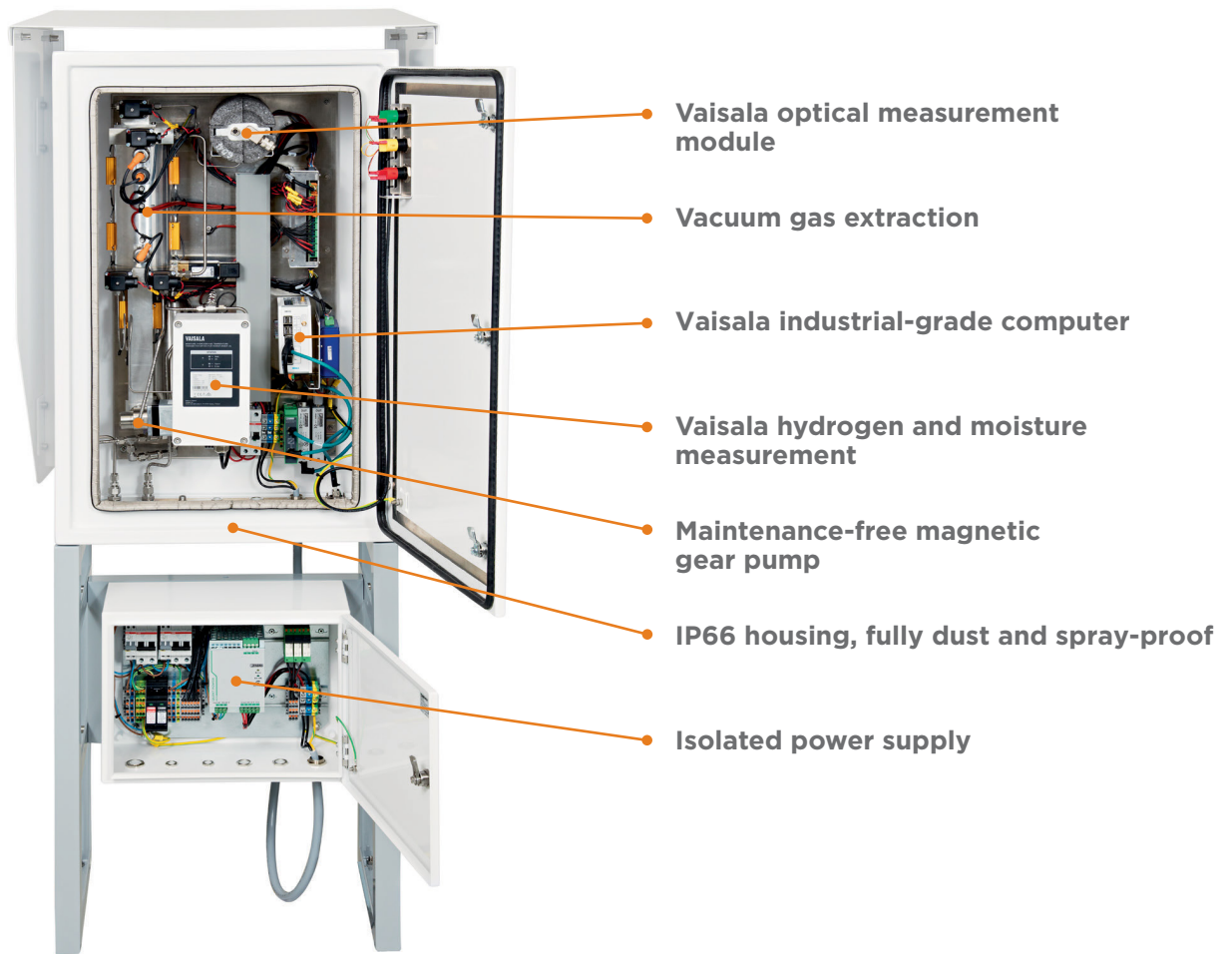




# OPT100 Optimus™ DGA Monitor

For power transformers



## Patented Vaisala measurement technology

- Optical IR sensors designed and manufactured in Vaisala cleanrooms
- Spectral scanning provides selective gas measurement
- Vacuum gas extraction independent of oil temperature and pressure
- Autocalibration eliminates long-term drift – no need to recalibrate
- Total gas pressure measurement – the most reliable method for detecting air leaks

## Robust design – made to last

- Hermetically sealed structure tolerates vacuum and pressure changes
- Stainless steel and aluminum components and piping used in contact with oil
- No consumables required – no regular maintenance needed
- Magnetic drive gear pump and high quality valves provide enhanced durability

## Simplified installation and operation

- Install and commission in as little as two hours
- Continuous operation with ca. one-hour output interval – no data averaging needed
- Clear browser-based interface – easily view and share data, change settings, and more
- Self-diagnostics with automatic self-recovery after disturbances



## Prevent transformer failure

**There is nothing worse than an unplanned outage. Lost revenue. Incalculable damage to your reputation and brand. All of it avoidable. Over 50 percent of serious power transformer faults can be detected with the right online monitoring tools, meaning that severe failures can be prevented.**

But monitors are not made equal. That's why we created the Vaisala Optimus™ DGA Monitor. With realtime, trouble-free fault gas monitoring. No false alarms, no maintenance and no consumables required.

Made with the ultimate safety and reliability in mind, ready for the most demanding operating environments. Optimus™ is the culmination of decades of experience, extensive research, and listening to real-life customer needs.

### Dependable data – no false alarms

The IR sensor is based on Vaisala core measurement technology and components manufactured in our own cleanroom. Vacuum gas extraction means no data fluctuation due to oil temperature or pressure, while hermetically sealed and protected optics prevent sensor contamination. Moisture

is measured directly in the oil with our capacitive thin-film polymer HUMICAP® sensor – used for transformer monitoring for over 20 years. Hydrogen is also measured directly in the oil with the same solid-state sensor used in Vaisala MHT410.

### Air leak detection using total gas pressure

Air leaks accelerate the aging of transformers. Using a new, groundbreaking method, Vaisala Optimus™ DGA Monitor measures the total dissolved gas pressure of the sampled oil volume and detects any air leaks on sealed transformers. In case of an air leak into the transformer's tank, majority of the dissolved gases are nitrogen and oxygen, and the proportion of fault gases in the pressure value is negligible. The pressure trend of the dissolved gasses gives a reliable indication of a leak, as nitrogen is the dominant component, and it is not formed or consumed in reactions inside the transformer.

### DGA diagnostics with Duval Triangles

The publicly available and commonly used dissolved gas analysis method for transformer fault diagnostics purposes, Duval Triangles (IEC 60599, Annex B),

is available as an optional feature. User interface displays the progression of data points from the past year overlaid on top of Duval Triangles number 1, 4, and 5. Data point selection is automatically performed by the DGA monitor based on reliability and gas concentration criteria.

### Robust construction

Stainless steel pipes, IP66-rated and temperature-controlled housing, as well as a magnetic drive gear pump and valves mean superb performance and durability – from the arctic to the tropics. What's more, there are no consumables to service or replace.

### Smooth and smart design

The web-based user interface completely eliminates the need for additional software. The monitor can be installed in less than two hours: connect oil, power, and data – and you're set. It can be connected to an existing control and monitoring system via digital communication and relays, or used as a standalone monitoring device. And in case of a disturbance such as a power outage, self-diagnostics allow for automatic self-recovery.

# Technical data

## Measurement specification

Parameter	Range	Accuracy <sup>1) 2)</sup>	Repeatability <sup>2)</sup>
Methane (CH <sub>4</sub> )	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Ethane (C <sub>2</sub> H <sub>6</sub> )	0 ... 10 000 ppm <sub>v</sub>	±10 ppm or ±5 % of reading	10 ppm or 5 % of reading <sup>3)</sup>
Ethylene (C <sub>2</sub> H <sub>4</sub> )	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Acetylene (C <sub>2</sub> H <sub>2</sub> )	0 ... 5000 ppm <sub>v</sub>	±0.5 ppm or ±5 % of reading	1 ppm or 5 % of reading
Carbon monoxide (CO)	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Carbon dioxide (CO <sub>2</sub> )	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Hydrogen (H <sub>2</sub> )	0 ... 5000 ppm <sub>v</sub>	±15 ppm or ±10 % of reading	15 ppm or 10 % of reading
Moisture <sup>4)</sup> (H <sub>2</sub> O)	0 ... 100 ppm <sub>w</sub> <sup>5)</sup>	±2 ppm <sup>6)</sup> or ±10 % of reading	Included in accuracy
Total gas pressure	0 ... 2000 hPa	±10 hPa or ±2 % of reading	10 hPa or 5 % of reading

- 1) Accuracy specified is the accuracy of the sensors during calibration gas measurements.  
 2) Whichever is greater.  
 3) Repeatability of ethane measurement is specified with averaging of five measurements.  
 4) Measured as relative saturation (%RS).  
 5) Upper range limited to saturation.  
 6) Calculated ppm value is based on average solubility of mineral oils.

## Measurement operation

Measurement cycle duration	1 ... 1.5 h (typical)
Response time (T63)	One measurement cycle <sup>1)</sup>
Warm-up time until first measurement data available	Two measurement cycles
Initialization time to full accuracy	Two days
Data storage	At least 10 years
Expected operating life	> 15 years

- 1) Three cycles for ethane and hydrogen.

## Field performance

Parameter	Typical variance to laboratory DGA <sup>1)</sup>
Acetylene (C <sub>2</sub> H <sub>2</sub> )	±1 ppm or ±10 % of reading
Hydrogen (H <sub>2</sub> )	±15 ppm or ±15 % of reading
Other measured gases	±10 ppm or ±10 % of reading
Moisture (H <sub>2</sub> O)	±2 ppm or ±10 % of reading

- 1) Compared with gas chromatography result from an oil sample considering also laboratory uncertainty. Performance of the gas-in-oil measurement may also be affected by oil properties and other chemical compounds dissolved in oil.

## Calculated parameters

Total dissolved combustible gases (TDCG)	Combined total of H <sub>2</sub> , CO, CH <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , C <sub>2</sub> H <sub>4</sub> , and C <sub>2</sub> H <sub>2</sub>
24 h average	Available for single gases, moisture, TDCG, and total gas pressure
Rate of change (ROC)	Available for single gases and TDCG for 24 h, 7 d, and 30 d periods
Gas ratios <sup>1)</sup>	Available ratios: <ul style="list-style-type: none"> <li>• CH<sub>4</sub>/H<sub>2</sub></li> <li>• C<sub>2</sub>H<sub>2</sub>/C<sub>2</sub>H<sub>4</sub></li> <li>• C<sub>2</sub>H<sub>2</sub>/CH<sub>4</sub></li> <li>• C<sub>2</sub>H<sub>6</sub>/C<sub>2</sub>H<sub>2</sub></li> <li>• C<sub>2</sub>H<sub>4</sub>/C<sub>2</sub>H<sub>6</sub></li> <li>• CO<sub>2</sub>/CO</li> </ul>

- 1) Calculated from 24 h average values. See standard IEC 60599.

## Operating environment

Transformer oil type	Mineral oil
Required minimum fire point <sup>1)</sup> of transformer oil	+125 °C (+257 °F)
Transformer oil pressure at oil inlet	Max. 2 bar <sub>abs</sub> continuous Burst pressure 20 bar <sub>abs</sub>
Transformer oil temperature at oil inlet	Max. +100 °C (+212 °F)
Ambient humidity range	0 ... 100 %RH, condensing
Ambient temperature range in operation	-40 ... +55 °C (-40 ... +131 °F)
Storage temperature range	-40 ... +60 °C (-40 ... +140 °F)

- 1) The fire point [of transformer oil] is normally approximately 10 °C [18 °F] higher than the closed flash point. See, for example, Heathcote, Martin J. *The J & P Transformer Book*. 13th ed. Elsevier, 2007.

## Power supply

Operating voltage	100 ... 240 VAC, 50 ... 60 Hz, ±10 %
Overvoltage category	III
Maximum current consumption	10 A
Maximum power consumption	500 W
Typical power consumption at +25 °C (+77 °F)	100 W

## Outputs

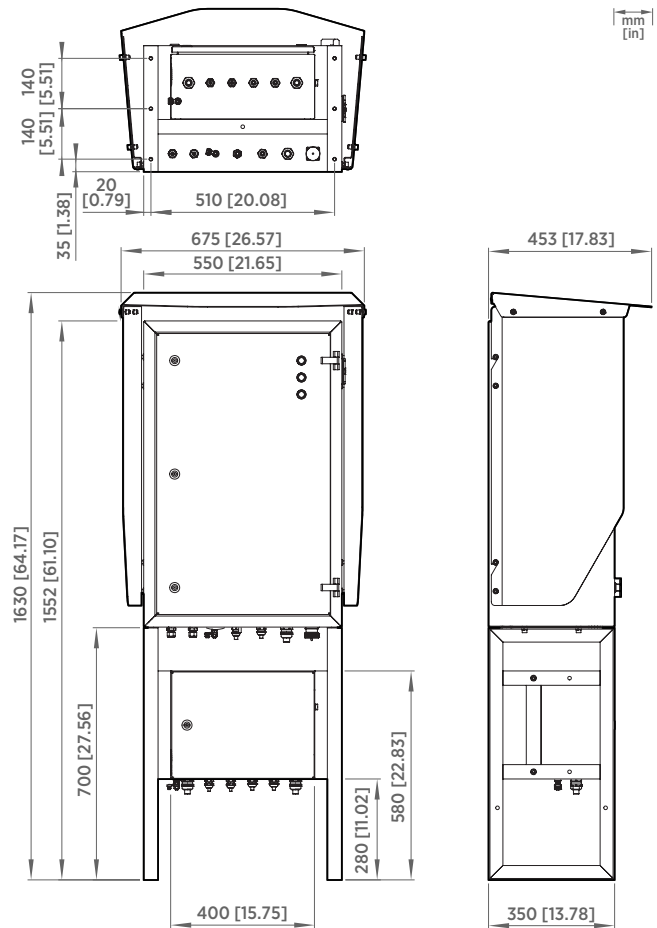
<b>RS-485 Interface</b>	
Supported protocols	Modbus RTU, DNP3 (optional feature)
Galvanic isolation	2 kV RMS, 1 min
<b>Ethernet Interface</b>	
Supported protocols	Modbus TCP, HTTP, HTTPS, DNP3 (optional feature), IEC 61850 (optional feature)
Galvanic isolation	4 kV AC (50 Hz, 1 min)
<b>Relay outputs</b>	
Number of relays	3 pcs, normally open (NO) or normally closed (NC), user selectable
Trigger type	Gas alert with user selectable limits
Max. switching current	6 A (at 250 VAC) 2 A (at 24 VDC) 0.2 A (at 250 VDC)
<b>User interface</b>	
Interface type	Web based user interface, can be operated with standard web browsers

## Mechanical specifications

Oil fitting	Stainless steel Swagelok® fitting for 10 mm (0.39 in) outer diameter tubing. See list of accessories for adapters available from Vaisala.
Max. length of oil pipe to transformer	Max. 10 m (33 ft) with 7 mm (0.28 in) inner diameter tubing Max. 5 m (16 ft) with 4 mm (0.15 in) inner diameter tubing
Material	Marine aluminum (EN AW-5754), stainless steel AISI 316

## Type tests

Category	Standard	Class/Level	Test
EMC compliance	IEC61000-6-5	Class 4 (interface type 4)	Immunity for Power Station and Substation Environments
	IEC61326-1	Industrial	Electrical equipment for measurement, control, and laboratory use - EMC requirements
	FCC 47 CFR 15, section 15.107	Class A	Limits for conducted emissions
	ISED ICES-003, section 5(a)(i)	Class A	Limits for conducted emissions
Environmental	IEC60529	IP66	Ingress protection
	SFS-EN ISO 6270-1:2017	+40 °C / 100 %RH for 480 h	Constant humidity condensation atmosphere (C5-M class)
	SFS-ISO 9227:2017	Neutral Salt Spray (NSS), 35 °C, 5 %, PH 6-7, 1000 h	Salt fog (C5-M class)
Safety	IEC/EN 61010-1, 3rd edition UL 61010-1:2012 CSA C22.2 No. 61010-1-12	Compliant	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements



Dimensions with Ground Mounting Set

## Compliance

CE marking

EMC directive, Low voltage directive, RoHS directive, WEEE directive

### You can count on Vaisala

Vaisala has created measurement devices for 80 years. Our instruments and systems are used in over 150 countries in industries where failure is not an option, including airports, pharmaceuticals, and power generation. Over 10,000 companies in safety and quality-critical sectors rely on Vaisala.

Vaisala sensors are used in the harshest places on Earth – Arctic, maritime, and tropical environments – and even on Mars.

### Power transformer monitoring that works

Vaisala Optimus™ DGA Monitor delivers out-of-the-box performance, eliminates false alarms, and gives you the best long-term stable measurements for the key fault gases used in transformer diagnostics.



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