Electricity
Fundamentals of electricity
Kirchhoff’s laws

Principle of a Wheatstone bridge

Description from CASSY Lab 2

For loading examples and settings, please use the CASSY Lab 2 help.
Principle of Wheatstone's bridge

![Wheatstone's bridge diagram](image)

can also be carried out with Micro-CASSY

**Task**

In order to measure an "unknown" resistance $R_x$, vary the variable resistance $R_3$ (potentiometer) in the bridge circuit until no current flows between the two arms of the bridge.

**Equipment list**

1. **Pocket-CASSY** 524 006
2. **CASSY Lab 2** 524 220
3. **UIP sensor S** 524 0621
4. **Plug-in board A4** 576 74
5. **Set of 10 bridging plugs** 501 48
6. **Resistor 220 Ω STE 2/19** 577 36
7. **Resistors 330 Ω STE 2/19** 577 38
8. **Resistor 470 Ω STE 2/19** 577 40
9. **Resistor 1 kΩ STE 2/19** 577 44
10. **Potentiometer 1 kΩ, 1 W STE 4/50** 577 92
    - or 10-turn potentiometer 1 kΩ, 2 W 577 93
11. **Connecting leads, red, 25 cm** 500 411
12. **Connecting leads, blue, 25 cm** 500 412
13. **Voltage source, 0...15 V, adjustable** e.g. 521 45
14. **PC with Windows XP/Vista/7/8**

**Experiment setup (see drawing)**

Set up the circuit with the combination of resistors $R_1 = 1kΩ / R_2 = 470 Ω$ as shown in the drawing, and connect the UIP sensor for the current measurement.

**Carrying out the experiment**

- **Load settings**
  - If necessary, set the display of the current to $\rightarrow 0 \leftarrow$ in Settings I1.
  - Apply a voltage of approx. 9 V.
  - Adjust the potentiometer for a selected resistance $R_x$ (e.g. 330 Ω) so that no current $I_1$ flows between the arms of the bridge circuit.
  - Read the value $R_3$ of the adjusted resistance, and write it in the prepared table. The value of the resistance $R_3$ can be estimated from the position of the rotary knob if the STE potentiometer 1 kΩ is used: the left stop corresponds to approx. 1 kΩ.
  - Repeat the measurement for other resistances $R_x$. 
Evaluation

- What is the relation between the ratios of the resistances in the two arms of the bridge circuit if no current flows between the two arms \( (I_1 = 0) \)?

- How is \( R_x \) determined if the resistances \( R_1, R_2 \) and \( R_3 \) are known?

- What is the relation between the voltage drops \( U_1 \) and \( U_3 \) or \( U_2 \) and \( U_x \), respectively, at the 4 resistances \( R_1 \) and \( R_3 \) or \( R_2 \) and \( R_x \), respectively, if the bridge is balanced \( (I_1 = 0) \)?

- What is the effect of the applied voltage \( U \) on the determination of the resistance \( R_x \) if the bridge is balanced \( (I_1 = 0) \)?

Remark

The resistance \( R_x \) could, of course, also be determined by measuring the voltage drop \( U \) while a current \( I \) is flowing, i.e. using the relation \( R_x = U/I \). However, this presupposes that the internal resistances of the measuring instruments can be neglected, which is usually the case. If the bridge circuit is used, the internal resistance of the ammeter does not play a role at all because no current flows. Therefore the bridge circuit provides an opportunity of an accurate measurement of the fourth resistance if the other three resistances are known precisely.