



PD Scan

Online Partial Discharge Handheld Scanner

USER GUIDE

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Consultation with Megger

The present system manual has been designed as an operating guide and for reference. It is meant to answer your questions and solve your problems in as fast and easy a way as possible. Please start with referring to this manual should any trouble occur.

In doing so, make use of the table of contents and read the relevant paragraph with great attention. Furthermore, check all terminals and connections of the instruments involved.

Should any question remain unanswered or should you need the help of an authorized service station, please contact:

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General Notes

Safety precautions This manual contains basic instructions for the commissioning and operation of the device / system. For this reason, it is important to ensure that the manual is always available to the authorised and trained operator. He needs to read the manual thoroughly. The manufacturer is not liable for damage to material or humans due to non-observance of the instructions and safety advices provided by this manual.

Locally applying regulations have to be observed!

Signal words and symbols used The following signal words and symbols are used in this instruction manual and also on the product itself:

Signal word / symbol	Description
DANGER	Indicates a potential danger that will lead to fatal or serious injuries, if it is not avoided.
WARNING	Indicates a potential danger that may lead to fatal or serious injuries, if it is not avoided.
CAUTION	Indicates a potential danger that may lead to moderate or minor injuries, if it is not avoided.
NOTE	Indicates a potential danger that may lead to material damage, if it is not avoided.
	Serves to highlight warning and safety information in the instruction manual. A sticker on the product serves to identify the sources of danger and the safe handling of these dangers is ensured by reading the instruction manual.
	Serves to highlight warning and safety information which explicitly refers to danger of electric shock.
	Serves to highlight important information and useful tips for operating the product. Failure to observe them can render the measurement results useless.
	The parabolic acoustic sensor AA PR400 is fitted with a class 2 laser. The available laser beam is therefore only within the visible spectral range (650 nm). It is not harmful to the eye in the event of brief periods of exposure (up to 0.25 sec.). Longer periods of exposure are prevented by the natural corneal reflex.

- Working with products from Megger* It is important to observe the generally applicable electrical regulations of the country in which the device will be installed and operated, as well as the current national accident prevention regulations and internal company directives (work, operating and safety regulations).
- After working on the system, it must be voltage-free and secured against reconnection as well as having been discharged, earthed and short-circuited.
- Use genuine accessories to ensure system safety and reliable operation. The use of other parts is not permitted and invalidates the warranty.
- Operating staff* The system may only be installed and operated by an authorised electrician. DIN VDE 0104 (EN 50191), DIN VDE 0105 (EN 50110) and the German accident prevention regulations (UVV) define an electrician as someone whose knowledge, experience and familiarity with the applicable regulations enables him to recognise potential hazards.
- Anyone else must be kept away!
- Declaration of Conformity (CE)* The product meets the following security requirements of the European Council Directives:
- Radio Equipment Directive (RED 2014/53/EU)
 - RoHS Directive (2011/65/EU)
 - Artificial Optical Radiation Directive (2006/25/EC)
- Device transportation* The transportation of lithium batteries, as well as devices in which such batteries or rechargeable batteries are installed, is governed by regulations that are based on the model regulations of the United Nations for the transport of dangerous goods on land (UN document ST/SG/AC.10-1).
- Inform yourself about the transport regulations and observe them when transporting the device.
- Use of third party software* This product contains protected software, which is licensed under the General Public License (GPL) and the Lesser General Public License (LGPL). This certifies your right to request the source code for these software components.
- You can find detailed information on the GPL/LGPL licenses under www.gnu.org.
- Used trademarks* The **Bluetooth®** word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks is under license.
- Intended use* The operating safety of the system delivered is only guaranteed in the event of intended use (see page 9). Incorrect use may expose the operator, the system and any equipment connected to risks.
- The thresholds listed in the technical data may not be exceeded under any circumstances.

1 Technical description

1.1 System description

Intended use Defects on medium and high voltage components not only require costly repairs, but can also lead to failures of network sections with associated adverse consequences. It is therefore in the interest of all network operators to be able to detect signs of imminent defects as early as possible so as to take suitable countermeasures promptly.

Megger is offering a lightweight, robust and portable measuring device in the form the PD Scan which allow a range of operating equipment to be examined quickly for partial discharge signals.

The PD Scan is used for early detection of partial discharges in medium voltage substations and other electrical operating equipment. The convenient device features two internal sensors (TEV, airborne acoustic) for this purpose, and can also be operated with a range of external sensors (TEV, HFCT, airborne acoustic, acoustic contact probe). The device can be operated by using three soft buttons and by using the touch display.

All components (sensors and accessories) which may be used with the PD Scan are described in this manual. The product delivered to customers is, in fact, always a customer-specific configuration. At present, five versions exist, each housed in a special case.

Performance features The PD Scan combines the following features in one device:

- Measurement of partial discharge signals (inductive, capacitive and acoustic)
- Simple operation using a touchscreen or operating buttons
- High-performance internal rechargeable battery enables long operating time
- USB port
- Function testing
- Integrated camera
- QR code scanner
- Measured data evaluation
- Recording of the measured data and reporting using the MeggerBook Reporting Edition

Included in delivery The PD Scan is available in five different, application-based sets (set 1 to 4 and an additional set called "DIS"). Depending on the set purchased, the maximum scope of delivery includes the following components:

Component	1	2	3	4	DIS	Item number
PD Scan, handheld PD scanner	●	●	●	●	●	1009814
USB stick with instruction manual and reporting software	●	●	●	●	●	2010642
Charger	●	●	●	●	●	90025102
USB connection cable, type C	●	●	●	●	●	90027768
Headphones + adapter cable	●	●				90026232 + 90026230
Bluetooth headphones			●	●	●	90028677
Function tester, FC 1	●	●	●	●	●	1010219
Temperature and humidity sensor (with two additional protective caps)	●	●	●	●		1010217
External TEV sensor, C900-PD	●	●	●	●		1010524
HFCT sensor, SC40 + connection cable		●	●	●	●	1009667 + 90026538
Parabolic acoustic sensor, AA PR400-1				●	●	1012287
Flexible airborne acoustic sensor, AA FR130			●	●		1009757
Acoustic contact probe, ACP 30			●	●		1012924
Transport case	●	●				90026227 90031295
USB in-car charger			●	●		90028407



Check contents Check the contents of the package for completeness and visible damage right after receipt. 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 local sales representative.

Optional accessories / Upgrade kits When required, you can order the following accessory parts and upgrade kits from the usual sales channels:

Option / Kit	Description	Item number
Upgrade kit set 1 to set 4	Includes a parabolic acoustic sensor, flexible acoustic sensor, acoustic contact probe, HFCT sensor, Bluetooth® headphones and larger transport case	1011550
Upgrade kit set 2 to set 4	Includes a parabolic acoustic sensor, flexible acoustic sensor, acoustic contact probe, Bluetooth® headphones and larger transport case	1011551
PD Scan demonstrator box	Incl. transport case and batteries	1011423
PD Scan-WMSD	Wireless mass storage device that can be used for rapid data transfer and as a power bank	1012538
Coupling paste	For improved signal coupling when using the acoustic contact probe	1007238
USB in-car charger	For charging using a 12 V onboard power supply	90028407
HFFCTsensor HFFCT 20	 HFCT sensor (20 mm diameter) for permanent installation with fixed coaxial cable (3 m)	1006296
HFCT sensor HFCT SC60	 Split-core HFCT sensor with 20 mm inner diameter	1012681
LRHR connection cable	Connection cable for connection to capacitive Voltage Detection Systems (VDS) with LRM or HR interfaces	90033330

1.2 Technical data

The PD Scan is defined by the following parameters:

Parameter	Value
PD Scan Handheld	
Display	3.5" touch display, 320 x 240 pixels
Battery	Li-ion rechargeable battery; 3.6 V, 3.35 Ah
Operating time	>8 hours
Charger input	90 to 264 V AC, 50 / 60 Hz
Charger output	5 V DC
Interfaces	USB type C (charging, headphones, PC) Bluetooth® Connection socket for external sensors
Memory	32 MB internal memory / up to 1000 measurements
IP protection class (in accordance with IEC 60529 (DIN VDE 0470-1))	IP54
Operating temperature	-10 to 55 °C; 30 °C 93% r.h.
Storage temperature	-20 to 70 °C; 40 °C 95% r.h.
Dimensions W x H x D	220 mm x 80 mm x 30 mm
Weight	420 g
TEV sensors (internal and C900-PD)	
Measurement range	-10 to 80 dBmV
Bandwidth	2 to 80 MHz
Resolution	1 dBmV
Accuracy	±1 dBmV
Max. number of pulses per cycle	>1226
Min. level for pulse counter	10 dBmV
Acoustic sensors (internal, AA PR400, AA FR130) and solid borne vibration sensor ACP 30	
Measurement range	-10 to 70 dBμV
Resolution	1 dB
Accuracy	±1 dB
Converter centre frequency	30, 40 and 80 kHz
Laser (AA PR400 only)	Class 2 (max. 1 mW)

Parameter	Value		
HFCT sensors			
	HFCT SC40	HFCT 20 (optional)	HFCT SC60 (optional)
Split-core	Yes	No	Yes
Measurement range	-10 ... 80 dB	-10 ... 80 dB	-10 ... 80 dB
Bandwidth	100 kHz ... 20 MHz	100 kHz ... 150 MHz	100 kHz ... 20 MHz
Resolution	1 dB	1 dB	1 dB
Accuracy	±1 dB/ < ±10	±1 dB/ < ±10	±1 dB/ < ±10
Transfer impedance	ca. 4 Ω	ca. 4.2 Ω	ca. 4 Ω
Input resistance	50 Ω	50 Ω	50 Ω
Max. number of pulses per cycle	>1226	>1226	>1226
Operating temperature	-20 55 °C	-20 55 °C	-20 55 °C
Application area	Indoor	Indoor	Indoor
Inner diameter in mm	40 x 22	21	60
Dimensions (W x H x D) in mm	85 x 93 x 22	72 x 48 x 26	116 x 145 x 21
Weight	250 g	240 g	500 g
Function tester FC1			
Battery	Lithium button cell (CR1216 / 3 V, 25 mAh)		
Transmitted TEV level	25 dB ±5 dB		

The optional demonstrator box is defined by the following parameters:

Parameter	Value
Internal batteries	4 x AA battery
Operating time	>50 hours (if standard AA batteries with 2000 mAh are used)
Level of transmitted pulses	Adjustable (low, moderate, high, random)
Transmitted pulses per cycle	Adjustable (2, 8, 20, random)
Frequency of acoustic pulses	40 kHz
IP protection class (in accordance with IEC 60529 (DIN VDE 0470-1))	IP42
Operating temperature	-10 55 °C; 30°C 93% r.h.
Storage temperature	-20 ... 70 °C; 40°C 95% r.h.
Dimensions W x H x D	235 x 73 x 135mm
Weight	795 g

The optional PD Scan WMSD mass storage device is defined by the following parameters:

Parameter	Value
Internal memory	8 GB
Ports	Wi-Fi (2.4 GHz) USB Type A (data transfer) Micro USB (charging)
Battery	Li-ion battery: 3.6 V, 4.7 Ah
Operating time	10 hours
Charging time	5 hours
Dimensions W x H x D	150 x 29 x 92 mm
Weight	280 g
IP rating (according to IEC 60529 [DIN VDE 0470-1])	IP21
Operating temperature	-20 to 60°C
Storage temperature	-25 to 70°C.
Relative humidity	93% at 30°C (non-condensing)

1.3 Connection, display and control elements

The PD Scan features the following connection, display and control elements:



Element	Description
①	LED for displaying the charging activity
②	Socket for connecting external sensors
③	On/off switch, back to higher menu level
④	Touch display
⑤	TEV sensor contact area
⑥	Camera/QR code scanner
⑦	Ultrasonic microphone
⑧	Soft buttons with changing functionality
⑨	USB port for data transfer, headphones and charger

2 Principles of operation

2.1 General operation

Basic operation The device can be operated using the touch display or the three soft buttons. Briefly tapping the screen or the soft button positioned below the required symbol selects the required function:



- Exit measuring mode, selection window or menu



- Select confirm function/setting;
call up selected menu item



- Save the measured values



- Scroll through menu/access required function



- Continue to the next measurement screen



- Switch over to editing mode to change entries



- Undo changes/exit menu without saving



- Keypad control for input of names and numbers
(press briefly: continue to character field or keypad; press
and hold: applies the letters or number selected)



- Start scanning a QR code



- Continues the measurement after pausing



- Jump back one step during a TEV sequence measurement

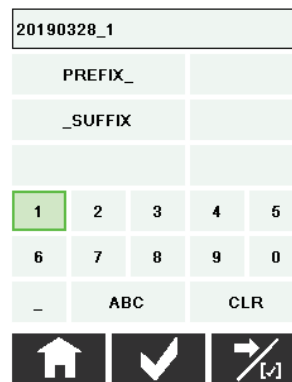
Special functions during the measurement Along with the standard functions which can be accessed using the three buttons at the lower edge of the display, the following special functions can be activated during the actual measurement:

Action	Function
Briefly tapping the measurement screen 	The measurement is paused and the current measurement results are frozen. If headphones are connected to the device, then the acoustic, audible signal is also muted. Instead of the  button, the button used to continue the measurement  now appears at the bottom edge of the screen. Briefly tapping the display again also allows the measurement to be continued.
Tapping and holding a specific segment 	The respective settings screen is called up. This would be the menu for adjusting the evaluation thresholds in the example shown. Once the required settings have been made, the  button is used to return to the measurement screen.
Pressing and holding the screen selection button 	The current measurement screen is saved as a screenshot. A keypad for entering the file name appears. Pressing the  button saves the screenshot in the data folder for the current measurement. The software then immediately returns to the measurement screen. The screenshot function is not limited to the measurement screens and can, for example, also be used in the menu screens. The only exception are the text entry screens which cannot be captured as screenshot.
Pressing and holding the "Save" button 	<u>Only available when using an acoustic sensor</u> An audio stream of the input signal is recorded for 10 seconds. The recording must be started manually by pressing the  button. Pressing the  button once the recording is complete saves the audio stream as a .wav file in the data folder for the current measurement. If the desired events are not recorded during the first recording, a second recording can be started instantly by pressing .

Input using the keypad This is used, for example, for the definition of folder names in which the measurement results should be saved.



Briefly pressing the  button allows the user to scroll through the list of fields on the touch screen. Pressing the  button deletes the last character that was entered. Pressing and holding the button deletes all characters. You can switch to the numeric keypad by pressing . In addition to number keys, the keypad also has six freely assignable keys for frequently used text modules.



Briefly pressing a text module adds it to the end of the current character string. Pressing and holding the text module opens it for editing.

Pressing the  button saves the character string entered.

3 Using/attaching the sensors provided

Internal acoustic sensor The internal airborne acoustic sensor is used for the acoustic detection of partial discharges. To do this, the front end of the PD Scan must be aligned with the openings in the substation, or directly with the freely accessible test object.

The distance to the measurement object should always be roughly the same, when possible, to ensure the measured values recorded are comparable.

Internal TEV sensor The internal TEV sensor measures electromagnetic waves. To do this, the front end of the PD Scan is held at the surface of the substation, preferably close to any openings/gaps in the substation.



Flexible airborne acoustic sensor This external, acoustic sensor is specially designed for openings, air holes and gaps, out of which the acoustic waves of the partial discharges can escape from the switchgear.



Parabolic acoustic sensor

**DANGER**

Danger of injuries to the eyes due to laser beam

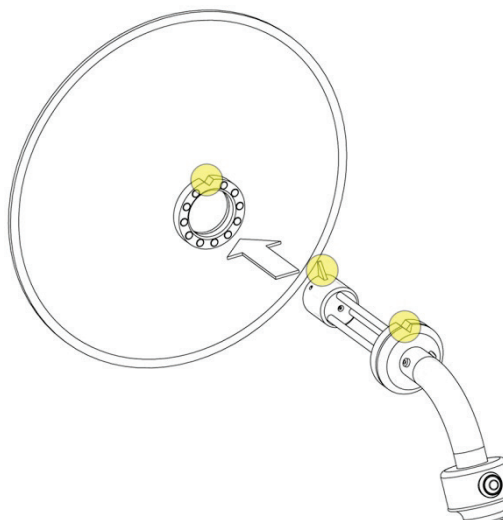
- Avoid direct exposure to the eyes!

This external sensor is suitable for acoustic measurements indoors or outdoors on systems on which direct measurements are not possible. The maximum distance possible is largely dependent on the level of the exciter and the ambient conditions (humidity, temperature and reflection points). When weather conditions are adverse, the signal can be attenuated by up to 2 dB/m by the air alone.



Using the parabolic acoustic sensor allows the distance to be increased by around ten times while retaining the same level in comparison to an internal acoustic receiver. If the internal acoustic receiver allowed a reading of, for example, 20 dB μ V to be taken at a distance of 1 m to the measurement object, then parabolic acoustic sensor allows the same level to be recorded at a distance of around 10 m. As for the internal acoustic sensor, the following applies: The distance to the measurement object should always be roughly the same, when possible, to ensure the measured values recorded are comparable.

Before use, the handle with the integrated laser pointer must be attached to the parabolic concentrator. A magnetic lock provides the necessary support. When assembling, make sure that the two notches indicated in the picture below are in line with the retractable sight.



The sensor features a laser pointer that is activated by pressing a button, and which can be aligned with the measurement object. This ensures the microphone is optimally aligned. The parabolic umbrella acts as a light filter and ensures that the red laser point is easier to detect.

Alternatively, the object being measured can also be "targeted" via the notch and the post using the front and rear sight principle.

*Acoustic contact probe
(ACP 30)*

NOTE

Danger of damage in the event of shocks and impact stress

The acoustic contact probe contains a Piezo element, which can suffer irreparable damage due to shocks or impact stress and which can cause the sensor to make inaccurate measurements.

The sensor should therefore be treated carefully, and be placed down on the metal surface gently.

This external sensor measures solid borne vibrations on the surfaces of substations. To do this, the magnetic sensor is attached to the measuring point.

This measurement is ideally suited for substations with a single enclosure and on which airborne acoustic measurements cannot be conducted.



It is essential that this type of sensor is used correctly. The sensor head must be placed flush on a surface that is as smooth as possible. Even the smallest air inlets pose a risk of preventing signals caused by partial discharges from being measured.

When using the sensor, you must observe the following:

- **Clean contact surfaces before measuring**
Before using the sensor, you must remove any dust particles and irregularities that will prevent the sensor from making full contact with the surface.
- **Apply a coupling agent**
For rough or uneven surfaces, you must apply a coupling agent to the surface before performing the measurement to provide a better signal coupling. For this purpose, we recommend using the coupling paste that is available as an optional accessory (see page 9).



- **Identify and prevent noise interference**
You must ensure that the measurement is not impaired or masked by unwanted signals (such as noises and vibrations caused by transformers or motors). If this is the case, the offending device must be switched off or the measurement must be taken at a later date.

External TEV sensor (C900-PD) As soon as the external TEV sensor is connected, every TEV measurement is performed automatically via this sensor. This sensor can also be used in hard-to-reach places and, thanks to its built-in magnet, can be attached to metallic surfaces.

In addition, when an external TEV sensor is connected, this can be used to perform a comparison measurement with the internal TEV sensor (see page 39). In this case, the external TEV sensor must be placed parallel to the internal sensor on the object selected for the comparison measurement (e.g. on a neighbouring switch cabinet) while the measurement is being performed.



HFCT sensor (HFCT)



WARNING

Danger of fatal injury due to electric shock

Before an HFCT sensor is attached, it is imperative that the five safety rules are followed:

1. Disconnect the power
2. Secure against reconnection
3. Check for presence of voltage
4. Make earth connection and short-circuit
5. Cover or block access to adjacent components which are live

The HFCT sensor is suitable for inductive decoupling of PD pulses directly on cable ends. To do this, the magnetically closing sensor must be installed on the ground wire connected to a cable end.



In principle, the PD Scan can also be used in combination with other HFCT couplers, as long as they feature an accessible BNC interface. However, depending on the sensor used, this may result in differences in the level display. The PD Scan has been precisely harmonised with the HFCT sensor in terms of its measurement accuracy.

LRHR connection cable (optional) The optionally available LRHR connection cable offers another possibility to carry out PD measurements on encapsulated switchgear without having to disconnect it. The LRHR cable can be connected to all Voltage Detection Systems (VDS) that have interfaces of type LRM or HR. The red end of the cable must be connected to the desired phase and the black end to the earthing socket.



The PD levels themselves are of less importance for this type of measurement. Rather, the PRPD diagram should be checked for typical PD clusters and patterns.

If this is the case, further TEV and acoustic measurements on the affected cabinet are recommended in order to limit the origin of the partial discharges. If these measurements show no abnormalities, the TE activity measured on the Voltage Detection System most likely comes from the cable. The measurement with the LRHR connection cable is therefore well suited to preselect conspicuous cables for a planned offline measurement.

However, there are of course limits in terms of cable length. On XLPE cables, PD faults in 1.5 to 2 km distance could be successfully detected. The "measuring range" may also be smaller due to interference or high attenuation.

The manufacturing quality of the cable termination within the switchgear also affects the usability of the measurement results. Experience has shown that the newer and more modern the switchgear, the better the measurement results.

4 Performing measurements



DANGER

Danger to life from electric shock or electric arcs

To avoid any electrical hazards when starting up and using the PD Scan, the following instructions must be followed:

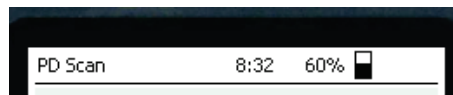
- All notices, instructions, rules of conduct and operating manuals of the facility manager/plant operator must be complied with!
- When approaching live equipment, the safe distances applicable for the corresponding voltage level must be observed at all times! Information regarding the minimum distances to be observed must be obtained from the facility manager/plant operator before beginning work.
- Antennas which are connected to the detector for measuring purposes are conductive components. Their length is therefore especially to be taken into account when approaching live components!

4.1 First steps

Switching on Pressing the on/off switch  switches on the PD Scan.

The PD Scan is fitted with an internal Li-ion rechargeable battery. This allows the device to be operated for up to 8 hours, depending on the operating mode.

Before using the device on-site, the PD Scan should be switched on briefly and the charge status of the battery be checked at the upper right of the display.



When the remaining capacity is low, recharging the battery before starting the measurement is recommended (see page 71). No measurements can be performed during the charging process.

Measuring temperature

NOTE**Risk of damage when stored without protective cap**

Always protect sensor side with the provided protective cap, if not in use.



Before starting the measurements, the ambient temperature and humidity should be measured, as both parameters can exert a significant influence on the measurement results. To do so, the temperature and humidity sensor must be connected to the socket **2** provided for this purpose and the protective cap needs to be removed from the sensor side.



The values appear on the display and can be saved using . The  symbol appears in the display at the top right, and confirms that the measurement is working properly. The results are saved and filed among the measured data in measurement mode.

The measured data for temperature and humidity remained saved in the memory until they are overwritten by a new measurement, or are automatically deleted when the device is switched off.

Function test To prevent incorrect measurements, a function test is recommended before each use.

1. Start the TEV measurement (⚡ → |⚡|).
2. Press the front ends of the PD Scan and of the function tester together.



3. Press the push-button on the function tester to generate a PD-like signal.
4. Read the measurement result on the display. A level between 18 ... 23 dB should be reached. This provides proof of proper function.

If, despite pressing the push-button, no PD level can be measured and/or the LED in the push-button does not light up, then this can most likely be attributed to a discharged battery (see page 73).

4.2 Preparing a measurement

Connecting the sensor If the measurement is to be performed using one of the external sensors included in the scope of delivery, this must be connected to the socket **2** of the PD Scan.



The device automatically detects the connected sensor after being switched on, and offers a choice between the potential operating modes.

Connecting/pairing headphones In preparation for an acoustic PD measurement, the headphones provided can either be connected using the USB port **9** or be paired by means of Bluetooth (see chapter 6). The headphones are used to reproduce the level measured acoustically. The acoustic signal processing is only available in the acoustic measurements. No acoustic output occurs in the operating modes **TEV**, **TEV Seq**, **TEV Loc** and **HFCT**.

The volume of the headphones connected by cable can be adjusted in the settings menu for the respective operating modes (see page 48). The volume of the Bluetooth headphones can be controlled directly on the headphones by using the buttons provided for this purpose.

4.2.1 Creating a measurement data folder

Introduction As soon as the recommended temperature/humidity measurement and the function test have been completed, measurements can begin.

In order to be able to allocate the saved measured data to the individual measurement objects later on, **a new measurement data folder should be created every time measurements will start on a measurement object.**

A measurement data folder can be created in the following ways:

- Scanning the QR code on the measurement object (see next section)
- Creating a new folder manually (see page 31)

4.2.1.1 Scanning the QR code on the measurement object

General information on this function QR codes are frequently used in the industrial sector for unique inventory designation, and allow an overview of all data and events archived in relation to the inventory object to be obtained quickly. In order to be able to use the advantages of this for equipment in substations and for the measurements made on them, the PD Scan features an integrated QR code scanner.

When scanning a QR code affixed to a measurement object, the character string encoded in it is decrypted, and a folder name comprised of this character string, the current data and a running index is automatically created. The character string is also saved in the sets of measured data, which make allocation and archiving easier.

The QR code method also has benefits for the actual measurement. The PD Scan automatically starts by checking, for example, whether older measurements on a measurement object with this code are available in the internal memory and, if this is the case, offers a comparison between the old and the current measured values (see page 36).

Requirements of the QR code The character string encoded in the QR code must satisfy the following prerequisites in order for the PD Scan to scan it and process it internally:

- It may be a maximum of 19 characters
- It may only contain upper-case and lower-case letters from the Latin alphabet, numbers and underscores (_).

The generators available in the Internet can be used for creating the QR code.

- Scanning the QR code on the measurement object* Proceed as follows to scan a QR code affixed to a measurement object:
1. Select the menu item **New measurement** in the main menu.
 2. Select the menu item **Read QR code**.



3. Hold the PD Scan up to the QR code and press the  button. The integrated camera will now try to read the QR code, and will show its character string at the bottom of the display as soon as it was able to be scanned.

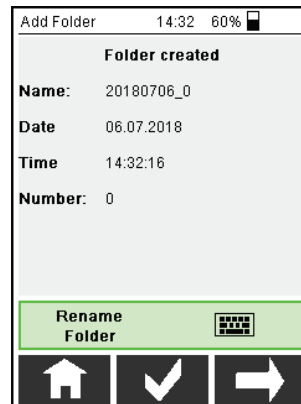


4. Select  to confirm the code and to access the operating mode selection.
5. Repeat these steps as soon as you change to a different measurement object.

4.2.1.2 Creating a folder manually

If there is no QR code on the measurement object, then a measurement data folder must be created manually. To do so, proceed as follows:

1. Select the menu item **New measurement** in the main menu.
2. Select the menu item **Create new folder**.



A new folder is created, the name of which is comprised of the current data and a running index.

3. If you would like to modify the name of the folder, select the **Rename folder** button. In most cases, including the number/designation of the measurement object in the folder is useful, in order to be able to clearly allocate the measured data recorded easier later on.

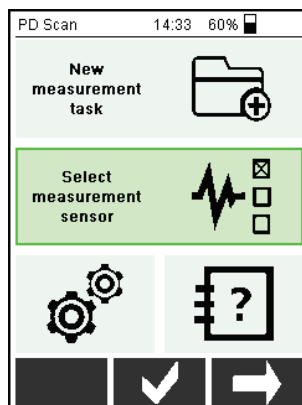


To save time, you may also skip renaming the folder and instead save a photo containing details of the measured object in the data folder during the measurement (see page 35).

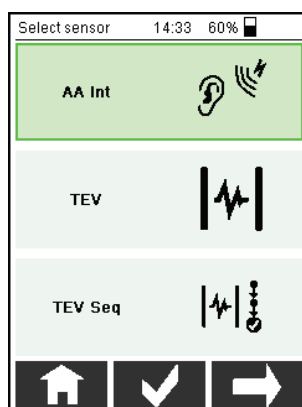
4. Confirm the folder name using  and select  to access the operating mode selection.
5. Repeat these steps as soon as you change to a different measurement object.

4.2.2 Selecting the operating mode

Once the new folder name has been created, the measurements can be started by selecting the required sensor.

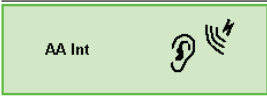


Pressing the **Select measurement sensor** field on the touch display or pressing  opens the menu for selection of the operating mode.



Pressing the required field on the touch display, or navigating to the required field using , followed by , allows the required operating mode to be started.

Depending on the sensor connected, the operating modes available differ as follows:

Connected sensor	Possible measurement procedures
No external sensor connected	Acoustic measurement with the internal sensor (AA Int) or measurement using the internal TEV sensor (TEV or TEV Seq)   

Connected sensor	Possible measurement procedures
Flexible airborne acoustic sensor	Acoustic measurement with the flexible airborne acoustic sensor (AA FR130) or measurement using the internal TEV sensor (TEV or TEV Seq) AA FR130  TEV  TEV Seq 
Parabolic acoustic sensor	Acoustic measurement with the parabolic sensor (AA PR400) or measurement using the internal TEV sensor (TEV or TEV Seq) AA PR400  TEV  TEV Seq 
Solid borne vibration contact sensor	Measurement with the acoustic contact probe (ACP 30) or using the internal TEV sensor (TEV or TEV Seq) ACP30  TEV  TEV Seq 
HFCT sensor	Measurement using the HFCT sensor (HFCT) New measurement task  HFCT 
External TEV sensor	Comparative measurement between the internal and external TEV sensor (TEV LOC) or measurement using the external TEV sensor (TEV Ext. or TEV Seq) Select sensor 10:08 60%  TEV LOC  TEV Ext.  TEV Seq 
LRHR connection cable	Measurement on the Voltage Detection Systems (VDS) of enclosed switchgear Select sensor 14:21 60%  LRHR  TEV  TEV Seq 

4.3 Measuring the ambient noise level

Before a measurement using a TEV or an HFCT sensor, the ambient noise level should always be measured in order to be able to factor this into the subsequent evaluation of the measurement results. To do so, proceed as follows:

1. Create a measured data folder with a suitable name (e.g. "GSP") (see page 29).
2. Place the sensor on external equipment parts. The front end of the PD Scan can be held on a metallic access door, for example, for an ambient noise level measurement. When using an HFCT sensor, attaching it to the earth line of a low voltage line is recommended.
3. Start the operating mode **TEV** or **HFCT** according to the measurement procedure you would like to use to measure the ambient noise level.
4. Record measured values for around 10 seconds and then press the  button in order to save the noise level to a folder specifically created for it.
5. Create a new measured data folder for the subsequent measurements on the actual measurement object.

4.4 Standard measurement

Basic procedure Directly after selecting the operating mode, the measurement screen opens and the device starts to record measured data. Measured data should be recorded for at least 10 seconds while the sensor being used is in contact, or aligned, with the measurement object in the correct way (see section 3).

After doing so, the measured data can be saved using the  button, which appears on all measurement screens (not, however, on the camera screen). Saving again over the course of further measurements is also possible without problems. In this case, the data are filed in the same measured data folder as an additional data set.



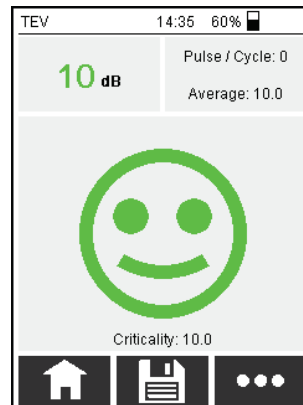
If the primary objective of the measurement is to reliably identify vulnerable equipment while performing regular, short inspections, it is not necessary to save every single measurement that you take. In this case, it makes sense to save only unusual measurements so that it takes less time for you to find these in the memory and analyse them at a later date.

The  button can be used to switch between the different measurement screens described in the following sections.

Once the measurement using the respective sensor has been completed on the measurement object,  can be used to open the screen for selecting the operating mode and another measurement with a different type of sensor can be started on the same measurement object straight away. The measured data are saved in the same measured data folder.

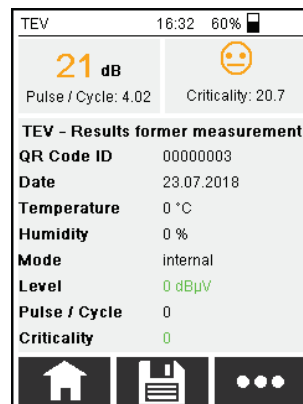
If, in contrast, the measurement is to be continued on another measurement object, a new measured data folder must be created in advance (see page 28).

Overview screen This screen provides a compact overview of the most important measured values and the criticality value determined on their basis (see page 43). The coloured smiley symbol is used to make a statement about the condition of the measurement object based on one of the thresholds saved (see page 52).



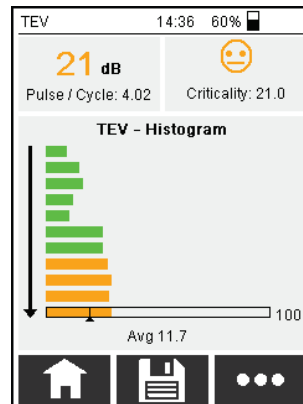
The average measurement shown is calculated from the level values measured for the last 10 seconds.

Comparison screen This screen is only shown when the QR code of the operating equipment was scanned, and there is a previous measurement for this measurement object in the internal memory. The QR code can be used to identify the operating equipment uniquely.



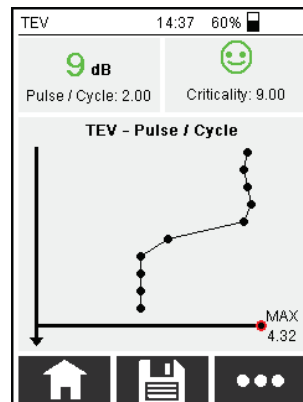
This screen allows you to quickly and reliably identify whether the measured values have, for example, worsened in comparison to a measurement performed 6 months ago.

Histogram screen This histogram shows the measured values from the last 10 seconds in dB μ V (averaged per second).



The bar at the bottom shows the maximum value measured within the last 10 measurements. The average measurement displayed (**Avg**) also refers to the last 10 seconds.

Pulse / Cycle screen This screen shows the course of the pulse-per-cycle values measured over the last 10 seconds.



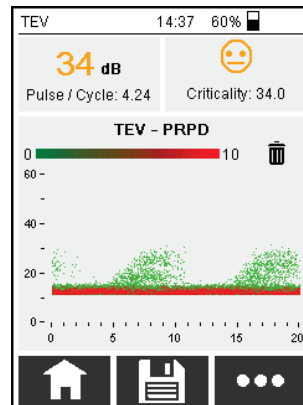
The value is updated every second, i.e. the value is averaged over the mains voltage periods occurring within one second.

The bar at the bottom also specifies the maximum value measured in this case.

PRPD screen The PRPD diagram (phase resolved partial discharge) provides information about the distribution of the measured PD pulses over a mains voltage cycle (X-axis).

To do so, the levels (Y-axis / dB μ V) and relative phasing (X-axis / ms) of the measured PD pulses are plotted in a diagram. If multiple pulses with exactly identical coordinates (level and phase relationship) are measured, then the respective dot in the diagram gradually changes colour from green to red in accordance with the colour scale shown.

In the case of PD activity, cloud-shaped clusters take shape over the course of the measurement, the form and colour of which allow conclusions about the type of PD to be made (e.g. corona discharge or surface discharge). This is described in detail in specialist literature.



Example: One PD pulse with a level of 40 dB μ V was measured after 7 ms (within a 20 ms mains frequency period). A green dot is drawn at this position. With each additional pulse that strikes exactly this parameter, the colour increasingly changes to red. After the number of pulses defined in the settings under **Max quantity** has been measured in this position, then the dot is displayed in a vibrant red (end of the colour scale shown). The colour is not modified any further. This allows the assumption to be made that an infinitely long measurement would result in all dots (at least those inside the cloud) being shown in red.

The screen can be deleted again using the trash symbol, and a new recording can begin.

Camera screen This screen is used to photograph the current measurement object, the station or switching cell name, or any other special features, and to file the image together with the actual measured data in the measured data folder.



If the green cross indicating which can be enabled /disabled (see page 50) appears in the centre of the screen, it should be positioned as precisely as possible on the identified problem area or any other point relevant to the measurement when capturing the image. The green mark will then also be visible in the image file afterwards.

The  button functions as the shutter release in this screen, and is not used for saving measured data.

4.5 TEV comparative measurement between an internal and external sensor

Purpose Because the PD pulses proliferate well on metallic surfaces, often only marginal differences in the level can be measured at close range, which makes localising the weak point exactly much more difficult. It is for exactly cases like these in which the equipment affected by partial discharge cannot be identified precisely that a comparative measurement between an internal and external TEV sensor is recommended (e.g. on two adjacent switchgears).

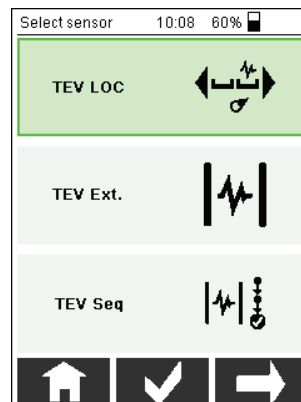
Although the PD level is also measured and output on both sensors during a comparative measurement like this, this only plays a minor role in localising the weak point. The propagation time of the pulse from the weak point to the sensor (the so-called "time of flight") provides significantly better insights in this case. This provides insight into which of the two sensors is closer to the weak point.

Procedure Proceed as follows to perform a TEV comparative measurement:

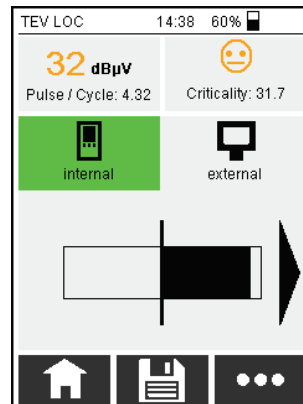
1. Connect the TEV-C900-PD to the socket **2**.
2. Hold the front ends of the PD Scan and the TEV-C900-PD on the two metal surfaces for comparison.



3. Start the **TEV LOC** operating mode.



- Use the indicators in the measurement screen to determine which of the two sensors is closer to the source of the partial discharges.



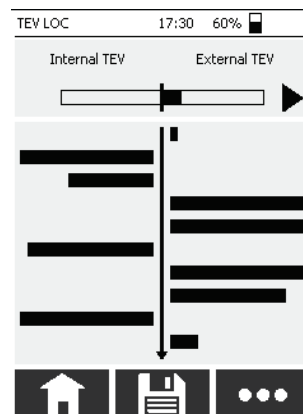
The black bar deflects in the direction of the sensor that is closer to the weak point. In the example, the weak point is considerably closer to the external sensor.



Time of flight measurement only takes place, if the values exceed 10 dBµV. Otherwise, no direction cannot be indicated.

The **internal** and **external** buttons can be used to switch over between the current measured value display of the two sensors during the measurement.

- If applicable, change the position of the sensors to move closer to the weak point. Once a bar deflection is barely noticeable, then the weak point is likely to be exactly between the two sensors.
- You can switch to a second measurement screen which shows the course of the last 10 measurements using the  button.



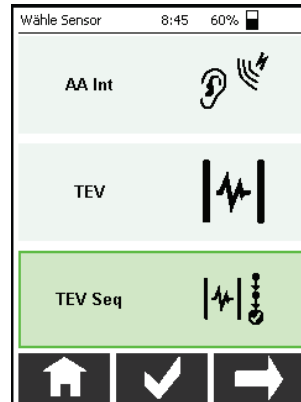
This screen allows you to monitor precisely how repositioning the sensors affects the measured levels.

4.6 TEV measurement sequence

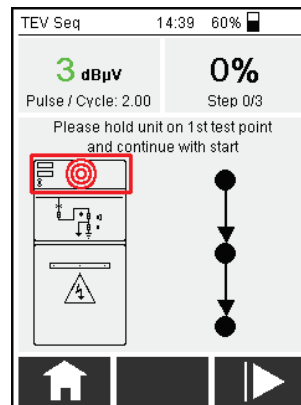
Purpose This measurement is used for the sequential PD measurement with the internal TEV sensor at different points on a substation in a specific sequence. This has the advantage of allowing several measuring points on a substation to be measured in one round of measurements, and the results to be allocated to the respective positions correctly during the evaluation. The number and order of the measuring points can be defined in the device settings (see page 50).

Procedure Proceed as follows to perform a sequence of measurements on a substation:

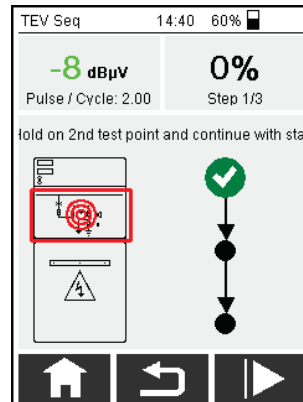
1. Start the operating mode **TEV Seq.**



The first measurement point is displayed.



2. Hold the front end of the PD Scan on the first measurement point and press . The first measurement starts. Once complete, a prompt appears to perform the next measurement.



3. Perform the additional measurements in accordance with the respective measurement point displayed. The  button can be used to jump back one measurement when necessary, and repeat this measurement.
4. Save the measurements using .

4.7 Evaluation of the measurement results

The following three measured values appear permanently in the upper part of the measurement screens, and can be used for an evaluation of the PD activity:

Level (in dB or dB μ V)

The signal level is measured continuously, and the value displayed is updated every second. The highest respective value measured during the last second is displayed. The colour of the text indicating the value of the level is based on the thresholds entered in the settings (see page 52).

Pulse per cycle (PpC)

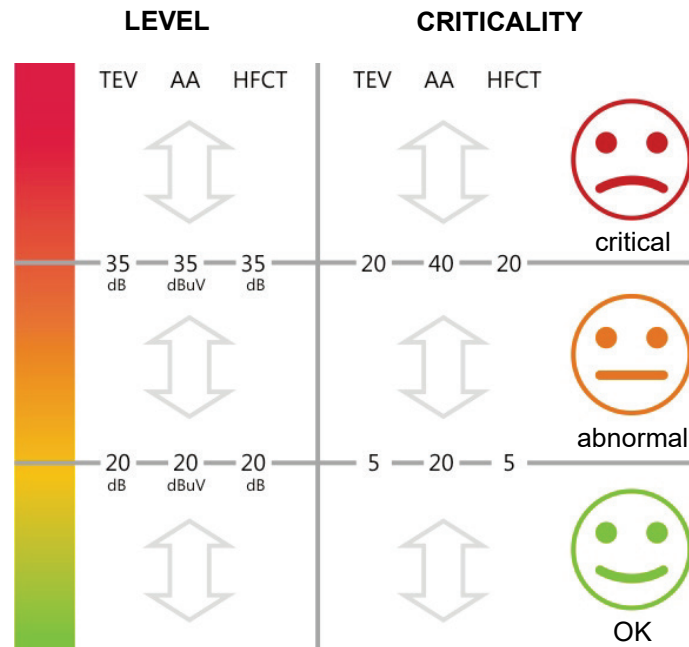
The PpC value describes the number of pulses measured during a mains frequency period (20 ms or 16.67 ms). The signals evaluated as pulses are determined in two stages. Once noise suppression has been performed by the hardware filter, the pulses that were not suppressed by the noise suppression are filtered again in the memory by means of an algorithm, and the remaining number is used for the calculation of the PpC value. Because this process is repeated multiple times before the display is updated, this may also result in PpC values that are not integers.

Criticality

The values for the criticality can vary from 0 to 100, whereby 0 is considered absolutely uncritical. An increasing criticality value means that a PD weak point is more and more likely in the measurement object being examined. A distinction is made between acoustic measurements and the TEV/HFCT measurements to determine the criticality.

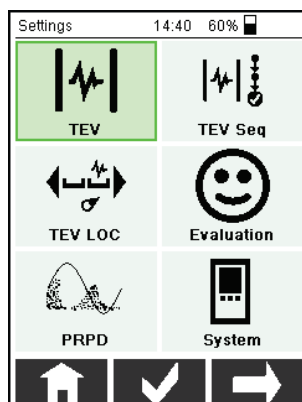
The level measured and the PpC value are used as a basis for the calculation. Over the course of the calculation, the level is standardised and evaluated using a weighting factor, which is based on empirical values measured on different measurement objects. The internal weighting factors are modified in accordance with the sensors used and may, in part, differ. While the measured values are added up when acoustic measurements are made, the values are multiplied when TEV and HFCT measurements are made.

The PD level measured and the criticality value that was reached undergo a direct, automatic evaluation during the ongoing measurement, and this is displayed by means of the colour of the text and the type of smiley. The evaluation is made using the thresholds saved, which can be modified at any time for an individual classification system in the device settings (see page 52). The following **guideline values** are specified upon delivery:



5 Settings

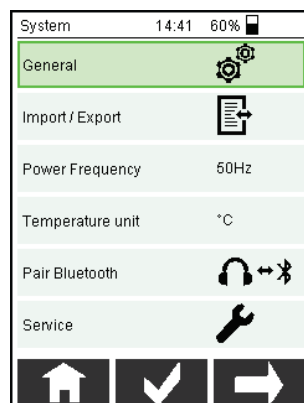
The settings menu can be accessed from the main menu by using the menu item .



Along with the menus that are always available for editing device settings, the evaluation criteria and the PRPD diagram settings, the settings for the respective operating modes available (depending on the sensor connected) can also be entered.

5.1 Device settings

Adapting device settings The menu item **System** can be used to access the device settings, in which the following modifications can be made:



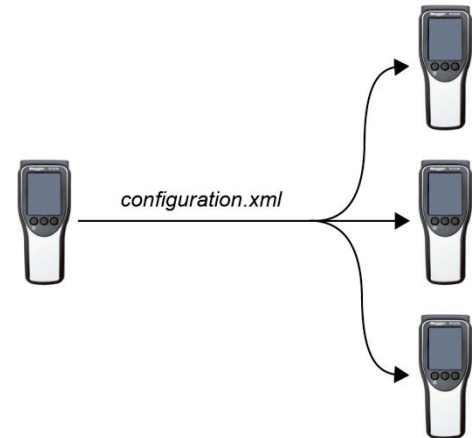
Setting	Description
General	
Language	Menu language
Date	Date
Time	Time
Automatic switch off	Time until the device automatically switched off in the event of inactivity (1–60 minutes)
Schemes	Setting for the preferred colour schemes, the screen brightness and the acoustic notifications
Default settings	Reset device to default settings
Import/Export	Imports/exports the configuration file and the comparison data set (see page 47).
Power frequency	Mains frequency in the area of use (50 Hz or 60 Hz)
Pair Bluetooth	Pairing Bluetooth headphones (see page 48)
Service	Access to the service menu is password-protected and reserved for service staff.

5.1.1 Importing and exporting configuration and comparison data

General information In addition to the actual measurement data export (see page 55), there are two other file formats that can be imported and exported and thereby exchanged between different devices:

Configuration file

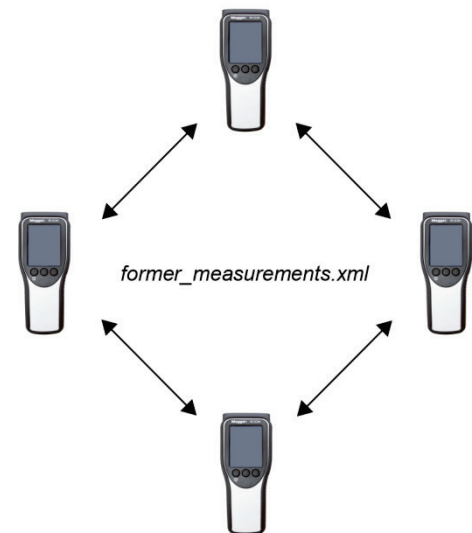
This file contains all the variable setting parameters (such as the evaluation threshold values and operating mode settings). The file can be transferred to other devices. This allows a company to apply the same settings to all the devices they use, for example.



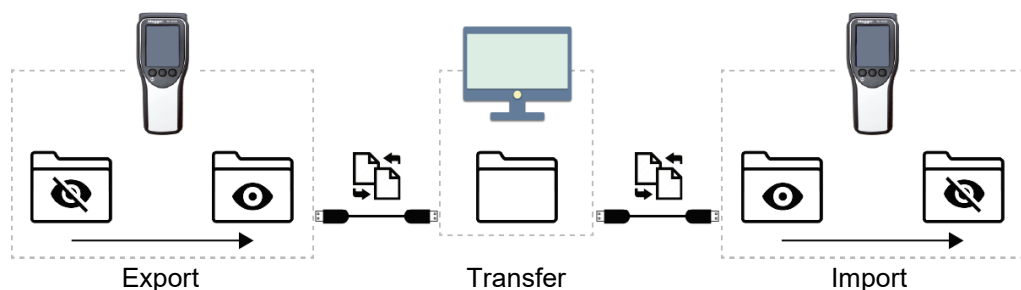
Comparison data set

This file contains elementary measurement data of the last measurement performed for each measured object identified using a QR code. The next time the same object is measured, this data is then displayed as reference values in the comparison screen.

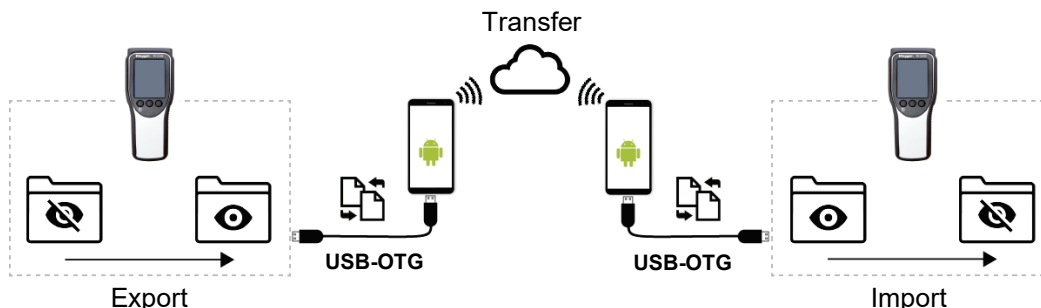
Regularly exchanging this file between all the devices used ensures that the comparison data set on each device is complete and up to date.



To prevent these important files from being deleted accidentally, the actual files are located in an invisible area of the memory, which cannot be accessed even when devices are connected via USB. The files must be "exported" to the visible memory before they can be exchanged with other devices. Only from this location can the files then be copied from the device and transferred to another, where they must then once again be "imported" into the invisible area of the memory before they can be used.



Files can also be transferred via email, messaging and cloud-based services using a USB OTG adapter and a suitable Android phone. This means that the devices do not all need to be in the same place. Once the PD Scan is connected to the Android phone, a compatible file management app can be used to access the visible memory and share or send the desired file.



Procedure To transfer the configuration file or the comparison data set from one device to another, proceed as follows:

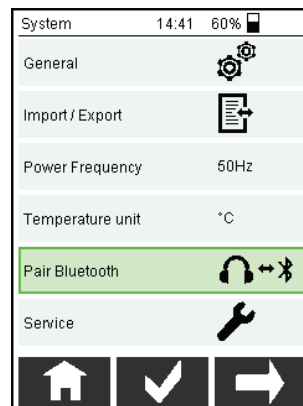
1. Turn on the device from which you want to export a file.
2. In the main menu, press the  button to open the **System** settings menu.
3. Tap **Import/Export**.
4. Go to **Export** and tap **Configuration** or **Former measurements** to export the current configuration file or the current comparison data set to the visible memory.
5. To access the file that was just exported (*configuration.xml* or *former_measurements.xml*), use a USB cable to connect the device to a PC or an Android phone.
6. Copy the file to your PC or send it to another phone or cloud-based storage service.
7. Turn on the device into which you want to import the file.
8. Use a USB cable to connect the device to a PC or an Android phone on which you can access the exported file.
9. Copy the file to the visible memory of the device (root directory).
10. In the main menu, press the  button to open the **System** settings menu.
11. Tap **Import/Export**.
12. Go to **Import** and tap **Configuration** or **Former measurements** to enable the configuration file to be used on this device or to align the imported comparison data set with the existing comparison data set.

When the comparison data sets are compared, the data set for a measured object is only overwritten if the imported data set is more recent or if there is no data set for the measured object on this device.

5.1.2 Pairing Bluetooth headphones

Bluetooth headphones must be paired with the PD Scan once before being used for the first time. To do so, proceed as follows:

1. Switch on the headphones and check the charge level.
2. Make sure that so-called pairing mode is activated on the headphones. The headphones provided with the device signalise this with an LED that flashes red and blue in alternation.
3. Tap the  button in the main menu and open the **System** settings menu.
4. Tap on the **Pair Bluetooth** button.



The PD Scan will now search for Bluetooth devices nearby.

5. Select the required Bluetooth device. The headphones have been successfully paired when the message **Pairing succeeded** appears in the display and the  appears on the upper edge of the screen.



After being successfully paired for the first time, the headphones only have to be switched on after the PD Scan in future, and should then connect to it automatically. However, the  symbol only appears after an acoustic measurement was started.

5.2 Operating mode settings

Depending on the sensor connected, the settings menu  provides different submenus for configuring the operating modes currently available. Depending on the menu/operating mode, the following parameters can be specified:

Parameter	Menu/ Operating mode					Description
						
Frequency			●			Frequency at which the acoustic measurement is performed (30 kHz , 40 kHz or 80 kHz)
Volume			●			Headphone volume between 1–100%
TEV LEVEL default				●		Selection of the sensor for which the measured values should be shown by default when making a comparative measurement (internal external)
Number of steps					●	Number of measurement points for a TEV measurement sequence (2 or 3)
1st position, 2nd position, 3rd position					●	Order of the measurement points at the substation during a TEV measurement sequence (top , middle , bottom)
Diagram – Histogram	●	●	●	●		Activates/deactivates the histogram screen in the respective operating mode
Diagram – Pulse per cycle	●	●	●			Activates/deactivates the pulse-per-cycle screen in the respective operating mode
Diagram – PRPD	●	●	●			Activates/deactivates the PRPD screen in the respective operating mode
Camera	●	●	●			Activates/deactivates the camera function in the respective operating mode (On , Off , Marker). If set to Marker , a green cross is displayed on the camera screen as well. This cross is saved in the image file.

Along with the option of activating/deactivating the individual measurement screens for specific operating modes, the measurement screen that should be displayed directly after entering the operating mode can also be defined in this menu.

To do so, the corresponding entry in the settings menu must be tapped for around 2 seconds. This will then be marked with a *, and the operating mode will appear as the start screen by default the next time the device is started.

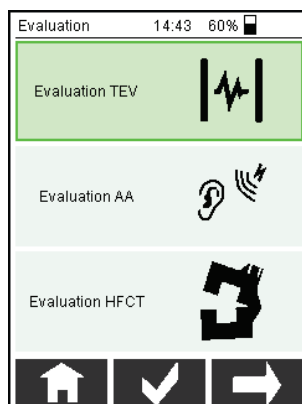
Diagram - Histogram	On
Diagram - Pulse per cycle *	On
Diagram - PRPD	On
Camera	On

Tapping and holding again allows the selection to be undone.

5.3 Adjusting the evaluation thresholds

The preset evaluation thresholds can be adjusted to the individual, in-house company specifications at any time. To do so, proceed as follows:

1. Tap the  button in the main menu and open the **Evaluation** settings menu.
2. Select the operating mode for which you wish to adjust the evaluation thresholds.



3. Select the threshold you want to adjust.

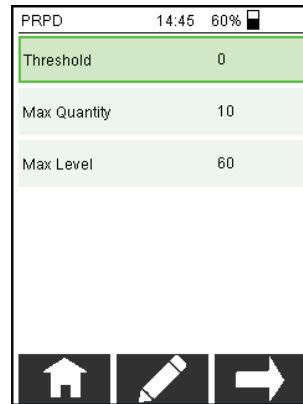
Threshold	Description
ORANGE	dB value above which the measured level is displayed in an orange text colour.
RED	dB value above which the measured level is displayed in a red text colour.
	Criticality value above which a neutral smiley appears.
	Criticality value above which a sad smiley appears.

4. Tap on  and enter the passcode **1234509876** required to adjust the threshold.
5. Adjust the threshold and save the new setting.

5.4 PRPD diagram display settings

If necessary, the display settings for the PRPD diagram can be adjusted. To do so, proceed as follows:

1. Tap the  button in the main menu and open the **PRPD** settings menu.
2. Adjust the parameters to your specifications.



Parameter	Description
Threshold	Lower threshold for the charge level shown in the diagram.
Max Quantity	This value defines the upper quantity threshold. If this value was set at 50 as shown in the example below, a total of 50 charge pulses with the exact same amplitude and phasing must be measured before the right-hand end of the colour scale is reached. Every further pulse measured with these values no longer causes a change of colour.
Max Level	This value defines the maximum value on the Y-axis and can be set to between 40 and 100 dB. When set to Auto, the measurement starts with an upper limit of 40 dB and is automatically increased, if higher values are measured.

5.5 System information

The system information can be accessed directly from the main screen using the menu item , and provides the following data:

Parameter	Description
Serial number	Serial number of the device (please specify in the event of servicing)
Software version	Software status of the device.
Hardware version	Information about the hardware status of the device. (Please specify in the event of servicing)
Free memory	Display indicating the internal memory still available. The remaining capacity should be checked regularly, as when the memory is full, the oldest measured data still in the memory are automatically overwritten.
Last factory test	Information about the last factory test performed on the device. Information on the recommended test cycles can be found on page 71.
Battery voltage	Current battery voltage
Charge current	Current charge current

6 Processing the measured data

6.1 Transmitting measurement data to a mobile device

6.1.1 Transferring the data via USB OTG adapter

To quickly send recorded measurement data for more accurate evaluation to another person, the PD Scan can be connected to any compatible Android phone via a USB OTG adapter (not included in scope of delivery).



The measurement data stored in the internal memory of the PD Scan can then be easily and quickly shared via email, messaging or a cloud-based service using a compatible Android file management app.

6.1.2 Transferring data via PD Scan WMSD mass storage devices (optional)

Introduction If measurement data cannot be transferred using a USB OTG adapter (e.g. in the case of iOS devices), the optional PD Scan WMSD mass storage device (hereafter referred to as "WMSD") can be used as a data interface between the PD Scan and Wi-Fi-enabled devices.

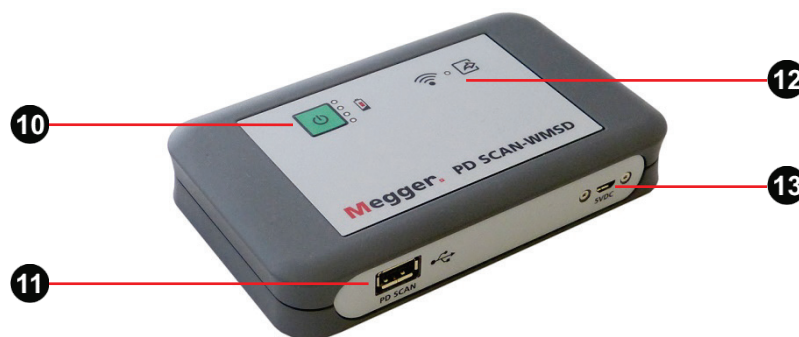
Accessing the measurement data on a connected PD Scan and quickly forwarding it simply requires a wireless connection to the WMSD's Wi-Fi access point.



When a PD scan PD Scan is connected to the WMSD, all new measurement data sets are automatically downloaded to the internal memory of the WMSD. This function means that the mass storage device can also be used to collect the measurement data from multiple measuring devices that are in use without having to bring them to the office.

As the WMSD automatically charges the connected PD Scan, it can also be used as a power bank if required.

Ports, indicators and controls The WMSD has the following ports, indicators and controls:



Element	Description
10	On/off button with LEDs to indicate the battery level. Press the button briefly to switch on the WMSD. Press and hold the button for approximately three seconds to switch the device off.  The remaining battery life of the internal battery is still very high.  The remaining battery life of the internal battery is less than 25%.  When the last LED starts flashing (battery life <10%), the device should be charged without delay.
11	USB Type A port for connecting a PD Scan.
12	LED indicating the connection status.
13	Micro USB charging port

6.1.2.1 Connecting

Switching on the WMSD Switch on the device by briefly pressing the on/off button 10. The startup process takes approximately 30 seconds. During this time, the LEDs on the front panel will flash to indicate the various startup sequences. Once the startup process is complete, the blue status LED 12 will flash three times in a row for approximately one second each time to indicate that the Wi-Fi access point is now available. From now on, the LEDs to the right of the on/off button indicate the residual battery life.

If required, the WMSD can be charged using the USB charging cable supplied and the charger supplied with the PD Scan. It takes around four to five hours to charge fully. The LED  lights up red while the device is charging and turns off once the battery is fully charged.

We advise against charging the device via a USB port on a PC or notebook as the charging current supplied by these ports is usually too low.

Connecting and switching on the PD Scan

To use the mass storage device to read measurement data from the memory of a PD Scan or charge its internal battery, connect the supplied USB cable between the USB port **9** on the PD Scan and the USB port **11** on the WMSD. The charging process will begin as soon as the two devices are connected and will be indicated by the charging indicator **1** on the PD Scan.

To access the data on the PD Scan, switch it on by briefly pressing the on/off button **3**. In contrast to the standard switch-on process, the software remains on the startup screen when the mass storage device is connected. The status LED **12** on the WMSD should light up briefly and then flash blue. In the background, all new measurement data sets will be automatically transferred to the memory of the mass storage device. Once the transfer is complete, the LED will stop flashing and remain lit blue. If the two devices were only connected in order to carry out automatic data transfer, they can now be disconnected again.

Accessing the WMSD user interface

To download the measurement data from the internal memory of the WMSD or the connected PD Scan, you need to access the user interface of the mass storage device via a web browser. The device onto which you want to download the data must have Wi-Fi capability in order to do this.

To connect to the WMSD and access the user interface:

1. Make sure that the WMSD is switched on and that Wi-Fi is enabled on your device.
2. In your device's Wi-Fi settings, find the access point with an SSID that starts with **PDSCAN-WMSD-ID** (the complete SSID can be found on the nameplate of the WMSD).
3. Connect to this access point and enter the password stated on the WMSD's nameplate.
4. If your device has a camera and an application for scanning QR codes, you can now scan the QR code on the back of the WMSD and follow the link. The user interface will then open in the default browser.

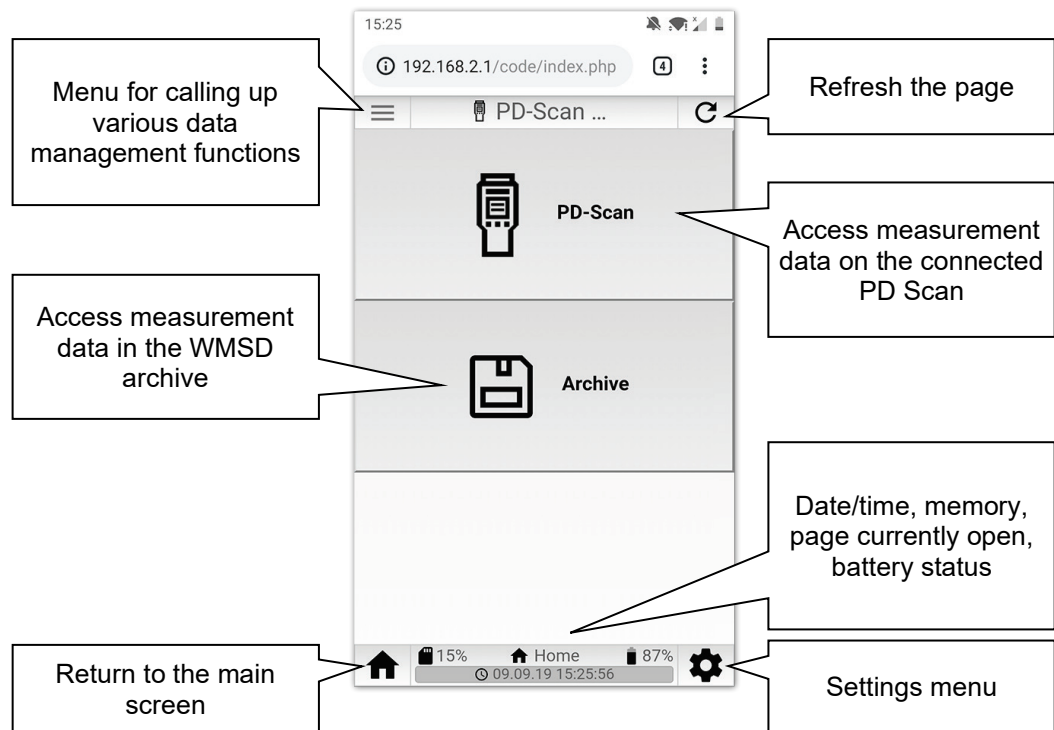
If your device does not have a camera or QR scanner, you will need to open your desired browser manually and enter the URL **<http://192.168.2.1/index.html>** in the address bar. The user interface should open.



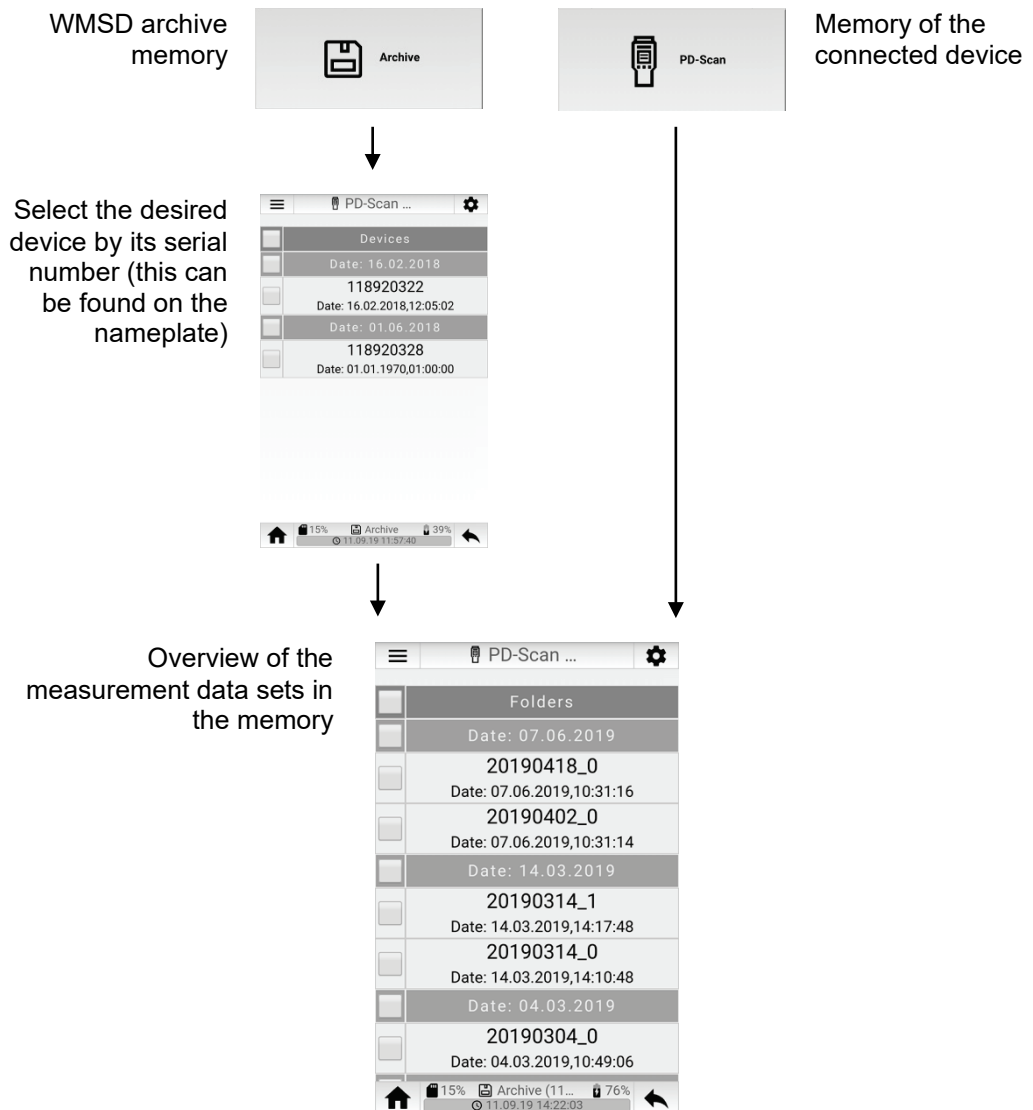
If you are connected to Wi-Fi but the user interface will not load, try disabling any other network connections (e.g. LAN, mobile data). If other connections are active, the browser may not be using the Wi-Fi connection to access the URL.

6.1.2.2 Managing measurement data and settings via the user interface

Main screen The first time the user interface is accessed in the browser, the main screen will be displayed. The screen features the following elements:



Selecting the required measurement data To select the measurement data to be used for further processing, you first need to select the memory where the files are stored on the main screen:

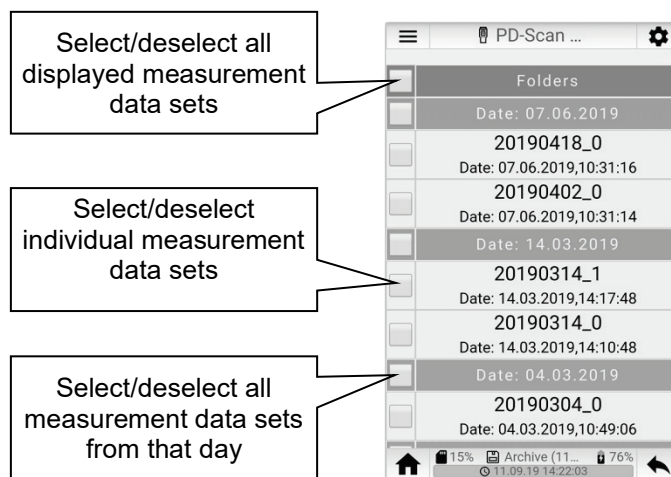


All measurement data stored in the memory of the connected PD Scan should also be stored in the archive database once the automatic data transfer is complete. However, the measurement data on the connected device can usually be located more quickly in the device's memory as it normally contains fewer data sets and the device does not need to be selected as described above.

The menu at the top left of the screen provides various functions for sorting/filtering the data sets:

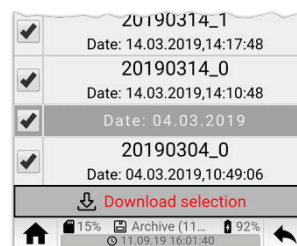
Menu item	Function
	Sort measurement data sets chronologically. Calling the menu item up again sorts the sets in reverse order.
	Sort measurement data sets alphabetically. Calling the menu item up again sorts the sets in reverse order.
	Selecting this menu item opens a search box at the top of the screen. Enter a search term to limit the data sets displayed to those with a folder name that contains the search term.

Once you have found the measurement data sets you are looking for, tick the relevant checkboxes to select them:



Downloading the selected measurement data

If at least one measurement data set has been selected, a button for downloading the data will appear at the bottom of the screen.



Pressing the button compiles the selected data sets into a zip archive and then downloads this onto the device. The file name will consist of the word "archive" and the Unix timestamp at the time of downloading (e.g. *archive_1568270193.zip*).

The archive will be stored in the device's downloads folder. It can then be further processed and forwarded directly from there.

Deleting the selected measurement data To remove data sets you no longer need from the memory of the PD Scan or the WMSD, the selected sets can also be deleted by selecting the  menu item from the menu at the top left of the screen.

Settings menu The  menu item can be used to open the settings menu of the WMSD at any time and access the following functions and information:

Menu item	Function
	View information about the hardware, software, memory usage, battery status and system time of the WMSD.
	Safely disconnect the connected PD Scan.
	Change the region and time zone of the WMSD.
	Firmware update To start a firmware update, insert a USB stick containing the firmware files into the USB port  on the WMSD. The latest firmware version can be downloaded from the Megger website ("Software & Firmware" section).
	Open the operating manual.
	Shut down the WMSD.

6.2 Transferring measured data onto a PC

In order to copy the measured data onto a Windows PC, the PD Scan must be connected to a PC when it is switched on using the USB port.

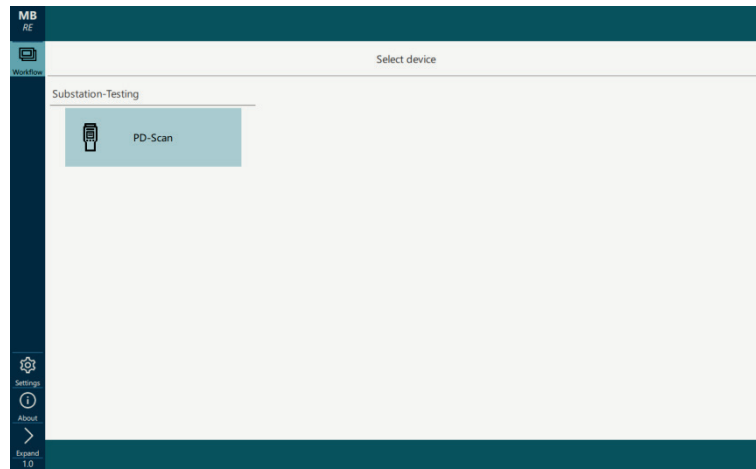
The PD Scan should then be identified as a data medium, and be integrated as a drive. The measured data folder with the measured data (*.data and *.xml) and the photos saved can be found in the App directory and can now be easily copied onto the PC and be archived, or be imported directly into the MeggerBook Reporting Edition (see next section).

6.3 Preparing a report

The measured data recorded on a measurement object can be compiled to form a report for printing using the MeggerBook Reporting Edition software supplied on the enclosed USB stick. The latest version of the software can be downloaded at any time from the PD Scan website (section "Software and firmware").

To create a report, proceed as follows:

1. If you have not already done so, install the software on a computer with Windows 7 or later.
2. Start the software.



- Click on the **PD Scan** tile. The following input screen appears:

The screenshot shows the 'General information' screen in the MB RE application. The top navigation bar includes 'General', 'Background noise level', 'Measurement data', and 'Results'. The 'PD-Scan' icon is in the top right. The left sidebar contains 'Workflow', 'Settings', 'About', and 'Expand 1.0'. The main content area has four sections: 'Station details' with fields for Name, Location, and Number; 'Switchgear details' with fields for Voltage U0, Manufacturer, and Installation date; 'Measurement details' with fields for Inspector and Customer; and a 'Recommendation' field. A 'Next step' button is located at the bottom right.

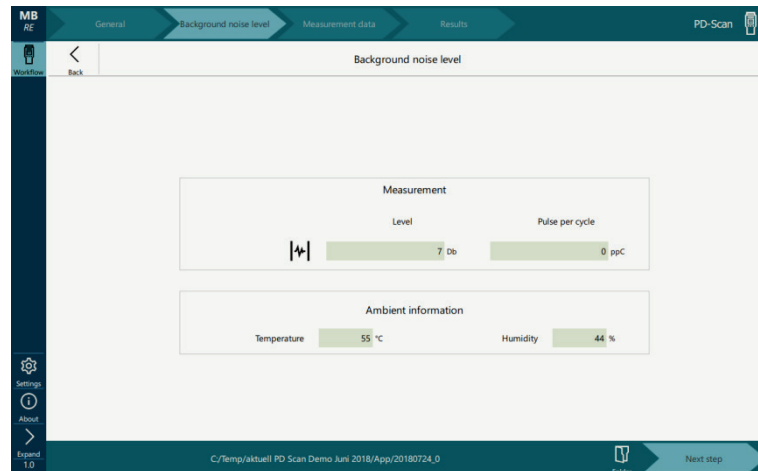
This menu allows general information about the station, the measurement itself and recommended action based on the measurement results to be entered.

- Click on the **Next step** button.

The screenshot shows the 'Background noise level' screen in the MB RE application. The top navigation bar includes 'General', 'Background noise level', 'Measurement data', and 'Results'. The 'PD-Scan' icon is in the top right. The left sidebar contains 'Workflow', 'Settings', 'About', and 'Expand 1.0'. The main content area features a large blue button with a plus sign and the text 'Select background noise'. A 'Next step' button is located at the bottom right.

- Click on the **Select background noise** button.
- Use the Windows Explorer to navigate to the directory containing the measured data. This can either be any measured data archive folder on the hard disk, or the internal memory of the PD Scan connected by USB cable. If you import the measured data directly from the PD Scan, then you must open the *App* directory first, in which all measured data folders that have been created can be found.

The measured data are shown.



7. Click on the **Next step** button and then on **Select measurement data**.
8. Select the directory with the measured data recorded on the measurement object. The measured data are shown.

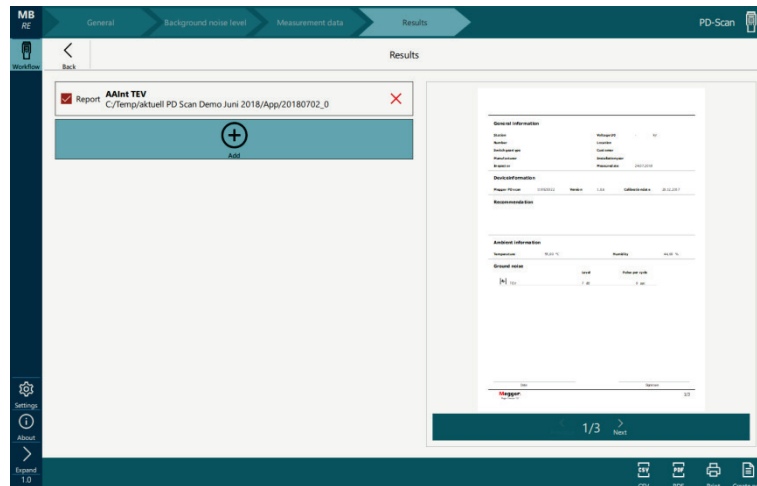


Information about the measurement object are entered in the input fields on the left side of the screen.

The measurements and diagrams that should appear in the report can be selected on the right side of the screen, and a comment can be added to each entry if necessary.

The $\oplus$ button in the footer can be used to add any relevant images to the report (e.g. weak point that was identified).

9. Click on the **Next step** button. The preview of the report is displayed.



Should there be any other measured data folders for the same measurement object, which are relevant for the report, then they can be added to the report using the **+** button. If there are several measured data folders, then the order in which they appear in the report can be changed using drag-and-drop.

The **<** button is used to return to the last step at any time, if necessary, in order to make changes to the content of the report.

Once the preview on the right side of the screen corresponds to your own idea of what it should look like, then the report can be printed, saved as a PDF file or be exported as a CSV file using the buttons on the lower right edge of the screen.

7 Using the demonstrator box

Introduction The optional demonstrator box can be used to test and demonstrate all functionalities of the device. Because the pulse level and frequency can be adjusted, a wide range of measurement scenarios can be simulated, which is why the demonstrator box is outstandingly suited for in-house product training sessions.

Starting up the demonstrator box The box can be switched on and off again by briefly pressing the **I** button. The LED that lights up in red on the button signals that it is ready for operation. If the LED does not light up, this indicates that the battery is weak. In this case, the 4 x AA batteries in the battery compartment on the bottom of the box must be replaced.

The magnets affixed to the bottom allow the box to be conveniently attached to a metallic surface (e.g. a substation) for demonstration purposes.

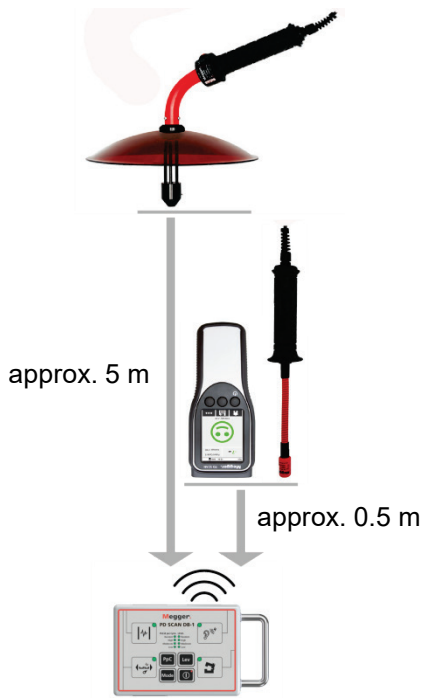


The box starts operating directly after being switched on, and generates partial discharge-like pulses. The level and frequency of the pulses, as well as the type of decoupling, are based on the current settings, which can be adjusted as following using the buttons on the front panel:

Button	Setting								
Mode	Selection of operating mode Pressing this button repeatedly activates the available operating modes in succession. The respective operating mode that is active is indicated by a green LED. The selected operating mode also directly determines the type of signal decoupling (see next page).								
Lev	Adjustment of the pulse level Pressing this button repeatedly activates the available settings in succession. The respective setting that is active is indicated by the LED that lights up above the button. The following selection options are available: <table> <tr> <td>Low</td><td>Low level, which should induce measured values that are uncritical for the thresholds preset by default (green)</td></tr> <tr> <td>Moderate</td><td>Moderate level, which should induce measured values that are only slightly critical for the thresholds preset by default (yellow)</td></tr> <tr> <td>High</td><td>High level, which should induce measured values that are critical for the thresholds preset by default (red)</td></tr> <tr> <td>Random</td><td>Level that changes every second</td></tr> </table>	Low	Low level, which should induce measured values that are uncritical for the thresholds preset by default (green)	Moderate	Moderate level, which should induce measured values that are only slightly critical for the thresholds preset by default (yellow)	High	High level, which should induce measured values that are critical for the thresholds preset by default (red)	Random	Level that changes every second
Low	Low level, which should induce measured values that are uncritical for the thresholds preset by default (green)								
Moderate	Moderate level, which should induce measured values that are only slightly critical for the thresholds preset by default (yellow)								
High	High level, which should induce measured values that are critical for the thresholds preset by default (red)								
Random	Level that changes every second								

Button	Setting
PpC	Adjustment of the number of pulses per mains frequency period (pulse per cycle) Pressing this button repeatedly activates the available settings in succession. The respective setting that is active is indicated by the LED that lights up above the button. The following selection options are available: Low 2 pulses in 20 ms Moderate 8 pulses in 20 ms High 20 pulses in 20 ms Random Changes every second between 0 and 50 pulses in 20 ms

Performing measurements Depending on the operating mode selected, proceed as following when making measurements on the demonstrator box:

Operating mode (to be set on demo box and PD Scan!)	Procedure
	The levels are coordinated for the acoustic measurement so that the expected values are measured at a distance of around 50 cm with the PD Scan and the flexible sensor, while the distance should total approx. 5 m when the more sensitive parabolic acoustic sensor is used.  When performing acoustic measurements with the demonstrator box, the frequency has to be set to 40 kHz (see page 50)!

Operating mode (to be set on demo box and PD Scan!)	Procedure
	The HFCT sensor provided must be placed around the carry handle of the demonstrator box in HFCT mode in order to be able to measure the pulses generated. 
	The front end of the PD Scan must be held against the contact surface marked with TEV 1 in TEV mode in order to be able to measure the pulses generated. 
	When performing the “time of flight” comparative measurement, the front end of the PD Scan must be held against the TEV 1 contact surface and the external TEV sensor against the TEV 2 contact surface.  Since a bar deflection only takes place above 10 dB, the setting High must be selected using the Lev button in this operating mode! The dependency of the propagation time on distance (“time of flight”) can be demonstrated by alternately removing the sensors from the contact surface.

8 Maintenance and care

Charging the battery In order to charge the PD Scan, connect the device to the mains power. Always use the charger provided, which must be connected to the device using the USB cable with the USB interface **9** provided.

The device is also charged when it is connected to a PC, a commercially available USB charger or a vehicle USB charging adapter by USB cable. The charging time may be prolonged according to the power output.

A full charge cycle takes a maximum of 3 hours. During charging, the charging indicator light **1** lights up in red. The battery is fully recharged once the charging indicator light goes out.

	NOTE To avoid damage, please observe the following when charging: • Give preference to use of the charger supplied. • The ambient temperature should lie between 10 °C and 35 °C. • In the event of problems with the battery, contact your sales or service partner at Megger. Do not open the device yourself.
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If the device is not used for an extended period, it should be stored in a dust-free and dry environment.

In the event of an extended period of non-use, the battery should be recharged around once a year.

Repair and maintenance Repair and maintenance work may only be performed by Megger or authorised service partners and only using genuine replacement parts. Megger also offers its customers on-site service. Please contact your service centre as needed.

To ensure that a high measuring accuracy can be maintained for a long period of time, the device should be regularly (a two-year cycle is recommended) examined at manufacturer's facility or an authorized service and calibration center, and be fine-tuned if necessary.

Maintaining the display Do not clean the display with aggressive products such as solvents or spirits.

Instead, handwarm water containing some washing-up liquid and a microfibre cloth should be used to clean the display.

Updating the firmware In order to update the firmware for the PD Scan, you will require the PDSCANUBL software, which can be found on the USB flash drive provided. The latest version of the firmware can be downloaded at any time from the PD Scan website (section "Software and firmware").

To update the firmware, proceed as follows:

1. Make sure that there is no USB connection, and switch the PD Scan off.
2. Press and hold the middle button.



3. Also press the left button.



4. Let go of the left button again a few moments later.



5. Also let go of the middle button. A few seconds later, the **Bootloader** message should appear in the display.
6. Start the PDSCANUBL software on your PC by double clicking *pdscanubl.exe*.
7. Connect the PD Scan to the PC using the USB cable provided **only now**.
8. Click **Connect** in the PDSCANUBL software. The **Device connected** message should appear just afterwards. Otherwise, please repeat the procedure from the start and make sure that the **Bootloader** message appears in the display after it starts.
9. Click on **Load Hex File** in the PDSCANUBL software, and select the firmware file.
10. Click on **Program** in the PDSCANUBL software and wait until the firmware has been transferred. The installation is complete. The USB cable can be unplugged and the PD Scan can be restarted.

9 Troubleshooting

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

Problem / error message	Possible cause / remedy
The software crashes and the software no longer reacts to user actions.	Perform a hard reset by pressing the left and right button at the same time for a few seconds. 
• The function test using the function tester FC 1 fails. • The LED on the function tester FC 1 does not light up, although the push-button was pressed.	Weak/empty battery Open the function tester by undoing the Phillips-head screw on the back, and replace the lithium round cell battery type CR1216 or CR1220.



Tento symbol indikuje, že výrobek nesoucí takovéto označení nelze likvidovat společně s běžným domovním odpadem. Jelikož se jedná o produkt obchodovaný mezi podnikatelskými subjekty (B2B), nelze jej likvidovat ani ve veřejných sběrných dvorech. Pokud se potřebujete tohoto výrobku zbavit, obraťte se na organizaci specializující se na likvidaci starých elektrických spotřebičů v blízkosti svého působistě.



Dit symbool duidt aan dat het product met dit symbool niet verwijderd mag worden als gewoon huishoudelijk afval. Dit is een product voor industrieel gebruik, wat betekent dat het ook niet afgeleverd mag worden aan afvalcentra voor huishoudelijk afval. Als u dit product wilt verwijderen, gelieve dit op de juiste manier te doen en het naar een nabij gelegen organisatie te brengen gespecialiseerd in de verwijdering van oud elektrisch materiaal.



This symbol indicates that the product which is marked in this way should not be disposed of as normal household waste. As it is a B2B product, it may also not be disposed of at civic disposal centres. If you wish to dispose of this product, please do so properly by taking it to an organisation specialising in the disposal of old electrical equipment near you.



Този знак означава, че продуктът, обозначен по този начин, не трябва да се изхвърля като битов отпадък. Тъй като е B2B продукт, не бива да се изхвърля и в градски пунктове за отпадъци. Ако желаете да изхвърлите продукта, го занесете в пункт, специализиран в изхвърлянето на старо електрическо оборудване.



Dette symbol viser, at det produkt, der er markeret på denne måde, ikke må kasseres som almindeligt husholdningsaffald. Eftersom det er et B2B produkt, må det heller ikke bortskaffes på offentlige genbrugsstationer. Skal dette produkt kasseres, skal det gøres ordentligt ved at bringe det til en nærliggende organisation, der er specialiseret i at bortskaffe gammelt el-udstyr.



Sellise sümboliga tähistatud toodet ei tohi käidelda tavalise olmejäätmena. Kuna tegemist on B2B-klassi kuuluva tootega, siis ei tohi seda viia kohaliku jäätmekäitluspunkti. Kui soovite selle toote ära visata, siis viige see lähimasse vanade elektriseadmete käitlemisele spetsialiseerunud ettevõttesse.



Tällä merkinnällä ilmoitetaan, että kyseisellä merkinnällä varustettua tuotetta ei saa hävittää tavallisen kotitalousjätteen seassa. Koska kyseessä on yritysten välisen kaupan tuote, sitä ei saa myöskään viedä kuluttajien käyttöön tarkoitettuihin keräyspisteisiin. Jos haluatte hävittää tämän tuotteen, ottakaa yhteys lähimpään vanhojen sähkölaitteiden hävittämiseen erikoistuneeseen organisaatioon.



Ce symbole indique que le produit sur lequel il figure ne peut pas être éliminé comme un déchet ménager ordinaire. Comme il s'agit d'un produit B2B, il ne peut pas non plus être déposé dans une déchetterie municipale. Pour éliminer ce produit, amenez-le à l'organisation spécialisée dans l'élimination d'anciens équipements électriques la plus proche de chez vous.



Cuireann an siombail seo in iúl nár cheart an táirgeadh atá marcáilte sa tsí seo a dhiúscairt sa chóras fuíoll teaghlaigh. Os rud é gur táirgeadh ghnó le gnó (B2B) é, ní féidir é a dhiúscairt ach oiread in ionaid dhiúscairthe phobail. Más mian leat an táirgeadh seo a dhiúscairt, déan é a thógáil ag eagraíocht gar duit a sainfheidhmiú in ndiúscairt sean-fhearais leictreacha.



Dieses Symbol zeigt an, dass das damit gekennzeichnete Produkt nicht als normaler Haushaltsabfall entsorgt werden soll. Da es sich um ein B2B-Gerät handelt, darf es auch nicht bei kommunalen Wertstoffhöfen abgegeben werden. Wenn Sie dieses Gerät entsorgen möchten, bringen Sie es bitte sachgemäß zu einem Entsorger für Elektroaltgeräte in Ihrer Nähe.



Αυτό το σύμβολο υποδεικνύει ότι το προϊόν που φέρει τη σήμανση αυτή δεν πρέπει να απορρίπτεται μαζί με τα οικιακά απορρίμματα. Καθώς πρόκειται για προϊόν B2B, δεν πρέπει να απορρίπτεται σε δημοτικά σημεία απόρριψης. Εάν θέλετε να απορρίψετε το προϊόν αυτό, παρακαλούμε όπως να το παραδώσετε σε μία υπηρεσία συλλογής ηλεκτρικού εξοπλισμού της περιοχής σας.



Ez a jelzés azt jelenti, hogy az ilyen jelzéssel ellátott terméket tilos a háztartási hulladékokkal együtt kidobni. Mivel ez vállalati felhasználású termék, tilos a lakosság számára fenntartott hulladékgyűjtőbe dobni. Ha a terméket ki szeretné dobni, akkor vigye azt el a lakóhelyéhez közel működő, elhasznált elektromos berendezések begyűjtésével foglalkozó hulladékezelő központhoz.



Questo simbolo indica che il prodotto non deve essere smaltito come un normale rifiuto domestico. In quanto prodotto B2B, può anche non essere smaltito in centri di smaltimento cittadino. Se si desidera smaltire il prodotto, consegnarlo a un organismo specializzato in smaltimento di apparecchiature elettriche vecchie.



Ští zíme noráda, ka izstrádájumu, uz kura tā atrodas, nedrīkst izmest kopā ar parastiem mājsaimniecības atkritumiem. Tā kā tas ir izstrādājums, ko cits citam pārdod un lieto tikai uzņēmumi, tad to nedrīkst arī izmest atkritumos tādās izgāztuvēs un atkritumu savāktuvēs, kas paredzētas vietējiem iedzīvotājiem. Ja būs vajadzīgs šo izstrādājumu izmest atkritumos, tad rīkojieties pēc noteikumiem un nogādājiet to tuvākajā vietā, kur īpaši nodarbojas ar vecu elektrisku ierīču savākšanu.



Šis simbols rāda, kad jau paženklīto gaminio negalima iņmesti kaip paprastų buitinių atliekų. Kadangi tai B2B (verslas verslui) produktas, jo negalima atiduoti ir buitinių atliekų tvarkymo įmonei. Jei norite išmesti šį gaminį, atlikite tai tinkamai, atiduodami jį arti jūsų esančiai specializuotai senos elektrinės įrangos utilizavimo organizacijai.



Dan is-simbolu jindika li l-prodott li huwa mmarkat b'dan il-mod m'ghandux jintrema bhal skart normali tad-djar. Minhabba li huwa prodott B2B , ma jistax jintrema wkoll f'centri civici ghar-rimi ta' l-iskart. Jekk tkun tixtieq tarmi dan il-prodott, jekk joghgbok ghamel dan kif suppost billi tiehdu ghand organizzazzjoni fil-qrib li tispécializza fir-rimi ta' taghmir qadim ta' l-elettriku.



Dette symbolet indikerer at produktet som er merket på denne måten ikke skal kastes som vanlig husholdningsavfall. Siden dette er et bedriftsprodukt, kan det heller ikke kastes ved en vanlig miljøstasjon. Hvis du ønsker å kaste dette produktet, er den riktige måten å gi det til en organisasjon i nærheten som spesialiserer seg på kassering av gammelt elektrisk utstyr.



Ten symbol oznacza, że produktu nim opatrzonego nie należy usuwać z typowymi odpadami z gospodarstwa domowego. Jest to produkt typu B2B, nie należy go więc przekazywać na komunalne składowiska odpadów. Aby we właściwy sposób usunąć ten produkt, należy przekazać go do najbliższej placówki specjalizującej się w usuwaniu starych urządzeń elektrycznych.



Este símbolo indica que o produto com esta marcação não deve ser deixado fora juntamente com o lixo doméstico normal. Como se trata de um produto B2B, também não pode ser deixado fora em centros cívicos de recolha de lixo. Se quiser desfazer-se deste produto, faça-o correctamente entregando-o a uma organização especializada na eliminação de equipamento eléctrico antigo, próxima de si.



Acest simbol indică faptul că produsul marcat în acest fel nu trebuie aruncat ca și un gunoi menajer obișnuit. Deoarece acesta este un produs B2B, el nu trebuie aruncat nici la centrele de colectare urbane. Dacă vreți să aruncați acest produs, vă rugăm să o faceți într-un mod adecvat, ducând-ul la cea mai apropiată firmă specializată în colectarea echipamentelor electrice uzate.



Tento symbol znamená, že takto označený výrobek sa nesmie likvidovať ako bežný komunálny odpad. Keďže sa jedná o výrobok triedy B2B, nesmie sa likvidovať ani na mestských skládkach odpadu. Ak chcete tento výrobok likvidovať, odneste ho do najbližšej organizácie, ktorá sa špecializuje na likvidáciu starých elektrických zariadení.



Ta simbol pomeni, da izdelka, ki je z njim označen, ne smete zavreči kot običajne gospodinske odpadke. Ker je to izdelek, namenjen za druge proizvajalce, ga ni dovoljeno odlagati v centrih za civilno odlaganje odpadkov. Če želite izdelek zavreči, prosimo, da to storite v skladu s predpisi, tako da ga odpeljete v bližnjo organizacijo, ki je specializirana za odlaganje stare električne opreme.



Este símbolo indica que el producto así señalizado no debe desecharse como los residuos domésticos normales. Dado que es un producto de consumo profesional, tampoco debe llevarse a centros de recogida selectiva municipales. Si desea desear este producto, hágalo debidamente acudiendo a una organización de su zona que esté especializada en el tratamiento de residuos de aparatos eléctricos usados.



Den här symbolen indikerar att produkten inte får blandas med normalt hushållsavfall då den är förbrukad. Eftersom produkten är en så kallad B2B-produkt är den inte avsedd för privata konsumenter, den får således inte avfallshanteras på allmänna miljö- eller återvinningsstationer då den är förbrukad. Om ni vill avfallshanterar den här produkten på rätt sätt, ska ni lämna den till myndighet eller företag, specialiserad på avfallshantering av förbrukad elektrisk utrustning i ert närområde.