

TESTING DIAGNOSTIC MONITORING

Technical Assessment of
Power Equipment



www.ohv-diagnostic.com



ohv diagnostic

EXPERTISE AND EXPERIENCE

ohv diagnostic - Expertise in high voltage diagnostic technology

Reliable data on the condition of power generation and distribution equipment is now more critical than ever. As a grid operator, you need dependable information in order to make practical decisions on maintenance and repairs. For example, you need answers to questions such as: "Is the insulation on our generators, cables, substations, and transformers operationally reliable? Do we need special inspection or handling procedures?" This information is essential for developing maintenance strategies and for planning optimal technical and commercial investments. It also significantly reduces the risk of unplanned power supply interruptions.

Obtaining this information calls for comprehensive diagnostic measurements that allow the nondestructive assessment of grid conditions. Such measurements are technically demanding, however, and call for appropriate instrumentation, operational experience, and extensive know-how to evaluate the results. That is why you need the expertise and practical experience offered by the engineers at ohv diagnostic!

ohv diagnostic - years of experience in a young company

We founded ohv diagnostic GmbH in 2013 as a group of engineers with many years of experience in the industry. We develop and build modern measurement and testing systems, repair and upgrade existing equipment, and provide diagnostic measurements and other services.

In our young company, we manufacture testing and measurement equipment for diagnosing conditions of electrical operating equipment in medium and high voltage grids. Our top goals in development

are maximum precision and easy operation. Our product range is constantly growing, and includes DAC testing devices for medium and high voltage cables, probes, couplers, and accessories for partial discharge measurements, as well as customer-specific devices and systems. We also develop systems based upon your special requirements, build or repair OEM devices, and modify existing testing equipment.

We also support your operations with a variety of services. We perform diagnostic measurements for many types of operating equipment, and create a complete test report with recommendations for action. In commissioning projects, training courses, and seminars, your employees receive the tools they need to perform measurements on their own. Our range of services also includes calibration of instruments used for partial discharge measurement. You can learn more about our products and services in the last section of the brochure.

ohv diagnostic - exclusive distributor for Haefely Test AG and Hipotronics, Inc.

As the exclusive German distributor for Haefely Hipotronics, we have enhanced our portfolio with the wide range of products offered by Tettex measurement instruments and complete high voltage testing systems. Haefely Test AG is one of the world's best-known manufacturers of laboratory testing and measurement technology for high voltage applications, with more than 100 years of established tradition and quality, "Made in Switzerland."



A TEAM OF EXPERTS

Experience, knowledge, and creativity - our experts

With experience gained through countless on-site assignments, we understand requirements for test stations, laboratories, and high voltage substations. Our specialists have years of experience in diagnostic measurements, scientific studies, and the development of our own high voltage measurement and testing systems. At ohv diagnostic, we combine valuable knowledge from the fields of

- manufacturing
- power utilities and distribution
- research institutions
- assembly

We understand the challenges involved and can work together with you to find appropriate strategies and solutions.

We integrate user experiences as we optimize our technical developments. Our special focus is on reliable and meaningful measurement results for grid operation and asset management, combined with simple and easy-to-use designs. As practitioners, we also understand the importance of flexibility and cost-awareness in on-site service, so portability and an outstanding price-performance ratio are also vital criteria for our work. Comprehensive quality controls are an integral part of our company philosophy. ohv diagnostic is part of a network of international specialists. We do business worldwide.

You too can profit from our outstanding expertise. We combine scientific know-how, technical expertise, and practical experience, all for your benefit!

Thomas Strehl, **Managing Director**



Thilo Ihle, **Managing Director, Director of Development**



Jens Fischer, **Sales & Service Director**



OUR PRODUCTS AND SERVICES

ohv diagnostic - measurement and testing equipment, on-site diagnosis, and training

ohv diagnostic offers a variety of services, ranging from comprehensive on-site service and implementation of maintenance strategies to targeted testing of individual operating equipment. We also offer testing, measurement, and monitoring technology for on-site applications, production environments, and test stations.



Services



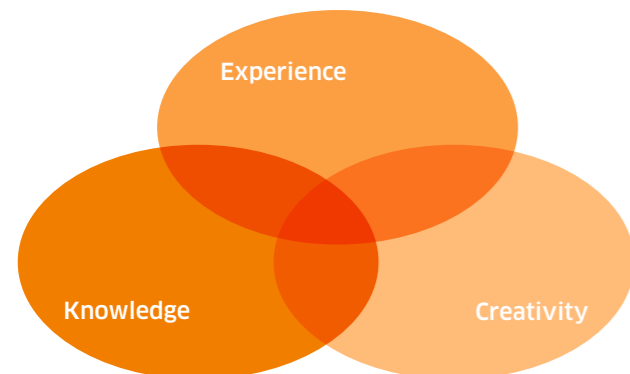
Testing & measurement equipment



Theoretical and practical training

Diagnosis, commissioning, training sessions, and seminars

The facing page provides an overview of our services.



Products

Our products include:

- Our own internally developed testing and measurement technology - primarily for on-site use. You can find these on the following pages.
- Laboratory testing and measurement technology from Haefely Hipotronics - particularly for use in laboratories



We will be happy to advise you at your location. Please contact our sales specialists.



SERVICES

Our experts - working for our customers

Diagnosis, commissioning, training sessions, and seminars

Effective condition assessment of energy cables, substations, and transformers ensures the safe and problem-free operation of electrical power grids. Performing tests and diagnostics on electrical operating equipment can be a highly complex task, however. Medium and high voltage technology in particular requires a great deal of fundamental knowledge in order to understand the processes and interpret the measured values. Thanks to our many years of know-how in diagnostics for electrical operating equipment, we can offer you a package of services tailored to your needs.



Partial discharge diagnosis on a medium voltage cable

Services:

- Commissioning test for cables with accompanying PD diagnosis
- Substation commissioning and diagnosis
- Measurement and testing technology for transformers
- Online monitoring

Highly refined instrumentation and diagnostic tools help you identify and localize defects. The best way to prevent defects, however, is through ongoing theoretical and practical training for your employees. Most of the defects found in medium and high voltage cable grids are the result of faulty assembly of joints and terminations.



Signs of partial discharge on a defective termination



Signs of PD on a substation bushing

Training (excerpt):

- Fundamentals of cable technology
- Partial discharge diagnosis for electrical operating equipment
- Commissioning and practical exercises

To ensure problem-free equipment use and prevent errors, we tailor our training offerings to meet your specific needs. We train your employees at your company's location to save you costs and travel time. By working in a familiar environment, your employees gain the needed confidence and learn the routines for their assigned measurement tasks.

OUR PRODUCTS

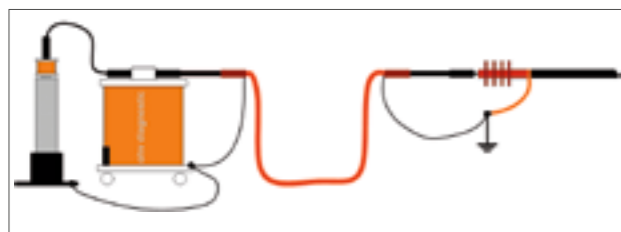
ohv diagnostic - our products for informative, reliable measurements and tests

ohv diagnostic manufactures testing and measurement devices for condition assessment of high voltage operating equipment. Based upon our experience, we have developed testing and measurement devices that offer the highest level of confidence when determining the actual condition of high voltage systems. Our product development also incorporates the latest findings from research, such as optimization of handling (primarily on-site) and precision.

ohv diagnostic - on-site testing technology:

Voltage testing, PD measurement, and localization - fast and precise

In the field of testing technology, we offer equipment for on-site testing of medium and high voltage cables based upon "oscillating discharge voltage" (Damped AC, or DAC). Please refer to the brief descriptions on pages 7 and 8 for the functions and areas of use for medium voltage testing systems and page 9 for high voltage applications. You can also contact our sales office for individual consultation and on-site demonstrations.



Schematic diagram of a DAC test setup

ohv diagnostic - Partial discharge measurement technology

Offline measurement, online monitoring - simple application and maximum informative value:

We offer the following solutions for on-site PD measurement:

- **Offline PD measurement**

We have developed easy-to-use partial discharge measurement systems that permit **IEC 60270-compliant PD measurement** - i.e., with operating equipment that is generally isolated from the operating voltage

- **Online PD determination**

We also offer solutions for **online PD determination**, e.g. for cable terminals, using ultra high frequency signal decoupling (UHF technology). This technology enables PD determination during ongoing operation.

- **Online PD monitoring**

In this process, permanent PD sensors are installed in the system (UHF, HFCT, or our CD 17/24 couplers, see below). These permit permanent PD monitoring of high voltage equipment, using an analysis and memory unit.

In addition to standard PD measurement through four-pole coupling and UHF decoupling, we also utilize HFCT (High Frequency Current Transformer) and acoustic PD detection.

Together with our partners, we have developed PD sensors specifically for these applications. The sensors have proven their usefulness in many field installations.

DAC M30 / M60

On-site testing with Damped AC (DAC)

Medium and high voltage cables must be tested after installation or transfer to ensure operational safety. Tests are also needed when information on the condition of a cable system is needed after many years of operation.

Here the standard specifies a voltage test with voltage levels above the system voltage, the result of which is either a disruptive discharge (serious defect in cable) or "no disruptive discharge." Refinements of the instrumentation now permit precise on-site measurement and localization of partial discharges in cable systems. This significantly increases the usefulness of the information provided by a test, and there is no need to force a disruptive discharge in the cable in order to discover a defect. Analysis of the partial discharge also permits more precise statements about the severity of the defect and its location.

By determining the dissipation factor, statements can be made about the aging condition of older cable systems during measurement.

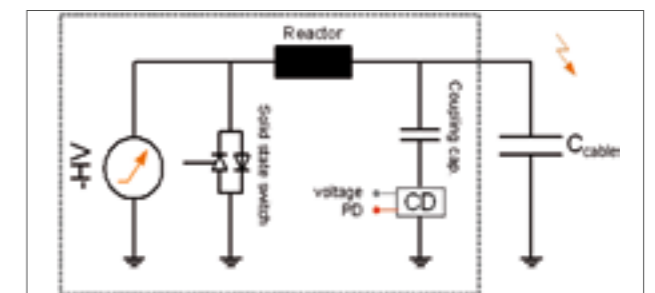
The use of **partial discharge and dissipation factor measurement during testing** allows users to detect defects caused by

- faulty assembly
- incorrect handling during transportation or installation
- faulty joints or terminations
- aging of cables or the insulation of cables and cable accessories

This provides a great deal more information than a simple voltage test.

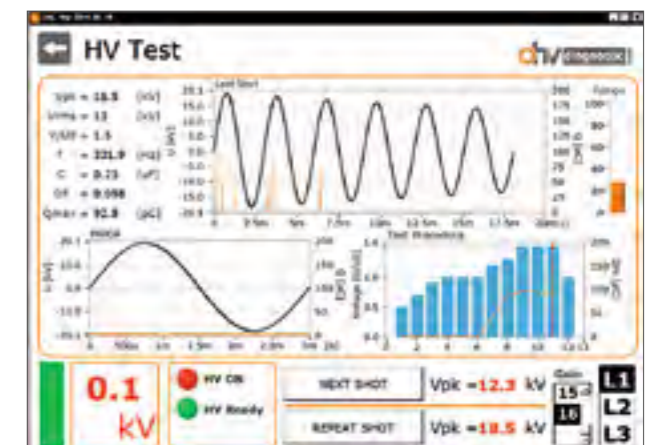
As a voltage source, ohv diagnostic uses **damped AC (DAC)**, also known as **OWTS**. The test voltage requires very little power on site and can supply sufficiently high test levels to cable sections of typical length. The frequency is within the standard-compliant range of 20 Hz to 300 Hz.

In this process, high voltage is generated based upon the simple principle of serial resonance: the cable is continuously charged and when the test voltage level is reached, it is discharged using a high-voltage semiconductor switch on an inductor. This creates an oscillating discharge voltage, during which partial discharges and the dissipation factor can be measured. The number of oscillating discharges (impulses) is usually 50, since scientific studies have proven that defects hazardous to operations safely change into measurable partial discharges within these 50 discharges.



Circuit of a DAC system

ohv diagnostic Suite



DAC M30 / M60

Professional testing and diagnosis of medium voltage cables

In addition to voltage testing, our proven M30 and M60 medium voltage cable testing systems measure and precisely localize partial discharges. They also determine the dissipation factor in the same operation, in order to assess age condition in aging cables. This translates into maximum informative value and confidence for a rapid assessment of your cable system's condition.

The M30 was developed for on-site testing of 10 kV and 15 kV cable systems. The M30 can generate on-site oscillating discharge voltages with a maximum peak voltage of 30 kV, or 21.2 kV_{eff}. The system is small and light, and can fit into a large van. Depending upon the cable type, the system can be used to test cable sections up to several kilometers in length, even though its power consumption is only 500 W.

We developed the M60 for testing 20 kV and 30 kV cables. It has slightly larger dimensions and weight than the M30, but in return offers a maximum test voltage of 60 kV peak or 42.4 kV_{eff}.

M30 - voltage testing, PD measurement, localization, and dissipation factor determination.



Specifications

System parameter	OWTS M30	OWTS M60
DAC output voltage	30 kV (peak)/21.2 kV (RMS)	60 kV (peak)/42.4 kV (RMS)
DAC frequency range	20 Hz - 1000 Hz (acc. to IEC 60060-3)	
Test object capacity	0,025 µF - 5 µF	
PD measurement range/resolution	5 pC - 100 nC / 1 pC	
PD measurement bandwidth	100 kHz - 500 kHz (acc. to IEC 60270)	
Joint localization in calibration mode	integrated	
PD defect localization	broadband, 100 kHz - 20 MHz, automatic settings	
Input voltage	single phase, 94 - 250 V, 48 - 63 Hz, 500 VA	
Dimensions	Diameter: approx. 620mm Height: approx. 690mm	Diameter: approx. 620mm Height: approx. 890mm
Weight	approx. 75 kg	approx. 90 kg
Transport	Aluminum carrying handles	
Control	Laptop via LAN	
Software	ohv diagnostic suite incl. TDR, mapping, PRPDA pattern recognition, import of older file formats, test report generator	

DAC H200

Professional testing and diagnosis for high voltage cables

We designed the new H200 for on-site testing of **110 kV - 145 kV cable systems**. This powerful and mobile high-voltage testing system can generate maximum on-site test voltages of up to 200 kV peak or 141.5 kV_{eff}. The functioning and operation of this unit is basically comparable to that of our M30 and M60 units. Thus this unit also measures and localizes partial discharges while checking voltage, and determines the dissipation factor for the cable section.

The H200 is also operated with the new **ohv diagnostic suite**:



While developing this test voltage system, we placed a high priority on ensuring optimal size and weight. The result is a system that can be easily transported in a minivan, which means it can be used almost anywhere. Testing a three-phase 110 kV cable section requires only two people and approximately 7 hours. Thanks to its small size and low weight, the system can easily perform even complex testing tasks, such as connecting to a GIS in a building.

Despite this system's very low power consumption, it can test 145 kV cable sections of up to several kilometers in length. For technical data, please refer to the data sheet on our website:

www.ohv-diagnostic.com.

Professional testing and diagnosis for high voltage cables



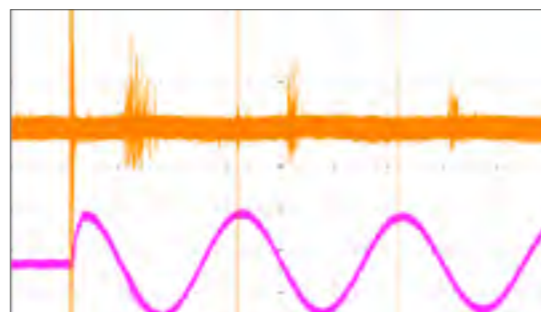
PARTIAL DISCHARGE TECHNOLOGY

Partial discharge measurement equipment and calibrators

Partial discharge measurements are becoming increasingly important for quality inspection and condition assessment in high voltage insulation. In many cases, these nondestructive testing methods are the only practical type of diagnostics possible.

With our experience in the development and use of various PD measurement technologies, we are your expert partner and advisor when selecting appropriate technology for your testing needs. We offer a variety of PD measurement and monitoring equipment, as well as special calibrators for calibrating the standard PD measurement circuit to determine the apparent charge.

On-site partial discharge testing frequently uses unconventional measurement technology in the higher frequency range (HF and UHF). The use of such sensors often eliminates the need to shut off the operating equipment, since this measurement method does not require galvanic coupling to the high voltage conductors. The stronger attenuation of more distant signals also allows for more favorable signal/noise ratios and locally selective PD tests.



Partial discharge impulses

We offer UHF measurement technology, a variety of sensors, and UHF signal injectors.



PD coupler CD-24



PDMS-400



PD calibrator C-1

PD PROBES

Acoustic localization of partial discharges

Less complex probes are also well suited for rapid inspection or localization of partial discharges. These probes are very easy to use and quickly produce high-quality information.

The **ohv ultradetect** probe allows users to acoustically localize a defect source based upon the physical properties of partial discharge events.



Probes are also a cost-effective alternative when a quantitatively precise determination of the apparent charge is not required.



ohv Ultradetect ultrasound probe

- Quickly localizes the ultrasound waves emitted by partial discharges
- Prevents insulation defects through timely detection of partial discharges
- Ultrasound probe with a variety of attachments and parabolic mirror included as standard
- Variety of uses in PD diagnosis, leak localization, or inspection of mechanical parts
- Sound level output on LCD display and through headphones
- Unaffected by light, weather, or other external influences
- Easy handling, fast setup
- Very compact dimensions, low weight
- Can be operated with standard batteries, on-screen battery status display

Specifications	
Frequency range	approx. 40 kHz
Connections	Ultrasound probes, headset
Display	LCD with illumination
Power supply	Batteries 2 x 1,5 V (AA)
Operating life on battery power	approx. 24 hours
Dimensions	Length: 130 mm Width: 85 mm Height: 30 mm Weight: 250 g

With HFCT, TEV, and other sensors, you can use our ohv Ultra PD probe for PD diagnosis, for example on metal-clad switchgears.

SENSORS

Depending upon the application, a partial discharge diagnosis requires specific decoupling units to make

the signal measurable. We can help you make the right choice. Here are several of our sensors.

Measuring impedances

In a standardized PD measurement circuit, measuring impedances and coupling capacitors are used for decoupling. A reference signal is also provided for voltage measurement and synchronization.

We provide you with customized measuring impedances, also switchable or as bridge impedance.



Measuring impedance CD-2

Specifications for CD-1 and CD-2	
Signal inputs	Test Object, Ground
Connection for signal inputs	Terminals, 4 mm connector, outer diameter 6 mm
Signal outputs	PD Pulse, test voltage
Connection for signal outputs	BNC connectors
Dimensions, approx.	Length: 174 mm Width: 114 mm Height: 87 mm Weight: 1,1 kg

CD-17 / CD-24

These units, which combine a coupling capacitor and measuring impedance, are particularly well-suited for permanent installation in high voltage applications. They are used for online monitoring of rotating machines, for example.



CD-24

Specifications for CD-24	
Rated voltage	24 kV
Ratio of upper to lower voltage capacitance	2 nF / 3300 nF
Signal outputs	TNC connector
Dimensions, approx.	Insulator diameter: 120 mm Base diameter: 180 mm Height: 345 mm Weight: 7,5 kg

Connection box CB-3



CD-17



Specifications for CD-17	
Rated voltage	17,5 kV
Ratio of upper to lower voltage capacitance	2 nF / 1500 nF
Signal outputs	Connector cable with TNC connector
Dimensions, approx.	Insulator diameter: 105 mm Base diameter: 140 mm Height: 145 mm Weight: 2,1 kg

Splitting box SB-1



CT-1

The most attractive feature of this UHF sensor is its easy installation and wide variety of uses. It can be used on cables, terminations, bushings, and ground connections for many other types of high-voltage operating equipment.



UHF CT PD Sensor

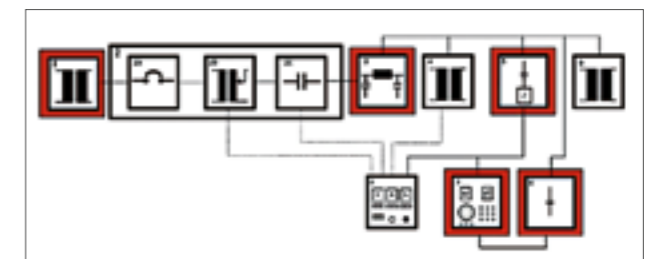
CUSTOMER-SPECIFIC SYSTEM DESIGN

Every test station is individually adapted to your requirements - or at least that is how it should be. But an "off-the-shelf" test system can't always do what you need. This means making compromises, and who likes compromises? From design and manufacturing to commissioning and training, we build entire systems tailored to your specific needs, or we can optimize existing systems.

We incorporate our manufacturing and research experience into our development efforts, provide ideas, and deliver all the advice and help you need throughout the entire process. In cooperation with our partner, Haefely Hipotronics, we deliver customized systems up to the highest voltage levels. Call us to discuss your needs!



Front panel of a customized high-voltage control unit



Schematic diagram of a high-voltage system

WE ARE THERE WHERE YOU NEED US

Other services: Calibration

You need certainty, for your customers and for yourself: Our partial discharge measurement equipment meets the specifications of the applicable IEC standard IEC 60270.

For partial discharge detectors and calibrators, we offer a calibration service in accordance with the mandatory performance test. You also receive a detailed calibration certificate to document the obtained parameters.

ohv diagnostic

**Kalibrierschein für Werkskalibrierung
Proprietary Calibration Certificate**

**Kalibrierschein-Nummer
Calibration Certificate No.** 00*

**Kalibriergegenstand
Calibration object**

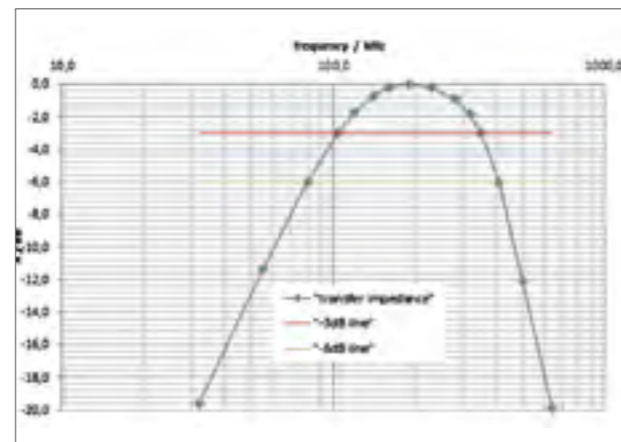
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20	20,6	1,1	9,1	3,1	69,9	3,7
100	103,3	3,6	10,7	3,1	72,3	3,7

Sample calibration certificate

Repairs

High-voltage testing systems and specialized instrumentation are subject to extreme stresses, particularly when used in routine testing. We are happy to perform any maintenance and repairs. We also add new functions as requirements change over time. We offer this service both for devices we manufacture and for third-party equipment.



ohv diagnostic has its headquarters in Dresden. We are part of an international network of companies, which allows us to rapidly send specialists almost anywhere.

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