



# Calisto 2

Hydrogen - Carbon Monoxide - Moisture

by Morgan Schaffer

High accuracy IED for transformer fault detection  
and insulation condition monitoring

**MS MORGAN<sup>®</sup>  
SCHAFFER**  
*Transformers - The Inside View*

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## Monitor what is essential for effective predictive maintenance

Calisto 2 delivers accurate, cost-effective and essential monitoring to keep your fleet running. Incorporating the latest enhancements to Morgan Schaffer's benchmark measurement technologies, Calisto 2 is a substation-tough IED that detects transformer faults at their earliest stage while monitoring conditions of cellulose degradation. Engineered for CE conformity and versatile connectivity, Calisto 2 features relays, analog I/Os and the most popular industry communication protocols: Modbus, DNP3 and IEC 61850.

## Detect transformer faults at their earliest stage

Hydrogen is produced to a greater or lesser extent by all transformer faults. Calisto 2 measures dissolved hydrogen continuously and accurately. Installing Calisto 2 on your critical transformers guarantees that incipient faults will be detected at their earliest stage, thus reducing unplanned outages and the risk of catastrophic failure.

## Monitor conditions of insulation degradation

Insulation integrity is vital to your transformer's operation. Moisture buildup and transformer overheating are two conditions which may lead to irreversible insulation degradation. Calisto 2 accurately monitors the evolution of both moisture and carbon monoxide, allowing optimal scheduling of additional insulation integrity tests such as Dissolved Gas Analysis (DGA) and Furan testing.



## High accuracy IED for transformer fault detection and insulation condition monitoring

Calisto 2, Morgan Schaffer's newest IED, monitors dissolved hydrogen, carbon monoxide and moisture in oil. Building on more than 15 years of experience in the design and manufacture of on-line monitors and portable gas analyzers, Calisto 2 employs Morgan Schaffer's latest innovations in dissolved hydrogen, carbon monoxide and moisture measurement. Calisto 2 dependably delivers accurate concentration measurements all the way down to the lowest detection limits in the industry.

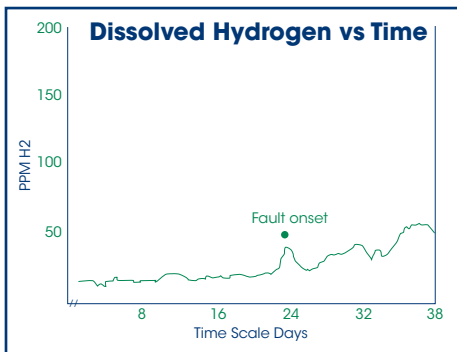


## HYDROGEN MONITORING

Even at the earliest stages of fault development, both thermal and electrical stresses on transformer oil will generate dissolved hydrogen. In addition, the highly mobile hydrogen is quickly distributed throughout the oil, providing an early and reliable fault signature.

Calisto 2 excels at timely and accurate low-level hydrogen measurements. When installed on your critical transformers, Calisto 2 provides the earliest possible fault detection, and allows accurate real-time monitoring of subsequent fault evolution.

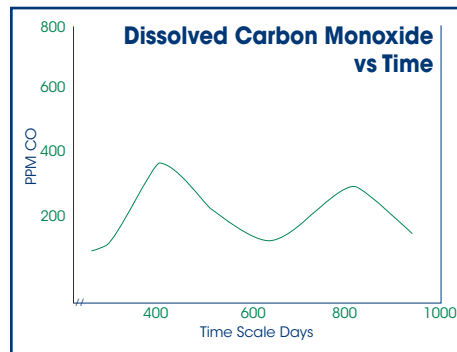
Morgan Schaffer's unique hydrogen measurement technology requires no calibration and is field-proven to prevent equipment failure and extend transformer life.



Fault onset on 750 MVA transformer, detected at low hydrogen concentration (25 ppm)

## CARBON MONOXIDE MONITORING

Carbon monoxide is a by-product of cellulose degradation. Although generated in all transformers under normal operating conditions, anomalous amounts of carbon monoxide may be generated when localized cellulose overheating occurs. Calisto 2 provides a dependable measurement of the CO baseline, and will alarm on a sudden increase of CO concentration. Timely follow-up with laboratory DGA and furan analysis will enable early detection of accelerated aging of solid insulation, before significant and irreversible damage is incurred.

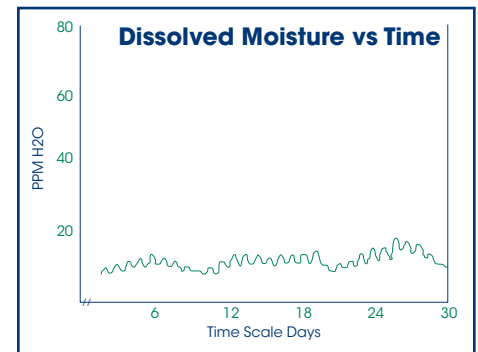


Typical long term carbon monoxide behavior on 700 kV, 170 MVA transformer

## MOISTURE MONITORING

In combination with polar products and acids, moisture can significantly affect the dielectric properties of insulating fluids and materials. Engineered for reliability, Morgan Schaffer's solid-state moisture-in-oil sensors deliver exceptional accuracy when compared against laboratory measurements and moisture-in-oil standards. Precision temperature measurement and proven conversion algorithms are used to report moisture content in parts per million (ppm), %RS at 25°C or %RS at a specific transformer temperature<sup>(1)</sup>. Load based moisture variations can therefore be tracked accurately and corrective actions undertaken with confidence in cases of troublesome trends or unexpected transients.

(1) Refer to Calisto Expert Series for Calisto Oil Temperature Probe.



Typical daily and weekly moisture behavior pattern from transformer installed in Arizona, USA

## TEMPERATURE CONDITIONING

Oil temperature variations compromise the accuracy of on-line gas measurements. Gas solubilities and diffusion rates vary significantly with temperature, and the variations depend on oil type, age and purity. Calisto 2 eliminates the impact of oil temperature variations by heating or cooling the oil to a precise standard temperature, enabling concentration measurements of unequalled sensitivity, stability and accuracy.

## GAS MEASUREMENT TECHNOLOGY

Morgan Schaffer's proprietary second-generation gas measurement cell sets a new standard for accuracy and low-level measurements of both H<sub>2</sub> and CO in transformer insulating fluids. Dissolved gases from the oil quickly equilibrate with gases in the cell through Morgan Schaffer's ultra-reliable vacuum-tolerant Teflon capillary probe. Every Calisto 2 monitor is calibrated using certified gas mixtures traceable to NIST and Morgan Schaffer's IEC/ISO 17025 certified oil-testing laboratory.

## OIL CIRCULATION

For reliable readings and fast response to transients, Calisto 2 continuously draws representative oil from the transformer using an internal electromagnetic pump with an outstanding reliability record. An oil flow monitoring system ensures adequate flow is maintained at all times.

## COST BENEFITS

Investing in a Calisto 2 will reduce capital expenditures and operating costs:

- Reduced unplanned outages
- Prevent irremediable deterioration of solid insulation
- Reduce downtime from false alarms
- Optimize your maintenance schedule
- Better control of load on equipment known to have faults
- Prevent equipment failure and production losses
- Monitor critical equipment continuously

## TECHNICAL BENEFITS

- Unit can be field installed and commissioned in less than 5 hours
- Easily integrated to existing data acquisition or transformer/sub-station monitoring systems
- Reliable, accurate and stable signals
- Eliminates sampling and analysis for moisture content
- Fast response to fault onset
- Vacuum tolerant

## FEATURES

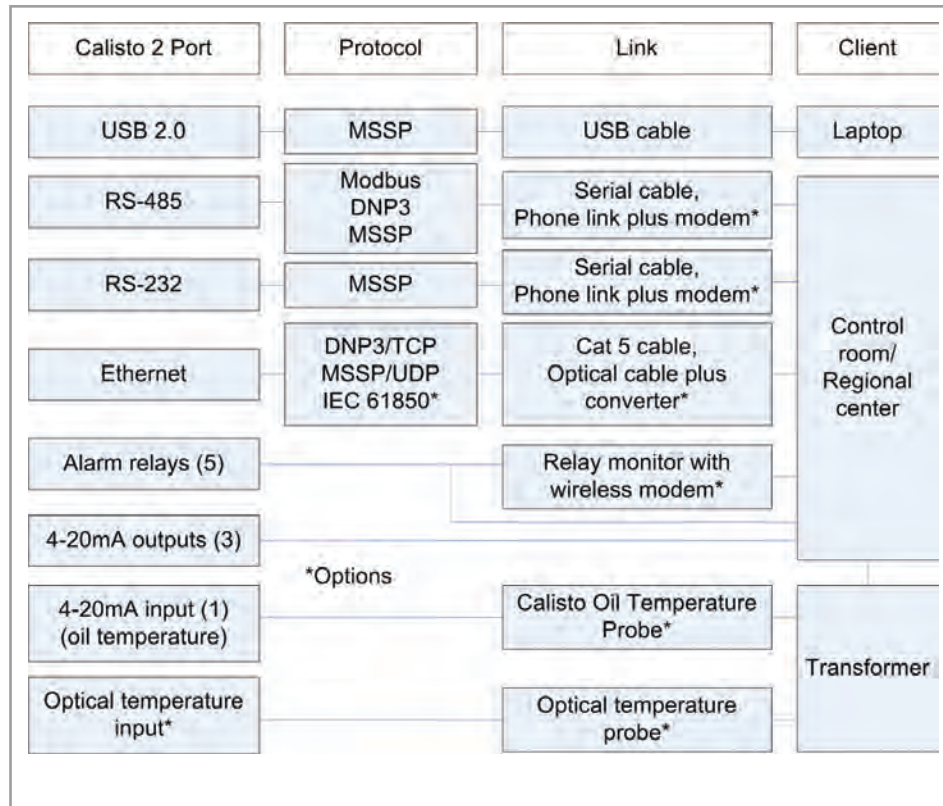
- Accurate Hydrogen and Carbon Monoxide measurements
- Continuous moisture monitoring
- High sensitivity and wide range
- Continuous oil circulation with flow monitoring
- Proven dissolved gas extraction technology
- Extensive connectivity features and protocols
- Optional Calisto Expert Series accessories
- Optional fiber-optic temperature input kit

Significant changes in Hydrogen concentrations should lead to immediate laboratory dissolved gas analysis (DGA). High levels of dissolved moisture and/or carbon monoxide should be complemented by frequent ASTM oil quality tests and Furan analysis.



## VERSATILE CONNECTIVITY

Calisto 2 can be operated on-site using its standard day/night VFD display and 3-button interface panel. However, numerous standard connectivity features offer improved functionality. Three isolated 4-20mA outputs are provided, for hydrogen, carbon monoxide and moisture measurement transmission. Five NO/NC relays can be configured with regular or fail-safe logic to react to measurement level alarms, trend alarms or self-test errors. Digital communication can be established using local USB-2, and isolated RS-232, RS-485 and Ethernet ports. Native protocols include MSSP, Modbus and DNP3, and an optional IEC 61850 kit is available. An isolated 4-20mA oil temperature input can also be used with Morgan Schaffer's Calisto Expert Series Oil Temperature Sensor. Other options include a fiber-optic temperature input kit, modem, and wireless modem.



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Our mission is to maximize protection of oil-filled electrical assets against incipient faults by providing the worldwide power industry with knowledge, products and services of the highest precision and accuracy.

VISIT OUR WEBSITE AT: [www.morganschaffer.com](http://www.morganschaffer.com)