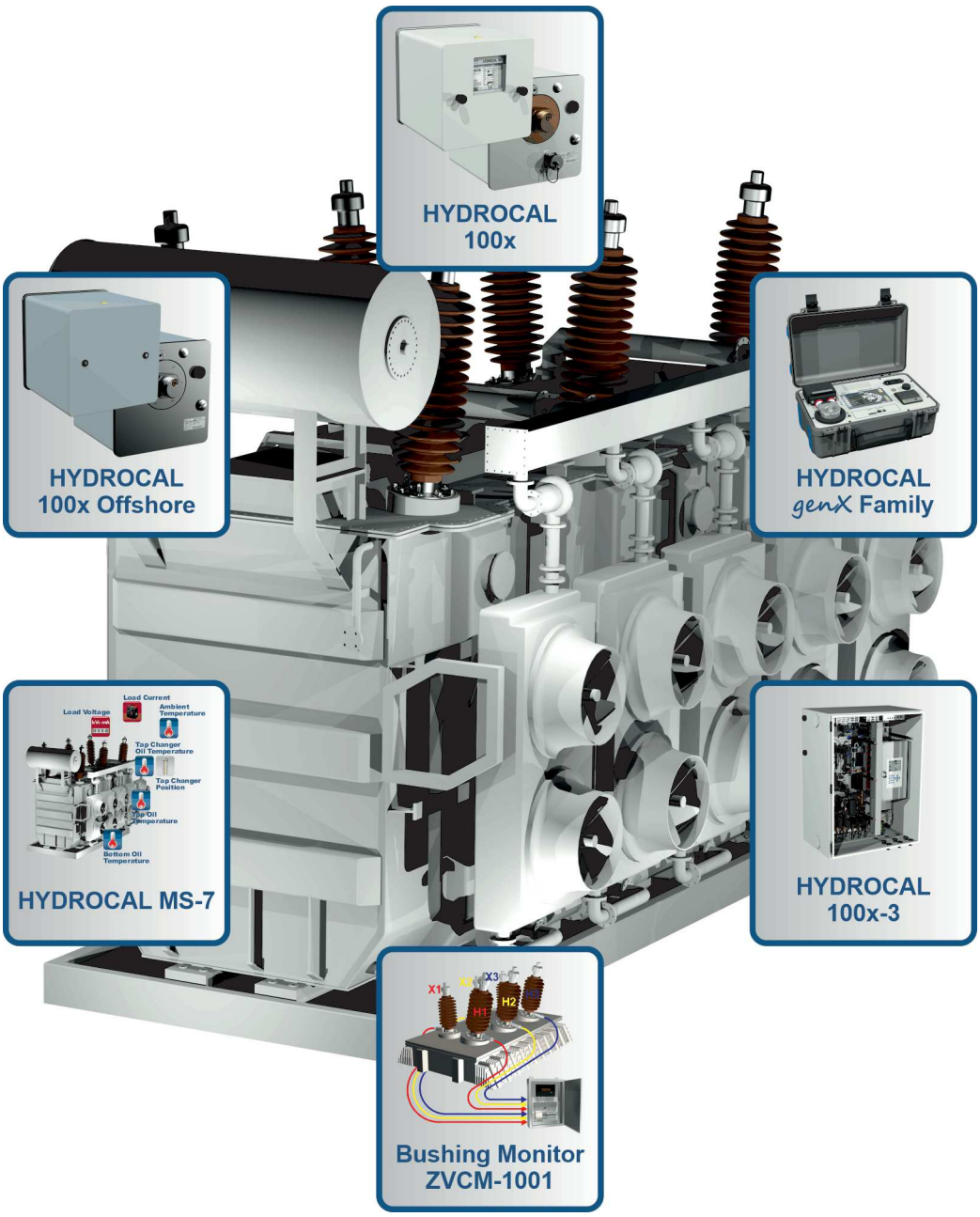
MTE

# Meter Test Equipment



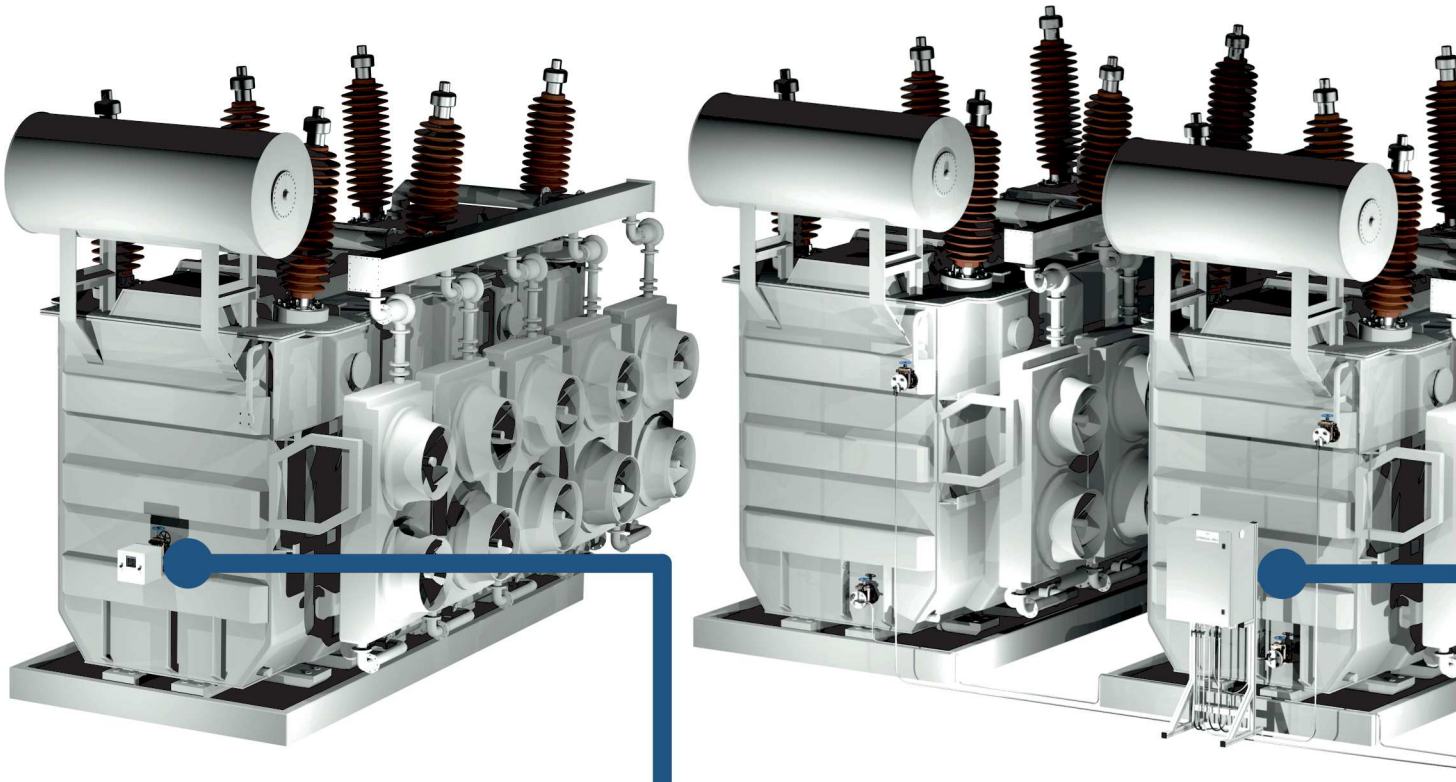

# Transformer Monitoring

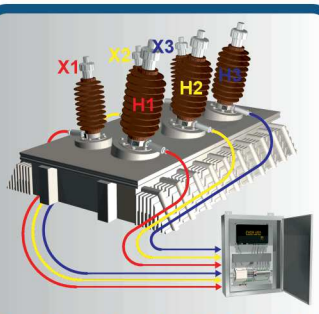
# Overview and MTE´s approach

Transformers are crucial for failure-free and stabilized operation of high-voltage power transmission. Transformer failures or disruptions can result in costly power outages or even in the total loss of expensive plant assets. Moreover transformers are the most cost intensive single component assets in high-voltage power transmission and should therefore be supervised with special care.

Analysis of the gases dissolved in power transformer oil is recognized as the most useful tool for early detection and diagnosis of incipient faults in transformers. The cost effectiveness of online dissolved gas analysis (DGA) and control systems are gaining importance worldwide.

With its comprehensive product range for the online monitoring of transformers, MTE offers both the extension of the transformer lifetime and the contribution to a more secure high-voltage power transmission.

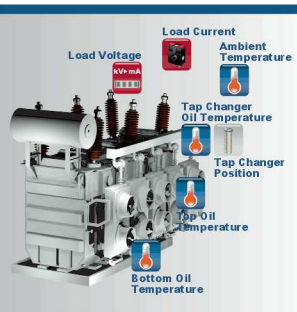




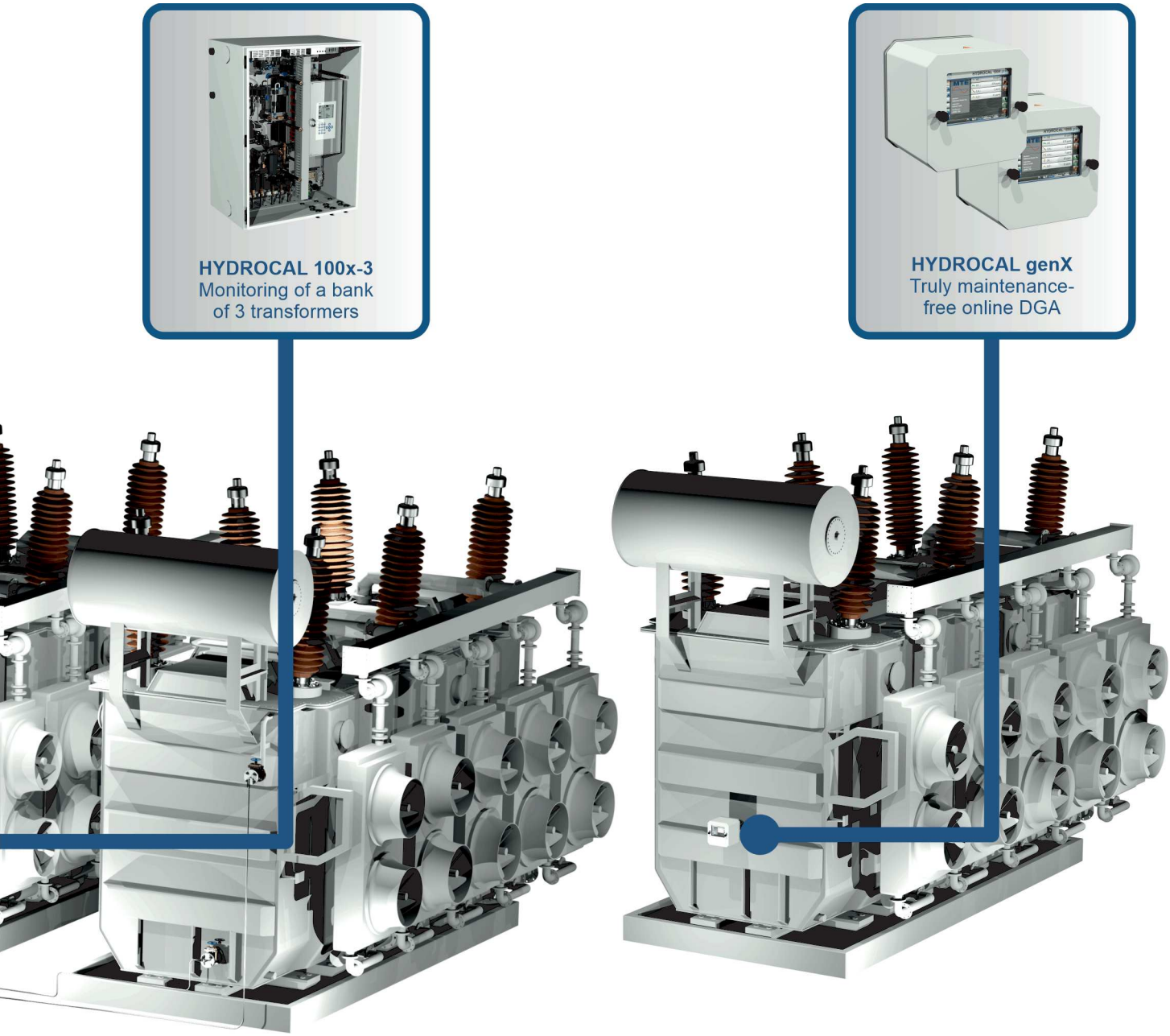

**Bushing Monitor ZVCM-1001**
Extension package



**HYDROCAL 100x**
Online DGA up to 8 fault gases and moisture




**HYDROCAL MS-7**
Extension package




## Advantages of MTE´s solutions for Transformer Monitoring

- Permanent online monitoring of transformer condition
- Early warning
- Less risk of expensive power outages
- Reduced on-site inspections
- Maintenance free system
- Extending transformer life time due to improved preventative maintenance and faster reaction time in case of failures
- Modular system components and extension packages for the specific customer requirements
- Easy and fast mounting on the operating transformer (HYDROCAL 100x, genX and Offshore versions)
- Approved solution with more than 6´500 supplied units

# Product portfolio

| | HYDROCAL 1001+ | HYDROCAL 1003 | HYDROCAL 1004 genX | HYDROCAL 1005 |
|---|---|---|---|---|
| |  |  |  |  |
| Gas-in-oil analysis | $H_2$<br>CO<br>$CH_4$<br>$C_2H_2$<br>$C_2H_4$<br>$C_2H_6$<br>(composite) | $H_2$<br>CO<br>(individual) | $H_2$<br>CO<br>$C_2H_2$<br>(individual) | $H_2$<br>CO<br>$C_2H_2$<br>$C_2H_4$<br>(individual) |
| Moisture in oil analsis ($H_2O$) | ✓ | ✓ | ✓ | ✓ |
| Transformer monitoring inputs / outputs | ✗ | ✓ | ✓ | ✓ |
| Offshore suitable [1] | ✗ | ✓ | ✗ | ✓ |
| HYDROCAL MS-7 [2] | ✗ | ✓ | ✓ | ✓ |
| Bushing Monitor ZVCM-1001 [2] | ✗ | ✗ | ✓ | ✓ |
| Communication<br><br>(Options) | TCP/IP,<br>RS 485,<br>MODBUS | RS 232,<br>RS 485,<br>MODBUS<br><br>TCP/IP,<br>IEC 61850<br>DNP 3.0,<br>3G Modem | TCP/IP,<br>RS 485,<br>MODBUS<br><br>IEC 61850<br>DNP 3.0,<br>3G Modem | TCP/IP,<br>RS 485,<br>MODBUS<br><br>IEC 61850<br>DNP 3.0,<br>3G Modem |
| Monitoring of multiple transformers | ✗ | ✗ | ✗ | ✗ |

1) Special version with corrosive protection for the installation on offshore platforms
2) Extension packages (options)

| | HYDROCAL 1006 genX | HYDROCAL 1008 | HYDROCAL 1009 | HYDROCAL 100x-3 | HYDROCAL 1011 genX P |
|---|---|---|---|---|---|
| |  |  |  |  |  |
| | $H_2$<br>CO<br>$CH_4$<br>$C_2H_2$<br>$C_2H_4$<br>(individual) | $H_2$<br>CO<br>$CO_2$<br>$CH_4$<br>$C_2H_2$<br>$C_2H_4$<br>$C_2H_6$<br>(individual) | $H_2$<br>CO<br>$CO_2$<br>$CH_4$<br>$C_2H_2$<br>$C_2H_4$<br>$C_2H_6$<br>$O_2$<br>(individual) | $H_2$<br>CO<br>$CO_2$<br>$CH_4$<br>$C_2H_2$<br>$C_2H_4$<br>$C_2H_6$<br>$O_2$<br>(individual) | $H_2$<br>CO<br>$CO_2$<br>$CH_4$<br>$C_2H_2$<br>$C_2H_4$<br>$C_2H_6$<br>$C_3H_8$<br>$O_2$<br>$N_2$<br>(individual) |
| | ✓ | ✓ | ✓ | ✓ | ✓ |
| | ✓ | ✓ | ✓ | ✓ | ✗ |
| | ✗ | ✓ | ✓ | ✗ | ✗ |
| | ✓ | ✓ | ✓ | ✓ | ✗ |
| | ✓ | ✓ | ✓ | ✗ | ✗ |
| | TCP/IP,<br>RS 485,<br>MODBUS<br><br>IEC 61850<br>DNP 3.0,<br>3G Modem | TCP/IP,<br>RS 485,<br>MODBUS<br><br>IEC 61850<br>DNP 3.0,<br>3G Modem | TCP/IP,<br>RS 485,<br>MODBUS<br><br>IEC 61850<br>DNP 3.0,<br>3G Modem | TCP/IP,<br>RS 485,<br>MODBUS<br><br>IEC 61850<br>DNP 3.0,<br>3G Modem | ETHERNET,<br>WLAN / WiFi,<br>USB Type B |
| | ✗ | ✗ | ✗ | ✓ | ✗ |

# Early warning




HYDROCAL 1001+

The HYDROCAL 1001+ is a permanently installed composite gas in oil sensor for the Total Dissolved Combustible Gases (TDCG) analysis of the key fault gases Hydrogen ($H_2$), Carbon Monoxide (CO), Methane ($CH_4$), Acetylene ($C_2H_2$), Ethylene ($C_2H_4$) and Ethane ($C_2H_6$).

To detect an even wider range of potential transformer faults, the HYDROCAL 1001+ analyses additionally the content of Moisture ($H_2O$) in the transformer oil.

The HYDROCAL 1001+ is a fully integrated (6 key fault gases and Moisture in oil) compact and cost effective device used in particular for early transformer fault detection and preventative maintenance.

**Key advantages:**

- Cost effective and comprehensive monitoring of 6 fault gases
- Measurement of Moisture ($H_2O$) in the transformer oil
- Easy and fast installation while the transformer is operating
- Compact and resistant design for long lasting usage
- ETHERNET and RS 485 interfaces to support MODBUS®TCP proprietary communication




HYDROCAL 1003

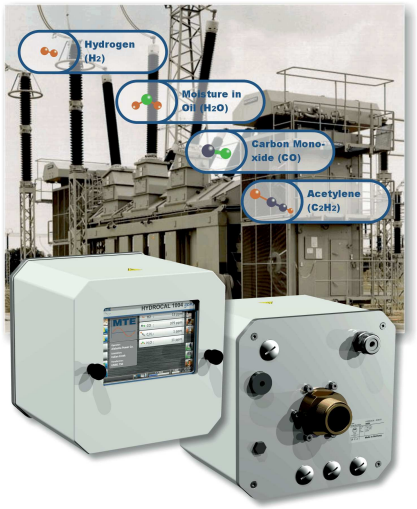
The HYDROCAL 1003 is an online transformer monitoring device for the dissolved gas analysis (DGA) of the key fault gases Hydrogen ($H_2$) and Carbon Monoxide (CO).

In addition, water contamination deteriorates the performance of the oil as high moisture content increases the risk of corrosion and overheating.

The HYDROCAL 1003 reacts on this issue and provides its users the analysis of Moisture ($H_2O$) in the transformer oil to achieve an even higher safety standard.

**Key advantages:**

- Easy to mount on the operating transformer without any operational interruption
- ETHERNET (Option), RS 232 and RS 485 interfaces to support MODBUS®RTU/ASCII, DNP3 proprietary communication and IEC 61850 protocols
- Option: Offshore version




HYDROCAL 1004 *genX*

The HYDROCAL 1004 genX is the first truly maintenance free multi-gas online DGA solution combining proven near infrared (NIR) measuring technology with vacuum protected membrane extraction.

As Hydrogen ($H_2$) is involved in nearly every fault of the insulation system of power transformers and Carbon Monoxide (CO) is a sign of an involvement of the cellulosic / paper insulation, the presence and increase of Acetylene ($C_2H_2$) further classifies the nature of a fault as overheating, partial discharge or high energy arcing.

**Key advantages:**

- Maintenance free system
- Easy to mount on the operating transformer without any operational interruption
- Advanced software (on the unit and via PC) with intuitive operation by 7" color TFT capacitive touchscreen, WLAN and Webserver operation from any smart phone, tablet or notebook PC
- ETHERNET and RS 485 interfaces to support MODBUS®RTU/ASCII, MODBUS®TCP, DNP3 proprietary communication and IEC 61850 protocols




HYDROCAL 1005

The HYDROCAL 1005 is a permanently installed multi-gas-in-oil analysis system with transformer monitoring functions. It individually measures Moisture in oil ($H_2O$) and the key gases Hydrogen ($H_2$), Carbon Monoxide (CO), Acetylene ($C_2H_2$) and Ethylene ($C_2H_4$) dissolved in the transformer oil.

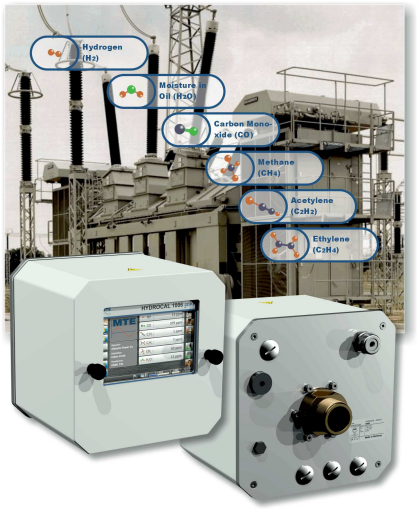
Especially the presence and increase of Acetylene ($C_2H_2$) and Ethylene ($C_2H_4$) further classifies the nature of a fault as overheating, partial discharge or high energy arcing.

The HYDROCAL 1005 acts as a compact transformer monitoring system by the integration of other sensors present on a transformer (HYDROCAL MS-7 and / or bushing monitoring ZVCM-1001 extension packages).

**Key advantages:**

- Easy to mount on the operating transformer without any operational interruption
- ETHERNET and RS 485 interfaces to support MODBUS®RTU/ASCII, MODBUS®TCP, DNP3 proprietary communication and IEC 61850 protocols
- Option: Offshore version

# Intensive care




HYDROCAL 1006 *genX*

The HYDROCAL 1006 genX is the first truly maintenance free multi-gas online DGA solution combining proven near infrared (NIR) measuring technology with vacuum protected membrane extraction.

As Hydrogen ($H_2$) is involved in nearly every fault of the insulation system of power transformers and Carbon Monoxide (CO) is a sign of an involvement of the cellulosic / paper insulation, the presence and increase of Acetylene ($C_2H_2$) further classifies the nature of a fault as overheating, partial discharge or high energy arcing.

The additional measurement of Methane ($CH_4$) serves for further analysis, e.g. Duval triangle acc. IEC 60599

**Key advantages:**

- Maintenance free system
- Easy to mount on the operating transformer without any operational interruption
- Advanced software (on the unit and via PC) with intuitive operation by 7" color TFT capacitive touchscreen, WLAN and Webserver operation from any smart phone, tablet or notebook PC
- ETHERNET and RS 485 interfaces to support MODBUS®RTU/ASCII, MODBUS®TCP, DNP3 proprietary communication and IEC 61850 protocols




HYDROCAL 1008

The HYDROCAL 1008 is a permanently installed multi-gas-in-oil analysis system with transformer monitoring functions. It individually measures Moisture in oil ($H_2O$) and the key gases Hydrogen ($H_2$), Carbon Monoxide (CO), Carbon Dioxide ($CO_2$), Methane($CH_4$), Acetylene ($C_2H_2$), Ethylene ($C_2H_4$) and Ethane ($C_2H_6$) dissolved in the transformer oil.

The HYDROCAL 1008 acts as a compact transformer monitoring system by the integration of other sensors present on a transformer (HYDROCAL MS-7 and / or bushing monitoring ZVCM-1001 extension packages).

**Key advantages:**

- Easy to mount on the operating transformer without any operational interruption
- ETHERNET and RS 485 interfaces to support MODBUS®RTU/ASCII, MODBUS®TCP, DNP3 proprietary communication and IEC 61850 protocols
- Option: Offshore version




HYDROCAL 1009

The HYDROCAL 1009 is a permanently installed multi-gas-in-oil analysis system with transformer monitoring functions. It individually measures, Moisture in Oil ($H_2O$) and the key gases Hydrogen ($H_2$), Carbon Monoxide (CO), Carbon Dioxide ($CO_2$), Methane ($CH_4$), Acetylene ($C_2H_2$), Ethylene ($C_2H_4$), Ethane ($C_2H_6$) and Oxygen ($O_2$) dissolved in transformer oil.

Oxygen ($O_2$) can be a sign of excessive ageing or leakages within the sealing of hermetic transformers.

The HYDROCAL 1009 is MTE´s most comprehensive transformer monitoring system, which can be even expanded with different extension packages (HYDROCAL MS-7 and / or Bushing Monitor ZVCM-1001).

**Key advantages:**

- Easy to mount on the operating transformer without any operational interruption
- ETHERNET and RS 485 interfaces to support MODBUS®RTU/ASCII, MODBUS®TCP, DNP3 proprietary communication and IEC 61850 protocols
- Option: Offshore version



HYDROCAL 100x-3

The HYDROCAL 100x-3 is a multi-gas-in-oil analysis system for the monitoring of a bank of three single phase transformers located close to each other.

The wall mounted system individually measures Moisture in oil ($H_2O$) and the key gases Hydrogen ($H_2$), Carbon Monoxide (CO), Carbon Dioxide ($CO_2$), Methane($CH_4$), Acetylene ($C_2H_2$), Ethylene ($C_2H_4$) and Ethane ($C_2H_6$) dissolved in the transformer oil utilising a smart sampling system that samples oil from each tank via three separate oil channels.

It furthermore serves as a compact transformer monitoring system by the integration of other sensors present on a transformer.

**Key advantages:**

- Cost efficient monitoring of three transformer tanks with one of the HYDROCAL 100x-3
- ETHERNET and RS 485 interfaces to support MODBUS®TCP, DNP3 proprietary communication and IEC 61850 protocols
- Permanent (online) monitoring of multiple transformers

# Portable DGA and Software




HYDROCAL 1011 *genX* P

The HYDROCAL 1011 genX P is a portable device for the analysis of dissolved and free gases from the insulation fluid of oil-filled power transformers and other electrical equipment. It individually measures Moisture in Oil ($H_2O$) and the key gases Hydrogen ($H_2$), Carbon Monoxide (CO), Carbon Dioxide ($CO_2$), Methane ($CH_4$), Acetylene ($C_2H_2$), Ethylene ($C_2H_4$), Ethane ($C_2H_6$), Oxygen ($O_2$), Nitrogen ($N_2$) and Propane ($C_3H_8$) dissolved in transformer oil.

## Key advantages:

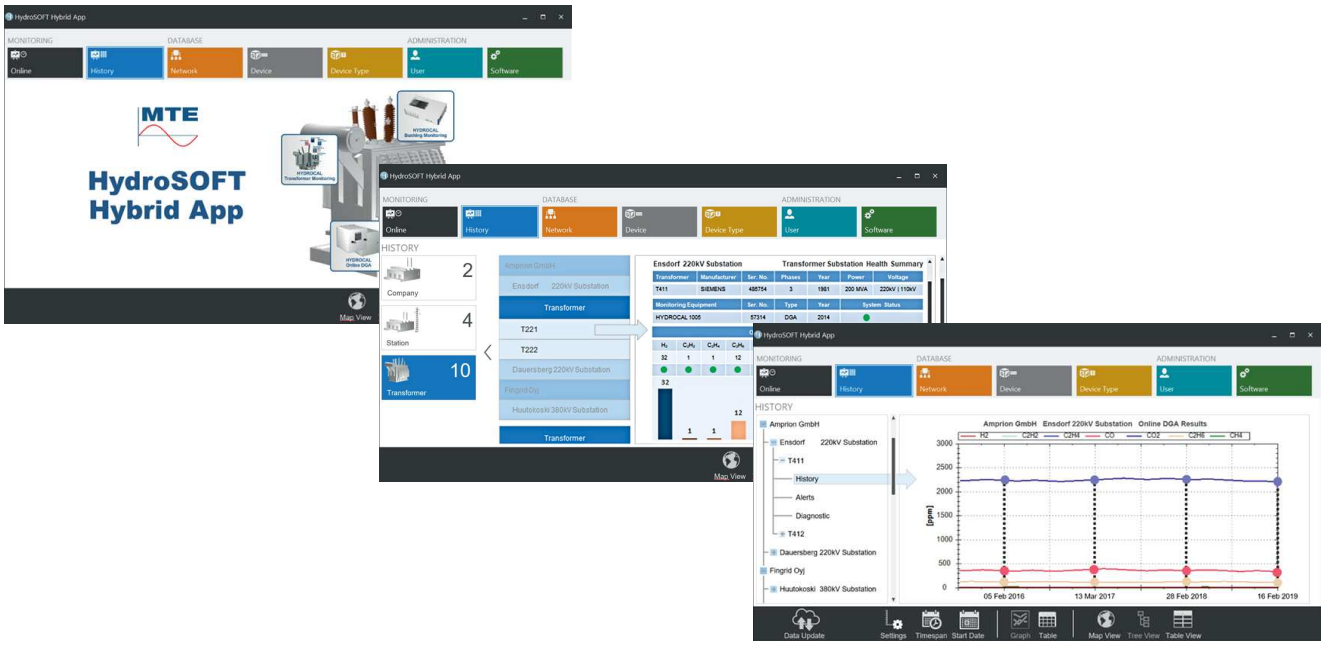
- Maintenance-free near infrared measurement system with head-space gas extraction acc. IEC 60567
- Operation by integrated 7” color TFT (800x480 pixel) touch-screen or via genX webserver from any smart phone, notepad or PC
- Communication interfaces WiFi, USB or ETHERNET 10/100 Mbit/s
- SD memory of test results, history and diagnostic data of power transformers and oil-filled electrical equipment
- Integrated thermal report printer

## Software Tool HydroSOFT Hybrid App

HydroSOFT Hybrid App is the new central software tool to collect, display and report DGA results from HYDROCAL 1011 genX P as well as all other HYDROCAL online DGA devices (upon request).

The software is designed for touchscreen operation as well as for classical operation by keyboard / mouse.

It is supported by a powerful SQL Server Express database allowing multi-user access as well as the configuration of HYDROCAL devices.



# Offshore versions and extension packages



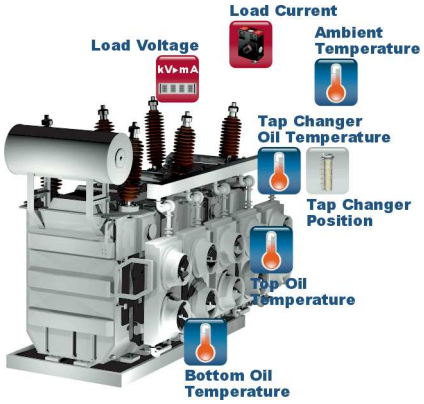

HYDROCAL Offshore
1003 / 1005 / 1008 / 1009

The HYDROCAL Offshore (1003, 1005, 1008 and 1009) transformer monitoring systems are specially designed for the harsh conditions (salt water, corrosion) on offshore platforms (e.g. wind mill parks). Special painted housing with no window and the application of chrome nickel and stainless steel ensures the reliability and the persistence of the device.

**Key advantages:**

- Special design for offshore applications:
  - Housing without window painted in C5M
  - Back plate with 2 cable glands M20 (chrome-nickel steel, IP 68, corrosion-free and acid-resistant)
  - Back plate, oil entrance and housing screws made of stainless steel V4A

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HYDROCAL MS-7
extension package

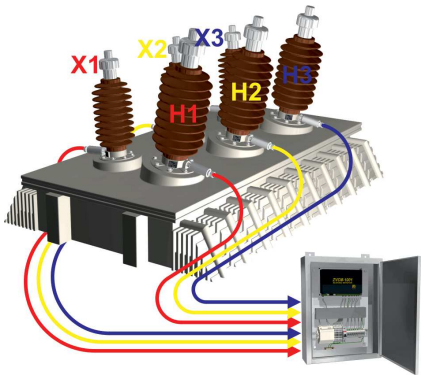
The HYDROCAL MS-7 is an extension package to the HYDROCAL 1003, 1004 genX, 1005, 1006 genX, 1008 and 1009 that measures 3 oil temperatures (top oil, bottom oil & tap changer oil), ambient temperature, load current, load voltage and the tap changer position of a transformer.

With this solution MTE addresses the issue that thermal conditioning is one of the most important means to detect transformer problems and to avoid transformer outages.

**Key advantages:**

- Complete on-line transformer monitoring extension package with direct integration into hardware, firmware and into HydroSoft
- Individual measurement of top oil temperature, bottom oil temperature, ambient temperature, tap changer oil temperature, tap changer position, load current and load voltage

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Bushing Monitor ZVCM-1001
extension package

ZTZ Services

The Bushing Monitor ZVCM-1001, which is an extension package to the HYDROCAL 1004 genX, 1005, 1006 genX, 1008 and 1009 is a permanently installed on-line bushing monitoring system. It continuously measures up to six leakage currents, tests the power factor and the capacitance values. Moreover, the bushing monitoring system, which has been developed in cooperation with ZTZ Services, monitors the condition of bushings, the capacitance coupled voltage transformers (CCVT`s) and the free standing CT`s.

**Key advantages:**

- Complete on-line transformer monitoring and bushing monitoring system in conjunction with HYDROCAL 1004 genX, 1005, 1006 genX, 1008 and 1009
- No more off-line testing and shutting down of the transformers to measure the capacitance and the dissipation / power factor
- Simultaneous measurement of up to six bushing leakage currents
- Compatibility to various transformer test taps and bushing types

**The following MTE leaflets for Transformer Monitoring are available:**
HYDROCAL 1001+ / 1003 / 1004 *genX* / 1005 / 1006 *genX* / 1008 / 1009 / 1011 *genX* P
HYDROCAL 1003 Offshore / 1005 Offshore/ 1008 Offshore / 1009 Offshore
HYDROCAL 1008-3 / 1009-3
HYDROCAL MS-7
Bushing Monitor ZVCM-1001

# MTE Meter Test Equipment


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Test it!