Evaluation unit

DUO XPERT LB 470RID Level

Operating Manual
56925-1BA2

Rev. No.: 02, 05/2021
Embedded software version as of vers. 1.5.2 (CPU) and 1.5.2 (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

Operating Manual

Technical Information

1 About this Operating Manual

1.1 Applicable Documents

This manual contains the following documents:

- Technical Information, 56925TI1L (see appendix)
- Informations sur la sécurité, 56925BA59 (see appendix)

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

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

1.2 Some Prior Remarks

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

This operating manual illustrates how to:

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

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

1.3 Storage Place

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

1.4 Target Group

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

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

1.5 Validity of the Operating Manual

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

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

IMPORTANT

Intrinsically safe operation

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

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

1.6 Structure of the Operating Manual

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

1.7 Copyright

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

1.8 Representation

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

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

1.9 Warning Notes

Warning notes are designed as follows:

Signal Word

Source and consequence
Explanation, if required
- ▶ Prevention

In case of emergency

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

1.9.1 Symbols Used in the Operating Manual

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

IMPORTANT

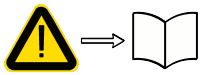
Sections marked with this symbol point out important information on the product or on handling the product.

Tip

Provides tips on application and other useful information.

1.9.2 Symbols Used on the Device

Read the operating manual



Please observe the instructions in this operating manual.

Electrostatic discharge

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

Protective earth connection

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

Equipotential bonding connection

At this position, connect the equipotential bonding conductor.

Direct voltage

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

Alternating voltage

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

No domestic waste

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

1.10 Conformity

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

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

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

2 Safety

2.1 Dangers and Safety Measures

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

2.2 Proper Use

The evaluation unit DuoXpert LB 470RID (EVU) measures the level together with compatible detectors and an appropriate radiation source and may only be used for this purpose.

The following constitutes proper use:

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

Improper use to be prevented:

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

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

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

NOTICE

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

2.3 Qualification of the Personnel

NOTICE

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

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

These three groups of people are:

- Employees with General Knowledge
- Experts
- Authorized Persons.

Employees with General Knowledge

NOTICE

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

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

Experts

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

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

Authorized Persons

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

2.4 Operator's Obligations

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

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

3 System Description

3.1 Overview

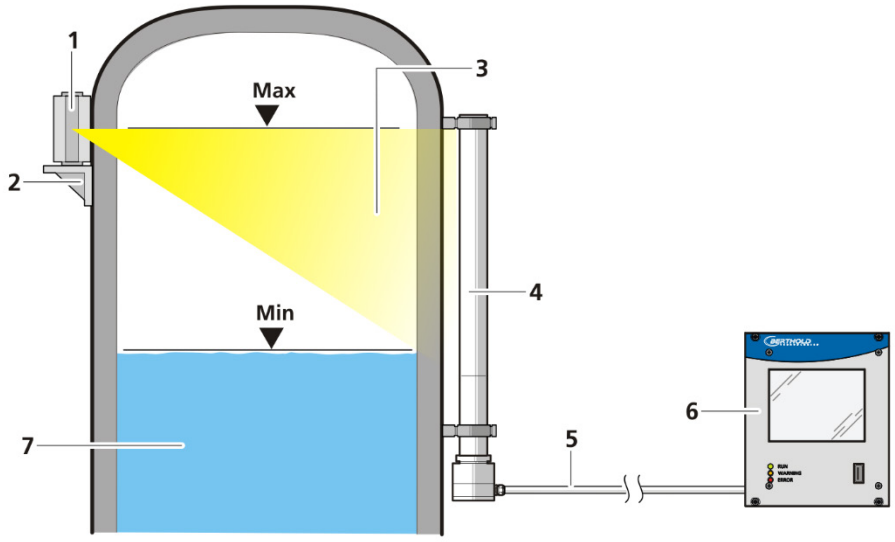
The level measuring device LB 470RID is an industrial measuring system for the contactless and continuous determination of the level of a product in a container. The LB 470RID measuring system extends the functionality of the radiometric level measurement of the LB 470 by the function of Radiation Interference Discrimination (RID).

A complete measuring system consists of the following components:

- Evaluation unit DuoXpert LB 470RID
- Source
- Shields
- Point detector / rod detector(s)

These instructions concern the operation of the evaluation unit DuoXpert LB 470RID (Fig. 1, item 6). The operation of other system components is part of the independent instructions of the respective system components. The EVUs are standard equipment in switch rooms with 19" subracks or switchboards.

Depending on the measuring task and the composition of the measuring product and containers, different arrangements and system components are required, see 3.5 Measurement Arrangements.



1 Point source shield
2 Mounting base
3 Radiation beam
4 Rod detector
5 Measurement line to master EVU
6 Master EVU
7 Product

Fig. 1 Example measurement arrangement

3.2 Measuring Principle

Gamma radiation is used to penetrate a medium in a container. The attenuation of the radiation is analyzed to measure the level in the container.

The evaluation DuoXpert LB 470RID (master EVU) is used for the evaluation, transmission and visualization of measured values which it receives from the connected detectors.

The EVU is an independent measurement channel. If several measurement channels are required, an independent EVU must be used for each channel.

For covering larger measuring ranges with level measurements, it is possible to connect multiple detectors on a level measuring device LB 470. To do this, an additional slave module is required (optional) for each additional detector after the first. A maximum of 16 slave modules can be connected per master EVU. A cascaded measurement system with a maximum of 17 detectors can be set up in this way.

Tip

Further information on the functional principle of the detectors can be found in the operating manual of the detector.

3.3 Radiation Interference

Radiometric continuous Level Measurements and Interference Radiation

The highly sensitive large volume gamma-ray detectors used in continuous level measurements are susceptible to the effects of strong radiation external to the level measurement system. Problems can occur when very powerful radioactive sources, (typically used in the testing of welds and other material properties in the construction or refurbishment of pipes), are in use in the vicinity of the level measurement system.

These strong and sporadic radiation fields are detected and counted by the level system in addition to the valid counts resulting from the source used to determine the level in the vessel. Without additional precautions, the evaluation unit would add the unwanted counts to the wanted counts and provide an incorrectly low reading for the level in the measured vessel. This type of process error can be expensive and even dangerous.

he standard LB 470 evaluation unit is configured to deal with the effects of sporadic unwanted radiation by recognizing a fast increase of input count rate due to unwanted radiation and freezing the signal representing fluid level in the vessel at the last correct value for the duration of the interference, then reverting to a normal measurement mode when the unwanted radiation stops. During this time, no information about the actual fill level is available and the process has to be controlled manually. This is satisfactory for situations where level changes are relatively slow or interference takes place infrequently. However, in processes where the level in the vessel fluctuates quickly and interfering radioactive sources are in use at the site, automated safety features are required to avoid errors due to interfering radiation.

Suppression of Unwanted Radiation Signals

A patented LB 440-RID[1] continuous level system is now available which almost completely eliminates the effects of interference radiation on the accuracy of level

[1] US patent 6,753,532 B2, EU patent pending

measurements. This system distinguishes between the energies of the wanted and unwanted radioactive isotopes and suppresses the effects of the unwanted radiation. This represents a huge advantage in situations where frequent weld testing is performed.

3.3.1 Scintillation Detectors

Every gamma absorbed in the scintillator material generates a light flash whose intensity depends on the energy of the gamma radiation. The light pulses are converted in the coupled photomultiplier into voltage pulses whose height is proportional to the energy of the gamma which generated it.

The detector electronics compares the height of the measured voltage pulse to a preset voltage, the measuring threshold. Only pulses of sufficient voltage (height) to exceed the measuring threshold are counted by the evaluation electronics and determine the measured pulse rate in the measuring channel (MC) and the level in the container is calculated from the pulse rate in the measuring channel. To be able to work with as low as possible radioactive source activities, the measuring threshold is set so low that all radiation pulses are registered, and high enough that the noise of the electronics cannot contribute to the measured pulse rate. The height of the measuring threshold is a direct measure of the sensitivity of the measuring system: The higher the measuring threshold, the higher is the source activity required to reach the same count rate.

3.3.2 Interference Radiation and Pulse Height Analysis

Ionizing radiation registered by the detector which does not come from the measuring source is called interference radiation. In the testing of welds and other material testing, radioactive sources of very high activity (up to 100 Ci) are used. These applications almost always use low energy radiation sources for example, Ir-192 or Se-75. In contrast, the Nuclides used in the level measurements, in particular Co-60, are high energetic radiation sources, with much lower activity.

An analysis of the voltage pulses (pulse amplitude or "height") registered by the detector permits a differentiation between interference radiation and measuring radiation since the pulse height is dependent on the energy of the isotope. The pulse height spectrum in illustration 3 shows the distribution of the pulse heights generated by gamma radiation from Co-60 or Ir-192 sources in a rod detector with plastic scintillator. On account of the high radiation energy, the spectrum of Co-60 includes big pulse heights, as opposed to pulse heights for an Ir-192 source. In the pulse height spectrum from illustration 3, practically no Ir-192 pulses lie above a height of 700 mV. The energy of Se-75 is below Ir-192 and generates even lower pulse heights.

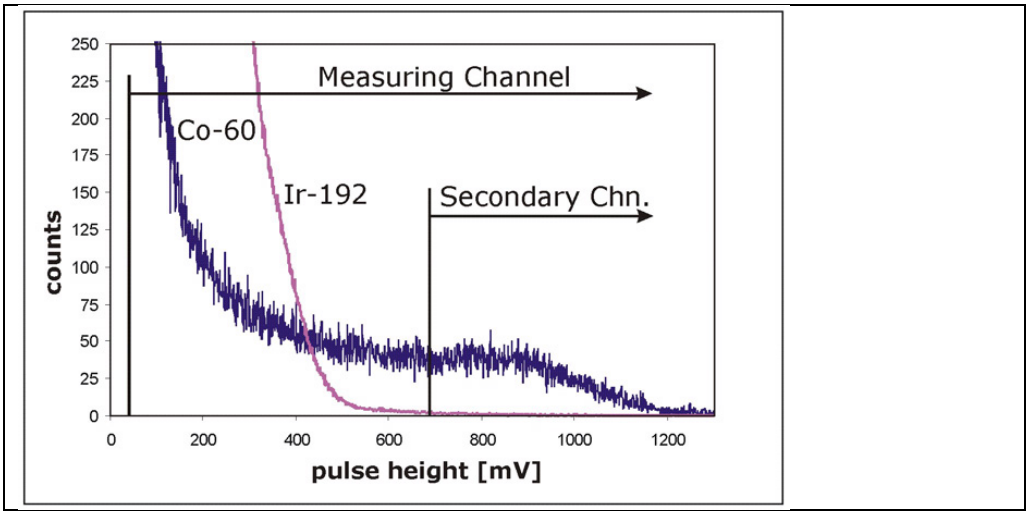


Fig. 2 Pulse Height Spectrum

All pulses above the measuring threshold contribute to the count rate in the measuring channel. When Ir-192 interference radiation influence is present, all Ir-192 pulses are also counted. This causes the level measurement in the vessel to read too low.

3.3.3 Secondary Channel

As is shown in illustration 3, a second channel (SC) with a different threshold setting is provided (threshold 2). Only pulses which cross the threshold 2 voltage (height) level are processed in channel SC, the secondary channel. The number of pulses coming from the interference radiation source which fulfil this criterion is small and can be neglected in most cases. Hence, in contrast to measuring channel, the pulse rate in the secondary channel remains uninfluenced by interference radiation.

Conversely, a large number of the Co-60 impulses also fall below threshold 2 and do not contribute to the pulse rate in the secondary channel, which is therefore smaller than the pulse rate in the measuring channel. This difference in sensitivity compared with the measuring channel results is bigger statistical variations of the pulse rate registered by the secondary channel.

To sum up, it can be said that the LB 470 measuring system-RID contains two channels which measure at the same time and independently of each other a change in pulse rate dependent on the continuous level:

- The highly sensitive Measuring Channel (MC) which shows only low pulse rate variations but is however, susceptible for interference radiation.
- The less sensitive Secondary Channel (SC) with larger pulse rate variations which is, however, at the same time insensitive to interference radiation.

3.3.4 Interference Radiation Suppression

If interference radiation hits the detector, the count rate in the measuring channel MC rises quickly and the resulting level signal drops. At the same time, the change in counts and therefore also the resulting level signal in the secondary channel SC remains uninfluenced by interference radiation. The resultant difference between the levels represented by the secondary channel SC and the measuring channel MC, the channel difference CD, is a measure of the strength of the interference radiation. If the CD value exceeds a value preset by the user, the interference radiation tolerance *T* (factory set: 10%), the active channel is switched from the measuring channel MC to the secondary channel SC, i.e. under interference radiation conditions, the indicated level is determined by the secondary channel SC.

Equation Channel Selection Criteria between the Measuring Channel MC and the Secondary Channel SC

$$CD \geq T$$

$$CD = L_{SC} - L_{MC}$$

In Equation 1, L_{SC} and L_{MC} represent the level measurements from the Secondary Channel or Measuring Channel; CD is the channel difference (live value) and *T* is the interference radiation tolerance (Fixed value, factory set = 10%)

A channel difference smaller than the interference radiation tolerance *T* is due to statistical variations or differences in the calibrations and does not result in switching channels.

Due to the low pulse rate in the Secondary Channel the level measurement variations are somewhat greater during periods of interference. However, the level is measured continuously and reliably.

When the interference ends, the count rate in the measuring channel drops to normal and the channel difference decreases. When the channel difference falls to less than the value of *T* the instruments switches back to its normal configuration.

3.3.5 Automatic Calibration Improvement

For an optimum recognition of interference radiation and reliable switching from Measuring to Secondary Channel, the level must be measured exactly equally in both channels under normal operating conditions without interference radiation, i.e. the channel difference should be near zero.

Deposits on the vessel walls, high voltage variations, Photomultiplier and scintillator ageing, have different effects on each channel. Errors between channels could therefore increase after some operating period leading to false level determinations and degradation of the interference suppression function. This would surface as false radiation interference readings. To avoid this, the system includes automatic compensation.

For this reason, it is inevitable to constantly balance the levels measured in both channels and to minimize the channel difference during normal operation. The LB 470RID system therefore has an integrated automatic channel difference minimization function. As a result, the above influences are compensated and the function of the interference radiation suppression is maintained even after a long period of operation.

3.3.6 Restrictions and Limits of Interference Radiation Suppression

To be able to use the total functionality of the LB 470RID and to avoid incorrect settings, understanding of the restrictions and limits of the interference radiation suppression system is required.

Radioactive sources

Because interference radiation and measuring radiation are distinguished by recognizing the different energies of the employed isotopes, the difference in these energies must be sufficiently large for the suppression system to operate properly. This means that an isotope with high-energy gamma radiation must be used for the measuring source.

Therefore, continuous level measurements using the LB 470RID are only effective if the measurement isotope is Co-60. The radiation energy of Cs-137 sources and typical interference radiation are too close together to be distinguished by the measurement system. Existing level measurements with Cs-137 sources must be converted to Co-60 to be able to work with the interference radiation suppression of the LB 470RID.

Interference Radiation Sources

Interference radiation cannot be suppressed reliably if isotopes with high radiation energy are used in the welding checks. In such cases the Measuring and the Secondary Channel are both influenced by the interference radiation. Then interference radiation is recognized merely as a sudden increase in pulse rate and the level signal is frozen for the duration of the interference.

However, high energy isotopes (e.g., Co-60) are used extremely rarely in weld checking and material testing. The vast majority of testing applications use Ir-192 and Se-75, which are recognized reliably by the LB 470RID system as an interference radiation and are suppressed.

Strong Interference Radiation

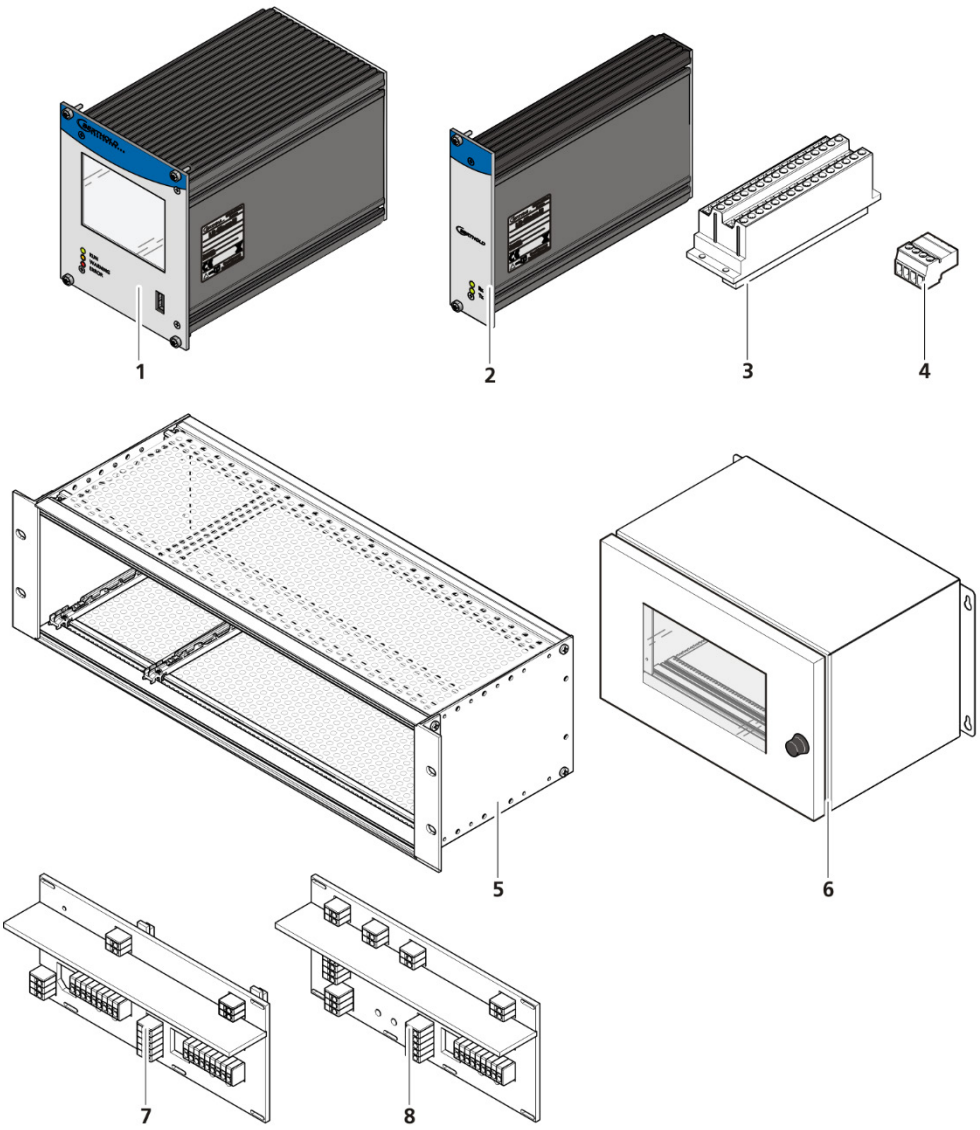
If weld checking using extremely strong interference radiation sources (activity of 40 Ci and more) takes place in less than approx. 50-100 m from the measuring arrangement, the pulse rate in the Secondary Channel can also be influenced and lead to errors in the continuous level measurement. If an inadmissibly high increase in pulse rate occurs in the Secondary Channel, the measuring signal is frozen and an error message is given.

Automatic CD Minimization

Accurate balancing of the measuring channel to the second channel takes place in those parts of the measuring range in which the filling level is located. The other parts of the measuring range are also corrected according to this adjustment.

If reliable interference radiation suppression is required in all parts of the measuring ranges, it must be ensured that the entire measuring range is passed from time to time.

3.4 System Components



1 Master-EVU with wide range supply (100-240 V AC, 50/60 Hz)
Alternatively: Master-EVU with 24 V supply (18-32 V DC)
2 Slave module with wide range power supply (optional)
Alternatively: Slave module with 24 V supply (optional)
3 Clamp block for electrical connections (optional)
only for installation in subrack / switchboard)
4 Master/Slave plug
5 19" subrack (optional)
6 Wall housing (optional)
7 Backplane Master-Master with cover
8 Backplane Master-Slave with cover

Fig. 3 System components

3.4.1 Software

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

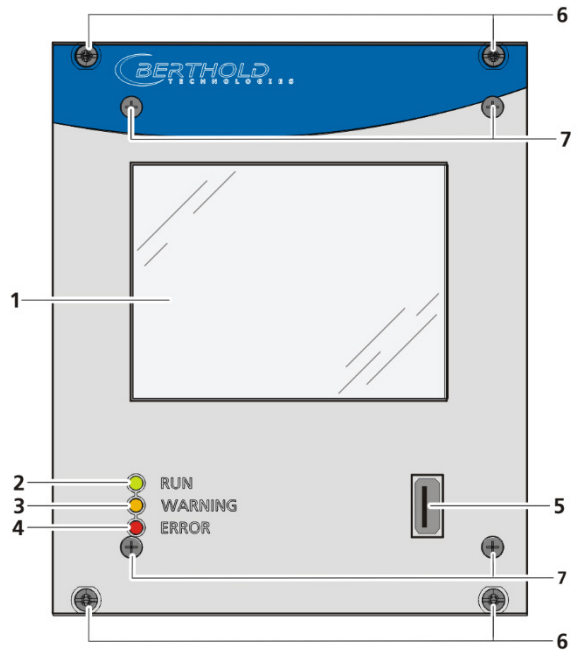
This operating manual describes the software version 1.5.2 (Control Unit / CU) and 1.5.2 (Measurement Unit / MU).

3.4.2 Front/rear View Master EVU

Front View Master EVU

The following control elements are found on the front of the master EVU:

- 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 Mounting screws
7 Screws front plate

Fig. 4 Front view of the master EVU

Operation Display / Touch Screen

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

NOTICE

Damage to the touch screen

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

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

Status displays of the master EVU

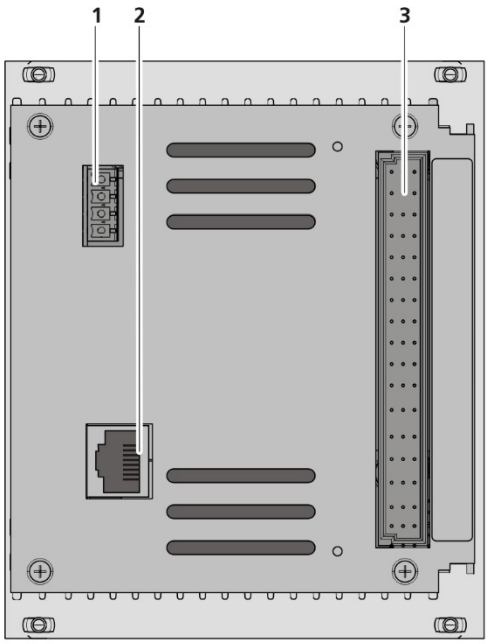
The LEDs (Fig. 4, items 2-4) below the touch display show the current operating status of the master EVU.

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

Rear view master 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



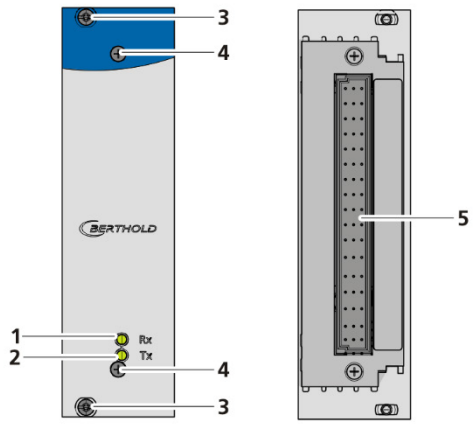
1 Master/slave 4-pin connector
2 RJ45 socket for Ethernet
3 32-pin plug connector

Fig. 5 Rear view master EVU

3.4.3 Front/rear View Slave Module

The LEDs Rx and Tx are found on the front of the slave module.

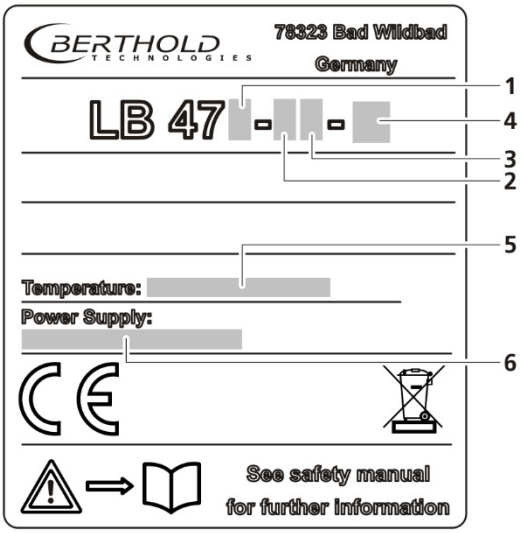
- The LED Rx flashes green when data is received.
- The LED Tx flashes green when data is sent.
- The 32-pin plug connector is found on the back side.



1 LED Rx
2 LED Tx
3 Mounting screws
4 Screws front plate
5 32-pin plug connector

Fig. 6 Front and rear view slave module

3.4.4 Type Plate



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

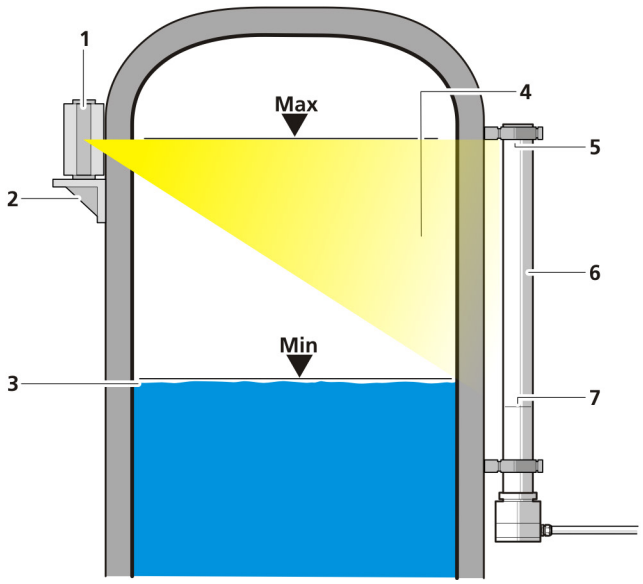
Fig. 7 Type plate

3.5 Measurement Arrangements

The detector and/or the source are rod-shaped for a radiometric level measurement, so as to form a triangular or rectangular useful beam field. The change of the measurement signal for different level results from the different sized covering of the radiation field.

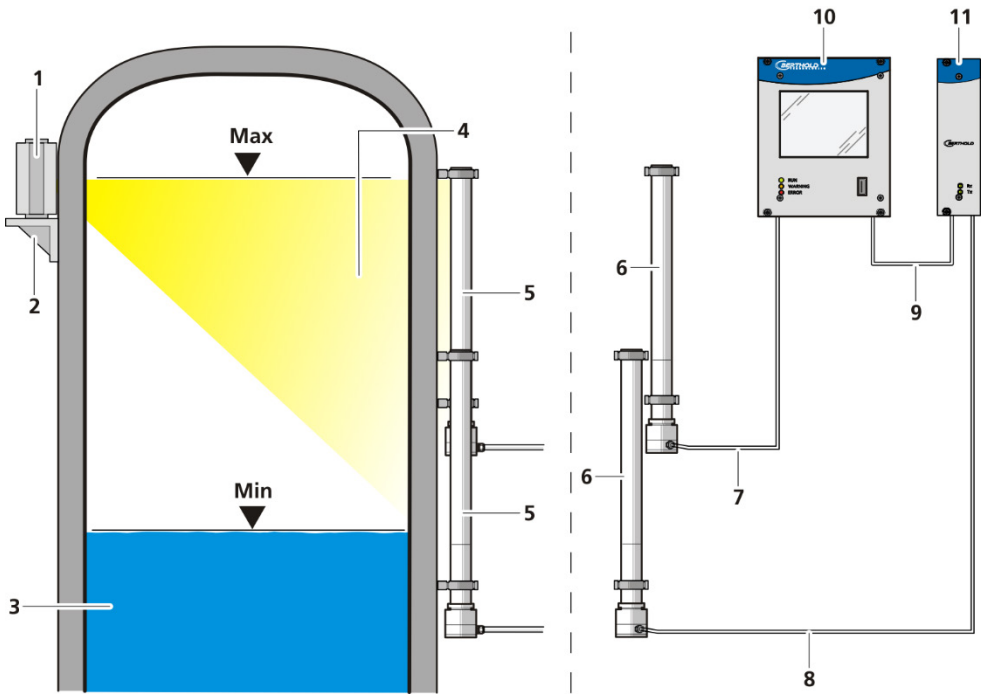
The marking grooves on the detector housing highlight the sensitive area of the detector. The detector must be mounted on the container so that the desired measuring range is covered by the sensitive area.

In a cascaded system (with multiple detectors), the lower marking groove of the 1st detector must match the upper of the 2nd detector etc. (Fig. 9).



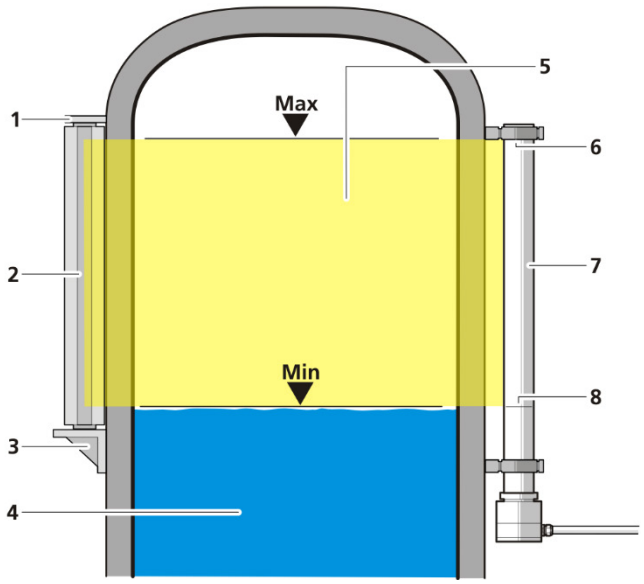
1 Point source / shield
2 Mounting base with source
3 Level
4 Radiation field
5 Upper marking groove
6 Rod detector
7 Lower marking groove

Fig. 8 Schema point source - rod detector



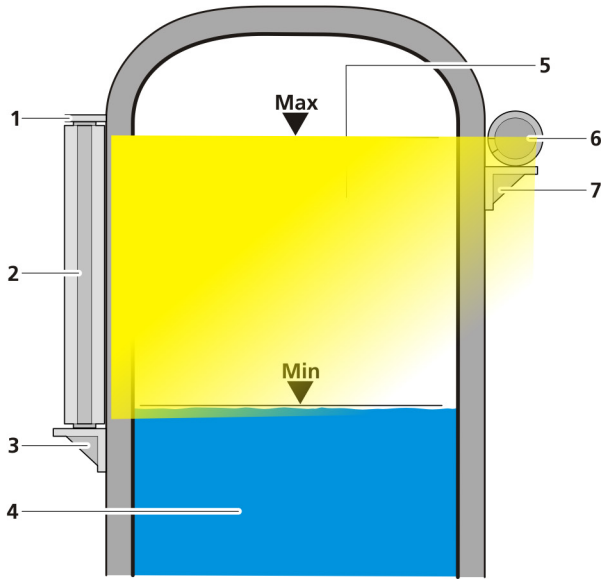
1 Point source / shield
2 Mounting base with source
3 min / max level
4 Radiation field
5 Rod detector 1 + 2
6 Rod detector 1 + 2 (side view)
7 Measurement line (1st detector - master EVU)
8 Measurement line (2nd detector - slave module)
9 Connection master EVU - slave module
10 Master EVU
11 Slave module

Fig. 9 Schema Point source-rod detector cascaded



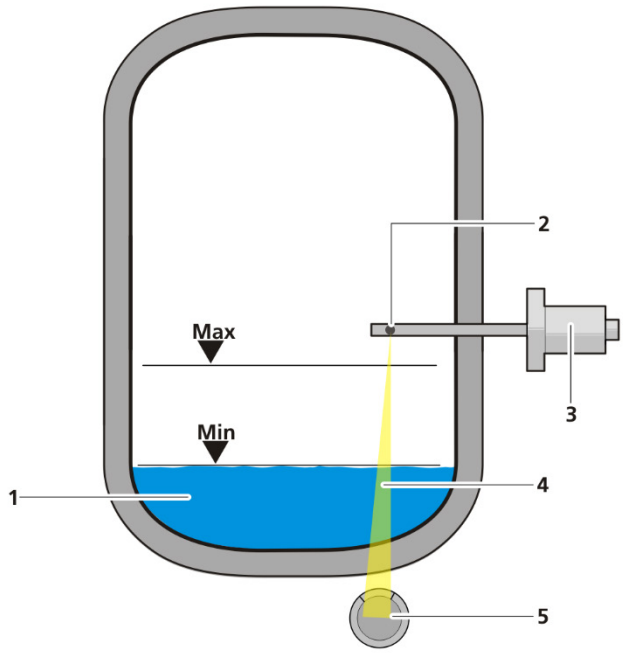
1 Mounting base
2 Rod source / shield
3 Mounting base with source
4 Min/max level
5 Radiation field
6 Upper marking groove
7 Rod detector
8 Lower marking groove

Fig. 10 Schema rod source - rod detector



1 Mounting base
2 Rod source / shield
3 Mounting base with source
4 Min/max level
5 Radiation field
6 Detector
7 Mounting base

Fig. 11 Schema rod source - point detector



1 Min / max level
2 Point source in the dip tube
3 Shield
4 Radiation beam
5 Detector

Fig. 12 Schema point source - point detector (absorption level measurement)

The detector and the source are usually formed as points in an absorption level measurement.

Based on the arrangement of source and detector (Fig. 12), the change in the measurement signal results from the different material thickness of the product being measured.

3.6 Storage

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

4 Installation

4.1 General Instructions

The applicable national regulations of the country of use have to be observed! Repair and maintenance on the devices may only be performed by experts (see chapter 2.3). In case of doubt, the complete device must be returned to Berthold for repair.

⚠ WARNING

Danger to life due to explosion!

- No installation of the evaluation unit / the wall housing / the 19" subrack in the explosive area.

NOTICE

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

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

4.2 Unpacking/Scope of Delivery

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

4.3 Installation Variants

See document "Technical Information" in the appendix.

4.4 Mounting the Wall Housing

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

NOTICE

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

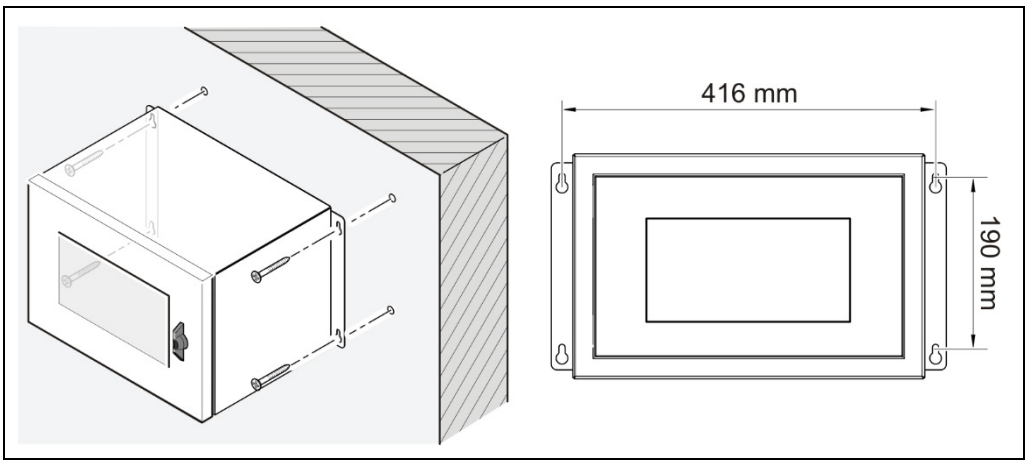


Fig. 13 Mounting the wall housing

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

IMPORTANT

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

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

- The wall housing is installed correctly.

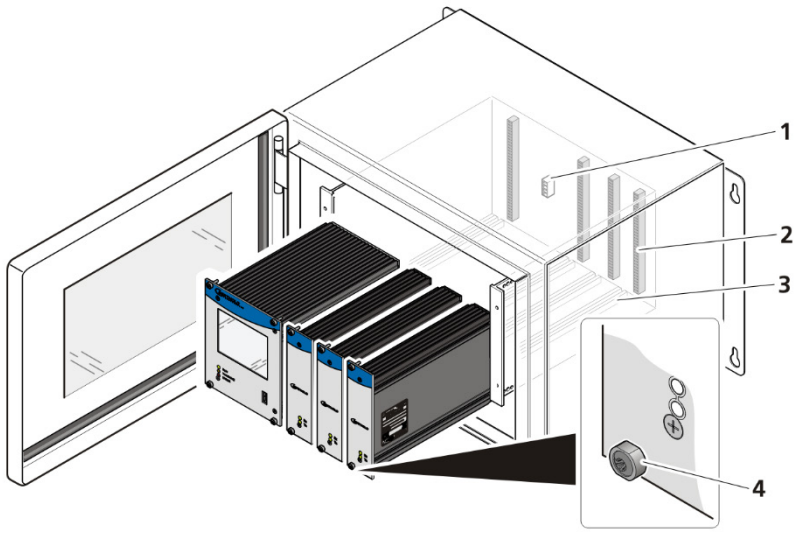
4.5 Installation in the Wall Housing

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

NOTICE

- The master EVUs / slave modules must be secured against pulling out by fixing screws (Fig. 14, item 4).
- The device must be disconnected from the mains voltage before it is pulled out.

Installation of the modules (master-slave)

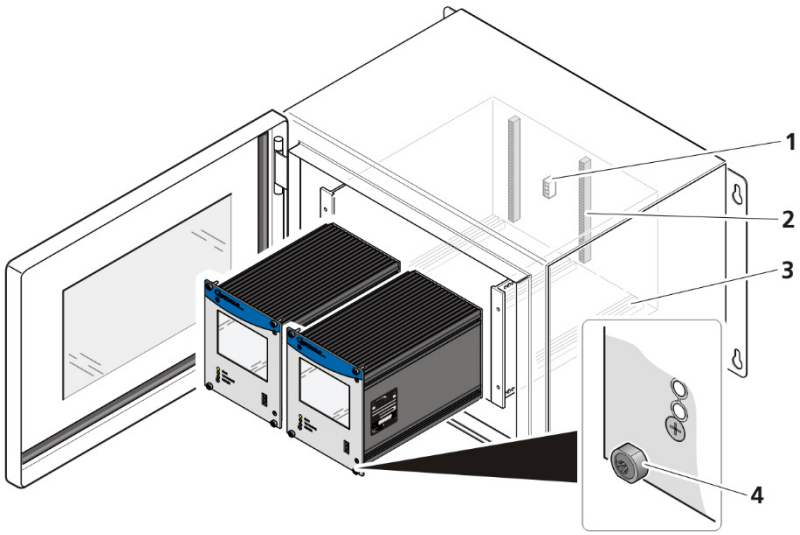


1 Master-slave connector
2 Socket board
3 Guide rails
4 Fixing screws

Fig. 14 Installation of the modules (master-slave)

1. Set modules into the guide rails (Fig. 14, item 3) and push it gently until the plug connector of the module (Fig. 14, item 2) is inserted into the socket board.
2. Tighten all fixing screws (Fig. 14, item 4).
   - The modules are installed correctly.
3. Unused slots must be covered with dummy panels.

Installation of the modules (master-master)



1 Master-slave connector
2 Socket board
3 Guide rails
4 Fixing screws

Fig. 15 Installation of the modules (master-master)

1. Set modules into the guide rails and push it gently until the plug connector of the module (Fig. 15, item 2) is inserted into the socket board.
2. Tighten all fixing screws (Fig. 15, item 4).

▶ The modules are installed correctly.

3. Unused slots must be covered with dummy panels.

4.6 Installation in the 19" Subrack

The 19" subrack can be equipped differently, depending on requirements (see document “Technical Information”). The rear clamp blocks (Fig. 16, item 3) or terminal panels (Fig. 17, item 4) 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. 17, item 4) that should 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

4.6.1 Installation with Clamp Blocks

⚠ DANGER

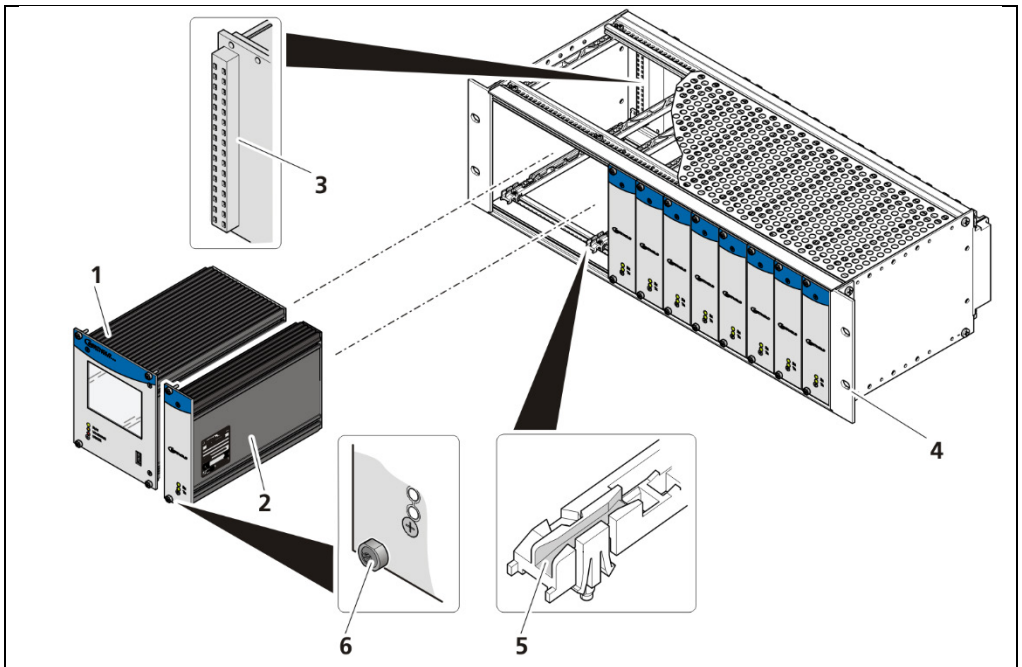
Danger to life from electric shock!

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

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

NOTICE

- The master's EVUs / slave modules must be secured against pulling out by fixing screws (Fig. 16, item 6).
- The device must be disconnected from the mains voltage before it is pulled out.



1	Master EVU	4	Drilling
2	Slave module	5	Guide rail
3	Clamp block	6	Fixing screw

Fig. 16 19" subrack with clamp block (Ex: 1x Master, 9x Slave)

1. Set master EVU / slave module (Fig. 16, item 1, item 2) in the guide rails (Fig. 16, item 5).
2. Carefully slide module into the subrack until the plug connector is inserted into the clamp block.
3. Tighten fixing screws (Fig. 16, item 6).
4. Unused slots must be covered with dummy panels.

- The EVU is correctly inserted and can be connected.

4.6.2 Installed with Terminal Panels

⚠ DANGER

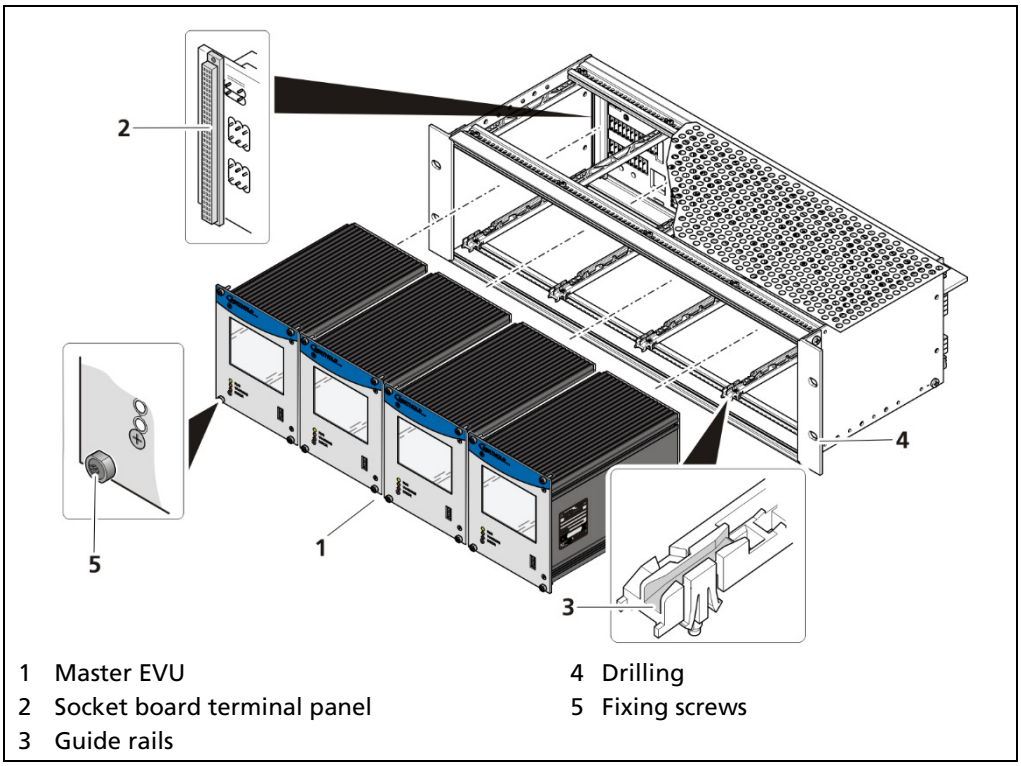
Danger to life from electric shock!

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

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

NOTICE

- The master's EVUs / slave modules must be secured against pulling out by fixing screws (Fig. 17, item 5).
- The device must be disconnected from the mains voltage before it is pulled out.



1 Master EVU
2 Socket board terminal panel
3 Guide rails
4 Drilling
5 Fixing screws

Fig. 17 19" subrack with terminal panel (Ex.: 4x master)

1. Set master EVU / slave module (Fig. 17, item 1) into the guide rails (Fig. 17, item 3).
2. Carefully slide module into the subrack until the plug connector is inserted into the socket board (Fig. 17, item 2).
3. Tighten fixing screws (Fig. 17, item 5).
4. Unused slots must be covered with dummy panels.

- The EVU is correctly inserted and can be connected.

5 Electric Installation

5.1 General Instructions

⚠ DANGER

Danger to life from electric shock!

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

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

NOTICE

Apply the voltage of the specified and marked range only!

The relay of the LB 470RID can only switch low voltages. Please note the specifications in appendix Technical Information.

NOTICE

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

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

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

General important points for installation

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

5.1.1 Circuit Breaker

A circuit breaker according to DIN EN 61010-1

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

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

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

IMPORTANT

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

5.1.2 Cables and Lines

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

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

When routing the connection lines, make sure that

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

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

5.1.3 Cable Glands and Blanking Elements

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

5.1.4 Protective Earth and Equipotential Bonding

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

5.1.5 EIA-485 (RS-485) Network

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

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

5.2 Exchange LB 44x to LB 47x

NOTICE

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

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

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

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

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

Fig. 18 Assignment clamp block at exchange LB 44x -> LB 47x

NOTICE

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

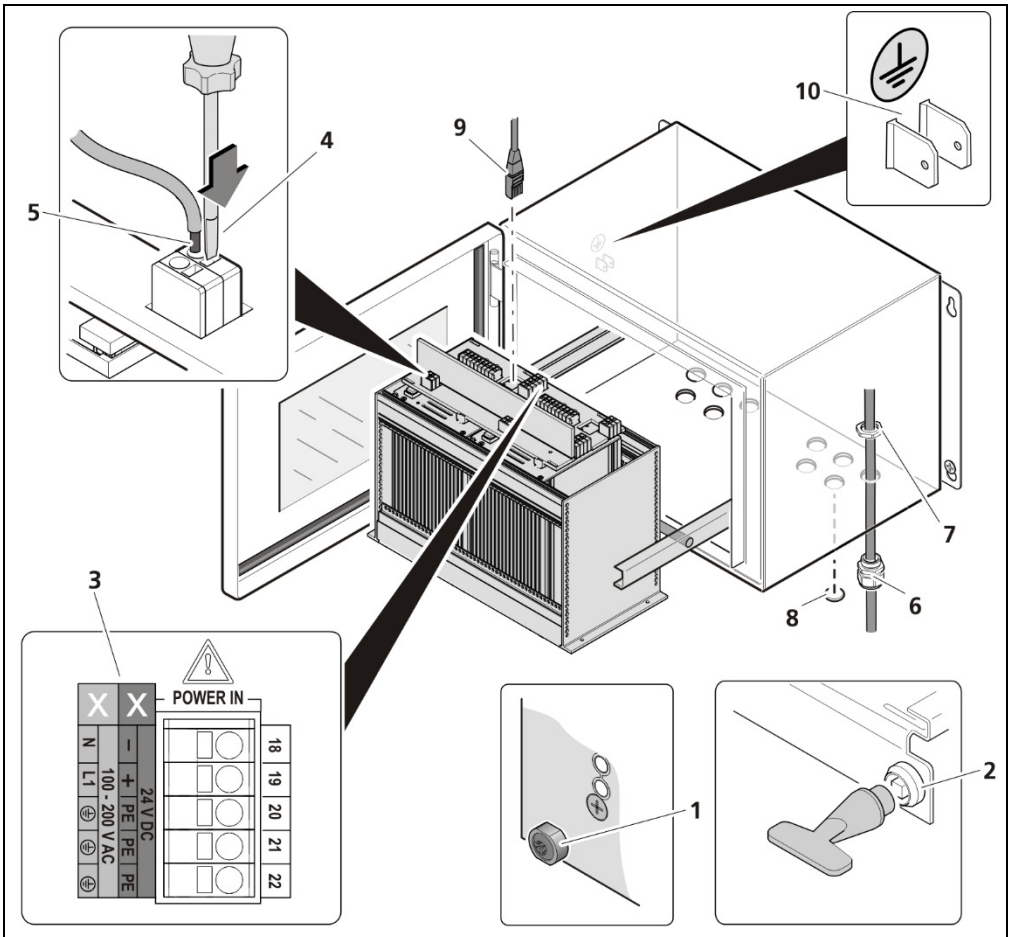
5.3 Electric Connection in the Wall Housing

⚠ DANGER

Danger to life from electric shock!

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

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



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

Fig. 19 Electrical connection in the wall housing

1. Make sure that the locking bolts (Fig. 19, item 1) of all modules are tightened in order to prevent slipping.
2. Loosen the lock (Fig. 19, item 2) using the supplied square key and pull the subrack out.
3. Fold the subrack downward cautiously.

4. Run the cables through the cable glands (Fig. 19, item 6) through the openings of the wall housing and through the counternut cable glands (Fig. 19, item 7).
5. Screw the cable glands (Fig. 19, item 6) with the counternut cable glands (Fig. 19, item 7).

NOTICE

Apply the voltage of the specified and marked (Fig. 19, item 3) range only!

NOTICE

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

6. Connect the lines according to assignment (see 2.3 Connection Diagram Terminal Board Master/Master or 2.4 Connection Diagram Terminal Board Master/Slave in "Technical Information").
7. Open the terminal connection (Fig. 19, item 4) with an operating tool (slotted screwdriver) and insert the stripped wire (min. 8 mm) (Fig. 19, item 5). The terminal connection closes by pulling out the operating tool. The terminal connections are designed for the flexible wires:
   - 0.2 mm² … 2.5 mm² or AWG 24 …12 without end sleeve
   - 0.25 mm² ... 2.5 mm² with end sleeve without plastic sleeve
   - 0.25 mm² ... 1.5 mm² with end sleeve with plastic sleeve.
8. Plug the network plug into the RJ45 socket (Fig. 19, item 9) (optional).
9. Tighten all cable glands (Fig. 19, item 6) to ensure optimal sealing and tension relief until the gasket insert closes between screw down nut and cable.
10. Check tension relief of all cable glands by pulling the cables smoothly.

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

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

NOTICE

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

NOTICE

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

Tip

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

▶ The connection was made correctly.

5.4 Electrical Connection in a 19" subrack with Terminal Board

⚠ DANGER

Danger to life from electric shock!

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

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

NOTICE

Prior to initial start-up, the voltage range (Fig. 20, item 8) must be marked with chemical resistance on all input and output terminals!
Only cable that is suitable for connection to the corresponding terminals may be used. Detailed specifications can be found in the chapter 5.1.2 Cables and Lines.

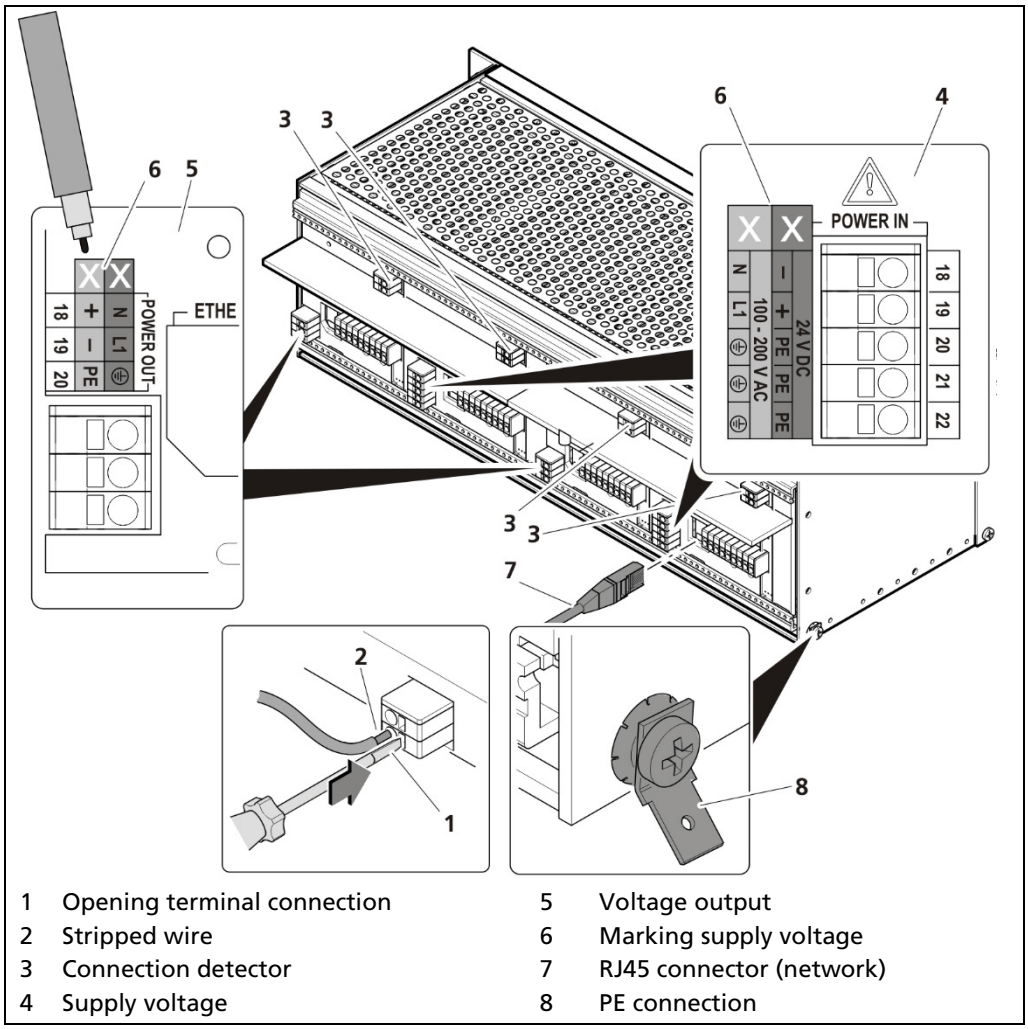
The 19" subrack must be accessible from the rear for the electrical installation.

The terminal board master/slave is used twice (Fig. 20, item 2) for the variant to install 2 master EVUs and 6 slave modules.

The terminal board master/master (Fig. 20, item 1) is used twice for the variant to install 4 master EVUs.

master / master
CHANNEL A
CHANNEL B
CHANNEL C
CHANNEL D

master / 3x slave
CHANNEL A
CHANNEL B



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

Fig. 20 Electrical connection in the 19" subrack

NOTICE

Apply the voltage of the specified and marked (Fig. 20, item 6) range only!

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

1. Unused slots must be closed with blinds.
2. Label the voltage range permanently and chemically (Fig. 20, item 6).
3. Connect the lines according to assignment to the terminal board (see 2.3 Connection Diagram Terminal Board Master/Master or 2.4 Connection Diagram Terminal Board Master/Slave in “Technical Information”). The protective conductor must be connected to all connections marked PE.
4. Open the terminal connection (Fig. 20, item 1) with an operating tool (slotted screwdriver) and insert the stripped wire (min. 8 mm) (Fig. 20,item 2). The terminal connection closes by pulling out the operating tool. The terminal connections are designed for flexible wires:
   - 0.2 mm² ... 2.5 mm² / AWG 24 ... 12 without ferrules
   - 0.25 mm² ... 2.5 mm² with ferrules without plastic sleeves
   - 0.25 mm² ... 1.5 mm² with ferrules with plastic sleeves
5. Plug the network plug into the RJ45 socket (Fig. 20, item 7) (optional).
6. Check the correct connection of the PE conductor (Fig. 20, item 8).

NOTICE

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

- The connection was made correctly.

5.5 Electrical connection in the 19” subrack with clamp block

⚠ DANGER

Danger to life from electric shock!

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

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

If the 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

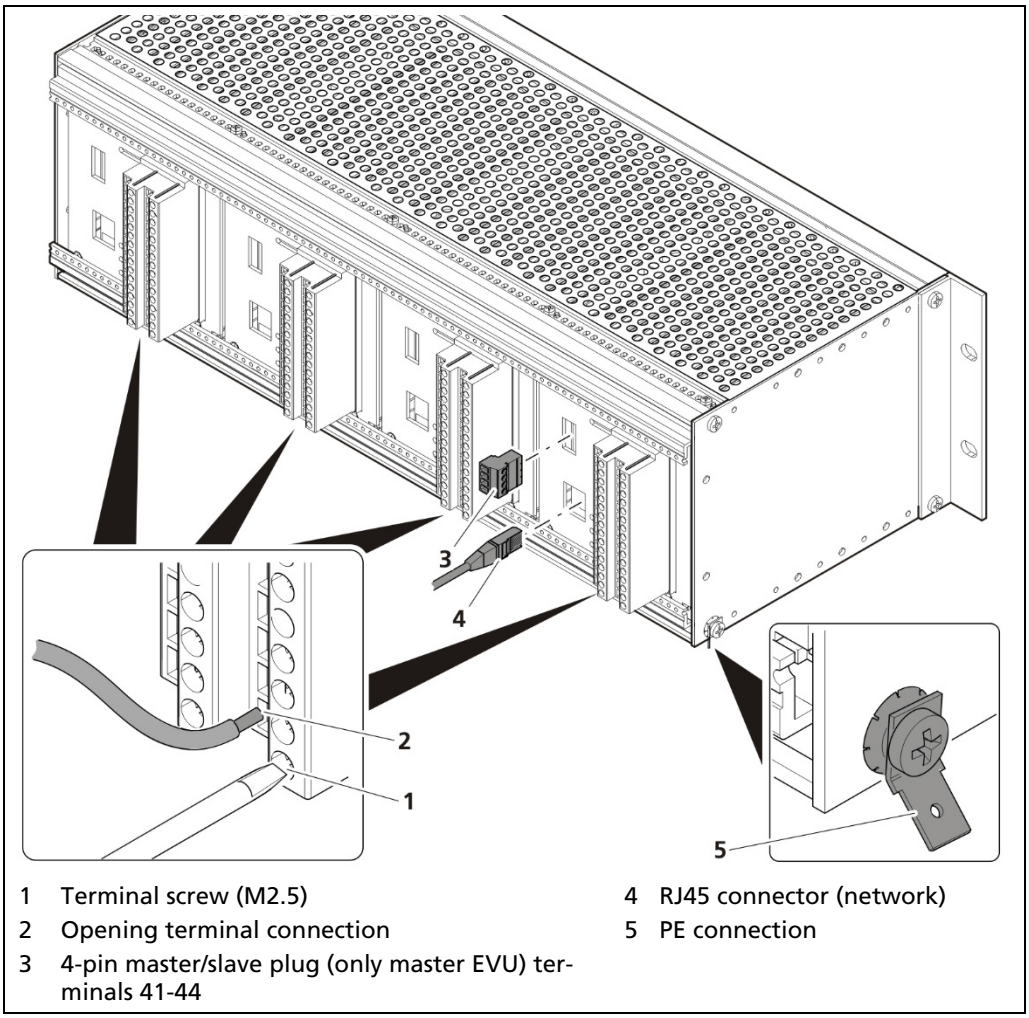
In the case of applications with clamp blocks a contact protection must be provided by the customer when voltage is applied. The cable connections of clamp blocks have to be in accordance with IEC 61010-1 (2010).

The connection between the master EVU and slave modules is made with a 4-pin master/slave plug (see chap. 5.5.1).

NOTICE

The LB 470RID is restricted pin-compatible with the terminals of the LB 440RID. The pins for the power supply, the probe interface and the current output are at the same position. If only those ports are used, then a LB 440RID can be replaced by a LB 470RID without re-wiring.

- Note information in chapter 5.2 Exchange LB 44x to LB 47x.



1 Terminal screw (M2.5)
2 Opening terminal connection
3 4-pin master/slave plug (only master EVU) terminals 41-44
4 RJ45 connector (network)
5 PE connection

Fig. 21 Electrical connection in the 19" component rack (Ex.: 4x Master)

1. Unused slots must be closed with blinds.
2. Connect the lines to the clamp blocks according to assignment (see 2.5 Assignment Terminal Block Master EVU or 2.6 Assignment Terminal Block Slave in "Technical Information"). To ensure protection against accidental contact in accordance with EN61010-1, the rear side with the terminals must be covered with a protective cover, e.g. with a door of a 19" cabinet.
3. Open the terminal screw (Fig. 24, item 1) and insert the stripped wire (min. 8 mm).

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

4. Screw the terminal screw with a tightening torque of 0.4 - 0.5 Nm.
5. Plug in the master/slave plug and reconnect the lines in accordance with assignment (chap. 5.5.1).
6. Plug the network plug into the RJ45 socket (Fig. 24, item 4) (optional).
7. Check the correct connection of the PE conductor (Fig. 24, item 5).

NOTICE

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

▶ The connection was made correctly.

5.5.1 Master/Slave Plug

The master/slave plug is used by applications with terminal blocks. Further information on the connection can be found in chapters 2.5 Assignment Terminal Block Master EVU and 2.7Assignment Terminals Master/Slave Plug under “Technical Information”.

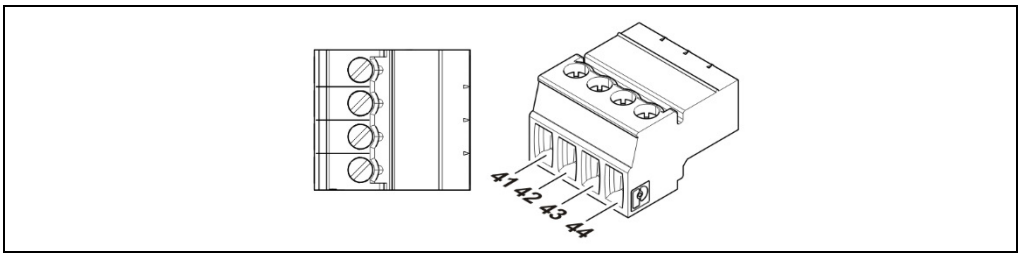


Fig. 22 Assignment Terminals master/slave plug

5.6 Switching Current Output

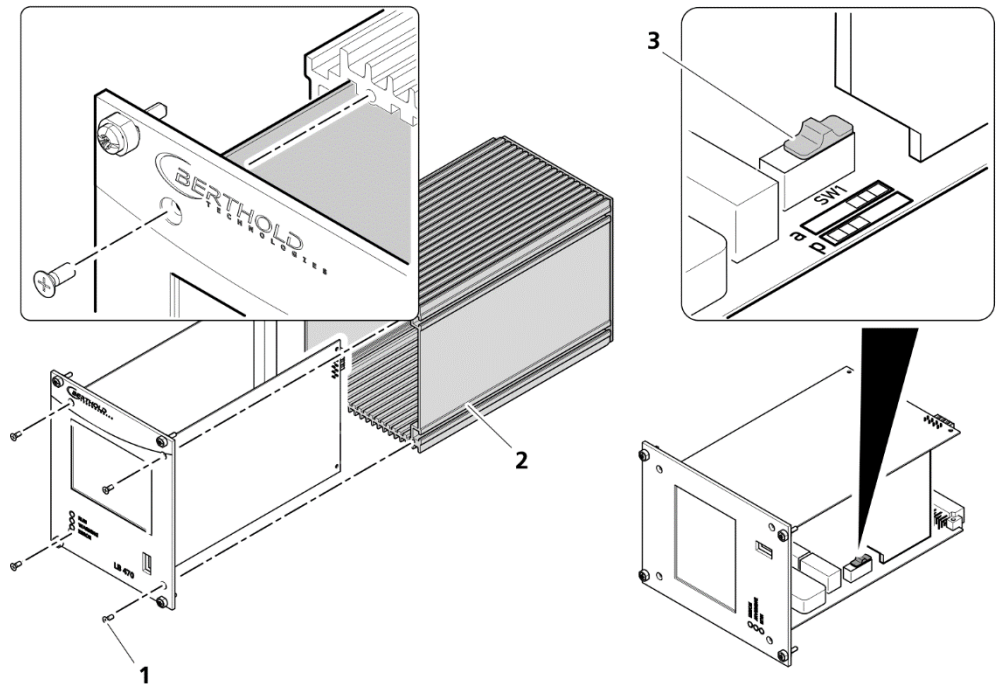
Switching between "SOURCE" (active) and "SINK" (passive) is possible using the slide switch on the I/O board. Factory setting EVU is delivered in "SOURCE" mode. Please note that the polarity at the current output must be inverted as soon as the current output is switched at the switch.

⚠ DANGER

Danger to life from electric shock!

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

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



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

Fig. 23 Switching of the current output

1. Loosen the four sunken screws on the front side of the EVU (Fig. 23, item 1).
2. Pull out the housing (Fig. 23, item 2) carefully.
3. Slide the switch (Fig. 23, item 3) to position ***a*** for "active" (SOURCE), to position ***p*** for "passive" (SINK).
4. Carefully insert the front panel into the housing. Pay attention to the correct guide rail!
5. Screw the front panel to the housing (Fig. 23, item 2) with the four screws (Fig. 23, item 1).

- The switching has been carried out correctly.

6 Operation of the Software

6.1 System Start

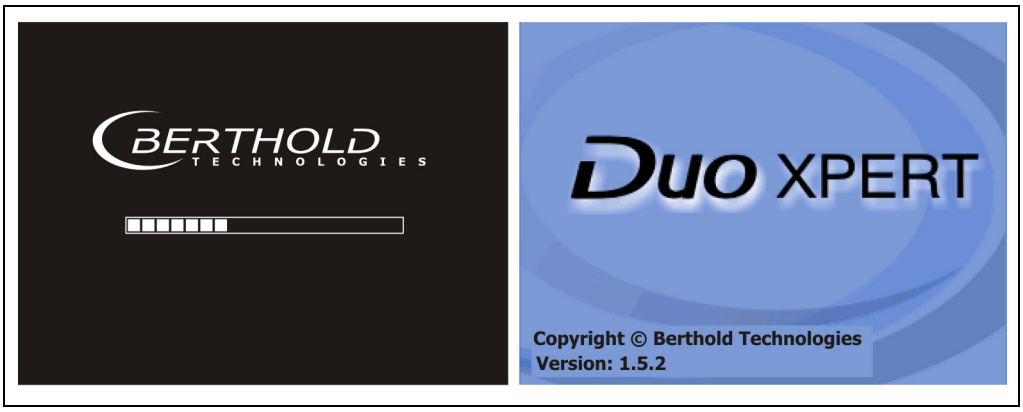


Fig. 24 Start screens with display of the software version

System start with invalid application software

A different menu structure is present in this mode.

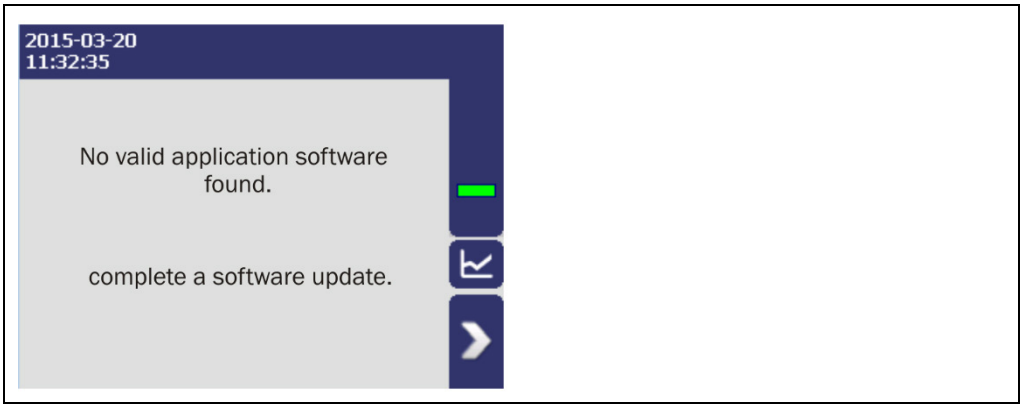


Fig. 25 Start screen (Invalid application software)

IMPORTANT

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

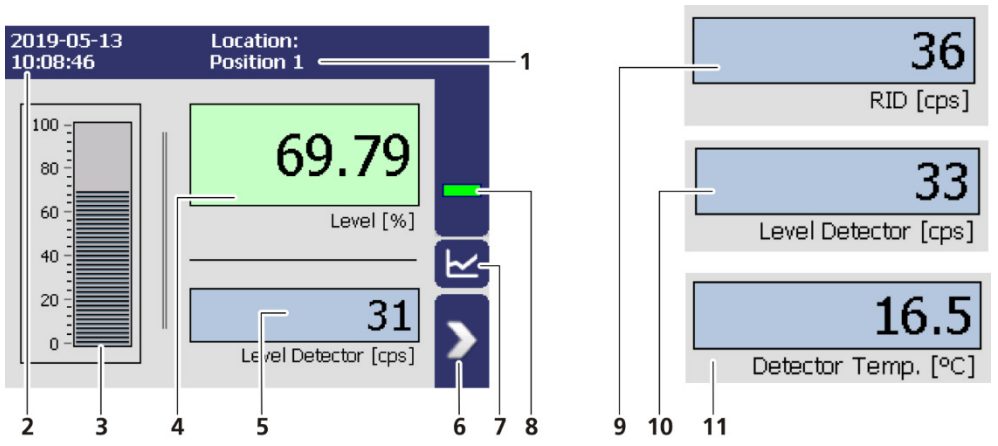
All set values as well as the calibration data are stored in a non-volatile memory.

The real-time clock for date and time is buffered via a capacitor and continues to run for up to approx. 4 weeks even when the device is switched off. See also "Date and time" on page 72.

6.2 EVU Standard Display

IMPORTANT

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

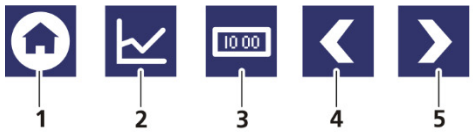


1	Description of the measuring point	7	Button “Diagram”
2	Date and Time	8	State information
3	Level scale	9	Count rate RID [cps]
4	Process value	10	Count rate level detector [cps]
5	Count rate	11	Temperature detector
6	Button “Menu”		

Fig. 26 Standard display of the EVU

Location	Name of the measuring point in the menu Device Setup | Identification.
Date and Time	The date and time displayed in the menu Device Setup | Setup | System | Date/Time was set.
Level scale	The scale range of the set PV value in the menu Device Setup | Setup | System | Calibration | Calibration Settings displayed.
Process value	The current process value with the set unit in the menu Device Setup | Setup | System | Calibration | Units displayed.
Count rate [cps]	The current count rate is displayed. Click on the blue field to switch between count rate, RID count rate and product temperature.
Count Rate RID [cps]	"RID [cps]" shows the average count rate in the secondary channel.
Count Rate level detector [cps]	"Level Detector [cps]" displays the total count rate in the measurement channel (MC) of all connected level detectors. The measured value is displayed averaged.
Temperature detector	Display of the current temperature of the detector with the in the menu Device Setup | Setup | System | Units selected unit.
Button “Menu”	The main menu opens
Button “Diagram”	The view changes to the diagrams
Status information	The current system status is displayed.

6.3 Navigation



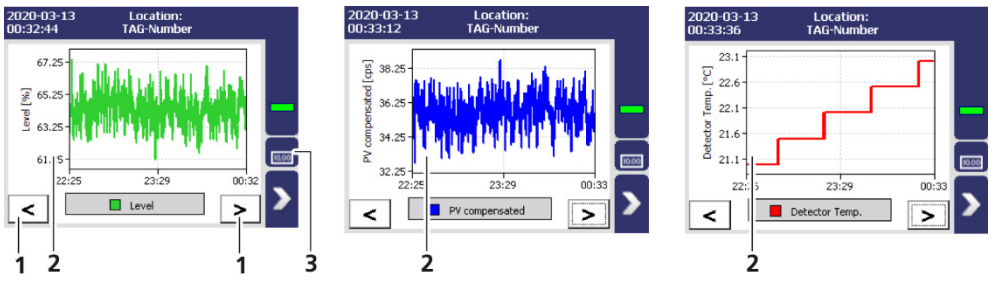
1 Home (standard display)
2 Diagram display
3 Data
4 One menu level back
5 One menu level forward

Fig. 27 Icons for navigation

6.3.1 Diagram Display

Clicking the diagram symbol (Fig. 26, item 5) changes the view to the diagram display. The arrow keys (Fig. 28, item 1) are used to switch between the diagrams Level – Count Rate – Detector Temperature.

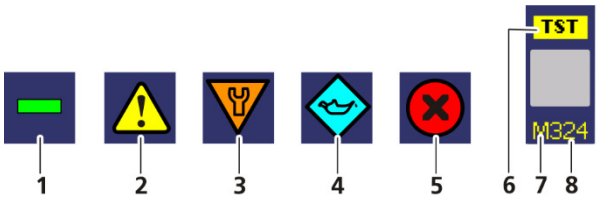
Clicking the display symbol (Fig. 28, item 3) changes the view to the standard display.



1 Arrow keys
2 Diagrams
3 Standard display

Fig. 28 Diagram display of the EVU

6.3.2 Status Messages



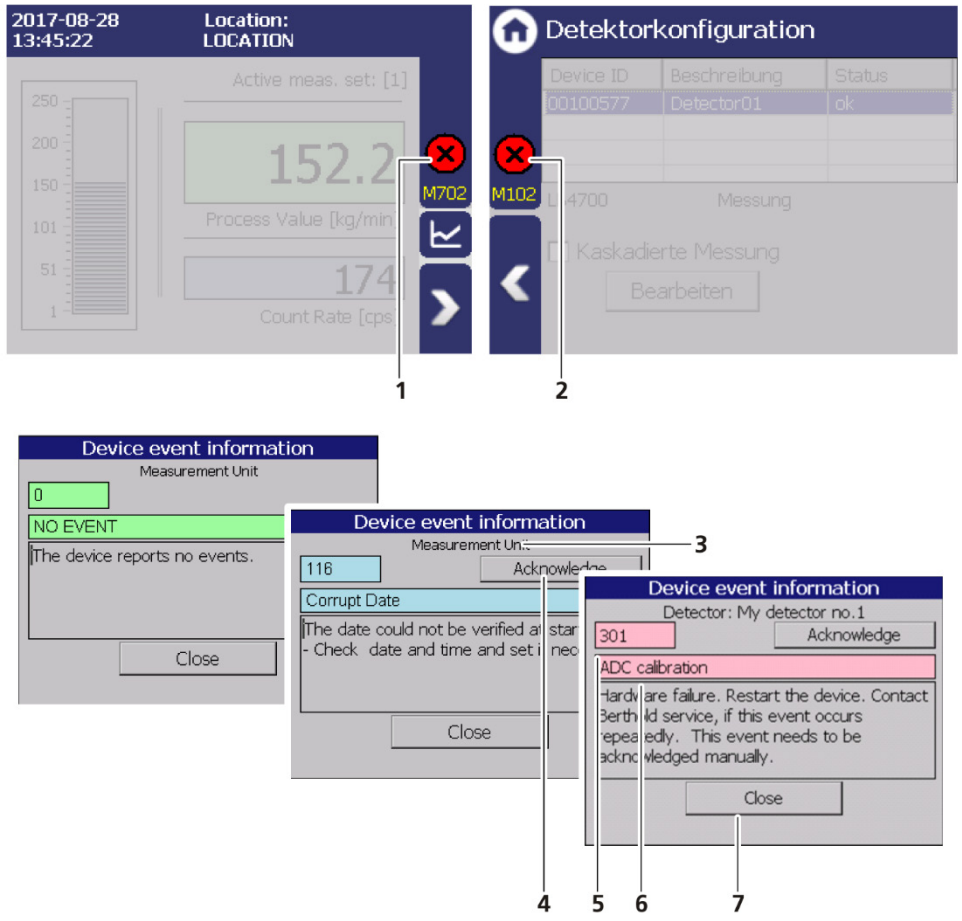
1	No event	5	Failure (error)
2	Outside of specification	6	Information test (simulation)
3	Function check	7	Character D (detector) or M (measuring unit)
4	Maintenance required	8	Event code

Fig. 29 Status messages

6.3.3 Event Reports

Events are displayed in the standard display and in the submenus and windows as a symbol. All events are displayed on the main screen. A specific “D” (for detector) indicates that a detector has an event, the prefix “M” (for measuring unit) indicates that there is an event in the LB 470RID transmitter. In the event of a detector fault, the operating manual of the detector must be observed.

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



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

Fig. 30 Event reports (examples)

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.

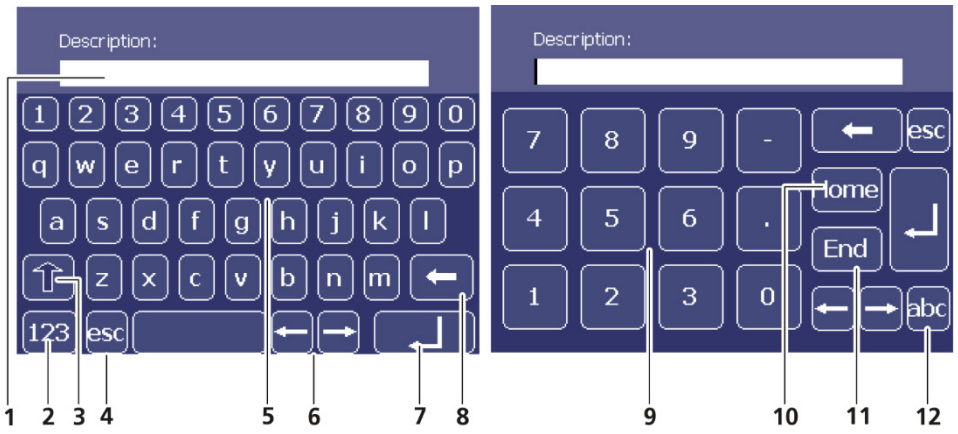
IMPORTANT

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

6.4 Input Field

NOTICE

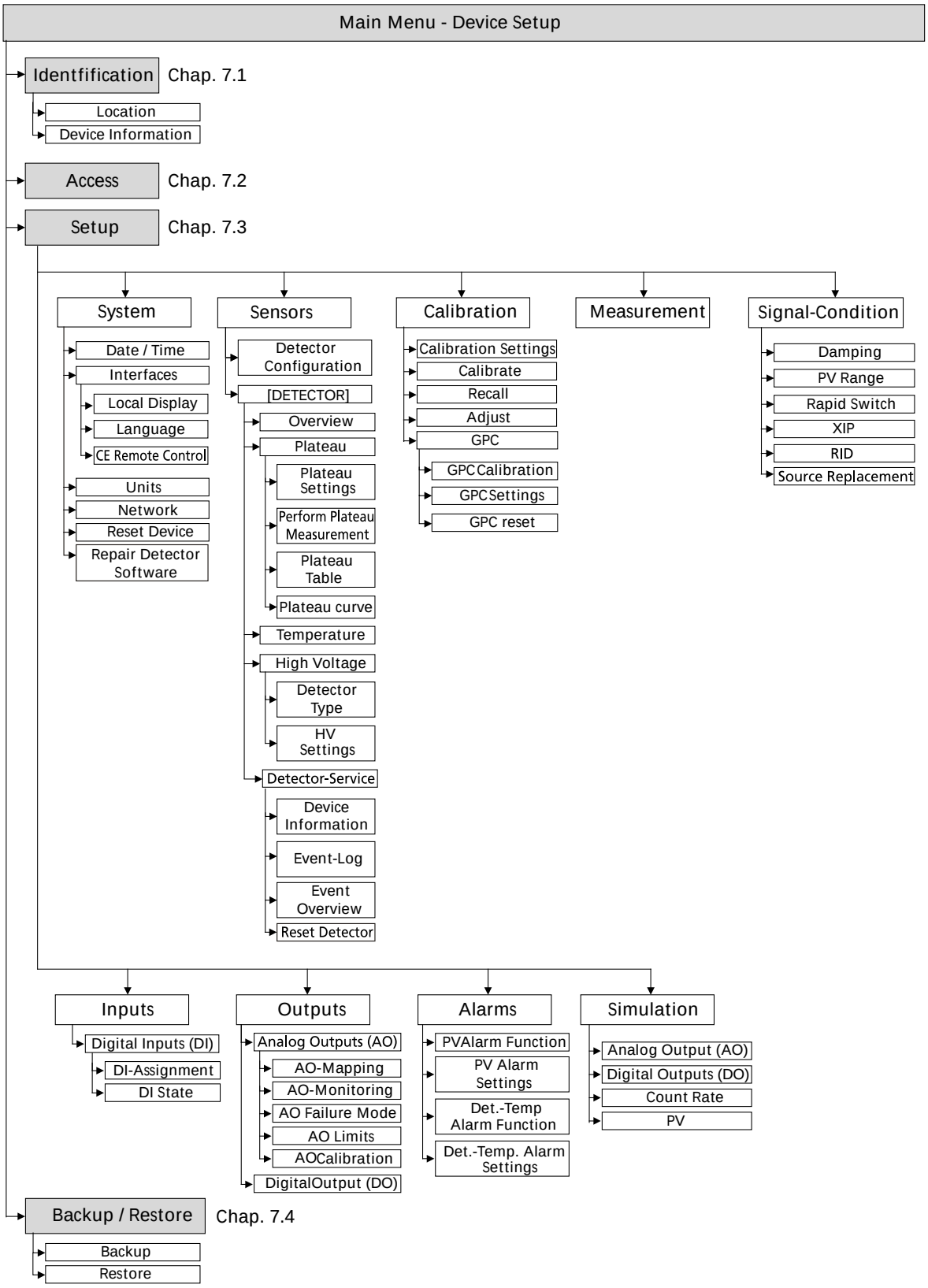
The input field appears by clicking on the blue display panels.



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

7 Main Menu Device Setup



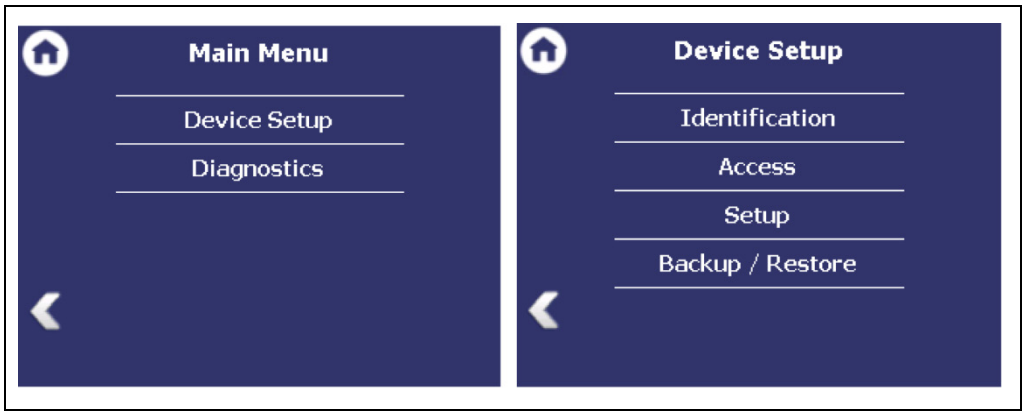


Fig. 32 Menu “Main Menu”, "Device Setup"

7.1 Menu Identification

Device Setup | Identification

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

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

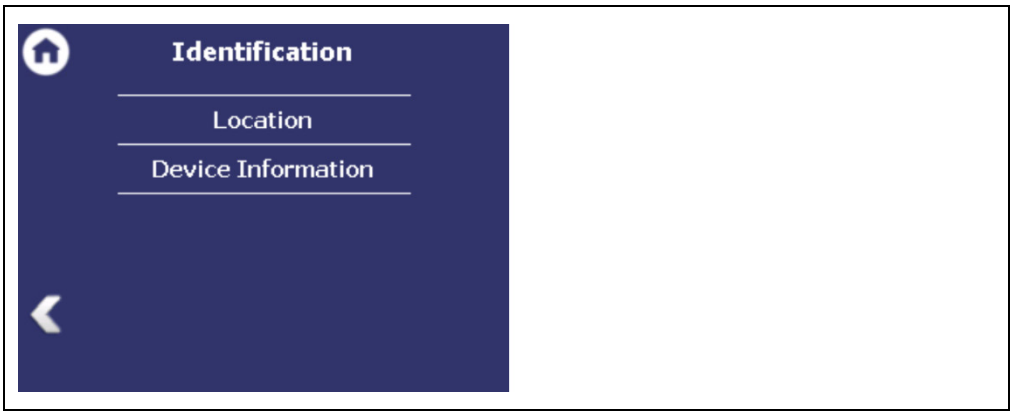
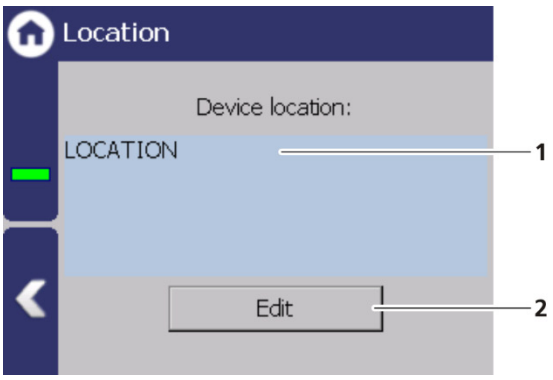


Fig. 33 Menu "Identification"

7.1.1 Location

Device Setup | Identification | Location

The location of the evaluation unit is displayed (Fig. 34, item 1) in the “Location” menu. The name can only be edited (7.2 Menu Access) in the access level "Standard". The Location is displayed on the EVU standard display (Fig. 26, item 1).



1 Name Device location
2 Button <Edit>

Fig. 34 Device Location

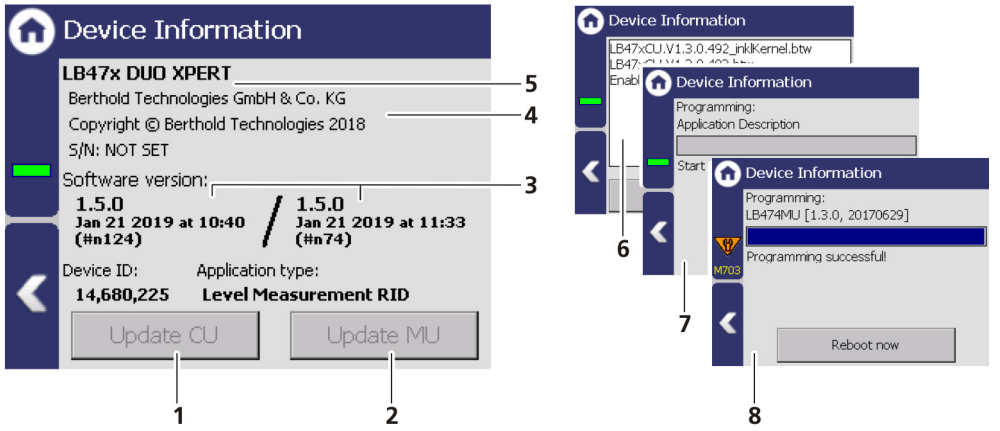
1. Click <Edit> (Fig. 39, item 2) to open the input field.
2. Enter a location name for the evaluation unit.
3. Confirm with the Enter key.

▶ The name has been changed.

7.1.2 Device Information

Device Setup | Identification | Device Information

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



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

Fig. 35 Device Information

7.1.3 Perform Software Update

NOTICE

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

NOTICE

Settings are deleted!

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

Tip

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

Perform CU Update

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

IMPORTANT

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

3. In the “Device Setup” menu, click on “Device Information” (Device Setup | Identification | Device Information).
4. The USB storage device is recognized by the system after a few seconds and the <CU Update> (Fig. 35, item 1) button can be clicked.

- The selection window “update file” (Fig. 35, item 6) opens.

5. Select the appropriate file and click on the button <CU Update> (Fig. 35, item 1). Confirm with <Yes>.
6. The update is performed and the measurement is interrupted.

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

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

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

NOTICE

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

Perform MU Update

1. Save the current update file of the MU software on a USB storage device.
2. Connect a USB storage device to the front of device (Fig. 4, item 5).
3. In the “Device Setup” menu, click on “Device Information” (Device Setup | Identification | Device Information).
4. The USB storage device is recognized by the system after a few seconds and the <MU Update> (Fig. 35, item 2) button can be clicked.

▶ The selection window “update file” (Fig. 35, item 6) opens.

5. Select the appropriate file and click on the button <MU Update> (Fig. 35, item 2). Confirm with <Yes>.

▶ The update is performed and the measurement is interrupted.

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

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

NOTICE

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

7.2 Access

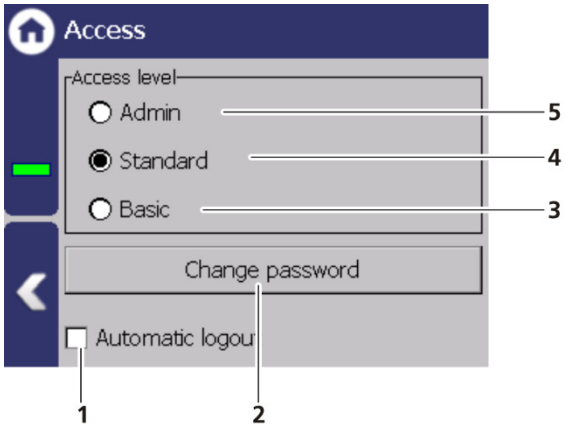
Device Setup | Access

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

IMPORTANT

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

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



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

Fig. 36 Access

The following user levels are available to you:

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

User Level Admin	This access 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).

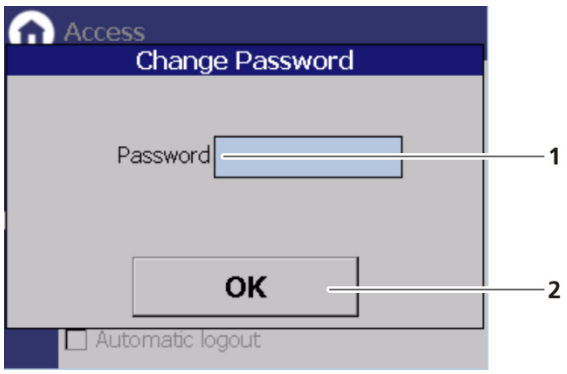
NOTICE

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

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

Assign / change password

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



1 Input field
2 Button <OK>

Fig. 37 Change password

1. Click on the text field (Fig. 37, item 1.) to open the input field.
2. Enter a password (case-sensitive!).
3. Confirm with the Enter key.
4. Click <OK> (Fig. 37, item 2) to confirm.

▶ The password has been set / changed.

7.3 Menu Setup

Device Setup | Setup

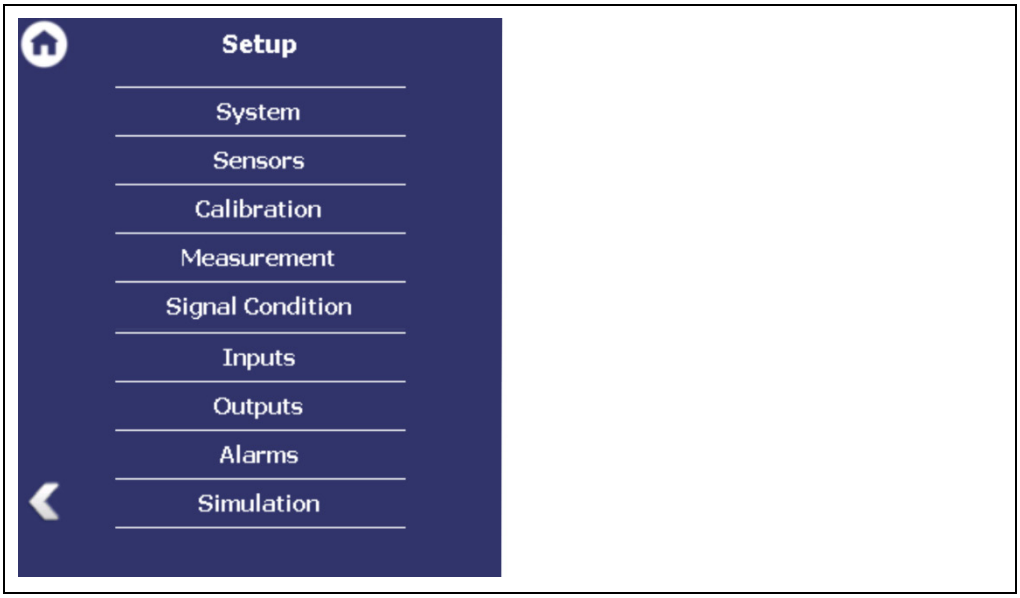


Fig. 38 Menu "Setup"

7.3.1 System (Date / Time, Interfaces, Units, Network, Reset, Repair Det. Software)

Device Setup | Setup | System

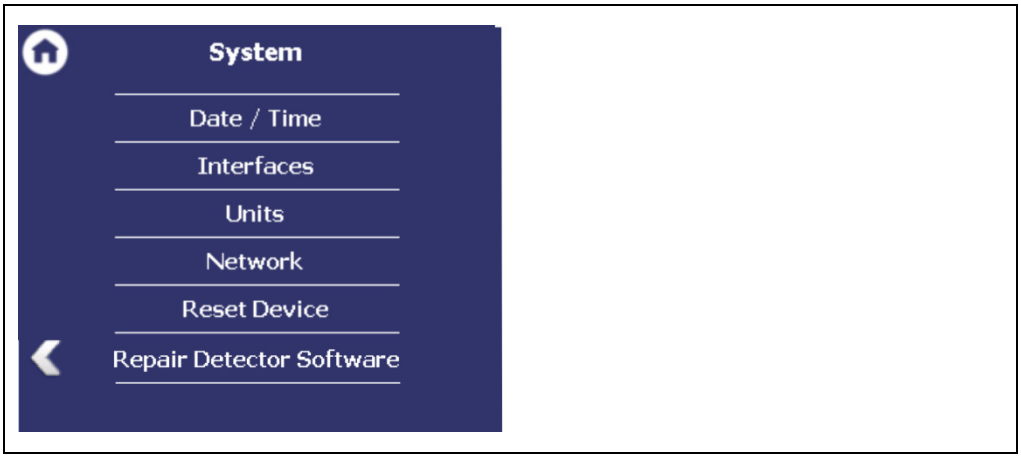


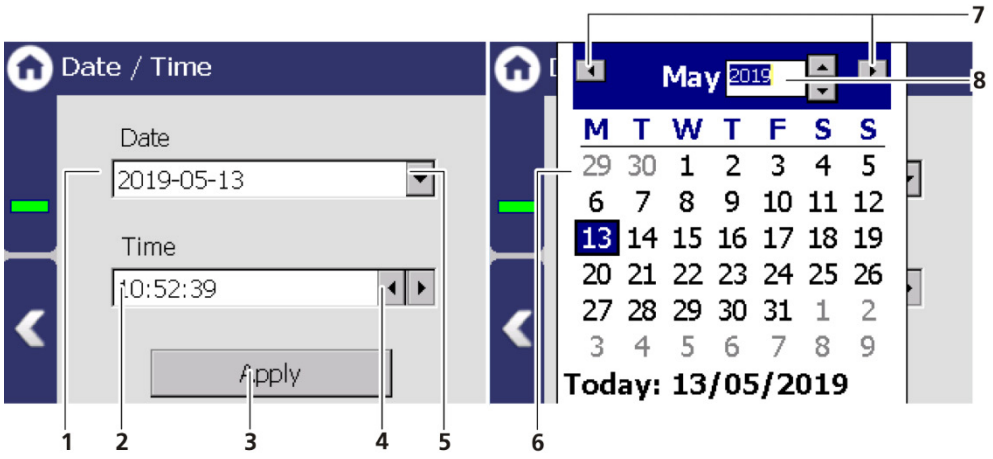
Fig. 39 Submenu "System"

Set Date and Time

Device Setup | Setup | System | Date / Time

IMPORTANT

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



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

Fig. 40 Date / Time, calendar

1. Click on the arrow key (Fig. 40, item 5) in order to set the date.
   ▶ The calendar is opened (Fig. 40, item 6).
2. Click on the year number (Fig. 40, item 8) in order to enter the year.
3. Set the month (Fig. 40, 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. 40, item 4).
6. Click on <Apply> (Fig. 40, item 3), to accept the date and time settings.
   ▶ Date and the time have been set

NOTICE

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

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

Interfaces

Device setup | Setup | System | interfaces

You can adjust the following settings in the submenu “Interfaces” (Fig. 41):

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

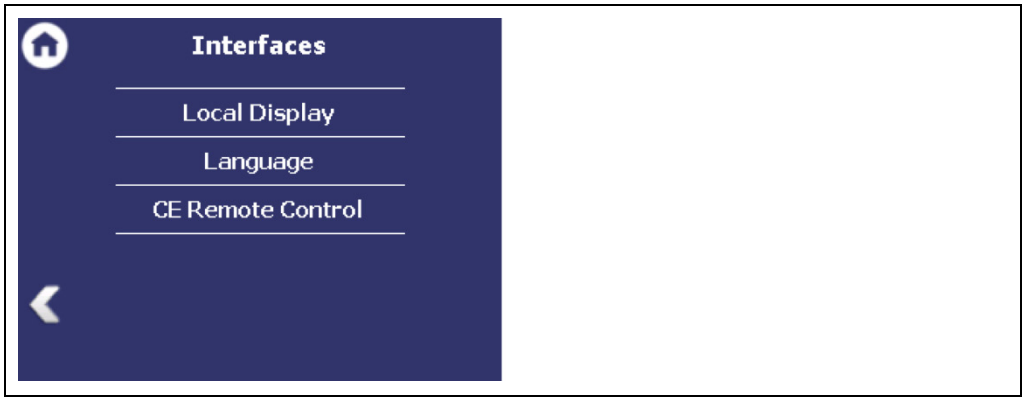


Fig. 41 Menu “Interfaces”

Local Display

Device setup | Setup | System | Interfaces | Local Display

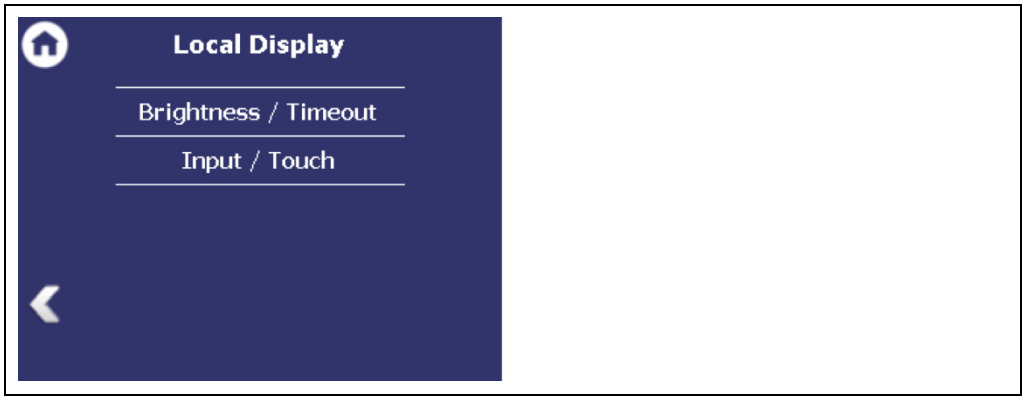
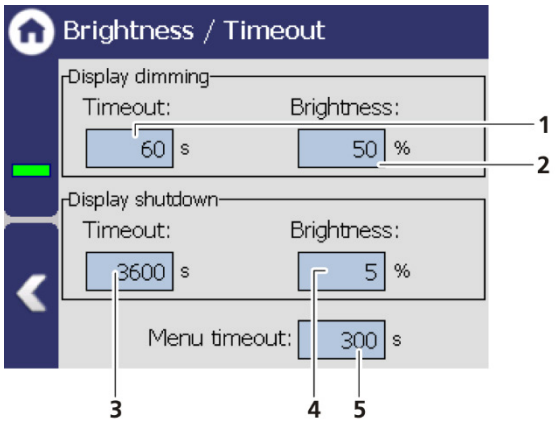


Fig. 42 Submenu "Local Display"

Brightness / Timeout

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

"Timeout" refers to the period of time during which the display is not operated. The value "Time out display brightness" cannot be set greater than the value at "Time out display switch-off".



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

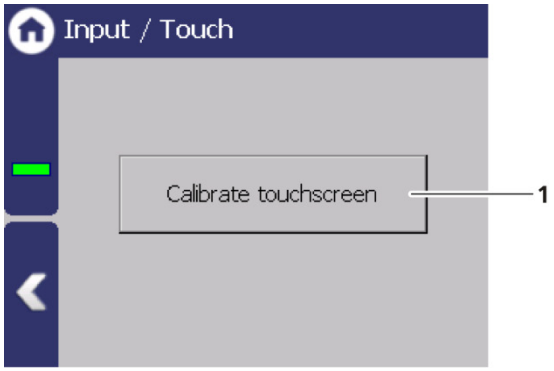
Fig. 43 Brightness / Timeout

Display dimming	In the field Display dimming, clicking the input fields allows the entering of the brightness (Fig. 43, item 2) in percent, that is set after expiry of the time (Fig. 43, item 1).
Display shutdown	In the field Display shutdown, clicking the input fields allows the entering of the brightness (Fig. 43, item 4) in percent, that is set after expiry of the time (Fig. 43, item 3).
Menu timeout	Under "Menu timeout" clicking on the input field (Fig. 43, item 5) changes the time period (seconds) in which the menu view changes to the standard view.

Input / Touch

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

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



1 Button <Calibrate touchscreen>

Fig. 44 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. Calibration via the remote control software is not possible.

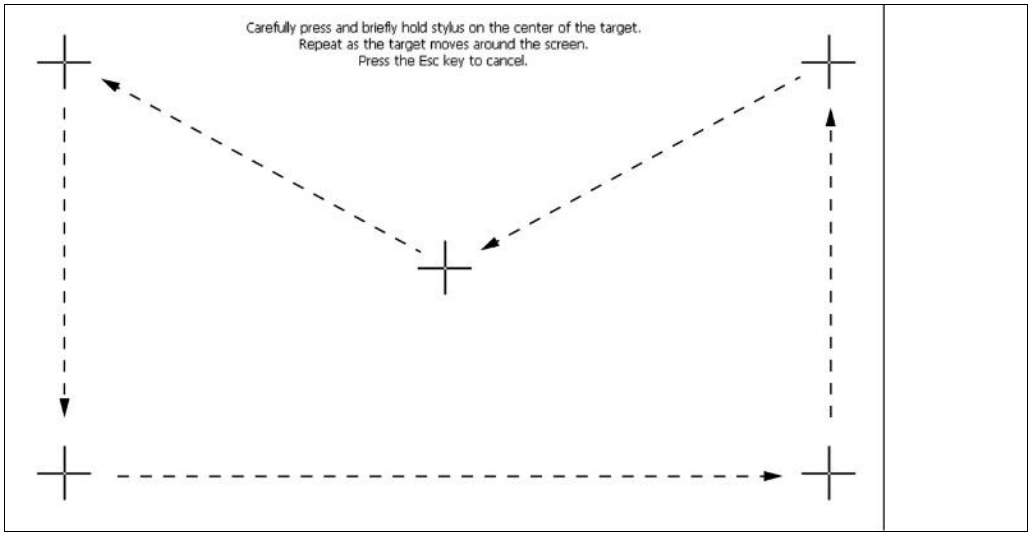


Fig. 45 System menu, Settings - Display (Calibrate touch display)

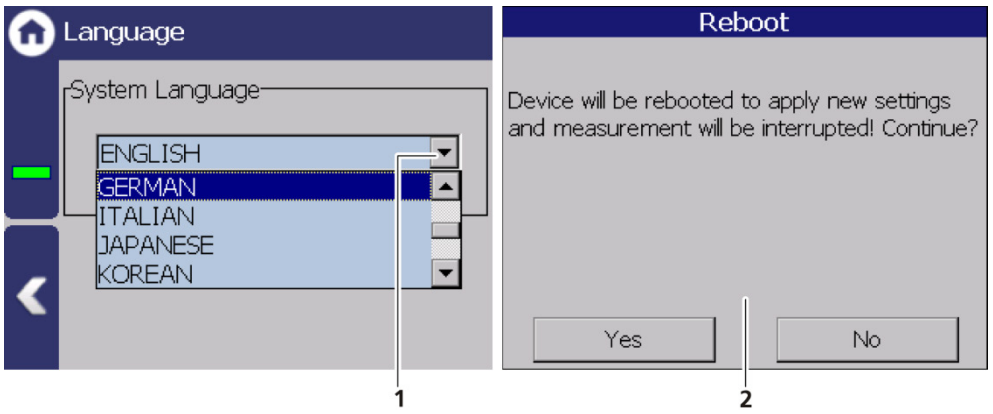
1. Click on <Calibrate touchscreen>.
   - ▶ The calibration screen opens.
2. Press the middle of the displayed cross with your finger.
   - ▶ If you take your finger off the cross again, the cross jumps to the top left corner.
3. Repeat the process until the cross is no longer displayed and the calibration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

4. Confirm the calibration by clicking on the white screen to go back to "Input/Touch"
5. Execute a restart of the EVU after prompting.

▶ The touch display is calibrated.

Language

Device Setup | Setup | System | interfaces | Language



1 Selection arrow
2 Information window

Fig. 46 Language

Change System Language

1. Click on the selection arrow (Fig. 46, item 1) and select a language.

▶ An information window “Restart” appears.

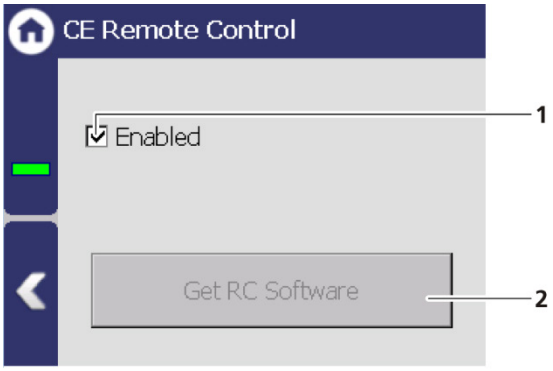
2. Confirm with <Yes> to restart the device.

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

CE Remote Control

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

By activating (Fig. 47, item 1) the CE Remote Control, the unit can be operated via the network connection. The software of the remote control (RC software) is stored on the device and can be copied to a USB storage device.



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

Fig. 47 Remote Control

Copy RC software

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

▶ The USB storage device is recognized by the system after a few seconds and the button <Get RC software> (Fig. 47, item 2) can be clicked.

2. Click on the button <Get RC software> (Fig. 47, item 2).

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

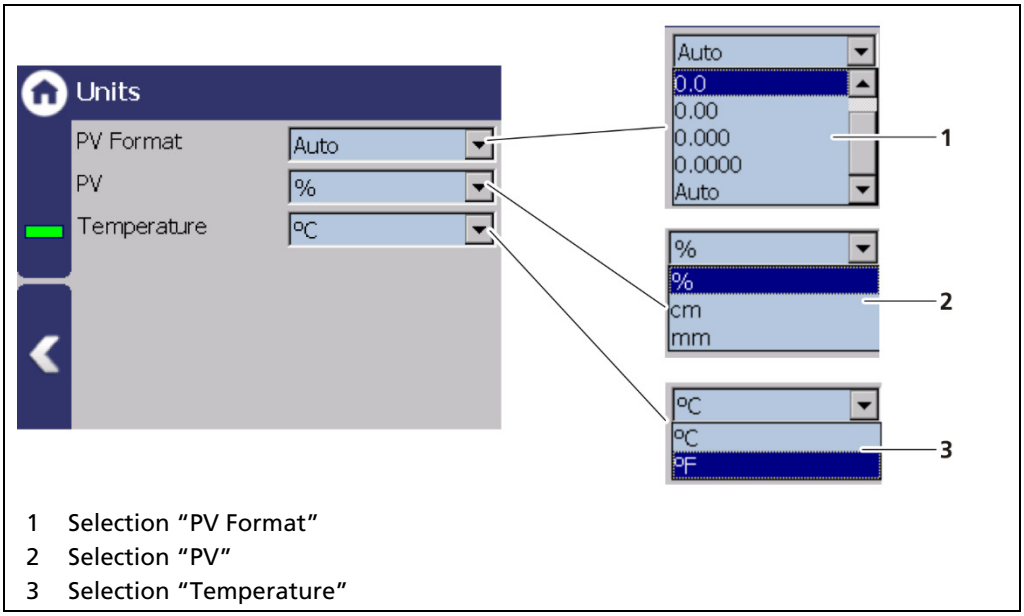
Information

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

Units

Device Setup | Setup | System | Units

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



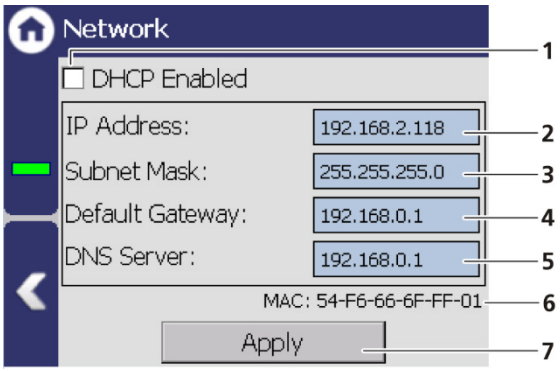
1 Selection “PV Format”
2 Selection “PV”
3 Selection “Temperature”

Fig. 48 Units

Network

Device Setup | Setup | System | Network

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



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

Fig. 49 Network settings

You can set the network address either manually or using DHCP (automatic assignment). To do this, check the "DHCP active" in the selection field (Fig. 49, item 1).

IMPORTANT

The PC and the LB 47x have to be in the same IP subnet.
In the event of an automatic assignment of the IP address by a DHCP server, you can only look at the given IP address. A modification of the IP address is not possible. On this side, you can also read the MAC address of the device (Fig. 49, item 6).

Manual Setting

1. Click on the text field (Fig. 49, 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. 49, item 7) to adopt the network settings.

IMPORTANT

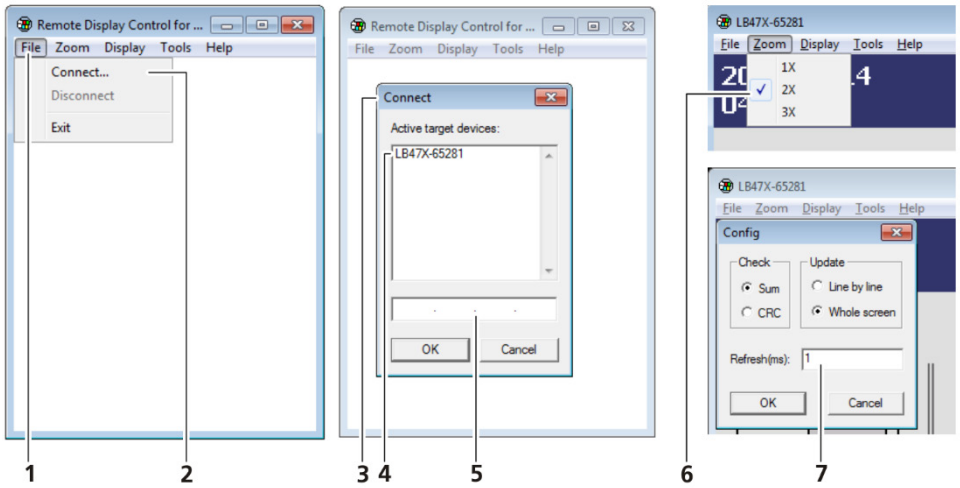
All settings performed must be confirmed by clicking on <Apply> so that the settings become real.

Remote Control Software

If the EVU is connected to a network at the RJ45 socket (Fig. 5, 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. 47, item 1).



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

Fig. 50 Establishing connection to the EVU using the RC software

1. Click on "LB47xRemoteControl.exe", to start the program.
   - The program starts (Fig. 50, item 1).
2. Click on the <File> tab and then on <Connect…> (Fig. 50, item 2), to establish a connection to the EVU.
   - A new window “Connect” is opened (Fig. 50, item 3) and the connected transmitters are listed.

IMPORTANT

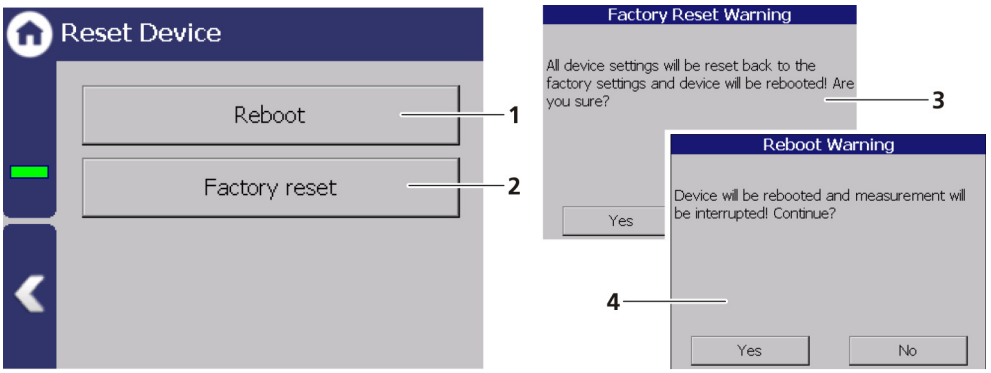
The IP address of the EVU must be in the same sub-network (Fig. 49, item 3) as the network adapter of the computer (see previous Chapter “Network”).

3. Click on the identifier of the transmitter (Fig. 50, item 4) or enter the IP address of the EVU in the input box (Fig. 50, item 5) (see Fig. 50, item 2).
4. Click on <OK>.
   - The connection to the EVU is established.
5. You can enlarge the view in the “Zoom” menu (2x,3x). In the menu "Tools | Config“ you can change the display refresh rate.

Reset Device (Evaluation Unit)

Device Setup | Setup | System | Reset Device

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



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

Fig. 51 Reset device

Restart Device

IMPORTANT

The measurement is interrupted during a restart!

1. To restart the device, click the button <Restart> (Fig. 51, item 1).
   - A window with a warning "Restart" (Fig. 51, item 3) opens.
2. Click on <Yes> to confirm.
   - The device is restarted.

Reset Device (Factory Reset)

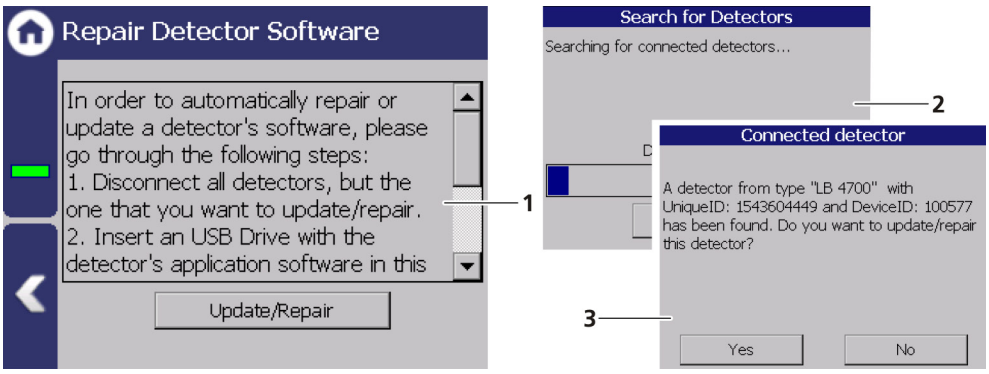
IMPORTANT

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

1. To reset the evaluation unit to the factory settings, click the button <Factory settings> (Fig. 51, item 2).
   - A window with the warning "Factory settings" (Fig. 51, item 4) opens.
2. Click on <Yes> to confirm.
   - The device is reset to factory settings and restarts.

Repair Detector Software

Device Setup | Setup | System | Repair Detector Software



1 Description Update / Repair
2 Process "Search for Detectors"
3 Search result

Fig. 52 Repair Detector Software

⚠ DANGER

Danger to life from electric shock!

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

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

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

Tip

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

7.3.2 Sensors

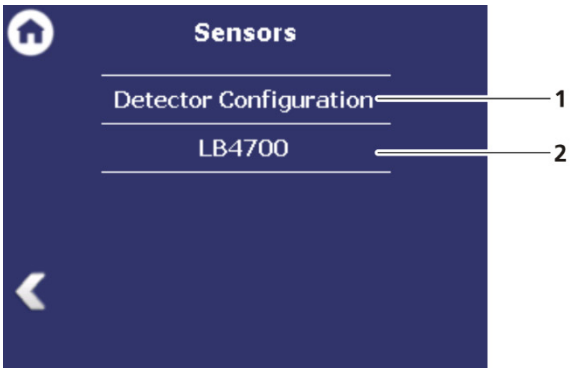
Device Setup | Setup | Sensors

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

- Detector configuration (Fig. 53, item 1)
  - Add / Remove detectors
  - Settings of the detectors
- Configuration of the respective detector (Fig. 53, item 2)
  - Overview
  - Plateau
  - Temperature
  - High voltage
  - Detector Service

IMPORTANT

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



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

Fig. 53 Menu "Sensors"

Detector Configuration

Device Setup | Setup | Sensors | Detector Configuration

In the window “Detector Configuration” the detectors for the measuring system are added and configured. Only configured detectors are listed and shown in the menu (Fig. 53). When a detector is selected (Fig. 54, item 6), the detector type (Fig. 54, item 4) and measuring task (Fig. 54, item 5) are shown.

Clicking the box <Edit> (Fig. 54, item 3) selects the type of detector and changes the description. The boxes <+> and <-> can be used to add and remove detectors for cascading measurement.

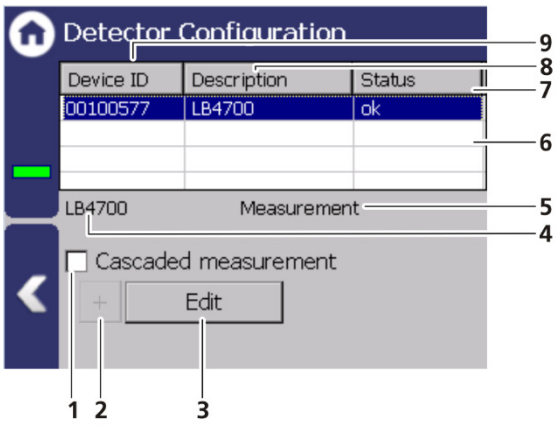
Evaluation of the measurement data from detectors type LB 44xx and LB 54xx is only possible with master units (Fig. 3, item 1).

Information

Information and settings for the detector are in the individual detector menu (Fig. 57).

IMPORTANT

In systems with a single detector the device ID is determined automatically and listed. The description can be edited by clicking on <Edit> (Fig. 54, item 3).



1 Selection box “Cascaded measurement”
2 Button < + > to add Detector
3 Button < Edit >
4 Type of selected detector
5 Measuring task for the selected detector
6 List of the Detectors
7 Status of the Detector
8 Description of the Detector
9 Device ID of the detector

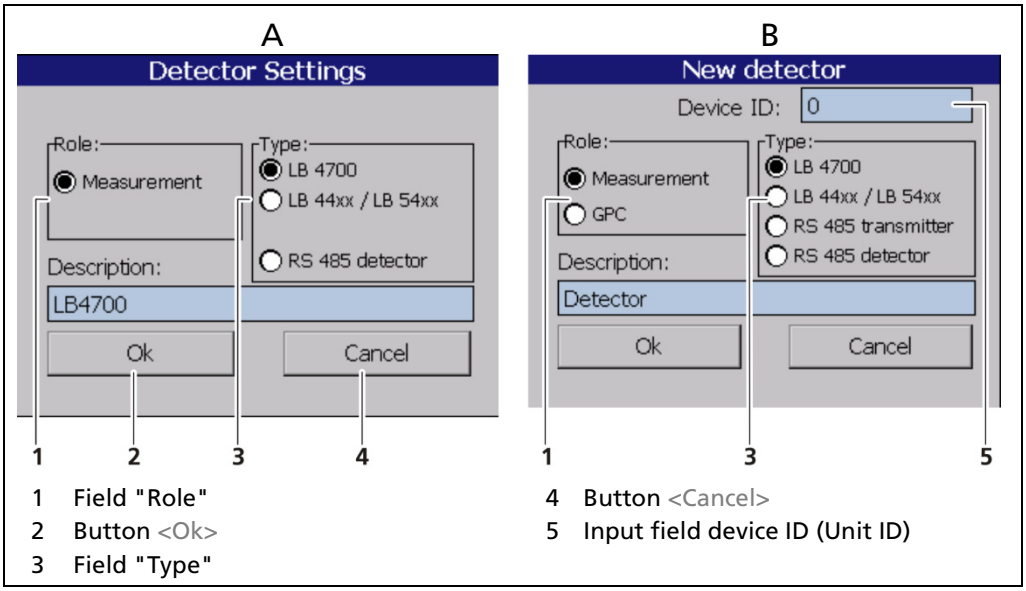
Fig. 54 Detector Configuration

Detector Settings

The settings of a configured detector are edited by selecting and clicking on <Edit> (Fig. 54, item 3).

IMPORTANT

For systems with a single detector, window A is displayed. For cascaded systems, window B is displayed.



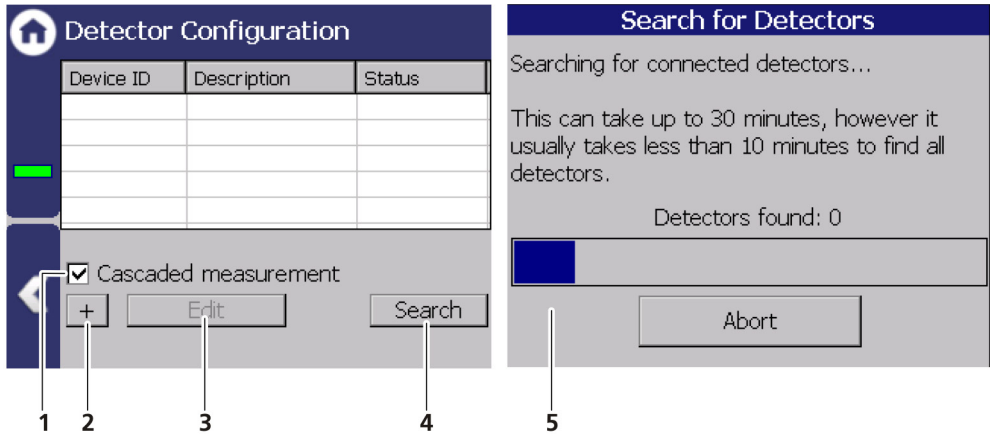
1 Field "Role"
2 Button <Ok>
3 Field "Type"
4 Button <Cancel>
5 Input field device ID (Unit ID)

Fig. 55 Detector Settings

Measurement	The selection “Measurement” determines the level of the container.
GPC	The selection “GPC” (Gas Properties Compensation) determines the gas density in order to compensate these for a precise measurements.
LB 4700	Detector of type LB 4700 (a LB 4700 detector can be connected either to the master unit itself or to a slave module).
LB 44xx / LB 54xx	Detector of the type LB 44xx and LB 54xx (no device ID; can capture measurement data only with master EVU)
RS 485 transmitter	By selecting “RS 485 transmitter”, other LB 470 master units can be used to perform cascaded measurements. This way multiple detectors of different designs can be integrated into a measurement system. Please refer to the instructions in the following chapters.
RS 485 detector	With the selection “RS 485 detector” it is possible to connect a specific detector via the RS 485 interface.
Description	Detector description. Also used for error messages, logs and in the menu structure (Fig. 53).

Configure a cascaded system

Note the arrangement of the system components during configuration (see chapter 3.2 Measuring Principle).



1 Selection box “Cascaded measurement”
Button < + >
2 Button <Edit>
3
4 Button <Search>
5 Window “Search for Detectors”

Fig. 56 Configure cascaded system

1. If the connection to the EVU (Master-Slave) is correct, the detectors type LB 47xx are detected and incorporated automatically. Click on the button <Search> (Fig. 56, item 4) to incorporate connected detectors.
2. Activate the selection box “Cascaded measurement” (Fig. 56, item1).
3. Set the appropriate function for each detector (Fig. 55).

▶ Both LED (Rx, Tx) indicators flash with proper installation and configuration of a detector on the slave module.

Tip

If a detector is correctly installed and configured on the slave module both LED displays (Rx, Tx) flash.

Detector Settings

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

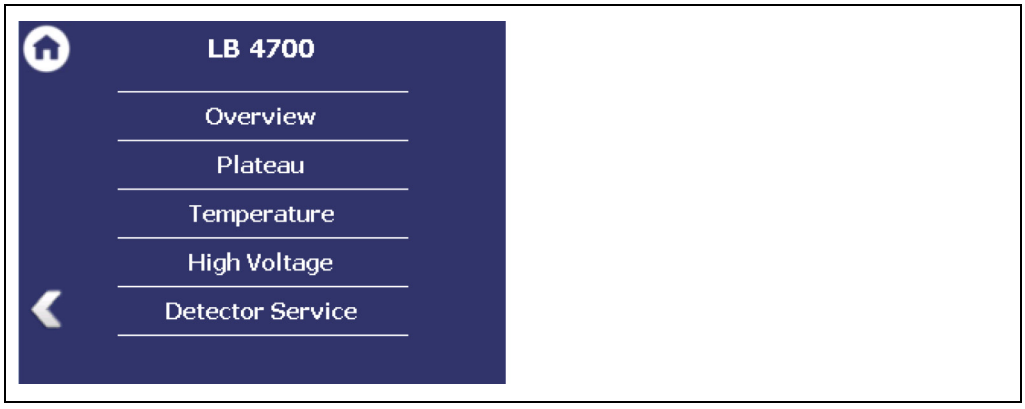
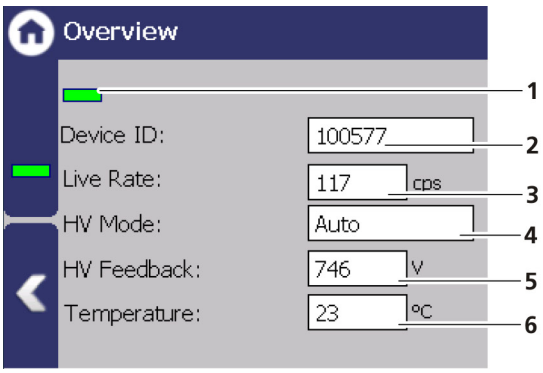


Fig. 57 Submenu “Detector”

Detector Settings: Overview

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

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



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

Fig. 58 Overview Detector Information

	A green bar appears with error-free status of the detector (Fig. 58, item 1).
Device ID	Shows the ID (Fig. 58, item 2) of the detector.
Live Rate	The "Live Rate" (Fig. 58, item 3) displays the current, unfiltered count rate.
HV Mode	In the field “HV mode” (Fig. 58, 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. 58, item 5) displays the actual measured value in volts.
Temperature	The field “Temperature” (Fig. 58, item 6) indicates the current temperature of the detector in C°.

Detector Settings: Plateau

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

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

The high voltage necessary for the operation of the photomultipliers is increased stepwise for the plateau recording and the pulse rate measured after each increase. The determined plateau curve is displayed on a diagram. The pulse rate increases with increasing voltage. This must form a unique plateau. If a too short or too steep plateau is detected, the detector is operating in an unstable manner. The submenu “Plateau” (Fig. 59) leads to the plateau measuring and the display of plateau values.

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

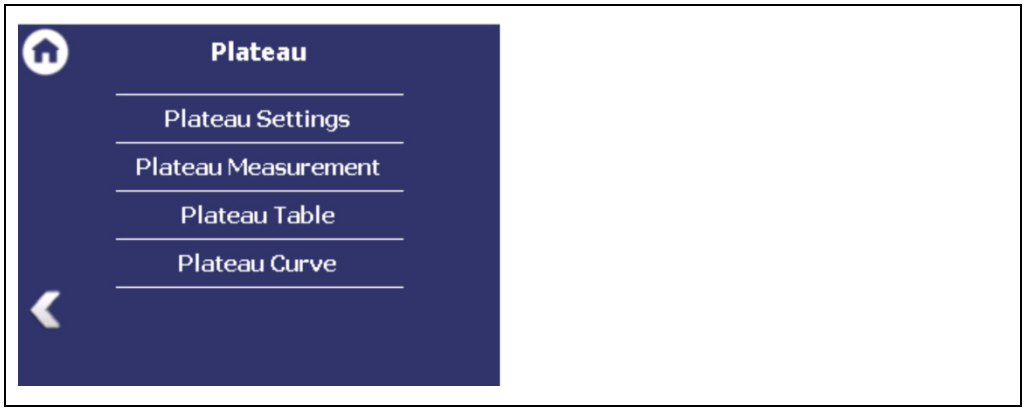
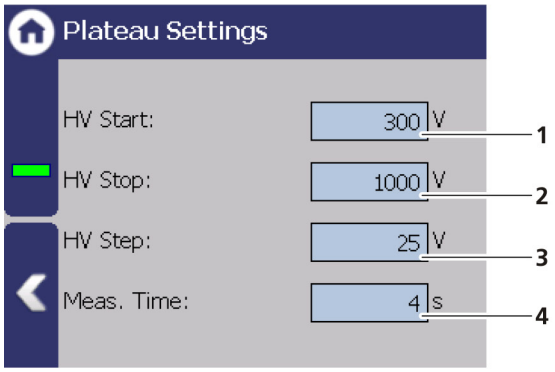


Fig. 59 Menu "Plateau"

Plateau Settings

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

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



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

Fig. 60 Plateau Settings

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

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

1. Click on the corresponding input field (Fig. 60, item 1-4).

▶ The input field opens.

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

▶ The values for the recording plateau have been changed.

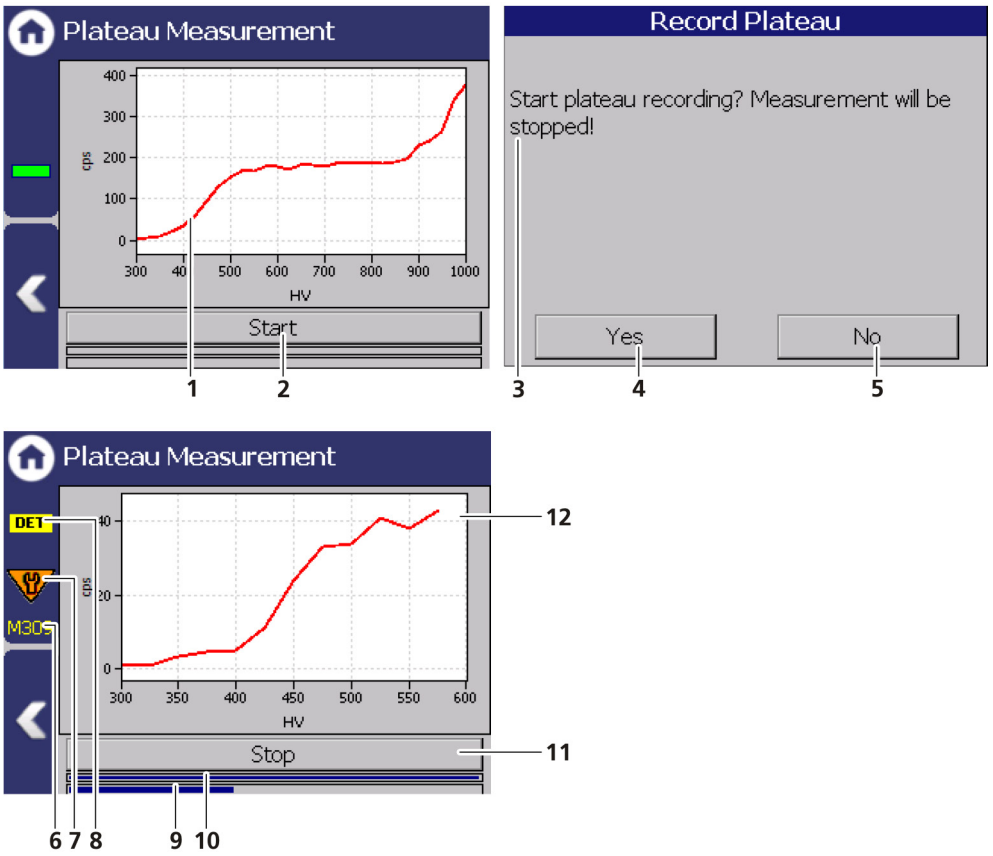
Perform Plateau Measurement

Device Setup | Setup | 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	Event message code	12	New plateau curve

Fig. 61 Recording a plateau curve

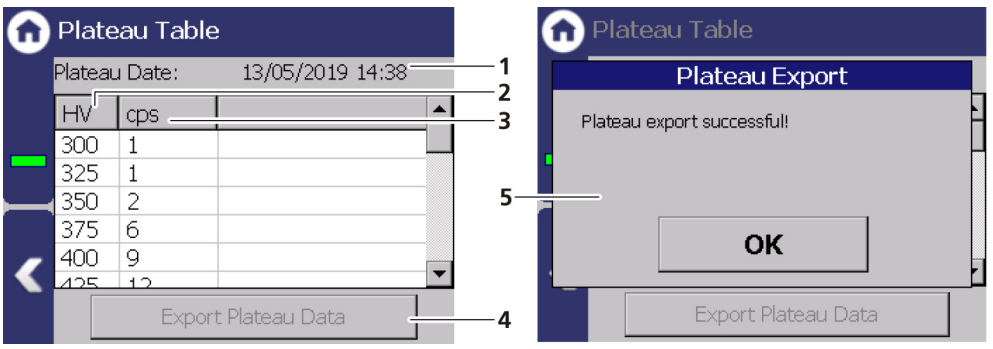
1. Click on <Start> (Fig. 61, item 2) to perform a plateau measurement.
- The confirmation message "Record plateau" (Fig. 61, item 3) opens.
2. Confirm with <Yes> (Fig. 61, item 4).
- The EVU switches to mode "DET" (Fig. 61, item 8) and the current measurement is stopped.
- The information (Fig. 61, item 6 - 8) from the plateau measurement are displayed in the status information. The LED Run flashes on the EVU during the plateau measurement. The LED “Warning” LED lights up at the same time.
- If you click on the < Stop > button during the measurement, the measuring process is interrupted. The measurement data are invalid and will be deleted.

- The recorded values are read and entered into the table (Fig. 62), the plateau curve (Fig. 63) is drawn and stored automatically.

Plateau Table

Device 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. 62 Plateau Table

Export Plateau Data

1. Connect a USB flash drive to the USB port of the EVU.
- The USB memory device is recognized by the system after a few seconds and the button <Export Plateau Data> can be clicked.
2. Click on the button <Export Plateau Data> (Fig. 62, item 4).
- The values of the plateau measurement have been stored in a .txt file.
3. Confirm the message with <OK>.

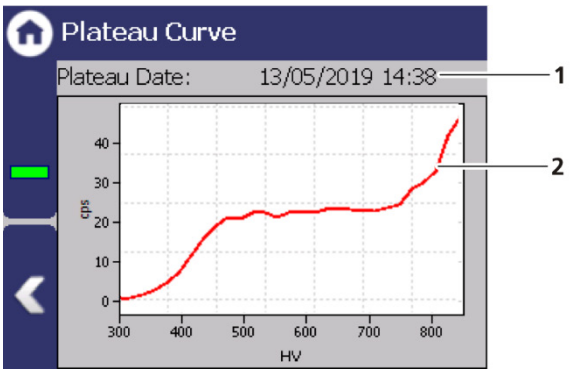
Information

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

Plateau Curve

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

The mapped characteristic curve (Fig. 63, item 2) of the last complete plateau measurement is displayed in the window “Plateau Curve”.



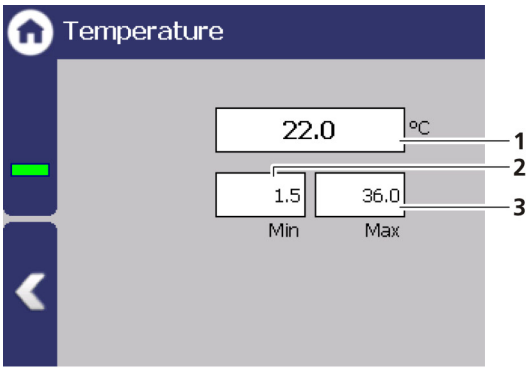
1 Date and Time of measurement recording
2 Characteristic curve

Fig. 63 Plateau Curve

Detector Settings: Temperature

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

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



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

Fig. 64 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.

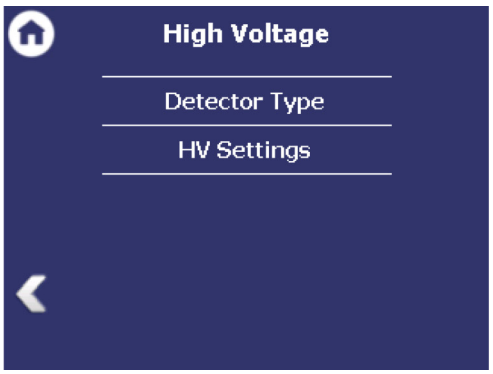


Fig. 65 Submenu “High Voltage”

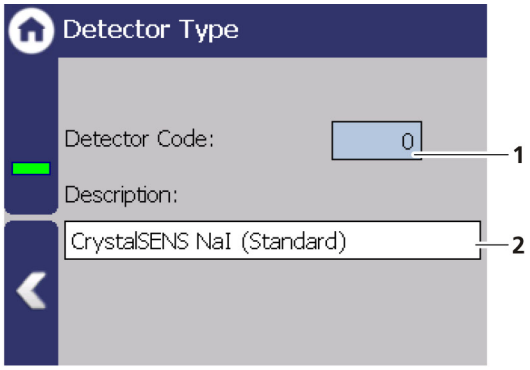
Detector Settings: High Voltage | Detector Type

Device 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.

IMPORTANT

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

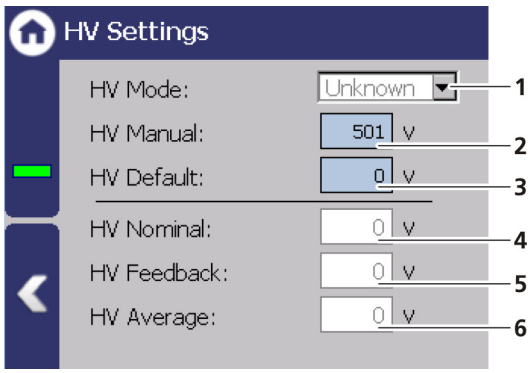


1 Input field Detector code
2 Description of the scintillator type

Fig. 66 Detector Code: Setting the scintillator type

Detector Settings: High Voltage | HV Settings

Device 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 field setting value high voltage
5 Display field actual value high voltage
6 Display field average high voltage

Fig. 67 HV Settings

NOTICE

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

NOTICE

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

Make HV Settings

1. Click on the selection arrow (Fig. 67, 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. 67, item 2).
2. Click in the input field "HV Default" (Fig. 67, item 3) to open the input field.
3. Enter the desired starting value for the high-voltage regulation.
4. Confirm with the Enter key.

▶ The start value has been changed.

Detector Settings: Detector Service

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

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

- Device Information
- Event Log
- Event overview
- Reset Detector

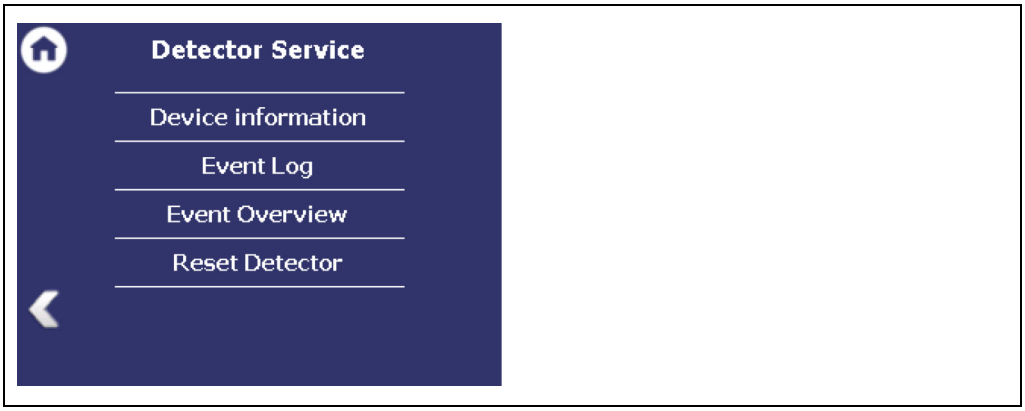
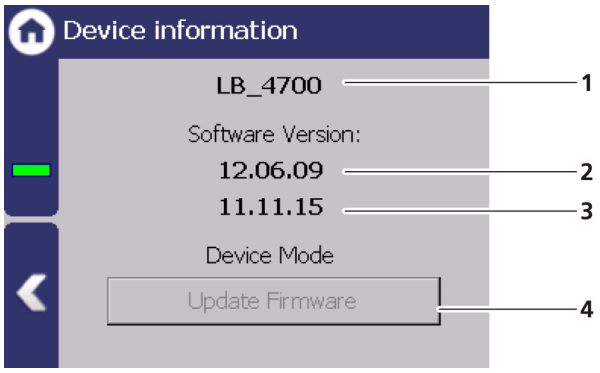


Fig. 68 Menu “Detector Service”

Detector Settings: Service | Device information

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

This window shows you the type of detector (Fig. 69, item 1) as well as an overview of the software version (Fig. 69, item 2, item 3) of the detector.



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

Fig. 69 Device Information

Perform Firmware Update

NOTICE

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

Tipp

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

IMPORTANT

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

1. Save the current update file of the firmware of the detector on a USB storage device.
2. Connect a USB storage device to the device (Fig. 4, item 5).
3. The USB storage device is recognized by the system after a few seconds and the <Firmware Update> (Fig. 69, item 4) button can be clicked.
4. Click on the button <Firmware Update> (Fig. 69, item 4).
   - ▶ A warning message appears (Fig. 69, item 5).
5. Confirm with <Yes>.
   - ▶ After a short search, the "Select firmware file" window appears.
6. Select the file and click on <Update>.
   - ▶ The old firmware is deleted and the new version is installed automatically. After the update is finished, an update log is displayed.

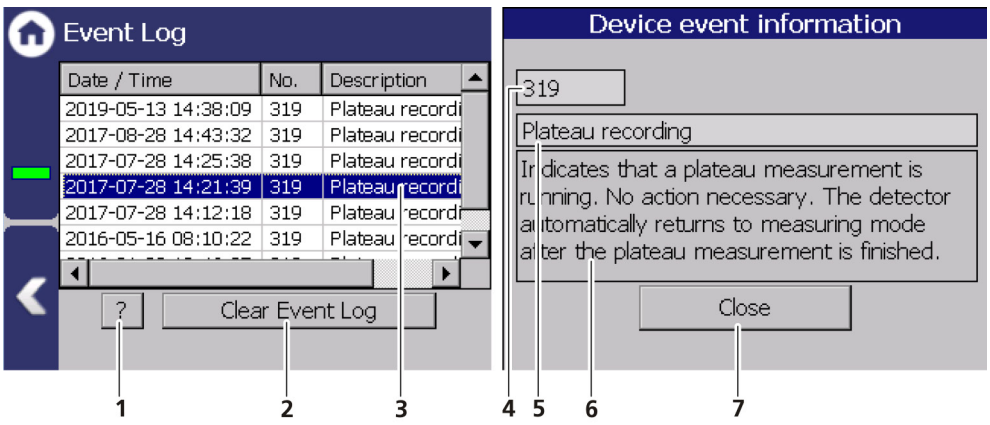
NOTICE

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

Detector Settings: Service | Event Log

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

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



1 Button <?> to display the detailed event description.
2 Button <Clear event log>
3 Highlighted event
4 Event no.
5 Event title
6 Event description
7 Button <Close>

Fig. 70 Event Log

Display Event Description

1. Click on a line in the list (Fig. 70, item 3).
2. Click on <? > (Fig. 70, item 1)

▶ The event description appears.

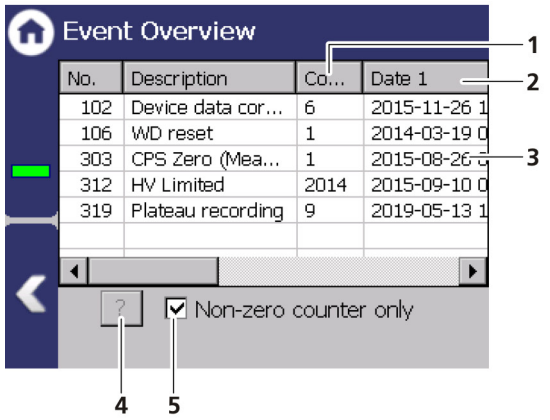
3. With the button <Close>, close the event description (Fig. 70, item 7).

▶ With the button <Clear event log> (Fig. 70, item 2) all events are deleted permanently.

Detector Settings: Detector Service | Event Overview

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

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



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

Fig. 71 Event Overview

1. Click on a line in the list (Fig. 71, item 3).
2. Click on <? > (Fig. 71, item 4).

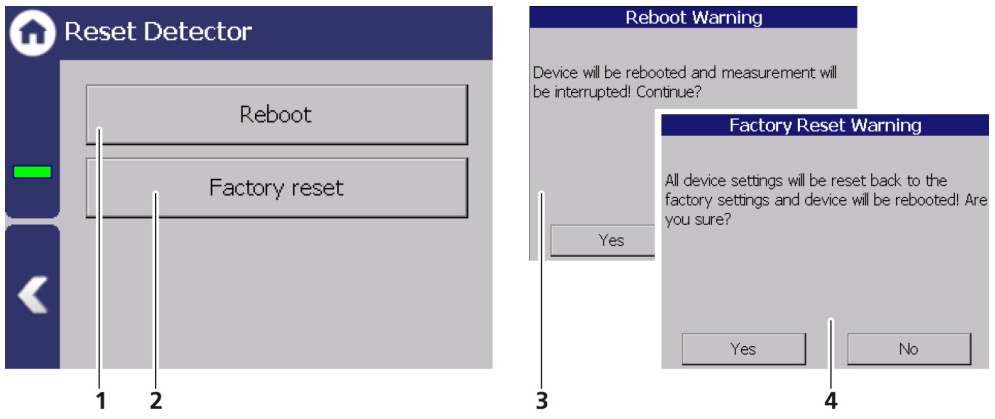
▶ The event description appears.

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

Detector settings: Detector Service | Reset Detector

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

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



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

Fig. 72 Reset Detector

IMPORTANT

The measurement is interrupted during a restart!

1. To restart the Detector, click the button <Reboot> (Fig. 72, item 1).
   ▶ A window with a warning “Reboot” (Fig. 72, item 3) opens.
2. Click on <Yes> to confirm.
   ▶ The device is restarted.

IMPORTANT

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

1. To reset the detector to the factory settings, click the button <Factory reset> (Fig. 72, item 2).
   ▶ A window with the warning Factory settings (Fig. 72, item 4) opens.
2. Click on <Yes> to confirm.
   ▶ The device is reset to factory settings and restarts.

7.3.3 Calibration

Device Setup | Setup | Calibration

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

NOTICE

Material damage to the device or the system!

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

IMPORTANT

- The RID function must be activated in the menu Device Setup | Setup | Signal processing | RID.
- Interference Radiation Suppression using the LB 470RID operates only with detectors having plastic scintillators; these are especially susceptible to interference radiation on account of their large volumes.

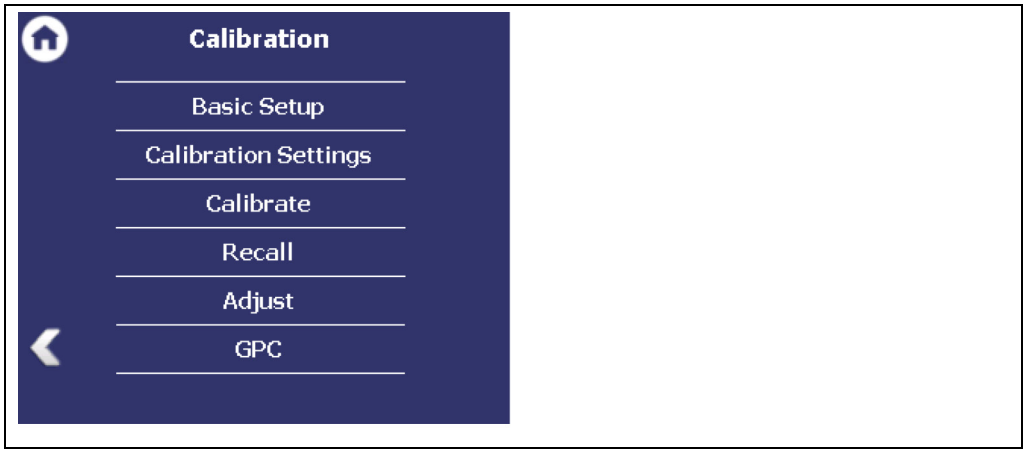
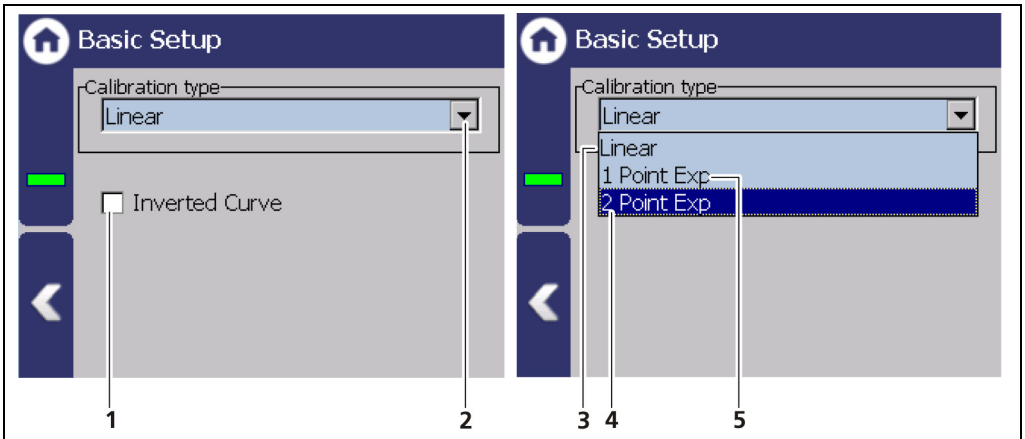


Fig. 73 Menu “Calibration”

Basic Setup

Device Setup | Setup | Calibration | Basic Setup



1 Checkbox “Inverted Curve”
2 Selection calibration Type
3 Calibration “Linear”
4 Calibration “1 Point Exp.”
5 Calibration “2 Point Exp.”

Fig. 74 Basic Setup

Calibration Method

The method by which the measuring system must be calibrated depends on the respective measuring arrangement.

Inverted Curve	If the check box “Inverted curve” (Fig. 74, item1) is activated, the monotony criterion of the validation changes is strictly ascending.
Linear	Two points (usually 0% and 100%) are required. The container is emptied and filled to determine the count rate at 0% or 100% level. To increase the accuracy of measurement and take non-linearities of the characteristic curve into account, a larger number of measurement points can be used.
1 Point Exp.	The absorption coefficient, the measuring path and the product density must be known. The second calibration point is thereby calculated.
2 Point Exp.	Exactly two calibration points must be entered.

Calibration Settings: Background

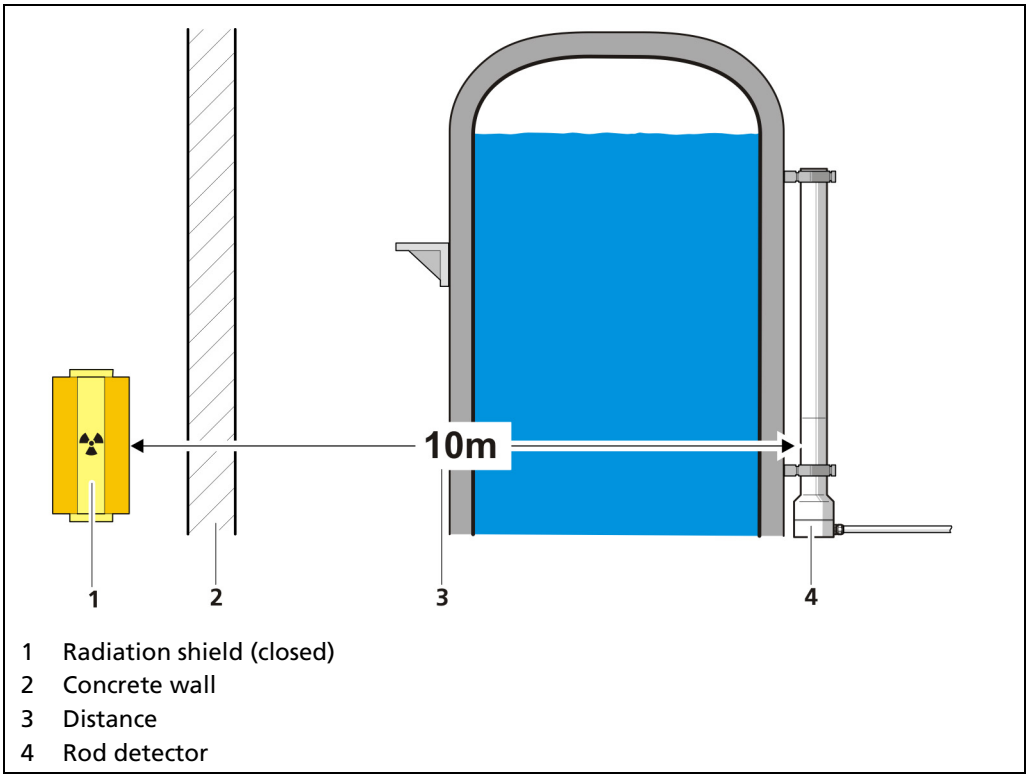
Device Setup | Setup | Calibration | Calibration Settings

The background count rate (Fig. 76, item 1) is the natural background radiation seen by the detector and must be measured at least for rod detectors. This count rate is compensated for by the system. The best approach for your background measurement is dependent on the situation on site and on the type of radiation source.

NOTICE

A closed shield also results in measurable residual radiation, which can falsify the measurement of background radiation. For this reason, it is recommended that the detector (Fig. 75, item 4) be determined at a suitable distance (approx. 10 m) or behind a thick concrete wall (Fig. 75, item 2).

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

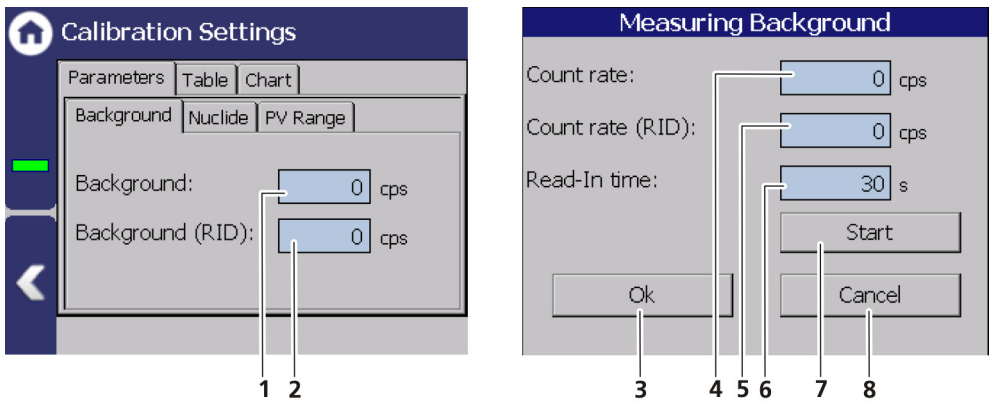


1 Radiation shield (closed)
2 Concrete wall
3 Distance
4 Rod detector

Fig. 75 Conditions during background determination

IMPORTANT

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



1	Input field Background [cps]; Meas. Channel Input field Background (RID); Second channel	5	Count rate RID
2	Button <Ok>	6	Input field “read in time”
3	Input field count rate	7	Button <Start>
4		8	Button <Cancel>

Fig. 76 Calibration Parameters: Background

Determine Background

Device Setup | Setup | Calibration | Calibration Settings

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

1. Click on the text field “Background” (Fig. 76, item 1).

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

NOTICE

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

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

▶ The measurement is performed.

4. Click on <OK> to accept the count rate.

▶ The window closes and the values are accepted.

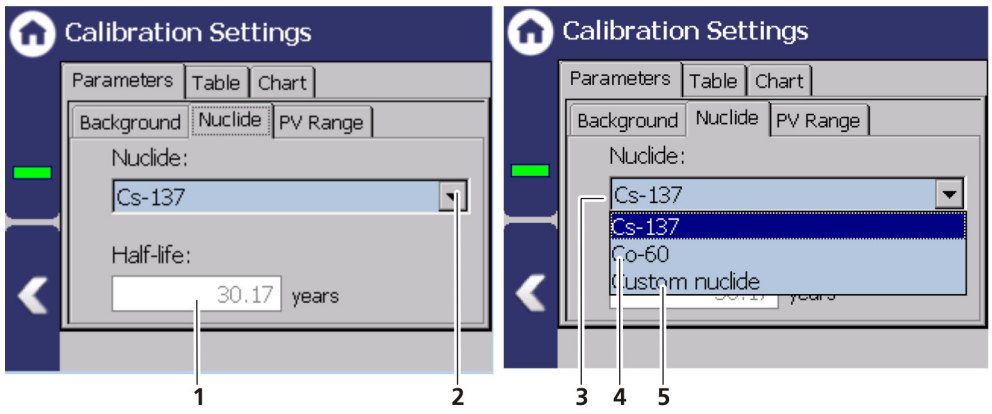
Calibration Settings: Nuclide

Device Setup | Setup | Calibration | Calibration Settings

The isotope used can be selected in the “Nuclide” tab. The half-life of the isotope is shown on the display field (Fig. 77, item 1).

NOTICE

The sources for level measurement and the sources of the GPC measurement must contain the same Nuclide.



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

Fig. 77 Calibration Parameters: Nuclide

1. Click on the selection arrow (Fig. 77, item 2).
2. Select the isotope used. Cs-137 (Fig. 77, item 3) or Co-60 (Fig. 77, item 4). The isotope of the source is on the type plate of the screen (Fig. 78).
3. When selecting “Custom nuclide” (Fig. 77, item 5), the half-life of the isotope can be entered.

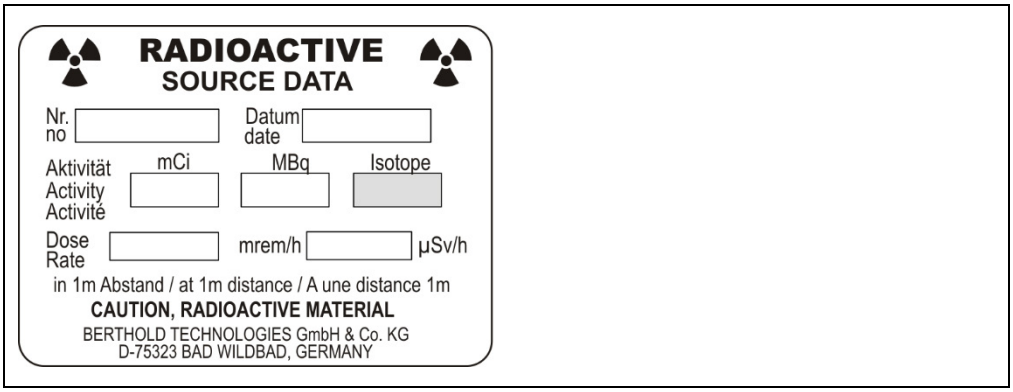
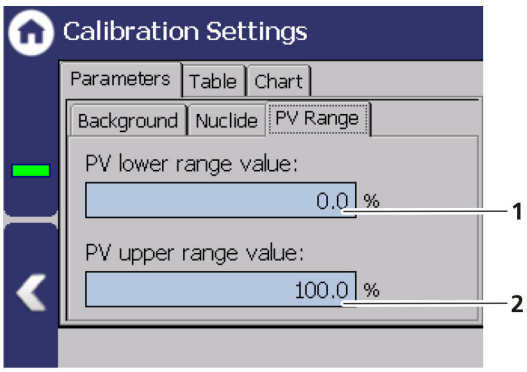


Fig. 78 Type Plate Source

Calibration Settings: PV Range

Device Setup | Setup | Calibration | Calibration Settings



1 Input field “PV lower range value” [%]
2 Input field “PV upper range value” [%]

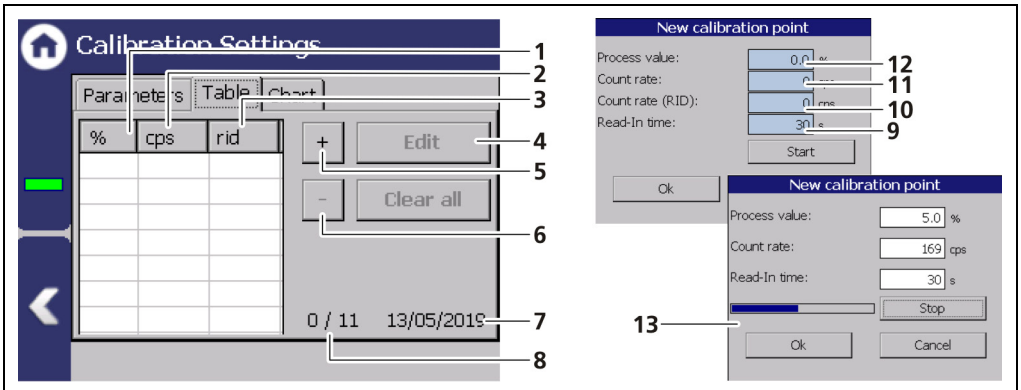
Fig. 79 Calibration Parameters (PV Range)

PV 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 (see chapter 7.3.5 Signal Condition).
PV 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 (see chapter 7.3.5 Signal Condition).

During calibration, the count rates of both channels (measurement channel and secondary channel) are recorded.

Calibration Settings: Table (linear calibration type)

Device Setup | Setup | Calibration | Calibration Settings



1	Column count rate [%]	8	Count of the calibration points
2	Column count rate [cps]	9	Read-In-Time [s]
3	Column count rate [rid]	10	Count rate RID [cps]
4	Button <Edit>	11	Count rate [cps]
5	Button Add measuring point < + >	12	Process value [%]
6	Button Delete point < - >	13	Measuring process (determine new calibration point)
7	Date of the last editing		

Fig. 80 Calibration parameters (Table linear calibration type)

NOTICE

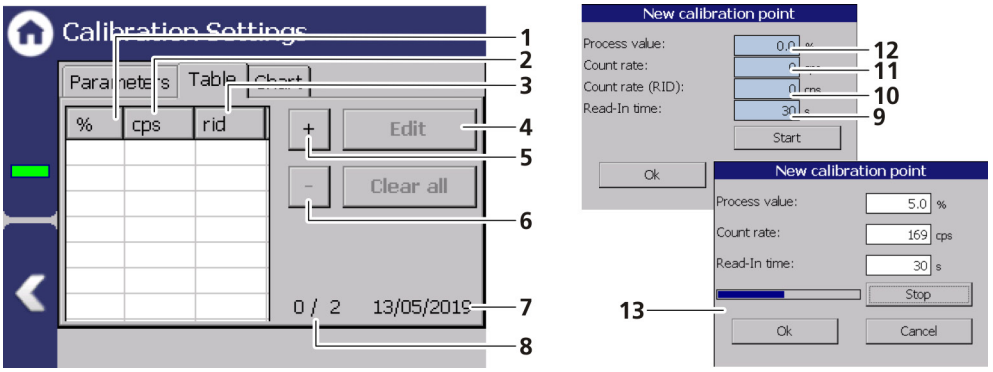
To avoid calibration errors, it must be ensured that during calibration and commissioning of the measuring equipment no welding tests are being done on the site, even at long distance.

Add new calibration point

1. Click on the button < + > (Fig. 80, item 5).
▶ The window “New calibration point” (Fig. 80, item 9-12) opens.
2. Click on the input field “Process value” (Fig. 80, item 12) to open the input field.
3. Specify the current, actual level in percent and confirm with the Enter key.
4. Click on the input field “Read-In-Time” (Fig. 80, item 9) to open the input field.
5. Specify a read-in time and confirm with the Enter key.
6. Click on the button <Start>.
▶ The Window “New calibration Point” (Fig. 80, item 13) opens and the count rate is determined.
7. Click on <Ok> to confirm the new calibration point.
▶ The new calibration point is recorded in the table.

Calibration Settings: Table (2 Point Exp. calibration type)

Device Setup | Setup | Calibration | Calibration Settings



1	Column count rate [%]	8	Count of the calibration points
2	Column count rate [cps]	9	Read-In-Time [s]
3	Column count rate [rid]	10	Count rate RID [cps]
4	Button <Edit>	11	Count rate [cps]
5	Button Add measuring point < + >	12	Process value [%]
6	Button Delete point < - >	13	Measuring process (determine new calibration point)
7	Date of the last editing		

Fig. 81 Calibration parameters (Table 2 Point Exp. calibration type)

NOTICE

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

Add new Calibration Point

1. Click on the button < + > (Fig. 81, item 5).

▶ The window “New calibration point” (Fig. 81, item 9-12) opens.

2. Click on the input field “Process value” (Fig. 81, item 12) to open the input field.
3. Specify the current, actual level in percent and confirm with the Enter key.
4. Click on the input field “Read-In Time” (Fig. 81, item 9) to open the input field.
5. Specify a read-in time and confirm with the Enter key.
6. Click on the button <Start>.

▶ The Window “New calibration Point” (Fig. 81, item 13) opens and the count rate is determined.

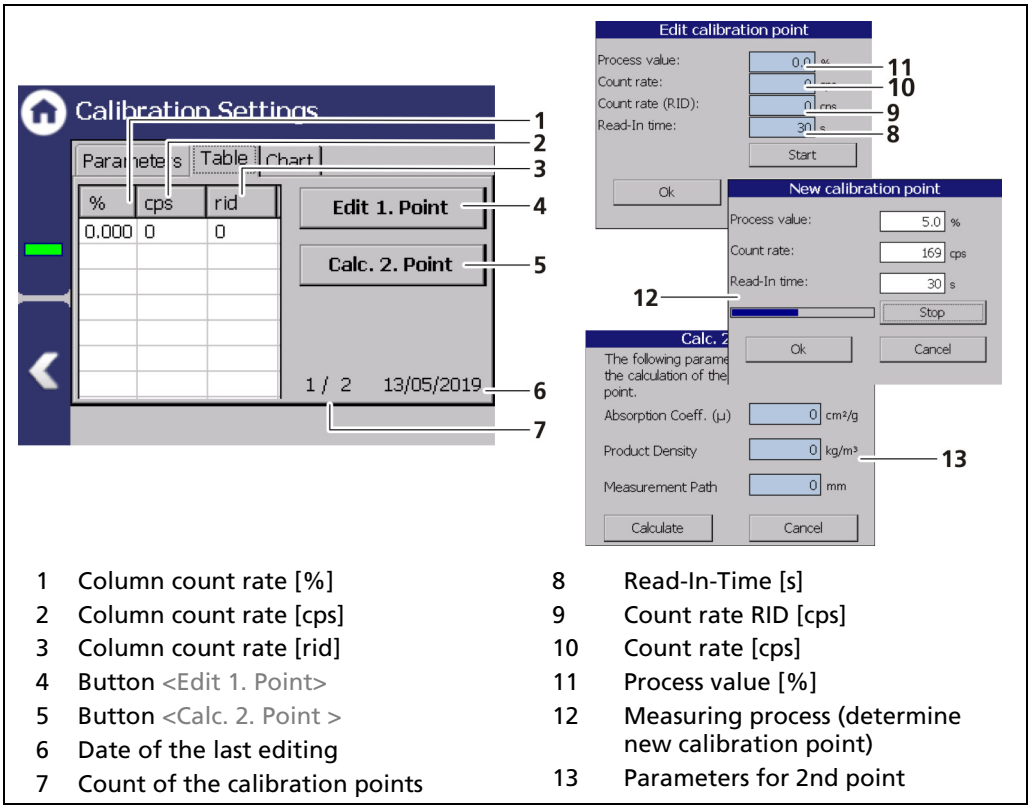
7. Click on <OK> to confirm the new calibration point.

▶ The new calibration point is recorded in the table.

Calibration Settings: Table (1 Point Exp. calibration type)

Device Setup | Setup | Calibration | Calibration Settings

The absorption coefficient, the measuring path and the product density must be known. The second calibration point is thereby calculated.



1	Column count rate [%]	8	Read-In-Time [s]
2	Column count rate [cps]	9	Count rate RID [cps]
3	Column count rate [rid]	10	Count rate [cps]
4	Button <Edit 1. Point>	11	Process value [%]
5	Button <Calc. 2. Point >	12	Measuring process (determine new calibration point)
6	Date of the last editing	13	Parameters for 2nd point
7	Count of the calibration points		

Fig. 82 Calibration Parameters (Table 1 Point Exp. calibration type)

NOTICE

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

Add new Calibration Point

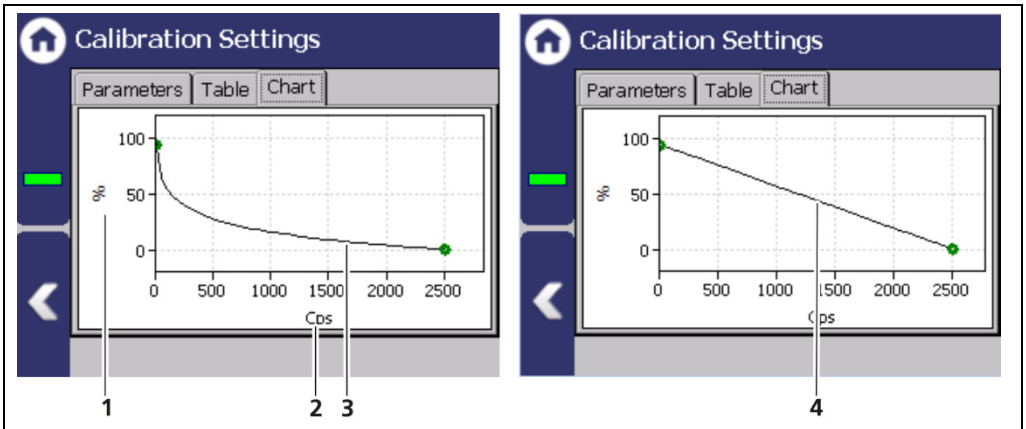
1. Click on the button <Edit 1. Point > (Fig. 82, item 2).
▶ The window “Edit calibration point” (Fig. 82, item 8-11) opens.
2. Click on the input field “Read-In Time” (Fig. 82, item 9) to open the input field.
3. Specify a measurement time and confirm with the Enter key.
4. Click on the input field “Process value” (Fig. 82, item 11) to open the input field.
5. Specify the current, actual level in percent and confirm with the Enter key.
6. Click on the button <Start>.
▶ The count rate is determined.
7. Click on <OK> to confirm the new calibration point.
8. Click on the button <Calc. 2. Point > (Fig. 82, item 5).
▶ The "Calc. 2nd point" window opens.

9. Enter the absorption coefficient of the product. Enter it with a negative prefix. Unless it is one of the very rare applications with an inverted characteristic.
10. Enter the product density.
11. Enter the measurement path.
12. Click on the button <Calculate>.
- ▶ The second Point was calculated.
13. Click on <OK> to confirm the new calibration point.

Calibration Settings: Chart

Device Setup | Setup | Calibration | Calibration Settings

The characteristic curve of the calibration performed is shown in the tab “Chart”.



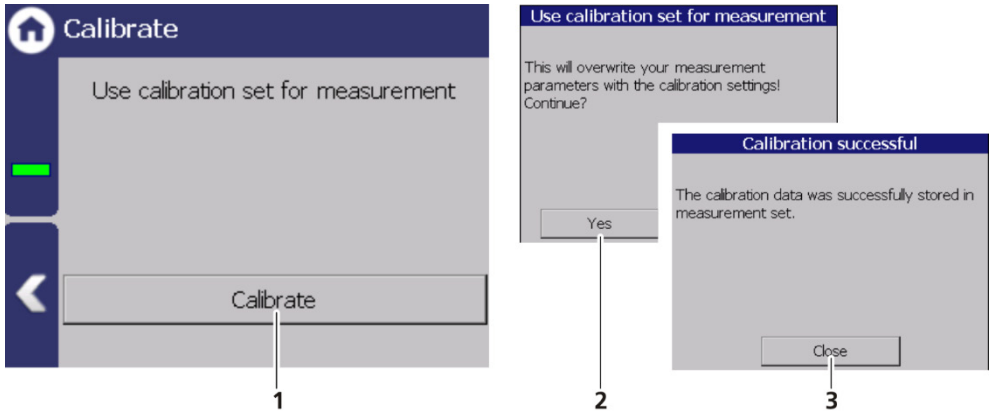
1 Axis level [%]
2 Axis count rate [cps]
3 Characteristic chart (exponential)
4 Characteristic chart (linear)

Fig. 83 Calibration Parameters (Chart)

Calibrate

Device Setup | Setup | Calibration

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



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

Fig. 84 Calibrate

1. Click on the button <Calibrate> (Fig. 84, item 1).
   - A new window with the message “Use calibration set for measurement” appears.
2. Click on the <Yes> button (Fig. 84, item 2) to overwrite your measurement parameters with the calibration settings.
   - A new window with the message “Calibration successful” appears.
3. Click on the <Close> button (Fig. 84, item 3)
   - The calibration was performed.
4. Activate the check box in the Device Settings | Setup | Signal processing | RID.

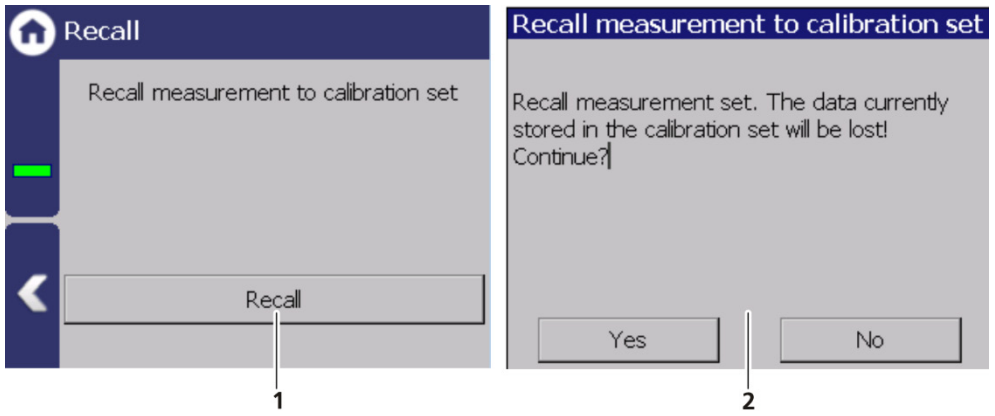
NOTICE

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

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

Recall

Device Setup | Setup | Calibration | Recall



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

Fig. 85 Recall

Recall to calibration set

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

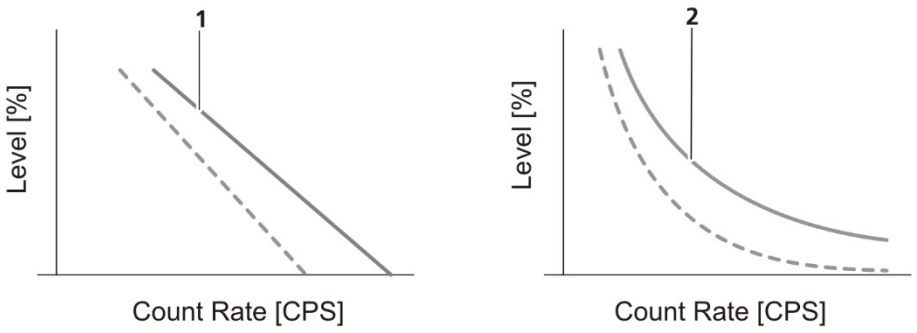
▶ The calibration parameter set was overwritten.

Adjust: Standard Adjust

Device Setup | Setup | Calibration | Adjust

Use the functionality after source exchange or after entering a theoretical, normalized multi-point calibration (e.g. a Radical calculation) to adjust the table in the measuring set.

That will keep the shape of the curve, because all calibration points are extrapolated as percentage of the difference between the old- and the new calibration points.

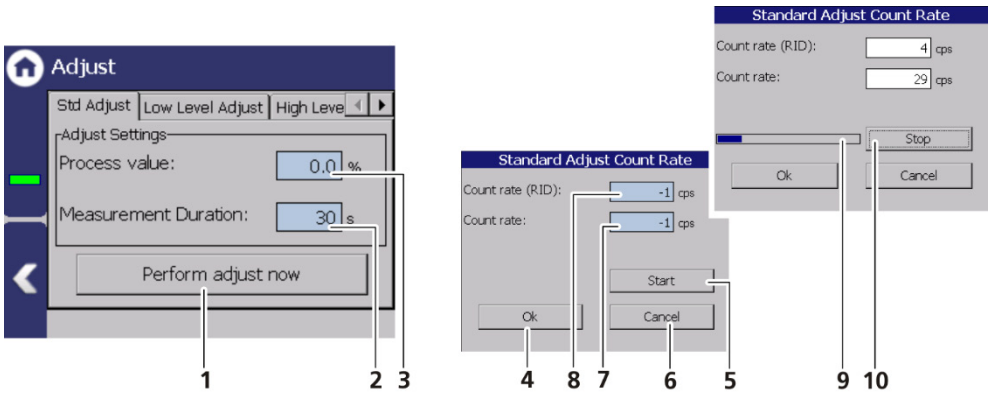


1 Adjusted curve (linear calibration type)
2 Adjusted curve (exponential calibration type)

Fig. 86 Adjusted curves

NOTICE

During the Standard Adjust, level and pressure must remain constant.



1 Button <Perform adjust now>
2 Input field "Measurement Duration"
3 Input field "Process value"
4 Button <Ok>
5 Button <Start>
6 Button <Cancel>
7 Input field count rate [cps]
8 Input field count rate (RID) [cps]
9 Process bar
10 Button <Stop>

Fig. 87 Standard adjustment

1. Click on the field "Process value" (Fig. 87, item 3) to open the input field.
2. Enter the process value % (acc. to standard display) and confirm.
3. Click on the field "Measurement Duration" field (Fig. 87, item 2) and specify

the duration of measurement in seconds. The higher you set the measurement time, the more accurate the result.

4. Click <Ok> to accept the value.
5. Click on the button <Perform adjust now> (Fig. 87, item 1).

▶ A new window opens (Standard Adjust Count Rate).

6. Click on the button <Start> (Fig. 87, item 5) to start the measurement.
7. Click <Ok> (Fig. 87, item 4) to accept the values.

▶ The standard adjust was performed.

IMPORTANT

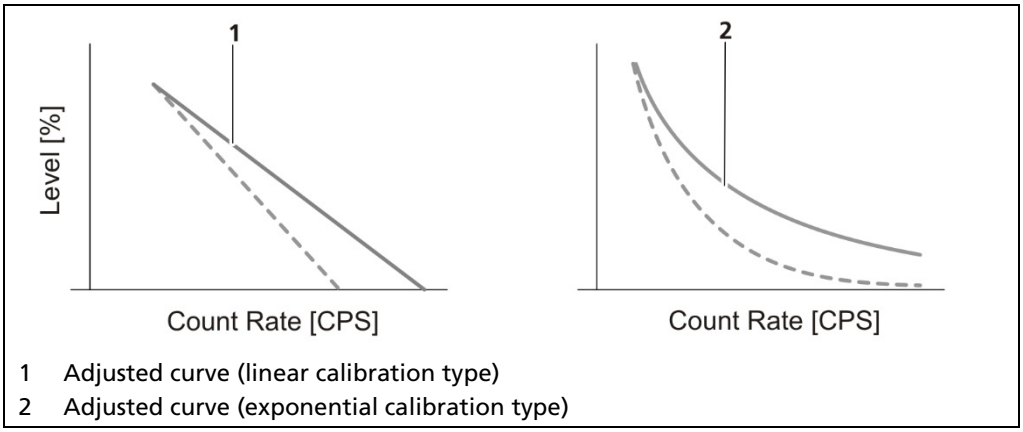
When executing an Adjust, the measurement parameter set was overwritten.

▶ If the system should be recalibrated, a recall of the measurement parameter set to the calibration parameter must be performed (see subchapter “recall”. Otherwise the adjust will become lost.

Adjust: Low Level Adjust

Device Setup | Setup | Calibration | Adjust

After calibration, a level adjustment can be performed. A level adjustment must be performed if the level shown is not the actual level. The lower adjustment can only be performed at a level < 50%. The count rate at 100% will be kept fixed, while all other points of the curve will be adjusted according to the adjusted count rate at the entered level value.

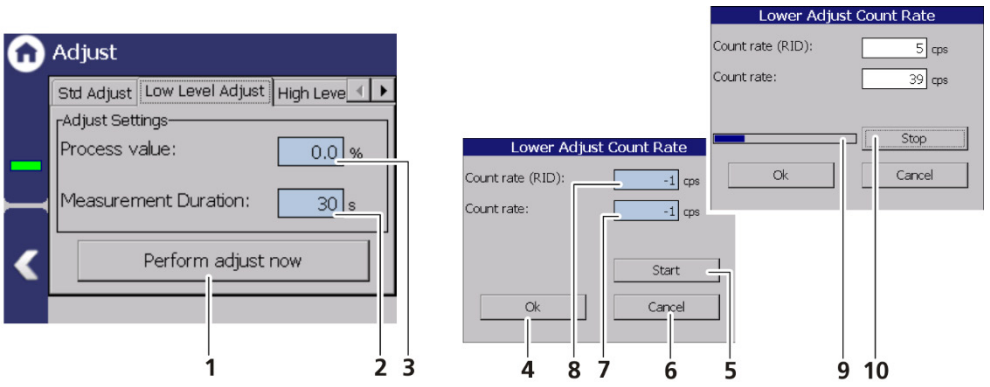


1 Adjusted curve (linear calibration type)
2 Adjusted curve (exponential calibration type)

Fig. 88 Adjusted curves (Low Level Adjust)

NOTICE

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



1 Button <Perform adjust now>
2 Input field “Measuring Duration”
3 Input field “Process value”
4 Button <Ok>
5 Button <Start>
6 Button <Cancel>
7 Input field count rate [cps]
8 Input field count rate (RID) [cps]
9 Process bar
10 Button <Stop>

Fig. 89 Lower adjustment

1. Click on the field Process value (Fig. 89, item 3) to open the input field.
2. Specify a percentage value for the lower adjustment and confirm with the Enter key.
3. Click on the “Measuring Duration” field (Fig. 89, item 2) and specify the duration of measurement in seconds. The higher you set the measurement time, the more accurate the result.
4. Click on the button <Perform adjust now> (Fig. 89, item 1).

- A new window opens.

5. Click on the button <Start> (Fig. 89, item 5).

- The measurement starts.

6. Click < Ok > to accept the values.

- The level has been adjusted to the process value (see standard display).

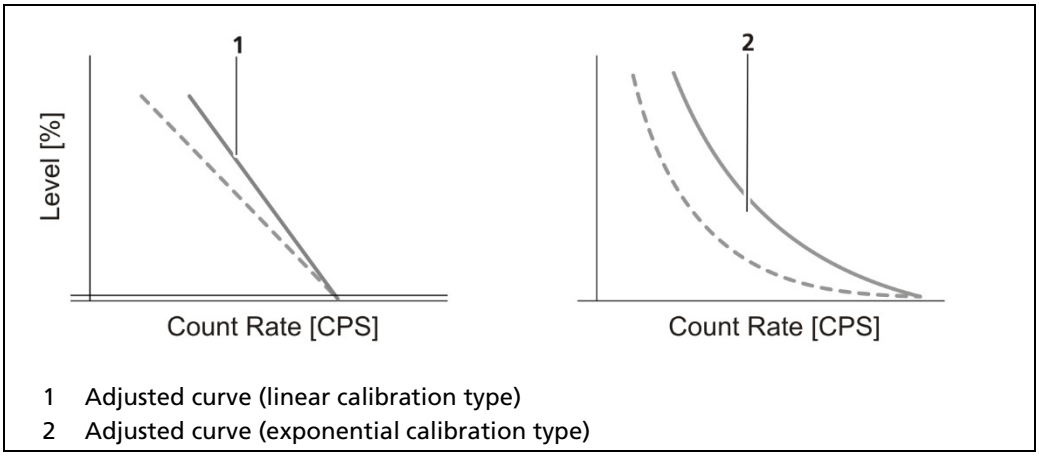
IMPORTANT

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

Adjust: High Level Adjust

Device Setup | Setup | Calibration | Adjust

The upper adjustment can only be performed at a level > 50%. The count rate at 0% will be kept fixed, while all other points of the curve will be adjusted according to the adjusted count rate at the entered level value.

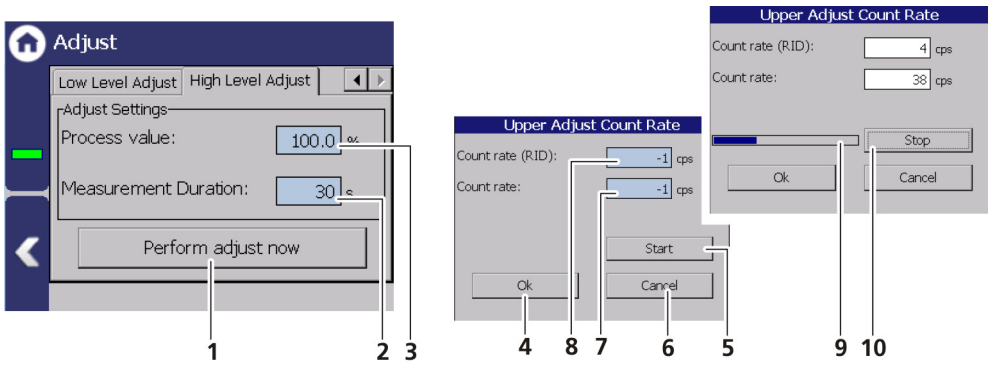


1 Adjusted curve (linear calibration type)
2 Adjusted curve (exponential calibration type)

Fig. 90 Adjusted curves (High Level Adjust)

NOTICE

Make sure that the source is mounted and the beam path is open. The container must be full during the upper adjustment.



1 Button <Perform adjust now>
2 Input field “Measuring Duration”
3 Input field “Process value”
4 Button <Ok>
5 Button <Start>
6 Button <Cancel>
7 Input field count rate [cps]
8 Input field count rate (RID) [cps]
9 Process bar
10 Button <Stop>

Fig. 91 Upper adjustment

1. Click on the field Process value (Fig. 91, item 3) to open the input field.
2. Specify a percentage value for the upper adjustment and confirm with the Enter key.
3. Click on the field “Measurement Duration” field (Fig. 91, item 2) and specify the duration of measurement in seconds. The higher you set the measurement time, the more accurate the result.
4. Click on the button <Perform adjust now> (Fig. 91, item 1).
5. Click on the <Start> button (Fig. 91, item 5).

- The measurement starts.

6. Click <Ok> to accept the values.

- The level has been adjusted to the process value (see standard display).

IMPORTANT

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

GPC[2]

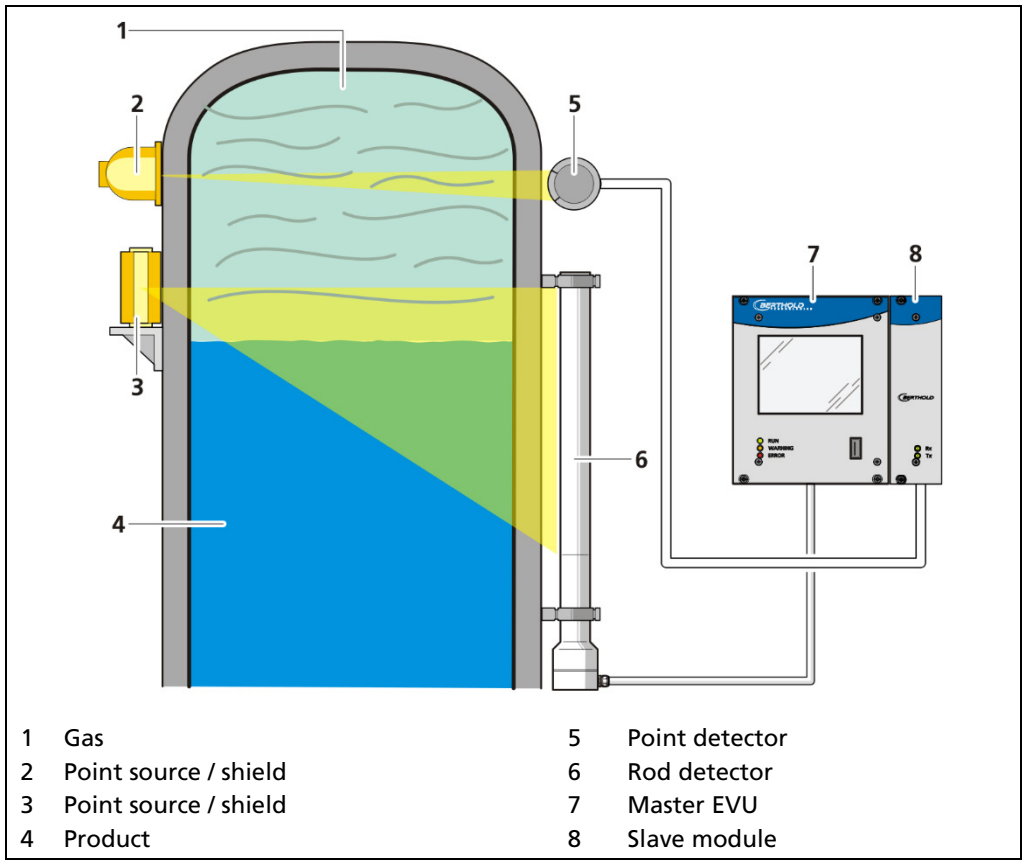
Device Setup | Setup | Calibration | GPC

If the container is operating under gas pressure and the gas pressure is not constant, then a continuous gas density compensation is recommended. For this purpose, an additional measurement is required which is located above the level measurement and which continuously measures the gas density in the container.

NOTICE

For the gas property compensation (GPC) an additional detector is mandatory to measure the gas density. This detector is connected with the LB 470RID level evaluation unit, via a slave module, or via another LB 470RID evaluation unit.

- Add this detector according the instructions in chapter 7.3.2 and activate it as GPC detector Fig. 55.



1	Gas	5	Point detector
2	Point source / shield	6	Rod detector
3	Point source / shield	7	Master EVU
4	Product	8	Slave module

Fig. 92 GPC example measurement arrangement

NOTICE

This functionality presupposes comprehensive knowledge and should only be activated by a Berthold service technician or a specially trained and instructed person.

[2] GPC = Gas Property Compensation

You can make the following settings in the submenu GPC (gas properties compensation) (Fig. 93):

- GPC Calibration
  - Reference count rate
  - Background
  - Factor M
  - Max. GPC factor
  - Time constant
- GPC settings
- Reset GPC

NOTICE

An additional compatible Berthold probe for measuring the gas density is absolutely necessary for the gas properties compensation. The probe is connected to the level measurement via the slave interface.

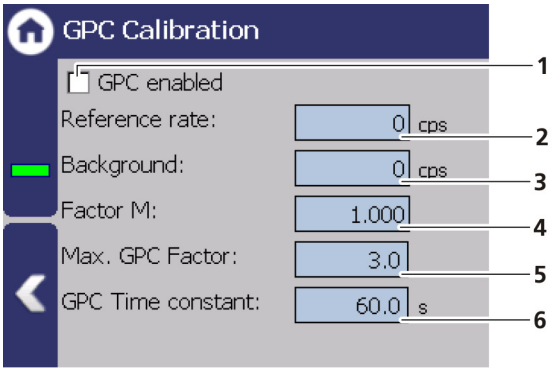
Fig. 93 Submenu „GPC“

GPC Calibration

Device Setup | Setup | Calibration | GPC | GPC Calibration

The "GPC calibration" is used to adapt the measuring sensitivity of the gas density detector to that of the level detector.

The check box “GPC enabled” (Fig. 94, item 1) can only be selected when a detector is configured for gas density measurement and the unit % is for “PV” selected.



1 Check box “GPC enabled”
2 Check box Reference count rate [cps] for the detector under calibration conditions[3]
3 Input field Background (background radiation) [cps]
4 Calibration menu for Factor M
5 Input field Max. GPC Factor
6 GPC Time constant

Fig. 94 GPC Calibration

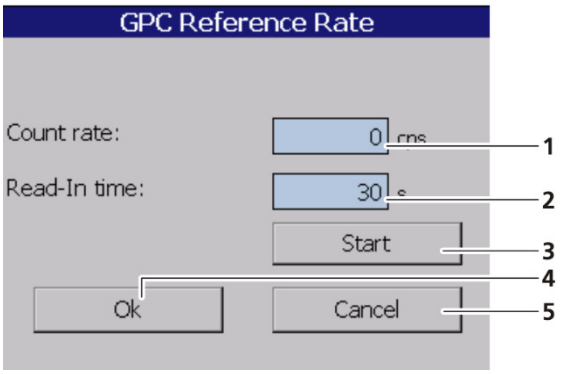
[3] Calibration conditions exist when the gas density is the same as in the calibration of the level measurement.

GPC Calibration: Reference Rate

The reference count rate of the connected density measurement must be recorded at the same pressure at which the level calibration table was recorded. Therefore, it is recommended to read in the reference count rate immediately after recording the empty level count rate. Click on the input field for the reference count rate (Fig. 94, item 2) to read in the reference count rate.

NOTICE

To determine the reference count rate of the GPC detector, there must be a constant gas density (calibration conditions) in the container.



1 Input field count rate [cps]
2 Input field read-in time [s]
3 Button <Start>
4 Button <Cancel>
5 Button <Ok>

Fig. 95 GPC Reference count rate

Determine Reference Count Rate

1. Click on the input field “Count Rate” (Fig. 94, item 2).

▶ A new window “GPC Reference Rate” opens (Fig. 95).

2. Click on the “Read-In time” field (Fig. 95, item 2) and specify the duration of measurement in seconds. The higher you set the measurement time, the more accurate the result.
3. Confirm with the Enter key and click on the button <Start> to start the measurement.

▶ The measurement is performed.

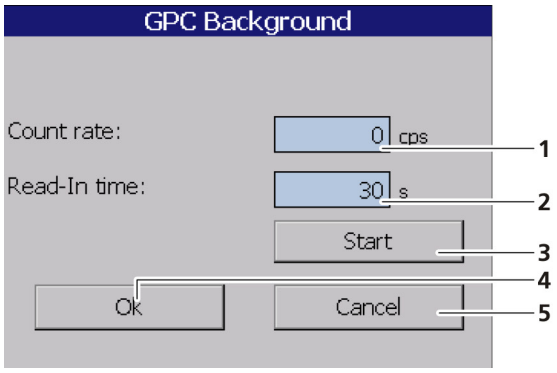
4. Click on <OK> to accept the count rate.

IMPORTANT

The value of the count rate may be entered manually (Fig. 95, item 1), if a determination of the unique reference count rate is not possible.

GPC Calibration: Background

The background count rate (Fig. 94, item 3) indicates the natural background radiation of the gas density detector if no radiation source is installed. This count rate is compensated by the system.



1 Input field count rate [cps]
2 Input field read-in time [s]
3 Button <Start>
4 Button <Cancel>
5 Button <Ok>

Fig. 96 GPC calibration background

Determine background

1. Click on the text field "Background" (Fig. 94, item 3).

▶ A new window "Background" opens to determine the background radiation (Fig. 96).

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

▶ The measurement is performed.

4. Click on <OK> to accept the count rate.

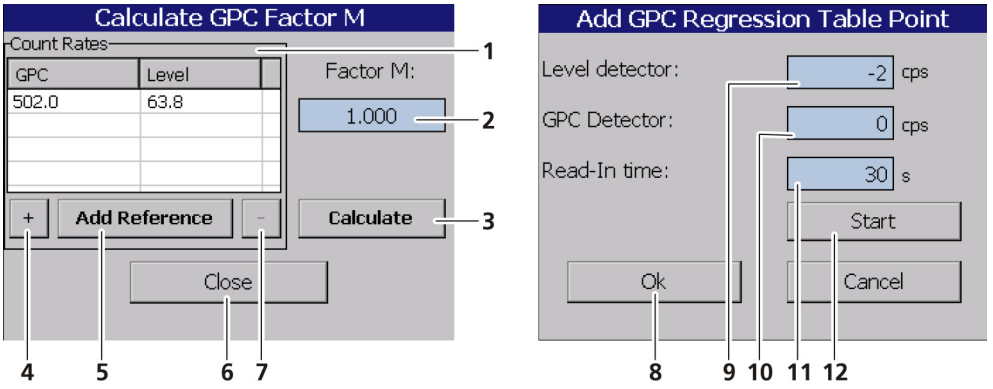
IMPORTANT

The value of the count rate can be entered manually (Fig. 96, item 1) if a determination of background radiation without foreign radiation effects is not possible.

GPC calibration: Factor M

To calculate the correct factor M, click on the input field for the factor M. In this table the first calibration point can be inserted directly from the available data with the button <Add Reference> (Fig. 97, item 5). At least one more point is required to calculate a factor M. This second point is ideally taken at the highest occurring gas density. Further table points with other gas densities improve the accuracy of Factor M. With the button <Calculate> (Fig. 97, item 3) the factor M is calculated from the table values.

For complex applications, differences in geometry between level measurement and density measurement may exist and/or highly different absorption coefficients (e.g. by different nuclides) may occur. In this case, an adjustment for at least 2 (up to 10) different gas densities is necessary to determine the manual correction factor (M). No adjustment needs to be performed for standard applications.



1 List GPC count rates
2 Input field Factor M
3 Button <Calculate>
4 Button <+> (manual adding count rates)
5 Button <Add Reference> (current calibration value)
6 Button <Close>
7 Button < - > (removal of the point)
Button <Ok>
8 Input field level detector
9 Input field GPC detector
10 Read-In time
11 Button <Start>
12

Fig. 97 GPC calibration: calculate factor M

Read in the Count Rates

IMPORTANT

If it is not possible to capture the count rates, the values may be entered manually into the input fields (Fig. 97, item 9 and item 10).

1. Click on the < + > button (Fig. 97, item 4) to add a new point.
2. Click on the input field “Read-In-Time” (Fig. 97, item 11) and enter a measurement time. Confirm with the Enter key.
3. Click on the button <Start> (Fig. 97, item 12). Make sure that the actual level in the container does not change during the read-In time.

▶ Repeat the capture for at least one other level.

4. A new point is added when clicking on the button <Add Reference> (Fig. 97, item 5), which takes over the count rates of the measurement during calibration.

Calculate Factor M

After all values have been entered or calculated in the GPC calibration window, the GPC function can be activated with the "GPC activated" check box (Fig. 94, item 1).

The “Factor M” (Fig. 97, item 2) is close to *1* (default value) for standard applications.

1. Click the button <Calculate> (Fig. 97, item 3) to determine Factor M from the count rate.

▶ Factor M has been calculated and is displayed in the input field (Fig. 97, item 2).

2. Click the button <Close> (Fig. 97, item 6) to return to “GPC calibration” in the submenu.

▶ The determined Factor M has been accepted.

IMPORTANT

The M factor can be entered manually (Fig. 97, item 2), if a determination of the counting rates is not possible.

GPC Calibration: Max. GPC Factor

The maximum factor with which the level count rate may be compensated is specified in the field “Max. GPC Factor” (Fig. 94, item 5). The default value is 3.0.

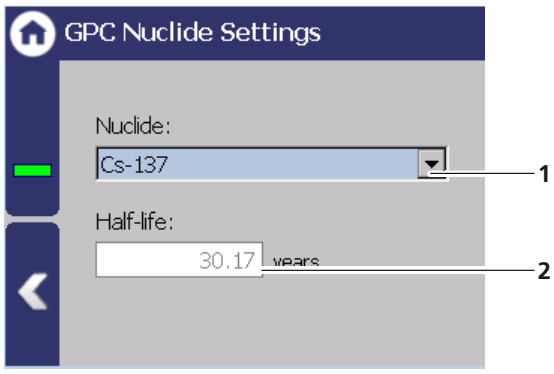
GPC Nuclide Settings

Device Setup | Setup | Calibration | GPC | GPC Nuclide Settings

Under "GPC Settings" the isotope of the source for gas density measurement can be selected (Fig. 98, item 1). The half-life time of the isotope is shown in the display field (Fig. 98, item 2).

NOTICE

The sources for level measurement and the sources of the GPC measurement must contain the same Nuclide (see Device Setup | Setup | Calibration | Calibration Settings tab "Nuclide).



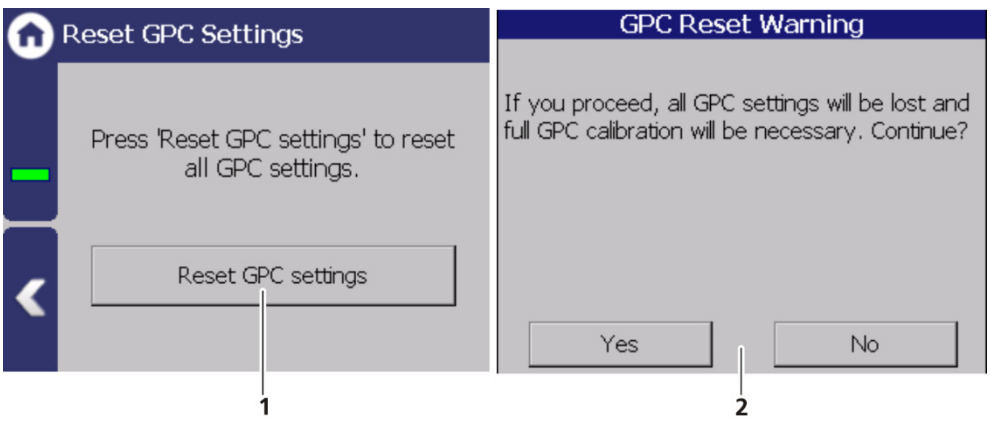
1 Selection arrow "Nuclide"
2 Display field "Half-life" [years]

Fig. 98 GPC Nuclide Settings

Reset GPC Settings

Device Setup | Setup | Calibration | GPC | Reset GPC

All GPC settings can be reset in the window "Reset GPC Settings".



1 Button <Reset GPC settings>
2 Window "GPC Reset Warning"

Fig. 99 Reset GPC Settings

1. Click on the button <Reset GPC settings> (Fig. 99, item 1).

▶ A confirmation message (Fig. 99, item 2) appears.

2. Click on <Yes> to set all values to "Default", click on <No> to cancel.

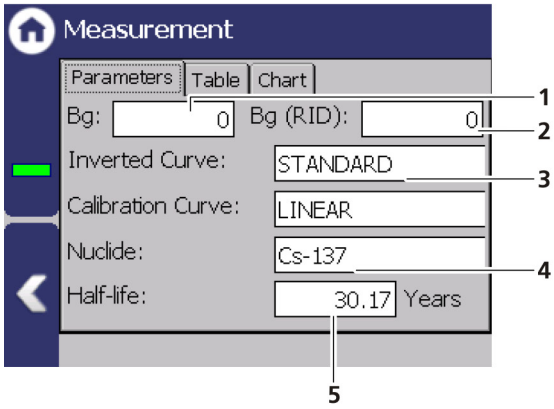
7.3.4 Measurement

Device Setup | Setup | Measurement

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

Measurement: Parameter

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

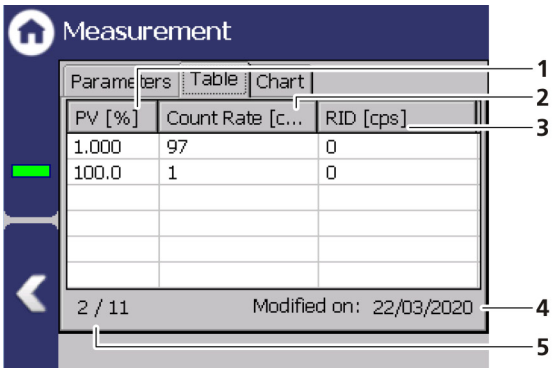


1 Background count rate [cps]
2 RID Background count rate [cps]
3 Characteristic curve (standard or inverted)
4 Nuclide (Cs-137 or Co-60)
5 Half-life [years]

Fig. 100 Measurement (Parameters)

Measurement: Table

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

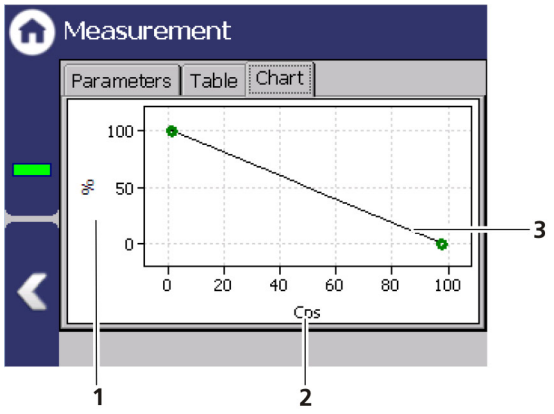


1 PV measurement point in percent [%]
2 RID count rate [cps]
3 Count rate [cps]
4 Date of last change of the measurement parameter set
5 Number of measuring points

Fig. 101 Measurement (Table)

Measurement: Chart

The characteristic curve of the current measurement is displayed in the “Graphics” tab.



1 Axis level [%}
2 Axis count rate [cps]
3 Characteristic curve

Fig. 102 Measurement (Chart)

7.3.5 Signal Condition

Device Setup | Setup | Signal Condition

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

- Damping (time constant)
- PV range
- Rapid Switch
- XIP (X-Ray interference protection)
- RID
- Source Replacement

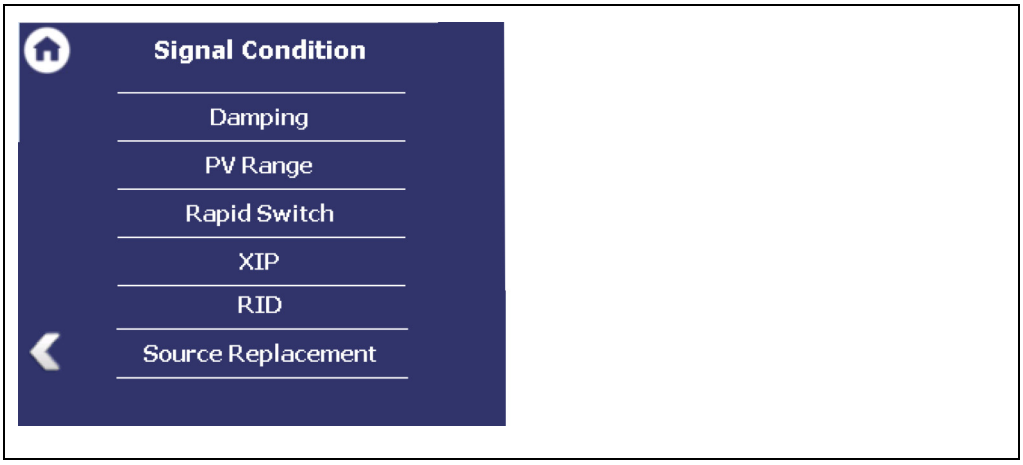


Fig. 103 Menu “Signal Condition”

Signal Condition: Damping

Device Setup | Setup | Signal Condition | Damping

The reaction time of the measured value display (standard display) can be set in the window “Damping”. The measurement reacts quickly to rapid process changes (e.g. by agitators) for a small time constant (min. 1 sec). The measurement reacts correspondingly slower for a larger time constant. However, due to the stronger filtering, the statistical error is reduced with a larger time constant and the measurement is correspondingly less noisy. A typical time constant for radiometric level measurements is 20 seconds.

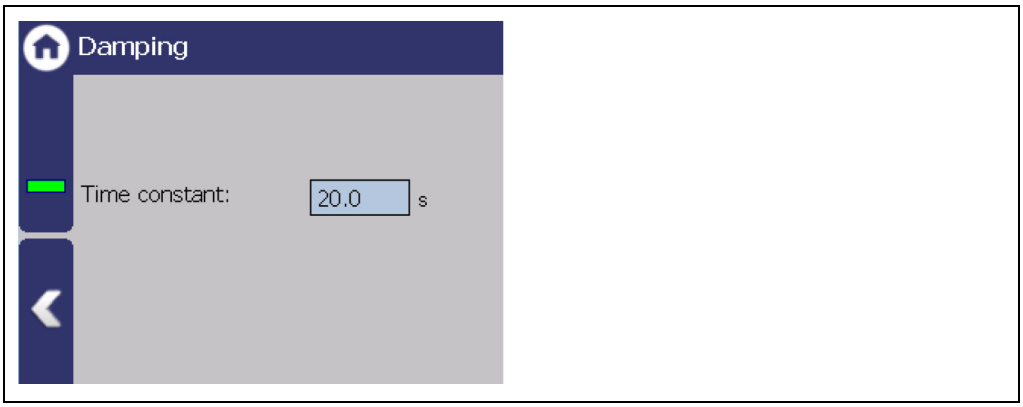


Fig. 104 Signal Condition (damping)

1. Click on the input field to change the time constant.

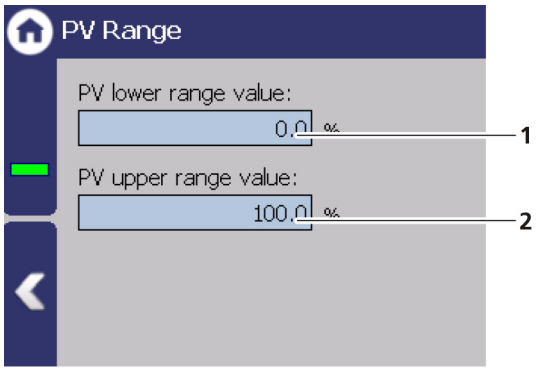
2. Confirm the value with the Enter key.

▶ 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 (4 ... 20 mA or 0 ... 20 mA). The unit is displayed that is selected in the menu System | Units in the box "PV".



1 Input field lower range value [%]
2 Input field upper range value [%]

Fig. 105 Signal Condition (PV Range)

1. Click on the input field (Fig. 105, item 1) to enter, in percent [%], the level which should correspond to an output current of e.g. 4 mA.
2. Confirm with the Enter key.
3. Click on the input field (Fig. 105, item 2) to enter, in percent [%], the level which should correspond to an output current of 20 mA.
4. Confirm with the Enter key.

▶ The PV values are set.

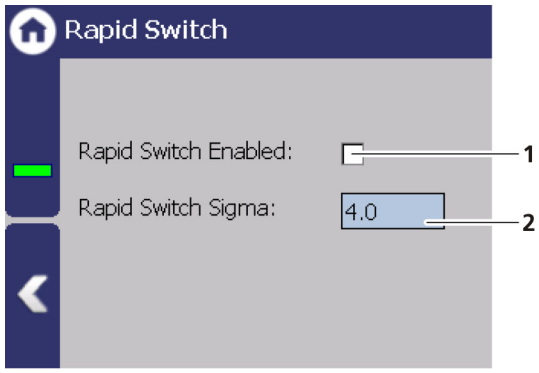
Signal Condition: Rapid Switch

Device Setup | Setup | Signal Condition | Rapid Switch

IMPORTANT

The use of the function "Rapid Switch" is recommended only for special applications where the output signal has to adapt rapidly to the new value, e.g. in case of measurements on small tanks and if sudden level changes occur.

When “Rapid Switch” (Fig. 106, item 1) is activated, there is a rapid reaction ((Fig. 106, item 2) to a quick change in level. The time constant in this case is set to 1/10. After that, the time constant is reset to the original value. A change in level is considered to be a ”rapid” change when the count rate is changing more than the entered sigma value within a short time. The sigma value can be adjusted to the process. A sigma of 4.0 is factory set at delivery.



1 Activate check box Rapid Switch Enabled
2 Input field Rapid Switch Sigma

Fig. 106 Signal Condition (Rapid Switch)

NOTICE

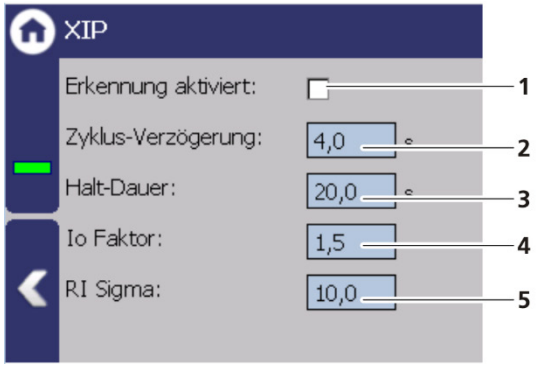
Rapid Switch and XIP / RID detection must not be activated simultaneously.

Signal processing: XIP[4] (Radiation Interference)

Device Setup | Setup | Signal Condition | XIP

This function allows you to take interference (XIP) into consideration. Measurement jumps that influence the process can arise through interference. Only rapid increases are considered. If detection (Fig. 107, item 1) is activated, the last valid measured value is frozen.

Cycle delay [s]	This value determines the wait time for the measured value generation. The change does not affect the measurement above this time.
Hold time [s]	The valid measurement value is frozen at this time after detection of interference.
I_0 factor	The "I_0 factor" determines the recognition criteria for interference.
RI Sigma	A sudden increase in the count rate is an indication of interference radiation. The smaller the value, the more sensitive the setting. To avoid false alarms, a value for RI Sigma >5 (e.g. 6) should be selected. In the case of turbulence and stirrers that cause the measured level value to fluctuate, the value must be set correspondingly higher. If the level measurement is used as a limit switch with point source and point detector, then it is recommended to set the value to 999 and deactivate the sigma function. Otherwise it is possible that an XIP alarm is triggered when the value falls below the limit value.



1 Check box the "Activate detection"
2 Input field measurement delay
3 Input field hold time
4 Input field I_O factor
5 Input field RI Sigma

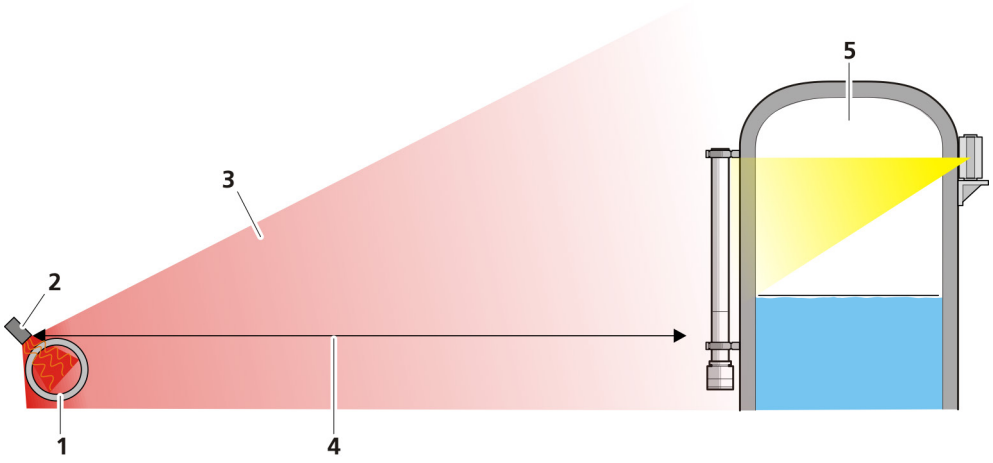
Fig. 107 Signal Condition (Radiation Interference)

NOTICE

Rapid Switch and Interference detection must not be activated simultaneously.

[4] XIP = X-Ray Interference Protection

Detecting Interference Radiation XIP



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

Fig. 108 Interference radiation during a weld inspection

Detecting Interference Radiation

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

The alarm is triggered by:

Scenario A - Maximum possible count rate (empty calibration)

$$Is > Io * 1.5$$

Is = current count rate in cps integrated over one second
Io = maximum count rate at empty calibration

Scenario B - Mean value of current count rate monitored

The system sensitivity, i.e. the distance of the alarm thresholds is defined as the multiple of the mean statistical variations and can be entered as Sigma value as needed. The time constant is one second.

When reaching the alarm threshold, a message is output via the error relay and on the device display.

$$Is > Im + n * Sigma$$

Im = current count rate integrated over one second
n = multiple value of Sigma

Further information on scenario A

A relative limit value is monitored, i.e. the alarm threshold is reached when exceeding a maximum dose rate (calibration value at empty vessel) at the detector.

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

Further information on scenario B

A differential limit value is monitored, i.e. each fast rise of the dose rate triggers an alarm.

Even minor outside radiation is detected, when it occurs erratically. Operative factors such as fast emptying of the vessel or opening the shielding container may trigger false alarms.

To rule out false alarms with sufficient statistical safety, you should enter n > 5. The mathematical correlation shows that the distance of the alarm threshold is dependent upon the respective mean count rate in.

For calculation it holds:

$$\text{Sigma} = \sqrt{\text{Ips}}$$

Example:

Count rate Im = 300 cps, n = 6

$$Is = \text{Im} + n \times \sqrt{\text{In}}$$

$$Is = 300 + 6 \times \sqrt{300} = 404 \text{ Ips}$$

Thus, an alarm is signaled as soon as *Is* exceeds 404 cps.

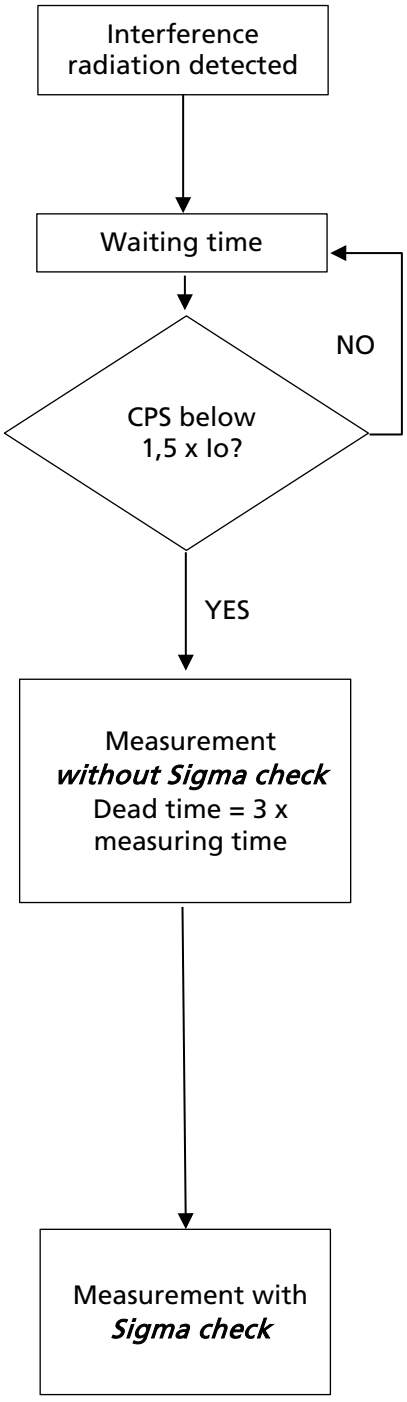
IMPORTANT

Due to the dynamic behavior of the interfering radiation detection, a quick increase of the pulse rate due to operational factors (e.g. very fast emptying of the vessel or large short-term level changes caused by agitators) can be interpreted as interfering radiation. Due to a high Sigma value, false triggering by these operating conditions can be suppressed. However, the radiation interference detection also becomes less sensitive.

For example, opening the useful beam channel on the shielding can also cause a quick increase of the count rate. You have to reset the alarm that is then triggered, or better, do not enable the interfering radiation detection at first. However, it would be better not to enable the interfering radiation detection at first. Enable the interfering radiation detection only after calibration.

Interference Radiation Detection Flow Chart

If radiation interference is detected, following will happen:



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

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

At the end of the waiting time the system checks if the arriving count rate is smaller than 1.5-times the calibrated empty count rate (Io) (see scenario A). If not, the waiting time starts again.

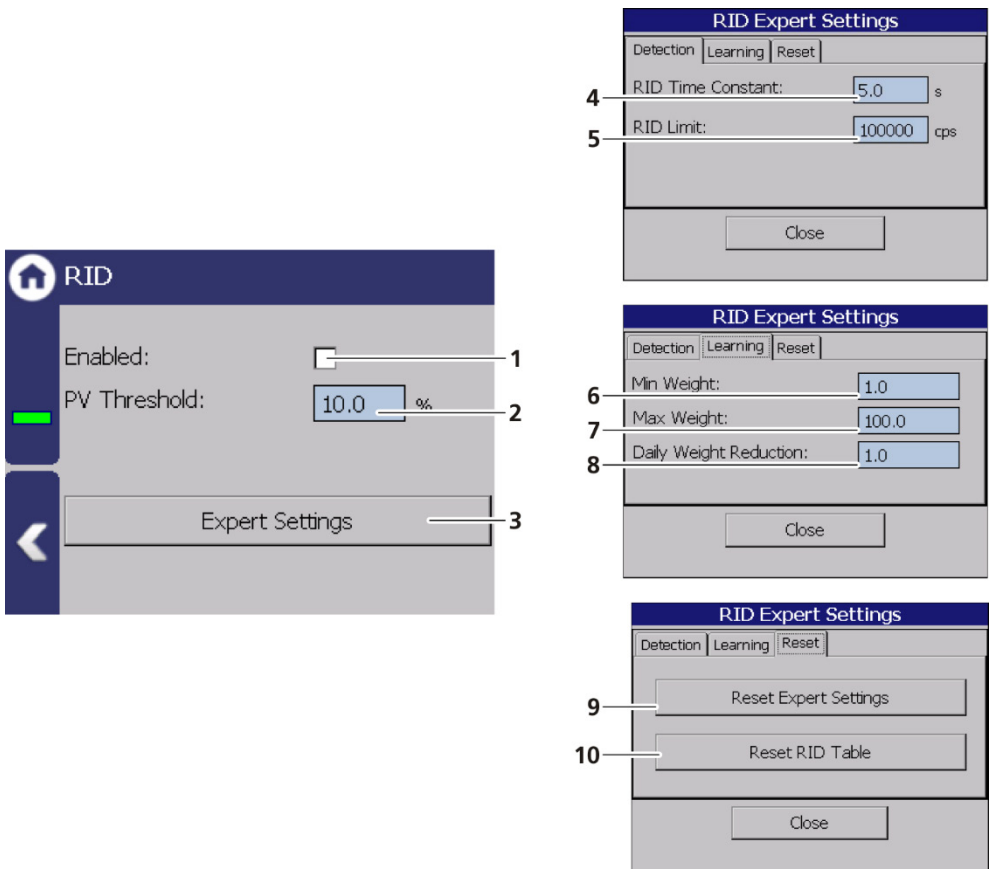
If the count rate is below 1.5-times the empty count rate, the measurement automatically switches to the RUN mode. Sigma detection (see scenario B) is disabled for 3 x measuring time (= dead time).

Example:
If the measurement time is 20 s, the dead time is 60 s. This time is needed for the measurement to adjust to a possibly changed level, without triggering interference radiation detection. During this time, interference radiation is detected only when the count rate has increased to 1.5-times the empty count rate.

At the end of the waiting time the system the sigma detection is reactivated.

Signal processing: RID[5]

Device Setup | Setup | Signal Condition | RID



1	Checkbox “Enabled”	6	Input field “Min. Weight”
2	Input field “PV Threshold”	7	Input field ”Max. Weight”
3	Button <Expert Settings>	8	Input field ”Daily Weight Reduction”
4	Input field “RID Time Constant”	9	Button <Expert-Settings>
5	Input field “RID Limit”	10	Button <Reset RID Table>

Fig. 109 Signal Condition (RID)

NOTICE

The following parameters should be changed only by Berthold employees, or in consultation with Berthold.

Explanation "Weight"

The RID table consists of 100 points. Through these points, a characteristic curve is formed from the function between the secondary channel and the measurement channel. The weight describes how strongly the respective point affects the characteristic curve. The higher the weight the stronger the characteristic is forced by the respective point.

[5] Radiation Interference Discrimination

PV Threshold	External radiation is detected if the measured value in the secondary channel deviates from the measurement channel by the value of PV Threshold. The larger the value, the more unclear the external radiation is detected. The smaller the value, the greater the risk of RID faulty activation.
RID Time Constant	The RID time constant affects the comparison between secondary channel and measurement channel. The RID time constant must be set smaller than the standard time constant. If the time is too low, the risk of RID misfiring increases.
RID Limit	The RID limit describes the count rate threshold from RID to XIP. In two scenarios we recommend to adjust the RID Limit value: • for RID measurements using SuperSENS detectors. • for existing installations where LB 440 RID is replaced by LB 470 RID and the recommended count rate of 30,000 cps is not reached, and an increase of the count rate is not possible. For new installations with rod detectors, we recommend a count rate of at least 30,000 cps to guarantee a safe RID function.
Min. Weight	Minimum weight of the individual measuring points, which cannot be lower by the daily reduction (Daily Weight Reduction).
Max. Weight	Maximum weight of the measuring point that can be achieved by frequent learning of this point.
Daily Weight Reduction	This parameter specifies how much the respective point of the RID table loses weight if it is not learned again.
Button <Reset Expert Settings>	Reset the settings under "Expert Settings" to default values.
Button <Reset RID Table>	Deletion of all learned points in the RID table. If the RID table has been deleted and the last calibration is older than about three months, it is recommended to recalibrate.

NOTICE

If the level measurement is used as a min-level switch, with point source and point detector, it is recommended that the measurement be carried out approximately every six months, at least briefly when the container is empty, or with a level below the limit. This automatically compensates for any changes in sensitivity due to aging and the function of external radiation detection remains guaranteed. Similarly, with the maximum level switch, it is recommended that the fill level be exceeded about the limit value every six months.
Alternatively, you can also recalibrate with an empty and full adjustment.

Recommended Parameters

	Default recommended settings for level applications in which the measuring range is passed through frequently and widely.	**Settings (slow)** Recommended settings for limit switches and for level measurements where an almost constant level is used during operation.
PV Threshold	10%	10%
RID Time Constant	5s	5s
Min. Weight	1	20
Max. Weight	100	100
Daily Weight Reduction	1	1
XIP: RI Sigma (see page 134)	10	999

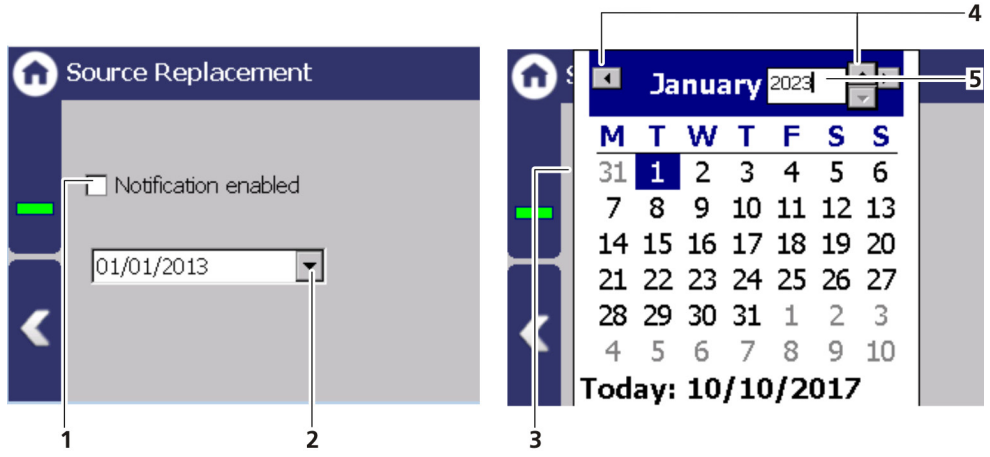
Signal Processing: Source Replacement

Device Setup | Setup | Signal Condition | Source Replacement

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

NOTICE

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



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

Fig. 110 Source replacement

Setting source replacement date

1. Activate the check box (Fig. 110, item 1).
2. Click on the arrow key (Fig. 110, item 2) in order to set the date.

▶ The calendar is opened.

3. Click on the year (Fig. 110, item 5) to select the year with the arrow keys.
4. Set the month and day in the calendar.

▶ The calendar retracts and the notification has been established.

7.3.6 Inputs

Device Setup | Setup | Inputs

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

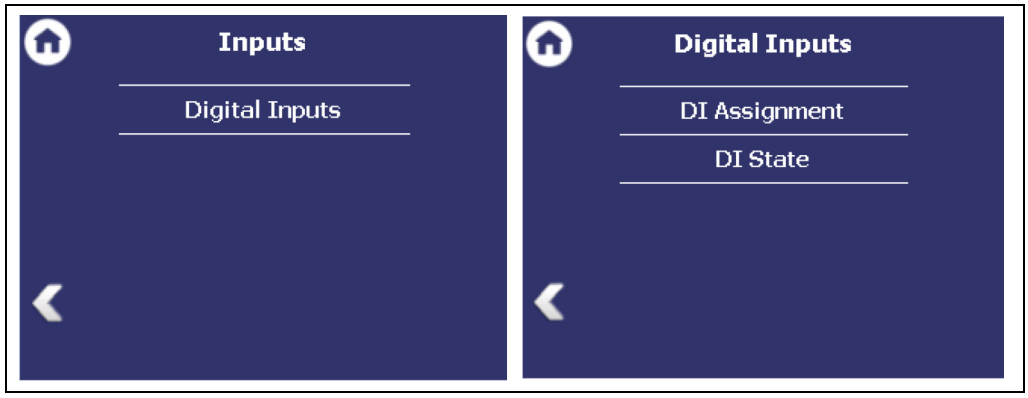


Fig. 111 Menu "Inputs"; Submenu "Digital inputs (DI)"

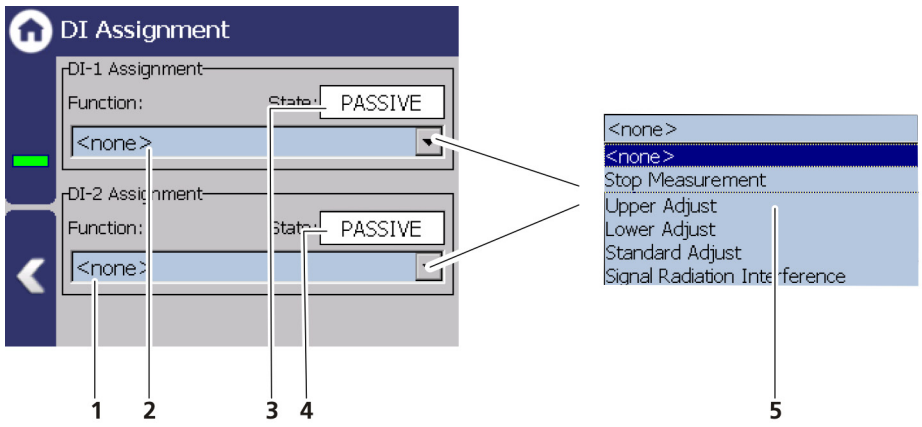
Digital inputs (DI) Assignment

Device Setup | Setup | Inputs | Digital Inputs | Assignment

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

The functions Standard Adjust / Lower Adjust / Upper Adjust are used for external control of the adjustment. The parameters of the adjustment function are thereby used (Device Setup | Setup | Calibration | Adjust).

The function “Signal Radiation Interference” is used to switch manually to the secondary channel of the RID function instead of waiting for the automatic detection. In the case of announced interference radiation events, such as weld inspections, it is therefore possible to activate this function manually and keep it active until the weld inspection is completed.



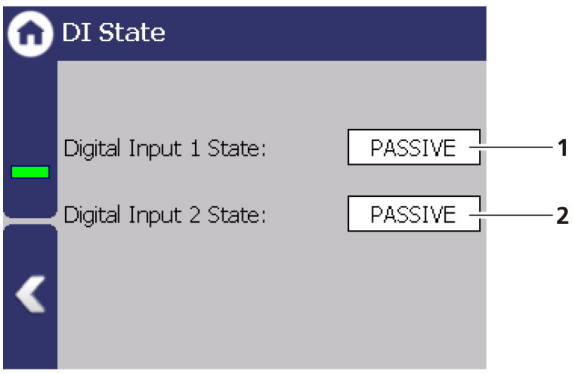
1 DI-2 Assignment: Selection of function
2 DI-1 Assignment: Selection of function
3 DI-1 Assignment state
4 DI-2 Assignment state
5 Selection box function

Fig. 112 DI Inputs Assignment

DI State

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

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



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

Fig. 113 DI Inputs State

7.3.7 Outputs

Device Setup | Setup | Outputs

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

- Analog Output Mapping (AO)
  - Function
  - AO monitoring
  - Failure mode
  - Current limits
  - Calibrate
- Digital output (DO)
  - Alarm assignment

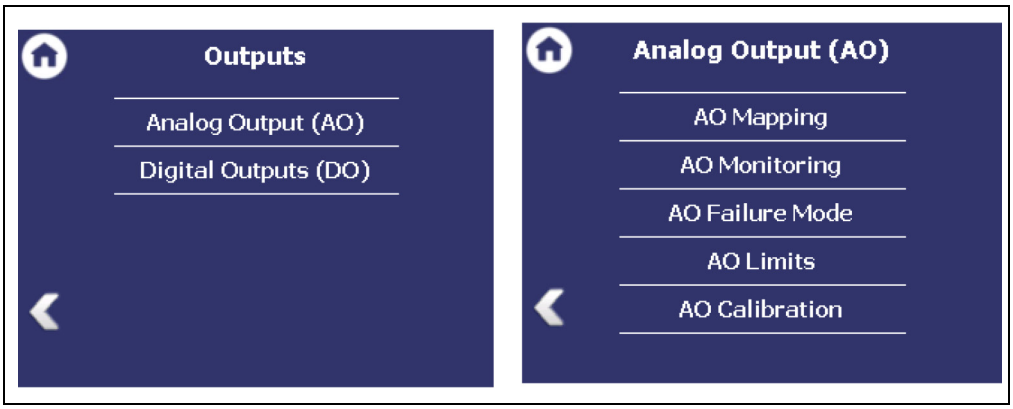
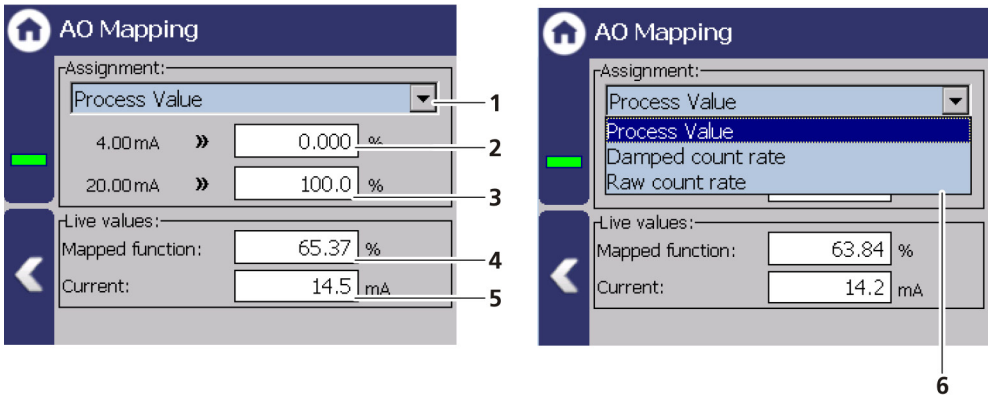


Fig. 114 Menu “Outputs”; Submenu "Analog Output"

Analog Output: AO Mapping

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

A function can be assigned to an analogue output in the window “AO Mapping”. The current output signal is between 4 mA and 20 mA. The corresponding values (e.g. level) can be freely assigned.



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

Fig. 115 Analog Output Mapping (Assignment)

The value which is assigned to a current output signal of 4 mA must be smaller than the value which is assigned to that of 20 mA.

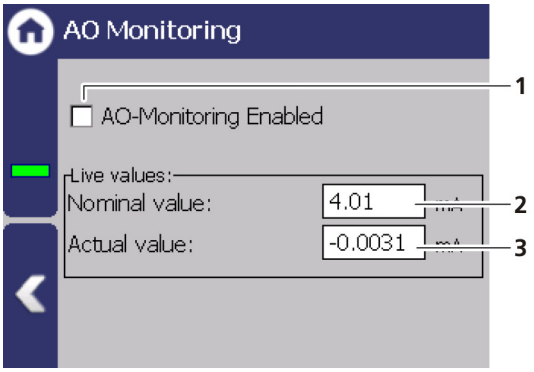
Process value	The values of the process value can be assigned in the menu Signal Condition | PV Range or in the calibration settings.
Damped Count Rate	Enter a count rate range that outputs the damped count rate at the current output.
Raw count rate	Enter a count rate range that outputs the current count rate at the current output.

Analog Output: AO Monitoring

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

If “AO Monitoring” is activated (Fig. 116, item 1), the current output will be monitored. It is continuously monitored whether the current value flowing in the current loop is correct.

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



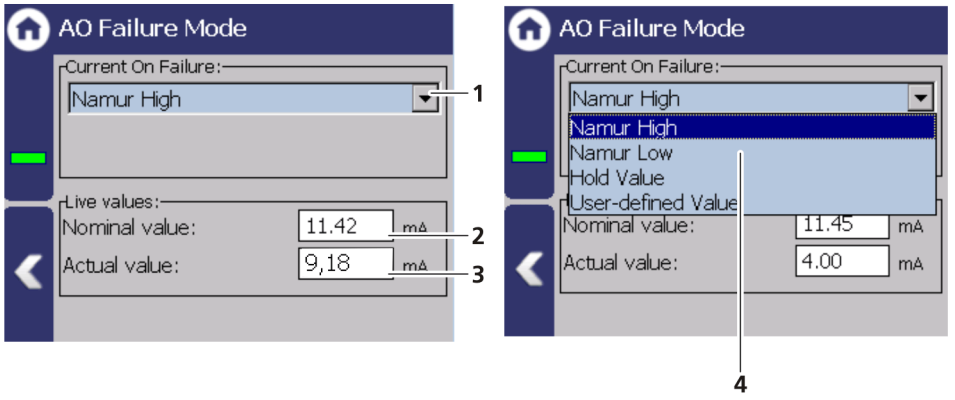
1 Activate check box “AO-Monitoring Enabled”
2 Target value [mA]
3 Actual value [mA]

Fig. 116 Analog Output Monitoring

Analog Output: AO Failure Mode

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

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



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

Fig. 117 Analog Output (AO Failure Mode)

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

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

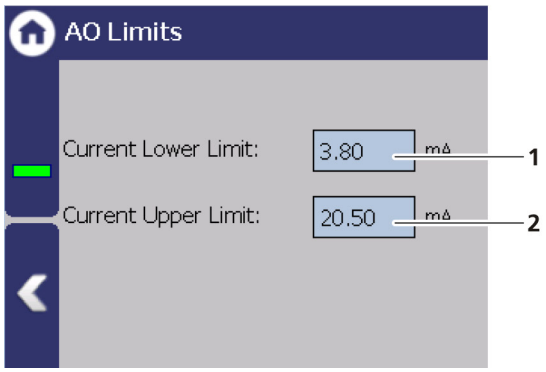
NOTICE

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

Analogue Output: AO Limits

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

By clicking on the input fields (Fig. 118, item 1, item 2), the values [mA] for the lower and upper current limit can be set. In addition to the default value of 3.8 mA, the lower current limit can be set to 0 mA in order to switch the current output from 4 ... 20 mA to 0 ... 20 mA.



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

Fig. 118 Analog Output (AO Limit)

NOTICE

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

Analog Output: Calibrate

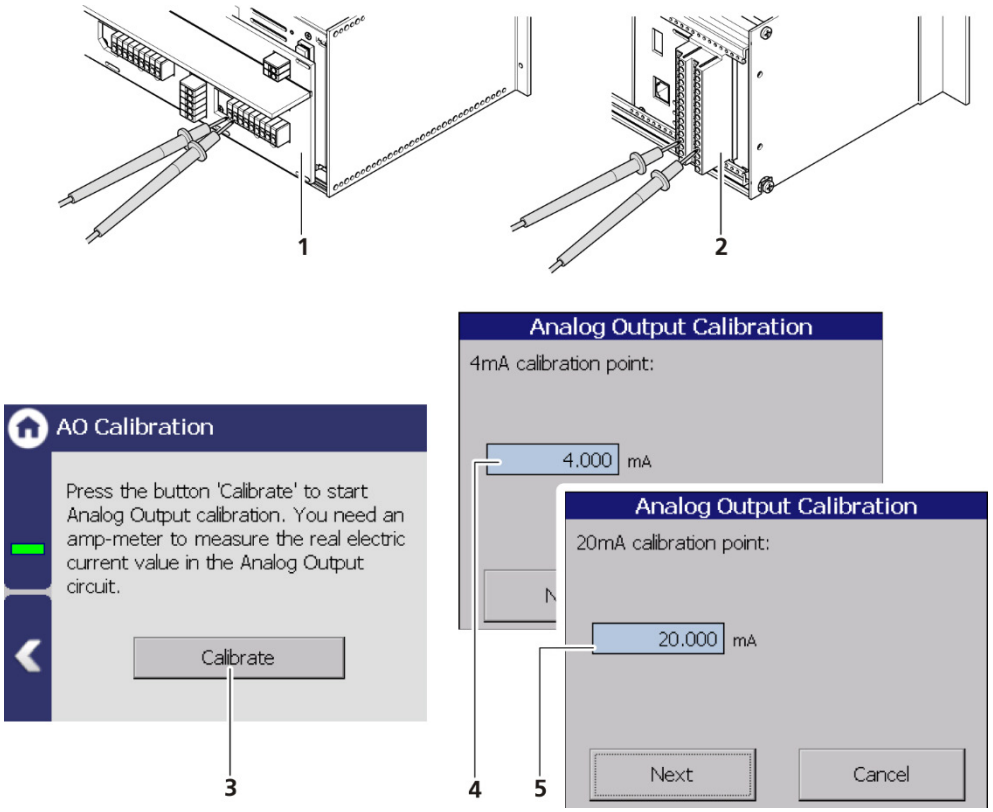
Device Setup | Setup | Output | Analog Output (AO) | AO Calibration

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

NOTICE

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

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



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

Fig. 119 Analog Output (Calibration)

Perform calibration

⚠ DANGER

Danger to life from electric shock!

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

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

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

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

3. Enter the indicated value on the current measuring instrument in the input box (Fig. 119, item 4).
4. Click on the button <Continue>.

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

5. Enter the indicated value on the current measuring instrument in the input box (Fig. 119, item 5).
6. Click on the button <Continue>.

- A message appears "Calibration successful".

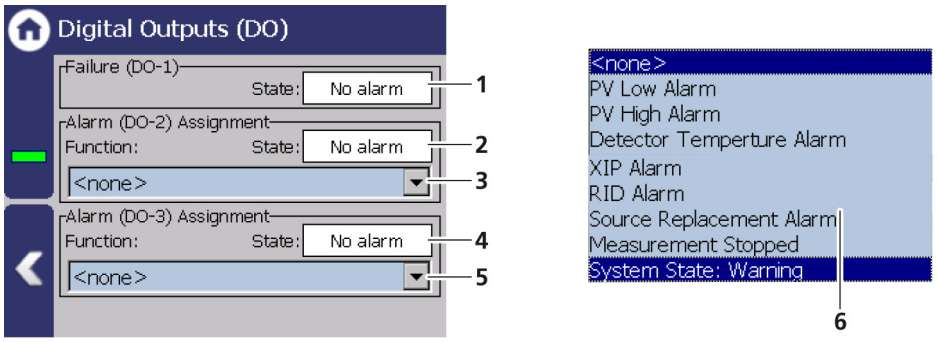
7. Click on the button <Continue>.

- The calibration of the analog output is completed.

Digital Outputs (DO)

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

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



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

Fig. 120 Digital Outputs

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

PV Low Alarm	The relay alarms when the value at Device Setup | Setup | Alarms | PV alarm settings is below the threshold.
PV High Alarm	The relay alarms if the value under Device Setup | Setup | Alarms | PV Alarm Settings is exceeded.
Detector Temperature Alarm	The relay alarms when values set at Device Setup | Setup | Alarms | Det.-Temp. Alarm function are exceeded or below the threshold.
XIP Alarm	The relay alarms when detection is activated at Device Setup | Setup | Signal processing | XIP and interference was detected, so that the measurement was frozen. See next chapter (Interference Radiation Alarm)
RID Alarm	The relay alarms when detection is activated at Device Setup | Setup | Signal processing | RID and interference was detected, but the measurement can still measure in the secondary channel. See next chapter (Interference Radiation Alarm)
Source Replacement Alarm	The relay alarms when notification at Device Setup | Setup | Signal processing | Source replacement is activated and interference is detected.
Measurement Stopped	The relay alarms on during tests or other states where the measurement is stopped.

	For example, Simulation, plate space measurement, and detector update.
System State: Warning	The relay alarms when the event message “Warning” is displayed. (Warning includes “Out of specification”, “function check” and “maintenance required”).

Interference Radiation Alarm

According to intensity of the interference radiation at the detector, one of three operating states of the measuring equipment is recognized

Normal operation	During normal operation the level measurement is determined by the pulse rate in the measuring channel and is indicated in percent of the measuring range. The current output value corresponds to the level measured in the vessel.
Strong interference radiation	If the measurement is influenced by interference radiation and exceeds the channel difference tolerance band, the level measurement can no longer be determined by the pulse rate in the Measuring Channel. Then the EVU switches over to interference radiation operation and derives the actual level from the pulse rate in the Secondary Channel. The analog current output is now the value taken from the Secondary Channel. When the interference radiation stops, (channel difference <2%), the EVU switches back to the Measuring Channel and the system returns to the normal operating state.
Weak interference radiation	If the interference radiation cannot be suppressed on account of the intensity or the energy of the isotopes used in the weld check, the EVU freezes the measurement on the last reliably measured level value. When the interference radiation stops the EVU switches back to the Measuring Channel and the system returns to the normal operation state.

7.3.8 Alarms

Device Setup | Setup | Alarms

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

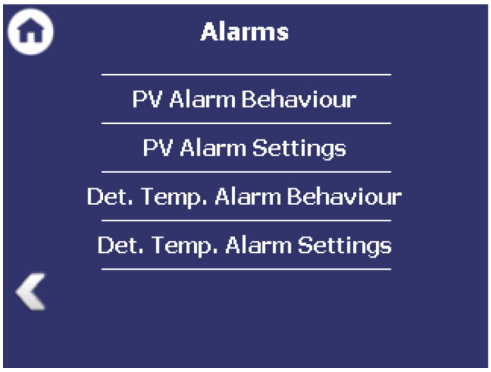
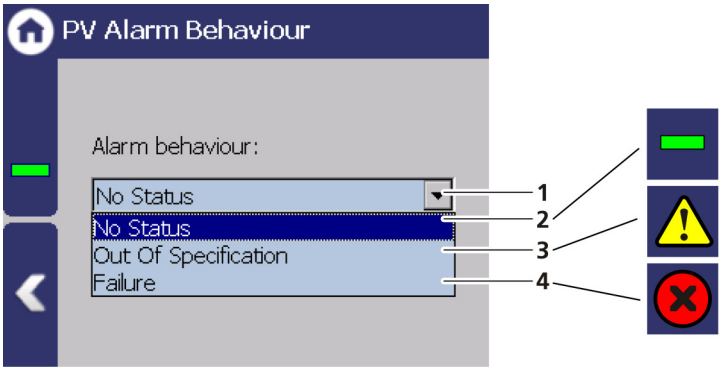


Fig. 121 Menu "Alarms"

PV Alarm Behavior

Device Setup | Setup | Alarms | PV Alarm Behavior

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



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

Fig. 122 PV Alarm Behavior

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 master display is therefore no longer possible.

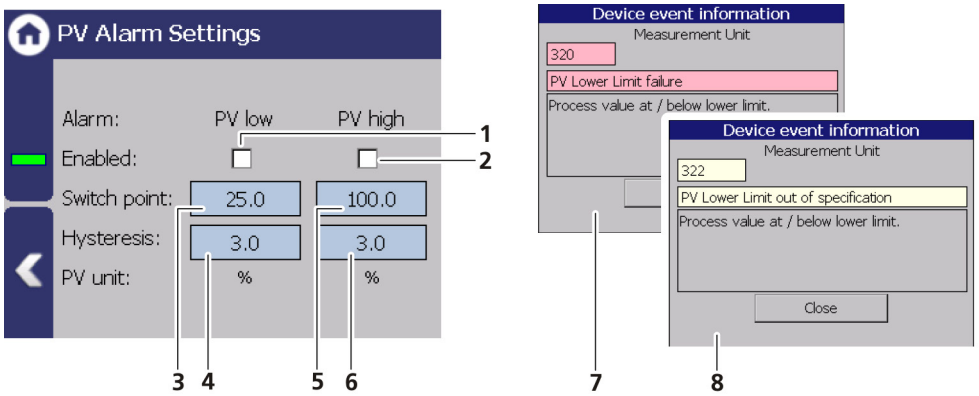
PV Alarm Settings

Device Setup | Setup | Alarms | PV Alarm Settings

You can set the values for the level alarms (max. and min.) and the hysteresis of these in the window “PV Alarm Settings”.

When exceeding or falling below the switching point, an event message appears in the status display. If a digital output “min. level Alarm” or "max. Level Alarm" is assigned under the function (Fig. 120, item 6), the relay alarms.

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”	5	Input box “Switch point High”
2	Selection box ”PV high”	6	Input box “Hysteresis Low”
3	Input box “Switch point Low”	7	Event message “Failure”
4	Input box “Hysteresis Low”	8	Event message “Out of specification”

Fig. 123 PV Alarm Settings

Example

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

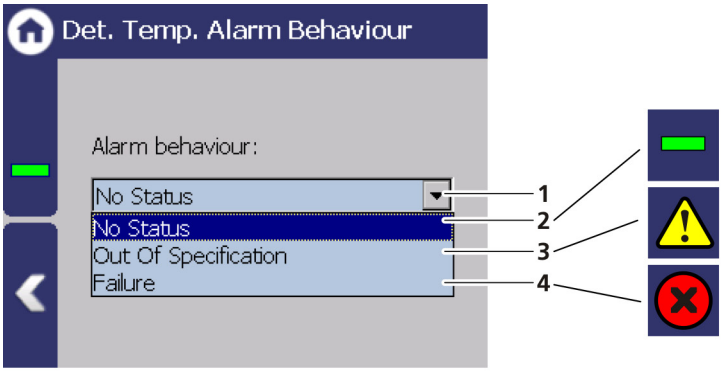
In the event of a rising process range, the max. alarm is triggered when a process range of 85% is exceeded. When the process range falls again, then the alarm does not switch off again until the process range falls below 85% - 5% = 80%.

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 Behavior

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

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



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

Fig. 124 Det.-Temp. Alarm Behavior

NOTICE

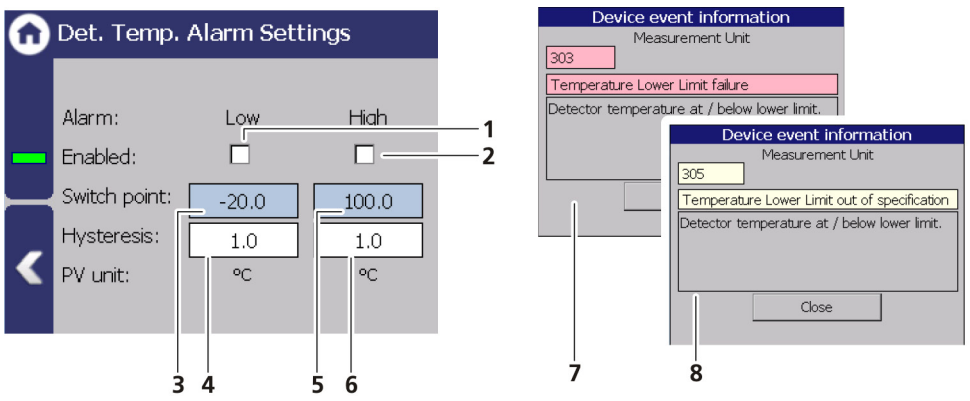
If the detector alarms are set to “Failure”, the measurement is switched in the error current during the occurrence of a temperature alarm. Monitoring of the PV in the master display is therefore no longer possible.

Detector Temperature Alarm Settings

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

The values for the detector temperature (max. and min.) can be set in the window "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 alarms.



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

Fig. 125 Det.-Temp Alarm Settings

Setting max. Temperature Alarm:

1. Activate the check box (Fig. 125, item 1).
1. Click on the input field (Fig. 125, item 2) to enter a switching point.
2. Confirm with the Enter key

▶ The value was changed.

Set min. Temperature Alarm:

1. Activate the check box (Fig. 125, item 3).
2. Click on the input field (Fig. 125, item 4) to enter a switching point.
3. Confirm with the Enter key

▶ The value was changed.

7.3.9 Simulation

Device Setup | Setup | Simulation

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

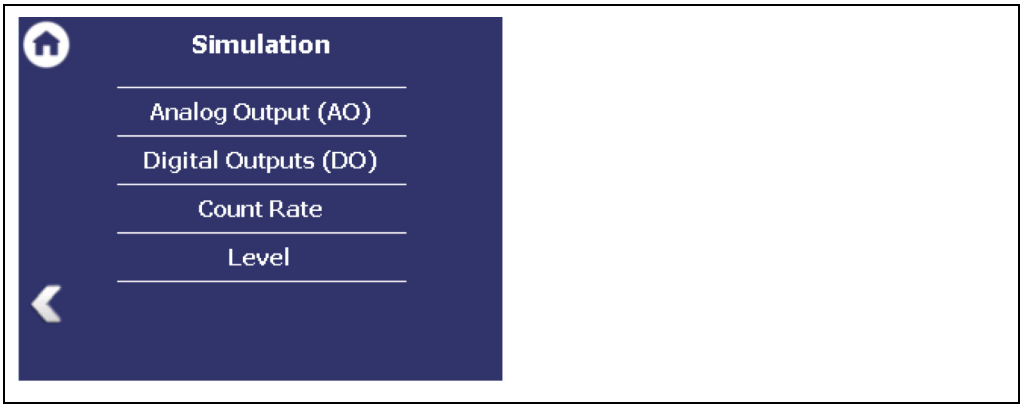


Fig. 126 Menu "Simulation"

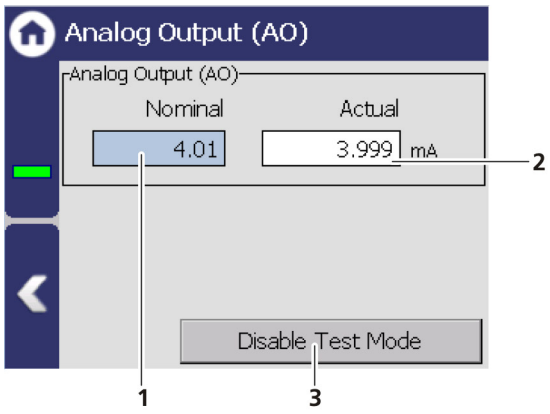
NOTICE

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

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

Simulation Analog Output

Device Setup | Setup | Simulation | Analog Output



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

Fig. 127 Simulation Analog Output

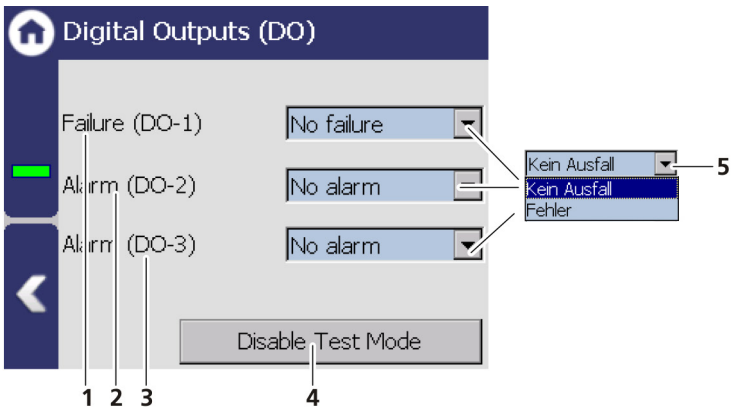
1. Click on the input field (Fig. 127, item 1) and enter the target value for the simulation.
2. Confirm with the Enter key.

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

3. Click on the <Disable Test Mode> button (Fig. 127, item 3) to stop the simulation.

Simulation Digital Output

Device Setup | Setup | Simulation | Digital Output



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

Fig. 128 Simulation Digital Outputs

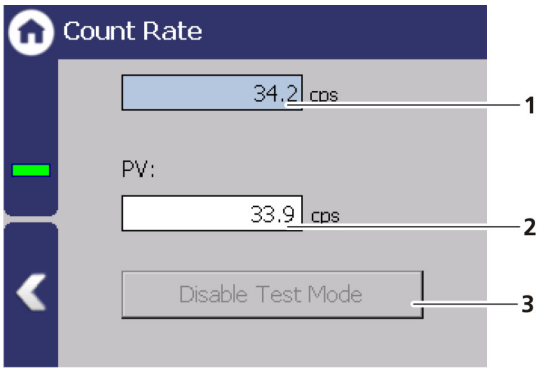
1. Click on the dropdown field (Fig. 128, item 5) and select "FAILURE" or "ALARM" for the simulation.

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

2. Click on the <Disable Test Mode> button (Fig. 128, item 4) to stop the simulation.

Simulation Count Rate

Device Setup | Setup | Simulation | Count Rate



1 Input field Dampened count rate
2 Display field process value “PV”
3 Button <Disable Test Mode>

Fig. 129 Simulation Count Rate

1. Click on the input field (Fig. 129, item 1) and enter count rate for the simulation.
2. Confirm with the Enter key.

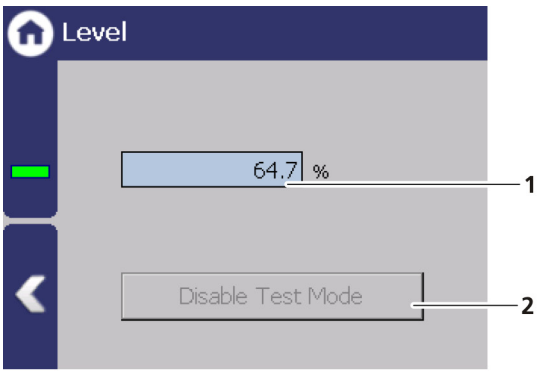
▶ The measurement is interrupted.

▶ The test is performed, and the process value (Fig. 129, item 2) is displayed.

3. Click on the <Disable Test Mode> button (Fig. 129, item 3) to stop the simulation.

Simulation Level

Device Setup | Setup | Simulation | Level



1 Input field level
2 Button <End test mode>

Fig. 130 Simulation Level

1. Click on the input field (Fig. 130, item 1) and enter a 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. 130, item 2) to stop the simulation.

7.4 Menu Backup/Restore

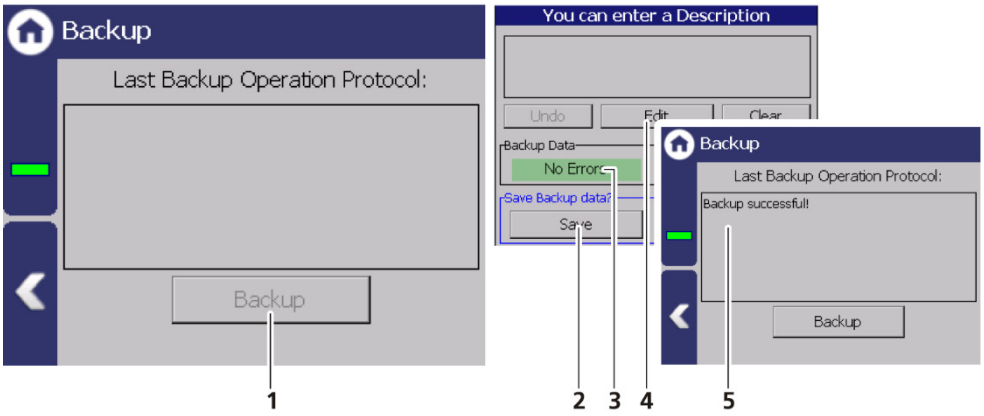
Device Setup | Backup/Restore

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

Fig. 131 Menu "Backup/Restore"

7.4.1 Backup

Device Setup | Backup/Restore | Backup



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

Fig. 132 Backup

Perform Backup

1. Connect a USB storage device to the device.
2. The USB storage device is recognized by the system after a few seconds and the button <Backup> (Fig. 132, item 1) can be clicked.

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

3. Click on the button <Backup> (Fig. 132, item 1).

- The window “Enter description” appears.
- The message “Error free” (Fig. 132, item 3) appears in the field “Backup data” for error-free backup files.

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

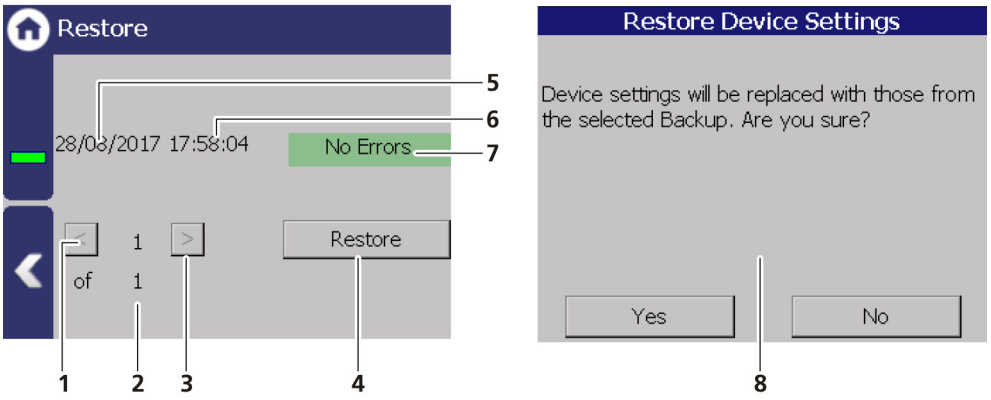
- The backup files are copied to the USB storage device.
- The message “Backup successful” appears after a successful copy process (Fig. 132, item 6).

Information

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

7.4.2 Restore

Device Setup | Backup/Restore | Restore



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

Fig. 133 Restore

Executing restore

1. Connect a USB storage device to the device.
2. Select the backup file with the buttons (Fig. 133, item 1,3)

▶ The date and time of the backup is displayed (Fig. 133, item 5, 6). Only error-free (Fig. 133, item 7) backup files can be loaded.

3. Click on the button "Restore" (Fig. 133, item 4).
4. A confirmation message (Fig. 133, item 8) appears.
5. Click on <Yes> to confirm.

▶ The restore of data is carried out.

8 Main Menu Diagnostics

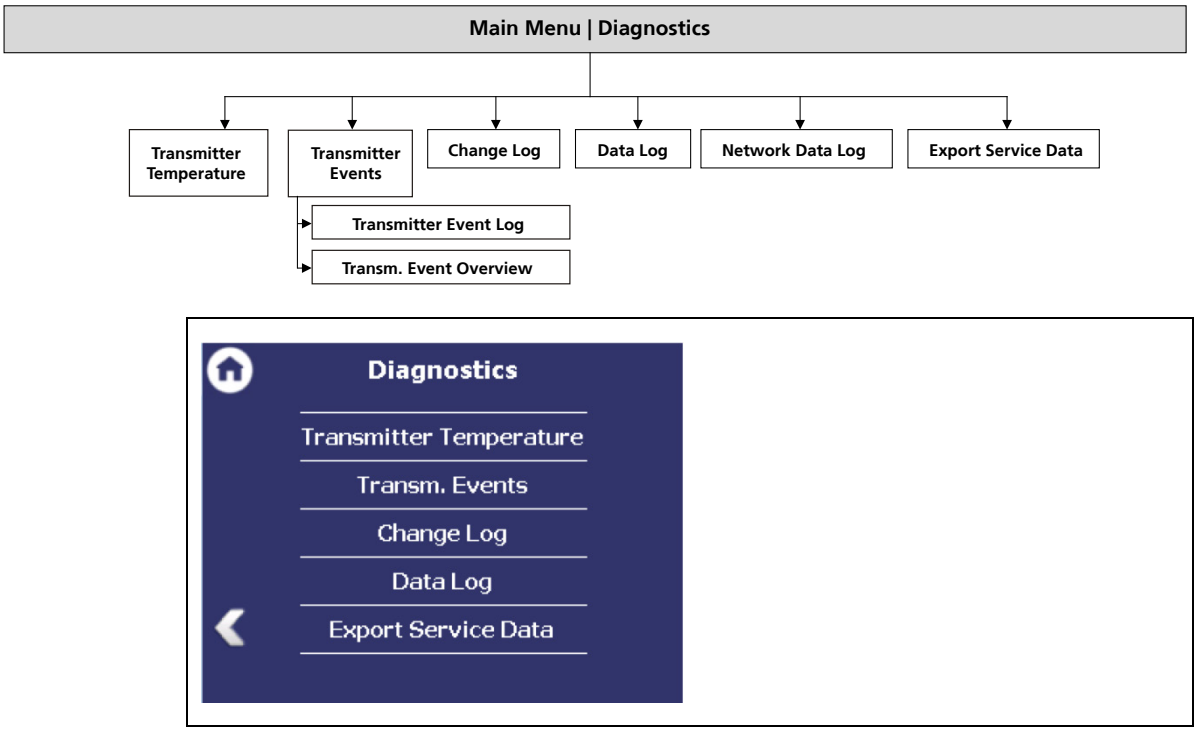
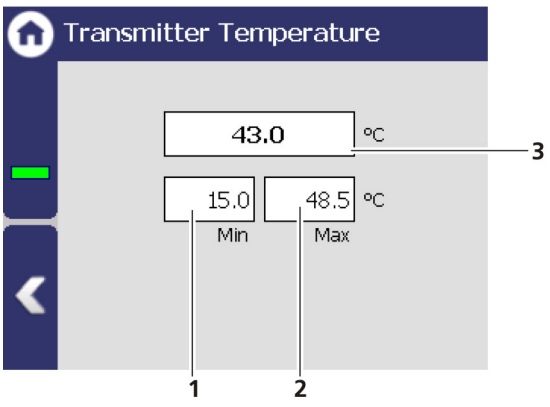


Fig. 134 Menu "Diagnostics"

8.1 Transmitter Temperature

Diagnostics | Transmitter Temperature

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



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

Fig. 135 Transmitter Temperature

8.2 Events

Diagnostics | Transm. Events

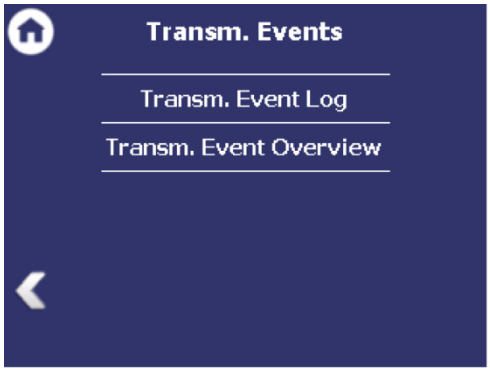


Fig. 136 Menu "Transm. Events"

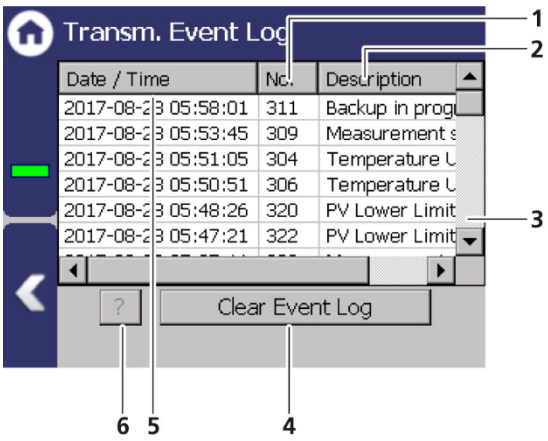
Information

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

8.2.1 Transmitter Event Log

Diagnostics | Transmitter Events | Transmitter Event Log

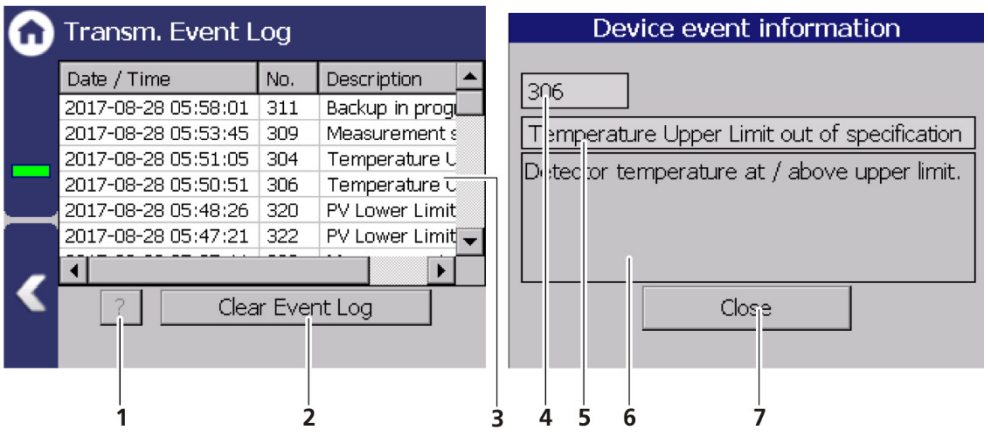
The last 25 events of the detector are displayed in the window "Event Log".



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

Fig. 137 Event Log (Transmitter)

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. 138 Display an Event Log Information

1. Click on a line in the list (Fig. 138, item 3).
2. Click on <?> (Fig. 138, item 1).

▶ The event description appears.

3. With the button <Close>, close the event description (Fig. 138, item 7).

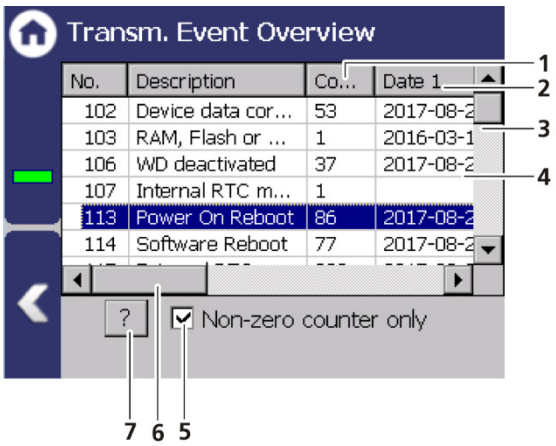
NOTICE

With the button <Clear event log> (Fig. 138, item 2) all events are deleted irrevocable.

8.2.2 Transm. Event Overview

Diagnostics | Transm. Events | Transm. Event Overview

All events that can be logged are chronologically presented in tabular form in the window “Event overview”. Activate the check box “Non-zero Counter only 0” (Fig. 139, item 5) in order to display events that have occurred.



1	“Number” column	5	check box “Non Zero counter only”
2	“Date” column	6	Horizontal scroll bar
3	Vertical scroll bar	7	Button <?>
4	Event line		

Fig. 139 Transmitter Event Overview

1. Click on a line in the list (Fig. 139, item 4).
2. Click on <? > (Fig. 139, item 7).

▶ The event description appears.

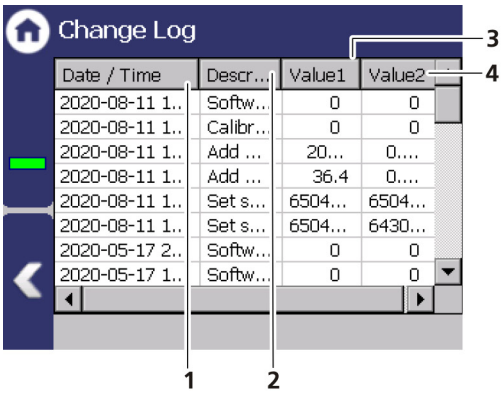
3. Close the event description with the button <Close>.
4. Slide the bar of the horizontal scroll bar (Fig. 139, item 6) to the right to see at what times (date, time) the event occurred.

▶ The last 5 time points are displayed.

8.3 Change Log

Diagnostics | Change Log

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



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

Fig. 140 Change Log (Transmitter)

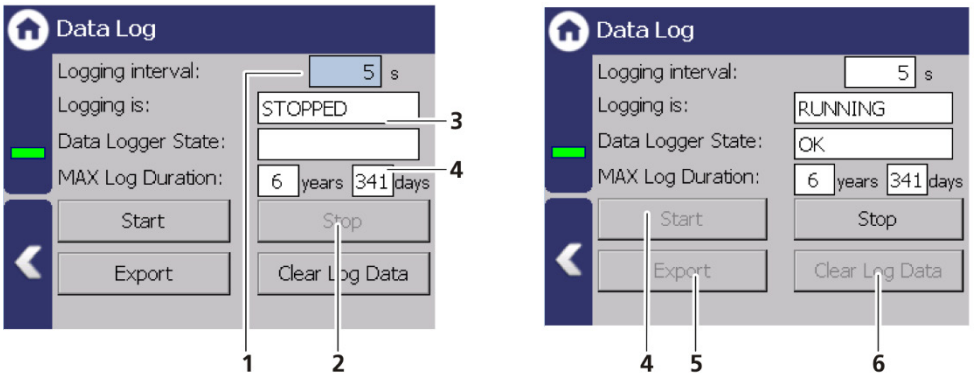
8.4 Data Log

Diagnostics | Data Log

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

IMPORTANT

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



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

Fig. 141 Data Log

Change log interval

1. Click on the button <Stop> (Fig. 141, item 2) to stop the data log process.
2. Click on the input field “Log interval” (Fig. 141, 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. 141, item 4) to start the data log process.

Export log data

1. Click on the button <Stop> (Fig. 141, item 2) to stop the data log process.
2. Connect a USB storage device to the device (Fig. 3, item 5).
3. Click on the button <Export> (Fig. 141, item 5).

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

Information

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

Exported Data Structure

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

Fig. 142 Data structure

8.5 Network Data Log

Diagnostics | Network Data Log

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

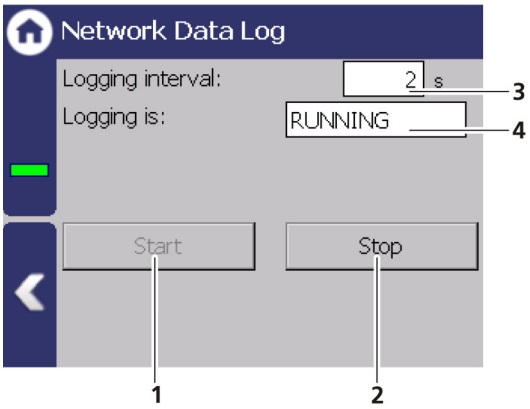
IMPORTANT

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

- Observe the notes in chapter 7.3.1 – Network.

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

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



1 Button <Start>
2 Button <Stop>
3 Display field / Input field „Logging Interval“
4 Display field „Logging State“

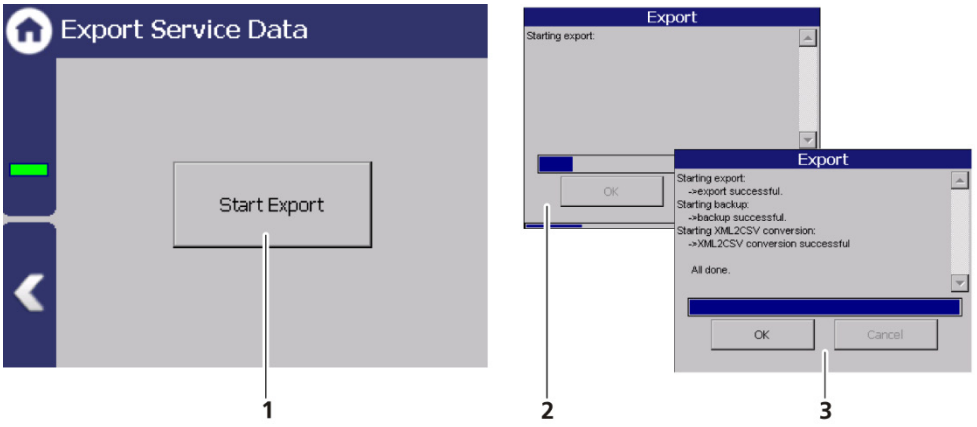
Fig. 143 Network Data Log (started)

1. Click Stop if necessary. Click on the entry field “Logging interval” (Fig. 144, item 3) and enter an interval.
2. Start the network data log with the button <Start> (Fig. 144, item 1).
3. Make a note of the EVUs IP address (Device Settings | Settings | System | Network).
4. Enter the following input in the command line of the PC:
   > telnet "IP Address" -f "LogFileName" (for example 192.168.83 -f C:\\Users\Test\log.txt).

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

8.6 Export Service Data

Diagnostics | Export Service Data



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

Fig. 144 Export Service Data

1. Connect a USB storage device to the device (Fig. 3, item 5).
2. The USB storage device is recognized by the system after a few seconds and the button <Export service data> (Fig. 144, item 1) can be clicked.
3. Click on the button <Export service data> (Fig. 144, item 1).

- The process window is displayed and the export of service data will be carried out (Fig. 144, item 2).
- After successful export a confirmation message Fig. 144, item 3) is displayed.

Information

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

9 Troubleshooting

9.1 Error Search

Problem	Cause	Measure
Master unit: Screen black; LEDs are not illuminated	EVU does not work	▶ Check power supply and fuses
Slave module: LEDs are not illuminated	Slave module not clamped properly	▶ Check cabling, contact sockets
No signal	Detector does not work	▶ Check the functioning of the detector
Count rate too low	Shield not opened or not opened correctly	▶ Check lock and ensure it is in OPEN position
	Incorrect focus of the effective radiation on the detector	▶ Correct and optimize the alignment
	Objects in the beam path	▶ Offset irradiation level
	Source at the end of its usable life span	▶ Replace source
No or incorrect level display	level value entry incorrect	▶ Check the calibration value and the level display
The level display deviates	Defect in detector	▶ Check detector
	Incorrect calibration	▶ Check calibration values
	Count rate too low (see above)	▶ Check source age and irradiation level, replace detector
Detector is not detected (software)	Terminals / wiring	▶ Check terminal connection; check terminal assignment
	Damaged line	▶ Check cable; examine with measurement device.
	Incorrect type LB 44xx / LB 54xx / LB 4700 in the configuration	▶ Check type of detector (see type plate on the detector)

Error Search (continued)

Detector is not detected (software)	Incorrect ID in the configuration	▶ Check ID of the detector (see type plate on the detector)
Touch panel does not respond	Error in operating system	▶ Restart EVU
Buttons are missed when you click	Incorrect screen calibration	▶ Calibrate screen again

9.2 Error Codes of the Evaluation Unit

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

System events are classified in

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

Failure (F)

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

Out of specification (S)

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

Function Check (C)

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

Maintenance required (M)

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

9.2.1 System

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

M115	Extern RTC malfunction	M	Failure of the external real time clock. Contact Berthold service, if this event occurs repeatedly.
M116	Corrupt Date	M	The date could not be verified at startup. Check date and time and set if necessary.

9.2.2 Application

Code	Message	NAMUR107	Help Text
M301	Default parameter set	M	Device not calibrated. Measurement with default parameters. Calibrate device
M302	Decay compensation	S	Decay compensation failed. Contact Berthold service, if this event occurs repeatedly.
M303	Det Temp LL failure	F	Detector temperature at / below lower limit. Limit value can be configured. Factory setting: -20°C.
M304	Det Temp UL failure	F	Detector temperature at / above upper limit. Limit value can be configured. Factory setting: 60°C
M305	Det Temp LL OOS	S	Detector temperature at / below lower limit. Limit value can be configured. Factory setting: -20°C.
M306	Det Temp UL OOS	S	Detector temperature at / above upper limit. Limit value can be configured. Factory setting: 60°C.
M307	Stray radiation	S	Interference radiation detected. Measurement stopped.
M308	Source replacement	M	Source replacement date reached. Replace source.
M309	Application stopped	C	Measurement stopped
M310	PV calc not possible	S	Process value could not be calculated. Check measuring range and calibration.
M311	Backup process	C	Backup in process.
M312	Restore process	C	Restore in process.
M320	PV LL failure	F	Process value at / below lower limit.
M321	PV UL failure	F	Process value at / above upper limit.
M322	PV LL OOS	S	Process value at / below lower limit.
M323	PV UL OOS	S	Process value at / above upper limit.
M324	Level under 0%	S	Level below 0%. Check measuring range and calibration.
M325	Level over 100%	S	Level above 100%. Check measuring range and calibration.
M326	GPC out of spec	S	Compensation factor of Gas Properties Compensation has reached its limit. Check process.
M327	No GPC detector	S	No detector for Gas Properties Compensation found. Connect / configure detector.

M399	Internal program err	F	Internal software failure. Restart the device. Contact Berthold service, if this event occurs repeatedly.

9.2.3 RID

Code	Short Description	Description	NAMUR 107	Effect	Relais: XIP Alarm	Relais: RID Alarm	Note
M371	XIP (meas ch)	XIP in MC has been triggered + RID was not detected	S	Count rate in the MC is frozen	X		RI was detected, but the measurement is outside the learned range, or the RID detection threshold (typically 10%) has been set very high
M372	XIP (rid ch)	XIP was detected only in the secondary channel, RID was not detected (no deviation SC to MC)	S	SC frozen	X		Measurement continues normally
M373	RID Ch active	RID was detected, XIP was detected neither in the MC nor in the SC	S	It continues to be measured on the SC		X	with a relatively slow increase in the count rate in the MC, RI was detected
M374	RID Ch frozen	RID was previously detected, but SC is now outside of the learned measuring range	S	SC frozen	X		Interference was detected in the learned area, later the measurement moved outside the learned area
M371 M373	XIP (meas ch) + RID Ch active	XIP has been triggered in the MC + RID has been detected	S	It continues to measure on the SC + MC is frozen		X	typical case, if RI was detected
M371 M372 M373	XIP (meas ch + aux ch) + RID Ch active	XIP has been triggered in the MC + SC has responded + RID has been detected	S	It is switched to the SC, but MC + SC are frozen	X		for example, Co60 as a source of interference, or count rate in MC > 100,000
M371 M372	XIP (meas ch + aux ch)	XIP has been triggered in MC + SC	S	MC + SC frozen, no switch to SC	X		for example, Co60 as a source of interference, or count rate in MC > 100,000
M372 M373	XIP (aux ch) + RID Ch active	XIP has been triggered in MC + SC RID hasn't been detected	S	It is switched to the SC, SC has been frozen	X		XIP has been triggered, simultaneously RID was detected. (A rather unlikely case, but not completely excluded.)
M371 M374	XIP (meas ch) + RID Ch frozen	XIP in the MC has been triggered + RID has been previously detected, but SC is now outside of the learned measuring range	S	Measurement is already running via SC, SC has been frozen	X		Interference was detected in the learned measuring range, later the measurement moved outside the learned measuring range
M371 M372 M374	XIP (meas ch + aux ch) + RID Ch frozen	XIP in the MC + SC has been triggered + RID has been detected before, but SC is now moving outside the learned measuring range	S	Measurement is already running via SC, SC has been frozen	X		Interference was detected in the learned measuring range, later the measurement moved outside the learned measuring range and made a jump to the SC
M372 M374	XIP (aux ch) + RID Ch frozen	XIP in SC addressed + RID detected earlier, but SC is now outside of the learned measuring range	S	Measurement is already running via SC, SC has been frozen	X		Interference was detected in the learned measuring range, later the measurement moved outside the learned measuring range and made a jump in the SC

RID = Radiation Interference Depression (RID Alarm: the measurement continuous in the SC)
Ch = Channel | MK = Measuring Channel | SC = Second Channel | RI = Radiation Interference

XIP = X-ray Interference Protection (XIP Alarm: the reading and the signal output is frozen)

If interference radiation is detected, then there are cases in which only a message (a code) is displayed. There are other cases where multiple messages (multiple codes) occur in combination. The previous list describes both cases. Because the errors overlap, only one error becomes visible. In the "EVU event log" is visible which errors occurred at the same time.

9.2.4 Detector

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

9.2.5 RS 485 Interface

Code	Message	NAMUR107	Help Text
M699	Internal program error	F	Internal software failure. Restart the device. Contact Berthold service, if this event occurs repeatedly.

9.2.6 Process Connection

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

10 Maintenance and Repair

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

IMPORTANT

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

NOTICE

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

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

IMPORTANT

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

10.1 Replacing of Fuses

⚠ DANGER

Danger to life from electric shock!

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

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

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

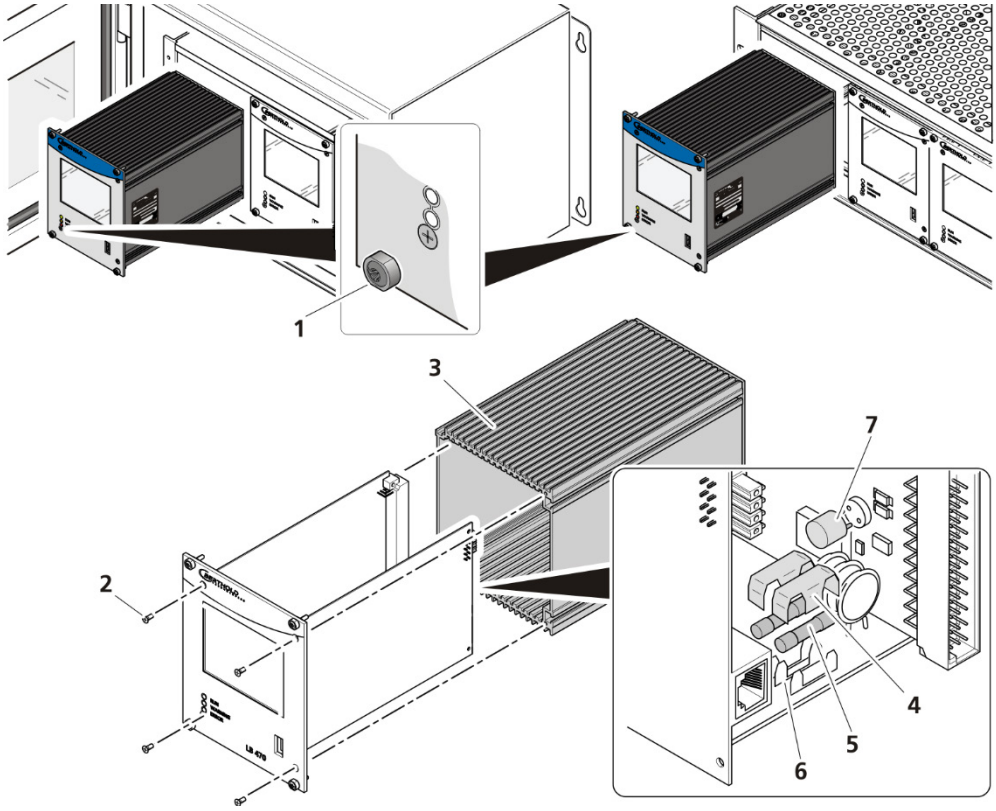
NOTICE

Damage to the device! Short circuit!

The EVU can be damaged if incorrect fuses are used.

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

Replacing Fuse in the Master Module



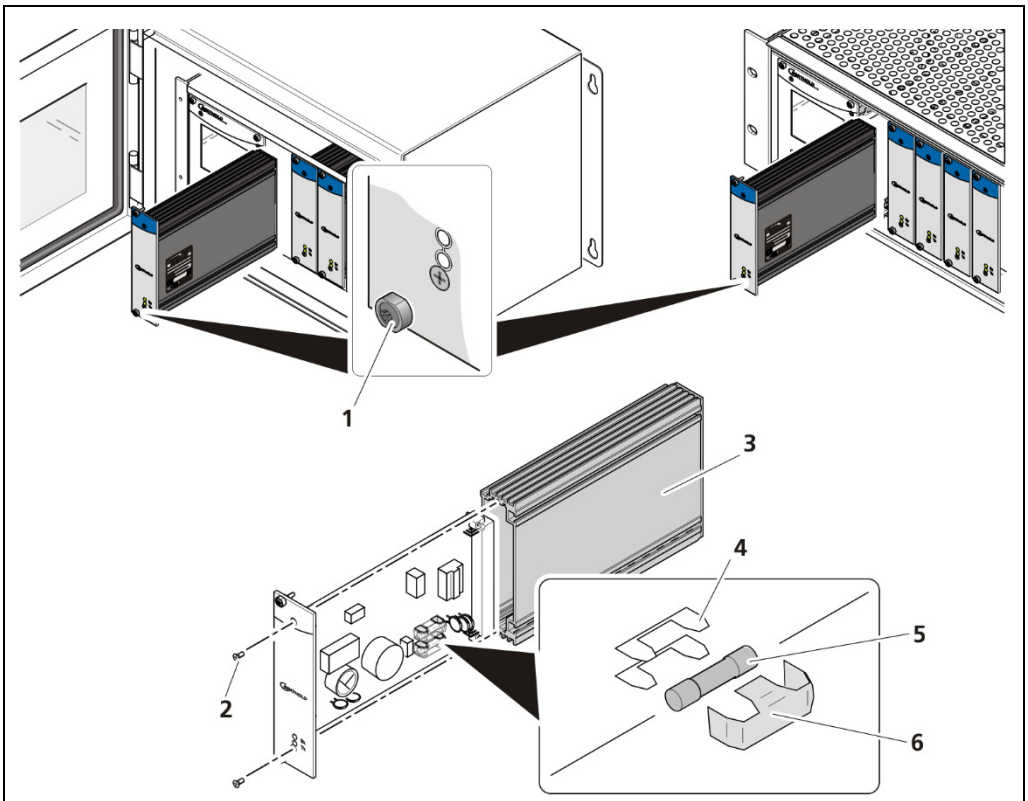
1	Fixing screws	5	Fuse 250V 1A T (5x20 mm)
2	Screws	6	Base
3	Housing	7	Fuse 250V TR5 T80mA (Ø 8,5 mm)
4	Covering fuse		

Fig. 145 Replacing fuses master EVU

1. De-energize the device.
2. Loosen the four fixing screws (Fig. 145, item 1) and remove the EVU from the wall housing or subrack.
3. Loosen the four sunken screws on the front side of the EVU (Fig. 145, item 2).
4. Pull out the housing (Fig. 145, item 3) carefully.
5. Remove the protective covering of the fuse (Fig. 145, item 4)
6. Remove the fuse (Fig. 145, 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. 145, item 2).
10. Set module into the guide rails and push it gently until the plug connector of the module is inserted into the socket board.
11. Tighten all fixing screws (Fig. 145, item 1).

▶ The fuse change was carried out correctly.

Replacing Fuse in the Slave Module



1 Fixing screws
2 Screws
3 Housing
4 Base
5 Fuse
6 Covering fuse

Fig. 146 Exchange fuses slave EVU

1. De-energize the device.
2. Loosen the four fixing screws (Fig. 146, item 1) and remove the slave module from the wall housing or subrack.
3. Loosen the two sunken screws on the front side of the slave module (Fig. 146, item 2).
4. Pull out the housing (Fig. 146, item 3) carefully.
5. Remove the protective covering of the fuse (Fig. 146, item 6)
6. Remove the fuse (Fig. 146, item 5).
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 two screws.
10. Set module into the guide rails and push it gently until the plug connector of the module is inserted into the socket board.
11. Tighten all fixing screws (Fig. 146, item 1).

▶ The fuse change was carried out correctly.

10.2 Cleaning

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

NOTICE

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

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

NOTE

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

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

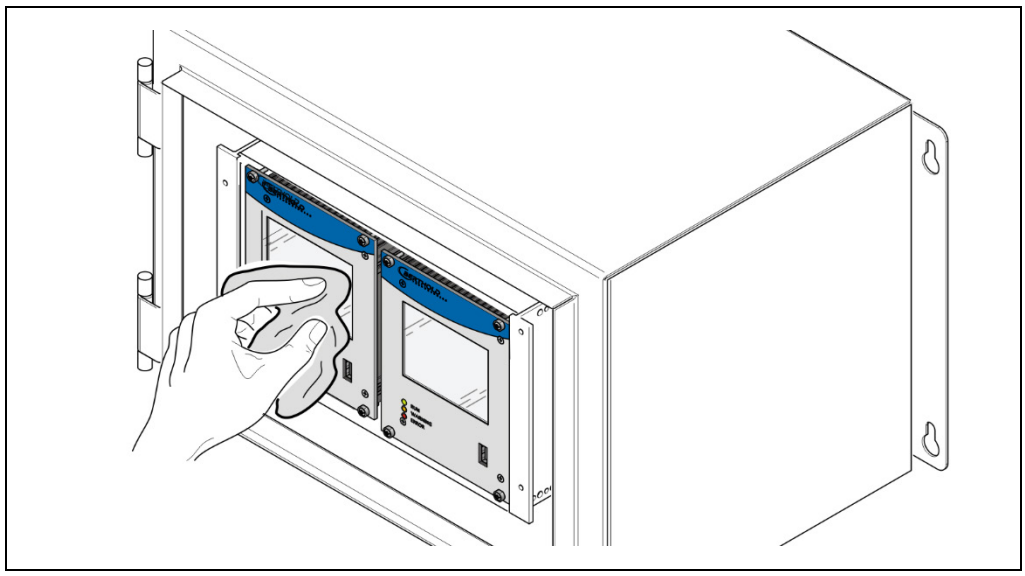


Fig. 147 Cleaning the display

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

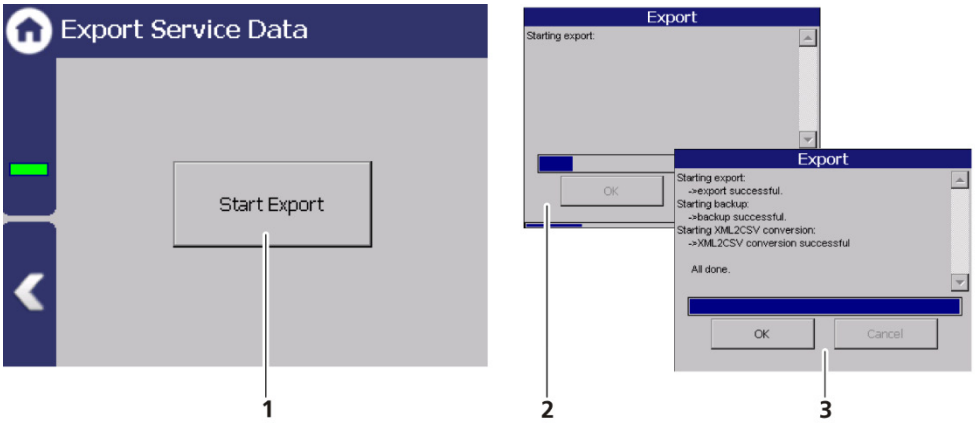
- ▶ The cleaning of the display was carried out correctly.

10.3 Data Backup

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

Export Service Data

Diagnostics | Export Service Data



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

Fig. 148 Export Service Data

1. Connect a USB storage device to the device (Fig. 4, item 5).
2. The USB storage is recognized by the system after a few seconds and the button <Export service data> (Fig. 144, item 1) can be clicked.
3. Click on the button <Export service data> (Fig. 144, item 1).

- The process window is displayed and the export of service data will be carried out (Fig. 144, item 2).
- After successful export a confirmation message Fig. 144, item 3) is displayed. A new folder "LB47x_Export" is created.

11 Decommissioning

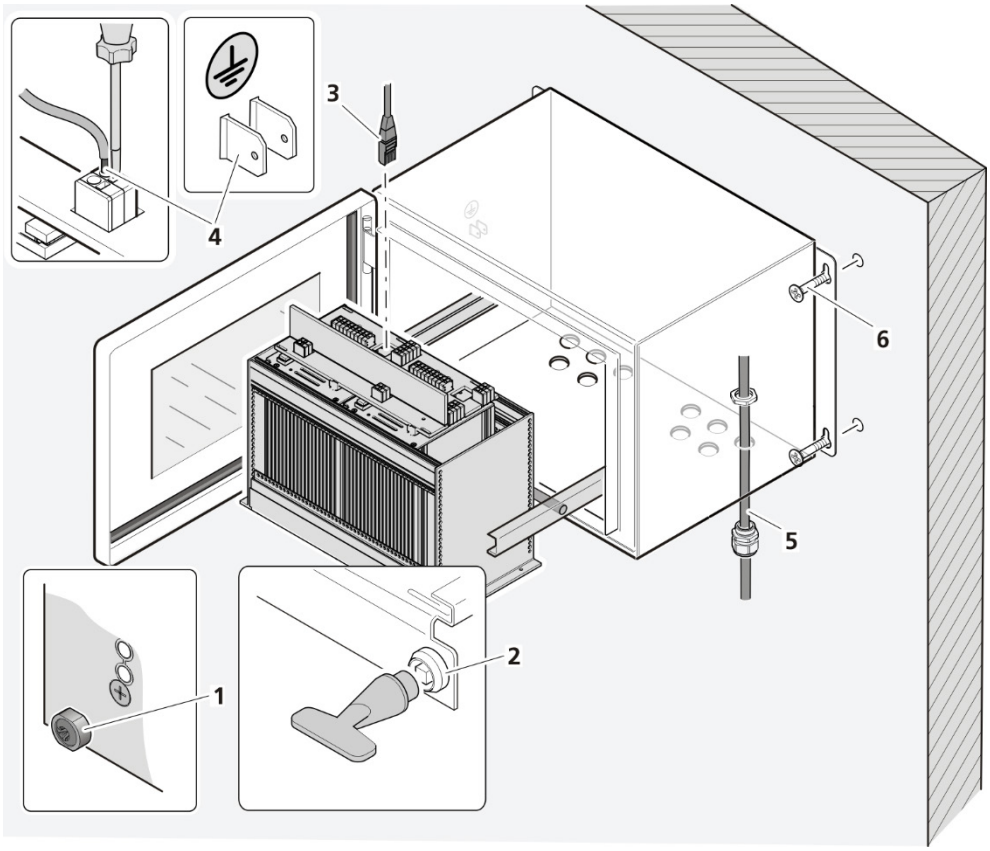
⚠ DANGER

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

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

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

11.1 Decommissioning wall housing



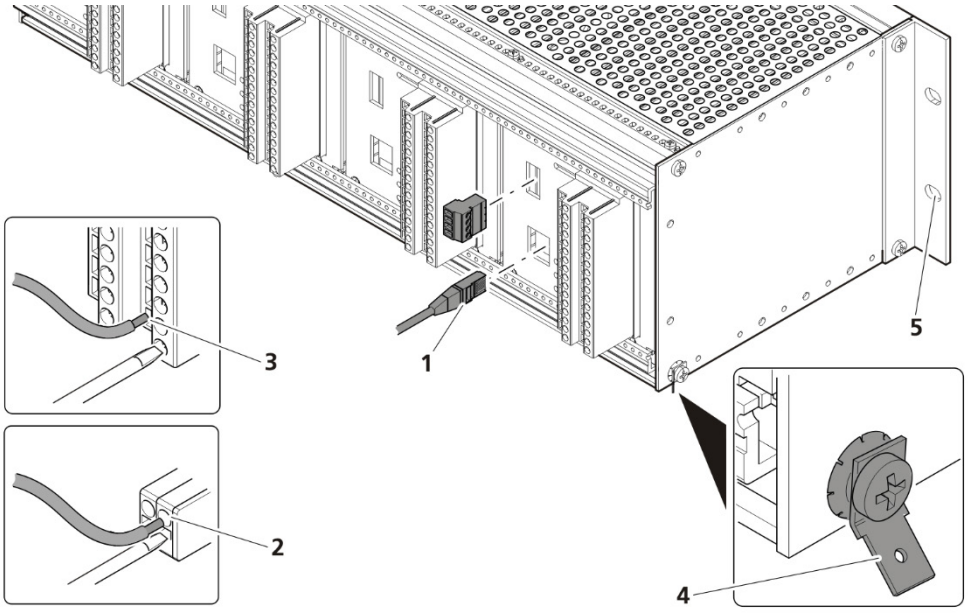
1	Fixing screws	4	Connecting Terminals
2	Locking	5	Cable gland
3	RJ45 connector (network)	6	Mounting screws

Fig. 149 Decommissioning wall housing

1. Make sure that the locking bolts (Fig. 149, item 1) of all modules are tightened in order to prevent slipping.

2. Loosen the lock (Fig. 149, item 2) using the supplied square key and pull the subrack out.
3. The subrack can be folded down by the folding mechanism.
4. Fold the subrack downward cautiously.
5. Remove the network plug (Fig. 149, item 3).
6. Remove all lines from the terminal board (Fig. 146, item 4).
7. Loosen the cable gland (Fig. 149, item 5) on the bottom side of the wall housing and pull all cables from the wall housing.
8. Slide the subrack into the wall housing and close the housing doors.
9. Loosen the mounting screws (Fig. 149, item 6) and remove the wall housing.

11.2 Decommissioning 19" Subrack



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

Fig. 150 Decommissioning 19“ subrack

1. De-energize the device.
2. Remove the network plug (Fig. 150, item 1).
3. Remove all lines from the terminal board (Fig. 150, item 2) or the clamp blocks (Fig. 150, item 3).
4. Remove the PE cable (Fig. 150, item 4).
5. Remove the connections (Fig. 150, item 5) and pull the subrack from the 19" rack.

11.3 Disposal of Measurement System

⚠ CAUTION

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

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

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

12 Appendix

12.1 Setup Protocol

General data	
Date	
Measuring point	
Source No.	
Number of detectors	____ LB 4700 ____ LB 44xx ____ LB 54xx
Activity	
Isotope	☐ Cs-137 ☐ Co-60
Container	
Product	
Cascaded measurement	☐ YES ☐ NO

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

Setup Protocol (Continued)

Parameters	
Password	_____
Language	☐ DE ☐ EN ☐ _____
CE Remote Control	☐ enabled
Network	☐ DHCP active IP Address _____ • _____ • _____ • _____ Subnet _____ • _____ • _____ • _____ Gateway _____ • _____ • _____ • _____ DNS-Server _____ • _____ • _____ • _____ MAC Address _____
Calibration Characteristic	☐ Linear ☐ Exponential ☐ inverted Curve
GPC	☐ enabled ☐ Cs-137 ☐ Co-60
Damping	_____ s time constant
Process Value Range	min. Value 4,00 mA _____ % max. Value 20,00 mA _____ %
Rapid Switch (0 – 9,9999)	☐ Enabled Sigma _____
RID	☐ Enabled PV Threshold _____
XIP	☐ Detection enabled Measurement Delay _____ s Hold Time _____ s I_O Factor _____ RI Sigma _____
Source replacement	☐ Notification enabled
Digital inputs	DI-1 Assignment ☐ none ☐ Stop measurement ☐ Upper Adjust ☐ Lower Adjust ☐ Standard Adjust ☐ Signal Rad. Interf. DI-2 Assignment ☐ none ☐ Stop measurem. ☐ Upper Adjust ☐ Lower Adjust ☐ Standard-Adjust ☐ Signal Rad. Interf.
Analog output	AO Assignment ☐ Level ☐ Damped count rate ☐ Raw count rate ☐ Count rate (GPC detector) ☐ GPC Factor ☐ AO-Monitoring enabled AO-Failure Mode ☐ Namur High ☐ Namur Low ☐ Hold value ☐ User-def. Value

Parameters		
Digital Outputs	Function DO-2 ☐ none ☐ Low level alarm ☐ High level alarm ☐ Det. temperature alarm ☐ XIP alarm ☐ RID alarm ☐ Source Replacement Alarm ☐ Measurement stopped ☐ System state: Warning	Function DO-3 ☐ none ☐ Low level alarm ☐ High level alarm ☐ Det. temperature alarm ☐ XIP alarm ☐ RID alarm ☐ Source replacement alarm ☐ Measurement stopped ☐ System state: Warning
PV Alarm Behavior	NE 107 Status when Alarm ☐ No Status ☐ Out of Specification ☐ Failure	
Detector Temperature Alarm Behavior	NE 107 Status when Alarm ☐ No Status ☐ Out of Specification ☐ Failure	

Modifications due to technical advancement reserved.

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BERTHOLD TECHNOLOGIES GmbH & Co. KG

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

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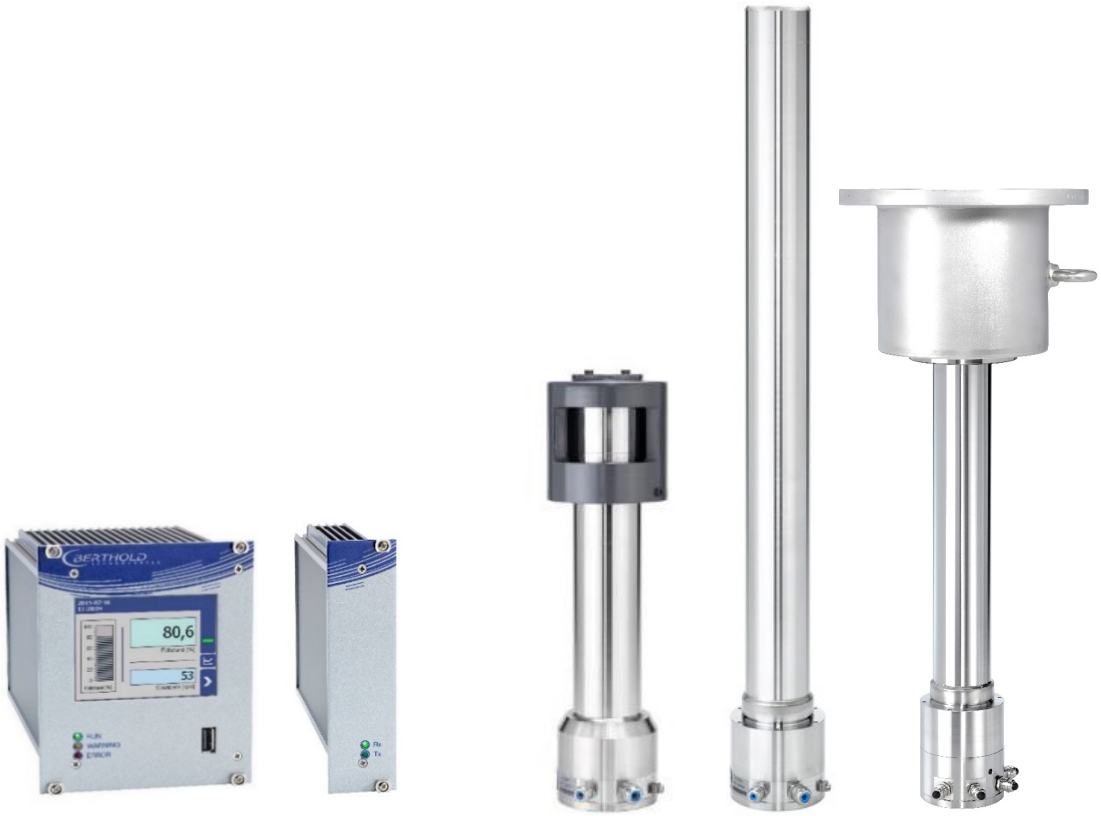


Unité d'évaluation

DUO SERIES

LB 47x

Détecteurs

DUO XPERT

LB 4700

Informations sur la sécurité

56925BA59

Rev. No.: 04, 09/2019

1 A propos de ce manuel d'utilisation

1.8 Avertissement

Les avertissements sont identifiés comme suit :

Signalement

Source et conséquence
Explication si requise
- ▶ Prévention

En cas de danger

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

1.8.1 Symboles employés dans le manuel d'utilisation

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

DANGER

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

AVERTISSEMENT

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

PRUDENCE

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

RECOMMANDATION

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

IMPORTANT

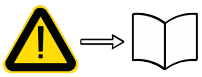
Les sections identifiées avec ce symbole signalent des informations importantes du produit ou de son fonctionnement.

Tip

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

1.8.2 Symboles utilisés sur l'appareil

Lire le manuel d'utilisation



Veuillez suivre les instructions dans ce manuel d'utilisation.

Décharge électrostatique

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

Connexion de mise à la terre

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

Raccordement equipotentiel

Raccorder le conducteur d'équipotentialité à cet endroit

Tension continue

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

Tension alternative

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

Déchet non domestique

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

1.9 Conformité

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

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

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

2 Sécurité

2.1 Dangers et mesures de sécurité

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

2.2 Utilisation appropriée

Ce qui suit constitue une utilisation appropriée :

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

Utilisation inappropriée à éviter:

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

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

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

RECOMMANDATION

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

2.3 Qualification du personnel

RECOMMANDATION

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

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

Les trois groupes de personnes sont :

- Employés avec des connaissances générales
- Experts
- Personnes autorisées

Employés avec connaissances générales

RECOMMANDATION

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

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

Experts

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

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

Personnes autorisées

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

2.4 Les obligations de l'opérateur

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

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

Sous réserve de modifications dans le cadre du progrès technique.

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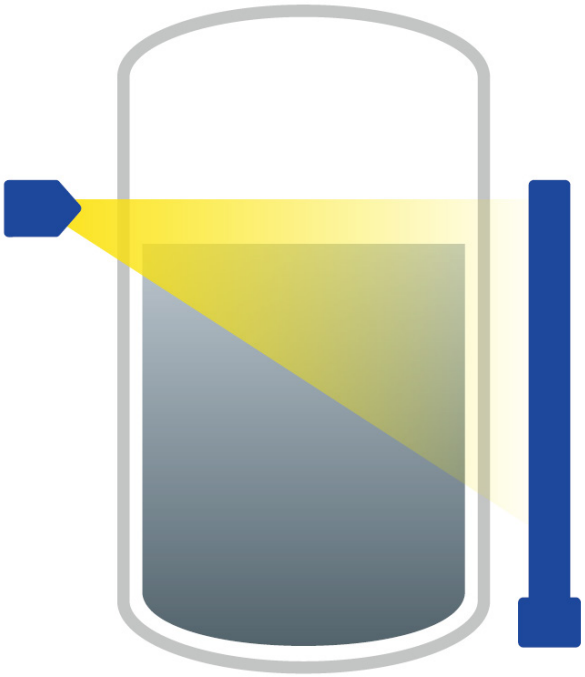
BERTHOLD TECHNOLOGIES GmbH & Co. KG

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

Id.-Nr. 56925BA59



Level
Füllstand
Technical Information
Technische Information

56925TI1L
Rev. No.: 04, 05/2021

1. Information on 2-Wire Technology

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

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

Sophisticated Measuring System in 2-Wire Technology

- Unique: Radiometric system with intrinsically safe power supply (Full Ex-i) for detectors
- Real 2-wire technology, only 2 wires in the field
- Advanced self-diagnostics and monitoring features
- Easy to use touch screen panel for local display and operation
- Integrated gas density compensation feature
- Direct replacement of predecessor model LB 440
- Interfaces with all 2-wire detectors LB 44xx, LB 54xx and LB 47xx
- Optional Radiation Interference Discrimination (LB 470RID)

1. Informationen zur 2-Leiter Technologie

Das DuoSeries / DuoXpert Messsystem besteht aus einem Detektor mit Szintillatortechnolgie sowie einer separaten Auswerteeinheit zur Anzeige und Bedienung.

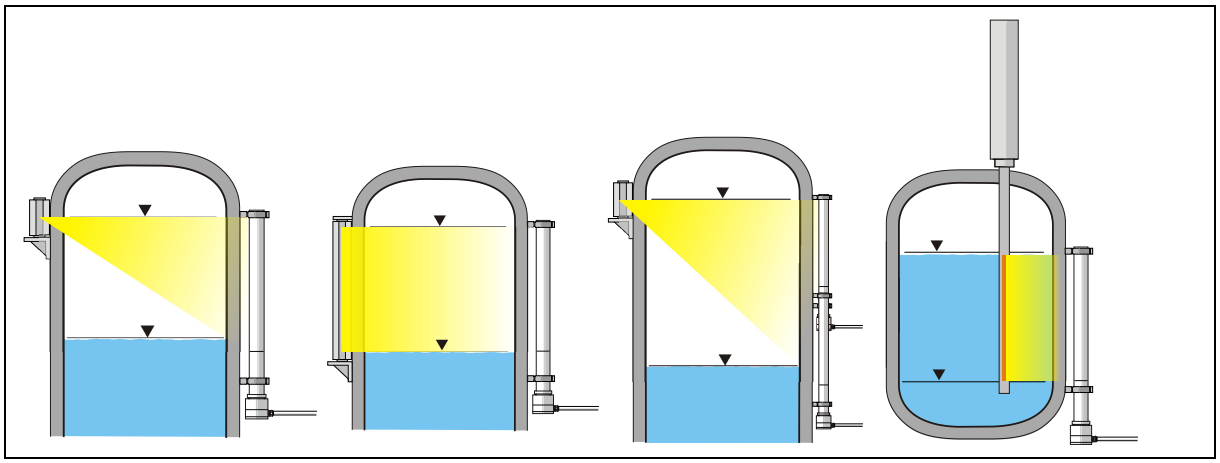
Die moderne Auswerteeinheit verfügt über ein 3,5" Touch Panel, eine starke Dual Core CPU und verschiedenen Bedien-Optionen. Erweiterte Funktionen zur Selbstdiagnose und Überwachung sorgen zudem für höchste funktionale Sicherheit der Messung im Betrieb. Darüber hinaus können die Betreiber die Daten-Log Funktionen für eine detaillierte Prozessanalyse nutzen und so zum Beispiel Trends entwickeln oder Prozessänderungen nachvollziehen.

Hochentwickeltes Messsystem in 2-Leiter Technologie

- Einzigartig: Radiometrische Messung mit eigensicherer Spannungsversorgung (Voll Ex-i) für den Detektor
- Echte 2-Leiter Technik, nur 2 Adern im Feld
- Verbesserte Diagnosefunktionen und Selbstüberwachung
- Einfache, intuitive Bedienung über Touchscreen
- Integriertes Feature zur Kompensation von Gas-Phasen Schwankungen
- Volle Kompatibilität zum Vorgängermodell LB 440
- Kompatibel zu alle 2-Leiter Detektoren LB 44xx, LB 54xx und LB 47xx
- Optionale Störstrahlungserkennung (LB 470RID)

1.1. Measurement Arrangements with Rod Detector

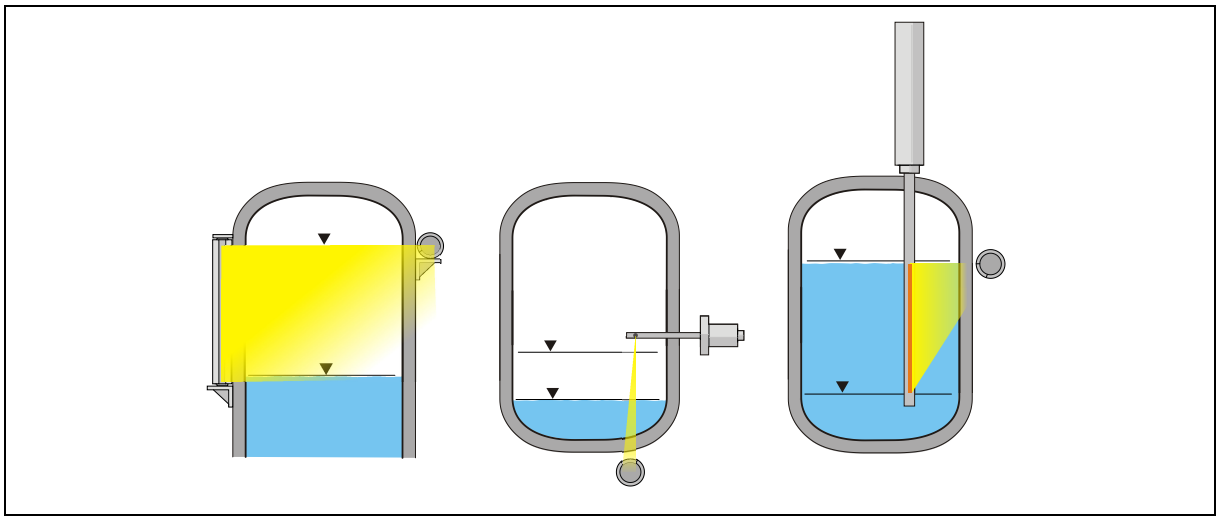
1.1. *Messanordnungen mit Stabdetektor*



TI-Abb. 1 Beispielhafte Messanordnungen mit Stabdetektor
Exemplary measurement arrangements with rod detector

1.2. Measurement Arrangements with Point Detector

1.2. *Messanordnungen mit Punktdetektor*



TI-Abb. 2 Exemplary measurement arrangements with point detector
Beispielhafte Messanordnungen mit Punktdetektor

2. 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.

⚠ WARNING

Danger to life due to explosion!

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

NOTICE

Note the compatibility!

- Detector of the type LB 44xx and LB 54xx can capture measurement data only with master EVU.

2. Auswerteeinheit

Die Module können entweder in Wandgehäusen oder 19"-Baugruppenträgern eingebaut und kann je nach Bedarf unterschiedlich bestückt werden. Zum elektrischen Anschluss werden die rückwärtigen Klemmenblöcke oder Anschlussplatinen verwendet.

⚠ WARNUNG

Lebensgefahr durch Explosion!

- Diese Ausführung der Auswerteeinheit ist nicht ex-geschützt ausgeführt und darf nicht in explosionsgefährdete Bereiche verwendet werden.
- Beachten Sie für Ausführungen der Auswerteeinheit für den eigensicheren Betrieb die mitgeltenden Dokumente, siehe Betriebsanleitung Kapitel 1.1 .

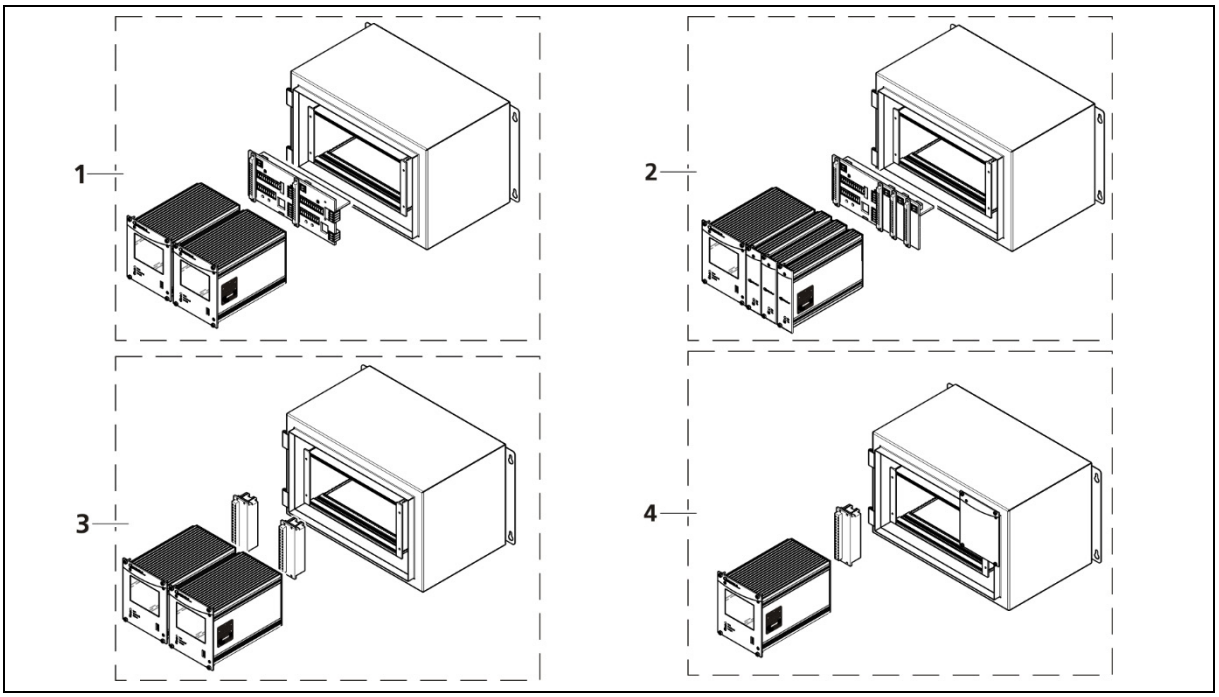
HINWEIS

Kompatibilität beachten!

- Messdaten der Detektoren vom Typ LB 44xx und LB 54xx können nur mit einem Master-Modul erfasst werden.

2.1. Installation Variants Wall Housing

2.1. *Installationsvarianten Wandgehäuse*



TI-Abb. 3 Installation variants wall housing
Installationsvarianten Wandgehäuse

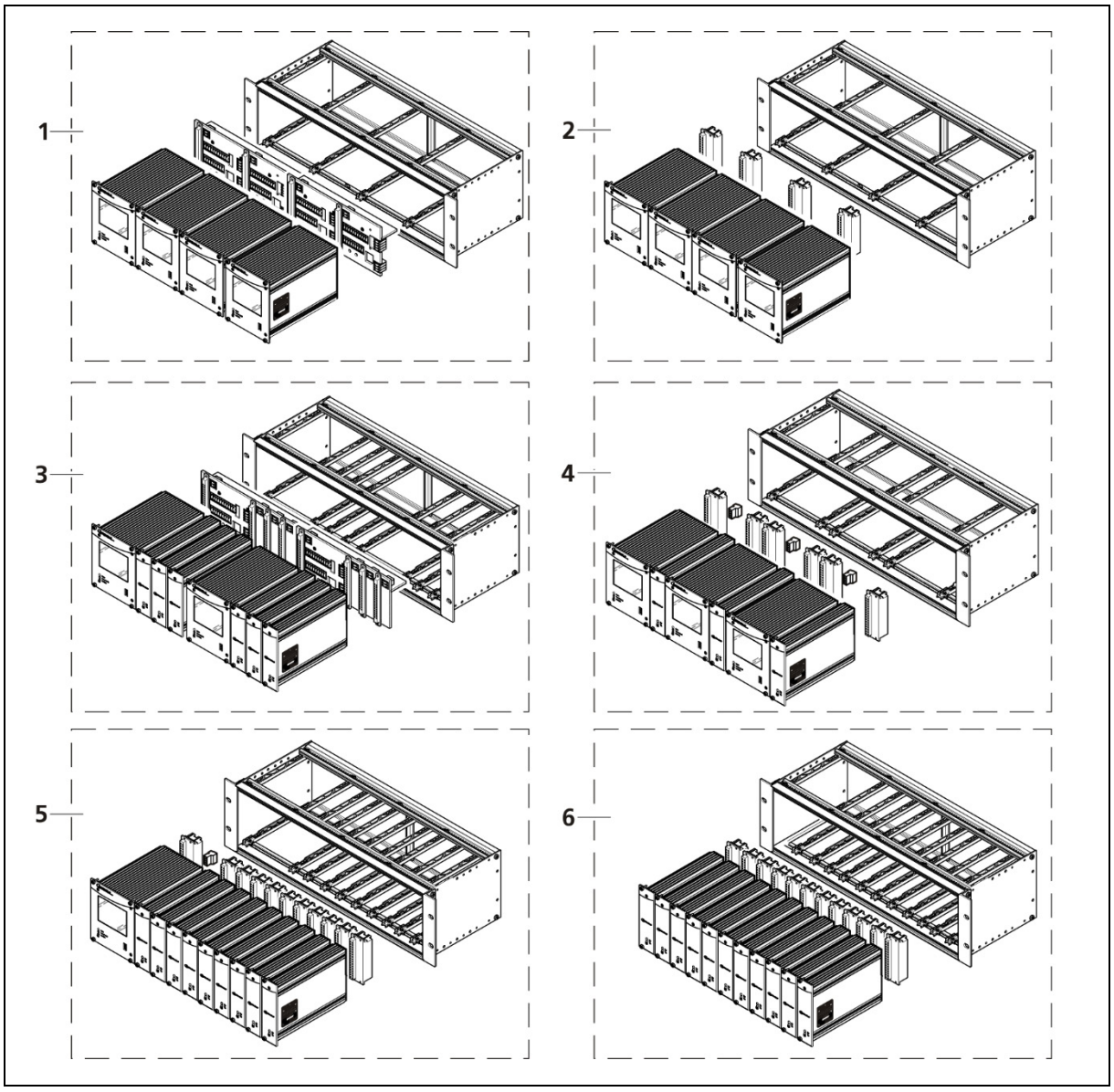
Item *Pos.*	Compontens *Komponenten*	Connection *Anschluss*
1	2 Master	1 Terminal panel master/master[1] *1 Anschlussplatine Master/Master[1]*
2	1 Master, 3 Slaves	1 Terminal panel master/slave[1] *1 Anschlussplatine Master/Slave[1]*
3	2 Master	2 Terminal blocks *2 Klemmenblöcke*
4	1 Master, 0 – 3 Slaves	1 Terminal block for master, 0 – 3 Terminal block for slave module *1 Klemmenblock für Master,* *0 – 3 Klemmenblöcke für Slave Modul*

[1] NRTL certification US/CAN

[1] NTRL Zertifikat US/CAN

2.2. Installation Variants 19" Subrack

2.2. *Einbauvarianten 19" Baugruppenträger*



TI-Abb. 4 Installation variants 19" subrack
Installationsvarianten 19" Baugruppenträger

Item *Pos.*	Compontens *Komponenten*	Connection *Anschluss*
1	4 Master	2 Terminal panel master *2 Anschlussplatine Master*
2	4 Master [2]	4 Terminal blocks *4 Klemmenblöcke*
3	2x (1 Master, 3 Slaves)	2 Terminal panel master/slave *2 Anschlussplatinen Master/Slave*
4	4x (1 Master, 1 Slave)[2]	6 Terminal blocks; master/slave plugs *6 Klemmenblöcke; Master/Slave Stecker*

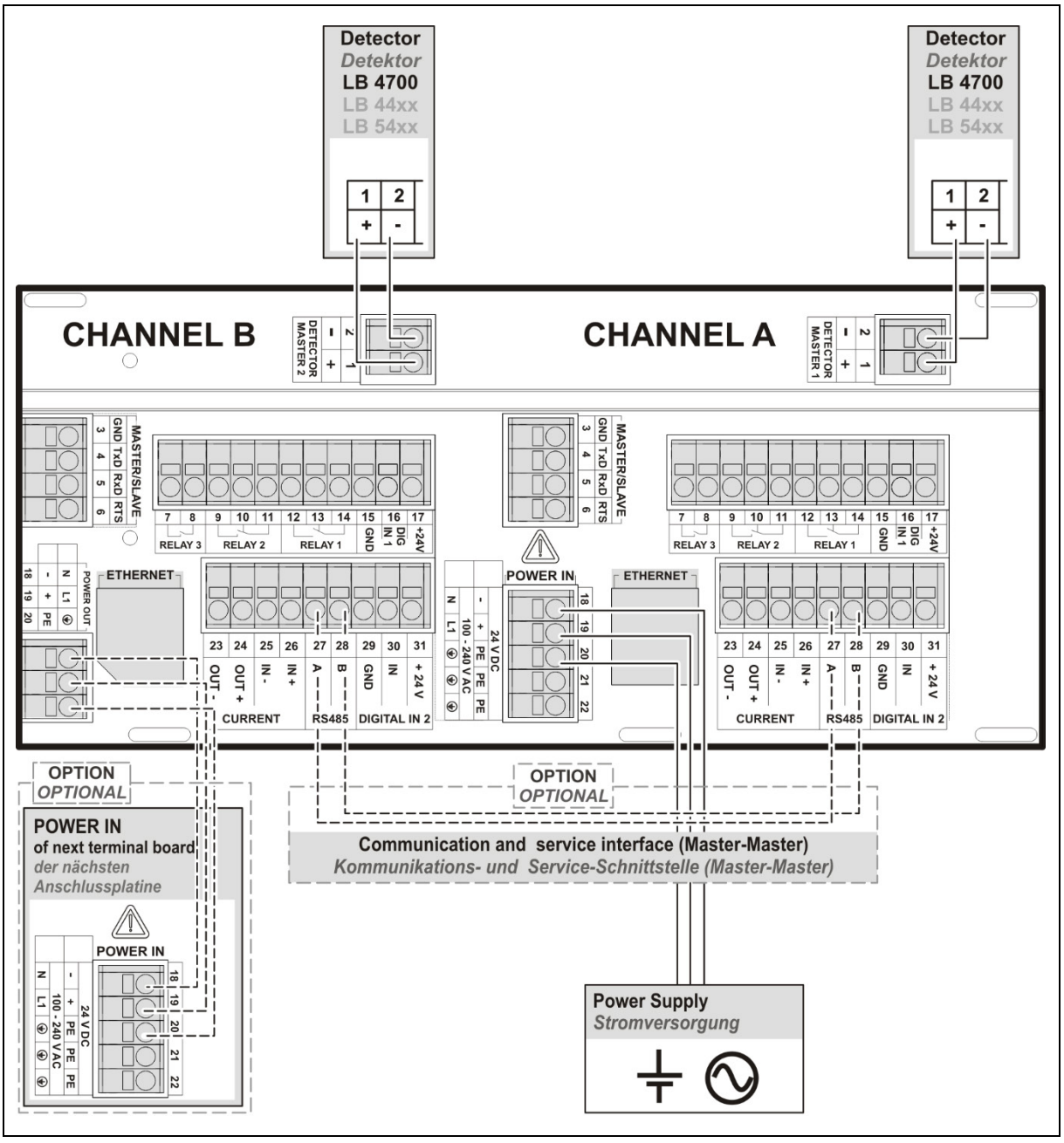
5	1 Master, 9 Slaves[2]	10 Terminal blocks; master/slave plug *10 Klemmenblöcke; Master/Slave Stecker*
6	11 Slaves[2]	11 Terminal blocks *11 Klemmenblöcke*

[2] Application example. The modules can be arranged arbitrarily with terminal blocks.

[2] Anwendungsbeispiele. Mit Klemmenblöcken können Module frei zusammengestellt werden.

2.3. Connection Diagram Terminal Board Master/Master

2.3. *Anschlussplan Anschlussplatine Master/Master*



TI-Abb. 5 Connection Diagram Terminal Board Master/Master
Anschlussplan Anschlussplatine Master/Master

IMPORTANT

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

LB 44xx and LB 54xx detectors can only be operated with master evaluation units, which can be used as slave units in cascaded systems.

WICHTIG

In einem 19" Baugruppenträger für 4 Master (Mat. Nr. 59484), ist neben der oben gezeigten Anschlussplatine für Channel A/B, eine weitere mit Channel C/D enthalten. Die Klemmenbelegung von Channel C/D ist identisch mit der von Channel A/B.

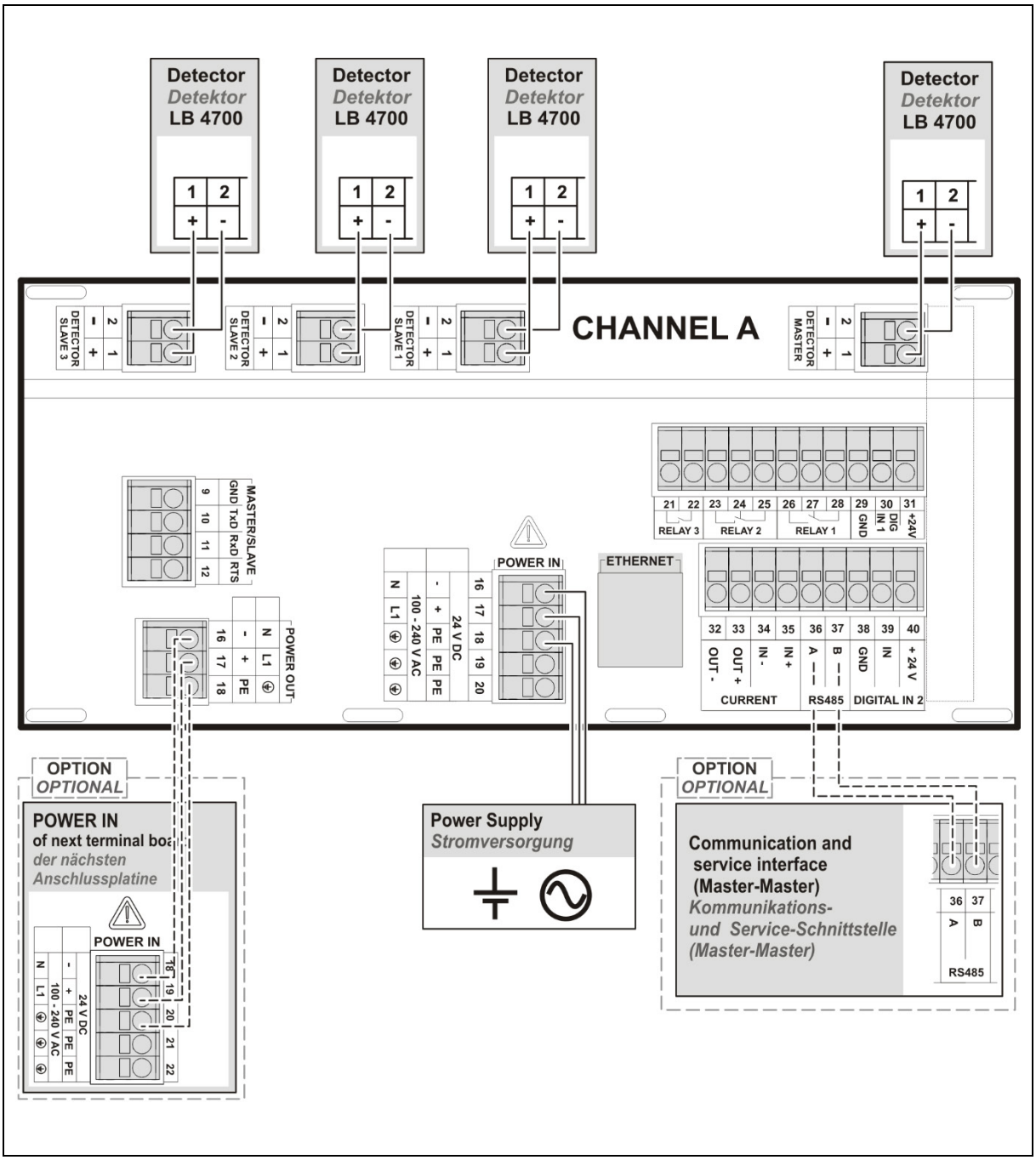
Detektoren vom Typ LB 44xx und LB 54xx können nur mit Master-Auswerteeinheiten betrieben werden, welche bei kaskadierten Systemen als Slaves eingesetzt werden können.

Terminals terminal board master/master
Klemmen Anschlussplatine Master/Master

#	Connection *Anschluss*	Function *Funktion*
1	DETECTOR MASTER +	Connection Detector LB 4700 / LB 44xx / LB 54xx *Verbindung Detektor LB 4700 / LB 44xx / LB 54xx*
2	DETECTOR MASTER -	
3	MASTER/SLAVE GND	Connection of additional slave units *Anschluss von weiteren Slave-Einheiten*
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 *Fehler DIGITAL OUT*
13	RELAIS 1 NO	
14	RELAIS 1 COM	
15	DIGITAL IN 1 GND	GND
16	DIGITAL IN 1 IN	Logic Input
17	+ 24 V (GND -->15)	24 V out (max. 200 mA)
18	POWER DC 24 V – / AC N	24 V DC / 100-240 V AC
19	POWER DC 24 V + / AC L1	
20	PE	
21	PE	
22	PE	
23	CURRENT OUT –	4 mA … 20 mA
24	CURRENT OUT +	
25	CURRENT IN –	Not used for LB 470 / LB 470RID *Keine Verwendung bei LB 470 / LB 470RID*
26	CURRENT IN +	
27	RS 485 A	Communication and service interface (Master-Master) *Kommunikations- und Serviceschnittstelle (Master-Master)*
28	RS 485 B	
29	DIGITAL IN 2 GND	GND
30	DIGITAL IN 2 IN	Logic Input
31	+ 24 V (GND --> 29)	24 V out (max. 200 mA)

2.4. Connection Diagram Terminal Board Master/Slave

2.4. *Anschlussplan Anschlussplatine Master/Slave*



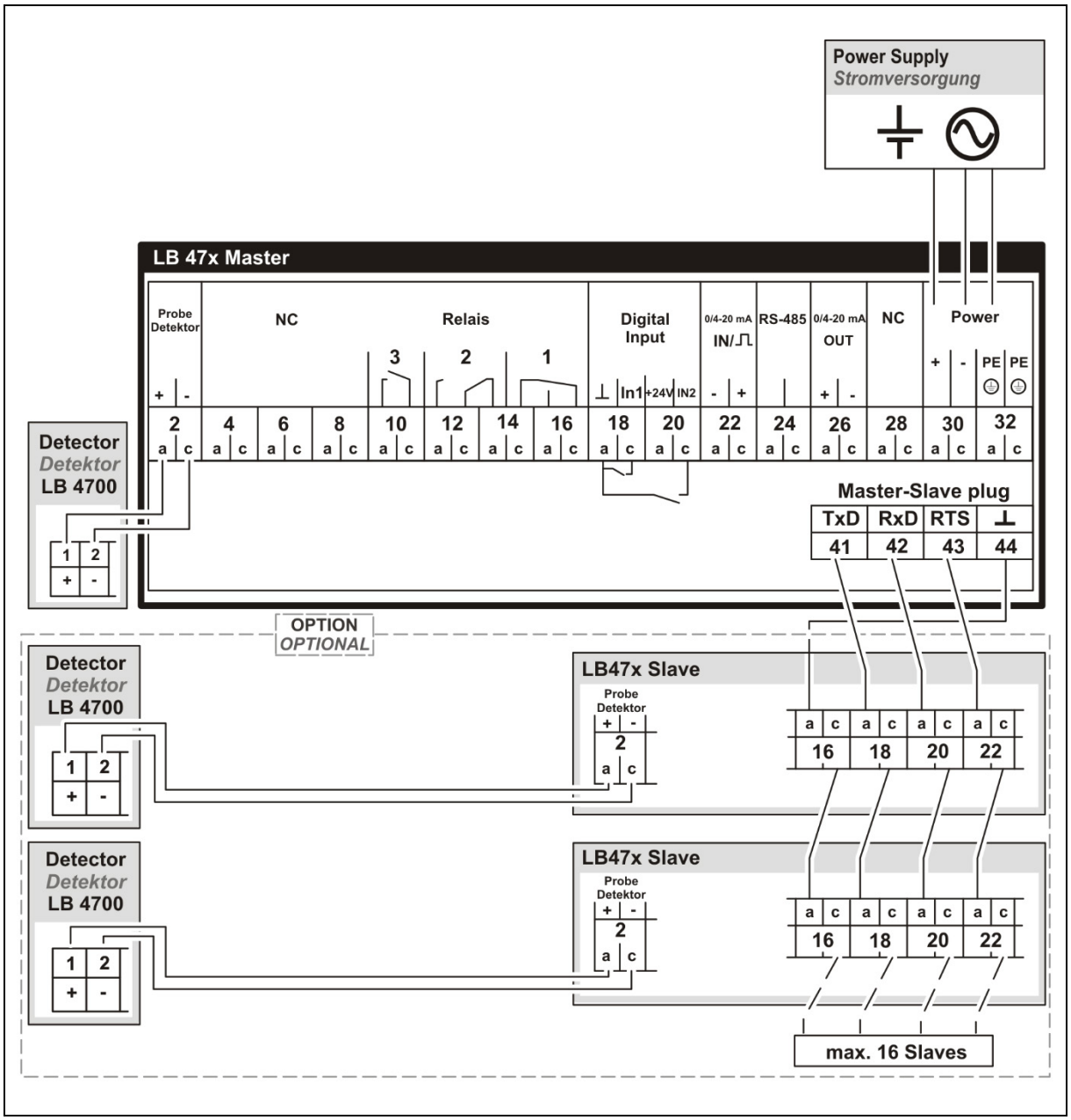
TI-Abb. 6 Connection Diagram Terminal Board Master/Slave
Anschlussplan Anschlussplatine Master/Slave

Terminals terminal board master/slave
Klemmen Anschlussplatine Master/Slave

#	Connection *Anschluss*	Function *Funktion*
1	DETECTOR MASTER +	Connection Detector LB 4700 *Verbindung Detektor LB 4700*
2	DETECTOR MASTER -	
1	DETECTOR SLAVE 1 +	Connection Detector LB 4700 *Verbindung Detektor LB 4700*
2	DETECTOR SLAVE 1 -	
1	DETECTOR SLAVE 2 +	
2	DETECTOR SLAVE 2 -	
1	DETECTOR SLAVE 3 +	
2	DETECTOR SLAVE 3 -	
9	MASTER/SLAVE GND	Connection of additional slave units *Anschluss von weiteren Slave-Einheiten*
10	MASTER/SLAVE TxD	
11	MASTER/SLAVE RxD	
12	MASTER/SLAVE RTS	
16	POWER DC 24 V – / AC N	24 V DC / 100-240 V AC
17	POWER DC 24 V + / AC L1	
18	PE	
19	PE	
20	PE	
21	RELAIS 3 NC	DIGITAL OUT
22	RELAIS 3 COM	
23	RELAIS 2 NC	DIGITAL OUT
24	RELAIS 2 NO	
25	RELAIS 2 COM	
26	RELAIS 1 NC	Error DIGITAL OUT *Fehler DIGITAL OUT*
27	RELAIS 1 NO	
28	RELAIS 1 COM	
29	DIGITAL IN 1 GND	GND
30	DIGITAL IN 1 IN	Logic Input
31	+ 24 V (GND --> 29)	24 V out (max. 200 mA)
32	CURRENT OUT –	4 mA … 20 mA
33	CURRENT OUT +	
34	CURRENT IN –	Not used for LB 470 / LB 470RID *Keine Verwendung bei LB 470 / LB 470RID*
35	CURRENT IN +	
36	RS 485 A	Communication and service interface (Master-Master) *Kommunikations- und Service-Schnittstelle (Master-Master)*
37	RS 485 B	
38	DIGITAL IN 2 GND	GND
39	DIGITAL IN 2 IN	Logic Input
40	+24 V (GND --> 38)	24 V out (max. 200 mA)

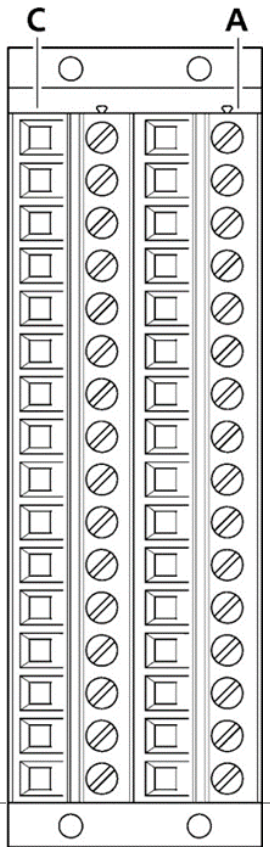
2.5. Assignment Terminal Block Master EVU

2.5. *Belegung Klemmenblock Master AWE*



TI-Abb. 7 Assignment Terminal Block Master EVU
Belegung Klemmenblock Master AWE

Terminal Block Master EVU
Klemmenblock Master AWE



Signal	Pin
DETECTOR GND	C - 2
n.a. *	C - 4
n.a. *	C - 6
n.a. *	C - 8
RELAIS 3 COM	C - 10
RELAIS 2 COM	C - 12
RELAIS 1 NC	C - 14
RELAIS 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
n.a. *	C - 28
Main *Netz* N AC, DC 24 V (–)	C - 30
PE**	C - 32

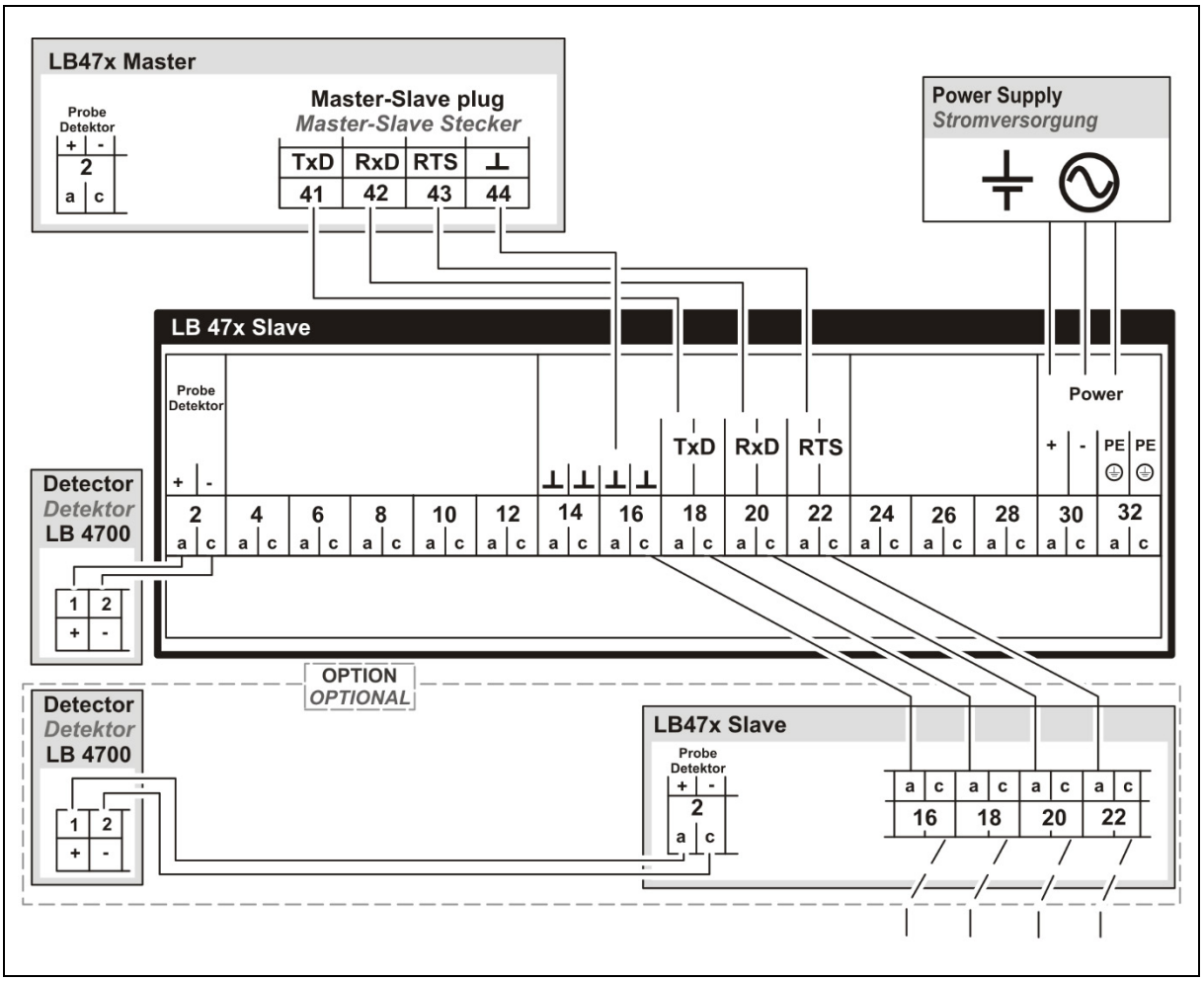
Pin	Signal
A - 2	DETECTOR +
A - 4	n.a. *
A - 6	n.a. *
A - 8	n.a. *
A -10	RELAIS 3 NO
A - 12	RELAIS 2 NO
A - 14	RELAIS 2 NC
A - 16	RELAIS 1 NO
A - 18	DIGITAL IN GND
A - 20	+ 24 V (GND --> A-18)
A - 22	CURRENT IN –
A - 24	RS 485 A
A - 26	CURRENT OUT +
A - 28	n.a. *
A - 30	Main *Netz* L1 AC, DC 24 V (+)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

* not assigned
nicht belegt

** Protective conductor
Schutzleiter

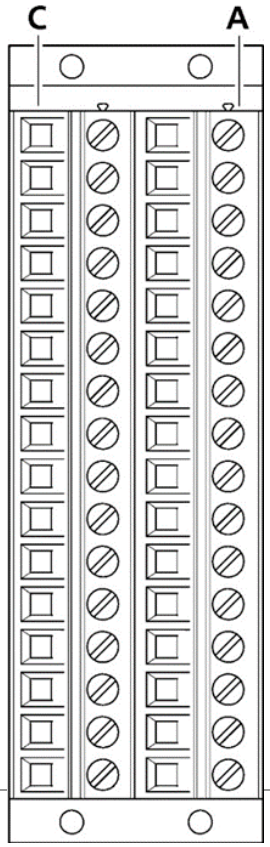
2.6. Assignment Terminal Block Slave

2.6. *Belegung Klemmenblock Slave*



TI-Abb. 8 Assignment terminal block slave
Belegung Klemmenblock Slave

Terminal Block Slave
Klemmenblock Slave



Signal	Pin	Pin	Signal
DETECTOR SLAVE GND	C - 2	A - 2	DETECTOR SLAVE +15 V
n.a**	C - 4	A - 4	n.a**
n.a**	C - 6	A - 6	n.a**
n.a**	C - 8	A - 8	n.a**
n.a**	C - 10	A - 10	n.a**
n.a**	C - 12	A - 12	n.a**
GND	C - 14	A - 14	GND
GND	C - 16	A - 16	GND
TxD to *zu* SLAVE *	C - 18	A - 18	TxD from *von* MASTER/SLAVE
RxD to *zu* SLAVE *	C - 20	A - 20	RxD from *von* MASTER/SLAVE
RTS to *zu* SLAVE *	C - 22	A - 22	RTS from *von* MASTER/SLAVE
n.a**	C - 24	A - 24	n.a**
n.a**	C - 26	A - 26	n.a**
n.a**	C - 28	A - 28	n.a**
Main *Netz* N AC, DC 24 V (–)	C - 30	A - 30	Main *Netz* L1 AC, DC 24 V (+)
PE ***	C - 32	A - 32	PE ***

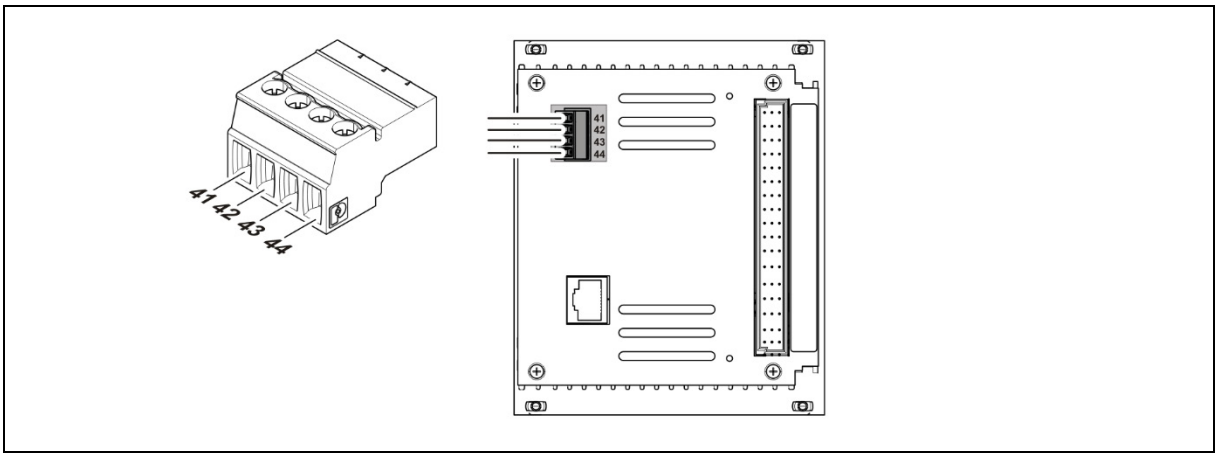
* option
optional

** not assigned
nicht belegt

*** Protective conductor
Schutzleiter

2.7. Assignment Terminals Master/Slave Plug

2.7. *Klemmenbelegung Master/Slave Stecker*



TI-Abb. 9 Assignment Terminal Master/Slave Plug
Klemmenbelegung Master/Slave Stecker

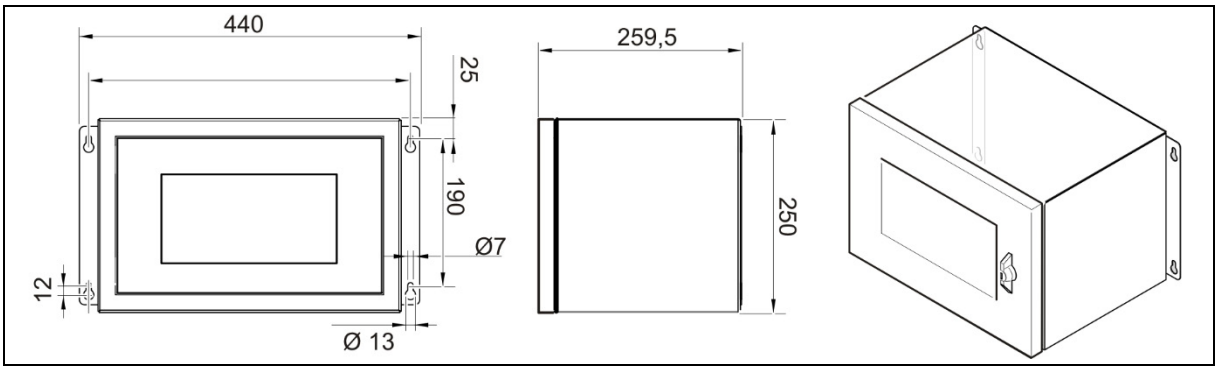
Signal	Pin
TxD	41
RxD	42
RTS	43
GND	44

The master/slave plug is not used by applications with terminal panels. The master/slave plug is contained in the purchase order terminal block (Mat. No. 59477). In the case of existing 19" subrack and retrofitting to LB 470, the master-slave plug (Part No. 64608) must be ordered separately.

Der Master/Slave Stecker wird bei Einbauvarianten mit Anschlussplatinen nicht benötigt. Der Master/Slave Stecker ist im Lieferumfang des Klemmenblocks (Mat. Nr. 59477) enthalten. Bei der Nachrüstung eines 19" Baugruppenträgers mit LB 470 Modulen muss der Master-Slave Stecker (Mat. Nr. 64608) gesondert bestellt werden.

3. Wall Housing

3. Wandgehäuse



TI-Abb. 10 Drawing wall housing
Zeichnung Wandgehäuse

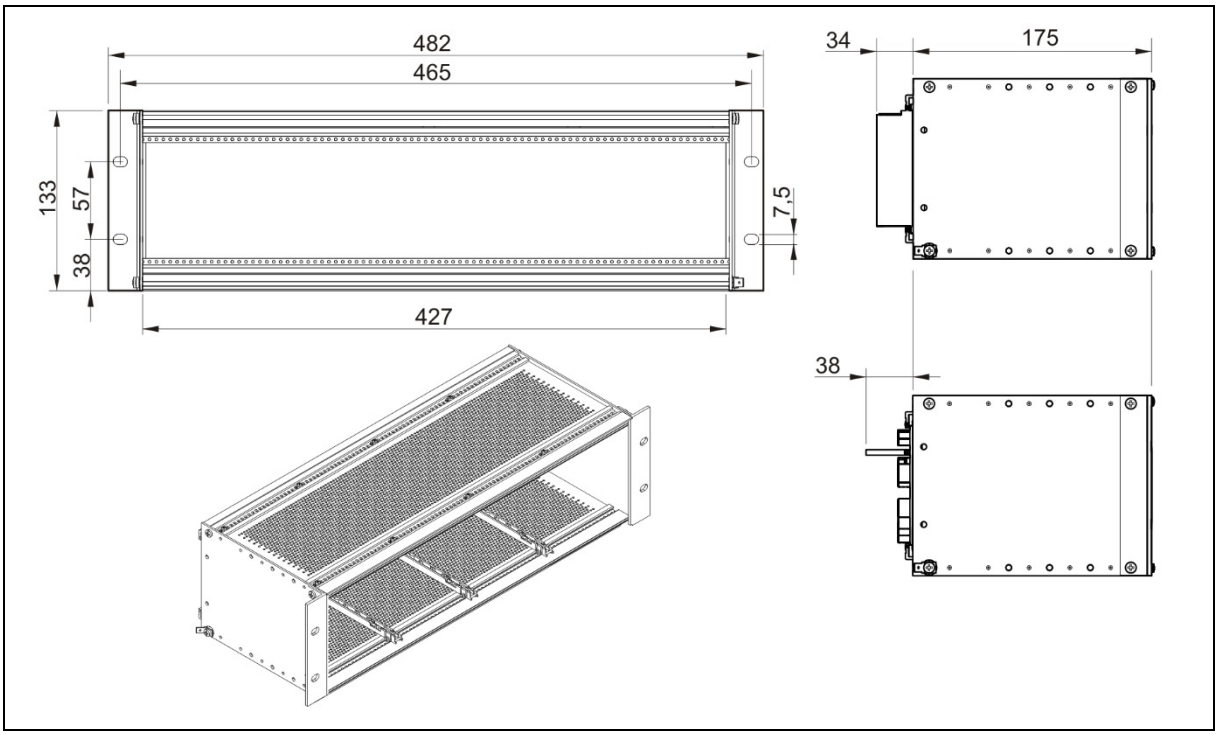
Technical Data *Technische Daten*	
Max. assembly *Max. Bestückung*	2 Master with terminal board (master/master)[1] 1 Master, 3 Slave with terminal board (master/slave)[1] 2 Master with calmp blocks[2] *2 Master mit Anschlussplatine (Master/Master)[1]* *1 Master, 3 Slave mit Anschlussplatine (Master/Slave)[1]* *2 Master mit Klemmenblöcken[2]*
Weight (with circuit board, without modules) *Gewicht (mit Anschlussplatine, ohne Module)*	8.8 kg *8,8 kg*
Degree of protection *Schutzart*	IP65
Operational temperature *Betriebstemperatur*	-20°C … +40°C
Storage temperature *Lagertemperatur*	-25 … 80°C
General ambient conditions *Allgemeine Umgebungsbedingungen*	Overvoltage category: II Pollution Degree: 2 Altitude: up to 2000 m Rel. humidity: 93% or less *Überspannungskategorie: II* *Verschmutzungsgrad: 2* *Höhenlage: bis zu 2000 m* *Rel. Luftfeuchtigkeit: 93% oder weniger*
User interface, colours *Oberfläche, Farbe*	powder coated, grey *pulverbeschichtet, grau*
Cable entry *Kabeleinführung*	8 x M16, 2 x M32

[1] NRTL certification US/CAN
[2] No certification

[1] NRTL Zertifikat US/CAN
[2] Kein Zertifikat

4. 19" Subrack

4. 19" Baugruppenträger

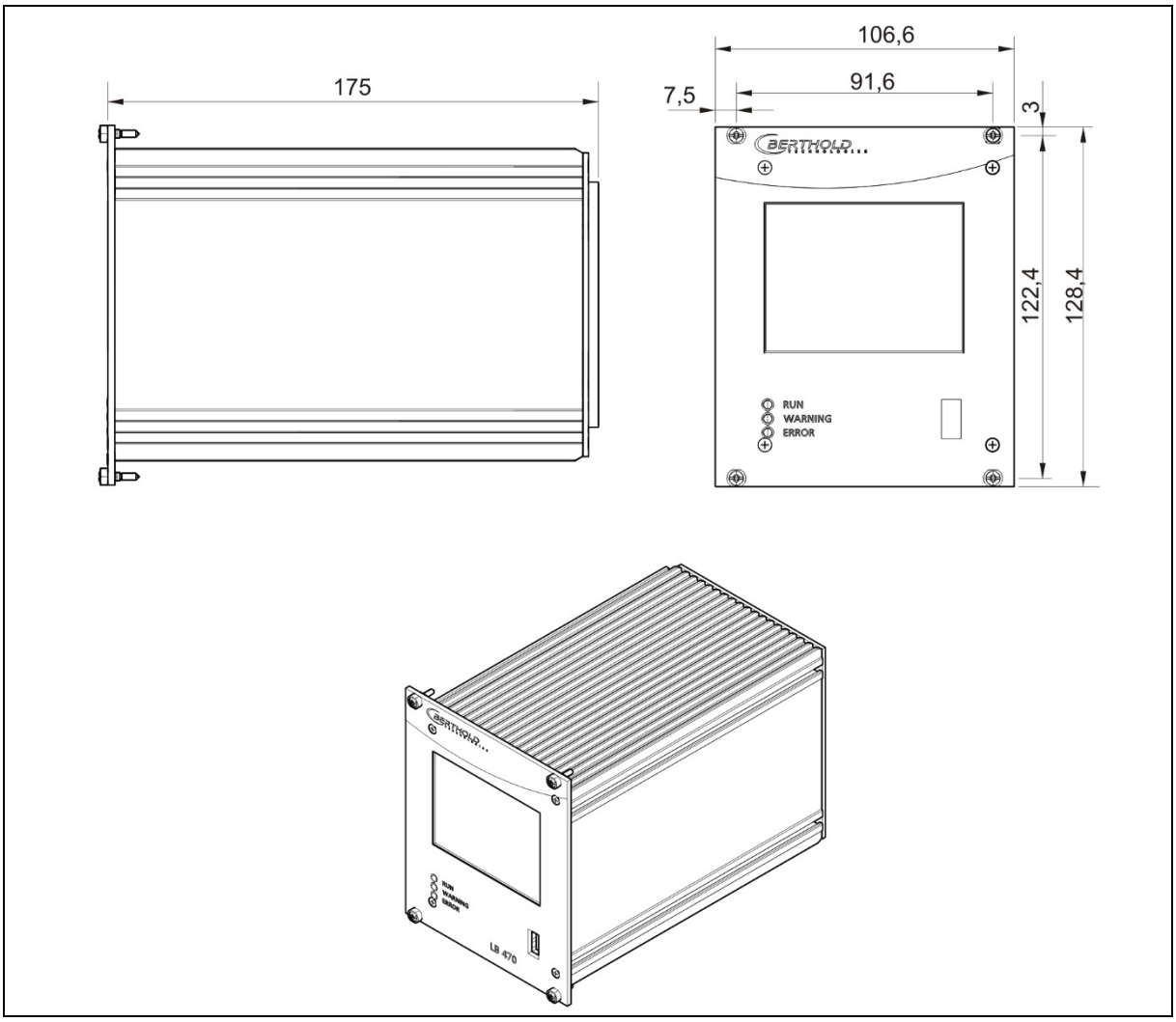


TI-Abb. 11 Drawing 19" subrack
Zeichnung 19" Baugruppenträger

Technical Data *Technische Daten*	
Standard units *Normeinheiten*	3HE/84TE/5T
Max. Assembly *Max. Bestückung*	3 Master + 3 Slave / 2 Master + 6 Slave / 4 Master / 1 Master+ 9 Slave / 12 Slave
Weight (with circuit board, without modules) *Gewicht (mit Anschlussplatine, ohne Module)*	1.4 kg *1,4 kg*
Weight terminal block *Gewicht Klemmenblock*	220 g
Operational temperature *Betriebstemperatur*	-20°C … +50°C, not condensing *-20°C … +50°C, nicht kondensierend*
Storage temperature *Lagerungstemperatur*	-25°C … +80°C
Degree of protection *Schutzart*	IP20

5. Master EVU

5. Master AWE



TI-Abb. 12 Drawing Master EVU
Zeichnung Master AWE

Technical Data *Technische Daten*	
Weight *Gewicht*	1200 g
Operational temperature *Betriebstemperatur*	-20 °C … +50 °C not condensing. Avoid direct sunlight. Unobstructed air circulation must be provided to the sub-rack. *-20°C … +50°C nicht kondensierend. Direkte Sonneneinstrahlung ist zu vermeiden. Für eine ungehinderte Luftzirkulation ist zu sorgen.*
Strorage temperature *Lagerungstemperatur*	-30° C … +80° C
Degree of protection *Schutzart*	IP20

General ambient conditions *Allgemeine Umgebungsbedingungen*	Overvoltage category: II Pollution Degree: 2 Altitude: up to 2000 m Rel. humidity: 93% or less *Überspannungskategorie: II* *Verschmutzungsgrad: 2* *Höhenlage: bis zu 2000 m* *Rel. Luftfeuchtigkeit: 93% oder weniger*
Connections *Anschlüsse*	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 *USB-Port zum Anschluss von USB-Speichermedium* *Master/Slave Buchse (4-polig) und Stecker* *RJ45-Buchse für Ethernet (an Rückwand)* *32 polige Stiftleiste nach DIN 19465 Baureihe C*
Display *Display*	graphical LCD display 320 x 240 points, 262,000 colours Dimmable LED background lighting Touchscreen *graphisches LCD-Display* *320 x 240 Punkte, 262.000 Farben* *Dimmbare LED Hintergrundbeleuchtung* *Touchscreen*
Computer core *Rechnerkern*	Processor: Dual Core DSP/ARM Controller clock frequency: 300 MHz internal (20 MHz external quartz) ROM: 512 KByte RAM: 64 MByte ext. SDRAM, 128 KByte int. shared RAM FLASH: 8 MByte external serial *Prozessor: Dual Core DSP/ARM Controller* *Taktfrequenz: 300 MHz intern (20 MHz externer Quarz)* *ROM: 512 KByte* *RAM: 64 MByte ext. SDRAM, 128 KByte int. shared RAM* *FLASH: 8 MByte extern seriell*

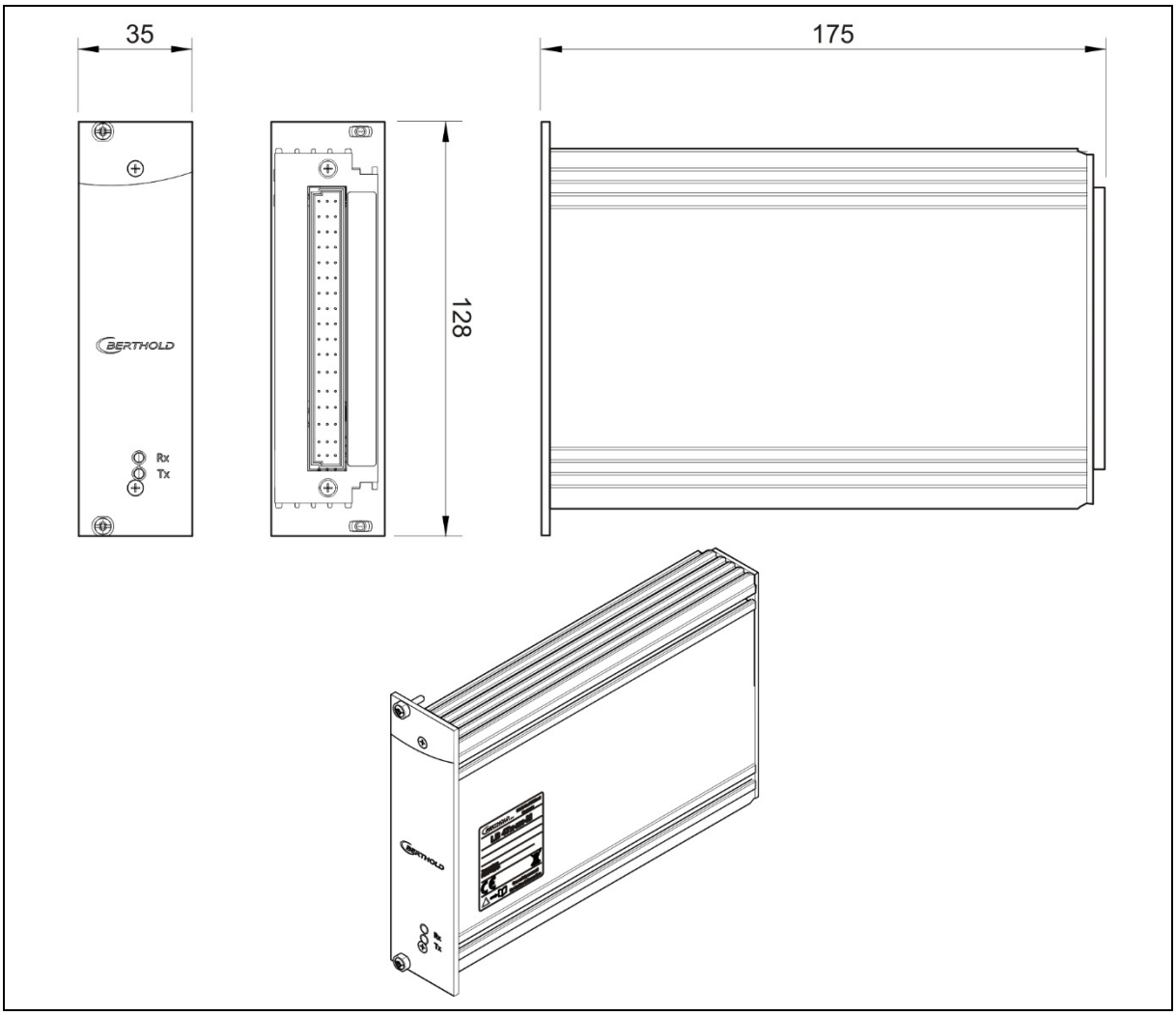
Power Supply *Stromversorgung*	
Voltage *Spannung*	100 … 240 V AC 50/60 Hz (wide range input) +/- 10% 21 … 32 V DC (24 V DC power input)
Power consumption *Leistungsaufnahme*	22 VA, 15 W
Fuses *Sicherungen*	Internal, 2 x 250 V, 1A delayed, 5x20 mm, 1500 A breaking capacity IEC 60127-2, 1x 250 V TR5 T80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

Interfaces *Schnittstellen*	
Current Output	4-20mA internally switched from power source to sink current (according to NAMUR recommendation NE 006 and NE 043). Dip switch source/sink on the electronic board of the LB 47x. Standard setting is source current. Continuous short circuit proof and galvanically isolated (500 V). Internal resistance about 105 ohms max. Burden when operating as a power source: 850 ohms. Internal monitoring of the loop current and additional error signalling by hardware on detection of a fault condition.
Stromausgang	*4-20mA (nach Namur-Empfehlung NE 006 und NE 043) intern von Stromquelle auf Stromsenke umschaltbar. Dip-Schalter auf der Elektronik-Platine in der Auswerteeinheit. Standard-Einstellung ist aktiver Stromausgang.* *Dauerhaft kurzschlussfest und potentialgetrennt (500 V).* *Innenwiderstand ca. 105 Ohm max.* *Bürde bei Betrieb als Stromquelle: 850 Ohm.* *Interne Überwachung des Schleifenstroms und zusätzliche Fehlersignalisierung durch Hardware bei Erkennung eines Fehlerzustands.*
Current input	4-20 mA (according to NAMUR recommendation NE 006 and NE 043) switchable via software on frequency input, electrically isolated (500 V). Internal resistance approx. 300 ohms max. input voltage: 24 V DC
Stromeingang	*4-20 mA (nach Namur-Empfehlung NE 006 und NE 043) per Software umschaltbar auf Frequenzeingang, potentialgetrennt (500 V). Innenwiderstand ca. 300 Ohm max. Eingangsspannung: 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
Impulseingang	*Frequenz 0 … 100 kHz, U_{max} = 28 V,* *Rechteck-Signalform, Low <1,5 V; High 4 - 28 V.* *Umschaltbar auf Stromeingang*
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
Digitale Ausgänge	*3 Relais, U_{max} = 33 V AC_{eff}, 46V DC; I_{max} = 1 A* *Funktionen: Relais 1: SPDT zur Fehlersignalisierung* *Relais 2: SPDT über Software zuweisbar* *Relais 3: SPST über Software zuweisbar*
Digital inputs	2 x together electrically isolated (500 V) Switch between DigIn and GND, U_{outmax} approx. 24 V Function configurable via software
Digitale Eingänge	*2 x gemeinsam potentialgetrennt (500 V),* *Schalter zwischen DigIn und GND, U_{outmax} ca. 24 V* *Funktion über Software konfigurierbar*

External supply *Externe Versorgung*	Output voltage: 24 V DC Output current: max. 150 mA *Ausgangsspannung: 24 V DC* *Ausgangsstrom: max. 150 mA*
RS485 *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) *für Master/Master Kommunikation und Prüf-und Testzwecke. Nicht potentialgetrennt von Hauptelektronik und USB-Anschluss* *potentialgetrennt von restlichen I/Os (500 V)*
USB port *USB Anschluss*	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_{outmax} = 0.5 A *1 x USB 2.0 Typ A (Host) über Frontplatte zum Anschluss einer ext. Maus, Tastatur oder Speichermedium* *U_{out} = 5 V, I_{outmax} = 0,5 A*
Ethernet *Ethernet*	RJ45 connection via back wall, 10 Mbit, DHCP supported, max. 3 m Designed for maintenance purposes. Not designed for long-term operation. *RJ45-Buchse über Rückwand, 10 Mbit,* *DHCP unterstützt, max. 3 m* *Vorgesehen für Wartungszwecke. Nicht vorgesehen für den Dauerbetrieb.*

6. Slave Module

6. Slave Modul



TI-Abb. 13 Drawing Slave Module
Zeichnung Slave Modul

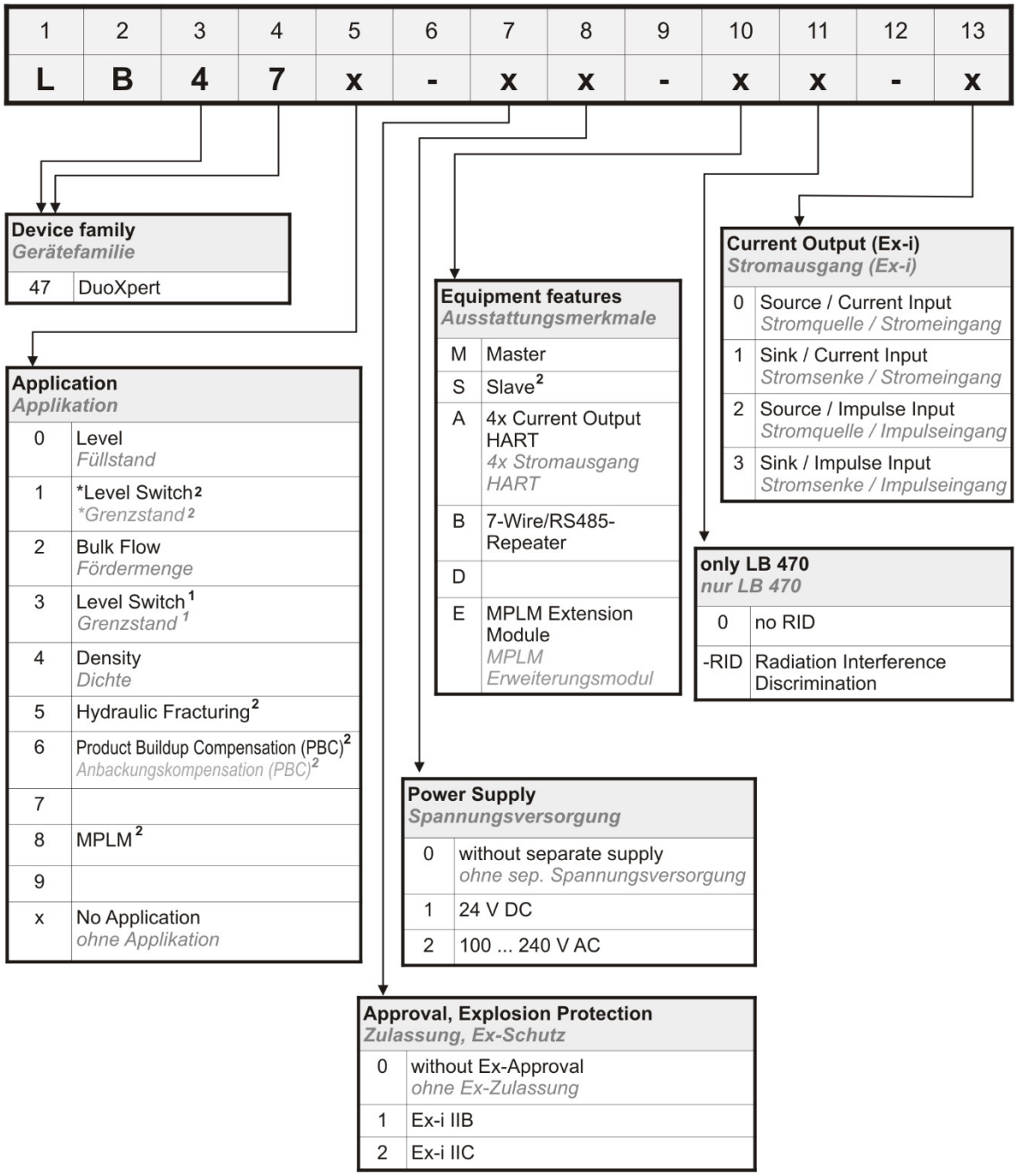
Mechanical Data ***Mechanische Daten***	
Weight *Gewicht*	600 g
Operational temperature *Betriebstemperatur*	-20 °C … +50 °C, not condensing. Avoid direct sunlight. Unobstructed air circulation must be provided to the sub-rack. *-20°C … +50°C nicht kondensierend. Direkte Sonneneinstrahlung ist zu vermeiden. Für eine ungehinderte Luftzirkulation um den Baugruppenträger ist zu sorgen.*
Storage temperature *Lagertemperatur*	-30 °C … +80 °C
Degree of protection *Schutzart*	IP20

General ambient conditions *Allgemeine Umgebungsbedingungen*	Overvoltage category: II Pollution Degree: 2 Altitude: up to 2000 m Rel. humidity: 93% or less *Überspannungskategorie: II* *Verschmutzungsgrad: 2* *Höhenlage: bis zu 2000 m* *Rel. Luftfeuchtigkeit: 93% oder weniger*

Electrical Data ***Elektrische Daten***	
Power consumption *Leistungsaufnahme*	6 VA, 5 W
Fuses *Sicherungen*	Internal, 2 x 250 V, 1 A delayed, 5x20 mm, 1500 A breaking capacity IEC 60127-2 *Intern, 2 x 250 V, 1 A träge, 5x20 mm, 1500 A Abschaltvermögen IEC 60127-2*
Connections *Anschlüsse*	32-pin plug connector *32-polige Stiftleiste*

7. Number Key LB 47x

7. Nummernschlüssel LB 47x



TI-Abb. 14 Number key
Nummernschlüssel

[1] Only available as Ex-i version
[2] Only available as a standard version
* Other Hardware

[1] Nur verfügbar als Ex-i Version
[2] Nur verfügbar als Standard-Version
** Andere Hardware*

8. Declaration of Conformity LB 47x

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

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

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

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

Produktbezeichnung: ***radiometrisches Auswertesystem DuoXpert***

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

	Richtlinie (Fundstelle)	angewendete Normen und weitere Spezifikationen	
NSR	2014/35/EU	EN 61010-1	2010
RoHS	2011/65/EG		
EMV	2014/30/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

Diese Erklärung wird verantwortlich für den Hersteller

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

abgegeben durch

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

8. Konformitätserklärung LB 47x

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

EG-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

9. NTRL Certification US/CAN wall-mounted housing

9. NRTL Zertifikat US/CAN Wandgehäuse

Nemko

Certificate of Compliance

Nemko-CCL, Inc.

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

Project: 257087-7.1

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

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

c Nemko US

Issued by: Robert Keller, Senior Engineer/Safety Supervisor

Authorized by: Thomas Jackson, Certification Manager

PRODUCTS

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

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

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

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

NFCC-002 Issue 2 May 2014 Page 1 of 3

APPLICABLE REQUIREMENTS

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

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

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

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

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

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 Straße 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

NFCC-002 Issue 2 May 2014 Page 3 of 3

10. NTRL Certifikate US/CAN DuoXpert LB 47x

10. NTRL Zertifikat US/CAN DuoXpert LB 47x

Nemko

Nemko-CCL, Inc.

Certificate of Compliance

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

Project: 235982-14.1

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

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

c Nemko US

Issued by: Robert Keller, Senior Engineer/Safety Supervisor

Authorized by: Thomas Jackson, Certification Manager

PRODUCTS

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

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

APPLICABLE REQUIREMENTS

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

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

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

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

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

NFCC-002 Issue 2 May 2014 Page 1 of 2

Supplement to Certificate of Compliance

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

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

Factory Information

Factory Name	Location
Berthold Technologies GmbH & Co. KG	Calmbacher Straße 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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11. Parts Overview

11. Übersicht Zubehör

Mat. No. *Mat.-Nr.*	Description *Beschreibung*
63284	LB 470-01-M0 Level Transmitter (Master, 24 VDC) *LB 470-01-M0 Füllstandsmessgerät (Master, 24 VDC)*
63283	LB 470-02-M0 Level Transmitter (Master, 100…240 VAC) *LB 470-02-M0 Füllstandsmessgerät (Master, 100…240 VAC)*
65092	LB 470-21-M0-0 Level Transmitter Ex-i (Master, 24 VDC, Source) *LB 470-21-M0-0 Füllstandsmessgerät Ex-i (Master, 24 VDC, Stromquelle)*
65091	LB 470-22-M0-0 Level Transmitter Ex-i (Master, 100…240 VAC, Source) *LB 470-22-M0-0 Füllstandsmessgerät Ex-i (Master, 100…240 VAC, Stromquelle)*
72364	LB 470-21-M0-0 Level Transmitter Ex-i (Master, 24 VDC, Sink) *LB 470-21-M0-0 Füllstandmessgerät Ex-i (Master, 24 VDC, Stromsenke)*
72363	LB 470-22-M0-0 Level Transmitter Ex-i (Master, 100...240 VAC, Sink) *LB 470-22-M0-0 Füllstandmessgerät Ex-i (Master, 100...240 VAC, Stromsenke)*
68640	LB 470-01-M-RID Level Transmitter with RID (Master, 24 VDC) *LB 470-01-M-RID Füllstandsmessgerät mit RID (Master, 24 VDC)*
68639	LB 470-02-M-RID Level Transmitter with RID (Master, 100...240 VAC) *LB 470-02-M-RID Füllstandsmessgerät mit RID (Master, 100...240 VAC)*
72059	LB 470-21-M-RID-0 Level Transmitter Ex-i with RID (Master, 24 VDC, Source) *LB 470-21-M-RID-0 Füllstandsmessgerät Ex-i mit RID (Master, 24 VDC, Stromquelle)*
72060	LB 470-22-M-RID-0 Level Transmitter Ex-i with RID (Master, 100...240 VAC, Source) *LB 470-22-M-RID-0 Füllstandsmessgerät Ex-i mit RID (Master, 100...240 VAC, Stromquelle)*
72366	LB 470-21-M-RID-0 Level Transmitter Ex-i with RID (Master, 24 VDC, Sink) *LB 470-21-M-RID-0 Füllstandsmessgerät Ex-i mit RID (Master, 24 VDC, Stromsenke)*
72365	LB 470-22-M-RID-0 Level Transmitter Ex-i with RID (Master, 100...240 VAC, Sink) *LB 470-22-M-RID-0 Füllstandsmessgerät Ex-i mit RID (Master, 100...240 VAC, Stromsenke)*
63286	LB 47x-01-S0 Slave (24 VDC) *LB 47x-01-S0 Slave (24 VDC)*
63285	LB 47x-02-S0 Slave (100...240 VAC) *LB 47x-02-S0 Slave (100...240 VAC)*

56925BA1	Operating Manual DuoSeries LB 470 Level, German *Betriebsanleitung Füllstand (deutsch)*
56925BA2	Operating Manual DuoSeries LB 470 Level, English Betriebsanleitung Füllstand (englisch)
56925-1BA1	Operating Manual DuoSeries LB 470RID Level, German *Betriebsanleitung DuoSeries LB 470RID Füllstand, Deutsch*
56925-1BA2	Operating Manual DuoSeries LB 470RID Level, English *Betriebsanleitung DuoSeries LB 470RID Füllstand, Englisch*
56925BA16	Safety Manual / Explosion Protection Manual LB 47x Ex-i (ATEX / IECEx), German *Sicherheitshandbuch / Explosionsschutzhandbuch LB 47x Ex-i (ATEX / IECEx), Deutsch*
56925BA26	Safety Manual / Explosion Protection Manual LB 47x Ex-i (ATEX / IECEx), English *Sicherheitshandbuch / Explosionsschutzhandbuch LB 47x Ex-i (ATEX / IECEx), Englisch*
63781	Wall-mounted Housing for LB 47x 1x Master / 3x Slave (24 VDC) *Wandgehäuse für LB 47x 1x Master / 3x Slave (24 VDC)*
63782	Wall-mounted Housing for LB 47x 1x Master / 3x Slave (110...240 VAC) *Wandgehäuse für LB 47x 1x Master / 3x Slave (110...240 VAC)*
63783	Wall-mounted Housing for 2x LB 47x Master (24 VDC) *Wandgehäuse für 2x Master LB 47x (24 VDC)*
63784	Wall-mounted Housing for 2x LB 47x Master (110...240 VAC) *Wandgehäuse für 2x LB 47x Master (110...240 VAC)*
64402	Wall-mounted Housing for 2x LB 47x Master (terminal blocks) *Wandgehäuse für 2x LB 47x Master (Klemmblöcke)*
72812	Wall-mounted Housing for 2x LB 47x Ex-i Master (with Ex-i terminal blocks) *Wandgehäuse für 2x LB 47x Ex-i Master (mit Ex-i Klemmblöcke)*
59493	19" rack for LB 47x, 2x (1x Master & up to 3x Slaves) *19"-Baugruppenträger für LB 47x, 2x (je 1x Master & bis zu 3x Slaves)*
59484	19" rack for LB 47x, 4x Master *19"-Baugruppenträger für LB 47x, 4x Master*
59481	19" rack for LB 47x, 3x (1x Master & 1x Slave) *19"-Baugruppenträger für LB 47x, 3x (je 1x Master & 1x Slave)*
64607	19" rack, 84 HP / 3 RU for use with terminal blocks *19"-Baugruppenträger, 84 TE / 3 HE für den Einsatz mit Klemmblöcken*
72051	19" rack Ex-i, 84 HP / 3 RU with 4x tension spring terminal blocks *19"-Baugruppenträger Ex-i, 84 TE / 3 HE mit 4x Zugfederklemmblöcken*
59477	Terminal block for LB 47x Master and Master-Slave plug *Klemmenblock für LB 47x Master und Master-Slave Stecker*
59478	Terminal block for LB 47x Slave (with guide rails) *Klemmenblock für LB 47x Slave (mit Führungsschienen)*

37526	Front Cover Plate 21 HP / 3 RU (Master) *Blindplatte 21TE / 3 HE (Master)*
59501	Front Cover Plate 7 HP / 3 RU (Slave) *Blindplatte 7TE / 3 HE (Slave)*
64608	Master-slave plug and terminal assignment for LB 47x slaves e.g. when changing from LB 44x to LB 47x slaves *Master-Slave Stecker und Klemmenbelegung für LB 47x Slaves bei Umrüstung von LB 44x auf LB 47x Slaves*