

# HYDROCAL 1005-3/-2/-1

## Multi-Gas-in-Oil Analysis System with Transformer Monitoring Functions



The HYDROCAL 1005-3/-2/-1 is designed for multi-gas-in-oil analysis on a bank of three single phase transformers located next to each other. This new wall mounted system allows for the individual measurement of Moisture (H<sub>2</sub>O) and the key gases Hydrogen (H<sub>2</sub>), Carbon Monoxide (CO), Acetylene (C<sub>2</sub>H<sub>2</sub>) and Ethylene (C<sub>2</sub>H<sub>4</sub>) dissolved in transformer oil utilising a sampling system that samples oil from each tank via three separate oil channels expertly engineered to provide negligible mixing of oil.

As Hydrogen (H<sub>2</sub>) is involved in nearly every fault of the isolation system of power transformers and Carbon Monoxide (CO) is a sign of an involvement of the cellulosic / paper isolation the presence and increase of Acetylene (C<sub>2</sub>H<sub>2</sub>) and Ethylene (C<sub>2</sub>H<sub>4</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 it's analog inputs:

- 4 analog inputs 0/4-20 mA DC
- 6 analog inputs 0/4-20 mA DC +20% / 0-80 VAC +20% configurable by jumpers

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

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

### Key Advantages

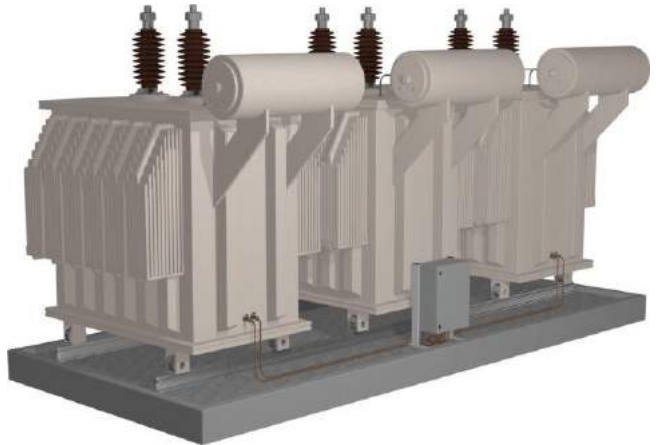
- Hydrogen (H<sub>2</sub>), Carbon Monoxide (CO), Acetylene (C<sub>2</sub>H<sub>2</sub>) and Ethylene (C<sub>2</sub>H<sub>4</sub>) measurement
- Moisture-in-Oil (H<sub>2</sub>O) measurement
- Monitor three tanks with one HYDROCAL 1005-3/-2/-1
- Communication interfaces ETHERNET 10/100 Mbit/s (copper-wired / 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
- 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 1005-3/-2/-1**

**HYDROCAL 1005-3**



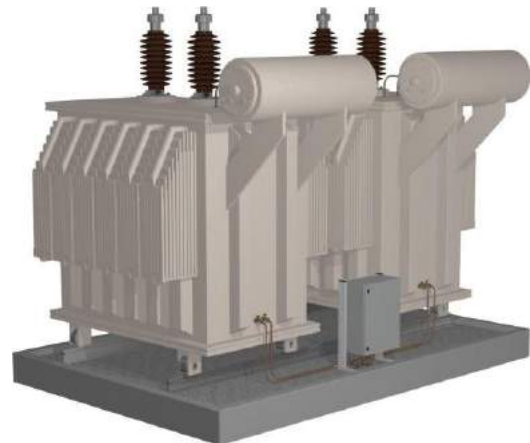
To monitor a bank of three single phase transformers



**HYDROCAL 1005-2**



To monitor a bank of two single phase transformers



**HYDROCAL 1005-1**



To monitor a single phase transformer



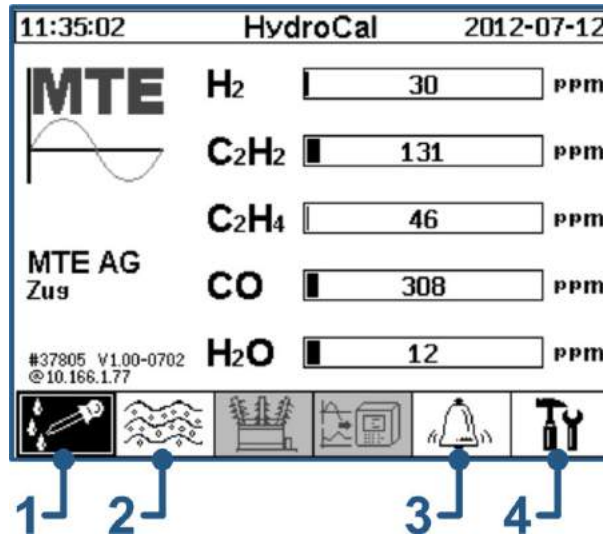
## Sensor firmware main menu

### 1 Extraction Status

- Shows the actual operating status of the unit

### 2 Gas-in-Oil Overview

- Column Chart
- Trend Graph
- Data Table



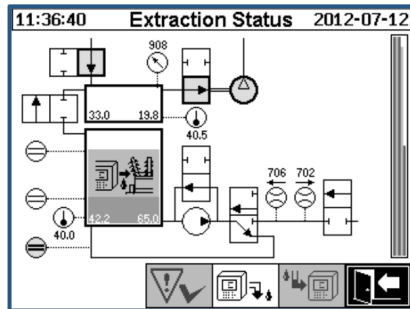
### 3 Alert Overview

- Alert acknowledgement
- Alert Table

### 4 Device Setup

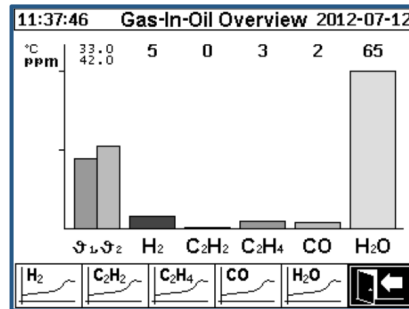
- Transformer related Setup
- Analog Output Setup
- External Sensors
- Alert-Level and Alert-Sensors
- HYDROCAL Setup

### 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), Acetylene (C<sub>2</sub>H<sub>2</sub>), Ethylene (C<sub>2</sub>H<sub>4</sub>) and Moisture (H<sub>2</sub>O).

### Alert Overview

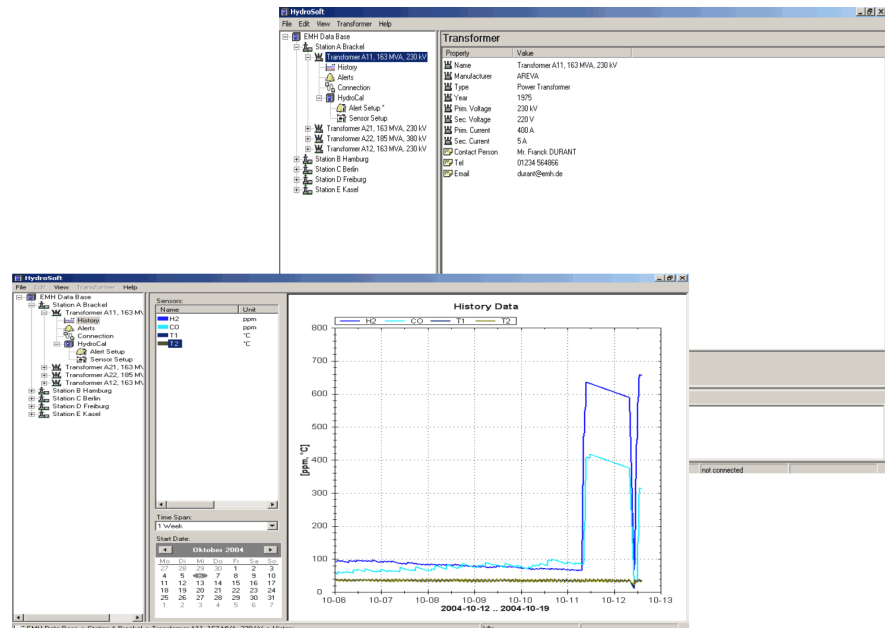
Selection of Alert			
#	Name	Date/Time	Status
1	H2-Alert	07-12 11:56	✓
2	CO-Alert	07-12 11:58	Δ
3	C2H2-Alert	07-12 11:58	Δ
4	C2H4-Alert	07-12 11:58	Δ

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 1005-3/-2/-1

## General

Optional nominal voltages of auxiliary supply:	110 V (120 V) -20% +15% AC 50/60 Hz <sup>1)</sup> 220 V (240 V) -20% +15% AC 50/60 Hz <sup>1)</sup> 110 V (120 V) -20% +15% DC <sup>1)</sup> 220 V (240 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: (inside transformer)	-20°C ... +90°C
Oil Pressure:	up to 800 kpa (negative pressure permitted)
Mounting:	Wall mounted enclosure
Application:	Designed to monitor up to three-phase transformer with separate tanks per phase
Sampling: sequence:	User configurable

## Safety

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

## Measurements

Gas/Humidity-in-Oil Measurement		
Measuring Quantity	Range	Accuracy
Hydrogen H <sub>2</sub>	0 ... 2.000 ppm	± 15 % ± 25 ppm
Carb. Monoxide CO	0 ... 5.000 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
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, C<sub>2</sub>H<sub>2</sub> and C<sub>2</sub>H<sub>4</sub>
- Micro-electronic gas sensor for H<sub>2</sub>
- Thin-film capacitive moisture sensor H<sub>2</sub>O

## Connections

## Analog and Digital Outputs

Analog DC Outputs		Default Concentration (Free configurable)
Type	Range	
Current DC	0/4 ... 20 mADC	Hydrogen H <sub>2</sub>
Current DC	0/4 ... 20 mADC	Carbon Monoxide CO
Current DC	0/4 ... 20 mADC	Acetylene C <sub>2</sub> H <sub>2</sub>
Current DC	0/4 ... 20 mADC	Ethylene C <sub>2</sub> H <sub>4</sub>
Current DC	0/4 ... 20 mADC	Moisture-in-Oil H <sub>2</sub> O

Digital Outputs		
Type	Control Voltage	Max. Switching Capacity
5 x Relay	12 VDC	220 VDC/VAC / 2 A / 60 W

## Analog Inputs and Digital Outputs (Option)

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

Analog AC/DC Inputs		Accuracy	Remarks
Type	Range	of the measuring value	
6 x Voltage AC or 6 x Current AC/DC	0 ... 80 VAC +20% 0/4 ... 20 mAAC / mADC +20%	≤ 1.0 %	Configurable via jumper

Digital Outputs		
Type	Control Voltage	Max. Switching Capacity
5 x Opto-Coupler	5 VDC	U <sub>CE</sub> : 4 V (rated) / 35 V (max.) U <sub>EC</sub> : 7 V (max.) I <sub>CE</sub> : 40 mA (max.)

## Communication

- ETHERNET 10/100 Mbit/s (copper-wired / RJ 45 or fibre-optical / SC Duplex)
- RS 485 (proprietary or MODBUS, TCP and DNP 3.0 protocol)
- On-board GSM or analog modem (Option)

## Notes<sup>1)</sup>

110 V (120 V) ⇒	110 V -20% = 88 V <sub>min</sub>	(120 V) +15% = 138 V <sub>max</sub>
220 V (240 V) ⇒	220 V -20% = 176 V <sub>min</sub>	(240 V) +15% = 276 V <sub>max</sub>