MONCABLO
Permanent on-line partial discharge monitoring system for high-voltage cables
Permanent PD monitoring prevents cable system failures

Preventing in-service failure of HV cables
High-voltage (HV) power cables, terminations and joints are factory-tested before installation to ensure quality and reliability according to customer requirements and standards.

However, cables can be damaged during transportation, laying and during the installation of terminations and joints. These defects may not cause initial failure under voltage but can create partial discharge (PD) in the insulation system.

Partial discharge destroys cable insulation
If allowed to continue, PD will degrade the insulation and result in flashovers and cable system failures. This causes unplanned power outages, loss of plant production, damage to adjacent equipment, and in the worst case, personal injury.

Detect and remove defects prior to failure
By detecting and trending PD activity with a monitoring system, it is possible to continuously observe its development over time. This information helps you to make important decisions regarding the timely replacement of the HV cable or cable accessory before a failure occurs.

PD monitoring of cable accessories in short and long cable systems

Insulation breakdown at a cable termination

Terminations of a 230 kV short cable system

Terminations of a 380 kV buried cable system

Joints of a 380 kV tunnel cable system
MONCABLO at a glance

Continuous PD detection in HV cables
Our MONCABLO permanent on-line PD monitoring system combines advanced hardware and software technologies for continuous condition assessment of electrical insulation in HV cables, terminations and joints.

Suitable for cable system after-installation testing
MONCABLO can also be used to perform simultaneous PD measurements at each cable accessory during the AC voltage after-installation test of the cable system. Potential defects are quickly detected and localized using a patented feature.

Automatic notification of asset status changes
You are automatically notified by email whenever PD activity exceeds pre-set warning or alarm thresholds. An intelligent algorithm prevents the generation of false alarms triggered by external events, for example by noise.

Intuitive web-based user interface
The MONCABLO software web-based user interface allows you to remotely configure the monitoring system, view real-time PD data and historical trends, and to analyze the collected raw data.
The software also allows you to correlate the PD data with data from other sensors (e.g. temperature, oil pressure, etc.) also installed on the cable system.

PD data evaluation
Automated features are available via the same web interface to make PD data evaluation and report generation more convenient for users.
Multiple PD sources are automatically separated from each other and from external noise through synchronous multichannel techniques such as our 3-Phase Amplitude Relation Diagram (3PARD).

Complete monitoring project support
We have extensive experience in the field of PD monitoring on HV cable systems. Our dedicated team of service engineers provides you with complete guidance and support during the design, installation and commissioning of the MONCABLO PD monitoring system.

Your benefits

> Cable monitoring and diagnosis features available in one system
> Synchronous data acquisition at all cable accessories for after-installation testing and monitoring of the cable system
> Advanced on-line defect localization along the entire cable length
> Web-based data access, management and visualization
> Email notification of alarms
> Seamless integration with third-party monitoring devices and SCADA systems

Visit our website at www.omicronenergy.com/moncablo
One system for complete on-line PD monitoring

MONCABLO system components

1. MCT 120 High-frequency current transformer
   - Designed for permanent installation at cable terminations and joints
   - Split core for easy installation on the cable sheaths or grounding connections
   - Ensures sensitive measurements even when there are high currents on the cable sheath or grounding connections

2. OMS 841 Acquisition unit and protective enclosure
   - 4-synchronous channels, IEC 60270 certified PD data acquisition
   - Fully digital bandpass filter with adjustable bandwidth and center frequency
   - Robust enclosure (IP65) protects data acquisition unit from dust, moisture and unauthorized access

PD monitoring system architecture

MONCABLO has a modular and flexible design, which can be easily customized to match different layout requirements of tunnel or buried cable systems.
3 IPS 820 Inductive power supply
> Installed on one phase of the power cable
> Inductive power supply for tunnel cable systems where conventional low-voltage sources are not allowed or available
> Ensures stable output voltage for the monitoring system supply, even under low cable loads

4 Fiber optic communications
> Enables uninterrupted data transmission over long distances
> Ensures the synchronicity of PD data acquisition
> Guarantees operator personal safety due to complete galvanic isolation

5 MCU Master control unit
> Converts the optical signal to an electrical signal and transfers it to the computer via the USB
> Can operate with both single-mode and multi-mode fiber optics

6 Central computer with monitoring software
> State-of-the-art database system for long-term data storage and retrieval
> Web-based data access & visualization
> Customizable integration of third-party sensors and export to SCADA systems
Software for complete PD monitoring and analysis

Real-time data display

Real-time condition visualization of all monitored cable accessories

Event Log displays and manages the warnings and alarms for the selected asset

Real-time data displayed next to the individual measuring points

Scroll over the data points to view date, time and PD values for each phase

**a** Recording PD data sets

MONCABLO allows the recording of raw PD data sets for detailed analysis. They can be recorded periodically, when triggered by a threshold violation or by the user.
Historical trend display

> Scroll over data points to view date, time and scalar values (PD charge, pulse count, voltage).
> Zoom into any part of a historical diagram to see more detail of the trend.
> Click on the trend points in order to obtain more information about a specific time stamp (PRPD patterns, 3PARD diagrams, PD data sets, PD pulse distribution diagram etc.).

Automatic PD cluster separation

> Performed either regularly, when triggered by an event (violation of preset warning/alarm threshold), or when triggered by the user.
> Click on a separated cluster to obtain its individual PRPD pattern.
> For each cluster, the most probable phase of signal origin is identified.
> Available via the web interface.

Data analysis

The software enables the correlation of multiple monitored parameters in one graph.
Comprehensive cable diagnosis

AC voltage after-installation testing of cable systems

> Simultaneous PD measurement performed directly at each cable accessory during the AC voltage after-installation test of the cable system.
> Synchronization with the test voltage source is performed.
> Complete recording of PD activity is available during the commissioning test.

Defect localization

A unique, patented technology based on dual-end statistical Time Domain Reflectometry (sTDR) pinpoints the location of PD defects along the entire length of HV cables.

AC voltage after-installation test of four parallel 380 kV cable lines – 12 phases were sequentially tested off-line with MONCABLO.
OMICRON support during project realization

A complete range of services to ensure monitoring project success

Our service engineers support you in all stages of your cable monitoring project. From requirements evaluation and system design to installation, site acceptance testing, user training, and help with data evaluation, they provide you with a wide range of services to ensure ongoing project success.

Phase 1

Monitoring system design for buried or tunnel cable systems

> Solutions for monitoring system power supply:
  > Low-voltage circuitry, typically for buried cable systems
  > Inductive power supply for tunnel cable systems
  > Safe positioning and installation of PD sensors in the link boxes
  > Monitoring system installation
  > Integration of data from other sensors and export to SCADA

Phase 2

AC voltage after-installation testing of cable system

> Perform PD measurements simultaneously at all cable accessories during the AC voltage after-installation test of the cable system

Phase 3

Services during cable system operation

> Data evaluation (periodic or on request)
> Software updates
### Technical specifications

#### MCT 120 High-frequency current transformer
- **Frequency Range (-6 dB):** 80 kHz ... 40 MHz
- **Inner hole dimensions:** ø ~53.5 mm / 2.11 in
- **Outer dimensions:** 114 × 154 × 62 mm / 4.49 × 6.07 × 2.45 in
- **Ferrite core:** Split
- **Connector type:** BNC, 50 Ohm, female
- **Weight:** 1.2 kg / 2.65 lb
- **Operating temperature:** -30 °C...100 °C / -22 °F...212 °F

#### OMS 841 Acquisition unit
- **Number of input channels:** 4
- **Connector type:** BNC
- **Frequency range:**
  - AC: DC ... 16 kHz
  - PD: 16 kHz ... 30 MHz
- **Sampling rate:**
  - AC: 31.25 kS/s
  - PD: 125 MS/s
- **Peak input levels:**
  - AC: 200 mA
  - PD: 80 V
- **Measurement accuracy:**
  - AC: ±0.25% (40 Hz < f < 70 Hz)
  - PD: ±5 % (f = 300 kHz, Δf = 150 kHz)
- **Maximum double pulse resolution:** < 200 ns
- **PD event time resolution:** < 2 ns
- **PD filter bandwidth:** 9 kHz ... 5 MHz (10 bandwidth settings)
- **System noise:** < 1 pC
- **Power supply requirements:** 24 V DC / 0.5 A

#### OMS 841 Protective enclosure
- **Dimensions (W × H × D):** 400 × 500 × 210 mm / 15.7 × 19.7 × 8.3 in.
- **Weight:** ~15 kg / 33 lb.

#### OMS 841 External power supply
- **AC:**
  - 110 V AC ... 240 V AC / 50/60 Hz
- **DC:**
  - 110 V DC ... 300 V DC

#### IPS 820 Inductive power supply
- **Current range:** > 100 A
- **Frequency:** 45 Hz...65 Hz
- **Output voltage:** 8.5 V DC...18.5 VDC
- **Operating temperature:** -40 °C ... + 65 °C / -40 °F ... + 149 °F
- **Dimensions (W × H × D):** 35.8 × 36.8 × 8 cm / 14.1 × 14.5 × 3.1 in.
- **Weight:** 15 kg / 33.1 lb

#### Fiber optic connection
- **Medium:** Standard: Duplex multi-mode fiber optic cables 50/125 μm (OM3 or better)
  - Optional: Duplex single-mode fiber optic cables 9/125 μm (OS1 or better)
- **Wavelength:** 1300 nm
- **Maximum cable length:** 4 km (multi-mode), 40 km (single mode)
- **Connector type:** LC
**Vibration, shock and protection class**

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<th>Standard</th>
<th>Rating</th>
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<tr>
<td>Vibration</td>
<td>EN 60068-2-6</td>
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<tr>
<td>Frequency range</td>
<td>10 Hz ... 150 Hz</td>
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<tr>
<td>Acceleration</td>
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<tr>
<td>Shock</td>
<td>EN 60068-2-27</td>
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<td>15 g/11 ms, half-sinusoid, per axis</td>
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<td>Protection class</td>
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<tr>
<td>IP 50 (OMS 841)</td>
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<td>IP 65 (OMS enclosure)</td>
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</tbody>
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**Environmental specifications**

- Operating temperature: -30 ... +55 °C / -22 ... +131 °F
- Storage temperature: -40 ... +80 °C / -40 ... +176 °F
- Humidity: Up to 95 % r.H. (non-condensing)

**Electromagnetic compatibility**

- Emission: EN 55011/22, 30 MHz ... 3 GHz
- FCC Subpart B, 30 MHz ... 1 GHz
- Immunity: EN 61000-6-5: MV/HV substations

**Safety requirements**

Safety requirements for electrical equipment for measurement, control and laboratory use: EN 61010-1

**OMS System & Monitoring Software**

- The minimum system requirements for running the OMS System Software and the Monitoring Software are:
  - Windows 7 (64bit), Windows 8 (64bit) or Windows Server 2012 (64bit)
  - Processor: Intel i5 2.4 GHz or a comparable x64 processor
  - RAM: 4GB
  - USB 2.0 high speed port
  - Screen resolution (minimum): 1024 x 768 pixels

A centralized computer that meets these software requirements is provided by OMIcron.

**Communication protocols**

- Modbus TCP
- DNP3
- IEC 61850

**MCU Master control unit**

- Data output: USB 2.0
- Power supply: via USB 2.0

**Central computer with OMS System & Monitoring Software**
OMICRON is an international company serving the electrical power industry with innovative testing and diagnostic solutions. The application of OMICRON products allows users to assess the condition of the primary and secondary equipment on their systems with complete confidence. Services offered in the area of consulting, commissioning, testing, diagnosis and training make the product range complete.

Customers in more than 150 countries rely on the company’s ability to supply leading-edge technology of excellent quality. Service centers on all continents provide a broad base of knowledge and extraordinary customer support. All of this together with our strong network of sales partners has made our company a market leader in the electrical power industry.