

Voltage in a series connection (Item No.: P1373000)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional information

With the first experiment, an introduction to this topic, the function of a series resistance is explained as motivation for the quantitative examination of the law of voltage in series connections. A variant of this introductory experiment, based on a chain of electric Christmas tree lights, could be the preparation of a model of such a light chain with two identical filament lamps (4 V / 0.04 A).

Notes on setup and procedure

Prior to the experiments, remind the students that the voltmeter must always be correctly poled. Connecting errors frequently occur, when the voltmeter is switched in parallel with the partial resistances in each case

Remark

The term "total current" has not been used, because it could lead to confusion.

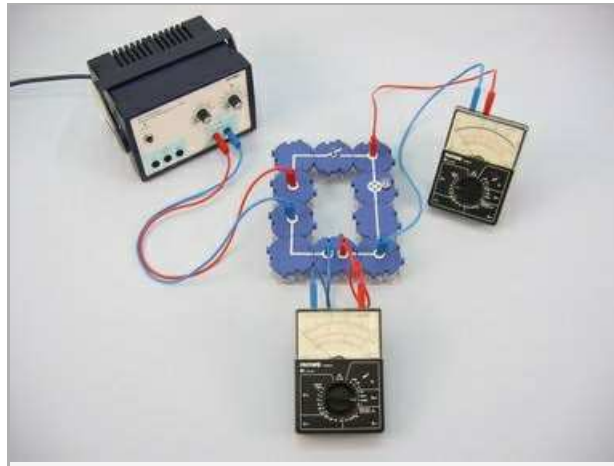
Voltage in a series connection (Item No.: P1373000)

Task and equipment

Task

How can an electrical device be operated at a higher voltage than its rated voltage?

Examine the voltage conditions in a series connection of technical resistances in unbranched circuits.



Equipment



Position No.	Material	Order No.	Quantity
1	Straight connector module, SB	05601-01	3
2	Angled connector module, SB	05601-02	2
3	Interrupted connector module, SB	05601-04	1
4	Junction module, SB	05601-10	2
5	Straight connector module with socket, SB	05601-11	1
6	Angled connector module with socket, SB	05601-12	2
7	On-off switch module, SB	05602-01	1
8	Socket module for incandescent lamp E10, SB	05604-00	1
9	Resistor module 50 Ohm, SB	05612-50	1
10	Resistor module 100 Ohm, SB	05613-10	1
11	Connecting cord, 32 A, 250 mm, red	07360-01	2
12	Connecting cord, 32 A, 250 mm, blue	07360-04	2
13	Connecting cord, 32 A, 500 mm, red	07361-01	2
14	Connecting cord, 32 A, 500 mm, blue	07361-04	2
15	Filament lamps 4V/0.04A, E10, 10	06154-03	1
16	Multi-range meter, analogue	07028-01	2
17	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

Set-up and procedure

Set-up

First experiment

Set up the circuit as shown in Fig. 1. Connect the power supply (left), amperemeter (bottom) and a voltmeter (top) as seen in Fig. 2.

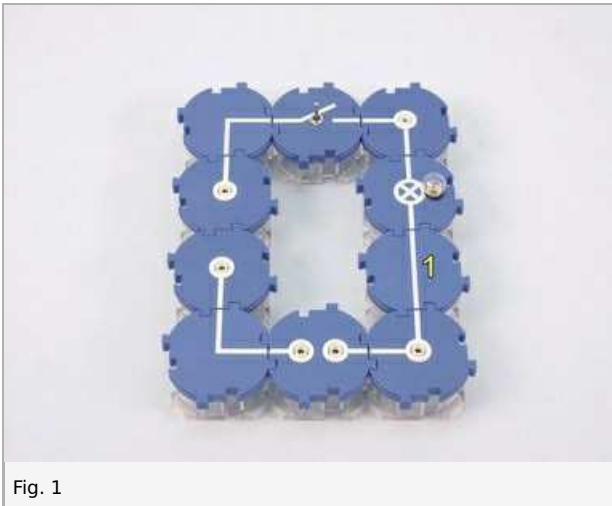


Fig. 1

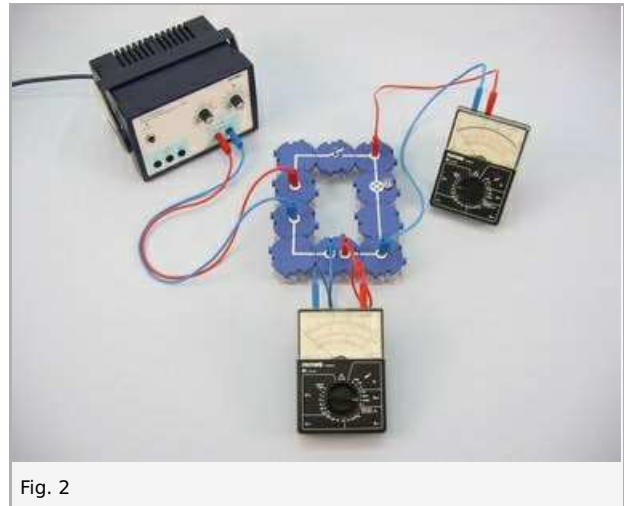


Fig. 2

Second experiment

Set up the circuit as shown in Fig. 3 and Fig.4.

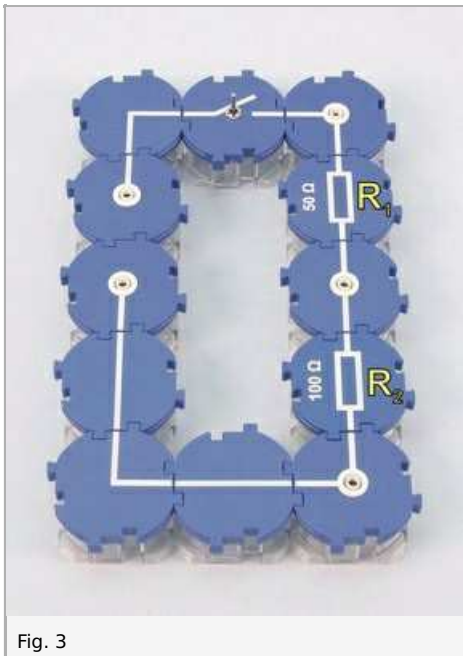


Fig. 3

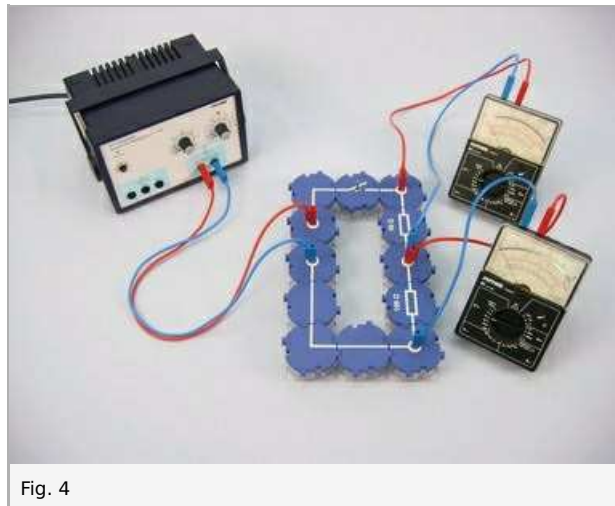


Fig. 4

Procedure

First experiment

- Set the power supply voltage to 4 V–.
- Measure the current and observe the brightness of the lamp; note the measured value in the report.
- Remove the straight connector module 1 (see Fig. 1) from the circuit and replace it with the resistor $R_V = 100 \Omega$ as shown in Fig. 5 and Fig. 6.
- Observe the brightness of the lamp; note your observation in the report, too.
- Increase the power supply voltage until the current has again reached its original value, note the voltage (report).
- Switch off the power supply.

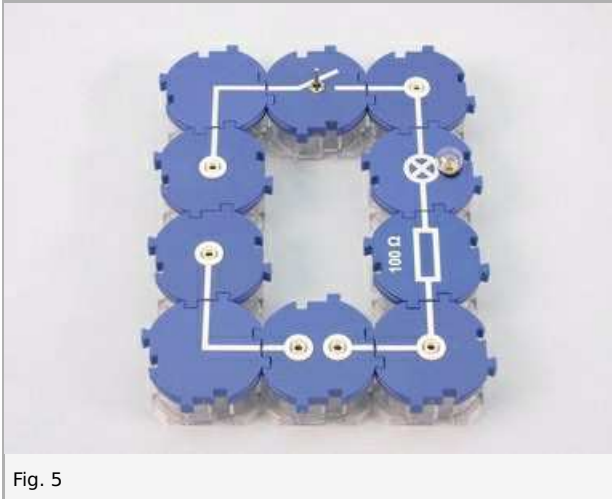


Fig. 5

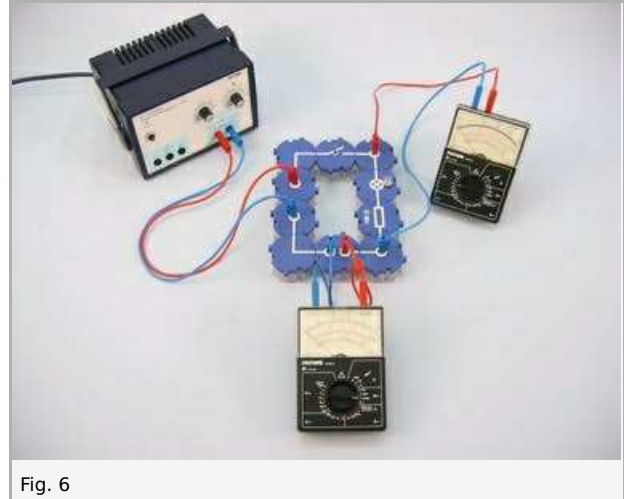


Fig. 6

Second experiment

- Switch on the power supply and set it to a direct voltage of 10 V ($= U_t$).
- Measure the voltage across R_1 (partial voltage U_1); note the measured value in table 1 in the report.
- In the same way, measure the partial voltage U_2 across R_2 (Fig. 7) and enter the measured value in table 1, too.
- Switch off the power supply.

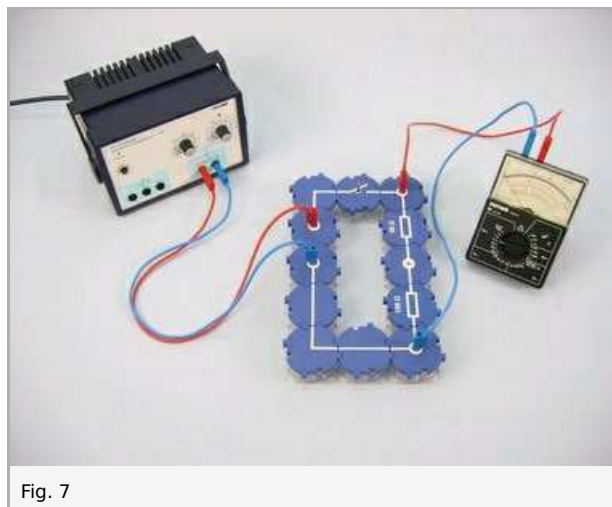


Fig. 7

Report: Voltage in a series connection

Result - Observations

Write down your observations about first experiment:

- a) Current I
- b) Brightness of the lamp after connecting R_V
- c) Required voltage U

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Result - Table 1

Enter measured values of the first experiment in the table 1.

U_t in V	U_1 in V	U_2 in V
10 V	1	1

Evaluation - Question 1

Summarise the result of the first experiment and answer the header question.

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Evaluation - Question 2

A general relationship can be derived from table 1 - taking the possibility of measurement errors into consideration. Formulate this relationship in writing and in the form of an equation.

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Evaluation - Table 2

Enter the measured values for the partial voltages U_1 and U_2 , the given resistance values for R_1 and R_2 and their quotients U_1/U_2 and R_1/R_2 in Table 2.

U_1 in V	U_1 in V	U_2 in V	R_1 in Ω	R_2 in Ω	U_1 / U_2	R_1 / R_2
	1	1	1	1	1	1

Evaluation - Question 3

Formulate the relationship which can be derived from the right hand 2 columns of the table 2 in writing and in the form of an equation.

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Evaluation - Table 3

Complete table 3.

U_t/R_t in A	U_t/R_t in A	U_1/R_1 in A	U_2/R_2 in A
	1	1	1

Evaluation - Question 4

Formulate the general relationship that you can derive from table 3 in writing and in the form of an equation. Which law for series connections known to you expresses this relationship?

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Evaluation - Question 5

Name applications of series connections.

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