Study of the characteristics of PN junction Diode

Experiment no.
Date:

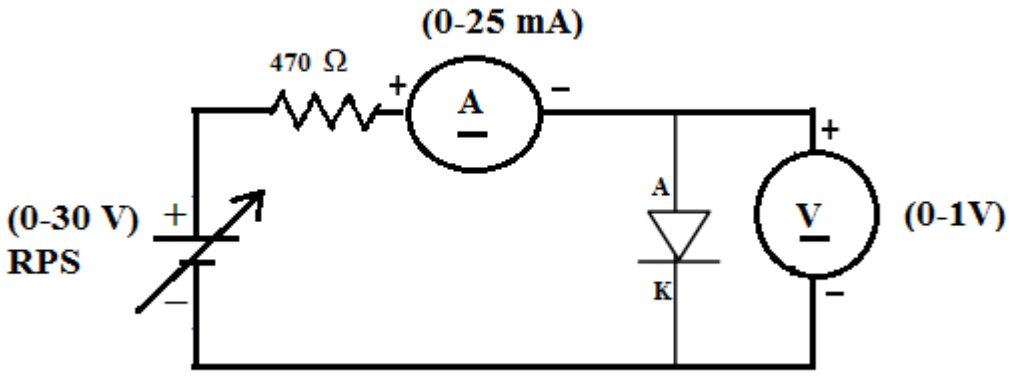
Aim: To study the VI characteristics of PN junction.

Apparatus Required:

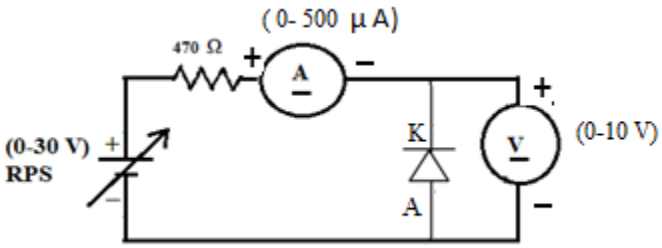
Sl. No.	Item	Range	Quantity
1.	PN junction diode	1N4002	1
2.			
3.	Resistor	470Ω	1
		1 kΩ	1
4.	Ammeter	25 mA	1
		500 μA	1
5.	Voltmeter	1 V	1
		10 V	1
6.	Breadboard	-	1
7.	Wires	-	As required
8.	Regulated power supply	0-30 V	1

Circuit Diagram:

Forward bias of PN junction diode



Reverse bias of PN junction diode



Theory:

PN junction diode

A p-n junction is a piece of semiconductor material in which part of the material is p-type and part is n-type. When a junction is formed between p-type and n-type semiconductor materials, the resulting device is called a semiconductor diode. This component offers an extremely low resistance to current flowing in one direction and an extremely high resistance to current flowing in the other. Various types of diodes are available for different applications. These include rectifier diodes for use in power supplies, Zener diodes for use as voltage reference sources, light emitting diodes etc. The connection to the p-type material is referred to as the anode while that to the n-type material is called the cathode.

Figure 1.Circuit symbol of PN junction diode

PN junction diode in forward bias

When an external voltage is applied to a p-n junction making the p-type material positive with respect to the n-type material, the p-n junction is forward biased. The applied voltage opposes the contact potential, and, in effect, closes the depletion layer. Holes and electrons can now cross the junction and current flows. An increase in the applied voltage above that required to narrow the depletion layer (about 0.3 V for germanium and 0.7 V for silicon), results in a rapid rise in the current flow. The voltage at which the diode starts conducting is called knee voltage

or threshold voltage or barrier cut in voltage. The applied voltage should not be increased beyond certain safe limit; otherwise the diode is likely to burn out.

PN junction diode in reverse bias

When an external voltage is applied to a p-n junction making the p-type material negative with respect to n type material, the p-n junction is reverse biased. The applied voltage is now in the same sense as the contact potential and opposes the movement of holes and electrons due to opening up of the depletion layer. Thus, in theory, no current flows. However, at normal room temperature certain electrons in the covalent bond lattice acquire sufficient energy from the heat available to leave the lattice, generating mobile electrons and holes. This process is called electron-hole generation by thermal excitation. The electrons in the p-type material and holes in the n-type material caused by thermal excitation are called minority carriers and these will be attracted by the applied voltage. Thus, in practice, a small current of a few microamperes for germanium and less than one microampere for silicon, at normal room temperature, flows under reverse bias conditions.

Procedure:

1. V-I characteristics of PN junction

Forward characteristics:

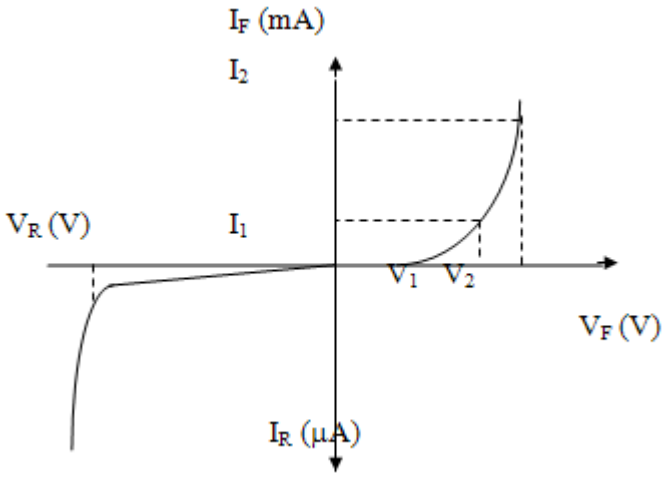
1. Construct the circuit as per the circuit diagram.
2. Vary the voltage in steps by using the regulated power supply and note down the current in each step correspondingly.
3. Plot the characteristics between forward voltage and forward current showing the turn-on voltage (cut in voltage / knee voltage) explicitly.

Reverse characteristics:

1. Construct the circuit as shown in the circuit diagram.
2. Vary the voltage in steps by using the regulated power supply and note down the current in each step correspondingly.
3. Plot the characteristics between reverse voltage and reverse current showing breakdown voltage explicitly.

Model Graph

VI characteristics of PN junction diode



Observation:

Tabular column: PN Junction Diode

Forward bias

Sl. No.	Voltage, V_F (V)	Current, I_F (mA)

Reverse bias

Sl. No.	Voltage, V_R (V)	Current, I_R (μA)

Result

Thus, the VI characteristics of PN junction diode and Zener diode were studied.