

The Eaton logo is displayed in white, bold, sans-serif font. It consists of the letters 'E', 'A', 'T', and 'N' with a small circle between the 'A' and 'T'. The background of the entire page is a silhouette of a power line tower against a vibrant orange and yellow sunset sky.The Cutler-Hammer logo is displayed in white, bold, sans-serif font. It consists of the words 'Cutler-Hammer' with a hyphen between the two words. The background of the entire page is a silhouette of a power line tower against a vibrant orange and yellow sunset sky.

FaultGard

Dissolved Hydrogen and Water Monitor

FaultGard

High accuracy relay for transformer fault detection and moisture monitoring

FaultGard is a high accuracy predictive relay designed to detect incipient faults and monitor moisture content in critical oil-filled transformers. The instrument is specially designed to withstand extreme environments and to be easily integrated to SCADA and larger transformer/substation monitoring systems.

Detect transformer faults at their earliest stage

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

Integrity, continuously

Insulation integrity is vital to your transformer's operation. Moisture content can quietly build up to the point where serious deterioration to the paper/oil system can arise, leading to major transformer problems. FaultGard detects and monitors the evolution of dissolved water and is therefore an invaluable tool in assessing insulation integrity on a continuous basis.



FaultGard

The future of predictive maintenance

FaultGard is Eaton's newest predictive relay for monitoring dissolved hydrogen and water in oil. Based on more than 10 years of experience in the manufacturing of on-line monitors and portable gas analyzers, FaultGard uses Eaton's latest developments in dissolved hydrogen and water measurement technologies to offer unequalled measuring performance, especially at low concentrations.

Dissolved hydrogen monitoring

Hydrogen is a reliable indicator of a recent or existing fault as it is produced to a greater or lesser extent by all fault types. Hydrogen's low solubility in oil and high diffusibility facilitate its detection at low concentrations thus providing the earliest warning of the presence of a fault. Installing FaultGard on critical transformers guarantees that low levels of dissolved hydrogen will be detected as soon as an incipient fault appears. FaultGard will prevent equipment failure and extend transformer life

Water-in-oil monitoring

In combination with polar products and acids, dissolved water can significantly affect the dielectric properties of insulating fluids and materials. Monitoring dissolved water over an extended period of time and taking proper action after a sudden or abnormal increase in dissolved water will extend the life, performance and serviceability of oil-filled equipment.

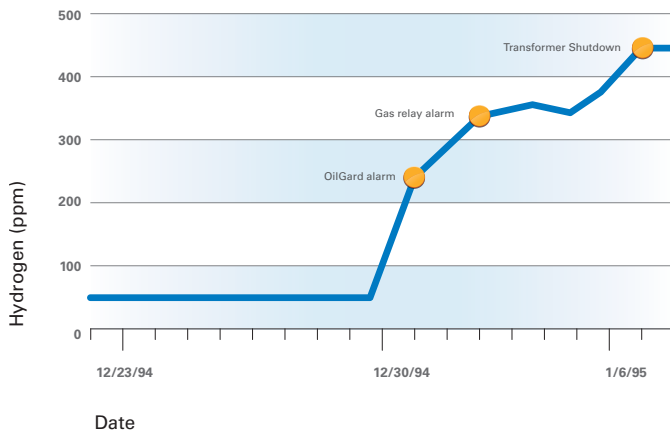
Temperature conditioning

The most important source of interference on dissolved gas sensors comes from the environment. Varying ambient and oil temperatures significantly affect the solubility and diffusion rates of dissolved fault gases thus creating baseline drift and signal oscillation. This often limits the ability of the sensors to monitor low levels of fault gases. FaultGard features highly efficient passive and thermo-electric temperature conditioning modules which eliminate interference from varying oil and ambient temperatures. This leads to unequalled sensitivity, repeatability and long-term stability. The result: amazing fault detection performance, especially at low concentrations

Connectivity

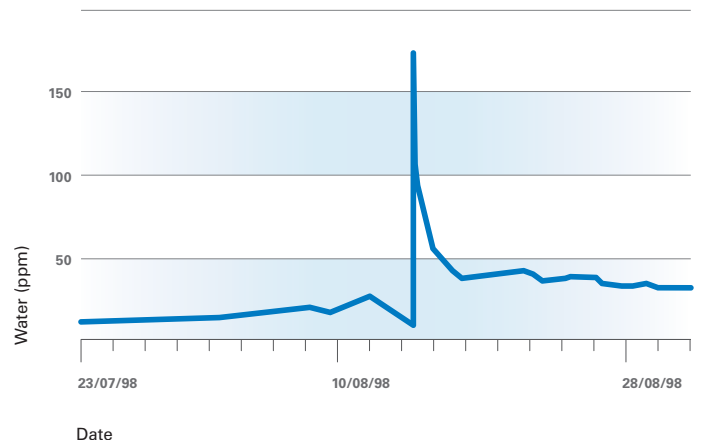
FaultGard can be delivered with today's most popular communication packages. Standard features include isolated 4-20 mA output signals (hydrogen and water), two RS-232 communication ports (local and remote communication) and an isolated RS-485 port. Event monitoring (alarm on/off) is also standard via high capacity dry-contact relays. Options include a V90 modem, a fiber optic module and Ethernet communication.

HYDROGEN VS. TIME



Inadvertent core ground on 360 MVA step-up transformer is caught by FaultGard.

DISSOLVED WATER VS. TIME



Stirring of free water during re-inhibiting operation suddenly increases moisture content in 700 MVA transformer. Event is caught by FaultGard and degassing/drying operation is scheduled right away.

FaultGard

The future of predictive maintenance

On-line monitoring of dissolved hydrogen requires that sensors be continuously in contact with representative oil from the transformer to react quickly upon variations in gas concentrations. In order to guarantee accuracy and fast responses on fault on-sets, FaultGard features its own oil circulation system (small, 10-year MTBF, internal 60 mL/min circulation pump).

If a significant change in hydrogen concentration or water content is detected by FaultGard, oil samples should be obtained for a complete dissolved gas analysis, either on-site or at the laboratory.

Gas extraction technology

Dissolved hydrogen is continuously extracted by a specially designed probe made of PTFE capillary tubes. Hydrogen diffuses in the capillary tubes to form a gas sample inside the probe. Once the probe is filled and stabilized, any change in hydrogen concentration in the oil modifies the equilibrium in the probe immediately. Hydrogen concentration is measured using a specially designed thermal conductivity detector.

Water-in-oil measurement

Dissolved water is measured using high-end IC technology. Content can be reported in parts per million (ppm), %RS at 25 °C or %RS at a specific transformer temperature¹. This measurement combined with the continuous measurement of dissolved hydrogen, makes the FaultGard IED one of the most effective instruments for the low-cost prevention of transformer failures and early aging for utilities worldwide.

Cost benefits:

Operating and capital costs as well as consequential damages can be avoided by using FaultGard on all critical transformers:

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

Technical benefits:

- Unit can be field installed in less than 2 hours
- Easily integrated to existing data acquisition or transformer/sub-station monitoring systems
- Reliable, accurate and stable signals
- Eliminates sampling and analysis for water content
- Fast response on fault onsets
- Unit withstands vacuum

Features:

- Low cost
- Hydrogen specific
- Continuous water monitoring
- High sensitivity and wide range
- Continuous oil circulation
- Proven gas extraction technology
- RS-232, RS-485 and 4-20 mA output ports

¹Temperature input to monitor is required to use this mode.



FaultGard Specifications



Application

Early detection of transformer incipient faults using continuous monitoring of dissolved hydrogen. Predictive maintenance action triggering using continuous monitoring of dissolved water content.

Range

0 to 50000 ppm of dissolved hydrogen in oil. 0 to 100% RS, displayed in %RS at 25¼C, PPM, or %RS at specific transformer temperature (temperature input to monitor required), for dissolved water in oil.

Interferences (H₂ measurement)

+0.5% or less for carbon monoxide. Less than 0.1% for all other fault and atmospheric gases.

Step response

Instantaneous at start of step. Better than 50% of step change after 60 minutes for hydrogen. Better than 90% of step change after 5 minutes for water.

Repeatability

Better than 5% or 5 ppm, whichever is greater, for hydrogen. Better than 2% or 2 ppm, whichever is greater, for water.

Sensitivity

Better than 5 ppm in oil for hydrogen. Better than 2 ppm in oil for water.

Data updates

Validated (hydrogen): maximum update frequency of 8 times per day.

Continuous (hydrogen and water): maximum update frequency of 0.2 Hz.

Environment

Unlimited probe lifetime in oil.

Unlimited hydrogen sensor lifetime.

Unlimited moisture sensor lifetime.

Operating ambient temperature range (¼C): -40 to 55¹.

Operating oil temperature range (¼C): -40 to 120 at monitor input valve.

Storage temperature range (¼C): -30/75. Pressure withstand (oil phase): vacuum/40 psig.

¹ Ambient conditions up to 65 ¼C can be achieved using special factory setup.

Gas extraction technology

Oil-immersed PTFE fibers.

Detection technology

Proprietary TCD cell for hydrogen. Oil-immersed RS capacitive sensor for water.

Calibration

Field calibration not required.

Oil circulation

Solenoid pump, 30-240 ml/min (0.01 to 0.06 gpm) flow rate, pulsing.

Inlet line to monitor:

3/8" OD copper (or S.S.) tubing with brass compression fitting.

Return line to transformer:

1/4" OD copper (or S.S.) tubing with brass compression fitting.

Physical dimensions

Width: 14.0 in/356 mm Depth: 10.4 in/264 mm Height: 16.0 in/406 mm Operating weight: 50.0 lb/23 kg Shipping weight: 65.0 lb/30 kg

Enclosure material

14-gauge stainless steel.

Power requirements

All lines single phase, line to neutral. 90/250 VAC 47-63 Hz, universal power input, 250 watts.

Enclosure temp. conditioning

Thermo-electric elements, 40 watts, electronically controlled.

Oil temp. Conditioning

First stage: passive counter-flow heat exchanger.

Second stage: thermo-electric elements, 40 watts, electronically controlled.

Safety

Complete shutdown using fusible thermal link rated at 76 ¼C.

Readout and data management

8-digit LCD display.

Data storage capacity: 3000 records.

Communication

RS-232 ports (2). Analog 4-20 mA isolated outputs (2). Isolated RS-485 port. See below for optional communication features.

Alarms

Hydrogen: Two programmable alarm levels with corresponding NO/NC solid state relays rated 10A @ 250 Vac. Water: Two programmable alarm levels activating NO/NC solid state relay rated 10A @ 250 Vac.

Standard features

- Separate hydrogen and water measurements
- 8-digit LCD display
- RS-232 ports (2)
- Isolated RS-485 port
- Analog 4-20 mA isolated outputs (2)
- PC/104 based electronics
- Oil and box temp. conditioning
- Oil circulation
- Windows-based configuration software
- PC based data trending software
- User manual
- One-year warranty

Options*

- Extended warranty
- V90 Modem
- Ethernet Communication

Warranty and support

Eaton's FaultGard monitor is backed by a 12-month factory warranty.

NOTE: Continuing research and improvements may result in specification or appearance changes at any time.

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