Rectifiers

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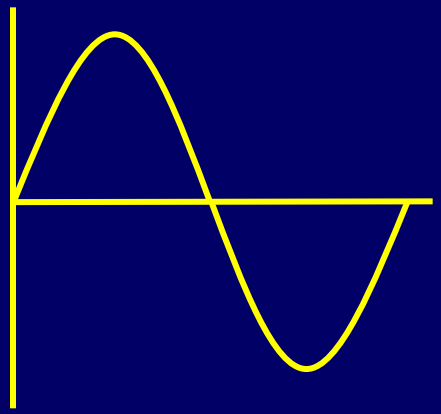
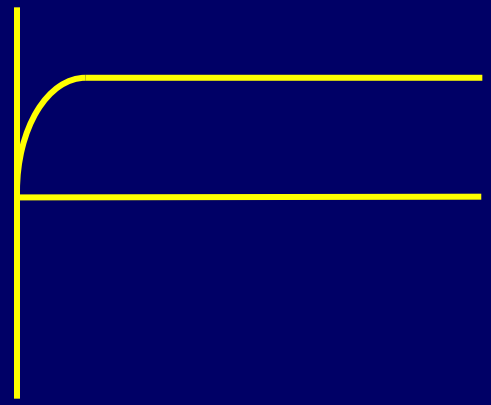
Rectifiers

A **rectifier** is an electrical device that converts Alternating Current (AC), which periodically reverses direction, to Direct Current (DC), which flows in only one direction.

This process is known as:- **Rectification**



AC SIGNAL



DC SIGNAL

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Rectifiers

The output we are trying to produce from a rectifier is a pure DC
This is similar to the output of a battery.

Note

When batteries are in
Series voltage is added up

When in parallel
voltage stays the same

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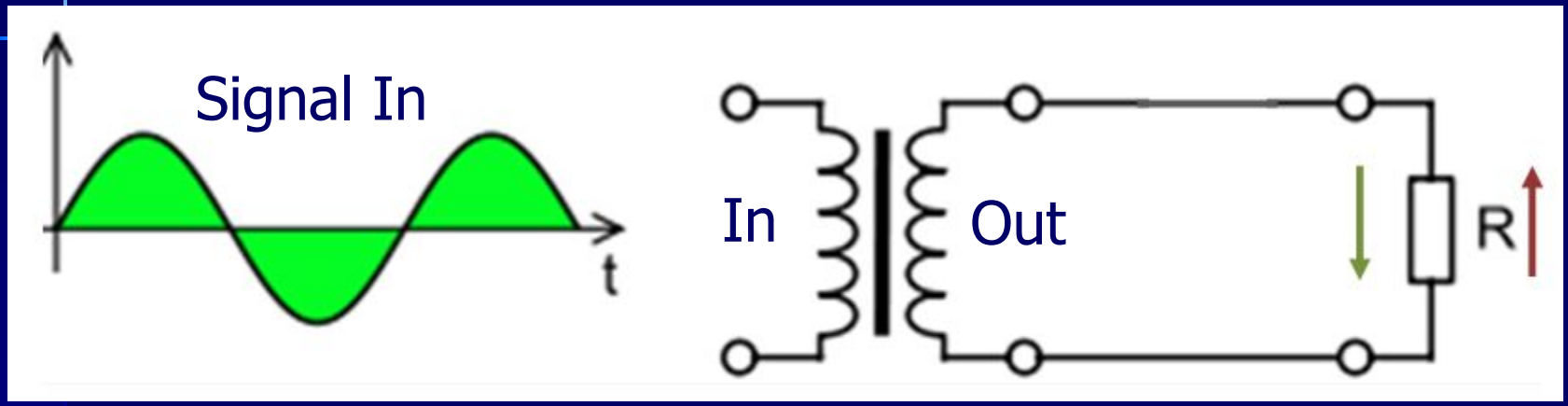
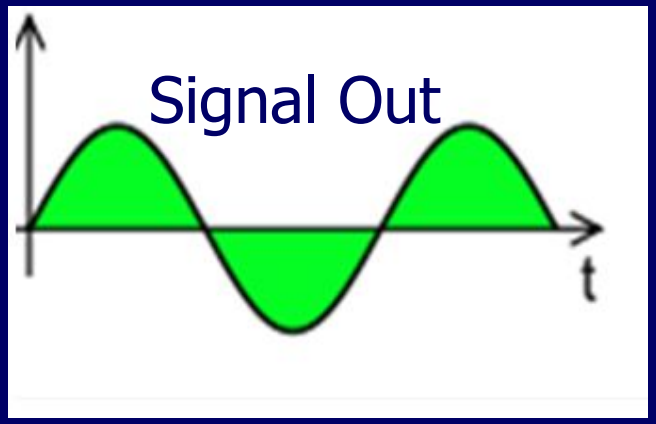
Alternating Current AC





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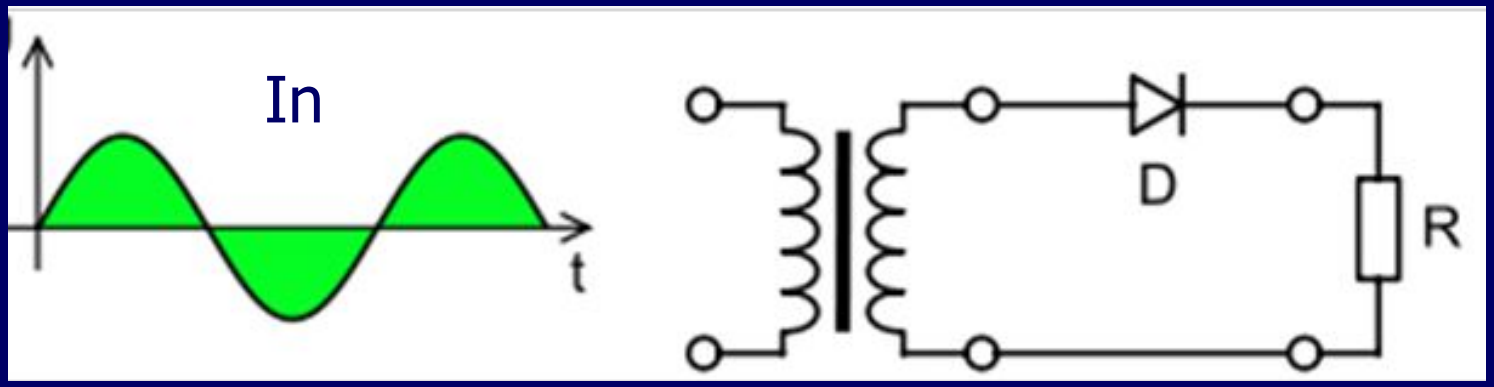
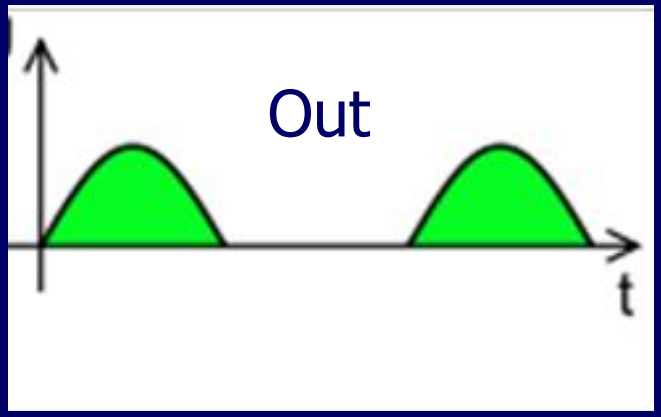
Half Wave Rectification





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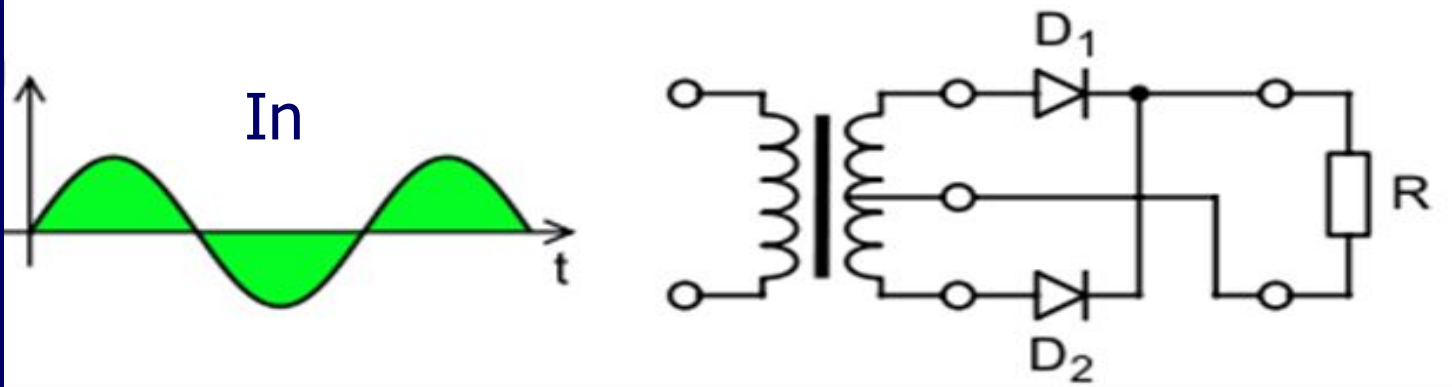
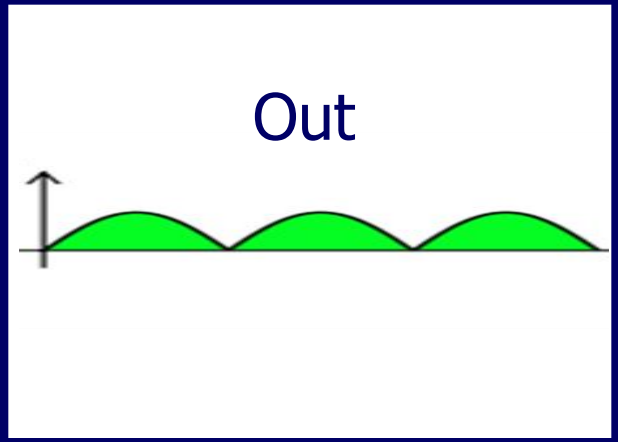
Full Wave Rectification
Using center tapped transformer





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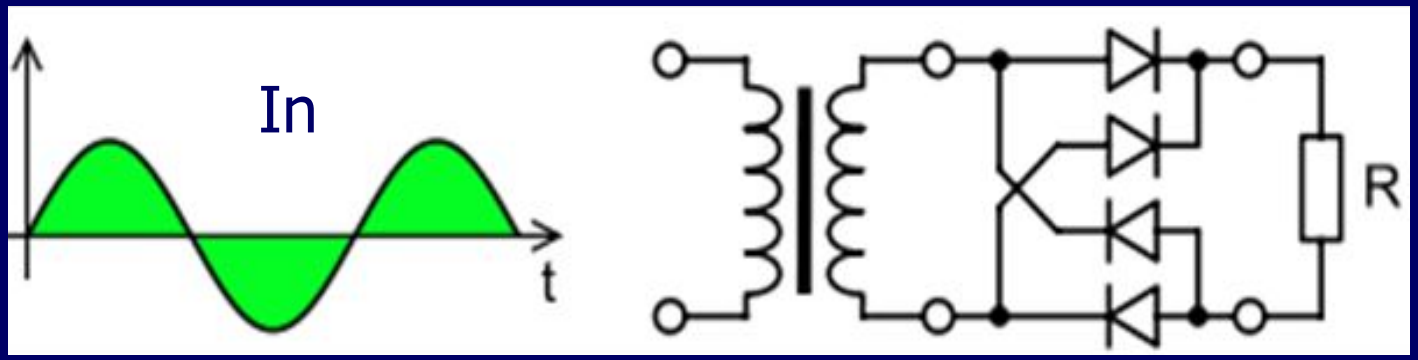
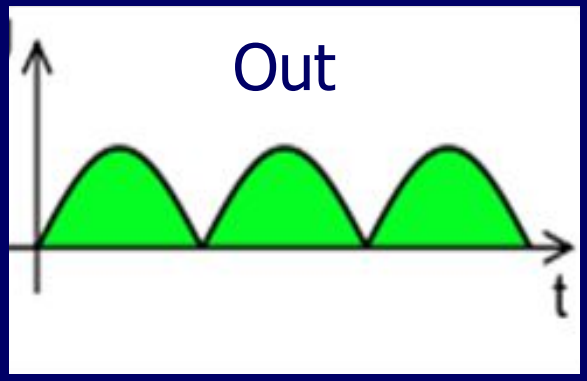
Full Wave Bridge Rectifier





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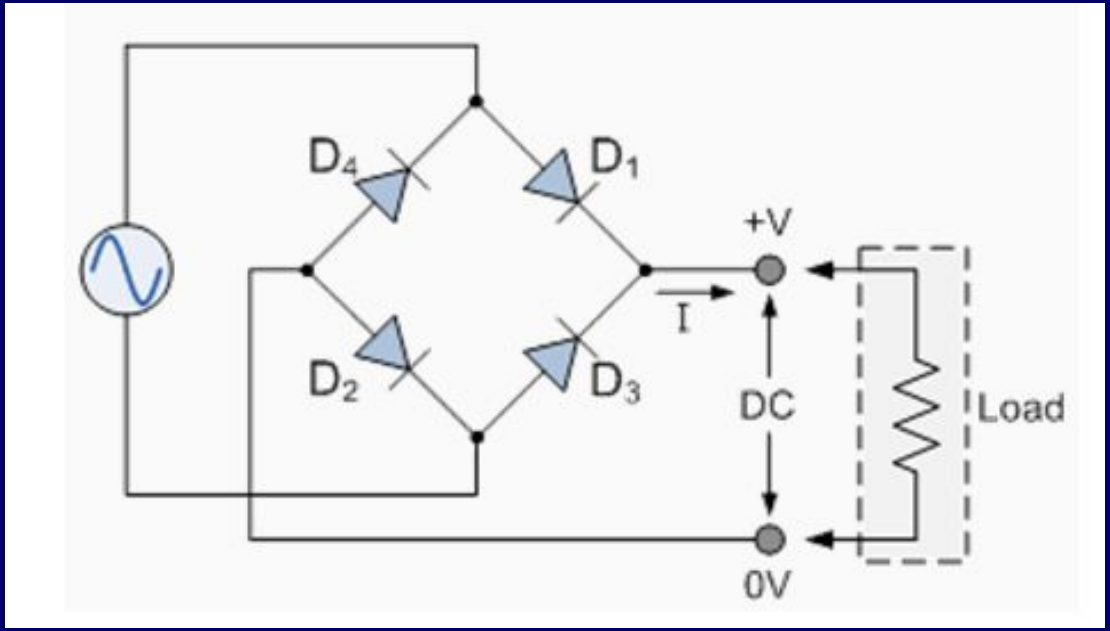
Full Wave Bridge Rectifier

This type of single phase rectifier uses four individual rectifying diodes connected in a closed loop "bridge" configuration to produce the desired output. The main advantage of this bridge circuit is that it does not require a special centre tapped transformer, thereby reducing its size and cost.



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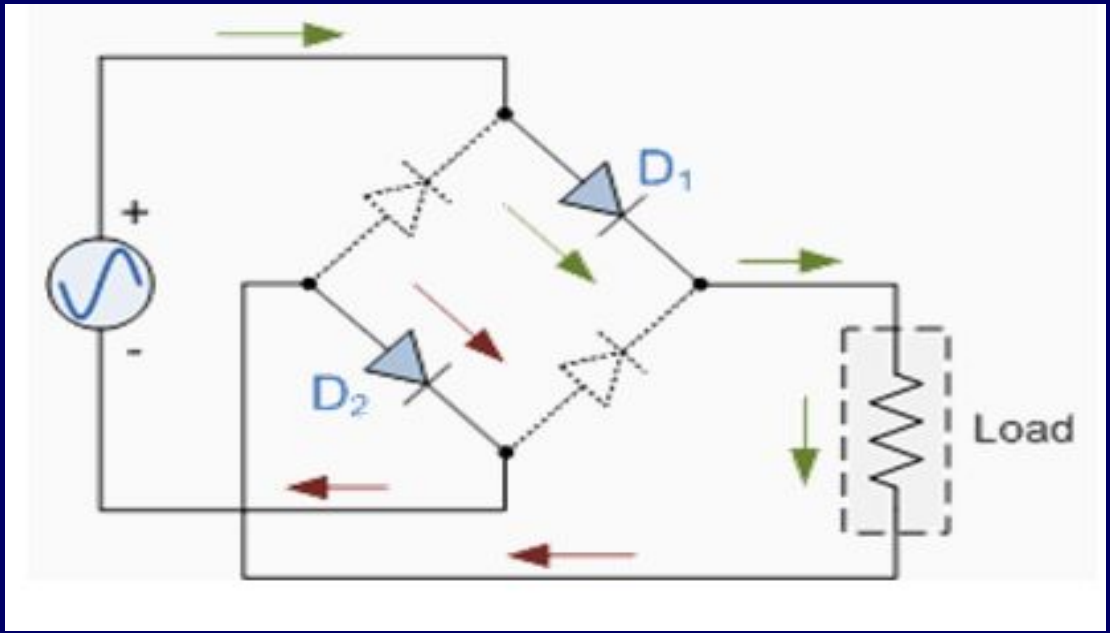
Full Wave Bridge Rectifier

The four diodes labelled D1 to D4 are arranged in "series pairs" with only two diodes conducting current during each half cycle. During the positive half cycle of the supply, diodes D1 and D2 conduct in series while diodes D3 and D4 are reverse biased and the current flows through the load.



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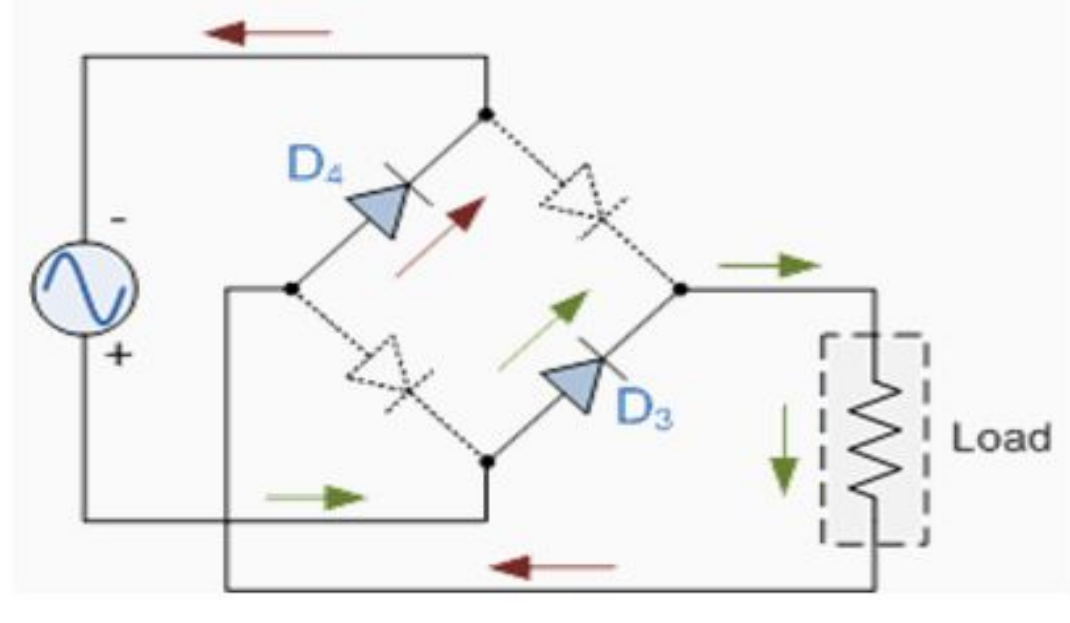
Full Wave Bridge Rectifier

During the negative half cycle of the supply, diodes D3 and D4 conduct in series, but diodes D1 and D2 switch "OFF" as they are now reverse biased. The current flowing through the load is the same direction as before.



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Full Wave Bridge Rectifier

As the current flowing through the load is unidirectional, so the voltage developed across the load is also unidirectional the same as for the previous two diode full-wave rectifier, therefore the average DC voltage across the load is $0.637V_{max}$. However in reality, during each half cycle the current flows through two diodes instead of just one so the amplitude of the output voltage is two voltage drops (2 x 0.6 = 1.2V) less than the input V_{MAX} amplitude. The ripple frequency is now twice the supply frequency (e.g. 100Hz for a 50Hz supply)

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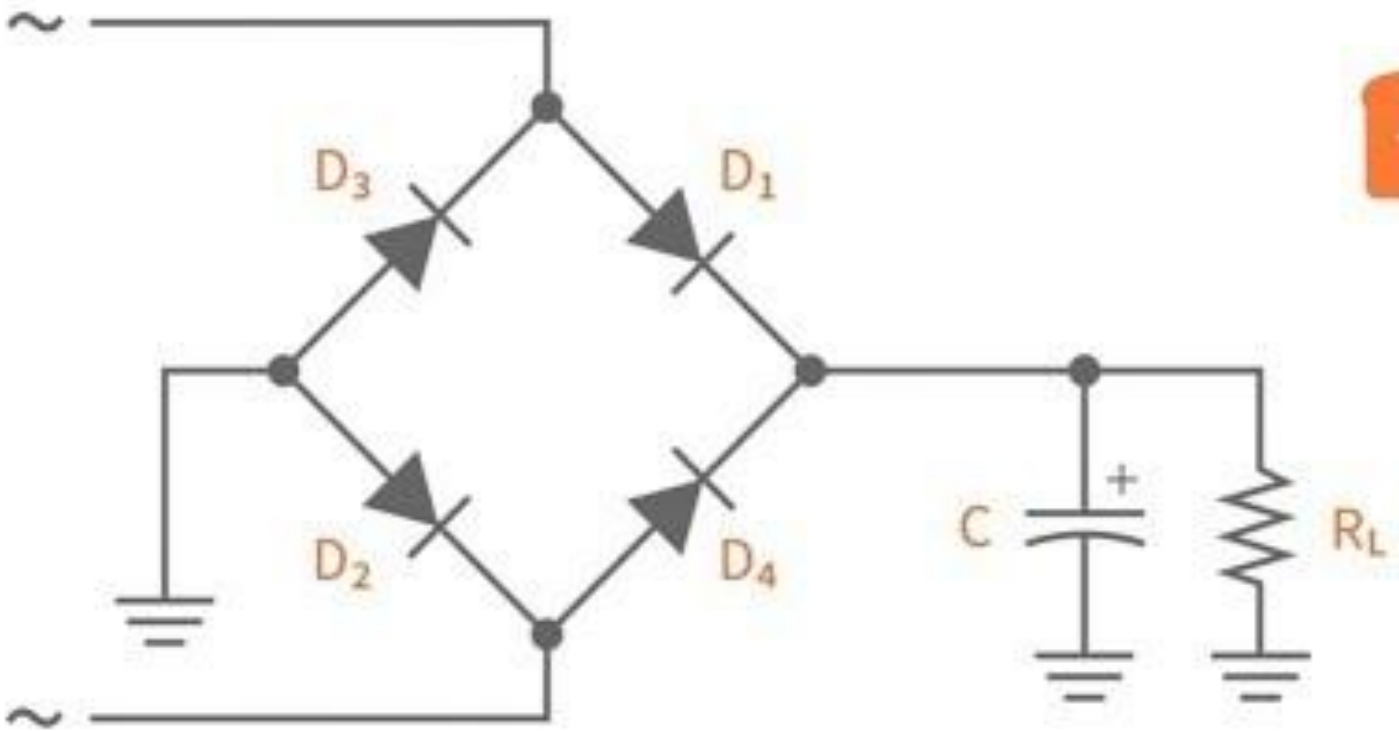

Full Wave Rectifier Conceptual

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The Smoothing Capacitor

We saw in the previous section that the single phase half-wave rectifier produces an output wave every half cycle and that it was not practical to use this type of circuit to produce a steady DC supply. The full-wave bridge rectifier however, gives us a greater mean DC value ($0.637V_{max}$) with less superimposed ripple while the output waveform is twice that of the frequency of the input supply frequency. We can therefore increase its average DC output level even higher by connecting a suitable smoothing capacitor across the output of the bridge circuit.

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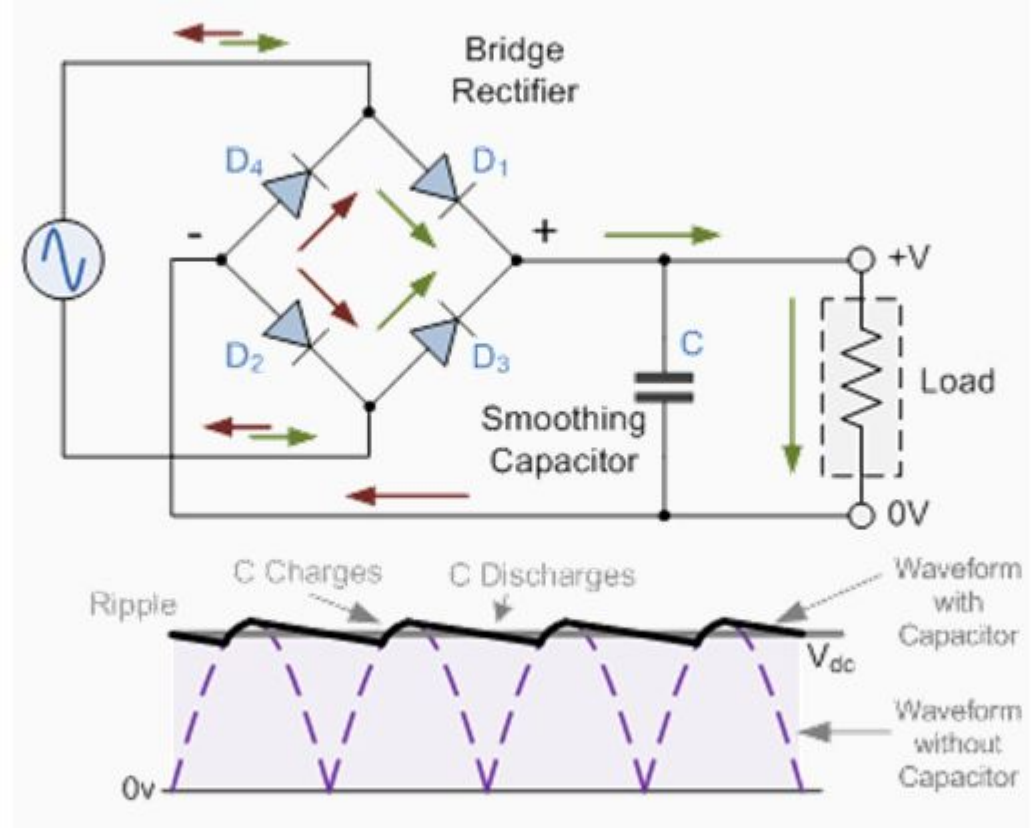
The Smoothing Capacitor



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The Smoothing Capacitor

The smoothing capacitor converts the full-wave rippled output of the rectifier into a smooth DC output voltage. Generally for DC power supply circuits the smoothing capacitor is an Aluminium Electrolytic type that has a capacitance value of 100uF or more with repeated DC voltage pulses from the rectifier charging up the capacitor to peak voltage.

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The Smoothing Capacitor

However, their are two important parameters to consider when choosing a suitable smoothing capacitor and these are

Working Voltage, which must be higher than the no-load output value of the rectifier and

Capacitance Value, which determines the amount of ripple that will appear superimposed on top of the DC voltage.

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The Smoothing Capacitor

Too low a value and the capacitor has little effect but if the smoothing capacitor is large enough (parallel capacitors can be used) and the load current is not too large, the output voltage will be almost as smooth as pure DC.

As a general rule of thumb, we are looking to have a ripple voltage of less than 100mV peak to peak.

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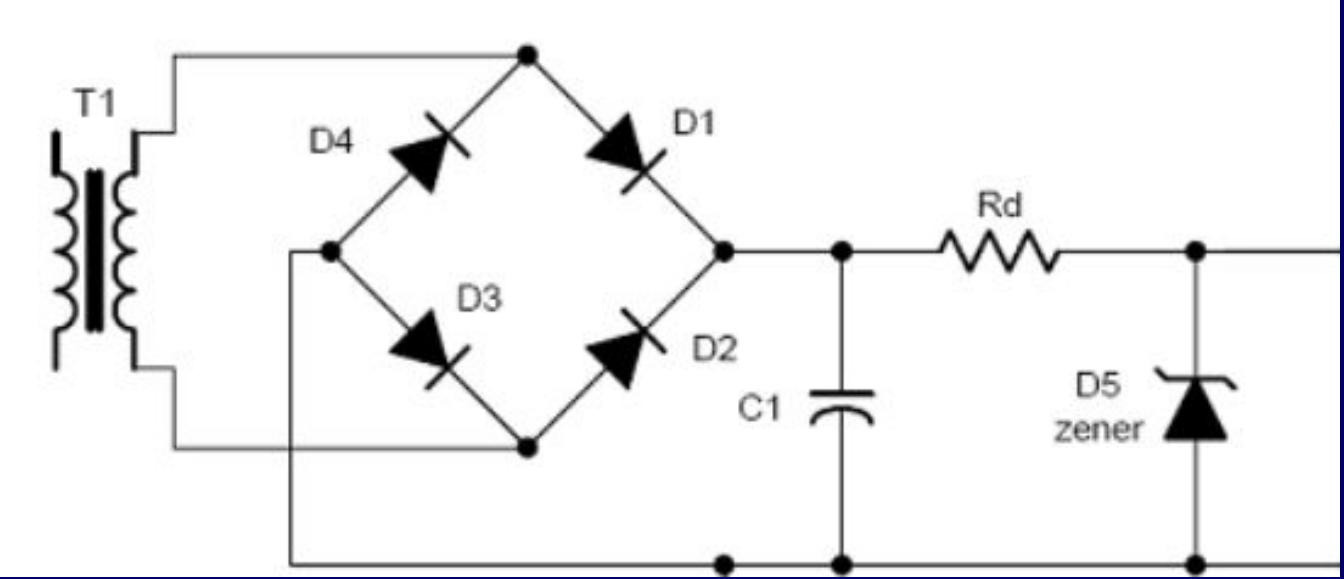
Basic Power Supply



The power supply above consists of
Transformer - Used for stepping down the ac input voltage
Bridge Rectifier D1-D4 To change the ac input to dc output
Capacitor For smoothing the output DC voltage
Resistor To limit current through zener diode
Zener Diode For Voltage regulation

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Full Wave Bridge Rectifier

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