

# DE ANZA COLEGE – PHYSICS 4B LAB – FALL 2024

## Lab 4 – Diodes

### TITLE

Diodes

### OBJECTIVE

1. Understanding the properties of diodes
2. Construct an experimental characteristic curve of  $I$  vs.  $V$  for two diodes and answer the following:
  - a. Find the threshold voltage in forward bias and reverse bias for a Ge and Si diode. The threshold voltage in reverse bias is called the breakdown voltage (Zener voltage for a Zener diode).
  - b. Determine which diode is Ge and which is Si. The threshold voltage for Ge is  $0.3V$  and for Si is  $0.7V$ .
  - c. Determine the resistance of the diode in forward and reverse bias.

### THEORY

Diodes can be classified as either **signal diodes** or **rectifier diodes**.

**Signal Diodes** – Used to process information (electrical signals) in circuits. Use very small currents.

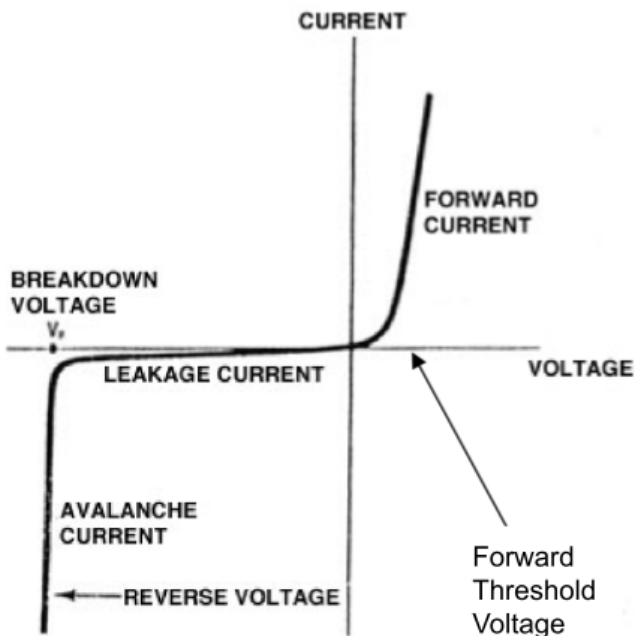
**Rectifier Diodes** – Used in power supplies to convert alternating current (AC) to direct current (DC).

Diodes allow current to flow in only one direction. The symbol for a diode is shown below:



The arrow indicates the direction in which the current can flow and in the real world diode, the line on the package corresponds to the line in the schematic. The end without the line is the positive end..

It takes a small amount of energy for the current (charges) to push their way through the diode. This requires a small forward threshold voltage drop. This voltage drop is dependent on the characteristics of the semi conductor used in the diode. The forward threshold voltage drop is  $0.3V$  for Ge and  $0.7V$  for Si. Once this threshold voltage is reached, the current increases very rapidly and the diode starts acting like a “conductor” with very low resistance as seen in the V-I diagram below:



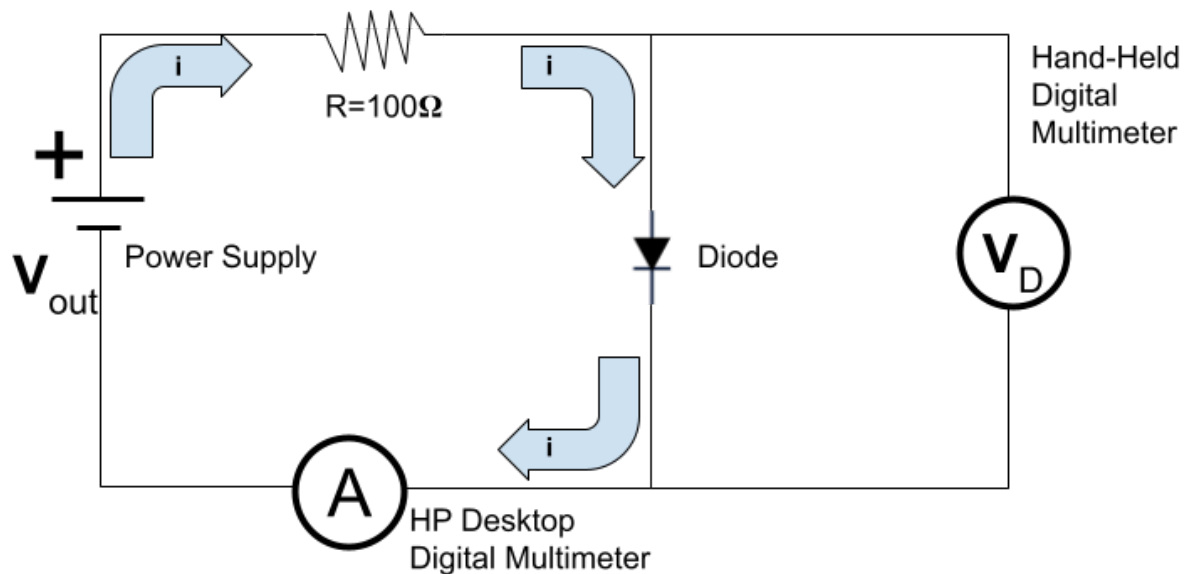
When a reverse voltage is applied a perfect diode does not conduct, but real diodes leak a very small amount of current of a few  $\mu A$  or less. This can be ignored in most circuits because it will be very small compared to the current flowing in the forward bias direction. However, all diodes have a maximum reverse voltage called the breakdown voltage and if it is exceeded the diode will fail and allow a large current to flow in the reverse bias.

## APPARATUS

1. Two diodes
2.  $300-600\Omega$  resistor
3. Circuit board
4. DC power supply
5. HP DMM (used as an ammeter)
6. Hand-held DMM (used as a voltmeter)

## PROCEDURE

1. Set up the following circuit



2. Adjust the voltage output  $\Delta V_{out}$  of power supply and collect data for 10 values of  $\Delta V_D$  and  $I$ .
  - a. Do it for the forward threshold voltage characteristics
  - b. Reverse the polarity of the diode on the circuit board and do the same for breakdown voltage characteristics. (The line of the diode should be on the positive connection)
3. Graph data using EXCEL to obtain the characteristic curve for each diode.
4. Determine which characteristic curve corresponds to Ge and Si.
5. Calculate the forward threshold voltage and the reverse threshold voltage (breakdown voltage) and compare with expected.
6. Obtain the equation of best curve-fit for forward-bias.
7. Using equation of best curve-fit calculate the resistance in forward bias for the points indicated by instructor.
8. In the conclusion explain the behavior of the characteristic curve for each diode.