

Introduction

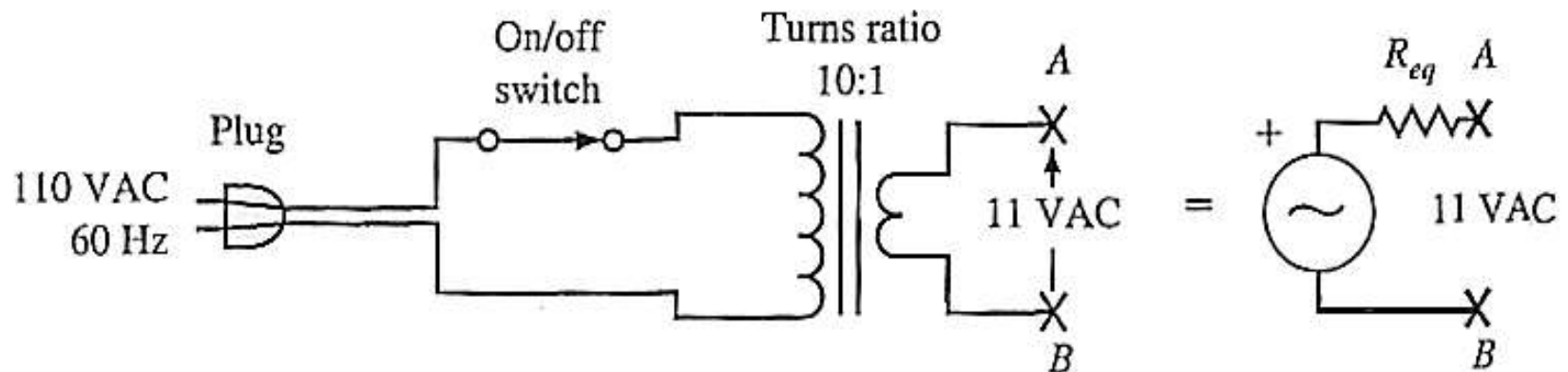
A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which is in only one direction, a process known as rectification.

Power Supply Circuits

- To achieve its purpose a power supply must:
 - Step down the voltage supplied;
 - Convert ac to dc by rectifying the ac.
- A transformer is used to step down the magnitude of the voltages from the wall receptacle.

Transformer

- A transformer consists of two coils of wire on a common iron core. The voltages on these two coils are related by the *turns ratio*, which is the ratio of the number of turns of wire in the secondary coil to that in the primary coil.



RMS Values

- Note that the 110-120 volts and 220-240 volts are RMS values.
- The actual amplitude of that sinusoidal signal is a factor of $\sqrt{2}$ larger.

Types of Rectifiers

➔ Half wave Rectifier

➔ Full wave Rectifier

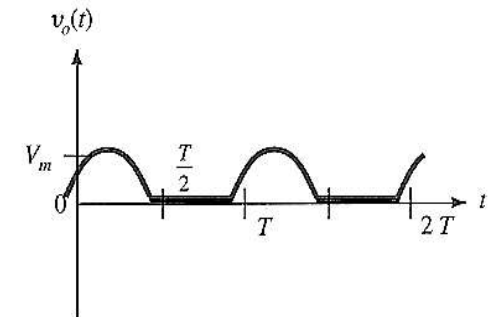
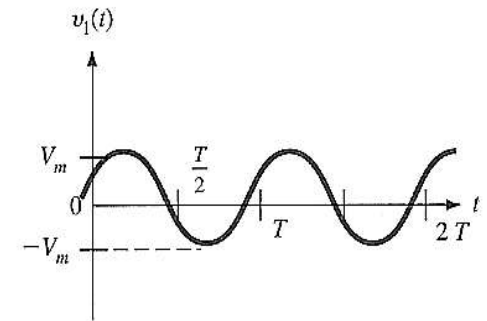
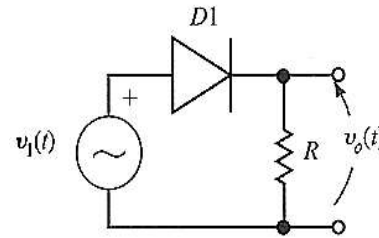
➔ Bridge Rectifier

Half wave rectifier

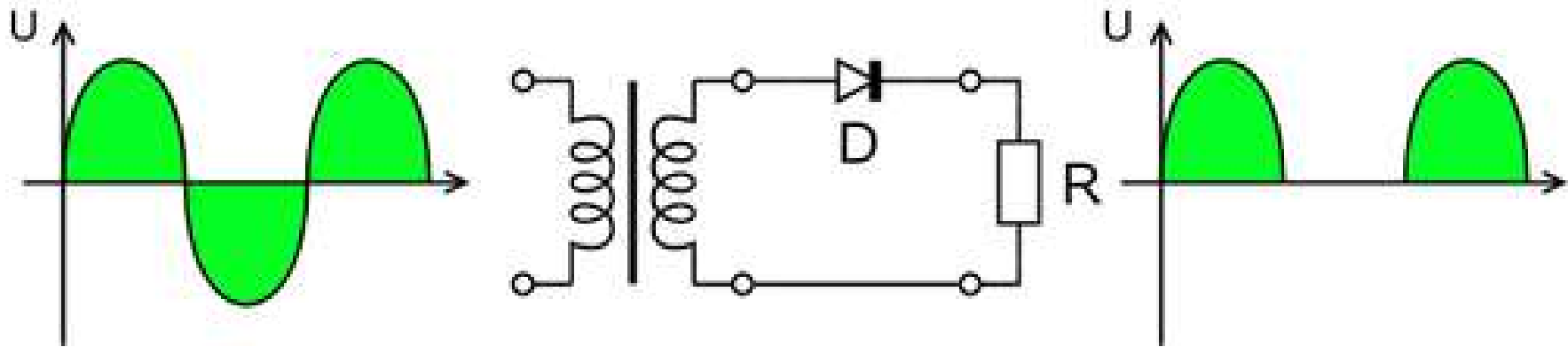
- In half wave rectification, either the positive or negative half of the AC wave is passed, while the other half is blocked.
- Because only one half of the input waveform reaches the output, it is very inefficient if used for power transfer.

Half-wave Rectification

- Simplest process used to convert ac to dc.
- A diode is used to clip the input signal excursions of one polarity to zero.



Half wave rectification



Output dc voltage calculation

- The output DC voltage of a half wave rectifier can be calculated with the following two ideal equations

$$V_{rms} = \frac{V_{peak}}{2}$$

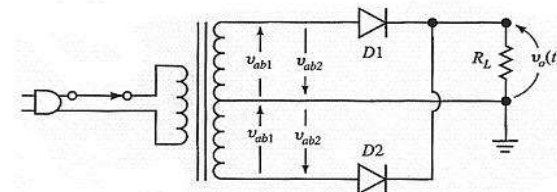
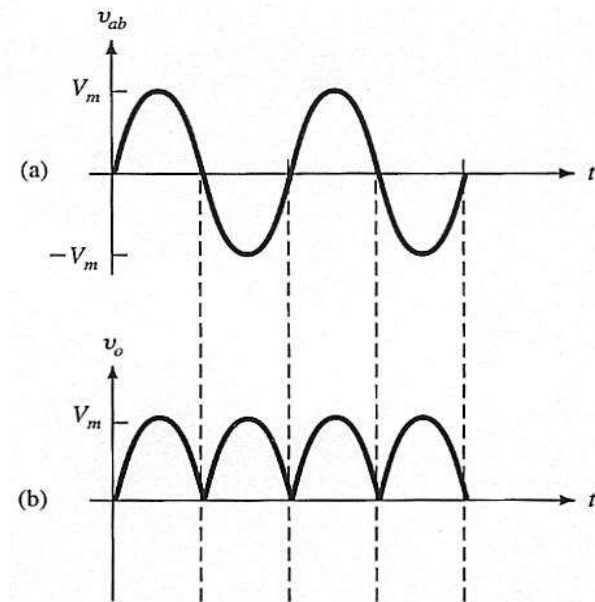
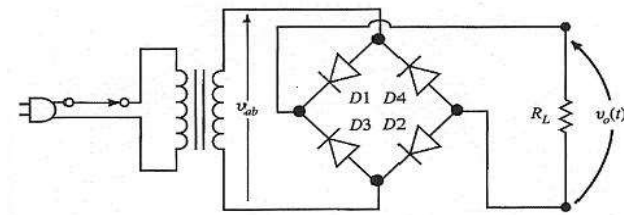
$$V_{dc} = \frac{V_{peak}}{\pi}$$

Full wave rectifier

- *
** A full-wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output.
- *
** Full-wave rectification converts both polarities of the input waveform to DC (direct current), and is more efficient.0

Full-wave Rectification

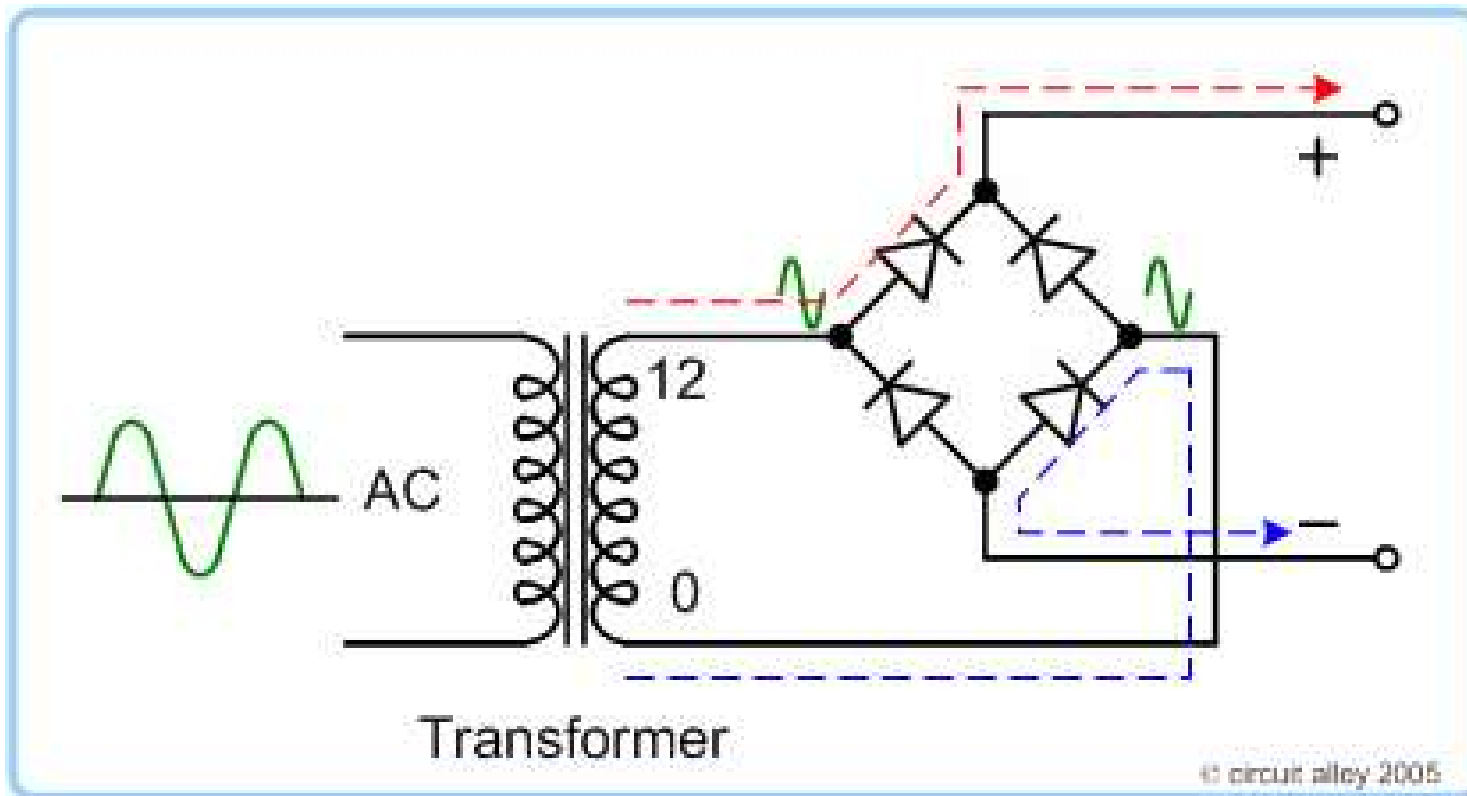
- The output of a full-wave rectifier is driven by both the positive and negative cycles of the sinusoidal input, unlike the half-wave rectifier which uses only one cycle.



Full wave rectifier

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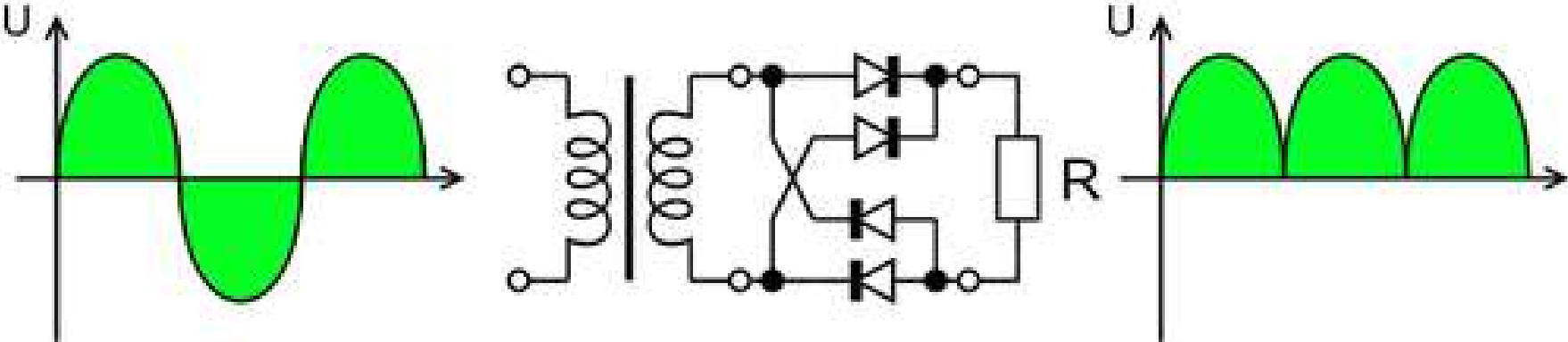
Full wave rectifier working animation



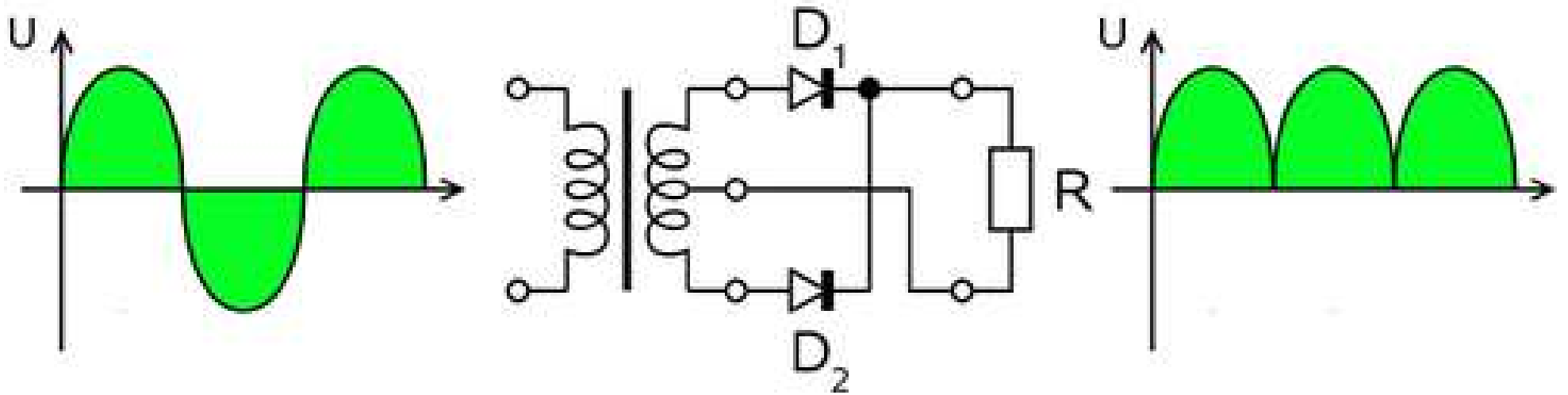
Full wave rectification

- ✱✱ In a circuit with a non - center tapped transformer, four diodes are required instead of the one needed for half-wave rectification.
- ✱✱ For single-phase AC, if the transformer is center-tapped, then two diodes back-to-back (i.e. anodes-to-anode or cathode-to-cathode) can form a full-wave rectifier.

Full wave rectifier using 4 diodes



Full wave rectifier using transformer and 2 diodes

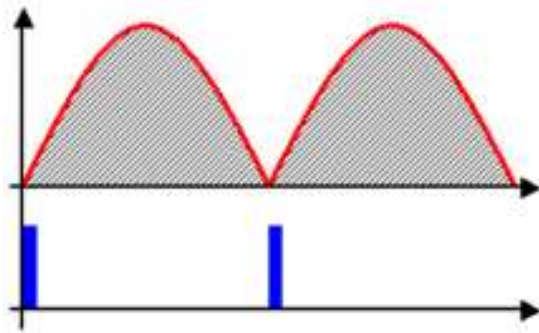


The average and root-mean-square output voltages of an ideal single phase full wave rectifier can be calculated as:

$$V_{dc} = V_{av} = \frac{2V_p}{\pi}$$

$$V_{rms} = \frac{V_p}{\sqrt{2}}$$

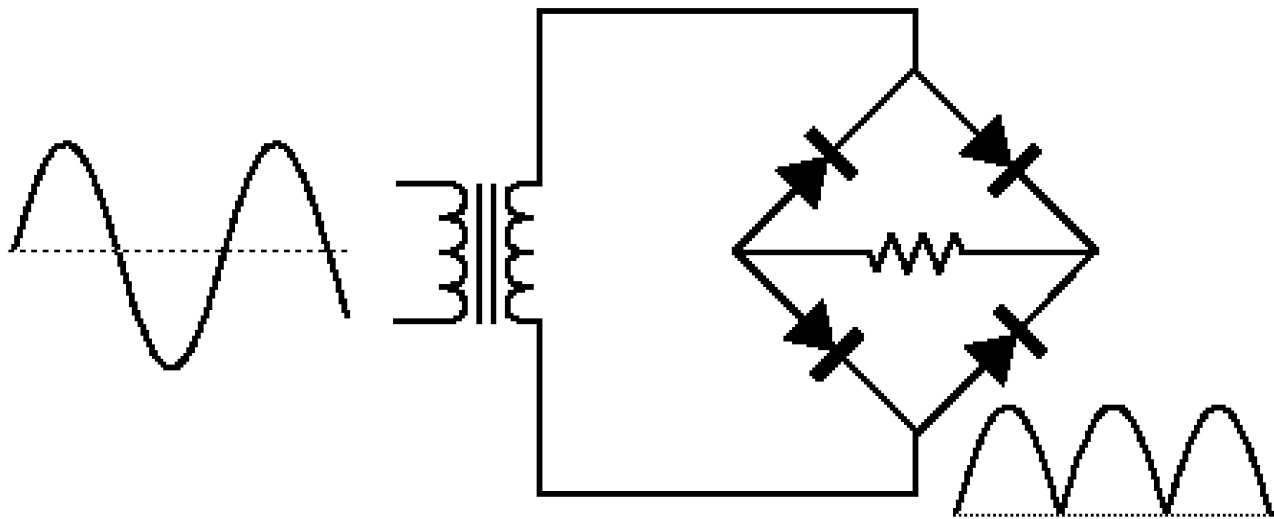
Output voltage of the full wave rectifier Animation



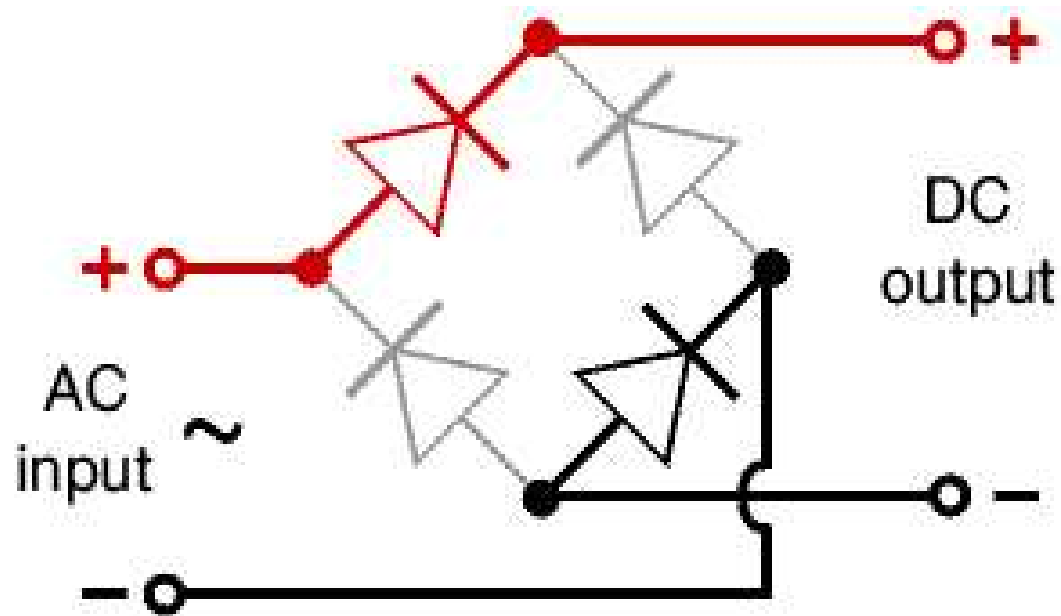
Bridge rectifier

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** A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification.

Bridge rectifier circuit

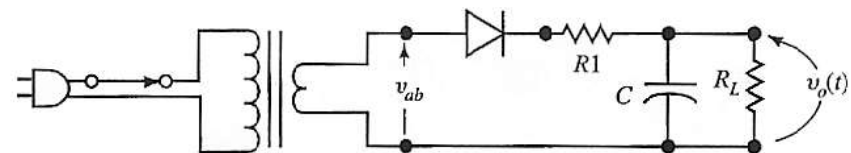
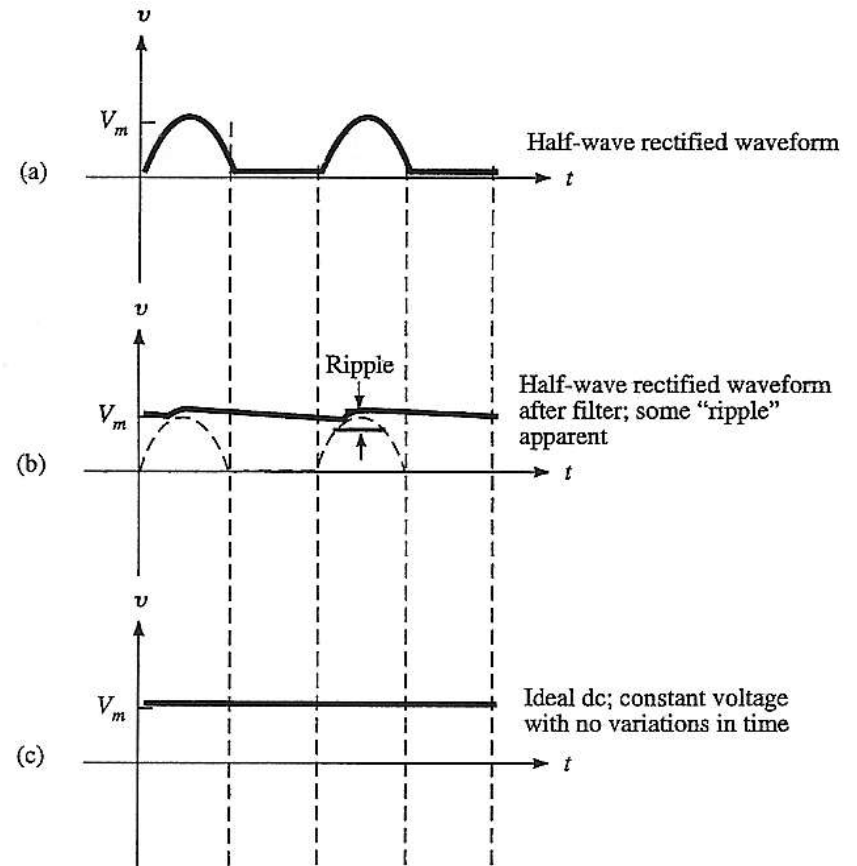


Bridge rectifier working animation

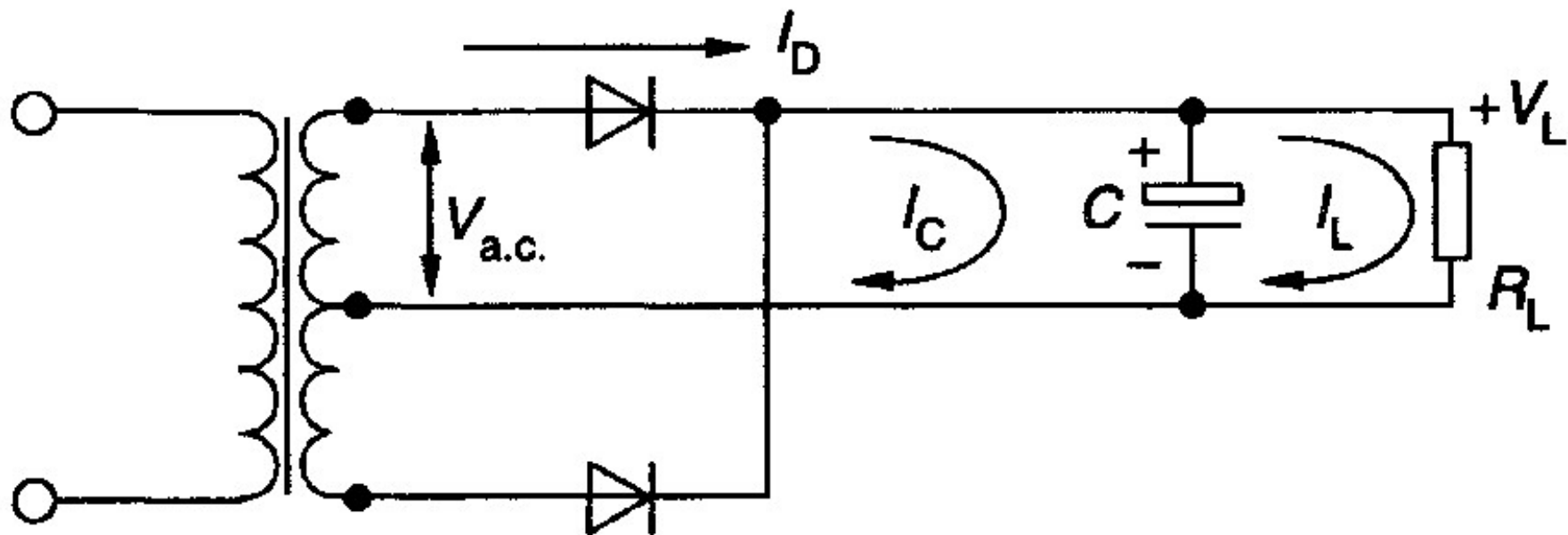


Filtering

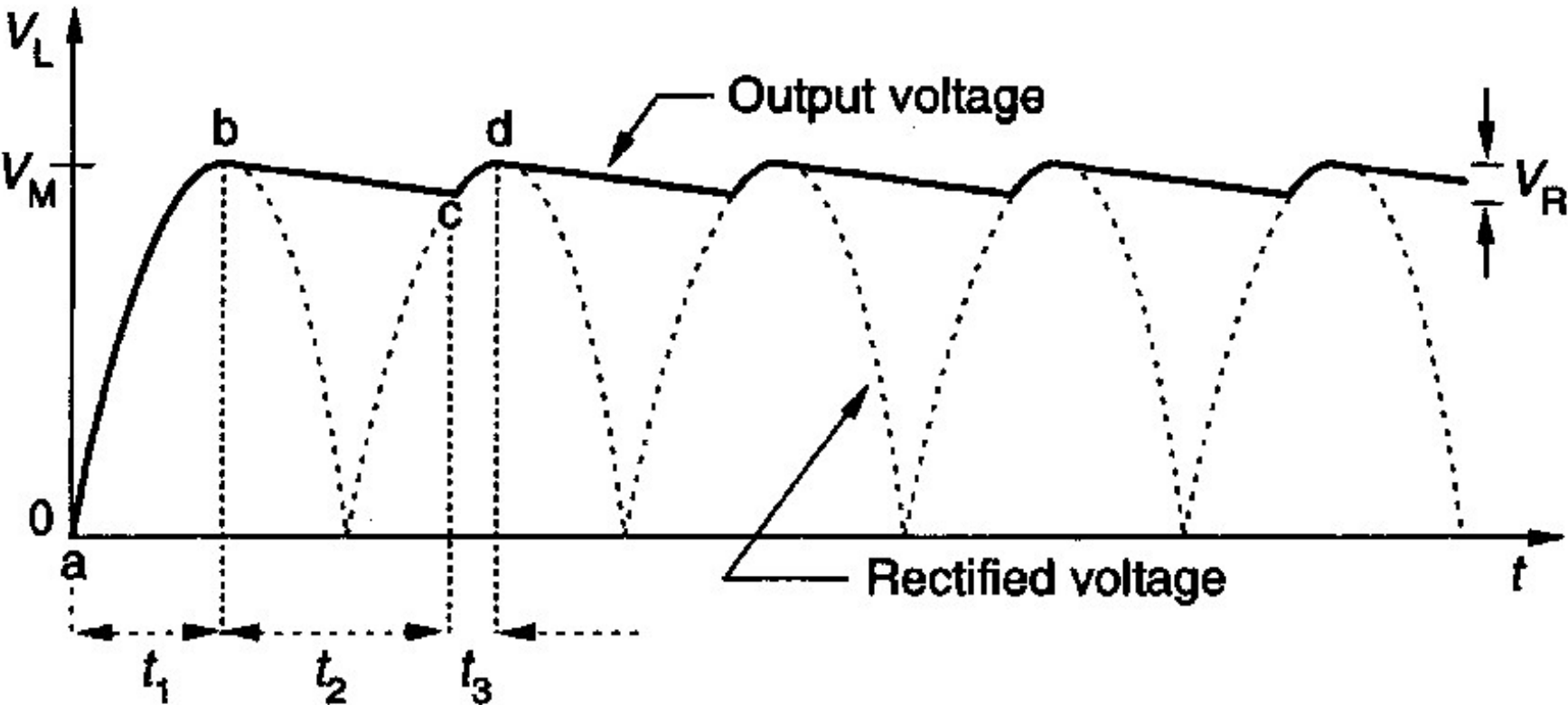
- Process used to smooth out the output of the rectifier circuit.
- One of the most common filter is the RC network.



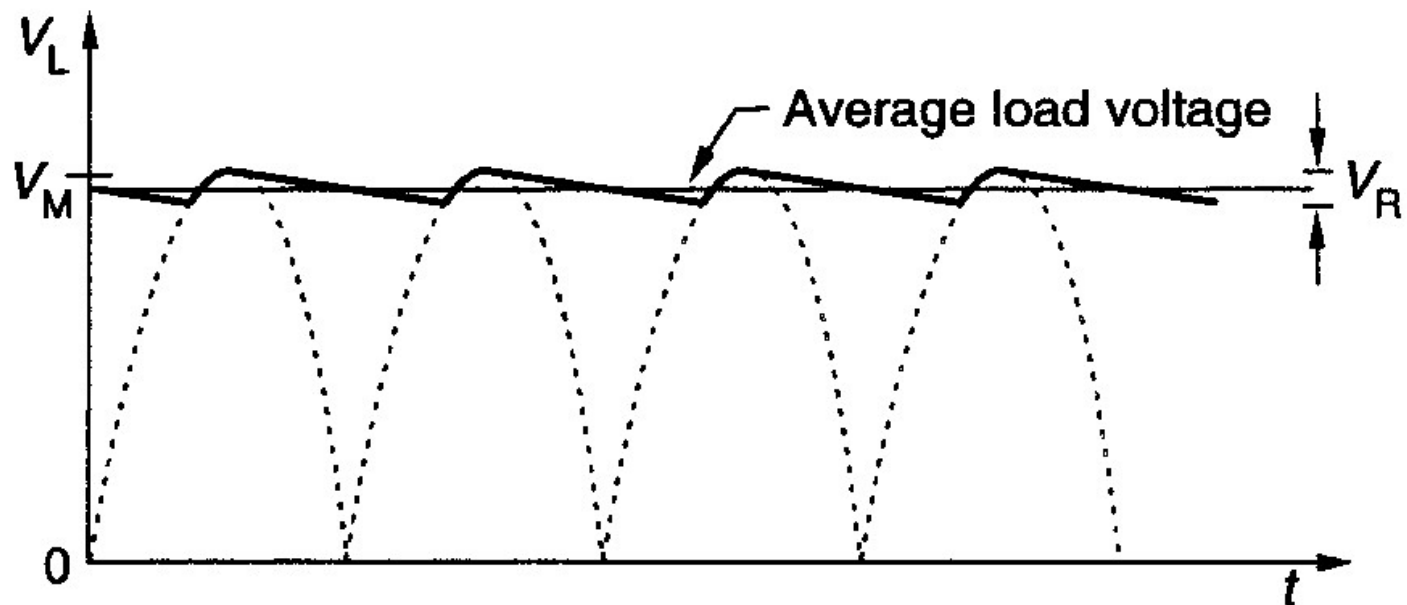
Full-wave centre-tap rectifier and capacitor filter with load connected



Capacitor filter output waveforms with load connected

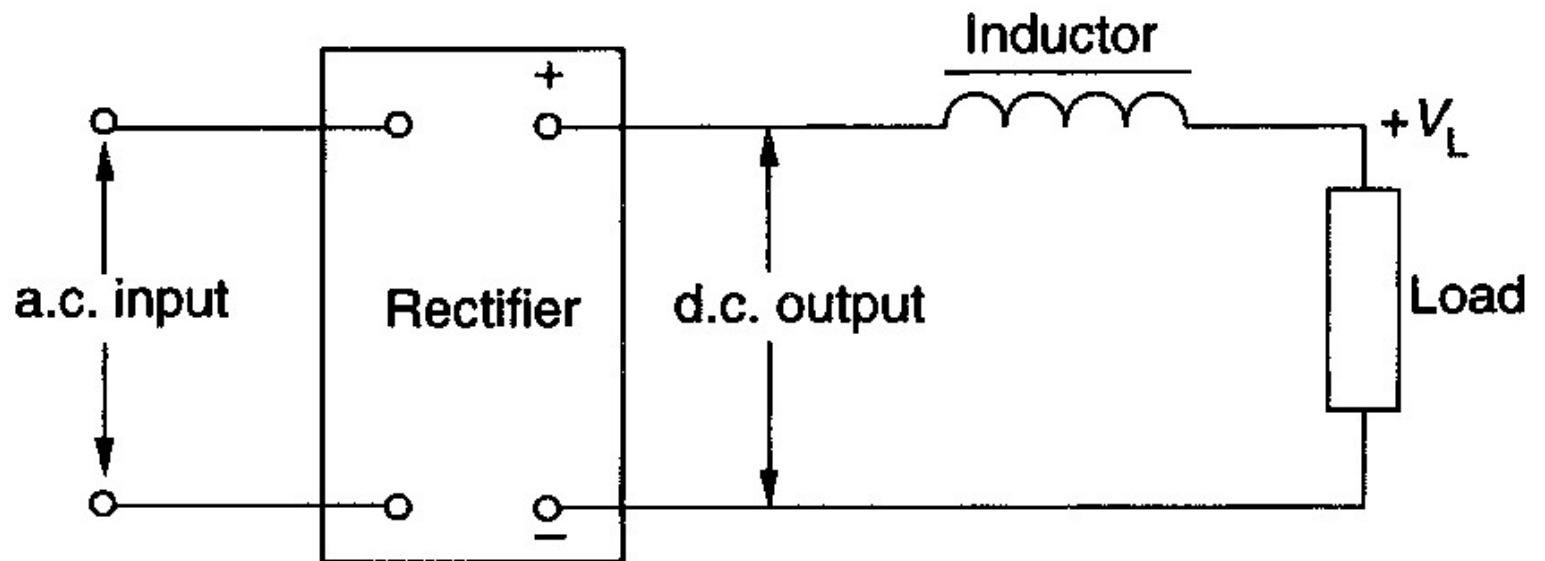


Effect of load on the output of a capacitor filter circuit

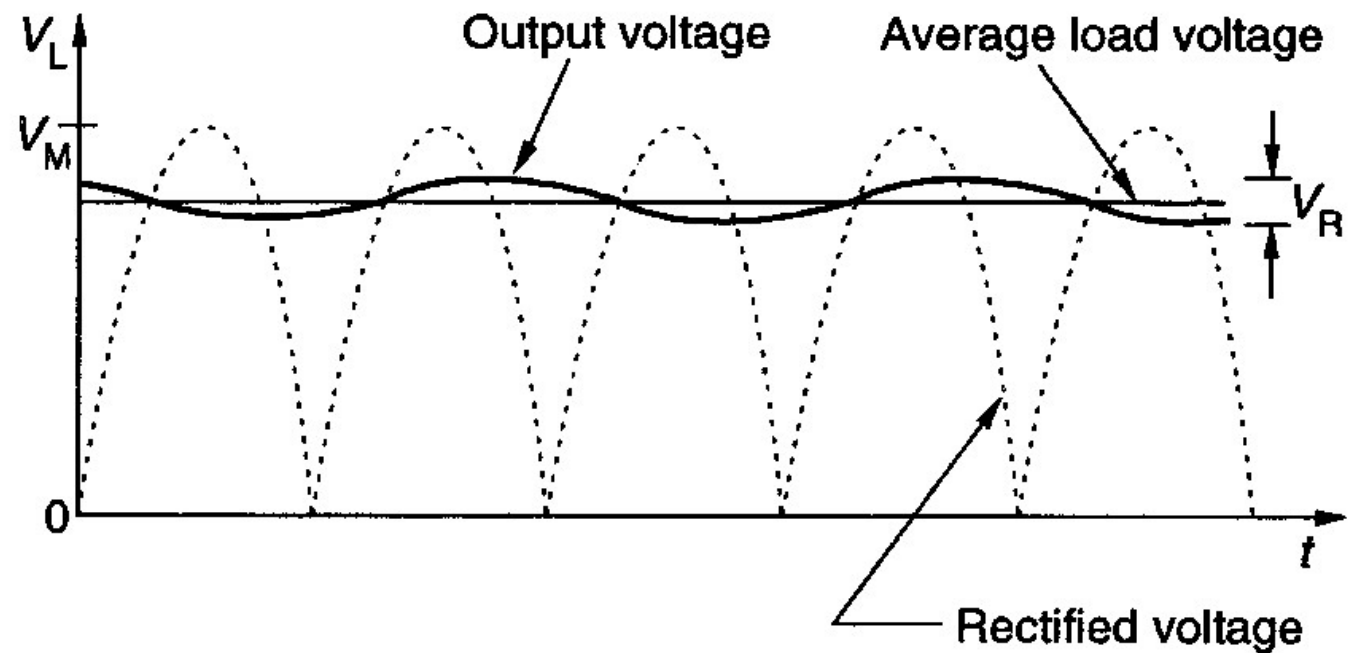


(a) Capacitor filter on light load

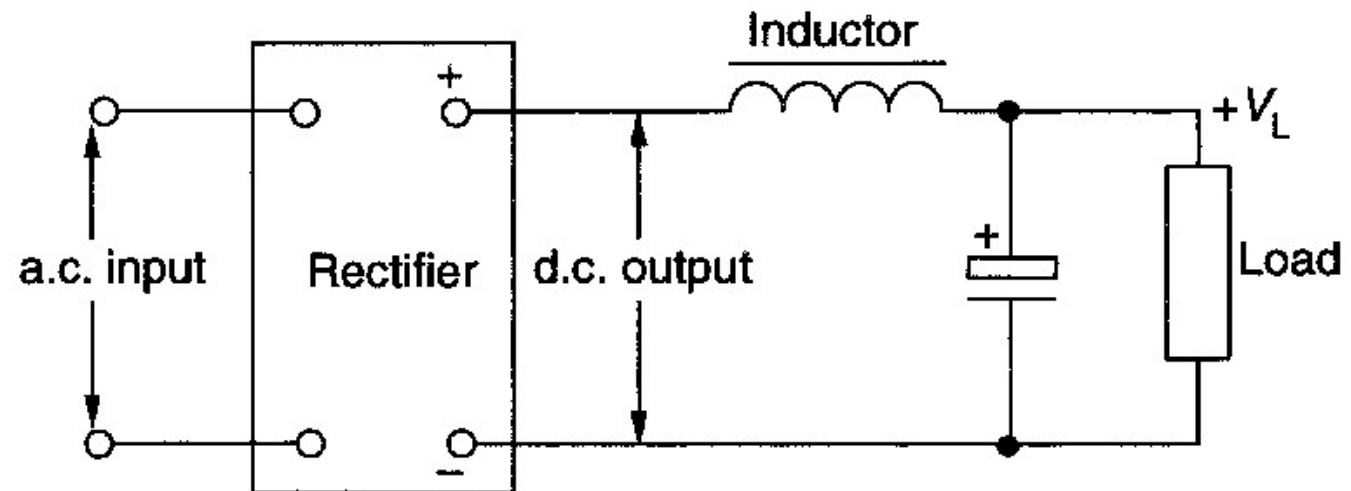
Inductor filter



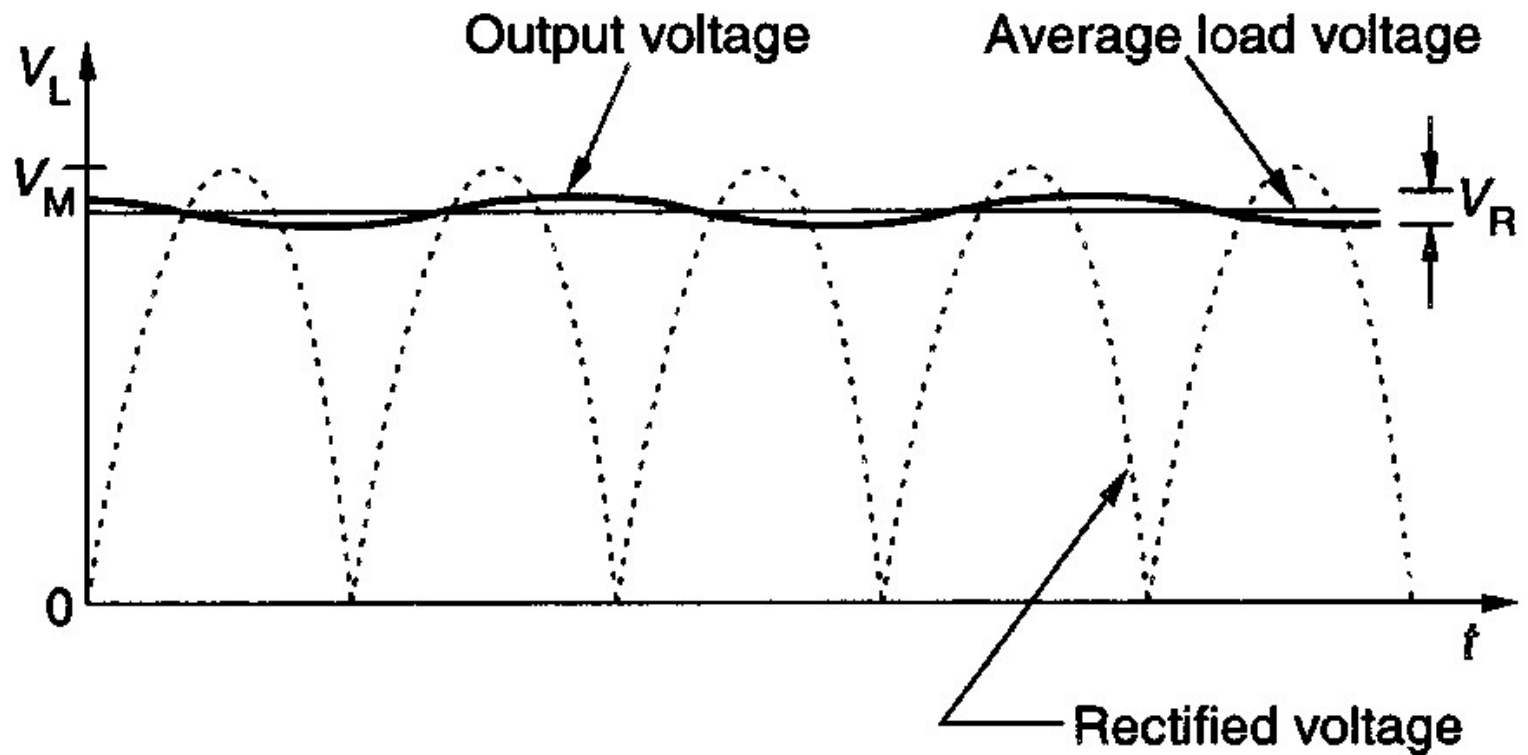
Inductor filter output voltage waveforms



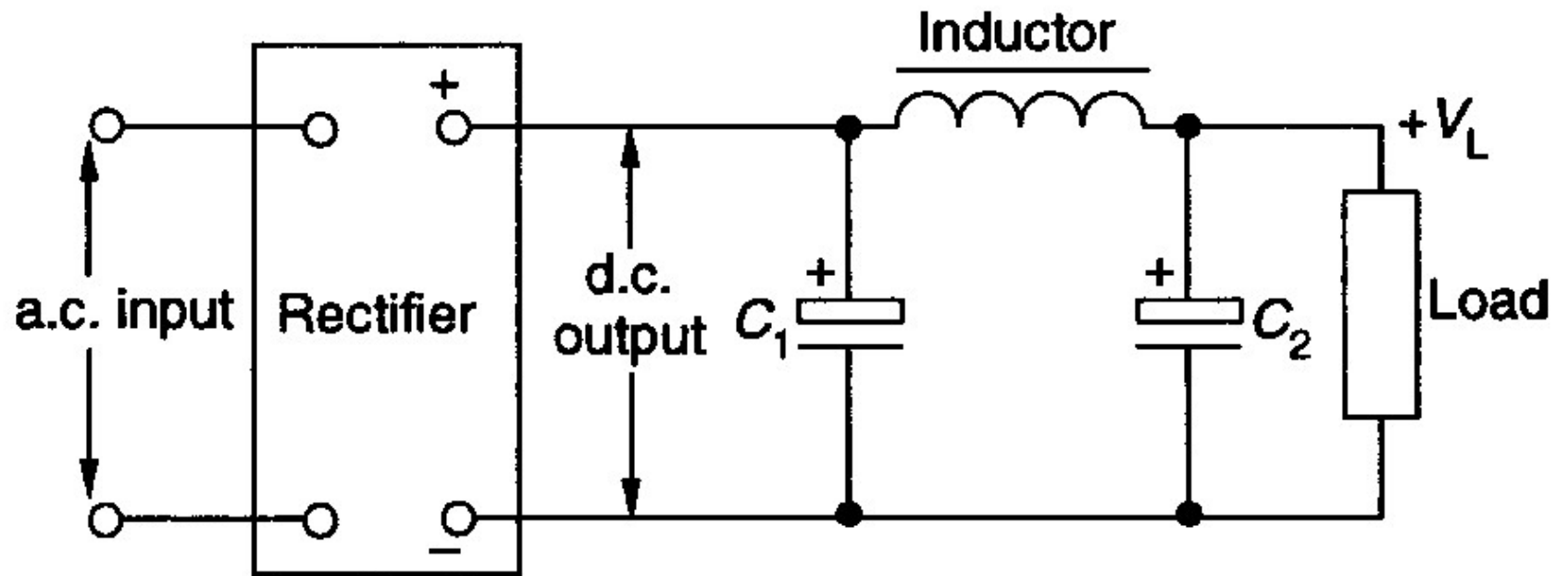
Choke input filter (L-section filter)



Choke input filter load voltage waveforms



π -type filter



π -type filter output voltage waveforms

