Embedded software version as of vers. 1.3.0 (CPU) and 1.3.0 (MU)
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1 About this Operating Manual

1.1 Some Prior Remarks

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

This operating manual illustrates how to:

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

Read these instructions thoroughly and completely before working with the product. We have tried to compile all information for safe and proper operation for you.

However, should questions arise which are not answered in this operating manual, please refer to BERTHOLD.

1.2 Storage Place

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

1.3 Target Group

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

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

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

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

**NOTICE**

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

1.5 Structure of the Operating Manual

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

1.6 Copyright

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

1.7 Representation

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Meaning</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quotation mark</td>
<td>Field in the software user interface</td>
<td>&quot;Calibrate&quot;</td>
</tr>
<tr>
<td>Vertical line</td>
<td>Path specification</td>
<td>Settings</td>
</tr>
<tr>
<td>Pointed brackets</td>
<td>Keys and buttons</td>
<td>&lt;Update&gt;</td>
</tr>
<tr>
<td>Round brackets</td>
<td>Image reference</td>
<td>Connect the plug (fig. 1, item 1)</td>
</tr>
</tbody>
</table>

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

Warning notes are designed as follows:

<table>
<thead>
<tr>
<th>Signal Word</th>
<th>Source and consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td>Explanation, if required</td>
</tr>
</tbody>
</table>

- Prevention
- In case of emergency

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

1.8.1 Symbols Used in the Operating Manual

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

**⚠️ DANGER**

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

**⚠️ WARNING**

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

**⚠️ CAUTION**

Refers to a **potentially dangerous** situation, which can result in medium or minor physical injuries or damages to property, if it is not avoided.
**NOTICE**
If this information is not observed, deterioration in the operation and/or property damage may occur.

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

**Tip**
Provides tips on application and other useful information.
1.8.2 Symbols Used on the Device

Read the operating manual

Please observe the instructions in this operating manual.

Electrostatic discharge

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

Protective earth connection

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

Equipotential bonding connection

At this position, connect the equipotential bonding conductor.

Direct voltage

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

Alternating voltage

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

No domestic waste

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

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

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

For the original declaration of conformity, please refer to Declaration of Conformity in Technical Information.
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 470 (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, unauthorised practices which could endanger your safety and the operational reliability of the EVU!
- Observing the given safety instructions!
- Carrying out the prescribed maintenance measures or having them carried out for you!
- Only use accessories and spare parts from BERTHOLD.
Improper use to be prevented:

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

BERTHOLD shall only accept liability for / guarantee the correspondence of the device to its publicised specifications.

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

**NOTICE**

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

### 2.3 Qualification of the Personnel

**NOTICE**

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

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

These three groups of people are:

- Employees with General Knowledge
- Experts
- Authorised Persons.
Employees with General Knowledge

**NOTICE**

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

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

**Experts**

- Experts are persons who have sufficient knowledge in the required area due to their specialist training and who are familiar with the relevant national health and safety regulations, accident prevention regulations, guidelines and recognised technical rules.
- Expert personnel must be capable of safely assessing the results of their work and they must be familiar with the content of this operating manual.

**Authorised Persons**

Authorised persons are those who are either designated for the corresponding task due to legal regulations or those who have been authorised by BERTHOLD for particular tasks. When dealing with radioactive materials, a radiation safety officer must also be consulted.
2.4 Operator's Obligations

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

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

3.1 Overview

The level measuring device LB 470 is an industrial measuring system for the contactless and continuous determination of the level of a product in a container.

A complete measuring system consists of the following components:

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

These instructions concern the operation of the evaluation unit DuoXpert LB 470 (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.

![Example measurement arrangement](image_url)

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 analysed to measure the level in the container.

The evaluation DuoXpert LB 470 (master EVU) is used for the evaluation, transmission and visualisation 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.
3.3 System Components

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

Fig. 2 System components
3.3.1 Software

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

This operating manual describes the software version 1.3.0 (Control Unit / CU) and 1.3.0 (Measurement Unit / MU).
3.3.2 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.

![Diagram of front view master EVU]

Fig. 3 Back 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.1, items 2-4) below the touch display show the current operating status of the master EVU.

<table>
<thead>
<tr>
<th>Display LED</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RUN</strong></td>
<td>This LED lights up green if the device is in operation and fault-free. The current measurement is carried out.</td>
</tr>
</tbody>
</table>
| **WARNING** | 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). |
| **ERROR**   | WARNING  
This LED lights up yellow when a system event of the type "Outside of specification", "Maintenance required" or "Function check" is present.  
All system events are described in chapter 8. |
| **ERROR**   | ERROR  
This LED lights up red if a system event of the type "Failure" is present. The current measurement is retained.  
Check the device settings.  
All system events are described in chapter 8. |
| **RUN / WARNING / ERROR flashing** | 
All three LEDs flash during the system test which is performed as part of the start up process. |
Rear view 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

Fig. 4 Front/rear view master EVU
### 3.3.3 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.

![Front/rear view slave module](image)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LED Rx</td>
</tr>
<tr>
<td>2</td>
<td>LED Tx</td>
</tr>
<tr>
<td>3</td>
<td>Mounting screws</td>
</tr>
<tr>
<td>4</td>
<td>Screws front plate</td>
</tr>
<tr>
<td>5</td>
<td>32-pin plug connector</td>
</tr>
</tbody>
</table>

**Fig. 5** Front/rear view slave module

### 3.3.4 Type plate

![Type plate](image)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Application (0 = level)</td>
</tr>
<tr>
<td>2</td>
<td>Approval explosion protection (0 = no explosion approval)</td>
</tr>
<tr>
<td>3</td>
<td>Power supply (1 = 24V DC; 2=100...24V AC -10 +10%)</td>
</tr>
<tr>
<td>4</td>
<td>Master (M) or slave (S)</td>
</tr>
<tr>
<td>5</td>
<td>Permissible temperature range for operation (ambient temperature)</td>
</tr>
<tr>
<td>6</td>
<td>Power specifications</td>
</tr>
</tbody>
</table>

**Fig. 6** Type plate
3.4 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. 8).

![Diagram of Point source - rod detector](image)

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. 7 Schema Point source - rod detector

3.5 Storage

Keep devices in a dry (no condensation), dark (no direct sunlight), clean and lockable room. Stay within the temperature range for storage.
3 System Description

Fig. 8  Schema Point source-rod detector cascaded

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
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. 9 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. 10 Schema Rod source - point detector
The detector and the source are usually formed as points in an absorption level measurement.

Based on the arrangement of source and detector (Fig. 11), the change in the measurement signal results from the different material thickness of the product being measured.
4 Installation

4.1 General Instructions

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

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

**NOTICE**
Only mounting accessories approved by BERTHOLD should be used for installation of the devices.

**NOTICE**
The device should only be operated if firmly installed.

4.2 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

The modules can be installed either in wall housings (Fig. 12) or 19" subracks (Fig. 13).

Installation variants wall housing

<table>
<thead>
<tr>
<th>Installation variant</th>
<th>Connection</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall housing</td>
<td>Terminal panel master</td>
<td>2 Master (Fig. 12, item 2)</td>
</tr>
<tr>
<td></td>
<td>Terminal panel master/slave</td>
<td>1 Master, 3 Slaves (Fig. 12, item 1)</td>
</tr>
<tr>
<td></td>
<td>Clamp blocks</td>
<td>2 Master (Fig. 12, item 2)</td>
</tr>
</tbody>
</table>

Fig. 12 Installation variants wall housing
Installation variants subrack

Fig. 13  Installation variants 19" subrack with terminal panel

<table>
<thead>
<tr>
<th>Installation variant</th>
<th>Connection</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>19&quot; subrack</td>
<td>2 terminal panel master (Fig. 13, item 1)</td>
<td>4 Master</td>
</tr>
<tr>
<td></td>
<td>2 terminal panel master/slave (Fig. 13, item 2)</td>
<td>2 Master, 6 Slaves</td>
</tr>
</tbody>
</table>

Fig. 14  Installation variants 19" subrack with clamp blocks

<table>
<thead>
<tr>
<th>Installation variant</th>
<th>Connection</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>19&quot; subrack</td>
<td>6 clamp blocks (Fig. 14, item 1)</td>
<td>3 Master, 3 Slaves</td>
</tr>
<tr>
<td></td>
<td>10 clamp blocks (Fig. 14, item 2)</td>
<td>1 Master, 9 Slaves</td>
</tr>
<tr>
<td></td>
<td>12 clamp blocks (Fig. 14, item 3)</td>
<td>12 Slaves</td>
</tr>
</tbody>
</table>
4.3.1 Installation in the wall housing

The wall housing may be equipped differently, depending on requirements (see chap. 4.3 Installation variants). 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. 15, item 4).

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

---

**Installation of the modules (master-slave)**

![Diagram](image)

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

---

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

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).
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. 16, item 2) is inserted into the socket board.
2. Tighten all fixing screws (Fig. 16, item 4).
Mounting the wall housing

4 holes (Fig. 17) are provided for mounting on the wall etc.

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

**NOTICE**

It is recommended that the wall housing be protected from direct sunlight in order to maintain maximum ambient temperature (see appendix “Technical Information”).
4.3.2 Installation in the 19" subrack

The 19" subrack can be equipped differently, depending on requirements (see chap. 4.3 Installation variants). The rear clamp blocks (Fig. 18, item 3) or terminal panels (Fig. 19, 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. 19, 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
Installation with clamp blocks

⚠️ DANGER

Danger to life from electric shock!

- Installation/maintenance may only be carried out if the device has been de-energised.
- 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.

---

1. Set master EVU / slave module (Fig. 18, item 1, item 2) in the guide rails (Fig. 18, item 5).
2. Carefully slide module into the subrack until the plug connector is inserted into the clamp block.
3. Tighten fixing screws (Fig. 18, item 6).

---

NOTICE

The master's EVUs / slave modules must be secured against pulling out by fixing screws (Fig. 18, item 6).

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

---

19" subrack with clamp block (Ex: 1x Master, 9xSlave)
Installed with terminal panels

⚠️ DANGER

Danger to life from electric shock!

- Installation/maintenance may only be carried out if the device has been de-energised.
- 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. 19, item 5).

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

---

1. Set master EVU / slave module (Fig. 19, item 1) into the guide rails (Fig. 19, item 3).
2. Carefully slide module into the subrack until the plug connector is inserted into the socket board (Fig. 19, item 2).
3. Tighten fixing screws (Fig. 19, item 5).
5 Electric Installation

5.1 General Instructions

⚠️ DANGER

Danger to life from electric shock!

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

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

NOTICE

Apply the voltage of the specified and marked range only!

NOTICE

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

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-energised via the external power supply.

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

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

5.1.2 Cables and Lines

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

For intrinsically safe systems, the detector must be connected to the equipotential bonding of the system. The detector is connected via a 2-core (2 x 12) cable with approx. 5 ... 10 mm diameter. A screened cable can be used in systems with extremely strong electrical noise. The screen may only be laid out on one side of the detector. The maximum cable length depends on the cable resistance, which may not exceed a total (there and back) of 40 ohms. For standard cables from BERTHOLD TECHNOLOGIES (Id. no. 32024), this results in a cable length of 1000m, from the evaluation unit to the detector. For intrinsically safe systems, the maximum permissible inductance and capacitance of the cable should be considered to the max. 40 ohm.
When routing the connection lines, make sure that

- no dirt or moisture reaches the connection room,
- the conductors are not damaged when the cable insulation is removed,
- the conductor insulation or the sleeve of the wire end ferrules reach into the housing of the terminal unit,
- blank, conductive segments of the lines (e.g. wires of a litz wire) do not reach outside the terminal unit,
- the wire end ferrule or the stripped wire have a length of 8 mm so that the wire is held securely in the clamp,
- the line insulation reaches into the sleeve of the wire end ferrule if these components are used,
- the admissible minimum bending radius for the respective line cross-section is not exceeded and
- the cables are laid out in a strain-relieved and friction-free manner.
- Only use cables whose diameters are approved for the respective cable gland. The cables must comply with the requirements and cross-sections specified in the technical data.
- The connected cables must be appropriate for temperatures of at least 10°C above the maximum admissible ambient temperature.

5.1.3 Cable Glands and 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 121 Ω.
5.2 Electric connection in the wall housing

⚠️ DANGER

Danger to life from electric shock!

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

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

Fig. 20  Electrical connection in the wall housing (Ex.: master-master)

1. Make sure that the locking bolts (Fig. 20, item 1) of all modules are tightened in order to prevent slipping.
2. Loosen the lock (Fig. 20, 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. 20, item 6) through the openings of the wall housing and through the counternut cable glands (Fig. 20, item 7).
5. Screw the the cable glands (Fig. 20, item 6) with the counternut cable glands (Fig. 20, item 7).

**NOTICE**

Apply the voltage of the specified and marked (Fig. 20, 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 (chap.5.4 or chap.5.5) to the terminal board (Fig. 20, item 3).

7. Open the terminal connection (Fig. 20, item 4) with an operating tool (slotted screwdriver) and insert the stripped wire (min. 8 mm) (Fig. 20, item 5). The terminal connection closes by pulling out the operating tool.

   - The terminal connections are designed for wires (flexible) with a conductor cross-section from 0.2 mm² to 2.5 mm² (with ferrule without plastic sleeve) or 0.2 mm² to 1.5 mm² (with ferrule with plastic sleeve). AWG = 24 – 12.

8. Plug the network plug into the RJ45 socket (Fig. 20, item 9) (optional).

9. Tighten all cable glands (Fig. 20, 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 master/slave connections of the installed devices are already manufactured above the circuit board in the wall housing. If additional slave modules (e.g. from other wall housings) are connected, the terminals appropriate for use on the terminal board should be used.
5.3 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-energised.
- Only open the device when free of voltage.

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

The terminal board master/slave is used twice (Fig. 21, item 2) for the variant to install 2 master EVUs and 6 slave modules.

The terminal board master/master (Fig. 21, item 1) is used twice for the variant to install 4 master EVUs.

<table>
<thead>
<tr>
<th>master / master</th>
<th>master / 3x slave</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHANNEL A</td>
<td>CHANNEL A</td>
</tr>
<tr>
<td>CHANNEL B</td>
<td>CHANNEL B</td>
</tr>
<tr>
<td>CHANNEL C</td>
<td></td>
</tr>
<tr>
<td>CHANNEL D</td>
<td></td>
</tr>
</tbody>
</table>

⚠️ NOTICE

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

⚠️ NOTICE

Prior to initial start-up, the voltage range (Fig. 21, item 8) must be marked with chemical resistance on all input and output terminals!
1. Unused slots must be closed with blinds.
2. Label the voltage range permanently and chemically (Fig. 21, item 8).
3. Connect the lines according to assignment (chap. 5.4 or chap. 5.5) to the terminal board.

NOTICE

Apply the voltage of the specified and marked (Fig. 20, item 3) range only!

NOTICE

Note the specification relating to Cables, Protective earth, equipotential bonding and EIA-485 (RS-485) in chapter 5.1.
4. Open the terminal connection (Fig. 21, item 3) with an operating tool (slot-ted screwdriver) and insert the stripped wire (min. 8 mm) (Fig. 21, item 4). The terminal connection closes by pulling out the operating tool.

5. The terminal connections are designed for wires (flexible) with a conductor cross-section from 0.2 mm² to 2.5 mm² (with ferrule without plastic sleeve) or 0.2 mm² to 1.5 mm² (with ferrule with plastic sleeve). AWG = 24 – 12.

6. Plug the network plug into the RJ45 socket (Fig. 21, item 9) (optional).

7. Check the correct connection of the PE conductor (Fig. 21, item 10).

**NOTICE**

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

**NOTICE**

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

Fig. 22 Terminal board master/master back side (Label A/B)
### Pin assignment master/master

<table>
<thead>
<tr>
<th>Item</th>
<th>Plug connectors</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DETECTOR MASTER –</td>
<td>Connection LB 4700 or LB 44xx detector</td>
</tr>
<tr>
<td>2</td>
<td>DETECTOR MASTER +</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>MASTER/SLAVE GND</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>MASTER/SLAVE TxD</td>
<td>Connection of further slave units</td>
</tr>
<tr>
<td>5</td>
<td>MASTER/SLAVE RxD</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>MASTER/SLAVE RTS</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>RELAIS 3 NC</td>
<td>DIGITAL OUT</td>
</tr>
<tr>
<td>8</td>
<td>RELAIS 3 COM</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>RELAIS 2 NC</td>
<td>DIGITAL OUT</td>
</tr>
<tr>
<td>10</td>
<td>RELAIS 2 NO</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>RELAIS 2 COM</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>RELAIS 1 NC</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>RELAIS 1 NO</td>
<td>Error DIGITAL OUT</td>
</tr>
<tr>
<td>14</td>
<td>RELAIS 1 COM</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>DIGITAL IN 1 GND</td>
<td>GND</td>
</tr>
<tr>
<td>16</td>
<td>DIGITAL IN 1 IN</td>
<td>Logic Input</td>
</tr>
<tr>
<td>17</td>
<td>+ 24 V OUT</td>
<td>24 V out (max. 200 mA)</td>
</tr>
<tr>
<td>18</td>
<td>POWER DC 24 V – / AC N</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>POWER DC 24 V + / AC L1</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>PE</td>
<td>24 V DC / 100-240 V AC</td>
</tr>
<tr>
<td>21</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>CURRENT OUT –</td>
<td>4 mA ... 20 mA</td>
</tr>
<tr>
<td>24</td>
<td>CURRENT OUT +</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>CURRENT IN –</td>
<td>Not used at LB 470</td>
</tr>
<tr>
<td>26</td>
<td>CURRENT IN +</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>RS 485 A</td>
<td>Communication and service interface (master-master)</td>
</tr>
<tr>
<td>28</td>
<td>RS 485 B</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>DIGITAL IN 2 GND</td>
<td>GND</td>
</tr>
<tr>
<td>30</td>
<td>DIGITAL IN 2 IN</td>
<td>Logic Input</td>
</tr>
<tr>
<td>31</td>
<td>+ 24 V OUT</td>
<td>24 V out (max. 200 mA)</td>
</tr>
</tbody>
</table>

**NOTICE**

The connections master A, B, C, D are identical.
5.5 Terminal board master/slave

Fig. 23 Terminal board master/slave back side (label A)
## Pin assignment master/slave

<table>
<thead>
<tr>
<th>Item</th>
<th>Plug connectors</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<tr>
<td>2</td>
<td>DETECTOR MASTER +</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>DETECTOR SLAVE 1 –</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>DETECTOR SLAVE 1 +</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>DETECTOR SLAVE 2 –</td>
<td>Connection of further slave units</td>
</tr>
<tr>
<td>6</td>
<td>DETECTOR SLAVE 2 +</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>DETECTOR SLAVE 3 –</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>DETECTOR SLAVE 3 +</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>MASTER/SLAVE GND</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>MASTER/SLAVE TxD</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>MASTER/SLAVE RxD</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>MASTER/SLAVE RTS</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>POWER DC 24 V – / AC N</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>POWER DC 24 V + / AC L1</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>RELAIS 3 NC</td>
<td>DIGITAL OUT</td>
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<tr>
<td>22</td>
<td>RELAIS 3 COM</td>
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<td>DIGITAL OUT</td>
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<td>RELAIS 2 NO</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>RELAIS 2 COM</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>RELAIS 1 NC</td>
<td>Error DIGITAL OUT</td>
</tr>
<tr>
<td>27</td>
<td>RELAIS 1 NO</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>RELAIS 1 COM</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>DIGITAL IN 1 GND</td>
<td>GND</td>
</tr>
<tr>
<td>30</td>
<td>DIGITAL IN 1 IN</td>
<td>Logic Input</td>
</tr>
<tr>
<td>31</td>
<td>+ 24 V OUT</td>
<td>24 V out (max. 200 mA)</td>
</tr>
<tr>
<td>32</td>
<td>CURRENT OUT –</td>
<td>4 mA ... 20 mA</td>
</tr>
<tr>
<td>33</td>
<td>CURRENT OUT +</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>CURRENT IN –</td>
<td>Not used at LB 470</td>
</tr>
<tr>
<td>35</td>
<td>CURRENT IN +</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>RS 485 A</td>
<td>Communication and service interface (master-master)</td>
</tr>
<tr>
<td>37</td>
<td>RS 485 B</td>
<td></td>
</tr>
</tbody>
</table>
### NOTICE

The connections master/slave A and master/slave B are identical.

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>DIGITAL IN 2 GND</td>
<td>GND</td>
</tr>
<tr>
<td>39</td>
<td>DIGITAL IN 2 IN</td>
<td>Logic Input</td>
</tr>
<tr>
<td>40</td>
<td>+ 24 V OUT</td>
<td>24 V out (max. 200 mA)</td>
</tr>
</tbody>
</table>
5.6 Electrical connection in the 19" subrack with clamp block

⚠️ DANGER

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

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

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

❗️ IMPORTANT

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. 5.6.1).

⚠️ NOTICE

The LB 470 is restricted pin-compatible with the terminals of the LB 440. 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 440 can be replaced by a LB 470 without re-wiring.
1. Connect the lines to the clamp blocks according to assignment (chap. 5.6.2 or 5.6.3).
2. Open the clamping 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.
3. Screw the clamping screws with a tightening torque of 0.4 - 0.5 Nm.
4. Plug in the master/slave plug and reconnect the lines in accordance with assignment (chap. 5.6.1 and chap. 5.6.2 or chap. 5.6.3).
5. Plug the network plug into the RJ45 socket (Fig. 24, item 4) (optional).
6. 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.

**NOTICE**

Only cable that is suitable for connection to the corresponding terminals may be used. For further specifications, see appendix "Technical Information".

## 5.6.1 Assignment terminals master/slave plug

<table>
<thead>
<tr>
<th>Signal</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>TxD</td>
<td>41</td>
</tr>
<tr>
<td>RxD</td>
<td>42</td>
</tr>
<tr>
<td>RTS</td>
<td>43</td>
</tr>
<tr>
<td>GND</td>
<td>44</td>
</tr>
</tbody>
</table>

Fig. 25 Assignment Terminals master/slave plug
### 5.6.2 Assignment clamp block master EVU

#### Table: Assignment of Signals to Pins

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

#### Table: Assignment of Pins to Signals

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - 2</td>
<td>DETECTOR +</td>
</tr>
<tr>
<td>A - 4</td>
<td>not assigned</td>
</tr>
<tr>
<td>A - 6</td>
<td>not assigned</td>
</tr>
<tr>
<td>A - 8</td>
<td>not assigned</td>
</tr>
<tr>
<td>A - 10</td>
<td>RELAY 3 NO</td>
</tr>
<tr>
<td>A - 12</td>
<td>RELAY 2 NO</td>
</tr>
<tr>
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<td>RELAY 2 NC</td>
</tr>
<tr>
<td>A - 16</td>
<td>RELAY 1 NO</td>
</tr>
<tr>
<td>A - 18</td>
<td>DIGITAL IN GND</td>
</tr>
<tr>
<td>A - 20</td>
<td>+ 24 V</td>
</tr>
<tr>
<td>A - 22</td>
<td>CURRENT IN – (−)</td>
</tr>
<tr>
<td>A - 24</td>
<td>RS 485 A</td>
</tr>
<tr>
<td>A - 26</td>
<td>CURRENT OUT +</td>
</tr>
<tr>
<td>A - 28</td>
<td>not assigned</td>
</tr>
<tr>
<td>A - 30</td>
<td>100-240 V AC, 24 V DC +</td>
</tr>
<tr>
<td>A - 32</td>
<td>Protective conductor PE</td>
</tr>
</tbody>
</table>

**Fig. 26** Assignment clamp block master EVU

**Fig. 27** Terminal assignment master EVU (display on the module)
### 5.6.3 Assignment clamp block slave module

<table>
<thead>
<tr>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>DETECTOR SLAVE GND</td>
<td>C - 2</td>
<td>A - 2 DETECT. SLAVE +15 V</td>
<td></td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 4</td>
<td>A - 4 not assigned</td>
<td></td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 6</td>
<td>A - 6 not assigned</td>
<td></td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 8</td>
<td>A - 8 not assigned</td>
<td></td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 10</td>
<td>A - 10 not assigned</td>
<td></td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 12</td>
<td>A - 12 not assigned</td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td>C - 14</td>
<td>A - 14 GND</td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td>C - 16</td>
<td>A - 16 GND</td>
<td></td>
</tr>
<tr>
<td>RTS to the SLAVE</td>
<td>C - 18</td>
<td>A - 18 RTS to MASTER/SLAVE(^1)</td>
<td></td>
</tr>
<tr>
<td>RxD to the SLAVE</td>
<td>C - 20</td>
<td>A - 20 RxD to the MASTER/SLAVE</td>
<td></td>
</tr>
<tr>
<td>TxD to the SLAVE</td>
<td>C - 22</td>
<td>A - 22 TxD to the MASTER/SLAVE</td>
<td></td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 24</td>
<td>A - 24 not assigned</td>
<td></td>
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<tr>
<td>not assigned</td>
<td>C - 26</td>
<td>A - 26 not assigned</td>
<td></td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 28</td>
<td>A - 28 not assigned</td>
<td></td>
</tr>
<tr>
<td>Main AC, DC 24 V –</td>
<td>C - 30</td>
<td>A - 30 Main AC, DC 24 V +</td>
<td></td>
</tr>
<tr>
<td>Protective conductor PE</td>
<td>C - 32</td>
<td>A - 32 Protective conductor PE</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) _optional_

---

**Fig. 28** Assignment clamp block slave module

**Fig. 29** Terminal assignment (display on slave module)
6 Operation of the Software

6.1 System start

Fig. 30 Start screen with display of the software version

System start with invalid application software

A different menu structure is present in this mode.

Fig. 31 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.
6.2 EVU standard display

**IMPORTANT**

Changing the language of the user interface is described in chapter 7.3.1 System | Interface.

Click on the blue field in order to switch the display between detector temperature (Fig. 32, item 3) and count rate (Fig. 32, item 3). The designation of the measuring point (Fig. 32, item 7) can be changed in Chapter 7.1.1.

![Standard display of the EVU](image)

Fig. 32 Standard display of the EVU

6.3 Navigation

![Icons for navigation](image)

Fig. 33 Icons for navigation
6.3.1 Diagram display

Clicking the diagram symbol (Fig. 32, item 5) changes the view to the diagram display. The arrow keys (Fig. 34, item 1) are used to switch between the diagrams Level– Count Rate – Detector Temperature.

Clicking the display symbol (Fig. 34, item 3) changes the view to the standard display.

![Diagram display of the EVU](image)

Fig. 34    Diagram display of the EVU

6.4 Status messages

![Status information](image)

Fig. 35    Status information
6.4.1 Event reports

Events are displayed in the standard display and in the submenus 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 470 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. Click on the icon (Fig. 36, 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.

### 6.5 Input field

**NOTICE**

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

---

Fig. 37 Screen keyboard

<table>
<thead>
<tr>
<th></th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Input line</td>
</tr>
<tr>
<td>2</td>
<td>Shift key for numbers</td>
</tr>
<tr>
<td>3</td>
<td>Shift to upper case characters</td>
</tr>
<tr>
<td>4</td>
<td>Escape key</td>
</tr>
<tr>
<td>5</td>
<td>Keypad</td>
</tr>
<tr>
<td>6</td>
<td>Navigation buttons</td>
</tr>
<tr>
<td>7</td>
<td>Input key</td>
</tr>
<tr>
<td>8</td>
<td>Delete key</td>
</tr>
<tr>
<td>9</td>
<td>Number field</td>
</tr>
<tr>
<td>10</td>
<td>Home (item1) key</td>
</tr>
<tr>
<td>11</td>
<td>End key</td>
</tr>
<tr>
<td>12</td>
<td>Shift key for letters</td>
</tr>
</tbody>
</table>
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
7.1.1 Location

Device Setup | Identification | Location

The location of the evaluation unit is displayed (Fig. 39, 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. 32, item 8).

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".

Fig. 41 Device information

**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).

**IMPORTANT**

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

**Perform CU update**

1. Save the current update file of the CU software on a USB storage device.
2. Connect a USB storage device to the device (Fig. 3, item 5).
3. The USB storage device is recognised by the system after a few seconds and
the <CU Update> (Fig. 40, item 1) button can be clicked.
4. Click on the button <CU Update> (Fig. 40, item 1).
   ▶ The update is performed.
5. Measurement is interrupted.
6. Click the Button <Restart> to reboot the EVU.

Perform MU update
1. Save the current update file of the MU software on a USB storage device.
2. Connect a USB storage device to the device (Fig. 3, item 5).
3. The USB storage device is recognised by the system after a few seconds and the <MU Update> (Fig. 40, item 1) button can be clicked.
4. Click on the button <MU Update> (Fig. 40, item 1).
   ▶ The update is performed.
5. Measurement is interrupted.
6. Click the Button <Restart> to reboot the EVU.

**NOTICE**

BERTHOLD TECHNOLOGIES recommends calibrating the current outputs whenever a module has been installed/replaced or if a software update has been carried out.
7.2 Menu Access

Device Setup | Access

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

The following user levels are available to you:

- **User Level Basic**
  You can see all important data but cannot make any changes.

- **User Level Standard**
  You can change all data necessary for operation (e.g. calibration).

- **User Level Admin**
  This user level is only intended for the system management by BERTHOLD.

- **Automatic logout**
  Activating the selection box (Fig. 42 item 1) automatically resets the access level Standard to “Basic” when the system changes to the standard display after the timeout (chapter 7.3.1).

---

**NOTICE**

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

- Protect the measuring system from unauthorised entries with a password and activate the function "Automatic logout".
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. Click on the text field (Fig. 43, item 1.) to open the input field.
2. Enter a password (case-sensitive!).
3. Confirm with the Enter key.
4. Click <OK> (Fig. 43, item 2) to confirm.
   ▶ The password has been set / changed.
7.3 Menu Setup

Device Setup | Setup

Fig. 44 Menu "Setup"

7.3.1 System (Date / Time, Interfaces, Units, Network, Reset)

Device Setup | Setup | System

Fig. 45 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. Click on the arrow key (Fig. 46, item 5) in order to set the date.
   - The calendar is opened (Fig. 46, item 6).

2. Click on the year number (Fig. 46, item 8) in order to enter the year.

3. Set the month (Fig. 46, item 7) by clicking on the arrow keys.

4. Set the day by clicking on a number in the calendar.

5. Change the time by clicking on the arrow keys (Fig. 46, item 4).

6. Click on <Apply> (Fig. 46, item 3), to accept the date and time settings.
Interfaces

You can adjust the following settings in the submenu "Interfaces" (Fig. 47):

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

![Fig. 47 Menu "Interfaces"]

Local Display

![Fig. 48 Submenu "Local Display"]
Brightness / Timeout

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

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

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

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

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.

![Calibrate touch screen](image)

**Calibrate touch screen**

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

![Calibrate touch screen](image)

1. **Click on** *<Calibrate touch screen>*.
   - The calibration screen opens.

2. **Press the middle of the displayed cross with your finger.**
   - If you take your finger off the cross again, the cross jumps to the top left corner.
3. Repeat the process until the cross is no longer displayed and the calibration is finished.

4. Confirm the calibration by clicking on the white screen to go back to "Input/Touch".

5. Execute a restart of the EVU after prompting.

**Language**

Device Setup | Setup | System | interfaces | Language

1. Click on the selection arrow (Fig. 52, item 1) and select a language.
   - A message window "Restart" appears.

2. Confirm with "OK" to restart the device.
   - The device is restarted and the language has been changed.
CE Remote Control

By activating (Fig. 53, 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 <Copy RC software>**

![Remote Control Diagram]

Fig. 53 Remote Control

### Copy RC software

1. Connect a USB storage device to the device (Fig. 3, item 5).
   - The USB storage device is recognised by the system after a few seconds and the button <Copy RC software> (Fig. 53, item 2) can be clicked.

2. Click on the button <Copy RC software> (Fig. 53, item 2).
   - The software 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.

Fig. 54 Units
Network

Device Setup | Setup | System | Network

In the Network settings submenu, 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).

![Network settings diagram](image)

1. Check box "DHCP active"
2. IP address
3. Subnet mask
4. Standard gateway
5. DNS server
6. MAC address
7. Button <Apply>

**Fig. 55  Network Settings**

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

**IMPORTANT**

In the event of an automatic assignment of the IP address by a DHCP server, you can only look at the given IP address. A modification of the IP address is not possible. On this side, you can also read the MAC address of the device (Fig. 55, item 6).

**Manual settings:**

1. Click on the text field (Fig. 55, item 2 - 5) to open the input field.
2. Enter the appropriate network addresses.
3. Confirm with the Enter key.
4. Click on <Apply> (Fig. 55, item 7) to adopt the network settings.

**IMPORTANT**

All settings 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. 3, item 2), the EVU can be operated via a computer. The software can be loaded onto a USB storage device (see Chapter “CE Remote Control”).

**IMPORTANT**

In order for the Remote Control to function, the selection check mark in the menu "CE Remote Control" must be set to "Active" (Fig. 53, item 1).

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

1. Click on "LB47xRemoteControl.exe", to start the programme.
   ▶ The program starts (Fig. 56, item 1).

2. Click on the <File> tab and then on <Connect…> (Fig. 56, item 2), to establish a connection to the EVU.
   ▶ A new window “Connect” is opened (Fig. 56, item 3) and the connected transmitters are listed.

**IMPORTANT**

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

3. Click on the identifier of the transmitter (Fig. 56, item 4) or enter the IP address of the EVU in the input box (Fig. 56, item 5) (see Fig. 56, 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).
Reset Device (evaluation unit)

Device settings | Setup | System | Reset Device

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

![Diagram showing Reset Device process]

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

Fig. 57  Reset device

Restart the device

**IMPORTANT**

The measurement is interrupted during a restart!

1. To restart the device, click the button <Restart> (Fig. 57, item 1).
   - A window with a warning "Restart" (Fig. 57, 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!

1. To reset the evaluation unit to the factory settings, click the button <Factory settings> (Fig. 57, item 2).
   - A window with the warning "Factory settings" (Fig. 57, item 4) opens.
2. Click on <Yes> to confirm.
   - The device is reset to factory settings and restarts.

**IMPORTANT**
If error M102 appear, the device possibly must be reset twice.
7.3.2 Sensors

Device settings | Setup | Sensors

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

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

**IMPORTANT**

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

Fig. 58 Menu “Sensors”
Detector configuration

Device settings | Setup | Sensors | Detector configuration

In the sub-menu “Detector configuration” the detectors for the measuring system are added and configured. Only configured detectors are listed and shown in the menu (Fig. 58). When a detector is selected (Fig. 59, item 6), the detector type (Fig. 59, item 4) and measuring task (Fig. 59, item 5) are shown.

Clicking the box <Edit> (Fig. 59, 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 LB44xx and LB54xx is only possible with Master units.

Information

Information and settings for the detector are in the individual detector menu (Fig. 62).

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. 59, item 3).

Fig. 59   Detector configuration
Detector Settings

The settings of a configured detector are edited by selecting and clicking on <Edit> (Fig. 59, item 3).

**IMPORTANT**

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

---

![Diagram of Detector Settings](image)

Field "Role"  Button <Ok>
Field "Type"  Button <Cancel>
Input field Device (Unit ID)

**Fig. 60** 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.

**LB4700**

Detector of type LB4700 (A LB 4700 detector can be connected either to the master unit itself or to a slave module).

**LB44xx/LB54xx**

Detector of the type LB44xx and LB54xx (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. 58).
Configure a cascaded system

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

1. If the connection to the EVU (Master-Slave) is correct, the detectors type LB47xx are detected and incorporated automatically. Click on the button <Search> to incorporate connected detectors.

2. Activate the selection box “Cascaded measurement” (Fig. 61, item1).

3. Set the appropriate function for each detector (Fig. 60).

**IMPORTANT**

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

**NOTICE**

Calibration must be performed according to the configuration of the entire measuring system.
Detector settings
Device settings | 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. 62 Submenu "Detector"
Detector settings: Overview

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

All important parameters and measured values of the detector are clearly displayed in the submenu "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. 63 Overview detector information

- A green bar appears with error-free status of the detector (Fig. 63, item 1).

- Device ID
  Shows the ID of the detector.

- Live count rate
  The "Live count rate" (Fig. 63, item 3) displays the current, unfiltered count rate.

- HV mode
  In the field "HV mode" (Fig. 63, item 4), the HV mode is displayed, which is chosen under Device settings | Setup | Sensors | [NAME DETECTOR] | High voltage | HV settings.

- HV Feedback
  The field "HV Feedback" (Fig. 63, item 5) displays the actual measured value in volts.

- Temperature
  The field "Temperature" (Fig. 63, item 6) indicates the current temperature of the detector in °C.
Detector settings: Plateau

Device settings | 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. 64) 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.

![Plateau Menu](image)

Fig. 64  Menu "Plateau"
Plateau Settings
Device settings | Setup | Sensors | [NAME DETECTOR] | Plateau | Plateau settings

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

You have the following settings options in the submenu "Plateau Settings":

**HV start / HV stop**
Defining the range of the plateau recording.

**HV step**
Specifies the step (interval) between two measuring points.

**Measuring time**
Identifies the time that is used per measuring point for the counting of the count rate.

---

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

**Fig. 65** Plateau settings

1. Click on the corresponding text field.
   - The input field opens.
2. Change to the keypad and enter the value.
3. Confirm with the Enter key.
   - The values for the recording plateau have been changed.
Perform Plateau Measurement

**IMPORTANT**
The environmental conditions and the dose rate must be constant during the plateau recording.
Observe the operating manual of the detector!

---

**Fig. 66  Recording a plateau curve**

1. Click on <Start> (Fig. 66, item 2) to perform a plateau measurement.
   - The confirmation message "Record plateau" (Fig. 66, item 3) opens.

2. Confirm with <Yes> (Fig. 66, item 4).
   - The EVU switches to mode "DET" (Fig. 66, item 8) and the current measurement is stopped.
The information (Fig. 66, 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. 67), the plateau curve (Fig. 68) is drawn and stored automatically.

**Plateau Table**

Device settings | 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.

![Plateau Table](image)

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"

![Plateau Export](image)

**Export plateau data**

1. Connect a USB storage device to the device (Fig. 3, item 5).
   - The USB memory device is recognised by the system after a few seconds and the button <Export plateau data> can be clicked.

2. Click on the button <Export plateau data> (Fig. 67, 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 settings | Setup | Sensors | [NAME DETECTOR] | Plateau | Plateau Curve

The mapped characteristic curve (Fig. 68, item 2) of the last complete plateau measurement is displayed in the submenu "Plateau curve".

1. Date and Time of measurement recording
2. Characteristic curve

Fig. 68 Plateau curve
Detector settings: Temperature

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

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

![Temperature display of the detector](image)

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

Fig. 69  Temperature display of the detector

Detector settings: High Voltage

Device settings | 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.

![Submenu "High Voltage"](image)

Fig. 70  Submenu "High Voltage"
Detector settings: High Voltage | Detector Type
Device settings | 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. 71   Detector Code: Setting the scintillator type

---

Detector settings: High voltage | HV Settings
Device settings | Setup | Sensors | [NAME DETECTOR] | High Voltage | HV Settings

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

---

Fig. 72   Submenu "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. 72, 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. 72, item 2).
2. Click in the input field "HV Default" (Fig. 72, item 3) to open the input field.
3. Enter the desired starting value for the high-voltage regulation.
4. Confirm with the Enter key.
Detector settings: Detector Service
Device settings | 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. 73  Menu "Detector Service"

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

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

Fig. 74  Device Information
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.

Perform firmware update

1. Save the current update file of the firmware of the detector on a USB storage device.
2. Connect a USB storage device to the device (Fig. 3, item 5).
3. The USB storage device is recognised by the system after a few seconds and the <Firmware Update> (Fig. 74, item 4) button can be clicked.
4. Click on the button <Firmware Update> (Fig. 74, item 4).
5. The update is performed.

NOTICE

Berthold recommends a test or a calibrating the current outputs whenever if a software update has been carried out.
Detector settings: Service | Event Log

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

![Event Log Diagram](image_url)

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

Fig. 75 Event Log (Detector)

Display event description

![Event Log Diagram](image_url)

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

Fig. 76 Event Log

1. Click on a line in the list (Fig. 76, item 3).
2. Click on <?> (Fig. 76, item 1)
   ▶ The event description appears.
3. With the button <Close>, close the event description (Fig. 76, item 7).
   - With the button <Clear event log> (Fig. 77, item 2) all events are deleted.

Detector settings: Detector Service | Event Overview

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

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

![Event Overview Diagram]

Fig. 77  Event Overview

1. Click on a line in the list (Fig. 77, item 3).
2. Click on <? > (Fig. 77, item 4).
   - The event description appears.

3. With the button <Close>, close the event description.
4. Slide the bar of the horizontal scroll bar (Fig. 77, item 5) to the right to see at what times (date, time) the event occurred.
   - The last 5 time points are displayed.
Detector settings: Detector Service | Reset Detector

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

In the submenu "Reset Detector", the detector can be restarted and be reset to the factory settings.

![Diagram of Reset Detector]

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

**IMPORTANT**

The measurement is interrupted during a restart.

1. To restart the Detector, click the button <Reboot> (Fig. 78, item 1).
   - A window with a warning "Reboot" (Fig. 78, item 3) opens.

2. Click on <Yes> to confirm.
   - The device is restarted.

**IMPORTANT**

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

1. To reset the detector to the factory settings, click the button <Factory reset> (Fig. 78, item 2).
   - A window with the warning Factory settings (Fig. 78, item 4) opens.

2. Click on <Yes> to confirm.
   - The device is reset to factory settings and restarts.
7.3.3 Calibration

Device settings | 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.

Fig. 79 Menu "Calibration"
Basic Setup

Device Setup | Setup | Calibration | Basic Setup

![Basic Setup Diagram]

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

Fig. 80  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. 80, 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

The background count rate (Fig. 82, item 1) indicates the natural background radiation of the detector, if no radiation source is installed. 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. 81, item 4) be determined at a suitable distance (approx. 10 m) or behind a thick concrete wall (Fig. 81, 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.

---

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

Fig. 81  Conditions during background determination
**IMPORTANT**

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

---

**Determine background**

Device settings | Setup | Calibration | Calibration Settings

1. Click on the text field "Background" (Fig. 82, item 1).
   - A new window "Background" opens to determine the background Count rate.

   **NOTICE**

   Influences from neighbouring 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.
Calibration Settings: Nuclide

Device settings | 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. 83, item 1).

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

Fig. 83  Calibration parameters: Nuclide

1. Click on the selection arrow (Fig. 83, item 2).
2. Select the isotope used. Cs-137 (Fig. 83, item 3) or Co-60 (Fig. 83, item 4). The isotope of the source is on the type plate of the screen (Fig. 84).
3. When selecting "Custom nuclide" (Fig. 83, item 5), the half-life of the isotope can be entered.

Fig. 84  Type plate source
Calibration Settings: Table (linear calibration type)

Device settings | Setup | Calibration | Calibration Settings

Fig. 85  Calibration parameters (Table linear calibration type)

Add new calibration point

1. Click on the button < + > (Fig. 85, item 3).
   ▶ The window "New calibration point" (Fig. 85, item 8 - 10) opens.

2. Click on the input field "Process value" (Fig. 85, item 10) 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. 85, item 8) to open the input field.

5. Specify a measurement time and confirm with the Enter key.

6. Click on the button < Start >.
   ▶ The Window “New calibration Point” (Fig. 85, item 11) 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 settings | Setup | Calibration | Calibration Settings

1. Click on the button `< + >` (Fig. 86, item 3).
   - The window "New calibration point" (Fig. 86, item 11) opens.

2. Click on the input field "Process value" (Fig. 86, item 9) 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. 86, item 10) to open the input field.

5. Specify a measurement time and confirm with the Enter key.

6. Click on the button `< Start >`.
   - The Window “New calibration Point” (Fig. 86, item 11) 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 settings | Setup | Calibration | Calibration Settings

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

![Calibration Settings diagram]

Fig. 87 Calibration parameters (Table 1 Point Exp. calibration type)

Add new calibration point
1. Click on the button <Edit 1. Point> (Fig. 87, item 2).
   ▶ The window "Edit calibration point" (Fig. 87, item 6-8) opens.
2. Click on the input field "Read-In Time" (Fig. 86, item 8) 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. 86, item 6) 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. 87, item 3).
9. Enter the absorption coefficient of the product (Fig. 87, item 9).
10. Enter the product density (Fig. 87, item 10).
11. Enter the measurement path (Fig. 87, item 11).
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 settings | Setup | Calibration | Calibration Settings

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

![Characteristic chart](image)

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

Fig. 88 Calibration parameters (Chart)
Calibrate

Device settings | 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. Click on the button <Calibrate> (Fig. 89, item 1).
   ▶ A new window with the message "Use calibration set for measurement" appears.

2. Click on the <Yes> button (Fig. 89, 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. 89, item 3)
   ▶ The calibration was performed.

**NOTICE**

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

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

Device settings | Setup | Calibration | Recall

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.

Recall to calibration set
Adjust: Standard Adjust

Device settings | 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.

![Graphs showing adjusted curves](image)

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

Fig. 91 Adjusted curves

**NOTICE**

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

![Standard adjustment interface](image)

1 Button < Perform adjust now >
2 Input field “Read-In-Time”
3 Input field “Process value” %
4 Button < Ok >
5 Button < Start >
6 Button < Cancel >
7 Input field “Count rate” [cps]
8 Process bar
9 Button < Stop >

Fig. 92 Standard adjustment
1. Click on the field "Process value" (Fig. 92, item 3) to open the input field.
2. Enter the process value % (acc. to standard display) and confirm.
3. Click on the "Read-In-Time" field (Fig. 92, item 2) and specify the duration of measurement in seconds. The higher you set the measurement time, the more accurate the result. Click
4. Click <Ok > to accept the value.
5. Click on the button <Perform adjust now > (Fig. 92, item 1).
   ▶ A new window opens (Standard Adjust Count Rate).
6. Click on the button <Start > (Fig. 92, item 5) to start the measurement.
7. Click <Ok > (Fig. 92, item 4) to accept the value.
   ▶ 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. Otherwise the Adjust will become lost.
Adjust: Low Level Adjust

Device settings | 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.

![Diagram of count rate vs. level]

Fig. 93  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.

![Adjustment interface diagram]

Fig. 94  Lower adjustment

1. Click on the field Process value (Fig. 94, 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 "Read-In-Time" field (Fig. 94, item 2) and specify the duration of measurement in seconds. The higher you set the measurement time, the
4. Click on the button <Perform adjust now> (Fig. 94, item 1).
   ▶ A new window opens.

5. Click on the button <Start> (Fig. 94, item 5).
   ▶ The measurement starts.

6. Click <Ok> to accept the value.
   ▶ 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 settings | 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.

![Diagram showing adjusted curves](image)

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

Fig. 95  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.

![Diagram showing upper adjustment](image)

1. Button < Perform adjustment >
2. Input field *Process value*
3. Input field *Measuring time*
4. Process bar
5. Button < Ok >
6. Display field *count rate* [cps]
7. Button < Cancel >
8. Button < Start >
9. Button < Stop >

Fig. 96  Upper adjustment

1. Click on the field Process value (Fig. 96, 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 "Read-In-Time" field (Fig. 96, 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. 96, item 1).
5. Click on the <Start> button (Fig. 96, item 5).
   ▶ The measurement starts.

6. Click <Ok> to accept the value.
   ▶ 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

Device settings | 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.

Fig. 97  GPC example measurement arrangement

NOTICE

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

You can make the following settings in the submenu GPC (gas properties compensation) (Fig. 98):

- GPC calibration
  - Reference count rate
  - Background
  - Factor M
  - Max. GPC factor
- 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. 98  Submenu “GPC”

GPC calibration

Device settings | Setup | Calibration | GPC | GPC calibration

The submenu “GPC calibration” is used for the adaptation of the measurement system to the respective environmental conditions, the actual radiation activity and the adaptation of the background radiation (background).

The check box “GPC enabled” (Fig. 99, item 1) can only be selected when a detector is configured for gas density measurement and under Units (Device Settings | Setup | System | Units) “PV” the unit % is selected.

Fig. 99  Submenu GPC calibration

1  Check box "GPC enabled"
2  Check box Reference count rate [cps] for the detector under calibration conditions
3  Input field Background (background radiation) [cps]
4  Input field Factor M (Manual correction factor)
5  Input field Max. GPC factor

2 Calibration conditions exist when the level measurement is performed.
3 Correction of geometry differences between gas density measurement and level measurement.
GPC calibration: 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.

![GPC Reference Rate diagram](image)

Fig. 100  GPC calibration reference count rate

Determine reference count rate

1. Click on the text field "count rate" (Fig. 99, item 3).
   - A new window "GPC reference rate" opens (Fig. 100).

2. Click on the "Read-In-Time" field (Fig. 100, 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. 100, item 1), if a determination of the unique reference count rate is not possible.
GPC calibration: Background

The background count rate (Fig. 99, item 3) indicates the natural background radiation of the gas density detector if no radiation source is installed. This count rate is compensated for by the system.

1. Click on the text field "Background" (Fig. 99, item 3).
   ▶ A new window "Background" opens to determine the background radiation (Fig. 101).

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. 101, item 1) if a determination of background radiation without foreign radiation effects is not possible.
GPC calibration: Factor M

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.

![Fig. 102  GPC calibration: Calculate factor M](image)

Capturing 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. 102, item 9, item 10).

1. Click on the < + > button (Fig. 102, item 4) to add a new point.
2. Click on the input field "Read-In-Time" (Fig. 102, item 11) and enter a measurement time. Confirm with the Enter key.
3. Click on the button <Start> (Fig. 102, item 12). Make sure that the actual level in the container does not change during the measurement time.
   - Repeat the capture for at least one other level.
4. A new point is added when clicking on the button <Add Reference> (Fig. 102, item 5), which takes over the count rates of the measurement during calibration.
Calculate Factor M
The "Factor M" (Fig. 102, item 2) is close to 1 (default value) for standard applications.

1. Click the button < Calculate > (Fig. 102, item 3) to determine Factor M from the count rate.
   ▶ Factor M has been calculated and is displayed in the input field (Fig. 102, item 2).

2. Click the button < Close > (Fig. 102, 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. 102, 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. 99, item 5). The default value is 3.0.

GPC settings
Device settings | Setup | Calibration | GPC | GPC settings
The isotope specified by the source can be selected for the gas density in the submenu "GPC settings" (Fig. 103, item 1). The half-life of the isotope is shown on the display field (Fig. 103, item 2).

**NOTICE**
The sources for level measurement and the sources of the GPC measurement must contain the same Nuclide.
Reset GPC Settings

All GPC settings can be reset in the submenu “Reset GPC Settings”.

1. Click on the button Reset GPC (Fig. 104, item 1).
   ▶ A confirmation message (Fig. 104, item 2) appears.

2. Click on <Yes> to confirm, click on <No> to cancel.
7.3.4 Measurement

Device settings | Setup | Measurement

The submenu "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 Characteristic curve (standard or inverted)**
- **3 Nuclide (Cs-137 or Co-60)**
- **4 Half-life [years]**

![Image of parameters](image1.png)

Fig. 105 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 Count rate [cps]**
- **3 Date of last change of the measurement parameter set**
- **4 Number of measuring points**

![Image of table](image2.png)

Fig. 106 Measurement (Table)
Measurement: Chart

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

Fig. 107 Measurement (Chart)
7.3.5 Signal Condition

Device settings | 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)
- Source Replacement

![Signal Condition Menu](image)

**Fig. 108** Menu "Signal Condition"

**Signal processing: Damping**

Device settings | Setup | Signal Condition | Damping

The reaction time of the measured value display (standard display) can be set in the submenu "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.

![Damping Time Constant](image)

**Fig. 109** 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 settings | 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 bzw. 0 ... 20 mA). The unit is displayed that is selected in the menu System | Units in the box “PV”.

1. Click on the input field (Fig. 110, item 1) to enter, in percent [%], the level which should correspond to an output current of e.g. 4mA.
2. Confirm with the Enter key.
3. Click on the input field (Fig. 110, item 2) to enter, in percent [%], the level which should correspond to an output current of 20mA.
4. Confirm with the Enter key.

Fig. 110  Signal Condition (PV Range)
Signal Condition: Rapid Switch

Device settings | 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. 108, item 1) is activated, there is a rapid reaction (Fig. 108, 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.

**NOTICE**

Rapid Switch and Interference detection must not be activated simultaneously.
Signal processing: XIP (Radiation Interference)

Device settings | 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. 112, 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.

- **I₀ factor**
  The "I₀ factor" determines the recognition criteria for interference.

- **RI Sigma**
  The standard deviation is set in the field "RI sigma" (radiation interference sigma).

![XIP Diagram]

1. Check box the "Activate detection"
2. Input field measurement delay
3. Input field hold time
4. Input field I₀ factor
5. Input field RI Sigma

Fig. 112  Signal Condition (Radiation Interference)

**NOTICE**

Rapid Switch and Interference detection must not be activated simultaneously.
Signal processing: Source replacement

Device settings | Setup | Signal Condition | Source replacement

Notification for a source replacement can be activated in this submenu. 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)

---

**Setting source replacement date**

1. Activate the check box (Fig. 113, item 1).
2. Click on the arrow key (Fig. 113, item 2) in order to set the date.
   - The calendar is opened.
3. Click on the year (Fig. 113, 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.

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---

---
7.3.6 Inputs

Device settings | Setup | Inputs

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

Fig. 114 Menu "Inputs"; Submenu "Digital inputs (DI)"
Digital inputs (DI) Assignment

Device settings | 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 settings | Setup | Calibration | Adjust).

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

Fig. 115  DI Inputs Assignment
**DI State**

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

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

![DI State](image)

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

Fig. 116  DI inputs status
7.3.7 Outputs

Device settings | Setup | Outputs

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

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

Fig. 117 Menu "Outputs"
**Analogue output: AO Mapping**

Device settings | Setup | Outputs | Analogue Output (AO) | AO Mapping

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

**Process value**

The values of the process value can be assigned in the menu Signal Condition | PV Range or in the calibration settings.

**Raw count rate**

Enter a count rate range that outputs the current count rate at the current output.
Analogue output: AO Monitoring

Device settings | Setup | Output | Analogue Output (AO) | AO Monitoring

If "AO Monitoring" is activated (Fig. 120, 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.

![AO Monitoring Interface](image)

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

Fig. 120  Analog output monitoring
Analogue output: AO Failure Mode

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

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

Fig. 121  Analogue output (AO Failure Mode)

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

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

**NOTICE**

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

By clicking on the input fields (Fig. 122, 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 Lower current limit [mA]
2. Input field Upper current limit [mA]

Fig. 122 Analogue 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 settings | 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.

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

Fig. 123  Analog Output (Calibration)
Perform calibration

1. Connect the measuring lines of the current measuring device on the back of the EVU to the analog output.

2. Observe the terminal allocation in Chapter 5.4 and 5.5 for executions with connection boards (Fig. 123, item 1) or allocation with terminal block (Fig. 123, item 2) in Chapter 5.6.2.

3. Click on the button <Calibration>.
   ▶ The device switches to test mode and a new window (Analog output calibration) opens.
   ▶ The calibration point 4 mA is displayed and the current measuring instrument shows a value.

4. Enter the indicated value on the current measuring instrument in the input box (Fig. 123, item 4).

5. Click on the button <Continue>.
   ▶ The calibration point 20 mA is displayed and the current measuring instrument shows a value.

6. Enter the indicated value on the current measuring instrument in the input box (Fig. 123, item 5).

7. Click on the button <Continue>.
   ▶ A message appears “Calibration successful”.

8. Click on the button <Continue>.
   ▶ The calibration of the analog output is concluded.
Digital Outputs (DO)

Device settings | 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 chapter 5 show the relay contacts in the de-energized state.

![Digital Outputs (DO)](image)

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. 124  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 switches when the value at Device Setup | Setup | Alarms | PV alarm settings is underrun.
- **PV High alarm**: The relay switches if the value under Device Setup | Setup | Alarms | PV Alarm Settings is exceeded.
- **Detector temperature Alarm**: The relay switches when values set at Device Setup | Setup | Alarms | Det.-Temp. Alarm function are exceeded or underrun.
- **XIP Alarm**: The relay switches when detection is activated at Device settings | Setup | Signal processing | XIP and interference was detected.
- **Source Replacement Alarm**: The relay switches when notification at Device settings | Setup | Signal processing | Source replacement is activated and interference is detected.
- **Measurement Stopped**: The relay switches 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 switches when the event message "Warning" is displayed.
7.3.8 Alarms

Device settings | Setup | Alarms

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

![Menu "Alarms"](image)

Fig. 125 Menu "Alarms"

**PV Alarm Behaviour**

Device Setup | Setup | Alarms | PV Alarm Behaviour

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

![Submenu "PV alarm Behaviour"](image)

Fig. 126 Submenu "PV alarm Behaviour"

**NOTICE**

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

Device settings | Setup | Alarms | PV alarm settings

You can set the values for the level alarms (max. and min.) and the hysteresis of these in the submenu "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. 126, item 6), the relay switches.

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

![PV Alarm Settings Diagram]

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

Fig. 127 PV Alarm Settings

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

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

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

Device settings | Setup | Alarms | Det.-Temp. Alarm Behaviour

The behaviour in case of alarm (NE107 status) can be set for the detector temperature in the submenu "Det.-Temp. Alarm Behaviour".

![Diagram of Det.-Temp. Alarm Behaviour]

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. 128 Submenu "Det.-Temp. Alarm Behaviour"

**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 settings | Setup | Alarms | Det.-Temp. Alarm Settings

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

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

Setting max. temperature alarm:
1. Activate the check box (Fig. 129, item 1).
2. Click on the input field (Fig. 129, item 2) to enter a switching point.
3. Confirm with the Enter key
   ▶ The value was changed.

Set min. temperature alarm:
1. Activate the check box (Fig. 129, item 3).
2. Click on the input field (Fig. 129, item 4) to enter a switching point.
3. Confirm with the Enter key
   ▶ The value was changed.
7.3.9 Simulation

Device settings | Setup | Simulation

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

![Simulation Menu](image)

Fig. 130 Menu "Simulation"

**NOTICE**

When starting a simulation, the measurement is stopped and a status message 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 settings | Setup | Simulation | Analog Output

![Diagram](image)

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

Fig. 131 Simulation Analog Output

1. Click on the input field (Fig. 131, 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. 131, item 3) to stop the simulation.
Simulation Digital Output

Device settings | Setup | Simulation | Digital Output

![Digital Outputs (DO)](image)

1. ERROR (DO-1)
2. ALARM (DO-2)
3. ALARM (DO-3)
4. Dropdown field
5. Button <Disable test mode>

Fig. 132  Simulation Digital Outputs

1. Click on the dropdown field (Fig. 132, 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. 132, item 4) to stop the simulation.
Simulation Count Rate

Device settings | Setup | Simulation | Count Rate

1. Click on the input field (Fig. 133, item 1) and enter count rate 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. 133, item 2) to stop the simulation.
7.4 Menu Backup/Restore

Device settings | Backup/Restore

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

![Backup / Restore menu](image)

**Fig. 134 Menu "Backup/Restore"**

7.4.1 Backup

Device settings | Backup/Restore | Backup

![Backup screen](image)

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!"

![Backup screen with notes](image)

**Fig. 135 Backup**

**Perform Backup**

1. Connect a USB storage device to the device (Fig. 3, item 5).
2. The USB storage device is recognised by the system after a few seconds and the button <Backup> (Fig. 135, item 1) can be clicked.
3. Click on the button <Backup> (Fig. 135, item 1).
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. 135, item 6).

**Information**

The backup includes an XML file that is created in the folder "Backup_LB4700". The file name is derived from "Backup", the date and time (Backup_YYYYMMDD_ hr-min-sec).
7.4.2 Restore

Device settings | Backup/Restore | Restore

Fig. 136  Restore

Executing restore

1. Connect a USB storage device to the device (Fig. 4, item 5).
2. Select the backup file with the buttons (Fig. 136, item 1,3)
   ▶ The date and time of the backup is displayed (Fig. 136, item 5,6). Only error-free (Fig. 136, item 7) backup files can be loaded.
3. Click on the button "Restore" (Fig. 136, item 4).
4. A confirmation message (Fig. 136, item 8) appears.
5. Click on < Yes > to confirm, click on < No > to cancel.
   ▶ The restore of data is carried out.
8 Main Menu Diagnostics

8.1 Transmitter Temperature

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

![Transmitter Temperature diagram]
8.2 Events

Diagnostics | Transm. Events

Fig. 139 Menu "Transm. Events"

Information

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

8.2.1 EVU event Log

Diagnostics | Transmitter Events | Transmitter Event Log

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

Fig. 140 Event log (Transmitter)
Display event description

![Diagram showing event log display](image)

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

Fig. 141 display an event log

1. Click on a line in the list (Fig. 141, item 3).
2. Click on <?> (Fig. 141, item 1).
   - The event description appears.
3. With the button <Close>, close the event description (Fig. 141, item 7).

**NOTICE**

With the button <Clear event log> (Fig. 141, item 2) all events are deleted irrevocable.
8.2.2 Transm. Event Overview

All events that can be logged are chronologically presented in tabular form in the submenu "Event overview". Activate the check box "Non-zero Counter only 0" (Fig. 142, item 5) in order to display events that have occurred.

![Event Overview (transmitter)](image)

1. Click on a line in the list (Fig. 142, item 4).
2. Click on < ? > (Fig. 142, item 7).
   - The event description appears.
3. Close the event description (Fig. 142, item 7) with the button <Close>.
4. Slide the bar of the horizontal scroll bar (Fig. 142, 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 submenu "Change log".

Fig. 143 Change Log (Transmitter)
8.4 Menu 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.

Change log interval

1. Click on the button <Stop> (Fig. 144, item 2) to stop the data log process.
2. Click on the input field "Log interval" (Fig. 144, 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. 144, item 4) to start the data log process.
Export log data

1. Click on the button <Stop> (Fig. 144, 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. 144, 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. 145 Data structure
## 8.5 Export service data

Diagnostics | Export Service Data

![Diagram](image)

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

Fig. 146   Export Service Data

1. Connect a USB storage device to the device (Fig. 3, item 5).
2. The USB storage is recognised by the system after a few seconds and the button <Export service data> (Fig. 146, item 1) can be clicked.
3. Click on the button <Export service data> (Fig. 146, item 1).
   - The process window is displayed and the export of service data will be carried out (Fig. 146, item 2).
   - After successful export a confirmation message Fig. 146, item 3) is displayed.

### Information

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

### Information

A new folder "Backup_LB470" is created and the Backup-File (.xml) is copied when exporting.
## 9 Troubleshooting

### 9.1 Error Search

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master unit: Screen black; LEDs are not illuminated</td>
<td>EVU does not work</td>
<td>Check power supply and fuses</td>
</tr>
<tr>
<td>Slave module: LEDs are not illuminated</td>
<td>Slave module not clamped properly</td>
<td>Check cabling, contact sockets</td>
</tr>
<tr>
<td>No signal</td>
<td>Detector does not work</td>
<td>Check the functioning of the detector</td>
</tr>
<tr>
<td>Count rate too low</td>
<td>Shield not opened or not opened correctly</td>
<td>Check lock and ensure it is in OPEN position</td>
</tr>
<tr>
<td></td>
<td>Incorrect focus of the effective radiation on the detector</td>
<td>Correct and optimise the alignment</td>
</tr>
<tr>
<td></td>
<td>Objects in the beam path</td>
<td>Offset irradiation level</td>
</tr>
<tr>
<td></td>
<td>Source at the end of its usable life span</td>
<td>Replace source</td>
</tr>
<tr>
<td>No or incorrect level display</td>
<td>level value entry incorrect</td>
<td>Check the calibration value and the level display</td>
</tr>
<tr>
<td>The level display deviates</td>
<td>Defect in detector</td>
<td>Check detector</td>
</tr>
<tr>
<td></td>
<td>Incorrect calibration</td>
<td>Check calibration values</td>
</tr>
<tr>
<td></td>
<td>Count rate too low (see above)</td>
<td>Check source age and irradiation level, replace detector</td>
</tr>
<tr>
<td>Detector is not detected (software)</td>
<td>Terminals / wiring</td>
<td>Check terminal connection; check terminal assignment</td>
</tr>
<tr>
<td></td>
<td>Damaged line</td>
<td>Check cable; examine with measurement device.</td>
</tr>
<tr>
<td></td>
<td>Incorrect type LB44xx / LB54xx / LB4700 in the configuration</td>
<td>Check type of detector (see type plate on the detector)</td>
</tr>
</tbody>
</table>
### Error search (continued)

<table>
<thead>
<tr>
<th>Issue</th>
<th>Error Cause</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector is not detected (software)</td>
<td>Incorrect ID in the configuration</td>
<td>▶ Check ID of the detector (see type plate on the detector)</td>
</tr>
<tr>
<td>Touch panel does not respond</td>
<td>Error in operating system</td>
<td>▶ Restart EVU</td>
</tr>
<tr>
<td>Buttons are missed when you click</td>
<td>Incorrect screen calibration</td>
<td>▶ Calibrate screen again</td>
</tr>
</tbody>
</table>
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.

Function Check (C)
Indicates that entries are made at the detector or a function check/simulation is being performed.

9.2.1 System

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>NAMUR107</th>
<th>Help Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>M101</td>
<td>HW Module</td>
<td>F</td>
<td>Hardware electronics module corrupt. Restart the device. Contact Berthold service, if this event occurs repeatedly.</td>
</tr>
<tr>
<td>M102</td>
<td>Device data-set</td>
<td>F</td>
<td>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.</td>
</tr>
<tr>
<td>M103</td>
<td>RAM, Flash or CPU</td>
<td>F</td>
<td>Internal hardware failure. Restart the device. Contact Berthold service, if this event occurs repeatedly.</td>
</tr>
<tr>
<td>M104</td>
<td>WD Reboot</td>
<td>M</td>
<td>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.</td>
</tr>
<tr>
<td>M105</td>
<td>WD Failure</td>
<td>F</td>
<td>Watchdog malfunction. Contact Berthold service, if this event occurs repeatedly.</td>
</tr>
<tr>
<td>M106</td>
<td>WD Off</td>
<td>M</td>
<td>Watchdog is inactive. Activate Watchdog</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Severity</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>M107</td>
<td>Error in the internal real time clock</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>M108</td>
<td>CPU temperature sensor</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>M109</td>
<td>Lower temperature limit: Maintenance required</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>M110</td>
<td>Temp LL OOS</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>M111</td>
<td>Temp UL maintenace</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>M112</td>
<td>Temp UL OOS</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>M113</td>
<td>Power On Reboot</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>M114</td>
<td>Software Reboot</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>M115</td>
<td>Extern RTC malfunction</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>M116</td>
<td>Corrupt Date</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>M107</td>
<td>Intern RTC malfunction</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>M108</td>
<td>CPU temp sensor</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>M109</td>
<td>Temp LL maintenance</td>
<td>M</td>
<td></td>
</tr>
</tbody>
</table>

- **M107**: Malfunction of the real-time clock. Check Date and Time. If the event occurs frequently, contact Berthold Service.
- **M108**: The temperature sensor of the device is defective. Contact Berthold Service. The hardware is defective and, if necessary, must be checked and replaced.
- **M109**: The internal temperature of the device is close to the lower threshold value of the permissible operating temperature.
- **M110**: The internal temperature of the device is below the lower limit. The correct function of the device cannot be guaranteed. It is recommended to have the device checked by Berthold Service, even if it seems to work normally.
- **M111**: The internal temperature of the device is close to the upper limit.
- **M112**: The internal temperature of the device is above the upper limit. The correct function of the device cannot be guaranteed. It is recommended to have the device checked by Berthold Service, even if it seems to work normally.
- **M113**: The device was restarted due to unknown reasons.
- **M114**: The device was restarted by user input.
- **M115**: Failure of the external real time clock. Contact Berthold service, if this event occurs repeatedly.
- **M116**: The date could not be verified at startup. Check date and time and set if necessary.
- **M107**: Failure of the real time clock. Verify date and time. Contact Berthold service, if this event occurs repeatedly.
- **M108**: Failure of the device temperature sensor. Contact Berthold service. The hardware is defective and needs to be checked / replaced.
- **M109**: The internal temperature of the device is close to the lower limit.
## 9.2.2 Application

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>NAMUR107</th>
<th>Help Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>M301</td>
<td>Default parameter set</td>
<td>M</td>
<td>Device not calibrated. Measurement with default parameters. Calibrate device</td>
</tr>
<tr>
<td>M302</td>
<td>Decay compensation</td>
<td>S</td>
<td>Decay compensation failed. Contact Berthold service, if this event occurs repeatedly.</td>
</tr>
<tr>
<td>M303</td>
<td>Det Temp LL failure</td>
<td>F</td>
<td>Detector temperature at / below lower limit.</td>
</tr>
<tr>
<td>M304</td>
<td>Det Temp UL failure</td>
<td>F</td>
<td>Detector temperature at / above upper limit.</td>
</tr>
<tr>
<td>M305</td>
<td>Det Temp LL OOS</td>
<td>S</td>
<td>Detector temperature at / below lower limit.</td>
</tr>
<tr>
<td>M306</td>
<td>Det Temp UL OOS</td>
<td>S</td>
<td>Detector temperature at / above upper limit.</td>
</tr>
<tr>
<td>M308</td>
<td>Source replacement</td>
<td>M</td>
<td>Source replacement date reached. Replace source.</td>
</tr>
<tr>
<td>M309</td>
<td>Application stopped</td>
<td>C</td>
<td>Measurement stopped</td>
</tr>
<tr>
<td>M310</td>
<td>PV calc not possible</td>
<td>S</td>
<td>Process value could not be calculated. Check measuring range and calibration.</td>
</tr>
<tr>
<td>M311</td>
<td>Backup process</td>
<td>C</td>
<td>Backup in process.</td>
</tr>
<tr>
<td>M312</td>
<td>Restore process</td>
<td>C</td>
<td>Restore in process.</td>
</tr>
<tr>
<td>M320</td>
<td>PV LL failure</td>
<td>F</td>
<td>Process value at / below lower limit.</td>
</tr>
<tr>
<td>M321</td>
<td>PV UL failure</td>
<td>F</td>
<td>Process value at / above upper limit.</td>
</tr>
<tr>
<td>M322</td>
<td>PV LL OOS</td>
<td>S</td>
<td>Process value at / below lower limit.</td>
</tr>
<tr>
<td>M323</td>
<td>PV UL OOS</td>
<td>S</td>
<td>Process value at / above upper limit.</td>
</tr>
<tr>
<td>M324</td>
<td>Level under 0%</td>
<td>S</td>
<td>Level below 0%. Check measuring range and calibration.</td>
</tr>
<tr>
<td>M325</td>
<td>Level over 100%</td>
<td>S</td>
<td>Level above 100%. Check measuring range and calibration.</td>
</tr>
<tr>
<td>M326</td>
<td>GPC out of spec</td>
<td>S</td>
<td>Compensation factor of Gas Properties Compensation has reached ist limit. Check process.</td>
</tr>
<tr>
<td>M327</td>
<td>No GPC detector</td>
<td>S</td>
<td>No detector for Gas Properties Compensation found. Connect / configure detector.</td>
</tr>
<tr>
<td>M399</td>
<td>Internal program err</td>
<td>F</td>
<td>Internal software failure. Restart the device. Contact Berthold service, if this event occurs repeatedly.</td>
</tr>
</tbody>
</table>
### 9.2.3 Detector

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>NAMUR107</th>
<th>Help Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>D501</td>
<td>Detector not found</td>
<td>F</td>
<td>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.</td>
</tr>
<tr>
<td>D502</td>
<td>Detector comm. error</td>
<td>M</td>
<td>Temporarily lost connection to at least one detector. Check detector settings and connections. Contact Berthold service, if this event occurs repeatedly.</td>
</tr>
<tr>
<td>D503</td>
<td>Detector failure</td>
<td>F</td>
<td>At least one detector register Failure&quot;. Check detector events.</td>
</tr>
<tr>
<td>D504</td>
<td>Detector out of spec.</td>
<td>S</td>
<td>At least one detector register &quot;out of specification&quot;. Check detector events.</td>
</tr>
<tr>
<td>D505</td>
<td>Detector function check</td>
<td>C</td>
<td>At least one detector register &quot;function check&quot;. Check detector events.</td>
</tr>
<tr>
<td>D506</td>
<td>Detector maintenance</td>
<td>M</td>
<td>At least one detector register &quot;maintenance&quot;. Check detector events.</td>
</tr>
<tr>
<td>D599</td>
<td>Internal program error</td>
<td>F</td>
<td>Internal system failure. Powercycle device. If the event remains it could be caused by a defective hardware. Contact Berthold service.</td>
</tr>
</tbody>
</table>

### 9.2.4 RS 458 Interface

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>NAMUR107</th>
<th>Help Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>M699</td>
<td>Internal program error</td>
<td>F</td>
<td>Internal software failure. Restart the device. Contact Berthold service, if this event occurs repeatedly.</td>
</tr>
</tbody>
</table>

### 9.2.5 Process Connection

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>NAMUR107</th>
<th>Help Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>M701</td>
<td>Current output</td>
<td>F</td>
<td>Deviation of analog output value from feedback value is too high. Calibrate analog output. Contact Berthold service, if this event occurs repeatedly.</td>
</tr>
<tr>
<td>M702</td>
<td>Current loop open</td>
<td>F</td>
<td>Current output loop open. Check cable connection.</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Action</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>M703</td>
<td>Software update</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indicates that a software update is running. No action necessary. The device automatically returns to measuring mode after the software update is finished.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M799</td>
<td>Internal program error</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal software failure. Restart the device. Contact Berthold service, if this event occurs repeatedly.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 "Safety manual".

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

**IMPORTANT**
To achieve optimum measuring accuracy, we recommend recalibrating the measuring system after a repair (not after changing the housing).
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-energised.
- Only open the device when free of voltage.
In case of an electric shock, carry out first aid measures and immediately call an emergency service.

NOTICE

Damage to the device! Short circuit!
The EVU can be damaged if incorrect fuses are used.
- Only use fuses which correspond to the fuses on the circuit board of the module.

Fuses:
- Master EVU 250V 1A T (5x20 mm)
- Master EVU 250V TR5 T80mA (Ø 8,5 mm)
- Slave module 250V 315mA T (5x20 mm)
Replacing fuse in the master module

1. De-energise the device.
2. Loosen the four fixing screws (Fig. 147, 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. 147, item 2).
4. Pull out the housing (Fig. 147, item 3) carefully.
5. Remove the protective covering of the fuse (Fig. 147, item 3).
6. Remove the fuse (Fig. 147, 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. 147, 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. 147, item 1).
Replacing fuse in the slave module

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

Fig. 148 Exchange fuses slave EVU

1. De-energise the device.
2. Loosen the four fixing screws (Fig. 148, 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. 148, item 2).
4. Pull out the housing (Fig. 148, item 3) carefully.
5. Remove the protective covering of the fuse (Fig. 148, item 6)
6. Remove the fuse (Fig. 148, 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. 148, item 1).
10.2 Cleaning

**NOTICE**
Damage to the touch display!

Solvents and abrasive additives can damage the touch display.
- Only clean the touch display with a wet cloth.

- Only clean the EVU with a dry cloth or a dusting brush.
- Only clean the front panel and the touch display with a wet cloth.
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-energised.
- Only open the device when free of voltage.

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

![Diagram of decommissioning wall housing](image)

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

De-energise 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.

Fig. 150 Decommissioning wall housing

1. RJ45 connector (network)  4. PE cable
2. Clamps terminal board     5. Screw Connections
3. Clamp blocks
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 2002/96/EC) by a specialised waste management company.
## 12 Appendix

### 12.1 Setup Protocol

<table>
<thead>
<tr>
<th>General data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td></td>
</tr>
<tr>
<td>Measuring point</td>
<td></td>
</tr>
<tr>
<td>Source No.</td>
<td></td>
</tr>
<tr>
<td>Number of detectors</td>
<td>LB44x  LB47x  LB54x</td>
</tr>
<tr>
<td>Activity</td>
<td></td>
</tr>
<tr>
<td>Isotope</td>
<td>Cs-137  Co-60</td>
</tr>
<tr>
<td>Container</td>
<td></td>
</tr>
<tr>
<td>Product</td>
<td></td>
</tr>
<tr>
<td>Cascaded measurement</td>
<td>YES   NO</td>
</tr>
</tbody>
</table>

| Device configuration             |                  |
| Model                            |                  |
| Installation variant             | Wall housing  Subrack |
| Anschluss                        | Platine  Clamp block |
| Power supply                     | 100-240V AC  18-32V DC |
| Number of Master EVU             |                  |
| Number of modules                |                  |
| Device ID                        |                  |
| Software Version                 |                  |
## Setup Protocol (Continued)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Password</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td>[ ] DE  [ ] EN  [ ]</td>
</tr>
<tr>
<td><strong>CE Remote Control</strong></td>
<td>[ ] enabled</td>
</tr>
<tr>
<td><strong>Network</strong></td>
<td>[ ] DHCP aktiv</td>
</tr>
<tr>
<td></td>
<td>IP Adress [_____]</td>
</tr>
<tr>
<td></td>
<td>Subnet [_____]</td>
</tr>
<tr>
<td></td>
<td>Gateway [_____]</td>
</tr>
<tr>
<td></td>
<td>DNS-Server [_____]</td>
</tr>
<tr>
<td></td>
<td>MAC Adress [_____]</td>
</tr>
<tr>
<td><strong>Calibration</strong></td>
<td>[ ] Linear  [ ] Exponential  [ ] inverted Curve</td>
</tr>
<tr>
<td><strong>GPC</strong></td>
<td>[ ] enabled  [ ] Cs-137  [ ] Co-60</td>
</tr>
<tr>
<td><strong>Damping</strong></td>
<td>[ ] [_____] s  time constant</td>
</tr>
<tr>
<td><strong>Process Value Range</strong></td>
<td>min. Value 4,00 mA  [_____] %</td>
</tr>
<tr>
<td></td>
<td>max. Value 20,00 mA  [_____] %</td>
</tr>
<tr>
<td><strong>Rapid Switch</strong></td>
<td>(0 – 9,9999) [ ] [ ] [ ]</td>
</tr>
<tr>
<td><strong>Radiation</strong></td>
<td>[ ] Detection enabled</td>
</tr>
<tr>
<td></td>
<td>Measurement Delay [_____] s</td>
</tr>
<tr>
<td></td>
<td>Hold Time [_____] s</td>
</tr>
<tr>
<td></td>
<td>I_O Factor [_____]</td>
</tr>
<tr>
<td></td>
<td>RI Sigma [_____]</td>
</tr>
<tr>
<td><strong>Source replacement</strong></td>
<td>[ ] Notification enabled</td>
</tr>
<tr>
<td><strong>Digital inputs</strong></td>
<td>[ ] DI-1 Assignment [none  Stop measurement  Upper Adjust  Lower Adjust  Standard Adjust]</td>
</tr>
<tr>
<td><strong>Analog output</strong></td>
<td>[ ] AO Assignment [Level  Damped count rate  Raw count rate  Count rate (GPC detector)  GPC Factor]</td>
</tr>
<tr>
<td></td>
<td>[ ] AO-Monitoring enabled</td>
</tr>
</tbody>
</table>
## Setup Protocol (Continued)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Function DO-2</th>
<th>Function DO-3</th>
</tr>
</thead>
</table>
Unité d'évaluation

**Duo** XPERT

LB 47x

Détecteurs

**Duo** SERIES

LB 4700

Informations sur la sécurité

56925BA59

Rev. No.: 01, 11/2017
1 A propos de ce manuel d’utilisation

1.8 Avertissement

Les avertissements sont identifiés comme suit :

<table>
<thead>
<tr>
<th>Signalement</th>
<th>Source et conséquence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explication si requise</td>
<td></td>
</tr>
<tr>
<td>Prévention</td>
<td></td>
</tr>
<tr>
<td>En cas de danger</td>
<td></td>
</tr>
</tbody>
</table>

- 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». 
1 A propos de ce manuel d’utilisation  
LB 470 Niveau Level
2 Sécurité

2.1 Dangers et mesures de sécurité

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

2.2 Utilisation appropriée

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

Ce qui suit constitue une utilisation appropriée :

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

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

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

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

**RECOMMANDATION**

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

**RECOMMANDATION**

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

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

Les trois groupes de personnes sont :
- **Employés avec des connaissances générales**
- **Experts**
- **Personnes autorisées**

**Employés avec connaissances générales**

**RECOMMANDATION**

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


**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.
Level
Füllstand

Technical Information
Technische Information

5692ST11L
Rev. No.: 00, 11/2017
2 wire technology

The DuoSeries/DuoXPERT measuring system consists of a scintillation detector – CrystalSENS point detector or UniSENS rod 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)
- 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

2-Leiter Technologie

Das DuoSeries/DuoXpert Messsystem besteht aus einem Detektor mit Szintillator-Technologie – CrystalSENS Punktendetektor oder UniSENS Stabdetektor – 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)
- Echte 2-Leiter Technik, nur 2 Adern im Feld
- Verbesserte Diagnosefunktionen und Selbstüberwachung
- Einfache, intuitive Bedienung über Touch-Screen
- 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

56925TI1L Rev. 00, 11/2017
Measurement arrangements level
*Messanordnungen Füllstand*

Measurement arrangements with rod detector
*Messanordnungen mit Stabdetektor*

Measurement arrangements with point detector
*Messanordnungen mit Punktdetektor*
Mounting Clamps for Detector
Befestigungsschellen für Detektor

Position for the clamps, see detector drawing.
Position für die Schellen-Befestigung siehe Detektor-Zeichnung.

for Detectors without water cooling
für Detektoren ohne Wasserkühlung

Dimensions in mm
Abmessungen in mm

Material: 316Ti 1.4571
Werkstoff: 316Ti 1.4571

Part No. 31346 (1 set = 2 clamps)
Id. Nr. 31346 (1 Set = 2 Schellen)

Part No. 31345 (single clamp)
Id. Nr. 31345 (einzeln Schelle)

for Detectors with water cooling
für Detektoren mit Wasserkühlung

Dimensions in mm
Abmessungen in mm

Material: 316Ti 1.4571
Werkstoff: 316Ti 1.4571

Part No. 31347 (1 set = 2 clamps)
Id. Nr. 31347 (1 Set = 2 Schellen)

Part No. 31344 (single clamp)
Id. Nr. 31344 (einzeln Schelle)
Heavy Duty Detector Holder (stainless steel)
Robuste Detektor Halterung (Edelstahl)

Part No. 39246 = without water cooling
Id. Nr. 39246 = ohne Wasserkühlung

Part No. 39247 = with water cooling
Id. Nr. 39247 = mit Wasserkühlung

Dimensions in mm
Abmessungen in mm

Remove the plastic ring for detectors with water cooling.

Kunststoffring bei Detektoren mit Wasserkühlung entfernen.
Collimator for Rod Detector
*Kollimator für Stabdetektor*

For installation/deinstallation, space for swiveling the collimator is recommended.

*Empfohlener Installations-/Deinstallationsraum zum Ausschwenken des Kollimators.*

for Detectors without water cooling
*für Detektoren ohne Wasserkühlung*
for Detectors with water cooling
für Detektoren mit Wasserkühlung

---

**Technical Information - Level**

**Technische Information - Füllstand**

---

**Part No.**

**for WC* für WK**

**L1 (sensitive length) (empfindliche Länge)**

**A**  | **B**  | **L (detector length) (Detektorlänge)**

<table>
<thead>
<tr>
<th>Part No. Id. Nr.</th>
<th>for WC* für WK*</th>
<th>L1 (sensitive length) (empfindliche Länge)</th>
<th>A</th>
<th>B</th>
<th>L (detector length) (Detektorlänge)</th>
<th>C</th>
<th>X</th>
<th>Weight (kg) Gewicht (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>59957-050</td>
<td>-</td>
<td>500</td>
<td>620</td>
<td>655</td>
<td>925</td>
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<td>195</td>
</tr>
<tr>
<td>59957-150</td>
<td></td>
<td>1500</td>
<td>1620</td>
<td>1655</td>
<td>1925</td>
<td>1590</td>
<td>2000</td>
<td>280</td>
</tr>
<tr>
<td>59957-200</td>
<td></td>
<td>2000</td>
<td>2120</td>
<td>2155</td>
<td>2425</td>
<td>2090</td>
<td>2500</td>
<td>365</td>
</tr>
<tr>
<td>60085-050</td>
<td>✓</td>
<td>500</td>
<td>620</td>
<td>655</td>
<td>929</td>
<td>590</td>
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<td>100</td>
</tr>
<tr>
<td>60085-100</td>
<td></td>
<td>1000</td>
<td>1120</td>
<td>1155</td>
<td>1429</td>
<td>1090</td>
<td>1500</td>
<td>180</td>
</tr>
<tr>
<td>60085-150</td>
<td></td>
<td>1500</td>
<td>1620</td>
<td>1655</td>
<td>1929</td>
<td>1590</td>
<td>2000</td>
<td>255</td>
</tr>
<tr>
<td>60085-200</td>
<td></td>
<td>2000</td>
<td>2120</td>
<td>2155</td>
<td>2429</td>
<td>2090</td>
<td>2500</td>
<td>330</td>
</tr>
</tbody>
</table>

---

* Watercooling
* Wasserkühlung
Collimator mounting Devices
*Kollimator Halterungen*

**Stabilizer**
*Kippsicherung*

Notices / Hinweise

Alternative to the stabilizer against tilting, you can use a one-sided mounted angle bracket as a stabilizer too (see next drawing).

Alternativ zur Kippsicherung, können auch einseitig montierte Winkeleisen als Kippsicherung verwendet werden (siehe nächste Zeichnung).
Angle bracket

Winkeleisen

Angle bracket as tilt protection, welded.

Winkeleisen als Kippsicherung, angeschweißt

Material thickness 8 – 10 mm

Materialstärke 8 – 10 mm

Distance to the vessel wall approx. 100 mm

Abstand zur Behälterwand ca. 100 mm
Mounting point detector
*Befestigung Punktdetektor*

Mounting with clamps
*Montage mit Schellen*

Mounting with detector holder
*Montage mit Detektorhalterung*

Dimensions in mm
*Abmessungen in mm*
**NOTICE / HINWEIS**

Direct sun radiation can overheat the detector. If the detector temperature can reach more than 50°C, a suitable sun roof must be installed. The heating of the detector by thermal radiation from the vessel can also be moderated by a thermal sheet, e.g. by a thin metal plate. For each detector a water cooling (option) is available.

Wird durch Sonneneinstrahlung eine Detektortemperatur von über 50°C erreicht, so ist ein geeigneter Sonnenschutz zu montieren. Auch die Aufheizung des Detektors durch Wärmeabstrahlung vom Behälter kann durch ein dünnes Wärmeableitblech gemildert werden. Für jeden Detektor steht auch eine geeignete Wasserkühlung (Option) zur Verfügung.
Clamping and Mounting Positions for rod detectors
*Klemmenposition und Montageposition Stabdetektoren*

**Clamping Position for Rod Detectors**
*Klemmenposition für Stabdetektoren*

**Mounting Position for Rod Detector Shieldings**
*Klemmenposition für Stabdetektor abschirmungen*

The drawings on this page are valid for detectors with and without water cooling jacket.
*Die Zeichnungen auf dieser Seite sind gültig für Detektoren mit und ohne Wasserkühlung.*

**Clamping Position for Multi Detector Arrangement**
*Klemmenposition für Multidetektor-Anordnung*

**Mounting Position for Rod Detector Shieldings**
*Klemmenposition für Stabdetektorabschirmungen*

Dimensions in mm
*Abmessungen in mm*
Evaluation unit

Auswerteinheit
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. The connection between the master EVU and slave modules (level measurement only) is made with a 4-pin master/slave plug.

Auswerteinheit


Notice / Hinweis

Detector of the type LB44xx and LB54xx can capture measurement data only with master EVU.

Messdaten der Detektoren vom Typ LB44xx und LB54xx können nur mit einem Master-Modul erfasst werden.

Notice / Hinweis

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

Diese Auswerteinheit ist nicht ex-geschützt ausgeführt und darf nicht in explosionsgefährdete Bereiche verwendet werden.
## Installation variants wall housing

_Einbauvarianten Wandgehäuse_

<table>
<thead>
<tr>
<th>Item Pos.</th>
<th>Components</th>
<th>Connection</th>
</tr>
</thead>
</table>
| 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  
_NRTL Zertifikat US/CAN_
### Installation variants 19” subrack

*Einbauvarianten 19” Baugruppenträger*

<table>
<thead>
<tr>
<th>Item</th>
<th>Components</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4 Master</td>
<td>2 Terminal panel master&lt;br&gt;2 Anschlussplatine Master</td>
</tr>
<tr>
<td>2</td>
<td>4 Master &lt;sup&gt;2&lt;/sup&gt;</td>
<td>4 Terminal blocks&lt;br&gt;4 Klemmenblöcke</td>
</tr>
<tr>
<td>3</td>
<td>2x (1 Master, 3 Slaves)</td>
<td>2 Terminal panel master/slave&lt;br&gt;2 Anschlussplatinen Master/Slave</td>
</tr>
<tr>
<td>4</td>
<td>4x (1 Master, 1 Slave) &lt;sup&gt;2&lt;/sup&gt;</td>
<td>6 Terminal blocks; master/slave plugs&lt;br&gt;6 Klemmenblöcke; Master/Slave Stecker</td>
</tr>
<tr>
<td>5</td>
<td>1 Master, 9 Slaves &lt;sup&gt;2&lt;/sup&gt;</td>
<td>10 Terminal blocks; master/slave plug&lt;br&gt;10 Klemmenblöcke; Master/Slave Stecker</td>
</tr>
<tr>
<td>6</td>
<td>11 Slaves &lt;sup&gt;2&lt;/sup&gt;</td>
<td>11 Terminal blocks&lt;br&gt;11 Klemmenblöcke</td>
</tr>
</tbody>
</table>

<sup>2</sup>Application example. The modules can be arranged arbitrarily with terminal blocks.<br>
*Anwendungsbeispiele. Mit Klemmenblöcken können Module frei zusammengestellt werden.*
The connections master 1 and master 2 are identical.

Die Anschlüsse Master A,B,C,D sind identisch.

<table>
<thead>
<tr>
<th>#</th>
<th>Connector</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DETECTOR MASTER –</td>
<td>Connection Detector Verbindung Detektor LB 4700 / LB 44xx</td>
</tr>
<tr>
<td>2</td>
<td>DETECTOR MASTER +</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>MASTER/SLAVE GND</td>
<td>Connection of additional slave units Anschluss von weiteren Slave-Einheiten</td>
</tr>
<tr>
<td>4</td>
<td>MASTER/SLAVE TxD</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>MASTER/SLAVE RxD</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>MASTER/SLAVE RTS</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>RELAIS 3 NC</td>
<td>DIGITAL OUT</td>
</tr>
<tr>
<td>8</td>
<td>RELAIS 3 COM</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>RELAIS 2 NC</td>
<td>DIGITAL OUT</td>
</tr>
<tr>
<td>10</td>
<td>RELAIS 2 NO</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>RELAIS 2 COM</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>RELAIS 1 NC</td>
<td>Error DIGITAL OUT Fehler DIGITAL OUT</td>
</tr>
<tr>
<td>13</td>
<td>RELAIS 1 NO</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>RELAIS 1 COM</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>DIGITAL IN 1 GND</td>
<td>GND</td>
</tr>
<tr>
<td>16</td>
<td>DIGITAL IN 1 IN</td>
<td>Logic Input</td>
</tr>
<tr>
<td>17</td>
<td>DIGITAL IN 1 + 24 V</td>
<td>24 V out (max. 200 mA)</td>
</tr>
<tr>
<td>18</td>
<td>POWER DC 24 V – / AC N</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>POWER DC 24 V + / AC L1</td>
<td>24 V DC / 100-240 V AC</td>
</tr>
<tr>
<td>20</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>CURRENT OUT –</td>
<td>4 mA … 20 mA</td>
</tr>
<tr>
<td>24</td>
<td>CURRENT OUT +</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>CURRENT IN –</td>
<td>Not used for LB 470 Wird bei LB 470 nicht verwendet</td>
</tr>
<tr>
<td>26</td>
<td>CURRENT IN +</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>RS 485 A</td>
<td>Communication and service interface (Master-Master) Kommunikations- und Service-Schnittstelle (Master-Master)</td>
</tr>
<tr>
<td>28</td>
<td>RS 485 B</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>DIGITAL IN 2 GND</td>
<td>GND</td>
</tr>
<tr>
<td>30</td>
<td>DIGITAL IN 2 IN</td>
<td>Logic Input</td>
</tr>
<tr>
<td>31</td>
<td>DIGITAL IN 2 + 24 V</td>
<td>24 V out (max. 200 mA)</td>
</tr>
</tbody>
</table>
Connection diagram terminal board master/slave
Anschlussplan Anschlussplatine Master/Slave

<table>
<thead>
<tr>
<th>#</th>
<th>Connector</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DETECTOR MASTER –</td>
<td>Connection Detector</td>
</tr>
<tr>
<td>2</td>
<td>DETECTOR MASTER +</td>
<td>Verbindung Detektor</td>
</tr>
<tr>
<td>3</td>
<td>DETECTOR SLAVE 1 –</td>
<td>LB 4700 / LB 44xx</td>
</tr>
<tr>
<td>4</td>
<td>DETECTOR SLAVE 1 +</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>DETECTOR SLAVE 2 –</td>
<td>Connection Detector</td>
</tr>
<tr>
<td>6</td>
<td>DETECTOR SLAVE 2 +</td>
<td>Verbindung Detektor</td>
</tr>
<tr>
<td>7</td>
<td>DETECTOR SLAVE 3 –</td>
<td>LB 4700 / LB 44xx</td>
</tr>
<tr>
<td>8</td>
<td>DETECTOR SLAVE 3 +</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>MASTER/SLAVE GND</td>
<td>Connection of additional slave units</td>
</tr>
<tr>
<td>10</td>
<td>MASTER/SLAVE TxD</td>
<td>Anschluss von weiteren Slave-Einheiten</td>
</tr>
<tr>
<td>11</td>
<td>MASTER/SLAVE RxD</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>MASTER/SLAVE RTS</td>
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</tr>
<tr>
<td>13</td>
<td>POWER DC 24 V – / AC N</td>
<td>24 V DC / 100-240 V AC</td>
</tr>
<tr>
<td>14</td>
<td>POWER DC 24 V + / AC L1</td>
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<td>PE</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>RELAIS 3 NC</td>
<td>DIGITAL OUT</td>
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<tr>
<td>19</td>
<td>RELAIS 3 COM</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>RELAIS 2 NC</td>
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<td>26</td>
<td>DIGITAL IN 1 GND</td>
<td>GND</td>
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<tr>
<td>27</td>
<td>DIGITAL IN 1 IN</td>
<td>Logic Input</td>
</tr>
<tr>
<td>28</td>
<td>DIGITAL IN 1 + 24 V</td>
<td>24 V out (max. 200 mA)</td>
</tr>
<tr>
<td>29</td>
<td>CURRENT OUT –</td>
<td>4 mA … 20 mA</td>
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<tr>
<td>30</td>
<td>CURRENT OUT +</td>
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<tr>
<td>31</td>
<td>CURRENT IN –</td>
<td>Not used for LB 470</td>
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<tr>
<td>32</td>
<td>CURRENT IN +</td>
<td>Wird bei LB 470 nicht verwendet</td>
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<td>33</td>
<td>RS 485 A</td>
<td>Communication and service interface (Master-</td>
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<tr>
<td>34</td>
<td>RS 485 B</td>
<td>Master)</td>
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<td>GND</td>
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<tr>
<td>36</td>
<td>DIGITAL IN 2 IN</td>
<td>Logic Input</td>
</tr>
<tr>
<td>37</td>
<td>DIGITAL IN 2 + 24 V</td>
<td>24 V out (max. 200 mA)</td>
</tr>
</tbody>
</table>

The connections master/slave A and master/slave B are identical.

Die Anschlüsse Master/Slave A und Master/Slave B sind identisch.
Assignment terminals master/slave plug
Klemmenbelegung Master/Slave Stecker

<table>
<thead>
<tr>
<th>Signal</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>TxD</td>
<td>41</td>
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<tr>
<td>RxD</td>
<td>42</td>
</tr>
<tr>
<td>RTS</td>
<td>43</td>
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<tr>
<td>GND</td>
<td>44</td>
</tr>
</tbody>
</table>

The master/slave plug is not used by applications with terminal panels. The master/slave plug is contained in the purchase order terminal block (Part No. 59477). In the case of existing 19" subrack and retrofitting to LB470, the master-slave plug (Part No. 64608) must ordered separately.

## Assignment terminal block master EVU

### Belegung Klemmenblock Master AWE

<table>
<thead>
<tr>
<th>Signal</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>DETECTOR GND</td>
<td>C - 2</td>
</tr>
<tr>
<td>not assigned <em>nicht belegt</em></td>
<td>C - 4</td>
</tr>
<tr>
<td>not assigned <em>nicht belegt</em></td>
<td>C - 6</td>
</tr>
<tr>
<td>not assigned <em>nicht belegt</em></td>
<td>C - 8</td>
</tr>
<tr>
<td>RELAY RELAIS 3 COM</td>
<td>C - 10</td>
</tr>
<tr>
<td>RELAY RELAIS 2 COM</td>
<td>C - 12</td>
</tr>
<tr>
<td>RELAY RELAIS 1 NC</td>
<td>C - 14</td>
</tr>
<tr>
<td>RELAY RELAIS 1 COM</td>
<td>C - 16</td>
</tr>
<tr>
<td>DIGITAL IN 1</td>
<td>C - 18</td>
</tr>
<tr>
<td>DIGITAL IN 2</td>
<td>C - 20</td>
</tr>
<tr>
<td>CURRENT IN +</td>
<td>C - 22</td>
</tr>
<tr>
<td>RS 485 B</td>
<td>C - 24</td>
</tr>
<tr>
<td>CURRENT OUT –</td>
<td>C - 26</td>
</tr>
<tr>
<td>not assigned <em>nicht belegt</em></td>
<td>C - 28</td>
</tr>
<tr>
<td>Main Netz N, DC 24 V –</td>
<td>C - 30</td>
</tr>
<tr>
<td>Protective conductor PE</td>
<td>C - 32</td>
</tr>
<tr>
<td>Schutzleiter PE</td>
<td></td>
</tr>
</tbody>
</table>

### Diagram

The diagram shows the layout of the terminal block with pins labeled for each signal. The signals include detector GND, not assigned, relay outputs, digital inputs, current inputs, and RS485 connections. The protective conductor and main network are also indicated. The diagram is a visual representation of the assignment details provided in the table.
Assignment terminal block slave module

**Belegung Klemmenblock Slave Modul**

<table>
<thead>
<tr>
<th>Signal</th>
<th>Pin</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>DETECTOR SLAVE GND</td>
<td>C - 2</td>
<td>A - 2</td>
<td>DETECTOR SLAVE +15 V</td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 4</td>
<td>A - 4</td>
<td>not assigned</td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 6</td>
<td>A - 6</td>
<td>not assigned</td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 8</td>
<td>A - 8</td>
<td>not assigned</td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 10</td>
<td>A - 10</td>
<td>not assigned</td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 12</td>
<td>A - 12</td>
<td>not assigned</td>
</tr>
<tr>
<td>GND</td>
<td>C - 14</td>
<td>A - 14</td>
<td>GND</td>
</tr>
<tr>
<td>GND</td>
<td>C - 16</td>
<td>A - 16</td>
<td>GND</td>
</tr>
<tr>
<td>RTS to the SLAVE</td>
<td>C - 18</td>
<td>A - 18</td>
<td>RTS to MASTER/SLAVE *</td>
</tr>
<tr>
<td>RxD to the SLAVE</td>
<td>C - 20</td>
<td>A - 20</td>
<td>RxD to the MASTER/SLAVE</td>
</tr>
<tr>
<td>TxD to the SLAVE</td>
<td>C - 22</td>
<td>A - 22</td>
<td>TxD to the MASTER/SLAVE</td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 24</td>
<td>A - 24</td>
<td>not assigned</td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 26</td>
<td>A - 26</td>
<td>not assigned</td>
</tr>
<tr>
<td>not assigned</td>
<td>C - 28</td>
<td>A - 28</td>
<td>not assigned</td>
</tr>
<tr>
<td>Main Netz N AC, DC 24 V</td>
<td>C - 30</td>
<td>A - 30</td>
<td>Main Netz L1 AC, DC 24 V (+)</td>
</tr>
<tr>
<td>Protective conductor</td>
<td>C - 32</td>
<td>A - 32</td>
<td>Protective conductor PE</td>
</tr>
<tr>
<td>Schutzleiter PE</td>
<td></td>
<td></td>
<td>Schutzleiter PE</td>
</tr>
</tbody>
</table>

* optional
# Technical Data

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Technical Information: 440x250x257mm (WxHxD)</th>
</tr>
</thead>
</table>

| Max. Assembly | Technical Information: 2 Master with terminal board (Master/Master) 1  
- 2 Master mit Anschlussplatine (Master/Master) 1  
- 1 Master, 3 Slave with terminal board (Master/Slave)  
- 1 Master, 3 Slave mit Anschlussplatine (Master/Slave)  
- 2 Master with clamp blocks 2  
- 2 Master mit Klemmenblöcken 2 |

<table>
<thead>
<tr>
<th>Weight (with circuit board, without modules)</th>
<th>Technical Information: 8.8 kg</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Operational Temperature</th>
<th>Technical Information: -20°C ... +40°C</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>User Interface, Colours</th>
<th>Technical Information: powder coated, grey</th>
</tr>
</thead>
</table>

---

1 NRTL certification US/CAN  
NRTL Zertifikat US/CAN

2 Kein Zertifikat  
No certification
Technical Data

**Dimensions**

3HE/84TE/5T, 482x132x172mm (WxHxD)

**Max. Assembly**

- 3 Master, 3 Slave
- 2 Master, 6 Slave
- 4 Master
- 1 Master, 9 Slave
- 12 Slave

**Weight (with circuit board, without modules)**

1.4 kg

**Weight terminal block**

220 g

**Operational temperature**

-20°C … +50°C, not condensing

**Storage temperature**

-30°C … +60°C

**Degree of protection**

IP20
Master EVU

Master AWE

Technical Data

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>117/128/172mm (WxHxD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>1200 g</td>
</tr>
<tr>
<td>Operational temperature</td>
<td>-20°C ... +50°C, not condensing. Avoid direct sunlight. Unobstructed air circulation must be provided to the subrack.</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-20°C ... +85°C</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP20</td>
</tr>
</tbody>
</table>
### Connections
- USB port for the connection to the USB storage medium
- Master/slave connection (4-pin) and plug
- RJ45 connection for Ethernet (on back wall)
- 32-pin plug connector according to DIN 19465 Series C

### Display
- Graphical LCD display
- 320 x 240 points, 262,000 colours
- Dimmable LED background lighting
- Touch screen

### Computer core
- Processor: Dual Core DSP/ARM Controller
- Clock frequency: 300 MHz internal (20MHz external quartz)
- ROM: 512 KByte
- RAM: 64 MByte ext. SDRAM, 128 KByte int. shared RAM
- FLASH: 8 MByte external serial

### Power Supply

<table>
<thead>
<tr>
<th>Voltage</th>
<th>100-240 V AC 50/60 Hz (wide range input) +/- 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spannung</td>
<td>21-32 V DC (24V DC power input)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>22 VA, 15 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leistungsaufnahme</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuses</th>
<th>Internal, 2 x 250 V, 1A delayed, 5x20mm, 1500 A breaking capacity IEC 60127-2, 1x 250V TR5 T80mA (Ø 8,5 mm)</th>
</tr>
</thead>
</table>
## Interfaces
### Schnittstellen

| **Current output** | 4-20mA internally switched from power source to sink current (according to NAMUR recommendation NE 006 and NE 043). Continuous short circuit proof and isolated (500V). Internal resistance about 105 ohms max. Burden when operating as a power source: 850 ohm. Internal monitoring of the loop current and additional error signalling by hardware on detection of a fault condition. |

| **Current input** | 4-20mA (according to NAMUR recommendation NE 006 and NE 043) switchable via software on frequency input, electrically isolated (500V). Internal resistance approx. 300 ohm max. input voltage: 24V DC |
| **Stromeingang** | 4-20mA (nach Namur-Empfehlung NE 006 und NE 043) per Software umschaltbar auf Frequenzeingang, potentialgetrennt (500V). Innenwiderstand ca. 300 Ohm max. Eingangsspannung: 24V DC |

| **Impulse input** | Frequency 0-100kHz, Umax = 28V, right angle signal form, low <1,5V; high 4 – 28V. Switchable to current input |
| **Impuls-eingang** | Frequenz 0-100kHz, Umax = 28V, Rechteck-Signalform, Low <1,5V; High 4 – 28V. Umschaltbar auf Stromeingang |

| **Digital outputs** | 3 relays, Umax = 33V ACeff, 46V DC; Imax = 1A functions: Relay 1: SPDT for error signalling Relay 2: SPDT assignable by software Relay 3: SPST assignable by software |
| **Digitale Ausgänge** | 3 Relais, Umax = 33V ACeff, 46V DC; Imax = 1A 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 (500V) Switch between DigIn and GND, Uoutmax approx. 24V Function configurable via software |
| **Digitale Eingänge** | 2 x gemeinsam potentialgetrennt (500V), Schalter zwischen DigIn und GND, Uoutmax ca. 24V Funktion über Software konfigurierbar |

| **External supply** | Output voltage: 24V DC Output current: max. 150mA |
| **Externe ersorgung** | Ausgangsspannung: 24V DC Ausgangsstrom: max. 150mA |

| **RS485** | for master/master communication, and testing and evaluation purposes. not isolated from main electronics and USB port electrically isolated from remaining I/Os (500V) für Master/Master Kommunikation und Prüf-und Testzwecke. Nicht potentialgetrennt von Hauptelektronik und USB-Anschluss potentialgetrennt von restlichen I/Os (500V) |
| **USB port** | 1 x USB 2.0 Type A (Host) via front plate to the connection of an ext. mouse, keyboard or storage medium  
Uout = 5V, Ioutmax = 0.5A  
1 x USB 2.0 Typ A (Host) über Frontplatte zum Anschluss einer ext. Maus, Tastatur oder Speichermedium  
Uout = 5V, Ioutmax = 0,5A |
| **Ethernet** | RJ45 connection via back wall, 10Mbit,  
DHCP supported, max. 3m  
RJ45-Buchse über Rückwand, 10Mbit,  
DHCP unterstützt, max. 3m |
Slave Module
Slave Modul

Dimensions in mm
Abmessungen in mm

Technical Data
Technische Daten

<table>
<thead>
<tr>
<th>Dimensions Abmessungen</th>
<th>35/128/172mm (WxHxD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Gewicht</td>
<td>600 g</td>
</tr>
<tr>
<td>Operational temperature Betriebstemperatur</td>
<td>-20°C … +50°C, not condensing. Avoid direct sunlight. Unobstructed air circulation must be provided to the subrack. -20°C … +50°C nicht kondensierend. Direkte Sonneneinstrahlung ist zu vermeiden. Für eine ungehinderte Luftzirkulation um den Baugruppenträger ist zu sorgen.</td>
</tr>
<tr>
<td>Storage temperature Lagertemperatur</td>
<td>-20°C … +60°C</td>
</tr>
<tr>
<td>Degree of protection Schutzgrad</td>
<td>IP20</td>
</tr>
</tbody>
</table>
### Electrical data

<table>
<thead>
<tr>
<th><strong>Power consumption</strong></th>
<th>Leistungsaufnahme</th>
<th>6VA, 5W</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fuses</strong></td>
<td>Sicherungen</td>
<td>Internal, 2 x 250 V, 1A delayed, 5x20mm, 1500 A breaking capacity IEC 60127-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intern, 2 x 250 V, 1A träge, 5x20mm, 1500 A Abschaltvermögen IEC 60127-2</td>
</tr>
<tr>
<td><strong>Connections</strong></td>
<td>Anschlüsse</td>
<td>- 32-pin plug connector</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 32 polige Stifteleiste</td>
</tr>
</tbody>
</table>
## Technical Information - Level

### Number Key LB 47x

#### Nummernschlüssel LB 47x

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>LB 47x</td>
<td>-</td>
<td>11</td>
<td>-</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Options / Austattungsmerkmale

- **M**: Master
- **S**: Slave Module

#### Power Supply / Spannungsversorgung

- **0**: without separate power supply / ohne sep. Versorgung
- **1**: 24 VDC
- **2**: 100 ... 240 VAC -15% +10%

#### Explosion Protection / Zulassung Ex-Schutz

- **0**: General Area / ohne Ex-Schutz
- **1**: Ex-i IIB
- **2**: Ex-i IIc

#### Family / Gerätefamilie

- 47 DuoXpert

#### Family / Application / Applikation

- **0**: Level / Füllstand
- **1**: Level switch / Grenzschalter
- **2**: Bulk Flow / Durchsatz
- **3**: Potassium content / Kaligehalt
- **4**: Density / Dichte
- **5**: Hydraulic Fracturing
- **6**: Backscatter / Rückstreu
- **7**: Neutrons / Neutronen

#### RID (only LB 470 / nur LB 470)

- **0**: No RID / Kein RID
- **-RID**: Radiation Interference Discrimination

* used by other hardware / belegt durch andere Hardware
Declaration of Conformity
Konformitätserklärung

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:  radiometric 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

Registereinheit / Court of Registration
Pflichthaftende Gesellschafterin / Holy liable Associates
Registereinheit / Court of Registration
Geschäftsführung / Management
VSK-ID-Nr. / VAT Reg. No.
Deutsche Steuernummer / German Tax No.
WEEE-Reg. No.

Sparkasse PF-CW
Volksbank
Commerzbank

Konto/Account No. 3 045 003 (BLZ 466 509 85)
Konto/Account No. 957 094 (BLZ 466 909 60)
Konto/Account No. 6 511 120 (BLZ 466 809 15)
SWIFT-BIC FZHSDE66
SWIFT-BIC VDBOFRDE66
SWIFT-BIC DRESDEFF66
EG-Konformitätserklärung (ORIGINAL)

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**

<table>
<thead>
<tr>
<th>Richtlinie (Fundstelle)</th>
<th>angewendete Normen und weitere Spezifikationen</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSR 2014/35/EU</td>
<td>EN 61010-1 2010</td>
</tr>
<tr>
<td>RoHS 2011/65/EG</td>
<td></td>
</tr>
</tbody>
</table>
| EMV 2014/30/EU         | EN 61326-1 2013 EN 61000-4-2 2013 EN 61000-4-3 2013
|                        | EN 61000-4-4 2013 EN 61000-4-5 2013 EN 61000-4-6 2013
|                        | EN 61000-4-11 EN 61000-3-2 Namur NE21 2012    |

Diese Erklärung wird verantwortlich für den Hersteller

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

abgegeben durch

Dr. Jürgen Braggmann
Leiter Entwicklung
Bad Wildbad, den 1. September 2015
Certificates
Zertifikate

NRTL certification US/CAN wall-mounted housing
NTRL Zertifikat US/CAN Wandgehäuse

Certificate of Compliance

Nemko-CCL, Inc.

Certificate: NA201610500  Date Issued: January 20, 2016
Project: 257087-7.1

Issued to: Berthold Technologies GmbH & Co. KG
Calmbacher Straße 22
75523 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:

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
APPLICABLE REQUIREMENTS

UL Std. No. 61010-1 2nd 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.
Supplement to Certificate of Compliance

Certificate: NA201610530  Project: 257087-7.1

Nemka-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: Berthold Technologies GmbH & Co. KG
Location: 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

<table>
<thead>
<tr>
<th>Project</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>257087-7.1</td>
<td>January 20, 2016</td>
<td>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</td>
</tr>
</tbody>
</table>

This Supplement forms an integral part of the Certificate of Compliance.
Certificate of Compliance

Nemko-CCL, Inc.

Certificate: NA201510498  Date Issued: September 17, 2015
Project: 235982-141

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

Nemko

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


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.

For more information, please visit our website or contact us directly.

Nemko-CCL, Inc. 1940 West Alexander Way, Salt Lake City, Utah 84110-2689  Tel (801) 972-6146  Fax (801) 972-6422

MFC0-002 Issue 2 May 2014  Page 1 of 2
NRTL certification US/CAN DuoXpert LB 47x (continued)
NTRL Zertifikat US/CAN DuoXpert LB 47x (Fortsetzung)

Supplement to Certificate of Compliance

Certificate: NA201516498  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

<table>
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<th>Location</th>
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<tbody>
<tr>
<td>Berthold Technologies GmbH &amp; Co. KG</td>
<td>Gaimbacher Straße 22</td>
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<tr>
<td></td>
<td>75323 Bad Wildbad</td>
</tr>
<tr>
<td></td>
<td>Germany</td>
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</tbody>
</table>

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

Product Certification History

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<th>Date</th>
<th>Description</th>
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<td>September 17, 2015</td>
<td>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</td>
</tr>
</tbody>
</table>

This Supplement forms an integral part of the Certificate of Compliance.
## Parts overview

**Übersicht Zubehör**

<table>
<thead>
<tr>
<th>ID. No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>63284</td>
<td>LB 470-01-M Level Transmitter (Master, 24 VDC)</td>
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<td>LB 470-01-M Füllstandmessgerät (Master, 24 VDC)</td>
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<tr>
<td>63283</td>
<td>LB 470-02-M Level Transmitter (Master, 100...240 VAC)</td>
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<td>LB 470-02-M Füllstandmessgerät (Master, 100...240 VAC)</td>
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<td>63286</td>
<td>LB 470 Slave (24 VDC)</td>
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<td>LB 470 Slave (24 VDC)</td>
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<td>63285</td>
<td>LB 470 Slave (100...240 VAC)</td>
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<td>LB 470 Slave (100...240 VAC)</td>
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<td>56925BA1</td>
<td>Operating manual DuoSeries LB 470 Level, German</td>
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<td>Betriebsanleitung Füllstand (deutsch)</td>
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<td>Betriebsanleitung Füllstand (englisch)</td>
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<td>63781</td>
<td>Wall-mounted Housing for LB 47x 1x Master / 3x Slave (24 VDC)</td>
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<td>Wandgehäuse für LB 47x, 1x Master / 3x Slave (24 VDC)</td>
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<td>63782</td>
<td>Wall-mounted Housing for LB 47x 1x Master / 3x Slave (110...240 VAC)</td>
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<td>Wandgehäuse für LB 47x, 1x Master / 3x Slave (110...240 VAC)</td>
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<td>63783</td>
<td>Wall-mounted Housing for 2x LB 47x Master (24 VDC)</td>
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<td>Wandgehäuse für LB 47x, 2x Master (110...240 VAC)</td>
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<td>64402</td>
<td>Wall-mounted Housing for 2x LB 47x Master (terminal blocks)</td>
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<td>Wandgehäuse für LB 47x, 2x Master (Klemmblöcke)</td>
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<tr>
<td>59484</td>
<td>19&quot; rack for LB 47x, 4 x Master</td>
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<td>19&quot;-Baugruppenträger für LB 47x, 4 x Master</td>
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<td>59481</td>
<td>19&quot; rack for LB 47x, 3x (1x Master &amp; 1x Slave)</td>
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<td>19&quot;-Baugruppenträger für LB 47x, 3x (je 1x Master &amp; 1x Slave)</td>
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<td>64607</td>
<td>19&quot; rack, 84 HP / 3 RU for use with terminal blocks</td>
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<td>19&quot;-Baugruppenträger für den Einsatz mit Klemmblöcken</td>
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<td>59477</td>
<td>Terminal block for LB 47x, Master</td>
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<td>Klemmenblock für LB 47x, Master</td>
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<td>59478</td>
<td>Terminal block for LB 47x, Slave</td>
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<td>Klemmenblock für LB 47x, Slave (mit Führungsschienen)</td>
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<td>37526</td>
<td>Front Cover Plate 21 HP / 3 RU (Master)</td>
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<td>Blindplatte 21TE / 3 HE (Master)</td>
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<td>59501</td>
<td>Front Cover Plate 7 HP / 3 RU (Slave)</td>
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<td>64608</td>
<td>Connector for LB 47x slaves when changing from LB 44x to LB 47x slaves</td>
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<td>Stecker für LB 47x Slaves bei Umrüstung von LB44x auf LB47x Slaves</td>
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