EXPERIMENT //1 Diode Characteristics

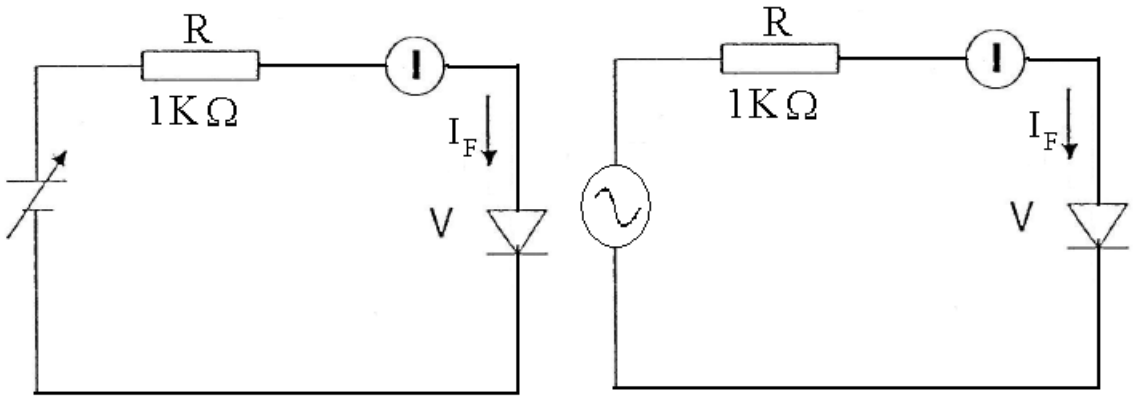
OBJECTIVE

To become familiar with the characteristic of a silicon and germanium diode,

MATERIAL REQUIRED

1. Dc . power supply.
2. A.c. power supply sinusoidal voltage V = 12 V, f = 50 Hz.
3. Multimeter
4. Resistor 1KΩ
5. Si . Diode (N4007) & Ge Diode (AA118).
6. Connecting leads.
7. Oscilloscop

Circuit diagram:



(a) (b)

PROCEDURE

Exercise 1

1- Connect the Circuit as shown in fig (a),with the diode forward biased.

2- Increase the voltage in 0.1 V steps to a maximum 1 V .

3- Measure the current and record the results in table.

4- Reverse the diode in the circuit. Measure the current as the voltage of the supply is varied in 5 volts steps.

5- Plot a graph between V and I, from the graph calculate V_T.

6- Replace the silicon diode with germanium diode and repeat all of the above steps.

7- Calculate the diode resistance:

a) Static resistance $R_{DC} = V_D / I_D\ \Omega$

b) The average $R_{av} = \Delta V_D / \Delta I_D$

Exercise 2

8- Connect the Circuit as shown in fig (b), with the silicon diode.

9- Measure the current and

c) Calculate the diode dynamic resistance using the formula: from (b) $r_d = 26mv / I_D$

Observation Table:

Forward bias			Reverse bias		
V(volt)	I(mA) Si	I(mA) Ge	V(volt)	I(μA) Si	I(μA) Ge
0			0		
0.1			-5		
0.2			-10		
0.3			-15		
0.4			-20		
0.5			-25		
0.6			-30		
0.7			-35		
0.8			-40		
0.9					
1					

Precautions:

- Read the ammeter at eye level.
- Make sure to change the range of ammeter and voltmeter while switching from forward bias to reverse bias connection.
- Check the circuit connections before starting.

Questions:

1) Compare the threshold voltage for germanium and silicon from the I -V data plot. Are these as expected? Why not?

2) Compare the two characteristics in the region $V_F > V_{th}$ and Comment.

3) Compare the I -V characteristics of a resistor to that of diode to explain the difference?

4) How Can you determine which lead of a diode is Anode or Cathode?

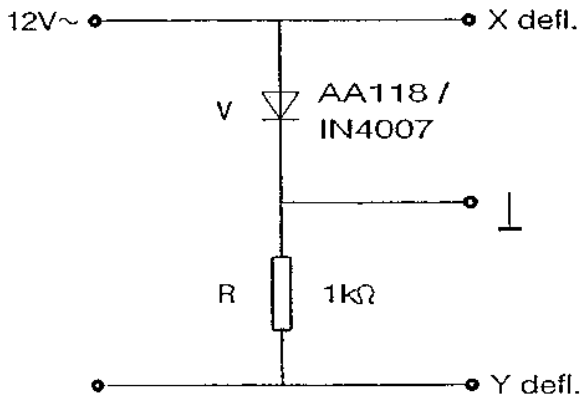
5) Draw an equivalent circuit for the diode?

6) How and when you can simplify the equivalent circuit?

7) How can you compute the ac. resistance of the diode in the linear portion of V-I characteristics?

Exercise 3

[Dynamic representation of the current-voltage characteristic $l_F = f(V_F)$ of a germanium and a silicon diode



1.1

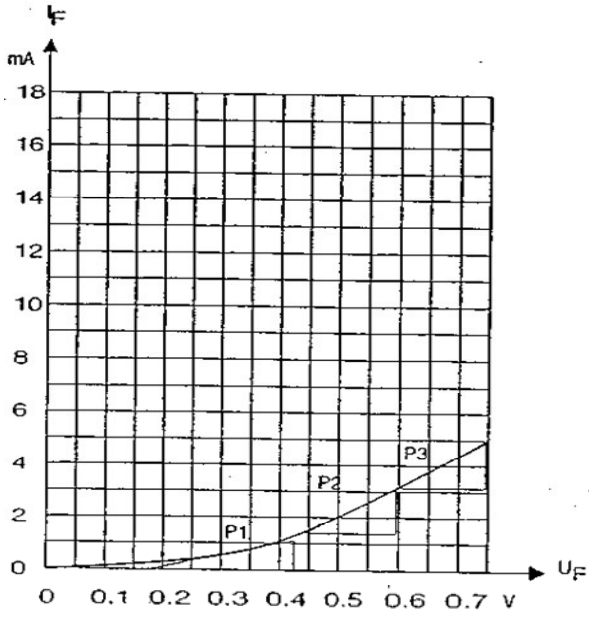
1. Assemble the circuit as shown in fig. 1.1 and apply an a.c. sinusoidal voltage V = 12 V, f = 50 Hz.
2. Settings on the oscilloscope
   a. X-deflection: 0.5 V/div (DC)
   b. Y-deflection: 5 V/div (DC) (inverted)
3. Use the oscilloscope to record the silicon and Germanium diode characteristics and compare these with the statically recorded characteristics.
4. Comment on your conclusions.

5. The average $R_{av} = \Delta V_D/\Delta I_D$

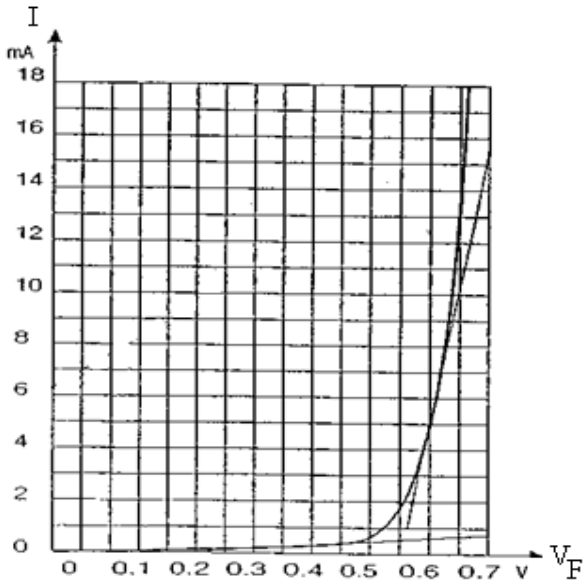
6. Dependence on the differential resistance of the diode used and the voltage V_F

7. Transfer the germanium diode characteristic into diagram fig. 1.2

   and that of the silicon diode into diagram fig. 1.3



1.2



1.3

The differential resistance is determined by using a tangent at the point (V_F ,I_F) as the hypotenuse for a right-angled triangle. The horizontal side of the triangle gives the voltage change ΔV_F and the vertical side gives the *current change* ΔI_F.
The differential resistance r_F is given by the equation.

$$r_F = \Delta V_F / \Delta I_F$$

Calculate the differential resistance

a. for the germanium diode in fig. at the points
   P_1 (0.3 V, f(0.3 V));
   P_2 (0.5 V, f(0.5 V));
   P_3 (0.65 V, f(0.65 V));

   $r_{F1} = 225\ \Omega$

   $r_{F2} = 100\ \Omega$

   $r_{F3} = 78\ \Omega$

b. for the silicon diode in fig. at the points
   P1 (0.5 V, f(0.5 V));
   P_2 (0.65 V, f(0.65 V));

   $r_{F1} = 500\ \Omega$

   $r_{F2} = 12\ \Omega$

Compare the differential resistance of the two characteristics and comment on your conclusions.