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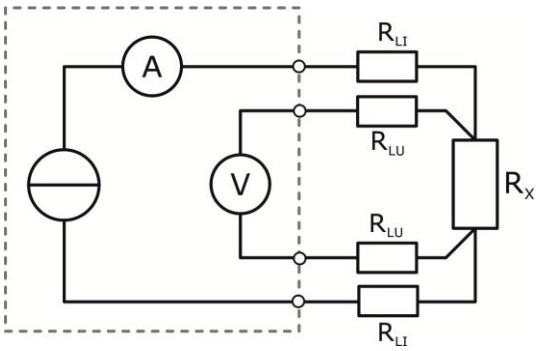
Glossary

Faraday, Michael
Michael Faraday, born on 22 September 1791 in Newington, Surrey, died on 25 August 1867 in Hampton Court Green, Middlesex, was an English scientist.

Four-wire / Kelvin measurement method
The four-wire or Kelvin measurement method is used for resistance measurements in the micro-ohm and milli-ohm range as it allows highly accurate and repeatable measurements of these low resistances.
Four separate leads are used with the Kelvin measurement method. Two leads carry the current through the test object. The other two leads measure the voltage drop. A constant current which is independent of the resistances of the supply cable flows through the measurement object. The resistance is measured directly on the measurement object via a high-resistance input amplifier. Because of the constant measurement current and the high internal resistance of the voltage input, the resistances of the measurement leads / supply cables and of the contact transitions do not affect the measurement result and no additional measuring error occurs.



Four-wire or Kelvin measurement method

Induction
Electromagnetic induction is the interaction between magnetism and electricity which was discovered by Faraday in 1831. If the magnetic flux through a surface which is surrounded by an electrical conductor changes, an electrical voltage is induced in a conductor. This law of induction is of great technical importance. Generators, and therefore power generation, transformers and motors operate on the basis of this law.

Kelvin
Unit symbol K. SI base unit of temperature named after the English physicist W. Thomson, who later became Lord Kelvin. The Kelvin is the 273.16th part of the thermodynamic temperature of the triple point of water.

Kelvin measurement clamps
In order to fulfil the conditions of the four-wire method and to simplify the connection of four wires, two test contacts, insulated from one another, are provided in one set of Kelvin measurement clamps. One set of contacts is used for power supply, the other as potential tap.

Kelvin measurement clamps

Kelvin scale
Thermodynamic (absolute) temperature scale. This temperature scale starts at absolute zero (0 K = -273.15 °C). Temperature differences are the same in the Kelvin and Celsius scales and are preferably expressed in Kelvin (K), e.g. room temperature +20 °C ± 2 K.

Measurement bridges
A Wheatstone bridge consists of four resistance legs in one circuit (fig. 1). If the resistances are set in such a way that the voltage difference between B and D becomes zero, no current flows through the galvanometer. The following formula applies:

$$R_X / R_1 = R_2 / R_3$$

Resistances between 0.1 and 10^7 Ω can be measured with the Wheatstone bridge.

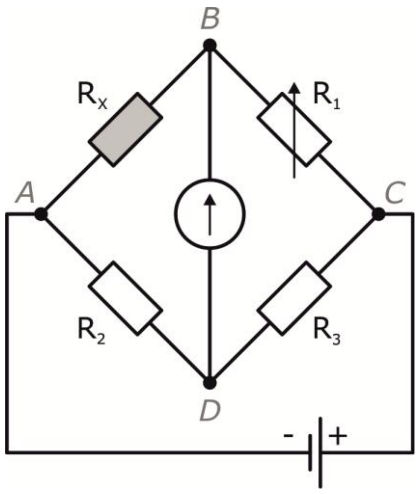


Fig. 1: Wheatstone bridge

The measurement bridge according to Thomson (fig. 2) is suitable for measuring very small resistance values, where the influence of the supply cable resistances and the contact transitions is suppressed. The voltage drop at R_X is compared with the reference resistance R_N. The measuring range goes down to 10^{-6} Ω.

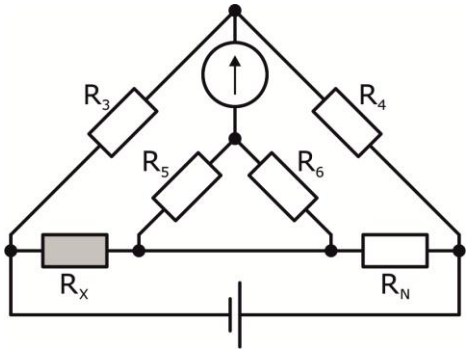


Fig. 2: Thompson bridge

Micro-ohm meter / Milli-ohm meter
Ohm meters for the determination of low electrical resistances from the micro-ohm to milli-ohm range.

High-precision ohm meter PROMET SMO

Ohm, Georg Simon
Georg Simon Ohm, born on 16 March 1789 in Erlangen, died on 6 July 1854 in Munich, was a German physicist.

Ohm
Unit symbol Ω. SI unit of electrical resistance named after the German physicist G. S. Ohm. 1 Ω is the resistance between two points on a metallic conductor through which a current of 1 A flows at a voltage of 1 V.

1 Ω = 1 V/A

Ohmic resistance
The proportionality factor between the current and voltage of a conductor configuration as defined by Ohm's law.

Ohm meter / Resistance meter
A direct-indicating electrical measuring instrument for measuring ohmic resistances. A known voltage U is applied to the resistor and the current flowing through it is measured. Since the resistance is given by R = U/I, the scale can be calibrated in resistance values.

Ohm's law
A basic law of electricity discovered by the German physicist G. S. Ohm in 1826. It states that there is proportionality between the voltage drop u across a conductor configuration and the current i through the conductor configuration. The proportionality factor R is the ohmic resistance. The following formula applies:

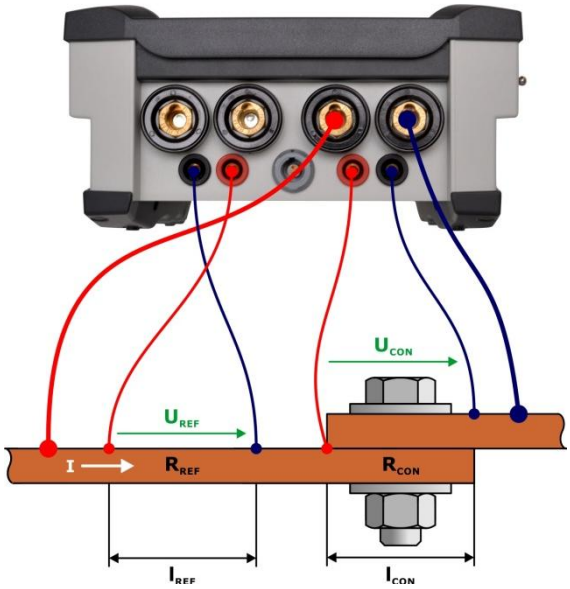
u = Ri

Quality of a connection

It is possible to determine the quality of a connection (e.g. busbar connection) by simultaneously determining two resistances (R_1 and R_2).

The quality factor K of an electrical connection results from the ratio of the resistance of the connection R_{CON} over the overlap length l_{CON} to the resistance of the busbar R_{REF} over the same length l_{REF}.

$$K = R_{CON} / R_{REF}$$



Quality factor measurement with PROMET SE

Resistance

The proportionality factor between the current and voltage of a conductor configuration (ohmic resistance) according to Ohm's law. The unit of electrical resistance is the ohm:

$$1\ \Omega = 1\ V/A$$

Resistance measurement

Electrical resistances can be determined by separate measurements of current and voltage, by bridge circuits or by direct-indicating electrical measuring instruments.

Temperature coefficient

The relative change of a physical quantity at a change in temperature of 1 K. If A is a physical quantity and if its temperature dependence in a temperature interval $\Delta t = T - T0$ is approximately given by the relationship $A(T) = A(T0) \times (1 + \alpha(T - T0))$, then α is the temperature coefficient for quantity A.

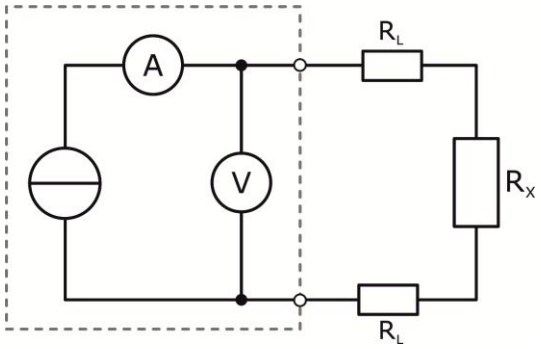
The temperature coefficient for the electrical resistance of most pure metals is between 1/200 and 1/300. K-1 is the unit for the temperature coefficient.

Thomson, William

William Thomson (Lord Kelvin), born on 26 June 1824 in Belfast, Northern Ireland, died on 17 December 1907 in Netherhall near Largs, Scotland, was a British physicist.

Two-wire measurement method

The two-wire measuring method is used for high resistances. However, with this measurement method, the resistance of the measuring leads influences the resistance result and this can lead to a large measuring error when measuring low resistances.



Two-wire measurement method

Wheatstone, Charles

Sir Charles Wheatstone, born on 6 February 1802 in Gloucester, died on 19 October 1875 in Paris, was a British physicist.