Calisto 5
5 fault gases - moisture

Calisto 9
complete DGA - moisture

ACCURACY BY DESIGN

# Technical Specifications

Models C501 and C901

## Application

Online monitoring of fault gases, air components and moisture in transformer insulating fluids.

## Technology

| | |
|---|---|
| **Gas measurements** | Proprietary chromatographic method |
| **Gas extraction** | Oil-immersed Teflon® tubing |
| **Moisture measurements** | Oil-immersed relative saturation (RS) sensor |
| **Communications** | Electrical isolation rated for substation environments |

## Performance

| | $H_2$ | CO | $CH_4$ | $C_2H_2$ | $C_2H_4$ | $C_2H_6$ | $CO_2$ | $O_2$ | $N_2$ | $H_2O$ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lower detection limit (LDL)** (1) | ppm | | | | | | | | | 2 ppm, or 2% RS |
| | 0.5 | 10 | 0.2 | 0.2 | 0.2 | 0.2 | 15 | 500 | 2,000 | |
| **Range** | ppm | | | | | | | | | Saturation, or 100% RS |
| | 0 - 20,000 | 0 - 30,000 | 0 - 100,000 | 0 - 100,000 | 0 - 200,000 | 0 - 200,000 | 0 - 100,000 | 0 - 100,000 | 0 - 150,000 | |
| **Accuracy in factory**(2) | Percent | | | | | | | | | |
| | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% | |
| **Accuracy in service**(3) | (LDL plus X% of reading) ppm | | | | | | | | | 3 ppm, or 3% RS |
| | X=5 | X=5 | X=5 | X=5 | X=5 | X=6 | X=5 | X=15 | X=15 | |
| **Repeatability** | (LDL plus Y% of reading) ppm | | | | | | | | | 2 ppm, or 2% RS |
| | Y=3 | Y=3 | Y=3 | Y=3 | Y=3 | Y=4 | Y=3 | Y=10 | Y=10 | |
| **Resolution at LDL** | ppm | | | | | | | | | 1 ppm, or 1% RS |
| | 0.5 | 2 | 0.2 | 0.2 | 0.2 | 0.2 | 5 | 100 | 1,000 | |
| **Measurement interval** | User configurable: 80, 160 and 240 minutes. Conditional cycle on alarm. | | | | | | | | | 6 seconds |
| **Step response (typical)** | In 80 minutes: 95% $H_2$; 90% CO, $CH_4$, $CO_2$, $O_2$, $N_2$; 80% $C_2H_2$, $C_2H_4$, $C_2H_6$ | | | | | | | | | 95% in 20 minutes |

(1) All ppm in mineral oil. (2) Accuracy in factory at calibration gas concentrations without regard for gas extraction from oil. (3) Accuracy in service throughout product lifetime even in the presence of potential interfering gases/compounds in the oil. Reference: Morgan Schaffer ISO 17025 accredited laboratory and True North/Atlantis oil standards. The shaded area applies to the Calisto C901 model only.

## Reliability

| | |
|---|---|
| **Gas management** | Continuous monitoring of carrier and calibration gas pressure to detect and report gas leak errors and to predict cylinder replacement time |
| **Enclosure and oil temperature conditioning** | Improves measurement accuracy and extends the lifetime of internal components |
| **Power interruption protection** | 250 ms advanced power loss system |
| **Expected operating life (EOL)** | > 15 years.<br>Chromatography column lifetime field-proven to be at least 10 years. |

## Operation

| | |
|---|---|
| **Operating temperature range** | -50 to +55 ºC; cold start -50 ºC |
| **Storage temperature range** | -40 to +75 ºC |
| **Operating oil temperature range** | -40 to +120 ºC |
| **Operating oil pressure range** | Full vacuum to 40 psi |
| **Operating humidity range** | 0 - 100% RH |

| | |
|---|---|
| **Storage humidity range** | 5 - 95%, non-condensing, with caps installed on the carrier gas inlet and outlet of the monitor |
| **Elevation range** | Up to 4,000 m |
| **Construction** | |
| **Width x height x depth** | Instrument: 610 x 489 x 337 mm (24 x 19 x 13.3 in.) |
| **Weight** | Instrument: 45 kg / 99 lbs |
| **Enclosures** | Instrument: 304 S.S., gauge 16, lockable<br>Carrier gas manifold: 304 S.S., gauge 14, lockable option |
| **Oil circulation** | Anti-cavitation reciprocating pump, 10 - 60 ml/min. |
| **Oil flow monitoring** | Proprietary Morgan Schaffer system with low flow error |
| **Oil lines** | ⅜ in. OD stainless steel |
| **Air bubble elimination** | Proprietary Morgan Schaffer system: Intelligent Bubble Trap |
| **Enclosure temperature conditioning** | Thermoelectric feedback |
| **Oil temperature conditioning** | Passive heat exchanger plus thermoelectric feedback |
| **Cooling** | Forced air |
| **Equipment protection** | Thermal cut-off fuse (77 °C), over-current mains fuse |
| **Oil sampling installation** | External quick-connect port plus sampling accessories |
| **Installation** | |
| **Calibration** | On-board NIST traceable calibration gas, automatic calibration, aluminum cylinder. 4 year lifetime with daily calibration interval.<br>Note: Not compatible with earlier models C500, C500B, C900 & C900B |
| **Carrier gas requirements** | 99.9999% He, 3600 psi maximum<br>4 year lifetime independent of measurement interval with 44L He cylinder |
| **Maintenance** | Visual inspection every 12 months<br>Carrier gas replacement every 48 months<br>Calibration gas replacement every 48 months |
| **Electrical entry holes (standard)** | 5 x 22.2 mm / 0.875 in. diameter |
| **Commissioning time** | 5 hours installation, plus 4 - 12 hours before first readings |
| **Mounting** | Shock mounts. MS Calisto Mounting Stand recommended |
| **Power requirements (no selection required)** | 100 - 240 VAC ±10% (4), 50 - 60Hz, 1Ø, 350W<br>100 - 220 VDC ±10% (4), 350W / 10 A minimum client disconnect breaker |
| **Power conductor size** | Max. 2.05 mm / AWG 12 |
| **Oil supply line length** | 1.5 - 10.5 m / 5 - 35 ft |
| **Oil return line length** | 1.5 - 10.5 m / 5 - 35 ft |
| **Communication and Data** | |
| **Front panel interface** | English and French<br>256 x 64 pixel display, vacuum fluorescent, day/night, screen-saver<br>Three weatherproof, UV resistant buttons<br>Menu functions for readings, alarms, databank, set-up and maintenance |
| **Communication** | SCADA: Modbus, DNP3 Level 2, Optional IEC 61850 kit<br>Time Synchronization: SNTP<br>HTTP: Calisto Web Server<br>Integrator: MSSP (Morgan Schaffer System Protocol) |
| **Local temporary connection** | USB 2.0 (cable provided), RS-232 |
| **Permanent connection (5 kV impulse, 2.6 kVAC)** | RS-485, 2 x copper Ethernet, *See options |
| **Isolated analog ports (5 kV impulse, 2.6 kVAC)** | 1 assignable 4-20 mA input, *See options |
| **Measurement alarms** | Programmable dual-level and trend alarms for all readings |
| **Relay outputs (250VAC, 5A; 48VDC, 1.5A)** | 5 NO/NC contacts assignable for set-up, self-test and measurement alarm conditions, *See options |
| **Data storage** | 8 years |
| **Self diagnostics** | 192 error codes with intuitive descriptions and recommended client actions |

(4) As per IEC/EN 61010

| | |
|---|---|
| **Interface Software** | |
| **Calisto Manager™** | English, French, Simplified and Traditional Chinese<br>Local and remote Calisto configuration, maintenance, data downloads and diagnostic downloads<br>Tracking network of Calisto, Calisto 2, Calisto 5, and/or Calisto 9 monitors<br>Database of Calistos, transformers and measurements. |
| **Platforms** | Windows XP / Vista / Windows 7 / Windows 8 / Windows 10 |
| **DGA data management and diagnostics** | **Inside View** software integrates DGA data from monitors and portable analyzers with laboratory oil quality data.<br>Diagnostic tools for fleetwide transformer health management (sold separately). |
| **Regulatory** | |
| **CE marking** | Low Voltage Directive 2006 / 95 / EC<br>EMC Directive 2004 / 108 / EC<br>WEEE Directive 2012 / 19 / EC<br>RoHS Directive 2011 / 65 / EC |
| **EMC (Electromagnetic Compatibility)** | IEC/EN 61326<br>IEC/EN 61000-6-5<br>IEC/EN 61850-3<br>FCC part 15 (US)<br>Class A, ICES-003 (Canada) |
| **Electrical safety** | IEC/EN 61010<br>IEC/EN 60255-27 |
| **Ingress protection** | IEC/EN 60529, IP 56 |
| **Shipping** | |
| **Gross weight** | Instrument: 56 kg / 124 lbs<br>Standard accessories: 9 kg / 20 lbs |
| **Packaging dimensions** | Instrument: 775 x 700 x 521 mm (30.5 x 27.5 x 20.5 in.)<br>Standard accessories: 560 x 510 x 270 mm (22 x 20 x 10.5 in.) |
| **Options (may be purchased as factory installed)** | |
| | IEC 61850 Ethernet communication kit<br>Ethernet outdoor connectivity kit (copper)<br>USB outdoor connectivity kit<br>Optional client communication cards (choose 2 maximum per Calisto);<br>• Optical Ethernet card: Multimode, SC connector, 100BASE-FX, 1300 nm<br>• 4-20mA card: 10 outputs plus 2 inputs (5 kV impulse, 2.6 kVAC)<br>• Relay card: 5 NO/NC outputs (250 VAC, 5A; 48 VDC, 1.5A) |
| **Accessories** | |
| | Morgan Schaffer Calisto Mounting Stand<br>Calisto precision oil temperature probe (4-20mA)<br>All metal stainless steel flexible oil lines<br>Low-temperature insulated oil lines<br>Calisto isolation valves<br>Cellular modem (Ethernet)<br>Sun shield to reduce thermal load in extreme hot environments<br>Breather drain kit for humid environments<br>Enclosure locking block |
| **Warranty** | |
| Morgan Schaffer's Calisto 5 and Calisto 9 monitors are backed by a 30-month standard warranty.<br>1,2 and 3 year extended warranty available. | |
| **Service and Support** | |
| On-site commissioning service and on-site maintenance program available upon request. | |
| **Note** | |
| Continuous research and product improvements may result in specification or appearance changes at any time. | |

## Comparison Table

| | Calisto | Calisto 2 | Calisto 501 | Calisto 901 |
|---|---|---|---|---|
| Hydrogen ($H_2$) | ✓ | ✓ | ✓ | ✓ |
| Carbon monoxide (CO) | | ✓ | ✓ | ✓ |
| Methane ($CH_4$) | | | ✓ | ✓ |
| Acetylene ($C_2H_2$) | | | ✓ | ✓ |
| Ethylene ($C_2H_4$) | | | ✓ | ✓ |
| Ethane ($C_2H_6$) | | | | ✓ |
| Carbon dioxide ($CO_2$) | | | | ✓ |
| Oxygen ($O_2$) | | | | ✓ |
| Nitrogen ($N_2$) | | | | ✓ |
| Total Dissolved Gas (TDG) | | | | ✓ |
| Total Dissolved Combustible Gas (TDCG) | | | | ✓ |
| Total Headspace Combustible Gas (THCG) | | | | ✓ |
| Moisture | ✓ | ✓ | ✓ | ✓ |
| Programmable alarming | ✓ | ✓ | ✓ | ✓ |
| Oil flow monitoring | ✓ | ✓ | ✓ | ✓ |
| Compatible mounting | ✓ | ✓ | ✓ | ✓ |
| 180 minute measurement interval | ✓ | ✓ | | |
| 80, 160, 240 minutes measurement intervals | | | ✓ | ✓ |
| Real-time hydrogen | ✓ | ✓ | | |
| All Duval Triangle* gases | | | ✓ | ✓ |
| All DGA Diagnostic* gases | | | | ✓ |
| DNP3 & Modbus | ✓ | ✓ | ✓ | ✓ |
| IEC 61850 protocol (optional) | ✓ | ✓ | ✓ | ✓ |
| CE marked-FCC compliant | ✓ | ✓ | ✓ | ✓ |
| IP 56 enclosure | ✓ | ✓ | ✓ | ✓ |

*Additional software required, such as Morgan Schaffer's Inside View.


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### Accreditation

Morgan Schaffer is ISO 9001:2015 certified.
Morgan Schaffer laboratory is ISO/IEC 17025:2017 accredited by the ANSI-ASQ National Accreditation Board for the tests listed on its scope of accreditation. Morgan Schaffer is also ISO 17034:2016 accredited by the ANSI-ASQ National Accreditation Board for the production of reference materials listed on its scope of accreditation.

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