

# GISmonitor

## On-line Partial Discharge Monitoring on GIS Systems



## Operation and Maintenance

Rev. e1.00



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## I General

### I.1 About this Manual

This manual describes the operation and maintenance of the Partial Discharge Monitoring System (PDMS) type GISmonitor. Software updates are available through Power Diagnostix's web site ([www.pdix.com](http://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.

### I.2 Instrument Safety

This manual is intended for technically qualified personnel who has corresponding knowledge in the field of measurement, electrical installations and related technology.

The precise information about all safety notes contained in this manual and warnings as well as its perfect technical conversion are precondition for safe operation and maintenance Power Diagnostix products. For this purpose, it is necessary that all works are carried out by qualified personnel.

For the reason of clarity, this manual can not represent all details for the handling of Power Diagnostix instruments or all conceivable situations that might occur. If you wish further information or assistance for special problems that are not or not extensive enough represented in this manual, please request these information by contacting Power Diagnostix directly.

Before using the GISmonitor, read the following safety information and this manual carefully. Especially read and obey the information, which are 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:

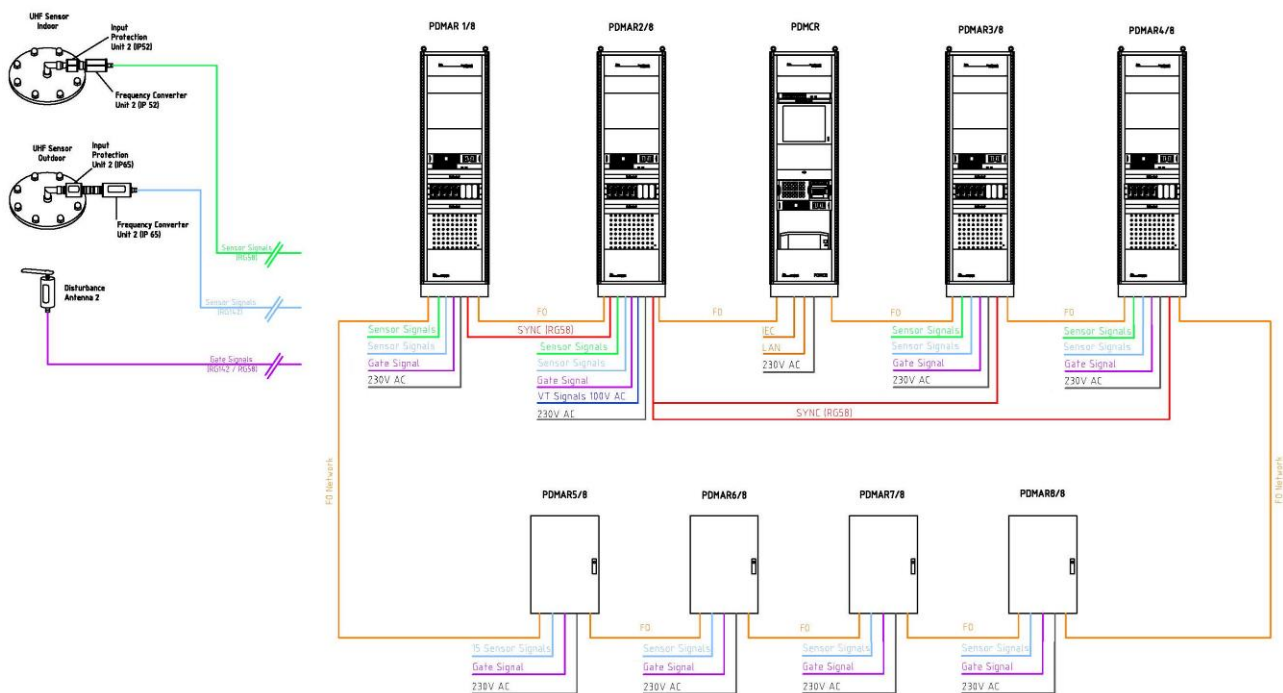
- Always provide solid grounding of the cabinets. Never operate the instrument without protective grounding.
- Avoid working alone.
- Do not allow the instrument to be used if it is damage, or its safety is impaired.
- Do not use the instrument in explosion endangered environment.

## II Introduction

### II.1 Overview

The main task of the Partial Discharge Monitoring System (PDMS), type *GISmonitor*, of Power Diagnostix is to detect internal partial discharge in the 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 SF<sub>6</sub> gas, partial discharge activity in gas insulated switchgear covers a bandwidth of well beyond 2 GHz. The mechanical properties of the components of 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 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 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 (*GISmonitor*). 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:



This overview shows an example of a full 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 fiber 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 (*GISmonitor*), each scanning up to eight sensors.

In combination with the monitoring software installed on the Industrial PC, the trending data of peak values (Qp) and normalized quantities (averaged) values (NQS) 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.

## II.2 Signal Flow

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

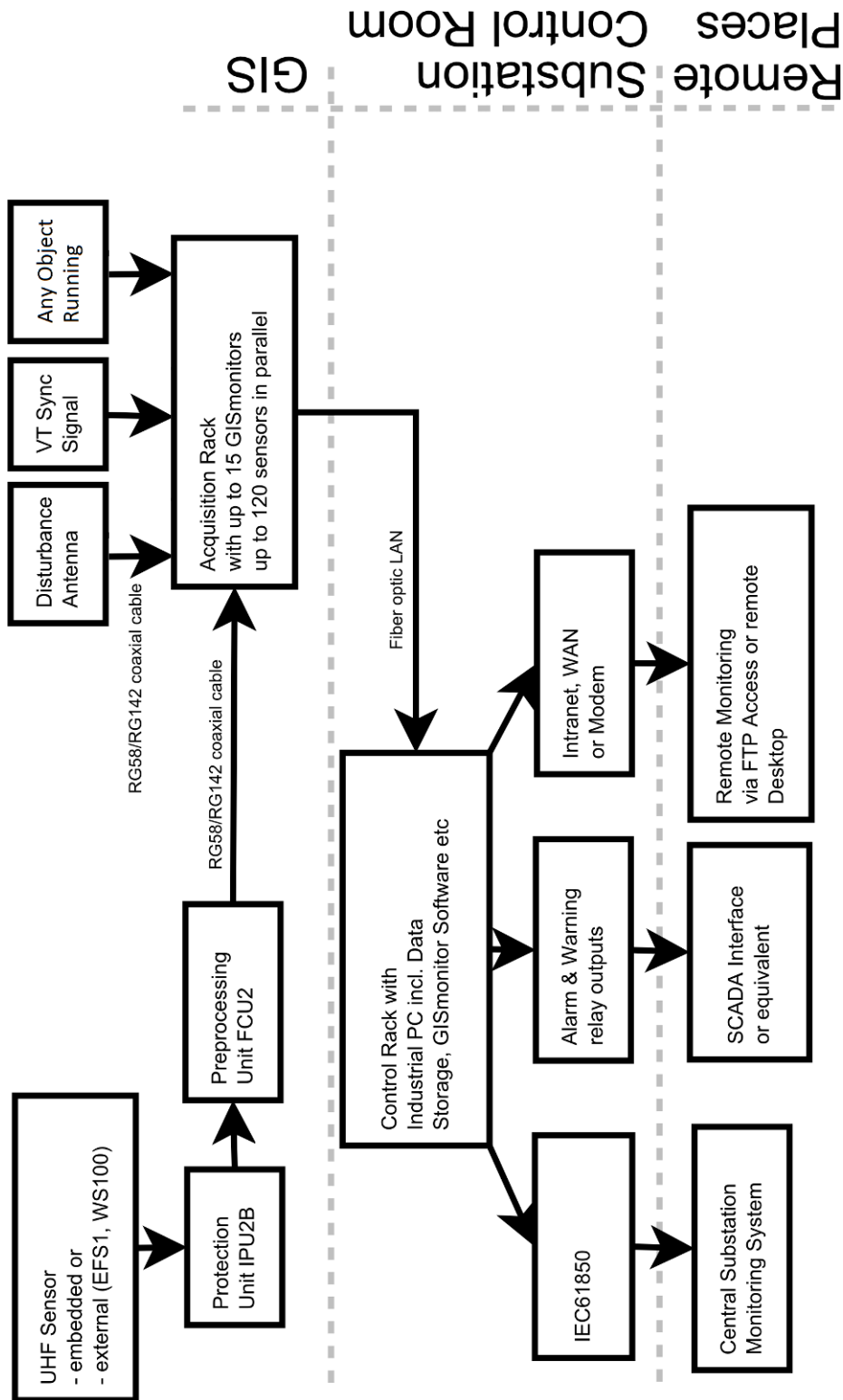


Figure II. 1: Signal flow

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 overvoltage.



Figure II.2: IPU2B

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



Figure II.3: FCU2

The transformed signal is transmitted by use of 50 Ohm coaxial cable (RG58 for indoor use, RG142 for outdoor use) and digitized by the GISmonitor 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 traveling along the shielding of the cable.

To provide noise suppression, the plug-in board uses a gate input. This input is connected to a Disturbance Combiner Unit (DCU3), 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 II.4: Disturbance Combiner Unit (DCU3)

An external synchronization signal is used to guarantee a phase-stable pattern at any time. To do so, the Sync Switching Box (SSB1), selects one of up to four valid signals and transmits them to the GISmonitor plug-in board. In case of no synchronization, the system uses a line-sync as a fallback. The phase shift between the line signal and the first phase can be set up in the software.



## III Maintenance

### III.1 Hardware Maintenance

#### III.1.1 PDM Control Rack

- Check UPS battery regularly and change every two years.
  - **Warning! Please refer to the manual of the UPS for further safety instructions!**
- Check operation of all fans and coolers regularly.
  - To check the functionality of fans for indoor cabinets, the temperature of the thermostat located in each cabinet needs to be adjusted to the minimal adjustable temperature. The thermostat is usually located in the top left and can be adjusted by turning the dial.
- Check overvoltage protection regularly.
  - The overvoltage protection is located on the hatrail in the bottom front of the cabinet. The indicator in the front is green in case the device is healthy. A different color is indicating that the device needs to be replaced. The pluggable overvoltage protection can be pulled of the base element. A new protection can be plugged in.

#### III.1.2 PDM Acquisition Racks

- Check UPS battery regularly and change every two years.
  - **Warning! Please refer to the manual of the UPS for further safety instructions!**
- Check operation of all fans and coolers regularly.
  - To check the functionality of fans for indoor cabinets, the temperature of the thermostat located in each cabinet needs to be adjusted to the minimal adjustable temperature. The thermostat is usually located in the top left and can be adjusted by turning the dial.
  - To check the functionality of the peltier elements in outdoor cabinets, the temperature of the thermostat located on the upper hatrail needs to be adjusted to the minimal adjustable temperature by using the upper adjustment wheel.
- Check overvoltage protection regularly.
  - The overvoltage protection is located on the hatrail in the bottom front of the cabinet. The indicator in the front is green in case the device is healthy. A different color is indicating that the device needs to be replaced. The pluggable overvoltage protection can be pulled of the base element. A new protection can be plugged in.

## III.2 Software Maintenance

### Warning

Please be aware, that the GISmonitor PDMS is designed to provide continuous on-line monitoring of a GIS and is forwarding alarm situations to the Substation Automation System (SAS). In the process of any software maintenance, the PDMS might indicate alarms, warnings or failures. It is therefore suggested to inform the personal of the substation about your work and possible temporary effects.

### III.2.1 Updates of the GISmonitor control software

Software updates for the GISmonitor control software are available through Power Diagnostix's web site ([www.pdix.com](http://www.pdix.com)). The access to the download area of the web site is password protected and requires a registration.

- 1) Install the newest GISmonitor control software by double clicking the *setup.exe*.
- 2) Open the ICMserver application by clicking on the PDIX symbol in the taskbar on the bottom right next to the clock.
- 3) Detach the old GISmonitor control software version by left clicking on it in the *Software Watchdog* tap an then selecting *Detach Process*.
- 4) Close the currently running software version by selecting File\Exit
- 5) Start the newly installed software by double clicking the desktop shortcut.
- 6) Activate the watchdog functionality for the new selecting the *gismon.exe* from the installation directory. The standard directory is:  
C:\pdix\Software\GISmonitor\GISmonitor.XXX\gismonnoiec.exe  
and by clicking Attach Process.

### III.2.2 Updates of Windows operating system

Frequent updates of the Windows based operation system are recommended to prevent unwanted failures of the operating system. Commonly known update processes are applicable.

### III.2.3 Updates of Antivirus programs

Frequent updates of the antivirus program are recommended to prevent unwanted failures of the operating system.

### III.2.4 Check of the Redundant Array of Independent Disks (RAID)

The IPC is equipped with a *Redundant Array of Independent Disks (RAID)*.

In case of one faulty HDD, the PDMS will stay fully functional. The status of the RAID is control by the *Intel Rapid Storage Technology* software installed on the IPC. Information about the condition of the RAID can be found in the status tap of the software. A faulty HDD can be replaced during operation of the IPC by following these steps:

- 1) Open the front cover of the IPC.
- 2) Pull out the faulty HDD by pulling the handle on the front.
- 3) Plug in a new HDD.
- 4) Click on *Repair Raid* in the *Intel Rapid Storage Technology* software installed on the IPC. Please note that the process of repairing the raid can take several hours and the operation system might react slower during this time period.

## IV Trouble Shooting Guide

The following table shall give possible solutions for problems that might occur during operation of the PDMS.

<p>Connection to module PDMARX-YY not establish</p> <p>Connection to module PDMARX-YY lost</p>	<p>Make sure the cabinet is powered up. Make sure the plug-in board is powered up.</p> <p>Make sure cabling is properly connected. Plug-in board is indicating correct initialization by green LED. Reset alarm in GISmonitor control software</p>
<p>MCB tripped</p>	<p>Check cabinet for damages or indication of problems Reactivate the MCB Reset alarm in GISmonitor control software</p>
<p>MCB constantly trips</p>	<p>Bridge out UPS (backside of cabinet) Measure insulation resistance of cabinet power supply Disconnect components from terminals until insulation resistance is in acceptable magnitude Report affected component to Power Diagnostix If possible (depending on component): Reset alarm in GISmonitor control software</p>
<p>Ring Network opened</p>	<p>A connection of the fiber optic ring connecting all cabinets has been opened. Check if all cabinets are powered up. Check the switches on the hat rail the cabinets to identify the opened connection (port 7 and 8 must be indicated with green LED). Check FO cabling between affected switches Repair FO cable Check the system for normal operation Reset alarm in GISmonitor control software</p>
<p>Lightning Protection triggered</p>	<p>The overvoltage protection in stated cabinet has been triggered and needs to be replaced. Check concerned cabinet for damage and adequate function. Unplug OV protection module. Plug in new module. Reset alarm in GISmonitor control software</p>
<p>Message "UPS on Battery"</p>	<p>UPS is operating on battery (power supply missing) Check if MCB is tripped Measure power supply Check all cables for connection Reset alarm in GISmonitor control software</p>

UPS not working	Check backside of UPS for thermal fuse Reset thermal fuse by pushing in the red button Test if system works normal Reset alarm in GISmonitor control software
Message "Replace Battery"	This message indicates that a UPS battery has to be replaced. Please contact the UPS manufacturer or Power Diagnostix for a new battery and follow the manufacturer battery replacement instructions.