DuoXpert
LB 473 Level Switch

Operating Manual

56925-3BA2 Rev.00 07/2024
Embedded software of EVU as of version 1.7.0 (CU and MU)

BERTHOLD

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Operating Manual

1 About this Operating Manual

1.1 Applicable Documents

This manual contains the following documents:

- Technical Information, 56925TI2LS (see appendix)
- Informations sur la sécurité, 56925BA59 (see appendix)

This operating manual does not contain the information required for intrinsically safe operation. The following document must be used for this purpose:

- Safety Manual / Explosion Protection Manual LB 47x Ex-i (ATEX / IECEx), 56925BA26

1.2 Some Prior Remarks

The product is handed over to you by the manufacturer BERTHOLD TECHNOLOGIES GmbH & Co. KG (designated as Berthold in the following) in a complete and functionally reliable condition.

This operating manual illustrates how to:

- set up/install the product,
- make electrical connections,
- perform measurements,
- apply software settings,
- Install the extension module (optional),
- carry out maintenance on the product,
- fix errors,
- disassemble the product,
- and dispose of the product.

Read these instructions thoroughly and completely before working with the product. We have tried to compile all information for safe and proper operation for you. However, should questions arise which are not answered in this operating manual, please refer to Berthold.

1.3 Storage Place

This operating manual as well as all product-related documentation relevant to the respective application must be accessible at all times.

1.4 Target Group

This operating manual is directed at qualified specialist personnel who are familiar with handling electrical and electronic assemblies as well as with communication and measuring techniques.

Specialist personnel refers to those who can assess the work assigned to them and recognize possible dangers through their specialist training, knowledge and experience as well as knowledge of the relevant regulations.

1.5 Validity of the Operating Manual

The operating manual is valid from the delivery of the Berthold product to the user until its disposal. Version and release date of this operating manual can be found in the bottom of each page. Modification services are not performed by the manufacturer Berthold.

The manufacturer reserves the right to make changes to this operating manual at any time without stating reasons.

IMPORTANT

Intrinsically safe operation

This operating manual does not contain the information required for intrinsically safe operation. The safety manual 56925BA26 must be used for this purpose.

The current revision of this operating manual replaces all previous revisions.

1.6 Structure of the Operating Manual

This operating manual has been divided into chapters. The series of chapters should help you to familiarize yourself quickly and properly with the operation of the product.

1.7 Copyright

1.8 Representation

Identifier	Meaning	Example
Quotation mark	Field in the software user interface	"Calibrate"
Vertical line	Path specification	Settings | Selection
Pointed brackets	Keys and buttons	<Update>
Round brackets	Image reference	Connect the plug (fig. 1, item 1)

In the software description, the term "clicking" is used if a process is to be activated. This also refers to the pressing of a button or an area on the touch display if a mouse is not used for control.

1.9 Warning Notes

Warning notes are designed as follows:

Signal Word

Source and consequence
Explanation, if required
▶ Prevention
In case of emergency

- **Warning symbols:** (warning triangle) draws attention to the hazard.
- **Signal word:** Indicates the severity of danger.
- **Source:** Specifies the type or source of danger.
- **Consequence:** Describes the consequences of non-compliance.
- **Prevention:** Specifies how the hazard can be avoided.
- **In case of emergency:** Specifies which actions are required in the event of the occurrence of risk.

1.9.1 Symbols Used in the Operating Manual

In this manual, warning instructions before instructions for action refer to risks of injury or damage to property. The hazard-prevention measures described must be observed.

⚠ DANGER

Indicates an **imminent**, major hazard, which will certainly result in serious injuries or even death if the hazard is not avoided.

⚠ WARNING

Indicates a **potential** hazard, which can result in serious injuries or even death if the hazard is not avoided.

⚠ CAUTION

Refers to a **potentially dangerous** situation, which can result in medium or minor physical injuries or damages to property, if it is not avoided.

NOTICE

If this information is not observed, deterioration in the operation and/or property damage may occur.

IMPORTANT

Sections marked with this symbol point out important information on the product or on handling the product.

Tip

Provides tips on application and other useful information.

1.9.2 Symbols Used on the Device

Read the operating manual

Please observe the instructions in this operating manual.

Electrostatic discharge

Please note the handling instructions. Electrostatically endangered components. Please observe the instructions in this operating manual.

Protective earth connection

At this position, connect the protective earth conductor (PE).

Equipotential bonding connection

At this position, connect the equipotential bonding conductor.

Direct voltage

The device is operated with direct voltage and may only be connected with a direct voltage source.

Alternating voltage

The device is operated with alternating voltage and may only be connected with an alternating voltage source.

No domestic waste

The electric product must not be disposed of in domestic waste.

1.10 Conformity

The company Berthold hereby declares in its sole responsibility that the design of this product, which is brought to the market by Berthold, complies with relevant EU directives stated in the original declaration of conformity.

This statement shall become void in the case of changes not authorized by Berthold or improper use.

For the original declaration of conformity, please refer to Declaration of Conformity LB 47x in the document “Technical Information” (see appendix).

2 Safety

2.1 Dangers and Safety Measures

- Read these instructions thoroughly and completely before working with the product.
- Store the instructions where they are accessible for all users at all times.

2.2 Proper Use

The evaluation unit DuoXpert LB 473 (EVU) measures the limit level together with compatible detectors and an appropriate radiation source and may only be used for this purpose.

The following constitutes proper use:

- Adhering strictly to the instructions and operation sequences and not undertaking any different, unauthorized practices which could endanger your safety and the operational reliability of the EVU!
- Observing the given safety instructions!
- Carrying out the prescribed maintenance measures or having them carried out for you!
- Only use accessories and spare parts from Berthold.

Improper use to be prevented:

- Failing to observe the specified safety instructions and instructions for the operation, maintenance and disposal in the operating manual.
- Any non-compliance with the present operating manual for the supplied products.
- Applying conditions and requirements which do not conform to those stated in the technical documents, data sheets, operation manuals and assembly instructions and other specific guidelines of the manufacturer.
- Use of the product if parts of it are damaged or corroded. This also applies for seals and used cables.
- Restructuring or changing the system components.
- The evaluation unit is not suitable for use in potentially explosive areas and may therefore not be operated in such areas. The product is not explosion-proof.
- Operation ...
  - in a state where live parts are accessible.
  - in a wall housing with inadequately sealed glands and / or insufficiently tightened or damaged cable glands.
- Operation without the safety precautions provided by the manufacturer.
- Manipulation or avoidance of existing safety equipment.

Berthold shall only accept liability for / guarantee the correspondence of the device to its publicized specifications.

If the product is used in a way which is not described in the present operating manual, the device's protection is compromised and the warranty claim becomes invalid.

NOTICE

The device is not approved according to IEC 61508 “Functional safety of safety-related electric/electronic/programmable electronic systems”.

2.3 Qualification of the Personnel

NOTICE

A minimum requirement for all work on or with the product would be employees with general knowledge who are instructed by an expert or authorized person.

At different parts in this operating manual, reference is made to groups of people with certain qualifications who can be entrusted with different tasks during installation, operation and maintenance.

These three groups of people are:

- Employees with General Knowledge
- Experts
- Authorized Persons.

Employees with General Knowledge

NOTICE

Employees with general knowledge must always be guided by an expert at the very least. When dealing with radioactive substances, a radiation safety officer must also be consulted.

Employees with general knowledge are e.g. technicians, who can undertake different tasks during the transportation, assembly and installation of the product under the guidance of an authorized person. This can also refer to construction site personnel. The persons in question must have experience in handling the product.

Experts

Experts are persons who have sufficient knowledge in the required area due to their specialist training and who are familiar with the relevant national health and safety regulations, accident prevention regulations, guidelines and recognized technical rules.

Expert personnel must be capable of safely assessing the results of their work and they must be familiar with the content of this operating manual.

Authorized Persons

Authorized persons are those who are either designated for the corresponding task due to legal regulations or those who have been authorized by Berthold for particular tasks. When dealing with radioactive materials, a radiation safety officer must also be consulted.

2.4 Operator's Obligations

The operator of the product must regularly train his personnel in the following topics:

- Observation and use of the operating manual and the legal provisions.
- Intended operation of the product.
- Observation of the plant security instructions and the operating instructions of the operator.
- Regular monitoring/maintenance of the product.

3 System Description

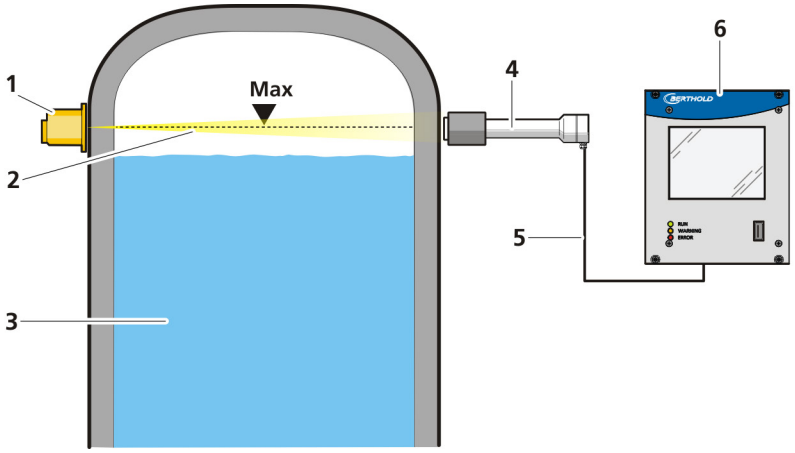
3.1 Overview

The level switch measuring device LB 473 is an industrial measuring system for the contactless determination of the limit level of a product in a vessel. The measuring system can be employed for the detection and indication of maximum levels (overflow protection) and minimum levels (protection against dry running).

A complete measuring system consists of the following components:

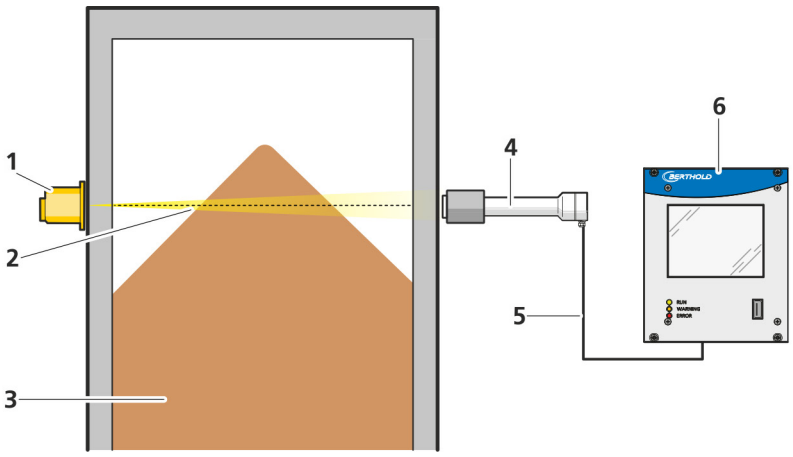
- Evaluation unit DuoXpert LB 473
- Source
- Shields
- Point detector / rod detector(s)

These instructions concern the operation of the evaluation unit DuoXpert LB 473. The operation of other system components is part of the independent instructions of the respective system components. The EVUs are standard equipment in switch rooms with 19" subracks or switchboards.



1 Point source shield with source inside
2 Radiation beam
3 Product
4 Point detector
5 Measurement line to EVU
6 EVU

Fig. 1 Example measurement arrangement



1 Point source shield with source inside
2 Radiation beam
3 Product
4 Point detector
5 Measurement line to EVU
6 EVU

Fig. 2 Example bulk cone measurement arrangement

The bulk cone measurement is a special case and is described in more detail in chapter 7.3.5 Level Switch.

3.2 Measuring Principle

The measuring device LB 473 is working on the basis of non-contact Gamma absorption measurement. The system can also be employed with heavy process conditions and aggressive media.

In order to obtain an optimum measurement effect at minimum source activity the best measurement geometry is calculated for the respective measuring point and the source is designed on the basis of this calculation.

The shielded radiation source (Fig. 1, item 1) is installed outside the container on the level to be measured. A detector (Fig. 1, item 4) is installed on the opposite side of the container. The evaluation unit (Fig. 1, item 6) is connected to the detector by a 2-wire line (Fig. 1, item 5). If the level of the medium inside the container comes up to the level of the detector or the source, the radiation is absorbed and the evaluation unit sends a corresponding signal.

Tip

Further information on the functional principle of the detectors and shields can be found in the respective operating manuals.

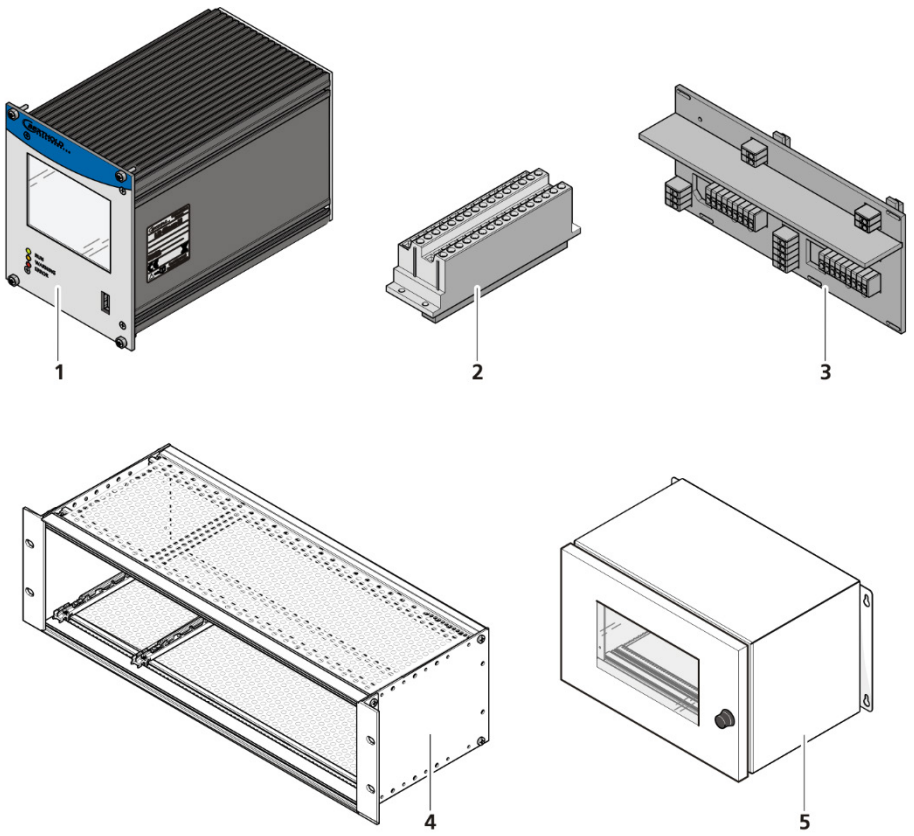
3.2.1 Safety Function

The safety function of the measuring system comprises the detection and indication of changes in the count rate of the detectors caused by the presence of product being measured in the measuring path between radiation source and measuring system.

The safe status is dependent on the mode of operation:

- Maximum level (overflow protection): Product between radiation source and detector → low count rate
- Minimum level (protection against running dry): No product between radiation source and detector → high count rate

3.3 System Components



1 Master-EVU with wide range supply (100-240 V AC, 50/60 Hz)
or Master-EVU with 24 V supply (18-32 V DC)
2 Clamp block for electrical connections (optional)
3 Backplane Master-Master (optional)
4 19" subrack (optional)
5 Wall housing (optional)

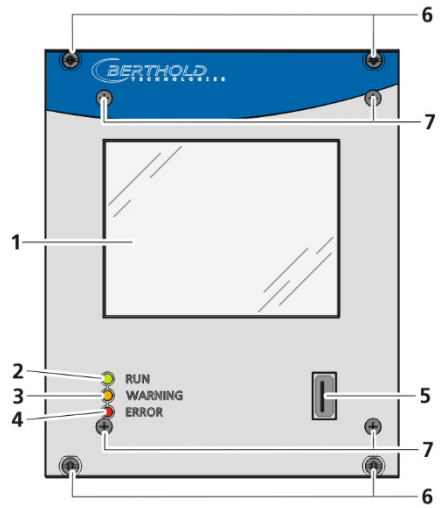
Fig. 3 System components

3.3.1 Software

The EVU is delivered with pre-installed software. The revision status (version) of the software can be seen on the screen display when starting up the EVU or in the menu "Device information" (Chapter 7.1.2).

This operating manual describes the software version 1.7.0 (Control Unit / CU) and 1.7.0 (Measurement Unit / MU) and the following versions.

3.3.2 Master EVU



1	3.5'' touchscreen	6	Mounting screws
2	RUN LED	7	Screws front plate
3	WARNING LED	8	Master/Slave 4-pin connector (not used with LB 473)
4	ERROR LED	9	RJ45 socket for Ethernet
5	USB port	10	32-pin plug connector

Fig. 4 Front/rear view of the master EVU

Operation Display / Touchscreen

The EVU is operated via the touchscreen. Alternatively, the device can be connected to a mouse at the USB port. The device can also be operated by remote control (see chap. 7.3.1).

NOTICE

Damage to the touchscreen

Pointed or sharp objects can damage the plastic surface of the touchscreen.

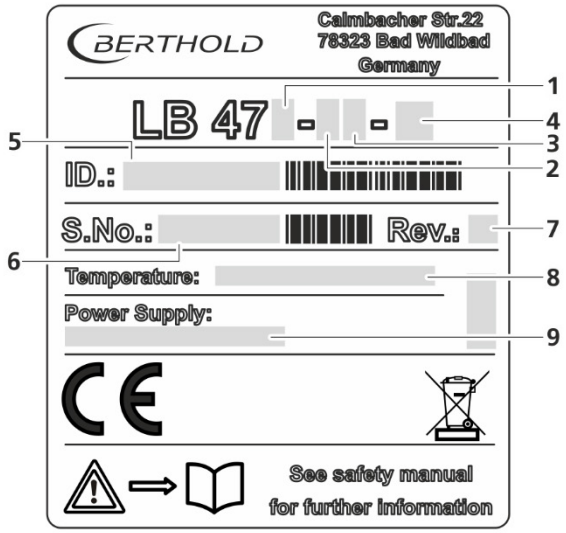
- Operate the touch screen only with your fingers or with a touch pen or connect a mouse.

Status displays of the master EVU

The LEDs (Fig. 4, items 2-4) below the touchscreen show the current operating status of the master EVU.

Display LED	Description
	**RUN** This LED lights up green if the device is in operation and fault-free.
	**RUN (flashing)** The RUN LED flashes green while the measurement is (held) in the STOP state by user actions (e.g. stop function, simulation mode, plateau recording).
	**WARNING** This LED lights up yellow when a system event of the type "Outside of specification", "Maintenance required" or "Function check" is present. All system events are described in chapter 9.2.
	**ERROR** This LED lights up red if a system event of the type "Failure" is present. The current measurement is retained. Check the Device Setup. All system events are described in chapter 9.2.
	**RUN / WARNING / ERROR flashing** All three LEDs flash during the system test which is performed as part of the start-up process.

3.3.3 Type Plate



1	Application	5	Identification number
2	Approval explosion protection (0 = no explosion approval)	6	Serial number
3	Power supply (1 = 24 V DC; 2=100…240 V AC -10 +10%)	7	Revision
4	Master (M) or slave (S)	8	permissible temperature range for operation (ambient temperature)
		9	Power specifications

Fig. 5 Type plate

3.4 Storage

Keep devices in a dry (no condensation), dark (no direct sunlight), clean and lockable room. Stay within the temperature range for storage (see document “Technical Information”).

4 Installation

4.1 General Instructions

The applicable national regulations of the country of use have to be observed! Repair and maintenance on the devices may only be performed by experts (see chapter 2.3).

⚠ DANGER

Danger to life from electric shock!

- Installation may only be carried out if the device has been de-energized.
- Test of absence of harmful voltages when the front side is open.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

⚠ WARNING

Danger to life due to explosion!
The installation of the evaluation unit / the wall housing / the 19" subrack in the hazardous area is not permitted.

NOTICE

Installation specifications and information for intrinsically safe versions of the EVU are listed in a separate safety manual / explosion protection manual, 56925BA26.

Only mounting accessories approved by Berthold should be used for installation of the devices. The device should only be operated if firmly installed.

4.2 Unpacking/Scope of Delivery

The product will be delivered completely configured according to the purchase order. Check your delivery for completeness and damage according to your order. Please report missing, defective or incorrect parts immediately.

4.3 Mounting the Wall Housing

Observe the permitted ambient conditions (refer to document "Technical Information" in the appendix).

NOTICE

- It is recommended that the wall housing be protected from direct sunlight in order to maintain maximum ambient temperature (refer to “Technical Information”).
- The wall housing must not be walked on, used as a climbing aid or otherwise used for other purposes (storage, attachment point).

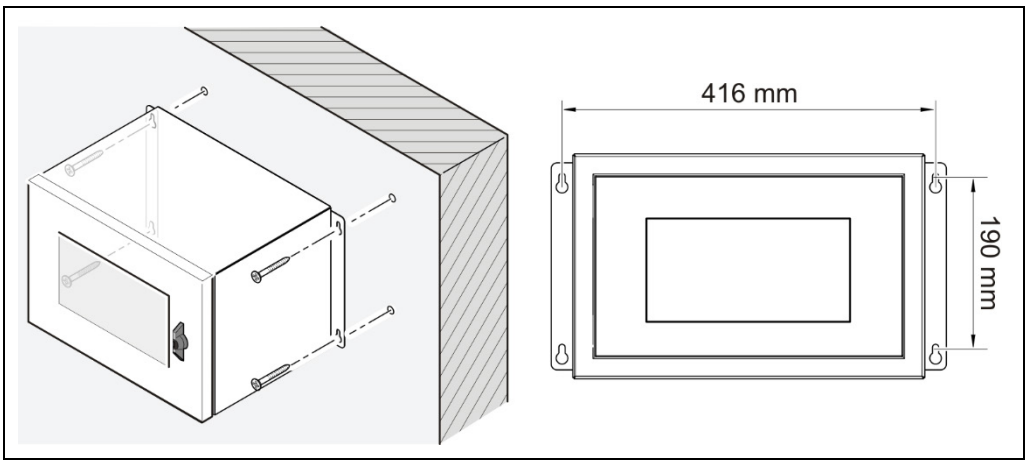


Fig. 6 Mounting the wall housing

1. Mount the wall housing horizontally, in user-friendly height.
2. Prepare the holes.
3. For the total weight of the wall housing, use adequately sized mounting hardware.
4. Screw the housing securely to the wall.

IMPORTANT

Make sure that only authorized personnel can open the wall housing.

- Keep the key of the wall housing in a place where only authorized persons have access.

- The wall housing is installed correctly.

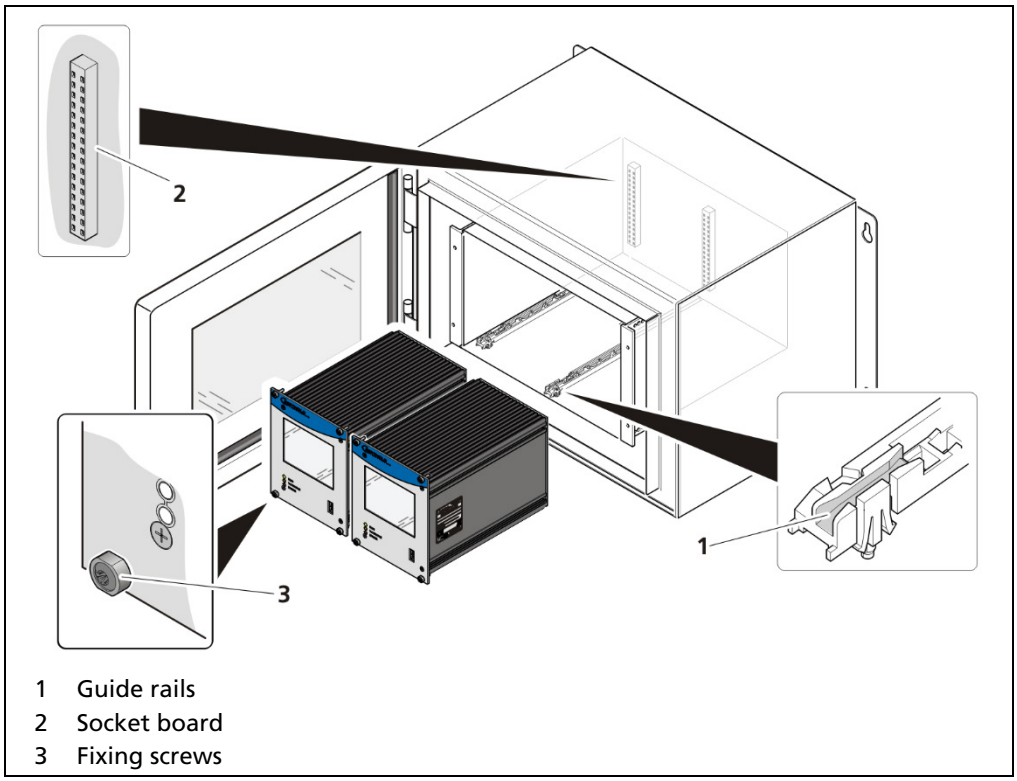
4.4 Installation in the Wall Housing

The wall housing may be equipped differently, depending on requirements (refer to document “Technical Information”). To do this, a corresponding terminal panel is located in the wall housing.

NOTICE

- The master EVUs must be secured against pulling out by fixing screws (Fig. 7, item 3).
- The device must be disconnected from the mains voltage before it is pulled out.

Installation of the EVUs



1 Guide rails
2 Socket board
3 Fixing screws

Fig. 7 Installation of the modules (example with 2 EVUs)

1. Set modules into the guide rails (Fig. 7, item 1) and push it gently until the plug connector of the module is inserted into the socket board (Fig. 7, item 2).
2. Tighten all fixing screws (Fig. 7, item 3).

- The modules are installed correctly.

3. Unused slots must be covered with dummy panels.

4.5 Installation in the 19" Subrack

The 19" subrack can be equipped differently (see document “Technical Information”). The rear clamp blocks or terminal panels (Fig. 8, item 3) are used for the electrical connection.

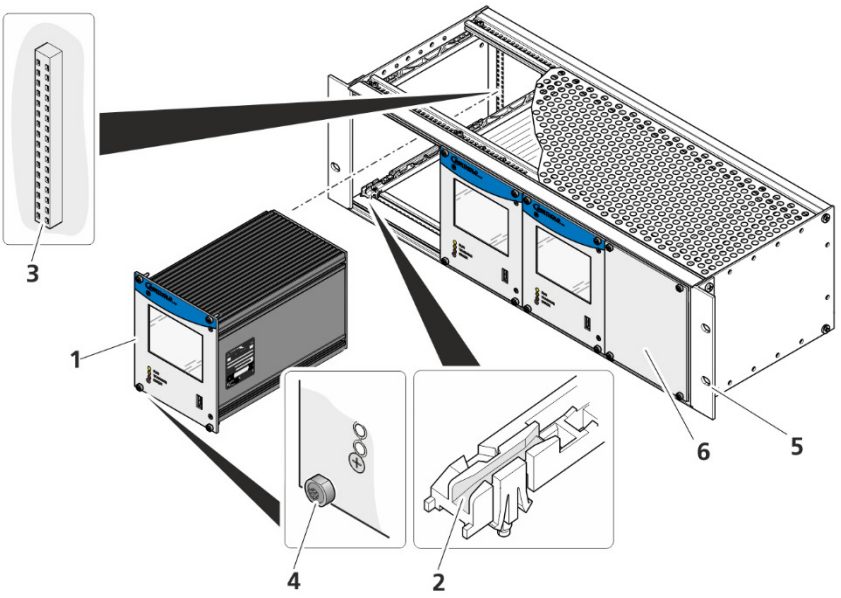
NOTICE

The 19" subrack may only be installed in a dry environment.

The EVU is delivered equipped, depending on the order. The installation of the modules is only necessary if:

- another measurement channel is to be fitted.
- a defective module is to be replaced.

The subrack is installed in a 19" control cabinet or a control panel (switchboard). The 4 side holes (Fig. 8, item 5) that should be provided with fitting screws are used to fasten the subrack.



1	Master EVU	4	Fixing screw
2	Guide rail	5	Drilling
3	Socket of terminal panel or clamp block	6	Dummy panel

Fig. 8 19" subrack with clamp blocks (Example 3x Master)

NOTICE

- The master's EVU modules must be secured against pulling out by fixing screws (Fig. 8, item 4).
- The device must be disconnected from the mains voltage before it is pulled out.

1. Place required master EVU (Fig. 8, item 1) in the guide rail (Fig. 8, item 2).
2. Carefully slide the EVU into the subrack until the plug connector is inserted into the socket (Fig. 8, item 3).
3. Tighten fixing screws (Fig. 8, item 4).
4. Unused slots must be covered with dummy panels (Fig. 8, item 6).

- The EVU is correctly inserted and can be connected.

5 Electric Installation

5.1 General Instructions

⚠ DANGER

Danger to life from electric shock!

- The installation may only be carried out by a qualified electrician.
- Please adhere to the relevant safety regulations.
- Open the housing only in a dry environment and for installation, maintenance and servicing.
- During installation and servicing on the hardware as well as during wiring of the detector, the measuring system, connected relay contacts and all inputs and outputs must be de-energized.
- Connect only devices onto the product that comply with the applicable safety standards.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

NOTICE

Apply the voltage of the specified and marked range only!

The relay of the LB 473 can only switch low voltages. Please note the specifications in appendix Technical Information.

NOTICE

Installation details and information for intrinsically safe versions of the evaluation unit are listed in a separate safety manual / explosion protection manual 56925BA26.

The power source of 24 V DC version of the product must meet the requirements of the Low Voltage Directive and be equipped with double or reinforced insulation.

The voltage parameters of all devices connected to the outputs of the product (e.g. relay circuit, RS-485, current output) must comply with the limit values of the safety directives for electrical measurement, control, regulation and laboratory devices (DIN EN 61010-1) and be equipped with double or reinforced insulation. These protective measures are necessary to avoid the risk of contact with life-threatening voltages. Changing the installation without precise knowledge of this operating manual is not permitted.

General important points for installation

- Connect the earth conductor.
- Ground the housing.
- Please observe the information signs on the devices.

5.1.1 Circuit Breaker

A circuit breaker according to DIN EN 61010-1

- must be available,
- must be easily accessible for the maintenance personnel and
- is to be included in the company-internal documentation.

The master EVUs are not equipped with a separate ON/OFF switch to connect or disconnect the voltage supply. Make sure that the system can be de-energized via the external power supply.

The circuit breaker can be installed as an automatic fuse or switch and has to comply with the requirements according to IEC 947-1 and IEC 947-3. If a fuse is applied, it must not be triggered under a current strength of 4 A per device.

IMPORTANT

The circuit breaker must be located near the device and be properly marked as belonging to it.

5.1.2 Cables and Lines

- Lines are to be connected with special care.
- Connection lines and routing must comply with the applicable regulations.
- When routing the cables, make sure that the cable insulation cannot be mechanically damaged by sharp edges or movable metal parts.
- Use the approved Berthold cable or a cable with equivalent specifications for the connection.

The detector is connected via a 2-core (0.2 ... 2.5 mm²) cable with approx. 5 ... 10 mm diameter. A screened cable must be used in systems with extremely strong electrical noise. The screen may only be laid out on one side of the detector. The maximum cable length depends on the cable resistance, which may not exceed a total (there and back) of 40 ohms. For standard cables from Berthold (Mat. No. 32024), this results in a cable length of 1000m, from the evaluation unit to the detector.

When routing the connection lines, make sure that

- signal lines (detector cables, power signal cables) are not laid together with supply lines,
- no dirt or moisture reaches the connection room,
- the conductors are not damaged when the cable insulation is removed,
- the conductor insulation or the sleeve of the wire end ferrules reach into the housing of the terminal unit,
- blank, conductive segments of the lines (e.g. wires of a litz wire) do not reach outside the terminal unit,
- the wire end ferrule or the stripped wire have a length of 8 mm so that the wire is held securely in the clamp,
- the line insulation reaches into the sleeve of the wire end ferrule if these components are used,
- the admissible minimum bending radius for the respective line cross-section is not exceeded and
- the cables are laid out in a strain-relieved and friction-free manner.

- only use cables whose diameters are approved for the respective cable gland. The cables must comply with the requirements and cross-sections specified in the technical data.
- The connected cables must be suitable for a temperature that is at least 10°C above the maximum permissible ambient temperature.

5.1.3 Cable Glands and Blanking Elements

- The feeding of cables into the wall housing is only permitted via a cable entry.
- Cable glands must be suitable for the respective application.
- All cable glands must be assembled according to manufacturer's instructions and be tightened to the appropriate tightening torque.
- Cable glands that are not required for installation must be covered with suitable blanking elements.
- Line cross-sections must comply with the respectively used cables.
- Cable bushings and blanking elements must comply with the applicable IP protection class and with the requirements for the operational environment.
- We recommend ordering missing cable glands, blanking elements or adapters from Berthold.

5.1.4 Protective Earth and Equipotential Bonding

- The protective earth conductor has to be connected to the terminals marked with "PE".
- The housing must be connected to local equipotential bonding.

5.1.5 EIA-485 (RS-485) Network

For integration of EVU units into an EIA-485 (RS-485) network, all participants must be connected one after the other in the configuration Master-Master. Star connection is not permitted.

The first and last station (physical, independent of the master's position) on the network needs a terminating resistor of 120 Ω.

5.2 Exchange LB 44x to LB 47x

NOTICE

- If you install a DuoSeries LB 47x transmitter, in order to replace a LB 44x, it is necessary to consider an incompatibility in the connecting terminals.
- **In the most unfavorable case a short circuit in the connected terminals can happen!**
- Consider the following information.

When using the terminal blocks, the most important electrical connections are identical (detector connection, current output, voltage supply). Other terminals like the I/O connections are not compatible.

The following figure shows the terminal assignments of the DuoSeries LB 47x.

Green: Identical connections LB 44x / DuoSeries LB 47x
Red: Changed clamp assignment DuoSeries LB 47x in comparison to LB 44x

Signal	Pin	C	A	Pin	Signal
DETECTOR GND	C - 2			A - 2	DETECTOR +
not assigned	C - 4			A - 4	not assigned
not assigned	C - 6			A - 6	not assigned
not assigned	C - 8			A - 8	not assigned
RELAY 3 COM	C - 10			A - 10	RELAY 3 NO
RELAY 2 COM	C - 12			A - 12	RELAY 2 NO
RELAY 1 NC	C - 14			A - 14	RELAY 2 NC
RELAY 1 COM	C - 16			A - 16	RELAY 1 NO
DIGITAL IN 1	C - 18			A - 18	DIGITAL IN GND
DIGITAL IN 2	C - 20			A - 20	+ 24 V
CURRENT IN + (⎍⎍)	C - 22			A - 22	CURRENT IN – (⊥)
RS 485 B	C - 24			A - 24	RS 485 A
CURRENT OUT –	C - 26			A - 26	CURRENT OUT +
not assigned	C - 28			A - 28	not assigned
100-240 V AC, 24 V DC –	C - 30			A - 30	100-240 V AC, 24 V DC +
Protective conductor PE	C - 32			A - 32	Protective conductor PE

Fig. 9 Assignment clamp block at exchange LB 47x → LB 47x

NOTICE

Together with an exchange unit a terminal sticker is delivered that must be placed on the terminal block.

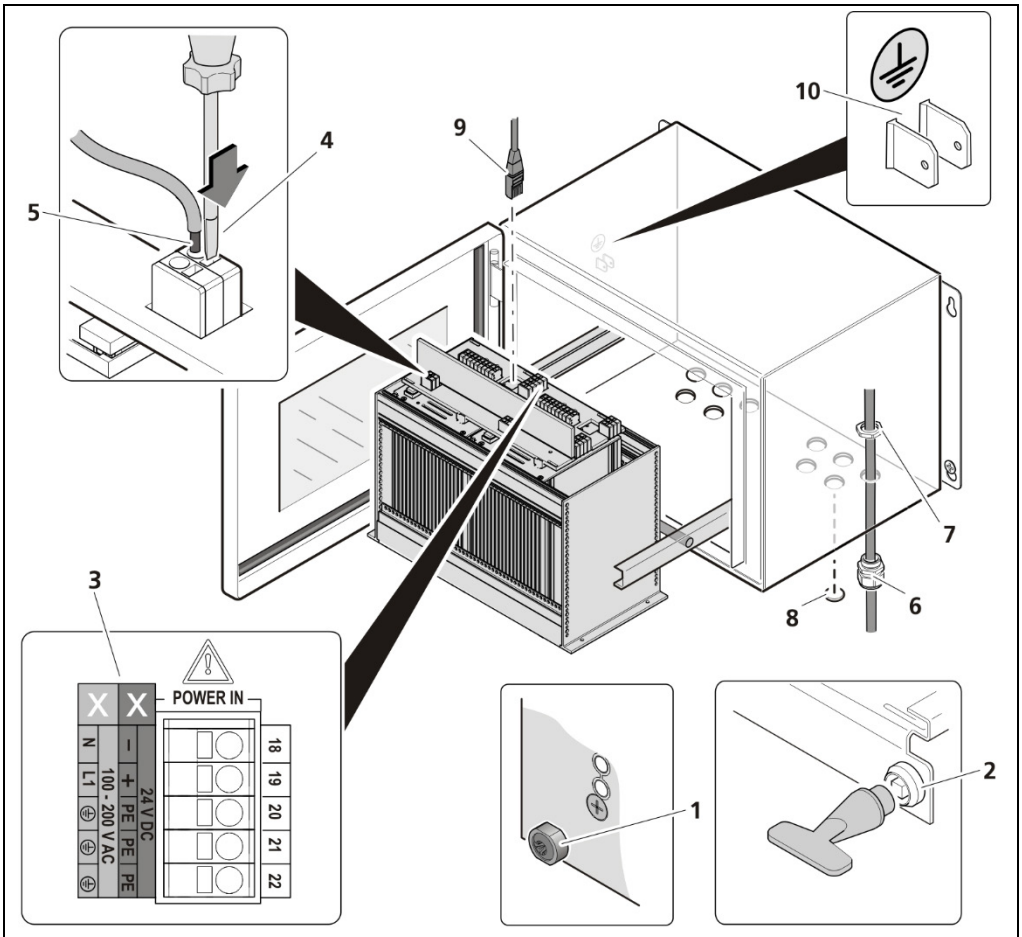
5.3 Electric Connection in the Wall Housing

⚠ DANGER

Danger to life from electric shock!

- The installation may only be carried out by a qualified electrician.
- Please adhere to the relevant safety regulations.
- Installation/maintenance may only be carried out if the device has been de-energized.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.



1	Fixing screws	6	Cable gland
2	Locking	7	Counternut cable gland
3	Marked voltage supply	8	Plugs
4	Opening terminal connection	9	RJ45 connector (network)
5	Stripped wire	10	Ground connection

Fig. 10 Electrical connection in the wall housing (example 2x master EVU at backplane)

1. Make sure that the locking bolts (Fig. 11, item 1) of all WVUs are tightened in order to prevent slipping.
2. Loosen the lock (Fig. 11, item 2) using the supplied square key and pull the subrack out.
3. Fold the subrack downward cautiously.

4. Run the cables through the cable glands (Fig. 11, item 6) through the openings of the wall housing and through the counternut cable glands (Fig. 11, item 7).
5. Screw the cable glands (Fig. 11, item 6) with the counternut cable glands (Fig. 11, item 7).

NOTICE

Apply the voltage of the specified and marked (Fig. 11, item 3) range only!

NOTICE

Note the specification relating to Cables, Protective earth, equipotential bonding and EIA-485 (RS-485) in chapter 5.1.

6. Connect the lines according to assignment (see 2.3 or 2.4 in “Technical Information”).
7. Open the terminal connection (Fig. 11, item 4) with an operating tool (slotted screwdriver) and insert the stripped wire (min. 8 mm) (Fig. 11, item 5). The terminal connection closes by pulling out the operating tool. The terminal connections are designed for the flexible wires:
   - 0.2 mm² … 2.5 mm² or AWG 24 …12 without end sleeve
   - 0.25 mm² ... 2.5 mm² with end sleeve without plastic sleeve
   - 0.25 mm² ... 1.5 mm² with end sleeve with plastic sleeve.
8. Plug the network plug into the RJ45 socket (Fig. 11, item 9) (optional).
9. Tighten all cable glands (Fig. 11, item 6) to ensure optimal sealing and tension relief until the gasket insert closes between screw down nut and cable.
10. Check tension relief of all cable glands by pulling the cables smoothly.

▶ The cables must not move. If necessary tighten the cap nuts of the cable glands.

11. Slide the subrack into the wall housing and lock it with the square wrench.

NOTICE

The wall enclosure is supplied with blanking elements in all cable glands. It must be ensured that there are blanking elements in all unused cable glands. Otherwise, the IP protection is not given.

NOTICE

Only use cable that is suitable for connection to the corresponding terminals may be used. Detailed specifications can be found in the chapter 5.1.2 Cables and Lines.

Tip

The connections of the installed devices are already manufactured above the circuit board in the wall housing. If additional modules (e.g. from other wall housings) are connected, the terminals appropriate for use on the terminal board should be used.

▶ The connection was made correctly.

5.4 Electrical Connection in a 19" Subrack with Terminal Board

⚠ DANGER

Danger to life from electric shock!

- The installation may only be carried out by a qualified electrician.
- Please adhere to the relevant safety regulations.
- Installation/maintenance may only be carried out if the device has been de-energized.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

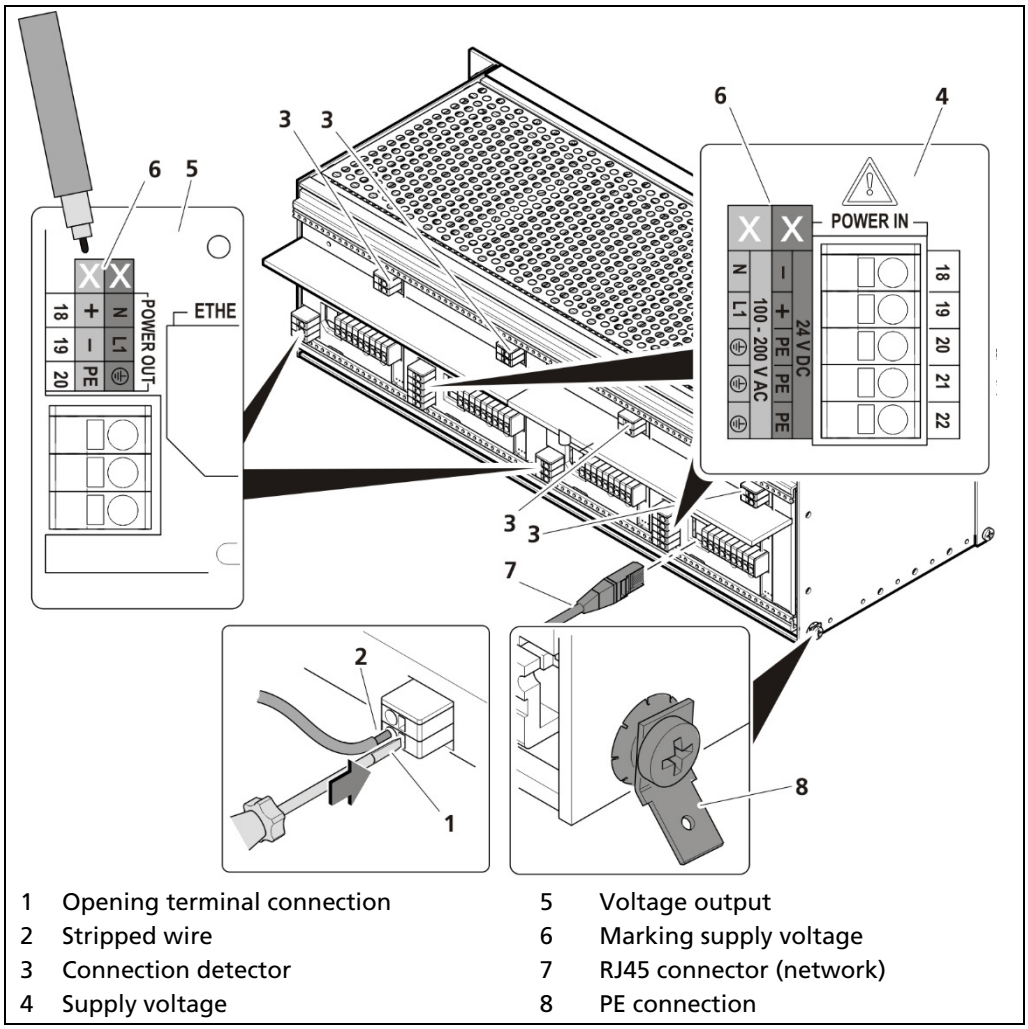
NOTICE

Prior to initial start-up, the voltage range (Fig. 12, item 8) must be marked with chemical resistance on all input and output terminals!
Only cable that is suitable for connection to the corresponding terminals may be used. Detailed specifications can be found in the chapter 5.1.2 Cables and Lines.

The 19" subrack must be accessible from the rear for the electrical installation.

The terminal board master/master (Fig. 12) is used twice for the variant to install 4 master EVUs.

master / master
CHANNEL A
CHANNEL B
CHANNEL C
CHANNEL D



1	Opening terminal connection	5	Voltage output
2	Stripped wire	6	Marking supply voltage
3	Connection detector	7	RJ45 connector (network)
4	Supply voltage	8	PE connection

Fig. 11 Electrical connection in the 19" subrack (example: 2 backplanes)

NOTICE

Apply the voltage of the specified and marked (Fig. 12, item 6) range only!

- Note the specification relating to Cables, Protective earth, equipotential bonding and EIA-485 (RS-485) in chapter 5.1.

1. Unused slots must be closed with blinds.
2. Label the voltage range permanently and chemically (Fig. 12, item 6).
3. Connect the lines according to assignment to the terminal board (see 2.3 or 2.4 in “Technical Information”). The protective conductor must be connected to all connections marked PE.
4. Open the terminal connection (Fig. 12, item 1) with an operating tool (slotted screwdriver) and insert the stripped wire (min. 8 mm) (Fig. 12,item 2). The terminal connection closes by pulling out the operating tool. The terminal connections are designed for flexible wires:
   - 0.2 mm² ... 2.5 mm² / AWG 24 ... 12 without ferrules
   - 0.25 mm² ... 2.5 mm² with ferrules without plastic sleeves
   - 0.25 mm² ... 1.5 mm² with ferrules with plastic sleeves
5. Plug the network plug into the RJ45 socket (Fig. 12, item 7) (optional).
6. Check the correct connection of the PE conductor (Fig. 12, item 8).

NOTICE

Note the specification relating to Protective earth and equipotential bonding in chapter 5.1.4.

- The connection was made correctly.

5.5 Electrical Connection in the 19” Subrack with Clamp Block

⚠ DANGER

Danger to life from electric shock!

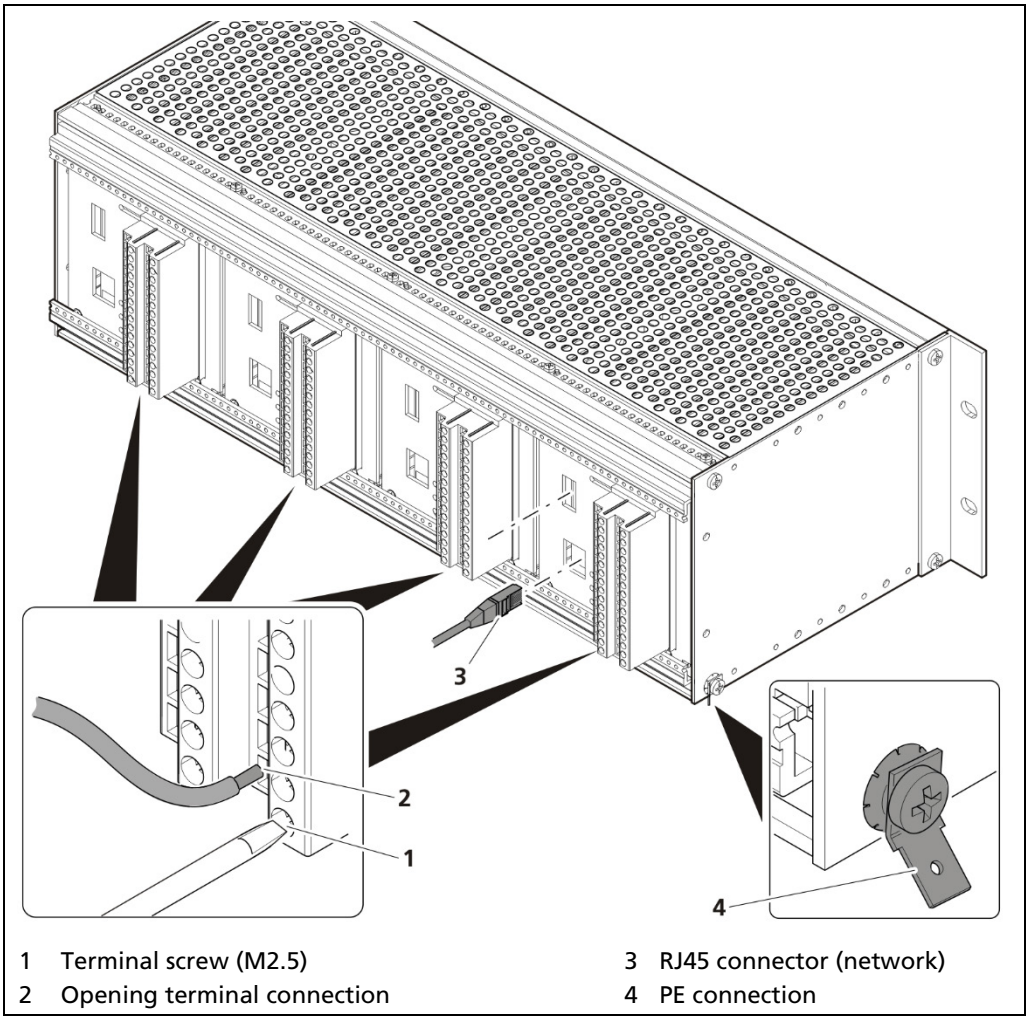
- The installation may only be carried out by a qualified electrician.
- Please adhere to the relevant safety regulations.
- Installation/maintenance may only be carried out if the device has been de-energized.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

If the EVUs are installed in the 19" subrack without terminal board, the electrical connections are made via clamp blocks. These clamp blocks are already installed in the 19" subracks and are also available as an optional accessory.

IMPORTANT

In the case of applications with clamp blocks a contact protection must be provided by the customer when voltage is applied. The cable connections of clamp blocks have to be in accordance with IEC 61010-1 (2010).



1 Terminal screw (M2.5)
2 Opening terminal connection
3 RJ45 connector (network)
4 PE connection

Fig. 12 Electrical connection in the 19” component rack (example: 4x master)

1. Unused slots must be closed with blinds.
2. Connect the lines to the clamp blocks according to assignment (see 2.4 in “Technical Information”). To ensure protection against accidental contact in accordance with EN61010-1, the rear side with the terminals must be covered with a protective cover, e.g. with a door of a 19" cabinet.
3. Open the terminal screw (Fig. 24, item 1) and insert the stripped wire (min. 8 mm).

▶ The terminal connections are designed for wires with a conductor cross-section from 0.2 mm² to 2.5 mm².

4. Screw the terminal screw with a tightening torque of 0.4 - 0.5 Nm.
5. Plug the network plug into the RJ45 socket (Fig. 24, item 3) (optional).
6. Check the correct connection of the PE conductor (Fig. 24, item 4).

NOTICE

Note the specification relating to Protective earth and equipotential bonding in chapter 5.1.4 .

▶ The connection was made correctly.

5.6 Switching Current Output

NOTICE

Switching the current output on LB 47x Ex-i versions is not permitted because it is not allowed to open the housing.

- Please note the safety manual / explosion protection manual LB 47x Ex-i (ATEX / IECEx), 56925BA26.

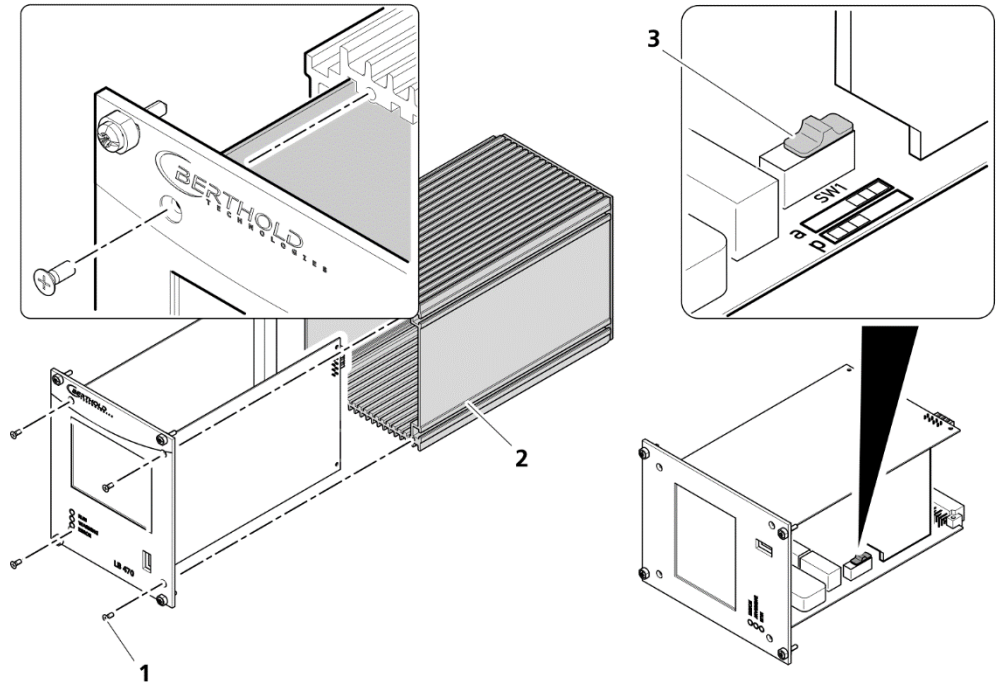
Switching between "SOURCE" (active) and "SINK" (passive) is possible using the slide switch on the I/O board. Factory setting EVU is delivered in "SOURCE" mode. Please note that the polarity at the current output must be inverted as soon as the current output is switched at the switch.

⚠ DANGER

Danger to life from electric shock!

- The switching may only be carried out by a qualified electrician.
- Please adhere to the relevant safety regulations.
- Switching may only be carried out if the device has been de-energized.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.



1 Screws
2 Housing
3 Slide switch (a=active "SOURCE"; p=passive "SINK")

Fig. 13 Switching of the current output

1. Loosen the four sunken screws on the front side of the EVU (Fig. 14, item 1).
2. Pull out the housing (Fig. 14, item 2) carefully.
3. Slide the switch (Fig. 14, item 3) to position ***a*** for "active" (SOURCE), to position ***p*** for "passive" (SINK).

4. Carefully insert the front panel into the housing. Pay attention to the correct guide rail!
5. Screw the front panel to the housing (Fig. 14, item 2) with the four screws (Fig. 14, item 1).

▶ The switching has been carried out correctly.

6 Operation of the Software

6.1 System Start

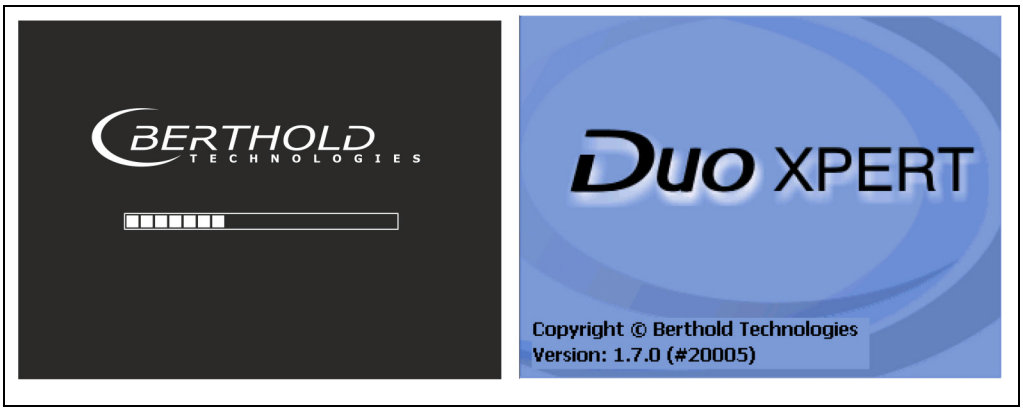


Fig. 14 Start screens with display of the software version

IMPORTANT

The communication between the detector and EVU is limited to 1200 baud. Accordingly, there is a load time for data that are retrieved in the detector.

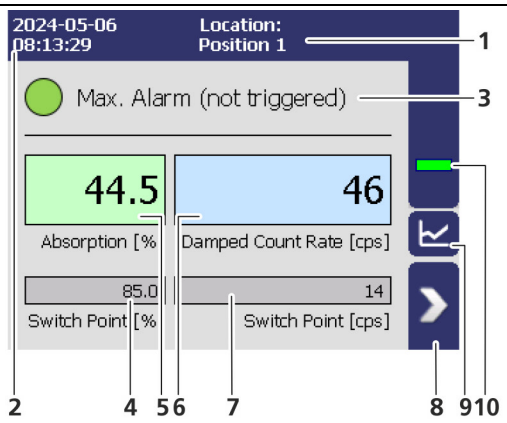
All set values as well as the calibration data are stored in a non-volatile memory.

The real-time clock for date and time is buffered via a capacitor and continues to run for up to approx. 4 weeks even when the device is switched off. See also "Date and time" on page 52.

6.2 EVU Display

IMPORTANT

Changing the language of the user interface is changed in menu Device Setup | Setup | System | Interfaces | Languages.



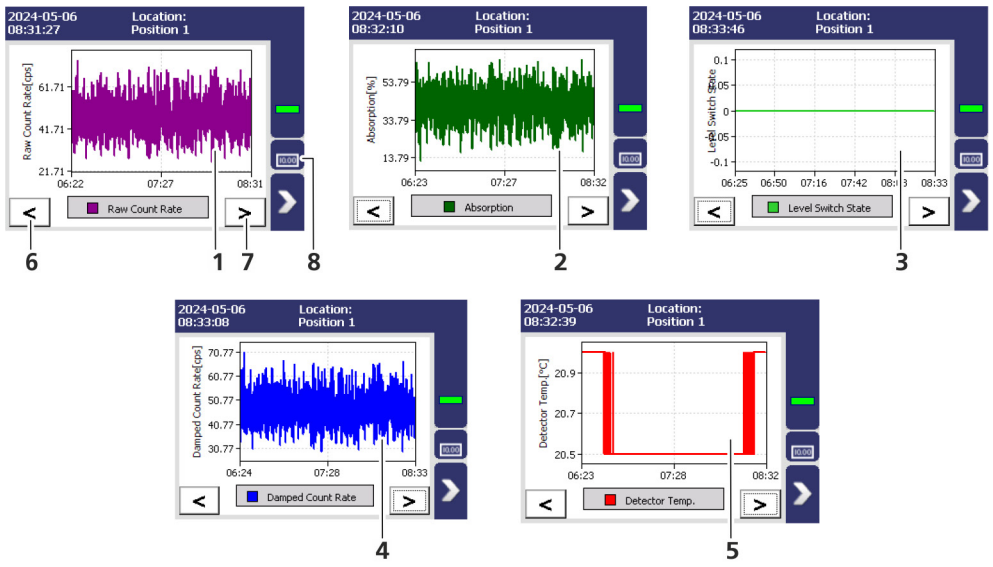
1	Description measuring point	6	Display damped count rate [cps]
2	Date and time	7	Display switch point [cps]
3	State level switch	8	Button “Menu”
4	Switch point [%]	9	Button “Chart display”
5	Absorption [%]	10	Status Information

Fig. 15 Display of the EVU

Name of measuring point	Name of the measuring location. Setting in Device Settings | Identification.
Date and Time	Actual date and time. Setting in Device Settings | Setup | System | Date / Time.
Level switch status	Displays the status of the level switch. Max. alarm or Min. alarm (triggered / not triggered.)
Switch point [%]	Displays the percentage switch point that can be set in Device Settings | Setup | Level Switch.
Absorption [%]	Shows the absorption of radiation in the measuring path in percent.
Damped count rate [cps]	Displays the damped count rate. In Device settings | Setup | System | Signal Condition the time constant can be set for damping.
Display switch point [cps]	Displays the count rate of the switch point that can be set in Device Settings | Setup | Level Switch.
Menu button	The main menu opens.
Button “Chart display”	The view switches to the diagrams, see 6.3.
Status information	The current system status of the EVU is displayed.

6.3 Chart Display

Clicking the chart symbol (Fig. 16, item 5) changes the view to the chart display. The arrow keys (Fig. 17, item 1) are used to switch between the charts. Clicking the display symbol (Fig. 17, item 3) changes the view to the standard display.

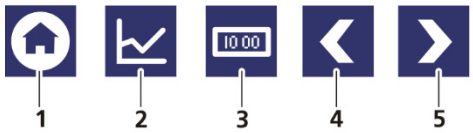


1	Chart “Raw Count Rate”	5	Chart “Detector Temperature”
2	Chart “Absorption”	6	Left arrow key
3	Chart “Level Switch State”	7	Right arrow key
4	Chart “Damped Count Rate“	8	Standard display button

Fig. 16 Chart display of the EVU

Chart “Damped Count Rate”	The "Damped count rate" chart shows the dampened count rate.
Chart “Raw Count Rate”	The "Raw Count Rate" chart shows the count rate that is transmitted directly from the detector without damping.
Chart “Absorption”	The "Absorption" chart shows the percentage absorption of the radiation in the measuring path.
Chart “Level Switch State”	The chart shows the status of the level switch (triggered / not tripped).
Chart “Detector Temperature”	The chart shows the temperature of the detector. The temperature unit can be modified in Device Settings | Setup | System | Units.

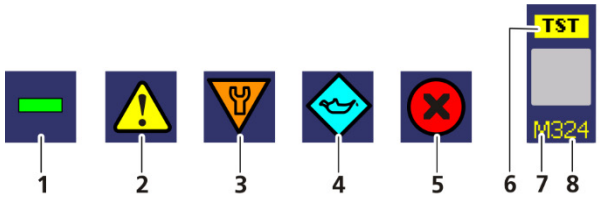
6.4 Navigation



1 Home (standard display)
2 Diagram display
3 Data
4 One menu level back
5 One menu level forward

Fig. 17 Icons for navigation

6.5 Status Messages



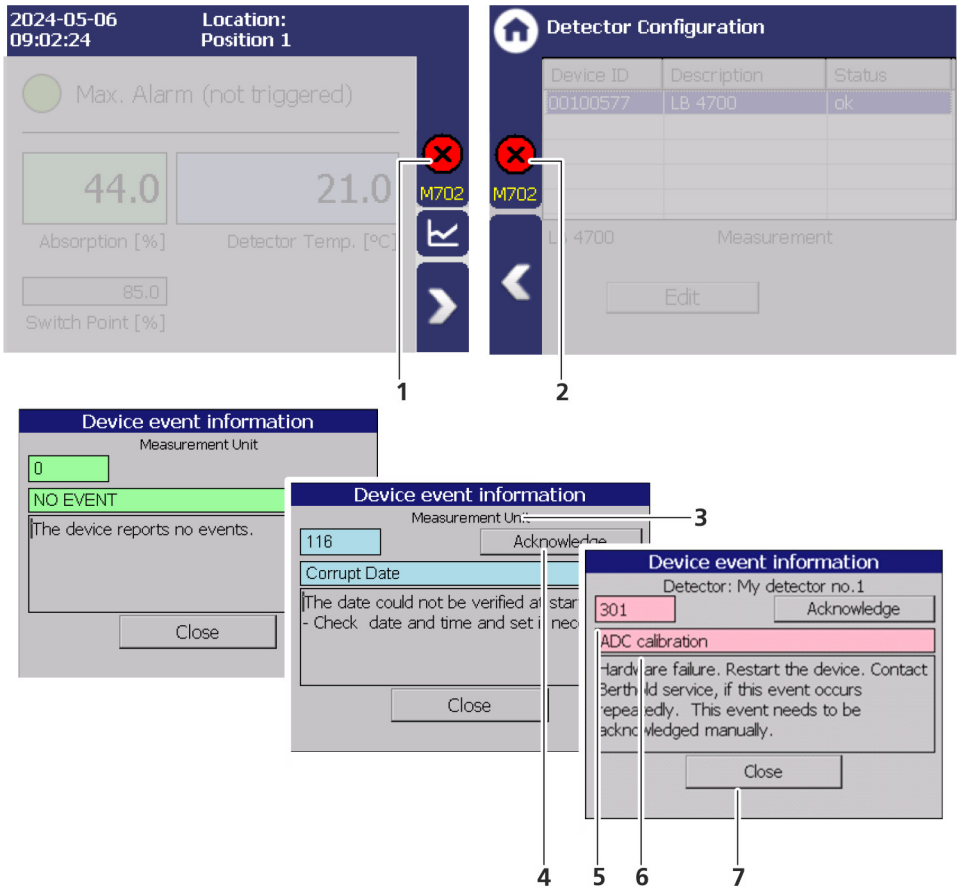
1 No event
2 Outside of specification
3 Function check
4 Maintenance required
5 Failure (error)
6 Information test (simulation)
7 Character D (detector) or M (measuring unit)
8 Event code

Fig. 18 Status messages

6.6 Event Reports

Events are displayed in the standard display and in the menus and submenus as a symbol. All events are displayed on the main screen. A specific “D” (only with LB 4700 detector) indicates that a detector has an event, the prefix “M” (for measuring unit) indicates that there is an event in the LB 473 transmitter. In the event of a detector fault (LB 4700), the operating manual of the detector must be observed.

Only the event with the highest priority will be displayed. Refer to the menus Transmitter Events (chapter 8) and Detector Service (chapter 7.3.2) for additional information.



1 Event reporting in the standard display
2 Event message in the menu structure
3 Device concerned (detector / EVU)
4 Button <Acknowledge>
5 Error number
6 Title of event report
7 Button <Close>

Fig. 19 Event reports (examples)

1. Click on the icon (Fig. 20, item 1, item 2) to display detailed information about the event.
2. Click the button <Acknowledge> to confirm an event that requires a manual confirmation.

▶ The event description indicates the next event or reports no further events.

3. Click <Close> to return to the submenu or to the standard display.

▶ The icon disappears from the status information.

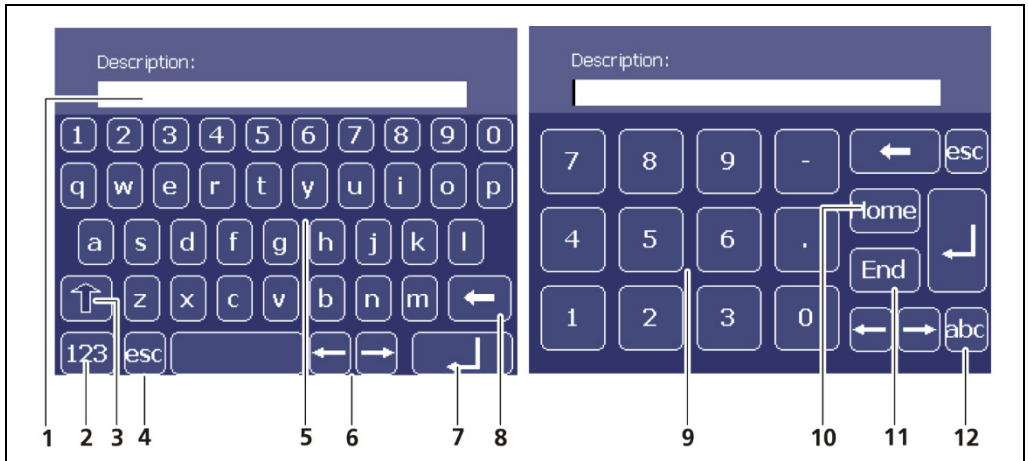
IMPORTANT

If you click the button <Close>, the event message is closed, the icon continues to be displayed.

6.7 Input Field

NOTICE

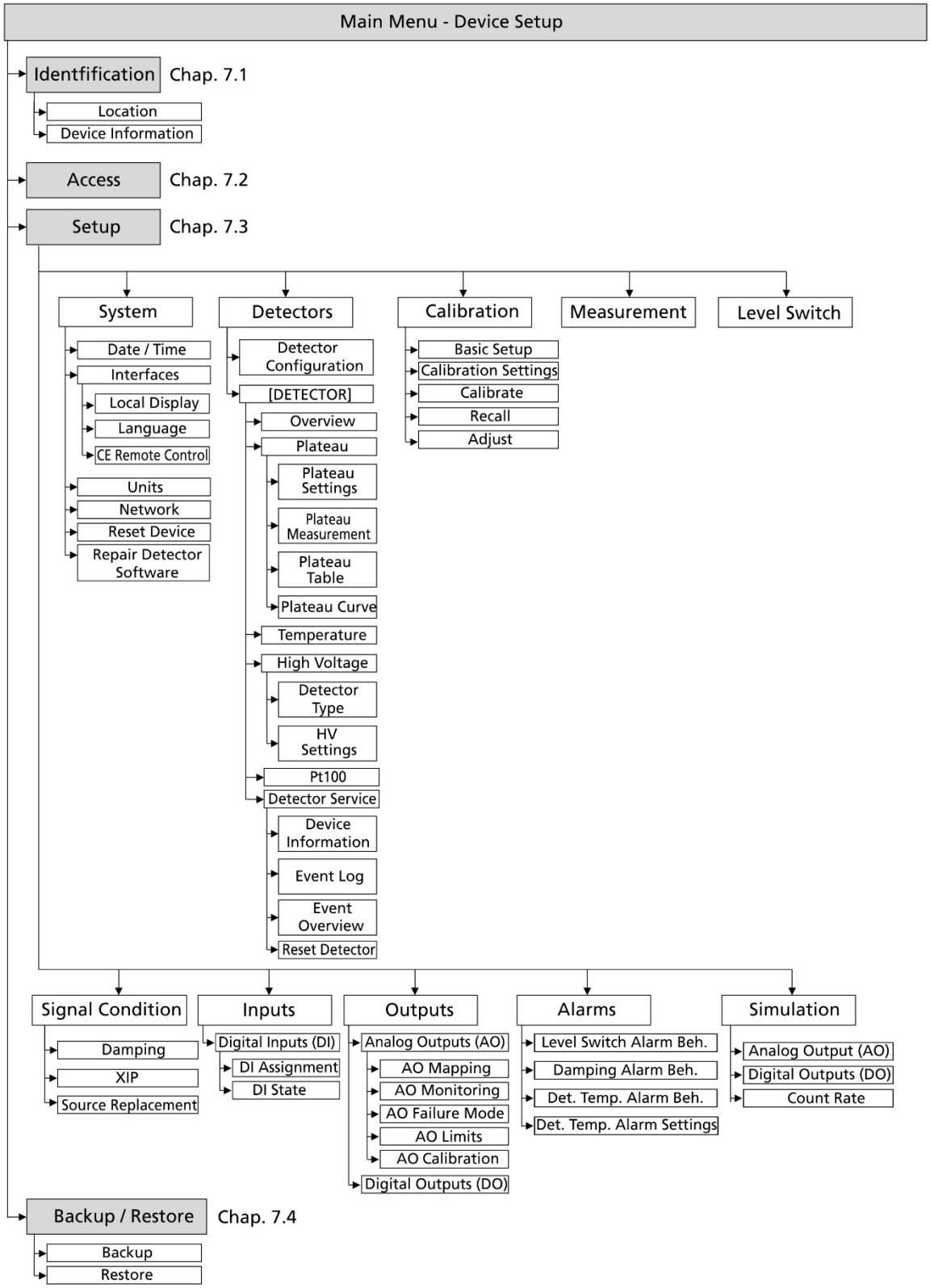
The input field appears by clicking on the blue display fields.



1	Input line	7	Input key
2	Shift key for numbers	8	Delete key
3	Shift to upper case characters	9	Number field
4	Escape key	10	Home key
5	Keypad	11	End key
6	Navigation buttons	12	Shift key for letters

Fig. 20 Screen keyboard

7 Main Menu Device Setup



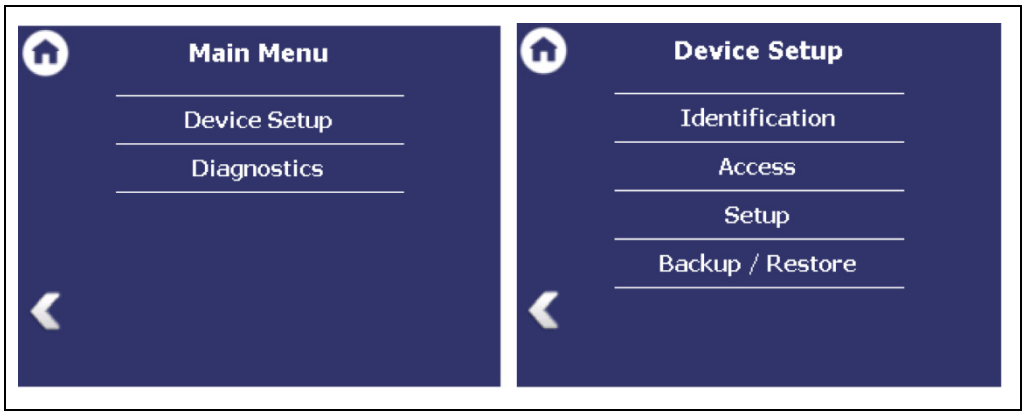


Fig. 21 Menu “Main Menu”, "Device Setup"

7.1 Menu Identification

Device Setup | Identification

You can make the following settings and read information in the Identification menu:

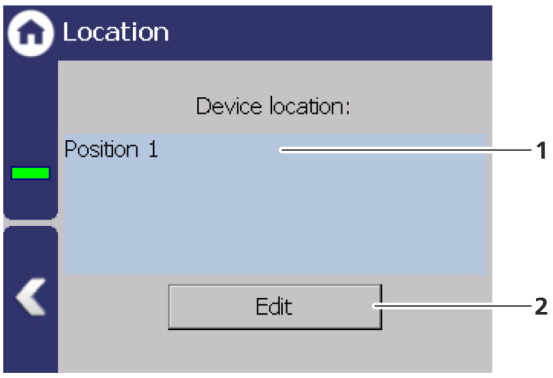
- Display and change the location name
- Display of hardware and software information
- Perform software update

Fig. 22 Menu "Identification"

7.1.1 Location

Device Setup | Identification | Location

The location of the evaluation unit is displayed (Fig. 24, item 1) in the “Location” menu. The name can only be edited (7.2 Menu Access) in the access level "Standard". The Location is displayed on the EVU standard display (Fig. 16, item 1).



1 Name Device location
2 Button <Edit>

Fig. 23 Device Location

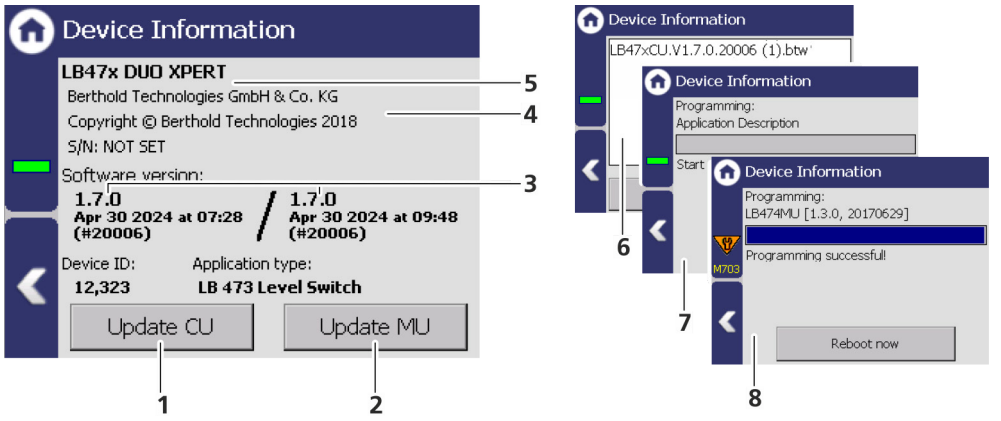
1. Click <Edit> (Fig. 39, item 2) to open the input field.
2. Enter a location name for the evaluation unit.
3. Confirm with the Enter key.

▶ The name has been changed.

7.1.2 Device Information

Device Setup | Identification | Device Information

Information about hardware and software of the evaluation unit are displayed in the submenu "Device Information".



1	CU update (Control Unit)	5	Device Information
2	MU update (Measurement Unit)	6	Selection window “update file”
3	Software versions	7	Process window
4	Manufacturer	8	Result window

Fig. 24 Device Information

Tip

The current software versions can be downloaded from the Berthold website (www.berthold.com).

7.1.3 Perform Software Update

NOTICE

During an update where the first or second digit of the version changes, it is necessary to reset the EVU to factory settings.

NOTICE

Settings are deleted!

- Carry out a backup of the measuring settings before resetting and the update of the EVU (7.4.1 Backup).
- The secured settings should then be imported after the successful software update.

Perform CU Update

1. Save the current update file of the CU software on a USB storage device.
2. Connect a USB storage device to the front of the device (Fig. 4, item 5).

IMPORTANT

In order for the system to detect the update files it must not be located in a directory in the USB storage device.

3. In the “Device Setup” menu, click on “Device Information” (Device Setup | Identification | Device Information).
4. The USB storage device is recognized by the system after a few seconds and the <CU Update> (Fig. 25, item 1) button can be clicked.

- The selection window “update file” (Fig. 25, item 6) opens.

5. Select the appropriate file and click on the button <CU Update> (Fig. 25, item 1). Confirm with <Yes>.
6. The update is performed and the measurement is interrupted.

- After the loading process, the message "also update MU Software?" appears

7. Click the Button <Yes> to carry out the MU update. Click the Button <No> to reboot the EVU.

- The device restarts and the new CU software has been installed.

NOTICE

Berthold recommends calibrating the current outputs whenever a module has been installed/replaced or if a software update has been carried out.

Perform MU Update

1. Save the current update file of the MU software on a USB storage device.
2. Connect a USB storage device to the front of device (Fig. 4, item 5).
3. In the “Device Setup” menu, click on “Device Information” (Device Setup | Identification | Device Information).
4. The USB storage device is recognized by the system after a few seconds and the <MU Update> (Fig. 25, item 2) button can be clicked.

▶ The selection window “update file” (Fig. 25, item 6) opens.

5. Select the appropriate file and click on the button <MU Update> (Fig. 25, item 2). Confirm with <Yes>.

▶ The update is performed and the measurement is interrupted.

6. Click the Button <Restart> to reboot the EVU.

▶ The device restarts and the new MU software has been installed.

NOTICE

Berthold recommends calibrating the current outputs whenever a module has been installed/replaced or if a software update has been carried out.

7.2 Access

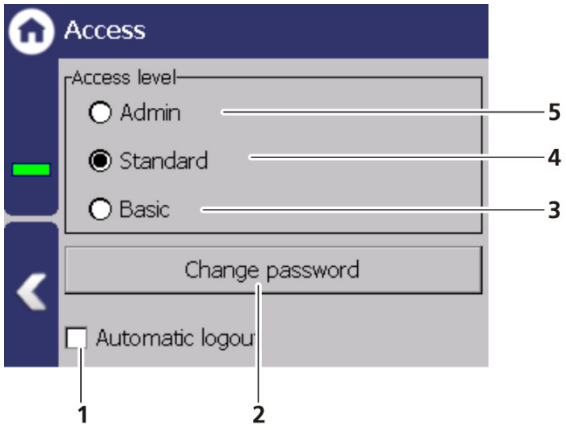
Device Setup | Access

You can set the user rights via the user levels and assign passwords in the menu “Access”. After assigning a password the device is protected against unauthorized manipulation of the parameters.

IMPORTANT

Make sure that the password is known to you before you select the "Basic" access level and lock the device. The same applies if you set "Automatically log-out".

If you do not know the password, you will not be able to unlock the device! If in doubt, enter a new password with "Change Password".



1 Check box "Automatic logout"
2 Change <Change password>
3 Access level "Basic"
4 Access level "Standard"
5 Access level "Admin"

Fig. 25 Access

The following user levels are available to you:

Access Level Basic	Select "Basic" to lock the device against unwanted manipulation. After the device has been locked, it is still possible to read all data, but changes to the data are no longer possible. If "Basic" is already set, then the device is already in the locked state. To unlock the device, select the access level "Standard".
Access Level Standard	If the device is in the "Standard" access level, all parameters are accessible and can be changed. If the device is in the "Basic" access level (locked), you can unlock the device with the "Standard" access level. The password will be asked for. You can unlock the device only if you enter the correct password.
Access Level Admin	This access level is only intended for the system management by Berthold.

Automatic logout Activating the selection box (Fig. 26, item 1) automatically resets the access level Standard to “Basic” when the system changes to the standard display after the timeout (chapter 7.3.1).

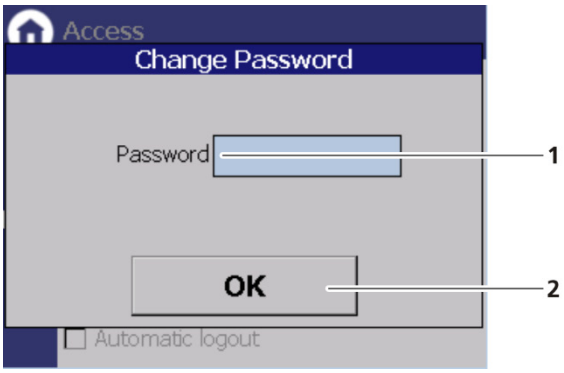
NOTICE

Incorrect measurement and calibration parameters can be set through unauthorized inputs. These can possibly lead to production losses and damage in the system.

- Protect the measuring system from unauthorized entries with a password and activate the function "Automatic logout".

Assign / change password

To set or change a password, select "Standard" (Fig. 26, item 4) and click on <Change password> (Fig. 26, item 2) to open the input field.



1 Input field
2 Button <OK>

Fig. 26 Change password

1. Click on the text field (Fig. 27, item 1.) to open the input field.
2. Enter a password (case-sensitive!).
3. Confirm with Enter.
4. Click <OK> (Fig. 27, item 2) to confirm.

- The password has been set / changed.

7.3 Menu Setup

Device Setup | Setup

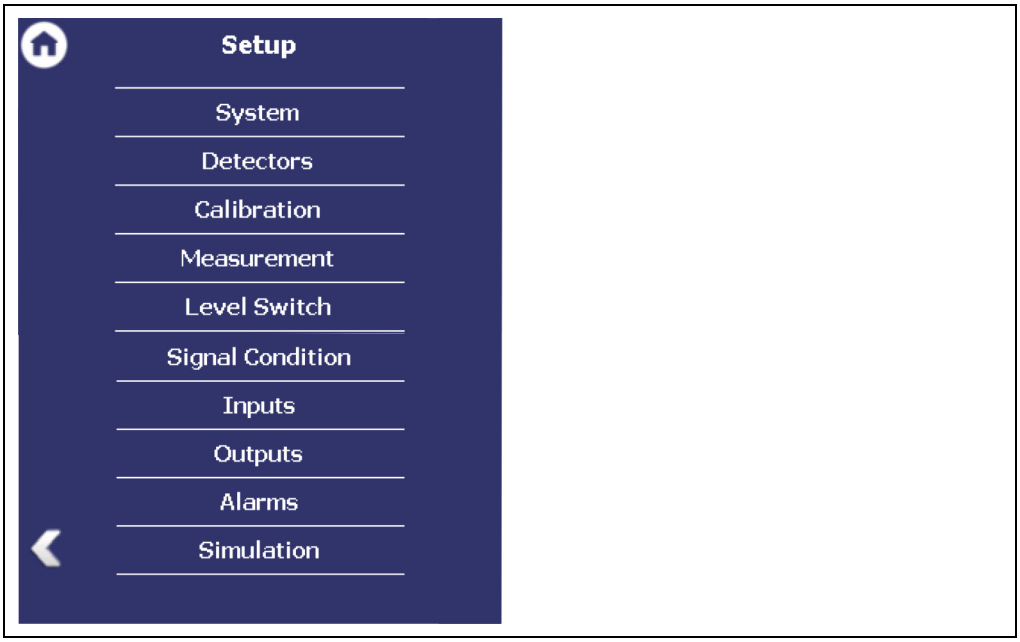


Fig. 27 Menu "Setup"

7.3.1 System (Date / Time, Interfaces, Units, Network, Reset Device, Repair Detector Software)

Device Setup | Setup | System

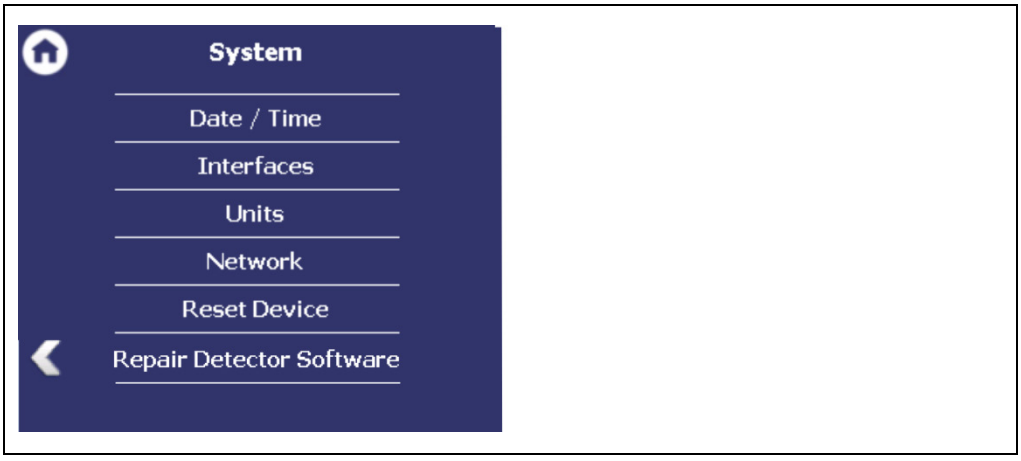


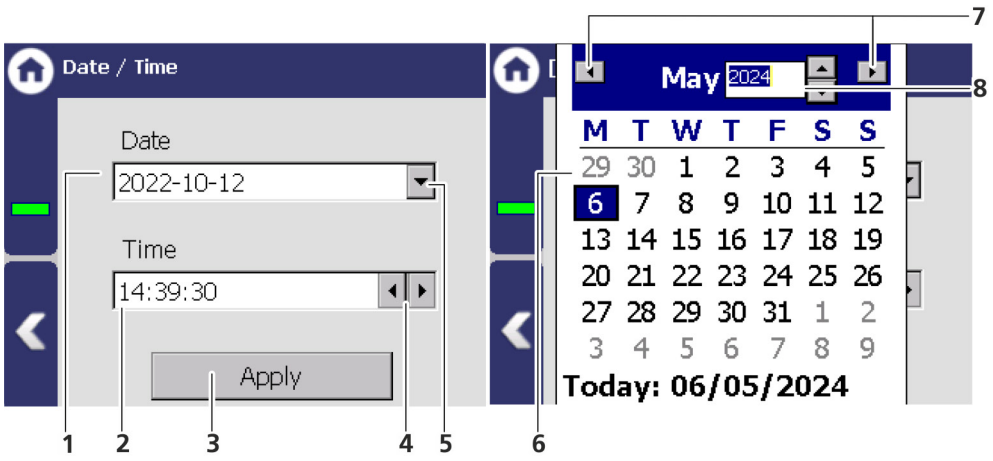
Fig. 28 Submenu "System"

Set Date and Time

Device Setup | Setup | System | Date / Time

IMPORTANT

The date and time must always be set correctly so that all records (log files) have the correct metadata. The correct date is also indispensable for the decay compensation.



1	Display date	5	Selection arrow Date
2	Display time	6	Calendar
3	Button <Apply>	7	Arrow keys Month
4	Arrow key Time	8	Input field year

Fig. 29 Date / Time, calendar

1. Click on the arrow key (Fig. 30, item 5) in order to set the date.
   ▶ The calendar is opened (Fig. 30, item 6).
2. Click on the year number (Fig. 30, item 8) in order to enter the year.
3. Set the month (Fig. 30, item 7) by clicking on the arrow keys.
4. Set the day by clicking on a number in the calendar.
5. Change the time by clicking on the arrow keys (Fig. 30, item 4).
6. Click on <Apply> (Fig. 30, item 3), to accept the date and time settings.
   ▶ Date and the time have been set

NOTICE

The real-time clock for date and time is buffered via a capacitor and continues to run for up to approx. 4 weeks even when the device is switched off.

▶ If the device has been out of operation for more than 4 weeks, error M116 appears. The date and time must then be reset.

Interfaces

Device setup | Setup | System | Interfaces

You can adjust the following settings in the submenu “Interfaces” (Fig. 31):

- Local Display
  - Brightness / Touch
  - Input / Output
- Language
- CE Remote control

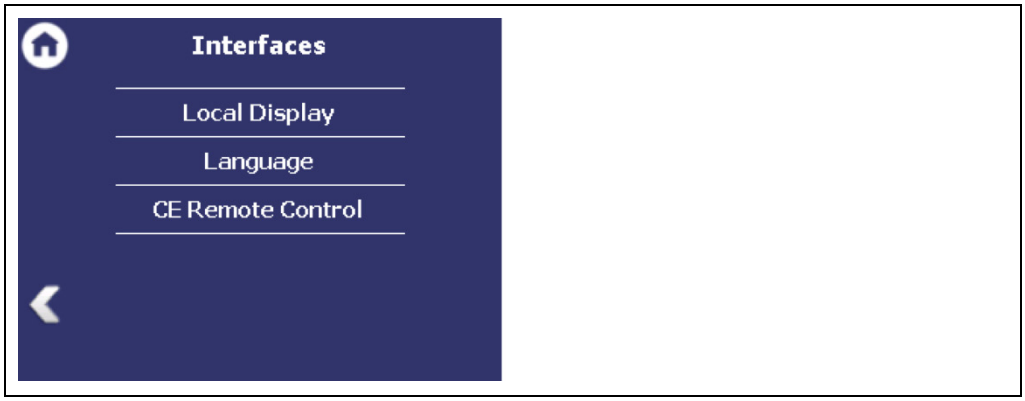


Fig. 30 Menu “Interfaces”

Local Display

Device setup | Setup | System | Interfaces | Local Display

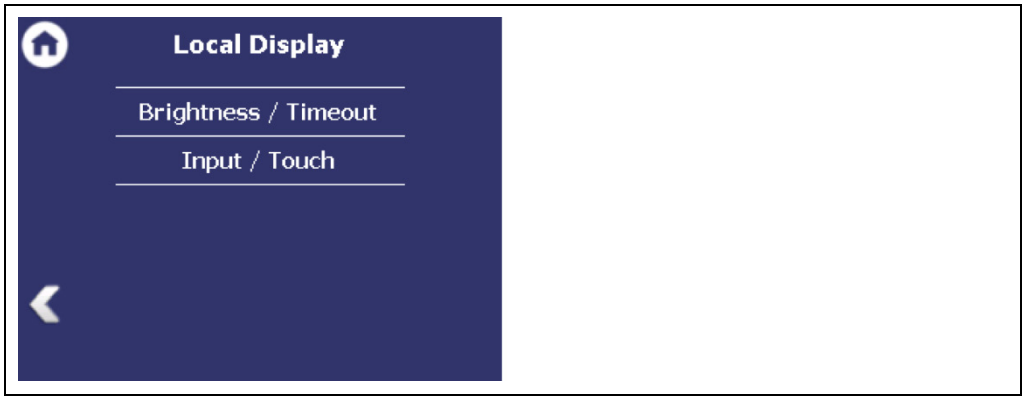
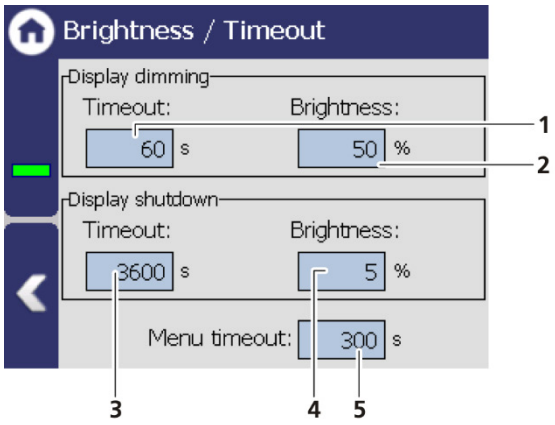


Fig. 31 Submenu "Local Display"

Brightness / Timeout

Device Setup | Setup | System | interfaces | Local Display | Brightness / Timeout

“Timeout” refers to the period of time during which the display is not operated. The value “Time out display brightness” cannot be set greater than the value at “Time out display shutdown”.



1 Input field “Timeout”
2 Input field “Dimming”
3 Input field Display shutdown “Timeout”
4 Input field Display shutdown “Brightness”
5 Input field “Menu timeout”

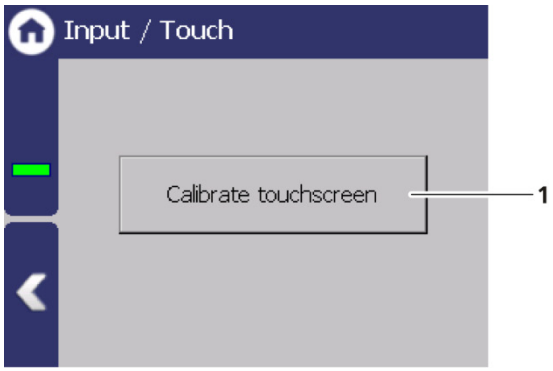
Fig. 32 Brightness / Timeout

Display dimming	In the field Display dimming, clicking the input fields allows the entering of the brightness (Fig. 33, item 2) in percent, that is set after expiry of the time (Fig. 33, item 1).
Display shutdown	In the field Display shutdown, clicking the input fields allows the entering of the brightness (Fig. 33, item 4) in percent, that is set after expiry of the time (Fig. 33, item 3).
Menu timeout	Under "Menu timeout" clicking on the input field (Fig. 33, item 5) changes the time period (seconds) in which the menu view changes to the standard view.

Input / Touch

Device Setup | Setup | System | Interfaces | Local Display | Input / Touch

The mouse pointer automatically becomes visible when a mouse is inserted into the USB port.



1 Button <Calibrate touchscreen>

Fig. 33 Input/ Touch

Calibrate Touchscreen

The calibration may only be carried out with direct skin contact. Take gloves or any other protective equipment off your hands. Calibration via the remote control software is not possible.

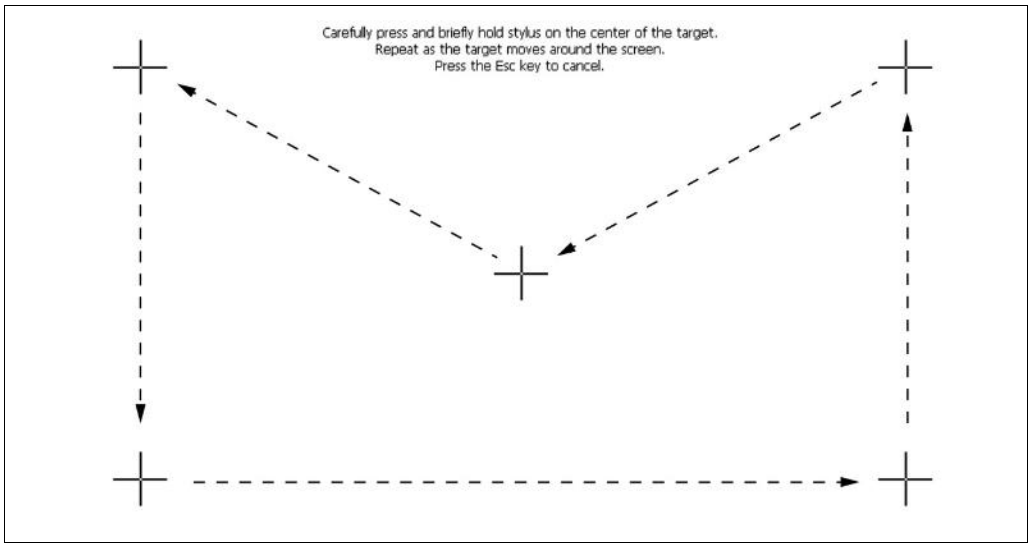


Fig. 34 Calibrate touchscreen

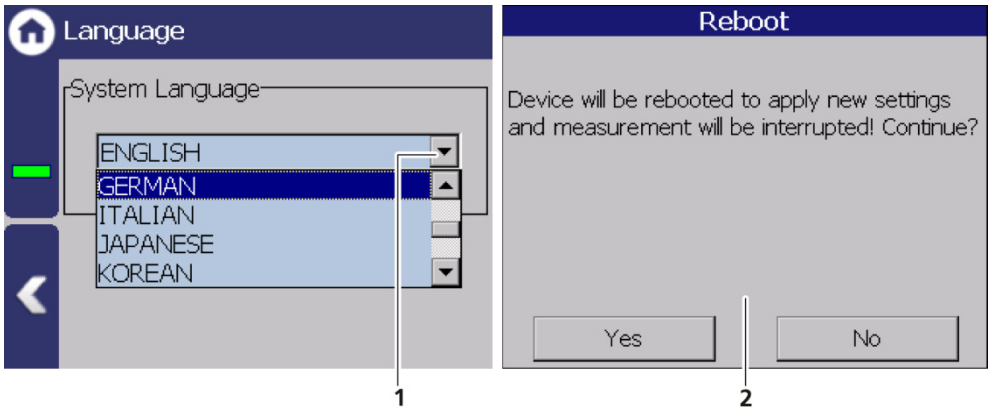
1. Click on <Calibrate touchscreen>.
   - ▶ The calibration screen opens.
2. Press the middle of the displayed cross with your finger.
   - ▶ If you take your finger off the cross again, the cross jumps to the top left corner.
3. Repeat the process until the cross is no longer displayed and the calibration is finished.
4. Confirm the calibration by clicking on the white screen to go back to "Input/Touch"

5. Execute a restart of the EVU after prompting.

▶ The touch display is calibrated.

Language

Device Setup | Setup | System | interfaces | Language



1 Selection arrow
2 Information window “Reboot”

Fig. 35 Language

Change System Language

1. Click on the selection arrow (Fig. 36, item 1) and select a language.

▶ An information window “Reboot” (Fig. 36, item 2) appears.

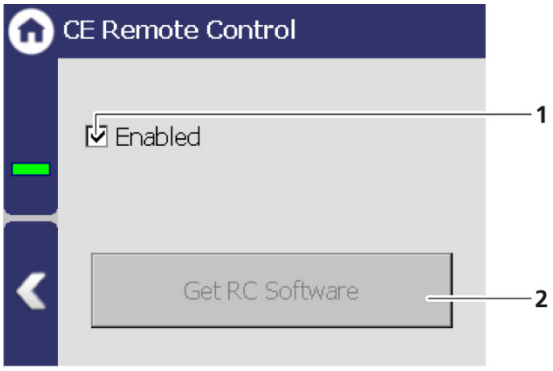
2. Confirm with <Yes> to reboot the device.

▶ The measurement is interrupted, device is restarted and the language has been changed.

CE Remote Control

Device Setup | Setup | System | interfaces | Local Display | CE Remote Control

By activating (Fig. 37, item 1) the CE Remote Control, the unit can be operated via the network connection. The software of the remote control (RC software) is stored on the device and can be copied to a USB storage device.



1 Check box remote control “Enabled”
2 Button <Get RC Software>

Fig. 36 CE Remote Control

Copy RC software

1. Connect a USB storage device to the device (Fig. 4, item 5).

▶ The USB storage device is recognized by the system after a few seconds and the button <Get RC software> (Fig. 37, item 2) can be clicked.

2. Click on the button <Get RC software> (Fig. 37, item 2).

▶ The software (“LB47xRemoteControl.exe“) is copied to the USB storage device.

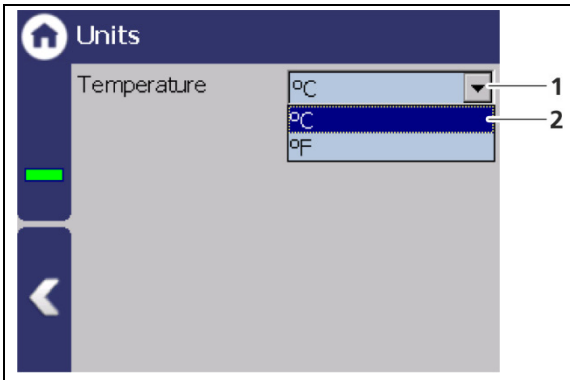
Information

The RC software includes the file “LB47xRemoteControl.exe” and runs without installation.
Operation of the RC software is described in Chapter “Remote Control Software” (see next but one chapter).

Units

Device Setup | Setup | System | Units

Clicking on the individual selection arrow lists the available units for the measuring value. The selected unit is shown in the standard display and used in the calibration settings.



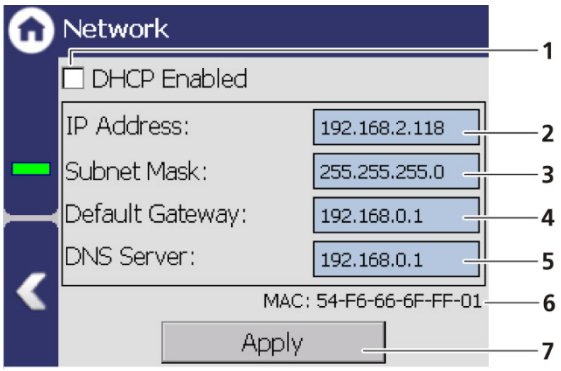
1 Selection arrow
2 Selection “°C” or “°F”

Fig. 37 Unit temperature

Network

Device Setup | Setup | System | Network

In the Network settings menu, you can make changes to the network settings. The information can only be edited in the access level "Standard" (see chap. 7.2 Menu Access).



1	Check box "DHCP Enabled"	5	DNS Server
2	IP Address	6	MAC Address
3	Subnet Mask	7	Button <Apply>
4	Default Gateway		

Fig. 38 Network settings

You can set the network address either manually or using DHCP (automatic assignment). To do this, check the "DHCP active" in the selection field (Fig. 39, item 1).

IMPORTANT

The PC and the LB 47x have to be in the same IP subnet.
In the event of an automatic assignment of the IP address by a DHCP server, you can only look at the given IP address. A modification of the IP address is not possible. On this side, you can also read the MAC address of the device (Fig. 39, item 6).

Manual Setting

1. Click on the text field (Fig. 39, item 2-5) to open the input field.
2. Enter the appropriate network addresses.
3. Confirm with the Enter key.
4. Click on <Apply> (Fig. 39, item 7) to adopt the network settings.

IMPORTANT

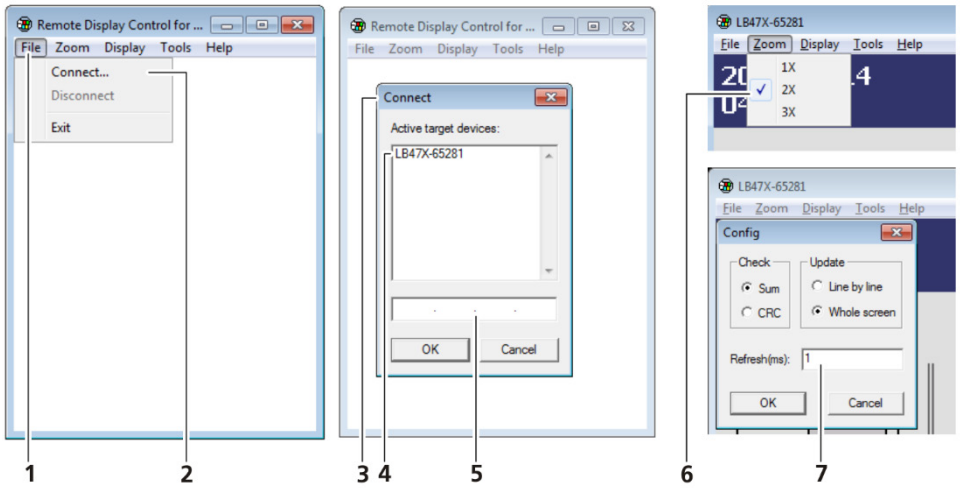
All settings performed must be confirmed by clicking on <Apply> so that the settings become real.

Remote Control Software

If the EVU is connected to a network at the RJ45 socket (Fig. 4, item 9), the EVU can be operated via a computer. The software can be loaded onto a USB storage device (see chapter “CE Remote Control”).

IMPORTANT

In order for the Remote Control to function, the selection check mark in the menu “CE Remote Control” must be set to "Active" (Fig. 37, item 1).



1	Program Remote Control	5	Input box IP address
2	Box <Connect…>	6	Zoom
3	Window Connect	7	Number of Refresh in milliseconds
4	List of transmitters		

Fig. 39 Establishing connection to the EVU using the RC software

1. Click on "LB47xRemoteControl.exe", to start the program.
   - ▶ The program starts (Fig. 40, item 1).
2. Click on the <File> tab and then on <Connect…> (Fig. 40, item 2), to establish a connection to the EVU.
   - ▶ A new window “Connect” is opened (Fig. 40, item 3) and the connected transmitters are listed.

IMPORTANT

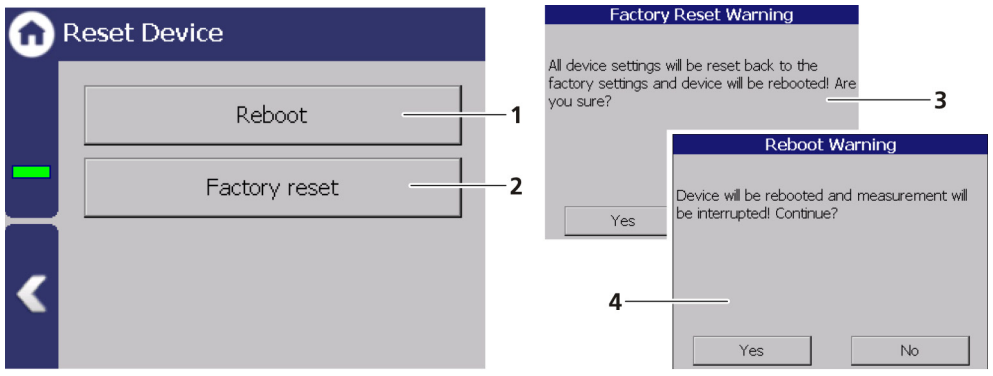
The IP address of the EVU must be in the same sub-network (Fig. 39, item 3) as the network adapter of the computer (see previous Chapter “Network”).

3. Click on the identifier of the transmitter (Fig. 40, item 4) or enter the IP address of the EVU in the input box (Fig. 40, item 5) (see Fig. 40, item 2).
4. Click on <OK>.
   - ▶ The connection to the EVU is established.
5. You can enlarge the view in the “Zoom” menu (2x, 3x). In the menu "Tools | Config“ you can change the display refresh rate.
   - ▶ When closed, the RS software is simply minimized and can be opened using the icon in the Windows taskbar.

Reset Device (EVU)

Device Setup | Setup | System | Reset Device

The evaluation unit can be restarted and reset to factory settings in the window “Reset device”.



1 Button Reboot
2 Button Factory settings
3 Window “Warning: Reboot”
4 Window “Warning: Factory Reset”

Fig. 40 Reset Device

Restart Device

IMPORTANT

The measurement is interrupted during a reboot!

1. To restart the device, click the button <Restart> (Fig. 41, item 1).
▶ A window with a warning "Reboot" (Fig. 41, item 3) opens.
2. Click on <Yes> to confirm.
▶ The device is restarted.

Reset Device (Factory Reset)

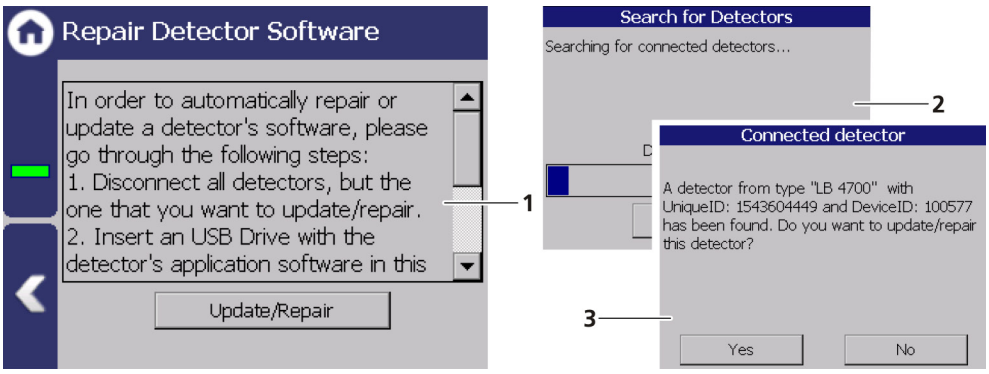
IMPORTANT

- ▶ When there is a reset to factory settings, all data logs are deleted and all user-defined configuration settings are reset!
- ▶ If error M102 appear, the device possibly must be reset twice.

1. To reset the evaluation unit to the factory settings, click the button <Factory settings> (Fig. 41, item 2).
▶ A window with the warning "Factory settings" (Fig. 41, item 4) opens.
2. Click on <Yes> to confirm.
▶ The device is reset to factory settings and restarts.

Repair Detector Software

Device Setup | Setup | System | Repair Detector Software



1 Button <Update / Repair>
2 Process "Search for Detectors"
3 Search result

Fig. 41 Repair Detector Software

⚠ DANGER

Danger to life from electric shock!

- The repair may only be carried out by a qualified electrician.
- Please adhere to the relevant safety regulations.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

If a communication interruption occurs during an update of the detector software, it is not possible to reinstall the software. With the "Repair detector software" function, the connection to the detector can be re-established and the update re-started. Corresponding information is displayed to the user in this menu.

Tip

The current software versions for the detectors can be downloaded from the Berthold website (www.berthold.com).

7.3.2 Detectors

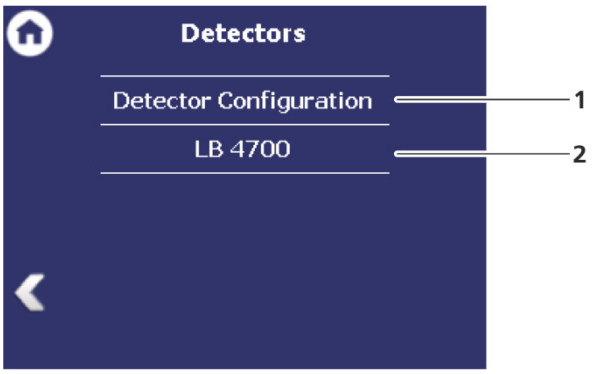
Device Setup | Setup | Detectors

You can perform the following settings and read information in the submenu “Detectors”:

- Detector configuration (Fig. 43, item 1)
  - Add / Remove detectors
  - Settings of the detectors
- Configuration of the respective detector (Fig. 43, item 2)
  - Overview
  - Plateau
  - Temperature
  - High voltage
  - Detector Service

IMPORTANT

If the system does not detect a detector, then the detector submenu cannot be selected.



1 Detector configuration
2 Detector name (as entered in the detector description)

Fig. 42 Menu "Detectors"

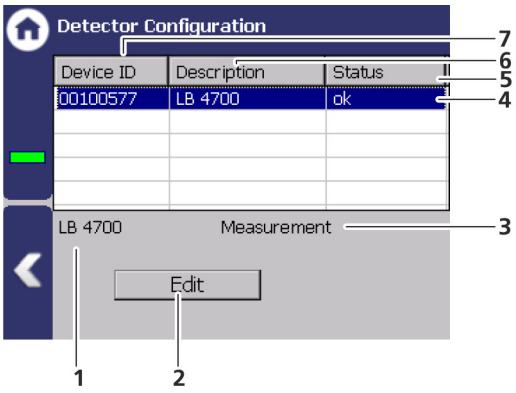
Detector Configuration

Device Setup | Setup | Detectors | Detector Configuration

In the window “Detector Configuration” the detectors for the measuring system are added and configured. Only configured detectors are listed and shown in the menu (Fig. 43). When a detector is selected (Fig. 44, item 6), the detector type (Fig. 44, item 4) and measuring task (Fig. 44, item 5) are shown. In systems with a single detector the device ID is determined automatically and listed.

Information

Information and settings for the detector are in the individual detector menu (Fig. 46).

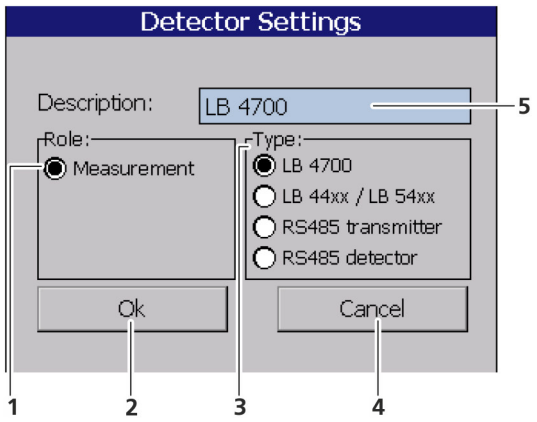


1 Type of selected detector
2 Button <Edit>
3 Measuring task for the selected detector
4 List of the Detectors
5 Status of the Detector
6 Description of the Detector
7 Device ID of the detector

Fig. 43 Detector Configuration

Detector Settings

The settings of a configured detector are edited by selecting and clicking on <Edit> (Fig. 44, item 2).



1 Field "Role" (no selection possible)
2 Button <Ok>
3 Field "Type"
4 Button <Cancel>
5 Input field “Description”

Fig. 44 Detector Settings

Measurement	The selection “Measurement” determines the level of the container.
LB 4700	Detector of type LB 4700.
LB 44xx / LB 54xx	Detector of the type LB 44xx and LB 54xx (no device ID).
RS 485 transmitter	By selecting “RS 485 transmitter”, other EVUs can be connected.
RS 485 detector	With the selection “RS 485 detector” it is possible to connect a specific detector via the RS 485 interface.
Description	Detector description. Also used for error messages, logs and in the menu structure (Fig. 43).

Detector Settings

Device Setup | Setup | Detectors | [NAME DETECTOR]

You can adjust the following settings and read information in the submenu of the respective detector:

- Overview of count rate, HV value and temperature
- Plateau
  - Plateau Settings
  - Plateau Measurement
  - Plateau Table
  - Plateau Curve
- Current temperature and extreme values
- High Voltage
  - Detector Type
  - HV Settings
- Pt100
- Detector Service
  - Device information
  - Event Log
  - Event Overview
  - Reset Detector

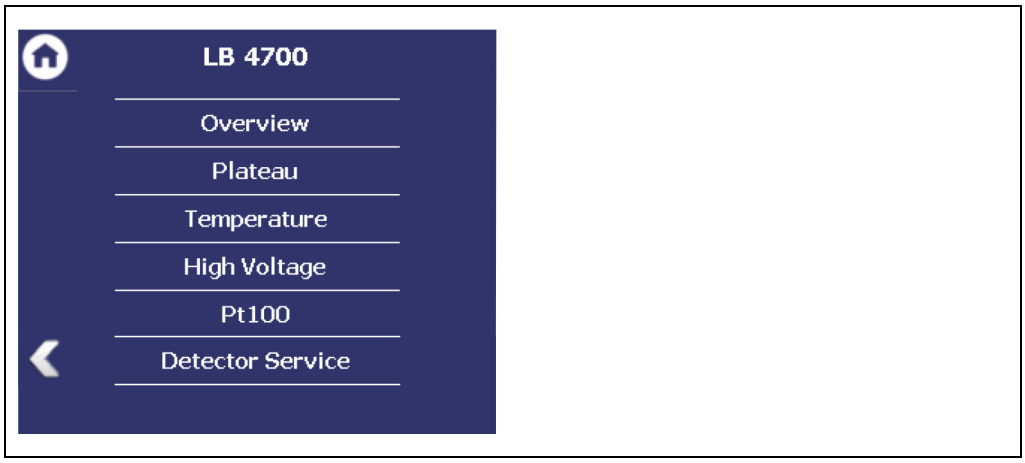
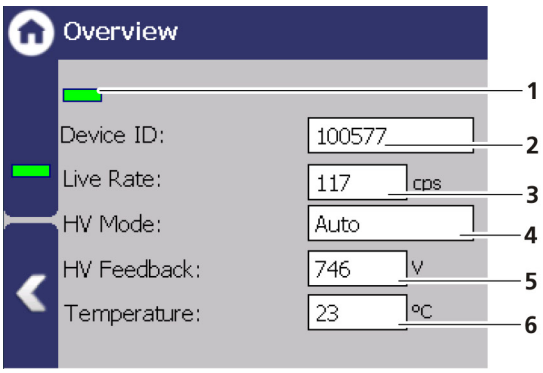


Fig. 45 Submenu “Detector”

Detector Settings: Overview

Device Setup | Setup | Detectors | [NAME DETECTOR] | Overview

All important parameters and measured values of the detector are clearly displayed in the window “Overview”.



1 Status information of the detector
2 Device ID
3 Live rate [cps]
4 HV mode
5 HV feedback [V]
6 Temperature [°C]

Fig. 46 Overview detector information

	A green bar appears with error-free status of the detector (Fig. 47, item 1).
Device ID	Shows the ID (Fig. 47, item 2) of the detector.
Live Rate	The "Live Rate" (Fig. 47, item 3) displays the current, unfiltered count rate.
HV Mode	In the field “HV mode” (Fig. 47, item 4), the HV mode is displayed, which is chosen under Device Setup | Setup | Detectors | [NAME DETECTOR] | High Voltage | HV Settings.
HV Feedback	The field “HV Feedback” (Fig. 47, item 5) displays the actual measured value in volts.
Temperature	The field “Temperature” (Fig. 47, item 6) indicates the current temperature of the detector in C°.

Detector Settings: Plateau

Device Setup | Setup | Detectors | [NAME DETECTOR] | Plateau

The plateau provides information on whether the detector is stable. A plateau measurement is therefore only carried out when the measured value drifts, or other doubts exist about the function of the detector. Panel measurement can help narrow down the possible cause of the problem.

The high voltage necessary for the operation of the photomultipliers is increased stepwise for the plateau recording and the pulse rate measured after each increase. The determined plateau curve is displayed on a diagram. The pulse rate increases with increasing voltage. This must form a unique plateau. If a too short or too steep plateau is detected, the detector is operating in an unstable manner. The submenu “Plateau” (Fig. 48) leads to the plateau measuring and the display of plateau values.

Please contact your responsible service or sales partner, or Berthold directly, so that they can get a qualified assessment to the measured plateau.

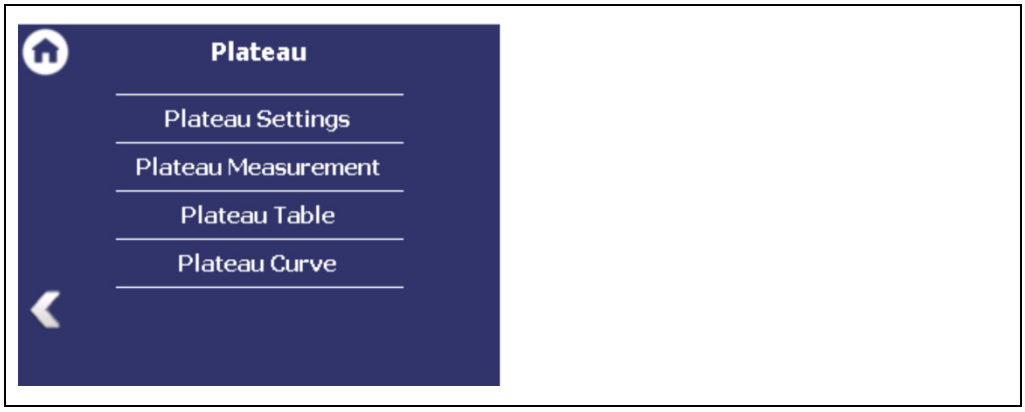
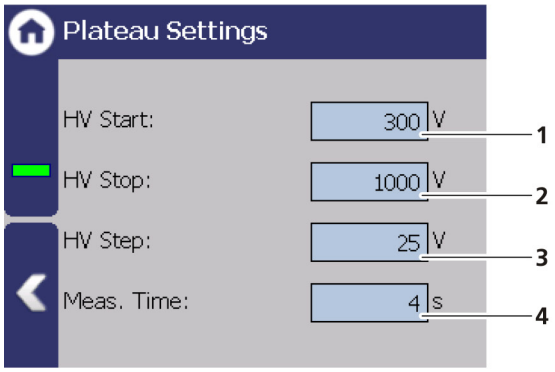


Fig. 47 Menu "Plateau"

Plateau Settings

Device Setup | Setup | Detectors | [NAME DETECTOR] | Plateau | Plateau Settings

The values in the menu “Plateau settings” are pre-set by Berthold on delivery and can be used in most situations.



1 Input field HV start value in volts
2 Input field HV end value in volts
3 Input field HV increment in volts
4 Input field measuring time in seconds

Fig. 48 Plateau Settings

You have the following settings options in the menu “Plateau Settings”:

HV Start / HV Stop	Defining the range of the plateau recording.
HV Step	Specifies the step (interval) between two measuring points.
Measuring Time	Identifies the time that is used per measuring point for the counting of the count rate.

1. Click on the corresponding input field (Fig. 49, item 1-4).

▶ The input field opens.

2. Change to the keypad and enter the value.
3. Confirm with the Enter key.

▶ The values for the recording plateau have been changed.

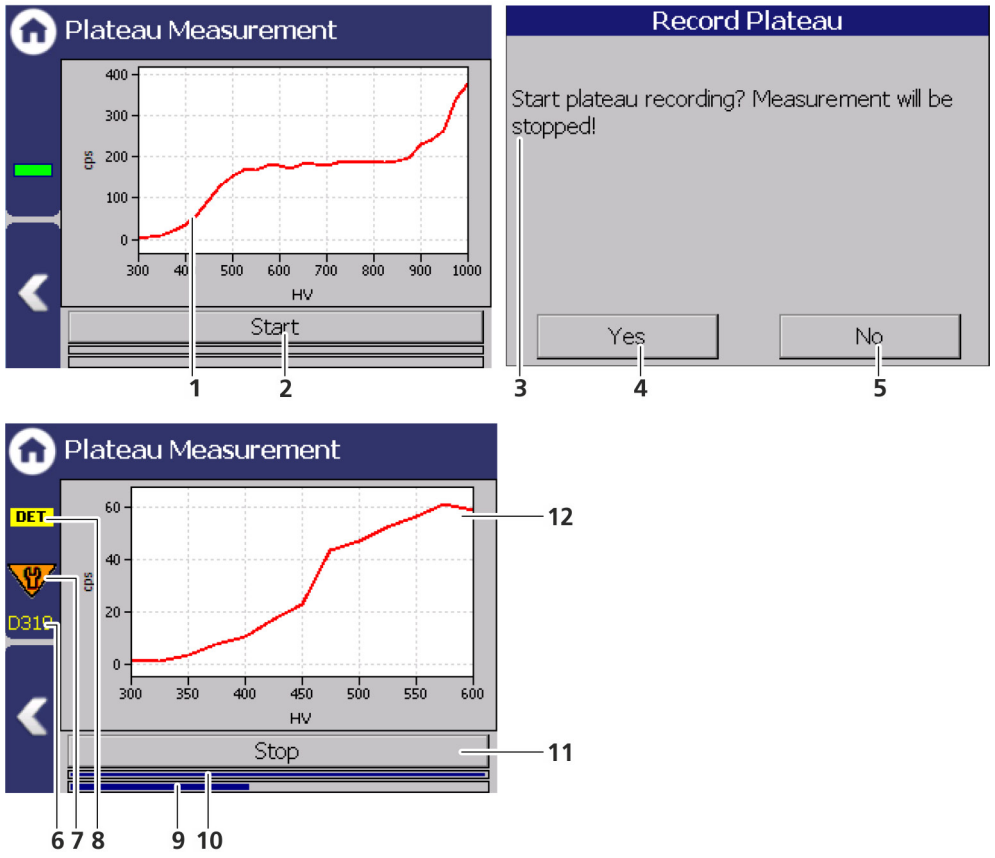
Perform Plateau Measurement

Device Setup | Setup | Detectors | [NAME DETECTOR] | Plateau | Plateau Measurement

IMPORTANT

The environmental conditions and the dose rate must be constant during the plateau recording.

- Observe the operating manual of the detector.



1	Plateau curve	7	Notice Maintenance
2	Button <Start>	8	Notice “DET”
3	Window “Record plateau”	9	Progress bar measuring process
4	Button <Yes>	10	Progress bar measuring step
5	Button <No>	11	Button <Stop>
6	Event message code	12	New plateau curve

Fig. 49 Recording a plateau curve

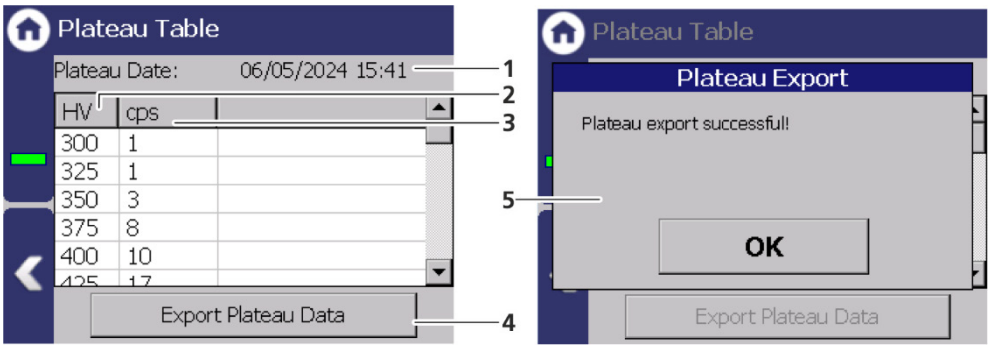
1. Click on <Start> (Fig. 50, item 2) to perform a plateau measurement.
- The confirmation message "Record Plateau" (Fig. 50, item 3) opens.
2. Confirm with <Yes> (Fig. 50, item 4).
- The EVU switches to mode "DET" (Fig. 50, item 8) and the current measurement is stopped.
- The information (Fig. 50, item 6 - 8) from the plateau measurement are displayed in the status information. The LED Run flashes on the EVU during the plateau measurement. The LED “Warning” LED lights up at the same time.
- If you click on the <Stop> button during the measurement, the measuring process is interrupted. The measurement data are invalid and will be deleted.

- The recorded values are read and entered into the table (Fig. 51), the plateau curve (Fig. 52) is drawn and stored automatically.

Plateau Table

Device Setup | Setup | Detectors | [NAME DETECTOR] | Plateau | Plateau Table

The data from each measurement point are listed in the plateau table. The data from the plateau table can be exported to a USB memory device.



1 Date and time of measurement recording
2 High voltage (HV) in volts
3 Count rate in the measurement channel (cps)
4 Button <Export Plateau Data>
5 Window “Plateau export successful”

Fig. 50 Plateau Table

Export Plateau Data

1. Connect a USB flash drive to the USB port of the EVU.
- The USB memory device is recognized by the system after a few seconds and the button <Export Plateau Data> can be clicked.
2. Click on the button <Export Plateau Data> (Fig. 51, item 4).
- The values of the plateau measurement have been stored in a .txt file.
3. Confirm the message with <OK>.

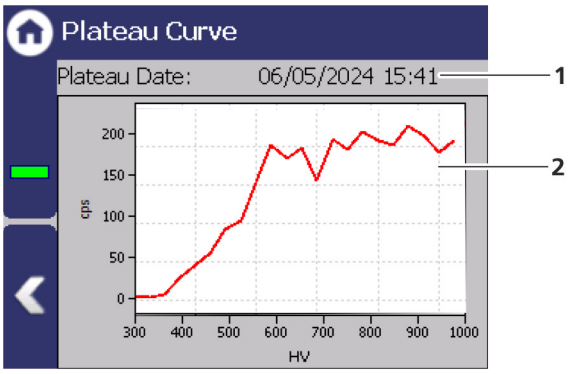
Information

The file name is derived from "Plateau", the date and time of the measurement process (PlateauYYYYMMDD_hr_min_sec.txt).

Plateau Curve

Device Setup | Setup | Detectors | [NAME DETECTOR] | Plateau | Plateau Curve

The mapped characteristic curve (Fig. 52, item 2) of the last complete plateau measurement is displayed in the window “Plateau Curve”.



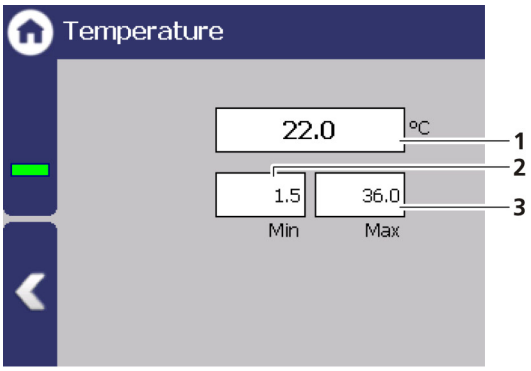
1 Date and Time of measurement recording
2 Characteristic curve

Fig. 51 Plateau Curve

Detector Settings: Temperature

Device Setup | Setup | Detectors | [NAME DETECTOR] | Temperature

The current temperature and the extreme values of the detector is displayed in the window “Temperature".



1 Current temperature of the detector [°C]
2 Maximum measured temperature [°C]
3 Minimum measured temperature [°C]

Fig. 52 Temperature of the detector

Detector Settings: High Voltage

Device Setup | Setup | Detectors | [NAME DETECTOR] | High Voltage

You can select the detector code and make settings for high-voltage regulation in the submenu “High Voltage” of the respective detector.

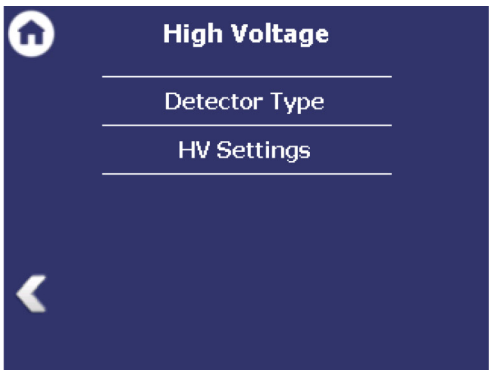


Fig. 53 Submenu “High Voltage”

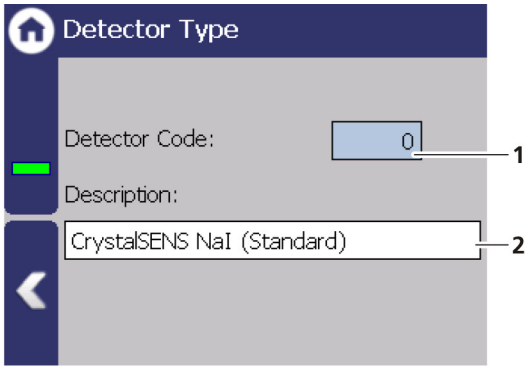
Detector Settings: High Voltage | Detector Type

Device Setup | Setup | Detectors | [NAME DETECTOR] | High Voltage | Detector Type

Internal device parameters are adjusted to suit the size of the used scintillator by setting the detector code. The correct detector code is already set at the factory and a change is not normally required.

IMPORTANT

A table with the detector code to be used is in the operating manual of the respective detector.

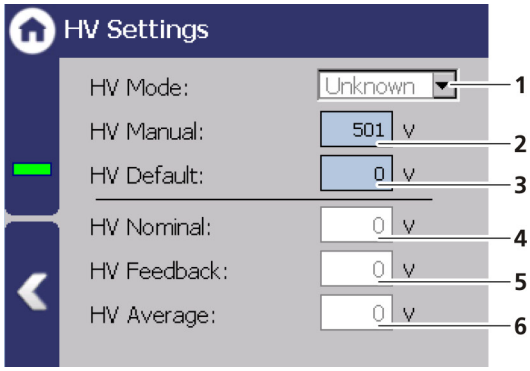


1 Input field Detector code
2 Description of the scintillator type

Fig. 54 Detector Type: Setting the detector code (scintillator type)

Detector Settings: High Voltage | HV Settings

Device Setup | Setup | Detectors | [NAME DETECTOR] | High Voltage | HV Settings



1 Selection High voltage mode “Auto” / “Manual”
2 Input field Manual high voltage
3 Input field HV Default (starting value of the high voltage regulation)
4 Display field setting value high voltage
5 Display field actual value high voltage
6 Display field average high voltage

Fig. 55 HV Settings

NOTICE

Default HV is preset by Berthold. A subsequent change is not usually necessary. The default value HV = 0 may only be set for testing purposes. An incorrect setting may cause malfunction.

NOTICE

It is not recommended to use the “Manual” mode as a normal operating mode for high voltage control. “Manual” should only be used for service purposes.

Make HV Settings

1. Click on the selection arrow (Fig. 56, item 1) in order to set the desired HV mode (auto or manual).
   - AUTO: The optimum high-voltage supply of the photomultiplier is automatically determined and set by the device.
   - MANUAL: The high voltage is maintained at a fixed, user-entered value (Fig. 56, item 2).
2. Click in the input field "HV Default" (Fig. 56, item 3) to open the input field.
3. Enter the desired starting value for the high-voltage regulation.
4. Confirm with the Enter key.

▶ The start value has been changed.

Detector Settings: Detector Service

Device Setup | Setup | Detectors | [NAME DETECTOR] | Detector Service

You can adjust the following settings and read information in the submenu “Service":

- Device Information
- Event Log
- Event Overview
- Reset Detector

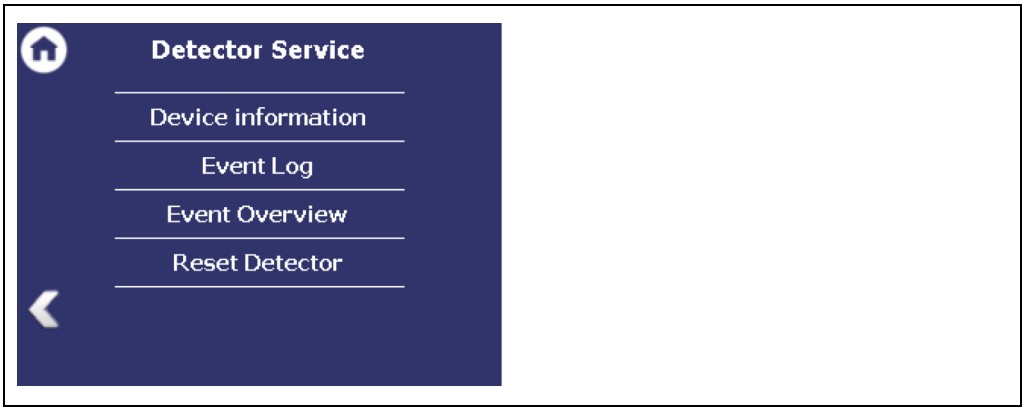
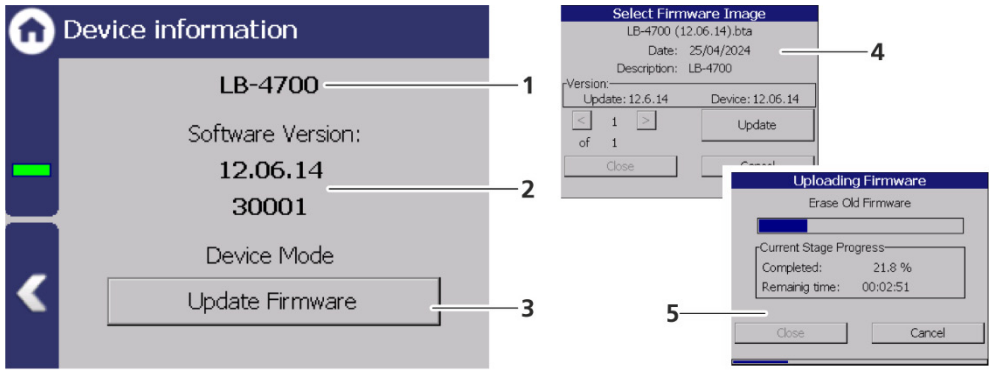


Fig. 56 Menu “Detector Service”

Detector Settings: Service | Device information

Device Setup | Setup | Detectors | [NAME DETECTOR] | Detector Service | Device information

This menu shows you the type of detector (Fig. 58, item 1) as well as an overview of the software version (Fig. 58, item 2, item 3) of the detector.



1 Detector type
2 Software version
3 Button <Update Firmware >
4 Window “Firmware file”
5 Window “Firmware upload”

Fig. 57 Device Information

Perform Firmware Update

NOTICE

An update of the firmware of the detector may take 1 hour and may only be performed by qualified specialists.

Tipp

The current software versions can be downloaded from the Berthold website (www.berthold.com).

IMPORTANT

In order for the system to detect the update file it must not be located in an index in the USB storage device.

1. Save the current update file of the firmware of the detector on a USB storage device.
2. Connect a USB storage device to the device (Fig. 4, item 5).
3. The USB storage device is recognized by the system after a few seconds and the <Firmware Update> (Fig. 58, item 4) button can be clicked.
4. Click on the button <Firmware Update> (Fig. 58, item 4).
   - A warning message appears (Fig. 58, item 5).
5. Confirm with <Yes>.
   - After a short search, the "Select firmware file" window appears.
6. Select the file and click on <Update>.
   - The old firmware is deleted and the new version is installed automatically.

After the update is finished, an update log is displayed.

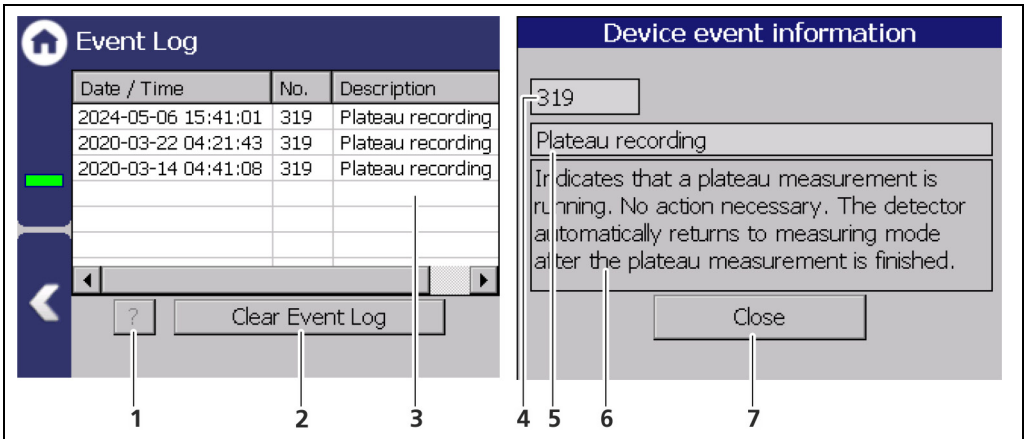
NOTICE

Berthold recommends a test or a calibrating the current outputs whenever if a software update has been carried out.

Detector Settings: Service | Event Log

Device Setup | Setup | Detectors | [NAME DETECTOR] | Detector Service | Event Log

The last 25 events of the detector are displayed in the window "Event Log".



1 Button <?> to display the detailed event description.
2 Button <Clear Event Log>
3 Event (Example: Plateau recording)
4 Event no.
5 Event title
6 Event description
7 Button <Close>

Fig. 58 Event Log

Display Event Description

1. Click on a line in the list (Fig. 59, item 3).
2. Click on <? > (Fig. 59, item 1)

▶ The event description appears.

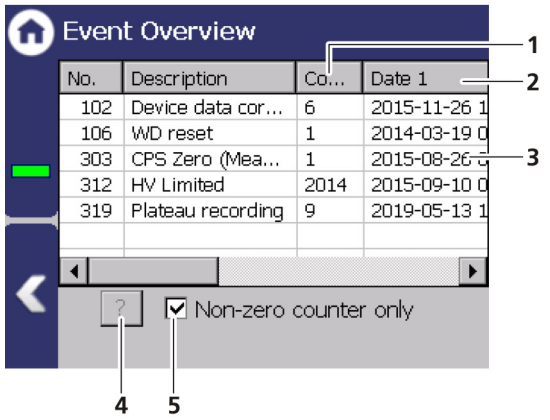
3. Close the event description with the button <Close> (Fig. 59, item 7).

▶ With the button <Clear Event Log> (Fig. 59, item 2) all events are deleted permanently.

Detector Settings: Detector Service | Event Overview

Device Setup | Setup | Detectors | [NAME DETECTOR] | Detector Service | Event Overview

All events that can be logged are chronologically presented in tabular form in the menu “Event overview”. Activate the check box “Non-zero counter only” in order to display events that have occurred.



1 “Count” column
2 “Date” column
3 Event line
4 Button <?>
5 Display check box "Non-zero counter only"

Fig. 59 Event Overview

1. Click on a line in the list (Fig. 60, item 3).
2. Click on <?> (Fig. 60, item 4).

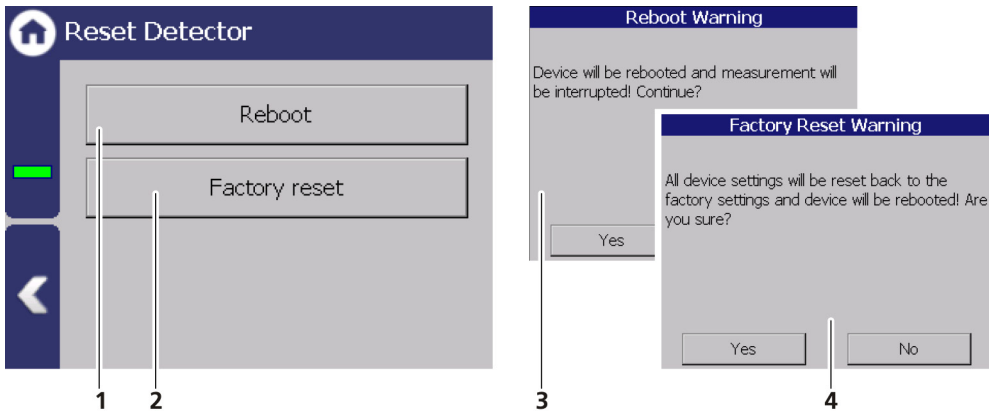
▶ The event description appears.

3. With the button <Close>, close the event description.
4. Slide the bar of the horizontal scroll bar to the right to see at what times (date, time) the event occurred.

Detector Settings: Detector Service | Reset Detector

Device Setup | Setup | Detectors | [NAME DETECTOR] | Detector Service | Reset Detector

In the window “Reset Detector”, the detector can be restarted and be reset to the factory settings.



1 Button <Restart>
2 Button <Factory settings>
3 Window "Warning: Reboot"
4 Window "Warning: Factory Reset"

Fig. 60 Reset Detector

IMPORTANT

The measurement is interrupted during a restart!

1. To restart the Detector, click the button <Reboot> (Fig. 61, item 1).
▶ A window with a warning “Reboot” (Fig. 61, item 3) opens.
2. Click on <Yes> to confirm.
▶ The device is restarted.

IMPORTANT

All custom configuration settings will be lost with a reset to factory settings!

1. To reset the detector to the factory settings, click the button <Factory reset> (Fig. 61, item 2).
▶ A window with the warning Factory settings (Fig. 61, item 4) opens.
2. Click on <Yes> to confirm.
▶ The device is reset to factory settings and restarts.

7.3.3 Calibration

Device Setup | Setup | Calibration

The Calibration menu is used for the selection of the calibration and calculation method and for adaption of the measurement system to the respective environmental conditions, the actual radiation activity and the adaptation of the background radiation (background).

NOTICE

Material damage to the device or the system!

- Errors in calibration or in the parameter setting can lead to incorrect measurement results. This may possibly lead to loss of production or to damage in the system.
- We encourage you to have the calibration and commissioning performed by Berthold service.

IMPORTANT

All entries and changes in the “Parameters” tab will take effect only when you click on the <Calibrate> button in the menu Calibration | Calibrate.

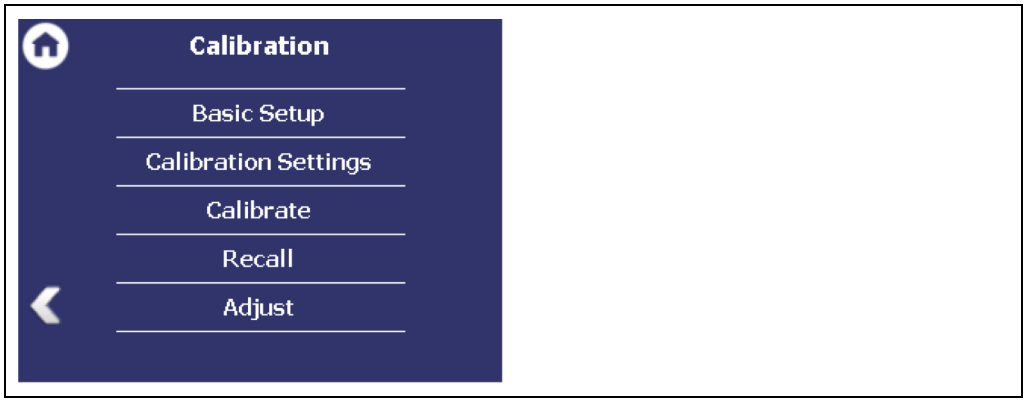
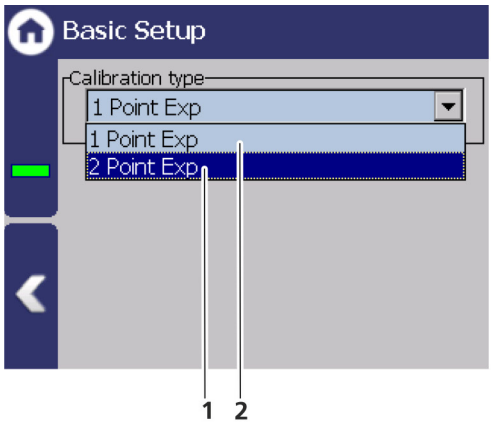


Fig. 61 Menu “Calibration”

Basic Setup

Device Setup | Setup | Calibration | Basic Setup



1 Calibration method “1 Point Exp”
2 Calibration method “2 Point Exp”

Fig. 62 Basic Setup

Calibration type

The method by which the measuring system must be calibrated depends on the respective measuring arrangement. Depending on the production or commissioning conditions, only one method is possible.

1 Point Exp	The calibration point for “empty” must be determined or entered. The second calibration point is calculated using the absorption coefficient, the measuring path and the product density.
2 Point Exp	The calibration points for “empty” and “full” must be determined or entered.

Calibration Settings: Background

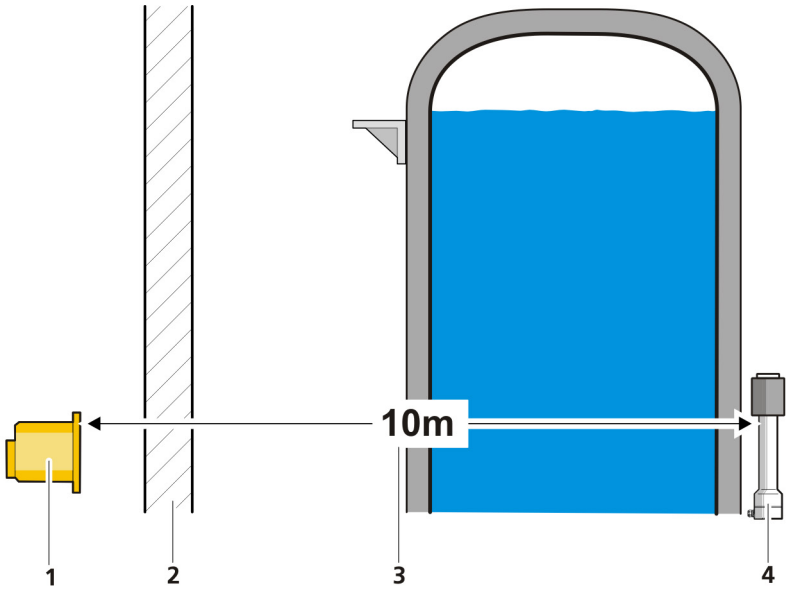
Device Setup | Setup | Calibration | Calibration Settings

The background count rate (Fig. 65, item 1) is the natural background radiation detected by the detector and must be measured. The correct recording of the background enables correct decay compensation and influences the long-term stability of the measured value.

NOTICE

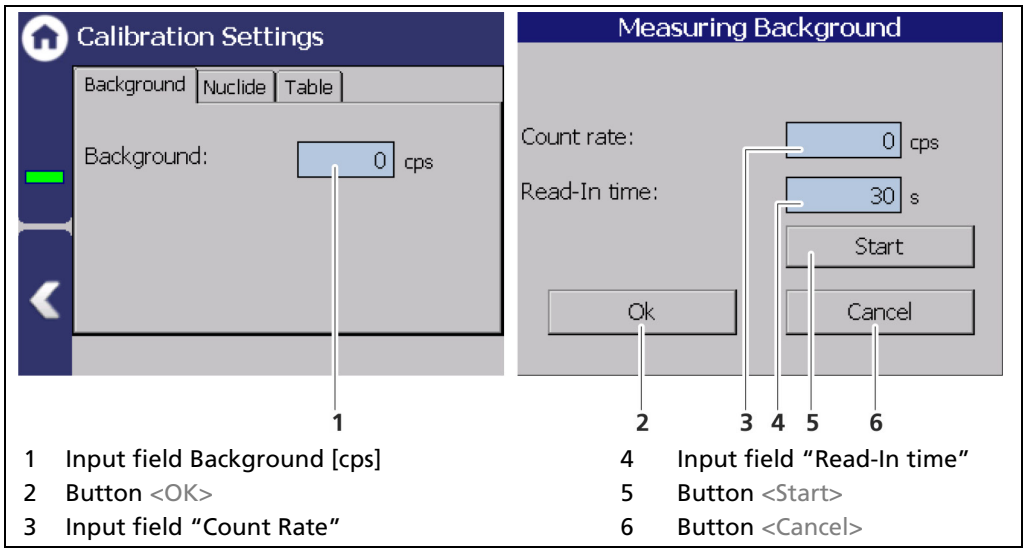
Even through a closed shield, measurable residual radiation remains, which can falsify the measurement of the background radiation.

- To determine the background count rate, it is recommended to place the shield with source at a suitable distance (approx. 10 m) to the detector, or behind a thick concrete wall.
- To avoid calibration errors, it must be ensured that during calibration and commissioning of the measuring equipment no welding tests are being done on the site, even at long distance.



1 Radiation shield (closed)
2 Concrete wall
3 Distance
4 Rod detector

Fig. 63 Conditions during background determination



1	Input field Background [cps]	4	Input field “Read-In time”
2	Button <OK>	5	Button <Start>
3	Input field “Count Rate”	6	Button <Cancel>

Fig. 64 Calibration settings: Background

Determine Background

Device Setup | Setup | Calibration | Calibration Settings

When determining the background, the natural background radiation for the measurement channel and the second channel is determined simultaneously.

1. Click on the text field “Background” (Fig. 65, item 1).

▶ A new window “Background” opens to determine the background count rate.

NOTICE

Influences from neighboring sources must be excluded in order to avoid errors in the measurement of natural background radiation.

2. Click on the “Read-In time” field (Fig. 65, item 4) and specify the duration of the measurement in seconds. The higher you set the measurement time, the more accurate the result.
3. Confirm with the Enter key and click on the button <Start> (Fig. 65, item 5) to start the measurement.

▶ The measurement is performed.

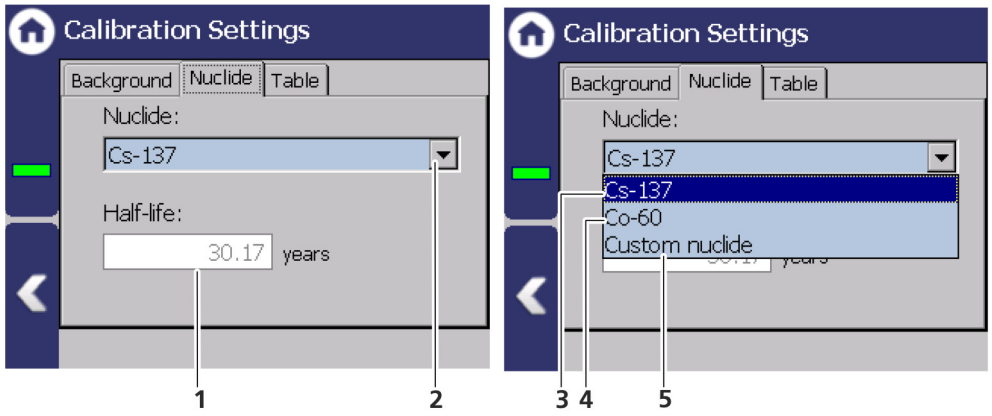
4. Click on <OK> (Fig. 65, item 2) to accept the count rate.

▶ The window closes and the values are accepted.

Calibration Settings: Nuclide

Device Setup | Setup | Calibration | Calibration Settings

The isotope used can be selected in the “Nuclide” tab. The half-life of the isotope is shown on the display field (Fig. 66, item 1).



1 Display field half-life [years]
2 Selection arrow Nuclide
3 Selection Caesium-137
4 Selection Cobalt-60
5 Custom nuclide

Fig. 65 Calibration settings: Nuclide

1. Click on the selection arrow (Fig. 66, item 2).
2. Select the isotope used. Cs-137 (Fig. 66, item 3) or Co-60 (Fig. 66, item 4). The isotope of the source is on the type plate of the screen (Fig. 67).
3. When selecting “Custom nuclide” (Fig. 66, item 5), the half-life of the isotope can be entered.

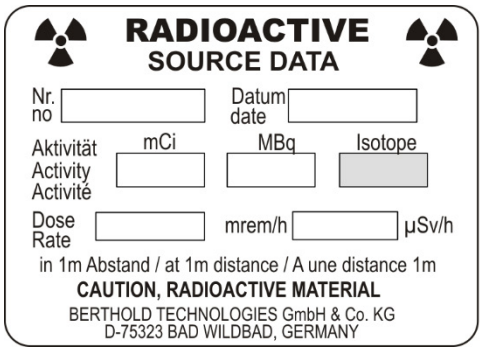
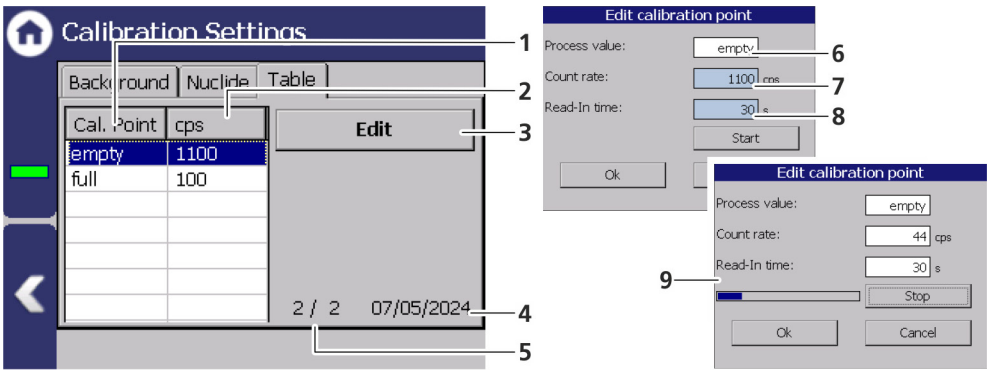


Fig. 66 Type Plate Source

Calibration Settings: Table (2 Point Exp calibration type)

Device Setup | Setup | Calibration | Calibration Settings



1 Column Cal. Point [empty/full]
2 Column count rate [cps]
3 Button <Edit>
4 Date of the last editing
5 Count of the calibration points
6 Process value (calibration point)
7 Count rate [cps]
8 Read-In-Time [s]
9 Measuring process

Fig. 67 Calibration setting table (2 Point Exp calibration type)

NOTICE

To avoid calibration errors, it must be ensured that during calibration and commissioning of the measuring equipment no welding tests are being done on the site, even at long distance.

Add new Calibration Point

1. Select in the column "Cal. Point" the first line (empty) (Fig. 68, item 1).
2. Click on the <Edit> button (Fig. 68, item 3).

▶ The “Edit” window (Fig. 68, items 6-8) opens.

3. Click on the “Read-in time” input field (Fig. 68, item 8).
4. Enter a read-in time and confirm with the Enter key.
5. Click on the <Start> button.

▶ The measuring process (Fig. 68, item 9) begins and the count rate is transferred to the count rate field (Fig. 68, item 7) after the read-in time has elapsed.

6. Click <Ok> to confirm the new calibration point.

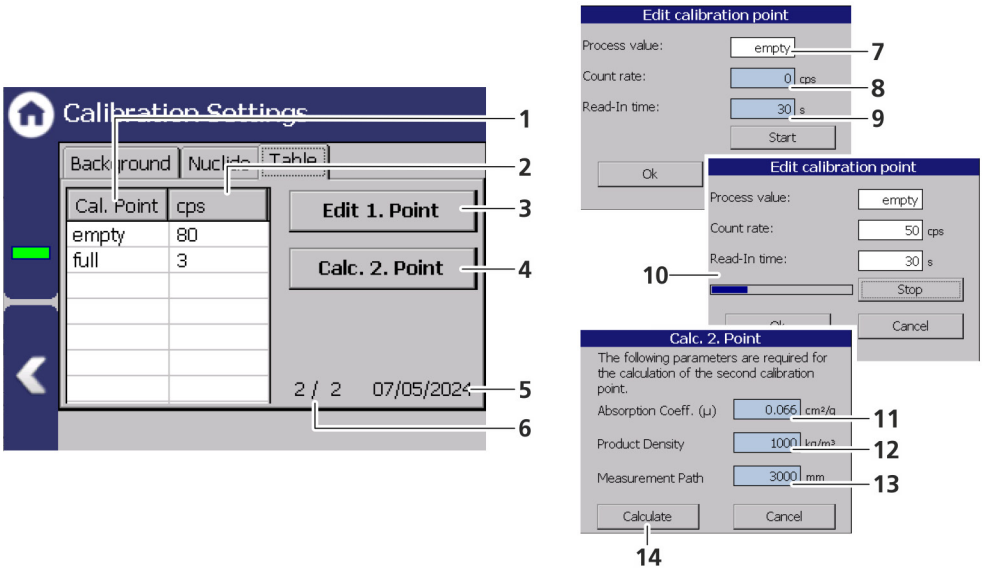
▶ The calibration point has been added to the table.

7. Select in the column "Cal. Point" the second line (full) (Fig. 68, item 1).
8. Repeat steps 2 to 6 to add the second calibration point (full).

Calibration Settings: Table (1 Point Exp calibration type)

Device Setup | Setup | Calibration | Calibration Settings

Using the 1 point exp. calibration method, the absorption coefficient, the measuring path and the product density must be known. Based on this, the second calibration point is calculated.



1	Column Cal. Point (empty / full)	8	Count rate [cps]
2	Column count rate [cps]	9	Read-In time [s]
3	Button <Edit 1. Point>	10	Measuring process
4	Button <Calc. 2. Point >	11	Absorption coefficient
5	Date of the last editing	12	Product density (or density of the bulk)
6	Count of the calibration points	13	Measurement path
7	Process value (calibration point)	14	Button <Calculate>

Fig. 68 Calibration settings table (1 Point Exp calibration type)

NOTICE

To avoid calibration errors, it must be ensured that during calibration and commissioning of the measuring equipment no welding tests are being done on the site, even at long distance.

IMPORTANT

The absorption coefficient (μ) is preset according to the selected nuclide.

Determine calibration point

1. Click on the button <Edit 1. Point > (Fig. 69, item 2).
   ▶ The window “Edit calibration point” (Fig. 69, item 7-9) opens.
2. Click on the input field “Read-In time” (Fig. 69, item 9) to open the input field.
3. Specify a read-in time and confirm with the Enter key.
4. Click on the button <Start>.

- The measuring process (Fig. 69, item 10) begins and the count rate is transferred to the count rate field (Fig. 69, item 8)

5. Click on <OK> to confirm the new calibration point.
- The calibration point “empty” has been added to the table.

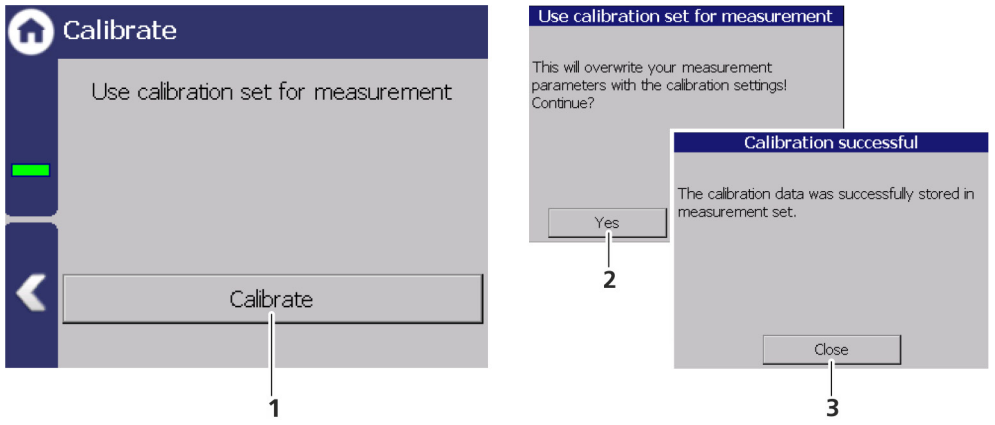
6. Click on the button <Calc. 2. Point > (Fig. 69, item 4).
- The "Calc. 2nd point" window (Fig. 69, item 11-14) opens.

7. Enter the absorption coefficient of the product. Enter it with a negative prefix. Unless it is one of the very rare applications with an inverted characteristic.
8. Enter the product density.
9. Enter the measurement path.
10. Click on the button <Calculate>.
- The calibration point “full” has been calculated and added to the table.

Calibrate

Device Setup | Setup | Calibration

Data that are necessary for a complete measurement are found in the calibration parameter set. All the data of the calibration parameter set are transferred to the measurement parameter set when the button “Calibrate” is clicked. Only after this are they can be used for measurement value calculation.



1 Button <Calibrate>
2 Button <Yes>
3 Button <Close>

Fig. 69 Calibrate

1. Click on the button <Calibrate> (Fig. 70, item 1).
▶ A new window with the message “Use calibration set for measurement” appears.
2. Click on the <Yes> button (Fig. 70, item 2) to overwrite your measurement parameters with the calibration settings.
▶ A new window with the message “Calibration successful” appears.
3. Click on the <Close> button (Fig. 70, item 3)
▶ The calibration was performed.

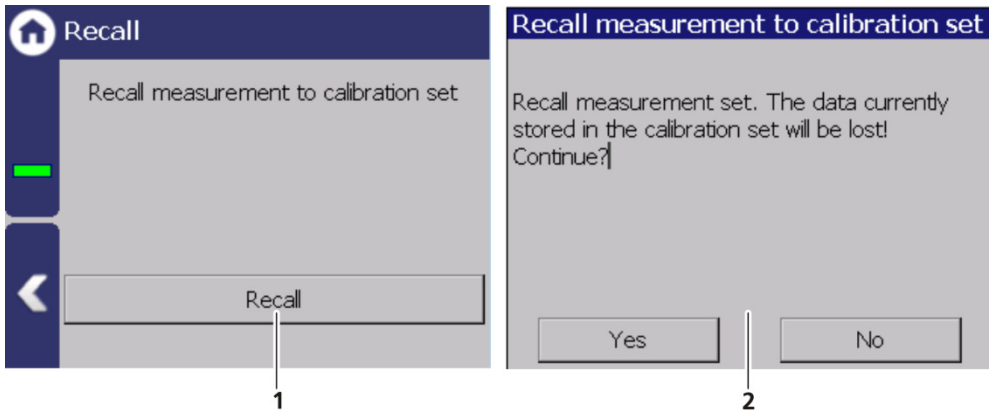
NOTICE

Check your calibration by simulating a detector count rate. Use the test count rate in the simulation menu.

As the value of the test count rates, e.g. the counting rates from the calibration points are used. Check whether the correct measured value is displayed at the respective test count rate.

Recall

Device Setup | Setup | Calibration | Recall



1 Button <Recall>
2 Window “Recall measurement to parameter set”

Fig. 70 Recall

Recall to calibration set

1. Click on the button <Recall> if you want to copy the measurement set into the calibration set.
2. The window with the message “Recall measurement to calibration set” appears.
3. Click on <Yes>.

▶ The calibration parameter set was overwritten.

Adjust

Wall deposits and caking may trigger false alarms. If these deposits build up slowly and their layer thickness changes only gradually, you can ensure the safe function of the measurement by carrying out regular empty calibrations. A digital input allows automatic empty adjust directly from the control room.

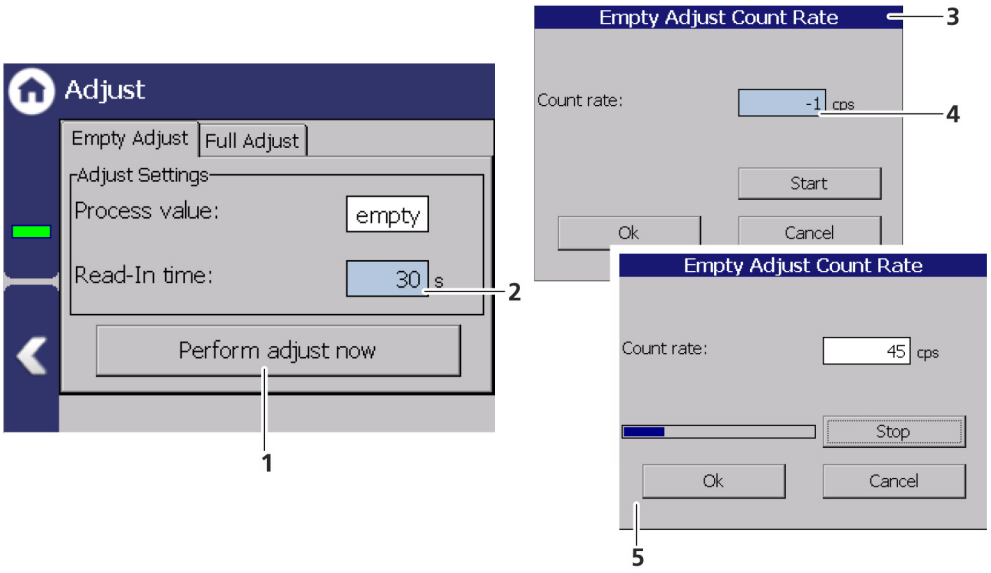
Empty Adjust

Device Setup | Setup | Calibration | Adjust - Empty Adjust

An empty adjust may only be carried out when the level is below the monitored limit level.

NOTICE

Make sure that the source is mounted and the beam path is open. The container must be empty, or be below the limit value.



1 Button <Perform adjust now>
2 Input field “Read-In time”
3 Window “Empty Adjust Count Rate”
4 Input field “Count rate”
5 Measuring process

Fig. 71 Empty Adjust

1. Click on the “Read-In time” field (Fig. 72, item 2) and specify the duration of measurement in seconds. The higher you set the time, the more accurate the result.
2. Click on the button <Perform adjust now> (Fig. 72, item 1).

▶ The window “Empty Adjust Count Rate” (Fig. 72, item 3) opens.

3. Click on <Start>.

▶ The measurement starts (Fig. 72, item 5).

4. Click on <OK> to carry out the adjust with the count rate.

▶ The message “The adjust operation was successful” appears and the count rate has been adjusted (see standard display).

IMPORTANT

When executing an Adjust, the measurement parameter set is overwritten. If the system should be recalibrated, a Recall of the measurement parameter set to the calibration parameter must be performed. Otherwise the Adjust will become lost.

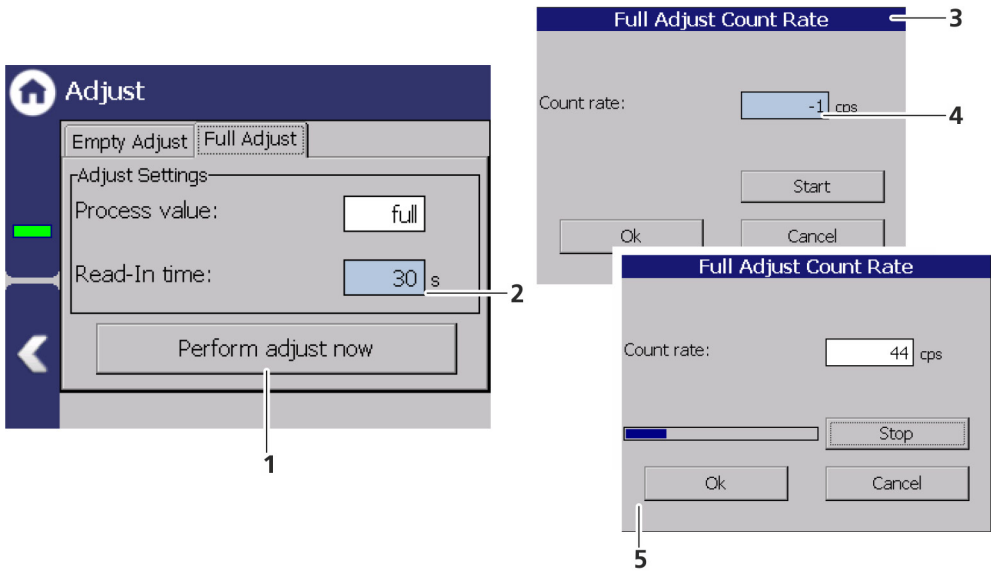
Full Adjust

Device Setup | Setup | Calibration | Adjust - Full Adjust

A full level adjust may only be carried out if the current level is above the monitored limit level.

NOTICE

Make sure that the source is mounted and the beam path is open. The vessel must be full, or the level must be above the limit value.



1 Button <Perform adjust now>
2 Input field “Read-in time”
3 Input field “Full Adjust Count Rate”
4 Input field “Count rate”
5 Measuring process

Fig. 72 Full Adjust

1. Click on the field “Read-in Time” field (Fig. 73, item 2) and specify the duration of measurement in seconds. The higher you set the measurement time, the more accurate the result.
2. Click on the button <Perform adjust now> (Fig. 73, item 1).
   - The window “Full Adjust Count Rate” (Fig. 73, item 3) opens.
3. Click on the <Start> button.
   - The measurement starts (Fig. 73, item 5).
4. Click on <OK> to carry out the adjust with the count rate.
   - The message “The Adjust was successful” appears and the count rate has been adjusted (see standard display).

IMPORTANT

When executing an adjust, the measurement parameter set was overwritten. If the system should be recalibrated, a recall of the measurement parameter set to the calibration parameter must be performed. Otherwise the Adjust will become lost.

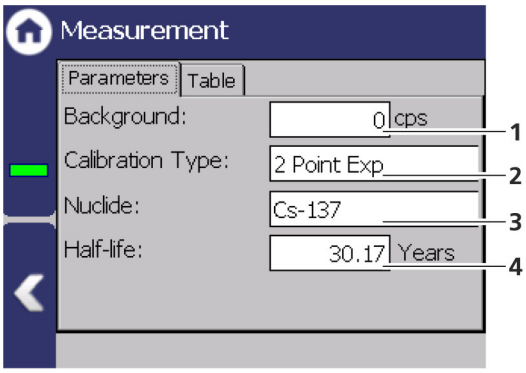
7.3.4 Measurement

Device Setup | Setup | Measurement

The menu “Measurement” is used for an overview of the measurement parameters and calibration settings used.

Measurement: Parameter

The parameters used for the current measurement are displayed in the “Parameters” tab.

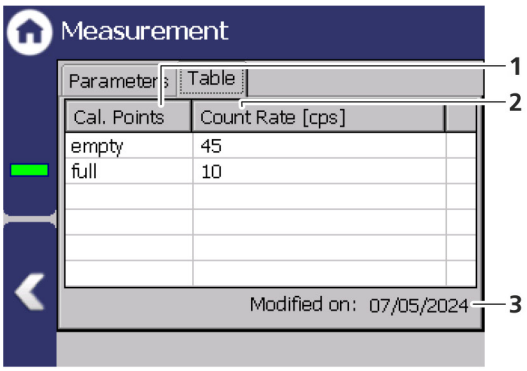


1 Background count rate (Bg) [cps]
2 Calibration type
3 Nuclide (Cs-137 or Co-60)
4 Half-life [years]

Fig. 73 Measurement (Parameters)

Measurement: Table

The measurement points used for the current measurement are displayed in the “Table” tab.



1 Column calibration point (empty/full)
2 Count rate [cps]
3 Date of last change of the measurement parameter set

Fig. 74 Measurement (Table)

7.3.5 Level Switch

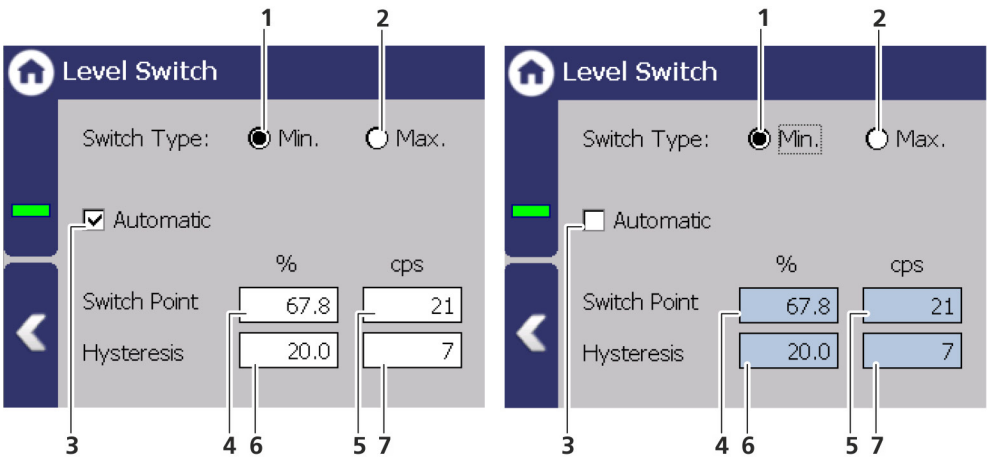
Device Setup | Setup | Level Switch

In the “Level switch” menu, the functionality of the level switch is determined by selecting “Switch Type Min.” (Fig. 76, item 1) or “Switch Type Max.” (Fig. 76, item 2). The switch point and hysteresis can either be calculated automatically or entered manually.

NOTICE

In automatic mode, the calculated switch point is optimally determined based on the calibration and the hysteresis is calculated based on the time constant. With manual entry, the switch point and the hysteresis can be freely selected, which means that process peculiarities can be taken into account.

In the case of a bulk cone measurement, the switch point and the hysteresis must be set manually. Please refer to the information on bulk cone measurements on page 82.



1 Selection “Switch type Min.”
2 Selection “Switch type Max.”
3 “Automatic” checkbox
4 Switch Point [%]
5 Switch point [cps]
6 Hysteresis [%]
7 Hysteresis [cps]

Fig. 75 Menu “level switch”;
Automatic (left): view with the selection box activated
Manual (right): view with the selection box deactivated

Switch Type Min.	Select "Min." if an alarm is to be triggered when the tank is underfilled.
Switch Type Max.	Select "Max." if an alarm is to be triggered when the tank is overfilled.
Automatic	The automatic mode is activated by factory setting. When automatic mode is activated, the switch point and the hysteresis are already optimally set. If a different switching point and a different hysteresis are to be set, the corresponding values can be entered by deactivating the "Automatic" checkbox.
Switch Point	Switch point in % and cps. In manual mode, the switch point can be entered either in % or cps. Each entry in cps or % automatically recalculates the corresponding value in % or cps.

Hysteresis	Hysteresis in % and cps. The hysteresis increases the safety of the system against incorrect switching due to statistical fluctuations. The hysteresis is above or below the switch point depending on the switch type selected. In manual mode, the hysteresis can be entered either in % or cps. Each entry in cps or % automatically recalculates the corresponding value in % or cps.

Special case: bulk cone measurement

With bulk goods, the monitoring level is determined at a defined bulk cone diameter. The measurement configuration has to be installed at that point where the bulk cone diameter is to be monitored (see Fig. 2).

The automatic calculation is not applicable as described under Device Settings | Setup | Level Switch. The switch point and the hysteresis must therefore be set manually. To do this, uncheck “Automatic” (Fig. 76, item 3).

The switch point for bulk cones can be determined in three ways.

1) Approaching the bulk cone under operating conditions
2) Simulating the absorption of the bulk cone with steel plates
3) Calculating the count rate of the switch point (approaches under 1) and 2) should be preferred to the calculation)

1) Approaching the bulk cone under operating conditions

After the bulk cone with the specified diameter has reached the monitoring level, the current count rate must be entered under “Switch point” in cps (Fig. 76, item 5).

2) Simulating the absorption of the bulk cone with steel plates

To use this method, the steel plate must have the same weight per unit area as the bulk cone. The necessary thickness of the steel plate is determined as follows:

$$d_{Steel} = \frac{\rho_{product} * d_{product}}{\rho_{steel}}$$

d_{steel} = thickness of the steel plate in cm

ρ_{steel} = solids density of the steel in g/cm³

$d_{product}$ = diameter of the bulk cone in cm

$\rho_{product}$ = bulk density of the material to be measured in g/cm³

In order to achieve the required thickness of the steel plate, several plates can also be used. To determine the switching point, the container must be empty or the tip of the bulk cone must be below the monitoring height.

To simulate the absorption of the bulk cone with the steel plate, the steel plate must completely cover the scintillator of the detector in the direction of the radiation source. To do this, the plate must be held between the detector and the container wall. The steel plate should have the following minimum dimensions:

- 70 x 70 mm for CrystalSENS detectors
- 200 x 200 mm for SuperSENS detectors

While the plate is being held in front of the scintillator, enter the current count rate in cps in the input field “switch point” (Fig. 76, item 5).

3) Calculating the count rate of the switch point

If the methods mentioned cannot be implemented, the switch point can also be calculated. The switch point is determined mathematically as follows:

$$I_S = I_{full} + \left(I_{empty} - I_{full}\right) * e^{-(\mu\rho d)}$$

I_S = switch point count rate in cps

I_{full} = full count rate in cps

I_{empty} = empty count rate in cps

μ = absorption coefficient in cm²/g
(0,057 cm²/g for Cs-137 und 0,040 cm²/g for Co-60)

ρ = bulk density of the material to be measured in in g/cm³

d = diameter of the bulk cone in cm

The calculated counting rate must be entered in the input field “switch point” in cps (Fig. 76, item 5).

7.3.6 Signal Condition

Device Setup | Setup | Signal Condition

You can perform the following settings and read information in the “Signal Condition” submenu:

- Damping (time constant)
- XIP (X-Ray interference protection)
- Source Replacement

Fig. 76 Menu “Signal Condition”

Signal Condition: Damping

Device Setup | Setup | Signal Condition | Damping

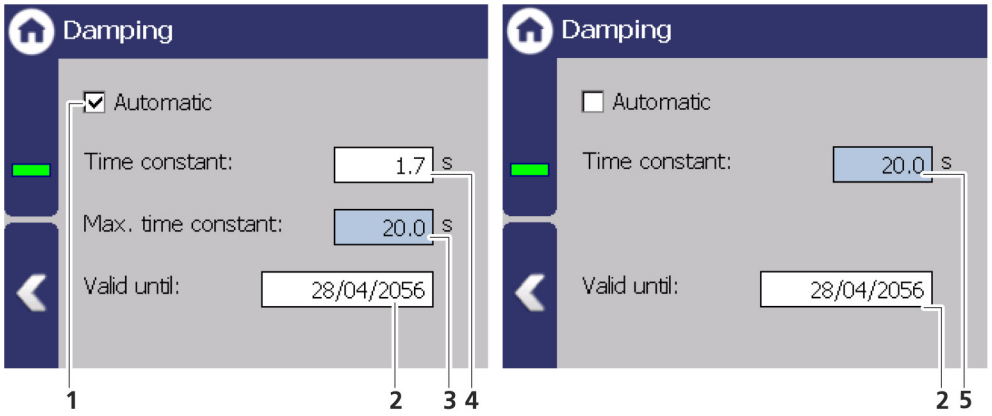
The reaction time of the measurement (determined process value based on the damped count rate) can be set in the menu “Damping”. With a small time constant, the measurement reacts quickly to rapid process changes. With a large time constant, the measurement reacts correspondingly more slowly. However, due to the larger time constant statistical fluctuations are reduced and thus the measurement is correspondingly less noisy.

Automatic mode (selection “Automatic” activated)

If the time constant is calculated automatically, the smallest possible time constant is determined based on the calibration (and optionally based on the manually set switch point). This value is adjusted daily as part of decay compensation to ensure safe level switch operation at all times. In automatic mode, the user must specify a maximum time constant. This maximum time constant corresponds to the maximum time constant that can be tolerated by the process. "Valid until" indicates the date when the automatically calculated time constant has reached the maximum time constant. 30 days before a warning message is displayed, and when the date is reached an error message is displayed.

Manual mode (selection "Automatic" disabled)

If the time constant is entered manually, "Valid until" indicates the date when this time constant is sufficient to ensure safe level switch operation. 30 days before a warning message is displayed, and when the date is reached an error message is displayed. Please note that due to a background check, it is not possible to enter time constants that are too small with regard to switching reliability.



1 Checkbox “Automatic”
2 Display field “Valid until”
3 Input field “Max. time constant"
4 Display field “Time constant”
5 Input field “Time constant”

Fig. 77 Signal Condition (Damping);
Automatic (left): view with the selection box activated
Manual (right): view with the selection box deactivated

Check box "Automatic"	If the check box is activated, the time constant is automatically calculated based on the calibration settings. If the selection is deactivated, the time constant can be entered manually.
Display field "Time constant"	Display of the calculated time constant. The time constant is automatically updated daily.
Input field "Max. time constant"	This input field is only visible if the "Automatic" check box is activated. The value must be set based on the maximum time constant that can be tolerated in the process.
Input field "Time constant"	This input field can only be edited if the "Automatic" check box is deactivated. The value to be entered can be entered individually and remains unchanged.
Display field "Valid until"	The date displayed is automatically calculated based on the entered values. The time constant remains valid until this date. When the displayed date is reached, the settings must be adjusted or the source must be replaced.

IMPORTANT

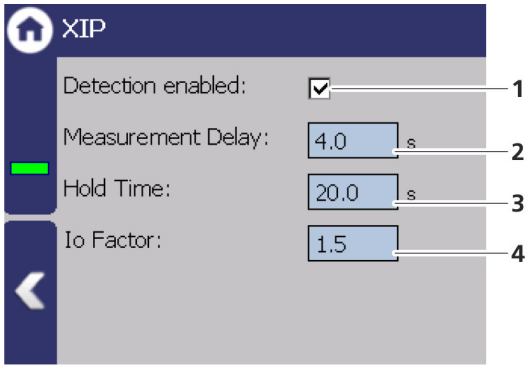
If the time constant loses its validity, warnings and error messages are triggered.

Signal processing: XIP[1] (Radiation Interference Protection)

Device Setup | Setup | Signal Condition | XIP

This function allows you to take radiation interference (for example x-rays) into consideration. Measurement jumps that influence the process can arise through radiation interference. Only rapid count rate increases are considered. If detection (Fig. 79, item 1) is activated, the last valid measured value is frozen.

Cycle delay [s]	This value determines the waiting time for the measured value generation. The change does not affect the measurement above this time.
Hold time [s]	The valid measurement value is frozen at this time after detection of radiation interference.
I_0 factor	The "I_0 factor" determines the recognition criteria for radiation interference.

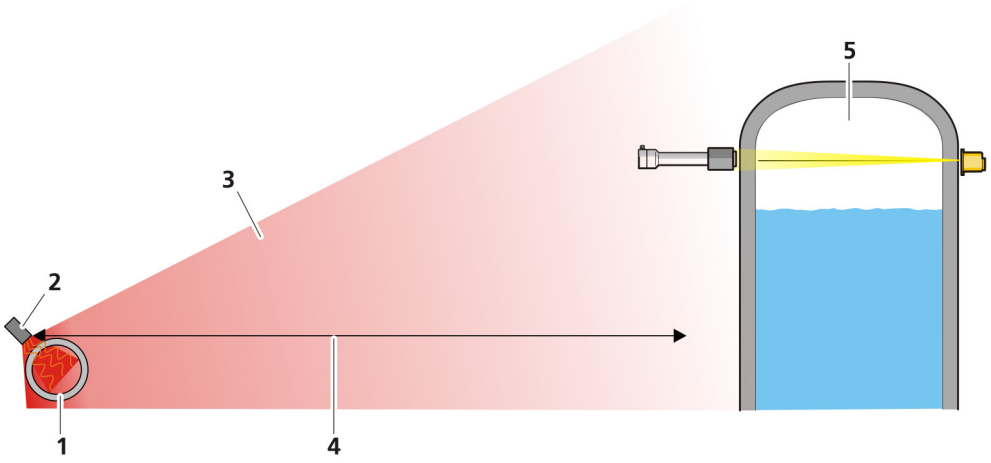


1 Check box the "Detection enabled"
2 Input field "Measurement delay"
3 Input field "Hold time"
4 Input field "I_0 factor"

Fig. 78 Signal Condition (Radiation Interference)

[1] XIP = X-Ray Interference Protection

Detecting Radiation Interference with XIP



1 Pipe
2 Welding seam tests with X-rays
3 Radiation interference
4 Distance up to 200 m
5 Level Measurement

Fig. 79 Radiation interference during a weld inspection

Detecting Radiation Interference

The high Gamma sensitivity of scintillation detectors may cause a false reading. To detect radiation interference, a check can be enabled.

The alarm is triggered by:

Exceeding the maximum possible count rate

$$I > I_0 * I_0 \text{ factor}$$

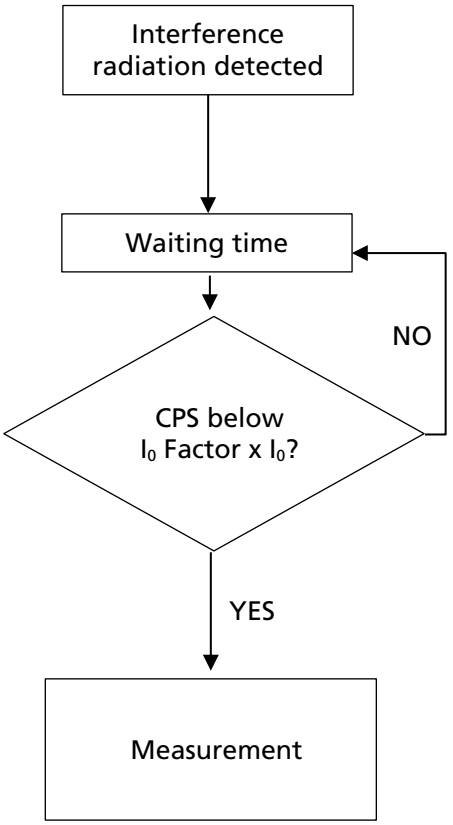
I = current count rate in cps integrated over one second
I_0 = empty count rate in cps
I_0 factor = freely selectable multiples of I_0

This means that a limit value based on the empty count rate (I_0) and the I_0 factor is monitored. Exceeding this limit count rate corresponds to the detection of external radiation, which means that the process value remains "frozen" until no longer any external radiation is detected by the detector.

False alarms due to operative factors are not possible. However, only stronger interfering radiation is detected.

Radiation Interference Detection Flow Chart

If radiation interference is detected, following will happen:



- Measured value and current output are "frozen".
- Error relay indicates alarm.

The measurement is "frozen" up to the end of the defined waiting time.

At the end of the waiting time the system checks if the current count rate is smaller than set multiples (I_0 factor) of the calibrated empty count rate (I_0). If not, the waiting time starts again.

If the count rate is below the set multiples (I_0 factor) of the empty count rate, the measurement automatically switches to the RUN mode.

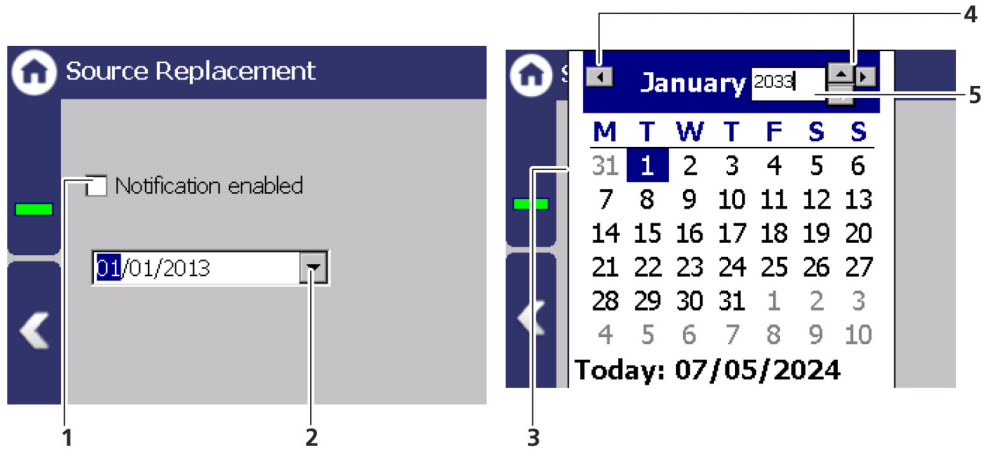
Signal Processing: Source Replacement

Device Setup | Setup | Signal Condition | Source Replacement

Notification for a source replacement can be activated in this menu. The maintenance message “Replace source” when this date is reached.

NOTICE

For radiation protection reasons, a source replacement is recommended after 15 years. After a source exchange, a standard adjust must be performed (see “Standard Adjust” in chapter 7.3.3 Calibration)



1 Selection box "Notification enabled”
2 Selection arrow Calendar
3 Month view Calendar
4 Selection arrow Month
5 Input field number

Fig. 80 Source replacement

Setting source replacement date

1. Activate the check box (Fig. 81, item 1).
2. Click on the arrow key (Fig. 81, item 2) in order to set the date.

▶ The calendar is opened.

3. Click on the year (Fig. 81, item 5) to select the year with the arrow keys.
4. Set the month and day in the calendar.

▶ The calendar retracts and the notification has been established.

7.3.7 Inputs

Device Setup | Setup | Inputs

The two digital inputs (DI) can be set, as well as displaying the DI status, in the submenu Inputs.

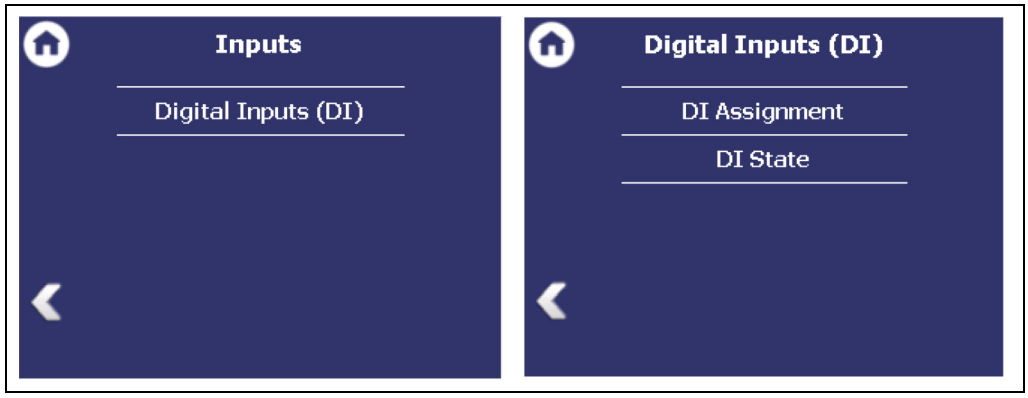


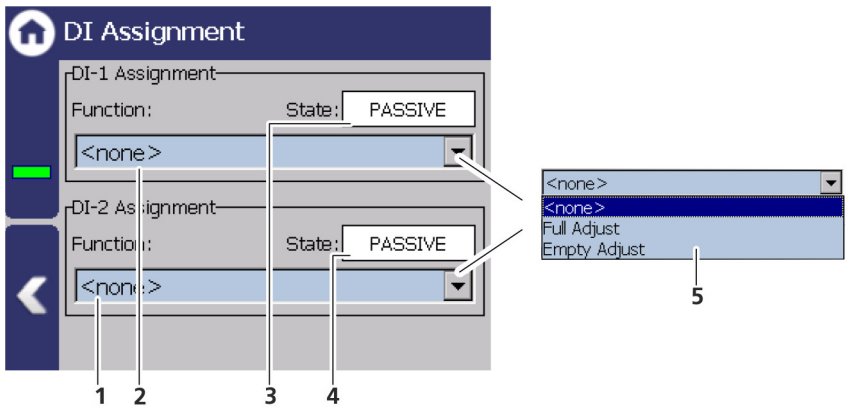
Fig. 81 Menu "Inputs“; Submenu "Digital inputs (DI)“

Digital inputs (DI) Assignment

Device Setup | Setup | Inputs | Digital Inputs | Assignment

The menu Assignment determines which function is executed when the digital input is switched. In the "ACTIVE" state, the selected function is executed. The active state is initiated by closing the digital input.

The functions Empty Adjust and Full Adjust are used for external control of the adjustment. The parameters of the adjustment function are thereby used (Device Setup | Setup | Calibration | Adjust).



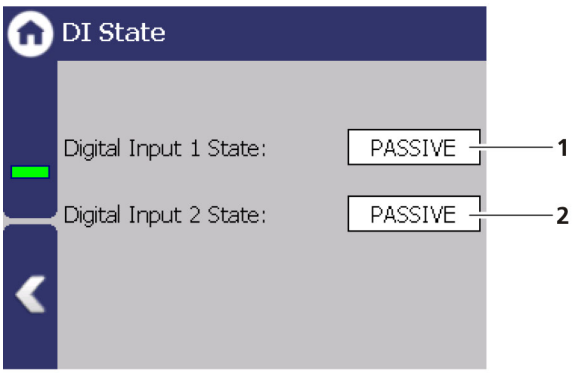
1 DI-2 Assignment: Selection of function
2 DI-1 Assignment: Selection of function
3 DI-1 Assignment State
4 DI-2 Assignment State
5 Selection box “function”

Fig. 82 DI Inputs Assignment

DI State

Device Setup | Setup | Inputs | Digital Inputs | DI State

The states of the two digital inputs are displayed in the window “DI State”.



1 DI Input 1 state (ACTIVE / PASSIVE)
2 DI Input 2 state (ACTIVE / PASSIVE)

Fig. 83 DI Inputs State

7.3.8 Outputs

Device Setup | Setup | Outputs

You can make the following settings and read information in the submenu “Outputs”:

- Analog Output Mapping (AO)
  - AO Mapping
  - AO Monitoring
  - AO Failure Mode
  - AO Limits
  - AO Calibration
- Digital Output (DO)
  - Alarm Assignment

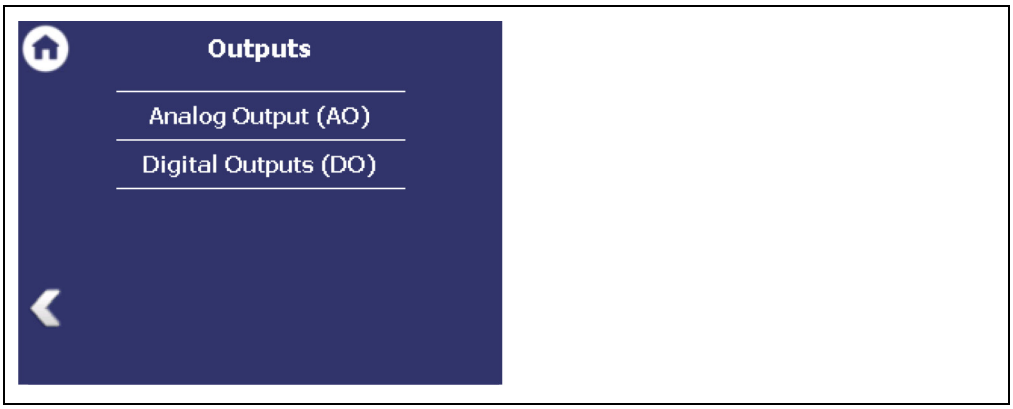


Fig. 84 Menu “Outputs”

Analog Output (AO)

Device Setup | Setup | Outputs | Analog Output (AO)

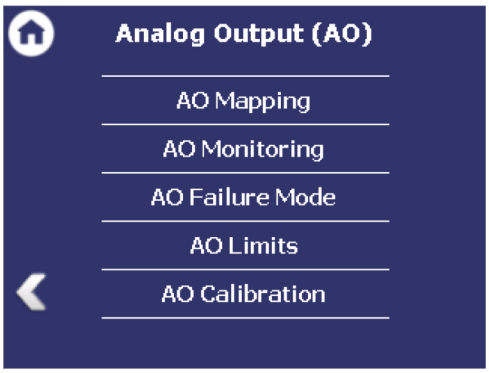
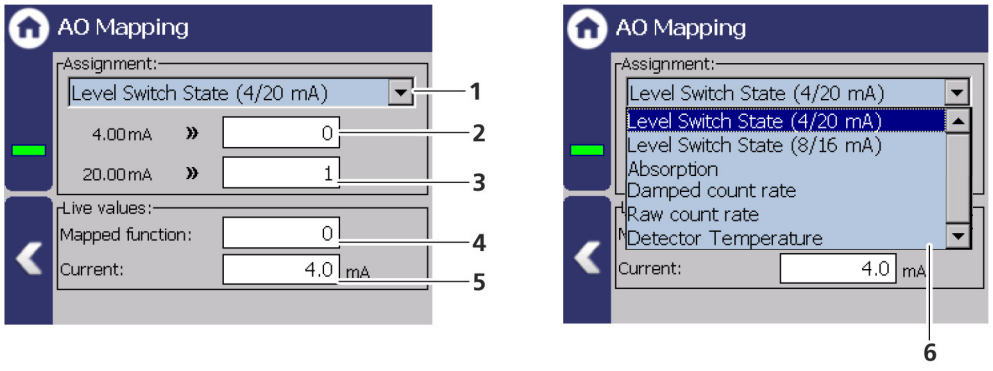


Fig. 85 Submenu “Analog Output”

Analog Output: AO Mapping

Device Setup | Setup | Outputs | Analog Output (AO) | AO Mapping

A function can be assigned to an analog output in “AO Mapping”. The current output signal is depending on the setting, between 4 mA and 20 mA or between 8 mA and 16 mA.



1 Selection arrow “Assignment”
2 Display field lower value [%]
3 Display field upper value [%]
4 Display field Live value assigned function
5 Display field Live value current [mA]
6 Selection Assignment

Fig. 86 Analog Output Mapping (Assignment)

For input fields, the value assigned to a current output signal of 4 mA must be smaller than the value assigned to 20 mA.

Limit Switch State (4/20 mA)	Discrete output of 4 mA (no alarm or level switch not triggered) and 20 mA (alarm or level switch triggered).
Limit Switch State (8/16 mA)	Discrete output of 8 mA (no alarm or limit switch not triggered) and 16 mA (alarm or limit switch triggered).
Absorption	Enter a range in percent that outputs the current absorption based on the calibration. Output from 4 mA to 20 mA.

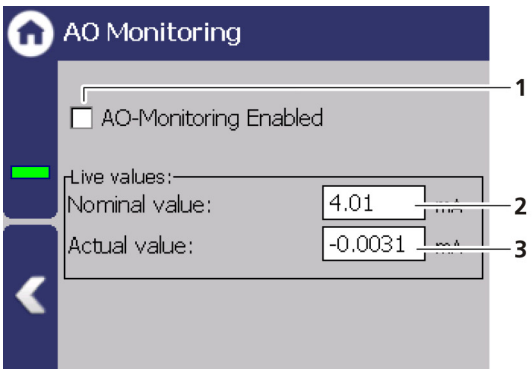
Damped count rate	Enter a count rate range that outputs the dampened count rate. Output from 4 mA to 20 mA
Raw count rate	Enter a count rate range that outputs the current raw count rate. Output from 4 mA to 20 mA.
Detector temperature	Discrete output of 4 mA (min. value temperature range) and 20 mA (max. value temperature range). The corresponding values can be assigned individually.

Analog Output: AO Monitoring

Device Setup | Setup | Output | Analog Output (AO) | AO Monitoring

If "AO Monitoring" is activated (Fig. 88, item 1), the current output will be monitored. It is continuously monitored whether the current value flowing in the current loop is correct.

In the event of a variation e.g. owing to an error in the hardware, too large a load or a disruption in the loop, an error message is triggered.



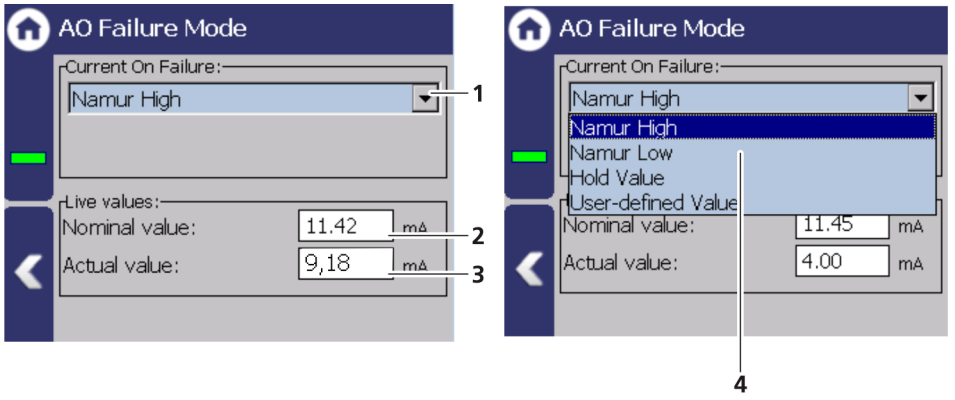
1 Activate check box "AO-Monitoring Enabled"
2 Target value [mA]
3 Actual value [mA]

Fig. 87 Analog Output Monitoring

Analog Output: AO Failure Mode

Device Setup | Setup | Output | Analog Output (AO) | AO Failure Mode

The alarm function is set when an error is detected at the current output in the menu “AO Failure Mode”.



1 Selection arrow Alarm function
2 Live target value [mA]
3 Live actual value [mA]
4 Selection of the alarm function

Fig. 88 Analog Output (AO Failure Mode)

The following behavior of the current output can be assigned in case of error:

Namur High	22 mA (in error mode).
Namur Low	2 mA (in error mode).
Hold Value	Last value before the error.
User-defined value	The value can be set manually.

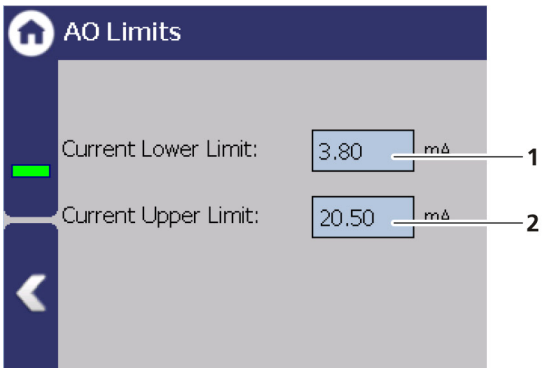
NOTICE

If the value "Hold Value" is set, it is recommended that the error relay is connected in order to allow device errors to be transmitted to the control system.

Analogue Output: AO Limits

Device Setup | Setup | Output | Analog Output (AO) | AO Limits

By clicking on the input fields (Fig. 90, item 1, item 2), the values [mA] for the lower and upper current limit can be set. In addition to the default value of 3.8 mA, the lower current limit can be set to 0 mA in order to switch the current output from 4 ... 20 mA to 0 ... 20 mA.



1 Input field Current lower limit [mA]
2 Input field Current upper limit [mA]

Fig. 89 Analog Output (current limits)

NOTICE

If the measurement is operated according to Namur, the standard current values of 3.8 or 20.5 mA must be maintained.

Analog Output: Calibrate

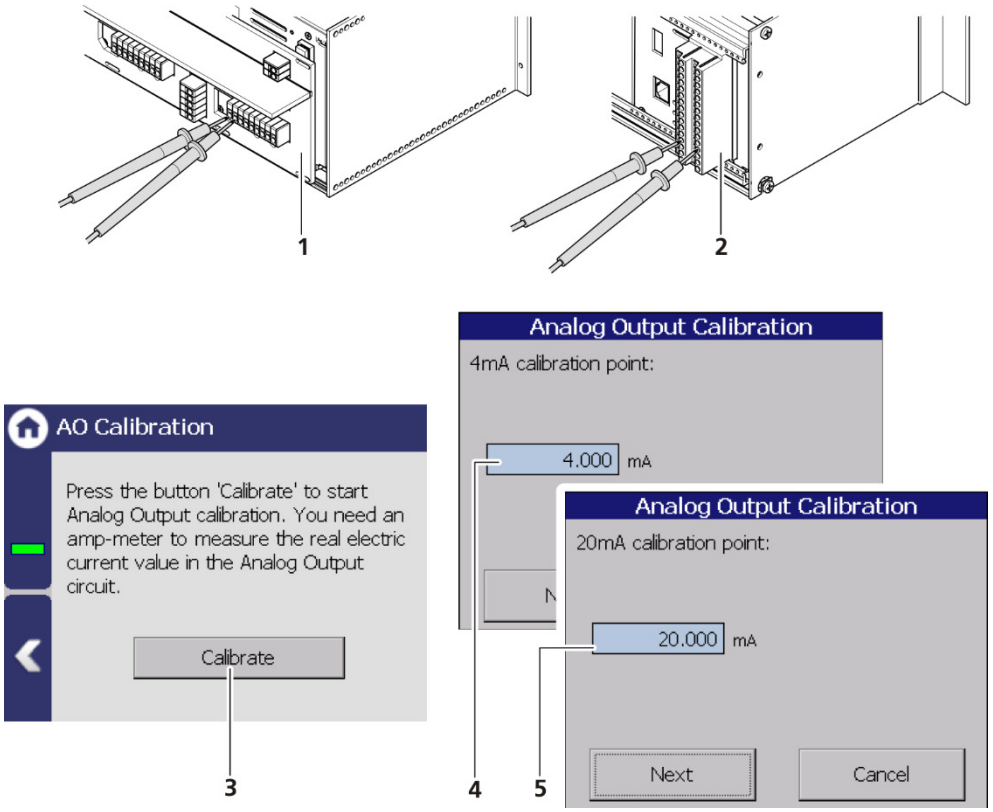
Device Setup | Setup | Output | Analog Output (AO) | AO Calibration

If there are any discrepancies between the target value and the actual value of the current signal, then the current output may be calibrated again.

NOTICE

For calibration of the current output, an ammeter (not included in the scope of delivery) is required, which is connected to the current output.

Berthold recommends calibrating the current outputs whenever a module has been installed/replaced or if a software update has been carried out.



1	Version with connection board	4	Input field 4 mA Calibration point
2	Version with terminal block	5	Input field 20 mA Calibration point
3	Button <Calibrate>		

Fig. 90 Analog Output (Calibration)

Perform calibration

⚠ DANGER

Danger to life from electric shock!

- The calibration may only be carried out by a qualified electrician.
- Observe the relevant safety regulations.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

1. Connect the test leads of the ammeter to the analog current output terminals on the rear of the EVU. Observe the terminal allocation in the document "Technical Information".
2. Click on the button <Calibration>.

- The device switches to test mode and a new window (Analog output calibration) opens.
- The calibration point 4 mA is displayed and the current measuring instrument shows a value.

3. Enter the indicated value on the current measuring instrument in the input box (Fig. 91, item 4).
4. Click on the button <Continue>.

- The calibration point 20 mA is displayed and the current measuring instrument shows a value.

5. Enter the indicated value on the current measuring instrument in the input box (Fig. 91, item 5).
6. Click on the button <Continue>.

- A message appears "Calibration successful".

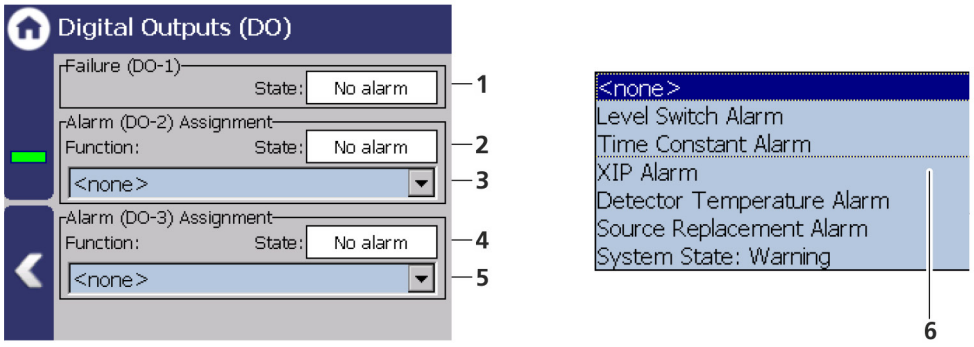
7. Click on the button <Continue>.

- The calibration of the analog output is completed.

Digital Outputs (DO)

Device Setup | Setup | Output | Digital Outputs (DO)

The signals of the digital outputs are switched via potential-free relay contacts. The contacts are controlled "fail safe", i.e., in the event of an alarm, the current at the relay coil drops and the NO contact (normally open) is opened. The wiring diagrams in the document "Technical Information" show the relay contacts in the de-energized state.



1 State DO-1 (ACTIVE / PASSIVE)
2 State DO-2 (ACTIVE / PASSIVE)
3 Selection arrow Function DO-2
4 State DO-3 (ACTIVE / PASSIVE)
5 Selection arrow Function DO-3
6 Function selection

Fig. 91 Digital Outputs

The alarm relays 1 and 2 can be assigned to the following functions in the event of an alarm:

Level Switch Alarm	The relay alarms when the limit switch is triggered.
Time Constant Alarm	The relay alarms when the current time constant (Device Settings | Setup | Signal processing | Damping) is too small to ensure a safe level switch operation.
Detector Temperature Alarm	The relay alarms when the values set under Device Settings | Setup | Alarms | Det. Temp. Alarm are exceeded or undershot.
XIP Alarm	The relay alarms, if XIP detection is activated under Device Settings | Setup | Signal processing | XIP alarm and radiation interference is detected.
Source Replacement Alarm	The relay alarms when the notification in Device Settings | Setup | Signal Processing | Source Replacement is activated and the set date is reached.
System State: Warning	The relay alarms when "Warning" is displayed in the event message (Warning includes "Out of Specification", "Function Check" and "Maintenance").

7.3.9 Alarms

Device Setup | Setup | Alarms

You can make the following settings and read information in the submenu "Alarms":

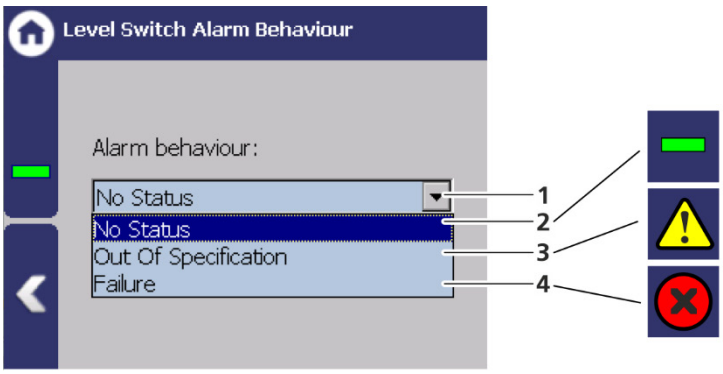
- Level Switch Alarm Behavior
- Damping Alarm Behavior
- Detector temperature Alarm Behavior
- Detector temperature Alarm Settings

Fig. 92 Menu "Alarms"

Level Switch Alarm Behavior

Device Setup | Setup | Alarms | Level Switch Alarm Behavior

The behavior in case of alarm (NE107 Status) for the level switch can be set in the window “Level Switch Alarm Behavior”.



1 Selection arrow NE107 Status
2 Selection “No Status” (no Event Viewer, relay circuit)
3 Selecting “Out of specification” (Event Viewer, relay circuit)
4 Selection “Failure” (Event Viewer, the relay circuit)

Fig. 93 Level Switch Alarm Behavior

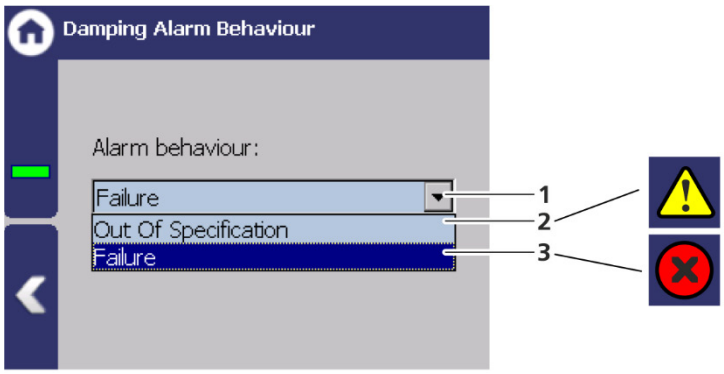
NOTICE

If the level switch alarm function is set to “Failure”, the measurement for the occurrence of a level switch alarm is switched to the error current. Monitoring of the level switch in the master display is therefore no longer possible.

Damping Alarm Behavior

Device Setup | Setup | Alarms | Damping Alarm Behavior

The behavior in case of alarm (NE107 Status) for the process value can be set in the menu “Damping Alarm Behavior”.



1 Selection arrow NE107 Status
2 Selecting “Out of specification” (Event Viewer, relay circuit)
3 Selection “Failure” (Event Viewer, the relay circuit)

Fig. 94 Damping Alarm Behavior

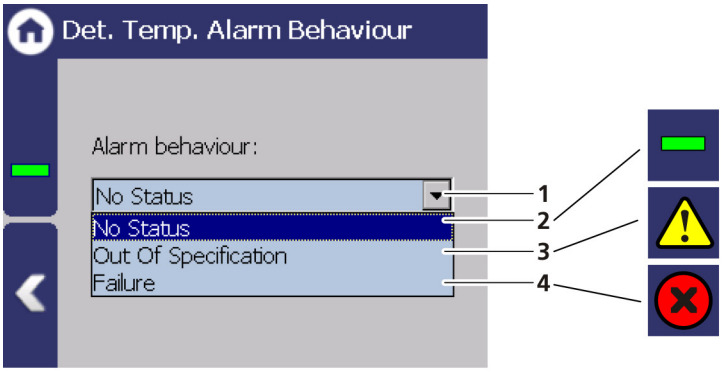
NOTICE

If the NE107 status of the damping is set to “Failure”, the measurement is switched to the error current when an alarm occurs.

Detector Temperature Alarm Behavior

Device Setup | Setup | Alarms | Det. Temp. Alarm Behavior

The behavior in case of alarm (NE107 status) can be set for the detector temperature in the menu “Det.-Temp. Alarm Behavior“.



1 Selection arrow NE107 Status
2 Selection “No Status” (no Event Viewer, relay circuit)
3 Selecting “Out of specification” (Event Viewer, relay circuit)
4 Selection “Failure” (Event Viewer, the relay circuit)

Fig. 95 Detector Temperature Alarm Behavior

NOTICE

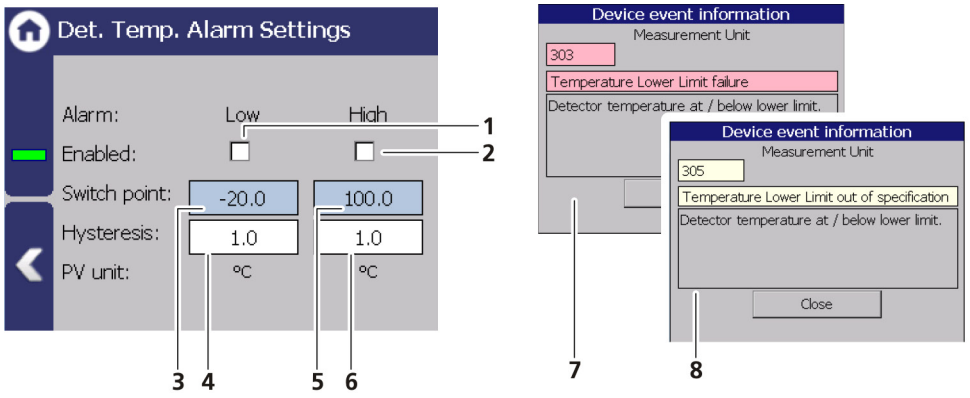
If the detector alarms are set to “Failure”, the measurement is switched in the error current during the occurrence of a temperature alarm. Monitoring of the PV in the master display is therefore no longer possible.

Detector Temperature Alarm Settings

Device Setup | Setup | Alarms | Det.-Temp. Alarm Settings

The values for the detector temperature (max. and min.) can be set in the menu “PV Det.-Temp. Alarm Settings”.

When there is exceeding or falling below the switch point, an event message appears in the status display. If a digital output “Detector temperature alarm” is assigned under “Function”, the relay alarms.



1	Selection box “Min. Active”	5	Input field “Switch point Max.”
2	Selection box “Max. Active”	6	Display field “Hysteresis Max.”
3	Input field “Switch point Min.”	7	Event message “Error”
4	Display field “Hysteresis Min. “	8	Event message “Outside the specification”

Fig. 96 Det.-Temp Alarm Settings

Setting max. Temperature Alarm:

1. Activate the check box (Fig. 97, item 1).
1. Click on the input field (Fig. 97, item 2) to enter a switch point.
2. Confirm with the Enter key

▶ The value was changed.

Set min. Temperature Alarm:

1. Activate the check box (Fig. 97, item 3).
2. Click on the input field (Fig. 97, item 4) to enter a switch point.
3. Confirm with the Enter key

▶ The value was changed.

7.3.10 Simulation

Device Setup | Setup | Simulation

A check for the following functions can be performed in the submenu “Simulation”.

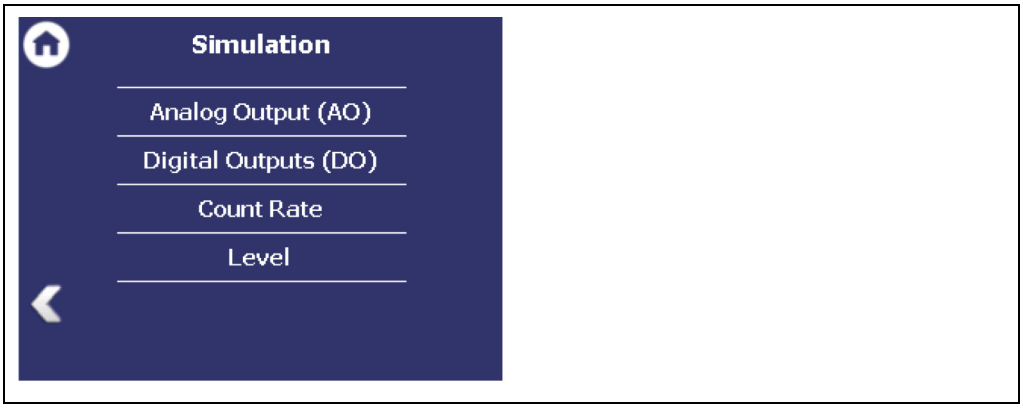


Fig. 97 Menu "Simulation"

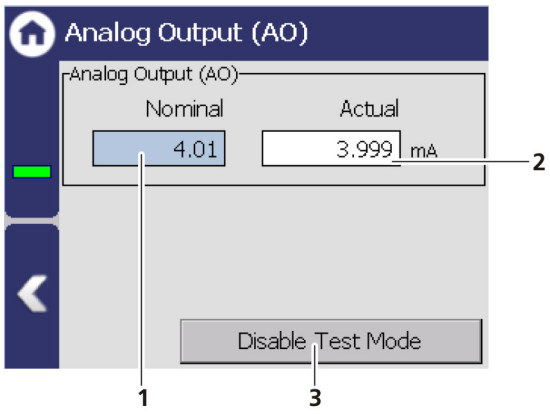
NOTICE

When starting a simulation, the measurement is stopped and a status message T$T appears.

The simulation mode is automatically terminated after about 5 minutes. If the simulation is to be reactivated, you must enter the value again in the input field.

Simulation Analog Output

Device Setup | Setup | Simulation | Analog Output



1 Input field “Nominal”
2 Display field “Actual” [mA]
3 Button <Disable Test Mode>

Fig. 98 Simulation Analog Output

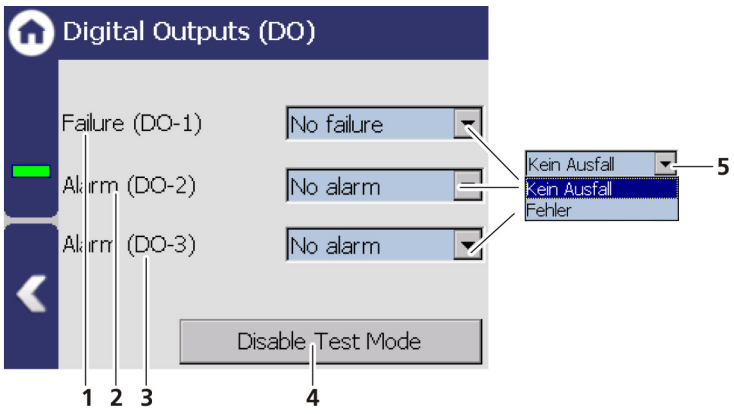
1. Click on the input field (Fig. 99, item 1) and enter the target value for the simulation.
2. Confirm with the Enter key.

▶ The test is performed, and a system event is displayed.

3. Click on the <Disable Test Mode> button (Fig. 99, item 3) to stop the simulation.

Simulation Digital Output

Device Setup | Setup | Simulation | Digital Output



1 ERROR (DO-1)
2 ALARM (DO-2)
3 ALARM (DO-3)
4 Button <Disable Test Mode>
5 Dropdown field

Fig. 99 Simulation Digital Outputs

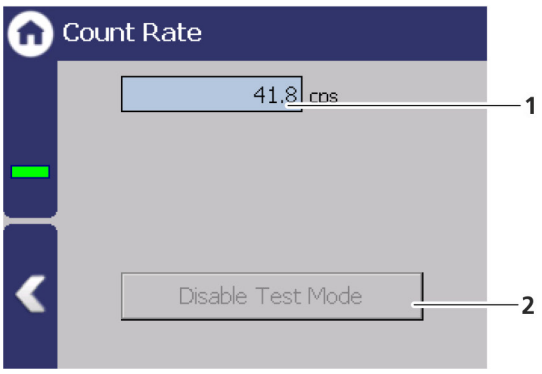
1. Click on the dropdown field (Fig. 100, item 5) and select "FAILURE" or “ALARM” for the simulation.

▶ The test is performed and a system event is displayed.

2. Click on the <Disable Test Mode> button (Fig. 100, item 4) to stop the simulation.

Simulation Count Rate

Device Setup | Setup | Simulation | Count Rate



1 Input field Dampened count rate
2 Button <Disable Test Mode>

Fig. 100 Simulation Count Rate

1. Click on the input field (Fig. 101, item 1) and enter count rate for the simulation.
2. Confirm with the Enter key.

▶ The measurement is interrupted.

▶ The test is performed, and the simulated process value is displayed at the standard display (Fig. 16).

3. Click on the <Disable Test Mode> button (Fig. 101, item 2) to stop the simulation.

7.4 Menu Backup / Restore

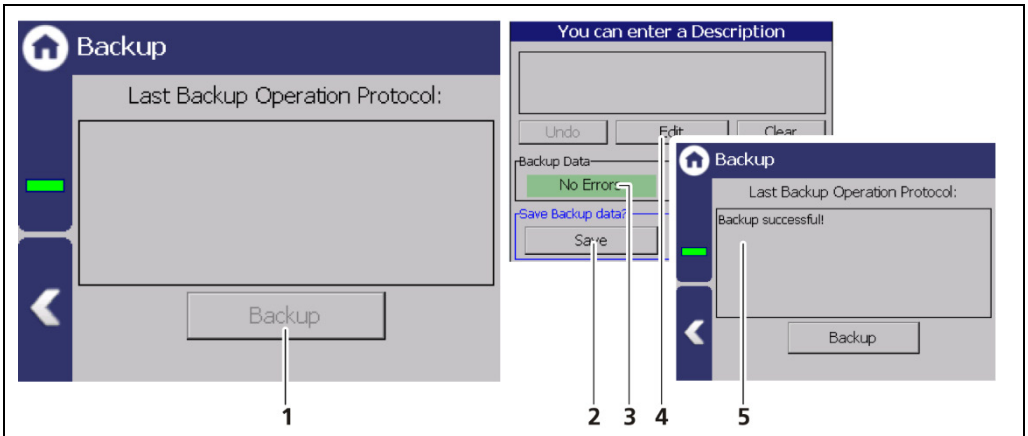
Device Setup | Backup / Restore

You can make a backup copy of the configuration data, and perform a recovery in the submenu Backup / Restore.

Fig. 101 Menu "Backup / Restore"

7.4.1 Backup

Device Setup | Backup / Restore | Backup



1 Button <Backup>
2 Button <Save>
3 Information about the backup data (error / error free)
4 Button <Edit>
5 Note "Backup successful!"

Fig. 102 Backup

Perform Backup

1. Connect a USB storage device to the device.
2. The USB storage device is recognized by the system after a few seconds and the button <Backup> (Fig. 103, item 1) can be clicked.

▶ The read-in time of the USB storage device can be longer if the storage capacity of the USB storage device and the number of data records are high.

3. Click on the button <Backup> (Fig. 103, item 1).

▶ The window "Enter description" appears.

- The message “Error free” (Fig. 103, item 3) appears in the field “Backup data” for error-free backup files.

4. Click the button <Edit>, enter a description, and confirm with the Enter key.
5. Click on the button <Save>.

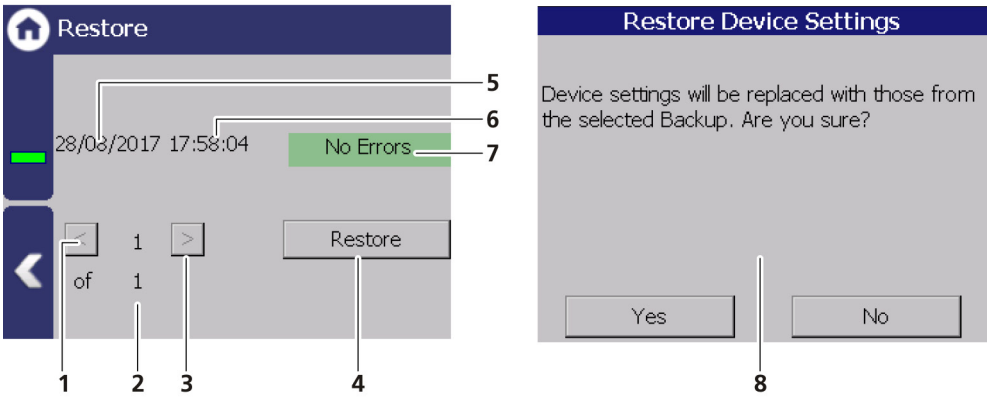
- The backup files are copied to the USB storage device.
- The message “Backup successful” appears after a successful copy process (Fig. 103, item 5).

Information

The backup includes an XML file that is created in the folder “../LB47x/Export/Location_DevID_xxxxxx/LB47x_Backup”. The file name is derived from “Backup”, the date and time (Backup_YYYYMMDD_ hr-min-sec).

7.4.2 Restore

Device Setup | Backup / Restore | Restore



1 Button < "previous"
2 Number of recovery files on the USB storage device
3 Button > "next"
4 Button <Restore>
5 Recording date of the backup file
6 Time of backup file recording
7 Information about the backup data (error / error free)
8 Confirmation window

Fig. 103 Restore

Executing restore

1. Connect a USB storage device to the device.
2. Select the backup file with the buttons (Fig. 104, item 1,3)

▶ The date and time of the backup is displayed (Fig. 104, item 5, 6). Only error-free (Fig. 104, item 7) backup files can be loaded.

3. Click on the button "Restore" (Fig. 104, item 4).
4. A confirmation message (Fig. 104, item 8) appears.
5. Click on <Yes> to confirm.

▶ The restore of data is carried out.

8 Main Menu Diagnostics

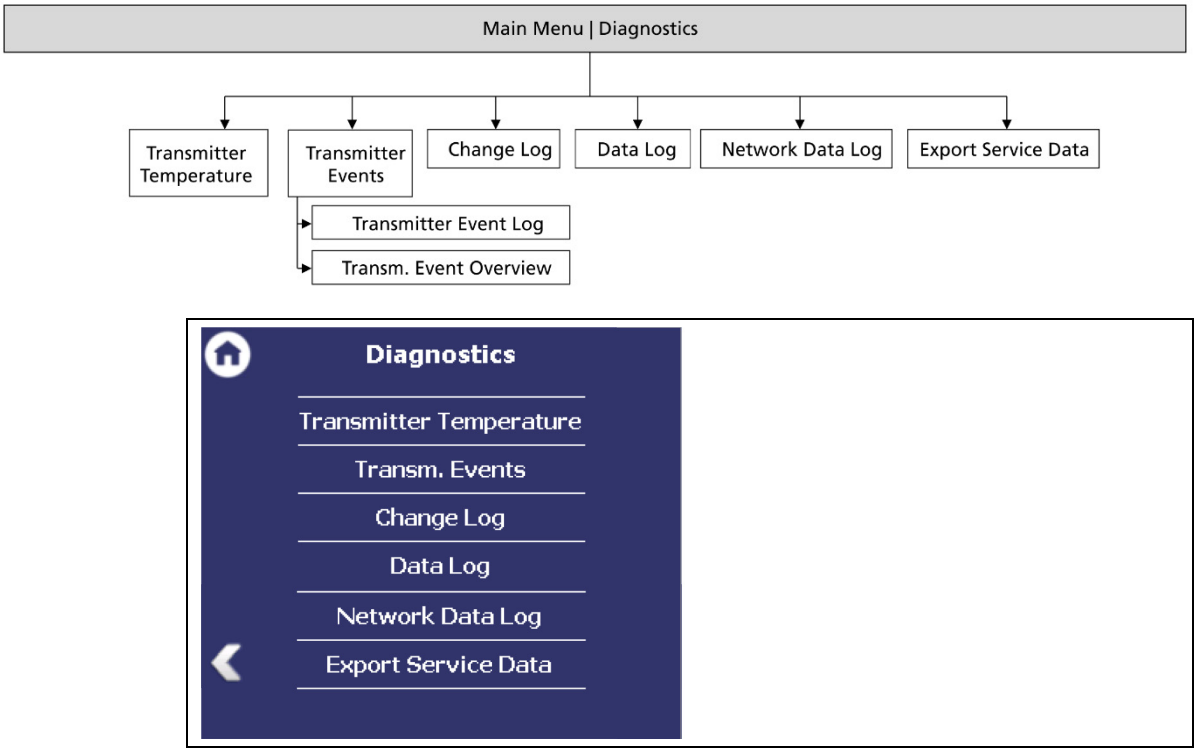
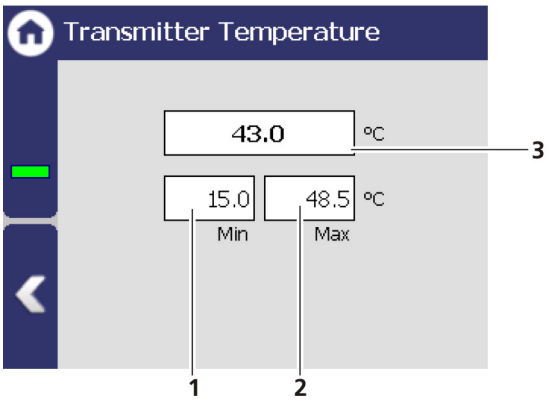


Fig. 104 Menu "Diagnostics"

8.1 Transmitter Temperature

Diagnostics | Transmitter Temperature

Temperature values from the evaluation unit (processor) are displayed in the menu item “Transmitter Temperature”.



1 Minimal extreme value [°C]
2 Maximum extreme value [°C]
3 Current value [°C]

Fig. 105 Transmitter Temperature

8.2 Events

Diagnostics | Transm. Events

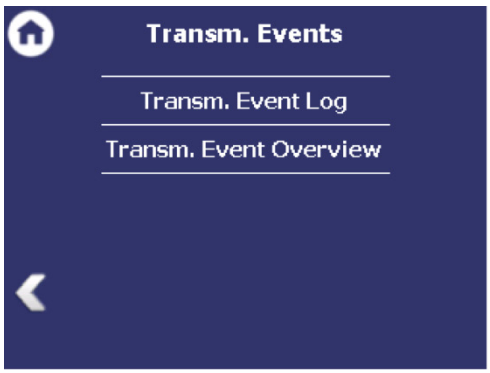


Fig. 106 Menu "Transm. Events"

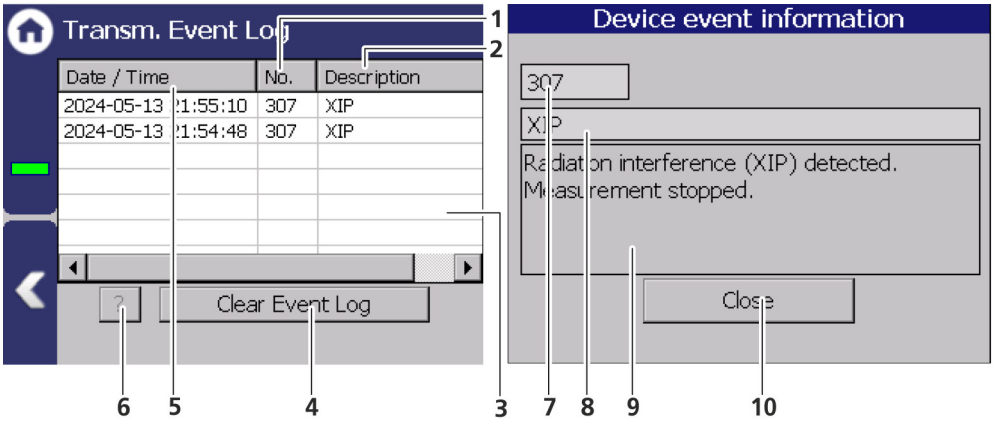
Information

Events of the respective detector can be seen at Device Setup | Setup | Detectors | [NAME OF DETECTOR] | Detector Service.

8.2.1 Transmitter Event Log

Diagnostics | Transmitter Events | Transmitter Event Log

The last 25 events of the detector are displayed in the window "Event Log".



1 Event no.
2 Description (event title)
3 Scrollbar
4 Button <Clear event log>
5 Date / time of the event
6 Button <?> (to display the detailed event description)
7 Event No.
8 Event Title
9 Event Description
10 Button <Close>

Fig. 107 Transmitter Event Log

1. Click on a line in the list (Fig. 110, item 3).
2. Click on <?> (Fig. 110, item 6).
   ▶ The event description appears.
3. With the button <Close>, close the event description (Fig. 110, item 10).

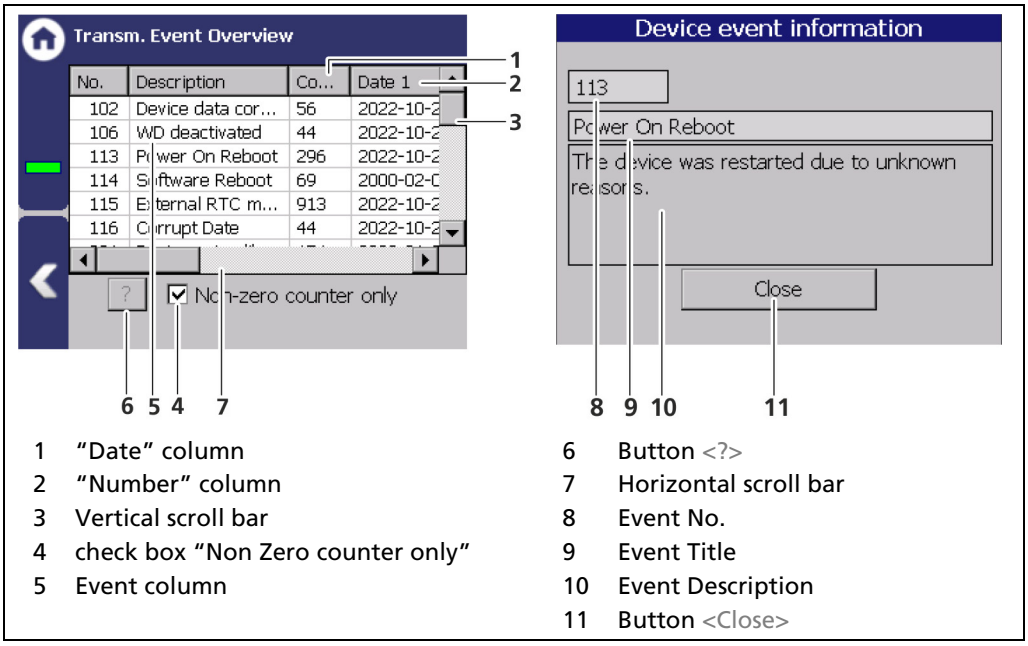
NOTICE

With the button <Clear event log> (Fig. 110, item 2) all events are deleted irrevocable.

8.2.2 Transmitter Event Overview

Diagnostics | Transm. Events | Transm. Event Overview

All events that can be logged are chronologically presented in tabular form in the menu “Event overview”. Activate the check box “Non-zero Counter only 0” (Fig. 109, item 5) in order to display events that have occurred.



1	“Date” column	6	Button <?>
2	“Number” column	7	Horizontal scroll bar
3	Vertical scroll bar	8	Event No.
4	check box “Non Zero counter only”	9	Event Title
5	Event column	10	Event Description
		11	Button <Close>

Fig. 108 Transmitter Event Overview

1. Click on a line in the list (Fig. 109, item 4).
2. Click on <?> (Fig. 109, item 7).

▶ The event description appears.

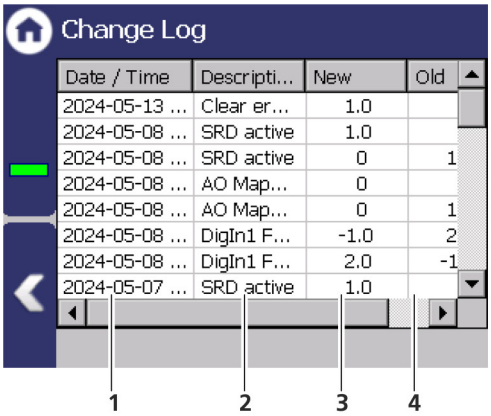
3. Close the event description with the button <Close>.
4. Slide the bar of the horizontal scroll bar (Fig. 109, item 6) to the right to see at what times (date, time) the event occurred.

▶ The last 5 time points are displayed.

8.3 Change Log

Diagnostics | Change Log

You can track changes that were performed on the device in the window “Change Log”.



1 Time of the change
2 Short info of the change
3 Old state
4 New state

Fig. 109 Change Log (Transmitter)

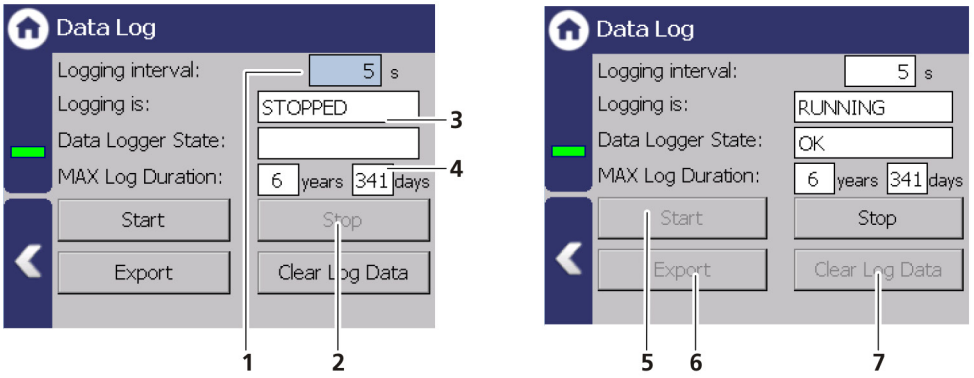
8.4 Data Log

Diagnostics | Data Log

You can set the log interval as well as delete and export the log data in the sub-menu “Data log”.

IMPORTANT

The data cannot be viewed on the EVU Display or via Ethernet. The data must be exported to a USB storage device to view it on a PC.



1 Input field Log interval [s]
2 Button <Stop>
3 Display field “max. Log Duration”
4 Display field “Logging is” (Stopped / Started)
5 Button <Start>
6 Button <Export>
7 Button <Clear log data>

Fig. 110 Data Log

Change log interval

1. Click on the button <Stop> (Fig. 111, item 2) to stop the data log process.
2. Click on the input field “Log interval” (Fig. 111, item 1) and enter the time in seconds.
3. Confirm with the Enter key.

▶ The interval was accepted

4. Click on the button <Start> (Fig. 111, item 5) to start the data log process.

Export log data

1. Click on the button <Stop> (Fig. 111, item 2) to stop the data log process.
2. Connect a USB storage device to the device (Fig. 3, item 5).
3. Click on the button <Export> (Fig. 111, item 6).

- The export process is started and can take several minutes to complete under certain circumstances.
- The message window “Export successful!” appears with a successful export.

Information

The export includes a zip file that is created in the folder “ExtendedLogExport”. The file name is derived from “ExtendedLogExport", the date and time (ExtendedLogExport_YYYYMMDD_hr-min-sec).

Exported Data Structure

1 Zip file
2 Folder year
3 Folder month
4 File Day

Fig. 111 Data structure

8.5 Network Data Log

Diagnostics | Network Data Log

In the window “Network data log”, the transmission of log data via the ethernet network can be started. With a log program, the data can be displayed on the PC.

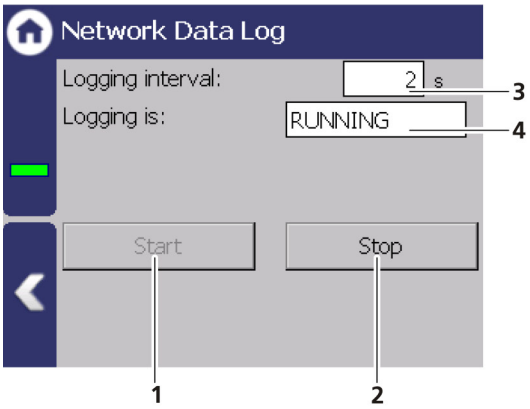
IMPORTANT

The PC and the LB 47x have to be in the same IP subnet.

- Observe the notes in chapter 7.3.1 – Network.

The network logger utilizes the Telnet protocol to send data over the local network. There are terminal emulator programs that can read this data and save it in a log file. Note the following links:

- https://support.microsoft.com/help/2801292
- https://social.technet.microsoft.com/wiki/contents/articles/38433.windows-10-enabling-telnet-client.aspx



1 Button <Start>
2 Button <Stop>
3 Display field / Input field “Logging Interval”
4 Display field “Logging State” (Stopped / Started)

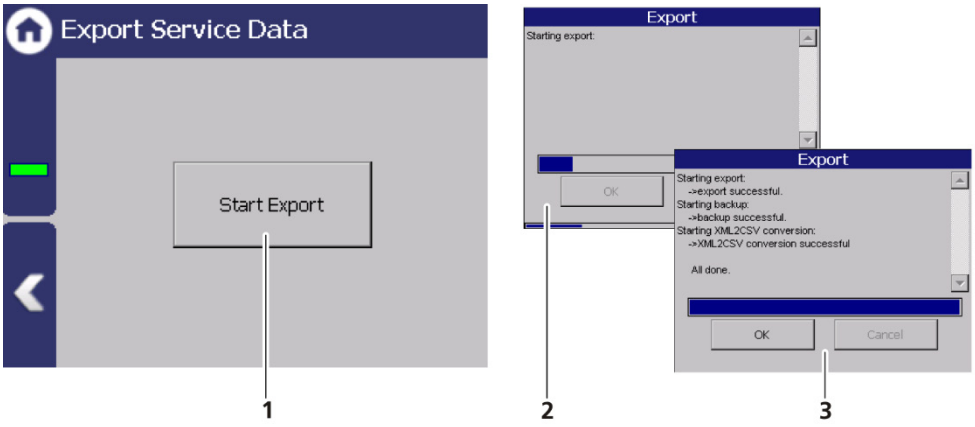
Fig. 112 Network Data Log (started)

1. Click <Stop> if necessary. Click on the entry field “Logging interval” (Fig. 114, item 3) and enter an interval.
2. Start the network data log with the button <Start> (Fig. 114, item 1).
3. Make a note of the EVUs IP address (Device Settings | Settings | System | Network).
4. Enter the following input in the command line of the PC:
   > telnet "IP Address" -f "LogFileName" (for example 192.168.83 -f C:\\Users\Test\log.txt).

- The log data is displayed and saved in the created log file.
- Use the key combination "CTRL" and "+" to stop the recording of the log data.

8.6 Export Service Data

Diagnostics | Export Service Data



1 Button <Export service data>
2 Process window
3 Confirmation message

Fig. 113 Export Service Data

1. Connect a USB storage device to the device (Fig. 3, item 5).
2. The USB storage device is recognized by the system after a few seconds and the button <Export service data> (Fig. 114, item 1) can be clicked.
3. Click on the button <Export service data> (Fig. 114, item 1).

- The process window is displayed and the export of service data will be carried out (Fig. 114, item 2).
- After successful export a confirmation message Fig. 114, item 3) is displayed.

Information

A new folder "LB47x_Export" is created and the Backup-File is copied when exporting.

9 Troubleshooting

9.1 Error Search

Problem	Cause	Measure
EVU: Screen black; LEDs are not illuminated	EVU does not work	▶ Check power supply and fuses
No signal	Detector does not work	▶ Check the functioning of the detector
Count rate too low	Shield not opened or not opened correctly	▶ Check lock and ensure it is in OPEN position
	Incorrect focus of the effective radiation on the detector	▶ Correct and optimize the alignment
	Objects in the beam path	▶ Offset irradiation level
	Source at the end of its usable life span	▶ Replace source
No or incorrect level display	level value entry incorrect	▶ Check the calibration value and the level display
Absorption display deviates	Defect in detector	▶ Check detector
	Incorrect calibration	▶ Check calibration values
	Count rate too low (see above)	▶ Check source age and irradiation level, replace detector
Detector is not detected (software)	Terminals / wiring	▶ Check terminal connection; check terminal assignment
	Damaged line	▶ Check cable; examine with measurement device.
	Incorrect type LB 44xx / LB 54xx / LB 4700 in the configuration	▶ Check type of detector (see type plate on the detector)
Detector is not detected (software)	Incorrect ID in the configuration	▶ Check ID of the detector (see type plate on the detector)
Touch panel does not respond	Error in operating system	▶ Restart EVU
Buttons are missed when you click	Incorrect screen calibration	▶ Calibrate screen again

9.2 Error Codes of the Evaluation Unit

In the following tables you can find the EVU and detector error codes which give you exact information on how to fix them. The error codes of the detectors can be found in the operating instructions of the respective detectors.

System events are classified in

- FAILURE (F)
- OUT OF SPECIFICATION (S)
- FUNCTION CHECK (C)
- MAINTENANCE REQUIRED (M)

Failure (F)

Severe device error. The current output emits an error current. The error relay gives alarm (contact opens).

Out of specification (S)

The detector, one of its components or the process itself, are out of normal specification. The message appears on the display and is stored in the error log (error relay and current output remain unaffected).

Function Check (C)

Indicates that entries are made at the detector or a function check/simulation is being performed. The message appears on the display and is stored in the error log (error relay and current output remain unaffected).

Maintenance required (M)

Appears e.g. at M308 "Source Replacement". See table in section 9.2.2. The message appears on the display and is stored in the error log (error relay and current output remain unaffected).

9.2.1 System

Code	Message	NAMUR107	Help Text
M101	HW Module	F	Hardware electronics module corrupt. Restart the device. Contact Berthold service, if this event occurs repeatedly.
M102	Device dataset	F	Failure of the permanent memory. No parameter set found. Factory reset and / or restart the device. Contact Berthold service, if this event occurs repeatedly. The device possibly must be reset twice.
M103	RAM, Flash or CPU	F	Internal hardware failure. Restart the device. Contact Berthold service, if this event occurs repeatedly.
M104	WD Reboot	M	The Watchdog has caused the device to restart. Contact Berthold service, if this event occurs repeatedly. Check, if massive electromagnetic interferences have caused this event.
M105	WD Failure	F	Watchdog malfunction. Contact Berthold service, if this event occurs repeatedly.
M106	WD Off	M	Watchdog is inactive.
M107	Error in the internal real time clock	M	Malfunction of the real-time clock. Check Date and Time. If the event occurs frequently, contact Berthold Service.
M108	CPU temperature sensor	M	The temperature sensor of the device is defective. Contact Berthold Service. The hardware is defective and, if necessary, must be checked and replaced.
M109	Lower temperature limit: Maintenance required	M	The internal temperature of the device is close to the lower threshold value (-20°C) of the permissible operating temperature.
M110	Temp LL OOS	S	The internal temperature of the device is below the lower limit (-30°C). The correct function of the device cannot be guaranteed. It is recommend to have the device checked by Berthold Service, even if it seems to work normally.
M111	Temp UL maintenance	M	The internal temperature of the device is close to the upper limit (70°C).
M112	Temp UL OOS	S	The internal temperature of the device is above the upper limit (85°C). The correct function of the device cannot be guaranteed. It is recommend to have the device checked by Berthold Service, even if it seems to work normally.
M113	Power On Reboot	C	The device was restarted, e.g. due to a power failure.
M114	Software Reboot	C	The device was restarted by user input.
M115	Extern RTC malfunction	M	Failure of the external real time clock. Contact Berthold service, if this event occurs repeatedly.

M116	Corrupt Date	M	The date could not be verified at startup. Check date and time and set if necessary.

9.2.2 Application

Code	Message	NAMUR107	Help Text
M301	Default parameter set	M	Device not calibrated. Measurement with default parameters. Calibrate device
M302	Decay compensation	S	Decay compensation failed. Contact Berthold service, if this event occurs repeatedly.
M303	Det Temp LL failure	F	Detector temperature at / below lower limit. Limit value can be configured. Factory setting: -20°C.
M304	Det Temp UL failure	F	Detector temperature at / above upper limit. Limit value can be configured. Factory setting: 60°C
M305	Det Temp LL OOS	S	Detector temperature at / below lower limit. Limit value can be configured. Factory setting: -20°C.
M306	Det Temp UL OOS	S	Detector temperature at / above upper limit. Limit value can be configured. Factory setting: 60°C.
M307	Stray radiation	S	Interference radiation (XIP) detected. Measurement stopped.
M308	Source replacement	M	Source replacement date reached. Replace source.
M309	Application stopped	C	Measurement stopped.
M310	PV calc not possible	S	Process value could not be calculated. Check measuring range and calibration. If necessary, also check limit switch settings.
M311	Backup process	C	Backup in process.
M312	Restore process	C	Restore in process.
M320	PV LL failure	F	Process value at / below lower limit.
M321	PV UL failure	F	Process value at / above upper limit.
M322	PV LL OOS	S	Process value at / below lower limit.
M323	PV UL OOS	S	Process value at / above upper limit.
M326	GPC out of spec	S	Compensation factor of Gas Properties Compensation has reached its limit. Check process.
M327	No GPC detector	S	No detector for Gas Properties Compensation found. Connect / configure detector.
M332	Damping time constant maintenance.	M	In less than 30 days, the time constant will be too low to guarantee a safe level switch function. Please adjust the "Damping" settings or contact Berthold Technologies for source replacement.
M333	Damping time constant failure.	F	The time constant is too low to guarantee a safe level switch function. Please adjust the "Damping" settings or contact Berthold Technologies for source replacement.

M334	Damping time constant out of specification.	S	The time constant is too low to guarantee a safe level switch function. Please adjust the "Damping" settings or contact Berthold Technologies for source replacement.
M399	Internal program err	F	Internal software failure. Restart the device. Contact Berthold service, if this event occurs repeatedly.

9.2.3 Detector

Code	Message	NAMUR107	Help Text
M501	Detector not found	F	Lost connection to at least one detector. Check detector settings and connections. It is recommend to have the device checked by Berthold Service, even if it seems to work normally.
M502	Detector comm. error	M	Temporarily lost connection to at least one detector. Check detector settings and connections. Contact Berthold service, if this event occurs repeatedly.
M503	Detector failure	F	At least one detector registers “Failure". Check detector events. Error only appears in the event log. Instead, the corresponding detector error is shown in the display.
M504	Detector out of spec.	S	At least one detector registers "out of specification". Check detector events. Error only appears in the event log. Instead, the corresponding detector error is shown in the display.
M505	Detector function check	C	At least one detector registers "function check". Check detector events. Error only appears in the event log. Instead, the corresponding detector error is shown in the display.
M506	Detector maintenance	M	At least one detector registers "maintenance". Check detector events. Error only appears in the event log. Instead, the corresponding detector error is shown in the display.
M599	Internal program error	F	Internal system failure. Powercycle device. If the event remains it could be caused by a defective hardware. Contact Berthold service.

9.2.4 Process Connection

Code	Message	NAMUR107	Help Text
M701	Current output	F	Deviation of analog output value from feedback value is too high. Calibrate analog output. Several passes may be necessary. Contact Berthold service, if this event occurs repeatedly.
M702	Current loop open	F	Current output loop open. Check cable connection.
M703	Software update	C	Indicates that a software update is running. No action necessary. The device automatically returns to measuring mode after the software update is finished.
M799	Internal program error	F	Internal software failure. Restart the device. Contact Berthold service, if this event occurs repeatedly.

10 Maintenance and Repair

The replacing of fuses and the cleaning of the EVU are described in the maintenance chapter.

IMPORTANT

The applicable national regulations of the respective country of use have to be observed!
Repair and servicing on the EVU may only be carried out by experts (see chapter 2.3). In case of doubt, the complete EVU is to be sent to Berthold.

NOTICE

Repair on electronic circuits on the circuit boards of a field device may only be carried out in the manufacturer's factory.
When working at electronic components, the relevant safety regulations must always be observed. Particularly observe the safety instructions in the chapter “2 Safety”.

- ▶ De-energize the detector and potentially connected relay contacts as well as all inputs and outputs.

IMPORTANT

To achieve optimum measuring accuracy, we recommend recalibrating the measuring system after a repair (not after changing the housing).

10.1 Replacing of Fuses

⚠ DANGER

Danger to life from electric shock!

Replacing of fuses may only be carried out by a qualified electrician.

- Please adhere to the relevant safety regulations.
- Installation/maintenance may only be carried out if the device has been de-energized.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

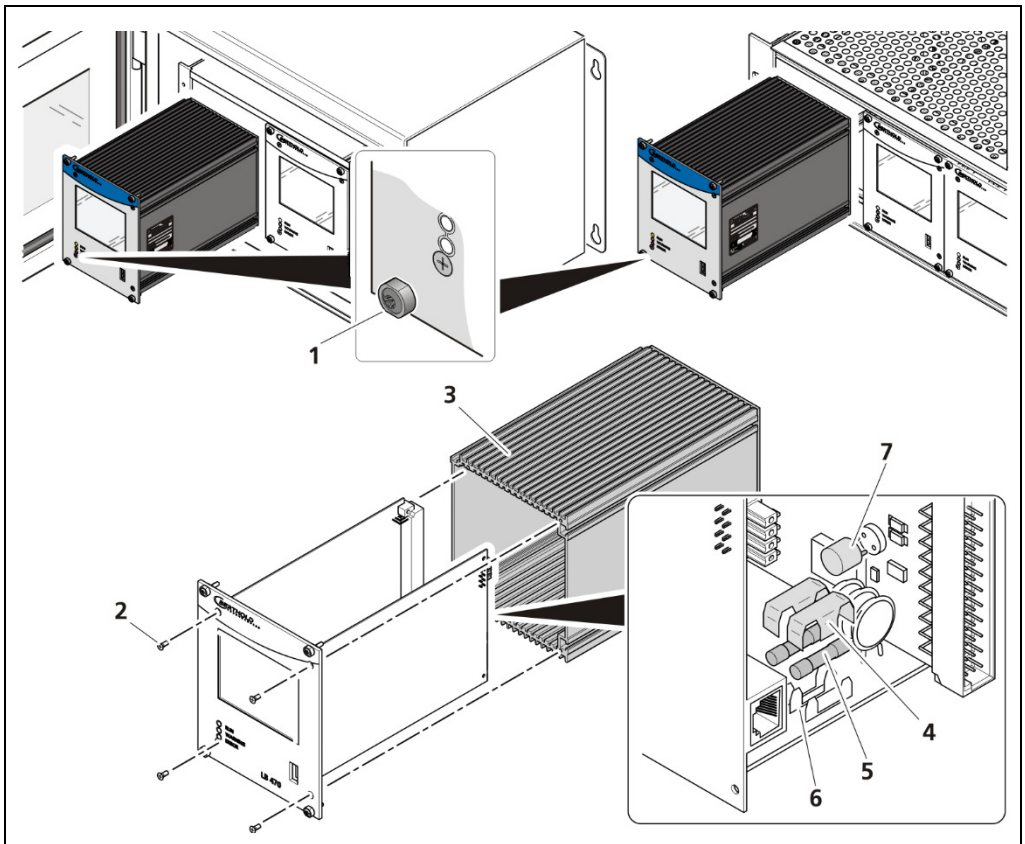
NOTICE

Damage to the device! Short circuit!

The EVU can be damaged if incorrect fuses are used.

- Only use fuses which correspond to the fuses on the circuit board of the module (see document “Technical Information”).

Replacing Fuse in the Master Module



1	Fixing screws	5	Fuse 250V 1A T (5x20 mm)
2	Screws	6	Base
3	Housing	7	Fuse 250V TR5 T80mA (Ø 8,5 mm)
4	Covering fuse		

Fig. 114 Replacing fuses master EVU

1. De-energize the device.
2. Loosen the four fixing screws (Fig. 115, item 1) and remove the EVU from the wall housing or subrack.
3. Loosen the four sunken screws on the front side of the EVU (Fig. 115, item 2).
4. Pull out the housing (Fig. 115, item 3) carefully.
5. Remove the protective covering of the fuse (Fig. 115, item 4)
6. Remove the fuse (Fig. 115, item 5, item 7).
7. Insert the new fuses and attach the protective covering again.
8. Carefully slide the circuit board into the housing.
9. Screw the front panel to the housing with the four screws (Fig. 115, item 2).
10. Set module into the guide rails and push it gently until the plug connector of the module is inserted into the socket board.
11. Tighten all fixing screws (Fig. 115, item 1).

▶ The fuse change was carried out correctly.

10.2 Cleaning

The display is designed for maintenance-free operation. Make sure you keep the touch screen and keyboard membrane clean. Use a cleaning cloth dampened with a cleaning agent to clean the equipment. Only use water with a little liquid soap or a screen cleaning foam.

NOTICE

Unintentional reaction!
When cleaning the touchscreen, touching keys can trigger an unintentional reaction in the EVU.

- ▶ When cleaning, make sure that no unintentional reactions are triggered.

NOTE

Damage caused by unauthorized cleaning products!
The display may be damaged if compressed air, steam jet blowers, aggressive solvents or scouring powders are used for cleaning purposes.

- ▶ Clean the EVU with a cleaning cloth dampened with a cleaning agent

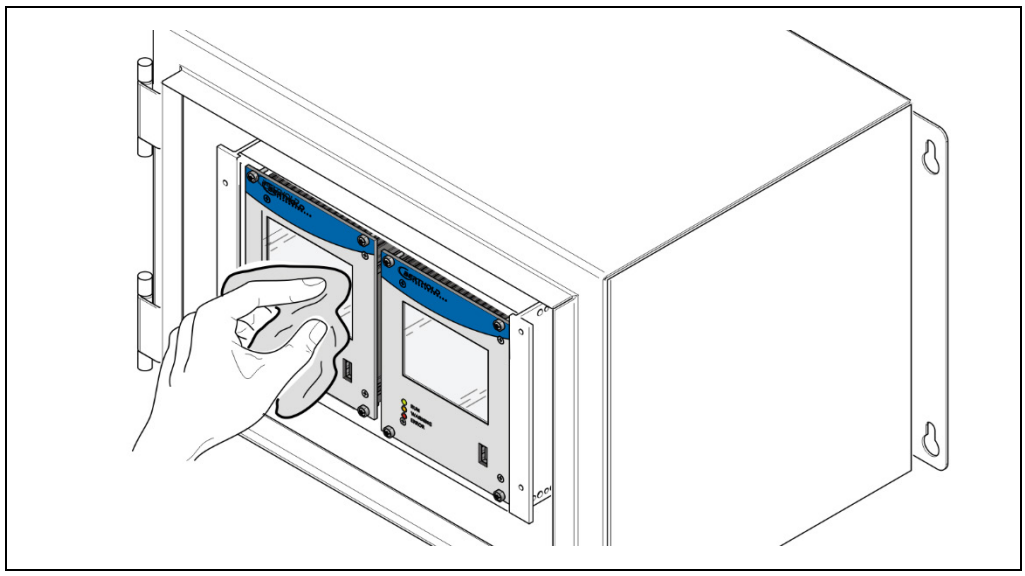


Fig. 115 Cleaning the display

1. Shut down the device.
2. Spray the cleaning solution onto a cleaning cloth.
3. Do not spray directly onto the display.
4. Clean the display.
5. When cleaning the display wipe from the screen edge inwards.

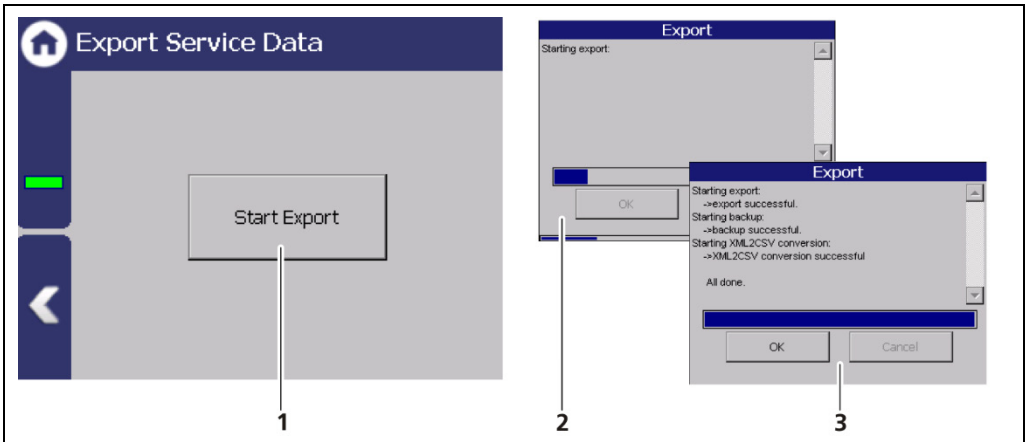
- ▶ The cleaning of the display was carried out correctly.

10.3 Data Backup

Activate the data log (see chapter 8.4) or the network data log (see chapter 8.5) so that all data are recorded. Perform a log data and service data backup at regular intervals.

Export Service Data

Diagnostics | Export Service Data



1 Button <Start Export>
2 Process window
3 Confirmation message

Fig. 116 Export Service Data

1. Connect a USB storage device to the device (Fig. 4, item 5).
2. The USB storage is recognized by the system after a few seconds and the button <Export service data> (Fig. 114, item 1) can be clicked.
3. Click on the button <Export service data> (Fig. 114, item 1).

- ▶ The process window is displayed and the export of service data will be carried out (Fig. 114, item 2).
- ▶ After successful export a confirmation message Fig. 114, item 3) is displayed. A new folder "LB47x_Export" is created.

11 Decommissioning

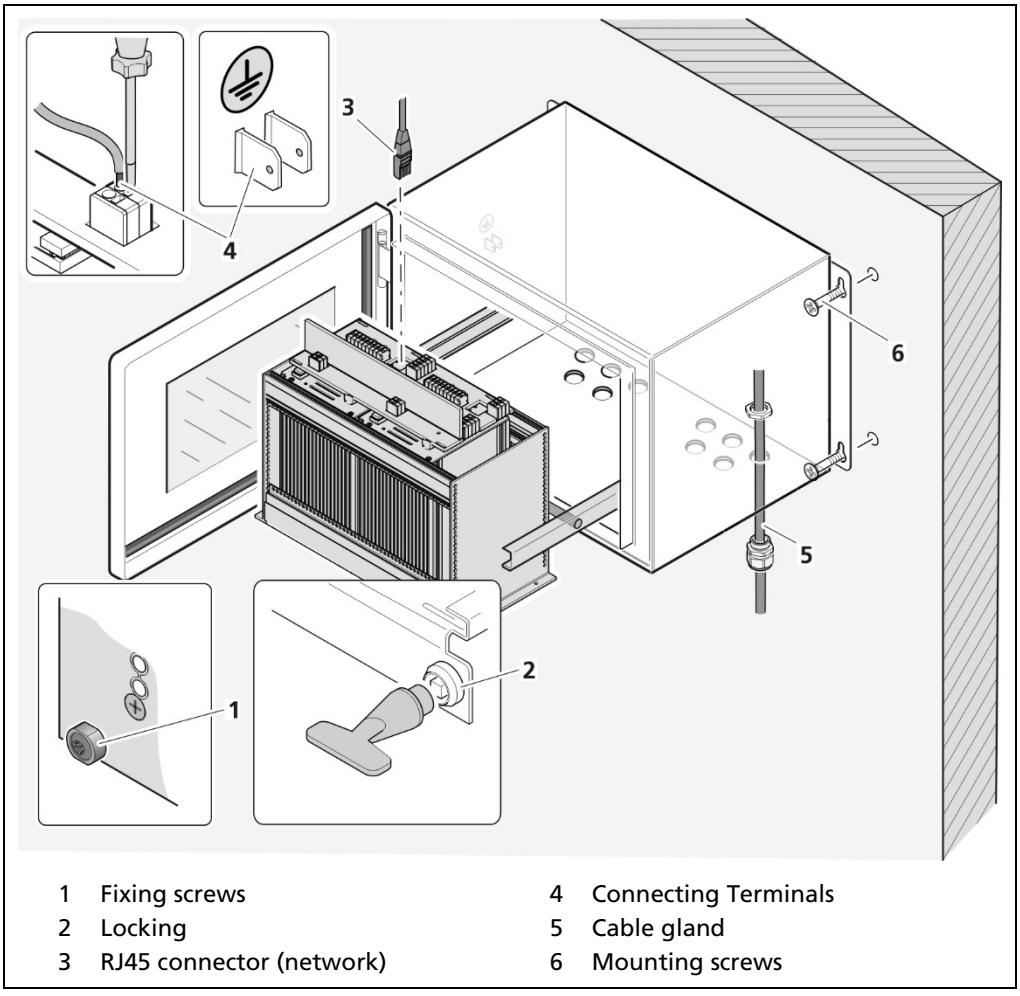
⚠ DANGER

Danger to life from electric shock!
Decommissioning may only be carried out by qualified electricians.

- Please adhere to the relevant safety regulations.
- Decommissioning may only be carried out if the device has been de-energized.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

11.1 Decommissioning wall housing



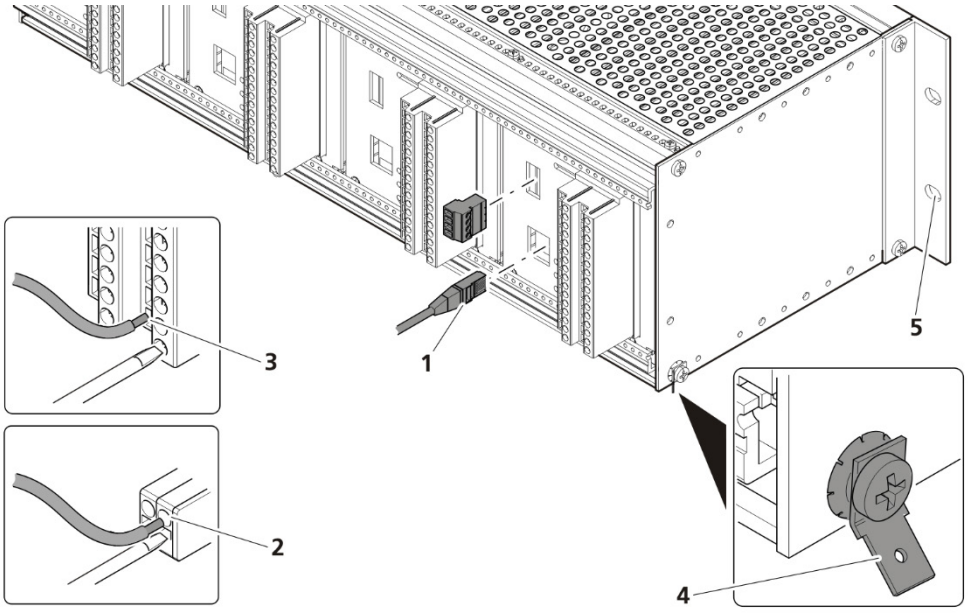
1	Fixing screws	4	Connecting Terminals
2	Locking	5	Cable gland
3	RJ45 connector (network)	6	Mounting screws

Fig. 117 Decommissioning wall housing

1. Make sure that the locking bolts (Fig. 119, item 1) of all modules are tightened in order to prevent slipping.

2. Loosen the lock (Fig. 119, item 2) using the supplied square key and pull the subrack out.
3. The subrack can be folded down by the folding mechanism.
4. Fold the subrack downward cautiously.
5. Remove the network plug (Fig. 119, item 3).
6. Remove all lines from the terminal board (Fig. 146, item 4).
7. Loosen the cable gland (Fig. 119, item 5) on the bottom side of the wall housing and pull all cables from the wall housing.
8. Slide the subrack into the wall housing and close the housing doors.
9. Loosen the mounting screws (Fig. 119, item 6) and remove the wall housing.

11.2 Decommissioning 19" Subrack



1 RJ45 connector (network)
2 Clamps terminal board
3 Clamp blocks
4 PE cable
5 Screw Connections

Fig. 118 Decommissioning 19“ subrack

1. De-energize the device.
2. Remove the network plug (Fig. 120, item 1).
3. Remove all lines from the terminal board (Fig. 120, item 2) or the clamp blocks (Fig. 120, item 3).
4. Remove the PE cable (Fig. 120, item 4).
5. Remove the connections (Fig. 120, item 5) and pull the subrack from the 19" rack.

11.3 Disposal of Measurement System

⚠ CAUTION

Toxic!
The product contains electronic components containing toxic substances that are harmful to health.

- ▶ Disposal is to be carried out in accordance with the disposal regulations via a disposal expert.

If the device is to be decommissioned, have it disposed of according to legal regulations (e.g. RL 2012/19/EU) by a specialized waste management company.

12 Appendix

12.1 Setup Protocol

General data	
Date	
Measuring point	
Source No.	
Activity	
Isotope	☐ Cs-137 ☐ Co-60
Container	
Product	

Device configuration		
Model		
Installation variant	☐ Wall housing	☐ Subrack
Anschluss	☐ Platine	☐ Clamp block
Power supply	☐ 100-240 V AC	☐ 18-32 V DC
Number of Master EVU		
Number of modules		
Device ID		
Software Version		

Setup Protocol (Continued)

Parameters	
Password	_____
Language	☐ DE ☐ EN ☐ _____
CE Remote Control	☐ enabled
Network	☐ DHCP active IP Address _____ • _____ • _____ • _____ Subnet _____ • _____ • _____ • _____ Gateway _____ • _____ • _____ • _____ DNS-Server _____ • _____ • _____ • _____ MAC Address _____
Calibration Method	☐ 1 Point ☐ 2 Point
Damping	☐ Automatic Max. Time Constant: _____ Date of Expiry: _____ ☐ Manual Time Constant: _____ Date of Expiry: _____
Level Switch	☐ Max. ☐ Min.
XIP	☐ Detection enabled Measurement Delay _____ s Hold Time _____ s I_0 Factor _____
Source replacement Notification	☐ enabled
Digital inputs	DI-1 Assignment ☐ none ☐ Empty Adjust ☐ Full Adjust DI-2 Assignment ☐ none ☐ Empty Adjust ☐ Full Adjust
Analog output	AO Assignment ☐ Level Switch 4/20 mA ☐ Level Switch 8/16 mA ☐ Absorption ☐ Damped Count Rate ☐ Raw Count Rate ☐ Detector Temperature ☐ AO-Monitoring Enabled AO-Failure Mode ☐ Namur-high ☐ Namur-low ☐ Hold value ☐ User Def. Value

Parameters		
Digital Outputs	Function DO-2 ☐ none ☐ Level switch alarm ☐ Time constant alarm ☐ Det. temperature alarm ☐ XIP alarm ☐ Source Replacement Alarm ☐ System state: Warning	Function DO-3 ☐ none ☐ Level switch alarm ☐ Time constant alarm ☐ Det. temperature alarm ☐ XIP alarm ☐ Source replacement alarm ☐ System state: Warning
PV Alarm Behavior	NE 107 Status when Alarm ☐ No Status ☐ Out of Specification ☐ Failure	
Detector Temperature Alarm Behavior	NE 107 Status when Alarm ☐ No Status ☐ Out of Specification ☐ Failure	

Modifications due to technical advancement reserved.

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Id.-No. 56925-3BA2

Unité d'évaluation
DuoSeries
LB 47x

Détecteurs
DuoSeries
LB 4700

Informations sur la sécurité

56925BA59 Rev.05 08/2023

BERTHOLD

1 A propos de ce manuel d’utilisation

1.8 Avertissement

Les avertissements sont identifiés comme suit :

Signalement

Source et conséquence
Explication si requise
▶ Prévention
En cas de danger

- **Symboles d’alerte :** (triangle d’alerte) attire l’attention sur le risque.
- **Signalement :** Indique la sévérité du danger.
- **Source :** Précise le type ou la source de danger.
- **Conséquence :** Décrit les conséquences d’un non respect.
- **Prévention :** Précise comment le risque peut être écarté.
- **En cas de danger :** Précise quelles actions sont requises en cas d’occurrence du risque

1.8.1 Symboles employés dans le manuel d’utilisation

Dans ce manuel, les avertissements indiqués avant les instructions d’utilisation se réfèrent aux risques de blessures ou de dégâts matériels. Les mesures de prévention de danger décrites doivent être respectées.

DANGER

Indique un danger majeur imminent, qui entraînera certainement des blessures sérieuses ou la mort s’il n’est pas évité.

AVERTISSEMENT

Indique un danger potentiel qui peut entraîner des blessures sérieuses ou la mort s’il n’est pas évité.

PRUDENCE

Se réfère à une situation potentiellement dangereuse qui peut entraîner des blessures physiques mineures ou graves, ou des dégâts matériels si elle n’est pas évitée.

RECOMMANDATION

Si cette information n'est pas appliquée, un dysfonctionnement et/ou un dégât matériel peuvent apparaître.

IMPORTANT

Les sections identifiées avec ce symbole signalent des informations importantes du produit ou de son fonctionnement.

Tip

Fournit des conseils sur l'application ou d'autres informations utiles.

1.8.2 Symboles utilisés sur l'appareil

Lire le manuel d'utilisation

Veuillez suivre les instructions dans ce manuel d'utilisation.

Décharge électrostatique

Veuillez noter les instructions de manipulation. Composants sensibles aux décharges électrostatiques. Veuillez suivre les instructions de ce manuel d'utilisation.

Connexion de mise à la terre

Raccorder le conducteur de mise à la terre à cet endroit.

Raccordement equipotentiel

Raccorder le conducteur d'équipotentialité à cet endroit

Tension continue

L'appareil fonctionne en tension continue et ne doit être raccordé qu'à une source de tension continue.

Tension alternative

L'appareil fonctionne en tension alternative et ne doit être raccordé qu'à une source de tension alternative.

Déchet non domestique

Cet appareil électrique ne doit pas être éliminé avec les déchets domestiques

1.9 Conformité

La société Berthold déclare par la présente, sous son entière responsabilité, que la conception de ce produit mis sur le marché par Berthold est conforme aux directives EU indiquées dans la déclaration de conformité originale.

Cette disposition devient nulle en cas de modifications non autorisées par Berthold ou dans le cas d'une utilisation impropre.

Pour la déclaration de conformité originale, se «Technical information».

2 Sécurité

2.1 Dangers et mesures de sécurité

- Lire ces instructions entièrement et avec attention avant d'utiliser l'appareil.
- Stocker ces instructions dans un endroit accessible à tous les utilisateurs en permanence.

2.2 Utilisation appropriée

Ce qui suit constitue une utilisation appropriée :

- Se conformer strictement aux instructions et séquences d'utilisation mentionnées. Ne pas procéder à des pratiques différentes non autorisées qui pourraient engager votre sécurité et la fiabilité fonctionnelle de l'EVU !
- Suivre les instructions de sécurité mentionnées !
- Effectuer les opérations de maintenance prescrites ou les faire réaliser pour vous !
- Utiliser uniquement les accessoires et pièces de rechange Berthold.

Utilisation inappropriée à éviter:

- Ne pas suivre les instructions de sécurité et les instructions pour l'utilisation, la maintenance et la mise au déchet indiquées dans le manuel.
- Un non respect quelconque avec le présent manuel d'utilisation pour le produit délivré.
- Appliquer des dispositions et conditions non conformes à celles mentionnées dans les documents techniques, feuilles de spécifications, manuels d'utilisation et instructions de montage, ou tout autre document spécifique du constructeur.
- Utiliser l'appareil si des éléments sont endommagés ou corrodés. Ceci s'applique aussi aux joints et aux câbles.
- Modification ou changement des éléments du système.
- L'appareil ne doit pas être installé en atmosphère explosive et de ce fait, ne peut pas être utilisé dans une telle atmosphère. Il n'est pas antidéflagrant.
- Utilisation...
  - où les éléments sous tension sont accessibles.
  - dans un boîtier mural avec presse-étoupes insuffisamment étanches et/ou non adaptés pour le passage des câbles.
- Utilisation sans les précautions de sécurité recommandées par le constructeur.
- Manoeuvre inappropriée ou oubli des équipements de sécurité présents.

Berthold assume la responsabilité de la garantie seulement dans le cadre de ses spécifications publiées.

Si le produit est utilisé dans des conditions autres que celles décrites dans le présent manuel, la sécurité du produit est compromise et la garantie devient nulle.

RECOMMANDATION

L'appareil n'est pas conforme à IEC 61508 « Sureté de fonctionnement des systèmes comportant des composants électriques, électroniques ou électroniques programmables »

2.3 Qualification du personnel

RECOMMANDATION

Le minimum requis pour intervenir sur nos appareils ou pour les utiliser est un personnel avec des connaissances générales complétées par une formation d'un expert ou d'une personne autorisée.

A plusieurs endroits dans ce manuel d'utilisation, il est fait références à des groupes de personnes avec des qualifications particulières et à qui différentes tâches peuvent être confiées pendant l'installation, l'utilisation et la maintenance.

Les trois groupes de personnes sont :

- Employés avec des connaissances générales
- Experts
- Personnes autorisées

Employés avec connaissances générales

RECOMMANDATION

Les employés avec des connaissances générales doivent être guidés par un expert pour le moins. Lors de la mise en œuvre de matières radioactives, la personne compétente en radioprotection doit être consultée.

Les employés avec connaissances générales sont, par exemple, des techniciens, des soudeurs, qui vont assurer différentes tâches lors du transport, de l'assemblage et de l'installation de l'appareil sous l'encadrement d'une personne autorisée. Il peut s'agir aussi de personnel de montage du site. Les personnes concernées doivent posséder une expérience dans la manipulation du produit.

Experts

Les experts sont des personnes avec des compétences suffisantes dans le domaine requis, dues à leur formation spécialisée et qui sont familiers avec les lois nationales relatives à la santé et la sécurité, les règlements concernant la prévention des accidents, et les usages techniques applicables.

Le personnel expert doit être capable de déterminer et d'évaluer le résultat de ses tâches et doit être très familier avec le contenu de ce manuel d'utilisation.

Personnes autorisées

Les personnes autorisées sont celles désignées pour les tâches correspondantes dans le cadre de dispositions réglementaires, ou celles dûment autorisées par Berthold pour des tâches particulières. Lors de la mise en œuvre de matières radioactives, la personne compétente en radioprotection doit être consultée.

2.4 Les obligations de l'opérateur

L’opérateur de ces appareils doit régulièrement former son personnel sur les sujets suivants :

- Connaissance et utilisation **du manuel d’utilisation et des clauses légales**.
- Utilisation prévue de l’appareil.
- Respect des instructions de sécurité du site et des conditions d’utilisation de l’opérateur.
- Gestion régulière de la maintenance du produit.

Sous réserve de modifications dans le cadre du progrès technique.

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DuoXpert
LB 473 Level Switch

Technical Information

56925TI2LS Rev.00 07/2024

BERTHOLD

Table of Contents

1. Information on 2-Wire Technology

The DuoSeries/DuoXpert measuring system consists of a scintillation detector and a sophisticated evaluation unit (DuoXpert) for display and operation.

The evaluation unit is a state-of-the-art control unit with robust 3.5" TFT touch panel, powerful Dual Core CPU and diverse operator interfaces. Advanced self-diagnostics and monitoring features ensure a safe function of the system. Furthermore, the data logging functionality allows operators to analyze their processes in depth, e.g. develop trends, track process changes etc.

Sophisticated Measuring System in 2-Wire Technology

- Real 2-wire technology, only 2 wires in the field
- Advanced self-diagnostics and monitoring features
- Easy to use touch screen panel for local display and operation
- Interfaces with all 2-wire detectors LB 4700, LB 44xx and LB 54xx

2. Evaluation Unit

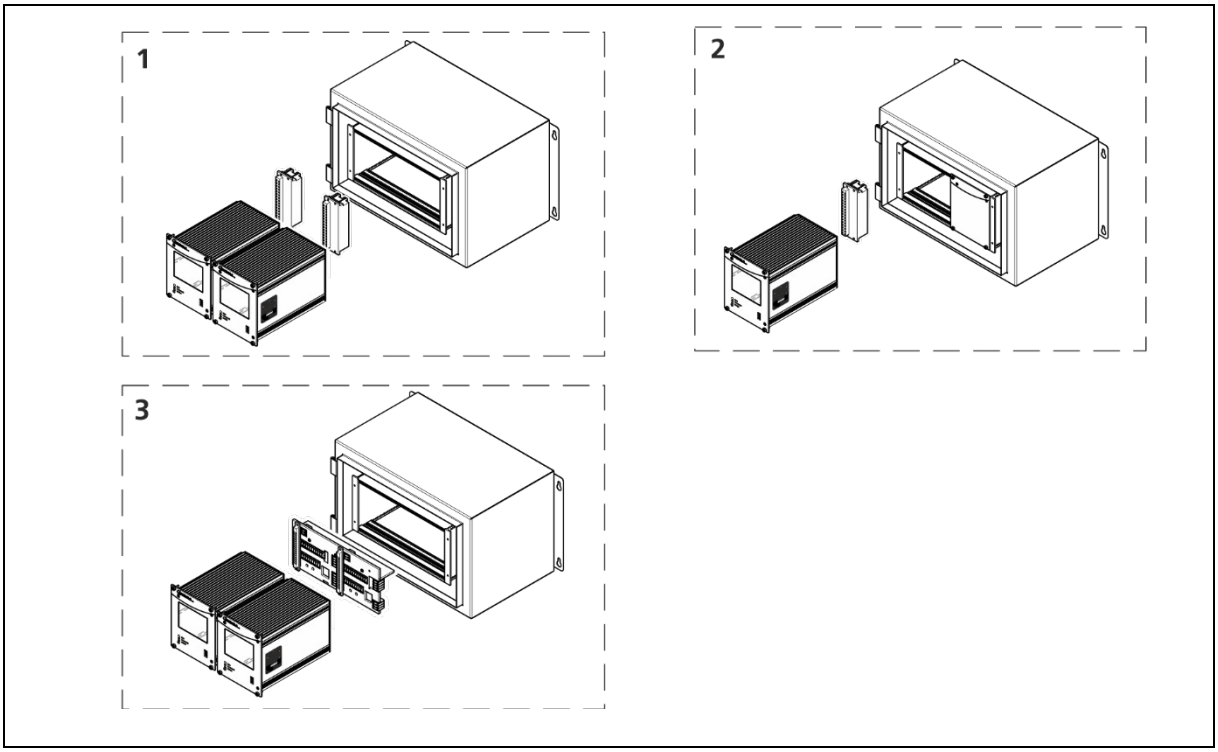
The master evaluation units can be installed either in wall housings or 19" subracks. Both can be equipped differently, depending on requirements. The rear terminal blocks are used for the electrical connection.

⚠ WARNING

Danger to life due to explosion!

- This version of the evaluation unit is not explosion protected and is not designed for hazardous environments.
- Please note the applicable documents for versions of the evaluation unit for intrinsically safe operation, see operating manual chapter 1.1.

2.1. Installation Variants Wall Housing

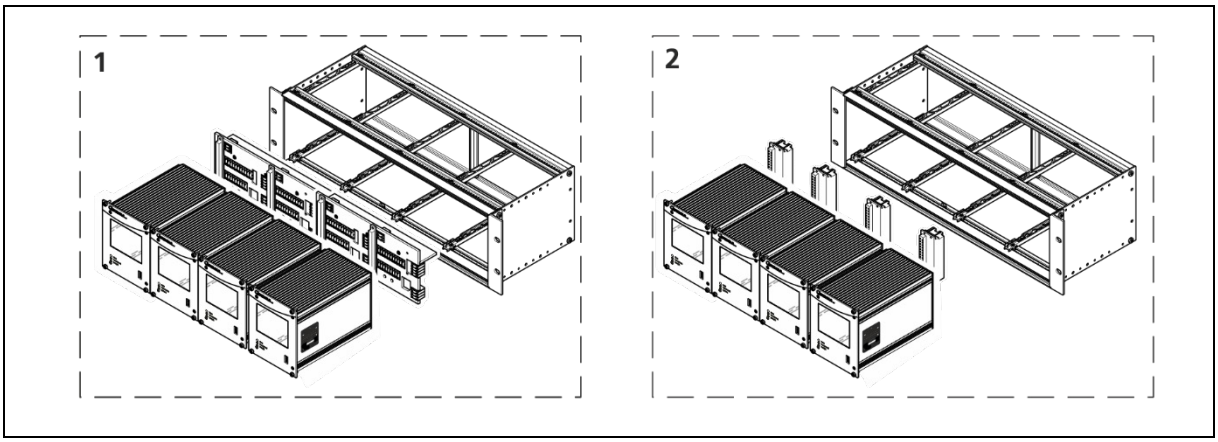


TI-Fig. 1 Installation variants wall housing

Item	Components	Connection
1	2 Masters	2 Terminal blocks
2	1 Master	1 Terminal block
3	2 Master	1 Terminal panel master/master[1]

[1] NRTL certification US/CAN

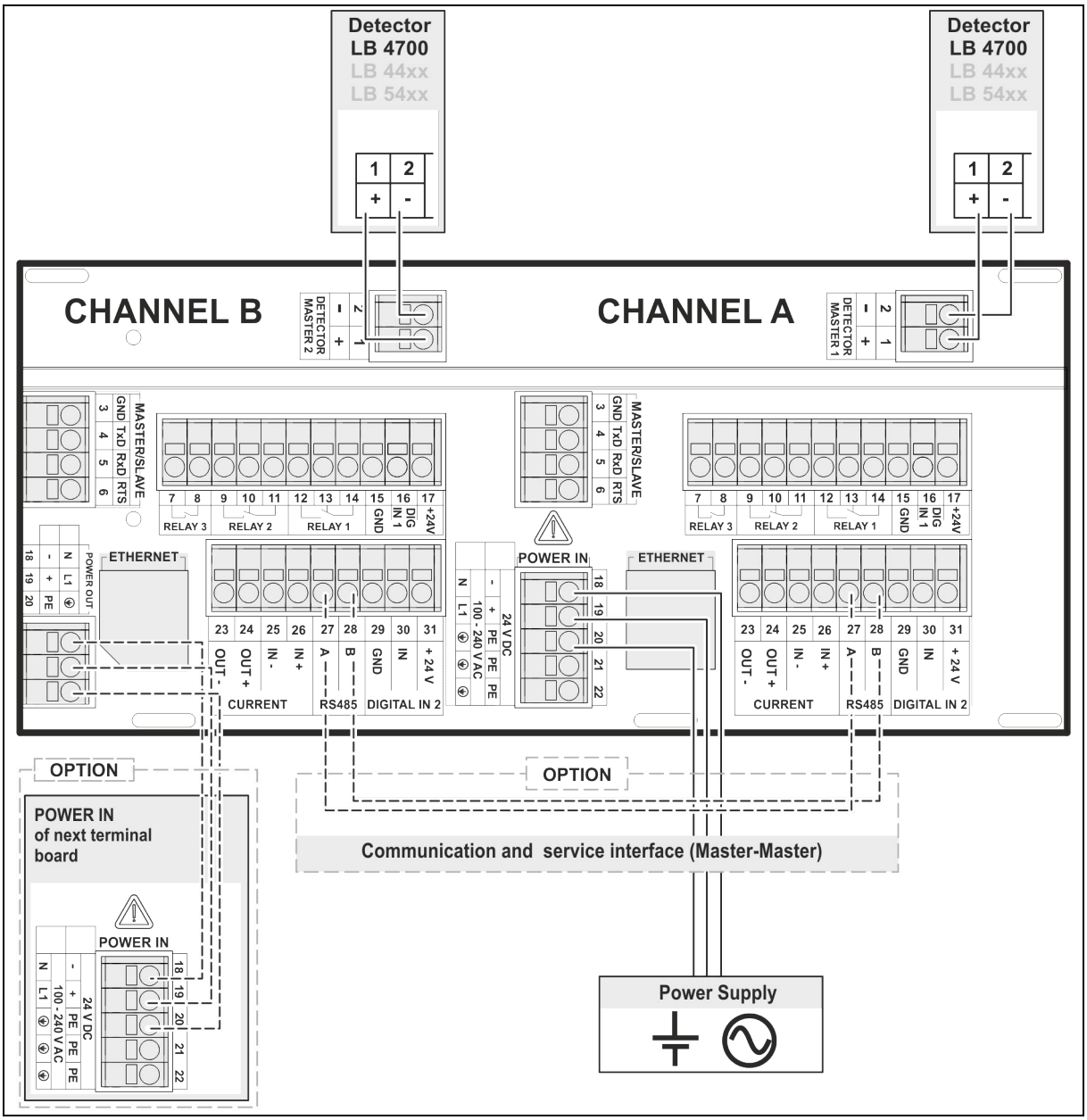
2.2. Installation Variants 19" Subrack



TI-Fig. 2 Installation variants 19" subrack

Item	Components	Connection
1	4 Masters	2 Terminal panel master
2	4 Masters	4 Terminal blocks

2.3. Connection Diagram Terminal Board Master



TI-Fig. 3 Connection diagram terminal board Master

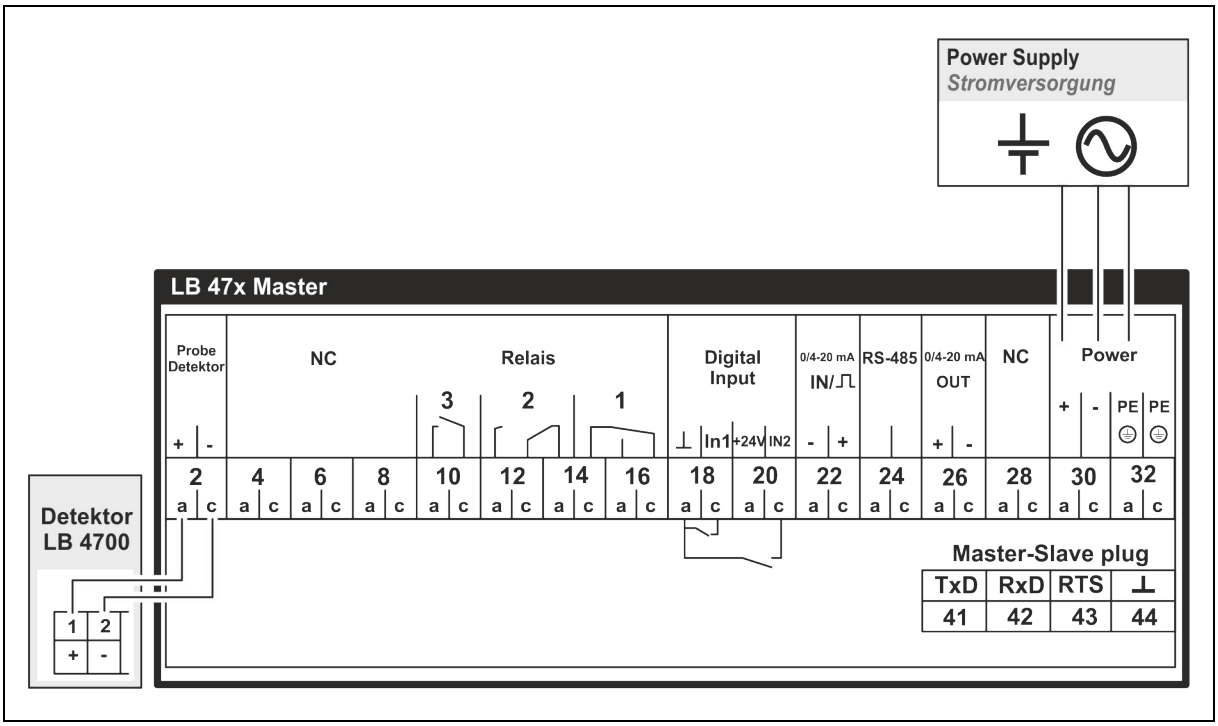
IMPORTANT

In a 19 "subrack for 4 masters (Mat. No. 59484), there is another one with Channel C / D next to the connector board for Channel A / B. The channel assignment of Channel C / D is identical to that of Channel A / B.

Terminals terminal board Master/Master

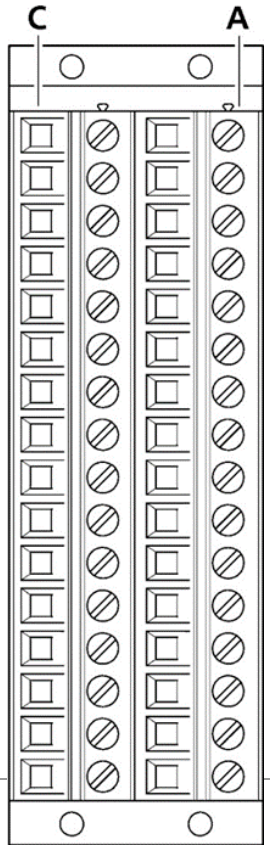
#	Connection	Function
1	DETECTOR MASTER +	Connection Detector LB 4700 / LB 44xx / LB 54xx
2	DETECTOR MASTER -	
3	MASTER/SLAVE GND	Connection of additional slave units
4	MASTER/SLAVE TxD	
5	MASTER/SLAVE RxD	
6	MASTER/SLAVE RTS	
7	RELAIS 3 NC	DIGITAL OUT
8	RELAIS 3 COM	
9	RELAIS 2 NC	DIGITAL OUT
10	RELAIS 2 NO	
11	RELAIS 2 COM	
12	RELAIS 1 NC	Error DIGITAL OUT
13	RELAIS 1 NO	
14	RELAIS 1 COM	
15	DIGITAL IN 1 GND	GND
16	DIGITAL IN 1 IN	Logic Input
17	+ 24 V (GND →15)	24 V out (max. 200 mA)
18	POWER DC 24 V – / AC N	24 V DC / 100-240 V AC
19	POWER DC 24 V + / AC L1	
20	PE	
21	PE	
22	PE	
23	CURRENT OUT –	4 mA … 20 mA
24	CURRENT OUT +	
25	CURRENT IN –	Not used for LB 473
26	CURRENT IN +	
27	RS 485 A	Communication and service interface (Master-Master)
28	RS 485 B	
29	DIGITAL IN 2 GND	GND
30	DIGITAL IN 2 IN	Logic Input
31	+ 24 V (GND → 29)	24 V out (max. 200 mA)

2.4. Assignment Terminal Block EVU



TI-Fig. 4 Assignment Terminal Block EVU

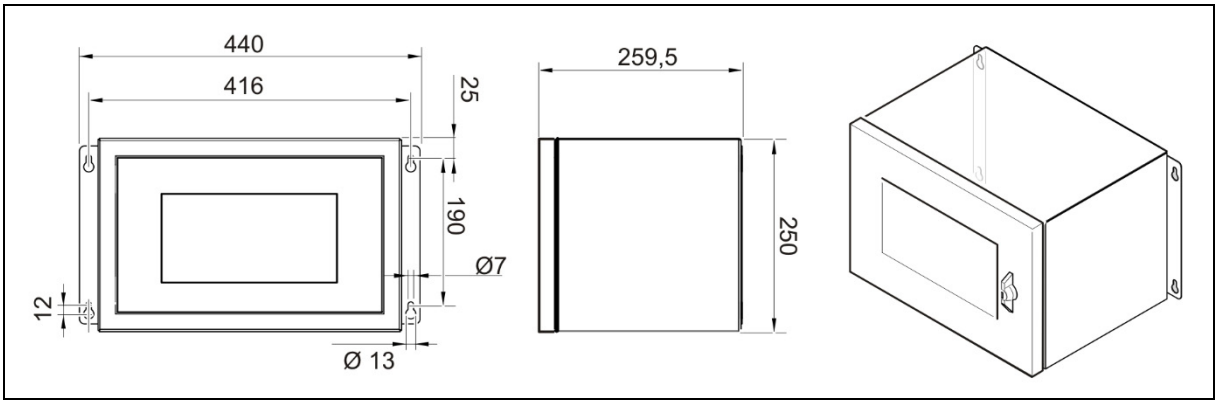
Terminal Block EVU



Signal	Pin	Pin	Signal
DETECTOR GND	C - 2	A - 2	DETECTOR +
n.a. *	C - 4	A - 4	n.a. *
n.a. *	C - 6	A - 6	n.a. *
n.a. *	C - 8	A - 8	n.a. *
RELAIS 3 COM	C - 10	A -10	RELAIS 3 NO
RELAIS 2 COM	C - 12	A - 12	RELAIS 2 NO
RELAIS 1 NC	C - 14	A - 14	RELAIS 2 NC
RELAIS 1 COM	C - 16	A - 16	RELAIS 1 NO
DIGITAL IN 1	C - 18	A - 18	DIGITAL IN GND
DIGITAL IN 2	C - 20	A - 20	+ 24 V (GND → A-18)
CURRENT IN +	C - 22	A - 22	CURRENT IN –
RS 485 B	C - 24	A - 24	RS 485 A
CURRENT OUT –	C - 26	A - 26	CURRENT OUT +
n.a. *	C - 28	A - 28	n.a. *
Main N AC, DC 24 V (–)	C - 30	A - 30	Main L1 AC, DC 24 V (+)
PE**	C - 32	A - 32	PE**

* Not assigned
** Protective conductor

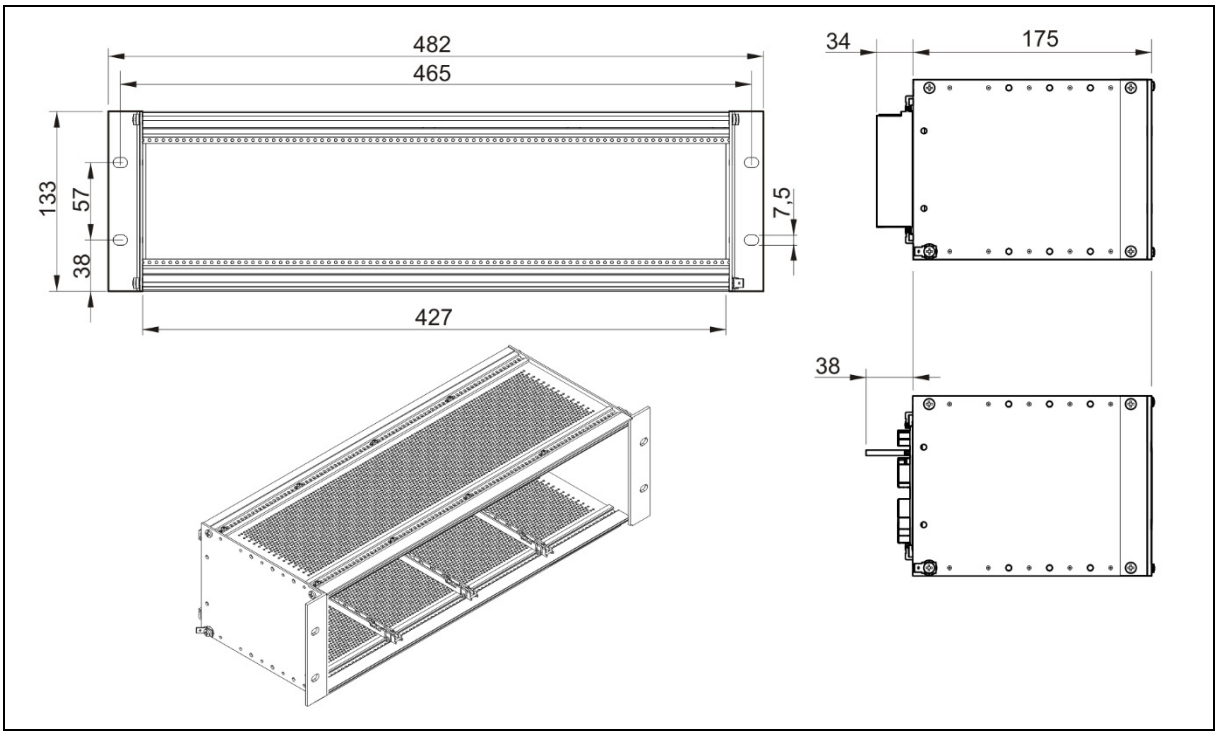
3. Wall Housing



TI-Fig. 5 Dimensions wall housing

Technical Data	
Max. assembly	2 Master
Weight (without modules)	8.8 kg
Degree of protection	IP65
Operational temperature	-20°C … +40°C
Storage temperature	-25°C … 80°C
General ambient conditions	Overvoltage category: II Pollution Degree: 2 Altitude: up to 2000 m Rel. humidity: 93% or less
User interface, colors	powder coated, grey
Cable entry	8 x M16, 2 x M32

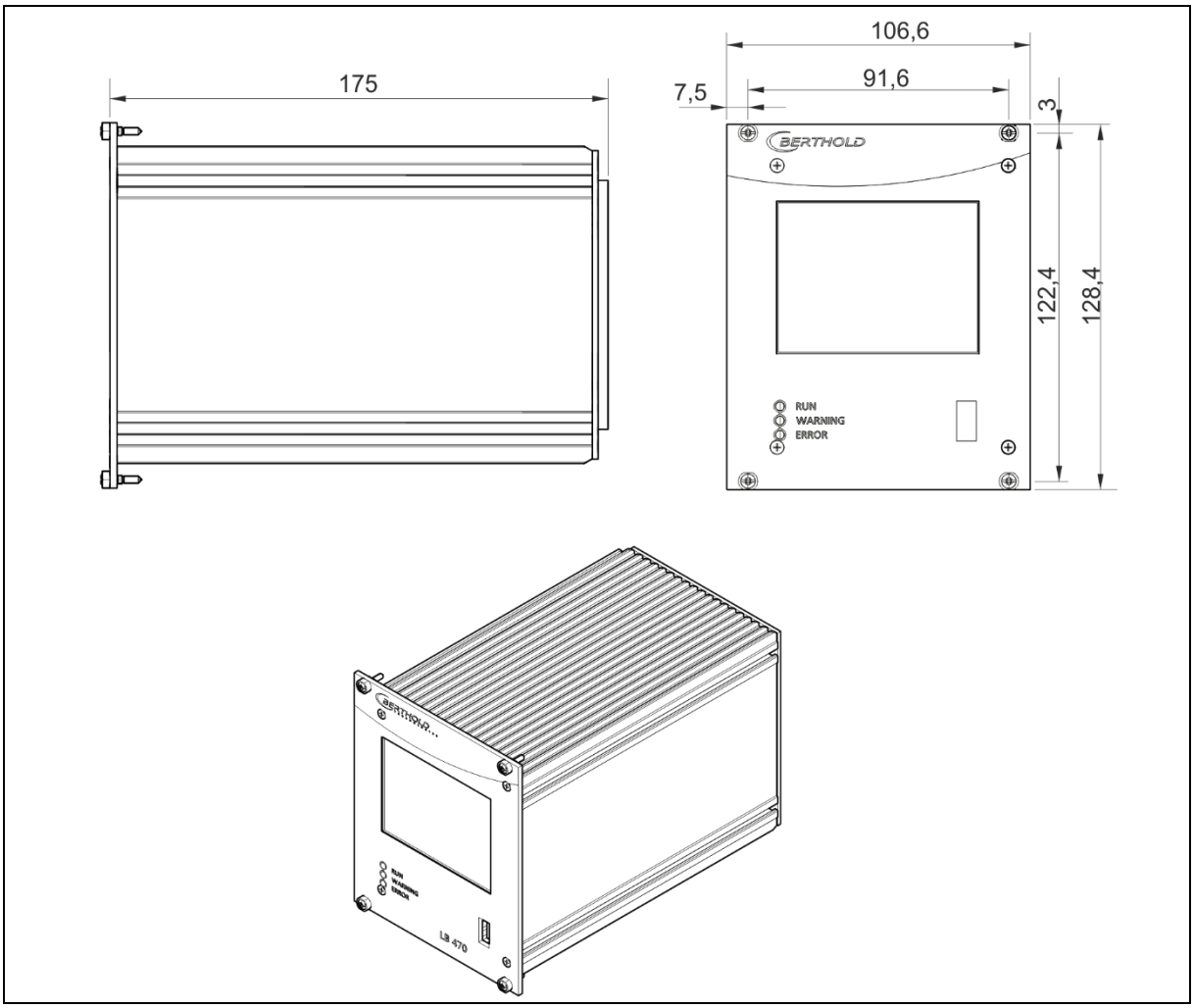
4. 19" Subrack



TI-Fig. 6 Dimensions 19" subrack

Technical Data	
Standard units	3HE/84TE/5T
Max. Assembly	4 master
Weight (without EVUs)	1.4 kg
Weight terminal block	220 g
Operational temperature	-20°C … +50°C, not condensing
Storage temperature	-25°C … +80°C
Degree of protection	IP20

5. EVU



TI-Fig. 7 Dimensions EVU

Technical Data	
Weight	1200 g
Operational temperature	-20°C … +50°C not condensing. Avoid direct sunlight. Unobstructed air circulation must be provided to the subrack.
Storage temperature	-30°C … +80°C
General ambient conditions	Overvoltage category: II Pollution Degree: 2 Altitude: up to 2000 m Rel. humidity: 93% or less
Degree of protection	IP20[1]
Connections	- USB port for the connection to the USB storage medium - Master/slave connection (4-pin) and plug - RJ45 connection for Ethernet (on back wall) - 32-pin plug connector according to DIN 19465 Series C

Display	- graphical LCD display - 320 x 240 points, 262,000 colors - Dimmable LED background lighting - Touchscreen
Computer core	- Processor: Dual Core DSP/ARM Controller - clock frequency: 300 MHz internal (20 MHz external quartz) - ROM: 512 KByte - RAM: 64 MByte ext. SDRAM, 128 KByte int. shared RAM - FLASH: 8 MByte external serial

Power Supply	
Voltage	100 … 240 V AC 50/60 Hz (wide range input) +/- 10% 21 … 32 V DC (24 V DC power input)
Power consumption	22 VA, 15 W
Fuses	Internal, 2x 250 V, 1A delayed, 5x20 mm, 1500 A breaking capacity IEC 60127-2, 1x 250 V TR5 T80 mA (Ø 8,5 mm)

[1]Designed for indoor use. Outdoor use only possible if installed in wall housing.

Interfaces	
Current Output	4-20mA internally switched from power source to sink current (according to NAMUR recommendation NE 006 and NE 043). Dip switch source/sink on the electronic board of the LB 47x. Standard setting is source current. Continuous short circuit proof and galvanically isolated (500 V). Internal resistance about 105 ohms max. Burden when operating as a power source: 850 ohms. Internal monitoring of the loop current and additional error signaling by hardware on detection of a fault condition.
Digital outputs	3 relays, U_{max} = 33 V AC_{eff}, 46 V DC; I_{max} = 1 A functions: Relay 1: SPDT for error signaling Relay 2: SPDT assignable by software Relay 3: SPST assignable by software
Digital inputs	2x together electrically isolated (500 V) Switch between DigIn and GND, U_{outmax} approx. 24 V Function configurable via software
External supply	Output voltage: 24 V DC Output current: max. 150 mA
RS485	For master/master communication, and testing and evaluation purposes. not isolated from main electronics and USB port electrically isolated from remaining I/Os (500 V)
USB port	1x USB 2.0 Type A (Host) via front plate to the connection of an ext. mouse, keyboard or storage medium U_{out} = 5 V, I_{outmax} = 0.5 A
Ethernet	RJ45 connection via back wall, 10 Mbit, DHCP supported, max. 3 m Designed for maintenance purposes. Not designed for long-term operation.

6. Number Key LB 47x

1	2	3	4	5	6	7	8	9	10	11	12	13
L	B	4	7	x	-	x	x	-	x	x	-	x

Device family	
47	DuoXpert

Application	
0	Level
1	*Level-Switch[1]
2	Bulk Flow
3	Level Switch
4	Density
5	Hydraulic Fracturing[1]
6	Level+[1]
8	MPLM[1]
x	No Application

Equipment features	
M	Master EVU
S	Slave Modul[1]
A	4x Current Output HART
B	7 Wire/RS485 Repeater
E	MPLM Extension Module

Current Output (Ex-i)	
0	Source / Current Input
1	Sink / Current Input
2	Source / Impulse Input
3	Sink / Impulse Input

only LB 470	
0	no RID
-RID	Radiation Interfrerene Descrimination

Power Supply	
0	without separate supply
1	24 V DC
2	100 ... 240 V AC

Approval, Explosion Protection	
0	without Ex-Approval
1	Ex-i IIB
2	Ex-i IIC

TI-Fig. 8 Number key

[1] Only available as standard version
* Other Hardware

7. Declaration of Conformity LB 47x

BERTHOLD TECHNOLOGIES GmbH & Co. KG
Calmbacher Straße 22
75323 Bad Wildbad, Germany
Phone +49 7081 177-0
Fax +49 7081 177-100
info@Berthold.com
www.Berthold.com

EG-Konformitätserklärung (ORIGINAL) Dok.Nr.: CE20028-1

Hiermit erklären wir in alleiniger Verantwortung, dass die Bauart des(r) nachfolgend bezeichneten Geräte / Systems / Anlage / Maschine in der von uns in den Verkehr gebrachten Ausführung den unten genannten einschlägigen Harmonisierungsvorschriften der EU entsprechen.

Durch nicht mit uns abgestimmte Änderungen oder nicht bestimmungsgemäßen Gebrauch verliert diese Erklärung ihre Gültigkeit.

Produktbezeichnung: ***radiometrisches Auswertesystem DuoXpert***

Typenbezeichnung / Modell: ***LB 47x***

	Richtlinie (Fundstelle)	angewendete Normen und weitere Spezifikationen	
NSR	2014/35/EU	EN 61010-1	2010
RoHS	2011/65/EG		
EMV	2014/30/FU	EN 61326-1	2013
		EN 61000-4-2	
		EN 61000-4-3	
		EN 61000-4-4	
		EN 61000-4-5	
		EN 61000-4-6	
		EN 61000-4-11	
		EN 61000-3-2	
		Namur NE21	2012

Diese Erklärung wird verantwortlich für den Hersteller

BERTHOLD TECHNOLOGIES GmbH & Co. KG
Calmbacher Str. 22, D-75323 Bad Wildbad

abgegeben durch

Dr. Jürgen Briggmann
Leiter Entwicklung
Bad Wildbad, den 1. September 2015

BERTHOLD TECHNOLOGIES GmbH & Co. KG
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info@Berthold.com
www.Berthold.com

EG-Declaration of Conformity (ORIGINAL)

File.No.: CE20028-2

We, hereby declare under our sole responsibility that the design of the following products / systems / units / machines brought into circulation by us comply with the relevant harmonized rules of the EU.

This declaration loses its validity should modifications or unsuitable and improper use take place without our authorisation.

Product name: ***radiomatric evaluation system DuoXpert***

Type / model: ***LB 47x***

	directive	applied standards	
LVD	2014/35/EU	EN 61010-1	2010
RoHS	2011/65/EG		
EMC	2014/30/EU	EN 61326-1	2013
		EN 61000-4-2	
		EN 61000-4-3	
		EN 61000-4-4	
		EN 61000-4-5	
		EN 61000-4-6	
		EN 61000-4-11	
		EN 61000-3-2	
		Namur NE21	2012

This declaration is issued by the manufacturer

BERTHOLD TECHNOLOGIES GmbH & Co. KG
Calmbacher Str. 22, D-75323 Bad Wildbad, Germany

released by

Dr. Jürgen Briggmann

Head of R&D
Bad Wildbad, 1st of September, 2015

Registergericht / Court of Registration: Stuttgart HRA 330981
Persönlich haftende Gesellschafterin / Fully liable Associates: BERTHOLD TECHNOLOGIES Verwaltungs-GmbH
Registergericht / Court of Registration: Stuttgart HRB 331520
Geschäftsführung / Management: Horst Knauß, Dr. Dirk Mönnich
USt.-Id-Nr. / VAT Reg. No.: DE813050511
Deutsche Steuernummer / German Tax No.: 43038/08038
WEEE-Reg. No.: DE95468650

Sparkasse Pf-CW 75323 Bad Wildbad Konto/Account No. 8 043 003 (BLZ 666 500 85) SWIFT-BIC PZHSDE66 IBAN: DE37 6665 0085 0008 0450 03
Volksbank 75179 Pforzheim Konto/Account No. 557 004 (BLZ 666 900 00) SWIFT-BIC VBPFDE6G IBAN: DE85 6669 0000 0008 9570 04
Commerzbank 75165 Pforzheim Konto/Account No. 6 511 120 (BLZ 666 800 12) SWIFT-BIC DRES DEFF 666 IBAN: DE05 6668 0013 0651 1120 00

8. NTRL Certification US/CAN wall-mounted housing

Nemko

Certificate of Compliance

Nemko-CCL, Inc.

Certificate: NA201610530 **Date Issued:** January 20, 2016

Project: 257087-7.1

Issued to: Berthold Technologies GmbH & Co. KG
Calmbacher Straße 22
75323 Bad Wildbad
Germany

The products listed below have been certified as being compliant with all applicable requirements of the specifications listed and are eligible to bear the following certification mark

c Nemko US

Issued by: Robert Keller, Senior Engineer/Safety Supervisor

Authorized by: Thomas Jackson, Certification Manager

PRODUCTS

MEASUREMENT, CONTROL, OR LABORATORY EQUIPMENT – Certified to US and Canada Standards

Product: Process measurement unit
Model: Wall-mounted LB 47x, 1M/3S; Wall-mounted LB 47x, 2M (x can be 0 to 8 and describes different software versions for the master and slave modules not affecting safety).
Ratings: Wall-mounted LB 47x, 1M/3S: 40VA 100-240V, 50/60Hz, Class I; Wall-mounted LB 47x, 2M: 44VA 100-240V, 50/60Hz, Class I

The certification system, as described in ISO/IEC Guide 67 (Conformity Assessment – Fundamentals of Product Certification), most closely resembles System 3

Nemko-CCL, Inc. 1940 West Alexander Street Salt Lake City, Utah 84119-2039 Tel (801) 972-6146 Fax (801) 972-8432

NFCC-002 Issue 2 May 2014 Page 1 of 3

APPLICABLE REQUIREMENTS

UL Std. No. 61010-1 2nd Edition - Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements

CAN/CSA-C22.2 No. 61010-1-04 Second Edition - Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements

This certificate is issued on condition that the holder complies and will continue to comply with the requirements of the above mentioned specifications and pursuant to the terms and conditions specified in the Certification Agreement.

The certification system, as described in ISO/IEC Guide 67 (Conformity Assessment – Fundamentals of Product Certification), most closely resembles System 3

Nemko-CCL, Inc. 1940 West Alexander Street Salt Lake City, Utah 84119-2039 Tel (801) 972-6146 Fax (801) 972-8432

NFCC-002 Issue 2 May 2014 Page 2 of 3

Supplement to Certificate of Compliance

Certificate: NA201610530 **Project:** 257087-7.1

Nemko-CCL grants a license to the applicant to apply the Certification Mark to the certified products and that the mark shall only be affixed at the following factory locations

Factory Information

Factory Name	Location
Berthold Technologies GmbH & Co. KG	Calmbacher Straβe 22 75323 Bad Wildbad Germany

The products listed, including the latest revision described below, are eligible to be marked in accordance with the referenced Certificate.

Product Certification History

Project	Date	Description
257087-7.1	January 20, 2016	**Original Certification: Model:** Wall-mounted LB 47x, 1M/3S; Wall-mounted LB 47x, 2M (x can be 0 to 8 and describes different software versions for the master and slave modules not affecting safety). **Ratings:** Wall-mounted LB 47x, 1M/3S: 40VA 100-240V, 50/60Hz, Class I; Wall-mounted LB 47x, 2M: 44VA 100-240V, 50/60Hz, Class I

This Supplement forms an integral part of the Certificate of Compliance

The certification system, as described in ISO/IEC Guide 67 (Conformity Assessment – Fundamentals of Product Certification), most closely resembles System 3

Nemko-CCL, Inc. 1940 West Alexander Street Salt Lake City, Utah 84119-2039 Tel (801) 972-6146 Fax (801) 972-8432

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9. NTRL Certificate US/CAN DuoXpert LB 47x

Nemko

Certificate of Compliance

Nemko-CCL, Inc.

Certificate: NA201510498 **Date Issued:** September 17, 2015

Project: 235982-14.1

Issued to: Berthold Technologies GmbH & Co. KG
Calmbacher Straße 22
75323 Bad Wildbad
Germany

The products listed below have been certified as being compliant with all applicable requirements of the specifications listed and are eligible to bear the following certification mark

c Nemko US

Issued by: Robert Keller, Senior Engineer/Safety Supervisor

Authorized by: Thomas Jackson, Certification Manager

PRODUCTS

MEASUREMENT, CONTROL, OR LABORATORY EQUIPMENT – Certified to US and Canada Standards

Product: Process measurement unit for building-in
Model: DuoXpert LB47x-02-M; DuoXpert LB47x-02-S (x can be 0 to 8 and describes different software versions for the master and slave modules not affecting safety)
Ratings: LB47x-02-M: 100-240V AC 22VA 50/60Hz; LB47x-02-S: 100-240V AC 6VA 50/60Hz

APPLICABLE REQUIREMENTS

UL Std. No. 61010-1 3rd Edition - Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements

CAN/CSA-C22.2 No. 61010-1-12 Third Edition – Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements

This certificate is issued on condition that the holder complies and will continue to comply with the requirements of the above mentioned specifications and pursuant to the terms and conditions specified in the Certification Agreement.

The certification system, as described in ISO/IEC Guide 67 (Conformity Assessment – Fundamentals of Product Certification), most closely resembles System 3

Nemko-CCL, Inc. 1940 West Alexander Street Salt Lake City, Utah 84119-2039 Tel (801) 972-6146 Fax (801) 972-8432

NFCC-002 Issue 2 May 2014 Page 1 of 2

Supplement to Certificate of Compliance

Certificate: **NA201510498** **Project:** **235982-14.1**

Nemko-CCL grants a license to the applicant to apply the Certification Mark to the certified products and that the mark shall only be affixed at the following factory locations

Factory Information

Factory Name	Location
Berthold Technologies GmbH & Co. KG	Calmbacher Straβe 22 75323 Bad Wildbad Germany

The products listed, including the latest revision described below, are eligible to be marked in accordance with the referenced Certificate.

Product Certification History

Project	Date	Description
235982-14.1	September 17, 2015	**Original Certification:** **Model:** DuoXpert LB47x-02-M; DuoXpert LB47x-02-S (x can be 0 to 8 and describes different software versions for the master and slave modules not affecting safety) **Ratings:** LB47x-02-M: 100-240V AC 22VA 50/60Hz; LB47x-02-S: 100-240V AC 6VA 50/60Hz

This Supplement forms an integral part of the Certificate of Compliance

The certification system, as described in ISO/IEC Guide 67 (Conformity Assessment – Fundamentals of Product Certification), most closely resembles System 3

Nemko-CCL, Inc. 1940 West Alexander Street Salt Lake City, Utah 84119-2039 Tel (801) 972-6146 Fax (801) 972-8432

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10. Parts Overview

Mat. No.	Description
64653	LB 473-01-M0 Level Switch Transmitter (Master, 24 VDC)
64652	LB 473-02-M0 Level Switch Transmitter (Master, 100…240 VAC)
72063	LB 473-21-M0-0 Level Switch Transmitter Ex-i (Master, 24 VDC, Source)
72064	LB 473-22-M0-0 Level Switch Transmitter Ex-i (Master, 100…240 VAC, Source)
72370	LB 473-21-M0-1 Level Switch Transmitter Ex-i (Master, 24 VDC, Sink)
72369	LB 473-22-M0-1 Level Switch Transmitter Ex-i (Master, 100...240 VAC, Sink)
56925-3BA1	Operating Manual DuoSeries LB 473 Level Switch, German
56925-3BA2	Operating Manual DuoSeries LB 473 Level Switch, English
56925BA16	Safety Manual / Explosion Protection Manual LB 47x Ex-i (ATEX / IECEx), German
56925BA26	Safety Manual / Explosion Protection Manual LB 47x Ex-i (ATEX / IECEx), English
63783	Wall-mounted Housing for 2x LB 47x Master (24 VDC)
63784	Wall-mounted Housing for 2x LB 47x Master (110...240 VAC)
64402	Wall-mounted Housing for 2x LB 47x Master (terminal blocks)
72812	Wall-mounted Housing for 2x LB 47x Ex-i Master (with Ex-i terminal blocks)
59484	19" rack for LB 47x, 4x Master
64607	19" rack, 84 HP / 3 RU for use with terminal blocks
72051	19" rack Ex-i, 84 HP / 3 RU with 4x tension spring terminal blocks
37526	Front Cover Plate 21 HP / 3 RU (Master)