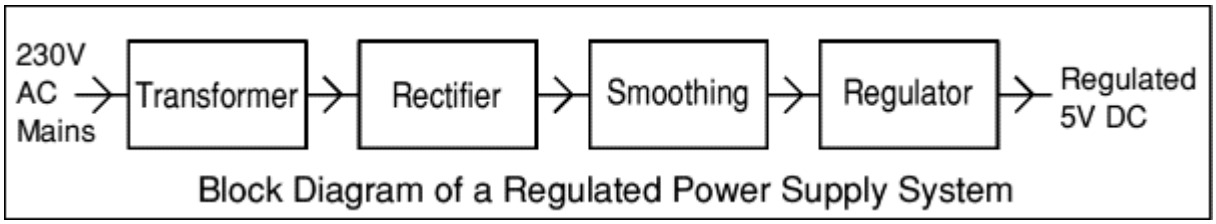
Power Supply Circuit

Power supply is the circuit from which we get a desired dc voltage to run the other circuits. The voltage we get from the main line is 230V AC but the other components of our circuit require 5V DC. Hence a step-down transformer is used to get 12V AC which is later converted to 12V DC using a rectifier. The output of rectifier still contains some ripples even though it is a DC signal due to which it is called as Pulsating DC. To remove the ripples and obtain smoothed DC power filter circuits are used. Here a capacitor is used. The 12V DC is rated down to 5V using a positive voltage regulator chip 7805. Thus a fixed DC voltage of 5V is obtained.

A 5V regulated supply is taken as followed:



Block Diagram of a Regulated Power Supply System

Each of the blocks is described in more detail below:

- Transformer - steps down high voltage AC mains to low voltage AC.
- Rectifier - converts AC to DC, but the DC output is varying.
- Smoothing - smoothes the DC from varying greatly to a small ripple.
- Regulator - eliminates ripple by setting DC output to a fixed voltage.

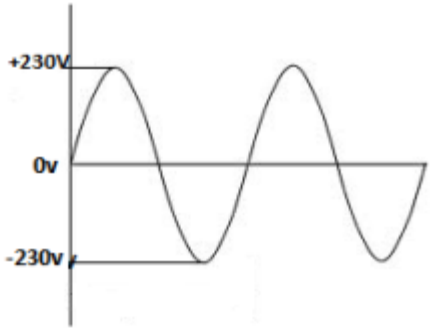
TRANSFORMER

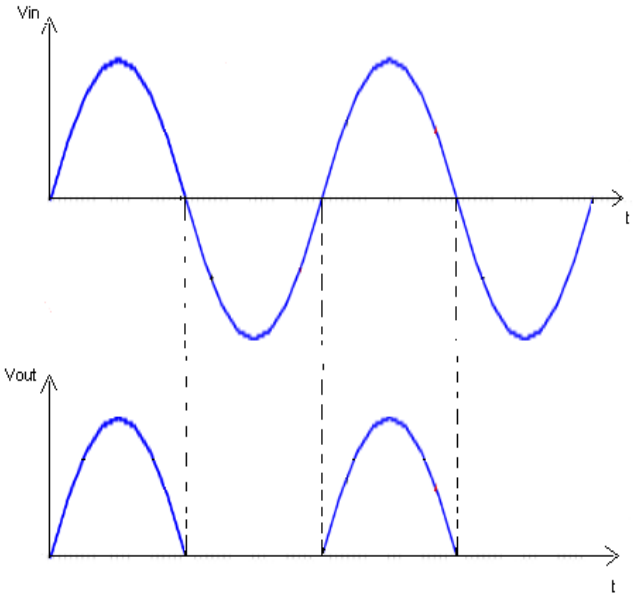
Transformer is the electrical device that converts one voltage to another with little loss of power. Transformers work only with AC. There are two types of transformers as Step-up and Step-down transformer. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage to a safer low voltage. Here a step down transformer is used to get 12V AC from the supply i.e. 230V AC.

RECTIFIERS

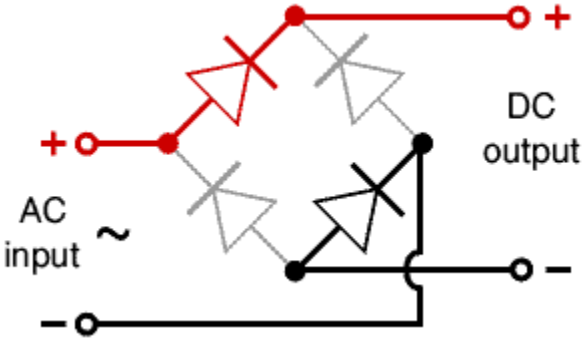
A rectifier is a circuit that converts AC signals to DC. A rectifier circuit is made using diodes. There are two types of rectifier circuits as Half-wave rectifier and Full-wave rectifier depending upon the DC signal generated.

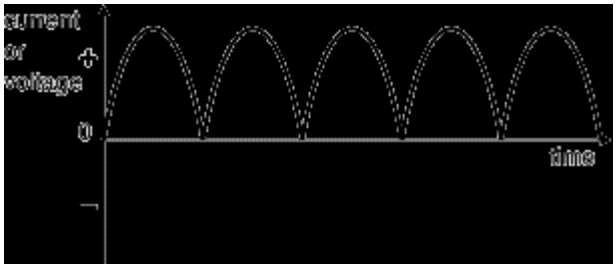
Half-wave Rectifier: It is the rectifier circuit that rectifies only half part of the AC signal. It uses only a single diode. It only uses only positive part of the AC signal to produce half-wave varying DC and produce gaps when the AC is negative.

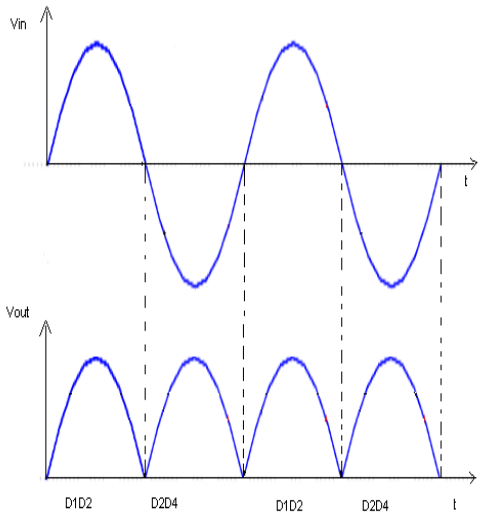




Full-wave Rectifier: It is also called as Bridge Rectifier. A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier because it uses the total AC wave (both positive and negative sections).

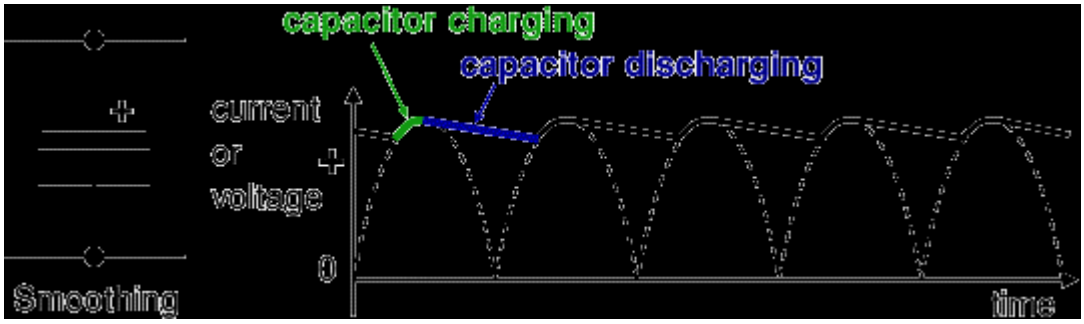






SMOOTHING

Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The diagram shows the unsmoothed varying DC (dotted line) and the smoothed DC (solid line). The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output. Here a capacitor of 330uF is used as a smoothing circuit.



VOLTAGE REGULATION

Voltage regulators produce fixed DC output voltage from variable DC (a small amount of AC on it). Normally we get fixed output by connecting the voltage regulator at the output of the filtered DC. It can also used in circuits to get a low DC voltage from a high DC voltage (for example we use 7805 to get 5V from 12V). There are two types of voltage regulators

1. fixed voltage regulators (78xx, 79xx)
2. Variable voltage regulators (LM317)

In fixed voltage regulators there is another classification

1. Positive voltage regulators
2. Negative voltage regulators

POSITIVE VOLTAGE REGULATORS:

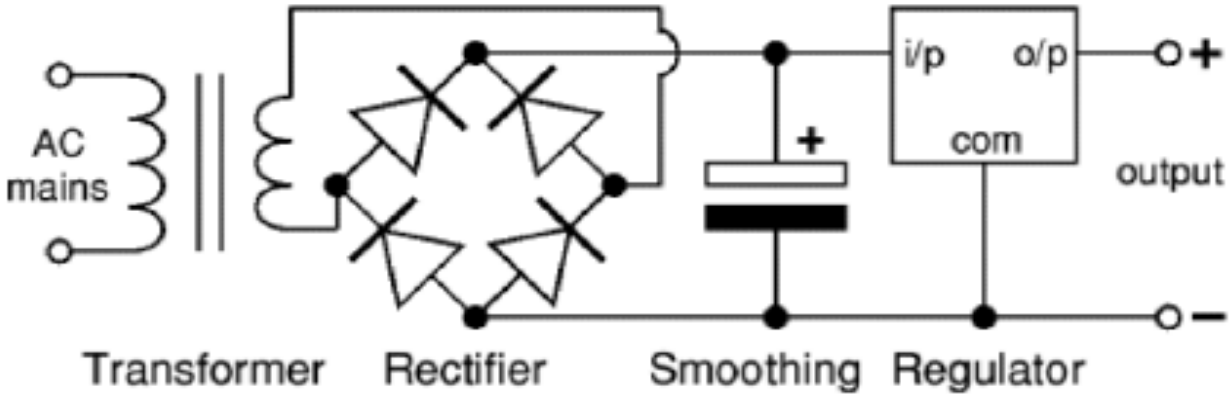
This includes 78xx voltage regulators. The most commonly used ones are 7805 and 7812. 7805 gives fixed 5V DC voltage if input voltage is in (7.5V-20). You may sometimes have questions like, what happens if input voltage is <7.5 V or some 3V, the answer is that regulation won't be proper. Suppose if input is 6V then output may be 5V or 4.8V, but there are some parameters for the voltage regulators like maximum output current capability, line regulation etc. won't be proper. Remember that electronics components should be used in the proper voltage and current ratings as specified in datasheet. You can work without following it, but you won't be able to get some parameters of the component.

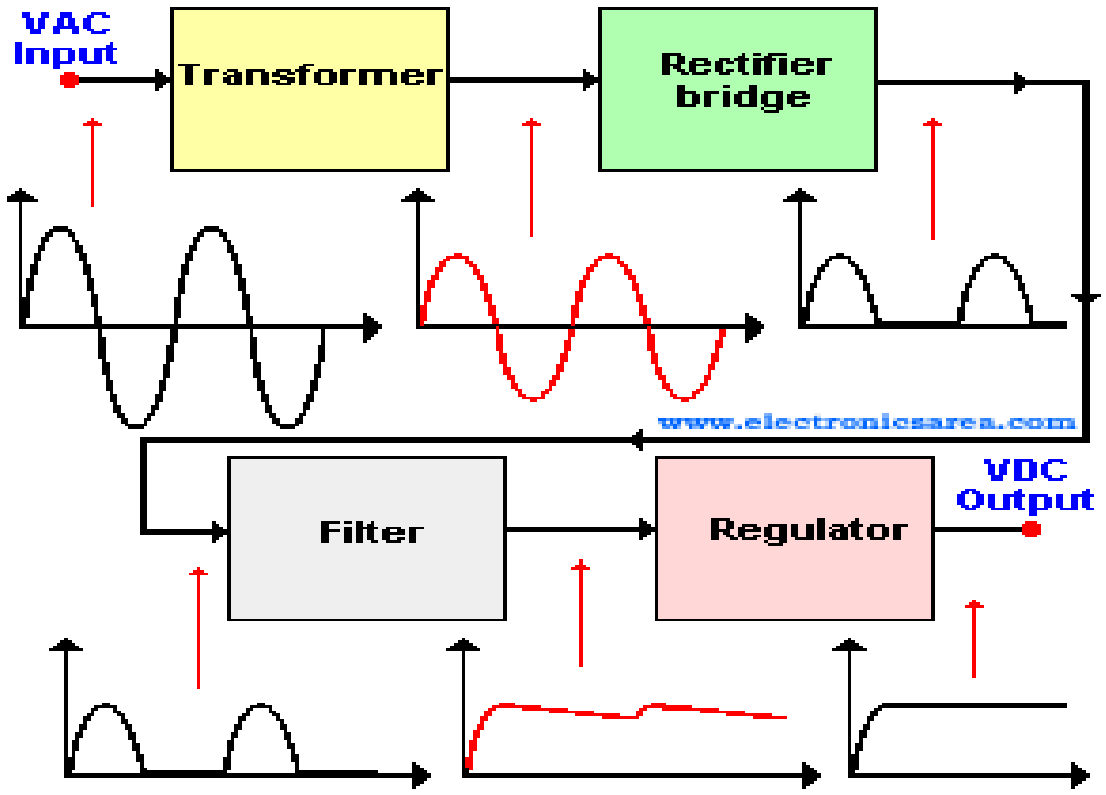
NEGATIVE VOLTAGE REGULATORS:

Mostly available negative voltage regulators are of 79xx family. The mainly available 79xx IC's are 7905,7912 1.5A output current ,short circuit protection, ripple rejection are the other features of 79xx IC's.

Many of the fixed voltage regulators have 3 leads and look like power transistors, such as the 7805 (+5V 1A) regulator shown on the above. If adequate heat sinking is provided then it can deliver up to maximum 1A current. For an output voltage of 5v-18v the maximum input voltage is 35v and for an output voltage of 24V the maximum input voltage is 40V.For 7805 IC, for an input of 10v the minimum output voltage is 4.8V and the maximum output voltage is 5.2V. The typical dropout voltage is 2V.

TOTAL CIRCUIT DIAGRAM OF POWER SUPPLY




VAC
Input
Transformer
Rectifier
bridge
www.electronicsarea.com
Filter
Regulator
VDC
Output