The Vaisala Optimus™ DGA Monitor Technology Overview

The Vaisala Optimus DGA Monitor gives our customers trouble-free online monitoring of fault gases in power transformers, with no false alarms. The monitor doesn't require frequent maintenance and is designed to be safe and reliable – even in harsh and demanding operating environments. More information about the key technology components and functions is given below.

Sensing Technology

The sensing technology for carbon oxides and hydrocarbons is based on infrared (IR) light absorption, where different gases have unique absorption characteristics. The extracted gases are compressed in the optical module and the gas mixture is exposed to IR light from microglow light sources.

The optical module scans a wide range of IR wavelengths and analyzes IR absorption as well as the shape of absorption peaks to offer good selectivity for different detected gases and their concentrations. This proprietary measurement method eliminates interference from other evaporative hydrocarbons present in transformer oil, preventing cross-sensitivity.

Moisture is measured directly in the oil with our capacitive thin-film polymer HUMICAP® sensor, which has been used for transformer monitoring for 20 years. Hydrogen is also measured directly in the oil with the same solid-state sensor technology used in the Vaisala MHT410 transmitter.

IR Sensor Elements

All IR sensor elements, light sources, filters, and detectors are based on microelectromechanical systems (MEMS) with single crystal wafers. These elements are designed and optimized for the Optimus DGA Monitor and are manufactured in Vaisala cleanrooms. To maximize reliability, there are no moving parts in the optical measurement module.

Gas Extraction

Gases are extracted from transformer oil under partial vacuum, meaning very low absolute pressure at a controlled temperature. Vacuum extraction results in more complete gas separation than the traditional headspace method, increasing measurement reliability. This is also true when the pressure of total dissolved gases is far below saturation, for example after a transformer degassing process.

As vacuum extraction is significantly less dependent than the headspace method on gas solubility in oil (Ostwald constants), there is no need for any temperature or oil specific compensation. The gas extraction method used in the Optimus DGA Monitor is derived from the principle presented in the publication IEC 60567:2005 "7.3 Vacuum extraction by partial degassing method".

Optical Components

Traditionally, optical components can be subject to internal or external contamination. With the Vaisala Optimus DGA Monitor, internal gas extraction and oil handling mechanics are built and controlled so that contaminating compounds from oil cannot gather on the optical surfaces. Any external contamination is eliminated with a fully hermetic structure, which means ambient air cannot contact any part of the optical module.

Auto-calibration

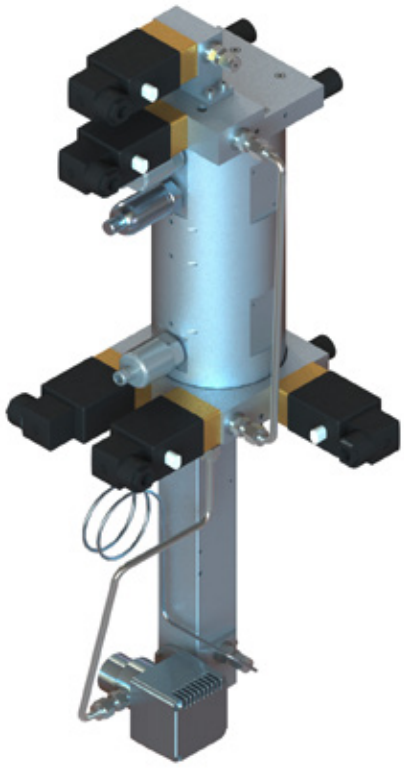
The Optimus DGA Monitor has several proprietary and unique automatic functions that can detect and eliminate known drift mechanisms of IR-based technologies, such as a decrease in light source intensity or changes in filter transmission.

Dissolving Gases

After the extracted gases have been analyzed, they are dissolved back into the oil. The automatic dissolving process is carefully controlled and monitored. There are special secondary mechanical structures to prevent any gas bubbles from leaving the monitor and entering the transformer. After the gases are dissolved, the oil is returned to the transformer in the same condition as it was taken. The dissolving process and hermetic structure of the oil and gas handling parts also eliminates the risk of flammable gases accumulating in the instrument housing.

Hermetic Mechanical Structure

All mechanical parts and structures in contact with oil and gas are made of aluminum or stainless steel, and there is no plastic piping in contact with the oil. As the whole structure is hermetically sealed, no oxygen or moisture from ambient air can enter the system and contaminate the transformer oil, even in the unlikely case of device failure. The risk of oil leakage is also minimized under all circumstances.



The oil handling unit for the Optimus DGA Monitor is made of aluminum and stainless steel, providing a robust and reliable structure in even the most harsh and demanding operating environments.

Self-diagnostics

The Optimus DGA Monitor continuously tracks internal functions during measurement cycles by comparing the different parameters and settings to carefully pre-defined reference values. The unit constantly records the status of integral elements like sensors, valves, and the pump. To confirm leak-free operation, the tightness of the structure that is in contact with oil and gases is continuously monitored with pressure sensors both under vacuum and during gas compression into the optical module.

In case of sudden power loss, the device stops operating and closes all valves automatically. Once mains power recovers, self-diagnostics automatically identify the status of the monitor and the measurement cycle phase before running the device to a safe starting point to continue normal operation. The unit records all main operational parameters into a self-diagnostics log file, which can be downloaded and analyzed remotely in case of any abnormal phenomena occurring.

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