Electricity with the Modular System

Basic Electric Circuits

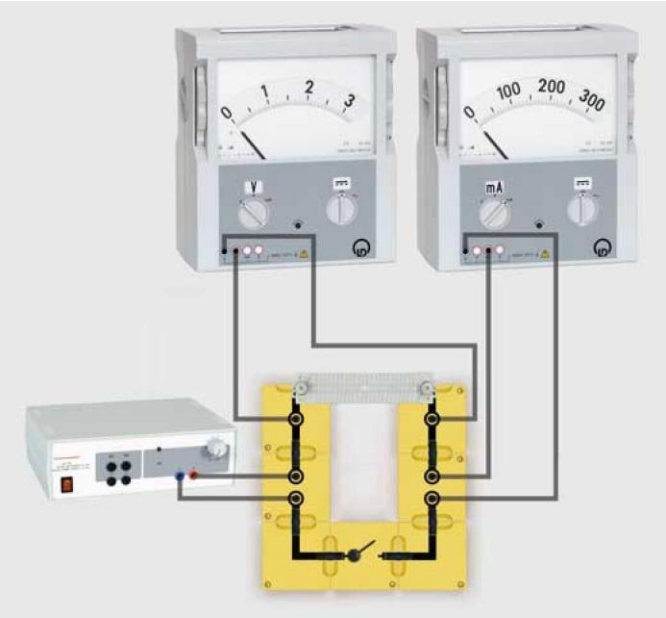
Electrical resistance

How a wire's resistance depends on its material

Objective of the experiment

To investigate how a wire's resistance depends on its material.

Setup



Apparatus

1	567 18	Wire wrapping plate
1	550 47	Chrome-nickel wire, *d* = 0.35 mm
1	550 42	Constantan wire, *d* = 0,35 mm
2	539 060	Adapter plug, BST
1	539 025	Toggle switch, BST
2	539 002	Connector blocks BST, straight, 1 socket
2	539 003	Connector blocks BST, straight, 2 sockets
2	539 004	Connector blocks BST, 90° angle
6	539 000	Bridging plug, BST
2	531 906	Demo multimeter, passive
1	521 49	Power supply, 12 V DC, 230 V
6	500 644	Safety connection lead, 100 cm
1	301 300	Demonstration experiment frame
1	301 301	Adhesive magnetic board

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Carrying out the experiment

- Wind the chrome-nickel wire around the wire wrapping plate (25 turns) and clamp the ends of the wire used for contacting under the clamping screws.
- Insert the wire wrapping plate into the adapter plug.
- Close the switch and adjust the power supply to a voltage of 3 V across the wire wrapping plate.
- Read the current and voltage from the demo multimeter and enter them into the table.
- Repeat the measurement with constantan wire of the same cross-section and length.
- Calculate the resistances R from voltages U and currents I ($R = \frac{U}{I}$).

Measuring example

Material	Voltage U / V	Current I / A	Resistance R / Ω
Chrome-nickel	3	0.135	22
Constantan	3	0.300	10

Evaluation

The resistance of a wire depends on its material.

The material of an electrical conductor is characterized by a substance-specific magnitude. This magnitude is called electrical resistivity. Symbol: ρ Unit: $\frac{\Omega \cdot mm^2}{m}$

From the electrical resistivity ρ, length L and cross-section A, the resistance of any electrical conductor can be calculated:

$$R = \rho \frac{L}{A}$$

Table values (at 20° C):

Chrome-nickel: $\rho = 1.12 \frac{\Omega \cdot mm^2}{m}$

Constantan: $\rho = 0.50 \frac{\Omega \cdot mm^2}{m}$