

Reference: Microelectronics Circuits by Sedra Smith

Importance of Power Supply

One application of diodes is in the design of rectifier circuits. A diode rectifier forms the first stage of a dc power supply. A dc voltage is required to power essentially every electronic device, including personal computers, televisions, and stereo systems. An electrical cord that is plugged into a wall socket and attached to a television, for example, is connected to a rectifier circuit inside the TV. In addition, battery chargers for portable electronic devices such as cell phones and laptop computers contain rectifier circuits.

Block Diagram of DC Power Supply

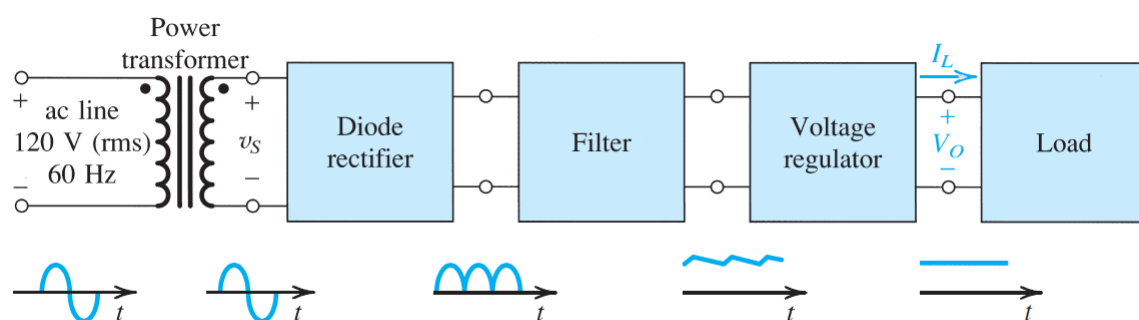


Figure 4.20 Block diagram of a dc power supply.

4.5 Rectifier Circuits

One of the most important applications of diodes is in the design of rectifier circuits. A diode rectifier forms an essential building block of the dc power supplies required to power electronic equipment. A block diagram of such a power supply is shown in Fig. 4.20. As indicated, the power supply is fed from the 120-V (rms) 60-Hz ac line, and it delivers a dc voltage V_O (usually in the range of 5 V to 20 V) to an electronic circuit represented by the *load* block. The dc voltage V_O is required to be as constant as possible in spite of variations in the ac line voltage and in the current drawn by the load.

1. Power Transformer:

The first block in a dc power supply is the **power transformer**. It consists of two separate coils wound around an iron core that magnetically couples the two windings. The **primary winding**, having N_1 turns, is connected to the 120-V ac supply, and the **secondary winding**, having N_2 turns, is connected to the circuit of the dc power supply. Thus an ac voltage v_s of $120(N_2/N_1)$ V (rms) develops between the two terminals of the secondary winding. By selecting an appropriate turns ratio (N_1/N_2) for the transformer, the designer can step the line voltage down to the value required to yield the particular dc voltage output of the supply. For instance, a secondary voltage of 8-V rms may be appropriate for a dc output of 5 V. This can be achieved with a 15:1 turns ratio.

In addition to providing the appropriate sinusoidal amplitude for the dc power supply, the power transformer provides electrical isolation between the electronic equipment and the power-line circuit. This isolation minimizes the risk of electric shock to the equipment user.

2. Rectifier:

The diode rectifier converts the input sinusoid v_s to a unipolar output, which can have the pulsating waveform indicated in Fig. 4.20. Although this waveform has a nonzero average or a dc component, its pulsating nature makes it unsuitable as a dc source for electronic circuits, hence the need for a filter. The variations in the magnitude of the rectifier output are considerably reduced by the filter block in Fig. 4.20.

3. Filter and Regulator:

The output of the rectifier filter, though much more constant than without the filter, still contains a time-dependent component, known as **ripple**. To reduce the ripple and to stabilize the magnitude of the dc output voltage of the supply against variations caused by changes in load current, a voltage regulator is employed. Such a regulator can be implemented using the zener shunt regulator configuration.