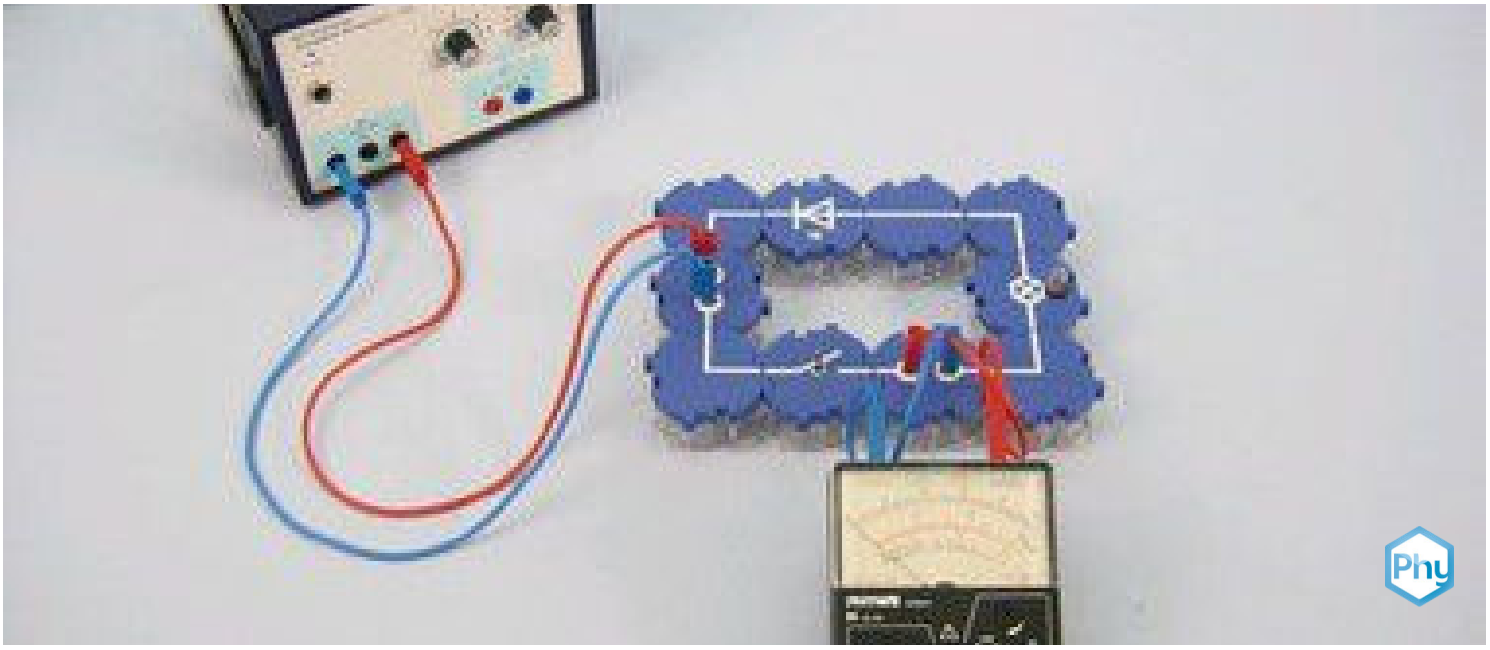
# The diode as rectifier



| | | |
|---|---|---|
| Physics | Electricity & Magnetism | Simple circuits, resistors & capacitors |
| Physics | Electricity & Magnetism | Electronics |
| Physics | Modern Physics | Solid state physics |

| Difficulty level | Group size | Preparation time | Execution time |
|---|---|---|---|
| medium | 2 | 10 minutes | 10 minutes |

This content can also be found online at:

http://localhost:1337/c/618d1f17f20c940003879f69

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# Teacher information

## Application

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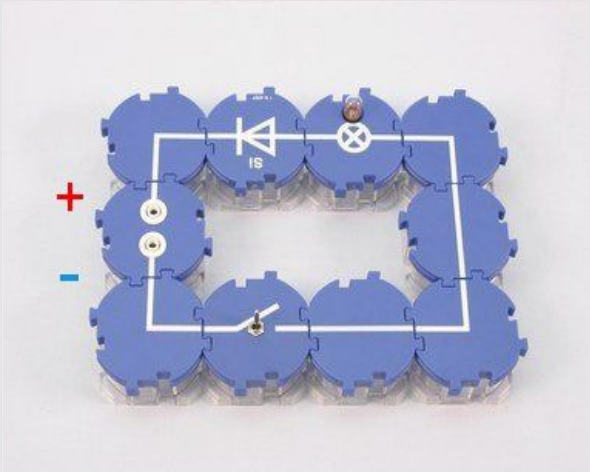


Test setup

Diodes are used everywhere nowadays.

Most obviously as a light source in the form of light-emitting diodes. One of the special features of a diode is that it can be used to block current in a particular direction or, for example, to limit voltages so that a component cannot be destroyed by overvoltage. Diodes are also used to convert alternating voltage into direct voltage. This is referred to as rectification.

In this experiment, students will learn about the property of rectification.



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## Other teacher information (1/3)

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**Previous**

The students should be able to construct a simple electric circuit. They should also understand what voltage and current are and explicitly what alternating current is.

In addition, students should be familiar with the principle of the diode (especially the Vertil effect) and should have understood the terms forward direction and reverse direction.

**Learning**

Students should identify the rectifying effect of a diode.

## Other teacher information (2/3)

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**Task**

Investigate the effect of a diode in an alternating current circuit.

For this purpose, the behaviour of the current intensity at DC voltage with and without diode in forward direction is to be measured first. This is then repeated for AC voltage.

**Principle**

The term diode is commonly used for semiconductor diodes (usually silicon diodes) that operate primarily with a p-n junction. The doped atoms, are stationary and form a space charge as ions, whose electrostatic field keeps the two types of charge away from each other and thus prevents recombination. The diffusion voltage is generated across the entire space charge zone. This can be compensated by an externally applied voltage - depending on the polarity - in which case the p-n junction becomes conductive, or amplified, in which case it remains blocked.



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# Other teacher information (3/3)

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## Notes

The experiment is designed in such a way that, in addition to the rectifying effect of the diode, the students also realise that the diode has a resistance - albeit a relatively small one - in the forward direction and that, before using the multimeter, one must choose its measuring range with care and also pay attention to the type of current so as not to destroy it.

Regarding 2. of the evaluation it has to be added that the ammeter cannot follow the fast oscillations of the alternating current due to its inertia and therefore does not indicate any current in the direct current measuring range. For many technical applications a largely smoothed direct current is required. Smoothing of the pulsating DC current generated by the diode can be achieved by means of capacitors.

# Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.



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# Student Information

## Motivation

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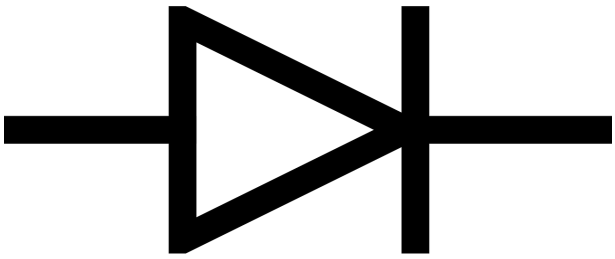

diode

Semiconductor diodes are used in many ways in today's technology due to their useful properties. Examples are solar cells or LEDs.

You should already know how a diode behaves at DC voltage; that they have a forward and a reverse direction. In the illustration of the switching symbol, the left connection wire is for the anode and the right for the cathode in the forward direction.

In this experiment, you'll learn about the benefits of this property and how a diode behaves under AC voltage.



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# Equipment

| Position | Material | Item No. | Quantity |
|---|---|---|---|
| 1 | Straight connector module, SB | 05601-01 | 2 |
| 2 | Angled connector module, SB | 05601-02 | 4 |
| 3 | Interrupted connector module with sockets, SB | 05601-04 | 2 |
| 4 | On-off switch module, SB | 05602-01 | 1 |
| 5 | Socket module for incandescent lamp E10, SB | 05604-00 | 1 |
| 6 | Silicon-diode module 1N4007, SB | 05651-00 | 1 |
| 7 | Connecting cord, 32 A, 250 mm, red | 07360-01 | 1 |
| 8 | Connecting cord, 32 A, 250 mm, blue | 07360-04 | 1 |
| 9 | Connecting cord, 32 A, 500 mm, red | 07361-01 | 1 |
| 10 | Connecting cord, 32 A, 500 mm, blue | 07361-04 | 1 |
| 11 | Filament lamps 12V/0.1A, E10, 10 pieces | 07505-03 | 1 |
| 12 | Analog multimeter, 600V AC/DC, 10A AC/DC, 2 MΩ, overload protection | 07021-11 | 1 |
| 13 | PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A | 13506-93 | 1 |



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## Set-up

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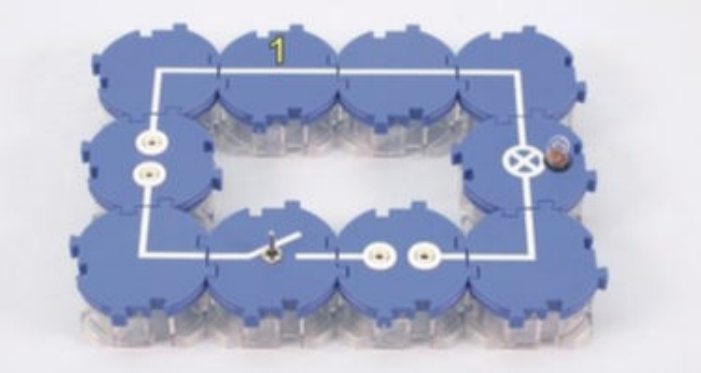
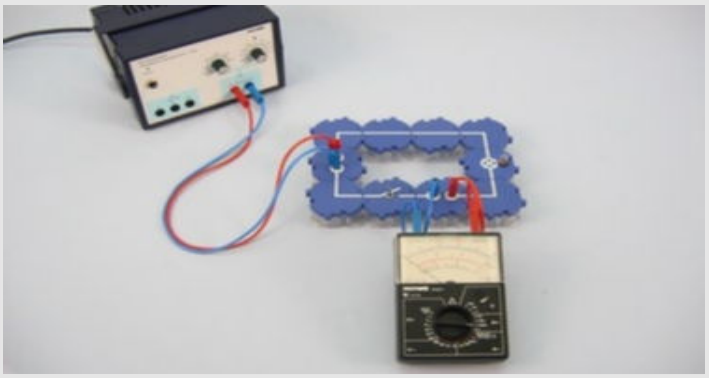
Set up a circuit with an incandescent lamp and an ammeter as shown in the figures. The switch should be open and a measuring range of 300 mA- should be selected for the ammeter.



## Procedure (1/3)

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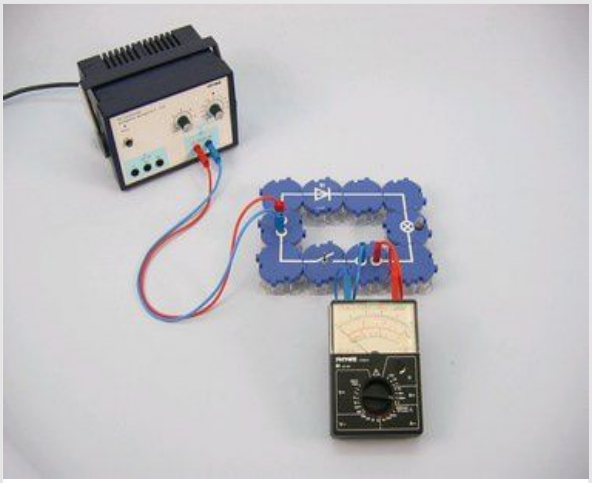

Experimental setup with direct voltage

- Switch on the power supply and apply a DC voltage of 12V-. Set the current limiter on the power supply to 1 A.
- Close the circuit and measure the resulting value for the current. Record the value in the log.
- Replace the conduction component 1 (see illustration of structure) with the diode in the forward direction (see illustration on the left).
- Measure the resulting current again and record it in the protocol.



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## Procedure (2/3)

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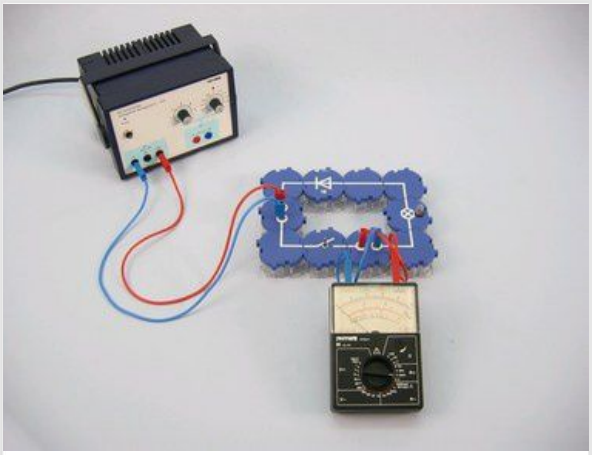

Experimental setup with alternating voltage

- Replace the diode again with a line component (see figure). Then apply an AC voltage of 12V~ and do not change the measuring range for the current intensity at first.
- Close the circuit, observe the light bulb and measure the current. Note the result again in the protocol.
- Now set a measuring range of 300mA~ (alternating current), measure the current and note it down.

## Procedure (3/3)

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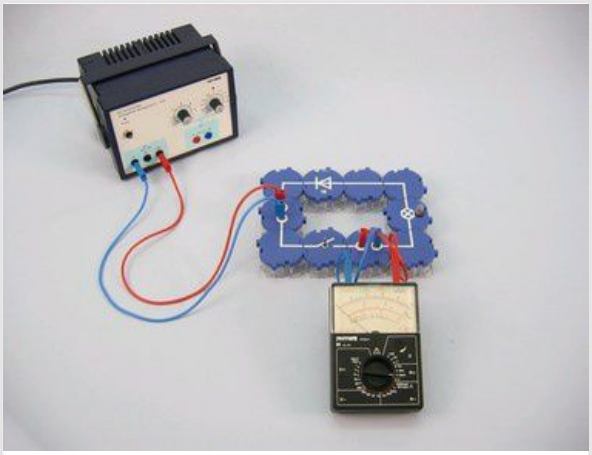

Experimental setup with alternating voltage

- Select again the measuring range 300mA- (direct current), replace the line component 1 again by the diode, measure the current and note it down.
- Open the switch, reverse the ammeter and turn the diode 180°. Close the switch again and measure and record the resulting current again.
- Turn off the power supply.



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# Report

## Table

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Note the measured currents for the different setups.

| | $I\,[mA]$ |
|---|---|
| DC voltage, without diode | |
| DC voltage, with diode | |
| AC voltage, without diode | |
| AC voltage, without diode, measuring range 300mA~ | |
| AC voltage, with diode, measuring range 300mA- | |
| Alternating voltage, with diode in reverse direction | |



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## Task 1

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Why is the current somewhat lower when the diode is installed in the DC circuit - in the forward direction - instead of the ladder component?

- The voltage drops to zero across the diode, so the current also changes.
- The diode has a small resistance.
- This is a measurement error due to the setup. The current should remain constant.

## Task 2

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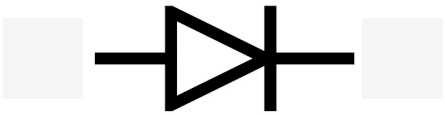
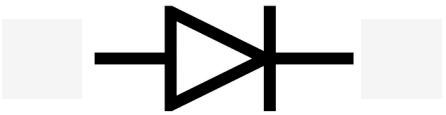
Switch the diode in forward direction!



− +

Check

Switch the diode in reverse direction!



− +

Check



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## Task 3

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Which of the following statements are correct for the incandescent lamp in the AC circuit (without diode, measuring range 300mA-)

- [ ] The current is not permanently zero - only on average. The respective current flow (plus and minus) causes the glow.
- [ ] The amperage is displayed as approximately zero and yet the light bulb is on.
- [ ] The light bulb is on. But the ammeter does not strike out because the meter is too sluggish.
- [ ] The bulb lights up because the polarity is irrelevant here.

Check

## Task 4

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Explain why, in the case of the applied AC voltage, the current strength with the diode inserted is only about half as great as that with the line component inserted.

The other two statements are false!

In the DC setting, the ammeter always measures only half as strong a signal as in the AC setting.

Since after insertion of the diode only the current flow in forward direction behind the diode is possible, about half of the current is blocked.



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# Task 5

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Drag the words into the correct gaps.

In a circuit with an applied _____, a diode can be used to generate _____, since current only flows when the polarity is in the _____. Figuratively, the diode acts as a _____ or valve of the current flow, so that the current only flows in one direction. When the polarity is opposite, it is referred to as the _____ direction. This is useful because some electrical components only work with DC current. Diodes thus act as _____ in AC circuits.

- directional filter
- blocking
- AC voltage
- DC current
- rectifiers
- conducting direction

Check

| Slide | Score / Total |
|---|---|
| Slide 16: Diode Direct current | 0/1 |
| Slide 17: Multiple tasks | 0/4 |
| Slide 18: incandescent lamp in alternating current circuit | 0/4 |
| Slide 19: Current intensity Direct current/alternating current | 0/1 |
| Slide 20: Generation and application of alternating current | 0/6 |

**Total** 0 / 16

Solutions Repeat Export text



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