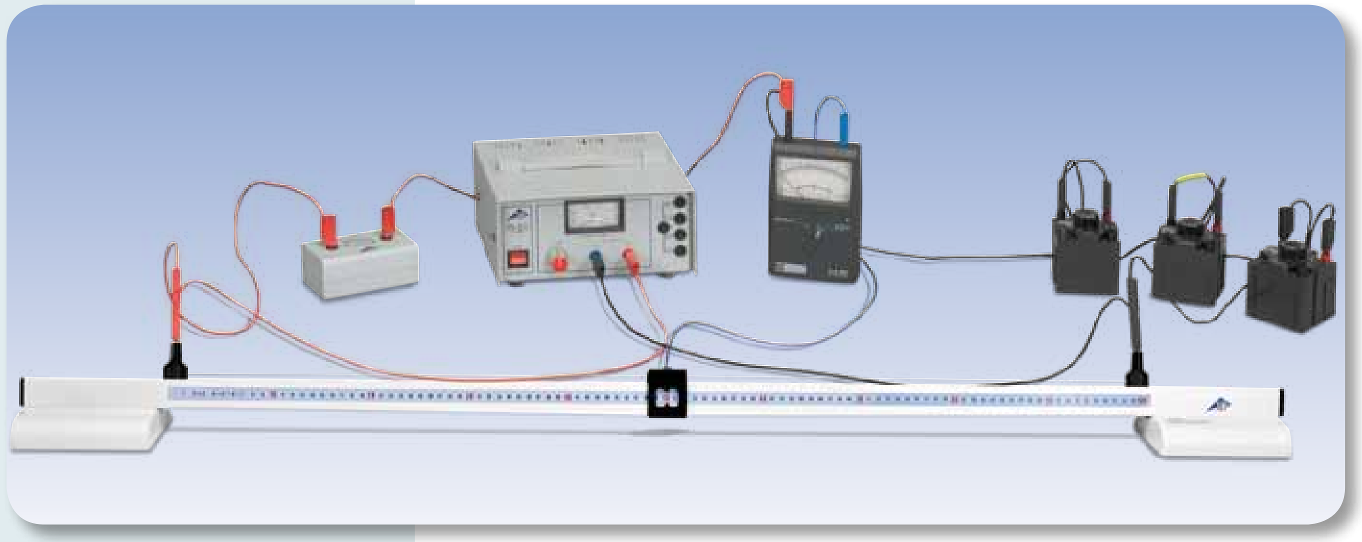
WHEATSTONE'S BRIDGE



EXPERIMENT PROCEDURE

- **Determine resistances using a Wheatstone Bridge.**
- **Estimate the accuracy of the measurements.**

OBJECTIVE

Determine the value of certain resistances.

SUMMARY

An arrangement in which two voltage dividers are connected in parallel and connected to the same DC voltage source can be used to obtain the values of certain resistors. The first voltage divider consists of the resistance that is to be measured along with a reference resistance, while the second consists of a resistance wire 1 m in length that is divided into two sections by a sliding contact. The ratio between the two sections is adjusted until the current across the diagonal between the two voltage dividers becomes zero.

REQUIRED APPARATUS

Quantity	Description	Number
1	Resistance Bridge	**1009885**
1	AC/DC Power Supply 0 – 12 V, 3 A (230 V, 50/60 Hz)	**1002776 or**
	AC/DC Power Supply 0 – 12 V, 3 A (115 V, 50/60 Hz)	**1002775**
1	Zero Point Galvanometer CA 403	**1002726**
1	Resistance Decade 1 Ω	**1002730**
1	Resistance Decade 10 Ω	**1002731**
1	Resistance Decade 100 Ω	**1002732**
1	Precision Resistor 1 Ω	**1009843**
1	Precision Resistor 10 Ω	**1009844**
1	Set of 15 Safety Experiment Leads, 75 cm	**1002843**

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BASIC PRINCIPLES

A classical method for measuring resistances uses a voltage balancing bridge named after *Charles Wheatstone* to compare the unknown resistance with a reference resistance. This involves setting up a circuit consisting of two voltage dividers in parallel, with a single DC voltage source connected across the whole. The first voltage divider consists of the resistance R_x that is to be measured and a reference resistance R_{ref}, while the second consists of two resistances R_1 and R_2, the sum of which remains constant during the balancing process (see Fig. 1).

The ratio between the resistances R_1 and R_2 and – if necessary – the value of the reference resistance R_{ref} are varied until the current across the diagonal is reduced to zero. This occurs when the ratio between the resistances is the same for both voltage dividers. This balance condition leads to the following expression for the unknown resistance R_x:

(1) $$R_x = R_{ref}\cdot\frac{R_1}{R_2}$$

The accuracy of the result depends on the precision of the reference resistance R_{ref}, the resistance ratio R_1/R_2 and the sensitivity of the null-detecting galvanometer.

In this experiment the second voltage divider consists of a resistance wire 1 m in length, which is divided into two sections of lengths s_1 and s_2 by a sliding contact. As the sum $R_1 + R_2$ remains constant, the reference resistance should, so far as possible, be chosen so that the two sections have about the same length, and therefore similar resistance.

EVALUATION

As the two resistances R_1 and R_2 correspond to the two sections of the resistance wire, Equation (1) can be rewritten as

$$R_x = R_{ref}\cdot\frac{s_1}{s_2} = R_{ref}\cdot\frac{s_1}{1\,\mathrm{m}-s_1}$$

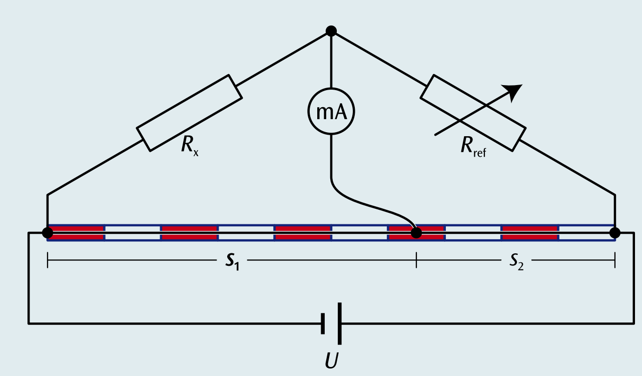

Fig. 1: Schematic diagram of a Wheatstone bridge