

Power Supplies

Power supplies

- Supply electric energy
- Convert power input into suitable output
 - Either AC or DC input
 - Usually DC output in electronics
- General block diagram:

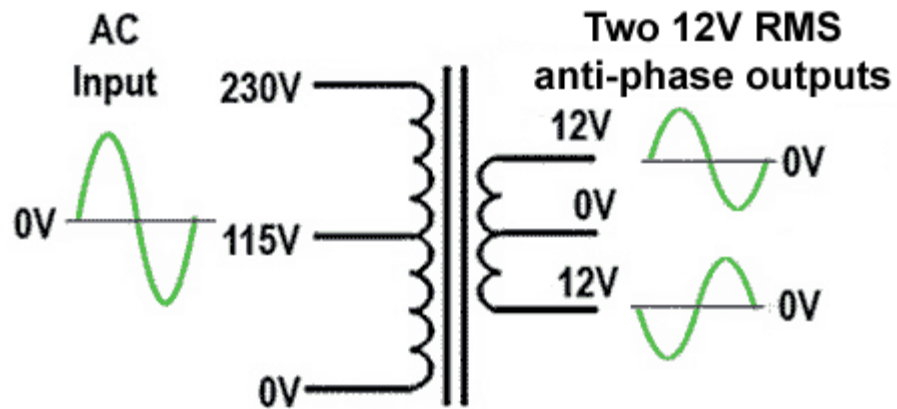


Unregulated power supplies

- Only use a transformer, a rectifier and a filter
- Prone to voltage drops under load
-

Transformer

- Used to transform the AC input to an AC output of a suitable amplitude
- Usually the most expensive part of a power supply unit

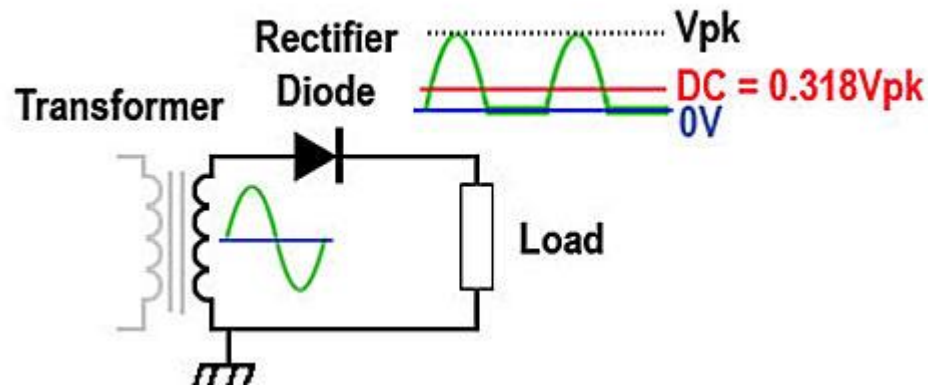


Rectifier

- Convert AC input to DC
- Different circuits can output different waveforms

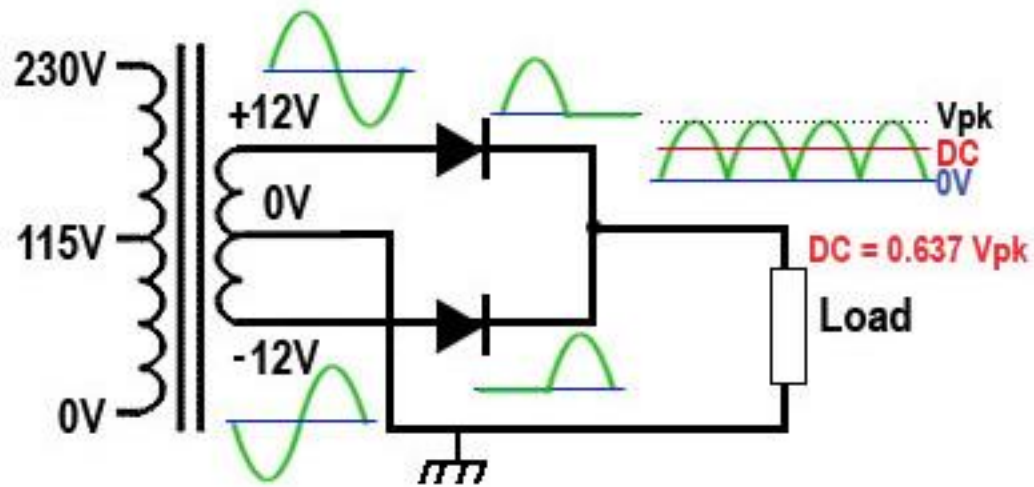
Half Wave Rectification

- A single diode is used
- Removes half of the AC input wave
- Supplies lower voltages



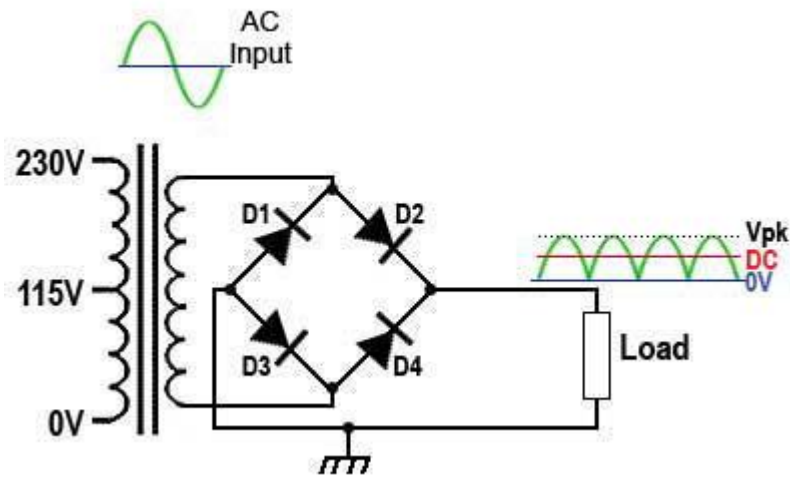
Full Wave rectification

- Uses two diodes and a centre tapping on the transformer
- More efficient, easier smoothing due to higher frequency
- More expensive (tapped transformer)



Bridge rectifier

- Uses four diodes, no need for centre tapped transformer
- Diodes only need half the reverse breakdown voltage

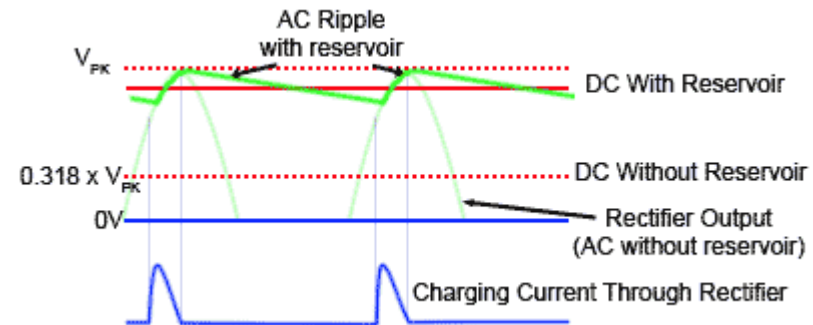
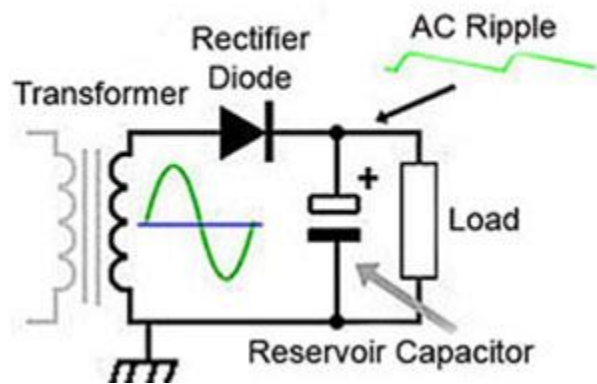


Filter circuit

- Typically consists of a reservoir capacitor and a low pass filter
- Contributes to removing the AC pulses

Reservoir capacitor

- A (large) capacitor acts as a storage for output current
- Supplies current when the rectifier circuit is not conducting

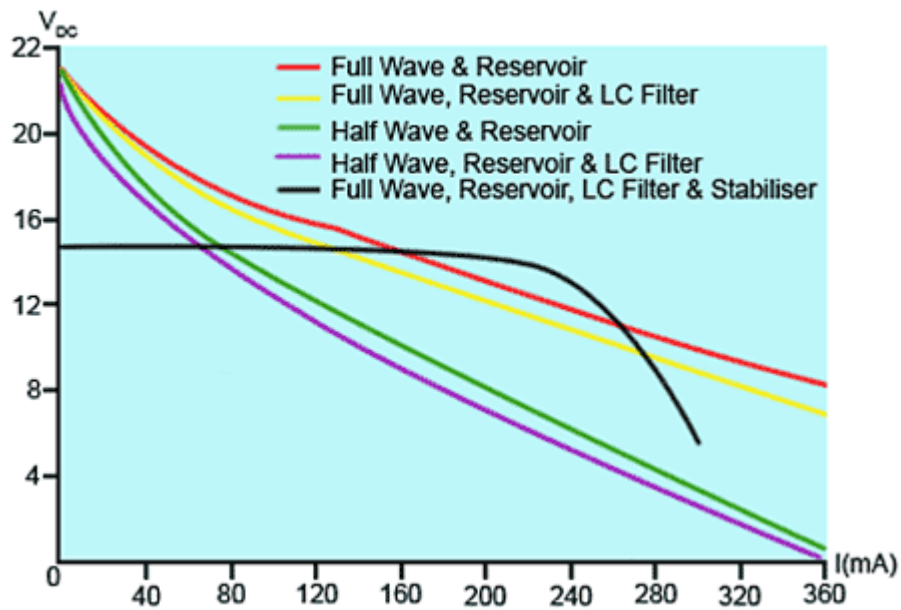


Low pass filter

- Removes even more of the AC ripple
- Passes lower frequencies (our DC, 0Hz)
- Blocks higher frequencies (the AC, e.g. 50Hz)
- Either LC or RC low pass filters are used
 - LC filters are usually more efficient due to higher X_L to X_C ratio

Regulated power supplies

- Output voltage drops at increasing load currents in unregulated power supplies
- This is usually solved by using a regulator (stabiliser)



Regulators

- Shunt regulators
 - In parallel with the load
 - Tries to maintain a steady total current between the load and the regulator depending on the load current
 - Zener diodes
- Series regulators
 - In series with the load
 - Uses a negative feedback system to control its own resistance

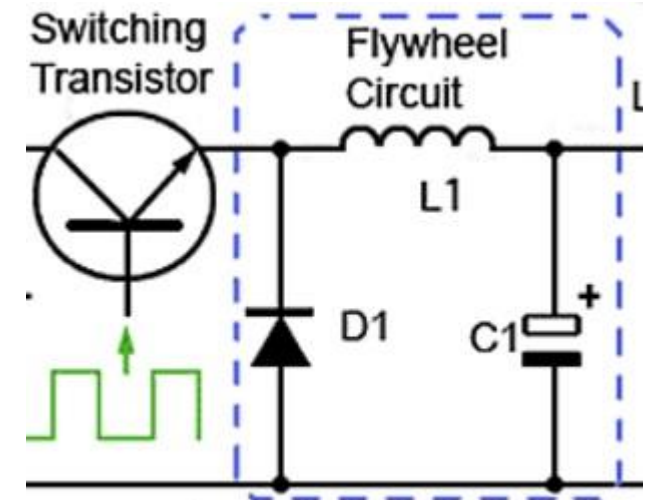
IC Regulators

- The mentioned circuits are rarely used with the introduction of ICs
- ICs use the same principles, with enhancements
- LM78Xxx, LM79xx for negative outputs



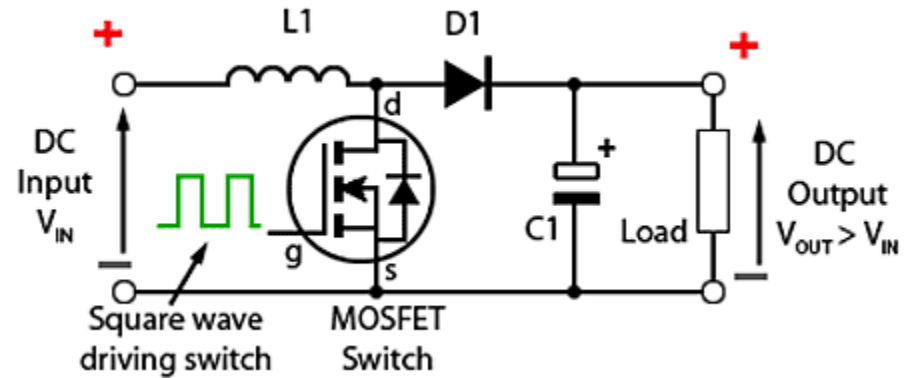
DC/DC conversion

- Buck converter
 - Consists of a switching transistor and a flywheel circuit
 - L1 & C1 keep the current going during transistor OFF periods
 - Output voltage depends on ratio of ON/OFF states of transistor
 - Output voltage always lower than input voltage



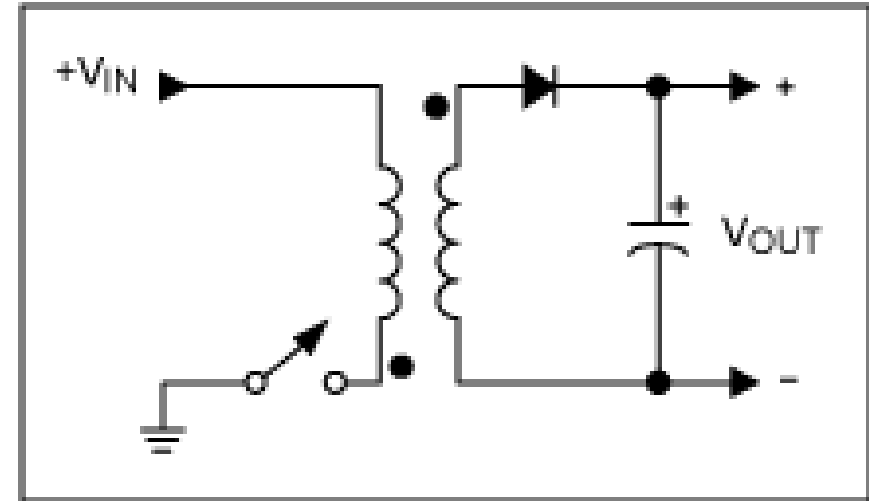
DC/DC conversion

- Boost converter
 - Similar operation (switching transistor)



DC/DC conversion

- Flyback converter
 - Uses a transformer to allow isolation



DC/DC conversion

- Inverting regulator
 - The induction changes polarity
 - The output is inverted/negative

