LaB-4

Zener diode Characteristics

Aim: To plot the V-I characteristics of the given zener diode both for forward and reverse bias conditions.

Apparatus

1. Power supply	0-30V	-1
2. Ammeters	0-10mA	-1
	0-50mA	-1
3. Voltmeters	0-10V, 0-10V	-1

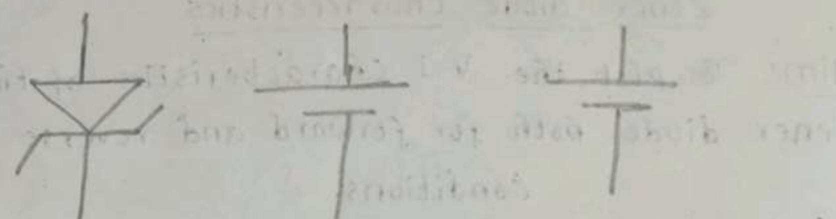
Components

1. Zener diode	6.1V / 5.1V	-1
2. Resistor	1kΩ	-1

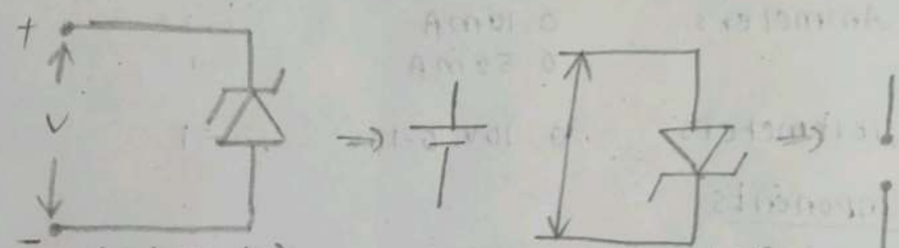
Theory

Diodes which have adequete power-dissipating capabilities to operate in the breakdown region are commonly called zener diodes. These devices are employed as voltage regulations. The location of the zener diode can be controlled by varying the doping levels. An increase in the doping produces an increase in the number added impurities. Further this will decrease the zener potential. zener diodes are they available in the zener potential range of 1.8V to 200V with power rating from 1/4 to 50W. Silicon usually preferred in the manufacturing of zener diodes because of its higher temparature and current handling capabilities.

To process which produce the breakdown region are avalanche multiplication and zener breakdown which are explained below.



Zener diode | Equivalent circuit | Approximated



(ON state) | (OFF state)

Forward Bias		
S.No	V (volts)	I (mA)

Reverse Bias		
S.No	V (volts)	I (mA)

Avalanche breakdown

The thermally generated electrons and holes acquire sufficient form the applied potential to produce new carriers by removing the valence electrons from their bonds. These new carriers in turn produce additional carriers again through the process of the disrupting bonds. This cumulative process is referred as avalanche breakdown. Avalanche multiplication involves when the reference voltage is above '6v'. The temparature coefficient is positive (% change in reference voltage per centegrade degree change in diode temparature.

A junction with broad depletion layer, and therefore low field intensity will breakdown by the avalanche mechanism. The networks employing zener diodes can be analyzed by replacing the zener diode with equivalent circuits (on & off states).

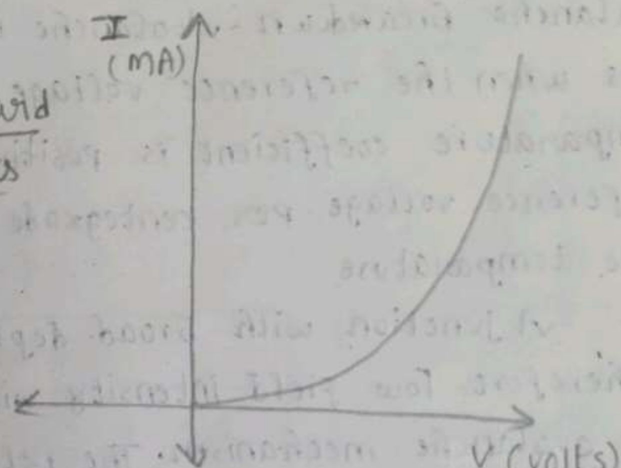
Procedure

Forward bias

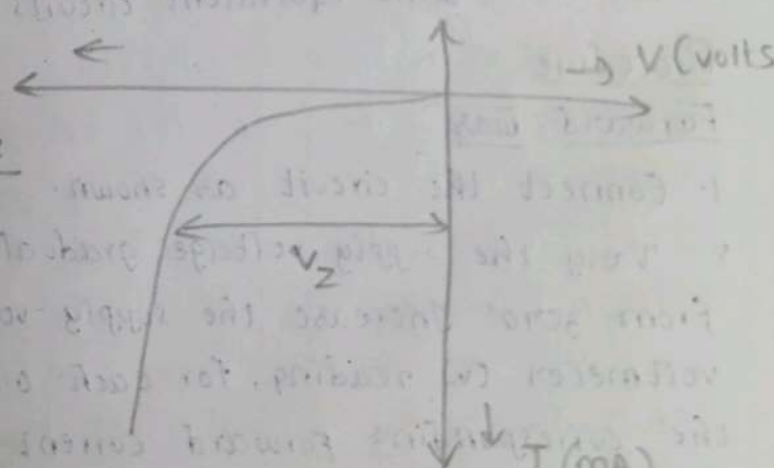
1. Connect the circuit as shown.
2. Vary the supply voltage gradually, starting from 'zero' Increase the supply voltage & note the voltmeter (v) reading, for each 0.1v step in v. note the corresponding forward current (I) till 'v' becomes 0.8v. I should not exceed 10mA.
3. Tabulate the results and draw the v-I characteristics under forward bias condition.

Model graphs

Forward Bias



Reverse Bias



Reverse Bias

1. Connect the circuit as shown.
2. Increase the supply voltage suitably, to read I_z in steps of 5mA, starting from zero upto say 40mA. note the corresponding values of V_z.
3. Tabulate the results and draw the VI characteristics under reverse bias condition.

Discussions

1. The basic principle of zener diode is the zener breakdown.
2. When a heavily doped diode, its depletion layer will narrow. When a high reverse voltage is applied accross the junction, a strong electric field is created. This produces electron hole pairs and heavy current flows. this is zener breakdown.

iii) The application of zener diode is the voltage regulator.

iv) Zener diode behaves as dc battery in ON state.

v) The voltage accross the diode remains constant until the voltage accross it drops less than V_z. This property makes it use as voltage regulator.

v) The value of the resistance is the inverse of the slope of the V-I charisteristics of zener diode.

vi) For currents greater than the knee current, the V-I curve is almost a straight line parallel to the X-axis.

(volts

Precautions

i) Excessive flow of current may damage the diode.

ii) Current for sufficiently long time may change the diode characteristics.

iii) Ensure that there are no loose connections in circuit.

Result