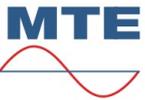




Transformer Multi-Gas-in-Oil Analysis System
변압기 유증가스 분석 시스템

Transformer Multi-Gas-in-Oil Analysis System



The HYDROCAL 1009 is a permanently installed multi-gas-in-oil analysis system with transformer monitoring functions. It individually measures, Moisture in Oil (H₂O) and the key gases Hydrogen (H₂), Carbon Monoxide (CO), Carbon Dioxide (CO₂), Methane (CH₄), Acetylene (C₂H₂), Ethylene (C₂H₄), Ethane (C₂H₆) and Oxygen (O₂) dissolved in transformer oil.

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 cellulosic / paper insulation the presence and increase of the other gases classify the nature of a fault as overheating, partial discharge or high energy arcing.

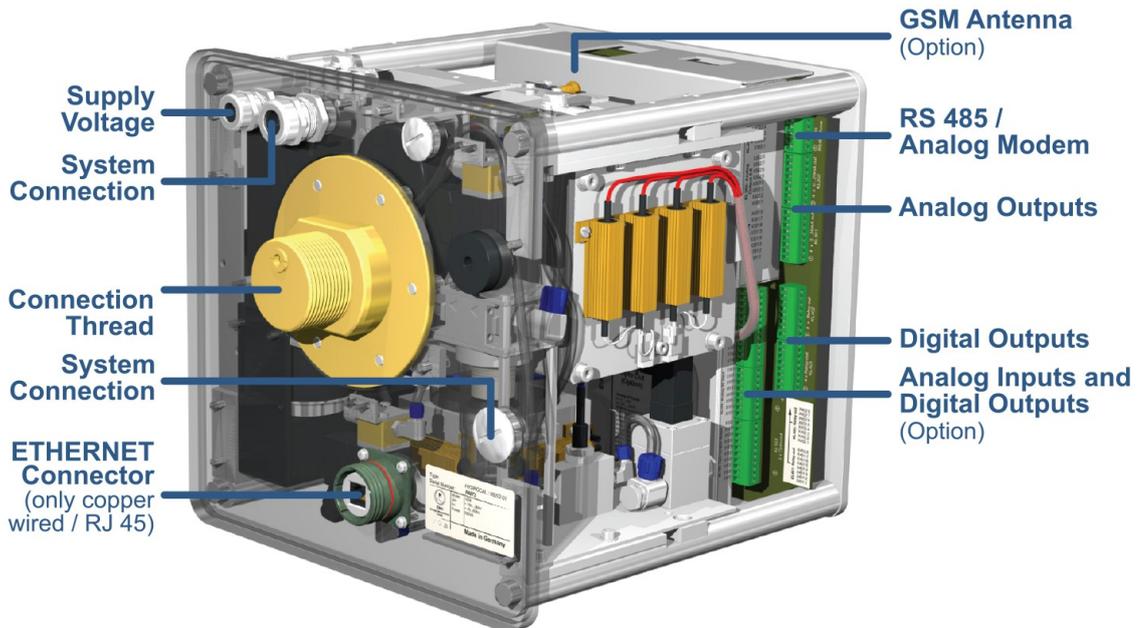
The device can serve as a compact transformer monitoring system by the integration / connection of other sensors present on a transformer via its optional analog inputs.

Key Advantages

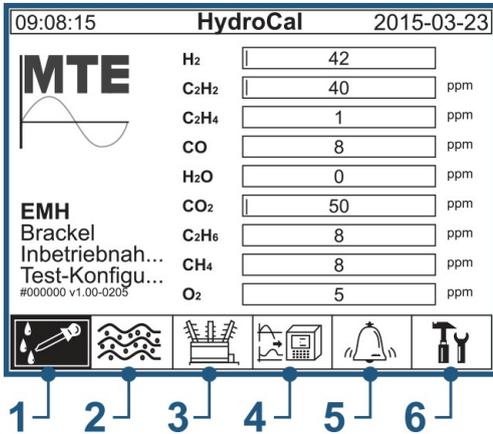
- Individual measurement of Hydrogen (H₂), Carbon Monoxide (CO), Carbon Dioxide (CO₂), Methane (CH₄), Acetylene (C₂H₂), Ethylene (C₂H₄), Ethane (C₂H₆) and Oxygen (O₂)
- Moisture in Oil (H₂O) measurement
- Easy to mount on a transformer valve (G 1½" DIN ISO 228-1 or 1½" NPT ANSI B 1.20.1)

Transformer monitoring functions

- Voltages and Currents (via voltage and current transformers / transducer)
- Temperature Monitoring Bottom and top oil temperature, ambient temperature (via additional temperature sensors)
- Cooling Stage / Tap Changer Position (e.g. via current transducer)
- Free configuration Analog inputs can be free allocated to any additional sensor
- Further Calculations: Hot-Spot (acc. IEC 60076) / Loss-of-Life / Ageing Rate

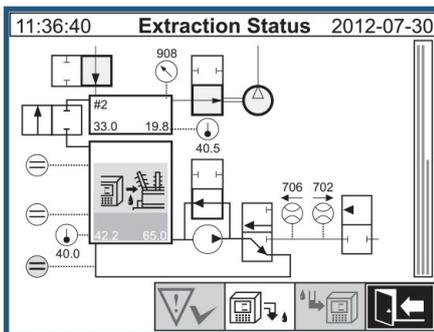


HYDROCAL firmware main menu



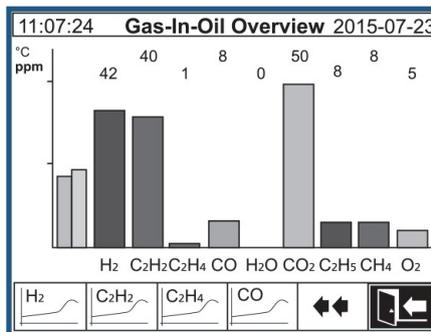
- 1 Extraction status**
 - Shows the actual operating status of the unit
- 2 Gas-in-oil overview**
 - Column chart
 - Trend graph
 - Data table
- 3 Transformer specific measurements**
 - Trend graph
 - Data table
- 4 Additional sensor measurements**
 - Trend graph
 - Data table (to be included)
- 5 Alert overview**
 - Alert acknowledgement
 - Alert table
- 6 Device setup**
 - Alert level setting
 - Communication setting
 - Transformer setting
 - In- and output setting

Extraction status



Shows the status of the actual process step and information of safety functions.

Gas-in-oil overview



Individual chart diagram for each gas and temperatures.

Alert overview

The screenshot shows the 'Alert Overview' screen. It features a table titled 'Selection of Alert' with the following data:

#	Name	Date/Time	Status
1	H ₂ -Alert	07-30 11:09	✓
2	CO-Alert	07-30 11:10	✓
3	CO ₂ -Alert	07-30 11:10	✓
4	C ₂ H ₂ -Alert	07-30 11:12	✓
5	C ₂ H ₄ -Alert	07-30 11:12	✓
6	C ₂ H ₆ -Alert	07-30 11:13	✓
7	CH ₄ -Alert	07-30 11:13	✓
8	H ₂ O-Alert	07-30 11:14	✓

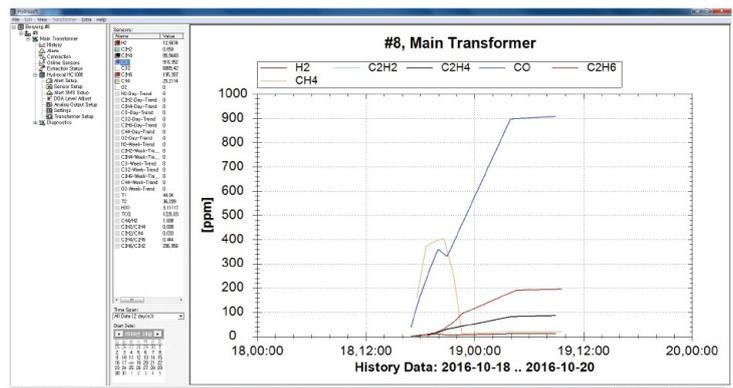
The top of the screen shows the time (11:14:36) and date (2012-07-30).

Display of alarm list. Details of each alarm and individual settings is shown.

HydroSoft PC-Software

Program key features

- Configuration and administration of each individual HYDROCAL unit
- Data and configuration read out of HYDROCAL units
- Processing and presentation of data read out (trend or table)
- Online functions (online sensors, extraction status and process flow)
- Diagnostic functions (Duval triangle and Rogers 3D graphic)
- Further processing of the processed data (Excel, CSV, clipboard and printing)
- Storage of the processed data and unit configuration
- Automatic data read out and alerting by e-mail



Technical data HYDROCAL 1009

General

Optional nominal voltages of auxiliary supply:	120 V -20% +15% AC 50/60 Hz or 230 V -20% +15% AC 50/60 Hz or 120 V -20% +15% DC or 230 V -20% +15% DC Other nominal voltages on request!
Power consumption:	max. 600 VA
Housing:	Aluminium
Dimensions:	W 263 x H 263 x D 327.5 mm
Weight:	approx. 15 kg
Operation temperature: (ambient)	-55°C ... +55°C (below -10°C display function locked)
Oil temperature: (in the transformer)	-20°C ... +90°C
Storage temperature: (ambient)	-20°C ... +65°C
Oil Pressure:	0 - 800 kpa (negative pressure allowed)
Connection to valve:	G 1½" DIN ISO 228-1 or 1½" NPT ANSI B 1.20.1

Safety

Insulation protection:	CE certified IEC 61010-1:2002
Degree of protection:	IP-56

Measurements

Gas/Moisture in oil Measurement		Accuracy ¹⁾²⁾³⁾⁴⁾	
Measuring quantity	Range		
Hydrogen H ₂	5 ... 10.000 ppm	± 5 %	± LDL
Carbon Monoxide CO	10 ... 10.000 ppm	± 5 %	± LDL
Carbon Dioxide CO ₂	25 ... 20.000 ppm	± 5 %	± LDL
Methane CH ₄	5 ... 5.000 ppm	± 5 %	± LDL
Acetylene C ₂ H ₂	3 ... 10.000 ppm	± 5 %	± LDL
Ethylene C ₂ H ₄	3 ... 10.000 ppm	± 5 %	± LDL
Ethane C ₂ H ₆	3 ... 10.000 ppm	± 5 %	± LDL
Oxygen O ₂	500 ... 50.000 ppm	± 5 %	± LDL
Moisture in Oil H ₂ O	0 ... 100 ppm	± 3 %	± 3 ppm

- 1) Related to temperatures ambient +20°C and oil +55°C
- 2) Accuracy for moisture in oil for mineral oil types
- 3) Whatever is greater (LDL: Lowest detection level)
- 4) Uncertainty of gas detector during calibration

Operation principle

- Miniaturized gas sample production based on headspace principle (no membrane, negative pressure proofed)
- Patent-pending oil sampling system (EP 1 950 560 A1)
- Near-infrared gas sensor unit for CO, C₂H₂ and C₂H₄
- Near-infrared gas sensor unit for CO₂, CH₄ and C₂H₆
- Micro-electronic gas sensor for H₂ and O₂
- Thin-film capacitive moisture sensor H₂O
- Temperature sensors (for oil and gas temperature)

Communication

- RS 485 (proprietary or MODBUS® RTU/ASCII protocol)
- ETHERNET 10/100 Mbit/s copper-wired / RJ 45 or fibre-optical / SC Duplex (proprietary or MODBUS® TCP protocol)
- On-board GSM or analog modem for remote access (Option)
- On-board DNP3 serial modem (Option)
- On-board IEC 61850 modem (Option)

Analog and digital outputs

8 x Digital outputs		Default concentration (Free assignment)
Type	Control voltage	
8 x Current DC	0/4 ... 20 mADC	

Analog inputs and digital outputs (option)

8 x Analog DC outputs		Default concentration (Free assignment)
Type	Range	
8 x Current DC	0/4 ... 20 mADC	H ₂ , C ₂ H ₂ , C ₂ H ₄ , CO, H ₂ O, CO ₂ , C ₂ H ₆ , CH ₄

8 x Digital outputs		Max. Switching capacity (Free assignment)
Type	Control voltage	
8 x Relay	12 VDC	220 VDC/VAC / 2 A / 60 W



Product Lineup

Model No.	Gas-in-oil analysis
HYDROCAL 1001+	H ₂ , H ₂ O, CO, CH ₄ , C ₂ H ₂ , C ₂ H ₄ , C ₂ H ₆ (Composite)
HYDROCAL 1003	H ₂ , CO, H ₂ O (Individual)
HYDROCAL 1005	H ₂ , CO, H ₂ O, C ₂ H ₂ , C ₂ H ₄ (Individual)
HYDROCAL 1008	H ₂ , H ₂ O, CO, CO ₂ , CH ₄ , C ₂ H ₂ , C ₂ H ₄ , C ₂ H ₆ (Individual)
HYDROCAL 1009	H ₂ , H ₂ O, CO, CO ₂ , CH ₄ , C ₂ H ₂ , C ₂ H ₄ , C ₂ H ₆ , O ₂ (Individual)