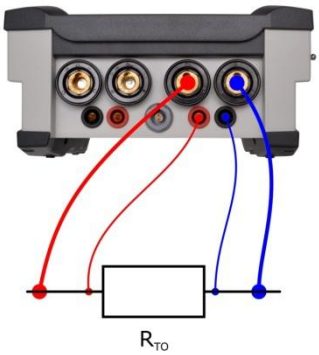
The measurement of very large or very small quantities is often difficult and resistance measurements are no exception. Large values over 1 GΩ and values under 1 Ω place tough demands on measurement equipment.

Resistance measurement

Ohm's law is the most important fundamental law of electrical engineering. It defines the relationship between the three fundamental electrical quantities: current, voltage and resistance. When a voltage is applied to a circuit which contains resistor elements, the current flows in accordance with Ohm's law.
A wide range of ohm meters which calculate and display the resistance value are on the market. These measuring devices use either two-wire or four-wire technology.
The two-wire method is used for large resistance values and is also used when high accuracy is not required. With this measurement method, the resistance of the measuring leads influences the resistance result and this can lead to a large measuring error.



Resistance measurement

In order to be able to measure even low resistance values with high accuracy, the PROMET SE ohm meter uses the four-wire method. With this method, four separate leads are used. Two leads carry the current through the test object. The other two leads measure the voltage drop.
A constant current is driven through the measurement object for this purpose and the voltage drop is measured directly on the measurement object. This is used to determine the resistance value.
A test current of up to 200 A can be generated in order to increase accuracy even further.
This measurement method even produces highly accurate results when resistance values in the micro-ohm range are to be measured.

Temperature

It is important to consider that the resistance of materials is influenced by the temperature. Depending on the accuracy required, it can be necessary to keep the ambient temperature at a constant level. However, this is only possible under laboratory conditions. It is not possible to control the temperature for most measurements. In order for a measurement to meet stringent accuracy requirements, automatic temperature compensation must be used. A temperature sensor can be connected to PROMET SE. Taking the temperature measured by the sensor into account, the calculated resistance value is corrected to correspond to the reference temperature of 20°C.

KoCoS Messtechnik AG
Suedring 42
D-34497 Korbach
Tel. +49 5631 9596-0
Fax +49 5631 9596-16
E-mail info@kocos.com
Internet www.kocos.com

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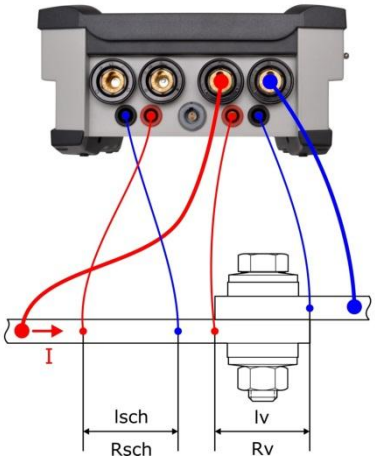
Quality



Quality factor

In the context of the transmission of high currents, there is the problem of connection resistances being too high at connection points. The resistance is influenced by a number of quantities and increases over time due to ageing leading to an increase in heat losses which influences longevity and can even result in the complete failure of the connection.
PROMET SE can determine the quality of a connection so that it can be assessed.
The quality factor k results from the ratio of the resistance of the connection Rv over the overlap length lv to the resistance of the busbar Rsch over the same length lSch.

Applications

The are many reasons for measuring the resistance of different materials. Here are just a few of them:

Manufacturers of components
At the end of the production line and during quality control it must be ensured that products such as resistors and current connectors etc. comply with specified resistance tolerances.

Manufacturers of breakers, relays and plugs
Checks must be made in order to ascertain whether the contact resistance is within defined limits. This can take place at the end of the production line during quality control.

Cable manufacturers
The resistance of manufactured leads is to be measured. If the resistance is too high, the current-carrying capacity of the cable is reduced. If the resistance is too low, more copper than is absolutely necessary is used for the cross-section of the line and this causes unnecessary expense.

Installation and maintenance of high-current cables,switchgear and on-load tap-changers
In order to prevent connections or contacts from becoming excessively hot, cable connections and switching contacts are required to have as low a resistance as possible.
A poor connection or a poor contact will fail as a result of this warming.
Preventive maintenance with regular resistance measurements ensures the longest possible service life.

Automotive industry
Requirement to measure the resistance of robot welding cables in order to ensure that the weld quality does not deteriorate, e.g. crimp connections of battery cables, air bag detonator resistance, wiring harness resistances, and the resistances of crimp connections on various components.

Railway

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Internet www.kocos.com

Including trams and underground railways -for measurements of high-current cable connections, including the resistance of railway track connections as the tracks are often used for signal information.

Potential and earth connections
Equipotential bonding connections are electrical connections between components and ensure that all are at the same potential. Earth connections establish the connection to earth potential. Both connections are to be measured in order to ensure that the connection has a low resistance value and is maintained. Typical connections are also to be found in switching stations.

Bonding (mass) connections in aircraft
All metallic connections in an aircraft, the frame in particular, must be connected electrically. These bonding connections ensure that protection is provided by the Faraday cage. For this reason, manufacturers are required to measure the bonding resistance of connections during production and maintenance.

KoCoS Messtechnik AG
Suedring 42
D-34497 Korbach
Tel. +49 5631 9596-0
Fax +49 5631 9596-16
E-mail info@kocos.com
Internet www.kocos.com