

## FILTERS AND TYPES OF FILTERS

### What is a Filter and Why Do We Need Filters?

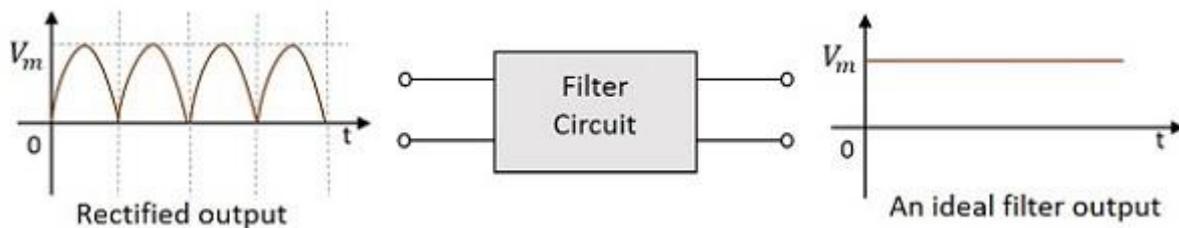
The rectifier converts the Alternating Current (AC) into Direct Current (DC). But the obtained Direct Current (DC) at the output is not a pure Direct Current (DC). It is a pulsating Direct Current (DC).

The pulsating Direct Current (DC) is not constant. It fluctuates with respect to time. When this fluctuating Direct Current (DC) is applied to any electronic device, the device may not work properly. Sometimes the device may also be damaged. So the fluctuating Direct Current (DC) is not useful in most of the applications.

Therefore, we need a Direct Current (DC) that does not fluctuate with respect to time. The only solution for this is smoothing the fluctuating Direct Current (DC). This can be achieved by using a device called filter.

A **filter circuit** is an electronic device which blocks the ac component present in the rectified output and allows the dc component to reach the load.

The following figure shows the functionality of a filter circuit.



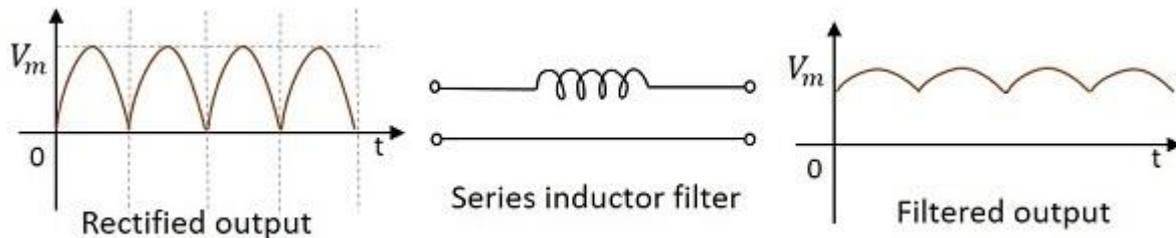
A filter circuit is constructed using two main components, inductor and capacitor

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

## TYPES OF FILTERS:

### ➤ Series Inductor Filter:

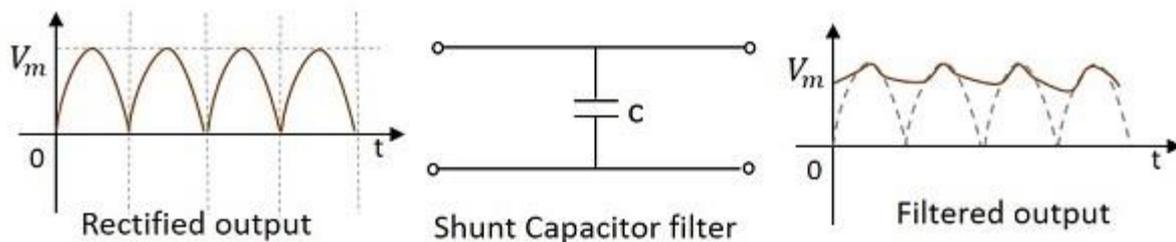
As an inductor allows dc and blocks ac, a filter called **Series Inductor Filter** can be constructed by connecting the inductor in series, between the rectifier and the load. The figure below shows the circuit of a series inductor filter.



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.

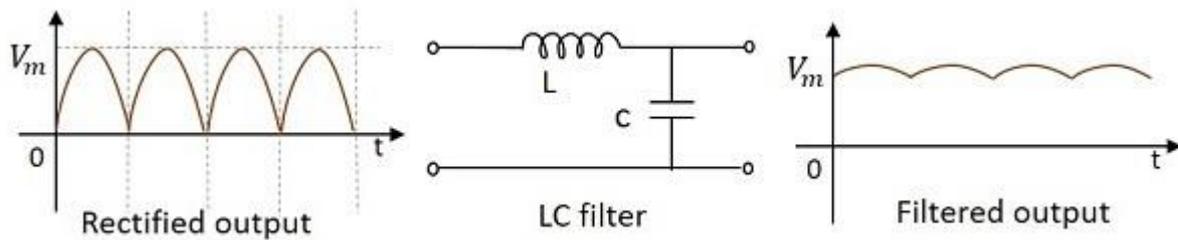


The rectified output when passed through this filter, the ac components present in the signal are grounded through the capacitor which allows ac components. The remaining dc components present in the signal are collected at the output.

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.



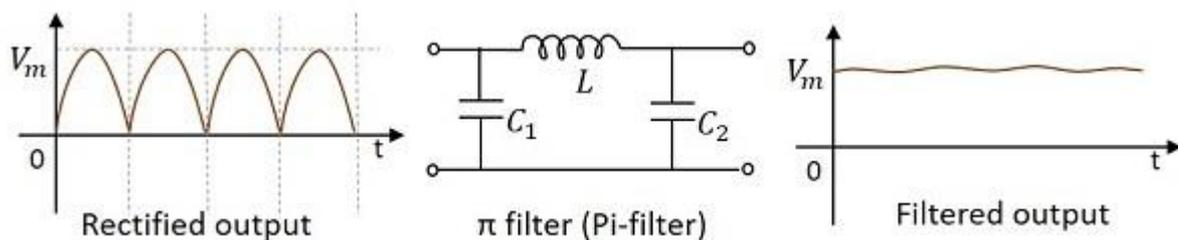
The rectified output when given to this circuit, the inductor allows dc components to pass through it, blocking the ac components in the signal. Now, from that signal, few more ac components if any present are grounded so that we get a pure dc output.

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  $\pi$  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  $\pi$  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 smoothed using this capacitor so that it allows any ac component present in the signal, which the inductor has failed to block.