User manual

Online PD Spot Tester

liona

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1 ABOUT THIS MANUAL

1.1 Validity of the user manual

This user manual applies for devices with the software versions:

- ***Spot Tester***: V3.0
- ***Cable Length***: V3.0
- ***Mapping***: V3.0

Information on the currently installed software is given in the title bar.

This user manual describes the full standard delivery, including all connection accessories. The availability of individual devices and functions depends on the actual item delivered.

1.2 Structure of safety instructions

The safety instructions in this user manual are presented as follows:

Danger symbol 	**SIGNAL WORD**
	Type of danger and its source Possible consequences of violation. ▸ Measure to prevent the danger.

If a dangerous situation could arise at a specific step, the safety instruction is displayed immediately before this dangerous step and is shown as follows:

SIGNAL WORD

Type of danger and its source. Possible consequences of violation.

1. Measure to prevent the danger.

Danger levels

Signal words in the safety instructions specify the danger levels.

DANGER	Will lead to severe injuries or death.
WARNING	May lead to severe injuries or death.
CAUTION	May lead to light to moderate injuries.
NOTICE	May lead to material damage.

Danger symbols

	**Warning about general danger**
	**Warning about electric voltage**
	**Risk of falling**

1.3 View settings

Symbol	Meaning
▸	You are requested to perform an action.
1. 2. ...	Perform the actions in this sequence.
a. b. ...	If an operation consists of several operating steps, specify these with "a, b, c". Perform the operating steps in this sequence.
1 2 ...	Numbering in the legend
▪	List
	Indicates further information on the topic.

1.4 Note on the screenshots and graphics used

The screenshots and graphics used are intended to illustrate the procedure and may differ from the actual state.

2 FOR YOUR SAFETY

We, the manufacturer, produce our devices and systems according to the latest technological standards and guarantee a high level of operational safety and reliability. However, responsibility for safe use lies with the responsible body[1] and operator[2]. The responsible body and operator of the device or system are responsible for any injuries or damage resulting from non-compliance with this user manual.

This chapter *For your safety* in this user manual is intended to help you implement the required safety measures.

2.1 Intended use

The BAUR liona online PD spot tester is used for monitoring and locating partial discharges in medium- and high-voltage cables or switchgear during normal cable network operation.

If the device is not used in accordance with this stipulation, safe operation cannot be guaranteed. The manufacturer cannot be held liable for any damage to persons and property resulting from incorrect operation.

- To ensure safe use as intended, follow the instructions in this user manual.

2.2 Operation by qualified personnel

The device may only be operated by qualified personnel. Qualified personnel are individuals who, thanks to their professional electrical engineering training, are able to identify and prevent dangers, and who are qualified to perform the respective tasks.

Before starting work, the responsible body and persons working with the device must have carefully read through and understood the user manual for the device, as well as the user manuals for all associated devices or systems.

[1] Responsible body is the person or group that is responsible for the safe operation of the device and its maintenance (EN 61010-1, 3.5.12).

[2] Operator is the person who uses the device for its intended purpose (according to the definition of user in compliance with EN 61010-1, 3.5.11).

2.3 Avoiding dangers, taking safety measures

- When erecting the test installations and operating liona, adhere to the latest applicable version of the following regulations and guidelines:
  - Accident prevention and environmental protection regulations applicable for your country
  - Safety instructions and regulations of the country where liona is being used
  - EU/CENELEC countries: EN 50191 *Erection and operation of electrical test equipment*

    Other countries: The standard for erection and operation of electrical test equipment applicable for your country
  - EU/CENELEC countries: EN 50110 *Operation of electrical installations*

    Other countries: The standards for operating electrical installations applicable in your country
  - Any other relevant national and international standards and guidelines
  - Local safety and accident prevention regulations
  - Employers' liability insurance association regulations (if any)

2.3.1 Operation of the device only if it is in a technically safe condition

Safety, function and availability depend on the proper condition of the device.

- Operate the device only in a technically perfect condition.
- In case of damage and malfunction, immediately stop the device, mark it accordingly and have the faults rectified by appropriately qualified and authorised personnel without delay.
- Comply with the inspection and maintenance conditions.
- Use only accessories and original spare parts recommended by BAUR. The use of spare parts, accessories and special fittings that have not been tested and approved by BAUR could adversely affect the safety, function and characteristics of the device.

2.3.2 No operation during condensation

Condensation can form in devices and systems due to temperature fluctuations and high air humidity, which in some components can result in leakage currents, flashovers and short-circuits.

- Always prevent condensation in devices. Temper the device and system before and during the measurements so that no condensation occurs.

2.3.3 Working under danger of falling, performing tasks at heights

Working under danger of falling, performing tasks at heights

If performing connection and measurement tasks at workplaces that are more than 1 m above ground, special safety measures must be taken to prevent accidents from falling.

DANGER

Danger of falling while working at heights

Danger to life, risk of injury due to fall

- Secure workplaces posing risk of falling with safety devices (e.g. railings, platforms, scaffolds, frameworks).
- Use personal safety equipment to protect against falling (e.g. belts)
- Cover or block places where there is danger of falling or stumbling.
- Tasks performed at heights must be supervised by a second person.

2.3.4 Dangers when working with high voltage during online testing

An online PD test is carried out on a live test object. Personnel need to pay special attention and must be very careful while working with high electric voltage.

When connecting the device to the test object, during the preparation and while performing the measurement, the operator may come close to live parts. In so doing, there is danger of touching the active parts directly or indirectly.

DANGER

Working in the vicinity of adjacent live parts

Danger to life or risk of injury due to electric shock.

- Before commencing work, the responsible body must assess the risks for the specific working conditions. Protective measures are based on the risk assessment and must be followed at the workplace.
- During connection, and when performing and monitoring the measurement, protection must be guaranteed for all parts, either
  - through safety devices, insulating cover material
  - or by adhering to the necessary safety distances. Safety distances and danger zones depend on the voltage level, plant model, personnel qualification and available space. In this regard, comply with EN 50110 or the applicable standards in your country, as well as the relevant national and local accident prevention regulations.
- Working in the vicinity of exposed live cables or faulty systems is forbidden. Notify the responsible authorities immediately.
- Never put the safety devices and accessories out of operation. It is forbidden to bypass the safety devices and accessories.
- Keep the measurement tasks as short as possible.
- Use suitable personal protective equipment to protect against electric hazards.
- To assess the local conditions adequately, provide sufficient lighting at the work place.

DANGER

Connection work on live parts

Danger to life or risk of injury due to electric shock.

- Select the sensors and connection technology suitable for the local conditions.
- Only connect the HFCT sensors if the earth connections of the cable screens on the test object are easily accessible and are located at a safe distance from live parts.
- Only attach the sensors to the earthed surfaces of the cabinet housing (TEV sensors) or cable screen (HFCT sensors).
- Never connect the sensors directly to the live terminations of the test object.

2.3.5 Guaranteeing immediate measures in an emergency

The device may be operated only if a second person with visual and audio contact to the tester is present and is in the position to detect possible dangers and to act immediately and properly.

Online testing (automatic recording of signals by the liona) can be performed without anyone being present.

2.3.6 Connecting the sensors to the de-energised system

- If safe access to the connection points is not assured, de-energise the switchgear in order to remove the sensors. Thereby, follow the 5 safety rules:
  a. Disconnect the test object.
  b. Secure against re-connection.
  c. Verify absence of operating voltage.
  d. Earth and short all phases.
  e. Provide protection against adjacent live parts.

2.4 Special personal protective equipment

Personal protective equipment based on the risk assessment for the relevant working conditions is part of the liona safety concept.

- Observe the internal operating instructions and the safety instructions applicable in your country.

3 PRODUCT INFORMATION

The BAUR liona online PD spot tester is used for monitoring and locating partial discharges in medium- and high-voltage cables or switchgear during normal cable network operation.

The following measurement methods are possible with liona:

- Online PD test

  An online PD test records the partial discharges in the insulation of cables and switchgear at operating voltage during normal cable network operation. The results of the online PD test are used, for example, for risk assessments and to prioritise further offline diagnostics on cables and systems.

  Therefore, the results of an online PD test can differ from the results of an offline measurement. Similarly, results of various online PD tests can differ from each other.

  The ***Spot Tester*** software offers 2 measurement modes: In ***SCOPE*** mode you can watch the PD activity in real time with an oscilloscope. This gives you a quick overview of the signals occurring on the system and their intensity. In ***PD TEST*** mode, you can perform PD tests and evaluate the results. You can also perform an automatic quick test of the cable route for partial discharges.

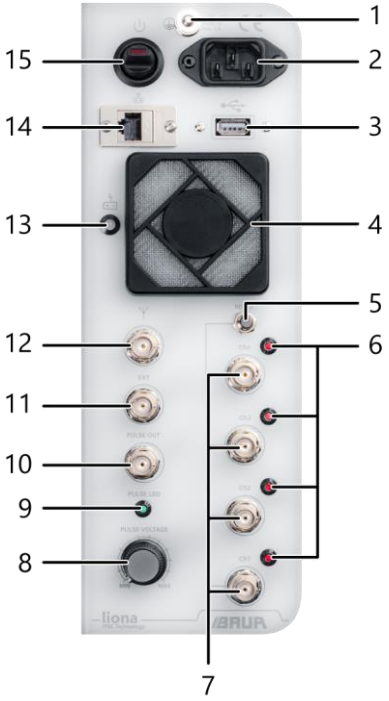
- Online cable length measurement (in combination with the optional iPD transponder and HFCT sensors)
- Online PD mapping (in combination with the optional iPD transponder and HFCT sensors)

Information on the technical data as well as standard delivery, accessories and options can be found in Chapter *Data sheet* (on page 99).

3.1 Device overview

No.	Element	Function
1	Laptop	Is used to perform and configure the measurements
2	Input/output panel	Includes display elements, operator controls and connection sockets Further information: Chapter *Connection panel* (on page 17)

3.2 Connection panel



No.	Element	Function
1	⏚ port	Is used to connect the protective earthing
2	Mains connection	Is used to connect the device to the mains voltage
3	USB connection	Is used to connect USB devices The USB devices can be connected and removed while operating liona.
4	Fan	Is used to cool the measurement electronics

No.	Element	Function
5	*RESET* button	Is used to reset the protective relay of the signal inputs
6	Protective relay LED	Indicates whether the protective relay for the signal input in question has tripped
7	Signal inputs *CH1* to *CH4*	Are used to connect HFCT and/or TEV sensors or the VDS-C
8	*PULSE VOLTAGE* rotary switch	Is used to set the pulse voltage for the cable length measurement
9	*PULSE LED* LED	Flashes when pulses are released.
10	*PULSE OUT* pulse output	Is used to connect an HFCT sensor for the cable length measurement
11	*EXT* external trigger input	Is used to receive the synchronisation signal from the VDS-C or an external synchronisation signal (in the case of measurements with the liona in rechargeable battery mode) The VDS-C supplies a synchronisation signal at the *Sync.* signal output, which is phase synchronous with the voltage signal of the test object that is connected to the $Ch1_{in}$ signal input of the VDS-C.
12	Antenna input	Is used to connect an external reception antenna
13	LED	Is used to display the battery charge status ▪ LED turns green: Battery is charged ▪ LED turns red: Battery charging
14	Network interface	Is used to connect the device to digital networks
15	On/Off switch	Is used to switch device on and off

3.3 HFCT sensor

High-frequency current transformers (HFCT) are used for the inductive coupling of PD signals. Small high-frequency currents are induced in the earth cable of the plant by partial discharge activity. These pulses travel from the plant earth to the station earth and can be detected by HFCT sensors.

HFCT sensors may only be used if the earth connection of the cable screen is separable.

3.4 TEV sensor

TEV sensors are capacitive couplers and detect transient earth voltages that are induced into the metal housing of switchgear through partial discharges. The transient earth voltages run on the housing surface along the outer side of the metal housing where they are detected by the TEV sensor.

TEV sensors are used for the detection of partial discharges in switchgear and at cable terminations and are affixed to the metal housing of the switchgear using built-in magnets.

3.5 Sync transmitter

Partial discharges occur in specific phasings in a power cycle, depending on the fault causing them. It is therefore important to synchronise the data acquisition with the power cycle during the PD test.

This synchronisation is normally accomplished by the PD measuring device with the help of the mains. If the measurement is carried out at a location where connection to the mains is not possible, the sync transmitter is used.

Front view

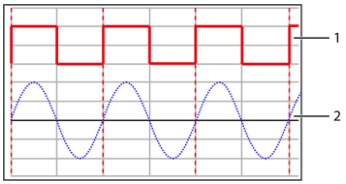
No.	Element	Function
1	Antenna	Is used for wireless signal transmission to the liona
2	*Power* LED	Displays the following operating states: ▪ LED flashes green: Batteries must be replaced ▪ LED turns green: Device is ready for operation
3	*Sync* LED	Displays the following operating states: ▪ LED off: No magnetic field detected ▪ LED flashes red: Magnetic field detected, the device tries to synchronise ▪ LED turns red: Signal output of the device is synchronised
4	On/Off switch	Is used to switch the device on and off

Mode of operation

The sync transmitter detects the magnetic field that is generated in the test object by the electric current. When a magnetic field is detected, a synchronisation signal is generated at the output of the sync transmitter. This synchronisation signal has the same frequency as the mains supply and is synchronised with the power cycle of the test object. The synchronised signal is transmitted wirelessly to the liona in the form of a synchronisation pulse.

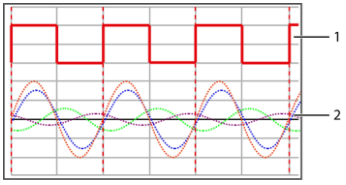
The sync transmitter can be mounted in the immediate vicinity of cables and switchgear and detects the magnetic field.

In a single-phase sinusoidal magnetic field (shown in blue), the sync transmitter is synchronised with the frequency of the magnetic field and generates a digital synchronisation signal (shown in red).



1 Synchronisation signal (sync transmitter)
2 Detected magnetic field

The sync transmitter is frequently used in 3-phase mains supplies where the phases are arranged relatively close to one another. The sync transmitter detects the magnetic field of the phase to which it is attached, as well as parts of the magnetic fields of the two adjacent phases. This distorts the sinusoidal magnetic fields (see Graph below). The sync transmitter is then synchronised with the strongest signal, which is found closest to the sync transmitter (see graph below: red line).



1 Synchronisation signal (sync transmitter)
2 Detected magnetic fields

3.6 VDS-C VDS PD coupler

The VDS-C VDS PD coupler is used to connect the liona to the VDS ports of the switchgear. The standard delivery therefore includes adapters for HR, MR, or LRM systems (as selected). The adapters for HR and MR systems comply with standard IEC 61243-5; the adapter for LRM systems complies with standards IEC 61243-5 and IEC 62271-213:2021.

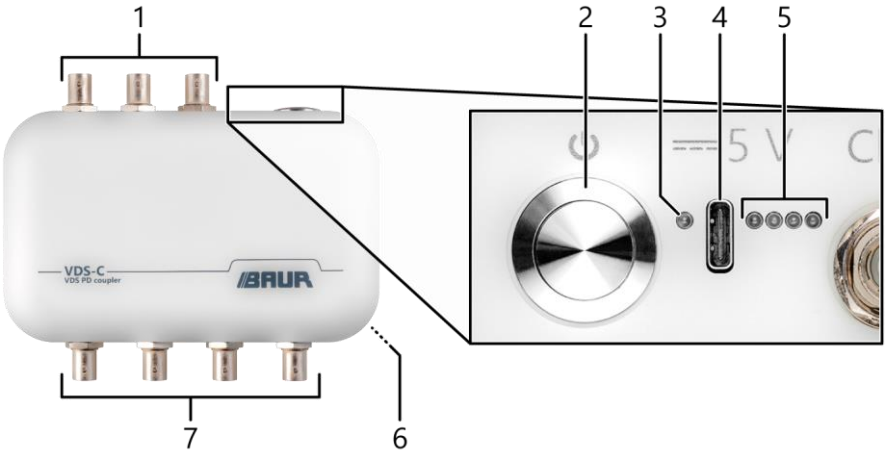
Depending on the design and local conditions of the switchgear, it may be necessary to take the test object out of operation in order to connect the liona with HFCT or TEV sensors. In contrast, when connecting the VDS-C to the VDS ports, the test object must not be taken out of operation.

Synchronising the data acquisition with the power cycle

Partial discharges occur in specific phasings in a power cycle, depending on the fault causing them. It is therefore important to synchronise the data acquisition with the power cycle during the PD test. If the measurement is carried out at a location where connection to the mains is not possible, the *Sync.* port on the VDS-C can be used. The synchronisation signal emitted at the *Sync.* port is generated by the voltage signal of the test object that is connected to the $Ch1_{in}$ signal input of the VDS-C and is phase synchronous with it.

Recommendation: When taking measurements with the VDS-C, the synchronisation signal that is emitted by its *Sync.* port must be used in order to synchronise the data acquisition with the power cycle.

Front view



No.	Element	Function
1	Signal inputs *Ch1*$_{in}$ – *Ch3*$_{in}$	Are used to connect the VDS-C to the VDS ports of the test object
2	ON/OFF key	Is used to switch the VDS-C on and off, and to display the battery charge status of the VDS-C ▸ To display the battery charge status, briefly press the On/Off button when the device is switched on.
3	Operating state indicator	Lights up when the VDS-C is switched on
4	Charger socket ⎓ *5 V* Type of interface:: USB Type C	
5	Battery charge status display	Indicates the charge status and charging phase of the rechargeable batteries and when the batteries overheat Further information: see section *Battery level indication*
6	Built-in magnets (rear side)	Are used to attach the VDS-C to the switchgear

No.	Element	Function
7	Signal outputs	Are used to connect the VDS-C to the liona ▪ $Ch1_{out}$ – $Ch3_{out}$: Prefiltered signals of the test object ▪ *Sync.*: Synchronisation signal for the liona

Battery charge status display

LED display	Meaning
Far left LED is flashing	The rechargeable batteries are almost empty. While the batteries are being charged, this LED flashes until a battery charge status of at least 25% is reached: ◎ ● ● ● Further information: Chapter *Charging the batteries of the VDS-C* (on page 80)
One or more LEDs illuminated	Indicates the battery charge status When all of the LEDs are illuminated, the rechargeable batteries are fully charged. Example: The batteries are between 25% and 50% charged: ● ● ● ●

LED display	Meaning
▪ One LED is flashing ▪ One or more LEDs illuminated	The batteries are being charged. While the batteries are being charged, the flashing LED indicates the current charging status. The battery charge level currently achieved is indicated by the illuminated LEDs. Example: The batteries are at least 50% charged; the current charging status is between 50% and 75%: ● ● ⊙ ● When all of the LEDs are illuminated, the rechargeable batteries are fully charged.
All LEDs are flashing	The rechargeable batteries are too hot. The device switches off automatically. Further information: Chapter *Overheating of VDS-C batteries during charging* (on page 81)

● – permanently on

⊙ – flashing

● – off

3.7 Connection cables and accessories

The connection cables and other accessories are located in the transport case of the respective connection set.

3.7.1 HFCT set

Figure	Component	Length	Function
	▪ HFCT sensors 100/50 mm, 3 pcs ▪ HFCT sensors 140/100 mm, 1 pc	–	Are used to connect the liona to the cable screen of the test object Further information: Chapter *Connecting with HFCT and/or TEV sensors* (on page 44)

Figure	Component	Length	Function
	TEV sensors, 2 pcs	–	Are used to connect the liona to the metal housing of the switchgear
	Protective earthing cable Cross section: 4 mm^2	2 m	Is used to connect the liona to the protective earthing
	BNC cable	1.5 m / 4 m (3 pcs each)	Are used to connect the liona to the HFCT and TEV sensors Further information: ▪ Chapter *Connecting the HFCT sensors* (on page 33) ▪ Chapter *Connecting the TEV sensors* (on page 43)
–	BNC connectors, 10 pcs	–	Are used to connect multiple BNC cables
	Mains supply cord	2.5 m	Is used to connect the liona to the supply voltage Further information: Chapter *Connecting to the supply voltage* (on page 48)
	Sync transmitter	–	Is used when the liona is in battery mode to synchronise the data acquisition with the power cycle during the PD test Further information: Chapter *Sync transmitter* (on page 19)

3.7.2 "VDS PD coupler" connection set

Figure	Component	Length	Function
	VDS-C VDS PD coupler		Is used to connect the liona to the VDS ports of the switchgear Further information: Chapter *VDS-C VDS PD coupler* (on page 22)
	Adapters for HR, MR, and LRM systems, 3 pcs (total)	–	Are used to connect the VDS-C to the VDS ports of the switchgear according to: ▪ IEC 61243-5: HR, MR, and LRM systems ▪ IEC 62271-213:2021: LRM systems
	Protective earthing cable Cross section: 4 mm^2	5 m	Is used to connect the liona to the protective earthing
	BNC cable	3 m (4 pcs)	Are used to connect the liona to the VDS-C Colours: red, yellow, blue, black
		0.5 m (3 pcs)	Are used to connect the VDS-C to the adapters for HR, MR, and LRM systems Colours: red, yellow, blue Further information: Chapter *Connecting with the VDS-C* (on page 45)
	Connection cables for LRM systems, 3 pcs	20 cm	Are used to connect the VDS-C to the VDS ports of the switchgear according to IEC 62271-213:2021 without an adapter Further information: Chapter *Connecting with the VDS-C to LRM systems without an adapter* (on page 47)

Figure	Component	Length	Function
	Mains supply cord	2.5 m	Is used to connect the liona to the supply voltage Further information: Chapter *Connecting to the supply voltage* (on page 48)
	USB charger incl. country-specific adapter and USB charging cable	1 m	Is used for the power supply and to charge the batteries of the VDS-C Further information: Chapter *Charging the batteries of the VDS-C* (on page 80)

3.8 Power supply

The power supply of the liona can be provided either via an on-site mains supply or independently of the mains via the built-in lithium-polymer battery.

Operation with mains voltage

Permissible mains voltage: 90 – 264 V

Permissible mains frequency: 50/60 Hz

Battery mode

If no mains voltage exists, the internal Lithium-ion-polymer battery automatically supplies power to the device. In this case, the operating life is at least 3 hours (with fully charged batteries).

Further information: Chapter *Data sheet* (on page 99)

3.9 Rating plates

3.9.1 Rating plates for the liona and VDS-C

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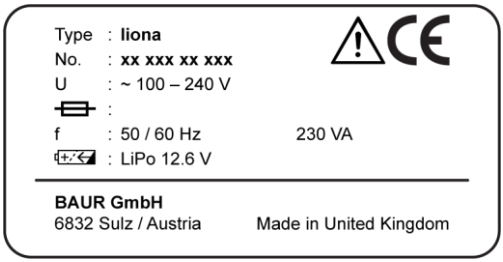
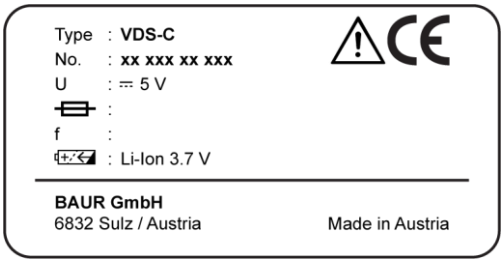


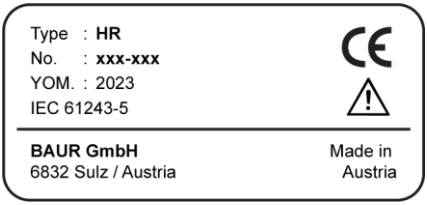
VDS-C:



Element	Description
Type	Device designation
No.	Serial number
U	Supply voltage If several supply voltages are possible, these are given consecutively one after another.
	Not applicable here
f	Mains frequency (only for liona)
VA	Max. recorded apparent output (only for liona)
	Integrated rechargeable battery

Element	Description
⚠	General warning sign Indicates that there is a potential risk of danger when using the product and hence the user manual must be observed
CE	CE mark Indicates that the device or system conforms to CE.
BAUR GmbH 6832 Sulz / Austria	Name and address of the manufacturer
Made in United Kingdom / Made in Austria	Indicates the country in which the device was manufactured.

3.9.2 Rating plates for the adapters for HR, MR, and LRM systems



Element	Description
Type	States the system that the adapter can be connected to: ▪ HR ▪ MR ▪ LRM
No.	BAUR item number of the adapter
YOM.	Year of manufacture

Element	Description
IEC 61243-5 / IEC 62271-213:2021	States the standard that the adapter complies with ▪ For HR and MR systems: IEC 61243-5 ▪ For LRM systems: IEC 61243-5 / IEC 62271-213:2021
	General warning sign Indicates that there is a potential risk of danger when using the product and hence the user manual must be observed
	CE mark Indicates that the device or system conforms to CE.
BAUR GmbH 6832 Sulz / Austria	Name and address of the manufacturer
Made in Austria	Indicates the country in which the device was manufactured.

4 COMMISSIONING

- Observe the safety instructions in chapter *For your safety* (on page 10).

DANGER

Connection work on live parts

Danger to life or risk of injury due to electric shock.

- Select the sensors and connection technology suitable for the local conditions.
- Only connect the HFCT sensors if the earth connections of the cable screens on the test object are easily accessible and are located at a safe distance from live parts.
- Only attach the sensors to the earthed surfaces of the cabinet housing (TEV sensors) or cable screen (HFCT sensors).
- Never connect the sensors directly to the live terminations of the test object.

4.1 Checks to perform before commissioning

1. Check the device and mechanical connections for damage.
2. Check electrical connections and cables for damage.
   Use only undamaged connection cables.

4.2 Installing the device

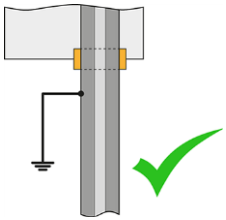
- Select the place of installation for the liona such that
  - a stable base is guaranteed,
  - the liona is standing on a flat horizontal surface,
  - the liona and the test object are accessible for the connections and operation.

4.3 Connecting the HFCT sensors

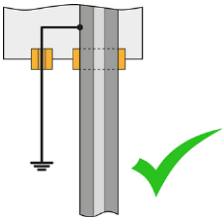
4.3.1 Connecting to live cables

If the earthing connection of the cable screen is insulated from the switchgear and can be accessed from outside, it is possible to mount the HFCT sensors for an online test during normal cable network operation.

Examples of plant models for which the connection of the HFCT sensors is possible during normal cable network operation:



The earth connection of the cable screen is insulated from the switchgear and executed externally.



The earthing connection of the cable screen is not disconnected from the switchgear and is executed internally, but is accessible from outside.

DANGER

Connection work on live parts

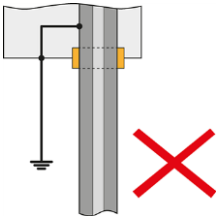
Danger to life or risk of injury due to electric shock.

- Select the sensors and connection technology suitable for the local conditions.
- Only connect the HFCT sensors if the earth connections of the cable screens on the test object are easily accessible and are located at a safe distance from live parts.
- Only attach the sensors to the earthed surfaces of the cabinet housing (TEV sensors) or cable screen (HFCT sensors).
- Never connect the sensors directly to the live terminations of the test object.

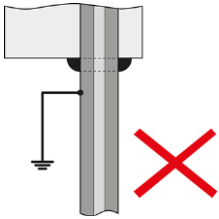
4.3.2 Connecting to de-energised cables

If the earth connection of the cable screen is not insulated from the switchgear and/or cannot be accessed, it is not possible to connect the HFCT sensors during normal cable network operation.

Examples of plant models for which it is not possible to connect the HFCT sensors during normal cable network operation:



The earthing connection of the cable screen is executed inside the switchgear and cannot be accessed without disconnecting the switchgear.



The earthing connection of the cable screen is connected with the housing of the switchgear.

DANGER

Danger due to electric voltage, flashovers at the connection point, or arcing fault on connection

Electric shock on touching live and active parts and due to residual charges and induction voltages;

Burns, electro-ophthalmia, and hearing damage.

- Use suitable personal protective equipment against electric shocks and arcing faults.
- Observe the isolating distances.
- Make sure that the workplace is de-energised.

  Further information: Chapter *Ensuring there is no voltage at the workplace* (on page 35)
- You may touch the parts that were under voltage only if they are visibly earthed and short-circuited.

Ensuring there is no voltage at the workplace

Before connecting the test object follow the 5 safety rules:

1. Disconnect the test object from all phases.
2. Secure the test object against reconnection.
3. Ensure that there is no voltage.
4. In the station, connect all phases of the test object with the station earth and short-circuit it.
5. Cover or cordon off adjacent live parts against accidental contact and flashovers.

4.3.3 Procedure

DANGER

Dangerous voltage in test object.

Danger to life or risk of injury due to electric shock.

- Never connect the sensors to non-insulated live plant parts.

1. Connect a BNC coaxial cable to the signal output of the sensor.
2. Open the lock of the HFCT sensor and place the HFCT around the earth connection of the cable screen.

   Thereby, the arrow next to the lock specifies the direction of the earth current.

   Connection examples:

3. Close the lock of the HFCT sensor.

4. Connect the HFCT sensor to a signal input on the liona.

4.3.4 Connection configuration in practice

Example 1

The cable earth is executed internally and there is secure access from below the switchgear.

- Connect the HFCT sensors from below the switchgear to the cable earth.

Example 2

In older switchgear, it can frequently happen that the cable earth is connected and insulated outside the cable box.

- Connect the HFCT sensors outside the cable box to the cable earth.

Example 3

In newer switchgear, the cable earth is often connected inside the switchgear. The earth connection of the cable screen is accessible below the cable box.

- Connect the HFCT sensors below the cable box to the cable earth.

Example 4

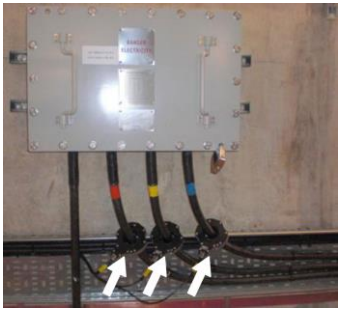
In some cases, the cable earth is accomplished separately inside the closed switchgear.

- If needed, connect the HFCT sensors in the cable cellar to the cable earth.

Example 5

Normally, high voltage and high voltage cable connections have an insulated cable earth.

- Connect the HFCT sensors to the insulated cable earth, either to the terminations or in the screen connection box.



Example 6

The cable earth is insulated and accessible, however only inside a protective cage that cannot be opened without first disconnecting the switchgear from the mains supply.

1. Ensure there is no voltage at the workplace.
   Further information: Chapter *Ensuring there is no voltage at the workplace* (on page 35)
2. Open the protective cage.
3. Connect the HFCT sensors.
4. Close the protective cage.
5. Put the test object into operation again and carry out an online test.

Example 7

A cable termination can be implemented fully sealed inside the switchgear to ensure that it is not accessible without disconnecting the switchgear from the mains and removing a protective cover.

1. Ensure there is no voltage at the workplace.

   Further information: Chapter *Ensuring there is no voltage at the workplace* (on page 35)
2. Open the protective cage.
3. Connect the HFCT sensors.
4. Close the protective cage.
5. Put the test object into operation again and carry out an online test.

Example 8

In some cases, it is not clear whether a cable termination is insulated or not.

1. To check if good signals can be detected, attach a HFCT sensor around the cable and the cable earthing and carry out an online PD test.
2. To compare the quality of the detected signals, attach the HFCT sensor only around the cable earthing and carry out another online PD test.

Note: Due to the unclear insulation conditions, it is recommended to have an experienced test engineer perform the online PD test.

4.3.5 Signal detection via the HFCT sensors

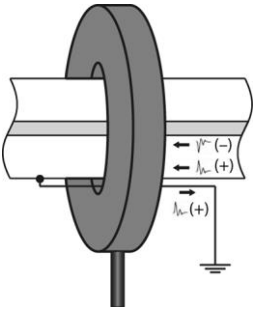
When a partial discharge occurs, a current pulse is induced both in the cable conductor and in the cable screen. The induced current pulses are equally strong, however of opposite polarity. This means: When both pulses are measured together, they are cancelled out. In this case, the HFCT sensor cannot detect a signal. This must be considered when connecting the HFCT sensors.

The HFCT sensor is placed around the cable and the cable earth

Signal detection:

The various rectified PD signals from cable and cable earth cancel out inside the cable.

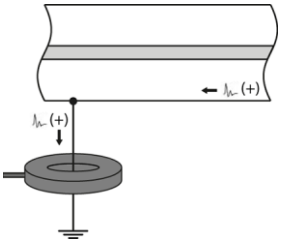
The sensor detects the PD signal through the cable earth.



The HFCT sensor is placed around the cable earth

Signal detection:

The sensor detects the PD signal through the cable earth.

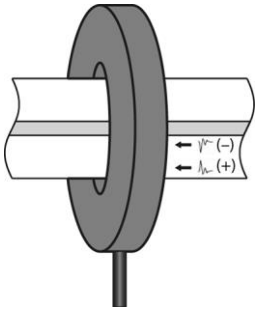


The HFCT sensor is placed around the cable (false)

Signal detection:

The various rectified PD signals from cable and cable earth cancel out inside the cable.

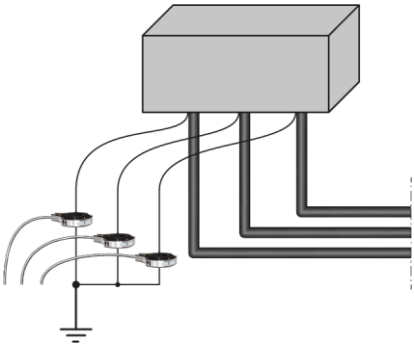
The sensor detects no signal.



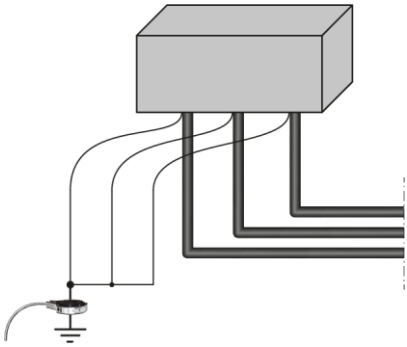
Connection examples for multiple cables

The HFCT sensors can be arranged around the individual cable earths (example 1) or around a common earthing cable (example 2).

Example 1



Example 2



4.3.6 Function test of HFCT sensors

The function test of the HFCT sensors can be used to check whether the HFCT sensors and the input channels of the liona are functioning correctly.

Procedure

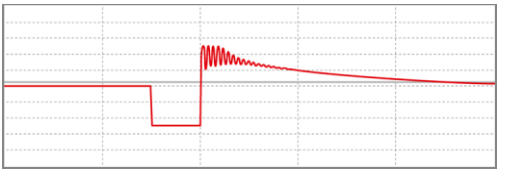
1. Connect the first HFCT sensor to the *PULSE OUT* pulse output of the liona.
2. Connect the second HFCT sensor to the *CH1* signal input of the liona.
3. Place the sensors inside each other.

4. Switch the liona pulse generator on using the *PULSE VOLTAGE* rotary switch.
5. Start the ***Spot Tester*** software and select the ***SCOPE*** tab.
6. In the ***Channels*** area, enable the input channel ***Ch 1***.
7. In the ***Trigger*** area, enable the ***Ch 1*** input channel as the synchronisation source.
8. Set the trigger level in such a way that the detected signal is displayed constantly.

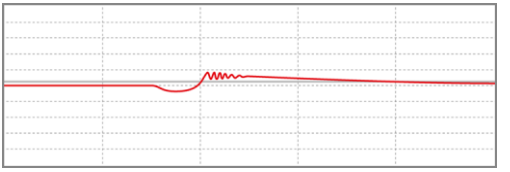
9. Turn the *PULSE VOLTAGE* rotary switch to the first scale mark.

Function test of HFCT sensors

Signal sequence for an intact HFCT sensor:



In case of a defective HFCT sensor, the signal level is clearly flatter.



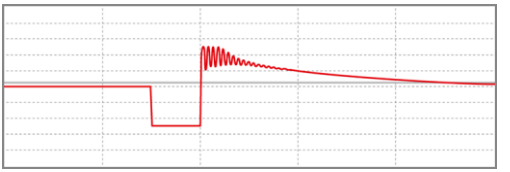
a. To test another HFCT sensor, connect the desired HFCT sensor to a signal input.

b. Repeat steps 3 to 9. In the ***Channels*** and ***Trigger*** areas in the ***Spot Tester*** software, set the input channel to which the HFCT sensor to be tested is connected.

Function test of the input channels of the liona

In the case of an intact input channel, the signals will be overloaded (clipping) from a voltage of ±1 V and above.

Signal sequence for an intact input channel:



a. To check all input channels of the liona, connect an HFCT sensor to the remaining signal inputs one by one.

b. Repeat steps 3 to 9 for each input channel. In the ***Channels*** and ***Trigger*** areas in the ***Spot Tester*** software, set the input channel to which the HFCT sensor is connected.

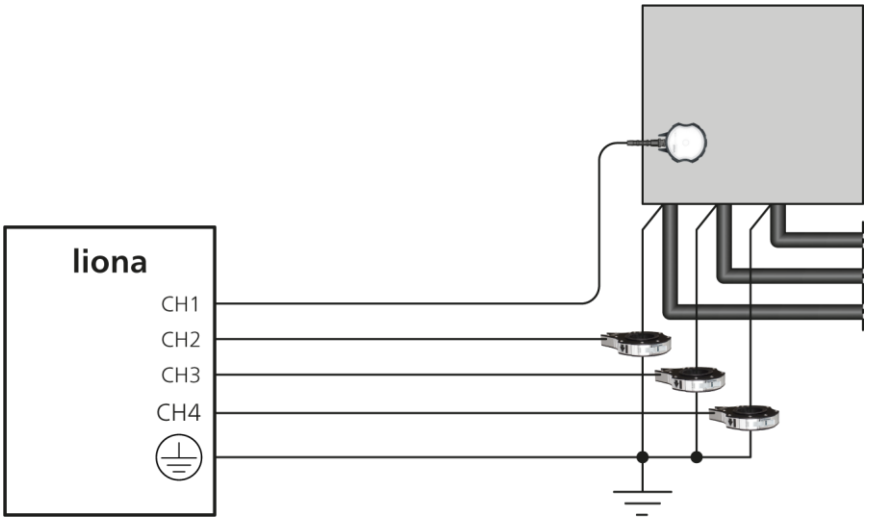
4.4 Connecting the TEV sensors

1. Connect a BNC coaxial cable to the signal output of the sensor.
2. Using the built-in magnets, attach the TEV sensor to the metal housing of the switchgear to be tested.

3. Connect the TEV sensor to a signal input on liona.

4.5 Connecting the device for the online PD test

4.5.1 Connecting with HFCT and/or TEV sensors



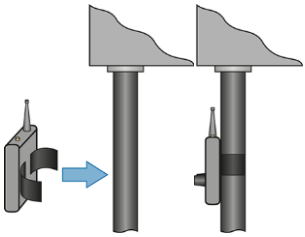
1. Earth the liona: use the earth cable to connect the protective earthing connection of the liona to the station earth.
2. Connect the sensors to the signal inputs *CH1* to *CH4* on the connection panel of the liona.

   You can connect up to 4 sensors simultaneously. HFCT sensors and TEV sensors can be connected simultaneously.
3. Place the sensors around the earth connections of the cable screens of the test object.

   Further information:

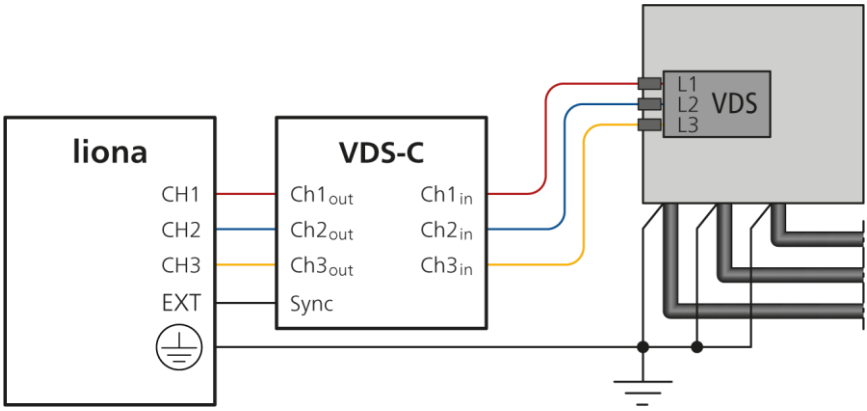
   - Chapter *Connecting the HFCT sensors* (on page 33)
   - Chapter *Connecting the TEV sensors* (on page 43)

Measurement with the liona in battery mode: Fitting the sync transmitter



- Using the hook and loop fastener, affix the sync transmitter to a phase of the test object.
  Recommendation: Using the hook and loop fastener, affix the sync transmitter to the phase to be tested.
- Only connect the sync transmitter to, or near to, earthed components.

4.5.2 Connecting with the VDS-C



1. Earth the liona: use the earth cable to connect the protective earthing connection of the liona to the station earth.
2. Using the built-in magnets, attach the VDS-C to the metal housing of the switchgear to be tested.
3. Connect the VDS-C to the liona and the test object. Proceed as follows:
   a. Connect the *CH1* signal input on the liona to the $Ch1_{out}$ signal output on the VDS-C.
   b. Connect the $Ch1_{in}$ signal input on the VDS-C to the VDS port of the desired phase of the test object.

   To do so, use the supplied BNC connection cable and adapter for HR, MR, or LRM systems.

   Recommendation: For an easier to navigate test assembly, use the BNC connection cable with the same colour coding.
4. If you want to perform the measurement on additional phases of the test object, repeat step 3 for the desired phase.

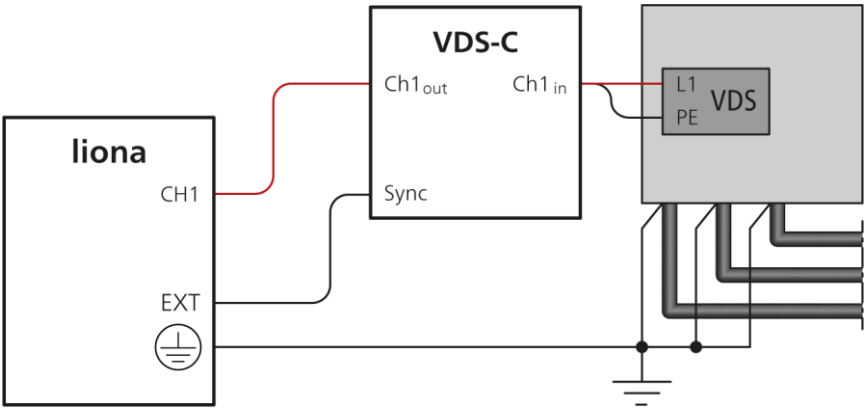
   A maximum of 3 phases of the test object can be connected for the measurement.
5. Use the synchronisation signal of the VDS-C to synchronise the data acquisition with the power cycle during the PD test. To do so, connect the *Sync.* port on the VDS-C to the *EXT* port on the liona.

   The synchronisation signal emitted at the *Sync.* port is generated by the voltage signal of the test object that is connected to the $Ch1_{in}$ signal input of the VDS-C and is phase synchronous with it.

   Measurement with the liona in battery mode

   For measurements with the liona in battery mode, the synchronisation signal of the VDS-C must always be used to synchronise the data acquisition with the power cycle during the PD test.

4.5.3 Connecting with the VDS-C to LRM systems without an adapter



1. Earth the liona: use the earth cable to connect the protective earthing connection of the liona to the station earth.
2. Using the built-in magnets, attach the VDS-C to the metal housing of the switchgear to be tested.
3. Connect the VDS-C to the liona and the test object. Proceed as follows:
   a. Connect the *CH1* signal input on the liona to the $Ch1_{out}$ signal output on the VDS-C.
   b. Connect the $Ch1_{in}$ signal input on the VDS-C to the VDS port of the desired phase and to the protective earthing connection of the test object.

   To do so, use the supplied connection cable for LRM systems.
4. If you want to perform the measurement on additional phases of the test object, repeat step 3 for the desired phase.

   A maximum of 3 phases of the test object can be connected for the measurement.
5. Use the synchronisation signal of the VDS-C to synchronise the data acquisition with the power cycle during the PD test. To do so, connect the *Sync.* port on the VDS-C to the *EXT* port on the liona.

   The synchronisation signal emitted at the *Sync.* port is generated by the voltage signal of the test object that is connected to the $Ch1_{in}$ signal input of the VDS-C and is phase synchronous with it.

Measurement with the liona in battery mode

For measurements with the liona in battery mode, the synchronisation signal of the VDS-C must always be used to synchronise the data acquisition with the power cycle during the PD test.

4.6 Connecting to the supply voltage

1. Connect the liona to the mains voltage using a mains supply cord. If necessary, use a country-specific adapter.

   Note that the mains supply earth is not isolated from the station earth.

   NOTICE! If the voltage is too low, the system will not work properly; if it is too high it may damage the device.
2. Ensure that the mains voltage matches the specifications on the rating plate.

   The LED on the liona turns red or green depending on the battery charge status.

   Note: If supply via the mains is not possible, the device can be operated with the internal battery.

4.7 Requirements for an external synchronisation signal

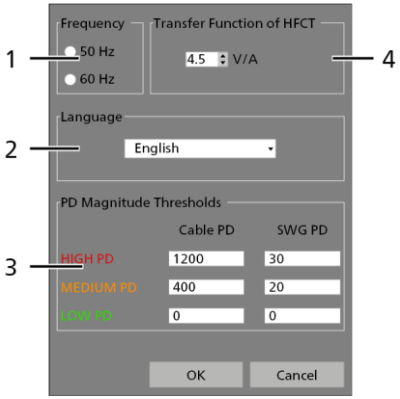
- Input voltage: DC 0 – 30 V (recommended: DC 0 – 5 V)
- Voltage shape: Rectangular wave voltage
- Input current: 2 – 30 mA
- Frequency: 50/60 Hz

4.8 Securing the test area

1. Mark out the path for pedestrians.
2. Secure the connection cables, e.g. with cable bridges or rubber mats. The connction cables must be protected against damage and there must be no danger of people tripping.
3. Mark the test area and terminals clearly. It must be very obvious that a measurement is in progress.
4. Make sure that unauthorised persons cannot access the connection point and the far end of the test object.

5 CONFIGURING THE “SPOT TESTER” SOFTWARE

SCOPE > ***Settings***



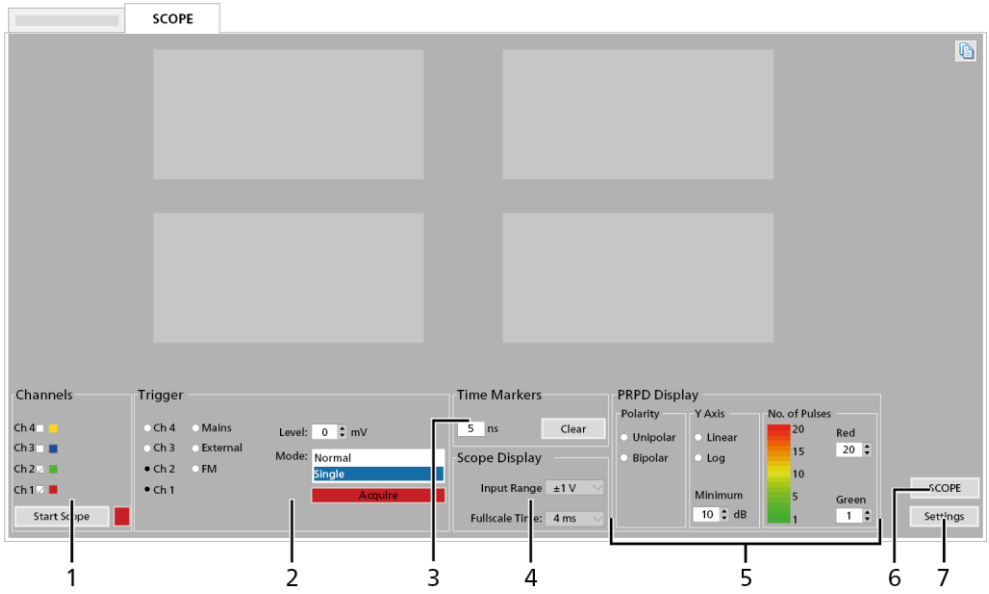
No.	Element	Function
1	***Frequency*** area	Is used to select the frequency of the test object
2	***Language*** area	Is used to select the language of the user interface The software restarts automatically once the language has been changed.

No.	Element	Function
3	***PD Magnitude Thresholds*** area	Is used to set the PD threshold values for cables (***Cable PD***) and switchgear (***SWG PD***) These threshold values are used to classify the partial discharges as strong, medium or weak. The following standard values are stored: ▪ ***HIGH PD*** ***Cable PD***: 1,200 pC / ***SWG PD***: 30 pC ▪ ***MEDIUM PD*** ***Cable PD***: 400 pC / ***SWG PD***: 20 pC ▪ ***LOW PD*** ***Cable PD***: 0 pC / ***SWG PD***: 0 pC
4	***Transfer Function of HFCT*** area	Is used to set the transfer function according to the sensitivity of the HFCT sensors The transfer function relates to the response characteristic of the HFCT sensor at the frequencies relevant for the PD detection.

6 “SCOPE” MODE

In ***SCOPE*** mode you can watch the PD activity in real time with an oscilloscope. The data cannot be saved.

6.1 Setting the parameters for the “Scope” mode



No.	Element	Function
1	***Channels*** area	▪ ***Ch 1*** – ***Ch 4***: Is used to enable and disable the input channels to be displayed The signal curves of the input channels are colour coded in the Scope display. The colour code is visible next to the channel. ▪ ***Start Scope*** / ***Stop Scope*** button: Is used to start and end the measurement

No.	Element	Function
2	***Trigger*** area	Is used to set the synchronisation source, the trigger level, and the measurement mode The following synchronisation sources are available: ▪ ***Ch 1*** – ***Ch 4***: The measurement is started as soon as the defined threshold value (***Level***) of the selected channel is exceeded. As soon as the measurement starts, the trigger level is shown in the Scope display as a white line. ▪ ***Mains***: The voltage from the mains supply system is used as the synchronisation source. The liona must be operated using mains voltage for this. ▪ ***External***: The synchronisation signal of the VDS-C or an external synchronisation signal is used as the synchronisation source. ▪ ***FM***: The sync transmitter is used as the synchronisation source. This synchronisation source is only used for the battery mode of the liona. The following measurement modes are available: ▪ ***Normal***: The measurement curve is automatically updated continuously. ▪ ***Single***: Click the ***Acquire*** button to display a snapshot of the measurement curve.
3	***Time Markers*** area	Shows the time between the two time markers Time markers can only be placed in the Scope display
4	***Scope Display*** area	▪ ***Input Range***: Is used to select the voltage ranges of the Scope display (y-axis). Signals can be recorded with max. ±1.2 V. Signals with a higher amplitude can lead to saturation of the input circuit. ***Fullscale Time***: Is used to select the time range (x-axis) of the Scope display.

No.	Element	Function
5	***PRPD Display*** area	This area is only displayed if the PRPD display is active. The ***Polarity*** area is used to define how signals are shown on the y-axis. ▪ ***Unipolar***: All input signals are rectified and shown on the positive y-axis. ▪ ***Bipolar***: The input signals are shown on the positive and negative y-axis. The ***Y Axis*** area is used to set the scaling of the y-axis for the phase-resolved PD presentation and to define the minimum value displayed on the y-axis. ▪ ***Linear***: The y-axis is scaled linearly, i.e. the signals are displayed in mV. ▪ ***Log***: The y-axis is scaled logarithmically, i.e. the signals are displayed in dB. The ***No. of Pulses*** area is used to define the colour code for the density of the partial discharges detected. The number of pulse peaks is displayed in colour at each position of the curve. Possible settings: ▪ ***Red***: 11 - 100 pulses, standard value: 20 pulses ▪ ***Green***: 0 - 10 pulses, standard value: 1 pulse
6	***SCOPE*** / ***PRPD*** button	Switches between the Scope and PRPD display (in screenshot: PRPD display active) It is only possible to switch from the Scope to the PRPD display if a measurement is running.
7	***Settings*** button	Opens the dialog for configuring the general settings Further information: Chapter *Configuring the "Spot Tester" software* (on page 49)

6.1.1 Tips and tricks for setting the trigger level

Signal display without a set trigger level

If no trigger level is specified (***Level***: 0 mV), all of the recorded signals (PD and noise signals) are continuously displayed on the enabled input channels.

Identifying recurring signals more easily

When there are periodically recurring signals, setting the trigger level makes it easier to identify whether, for example, more PD signals with the same voltage occur at the same time. In such cases, it is always the last measured signal that is displayed.

Determining the signal with the highest voltage

1. In order to determine the signal with the highest voltage, carry out a PD test in ***SCOPE*** mode.

   Use the Scope display to show the measured signal. The trigger level is shown as a white line.

   Further information: Chapter *Performing a measurement in the Scope mode* (on page 55)
2. In the ***Trigger*** area, set the trigger level (***Level***) to the maximum value and reduce the set level step by step.

   The trigger level is shown as a white line.

   As soon as a signal with a voltage that is the same as the current trigger level setting is recorded, the signal is displayed on the screen. The displayed signal is the signal with the highest voltage. It can be a PD signal or even a noise signal.

6.2 Performing a measurement in the Scope mode

1. Connect the liona to the cable to be tested.

   Further information: Chapter *Connecting the device for the online PD test* (on page 44)
2. Measurement with VDS-C: Switch the VDS-C on using the On/Off button.

   The operating state indicator lights up green. The charge status of the rechargeable batteries is displayed.
3. Switch on the liona using the On/Off switch on the connection panel.
4. Switch on the laptop and start the ***Spot Tester*** software.
5. In the ***Spot Tester*** software, select the ***SCOPE*** mode.
6. Define the parameters for the Scope measurement.

   Further information: Chapter *Setting the parameters for the "Scope" mode* (on page 51)
7. Click the ***Start Scope*** button.

   The button changes to ***Stop Scope***. The display field next to the button turns green. The trigger level is shown as a white line.
8. Click the ***Acquire*** button to initiate an individual measurement.

   The snapshot is displayed.
9. To switch between the Scope display and the PRPD display, click the ***PRPD*** or ***SCOPE*** button.

   The display changes.
10. To exit the measurement, click the ***Stop Scope*** button.

    The button changes to ***Start Scope***. The display field next to the button turns red.

6.3 PRPD display

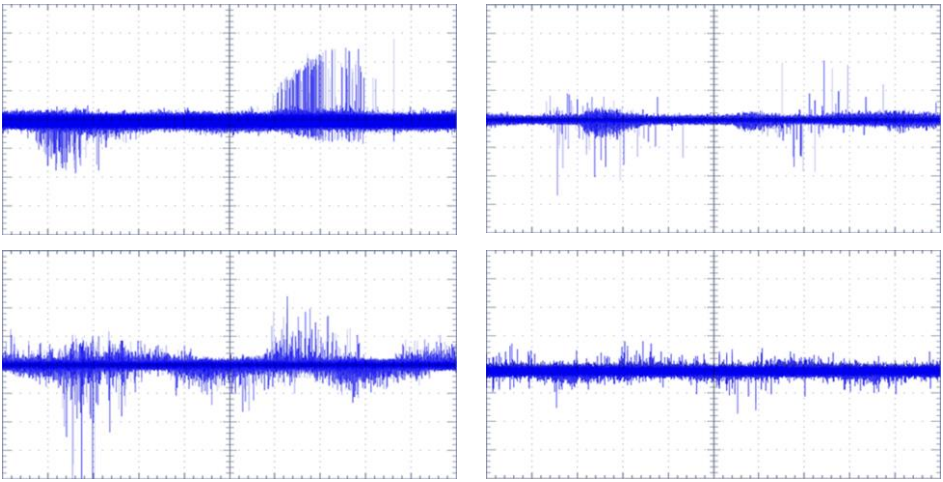
The PRPD display shows the recorded PD signal triggered for the power cycle of the selected channel, synchronised according to the set synchronisation source. A power cycle is displayed automatically, i.e. 16.67 ms at 60 Hz or 20 ms at 50 Hz. The number of pulses is indicated by a colour code.

Further information on the settings for the PRPD display: Chapter *Setting the parameters for the "Scope" mode* (on page 51)

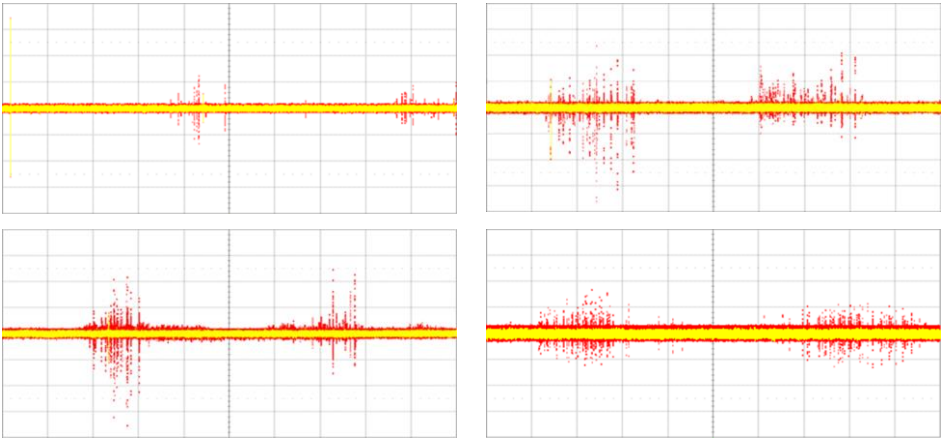
In the phase-resolved presentation of the PD test, you cannot zoom into or out of the individual signals.

Examples of PRPD displays

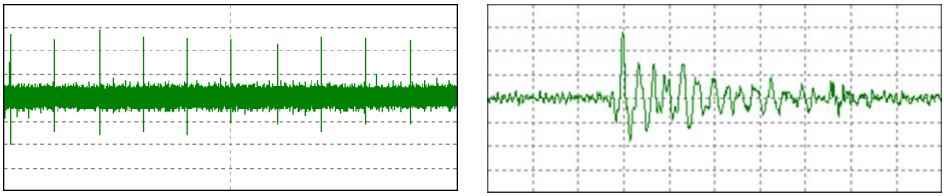
Cable PD pattern over a power cycle



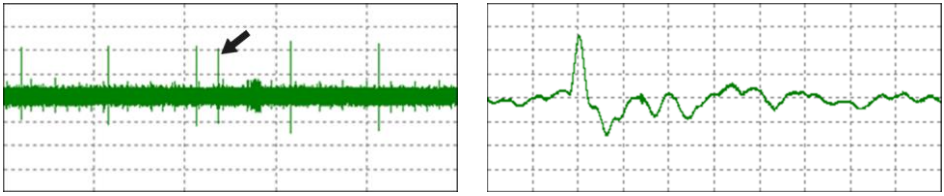
Switchgear PD pattern (local PD) over a power cycle



Noise signal (incl. waveform)



Partial discharge behind a noise signal (incl. waveform)



7 “PD TEST” MODE

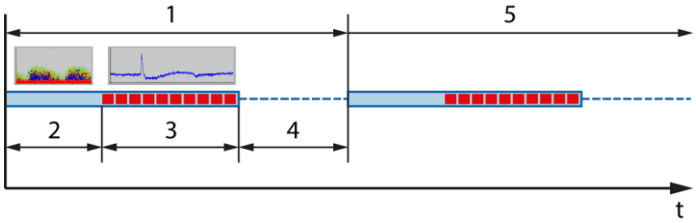
In ***PD TEST*** mode, you can perform PD tests and evaluate the results. You can also perform an automatic quick test of the cable route for partial discharges. This mode is recommended for routine and repetitive tests.

7.1 Measurement principle

During a PD test, a phase-resolved PD display (PRPD) is generated, and power cycles analysed using the DeCIFer® algorithm. The DeCIFer® algorithm filters the PD pulses from the detected signals and quantifies them. The DeCIFer® algorithm works with measurement data recorded at a sampling rate of 100 MSamples/s over one power cycle. In this way, up to 2 million measurement points are recorded. This means the processing of the recorded measurement data with the DeCIFer® algorithm takes a few seconds.

The test duration for PRPD and the number of power cycles to be analysed can be set under ***PD TEST*** > ***Settings***.

The data is recorded according to the following principle:

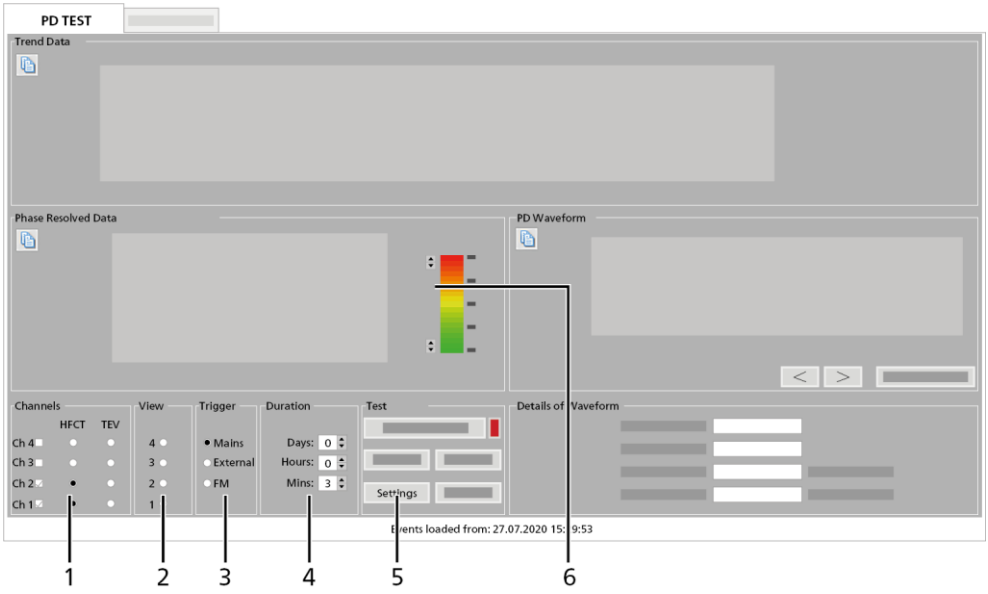


1	A measurement
2	PRPD cycle
3	Analysis with DeCIFer® algorithm
4	Interval between the measurements
5	Other measurements within the defined test duration

To keep the file size small when saving the recorded data, the measurements are performed in intervals. The interval between the measurements is calculated automatically according to the defined test duration.

Measuring time	Interval between the measurements
0 – 5 minutes	–
5 – 10 minutes	1 minute
10 – 30 minutes	2 minutes
30 – 60 minutes	3 minutes
1 – 6 hours	5 minutes
6 – 24 hours	20 minutes
1 – 7 days	30 minutes
7 – 30 days	60 minutes

7.2 Setting parameters for PD testing



No.	Element	Function
1	***Channels*** area	***Ch 1*** – ***Ch 4***: Is used to enable and disable the input channels to be displayed Use the radio buttons to assign each enabled channel to the sensor connected to the corresponding liona *CH1 – CH4* signal input. When taking measurements with the VDS-C, the radio buttons for the connected sensors are not relevant.
2	***View*** area	Is used to select the channel displayed in the ***Trend Data*** and ***Phase Resolved Data*** areas
3	***Trigger*** area	Is used to set the synchronisation source ▪ ***Mains***: The voltage from the mains supply system is used as the synchronisation source. The liona must be operated using mains voltage for this. ▪ ***External***: The synchronisation signal of the VDS-C or an external synchronisation signal is used as the synchronisation source. ▪ ***FM***: The sync transmitter is used as the synchronisation source. This synchronisation source is only used for the battery mode of the liona.
4	***Duration*** area	Is used to set the measuring time Possible settings: ▪ ***Days***: 0 – 30 days ▪ ***Hours***: 0 – 23 hours ▪ ***Mins***: 0 – 59 minutes For online PD spot testing, the test duration is typically 2 to 3 minutes per cable. When there is doubt about intermittent faults, it makes sense to test for a longer period.
5	***Test*** area	***Settings***: Opens the dialog for setting the phase-resolved PD presentation and defining the DeCIFer® algorithm Further information: Chapter *Settings for PRPD and DeCIFer® algorithm* (on page 61)

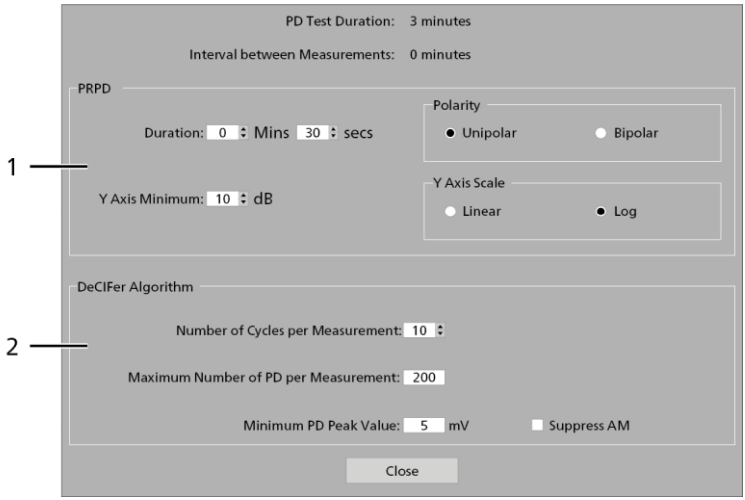
No.	Element	Function
6	***Phase Resolved Data*** area	Shows the phase-resolved PD presentation of the recorded partial discharges for the selected input channel The number of pulse peaks is displayed in colour at each position of the curve. You can change the colour coding with the arrow keys. Possible settings: ▪ ***Red***: 11 - 100 pulses, standard value: 20 pulses ▪ ***Green***: 0 - 10 pulses, standard value: 1 pulse Further information: Chapter *Settings for PRPD and DeCIFer® algorithm* (on page 61)

7.2.1 Settings for PRPD and DeCIFer® algorithm

The settings for the PRPD test and DeCIFer® algorithm are associated with the measurement principle.

Further information: Chapter *Measurement principle* (on page 58)

PD TEST > ***Test*** area > ***Settings***



No.	Element	Function
1	***PRPD*** area	▪ ***Duration***: Is used to set how long a PRPD cycle lasts When testing switching circuits with a lot of activity, a short duration of about 15 seconds is enough. On switching circuits where there is less activity, a duration of about 1 minute is recommended. A duration of 30 seconds is defined as standard. ▪ ***Unipolar***: All input signals are rectified and shown on the positive y-axis. ▪ ***Bipolar***: The input signals are shown on the positive and negative y-axis. ▪ ***Linear***: The y-axis is scaled linearly, i.e. the signals are displayed in mV. ▪ ***Log***: The y-axis is scaled logarithmically, i.e. the signals are displayed in dB. ▪ ***Y Axis Minimum***: Is used to set the minimum value displayed on the y-axis (standard value: 10)
2	***DeCIFer Algorithm*** area	Is used to set the parameter for the DeCIFer® algorithm ▪ ***Number of Cycles per Measurement***: Standard value: 10 ▪ ***Maximum Number of PD per Measurement***: Standard value: 200 ▪ ***Minimum PD Peak Value***: Is used to enter the voltage peak (in millivolts) from which the DeCIFer® algorithm records an event as a partial discharge (standard value: 5 mV) Events with low voltage peaks are not interpreted as partial discharges and are therefore not displayed. ▪ ***Suppress AM***: Enables and disables the suppression of amplitude-modulated noise signals Amplitude-modulated noise signals can occur in some circuits, e.g. due to signals from radio stations. They are seen as repetitive carrier waves with a fixed frequency. In rare cases, these noise signals can show the same frequency as the partial discharges. In connection with other noise signals, this could influence the DeCIFer® algorithm and result in misclassification of the partial discharges.

7.3 Performing a PD test

1. Connect the liona to the cable to be tested.

   Further information: Chapter *Connecting the device for the online PD test* (on page 44)
2. Measurement with VDS-C: Switch the VDS-C on using the On/Off button.

   The operating state indicator lights up green. The charge status of the rechargeable batteries is displayed.
3. Switch on the liona using the On/Off switch on the connection panel.
4. Switch on the laptop and start the ***Spot Tester*** software.
5. In the ***Spot Tester*** software, select the ***PD TEST*** mode.
6. Define the parameters for the PD test.

   Further information: Chapter *Setting parameters for PD testing* (on page 59)
7. Click the ***Start Test*** button.

   The measurement is active. The button changes to ***Stop Test***. The display field next to the button turns green.
8. The measurement ends after the defined test duration.

   To exit the measurement before the defined test duration, click the ***Stop Test*** button.

   The button changes to ***Start Test***. The display field next to the button turns red. The ***Save as*** dialog box opens automatically.
9. Select the folder in which you want to save the file.
10. To save the file under a different name, enter a name in the ***File name*** input field.

    Note: The file name must not contain the following characters: \ / : * ? "< > |
11. Click the ***OK*** button.

7.4 Analysing the PD events

The detected PD events can be analysed using the DeCIFer® algorithm. Each detected PD event can be considered individually to make sure that it actually pertains to a partial discharge.

- In the ***Phase Resolved Data*** area, click the desired PD event.

  The events are shown as colour points.

  The selected waveform and the waveform details are displayed.

Further information: Chapter *Phase-resolved PD presentation (PRPD)* (on page 65)

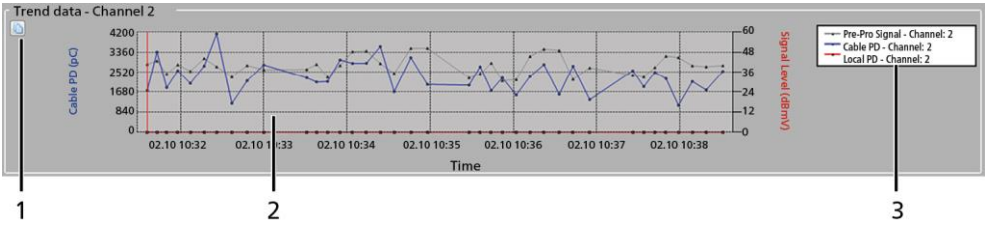
7.4.1 Display of trend data

The partial discharges detected are shown over time in the ***Trend Data*** area. The data refers only to one channel. The following data is shown:

- Partial discharges detected in cables: blue line
- Partial discharges detected in switchgear: red line
- Intensity of the pre-processed raw signal: grey line

On the left-hand side, the y-axis scale is graduated in pC for the measurement of the cable PD; on the right-hand side it is graduated in dBmV for the measurement of partial discharges in switchgear. In addition, the scaling on the right side is used for the measurement of the prepared raw signal. Both y axis scales are automatically scaled independently of one another.

The x axis shows the time and date. The display is likewise scaled automatically.



No.	Element	Function
1	button	Creates a screenshot of the current measurement results display The screenshot is stored in the clipboard. ▸ To insert the screenshot in a text editing program (e.g. *Microsoft Word*), open the program and press the key combination *Ctrl* + *V*.
2	Measurement results	Is used to display the recorded input curve The marker appears as a red line on the far left.
3	Legend	Shows the colour code of the detected input signal curve

Zoom in display

- To zoom into an area of the display, drag an area of the display with the left mouse button.

Zoom out display

- To zoom out of the display, right-click in the display.

Set marker

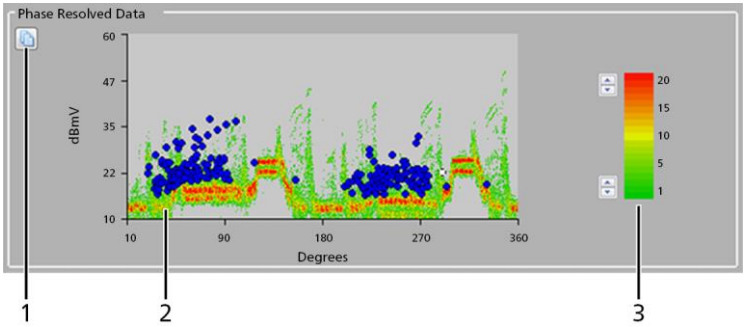
- Click on the point in the display where you wish to place the marker.

  The phase-resolved PD presentation (PRPD) and the PD waveform are adjusted to the marker position.

7.4.2 Phase-resolved PD presentation (PRPD)

The PRPD display is a phase-resolved display of the pre-processed raw signal for the time selected in the ***Trend Data*** area with the marker.

Phase-resolved display (PRPD)



No.	Element	Function
1	 button	Creates a screenshot of the current measurement results display The screenshot is stored in the clipboard. ▸ To insert the screenshot in a text editing program (e.g. *Microsoft Word*), open the program and press the key combination *Ctrl + V*.
2	Measurement results	Is used to display the recorded input signal as well as the partial discharges
3	Colour coding	Is used to define the colour code for the density of the recorded partial discharges. The number of pulse peaks is displayed in colour at each position of the curve. You can change the colour coding with the arrow keys.

As the PRPD display is based on the pre-processed signal, the pulse intensity is measured in mV. The pulse intensity is shown on the y-axis in dBmV.

The time duration of a power cycle is displayed on the x-axis of the PRPD display (20 ms at 50 Hz and 16.67 ms at 60 Hz). The power cycle is shown in 0 to 360°.

When recorded PD pulses have voltage values higher than the background noise, they generate a PRPD pattern typical for partial discharges. Different PD sources give rise to different patterns. In general, clusters of PD activities are formed about every 180°.

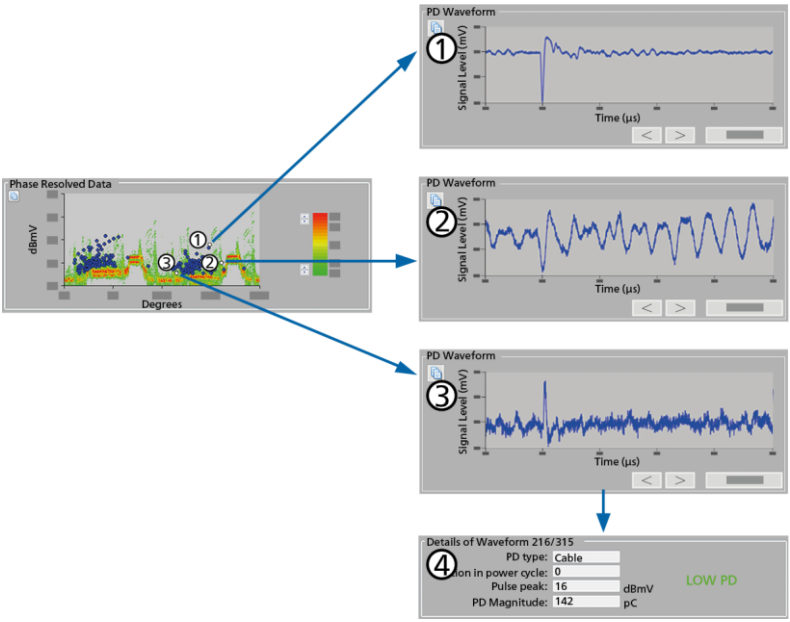
Detected partial discharges

All partial discharges detected by the DeCIFer® algorithm are quantified. The PRPD display presents each partial discharge with a colour point according to the phasing in the power cycle and the pulse intensity. Cable PDs are displayed with a blue point, switchgear PDs with a red point. For uniformity, the pulse intensity is likewise displayed in dBmV.

Selecting individual events

▸ Click on a partial discharge to see its waveform and more information about this waveform.

Examples for individually displayed events



1	Cable PD
2	Possible noise signal
3	Cable PD behind a high noise signal
4	Detailed waveform data for the selected PD

Further information: Chapter *Display of PD waveform and the waveform details* (on page 68)

Showing and hiding events

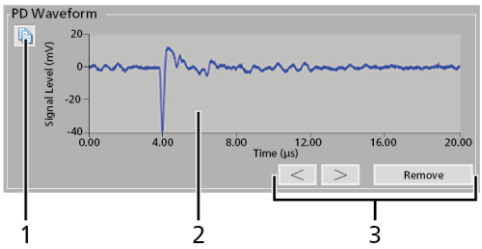
- Right-click in the display and select one of the menu items below from the context menu:
  - ***PRPD***: Enables and disables the phase-resolved PD presentation of the raw signal
  - ***Cable Events***: Enables and disables the display of the events detected in the cable
  - ***Switchgear Events***: Enables and disables the display of the events detected in the switchgear

  The selected events are displayed exclusively.

7.4.3 Display of PD waveform and the waveform details

PD waveform

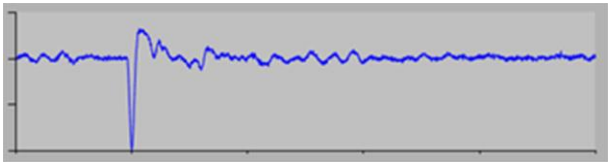
The waveform of the partial discharge that was selected in the trend data display or the PRPD display is shown in this area. The example below shows a waveform with a duration of 20 µs and with a PD peak at 4 µs.



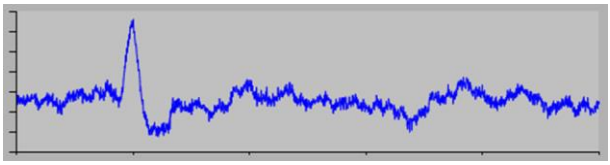
No.	Element	Function
1	button	Creates a screenshot of the current measurement results display The screenshot is stored in the clipboard. ▸ To insert the screenshot in a text editing program (e.g. *Microsoft Word*), open the program and press the key combination *Ctrl* + *V*.
2	Measurement results	Shows the signal curve of the partial discharge that is selected in the ***Phase Resolved Data*** area
3	Arrow keys	Are used to switch between individual partial discharges
	Remove Event button	Deletes the selected partial discharge

Examples of waveforms

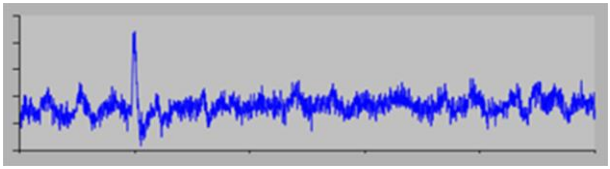
Cable PD



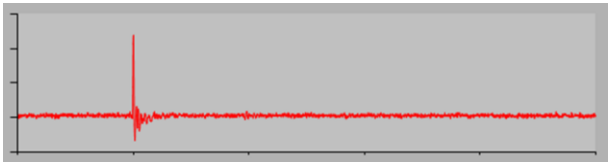
Cable PD



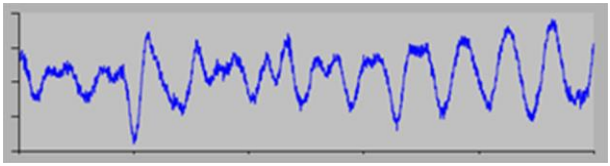
Cable PD behind a high noise signal



Switchgear PD

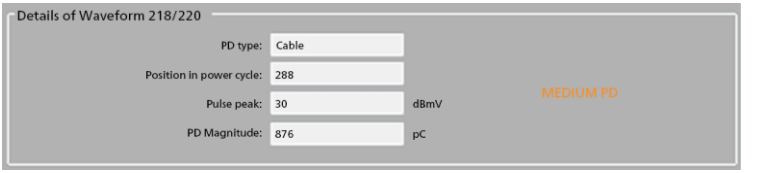


Possible noise signal



Details of Waveform

The software analyses the recorded partial discharges and displays the information in the ***Details of Waveform*** area.



Element	Function
PD Type	Shows the type of partial discharge
Position in Power Cycle	Shows the phasing of the partial discharge within a power cycle in degrees
Pulse Peak	Shows the level of the PD pulse in dBmV
PD Magnitude	Shows the charge of the recorded PD pulse in pC
Information area	Shows whether the selected partial discharge is classified as strong, medium or weak This information depends on the PD thresholds defined in the software configuration. Further information: Chapter *Configuring the “Spot Tester” software* (on page 49)

7.5 Creating the report

PD TEST > ***Test***

Creating a report for the current measurement

1. Carry out a partial discharge measurement.
   Further information: Chapter *Performing a PD test* (on page 63)
2. In the ***View*** area, select the channel for which you would like to create the report.
3. Click the ***Report*** button.
4. Enter information for the PD test.
5. Click the ***OK*** button.
6. Select the folder in which you want to save the file.
7. To save the file under a different name, enter a name in the ***File name*** input field.
   Note: The file name must not contain the following characters: \ / : * ? "< > |
8. Click the ***OK*** button.
   The report is saved in PDF format in the selected folder.

Creating a report from saved data

1. Click the ***Open*** button.
2. Select a file that you want to open.
3. Click the ***OK*** button.
   The file opens and the saved data is displayed.
4. Click the ***Report*** button.
5. Enter information for the PD test.
6. Click the ***OK*** button.
7. Select the folder in which you want to save the file.
8. To save the file under a different name, enter a name in the ***File name*** input field.
   Note: The file name must not contain the following characters: \ / : * ? "< > |
9. Click the ***OK*** button.
   The report is saved in PDF format in the selected folder.

8 PD TEST IN BATTERY MODE

8.1 Measurement with the sync transmitter

1. Connect the liona to the cable to be tested.

   Further information: Chapter *Connecting with HFCT and/or TEV sensors* (on page 44)
2. Using the hook and loop fastener, affix the sync transmitter to a phase of the test object.

   Recommendation: Using the hook and loop fastener, affix the sync transmitter to the phase to be tested.
3. Switch on the sync transmitter using the On/Off switch.

   The *Power* LED turns green. The *Sync* LED flashes red.
4. Wait until the *Sync* LED turns a steady red.

   A magnetic field was detected and the signal output is synchronised with the frequency of the test object. The synchronisation signal is sent wirelessly to the liona.

   When the *Sync* LED flashes or goes off, there is no magnetic field. In this case, change the position of the sync transmitter. This will aid the detection of the magnetic field.
5. Switch on the liona using the On/Off switch on the connection panel.
6. Switch on the laptop and start the ***Spot Tester*** software.
7. Set the measurement parameters and in the ***Trigger*** area, select the synchronisation source ***FM***.

   The sync transmitter is used as the synchronisation source.

   Further information: Chapter *Setting the parameters for the "Scope" mode* (on page 51)
8. Perform the measurement.

Further information:

- Chapter *Performing a PD test* (on page 63)

  Chapter *Performing a measurement in the Scope mode* (on page 55)

8.2 Measurement with the VDS PD coupler

1. Connect the VDS-C to the liona and the switchgear.

   Important: If the PD test is performed on only one phase of the test object, always connect the *Ch1*$_{in}$ signal input on the VDS-C to the VDS port of the desired phase of the test object.

   Further information:

   - Chapter *Connecting with the VDS-C* (on page 45)
   - Chapter *Connecting with the VDS-C to LRM systems without an adapter* (on page 47)

2. Connect the *Sync.* port on the VDS-C to the external trigger input *EXT* on the liona.

   The synchronisation signal emitted at the *Sync.* port is generated by the voltage signal of the test object that is connected to the *Ch1*$_{in}$ signal input of the VDS-C and is phase synchronous with it.

3. Switch the VDS-C on using the On/Off button.

   The operating state indicator lights up green. The charge status of the rechargeable batteries is displayed.

4. Switch on the liona using the On/Off switch on the connection panel.
5. Switch on the laptop and start the ***Spot Tester*** software.
6. Set the measurement parameters and in the ***Trigger*** area, select the synchronisation source ***External***.

   The synchronisation signal of the VDS-C is used as the synchronisation source.

   Further information: Chapter *Setting the parameters for the "Scope" mode* (on page 51)

7. Perform the measurement.

Further information:

- Chapter *Performing a PD test* (on page 63)

  Chapter *Performing a measurement in the Scope mode* (on page 55)

9 ENDING A MEASUREMENT

9.1 Removing the test assembly after measurements with HFCT and/or TEV sensors

9.1.1 Removing the test assembly from live cables

DANGER

Danger due to electric voltage, flashovers at the connection point, or arcing fault on removing the connection

Danger to life or risk of injury due to electric shock, risk of electro-ophthalmia.

- Comply with EN 50110, EN 50191 or the applicable standards in your country as well as the relevant national and local accident prevention regulations for carrying out tasks in the vicinity of live parts.
- Use suitable personal protective equipment against electric shocks and arcing faults.
- Ensure that adjacent live parts are protected against accidental contact and flashovers by suitable covers or barriers.
- Maintain safety distances. Safety distances depend on the voltage level, plant model, personnel qualification and available space (EN 50110).

1. Exit all open programs on the liona.
2. Shut down and switch off the laptop.
3. Switch off the liona using the On/Off switch.
4. Remove all cables that are connected to the connection panel of the liona.
5. Remove all sensors from the test object.

If a sync transmitter is connected

- Switch off the sync transmitter using the On/Off switch and remove it from the test object.

If an iPD transponder is connected

a. Switch off the iPD using the *OUTPUT PULSE VOLTAGE* rotary switch and disconnect the sensor.
b. Remove the protective earthing cable from the iPD.

6. Remove the protective earthing cable from the liona.

9.1.2 Removing the test assembly from de-energised cables

1. Exit all open programs on the liona.
2. Shut down and switch off the laptop.
3. Switch off the liona using the On/Off switch.
4. Remove all cables that are connected to the connection panel of the liona.
5. Remove all sensors from the test object.

If a sync transmitter is connected

- Switch off the sync transmitter using the On/Off switch and remove it from the test object.

If an iPD transponder is connected

a. Switch off the iPD using the *OUTPUT PULSE VOLTAGE* rotary switch and disconnect the sensor.
b. Remove the protective earthing cable from the iPD.

6. Remove the protective earthing cable from the liona.

9.2 Removing the test assembly after measurements with the VDS-C

1. If safe access to the connection points is not assured, de-energise the switchgear in order to remove the adapters for HR, MR, and LRM systems.
   a. Disconnect the test object.
   b. Secure against re-connection.
   c. Verify absence of operating voltage.
   d. Earth and short all phases.
   e. Provide protection against adjacent live parts.
2. Exit all open programs on the liona.
3. Shut down and switch off the laptop.
4. Switch off the liona using the On/Off switch.
5. Switch off the VDS-C using the On/Off button.
6. Remove the adapters from the VDS ports of the test object.
7. Remove all connection cables from the VDS-C and the adapters.
8. Remove all cables that are connected to the connection panel of the liona.
9. Remove the protective earthing cable from the liona.

10 MAINTENANCE

NOTICE

Damage to device due to improper handling

The user is liable for damages caused due to improper maintenance or care.

- Never take apart the device. This can lead to device damages. Inside the device there are no components that could be serviced or repaired by the user.
- Maintenance tasks must be carried out only by personnel trained and authorised by BAUR

10.1 Maintenance intervals

Component	Interval	Maintenance work
General maintenance tasks	Before each use	Check the devices and connection cables for physical damage
	After each use	Clean the devices and connection cables and check for physical damage
liona	Every 24 months by BAUR After Sales Service	Calibrate the device
	Every 6 months and as required	Charging the rechargeable battery
	As required by BAUR After Sales Service	Replace the battery
Laptop	As required	Clean the display
Sync transmitter	As required	Replacing the batteries
VDS-C	Every 3 months and as required	Charging the batteries
	As required by BAUR After Sales Service	Replace the batteries

1. Switch off the device before starting any maintenance tasks.
2. To disconnect the device completely from the supply voltage, pull out the mains plug.

10.2 Cleaning

NOTICE

Damage to the device may be caused by using the wrong cleaning agents

- Do not use any abrasive, corrosive cleaning agents or strong solvents.
- Ensure material compatibility.
- Do not clean the product with acetone or thinner.
- Never clean electrical devices with water.

Required equipment

- Mild detergent for cleaning the surfaces of the device
- Lint-free cleaning cloth

Cleaning the display

- Clean the displays with a dry or slightly damp lint-free cloth.

Cleaning the device surfaces and connection cable

1. Clean the device surfaces and connection cable with mild detergent and a lint-free cloth.
2. *NOTICE!* Damage to device due to leaking fluids. Do not allow liquids to leak into devices.

   Note that the splashproof protection is guaranteed only when the device is in a closed state.

10.3 Calibration intervals

We recommend that you have the liona calibrated every 24 months.

- For the calibration of the liona, please contact BAUR GmbH or your BAUR representative (http://www.baur.eu/baur-worldwide)

10.4 Charging the liona battery

The battery starts charging as soon as the liona is connected to the mains.

- Connect liona with a mains connection cable to the mains voltage. If necessary, use a country-specific adapter.

  The LED lights up.

  - red - battery is charging
  - green - battery is fully charged

10.5 Replacing the liona battery

The liona battery may only be replaced by BAUR After Sales Service.

- Contact BAUR After Sales Service.

10.6 Replacing the batteries of the sync transmitter

NOTICE
Material damage may be caused by wrong polarity of rechargeable or non-rechargeable batteries Wrong polarity of rechargeable or non-rechargeable batteries can destroy the electronics. - While inserting batteries, pay attention to the polarity of the rechargeable or non-rechargeable batteries.

Required equipment

Battery type: 1.5 V, IEC LR6, 2 pcs

Procedure

1. Switch off the sync transmitter using the On/Off switch.
2. Remove the sync transmitter from the flexible protective sheath.
3. Open the battery compartment on the back.
4. Remove the old batteries/rechargeable batteries.
5. Insert new batteries/rechargeable batteries.
6. Close the battery compartment.

7. Insert the sync transmitter into the flexible protective sheath.
8. Dispose off the old rechargeable or non-rechargeable batteries in compliance with the local regulations.

10.7 Charging the batteries of the VDS-C

- Connect the supplied charger to the mains voltage and to charger socket ⎓ *5 V* of the VDS-C.

  The VDS-C switches on automatically. The batteries are charged. The battery charge status is displayed. When all of the LEDs are illuminated, the rechargeable batteries are fully charged.

Notes:

- As soon as the charger is removed from charger socket ⎓ *5 V*, the VDS-C automatically switches off.
- If the On/Off button is pressed during the charging process, the VDS-C remains switched on, even if the charger is removed from charger socket ⎓ *5 V*.

10.8 Replacing the VDS-C batteries

The VDS-C batteries may only be replaced by BAUR After Sales Service.

- Contact BAUR After Sales Service.

11 FAULTS AND ERROR MESSAGES

NOTICE

Damage to device due to improper handling

The user is liable for damages caused due to repairs.

- Never take apart the device. This can lead to device damages. Inside the device there are no components that could be serviced or repaired by the user.
- Repairs must be carried out only by personnel trained and authorised by BAUR.

1. In the event of damage and malfunction, stop the device immediately.
2. Mark the faulty device accordingly.
3. Have the faults rectified by appropriately qualified personnel authorised by BAUR.

Error messages

When an error message appears, proceed as follows:

1. Check the supply voltage and connection and earth cables.
2. Check the charge status of the batteries.
3. If you are prompted to restart the device, restart the device.
4. If the error occurs again after device restart, contact your nearest BAUR representative (http://www.baur.eu/baur-worldwide).

   Specify the following data:

   - Serial number
   - Firmware or software version
   - Message on display
   - Procedure that caused the error.

11.1 Overheating of VDS-C batteries during charging

If the batteries of the VDS-C are too hot, all four of the battery level indication LEDs flash and the VDS-C automatically switches off.

1. Disconnect the VDS-C from the supply voltage and wait until the batteries have cooled down.

   This can take a few minutes.
2. Restart the charging process. While charging the batteries, ensure that the ambient conditions specified in the VDS-C technical data are maintained.

   Further information: Chapter *Data sheet* (on page 99)
3. If the fault reoccurs, contact BAUR After Sales Service.

12 TRANSPORTATION AND STORAGE

NOTICE

Damage to device due to incorrect transportation and improper storage

- Always transport and store the device with the lid closed.
- Always transport and store the accessories of the device in the cable compartment intended for this purpose.
- Always transport and store the device and its accessories horizontally.
- Protect the device and its accessories against strong vibrations, moisture, and unauthorised access.
- Comply with the ambient conditions specified in the technical data.

  Further information: Chapter *Data sheet* (on page 99)

NOTICE

Damage to the rechargeable or non-rechargeable batteries due to improper storage

The rechargeable batteries used for the liona and VDS-C are protected against deep discharge and overcharge. However, during longer periods of storage, the rechargeable batteries may still discharge themselves, e.g. due to weak leakage currents.

To prevent the rechargeable batteries from discharging themselves, they must be charged fully:

- **liona:** Every 6 months

  Further information: Chapter *Charging the liona battery* (on page 79)

- **VDS-C:** Every 3 months

  Important: The rechargeable batteries of the VDS-C must always be fully charged before storage.

  Further information: Chapter *Charging the batteries of the VDS-C* (on page 80)

13 Warranty and After Sales

Warranty

For warranty claims, please contact BAUR GmbH or your local BAUR representative. Improper use will render the warranty null and void. Wear parts are excluded from the warranty.

After Sales

For questions contact BAUR GmbH or your BAUR representative.

BAUR GmbH

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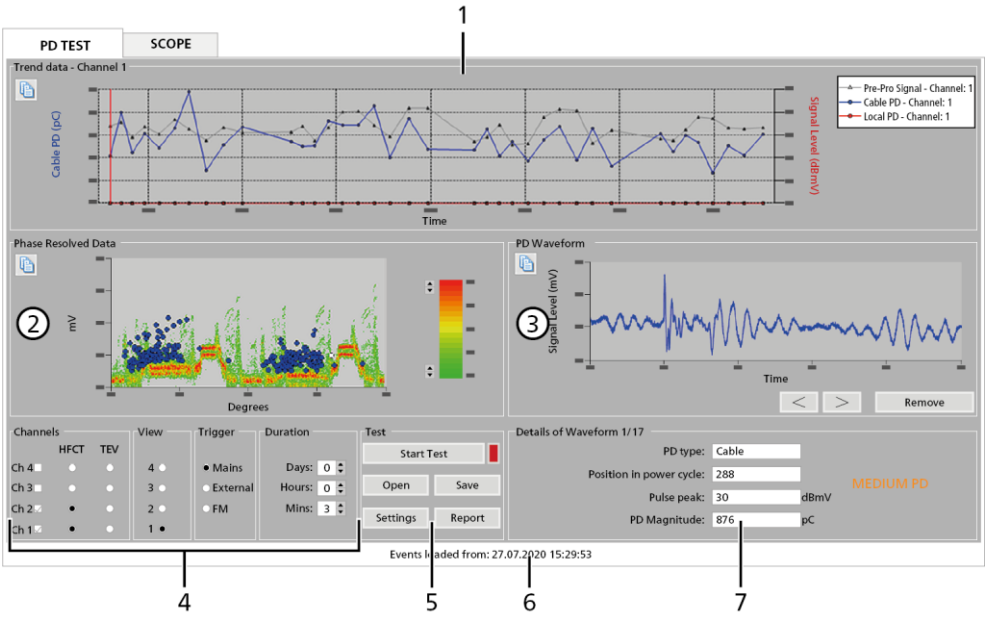
6832 Sulz / Austria
service@baur.eu
https://www.baur.eu

14 DESCRIPTION OF SOFTWARE USER INTERFACES

14.1 PD TEST tab

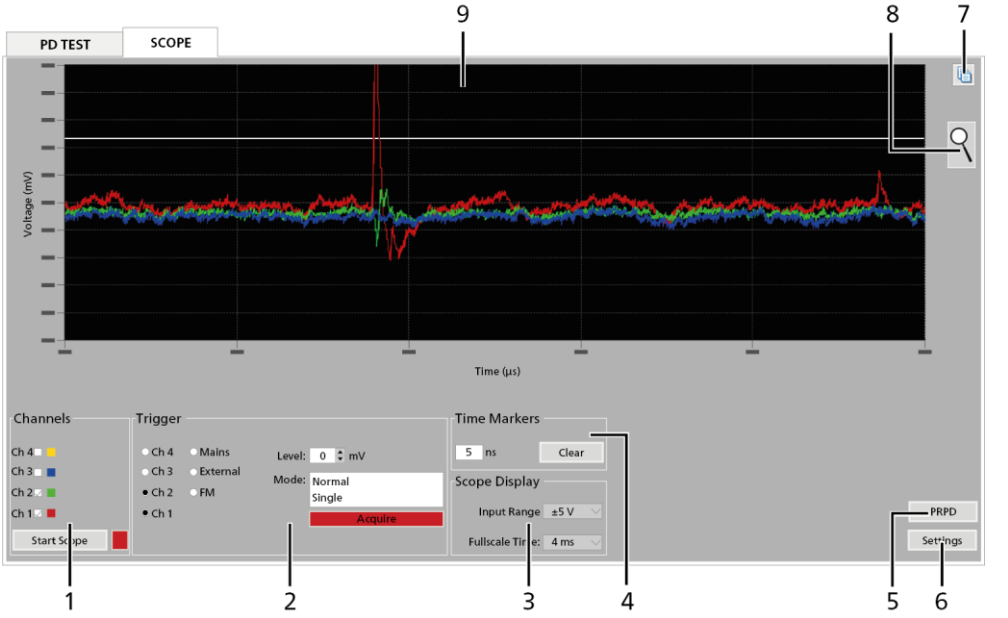


No.	Element	Function
1	***Trend Data*** area	Shows the data recorded for the selected input channel Further information: Chapter *Display of trend data* (on page 64)
2	***Phase Resolved Data*** area	Shows the phase-resolved PD presentation of the recorded partial discharges for the selected input channel Further information: Chapter *Phase-resolved PD presentation (PRPD)* (on page 65)

No.	Element	Function
3	***PD Waveform*** area	Shows the signal curve of the partial discharge that is selected in the ***Phase Resolved Data*** area Further information: Chapter *Display of PD waveform and the waveform details* (on page 68)
4	Settings for the measurement	Are used for setting the parameters for the measurement Further information: Chapter *Setting parameters for PD testing* (on page 59)
5	***Test*** area	▪ ***Start Test*** / ***Stop Test***: Is used to start and end the measurement The display field shows whether a measurement is running (green) or not (red). ▪ ***Open***: Opens the dialog to load saved measurement data ▪ ***Save***: Opens the dialog to save the current measurement data ▪ ***Settings***: Opens the dialog for setting the phase-resolved PD presentation and defining the DeCIFer® algorithm Further information: Chapter *Settings for PRPD and DeCIFer® algorithm* (on page 61) ▪ ***Report***: Opens the dialog to create a measurement report
6	Information bar	Is used to display information on the recorded data
7	***Details of Waveform*** area	Shows additional information for a partial discharge selected in the ***PD Waveform*** area Further information: Chapter *Display of PD waveform and the waveform details* (on page 68)

14.2 Scope tab

14.2.1 Scope display

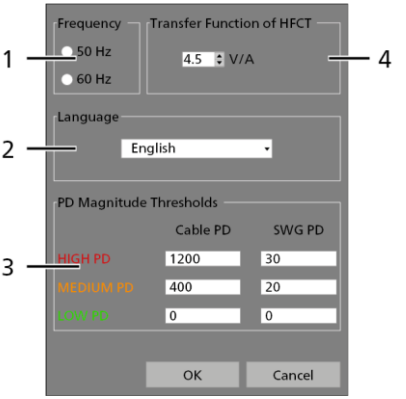


No.	Element	Function
1	***Channels*** area	▪ ***Ch 1*** – ***Ch 4***: Is used to enable and disable the input channels to be displayed The signal curves of the input channels are colour coded in the Scope display. The colour code is visible next to the channel. ▪ ***Start Scope*** / ***Stop Scope*** button: Is used to start and end the measurement

No.	Element	Function
2	***Trigger*** area	Is used to set the synchronisation source, the trigger level, and the measurement mode Further information: Chapter *Setting the parameters for the "Scope" mode* (on page 51)
3	***Scope Display*** area	Is used to set the x- and y-axes of the Scope display Further information: Chapter *Setting the parameters for the "Scope" mode* (on page 51)
4	***Time Markers*** area	Shows the time between the two time markers
5	***PRPD*** button	Is used to switch from Scope display to PRPD display
6	***Settings*** button	Opens the dialog for configuring the general settings Further information: Chapter *Configuring the "Spot Tester" software* (on page 49)
7	 button	Creates a screenshot of the current measurement results display The screenshot is stored in the clipboard. ▸ To insert the screenshot in a text editing program (e.g. *Microsoft Word*), open the program and press the key combination *Ctrl + V*.
8	 button	Allows you to zoom in on an area of the display **Zooming in on an area of the display** 1. Click the  button. The background of the button turns green; the Zoom function is active. 2. Drag an area of the measurement results display with the left mouse button. The selected area is enlarged. 3. To reset the display, right-click in the display. 4. To disable the Zoom function, click the  button. The background of the button turns grey and the Zoom function is deactivated.

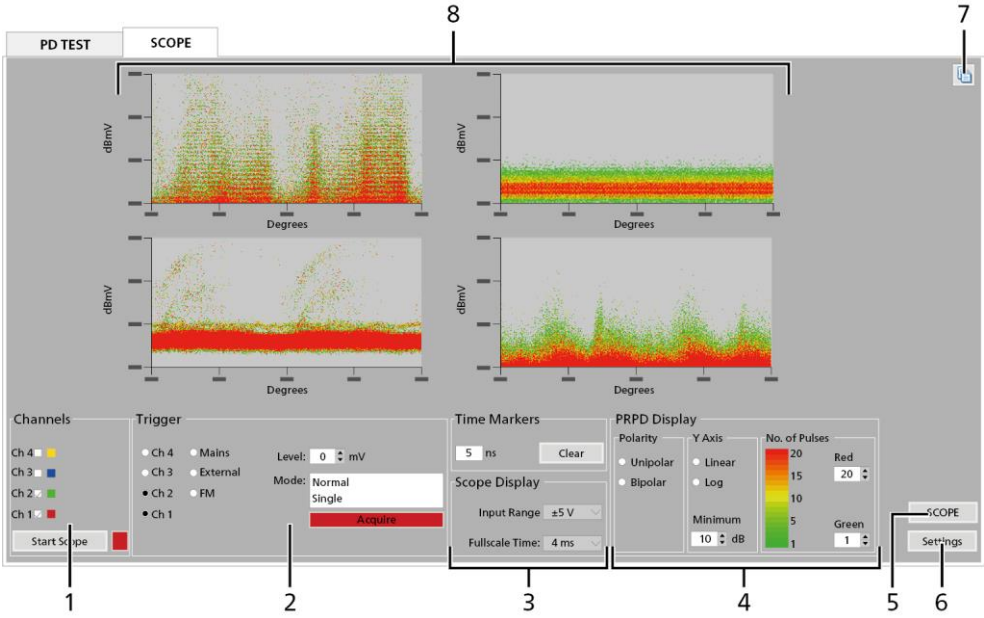
No.	Element	Function
9	Measurement results	Displays the analogue signal of each channel enabled in the ***Channels*** area You can place two markers in the display to calculate a time range more precisely. **Setting the time markers** 1. Ensure that the Zoom function is deactivated (button is grey) 2. Left-click in the Scope display. The first time marker is set. 3. Right-click in the Scope display. The second time difference between the two cursors is displayed.

Scope > Settings



No.	Element	Function
1	***Frequency*** area	Is used to select the frequency of the test object
2	***Language*** area	Is used to select the language of the user interface The software restarts automatically once the language has been changed.
3	***PD Magnitude Thresholds*** area	Is used to set the PD threshold values for cables (***Cable PD***) and switchgear (***SWG PD***) These threshold values are used to classify the partial discharges as strong, medium or weak. The following standard values are stored: ▪ ***HIGH PD*** ***Cable PD***: 1,200 pC / ***SWG PD***: 30 pC ▪ ***MEDIUM PD*** ***Cable PD***: 400 pC / ***SWG PD***: 20 pC ▪ ***LOW PD*** ***Cable PD***: 0 pC / ***SWG PD***: 0 pC
4	***Transfer Function of HFCT*** area	Is used to set the transfer function according to the sensitivity of the HFCT sensors The transfer function relates to the response characteristic of the HFCT sensor at the frequencies relevant for the PD detection.

14.2.2 PRPD display



No.	Element	Function
1	***Channels*** area	▪ ***Ch 1*** – ***Ch 4***: Is used to enable and disable the input channels to be displayed ▪ ***Start Scope*** / ***Stop Scope*** button: Is used to start and end the measurement
2	***Trigger*** area	Is used to set the synchronisation source, the trigger level, and the measurement mode Further information: Chapter *Setting the parameters for the "Scope" mode* (on page 51)
3	Areas ***Time Markers*** and ***Scope Display***	Is used to set and display data from the Scope display Further information: Chapter *Scope display* (on page 86)

No.	Element	Function
4	***PRPD Display*** area	Is used to set the PRPD display Further information: Chapter *Setting the parameters for the "Scope" mode* (on page 51)
5	***SCOPE*** button	Is used to switch from PRPD display to Scope display
6	***Settings*** button	Opens the dialog for configuring the general settings Further information: Chapter *Configuring the "Spot Tester" software* (on page 49)
7	 button	Creates a screenshot of the current measurement results display The screenshot is stored in the clipboard. ▸ To insert the screenshot in a text editing program (e.g. *Microsoft Word*), open the program and press the key combination *Ctrl + V*.
8	Measurement results	Shows the PD signals for each selected channel that have been recorded and synchronised according to the set synchronisation source Examples of PD patterns can be found in Chapter *PRPD display* (on page 55).

In the PRPD display, you cannot zoom into or out of the individual signals.

15 DECLARATIONS OF CONFORMITY

15.1 Declaration of conformity for the liona and the iPD transponder

We

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declare, under our sole responsibility, that the BAUR product

liona & iPD online PD spot tester & transponder

to which this declaration refers, conforms to the following standards or standard documents:

- Low Voltage Directive 2014/35/EC
  EN 61010-1:2010
- EMC Directive 2014/30/EU
  EN 55011:2009 + A1:2010
  EN 61000-3-2:2014
  EN 61000-4-2:2009
  EN 61000-4-4:2012
  EN 61000-4-5:2014
  EN 61000-4-11:2004

Signed: Torsten Berth, Technical Director

Dr. Eberhard Paulus, Director QM/QS

Sulz, 07/10/2015

15.2 Declaration of conformity for the VDS-C VDS PD coupler

We

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https://www.baur.eu

declare, under our sole responsibility, that the BAUR product

BAUR VDS-C VDS PD coupler

to which this declaration refers, conforms to the following standards or standard documents:

- Low Voltage Directive 2014/35/EC
  EN 61010-1:2010
- EMC Directive 2014/30/EU
  EN 55011:2009 + A1:2010
  EN 61000-3-2:2014
  EN 61000-4-2:2009
  EN 61000-4-4:2012
  EN 61000-4-5:2014
  EN 61000-4-11:2004
- Environmental testing
  EN 60068-2-ff

Signed: Dr. Markus Baur, CEO

Sulz, 10/07/2023

16 GLOSSARY

Amplitude-modulated noise signals

Amplitude-modulated noise signals can occur in some circuits, e.g. due to signals from radio stations. They are seen as repetitive carrier waves with a fixed frequency. In rare cases, these noise signals can show the same frequency as the partial discharges. In connection with other noise signals, this could influence the DeCIFer® algorithm and result in misclassification of the partial discharges.

DeCIFer® algorithm

The PD pulses are detected and quantified with the DeCIFer® algorithm.

HFCT sensor

The HFCT sensor is a High Frequency Current Transformer. It consists of a split ferrite core allowing the sensor to be placed around a cable earth. An aluminium housing enables a RF screen and better output in surroundings with high noise levels.

Overdrive (clipping)

When signals are applied to input channels that are located outside the permitted input range of the channels, it is called overdrive. Normally, input signals that are outside the permitted range are cut off.

Switchgear PD (local PD)

Switchgear PDs are partial discharges that occur close to the sensor. They are also called local partial discharges.

TEV sensor

The TEV sensor is a capacitively coupled sensor for recording transient earth voltages. The sensor is attached with built in magnets to the metal housing of a switchgear.

Transient Earth Voltage (TEV)

Transient earth voltages are small voltage pulses that are induced into the metal housing surfaces of switchgears through partial discharges.

The transient earth voltages can be recorded with the help of capacitive coupled sensors.

VDS-C VDS PD coupler

The VDS-C VDS PD coupler is used to connect the liona to the VDS ports of the switchgear. The standard delivery therefore includes adapters for HR, MR, or LRM systems (as selected). The adapters for HR and MR systems comply with standard IEC 61243-5; the adapter for LRM systems complies with standards IEC 61243-5 and IEC 62271-213:2021.

Depending on the design and local conditions of the switchgear, it may be necessary to take the test object out of operation in order to connect the liona with HFCT or TEV sensors. In contrast, when connecting the VDS-C to the VDS ports, the test object must not be taken out of operation.

Voltage Detection System (VDS)

Voltage Detection System, VDS

The voltage detection system indicates whether the phase of the switchgear is live. Depending on the design, additional information can be displayed, e.g. the presence of potential partial discharges.

17 INDEX

liona

BAUR online PD spot tester

Figure: liona incl. VDS-C VDS PD coupler and the optionally available iPD transponder

Reliable, cost saving, easy to use

- Online PD testing of cable routes during normal cable network operation
- Automatic evaluation of the PD: no expert knowledge necessary
- Unique new technology based on artificial reflections for online PD mapping
- Detection of faraway PD by means of patented frequency response modification with VDS PD coupler

liona is a portable online PD spot tester for measuring and locating partial discharges in cables and switchgear during normal mains operation.

liona lets you test cable systems and switchgear online without switching off partial discharge activities, and then generate trend analyses. Even a PD spot test (duration: 2 – 3 minutes) is capable of reliably assessing the current status of your system. This keeps you constantly informed of when in it necessary to intervene and further maintenance is required, e.g. comprehensive offline diagnostic measurements.

Using the DeCIFer® algorithm, the core of the software, the unit is able to clearly differentiate between noise signals and partial discharges. liona therefore provides meaningful results even in environments with high noise levels.

With the iPD transponder – available as an optional extra – it is possible to precisely locate partial discharges and determine the cable length.

NEW:

PD testing via VDS ports without taking critical cable routes out of operation

Functions and features

liona

- Easy and fast performance of an online PD test for inspecting the cable route for partial discharges (in just 2-3 minutes)
- Automatic partial discharge detection with the DeCIFer® algorithm
- Online PD testing possible even with high noise levels
- Can be used on medium- and high-voltage cables
- Continuous monitoring of a cable route for PD activity for up to 30 days
- 24-hour commissioning testing acc. to IEC 60840
- Regular PD monitoring of critical cable routes (e.g. industrial assets) by permanently installed sensors
- Simultaneous evaluation of 4 measurement channels
- Compact and light equipment that is easy to transport
- Measurements also possible without mains supply in battery mode
- VDS PD coupler for connection to the switchgear VDS ports during operation acc. to IEC 61243-5 (LRM, MR, and HR systems) and IEC 62271-213:2021 (LRM systems)

liona and iPD

- Online cable length measurement for medium- and high-voltage cables
- Automatic, precise online PD mapping thanks to the DeCIFer® algorithm and a new technology based on artificial reflections
- Length measurement also possible on cables with cross-bonding joints
- Simple application thanks to the special, automatic AUTO SWEEP trigger mode
- Measurements also possible without mains supply in battery mode

„Required equipment for the available measurement methods“ on page 4

Technical data

liona	
Measurement range for cable PD	5 pC – 1,000 nC
No. of signal inputs	4
Overvoltage protection	Up to 500 V
Sampling rate	100 MSamples/s
Resolution	14 bit
Analogue input voltage range	±1.0 V (Resolution 61 µV)
Data interface	USB 2.0, Ethernet
Power supply	
Mains voltage	100 – 240 V, 50/60 Hz
Rechargeable battery	Lithium-polymer battery, DC 12 V, 8 Ah, 96 Wh
Battery life	Min. 3 hours
Degree of protection	IP67 in closed state
Dimensions (W x H x D)	Approx. 550 x 350 x 225 mm
Weight	Approx. 13.5 kg
Ambient temperature (operational)	-10°C to +45°C
Storage temperature	-20°C to +60°C
Humidity	≤ 90%, non-condensing
Safety and EMC	CE-compliant in accordance with Low Voltage Directive (2014/35/EU) and EMC Directive (2014/30/EU)
liona software	
Software modules*	▪ Spot Tester: Is used for PD measurement ▪ Mapping: Is used for PD mapping ▪ Cable Length: Is used to measure the cable length
Operating modes of the Spot Tester software module	▪ PD TEST: used for routine and repetitive testing ▪ Scope: used for in-depth investigation
PD analysis	▪ PRPD (PD pattern analysis) ▪ Waveform (analysis of individual PD pulses)
Noise separation and PD classification**	DeCIFer® algorithm
Reporting	On screen, PDF
Software available in	English, German, Chinese, French, Portuguese, Russian, Spanish

"VDS PD coupler" set	
VDS-C VDS PD coupler	
No. of signal inputs	3
No. of signal outputs	▪ 3 x voltage signal ▪ 1 x synchronisation signal for liona
Frequency range	▪ Voltage signals: 100 kHz – 10 MHz ▪ Synchronisation signal: 47 – 63 Hz (depending on the test object)
Adapters for switchgear VDS ports	Adapter for: ▪ HR systems acc. to IEC 61243-5 ▪ MR systems acc. to IEC 61243-5 ▪ LRM systems acc. to IEC 61243-5 and IEC 62271-213:2021
Rechargeable battery	▪ 2 x lithium-ion battery, 3.7 V, 2,600 mAh, 19.2 Wh (total) ▪ Overtemperature protection (NTC), protection against deep discharge and overcharging
Battery life	Approx. 24 h
Charging time	Approx. 6 h
Charger socket	USB (type C plug)
Degree of protection	IP40
Dimensions (W x H x D)	Approx. 120 x 150 x 50 mm
Safety and EMC	CE-compliant in accordance with Low Voltage Directive (2014/35/EU), EMC Directive (2014/30/EU), and EN 60068-2-ff Environmental testing
Charger	
Power supply	100 – 240 V, 50/60 Hz
Charging voltage	5 V ± 5%
Charging current	2,200 mA
General	
Degree of protection (transport case)	IP67 in closed state
Transport case dimensions (W x H x D)	Approx. 470 x 176 x 357 mm
Weight (total)	Approx. 5.5 kg
Ambient temperature (operational)	-10°C to +45°C
Storage temperature	-20°C to +60°C
Humidity	≤ 90%, non-condensing

* „Required equipment for the available measurement methods" on page 4

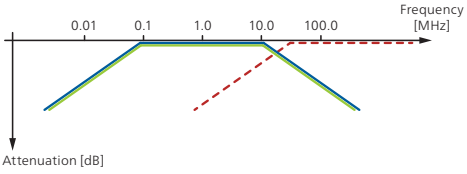
** In general, very high noise levels and interference in the PD frequency range can result in some limitations during PD testing.

Technical data – continued

HFCT set	
HFCT sensor 100/50	
Frequency range	60 kHz – 70 MHz
Diameter	Internal: 48 mm, external: 107 mm
HFCT sensor 140/100	
Frequency range	50 kHz – 80 MHz
Diameter	Internal: 96 mm, external: 150 mm
TEV sensor	
Frequency range	5 – 80 MHz
Dimensions (Diameter x H x D)	Approx. 68 x 78 x 27 mm
Sync transmitter	
Batteries	2 x alkaline batteries 1.5 V IEC LR6
Dimensions (W x H x D)	Approx. 75 x 200 x 45 mm
General	
Degree of protection (transport case)	IP67 in closed state
Transport case dimensions (W x H x D)	Approx. 295 x 146 x 347 mm
Weight (total)	Approx. 6.5 kg

iPD transponder (optional for PD mapping, cable length measurement)	
Pulse voltage	Max. 500 V
Trigger modes	▪ AUTO SWEEP ▪ LEVEL TRIGGER
Delay of the artificial reflection	▪ 10 µs ▪ 100 µs (for cable <800 m)
Power supply	
Mains voltage	100 – 240 V, 50/60 Hz
Rechargeable battery	Lithium-polymer battery, DC 12 V, 4 Ah, 48 Wh
Battery life	Approx. 15 h
Charging time	Approx. 4 h
Degree of protection	IP67 in closed state
Dimensions (W x H x D)	Approx. 295 x 146 x 347 mm
Weight (total)	Approx. 6 kg
Ambient temperature (operational)	-10°C to +45°C
Storage temperature	-20°C to +60°C
Humidity	≤ 90%, non-condensing
Safety and EMC	CE-compliant in accordance with Low Voltage Directive (2014/35/EU) and EMC Directive (2014/30/EU)

Frequency response modification with VDS-C



Frequency response of liona connected directly to the VDS ports of the switching station

Frequency response of liona with VDS-C connected to the VDS ports of the switching station

Frequency response of liona with HFCT sensors

The further away the partial discharges are from the liona online PD spot tester, the more strongly the PD pulse is damped. This causes the PD pulse to lose the high frequency components.

When liona is connected directly to the switchgear VDS ports (red line), the high-pass characteristic of the PD measurement setup prevents the detection of partial discharges that are far away.

However, when liona is connected to the VDS ports with the VDS-C VDS PD coupler, the signals of partial discharges that are a kilometre away can also be evaluated by modifying the frequency response.

The graphic serves as an example and is used to illustrate the principle of frequency response modification.

Required equipment for the available measurement methods

Measurement method	Required equipment			
	liona	"VDS PD coupler" set	HFCT set	iPD transponder (option)
PD measurement				
Connection to the switchgear VDS ports	✓	✓	–	–
Direct connection to the test object	✓	–	✓	–
PD mapping	✓	–	✓	✓
Measurement of cable length	✓	–	✓	✓

Standard delivery

- liona online PD spot tester, incl.:
  - Laptop acc. to quotation with installed liona software
  - User manual
  - Pocket guide (PDF)
- Connection set as selected, see below

Accessories and options

- iPD transponder, incl.
  - BNC cable, 4 m
  - Inductive HFCT sensor 100/50 mm
  - Earth cable, 2 m, with earth terminal
  - Mains supply cord, 2.5 m
  - User manual
- "VDS PD coupler" set in transport case
- HFCT set in transport case
- Inductive HFCT sensor 100/50 mm
- Inductive HFCT sensor 140/100 mm
- Capacitive TEV sensor
- Adapter for HR systems acc. to IEC 61243-5
- Adapter for MR systems acc. to IEC 61243-5
- Adapter for LRM systems acc. to IEC 61243-5 and IEC 62271-213:2021

Selectable connection sets

"VDS PD coupler" set in transport case, incl.:

- VDS-C VDS PD coupler
- USB charger incl. country-specific adapter
- USB charging cable, 1 m
- BNC cable, 0.5 m, 3 pcs, colours: red, yellow, blue
- BNC cable, 3 m, 4 pcs, colours: red, yellow, blue, black
- Connection cable for LRM systems acc. to IEC 62271-213:2021, 20 cm, 3 pcs
- Adapter for HR or MR systems acc. to IEC 61243-5 or for LRM systems acc. to IEC 61243-5 and IEC 62271-213:2021, 3 pcs (freely selectable)
- Earth cable, 5 m, with earth terminal
- Mains supply cord, 2.5 m

HFCT set in transport case, incl.:

- Inductive HFCT sensor 100/50 mm, 3 pcs
- Inductive HFCT sensor 140/100 mm
- Capacitive TEV sensor, 2 pcs
- BNC cable, 1.5 m, 3 pcs
- BNC cable, 4 m, 3 pcs
- BNC connector, 10 pcs
- Sync transmitter incl. batteries
- Earth cable, 2 m, with earth terminal
- Mains supply cord, 2.5 m

Would you like to discover more about this product?
If so, contact us: www.baur.eu > BAUR worldwide

Data sheet: BAUR GmbH · 826-102-5 · 09.2023 · Subject to modifications

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