

We take care of it.



Forewarned is Forearmed.

TraCoMo™ – Transformer Control and Monitoring System

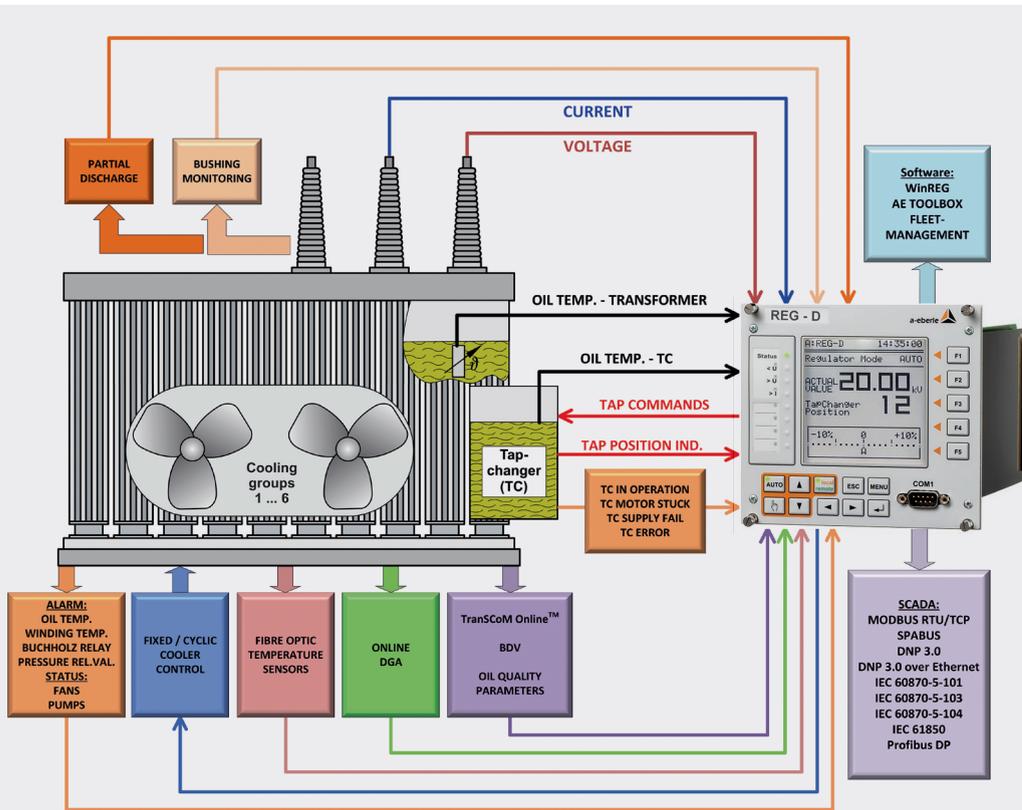


TraCoMo™

- Automatic Voltage Regulation (AVR)
- Transformer Monitoring
- Tap Changer Monitoring
- Fibre Optic Winding Temperature Monitoring
- Online Dissolved Gas Analysis (DGA)
- Bushing Monitoring
- Partial Discharge
- Breakdown Voltage

TraCoMo™





REGSys™

TraCoMo™

Transformer Control and Monitoring

Power transformers are key components of an electrical supply grid. The failure of a transformer not only has major economic consequences for the energy supplier, but it can also lead to serious losses for consumers.

To keep an eye on such a key asset it is possible to use the online monitoring data to do condition based, instead of time based, maintenance. The net result of this is a reduction of costs and unplanned outages.

To achieve this, it makes sense to monitor the transformer as closely as possible, to record its temperature evolution (the thermal image) and to collect information about the current load and the expected remaining service life as well as moisture content on oil and paper.

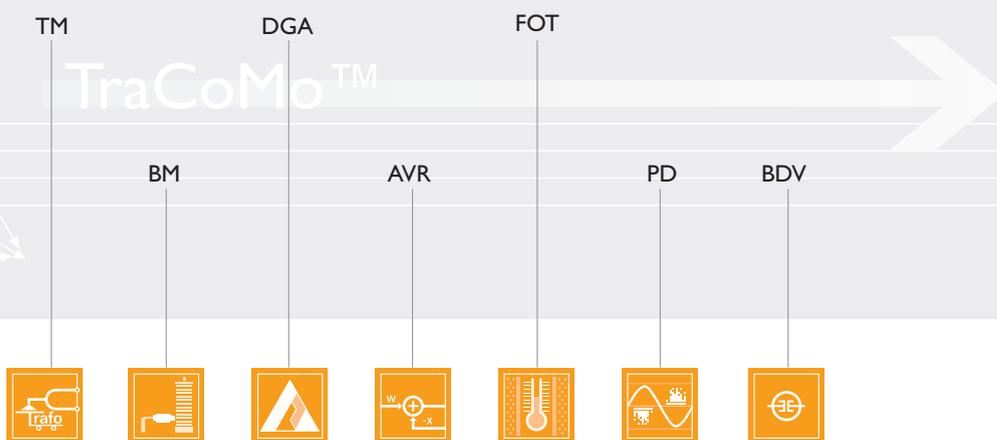
This task – based on IEC standards – is solved by electronic measuring and computing facilities. The basic monitoring consists of monitoring the easily accessed transformer's main parameters.

The hot spot temperature is determined from the oil temperature and the current in accordance with IEC 60354 or IEC 60076 and extrapolated to the transformer's service life consumption.

Additional alarms such as Buchholz pre-warning and/or Buchholz tripping can be fed into the monitoring system as binary signals, displayed and sent to a SCADA system for further processing.

Transformer Health Guaranteed

by TraCoMo™ – Transformer Control and Monitoring System



Basic monitoring and control features are covered by the OLTC control and Transformer monitoring system REGSys™.

The device is also the foundation for the TraCoMo™ system that uses the proven AVR's REG-D™ and REG-DA as well as the monitoring devices REG-DM and REG-DMA as centralized control and monitoring units, which are the brain of TraCoMo™.

To fulfill this task the TraCoMo™ system uses an upgraded processor, special software features as well as special screens and programming integrated on the REGSys™ platform.

Furthermore the TraCoMo™ system

consists of a large number of specialized sensors and devices.

Thereby the TraCoMo™ system is not only focused on sensors and devices manufactured by A. Eberle. The system is able to integrate various types of sensors via binary and analogue signal and protocol based communication (e.g. MODBUS or IEC 61850 GOOSE).

The modular design of the TraCoMo™ hard- and software enables also a step by step solution without big efforts and costs. For example it is possible to start with a REG-D™ AVR and upgrade it step by step to a fully featured monitoring system provided that the base system has been prepared for this expansion.

ACRONYMS

- TM** Transformer Monitoring
- BM** Bushing Monitoring
- DGA** Dissolved Gas Analysis
- AVR** Automatic Voltage Regulator
- FOT** Fibre Optic Winding Temperature Monitoring
- PD** Partial Discharge / on request
- BDV** Breakdown Voltage / on request



REGSys™



REGSys™ – REG-D™ /-DA with transformer monitoring functionality



The well-known voltage regulation system REGSys™ can be acquired with useful add-ons designed to care for all control and transformer monitoring functionalities around the power transformer. It also enables users to have a complete replacement of conventional (RTCCs) remote tap changer control cubicles.

Several programmable analogue inputs (e.g. mA, PT100) guarantee 100%-transformer monitoring parameter. As an example the system can monitor tap positions -with/without paralleling of transformers, oil and winding temperatures, dissolved gases in oil, moisture in oil, water in paper as well as bubbling temperature.

REGSys™ offers in addition intelligent fan or fan group and oil pump control.

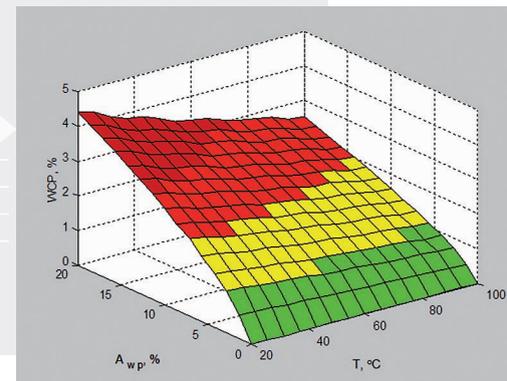
Based on this functionality it helps to achieve energy conservation as well as equal utilization of all fan or fan groups. With additional programmable binary inputs, all digital information from the power transformer side, (e.g. like Buchholz alarm/-trip, oil level low, tap changer motor trip) can be monitored, signaled and logged in the event recorder.

All tap changing operations as well as voltage violations are also logged by the event recorder.

A Transformer Allrounder

REGSys™ – OLTC Control and Transformer Monitoring System

TraCoMo™



Water content in paper (Wcp) depending on the temperature (T) and the water in paper activity (Awp) with diagnostic (color of the squares)

The tap changer statistics account for every tap operation so that it is possible to find out which tap position has been used and how often in general.

The statistic per tap is done under load, although total tappings are logged too. That means there is a current limit that defines „under load“ (standard: 5 % of nominal current). In addition the so called I^2t -value (fingerprint), indicator for the contact wear of the diverter switch of the tap changer, is calculated.

REGSys™ offers additionally the possibility of recording all standard measurement values (e.g. voltage and current, active and reactive power, oil

and winding temperature, respectively on continuous basis.) These records can be downloaded at a later date in the event of any requirement for analysis or investigation.

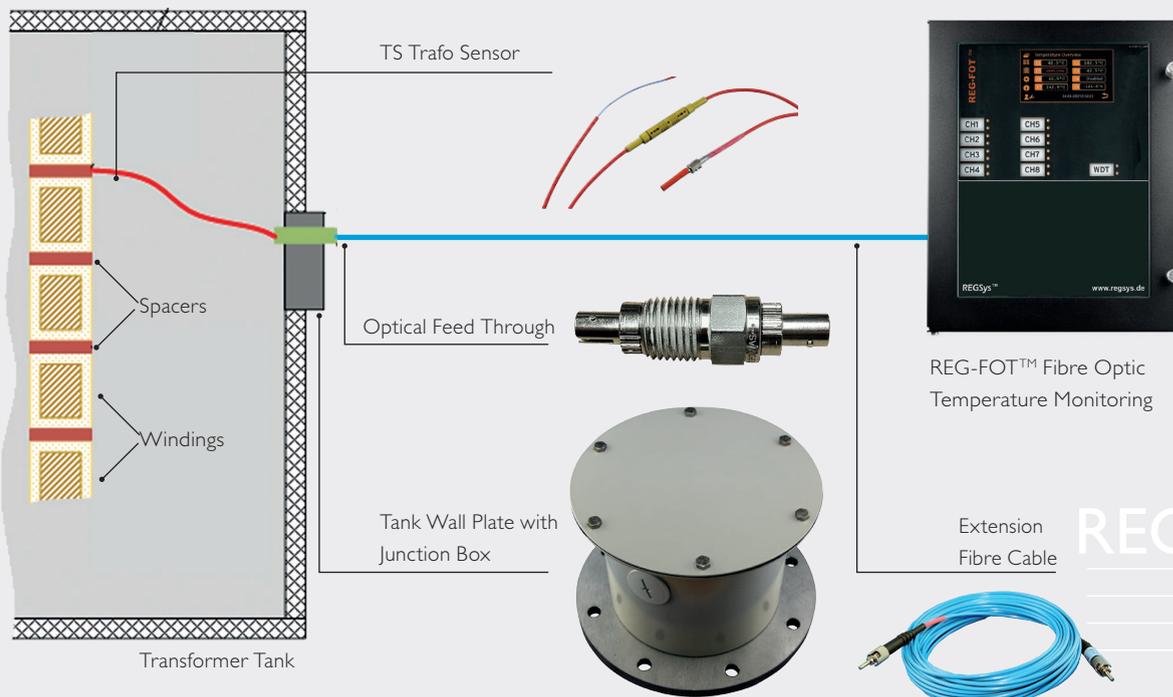
REGSys™ can be easily integrated into all SCADA systems through various protocols, including IEC 61850.

On the other hand REGSys™ can also act as a gateway that collects data from the sensors installed in the field via e.g. MODBUS or IEC 61850 GOOSE.

This data can be used not only for monitoring but also for OLTC control.

KEY SYSTEM FEATURES

- Tap changer control (AVR)
- Parallel operation of transformers
- Statistics
- Recorder function
- Logbook (event recorder)
- PLC functionality
- Hot spot temperature and loss of life calculation (IEC 60354 / 60076)
- Limit supervision (e.g. voltage, current, oil and winding temperature, oil level, moisture and gas in oil etc.)
- Fan and pump control
- Operating hours of pumps and fans
- Water in paper assessment
- Bubbling temperature evaluation
- Overload prediction
- Efficiency calculation
- SCADA integration
- Gateway function to collect, store and evaluate external sensor data



REG-FOT™

Fibre Optic Winding Temperature Monitoring



The REG-FOT™ is an accurate thermometer that is ideally suited for temperature measurement of hot spots in transformer windings. This multichannel device together with the TS Trafo temperature probe allows extremely precise measurements. The direct installation of the sensors in-between the winding layers makes fast online monitoring possible.

The fibre optic temperature sensors for high voltage temperature

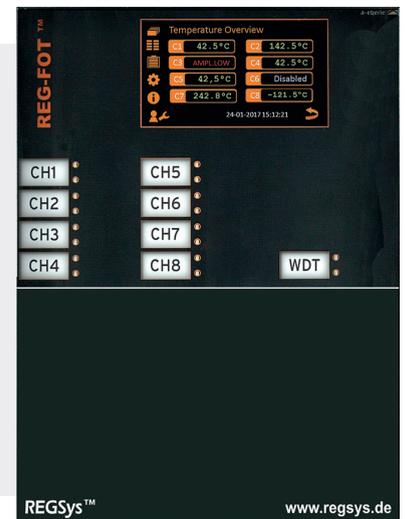
measurement are based on white light absorption/transmission by a GaAs (Gallium Arsenide) semiconductor.

The effects of the temperature variations on this semiconductor are well-known and predictable. As the temperature of the semiconductor increases, the semiconductor's transmission spectrum (i.e. the light that is not absorbed) shifts to higher wavelengths.

A Deeper Look Into The Transformer

REG-FOT™ – Fibre Optic Winding Temperature Monitoring

TraCoMo™



Transformer direct winding temperature monitoring can be achieved by monitoring the absorption shift of light in an optic fibre.

At any given temperature, transmission essentially jumps from 0 % to 100 % for a specific light wavelength. This jump is called the absorption shift. The relationship between the specific wavelength where the absorption shift takes place and temperature is predictable.

The TS Trafo sensor used for the

temperature measurement consists of a teflon coated glass fibre, which is provided with a GaAs crystal at the fibre tip and is therefore completely nonmetallic. The sensors are designed to withstand harsh and aggressive environments.

The TS Trafo sensor provides full immunity to magnetic fields, high voltages, RF and microwave radiation, high capability in high-temperature areas, high safety and a non-invasive use.

KEY FEATURES

- Direct measurement of the winding temperature
- Up to eight measuring channels
- Immune to signal attenuation
- No calibration in the field
- Temperature limit supervision for each channel
- Analogue outputs (mA or V) for the temperatures
- HMI with color display and touch screen
- Metal housing with IP 54
- Integrated MODBUS interface
- SCADA connection (e.g. IEC 61850) as option



REG-DGA

Dissolved Gas Analysis



Analysis of the gases dissolved in oil is recognized as one of the most useful tools for early detection and diagnosis of incipient faults in power transformers.

In addition, water contamination deteriorates the performance of the oil as high moisture content increases the risk of corrosion and overheating. This appears in particular when the water content

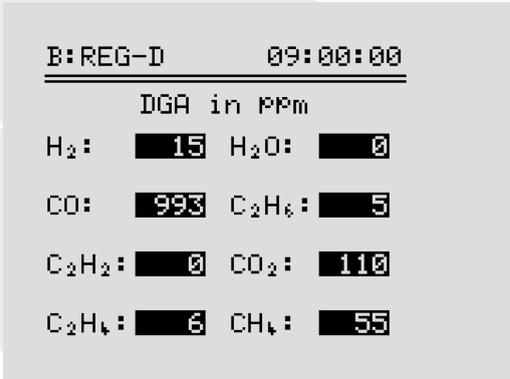
reaches the saturation point of the oil and hence free water appears.

Beyond regular Dissolved Gas Analysis (DGA) and offline moisture analysis of the insulation of power transformers, online monitoring systems are gaining importance worldwide. By online monitoring key fault gases and moisture, additional cost reductions and safety improvements can be gained.

The Transformer Blood Work Investigation

REG-DGA – Online Dissolved Gas Analyzer

TraCoMo™



Measurement values of the DGA shown on one of the TraCoMo™ screens.

As hydrogen (H₂) is involved in nearly every fault of the insulation system of power transformers and carbon monoxide (CO) is a sign of an involvement of the cellulose / paper insulation, the presence and increase of acetylene (C₂H₂) and ethylene (C₂H₄) further classifies the nature

of a fault as overheating, partial discharge or high-energy arcing.

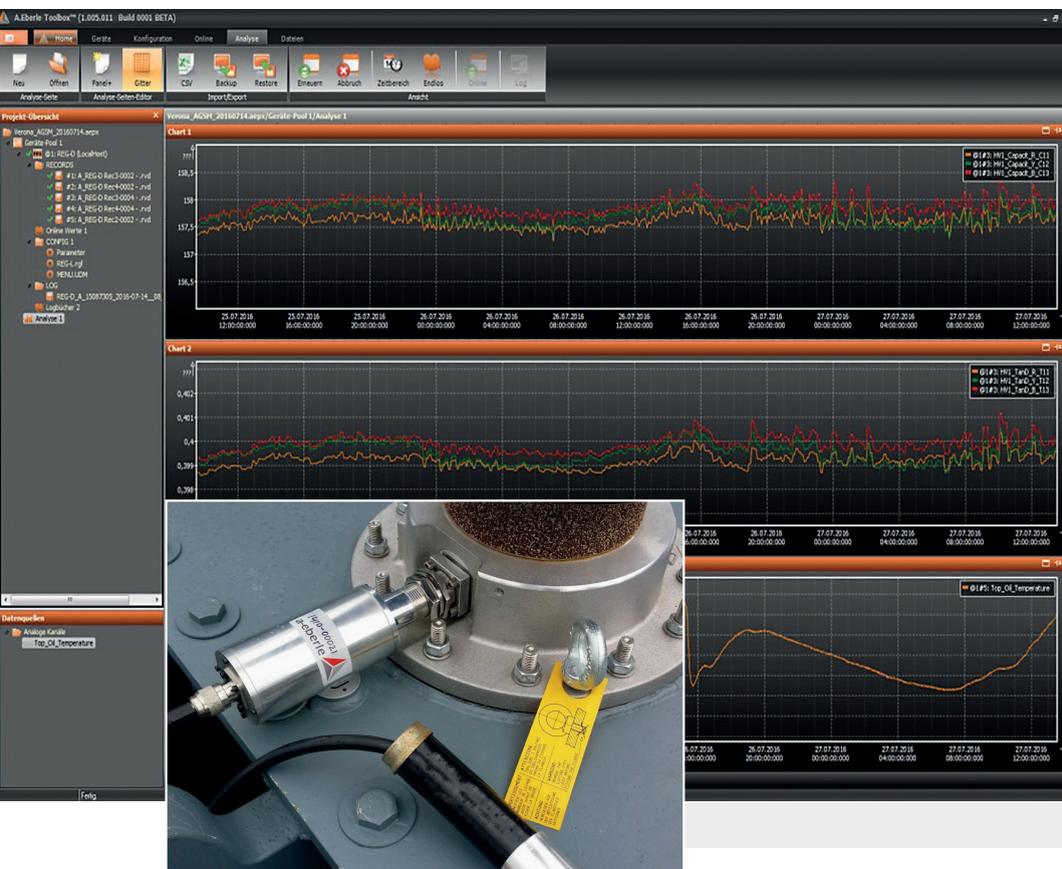
Furthermore, the presence of methane (CH₄) and ethane (C₂H₆) helps in analytics such as Duval's Triangle, Roger's Ratio and Dornenburg Ratio.

KEY FEATURES

- Easy installation on operational transformers
- No shutdown necessary for installation
- Light weight
- Tank easy mounting
- No moving parts
- MODBUS connection
- Integration with REGSys™ (and IEC 61850 if required)
- Duval's Triangle
- Roger's Ratio
- Dornenburg's Ratio
- GSM optional on board

	TDCG	H ₂	CO	H ₂ O	CO ₂	C ₂ H ₄	C ₂ H ₂	CH ₄	C ₂ H ₆	O ₂
HC01+	▲			▲						
HC03		▲	▲	▲						
HC05		▲	▲	▲		▲	▲			
HC08		▲	▲	▲	▲	▲	▲	▲	▲	
HC09		▲	▲	▲	▲	▲	▲	▲	▲	▲

TDCG: Total dissolved combustible gases



REGSys™

REG-BM™

Online Bushing Monitoring



Performing bushing time based maintenance may not be sufficient due to following reasons:

- Possibility of developing a defect between two maintenance intervals
- Planning of outage management
- Need of trained testing crew for every substation

By implementing the A. Eberle online monitoring methodology, the user can monitor the condition of bushings continuously and thereby can plan corrective measures to avoid any catastrophic failures.

REG-BM™ is a continuous online monitoring system based on the

Schering Bridge principle for monitoring the capacitance and $\tan \delta$ in high voltage condenser bushings.

The system consists of a Bushing Tap Coupler (BTC) used to create a voltage divider circuit by affixed to the bushing test tap.

The Data Acquisition Unit (DAU) is used to acquire, analyze and record the voltage from the BTC. It also acquires, analyzes and trends the data pertaining to capacitance and $\tan \delta$ of the bushings.

The unit can be interfaced to any existing SCADA by using various communication protocols (e.g. IEC 61850).

Extend Your Monitoring Horizons

Additional Transformer Monitoring Solutions

TraCoMo™



TranSCoM Online™

Breakdown Voltage
on request



The newly introduced TranSCoM Online™ technology provides the ability for electrical power supply grids to react in real time to problems caused by oil insulation quality reduction.

Automatic online monitoring of the transformer oil dielectric strength (BDV) allows to survey the safety condition of the transformer oil, to get trends and to undertake measures for improving the safety of the transformer, e.g. by oil purification or oil reclamation.

Each transformer is unique due to its own history, ageing stage and loading patterns. TranSCoM Online™ technology makes it possible to comprehensively acquire the individual fingerprints of the transformers and their "whole life story".

Only with this knowledge a reliable prediction of their remaining service lifetime could be achieved. That is precisely what the operator wants to know: How long will it take before the transformer needs to be replaced?

If you would like to know more about breakdown voltage evaluation and partial discharge, please contact A. Eberle or one of its representative.

Partial Discharge

on request



Partial discharge (PD) measurements are a proven method for effective, non-destructive evaluation of electrical insulation, preventing expensive unplanned outages by detecting insulation problems before they can cause breakdowns.

The partial discharge monitoring system employs a digital PD detector for permanent installation and continuous monitoring of medium and high-voltage insulation. In addition to this brain, the system consists of bushing couplers, UHF transformer sensors, signal couplers and a preamplifier.

The system is also applicable on GIS installations and in high voltage test facilities.

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