PD by Megger®

Power Diagnostix

GIS*monitor*

On-line partial discharge monitoring for GIS systems

LANGUAGE | EN

USER GUIDE

Power Diagnostix

This manual supersedes all previous issues of this manual. Please ensure that you are using the most recent issue of this document.

GIS*monitor*

On-line partial discharge monitoring for GIS systems

LANGUAGE | EN

USER GUIDE

Contents

1 General

1.1 About this manual

This manual describes the hardware and usage of the GIS*monitor* partial discharge monitoring system (PDMS). Software updates are available on Power Diagnostix's web site (www.pdix.com). The access to the download area of that web site is password protected and requires a valid software maintenance contract. Contact Power Diagnostix for details.

1.2 Instrument safety

Before using the GIS*monitor*, read the following safety information and this manual carefully. In particular, read and follow the information that is marked with the words 'Warning' and 'Caution'. The word 'Warning' is reserved for conditions and actions that pose hazards to the user, while the word 'Caution' is reserved for conditions and actions that may damage the instrument or its accessories, or that may lead to malfunction.

Warning

- Always provide solid grounding of the instrument. Never operate the instrument without protective grounding.
- Avoid working alone.
- Do not allow the instrument to be used if it is damaged or its safety is impaired.
- Do not use the instrument in an environment that is at risk of condensation or in an environment at risk of explosion.

2 Introduction

2.1 Overview

The main task of the partial discharge monitoring system (PDMS), type GIS*monitor*, of Power Diagnostix is to detect internal partial discharge in the gas-insulated switchgear (GIS) caused by hopping particles, floating potentials, cracks in insulators or spacers, or other degradation in the insulation system at an early stage.

Due to the dielectric properties of the SF6 gas, partial discharge activity in a gas insulated switchgear covers a bandwidth of well beyond 2 GHz. The mechanical properties of the components of a gas insulated switchgear further allow transmission of such signals over a distance of a couple of meters. Thus, the partial discharge monitoring of GIS equipment is done preferably in the ultra high frequency (UHF) range. The frequency converter unit (FCU2) picks up the UHF signal from the embedded UHF sensor. The FCU2 is a signal conditioning unit with a demodulating logarithmic transfer function. The frequency range of the input signal covers ~100 MHz up to ~1.8 GHz. The output of the FCU2 is the envelope of the UHF signal down-converted into the high frequency (HF) range. The FCU2 is mainly used with monitoring applications and for gating purposes. The logarithmic Y-axis somewhat complicates the calibration for standard measurements. It further takes some time to become familiar with the interpretation of partial discharge pattern with logarithmic Y-axis. The FCU2 is remote powered by a DC phantom voltage provided by the monitoring instrument (GIS*monitor*). A malfunction of the FCU2 will be detected automatically by the monitoring unit and will be indicated on the front panel of the software. The following drawing shows a system overview:

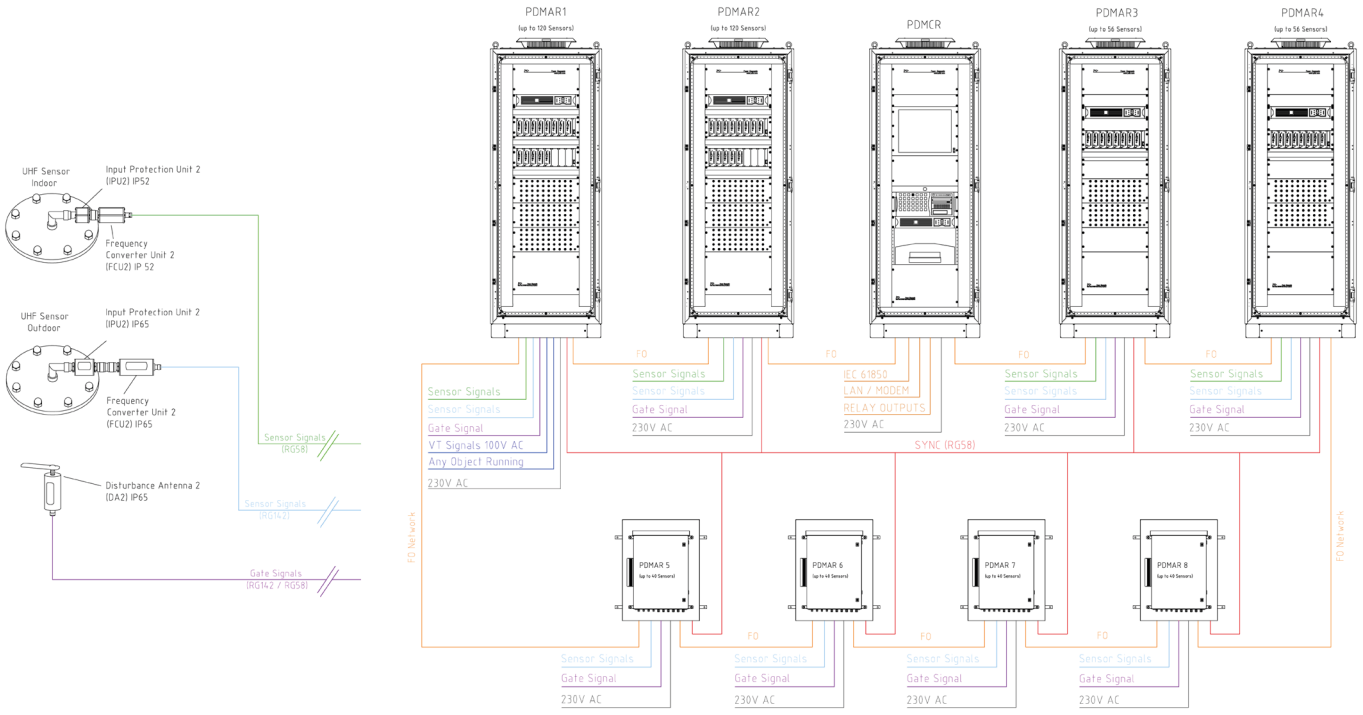

Figure 1: System overview

This overview shows an example of a full partial discharge (PD) monitoring system. The number of sensors to be monitored depends on the type of GIS and the individual specification of the customer. The signal of each sensor is limited by a special input protection unit IPU2 and converted into lower frequencies by a frequency converter unit FCU2. All signal cables from all sensors and antennas are brought together into several partial discharge monitoring acquisition racks (PDMAR). These cabinets are interconnected via a fibre optic LAN ring, providing n+1 communication redundancy. A partial discharge monitoring control rack (PDMCR)

receives all the measured data and processes it. With this system architecture, a nearly infinite number of sensors can be continuously monitored and observed. A special software reads the measured data of all stand-alone monitoring instruments (GIS*monitor*), each scanning up to eight sensors.

In combination with the monitoring software installed on the industrial PC (IPC), the trending data of peak values (Upp) and normalised quantities (averaged) values (Upavg) of years can be archived. Additionally, data like PD patterns, system health information, or alarm events can be stored and evaluated. If connected to the local intranet of the substation or to the utility, it allows remote diagnosis and control of the full PD monitoring system. Different functional levels can be set for administrative, operational, or evaluation purpose. The optional IEC interface provides IEC 61850 compliant sensor data, alarms, and health information.

2.2 Signal flow

The signal flow of a PDMS is shown in the following chart:

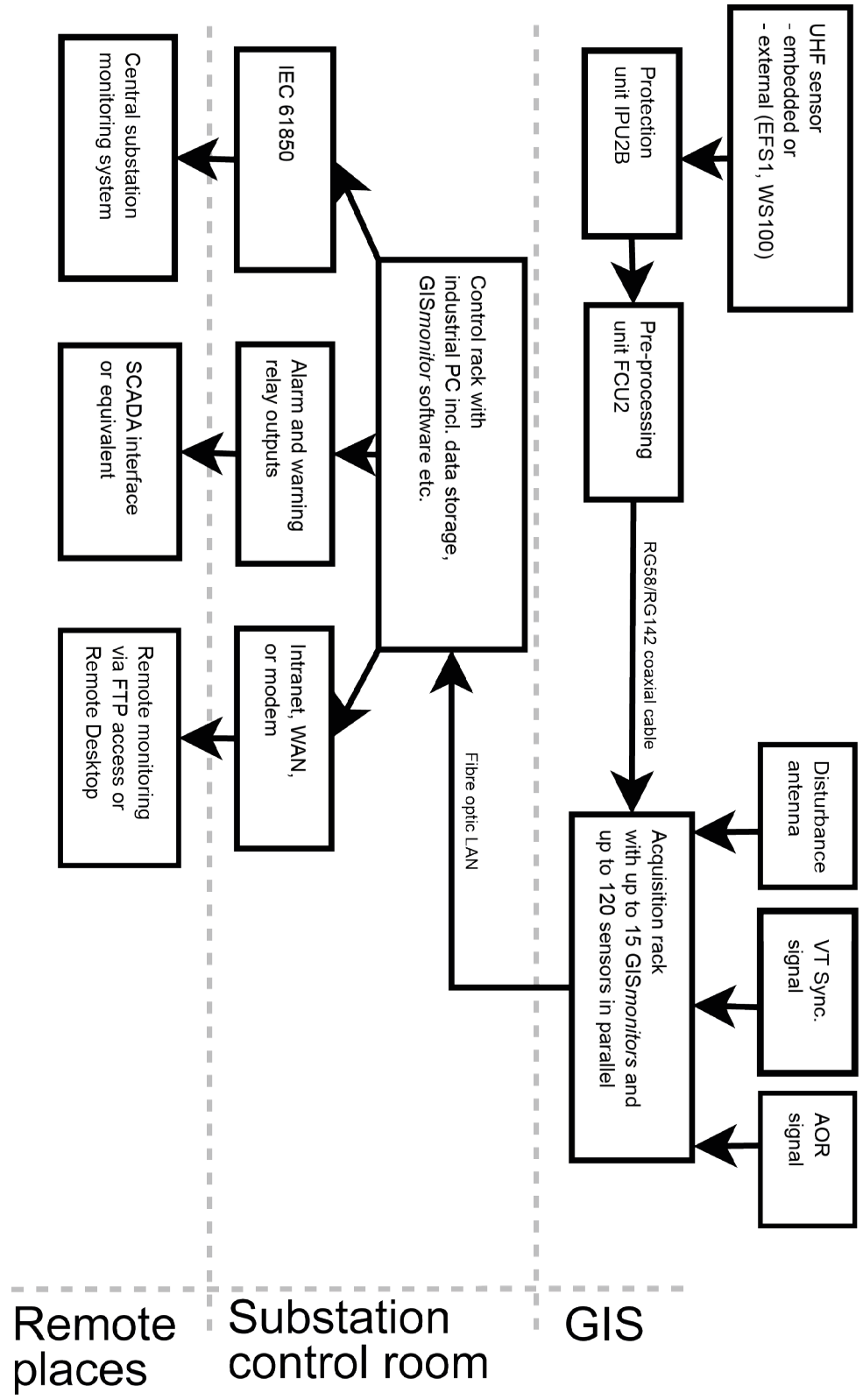

Figure 2: Signal flow

The UHF signal is picked up from the sensor via an N connector. The input protection unit (IPU2) protects the measurement system from high voltages generated by switching operations, transients, or overvoltages.

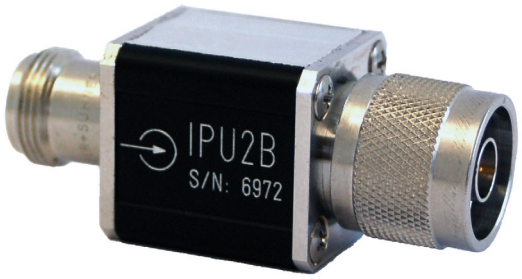

Figure 3: Input protection unit IPU2B

The signal is then transformed by a frequency converter unit (FCU2) into a lower frequency range for easy submission over longer distances.

Figure 4: Frequency converter unit FCU2

The transformed signal is transmitted by use of 50 Ohm coaxial cable (RG58 for indoor use, RG142 for outdoor use) and digitised by the GIS*monitor* plug-in board, which offers the acquisition of up to eight sensors in parallel. A clamp-on ferrite core at each side of every cable protects the electronic circuits against transients travelling along the shielding of the cable.

Caution!

The maximum length of cabling between the FCU2 and the GIS*monitor* plug-in board is 80 meters. Grounding loops should be minimised by using cables as short as possible and by laying them close to the common ground, e.g., along the GIS enclosures.

To provide noise suppression, the plug-in board uses a gate input. This input is connected to a disturbance combiner unit (DCU4), which mixes up to four disturbance signals. These signals are transmitted by at least one disturbance antenna (DA2), which receives disturbances created by cell phones, corona effects, or similar. Additionally, an 'Any Object Running' signal, provided to the first PDMAR, is used to suppress noises caused by events such as switching operations.

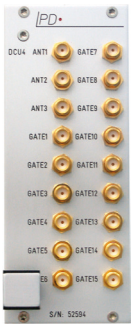

Figure 5: Disturbance combiner unit (DCU4)

GIS*monitor*
PD monitoring on gas-insulated switchgear

An external synchronisation signal is used to guarantee a phase-stable pattern at any time. To do so, the sync switching box (SSB2), selects one of up to four valid signals and transmits them to the GIS*monitor* plug-in board. In case there is no synchronisation available, the system uses a line sync as a fall-back. The phase shift between the line signal and the first phase can be set up in the software.

3 Hardware

3.1 Partial discharge monitoring acquisition rack (PDMAR)

Three versions of the data acquisition rack are available: Two for indoor use, one for outdoor operation. The indoor versions differ in the number of sensors which can be captured with one rack. One version allows the connection of up to 56 sensors with seven monitoring instruments, the other version covers up to 120 sensors with up to 15 monitoring instruments in one rack. The version with 56 sensors can be extended to 120 sensors at any time in the future.

The data acquisition rack accommodates the GIS*monitor* 19-inch rack, the GIS*monitor* plug-in boards, the disturbance combiner unit (DCU4), and the sync switching box (SSB2) inside the first cabinet of a system. It comes with a 19-inch swing frame, uninterruptible power supply (UPS), network switch, overvoltage protection, ioLogic, and temperature-controlled fans. The ioLogic provides information about temperature, heating, cooling, the fibre optic ring status, fuse status, and overvoltage protection. All cables from the outside are fed through the bottom into the rack.

Figure 6: PDMAR cabinet for up to 120 sensors

GIS*monitor*
PD monitoring on gas-insulated switchgear

The outdoor version of the data acquisition rack is of ingress protection class IP65 and allows the monitoring of up to 40 sensors. The cabinet is equipped with uninterruptible power supply (UPS), network switch, overvoltage protection, a heating and cooling Peltier element, and the monitoring instruments. The cabinet can be mounted on walls or girders. In areas of high temperatures and insolation, the PDMAR IP65 can be equipped with a sun protection.

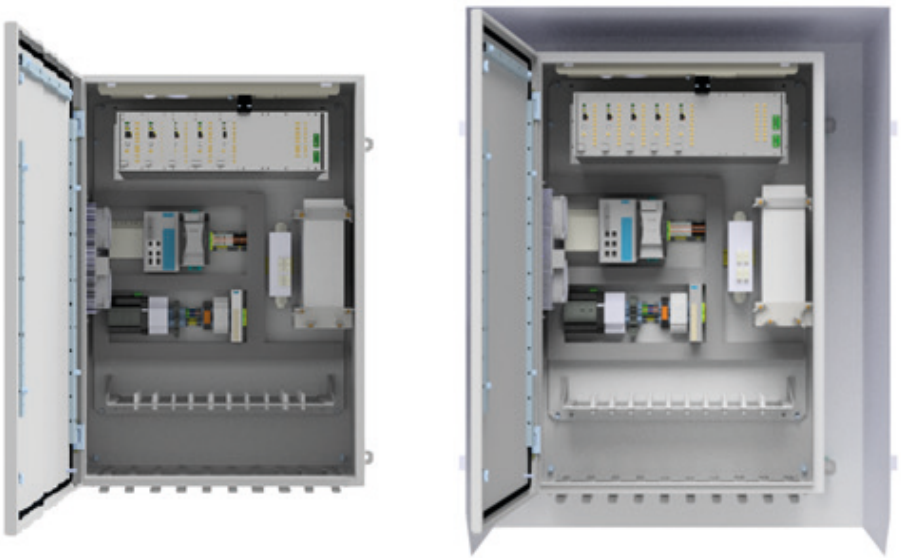

Figure 7: PDMAR IP65 cabinets with (right) and without (left) sun protection for up to 40 sensors

All outdoor racks are equipped with an ioLogic, which collects data like temperature, cooling/heating status, UPS status, fuse status, and overvoltage protection status. The information is brought together in the software, giving an overview of the system and warnings in case of action is needed.

Caution!
Do not attach devices with a rating of over 500 Watts to the power socket!

3.1.1 Disturbance combiner unit (DCU4)

The DCU4 combines all signals from the antennas and distributes them to the acquisition unit. The unit is built into the GIS*monitor* rack.

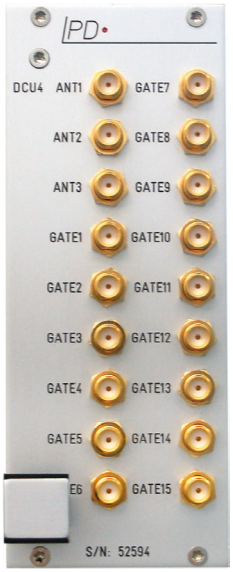

Figure 8: Disturbance combiner unit (DCU4)

3.1.2 Sync switching box (SSB2)

The SSB2 insures a valid synchronisation signal with the same phase to all sensors. The SSB2 is located in one PDMAR cabinet and distributes the sync signal to the other racks. The input signals are isolated from the system. This protects the PDMS against any kind of overvoltage on sync lines. The “SYNC” input is designed for a voltage in the range of 15 to 230 V RMS.

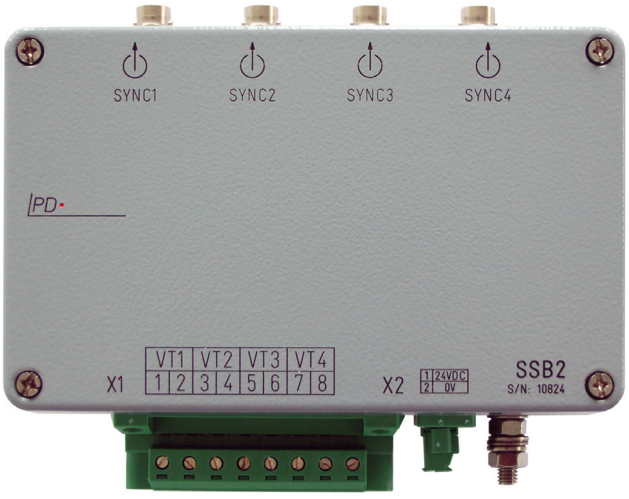

Figure 9: Sync switching box (SSB2)

3.1.3 ioLogic

The ioLogic monitors the PDMAR's fuses, fans, cooler, and lightning protection. Additionally, the unit controls the operating temperature and the proper operation of the network ring and the power supplies of the outdoor cabinet. In case of an error or a problem, the GIS*monitor* software will display an alert.

Figure 10: ioLogic

3.1.4 Switch

The industrial PC (IPC) located in the control room is linked with the GIS*monitor* cabinets via a fibre optic LAN ring.

This DIN rail switch is located in every cabinet and allows the recognition of a ring break. The switch located in the PDMAR cabinet is interconnected via standard LAN cables to each GIS*monitor* unit with eight input channels each.

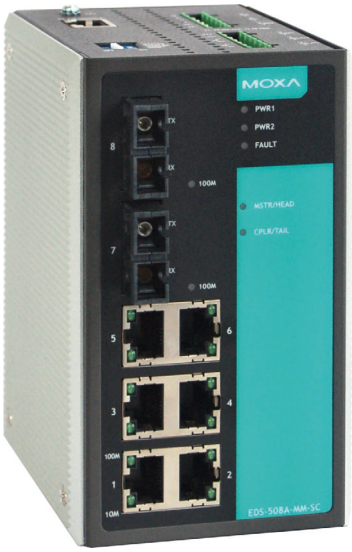

Figure 11: Switch in every cabinet

3.1.5 Monitoring unit (GIS*monitor*)

The GIS*monitor* is an instrument to continuously monitor partial discharge activity of high voltage gas insulated switchgear (GIS). Each GIS monitoring interface card is equipped with a LAN connection. The system can be adapted to use all commonly used types of couplers and sensors.

Figure 12: GISmonitor built into a 19-ich rack

One GIS*monitor* interface card can handle up to eight measurement points and has a “GATE” and “SYNC” input.

3.2 Partial discharge monitoring control rack (PDMCR)

The control rack accommodates the Windows-based industrial PC (IPC), a touchscreen, and a printer. It comes with a standard 19-inch metal supporter, uninterruptible power supply, network switch, and temperature-controlled fans. The built-in printer can be used to print single measurements, screenshots, or reports. The IPC is mounted on rails to ease maintenance. The cabinet provides four different alarm contacts on the DIN rail, which can be used with up to 110 V DC.

Figure 13: PDMCR cabinet

3.2.1 Industrial PC (IPC)

The IPC comes with a RAID-1 hard disc controller to prevent unwanted loss of data. The HDD capacity allows the storage of trending and PD patterns for up to several years.

The software can be used via the touch screen, or by the keyboard and the touchpad located in the drawer above the IPC.

Figure 14: IPC located in the PDMCR

3.2.2 Uninterruptible power supply (UPS)

The uninterruptible power supply (UPS) provides emergency power to the prime components of each rack. This assures instantaneous protection from input power interruptions, thereby preventing unwanted data loss.

4 Maintenance

Malfunctions of parts of the system or individual instruments will be detected automatically and indicated by the software. Interruptions in communication or missing data will cause an entry in the event list. This list is available with the software and should be checked by the operator from time to time. Firmware or software updates can be requested from Power Diagnostix.

The following actions are recommended:

4.1 Hardware maintenance

4.2 PDM control rack

- Check the UPS battery regularly and change every two years.
  Warning! Please refer to the manual of the UPS for further safety instructions.
- Check the operation of all fans and coolers regularly.
- Check the overvoltage protection regularly.

4.3 PDM acquisition racks

- Check the UPS battery regularly and change every two years.
  Warning! Please refer to the manual of the UPS for further safety instructions.
- Check the operation of all fans and coolers regularly.

4.4 Software maintenance

- Windows updates are recommended to prevent unwanted failures of the operating system.
- Update your antivirus programs regularly.
- Check raid state regularly.
- Updates of the GIS*monitor* software should be made if necessary.

5 Declaration of Conformity

The manufacturer
Power Diagnostix Instruments GmbH
Vaalser Strasse 250
52074 Aachen
Germany

declares that the product

GIS*monitor* PDMCR, GIS*monitor* PDMAR

Partial discharge monitoring control rack, partial discharge monitoring acquisition rack

provided it is installed, maintained, and used for which it was made, in accordance with relevant installation standards and manufacturer's instruction, meets the requirements of the following directive(s):

Low Voltage Directive 2014/35/EU
EMC Directive 2004/108/EG
RoHS Directive 2011/65/EU

It complies with the following standards and/or normative documents:

EN 61010-1:2020
EN 61326-1:2013
EN IEC 63000:2018

Aachen, 11/04/2024
Dr. Mihai Huzmezan
(CEO, Power Diagnostix Instruments GmbH)

Note: Since the measurement of partial discharge pulses is done in frequency bands partly occupied by radio transmission, and since further test leads may act as antennas, disturbance-free measurements may require well-shielded environments and/or additional filter techniques.

6 UK Declaration of Conformity

The manufacturer
Power Diagnostix Instruments GmbH
Vaalser Strasse 250
52074 Aachen
Germany

declares that the product

GIS*monitor* PDMCR, GIS*monitor* PDMAR

Partial discharge monitoring control rack, partial discharge monitoring acquisition rack

provided it is installed, maintained, and used for which it was made, in accordance with relevant installation standards and manufacturer's instruction, meets the requirements of the following Statutory Instruments:

SI 2016 no. 1101 The Electrical Equipment (Safety) Regulations 2016
SI 2016 no. 1091 The Electromagnetic Compatibility Regulations 2016
SI 2012 no. 3032 The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

It complies with the following standards and/or normative documents:

EN 61010-1:2020
EN 61326-1:2013
EN IEC 63000:2018

Aachen, 11/04/2024
Dr. Mihai Huzmezan
(CEO, Power Diagnostix Instruments GmbH)

Note: Since the measurement of partial discharge pulses is done in frequency bands partly occupied by radio transmission, and since further test leads may act as antennas, disturbance-free measurements may require well-shielded environments and/or additional filter techniques.

7 Certificates

Certificate

Standard **ISO 9001:2015**

Certificate Registr. No. **01 100 1900587**

Certificate Holder: **Megger Diagnostic Holding GmbH**
Dr.-Herbert-lann-Str. 6
96148 Baunach
Germany

including the locations according to annex

Scope: Design, development, production, testing, and sales of measurement and monitoring equipment for electrical power engineering and related services in this field

Proof has been furnished by means of an audit that the requirements of ISO 9001:2015 are met.

Validity: The certificate is valid from 2022-10-14 until 2025-09-09.
First certification 2019

2022-10-14

TÜV Rheinland Cert GmbH
Am Grauen Stein · 51105 Köln

www.tuv.com

DAkkS Deutsche Akkreditierungsstelle D-ZM-16031-01-00

TÜVRheinland®
Precisely Right.

Annex to certificate

Standard **ISO 9001:2015**

Certificate Registr. No. **01 100 1900587**

No.	Location	Scope
/01	c/o Megger Diagnostic Holding GmbH Dr.-Herbert-lann-Str. 6 96148 Baunach Germany	Design, development, production, testing, and sales of measurement and monitoring equipment for electrical power engineering and related services in this field
/02	c/o Power Diagnostix Systems GmbH Vaalser Str. 250 D 52074 Aachen Germany	Design, development, production, testing, and sales of measurement and monitoring equipment for electrical power engineering and related services in this field
/03	c/o Power Diagnostix Instruments GmbH Vaalser Str. 250D 52074 Aachen Germany	Design, development, production, testing, and sales of measurement and monitoring equipment for electrical power engineering and related services in this field
/04	c/o Power Diagnostix Service GmbH Vaalser Str. 250 D 52074 Aachen Germany	Design, development, production, testing, and sales of measurement and monitoring equipment for electrical power engineering and related services in this field

2022-10-14

TÜV Rheinland Cert GmbH
Am Grauen Stein · 51105 Köln

Page 1 of 1

www.tuv.com

TÜVRheinland®
Precisely Right.

8 Index

PD by Megger®

Power Diagnostix

GIS*monitor*

On-line partial discharge monitoring for GIS systems

LANGUAGE | EN

USER GUIDE

Power Diagnostix Systems GmbH · Vaalser Strasse 250 · 52074 Aachen·
Germany ·Telephone +49 241 74927 · Fax +49 241 79521 · www.pdix.com

GISmonitor_UG_e1.11 April 2024