

HYDROCAL 1011-3

Multi-Gas-in-Oil Analysis System for monitoring a bank of three single phase transformers located next to each other



The HYDROCAL 1011-3 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 in Oil (H_2O) and the key gases Hydrogen (H_2), Carbon Monoxide (CO), Carbon Dioxide (CO_2), Methane (CH_4), Acetylene (C_2H_2), Ethylene (C_2H_4), Ethane (C_2H_6), Oxygen (O_2), Nitrogen (N_2) and Propane (C_3H_8) dissolved in transformer oil utilizing 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_2) 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 light-weight hydrocarbon gases further classifies the nature of a fault as overheating, partial discharge or high energy arcing. Oxygen (O_2) can be a sign of excessive ageing or leakages of the sealing of hermetic transformers.

It is further equipped with digital outputs for the transmission of alarms or the execution of control:

- 10 analog outputs (optional)
- 10 digital relay outputs (optional)
- 5 digital opto-coupler outputs (optional)

Key Advantages

- Individual measurement of hydrogen (H_2), carbon monoxide (CO), carbon dioxide (CO_2), methane (CH_4), acetylene (C_2H_2), ethylene (C_2H_4), ethane (C_2H_6), oxygen (O_2), nitrogen (N_2) and propane (C_3H_8)
- Moisture in Oil (H_2O) measurement
- Monitor three tanks with one HYDROCAL 1011-3
- Communication interfaces ETHERNET 10/100 Mbit/s (copper-wired / RJ 45 or fibre-optical / SC Duplex) and RS 485 to support MODBUS[®] RTU/ASCII, MODBUS[®]TCP, DNP3, proprietary communication protocols and substation communication protocol IEC 61850
- Optional DNP3 software stack modem for SCADA connection
- Optional IEC 61850 software stack modem for SCADA connection

Technical data HYDROCAL 1011-3

General

Optional nominal voltages of auxiliary supply:	120 V -20% +15% AC 50/60 Hz ¹⁾ or 230 V -20% +15% AC 50/60 Hz ¹⁾ or 120 V +15% DC ¹⁾ or 230 V -20% +15% DC ¹⁾ Other nominal voltages on request!
Power consumption:	max. 650 VA
Housing:	Stainless Steel
Dimensions:	W 600 x H 855 x D 400 mm
Weight:	approx. 80 kg
Operation temperature: (ambient)	-55°C ... +55°C (below -10°C display function locked)
Oil temperature: (in the transformer)	-20°C ... +105°C
Storage temperature: (ambient)	-20°C ... +65°C
Connection to valve:	All Valves possible / pipe with diameter of 6mm connectable without adapters 2 valves necessary (in/out) / max. distance 30m

Safety

Insulation protection:	IEC 61010-1:2011-07
Degree of protection:	IP-65



Analog and digital outputs (optional)

12/24/36 x Analog DC outputs		Default concentration (Free assignment)
Type	Range	
1 x Current DC	0/4 ... 20 mADC	Hydrogen H ₂
1 x Current DC	0/4 ... 20 mADC	Carbon Monoxide CO
1 x Current DC	0/4 ... 20 mADC	Carbon Dioxide CO ₂
1 x Current DC	0/4 ... 20 mADC	Methane CH ₄
1 x Current DC	0/4 ... 20 mADC	Acetylene C ₂ H ₂
1 x Current DC	0/4 ... 20 mADC	Ethylene C ₂ H ₄
1 x Current DC	0/4 ... 20 mADC	Ethane C ₂ H ₆
1 x Current DC	0/4 ... 20 mADC	Oxygen O ₂
1 x Current DC	0/4 ... 20 mADC	Moisture in Oil H ₂ O
1 x Current DC	0/4 ... 20 mADC	Free programmable

12/24/36 x Digital outputs		Max. Switching capacity (Free assignment)
Type	Control voltage	
12/24/36 x Relay	12 VDC	220 VDC/VAC / 2 A / 60 W

Communication

- 1 x 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)
- DNP3 software stack modem (Option)
- IEC 61850 software stack modem (Option)

Notes

- ¹⁾ 120 V ⇒ 120 V = 120 V_{min} 120 V +15% = 138 V_{max}
 230 V ⇒ 230 V -20% = 184 V_{min} 230 V +15% = 264 V_{max}

Operation principle

- Miniaturized gas sample production based on headspace principle (no membrane, negative pressure proofed)
- Near-infrared gas sensor unit for CO, CO₂, C₂H₂, C₂H₄, C₂H₆, CH₄ and C₃H₈
- Micro-electronic gas sensor for H₂, O₂ and N₂
- Thin-film capacitive moisture sensor for H₂O measurement
- Temperature sensors (oil temperature, gas temperature)

Measurement

Dissolved Gas Analysis		Accuracy ^{2,3)}	
Measuring Quantity	Range	Gas Extraction	Gas Measurement
Hydrogen H ₂	0 ... 10000 ppm	≤ ± 8% ± 4 ppm	≤ ±10 % ± 20 ppm
Carbon Monoxide CO	0 ... 10000 ppm	≤ ± 8% ± 30 ppm	≤ ±10 % ± 5 ppm
Carbon Dioxide CO ₂	0 ... 20000 ppm	≤ ± 8% ± 30 ppm	≤ ±10 % ± 5 ppm
Acetylene C ₂ H ₂	0 ... 10000 ppm	≤ ± 8% ± 4 ppm	≤ ±10 % ± 5 ppm
Ethylene C ₂ H ₄	0 ... 10000 ppm	≤ ± 8% ± 4 ppm	≤ ±10 % ± 5 ppm
Ethane C ₂ H ₆	0 ... 10000 ppm	≤ ± 8% ± 4 ppm	≤ ±10 % ± 5 ppm
Methane CH ₄	0 ... 10000 ppm	≤ ± 8% ± 4 ppm	≤ ±10 % ± 5 ppm
Propane C ₃ H ₈	0 ... 5000 ppm	≤ ± 8% ± 4 ppm	≤ ±15 % ± 20 ppm
Oxygen O ₂	0 ... 50000 ppm	≤ ± 8% ± 500 ppm	≤ ±10 % ± 500 ppm
Nitrogen N ₂	0 ... 150000 ppm	≤ ± 8% ± 1500 ppm	≤ ±10 % ± 1500 ppm
Dissolved Moisture Analysis			
Measuring Quantity	Range	Accuracy	
Moisture in Oil (H ₂ O) – relative [%]	0 ... 100 %	≤ ± 3 %	
in Mineral Oil – absolute [ppm]	0 ... 150 ppm	≤ ± 3% ± 3 ppm	
in Ester Oil – absolute [ppm] ⁴⁾	0 ... 2000 ppm	≤ ± 3 % of MSC ⁵⁾	

²⁾ Related to temperatures ambient +20°C and oil +55°C | ³⁾ Accuracy for moisture in oil for mineral oil types | ⁴⁾ Option | ⁵⁾ Moisture Saturation Content