

Investigation of semiconductor diodes

Task 1. Studying volt-ampere characteristics of diodes using voltmeter and ammeter.

Commutation schemes can be modified by setting or removing jumpers on the pins labelled JP1–JP7. The jumper (a piece of conductor in plastic insulation) closes up a circuit when it is placed on the pins.

During the assembly, do not place the jumpers on the contacts JP4 and JP5 at the same time!

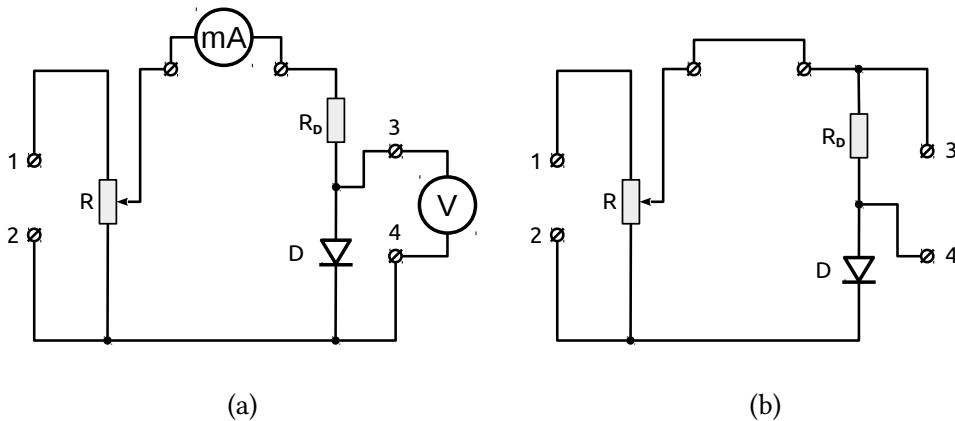


Figure 1: Connection schemes.

1. Assemble the electric circuit according to the scheme in Fig. 1a, where D stands for one of the following diodes: D1 – light-emitting diode, D2 – silicon diode, and D3 – Schottky diode. Turn on the DC power supply. If the power supply is regulated, set the output voltage to 5 V (**but no more!!**). Connect the + output of the power supply to the contact 1 of the circuit, – to the contact 2 (this corresponds to the direct current flow through the diode).
2. Set the resistance R to the maximum and measure the current I_{max} . While changing the resistance R, measure currents and corresponding voltages in the current range from 0.5 mA to I_{max} . Current changing step should be about $I_{max}/6$.
3. Repeat stage 2 for other diodes.

4. Change the polarity of the voltage applied to contacts 1 and 2 (reverse current flow through the diode). Measure voltage and current while changing the voltage in steps of 0.5 V from 0 to the maximal value. Every time when measuring the current, disconnect the voltmeter after the needed voltage has been achieved.
5. Repeat stage 4 for other diodes.
6. Build the plots $I = f(U)$ based on obtained data for the three diodes on the same diagram. It is recommended to choose milliamperes (mA) as the units for the direct current, and microamperes (μA) as the units for the reverse current

Taks 2. Observation of rectified alternating current.

1. Assemble the electric circuit according to the scheme in Fig. 1b. Connect the harmonic oscillations source to the contact 1, 2, and the oscilloscope to the contacts 3, 4.
2. Observe and make a schematic drawing of the rectified signal when diodes D2 and D3 are connected to the circuit. Measure the amplitudes of the rectified signals for both diodes. Explain the difference.

Questions.

1. Energy-band theory of solids.
2. Intrinsic conductivity of semiconductors. Impurity conductivity of semiconductors. Donor and acceptor levels.
3. Junction of two semiconductors with different conductivity types.
4. Volt-ampere characteristics of a semiconductor diode.
5. Breakdown of a p-n junction. Loss of rectifying capability of a p-n junction at high temperatures.
6. Operation principles of electrical circuits used for (a) obtaining volt-ampere characteristics of diodes and (b) observing the volt-ampere characteristics on an oscilloscope.