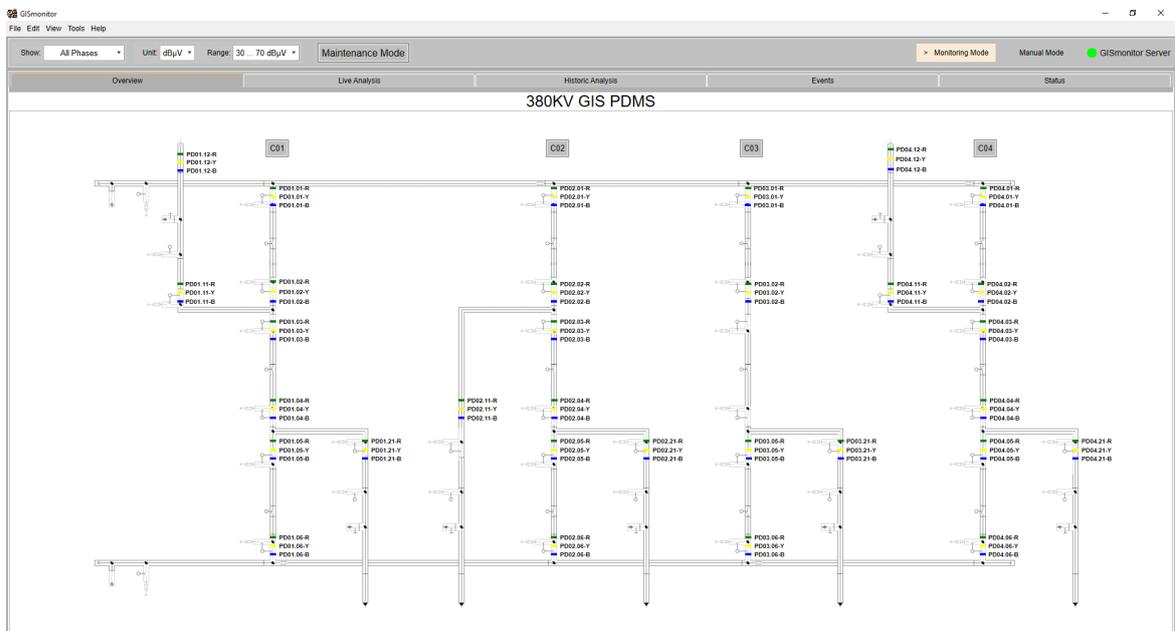


GISmonitor

Partial Discharge Monitoring on Gas Insulated Switchgear



Software Manual

Rev. 4.01

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I Introduction

The *GISmonitor* software visualises the current readings of the partial discharge sensors of a gas insulated switchgear (GIS) and indicates PD events or system notifications. The main panel of the software shows a layout of the GIS with the position of the individual sensors. Each sensor is linked with a specific input channel of a *GISmonitor* data acquisition board. The *GISmonitor* collects and stores the data of each connected sensor. This data is collected and analysed by the *GISmonitorServer* software and presented to the user in a variety of different visualisations in the *GISmonitor* viewer software. The software can operate in three modes. The default is the monitoring mode, in which trending data and system data are collected and stored in a database. Events will be created depending on pre-configured thresholds and several types of events are being logged. The manual mode is used for in-depth live visualisation and manual analysis of the current measurement data. Storing of the automated trending data and event creation is stopped as long as the manual mode is active. The maintenance mode stops the automated creation of events as well as the recording of measurement data during maintenance or rectification works.

II Monitoring mode

In the upper left-hand corner is a context sensual quick settings toolbar. The software is capable of monitoring multiple GIS in one site. If multiple GIS are monitored, a selector to switch between the different voltages is shown on the left-hand side. Switching between the assets will change the currently displayed gas diagram and all context sensitive elements, e.g., settings for this specific GIS. When only one GIS is monitored, the selector will not be visible. Other settings that can be changed are the unit (dBµV or dBm) that the software will display or the displayed range of visualised measurement data.

II.1 Overview

The GISmonitor software starts in the *Overview* tab. The sensors are visualised by coloured horizontal and vertical bars as shown in the figure below:

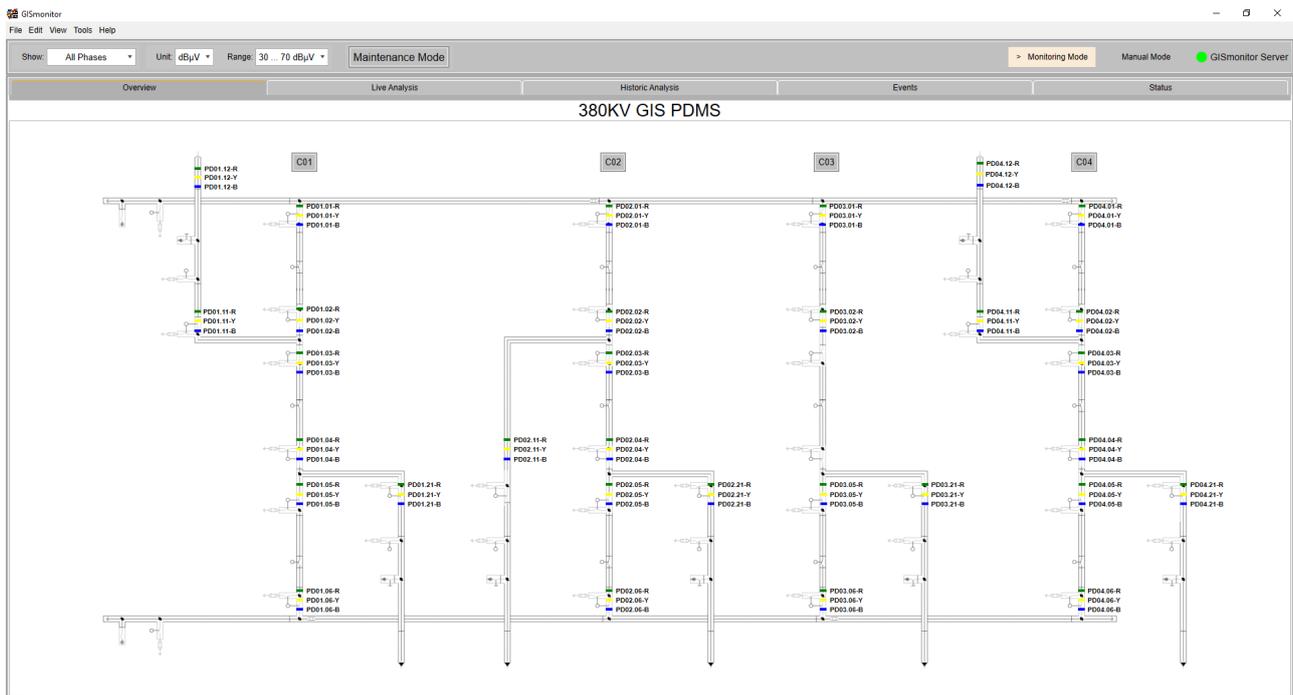


Figure II.1: Overview diagram

The schematic of the GIS is a drawing file, which is automatically loaded by the software, whereas the sensors can be individually positioned in the software. Sensors can be created, positioned, and removed with the *View -> Edit Mode* menu item. The configuration of the schematic and sensors is provided by Power Diagnostix during the initial system configuration.

The sensor colours can be changed in the *Edit -> Color Settings* menu. Default settings are green, yellow, and blue for appropriately working sensors of different phases. Black or grey sensors indicate false initiation or no connection to the related GISmonitor. In case the connection between the GISmonitor and a frequency converter unit (FCU) is lost, a flashing orange frame will appear around the associated bar. In case of a low-level PD warning, the sensors colour will turn to orange, in case of a high-level PD warning to red.

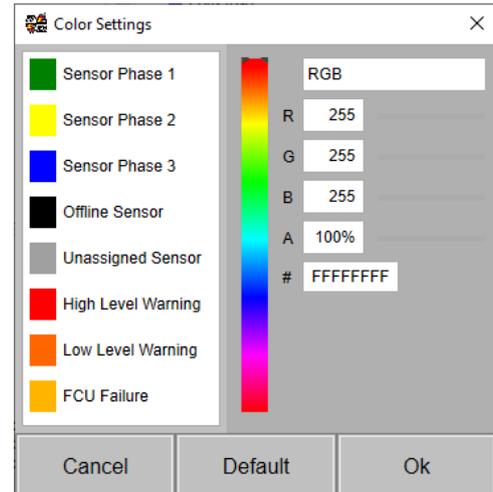


Figure II.2: Colour settings

Double-clicking on a sensor displays a window showing the previous trending data and the current measurement values of this sensor. If all three sensors of a phase are combined, the software will display all three sensors in this window.

On the upper left-hand side, the name and the associated rack of the sensor is displayed. The last average value and last pulse peak value of the sensor are shown as well as the configured event thresholds. On the upper right-hand side an accumulated pattern is displayed. The graph beneath shows the average and pulse peak trending values for the last six minutes. If *history* is selected in the *Show Trending* dropdown list, the data of the last month can be viewed. To get more detailed information about the sensor, the analysis panel can be opened by clicking the *Analysis* button. The analysis panel provides the complete trending data and allows the comparison between different sensors (see also section 0).

Press the *Print* button to either print the current panel or to save it as a file on the IPC.

Press the *Copy* button to copy the content of the window to the clipboard.

Pressing the *>>* button enlarges the window and displays a larger pattern.

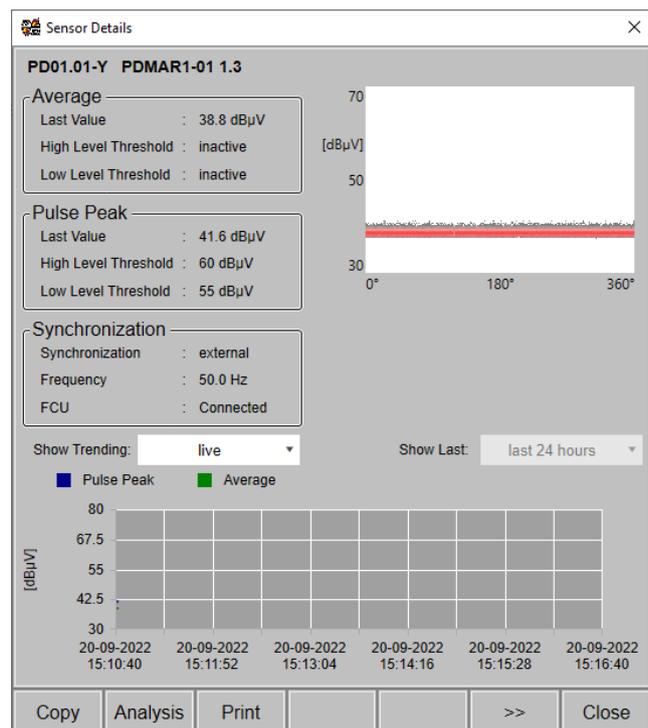


Figure II.3: Sensor details

II.2 Live analysis

Up to 15 sensors can be selected in the overview tab and viewed simultaneously by clicking on the *Live Analysis* tab. The upper part of the panel shows a trending graph that depicts the average and pulse peak values of all selected sensors. In the lower part the patterns for the selected sensors are shown.

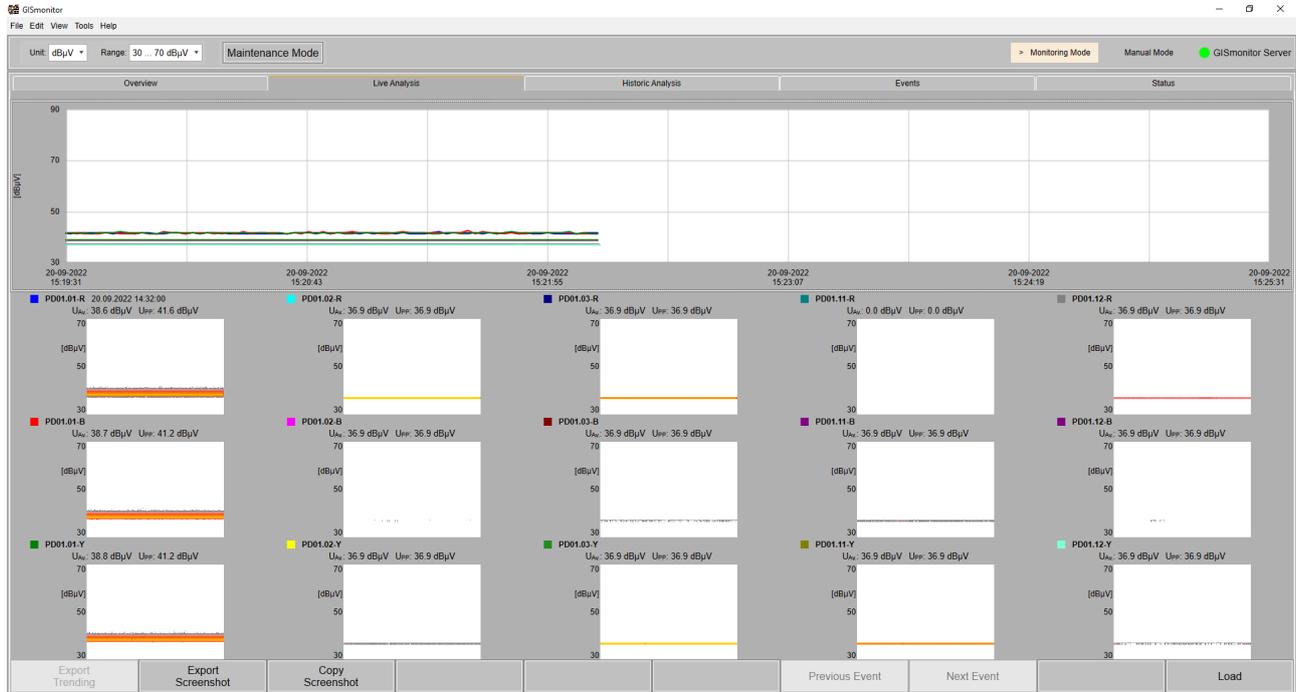


Figure II.4: Panel for live analysis

II.3 Historic analysis

For a detailed analysis of the trending data, please select the *Historic Analysis* tab. Up to 15 sensors can be selected in the overview.

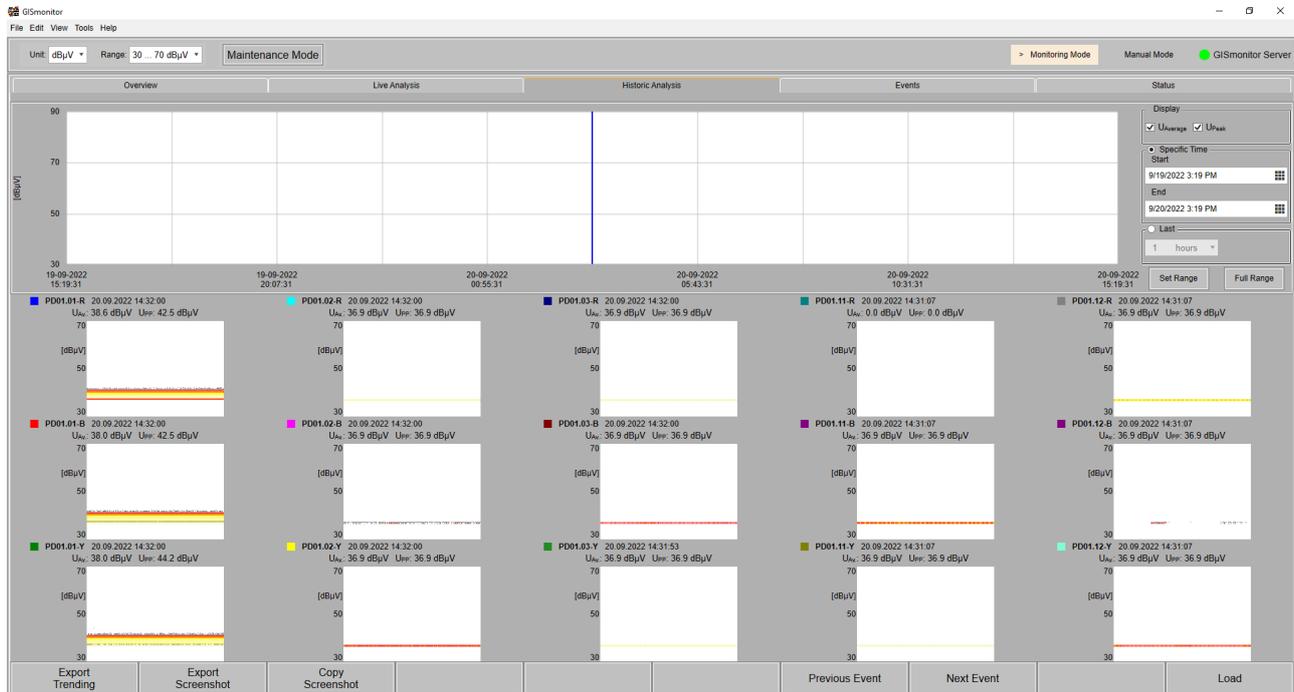


Figure II.5: Panel for the historic analysis

The upper part of the panel shows the trending graphs for the average and pulse peak value, and the lower part shows the patterns of the selected sensors for the selected cursor position. Moving the cursor of the graphs will show the values at the new cursor position and will display the pattern next to this time.

Zooming and shifting of the graph in x-direction is done by selecting either the specific time or selecting the pre-defined interval and pressing the *Set Range* button. The *Full Range* button sets the zoom of the graph to a level, that the full range of the selected interval is shown.

By pressing the *Export Trending* button, the measurement data can be saved as an *.xlsx file.

The *Copy Screenshot* button will copy the content of the window to the clipboard. *Export Screenshot* will save the content of the window as a *.jpg file.

II.4 Alert and warning events list

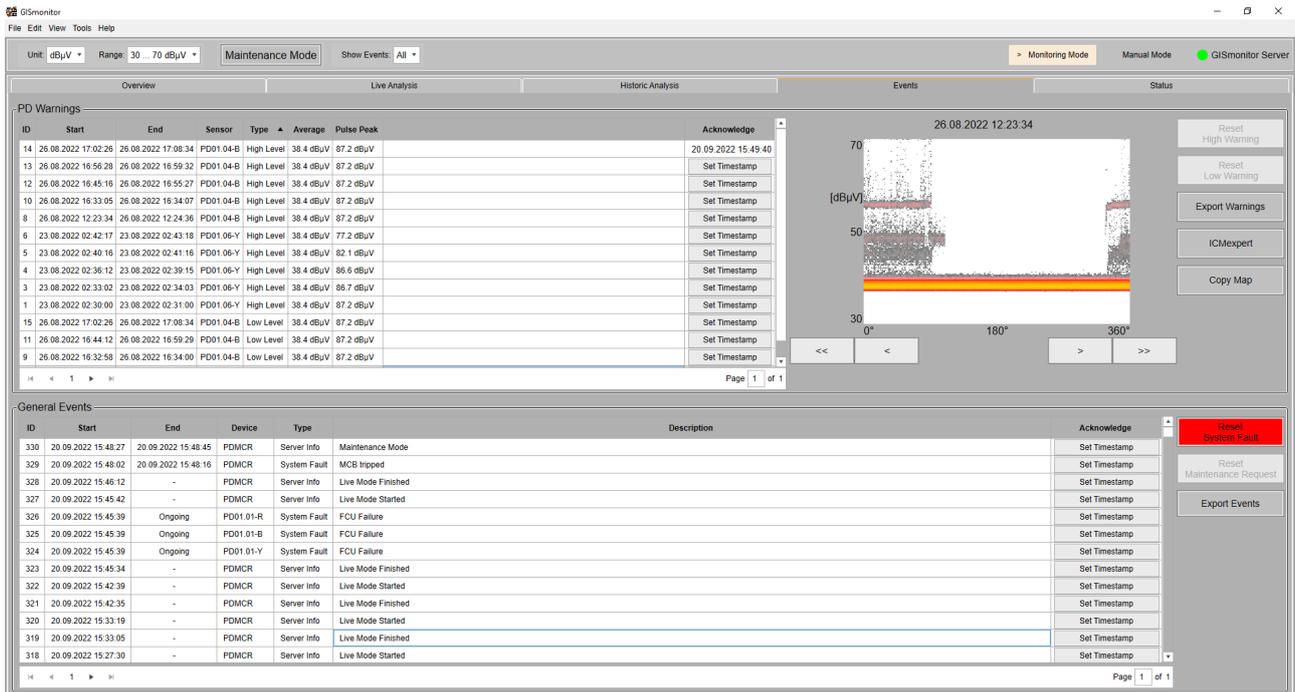


Figure II.6: Events list

All alerts and warnings are stored and can be displayed in the events list, which can be accessed via the *Events* tab in the tab menu of the GISmonitor application. The *PD Warnings* list on the upper left-hand side displays the high-level and low-level warnings of all sensors. By clicking on a specific event, the corresponding coloured pattern is shown on the upper right-hand side. High-level and low-level warnings are triggered independently, relying on the respective alert threshold. Events are grouped and can contain several smaller events, depending on how long the threshold was surpassed. Each event of the group can be inspected separately by pressing the < or > button. Pressing the << button will select the first event of the group, while pressing the >> button will select the last event. The *General Events* list at the bottom displays all maintenance and hardware events. Each event is tagged with a timestamp and provides information about the location, the type of error, and a short description. To acknowledge an event, you can click the *Set Timestamp* button, which will tag the event with date and time of acknowledgement.

Sensor high-level and low-level events as well as maintenance and hardware alerts can be reset by using the *Reset* buttons next to the respective list.

The event lists can be exported as .xlsx files by clicking the *Export Warnings* or *Export Events* button. The list shows the alarm and warning events sorted by the time they occurred. The list also shows if the alarm has triggered the relays of the I/O card (SCADA alarm).

II.5 Status overview

The GISmonitor software is providing a status overview of the whole monitoring system in the *Status* tab. The coloured overview indicates, among others, the status of the lightning protection, the heating, the network ring, the ventilation, and the uninterruptible power supply (USP) for every acquisition rack (PDMAR).

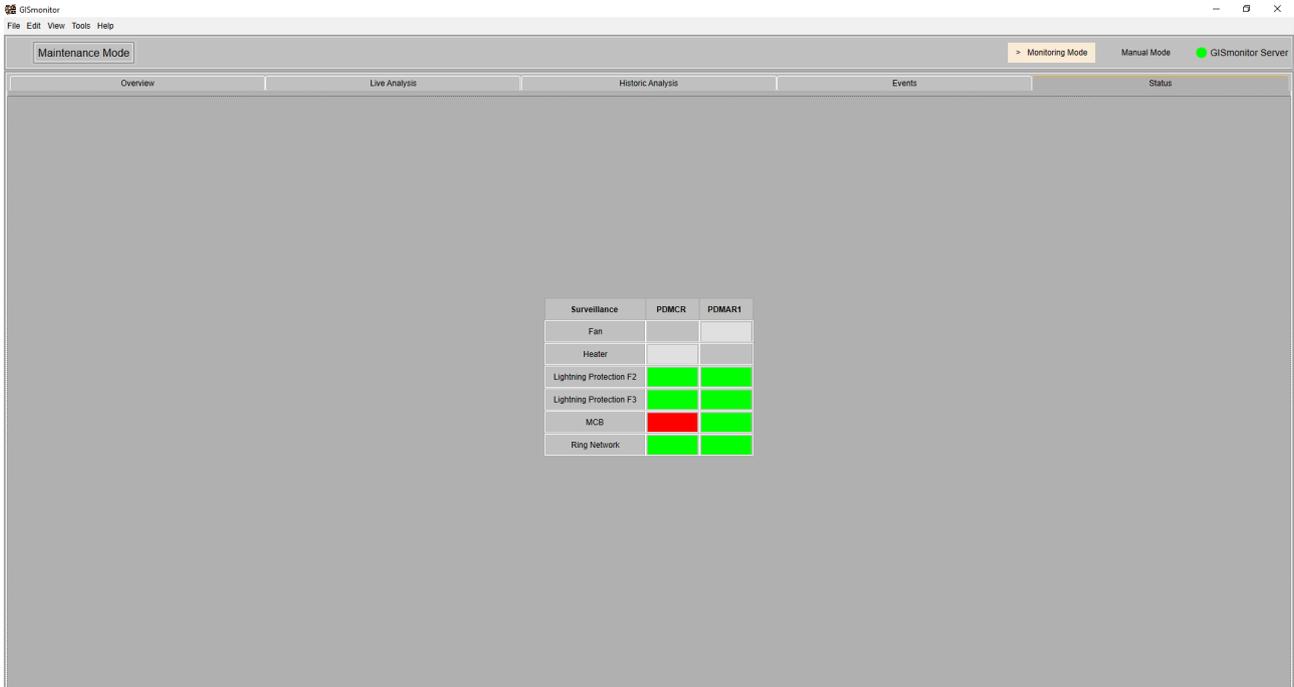


Figure II.7: Status overview

A green coloured box indicates the device is in operation, while dark grey signifies that the device is not in operation. If the device is not available in the rack, the overview will show a light grey box, whereas white signifies that there's connection to the device.

II.6 Configuration of the monitor mode

Power Diagnostix provides the GISmonitor software completely set up and individually configured for your on-line partial discharge monitoring system (PDMS), so, generally, there is no need to change the following options.

Please be aware that changing the set-up might corrupt the software functionality by worsen the detection and identification of partial discharges or preventing alarm and warning outputs.

Some changes will lead to a temporary disconnection between the control rack (PDMCR) and the acquisition rack (PDMAR). No data will be recorded during this timeframe.

II.6.1 General settings

The *General Settings* menu can be opened via *Edit* -> *General Settings*. The input field *Setup* allows the configuration of the settings regarding the presentation of PD patterns. For instance, the lower level of detection (LLD) can be set individually depending on the level of the background noise. The constant phase shift of the displayed patterns referring to the synchronisation voltage can be defined for each phase.

In the centre of the dialogue box the synchronisation and gating settings for each PDMAR can be adjusted. The synchronisation can be switched between line and external synchronisation.

In case a disturbance antenna (DA2) is used, external gating can be enabled, and a threshold can be defined. This will provide suppression of noise created by cell phones, corona effects, and similar.

At the bottom of the dialogue box the settings for the trending data analysis can be adjusted. The acquisition interval of trending can be selected. Depending on the settings for saving trending data and patterns to the hard disk, the estimated memory requirements are calculated, and the time till depletion of disk space is given.

Name	Sync	Shift to Sync Phase	Ext.Gating	Threshold
PDMAR1	External	0 °	Off	50.2 %

Estimated memory requirements			
per Month	per year	free disk space	disk full in
1.2 GB	15.2 GB	1714.0 GB	112 Years 357 Da

Figure II.8: General settings window

II.6.2 Device settings

The settings for the connection between the *GISmonitor* software, the *GISmonitor* plug-in boards, and the UHF sensors can be adjusted in the *Device Settings* dialogue box. This dialogue box is opened by selecting the *Edit -> Device Settings* menu item.

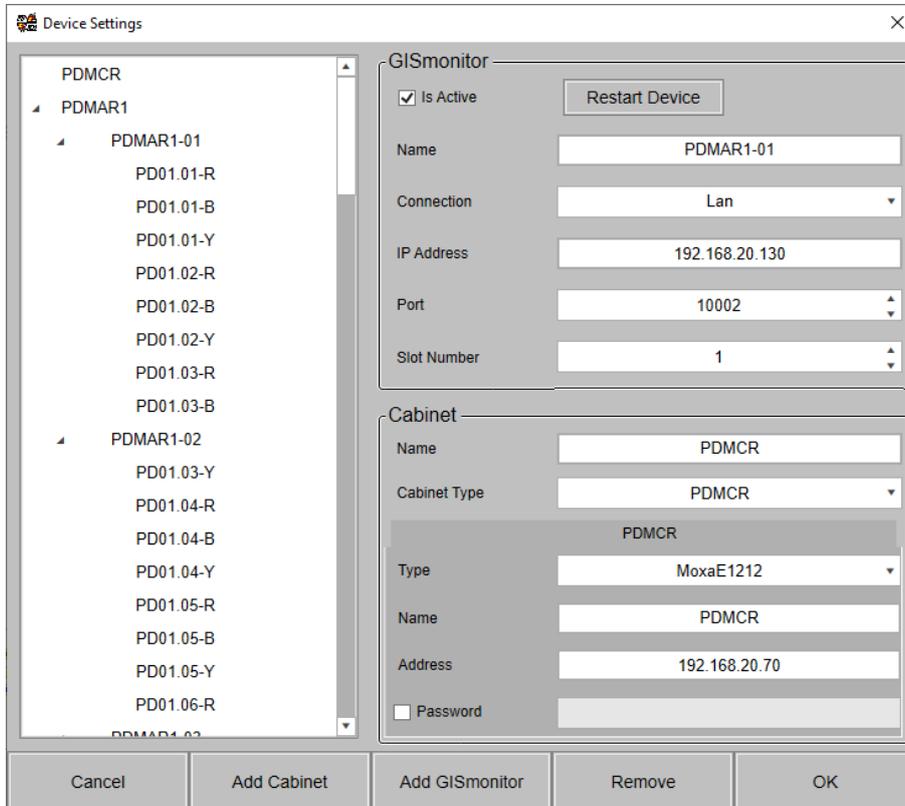


Figure II.9: Device settings

General settings can be modified in the upper part of the right-hand side. To define a new *GISmonitor*, the correct cabinet has to be selected in the list on the left-hand side, and afterwards the *Add GISmonitor* button must be pressed. This creates a new entry in the tree on the left-hand side. Enter the settings for this new *GISmonitor* in the fields on the right-hand side. First the name of this *GISmonitor* must be assigned. Then the type of connection to this *GISmonitor* must be chosen, *USB* or *LAN*. The default setting is *LAN*, and the default port for the *GISmonitor* is 10002. The *IP address* must be selected according to the setting of the corresponding *GISmonitor*. Newer revisions of the *GISmonitor* can be restarted by the software by clicking on the *Restart Device* button at the top of the settings, otherwise the button is disabled.

If the partial discharge monitoring system (PDMS) should be extended with an additional acquisition rack, the *Add Cabinet* button must be pressed, and the cabinet type must be chosen. Afterwards a proper cabinet name must be given. Then all *GISmonitors* must be added to this selected cabinet.

II.6.3 Project settings

The main panel of the software displays a schematic of the GIS. The drawing file and the headline for the schematic can be selected by *Edit -> Project Settings*.

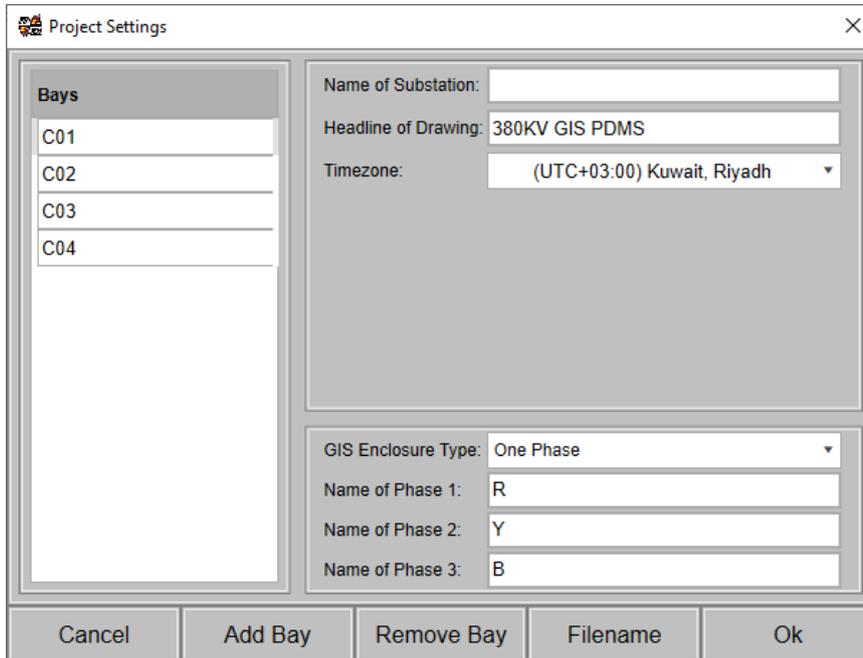


Figure II.10: Project settings

The name of each bay can be changed on the left-hand side of the *Project Settings* dialogue box. On the right-hand side a user-defined name of the substation and a headline for the drawing can be set. The headline will appear above the schematic in the main panel. The file with the schematic of the GIS must be of WMF or SVG format. By clicking the *Filename* button, the file can be selected, and the *Preview* field displays the selected file. The GIS enclosure type can be set up as single- or three-phase enclosure. Press the *OK* button to load the selected file and display it in the main panel.

II.6.4 Alert settings

The alarm settings can be configured by selecting the *Edit -> Alert Settings* menu item. The dialogue box that appears is shown in the figure below.

The screenshot shows the 'Alert Settings' dialog box for 'Group 1 (Default)'. It is organized into four main sections:

- High Level Warning:** Includes checkboxes for 'Activate Upavg Threshold' (unchecked, 55 dB μ V) and 'Activate Upp Threshold' (checked, 60.00 dB μ V). Other parameters include Minimal Detection Level (55.00 dB μ V), Minimal CR^{pd} (5 / s), Pattern Acquisition Time (60 s), Consecutive Patterns (1), and 'In case of a warning' options (Save Pattern every 2 minutes, For 30 minutes, or Until acknowledged).
- Low Level Warning:** Includes checkboxes for 'Activate Upavg Threshold' (unchecked, 50 dB μ V) and 'Activate Upp Threshold' (checked, 55.00 dB μ V). Other parameters include Minimal Detection Level (50.00 dB μ V), Minimal CR^{pd} (5 / s), Pattern Acquisition Time (60 s), Consecutive Patterns (1), and 'In case of a warning' options (Save Pattern every 2 minutes, For 30 minutes, or Until acknowledged).
- Auto Reset:** Checkboxes for High Level Warning, Low Level Warning, Maintenance Request, System Fault, and Battery Replacement.
- Disable Manual Reset Of Ongoing Fault:** Checkboxes for High Level Warning, Low Level Warning, Maintenance Request, System Fault, and Battery Replacement.

At the bottom, there is a 'Free Disk Space Warning Level' dropdown set to '10 GB' and a row of buttons: 'Cancel', 'Add Goup', 'Remove Goup', 'Define Goups', and 'OK'.

Figure II.11: Alert settings

The average and pulse peak values that trigger a low-level or high-level alert can be set individually. By surpassing this level, the measurement data will be evaluated using the respective detection level. The minimal count rate defines the number of pulses above the required detection level in a specified acquisition time to trigger an alert / warning event.

These alert settings can be defined for up to 16 groups in which the sensors can be included. Click on *Add Group* to create a new group. Pressing *Remove Group* will delete the currently selected group. Please note: Group 1 (default) can't be deleted. To assign a sensor to another group, press the *Define Groups* button and then click on the sensor's group entry to move the sensor to the desired group.

Bays	Sensor Name	Group
C04	PD04.12-Y	Group 1 (Default)
C04	PD04.12-R	Group 1 (Default)
C11	PD11.12-R	Group 1 (Default)
C11	PD11.12-B	Group 1 (Default)
C11	PD11.12-Y	Group 1 (Default)
C11	PD11.01-R	Group 1 (Default)
C11	PD11.01-Y	Group 1 (Default)
C11	PD11.01-B	Group 1 (Default)
C11	PD11.02-R	Group 1 (Default)
C11	PD11.02-Y	Group 1 (Default)
C11	PD11.02-B	Group 1 (Default)
C11	PD11.11-R	Group 1 (Default)
C11	PD11.11-Y	Group 1 (Default)
C11	PD11.11-B	Group 1 (Default)
C03	PD03.01-Y	Group 2

Figure II.12: Alarm group association

The default behaviour for automatic relay reset can be configured In the *Auto Reset* section, so that in case no respective event is active the relay will be automatically reset. In the *Disable Manual Reset of Ongoing Fault* section the manual reset of the relays can be blocked if an event is still ongoing.

A recommended configuration will be set up by Power Diagnostix during commissioning.

II.6.5 Rack settings

The online partial discharge monitoring system (PDMS) consists of the partial discharge measurement control rack (PDMCR) and a number of partial discharge measurement acquisition racks (PDMAR) or one rack for combined partial discharge measurement and control (PDMACR). To configure these racks, go to *Edit -> Rack Settings*.

Rack Settings ×

PDMCR				Indoor			
No.	Surveillance	Contact	Trigger	Direction	Std/Off Color	Alarm/On Color	Event Message [FAIL]
DI0	Lightning Protection F2	NO	MaintenanceRequest	Input	Green	Red	Lightning Protection F2 tripped
DI1	Lightning Protection F3	NO	MaintenanceRequest	Input	Green	Red	Lightning Protection F3 tripped
DI2	MCB	NO	SystemFault	Input	Green	Red	MCB tripped
DI3	Fan	NC	None	Input	Grey	Green	-
DI4	-	NC	None	Input	Grey	Grey	-
DI5	Ring Network	NO	MaintenanceRequest	Input	Green	Red	Ring Network opened
DI6	-	NC	None	Input	Grey	Grey	-
DI7	-	NC	None	Input	Grey	Grey	-
DIO0	High Level Warning	NC	HighLevelWarning	Output	Grey	Grey	-
DIO1	Low Level Warning	NC	LowLevelWarning	Output	Grey	Grey	-
DIO2	System Fault	NC	SystemFault	Output	Grey	Grey	-
DIO3	Maintenance Request	NC	MaintenanceRequest	Output	Grey	Grey	-
DIO4	-	NC	None	Output	Grey	Grey	-
DIO5	-	NC	None	Output	Grey	Grey	-
DIO6	-	NC	None	Output	Grey	Grey	-
DIO7	-	NC	None	Output	Grey	Grey	-

Figure II.13: Rack settings for a PDMCR

The tabbed view shows all groups of racks that exist within the PDMS. Depending on the configuration of the PDMS various groups can exist. Each surveillance task can be configured individually, including the respective output of the relay contacts. To test the correct configuration of the output channels, press the *Test Relays* button to open a window where the state of the relay can be toggled. All channels are pre-configured and should not be updated without need. These settings have influence on the overview of monitored components presented in the *Status* tab as well as on the events generated by the PDMS.

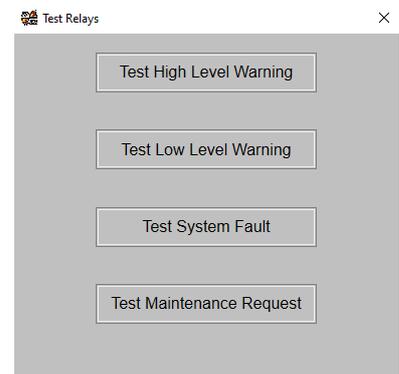


Figure II.14: Relay test window

Rack Settings

×

PDMCR				Indoor			
PDMAR1							
No.	Surveillance	Contact	Trigger	Direction	Std/Off Color	Alarm/On Color	Event Message [FAIL]
DI0	MCB	NO	SystemFault	Input	Green	Red	MCB tripped
DI1	Lightning Protection F2	NO	MaintenanceRequest	Input	Green	Red	Lightning Protection F2 tripped
DI2	Lightning Protection F3	NO	MaintenanceRequest	Input	Green	Red	Lightning Protection F3 tripped
DI3	Ring Network	NO	MaintenanceRequest	Input	Green	Red	Ring Network opened
DI4	Heater	NO	None	Input	Grey	Green	-
DI5	-	NC	None	Input	Green	Red	-
DI6	-	NC	None	Input	Green	Red	-
DI7	Switching Operation Relay	NC	SwitchingOperation	Input	Green	Red	-
DIO0	-	NC	None	Output	Grey	Grey	-
DIO1	-	NC	None	Output	Grey	Grey	-
DIO2	-	NC	None	Output	Grey	Grey	-
DIO3	-	NC	None	Output	Grey	Grey	-
DIO4	-	NC	None	Output	Grey	Grey	-
DIO5	-	NC	None	Output	Grey	Grey	-
DIO6	-	NC	None	Output	Grey	Grey	-
DIO7	-	NC	None	Output	Grey	Grey	-

Cancel
Test Relays
Add Group
Delete Group
Ok

Figure II.15: Rack settings for a PDMAR

II.6.6 IEC 61850 settings

If the IEC 61850 service is installed, the IEC 61850 interface can be enabled and configured in the GISmonitor software. The network settings of the interface can be modified here as well as the edition that the IEC 61850 server uses. The timestamp can be in the UTC format or the configured local time of the PDMCR. Modifying these settings will restart the IEC 61850 server if it is running.

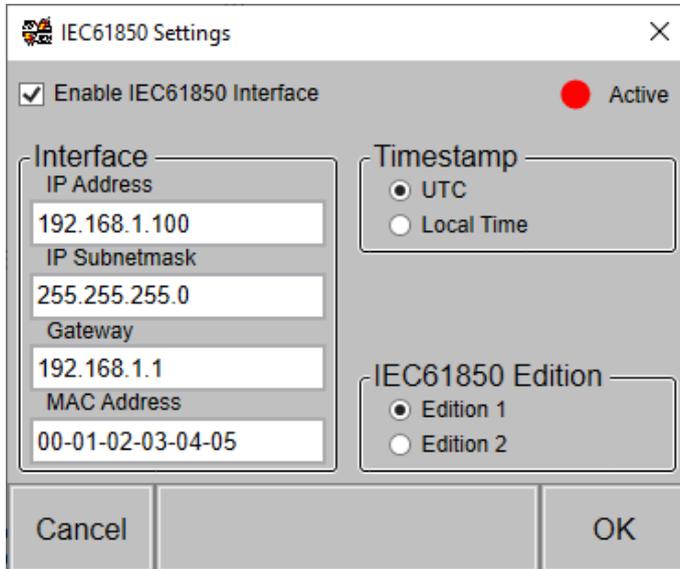


Figure II.16: IEC 61850 settings

To start and initialise the IEC 61850 server, a physical network link to another network interface is required, otherwise the server won't start.

II.6.7 Administrative settings

For maintenance purposes such as installing the software or Windows updates, it may be necessary to restart or close the GISmonitorServer software. This can only be done on the PDMCR by pressing the *Start* or *Stop* GISmonitorServer buttons. It will not work if the GISmonitor software is used on a remote computer. The manual shutdown of the GISmonitorServer will disable the watchdog, which restarts the software in case of a failure. It will automatically be enabled when the GISmonitorServer is started again or the PMCR gets restarted.

To ensure that only authorised people change the settings of the software, a password can be requested. To enable this option, press the *Enable Password* button. If you choose this option, you have to set an administrator password. This opens a dialogue box prompting for a password.

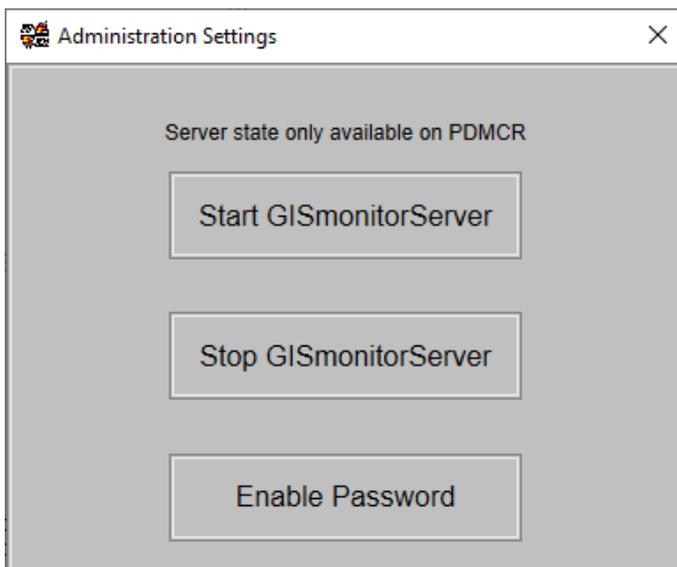


Figure II.17: Administration settings

If a password is enabled, it can be disabled by pressing the *Disable Password* button und entering the current administrator password.

If an administrator password is enabled, changes of settings must be verified with this password. It is also required to enable or disable the maintenance mode.

II.6.8 Preferences

The GISmonitorServer settings can be modified in the preferences window. The GISmonitor software can connect to a remote GISmonitorServer software running on a PDMCR and control it. The PDMCR usually offers three network interfaces that can be used to establish a remote connection to the GISmonitorServer. A dedicated network is used to communicate to the GISmonitor plugin boards. The PDMCR IPC has the IP address 192.168.20.2, which is the default address pre-configured when using the software. When using a remote connection, usually one of the two remaining interfaces is used. The customer LAN is pre-configured to use DHCP. If this interface is used, the assigned IP address has to be used. If a SCADA or an IEC 61850 network is used, the PDMCR usually has a static IP address assigned, which must be used.

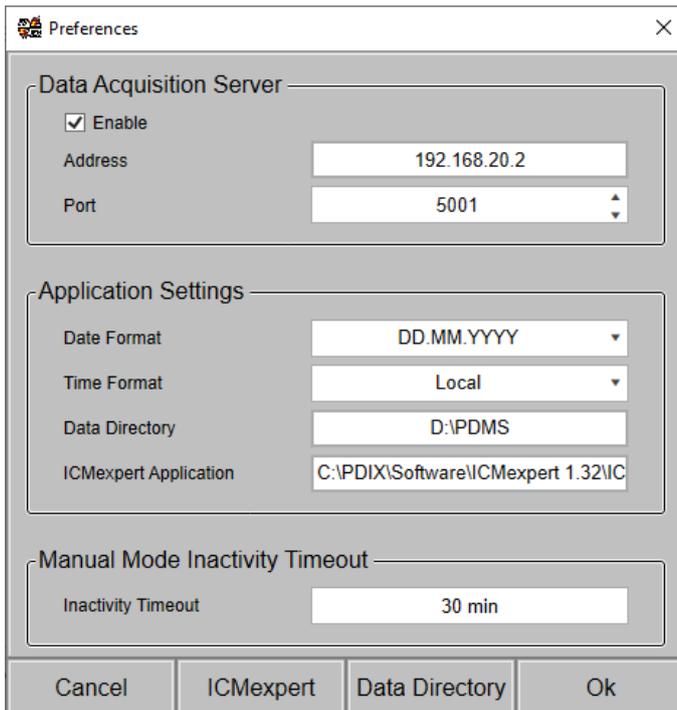


Figure II.18: Preferences window

The application settings can be modified to display the date or time format to the desired format.

The GISmonitor software requires a data directory which will be used to save files for HV tests or the sensitivity check, as well as temporary files for use with the ICMexpert software. The folder can be selected with the *Data Directory* button. If the ICMexpert functionality should be used, the ICMexpert application has to be installed on the computer, and the application has to be linked by selecting it with the ICMexpert button.

The GISmonitorServer usually monitors the GIS using the monitoring mode. If the manual mode is used, a timeout has to be defined, after which the GISmonitorServer automatically switches back to the monitoring mode. To do so, modify the inactivity timeout. If the manual mode is used for a HV test or sensitivity check, this timeout will be ignored. Please be aware that the use of the manual mode stops the continuous monitoring including the storing of data for the time that the manual mode is active.

II.7 Edit mode

The edit mode can be accessed by clicking on *View -> Edit* menu item. It allows changing the displayed elements in the single line diagram of the *Overview* tab and the sensor association of the GISmonitor plugin boards.

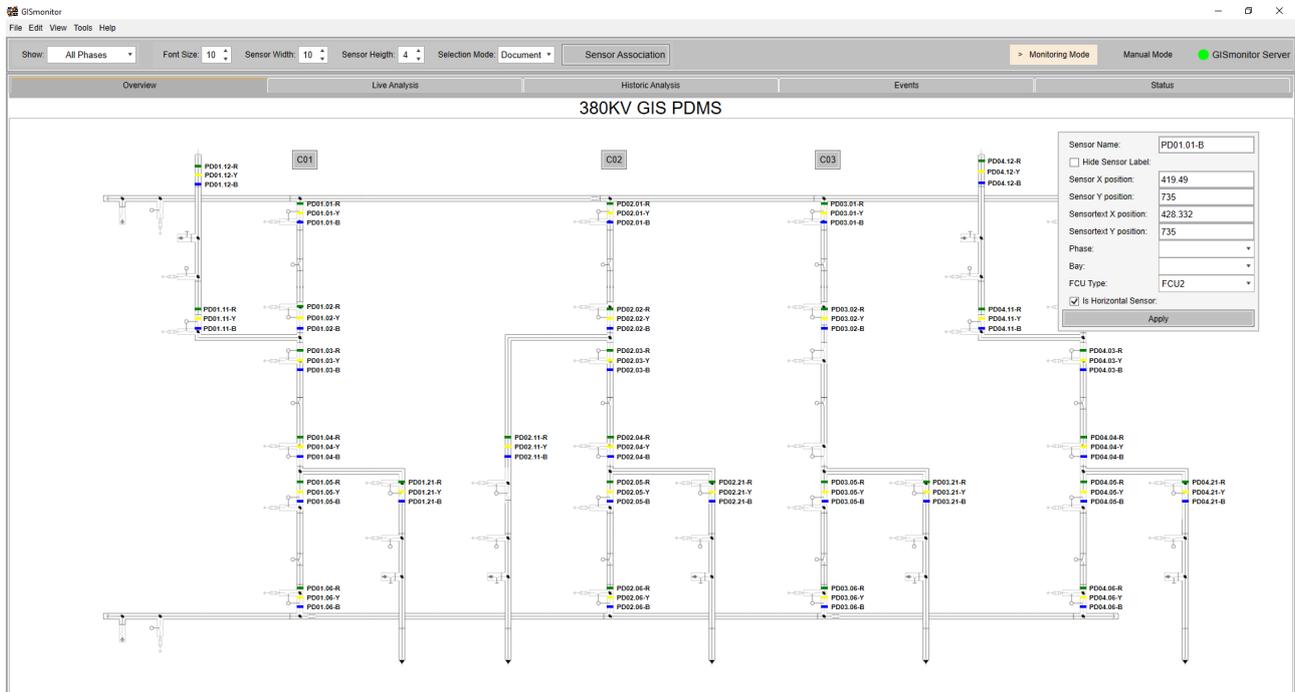


Figure II.19: Edit mode

The menu bar offers options for changing the font size as well as the width and height of the sensors.



Figure II.20: Menu bar of the edit mode

To edit the attributes of a displayed element, select the element type in the menu bar's *Selection Mode*.

The following options are available:

- **Multiple:** Allows the selection of multiple sensors and corresponding labels.
- **Sensor and Label:** Allows the selection of one sensor and a corresponding label by clicking on either the sensor or the label. The selected sensor and label can then be dragged to a new position.
- **Sensor:** Allows the selection of one sensor by clicking on either the sensor or its label. The selected sensor can then be dragged to a new position.
- **Label:** Allows the selection of one label by clicking on either the sensor or the label. The selected label can then be dragged to a new position.
- **Text:** Allows the selection of a text element such as a bay or diameter. The selected text can then be dragged to a new position.

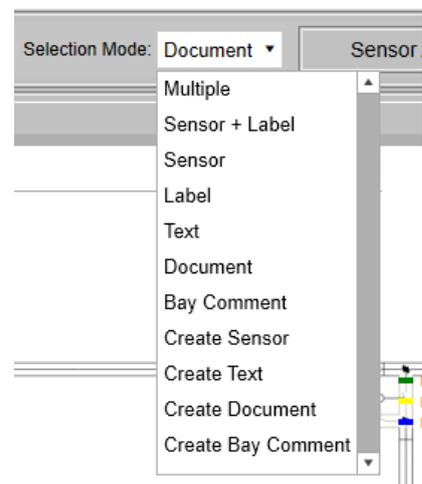
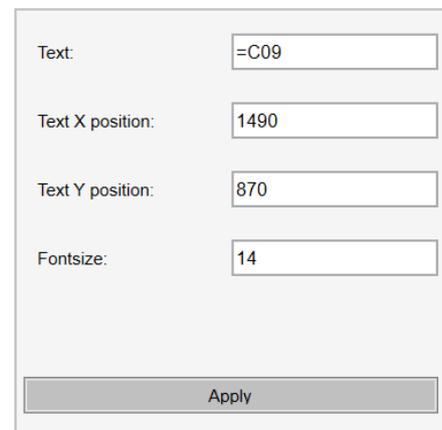


Figure II.21: Available selection modes

- Document: Allows the selection of a button element, which opens an attached document. The selected button can then be dragged to a new position.
- Bay Comment: Allows the selection of a button element, which opens a list which can be used to add comments like performed maintenance works with a timestamp or attach a file to it. The selected button can then be dragged to a new position.
- Create Sensor: By double clicking on a position within the single line diagram, an unassociated sensor is created. This sensor must be later assigned to a GISmonitor plugin board.
- Create Text: By double clicking on a position within the single line diagram, a text element is created.
- Create Document: By double clicking on a position within the single line diagram, a button element is created so that a document file can be linked to that button.
- Create Bay Comment: By double clicking on a position within the single line diagram, a button element is created so that a comment list can be linked to that button.

In edit mode the single line diagram shows an integrated pop-up window, which can be moved by dragging the window while the ctrl button is pressed.

With an element selected, options for this element can be edited in this window. Press *Apply* to permanently change and save the edited options.



Text:	<input type="text" value="=C09"/>
Text X position:	<input type="text" value="1490"/>
Text Y position:	<input type="text" value="870"/>
Fontsize:	<input type="text" value="14"/>

Figure II.22: Pop-up window for the change of element options

When the GIS is extended with new sensors or GISmonitor plugin boards, the newly created sensors must be assigned to the GISmonitor plugin board. By pressing the *Associate Sensors* button in the menu bar, a new window is opened, which shows a list of all GISmonitor plugin boards and all connected sensors on the left-hand side. The right-hand side presents a list of unassigned sensors. To assign a sensor to a GISmonitor plugin board's channel, select the correct plugin board's channel, which has no sensor assigned. Now select the sensor that is going to be assigned to this channel and click on the *Assign* button.

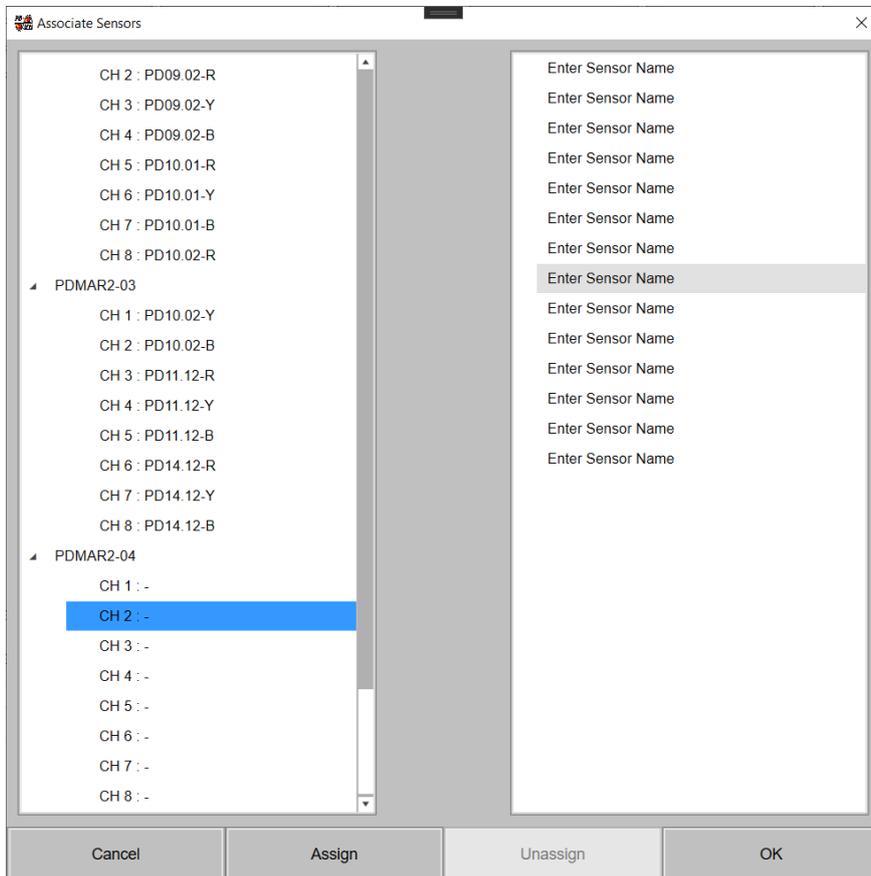


Figure II.23: Sensor assignment window

To unassign a sensor, proceed as follows: First select the plugin board's channel, then press the *Unassign* button. This will remove this assignment, and the sensor will appear in the list on the right-hand side.

The channel assignment is done during the factory acceptance test (FAT) and the commissioning of the PDMS. An incorrect change of the sensor associations will impact the overall performance of the system and can lead to false assumptions regarding events or failures of the site. It is highly recommended to only exchange sensors after consulting a Power Diagnostix professional.

III Manual mode

For commissioning purposes, the GISmonitor software offers a special commissioning display, which shows relevant data in three different modes: A view for normal operation, a view for HV tests, and a view to perform the sensitivity verification. The manual mode can be started by pressing the *Manual Mode* indicator at the top of the window.

III.1 Measurement

By selecting the measurement tab, up to 24 sensors show the scope and pattern displays of partial discharge activities versus phase position as black and white or coloured patterns. Additionally, for every sensor the recorded PD scope values of the last 50 periods can be shown as continuous 3D view or a larger phase-resolved partial discharge (PRPD) pattern by double clicking on a sensor.

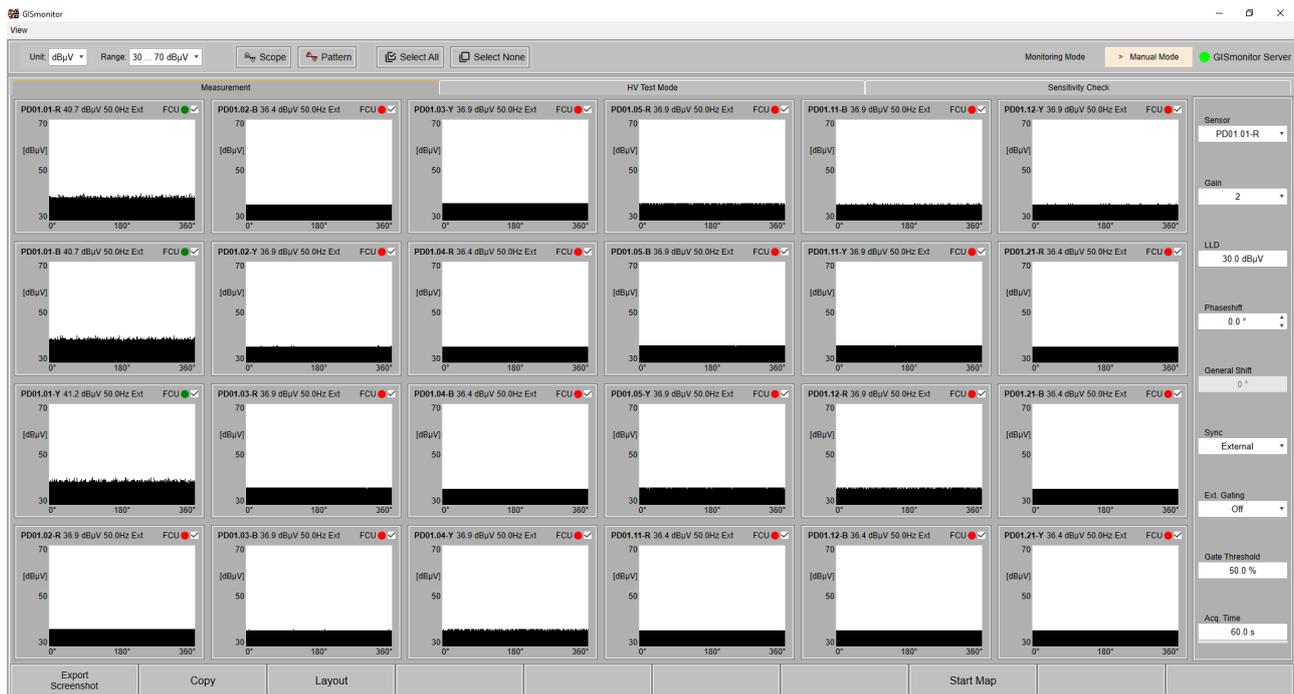


Figure III.1: Measurement tab of the commissioning panel

The sensors, whose data should be displayed in the commissioning panel, can be selected from the single line diagram in the monitoring mode or by pressing the *Layout* button of the commissioning panel. Depending on the screen resolution the settings of the currently selected sensor are shown beneath or next to the patterns.

The current view can be saved as PNG or BMP file to hard disk with the *Export Screenshot* button or can be copied to clipboard with the *Copy* button.

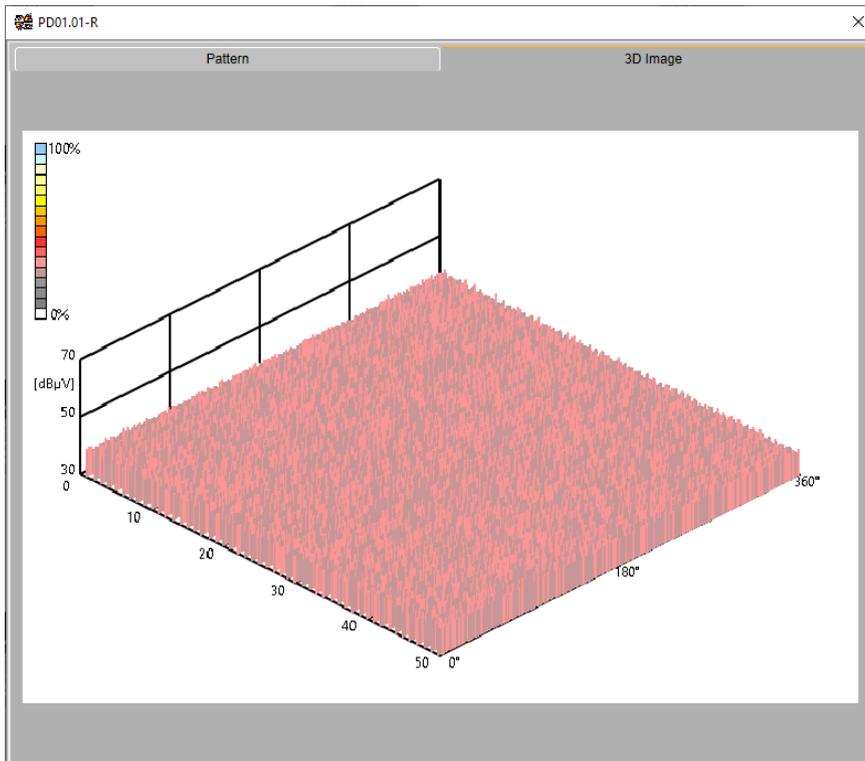


Figure III.2: 3D view of sensor data

III.2 HV Test

The HV test is performed on site before a GIS is finally energised. Different bays of the GIS are energised one after the other, and the UHF sensors located in these GIS sections are checked for PD signals originating from possible defects. This menu allows the operator to select the relevant sensors and record possible partial discharge signals as well as the profile of the applied voltage. This creates a playback that can serve as a fingerprint of the GIS and can be checked and viewed as many times as desired.

By selecting the *HV Test Mode* tab, a dedicated mode for HV testing purposes is opened. In the HV test mode the synchronisation is enforced to 'external', and the phase shift of each sensor is set to 0°. First the *Test Section* that is under testing has to be named. Afterwards, by pressing the *Start Recording* button, every scope image, every pattern image, and the measured voltage are stored for the duration of the recording.

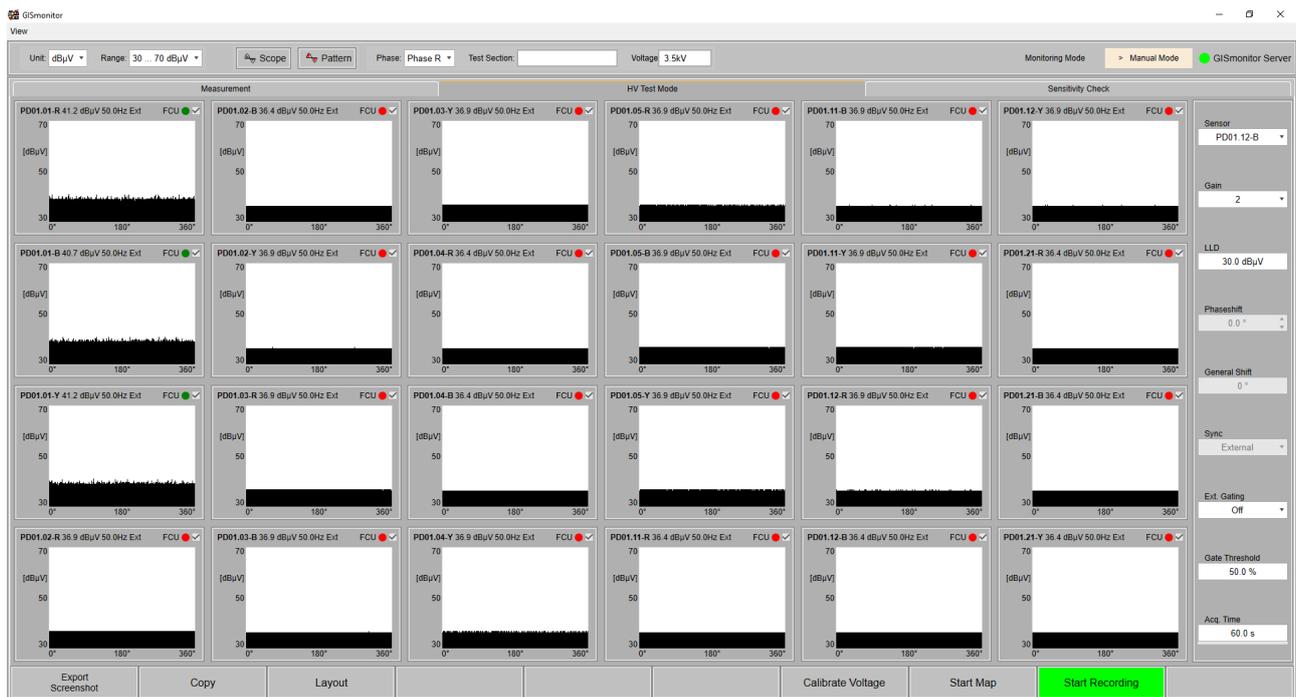


Figure III.3: HV tests tab

After applying an external voltage, the measured voltage can be calibrated with the *Calibrate Voltage* button. A click on the *Stop Recording* button finishes the HV test for the current section. Afterwards, all data is processed and saved in the data directory, which is specified in the preferences.

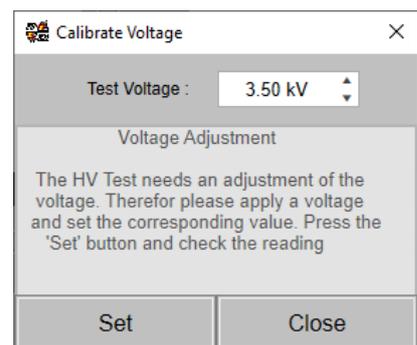


Figure III.4: Voltage adjustment

To review a measurement, use the *View -> HV Replay* menu item. This replay view can load and display up to 24 hvt files. Depending on how many files are shown, the software displays either just the recorded images or the images and, next to them, a trending graph including pulse peak values and the recorded voltage. If only images are shown, the corresponding trending graphs can be displayed by clicking on the *Trend* button in the menu bar at the top of the panel. To display only the images again, press the *Image* button.

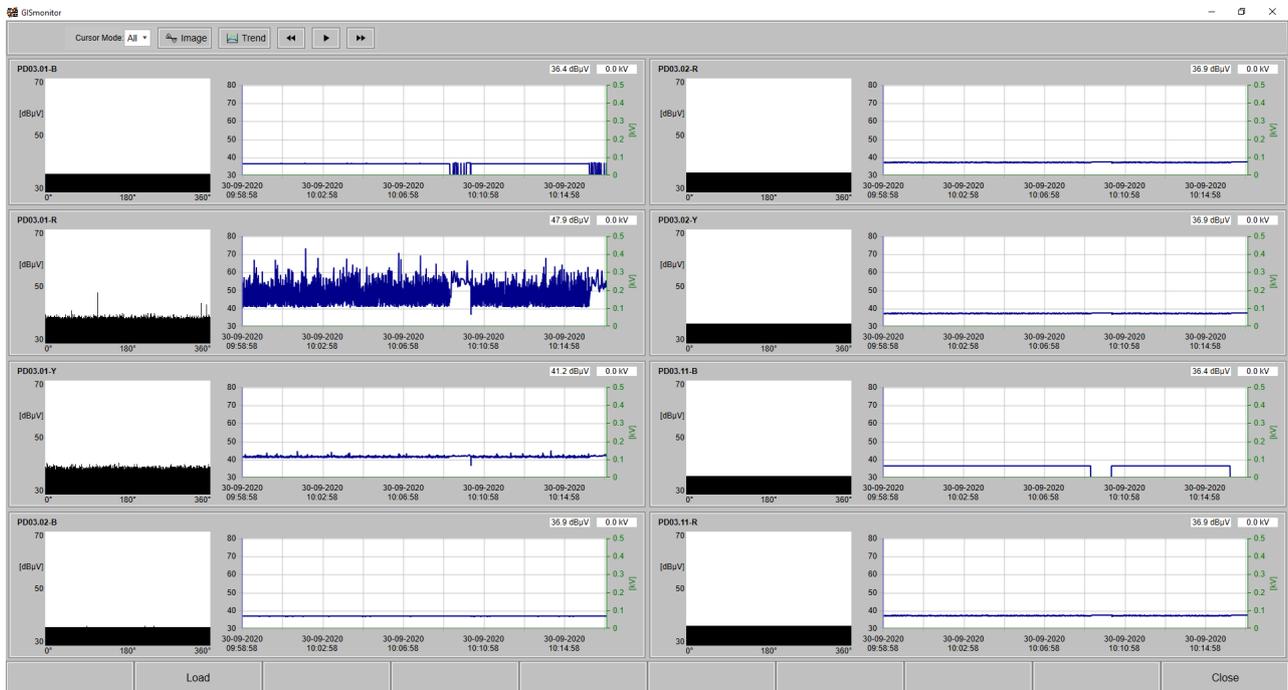


Figure III.5: HV tests panel with trending graphs active

The recorded HV measurement can be replayed with the *Play* button. Additionally, the cursor in the trending graph can be moved to replay the measurement at a faster speed or to show specific sections of the measurement.

III.3 Sensitivity check

By selecting the *Sensitivity Check* tab, up to six sensors can be used to perform the sensitivity verification.

The sensitivity check menu/feature has been developed in order to ease the commissioning activities for the so called 'sensitivity verification' step. Before the HV test can be performed on site, it is necessary to perform the sensitivity verification in order to ensure that the UHF sensors are able to pick up a signal coming from a possible defect located inside the GIS enclosure. This is done by injecting with a calibrator into a sensor and reading the signal from the closest sensors. Since a GIS can have hundreds of sensors, the sensitivity check menu helps keeping track of every sensor that has been checked.

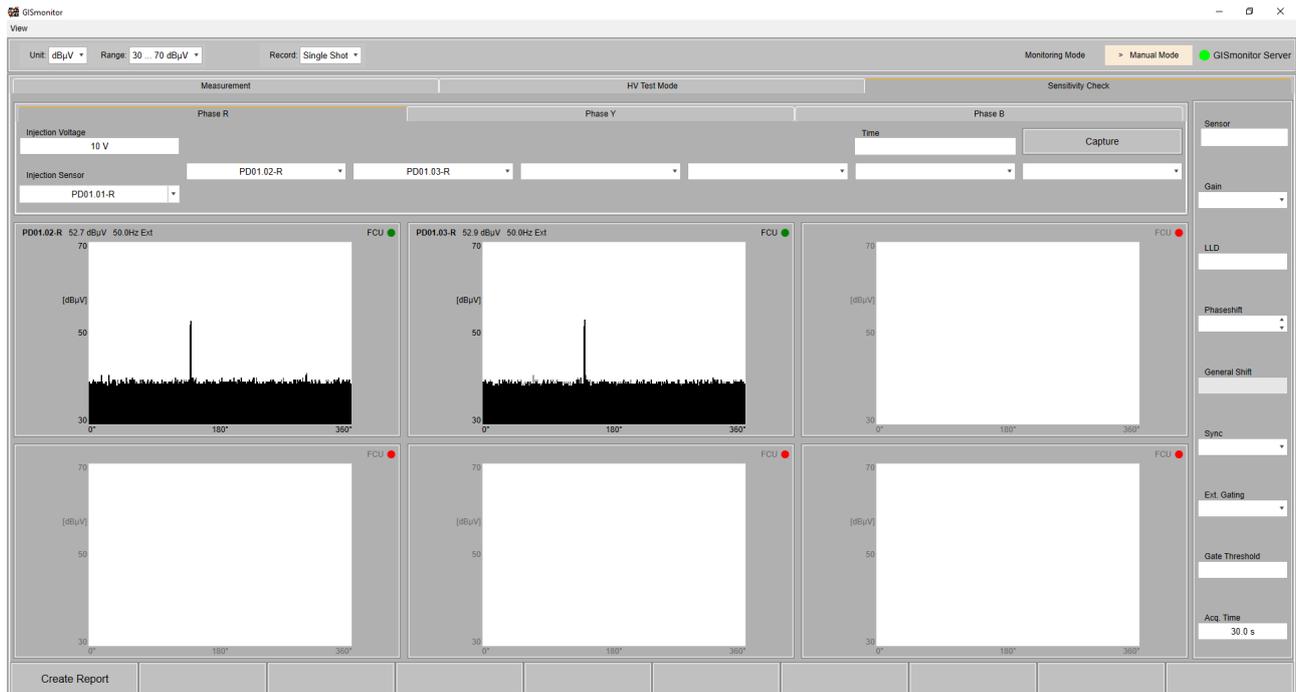


Figure III.6: Panel for sensitivity checks with one tab for every phase

First a given injection sensor must be chosen from the *Injection Sensor* dropdown list, or the name of an injection sensor can be entered. The signal of the injected voltage should be visible at the nearest sensors to verify that a fault that occurs in-between these sensors can be detected. The value of *Injection Voltage* should be set to the voltage injected by the calibrator CAL2B.

The software takes a single shot measurement (scope image), a 3D series of 50 accumulated scope images, or a PRPD (map), depending on the selection in the *Record* dropdown list of the toolbar.



Figure III.7: Record modes

By pressing the *Capture* button, the software will take the appropriate recording. After the measurement, a pop-up window will be shown, and the measurement can be stored in the data directory with the *Ok* button.

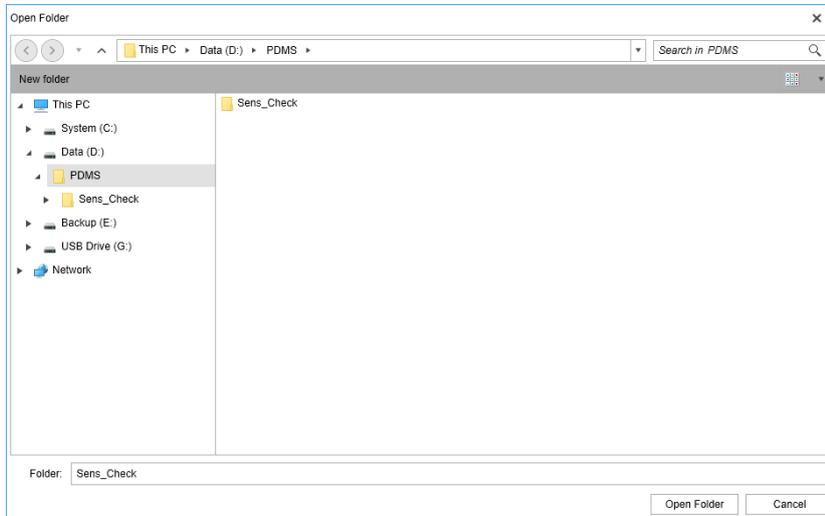


Figure III.8: Saving sensitivity check data

The software offers the creation of an automated report for completed sensitivity checks. A click on the *Create Report* button of the *Sensitivity Check* tab brings up a report window for the choice of the data directory. Clicking the *Create Report* button of the report window will create a Word file and paste in all the measurement data including the scope images, 3D series images, and the PRPDs.

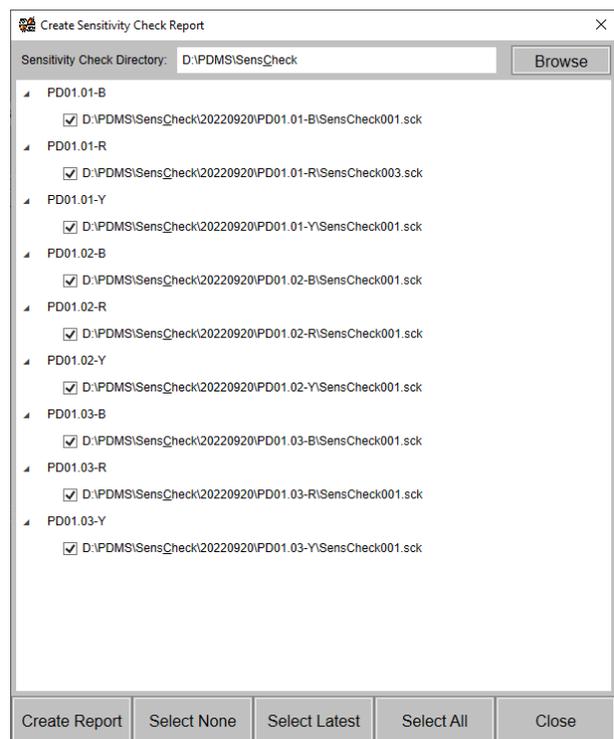


Figure III.9: Window for creating a sensitivity check report

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