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Experiments of analog electronics laboratory

Lab(1)

Characteristic of a silicon diode

1. **Aim of the experiment :**

Displaying the characteristic of a silicon diode and studying the relationship between the current and voltage in the biasing state (forward and reverse).

2. Theory:

A diode is the simplest sort of semiconductor device. Broadly speaking, a semiconductor is a material with a varying ability to conduct electrical current. Most semiconductors are made of a poor conductor that has had impurities (atoms of another material) added to it. The process of adding impurities is called doping. Semiconductor diode theory is at the very center of much of today's electronics industry. In fact semiconductor technology is present in almost every area of modern day technology and as such semiconductor theory is a very important element of electronics. One of the fundamental structures within semiconductor technology is the PN junction. It is the fundamental building block of semiconductor diodes and transistors and a number of other electronic components. The semiconductor diode has the valuable property that electrons only flow in one direction across it and as a result it acts as a rectifier. As it has two electrodes it receives its name - diode. In view of this, it is one of the most fundamental structures in semiconductor technology. Vast numbers of diodes are manufactured each year, and of course the semiconductor diode is the basis of many other devices apart from diodes. The bipolar junction transistor, junction FET and many more all rely on the PN junction for their operation. This makes the semiconductor PN junction diode one of the key enablers in today's electronics technology.

PN junction characteristics

The PN junction is not an ideal rectifier diode having infinite resistance in the reverse direction and no resistance in the forward direction.
Referring to figure (1) , in the forward direction (forward biased) it can be seen that very little current flows until a certain voltage has been reached. This represents the work that is required to enable the charge carriers to cross the depletion layer. This voltage varies from one type of semiconductor to another. For germanium it is around 0.2 or 0.3 volts and for silicon it is about 0.6-0.7 volts. In fact it is possible to measure a voltage of about 0.6-0.7 volts across most small current diodes when they are forward biased. Power rectifier diodes normally have a larger voltage across them but this is partly due to the fact that there is some resistance in the silicon, and partly due to the fact that higher currents are flowing and they are operating further up the curve.
From the diagram it can be seen that a small amount of current flows in the reverse direction (reverse biased). It has been exaggerated to show it on the diagram, and in normal circumstances it is very much smaller than the forward current. Typically it may be a pico amps or micro amps at the most. However it is worse at higher temperatures and it is also found that germanium is not as good as silicon.
This reverse current results from what are called minority carriers. These are a very small number of electrons found in a P type region or holes in an N type region. Early semiconductors Power has relatively high levels of minority carriers, but now that the manufacture of semiconductor materials is very much better the number of minority carriers is much reduced as are the levels of reverse currents.

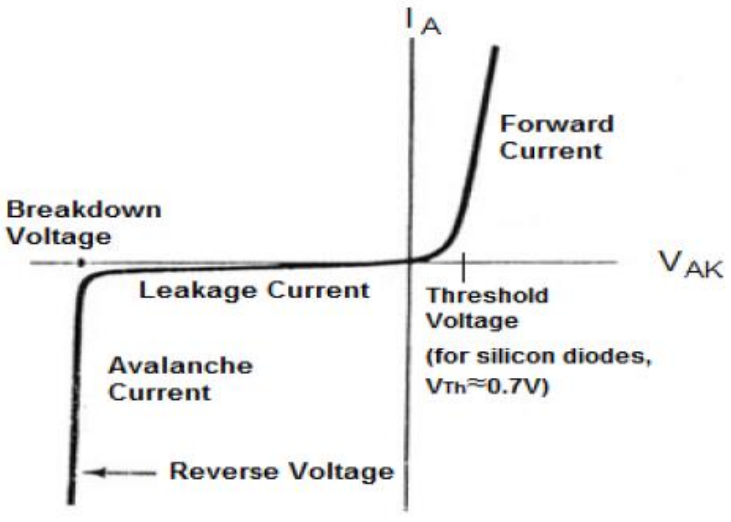
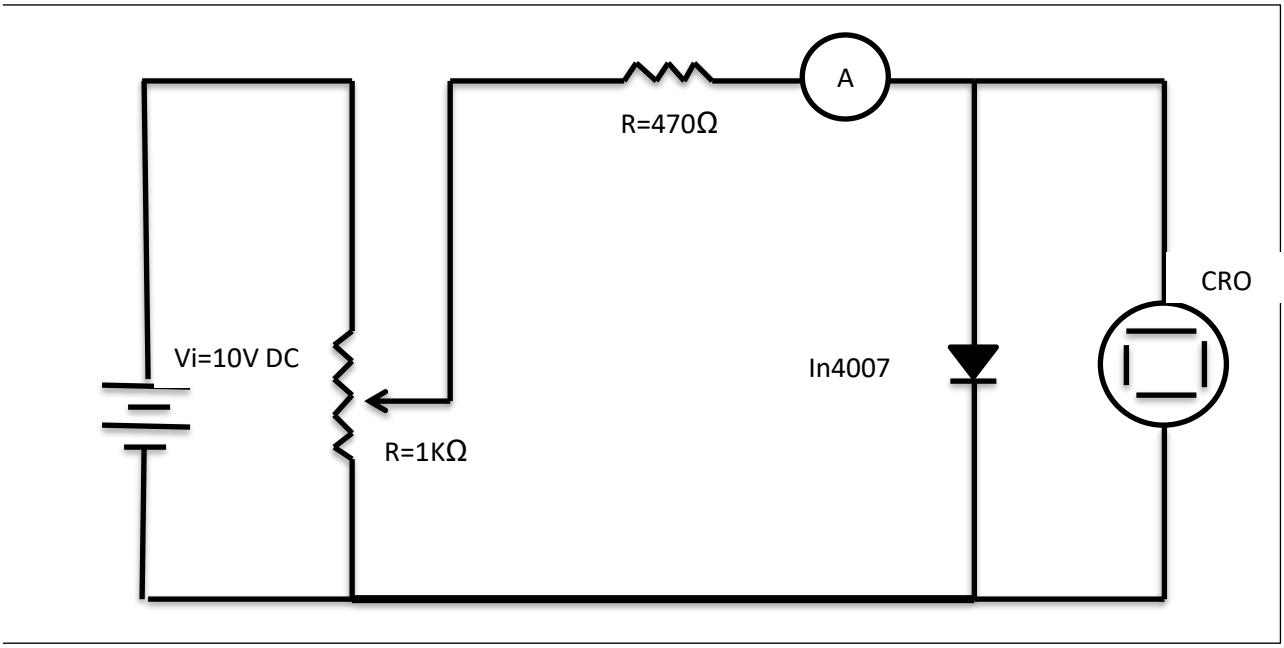


Figure (1)The characteristic of a diode.

3. practical part:

a. Assemble the circuit as follow:



b. Set the voltage on the power supply unit to 0 volt.

c. Switch on and slowly increase the voltage using variable resistance(1kΩ) and record the current values as follow:

V(volt)	0	0.1	0.2	0.4	0.5	0.55	0.6	0.65	0.7
I(mAmp)									

d. Reverse the diode or the power supply voltage and record the current as the table below:

V(volt)	0	1	2	3	4	5	6	7	8
I(mAmp)									

e. Draw the relationship between current and voltage in the state (forward and reverse) biasing.

4. Discuss the difference in the current in the state of forward and reverse biasing.