Slide 1

CHAPTER 9

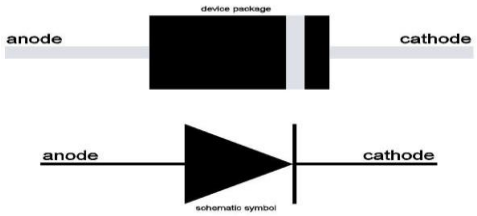
Actives Devices: Diodes, Transistors,Tubes

Slide 2

Diode Fundamentals

The electrodes of a semiconductor diode are known as **anode and cathode.**

In a semiconductor diode, electrons flow from **cathode to anode**. In order for a diode to conduct, it must be **forward-biased**.



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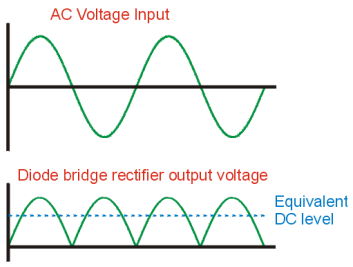
Slide 3

Diode Fundamentals

If alternating current is applied to the anode of a diode, at the cathode of the diode you would expect to see **pulsating direct current**

The action of changing alternating current (AC) to direct current (DC) is called **rectification**



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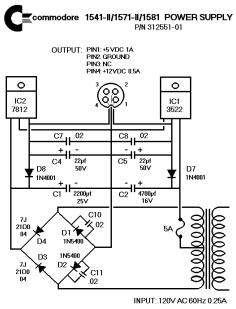
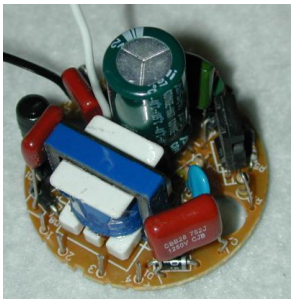
Diode Fundamentals





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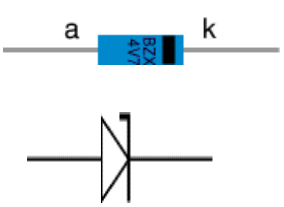
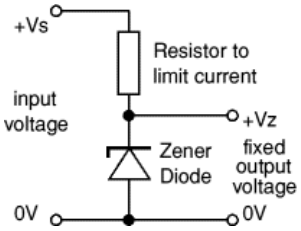
Diode Fundamentals

Zener diodes are used to maintain a fixed voltage. They are designed to 'breakdown' in a reliable and non-destructive way so that they can be used **in reverse** to maintain a fixed voltage across their terminals. The diagram shows how they are connected, with a resistor in series to limit the current.





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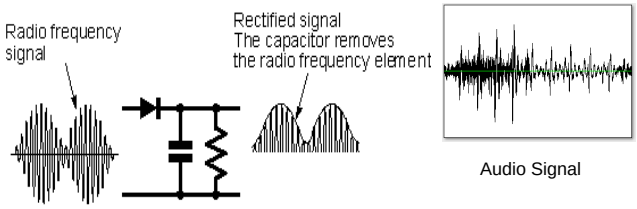
Diode Fundamentals

One important application for diodes is recovering information from transmitted signals. This is referred to as **demodulation.**

The AM detector or demodulator includes a capacitor at the output. Its purpose is to remove any radio frequency components of the signal at the output.



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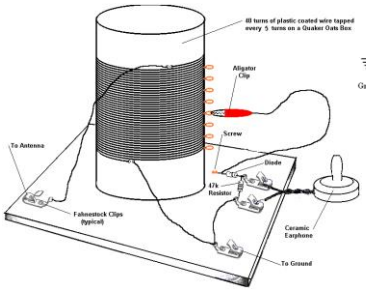
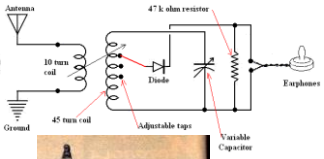
Diode Fundamentals

4.2 Diode Fundamentals





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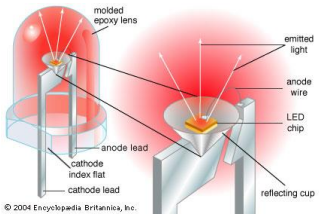
Diode Fundamentals

Light Emitting Diodes (LEDs) are solid-state semiconductor devices that convert electrical energy directly into light.

LED "cold" generation of light is highly efficient because most of the energy radiates within the visible spectrum.

Because LEDs are solid-state devices, they can be extremely small and durable; they also provide longer lamp life than other sources.



LEDs are made of various semiconducting compounds, depending on the desired colour output. Infrared and red LEDs generally use a gallium, aluminum, and arsenide compound. Orange and yellow LEDs most often use gallium, aluminum, and either indium or phosphorus. Green and blue LEDs typically use either silicon and carbon, or gallium and nitrogen.

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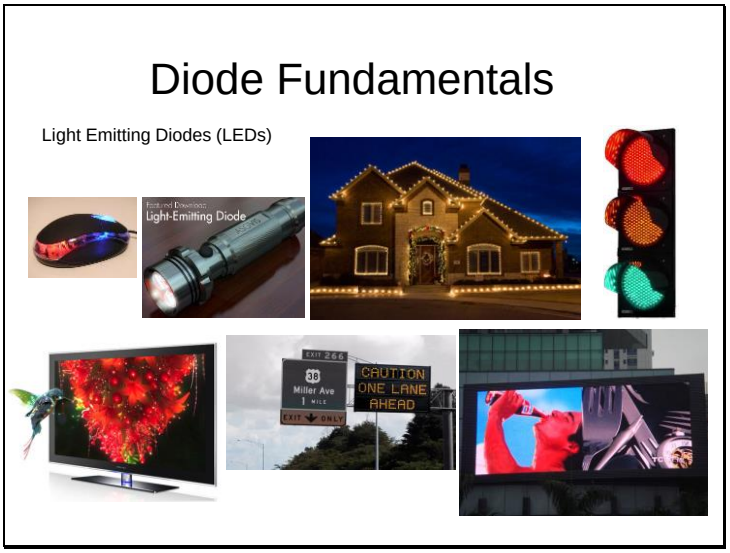
Diode Fundamentals
Light Emitting Diodes (LEDs)
Light-Emitting Diode
EXIT 266
38
Miller Ave
1 MILE
EXIT ONLY
CAUTION
ONE LANE
AHEAD

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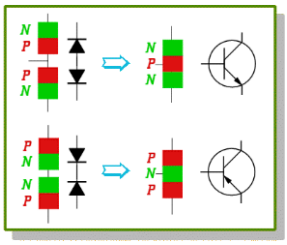
Bipolar Transistor Fundamentals

The basic semiconductor amplifying device is the **transistor**

A *Bipolar Transistor* essentially consists of a pair of *PN Junction Diodes* that are joined back-to-back.

This forms a sort of a sandwich where one kind of semiconductor is placed in between two others.

There are therefore two kinds of Bipolar sandwich, the ***NPN*** and ***PNP*** varieties. The three layers of the sandwich are conventionally called the ***Collector***, ***Base***, and ***Emitter***.



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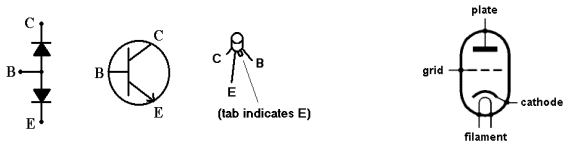
Bipolar Transistor Fundamentals

In a bipolar transistor the **base** compares closest to the **control grid** of a triode vacuum tube

In a bipolar transistor the **collector** compares closest to the **plate** of a triode vacuum tube

In a bipolar transistor the **emitter** compares closest to the **cathode** of a triode vacuum tube



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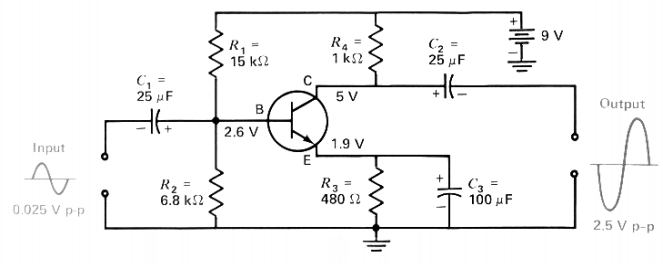
Bipolar Transistor Fundamentals

A **PNP transistor** can amplify a small signal using low voltages. If a low level signal is placed at the input to a transistor, a higher level of signal is produced at the output lead. This effect is known as **amplification**



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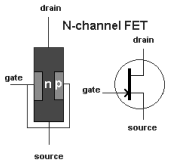
Field Effect Transistor (FET) Fundamentals

A field effect transistor has only two layers of semiconductor material, one on top of the other. Electricity flows through one of the layers, called the channel. A voltage connected to the other layer, called the gate, interferes with the current flowing in the channel. Thus, the voltage connected to the gate controls the strength of the current in the channel.



There are two basic varieties of field effect transistors - the junction field effect transistor (JFET) and the metal oxide semiconductor field effect transistor (MOSFET).

In a field effect transistor, the **gate** controls the conductance of the channel, the **source** is where the charge carriers enter the channel and the **drain** is where the charge carriers leave the channel.

The control element in a field effect transistor is the **gate**.

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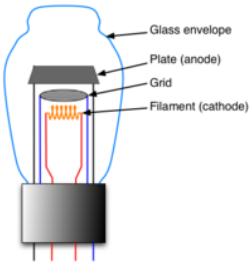
Triode Vacuum Tube Fundamentals

A vacuum tube consists of arrangements of electrodes in a **vacuum** within an insulating, temperature-resistant envelope.

The electrodes are attached to leads which pass through the envelope via an air tight seal.

When hot, the filament releases electrons into the vacuum: a process called thermionic emission.



The resulting negatively-charged cloud of electrons is called a space charge. These electrons will be drawn to a metal plate inside the envelope, if the plate (also called the anode) is positively charged relative to the filament (or cathode). The result is a flow of electrons from filament to plate.

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Triode Vacuum Tube Fundamentals

Vacuum Tube versus Transistor

- triode vacuum tube can be used instead of a transistor to handle **higher power**
- vacuum tube can amplify small signals but must use high voltages
- both tubes and transistors can amplify signals

In a vacuum tube:

- the electrode that is operated at the highest positive potential is the **plate**
- the electrode that is usually a cylinder of wire mesh is the **grid**
- the electrode that is farthest away from the plate is the **filament**
- the electrode that emits electrons is the **cathode**

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