

# HYDROCAL 1008-3/-2/-1

**Multi-Gas-in-Oil Analysis System for Monitoring a bank of up to three single phase Transformers located next to each other**



The HYDROCAL 1008-3/-2/-1 is designed for multi-gas-in-oil analysis on a bank of up to three single phase transformers located next to each other. This wall mounted system allows the individual measurement of Moisture (H<sub>2</sub>O) and the key gases Hydrogen (H<sub>2</sub>), Carbon Monoxide (CO), Carbon Dioxide (CO<sub>2</sub>), Methane (CH<sub>4</sub>), Acetylene (C<sub>2</sub>H<sub>2</sub>), Ethylene (C<sub>2</sub>H<sub>4</sub>) and Ethane (C<sub>2</sub>H<sub>6</sub>) dissolved in the transformer oil utilising a smart sampling system that samples oil from each tank via three separate oil channels.

As Hydrogen (H<sub>2</sub>) is involved in nearly every fault of the isolation system of power transformers and Carbon Monoxide (CO) / Carbon Dioxide (CO<sub>2</sub>) is a sign of degradation of the cellulosic / paper isolation the presence and increase of Acetylene (C<sub>2</sub>H<sub>2</sub>), Methane (CH<sub>4</sub>), Ethylene (C<sub>2</sub>H<sub>4</sub>) and Ethane (C<sub>2</sub>H<sub>6</sub>) further classifies 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 analog inputs:

- 4 Analog inputs 0/4-20mADC
- 6 Analog inputs 0/4-20mADC +20% / 0-80 VAC +20% configurable by jumpers

It is further equipped with digital outputs for the transmission of alarms or the execution of control functions (e.g. control of a cooling system of a transformer):

- 8 digital relay outputs
- 5 digital opto-coupler outputs

## Key Advantages

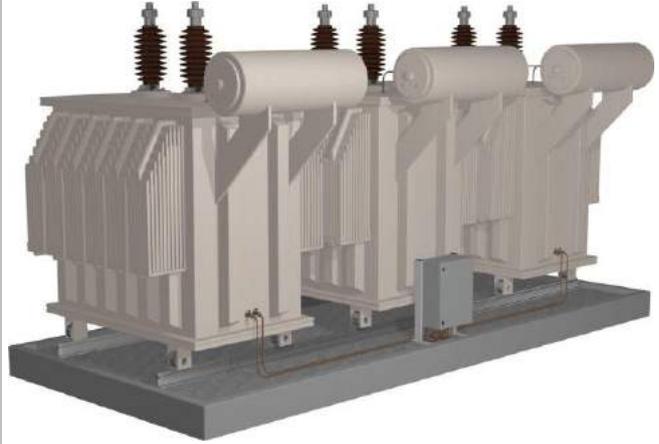
- Hydrogen (H<sub>2</sub>), Carbon Monoxide (CO), Carbon Dioxide (CO<sub>2</sub>), Methane (CH<sub>4</sub>), Acetylene (C<sub>2</sub>H<sub>2</sub>), Ethylene (C<sub>2</sub>H<sub>4</sub>) and Ethane (C<sub>2</sub>H<sub>6</sub>) measurement
- Moisture-in-Oil (H<sub>2</sub>O) measurement
- Monitoring of up to three tanks with one HYDROCAL 1008-3/-2/-1
- Communication interfaces ETHERNET 10/100 Mbit/s (copper-wired / RJ 45 or fibre-optical / SC Duplex) and RS 485 to support proprietary communication protocols and to be open / prepared for substation communication protocols IEC 61850, MODBUS, TCP and DNP 3.0 etc.
- Optional on-board GSM and analog modems for remote communication
- Optional capacitive HV bushing sensors for HV bushing monitoring applications via RS 485

**Possible configuration of HYDROCAL 1008-3/-2/-1**

**HYDROCAL 1008-3**



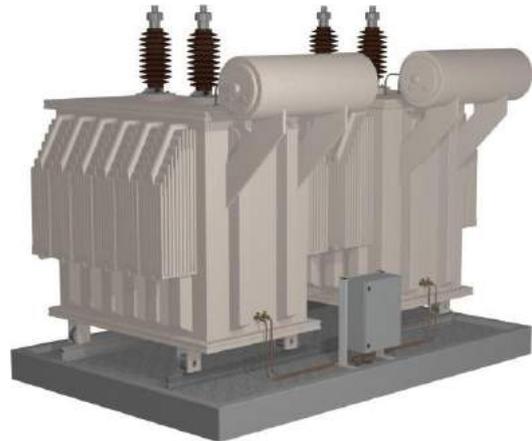
To monitor a bank of three single phase transformers



**HYDROCAL 1008-2**



To monitor a bank of two single phase transformers



**HYDROCAL 1008-1**



To monitor a single phase transformer



## Sensor firmware main menu

### 1 Extraction status

- Shows the actual operating status of the unit

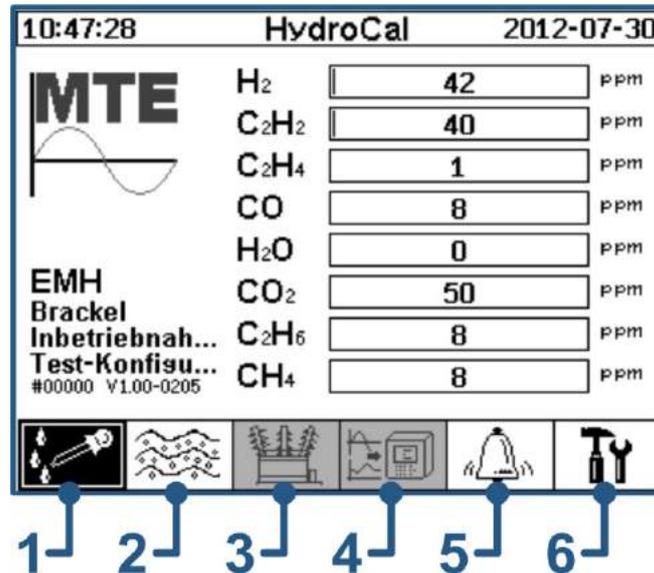
### 2 Gas-in-oil overview

- Column chart
- Trend graph
- Data table

### 3 Transformer specific measurements

- Trend graph
- Data table

(to be included)



### 4 Additional sensor measurements

- Trend graph
- Data table

(to be included)

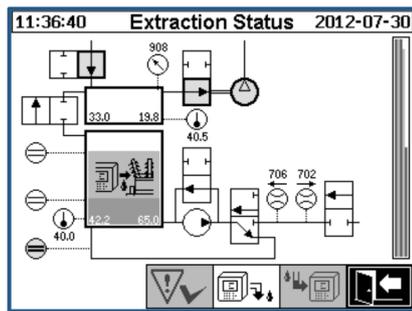
### 5 Alert overview

- Alert acknowledgement
- Alert table

### 6 Device setup

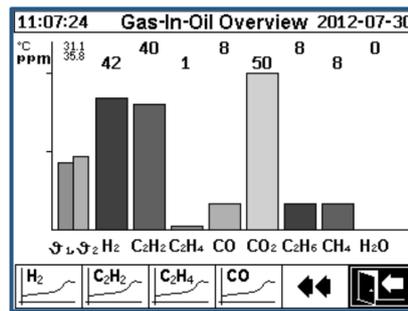
- Alert level setting
- Communication setting
- Transformer setting
- In- and output setting

## Extraction status



Status of each process steps and information of safety functions.

## Gas-in-oil overview



Individual chart diagram for Hydrogen (H<sub>2</sub>), Carbon Monoxide (CO), Carbon Dioxide (CO<sub>2</sub>), Methane (CH<sub>4</sub>), Acetylene (C<sub>2</sub>H<sub>2</sub>), Ethylene (C<sub>2</sub>H<sub>4</sub>) and Ethane (C<sub>2</sub>H<sub>6</sub>) and Moisture (H<sub>2</sub>O).

## Alert Overview

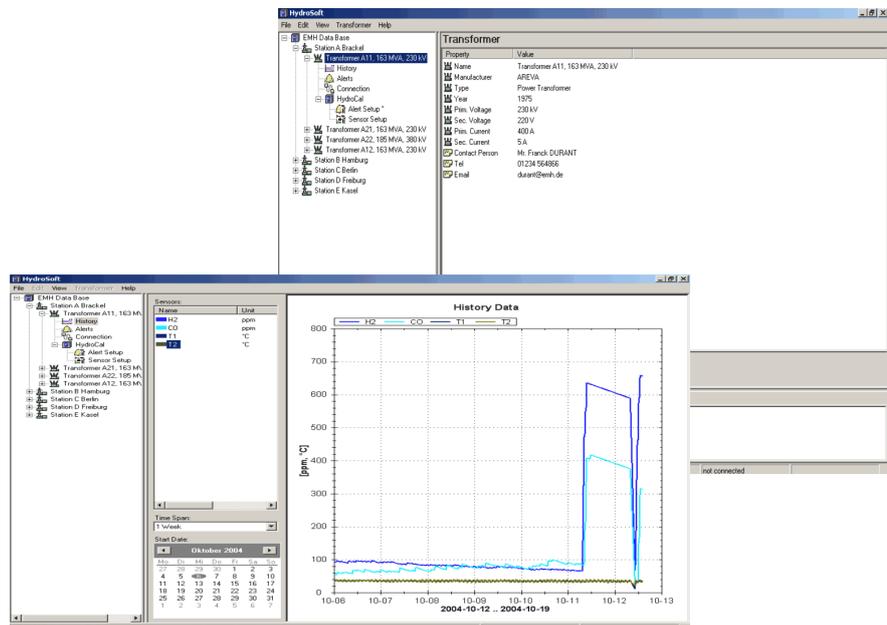
Selection of Alert			
#	Name	Date/Time	Status
1	H2-Alert	07-30 11:09	✓
2	CO-Alert	07-30 11:10	✓
3	CO2-Alert	07-30 11:10	✓
4	C2H2-Alert	07-30 11:12	✓
5	C2H4-Alert	07-30 11:12	✓
6	C2H6-Alert	07-30 11:13	✓
7	CH4-Alert	07-30 11:13	✓
8	H2O-Alert	07-30 11:14	✓

Display of alert list. Details of each alert and individual setting.

## PC-Software

### Transformer administration data

- All administration data of a transformer can be entered
- Network of different power plants and transformer banks can be configured
- Selective contact to each transformer in the network
- Obtaining information of total transformer situation



# Technical data HYDROCAL 1008-3/-2/-1

## General

Optional nominal voltages of auxiliary supply:	120 V -20% +15% AC 50/60 Hz <sup>1)</sup> or 230 V -20% +15% AC 50/60 Hz <sup>1)</sup> or 120 V -20% +15% DC <sup>1)</sup> or 230 V -20% +15% DC <sup>1)</sup> Other nominal voltages on request!
Power consumption:	max. 350 VA
Housing:	Aluminium
Dimensions:	W 600 x H 800 x D 300 mm
Weight:	approx. 80 kg
Operation temperature: (Ambient)	-55°C ... +55°C
Oil temperature: (in the transformer)	-20°C ... +90°C
Oil pressure:	0 - 800 kpa (negative pressure allowed)
Mounting:	Wall mounted enclosure
Application:	Designed to monitor up to three single phase transformers located next to each other
Sampling sequence:	User configurable

## Safety

	CE certified
Isolation protection:	IEC 61010-1:2002
Degree of protection:	IP-55

## Measurements

Gas/Moisture in oil Measurement		Accuracy <sup>2) 3)</sup>
Measuring quantity	Range	
Hydrogen H <sub>2</sub>	0 ... 2.000 ppm	± 15 % ± 25 ppm
Carbon Monoxide CO	0 ... 5.000 ppm	± 20 % ± 25 ppm
Carbon Dioxide CO <sub>2</sub>	0 ... 20.000 ppm	± 20 % ± 25 ppm
Methane CH <sub>4</sub>	0 ... 2.000 ppm	± 20 % ± 25 ppm
Acetylene C <sub>2</sub> H <sub>2</sub>	0 ... 2.000 ppm	± 20 % ± 5 ppm
Ethylene C <sub>2</sub> H <sub>4</sub>	0 ... 2.000 ppm	± 20 % ± 10 ppm
Ethane C <sub>2</sub> H <sub>6</sub>	0 ... 2.000 ppm	± 20 % ± 15 ppm
Moisture in Oil H <sub>2</sub> O	0 ... 100 ppm	± 3 % ± 3 ppm

## Operation principle

- Oil intake, sampling and flushing
- Miniaturized gas sample production based on headspace principle (no membrane, negative pressure-proof)
- Patent-pending oil sampling system (EP 1 950 560 A1)
- Infrared NIR gas sensor unit for CO, CO<sub>2</sub>, CH<sub>4</sub>, C<sub>2</sub>H<sub>2</sub>, C<sub>2</sub>H<sub>4</sub> and C<sub>2</sub>H<sub>6</sub>
- Micro-electronic gas sensor for H<sub>2</sub>
- Thin-film capacitive moisture sensor H<sub>2</sub>O

## Analog and digital outputs

8 x Analog DC outputs		Default concentration (Free assignment)
Type	Range	
1 x Current DC	0/4 ... 20 mADC	Hydrogen H <sub>2</sub>
1 x Current DC	0/4 ... 20 mADC	Acetylene C <sub>2</sub> H <sub>2</sub>
1 x Current DC	0/4 ... 20 mADC	Ethylene C <sub>2</sub> H <sub>4</sub>
1 x Current DC	0/4 ... 20 mADC	Carbon Monoxide CO
1 x Current DC	0/4 ... 20 mADC	Moisture in Oil H <sub>2</sub> O
1 x Current DC	0/4 ... 20 mADC	Carbon Dioxide CO <sub>2</sub>
1 x Current DC	0/4 ... 20 mADC	Ethane C <sub>2</sub> H <sub>6</sub>
1 x Current DC	0/4 ... 20 mADC	Methane CH <sub>4</sub>

8 x Digital outputs		Max. Switching capacity (Free assignment)
Type	Control voltage	
8 x Relay <sup>4)</sup>	12 VDC	220 VDC/VAC / 2 A / 60 W

## Analog inputs and digital outputs (option)

6 x Analog AC inputs		Accuracy of the measuring value	Remarks
Type	Range		
6 x Current AC or 6 x Voltage AC	0/4 ... 20 mA +20% or 0 ... 80 V +20%	≤ 1.0 %	Configurable by jumpers <sup>6)</sup>

4 x Analog DC inputs		Accuracy of the measuring value	Remarks
Type	Range		
4 x Current DC	0/4 ... 20 mADC	≤ 0.5 %	

5 x Digital outputs		Max. Switching capacity (Free assignment)
Type	Control Voltage	
5 x Optocoupler <sup>5)</sup>	5 VDC	U <sub>CE</sub> : 24 V rated / 35 V max. U <sub>EC</sub> : 7 V max. I <sub>CE</sub> : 40 mA max.

## Communication

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

## Notes

- <sup>1)</sup> 120 V ⇒ 120 V -20% = 96 V<sub>min</sub>                      120 V +15% = 138 V<sub>max</sub>  
230 V ⇒ 230 V -20% = 184 V<sub>min</sub>                      230 V +15% = 264 V<sub>max</sub>
- <sup>2)</sup> Related to temperatures ambient +20°C and oil +55°C
- <sup>3)</sup> Accuracy for moisture in oil for mineral oil types
- <sup>4)</sup> Relay 1: System alarm / Relay 2 ... 8: Free assignment
- <sup>5)</sup> Optocoupler 1 ... 5: Free assignment
- <sup>6)</sup> Default jumper configuration: Current