

Serveron® TM8™ On-line Transformer Monitor

Reliable energy through continuous, on-line DGA

Reliable energy flow is paramount and your transformers are critical, and some of the costliest, assets in your grid. DGA (dissolved gas analysis) of transformer oil is the best indicator of a transformer's overall condition. The Serveron TM8 On-line Transformer Monitor provides the most comprehensive DGA condition assessment available. It provides the important and timely information you need to maintain the reliability of your transformer fleet.

Asset Management Improved – Meet Your Reliability and Financial Goals:

- **Avoid transformer failures:** Continuous trending of key fault gases gives early and immediate notification of incipient faults that can lead to transformer failure.
- **Lower costs through condition-based maintenance:** Only comprehensive on-line monitoring can provide the information that enables continuous transformer condition assessment.
- **Defer capital expenditures:** Comprehensive analysis of key fault gases and other key parameters enables intelligent management of transformers, extending their useful life.

Protect Critical Assets

- Protect and manage transformer assets
- Avoid transformer failures
- Enable condition-based maintenance
- Extend transformer life

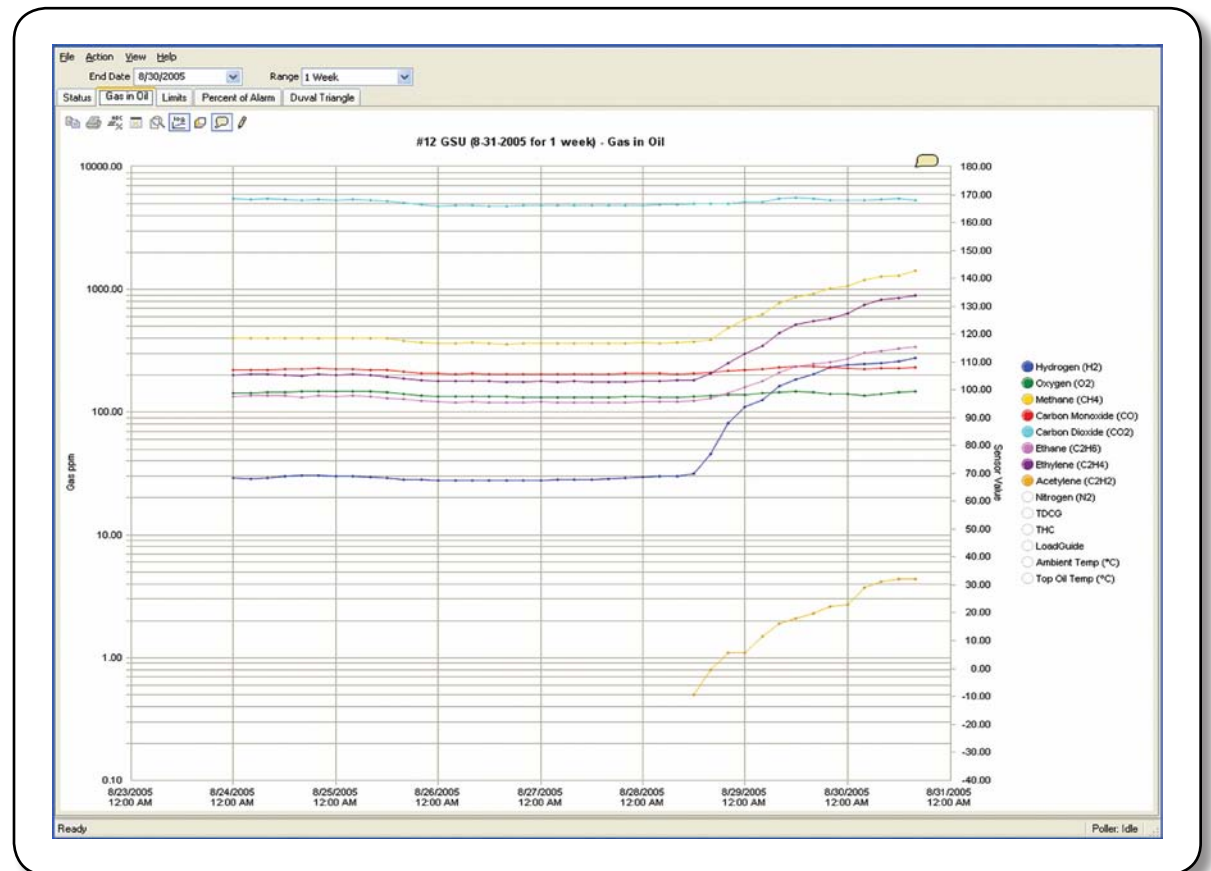


Many transformer failures can be prevented through the correlation of DGA data to real events. On-line monitoring of key gases is the most practical way to relate gassing levels to external events. Gas chromatography (GC) is the reference standard and accepted science for measuring gas-in-oil levels. The Serveron TM8 brings the DGA laboratory to your transformer with its rugged, closed-loop gas chromatograph system providing up to hourly sampling of eight critical fault gases. Correlation to real events is accomplished through time stamping of all gas data as well as relative load and ambient temperature measurements. The Serveron TM8 also provides optional measurement capabilities including oil temperature and moisture-in-oil readings. Field proven in utilities worldwide, the GC technology in the Serveron TM8 offers high reliability and low cost of ownership.

Serveron® TM8™ – For Critical Power Transformers

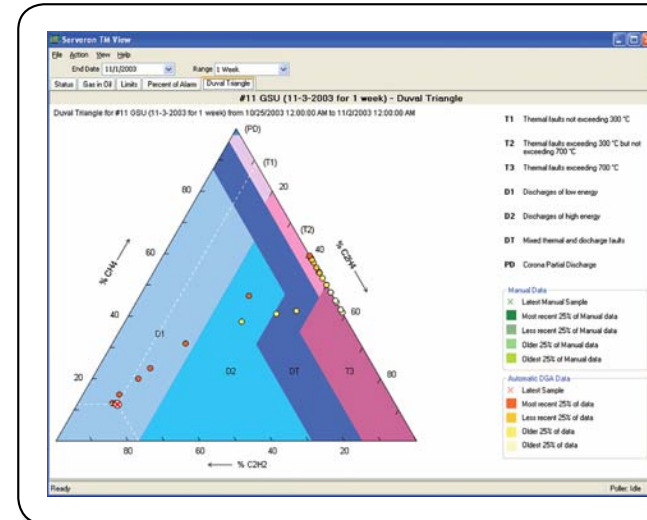
Throughout your system there are transformers that are vital to the reliability of your grid – GSU’s, large transmission transformers, and critical substation transformers. The Serveron TM8 offers the most comprehensive DGA assessment available. This assessment is provided through accurate and repeatable on-line measurements of the 8 critical fault gases and other key parameters:

- Correlates all 8 fault gases, oil temperature, ambient temperature and moisture-in-oil, to transformer load.
- Data from the Serveron TM8 supports all IEEE and IEC diagnostic tools for rapid warning and diagnosis of developing faults.



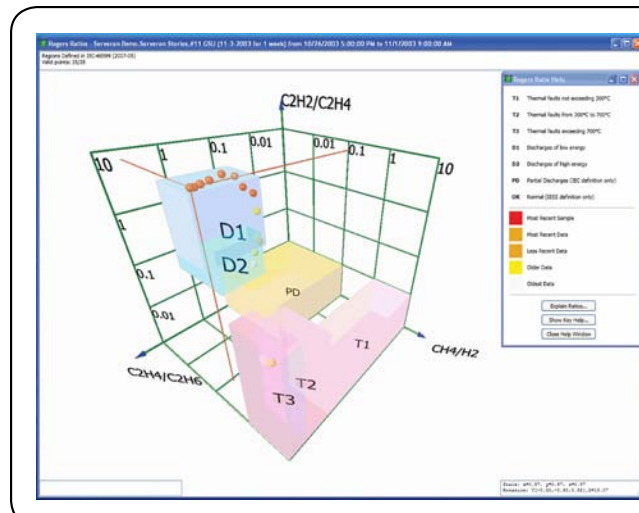
Comprehensive Data Requires Powerful Tools

- Serveron software and services offer simple yet powerful analytical tools for transformer monitor control, data presentation and analysis as well as management functions.
- Serveron application software, included with each transformer monitor product, is used to locally or remotely control, retrieve, store, and view data.
- The recorded on-line data (DGA plus other parameters) is populated on diagnostic tools that deliver new and immediate insights for possible fault conditions.
- Information is delivered where you need it through our TM View™ software.



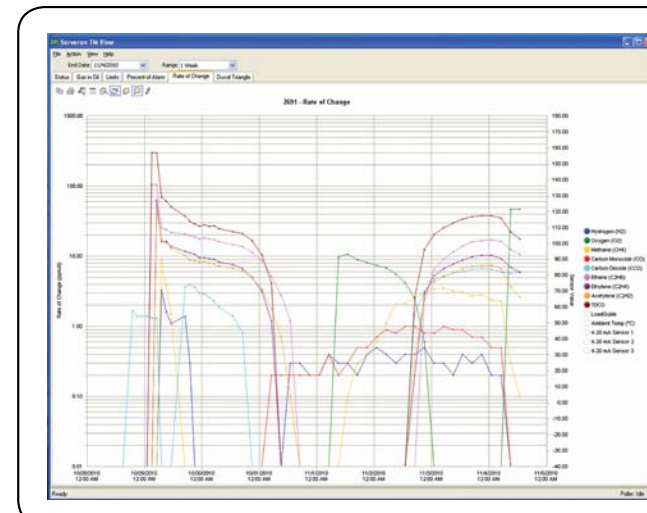
Duval Triangle

The Duval Triangle (IEC 60599-2007-05) provides a diagnostic outcome for various combinations of the fault gases.



Rogers and Basic Gas Ratios

The Rogers and Basic Gas Ratios (IEEE C57.104-2008 & IEC 60599-2007-05) provide a diagnostic outcome for various combinations of the fault gases.



Rate of Change

Alarms triggered by exceeding rate of change limits allow for early detection of incipient faults.

DGA Method: Laboratory Grade Gas Chromatography

Gas		Accuracy ¹	Repeatability ²	Range ³
Hydrogen	H ₂	±5% or ±3 ppm	<2%	3-3,000 ppm
Oxygen	O ₂	±5% or +30/-0 ppm	<1%	30-25,000 ppm
Methane	CH ₄	±5% or ±5 ppm	<1%	5-7,000 ppm
Carbon Monoxide	CO	±5% or ±5 ppm	<2%	5-10,000 ppm
Carbon Dioxide	CO ₂	±5% or ±5 ppm	<1%	5-30,000 ppm
Ethylene	C ₂ H ₄	±5% or ±3 ppm	<1%	3-5,000 ppm
Ethane	C ₂ H ₆	±5% or ±5 ppm	<1%	5-5,000 ppm
Acetylene	C ₂ H ₂	±5% or ±1 ppm	<2%	1-3,000 ppm
Nitrogen	N ₂	±10% or ±5,000 ppm	<20%	5,000-100,000 ppm

• All specifications are independent of oil temperature and gas pressure levels.

- 1) Percent or PPM - whichever is greater
- 2) At the calibration level
- 3) Gas-in-Oil

Moisture-in-oil and Oil Temperature Option

Parameter	Accuracy ⁴	Range
Moisture-in-Oil	±2%	0-100% RS
	< 10% of reading for oil temperature > 30°C	0 to 80 ⁵ ppm
	< 18% of reading for oil temperature < 30°C	0 to 80 ⁵ ppm
Oil Temperature	±0.1°C (typically)	-40°C to +180°C

- 4) Includes non-linearity and repeatability
- 5) Upper range limited to saturation

Total Dissolved Gases

True Total Dissolved Combustible Gas (TDCG) output is available

- Σ H₂, C₂H₂, C₂H₄, CO, CH₄, C₂H₆ in PPM
- Each gas is measured at 100% of detected level

Total Hydrocarbons (THC) output is available

- Σ CH₄, C₂H₂, C₂H₄, C₂H₆ in PPM
- Each gas is measured at 100% of detected level

Gas Analysis

- Oil sampling is continuous and gas analysis intervals are user-selectable from 2 hours to 12 hours (Default: 4 hours)
- All data is date and time stamped
- Up to two years of data is stored in memory
- Automatic schedule acceleration when rate of change alarm limit is exceeded (Default: 1 hr)
- System performs periodic auto-calibration to National Institute of Standards and Technology (NIST) traceable gas standard

Alarms

Two individually programmable relays – 50V dc or 240 V ac @ 3A max. (125 V dc @ 1A max.)

- Gas Caution & Alarm for Level (ppm) and/or Rate-of-Change (ppm/day)
- Power, Service Event or Gas Caution and Alarm

Relay contacts operate as Normally Open or Normally Closed

External Sensor Inputs

Three (3) analog 4 to 20 mA inputs

Sensors included are:

- Transformer Load Guide
- Ambient Temperature

Optional Moisture-in-Oil and Temperature Probe (uses 2 inputs)

Communications

Serveron offers a variety of physical and protocol layer alternatives:

- Standard Physical Layer Interfaces: RS-232, RS-485, Ethernet Fiber (100Base-FX), V.92 Internal POTS modem
- Optional Interfaces: Cellular modem, Ethernet Copper (10/100Base-TX), Wireless Radio
- Protocols supported: TCP/IP, DNP3, Modbus RTU, ASCII, OPC and IEC 61850 upon request

Environmental Specifications

Operating Temperature	-50°C to +55°C
Cold Start Temperature	-20°C
Operating Humidity	5% to 95% RH, non-condensing
Oil Inlet Pressure	0 to 45 psi (0 to 3 bar)
Storage Temperature	-40°C to +75°C
Storage Humidity	5% to 95% RH, non-condensing

Input Power Requirements

Voltage	115VAC or 230VAC ±15%
Frequency	50/60 Hz
Current	6A maximum @ 115V 3A maximum @ 230V

Physical Specifications

Height	22.0 in (55.9 cm)
Width	20.0 in (50.8 cm)
Depth	11.2 in (28.4 cm)
Weight	65 lb (29.5 kg)
Enclosure Rating	NEMA 4X, IP66
Packaged Dimensions	26.4 in x 26.4 in x 15.9 in (67 cm x 67 cm x 40.3 cm)
Shipping Weight, Monitor pkg. only	70 lb (31.8 kg)

Specifications are subject to change without notice. US Patents Pending: US Patents #6,365,105 and #6,391,096.

Certifications/Standards

Radiated and Conducted Emissions

<u>Specification</u>
EN 61326 Class A: 2002
EN 61000-3-2: 2000
EN 61000-3-3: 2001

<u>Test Method</u>
EN 61326: 2002 Radiated Emissions
EN 61326: 2002 Conducted Emissions
EN 61000-3-2: 2000 Current Harmonics
EN 61000-3-3: 2001 Voltage Fluctuations

Radiated and Conducted Immunity

<u>Specification</u>
EN 61326 Annex A: 2002

<u>Test Method</u>
IEC61000-4-2: 2001 ESD
IEC61000-4-3: 2002 Radiated Immunity
IEC61000-4-4: 2004 EFT
IEC61000-4-5: 2001 Surge
IEC61000-4-6: 2004 Conducted RF Immunity
IEC61000-4-8: 2001 Magnetic Field Immunity
IEC61000-4-11: 2004 Voltage Dips & Interrupts

Safety

IEC 61010-1, IEC 61010-2-81
UL 61010-1 (2nd Edition), UL 60950-1 Clause 6.4
CSA-C22.2 No. 61010-1-04

Environmental

IEC 60068-2-1
IEC 60068-2-2
IEC 60068-2-30
IEC 60068-2-52
IEC 60068-2-78
IEC 60529



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