Evaluation unit

DUO XPERT LB 475 Fracturing

Operating Manual
56925-5BA2

Rev. No.: 00, 02/2018
Embedded software version as of vers. 1.4.0 (CPU) and 1.4.0 (MU)

BERTHOLD TECHNOLOGIES GmbH & Co. KG
Calmbacher Str. 22
75323 Bad Wildbad, Germany
www.berthold.com

Telephone +49 7081 177-0
Fax +49 7081 177-100
industry@berthold.com

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1 About this Operating Manual

1.1 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
- 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.

1.2 Storage Place

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

1.3 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 recognise possible dangers through their specialist training, knowledge and experience as well as knowledge of the relevant regulations.

1.4 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.

NOTICE

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

1.5 Structure of the Operating Manual

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

1.6 Copyright

This operating manual contains copyright-protected information. None of the chapters may be copied or reproduced in any other form without prior authorisation from the manufacturer.

1.7 Representation

Identifier	Meaning	Example
Quotation mark	Field in the soft-wareuser 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.

1.8 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.

1.8.1 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.

1.8.2 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.

1.9 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 authorised by Berthold or improper use.

For the original declaration of conformity, please refer to the document “Technical Information” in the 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 475 (EVU) measures the density 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, unauthorised 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 product 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 publicised 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 authorised 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
- Authorised 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 or welders, who can undertake different tasks during the transportation, assembly and installation of the product under the guidance of an authorised 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 recognised 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.

Authorised Persons

Authorised persons are those who are either designated for the corresponding task due to legal regulations or those who have been authorised 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

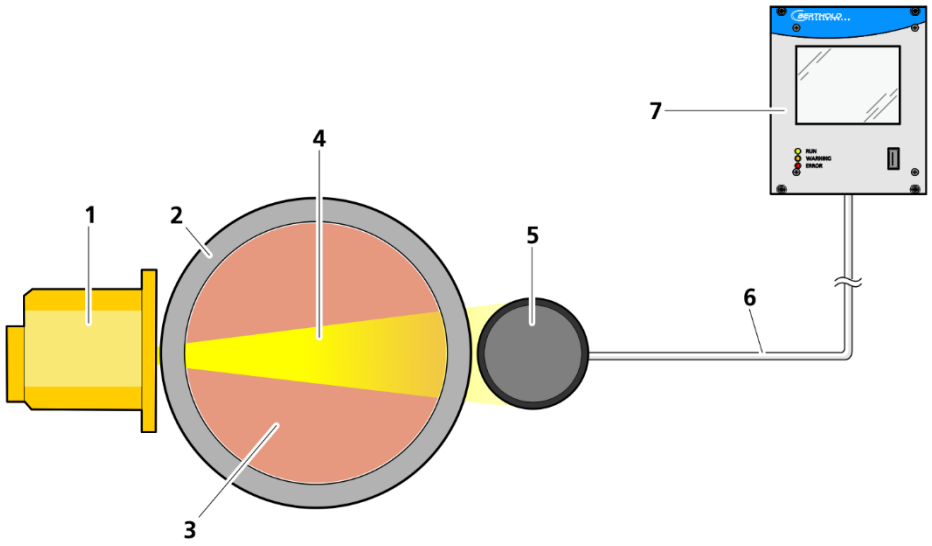
The measuring device LB 475 is an industrial measuring system for the contactless and continuous determination of the density of a product.

A complete measuring system consists of the following components:

- Evaluation unit DuoXpert LB 475
- Source
- Shield
- Detector

These instructions concern the operation of the evaluation unit DuoXpert LB 475 (Fig. 1, item 7). 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, switchboards or wall housings.



1 Source shielding
2 Pipe
3 Product
4 Radiation beam
5 Detector
6 Measuring line (2 conductors)
7 EVU

Fig. 1 Example measurement arrangement

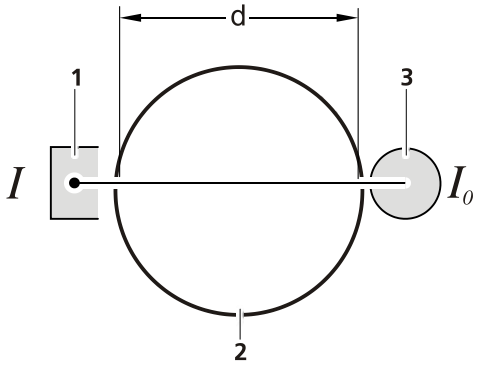
3.2 Measuring Principle

The density measurement is based on the through-beam method and uses the physical laws of absorption of radiation by matter. The resulting measurement effect is the ratio I/I_0 between the unattenuated radiation I_0 and the radiation I weakened by the measured medium. The incoming residual radiation still at the detector (scintillation counter) is a measure of the density of the product being measured (Fig. 2).

The following mathematical relationship exists for the attenuation of the radiation:

$$I = I_0 \times e^{-\mu \times \rho \times d}$$

I = incoming radiation at the detector
I_0 = unattenuated radiation
μ' = mass attenuation coefficient (absorption coefficient) in cm²/g
ρ = density of the absorbent material in g/cm3
d = inner pipe diameter (thickness of absorber)



1 Source
2 Piping
3 Detector

Fig. 2 Measurement principle

Tip

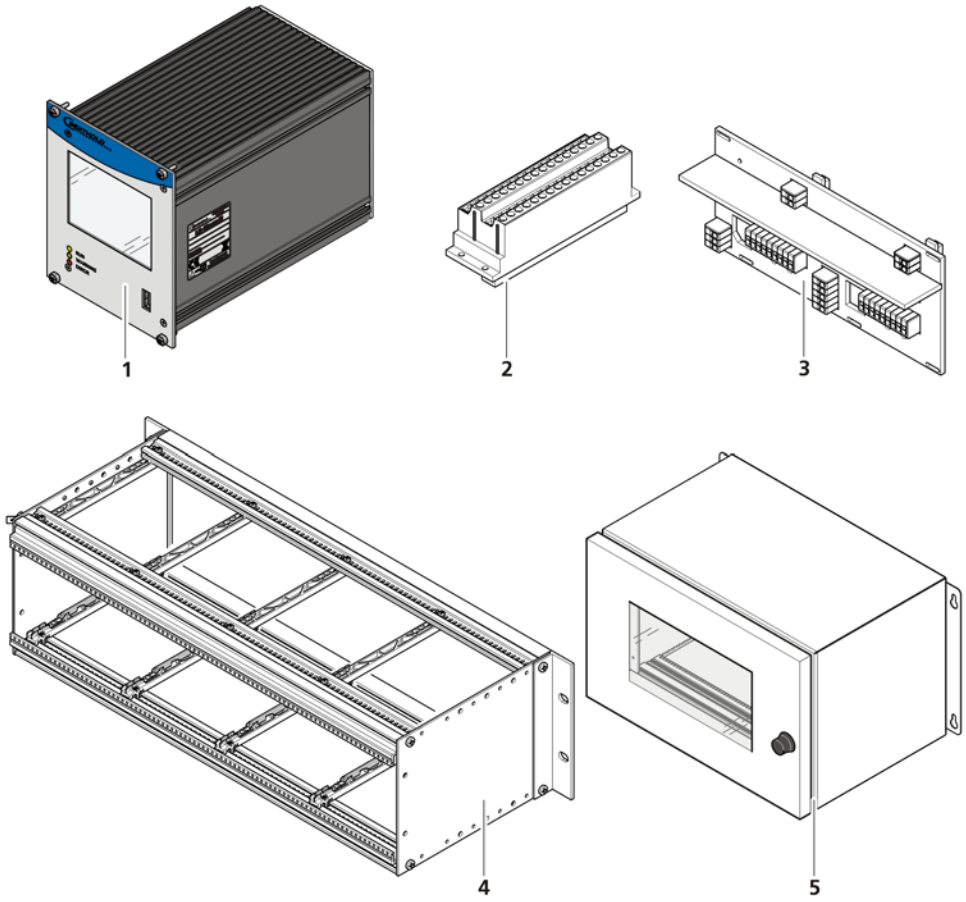
Further information on the functional principle of the detectors and radiation source shield can be found in the associated operating manual.

If selected, the evaluation unit converts the measured density to a pound proppant added (PPA) value. For this the carrier liquid density and the solid density of the proppant have to be known.

$$\mathrm{PPA} = \frac{\rho_{mix} - \rho_{water}}{1 - \frac{\rho_{mix}}{\rho_{propp}}} \cdot 8.35 = \frac{\rho_{mix} - \rho_{water}}{\rho_{propp} - \rho_{mix}} \cdot \rho_{propp} \cdot 8.35$$

Other specific fracturing units can be implemented on request.

3.3 System Components



1 **EVU with wide range supply (100-240 V AC, 50/60 Hz)**
Alternatively: EVU with 24 V supply (18-32 V DC)
2 **Terminal block for electrical connections (optional)**
only for installation in subrack
3 **Terminal panel master-master with cover**
4 **19" subrack (option)**
5 **Wall housing (option)**

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 (Fig. 4) the EVU or in the menu "Device information" (Chap. 9.1.2).

In this operating manual we describe the software from Version 1.4.0 (Control Unit / CU) and 1.4.0 (Measurement Unit / MU).

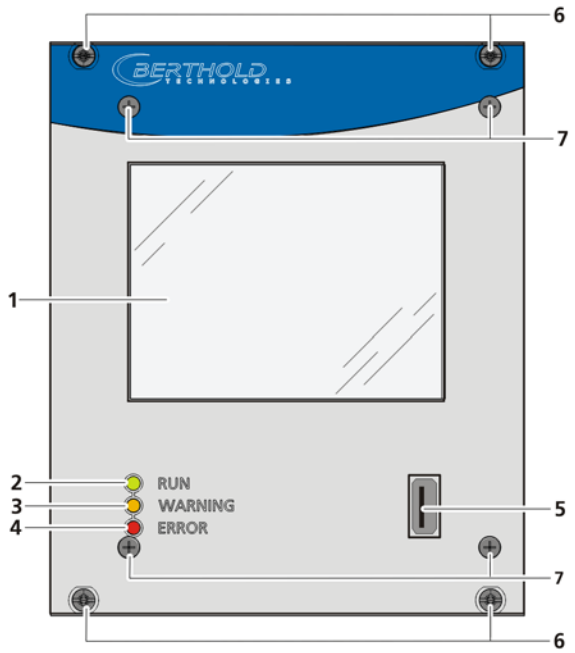
Fig. 4 View when starting up the EVU

3.3.2 Front/rear view EVU

Front view EVU

The following display and control elements are found on the front of the EVU (transmitter):

- LEDs for status display of individual operating states
- 3.5" Touch display
- USB port.



1 3.5'' Touch display
2 RUN LED
3 WARNING LED
4 ERROR LED
5 USB port
6 Fixing screws
7 Screws front plate

Fig. 5 Front view of the EVU

Display/Touch-Screen Operation

The EVU is operated using the Touch-Screen. As an alternative, the EVU can be connected to the USB connection with a mouse. The device can also be operated using a CE Remote (see Chap. 9.3.1).

NOTICE

Damage to the Touch-Screen

Pointed and sharp objects can cause damage to the plastic surface of the Touch-Screen.

- Operate the Touch-Screen only using your finger or a Touch-Stylus or connect a mouse to the EVU.

Status displays of the EVU

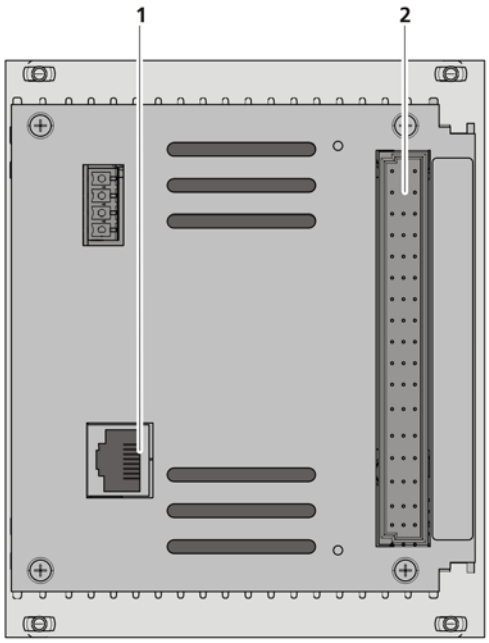
The LEDs (fig.1, items 2-4) below the touch display show the current operating status of the EVU.

Display LED	Description
	**RUN** This LED lights up green if the device is in operation and fault-free. The current measurement is carried out.
	**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 8.
	**ERROR** This LED lights up red if a system event of the type "ERROR" is present. The current measurement is retained. Check the device settings. All system events are described in chapter 8
	**RUN / WARNING / ERROR flashing** All three LEDS flash during the system test which is performed as part of the start up process.

Rear view EVU

The following connections are located on the back of the EVU:

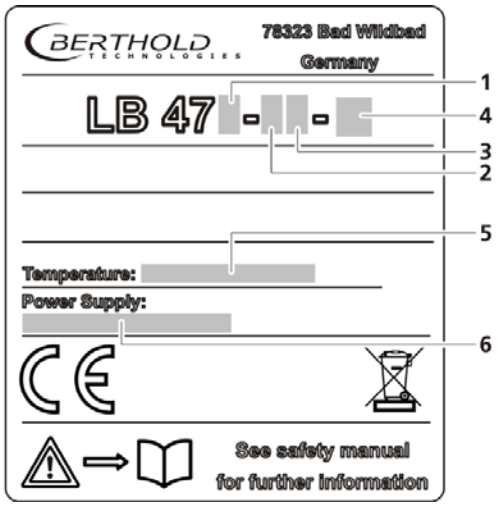
- Master/slave connector, 4-pin
- RJ45 socket for Ethernet
- 32-pin plug connector



1 RJ45 socket for Ethernet
2 32-pin plug connector

Fig. 6 Rear view EVU

3.3.3 Type plate



1 Application (5 = Fracturing)
2 Approval explosion protection (0 = no explosion approval)
3 Power supply (1 = 24 VDC; 2 = 100…240 VAC -10 +10%)
4 Master (M)
5 permissible temperature range for operation (ambient temperature)
6 Power specifications

Fig. 7 Type plate

3.4 Storage

Store the devices in a dry area (no dew), in the dark (no direct sunlight) in a clean locked room. Bear in mind the permissible temperature range when storing.

4 Installation

4.1 General Instructions

IMPORTANT

This transmitter is delivered in a non-ex protected version and must not be used in explosion-endangered areas.

NOTICE

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).

In case of doubt, the complete device must be returned to Berthold for repair.

NOTICE

Only mounting accessories approved by Berthold should be used for installation of the devices.

NOTICE

The device should only be operated if firmly installed.

4.2 Transport

NOTICE

Parts can be damaged during transport. Transport the evaluation unit in the original packaging and protect the parts from shocks

4.3 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.

4.4 Installation variants

The EVU can be installed either in wall housings (Fig. 8) or 19" subracks (Fig. 9).

Installation variants wall housing

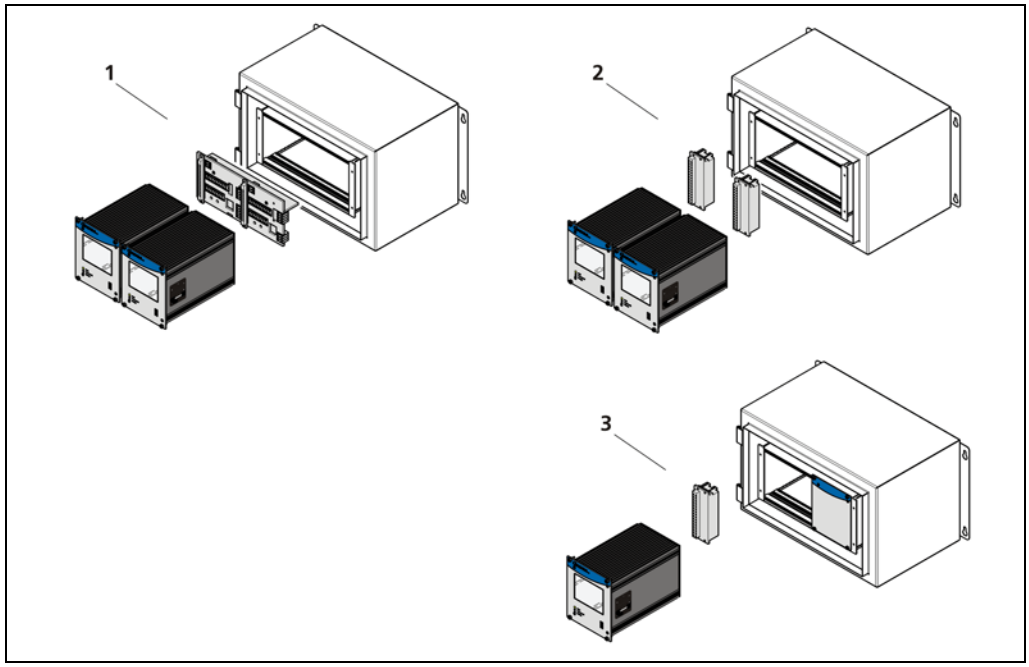


Fig. 8 Installation variants wall housing

Installation variant	Components	Connection
Wall housing	2 EVUs (Fig. 8, item 1)	1 Terminal panel master/master [1]
	2 EVUs (Fig. 8, item 2)	2 clamp blocks
	1 EVU (Fig. 8, item 3)	1 clamp block

[1] NRTL certification US/CAN

Installation variants subrack

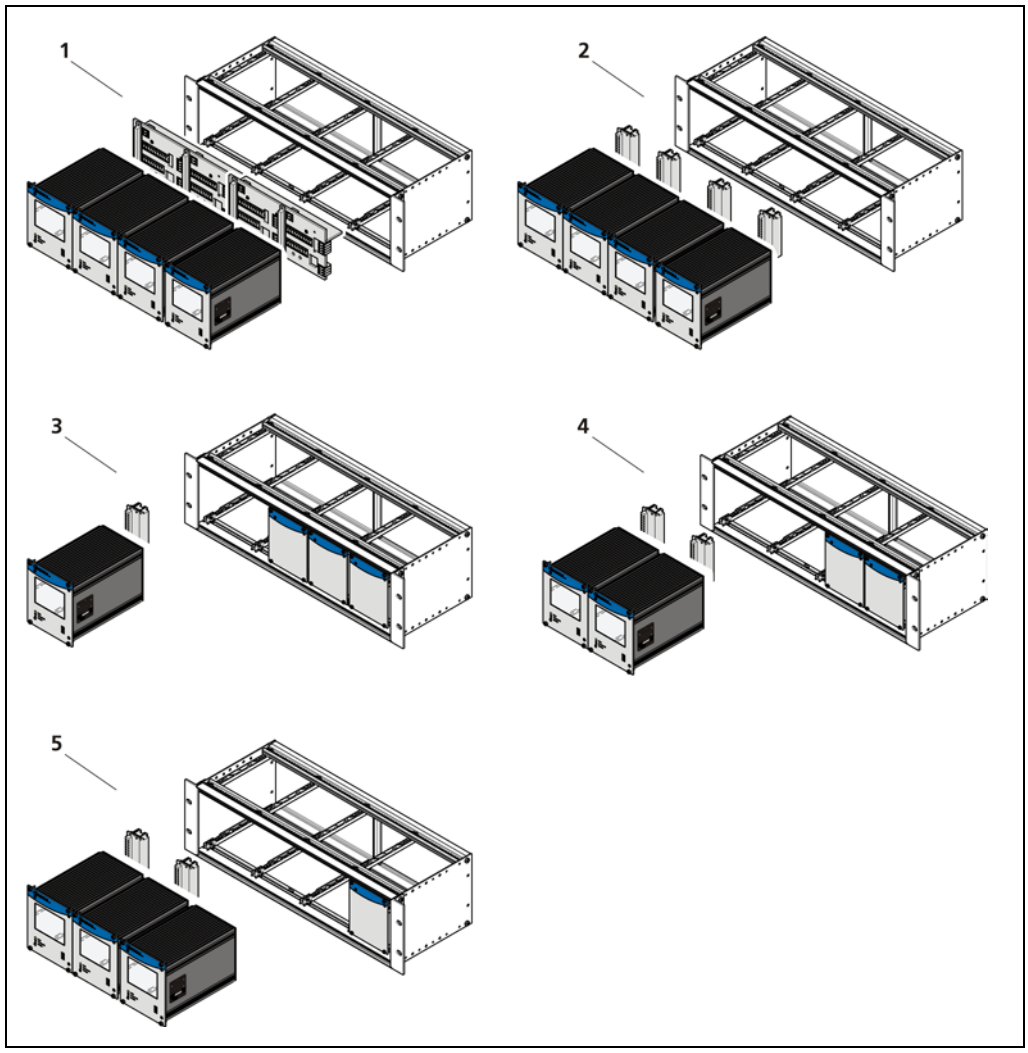


Fig. 9 Installation variants 19" subrack with terminal panel

Installation variant	Components	Connection
19" subrack	4 EVUs (Fig. 9, item 1)	2 Terminal panels master/master
	4 EVUs (Fig. 9, item 2)	4 clamp blocks
	1 EVUs (Fig. 9, item 3)	1 clamp block
	2 EVUs (Fig. 9, item 4)	2 clamp blocks
	3 EVUs (Fig. 9, item 5)	3 clamp blocks

4.4.1 Installation in the wall housing

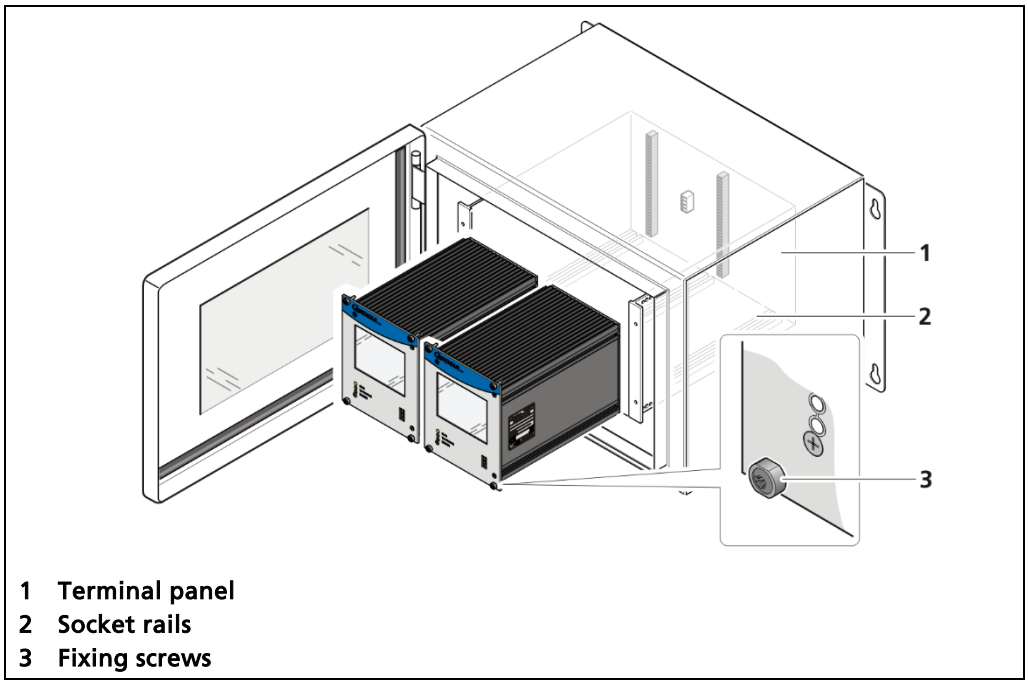
The wall housing may be equipped differently, depending on requirements (see Chap. 4.4 Installation variants). To do this, a corresponding terminal panel or a clamp block is located in the wall housing.

NOTICE

The EVUs modules must be secured by fixing screws (Fig. 10, item 3).

The device must be disconnected from the mains voltage before it is pulled out.

Installation of the modules



1 **Terminal panel**
2 **Socket rails**
3 **Fixing screws**

Fig. 10 Installation of the modules (ex.: Terminal panel master-master)

1. Insert the modules in the socket rails.
2. Slide the modules carefully into the wall housing until the pin rail on the module is inserted in the socket rail (Fig. 10, item 2).
3. Tighten all the fixing screws (Fig. 10, item 3)

Mounting the wall housing

4 holes (Fig. 11) are provided for mounting on the wall etc.

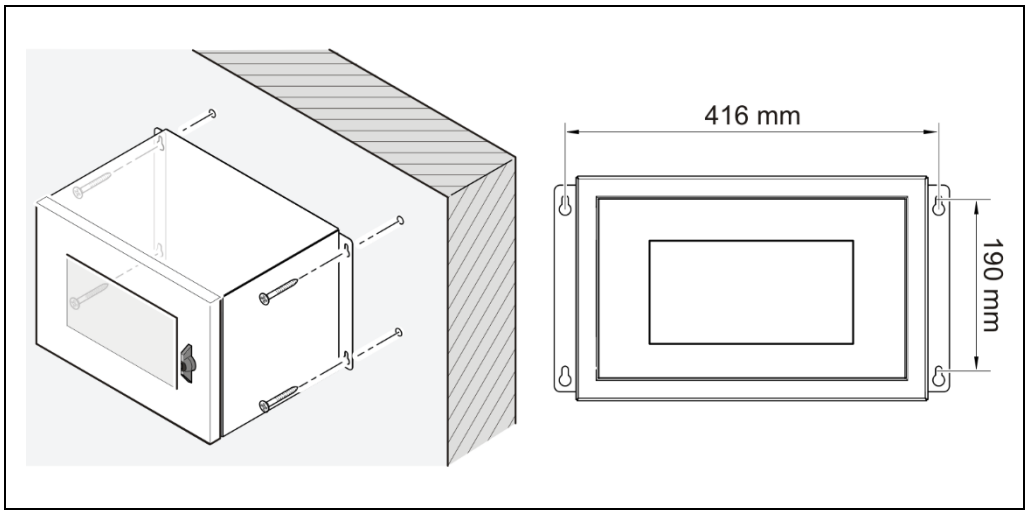


Fig. 11 Mounting the wall housing

1. Prepare the holes.
2. Use adequately dimensioned mounting material.
3. Screw the housing securely to the wall.

NOTICE

It is recommended that the wall housing be protected from direct sunlight in order to maintain maximum ambient temperature (document “Technical Information”, see Appendix).

4.4.2 Installation in the 19" subrack

The 19" subrack can be equipped differently, depending on requirements (see chap. 4.4 Installation variants). The rear clamp blocks (Fig. 12, item 2) or terminal panel (Fig. 13, item 2) are used for the electrical connection.

NOTICE

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

The subrack is installed in a 19" control cabinet or a control panel (switchboard). The 4 side holes (Fig. 12, item 3) that must be provided with fitting screws are used to fasten the subrack.

NOTICE

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

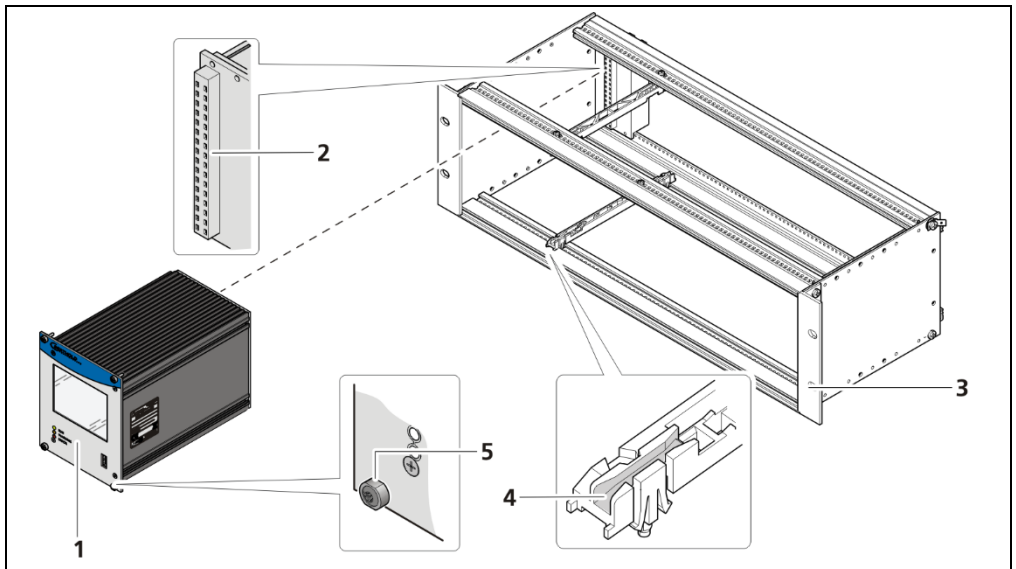
Installation with clamp blocks

⚠ DANGER !

Danger to life from electric shock!

- Installation/maintenance may only be carried out if the device has been de-energised.
- If the front is open, make sure that the device is not live.

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



1	Module (EVU)	4	Socket rail
2	Socket connectors on the clamp block	5	Fixing screw
3	Side holes		

Fig. 12 19" subrack with clamp block

NOTICE

The EVUs must be secured by fixing screws (Fig. 12, item 5).

The device must be disconnected from the mains voltage before it is pulled out.

1. Insert the module (Fig. 12, item 1) into the socket rails (Fig. 12, item 4).
2. Slide the module carefully into the subrack until the pin rail on the module is inserted in the socket connectors (Fig. 12, item 2).
3. Tighten all the fixing screws (Fig. 12, item 5).

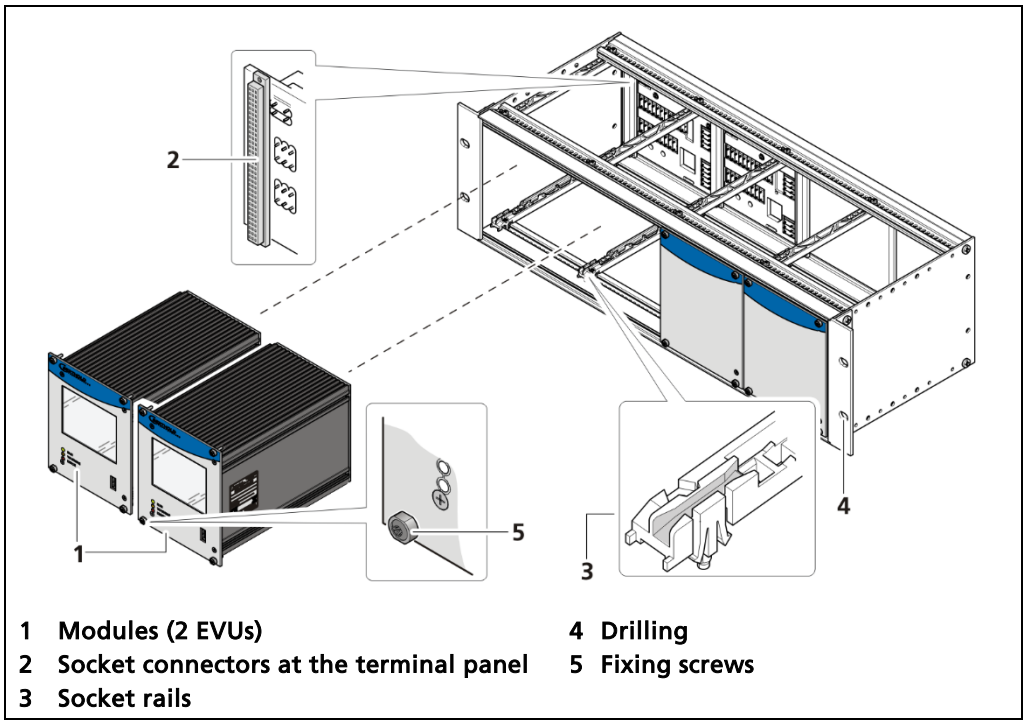
Installed with terminal panels

⚠ DANGER !

Danger to life from electric shock!

- Installation/maintenance may only be carried out if the device has been de-energised.
- If the front is open, make sure that the device is not live.

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



1 Modules (2 EVUs)
2 Socket connectors at the terminal panel
3 Socket rails
4 Drilling
5 Fixing screws

Fig. 13 19" subrack with connection boards (Ex.: 2x EVU)

NOTICE

The EVUs must be secured by fixing screws (Fig. 13, item 5).

The device must be disconnected from the mains voltage before it is pulled out.

1. Insert the module (Fig. 13, item 1) into the socket rails (Fig. 13, item 4).
2. Slide the module carefully into the subrack until the pin rail on the module is inserted in the socket connectors (Fig. 13, item 2).
3. Tighten all the fixing screws (Fig. 13, item 5).

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-energised.
- 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

Only power within the marked range must be applied!

NOTICE

The relay of the LB 475 can only switch low voltages. Please note the specifications in the document “Technical Information” (see Appendix).

The power source of the 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 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-energised 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.

For intrinsically safe systems, the detector must be connected to the equipotential bonding of the system. The detector is connected via a 2-core (2 x 12) cable with approx. 5 ... 10 mm diameter. A screened cable can 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 (Id. no. 32024), this results in a cable length of 1000m, from the evaluation unit to the detector. For intrinsically safe systems, the maximum permissible inductance and capacitance of the cable should be considered to the max. 40 ohm.

When routing the connection lines, make sure that

- 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 appropriate for temperatures of at least 10°C above the maximum admissible ambient temperature.

5.1.3 Cable glands and Blind Plugs

- 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, sealing plugs 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.

5.2 Wiring diagram

The LB 6770 detector is connected to the evaluation unit via the RS485 terminals. Connect the lines according to assignment to the terminal panel (Fig. 14) or clamp blocks (Fig. 15).

NOTICE

Use an external RS485 repeater (specified by Berthold) when communication errors occur.

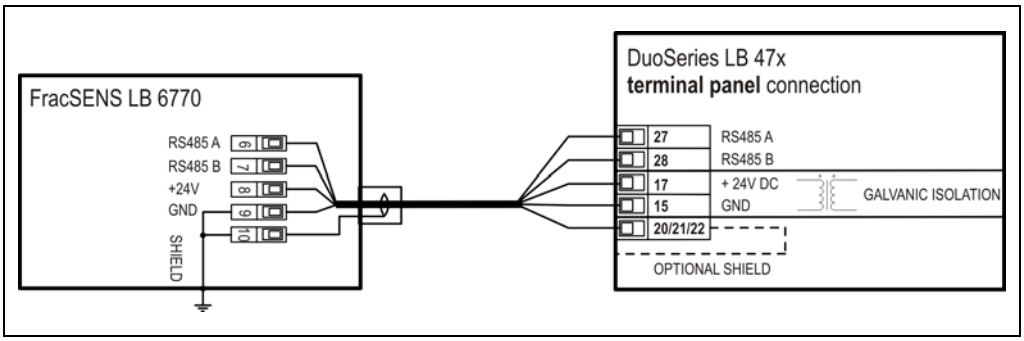


Fig. 14 Terminal panel connection

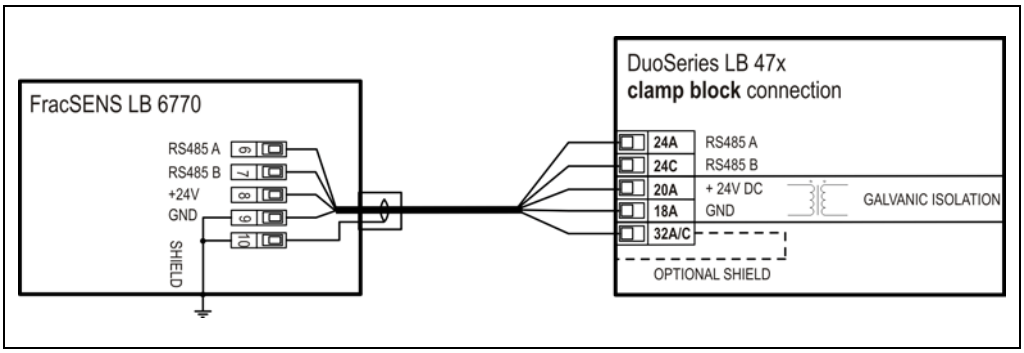


Fig. 15 Clamp block connection

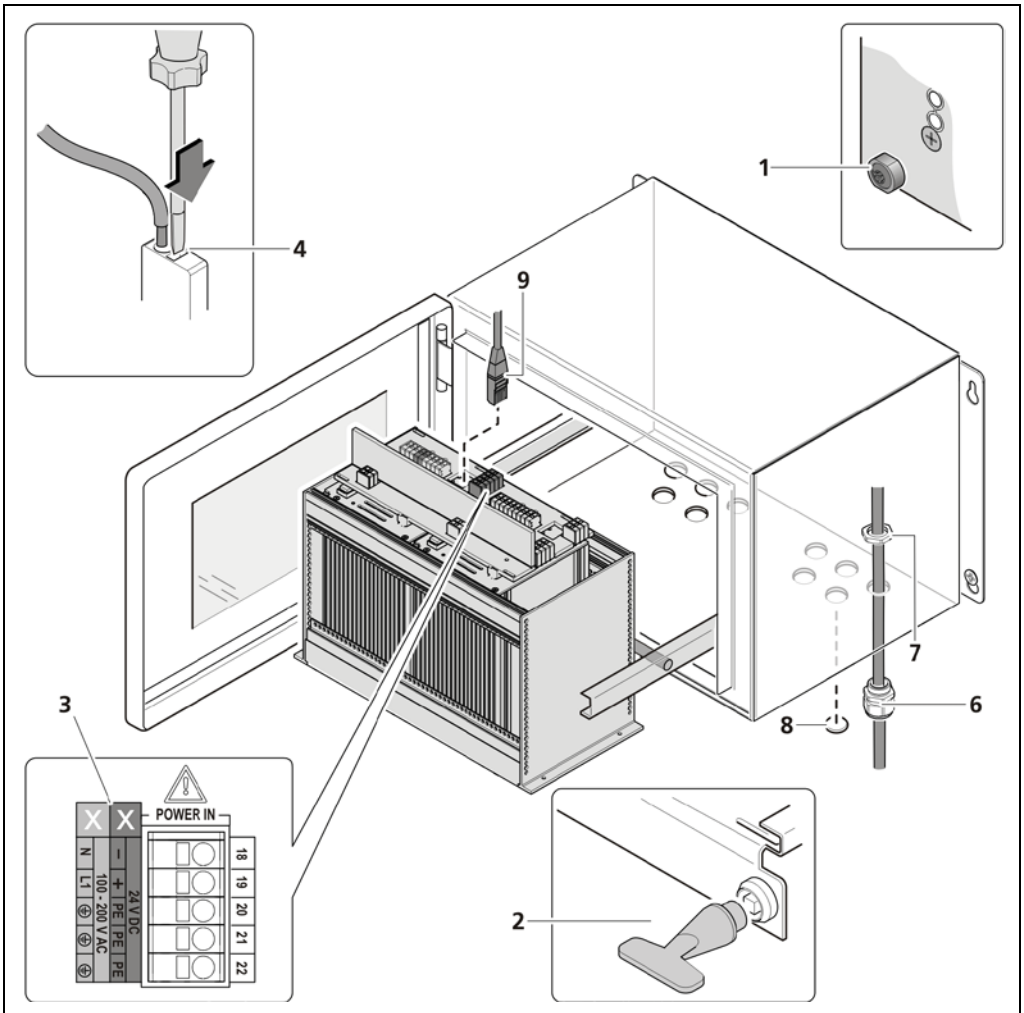
5.3 Electric connection in the wall housing

⚠ 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-energised.
- 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	Lock	7	Counter-nut cable gland
3	Marking power supply	8	Blind plug
4	Opening terminal connection	9	RJ45 connector (network)
5	Stripped wire		

Fig. 16 Electrical connection in the wall housing (terminal panel)

1. Make sure that the fixing screws (Fig. 16, item 1) of all modules are tightened in order to prevent slipping.

2. Loosen the lock (Fig. 16, item 2) using the supplied square key and pull the subrack out.
3. Fold the subrack downward cautiously.
4. Direct the lines through the cable glands (Fig. 16, item 6), through the openings in the wall housing and through the counter-nut of the cable glands (Fig. 16, item 7).
5. Screw the cable gland in place (Fig. 16, item 6) using the counter-nut (Fig. 16, item 7).

NOTICE

Only power within the marked range (Fig. 16, item 3) must be applied!

NOTICE

Observe the details concerning the cable, earth line and equipotential bonding and EIA-485 (RS-485) network in Chapter 5.1

6. Connect the lines according to assignment to the terminal panel (chap.5.4.1) or to the clamp block (chap.5.5.1).
7. Open the terminal connection (Fig. 16, item 4) with an operating tool (slotted screwdriver) and insert the stripped wire (min. 8 mm) (Fig. 16, item 5).

▶ The terminal connection is closed by pulling out the operating tool.

▶ The terminal connections are designed for wires (flexible) having a line cross-section of 0.2 mm^2 to 2.5 mm^2 (wire end sleeve without plastic sleeve) or 0.2 mm^2 to 1.5 (wire end sleeve with plastic sleeve). AWG = 24 – 12.

8. Plug the network plug into the RJ45 socket (Fig. 16, item 9) (optional).
9. For optimum sealing and strain relief of all cable glands (Fig. 16, item 6), tighten them until the sealing insert between the cable glands and the cable closes off.
10. Check the strain relief of all the cable glands by pulling the cables evenly and carefully.

▶ The cables should not be able to be pulled out of the wall housing. If necessary, tighten the cap nuts of the cable gland.

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

NOTICE

The wall housing is supplied with blind plug in all cable openings. It must be ensured that there are blind plugs in all unused cable openings. Otherwise, the IP protection is not given.

NOTICE

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.

5.4 Electrical connection in a 19" subrack with terminal panel

⚠ 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-energised.
- Only open the device when free of voltage.

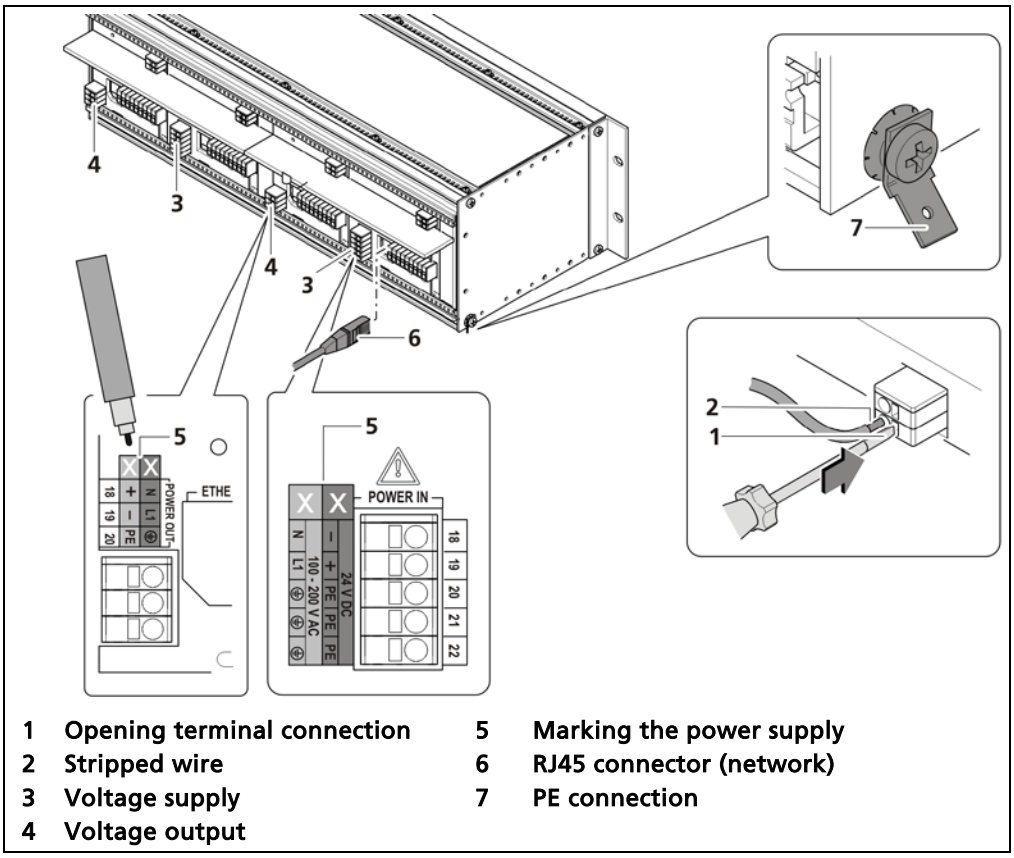
In case of an electric shock, carry out first aid measures and immediately call an emergency service.

NOTICE

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

NOTICE

Before the initial commissioning, the voltage range (Fig. 17, item 8) must be marked on all input and output terminals in a permanent and chemically-resistant marker!



1	Opening terminal connection	5	Marking the power supply
2	Stripped wire	6	RJ45 connector (network)
3	Voltage supply	7	PE connection
4	Voltage output		

Fig. 17 Electrical connection in the 19" subrack (terminal panels)

NOTICE

Only power within the marked range (Fig. 17, item 5) must be applied!

NOTICE

Observe the details concerning the cable, earth line and equipotential bonding and EIA-485 (RS-485) network in Chapter 5.1

1. Unoccupied plug locations must be closed off with front cover plates.
2. Mark the voltage range in a permanent and chemically-resistant marker (Fig. 17, item 5).

3. Connect the lines according to assignment (chap.5.4.1) to the terminal panel.
4. Open the terminal connection (Fig. 17, item 1) with an operating tool (slotted screwdriver) and insert the stripped wire (min. 8 mm) (Fig. 17, item 2).

- The terminal connection is closed by pulling out the operating tool.
- The terminal connections are designed for wires (flexible) having a line cross-section of 0.2 mm^2 to 2.5 mm^2 (wire end sleeve without plastic sleeve) or 0.2 mm^2 to 1.5 (wire end sleeve with plastic sleeve). AWG = 24 – 12.

5. Plug the network plug into the RJ45 socket (Fig. 17, item 6) (optional).
6. Check the correct connection of the PE conductor (Fig. 17, item 7).

NOTICE

Observe the details concerning the earth wire and equipotential bonding in Chapter 5.1.4.

NOTICE

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.

5.4.1 Terminal panel master/master

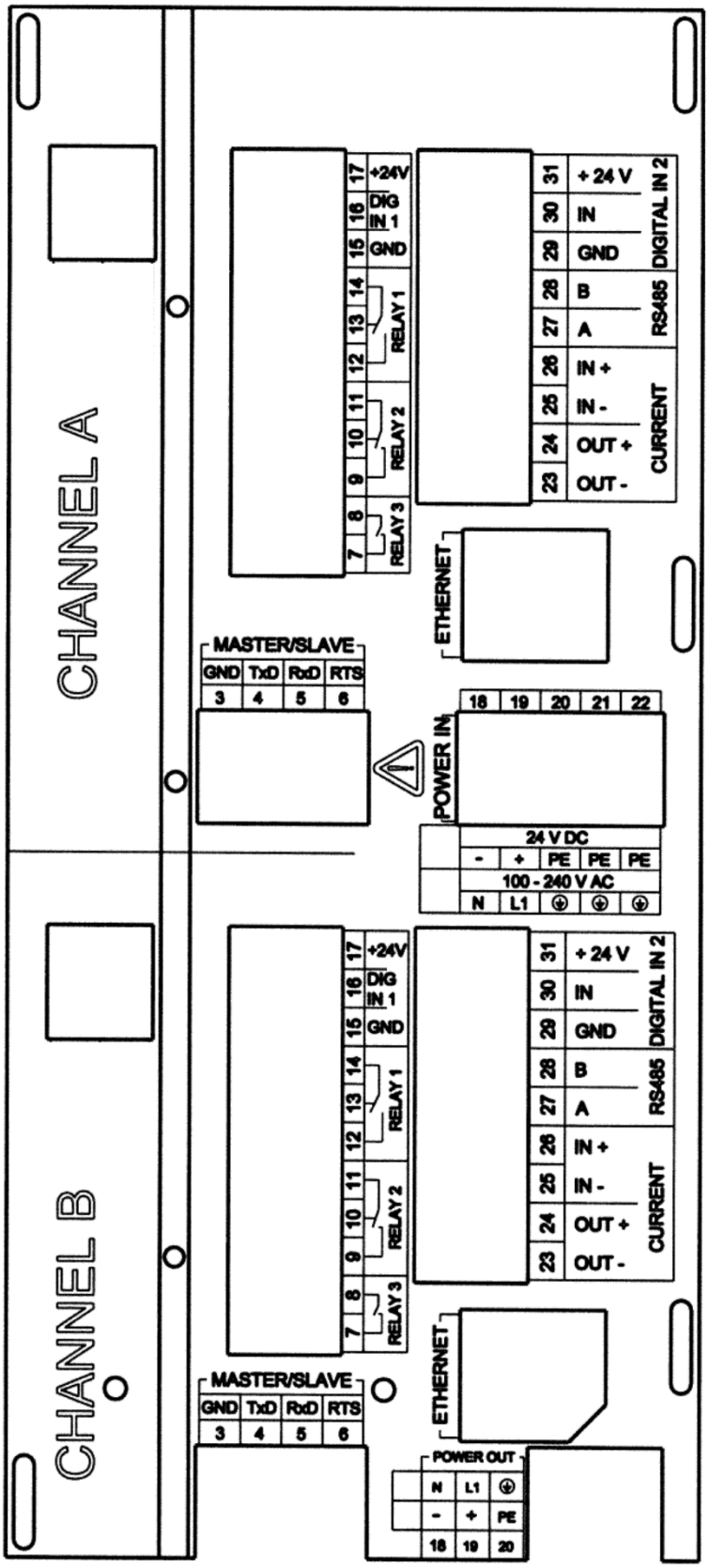


Fig. 18 Connection board master/master back side (Label A/B)

Pin assignment master/master

Item	Plug connectors	Function
1	DETECTOR MASTER –	Connection LB 4700 or LB 44xx detector
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 OUT	24 V out (max. 200 mA)
18	POWER DC 24 V – / AC N	24 VDC / 100-240 VAC
19	POWER DC 24 V + / AC L1	
20	PE	
21	PE	
22	PE	
23	CURRENT OUT –	0/4 mA … 20 mA
24	CURRENT OUT +	
25	CURRENT IN – (⊥)	Pulse input / analog power input
26	CURRENT IN + (⎍)	
27	RS 485 A	Connection LB 6770 detector
28	RS 485 B	
29	DIGITAL IN 2 GND	GND
30	DIGITAL IN 2 IN	Logic Input
31	+ 24 V OUT	24 V out (max. 200 mA)

NOTICE

The connections Channel A and Channel B are identical.

5.5 Electrical connection in the 19” subrack with clamp block

⚠ DANGER !

Danger to life from electric shock!

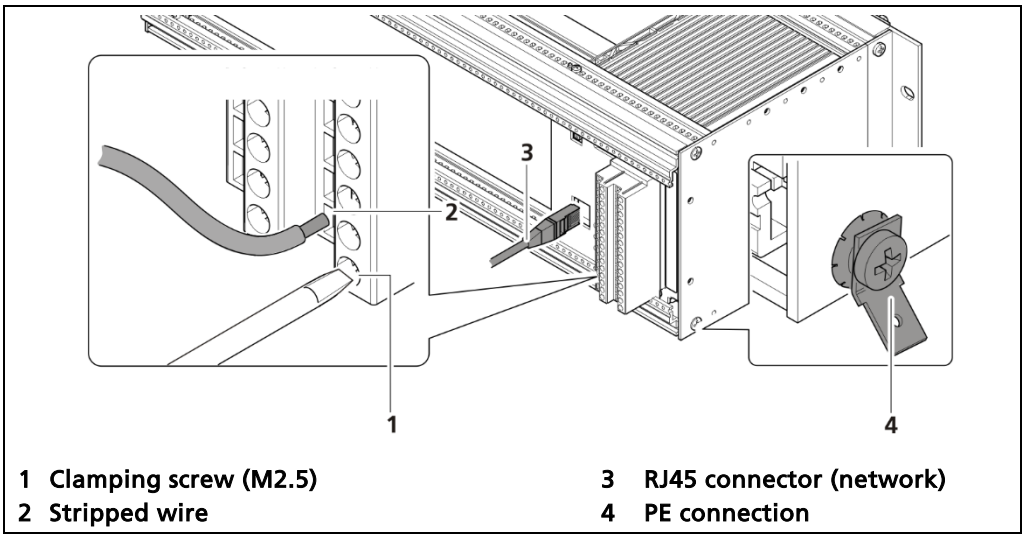
- The installation may only be carried out by a qualified electrician.
- Please adhere to the relevant safety regulations.
- Installation/maintenance may only be carried out if the device has been de-energised.
- Only open the device when free of voltage.

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

If the units 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

When using the terminal blocks, the customer must provide touch protection for the terminals when they are live. The terminals must be wired in accordance with IEC 61010-1 (2010).



1 Clamping screw (M2.5)
2 Stripped wire
3 RJ45 connector (network)
4 PE connection

Fig. 19 Electrical connection in the 19" subrack

1. Connect the lines according to assignment (Chap.5.5.1) to the clamp blocks.
2. Open the clamping screw (Fig. 19, item 1) and insert the stripped wire (min. 8 mm) (Fig. 19, item 2).
   - The terminal connections are designed for wires with a conductor cross-section from 0.2 mm² to 2.5 mm².
3. Screw the clamping screws with a tightening torque of 0.4 - 0.5 Nm.
4. Plug the network plug into the RJ45 socket (Fig. 19, item 3) (option).

5. Check the correct connection of the PE conductor (Fig. 19, item 4).

NOTICE

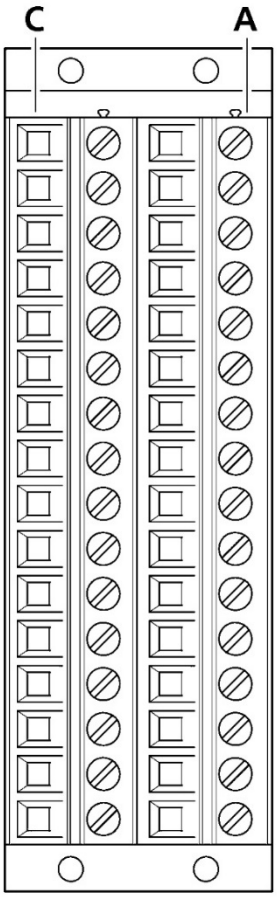
Observe the details concerning the earth wire and equipotential bonding in Chapter 5.1.4.

NOTICE

Only cable that is suitable for connection to the corresponding terminals may be used. Detailed specifications can be found in the document “Technical Information” (see Appendix).

5.5.1 Assignment clamp block EVU

Signal	Pin
LB4700/LB44xx DETECTOR GND	C - 2
not assigned	C - 4
not assigned	C - 6
not assigned	C - 8
RELAY 3 COM	C - 10
RELAY 2 COM	C - 12
RELAY 1 NC	C - 14
RELAY 1 COM	C - 16
DIGITAL IN 1	C - 18
DIGITAL IN 2	C - 20
CURRENT IN + (⎍)	C - 22
RS 485 B	C - 24
CURRENT OUT –	C - 26
not assigned	C - 28
100-240 V AC, 24 V DC –	C - 30
Protective conductor PE	C - 32

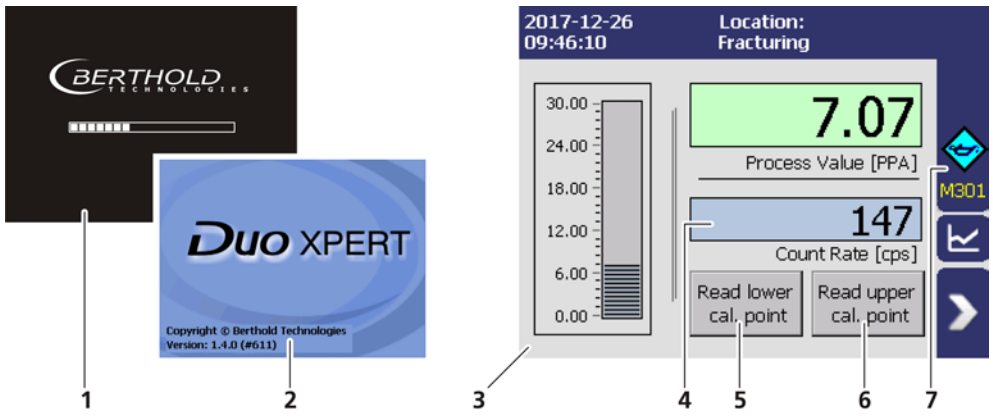


Pin	Signal
A - 2	LB4700/LB44xx DETECTOR +
A - 4	not assigned
A - 6	not assigned
A - 8	not assigned
A - 10	RELAY 3 NO
A - 12	RELAY 2 NO
A - 14	RELAY 2 NC
A - 16	RELAY 1 NO
A - 18	DIGITAL IN GND
A - 20	+ 24 V
A - 22	CURRENT IN – (⊥)
A - 24	RS 485 A
A - 26	CURRENT OUT +
A - 28	not assigned
A - 30	100-240 V AC, 24 V DC +
A - 32	Protective conductor PE

Fig. 20 Assignment clamp block EVU

6 Commissioning

This chapter describes the workflow for a new installation or after conversion work. To calibrate the system for daily use, see chapter 7.3 Read new calibration point.



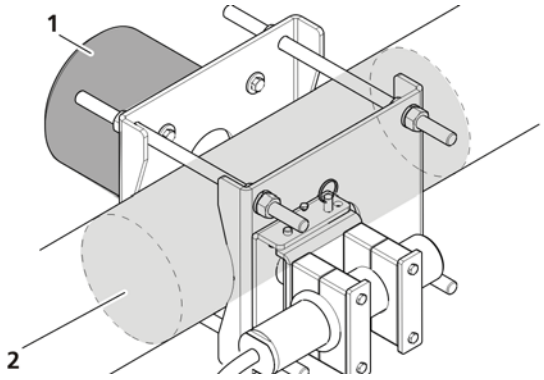
1	Screen "boot process"	5	Button <Read lower calibration point>
2	Screen "loaded software"	6	Button <Read upper calibration point>
3	Standard display	7	Status message M301 "Device not calibrated" (only at first start-up)
4	Count rate [cps]		

Fig. 21 EVU screens

Initial commissioning

1. Connect the detector to the EVU as described in chapter 5.2 Wiring diagram.
2. Connect the EVU according to the instructions in chapter 5 Electric Installation.

▶ The EVU starts up automatically (Fig. 21, item 1, item 2) if it is connected correctly. The standard display with non-calibrated values is displayed (Fig. 21, item 3).



1 Shield
2 Pipe (Measuring Point)

Fig. 22 Measuring arrangement

Initial settings

3. Make sure that the pipe is empty or filled with pure water at the measurement point (Fig. 22, item 2).
4. If necessary, open shield shutter (Fig. 22, item 3). Follow the instructions in the operating manual of the detector or the shield.

▶ The count rate increases on the standard display (Fig. 21, item 4)

5. Click on the button to open the Main Menu.
6. Click on “Basic Setup”.
7. Define the appropriate settings and enter the values in the submenus. Observe the information in the respective chapters in each submenu:

   Units ▸ 8.1 Units
   PV Range ▸ 8.2 PV Range
   Damping ▸ 8.3 Damping

8. Click on the button to switch to the standard display.

Periodic calibration

IMPORTANT

Calibration of the lower and upper calibration point can also be triggered via the digital inputs, which is set to the “Read Lower Cal. Point” or “Read Upper Cal. Point” function. Please refer chapter 9.3.5 Inputs | DI Assignment.

NOTICE

Note the specifications for the Digital Inputs. Detailed specifications for all interfaces can be found in the document “Technical Information” (see Appendix).

9. Click on the button (Fig. 22 item 5) to read in the lower calibration point.

▶ The window “New Calibration Point” opens.

10. Click on the input field to open the keyboard screen.
11. Enter **0** if the pipe is empty. Enter **1.0** (or other value for density of carrier fluid) if the pipe is filled with clear water.
12. Confirm with the Enter key.

▶ The recording of the detector value starts. The value is set automatically after the recording has been completed. The view changes to standard display and the lower calibration point is set.

13. Click on the button (Fig. 22 item 6) to read in the upper calibration point.

▶ The window “New Calibration Point” opens.

14. Click on the input field to open the keyboard screen.
15. Enter **1.0** (or other value for density of carrier fluid) if calibrating on empty pipe and pure water or the known density of the calibration fluid.
16. Confirm with the Enter key.

▶ The recording of the detector value starts. The value is set automatically after the recording has been completed. The view changes to standard display and the upper calibration point is set.

▶ The device is calibrated and ready to use.

7 Operation of the Software

7.1 System start

Fig. 23 Start screen with display of the software version

System start with invalid application software

A different menu structure is present in this mode.

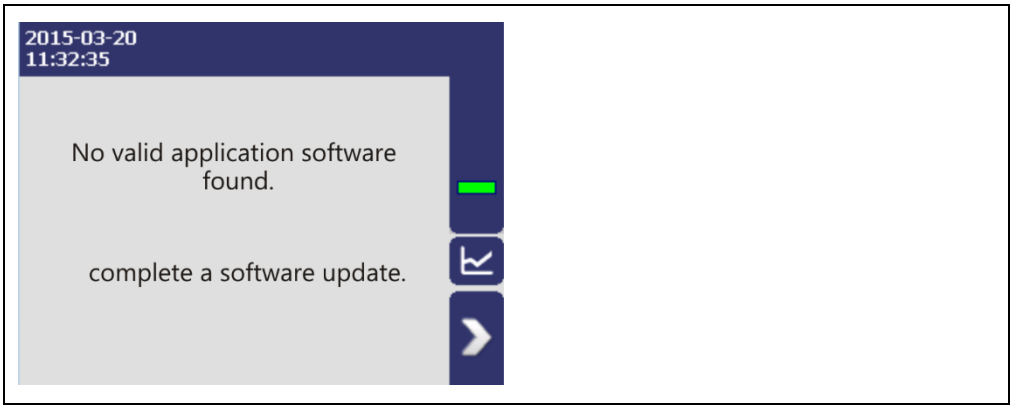


Fig. 24 Start screen (Invalid application software)

IMPORTANT

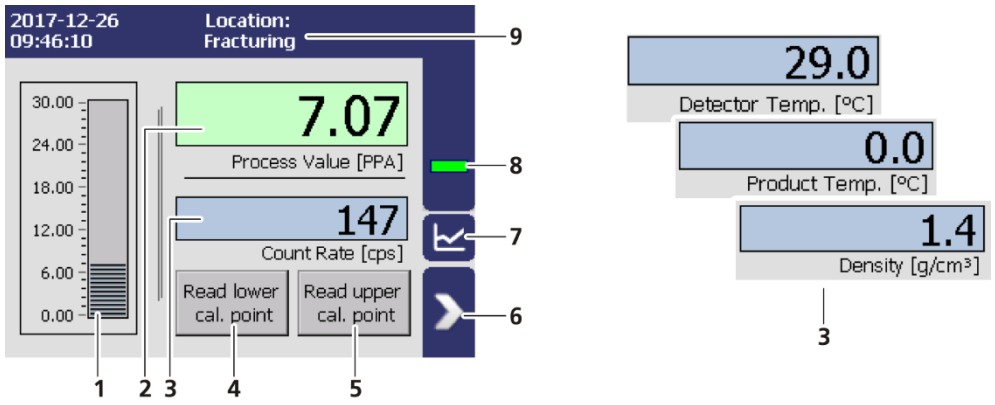
The communication between the detector and EVU is limited to 1200 baud. There is therefore a load time for data that are retrieved in the detector.

7.2 EVU standard display

IMPORTANT

The language can be changed in Expert Setup | Setup | System | Interfaces | Language

Clicking the blue box changes the display between Count Rate / Detector Temperature / Product Temperature / Density (Fig. 25, item 3). The units can be changed in Chapter 9.3.1. The Name of the measuring point (Fig. 25, item 9) can be changed in Expert Setup | Identification | Location.



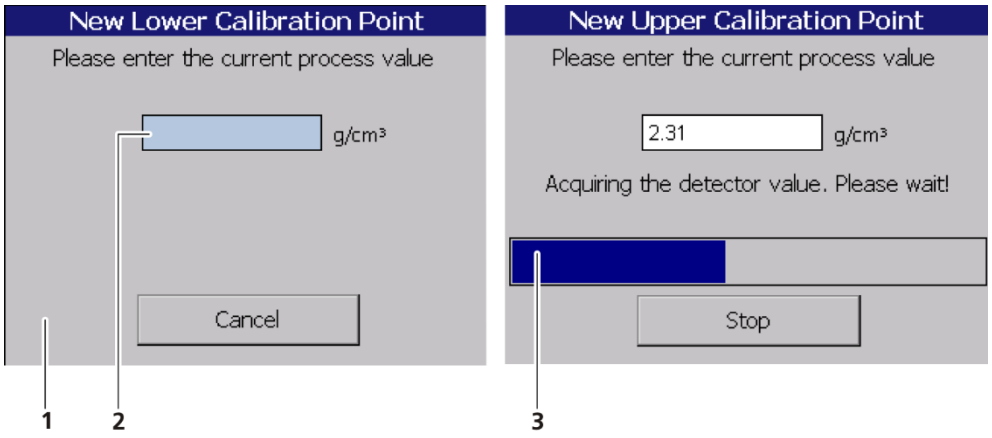
1 **Scale process value**
2 **Process value**
3 **Count Rate / Detector Temperature / Product Temperature / Density**
4 **Button** <Read lower calibration point>
5 **Button** <Read upper calibration point>
6 **Menu**
7 **Diagram display**
8 **Status information**
9 **Location of the measuring point**

Fig. 25 Standard display of the EVU

7.3 Read new calibration point

The two buttons on the standard display allow a quick set of the lower and upper calibration point. The duration of the calibration measurement can be changed in the submenu Calibration Settings Expert Setup | Setup | Measurement | Calibration Settings: Parameters.

Calibration of the lower and upper calibration point can also be triggered via the digital input, which is set to the "Read Lower Cal. Point" or "Read Upper Cal. Point" function. Please refer chapter 9.3.5 Inputs | DI Assignment.



1 Window "New Lower calibration point"
2 Input field "Density" [g/cm³]
3 Progress bar (duration)

Fig. 26 Set new calibration point (for ex. Lower calibration point)

1. Click on the button (Fig. 23, item 4 or item 5) to read in a new lower or upper Calibration point.

▶ The window "New Calibration Point" (Fig. 26, item 1) opens.

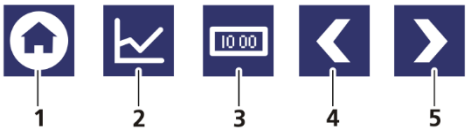
2. Click on the input field (Fig. 26, item 2).

▶ The screen keyboard opens.

3. Enter the density of the fluid.
4. Confirm with the Enter key.

▶ The recording of the detector value starts. The value is set automatically after the recording has been completed. The view changes to standard display and the new calibration point is set.

7.4 Navigation



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

Fig. 27 Icons for navigation

7.4.1 Diagram display

Clicking the diagram symbol (Fig. 25, item 7) changes the view to the diagram display.

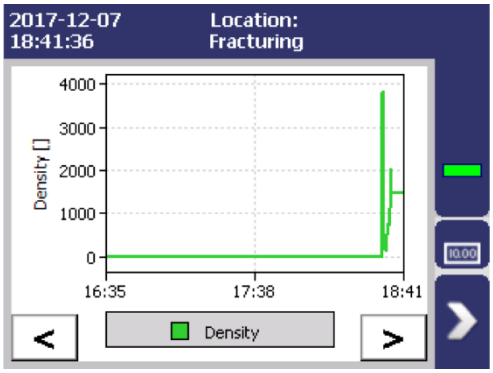
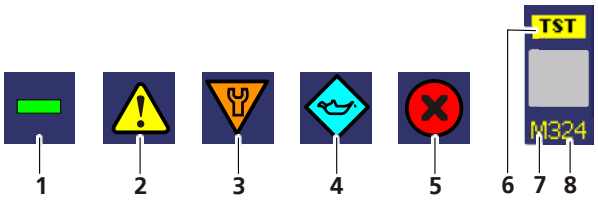


Fig. 28 Diagram display of the EVU

7.5 Status messages



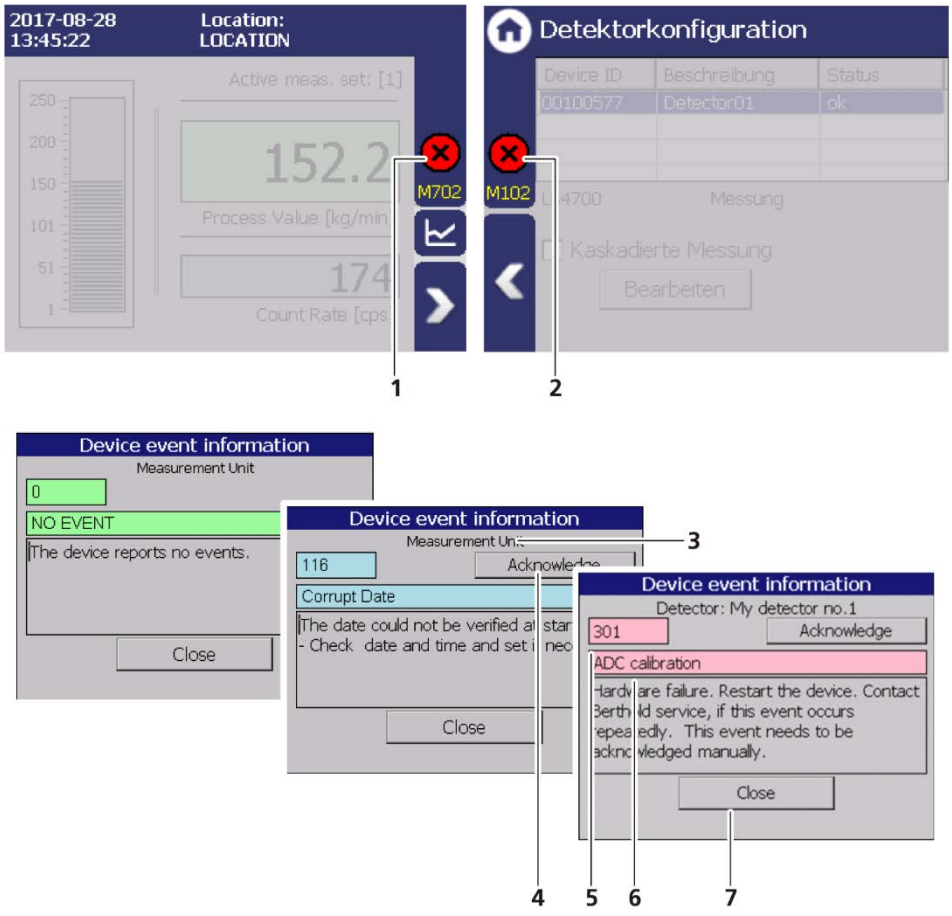
1 No event
2 Outside of specification
3 Function check
4 Maintenance required
5 Failure (error)
6 Information test (simulation)
7 Letter D (detector) or M (measuring instrument)
8 Event code

Fig. 29 Status information

7.5.1 Event reports

Events are displayed in the standard display and in the submenus as a symbol. All the events are shown on the standard display. The leading letter “D” (for detector) indicates that the detector is reporting an event. The letter “M” (for measuring instrument) indicates an event that refers to the transmitter LB 475, see Chapter 11.2 Error Codes of the Evaluation Unit. In the event of a detector fault, the operating manual of the detector must be observed.

The event with the highest priority is displayed. Further information about event reports on the measuring instrument are listed in Chapter 10. Information about the event reporting of the detector can be displayed in the menus in Chapter 9.3.2 Detector Service.



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

Fig. 30 Event report

1. Click on the icon (Fig. 30, 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.

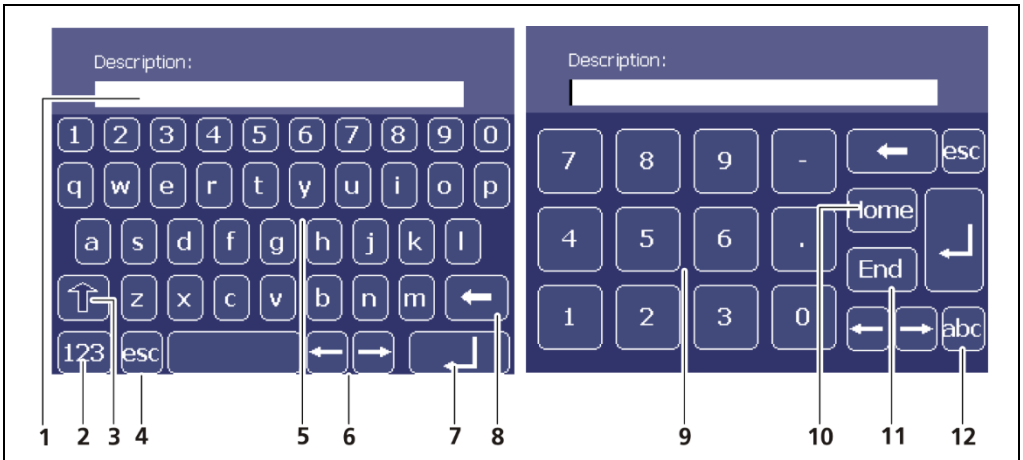
IMPORTANT

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

7.6 Screen keyboard

NOTICE

The screen keyboard appears by clicking on the blue display panels (input 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. 31 Screen keyboard

8 Main Menu Basic Setup

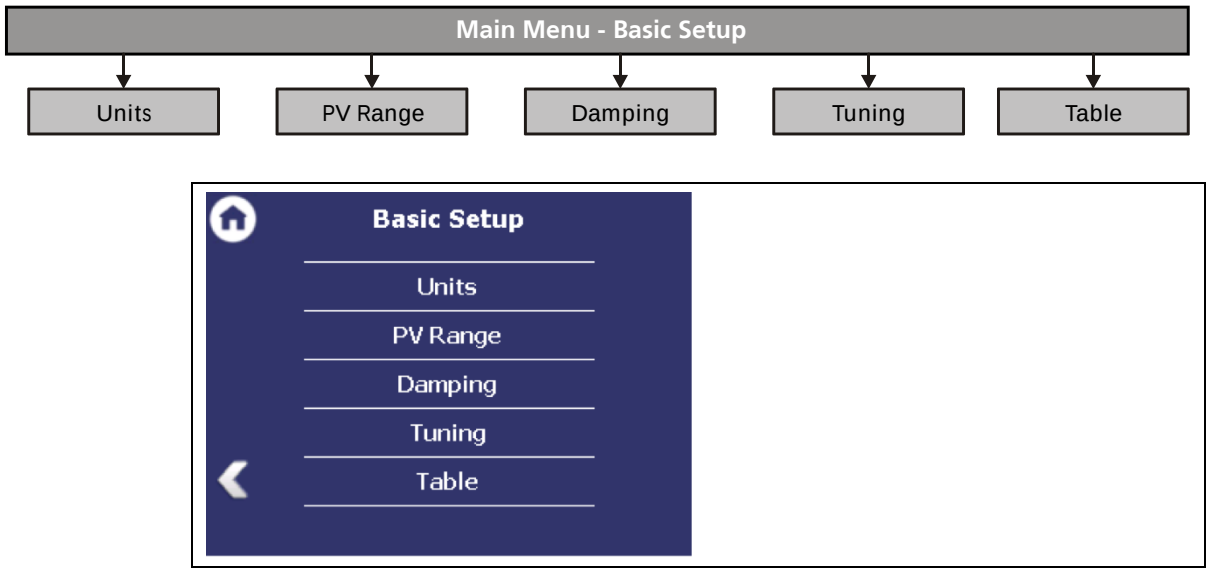


Fig. 32 Menu Basic Setup

IMPORTANT

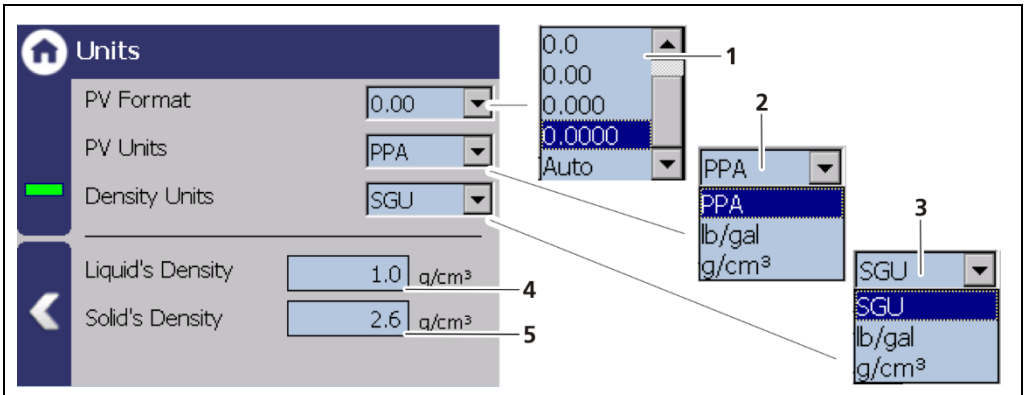
All settings in the Menu Basic Setup are transferred to the Main Menu Expert Setup and vice versa.

8.1 Units

Basic Setup | Units

Clicking on the individual selection arrow lists the available units for the measuring value. The selected format is used in basic menu settings, expert menu settings and standard display.

When selecting the unit PPA, the value for respective density g/cm³ must be entered in the input fields Liquid's Density (Fig. 33, item 4) and Solid's Density (Fig. 33, item 4).



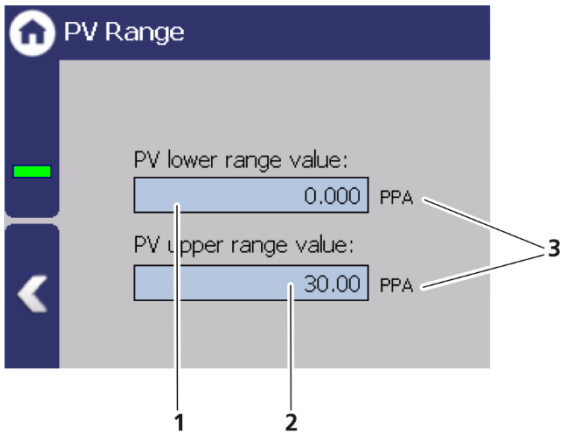
1 PV Format
2 PV Units
3 Density Units
4 Input field Liquid's Density
5 Input field Solid's Density

Fig. 33 Basic Setup Menu "Units"

8.2 PV Range

Basic Setup | PV Range

The lower and upper limit of the process range of the active measuring parameter set can be set in the Menu “PV Range” (Process Value Range). These limits define the signal range of the analog current output (0/4 ... 20 mA). The unit is displayed that is selected in the menu Basic Menu | Units in "PV Units".



1 Input field min. process value
2 Input field max. process value
3 Unit

Fig. 34 Basic Setup Menu “PV Range”

1. Click on the input box (Fig. 34, item 1) to enter the process value that is intended to correspond to an output current of 0/4 mA.
2. Confirm with the Enter key.
3. Click on the input box (Fig. 34, item 2) to enter the process value that is intended to correspond to an output current of 20 mA.
4. Confirm with the Enter key.

▶ The new value is set.

8.3 Damping

Basic Setup | Damping

The reaction time of the measured value display (standard display) can be set in the “Damping” menu. The measurement reacts quickly to rapid process changes at a small time constant (min. 1 second). The measurement reacts correspondingly slower with a large time constant. The stronger filtering reduces the statistical error at a larger time constant and thus smooths the fluctuations in the measuring signal.

Fig. 35 Basic Setup Menu “Damping”

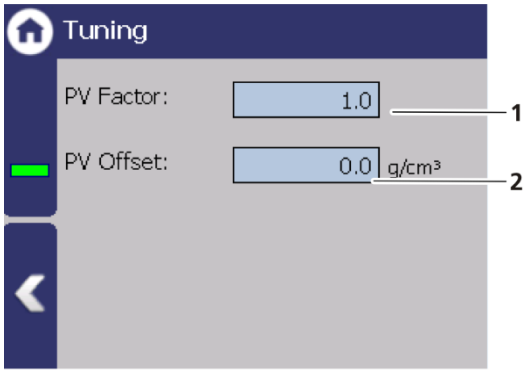
1. Click on the input field to change the time constant.
2. Enter the value and confirm with the Enter key.

▶ The time constant has been changed.

8.4 Tuning

Basic Setup | Tuning

In the Menu Tuning fine adjustments can be made.



1 Input field “PV Factor”
2 Input field “PV Offset”

Fig. 36 Basic Setup Menu “Tuning”

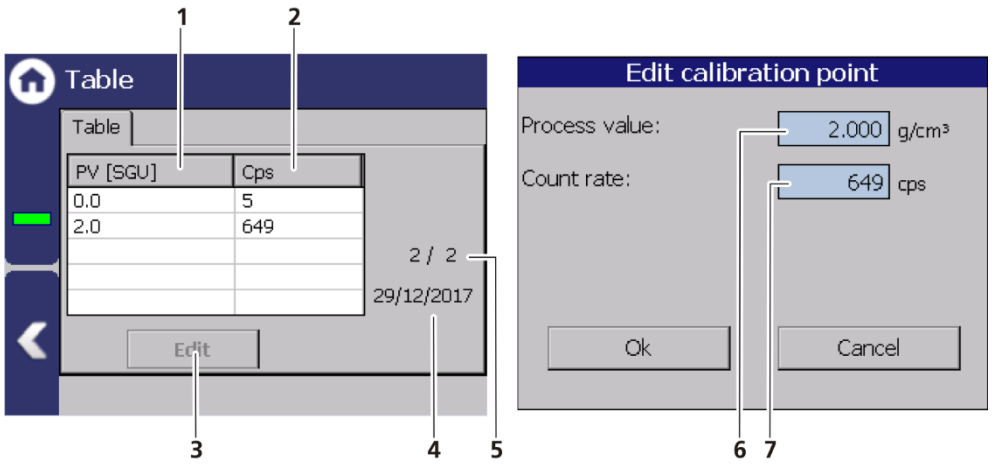
PV Factor A multiplicative factor (0 to 10) can be entered for the correction of the measured values here. Each measured value is multiplied by this value. The slope of the curve can thus be changed. The value is automatically set to "1.0" if the calibration curve is recalculated.

PV Offset For additive correction of the measured values. A parallel shift of the curve is thus possible. The value entered here is added for each measurement. The value is automatically set to "0.0" if the calibration curve is recalculated.

8.5 Table

Basic Setup | Table

The determined calibration points are displayed in the menu. “Table”. The values for PV and CPS can be changed with the button “Edit”.



1 **PV [Unit]**
2 **Cps (Counts per second)**
3 **Button** <Edit>
4 **Date of determination**
5 **Calibration points**
6 **Process Value**
7 **Count rate**

Fig. 37 Basic Setup Menu “Table”

9 Main Menu Expert Setup

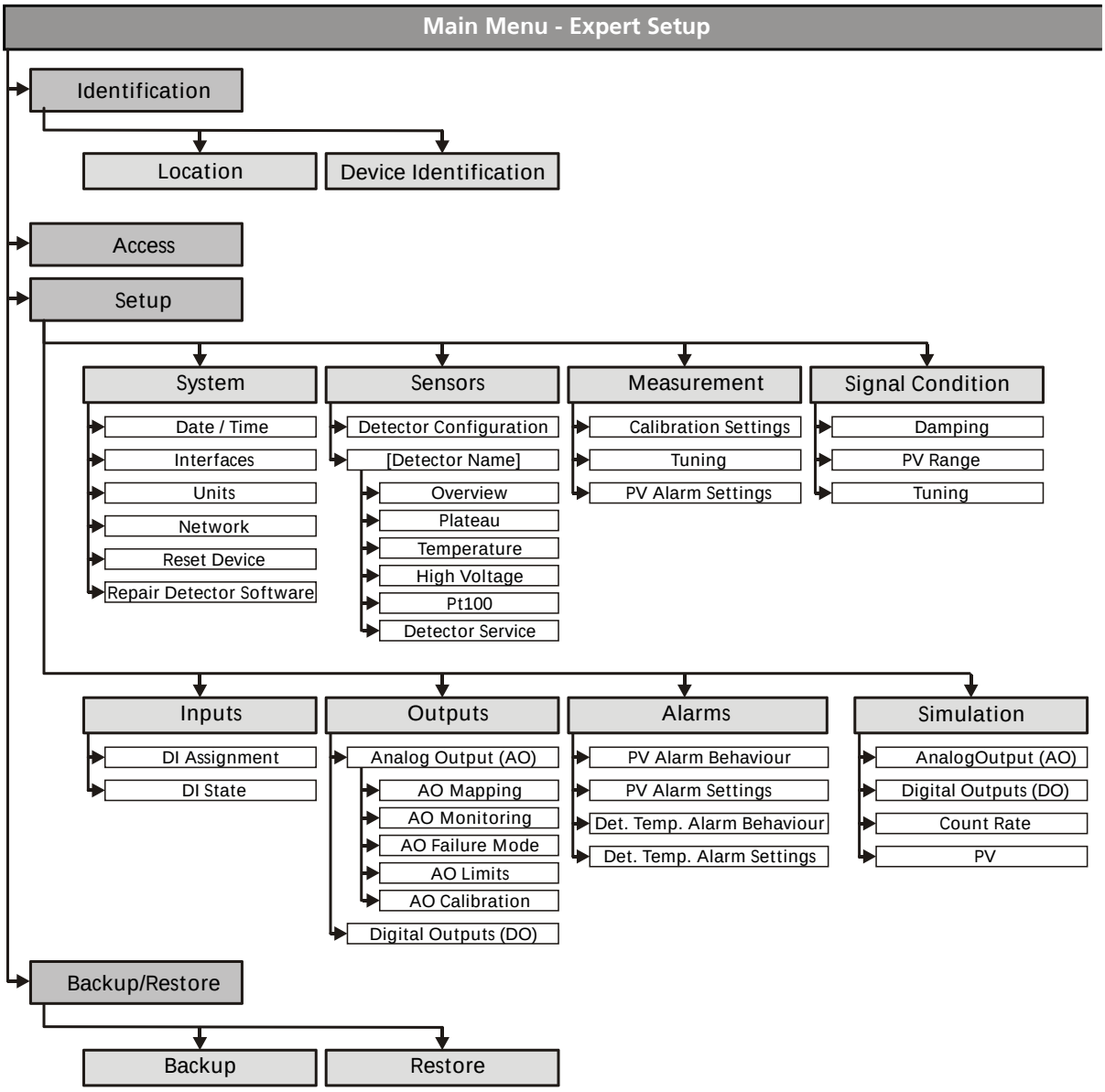


Fig. 38 Menu Expert Setup

9.1 Identification

Expert 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

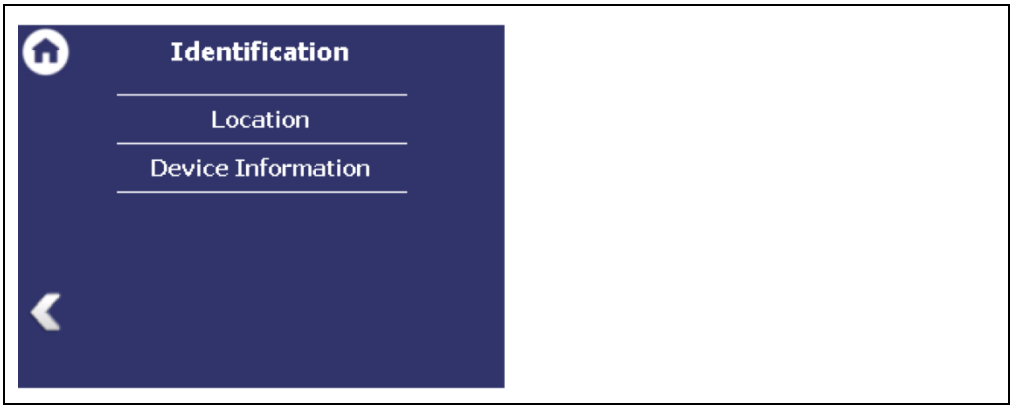
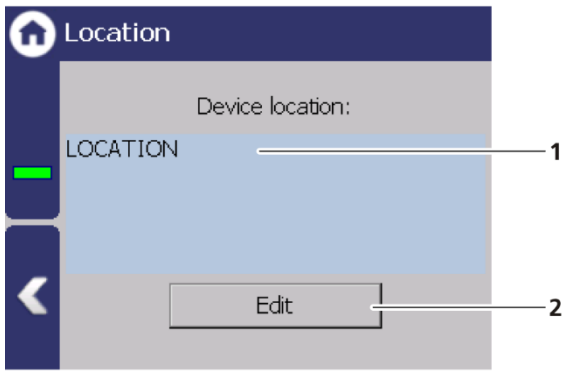


Fig. 39 Menu Identification

9.1.1 Location

Expert Setup | Identification | Location

The measuring point of the transmitter is displayed (Fig. 40, item 1) in the “Location” menu. The name can only be edited (9.2 Menu Access) in the access level "Standard". The location is displayed on the standard display at “Measuring point” (Fig. 25, item 9).



1 **Name Device location**
2 **Button** <Edit>

Fig. 40 Device location

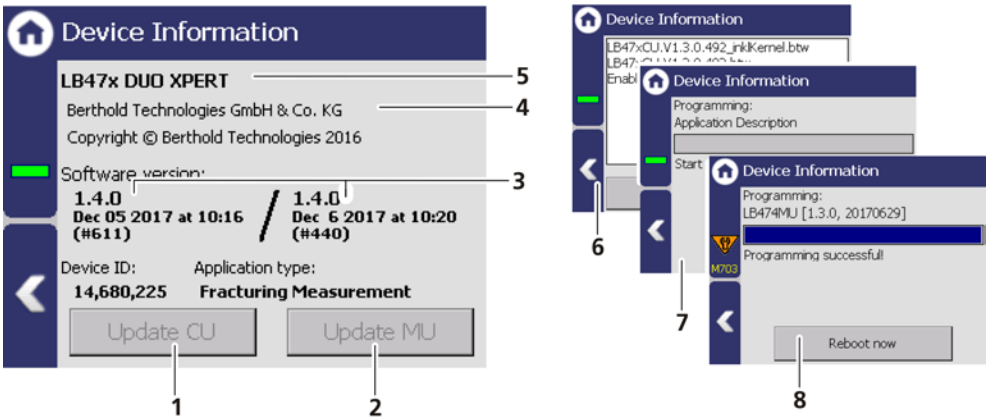
1. Click <Edit> (Fig. 40, item 2) to open the input field.
2. Enter a location name for the evaluation unit.
3. Confirm with the Enter key.

▶ The name has been changed.

9.1.2 Device Information

Expert 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. 41 Device information

NOTICE

Settings are deleted!

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

- Carry out a backup of the measuring channel settings before resetting and the update of the EVU (see 9.4.1 Backup).
- The secured settings should then be imported after the successful software update.

Tip

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.

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 device (Fig. 5, item 5).
3. The USB storage device is recognised by the system after a few seconds and the <CU Update> (Fig. 41, item 1) button can be clicked.
4. Click on the button <CU Update> (Fig. 41, item 1).

- The selection window opens.

5. Select the CU file and click on <CU-Update>.

▶ The measurement is interrupted and the update is carried out.

6. Click on <Restart now>, to restart the EVU.

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 device (Fig. 5, item 5).
3. The USB storage device is recognised by the system after a few seconds and the <MU Update> (Fig. 41, item 2) button can be clicked.
4. Click on the button <MU Update> (Fig. 41, item 2).

▶ The selection window opens.

5. Select the MU file and click on <MU-Update>.

▶ The measurement is interrupted and the update is carried out.

6. Click on <Restart now>, to restart the EVU.

NOTICE

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

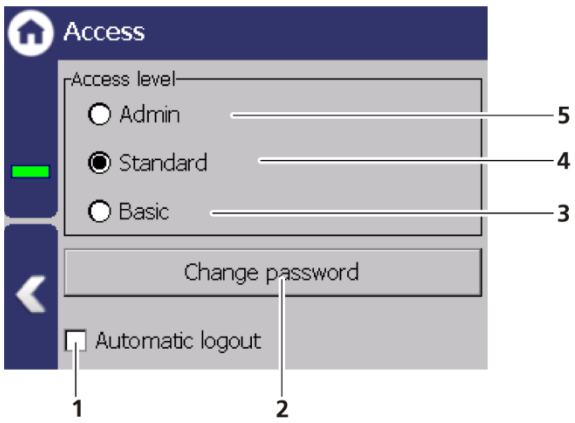
9.2 Menu Access

Expert Setup | Access

You can set the user rights via the user levels and assign passwords in the submenu Access. The system can be protected by a password against unauthorised changes.

The following user levels are available to you:

User Level Basic	You can see all important data but you cannot make any changes.
User Level Standard	You can change all data necessary for operation (e.g. calibration).
User Level Admin	This user level is only intended for the system management by Berthold.
Automatic logout	Activating the selection box (Fig. 39 item 1) automatically resets the access level Standard to “Basic” when the system changes to the standard display after the timeout (Chap. 7.3.1).



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

Fig. 42 Menu Access

NOTICE

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

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

Change password

To set or change a password, select "Standard" (Fig. 42, item 4) and click on <Change password> (Fig. 43, item 2) to open the input field.

1 **Text field**
2 **Button** <OK>

Fig. 43 Change password

1. Click on the text field (Fig. 43, item 1) to open the input field.
2. Enter a password (case-sensitive!).
3. Confirm with the Enter key.
4. Click <OK> (Fig. 43, item 2) to confirm.

▶ The password has been set / changed.

9.3 Menu Setup

Expert Setup | Setup

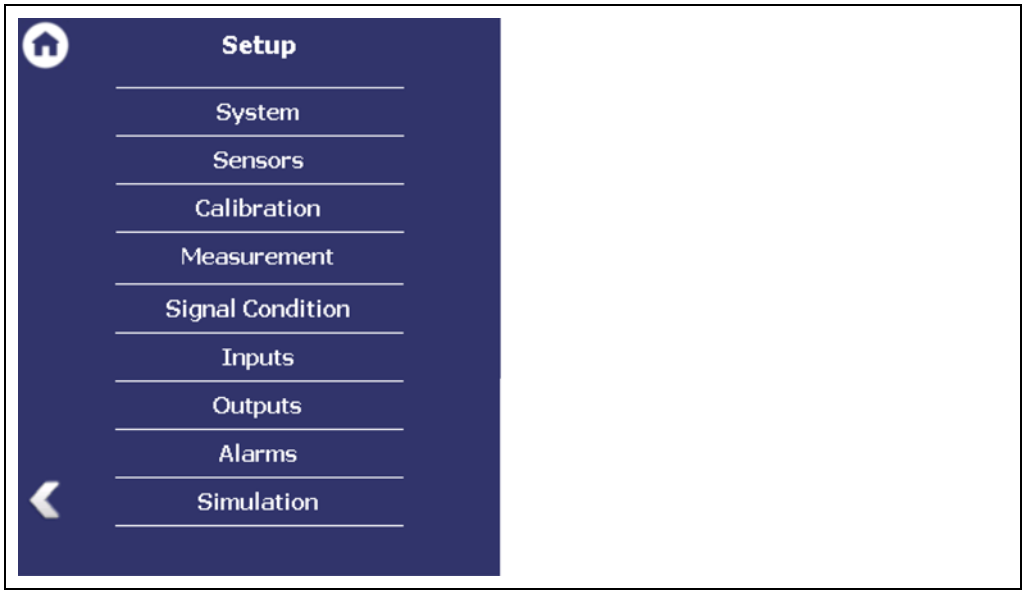


Fig. 44 Menu "Setup"

9.3.1 System (Date / Time, Interfaces, Units, Network, Reset, Repair)

Expert Setup | Setup | System

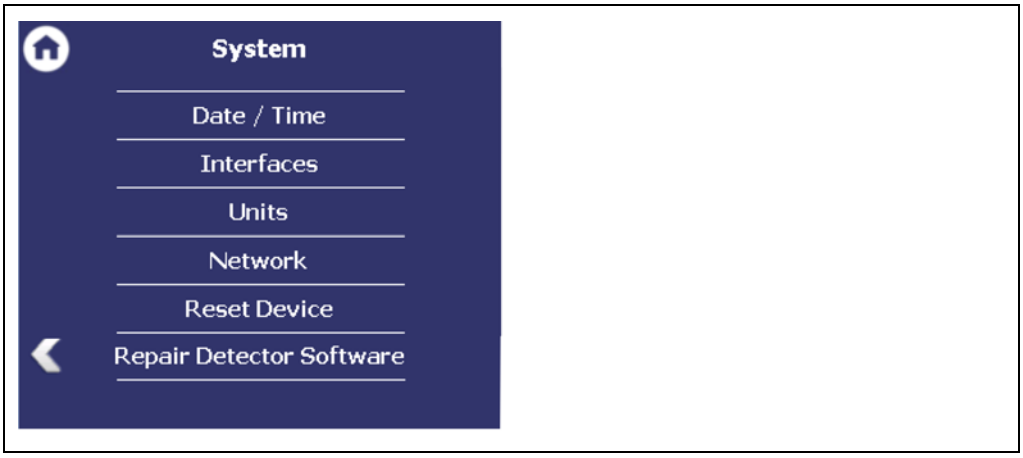


Fig. 45 Submenu “System”

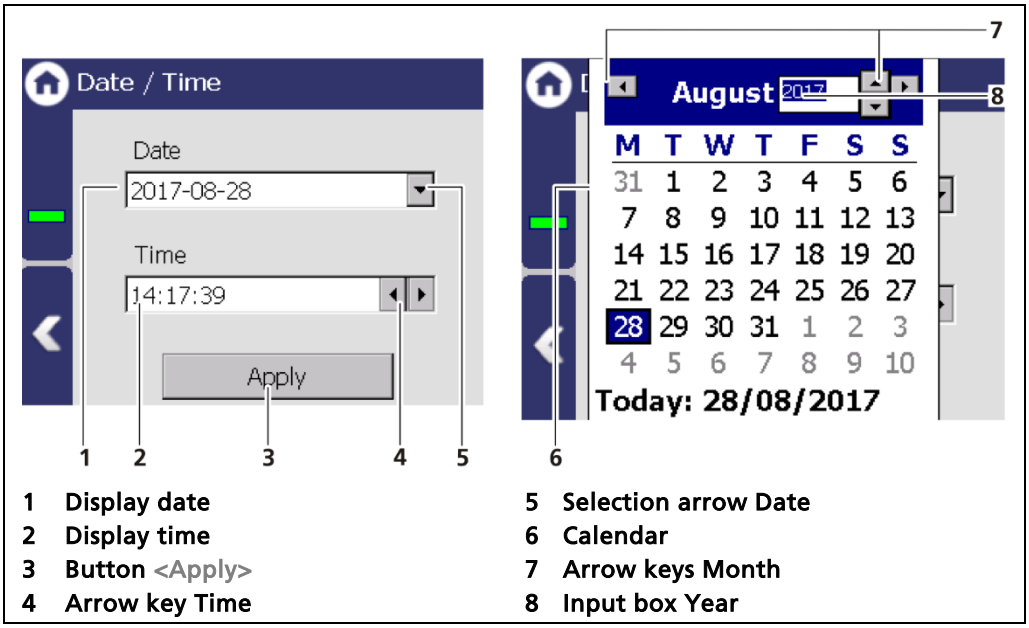
Set Date and Time

Expert 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**
2 **Display time**
3 **Button** <Apply>
4 **Arrow key Time**
5 **Selection arrow Date**
6 **Calendar**
7 **Arrow keys Month**
8 **Input box Year**

Fig. 46 Date / Time, Calendar

1. Click on the arrow key (Fig. 46, item 5) in order to set the date.

▶ The calendar is opened (Fig. 46, item 6).

2. Click on the year number (Fig. 46, item 8) in order to enter the year.
3. Set the month (Fig. 46, 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. 46, item 4).
6. Click on <Apply> (Fig. 46, item 3), to accept the date and time settings.

Interfaces

Expert Setup | Setup | System | Interfaces

You can adjust the following settings in the submenu “Interfaces”

- Local Display ▸ Brightness / Timeout
- Local Display ▸ Input / Touch
- Language
- CE Remote Control

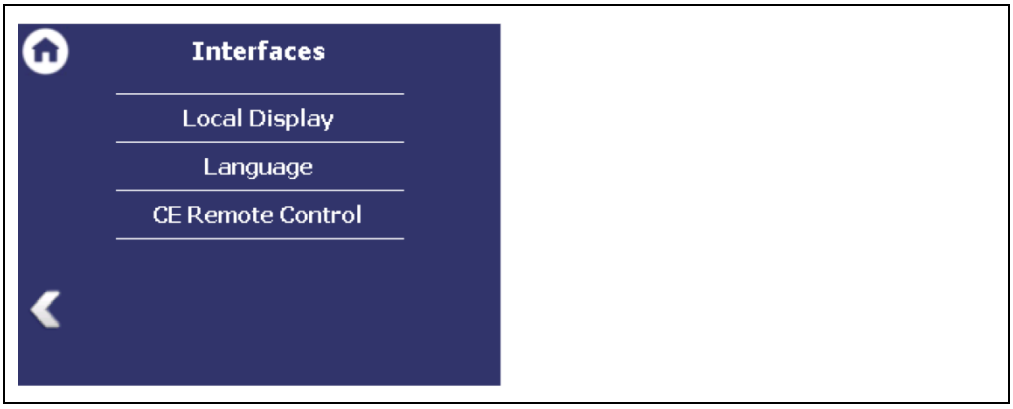


Fig. 47 Menu ”Interfaces”

Local Display

Expert Setup | System | Interfaces | Local Display

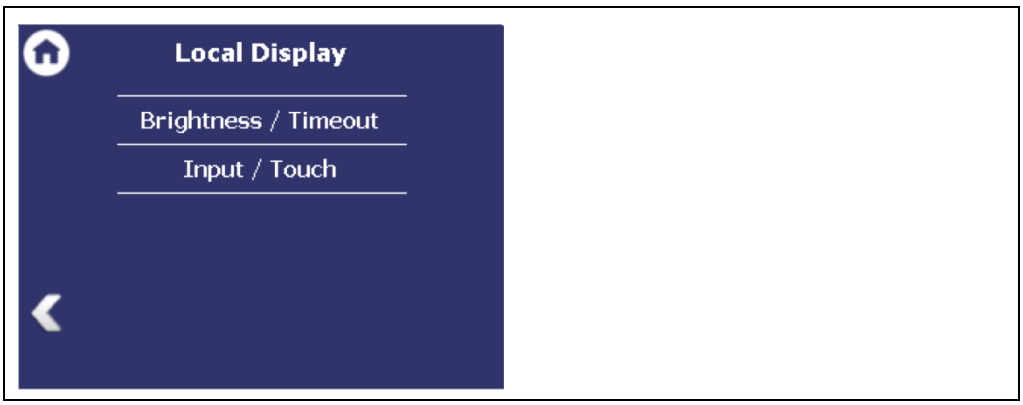
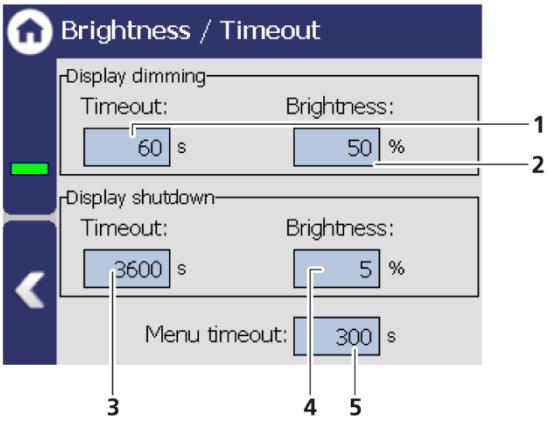


Fig. 48 Submenu "Local Display"

Brightness / Timeout

Expert Setup | Setup | System | Interfaces | Local Display | Brightness / Timeout



1 Input field "Time out"
2 Input field "Brightness"
3 Input field Display switch off "Time out"
4 Input field Display switch off "Brightness"
5 Input field menu time out

Fig. 49 Brightness / Timeout

"Time out" 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 switch-off".

Display dimming

In the field Display dimming, clicking the input fields allows the entering of the brightness (Fig. 49, item 2) in percent, that is set after expiry of the time (Fig. 49, item 1).

Display shutdown

In the field Display shutdown, clicking the input fields allows the entering of the brightness (Fig. 49, item 4) in percent, that is set after expiry of the time (Fig. 49, item 3).

Menu Timeout

Under "Menu Timeout" clicking on the input field (Fig. 49, item 5) changes the time period (seconds) in which the menu view changes to the standard view.

Input / Touch

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

The EVU is operated using the Touch-Screen. As an alternative, the EVU can be connected to the USB connection with a mouse. The mouse pointer automatically becomes visible when a mouse is inserted into the USB port (Fig. 5, item 5).

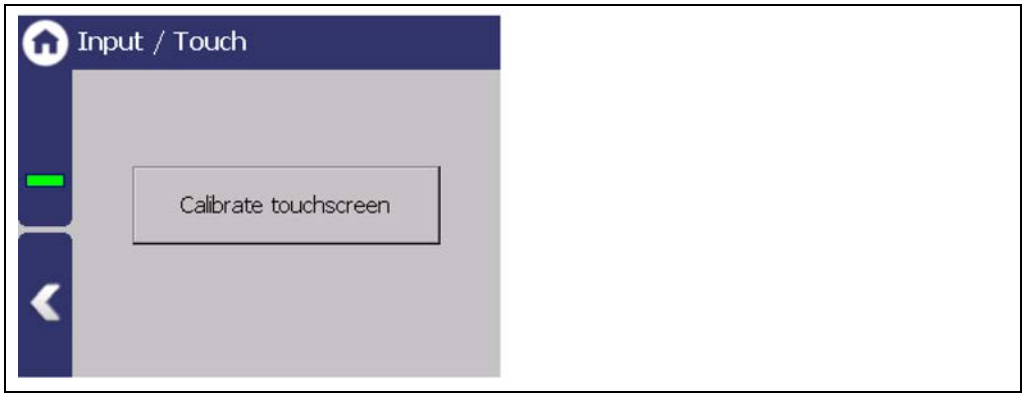


Fig. 50 Input / Touch

Calibrate touch screen

The calibration may only be carried out with direct skin contact. Take gloves or any other protective equipment off your hands.

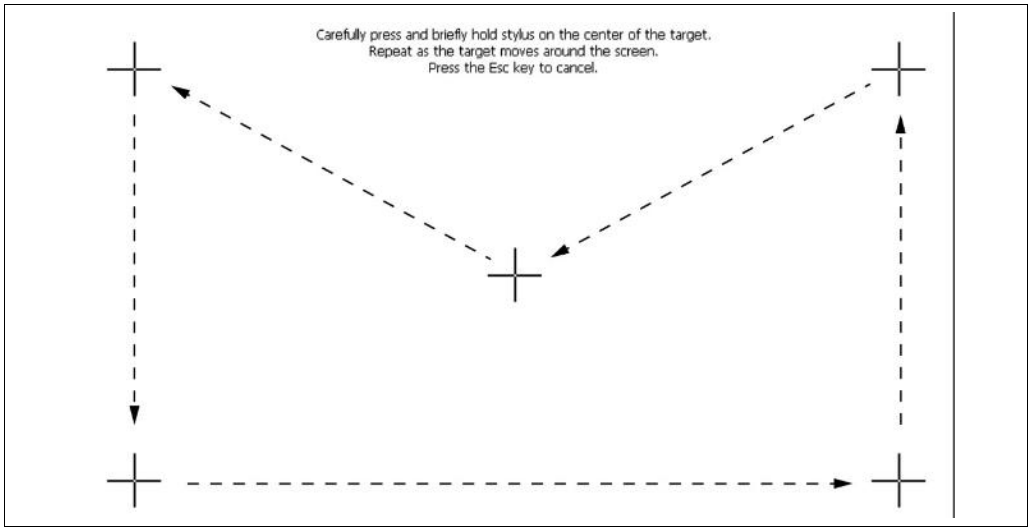


Fig. 51 Calibrate Touch screen

1. Click on <Calibrate touch screen>.

▶ 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.

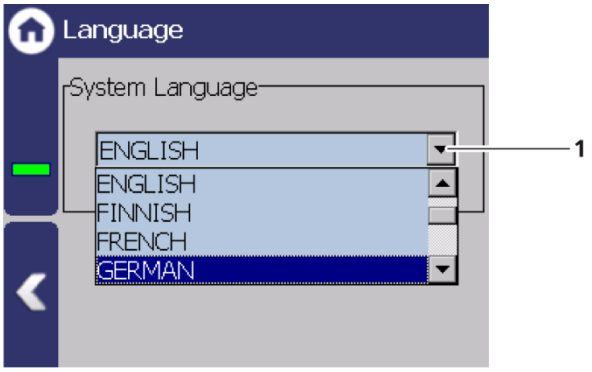
4. Confirm the calibration by clicking on the empty field. The display changes to screen "**Calibrate Touch screen**".

▶ The calibration was performed.

5. Execute a restart of the EVU after prompting.

Language

Expert Setup | Setup | System | Interfaces | Language



1 Selection arrow

Fig. 52 Language

Change language

1. Click on the selection arrow (Fig. 52, item 1) and select a language.

▶ A message window "Restart" appears.

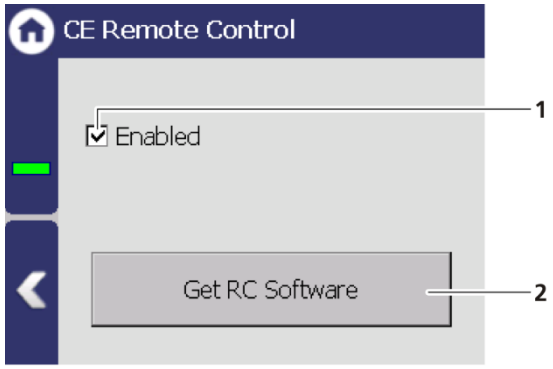
2. Confirm with <OK> to restart the device.

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

CE Remote Control

Expert Setup | Setup | System | Interfaces | Display | CE Remote Control

By activating (Fig. 53, item 1) on the CE Remote Control, the EVU 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** <Copy RC software>

Fig. 53 CE Remote Control

Copy RC software

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

▶ The USB storage device is recognised by the system after a few seconds and the button <Get RC software> (Fig. 53, item 2) can be clicked.

2. Click on the button <Get RC software> (Fig. 53, 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.

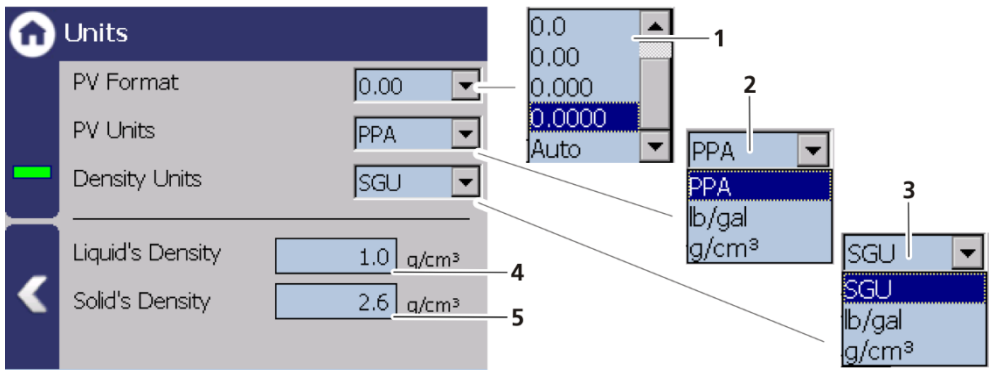
Operation of the RC software is described in Chapter "Remote Control Software" (see next but one chapter).

Units

Expert Setup | Setup | System | Units

Clicking on the individual selection arrow lists the available units for the measuring value. The selected format is used in basic menu settings, expert menu settings and standard display.

When selecting the unit PPA, the value for respective density g/cm³ must be entered in the input fields Liquid's Density (Fig. 54, item 4) and Solid's Density (Fig. 54, item 4).



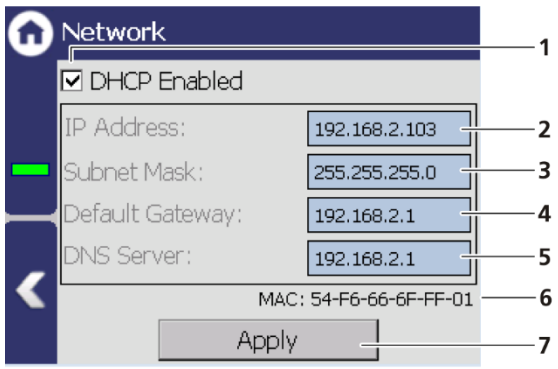
1 PV Format
2 PV Units
3 Density Units
4 Input field Liquid's Density
5 Input field Solid's Density

Fig. 54 Menu "Units"

Network

Expert Setup | Setup | System | Network

In the “Network” submenu, you can make changes to the network settings. The information can only be edited in the access level "Standard" (see chap. 9.2 Menu Access).



1 **Selection box “DHCP active”**
2 **IP address**
3 **Subnet mask**
4 **Standard gateway**
5 **DNS server**
6 **MAC address**
7 **Button** <Apply>

Fig. 55 Network settings

You can set the network address either manually or using DHCP (automatic assignment). To do this, check the "DHCP active" selection field (Fig. 55, item 1).

IMPORTANT

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. 55, item 6).

Changing the addresses

1. Click on the text field (Fig. 55, 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. 55, item 7) to adopt the network settings.

IMPORTANT

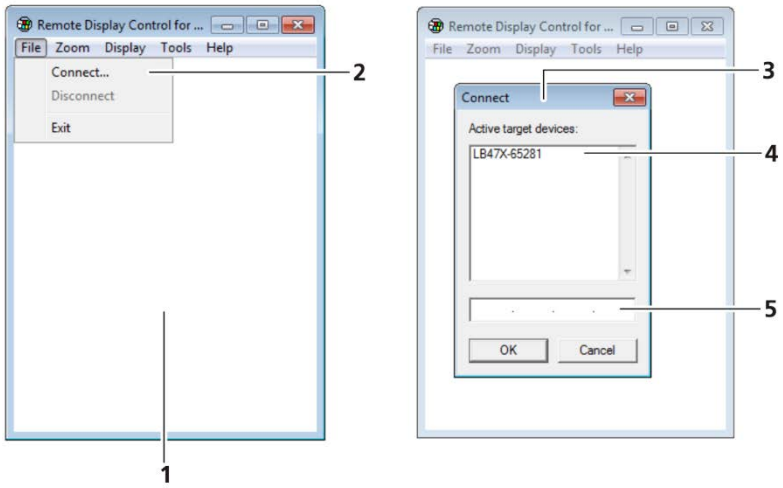
All settings applied must be confirmed by clicking on <Apply>, for the settings to become effective.

Remote Control Software

If the EVU is connected to a network at the RJ45 socket (Fig. 6, item 2), 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. 53, item 1).



1 **Programme Remote Control**
2 **Box** <Connect...>
3 **Window Connect**
4 **List of transmitters**
5 **Input box IP address**

Fig. 56 Establishing connection to the EVU using the RC software

1. Click on **"LB47xRemoteControl.exe"**, to start the program.

▶ The window of the program opens (Fig. 56, item 1).

2. Click on the <File> tab and then on <Connect...> (Fig. 56, item 2), to establish a connection to the EVU.

▶ A new window “Connect” is opened (Fig. 56, item 3) and the connected transmitters are listed.

IMPORTANT

The IP address of the EVU must be in the same sub-network (Fig. 55, item 3) as the network adapter of the computer (see previous Chapter “Network”).

3. Click on the identifier of the transmitter (Fig. 56, item 4) or enter the IP address of the EVU in the input box (see Fig. 55, item 2).
4. Click on <OK>.

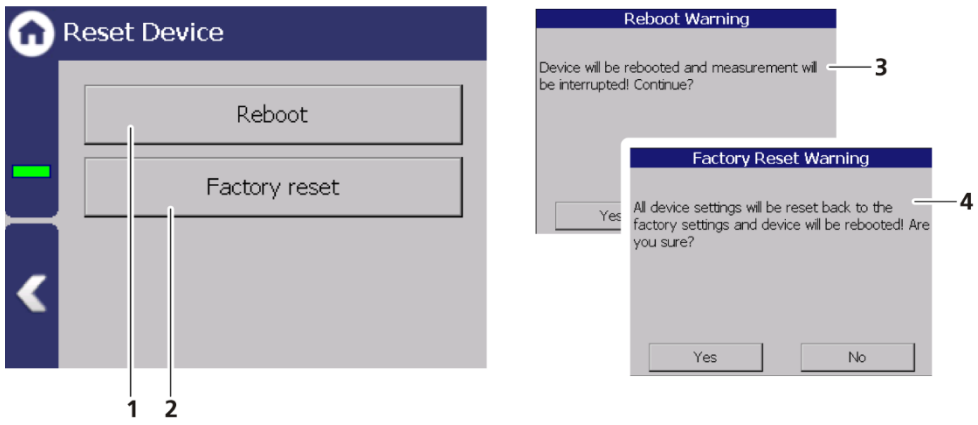
▶ The connection to the EVU is established.

5. You can enlarge the view in the “Zoom” menu (2x or 3x).

Reset Device (EVU)

Expert Setup | Setup | System | Reset Device

The EVU can be restarted and reset to factory settings in the submenu "Reset Device".



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

Fig. 57 Reset device

Restart the device

IMPORTANT

The measurement is interrupted during a restart!

1. To restart the device, click the button <Reboot> (Fig. 57, item 1).

▶ A window with a warning "Reboot" (Fig. 57, item 3) opens.

2. Click on <Yes> to confirm.

▶ The device is restarted.

Resetting the 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!

1. To reset the evaluation unit to the factory settings, click the button <Factory reset> (Fig. 57, item 2).

▶ A window with the warning "Factory settings" (Fig. 57, item 4) opens.

2. Click on <Yes> to confirm.

▶ The device is reset to factory settings and restarts.

IMPORTANT

In the event of the error code M102, the transmitter must be reset twice.

9.3.2 Sensors

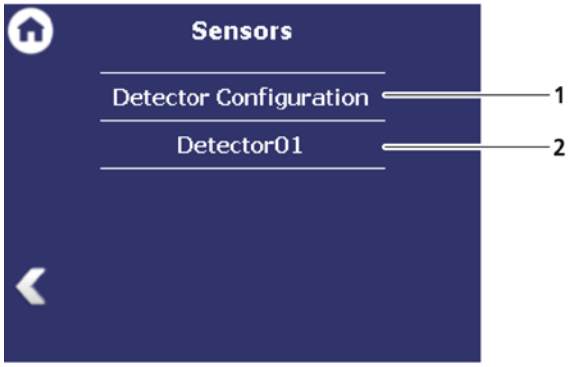
Expert Setup | Setup | Sensors

You can perform the following settings and read information in the submenu Sensors:

- Detector configuration (Fig. 58, item 1)
  - o Add / Remove detectors
  - o Settings of the detectors
- Configuration of the respective detector (Fig. 58, item 2)
  - o Overview
  - o Plateau
  - o Temperature
  - o High voltage
  - o Detector service

IMPORTANT

If the system does not detect a detector, then the sub-menu “Detector” cannot be selected.



1 Detector configuration
2 Configured detectors

Fig. 58 Menu "Sensors"

Detector configuration

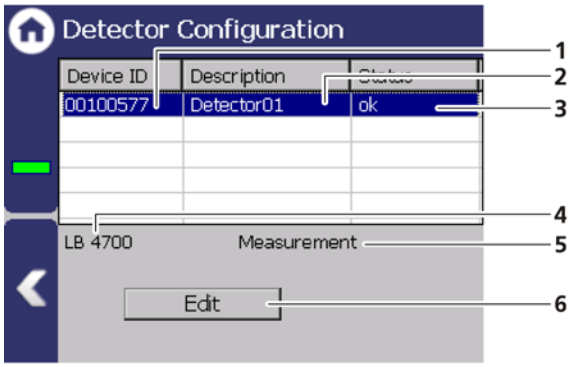
Expert Setup | Setup | Sensors | Detector configuration

In the sub-menu “Detector configuration” the detectors for the measuring system are added and configured. Only configured detectors are listed and shown in the menu (Fig. 58). When a detector is selected, the detector type (Fig. 59, item 4) and measuring task (Fig. 59, item 5) are shown.

Clicking the box <Edit> (Fig. 59, item 6) selects the type of detector and changes the description.

Information

Information and settings for the detector are in the individual detector menu (Fig. 61).

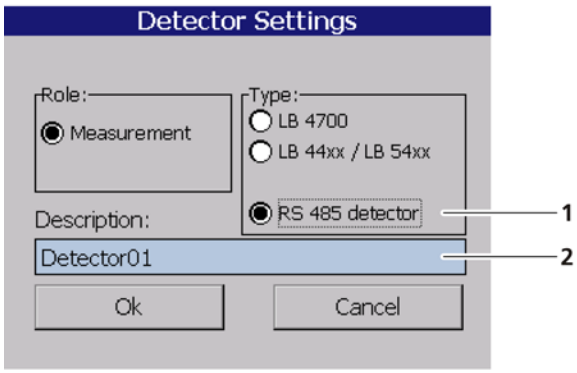


1	**Device ID**	4	**Detector type**
2	**Detector description**	5	**Measuring task**
3	**Detector status**	6	**Button** <Edit>

Fig. 59 Detector configuration

Detector Settings

The editing of the settings of a configured detector are edited by marking and clicking on <Edit> (Fig. 59, item 6).



1 **Selection detector type**
2 **Selection RS 485 detector**
3 **Input field "Description"**

Fig. 60 Detector Settings

RS 485 detector — This selection must be selected when the LB 6770 detector for fracturing systems is connected.

Description — Detector description. Is displayed in error messages, event logs and in the menu structure (Fig. 58).

Detector

Expert Setup | Setup | Sensors | [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
  - Detector reset

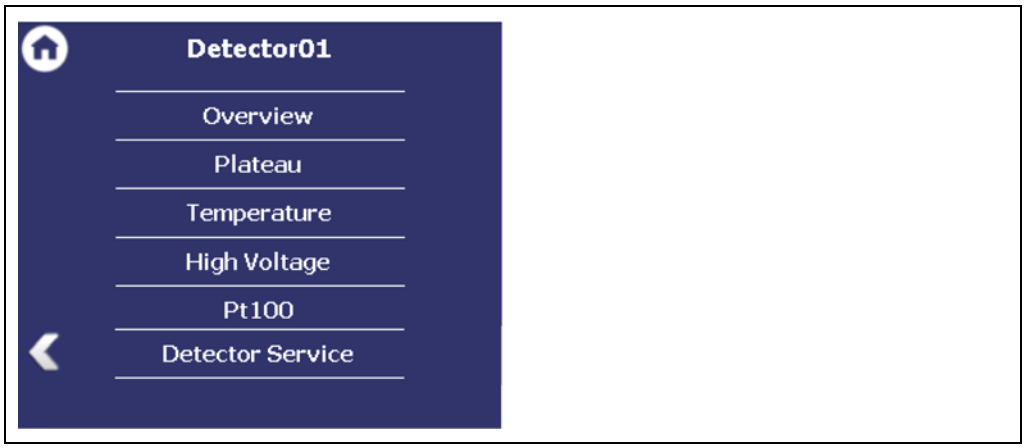
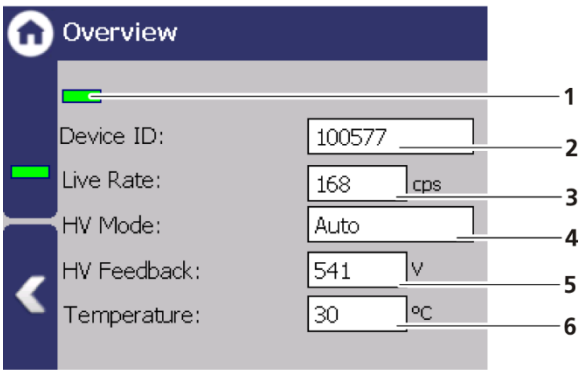


Fig. 61 Submenu "Detector"

Detector: Overview

Expert Setup | Setup | Sensors | [NAME DETECTOR] | Overview

Important parameters and measured values of the detector are clearly displayed in the submenu "Overview".



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

Fig. 62 Overview detector information

	A green bar appears with error-free status of the detector (Fig. 62, item 1).
Device ID	Shows the ID of the detector.
Live rate	The "Live rate" (Fig. 62, item 3) displays the current, unfiltered count rate.
HV mode	In the field "HV mode" (Fig. 62, item 4), the HV mode is displayed, which is chosen under Device Setup | Setup | Sensors | [NAME DETECTOR] | High voltage | HV settings.
HV Feedback	The field "HV Feedback" (Fig. 62, item 5) displays the actual measured value in volts.
Temperature	The field "Temperature" (Fig. 62, item 6) indicates the current temperature of the detector in C°.

Detector: Plateau

Expert Setup | Setup | Sensors | [NAME DETECTOR] | Plateau

The plateau provides information as to whether the detector is working in a stable condition. A plateau recording is therefore only carried out if the measured value drifts or if there are any other doubts about the function of the detector. The plateau recording can then assist in restricting 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. 63) leads to the plateau measuring and the display of plateau values.

Contact your service or sales partner, or Berthold direct, to obtain a qualified assessment of the measured plateau.

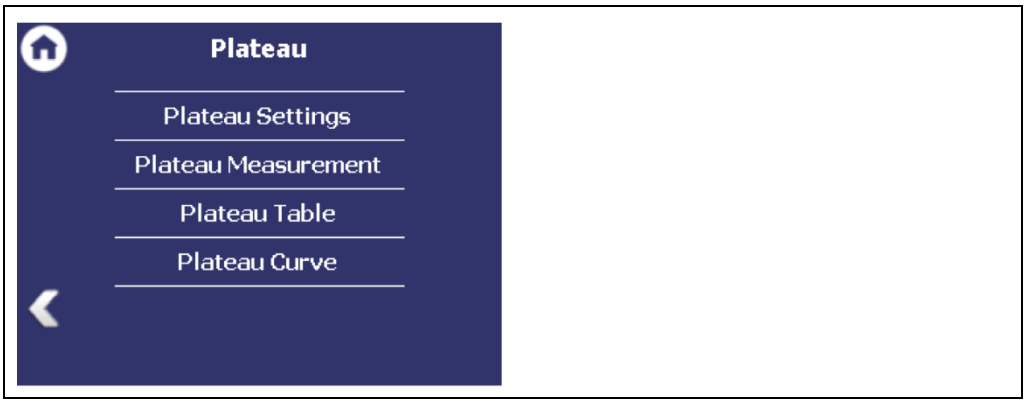


Fig. 63 Submenu "Plateau"

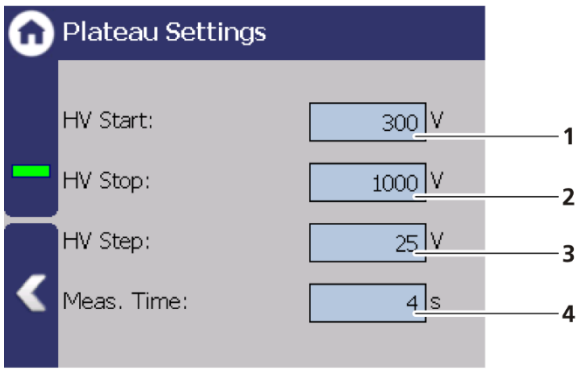
Plateau Settings

Expert Setup | Setup | Sensors | [NAME DETECTOR] | Plateau | Plateau settings

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

You have the following settings options in the submenu "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 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. 64 Plateau settings

1. Click on the corresponding text field.

▶ 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.

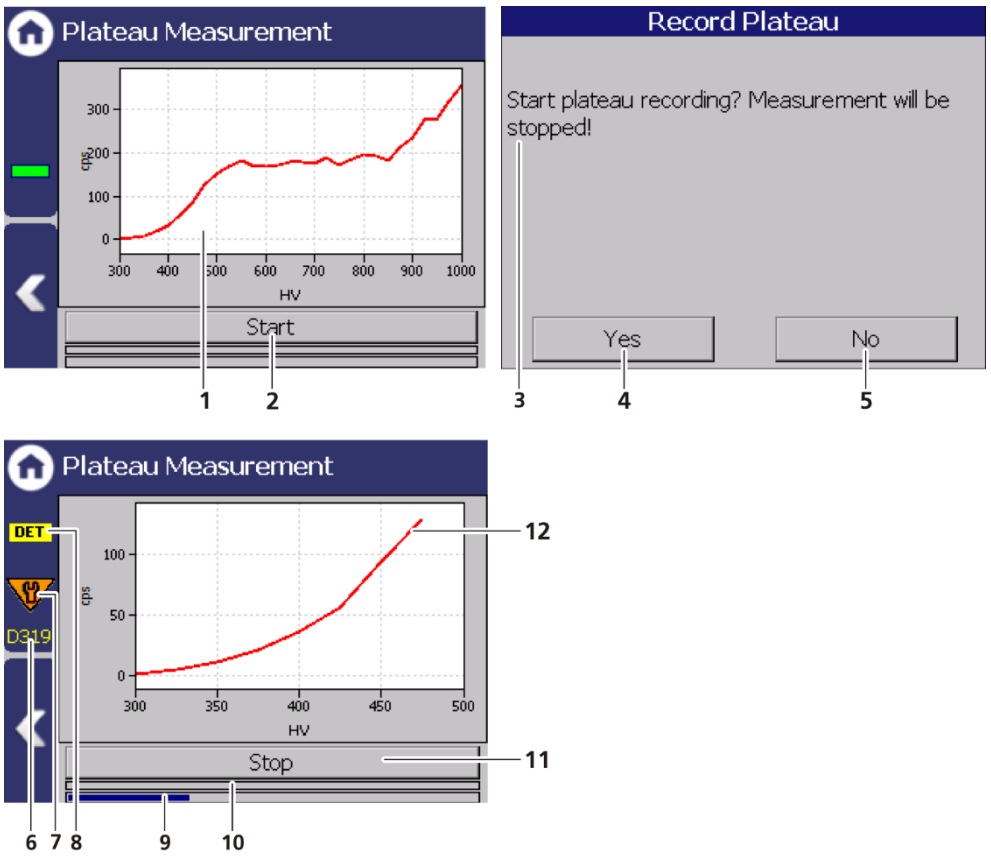
Plateau Measurement

Expert Setup | Setup | Sensors | [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	Notice Code	12	New plateau curve

Fig. 65 Recording a plateau curve

1. Click on <Start> (Fig. 65, item 2) to carry out a plateau measurement.

▶ The confirmation message "Record plateau" (Fig. 65, item 3) opens.

2. Confirm with <Yes> (Fig. 65, item 4).

▶ The EVU switches to mode "DET" (Fig. 65, item 8) and the current measurement is stopped.

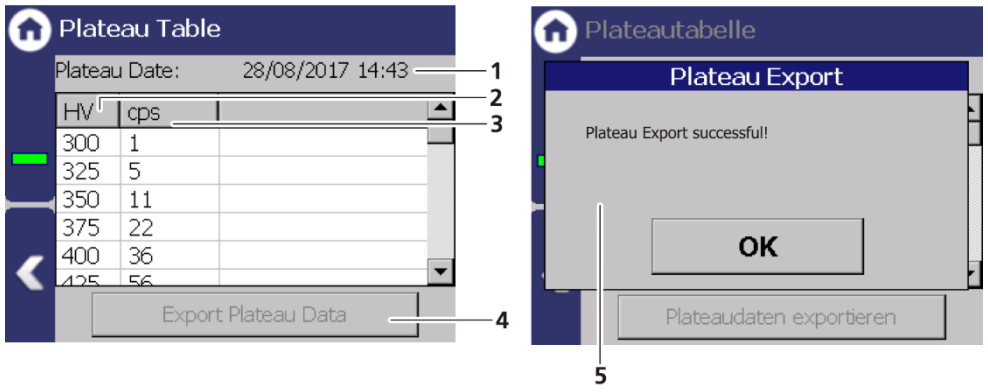
▶ The information (Fig. 65, item 6 - 8) from the plateau measurement are displayed in the status information. The LED Run flashes on the EVU during the plateau measurement. The LED "Warning" lights up at the same time.

- 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. 66), the plateau curve (Fig. 67) is drawn and stored automatically.

Plateau Table

Expert Setup | Setup | Sensors | [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 "Export successful"**

Fig. 66 Plateau Table

Export plateau data

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

▶ The USB memory device is recognised 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. 66, item 4).

▶ The values of the plateau measurement have been stored in a .txt file.

3. Confirm the message with <OK>.

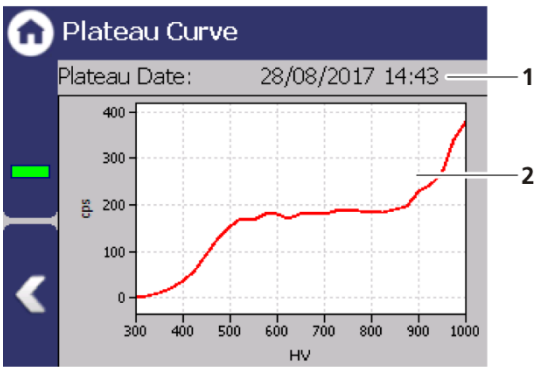
Information

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

Plateau Curve

Expert Setup | Setup | Sensors | [NAME DETECTOR] | Plateau | Plateau Curve

The mapped characteristic curve (Fig. 67, item 2) of the last complete plateau measurement is displayed in the submenu "Plateau curve".



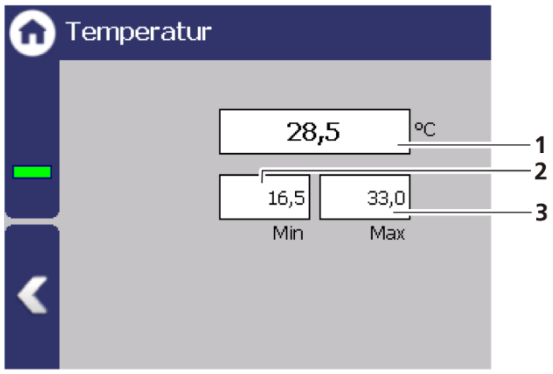
1 Date and time of measurement recording
2 Characteristic curve

Fig. 67 Plateau Curve

Detector: Temperature

Expert Setup | Setup | Sensors | [NAME DETECTOR] | Temperature

The current temperature (Fig. 68, item 1) and extreme values (Fig. 68, item 2, item 3) of the detector is displayed in the submenu “Temperature”.



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

Fig. 68 Temperature display of the detector

Detector settings: High voltage

Device Setup | Setup | Sensors | [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.

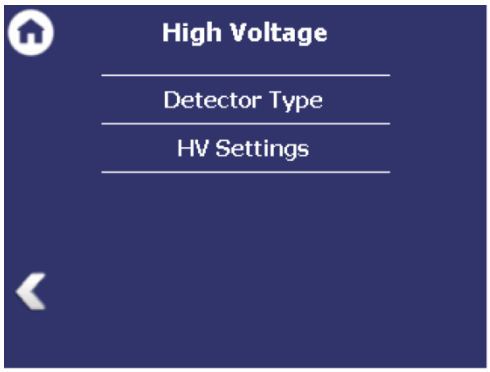
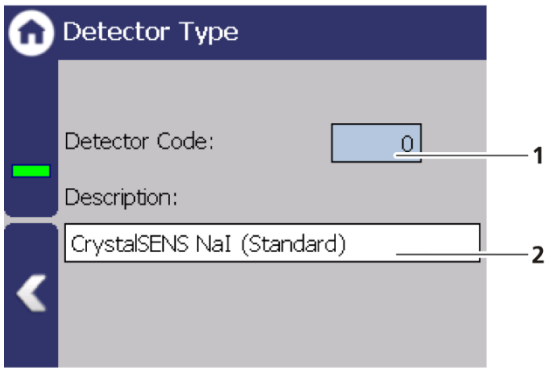


Fig. 69 Submenu "High voltage"

Detector: High Voltage - Detector Type

Expert Setup | Setup | Sensors | [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.

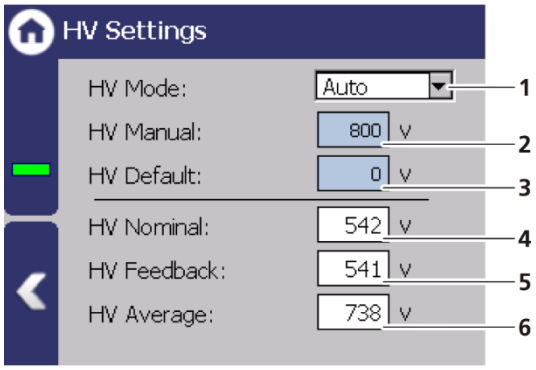


1 Input field Detector code
2 Description of the scintillator type

Fig. 70 Detector Type: Setting the scintillator type

Detector settings: High Voltage - HV Settings

Expert Setup | Setup | Sensors | [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 setting value high voltage
5 Display actual value high voltage
6 Display average high voltage

Fig. 71 Overview 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

The use of the "Manual" as a normal operating mode for high-voltage control is not recommended by Berthold. "Manual" should only be used for service purposes.

Make HV Settings

1. Click on the selection arrow (Fig. 71, 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. 71, item 2).

2. Click in the input field "HV Default" (Fig. 71, item 3) to open the input field.
3. Enter the desired starting value for the high-voltage regulation.
4. Confirm with the Enter key.

Detector: Pt100

Expert Setup | Setup | Sensors | [NAME DETECTOR] | Pt100

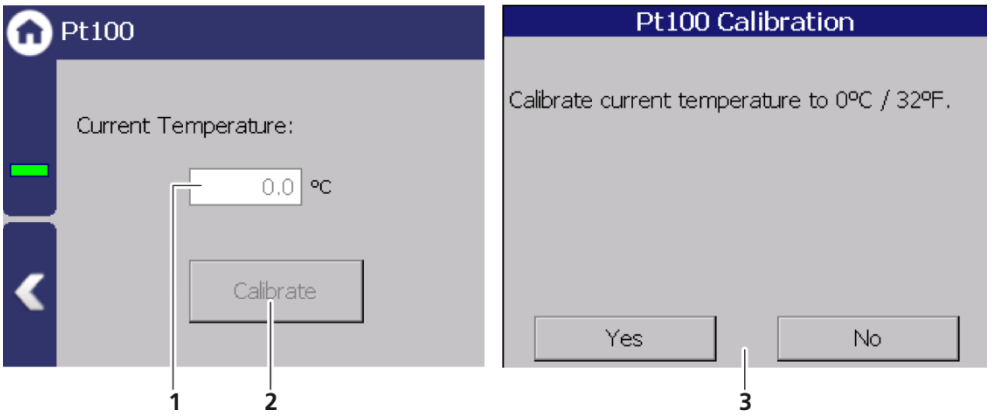
The current temperature of the measuring probe is displayed for the connected Pt 100 measuring probe. In this submenu. In addition, the Pt100 input can be calibrated.

IMPORTANT

The product temperature must be recorded for temperature compensation. This is carried out either by the measuring probe (Pt100) or by the infeed of the product temperature as a current signal 0/4 - 20 mA.

NOTICE

The temperature measurement must be carried out in such a way that the measured temperature is as similar as possible to the product temperature at the density measuring point. Observe the details for installation of the Pt100 in the detector operating manual.



1 **Display box current temperature °C**
2 **Button "Calibrate"**
3 **Window "Pt100 Calibration"**

Fig. 72 Pt100

Detector: Detector Service

Expert Setup | Setup | Sensors | [NAME DETECTOR] | Detector Service

You can adjust the following settings and read information in the submenu "Service" of the individual detector:

- Device information
- Event Log
- Event Overview
- Reset Detector

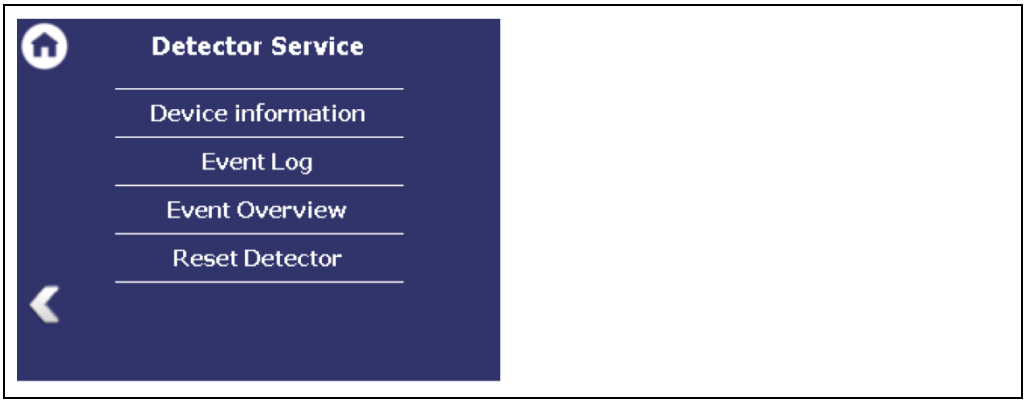
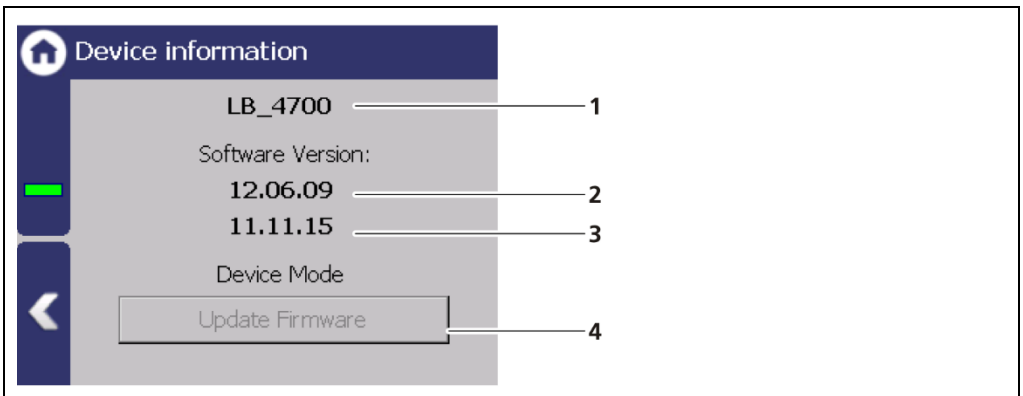


Fig. 73 Menu "Detector Service"

Detector: Detector Service - Device information

Expert Setup | Setup | Sensors | [NAME DETECTOR] | Detector Service | Device Information

This submenu shows you the type of detector (Fig. 74, item 1) as well as an overview of the software version (Fig. 74, item 2, item 3) of the detector.



1 **Detector type**
2 **Software version x**
3 **Software version**
4 **Button** <Firmware Update>

Fig. 74 Device information

NOTICE

An update of the firmware of the detector may takes about an 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.

Perform firmware update

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. 5, item 5).
3. The USB storage device is recognised by the system after a few seconds and the <Firmware Update> (Fig. 74, item 4) button can be clicked.
4. Click on the button <Firmware Update> (Fig. 74, item 4).
5. The update is performed.

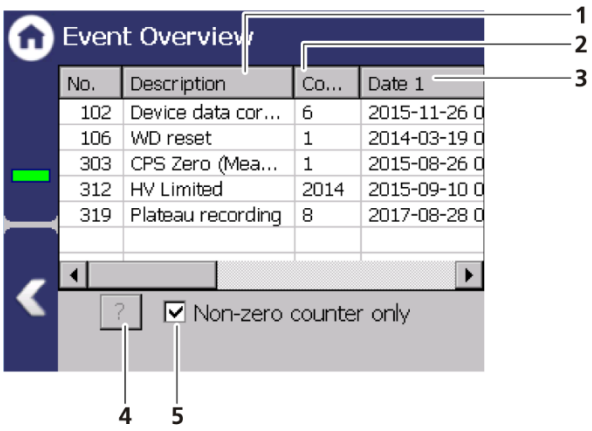
NOTICE

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

Detector: Service - Event Log

Expert Setup | Setup | Sensors | [NAME DETECTOR] | Service | Event log

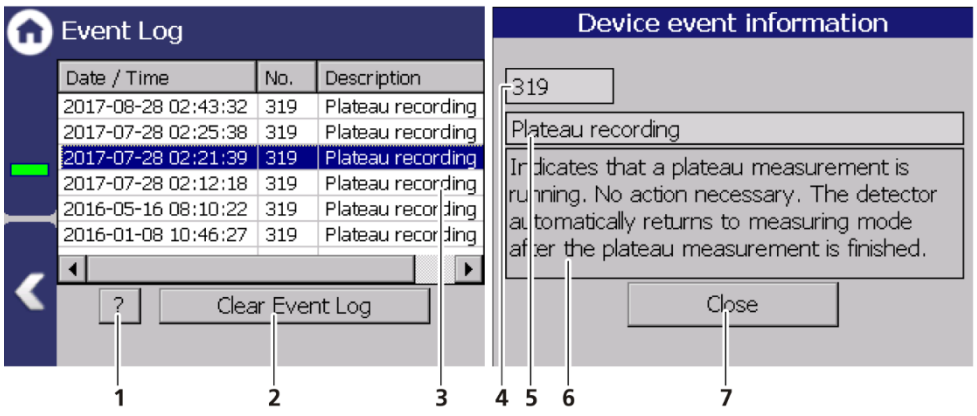
The last 25 events of the detector are displayed in the submenu "Event Log".



1 **Date / time of the event**
2 **Event no.**
3 **Info (event title)**
4 **Button <?> to display the detailed event description.**
5 **Button <Delete event log>**

Fig. 75 Event Log

Display event description



1 **Button <?>**
2 **Button <Clear Event Log>**
3 **Highlighted event**
4 **Event no.**
5 **Event title**
6 **Event description**
7 **Button <Close>**

Fig. 76 Event Log

1. Click on a line in the list (Fig. 76, item 3).
2. Click on <? > (Fig. 76, item 1)

▶ The event description appears.

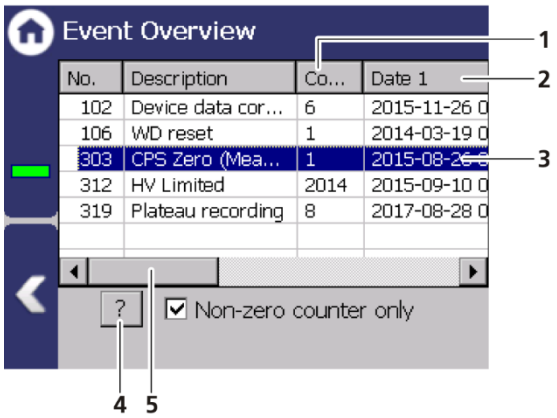
3. Close the event description (Fig. 76, item 7) with the button <Close>.

▶ With the button <Clear event log> (Fig. 76, item 2) all events are deleted.

Detector: Service - Event Overview

Expert Setup | Setup | Sensors | [NAME DETECTOR] | Detector Service | Event Overview

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



1	"Number" column	4	Button < ? >
2	"Date" column	5	Horizontal scroll bar
3	Event line	6	Check box "Non-zero counter only "

Fig. 77 Event overview

1. Click on a line in the list (Fig. 77, item 4).
2. Click on <? > (Fig. 77, item 7).

▶ The event description appears.

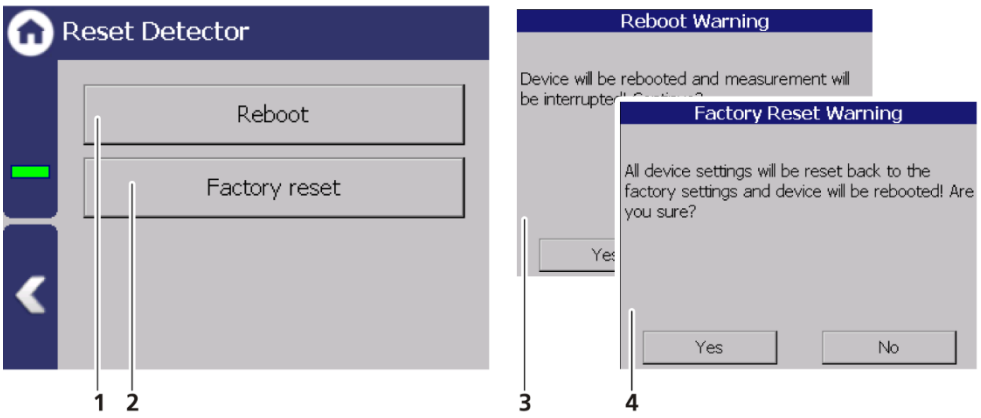
3. Close the event description with the button <Close>.
4. Slide the bar of the horizontal scroll bar (Fig. 77, item 6) to the right to see at what times (date, time) the event occurred.

▶ The last 5 times (dates 1 to 5) are displayed.

Detector: Service - Reset Detector

Expert Setup | Setup | Sensors | [NAME DETECTOR] | Detector Service | Reset Detector

In “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. 78 Reset Detector

IMPORTANT

The measurement is interrupted during a restart!

1. To restart the detector, click the button <Restart> (Fig. 78, item 1).
   - A window with a warning "Restart" (Fig. 78, 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 settings> (Fig. 78, item 2).
   - A window with the warning Factory settings (Fig. 78, item 4) opens.
2. Click on <Yes> to confirm.
   - The device is reset to factory settings and restarts.

9.3.3 Measurement

Expert Setup | Setup | Measurement

The submenu "Measurement" is used for an overview and configuration of the measurement parameters and calibration settings used.

NOTICE

Material damage to the device or the system!

Errors in the measurement settings 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.

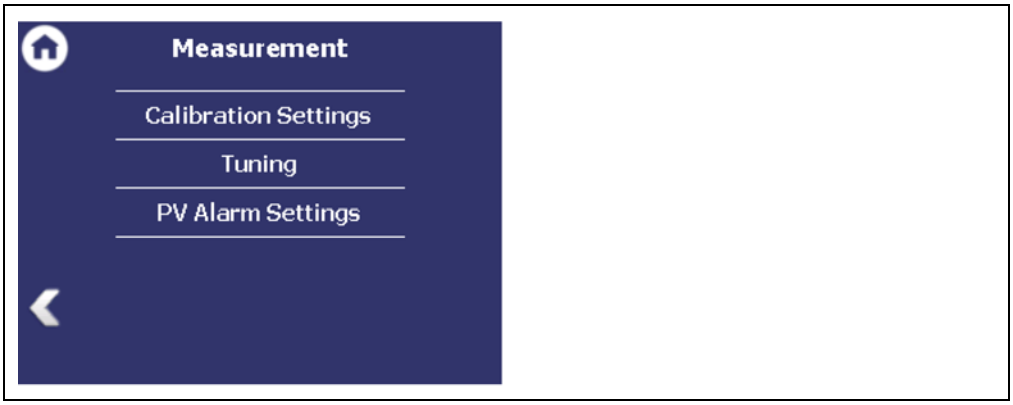


Fig. 79 Menu "Measurement"

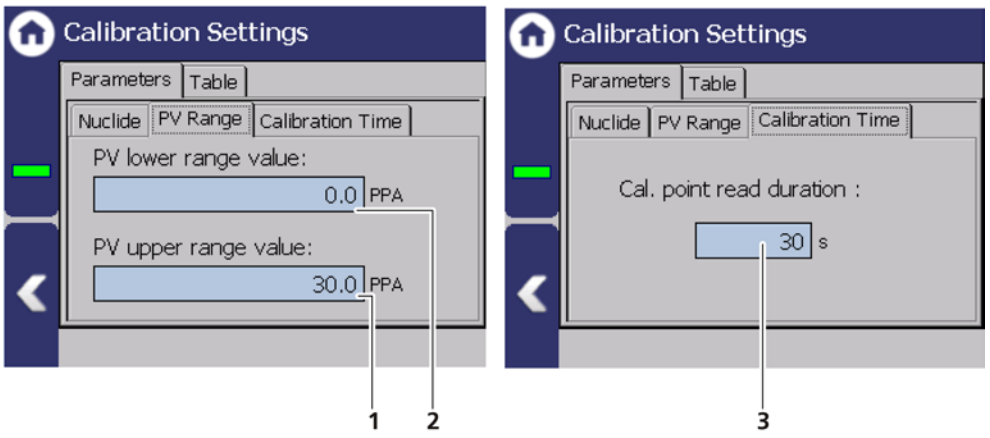
Calibration Settings

Expert Setup | Setup | Measurement | Calibration Settings

In the submenu "Calibration Settings" you can set the PV Range and the calibration time. In the tab "Table" the two calibration points can be viewed and changed.

Calibration Settings: Parameters

Expert Setup | Setup | Measurement | Calibration Settings: Parameters



1 Input field "PV lower range value"
2 Input upper "PV lower range value"
3 Input field "Cal. Point read duration"

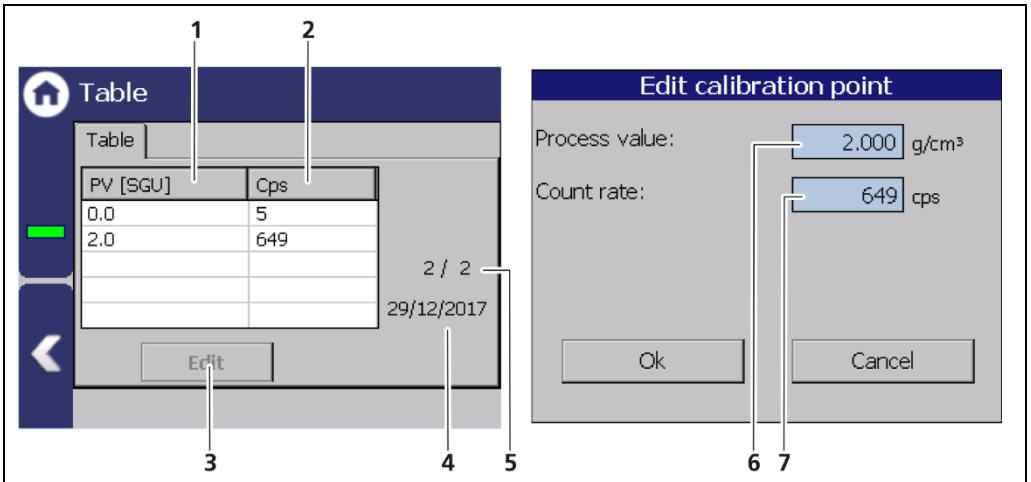
Fig. 80 Calibration settings: Nuclide

PV lower range value	Lower limit of the measuring range. Is also used as lower limit of the current output during calibration. These can subsequently be adjusted separately.
PV upper range value	Upper limit of the measuring range. Is also used as lower limit of the current output during calibration. These can subsequently be adjusted separately.
Cal. Point read duration	This duration is used when reading in the two calibration points.

Table

Expert Setup | Setup | Measurement | Calibration Settings: Table

The determined calibration points are displayed in the menu. “Table”. The values for PV and CPS can be changed with the button “Edit”.



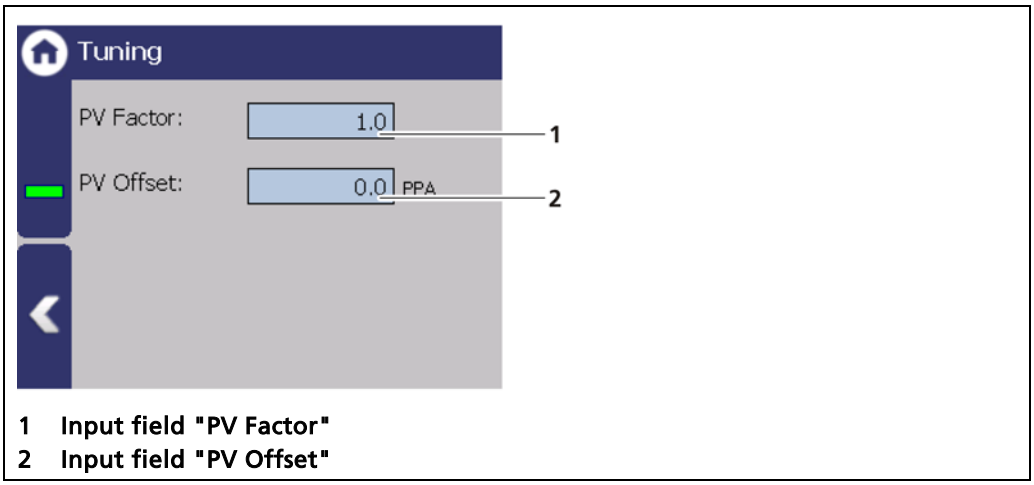
1 PV [Unit]
2 Cps (Counts per second)
3 Button <Edit>
4 Date of determination
5 Calibration points
6 Process Value
7 Count rate

Fig. 81 Expert Setup Menu “Table”

Tuning

Expert Setup | Setup | Measurement | Tuning

In the Menu Tuning fine adjustments can be made.



1 Input field "PV Factor"
2 Input field "PV Offset"

Fig. 82 Measurement set Tuning

PV Factor A multiplicative factor (0 to 10) can be entered here for the correction of the measured values. Each measured value is multiplied by this value. The slope of the curve can thus be changed. The value is automatically set to "1.0" if the calibration curve is recalculated.

PV Offset For additive correction of the measured values. A parallel shift of the curve is thus possible. The value entered here is added for each measurement. The value is automatically set to "0.0" if the calibration curve is recalculated.

IMPORTANT

The values "PV Factor" and "PV Offset" of the current measurement set can be changed in the submenu "Signal processing".

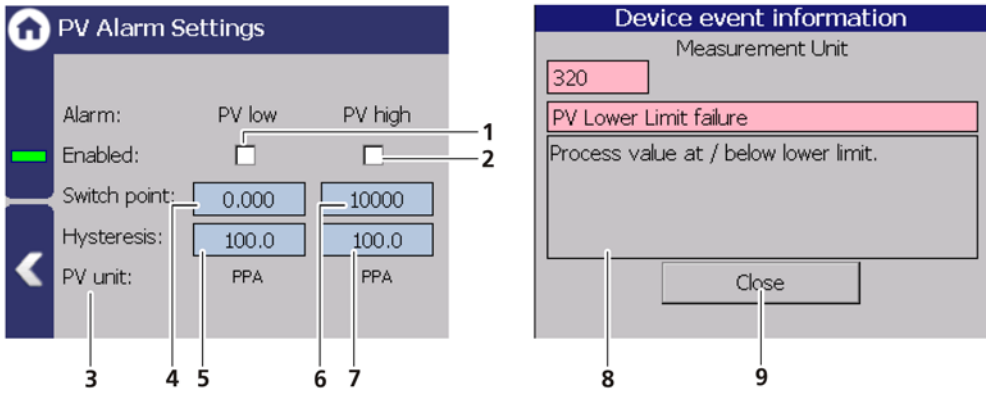
PV Alarm Settings

Expert Setup | Setup | Measurement | PV Alarm Settings

You can set the values for change (max. and min.) and its hysteresis for the measurement set (Fig. 98, item 9) used in the submenu "PV alarm settings".

When there is exceeding or falling below the switching point, an event message appears in the status display. If a digital output "min. value" or "max. value" is assigned under the function, the relay switches.

The PV unit (Fig. 83, item 3) is displayed that is selected in the menu Expert Setup | Setup | System | Units in the box "PV Units".



1 **Check box "PV low"**
2 **Check box "PV high"**
3 **PV unit**
4 **Input field switch point min.**
5 **Input field "Hysteresis min."**
6 **Input field switch point max.**
7 **Input field "Hysteresis min."**
8 **Event description "PV Lower limit"**
9 **Button** <close>

Fig. 83 PV Alarm Settings

9.3.4 Signal Condition

Expert Setup | Setup | Signal Condition

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

- Damping (Time constant)
- PV Range
- Tuning

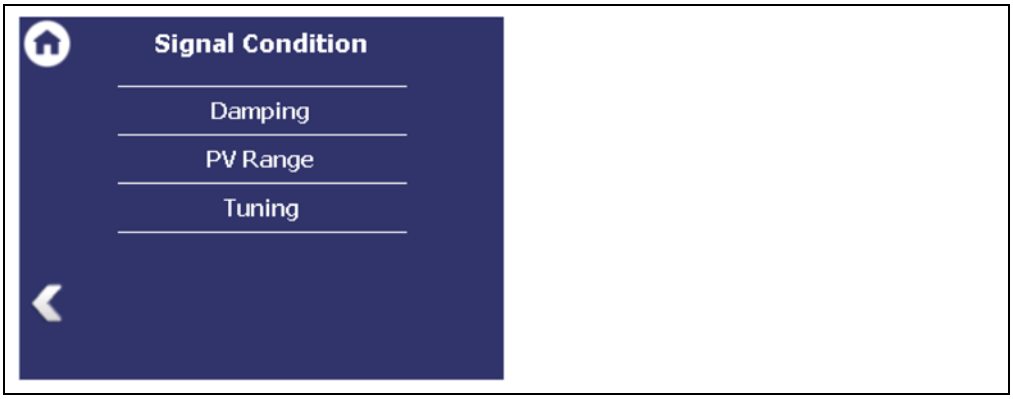


Fig. 84 Signal Condition

Signal Condition: Damping

Expert Setup | Setup | Signal Condition | Damping

The reaction time of the measured value display (standard display) can be set in the “Damping” submenu. The measurement reacts quickly to rapid process changes at a small time constant (min. 1 second). The measurement reacts correspondingly slower with a large time constant. The stronger filtering reduces the statistical error at a larger time constant and thus smooths the fluctuations in the measuring signal.

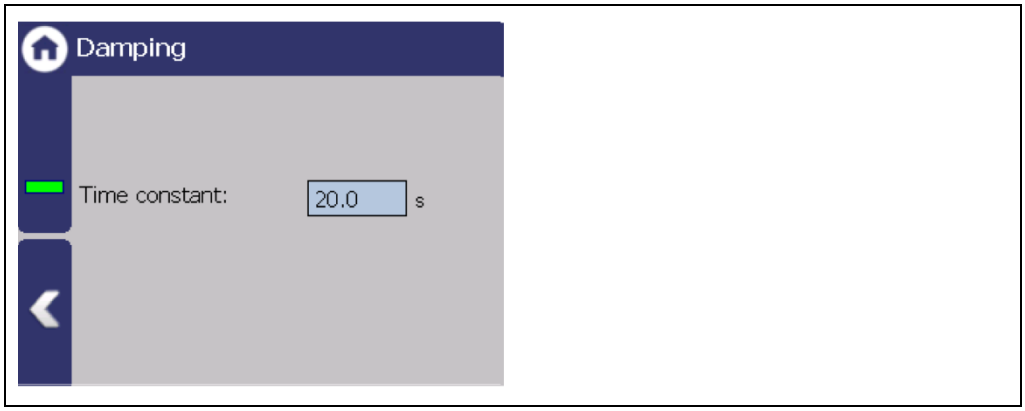


Fig. 85 Signal processing (Damping)

1. Click on the input field to change the time constant.
2. Confirm the value with the Enter key.

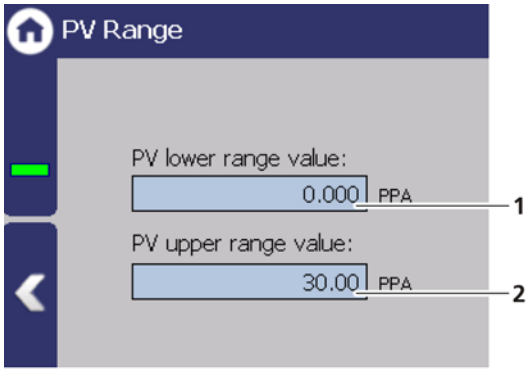
▶ The time constant has been changed.

Signal Condition: PV Range

Device Setup | Setup | Signal Condition | PV Range

The lower and upper limit of the process range of the active measuring parameter set can be set in the tab “PV Range” (Process Value Range). These limits define the signal range of the analog current output (0/4 ... 20 mA).

The PV unit is displayed that is selected in the menu Expert Setup | Setup | System | Units in the box "PV Units".



1 Input field min. process value
2 Input field max. process value

Fig. 86 Signal processing (PV Range)

1. Click on the input box (Fig. 86, item 1) to enter the process value that is intended to correspond to an output current of 0/4mA.
2. Confirm with the Enter key.

▶ The value has been changed.

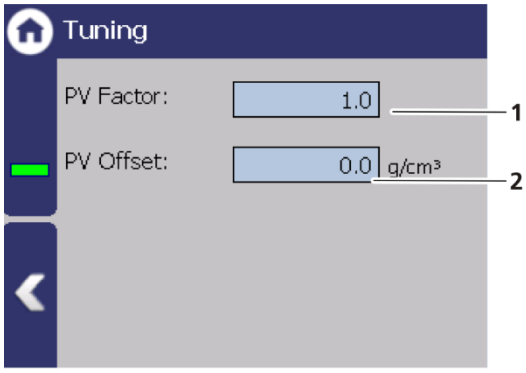
3. Click on the input box (Fig. 86, item 2) to enter the process value that is intended to correspond to an output current of 20mA.
4. Confirm with the Enter key.

▶ The value has been changed.

Signal Condition: Tuning

Device Setup | Setup | Signal Condition | Tuning

In the Menu Tuning fine adjustments can be made.



1 Input field "PV Factor"
2 Input field "PV Offset"

Fig. 87 Measuring set submenu "Tuning"

PV Factor	A multiplicative factor (0 to 10) can be entered for the correction of the measured values here. Each measured value is multiplied by this value. The slope of the curve can thus be changed. The value is automatically set to "1.0" if the calibration curve is recalculated.
PV Offset	For additive correction of the measured values. A parallel shift of the curve is thus possible. The value entered here is added for each measurement. The value is automatically set to "0.0" if the calibration curve is recalculated.

9.3.5 Inputs

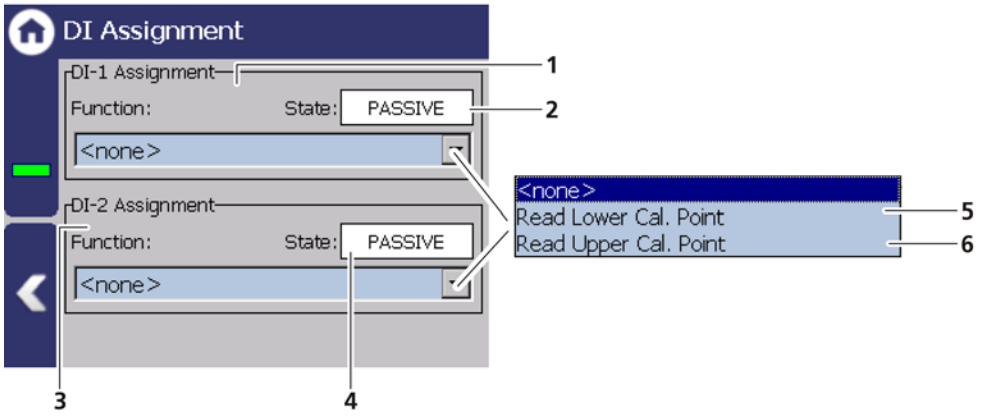
Expert Setup | Setup | Inputs

Fig. 88 Menu “Inputs”

Digital inputs: DI Assignment

Expert Setup | Setup | Inputs | DI Assignment

The menu Assignment determines which function is executed when the digital input is switched.



1 Field DI-1 assignment
2 DI-1 assignment state
3 Field DI-2 assignment
4 DI-2 assignment state
5 Selection “Read Lower Cal. Point”
6 Selection “Read Upper Cal. Point”

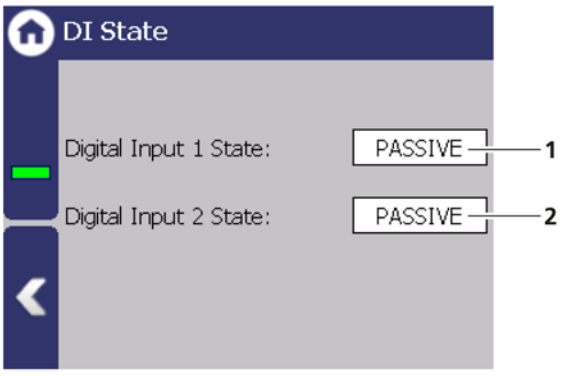
Fig. 89 DI Inputs Assignment

If the assignment state is "ACTIVE" (Fig. 89, item 2, item 4), the selected function is carried out. The active condition is created by closing the digital input.

DI State

Expert Setup | Setup | Inputs | DI State

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



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

Fig. 90 DI State

9.3.6 Outputs

Expert Setup | Setup | Outputs

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

- Analog Output (AO)
  - AO Mapping
  - AO monitoring
  - AO Failure mode
  - AO Limits
  - AO Calibration
- Digital Outputs (DO)
  - DO Assignment
  - DO Settings

Fig. 91 Menu “Outputs”

Analog Outputs

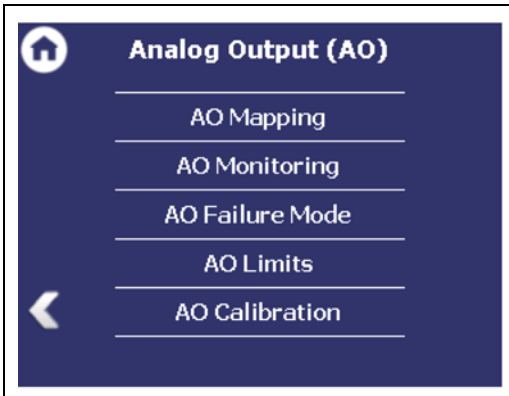
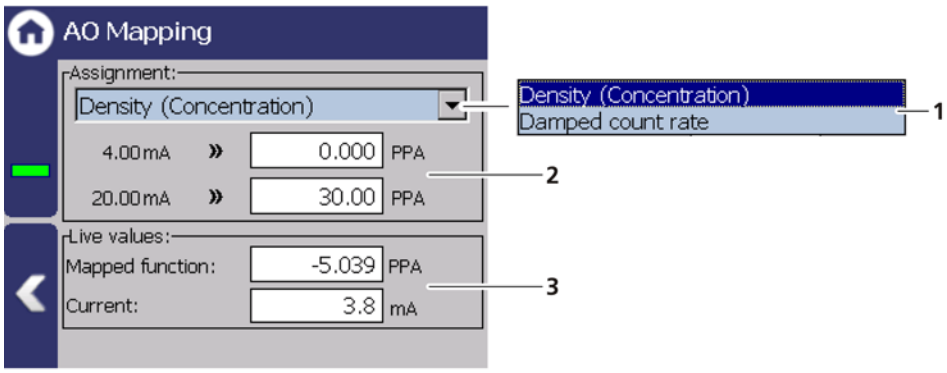


Fig. 92 Menu "Analog Output (AO)"

Analog Output: Mapping

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

A function can be assigned to an analogue output in the submenu "AO Mapping". The current output signal is between 0/4 mA and 20 mA.



1 Selection Density / Damped count rate
2 Assignment
3 Live Values

Fig. 93 Analog output (Mapping)

The value which is assigned to a current output signal of 0/4 mA must be less than the value which is assigned to 20 mA.

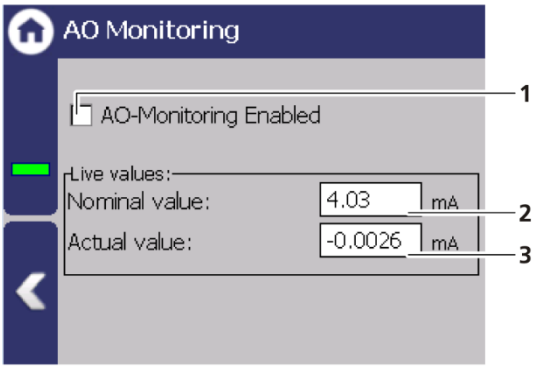
Density (Concentration)	The values of the density can be assigned in the menu Signal Condition | PV Range or in the calibration settings.
Damped count rate	Input of a count rate range which outputs the averaged counting rate at the current output.

Analog Output: Monitoring

Expert Setup | Setup | Outputs | Analog Output (AO) | AO Monitoring

If "AO Monitoring Enabled" is activated (Fig. 92, 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.



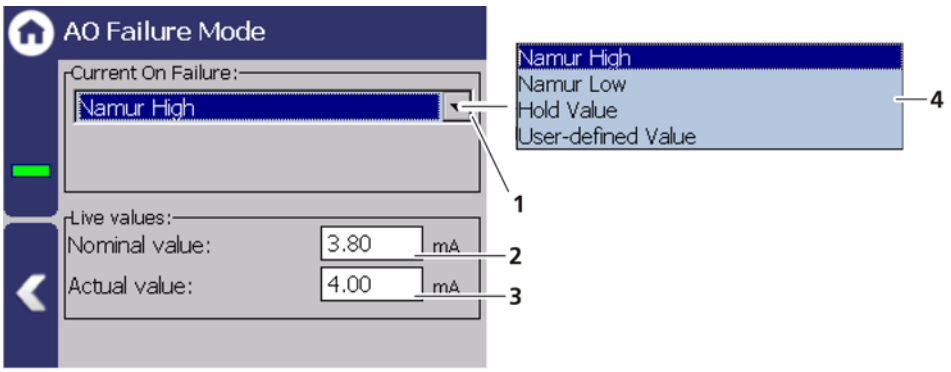
1 Activate selection box AO monitoring enabled
2 Target value [mA]
3 Actual value [mA]

Fig. 94 Analog Output Monitoring

Analog Output: Failure Mode

Expert Setup | Setup | Outputs | Analog Output (AO) | AO Failure Mode

The alarm function is set when an error is detected at the current output in the submenu "Error mode".



1 Selection arrow Alarm function
2 Nominal live values [mA]
3 Actual live values [mA]
4 Selection of the alarm function

Fig. 95 Analog Output (AO Failure Mode)

The following behaviour 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.

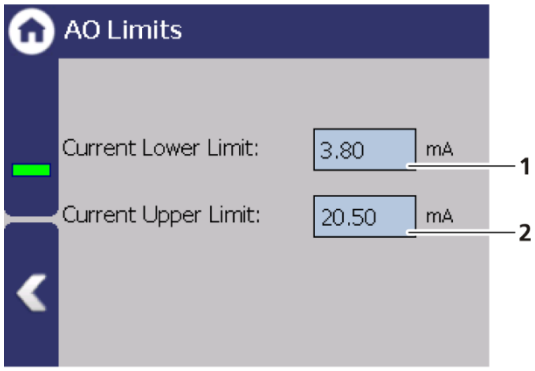
NOTICE

In the setting "Hold Value" we recommend that the error relay is connected to allow equipment errors to be transferred to the control system

Analog Output: AO Limits

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

The values [mA] for the lower and upper current limit can be set by clicking on the entry fields (Fig. 96, item 1, item 2). Alongside the default value 3.8 mA, the lower current limit can be set to 0 mA 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. 96 Analog Output (AO Limits)

NOTICE

If the measurement is operated in accordance with Namur, the standard current values 3.8 and 20.5 mA must be retained.

Analog Output: Calibration

Expert Setup | Setup | Outputs | Analog Output (AO) | AO Calibration

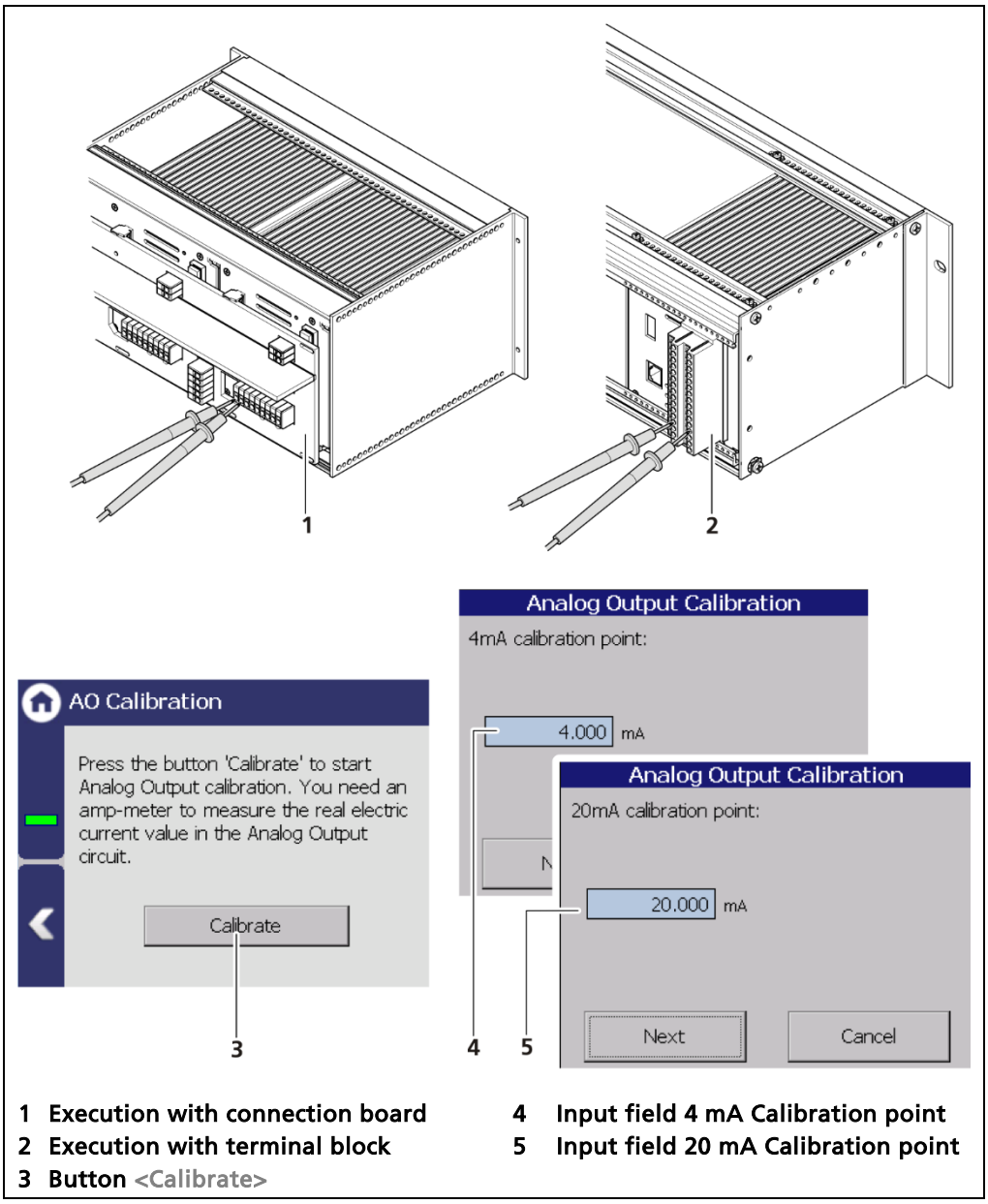
If there are any discrepancies between the target value and the actual value of the current signal, then the current output may be calibrated again.

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.

NOTICE

Berthold recommends a check or calibration the current outputs whenever a software update has been carried out.



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

Fig. 97 Analog Output (calibration)

Performing AO calibration

⚠ DANGER !

Danger to life from electric shock!

- The calibration must only be carried out by qualified electricians.
- Please adhere to the relevant safety regulations.
- Open the housing only in a dry environment and for installation, maintenance and servicing.
- 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.

1. Connect the measuring lines of the current measuring device on the back of the EVU to the analog output.
2. Observe the terminal allocation in Chapter 5.4.1 or Chapter 5.5.1 for executions with terminal panels (Fig. 97, item 1) or allocation with terminal block (Fig. 97, item 2).
3. 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.

4. Enter the indicated value on the current measuring instrument in the input box (Fig. 97, item 4).
5. Click on the button <Continue>.

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

6. Enter the indicated value on the current measuring instrument in the input box (Fig. 97, item 5).
7. Click on the button <Continue>.

- A message appears “Calibration successful”.

8. Click on the button <Continue>.

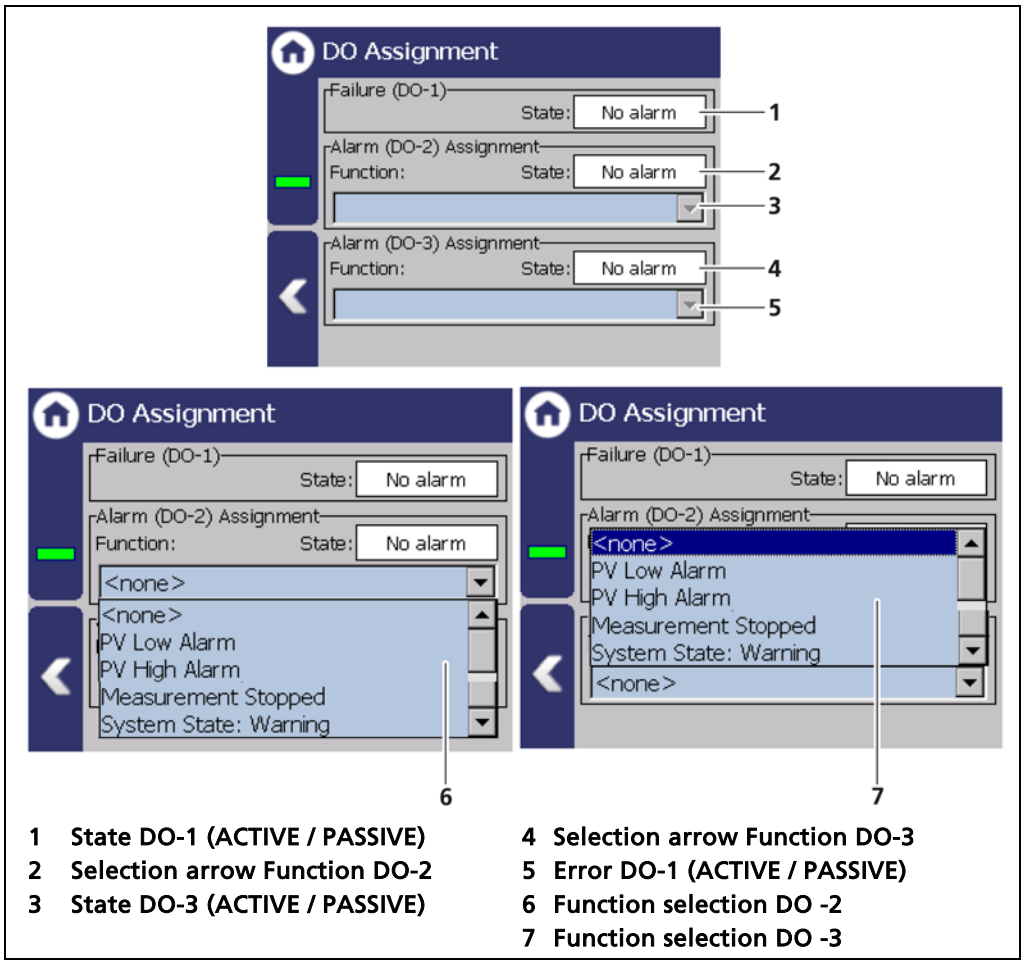
- The calibration of the analog output is concluded.

Digital Outputs (DO)

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

The signals of the digital outputs are switched via potential-free relay contacts. The contacts are controlled "fail safe", ie, 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 chapter 5 show the relay contacts in the de-energized state.

You can set the two different alarm signals for the alarm relays in the submenu Digital outputs (DO).



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

Fig. 98 DO Assignment

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

PV Low alarm	The relay switches when the value at Device Setup	Setup	Alarms	PV alarm settings is underrun.
PV High alarm	The relay switches if the value under Device Setup	Setup	Alarms	PV Alarm Settings is exceeded.
Detector Temperature Alarm	The relay switches when values set at Device Setup	Setup	Alarms	Det.-Temp. Alarm function are exceeded or underrun.

Measurement stopped	The relay switches in tests or other states where the measurement is stopped. For example, Simulation, plateau measurement, and detector update.
System state: Warning	The relay switches if the event message "Warning" is displayed.

9.3.7 Alarms

Device Setup | Setup | Alarms

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

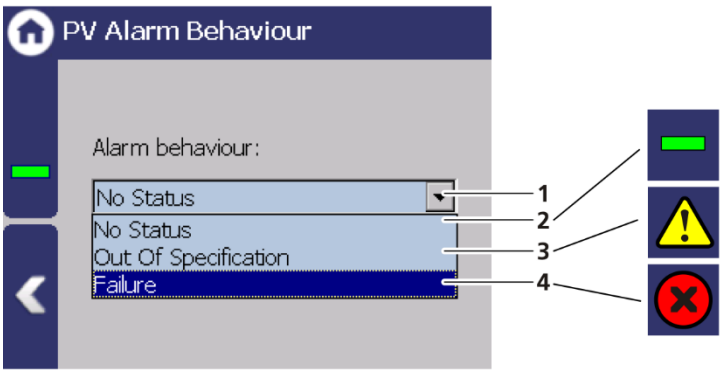
- PV Alarm behaviour
- PV Alarm settings
- Det.-Temp. Alarm Behaviour
- Det.-Temp. Alarm Settings

Fig. 99 Menu "Alarms"

PV Alarm Behaviour

Device Setup | Setup | Alarms | PV Alarm Behaviour

The behaviour in case of alarm (NE107 status) for the process value can be set in the submenu "PV alarm Behaviour" .



1 Selection arrow NE107 Status
2 Selection "No Status" (no Event Viewer, relay switching)
3 Selecting "Out of specification" (Event Viewer, relay switching)
4 Selection "Failure" (Event Viewer, relay switching)

Fig. 100 Submenu "PV Alarm Behaviour"

NOTICE

If the PV alarm function is set to "Failure", the measurement for the occurrence of a PV alarm is switched to the error current. Monitoring of the PV in the display is therefore no longer possible.

PV alarm settings

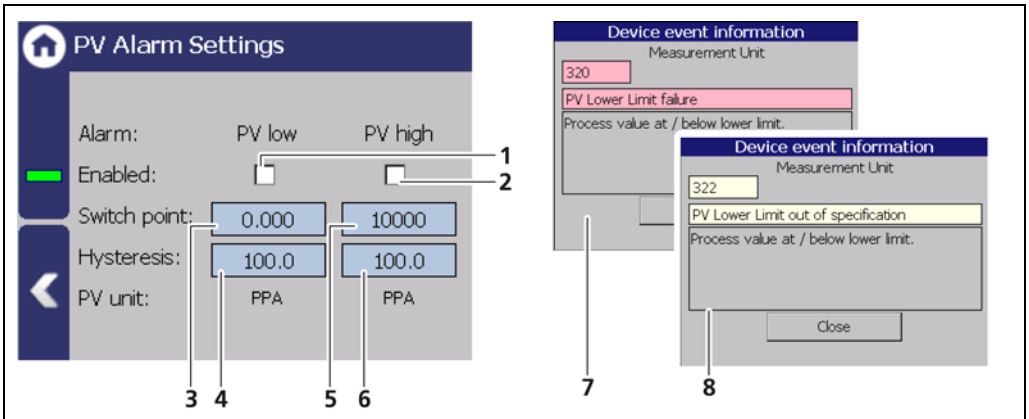
Expert Setup | Setup | Alarms | PV alarm settings

In the submenu "PV Alarm Settings" you can set the values for the Process Range alarm thresholds (max. and min.) and their hysteresis.

If a status is selected in the menu PV Alarm Behaviour, a corresponding event message appears if the switching point is exceeded or if it falls below this point (Fig. 101 item 7, item 8).

If, under "Function" (Fig. 98, item 6, item 7) of a digital output the "Upper PV range" or "Lower PV range" is selected, the relay switches.

Hysteresis is defined as the tolerance range of the alarm trigger which occurs at a predefined threshold of the process range.



1 Selection box "PV low"
2 Selection box "PV high"
3 Input box "Switch point Low"
4 Input box "Hysteresis Low"
5 Input box "Switch point High"
6 Input box "Hysteresis Low"
7 Event message "Error"
8 Event message "Outside the specification"

Fig. 101 Measuring set submenu "PV Alarm Settings"

Example: Tolerance range = 5%, Process range = 20% and 85%

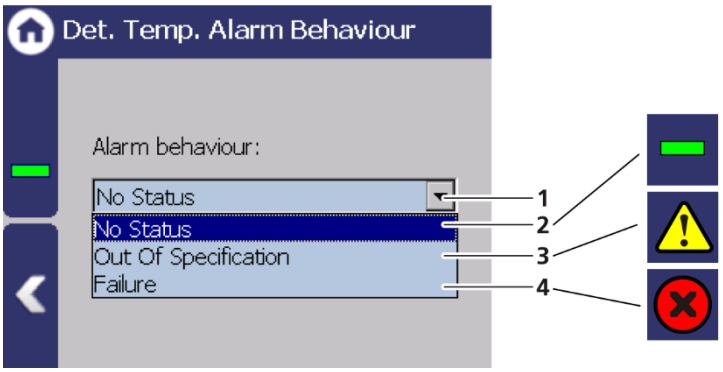
In the event of a rising process range, the max. alarm is triggered when a process range of 85% is exceeded. When the process range falls again, then the alarm does not switch off again until the process range falls below 85% - 5% = 80%.

In the event of a falling process range, the min. alarm is triggered when a process range falls below 20%. When the process range rises again, then the alarm does not switch off again until the process range rises above 20% + 5% = 25%.

Det.-Temp. Alarm Behaviour

Expert Setup | Setup | Alarms | Det.-Temp. Alarm Behaviour

The behaviour in case of alarm (NE107 status) can be set for the detector temperature in the submenu ” DetTemp. Alarm behaviour”.



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

Fig. 102 Submenu ”Det.-Temp. Alarm Behaviour“

NOTICE

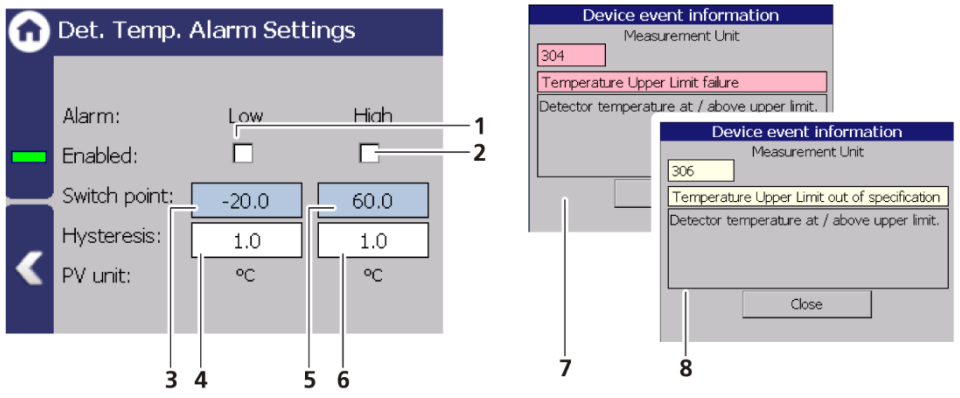
If the detector alarm behaviour is set to "Failure", the measurement is switched in the error current during the occurrence of a temperature alarm. Monitoring of the PV in the display is therefore no longer possible.

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 submenu ”PV Det-Temp. Alarm Settings”.

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



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

Fig. 103 Submenu “Det.-Temp Alarm Settings”

9.3.8 Simulation

Expert Setup | Setup | Simulation

A check for the following functions can be performed in the submenu "Simulation":

- Analog output (AO)
- Digital output (DO)
- Count Rate
- PV

NOTICE

When starting a simulation, the measurement is stopped and a status message TST 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.

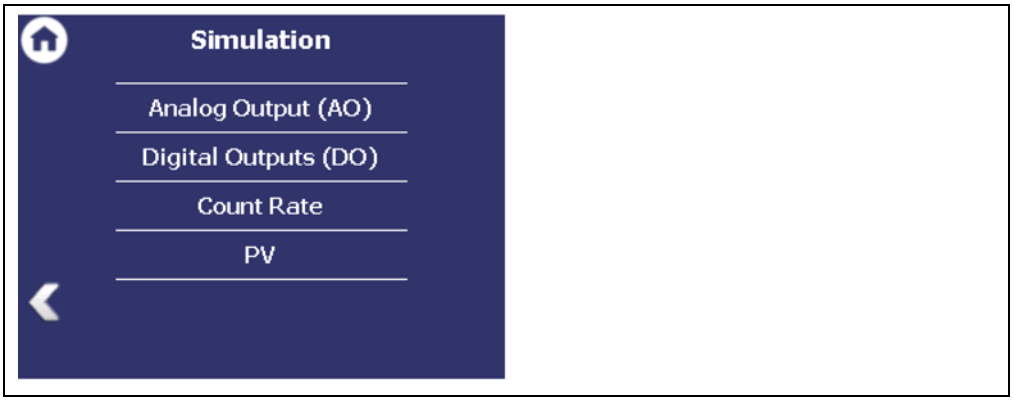
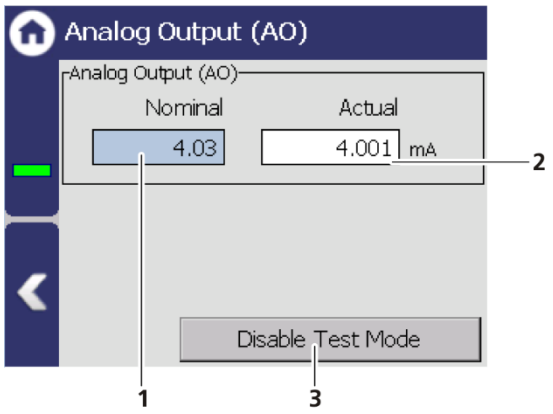


Fig. 104 Menu "Simulation"

Analog output simulation

Expert Setup | Setup | Simulation | Analog Output (AO)



1 **Input field "Target value"**
2 **Display field "Actual value" [mA]**
3 **Button** <Disable Test Mode>

Fig. 105 Analog output simulation

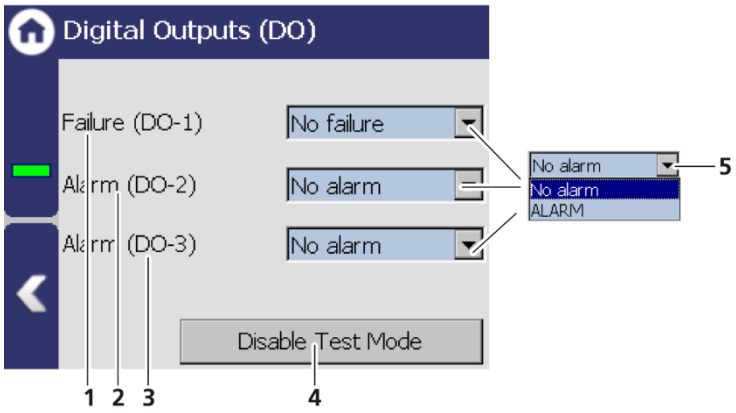
1. Click on the input field (Fig. 105, item 1) and enter the target value for the simulation.
2. Confirm with the Enter key.

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

3. Click on the <Disable Test Mode> button (Fig. 105, item 3) to stop the simulation.

Simulation Digital Output

Device Setup | Setup | Simulation | Digital output (DO)



1 **ERROR (DO-1)**
2 **ALARM (DO-2)**
3 **ALARM (DO-3)**
4 **Button** <Disable Test Mode>
5 **Selection box**

Fig. 106 Simulation Digital Output

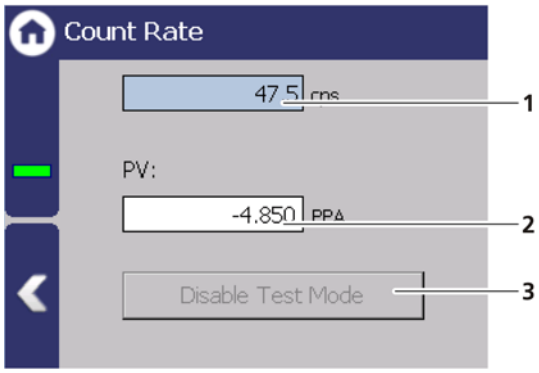
1. Click on the selection field (Fig. 106, item 5) and select “No Alarm” or “ALARM” for the simulation.

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

2. Click on the <Disable Test Mode> button (Fig. 106, item 4) to stop the simulation.

Simulation Count Rate

Device Setup | Setup | Simulation | Count Rate



1 Input field count rate [cps]
2 Display field Process value [unit]
3 Button <Disable Test Mode>

Fig. 107 Simulation count rate

1. Click on the input field (Fig. 107, item 1) and enter count rate for the simulation.

▶ The test is performed, and a system event is displayed. The PV value is displayed in the display field (Fig. 107, item 2).

2. Click on the <Disable Test Mode> button (Fig. 107, item 3) to stop the simulation.

9.4 Menu Backup/Restore

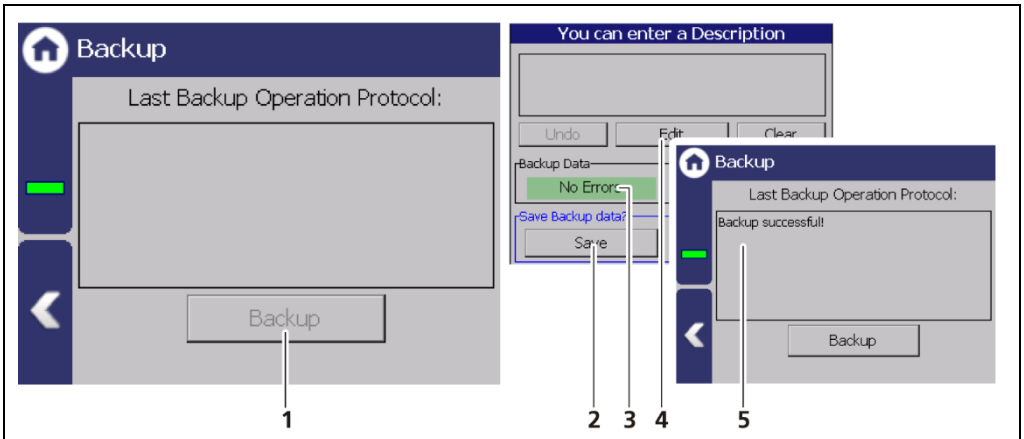
Device Setup | Backup/Restore

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

Fig. 108 Menu Backup/Restore

9.4.1 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. 109 Backup

Perform backup

1. Connect a USB storage device to the device (Fig. 5, item 5).
2. The USB storage device is recognised by the system after a few seconds and the button <Backup> (Fig. 109, item 1) can be clicked.
3. Click on the button <Backup> (Fig. 109, item 1).

▶ The window "You can enter a description" appears.

- The message "Error free" (Fig. 109, item 3) appears in the field "Backup data" for present and error-free backup files.

4. Click the button <Edit>, enter a description, and confirm with the Enter key.
5. Click on the button <Save> (Fig. 109, item 4).

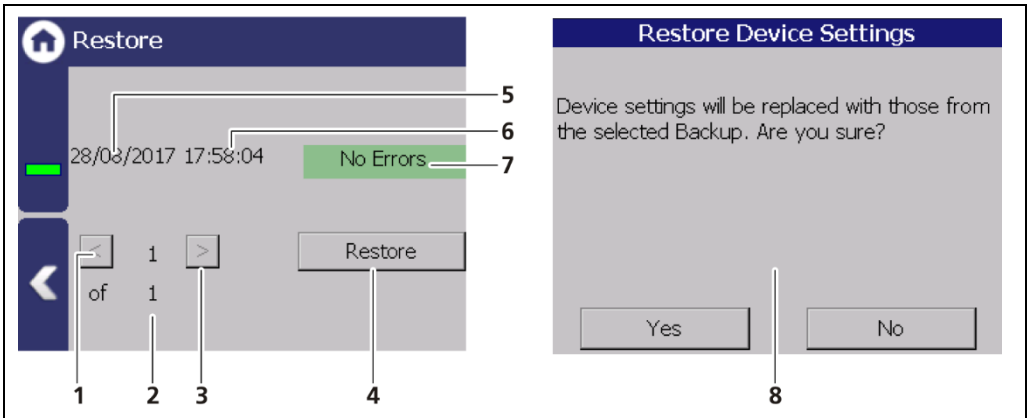
- The backup files are copied to the USB storage device.
- The message "Backup successful!" appears after a successful copy process (Fig. 109, item 5).

Information

The backup includes an XML file that is created in the folder "Backup_LB47xx". The file name is derived from "Backup", the date and time (Backup_YYYYMMDD_hr-min-sec).

9.4.2 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

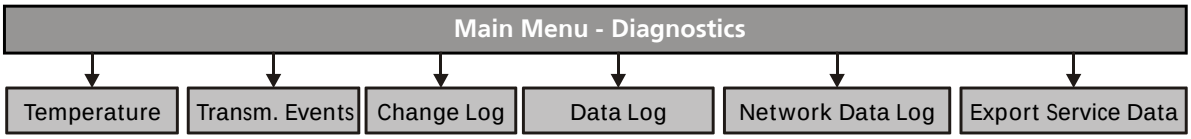
Fig. 110 Restore

Executing restore

1. Connect a USB storage device to the device (Fig. 5, item 5).
2. Select the backup file with the buttons (Fig. 110, item 1,3).
3. The date and time of the backup is displayed (Fig. 110, item 5,6). Only error-free (Fig. 110, item 7) backup files can be loaded.
4. Click on the button "Restore" (Fig. 110, item 4).
5. A confirmation message (Fig. 110, item 8) appears.
6. Click on <Yes> to confirm, click on <No> to cancel.

▶ The restore of data is carried out

10 Main Menu Diagnostics



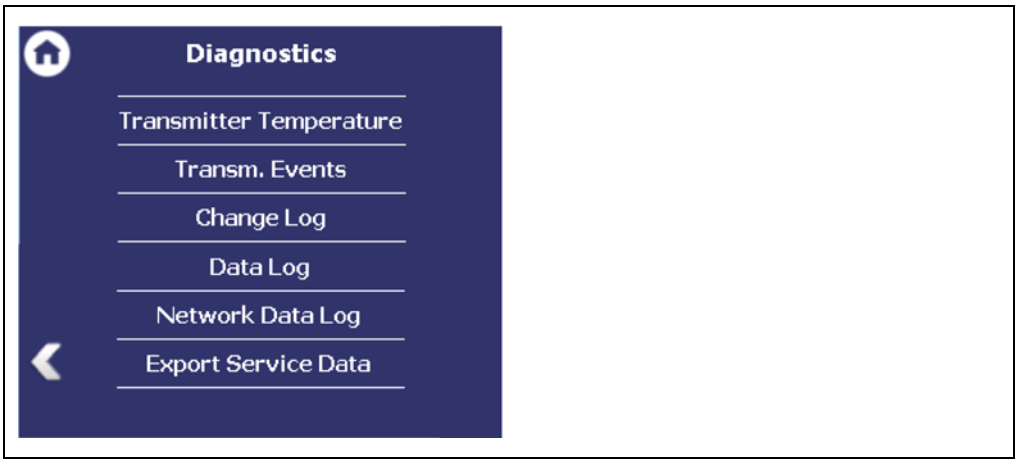
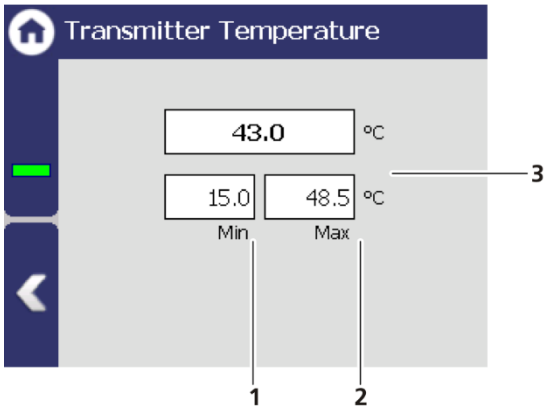


Fig. 111 Menu “Diagnostics”

10.1 Transmitter Temperature

Diagnostics | Transmitter Temperature

Temperature values from the transmitter (processor) are displayed in the menu item ”Temperature”.



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

Fig. 112 Menu " Transmitter Temperature"

10.2 Transmitter Events

Diagnostics | Transmitter Events

Fig. 113 Menu "EVU Events"

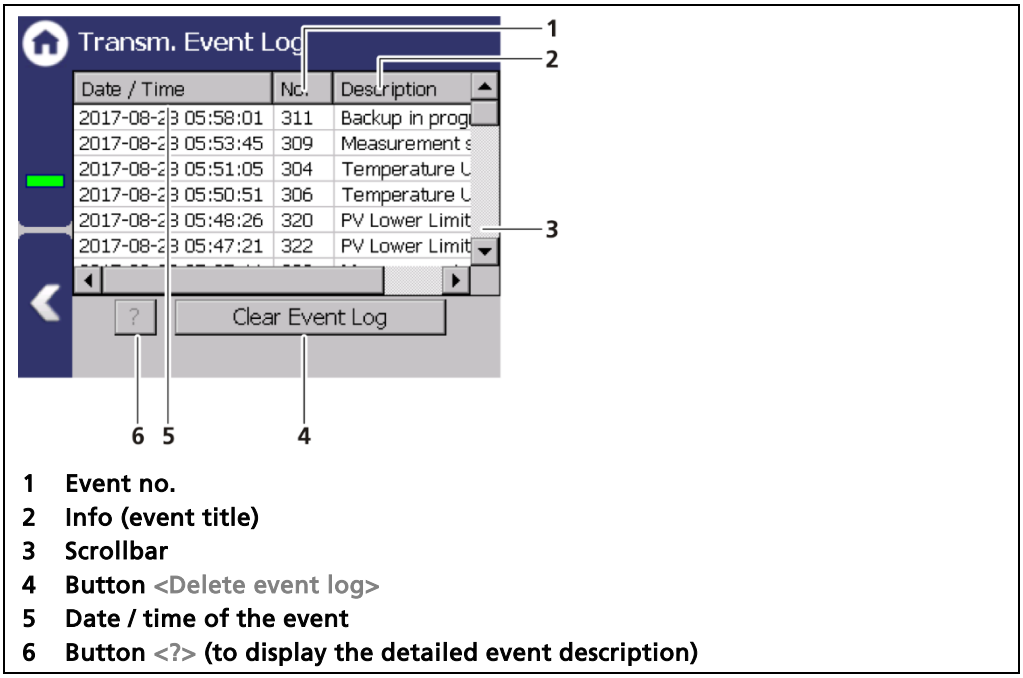
Information

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

10.2.1 Transmitter Event Log

Diagnostics | Transmitter Events | Transmitter Event Log

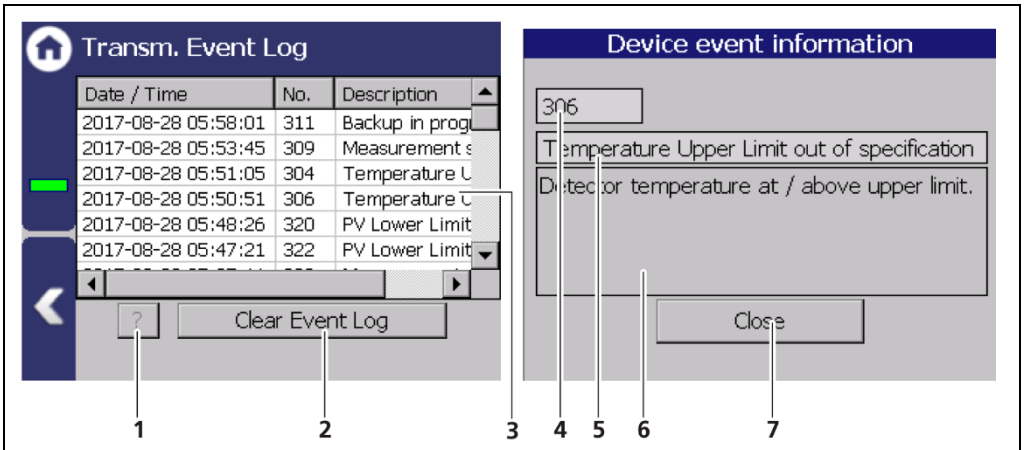
The last 25 events of the detector are displayed in the submenu "Transmitter Event Log".



1 **Event no.**
2 **Info (event title)**
3 **Scrollbar**
4 **Button <Delete event log>**
5 **Date / time of the event**
6 **Button <?> (to display the detailed event description)**

Fig. 114 Transmitter Event Log

Display event description



1 **Button** <?>
2 **Button** <Delete event log>
3 **Highlighted event**
4 **Event no.**
5 **Event title**
6 **Event description**
7 **Button** <Close>

Fig. 115 Transmitter Event Log description

1. Click on a line in the list (Fig. 115, item 3).
2. Click on <?> (Fig. 115, item 1).

▶ The event description appears.

3. Close the event description (Fig. 115, item 7) with the button <Close>.

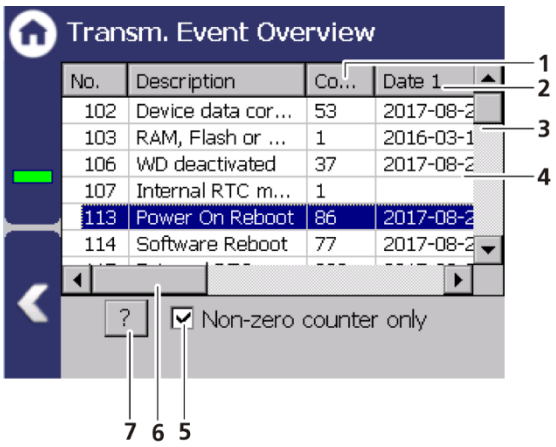
NOTICE

With the button <Delete event log> (Fig. 115, item 2) all events are deleted.

10.2.2 Transmitter Event Overview

Diagnostics | Transmitter Events | Transmitter Event Overview

All events that can be logged are chronologically presented in tabular form in the submenu "Transmitter Event Overview". Activate the selection box "Non-zero counter only" (Fig. 116, item 5) in order only to display events that have occurred.



1 "Number" column
2 "Date" column
3 Vertical scroll bar
4 Event line
5 Selection box "Non-zero counter only"
6 Horizontal scroll bar
7 Button < ? >

Fig. 116 EVU event overview

1. Click on a line in the list (Fig. 116, item 4).
2. Click on <?> (Fig. 116, item 7).

▶ The event description appears.

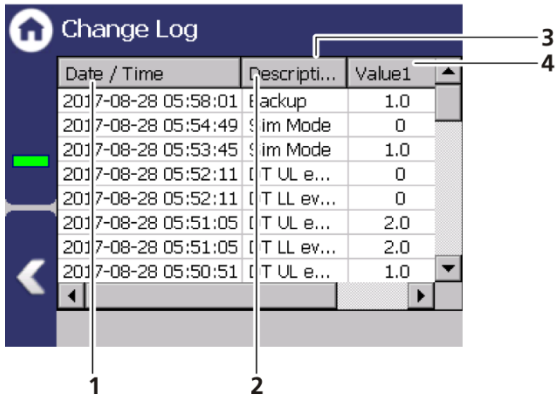
3. Close the event description with the button <Close>.
4. Slide the bar of the horizontal scroll bar (Fig. 116, item 6) to the right to see at what times (date, time) the event occurred.

▶ The last 5 time points are displayed.

10.3 Change log

Diagnostics | Change log

You can track changes that were performed on the device in the submenu “Change log”.



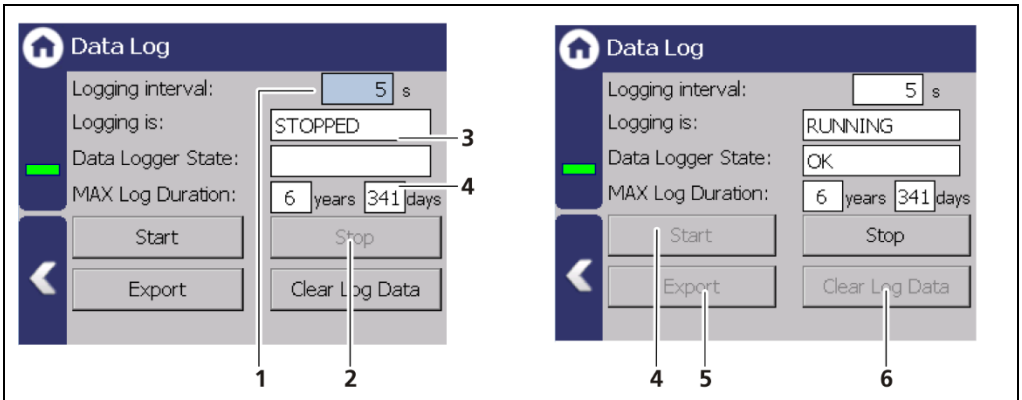
1 Time of the change
2 Short info of the change
3 Old state
4 New state

Fig. 117 Change log

10.4 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".



1 **Input field Log interval [s]**
2 **Button** <Stop>
3 **Display field**
4 **Button** <Start>
5 **Button** <Export>
6 **Button** <Clear Log Data>

Fig. 118 Data log

Change log interval

1. Click on the button <Stop> (Fig. 118, item 2) to stop the data log process.
2. Click on the input field "Logging interval" (Fig. 118, 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. 118, item 4) to start the data log process.

Export log data

1. Click on <Stop> (Fig. 118, item 2).
2. Connect a USB storage device to the device (Fig. 5, item 5).
3. Click on the button <Export> (Fig. 118, Pos5).

- 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).

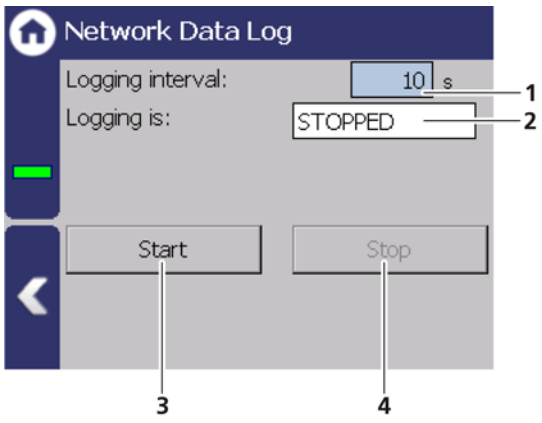
1 Zip file
2 Folder "Year"
3 Folder "Month"
4 File "Tag"

Fig. 119 Folder structure

10.5 Network Data log

Diagnostics | Network Data log

The log files can be transferred over the local network. The EVU use the telnet protocol to send data via the local network. This function must be activated in this menu.



1 **Input field Log interval [s]**
2 **Display field "Started / Stopped"**
3 **Button** <Start>
4 **Button** <Stop>

Fig. 120 Network Data log

Change log interval

1. Click on the button <Stop> (Fig. 120, item 4) to stop the data log process.
2. Click on the input field "Logging interval" (Fig. 120, 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. 120, item 3) to start the data log process.

Data Logger via Network

The data logs can be transferred with an emulation software via the local network. The software writes the logs to a file.

For example, the use of the free software “Tera Term” is described.

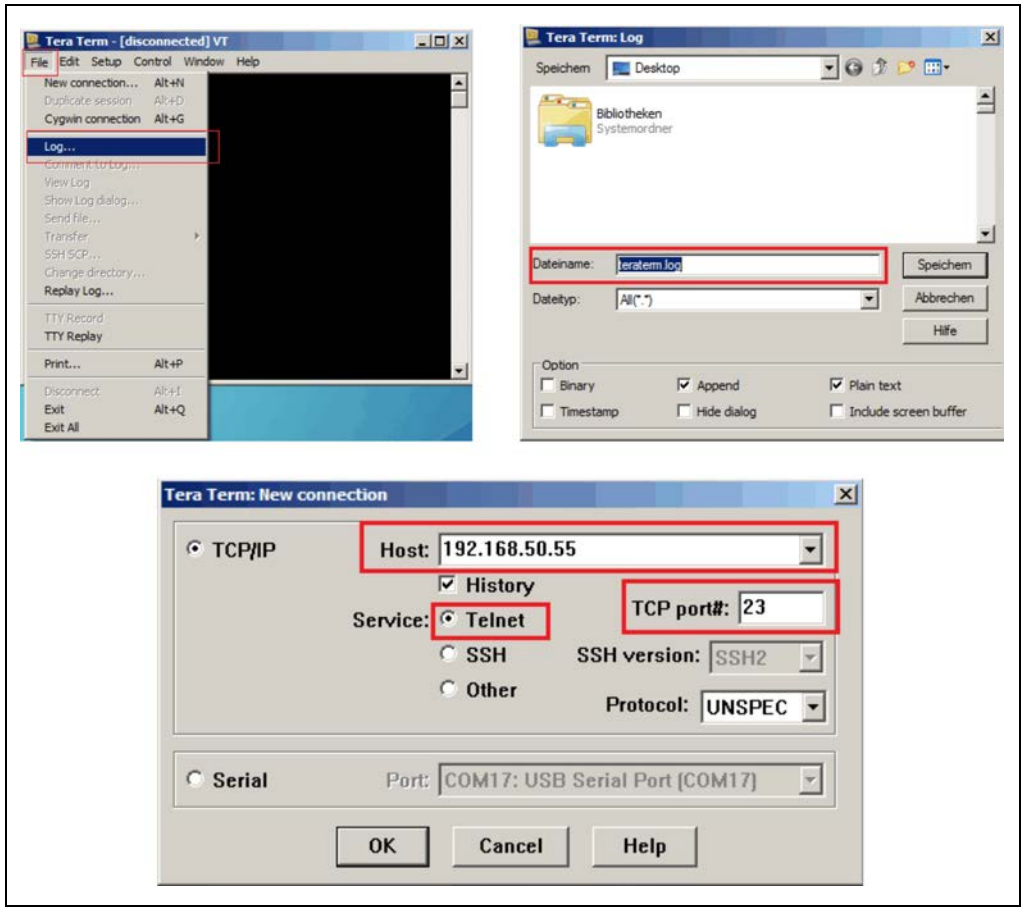


Fig. 121 Software “Tara Term”

1. To transfer the data, the logging must be “STARTED” (Fig. 120, item 2).
2. Install the latest version of "Tera Term".
3. Click "log" in the "File" menu.
4. Enter the location where the log file will be saved and click <OK>.
5. Click on "New Connection" in the "File" menu.

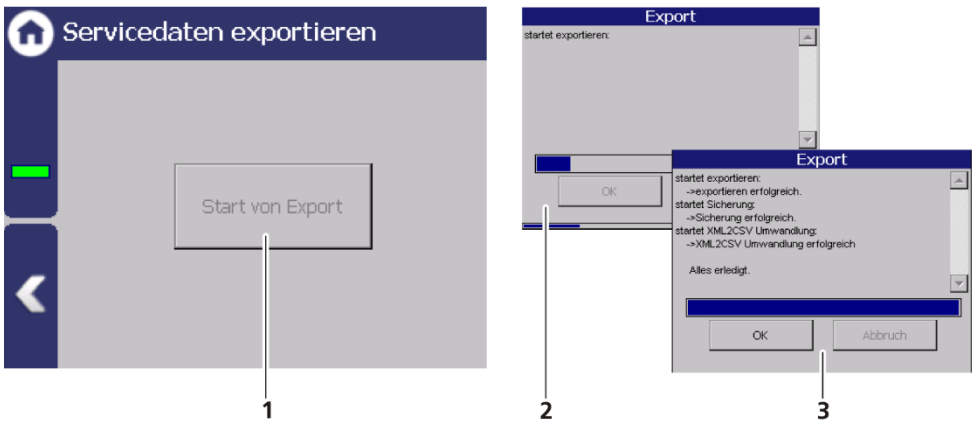
▶ The window for the connection values appears.

6. Select TCP / IP and enter the IP address of the EVU (Expert Setup | Setup | System | Network).
7. Select “Telnet” , enter “23” in the field TCPort# and click <OK>.

▶ In the window, the data logs appear and will written to the log file.

10.6 Export Service Data

Diagnostics | Export Service Data



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

Fig. 122 Export Service Data

Export Service Data

1. Connect a USB storage device to the device (Fig. 5, item 5).
2. The USB storage is recognised by the system after a few seconds and the button <Service data> (Fig. 122, item 1) can be clicked.
3. Click on the button <Export service data> (Fig. 122, item 1).

▶ The process window is displayed and the export of service data will be carried out (Fig. 122, item 2).

▶ After successful export a confirmation message (Fig. 122, item 3) is displayed

Information

Four .txt files are copied to the USB drive when exporting:
- ChangeLog
- ErrorHistory
- ErrorSummary
- SystemInfo

Information

During the export, a new folder is created “Backup_LB475” with a backup file (.xml).

11 Troubleshooting

11.1 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	Shielding 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 optimise the alignment
	Objects in the beam path	▶ Offset irradiation level
	Source at the end of its usable life span	▶ Replace source
no or incorrect process value display	Process values entry incorrect	▶ Check the calibration values and the process value ranges
Process value display fluctuates	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 detector type 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

11.2 Error Codes of the Evaluation Unit

In the following tables you can find the event messages and the error codes of the EVU which give you exact information on how to fix them in the event of an error.

The detector error codes can be seen in the operating manual of the respective detector.

The event messages are subdivided into

- ERROR (F)
- OUTSIDE OF SPECIFICATION (S)
- FUNCTION CHECK (C)
- MAINTENANCE REQUIREMENT (M)

Error (F)

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

Outside of specification (S)

The detector, one of the detector components or the process itself is outside the specification.

Function check (C)

On the detector the parameters are entered or a function check/simulation is carried out.

11.2.1 Error codes system

Code	Text	NAMUR 107	Correction
M101	Hardware module defective	F	Corrupt hardware electronics module. Restart the device. If the event occurs frequently, contact Berthold Service.
M102	Device data defective	F	Permanent memory error, no parameter set was found. Perform a factory reset and/or
M103	RAM error	F	Internal hardware error. Restart the device. If the event occurs frequently, contact Berthold Service.
M104	WD reset	M	The Watchdog has triggered a restart of the device. If the event occurs frequently, contact Berthold Service. Verify whether massive electromagnetic disturbances have triggered the event.
M105	WD error	F	Watchdog is faulty. If the event occurs frequently, contact Berthold Service.
M106	WD deactivated	M	Watchdog is deactivated. Activate Watchdog.
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 of the permissible operating temperature.
M110	Lower temperature limit: outside of the specification	S	The internal temperature of the device is below the lower threshold value. Proper function of the device can no longer be guaranteed. It is recommended to have the device checked by Berthold Technologies, even if it still seems to work properly.
M111	Upper temperature limit: Maintenance required	M	The internal temperature of the device is close to the upper threshold value of the permissible operating temperature.

M112	Upper temperature limit: outside of the specification	S	The internal temperature of the device is above the upper threshold value. Proper function of the device can no longer be guaranteed. It is recommended to have the device checked by Berthold Technologies, even if it still seems to work properly.
M113	Device restart	C	The device was restarted for an unknown reason
M114	Software restart	C	The device was restarted by a user input.
M115	Error of the external real time clock	M	Malfunction of the external real time clock. If the event occurs frequently, contact Berthold Service.
M116	Date faulty	M	The date could not be verified during starting. Check date and time and set if required.

11.2.2 Application

Code	Text	NAMUR 107	Correction
M301	Device not calibrated	M	Device not calibrated. Measurement with standard parameters. Calibrate the device
M302	Decay compensation	S	Decay compensation failed. If the event occurs frequently, contact Berthold Service.
M303	Lower temperature limit: Failure	F	Min. threshold value of the detector temperature achieved / not reached.
M304	Upper temperature limit: Failure	F	Min. threshold value of the detector temperature achieved / exceeded.
M305	Lower temperature limit: outside of the specification	S	Min. threshold value of the detector temperature achieved / not reached.
M306	Upper temperature limit: outside of the specification	S	Min. threshold value of the detector temperature achieved / exceeded.
M307	Remote radiation	S	Remote radiation detected. Stopped measurement.
M308	Radioactive source replacement	M	Radioactive source date reached. Radioactive source replacement to be instigated.
M309	Stopped measurement	C	Stopped measurement
M310	Process value calculation failed	S	Process value could not be calculated. Check measuring range and calibration.
M311	Backup is running	C	Backup carried out.
M312	Restore is running	C	Restore is carried out.
M320	Lower PV limit: Failure	F	Min. threshold value of the process value achieved / not reached.
M321	Upper PV limit: Failure	F	Min. threshold value of the process value achieved / exceeded.
M322	Lower PV limit: outside of the specification	S	Min. threshold value of the process value achieved / not reached.
M323	Upper PV limit: outside of the specification	S	Min. threshold value of the process value achieved / exceeded.
M324	Process value less than 0	S	Process value less than 0. Check measuring range and calibration.
M325	Process value above upper threshold	S	Process value above upper limit. Check process value range and calibration.

M399	Internal program error	F	Internal software error. Restart the device. If the event occurs frequently, contact Berthold Service.

11.2.3 Detector

Code	Text	NAMUR 107	Correction
D501	Detector separated	F	Connection to at least one detector lost. Check detector configuration and / or detector connection. If the event remains, contact Berthold Service.
D502	Detector communication error	M	Communication with at least one detector temporarily interrupted. Check detector connection. If the event occurs frequently, contact Berthold Service.
D503	Detector failure	F	At least one detector signals “Failure”. Check detector events.
D504	Detector outside of specification	S	At least one detector signals “Outside the specification”. Check detector events.
D505	Detector function control	C	At least one detector signals “Function check”. Check detector events.
D506	Detector maintenance required	M	At least one detector signals “Maintenance requirement”. Check detector events.
D599	Internal program error	F	Internal software error. Restart the device. If the event occurs frequently, contact Berthold Service.

11.2.4 RS 458 Interface

Code	Text	NAMUR 107	Correction
M699	Internal program error	F	Internal software error. Restart the device. If the event occurs frequently, contact Berthold Service.

11.2.5 Process Connection

Code	Text	NAMUR 107	Correction
M701	AO error	F	Current outlet value deviates more than permitted from the feedback measured value. Calibrate current output. If the event occurs frequently, contact Berthold Service.
M702	AO circuit open	F	Current circuit on current outlet not closed. Check cabling
M703	Software update is running	C	Indicates that a software update is running. No action is required. The detector returns automatically to measurement mode after software update.
M799	Internal program error	F	Internal software error. Restart the device. If the event occurs frequently, contact Berthold Service.

12 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 "Safety".
De-energise 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).

12.1 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-energised.
- 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!

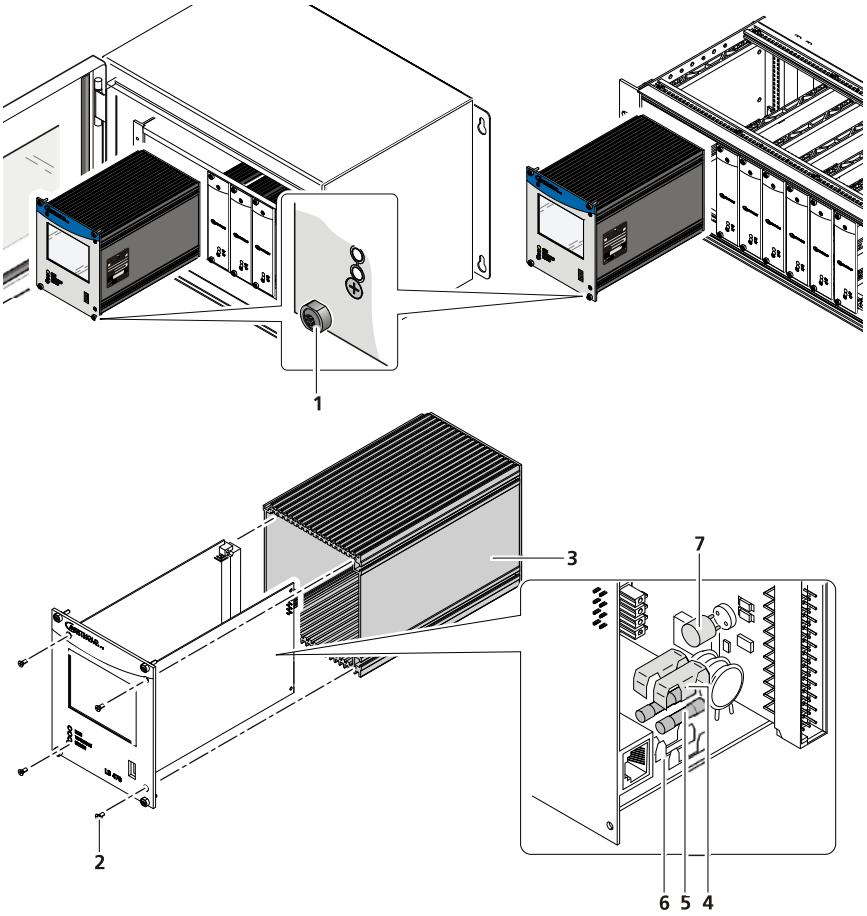
The EVU can be damaged if incorrect fuses are used.

- Only use fuses which correspond to the fuses on the circuit board of the module.

Fuses:

- EVU 250V 1A T (5x20 mm)
- EVU 250V TR5 T80mA (Ø 8.5 mm)

Replacing fuse in the EVU



1	Fixing screws	5	Fuse 250V 1A T (5x20 mm)
2	Cable glands	6	Base
3	Housing	7	Fuse 250V TR5 T80mA (Ø 8.5 mm)
4	Covering fuse		

Fig. 123 Replacing fuses EVU

1. De-energise the device.
2. Release the four fixing screws (Fig. 123, item 1) and pull the EVU out of the wall housing or the subrack.
3. Release the four recessed screws on the front of the EVU (Fig. 123, item 2).
4. Pull out the housing (Fig. 123, item 3) carefully.
5. Remove the protective covering of the fuse (Fig. 123, item 4)
6. Remove the fuse (Fig. 123, 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. 123, item 2).
10. Set module into the socket rails and push it gently until the plug connector of the module is inserted into the socket rail.
11. Tighten all fixing screws (Fig. 123, item 1).

12.2 Cleaning

NOTICE

Damage to the touch display!

Solvents and abrasive additives can damage the touch display.

- ▶ Only clean the touch display with a wet cloth.

- Only clean the EVU with a dry cloth or a dusting brush.
- Only clean the front panel and the touch display with a wet cloth.

13 Decommissioning

⚠ DANGER!

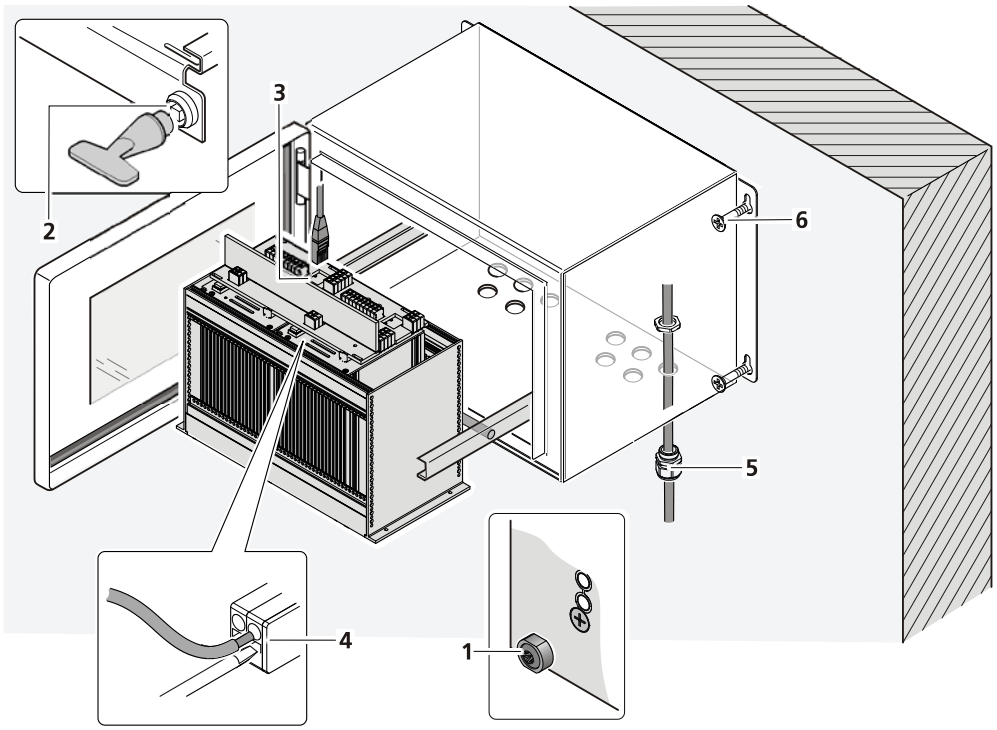
Danger to life from electric shock!

Decommissioning must 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-energised.
- 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.

13.1 Decommissioning wall housing

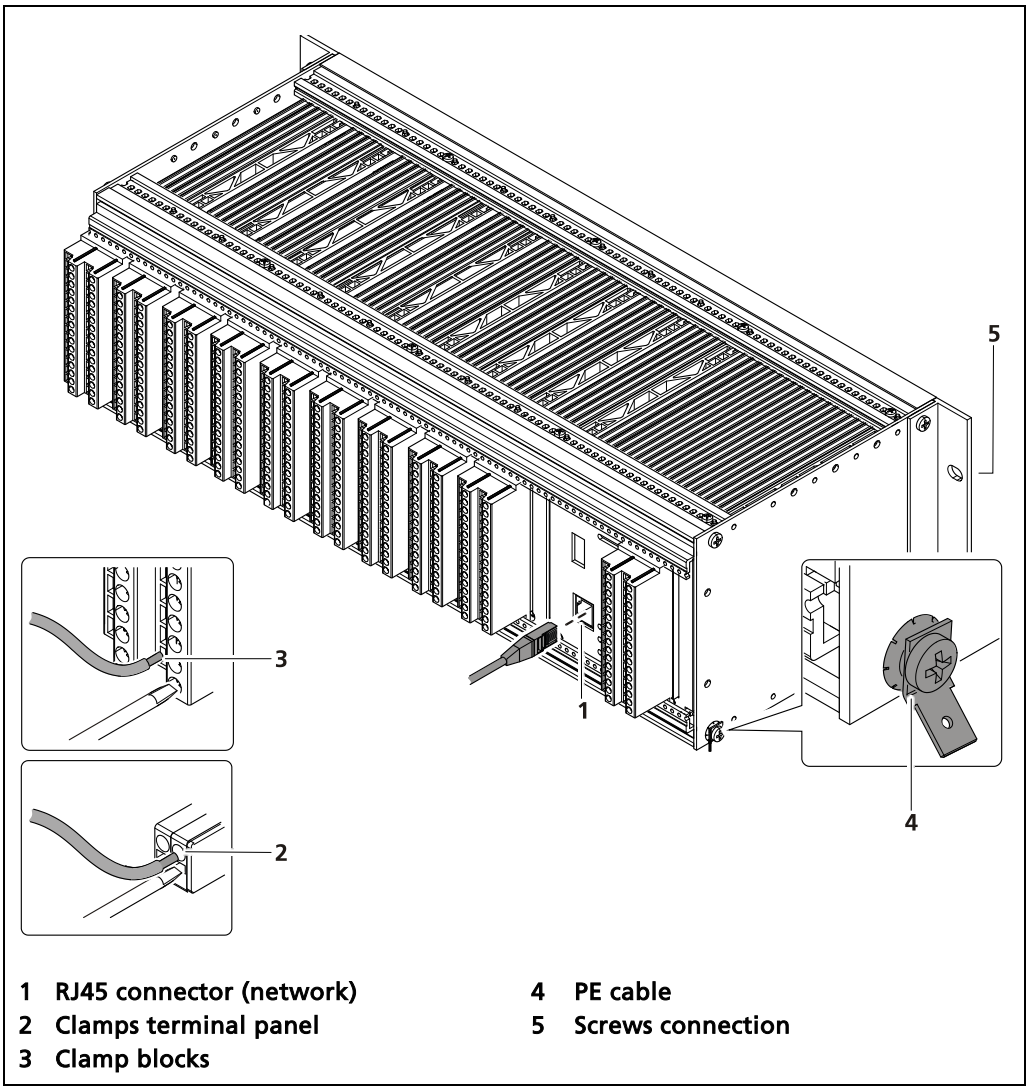


1	Fixing screws	4	Connection terminals
2	Lock	5	Cable glands
3	RJ45 connector (network)	6	Screws connection wall housing

Fig. 124 Decommissioning wall housing

1. De-energise the device.
2. Make sure that the fixing screws (Fig. 124, item 1) of all modules are tightened in order to prevent slipping.
3. Loosen the lock (Fig. 124, item 2) using the supplied square key and pull the subrack out.
4. The subrack can be folded down by the folding mechanism. Fold the subrack downward cautiously.
5. Remove the network plug (Fig. 124, item 3).
6. Remove all lines from the terminal panel (Fig. 124, item 4).
7. Loosen the cable glands (Fig. 124, 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 door.
9. Loosen the screws (Fig. 124, item 6) and remove the wall housing.

13.2 Decommissioning 19" subrack



1 RJ45 connector (network)
2 Clamps terminal panel
3 Clamp blocks
4 PE cable
5 Screws connection

Fig. 125 Decommissioning wall housing

1. De-energise the device.
2. Remove the network plug (Fig. 125, item 1).
3. Remove all lines from the terminal panel (Fig. 125, item 2) or the clamp blocks (Fig. 125, item 3).
4. Remove the PE cable (Fig. 125, item 4).
5. Pull out the EVU from the 19" subrack.

13.3 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 2002/96/EC) by a specialised waste management company.

14 Appendix

14.1 Commissioning report

General data	
Date	
Measuring point	
Radioactive source No.	
Number of detectors	____ LB 6770
Activity	
Isotope	☐ Cs-137 ☐ Co-60

Device configuration		
Model		
Installation variant	☐ Wall housing	☐ 19" Subrack
Connection	☐ Board	☐ Terminal block
Voltage supply	☐ 100-240 VAC	☐ 21-32 VDC
Number EVUs		
Device ID		
Software version		

Commissioning report (continued)

Parameter	
Password	_____
Language	☐ DE ☐ EN ☐ _____
CE Remote Control	☐ Activated
Network	☐ DHCP active IP Address _____ • _____ • _____ • _____ Subnet mask _____ • _____ • _____ • _____ Standard gateway _____ • _____ • _____ • _____ DNS server _____ • _____ • _____ • _____ MAC Address _____
Process Value Range	min. value 0 / 4.00 mA _____ max. value 20.00 mA _____
Digital inputs	Function DI-1 ☐ Read Upper Cal. Point ☐ Read Lower Cal. Point Function DI-2 ☐ Read Upper Cal. Point ☐ Read Lower Cal. Point
Analog output	AO assignment ☐ Density ☐ Damped count rate AO Failure mode ☐ Namur high ☐ Namur low ☐ Hold value ☐ User defined value ☐ AO-Monitoring Enabled
Digital outputs	Function DO-2 ☐ none ☐ Lower PV Alarm ☐ Upper PV Alarm ☐ Det. Temperature alarm ☐ Measurement stopped ☐ System state: Warning Function DO-3 ☐ None ☐ Lower PV Alarm ☐ Upper PV Alarm ☐ Det. Temperature alarm ☐ Measurement stopped ☐ System state: Warning
PV alarm behaviour	NE 107 Status with alarm ☐ No Status ☐ Outside of specification ☐ Error
Detector temperature alarm behaviour	NE 107 Status with alarm ☐ No Status ☐ Outside of specification ☐ Error

Modifications due to technical advancement reserved.

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BERTHOLD TECHNOLOGIES GmbH & Co. KG

Calmbacher Str. 22
75323 Bad Wildbad
Germany
www.berthold.com

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DUO XPERT

LB 47x

Détecteurs

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Informations sur la sécurité
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BERTHOLD TECHNOLOGIES GmbH & Co. KG
Calmbacher Str. 22
75323 Bad Wildbad, Germany
www.Berthold.com

Telephone +49 7081 177-0
Fax +49 7081 177-100
industry@Berthold.com

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

L'unité de traitement DuoXpert LB 470 (EVU) mesure le niveau de remplissage avec les détecteurs compatibles et avec une source de rayonnement appropriée. Elle ne doit être utilisée qu'à cette fin.

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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BERTHOLD TECHNOLOGIES GmbH & Co. KG

Calmbacher Str. 22
75323 Bad Wildbad
Germany
www.Berthold.com

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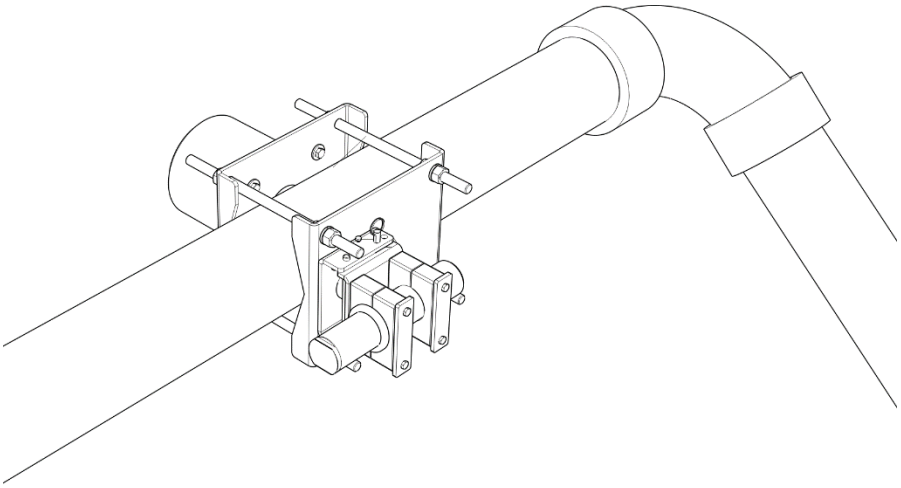


Fracturing
Technical Information

56925TI1F
Rev. No.: 00, 02/2018

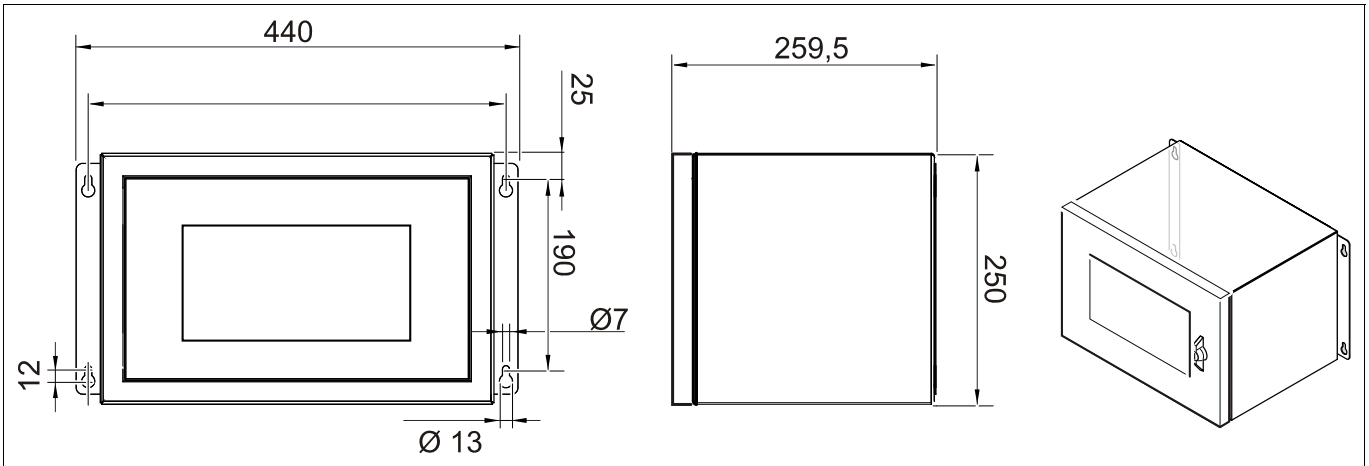
Evaluation unit

The modules can be installed either in wall housings or 19" subracks. It can be equipped differently, depending on requirements. The rear clamp blocks or terminal panels are used for the electrical connection.

NOTICE / HINWEIS

The Evaluation unit is not explosion protected and is not designed for hazardous environments.

Wall housing

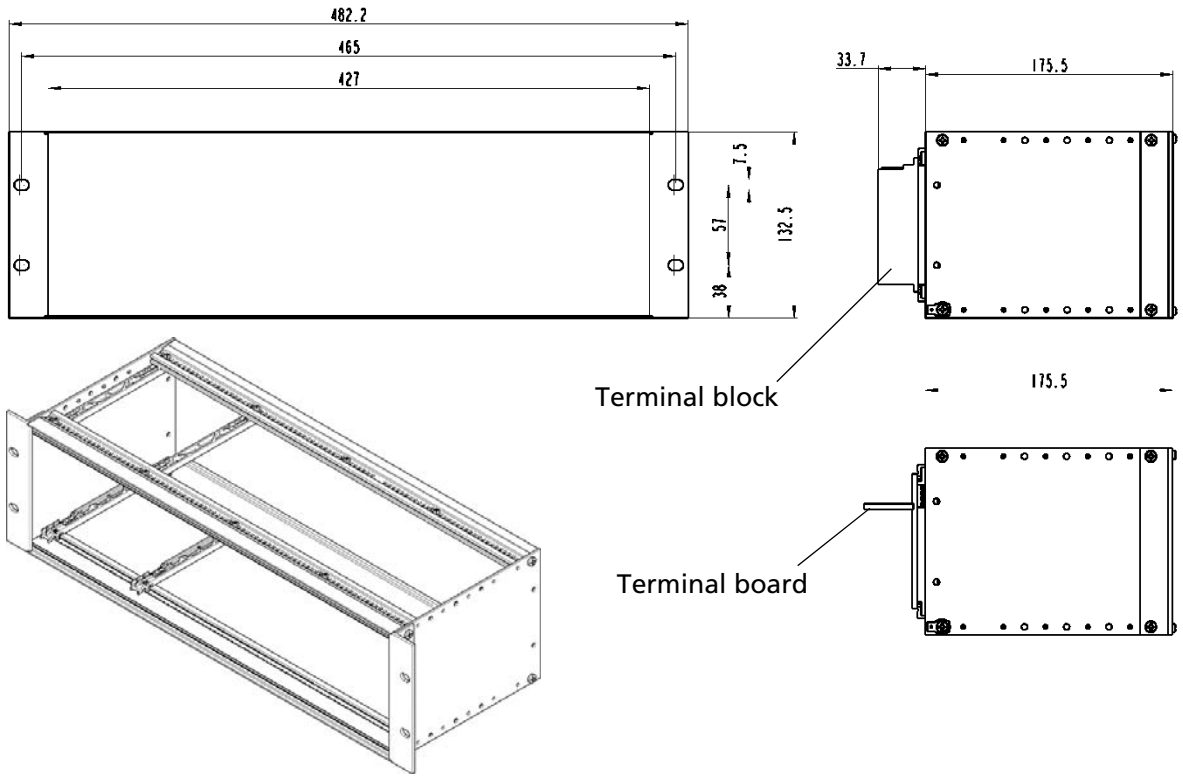


Dimensions in mm

Technical Data	
Dimensions	440x250x257 mm (WxHxD)
Max. Assembly	- 2 EVUs with terminal board (master/master) [1] - 2 EVUs with clamp blocks
Weight (with circuit board, without modules)	8.8 kg
Operational temperature	-20 °C … +40 °C
User interface, colours	powder coated, grey

[1] NRTL certification US/CAN

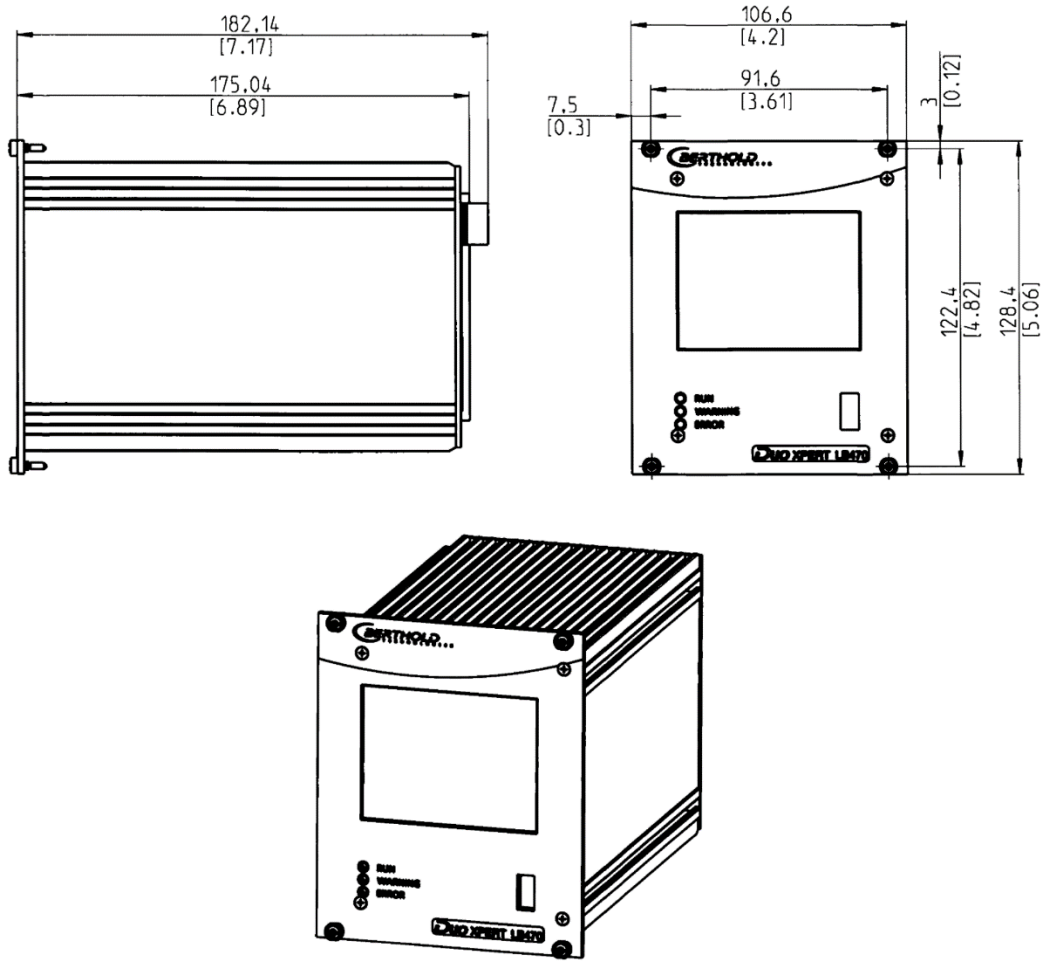
19" subrack



Dimensions in mm

Technical Data	
Dimensions	3HE/84TE/5T, 482x132x172 mm (WxHxD)
Max. Assembly	- 4 EVUs
Weight (with circuit board, without modules) *Gewicht (mit Anschlussplatine, ohne Module)*	1.4 kg
Weight terminal block *Gewicht Klemmenblock*	220 g
Operational temperature	-20 °C … +50 °C, not condensing
Storage temperature	-30 °C … +60 °C
Degree of protection	IP20

EVU



Dimensions in mm

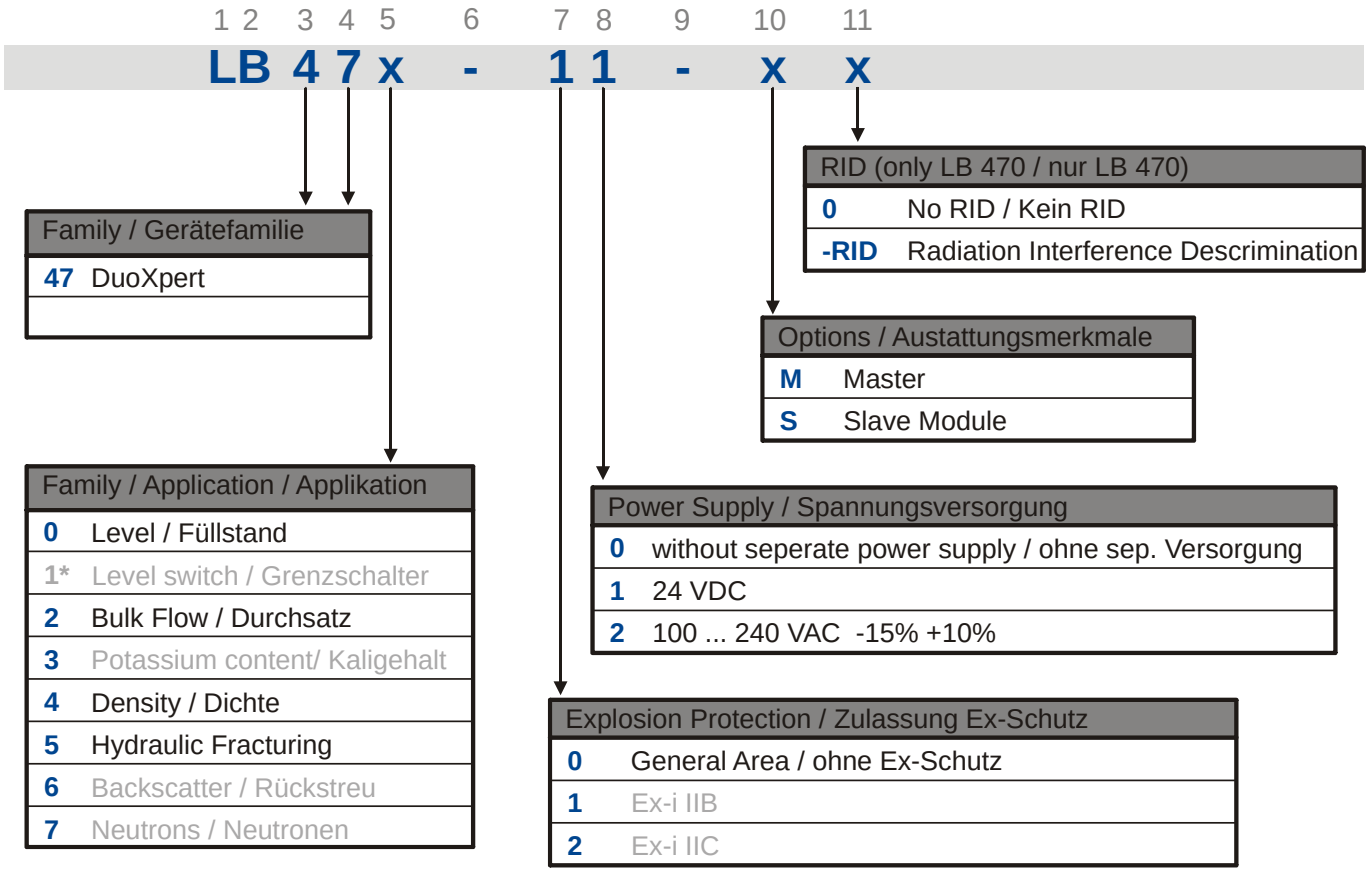
Technical Data	
Dimensions	117/128/172 mm (WxHxD)
Weight	1200 g
Operational temperature	-20 °C … +50 °C, not condensing. Avoid direct sunlight. Unobstructed air circulation must be provided to the subrack.
Storage temperature	-20 °C … +85 °C
Degree of protection	IP20
Connections	- USB port for the connection 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 colours - Dimmable LED background lighting - Touch screen
Computer core	- Processor: Dual Core DSP/ARM Controller - clock frequency: 300 MHz internal (20MHz 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 (24V DC power input)
Power consumption	22 VA, 15 W
Fuses	Internal, 2 x 250 V, 1 A delayed, 5x20 mm, 1500 A breaking capacity IEC 60127-2, 1x 250 V TR5 T80 mA (Ø 8,5 mm)

Interfaces	
Current output	- 4-20 mA internally switched from power source to sink current (according to NAMUR recommendation NE 006 and NE 043). - Continuous short circuit proof and isolated (500 V). - Internal resistance about 105 ohms max. - Burden when operating as a power source: 850 ohm. - Internal monitoring of the loop current and additional error signalling by hardware on detection of a fault condition.
Current input	4-20 mA (according to NAMUR recommendation NE 006 and NE 043) switchable via software on frequency input, electrically isolated (500V). Internal resistance approx. 300 ohm max. input voltage: 24 V DC
Impulse input	Frequency 0-100 kHz, U_{max} = 28 V, right angle signal form, low <1,5 V; high 4 – 28 V. Switchable to current input
Digital outputs	3 relays, U_{max} = 33 V AC_{eff}, 46 V DC; I_{max} = 1 A functions: Relay 1: SPDT for error signalling Relay 2: SPDT assignable by software Relay 3: SPST assignable by software
Digital inputs	- 2 x together electrically isolated (500 V) - Switch between DigIn and GND, Uoutmax 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	1 x USB 2.0 Type A (Host) via front plate to the connection of an ext. mouse, keyboard or storage medium U_{out} = 5 V, $I_{out\ max.}$ = 0.5 A
Ethernet	RJ45 connection via back wall, 10 Mbit, DHCP supported, max. 3 m

Number Key LB 47x



* used by othe hardware

Declaration of Conformity

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-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 330991
Persönlich haftende Gesellschafterin / Fully liable Associates: BERTHOLD TECHNOLOGIES Verwaltungs-GmbH
Registergericht / Court of Registration: Stuttgart HRB 331520
Geschäftsführung / Management: Horst Knauff, Dr. Dirk Mörmann
USt.-Id-Nr. / VAT Reg. No.: DE813050511
Deutsche Steuernummer / German Tax No.: 49038/08038
WEEE-Reg. No.: DE99468690

Sparkasse PF-CW	75323 Bad Wildbad	Konto/Account No. 8 045 003 (BLZ 666 500 85)	SWIFT-BIC PZHSDE66	IBAN: DE37 6665 0085 0008 0450 03
Volksbank	75119 Pforzheim	Konto/Account No. 957 004 (BLZ 666 900 00)	SWIFT-BIC VBPFDE66	IBAN: DE85 6669 0000 0000 9570 04
Commerzbank	75105 Pforzheim	Konto/Account No. 6 511 120 (BLZ 666 800 13)	SWIFT-BIC DRES DEFF 666	IBAN: DE05 6668 0013 0651 1120 00

Certificates

NRTL 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

NRTL certification US/CAN wall-mounted housing (continued)

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

1

NRTL certification US/CAN wall-mounted housing (continued)

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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NRTL certification 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

NRTL certification US/CAN DuoXpert LB 47x (continued)

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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Parts overview

ID. No.	Description
64576	LB 475-01-M Fracturing Transmitter (24 VDC)
64575	LB 475-02-M Fracturing Transmitter (100...240 VAC)
56925-5BA2	Operating manual DuoSeries LB 475 Fracturing, English
63783	Wall-mounted Housing for 2x LB 47x EVU (24 VDC)
63784	Wall-mounted Housing for 2x LB 47x EVU (110...240 VAC)
64402	Wall-mounted Housing for 2x LB 47x EVU (terminal blocks)
59484	19" rack for LB 47x, 4 x EVU
64607	19" rack, 84 HP / 3 RU for use with terminal blocks
59477	Terminal block for LB 47x, EVU
37526	Front Cover Plate 21 HP / 3 RU