PAS DGA

Laser Photoacoustic Spectroscopy · Dissolved Gas Analysis · 7 fault gases + moisture

DGM-900

On-line Multi-Gas DGA Monitor

Outdoor cabinet unit | Model: DGM-900 | Document DS-DGM900-EN-2026-10 Rev 1.0

1 Product Overview

The DGM-900 is an on-line Dissolved Gas Analysis (DGA) monitor for power transformers, reactors and converter transformers. A semiconductor laser and a miniature photoacoustic cell quantify seven dissolved fault gases plus moisture-in-oil directly from the insulating oil, giving early warning of insulation deterioration, partial discharge, overheating and arcing.

The measuring chain runs with **no carrier gas, no chromatography column and no consumables**. Dissolved gas is extracted in a closed, constant-temperature vacuum circuit and the sample oil is returned to the tank, so oil consumption is zero. A unit can be commissioned on a transformer that is already carrying load — installation does not require an outage.

2 Key Features

Feature	Detail
7 gases + moisture	H_2, CO, CO_2, CH_4, C_2H_2, C_2H_4, C_2H_6 and H_2O. O_2 and N_2 are optional channels.
0.1 ppm acetylene detection limit	Catches the earliest rise of a discharge fault, well below laboratory sampling intervals.
Zero oil consumption, zero consumables	Vacuum-assisted membrane extraction; no carrier gas, no column replacement, no reagents.
Diagnosis on board	Duval Triangle and Duval Pentagon, Rogers Ratio with 3D view, Doernenburg, plus gas-ratio trend plotting.
Open integration	MODBUS RTU/TCP, IEC 61850 MMS/GOOSE, IEC 60870-5-104, DNP3.0; RS-485 up to 1 Mbps on a 32-node daisy chain.
No routine recalibration	Calibrated once at commissioning; no periodic re-standardisation during operation.

3 Measuring Principle (L-PAS)

Insulating oil decomposes under thermal and electrical stress; each fault type generates a characteristic gas set, so concentration and rate of change allow the fault to be classified. The DGM-900 processes the oil in four steps:

1. **Degassing** — a vacuum-assisted membrane assembly extracts dissolved gas at constant temperature; the sample oil is returned to the tank, neither consumed nor exposed to air.
2. **Excitation** — a semiconductor laser with a **spectral line width of 15 fm (0.000015 nm)**, far narrower than the gas absorption lines, is tuned to each species in turn, giving very low cross-interference.
3. **Detection** — the modulated absorption generates an acoustic wave in a 1 mL photoacoustic cell, which is converted into a dissolved-gas concentration.
4. **Diagnosis** — ratio methods, Duval triangle/pentagon and trend analysis are executed inside the monitor and in the PC software, per IEC 60599 and IEEE C57.104.

4 Gas Coverage and Measurement Performance

Gas	Lower measuring limit (ppm)	Upper measuring limit (ppm)	Remarks
H_2	2	5,000	—
CO	20	5,000	—
CO_2	20	75,000	—
CH_4	0.5	5,000	—
C_2H_2	0.1	5,000	Arcing indicator
C_2H_4	0.5	5,000	—
C_2H_6	0.5	5,000	—
O_2	200	50,000	—
N_2 *	1,000	200,000	Calculated value, free-breathing units only
H_2O	0	100 %AW / 100 ppm	Moisture

* N_2 is a calculated value and is valid on free-breathing transformers only. Accuracy is the greater of the lower measuring limit or ±20% of reading, verified against standard gas.

Measurement cycle

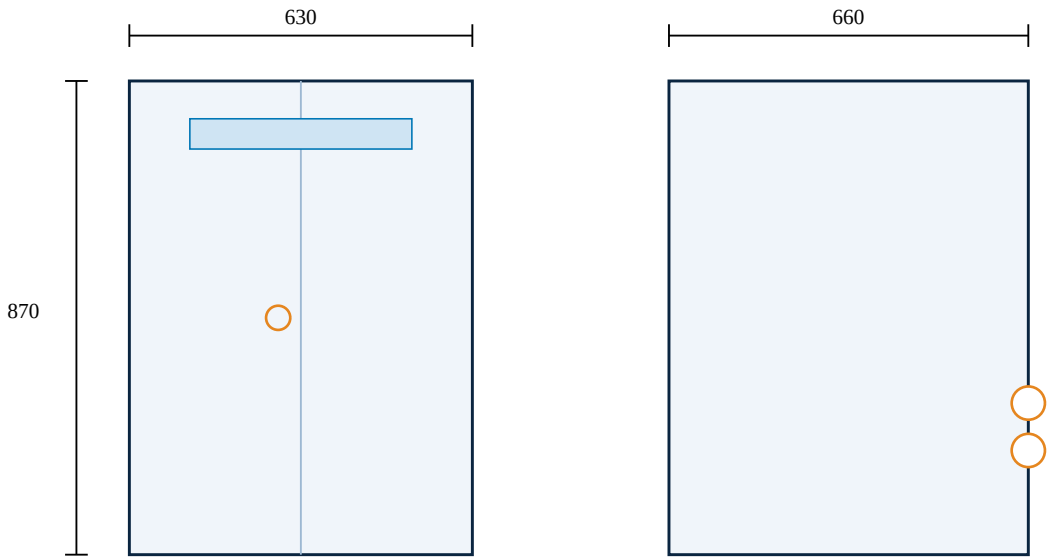
A full-component measurement can be completed in as little as **40 minutes**. A dedicated single-acetylene configuration reaches **10 minutes**, which suits converter transformers and reactors where acetylene is the decisive indicator.

5 Diagnostics and Alarm Management

Item	Detail
Fault criteria	Duval Triangle (IEC 60599), Duval Pentagon, Rogers Ratio (with 3D visualisation), Doernenburg
Trend analysis	Dynamic gas-ratio trend plotting for every monitored gas
Seal integrity	Assessment from the N_2 / O_2 readings
Alarm tiers	Attention 50% · Warning 80% · Critical 100% · Emergency 120% of the user-set threshold
Alarm logic	Conditional escalation and suppression; independent threshold and range per gas

6 Electrical and Mechanical Data

Item	Value
Power supply	AC 210 – 240 V, 50 / 60 Hz
Power consumption	2 kW
Enclosure protection	**IP55**, outdoor cabinet
Dimensions (W × D × H)	630 × 660 × 870 mm
Weight	< 150 kg
Ambient temperature (operation)	–40 … +55 °C
Start-up temperature	–10 … +55 °C
Oil temperature (sampling side)	10 … 100 °C
Relative humidity	10 – 95% RH



Front view (W x H) Side view (D x H)

7 Communication and Software

Item	Detail
Protocols	**MODBUS RTU / MODBUS TCP** · **IEC 61850 MMS / GOOSE** · **IEC 60870-5-104** · **DNP3.0**
Field bus	RS-485, up to 1 Mbps, 32-node daisy chain
Operating modes	Local single monitor, or central management of a fleet; bidirectional local and remote operation
Logging	Scheduled automatic logging; unlimited historical data storage; configuration backup and restore
Export	Excel templates, CSV for SCADA integration, clipboard, printer-ready PDF/paper reports
Cloud	Optional automatic cloud synchronisation
Configuration	Per-gas parameterisation of alarms and measuring ranges

8 Installation and Commissioning

- Oil connection at the transformer sampling valve; the unit can be connected to a transformer that is already in service — no outage required.
- The degassing circuit is closed and temperature-controlled; the sample oil is returned to the tank.
- One calibration at commissioning; no routine recalibration and no consumable replacement afterwards.
- Requires a 220 V class supply and a communication path (fibre, Ethernet or RS-485, per station practice).
- Outdoor cabinet, floor or bracket mounted; maintenance access must be kept clear.

9 Standards, Type Test and Quality

Item	Detail
Interpretation standards	IEC 60599 · IEEE C57.104
Type test	CEPRI type-test report **CEPRI-JS5-2025-100 (E)**, 34 test items, laboratory test Aug – Dec 2025. Measurement error, repeatability, minimum detection cycle, cross-sensitivity and minimum detectable concentration recorded as meeting **Grade A1** requirements; the remaining items recorded as acceptable.
Quality audit	Manufacturing and quality management audited by SGS and TÜV
Warranty	**36 months** as standard; extension available on request
Delivery documents	Factory test report per unit, type test report copy, user manual, communication point list, calibration certificate

10 Typical Applications

- Main transformers and high-voltage shunt reactors in 1000 kV to 110 kV substations.
- Converter transformers in ±800 kV and ±660 kV HVDC stations.
- Step-up transformers in wind and photovoltaic substations.
- Industrial, traction and generator transformers, subject to the oil-circuit conditions on site.
- **Field references** include 1000 kV UHV substations and converter stations, ±800 kV HVDC stations, 750 kV substations and nuclear power plants (Hongyanhe).

11 Ordering Information

Item	Option
Model	**DGM-900** — L-PAS multi-gas on-line DGA monitor, outdoor cabinet
Measuring configuration	Full component (default) / single-acetylene fast configuration (10 min)
Gas coverage	Seven fault gases + moisture; O_2 and N_2 optional (N_2 valid on free-breathing transformers only)
Communication	Fibre / Ethernet / RS-485; protocol set as listed in section 7
Scope of supply	Monitor, oil connection kit, user manual, communication point list, factory test report