Concentration / Moisture Measuring Systems

MicroPolar Moist

LB 568

User's Guide

Hardware Manual

41990BA2

Rev. Nr.: 03, 07/2017

The units supplied should not be repaired by anyone other than Berthold Technologies Service engineers or technicians by Berthold Technologies.

In case of operation trouble, please address to our central service department (address see below).

The complete user's guide consists of two manuals, the hardware description and the software description.

The **hardware manual** comprises the

- component description
- assembly instructions
- electrical installation description
- technical data
- certificates
- dimensional drawings

The **software manual** comprises the description of the

- operation
- software functions
- calibration
- error messages

The present manual is the hardware description.

Subject to change without prior notice.

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Table of Contents

Page

CHAPTER 1. **SAFETY SUMMARY** ... **7**

1.1 SYMBOLS AND WARNINGS ... 7
1.2 GENERAL INFORMATION ... 8
1.3 GENERAL SAFETY INSTRUCTIONS ... 9

CHAPTER 2. **GENERAL INFORMATION** ... **11**

2.1 USE AND FUNCTION ... 11
2.2 FREQUENCY LICENSE ... 12
2.3 INTENDED USE ... 13
2.4 DEFINITIONS ... 14

CHAPTER 3. **SYSTEM DESCRIPTION** ... **15**

3.1 PRINCIPLE OF MEASUREMENT ... 15
3.2 CALCULATION OF MEASURED VALUES ... 16
3.3 LOADING COMPENSATION ... 18
3.3.1 Radiometric Mass per Unit Area Compensation ... 19
3.4 MECHANICAL COMPONENTS ... 21
3.4.1 The Evaluation Unit ... 23
3.4.2 Horn and Spiral Antennas ... 25
3.4.3 The Radiometric Measuring Path ... 27
3.4.4 Measuring Chute ... 30
3.4.5 High-frequency Cable ... 31
3.5 CONVEYOR MEASUREMENT CONFIGURATION ... 32
3.6 CHUTE MEASUREMENT CONFIGURATION ... 33

CHAPTER 4. **GETTING STARTED** ... **35**

4.1 TRANSPORT ... 35
4.2 COMMISSIONING THE CONVEYOR BELT ... 35
4.2.1 Components ... 35
4.2.2 Measuring Geometry and Measuring Conditions ... 36
4.2.3 Installation of the Horn Antennas ... 39
4.2.4 Installation of the Spiral Antennas ... 42
4.2.5 Installation of the Radiometric Measuring Path ... 43
4.2.6 Installation of the Evaluation Unit ... 45
4.2.7 Connecting the HF Cable ... 46
4.3 COMMISSIONING THE CHUTE ... 47
4.3.1 Components ... 47
4.3.2 Measuring Geometry and Measuring Conditions ... 47
4.3.3 Installation ... 48
4.3.4 Installation of the Evaluation Unit ... 49
4.3.5 Connecting the HF Cable ... 49
4.4 CONNECTING THE EVALUATION UNIT ... 50
4.4.1 Pin Configuration of the Connector Strip ... 51
4.4.2 Connecting the Scintillation Counter ... 53
4.4.3 Digital Outputs, Relay ... 54

CHAPTER 5. **SERVICE INSTRUCTIONS** ... **55**

5.1 GENERAL INFORMATION ... 55
5.2 PARTS SUBJECT TO WEAR ... 55

5.3 INSTRUMENT CLEANING 55
5.4 BATTERY 55
5.5 FUSE REPLACEMENT 56

CHAPTER 6. **TECHNICAL DATA** **57**

6.1 TECHNICAL DATA EVALUATION UNIT 57
6.2 TECHNICAL DATA HORN AND SPIRAL ANTENNAS 60
6.3 TECHNICAL DATA RADIOMETRIC MASS PER UNIT AREA MEASUREMENT 61
6.4 TECHNICAL DATA MEASURING CHUTE 63
6.5 TECHNICAL DATA HF-CABLE 64
6.6 SERIAL DATA OUTPUT RS232 FORMAT 65

CHAPTER 7. **OTHER COMPENSATION OPTIONS** **67**

7.1 OPTIONAL LOADING COMPENSATION 67
7.1.1 Mass per Unit Area Compensation 67
7.1.2 Layer Thickness Compensation 67
7.1.3 Weight/Throughput Compensation 68
7.1.4 Layer Thickness and Weight Compensation......69
7.2 TEMPERATURE COMPENSATION 69
7.3 SYNCHRONIZATION OF INPUT SIGNALS 70

CHAPTER 8. **RADIATION PROTECTION GUIDELINES** **73**

8.1 BASICS AND DIRECTIVES 73
8.2 EMERGENCY INSTRUCTIONS 76

CHAPTER 9. **CERTIFICATES** **77**

9.1 EC DECLARATION OF CONFORMITY 77
9.2 FREQUENCY LICENSE 78

CHAPTER 10. **TECHNICAL DRAWINGS** **79**

10.1 DIMENSIONAL DRAWING EVALUATION UNIT CASE 79
10.2 ELECTRICAL WIRING DIAGRAM 80
10.3 ELECTRICAL WIRING DIAGRAM SCINTILLATION COUNTER 81
10.4 DIMENSIONAL DRAWINGS HORN AND SPIRAL ANTENNAS 82
10.4.1 Horn Antenna and Horn Antenna Brackets 82
10.4.2 Spiral Antennas 84
10.5 DIMENSIONAL DRAWINGS RADIOMETRIC MEASURING PATH 85
10.5.1 Scintillation Counter with Axial Collimator 85
10.5.2 Scintillation Counter with Radial Collimator 86
10.5.3 Scintillation Counter with Bracket 87
10.5.4 Shielding Container LB 7440/5 with Mounting Plate 88
10.5.5 Mounting Plate for Shielding Container 89
10.6 INSTALLATION PROPOSAL AT THE CONVEYOR BELT 90
10.7 INSTALLATION PROPOSAL AT THE MEASURING CHUTE 91

INDEX **92**

Chapter 1. **Safety Summary**

1.1 Symbols and Warnings

In this user manual, the term Berthold Technologies stands for the company Berthold Technologies GmbH & Co.KG.

To rule out bodily injury and property damage, please keep in mind the warning and safety instructions provided in this operation manual. They are identified by the following sings: DANGER, WARNING, CAUTION or NOTE.

DANGER

Indicates imminent danger. If it cannot be avoided, death or most severe personal injuries may be the consequences.

WARNING

Indicates a possibly dangerous situation. The consequences may be death or most severe personal injuries.

CAUTION

Indicates a possibly dangerous situation. The consequences may be minor or medium personal injuries.

NOTICE

Indicates a situation that may cause property damage if the instructions are not followed.

IMPORTANT
Paragraphs with this symbol provide important information on the product and how to handle it.

TIP
Includes application tips and particularly useful information.

Meaning of other symbols used in this documentation:

Warning: No intervention, do not alter anything

Requirement: Disconnect power

Requirement: Wear safety boots

1.2 General Information

The most important safety measures a summarized in this user manual. They supplement the corresponding regulations which *must* be studied by the personnel in charge.

Please pay attention to:

- the national safety and accident prevention regulations
- the national assembly and installation directions
- the generally recognized engineering rules
- the information on transport, assembly, operation, service, maintenance
- the safety instructions and information in these operating instructions
- the enclosed technical drawings and wiring diagrams
- the characteristic values, limit values and the information on operating ambient conditions on the type labels and in the data sheets
- the signs on the device
- the country-specific licensing provisions

1.3 General Safety Instructions

IMPORTANT
The instrument housing is protected according to protection type IP 65 and is suitable for outdoor application. The instrument has been tested by the manufacturer and is delivered in a condition that allows safe and reliable operation.

NOTICE

For outdoor operation, the measuring systems have to be protected against direct sunlight and rain, for example by a suitable canopy.

IMPORTANT
Never change the installation and the parameter settings without a full knowledge of these operating instructions, as well as a full knowledge of the behavior of the connected controller and the possible influence on the operating process to be controlled.

NOTICE

The systems may be used only in technically good order and only according to regulations!

CAUTION

Only persons may work with the system who have been authorized to do this and who have the proper qualification and have received the necessary instructions! Installations and modifications on the systems which may affect the operational safety are not permitted!

Ambient conditions

IMPORTANT
All system components require non-corrosive ambient conditions during transport, storage and operation.

IMPORTANT
If liquid gets inside the instrument, cut off the power supply. The instrument has to be checked and cleaned by an authorized service center.

⚠ WARNING

Electrical shock hazards

Disconnect power to ensure that contact with live part is avoided during installation and when servicing.

Turn off power supply before opening the instrument. Work on open and live instruments is prohibited.

NOTICE

Caution! Possible hazard, property damage!
For the device type:
LB 568-02 MicroPolar Moist (ID no. 41990-02)

If the 24 V DC auxiliary energy is connected, the + and – poles must be connected correctly. There is no reverse voltage protection!

NOTICE

Spare fuses must match the rating specified by the device manufacturer. Short-circuiting or manipulation is not permitted.

IMPORTANT
The LB 568 and all ancillary units have to be connected to mains via grounded connection.

IMPORTANT
The concentration measuring instrument LB 568 may only be installed, serviced and repaired by qualified persons.

Qualified persons

Qualified persons are persons who through their professional training have acquired sufficient skills in the respective field and who are familiar with the pertinent national labor safety directions, accident prevention directions, guidelines and with good engineering practice. They must be capable of safely assessing the result of their work and they must be familiar with the contents of these operating instructions.

⚠ DANGER

The guidelines for radiation protection and the stipulations of the handling license have to be complied with.

Chapter 2. **General Information**

2.1 Use and Function

The MicroPolar Moist LB 568 has been designed as a concentration/moisture measuring system and may be used only for this purpose. If the devices are used in a manner that are not described in this user manual, the protection of the devices is impaired and the warranty claim is void.

Berthold Technologies warrants and/or guarantees only that the devices comply with its published specifications. The LB 568 may be installed only in an undamaged, dry and clean condition. Alterations and modifications on the system components are not permitted.

The LB 568 is not qualified as a "safety-relevant measurement".

Conformity to standards

The standards and guidelines the LB 568 complies with are itemized in these device instructions in *chapter 2.2 Frequency License and chapter 9.1 EC Conformity Declaration*.

Protection type

The protection type of the LB 568 according to IEC 60529 is max. IP 65.

Warning against misuse

The following use is inappropriate and has to be prevented:

- Use under other conditions and prerequisites than those specified by the manufacturer in his technical documents, data sheets, operating and assembly instructions and other specifications.
- Use after repair by persons who were not authorized by Berthold Technologies.
- Use in a damaged or corroded state.
- Operation with open or inadequately closed cover.
- Operating with inadequately tightened adapters and cable fittings.
- Operation without observing the safety precautions foreseen by the manufacturer.
- Manipulating or bypassing existing safety facilities.

Authorized persons

Authorized persons are persons who are foreseen for the respective activity, either based on statutory regulations, or who have been licensed by Berthold Technologies for certain activities.

2.2 Frequency License

The MicroPolar Moist complies with Part 15 of the FCC Rules[1]. These meters are compliant in terms of interference immunity and interference emission and are approved for operation. The certificate can be found in *chapter 9.2 Frequency License*.

Frequency licenses

FCC license certificate

Trade Name: Berthold Technologies
Model No: LB 567, LB 568
FCC ID: R9ZFCC02X03

This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received,
including interference that may cause
undesired operation.

IMPORTANT

The FCC approval applies to the evaluation unit LB 568 in combination with flow cells of the type LB 354X-XX, horn and spiral antenna.

IMPORTANT

The LB 568 has been manufactured in compliance with the safety requirements for microwave devices. It will be the user's responsibility to adhere to any special legal provisions regarding the use of microwaves.

IMPORTANT

Any change in the frequency or otherwise tampering with the microwave device will lead to a loss of the frequency license and may result in criminal consequences.

The microwave modules do not include any replaceable components and must not be opened.

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[1] FCC ... Federal Communications Commission

2.3 Intended Use

The measuring system LB 568 has been designed to determine the water or moisture content or the concentration of almost any material. The microwave measurement technique employed enables non-contact on-line measurement.

The layer of material to be measured on a conveyor belt or in a measuring chute made of non-conductive material can be directly irradiated by the microwaves. The measurement is carried out through the walls or through the conveyor belt. Varying layer thicknesses and bulk densities of the measured product can be compensated by the additional radiometric mass per unit area measurement.

During operation, the LB 568 sends out electromagnetic radiation. The transmitting antenna is installed so close to the bottom side of the conveyor belt or to the measuring chute that the emitted electromagnetic radiation passes almost completely through the product.

To ensure proper function of the measuring system, please pay attention to the following:

TIP

- The material to be measured may be electrically conductive only to a limited degree.
- The product must not contain any gas bubbles or gas bubbles have to be compressed with adequate pressure when carrying out measurements in pipelines.
- The ion concentration, e.g. salt content, has to be nearly constant.

2.4 Definitions

Attenuation	Weakening of the microwave signals, microwaves measurement effect.
Evaluation unit	**Ev**aluation **U**nit
Factory setting	See factory setting
Factory setting	All parameters have been set by the manufacturer using standard values. In most cases this simplifies calibration of the instrument significantly. Despite factory setting, calibration should **always** be performed.
HF cable	**H**igh **f**requency cable
MBq	Mega Becquerel This unit is the activity of a source. Each Bq corresponds to one decay per second. 1 MBq = one million decays
Mpua	**M**ass **p**er **u**nit **a**rea
mCi	Milli Curie This unit is also used for the activity of a source. However, this is the older unit that has been replaced by the unit MBq. (1 mCi = 37 MBq)
Microwaves	Electromagnetic waves in a certain frequency range.
Nuclide / isotope	Substance of the radiation source. For the moisture measurement on a belt or in a chute usually Cesium-137 (Cs-137), rarely Americium-241 (Am-241)
Phase	Phase or phase shift, microwave measurement effect
Softkeys	Buttons associated with the software.
TC	**T**emperature **c**ompensation

Chapter 3. **System Description**

3.1 Principle of Measurement

The microwaves transmit the product being measured; their propagation speed is slowed down (= phase shift) and their intensity is damped (= attenuation). Figure 3-1 illustrates the principle of measurement: The propagation speed of microwaves passing through the product being measured is slowed down (phase shift) and their intensity (attenuation) is reduced, relative to a reference signal.

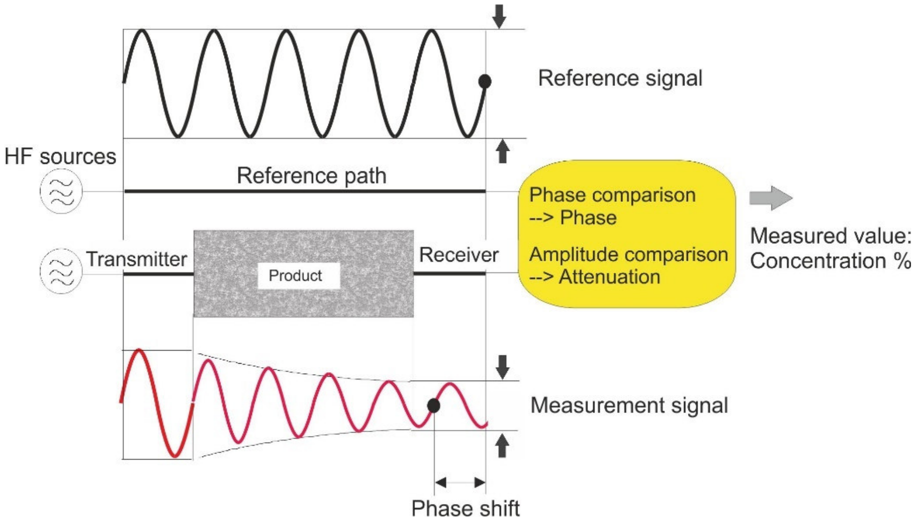


Figure 3-1: Schematic diagram: Microwaves are changed by the product

The prerequisite is that the product being measured shows dielectric properties. Generally, water is a very distinct dielectric fluid. The water or dry mass concentration can therefore be determined by measuring the phase shift and/or attenuation.

The concentration to be detected in the product is therefore in good approximation linearly dependent on the phase shift and the attenuation. For this reason, we can measure the concentration or the dry matter content of the product using a linear calibration (see *chapter 3.2 Calculation of Measured Values*).

3.2 Calculation of Measured Values

The microwave parameters phase shift or short phase and attenuation are calibrated according to an automatic plausibility analysis.

During calibration, a concentration value (or density value) is assigned through sampling to the phase and/or the attenuation. The calibration runs automatically and the sampling process is supported by the evaluation unit.

Which of the parameters (phase, attenuation or both) will be used for the calibration depends on the size of and the disturbing influence on the measuring effect. For example, the attenuation is more sensitive to electrolytic conductivity (salt content).

The measuring accuracy can be increased further only for some special applications through a combination of attenuation and phase measurement. Any possibly remaining grain size influence that may occur in a pure phase measurement can be reduced by using the combined measurement.

In many cases, the pure phase measurement is recommended and the measured value is calculated as follows:

Measured value = A · Phase + C **Eq. 3-1**

where:

Measured value	Concentration / Moisture / Dry mass
A, C	Coefficients of respective calibration function

The LB 568 allows you to calibrate, display and output two concentrations: Con1 and Con2. You have to enter the calibration coefficients separately for concentration 1 and 2. For more information please refer to the Software Manual.

Limitations

- Weakly bound water can be detected depending on the strength of the binding. Thus, the measuring effect may be dependent on the grain size distribution and the chemical properties of the product being measured, provided this changes the binding of water to the solid matter.
- Walls made of plastic, rubber or insulation materials with fairly low dielectricity hardly affect the measurement and are calibrated at a constant level.
- Ice and crystal water cannot be measured because the water molecules cannot rotate freely (ice and crystal are dry).

Conductive materials such as graphite or coke cannot be transmitted by microwaves. Metal walls can also not be transmitted by microwaves. Metal-reinforced conveyor belts may be transmitted only under certain conditions (see *chapter 4.2.3 Installation of the Horn Antenna and 4.2.5 Installation of the Radiometric Measuring Path*).

Compensation

In addition to the water content, the product temperature, product density and a varying material load (varying microwave irradiation path) may have an influence on the phase and attenuation. This influence has to be compensated for during calibration.

In general, a temperature compensation (TC) is not required for bulk material. If the product temperature has a significant impact on the microwave measuring signals phase or attenuation, a TC should be connected (see *chapter 7.2 Temperature Compensation).* The temperature influence depends on the product and water content.

3.3 Loading Compensation

The microwave irradiates the product to be measured and detects all changes in the product. Example conveyor belt, see Fig. 3-2:

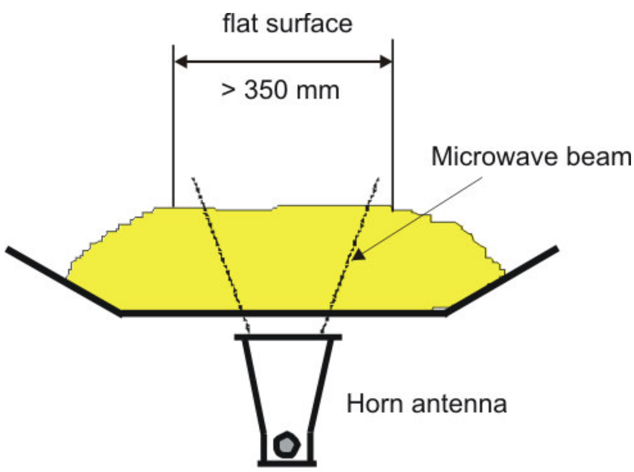


Figure 3-2: Material profile on the conveyor belt

The microwaves irradiate the entire material cross-section in the radiation field. If the material layer thickness or the bulk density changes (with constant moisture), then the microwave signals will be affected. The goal of loading compensation is to compensate for this influence. This is done by considering the two parameters layer thickness and bulk density which correspond to the mass per unit area:

Load = mass per unit area [g/cm²] = $\delta \cdot h$ **Eq. 3-2**

where:

δ bulk density [g/cm³]
h material layer thickness [cm]

With loading compensation, equation 3-1 is expanded as follows:

Measured value = A · Phase + G · Load + C **Eq. 3-3**

where:

Measured value	Concentration / Moisture / Dry mass
A, G, C	Coefficients of the calibration function

Depending on the type of load fluctuations, there are several possibilities for compensation; typically, the radiometric mass per unit area compensation is used, which is described below.

At constant bulk density or if the mass per unit area is already known, one may not need the radiometric measurement path under certain circumstances. In this case, there are alternative possibilities for compensation, see *chapter 7.1 Optional Loading compensation.*

3.3.1 Radiometric Mass per Unit Area Compensation

The influence of a varying material layer thickness and bulk density disappears through standardization with regard to the irradiated mass per unit area. The compensation is calculated as follows:

Load = mass per unit area [g/cm^2] Eq. 3-4

The radiometric measurement path supplies the mass per unit area signal.

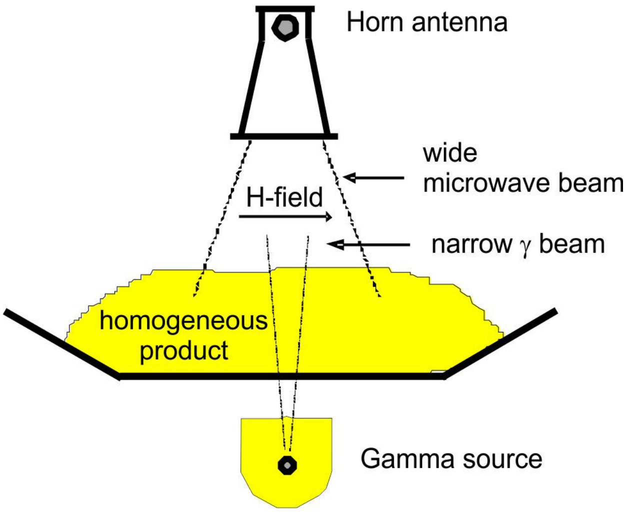


Figure 3-3: Microwaves and gamma radiation field at the conveyor belt

The radiometric mass per unit area measurement is based on the physical effect that gamma radiation passing through the material to be measured is subject to an exponential intensity attenuation (see Figure 3-3). The intensity attenuation can be described by the law of absorption:

$$\mathbf{I} = \mathbf{I_0} \cdot \mathbf{e}^{-\mu\delta\mathbf{d}} \qquad \textbf{Eq. 3-5}$$

Where:

μ = absorption coefficient
δ = bulk density
d = layer thickness
I = actual count rate
I_0 = zero count rate
Mpua = mass per unit area

Io is the intensity of the unattenuated radiation and **μ** the material-specific attenuation coefficient (absorption coefficient). This is specified as the default value for the chosen isotope (e.g. Cs-137 source, μ = 0.07), but can be adjusted.

The residual radiation still arriving at the scintillation of the intensity **I** is a measure of the mass per unit area (**Mpua**).:

$$\mathbf{Mpua} = \frac{\mathbf{1}}{\mu} \cdot \mathbf{ln}\left(\frac{\mathbf{I_0}}{\mathbf{I}}\right) \qquad \textbf{Eq. 3-6}$$

A constant distance is assumed between the radiation source and scintillation counter.

The thickness of a wall to be irradiated additionally, or the conveyor belt, is calibrated during the zero measurement, i.e. it does not have any influence on the measuring effect. The intensity of the radiation source decreases over time. The period in which it has fallen to half its initial intensity - the half-life - depends on the radiation source. MicroPolar Moist compensates for the source decay automatically depending on the selected radiation source. Therefore, it is important to enter a correct date!

3.4 Mechanical Components

The measurement system consists of the evaluation unit (short EVA, Figure 3-4), one pair of antennas with HF cable (short HF cable) and the radiometric mass per unit area measurement (short radio Mpua). The antenna pair consists either of two identical horn or spiral antennas, see Figure 3-5. The radiometric mass per unit area system consists of the point source with scintillation container and scintillation counter, see Figure 3-6.

Figure 3-4: Evaluation unit MicroPolar Moist

Figure 3-5: From left: Horn antenna pair, spiral antenna pair

Figure 3-6: From left: Point source shielding, scintillation counter with axial collimator

3.4.1 The Evaluation Unit

The evaluation unit comprises the evaluation computer with microwave unit and radiometry board. The microwaves are generated, received and analyzed in the microwave unit. Signal processing and communication take place in the evaluation computer. On the radiometry board there is a screw terminal strip for connection of the scintillation counter; the communication (RS485) and the auxiliary power supply of the scintillation counter take place via this screw terminal strip. For simple operation, the measuring system includes a display, 4 softkeys and an alphanumeric keypad. Different functions are assigned to the softkeys on the display. An RS232 interface is included on the bottom of the device.

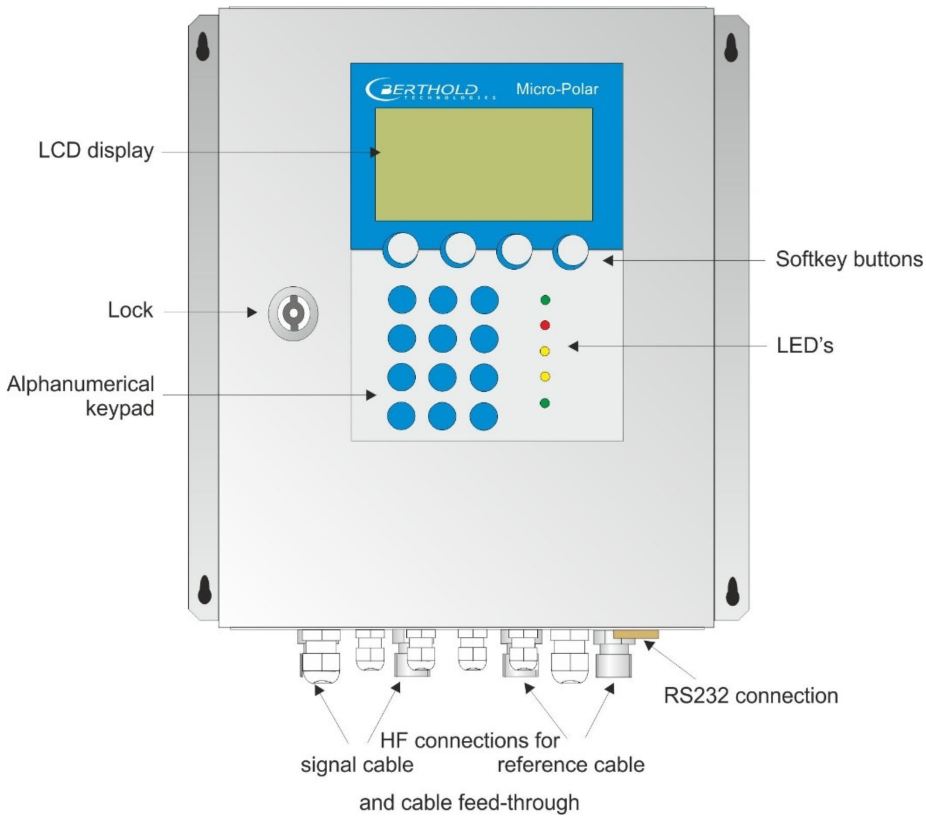


Figure 3-7: Front view of the evaluation units

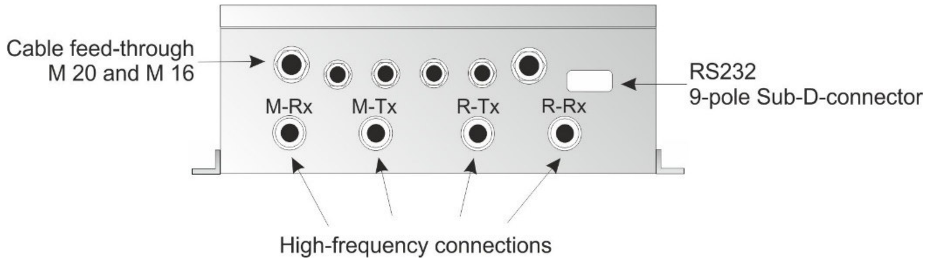


Figure 3-8: Evaluation units - bottom view

LED’s on the Front Panel

Five LED’s on the instrument front panel indicate the instrument status.

LED	Function
Run	On: Device in measurement mode Flashing + ERROR LED off: Device in warning state, on hold or low load state. A display message with error code indicates the cause (see *Software Manual, chapter 9. Error Lists and Device States).*
Error	On: Device in error state. A display message with error code indicates the cause *(see Software Manual, chapter 9. Error Lists and Device States).* Canceled after reset or if error has been eliminated
Signal 1	Display depending on the selected function of relay 1, possible functions: error, alarm min., alarm max., measurement stopped, low load.
Signal 2	Display depending on the selected function of relay 2, possible functions: error, alarm min., alarm max., measurement stopped, low load
Comm	Communication active, e.g. via RS232

For a description of the device states please see the *Software Manual, chapter 9. Error Lists and Device States*.

Terminal blocks

The electrical connections of the LB 568 are located on two connector strips in the wall housing. They are accessible from the front by opening the cover. There, you also find the fuses and a test switch (see Fig. 5-1). The high-frequency connections are located on the outside of the housing. All other elements, especially the live elements (on the motherboard) are provided with a protection cap.

3.4.2 Horn and Spiral Antennas

Various types of microwave antennas are available for moisture measurements on a conveyor belt or in a chute, taking into account the different geometries of the respective application. There are each an identical pair of antennas (transmitter and receiver) that are connected to the evaluation unit via an HF cable.

	Horn antenna	**Spiral antenna**
Polarization	Linear	Circular
Distance (field size)	up to 3 m	0.1 to 0.75 m
Application	Conveyor belt, bunker, steel reinforcement possible	Conveyor belt, bunker, steel reinforcement not possible, belt without strong troughing
Assembly conditions	Vertical or oblique to the belt, coupler parallel to the flow direction of the material (exception: steel-reinforced belt).	Vertical position
Product being measured	General	Only homogeneous material for phase measurement. Material with direction-dependent inhomogeneities, for example, chips: only for attenuation measurement

Horn antenna

The horn antenna is made out of stainless steel, see Fig. 3-9. The antenna openings are closed tightly by plastic windows. The horn antenna is a special construction where the wave guided in the HF-cable goes over into a free wave. The magnetic field disseminates vertically and the electrical field horizontally to the adapter (see Fig. 3-9).
If dust deposits may occur, these windows should be cleaned regularly. Dust depositions distort the results relative to their mass per unit area and their water contents. The antennas do not contain any electronic components; however, they should be protected against mechanical damage.

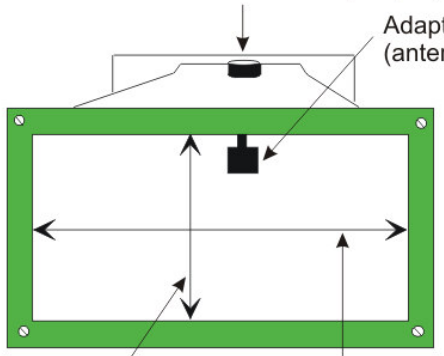


Figure 3-9: From left: Horn antenna, horn antenna with a view through the window

Spiral antenna

The spiral antenna sends or receives microwaves in circular polarization.
The spiral antenna is a near-field antenna and should be used only for distances between 0.1 and 0.7 m. On materials including inhomogeneities that change the direction of the microwaves it can be employed only with the attenuation measurement.

Figure 3-10: Spiral antenna

3.4.3 The Radiometric Measuring Path

The radiometric measuring path consists of
- a scintillation counter
- a radiation source (Cs-137 or Am-241) installed in a lockable shielding

Scintillation counter

Two scintillation counter versions with different collimators are available: the axial and radial collimator. With the axial collimator, the entrance window is located on the front side, with the radial collimator on the side, see Figure 3-11.

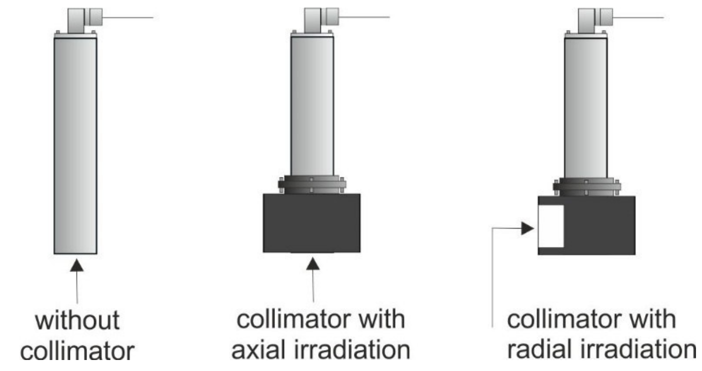


Figure 3-11: Scintillation counter with and without collimator

Radiation source

Cesium (Cs-137) and Americium (Am-241) gamma emitters are used as radiation sources.

Shielding

The point source Cs-137 is built into the shielding type LB 744X. The shielding container is made of a sturdy cast iron or stainless steel housing, see Figure 3-12. The container front side is closed by a metal plate. The radiation exit channel can be closed by a built-in rotating diaphragm. The diaphragm is operated from the rear via a lever which in the open and closed position can be secured by a lock. The source is installed so that it is also protected by the lock against unauthorized removal.
Alternatively, the lock can be pneumatically actuated (see following page).

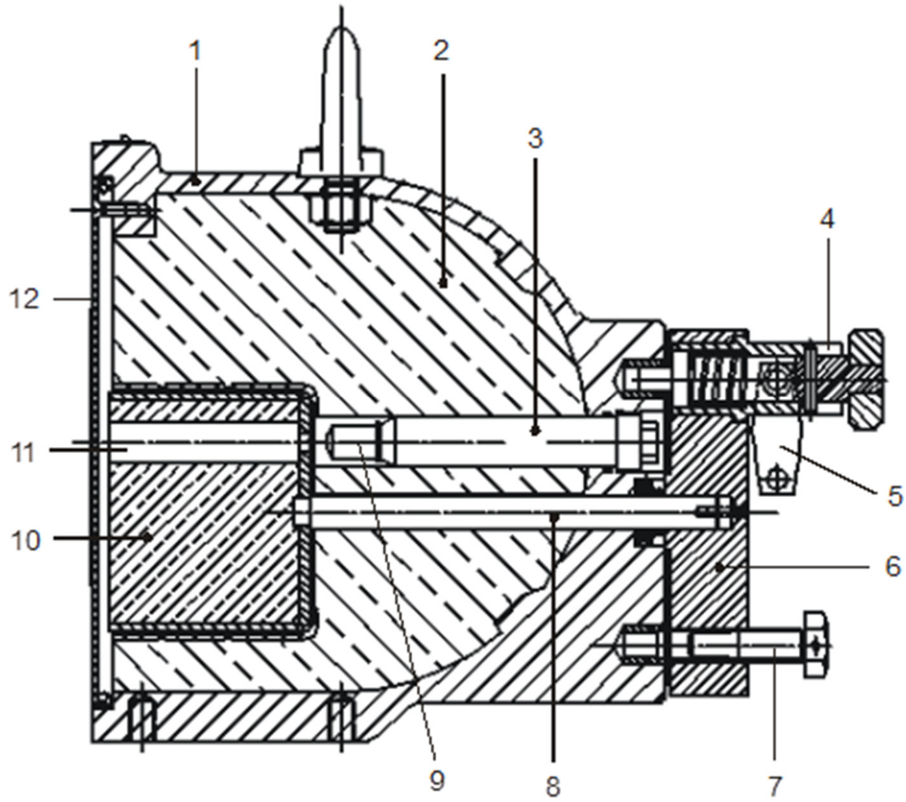


Figure 3-12: Cross-section shielding container with source

1	Shell	7	Lock
2	Lead filling	8	Rotation axis
3	Source bracket	9	Radiation source
4	Spring pin	10	Locking core
5	Padlock	11	Radiation exit channel
6	Locking lever	12	Cover plate

Shielding with pneumatically operated lock and shutter switch (option)

A pneumatic lock with switch contacts indicating the position of the lock is available as a special version.

The pressurized air moves the locking diaphragm to the OPEN position. If the pressurized air is turned off or in case of failure, a spiral spring turns the locking diaphragm back to the CLOSED position.

Technical details *in chapter 6.3 Technical Data Radiometric Mass per Unit Area Measurement.*

NOTICE

The pneumatic drive is equipped with a throttle valve. The valve must be set such that the opening and closing process for the shielding takes at least 2 s; otherwise the shielding may get damaged.

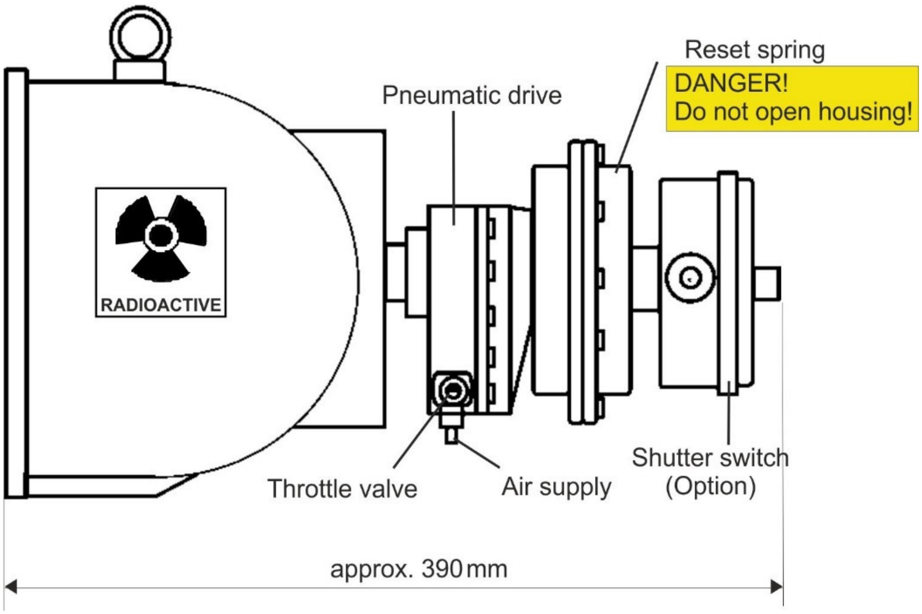


Figure 3-13: Pneumatic lock with limit switch

CAUTION

Do not open the spring unit, see Figure 3-13.

3.4.4 Measuring Chute

For bulk material Berthold Technologies delivers a measuring chute complete with mounting plate and brackets for horn antennas, scintillation counter and shielding containers. The chute is made of plastic PP-H or PVDF.

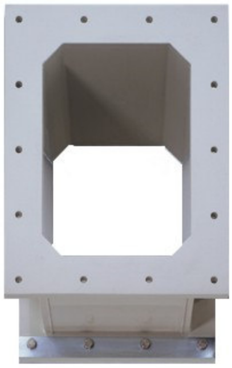


Figure 3-14: Measuring chute made of plastic PP-H

The horn antennas, the scintillation counter with collimator and contact protection, and the shielding container with source and contact protection are mounted on the assembly plate. The plastic chute is firmly connected to the assembly plate.
The assembly plate is already provided with all the necessary mounting holes, so that the microwave and radiometric measuring path can be aligned optimally, see Figure 3-15.

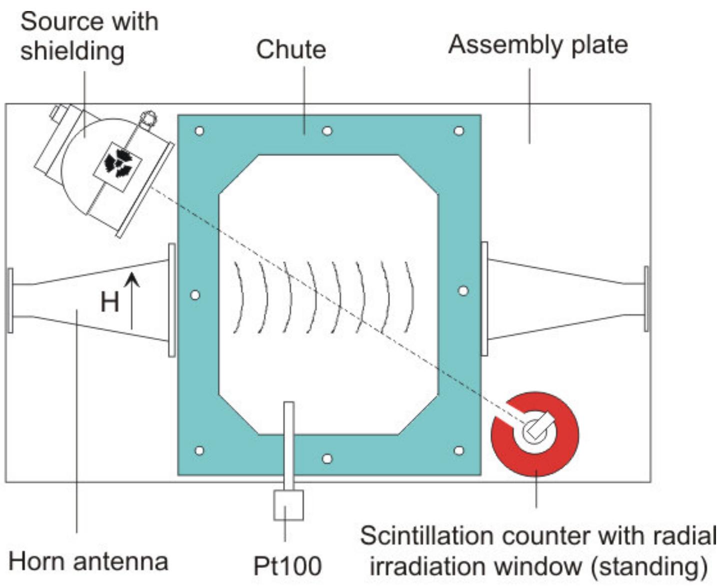


Figure 3-15: Assembly plate with chute, horn antennas and radiometric measuring path

3.4.5 High-frequency Cable

High-frequency cables (HF cable) are used to transmit the microwave signals.

HF cables change their conductivity (for microwaves) depending on the temperature. Therefore, they would create measurement errors if the ambient temperature varies. This error is compensated for by enabling the cable compensation. The influences of the ambient temperature on the signal cable are compensated for by means of the reference cable. To this end, the sum of the reference cables is chosen just as long as the sum of the measuring cables.

The HF cable is provided at the ends with an HF connector (N-type). Available lengths: 0.5 to 4 m (in 0.5 m steps, see Figure 3-16).

One HF cable (called measuring or antenna cable) connects the evaluation unit with the antenna. A third HF cable serves as reference line; its cable length corresponds to the sum of the lengths of both antenna cables.

The shorter the cable connections between antennas and evaluation unit, the better the stability of the measurement.

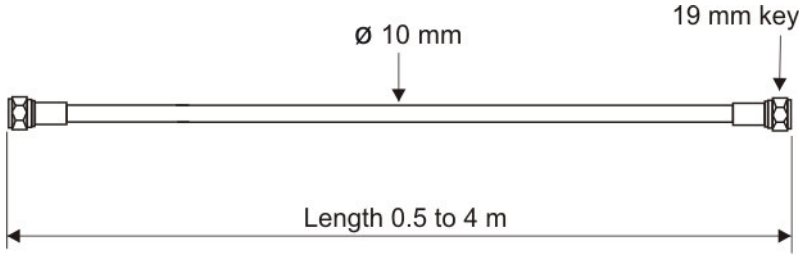


Figure 3-16: Semi-rigid cable

For further technical data, see *chapter 6.5 Technical Data HF-Cable*.

3.5 Conveyor Measurement Configuration

The antenna pair and the radiometric measuring path are assembled in a stable frame. The evaluation unit is installed in the direct vicinity of the horn antennas in order to limit the length of the HF cables to max. 2 m each. See also Figure 3-17 and the installation proposal in *chapter 10.6 Installation Proposal on the Conveyor Belt*.

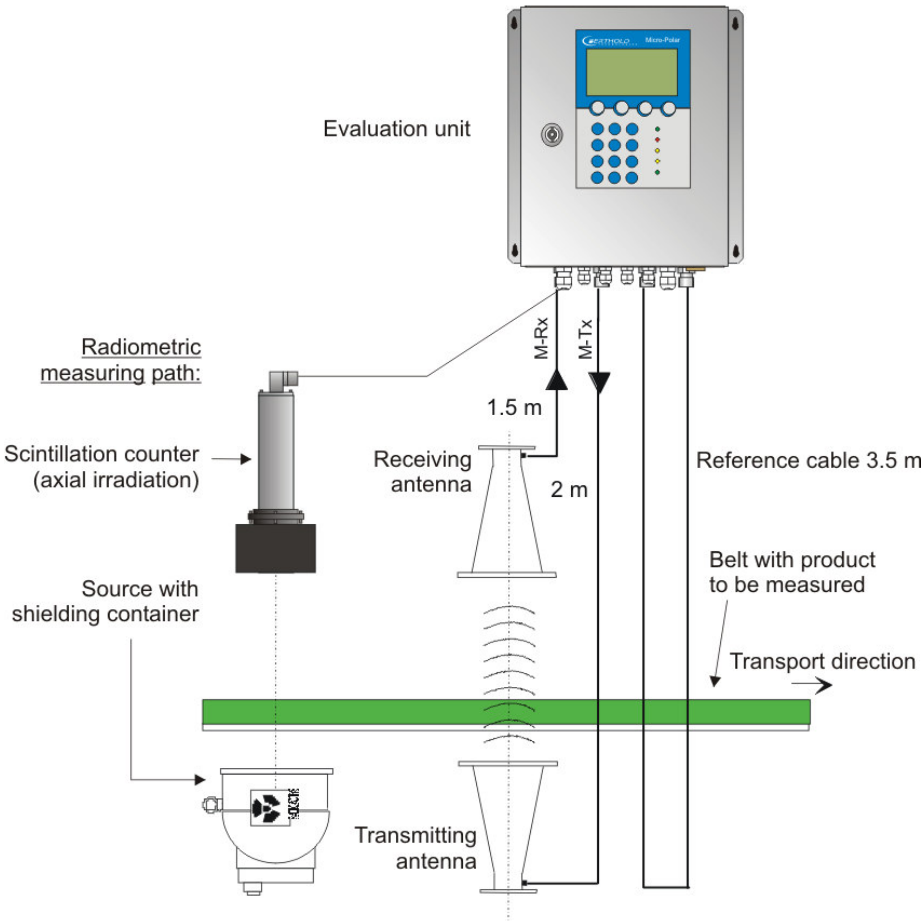


Figure 3-17: Typical measurement configuration on a non-steel reinforced conveyor belt. With horn antennas and radiometric mass per unit area measurement (with example values).

3.6 Chute Measurement Configuration

The measuring chute is installed directly in the product flow, or in a bypass. Complete filling of the chute during the measurement must be guaranteed. The antennas, the scintillation counter and the source with the shielding container are mounted on the mounting brackets provided on the measuring chute. The evaluation unit is installed in the direct vicinity of the horn antennas in order to limit the length of the HF cables to max. 2 m each. See also Figure 3-18 and the installation proposal in *chapter 10.7 Installation Proposal on the Measuring Chute*.

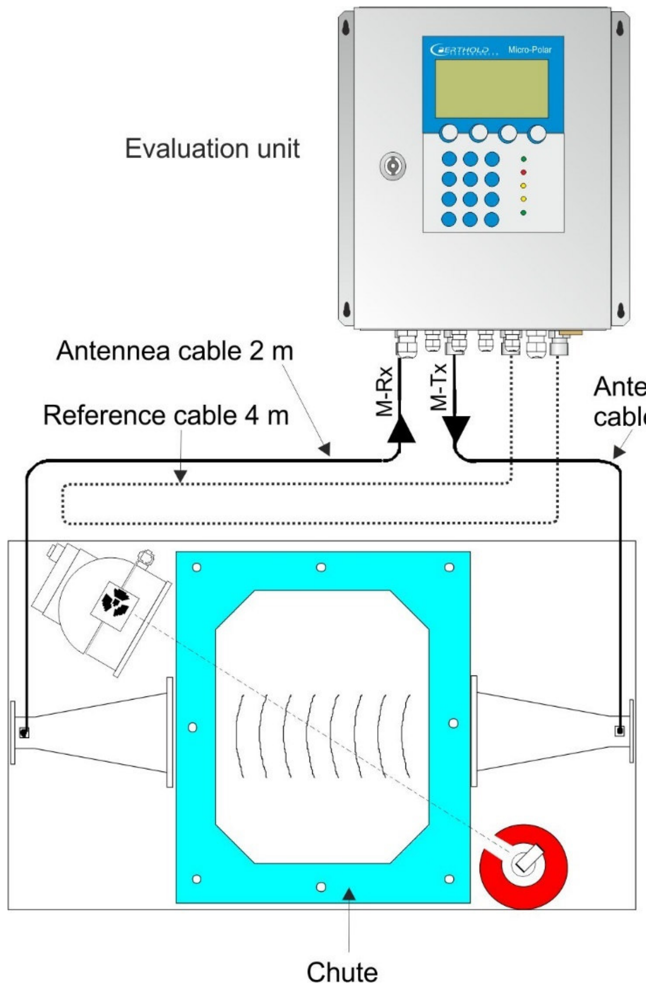


Figure 3-18: Typical measurement configuration on the measuring chute with example values

Chapter 4. **Getting Started**

4.1 Transport

IMPORTANT Risk of damage!

System parts may get damaged during transportation!

Transport all components in their original packaging. Protect parts against shocks. Especially the horn antenna must be protected against mechanical shocks, as otherwise the coupling pins may get bent and the function can be impaired severely.

After unpacking, make sure all parts listed on the packing list have been delivered and show no sign of damage; if necessary, clean these parts.

If you detect any damage, please notify the forwarder and the manufacturer immediately.

The weight of the system components may exceed 30 kg, depending on the version. We recommend, therefore, that you wear safety boots.

4.2 Commissioning the Conveyor Belt

4.2.1 Components

The measurement setup on a conveyor belt basically comprises the following components:

- a pair of horn <u>or</u> spiral antennas
- an evaluation unit
- a scintillation counter with collimator and connection cable
- a source with shielding container
- a set of HF cables

The MicroPolar Moist is usually delivered with radiometric mass per unit area measurement for compensation. If the bulk density is constant, optional compensations are possible, e.g. by a layer thickness or weight measurement. Details see *chapter 7. Other Compensation Options*.

4.2.2 Measuring Geometry and Measuring Conditions

1. Measuring condition: Required material profile

The product surface must be flat over a **width of at least 350 mm** (see Fig. 4-1). No gaps or slots in the product. This is absolutely essential to ensure that the microwave irradiation field always sees the same product density and the compensation measurement correlates with the microwave measurement.

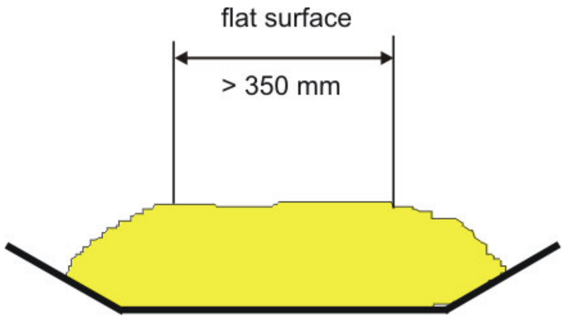


Figure 4-1: Flat surface in the beam range

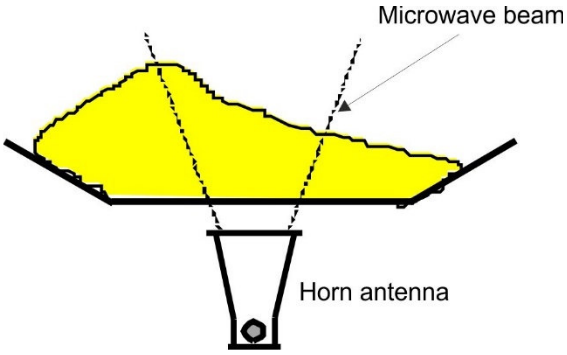


Figure 4-2: Example 1: The microwaves continuously irradiate a different material layer.

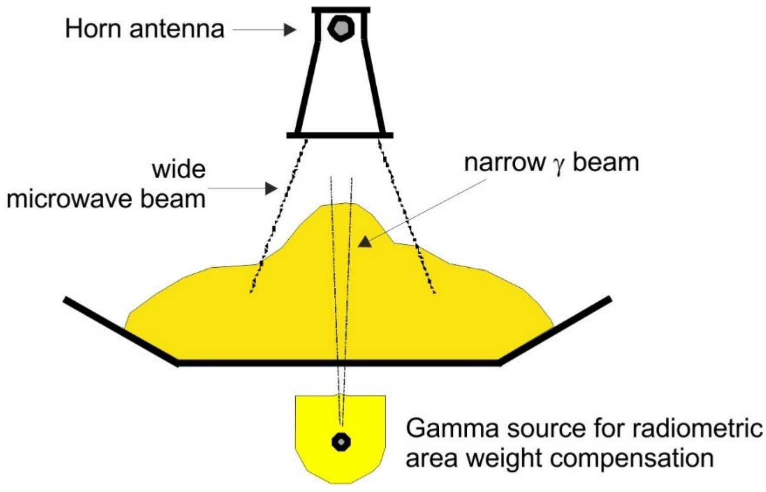


Figure 4-3: Example 2: Compensation and microwave measurement do not see the same material layer; therefore, both measurements do not correlate with each other.

2. Measuring condition: Homogeneous load on the belt

The product must be homogeneous. If the product is not mixed or asymmetrical on the belt, the moisture reading is not representative and the sampling (e.g. for calibration) may possibly be incorrect, see Fig. 4-4.

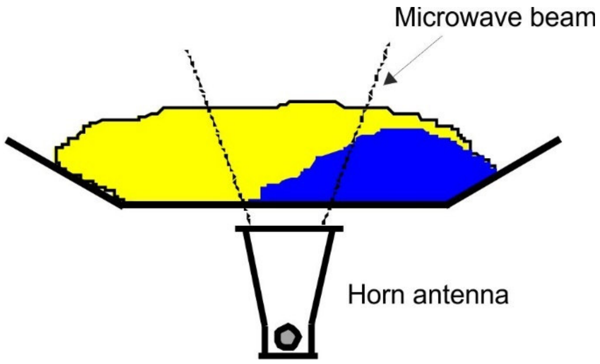


Figure 4-4: Two different products (e.g. due to different moistures), not mixed and filled asymmetrically.

3. Measuring condition: electrically conductive materials

No metals or other conductive materials must be located between transmitting and receiving antennas (in the radiation field).

It has to be ensured that rubber belts will not become too conductive by adding graphite to the rubber mixture.

A special case are steel reinforced conveyor belts, see the following chapters.

4. Measuring condition: Minimum load

The minimum load on the conveyor belt is dependent on the product composition and the material structure. In a first approximation, the minimum material thickness can be specified as follows:

$$d_{min} = \frac{4}{\delta} \quad \textbf{Eq. 4-1}$$

Where:

d_{min} = minimum material thickness [cm]
δ = bulk density [g/cm^3]

5. Measuring condition: Synchronous belt load

The loading compensation can only function correctly if the microwave and the compensation measurement measure the same product.

To this end, the product will first pass through the radiometric measuring path before it reaches the microwave measuring path. Furthermore, the belt load for a period of at least 1 second must remain the same, see Figure 4-5.

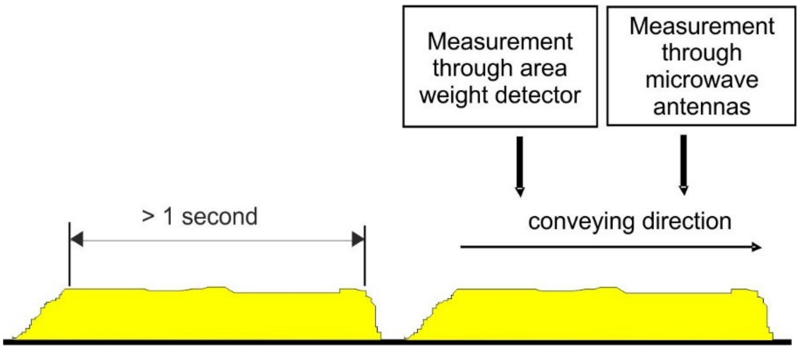


Figure 4-5: Correlate the same belt load

4.2.3 Installation of the Horn Antennas

The installation is done as shown in our example in Figure 3-17 or the installation proposal in *chapter 10.6.*

A stable bracket must be provided. The accessories include a bracket that allows variable orientation.

Setup of the Horn Antennas

- Install both horn antennas in diametrically opposite locations
- Transmitter and receiver must always have the same polarization; the couplers must always point in the same direction.
- Typical distances between the antennas are 30 to 80 cm, but may be up to 1 or 2 m.
- The coupler should always face the material flow, because then the waves are not deflected so much by the material flow.
- The transmitting antenna must be installed below, the receiving antenna, above the conveyor belt.
- When transmitting the upper and lower belt, you should allow for incorrect measurements caused by the geometry. Sufficient room for the horn antennas should be available below the upper belt. If necessary, a belt deflection has to be carried out, or you have to check if spiral antennas are better suited.
- Select the installation site of the horn antennas such that they will not be affected by dirt on the radiation exit window.
- Install the reference cable parallel to the signal cables. Its length corresponds to the sum of both signal cables.
- Install the antennas as far away as possible from the rollers or other metallic objects.
- The supplied HF cable can be bent depending on your installation situation (min. bending radius 10 cm). Fix the cables to prevent them from slipping. It is not permitted to change the cable lengths or to use other cables.
- In wet areas the cable connection always have to face down. Make sure that no humidity can penetrate. If necessary, you have to seal the HF-connection by taking suitable provisions.

- To ensure a satisfactory measurement on conveyor belts, the material layer should be plane-parallel with the belt. With bulk goods, one can achieve this smoothing effect quite easily, for example, by dragging a hinge-mounted plate over the material surface. The same effect is obtained with a free-sliding ski moving through parallel guide rods over the material surface. Especially for grain sizes above 10 mm, the ski is superior to the mobile plate. Experience shows that a fairly smooth surface and homogeneous layer will be obtained only when the minimum layer thickness is at least three times as high as the maximum grain size. For fine-grained materials we recommend using a "plow" to smooth the material surface without significantly changing the bulk density, especially if no bulk density or mass per unit area measurement is available

Exception: Oblique transmission

Typically, the horn antennas and the radiometric measuring path are installed at a 90° angle to the material flow. Whether oblique transmission is necessary and in which angle the antennas should be mounted has to be clarified before planning the project. The angle (see Fig. 4-6) will be specified by Berthold Technologies.

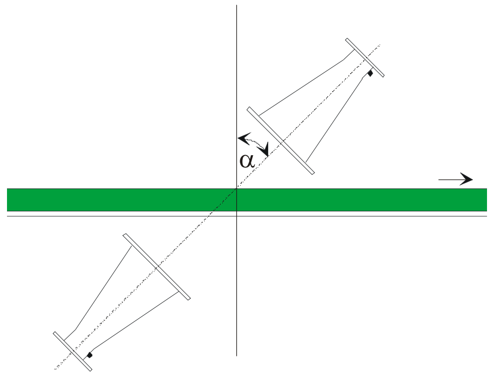


Figure 4-6: Setup for oblique transmission The angle will be defined by Berthold Technologies

In case of strong reflection, the interference of the reflected wave can be reduced through oblique transmission.

Exception: Steel-wire reinforced conveyor belt

If the conveyor belt is reinforced by metal ropes in the conveying direction, the antennas have to be mounted such that the electric field (E) runs at a 90° angle to the ropes. The connection socket of the antenna cable faces the same direction as the electric field, see Fig. 4-7 and 4-8.

Microwaves can irradiate conveyor belts with parallel metal wires or rods only if the horn antennas are oriented correctly.

Please contact the manufacturer and state the diameter of the steel ropes and their distance. Make sure that the belt itself is not made of conductive rubber (anti-static through additional graphite).

The surface of the product must be flat over a stretch of at least 500 mm (instead of 350 mm as in a regular configuration).

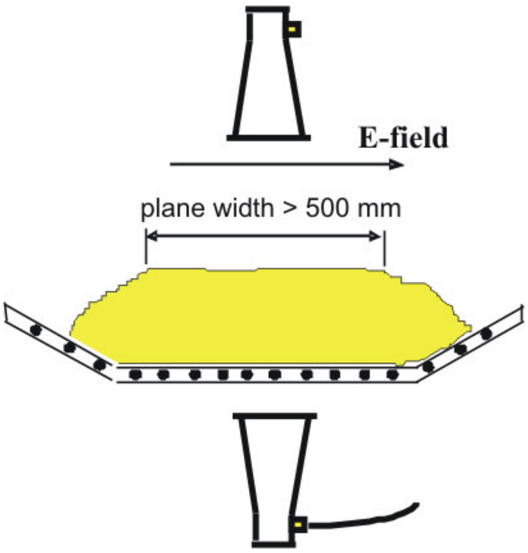


Figure 4-7: Setup of the horn antennas with steel-reinforced conveyor belt

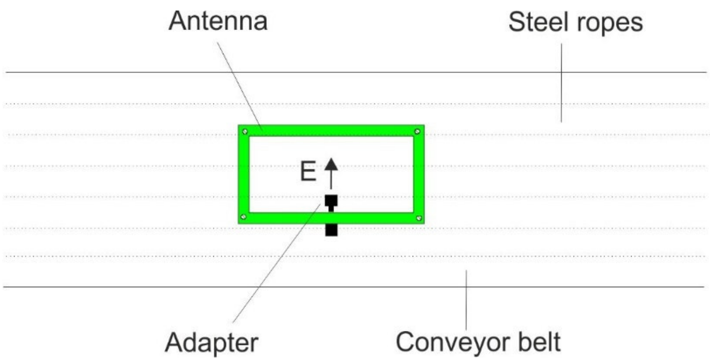


Figure 4-8: Alignment of the antenna in the case of parallel running steel ropes

In contrast to the recommended configuration without steel-reinforced belts, here the antennas have to be turned by 90° so that the cables come from the side, instead of running parallel to the conveying direction.

4.2.4 Installation of the Spiral Antennas

The installation is done as shown in our example in Figure 4-9. Stable brackets must be provided.

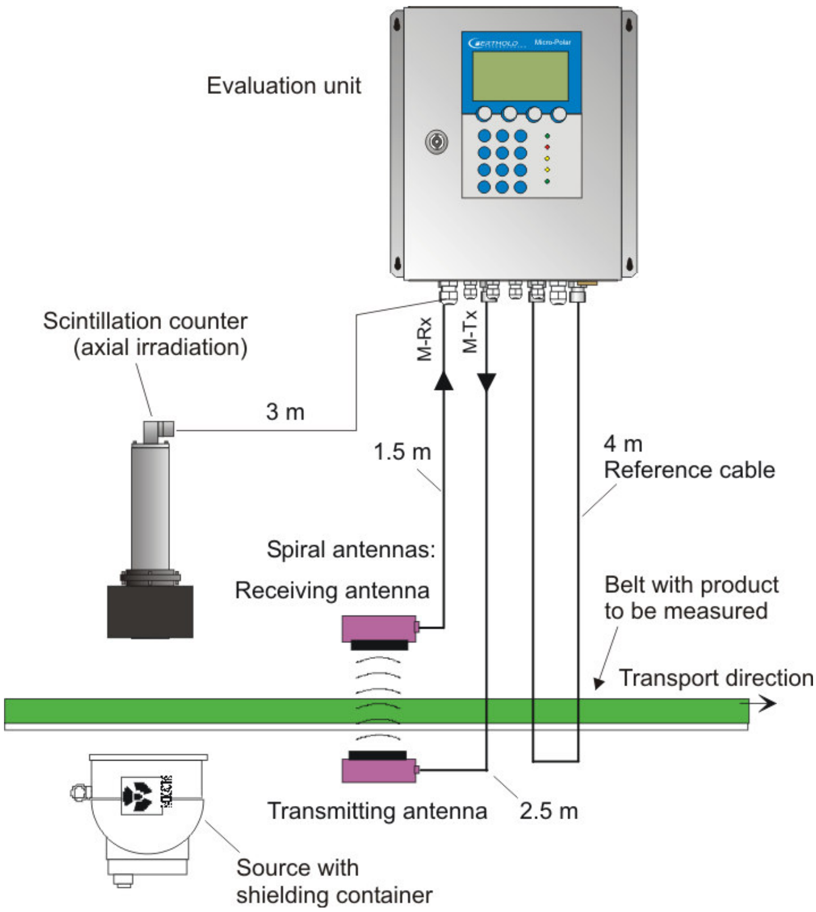


Figure 4-9: Measurement setup on a conveyor belt with spiral antennas (with example values)

Setup of the Spiral Antennas

- Install both antennas in diametrically opposite locations
- Typical antenna distances are approx. 10 to 70 cm.
- The transmitting antenna must be installed below, the receiving antenna, above the conveyor belt.
- The connection may face any direction.
- The spiral antennas must be installed at a 90° angle to the material.
- The spiral antennas should be installed at least 10 cm above the max. loading level.
- Select the installation site of the spiral antennas such that they will not be affected by dirt.

- The length of the reference path normally corresponds to the sum of the length of both antenna cables and has to follow the same way as long as possible.

Note: Oblique transmission and irradiation of steel-reinforced belts is not possible due to the circular polarization.

4.2.5 Installation of the Radiometric Measuring Path

The radiometric measuring path consists of the radiation source in a lockable shielding container and the scintillation counter with 3 m long connection cable (connection to the R-board in the evaluation unit).

Check if the shielding container is closed before you begin the installation.

DANGER

Radioactivity!

Installation and commissioning of radiometric measuring systems may be carried out only by persons who have been instructed adequately by professional personnel!

Work is carried out under the guidance and supervision of the Radiation Safety Officer. Make sure that the lock of the shielding is closed.

To do this, set the lever of the shielding container LB 744X clearly to the "CLOSED" position. Set the locking device to the "OPEN" position only for commissioning.

The shielding container and the scintillation detector must be exactly aligned. A suitable bracket is available for detector installation, allowing subsequent adjustment of the alignment. The fine position adjustment is done later by shifting the detector until the maximum count rate (signal intensity picked up by the detector) is reached. See also Figure 3-17 and the installation proposal in *chapter 10.6 Installation Proposal on the Conveyor Belt*.

The mounting frame must be so sturdy that any subsequent shifting of both components relative to each other is ruled out. This would alter the geometry of the measurement and cause measuring errors. Depending on the version, the detector is designed for frontal or radial irradiation.

The shielding container should be installed as close as possible to the conveyor belt. If no design documentation is available, a minimum distance of 5 cm should not be exceeded for radiation protection reasons. The conveyor belt must not touch the shielding container. A special mounting plate allows adjustment of the distance in steps of 35 mm.

The radiometric measuring path can be installed directly next to the microwave measuring path. Even a crossover of gamma radiation and microwaves is uncritical. A mutual interference will not occur.

In order not to limit the lifetime of the detector, the transmission of excessive vibration and temperatures above 50°C must be avoided by taking appropriate measures. For outdoor operation, the detector should be protected from direct sunlight and rain by a canopy. Accessories for the protection hood, see *chapter 6.3 Technical Data Radiometric Mass per Unit Area Measurement*.

Exception: Oblique transmission

The transmission angle α of the radiometric mass per unit area measurement, see Figure 4-10, corresponds to the transmission angle of the microwave antennas, see *chapter 4.2.3 Installation of the Horn Antennas*. This ensures that both measurements transmit the same layer thickness.

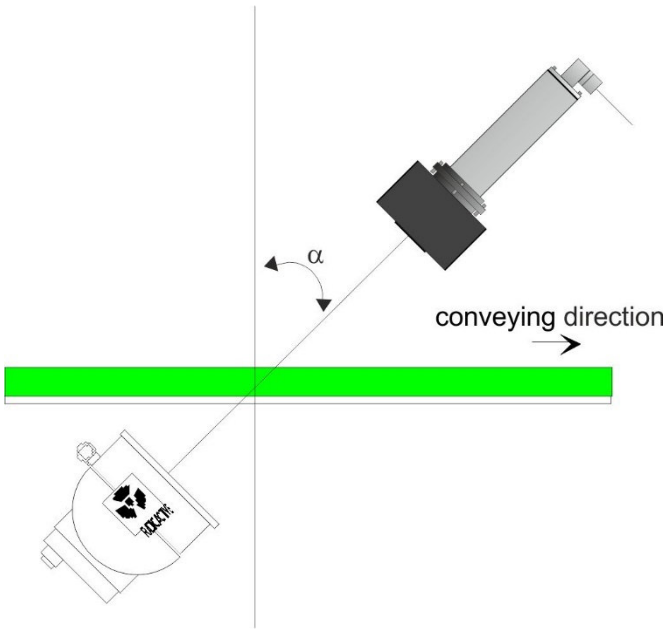


Figure 4-10: Exception: Oblique transmission

Exception: Steel-wire reinforced conveyor belt

If the conveyor belt is reinforced by metal ropes in the feed direction, the positions of source and detectors have to be exchanged (see Figure 4-11). The source with shielding container is then placed above and the scintillation counter below the conveyor belt.

If the distance between the upper and lower belt is too small for a detector with an axial radiation, one can use the detector with side window.

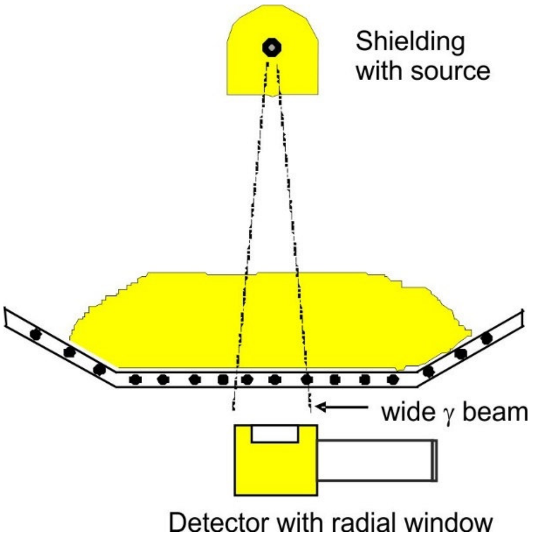


Figure 4-11: Setup on a steel-wire reinforced belt

4.2.6 Installation of the Evaluation Unit

For installation of the evaluation unit please keep in mind:

- Position the evaluation unit depending on the length of the HF cable in the vicinity of the microwave probe. The typical distance between evaluation unit and flow cell is about 2 m.
- The evaluation unit has to be protected against vibrations. In some cases, it is advisable to install the evaluation unit on a stand which is separated from the pipeline system.
- For instrument installation you should foresee a cutoff device to allow easy and quick disconnection of the device from the power supply.
- Provide an automatic separator (circuit breaker) which disconnects the device from mains within 0.03 seconds in case of failure. The separator must be adapted to the wire cross-section of the lead; it must be designed at least for 1 A continuous current.

- For outdoor operation, the evaluation unit has to be protected against direct sunlight and rain, for example by a suitable canopy.

4.2.7 Connecting the HF Cable

Connect the horn/spiral antennas and the evaluation unit (sockets M-Tx and M-Rx) with the antenna cables. The transmitting antenna is connected to M-Tx below the belt, and the receiving antenna to M-Rx above the belt.

Connect a reference cable to the reference sockets of the evaluation unit (R-Tx and R-Rx). The reference cable should have the same characteristics and if possible the same length as the total of both antenna cables.

Install the signal and reference cable in the same manner (if possible, parallel), so they are exposed to the same temperature (temperature compensation of ambient temperature on the antenna cable; this ensures long-term stability).

Hand tighten all screwed connections of the HF cable (2 Nm = 0.2 KG/m)! Before tightening, carefully screw on the cable by hand. **Caution! Threaded joint jams easily.**

Fix the antenna and reference cable after you have installed them.

IMPORTANT

A steel pipe may protect the cable and keep signal and reference cable on the same temperature for an effective temperature compensation.

Kinked cables falsify the results and make the cable useless. The bending radius should not be less than 100 mm.

Occasionally you should check if the screwed connection is still properly tightened. If the installation is exposed to vibrations, the screwed connection may come loose and this may result in inaccurate measurements or corrosion of the connections.

As long as the cables are not connected, the coaxial sockets have to be covered immediately with plastic caps and the cable connectors have to be protected by suitable provisions against moisture and dirt.

4.3 Commissioning the Chute

The moisture measurement on a chute is done using a fully assembled measurement configuration with horn antennas and radiometric measuring path. See also Figure 3-18 Typical measurement setup.

4.3.1 Components

The measurement setup on a measuring chute comprises the following components:

- a pair of horn antennas
- a measuring chute
- an assembly plate with two horn antenna brackets, installation material for scintillation counters and shielding containers
- a shielding container with point source and contact protection
- an evaluation unit
- two HF antenna cables, one HF reference cable and two HF angle connectors

4.3.2 Measuring Geometry and Measuring Conditions

1. Measuring condition: electrically conductive materials

No metals or other materials with high conductivity must be located between transmitting and receiving antennas (in the radiation field). Measuring pipes or chutes must also not be made of conductive material; otherwise, they have to be provided with an entrance window made of plastic, glass or ceramics. The standard dimensions of these entrance windows have to be chosen with regard to the antenna distance; for standard applications they have to be at least 15 x 15 cm up to 30 x 30 cm.

2. Measuring condition: Filling the chute

The bulk good has to be conveyed evenly through the measuring chute and it has to be ensured that the chute is completely filled for the measurement. In some cases, it is advisable to accumulate the product, for example by using a slider installed below the chute.

3. Measuring condition: Homogeneous filling

The product must be homogeneous. If the product is not mixed or asymmetrical in the chute, then the moisture reading is not representative and the sampling (e.g. for calibration) can be incorrect, see Fig. 4-12.

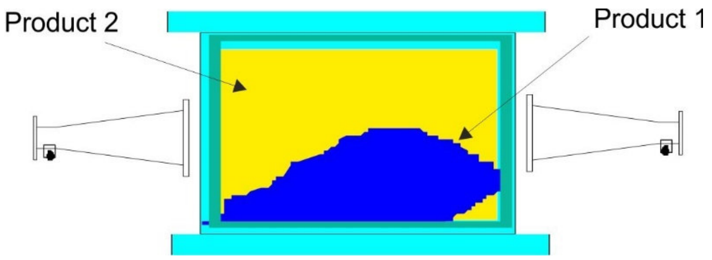


Figure 4-12: Two different products (e.g. through different moistures) cannot be mixed and filled asymmetrically.

4.3.3 Installation

The horn antennas, the scintillation counter and the source with shielding container are mounted with their respective brackets at the measuring chute, typically on the mounting plate provided by Berthold Technologies, see *chapter 10.7 Installation Proposal Measuring Chute*.

The measuring chute is installed into the conveyor flow at a suitable location. There must be no tapering of the chute and no installations at least 400 mm before and behind the measuring chute. In individual cases, these inlet and outlet sections can be shortened; this is planned in the project design phase.

Assemble the components as shown in the dimensional drawing in *chapter 10.7 Installation Proposal Measuring Chute*. All mounting holes for the brackets and the measuring chute are available on the mounting plate so that the measuring paths will be perfectly aligned.

Protect the antennas against dust and dirt. Install the measuring chute to your conveyor system such that you are able to reach all parts of the measuring chute easily. Provide for a stable and vibration-free mounting of the assembly plates. A material sampling location should be foreseen in the vicinity of the measuring chute for the necessary calibration.

If a PT100 is used, it should be oriented in the direction of the H-field, see Figure 3-15 in *chapter 3.4.4 The Measuring Chute*.

The connections of the horn antennas should preferably face down, so that they are better protected.

Important: Bulk good has to be conveyed evenly through the measuring chute, and it has to be ensured that the chute is filled completely for the measurement.

DANGER

Radioactivity!

Installation and commissioning of radiometric measuring systems may be carried out only by persons who have been instructed adequately by professional personnel!

Work is carried out under the guidance and supervision of the Radiation Safety Officer. Make sure that the lock of the shielding is closed.

4.3.4 Installation of the Evaluation Unit

Installation of the evaluation unit as described in *chapter 4.2.6*.

4.3.5 Connecting the HF Cable

Installation of the evaluation unit as described in *chapter 4.2.7*.

The two HF angle connectors can be used for the connection of the HF cable to the horn antenna. The length of cable between the antenna and evaluation unit may possibly be shortened.

4.4 Connecting the Evaluation Unit

⚠ WARNING

Electrical shock hazards

Disconnect power to ensure that contact with live part is avoided during installation and when servicing.

Turn off power supply before opening the instrument. Work on open and live instruments is prohibited.

NOTICE

Caution! Potential hazards, material damage!
Device type:
LB 568-02 MicroPolar Moist (ID no. 41990-02)

When connecting the 24 V DC power supply, the + and – poles must be connected correctly. There is no reverse polarity protection!

The line cross-section for power supply must be at least 1.0 mm^2.

- ➢ Connect all desired input and output signals to the terminal strip as shown on the following pages. Use the M feed-through to keep the degree of protection.
- ➢ Check if the voltage indicated on the type plate matches your local supply voltage.
- ➢ Connect the line cable to the terminals 3(L1), 2(N) and 1(PE).
- ➢ Check if the test switch (mains interruption) is in position "ON" (see Fig. 5-1).
- ➢ Close the instrument housing and turn on the power supply.

4.4.1 Pin Configuration of the Connector Strip

On the connector strip of the evaluation unit you find the following connections:

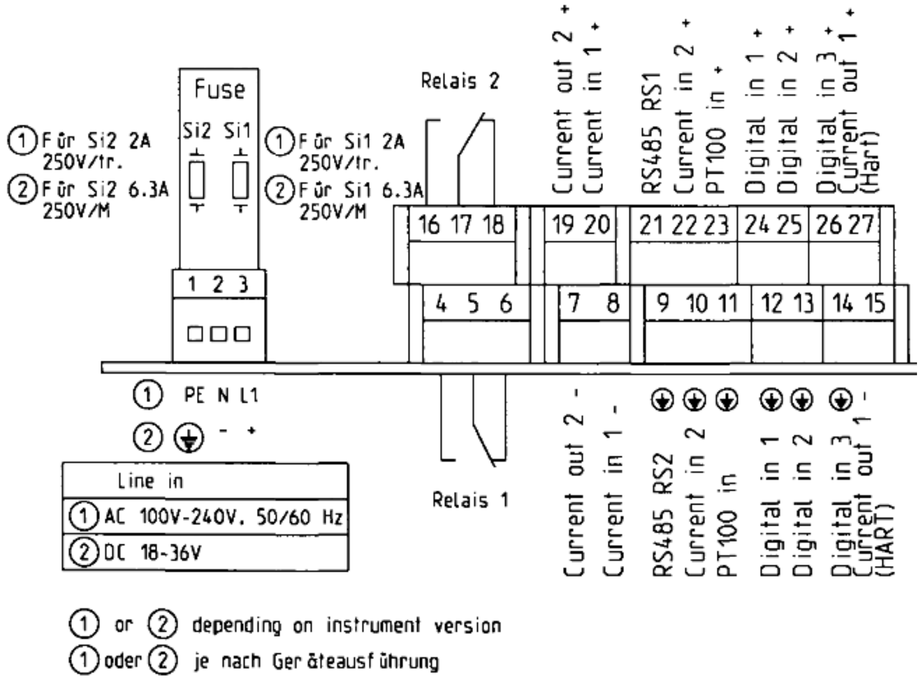


Figure 4-13: Wiring diagram LB 568

Mains connection:
Terminals 3 (L1, +), 2 (N, -) and 1 (PE, ⏚)

Depending on instrument version, see type label on the outer wall of the housing.
1.) 100 - 240 V AC, 50/60 Hz
2.) 18 - 36 V DC, no reverse voltage protection

Current input no. 1 (terminals 20+ and 8-), insulated

Current input no. 2 (terminals 22+ and 10-), not insulated

Input as 0/4 - 20 mA signal. e.g. for temperature compensation or reference signal recording.

Current output no. 1 (terminals 27+ and 15-), insulated

Output as 4 - 20 mA signal. Output options: moisture content / concentrations (1 / 2), current inputs signals (1 / 2), PT100 signal and mass per unit area

Current output no. 2 (terminals 19+ and 7-), insulated

Output as 0/4 - 20 mA signal. Output options: See current output no. 1

PT100 (terminals 23+ and 11-)

Connection for temperature measurement

Digital input 1: DI1 (terminals 24+ and 12-)

Configuration options:

- No function
- Measurement: Start (closed) and stop (open)

Digital input 2: DI2 (terminals 25+ and 13-)

Configuration options:

- No function
- Average value: hold (closed) and continue averaging (open)
- Product selection: product 1 (open) and product 2 (closed)

Digital input 3: DI3 (terminals 26+ and 14-)

Configuration options:

- No function
- Start sampling, open: no action, closed: unique measurement starts
- Product selection

Relay 1: (terminals 4, 5 and 6) and

Relay 2: (terminals 16, 17 and 18)

Change-over contacts (SPDT), insulated, configuration option:

- no function
- error message
- stop measurement
- limit value min. and max.
- below load limit

RS485 interface (terminals 21 (RS1) and 9 (RS2))

Occupied by the radiometry board

RS232 interface (on instrument underside)

9-pole Sub D-connector. Serial data interface for output of the live data (all readings for every sweep (measuring cycle), the minutes and data logs.

Data format: Data transfer rate 38400 baud, 8 data bits, 1 stop bit, no parity, no handshake

4.4.2 Connecting the Scintillation Counter

The scintillation counter is connected to the terminal strip on the radiometry board, see Figure 4-14. The connecting wires can be distinguished by the cable color.

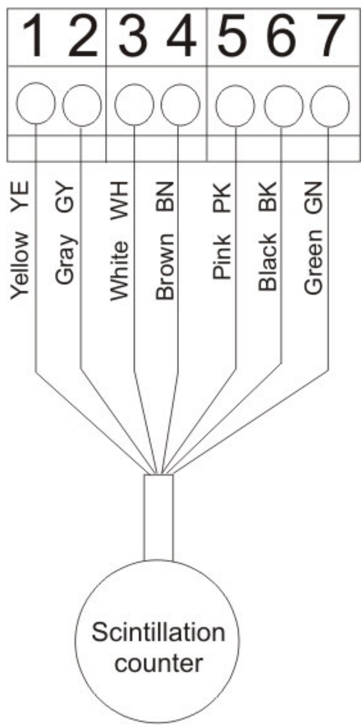


Figure 4-14: Wiring diagram Scintillation counter

The assignment of the terminal strip is as follows:

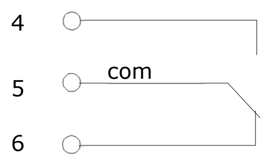
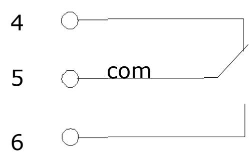
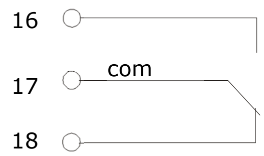
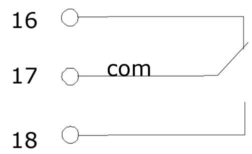
1	Detector +
2	Detector -
3	RS485-A
4	RS485-B
5	+ 24 V
6	Screen
7	24 V GND

4.4.3 Digital Outputs, Relay

The status of the measurement is output via two relays:

- Error
- Alarm (alarm min. and max.)
- measurement stopped
- below load limit

The respective switching status is also signaled via LED's on the front panel (LED's signal 1 and 2).

Relay no.	Error, alarm, measurement stopped, currentless state	Normal
1		
2		

The relays with changeover contacts can either be operated as make contact, terminals 4 & 5 (open at error, alarm ...) or as break contact, terminals 5 & 6 (closed at error, alarm ...).

Chapter 5. **Service Instructions**

5.1 General Information

A malfunction of the measuring system is not always due to a defect in the instrument. Often the error is caused by incorrect operation, wrong installation, or irregularities in the product being measured. If a malfunction occurs, anyway, the measuring system helps you to identify and eliminate errors by displaying error messages on the LCD, indicating operator errors and defects of the electronics.

Usually, faulty modules of the evaluation unit cannot be repaired but have to be replaced. The microwave module is fixed with screws to a shielding cover and must not be opened.

The locking mechanism of the shielding container has to work. In case of malfunctions or sluggishness, please contact the Berthold Technologies service.

The horn and spiral antennas do not require any special maintenance; however, the radiation exit window should always be kept clean.

For device disposal, please contact the Berthold Service and apply for a recycling passport.

5.2 Parts Subject to Wear

The evaluation unit does not include any parts that are subject to wear or components requiring any special maintenance.

Depending on the material to be measured, the measuring chute may be subject to wear over time; therefore, you should check it at regular intervals. The measuring chute must be replaced if required due to heavy wear.

5.3 Instrument Cleaning

Clean all system components only with a moistened cloth without chemical cleaning agent.

5.4 Battery

If the measuring system LB 568 is without power supply (power failure or disconnected from mains), the system clock is supplied with power via the Lithium battery on the motherboard.

If the battery voltage is no longer sufficient, the error message CODE 14 "Battery voltage" is displayed after restart of the evaluation unit. After acknowledging the error message, the device will continue to function correctly, but the date and time should be checked and corrected if necessary. We recommend changing the batteries immediately.

After battery replacement and if the zero count rate is set (I_0, for the radiometric mass per unit area measurement), the error message CODE 105 "Decay compensation failed: Enter date/time" is displayed. Please check and correct the date and time so that the decay compensation can work properly.

The service life of the battery, even under continuous load, is at least 8 years. Replace the fuses only if the instrument is disconnected from mains.

Battery type: 3 Volt lithium cell (round cell battery), type CR2032 (ID no. 17391)

5.5 Fuse Replacement

The mains fuses of the LB 568 are located in the wall housing. Replace the fuses only if the instrument is disconnected from mains.

Use only fuses with the correct rating, see *chapter 6.1*

NOTICE

Spare fuses must match the rating specified by the device manufacturer. Short-circuiting or manipulation is not permitted.

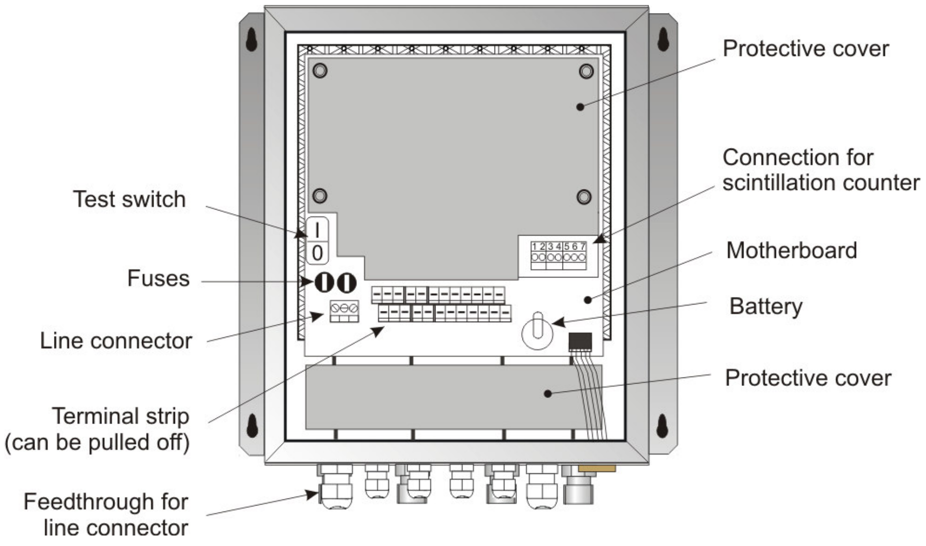


Figure 5-1: Look inside the instrument LB 568

Chapter 6. **Technical Data**

General Specifications	
Method	Microwave transmission measurement
Transmission power	< 10 µW (< -20 dBm), Coaxial line power
Applications	Concentration / moisture measurement on conveyor belts and in chutes.

6.1 Technical Data Evaluation Unit

Evaluation unit	
Housing	Wall housing made of stainless steel, see dimensional drawing in *chapter 10.1* HxWxD: 400x338x170 mm,
Protection type	IP 65
Weight	approx. 8.0 kg
Ambient conditions during operation	Relative humidity: max. 85 %, short-term up to 100 %, no condensation Altitude: max. 2000 m -20...45 °C (253 K ...318 K)
Ambient conditions during storage	-20...70 °C (253 K ...343 K) Relative humidity: max. 85 %, short-term up to 100 %, no condensation
Achievable accuracy	≤ 0.1 weight % (standard deviation) depending on product and process
Display	Dot matrix LC display, 114 mm x 64 mm, 240 x 128 pixels, with back-lighting, automatic contrast setting
Keyboard	Freely accessible foil keypad, light-stable and weatherproof: alphanumeric keyboard and 4 softkeys (software-assigned buttons)

Power supply	Depending on instrument version: 1.) 100...240 V AC, 50/60 Hz 2.) 24 V DC: 18 ... 36 V, no reverse voltage protection
Power consumption	max. (48/60) VA (AC/DC), depending on configuration
Fuses	2 x 250 V / 2.0 A / slow-blow at 100…240 V AC ID no. 4403 or 2 x 250 V / 6.3 A / M at 18…36 V DC; ID no. 4408
Battery type	3 V Lithium button cell, type CR2032 ID no. 17391
Measured value	e.g. concentration, moisture content
Inputs and Outputs	
Cable cross-section	min. 1.0 mm² (mains supply)
Cable feed-through	2 x M20x1.5 for cable 5...14 mm (depending on application) 4 x M16x1.5 for cable 5 ...8 mm (depending on application)
Sensor connection	Inputs and outputs for signal and reference channel, 50 Ω N-socket
HF-cable HF-cable	Different cable lengths and versions: 50 Ω; both sides with 4 N-connectors
Current input	2 x current input 0/4 ...20 mA, ohmic resistance 50 Ω, 1x insulated, 1x instrument grounded e.g. for temperature compensation
Current output	Current Output 1: 4...20 mA, ohmic resistance max. 800 Ω , insulated Current output 2: 0/4...20 mA, ohmic resistance max. 800 Ω , insulated e.g. for result or temperature output
PT100 connection	Measuring range: -50...200 °C (223...473 K); measurement tolerance: < 0.4 °C

Digital input	3 x digital inputs (DI1..3), for floating connectors Configuration options: DI1: none, measurement start/stop DI2: none, measurement hold, product selection DI3: none, sampling, product selection Function description: 1. Measurement (Start/Stop), open: Measurement stopped, closed: Measurement started and/or measurement running 2. Hold measurement, open: Measurement running, closed: Measurement stopped, i.e. average values and current output is held 3. Product selection via a DI: open: Product 1 (P1), closed: P2; Product selection via two DI's: DI2 & DI3 open: P1 DI2 closed & DI3 open: P2 DI2 open & DI3 closed: P3 DI2 & DI3 closed: P4 4. Start sampling: open: no actions, closed: single measurement starts
Relay outputs	2 x relays (SPDT), insulated Configuration options: - Collective failure message - Stop measurement - Limit value (min. and max.) - Low load Load capacity: AC: max. 400 VA DC: max. 90 W AC / DC: max. 250V, max. 2A, non-inductive ≥ 150V: voltage must be grounded The cable and the insulation of the cables to be connected at these connections must comply with a power supply cable. Restrictions for 24 V DC (18…36 V) mains supply, if the ground conductor is not connected to terminal 1 (PE): AC: max. 50 V DC: max. 70 V
Serial interfaces	RS232 on the device underside RS485 occupied by the radiometry board Data format: 38400 Bd, no handshake, 8 data bits, 1 stop bit, no parity

6.2 Technical Data Horn and Spiral Antennas

Horn antenna (ID no.: 10806)	
Application	Used in pairs, for example on conveyor belts and chutes for the moisture measurement in bulk goods.
Material	Stainless steel, microwave window made of Makrolon
Weight	1.4 kg
Temperature range	Ambient temperature: -20...60 °C (253...333 K) Storage temperature: 10...80 °C (283...353 K)
Connection	1 x HF connections: N-connector, 50 Ω
Dimensions	See dimensional drawings in *chapter 10.4.1*
Accessories antenna fixture (ID no. : 10805)	
Material	Galvanized steel
Weight	3.8 kg
Dimensions	See dimensional drawings in *chapter 10.4.1*

Spiral antenna (ID no. : 15394)	
Application	Used in pairs, for example on conveyor belts and chutes for the moisture measurement in bulk goods.
Material	Stainless steel, plastic
Weight	0.4 kg
Temperature range	Ambient temperature: -20…60 °C (253...333 K) Storage temperature: 10...80 °C (283...353 K)
Connection	1 x HF connections: N-connector, 50 Ω
Dimensions	See dimensional drawings in *chapter 10.4.2*

6.3 Technical Data Radiometric Mass per Unit Area Measurement

Scintillation counter	
Versions	1. With axial collimator (Id. 56942), for frontal irradiation 2. With radial collimator (Id. 56943), for radial irradiation
Crystal	CsI 40 x 50
Material	Stainless steel Collimator: Lead, painted steel
Protection type	IP 67
Weight	Without collimator: approx. 2 kg With axial collimator: approx. 10.6 kg With radial collimator: approx. 10 kg
Power supply	12...24 V DC, 1.2 W
Operating temperature	-20...50 °C (253...323 K)
Storage temperature	-20...60 °C (253...333 K)
Connection cable	3 m long, 7-wire, shielded (7 x 0.5 mm^2), cable connection angled 90°, temperature range: -40…70 °C (233…343 K)
Dimensions	See dimensional drawings in *chapter 10.5*
Accessory mounting options	
ID no.	Description
56860	Scintillation counter bracket, complete Material: galvanized steel, plastic Dimensional drawings in *chapter 10.5*
25668	Clamps (1 set = 2 clamps)

Shielding for point sources (LB 744X)	
ID no.:	Types:
37624	LB 7440-D-CR, internal parts made of stainless steel
38040	LB 7440-DE-CR, stainless steel
38042	LB 7445-D-CR, internal parts made of stainless steel, with leakage protection
38043	LB 7445-DE-CR, stainless steel, with leakage protection
Shielding accessories	
ID no.:	Types:
14716	Shielding bracket, complete for LB 7440 D
52752	Protective cover for shielding LB 7440/42/44
11213	Radiation sign (RADIOACTIVE), plastic
14658	Radiation sign (RADIOACTIVE), aluminum

Pneumatic shutter for shielding	
ID no.:	Description
36119	Pneumatic shutter actuator with limit switch, IP 65
Data for pneumatic shutter actuator	
Compressed air:	min. 4 x 4 bar max. 4 x 7 bar Connection: G 1/8
Air quality:	Clean as usual for pneumatic tools, oil-free
Temperature range:	-20…80 °C
Limit switch unit, signaling options for OPEN / CLOSE	
Option	IP 65 2 contacts (OPEN/CLOSE) 48 V DC, 1A

Point source Cs-137	
ID no.:	Made of stainless steel
54712-08	Pt. source Cs-137 370 MBq (10 mCi) - SSC-200
54712-12	Pt. source Cs-137 1110 MBq (30 mCi) - SSC-200
54712-13	Pt. source Cs-137 1850 MBq (50 mCi) - SSC-200
ID no.:	Made of titanium
54281-08	Pt. source Cs-137 370 MBq (10 mCi) – SSC-100
54281-12	Pt. source Cs-137 1110 MBq (30 mCi) – SSC-100
54281-13	Pt. source Cs-137 1850 MBq (50 mCi) – SSC-100

6.4 Technical Data Measuring Chute

Measuring chute, complete	
Application	For moisture and concentration determination in bulk material.
Variants / Chute material	1. Polypropylen homo polymer (PP-H) ID no. 56855 2. Polyvinylidene fluoride (PVDF), ID no. on request
Components	- Chute - Mounting plate - 4 brackets - two RF angle connectors - Fastening material
Weights	Only for the chute: Version 1: approx. 10 Kg Version 2: on request Measuring chute, complete Version 1: approx. 41 Kg Version 2: on request
Temperature range	Environment: 0...50 °C (273...323 K) Storage: 10...80 °C (283...353 K) Product temperature: Version 1: > 0...90 °C (273...363 K) Version 2: > 0…140 °C (273 … 413 K)
Mounting plates, brackets	Material: Stainless steel, galvanized steel
Dimensions	See dimensional drawings in *chapter 10.7*

6.5 Technical Data HF-Cable

HF cable	
Material	Cable sheath: Polyethylene (PE)
Protection type	IP 68 in the screwed on state
Temperature	Operating temperature: -40...85 °C Installation temperature: -40...85 °C
Attenuation load	approx. 0.3 dB/m

Cable length [m]	ID no.
0.5	11473
1.0	11474
1.5	11475
2.0	11476
2.5	11477
3.0	11478
3.5	11479
4.0	11480

6.6 Serial Data Output RS232 Format

Headline

Date·Time→State→Status→DetectorStatus→Synchronizer→Product→Att→Phi→Phi(f=0)→

R2→Corr→Tint→IN1→IN2→PT100→C→Cm→C2→C2m→CpsM→DetTemp→Mqua→Density¶

Following lines

01.01.2005·00:00:00→0000→0→0→5→1→0.43→5.30→0.07→0.98→

1 2 3 4 5 6 7 8 9 10

0.0→0.0→0.0→0.0→75.36→75.00→0.00→0.00→3653→35.8→10.25→0.8612¶

11 12 13 14 15 16 17 18 19 20 21 22

Column no.	Description	Format
1	Date and time	DD.MM.YY·HH:MM:SS
2	State	4 digits, HEX
3	Status: Information on the quality of the last measurement	0 : Measurement OK < 0 : Error
4	Detector status: Information on the quality of the last measurement	0 : Measurement OK < 0 : Error
5	Product synchronization	5 : not active 1: still asynchronous 0: all values synchronous -1: Error -2: Time to short for syn. -3: Speed outside range
6	Product number	X (1 to 4)
7	Attenuation [dB]	X.XX
8	Phase [°/GHz]	X.XX
9	Dispersion of phase regression	X.XX
10	Correlation of phase regression	X.XX
11	Device temperature [temperature unit]	X.X
12	Current input 1 [unit of current input]	X.X
13	Current input 2 [unit of current input]	X.X
14	PT100 temperature [temperature unit]	X.X

15	Concentration 1 live	X.XX
16	Concentration 1 averaged	X.XX
17	Concentration 2 live	X.XX
18	Concentration 2 averaged	X.XX
19	Averaged count rate [counts/s]	X
20	Detector temperature [°C]	X.X
21	Mass per unit area [g/cm^2]	X.XX
22	Density [g/cm^3]	X.XXXX

Special characters

"→" Tabulation "¶" Carriage return + Line feed "·" Blank characters

Chapter 7. **Other Compensation Options**

7.1 Optional Loading Compensation

At constant bulk density or if the mass per unit area is already known, one may not need the radiometric measurement path under certain circumstances. In this case, there are alternative compensation options, see the following chapter.

7.1.1 Mass per Unit Area Compensation

The influence of a varying material layer thickness and bulk density disappears through compensation of the mass per unit area. The compensation is calculated as follows:

Load = mass per unit area [g/cm^2] **Eq. 7-1**

The mass per unit area signal supplies a 0(4)...20 mA signal.

IMPORTANT
Current input 1 must be used for this mass per unit area compensation via an external current signal.

7.1.2 Layer Thickness Compensation

If only the layer thickness of the product to be measured changes, one has to compensate as follows:

Load = Loading level [cm] **Eq. 7-2**

The layer thickness supplies a 0(4)...20 mA signal which is proportional to the distance from the product surface to a sensor installed above it.

IMPORTANT
Current input 1 must be used for this compensation.

7.1.3 Weight/Throughput Compensation

If the material cross-section is rectangular (see Fig. 7-1), the mass per unit area [g/cm²] is proportional to the weight per length [kg/m]. Thus, the loading compensation becomes linear; it is calculated as follows:

Load = Weight [kg] **Eq. 7-3**

The 0(4)...20 mA signal is supplied by an existing weighing system.

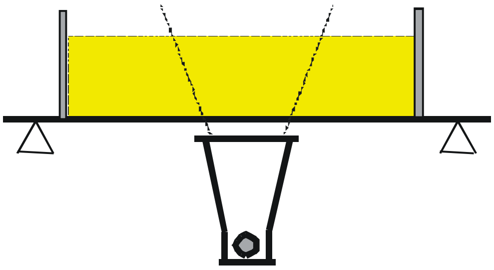


Figure 7-1: Rectangular material cross-section with weighing system

If the weighing system supplies a throughput signal (T/h), either the conveyor belt speed must be constant, or the belt speed must be fed as 0(4)…20 mA signal into the evaluation unit via the second current input. The compensation is then calculated according to:

$$\textbf{Load} = \frac{\textbf{Throughput [T/h]}}{\textbf{Belt speed [m/s]}} \qquad \textbf{Eq. 7-4}$$

IMPORTANT
The throughput signal must be fed in via current input 1 and the speed signal via current input 2.

7.1.4 Layer Thickness and Weight Compensation

The compensation of weight and layer height can be combined. Prerequisite is a rectangular material cross-section, as described in *chapter 7.1.3*. The compensation is then calculated according to:

Load = layer thickness [cm] x weight [kg] **Eq. 7-5**

The layer thickness and the weight supply a 0(4)...20 mA signal each.

The compensation signal of the weighing station can be used as throughput signal only if the speed is constant. Varying belt speeds cannot be taken into consideration.

IMPORTANT
The weight signal must be fed in via current input 1 and the layer thickness signal via current input 2.

7.2 Temperature Compensation

In general, temperature compensation (TC) is not required for bulk material.

If the product temperature has a significant impact on the microwave measuring signals phase or attenuation, a TC should be connected. To this end, a temperature signal (0/4.20 mA or PT-100) is connected to the evaluation unit and the TC is activated in the evaluation unit.

The evaluation unit is designed such that the required TC's can be calculated automatically. The variation in temperature where TC is required is dependent on the product and the water content.

If, for example, the product temperature is measured via the PT100 input, equation 3-1 will be expanded as follows:

Measured value = A · Phase + D · T_{meas} + C **Eq. 7-6**

Where:

Measured value	Concentration / Moisture / Dry mass
A, D, C	Coefficients of the calibration function
T_{meas}	Product temperature

How to work with the temperature compensation is described in detail in the Software Manual.

7.3 Synchronization of Input Signals

The LB 568 offers the option to synchronize the current input signals with the microwave information. The current input signals are stored temporarily.

This function is helpful, for example, if the weighing system (z. B. belt weigher) is located in a certain distance from the microwave measuring path. By means of the synchronization, both measurements can be correlated with each other, so that both measurement information come from the same product.

If a weight/throughput signal for loading compensation will be used and if the weighing system is more than 5 m away from the microwave measuring path, then - depending on the belt speed - the weight/throughput signal has to be synchronized with the microwave information so that both signals measure the same product.

Min. distance

The minimum distance is: **5 x v** **Eq. 7-7**

Where:

v = belt speed [m/s]

The permissible maximum distance of both measuring devices depends on the belt speed and is calculated as follows:

Max. distance

Belt speed [m/s]	Maximum distance [m]
< 1	50
> 1	100

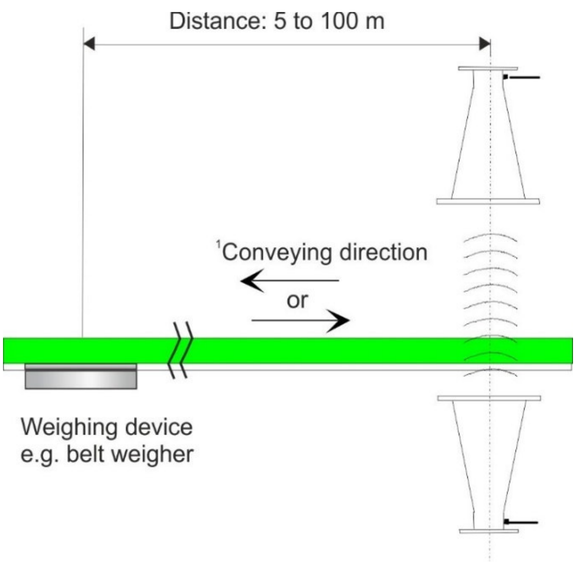


Figure 7-2: Synchronized belt weigher signal

[1] The weighing system can be set up before or after the microwave measuring path.

Belt speed

The belt speed may not exceed 5 m/s when the synchronization is used.

Varying conveyor belt speed

A varying belt speed has to be taken into account for the synchronization. The speed signal has to be fed into the evaluation unit as 0/4…20 mA via current input 2.

Chapter 8. **Radiation Protection Guidelines**

8.1 Basics and Directives

The radioactive isotopes used for mass per unit area measurements emit gamma radiation. Gamma radiation consists of high-energy electromagnetic radiation, i.e. it is a type of radiation which resembles light, but has a much higher energy, so that it can pass through matter having a higher density. This high-energy radiation is hazardous to living beings (cell damage and mutations). To keep this risk low, radioactive materials must be handled carefully.

The radioactive sources used for mass per unit area measurements are usually sealed sources, i.e. the actual radioactive substance is surrounded by at least one, often several sealed layers made of stainless steel, each of which is checked individually for leaks. Another check ensures that no radioactive particles are deposited on the surface of the capsule. The user will receive an official certificate specifying these features of the radioactive source.

To avoid health hazards when working with radioactive substances, limits for the maximum permissible radiation exposure of operating personnel have been established on an international level. The following information refers to the German Radiation Protection Ordinance as of August 2001.

Appropriate measures in the design of the shieldings and the arrangement of the measuring device at the measuring location ensure that the radiation exposure of the personnel will remain below the maximum permissible value of 1 mSv (100 mrem) per year.

To ensure proper handling and compliance with statutory requirements, the company must appoint a Radiation Protection Officer who is responsible for all radiation protection issues associated with the measuring equipment.

The Radiation Protection Officer shall monitor the use of the radiometric measuring device and, if necessary, formalize the safeguards and any special precautions applicable to a given establishment in formal procedural instructions, which in special cases may serve as a basis for radiation protection guidelines. This may be necessary, for example, if a container can be accessed and, therefore, it must be ensured that the active beam is shielded first by the shielding. Radiation protection zones outside the shielding - if they are accessible - must be marked and guarded.

These instructions should also include checks of the shutter device of the shielding and measures for serious operational trouble - such as fire or explosion.

Unusual incidents must immediately be reported to the Radiation Safety Officer who will then investigate any damage on site and immediately take suitable precautions if he detects defects that may adversely affect the function or safety of the system.

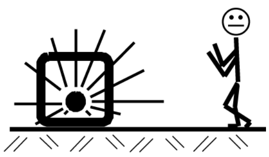
The Radiation Protection Officer has to ensure also that the provisions of the Radiation Protection Ordinance are complied with. In particular, his duties include instructing the staff on the proper handling of radioactive substances.

Radioactive sources that are no longer in use or have reached the end of their service life must be returned to a public collection point or to the supplier.

Basically, every company employee should strive, through prudent behavior and by observing the radiation protection rules, to keep the radiation exposure, even within the permissible limits, as low as possible.

The sum of the radiation absorbed by the body is determined by three variables, which can be derived from the basic radiation protection rules:

Distance

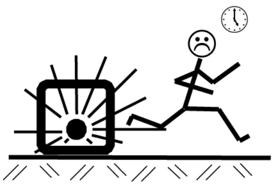


This means the distance between radioactive source and human body. The radiation intensity (dose rate) follows - just like light - an inverse square law. This means that doubling the distance from the source will reduce the dose rate to a quarter.

Conclusion:

Keep the maximum distance when carrying out any work in the vicinity of equipment containing radioactive material. This is especially true for persons who are not directly involved in this work.

Time

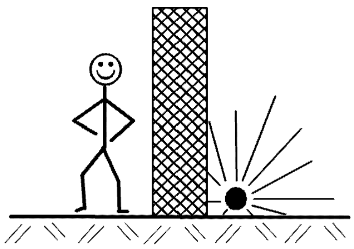


The total time a person stays in the vicinity of a radiometric measuring system and the body is exposed to radiation. The effect is cumulative and is, therefore, greater the longer the exposure to radiation.

Conclusion:

Required work in the vicinity of radiometric measuring devices has to be carefully prepared and organized so that it can be done in the shortest possible time. Providing the proper tools and resources is particularly important.

Shielding



The shielding effect is provided by the shielding material surrounding the source. Because the shielding effect is in an exponential relationship to the product of thickness and density of the shielding material, shielding materials with high specific weight are required. Sufficiently large dimensions of the shieldings are usually calculated by the supplier.

Conclusion:

Before installing or dismantling the shielding, make sure that the radiation exit channel is closed. The source must not be removed from the shielding and must not remain unshielded.

8.2 Emergency Instructions

In case of serious operational trouble, such as fire or explosion, which may affect the radiometric measuring system, it cannot be ruled out that the function of the shielding lock, the shielding effect or the stability of the source capsule have been compromised. In this case, it is possible that persons in the vicinity of the shielding have been exposed to higher levels of radiation.

If you suspect such a severe malfunction, the Radiation Safety Officer has to be notified immediately. He will then investigate the situation immediately and take all necessary provisions to prevent further damage and to avoid any unnecessary radiation exposure of operating personnel.

The Radiation Safety Officer has to make sure that the measuring system is no longer in operation and then take appropriate steps. He may have to inform the authorities or contact the manufacturer or supplier of the measuring system, so that any further action be taken under expert supervision.

Chapter 9. **Certificates**

9.1 EC Declaration of Conformity

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75323 Bad Wildbad, Germany

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EC-Declaration

We herewith confirm that the construction of the following indicated products / systems / units is brought into circulation to comply with the relevant EC regulations listed.

Description: ***Concentration- and Moisture-Measuring Systems Micro-Polar 2, Micro-Polar 2 ++, Micro-Polar Moist, and Micro-Polar Moist ++***

Type: ***LB 567-XX and LB 568-XX***

	Richtlinie und Änderungen	angewendete Normen	
EMC	2004/108/EC	EN 55011	1998
			+A1:1999
			+A2:2002
		EN 61326-1	2006-05
		EN 61000-4-2	1995
			+A1:1998
			+A2:2001
		EN 61000-4-3	2006-12
		EN 61000-4-4	2004
		EN 61000-4-5	1995
			+A1:2001
		EN 61000-4-6	1996
			+A1:2001
		EN 61000-4-11	1994-08
			+A1:2001-02
		Namur NE21	2004
LVD	2006/95/EC	EN 61010 part 1	2002-08

This declaration is issued by the manufacturer
BERTHOLD TECHNOLOGIES GmbH & Co. KG
Calmbacher Str. 22
75323 Bad Wildbad, Germany

released by

Dr. Wilfried Reuter – Technical Director
Bad Wildbad, 28th of April 2010

Registergericht / Court of Registration: Stuttgart HRA 330991
Persönlich haftende Gesellschafterin / Fully liable Associates: BERTHOLD TECHNOLOGIES Verwaltungs-GmbH
Registergericht / Court of Registration: Stuttgart HRB 331520
Geschäftsführung / Management: Hans J. Oberhofer, Dr. Wilfried Reuter
USt.-Id-Nr. / VAT Reg. No.: DE813050511
Deutsche Steuernummer / German Tax No.: 49038/08038
WEE-Reg. No.: DE99468690

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

9.2 Frequency License

TCB

GRANT OF EQUIPMENT AUTHORIZATION

TCB

Certification
Issued Under the Authority of the
Federal Communications Commission
By:

CETECOM ICT Services GmbH
Untertuerkheimer Strasse 6-10
66117 Saarbruecken,
Germany

Date of Grant: 02/10/2016

Application Dated: 10/07/2015

Berthold Technologies
Calmbacher Str. 22 75323 Bad Wildbad Germany
Bad Wildbad, 75323
Germany

Attention: Dirk Moermann , Dr.

NOT TRANSFERABLE

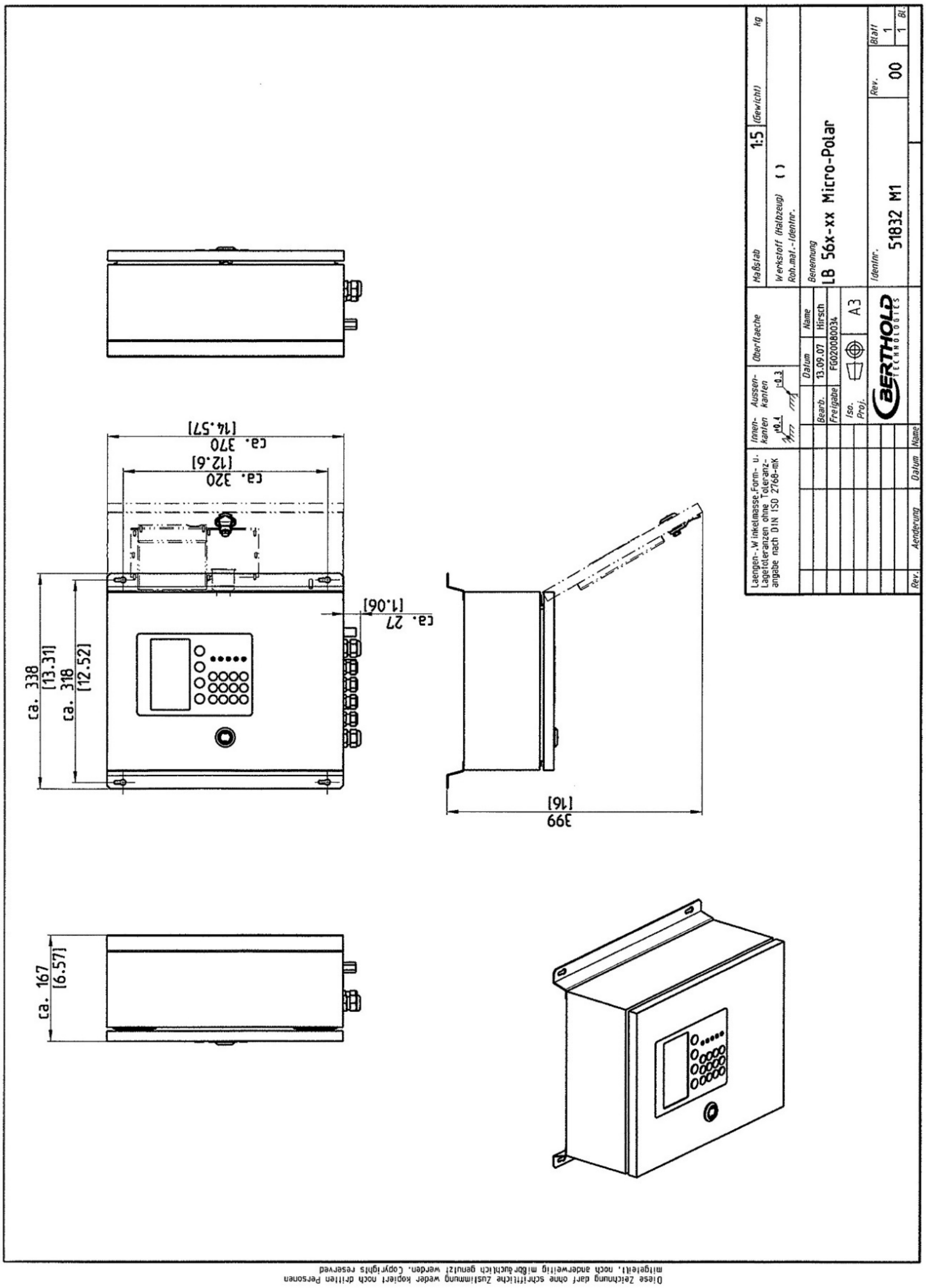
EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: R9ZFCC02X03
Name of Grantee: Berthold Technologies
Equipment Class: **Ultra Wideband Transmitter**
Notes: **Concentration / Moisture / Dry Mass / Density Measuring System**

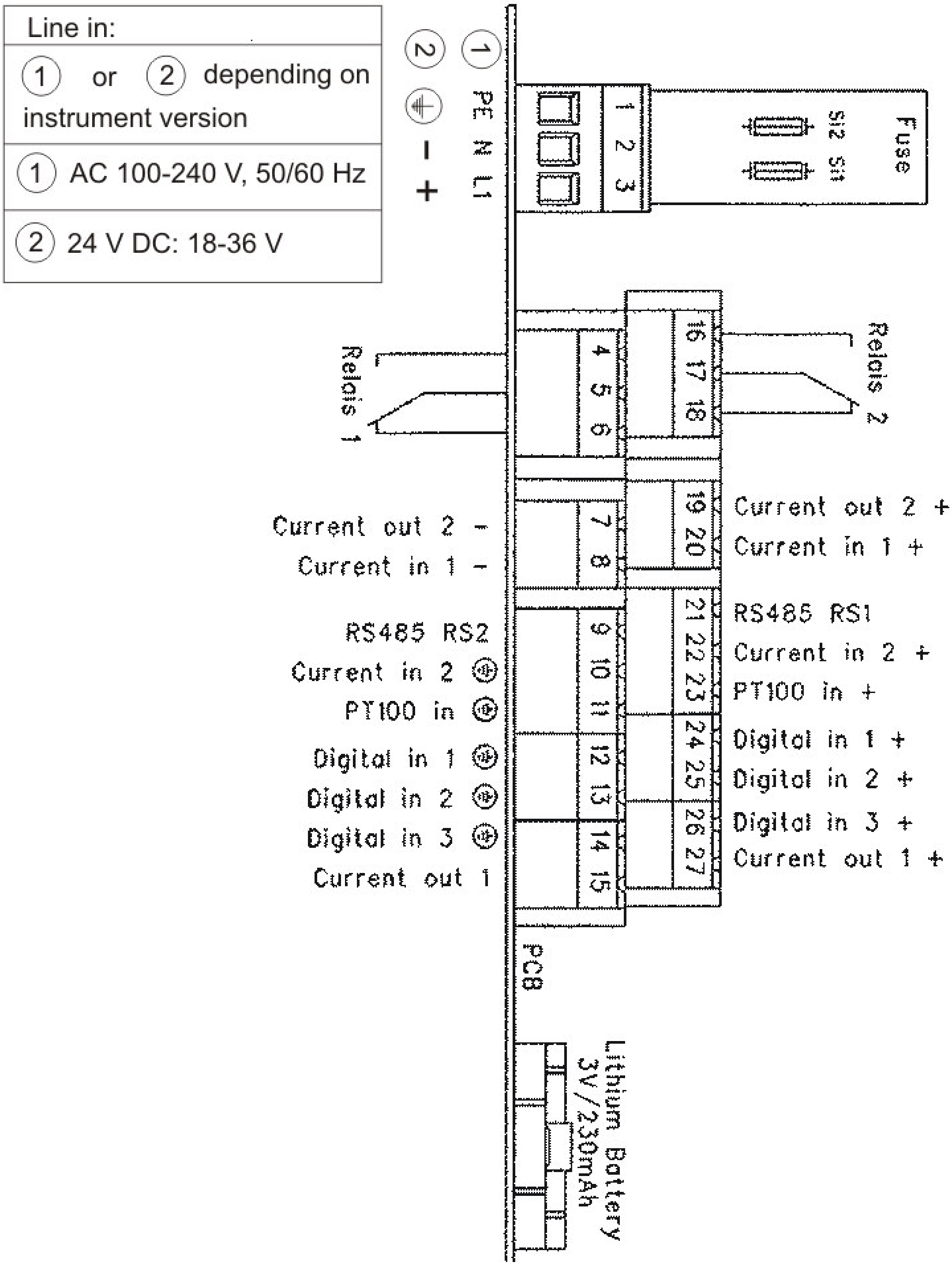
Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15F	3101.0 - 3881.0	7E-7		

Chapter 10. **Technical Drawings**

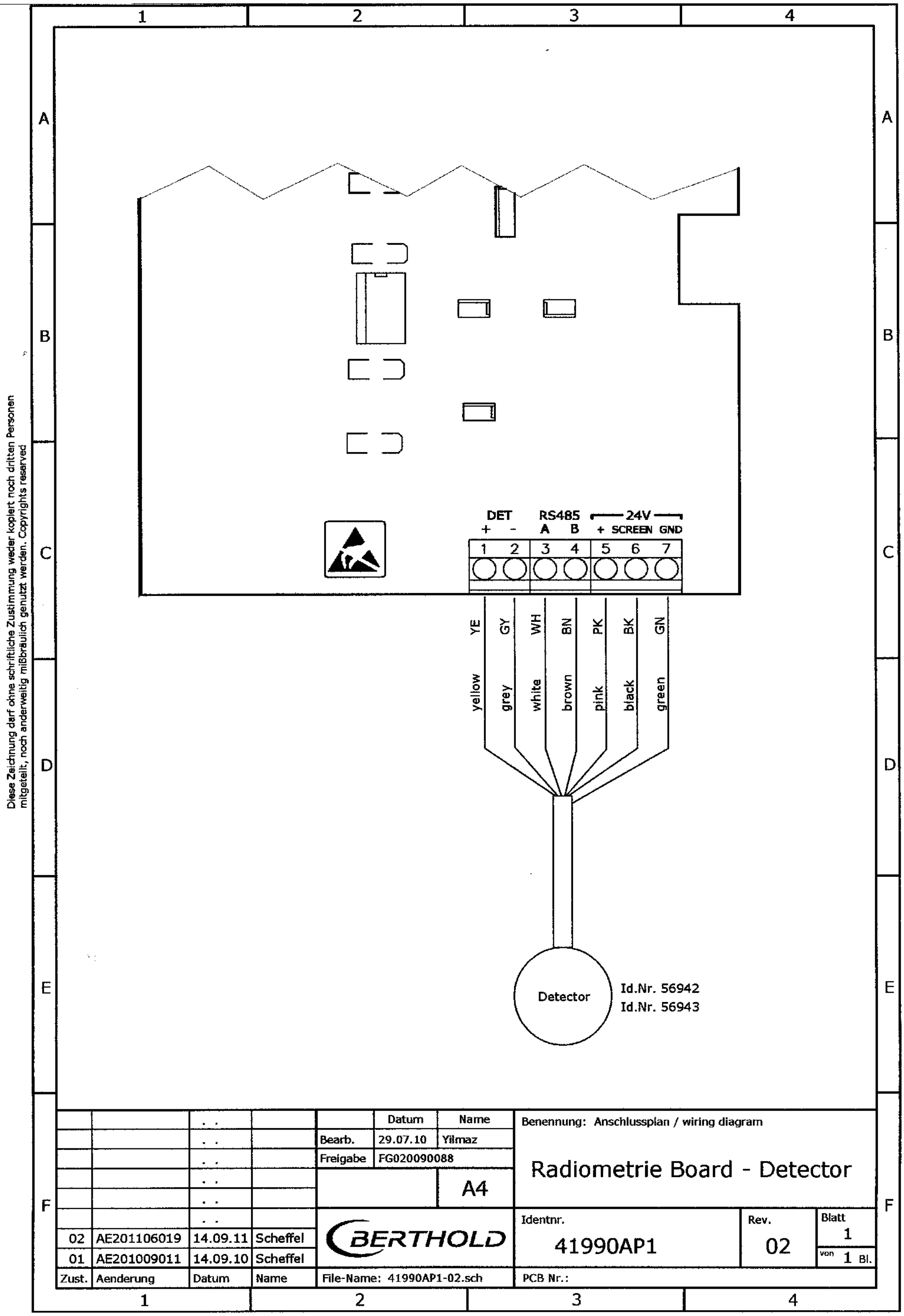
10.1 Dimensional Drawing Evaluation Unit Case



10.2 Electrical Wiring Diagram

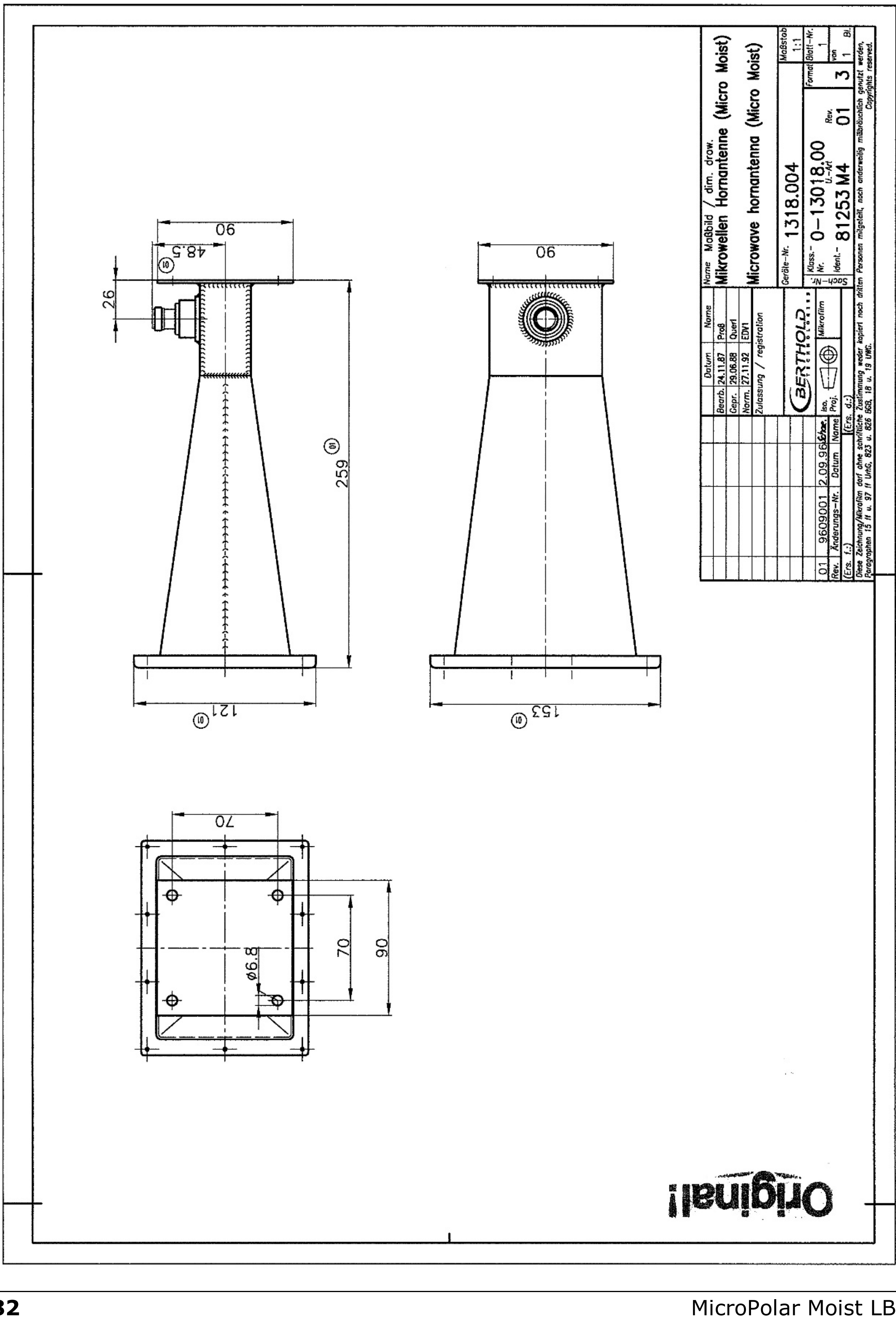


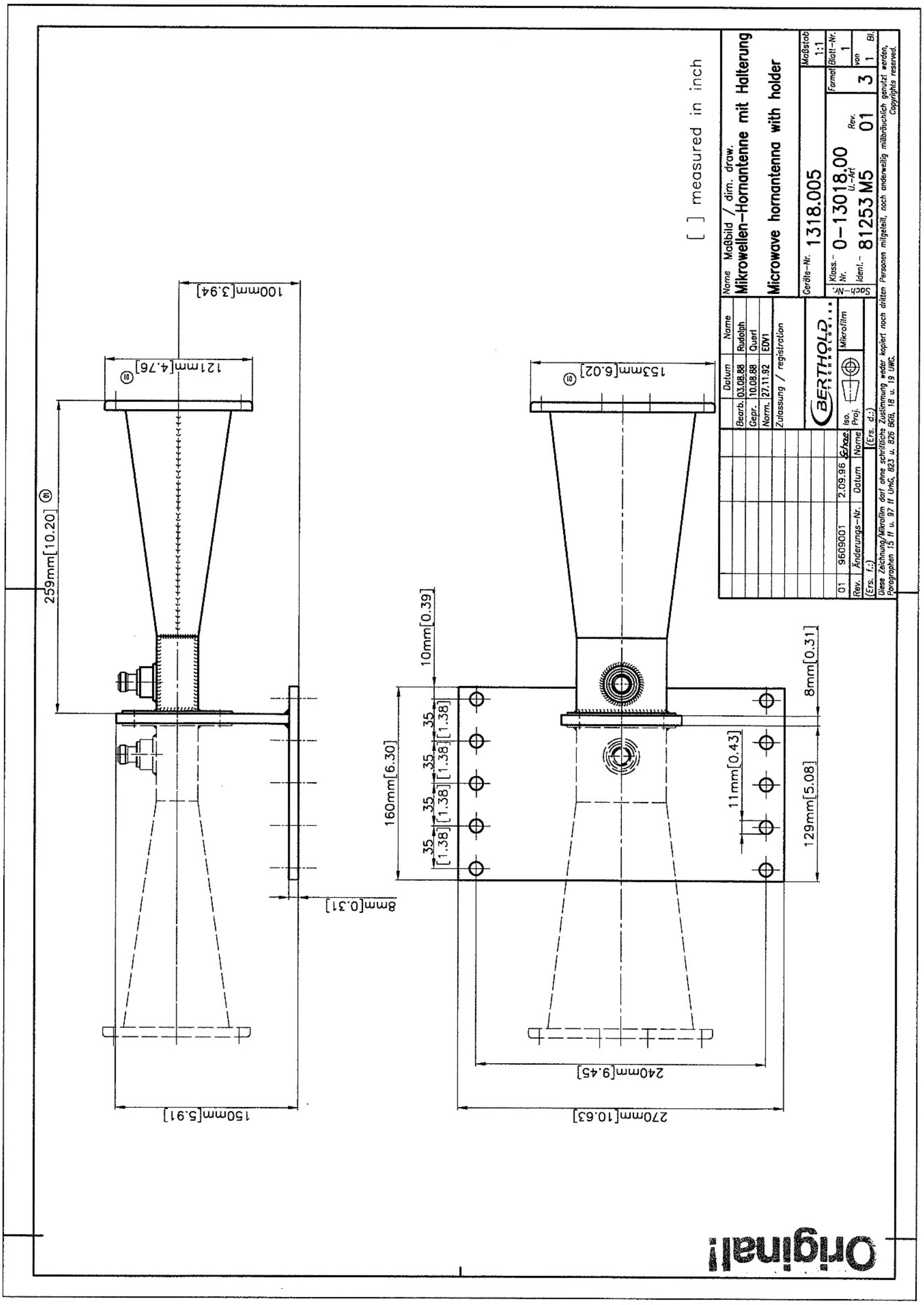
10.3 Electrical Wiring Diagram Scintillation Counter



10.4 Dimensional Drawings Horn and Spiral Antennas

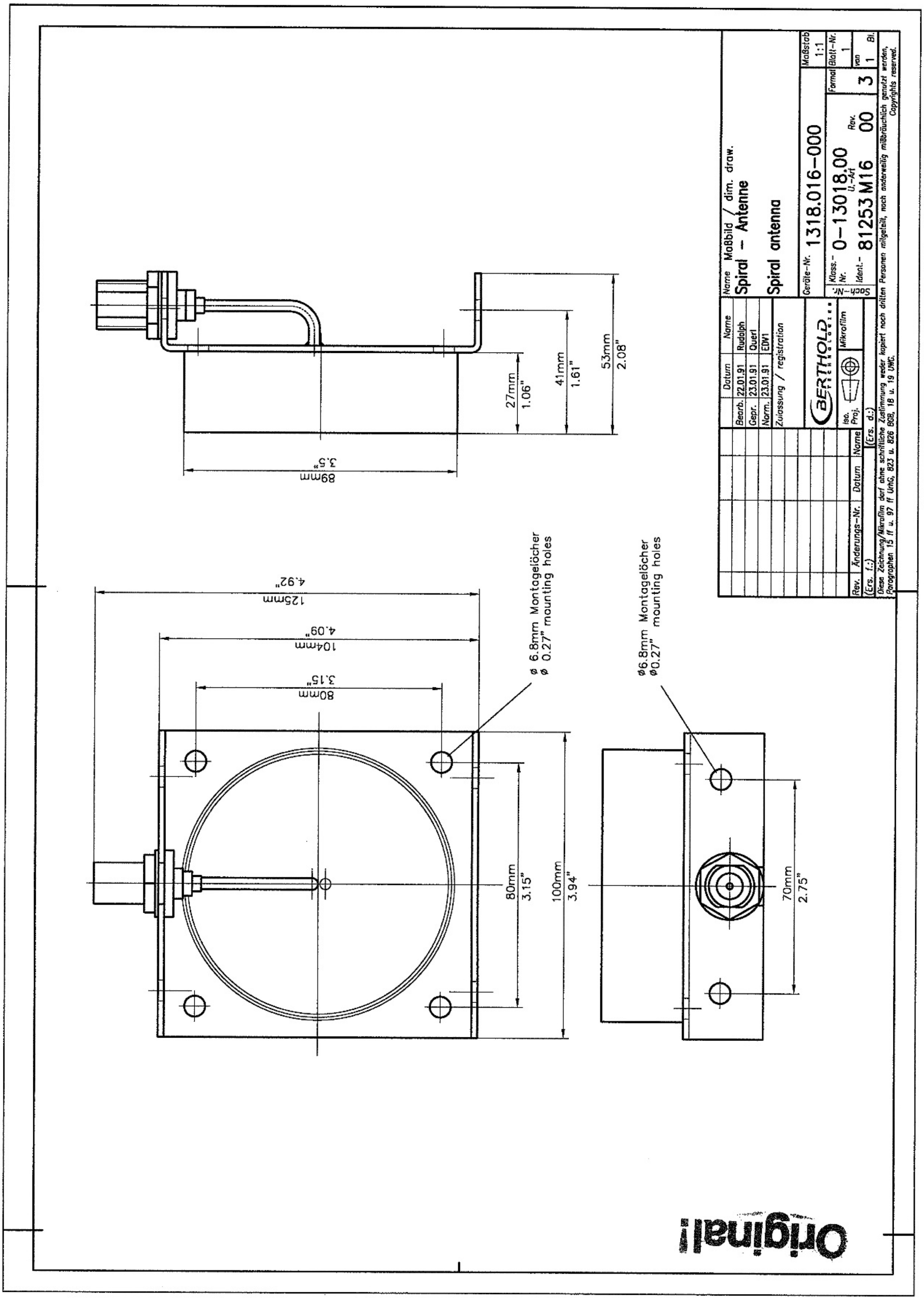
10.4.1 Horn Antenna and Horn Antenna Brackets





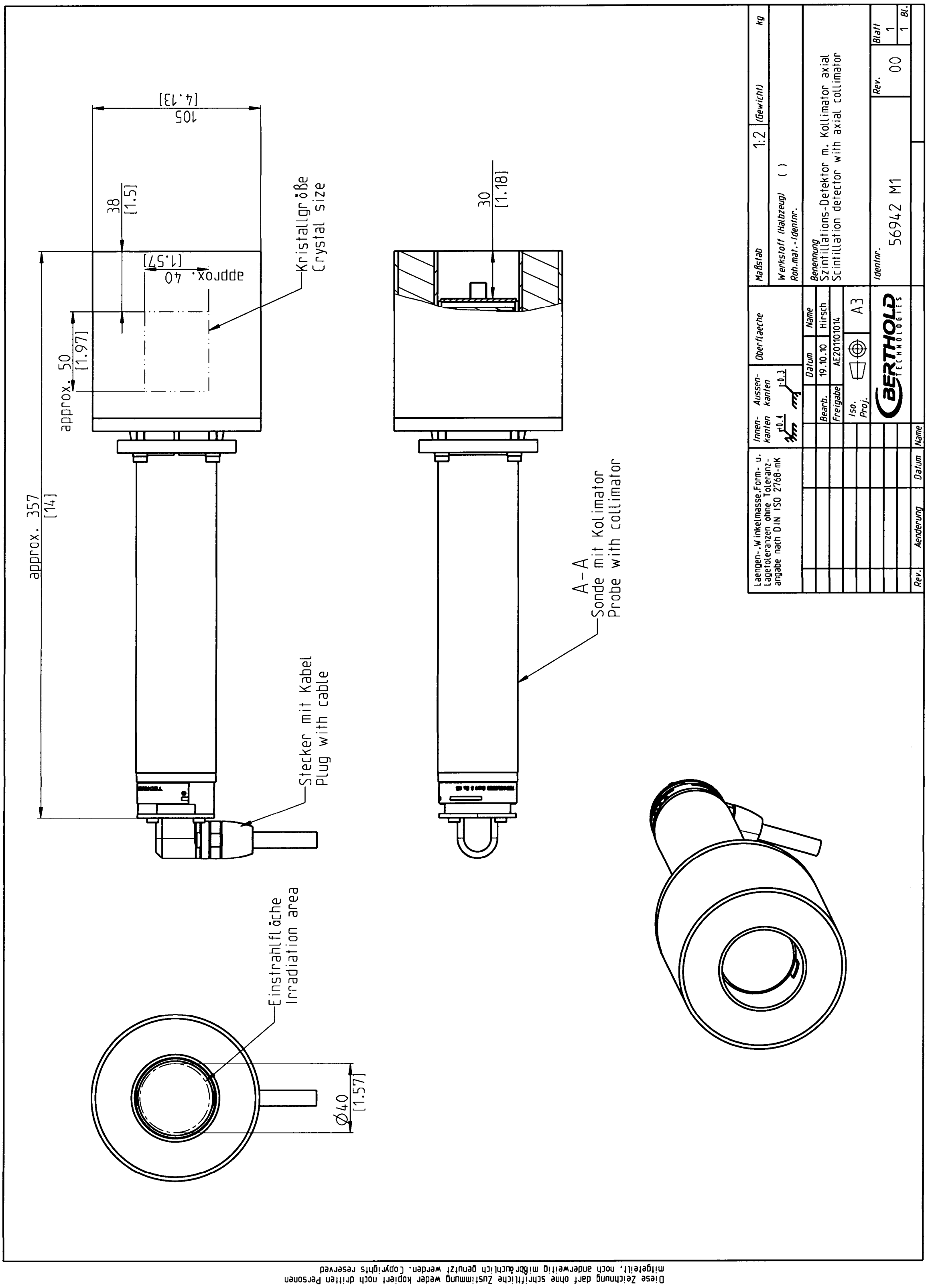
[ ] measured in inch
Maßbild / dim. draw.
Mikrowellen–Hornantenne mit Halterung
Microwave hornantenna with holder
Geräte-Nr. 1318.005
0–13018.00
81253 M5
100mm[3.94]
121mm[4.76]
259mm[10.20]
153mm[6.02]
10mm[0.39]
160mm[6.30]
8mm[0.31]
11mm[0.43]
129mm[5.08]
240mm[9.45]
150mm[5.91]
270mm[10.63]
Original!

10.4.2 Spiral Antennas

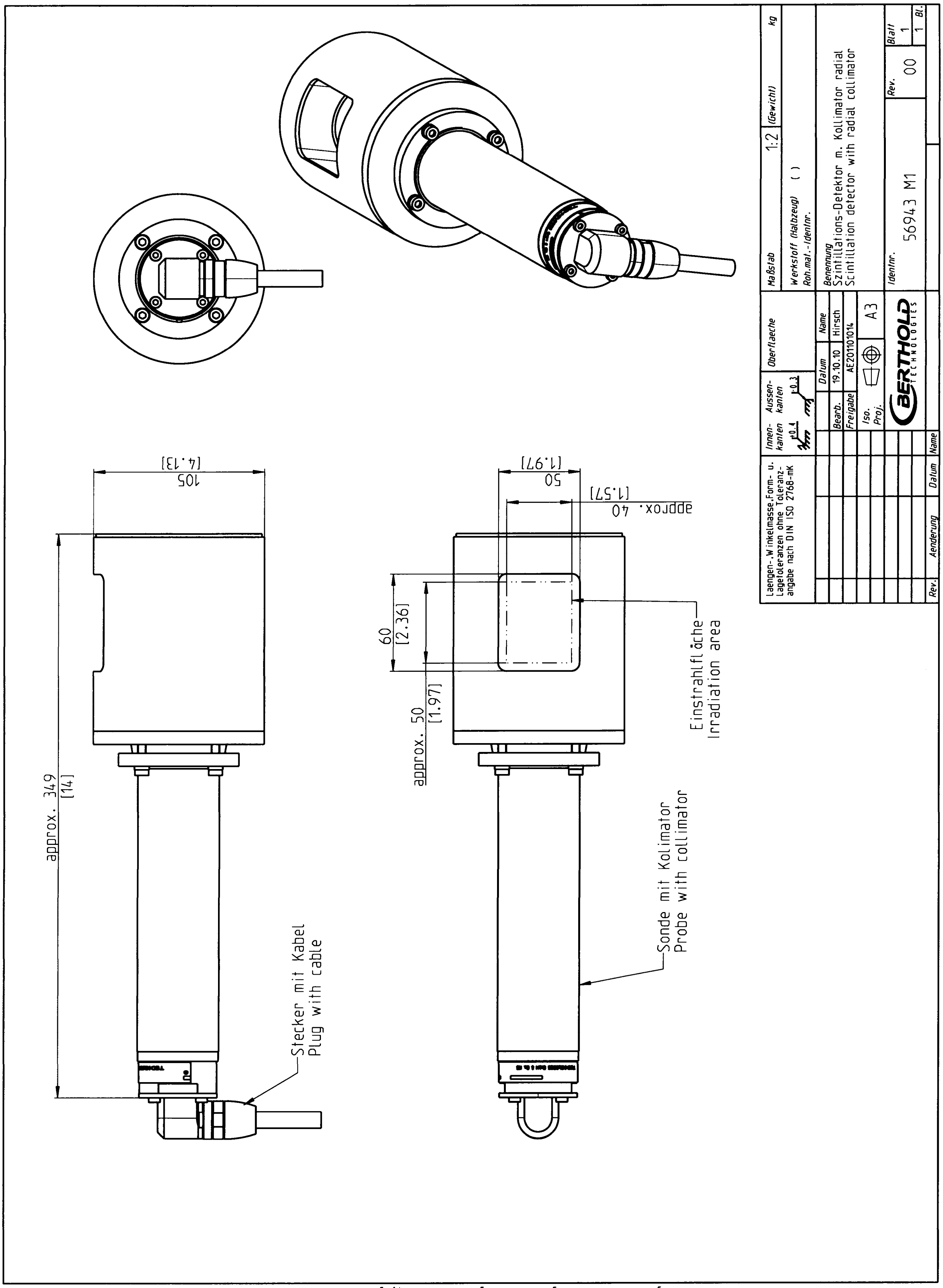


10.5 Dimensional Drawings Radiometric Measuring Path

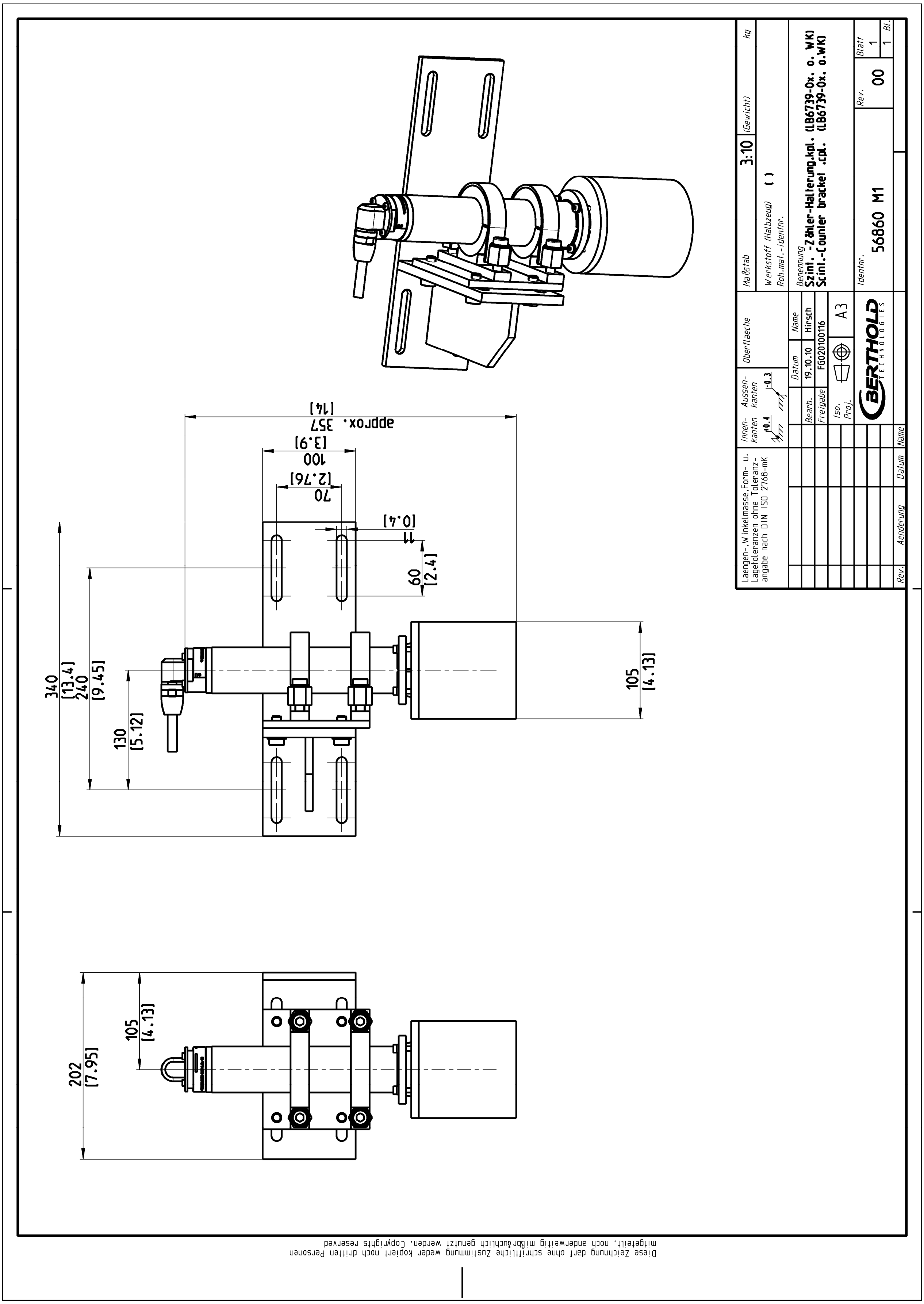
10.5.1 Scintillation Counter with Axial Collimator



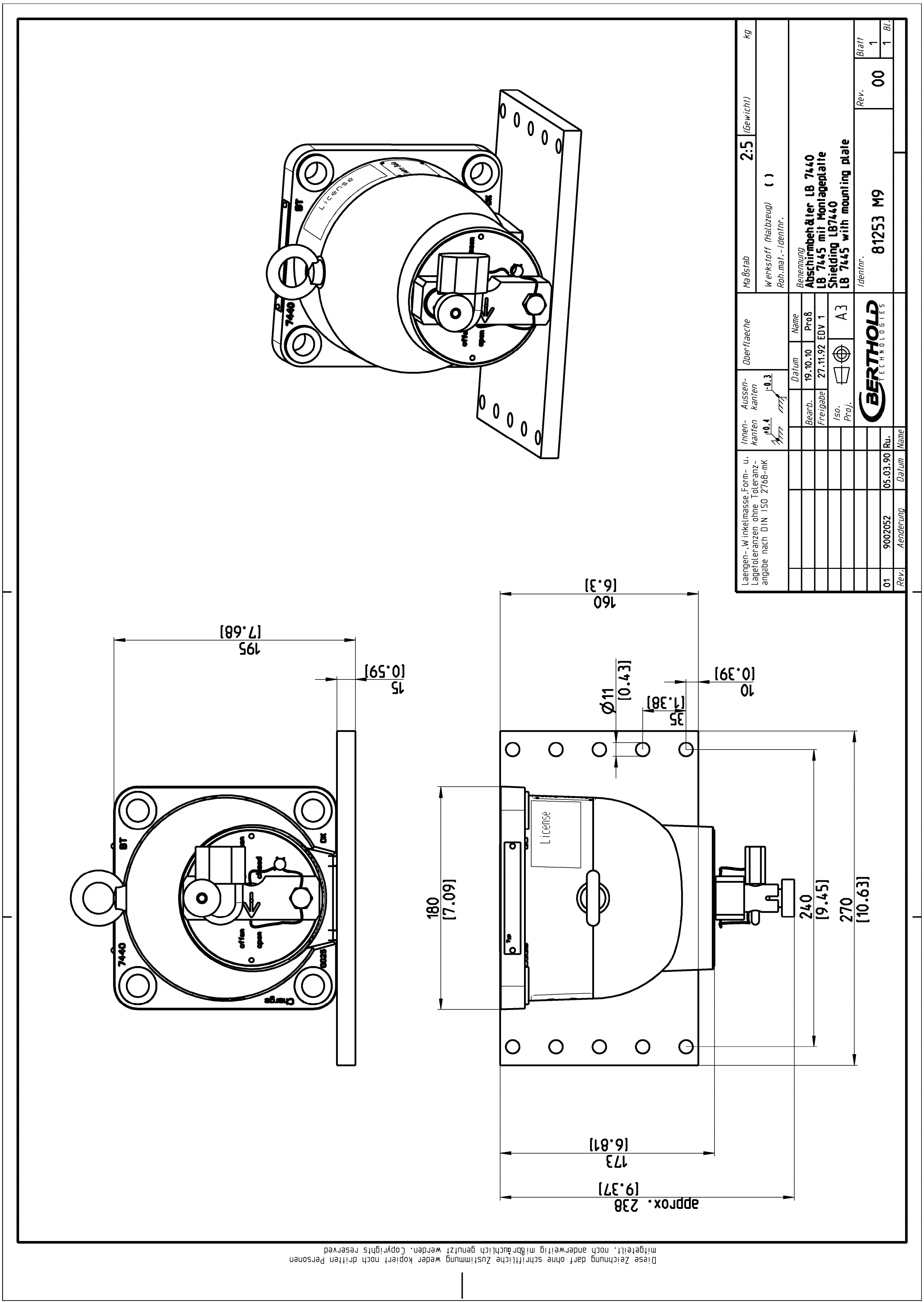
10.5.2 Scintillation Counter with Radial Collimator



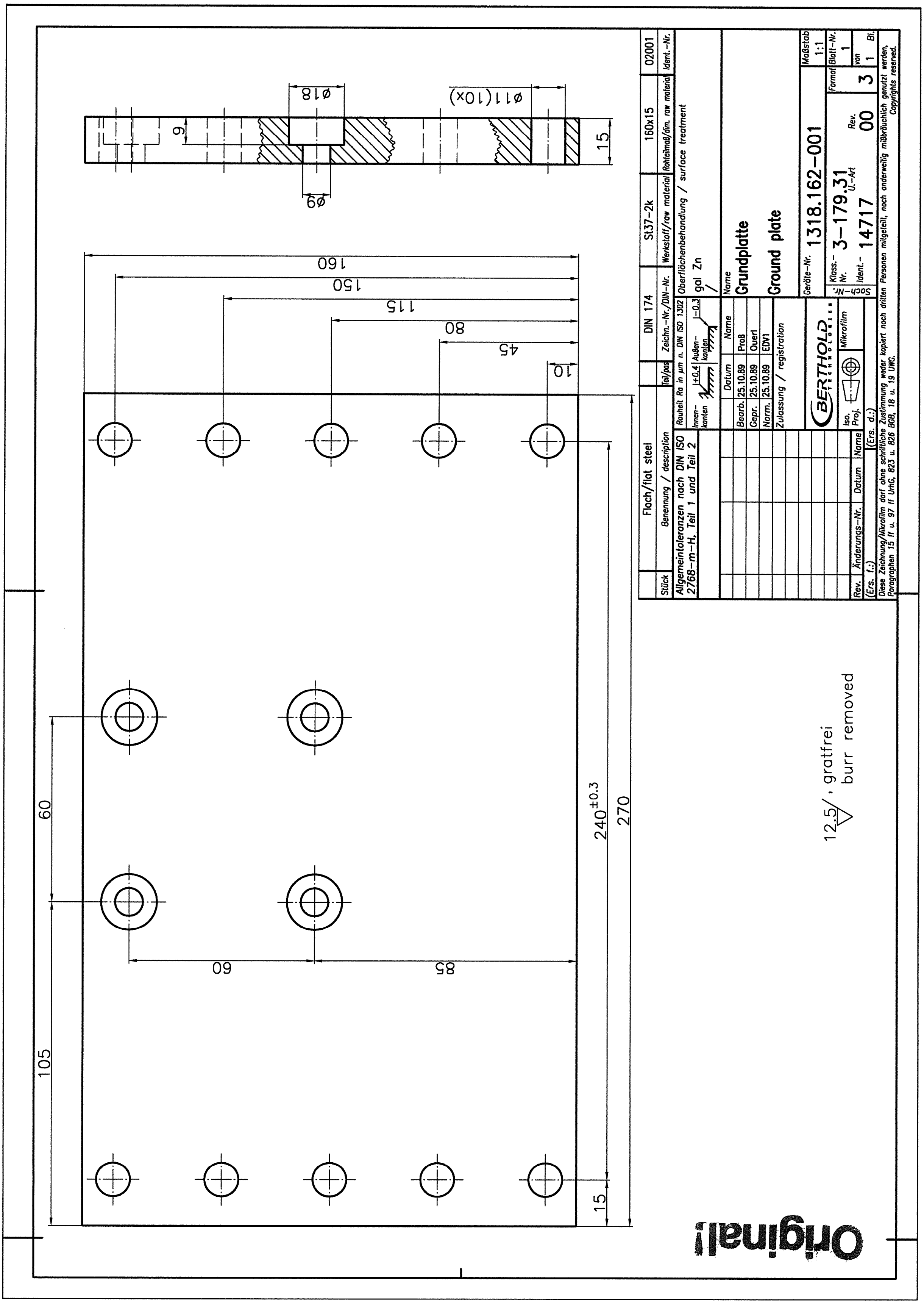
10.5.3 Scintillation Counter with Bracket



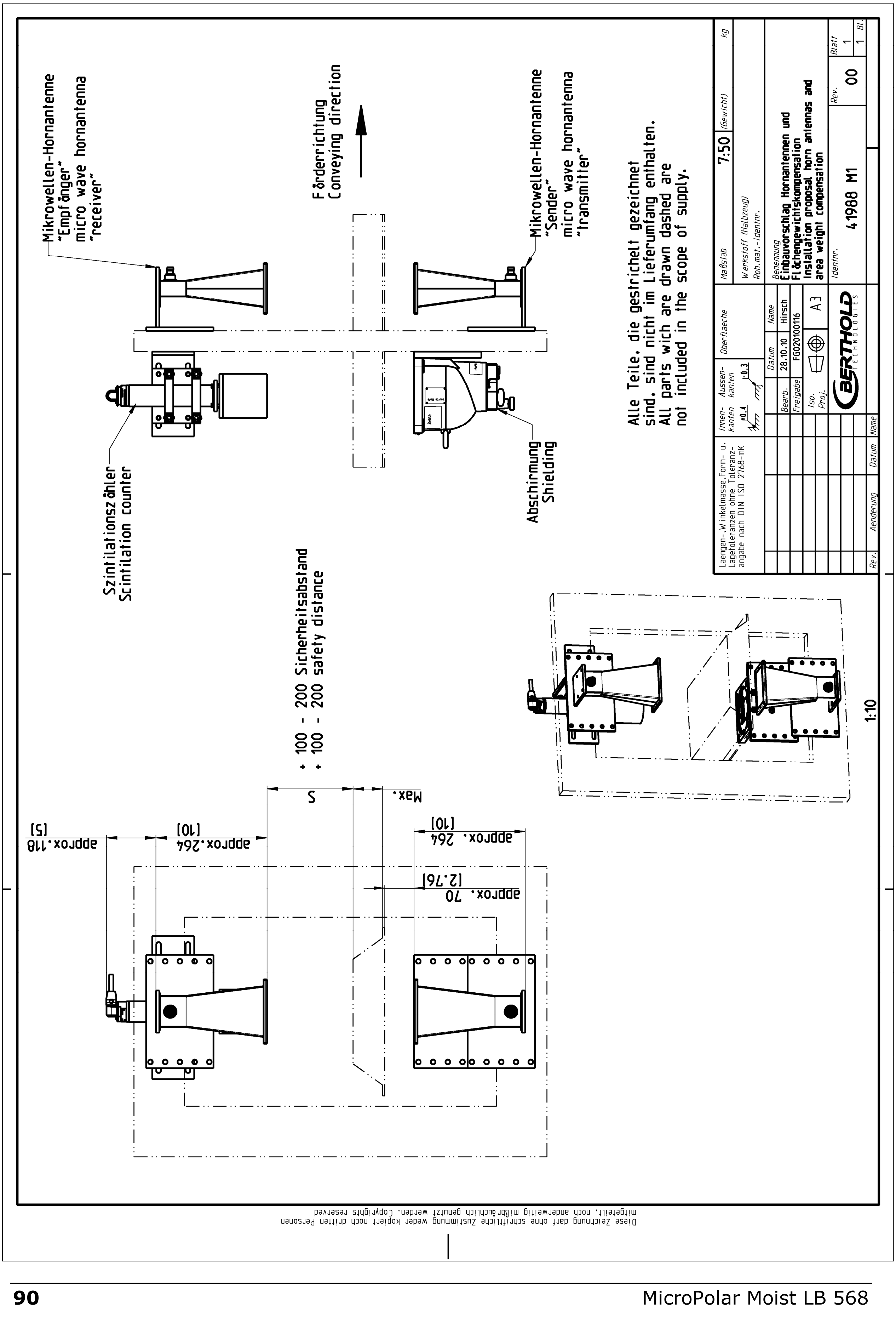
10.5.4 Shielding Container LB 7440/5 with Mounting Plate



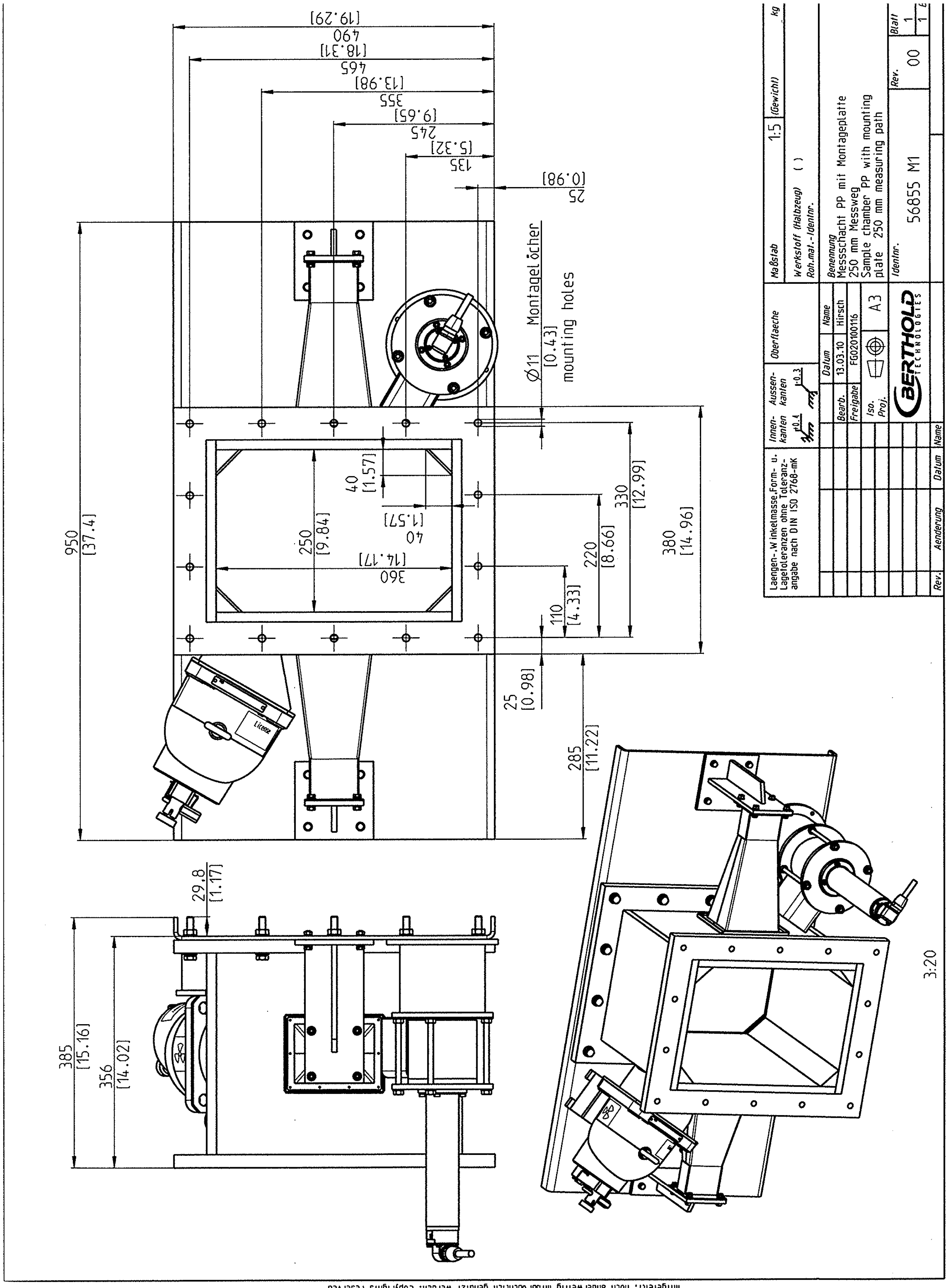
10.5.5 Mounting Plate for Shielding Container



10.6 Installation Proposal at the Conveyor Belt



10.7 Installation Proposal at the Measuring Chute



Index

A

Accuracy ... 57
Antenna distance ... 25
Assembly conditions ... 25

B

Battery ... 55

C

Calculation of measured values ... 16
Chute measurement configuration ... 33
Compensation ... 17
Components ... 21
Conductive materials ... 17
Connection scintillation counter ... 53
Connector strip ... 51
Conveyor measurement configuration ... 32

D

Data format RS232 ... 65
Data transfer rate ... 53
Device disposal ... 55
Digital outputs ... 54
Dimensional drawing EVU case ... 79

E

Evaluation unit ... 14, 23

F

Factory setting ... 14
Format RS232 ... 65
Frequency license ... 12, 78
Fuses ... 56

G

Gas inclusions ... 13

H

HF cable ... 31
Horn antennas ... 25

I

Instrument cleaning ... 55

L

Law of absorption ... 20
LED's ... 24, 54
Limitations ... 17
Loading compensation ... 18

M

Mains connection ... 50
Mains fuses ... 56
Mass per unit area ... 19, 20
Measuring chute ... 30
Measuring conditions ... 36, 47
Minimum load ... 37

O

Optional loading compensation ... 67

P

Parts subject to wear ... 55
Polarization ... 25
Principle of measurement ... 15

R

Radiometric measuring path ... 27
Recycling passport ... 55
Relay ... 54
RS232 interface ... 53
RS485 interface ... 52

S

Safety Summary ... 7
Salt content ... 13
Service instructions ... 55
Shielding ... 28
Spiral antennas ... 25
Steel-wire reinforced conveyor belt ... 40, 45
Symbols ... 7
Synchronization ... 70

T

Technical data 57
Technical data HF-cable 64
Technical drawings.. 79
Temperature compensation.. 17, 69
Terminal blocks 24
Torque of HF connector 46
Transmission power...57
Transport 35

W

Warning 7
Wiring diagram 80

Concentration / Moisture Measuring Systems
MicroPolar Moist
LB 568

User's Guide

Software Manual

41990BA2

Rev. Nr.: 03, 07/2017

The units supplied should not be repaired by anyone other than Berthold Service engineers or technicians by Berthold.

In case of operation trouble, please address to our central service department (address see below).

The complete user's guide consists of the hardware manual and the software manual.

The **hardware manual** comprises the

- component description
- assembly instructions
- electrical installation description
- technical data
- certificates
- dimensional drawings

The **software manual** comprises the description of the

- operation
- software functions
- calibration
- error messages

The present manual is the software description.

Subject to changes without prior notice.

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Table of Contents

Page

Chapter 1. Safety Summary **7**

Chapter 2. Communication with MicroPolar Moist **9**

Chapter 3. Getting Started Guide **11**

Chapter 4. Software Functions **13**

4.1 Information on the Menu Structure 13
4.2 Menu Structure 14
4.2.1 Start Menu 16
4.2.2 Diagnostic 16
4.2.3 Setup 18
4.2.4 Access Level 19
4.2.5 Language 19
4.2.6 Configuration 19
4.2.7 General Data 21
4.2.8 Measurement 21
4.2.9 Plausibility 22
4.2.10 Synchronization 23
4.2.11 Calibration 24
4.2.12 System Adjust 24
4.2.13 Calibrate Concentration 25
4.2.14 Sampling 26
4.2.15 Sample Data (expanded) 27
4.2.16 Advanced 27
4.2.17 Calibration 28
4.2.18 Loading Compensation 29
4.2.19 Inputs / Outputs 31
4.2.20 Current Output 32
4.2.21 Current Out 1 32
4.2.22 Current Out 2 33
4.2.23 Current input 33
4.2.24 Current Input 1 34
4.2.25 Current Input 2 34
4.2.26 PT100 34
4.2.27 Digital Output 35
4.2.28 Digital Input 35
4.2.29 Service 37
4.3 Menu Structure Radiometric Detector 39
4.3.1 Configuration Radiometric Detector 39
4.3.2 Service Radiometric Detector 41
4.4 Trend Display 43

Chapter 5. Configuration **45**

5.1 Configuration Setup 45
General Data 46
5.1.1 Measurement 46
5.1.2 Plausibility 47
5.1.3 Microwave 48
5.1.4 Configuration Radiometry 48
5.1.5 Units 49
5.1.6 Marker 50
5.2 Start Calibration Coefficients 50

Chapter 6. Calibration **51**
6.1 Scintillation Counter Calibration 51
6.2 System Adjust 52
6.2.1 Verifying the Reference Values 54
6.2.2 Tare Measurement 55
6.3 Sampling 56
6.3.1 Entering the Lab Values 58
6.4 Calibration 59

Chapter 7. Calibration and Advanced **61**
7.1 Calibration 61
7.1.1 Calibration with Load Compensation 64
7.1.2 Calibration with Two Concentrations 65
7.1.3 Calibration with Split Value 69
7.2 Adjusting the Calibration 71
7.3 Output of the Start-up Protocol 73

Chapter 8. Password **75**
8.1 Password Forgotten 75

Chapter 9. Error Lists and Device States **77**
9.1 Hardware and Error Prompts 77
9.2 Input Error 78
9.3 Measurement Error and Error Prompts 78
9.4 Device States 80

Chapter 10. Start-up Protocol **81**
10.1 Example of Start-up Protocol 84
10.2 Sampling 88

Chapter 1. **Safety Summary**

Please observe all safety instructions in the *Hardware Manual*, especially those in *chapter 1 Safety Summary*.

NOTICE

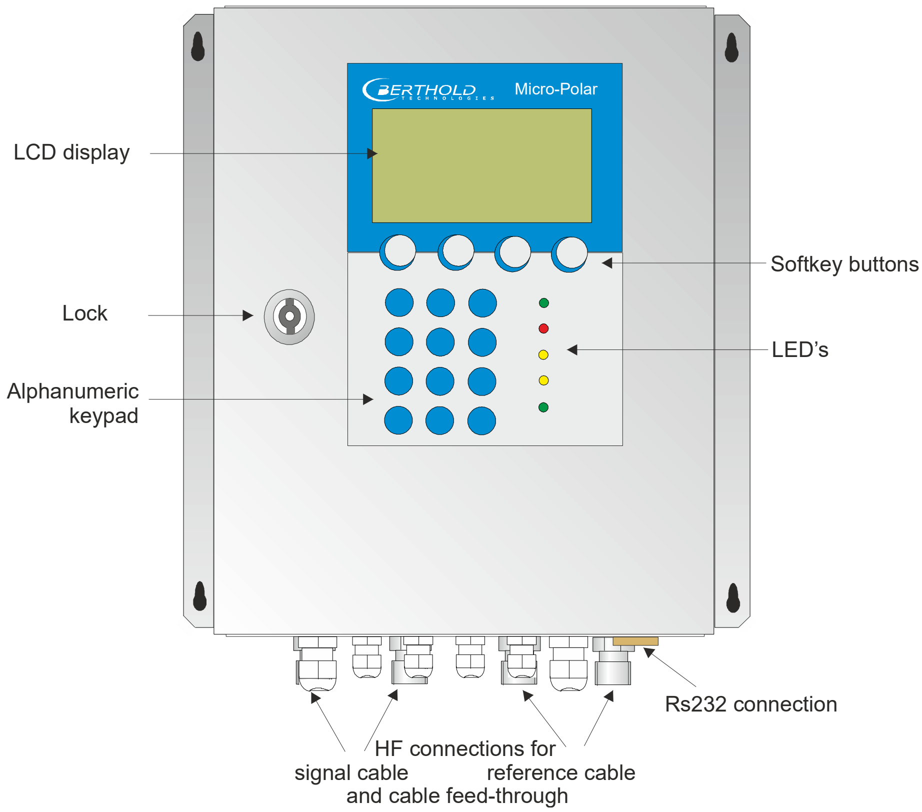
Parameter settings
Never change the installation and the parameter settings without a full knowledge of these operating instructions, as well as a full knowledge of the behavior of the connected controller and the possible influence on the operating process to be controlled.

Chapter 2. **Communication with MicroPolar Moist**

The communication with MicroPolar Moist is carried out via 4 softkey buttons. The function of the individual buttons changes relative to the position in the menu. Values and texts are entered via an alphanumeric keyboard. The instrument status is indicated by 5 LEDs.

TIP

Click on the help button ? in the display footer to view useful information.



Chapter 3. **Getting Started Guide**

To get started, please carry out the steps described below one after the other.

Chapter 4. Software Functions describes all software functions and also serves as a reference guide.

1. Step
Configure the analog inputs as needed: Current inputs 1, 2 and PT100. *See chapter 4.2.19 Input / Output.*

TIP
All analog inputs and outputs have already been set in the factory. Therefore, no adjustment work is required during commissioning.

---

2. Step
Review and edit the software parameters of the application. Some parameters have already been set in the factory. Carry out the steps described in *chapter 5. Configuration*.

3. Step
Carry out the calibration with sampling, *chapter 6. Calibration.*

4. Step
Configure the current outputs, digital in- and outputs as needed.

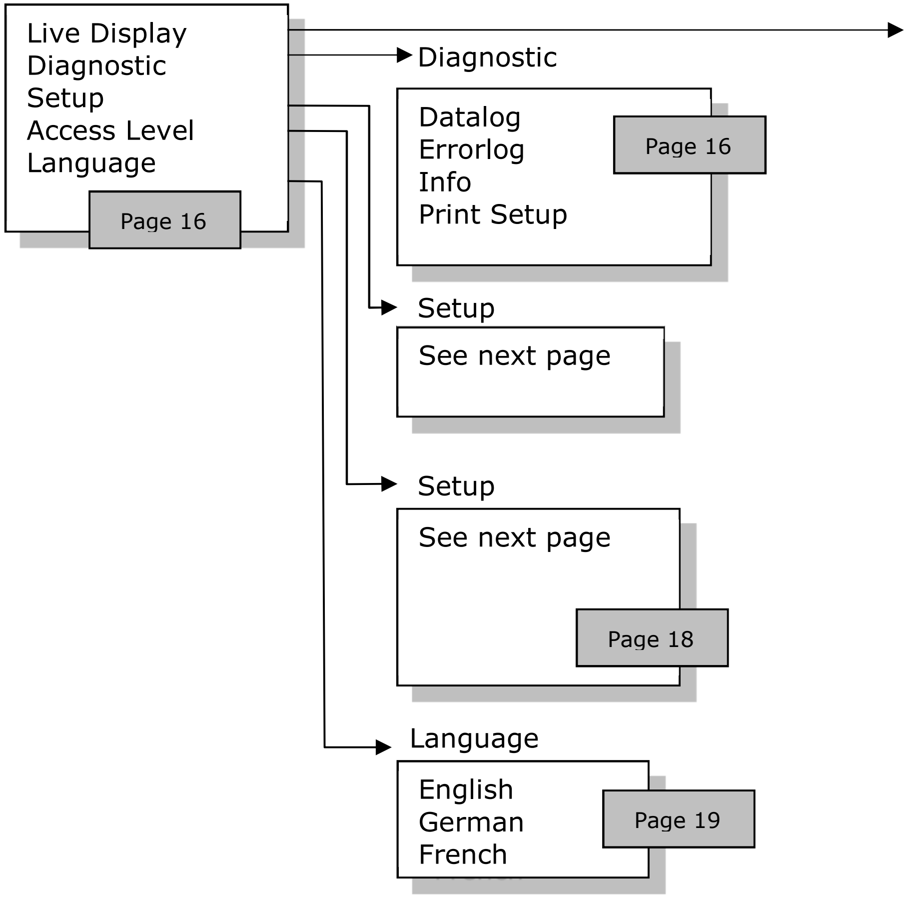
Chapter 4. **Software Functions**

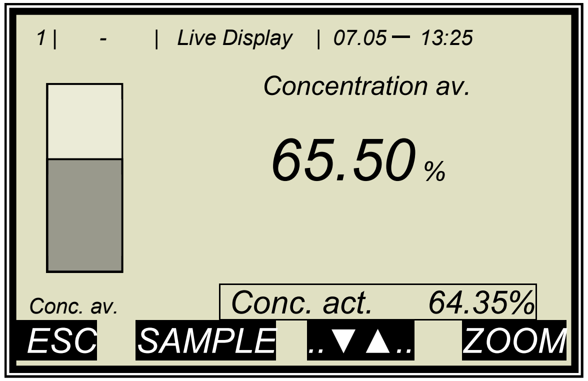
4.1 Information on the Menu Structure

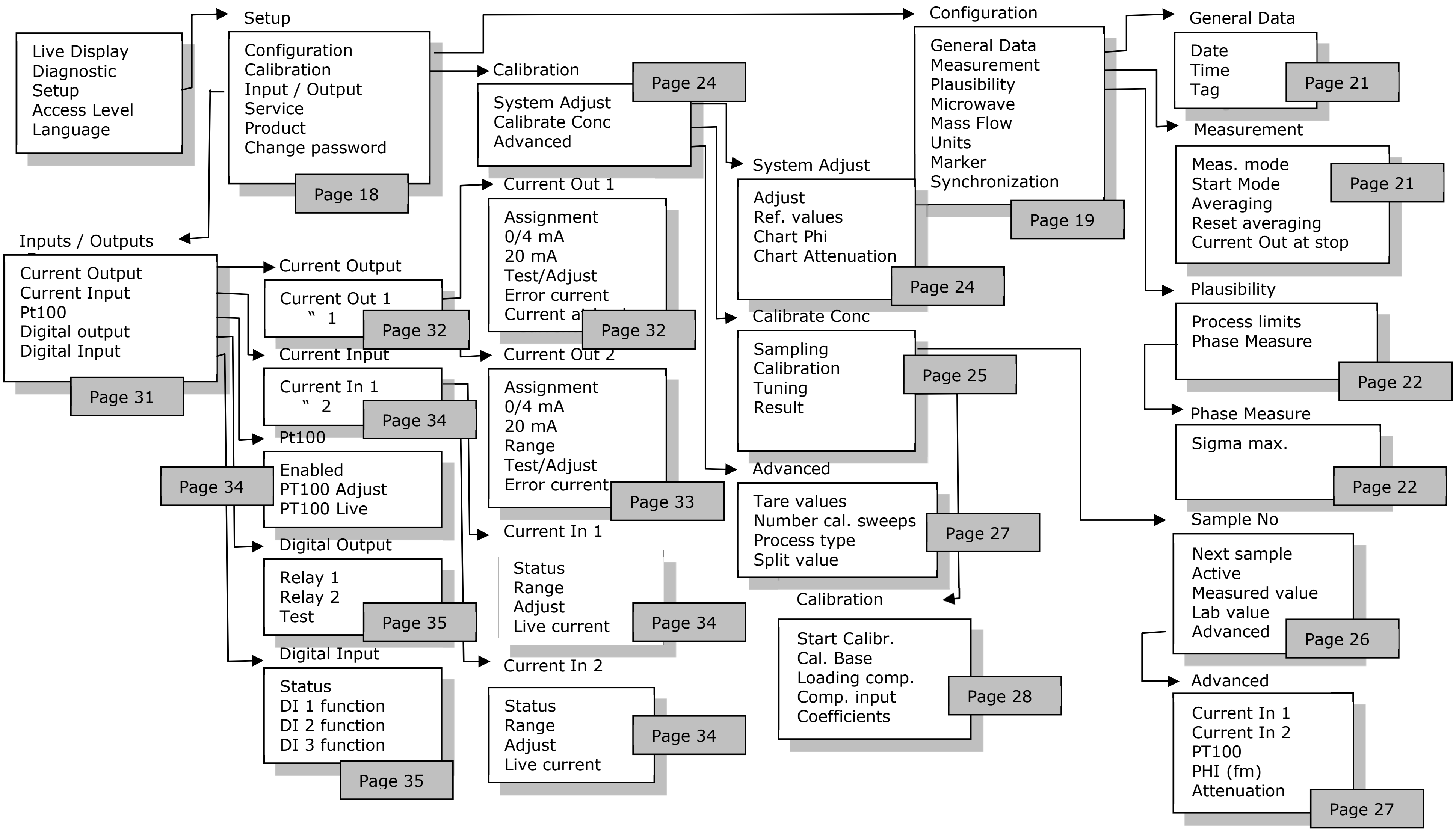
The menu structure on the following pages provides an overview of all functions of the LB 568. Using the **page numbers** indicated you can look up the function of the depicted window.

You have to enter a password to change from the **Read only** level to **User Mode**. The **Service level** is not accessible due to licensing regulations.

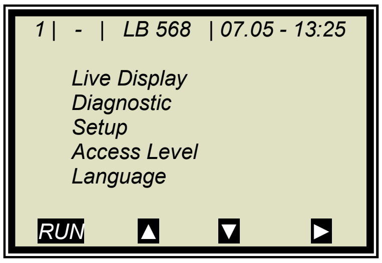
4.2 Menu Structure






Live Display
Diagnostic
Setup
Access Level
Language
Setup
Configuration
Calibration
Input / Output
Service
Product
Change password
Page 18
Inputs / Outputs
Current Output
Current Input
Pt100
Digital output
Digital Input
Page 31
Current Output
Current Out 1
" 1
Page 32
Current Input
Current In 1
" 2
Page 34
Pt100
Enabled
PT100 Adjust
PT100 Live
Page 34
Digital Output
Relay 1
Relay 2
Test
Page 35
Digital Input
Status
DI 1 function
DI 2 function
DI 3 function
Page 35
Calibration
System Adjust
Calibrate Conc
Advanced
Page 24
Current Out 1
Assignment
0/4 mA
20 mA
Test/Adjust
Error current
Page 32
Current Out 2
Assignment
0/4 mA
20 mA
Range
Test/Adjust
Error current
Page 33
Current In 1
Status
Range
Adjust
Live current
Page 34
Current In 2
Status
Range
Adjust
Live current
Page 34
System Adjust
Adjust
Ref. values
Chart Phi
Chart Attenuation
Page 24
Calibrate Conc
Sampling
Calibration
Tuning
Result
Page 25
Advanced
Tare values
Number cal. sweeps
Process type
Split value
Page 27
Calibration
Start Calibr.
Cal. Base
Loading comp.
Comp. input
Coefficients
Page 28
Configuration
General Data
Measurement
Plausibility
Microwave
Mass Flow
Units
Marker
Synchronization
Page 19
General Data
Date
Time
Tag
Page 21
Measurement
Meas. mode
Start Mode
Averaging
Reset averaging
Current Out at stop
Page 21
Plausibility
Process limits
Phase Measure
Page 22
Phase Measure
Sigma max.
Page 22
Sample No
Next sample
Active
Measured value
Lab value
Advanced
Page 26
Advanced
Current In 1
Current In 2
PT100
PHI (fm)
Attenuation
Page 27

4.2.1 Start Menu



Live Display:
Shows the live display.

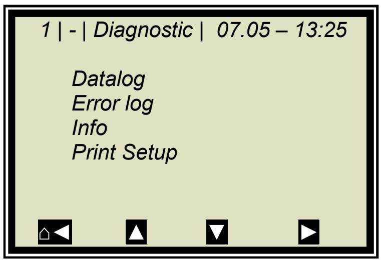
Diagnostic:
This menu item contains the submenu items data logger, error log, device information and print setup.

Setup:
All necessary inputs for operation of the measuring system can be entered here.

Access level:
Select the access level.
Areas protected by passwords can be unlocked.

Language:
Select the dialog language.

4.2.2 Diagnostic



Datalog:
Datalog records the data corresponding to the contents of the serial data output RS232 (see *Hardware Manual, chapter 6.6*).
All measured data of a measurement (sweep) are averaged over the averaging time (see below) and stored. This time is dependent on the selected log time. The contents of the datalog can be displayed on the live display, see *chapter 4.4 Trend Display*. Output as a text file is also possible by using RS232 or the Memory Tool (optional accessory).

- Log type — Disable
single
continuous
stop at error
- Log time — Logging period
15 minutes to 3 days
- Restart log — Clears the datalog and starts with the above setting
- Averaging time — Obtained from log time
- Print log — Printout of tables, output via RS232, format see *chapter 6.6 Hardware Manual*

Change datalog settings:

If you change the log type from any to "single", the datalog will be cleared and you start again with the current setting. If you change all other log types and log times, the datalog will not be cleared and you continue with the new settings.

Behavior with stopped measurement:

If the measurement is stopped for some time during the datalog, then the measurement pause will be interpreted as log time in the log type "single". For all other log types, the measurement pause will be added to the log time.

Error log:

Shows the logged error The last 20 error messages will be stored with date and time.

Info:

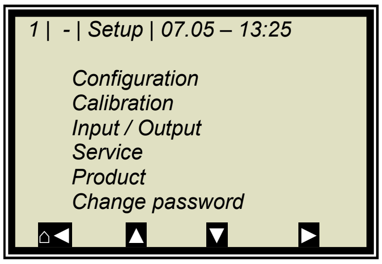
- Tag :...
- Device type : LB 568
- Supplier : Berthold Technologies
-
- Manufacturer : Berthold Technologies
- Device no. : ...
- Production no. : ...-...
- Software Ver. : V...
- SW rev. date : ...

Print Setup:

Printout of the start-up protocol via RS232.

Format, contents and example see *chapter 10. Start-up Protocol.*

4.2.3 Setup



Configuration:

Setup of

- General data
- Measurement-specific data
- Plausibility data
- Microwave data
- Radiometry data
- Units
- Marker
- Synchronization

Calibration:

- System Adjust
- Calibrate Conc
- Advanced

Input / Output:

- Current output
- Current input
- PT100
- Digital output
- Digital input

Service:

- Factory Setting
- General Reset
- Memory Tool (operation of the memory tool, optional accessory)
- Data Output (data contents can be selected via RS232)

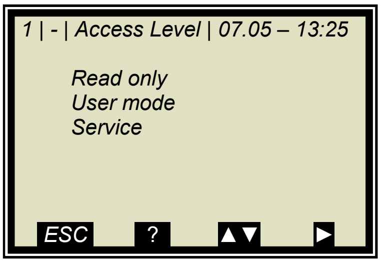
Product:

Product selection (1-4); if you select another product, the product-specific data will be loaded: outputs, inputs and calibration.
When you select the products 2 to 4 for the first time, all settings and contents (e.g. system calibration, sampling table, datalog and calibration) of the current product will be copied to the new product.

Change password:

The password for the User Mode access level can be changed here.
For more information, see *chapter 8. Password*.

4.2.4 Access Level



Read only:

In this mode, the measuring system can be protected against unauthorized access. You can exit this level only by entering a password. The measuring system cannot be started and stopped. You can go to Diagnostic and to Access Level only in the main menu.

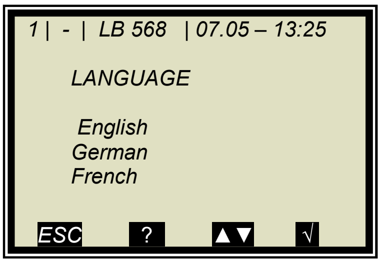
User Mode:

- The user mode is the default mode and provides access to all user-relevant parameters.
- On the *Read only* level you have to enter a password.
- The password can be changed.

Service:

- This level is reserved for the service personnel.

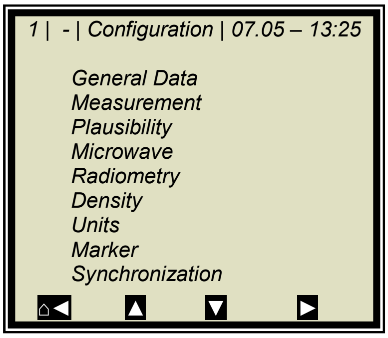
4.2.5 Language



Language:

- Select the dialog language

4.2.6 Configuration



General Data:

- Enter date, time and tag

Measurement:

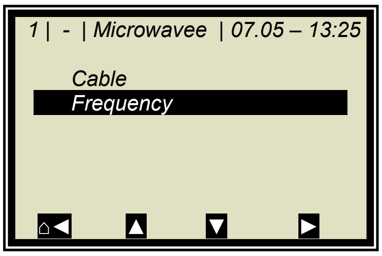
- Meas. Mode (batch/continuous)
- Start Mode (keyboard/external)
- Averaging (number of measured values used for averaging)
- Reset averaging (yes/no)
- Current output at stop

For more information, please see *chapter 4.2.8 Measurement*

Plausibility:

- The process limits define the permissible range within which the actual concentration must be.
- The phase measurement is subject to a plausibility analysis, which can be set here.

For more information please see *chapter 4.2.9 Plausibility*



Microwave:

- **Cable:** Enter the cable length for signal and reference and cable, for example, for 2 x 2 m HF cable in the signal cable, you have to enter 4 m for the signal cable.

- **Frequencies:** The frequency settings are password-protected and can only be edited on the Service access level.

Radiometry:

Here, the radiometric detector is configured. For details see *chapter 4.3.1 Configuration Radiometric Detector*.

Density:

The menu is displayed only when current input 1 and radiometry are enabled and the unit cm has been selected for current input 1.
Here the density calculation is enabled or disabled and the current density value is displayed.

Function:
The layer thickness signal is fed via current input 1 into the evaluation unit and the mass per unit area is measured by the radiometric measuring device. From these two signals, the evaluation unit calculates the density (unit g/m^3) and outputs it via the current output parallel to the moisture value.

Units:

Depending on the configuration, different units can be selected for concentrations, current inputs and temperature.
For the concentration (1 and 2) you can select:
none, specific, %, %TS, °Be, g/L, g/cm^3

For current input 1 you can select:
none, specific, °C, °F, g/cm^3, kg, t/h, cm

For current input 2 you can select:
none, specific, °C, °F, cm, m/s

For the PT100 input you can select:
none, °C, °F

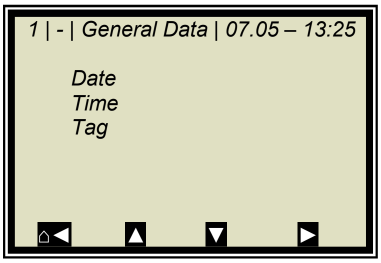
Markers:

Enter a value and a name (up to 5 characters) for the marker here. The presentation takes place in the live display and refers to the bar chart. To disable the marker, select a marker value outside of the chart limits or the current output limits.

Synchronization:

The current input signals can be synchronized with the microwave measurement; the current input signals will be stored temporarily. All settings are defined here.
For details see *chapter 4.2.10 Synchronization*.

4.2.7 General Data

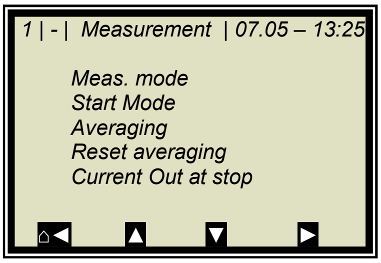


Date:
- Enter the current date

Time:
- Enter the current time

Tag:
- Enter the name of the measuring point. The tag (max. 8 characters) is displayed in the header on the display.

4.2.8 Measurement



Meas. Mode:

Select continuous or batch. In Batch mode, an average value is calculated between start and stop. In Continuous mode, a moving averaging is calculated depending on the adjusted averaging number.

Start Mode:

The measurement device can be started or stopped via external terminals (digital input) or via keyboard.

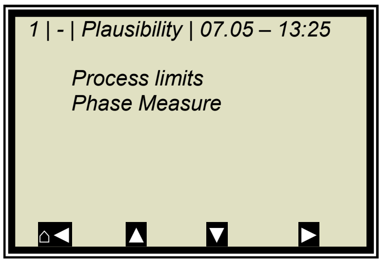
Averaging:

Enter the number of averaging processes. This number indicates over how many measurements the concentration value is to be averaged (moving average). This is true only for the measuring mode Continuous.

Reset Averaging:
Reset averaging (yes/no) This refers to Batch and Continuous.

Current output at stop:
Select "0/4 mA" or "Hold". The selection defines how the current outputs behave with stopped measurement. This is true only for the measuring mode Continuous.

4.2.9 Plausibility



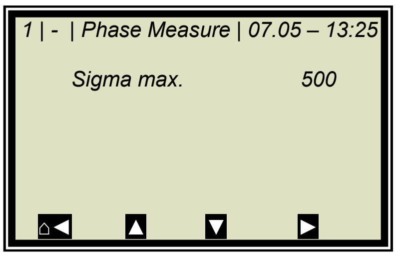
Process Limits:
Enter a permissible measuring range exceeding. If the concentration exceeds the range, the concentration average is put on hold and an error message is displayed (error state). The process limits are independent of the current output limits.

Phase Measure:

Phase and attenuation are calculated for each measured value (measurement cycle) from a variety of individual measurements at different frequencies in a wide frequency band (called sweep/frequency sweep). Such a measurement allows an ongoing review of the measurement results with respect to their plausibility.

The attenuation is calculated by averaging over the frequency range without further plausibility test.

The phase is calculated by regression formation over the frequency range and checking the spread of frequency points (Sigma).



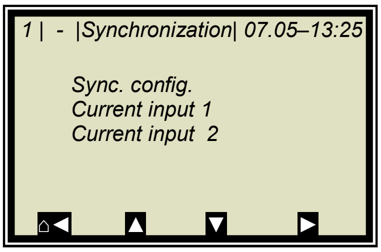
Sigma max.:
Here you set the maximum sigma of the regression Phase vs. Frequency.
During normal measurement operation, Sigma lies between 0 and 500.
Default: Sigma = 500.
With Sigma = 0 the plausibility is turned off.

4.2.10 Synchronization

If the compensation measurements are carried out in a large distance from the microwave measuring path, then the current input signals (compensation signals) can be stored temporarily and can be synchronized with the microwave information. The goal of the synchronization is to make sure that all measuring information of all systems relate to the same product section.

Please see the measuring conditions described in *chapter 7.3* in the *Hardware Manual*.

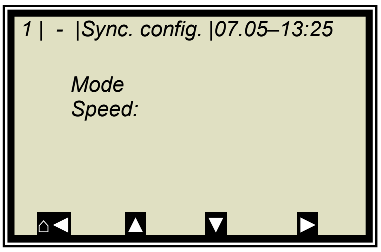
Variable conveying speed: Only one current input signal can be synchronized because current input 2 is used for the belt speed. The speed signal must be fed in via current input 2 and m/s has to be selected as the unit for current input 2.



Sync. config.:
Select the synchronization mode and, if necessary, enter the conveying speed.

Current Input 1/2:
Enter the distance between compensation measurement (for example, belt weigher) and microwave measurement. If the compensation measurement is installed before the microwave measurement, relative to the conveyor belt direction, enter a positive distance; otherwise, enter a negative distance.

The submenus CURRENT INPUT 1 and CURRENT INPUT 2 are displayed only if the current inputs and synchronization have been enabled.

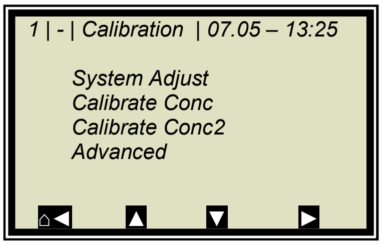


Mode:
- Disable
- Constant speed
- Variable speed

The item "Variable speed" is displayed only if m/s has been selected as the unit for current input 2.

Speed:
Enter the conveyor belt speed in m/s.
This menu appears only if the mode "Constant speed" is selected.

4.2.11 Calibration



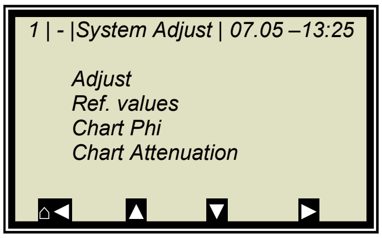
System Adjust:
System calibration is started here.
For details see *chapter 4.2.12 System Adjust*.

Calibrate Conc:
Opens the calibration menu of concentration 1.

Calibrate Conc2:
Opens the calibration menu of concentration 2.
The second concentration is displayed only if a second concentration is selected under menu | ADCANCED | PROCESS TYPE |.

Advanced:
Here you set the tare values, the number of sweeps when recording samples, the process type and the split value. For more details, see *chapter 4.2.16 Advanced*.

4.2.12 System Adjust



Adjust:
System adjustment is started. Phase and attenuation are set to zero, and thus, for example, all cable parameters are considered. This adjustment also forms the reference for the measurement.
The system adjustment (= reference measurement) must be carried out once.

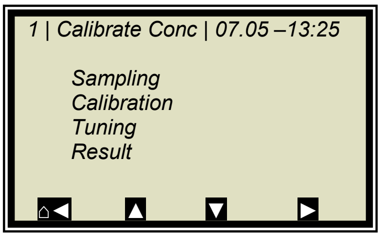
Ref. values:
Upon completion of the reference measurement, the reference values for phase, attenuation, slope and Sigma can be output.

Chart Phi:
Shows the phase versus the frequency.

Chart Atten.:
Shows the attenuation versus the frequency.

A system adjustment will not delete the datalog (see *chapter 4.2.2 Diagnostic*).

4.2.13 Calibrate Concentration



Sampling:

Shows all measured samples and entered lab values.

Calibration:

Here

- you select the calibration parameters, the temperature and loading compensation
- the calibration coefficients are calculated automatically
- the calibration coefficients are displayed

For more information, see *chapter 4.2.17 Calibration*.

Tuning:

Subsequent correction of the reading is possible by entering a factor and an offset.
Calculation is carried out according to the following formula:

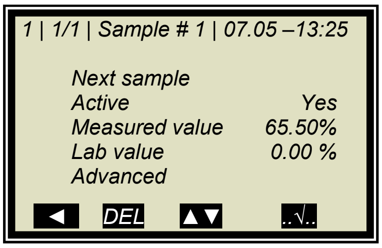
Eq. 4-1:

Corrected display = Display * Factor + Offset

Result:

Presentation of calibration curve, display of correlation and coefficients.

4.2.14 Sampling



The header includes the following information (from left to right):

- Product no.
- Current table position / Total number of entries
- Sample no. of current table position
- Date and time of sampling

Up to 30 sample entries are possible. The sample can be assigned to the lab value either via the sample no. or through data/time. The sample no. is assigned on a continuous basis. If a sample is deleted, the sample no. will not be assigned a second time. Up to 999 sample numbers are available. Only if all numbers have been assigned, you may assign a number for the second time; you will be alerted accordingly by a message on the display.

Next sample:
Continue with the next sample.

Active:
You can choose if this sample should be taken into account in the calibration.

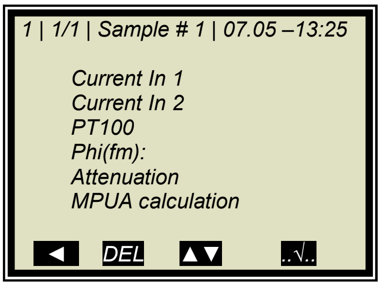
Measured value:
Display of the measured values, calculated with the actual coefficient.

Lab value:
Entry position for the lab value.

Advanced:
Switches to the next data page.

Delete:
Briefly push the softkey to delete the indicated sample entry. Push this key for a longer time to delete all sample entries.

4.2.15 Sample Data (expanded)



Current In 1:
Display of the first compensation input.

Current In 2:
Display of the second compensation input.

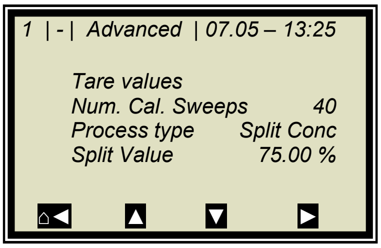
PT100:
Display of the PT100 input.

Phi(fm):
Display of the measured phase.

Attenuation:
Display of the measured attenuation.

MPUA calculation:
Display of the measured load [g/cm^2]

4.2.16 Advanced



Tare values:
Option to enter tare values for phase and attenuation. The tare values are added to the phase and/or the attenuation prior to calibration. The calculation is carried out as follows:

Eq. 4-2 and 4-3

Phase = Phase$_{meas}$ - Phi Tare

Attenuation = Attenuation$_{meas}$ - Phi Tare

Number of Calibration Sweeps:
Freely adjustable number of sweeps over which a calibration point (in the course of automatic sample measurement) will be averaged.

Process Type:
Select the operation mode:
- one concentration [1 measuring range]
- two concentrations [2 measuring ranges]
- split concentration [1 measuring range with switching point (split value) for coefficient switchover].

Split Value:
Setting of the switching point on a value basis.

4.2.17 Calibration

Calibration is performed using the following formula:

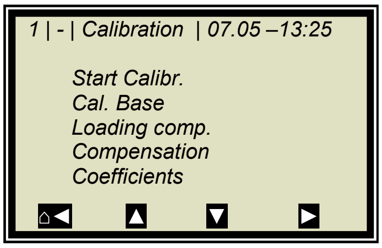
Eq. 4-4

Measured value = A · Phase + B · Attenuation + C + D · PT100 + E · Input1 + F · Input2 + G · Load

where:

Meas. value	Concentration / Moisture / Dry mass / Density
A	Phase coefficient
B	Attenuation coefficient
C	Offset
D	Compensation coefficient for PT100 input
E	Compensation coefficient for current input 1
F	Compensation coefficient for current input 2
G	Compensation coefficient for loading

The coefficients can be entered manually or calculated automatically from the entries of the sample table.



Start Calibr.

Starts the calibration using the parameters set and the coefficients are calculated automatically from the entries of the sample table.

Cal. Base

Selection of microwave signals, which are taken into account for the calibration. The following parameters can be set:

- Phase
- Attenuation
- Phase and attenuation

Default: Attenuation

Loading compensation:

The loading compensation can be selected here. After the selection, the required analog inputs are used automatically. A selection in the **Comp input** menu is then no longer necessary/possible.
For details see *chapter 4.2.18 Loading Compensation*.

Compensation

Here you can select the analog inputs (PT100, current input 1 and 2) required for compensation. Depending on the enabled analog inputs, the following options can be selected:

- None
- In1
- In1 + In2
- In1 + PT100
- In1 + In2 + PT100
- In2
- In2 + PT100
- PT100

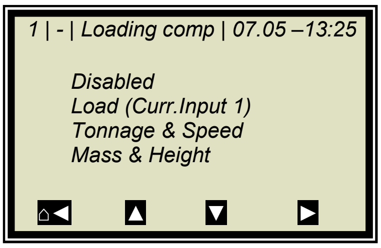
Coefficients:

Here all coefficients can be entered directly, e.g. start coefficient.

The automatically calculated coefficients are also stored here. Coefficients that are not used are set to zero.

4.2.18 Loading Compensation

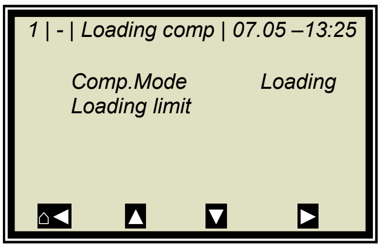
At least one analog input must be active so that the LOADING COMPENSATION menu is displayed. Some modes require two analog inputs for display/selection.



Comp. Mode:

The following parameters can be set:

- Disable / Enable
- Load (Cin 1)
- Tonnage & Speed
- Mass & Height



If loading compensation is selected, the Loading limit menu appears.

Loading limit:

Enter the minimum load; if this value is not reached, the evaluation unit changes the device status.
The device status for this mode is described in *chapter 9.4 Device States*.

Compensation mode Loading (Cin 1):

The following units can be used as a compensation signal:

- Weight
- Layer height
- Mass per unit area
- Throughput

Signal input

via current input 1

The unit can be selected at random for current input 1.

Compensation mode Tonnage & Speed (throughput & speed):

Signal input

- Throughput via current input 1
- Speed via current input 2

Units

- Throughput [tons per hour; T/h]
- Speed [m/s]
- Min. load [Kg]

The unit T/h must be selected for current input 1 and the unit m/s for current input 2.

Compensation mode Mass & Height (weight & layer thickness):

Signal input

- Weight via current input 1
- Layer thickness via current input 2

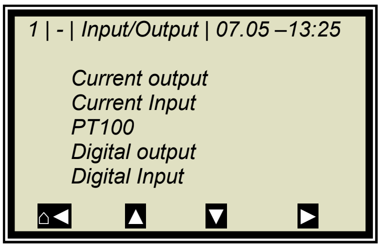
Units

- Weight [Kg]
- Layer thickness [cm]
- Min. load [kg x cm]

The unit kg must be selected for current input 1 and the unit cm for current input 2.

See additional explanation in the *Hardware Manual, chapter 3.3 Loading Compensation.*

4.2.19 Inputs / Outputs



Current Output:
Both outputs can be adjusted, assigned and set up on the selected level.

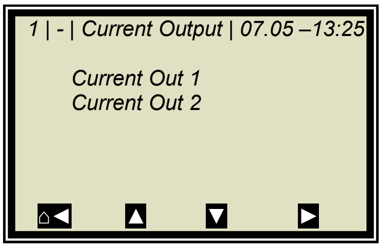
Current Input:
Activation level of current input, calibration and display of the live current signal.

PT100:
Here you can enable and adjust a connected PT100. Display of the actual temperature signal.

Digital Output:
Allocation of relays 1 and 2 and test function.

Digital Input:
Status control and assignment of the digital inputs.

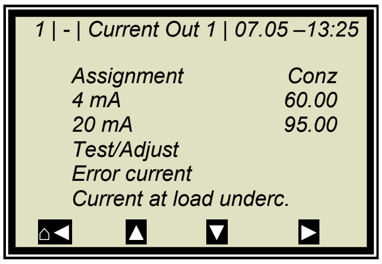
4.2.20 Current Output



IMPORTANT

If a measurement is running, enabling a current input which is not used or not adjusted may cause an error.

4.2.21 Current Out 1



Assignment:

The following signals can be assigned to the current output:

- None
- Concentration
- Concentration 2 (if active)
- Current input 1 or 2 (if active)
- PT100 (if active)
- Mass per unit area (if active)
- Density (if active)

4 mA:

Display value assigned to the 4 mA value.

20 mA:

Display value assigned to the 20 mA value.

TIP

Current output 1 only 4 – 20mA possible

If the current output limit is exceeded, the measurement switches to the warning state, *see chapter 9.4 Device States.*

Test/Adjust:

Current test, calibration and display of live current.

IMPORTANT

The measurement should be stopped for test function.

To check the current loop and possibly connected remote displays, you can set a current between 4 and 20 mA via the test function. If you quit the test function, the system automatically switches back to the live current.

Error current:

If the measurement switches to the fault state, a fault current is output via the current output; this can be set here.

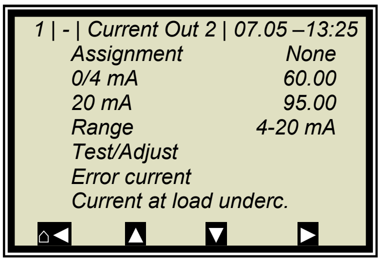
- 22 mA
- 3.5mA
- Hold
- Value (selectable)

Current at load undercut

The current output behavior in the event the load falls below the loading limit may be selected here:

- 22 mA
- 3.5mA
- Hold
- Value (selectable)

4.2.22 Current Out 2



All functions same as current output 1

TIP

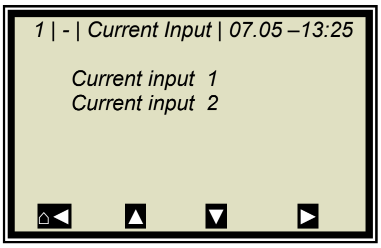
Current output 2 can either be set to 0/4 or to 20 mA.

Range:

Change the current output

- 0 – 20mA
- 4 – 20mA

4.2.23 Current input



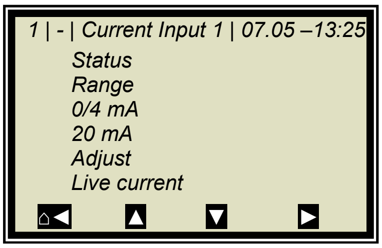
Current In 1:

When selected, change to the activation and calibration menu.

Current In 2:

As described above.

4.2.24 Current Input 1



Status:
Select yes/no to enable or disable the current input.

Range:
Change the current output

- 0 – 20mA
- 4 – 20mA

0/4 mA:
Display value assigned to 0/4 mA value.

20 mA:
Display value assigned to the 20 mA value.

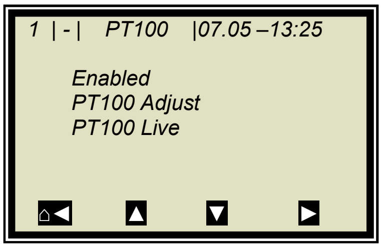
Adjust:
Follow the instructions on the display.

Live current:
Display of the live current signal.

4.2.25 Current Input 2

Settings correspond to current input 1.

4.2.26 PT100



Enabled:
If a PT100 is connected, the input has to be enabled first.

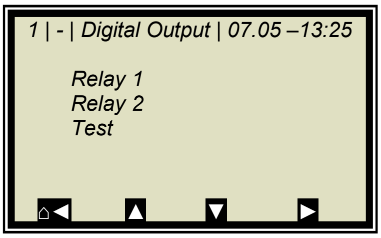
IMPORTANT
If a measurement is running, enabling a PT100 input which is not used or not adjusted may cause an error.

PT100 Adjust:
You need a 100 Ohm and a 138.5 Ohm resistance. Follow the instructions on the display.

PT100 Live:
Display of the live temperature.

Set and enabled same as input 1.

4.2.27 Digital Output



The meter has two relays. Relay 1 is linked with LED signal 1 and relay 2 with LED signal 2.

Relay 1:

Different functions can be assigned to relay 1:

- None
- Error
- Hold
- Alarm min
- Alarm max
- Current at load undercut

Function	Description
None	Relay and LED function disabled
Error	In case of error, relay and LED will be set.
Hold	If Hold function is enabled, relay and LED will be set.
Alarm min.	The relay switches if the value falls below the limit value to be set.
Alarm max.	The relay switches if the value exceeds the limit value to be set.
Current at load undercut	The relay is energized when the minimum load is not reached

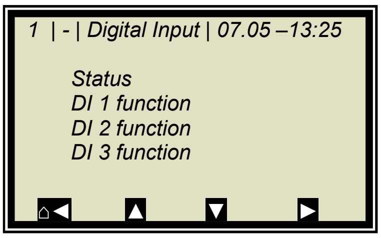
Relay 2:

Same assignments possible as above.

Test:

The switching status of the relays can be set here and checked at the respective terminals.

4.2.28 Digital Input



The meter has 3 digital inputs to which different functions can be assigned.

Status:

Shows the status of the input circuit

- open/closed

DI 1 Function

The following functions can be assigned to DI 1:

- None
- Start (external start)

DI 2 Function

The following functions can be assigned to DI 2:

- None

- Hold (averaging is stopped)
- Product (external product selection)

DI 3 Function

Assignments for DI 3:

- None
- Sample (external control of sampling)
- Product (external product selection)

For external start function, the start function has to be set to ***External*** in the ***Measurement*** menu window.

Hold means that averaging is stopped, but the measurement continues to run.

Sample means that sampling is started by closing the contact.

Product means that another product is selected by closing the contact (product 1 to 4).

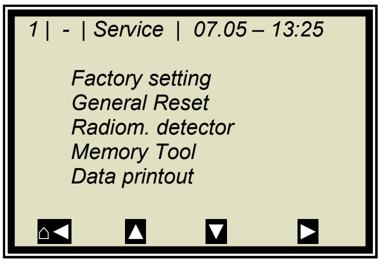
TIP

If you select a product for the first time (product 2 to 4), all settings and contents of the current product will be copied to the new product, including:
- Configuration data
- System adjust
- Calibration data (including sampling table)
- Input/Output definitions

To switch over all 4 products, DI 3 also has to be set to product. Please take the terminal configuration from the table below.

Terminals	DI 2 13 / 25	DI 3 14 / 26
Product 1	open	open
Product 2	closed	open
Product 3	open	closed
Product 4	closed	closed

4.2.29 Service



Factory setting and General reset:
See table on the next side.

Radiom. detector:
Description see *chapter 4.3.2 Service Radiometric Detector*.

Memory Tool:
Refers to the communication with the external memory tool (optional accessory). Data transfer takes place via the 9-pole SubD-connector on the bottom of the instrument.

- Save parameters: All instrument parameters for all products will be saved to the memory tool.
- Load parameters: All instrument parameters stored on the memory tool will be loaded onto the evaluation unit. All operating parameters in the evaluation unit will be deleted.
- Save datalog: The datalog will be saved to the memory tool.
- Save log: The start-up log will be saved to the memory tool.

NOTICE

The concentration average value is put on hold during communication with the memory tool. Thus, the measured value via current output is also put on hold!

Data printout:
All measured values are output for each measurement via the serial data interface RS232. The output can be set as follows:

- None (disabled)
- Row (data transfer, see *Hardware Manual, chapter 6.6*)
- Table (microwave data for each frequency point)
- Row and table

"Row" is defaulted.

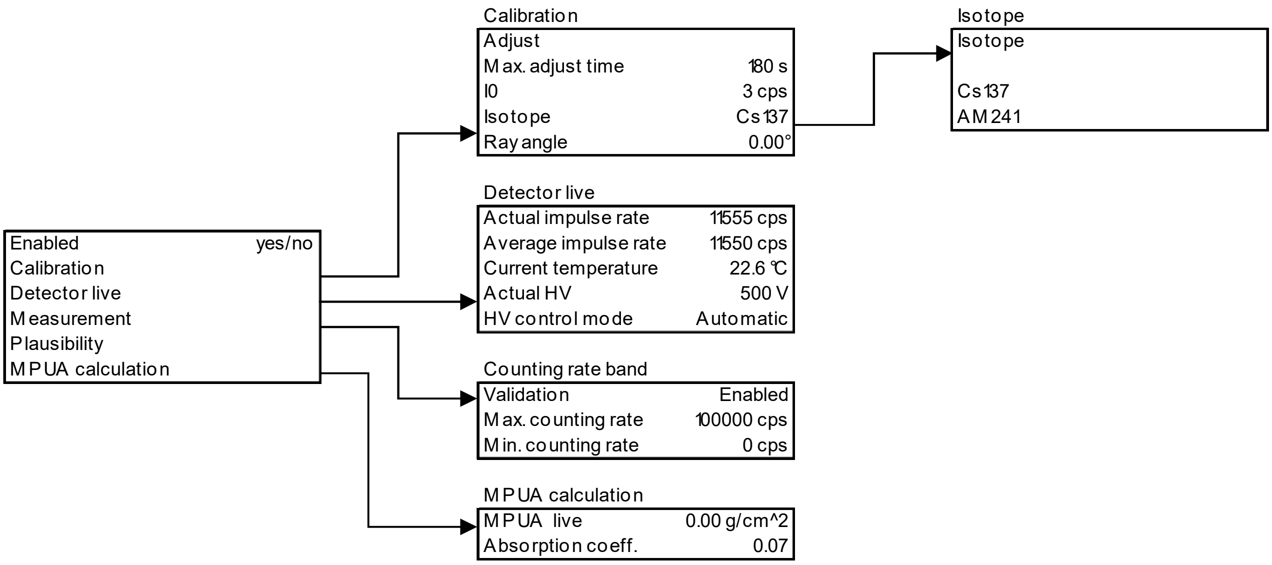
	Factory setting	General reset
Language selection	unchanged	unchanged
Access level	unchanged	default: User mode
Measurement	stopped	stopped
Password	unchanged	default: PASS1
Product selection	unchanged	all products deleted
Error log	not deleted	deleted
Data log	not deleted, default settings	deleted, default set-tings
System Adjust	not deleted	deleted
Cable length	unchanged	default
Sampling	not deleted	deleted
TAG label	default	default
All parameters on menu: Measurement Plausibility Marker Units	default	default
Calibration coefficients	default	default
All settings for the analog and digital inputs and out-puts	default	default
Adjustment of the analog in-puts and outputs	unchanged	unchanged
Comment:	affects only the cur-rent product	affects all products (P1 to P4)
-		

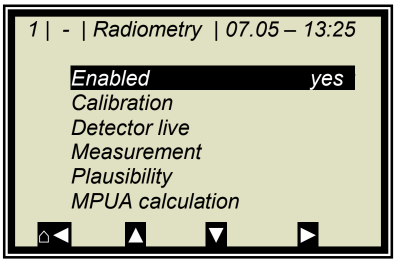
*Default: Default values, *see chapter 10.1 Example Start-up Protocol*

4.3 Menu Structure Radiometric Detector

4.3.1 Configuration Radiometric Detector

Starting from the main menu, you can reach the following menu via | SETUP | Configuration | Radiometry |

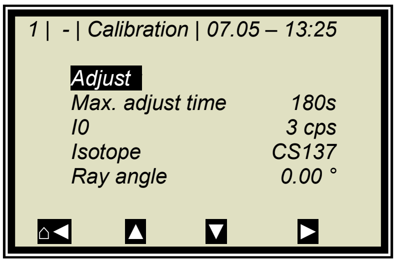




Enabled (Yes/No)
With this selection, the radiometric mass per unit area compensation of the evaluation unit is turned on or off.

If this item is disabled, no radiometry parameters can be set (hidden).

If it is enabled, the live data is requested by the detector. Errors occurring with respect to the radiometry will be displayed even if the measurement has been stopped.



Calibration
Configuration of the I0 recording (zero count rate); the following parameters can be configured:

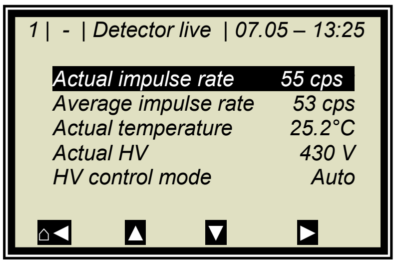
- Max. adjust time (duration of I0 recording)
- I0 (current I0 value)
- Isotope (Cs137 and Am241 selectable)
- Ray angle (radiometry)

If the irradiation path in the product is of different length in a microwave and radiometric measurement, this must be taken into account using the "Ray angle."

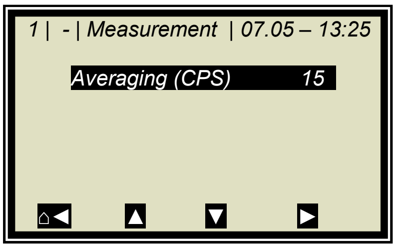
Enter an angle of 30° for applications in the measuring chute.

Adjust (I0 recording)
The I0 value can be entered directly or it can be recorded via the ADJUST menu.

The I0 recording can be started or stopped on the ADJUST menu. The I0 recording is possible only in the STOP mode of the evaluation unit. The progress of I0 recording is represented by a moving circle. The prerequisite is that the detector does not report an internal error and that the communication between evaluation unit and the detector is in order.



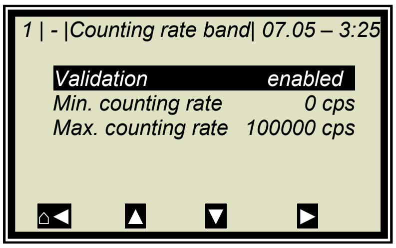
Detector live
Here the actual, averaged count rate, actual temperature (detector), actual HV and HV control mode are displayed. All parameters are only displayed here and cannot be edited.



Measurement
Here, the averaging of the count rate can be adjusted. The evaluation unit uses only the averaged pulse rate (CPSa) for calculating the mass per unit area.

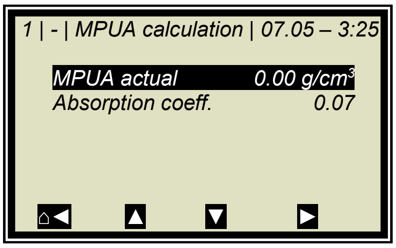
The averaging (moving average) takes place via the entered number of measurements.

Default: 15



Plausibility / Counting rate band
With these parameters, the current count rate from the detector can be checked for a valid range. If the count rate is out of range, then the evaluation unit goes to the error state. The following parameters are available

- Validation (enabled/disabled)
  Default: enabled
- Min. counting rate, default: 0
- Max. counting rate, default: 100000

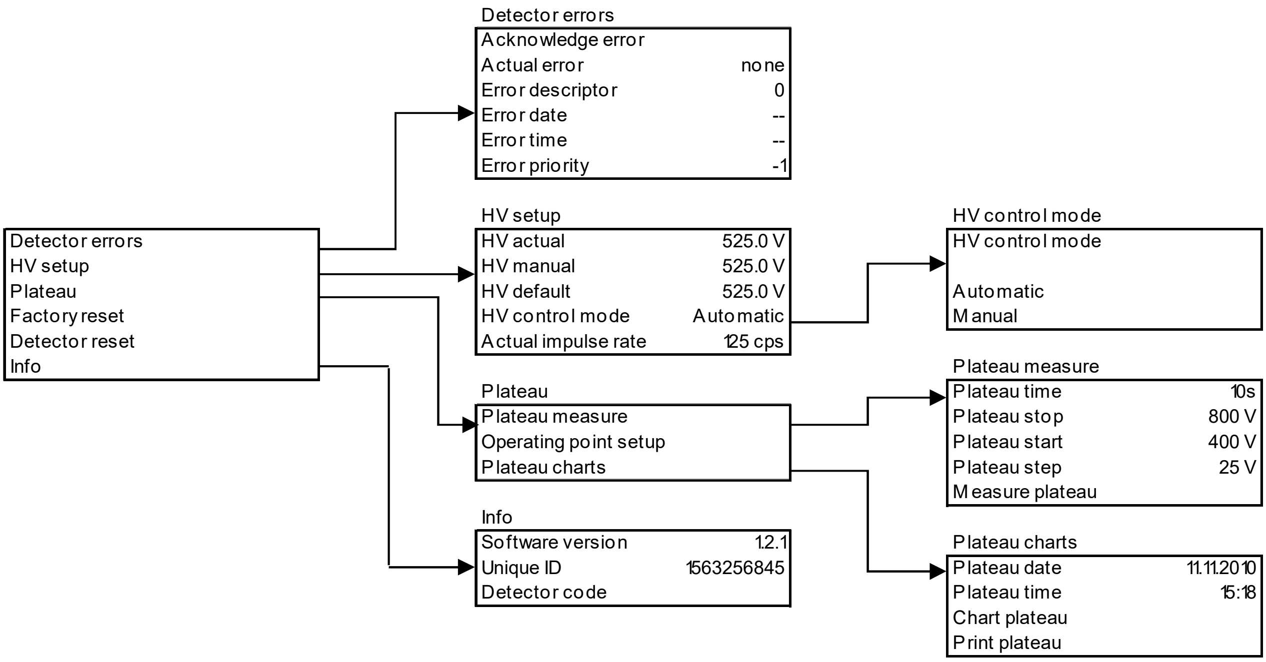


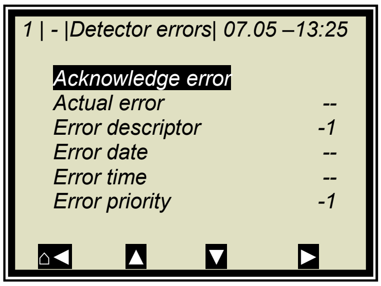
MPUA calculation
Input option absorption coefficient, default value: 0.07

The MPUA is displayed on the menu only if the loading compensation (radiometry) is enabled.
If the evaluation unit is in the RUN mode, then the MPUA is calculated and shown on the menu.
If the evaluation unit is in the STOP mode, then the MPUA is not calculated and 0.0 g/cm² shown on the menu.

4.3.2 Service Radiometric Detector

Starting from the main menu, you can reach the following menu via | SETUP | Services | Radiom. Detector |

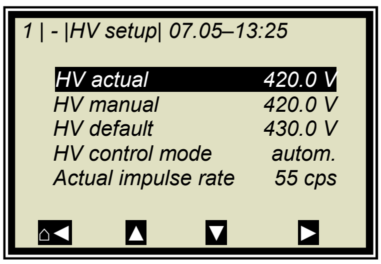




Detector errors
The menu shows the current detector error with the following additional information:

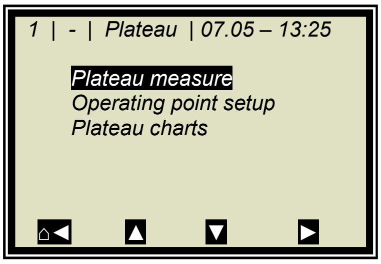
- Error Id
- Error date
- Error time
- Error priority

With "Acknowledge error", the error in the detector is acknowledged.



HV setup (HV = high voltage)
Here, the HV control can be configured.

- HV actual (read only, current HV in the detector current)
- HV manual (write, fixed value for the HV control mode manual)
- HV default (write, value where the HV control mode automatically starts to control)
- Actual impulse rate (read only)

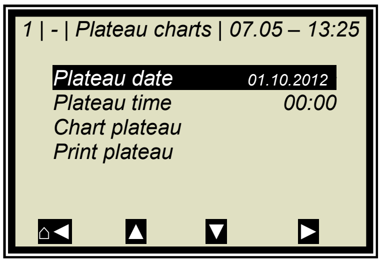


Plateau / Plateau measure

- Plateau time (how long is the measurement done on one HV point)
- Plateau stop (HV final value)
- Plateau start (HV start value)
- Plateau step, e.g. 25 V
- Measure plateau (detector starts recording the plateau, shows a progress bar)

Plateau / Operating point setup

- Set operating point (if no plateau is present, the message "Error! Canceled" is displayed)



Plateau / Plateau charts

- Plateau date: read only, date the plateau was recorded, if no plateau has been recorded, 01.01.2000 is displayed.
- Plateau time: read only, time the plateau was recorded, if no plateau has been recorded, 00:00 is displayed.
- Chart plateau: shows the plateau in a chart if the HV range is 300V to 1200V, for example, only a range of 400V to 800V is shown in the chart.
- Print plateau: the plateau can be printed via the RS232.

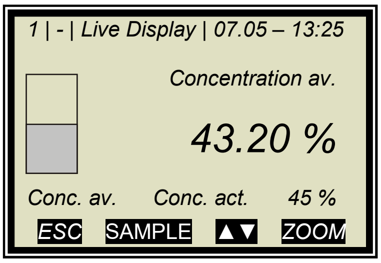
Factory reset
This function resets the detector to factory settings.

Detector reset
This function starts the detector new.

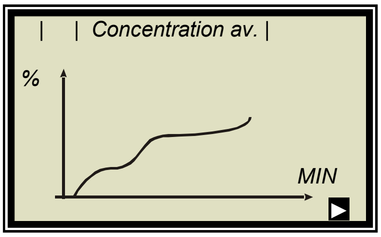
Info

- Software version (detector)
- Unique ID (detector)
- Detector code (e.g. CsI40/50)

4.4 Trend Display



Push the ZOOM button to enlarge the measurement value which is surrounded by a frame.



By pushing the ZOOM button for a longer time, the enlarged measurement value will be displayed as trend over the entire display.

The trend display corresponds to the contents of the datalog. The datalog has to be enabled for the trend display.

NOTICE

As long as the trend builds up, the measured value and/or the current output are put on hold!

Chapter 5. **Configuration**

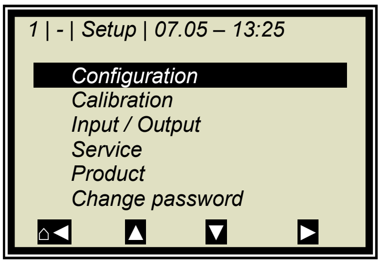
Before doing any calibration work, you have to enable and configure the required analog inputs and check and, if necessary, correct the configuration parameters.

If the required inputs are not enabled, some menus are not displayed and a proper configuration and calibration is not possible under certain circumstances. The current outputs, digital outputs can be enabled and configured after the calibration.

The measuring system includes two separate floating current outputs.

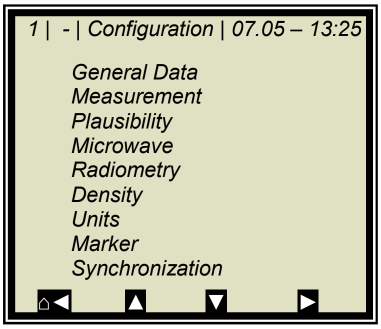
5.1 Configuration Setup

Starting from the main menu, go to the display shown on the left via | SETUP |

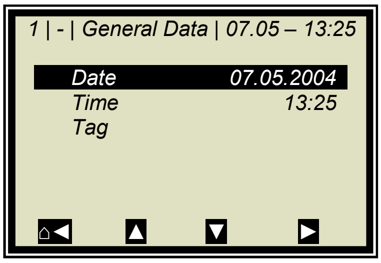


- CONFIGURATION

5.1.1 General Data

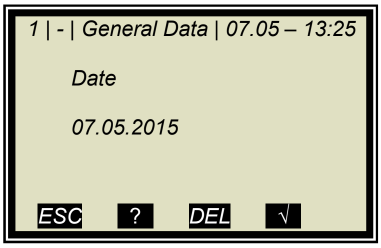


➢ GENERAL DATA



Example:
Select the respective entry, edit and store it.

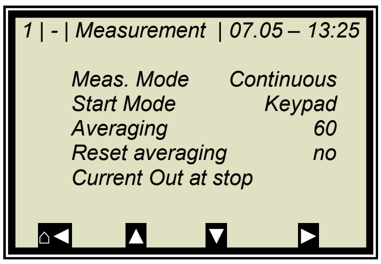
➢ DATE



Push DEL to delete the entry and then enter the new date. Push √ to confirm and store the changed date.

TIP
The colon for the time input (e.g. 13:25) is invoked by pushing the button [**.**].

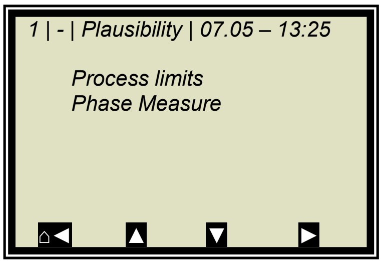
5.1.2 Measurement



You have to check the settings on this display and adapt them to the measurement conditions.

Averaging over 60 measurements is a good choice as a rule.

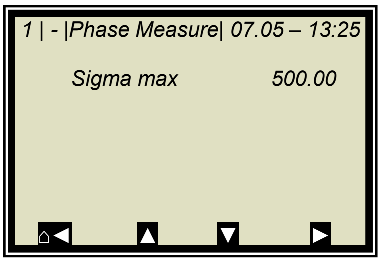
5.1.3 Plausibility



The **process limits** need to be adjusted. Allow exceeding of the measuring by ± 5% absolute.
Example: The measuring range is 65-95% TS. Enter 60-100% TS as process limit.

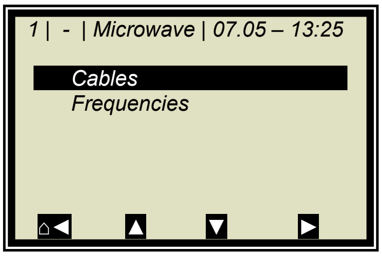
The process limits are independent of the current output limits.

- PHASE MEASURE

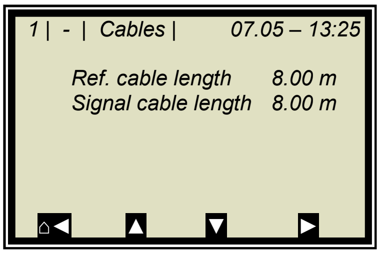


In the normal measurement mode **Sigma** is between 0 and 500. Therefore, $Sigma_{max}$ = 500 is a good choice for most applications. Higher Sigma values usually indicate a fault, such as a broken HF cable break or belt load too high which have to be eliminated.

5.1.4 Microwave



➢ CABLES



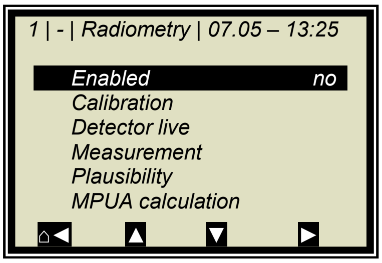
If the factory-set cable lengths do not match the actual geometry conditions, you have to correct the values.

Example: For a 2 x 2 m HF cable in the signal branch (way in and way out), you have to enter 4 m for the signal cable.

5.1.5 Configuration Radiometry

Configure the detector by enabling it.

Starting from the main menu, you get in the display shown to the left via | SETUP | CONFIGURATION | RADIOMETRY |



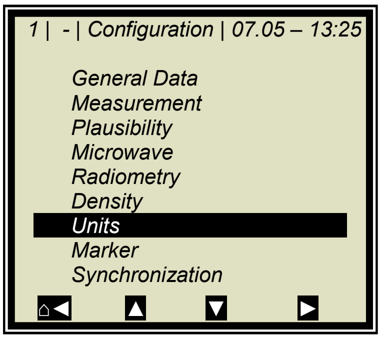
➢ ENABLED

Enable the detector here.

NOTICE

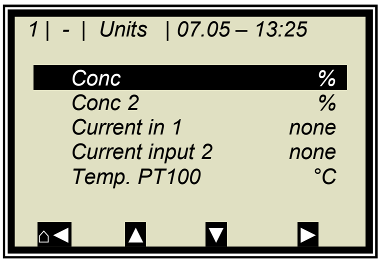
When enabled, the live data is retrieved from the detector. Since no adjustment of radiometry has yet been carried out, error messages concerning the radiometric detector may be displayed. Please confirm these with OK.

5.1.6 Units



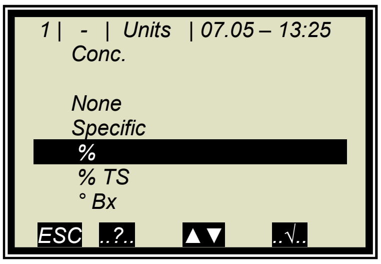
Set the units to the desired dimension.

➢ UNITS



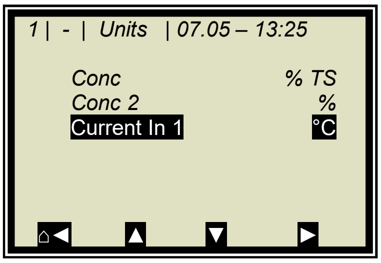
The units of the concentrations (conc 1 and 2) and those of the enabled analog inputs can be selected.

➢ CONC / CONC 2

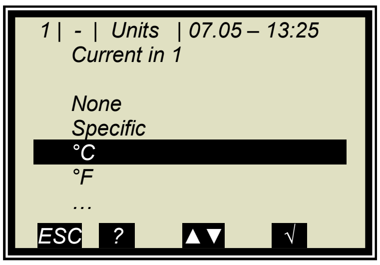


Different units can be set for both concentrations.

➢ %



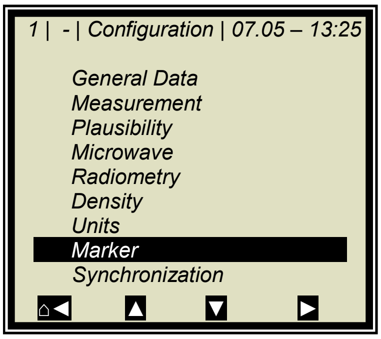
➢ CURRENT IN 1



➢ °C

The temperature input can be set to °C, °F, none or specific.

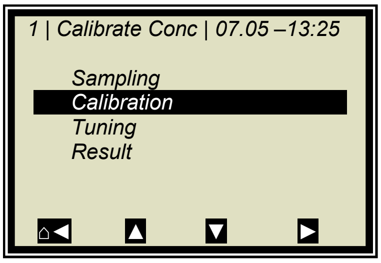
5.1.7 Marker



You can set a marker comprising max. 5 characters which identify the value set in the live display.

- ➢ MARKER

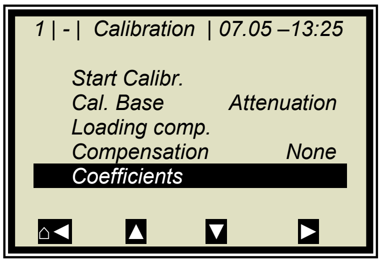
5.2 Start Calibration Coefficients



Starting from the main menu, go to the display shown on the left via:

ESC | SETUP | CALIBRATION | CALIBRATE CONC |

- ➢ CALIBRATION



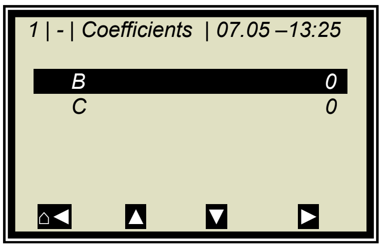
- ➢ COEFFICIENTS

For the default setting, the concentration is calculated as follows:

Measured value = B · Phase + C **Eq. 5-1**

where:

B, C: Calibration coefficients



Check the coefficients B and C and correct them, if necessary, as follows:

C = average measuring range value (concentration value)

B = 0

All coefficients that are not needed are automatically set to zero.

Note: With these calibration coefficients the concentration average value and thus the current output is put on hold during start-up.

Chapter 6. **Calibration**

Note: The measuring system must have reached normal operating temperature (approx. 45 min. warm-up time)).

Prerequisite: **Chapter 5. Configuration** have been completed.

6.1 Scintillation Counter Calibration

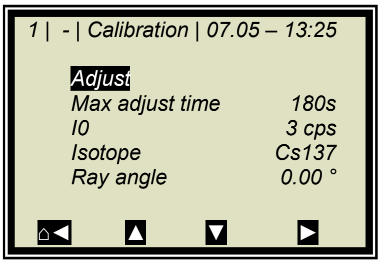
Calibration is performed by recording the zero count rate I_0 (adjustment).

For this purpose, the belt or the chute must **run empty, clean and dry**.

For a belt, the I_0 recording has to take place over at least an entire belt cycle. For example, belt speed 2 m/s, conveyor belt length 100 m:

belt cycle = 2 * conveyor belt length

Thus, min. recording time = 200 m / 2 m / s = 100 s

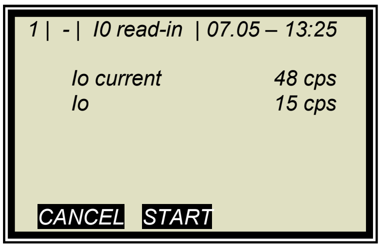


Starting from the main menu, you get in the display shown to the left via | SETUP | CONFIGURATION | RADIOMETRY | CALIBRATION |

Before the calibration, the parameters (default values) listed in the display to the left must be changed as needed. For details see *chapter 4.3.1 Configuration Radiometric Detector*.

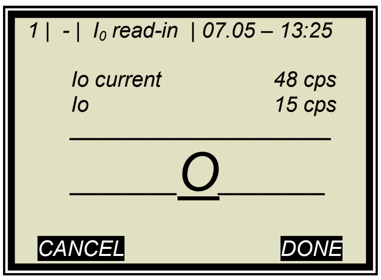
➢ ADJUST

TIP
Calibration is possible only in the STOP mode of the evaluation unit.



Start the plateau measurement:

➢ START



After expiration of the max. calibration period or early termination via the DONE button, the I_0 is automatically saved and the detector calibration is finished.

Push the CANCEL button to terminate the recording and I_0 is set to zero. The detector is now in the uncalibrated state.

6.2 System Adjust

Two reference measurements are used for system calibration. There are two options:

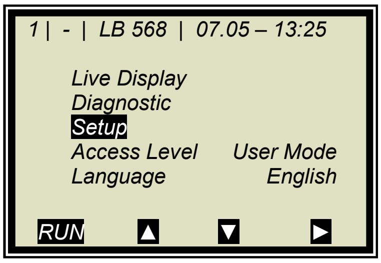
a) microwave reference measurement on an empty belt and/or chute (regular case)

b) microwave reference measurement with regular belt loading or chute filling

Both procedures concern the optimization of the reference path. They will be used for the phase adjustment in order to avoid phase jumps that may be caused by a less than optimum geometry.

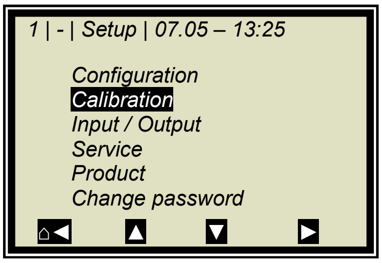
Normally, the reference measurement is carried out with empty belt or chute. The belt (chute) should **run empty, clean and dry**.

If you later get high values - under normal operating conditions - for Sigma (> 500), you have to carry out the reference measurement with full belt or chute (= with normal load in the operating point). In this case, a "tare" measurement with empty belt or chute has to be carried out.

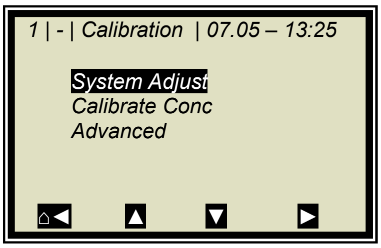


Starting from the main menu:

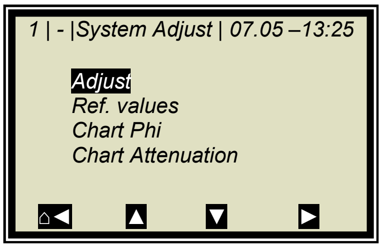
- ➢ SETUP



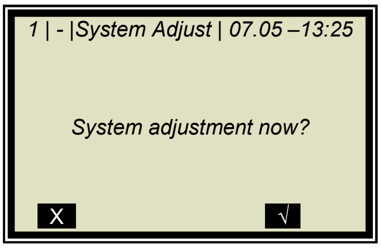
- ➢ CALIBRATION



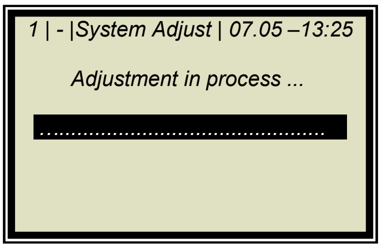
- ➢ SYSTEM ADJUST



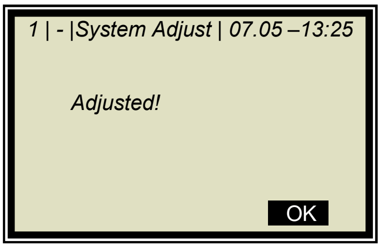
➢ ADJUST



Confirm



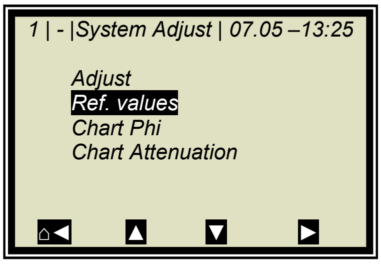
System adjustment is in process.



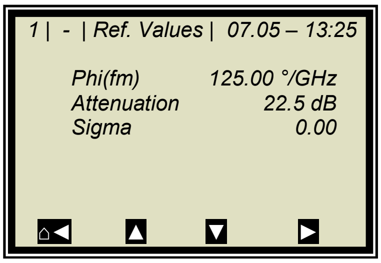
Push **OK** to confirm and push ⌂◄ three times to return to the main menu.

6.2.1 Verifying the Reference Values

Starting from the main menu, go to the display shown on the left via | SETUP | CALIBRATION | SYSTEM ADJUST |



- ➢ REFERENCE VALUES



Limit values for the reference measurement with empty belt (chute); of particular importance are:

Sigma: < 400 (reliable microwave transmission)
Attenuation < 25 dB (antennas and cable OK, belt non-conductive)

Limit values for the reference measurement with full belt (chute); of particular importance are:

Sigma: < 400 (reliable microwave transmission)
Attenuation: < 60 dB (antennas and cable OK, belt non-conductive)

6.2.2 Tare Measurement

Prerequisite:
- The conveyor belt or the shaft are empty, clean and dry.
- The measurement is in the measurement mode.

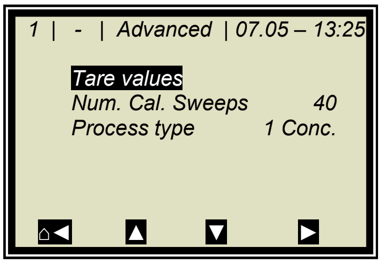
Following the reference measurement with full belt or chute, carry out a tare measurement with empty, clean and running belt. The measuring system is in the measurement mode. Please write down the following values from the live display:

Phi(fm)	= __________	GRD/GHz
Sigma	= __________	dimensionless amount
Attenuation	= __________	dB

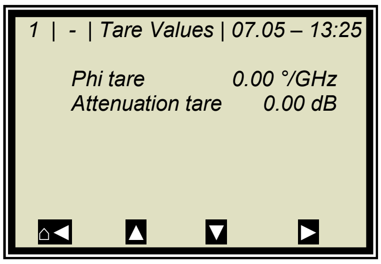
Typical values with empty belt/chute; of particular importance are:

Sigma:	should be less than 400 (reliable microwave irradiation)
Attenuation	should be 0 … -35 dB (antennas and cable O. K., belt not conductive)

Starting from the main menu, go to the display shown on the left via | SETUP | CALIBRATION | ADVANCED |



➢ TARE VALUES

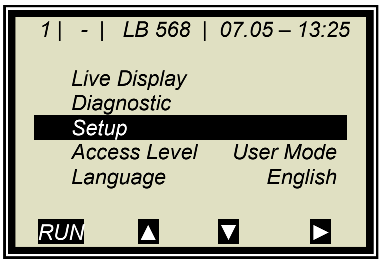


Enter the last recorded values of Phi(fm) and attenuation, taking into account the algebraic sign "- ".

6.3 Sampling

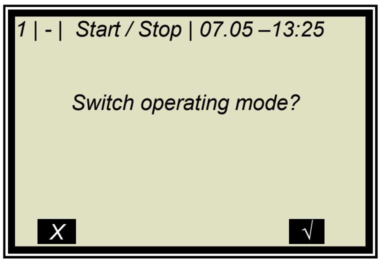
Before sampling, you have to enable the desired compensation inputs and check the calibration. Only the measured values of the activated inputs are stored in the sample table.

If the measuring system is not yet in the measurement mode, start the measurement now.



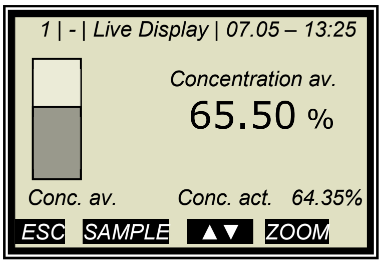
Push RUN to start the measuring system.

Push √ to confirm the safety prompt and the device switches to the measurement mode.



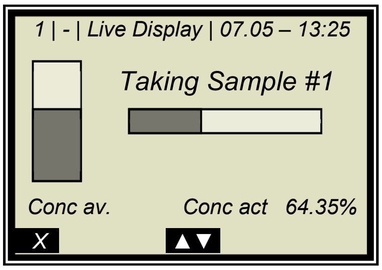
Watch the behavior of the microwave measurement with running full and empty belt, especially Sigma and Phi(fm) to ensure that not too many measurements will be rejected with empty belt or with maximum belt load.

Check before sampling whether all available compensation devices (e.g. height sensor, belt weigher) have been parameterized correctly via the analog inputs. Watch and check the compensation signals also with running full and empty belt, for example in the live display.



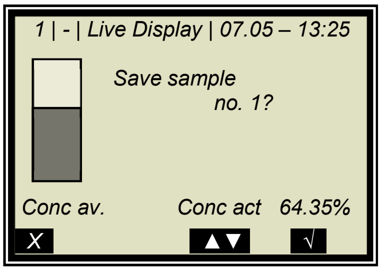
The display to the left appears if you push RUN.

Note: Push the SAMPLE button to start measurement of the raw data. At the same time, the laboratory sample has to be taken and marked. The analysis may be performed later, provided the product is not changed by this.



Sampling is in process......

Push the X button to stop the sampling process any time..



If the sampling process has been completed without any problem, push the √ button to save the sample in the table and the measurement continues.

The process previously described must be repeated for each additional sample.

The moisture of the samples should be distributed over the entire measuring range and should not vary too much during each sampling step.

The measuring system has to operate at a normal conveyor belt throughput and the usual material under actual operating conditions.

The minimum number of samples required is dependent on the selected calibration modes. If the sample size is too small, an error message is displayed after you have attempted to run a calibration.

Approximately six samples suffice for a rough calculation of the calibration coefficients, provided the moisture differs by at least 5%. At least 15 samples are required for a fine calibration.

Do not take the samples before the product has passed the measuring point! The measurement would be disturbed each time a gap is detected. See the following illustration.

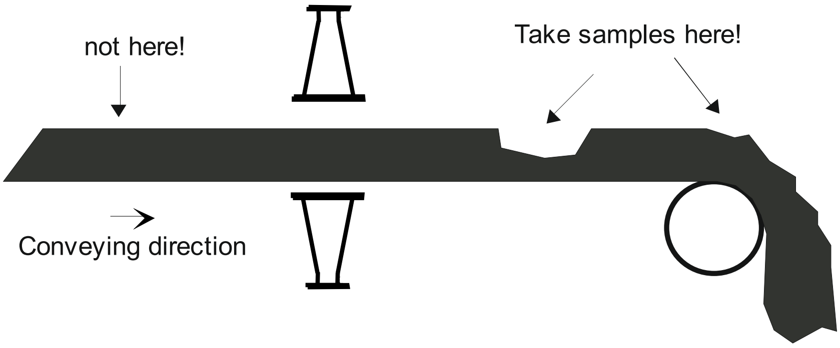
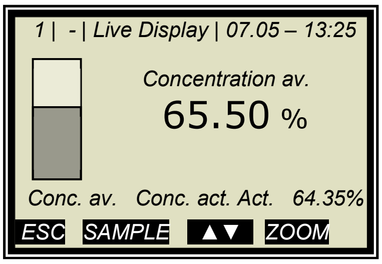
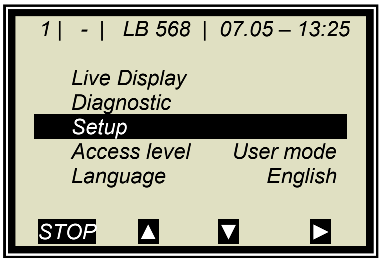


Figure 6-1: Sampling point on the conveyor belt

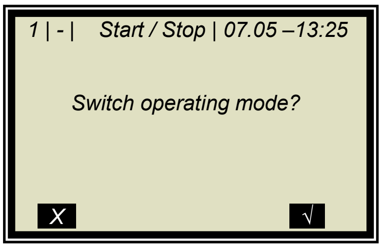
6.3.1 Entering the Lab Values



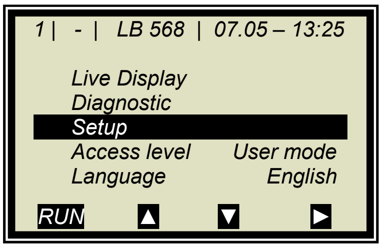
Push **ESC** to go to the main menu. A measurement can be stopped only on the main menu.



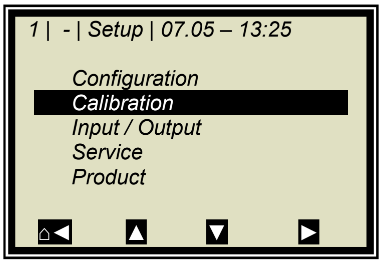
Push ***STOP*** to stop the measuring system.



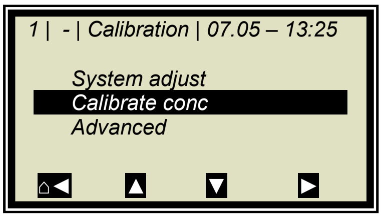
Push **√** to confirm the prompt and the measurement switches to the *STOP* mode.



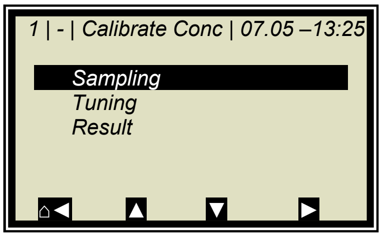
- SETUP



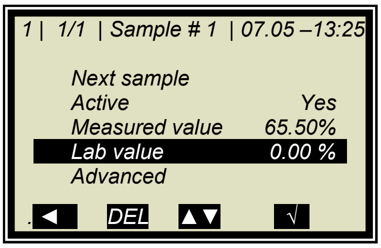
- CALIBRATION



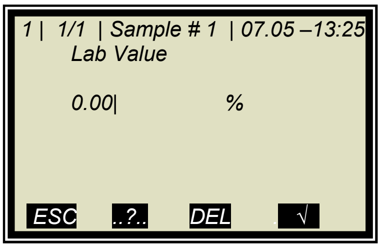
- CALIBRATE CONC



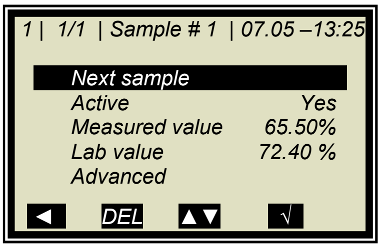
➢ SAMPLING



➢ LAB VALUE



Delete default value with DEL and enter new value and confirm with √



➢ NEXT SAMPLE

and repeat the step described above with the next sample.

After you have entered the last sample by pushing the ◀ button you get back to the Calibration menu. (Short push – one page, longer push of the button – you get back to the Calibration menu immediately)

6.4 Calibration

Proceed as described in *chapter 7.1.*

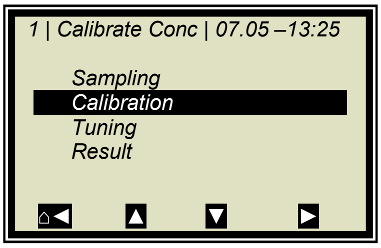
Chapter 7. **Calibration and Advanced**

7.1 Calibration

Prerequisite:
The steps described in chapter

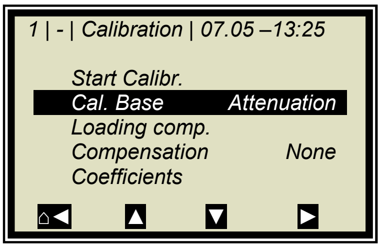
5.	**Configuration**
6.1	**Scintillation Counter Calibration**
6.2	**System Adjust**
6.3	**Sampling**

have been completed.

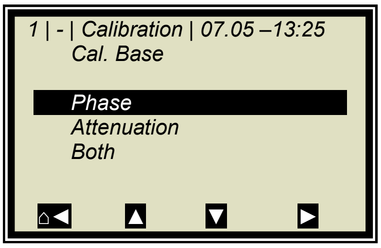


Starting from the main menu, go to the display shown on the left via:
| SETUP **|** CALIBRATION **|** CALIBRATE CONC **|**

- CALIBRATION



- CAL. BASE

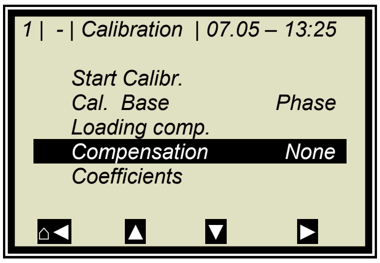


- PHASE (Phase measurement)

Standard for all applications: Phase

Setting the desired compensation:

If **loading compensation** is required (for conveyor belt and chute applications), you have to define the parameters as described in *chapter 7.1.1*. Then start the automatic calculation of the calibration coefficients, see below.



For all other compensations such as **temperature compensation** proceed as follows:

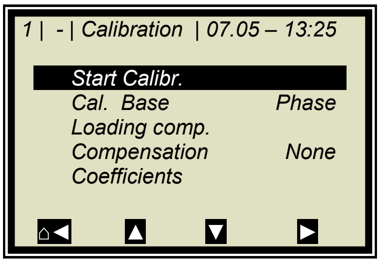
➢ COMPENSATION

Here you can select the analog inputs (PT100, current input 1 and 2) required for compensation (e.g. temperature compensation). You can select:

- None
- In1
- In1 + In2
- In1 + PT100
- In1 + In2 + PT100
- In2
- In2 + PT100
- PT100

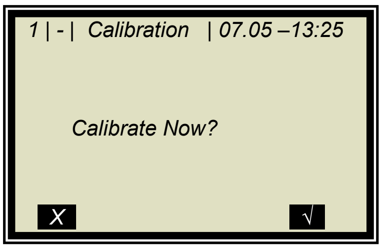
Select "None" if no compensation is required.

Automatic calculation of the calibration coefficients

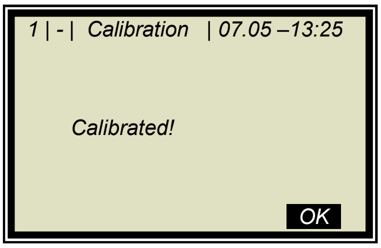


The automatic calculation of the calibration coefficients starts as soon as you have set the parameters for the compensation.

➢ START CALIBRATION

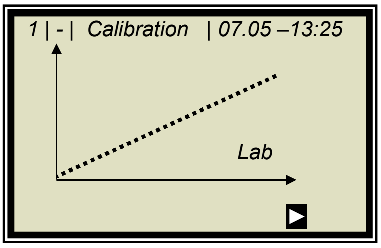


Push the √ button to start the calibration; push X to go back one page without calibration.



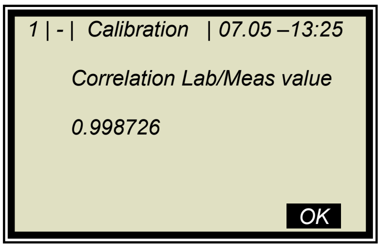
OK accepts the calibration and changes to the next display.

When calculating the new coefficient set, the Factor will be reset to 1 and the Offset to 0.



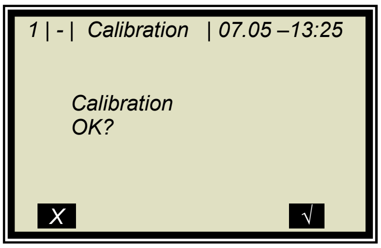
The graph on the left shows the measured value versus the lab value.

▶



Output of the correlation between measured value and lab value.

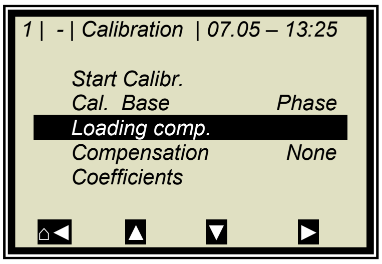
OK



As soon as you confirm this prompt, the calibration display appears again; from there you get back to the main menu by pushing ⌂◀ four times.

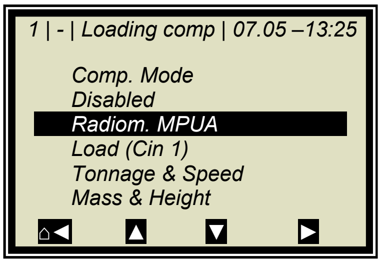
7.1.1 Calibration with Load Compensation

Starting from the main menu, go to the display shown on the left via:
| SETUP **|** CALIBRATION **|** CALIBRATE CONC **|** **|** CALIBRATION **|**



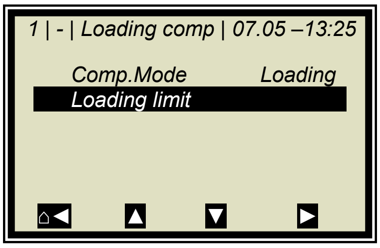
- LOAD COMP.

Select the desired compensation mode. For details see *chapter 4.2.18 Loading Compensation*.



For compensation with radiometric mass per unit area measurement, please select:

- RADIOM. MPUA



If loading compensation is selected, the Loading limit menu appears.

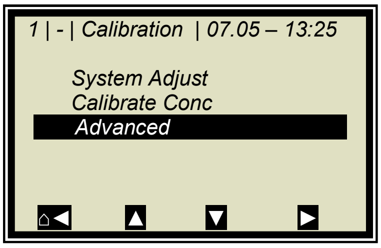
- LOADING LIMIT

Enter here a minimum mass per unit area of about 3 g/cm^2. With such small mass per unit areas the measurement error will be too large for a proper measurement.

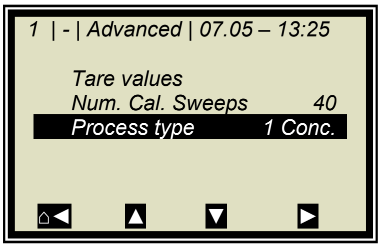
7.1.2 Calibration with Two Concentrations

Calibration for two concentrations starts by changing the process type as described below.

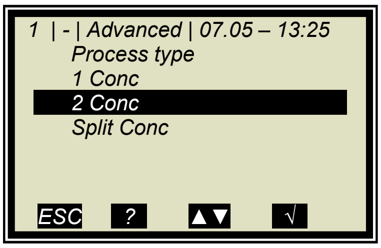
Starting from the main menu, go to the display shown on the left via
| SETUP | CALIBRATION |



➢ ADVANCED

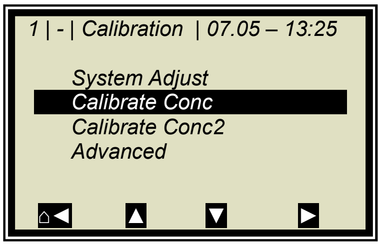


➢ PROCESS TYPE

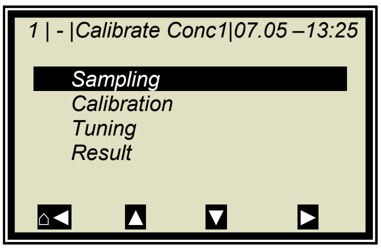


➢ 2 CONC

Push the √ button to accept the selected process type and push the ⌂◄ once to go to the display depicted below.



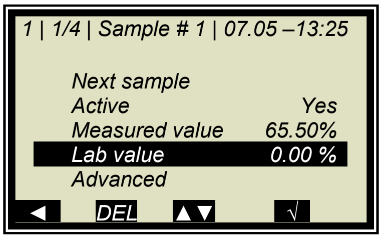
➢ CALIBRATE CONC (corresponding to concentration 1)



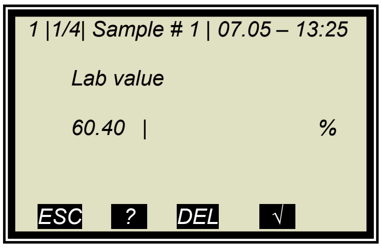
➢ SAMPLING

There is only one sample table for both calibrations.

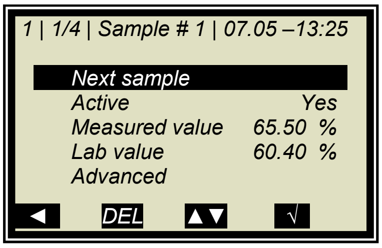
The lab values have to be entered for all samples used for calibration of concentration 1. All other samples have to be disabled (Active: Yes/No).



➢ LAB VALUE

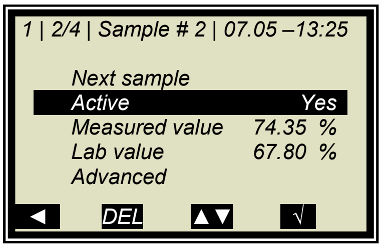


Delete default value with DEL and enter new value and confirm with √



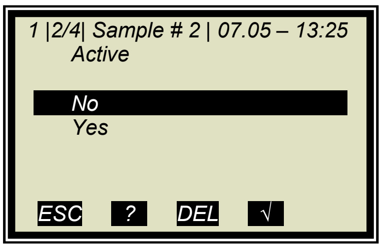
➢ NEXT SAMPLE

Continue with next sample

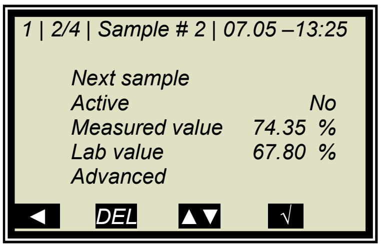


➢ ACTIVE

Disable sample

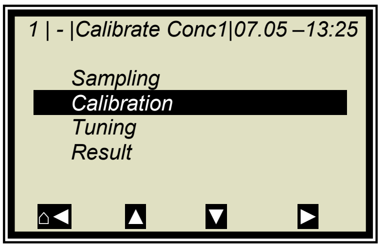


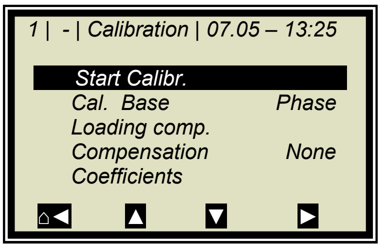
➢ NO



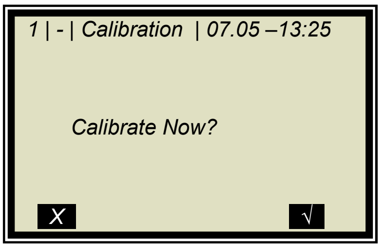
Make sure that all samples have been processed and only those samples are active which are relevant for this calibration.

Push ◄ to get to the Calibration page.

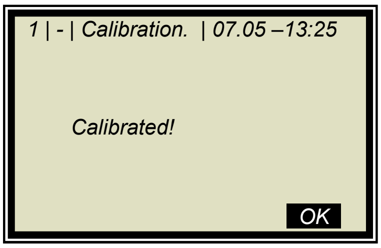




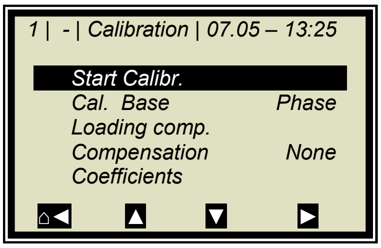
- ➢ START CALIBRATION



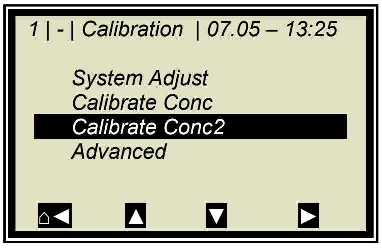
Push the √ button to start the calibration; push X to go back one page without calibration.



OK accepts the calibration and changes to the next display.

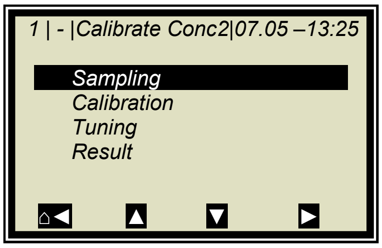


Push ⌂◄ twice to return two pages.



- CALIBRATE CONC 2

Repeat the steps as described above for concentration 2; all samples have to be enabled again in the sample table. Now you have to disable all samples which are not used for concentration 2.

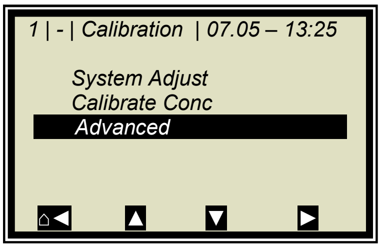


- SAMPLING

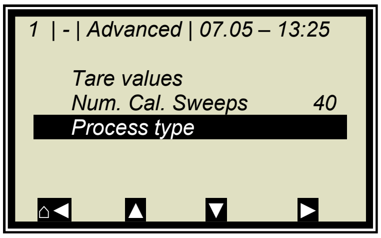
7.1.3 Calibration with Split Value

With this type of calibration, two characteristic curves (concentrations) are combined in one measuring range; their point of intersection defines the split value.

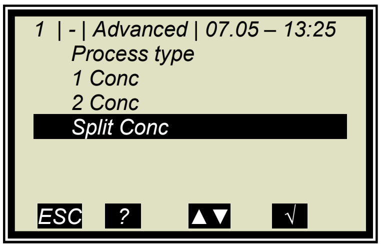
Conc 1 for the lower and conc 2 for the upper measuring range can be output only together via current output.



➢ ADVANCED

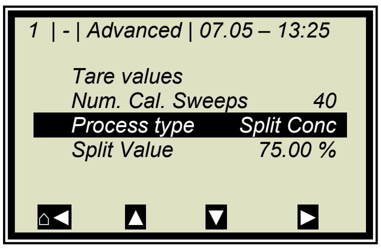


➢ PROCESS TYPE

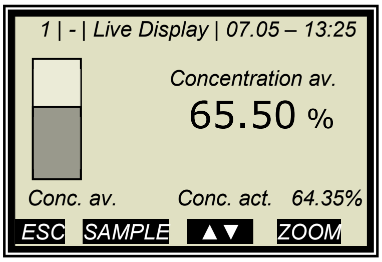


➢ SPLIT CONC

Push the √ button to accept the selected process type and push the ⌂◀ button once to go to the display depicted below. The displayed split value has been set by the manufacturer, but has to be adapted to the respective application.



The sample measurement should be selected such that the last sample of the lower concentration is fairly close to the first sample measurement of the upper concentration. Ideally, the last sample of the initial concentration is the first sample of the final concentration.



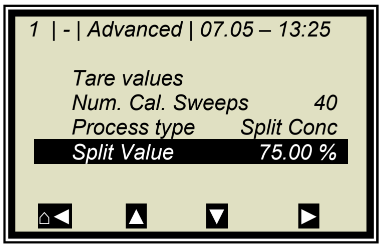
Sample measurements are carried out continuously over the entire measuring range with the display depicted to the left. See *chapter 6.3 Sampling*

After completion of sampling, the individual samples will be enabled or disabled during input of the laboratory values, relative to the set split values. All samples smaller or equal to the split value will be assigned to the lower concentration range and all samples above to the upper concentration range.

The assignment of the samples is carried out automatically, for example, by setting the split value or by entering the lab values have been entered (e.g. after re-sampling). The assignment depends on the split value and the lab value.

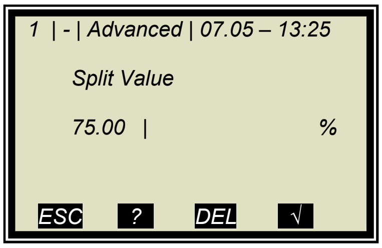
IMPORTANT

The split value entry allows you to enable samples that have been disabled earlier through automatic assignment! In these cases, disabled samples should better be deleted or disabled again after a split value entry!



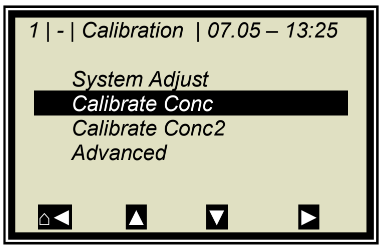
The split value to be set must correspond to the point of intersection of both calibration curves. This will be corrected automatically after the calibration (within certain limits).

➢ SPLIT VALUE

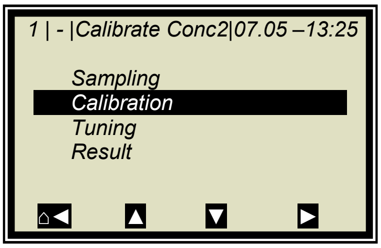


Enter the split value and confirm with √ .

Push ⌂◀ to get to the Calibration page.



➢ CALIBRATE CONC



➢ CALIBRATION

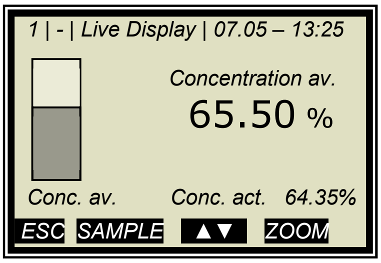
The lower concentration is now calibrated. Then select CONC2 and repeat the calibration process.
Go back to the main menu and start the measurement.

7.2 Adjusting the Calibration

A correction factor and an offset may be entered later to obtain a subsequent adjustment of the calibration (fine tuning).

Below please find an example for an offset adjustment.

The display to the left appears if you push RUN.

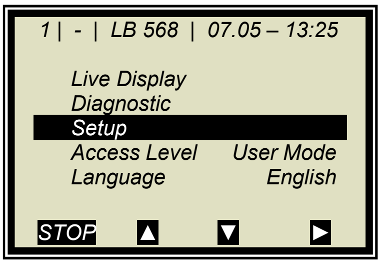


The display reading is now compared with the analysis value of the lab sample. The difference has to be entered as offset with the correct algebraic sign.

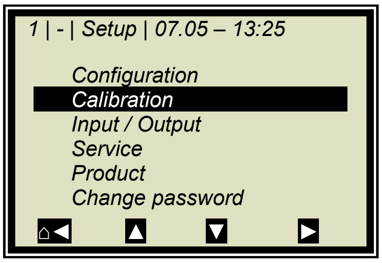
Calculation:

Analysis value – Display = Offset **Eq. 7-1**

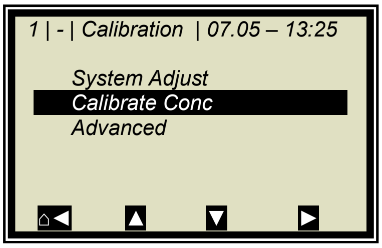
Push ESC to return to the main menu.



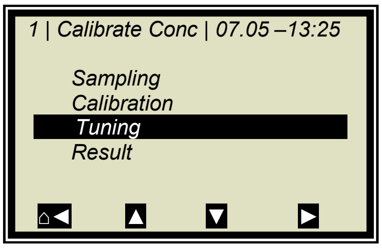
➢ SETUP



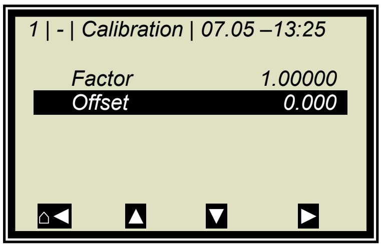
➢ CALIBRATION



➢ CALIBRATE CONC

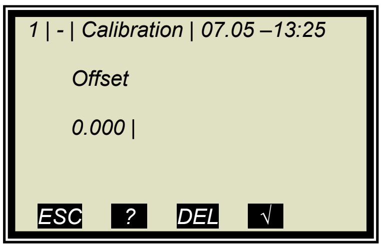


➢ TUNING

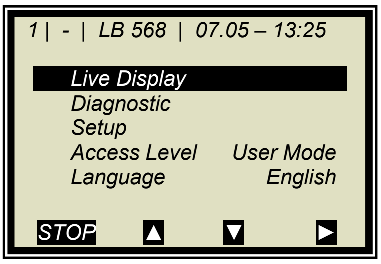


➢ OFFSET

Calculation formulas see *chapter 4.2.13 Calibrate Concentration*.



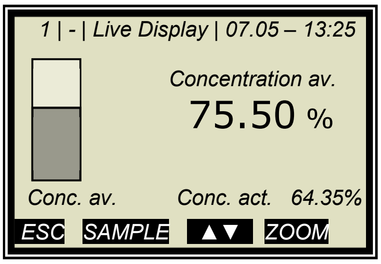
Enter the calculated offset value, confirm with √ button and push the Home button ⌂◄ four times to return to the main menu.



Select

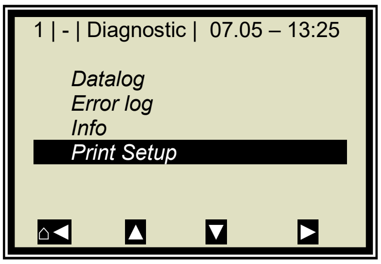
- ➢ LIVE DISPLAY

to get back to the display.



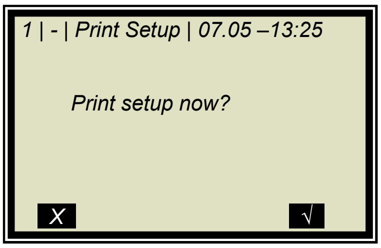
The reading value should now correspond to the actual value.

7.3 Output of the Start-up Protocol



Starting from the main menu, go to the display on the left by selecting | DIAGNOSTIC |

- ➢ PRINT SETUP



Push the √ button to print the setup via RS232. Push X to go back one page without printout.

The start-up protocol includes all parameters, system adjustment data, calibration data and entries in the sample table.

For further information on the start-up protocol see *chapter 10*. Start-up Protocol

Chapter 8. **Password**

The measuring system can be protected against unauthorized access by passwords.

The access levels are as follows.

Read only
The measuring system cannot be started and stopped. You can only switch from the live display to Diagnostic and to Access Level.

User mode
The user mode is the default mode and provides access to all user-relevant parameters.

Service
The service level is reserved to service personnel.

You have to enter a password to change from **Read only** to **User Mode**.
At the time of delivery, this password is

PASS1

The password can be changed in the menu | SETUP | CHANGE PASSWORD |.

8.1 Password Forgotten

The device is in the "Read only" mode and the user has forgotten the password. Please proceed as follows to carry out a "Reset" of the user level:
Turn off device.
Turn on device; as soon as all 5 LEDs light up when powering up, press 0 (zero) and keep it depressed for 8 seconds.
Device powers up in the "User Mode". You can now enter a new password.

IMPORTANT
Check your process before turning off the device. The current outputs drop to 0 mA.

Chapter 9. **Error Lists and Device States**

The LEDs indicate the device status. Once the errors have been corrected, the measurement returns to the state before the error occurred. An acknowledgment is not required.

9.1 Hardware and Error Prompts

Code	***Error***	***Possible cause***
14	*Battery voltage*	*Battery power is low, replace immediately,* see Hardware Manual, chapter 5.4
20	*Caution! Ambient temperature too high!*	*Check operating temperature of the evaluation unit, permissible range:* *-20 to 45° C*
21	*HF temperature out of range*	*Check operating temperature of the evaluation unit, permissible range:* *-20 to 45° C*
32	*Parameter memory faulty*	*Compatibility check after software download: A general reset must be carried out.*
39	*HF hardware failure*	*Faulty cable connection between the motherboard and HF unit. Check connector on the motherboard.* *Caution! First, disconnect the evaluation unit from the power supply!*
94	*No radiometric detector connected*	*No communication between scintillation counter and evaluation unit: broken cable, wiring faulty or not connected.*
For all other error messages, please contact the Berthold Technologies Service.		

9.2 Input Error

Error	***Probable Cause***
Value too large	*Input value is too large*
Value too small	*Input value is too small*
Table is empty	*Sampling has been selected without previous sample measurement*
Chart data faulty	*The measuring system has determined faulty chart data during calibration.*
No chart data available	*The calculated chart data have been deleted or calibration has not been completed.*
Sampling full	*You have tried to measure more than 30 samples.*

9.3 Measurement Error and Error Prompts

Code	***Error***	***Possible cause***
50	*Sigma of phase is too large*	*The measured phase exceeds the allowed Sigma limit.*
54	*No system calibration done*	*The system calibration has not yet been carried out.*
60	*Current in 1 out of range*	*The enabled current input has not yet been calibrated or is not occupied.*
61	*Current in 2 out of range*	*The enabled current input has not yet been calibrated or is not occupied.*
62	*PT100 temperature out of range*	*The enabled PT100 input has not yet been calibrated or is not yet occupied.*
70	*Concentration out of range*	*The concentration is outside the process limits.*
71	*Concentration 2 out of range*	*Concentration 2 is outside the process limits.*
72	*Loading value 1 below minimum load*	*Below the minimum load for concentration 1*
73	*Loading value 2 below minimum load*	*Below the minimum load for concentration 1*
74	*Loading compensation inactive current input upper & lower limit invalid*	*Current input is outside the range.*

Code	***Error***	***Possible cause***
75	*Synchronization time too long*	*Review settings for synchronization, see chapter 7.3 in Hardware Manual.*
76	*Synchronization: Speed out of range*	*Review settings for synchronization, see chapter 7.3 in Hardware Manual.*
77	*Wait for synchronous value*	*The measurement has not yet been synchronized, please wait.*
90	*Current output 1 out of range*	*The concentration calculated on the basis of the current is outside the current range*
91	*Current output 2 out of range*	*The concentration calculated on the basis of the current is outside the current range*
95	*Radiometric detector: current count rate > max. count rate*	*Max. count rate entered incorrectly or material loading too low*
96	*Radiometric detector: current count rate < min. count rate*	*Wrong input, material loading too high or source - detector not aligned.*
104	*Decay compensation: Device turned off more than 30 days. Check date/time*	*Check and correct the date and time.*
105	*Decay compensation failed: Enter date/time*	*Check and correct the date and time.*
120	*Date/Time not set*	*Please enter or check the date and time.*
150	*Density calculation: MPUA (Radiometry) out of range*	*Check the measured value of the radiometric MPUA*
151	*Density calculation: Height signal out of range*	*Check the measured value of the layer thickness sensor*
For all other error messages, please contact the Berthold Technologies Service.		

9.4 Device States

Error state:
This state occurs also in error codes 50 to 56, 60 to 62 and 70 to 71 (see table above). The evaluation units behave as follows:

LEDs:	RUN flashes, ERROR on, signal 1 and 2 depending on the configuration.
Current outputs:	Fault current, as selected
Display:	Error message with error code

Warning state:
This state occurs also in error codes 14, 21, 90 and 91 (see table above). The evaluation units behave as follows:

LEDs:	RUN flashes, ERROR off, signal 1 and 2 no connection.
Current outputs:	live
Display:	Error message with error code

Hold state:
Measurement stopped via digital input. The evaluation units behave as follows:
The averaged concentration value is frozen. The measurement continues, however, so that a measurement error can cause the fault condition also from the hold state.

LEDs:	RUN flashes, ERROR off, signal 1 and 2 depending on the configuration.
Current outputs:	frozen
Display:	No display message

Current at load undercut state:
Below minimum load the evaluation units behave as follows:

LEDs:	RUN flashes, ERROR off, signal 1 and 2 depending on the configuration.
Current outputs:	State as selected
Display:	Error message with code no. 072 or 073

Chapter 10. **Start-up Protocol**

The log can be output via RS232. The printout takes place on the menu | DIAGNOSTIC | PRINT SETUP |.

The serial interfaces RS232 have the following port settings:
Data transfer rate 38400 Bd, 8 data bits, no parity, 1 stop bit

The log is saved to a TXT file using a terminal program. To view the log (e.g. in Excel®), the following data format must be considered.

Separator: Tabulator
Decimal separator: .
Thousand separator ,

The following code list helps you to interpret the start-up protocol, see example in *chapter 10.1*.

Parameter	***Code no.***	***Information***
Log type		*Log type:*
	0	*Disabled*
	1	*Single*
	2	*Continuous*
	3	*Stop on error*
Log time		*Log time:*
	0	*15 mins*
	1	*1 hour*
	2	*4 hours*
	3	*8 hours*
	4	*1 day*
	5	*3 days*
Measuring mode		*Meas. Mode:*
	0	*Continuous*
	1	*Batch*
Start mode		*Start mode (Start/Stop):*
	0	*Keyboard*
	1	*Extern*

Parameter	***Code no.***	***Information***
Calibration input selection	 *0* *1* *2* *3* *4* *5* *6* *7*	*Exp. cal. input selection:* *None* *Input 1* *Input 1 + Input 2* *Input 1 + PT100* *Input 1 + Input 2 + PT100* *Input 2* *Input 2 + PT100* *PT100*
Calibration variable	 *0* *1* *2*	*Calibration base:* *Phase* *Attenuation* *Phase and attenuation*
Massflow calculation mode	 *0* *1*	*Throughput calculation:* *Off* *On*
Loading comp. selection	 *0* *1* *2* *3*	*Selection loading compensation:* *Disabled* *Radiometric MPUA* *Loading (Cin 1)* *Tonnage & Speed* *Mass & Height*
Synchronizer mode	 *0* *1* *2*	*Synchronization mode:* *Disabled* *Constant speed* *Variable speed*
Measure configuration	 *0* *1* *2*	*Process type:* *1 concentration* *2 concentrations* *Split concentration*
AO Assign Code	 *0* *1* *2* *3* *4* *5*	*Assignment of current output:* *None* *Concentration* *Concentration 2* *Current input 1* *Current input 2* *PT100*
AO Alarm select code	 *0* *1* *2* *3*	*Error current for current output:* *22 mA* *3.5 mA* *Hold* *Value*
Range selection	 *0* *1*	*Measuring range for current output:* *0 … 20 mA* *4 … 20 mA*
AI Range selection	 *0* *1*	*Measuring range for current input:* *0 … 20 mA* *4 … 20 mA*

Parameter	***Code no.***	***Information***
AI Ena-bled[2]		*State current in 2*
DO Function	 *0* *1* *2* *3* *4* *5*	*Function of digital outputs:* *None* *Error* *Hold* *No product* *Alarm min.* *Alarm max.*
DO Assign-ment	 *0* *1* *2* *3* *4*	*Digital output: the min./max. alarm is assigned to the following:* *Concentration* *Concentration 2* *Current input 1* *Current input 2* *PT100*
DI Function selection	 *0* *1* *2* *3* *4*	*Function of digital inputs:* *None* *Start/Stop* *Hold* *Sampling* *Product selection*
Printout mode	 *0* *1* *2* *3*	*Form of data printout:* *None* *Line* *Table* *Line + Table*
Access level	 *0* *1* *2*	*Access level:* *Read only* *User mode* *Service*
Language	 *0* *1* *2*	*Language selection* *English* *German* *French*

10.1 Example of Start-up Protocol

Menu: Product	Start of Setup: Entry	Start-up Protocol Product1	Prod-uct2	Prod. 3	Prod. 4	Interpretation: (* Only relevant for service)
Data log	Log type :	0				Log type: see code list
	Log time:	2				Log time: see code list
	Number of errors :	0				Number of entries in the error log
	NTC temperature :	45.3 °C				*
	max. NTC temperature :	46.7 °C				*
	9V power supply :	8.94 V				*
Info	Tag :	-				Tag
	Device type :	LB 568				Device type
	Unique device ID number :	761				
	Serial number :	4294967000				
	Final assembly number :	000-000				
	Software version :	2.00				
	Software release date :	02.02.2016				Software revision date
	Actual date :	10.02.2016				Date of logging
	Actual time :	12:15				Time of logging
Measure-ment	Measuring mode :	0				Measuring mode: see code list
	Start mode :	0				Start mode: see code list
	Filter damping value[2] :	60				Averaging Current output
	Filter damping value[3] :	40				Averaging number when sampling
	Reset average :	FALSE				Reset Averaging: Yes/No
Plausibility	Lower limit :	0.00				Min. process limit:
	Upper limit :	100.00				Max. process limit
	Raw data average value	15				*
	Max. phase sigma :	500				Sigma max.
	Phi slope filter damp:	15				*
Microwave	Ref. cable length :	4.00 m				Reference cable length
	Meas. cable length :	4.00 m				Signal cable length
	Wave band selection :	1				*
	Start frequency :	0				*
	Frequency step :	3				*
	Nbr of freq. points :	25				*
	Internal Attenuation :	0				
Marker	Marker name :	Mark1				Marker name for concentration
	Marker value :	50.00 %				Marker value for concentration
	Marker name[2] :	Mark2				Marker name for concentration 2
	Marker value[2] :	50.00 %				Marker value for concentration 2
System adjust	Nbr of sweeps for reference :	1				*
EVU type	HF amplifier mode :	0				*
	Minimal insertion loss :	50.00 dB				*

Calibrate Conc	Calibration input selection :	0	Exp. Cal. input selection: see code list
	Calibration mode	0	*
	Calibration variable :	1	Calibration basis: see code list
	Phase coefficients :	0	Phase coefficient A
	Attenuation coefficients :	0	Attenuation Coefficient B
	Constant coefficient :	10	Constant C
	d coefficient	0	Comp-coefficient for PT100 input
	e coefficient	0	Comp-coefficient for current input 1
	f coefficient	0	Comp-coefficient for current input 2
	g coefficient	0	Comp-coefficient for loading
	Adjust factor :	1	Factor
	Adjust offset :	0	Offset
	Density transducer enabled:	FALSE	Density calculation: Yes/No
	Loading comp. Selection:	0	Loading compensation: see code list
	Loading comp. Lower limit:	0	Value for minimum load
Synchroni-zation	Synchronizer mode:	0	Synchronization: see code list
	Current input1 distance to uWave	0	Distance of sensors
	Current input1 distance to uWave	0	Distance of sensors
	Radiometry distance to uWave	0	Distance of sensors
Calibrate Conc 2	Calibration input selection :	0	Exp. Cal. input selection: see code list
	Lower limit :	0.00 %	Min. process limit (plausibility for conc 2)
	Upper limit :	100.00 %	Max. process limit (plausibility for conc 2)
	Calibration mode :	0	*
	Calibration variable :	1	Calibration basis: see code list
	Phase coefficients :	0	Phase coefficient A
	Attenuation coefficients :	0	Attenuation Coefficient B
	Constant coefficient :	10	Constant C
	d coefficient	0	Comp-coefficient for PT100 input
	e coefficient	0	Comp-coefficient for current input 1
	f coefficient	0	Comp-coefficient for current input 2
	g coefficient	0	Comp-coefficient for loading
	Adjust factor :	1	Factor
	Adjust offset :	0	Offset
	Massflow calculation mode:	0	Throughput calculation: see code list
	Loading comp. Selection:	0	Loading compensation: see code list
	Loading comp. Lower limit:	0	Value for minimum load
Advanced	Tare Phase (°/GHz) :	0.00 °/GHz	
	Tare Attenuation (dB) :	0.00 dB	
	Measure configuration :	0	Process type: see code list
	Range split value :	75	Split value
Current output 1	AO Assign code :	0	Assignment: see code list
	AO Upper range value :	100	Upper value
	AO Lower range value :	0	Lower limit
	AO Alarm select code :	2	Error current: see code list
	AO Error current value :	22.00 mA	Error current value
Current output 2	AO Assign code[2] :	0	Assignment: see code list
	AO Upper range value[2] :	100	Upper value
	AO Lower range value[2] :	0	Lower limit
	Range selection[2] :	1	Range
	AO Alarm select code[2] :	2	Error current: see code list
	AO Error current value[2] :	22.00 mA	Error current value

Current output 1	AI Enabled :	0	Disabled: 0 Enabled: 1
	AI Range selection :	1	Range: see code list
	AI Upper range value :	100	Upper value
	AI Lower range value :	0	Lower limit
	Analog input filter constant :	15	*
Current output 2	AI Enabled[2] :	0	Disabled: 0 Enabled: 1
	AI Range selection[2] :	1	Range: see code list
	AI Upper range value[2] :	100	Upper value
	AI Lower range value[2] :	0	Lower limit
	Analog input filter constant :	15	*
PT100 input	AI Enabled[3] :	0	Disabled: 0 Enabled: 1
Relay 1	DO Function :	1	Function: see code list
	DO Assignment :	0	Assignment: see code list
	DO Threshold :	0.00%	*
	DO Hysteresis :	5.00%	*
Relay 2	DO Function[2] :	2	Function: see code list
	DO Assignment[2] :	0	Assignment: see code list
	DO Threshold[2] :	0.00%	*
	DO Hysteresis[2] :	5.00%	*
Digital Input	DI Function selection :	0	Function digital input 1: see code list
	DI Function selection[2] :	0	Function digital input 2: see code list
	DI Function selection[3] :	0	Function digital input 3: see code list
	Printout mode :	1	Data output: see code list
	Access level :	2	Access level: see code list
	Language :	1	Language: see code list
Radiom. Detector	Radiometric detector measurement state :	0	Disabled: 0 Enabled: 1
	Cps filter damp :	15	Averaging of count rate
	Cps validation mode :	1	Disabled: 0 Enabled: 1
	CPS max value :	100000 cps	Max. count rate
	CPS min value :	0 cps	Min. count rate
	HV control mode :	0	Automatic: 0 Manual: 1
	Actual HV :	450.0 V	Actual high voltage
	Detector software version :	1.2.4	Detector software version
	Detector unique id :	1161953277	Detector device ID no.
	Mass per unit area transducer state:	0	0 = no radiom. compensation enabled 1 = radiom. compensation enabled
	Absorption coefficient for MPUA calculation :	0.07	Absorption coefficient for MPUA calculation, MPUA = Mass per unit area
	Ray angle of radiation source :	0°	Angle of irradiation
	I0 rate :	0 cps	Background count rate
	Selected nuclide at I null determination :	0	0 = Cs137 1 =Am241
	I0 max. time :	180 s	Max. measurement time for I0
	Reference measurement done (I0) :	FALSE	Reference measurement performed: Yes/No
	Nuclide selection :	0	0 = Cs137 1 =Am241
	End of Setup		End

System adjustment data:

Start of Reference Data

Product 1:

Mean Atten.:	46.8509 dB
Phase at fm:	42.6285 deg/GHz
Phase sigma:	0.24575

Frequency[GHz]	Phase[Deg]	Transformed Phase[Deg]	Atten.[dB]
3.101	35.64	35.64	21.98
3.131	361.81	361.81	21.95
3.161	689.04	689.04	22.07
3.191	1014.44	1014.44	22.36
3.221	1339.01	1339.01	22.37
3.251	1664.16	1664.16	22.68
3.281	1989.9	1989.9	22.32
3.311	2319.19	2319.19	22.57
3.341	2642.87	2642.87	22.46
3.371	2972.88	2972.88	22.42
3.401	3296.79	3296.79	22.83
3.431	3623.71	3623.71	22.43
3.461	3949.32	3949.32	22.51
3.491	4275.35	4275.35	22.34
3.521	4601.84	4601.84	22.27
3.551	4929.07	4929.07	22.44
3.581	5254.83	5254.83	22.45
3.611	5582.38	5582.38	22.47
3.641	5907.4	5907.4	22.67
3.671	6230.12	6230.12	22.77
3.701	6489.69	6489.69	22.24
3.731	6755.95	6755.95	22.23
3.761	6922.09	6922.09	22.24
3.891	7387.71	7387.71	22.25
3.921	7687.71	7456.11	23.55

Sampling:

Start of Sample Data:

Product 1: Sample Data for Concentration 1:

Sample:	Active:	Con.(%):	Lab.(%):	AIN1:	AIN2:	Temp. (°C):	Phi. (°/GHz):	Att.(dB):	Mqua (g/cm^2)
1|17.08 - 12:37	TRUE	85	40	0	0	0	-0.35	0.02	8.00
2|17.08 - 12:37	TRUE	80	35	0	0	0	30.33	5.08	6.20
3|17.08 - 12:45	TRUE	70	25	0	0	0	59.02	18.98	10.12

Correlation factor between lab and meas values: 1

End of Sample Data

Do not use following data!

10.2 Sampling

No.	*Ac-tive*	*Measured value*	*Lab value*	*Current in 1*	*Current In 2*	*PT100*	*Phi(fm):*	*Attenua-tion*	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

Notes

Notes