MPD 600

High-End Measurement and Analysis System for Partial Discharges (PD)
Partial Discharge Analysis

The MPD 600 partial discharge analysis system is a precise and modular high-end toolbox for detecting, recording, and analyzing partial discharge events in many applications.

Partial Discharges:
Weak points in insulation systems

Partial discharge (PD) phenomena, as defined by IEC 60270, are localized dielectric breakdowns of a small portion of solid or liquid electrical insulation system under high-voltage stress.

PD phenomena often precede an insulation breakdown of high-voltage equipment, leading to cost-intensive outages and repairs. Therefore generators, motors, transformers, switchgear and cables are tested for partial discharge events for many years.

Accurate measuring devices to detect and analyze PD are an important base in modern quality assurance. The MPD 600 fully complies with relevant standards for power system testing and offers many additional powerful analysis tools.

Rising to the Challenge:
The OMICRON Solution

The challenge when analyzing PD is to detect and evaluate discharges in the range of pico-coulombs (pC), while dealing with test voltages of up to several hundred kilovolts (kV).

These sensitive measurements are often complicated by severe external interference or noise from nearby equipment, caused by corona or other radio frequency (RF) sources.

The MPD 600 incorporates a range of leading-edge technologies in order to provide accurate, reliable and reproducible measurements – even under the most demanding circumstances.

Worldwide in daily use for PD testing of medium- and high-voltage components
The System
The MPD 600’s high-tech is packed into a handy acquisition unit, a fiber optic USB-controller and the innovative software. High-resolution digital processing technology delivers exceptional measurement accuracy and a bunch of modern analysis tools.

Field-Proven Technology
Hundreds of units are operating world-wide in industrial and utility applications. The MPD 600’s reliability gets proven in some of the world’s largest PD measuring projects by major cable, transformer and rotating machine manufacturers.

Virtually Unlimited Multi-Channel Operation
The system can be expanded easily to a virtually unlimited number of channels. Thereby parallel measurements and truly synchronous multichannel measurements are viable. With the fiber optic connections the distance between adjacent units may also be up to 2 km/1.2 miles.

Your Benefits:
> PD detection in full conformity with IEC 60270
> Excellent noise immunity for measurements in tough environments
> Easily transportable acquisition units allow testing at different locations
> Well established technology due to hundreds of MPD systems in daily use
A Fully Digital System

A major problem to overcome when making PD measurements is interference from electrical noise. These disturbances may render the detection and location of PD signals difficult, or even impossible. Eliminating interferences from electrical noise is therefore critical for successful PD detection. The MPD offers several methods for passive and active noise suppression.

Optical Isolation

The unique high-speed fiber-optic network guarantees complete galvanic isolation between the individual acquisition units and the PC controller. This significantly minimizes ground loops, reduces interferences, and enables the system to have a higher sensitivity (better signal-to-noise ratio).

Fiber-optic connections are well proven in industrial environments. Electrical or radio frequency connections (e.g. WLAN) are less reliable because of frequent disturbances from machines or electrical discharges (e.g. PD).

Fiber-optic connections also may be very long, without degrading the instrument’s performance.

Another convincing advantage of fiber optics compared to copper wires, is the precise synchronicity of all connected units down to the range of nanoseconds. This simultaneous communication ensures a continuous, uninterrupted acquisition of time-critical PD events and the related test voltage, even under most demanding circumstances.
Advanced Fully Digital Filtering

In the MPD 600 the classical analog filter has been replaced by a mathematical algorithm. Therefore, no aging effects or drift over time and temperature occurs, resulting in an exceptionally high degree of reproducibility to perform reliable, calibrated and traceable PD quality control.

Battery Powered Acquisition Units

During battery operation no noise from mains power supply enters the measuring circuit. This way the measurement unit can also be operated at high-voltage potential. Due to the very low power consumption, an uninterrupted battery operation of more than 20 hours is ensured.

UHF Option

Changing the center frequency usually avoids interferences. For a widened range up into the ultra-high-frequencies (UHF), the MPD 600 is optional expandable with the UHF 608.

The UHF partial discharge testing method is traditionally used for gas-insulated switch gears and power lines (GIL and GIS). Using this technology also for cables and transformers is a modern way of using the UHF 608.

Various sensors, such as those used for conventional measurement systems like spectrum analyzer, can be combined with the UHF 608. Therefore it also works well with pre-mounted sensors, like those used in GIS systems.

Your Benefits:

- Optical fiber connections significantly reduce base noise level
- Safe operation due to full galvanic isolation of the PD acquisition units
- High measurement accuracy and sample rate due to fully digital system
- Flexible use and further noise reduction due to mains independent battery operation
Basic Mode
In Basic Mode, most parameters and settings are automatically determined by the software, so the user can focus on performing the PD measurement.

- Highly responsive real-time display (> 20 frames/sec)
- Configurable real-time oscilloscope view for PD and V input
- Flexible PD event visualization, including the phase resolved histogram view, ellipse and real-time view
- Reproduction of a classical analog feel

The user interface is divided into four sections:
- Large scope view
- Small scope view
- Measured quantities display
- Control panel

The large scope view shows (among other things):
- Sinusoidal, phase-resolved pattern of voltage source
- Phase resolved histogram in different visualizations
- 3PARD visualization
- Gating

Multiple measuring units can be shown in parallel.

The small scope view can be configured to show different sets of data:
- Spectrum of the input signal at the PD input
- Trend curves for a variety of measurement quantities
- Replay log

The measured quantities display shows the current values for quantities conforming with IEC 60270 such as: charge level, high-voltage, frequency, etc.

Cable Mode
The Cable Mode is an intuitive user interface for testing of medium- and high-voltage cables. This module is used for quality assurance at the manufacturing plant and to locate faults on site.

The user is guided through the entire measurement. Detecting partial discharge defects in cables accurate to a meter is thus most effective and precise.
Expert Mode

The Expert Mode allows manual control over every aspect of PD detection and analysis, while providing access to advanced visualization options.

**Expert Mode visualizations** (among others):

> 3PARD – 3-Phase Amplitude Relation Diagram
> 3FREQ – Multiband measurements
> DyNG – Advanced noise suppression
> Full oscilloscope style functionality for PD input signals
> Q(U) diagram

**Additional features** (among others):

> Hardware gating
> Control of RIV measurement
> PD detection and analysis for DC applications
> Long-term trending of all relevant PD related data for monitoring purposes
> Statistical PD fault location
> Additional PD event evaluation in accordance to IEC 60270 (e.g. QIEC average)

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**Your Benefits:**

> Tailor-made user interfaces
> Full overview of all relevant data
> Multiple display options for PD events to fit your requirements
> Oscilloscope view with full functionality
> Support of Radio Interference Voltage (RIV) and DC measurements
Active Noise Suppression

Adapting to the Surroundings

With freely selectable bandwidths and filtering options, the MPD 600 can be flexibly adapted to challenging on-site conditions. This results in a maximal signal-to-noise ratio compared to measuring systems with fixed filtering frequencies.

Powerful Gating Methodology

Some noise looks very similar to PD. With the increasing use of power electronic components, these pulses can be ever-present in industrial environments. PD fault recognition usually requires a great deal of experience and knowledge to differentiate fault patterns in phase resolved diagrams. It is also a challenge to distinguish several PD sources from each other and from superimposed disturbance pulses or crosstalk.

Manual gating: An unlimited number of phase/amplitude gates allows to suppress signals with a certain amplitude and fixed phase position (e.g. converter pulses, drives, irrelevant PD). The gating areas are easy to define by marking them with the mouse.

Antenna gating: To eliminate the effect of disturbances (e.g. corona) to the measurement results, an optional external MPD 600 can be used as unit gate (antenna gating). For example: On transformers all pulses which are identified by this unit and the PD measuring station simultaneously, result from disturbances.

DyNG (Dynamic Noise Gating): Non-stationary pulses which are not fixed in phase (‘moving’ vs. phase) – e.g. interference from drives, motor-generator test sets and temporary interference – can be suppressed by the unique Dynamic Noise Gating, in which the amplitude-phase window follows the disturbance pulses dynamically.
Advanced Noise Separation Tools

PD events on one phase can be detected also on the other phases. Distinction between different PD sources and superimposed noise pulses is a challenge due to this over coupling. The MPD 600 provides powerful tools for separation of different sources of interference and easy visualization.

The 3PARD (3-Phase Amplitude Relation Diagram) helps to differentiate various PD sources from each other. It also helps to differentiate similar PD disturbances, which increases the ease of PD source recognition. Through measuring three phases simultaneously, the combined results can be displayed in a single diagram, called the 3PARD. This allows to clearly separate noise from real PD signals within the test object. In some cases, this may save considerable expenses by dispensing with the need for a Faraday cage or reducing the need for shielding.

The 3FREQ (synchronous multi frequency measurements) characterizes PD sources by their frequency signature. Even for a single phase or a single PD decoupling position, pulse triples can be acquired by using three different PD filter settings. The synchronous signal output from three filters with different center frequencies or bandwidths, allows a pulse waveform analysis as 3CFRD (3-Center Frequency Relation Diagram) visualization.

Your Benefits:

- Adapting to on-site conditions with freely selectable center frequency and bandwidth
- Easy suppression of phase-fixed noise signals due to an unlimited number of gates
- Ability to separate inner and outer PD with an external gating unit (antenna gating)
- Easy-to-use 3PARD and 3CFRD functionality differentiates noise from inner PD
- Separation of PD and external interference
Post Processing of Real-Time Data

The comprehensive recording and reporting capabilities of the MPD’s software provides a quick and concise overview of complex test runs. The system records and stores every detail of a test, regardless of whether the test took minutes, hours or days to complete.

Measurements often have to be performed under tight time constraints. In many cases there is insufficient time to make a detailed analysis of the PD patterns or the changes in PD activities which occur during testing.

**Powerful Recording**

The MPD 600 can record millions of single PD events during a test to the computer’s hard-disk drive. The test voltage and all relevant settings are also recorded. This way a growing knowledge pool is created, and can be used as reference to interpret future measurement results.

**Like an interactive movie**

When replaying recorded data from on-site tests, the measurements can be reviewed and analyzed again. With this function it is possible to trace back the source of a failure after the breakdown happened, using previously recorded measurements.

Additionally, noise suppression like 3PARD or gating, can be applied to or removed from an existing recorded measurement. Due to the data recorded in raw format, it is possible to perform all analysis functions as if the test was performed again.
Comprehensive External Application Interface

The flexible application interface, based on Microsoft COM®, allows to transfer all measured quantities and configuration settings to further analysis and visualization tools, such as Microsoft Excel® or MATLAB®.

Integrated Reporting

A function that automatically generates clear reports is integrated into the software. Company logos can be added to the resulting XML files with common office applications.

Screenshots can be added to the report with a single keystroke at any time. This basic version for reporting is included in every software package.

Customizable Report Generator

The Microsoft Excel® based Report Generator offers much more flexibility, allowing the creation of customized reports and tests. It controls the MPD 600 application and integrates all measurement functions into a personalized protocol for immediate printing.

Selected measurement readings are added into the report as clear graphs or tables. A screenshot of the PD pattern can be embedded with one mouse click.

Your Benefits:

> Comprehensive assessment of PD events after measurements
> Replaying measurements with full control of all analysis methods
> Application oriented solutions using programmable COM interface
> Integrated, easy-to-use reporting function
> Microsoft Excel® based Report Generator for customized reports incl. tables, diagrams and more
Applications and Software Packages

Condition-based maintenance is being increasingly applied to improve the reliability and economy of medium- and high-voltage equipment. For this reason partial discharge measurements are used for on-line and off-line condition assessment of various electrical equipment.

Multichannel Measurements of Power Transformers

Power transformers are at the heart of a power system, vital for ensuring the security (reliability) of supplies. PD measurements, an important tool for transformer diagnostics, help to optimize operational availability. The MPD 600 enables the user to quickly measure all of the relevant quantities for a reliable PD measurement – no matter whether the transformer is single or three-phase.

Localizing PD Failures Accurate to a Meter

Finding cable failures with the MPD 600 is very precise. PD failures are localized with 0.2 % accuracy of the entire cable length, and therefore precise to a meter or even centimeter. Cables are tested with sensitive PD measurements after manufacturing. Therefore, during commissioning the focus is on quality control of cable accessories, such as joints and terminations.

Reliable Assessment of Rotating Machines

Measuring for partial discharges is more and more important in the area of power generation. Rotating machines, industrial drives and railway transportation must be assessed offline or in operation. With the help of the MPD 600 and its unique functions, the difficulties of nearby interfering fields can be overcome much easier than other systems.

Precise Assessment in Factories and Laboratories

In shielded laboratories, PD measurements on high-voltage components are carried out using coupling capacitors and measuring impedances. After calibration, the MPD shows the apparent charge according to IEC 60270. PD analysis is supported by graphical tools such as the PRPD pattern.
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<th>Basic Package</th>
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<td>DC measurements</td>
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<td>Additional statistic values in accordance with IEC 60270</td>
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<tr>
<td>Light-sensitive sensor triggers the histogram</td>
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<tr>
<td>Every MPD unit triggers itself</td>
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<td>Internal triggering if no artificial light source is available</td>
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<td>Cable fault locating mode using TDR, statistical TDR and dual-end method</td>
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<td>Guided cable assessment user interface</td>
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<td>Phase and phase-amplitude gating</td>
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<td>Unit gating (Antenna gating)</td>
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<td>Dynamic Noise Gating (DyNG)</td>
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<td>3PARD function</td>
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<td>3FREQ module - VESM 4104</td>
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<tr>
<td>&gt; 3FREQ multi-frequency measurements and 3CFRD visualization</td>
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<td>Generating XML reports</td>
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<td>Report module - VESM 4103</td>
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<td>&gt; Automated, Excel-based report generation</td>
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<td>&gt; Individual applications via COM®-interface</td>
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<tr>
<td>&gt; Providing voltage and PD values for external applications</td>
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• ... included   ○ ... optional
## MPD 600 - Technical Data

<table>
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<tr>
<th><strong>Input</strong></th>
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<tbody>
<tr>
<td><strong>Center frequency</strong></td>
<td>0 Hz to 32 MHz</td>
</tr>
</tbody>
</table>
| **Frequency domain bandwidth** | Standard: 9 kHz, 40 kHz, 100 kHz, 160 kHz, 300 kHz, 650 kHz, 1 MHz, 1.5 MHz  
With broadband filter: 9 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz |
| **Time domain** | 100 ns to 8 μs |
| **Input frequency range** | V input: 0 Hz to 4.3 kHz  
PD input: 0 Hz to 20 MHz |
| **Input impedance** | V input: 1 MΩ (parallel 1 μF)  
PD input: 50 Ω |
| **Input voltage** | V input: 60 V rms (max.)  
PD input: 10 V rms (max.) |
| **Dynamic range** | V input: 102 dB  
PD input: 132 dB (overall), 70 dB (per input) |

### Exactitude

- **PD event time resolution**: < 2 ns
- **System noise**: < 0.015 pC
- **Spectrum analyzer noise**: < -120 dB
- **Max. double pulse resolution**: < 200 ns (time domain integration superposition error < 1%)
- **Measurement accuracy**
  - Voltage: ± 0.05 % of calibrated V value
  - Frequency: ± 1 ppm
  - PD level: ± 2 % of calibrated PD value

### Dimensions and Ambient Condition

- **Humidity**: 5 % to 100 % non-condensing
- **Ambient temperature**
  - Operation: 0 °C to 55 °C  
  - Storage: -10 °C to 70 °C
- **Power supply**: 8 to 12 VDC (external charger input range: 110 - 240 V, 50 - 60 Hz)
- **Dimensions (W x H x D)**: 110 x 44 x 190 mm / 4.3 x 1.7 x 7.5 inch
- **Weight**: 600 g / 1.3 lbs

### PC Requirements

- **Min. Hardware**: Pentium 4® / Athlon 64® or better  
  1 GB RAM, USB 2.0
- **Software**: Windows 2000 Pro™, Windows XP™, Windows Vista™, or Windows 7™

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## Standard Components

### MPD 600

<table>
<thead>
<tr>
<th><strong>Order No.</strong></th>
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</table>
| **Set with one channel** | VE004110  
Including:  
1 MPD 600 acquisition unit  
1 MCU 502/504 controller*  
1 CPL 542/543 impedance*  
1 Fiber optical cable*  
1 MPP 600 power supply package  
+ “Basic Package” Software |
| **Set with three channels** | VE004130  
Including:  
3 MPD 600 acquisition unit  
1 MCU 502 controller  
3 CPL 542/543 impedance*  
3 Fiber optical cable*  
3 MPP 600 power supply package  
+ “Basic Package” Software |
| **Gating channel** | VE004120  
Including:  
1 MPD 600 G  
1 Fiber optical cable*  
1 MPP 600 power supply package |

### MPP 600

<table>
<thead>
<tr>
<th><strong>Data sheet</strong></th>
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<tbody>
<tr>
<td><strong>Lithium polymer battery</strong></td>
<td>L411</td>
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### Fiber optical cable

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<th><strong>Order No.</strong></th>
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<tbody>
<tr>
<td><strong>3 m Duplex FO cable</strong></td>
<td>VEHK4003</td>
</tr>
<tr>
<td><strong>20 m Duplex FO cable</strong></td>
<td>VEHK4001</td>
</tr>
<tr>
<td><strong>50 m Duplex FO cable</strong></td>
<td>VEHK4002</td>
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For other lengths please contact your OMICRON representative.

### MCU 502/504

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### Software

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<th><strong>Order No.</strong></th>
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<tr>
<td><strong>Package “Basic”</strong></td>
<td>VESM4101</td>
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<td><strong>Package “Advanced”</strong></td>
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<tr>
<td><strong>Package “Cable”</strong></td>
<td>VESM4103</td>
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<td><strong>Module “Report”</strong></td>
<td>VESM4104</td>
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<tr>
<td><strong>Module “3FREQ”</strong></td>
<td>VESM4104</td>
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* Different models selectable
**Accessories**

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<td>CAL 543</td>
<td>L414</td>
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<td>CAL 542 A/B/C/D</td>
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<td>MCC 112/124/205/210</td>
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<td>CPL 542/543</td>
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<td>Adapter for bushings</td>
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<td>MCT 100/110</td>
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**Options**

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<tr>
<td>UPG 620</td>
<td>L416</td>
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All data sheets, brochures and additional information are available on → www.omicron.at

Laptop not included
OMICRON is an international company serving the electrical power industry with innovative testing and diagnostic solutions. The application of OMICRON products provides users with the highest level of confidence in the condition assessment of primary and secondary equipment on their systems. Services offered in the area of consulting, commissioning, testing, diagnosis, and training make the product range complete.

Customers in more than 130 countries rely on the company's ability to supply leading edge technology of excellent quality. Broad application knowledge and extraordinary customer support provided by offices in North America, Europe, South and East Asia, and the Middle East, together with a worldwide network of distributors and representatives, make the company a market leader in its sector.

The following publications provide further information on the solutions described in this brochure:

**MPD 500**  
**Brochure**

**UHF 608**  
**Data sheet**

For a detailed list of literature currently available please visit the Literature & Videos section of our Website.