



Distributed Temperature Monitoring
of Energy Transmission Systems



Real Time Thermal
Rating (RTTR) –



Sophisticated Answers for
Modern Power Management



Real Time Thermal Rating (RTTR) – Sophisticated Answers for Modern Power Management

Rising demand for electricity is creating the need for utilizing important transmission backbones at their maximum capacity. Enormous benefits can be generated by improving utilization of existing and future installations, and this is where LIOS can supply valuable assistance. Based on the real time temperature measurements along the entire cable circuit and the actual electrical current reading LIOS builds the exact dynamic cable rating of the installation, based on the IEC 60287 and IEC 60853 standards.

The RTTR calculation engine computes the current-carrying capacity (or ampacity) under given conditions of the underground cable installation for the steady state and transient. Cable Operators will greatly appreciate the transient simulation that will allow them to estimate the current that can be safely transferred from another circuit to the monitored installation, due to unusual operating conditions in situations such as emergencies, maintenance, outages, faults, etc. The RTTR engine can be used for emergency ratings from 10 minutes and up to 2000 hours. This covers the entire emergency rating spectrum since typically emergencies last a few hours or days.

Power cable monitoring combined with Real Time Temperature Rating (RTTR) provides valuable data to Operators:

- Steady State Operation – Power cable conductor temperature at the core of the conductor



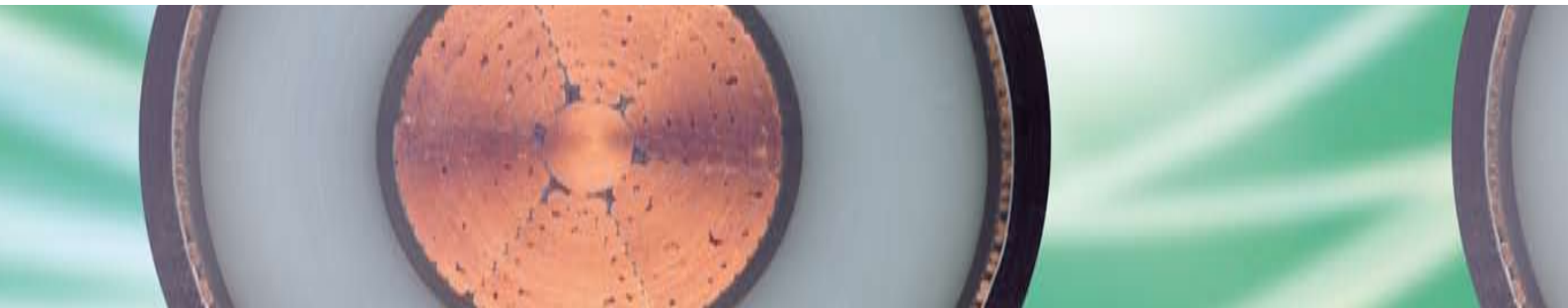
Sensor Cable

Passive and Maintenance-free Sensors for Your Assets

LIOS Technology provides the appropriate sensor cable for retrofit or newly built projects. One vital component is a stainless steel or plastic tube that can accommodate multiple optical fibres. The wall thickness of the sheathing of the tube, and the material used to make the sheathing, can be adjusted particularly to the necessary requirements.

For retrofit applications we recommend the use of metal free cable easily mountable on the surface of the power cable whereas new installations should gain from the benefit of embedding an appropriate cable into the power cable directly.





■ **Transient Operation – Emergency ratings, transient calculations for Time/Current/Temperature**

Furthermore, the RTTR system can provide continuous and automatic adjustment of calculation parameters such as (ambient temperature, thermal resistivity, etc.).

Modelling Capabilities

Virtually every cable construction available in the market can be modelled: one-core, three-core, sheathed cables, concentric neutrals, armoured cables, screens, shields, beddings, servings, jackets, combined sheath, etc. Most of the installation types

can be modelled: duct banks, backfills, directly buried, buried ducts, buried pipes, cables in air (including groups of cables and riser poles) and cables in tunnels.

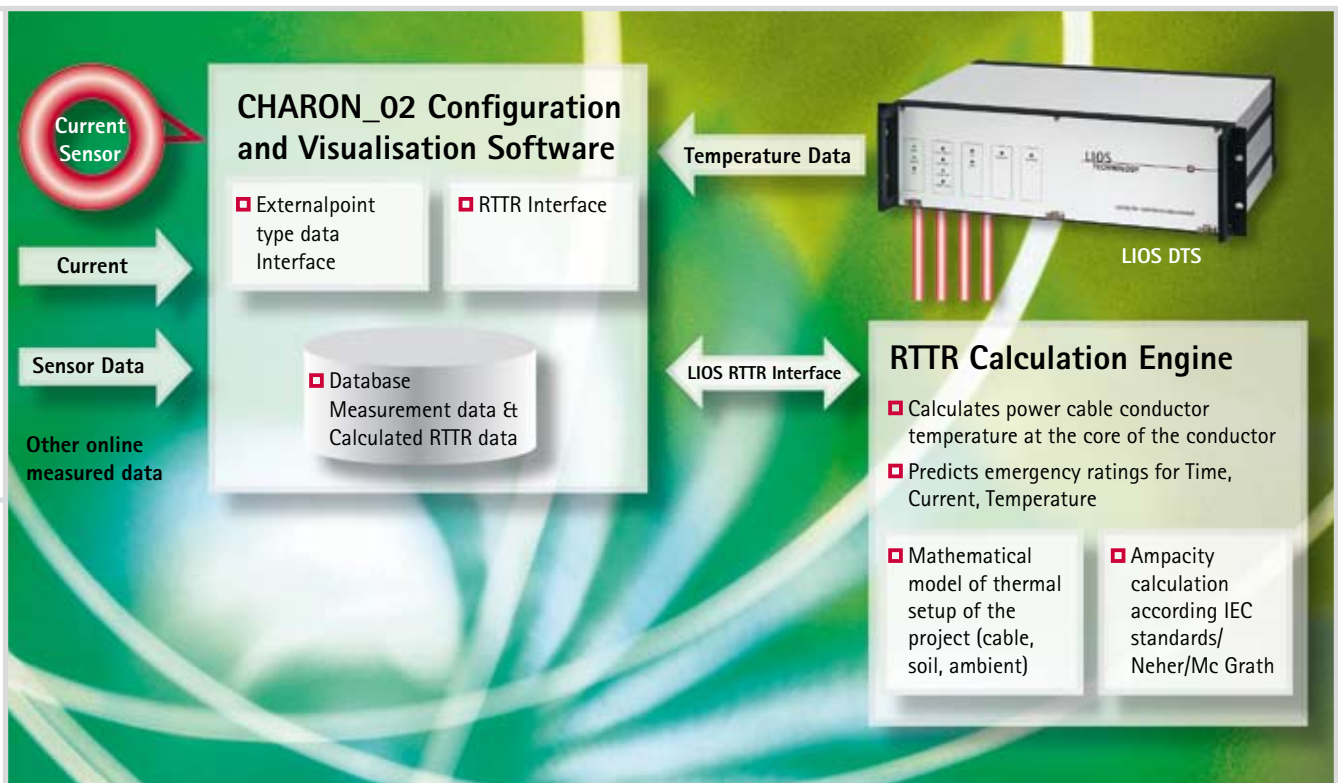
The installation may include adjacent heat sources/sinks such as steam or water pipes. Unique to LIOS RTTR is its ability to model several materials with different thermal resistivities, for example: stratified soil layers, multiple duct banks and multiple backfills.

Transient Calculations

The cable operating temperature very

much depends on the load shape applied to the cable. In other words, the temperature of a cable depends on the intensity of the current and its time variations. Therefore, cables have different ratings, i.e. steady state, cyclic, emergency and short circuit. Since cables installations have thermal inertia, it takes time to heat up the cable and its surroundings.

The emergency rating provides the following information useful for the cable operator under newly given operating conditions:



Increase Grid Safety and Prolong Working Life of your Assets



- Based on a higher load applied for so many hours: What the cable temperature will be at the end of the emergency case?
- Given the operating temperature and the applied (over) load, the RTTR software predicts the temperature of the cable in the future.
- Based on a higher load for a given period of time When will the installation reach its design emergency temperature?
- Given the operating temperature and the applied (over) load, the RTTR gives the time that it will take to the cable to reach a specified emergency temperature.
- Based on initial conditions and a maximum operating temperature What is the maximum current that can be pushed in the system?
- Given the operating temperature and a time frame for an over load, the RTTR computes the maximum current that the circuit can carry to reach certain emergency temperature.

Seamless Data Integration

LIOS DTS systems are perfectly suited for seamless integration into existing or new network or SCADA infrastructures. DTS measurement data, data of point type sensors (like conductor currents) and RTTR calculation outputs (like ampacity predictions) can be directly linked to SCADA and other overall management systems by proven protocol conversion libraries using industry standard protocols, like DNP3, IEC60870-5-104, POCS WITSML, Modbus (Master/Slave) etc. The DTS' communication module provides Ethernet access and comes with on-board storage of measurement data for automatic buffering in case of network break downs.

The CHARON_Q2 configuration and visualisation software associated with the DTS systems can be adapted to specific requirements and offers numerous options for displaying and processing the recorded measuring data. Its comprehensive database can handle huge amounts of historian measurement data of multiple DTS, point type sensors and RTTR calculation results.

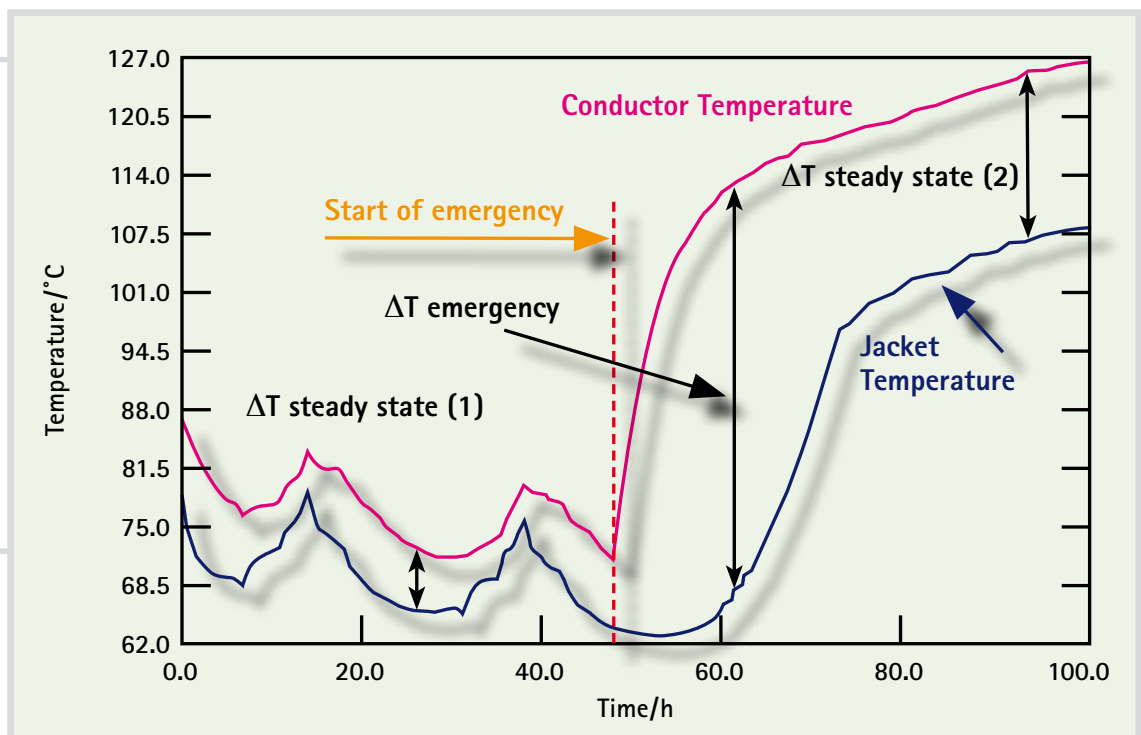


Why Adding RTTR to Distributed Temperature Sensing?

RTTR removes all uncertainty left by the DTS. The DTS measures the real time temperature at the sheath or jacket of a cable. The sheath temperature gives a good idea of the temperature of conductor, but unless an accurate model for the conductor is provided there will be some uncertainty left.

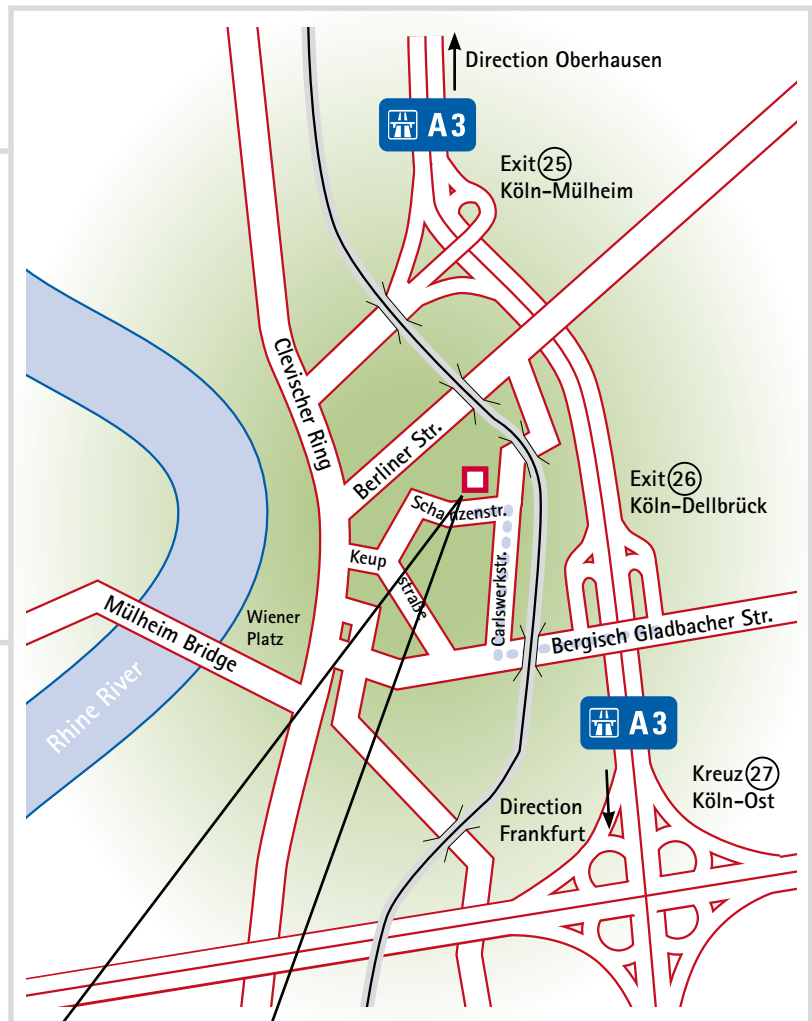
The uncertainty is small during steady state operation, but it could be (very) large during an emergency situation. The following figure illustrates the temperature of the jacket and conductor

during an emergency situation. One can appreciate that while the temperature difference (ΔT) between the jacket and the conductor can be small in steady state (1). However, moments after the onset of an emergency situation the temperature difference could be very large. The reason is that cable insulation has a large inertia and therefore the heating of the conductor can only be detected at the jacket several minutes (to hours) later. Additionally, the temperature difference changes with the loading level. The temperature difference is larger for larger loading levels.



About US

LIOS Technology GmbH – Linear Optical Sensors is the German based, global leader in the development and supply of state of the art frequency domain based distributed temperature monitoring systems. The LIOS DTS product line comprises a range of real-time, fibre optic based linear temperature measuring devices. LIOS offers Real Time Thermal Rating (RTR) solutions for ampacity predictions of the power cable and overhead transmission line installation transparently integrated with its field proven DTS systems.



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