# PTC Resistors (Item No.: P1377700)

## Curricular Relevance

**Area of Expertise:** Physik
**Education Level:** Klasse 7-10
**Topic:** Elektrizitätslehre
**Subtopic:** Eigenschaften elektrischer Bauelemente
**Experiment:** Der PTC-Widerstand

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

**Additional Requirements:**

- Matches

**Experiment Variations:**

**Keywords:**

## Task and equipment

## Information for teachers

# Additional information

In connection with Ohm's Law, the students have already learned that pure metallic conductors have a resistance which increases with increasing temperature.
PTC resistors (**P**ositive **T**emperature **C**oefficient) behave the same way in a certain temperature range. Both of these experiments are used to prove this.
The first experiment does not just serve as an introduction to this topic. It is also useful for demonstrating the terms self-heating (in the first experiment) and external heating (in the second experiment). The second experiment is useful in confirming these concepts.

## Notes on setup and procedure

The experiment setups should not present a problem to the students if they are already relatively familiar with connecting and operating the multi-range meters.
When heating externally with the lighted match, they should be extra careful not to destroy the PTC resistor.

## Remarks

PTC resistors are also referred to as PTC thermistors. They are widely used in circuits for measuring technique, control technique, and automatic control.
As opposed to pure metal resistors, PTC resistors only behave as demonstrated in these experiments in a certain temperature range (e.g. 30...110 °C). Outside of this range, they can behave the same way as NTC resistors. A complete explanation of the behaviour of the PTC resistor using a conductivity model is complicated and probably too complicated for a physics course for secondary school students.


Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

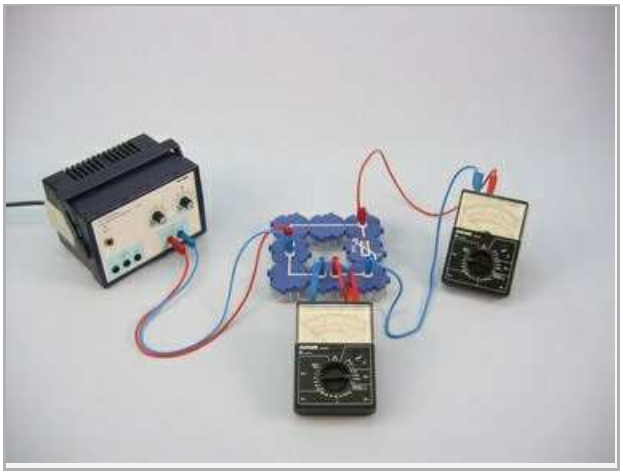
# PTC Resistors (Item No.: P1377700)

## Task and equipment

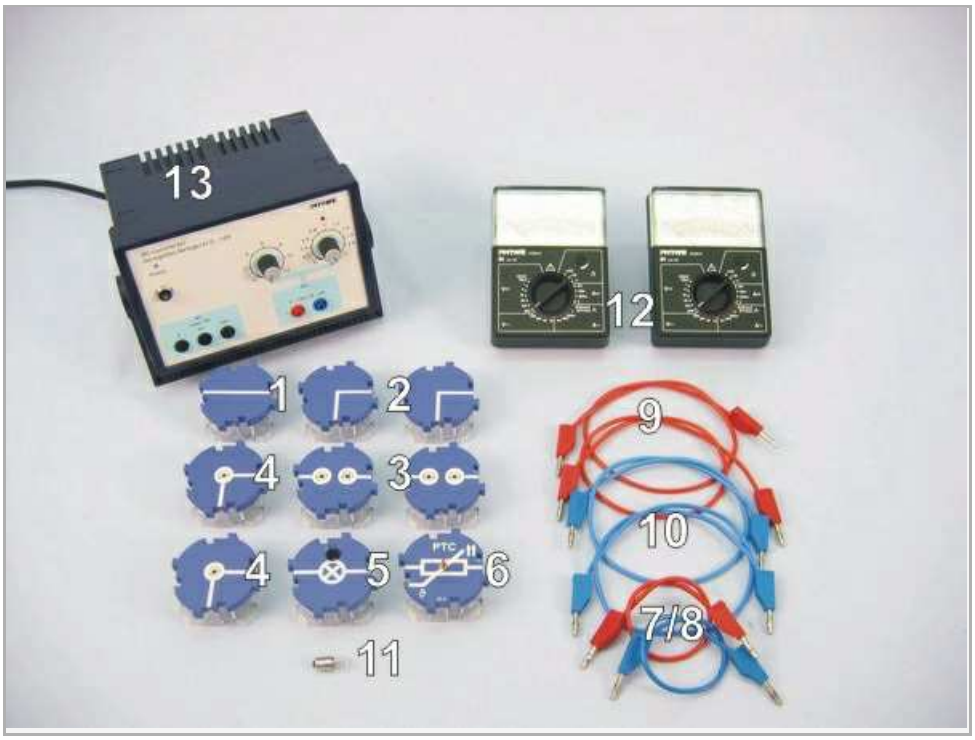
### Task

### How does a PTC resistor react to an increase in temperature?

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



## Equipment




| Position No. | Material | Order No. | Quantity |
|---|---|---|---|
| 1 | Straight connector module, SB | 05601-01 | 1 |
| 2 | Angled connector module, SB | 05601-02 | 2 |
| 3 | Interrupted connector module, 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 | Multi-range meter, analogue | 07028-01 | 2 |
| 13 | PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A | 13506-93 | 1 |
| Additional material | | | |
| | Matches | | |

# Set-up and procedure

## Set-up

## First experiment

Set up the experiment as shown in Fig. 1 and Fig. 2. Set the measurement ranges to 3 V- and 30 mA-.

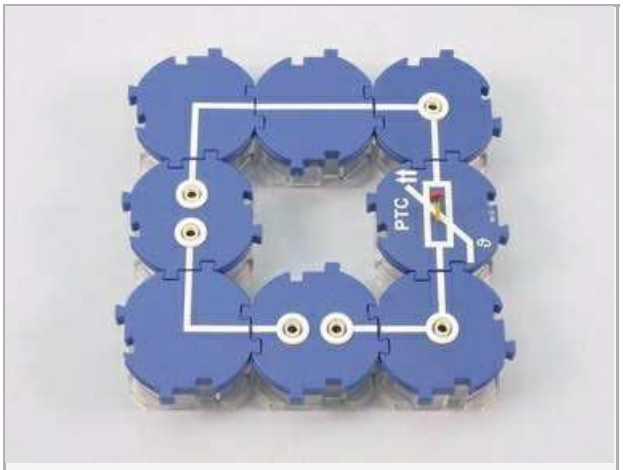



Fig. 1

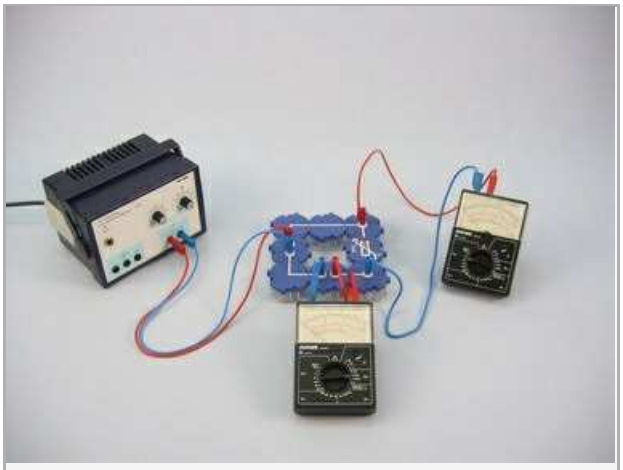


Fig. 2

## Second experiment

Change the circuit by replacing the straight connector building block by a lamp socket with 4 V lamp as shown in Fig. 3 and Fig. 4 and set the measurement range to 10 V-.

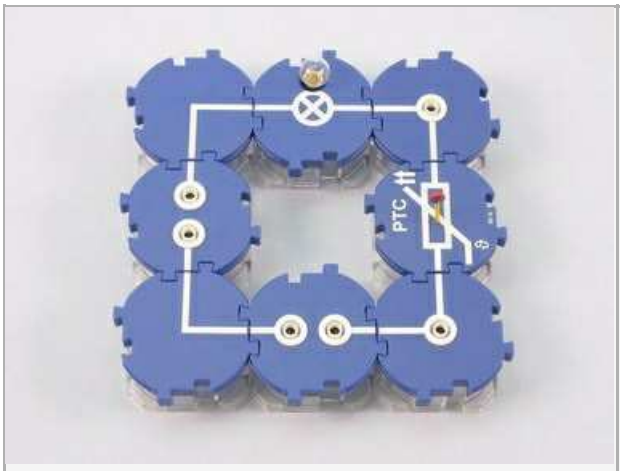



Fig. 3

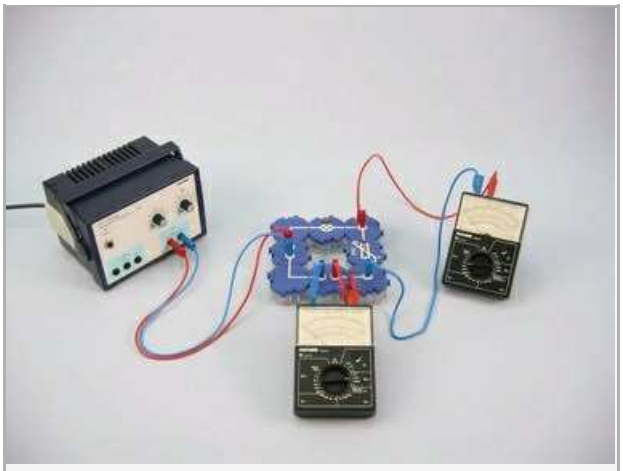


Fig. 4

# Procedure

## First experiment

- Switch on the power supply unit and set the current first to 15 mA and then to 30 mA, noting the respective voltages necessary for this in Table 1 in the report.

**Note:**When setting the current to 30 mA, observe the ammeter closely and, if necessary, reset the voltage until the current remains constant.

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

## Second experiment

- Switch on the power supply unit and set the current once again to 30 mA.
- Warm PTC resistor with a lighted match, as shown in Fig. 5.
- While warming the PTC resistor, observe the ammeter and the filament lamp.

**Important!**You should hold the lighted match with the flame next to the resistor at least 5 mm away. Too much heat will destroy the resistor.

- Keep observing the ammeter and the filament lamp after removing the lighted match from the PTC resistor. Touch the PTC resistor with your fingertips to cool it down more quickly.
- Note your observations in the report.
- Switch off the power supply unit.

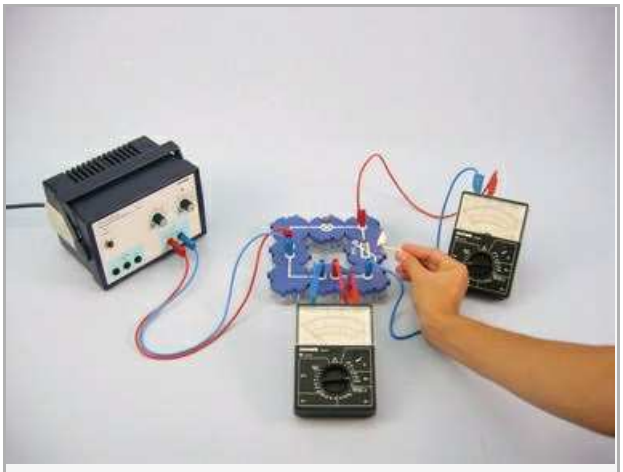


Fig. 5

# Report: PTC Resistors

## Result – Table 1

Record the measured values in table 1.

| $I$ in A | $U$ in V | $R$ in Ω |
|---|---|---|
| 15 | 1 ±0 | 1 ±0 |
| 30 | 1 ±0 | 1 ±0 |

## Result – Observations 1

Note down your observations during the first part of the experiment.

.....

.....

.....

.....

## Result – Observations 2

Note down your observations during the second part of the experiment.

.....

.....

.....

.....

## Evaluation – Question 1

Summarise the results of the first experiment.

.....

.....

.....

.....

## Evaluation – Question 2

How would you explain the behaviour of the PTC resistor?

.....

.....

.....

.....



Robert-Bosch-Breite 10
D - 37079 Göttingen

Tel: +49 551 604 - 0
Fax: +49 551 604 - 107

info@phywe.de
www.phywe.com