ITEC 262.01

Lab Write-up #1

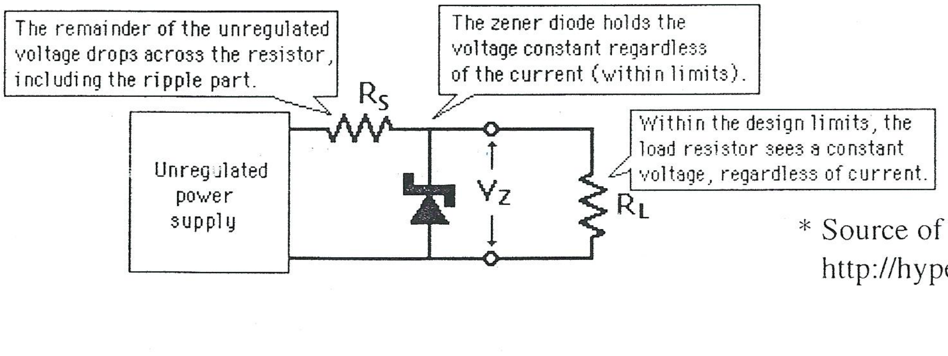
Diode Characteristics

10 Excellent.

In this lab we carefully observed characteristics of three types of diodes and how they function within a circuit. Silicon and germanium diodes are used to rectify AC current to DC current. A zener diode's unique characteristics were utilized in the reverse bias position to regulate voltage and current for a parallel resistive load.

When voltage is applied to a diode in the forward direction, current will not flow until the depletion region closes (P-N junction). Once the depletion region is closed, a resistance across the diode is very low and current flow increases rapidly. Reverse bias exists when voltage is applied to the diode in such a way that it causes it to act as an insulator. In the reverse bias position, the size of the depletion region in the diode is increased and thus, blocks current flow. The amount of voltage necessary to close the depletion region is called break-over voltage. We found that the silicon diode has a forward break-over voltage of about 0.6 volts while the germanium diode has a forward break-over voltage of about 0.3 volts. Though the germanium diode has a lower forward break-over voltage it is less effective in blocking reverse current flow and its operating characteristic curve is less vertical then that of the silicon diode after its break-over voltage is attained. For these reasons the silicon diode is more useful in electronic devices requiring precision and predictability in its circuitry.

If the reverse bias applied to a diode exceeds its peak inverse voltage (PIV) rating, the diode breaks down and passes current freely, causing the diode to be destroyed, unless the current is limited by an external resistance. Though the forward and reverse characteristics of the zener diode are similar to the standard diode, the zener diode normally operates in reverse bias position. When a source voltage is applied to the zener diode in the reverse direction, the current remains very low until the reverse voltage reaches reverse breakdown. The zener diode then conducts heavily or avalanches. Reverse current flow through a zener diode must be limited by a resistor or another device to prevent diode destruction. Like the forward voltage drop of a rectifier diode, the reverse voltage drop of the zener diode remains essentially constant, despite large current fluctuations. The zener diode is capable of being a constant voltage source because of the resistance changes that take place within the PN junction. A zener diode that is used as a voltage regulator (see illustration below *) is installed in series with a specified current-limiting resistor (R_S), and in parallel with a load (R_L). When the voltage across the zener diode increases, the resistance of the diode decreases. The reduced resistance causes the current to rise through the zener diode, increasing the voltage drop across R_S. The larger voltage drop across R_S lowers the output voltage and keeps the voltage across R_L constant. Decreasing voltage across the zener diode causes the current through it to decrease, and R_S drops less voltage. This in turn raises the output voltage to normal. Load changes also affect the zener diode as a regulator. As the load decreases or increases, the zener diode, acting as a shunt, will draw more or less current, respectively. The result of this change is a relatively constant output across the regulator.



* Source of illustration: http://hyperphysics.phy-astr.gsu.edu