

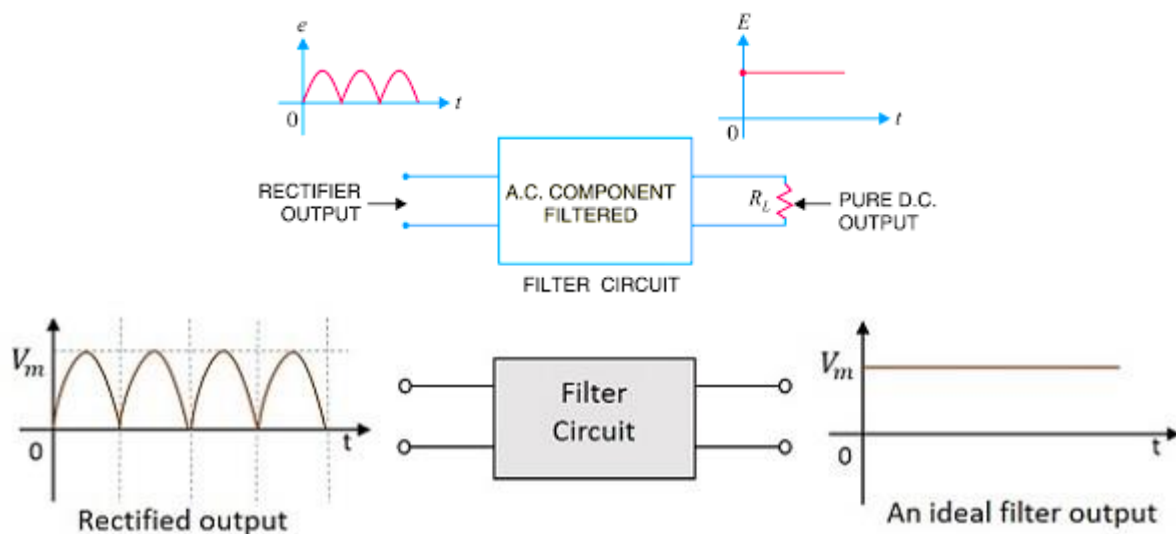
Filters

Definition:

It is sometimes desirable to have circuits capable of selectively filtering one frequency or range of frequencies out of a mix of different frequencies in a circuit. A circuit designed to perform this frequency selection is called a **filter circuit**, or simply **a filter**.

Need of Filters:

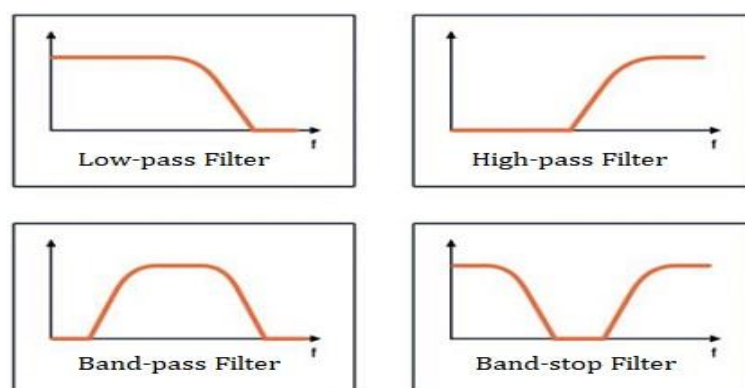
A common need for filter circuits is in high-performance stereo systems, where certain ranges of audio frequencies need to be amplified or suppressed for best sound quality and power efficiency.



The above figure shows the basic functionality of filter circuit.

In addition, the four primary types of filters include **the Low-pass Filter**, **the High-pass Filter**, **the Band-pass Filter**, and the notch filter (or the band-reject or band-stop filter), and they can be active or passive filters.

Active filters need outside sources for their operation, while **passive filters** do not need any outside source for their operation. Active filters have the capability of amplifying filter output, while passive filters consume the power of the input signal and cannot amplify the output signal.



Certain filters may be specified by family and band form, and each family of filters can be specified to a particular order.

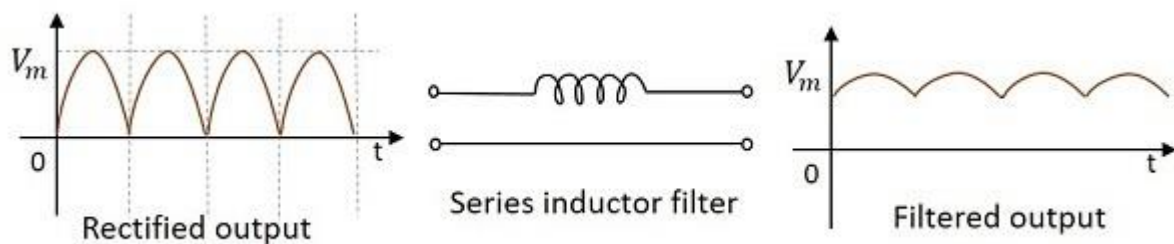
A filter circuit is constructed using two main components, inductor and capacitor. We have already studied in Basic Electronics tutorial that

- An inductor allows **dc** and blocks **ac**.
- A capacitor allows **ac** and blocks **dc**.

Let us try to construct a few filters, using these two components.

Series Inductor Filter

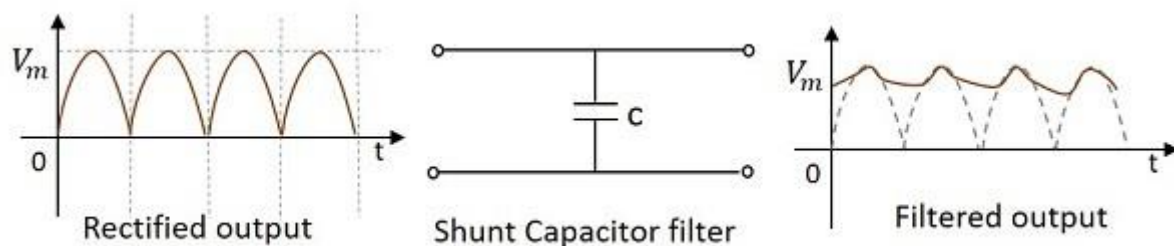
As an inductor allows dc and blocks ac, a filter called **Series Inductor Filter** can be constructed by connecting the inductor in series, between the rectifier and the load. The figure below shows the circuit of a series inductor filter.



The rectified output when passed through this filter, the inductor blocks the ac components that are present in the signal, in order to provide a pure dc. This is a simple primary filter.

Shunt Capacitor Filter

As a capacitor allows ac through it and blocks dc, a filter called **Shunt Capacitor Filter** can be constructed using a capacitor, connected in shunt, as shown in the following figure.

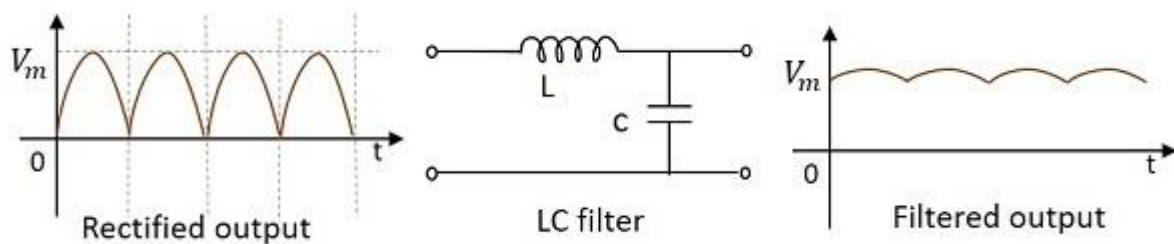


The rectified output when passed through this filter, the ac components present in the signal are grounded through the capacitor which allows ac components. The remaining dc components present in the signal are collected at the output.

The above filter types discussed are constructed using an inductor or a capacitor. Now, let's try to use both of them to make a better filter. These are combinational filters.

L-C Filter

A filter circuit can be constructed using both inductor and capacitor in order to obtain a better output where the efficiencies of both inductor and capacitor can be used. The figure below shows the circuit diagram of a LC filter.



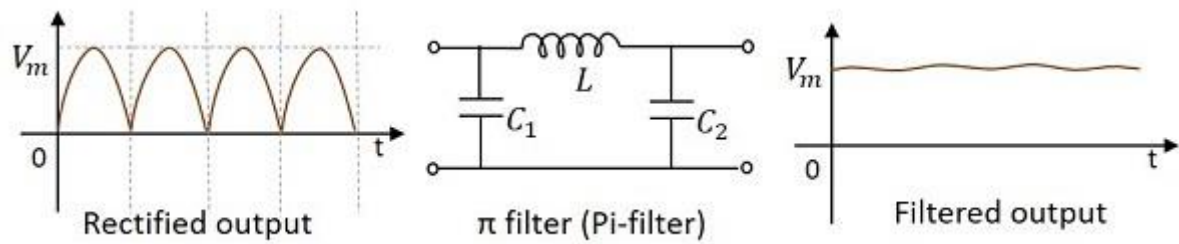
The rectified output when given to this circuit, the inductor allows dc components to pass through it, blocking the ac components in the signal. Now, from that signal, few more ac components if any present are grounded so that we get a pure dc output.

This filter is also called as a **Choke Input Filter** as the input signal first enters the inductor. The output of this filter is a better one than the previous ones.

II- Filter Pi Filter

This is another type of filter circuit which is very commonly used. It has capacitor at its input and hence it is also called as a Capacitor Input Filter. Here, two capacitors and one inductor are connected in the form of π shaped network. A capacitor in parallel, then an inductor in series, followed by another capacitor in parallel makes this circuit.

If needed, several identical sections can also be added to this, according to the requirement. The figure below shows a circuit for **π filter Pi-filter**.



Working of a Pi filter

In this circuit, we have a capacitor in parallel, then an inductor in series, followed by another capacitor in parallel.

- **Capacitor C_1** – This filter capacitor offers high reactance to dc and low reactance to ac signal. After grounding the ac components present in the signal, the signal passes to the inductor for further filtration.
- **Inductor L** – This inductor offers low reactance to dc components, while blocking the ac components if any got managed to pass, through the capacitor C_1 .
- **Capacitor C_2** – Now the signal is further smoothened using this capacitor so that it allows any ac component present in the signal, which the inductor has failed to block.