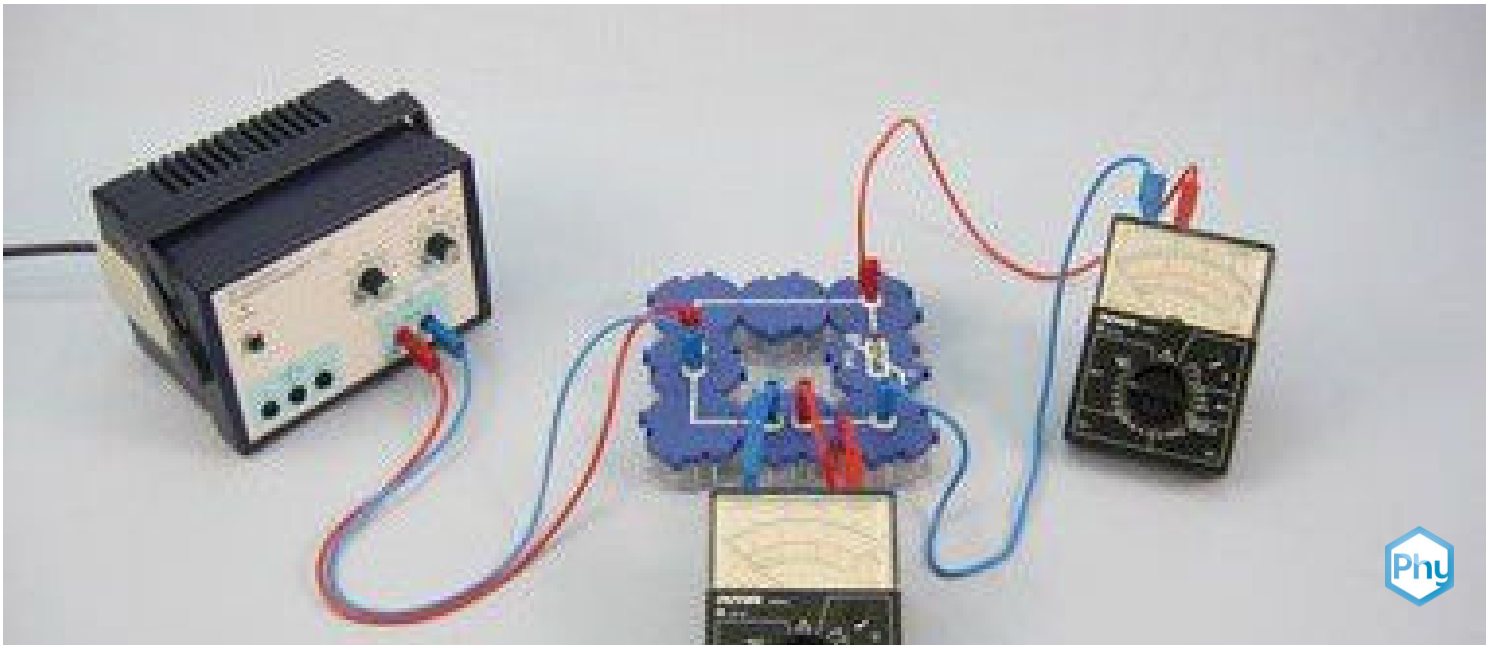
The PTC resistor



The students should use the experiment to learn how a PTC resistor works.

Physics > Electricity & Magnetism > Simple circuits, resistors & capacitors

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/6310dfce5f9bef000386647e

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Teacher information

Application

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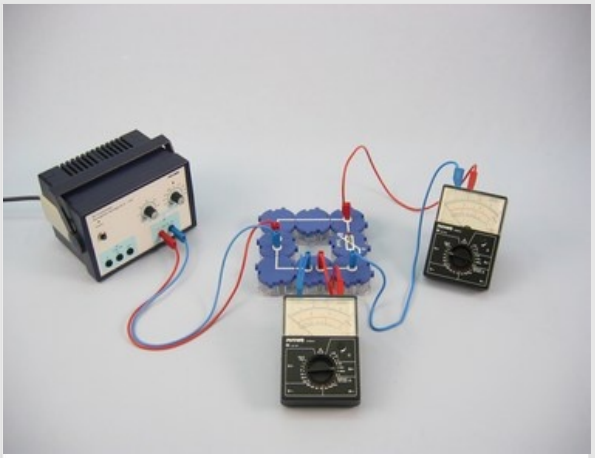

Experimental setup

In connection with the treatment of Ohm's law, the students have already learned that purely metallic conductors have a resistance that increases with an increase in temperature.

PTC resistors (**P**ositive **T**emperature **C**oefficient) also behave like this in a certain temperature range, and this is the aim of the two experiments. The first experiment is not only recommended as an introductory experiment. It is also appropriate if the concepts of self-heating (in the first experiment) and external heating (in the second experiment) are to be determined. The second experiment then has the character of a confirmation experiment.

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Other teacher information (1/2)

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Prior knowledge

Students should be familiar with ohmic resistance.

Principle

A PTC thermistor, PTC resistor or PTC thermistor (Positive Temperature Coefficient Thermistor) is a temperature-dependent resistor that belongs to the group of thermistors. Its main characteristic is a positive temperature coefficient and it conducts electricity better at low temperatures than at high temperatures.

Other teacher information (2/2)

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Learning objective

The students should use the experiment to see how a PTC resistor works.

Tasks

Determine the resistance values for a PTC resistor at different currents and temperatures.

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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

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Motivation

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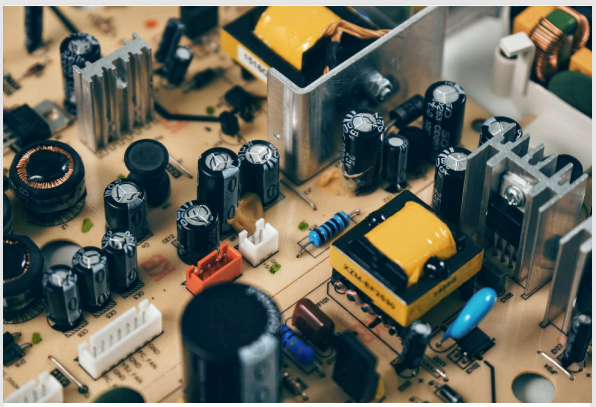
PTC resistors are also called PTC thermistors. They are widely used in measurement, control and regulation technology.

In contrast to purely metallic resistors, PTC resistors only show the behaviour proven in the tests within a certain temperature range (e.g. 30...110 °C). Outside this range, they can behave like NTC resistors. The deeper explanation of the behaviour of PTC resistors with the help of a conduction model is complicated and cannot be the subject of physics lessons.



Electronic components

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Equipment

Position	Material	Item No.	Quantity
1	Straight connector module, SB	05601-01	1
2	Angled connector module, SB	05601-02	2
3	Interrupted connector module with sockets, SB	05601-04	2
4	Angled connector module with socket, SB	05601-12	2
5	Socket module for incandescent lamp E10, SB	05604-00	1
6	PTC-resistor module, SB	05631-00	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	2
10	Connecting cord, 32 A, 500 mm, blue	07361-04	2
11	Filament lamps 4V/0.04A, E10, 10	06154-03	1
12	PHYWE Analog multimeter, 600V AC/DC, 10A AC/DC, 2 MΩ, overload protection	07021-11	2
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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1st experiment

- Set up the experiment according to Fig. 1 and Fig. 2. Select the measuring ranges 10 V- and 30 mA-.

2nd experiment

- Instead of the straight connector module, install the lamp socket with 4 V bulb, as in Fig. 3 and Fig. 4, and set the measuring range to 10 V-.

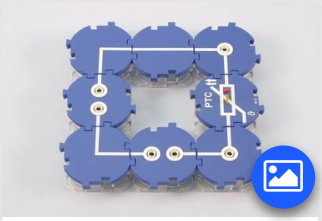

Fig. 1

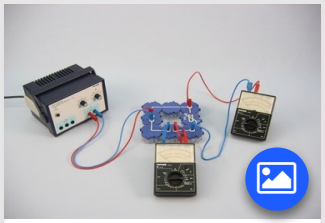

Fig. 2

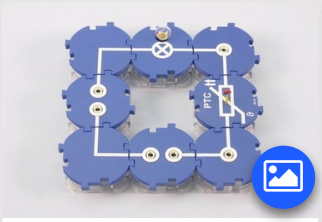

Fig. 3

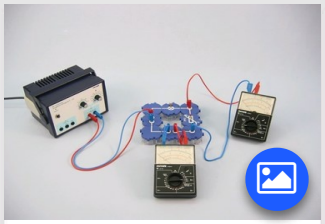

Fig. 4

Procedure (1/3)

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1st experiment

- Switch on the power supply unit and set the currents 15 mA or 30 mA one after the other. Determine the voltage required in each case and note it in the table in the report.

Note: When setting the current to 30 mA, watch the ammeter carefully. Adjust the voltage repeatedly - if necessary - until the amperage no longer changes.

- After the second measurement, touch the PTC resistor with your fingertips and observe the ammeter.
- Note down your observations and measurements in the report.
- Switch off the power supply unit.

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Procedure (2/3)

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2nd experiment

- Switch on the power supply and again set a current of 30 mA.
- Heat the PTC resistor with a match flame as in Fig. 5.
- Observe the ammeter and the bulb during heating.

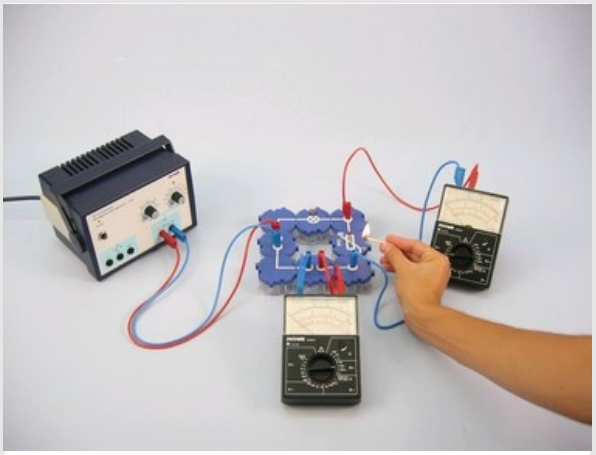

Fig. 5

Procedure (3/3)

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Attention! The burning match must be held so that the flame is next to the resistor and at least 5 mm away from it; too much heating would destroy the resistor!

- After removing the flame, continue to observe the ammeter and the bulb. Touch the PTC resistor with your fingertips so that it cools down faster.
- Note down the observations in the report.
- Switch off the power supply unit.

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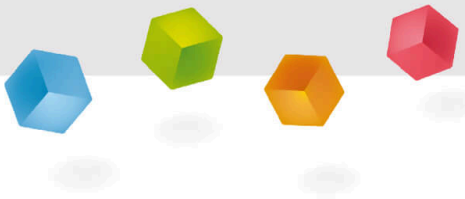

Report

Table

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I [A]	U [V]	R [Ω]
15		
30		

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Observation (1/2)

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Write down your observations on experiment part 1.

Observation (2/2)

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Write down your observations on experiment part 2.

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Task (1/3)

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Summarise the result of the 1st attempt.

Task (2/3)

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Drag the words into the correct boxes!

PTC thermistors are _____ that are temperature-dependent. PTC thermistors have a positive _____ (TC) and are therefore also called PTC resistors. With this type of semiconductor, one free _____ per atom is obtained through the _____ of the atoms.

- lattice arrangement
- valence electron
- temperature coefficient
- semiconductor resistors

Check

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Task (3/3)

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Drag the words into the correct boxes!

These electrons are easily movable. When connected to a current source, the free valence electrons move to the positive pole and cause electrical _____. Almost all metals are _____ because they conduct better at lower _____. PTCs consist of polycrystalline titanate ceramics which are contaminated with _____ (doping).

conductivity
foreign atoms
cold conductors
temperatures

Check

Slide	Score / Total
Slide 18: PTC thermistor	0/4
Slide 19: PTC	0/4

Total score 0 / 8

Show solutions | Repeat | Export text

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