

HYDROCAL 1005

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



The HYDROCAL 1005 is a permanently-installed multi-gas-in-oil analysis system with transformer monitoring functions. It allows for the individual measurement of moisture and the key gases hydrogen (H_2), carbon monoxide (CO), acetylene (C_2H_2) and ethylene (C_2H_4) dissolved in transformer oil.

As hydrogen (H_2) 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_2H_2) and ethylene (C_2H_4) 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 analogue inputs 0/4-20 mADC
- 6 analogue inputs 0/4-20 mADC +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):

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

Key Advantages

- Hydrogen (H_2), Carbon monoxide (CO), acetylene (C_2H_2) and ethylene (C_2H_4) measurement
- Moisture-in-oil measurement
- Communication interfaces ETHERNET 10/100 Mbit/s (copper-wired or fibre-optical) and RS 485 to support proprietary communication protocols and to be open / prepared for substation communication protocols IEC 61850, MODBUS, DNP 3 etc.
- Optional on-board GSM and analogue modems for remote communication
- 6 analog AC current inputs for the connection of capacitive HV bushing sensors for HV bushing monitoring applications



Transformer monitoring functions

Voltages and Currents

(via voltage and current transformers / transducer)

Temperature Monitoring

Bottom and oil temperature
(via additional temperatures sensors)

Free configuration

Analogue inputs can be free allocated to any additional sensor

Further Calculations:

Hot-Spot (acc. IEC 60076)

Loss-of-Life

Ageing Rate

Cooling Stage / Tap Changer Position (e.g. via current transducer)

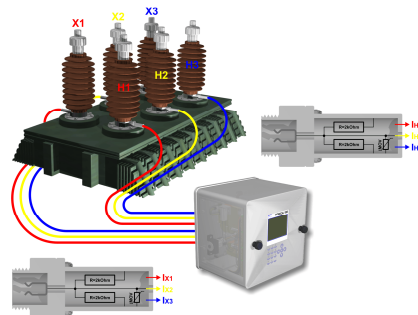
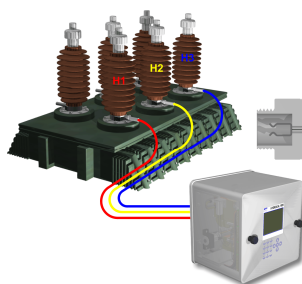
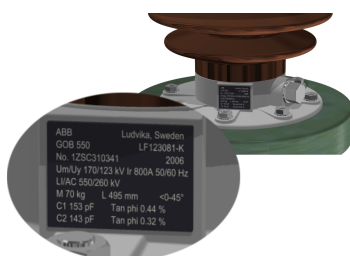
joint R&D design together with
power transformer manufacturer
PAUWELS



HV Bushing Monitoring

HV Bushing / Test tap / Name plate

Test methods: Leakage current
Sum of currents



Capacity C1 and $\tan\delta$ / PF under factory testing are documented on name plate of bushing

Configuration 1:
Monitoring of high voltage side

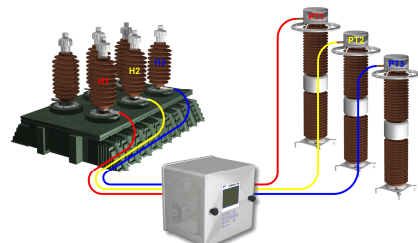
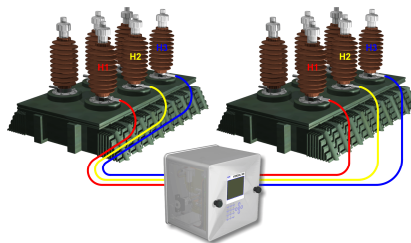
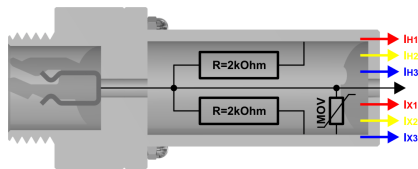
Configuration 2:
Monitoring of high voltage and low voltage side

Bushing sensor

(joint development with
ZTZ Services International,
USA)



Test method: $\tan\delta$ (dissipation factor)
PF (power factor)



Operation principle

Voltage range

Resistive Bridge

69 kV – 765 kV AC
(Bushing / Primary)

Max. 2.5 kV AC
(Sensor / Secondary)

Current range

0 – 140 mA AC

Thread

0.75" / 1.25" / 2.25"

(other configurations available upon request)

Configuration 1:
Reference HV bushing
(from other transformer)

Configuration 2:
Reference CCVT/CCPT

Sensor firmware main menu

User menu

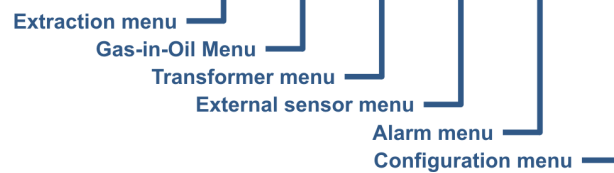
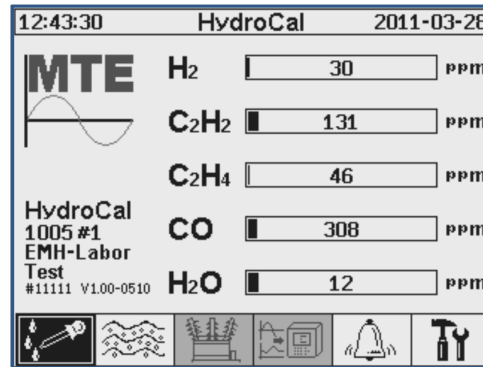
- Transformer administrator data
- Customer / Site administrator data

Gas-in-Oil menu

- Chart diagram
- Result table

Transformer menu

- Aging rate
- Hot spot temperature
- Loss-of-Live



External menu

- Voltage and current measurement
- Bottom and top oil measurement
- Oil humidity measurement

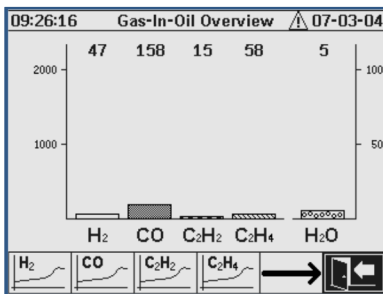
Alarm menu

- Report table
- Alarm acknowledgement

Configuration menu

- Alarm level setting
- Communication setting
- Transformer setting
- Installation

Gas-in-Oil overview menu



Individual chart diagram for hydrogen (H_2), carbon monoxide (CO), acetylene (C_2H_2), ethylene (C_2H_4) and moisture.

Alarm setup / edit menu

#	Name	Date/Time	Status
1	H2-Alert(#1)	04-07 13:02	🔔
2	CO-Alert(#2)	04-06 12:15	🔔
3	C2H2-Alert(#3)	04-06 12:15	🔔
4	C2H4-Alert(#4)	04-06 12:15	🔔
5	H2O-Alert(#5)	04-06 12:15	🔔

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

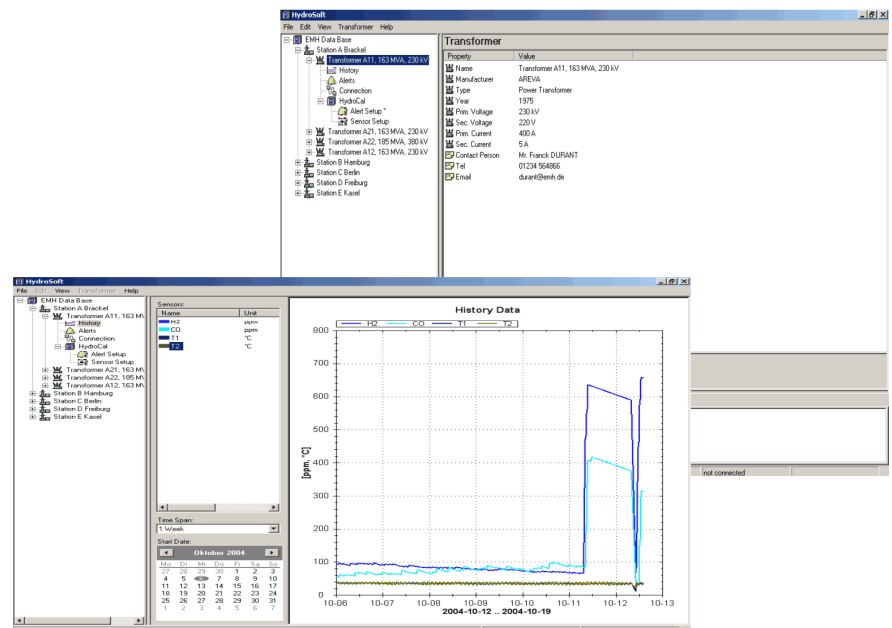
Bushing monitoring setup menu

The bushing monitoring setup menu allows the input of all basic parameters required for the bushing monitoring.

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

General

Auxiliary supply:	88 VAC _{min} ... 276 VAC _{max} Optional: 120 VDC _{min} ... 370 VDC _{max}
Power consumption:	max. 350 VA
Housing:	Aluminium
Dimensions:	W 263 x H 263 x D 327.5 mm
Weight:	Approx. 13.5 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)
Connection to valve:	G 1½" DIN ISO 228-1 Optional: 1½" NPT ANSI B 1.20.1

Safety

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

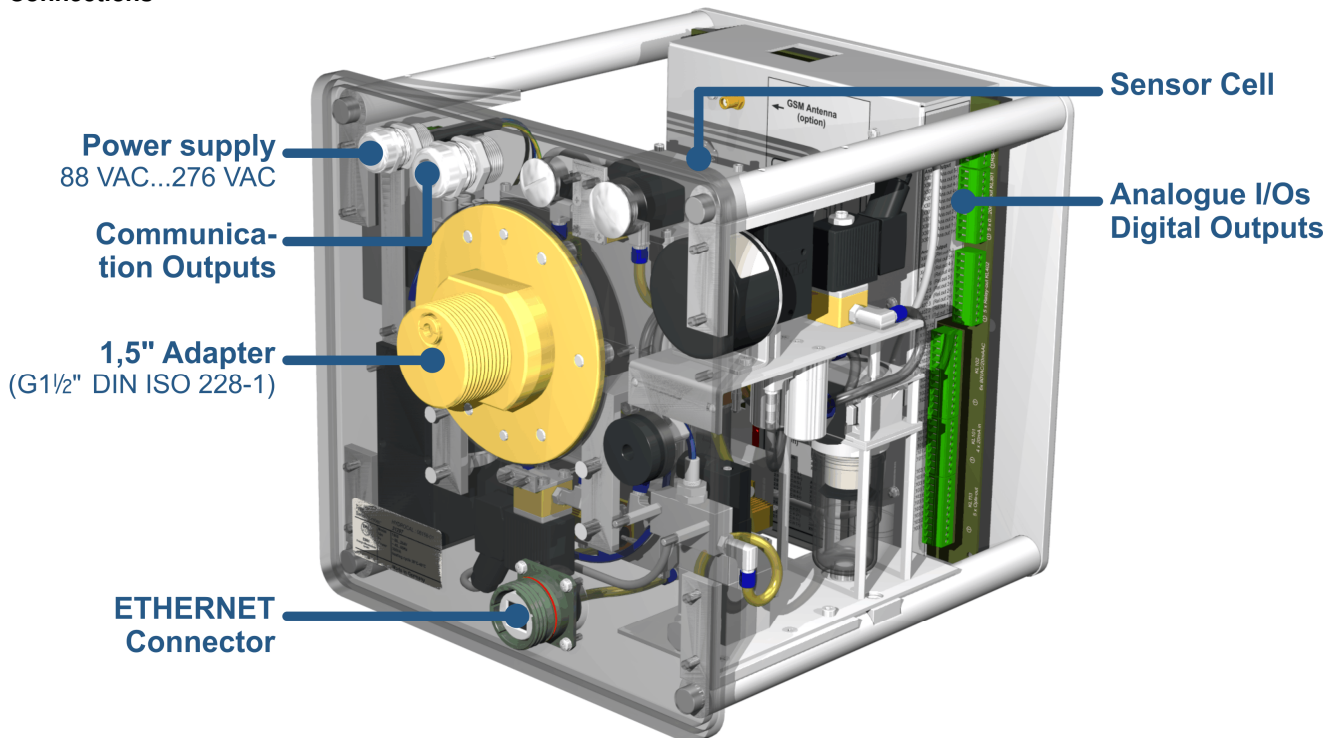
Measurements

Gas/Humidity-in-Oil Measurement		
Measuring Quantity	Range	Accuracy
Hydrogen H ₂	0 ... 2.000 ppm	± 15 % ± 25 ppm
Carb. Monoxide CO	0 ... 5.000 ppm	± 20 % ± 25 ppm
Acetylene C ₂ H ₂	0 ... 2.000 ppm	± 20 % ± 5 ppm
Ethylene C ₂ H ₄	0 ... 2.000 ppm	± 20 % ± 10 ppm
Moisture	0 ... 100 ppm	± 3 % ± 3 ppm

Operation Principle

- 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, C₂H₂ and C₂H₄
- Micro-electronic gas sensor for H₂
- Thin-film capacitive moisture sensor

Connections



Analogue and Digital Outputs (standard)

Analogue DC Outputs		Default functions	Alternative functions
Type	Range		
Current DC	0/4 ... 20 mADC	H ₂ Con.	Free config.
Current DC	0/4 ... 20 mADC	CO Con.	Free config.
Current DC	0/4 ... 20 mADC	C ₂ H ₂ Con.	Free config.
Current DC	0/4 ... 20 mADC	C ₂ H ₄ Con.	Free config.
Current DC	0/4 ... 20 mADC	Moisture Con.	Free config.

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

Analogue Inputs and Digital Outputs (optional)

Analogue DC Inputs (External sensors)		Accuracy	Remarks
Type	Range	of the measuring value	
Current	4 x 0/4 ... 20 mADC	≤ 0.5 %	

Analogue AC Inputs (Cap. HV Bushing)		Accuracy	Remarks
Type	Range	of the measuring value	
Voltage or Current	6 x 0 ... 80 V +20% 6 x 0/4 ... 20 mA +20%	≤ 1.0 %	Configurable via jumper

Digital Outputs		
Type	Control Voltage	Max. Switching Capacity
Opto-coupler	5 x 5 VDC	U _{CE} : 4 V (rated) / 35 V (max.) U _{EC} : 7 V (max.) I _{CE} : 40 mA (max.)

Analogue Outputs

Communication

- ETHERNET 10/100 Mbit/s (copper-wired or fibre-optical)
- RS 485 (proprietary or MODBUS protocol)
- On-board GSM or analog modem (optional)