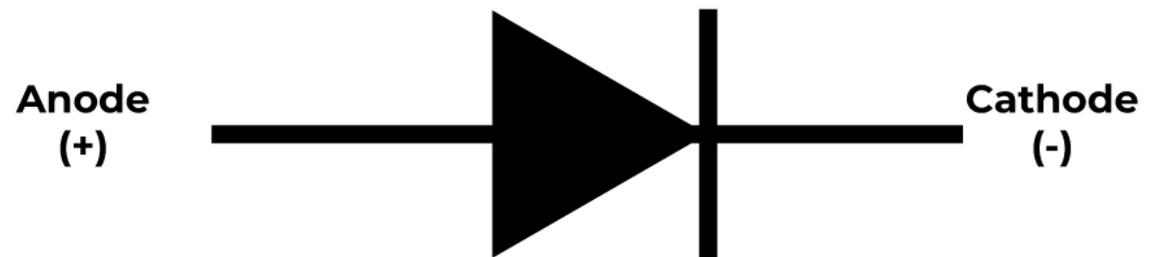# Rectifiers

What is a Rectifier

- A rectifier converts from AC to DC current

- They rely on Diodes to function

- They are essential in modern electronics to convert mains electricity into usable DC for appliances

What is a Diode

- Diodes are electrical components that control the direction of flow of current

- This is because diodes are directional with a positive and negative side

- They let current flow one way but not the other

Anode
(+)

Cathode
(-)

Half Wave Rectifiers

- Half wave rectifiers only convert half the wave to DC

- This creates a pulsing DC output, this is sometimes referred to as "rippling"

- This is usually is inadequate for modern scenarios as it is very inefficient converting under 50% of the original power

- This output requires heavy filtering to get a smooth DC output

- This is much cheaper and easier to build than full rectifiers though
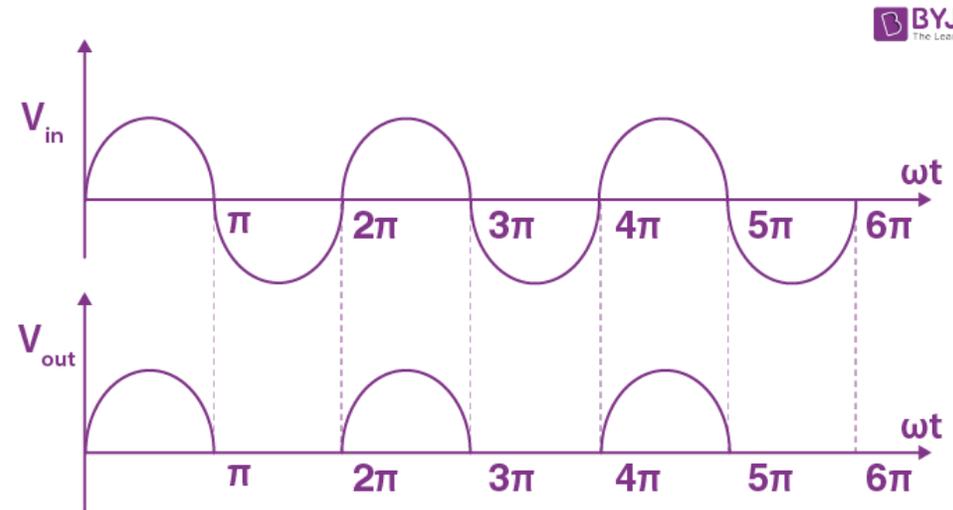
Half Wave Rectifier Circuit

- This is the circuit for a half wave rectifier

- The load resistor can be replaced by any load
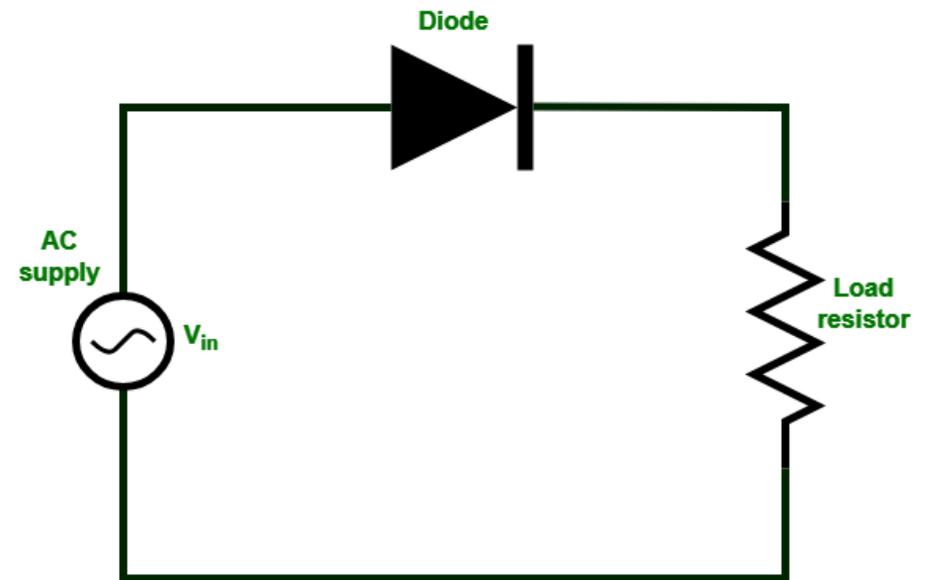
Full Wave Rectifier

- Full wave rectifiers convert the full AC wave to DC

- Still a pulsing DC but pulsing a lot faster, this is sometimes referred to as "rippling"

- Much more efficient than halfwave

- Uses two or four rectifiers to allow both halves of the AC waveform to pass

- Provides a higher average DC output

- A lot easier to filter to get a smooth DC output

V_{in}

V_p

t

V_{out} Full-wave signal

V_p

t
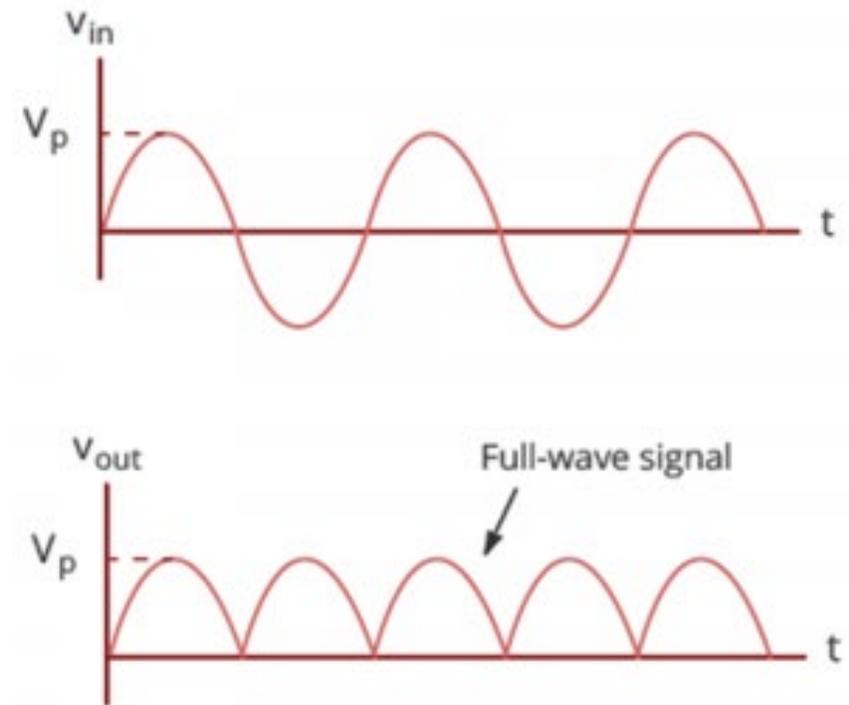
Full Wave Rectifier (Centre-Tap)

- Uses a centre-tapped transformer and two diodes

- Each diode conducts alternating parts of the wave
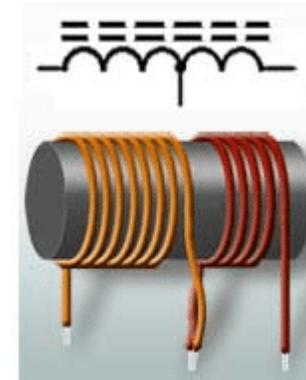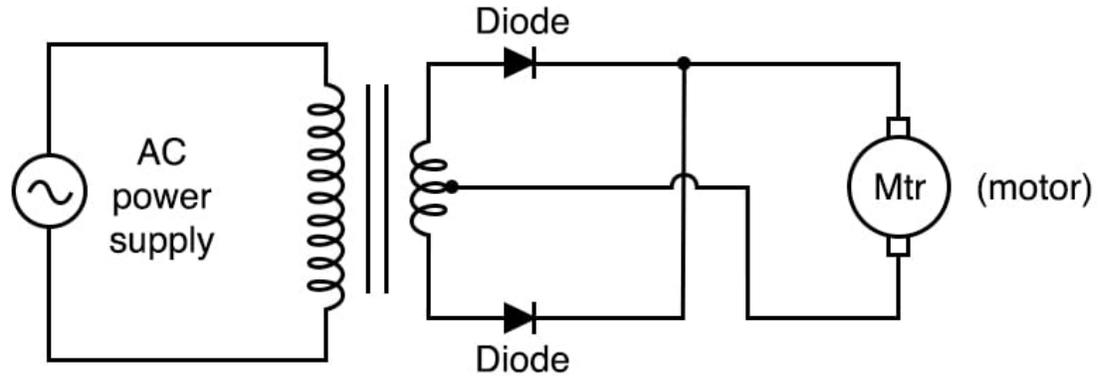
Full Wave Rectifier (Bridge)

- Uses a bridge constructed out of two pairs of diodes which work in unison

- The pairs are opposites (D1+D2) and (D3+D4)

- This is much cheaper and easier to construct as you don't need a centre-tapped inductor

- Provides higher efficiency and better voltage regulation
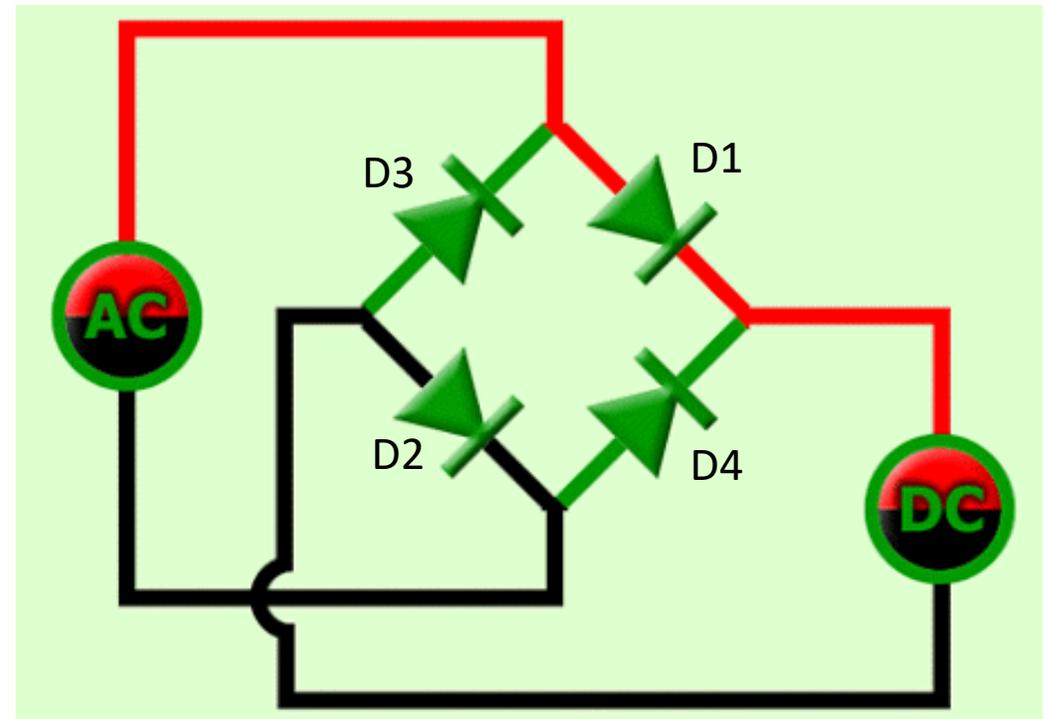
Filtering of Rectifier Outputs

- The output of a rectifier is filtered and "smoothed" using capacitors

- The capacitors take the spikes and then release them over time

- You will always be left with some rippling or pulsing however it will be a lot smoother
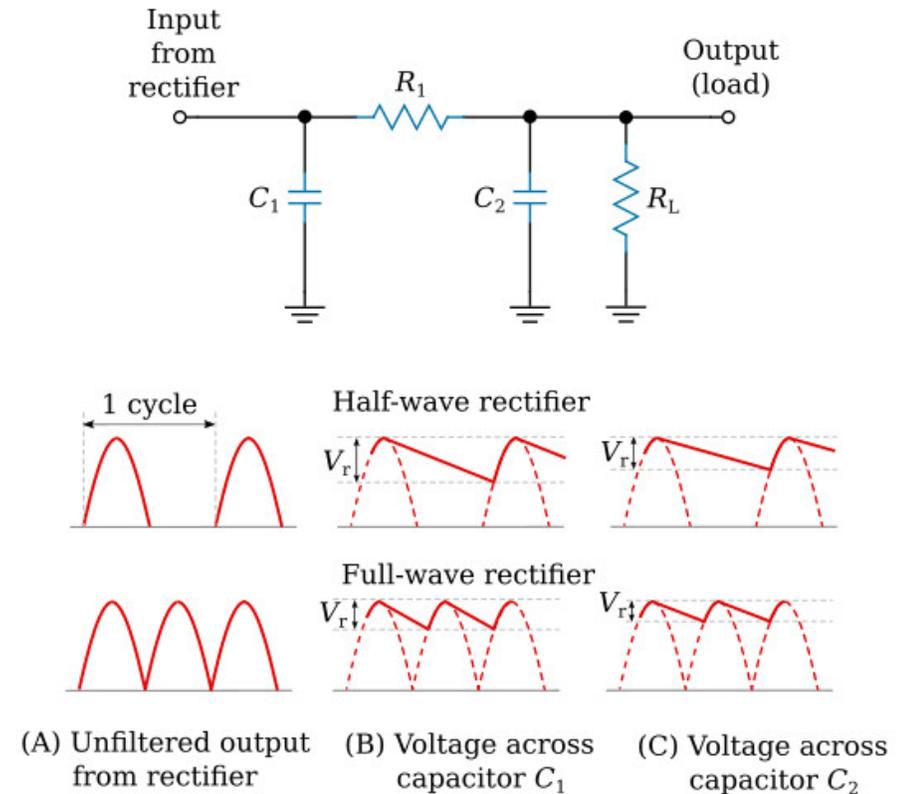
Equations

- Half Wave:

- $V_{DC} = \dfrac{V_m}{\pi}$

- $V_{rms} = \dfrac{V_m}{2}$

- γ = $\sqrt{(\dfrac{V_{rms}}{V_{DC}})^2 - 1}$ <- Ripple Factor

- Full Wave:

- $V_{DC} = \dfrac{2V_m}{\pi}$

- $V_{rms} = \dfrac{V_m}{\sqrt{2}}$

- γ = $\sqrt{(\dfrac{V_{rms}}{V_{DC}})^2 - 1}$ <- Ripple Factor