The diode as electrical valve (Item No.: P1382300)

Curricular Relevance

Area of Expertise: Physics
Education Level: Age 14-16
Topic: Electricity
Subtopic: Properties of electrical components
Experiment: The diode as electrical valve

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	10 Minutes	2 Students

Additional Requirements:

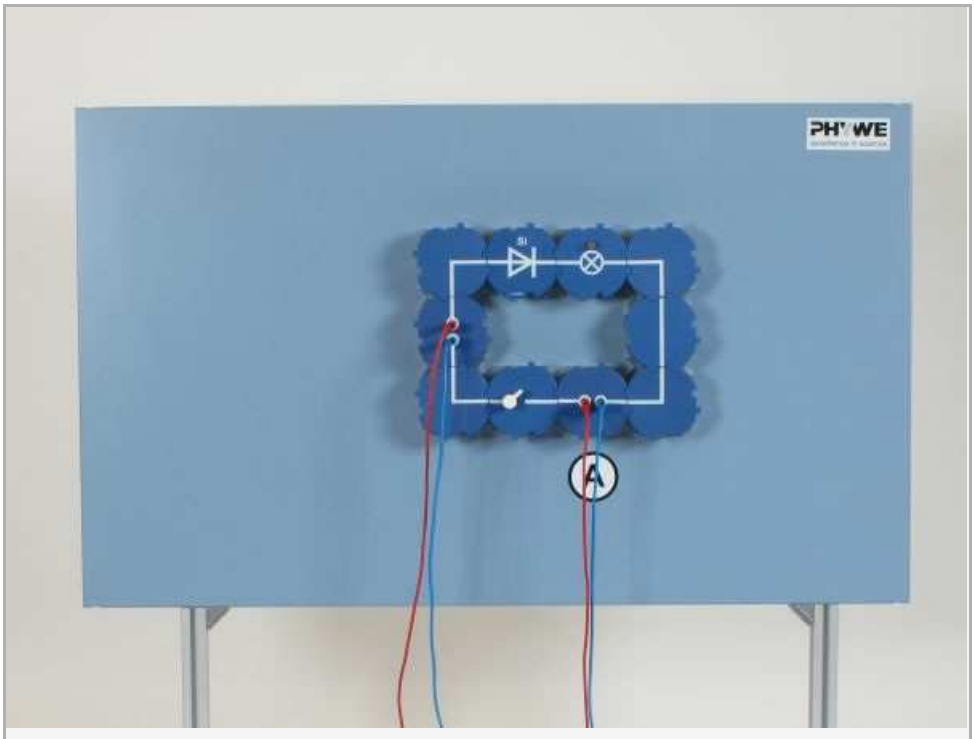
Experiment Variations:

Keywords:

Principle and equipment

Principle

It is to be demonstrated that a semiconductor diode only conducts electricity in one direction.



Experimental set-up

Equipment

Position No.	Material	Order No.	Quantity
1	Multimeter ADM2, demo., analogue	13820-01	1
2	PHYWE power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13500-93	1
3	Demo Physics board with stand	02150-00	1
4	Switch on/off, module DB	09402-01	1
5	Socket for incandescent lamp E10 ,module DB	09404-00	1
6	Connector interrupted, module DB	09401-04	2
7	Silicon diode 1N4007,module DB	09451-00	1
8	Electr.symbols f.demo-board,12pcs	02154-03	1
9	Connector, straight, module DB	09401-01	1
10	Connector, angled, module DB	09401-02	4
11	Filament lamps 12V/0.1A, E10, 10 pieces	07505-03	1
12	Connecting cord, 32 A, 1000 mm, red	07363-01	2
13	Connecting cord, 32 A, 1000 mm, blue	07363-04	2

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Set-up and procedure

- Connect up the circuit as shown in Fig. 1, with the switch open, and the diode poled for flow of current.
- Select the 100 mA- measurement range.
- Adjust to 12 V direct voltage, close the switch and observe the filament lamp and the ammeter.
- Open the switch.
- Turn the silicon diode module through 180°, or reverse the cable connections to the current source and to the ammeter.
- Close the switch and observe the filament lamp and the ammeter.

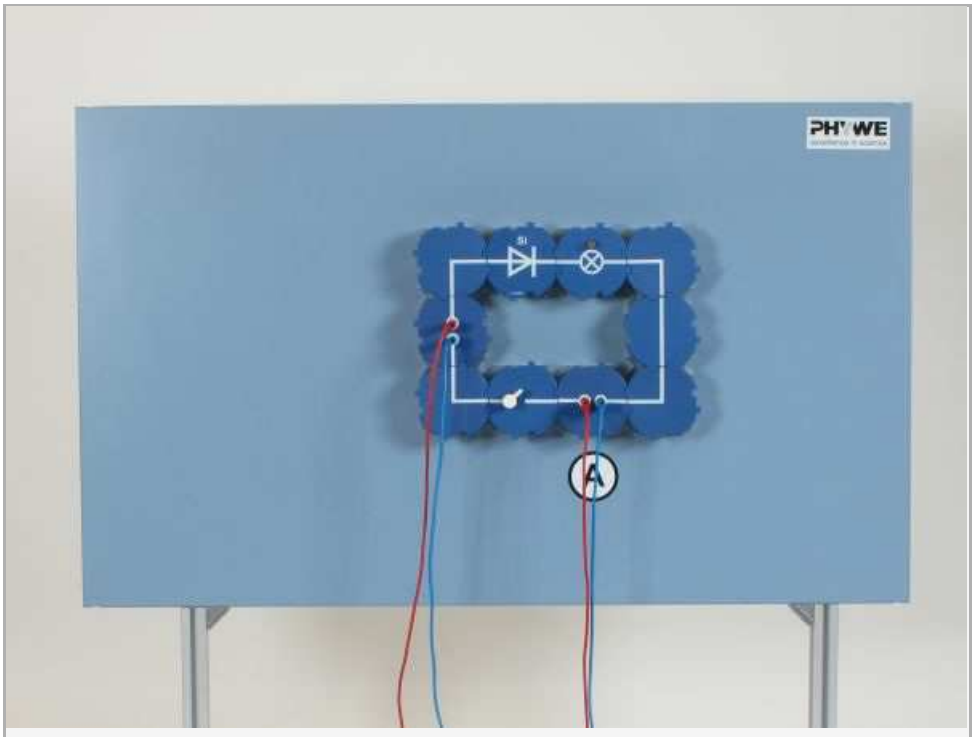

Fig. 1

Observation and evaluation

Observation

The semiconductor diode only conducts the current when the arrow on the diode symbol that is printed on it points towards the negative terminal, i.e. points in the (conventional or technical) direction of the current. The lamp then lights up and the ammeter indicates a current of approx. 100 mA. When the diode is subjected to pole reversal, then no current flows and the lamp does not light up.

Evaluation

A diode consists of a silicon single crystal that has been doped partly with 3-valent and partly with 5-valent “impurity” atoms. The result is the availability, for carrying current, of free electrons in the 3-valent region (n-region) and mobile holes in the 5-valent region (p-region). Electrons and holes diffuse and recombine at the junction of the nconducting and p-conducting regions, so that a there is a depletion of mobile charge carriers here.When a voltage is applied to the diode, this will either draw the charge carriers more strongly away from the junction, then the diode allows no current to flow, or, with the opposite polarity to the current source, charge carriers will be drawn into the junction and the diode has the correct polarity for current to pass.

The current which flows in the “blocked” direction, the reverse current, is so small with silicon diodes that it cannot be detected by common demonstration meters.

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