



# Power Diagnostix

## About Power Diagnostix

---

Power Diagnostix Systems GmbH provides quality instruments and engineering services for high-voltage diagnostic applications. Power Diagnostix has built a solid reputation since market introduction of our partial discharge detectors in early 1993. Our ICM series of digital partial discharge detectors is used for evaluation of electrical insulation by electric utilities, manufacturers, and research institutes worldwide.

In addition to digital partial discharge detectors and monitoring systems, Power Diagnostix produces instruments for commissioning tests of GIS systems, automated control of high-voltage tests, fiber optic connections for analog signal transmission between instruments and sensors, and for other applications in high voltage. All of our instruments and specialized software products are developed in Aachen, Germany. The company's principal engineers are active in several scientific committees.

In June 2019, Power Diagnostix became a part of the Megger group.

At Power Diagnostix, we understand that keeping the power on is essential for the success of your business. That is why we are dedicated to creating, designing and manufacturing safe, reliable, easy-to-use portable test equipment and professional technical services backed by world-leading support and expertise.

We can assist your acceptance, commissioning and maintenance testing for predictive, diagnostic or routine purposes. By working closely with electrical utilities, standards bodies and technical institutions, we contribute to the dependability and advancement of the electrical supply industry ... keeping the Power on.

Our engineers actively participate in regulars' committees, meetings with all the big trade associations around the world, training organisations and government organisations, to understand the needs of electrical contractors. So, when new legislation or rules are introduced, you can count on Power Diagnostix to put your interests first, because Power Diagnostix products and services help customers all over the world, improving their efficiency, reducing costs, and meeting standards. It operates globally, with dedicated field sales teams and distributors located all over the world.

**Power Diagnostix is certified according to ISO 9001:2015 and ISO 14001:2015. We offer full service, repair, and calibration service accredited to ISO 17025:2018.**



# Contents

Partial Discharges in Transformers .....	4
Importance of the Insulation System .....	4
Nature of Partial Discharge.....	5
Most common root causes of PD in transformers .....	5
Continuous On-line PD Monitoring with ICM <i>monitor</i> .....	6
ICM <i>monitor</i> .....	8
Aquisition Unit.....	8
Features.....	8
PD Acquisition Monitoring Rack PDMAR500 .....	9
Communication .....	10
ICM <i>monitor</i> Software.....	11

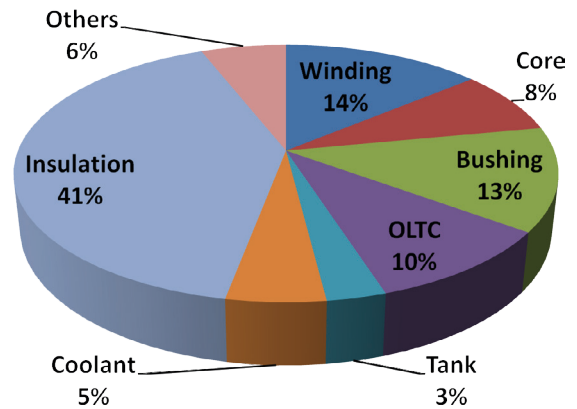


# Partial Discharges in Transformers

## IMPORTANCE OF THE INSULATION SYSTEM

Partial discharge testing is required in order to be able to assess the quality of the power transformers. In an electric system, the failure of the insulation may ultimately lead to a complete breakdown. It has been found out that high percentage of failures is related to insulation problems concerning the power transformers.

PD monitoring helps detecting insulation, bushing, and winding problems. Failures can be due to improper factory acceptance test (FAT), transportation as well as onsite commissioning. Random failures are caused by particular stress such as high load, lightning or switching impulses.

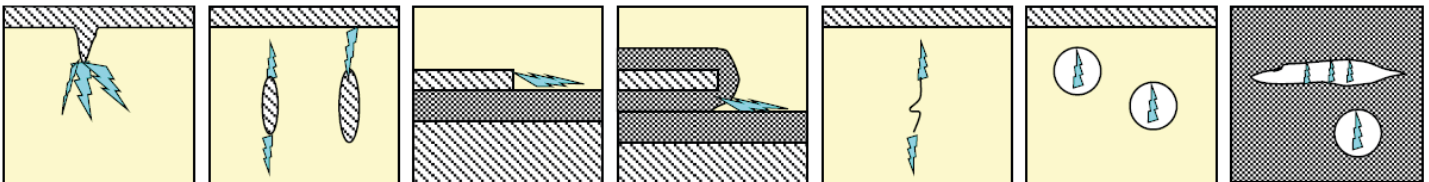


## MOST COMMON CAUSES OF PD IN TRANSFORMERS

The most common causes of PD in transformers are:

- Sharp points and particles
- Surface and tracking discharge
- Fiber bridges in oil
- Gas inclusions
- Humidity (indirect)

Online PD monitoring is important to assess the insulation condition of power transformers as well as transformer accessories. PD trending and changing PD patterns help to indicate an incipient failure. Further analysis of the phase resolved PD pattern assists with failure investigation in order to find out the root cause. In addition, PD monitoring can be extended to DGA, voltage, tan delta, temperature and load monitoring.



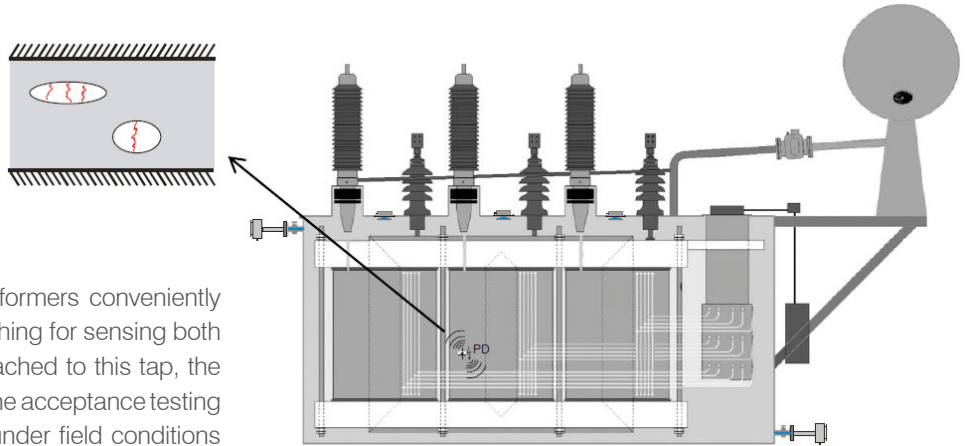


# Partial Discharges in Transformers

## NATURE OF PARTIAL DISCHARGE

Partial discharge is a breakdown of a small area in the overall insulation and each PD signal generates different measurable electrical signals. These are namely:

- Local displacement current pulse
- Electromagnetic pulses
- Acoustic signals



Partial discharge monitoring on power transformers conveniently uses the capacitive tap of the condenser bushing for sensing both partial discharge and line voltage signal. Attached to this tap, the combined measuring impedance is used for the acceptance testing in the IEC60270 frequency range, whereas under field conditions the built-in high frequency current transformer (HFCT) can be used.

General root causes of PD in power transformers are:

- Inferior quality of insulation materials
- Fundamental design related problems
- Assembling related problems
- Humidity in oil
- Aging of insulation materials
- Hot spots

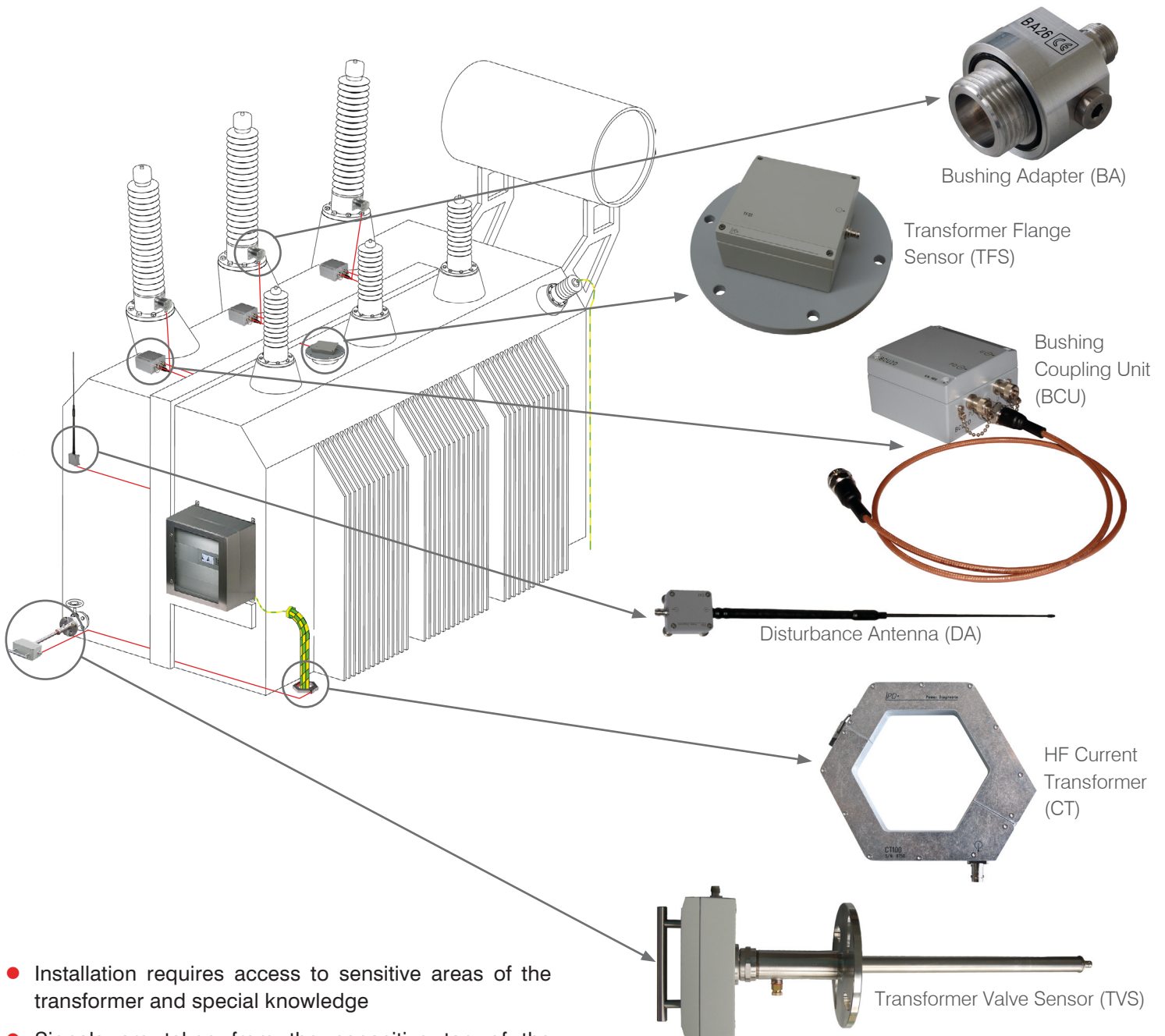
Partial discharges have a severe impact on transformer insulation systems and this depends on the nature of the PD and location in the main tank. Accordingly, accelerated degradation of the insulation material leads to reduced life expectancy of the grid system. The worst case scenario is the unexpected breakdown resulting in black outs. With the diagnostic testing the main task is to analyze the partial discharge pattern to assess the risk potential of the degradation process and subsequently to determine the location of the partial discharge source.





# Continuous On-line PD Monitoring with ICMmonitor

Continuous online PD monitoring or periodical online measurements help to detect incipient faults.



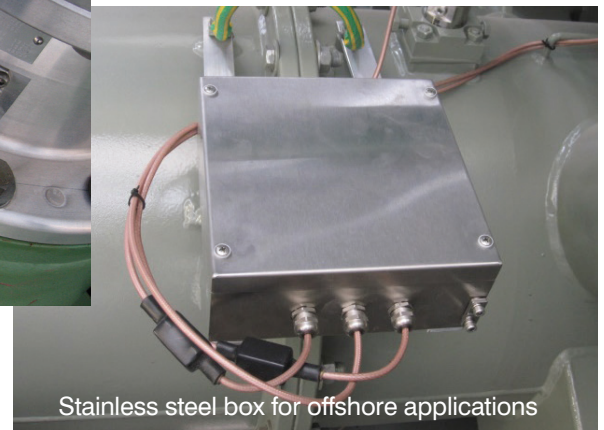
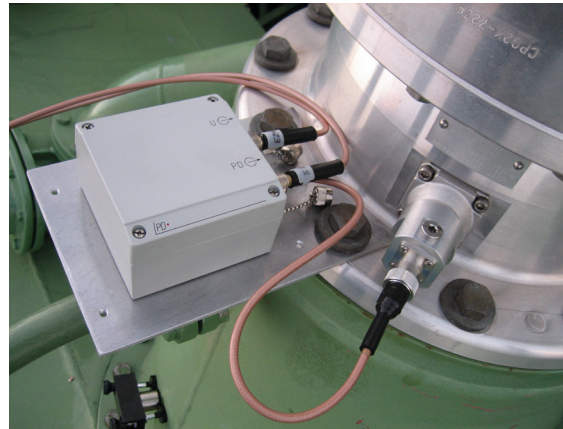
- Installation requires access to sensitive areas of the transformer and special knowledge
- Signals are taken from the capacitive tap of the transformer bushing by bushing adapter (BA) and bushing coupling unit (BCU)
- UHF sensors available for the oil drain valve (TVS2) and for spare flanges (TFS1)
- Gating signal from optional disturbance antenna (DA1) or high frequency current transformer (CT)



## Continuous On-line PD Monitoring with ICMmonitor

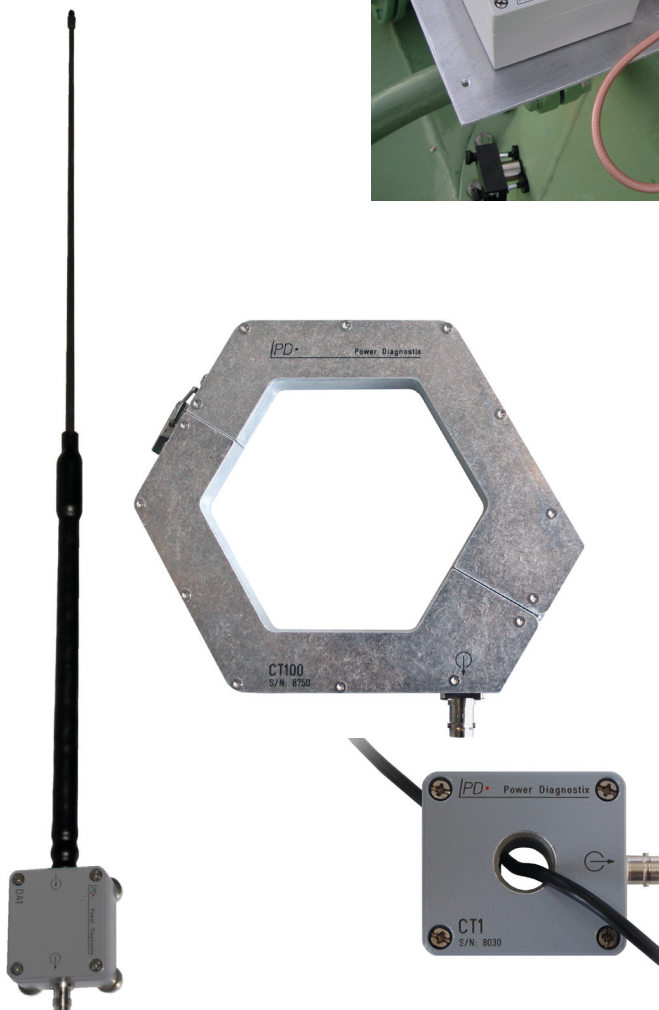
Monitoring the partial discharge activity continuously on-line with a power transformer unveils deterioration of the insulation system in an early stage. Continuous online monitoring of the partial discharge activity and the bushing capacitance helps maintaining the reliability of power transformers.

Coupling to the partial discharge signals is conveniently provided using the capacitive taps of the condenser bushing. Since a huge variety of capacitive taps designs exist, Power Diagnostix offers various versions of tap adapter units.



Stainless steel box for offshore applications

The coupling unit is equipped with circuits both for the measurement of voltage and partial discharge. For the PD measurement both a high frequency current transformer and a standard quadrupole is built-in.



External disturbances can be detected by an antenna e.g. DA1 or by clamp on HF current transformer (CT1, CT100, or similar)

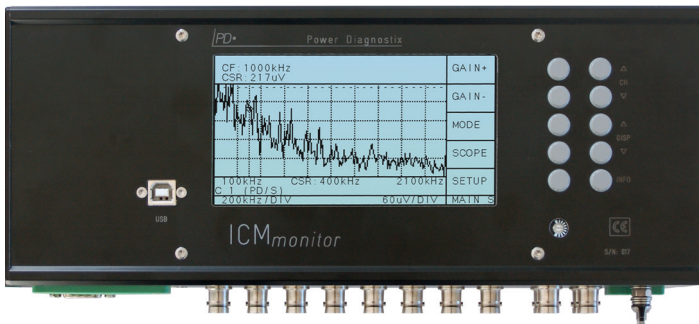
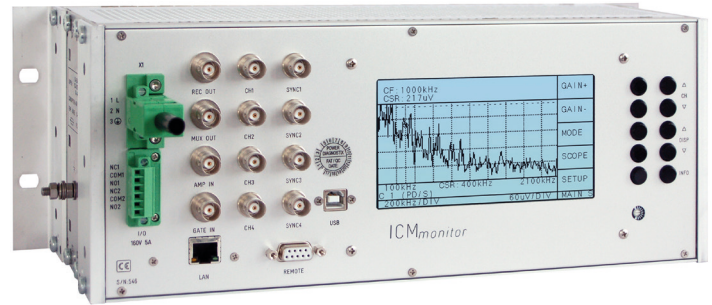


# ICMmonitor

## AQUISITION UNIT

The ICMmonitor is a stand-alone unit for the continuous online monitoring of PD activity. For each channel the unit acquires a phase resolved PD pattern. Trending curves are stored locally.

The system can be adapted to utilize all commonly used types of couplers and sensors. It offers a relay output to give a warning if a preset threshold level is exceeded. Alarm levels can be set for the average discharge current as well as for the peak level of discharge.



The ICMmonitor can also be installed on a power transformer with a waterproof enclosure. The unit can be integrated into a larger monitoring concept, in case correlation of the discharge activity with other operational parameters such as load, temperatures, or gas-in-oil analysis.

Furthermore, the ICMmonitor can be used with embedded UHF sensors along with special demodulating UHF preamplifiers. The UHF band offers noise-free measurements on discharges coming from shields within the transformer tank, for instance.

## FEATURES

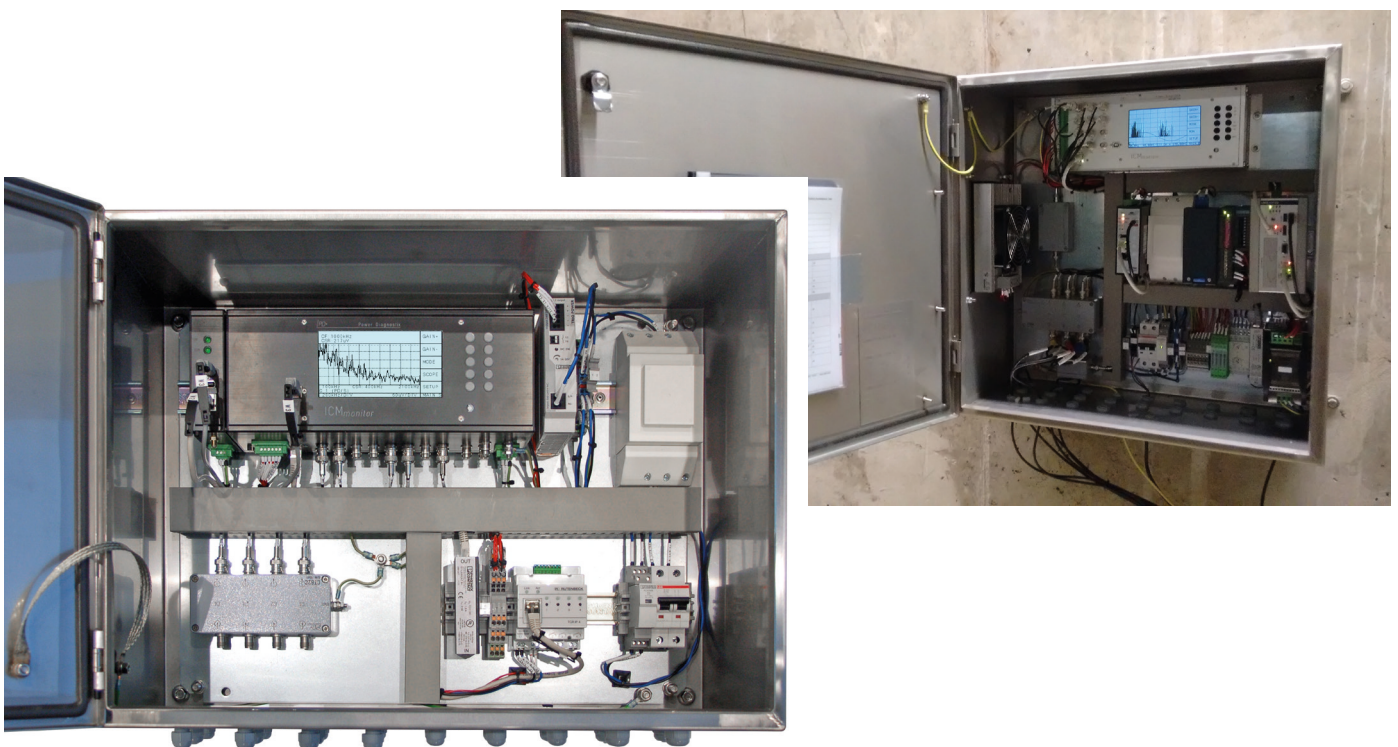
- Frequency selective measurements
- Wide band and narrow band filter
- Spectrum analysis
- Dry alarm contacts
- IEC61850 (optional)
- USB interface
- LAN interface





## PD ACQUISITION MONITORING RACK PDMAR500

- Compact design
- Built-in ICMmonitor, CTB, network interface, IOs, main switch,...
- User-friendly interface
- Corrosion proved design
- High quality PTFE coaxial cables suited for extreme weather conditions on site
- Heating installation or cooling system possible
- Stainless steel enclosure with protection class IP52 or special Explorer case with protection class IP65





# ICMmonitor

## COMMUNICATION

The ICMmonitor is equipped with a serial computer interface for downloading of trending data and remote access e. g. by telephone modem or LAN network (TCP/IP). The instrument talks to the local monitoring system covering temperatures, voltages, and other parameters, which then reports to the SCADA system.

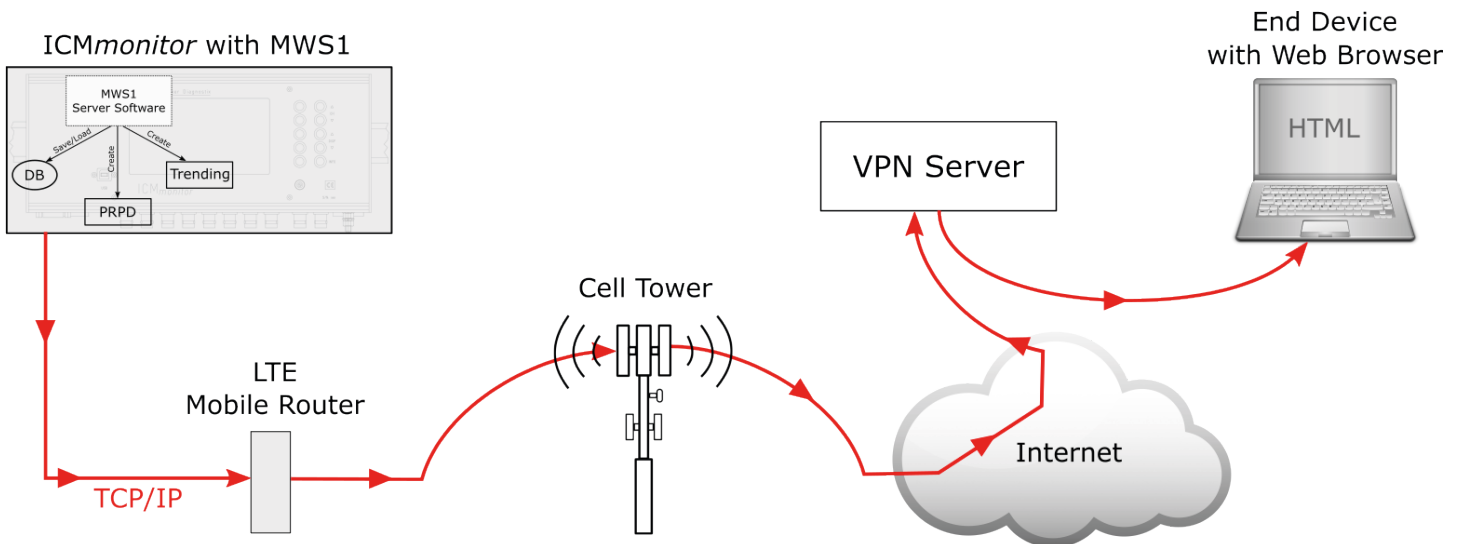
There is an optional terminal for communication with the ICMmonitor according to IEC61850. The hardware based protocol converter for IEC61850 compliant communication requires an additional terminal for communication via LAN that is used to transfer the data.

Furthermore, the Mobile Web Server (MWS1) provides a LAN or Ethernet gateway for platform independent remote access to an ICMmonitor device. The module is available for hat rail mounting, as built-in plug-in card, or as separate box.

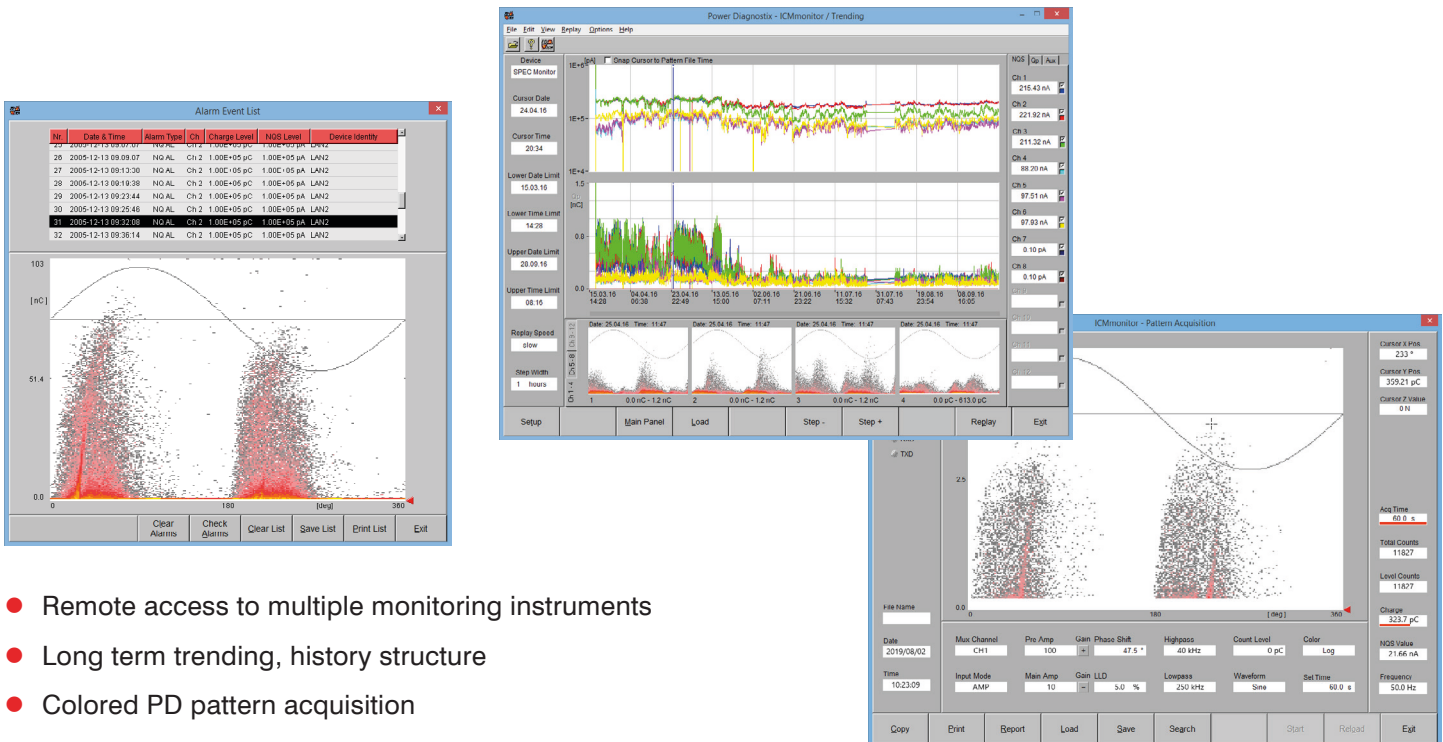
To access the ICMmonitor remotely a modern web browser is required. Combined with an LTE mobile router a secure remote access via Internet can be provided.



## Signal Flow



NQS and QP Trending panel & landing page of the MWS1 application



- Remote access to multiple monitoring instruments
- Long term trending, history structure
- Colored PD pattern acquisition
- Automated data acquisition
- USB and LAN interface

## SOLUTIONS THAT FIT FOR YOU

According to your specific needs Power Diagnostix provides the PD monitoring system that fits exactly to your requirements. Get in touch with us for a detailed quotation. For that purpose we need the following information:

- Tested assets
- Technical details of the asset (nameplate, specification)
- Environmental conditions
- Online or offline test conditions?
- Applicable or relevant standards, guidelines, or TBs

### Typical Package

Complete PD monitoring system for power transformers:

- 1 x ICMmonitor (incl. SPEC & gating function)
- 1 x ICMmonitor software
- 1 x Industrial monitoring cabinet (sheet metal or stainless steel)
- 1 x Analog input card for parallel recording of misc. sensor signals like temperatures, vibrations, load conditions, etc.
- 1 x Preamplifier RPA2B
- 1 x Preamplifier RPA1H
- 1 x High frequency current transformer CT1
- 1 x Impulse calibrator CAL1B
- 1 x Set of cables
- 1 x Set of three bushing coupling units BCU2D
- 1 x Set of bushing adapters BAXy (BA1–BA30)
- 1 x Mounting kit for PD decoupling units





Power Diagnostix Systems GmbH  
Vaalser Strasse 250, 52074 Aachen, Germany  
Tel. +49 241 74927, Fax. +49 241 79521  
E-Mail: support(at)pdix.com

[www.pdix.com](http://www.pdix.com)

PowerDiagnostix\_TrafoMon1.03

The word 'Megger' is a registered trademark. Copyright © 2020

**PD**  **by Megger®**  
Power Diagnostix Systems