

EXPERIMENT //1

Diode Characteristics

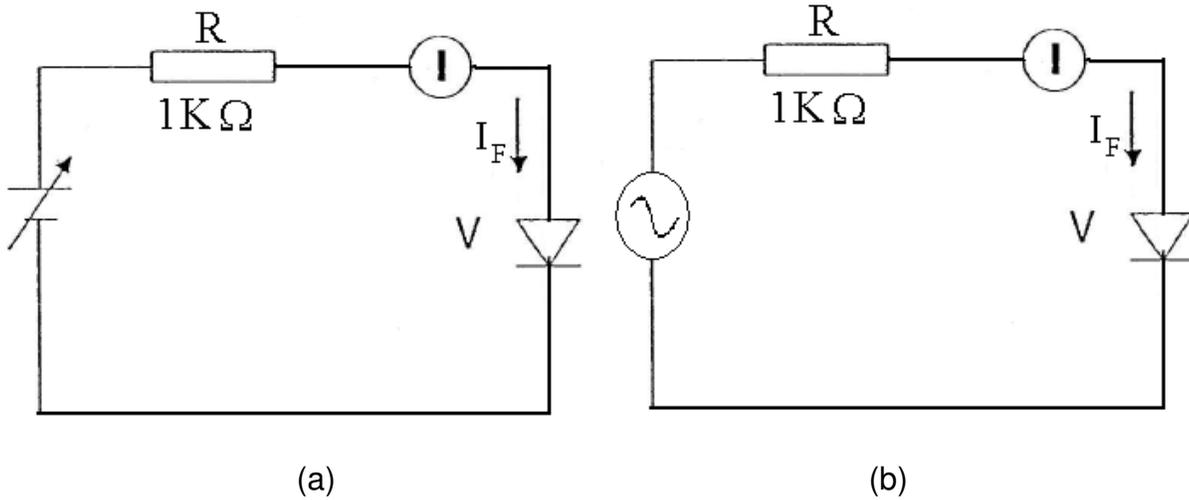
OBJECTIVE

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

REQUIRED

- 1 – Dc POWER SUPPLY.
- 2 - Multimeter.
- 3 – Resistor $1K\Omega$
- 4 – Si Diode (N4007) & Ge Diode (AA118).
- 5 – Connecting Leads.

Circuit diagram:



PROCEDURE

- 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 . Measure the current and record the results in table.
- 3- Reverse the diode in the circuit. Measure the current as the voltage of the supply is varied in 5 volts steps.
- 4- Plot a graph between V and I, from the graph calculate V_T .
- 5- Replace the silicon diode with germanium diode and repeat all of the above steps.
- 6- Connect the Circuit as shown in fig (b), with the silicon diode.
- 7- Calculate the diode resistance:
 - a) Static resistance $R_{DC} = V_D / I_D \Omega$
 - b) Dynamic resistance using the formula: from (b) $r_d = 26\text{mv} / I_D$
 - c) The average $R_{av} = \Delta V_D / \Delta I_D$
- 8- Comment on the results you obtained.

Observation Table:

Forward bias			Reverse bias		
V(volt)	I(mA) Si	I(mA) Ge	V(volt)	I(μ A) Si	I(μ A) 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:

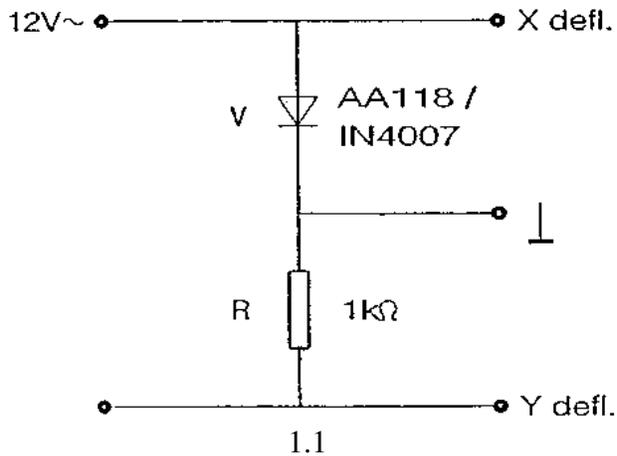
- Read the ammeter at eye level.
- Make sure to change the range of ammeter and voltmeter while switching from forward bias to reverse bias connection.
- Check the circuit connections before starting.

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 1

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



Assemble the circuit as shown in fig. 1.1 and apply an a.c. sinusoidal voltage $V = 12 \text{ V}$, $f = 50 \text{ Hz}$.

Settings on the oscilloscope

X-deflection: 0.5 V/div (DC)

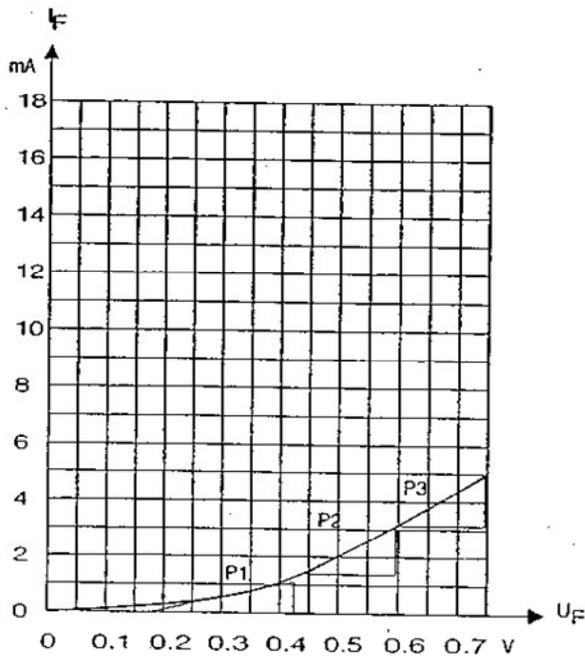
Y-deflection: $5 \text{ V/div (DC) (inverted)}$

Use the oscilloscope to record the silicon and Germanium diode characteristics and compare these with the statically recorded characteristics. Comment on your conclusions.

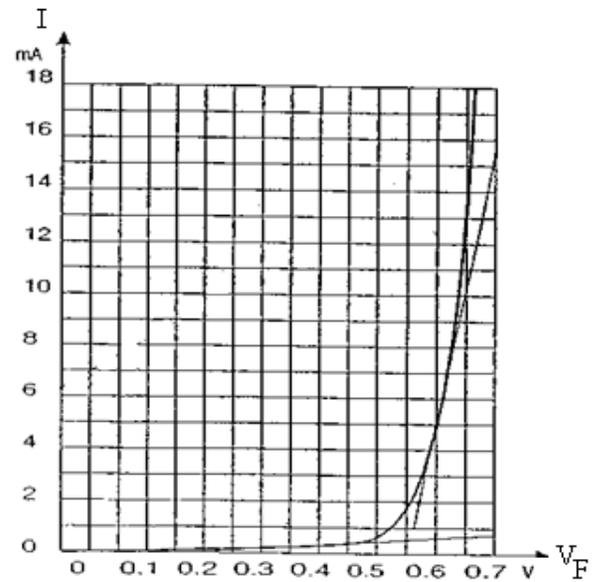
The dynamically recorded characteristics are in exact agreement with those recorded statically.

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

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

P₁ (0.3 V, f(0.3 V));

P₂ (0.5 V, f(0.5 V));

P₃ (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));

P2 (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**. The differential resistance of the silicon diode is much smaller than that of the germanium diode in the breakdown region.