PROMET R300/R600.
APPLICATION

PROMET R300/R600:
Load test of power connections

Dipl.-Ing. Jürgen Dreier, Product Manager

Whether in the field of power generation and energy supply for households and industry or, for example, in the automotive industry (keyword: electro mobility), electrical connections always have a special significance!

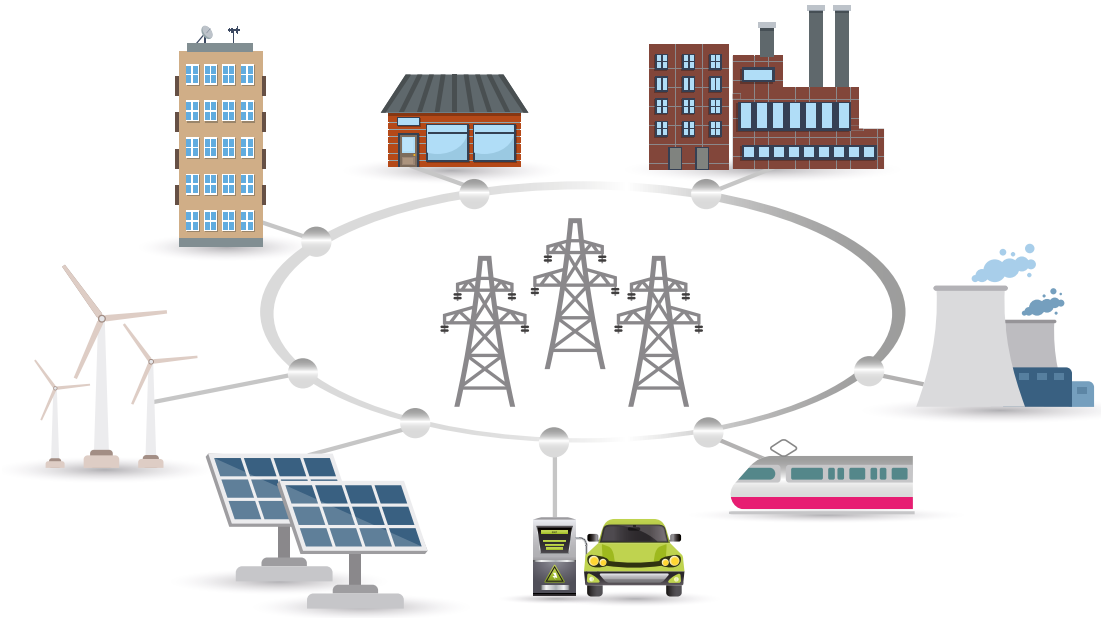

Fig. 1: Power supply from generation to consumer

The reliability and condition of connections have a decisive influence on the availability, safety and economy of electrical systems. Requirements for an electrical connection are permanent contact and low contact resistance. Connections must also retain their fault-free function over the entire service life of an electrical system.

Faulty electrical connections are often due to thermal loads, in the worst case with fire-hazardous temperatures. In electrical systems, circuits are protected by overcurrent protection devices such as fuses, but the protection devices are not suitable for detecting excessive contact resistances or their effect in order to react to them.

When current flows through electrical conductors, the electrical resistance of the junction creates a power loss. Conductor and junction heat up based on the formula $\mathbf{P=I^2 \cdot R}$.

The following examples show the increase in power as the resistance is increased:

$P = (600\ A)^2 / 10\ \mu\Omega = 3{,}6W$

$P = (600\ A)^2 / 100\ \mu\Omega = 36W$

$P = (600\ A)^2 / 1\ m\Omega = 360W$

In addition, metals found in compounds such as copper and aluminum are electrical PTC thermistors whose resistance increases with rising temperature. The more power dissipation is converted into heat at the contact point, the more the temperature rises, which in turn leads to an increase in resistance. Electrical stresses can cause current connections to become loose due to thermal effects. Mechanical stresses can also cause connections to deteriorate, leading to an increase in resistance.

If these basic effects are ignored, excessive heating can cause an electrical system to fail. In the worst case, this is a burnout, which opens a current-carrying circuit. By regularly measuring resistance and performing load tests while applying a current appropriate to the test object, effects such as resistance change, thermal expansion, and mechanical and thermal aging can be investigated and failures prevented.

Load test with PROMET R300 and R600

Especially for load tests, the PROMET R300/R600 resistance measuring instrument offers the possibility of applying high currents to the test object in a definable time. In automatic mode, the duration of the current output is automatically adjusted so that the shortest measurement duration is always applied.

In addition, the output duration of the test current can be set. Start and end of the current output can additionally be defined as a current ramp. In resistance measurement mode, the output and ramp time can be up to 999 seconds (approx. 16 minutes). In constant current mode, the output is permanently switched on until manual termination.

Measurement example for load testing

In the following measurement example, a copper bar with a cross section of 30 x 5 mm and a screw connection is subjected to a current of 600 A. The terminals of the voltage drop measurement are 300 mm apart.

Fig. 2: Measurement setup with PROMET R600 micro-ohmmeter

First, a resistance measurement was performed before the load test. At an ambient temperature of approximately 21 °C, a resistance of R = 46.56 µΩ was measured

For the load test, the ramp times from 0 to 600 A are parameterized with 10 seconds each. The constant current output for 180 seconds. The temperature sensor is mounted on the bus bar.

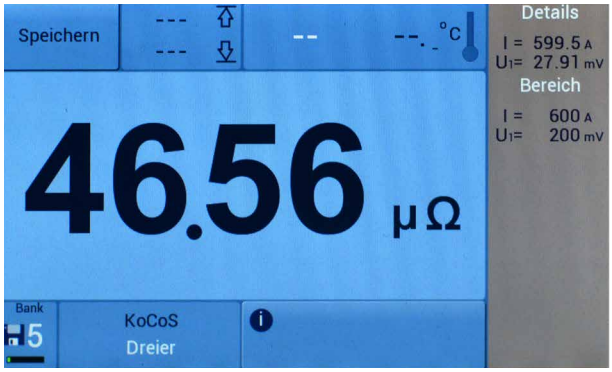

Fig. 3: Resistance measurement

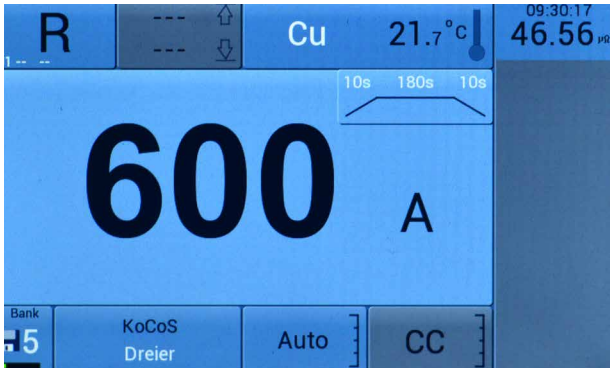

Fig. 4: Measurement settings for the load test

After the 200 seconds of load testing, the temperature at the bus bar has risen to 45.7 °C. The resistance has changed to 52.40 µΩ. The value compensated to 20 °C was calculated to be 47.60 µΩ.

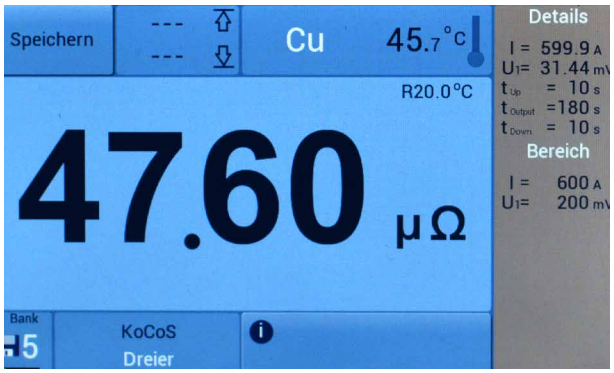

Fig. 5: Measurement result with uncompensated value and value compensated to 20 °C

Summary

When distributing electrical power, it is important to remember that poor connections cause losses that can lead to overheating and, in the worst case, interruption or burnout. Proper installation and regular maintenance, e.g. by means of a resistance measurement, are essential for a reliable power connection.

In combination with a load test, the correct function of a power connection can be proven and a reduction of electrical losses, an extension of the service life and an increase in safety can be achieved.

Not only for resistance measurement on power connections but also as a constant current source for load tests, the PROMET R300 and PROMET R600 resistance measuring instruments offer optimal conditions.