

# MONGEMO

Permanent on-line partial discharge monitoring system for power generators and electrical motors



# Continuous monitoring for extending the life of your machines



Turbo generators



Hydro generators



Electrical motors

## Knowing the condition of stator insulation is vital

Aging of the stator winding insulation can occur both in the slot and end-winding areas. If the insulation condition is not monitored regularly, an inadequate assessment can lead to improper maintenance. In worst cases it can also lead to dielectric failure and costly downtime.

## Early detection of partial discharges can prevent machine failure

A majority of insulation defects can be detected early through the permanent on-line monitoring of partial discharges (PD).

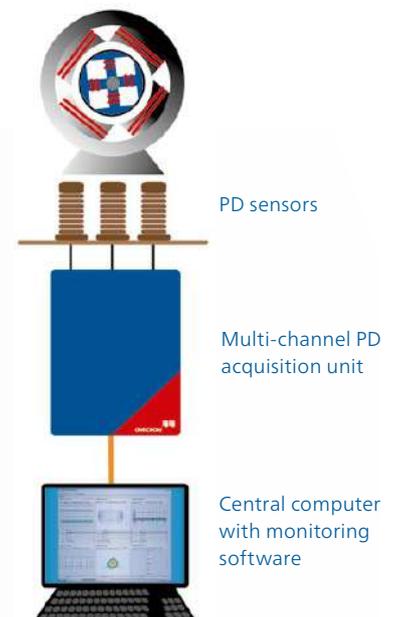
The insulation materials typically used for rotating machines are resistant to a certain level of PD. However, an increase in PD activity over time can indicate insulation degradation caused by operational stress and aging processes that could lead to serious damage and failure in rotating machines. .

Continuous on-line PD monitoring is a very effective and well-established technique used to continuously assess the condition of the stator winding insulation system.

Failures can be avoided through the timely implementation of maintenance and repair measures to ensure a longer service life.

## Modular, expandable design

The MONGEMO PD monitoring system can be implemented at any point of time during the service life of your rotating machines. Its modular design allows the system to be easily customized and expanded to match your exact monitoring requirements.



## MONGEMO at a glance

### Continuous PD detection in rotating machines

Our MONGEMO permanent on-line PD monitoring system combines advanced hardware and software for complete condition assessment of stator insulation in:

- > Turbo generators
- > Hydro generators
- > Electrical motors

### Complete on-line assessments

MONGEMO continuously records PD activity and reliably indicates the state of stator insulation while your machines are on-line during normal operating conditions.

### Condition-based action trigger

The system's condition-based action trigger determines when surrounding conditions, such as increased load or temperature, are present, and gates out their effect so they do not compromise measurement evaluation.

### Online/Offline Delay

The system also determines if the machine is online or offline by comparing the measured  $V_{rms}$  value to the given voltage threshold. Measurement results will not be stored for off-line rotating machine unless specified.

### Effective noise suppression and source separation

MONGEMO employs advanced noise suppression techniques to ensure accurate analysis, such as our 3-Phase Amplitude Relation Diagram (3PARAD) and automatic PD cluster separation.

### Pattern classification

When enough data is available, a pattern classification is performed for the phase with the highest amplitude. You can generate an automatic report that provides you with an explanation of the probable PD defect.

### Intuitive web-based user interface

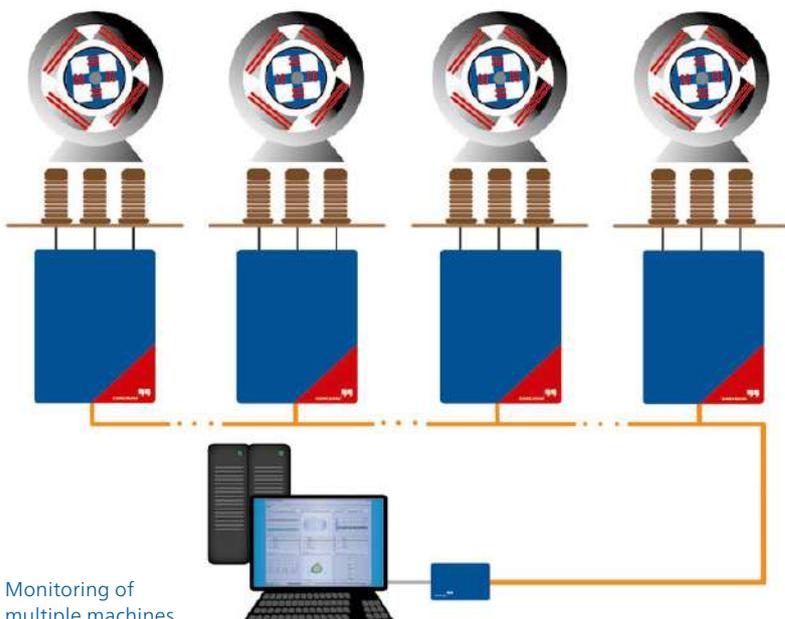
The MONGEMO software web-based user interface allows you to remotely configure the monitoring system, view real-time PD data and historical trends, and to analyze the collected raw data.

### Software for PD monitoring and analysis

With the *monitoring software* you can configure the system, set warning and alarm thresholds and view PD as well as record real-time data streams for in-depth post analysis. Collected PD data is shown in a trend chart for each phase.

### Customizable, automatic reporting

You can customize templates for different types of reports with relevant measurement and alarm data for a specified time period and manage email recipient lists. The reports are automatically generated and distributed.



Monitoring of multiple machines

## Your benefits

- > Synchronous, four-channel PD data acquisition for complete PD assessment
- > Advanced noise suppression and fully automated PD cluster separation for convenient evaluation
- > Sophisticated pattern classification explains probable PD defect type in a report
- > Recording of raw PD data at selected intervals for in-depth post analysis
- > Seamless integration with third-party monitoring devices and SCADA systems

[www.omicronenergy.com/mongemo](http://www.omicronenergy.com/mongemo)

# One system for complete on-line PD monitoring

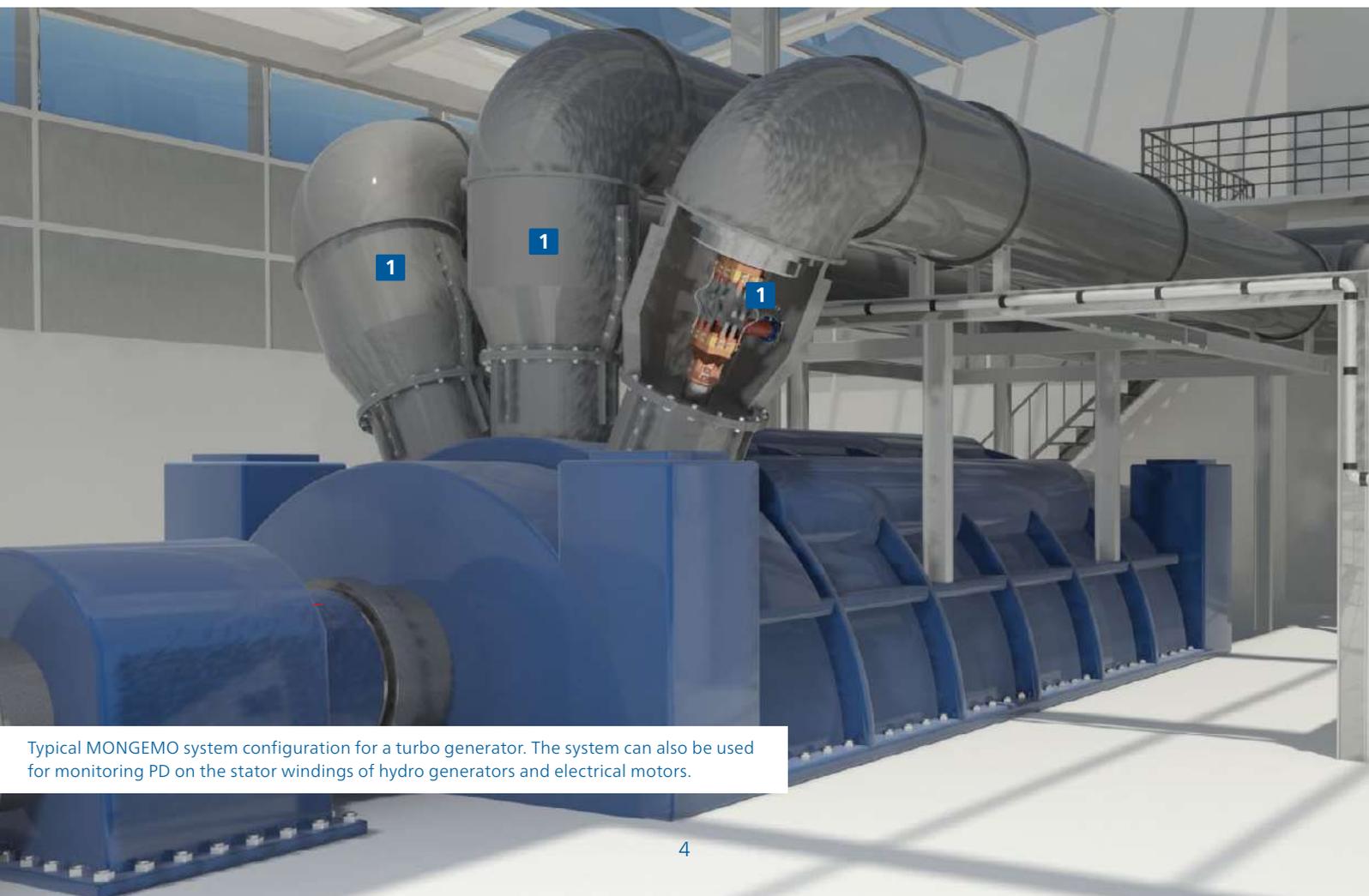
## MONGEMO system overview

The complete MONGEMO partial discharge (PD) monitoring system for rotating machines includes a variety of PD sensors (coupling capacitors), an acquisition unit for PD data recording and a central computer with monitoring and analysis software.

### 1 Coupling capacitors



- > Especially designed for detecting PD signals on generators and motors with up to 24 kV rated voltage.
- > Capacitive sensors from 80pF to 2.2nF are supported.
- > Detect PD in the frequency range according to the international standards IEC 60034-27-1, IEC 60034-27-2 and IEEE 1434.
- > Strong mechanical robustness allows installation in both horizontal and vertical positions.
- > Connected to the OMS 841 data acquisition unit via screened coaxial cables in order to minimize the impact of external interference.



Typical MONGEMO system configuration for a turbo generator. The system can also be used for monitoring PD on the stator windings of hydro generators and electrical motors.

## 2 Protective enclosure



- > Protects data acquisition unit from dust and moisture.
- > Lockable door prevents unauthorized access.
- > Input ports are available for connections from coupling capacitors.
- > Includes a port for fiber optic cable connections to the central monitoring computer or SCADA system.

## 3 OMS 841 acquisition unit



- > Allows 4-channel, simultaneous acquisition of PD data from all three phases and an additional monitoring point.
- > Includes adjustable PD band pass filter bandwidths up to 5 MHz.
- > Enables synchronous PD signal processing with advanced source separation.
- > External 12 V lead-acid battery bridges temporary power outages (optional).

## 4 Fiber optic connectivity

- > Connects each acquisition unit to the central computer.
- > Ensures uninterrupted data transmission over long distances.
- > Robust to prevent electromagnetic interferences.
- > Ensures personal safety with complete galvanic isolation.

## 5 Central controller and monitoring software

- > Includes a state-of-the-art database system for long-term data storage and retrieval.
- > Enables web-based data access & visualization.
- > Allows customizable integration of third-party sensors and export to SCADA systems.



# Software for complete PD monitoring and analysis

## Actionable data for reliable assessment

MONGEMO includes two software packages for partial discharge (PD) monitoring and analysis.

The *monitoring software* allows you to configure the system for remote monitoring of single or multiple machines via the central computer.

PD data is processed and displayed in either real-time or historical views. You are provided with warnings and alarms of increased PD activity well before failures occur.

The *OMS system software* is also included for PD settings configuration and in depth post-analysis of the raw PD data.

## 1 Getting started

### Monitoring software dashboard



Select desired activity, including:

- > Setup system configuration or make changes
- > View current monitoring session in real time (see 2)
- > View and analyze monitoring trend data (see 2)

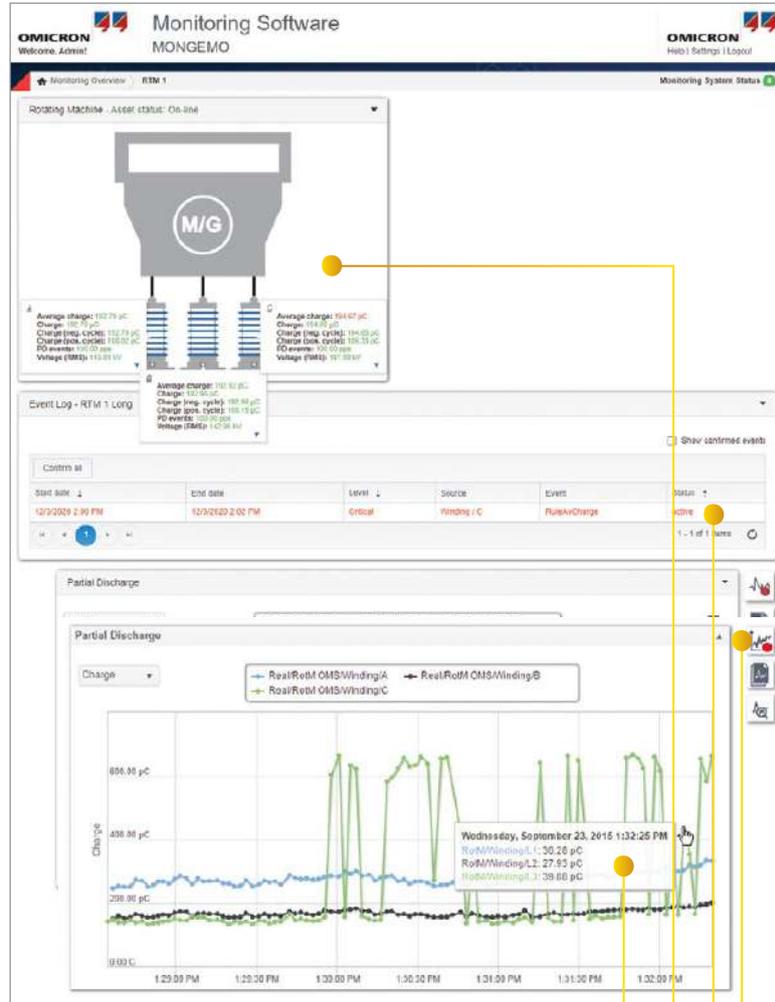
### System configuration and control



- > Configuration of all monitoring-related parameters
- > Define threshold settings for alarm notifications
- > Define recording of PD data sets

## 2 View PD data

### Real-time PD data



- > Scroll over data points to view date, time and PD values for each phase
- > View actual PD values and alarm status
- > Event log shows triggered alarms for selected assets

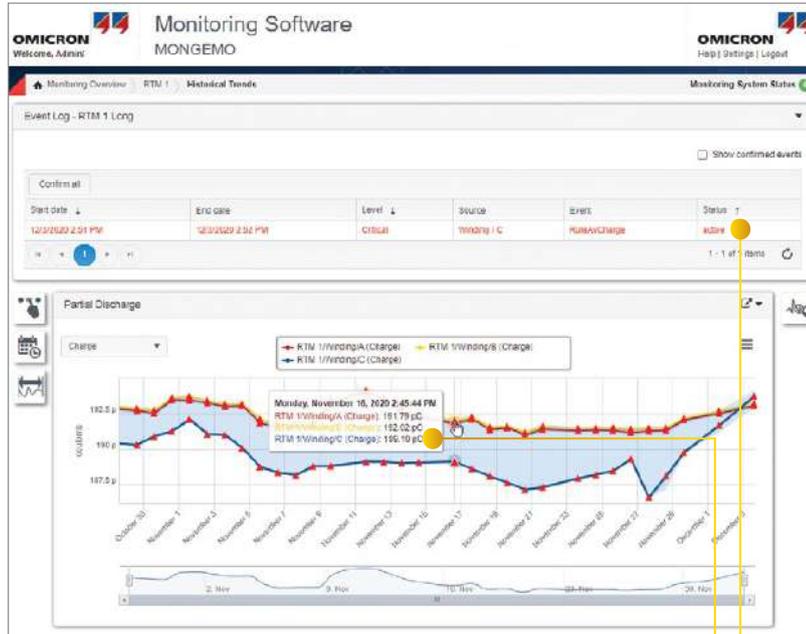
### Recording raw PD data sets

MONGEMO records raw PD data sets based on a defined time schedule – either in real time, periodically or when a PD parameter exceeds a pre-set threshold.

The raw PD data can be analyzed in depth with the expert PD analysis software provided. We can also assist you with PD data evaluation upon request. (See 3)

The main measurement values can be stored per channel in a .csv file during replay of a recorded PD Dataset. This enables you to perform further analysis and generate charts, for example with MS Excel.

## Historical PD data



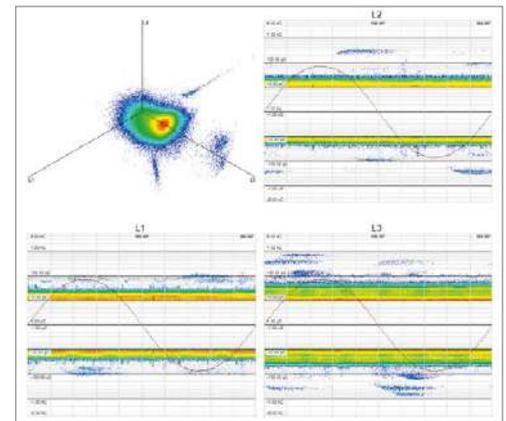
- > See PD trend charts for each phase/channel
- > Scroll over data points to view date, time and PD values
- > Event log shows corresponding warnings and alarms for all monitored assets
- > Zoom into any part of a historical diagram to see more detail
- > Trend data can be easily exported to a .csv data file

## Pop-up windows show PD diagrams

By clicking on each point of the historical PD trend diagram, a pop-up window will open with different types of PD diagrams to choose from:

- > 3PAR and PRPD
- > Automated clustering results
- > Pulse distribution
- > PD data sets

These enable you to quickly evaluate the PD data. All charts and diagrams can be printed and saved in various formats.



3PAR and PRPD pop-up window

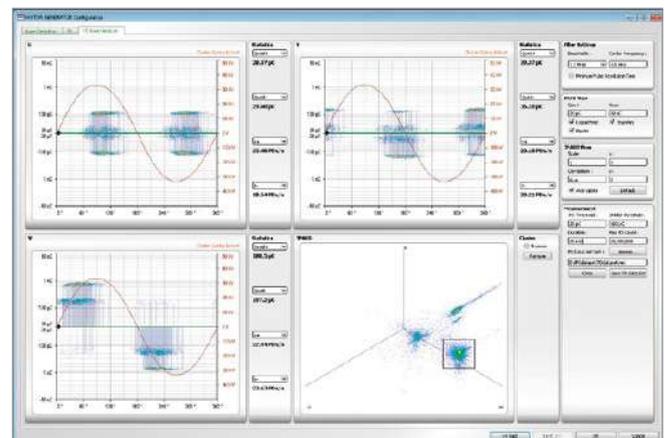
## 3 PD analysis

### When in-depth investigation is required

Detailed PD diagnosis can be done using the *OMS system software*. This advanced software allows you to apply various filters to see more detail of the PD activity.

### PD data evaluation support from OMICRON

We can also provide you with an in-depth analysis of collected PD data as well as condition reporting for your monitored machines. These optional monitoring services are available upon request.



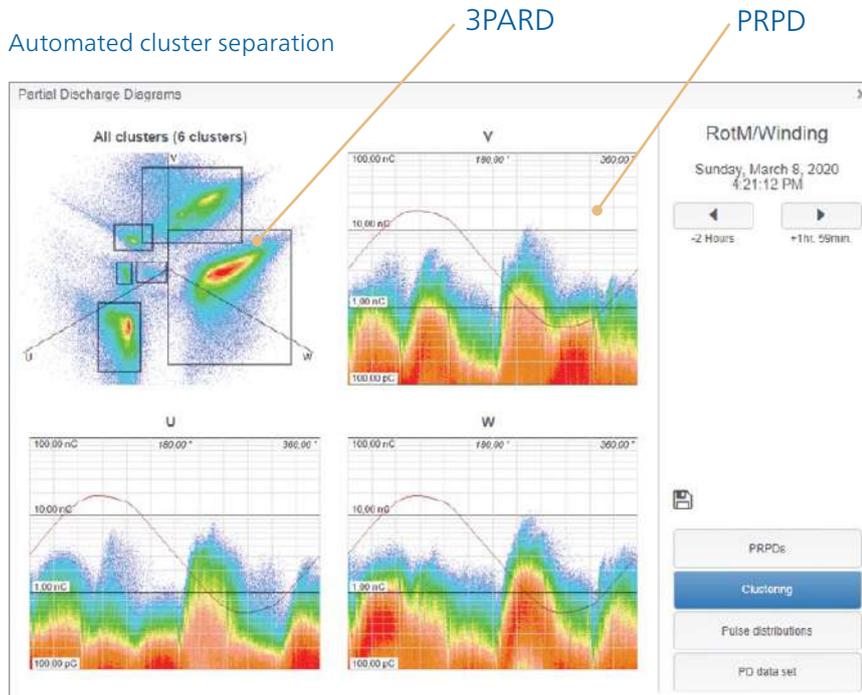
# Reliable and early PD detection in stator windings

## Effective source separation and evaluation techniques

The key to successful partial discharge (PD) measurement in stator windings is the separation of parallel active PD sources and the distinction between potentially damaging PD, tolerable PD occurrences and external noise inevitably present in industrial surroundings.

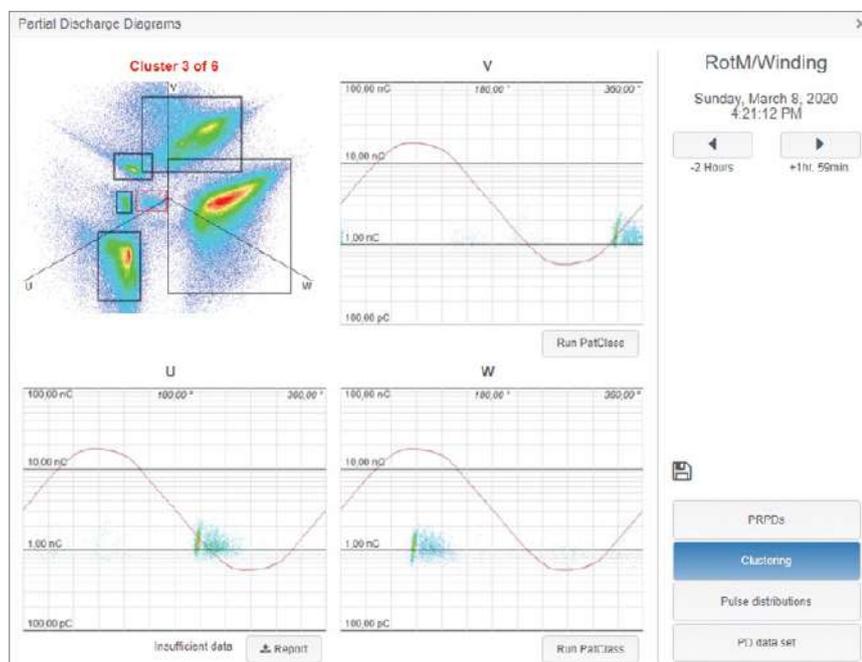
In order to separate clusters of multiple PD sources, MONGEMO employs synchronous, multi-channel techniques, such as 3PARD (3-Phase Amplitude Relation Diagram) and automatic cluster separation.

### Automated cluster separation



- > A highly efficient hierarchical density-based clustering algorithm is applied for the automatic clustering of heterogeneous 3PARD data.
- > Automated data evaluation and cluster separation are performed regularly, periodically or when triggered by an alarm (violation of pre-set threshold).
- > For each cluster, the MONGEMO monitoring software identifies the phase of signal origin.

### Unfiltered data

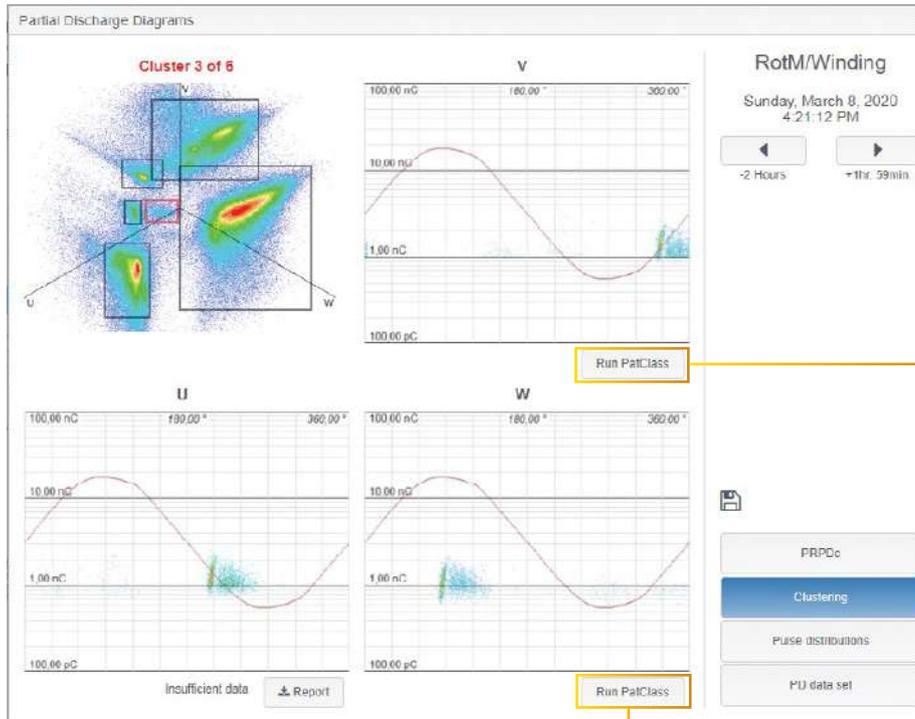


- > A user-selected cluster is transformed back to its correlated phase-resolved PD pattern (PRPD).
- > As a result of this separation, single PD sources are shown in the corresponding PRPD diagrams to enable even non PD experts to perform an initial assessment of PD activity and potential risk.
- > The related raw PD data is saved in order to carry out a more in-depth expert analysis at a later point in time.

### Filtered data

## Pattern Classification

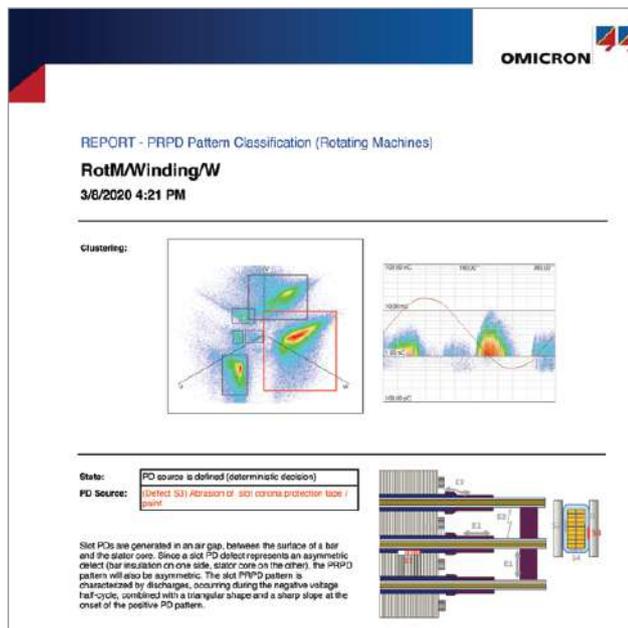
When enough data is available, a pattern classification is performed for the phase with the highest amplitude to provide you with an explanation of the probable PD defect. The reliability of the automatic pattern classification result is described in detail in the report you can generate with a click of your mouse.



A Report button appears with which you can download a report that contains a detailed explanation of the probable error.

If you are interested in a pattern classification in another phase, you can execute it manually with the *Run PatClass* button.

The *Run PatClass* button then changes to the *Report* button to download the report with an explanation of the probable error.



A report can be generated with the click of a mouse that provides you with detailed explanation of the probable error.

# Technical specifications

## Partial discharge measurements

Number of input channels	4
Connector type	BNC
Frequency range	Hardware: AC: DC ... 16 kHz Software: Selectable, 10 Hz ... 450 Hz 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: $\pm 0.25\%$ ( $40 \text{ Hz} < f < 70 \text{ Hz}$ ) PD: $\pm 5\%$ ( $f = 300 \text{ kHz}$ , $\Delta f = 150 \text{ kHz}$ )
Maximum double pulse resolution	$< 200 \text{ ns}$
PD event time resolution	$< 2 \text{ ns}$
PD filter bandwidth	9 kHz ... 5 MHz (10 bandwidth settings)
System noise	$< 1 \text{ pC}$ ( $f = 400 \text{ kHz}$ , $\Delta f = 300 \text{ kHz}$ , input range $\leq 320 \text{ mV}$ )

## Mechanical data – Enclosure with acquisition unit

Dimensions (W × H × D) (cable glands not mounted)	400 × 500 × 250 mm / 15.7 × 19.7 × 9.8 in.
Weight	~15 kg / 33 lb.

## OMS 841 power supply

24 V DC / 0.5 A

## OMS 841 external power supply

AC (max.)	DC (max.)
110 V AC ... 240 V AC / 50/60 Hz / max. 0.28 A	110 V DC ... 300 V DC / max. 0.12 A

## Fiber optic connection

Medium	Standard: Duplex multi-mode fiber optic cables 50/125 $\mu\text{m}$ (OM3 or better) Optional: Duplex single-mode fiber optic cables 9/125 $\mu\text{m}$ (OS1 or better)
Wavelength	1300 nm
Maximum cable length	4 km (multi-mode), 40 km (single mode)
Connector type	LC



## High-quality support at every stage of your monitoring project

MONGEMO is not only a complete set of hardware and software components. It also includes the dedicated service we provide you. Our monitoring experts are working for you to support you in all stages of your monitoring project.

We provide you with peace of mind while matching the actual needs of your high-voltage equipment over its operational lifetime.

## Environmental requirements

Operating temperature	-30 ... +55 °C / -22 ... +131 °F
Storage temperature	-40 ... +80 °C / -40 ... +176 °F
Humidity	Up to 95 % r.H. (non-condensing)
Maximum altitude	4,000 m / 13,123.4 ft.

## Vibration, shock and protection class

	Standard	Rating
Vibration	EN 60068-2-6	Frequency range: 10 Hz ... 150 Hz  Acceleration: 2 g continuous (20 m/s <sup>2</sup> ), 10 cycles per axis
Shock	EN 60068-2-27	15 g/11 ms, half-sinusoid, per axis
Protection class	EN 60529	IP50 (OMS 841) IP65 (OMS enclosure)
	Optional	IPX8 (OMS type 316L stainless steel enclosure)

## 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
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## Software requirements

### OMS System Software / Monitoring Software

The minimum system requirements for running the OMS System Software and the Monitoring Software are:

- > Win 10 or Win Server 2016 and above
- > Processor: 6 Cores / 12 Threads
- > RAM: 32 GB
- > USB 3.0
- > Screen resolution (minimum): 1024 x 768 pixels

A central computer that meets these software requirements is provided by OMICRON.

### Communication protocols

RS485	ModBus RTU
Ethernet/TCP IP	ModBus TCP
	DNP3
	IEC 61850

We start the implementation of your monitoring system by understanding your needs and challenges. With this input, the system can be designed and configured according to your needs. Then our team of specialists installs the system for you on-site.

During the commissioning of the system, its performance and measurement sensitivity are verified. You are then trained on how to use the system and how to take maximum advantage of its features.

Our HV experts are available to help you interpret and analyze the data. We can also provide you regular asset condition reports and recommendations for further action.

## Monitoring project knowledge and expertise you can rely on

- > Evaluation of monitoring requirements
- > Project-specific monitoring system design
- > Integration of monitoring system into existing infrastructure
- > Installation, commissioning and calibration of the monitoring system
- > Monitoring system and data evaluation training
- > Data analysis and interpretation
- > Worldwide customer service & hotline

We create customer value through ...

## Quality

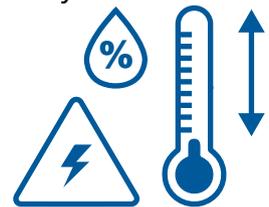
We always want you to be able to rely on our testing solutions. This is why our products have been developed with experience, passion and care and are continually setting ground-breaking standards in our industry sector.



You can rely on the highest safety and security standards

Superior reliability with up to

72



hours burn-in tests before delivery

100%



routine testing for all test set components

ISO 9001  
TÜV & EMAS  
ISO 14001  
OHSAS 18001



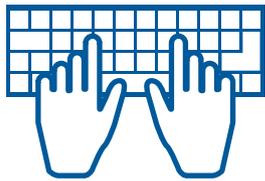
Compliance with international standards

## Innovation

Thinking and acting innovatively is something that's deeply rooted in our genes. Our comprehensive product care concept also guarantees that your investment will pay off in the long run – e.g. with free software updates.

More than

200



developers keep our solutions up-to-date

I need...



... a product portfolio tailored to my needs

More than

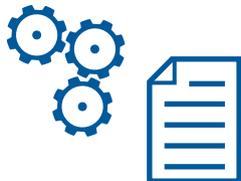
15%



of our annual sales is reinvested in research and development

Save up to

70%



testing time through templates, and automation

We create customer value through ...

## Support

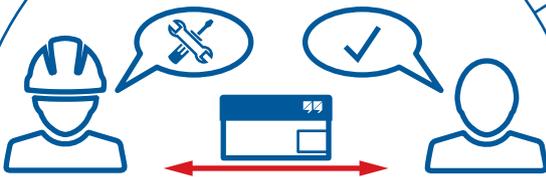
When rapid assistance is required, we're always right at your side. Our highly-qualified technicians are always reachable. Furthermore, we help you minimize downtimes by lending you testing equipment from one of our service centers.



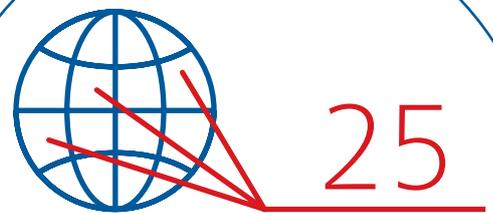
Professional technical support  
at any time



Loaner devices help to  
reduce downtime



Cost-effective and straight-  
forward repair and calibration



offices worldwide for local  
contact and support

## Knowledge

We maintain a continuous dialogue with users and experts. Customers can benefit from our expertise with free access to application notes and professional articles. Additionally, the OMICRON Academy offers a wide spectrum of training courses and webinars.



Frequently OMICRON hosted user meetings, seminars and conferences

More than

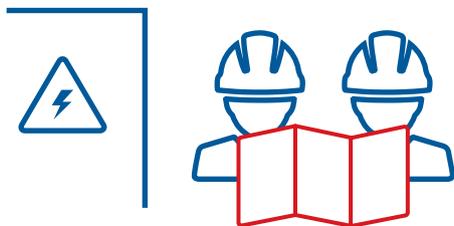
300



Academy and numerous hands-on trainings per year



to thousands of technical papers and application notes



Extensive expertise in consulting, testing and diagnostics

OMICRON is an international company that works passionately on ideas for making electric power systems safe and reliable. Our pioneering solutions are designed to meet our industry's current and future challenges. We always go the extra mile to empower our customers: we react to their needs, provide extraordinary local support, and share our expertise.

Within the OMICRON group, we research and develop innovative technologies for all fields in electric power systems. When it comes to electrical testing for medium- and high-voltage equipment, protection testing, digital substation testing solutions, and cybersecurity solutions, customers all over the world trust in the accuracy, speed, and quality of our user-friendly solutions.

Founded in 1984, OMICRON draws on their decades of profound expertise in the field of electric power engineering. A dedicated team of more than 900 employees provides solutions with 24/7 support at 25 locations worldwide and serves customers in more than 160 countries

For more information, additional literature, and detailed contact information of our worldwide offices please visit our website.

