



American International University- Bangladesh

Department of Electrical and Electronic Engineering

EEE2104: Electronic Devices Laboratory

Title: Study of Zener Diode

Abstract:

A **Zener diode** is a diode which allows current to flow in the forward direction in the same manner as an ideal diode, but also permits it to flow in the reverse direction when the voltage is above a certain value known as the “breakdown voltage”, “zener knee voltage”, “zener voltage”, “avalanche point”, or “peak inverse voltage”.

Introduction:

The main objective of this experiment is to-

1. Study the voltage-current characteristics of Zener diode and
2. Observe the voltage regulation characteristics of a Zener Diode.

Theory and Methodology:

The basic function of **Zener diode** is to maintain a specific voltage across its terminals within given limits of line or load change. Typically it is used for providing a stable reference voltage for use in power supplies and other equipment.

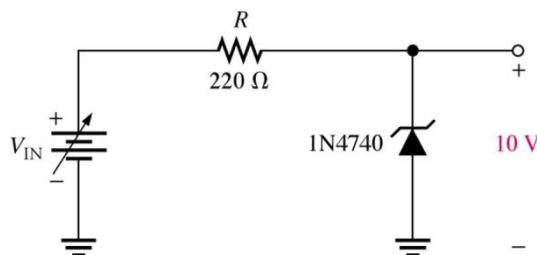


Figure 1: This particular Zener circuit will work to maintain 10 V across the load.

A **Zener diode** is much like a normal diode, the exception being is that it is placed in the circuit in reverse bias and operates in reverse breakdown. This typical characteristic curve illustrates the operating range for a Zener. Note that its forward characteristics are just like a normal diode.

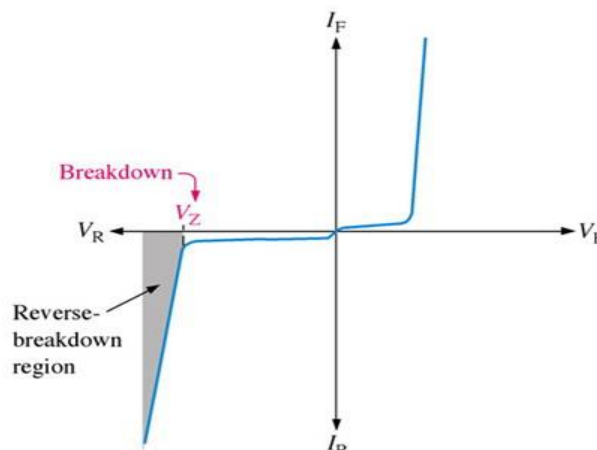


Figure 2: The normal operating region for a Zener diode is shaded

The doping process determines the Zener diode's breakdown characteristics. Low voltage Zeners less than 5V operate in the Zener breakdown range. Those designed to operate more than 5 V operate mostly in avalanche breakdown range. Zeners are available with voltage breakdowns of 1.8 V to 200 V.

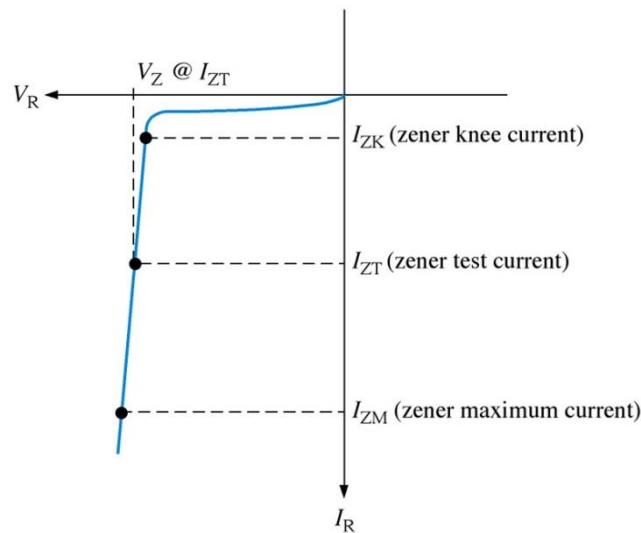


Figure 3: This curve illustrates the minimum and maximum ranges of current operation that the Zener can effectively maintain its voltage.

A voltage regulator is designed to keep the output voltage of a circuit at a constant value, independent of the input voltage and also independent of the load current. A Zener diode connected in parallel to the load is the simplest form of such a voltage regulator circuit shown in figure 1(right) in the Circuit Diagram part. If the voltage across the load tries to rise, then the Zener diode takes more current. The increase in current through the resistor causes an increase in voltage dropped across the resistor and the causes the voltage across the load to remain at its correct value. Similarly, if the voltage across the load tries to fall, then the Zener diode takes less current. The current through the resistor and the voltage across the resistor both fall down. The voltage across the load remains at its correct value.

Apparatus:

- | | | |
|--------------------|---|-----------------------|
| 1) ZenerDiode | : | [1 pc] |
| 2) Trainer Board | : | |
| 3) Resistors | : | 100 Ω [1 pc] |
| | | 220 Ω [1 pc] |
| | | 470 Ω [1 pc] |
| 4) Oscilloscope | | |
| 5) Multimeter | : | [1pc] |
| 6) Chord | : | [2pcs] |
| 7) POT | | 100k Ω [1pc] |
| 8) DC Power Supply | | |

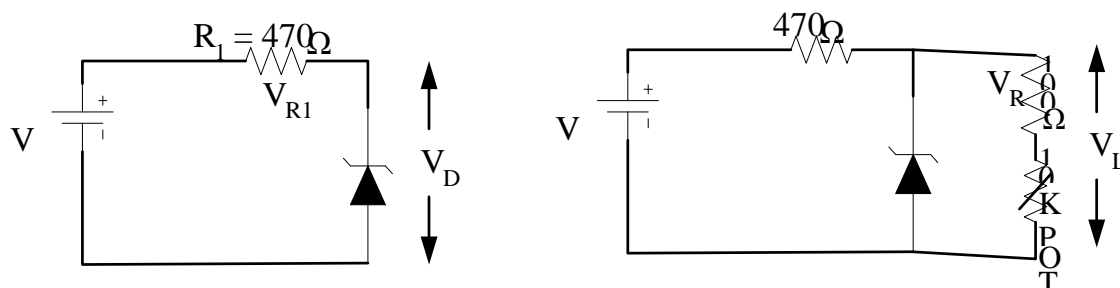
Circuit Diagram:

Figure 4: Zener Diode Circuits

Precautions:

The following is a list of some of the special safety precautions that should be taken into consideration when working with diodes:

1. Never remove or insert a diode into a circuit with voltage applied.
2. When testing a diode, ensure that the test voltage does not exceed the diode's maximum allowable voltage.
3. Ensure a replacement diode into a circuit is in the correct direction.

Pre-Lab Homework:

Implement the circuit (Figure 1) using Multisim. Measure the values of different parameters and fill up the tables (Table 1, Table 2 and Table 3) using the simulation tool.

Experimental Procedure:**Table – 1: Data Table for V – I characteristics using experimental values**

V (volt)	V_{R1} (volt)	V_Z (volt)	$I = (V_{R1}/R1)$ (A)

Table – 2: Data Table for Regulation due to load variation using experimental values

V_R (mV)	100	300	500	700
V_L (volts)				
$I_L = (V_R/R)$ (A)				

Table – 3: Table for regulation due to supply voltage variation using experimental values

V (volts)	16	12	9	6
V_R (volts)				
V_L (volts)				

1. Connect the circuit as shown in the left side of the diagram.
2. By varying the supply voltage take data necessary for completing table 1.
3. Connect the circuit as shown in the right side of the diagram.
4. Keep the POT at maximum resistance position and power up the circuit.
5. Gradually Decrease the POT resistance and complete table – 2.
6. Keeping the POT at lowest resistance position vary the supply voltage and take reading for table – 3.

Simulation and Measurement:

Compare the simulation results with your experimental data/ wave shapes and comment on the differences (if any).

Questions for report writing:

1. Plot the V – I characteristics of the Zener Diode. Determine the Zener Breakdown voltage from the plot.
2. Plot V_L vs I_L for the data of table – 2, find the voltage regulation.
3. Plot V_L vs V for the data of table – 3, find the voltage regulation
4. Discuss the experiment as a whole.

Discussion and Conclusion:

Interpret the data/findings and determine the extent to which the experiment was successful in complying with the goal that was initially set . Discuss any mistake you might have made while conducting the investigation and describe ways the study could have been improved.

References:

1. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, Saunders College Publishing, 3rd ed., ISBN: 0-03-051648-X, 1991.
1. David J. Comer, Donald T. Comer, Fundamentals of Electronic Circuit Design, John Wiley & Sons Canada, Ltd.; ISBN: 0471410160, 2002.