FILTERS AND ITS APPLICATIONS

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ABSTRACT

Filters are the basic electronic circuits used in vast. Filters are of different types and are classified in different sector and having applications in all streams. All kind of filter is used in analog communications, radio communications and so on. Here the usages of filter in 2202 kit, audio equalizer and power supply are explained in detail.

INTRODUCTION

Circuits with a response that depends upon the frequency of the input voltage are known as filters. Filter circuits can be used to perform a number of important functions in a system. Filters are fundamental and major technique used in signal processing. Although filters can be made from inductors, resistors and capacitors most filter circuits are based upon op-amps, resistors and capacitors. Filter circuit can also be designed by transistors.

CLASSIFICATION OF FILTERS

The entire filter has to lie among this classification
- ACTIVE FILTER
- PASSIVE FILTER

ACTIVE ELEMENTS

An active component is used in circuits to control the flow of electrons and holes and generates energy.
- Diodes
- Transistors
- Vacuum tubes
- Voltage operating devices
- Voltage and current sources

PASSIVE ELEMENTS

Passive elements are an electrical component that can’t generate power, instead of that these elements stores or dissipates the power.
- Resistors
- Capacitors
- Inductors

ACTIVE FILTERS

An active filter is an analog circuit as an electronic filter using active components (amplifier). for better performance and predictability of filter we do uses amplifier circuits.

Configurations
PASSIVE FILTERS
Passive filters are the filters made up of passive elements and no amplifier circuits are used in this. So, no signal gain is observed, therefore their output level is always less than its input.

- Low pass filter
- High pass filter
- Band pass filter
- Band stop filter
- Power line filter
- SAW filter
- Signal filter
- Sinusoidal filter

FILTERS
A filter is a circuit whose transfer function, that is the ratio of its output to its input, depends upon frequency.

LOW PASS FILTER
Low pass filter allows all the frequencies less than the character frequency \(f_l\) to output and can be amplifier at output stage. So, frequencies greater than \(f_l\) is attenuated.

![Fig(1). Low pass filter response](image)

![Fig(2). Low pass filter specification chart](image)
HIGH PASS FILTER

High pass filter allows all the frequencies greater than the characteristic frequency \( f_c \) to output and can be amplified at the output stage.

![High pass filter specification chart](image)

**Fig(3). High pass filter specification chart**

**Fig(4). High pass filter response**

BAND PASS FILTER

Band-pass filters allow frequencies in a particular range to pass to output or even amplified and remaining be attenuated.

![Band pass filter response](image)

**Fig(5). Band pass filter response**

![Band pass filter specification chart](image)

**Fig(6). Band pass filter specification chart**
BAND STOP FILTER

Band stop filter is a filter used to pass a particular band between two frequencies (pass band frequency and stop band frequency) and remaining be attenuated.

![Band stop filter response](image)

**Fig(7). Band stop filter response**

**MULTIBAND FILTER**

Multiband filter is a filter where the combination two or more filters explained above.

![Multiband filter response](image)

**Fig(9). Multiband filter response**

**Fig (10) Multiband filter specification chart**
APPLICATIONS

- Radio communication
- DC power supply
- Audio electronics
- Analog to digital conversion

RADIO COMMUNICATION:
Operational ranges of filters lies in 20 KHz to 300 GHz are known as radio frequency signals. High pass filters are mainly used in radio communication.

Radio signals:
In radio correspondences we jabber about radio sign. A radio signal is a very expansive articulation. The radio sign from a TV transmitter is in the VHF (Very High Frequency), UHF (Ultra High Frequency) or higher locale of the range and is around 7 MHz wide. A SSB(single side band) transmission from a novice station on HF is around 3 KHz wide. Accordingly, when we talk about getting, passing and dismissing 'signals' we have to remember that transfer speed of the sign can shift extraordinarily.

Spectrum space occupied by the bandwidth of the signal:
At the point when radio correspondence was in its initial structure, transmitters were expansive. Transmitters used to utilize a wide band of frequencies. Morse code was the main kind of sign sent. Marconi had a wide range of issues selling his development on the grounds that various transmitting and getting stations would meddle with one another.

Selectivity is the capacity of a recipient to get just the needed signal:
With tuned circuits and precious stone oscillators we would now be able to have a large number of transmitters working in a little space. Keeping them all from not being heard or meddling with one another is forceful undertaking, especially in high thickness metropolitan regions. I have dealt with impedance issues on Sydney tower. At that time, there was over 600 transmitters and receivers within a 600 meter radius of Sydney tower. At the point when transmitters do meddle with one another for reasons unknown, a large number of which will be examined, we frequently need to fall back on extra channels other than the ones previously incorporated with the transmitter or beneficiary.

Significant Attenuation:
It is significant for radio architects to concur on the point where a channel is considered to have critical constriction. The recurrence at which huge lessening starts to happen is known as the cutoff recurrence of the channel. The cutoff recurrence is the point on the channels attributes bend where the ideal recurrence has been constricted by 3 decibels. Take for instance an ordinary low-pass channel with cutoff recurrence of 36 MHz This channel ought to have a little addition loss of state 0.2 decibels for all frequencies up to and around 34 MHz Past 34 MHz the channel will constrict the sign more until, at around 36 MHz, the lessening has arrived at 3 dB. This 3 dB cutoff point is viewed as the higher furthest reaches of the working scope of the low-pass channel. Over the cutoff recurrence the low-pass channel will start to begin weakening signals significantly.

Advantages:
- Radio frequency filters are used in board casting receivers to select particular frequencies, radio receivers to attenuate the image frequencies, EMI filters to reduce noise levels in transverse to minimize output leakage levels.
- Trouble shooting is easy due to simple structure.
- RF filters are small in size.
Disadvantages:

- RF filters passes all the frequencies with different attenuations, so RF filters are chosen to attenuate undecided frequencies as needed.
- Highly expensive for setup.
- Manual cleaning is required to achieve decide return loss at either input or output port and it is time consuming process.

Application of radio frequency:

Scientech 2202: Amplitude modulation receiver kit

The Receiving Antenna:

The getting radio wire works in the turnaround mode to the transmitter reception apparatus. The electromagnetic wave strikes the radio wire and creates a little voltage in it. In a perfect world, the accepting reception apparatus must be adjusted to the polarization of the approaching sign so for the most part, a vertical transmitting receiving wire will be gotten best by utilizing a vertical getting radio wire. The genuine voltage produced in the reception apparatus is exceptionally little generally under 50 mill volts and frequently just a couple of microvolt’s. The voltage provided to the amplifier at the yield of the recipient is up to ten volts. We plainly need a great deal of enhancement.

Radio Frequency (RF) Amplifier:

The receiving wire gives low sufficiency input flag as well as it gets every single accessible transmission simultaneously. This would imply that the collector yield would remember all the different stations for top of one another which would make it difficult to tune in to any one transmission. The beneficiary circuits produce commotion signals, which are added to the needed sign. We hear this as a 'foundation murmur's and are especially observable if the collector is tuned between station and furthermore to begin the way toward choosing the needed station and dismissing the undesirable ones.

DC POWER SUPPLY

The principle reason for control supply sifts is to smooth through the wave contained in the beats of DC got from the rectifier circuit while expanding the normal yield voltage or current. For the most part Filter circuits utilized in control supplies are of two sorts:

A capacitor-input channel is a divert circuit in which the essential part is a capacitor related in parallel with the yield of the rectifier in an immediate power supply. The capacitor assembles the DC voltage and lessens the wave voltage portions of the yield. The capacitor is consistently insinuated as a smoothing capacitor or store capacitor.

![Capacitor input](Image)
The capacitor is as often as possible trailed by other trading plan and parallel channel parts to furthermore reduce swell voltage, or change DC yield voltage. It may in like manner be trailed by a voltage controller which in every way that really matters discards any lingering wave voltage, and modifies the DC voltage yield unequivocally to arrange the DC voltage required by the circuit.

**ADVANTAGES**

- The stifle input (LC) channel has a high yield D.C voltage.
- It has no stacking impact on the rectifier and power transformer.
- The diode doesn't need to convey flood flows.
- It has a low wave factor when contrasted with arrangement inductor channel and shunt capacitor channel.
- It has excellent burden guideline.
- It has no stacking impact on the rectifier and power transformer.
- It has preferable voltage guideline over that of π channel.

**DISADVANTAGES**

- It can't be utilized together with half wave rectifier.
- Due to inductor it creates the discernible clamor.
- It isn't helpful for very low burden flows.
- There is lost power in the arrangement inductor because of its DC obstruction.
- It has low yield D.C. voltage than that of π type channel.
- It has high wave factor than that of π type channel.
- It turns out to be exorbitant because of the utilization of huge estimation of an inductor L and a capacitor C.
- The utilization of bleeder resistor expands the rating of rectifier circuit.

Fig(12). Choke input.
The gain input channel utilizes an inductor in arrangement with the heap resistor. The inductor restricts changes in current to give smoother yield to the heap. The capacitor input channel will keep the yield voltage at a more significant level contrasted with a stifle input.

The stifle input will give a steadier current under changing burden conditions. From this, it tends to be seen that a capacitor input channel would be utilized where voltage is the prime factor and the stifle input channel is utilized where a relentless progression of current is required.

A few capacities that a dc control supply can perform

It changes line voltages esteems from sequential, redress AC, channel throbbing DC, or make more than one generally steady DC voltage accessible. Every one of these capacities are incorporated into most power supplies. The essential attributes that must be considered in the choice of a power supply are:

• The voltages required from the power supply.

• The greatest current required by the circuit segments to meet their capacity prerequisites. The current drawn is named the heap.

• The measure of variety in DC yield allowed under steady burden; this is alluded to as the measure of wave.

• The measure of variety in DC yield allowed with changes in load; this is alluded to as the measure of guideline required.

ADVANTAGES

Sorts of channels and their applications in control supply circuits

The four fundamental sorts of channels join the low-pass channel, the high-pass channel, the band-pass channel, and the progression channel (or the band-reject or band-stop channel). Watch, regardless, that the articulations "low" and "high" don't imply any absolute estimations of repeat, however rather they are relative characteristics with respect to the cut off repeat.

AUDIO FILTER DESIGN:

Audio filters can amplify, pass or attenuate some frequency ranges. An audio filter is a frequency dependent on amplifier circuit, the working in the audio frequency range, 0 Hz to beyond 20 kHz.

Audio filters used in Audio Equalizer:

A sound hybrid was structured by utilizing high pass and low pass sound channel. An Equalizer is sound hardware which constrains or supports the specific recurrence parts from the sound signal. This procedure of changing the recurrence segments is called as Equalization.

The equalizers are generally utilized in the sound frameworks during recording of sound just as in speakers and blenders. As they are utilized in the sound framework so are called Audio Equalizer. The Audio Equalizer can be related with the Jazz, Rock and Concert kind of impacts which are accessible on the PDAs.

In a framework, the sound sign initially gets split into various recurrence groups. More groups give more power over the wide scope of frequencies. Each band has a different slider to control the increase of the information sound signal. Toward the finish of the EQ framework, a midyear consolidates all the recurrence groups so the sound sign with various track is gotten.

There are two types of equalizers –

1) Parametric Equalizer
2) Graphic Equalizer
**Parametric Equalizer:** This type of EQ is majorly used in mixing and recording studios. There are knobs by which user can control the bandwidth, center frequency and gain of the audio signal.

**Graphic Equalizer:** This type of EQ has a fixed bandwidth and center frequency but the gain of a frequency band can be adjusted with the help of sliders. More sliders give more control on a wider range of frequencies.

The equalizers can be planned by utilizing either explicit coordinated chips like LA-3600 or by utilizing sound channels. The LA-3600 is a 5-band equalizer IC. In this instructional exercise, a realistic equalizer circuit utilizing sound channels will be structured.

A three band equalizer will be structured in this instructional exercise which will have low pass, band pass and high pass channel circuits to initially isolate low recurrence, mid go recurrence and high recurrence segments of the sound signal. All the channel circuits will be dynamic channels utilizing operational intensifier in their development. The addition for every recurrence band will be directed utilizing variable resistors associated at the contribution of the channel circuits. The distinctive recurrence parts will be consolidated at the yield phase of the channels and went to a LM386 based control enhancer circuit. The intensifier circuit will help the joined sound flag and direct it to a speaker.

For testing the planned equalizer, the recurrence reaction bend of the sound channels will be inspected. The recurrence reaction bend will be drawn by plotting the voltage levels of the sound sign regarding the frequencies. Along these lines for testing reason, work generator will be utilized as information source to deliver sinusoidal wave at various frequencies.

In this tutorial, there are some terms used which are associated with audio amplifiers or audio filters like gain, clipping effect, cut off frequency, bandwidth and Quality factor. For learning the basics of audio amplifiers and terms associated with them, check out the following tutorial –

**Basics of Audio Amplifier**

For learning the basics of audio filters and terms associated with them, check out the following tutorial –

**Audio Filters – Basics of Audio Filters**

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**Fig(13). Block Diagram of audio amplifier**

**Circuit Connections** –

This equalizer is designed using three audio filters. They are

A high pass filter for separating high frequency components, a band pass filter for separating mid range frequency components and a low pass filter for separating low frequency components. The gain for different frequency bands is controlled through variable resistors connected at the input of the filters. The frequency bands are finally combined to one signal and passed over to power amplifier and a speaker.
CONCLUSION
In this paper we presented the filters types, classification and the application description. In radio communication we do have used many filter in many applications mainly for providing specific bands (2202) amplitude modulation receiver kit, Filters used in DC power supply, audio filter design used in audio equalizer and filters used for analog to digital conversions (bilinear and impulse invariance transformations ), advantages and disadvantages for respective applications.

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