

MV DAC-30

Partial discharge measuring system



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1 Safety instructions

1.1 General Notes

About this manual

This manual contains basic information about commissioning and operating the device / system. Therefore, it must be ensured that this manual is accessible to authorised and trained operating personnel at all times. The operating personnel must read the manual carefully.

The manufacturer will not accept liability for any damage to persons or materials caused by a failure to observe the safety instructions contained in this manual.

Keep this manual for future reference until the product is disposed of.

National standards and regulations must be observed.

Working with products from Megger

The generally valid electrical regulations of the country in which the device is installed and operated, as well as the existing national regulations for accident prevention and any internal regulations (work, operating, and safety regulations) of the operator must be observed.

After working on the system, it must be disconnected from the power supply and secured against being switched on again, discharged, earthed, and short-circuited.

Original accessories are used for system safety and functional reliability. The use of other parts is not permitted and leads to the loss of warranty.

Operating personnel

The system must only be commissioned and operated by authorised, qualified electricians. Under DIN VDE 0104 (EN 50191), DIN VDE 0105 (EN 50110) and accident prevention regulations, the term 'qualified electrician' refers to persons who are able to identify hazards based on their knowledge, experience, and knowledge of the relevant regulations.

Other persons must be kept away.

Compatibility note

From product version V4 onwards, the device's cable connections have been modernised.

Although the device's functionality remains unchanged, cables from earlier versions are not compatible with the connections of version V4.

Accordingly, cables of version V4 are also not compatible with the connections of earlier versions.

In case of any questions or uncertainty regarding compatibility, please contact the responsible service centre.

Signal words and symbols used

The following signal words and symbols are used in this operating instructions and also on the product itself:

Signal word/symbol	Description
DANGER	Indicates a potential hazard that will result in death or serious injury if not avoided.
WARNING	Indicates a potential hazard that may result in death or serious injury if not avoided.
CAUTION	Indicates a potential hazard that may result in moderate or minor injuries if not avoided.
NOTE	Indicates a potential hazard that may result in property damage if not avoided.
	Used to highlight warning and safety instructions in the operating instructions. When present as a sticker on the product, it identifies sources of danger that require the user to read the operating instructions to ensure safe handling.
	Used to highlight warning and safety instructions that explicitly indicate danger of electric shock.
	Used to highlight important information and useful tips for operating the product. Failure to observe may result in unusable measurement results.
	Indicates further information in other operating instructions.

Declaration of Conformity (CE)

The product complies with the requirements of the following European directives:

Directive	Standard
2014/30/EC	Electromagnetic Compatibility EN 61000-6-2: 2005 EN 61000-6-4: 2007
2014/35/EC	Low Voltage Directive EN 61010-1: 2010
2011/65/EU	RoHS Directive Restriction of certain Hazardous Substances EN 50581: 2012

Disposal

Depending on where the device is used, the end user may be obliged by law (e.g. the German Electrical and Electronic Equipment Act (ElektroG)) to dispose of it separately from household waste.

Megger Germany GmbH as the manufacturer of the device undertakes to accept and properly dispose of the old device when a comparable new device is purchased.

If the old device is to be returned directly upon delivery of the new device, Megger Germany GmbH must be informed in advance if possible. Batteries and rechargeable batteries that can be removed from the old device must be handed in separately. The end user is responsible for deleting personal data from the old device.



The above points apply to all electrical and electronic equipment labelled with the adjacent symbol.

1.2 General Safety Instructions and Warnings

Intended use

The safety of the supplied system is only guaranteed if it is used as intended. Improper use can result in hazards for the operator, for the system, and for associated systems.

The limits specified in the technical data must not be exceeded under any circumstances.

The MV DAC-30 is used für measuring and localising partial discharges.

Reasonably foreseeable misuse

Every use of the delivered device beyond the application limits described in this manual is rated as misuse.

The supplied notebook is solely intended for measurements. The installation of additional software is not permitted.

The MV DAC-30 is not suitable for depositing objects.

Behaviour in the event of faults during normal operation

The system must only be operated if it is in perfect technical condition. In the event of damage, irregularity, or faults that cannot be rectified using the instructions in the operating manual, the system must be immediately shut down and marked accordingly. In this case, notify the relevant supervisor. Please contact the Megger service immediately to rectify the fault. The system must not be put back into operation until the fault has been rectified.

Five safety rules

These five safety rules must be consistently applied when working on the electrical connection between the measuring system and the test specimen.

1. Disconnect from the power supply
2. Secure it against being switched back on
3. Test to ensure that it has been disconnected
4. Earth and short-circuit the system
5. Cover or cordon off adjacent live components



Persons with pacemakers/defibrillators

Persons with pacemakers/defibrillators may be at risk in the vicinity of the device as a result of the physical processes in the high-voltage system.



Fire fighting in the vicinity of electrical equipment

- Correct extinguishing agent: **Carbon dioxide (CO₂)**.
- Carbon dioxide is electrically non-conductive and leaves no residue. It is safe to use on live systems but the appropriate safety distances must be observed. A CO₂ fire extinguisher should therefore always be available near the electrical system.
- Improper use of other extinguishing agents may damage the electrical system, for which Megger cannot accept any liability. Furthermore, if a powder extinguisher is used near high-voltage equipment, there is a risk of voltage being transferred to the person using the fire extinguisher (due to the powder mist).
- Please always observe the hazard warnings on fire extinguishers.
- DIN VDE 0132 applies.

Behaviour in the event of electrical accidents

In case of high voltage: Make an emergency call, rescue measures are only to be done by trained specialists!

In the event of electrical accidents, proceed as follows:

1. Disconnect the power supply!
2. Make an emergency call and inform the emergency call centre that there has been an electrical accident.
3. If the injured person is conscious:
 - Talk with the injured person.
 - Cover the burn with a sterile dressing.
4. If the injured person is unconscious, check the person's breathing:
 - If the injured person is breathing, place him or her in the recovery position and check breathing frequently until emergency services arrive.
 - If the injured person is not breathing, begin with CPR.

Always see a doctor after an electrical accident, even if you don't have visible injuries or symptoms!

2 Technical description

2.1 Abbreviations

In this manual the following abbreviations are used:

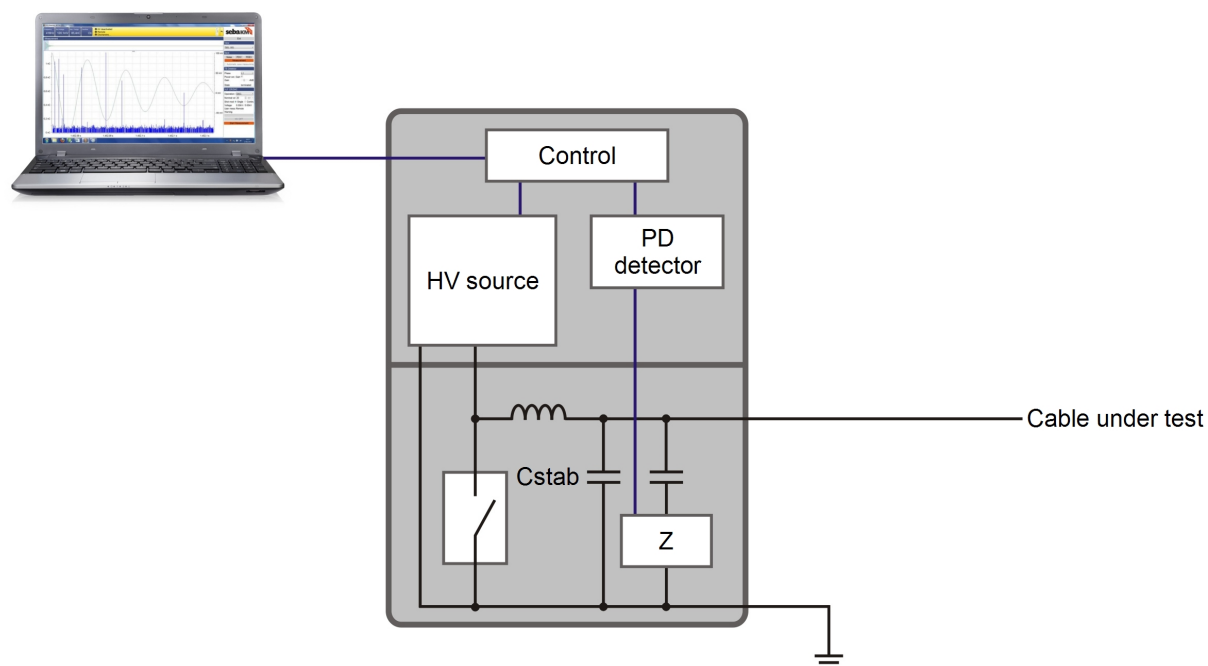
Abbreviation	Meaning
AKV	Ankoppelvierpol (Quadripole)
DAC	Sinusoidal, oscillating and damped AC voltage
MWT	Monitored Withstand Test
PDEV	Partial Discharge Extinction Voltage
PDIV	Partial Discharge Inception Voltage
TDR	Time Domain Reflectometry (or Time Domain Reflectometer)
PD	Partial discharge
VWD	Voltage Withstand Diagnosis

2.2 System description

Functional description

The MV DAC-30 is a partial discharge measurement system that allows for the identification, classification and location of PD faults in the insulation and the accessories of all kinds of medium voltage cables.

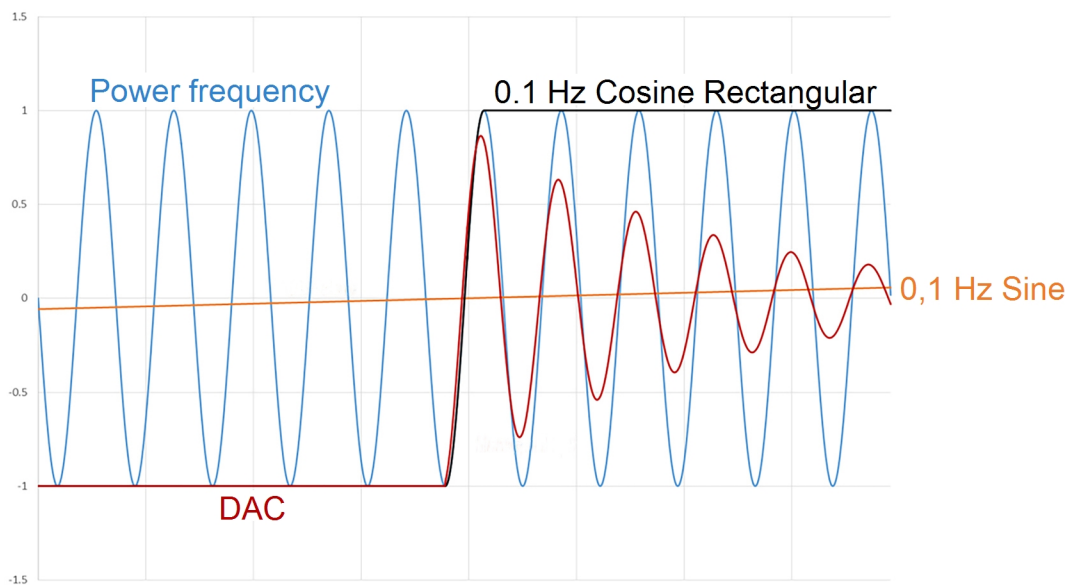
It consists of a HV source, a thyristor switch, a stabilizing capacitor, components for the signal decoupling (coupling capacitor, measuring impedance, measurement amplifier) and a PD detector that is responsible for the signal processing.



Both, the control of the voltage source and the visualization and analysis of the measurement data are made through a notebook that is connected via a network interface. All operational actions that are required for measuring and locating PD can be executed with the help of the preinstalled software. The analysis and management of the measurement data can be conducted either immediately after the measurement or later in the office.

For the purpose of measuring partial discharge, the test object is charged to the desired voltage using the HV source and then discharged using the switch and the specially designed inductor. Thus a sinusoidal DAC voltage with low damping is created. PD instigated during this process are decoupled via the coupling unit and processed in the PD detector.

The DAC voltage allows a cable-friendly PD diagnosis in conformity with IEC 60270 and works according to the principle of "50 Hz Slope Technology". In the diagram below the similarity between the VLF-CR and DAC slopes and the 50 Hz power frequency can be clearly seen.



This is particularly important for PD diagnosis, since reliable evaluation of the measured results requires a direct comparability with the power frequency. It is widely known that PD characteristics change in case of large frequency differences, making reliable evaluation impossible.

Features

The system offers the following features and functions:

- Intuitive control and analysis software, suitable for the universal use with different systems
- Quick and fully automatic calibration in one step
- PD mapping and statistical evaluation in real time
- Fully automatic report generation directly after a measurement possible
- Cable database with individually adaptable segment templates
- Import of measurement data from other PD measurement systems, e.g. Oscillating Wave Test System (OWTS)
- Software-assisted pinpointing of partial discharge (PD) fault locations
- Pinpointing of PD fault sites by means of an appropriate pulse transmitter

2.3 Scope of delivery

The scope of delivery includes the following:

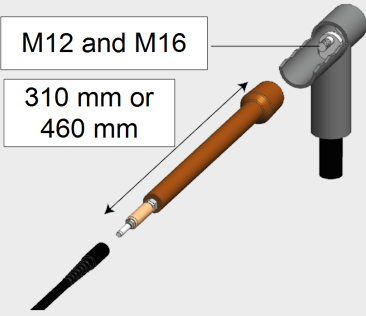
Component	Description	Article number	Quantity
Partial discharge measuring system MV DAC-30	Power cord included	1006132	1
Accessory bag		90016856	1
Notebook	With preinstalled software and case	language-dependent	1
PD software licence	1 licence, 3 activations, 5-year term	1389	1
PD calibrator CAL1	Conformity:	IEC 60270	1
	PD range:	100 pC ... 100 nC	
	Power supply:	9-volt battery	
Network cable	3 m	90013909	1
HV alligator clip	Red	810001055	1
HV connection cable	5 m	2006817	1
Earth lead	4 m	899003249	1
Tube with silicone paste	90 g	892746859	1
OE connection adapter MC10	Connection adapter	890022408	1
Manual		84563	1

Check contents

Check the scope of delivery immediately after receipt for completeness and externally visible damage. In the case of visible damage, the device must under no circumstances be taken into operation. If something is missing or damaged, please contact your sales partner immediately.

Optional accessories

Should the following optional accessories not be part of the scope of delivery, these can be ordered from sales:

Accessory	Description	Article number
Diagnostics connection set	Accessory set for PD-free connection to the test object	890017909
External safety device	External safety device with signal lamps, high-voltage control, emergency stop switch and key switch	108300322
HV connection cable	10 m	2008839
HV connection cable	15 m	2008840
Case Control Unit MV DAC	Transport box with wheels	90017826
Case HV unit MV DAC	Transport box with wheels	90017827
Additional PD software licence	1 additional licence, 1 activation, 5-year term	1390
PD SW package "Rating"	Enables the optional feature for rating of the cable systems, 1 licence, 3 activations, 5-year term	1391
Additional PD SW package "Rating"	Enables the optional feature for rating of the cable systems, 1 licence, 1 activation, 5-year term	1392
PD SW licence renewal	Valid for 1 licence, reactivation of the licence (all activated optional features included), 5-year term extension	1393
PD PA-MC-UNI	 M12 and M16 310 mm or 460 mm	1013564 (460 mm)
		1013563 (310 mm)
PD-TX	Optional PD-TX pulse transmitter	1007776

2.4 Technical data

Technical parameters

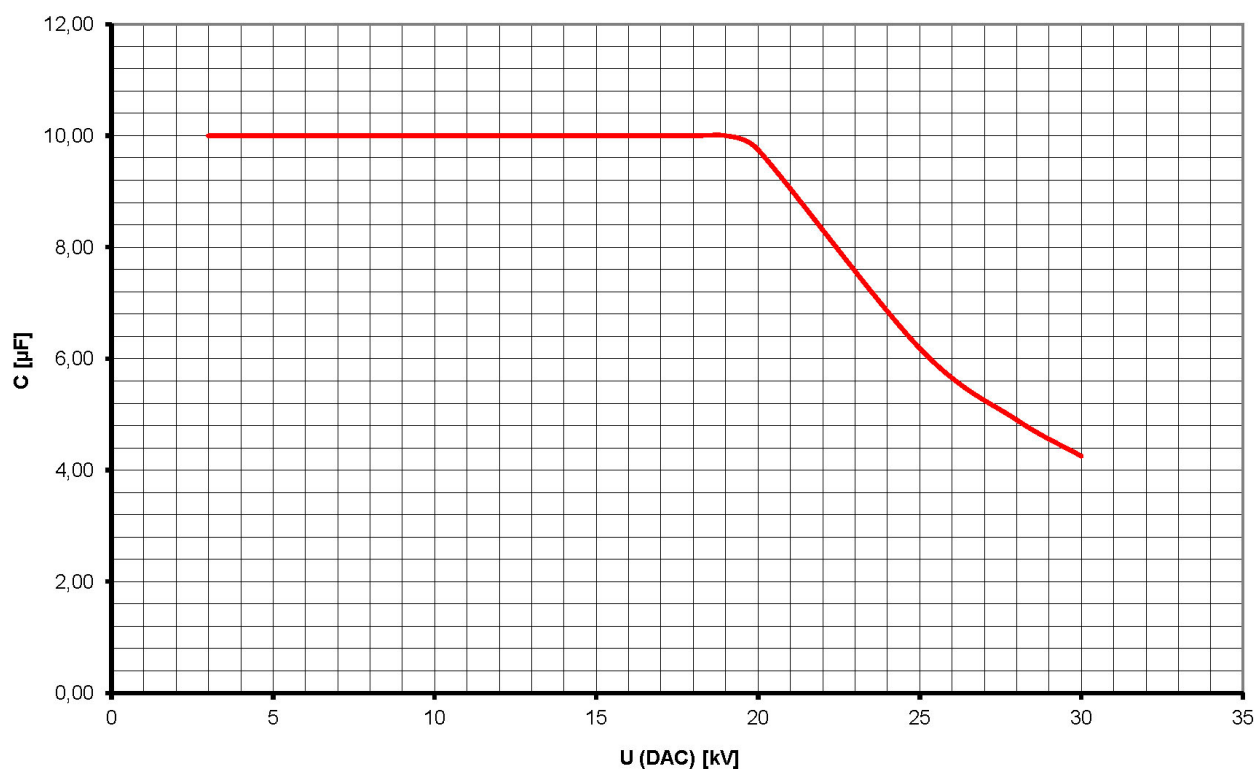
The partial discharge measurement system MV DAC-30 and the included PD detector are specified by the following parameters:

Parameter	Value
Voltage range	3 ... 30 kV kV DC
DAC frequency	20 Hz ... 500 Hz
Testable load capacitance	1 nF ... 10 μ F at 20 kV _{PEAK} (DAC) 1 nF ... 4.25 μ F at 30 kV _{PEAK} (DAC) (Load diagram)
Power supply	230 V, 50/60 Hz
Power consumption	500 VA at maximum
PD measuring range	2 pC ... >100 nC
System noise level	<20 pC at 30 kV kV _{p_{peak}} (DAC)
PD pulse repetition rate for charge evaluation	100 kHz
Charge evaluation	according to IEC 60270
PD localisation	
Measuring range	0 ... 16.000 m / $v/2 = 80$ m/ μ s
Minimum cable length	75 m
Propagation velocity $v/2$	50 ... 120 m/ μ s
Sample rate	125 MHz (8 ns)
Bandwidth	3 / 20 MHz (switchable)
Accuracy	1% of cable length
Resolution	± 1 pC / ± 1 m
Filtering	Analogue and digital
Interfaces	Ethernet, external safety device
Weight	45 kg (HV module) 30 kg (Control module)
Dimensions (W x D x H)	56 x 42 x 100 cm
Operating temperature	-20 °C ... 55 °C
Storage temperature	-30 °C ... 70 °C

Parameter	Value
Relative humidity ¹	93% at 30 °C (non-condensing)
Protection class (in accordance with IEC 61140 (DIN VDE 0140.1))	I
Ingress protection rating (in accordance with IEC 60529 (DIN VDE 0470 1))	IP20

Load diagram

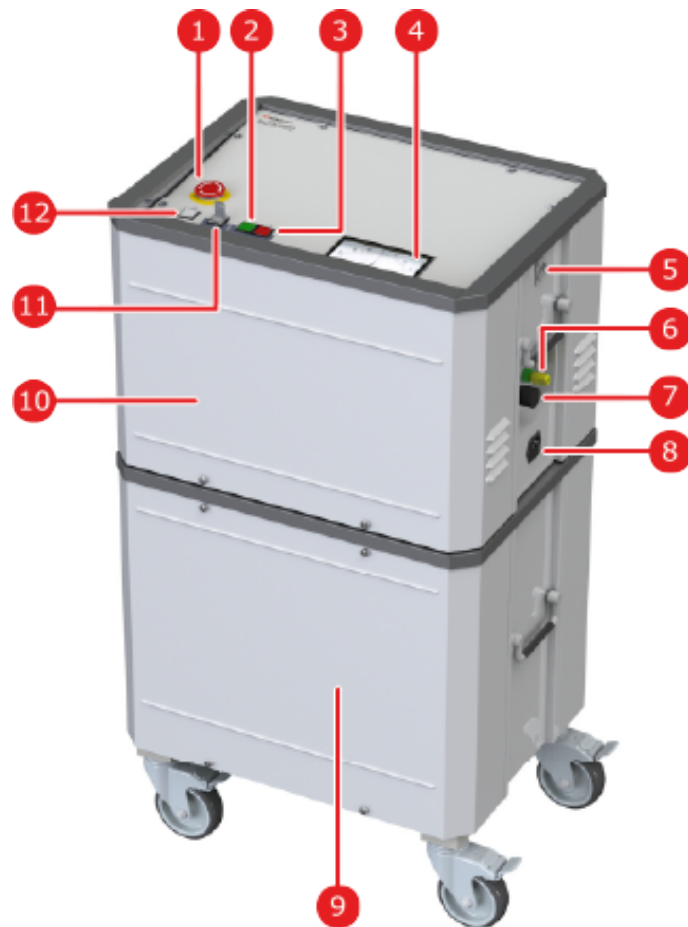
The following diagram illustrates the dependency of the maximum testable load capacity on the test voltage.



¹A relative humidity above 80% may lead to increased intra-system interference.

2.5 Modules, Connections and Control Elements

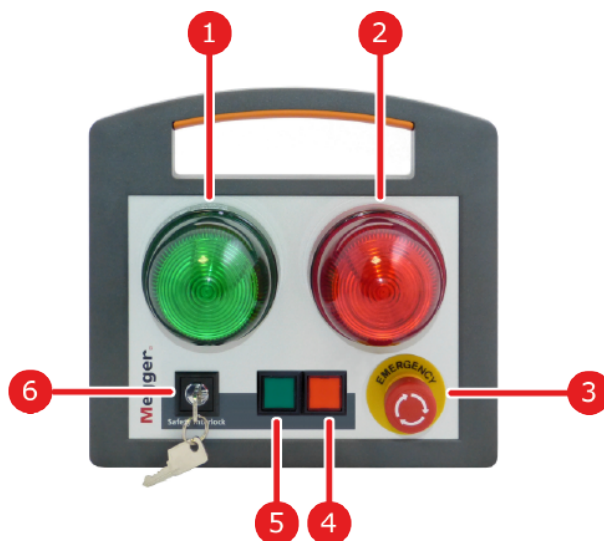
The system consists of the following two modules and offers the following control and connection elements:



Element	Description
1	EMERGENCY OFF switch
2	"HV ON" button
3	"HV OFF" button
4	Output voltage meter
5	Network jack
6	Protective earth connector
7	Socket for connecting the external safety device
8	Power supply socket with fuses (2 x T2.5A)
9	HV module
10	Control module
11	HV interlock key switch
12	ON/OFF button

2.6 External safety device

The external safety devices has the following controls and indicators:



Element	Description
1	Green signal light Lights up when the system is switched on but is not in high voltage operation.
2	Red signal light Lights up as soon as high voltage can be generated. The test object must be treated as live!
3	EMERGENCY OFF switch
4	"HV OFF" button (only on the external safety device with operating function)
5	"HV ON" button (only on the external safety device with operating function)
6	"HV interlock" key switch
	 High voltage unlocked
	 High voltage locked
When locked, the key can be removed and the system secured against unauthorised high-voltage operation.	

2.7 Technical Background

What is Partial Discharge and why test for it?

To be informed about the condition and residual life of their resources is increasingly important for network operators in order to be able to plan and optimise the investment and maintenance measures.

By the use of condition-based maintenance of medium voltage cable networks with the help of cable diagnosis and cable tests, it is possible to considerably reduce the costs for maintenance and renewal of the networks. Unnecessary repairs or renewals can be avoided and life expectancy can be maximized.

Moreover, the PD diagnosis also is an ideal method to verify the installation and assembly quality of a cable before commissioning.

The recognition, evaluation and location of PD faults has thereby been established as one of the most efficient and significant diagnostic methods. Partial discharge refers to the partial electrical breakdown of an insulation system in which only a limited area of the entire insulation section is bypassed. PD activity is an indication of incipient faults in the insulation and is widely regarded as one of the best indicators of potential weak spots in the accessories and insulation of medium and high voltage cables.

Inside cables, PD defects are generally ionisable, gas-filled voids, which were either developed during the production of the insulation or caused by one of the following events:

- Mechanical damage
- Incorrect installation of joints or terminations
- Thermal degradation processes inside joints due to improper conductor connections

Field of application

In principle, the system is designed for all kinds of medium voltage cables as long as the constructional requirements for the PD free connection of the test system are fulfilled.

With the system's output voltage of 30 kV kV_{peak} power cables with a rated voltage U_0/U of up to 18/30 kV can be diagnosed in accordance to the applicable standards.

The measurable cable lengths depend greatly on the type of cable and on the number and the design of the sleeves. Faulty or poor quality sleeves and wet cable sections severely reduce the propagation of PD pulses and hinder or prevent their detection.

Cable lengths of 5 to 6 km can be easily measured (in some cases, even longer stretches) on new VPE cables that have sleeves of at least the required quality and if measurements can be made from both cable ends.

PD pulses are much more attenuated in mass-impregnated cables, so the maximum length is 2 to 3 km. If the cables are wet or have multiple sleeves (especially connector sleeves), the lengths that can be measured are often significantly shorter.

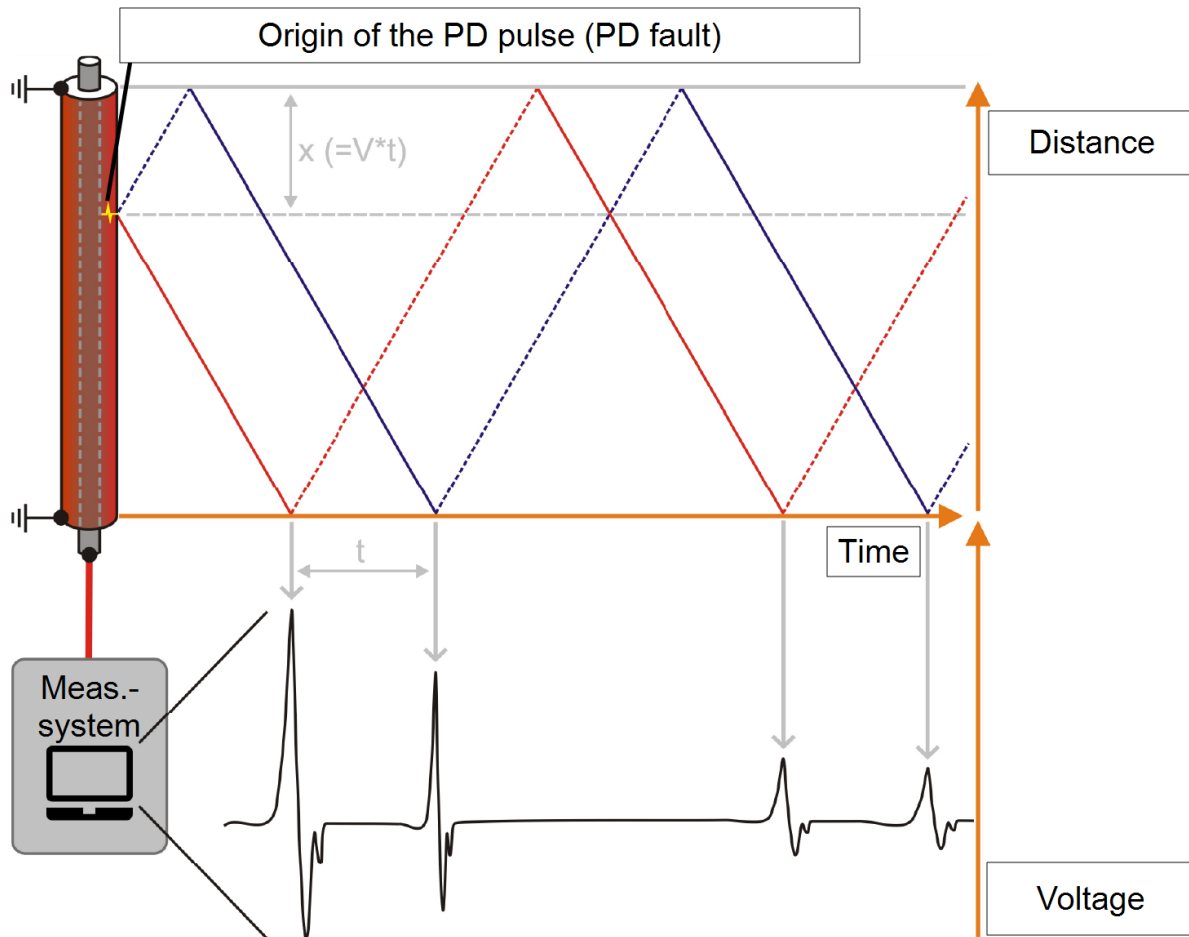
In locations where high interference voltages may obscure the measurement signal (e.g. in transformer stations), smaller PD levels are harder to identify. In these cases, a preferably short and direct earthing of the measurement system at the screen of the test object should be ensured.

How can partial discharges be measured and located?

In order to measure partial discharges, the test object is applied with the required voltage. The generated high-frequency PD signals are decoupled by means of a special AKV.

By gradually raising the voltage it is possible to detect at which voltage the PD ignites (PDIV) and how the PD level changes with increasing voltage. Conclusions regarding the type of PD fault can be drawn from the phase angle of the test voltage at the moment of the PD event. In a similar way, also the extinction voltage (PDEV) of an already activated PD can be determined during the decay of the DAC voltage.

The fact that generated high-frequency pulses in cables propagate in both directions is used to locate PD faults. During the measurement process, the measurement system records the incoming signals and, thanks to appropriate algorithms and filters, is able to identify both the directly incoming PD pulses and the respective reflections.



The position of the PD fault can then be calculated from the time difference between pulse and reflection and from the known or in the previous calibration determined pulse propagation velocity.

3 Commissioning



WARNING

General safety instructions for set-up and commissioning

- The guidelines for the implementation of occupational safety when operating a non-stationary test system often differ between different network operators and are frequently accompanied by national regulations (such as the German BGI 5191). Inform yourself about the guidelines applicable at the place of use before the measuring operation and carefully follow the rules set out therein for labour organisation and commissioning of the non-stationary test system.
 - Choose a location for the system that meets the requirements of weight and dimensions and ensures a stable footing.
 - Make sure that no other systems/system parts are impaired in their functionality when setting up or connecting the device. If changes have to be made to other systems/system parts, it must be ensured that these measures are reversed after the work has been completed. Always observe the special requirements of these systems/devices and only perform any work relating to them after prior consultation/approval from the person responsible for the work.
 - In the event of vast temperature differences between the storage and installation location (cold to warm), condensation may form on the high-voltage components (condensation effect). To prevent voltage flashovers that could put persons and equipment at risk, the system must not be operated in this condition. Instead, it should remain in the new environment for about an hour to acclimatise before being put into operation.
-

3.1 Electrical connection



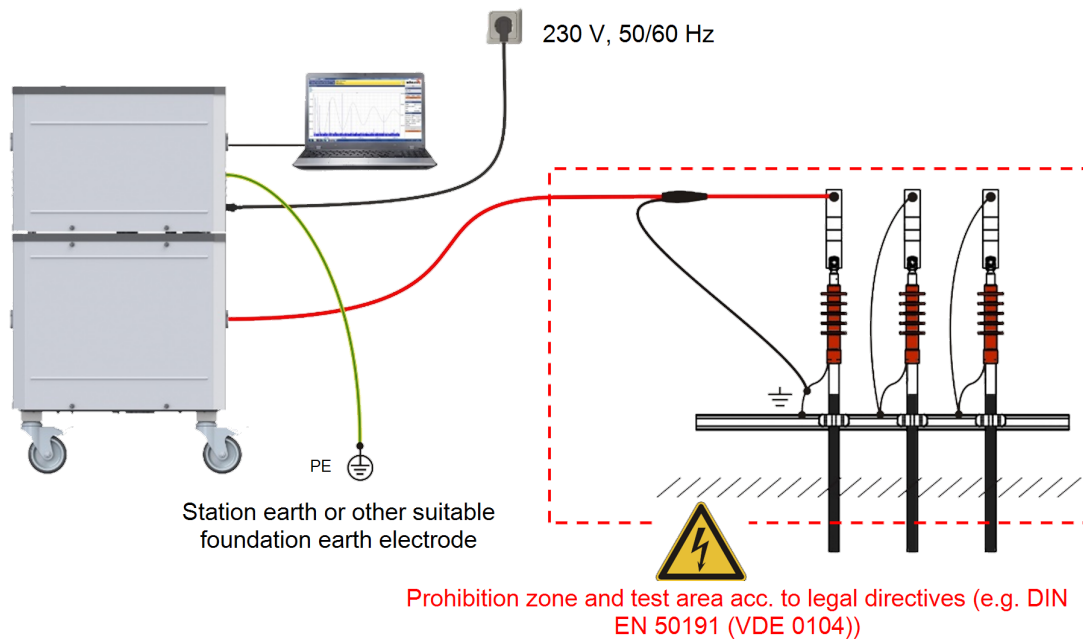
WARNING

Safety instructions regarding the electrical connection

- The system may only be connected to **de-energised** equipment. The general safety instructions and, in particular, the five safety rules ([General Safety Instructions and Warnings](#)) must always be followed prior to connection to the test object.
 - Follow the specified connection sequence.
 - Because the voltage applied to the device under test can exhibit values that represent a shock hazard, all cable ends must be shielded in accordance with the legal requirements to prevent contact. It must be ensured that all branching points are considered.
 - All cables at the measuring point that are out of service and at which no measurements are being taken must always be short-circuited and earthed.
-

Connection diagram

The following picture shows the simplified connection diagram:

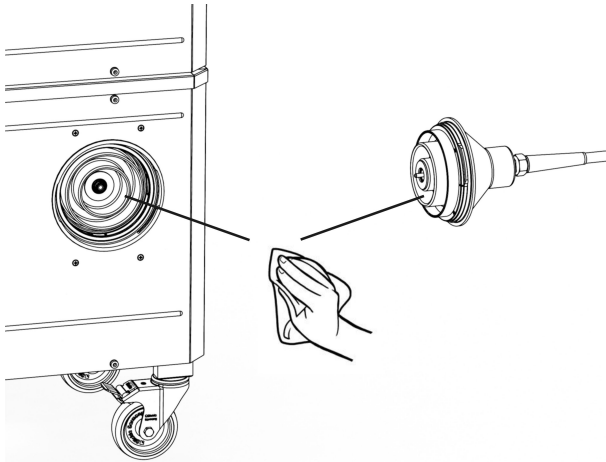


To connect the partial discharge measuring system, the following is required: HV module, control module, Earth lead, Tube with silicone paste (at particularly high humidity), HV connection cable, Notebook, Network cable, Mains connection cable, Ethanol, a soft and lint free cloth.

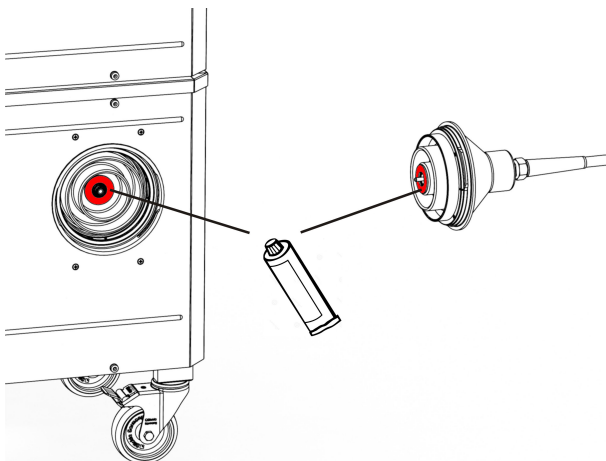
Proceed as follows to connect the MV DAC-30:

1. Roll the HV module to the desired installation site and apply all four wheel brakes.
2. Put the control module in the correct orientation on the HV module.
3. Make sure no gap remains underneath the control module.
4. Make sure that the connecting points of the earth lead (yellow/green) are not polluted or corroded and that they provide good metallic contact.
5. Connect the earth lead to protective earth connection **6** of the device and to a suitable point on the protective earth system (station earth).

6. Clean the plastic surfaces on the HV socket of the system and on the connector of the HV connection cable with a soft, lint-free cloth and ethanol to prevent system-related partial discharges. The surfaces must then be free of dirt, sweat and moisture!



7. For measurements in environments with particularly high humidity (>80%), the two silicone rings marked in red in the following image should be thinly coated, while avoiding any cavities, using the silicone paste supplied.



When uninstalling the system the paste must be fully removed from the both silicone rings.

8. Plug the connector of the HV connection cable all the way into the HV socket and then lock it with a quarter turn clockwise.
9. Connect the shield of the HV connecting cable to the earthed shield of the test object (system earth).
10. Connect the internal conductor of the HV connecting cable to the phase conductor of the test object.



In order to ensure a PD-free connection, keep sufficient distance between the earthed parts of the system and the cable. If possible, use the connection adapters and field control electrodes from the diagnostic connection set ([Scope of delivery](#)) which is available as special accessory.

11. Connect a notebook with latest version of the measurement software to the network jack **5** of the source by means of the supplied network cable.
12. Connect the supplied power cord to the system's power receptacle **8** and to a power socket.

3.2 Switching on

Proceed as follows to get everything ready for the measurement:

1. Switch on the test voltage source via the white ON/OFF button .
2. Switch on the notebook.
3. Start the measurement software by double-clicking the  desktop icon.



For information on how to install the software and configure the notebook, refer to the software booklet.

4 Basic operation of the software

4.1 Start screen

After the software has been opened, the main menu appears. This can be used to call up the individual modules of the software:



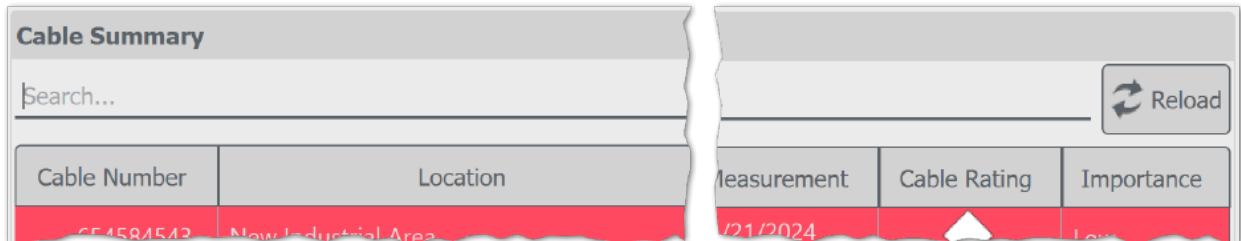
The following modules are available:

Module	Description
	Measurement task (Starting or Resuming a Measurement Task) Creating a new measurement task
	Calibration (Calibrating the Partial Discharge Measuring Circuit) Calibrating the partial discharge test circuit
	Measurement (Measuring) Parameterisation and conducting of the PD measurement
	Report (Evaluating Measurement Results and Creating a Report) Evaluating the measurement data and creating a report
	Pinpointing (Pinpointing PD fault points) Pinpointing the partial discharge fault location by means of a suitable pulse transmitter.
	Cable manager (Cable manager) Administrating measurement and cable data sets
	Settings (Adjusting the settings) Adjusting the software settings

4.2 Useful Features of the Software

Search and sort functions

In order to make the search in extensive lists (e.g. cable lists) easier there is always a search form near the list in which any character string can be entered. While entering, the list is immediately filtered by entries that contain this character string.

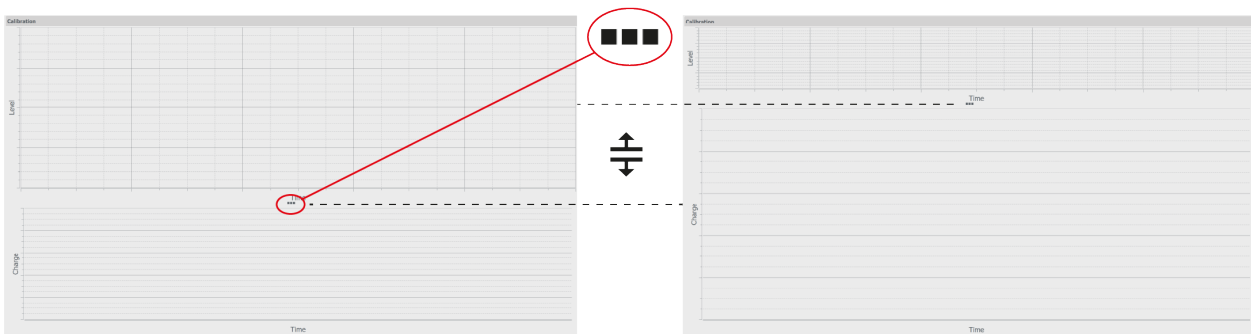


In order to cancel the filtering, either the character string needs to be deleted or, if available, the  button needs to be clicked.

When clicking on the title of a table column, the rows of the table are sorted according to the content of this column. Clicking again changes the direction of sorting. The column currently used for sorting is always indicated by a  or  (orientation depending on direction of sorting).

Adapting the screen layout

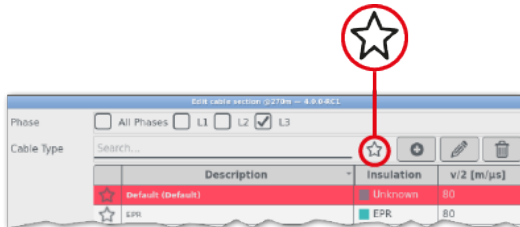
Where the symbol  appears, it indicates that the screen layout can be adjusted to the personal requirements depending on the situation. For this purpose, the symbol needs to be clicked and - with the mouse pressed - moved into the required position.



Administration of favourites

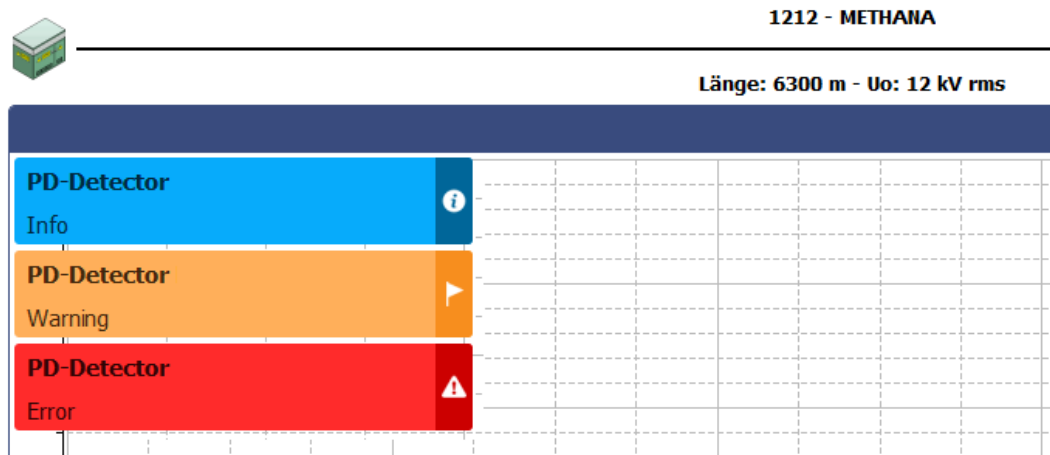
To guarantee quick access to frequently used cable templates, these can be added to the favourites (☆) list by clicking on the ★ symbol, or be removed from the list (☆) by clicking again.

The ☆ symbol which appears above the templates list allows you to toggle between the full view and the favourites view at any time.



Notifications

All notifications that are generated by the software or by the devices involved in the measurement appear in the display as an overlay for a few seconds.



The messages are divided into the following classes:

Class	Description
 Info	Information about the status of the involved devices or necessary operational actions
 Warning	Messages about problems that occurred in the course of the measurement, which do require user action (Troubleshooting)
 Error	Problems (e.g. in the communication between the devices) that need to be resolved (Troubleshooting) before continuing the measurement

Warnings and errors are automatically stored in the notification list, which can be accessed using the menu item  at the top right of the screen or by clicking on one of the error messages.

This ensures that the operator even takes note of short-term occurring problems.

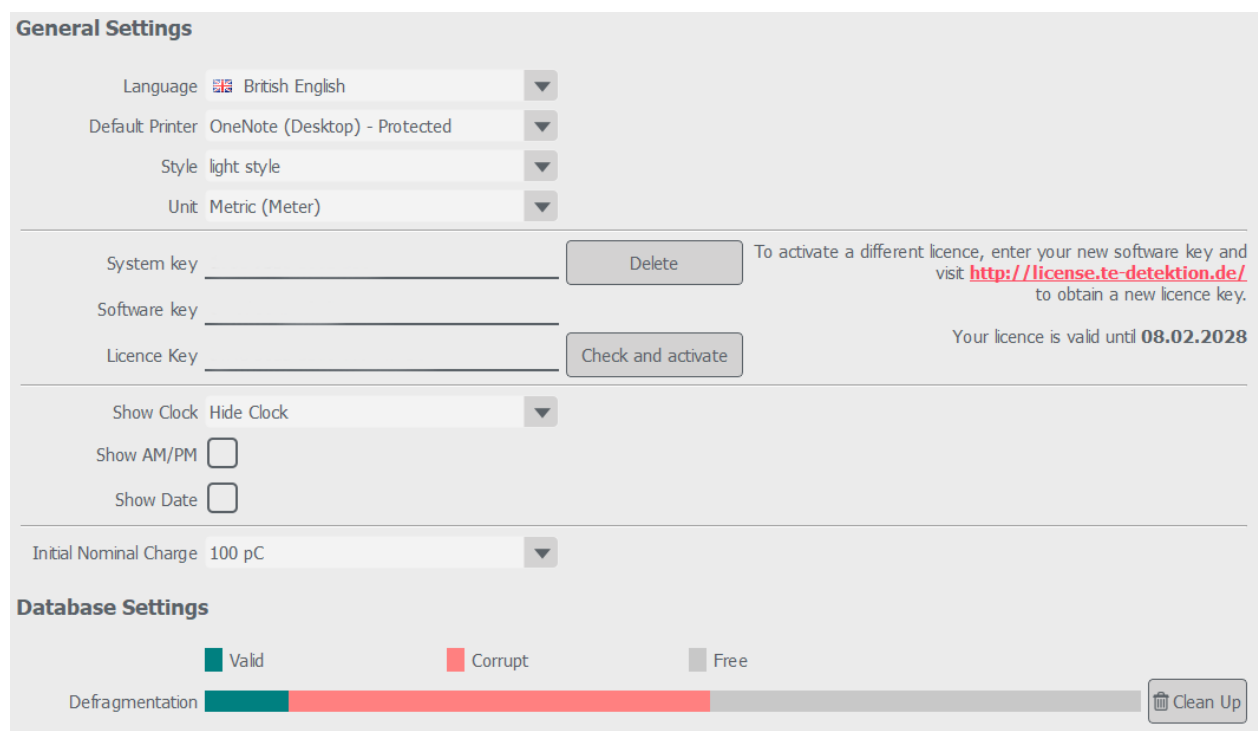
5 Adjusting the settings

In the software settings , adjustments can be made within the following categories:

- General (Category General)
- Report (Category Report)
- Printout (Category Printout)
- Devices (Category Devices)
- Phases (Category Phases)
- Localization (Category Localization)
- Testroutine (Category Testroutine)

5.1 Category General

This category contains the general software settings (language, default printer, appearance of the user interface), information about software and licences, presets for the nominal charge for the calibration mode and the database settings.



The screenshot shows the 'General Settings' and 'Database Settings' sections of the software. The 'General Settings' section includes dropdown menus for Language (British English), Default Printer (OneNote (Desktop) - Protected), Style (light style), and Unit (Metric (Meter)). It also has input fields for System key, Software key, and Licence Key, with buttons for 'Delete', 'Check and activate', and a 'Delete' button. A note on the right states: 'To activate a different licence, enter your new software key and visit <http://license.te-detektion.de/> to obtain a new licence key. Your licence is valid until 08.02.2028'. Below these are checkboxes for 'Show Clock', 'Show AM/PM', and 'Show Date'. The 'Initial Nominal Charge' is set to 100 pC. The 'Database Settings' section shows a progress bar for 'Defragmentation' with a legend for 'Valid' (green), 'Corrupt' (red), and 'Free' (grey). A 'Clean Up' button is at the bottom right.

The following settings can be made in this category:

Field	Description
Language	Select the menu language. To ensure that all texts are displayed in the selected language, a restart is required after changing the language setting.

Field	Description
Default Printer	Printer that should print the created PDF reports.
Style	Select the colour scheme for the screen display.
Unit	Selection between imperial and metric system of units (Imperial (Feet) or Metric (Meter))
Hardware key	Read-only access.
Software key	Display of the software key.
Licence Key	Display of the licence key.
Show Clock	These parameters can be used to specify whether and in what format the clock and date should be displayed on the upper right edge of the screen. This setting is especially important if the software is running in full-screen mode (as it is the case on a test van's IPC).
Show AM/PM	
Show Date	
Initial Nominal Charge	Pre-selected charge level when entering calibration mode.
Database Settings	Overview of database memory usage. If the database contains corrupt data sets, it is recommended to clean the database using the Cleanup button. Data sets can become corrupted if, for example, cables have been deleted from the cable database via another application. If this happens, the measurement data for the cables remains in the database without being assigned and must be cleaned using this function.

5.2 Category Report

This category contains the setting to automatically switch to the associated report after loading a measurement. If the additional package PD SW package "Rating" is used, this contains also the settings to evaluate the cable systems.

Settings

- General
- Report**
- Printout
- Devices
- Phases
- Localization
- Test routine

Report Settings

Always switch to report after loading a measurement ☐

Rating thresholds ☒

Values to be used for rating calculation

- ☒ Maximum
- ☐ Median
- ☐ Average

Deviation range +/- % of cable length (minimum +/- 5.0 m)

Select the equipment type(s) for which you want to adjust the thresholds. Click on column headers to select all elements.

Joint	Insulation	Termination
☒ Cast-resin	☒ EPR	☒ Cold-shrink
☒ Cold-shrink	☒ Mixed	☒ Connector technology
☒ Default	☒ PE	☒ Heat-shrink
☒ Heat-shrink	☒ PILC	☒ Oil-filled
☒ Oil-filled	☒ PVC	☒ Slip-on
☒ Slip-on	☒ TR-XLPE	☒ Unknown
☒ Taped	☒ Unknown	
	☒ XLPE	



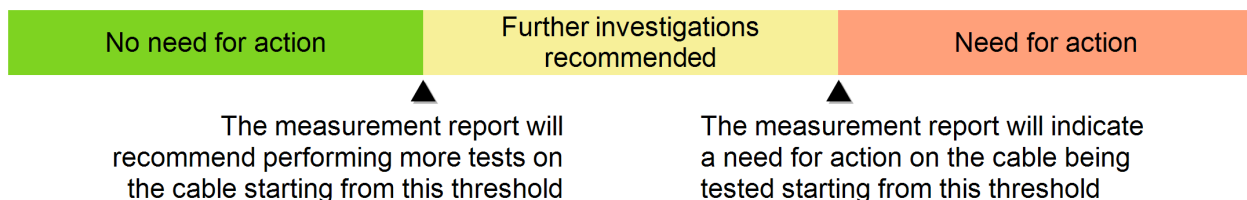
Any change of the evaluation criteria affects the rating of the diagnosed cable systems. Changes on these should only be made by experienced users to prevent the ratings becoming unusable.

The following settings can be made in this category:

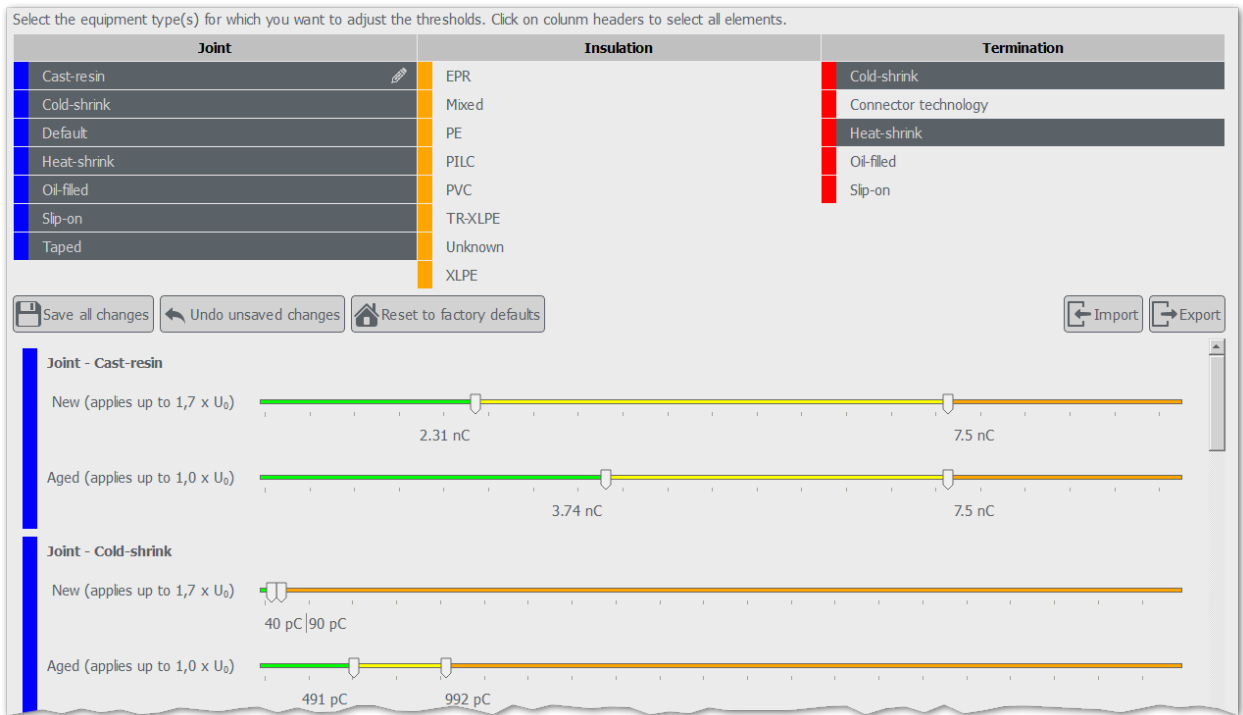
Field	Description						
Always switch to report after loading a measurement	This option automatically switches to the report after loading a measurement.						
Rating Thresholds	[Only available with additional package PD SW package "Rating"] This option enables the rating of cables.						
Values to be used for rating calculation	[Only visible if Rating Thresholds is selected] Selection of values used to determine the rating: <table> <tr> <td>Maximum</td><td>This option uses the largest measured values as evaluation basis.</td></tr> <tr> <td>Median</td><td> The median is the central value located exactly in the middle of a series of measured values (sorted by size). This option uses the median values as evaluation basis. </td></tr> <tr> <td>Average</td><td> The average is the arithmetic mean of the available measured values. This option uses the arithmetic mean of the measured values as evaluation basis. </td></tr> </table>	Maximum	This option uses the largest measured values as evaluation basis.	Median	The median is the central value located exactly in the middle of a series of measured values (sorted by size). This option uses the median values as evaluation basis.	Average	The average is the arithmetic mean of the available measured values. This option uses the arithmetic mean of the measured values as evaluation basis.
Maximum	This option uses the largest measured values as evaluation basis.						
Median	The median is the central value located exactly in the middle of a series of measured values (sorted by size). This option uses the median values as evaluation basis.						
Average	The average is the arithmetic mean of the available measured values. This option uses the arithmetic mean of the measured values as evaluation basis.						
Deviation range	[Only visible if Rating Thresholds is selected] Settings for determining the rating: <table> <tr> <td>Deviation range</td><td> The deviation range is indicated as a percentage of the cable length. In proximity to joints or terminations, partial discharges occurring within the deviation range are assigned to these and are included in the determination of the rating. </td></tr> <tr> <td>Thresholds</td><td>It is possible to modify the evaluation thresholds for the various types of joints, insulations and terminations.</td></tr> </table>	Deviation range	The deviation range is indicated as a percentage of the cable length. In proximity to joints or terminations, partial discharges occurring within the deviation range are assigned to these and are included in the determination of the rating.	Thresholds	It is possible to modify the evaluation thresholds for the various types of joints, insulations and terminations.		
Deviation range	The deviation range is indicated as a percentage of the cable length. In proximity to joints or terminations, partial discharges occurring within the deviation range are assigned to these and are included in the determination of the rating.						
Thresholds	It is possible to modify the evaluation thresholds for the various types of joints, insulations and terminations.						

Modifying thresholds

The limits for the rating sections of the cable system elements are defined by setting the thresholds. The following recommended actions apply to these rating sections.



It's possible to select several elements simultaneous to change their thresholds. Selected elements are underlaid in colour. Their thresholds are displayed below the selection list. They can be adapted via sliders. A distinction is made here as to whether the elements are considered to be new or aged.



Unsaved changes are marked in the selection list with .



As soon as the limit value on file is exceeded in a measurement, the software adopts the lower rating.

The following buttons are available to change the threshold values:

Button	Description
Save all changes	All changes to the thresholds are saved.
Undo unsaved changes	All unsaved changes are discarded. For selected elements, the saved thresholds are displayed.
Reset to factory defaults	All thresholds are set back to default settings and saved.
Import	Import thresholds in *.rat format from a local storage device.
Export	Currently saved threshold values are exported in *.rat format to a local storage device.

5.3 Category Printout

Within this category, it is possible to modify the content of the diagnostic report to your needs and to create any number of templates.

When the software is delivered, a template that satisfies the typical requirements for a diagnostics report is already included. However, this template cannot be modified or deleted.

Managing templates

Using the following buttons on the top of the screen, any number of individual templates can be created, edited, copied and also deleted:

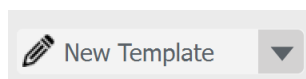
Button	Description
	Creating a new template
	Rename currently selected template
	Delete currently selected template
	Save changes to currently selected template
	Duplicate currently selected template under new name
	Import templates in *.pddt format from a local storage device
	Export currently selected template in *.pddt format to a local storage device

Creating a new template

Proceed as follows to create a new template:

1. Use the button  to create a new template.
2. Customise the content that a report based on this template should include based on your needs.

As soon as the template is modified, the icon  in the name field indicates unsaved changes.



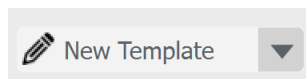
3. Save the changes using the  button.

Modifying the content of a template

Proceed as follows to modify the content of a template:

1. Using the pull-down menu, select the template that you want to modify.
2. Customise the content that a report based on this template should include based on your needs.

As soon as the template is modified, the icon  in the name field indicates unsaved changes.



3. Save the changes using the  button.

The following contents can be added to or removed from the report template based on your needs:

Category	Content
PDF-Quality:	Using these checkboxes it can be specified whether the PDF reports generated with this template should have a resolution of 100 DPI or 300 DPI.
Address / Logo	Address and logo that should appear in the header of the report.
General information about the cable	Data of the diagnosed cable. Cable data, cable plan and joint plan can be activated or deactivated individually.
Rating and Recommendation	[Only visible with the optional software package PD SW package "Rating"] Rating and recommendation for the diagnosed cable. Rating and recommendation can be activated or deactivated individually.
Custom Text	This segment can be used to add any number of custom text modules to the template. For example, this could be frequently used phrases, hints or recommendations, which are then activated or deactivated as needed in preparation for the actual report creation. The order of the modules can be adjusted using the  and  buttons. Clicking on the  button deletes the text module.
Summary	Tabular overview of the key measurement data (for example, PDEV, PDIV and charge level at various voltage levels). The voltage levels to be included in this summary table can be set during the preparation of the report (Preparing and Printing the Report).
Calibration	The TDR images of the various phases recorded during calibration.

PD-Mapping

List of the PD mappings to be included in the report.

PD-Mapping

☒ Cable plan ☒ Histogram ☒ Important Positions 2 ranges selected

☒ ☐ ☐ ☐

Voltage Range from 0.0 Uo to 1.0 Uo ☐ max

Min Uo Factor	Max Uo Factor	All Phases	L1	L2	L3
0.0	1.0	☒	☒	☒	☒
0.0	max	☒	☒	☒	☒

The checkboxes in the first line can be used to specify which information is to be displayed in each of the PD mappings contained in the report (cable plan, histogram, important positions, non-relevant PD events and non-localized PD events).

The list of PD mappings contained in the report can be shown using the button.

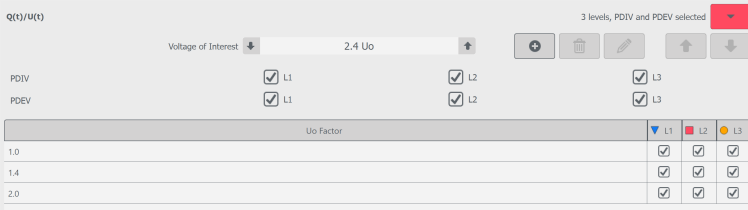
To add a PD mapping to the list, the voltage range must first be configured and then the button pressed.

Double-clicking in the corresponding table cell is sufficient to change the parameters (voltage values, phases) of an existing entry.

Using the and buttons, the order in which the PD mappings appear within the report can be changed.

To delete a PD mapping from the list, first select it and then press .

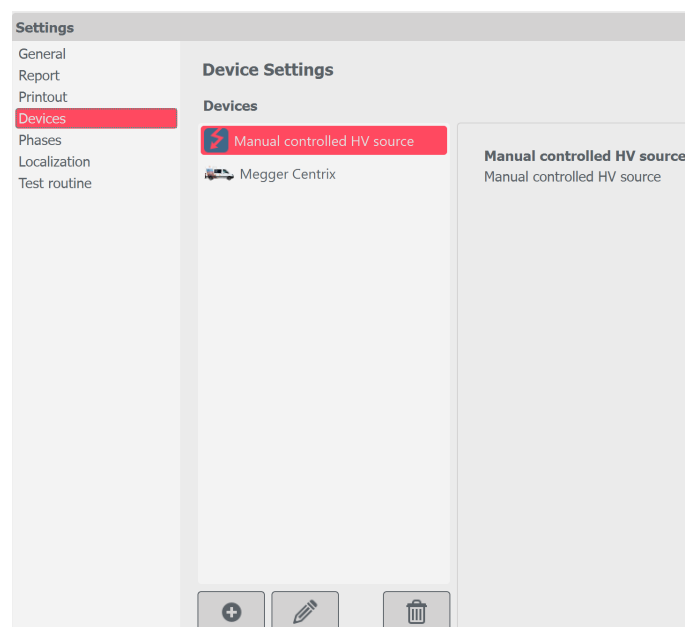
Using the and buttons, you can also specify whether the pulses classified as insignificant should also be displayed. This setting applies for all PD mappings included in the report.

Category	Content
Q(t)/U(t)	List of the Q(t)/U(t) diagrams to be included in the report.  The Q(t)/U(t) diagrams for the inception voltage (PDIV) and the extinction voltage (PDEV) are included by default (but can be disabled by unchecking the individual phases). To add another diagram to the list, the voltage level must first be selected and then the  button pressed. Double-clicking in the corresponding table cell is sufficient to change the parameters (voltage values, phases) of an existing entry. Using the  and  buttons, the order in which the diagrams appear within the report can be changed. To delete an entry from the list, first select it and then press .
PRPD	PRPD diagrams of the individual phases.
Localization Diagrams	The TDR diagrams which have been selected during the preparation of the report (Preparing and Printing the Report).
VWD Plots	The VWD diagrams which have been selected during the preparation of the report (Preparing and Printing the Report).
I-Leak Plots	The Leakage Current Diagrams which have been selected during the preparation of the report (Preparing and Printing the Report).

5.4 Category Devices

Within this category, all devices configured are listed. If one of the devices is selected, its settings are shown in the right section of the screen. In general, these settings (in particular the network and connection settings) should only be changed at the request of a service employee.

All changes that the user may make independently on the device configuration are described in the following sections.



Adding/removing devices

In general, the available devices are already added to the software in the factory. If, however, the software needs to be reinstalled or an additional device that can be used for the PD measurement is purchased, using the buttons directly under the device list the following changes can be made.

Button	Description
	Add new device to list. In addition to the device type, which must be set, a name or comment can also be added optionally.
	Change type, name or comment of the currently selected device.
	Delete currently selected device.



It is recommended that the device list is kept as small as possible and that devices are only added that are actually used regularly in combination with this software installation. In this way, device selection is made faster and easier at the start of a new measurement task. When the device list only contains one voltage source and one PD detector, this selection becomes unnecessary.

Updating the firmware of a PD detector

To be able to update the firmware of a PD detector, it must first be selected in the list of devices. Preferably, a firmware update should be performed prior or subsequent to a measurement when the system is properly erected and connected.

After a network connection to the PD detector has been established **Connect**, the firmware file (.pddf) can be selected using the **...** button. Only after a suitable file has been selected can the update process be started by clicking on the **Update firmware** button.



The system must not be switched off during the entire update process!

5.5 Category Phases

To be able to distinguish the curves and PD events of the different phases, the colours and labels used for the display can be changed in this screen.

The screenshot shows the 'Settings' menu on the left with 'Phases' highlighted. The main area is titled 'Phase settings' and contains three entries: '1. Phase L1' with a blue triangle icon, '2. Phase L2' with a yellow square icon, and '3. Phase L3' with a red circle icon.

Changing the phase designation

By default the designations used are L1 for phase 1, L2 for phase 2 and L3 for phase 3.

To change the designations, the required identifier has to be entered into the field to the right of the respective phase.

The change is instantly adopted. It's also changed in each measurement task that is either newly created or reloaded. Reports already stored in *.pdf format remain unchanged. To get the changed designations adopted into those, the reports have to be newly created.

Changing the colour of the phase symbols

Use the button of the respective symbol to change the colour of a phase symbol. A window opens where the colour can be adjusted.

Preset default colours

The following colors are preset for the respective phase by default:

Phase	HTML colour code
Phase 1	#127bf6
Phase 2	#ffa500
Phase 3	#ff4960

5.6 Category Localization



This category is not relevant for the use of MV DAC-30.

Changes to these settings can impact the results of the PD localisation in a negative way. It's necessary to redo the calibration after changing the settings!

In this category, settings can be made that influence the localisation of partial discharges.

Localization

Warning: The following settings could adversely affect the PD localization results! After changing this settings you must recalibrate!

Localisation start at -100m ☒

Polarity check ☒

Dynamic Bandwidth ☒

Maximum number of localisations in VLF SIN modes 5000

Default

The following settings can be made in this category:

Field	Description
Localisation start at -100m or Localisation start at -328ft	This function allows partial discharges that occur at the far end to be assigned to the far end in the "Localisation" view (Available diagram types).
Polarity check	With the polarity check active, only those pulses for which the original pulse and the reflection have the same polarity are considered as possible partial discharge pulses. This procedure complies with the requirements of the normal partial discharge measurement, which is why the polarity check should not normally be disabled! For special applications, such as pinpointing partial discharges with a pulse generator, original pulse and reflection may have different polarities. In such cases, the polarity check must be disabled temporarily.
Dynamic Bandwidth	If this function is active, based on the cable length, the optimal bandwidth for the localisation is calculated and used. Otherwise, the localisation is always performed with the maximum bandwidth. Using dynamic bandwidth is recommended for measurements.
Maximum number of localisations in VLF SIN modes	In VLF sine wave modes, the amount of incoming and processed localization results can reach very high levels depending on the duration of the measurement. Though, a limitation of the maximum value is only necessary if the error message "Processing Pipeline limit reached!" is repeatedly displayed during measurement indicating that the processing power of the computer in use is not sufficient.

5.7 Category Testroutine

Within this category, it is possible to create and adjust test routines to your needs. They can be enabled oder disabled.

The following settings can be made in this category:

Field	Description
Enable test routine	Enable or disable the use of test routines
Manage test routine:	Dropdown menu for selecting the respective test routine
	Create new test routine
	Delete currently selected test routine
	Save changes to currently selected test routine
	Duplicate currently selected test routine under new name
	Import test routines in *.trt format from a local storage device
	Export currently selected test routine in *.trt format to a local storage device
Name:	Free text field for changing the name

The editing of test routines is only possible while the field **Enable test routine** is enabled.

Editing test routines

Manage test routine:

Testroutine-1

Edit test routine

Name:
Testroutine-1

Voltage curve [Uo]

Step	Voltage [Uo]	DAC +/- [shots]	VLF Sin [periods]	Slope [periods]
1	0.05	1	5	3
2	0.10	2	5	3
3	0.15	3	5	3

When editing the individual steps, the following settings can be made:

Setting	Description
Step	It's possible to add new steps via the button
Voltage	Adjusting the test voltage with regard to Uo The selected test voltage is used for all measurements in this step.
DAC +/-	Shot quantity for this step in DAC mode
VLF Sin	Period quantity for this step in VLF Sinus mode
Slope	Period quantity for this step in VLF CR Slope mode
	Delete step from test routine

The settings for each individual step can be adjusted via the and buttons.

Creating a new routine

Proceed as follows to create a new test routine:

1. Use the button to create a new test routine.
2. Customise the name of the test routine in the free text field **Name:**.
3. Add a step to the test routine using the button in the column Step.
4. Customise this step to your requirements.
5. Repeat steps 3 and 4 until the test routine meets your requirements.
6. Save the changes using the button.

Editing an existing routine

Proceed as follows to edit an existing test routine:

1. Select a test routine from the dropdown menu `<html><head/><body><p><span style=" font-weight:700;">Manage test routine:</span></p></body></html>`.
2. Customise the name of the test routine in the free text field **Name:**.
3. Adjust the already existing steps to meet your requirements.
4. If necessary, add a step to the test routine using the button  in the column Step.
5. Customise this step to your requirements.
6. Repeat steps 4 and 5 until the test routine meets your requirements.
7. If necessary, delete steps no longer needed via the button .
8. Save the changes using the  button.

6 Cable manager

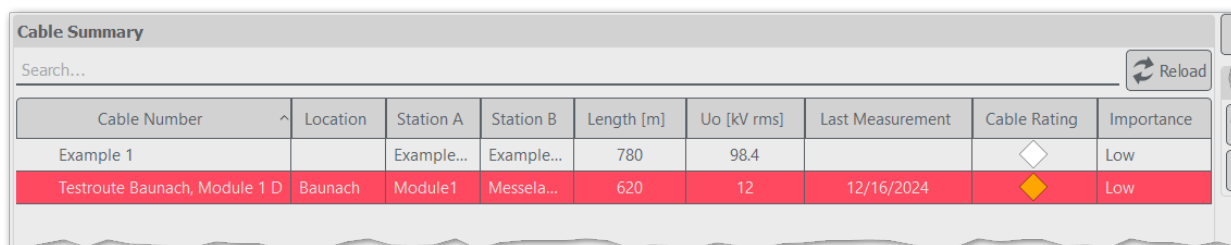
The cable manager  serves for maintaining the cable data. These are stored in a local database, which is also used by the MeggerBook Cable protocol software (if also installed on the computer). This ensures that the cable data is consistent across all applications installed on the machine, i.e. any changes to the cable data will be effective in the other application as well.

In addition to the cable data, the cable manager also shows and manages all measurement tasks carried out on the respective cables.

6.1 Viewing Cable Data and Administrating Measurement Tasks

Selecting a cable

In order to be able to look at the technical details, the sections or the measurement tasks of one particular cable, this cable needs to be selected from the list of available cables first of all:



The screenshot shows a window titled "Cable Summary" with a search bar and a "Reload" button. Below is a table with the following data:

Cable Number	Location	Station A	Station B	Length [m]	Uo [kV rms]	Last Measurement	Cable Rating	Importance
Example 1		Example...	Example...	780	98.4			Low
Testroute Baunach, Module 1 D	Baunach	Module1	Messela...	620	12	12/16/2024		Low

If changes were made to the cable data in the MeggerBook Cable protocol software during the current session, the cable list displayed should be reloaded using the **Reload** button.

In the event of an especially comprehensive cable list, the displayed cables can be filtered with the aid of the search function ([Useful Features of the Software](#)).

Details view

As soon as a cable has been selected, a table with the general cable data of the cable is displayed in the lower screen area (tab **Details**):

Cable Number	Testroute Baunach, Module 1 D	U ₀ [kV rms]	12.00
Cable Type	Three single-core	Length [m]	620
Installation Date		Last modified	09.01.2025 11:20
Comment	Test Baunach, Field D		

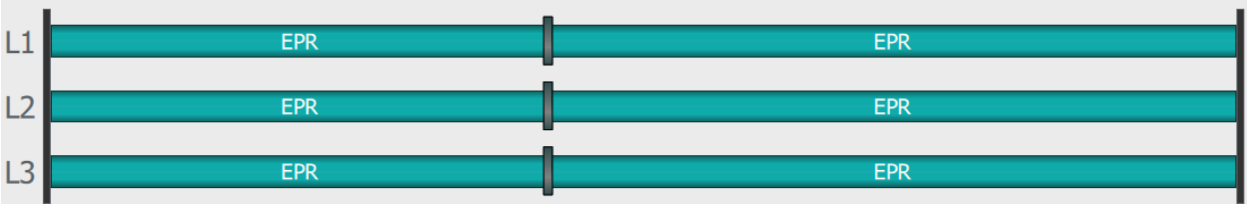
**Module1**

City	Baunach
Manufacturer	Megger
Insulation	Air insulated
Termination	Heat-shrink

**Messelager**

City	Baunach
Manufacturer	Megger
Insulation	Air insulated
Termination	Heat-shrink

Cable length: 620 m



Details Sections Measurement Tasks

Cable sections

Under the **Sections** tab, detailed information on the individual cable segments can be viewed:

Phase	Joint		Insulation	Position [m]	Length [m]	Installation Date
▼ L1		EPR	 EPR	0	260	
▼ L1	#1 Heat-shrink	EPR	 EPR	260	360	
■ L2		EPR	 EPR	0	260	
■ L2	#1 Heat-shrink	EPR	 EPR	260	360	
● L3		EPR	 EPR	0	260	
● L3	#1 Heat-shrink	EPR	 EPR	260	360	

Details **Sections** Measurement Tasks

Measurement Tasks

The **Measurement Tasks** tab provides a list of all measurements conducted on this cable system. An active measurement task is marked in bold.

Load

Delete

Cleanup

Show Report

Export Report

Resume Task

Clone Task

Date / Time	Tester	Measured at	Location	Report	PDIV	PDEV	Disturbance Level	Data	DAC+	DAC-	VLF CR	VLF Sin	Rating
16.12.2024 12:22	Megger	Module1	Ba...		✓	✓	✓	✓		✓	✓	✓	⬢
16.12.2024 12:17	Megger	Module1	Ba...										⬢
16.12.2024 12:16	Megger	Module1	Ba...										⬢
12.12.2024 13:48	Megger	Module1	Ba...		✓	✓	✓	✓		✓			⬢
12.12.2024 13:42	Megger	Module1	Ba...										⬢
12.12.2024 13:03	Megger	Module1	Ba...										⬢

Details

Sections

Measurement Tasks

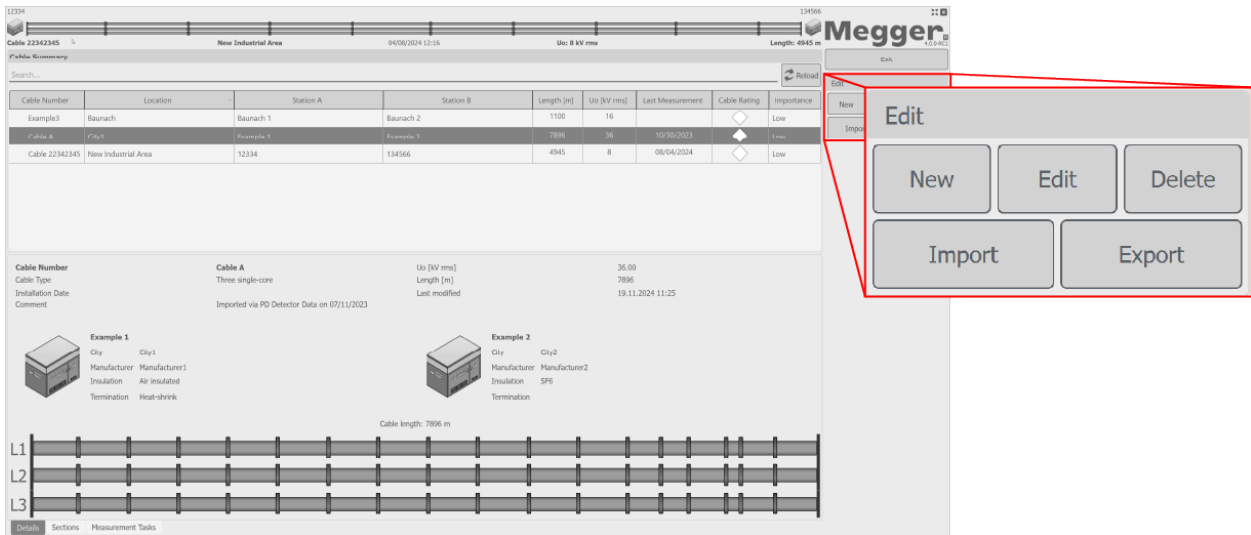
After an item of this list has been selected, the following functions can be called up:

Button	Function
Load	The measurement data of the selected measurement task are loaded into the memory. After a previous measurement task has been loaded, the Evaluating Measurement Results and Creating a Report menu point can be called up via the start screen and the measurement data can be once again evaluated ().  If there is an active measurement task going on at that moment it will be closed. Therefore, current measurements should be finished before loading a previous measurement task.
Delete	The measurement task including all corresponding measurement data is deleted.
Cleanup	This menu item can be used to delete the measurement data of the selected measurement task. This function can be used if, due to many previous measurements, the memory space on the data carrier becomes limited and the measured data are no longer needed. After the cleanup, the last saved state of the report can still be opened and exported. Measurement tasks for which no report has yet been created cannot be cleared.
Show Report	The current report is displayed as PDF file. Prerequisite for this is that a report has already been generated for this measurement task.
Export Report	The PDF file of the current report can be saved in a target directory of your choice. Prerequisite for this is that a report has already been generated for this measurement task.
Resume Task	The measurement task is continued and further measurements can be added to the existing ones. This function is intended to resume interrupted measurements when e.g. the software was terminated unintentionally or a measurement must be completed on the following day.
Clone Task	A new measurement task with the exact same settings is started.

6.2 Managing cables

Functions

With the help of the buttons of the **Edit** menu block, existing cables can be managed and new cables can be created.



The following functions are available in this menu:

Button	Description
New	Create a new cable (Entering/Changing General Cable Data)
Edit	Edit the cable that is currently selected in the cable list (Entering/Changing General Cable Data)
Delete	Delete the cable which is currently selected in the cable list
	 When a cable is deleted, all measurement data of the cable is lost!
Import	Import cable and measurement data (Importing Data)
Export	Export cable and measurement data (Exporting Data)

6.2.1 Entering/Changing cable data

Directly after clicking the buttons **New** or **Edit**, a mask that allows entering/correcting of the cable data appears.

6.2.1.1 Entering/Changing General Cable Data

General cable data are entered in the **General**. Mandatory fields are marked by a coloured background.

Cable Number

Testroute Baunach, Module 1 D

Uo [kV rms]

12.0

Cable Type

Three single-core

Installation Date

21/01/2025

☒ Unknown

Comment

Test Baunach, Field D

Importance

Low



Station A

Name

Module1

City

Baunach

Manufacturer

Megger

Insulation

Air insulated

Termination

Heat-shrink

Browse...

Default



Station B

Name

Messelager

City

Baunach

Manufacturer

Megger

Insulation

Air insulated

Termination

Heat-shrink

Browse...

Default

General

Sections

Module1

Cable length: 620 m

Messelager

L1

EPR

EPR

L2

EPR

EPR

L3

EPR

EPR

The following entry forms allow entering the cable parameters:

Entry form	Description
Cable Number	Number/designation of the cable system The cable number has to be unique and must not be used twice!
Uo [kV rms]	Nominal voltage U_0 of the cable (in kVrms)
Cable Type	Design of the cable system  It is important to select the Three single-core option for cable systems which exhibit differences in the insulation type between the individual phases. Only then can this type of inhomogeneity actually be represented when entering the cable sections (Specifying the sections of the cable).
Installation Date	Date of the installation / initial operation
Comment	Helpful comments regarding the cable's history

Beyond, with the help of the following buttons and entry forms, detailed information regarding the technical conditions on both ends of the cable can be entered.

Entry forms / Buttons	Description
Name	Name of the respective switchgear/substation
City	Location of the respective switchgear/substation Synchronising: If the  button is activated, the entries for the field City for switchgears/substations A and B are synchronised.
Manufacturer	Type/manufacturer of the switchgear
Insulation	Insulation of the switchgear
Termination	Type of the cable termination
Browse	With this button, a meaningful picture of the switchgear can be imported into the software and can be saved with the cable data.
Default	With this button the picture of the switchgear is reset.

6.2.1.2 Specifying the sections of the cable

Via the tab **Sections** you get to the second entry form in which all cable types and joints of all cable sections have to be specified.

Edit Cable

Add
Insert
Edit
Cut one Phase
Cut all Phases
Remove

Phase	Joint		Insulation	Position [m]	Length [m]	Installation Date
▼ L1		EPR	 EPR	0	260	
▼ L1	#1 Heat-shrink	EPR	 EPR	260	360	
■ L2		EPR	 EPR	0	260	
■ L2	#1 Heat-shrink	EPR	 EPR	260	360	
● L3		EPR	 EPR	0	260	
● L3	#1 Heat-shrink	EPR	 EPR	260	360	

General
Sections

Module1
Cable length: 620 m
Messelager

L1
L2
L3

EPR

EPR

EPR

EPR

EPR

EPR

Specifying the cable sections

The following functions are available in this menu:

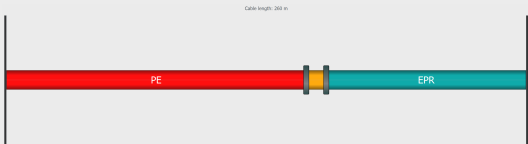
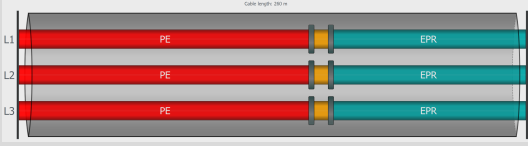
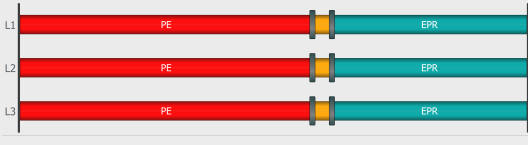
Button	Description
Add	Adds a section at the far end of the cable.
Insert	Inserts a section to the left of the currently selected section.
Edit	Enables changing of the characteristics of the selected section.
Cut one Phase	Enables cutting of one phase of the selected section.
Cut all Phases	Enables cutting of all phases of the selected section.
Remove	Removes the currently selected section.

General notes

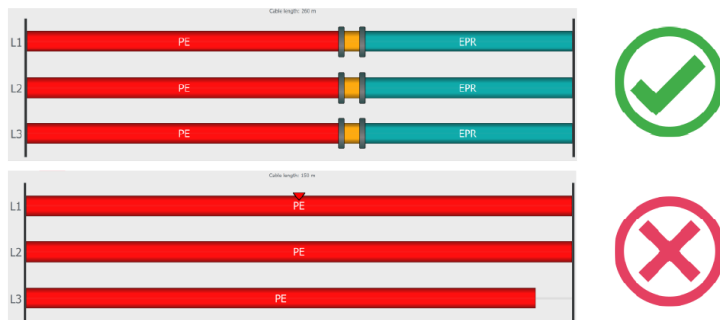
In case of homogeneous cable systems without joints exactly one section with the total cable length needs to be specified. The individual sections of cables with several sections must be entered step-by-step (starting with the cable end defined as **Station A**). The individual section lengths and the respective insulation types must be specified as exactly as possible. This makes it easier to identify relationships between PD faults and joint positions following the measurement, and incorrect conclusions can be avoided.

Depiction of the different cable types

The different cable types are depicted as follows:

Cable Type	Depiction
Single-core	
Three-core	
Three single-core	

For three phase cable systems, it is possible to enter cable sections for all three phases at once as well as for each phase individually. However, after completing entry, it must be ensured that all three phases exhibit the same total length:



Adding/Editing a section

After pressing one of these buttons (Add, Insert, Edit), a new window for entering/editing the section data opens.

Phase ☒ All Phases ☐ L1 ☐ L2 ☐ L3

Cable Type

	Description	Insulation	v/2 [m/μs]
<input checked="" type="star"/>	3x1x400+50 PEX-AL	XLPE	83
<input type="star"/>	Default (Default)	Unknown	80
<input type="star"/>	EPR	EPR	80
<input type="star"/>	Mixed	Mixed	76
<input type="star"/>	PE	PE	83
<input type="star"/>	PILC	PILC	80
<input type="star"/>	PVC	PVC	76
<input type="star"/>	TR-XLPE	TR-XLPE	76
<input type="star"/>	Unknown	Unknown	80

Length [m] 140

Joint

Installation Date ☒ Unknown

☒ Add additional section

The following properties can be defined:

Parameter	Description
Phase	Phase(s) of the cable system to which the changes should be applied (only available for cable types Three single-core or Three-core).
Cable Type	Cable type of the section The type can be selected from all the cable templates created. When delivered, a number of typical cable types are already stored in the database. When required, the    buttons can be used to add any number of templates of your own and to administrate existing templates (Managing Segment Templates). When there are a large number of cable templates, the Search and Favourites functions (Useful Features of the Software) can be used to help filter the templates displayed.
Length [m]	The length of the cable section in metres When adding a new cable section before the marked section, an additional tickbox is made available in this line. If this box is ticked, the length of the new section is subtracted from the length of the marked section (which is equivalent to cutting the marked section). If this box is not ticked, the marked section retains its original length and the total length of the cable is extended by the length of the new section (which is equivalent to the actual insertion of a new piece of cable).
Joint	Type of joint connecting the current cable section with the previous cable section. Accordingly, no selection need be made for the first section of a cable. The joint type can be selected from all the templates created. When delivered, a number of typical joint types are already stored in the database. When required, the    buttons can be used to add any number of joint templates of your own and to administrate existing templates (Managing Segment Templates).
Installation Date	Date of the installation of the cable section

Editing is completed using the **Add**, **Insert** or **Edit** buttons, and the section is added. The editing window is closed using the **Close** or **Cancel** buttons.

When adding new sections to the cable end, it is possible to continue adding another section directly if the **Add additional section** checkbox has been activated and the button **Add** has been used.

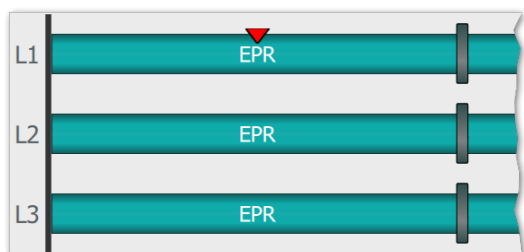
Cutting cable sections

If a cable was cut and a joint inserted during maintenance work, this change can also be made to the digital image of the cable using the buttons **Cut one Phase** and **Cut all Phases**.

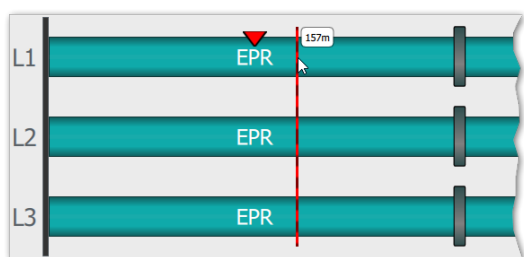
Proceed as follows to do so:

1. Select the cable section to be cut from the list or directly in the cable plan.

The selected section is marked with a red triangle.



2. Using the buttons placed above the list, activate the desired cutting mode.
3. Select the position where the cut was made by hovering the mouse over the respective section/phase in the cable plan. Using the mouse wheel, the position can be finely adjusted.



4. Click to make the cut.

6.2.1.3 Saving Cable Data

After the cable data have been entered as completely as possible, the new or edited cable can be saved via the button **Adjust to Target** at the right bottom side of the screen.

With the button **Cancel** the entry form will be closed without saving and all performed changes are discarded.

6.2.1.4 Managing Segment Templates

Introduction

To be able to specify the cable and joint types in a cable section explicitly, the corresponding templates must be filed in the database. A number of typical datasets are already stored in the database upon delivery. You can add/manage your own templates directly while editing a cable section ([Specifying the sections of the cable](#)) by using the buttons provided for this:

Phase ☒ All Phases ☐ L1 ☐ L2 ☐ L3

Cable Type Search... ☆ + ✎ 🗑

	Description	Insulation	v/2 [m/μs]
☆	3x1x400+50 PEX-AL	XLPE	83
☆	Default (Default)	Unknown	80
☆	EPR	EPR	80
☆	Mixed	Mixed	76
☆	PE	PE	83
☆	PILC	PILC	80
☆	PVC	PVC	76
☆	TR-XLPE	TR-XLPE	76
☆	Unknown	Unknown	80

Length [m] ↓ 140 ↑

Joint Default (Default) + ✎ 🗑

Installation Date 20/11/2024 ☒ Unknown

☒ Add additional section Add Close

Creating/editing a cable template

A new cable template can be created, and the cable template currently selected can be edited, using the + ✎ buttons. After clicking the button, a new window opens in which the following properties can be defined for the template:

Parameter	Description
Insulation	Insulation of the cable type
v/2	Signal propagation velocity of the cable type as a v/2 value
Description	Unique designation for the cable template
Favorite	The template can be added to the favourites list (★) or be removed from the list (☆) by clicking on the respective symbol (Useful Features of the Software).

Creating/editing a joint template

A new joint template can be created, and the joint template currently selected can be edited, using the   buttons. After clicking the button, a new window opens in which the following properties can be defined for the template:

Parameter	Description
Description	Type or unique designation for the joint template
Default	When this checkbox has been activated, the template is specified as default template for new cable sections

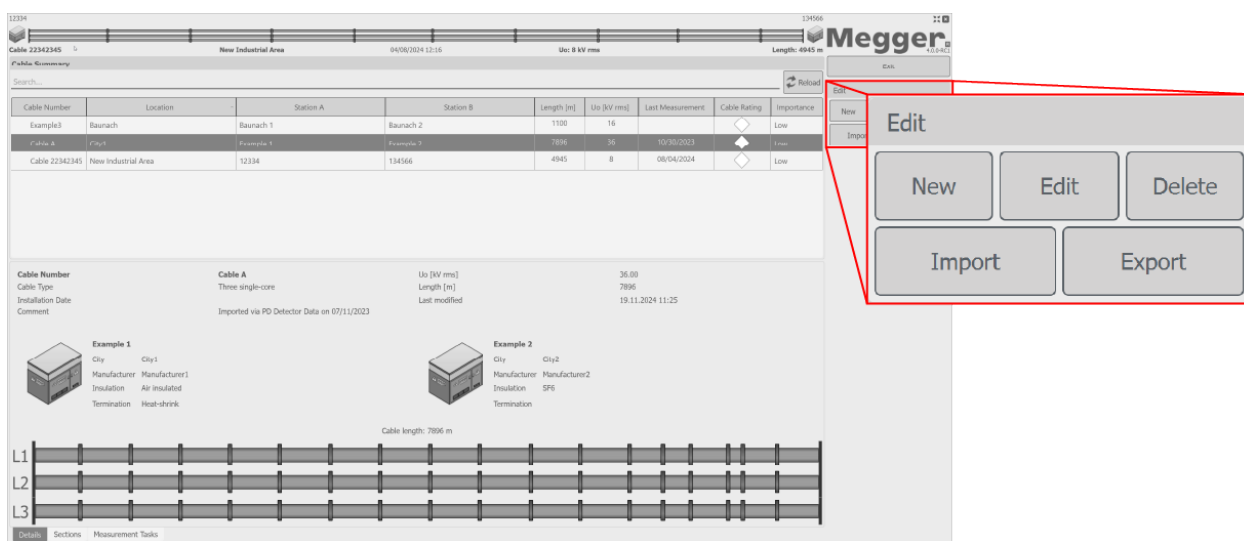
Deleting a template

To delete an existing segment template, this template must be selected first, after which the  button is clicked.

6.2.2 Managing Measuring and Cable Data

With the aid of the import and export assistants, measuring and cable data can be exchanged between the databases of various TE detector software installations. There is also the possibility of importing the measuring and cable data of an OWTS PD diagnostic system.

The assistants for the importing and exporting of data can be accessed via the **Import** and **Export** buttons in the **Edit** menu block.



The screenshot displays the Megger software interface. At the top, there's a header bar with 'Megger' logo and some status information. Below it, a table lists cable data with columns: Cable Number, Location, Station A, Station B, Length [m], U₀ [kV rms], Last Measurement, Cable Rating, and Importance. The table contains three rows of data. Below the table, there's a section for 'Cable A' with details like 'Three single-core', 'Length [m]: 7896', and 'U₀ [kV rms]: 35.00'. There are also two examples of cable configurations, 'Example 1' and 'Example 2', each with a diagram and associated data. At the bottom, there's a diagram of a cable layout with three lines labeled L1, L2, and L3. An 'Edit' menu overlay is shown on the right side of the interface, containing buttons for 'New', 'Edit', 'Delete', 'Import', and 'Export'.



When importing and exporting measurement data, very large amounts of data are copied. If an external storage device is used for export/import, it should be connected to the fastest USB interface (usually USB 3.0 or higher).

6.2.2.1 Exporting Data

Proceed as follows to export cable and measuring data from the local database to a data carrier of your choice:

1. Click on the **Edit** in the **Export** menu block.

Result: The export assistant is opened in a new window.

The screenshot shows the 'Export Assistant' window. At the top right, it says '2 cable(s) selected'. The window is divided into two main sections. The left section, titled 'Cable', contains a search bar, a 'Cable Details' icon, and a 'Reload' button. Below this is a table with columns: 'Cable Number', 'Location', and 'Last Measurement'. The table lists several cables, with the last one, '654584543' at 'New Industri...', selected and highlighted in red. The right section, titled 'Measurement Task', has a checkbox for 'show tasks of selected cables'. Below this is a table with columns: 'Date / Time' and 'Tester'. It shows a task for '04.08.2024 ...' using a 'Megger' tester. At the bottom, there is an 'Export to:' field with a 'Browse' button, and 'Cancel' and 'Next >' buttons.

Cable Number	Location	Last Measurement
987987		
2548787127		
1928381273	122	10/30/2023
102389	Baunach	
654584543	New Industri...	08/04/2024

Date / Time	Tester
04.08.2024 ...	Megger

2. In the left part of the window, select the cables to be exported.
In the event of an especially comprehensive cable list, the displayed cables can be filtered with the aid of the search function ([Useful Features of the Software](#)).
3. In the right part of the window, select the measurement tasks for the cables that are to be exported.
If **show tasks of selected cables** is enabled, the measurement tasks of all selected cables are displayed. If the checkbox is disabled, only the measurement tasks of the currently selected cable are displayed.
4. Use the **Browse** button to select an **empty** directory into which the data should be exported.
5. Click on **Next** and then on **Conclusion** to export the selected data.

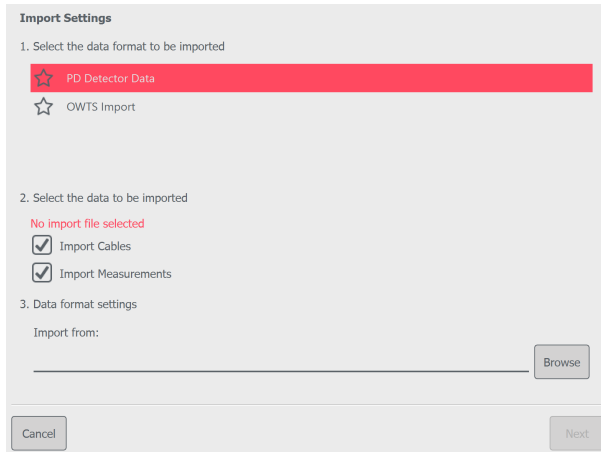
Result: The export is performed. In addition to the exported files and the import file (*.pddd), a file in CSV format is created in the export folder. This contains a short summary of the exported cables and measurement tasks. This makes it possible to recognise which cable data is in the export directory, which enables a precise import of cable data.

6.2.2.2 Importing Data

Proceed as follows to import cable and measurement data:

1. Click on the **Import** in the **Edit** menu block.

Result: The import assistant is opened in a new window.



2. Select the data format to import:

PD Detector data: Measuring and cable data from another TE detector software installation

OWTS: Measuring and cable data from a OWTS PD diagnostic system

3. Tick the data types (cable data, measuring data) that you would like to import.
If the local database does not yet contain any cable data, the cables must be imported.
4. Use the **Browse** button to select the file to be imported. Depending on the file type, the following file should be selected:

PD Detector data: Import file with the extension *.pddd (which was automatically created during data export)

OWTS: Import file StartMask.dat (which was automatically created during data export from the OWTS software)

5. [This setting is only required when OWTS data is to be imported]
Under **Language coding of import data**, select the language that is set in the source system.
This setting is required so the date information can be imported correctly.
6. Click on **Next**.

7. If the import of cable data is activated in the import settings, an overview of the identified cables appears. If required, the basic cable data can be adapted and cables can also be completely excluded from the import.

Imported Cables
The following cables will be imported upon completion of this wizard. [5 of 5]

☒ Select all

Cable Number	Uo [kV rms]	Station A	Station B	Location
102389	16	Baunach 1	Baunach 2	Baunach
1928381273	36	123412322	125645332	122
654584543	8	112165	8162	

Buttons: (next to each cable entry), (bottom left), (bottom right)

Using the **Next** button, the next page of the import assistant can then be accessed.

8. If the import of measuring data is activated in the import settings, an overview appears of the identified measuring tasks that can be excluded from the import if required.

Measurement task(s) Imported
The following tasks will be imported upon completion of this wizard. [2 of 2]

☒ Select all

Cable Number	Cable Location	Tester	Measured at	Created At
1928381273	122	Megger	123412322	30.10.2023 10:36
654584543	New Industrial Area	Megger	112165	04.08.2024 12:16

Buttons: (next to each task entry), (bottom left), (bottom right)

Measuring tasks that are imported without the associated cable data and cannot be automatically assigned to an existing cable are initially excluded from the import.

To be able to import these measurement tasks, the right cable must first be sought in the local database using the **Browse** button and selected by double clicking.

After selecting the measurement tasks intended for import, the next page of the import assistant can then be accessed by using the **Next** button.

9. If the import of measuring data is activated in the import settings, an overview appears of the identified reports that can be excluded from the import if required.

Reports imported
The following reports will be imported upon completion of this wizard.

☒ Select all

☒		Tester Megger	04.08.2024 12:30	Show Import
Cable number 654584543				
☒		Tester Megger	27.03.2024 12:36	Show Import
Cable number 1928381273				

Cancel Next

After selecting the reports intended for import, the next page of the import assistant can then be accessed by using the **Next** button.

10. The data are imported into the local database immediately after the selection of the data to be imported is completed. A summary of the import process is displayed. By clicking on the **Conclusion** button, the displayed changes can be confirmed and the import completed.

Using the **Cancel** button, the import can also still be cancelled at this time. The displayed changes are discarded in this case.

6.2.2.3 Backing Up Data

To prevent loss of data (e.g. in the event of a hard drive defect), it is recommended to regularly perform a backup of the measuring and cable data.

The following data must be saved:

Cable data: File %installation folder%\Megger.mcb

Measuring data: Directory %installation folder%\data\

A suitable backup strategy should be developed by the responsible system administrator.

7 Starting or Resuming a Measurement Task

Before starting the actual measurement, a measurement task  must be created or opened in the first step, under which all recorded measurement data are stored until either the software is closed or a new measurement job is started.

You can either:

- continue a previous measurement task ([Viewing Cable Data and Administrating Measurement Tasks](#)) which had to be suspended due to lack of time or other reasons,
- clone a previous measurement task ([Viewing Cable Data and Administrating Measurement Tasks](#)), if e.g. a repeat measurement has to be performed on a cable already diagnosed (in this case the settings from the previous task are adopted and preset).
- start a new measurement task.

Creating a new measuring task.

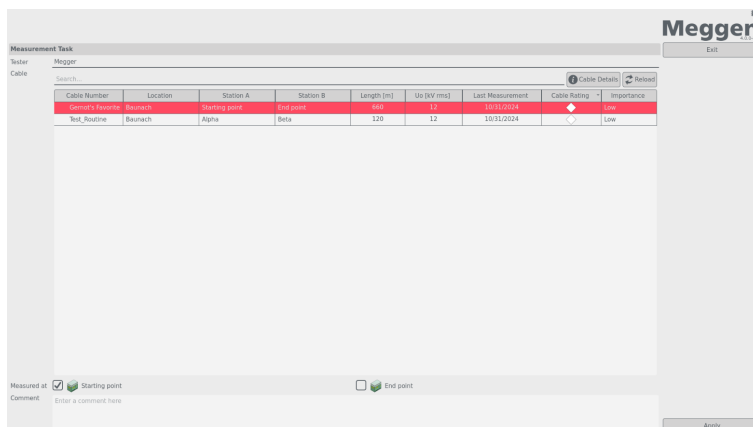


Before starting a new measurement task, ensure that the measurement data recording has been completed for the measurement task currently in progress!

Proceed as follows to create a new measuring task:

1. Call up the menu point  from the main menu of the measurement software.

Result: The following input mask opens.



Cable Number	Location	Station A	Station B	Length (m)	Up HV (mV)	Last Measurement	Cable Status	Impedance
Gerd's Favorite	Baurach	Starting point	End point	660	1.5	10/11/2014	Low	Low
Test_Routine	Baurach	Alpha	Beta	320	1.2	10/31/2014	Low	Low

2. Enter the name of the responsible measurement technician into the input field **Tester**.
3. Select the appropriate entry from the list of the defined cable systems for the measurement task. If needed, use the search and sort functions ([Useful Features of the Software](#)).
Should the cable system not yet be stored in the system, it has to be created before the start of the measurement task ([Entering/Changing cable data](#)).
4. Select the cable end at which the current measurement is conducted under **Measured at**.
5. If required, select **Megger MV DAC** from the **HV source** drop down list.
The drop down list is only available if more than one HV source is configured in the software.
6. If required, select **PD Detector v2** from the **PD Detector** drop down list.
The drop down list is only available if more than one PD detector is configured in the software.
7. If required, enter a few useful details on the measurement task in the **Comment** text field.

8. Click on **Apply** in order to confirm the selection.

Result: The software jumps back to the start screen. The measurement task initialises. The menu point  Calibration is available.



9. Proceed with the calibration ([Calibrating the Partial Discharge Measuring Circuit](#)).

8 Calibrating the Partial Discharge Measuring Circuit

Requirements

In order to be able to conduct a calibration , a new measurement task must have been started beforehand ([Starting or Resuming a Measurement Task](#)). Otherwise the menu point in the start screen is greyed out.

It is recommended to use the supplied calibrator. In principle though, any other calibrator that is in accordance with the requirements of the IEC 60270 can be used.

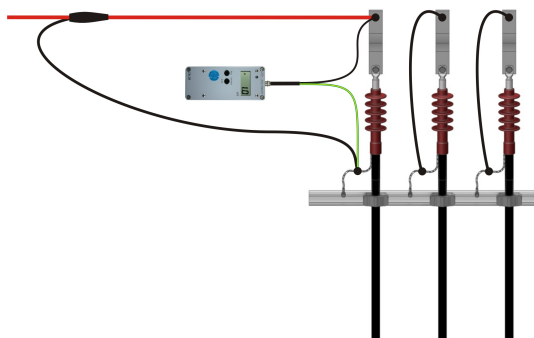
Necessity

After the measurement system has been set up and connected to the test object, the partial discharge measuring circuit needs to be calibrated by measuring current pulses of known charge. Only this way, a reproducible measurement and a reliable evaluation on the basis of comparable measurement data can be ensured.

8.1 Connecting the Calibrator

Connection diagram

The following figure shows the simplified connection diagram:



Procedure

Proceed as follows to connect the calibrator:

1. Connect the black connection line of the calibrator to the screen of the cable that is to be tested.



The connection should be made directly at the cable shield and as close as possible to the point where the shield is fed out of the termination. This way, unnecessary high basic interference levels can be avoided.

2. Connect the red connection line of the calibrator to the phase conductor of the cable that is to be tested.
3. Switch the calibrator on by shortly pressing the  button.

With the help of the  and  buttons the calibration pulse level can be adapted if required. In most cases, however, the calibration can be completed successfully with the preset calibration value of 1 nC.

4. Cancel the earthing and short circuiting measures on both ends of the cable that is to be tested.



Since the supplied calibrator automatically switches off approx. 2 minutes after the last operational action, the actual calibration should be conducted directly after connecting the calibrator.

8.2 Conducting the Calibration

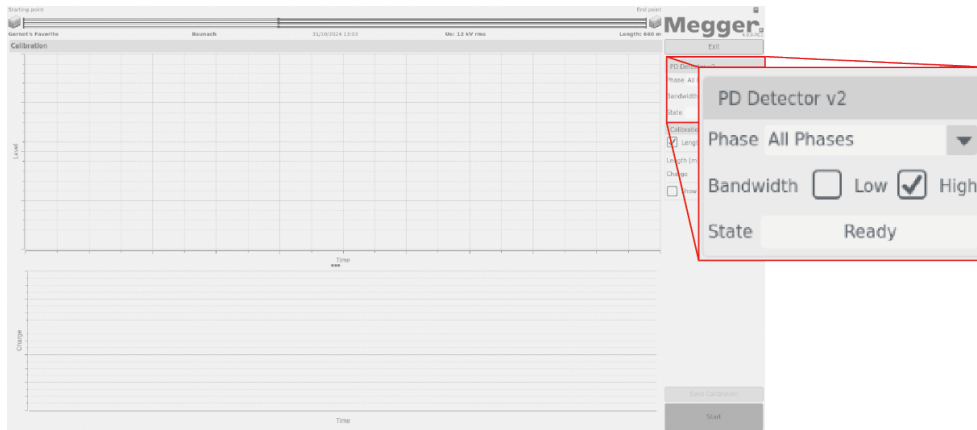
Preparing and starting the calibration

In order to calibrate the partial discharge measuring circuit proceed with the following steps:

1. Call up the menu point  from the main menu of the measurement software.

Result: The connection to the PD detector is being established (the HV source must be switched on). As soon as there is a connection, the **Start** button is activated (green). Otherwise, the cause for the failed connection needs to be determined.

2. Adjust the PD detector settings:



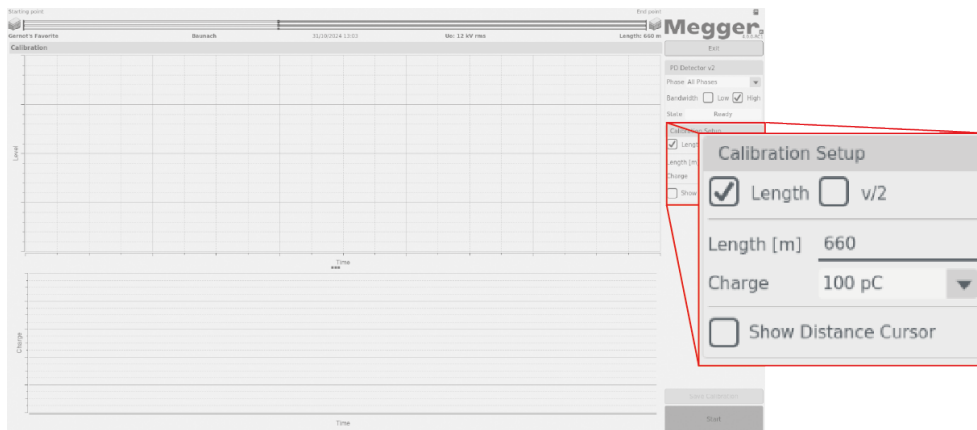
Select from the dropdown menu **Phase** either the phase of the test object that is currently connected to the measuring system or the option **All Phases**.



For 3-core cable systems it is generally sufficient to calibrate the circuit only once and apply the data for all phases. Only if you expect differences between the single phases you should calibrate each phase individually prior to the measurement.

The optimum **Bandwidth** setting is determined by the length of the cable. While a high bandwidth is recommended for short cables (up to 1 km), measuring with a low bandwidth is preferable for longer cables with higher attenuation.

3. Adjust the calibration settings:



The value in the input field **Length** has been adopted automatically from the cable data and normally does not have to be corrected.

Should the length value be uncertain and the exact pulse propagation velocity be known, then the velocity needs to be provided instead. To do so, check the radio box **v/2** and enter the v/2 of the cable into the input field **v/2** (in m/μs).

Select the calibration value that is set at the calibrator from the dropdown list **Charge**.

4. Click the **Start** button in order to start measuring the pulses.

Result: The PD detector measures the incoming pulses and tries to identify the calibration pulses and the respective reflections from the far cable end.

If the pulses are successfully measured, a TDR trace and a charge diagram are displayed in the left area of the window. The calibration process finishes automatically after roughly 15 to 30 seconds, it may also be stopped manually ahead of time using the **Stop** button, provided the pulses and charge level have been successfully calibrated and the markers placed.

If no pulses could be measured, the message **Calibration failed. Using default parameters!** appears in the message list. Check the troubleshooting section for possible causes ([Troubleshooting](#)).

Checking the markers

The quality of the subsequent measurement results depends on various factors, particularly the accuracy of calibration. It is therefore advisable to check the automatic positioning of the markers and correct them if necessary before applying the calibration data.

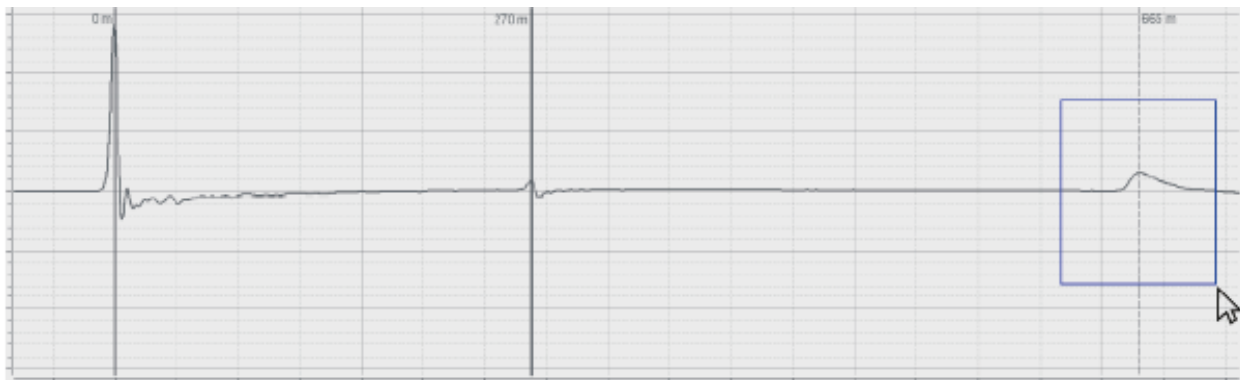
The propagation velocity or the length of the connected cable can be calibrated by means of the TDR trace. For this purpose, the peaks of both the original calibration pulse and the reflection need to be marked.



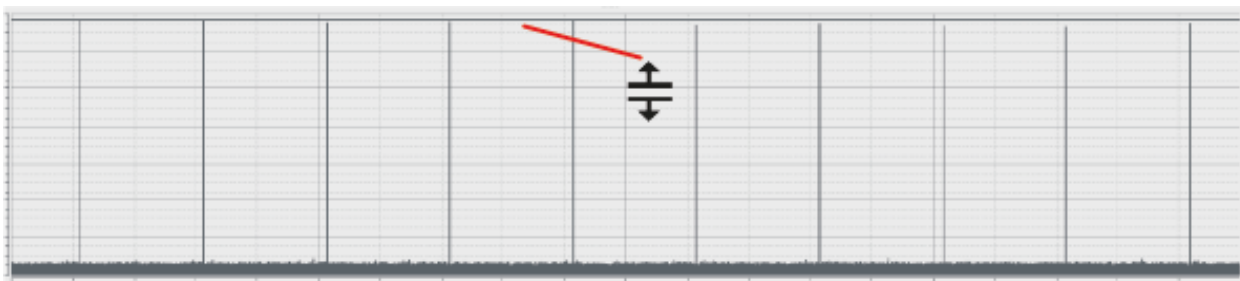
The **Show Distance Cursor** tickbox can be used to display an additional marker and move it along the curve. This allows, for example, the positions of joints to be measured and later entered manually into the cable plan.



If need be, the mouse can be used to drag a box across a specific area, allowing the user to zoom into this range.



In the charge diagram, the line should mark roughly the average value of the periodically measured calibration pulses.



If a correction has to be made, the respective mark has to be clicked once with the left mouse button. As a result, the line width of the marker increases and the mouse pointer changes into the ⚡ or ⚡ symbol. By clicking and holding the left mouse button again, the marker can be freely moved. As soon as the mouse button is released, the marker locks in the current position.

Applying the calibration data

After the markers have been checked and if required corrected, the calibration data can be applied by clicking on the **Save Calibration** button.

8.3 Disconnecting the Calibrator

Prior to the actual measurement, the calibrator has to be disconnected from the cable under test.



WARNING

Follow the five safety rules ([General Safety Instructions and Warnings](#)) before disconnecting the calibrator.

Afterwards, cancel the earthing and short circuiting measures on both ends of the cable that is to be tested. in order to be ready for the measurement.

9 Measuring

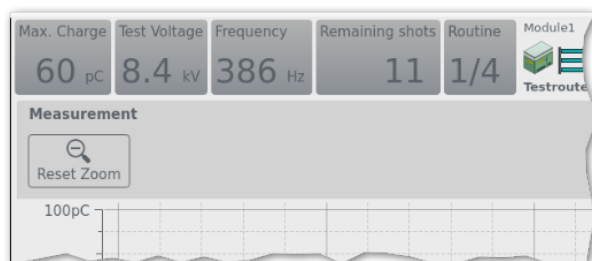
Requirements

In order to conduct the measurement , a new measurement task must have been started ([Starting or Resuming a Measurement Task](#)) beforehand and the partial discharge measuring circuit must have been calibrated ([Calibrating the Partial Discharge Measuring Circuit](#)). Otherwise the menu point in the start screen is greyed out.

9.1 Basic Information Regarding the Measurement Screen

Measurement data display

In the course of the measurement all relevant measurement data / measurement parameters are displayed at the top left screen:

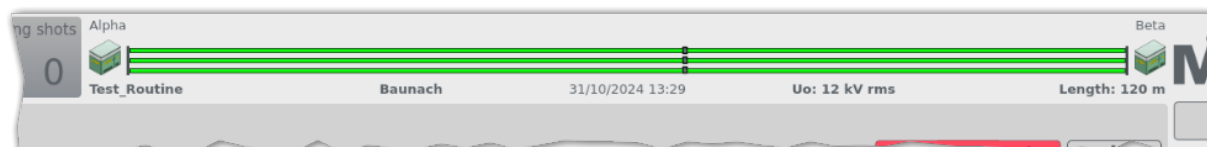


Depending on the set test parameters, a selection of the following values is displayed:

Measurement value	Description
Max. Charge	Maximum charge value that has been measured during last shot
Test voltage	Test voltage as peak value
Frequency	Frequency of the DAC oscillation
Remaining shots	Remaining DAC shots until the end of the ongoing measurement

Cable plan

At the top side of the screen all relevant data regarding the currently connected cable are displayed.

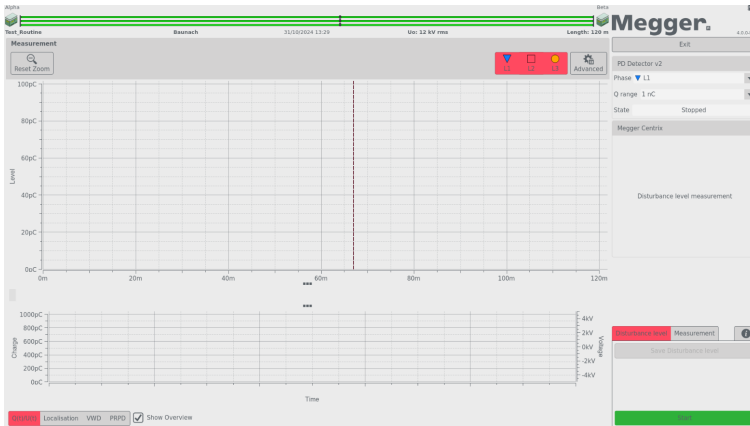


The cable end to which the measurement system is connected is shown on the left side.

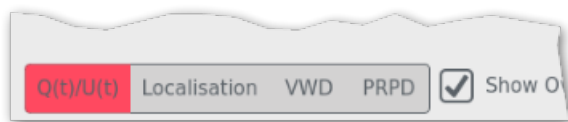
9.2 Available diagram types

Introduction

The measurement screen provides access to various diagrams during the measurement.



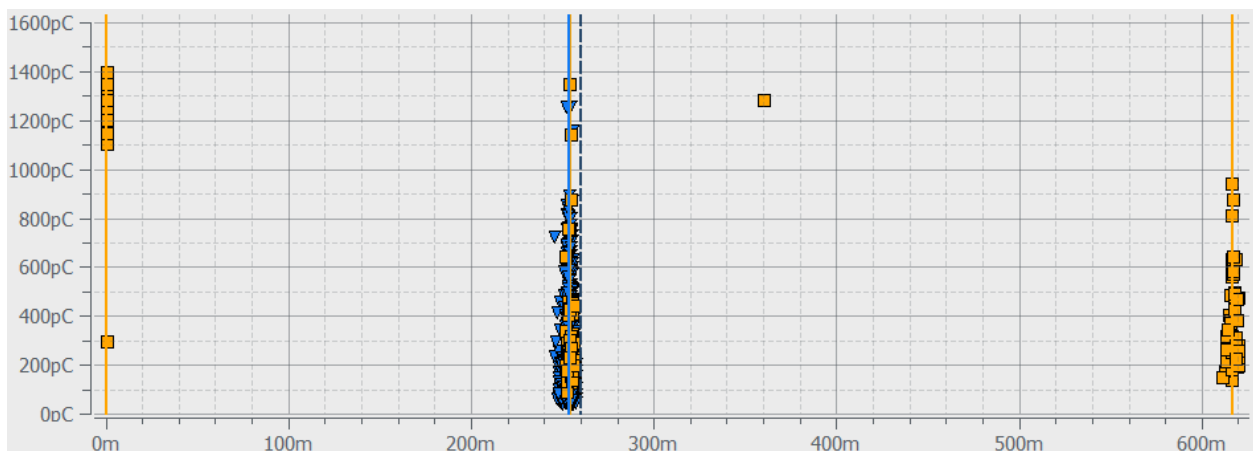
In the upper part of the screen, PD mapping with the previously recorded PD events is displayed by default. The diagram type directly below can be changed during measurements using the tabs at the bottom.



Using the ■■■ buttons between the diagrams, the proportions of the displayed diagrams can be adapted ([Useful Features of the Software](#)) according to the own preferences.

PD mapping

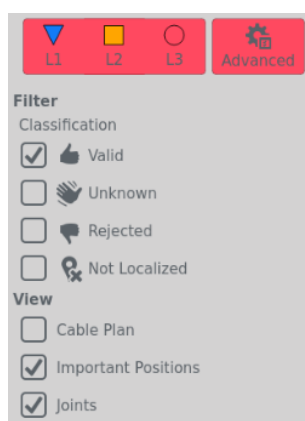
The PD mapping displays the measured partial discharge level in a location-resolved way over the length of the cable.



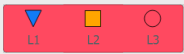
A localised cluster of PD events indicates actual PD faults. These events are shown with the colour and symbol of the respective phase. One-off events, which are most likely not the result of a PD fault, are shown in grey (or not displayed at all depending on the setting).

PD mapping displays the PD events of all measurements performed and saved during the measurement job. If a measurement is intentionally not saved, the corresponding events are removed from the PD mapping at the start of the next measurement.

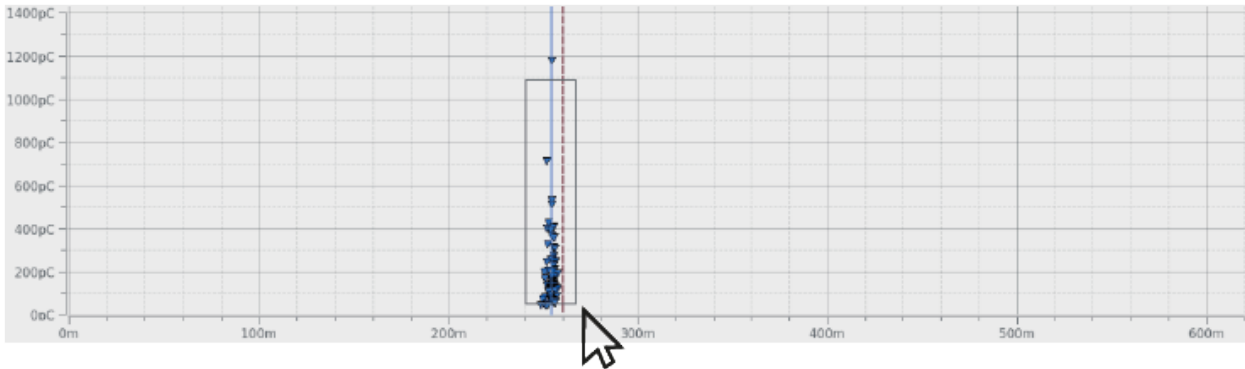
Using the **Advanced** menu item, you can display the advanced view filters and the pulses in the PD mapping can be filtered as you wish to provide a better overview:



The following buttons are available for this purpose:

Button	Description
	Filter view according to phase.
Classification	Show/hide pulses that were not identified (or not definitely identified) as PD.
	 All pulses classified as partial discharge.
	 All pulses classified as possible partial discharges (pale colours) are shown or hidden, respectively.
	 All pulses classified as negligible (grey) are shown or hidden, respectively.
	 Pulses for which no reflection could be determined. These pulses are placed at the beginning of the cable by default.
View	With the aid of these checkboxes, the individual auxiliary indicators (joint markers, cluster markers, cable plan) can be shown or hidden respectively.

In order to enlarge a certain area of the PD mapping, simply draw a frame around the area while holding the mouse button.



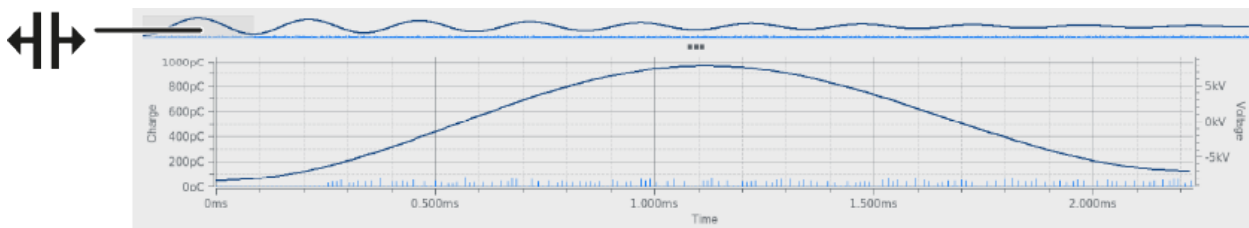
Clicking **Reset Zoom** removes the magnification.

Q(t)/U(t)

The **Q(t)/U(t)** view displays the temporal profile of the measured charge level (the partial discharge pattern) and the excitation voltage.

This type of diagram is particularly suited to detecting partial discharge events and distinguishing them from periodic interference.

In **DAC operation**, a low-resolution overview of the first 7 to 10 intervals (depending on the frequency) is shown above the actual diagram, which shows only one voltage period.

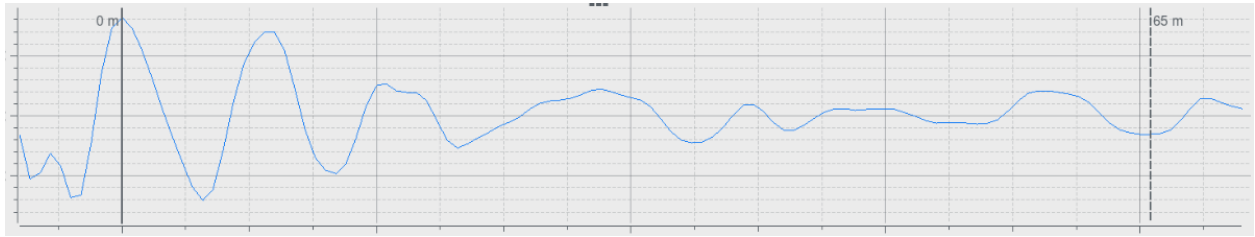


The section with the coloured background can be moved () with the aid of the mouse to any point along the overview for zooming in on a particular time frame. The scroll bar below the overview can be used to scroll through the individual shots of the measurement.

The overview diagram can be shown or hidden using the checkbox **Show Overview**.

Localisation

Once a PD event is recorded during a measurement, the software automatically switches to the **Localisation** view, in which the associated reflection image (TDR image) is shown. The TDR image is updated accordingly whenever another PD event is detected.



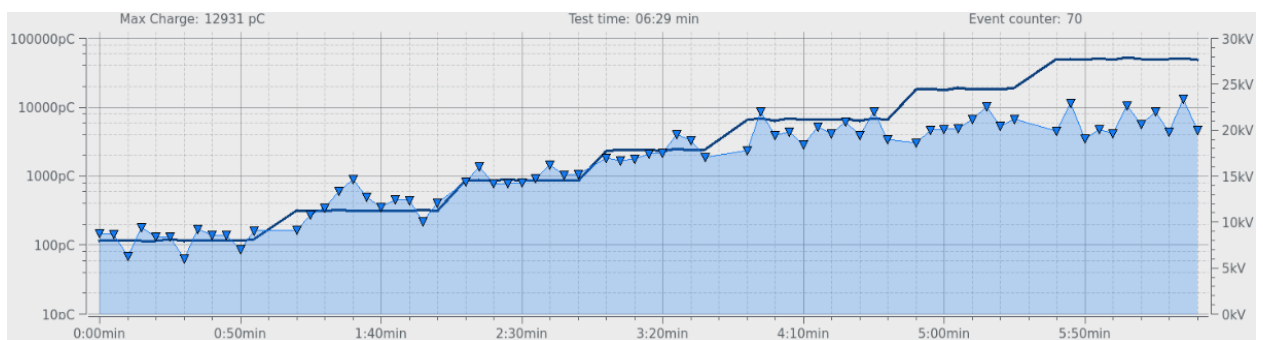
In the upper section of the display, the overview of the recorded measured data is shown. In it, all pulses identified as locatable PD events are marked with black lines. Using the ◀ and ▶ buttons it is possible to switch back and forth between these positions. In the actual diagram, the associated curve is displayed. The displayed time range corresponds to about four times the cable length.

With the scrollbar, depending on the voltage waveform, you can switch back and forth between the recorded measurement windows (the individual shots for DAC, the polarity reversals for VLF-CR or the triggered PD pulses for VLF-SIN).

The checkbox **Switch to this view on any new event** can be used to determine whether the software automatically switches to the localisation diagram with each recorded PD event.

VWD diagram

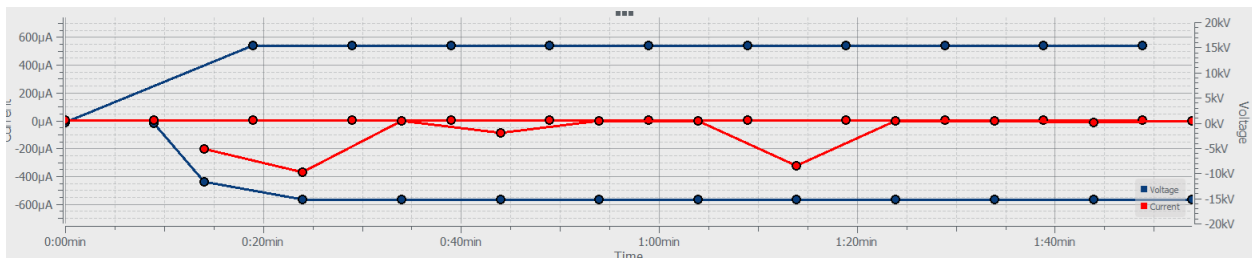
The diagram, which can be called up via the **VWD** tab, shows the trend of the measured maximum charge levels over the course of the measurement. This makes it possible to draw conclusions about a possible change/conditioning of PD faults, in particular if the cable under test is subjected to prolonged voltage stress.



The leakage current diagram is primarily used to detect local moisture in the cable system, which typically appears as a decreasing leakage current trend over time.

Moisture of this kind may occur due to a waterlogged joint or localized wet sections in paper-insulated cables.

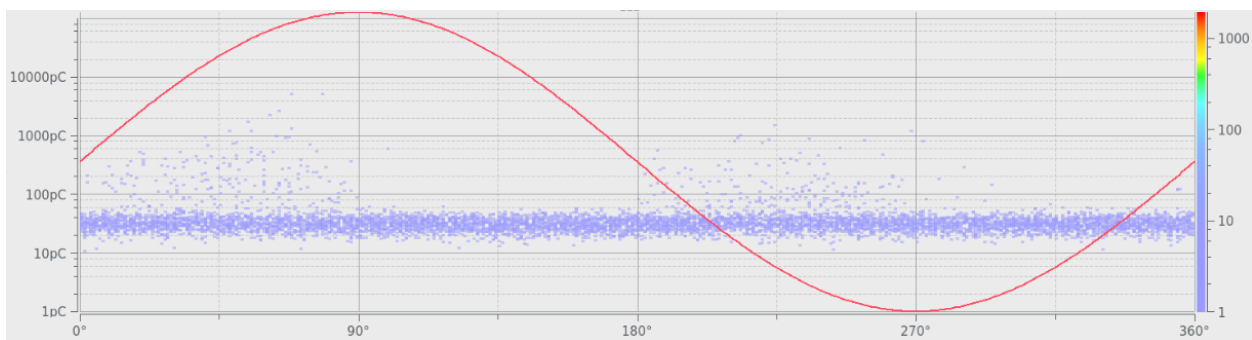
Technical evaluation requires the optional Additional PD Software package "Leakage Current" .



The leakage current indication is only provided during measurements with a cosine square-wave voltage.

Phase-resolved diagram

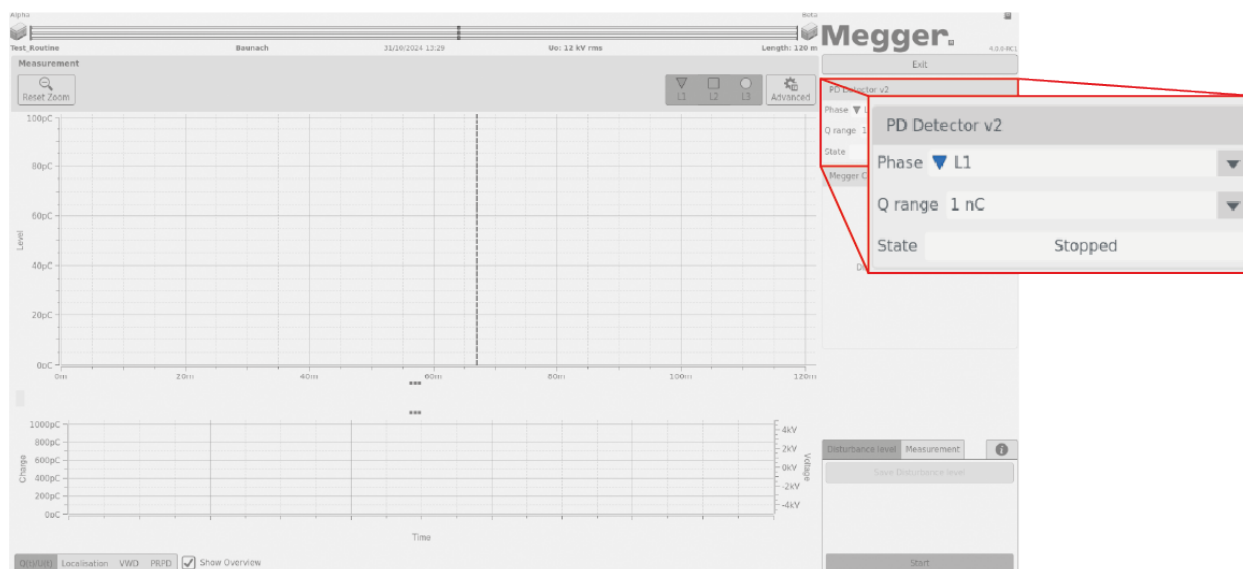
Using the **PRPD** tab, the PRPD diagram (Phase Resolved Partial Discharge) can be displayed, showing the distribution of the charge pulses relative to the phasing of the excitation voltage.



9.3 Setting the Measurement Parameters

Configuring the PD detector

The configuration of the PD detector must be performed through the menu block specially provided for this purpose:

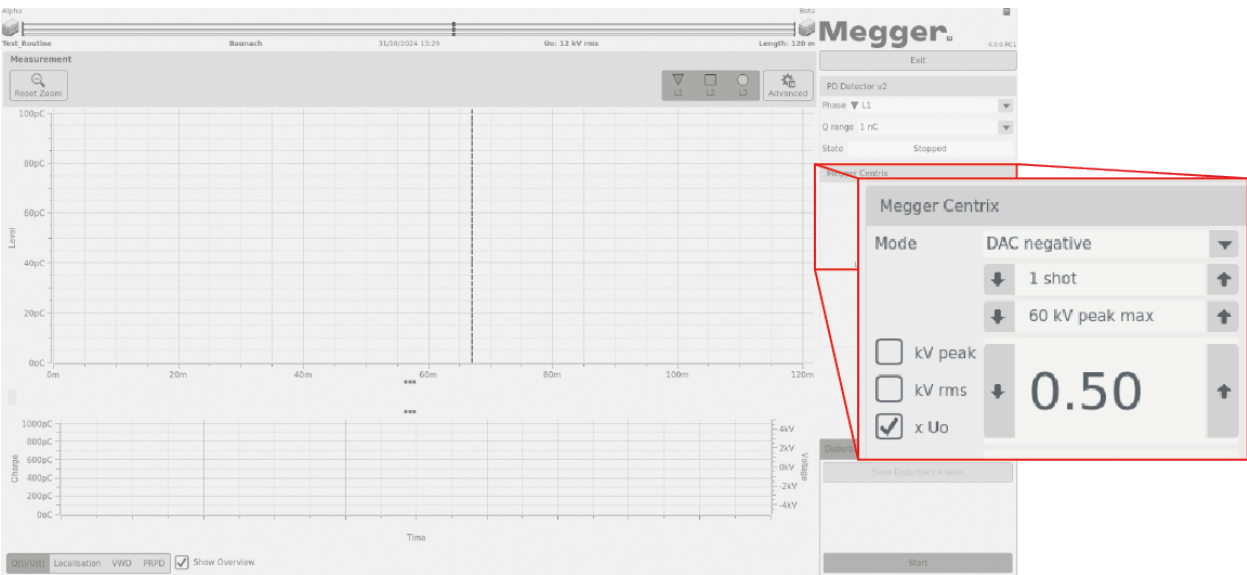


The following settings are possible:

Parameter	Description
Phase	Phase of the cable system currently being measured.
Q range	An optimally set measuring range is critical for ensuring the accuracy of the measured charge values. Before beginning the first measurement, a relatively low measuring range should initially be selected. If the PD level exceeds the set measuring range during the measurement, the message Overflow appears in the message list (Useful Features of the Software). In this case, the measuring range should be increased incrementally and further test measurements performed until the message no longer appears. Each further increase would unnecessarily reduce the sensitivity.

Configuring the test voltage source

The configuration of the test voltage source must be performed through the menu block specially provided for this purpose:



The following settings are possible:

Parameter	Description
Mode	Selection of the desired operating mode :
	DAC negative PD diagnosis with negative DAC voltage. The duration of the measurement is determined by the set number of shots and the voltage can be adjusted during the running measurement. DAC negative Withstand Monitored withstand test with negative DAC voltage and simultaneous measurement of the PD level. The duration of the measurement is specified in minutes and the voltage cannot be adjusted during the running measurement.
Number of shots	Only configurable in the operating mode DAC negative The number of shots (test cycles) can be chosen freely. With the beginning of the measurement, the shots are triggered in quick succession, taking into account the necessary loading and processing times. Every test cycle starts directly with the onset of the DAC oscillation and lasts a maximum of 10 periods. The measured data of the individual measuring cycles are accumulated.
Voltage range	The set voltage range limits the maximum voltage that can be set during the measurement and prevents an inadvertent overload of the connected test object.
Voltage	Specification of the test voltage. The test voltage can be entered as peak value (kV_{peak}), RMS value (kV_{rms}) or multiple of U_0 ($x U_0$). The actual test voltage (peak value) resulting from these settings is displayed at the bottom of the menu block.

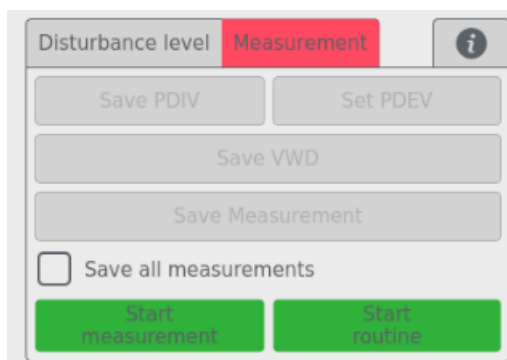
9.4 Performing a measurement

Starting the measurement

Directly from entering the measurement screen, the connection with all devices involved in the measurement is permanently checked. Deactivated buttons and the  symbol indicate connection problems, which have to be solved before the test is started ([Troubleshooting](#)).

Since a series of measurements should always be started with a disturbance level measurement ("zero shot"), the buttons to control the test voltage are not available when entering the measurement screen. They will, however, automatically show up as soon as the noise measurement has been conducted and saved or has manually been skipped by clicking on the **Measurement** tab.

As soon as the system is ready for measurement, the buttons for starting a measurement or test routine light up green and a single measurement or test routine can be started by clicking this buttons.



Activating the high-voltage generator

If high voltage has not already been released during a previous measurement, it needs to be done right after a measurement (except of the noise measurement) has been started. Any deviations from the high voltage switching requirements are displayed in the Message list ([Useful Features of the Software](#)) and the user must then eliminate them.

If all high voltage switching requirements are met, the following symbol appears in the menu block:



Ten seconds remain in which to enable the high voltage using the green illuminated "HV ON" push-button

2.

Directly after being activated, the button goes out and the red "HV OFF" push-button lights up. Load detection is performed automatically. If the capacitance of the connected cable is too high or too low, the measurement is ended directly and a corresponding error message ([Troubleshooting](#)) is displayed.

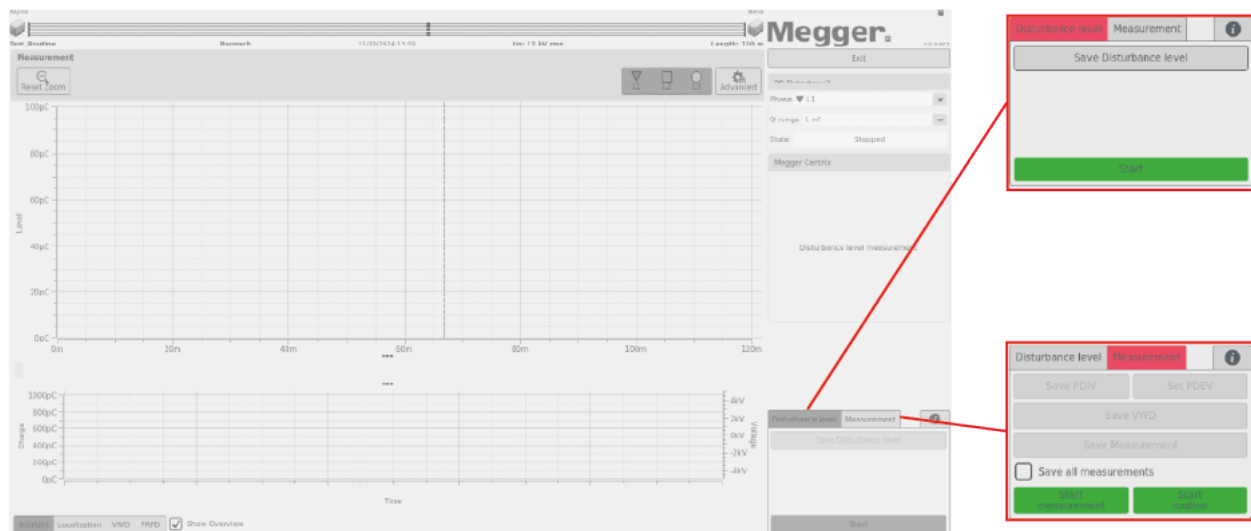


WARNING

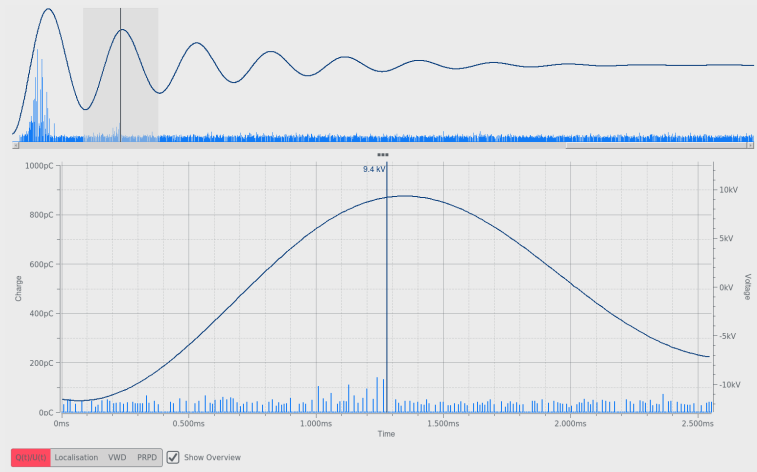
The red illuminated "HV OFF" push-button signals high voltage! The entire measuring circuit should be considered as "live" from this point onward.

Saving test data

The saving of test data is initiated exclusively with the buttons of the menu block specially provided for this purpose.



By default, each completed individual measurement must be saved manually. **Otherwise, the data are discarded when the next individual measurement is started!** Certain defined parameters, such as PDIV and PDEV, are to be saved using specially dedicated buttons. These are accordingly labelled in the test data and output separately in the report. For this purpose, the following buttons are to be used:

Button	Description
Save Disturbance level	This button must be clicked after the obligatory noise measurement ("zero shot") has been completed. Afterwards, the software automatically switches to the Measurement tab and by doing so activates the actual measurement mode.
Save Measurement	Any meaningful measurement, with the exception of the noise, PDIV and PDEV measurements (which are saved through separate buttons), needs to be saved by clicking on this button.
Save all measurements	If this checkbox is checked, any completed individual measurement is automatically saved with no confirmation required. This increases the volume of test data, but also prevents the loss of relevant data due to negligence in saving.  In order to save the PDIV or PDEV, the checkbox needs to be unchecked at least for this particular measurement.
Save PDIV	This button must be clicked if, during the previous measurement, initially critical PD of a defined strength were detected (PD inception). The voltage set prior to starting the measurement is saved as PDIV.
Set PDEV	This button for saving the PDEV should be clicked, if both the inception and the extinction of the PD can be clearly distinguished from the PD pattern of the previous measurement. Directly after clicking the button, the software automatically switches to the Q(t)/U(t) view and places a marker on the last detectable PD pulse.  If further evident PD pulses can be identified to the right of the selected pulse, the position of the marker needs to be manually corrected. By clicking on the Save PDEV button, the positioning is concluded and the marked voltage value is saved as the PDEV.

Button	Description
Save VWD	If a meaningful VWD diagram has been recorded during a measurement, the respective measurement should be saved by clicking this button. Basically, exactly the same information are saved as if the Save Measurement button is clicked. The only difference is that the VWD diagram of this measurement is automatically included in the report (but can be manually removed, if required).

Between the individual measurements, a summary of all data that has been saved as yet can be accessed by clicking on the **i** button.

Disturbance level		Measurement		
				
Type	L1	L2	L3	
Disturbance Level	✓			
PDIV	✓			
PDEV				
Measurement				

9.4.1 Typical Procedure for PD Diagnosis

Procedure

The following described procedure is a recommended, but by no means binding approach to PD diagnosis and **can deviate from parts of the applicable company-internal guidelines or country-specific standards**:



Since the levels of the PD pulses exhibit a certain stochastic character, several (typically 2 to 3) DAC shots per voltage level should definitely be applied. For documentation purposes, it's recommended to conduct and save several measurements at U_0 .

1. Start the **Disturbance level** measurement to determine the disturbance level of the PD measuring circuit and save the result with the **Save Disturbance level** button.
2. Perform a measurement at U_0 in **DAC negative** mode.
3. Check the measurement result for PD pulses.
4. Save the result, regardless of whether a PD was found, using the **Save Measurement** button.

If no PD activity was detected at U_0

1. Increase the voltage in increments of $0.2 U_0$ up to the maximum voltage ($1.7 U_0$ is widely recommended) and perform additional measurements in each case.

If PD activity appears during the increase, the first measurement with detectable PD events should be saved with the **Save PDIV** button. All additional measurements are to be saved as measurements.

If instead no PD activity appears, at least the measurement at maximum voltage should be saved.

2. If no partial discharges were detected up to the maximum voltage, the measurement can be ended. Otherwise, continue with the next step.

3. Carry out another measurement at maximum voltage.

If the time point at which partial discharge ceases can be clearly identified within the progression of the DAC voltage wave, click on the **Set PDEV** button, mark the last pulse in the diagram () and save the measurement using the (Performing a measurement) then save the measurement by clicking **Save PDEV**.

Otherwise, save the measurement with the **Save Measurement** button.

If PD activity was detected at U_0

1. Reduce the voltage in increments of $0.1 U_0$ and perform additional measurements until no more PD activity can be detected.

Then increase the voltage again until the PD reappears.

The measurement at which the PD reappears is to be saved using the **Save PDIV** button.

2. Increase the voltage in increments of $0.2 U_0$ up to the maximum voltage ($1.7 U_0$ is widely recommended) and perform additional measurements in each case.

Save the measurements.

3. Carry out another measurement at maximum voltage.

If the time point at which partial discharge ceases can be clearly identified within the progression of the DAC voltage wave, click on the **Set PDEV** button, mark the last pulse in the diagram () and save the measurement using the (Performing a measurement) then save the measurement by clicking **Save PDEV**.

Otherwise, save the measurement with the **Save Measurement** button.

9.4.2 Typical Procedure for Monitored Withstand Testing

Proceed as follows to perform a withstand test:

1. Start the **Disturbance level** measurement to determine the disturbance level of the PD measuring circuit and save the result with the **Save Disturbance level** button.
2. Switch to **DAC negative Withstand** operating mode and set the voltage and duration of the test.

The requirements for a meaningful cable test are found in the harmonisation documents HD 620 S1 and HD 621 S1 and often in company-internal testing guidelines as well. These documents recommend, depending on the type of test, the following settings:

Application	Test voltage	Test duration in minutes
Start-up test	3 U _o	15 to 60
Testing of aged cables	1.7 to 3 U _o	60



It is recommended to set the **Q range** parameter to **1 nC** or **10 nC** to make sure that the test must not be interrupted due to overflow.

3. Start the test with the **Start** button.

Result: The standard-compliant test starts and the test parameters can no longer be modified. Parallel to testing, the partial discharges are measured.

In the case of a breakdown, the test is immediately aborted and the test voltage source is earthed.

4. After the test is concluded, save the results with the **Save Measurement** button.

9.4.3 Procedure for measurements with test routine

Test routines make it possible to automate frequently required measurement sequences. The individual steps of the test routine are carried out one after the other with the preset measurement parameters. The consistent use of test routines for measurement operation ensures that the measurement results of individual cables can be compared with each other regardless of the measurement date.

After a test routine has been run, the software offers to carry out a PDIV measurement to determine the inception voltage and, depending on the operating mode, a PDEV measurement to determine the interruption voltage.

Requirements

To be able to carry out the measurement with test routines, the appropriate test routine must be created in advance and the use of test routines must be activated (**Category Testroutine**).

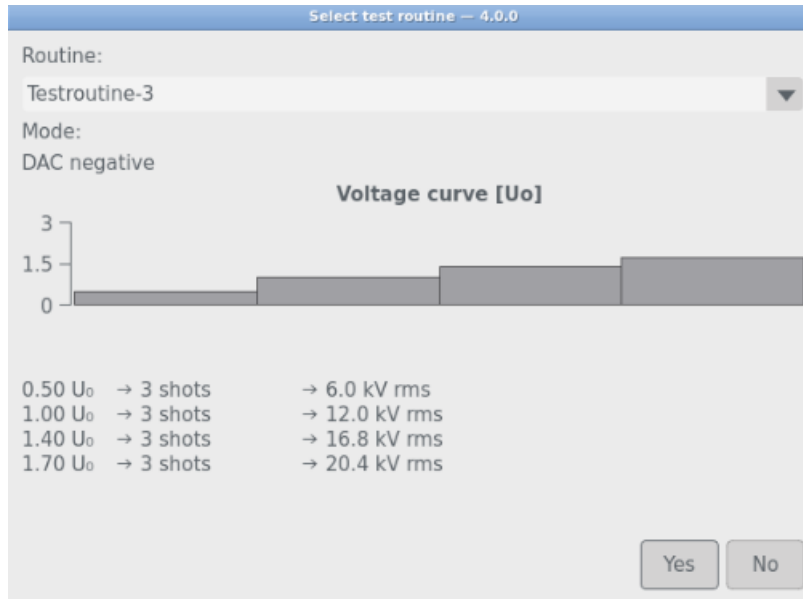
Performing measurements with test routines

Proceed as follows to carry out a measurement using a test routine:

1. Start the **Disturbance level** measurement to determine the disturbance level of the PD measuring circuit and save the result with the **Save Disturbance level** button.
2. Select the desired operation mode.

3. Start the test with the **Start routine** button.

Result: A new window opens. The button **Yes** can be used after 10 seconds.



4. Select the appropriate test routine from the drop-down list.
5. Confirm the selection with the **Yes** button.

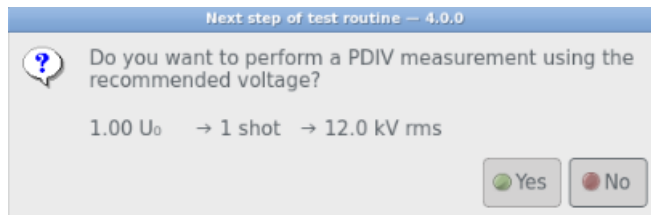
Result: The window closes. The Symbol for HV release appears in the menu block.

6. Release the high voltage.



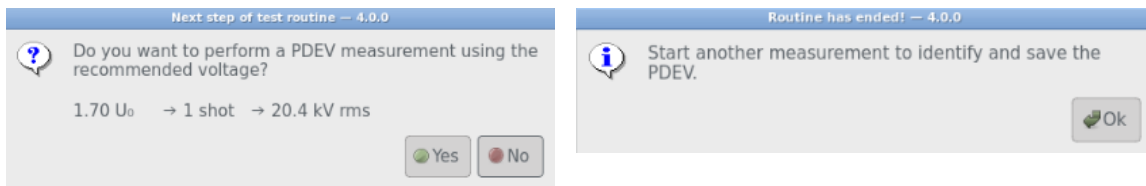
If the high voltage is not released within 10 seconds, the test routine has to be restarted.

Result: The test routine is performed and the measurements are saved. Once all steps have been completed, a new window for PDIV measurement opens.



7. To perform the PDIV measurement, start the measurement with the **Yes** button.

Result: The PDIV measurement is performed and saved. A new window for PDEV measurement then opens, depending on the selected operating mode.



The PDEV measurement can be carried out with the displayed parameters via the test routine.

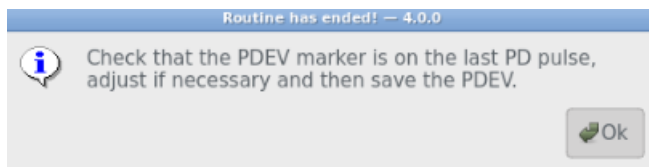
The button **No** ends the test routine without performing the PDEV measurement.

The PDEV measurement must be started outside the test routine as an independent measurement.

The test routine is complete.

8. To perform the PDEV measurement, start the measurement with the **Yes** button.

Result: The PDEV measurement is performed. A new window opens with a list of the steps required to successfully complete the PDEV measurement:



9. Close the window with the **OK** button.
10. Ensure that the time of the interruption is marked in the diagram (**Performing a measurement**) then save the measurement by clicking **Save PDEV**.

9.5 Stopping / Finishing a Measurement

Stopping a measurement

Each measurement is always ended automatically after the specified test cycles have run. In this case, the system lingers in the operating state of "Ready for switching on" after the measurement, which is indicated by the red illuminated "HV OFF" button. Additional measurements can be started directly without renewed enabling of the high voltage.

A measurement in progress can be interrupted both through the software (**Stop** and HV OFF buttons) as well as through the available switching elements ("HV OFF" push-button, EMERGENCY OFF switch, key switch). In the event of such a manual interruption, the high voltage is always immediately deactivated. This also occurs if the **HV Off** button is clicked after conclusion of a measurement.

Switching off the high-voltage generator

If no further measurements need to be conducted at this phase, HV switch-off is to be initiated by pressing the "HV OFF" push-button or clicking on the [HV Off](#) button.

After high voltage has been switched off, the following safety measures must be taken:



WARNING

- Earth and short-circuit the cable under test in accordance to the five safety rules ([General Safety Instructions and Warnings](#)).
 - The system components that were under voltage should only be touched once they have been earthed and short-circuited using a suitable earthing device.
-

Resuming a measurement job at another phase

After the measurement has been completed at the current phase and the high voltage has been switched off, the measurement job can be resumed at another phase of the same cable system. The electrical connection ([Commissioning](#)) has to be adopted accordingly. If no differences between the individual phases are expected, the measurement can be directly continued at the new phase with the existing calibration data. Otherwise, a new calibration of the PD measuring circuit should be performed ([Calibrating the Partial Discharge Measuring Circuit](#)).



It is essential to adapt the phase selection before starting the measurement/calibration in order to avoid unintentional falsifying of existing measurements.

Finishing the measurement

After the measurement has been completed at all phases to be tested, the measurement screen can be closed with the [Exit](#) button.

To dismantle, use the same method as for connecting ([Electrical connection](#)) but in reverse order.

Immediately after disassembly, install the short-circuit lead. If an internal PD coupler is used, connect it to the designated parking position. ([Storage](#)).

The evaluation of the test results and the creation of a report ([Evaluating Measurement Results and Creating a Report](#)) can be done either directly afterwards or at a later time ([Viewing Cable Data and Administering Measurement Tasks](#)).

9.6 Pinpointing PD fault points

Partial discharge faults rarely represent a breakdown fault, making conventional high-voltage pinpointing methods unsuitable for accurate fault localization.

Just as in cable fault location, accurate pinpointing of partial discharge faults is necessary to minimize costly and unnecessary excavation when repairing or replacing cables.

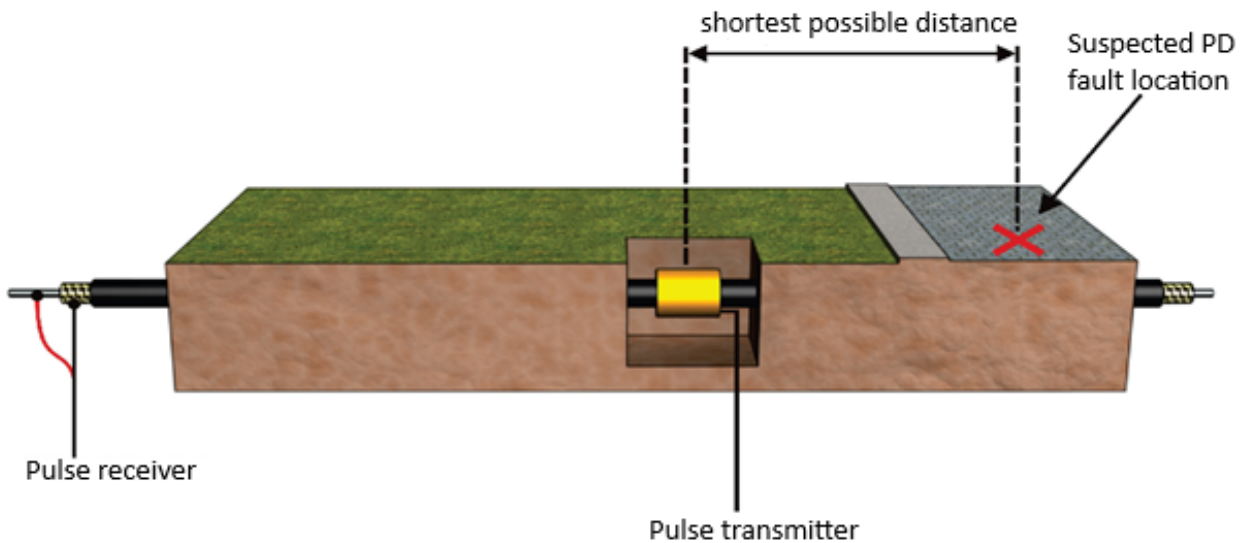
Pinpointing provides a straightforward, cost-efficient solution to validate the previously determined PD fault position.



If pinpointing is performed at a later time, first load the appropriate measurement task ([Starting or Resuming a Measurement Task](#)) and then carry out calibration again ([Conducting the Calibration](#)).

Positioning and connection of the pulse transmitter

The pulse transmitter (e.g., PD-TX) should be inductively coupled to the faulty phase using a split-core coil at an easily accessible point as close as possible to the suspected PD fault location.



The split-core coil must be positioned around the test cable so that it completely surrounds the conductor. To achieve optimal coupling, the contact areas must be clean and completely free of impurities.

Once the pulse transmitter is activated, pulses are coupled into the conductor at defined intervals.

Because of the cable's frequency-dependent attenuation and dispersion properties, every signal undergoes changes in amplitude and waveform over its propagation time. Of course, this also applies to the measuring pulse and its reflections.

As a result, narrow pulses containing a higher proportion of high frequencies undergo greater distortion than wider pulses. This factor must be taken into account when setting the pulse width.

As a result, narrow impulses are more suitable for short-range measurements where they provide a better resolution image than wide impulses. Conversely, they are excessively attenuated and expanded at long distances. Wider pulses are subject to much lower attenuation and produce stronger echoes so must always be used to measure long distances.

The following table provides recommendations for the pulse width that should be set depending on the distance from the fault location to the pulse transmitter:

Pulse width	Measurement range
100 ns	up to 500 m
200 ns	500 m - 2,5 km
500 ns	2,5 km - 7,5 km
1 μ s	from 5 km



The choice of pulse width is also significantly influenced by the shielding attenuation. As a result, high shielding attenuation requires selecting a wider pulse even for short cables, in order to couple more energy into the cable.

Pinpointing the transmitter position



The pulse transmitter must only be connected to de-energized equipment. The general safety instructions, and in particular the five safety rules, must be observed before connecting to the test object.

1. Uncover the cable at an appropriate point close to the suspected fault location.
2. Couple the pulse transmitter to the affected cable as previously described.
3. Switch on the pulse transmitter and set the desired pulse width.
4. Click the icon , to open the pinpointing window.

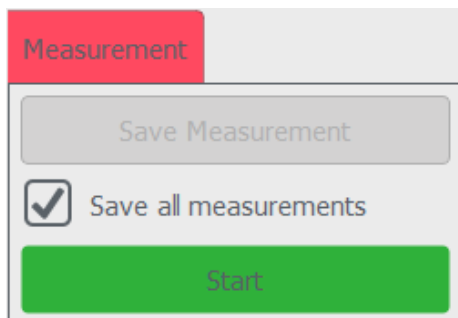


Immediately upon entering the pinpointing window, the connection to the PD detector is checked. Deactivated buttons and the  symbol indicate connection problems, which have to be solved before the test is started (see [Troubleshooting](#)).

5. Select **Save all measurements** to automatically save all measured pulses. Alternatively, you can manually save selected measurements using the **Save Measurement** button.



By default, each completed individual measurement must be saved manually. **Otherwise, the data are discarded when the next individual measurement is started!.**



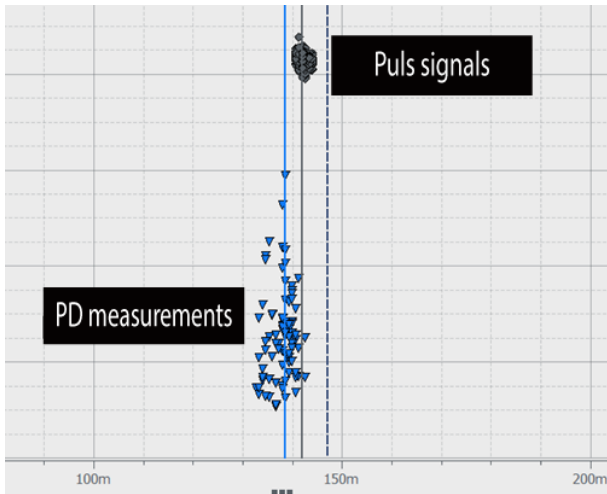
6. Compare the value of Max. Charge with the configured value of Leakage current. The latter should always be set slightly below the value of Max. Charge.



If the Leakage current is set higher than the Max. Charge, no pulse recording will take place.

- Click the **Start** button in order to start measuring the pulses.

Result The pulses appear directly in the PD mapping diagram.



- Once a sufficient number of pulses have been recorded for reliable position verification, end pulse recording using the **Stop** button.



If the transmitter pulses cannot be clearly localized, first check whether the pulse transmitter is correctly attached to the intended cable and the correct phase. If this is the case, try to improve the result by adjusting the pulse width.

- Next, click **Exit**.
- If necessary, perform steps 1 through 8 at other locations to narrow down the fault position as precisely as possible.
- Review the pulse recordings to ensure the identified pulse positions are correct. This verification is important to eliminate any doubts about the localization.



The analysis of individual pulse recordings is carried out according to the procedure described for PD events, as the approach is identical. ([Manual analysis](#))

10 Evaluating Measurement Results and Creating a Report

Opening the evaluation screen

If the evaluation of the measurement results will be performed directly after the measurement, you can directly call up the menu item  **Report** in the start screen.

However, if the software was closed in the meantime, the data of the measurement job being evaluated must first be loaded ([Viewing Cable Data and Adminstrating Measurement Tasks](#)) into memory before you can call up the menu item.

PD mapping

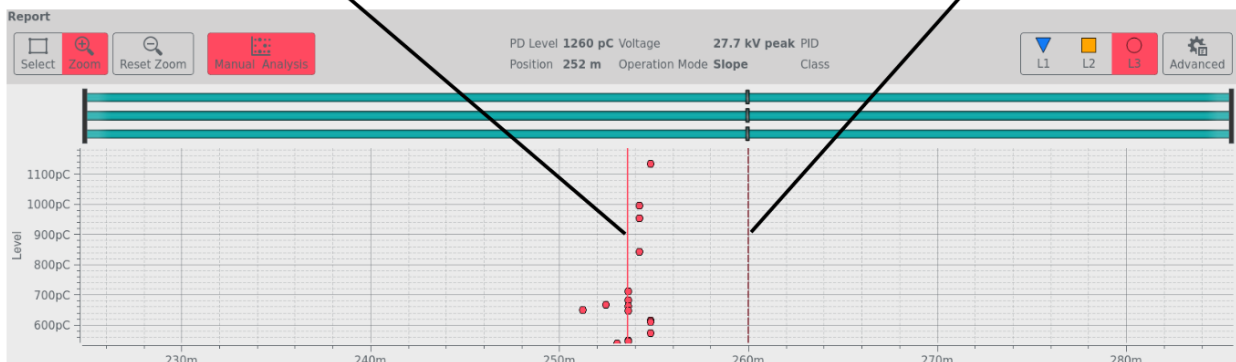
The already familiar PD mapping from the measurement screen ([Available diagram types](#)) forms the central element of the analysis screen. It provides the user with a location-resolved overview of the partial discharges identified by the PD evaluation algorithm.

Coloured lines:

clusters of PD events which have been automatically detected and marked by the software

Dashed black lines:

Joint positions within the diagram



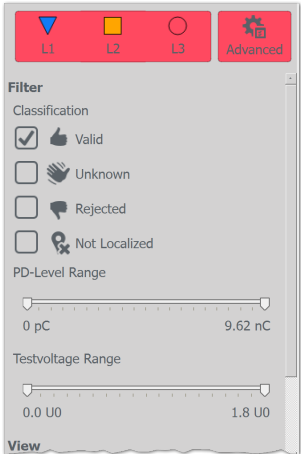
To generate the PD mapping, the software applies suitable algorithms and filters while the measurement is in progress for an automated analysis of the measured charge pulses. In doing so, it not only considers the level, but also other characteristics of the pulse, such as the phasing and edges. In the evaluation results, the majority of interference has largely already been identified and thrown out.

Based on the time difference between the arrival of the actual pulse and its reflection from the cable end, the remaining pulse can then be correlated ([Technical Background](#)) with a concrete position along the cable to a very high degree of accuracy. The now spatially resolved imaging is examined for localised clusters of PD events and colour-coded as follows:

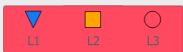
Colour	Description
Saturated colours	Pulses which were classified as a partial discharge. The clustering of PD pulses at this position points to a PD fault. These positions are additionally labelled in the PD mapping with a coloured marker matching the respective phase.
Pale colours	Pulses which were classified as a possible partial discharge. These pulses occur either at positions with a smaller pulse cluster or near larger clusters. Partial discharge cannot be excluded as the cause.
Grey	Pulses which were classified as negligible and are with considerable certainty not caused by a PD fault.

View filter

Using the **Advanced** menu item, you can display the advanced view filters and the pulses in the PD mapping can be filtered as you wish to provide a better overview:



The following buttons are available for this purpose:

Button	Description
	Filter view according to phase.
Classification	Show/hide pulses that were not identified (or not definitely identified) as PD.
	 All pulses classified as partial discharge
	 All pulses classified as possible partial discharges (pale colours) are shown or hidden, respectively.
	 All pulses classified as negligible (grey) are shown or hidden, respectively.
	 Pulses for which no reflection could be determined. These pulses are placed at the beginning of the cable by default.
PD-Level Range	With the aid of charge limiting, the display can be restricted to the pulses that appear in a particular charge range.
Testvoltage Range	With the aid of voltage limiting, the display can be restricted to the pulses that appear in a particular voltage range.
View	With the aid of these checkboxes, the individual auxiliary indicators (joint markers, cluster markers, cable plan) can be shown or hidden respectively.



The settings made with the aid of the functions described above have no effect on the PD pulses displayed in the report.

10.1 Manual classification of partial discharges

Necessity

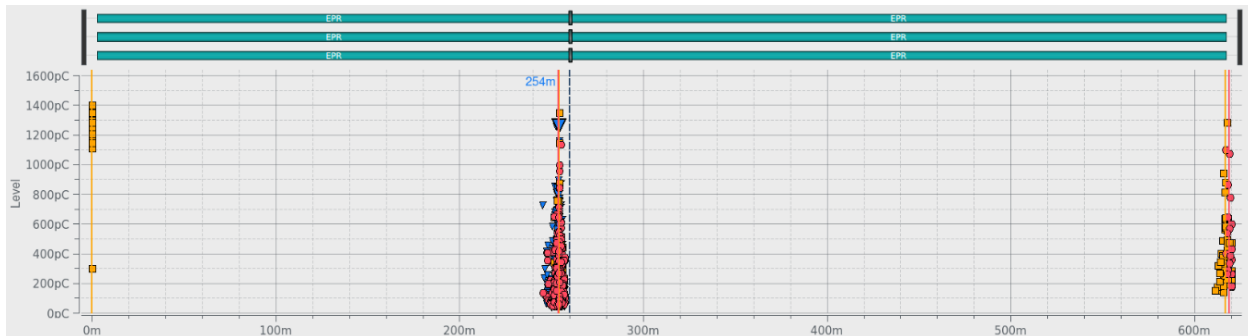
Generally, the automatic detection and location of partial discharges by the PD evaluation algorithm is very accurate. In most cases, a time-consuming post-processing of the measurement data is not needed and the report can be directly created ([Preparing and Printing the Report](#)).

However, if there are reasonable doubts as to the position or “realness” of identified PD faults, the functions described in this section enable experienced users to manually analyze and correct the localization data.

10.1.1 Determining Possible Sources of PD Faults

Cable plan

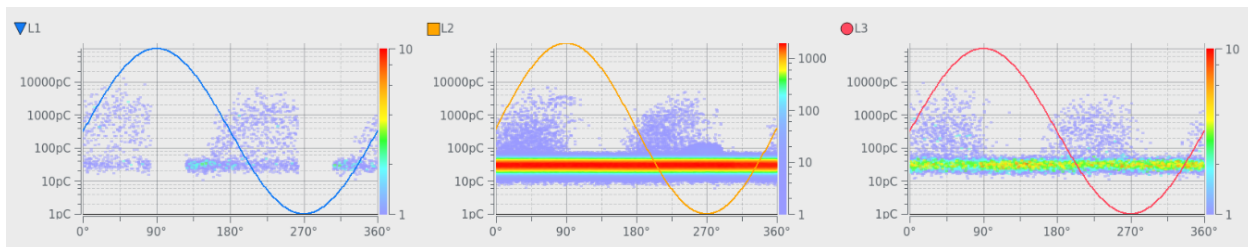
If it has not been manually deactivated via the view filter, the layout of the diagnosed cable is displayed, true-to-scale and with the correct orientation, over the PD mapping.



This view is ideally suited to identify any relations between the diagnosed PD faults certain characteristics (e.g. insulation types, joints) of the cable. A slight offset between the position of the accessory and the PD fault can often be attributed to an inaccurate cable plan or signal propagation velocity.

Phase-resolved diagrams

Using the **PRPD** tab at the bottom of the screen, the PRPD diagrams (Phase Resolved Partial Discharge) can be displayed under the PD mapping.



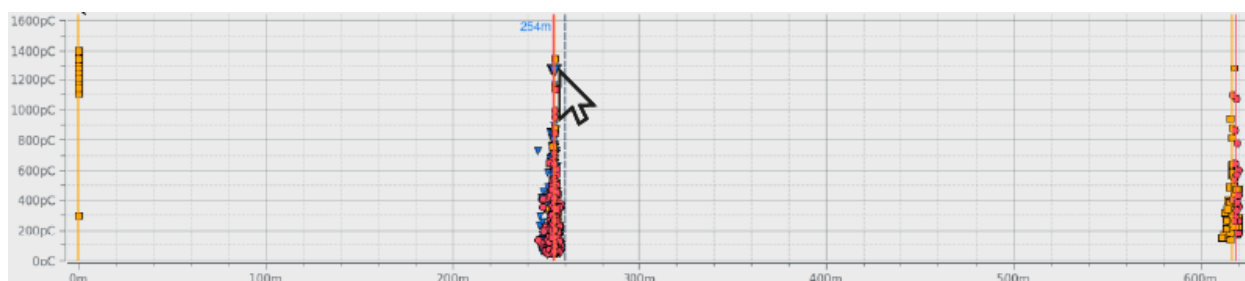
Using these diagrams, which display the distribution of charge pulses relative to the phasing, it is often possible to develop sound information about the characteristics and cause of a PD fault. The significance of the representation, however, depends greatly on the quantity of the recorded data.

To improve readability, phases can be shown or hidden as needed using the view filter. In addition, the quantity of the PD events used for the diagram can also be restricted ([Analysing Individual PD Events](#)).

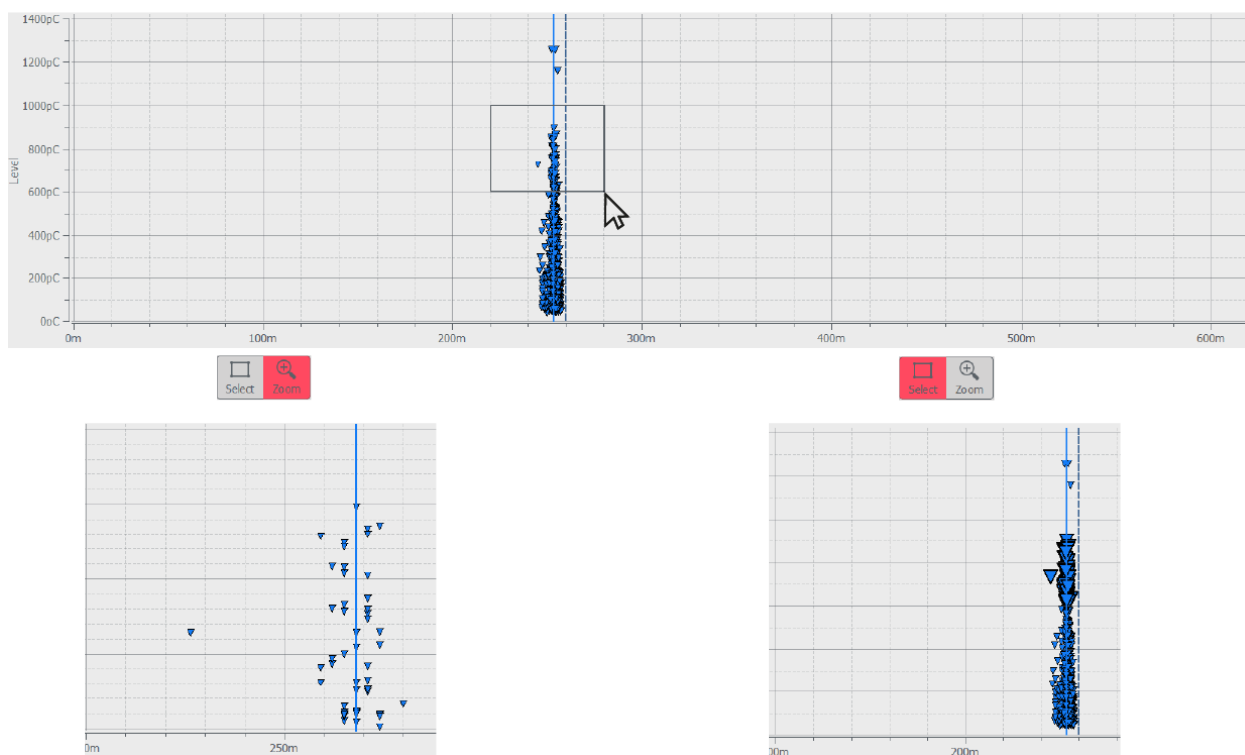
10.1.2 Analysing Individual PD Events

Selecting a PD event

Each measured and automatically (via the software) classified pulse can be manually evaluated by the user and given a different classification, if necessary. In order to carry out a manual evaluation, the pulse must first be selected with a left mouse click.



The selection box on the top left of the PD mapping determines whether dragging a frame zooms in the marked area or selects the PD events within the marked area.



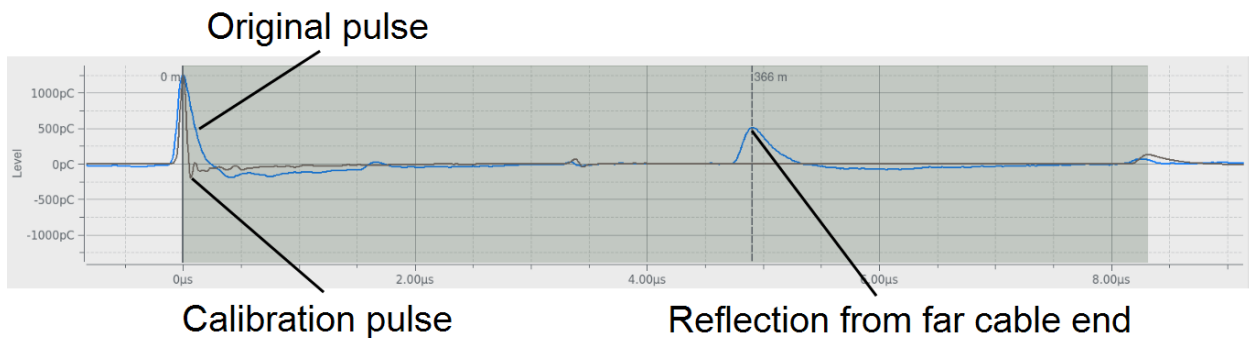
The **Zoom function** makes it easier to find and click on pulses in areas of dense accumulations. By clicking on the **Reset Zoom** button, the zoom can be canceled at any time.

After a number of PD events has been selected using the **Select function**, only these events are considered for the phase-resolved diagram (PRPD).

Manual analysis

Directly after a PD event has been selected, it can be analysed more precisely using the diagrams available under the PD mapping and can be classified differently if necessary.

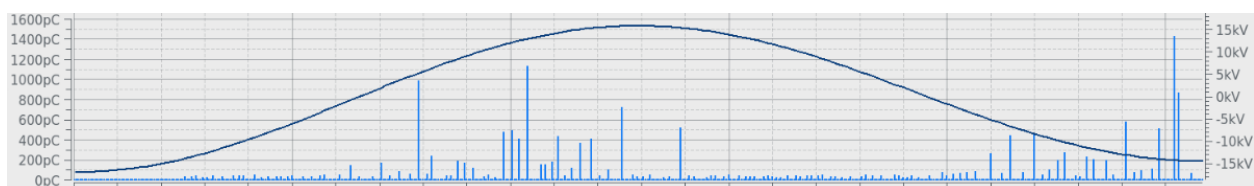
The **Localisation** tab can for example be used to call up the TDR image, which shows both the directly incoming pulse and its reflection at the far end of the cable.



The calibration pulse, shown in parallel with the PD pulse, serves particularly in uncovering system-inherent reflections (e.g. an impedance jump between high voltage connection cable and test object). It can be regarded as an undistorted reference pulse which was injected at the beginning of the cable and was not subjected to appreciable damping or dispersion. If, in comparison, the original PD pulse is visibly widened or damped, the PD certainly originates from within the cable. The calibration curve can be shown / hidden via the **Show Calibration Curve** checkbox.

For particularly experienced users, the software offers the option of checking the markings for the original pulse and its reflection which were automatically placed according to the algorithms so that corrections, if necessary, can be made. Should this be the case, the marker in question must be clicked briefly once with the left mouse button. The line thickness of the marker is thereby increased and the **↔** symbol is displayed instead of the mouse pointer. By clicking again and holding the mouse button depressed, you can now freely drag the marker along the X-axis. As soon as the mouse button is released, the marker locks in the current position.

Furthermore, the time segment of exciter voltage during which the PD pulse was measured can be viewed under the **Q(t)/U(t)** tab.



Manual classification

If a more detailed analysis of PD events reveals doubts about the automatically performed classification and it needs to be corrected manually, an additional toolbar can be displayed below the PD mapping using the **Manual Analysis** button.



Using the buttons in the toolbar, the events can be classified manually or even deleted. **The change is applied to all currently selected events.** Thus, for example, a group of PD events can be marked and in one step assigned the same classification.

The following functions are available:

Button	Description
	Jump to the event with the next highest pulse amplitude.
	Jump to the event with the next lowest pulse amplitude
	Classify pulse as partial discharge .
	Classify pulse as possible partial discharge .
	Classify pulse as negligible .
	If a pulse appears very close to the near or far end of the cable, this button - in case of reasonable suspicion - can be used to "move" the pulse to the opposite cable end. The resulting change in position is immediately visible in the PD mapping.
	Discard pulse. This action cannot be reversed.

Rating sections

The following rating sections are used:

Colour	Rating	Recommended action
white	Not rated	Evaluate measurement result
green	Inconspicuous	No need for action
yellow	Conspicuous	Carry out further tests
orange	Needs repair	Carry out repairs
red	Defective	Carry out repairs

The rating "**Not rated**" is the initial state which is automatically assigned to each new cable/segment. The rating "**Inconspicuous**" should be assigned to cables/segments that do not show any abnormalities and are in good condition. If problems have been found with a cable/segment, this should be assigned with the ratings "**Conspicuous**", "**Needs repair**" or "**Defective**" in accordance to the criticality of the problem.

The rating section "**Defective**" is not assigned automatically. To declare a segment as defective, it must be manually evaluated.

Evaluating the complete cable or a segment of the cable

Measurement results can be evaluated in the **Rating** tab. The evaluation can be performed both for the entire cable and for individual segments of the cable (joints, terminations, and cable sections). In this context, a higher-order element is automatically classified with at least the same level of criticality as a lower-order segment with the most critical classification. For example, when a joint is classified as in need of repair, both the phase and the measurement result of the cable are also classified as at least in need of repair. The rating of the measurement result can then be adopted as cable rating.

The rating of the measurements as well as the cable ratings are displayed in the **Cable Manager** section.

Cable Number	Location	Station A	Station B	Length [m]	Uo [kV rms]	Last Measurement	Cable Rating	Importance
Example 1		Example 1 A	Example 1 B	780	98.4		⬜	Low
Testroute Baunach, Module 1 D	Baunach	Module 1	Messelager	620	12	12/16/2024	⬜	Low

 Load

 Delete

 Cleanup

 Show Report

 Export Report

 Resume Task

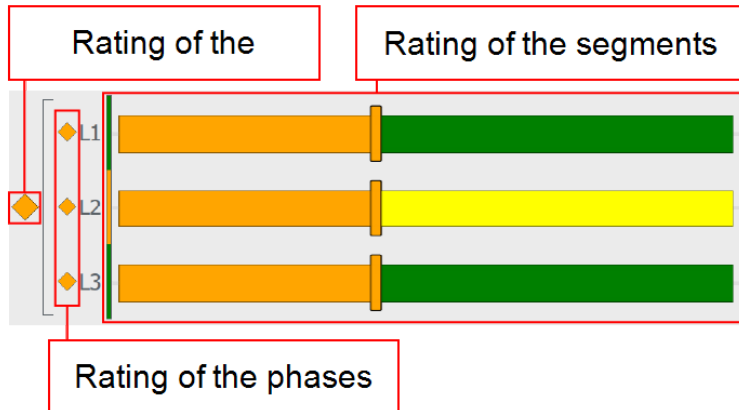
 Clone Task

Date / Time	Tester	Measured at	Location	Report	PDI V	PDPV	Disturbance Level	Data	DAC+	DAC-	VIF CR	VIF Sin	Rating
16.12.2024 12:22	Megger	Module 1	Ba...		✓	✓	✓	✓		✓	✓	✓	⬜
16.12.2024 12:17	Megger	Module 1	Bau...										⬜

Cable rating

Rating of the measurement

In the section **Report**, the rating of the individual segments as well as the resulting rating of the phases and measurement can be found in the tab **Rating**:



It is possible to evaluate the measurement results automatically by the software or manually.

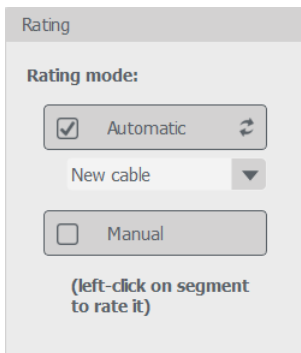
The automatic evaluation distinguishes between new and aged cable systems. For this, the thresholds set in the settings are used.

With manual evaluation, it is possible to rate the individual segments of a cable system independently of thresholds. This makes it possible to cater to special circumstances or requirements of individual cable systems.

Procedure for automatic evaluation

Proceed as follows to conduct an automatic evaluation of the cable system:

1. Ensure, that the button **Rating mode:** in the area "**Automatic**" is enabled.



2. Choose between the options **New cable** and **Aged cable** from the dropdown menu located below.

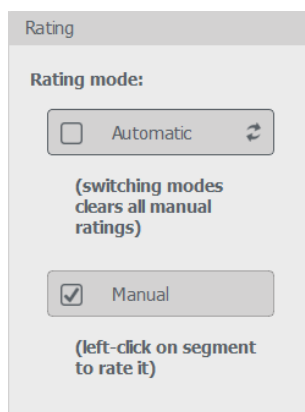
Result: The evaluation is conducted automatically with the settings on file. The colours of the affected elements change with the amendment of the rating.

If the evaluation settings are modified, it's possible to evaluate already rated cable systems again with the new settings via the button **Automatic**.

Procedure for manual evaluation

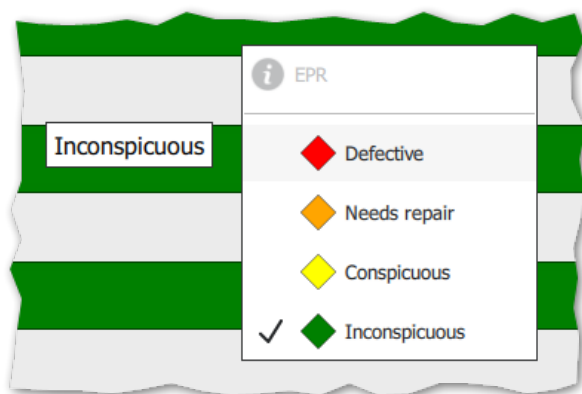
Proceed as follows to conduct a manual evaluation of the cable system:

1. Ensure, that the button **Rating mode:** in the area "**Manual**" is enabled.



2. Select an element whose rating you want to adjust.

Result: A window displaying the available rating categories opens:



3. Select the appropriate rating for the element.
4. Repeat the steps 2 and 3 for all elements that have to be adjusted.



By switching to automatic rating mode all manual adjusted ratings are overwritten.

Adopting a rating as current cable rating

If the measurement results provide information about the condition of a cable, the rating of this measurement can be adopted as cable rating. The cable rating is not updated automatically, but must be done manually. For cable ratings to remain meaningful, they need to be updated reliably and in a timely manner to the measurements.

Use the button **Yes, update** to adopt the rating of a measurement as cable rating. The rating of the selected measurement is accepted as new cable rating. The new cable rating is displayed in the cable manager.

Text field Advice:

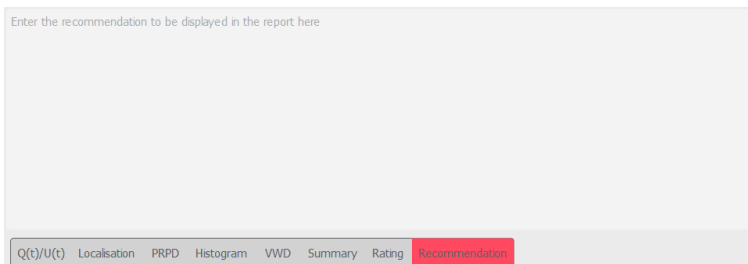
Advice, comments and notes to ratings made can be entered into the text field. These are reproduced in the report.

10.3 Preparing and Printing the Report

Risk assessment/recommendation

The risk assessment for reliable network operation must be performed taking into account the respective isolating systems, the type of faults as well as the measured PD.

A recommendation on how to proceed based on the risk assessment can be entered in the text field available through the **Recommendation** tab.

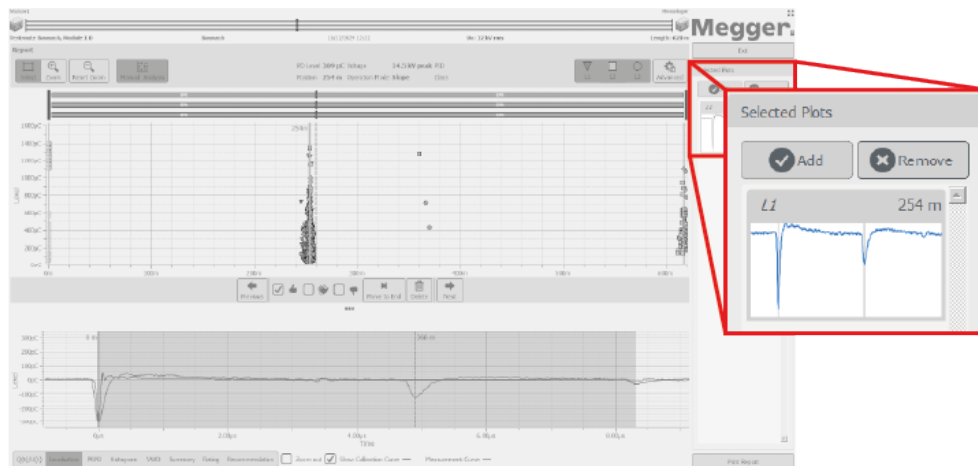
The screenshot shows a software interface with a large text input area at the top, labeled "Enter the recommendation to be displayed in the report here". Below this is a horizontal tab bar with several tabs: "Q(t)/U(t)", "Localisation", "PRPD", "Histogram", "VWD", "Summary", "Rating", and "Recommendation". The "Recommendation" tab is currently selected and highlighted in red.

The recommendation could, for example, suggest a repeat measurement for trend analysis or even the replacement of an affected cable section/accessory. The text of this recommendation is also contained in the printed report.

Selecting additional diagrams to be included in the report

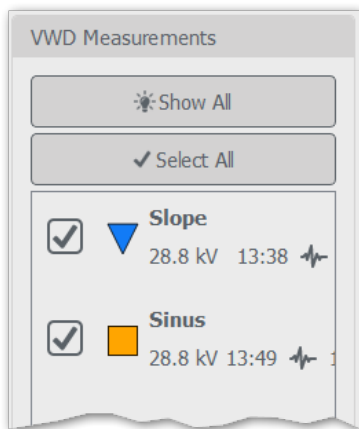
Depending on the selected template the report may already contain the cable plan, relevant PD mappings, the calibration curve, a tabular overview of the key measurement values and the recommendation.

In addition, individual TDR images may also be included in the report as required, e.g. if the original PD pulse and its reflection can be particularly well recognized in one of the reflectograms and, accordingly, a clear localization of the partial discharge fault can be made. To do so, you must first mark the respective pulse in the PD mapping and then click the **Add** button in the **Selected Diagrams** menu block. A miniature view of the pulse appears directly superimposed in the menu window.



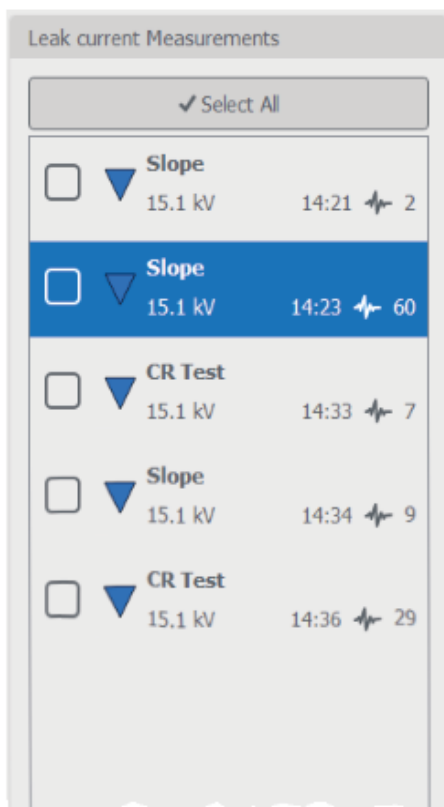
The pulses contained in the selection can be selected and brought to the display by clicking on them. Clicking the **Remove** button will remove them from the selection.

It's possible to add meaningful VWD diagrams to the report during the measurement by using the button **Save VWD**. Of course diagrams can be added to or removed from the report during report creation. As soon as the **VWD** view is opened, the diagrams which are already included in the report are displayed in the **VWD Measurements** menu block on the right.

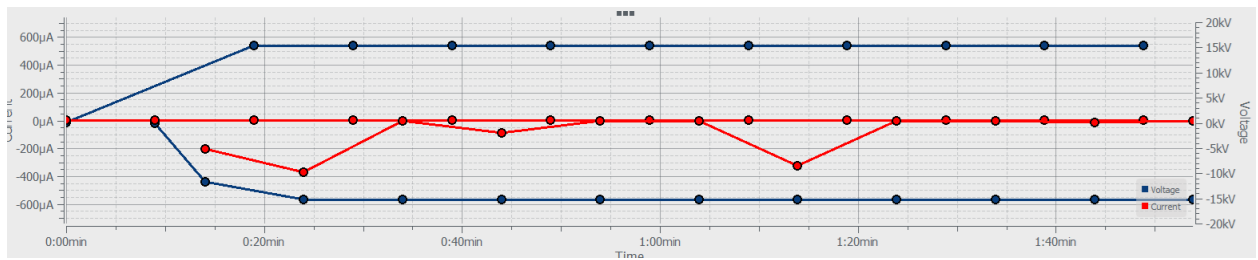


The **Show All** button can also be used to show and view all other available VWD diagrams. To include one of the VWD diagrams that has not yet been added to the report, tick the corresponding box.

Via the **I-Leak** tab, previously saved leakage current measurements are displayed in the menu block on the right-hand side.



This section allows you to display and review all available leakage current diagrams. Select an entry to display the corresponding curve in the diagram field.



Selecting the checkbox adds the corresponding leakage current measurement to the report. Multiple measurements or all measurements can also be selected simultaneously

☒ Select All

☐	▼ Slope	15.1 kV	14:21	⚡ 2
☒	▼ Slope	15.1 kV	14:23	⚡ 60
☐	▼ CR Test	15.1 kV	14:33	⚡ 7
☐	▼ Slope	15.1 kV	14:34	⚡ 9
☐	▼ CR Test	15.1 kV	14:36	⚡ 29

Preparing the summary table

By clicking on the **Summary** tab, a table can be called up which, depending on the template used, will also be included in the report (exactly as it is shown here) and shows the most important data of the measurement task.

	L1	L2	L3
Disturbance level [pC]	70	64	65
PDIV [kV rms]	-	-	6
PDEV [kV rms]	-	-	7.5
PD max [pC] (PDIV)	-	-	117
PD max [pC] (1.0 U ₀) ▲▼	3981	1524	5187
PD Level [pC] (1.0 U ₀)	1964	373	2739
PD max [pC] (1.7 U ₀) ▲▼	12931	6903	9350
PD Level [pC] (1.7 U ₀)	4762	3138	7156
PD max [pC] (2.0 U ₀) ▲▼	-	-	-
PD Level [pC] (2.0 U ₀)	-	-	-
Frequency [Hz]	396	0.1	386
Operating Mode	Slope	Sinus	DAC-

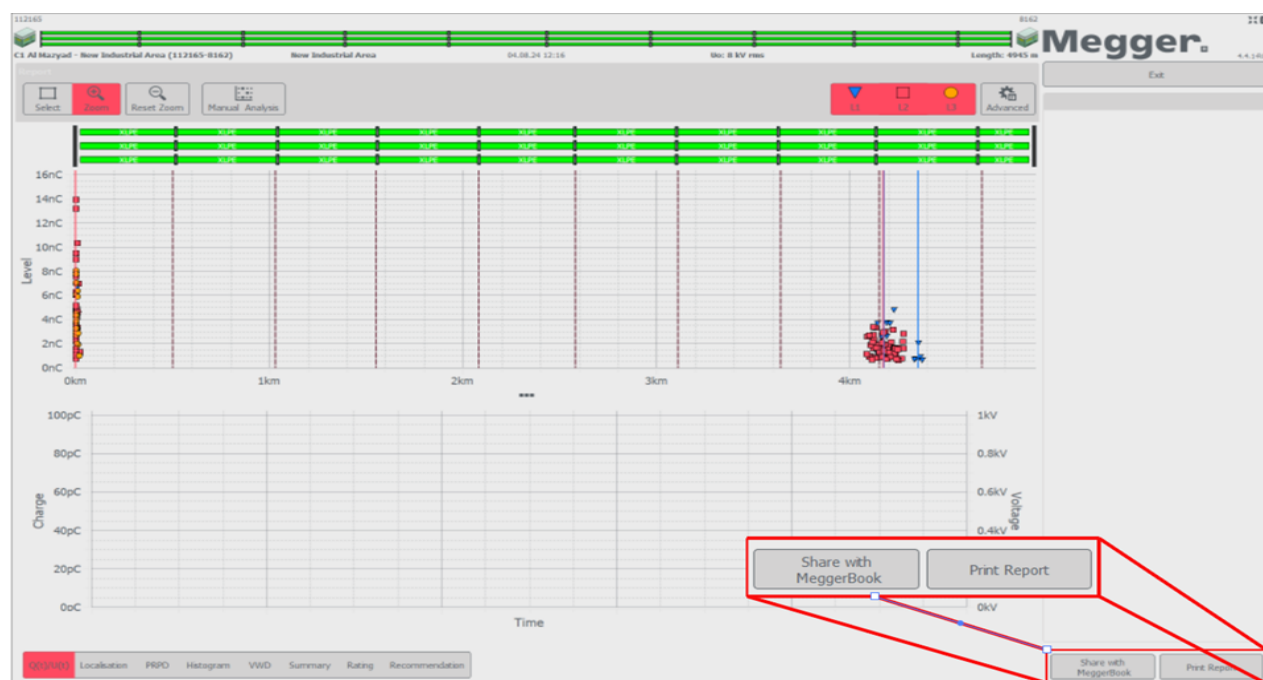
Q(t)/U(t) Localisation PRPD Histogram VWD **Summary** Rating Recommendation

The buttons ▲ and ▼ in the first column of the table can be used to set the test voltage levels for which the measured PD values are to be displayed in the table. The setting is automatically applied to the generated report as well (if the summary table is included in the selected report template at all).

Printing/exporting a report

After completing the analysis and the risk assessment, a selection of the essential data from the PD detector can be automatically transferred to MeggerBook via the button **Share with MeggerBook** located at the lower right (only displayed if MeggerBook is installed on the system / notebook). In this way, a consolidated PDF report of all measurements and tests performed on this cable can be created in MeggerBook.

The template manager can be opened via the button **Print Report**, allowing you to select the desired report template for later printing. The most recently Template in use will be automatically preselected. When generating the PDF file, the data transfer to MeggerBook described above is also carried out automatically.



If required by the measurement results, changes to the content of the selected template can still be made at this point, and individual content elements can be shown or hidden.

When the **Print PDF** button is pressed, a PDF report is generated based on the selected template. Depending on the data volume, this process may take several minutes. The report is then displayed in a PDF viewer, where it can be saved or printed using the configured printer ([Category General](#)).

Alternatively, the report data can be exported in CSV format (Comma-Separated Values). For this purpose, the corresponding template must be selected, which can also be adjusted prior to export but cannot be saved. The export is then started using the designated button.

The report data can alternatively be exported in the CSV (comma-separated values) file format. To do so, select the **Export CSV** template, which can also be modified before the export but cannot be saved. The actual export is then initiated using the **Save CSV** button.

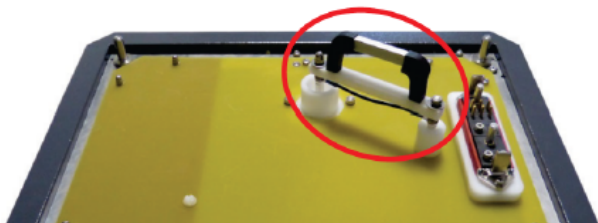


Deleting a cable entry in either TE Detector or MeggerBook automatically deletes the corresponding entry in the respective other system.

11 Storage

If the system is not used for a long period of time, it should be stored in a dust-free and dry environment. Persistent humidity, especially in combination with dust, can reduce critical insulation gaps that are essential for safe high-voltage operation.

To prevent charging of the capacitor, the short-circuit device has to be installed on top of the HV module as shown in the following picture:



12 Maintenance and care

Repair and maintenance

Repairs and maintenance work may only be carried out by Megger itself or by authorised service partners using original spare parts. Megger recommends having the system tested and maintained at a Megger service centre once a year.

Megger also offers on-site service to its customers. If necessary, please contact your local service centre.

The connections and connection leads of the system must be regularly cleaned and tested in accordance with the applicable national and company-specific arrangements, to ensure that they are free of defects and intact.

Replace fuses

If the device cannot be switched on when the mains supply is connected, check the two fuses below the mains socket . To do this, the fuse holder must be pulled out.

If the fuses are defective, they must be replaced with suitable microfuses (5 x 20 mm) of the type T2.5A (230 V version) or T5A (115 V version).

If the fuses are triggered repeatedly, please contact an authorised service centre to have the fault rectified.

13 Troubleshooting

Independent troubleshooting

If problems occur, these can - under certain circumstances - be diagnosed and solved using the following table:

Problem / Error message	Cause / Remedy
Connection to test voltage source or PD detector cannot be established	■ Restart the affected device ■ Restart notebook and measurement software ■ Check cabling ■ Make sure that the device is supplied with power and, if possible, measure the supply voltage
Software is very slow; delayed response to user actions	The processor is heavily utilized by other processes or running at reduced clock speed. ■ Close all other applications ■ Deactivate the virus scanner ■ Deactivate the power-saving mode
The software is slow to start and takes up a lot of space on the hard drive.	Large volumes of data may accumulate in the installation directory due to the amount of measurement data recorded. This depends on how long and how intensively the software is used and may also delay software start-up. ■ Cleaning measurement data (Viewing Cable Data and Admin-istrating Measurement Tasks) ■ Cleaning up the database (Category General)
When the software is opened for the first time, no new measurement job can be started	No devices have been configured (Category Devices) in the software.
"Overflow"	Measured data exceeds the input data range. Increase the measuring range (Q range) in the software.
"Processing Pipeline limit reached!"	The computing power of the computer used is not sufficient to process the amount of incoming measurement data. This problem can be counteracted by decreasing the maximum number of localizations during VLF sine wave voltage measurements (Category Localization).

Problem / Error message	Cause / Remedy
"Calibration failed. Using default parameters!"	The start and / or end reflection could not be unambiguously identified by the software. ■ Try again with low bandwidth setting ■ Check the electrical connection of the calibrator and whether it is still switched on ■ Make sure the cable under test is not earthed / short circuited ■ Try to manually position the markers
"PD Detector protocol not supported!"	The wrong PD Detector version may have been selected when the measurement task was started (Starting or Resuming a Measurement Task). Otherwise, a firmware upgrade (Category Devices) might solve the problem.
"PD Detector software not supported!"	
"PD Detector firmware not supported!"	
"You have to add at least one PD detector and one HV source in the settings first"	No devices were selected before the measurement task was created. (Category Devices)
"Import"	If no PD operating mode is selected, the internal PD coupler must be connected to the designated parking position. Otherwise, the message "Import" is displayed and the operating mode cannot be started. Solution: Ensure that the internal PD coupler is connected to the designated parking position.

Behaviour at persistent malfunction

When irregularities or malfunctions appear that cannot be solved consulting this manual, the equipment must immediately be put out of operation and marked as not functional. In this case, notify the relevant supervisor. Inform the Megger service to resolve the problem. The system must not be put back into operation until the fault has been rectified.

14 Information on PD Detector Software

This chapter only refers to the Windows version of the software and contains information on system requirements, installation and licensing of the software. This chapter is not relevant for the test van version of the software, as the control unit of the test van is already preconfigured and licenced.

14.1 System requirements

The measuring software is normally pre-installed on a notebook included in the scope of delivery, so that measurements can be started directly.

The configuration of the supplied notebook (the network settings and the power options in particular) should only be changed following consultation with Megger. You are also strongly discouraged to install any third-party software, as this may negatively affect the performance of the notebook and hence the functionality of the PD Detector Software. Repair costs which are due to a change in the system configuration or the installation of third-party software will be charged to the customer.

System requirements

Provided that the licences required are available, the software can also be installed on other computers without any difficulty. These computers should meet the following system requirements:

- Processor: Intel i5 or higher
- RAM: min. 4 GB
- Display: min. 1920 x 1080 pixels
- Interfaces: Gigabit Ethernet, USB 2.0
- Operating system: 64 Bit, Windows 7 or newer

Ethernet interfaces

The Ethernet interfaces need to be configured as follow:

Ethernet interface	Configuration
Primary Ethernet interface:	
IP address:	192.168.220.1
Subnet mask:	255.255.0.0
Secondary Ethernet interface:¹	
IP address:	192.168.220.2
Subnet mask:	255.255.0.0

¹Only required, if both voltage source and PD coupler need to be separately connected to the notebook (as it is the case when working with a stand-alone voltage source and the PDS 62-SIN).

14.2 Installing the software

Installing the software requires administration rights! Proceed as follows to install the software:

1. Insert/plug the data medium with the software into your computer and double-click the **setup-p-%version_number%.exe** setup file.
2. Click **Next** and then select the location where you would like to install the software. To confirm, click on **Next**.
3. Select the additional components you want to install. If the **CodeMeter Runtime** application is not yet installed on the system, then it must be selected. To confirm, click on **Next**.
4. Select whether or not a desktop icon should be created. To confirm, click on **Next**.
5. Start the installation by clicking **Install**.

14.3 At first start of the software

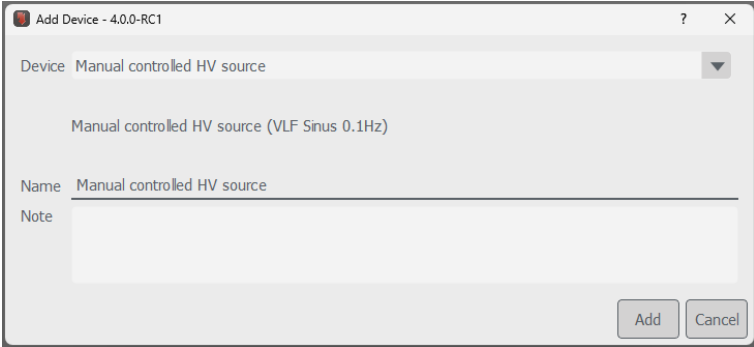
If the software has already been installed at the factory and configured for the hardware being used, no further configuration steps are required. The first measurements can be taken straight away. However, if the software has been installed on the PC for the first time or a new piece of measuring hardware has been purchased, the device configuration must be carried out after the software is launched for the first time.

Configuring the device

Proceed as follows to configure the device:

1. In the main menu, select the menu item .
2. Select the category **Devices**.
3. Press the  button to add another device.

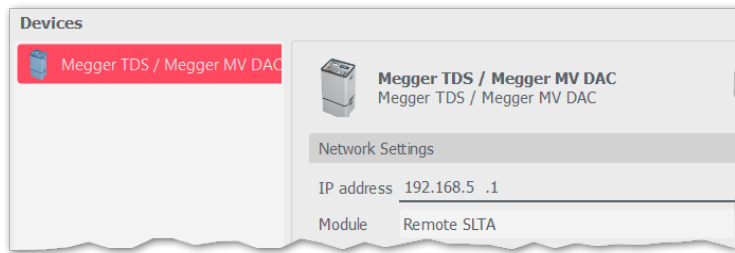
Result: the following input mask opens:



4. In the **Device** dropdown list, select the device you wish to add.
You can change the suggested name if required and add a brief description.

- Next, click on **Add** to enter the device.

Result: The device now appears in the device list and is ready to perform measurements. Click the device in the list to adjust its settings.



Available device types

The following device types can be added in this way:

Device	Device type		Default setting ¹
PD Detector v1	PD Detector	PD Detector of version 1	IP: 192.168.220.100
PD Detector v2 ²		PD Detector of version 2	IP: 192.168.220.100
Megger Centrix	HV source	TDM in Centrix test van	IP: 192.168.150.1
Megger HV DAC		HV DAC 200 / 300	IP: 192.168.220.99 LON module: Remote SLTA
Megger TDS / Megger MV DAC		TDS 40/60 / MV DAC 30	IP: 192.168.5.1 LON module: Remote SLTA
VLF Sinus		VLF Sinus test system	IP: 192.168.4.1 (VLF Sinus 28/34/54) IP: 192.168.4.4 (VLF Sinus 45/62)
Manual controlled HV source		Any other test voltage source	

As a matter of principle, at least one PD detector and one HV source must be added at all times. If multiple devices of the same type are configured, the device that is actually connected must be selected when creating a new measurement task.

¹Do not change without explicit instruction

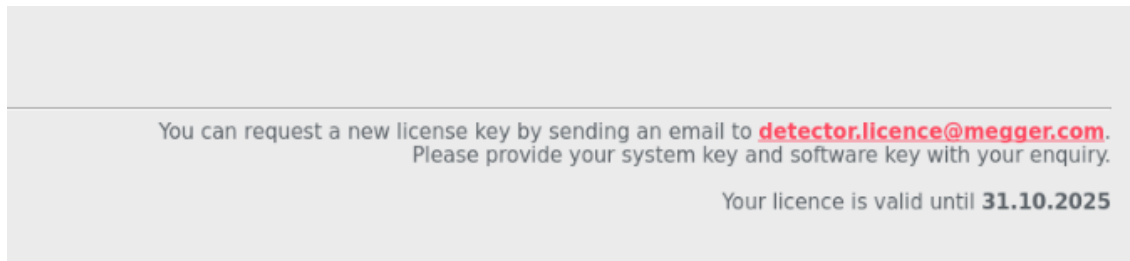
²The version can be read off the type plate

14.4 Software licences

Licence model

The licences of the PD Detector software are based on the subscription model. This means that the licences are activated for a defined period and have to be renewed/extended after that time has expired.

The expiration date is displayed in the category **Settings** in the area **General**:



Activating the licence

After reinstalling the software, changing the software package used or replacing hardware, it is necessary to (re)activate the licence. This requires Internet access and access to the licence documents provided (Software key).

Proceed as follows to generate a new licence key:

1. Start the software.

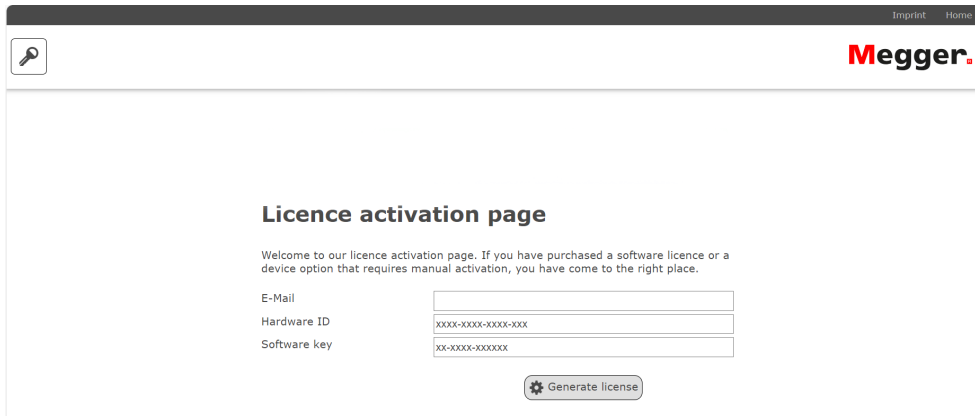
Result: A new window opens in which the field **Hardware ID** is already filled in:

A screenshot of a dialog box titled "Please enter a valid licence key". On the left is a QR code with a large red 'M' in the center. To the right of the QR code is instructional text: "If you don't have a license key, you can request one by visiting <http://license.te-detektion.de/>. Please provide your hardware key and the software key with your enquiry. After you received the license key, enter the key in the field below." Below the text are three input fields: "Hardware ID" (pre-filled with "xxxx-xxxx-xxxx-xxx"), "Software key" (empty), and "Licence key" (empty). At the bottom right are two buttons: "Update Licence" and "Close Application".

2. Type the software key into the field **Software key**.

3. Use the link or the QR code displayed in the window.

Result: A window opens in the browser. The values for the entered keys for hardware and software are adopted.



4. Enter your e-mail address.
5. Generate the licence by using the button .

Result: The licence key and the number of activations left are displayed.



If all activations of the licence have been used up, no licence key can be generated. In this case, contact your sales partner.

6. In the PD Detector Software, copy the licence key into the field **License Key**.
7. Save the licence key via the button **Update Licence** into the software.

Result: The PD Detector software opens.

Licence keys are only valid in combination with the associated system and software keys. This means that a new licence key needs to be generated after exchanging the hardware.

Activation of further software options

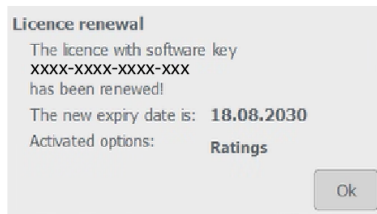
It is possible to activate additional software packages at any time. This is necessary if you have purchased additional software options that are not yet included in the current licence. Internet access and the new licence documents are required for activation.

Proceed as follows to switch the software package:

1. Ensure, that the PD Detector software is closed.
2. Open the installation folder of the software.
3. Delete the file *licence.lic* from the folder.
4. Follow the instructions for activating a licence key ([Activating the licence](#)).

Extending the licence period

The PD Detector Software checks the licence period each time it is started. If an extension of the period has been detected, the following pop-up window opens immediately after starting the software:



The expiration date in the area **Settings** in the category **General** is updated at the same time.

An HTTPS connection is required to determine the extension of the period. If it is not possible to create this connection, the licence period of the software must be updated manually by the user. This requires access to the Internet and access to the licence documents.

Proceed as follows to update the period manually:

1. Ensure, that the PD Detector software is closed.
2. Open the installation folder of the software.
3. Delete the file *licence.lic* from the folder.
4. Follow the instructions for activating a licence key ([Activating the licence](#)).

Result: If the software is reactivated on the same computer, none of the remaining activations will be used up. The pop-up window for extending the licence period does **not** open after restarting the software. The licence expiration date is displayed correctly.

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