

CHARACTERISTICS OF SEMICONDUCTORS DIODES

D-1

OBJECT

To determine the forward and reverse characteristics of semiconductors diodes such as:

- (a) Germanium Diode,
- (b) Silicon Rectifiers,
- (c) Zener diode
- and (d) Light emitting diode.

DIODE CHARACTERISTICS SAMPLES

- 1. Si Diode 1N4007: One
- 2. Ge Diode 1N34: One
- 3. Zener Diode 5.1V: One
- 4. LED Diode LED 5mm: One

THEORY

The typical characteristics of a semiconductor diode are shown in Fig. 1. The mathematical expression showing this behavior (except in the breakdown region) is given by

$$I = I_0 (e^{\frac{qV}{kT}} - 1)$$

In the case of germanium-silicon diodes and light emitting diode the parameters of interest are cut-in voltage V_c , dynamic resistance r_d , and the saturation current I_0 . In a number of devices the reverse saturation current may be too small to be measured. Zener diodes on the other hand are operated in the reverse mode and the parameters of interest include the zener voltage V_z , and the zener resistance r_z . All the characteristics mentioned above may be obtained from the experimental unit which consists of

- (a) A variable voltage supply in the range 0-9V with a switch selectable current limiter at 20 mA/100mA.
- (b) A 3½ digit voltmeter with a basic sensitivity of 100 mV which is used to measure all voltages and currents.
- (c) A set of three precision resistances : 1 ohm, 100 ohm and 10K ohm. When used with the DVM, these enable current measurements with full scales of 100 mA, 2 mA and 20 μ A (10 nA minimum) respectively.

PACKING LIST

- 1. Study of Characteristics of Semiconductor Diodes, D-1: One
- 2. Lead : One
- 3. Samples
 - (i) Si Diode 1N4007: One
 - (ii) Ge Diode 1N34: One
 - (iii) Zener Diode (5.1V): One.
 - (iv) LED Red: One
- 4. Dust Cover: One

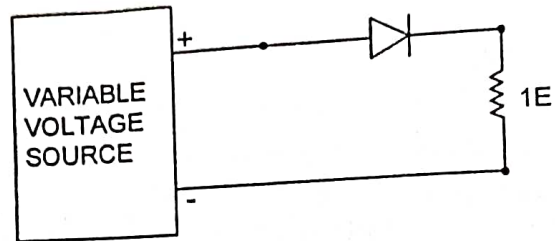


Fig.2 Forward characteristics

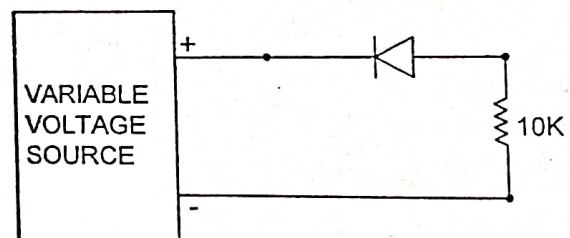


Fig.3 Reverse characteristics

PROCEDURE

I Forward Characteristics

- Set-up the circuit as in Fig. 2 (See layout diagram)
- Set the current limiter suitably, e.g. 100 mA for rectifiers and 20 mA for LED, zener diodes and small signal diodes.
- Vary the voltage in small steps and measure the current in terms of the voltage drop across the 1 ohm resistance. Note that while measuring voltage in position 'V', the DVM has a maximum range of 19.99 V (or 20V). During current measurements in position 'I', DVM is automatically set to 199.9 mV (or 200 mV), and displays the voltage drop across the connecting resistance in mV. The current in mA is obtained by dividing it by the value of resistance. Also, the actual voltage across the diode should be corrected for by taking into account the drop across the current measuring resistance, i.e. $V_D = V_M - V_R$ where V_D : Voltage across diode; V_M : Measured voltage; V_R : Voltage across current measuring resistance. Tabulate the readings.

NOTE : To obtain the initial position of the forward characteristics more accurately, the 100 ohm resistance may be used in place of 1 ohm resistance upto a current of approximately 2 mA.

- Sketch the V-I characteristics and extend the linear portion of the curve downward to obtain the cut-in voltage V_c . The slope of the linear portion gives the dynamic resistance r_d of the diode.

II. REVERSE CHARACTERISTICS

- Set-up the circuit as in Fig. 3.
- Set the current limit switch to 20 mA.
- Vary the voltage in steps of 1 volt and measure the current in terms of the voltage drop across the 10K resistance. Tabulate the readings.

NOTE: In a number of devices the reverse current may be too small to be read.

- In case of zener diode the reverse current would tend to rise steeply after the breakdown. To take subsequent readings replace the 10 K Ω resistance by 1 Ω and continue in small steps of voltage change.
- Plot the reverse characteristics and obtain from the graph the
 - Value of reverse saturation current I
 - Zener voltage V_z , in case of a zener diode.
 - Zener resistance r_z , in case of a zener diode.

PRECAUTIONS

- Set the current limit switch properly. An incorrect setting may damage the device under test.
- To sketch the characteristics accurately near the sharp bends (around the cut-in and breakdown points) a larger number of readings may be necessary. Choose suitable resistances, as suggested, for current measurements in these portions.

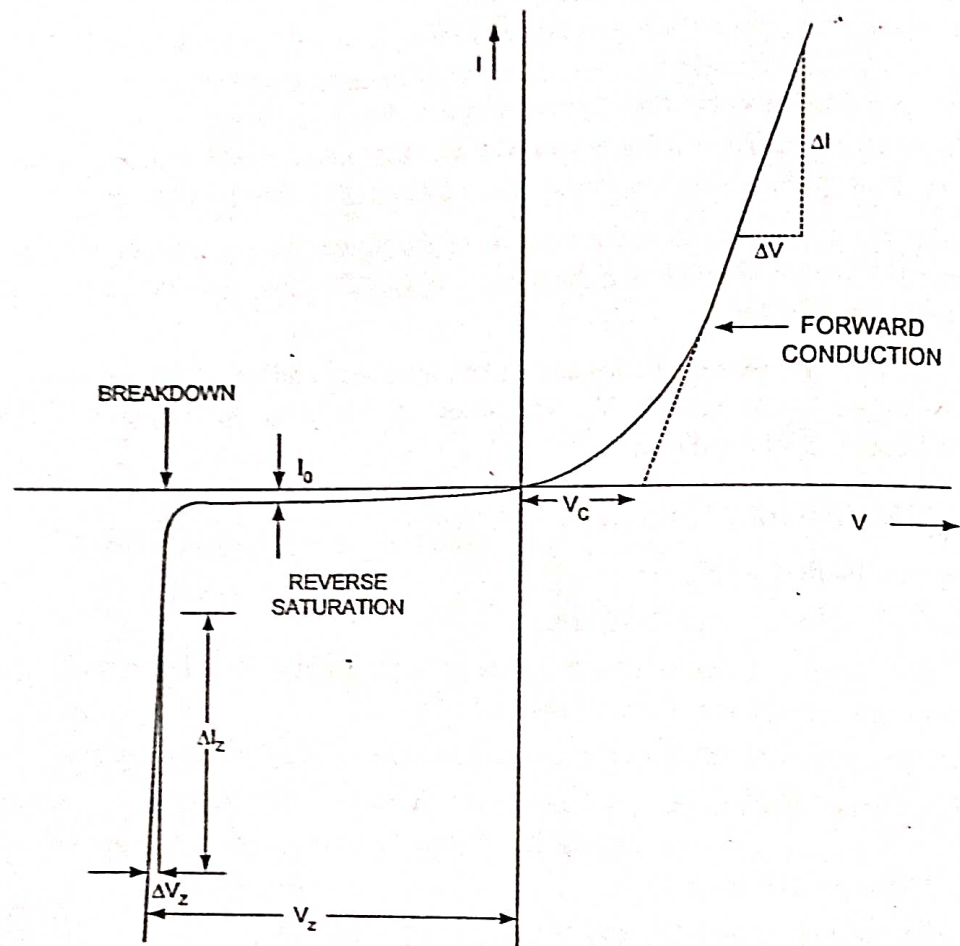


Fig.1 Typical diode characteristics

CHARACTERISTICS OF SEMICONDUCTOR DIODES, Model : D-1

