ptosensitive film can be peeled off.

- One of the transrent proctive films on the photosentive film is peeld off. The exposed side photoseitive film is placed aganst the copper. Air bubbs are elimated by applying presure from eter out. Next, we sepate coper with a piece of paper and apply heat getly with an iron through the paper so that the phseitive film attach properly to the copper.

- The straightforwardness with a configuration engraved in dull ink is determined to the introction box.The PCB is asociated by the photo polymer film. The phto polymer film is detached from the straightforwaness by a protective film. The ink side of the straightforwadness is set against the PCB. The preseation time depends upon the idea of the laser printer. A spleid printer, prepared for making an anticipated, dull and crisp arranment, conveys an image that can shield the phto polyr film from an increasingly drawn out UV presention, as such, provoking an unrivaled structure trade. We typially open the board to 10s UV light for a light mdel on the straghtforwardness and 30s to 45s for a dull precedt on the straighforwardness. The cautous film on the photosenstive film is striped after UV presntation. The protective film should be delicate and hard after intruction.

- After UV exposure, the board is developed with sodium carbonate. Other develoers such as potssium carbonate can also be used. The board is rinsed with the developer solution to bring out ptern on the board. Excess phosensitive film is remoed by rubbing the bard with sodium carbonate with a finger for 23 miutes. A darker layout pattern will emerge on the PCB if it is expsed to the UV ligt for a few more seconds.

- Finally, the board is etched with 30% Ferric Chloride. For a double sided PCB, the etching usually takes approximately 45 minutes. The PCB is rinsed with water and cleaed with acetone to complete the process.

Chapter 6

Simulation and Result

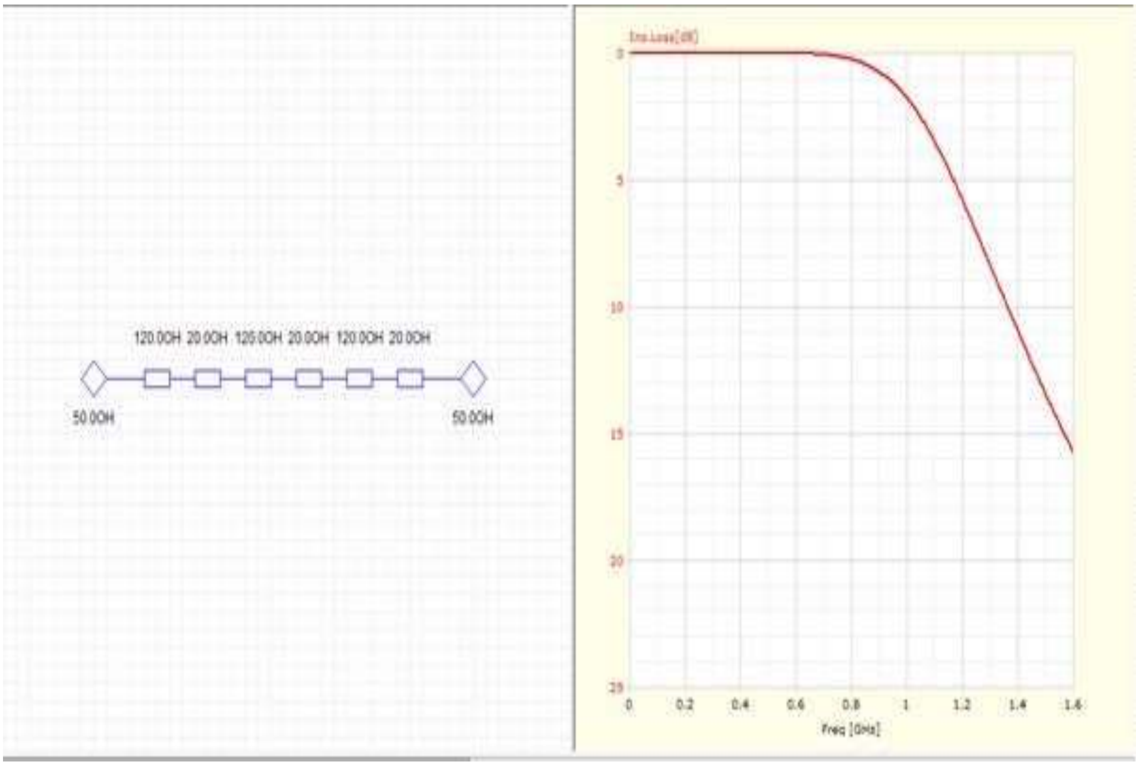


Figure 6.1: Simulated Performance of the Stepped Impedance Low Pass Filter at 1 GHz

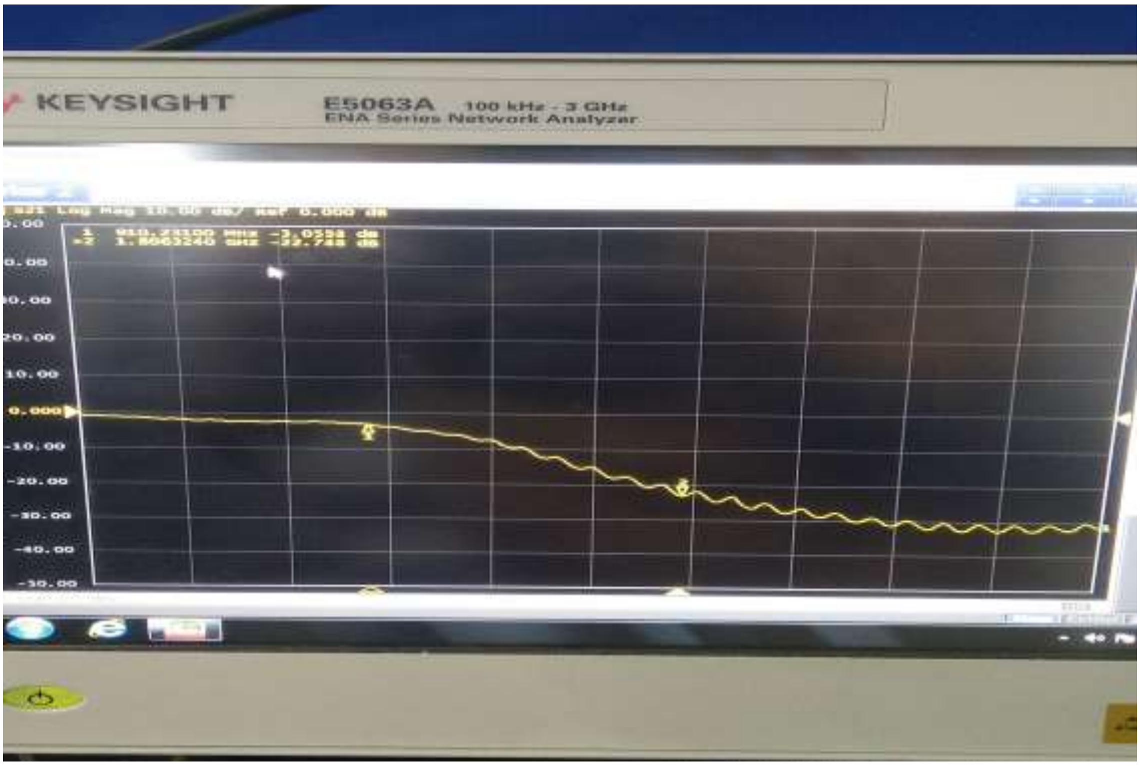


Figure 6.2: Response on ENA Series Network Analyzer

The desired cutoff frequency was 1GHz.As seen in the above response, a cut off frequency of approximately 910 MHz is obtained via our designed filter.

The desired Insertion loss(IL) was 20db at 1.8GHz.The insertion loss as obtained by our hardware design is 22.3db at 1.8GHz


ENA Series Network Analyz
5063A Network Analyzer
1 Active Ch/Trace 2 Response 3 Stimulus 4 Mkr/Analysis 5 Instr State
Marker 2 1.806323999 GHz
Tr1 S21 Log Mag 10.00 dB/ Ref 0.000 dB
1 910.23100 MHz -3.0589 dB
>2 1.8063240 GHz -22.738 dB
50.00
40.00
30.00
20.00
10.00
0.000
-10.00
-20.00
-30.00
-40.00

Chapter 7

Conclusion

For this semester, we emphasized more on:

1. Microstrips
2. Working principle of microstrip low-pass filter

We have successfully simulated and designed a low-pass filter using a microstrip.Also we have matched the theoretically calculated values with the response generated from our designed low pass filter.

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